Description

FIELD OF THE INVENTION

[0001] The present invention relates generally to the field of digital data processing devices, and more particularly to systems and methods for synchronizing operations among a plurality of independently-clocked digital data processing devices. The invention is embodied in a system for synchronizing operations among a plurality of devices, in relation to information that is provided by a common source. One embodiment of the invention enables synchronizing of audio playback as among two or more audio playback devices that receive audio information from a common information source, or channel.

[0002] More generally, the invention relates to the field of arrangements that synchronize output generated by a number of output generators, including audio output, video output, combinations of audio and video, as well as other types of output as will be appreciated by those skilled in the art, provided by a common channel. Generally, the invention will find utility in connection with any type of information for which synchrony among independently-clocked devices is desired.

BACKGROUND OF THE INVENTION

[0003] There are a number of circumstances under which it is desirable to maintain synchrony of operations among a plurality of independently-clocked digital data processing devices in relation to, for example, information that is provided thereto by a common source. For example, systems are being developed in which one audio information source can distribute audio information in digital form to a number of audio playback devices for playback. The audio playback devices receive the digital information and convert it to analog form for playback. The audio playback devices may be located in the same room or they may be distributed in different rooms in a residence such as a house or an apartment, in different offices in an office building, or the like. For example, in a system installed in a residence, one audio playback device may be located in a living room, while another audio playback device is be located in a kitchen, and yet other audio playback devices may be located in various bedrooms of a house. In such an arrangement, the audio information that is distributed to various audio playback devices may relate to the same audio program, or the information may relate to different audio programs. If the audio information source provides audio information relating to the same audio program to two or more audio playback devices at the same time, the audio playback devices will generally contemporaneously play the same program. For example, if the audio information source provides audio information to audio playback devices located in the living room and kitchen in a house at the same time, they will generally contemporaneously play the same program.

[0004] One problem that can arise is to ensure that, if two or more audio playback devices are contemporaneously attempting to play back the same audio program, they do so simultaneously. Small differences in the audio playback devices' start times and/or playback speeds can be perceived by a listener as an echo effect, and larger differences can be very annoying. Differences can arise because for a number of reasons, including delays in the transfer of audio information over the network. Such delays can differ as among the various audio playback devices for a variety of reasons, including where they are connected into the network, message traffic and other reasons as will be apparent to those skilled in the art.

[0005] Another problem arises from the following. When an audio playback device converts the digital audio information from digital to analog form, it does so using a clock that provides timing information. Generally, the audio playback devices that are being developed have independent clocks, and, if they are not clocking at precisely the same rate, the audio playback provided by the various devices can get out of synchronization.

SUMMARY OF THE INVENTION

[0006] The invention provides a new and improved system and method for synchronizing operations among a number of digital data processing devices that are regulated by independent clocking devices. Generally, the invention will find utility in connection with any type of information for which synchrony among devices connected to a network is desired. The invention is described in connection with a plurality of audio playback devices that receive digital audio information that is to be played back in synchrony, but it will be appreciated that the invention can find usefulness in connection with any kind of information for which coordination among devices that have independent clocking devices would find utility.

[0007] In brief summary, the invention provides, in one aspect, a system for maintaining synchrony of operations among plurality of devices that have independent clocking arrangements. The system includes a task distribution device that distributes tasks to a synchrony group comprising a plurality of devices that are to perform the tasks distributed by the task distribution device in synchrony. The task distribution device distributes each task to the members of the synchrony group over a network. Each task is associated with a time stamp that indicates a time, relative to a clock maintained by the task distribution device, at which the members of the synchrony group are to execute the task. Each

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member of the synchrony group periodically obtains from the task distribution device an indication of the current time indicated by its clock, determines a time differential between the task distribution device's clock and its respective clock and determines therefrom a time at which, according to its respective clock, the time stamp indicates that it is to execute the task.

[0008] In one embodiment, the tasks that are distributed include audio information for an audio track that is to be played by all of the devices comprising the synchrony group synchronously. The audio track is divided into a series of frames, each of which is associated with a time stamp indicating the time, relative to the clock maintained by an audio information channel device, which, in that embodiment, serves as the task distribution device, at which the members of the synchrony group are to play the respective frame. Each member of the synchrony group, using a very accurate protocol, periodically obtains the time indicated by the audio information channel device, and determines a differential between the time as indicated by its local clock and the audio information channel device's clock. The member uses the differential and the time as indicated by the time stamp to determine the time, relative to its local clock, at which it is to play the respective frame. The members of the synchrony group do this for all of the frames, and accordingly are able to play the frames in synchrony.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] This invention is pointed out with particularity in the appended claims. The above and further advantages of this invention may be better understood by referring to the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 schematically depicts an illustrative networked audio system, constructed in accordance with the invention;
FIG. 2 schematically depicts a functional block diagram of a synchrony group utilizing a plurality of zone players formed within the networked audio system depicted in FIG. 1 ;
FIG. 2A schematically depicts two synchrony groups, illustrating how a member of one synchrony group can provide audio information to the members of another synchrony group;
FIG. 3 depicts an functional block diagram of a zone player for use in the networked audio system depicted in FIG. 1 ; and
FIG. 4 is useful in understanding an digital audio information framing methodology useful in the network audio system depicted in FIG. 1.

DETAILED DESCRIPTION OF AN ILLUSTRATIVE EMBODIMENT

[0010] FIG. 1 depicts an illustrative network audio system 10 constructed in accordance with the invention. With reference to FIG. 1, the network audio system 10 includes a plurality of zone players 11(1) through 11(N) (generally identified by reference numeral 11(n)) interconnected by a local network 12, all of which operate under control of one or more user interface modules generally identified by reference numeral 13. One or more of the zone players 11(n) may also be connected to one or more audio information sources, which will generally be identified herein by reference numeral 14(n)(s), and/or one or more audio reproduction devices, which will generally be identified by reference numeral 15(n)(r). In the reference numeral 14(n)(s), index "n" refers to the index "n" of the zone player 11(n) to which the audio information source is connected, and the index "s" (s=1,...,S_n) refers to the "s-th" audio information source connected to that "n-th" zone player 11(n). Thus, if, for example, a zone player 11(n) is connected to four audio information sources 14(n)(1) through 14(n)(4), the audio information sources may be generally identified by reference numeral 14(n)(s), with S_n=4. It will be appreciated that the number of audio information sources S_n may vary as among the various zone players 11(n), and some zone players may not have any audio information sources connected thereto. Similarly, in the reference numeral 15(n)(r), index "n" refers to the index "n" of the zone player 11(n) to which the audio reproduction device is connected, and the index "r" (r=1,...,R_n) refers to the "r-th" audio information source connected to that "n-th" zone player 11(n). In addition to the audio information sources 14(n)(s), the network audio system 10 may include one or more audio information sources 16(1) through 16(M) connected through appropriate network interface devices (not separately shown) to the local network 12. Furthermore, the local network may include one or more network interface devices (also not separately shown) that are configured to connect the local network 12 to other networks, including a wide area network such as the Internet, the public switched telephony network (PSTN) or other networks as will be apparent to those skilled in the art, over which connections to audio information sources may be established.

[0011] The zone players 11(n) associated with system 10 may be distributed throughout an establishment such as residence, an office complex, a hotel, a conference hall, an amphitheater or auditorium, or other types of establishments as will be apparent to those skilled in the art or the like. For example, if the zone players 11(n) and their associated audio information source(s) and/or audio reproduction device(s) are distributed throughout a residence, one, such as zone player 11(1) and its associated audio information source(s) and audio reproduction device(s) may be located in a living

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room, another may be located in a kitchen, another may be located in a dining room, and yet others may be located in respective bedrooms, to selectively provide entertainment in those rooms. On the other hand, if the zone players 11(n) and their associated audio information source(s) and/or audio reproduction device(s) are distributed throughout an office complex, one may, for example, be provided in each office to selectively provide entertainment to the employees in the respective offices. Similarly, if the zone players 11(n) and associated audio information source(s) and/or audio reproduction device(s) are used in a hotel, they may be distributed throughout the rooms to provide entertainment to the guests. Similar arrangements may be used with zone players 11(n) and associated audio information source(s) and/or audio reproduction device(s) used in an amphitheater or auditorium. Other arrangements in other types of environments will be apparent to those skilled in the art. In each case, the zone players 11(n) can be used to selectively provide entertainment in the respective locations, as will be described below.

[0012] The audio information sources 14(n)(s) and 16(m) may be any of a number of types of conventional sources of audio information, including, for example, compact disc ("CD") players, AM and/or FM radio receivers, analog or digital tape cassette players, analog record turntables and the like. In addition, the audio information sources 14(n)(s) and 16(m) may comprise digital audio files stored locally on, for example, personal computers (PCs), personal digital assistants (PDAs), or similar devices capable of storing digital information in volatile or non-volatile form. As noted above, the local network 12 may also have an interface (not shown) to a wide area network, over which the network audio system 10 can obtain audio information. Moreover, one or more of the audio information sources 14(n)(s) may also comprise an interface to a wide area network such as the Internet, the public switched telephony network (PSTN) or any other source of audio information. In addition, one or more of the audio information sources 14(n)(s) and 16(m) may comprise interfaces to radio services delivered over, for example, satellite. Audio information obtained over the wide area network may comprise, for example, streaming digital audio information such as Internet radio, digital audio files stored on servers, and other types of audio information and sources as will be appreciated by those skilled in the art. Other arrangements and other types of audio information sources will be apparent to those skilled in the art.

[0013] Generally, the audio information sources 14(n)(s) and 16(m) provide audio information associated with audio programs to the zone players for playback. A zone player that receives audio information from an audio information source 14(n)(s) that is connected thereto can provide playback and/or forward the audio information, along with playback timing information, over the local network 12 to other zone players for playback. Similarly, each audio information source 16(m) that is not directly connected to a zone player can transmit audio information over the network 12 to any zone player 11(n) for playback. In addition, as will be explained in detail below, the respective zone player 11(n) can transmit the audio information that it receives either from an audio information source 14(n)(s) connected thereto, or from an audio information source 16(m), to selected ones of the other zone players 11(n'), 11(n"),... (n not equal to n', n",...) for playback by those other zone players. The other zone players 11(n'), 11(n"),... to which the zone player 11(n) transmits the audio information for playback may be selected by a user using the user interface module 13. In that operation, the zone player 11(n) will transmit the audio information to the selected zone players 11(n'), 11(n"),... over the network 12. As will be described below in greater detail, the zone players 11(n), 11(n'), 11(n"),... operate such that the zone players 11(n'), 11(n"),... synchronize their playback of the audio program with the playback by the zone player 11(n), so that the zone players 11(n), 11(n'), 11(n") provide the same audio program at the same time.

[0014] Users, using user interface module 13, may also enable different groupings or sets of zone players to provide audio playback of different audio programs synchronously. For example, a user, using a user interface module 13, may enable zone players 11(1) and 11(2) to play one audio program, audio information for which may be provided by, for example, one audio information source 14(1)(1). The same or a different user may, using the same or a different user interface module 13, enable zone players 11 (4) and 11(5) to contemporaneously play another audio program, audio information for which may be provided by a second audio information source, such as audio information source 14(5)(2). Further, a user may enable zone player 11(3) to contemporaneously play yet another audio program, audio information for which may be provided by yet another audio information source, such as audio information source 16(1). As yet another possibility, a user may contemporaneously enable zone player 11(1) to provide audio information from an audio information source connected thereto, such as audio information source 14 (1) (2), to another zone player, such as zone player 11(6) for playback.

[0015] In the following, the term "synchrony group" will be used to refer to a set of one or more zone players that are to play the same audio program synchronously. Thus, in the above example, zone players 11(1) and 11(2) comprise one synchrony group, zone player 11(3) comprises a second synchrony group, zone players 11 (4) and 11(5) comprise a third synchrony group, and zone player 11(6) comprises yet a fourth synchrony group. Thus, while zone players 11(1) and 11(2) are playing the same audio program, they will play the audio program synchronously. Similarly, while zone players 11(4) and 11(5) are playing the same audio program, they will play the audio program synchronously. On the other hand, zone players that are playing different audio programs may do so with unrelated timings. That is, for example, the timing with which zone players 11(1) and 11(2) play their audio program may have no relationship to the timing with which zone player 11 (3), zone players 11(4) and 11(5), and zone player 11(6) play their audio programs. It will be appreciated that, since "synchrony group" is used to refer to sets of zone players that are playing the same audio program

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synchronously, zone player 11(1) will not be part of zone player 11(6)'s synchrony group, even though zone player 11(1) is providing the audio information for the audio program to zone player 11(6).

[0016] In the network audio system 10, the synchrony groups are not fixed. Users can enable them to be established and modified dynamically. Continuing with the above example, a user may enable the zone player 11(1) to begin providing playback of the audio program provided thereto by audio information source 14(1)(1), and subsequently enable zone player 11(2) to join the synchrony group. Similarly, a user may enable the zone player 11 (5) to begin providing playback of the audio program provided thereto by audio information source 14(5)(2), and subsequently enable zone player 11(4) to join that synchrony group. In addition, a user may enable a zone player to leave a synchrony group and possibly join another synchrony group. For example, a user may enable the zone player 11 (2) to leave the synchrony group with zone player 11(1), and join the synchrony group with zone player 11(6). As another possibility, the user may enable the zone player 11(1) to leave the synchrony group with zone player 11(2) and join the synchrony group with zone player 11(6).In connection with the last possibility, the zone player 11(1) can continue providing audio information from the audio information source 14(1)(1) to the zone player 11(2) for playback thereby.

[0017] A user, using the user interface module 13, can enable a zone player 11(n) that is currently not a member of a synchrony group to join a synchrony group, after which it will be enabled to play the audio program that is currently being played by that synchrony group. Similarly, a user, also using the user interface module 13, can enable a zone player 11(n) that is currently a member of one synchrony group, to disengage from that synchrony group and join another synchrony group, after which that zone player will be playing the audio program associated with the other synchrony group. For example, if a zone player 11(6) is currently not a member of any synchrony group, it, under control of the user interface module 13, can become a member of a synchrony group, after which it will play the audio program being played by the other members of the synchrony group, in synchrony with the other members of the synchrony group. In becoming a member of the synchrony group, zone player 11(6) can notify the zone player that is the master device for the synchrony group that it wishes to become a member of its synchrony group, after which that zone player will also transmit audio information associated with the audio program, as well as timing information, to the zone player 11(6).As the zone player 11(6) receives the audio information and the timing information from the master device, it will play the audio information with the timing indicated by the timing information, which will enable the zone player 11(6) to play the audio program in synchrony with the other zone player(s) in the synchrony group.

[0018] Similarly, if a user, using the user interface module 13, enables a zone player 11(n) associated with a synchrony group to disengage from that synchrony group, and if the zone player 11(n) is not the master device of the synchrony group, the zone player 11(n) can notify the master device, after which the master device can terminate transmission of the audio information and timing information to the zone player 11(n). If the user also enables the zone player 11(n) to begin playing another audio program using audio information from an audio information source 14(n)(s) connected thereto, it will acquire the audio information from the audio information source 14(n)(s) and initiate playback thereof. If the user enables another zone player 11(n') to join the synchrony group associated with zone player I 11(n), operations in connection therewith can proceed as described immediately above.

[0019] As yet another possibility, if a user, using the user interface module 13, enables a zone player 11(n) associated with a synchrony group to disengage from that synchrony group and join another synchrony group, and if the zone player is not the master device of the synchrony group from which it is disengaging, the zone player 11(n) can notify the master device of the synchrony group from which it is disengaging, after which that zone player will terminate transmission of audio information and timing information to the zone player 11(n) that is disengaging. Contemporaneously, the zone player 11(n) can notify the master device of the synchrony group that it (that is, zone player 11(n)) is joining, after which the master device can begin transmission of audio information and timing information to that zone player 11(n). The zone player 11(n) can thereafter begin playback of the audio program defined by the audio information, in accordance with the timing information so that the zone player 11(n) will play the audio program in synchrony with the master device.

[0020] As yet another possibility, a user, using the user interface module 13, may enable a zone player 11(n) that is not associated with a synchrony group, to begin playing an audio program using audio information provided to it by an audio information source 14(n)(s) connected thereto. In that case, the user, also using the user interface module 13 or a user interface device that is specific to the audio information source 14(n)(s), can enable the audio information source 14(n)(s) to provide audio information to the zone player 11(n). After the zone player 11(n) has begun playback, or contemporaneously therewith, the user, using the user interface module 13, can enable other zone players 11(n'), 11(n''),... to join zone player 11(n) 's synchrony group and enable that zone player 11(n) to transmit audio information and timing information thereto as described above, to facilitate synchronous playback of the audio program by the other zone players 11(n'), 11(n'')....

[0021] A user can use the user interface module 13 to control other aspects of the network audio system 10, including but not limited to the selection of the audio information source 14(n)(s) that a particular zone player 11(n) is to utilize, the volume of the audio playback, and so forth. In addition, a user may use the user interface module 13 to turn audio information source(s) 14(n)(s) on and off and to enable them to provide audio information to the respective zone players 11(n).

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[0022] Operations performed by the various devices associated with a synchrony group will be described in connection with FIG. 2, which schematically depicts a functional block diagram of a synchrony group in the network audio system 10 described above in connection with FIG. 1. With reference to FIG. 2, a synchrony group 20 includes a master device 21 and zero or more slave devices 22(1) through 22 (G) (generally identified by reference numeral 22(g)), all of which synchronously play an audio program provided by an audio information channel device 23. Each of the master device 21, slave devices 22(g) and audio information channel device 23 utilizes a zone player 11(n) depicted in FIG. 1, although it will be clear from the description below that a zone player may be utilized both for the audio information channel device for the synchrony group 20, and the master device 21 or a slave device 22(g) of the synchrony group 20. As will be described below in more detail, the audio information channel device 23 obtains the audio information for the audio program from an audio information source, adds playback timing information, and transmits the combined audio and playback timing information to the master device 21 and slave devices 22(g) over the network 12 for playback. The playback timing information that is provided with the audio information, together with clock timing information provided by the audio information channel device 23 to the various devices 21 and 22(g) as will be described below, enables the master device 21 and slave devices 22(g) of the synchrony group 20 to play the audio information simultaneously.

[0023] The master device 21 and the slave devices 22(g) receive the audio and playback timing information, as well as the clock timing information, that are provided by the audio information channel device 23, and play back the audio program defined by the audio information. The master device 21 is also the member of the synchrony group 20 that communicates with the user interface module 13 and that controls the operations of the slave devices 22(g) in the synchrony group 20. In addition, the master device 21 controls the operations of the audio information channel device 23 that provides the audio and playback timing information for the synchrony group 20. Generally, the initial master device 21 for the synchrony group will be the first zone player 11(n) that a user wishes to play an audio program. However, as will be described below, the zone player 11(n) that operates as the master device 21 can be migrated from one zone player 11(n) to another zone player 11(n'), which preferably will be a zone player that is currently operating as a slave device 22(g) in the synchrony group.

[0024] In addition, under certain circumstances, as will be described below, the zone player 11(n) that operates as the audio information channel device 23 can be migrated from one zone player to another zone player, which also will preferably will be a zone player that is currently operating as a member of the synchrony group 20. It will be appreciated that the zone player that operates as the master device 21 can be migrated to another zone player independently of the migration of the audio information channel device 23. For example, if one zone player 11(n) is operating as both the master device 21 and the audio information channel device 23 for a synchrony group 20, the master device 21 can be migrated to another zone player 11(n') while the zone player 11(n) is still operating as the audio information channel device 23. Similarly, if one zone player 11(n) is operating as both the master device 21 and the audio information channel device 23 for a synchrony group 20, the audio information channel device 23 can be migrated to another zone player 11(n') while the zone player 11(n) is still operating as the master device 21. In addition, if one zone player 11(n) is operating as both the master device 21 and the audio information channel device 23 for a synchrony group 20, the master device 21 can be migrated to another zone player 11(n') and the audio information channel device can be migrated to a third zone player 11(n").

[0025] The master device 21 receives control information from the user interface module 13 for controlling the synchrony group 20 and provides status information indicating the operational status of the synchrony group to the user interface module 13. Generally, the control information from the user interface module 13 enables the master device 21 to, in turn, enable the audio information channel device 23 to provide audio and playback timing information to the synchrony group to enable the devices 21 and 22(g) that are members of the synchrony group 20 to play the audio program synchronously. In addition, the control information from the user interface module 13 enables the master device 21 to, in turn, enable other zone players to join the synchrony group as slave devices 22(g) and to enable slave devices 22(g) to disengage from the synchrony group. Control information from the user interface module 13 can also enable the zone player 11(n) that is currently operating as the master device 21 to disengage from the synchrony group, but prior to doing so that zone player will enable the master device 21 to transfer from that zone player 11(n) to another zone player 11(n'), preferably to a zone player 11(n') that is currently a slave device 22(g) in the synchrony group 20. The control information from the user interface module 13 can also enable the master device 21 to adjust its playback volume and to enable individual ones of the various slave devices 22(g) to adjust their playback volumes. In addition, the control information from the user interface module 13 can enable the synchrony group 20 to terminate playing of a current track of the audio program and skip to the next track, and to re-order tracks in a play list of tracks defining the audio program that is to be played by the synchrony group 20.

[0026] The status information that the master device 21 may provide to the user interface module 13 can include such information as a name or other identifier for the track of the audio work that is currently being played, the names or other identifiers for upcoming tracks, the identifier of the zone player 11(n) that is currently operating as the master device 21, and identifiers of the zone players that are currently operating as slave devices 22(g). In one embodiment, the user interface module 13 includes a display (not separately shown) that can display the status information to the user.

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[0027] It will be appreciated that the zone player 11(n) that is operating as the audio information channel device 23 for one synchrony group may also comprise the master device 21 or any of the slave devices 22(g) in another synchrony group. This may occur if, for example, the audio information source that is to provide the audio information that is to be played by the one synchrony group is connected to a zone player also being utilized as the master device or a slave device for the other synchrony group. This will be schematically illustrated below in connection with FIG. 2A. Since, as noted above, the zone player 11(n) that is operating as the audio information channel device 23 for the synchrony group 20 may also be operating as a master device 21 or slave device 22(g) for another synchrony group, it can also be connected to one or more audio reproduction devices 15(n)(r), although that is not depicted in FIG. 2. Since the master device 21 and slave devices 22(g) are all to provide playback of the audio program, they will be connected to respective audio reproduction devices 15(n)(r). Furthermore, it will be appreciated that one or more of the zone players 11(n) that operate as the master device 21 and slave devices 22(g) in synchrony group 20 may also operate as an audio information channel device for that synchrony group or for another synchrony group and so they may be connected to one or more audio information sources 14(n)(s), although that is also not depicted in FIG. 2. In addition, it will be appreciated that a zone player 11(n) can also operate as a audio information channel device 23 for multiple synchrony groups.

[0028] If the audio information channel device 23 does not utilize the same zone player as the master device 21, the master device 21 controls the audio information channel device by exchanging control information over the network 12 with the audio information channel device 23. The control information is represented in FIG. 2 by the arrow labeled CHAN_DEV_CTRL_INFO. The control information that the master device 21 provides to the audio information channel device 23 will generally depend on the nature of the audio information source that is to provide the audio information for the audio program that is to be played and the operation to be enabled by the control information. If, for example, the audio information source is a conventional compact disc, tape, or record player, broadcast radio receiver, or the like, which is connected to a zone player 11(n), the master device 21 may merely enable the zone player serving as the audio information channel device 23 to receive the audio information for the program from the audio information source. It will be appreciated that, if the audio information is not in digital form, the audio information channel device 23 will convert it to digital form and provide the digitized audio information, along with the playback timing information, to the master device 21 and slave devices 22(g).

[0029] On the other hand, if the audio information source is, for example, a digital data storage device, such as may be on a personal computer or similar device, the master device 21 can provide a play list to the audio information channel device 23 that identifies one or more files containing the audio information for the audio program. In that case, the audio information channel device 23 can retrieve the files from the digital data storage device and provide them, along with the playback timing information, to the master device 21 and the slave devices 22(g). It will be appreciated that, in this case, the audio information source may be directly connected to the audio information channel device 23, as, for example, an audio information source 14(n)(s), or it may comprise an audio information source 16(m) connected to the network 12. As a further alternative, if the audio information source is a source available over the wide area network, the master device 21 can provide a play list comprising a list of web addresses identifying the files containing the audio information for the audio program that is to be played, and in that connection the audio information channel device 23 can initiate a retrieval of the files over the wide area network. As yet another alternative, if the audio information source is a source of streaming audio received over the wide area network, the master device 21 can provide a network address from which the streaming audio can be received. Other arrangements by which the master device 21 can control the audio information channel device 23 will be apparent to those skilled in the art.

The master device 21 can also provide control information to the synchrony group's audio information channel device 23 to enable a migration from one zone player 11(n) to another zone player 11(n'). This may occur if, for example, the audio information source is one of audio information sources 16 or a source accessible over the wide area network via the network 12. The master device 21 can enable migration of the audio information channel device 23 for several reasons, including, for example, to reduce the loading of the zone player 11(n), to improve latency of message transmission in the network 12, and other reasons as will be appreciated by those skilled in the art.

[0030] As noted above, the audio information channel device 23 provides audio and playback timing information for the synchrony group to enable the master device 21 and slave devices 22(g) to play the audio program synchronously. Details of the audio and playback timing information will be described in detail below in connection with FIGS. 3 and 4, but, in brief, the audio information channel device 23 transmits the audio and playback timing information in messages over the network 12 using a multi-cast message transmission methodology. In that methodology, the audio information channel device 23 will transmit the audio and playback timing information in a series of messages, with each message being received by all of the zone players 11(n) comprising the synchrony group 20, that is, by the master device 21 and the slave devices 22(g). Each of the messages includes a multi-cast address, which the master device 21 and slave devices 22(g) will monitor and, when they detect a message with that address, they will receive and use the contents of the message. The audio and playback timing information is represented in FIG. 2 by the arrow labeled "AUD+PBTIME INFO," which has a single tail, representing a source for the information at the audio information channel device 23, and multiple arrowheads representing the destinations of the information, with one arrowhead extending to the master device

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21 and other arrowheads extending to each of the slave devices 22(g) in the synchrony group 20. The audio information channel device 23 may make use of any convenient multi-cast message transmission methodology in transmitting the audio and playback timing information to the synchrony group 20. As will be described in detail in connection with FIG. 4, the audio and playback timing information is in the form of a series of frames, with each frame having a time stamp. The time stamp indicates a time, relative to the time indicated by a clock maintained by the audio information channel device 23, at which the frame is to be played. Depending on the size or sizes of the messages used in the selected multi-cast message transmission methodology and the size or sizes of the frames, a message may contain one frame, or multiple frames, or, alternatively, a frame may extend across several messages.

[0031] The audio information channel device 23 also provides clock time information to the master device 21 and each of the slave devices 22(g) individually over network 12 using a highly accurate clock time information transmission methodology. The distribution of the clock time information is represented in FIG. 2 by the arrows labeled "AICD_CLK_INF (M)" (in the case of the clock time information provided to the master device 21) and "AICD_CLK_INF (S_1)" through "AICD_CLK_INF (S_G)" (in the case of audio information channel device clock information provided to the slave devices 22(g)). In one embodiment, the master device 21 and slave devices 22(g) make use of the well-known SNTP (Simple Network Time Protocol) to obtain current clock time information from the audio information channel device 23. The SNTP makes use of a unicast message transfer methodology, in which one device, such as the audio information channel device 23, provides clock time information to a specific other device, such as the master device 21 or a slave device 22(g), using the other device's network, or unicast, address. Each of the master device 21 and slave devices 22(g) will periodically initiate SNTP transactions with the audio information channel device 23 to obtain the clock time information from the audio information channel device 23. As will be described below in more detail, the master device 21 and each slave device 22(g) make use of the clock time information to determine the time differential between the time indicated by the audio information channel device's clock and the time indicated by its respective clock, and use that time differential value, along with the playback time information associated with the audio information and the respective device's local time as indicated by its clock to determine when the various frames are to be played. This enables the master device 21 and the slave devices 22(g) in the synchrony group 20 to play the respective frames simultaneously.

[0032] As noted above, the control information provided by the user to the master device 21 through the user interface module 13 can also enable the master device 21 to, in turn, enable another zone player 11(n') to join the synchrony group as a new slave device 22(g). In that operation, the user interface module 13 will provide control information, including the identification of the zone player 11(n') that is to join the synchrony group to the master device 21. After it receives the identification of the zone player 11(n') that is to join the synchrony group, the master device 21 will exchange control information, which is represented in FIG. 2 by the arrows labeled SLV_DEV_CTRL_INF (S_1) through SLV_DEV_CTRL_INF (S_G) group slave control information, over the network 12 with the zone player I 11(n') that is identified in the control information from the user interface module 13. The control information that the master device 21 provides to the new zone player 11(n') includes the network address of the zone player 11(n) that is operating as the audio information channel device 23 for the synchrony group, as well as the multi-cast address that the audio information channel device 23 is using to broadcast the audio and playback timing information over the network. The zone player that is to operate as the new slave device 22(g') uses the multi-cast address to begin receiving the multi-cast messages that contain the audio information for the audio program being played by the synchrony group.

[0033] It will be appreciated that, if the zone player 11(n) that is operating as the master device 21 for the synchrony group 20 is also operating the audio information channel device 23, and if there are no slave devices 22(g) in the synchrony group 20, the audio information channel device 23 may not be transmitting audio and playback timing information over the network. In that case, if the new slave device 22(g') is the first slave device in the synchrony group, the zone player 11(n) that is operating as both the master device 21 and audio information channel device 23, can begin transmitting the audio and playback timing information over the network 12 when the slave device 22(g') is added to the synchrony group 20. The zone player 11(n) can maintain a count of the number of slave devices 22(g) in the synchrony group 20 as they join and disengage, and, if the number drops to zero, it can stop transmitting the audio and playback timing information over the network 12 to reduce the message traffic over the network 12.

[0034] The new slave device 22(g') added to the synchrony group 20 uses the network address of the audio information channel device 23 for several purposes. In particular, the new slave device 22(g') will, like the master device 21 (assuming the zone player 11(n) operating as the master device 21 is not also the audio information channel device 23), engage in SNTP transactions with the audio information channel device 23 to obtain the clock timing information from the audio information channel device 23. In addition, the new slave device 22(g') can notify the audio information channel device 23 that it is a new slave device 22(g') for the synchrony group 20 and provide the audio information channel device 23 with its network address. As will be described below, in one embodiment, particularly in connection with audio information obtained from a source, such as a digital data storage device, which can provide audio information at a rate that is faster than the rate at which it will be played, the audio information channel device 23 will buffer audio and timing information and broadcast it over the network 12 to the synchrony group 20 generally at a rate at which it is provided by the source. Accordingly, when a new slave device 22(g') joins the synchrony group 20, the playback timing information may indicate

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that the audio information that is currently being broadcast by the audio information channel device 23 using the multicast methodology is to be played back some time in the future. To reduce the delay with which the new slave device 22(g') will begin playback, the audio information channel device 23 can also retransmit previously transmitted audio and timing information that it had buffered to the new slave device 22(g') using the unicast network address of the slave device 22(g').

[0035] The master device 21 can also use the slave device control information exchanged with the slave devices 22(g) for other purposes. For example, the master device 21 can use the slave device control information to initiate a migration of the master from its zone player 11(n) to another zone player 11(n'). This may occur for any of a number of reasons, including, for example, that the master device 21 is terminating playback by it of the audio program and is leaving the synchrony group 20, but one or more of the other devices in the synchrony group is to continue playing the audio program. The master device 21 may also want to initiate a migration if it is overloaded, which can occur if, for example, the zone player 11(n) that is the master device 21 for its synchrony group is also operating as an audio information channel device 23 for another synchrony group.

[0036] The user can also use the user interface module 13 to adjust playback volume by the individual zone players 11(n) comprising the synchrony group. In that operation, the user interface module 13 provides information identifying the particular device whose volume is to be adjusted, and the level at which the volume is to be set to the master device 21. If the device whose volume is to be adjusted is the master device 21, the master device 21 can adjust its volume according to the information that it receives from the user interface module 13. On the other hand, if the device whose volume is to be adjusted is a slave device 22(g), the master device 21 can provide group slave control information to the respective slave device 22(g), to enable it to adjust its volume.

[0037] The user can also use the user interface module 13 to enable a synchrony group 20 to cancel playing of the track in an audio program that is currently being played, and to proceed immediately to the next track. This may occur, for example, if the tracks for the program is in the form of a series of digital audio information files, and the user wishes to cancel playback of the track that is defined by one of the files. In that case, when the master device 21 receives the command to cancel playback of the current track, it will provide channel device control information to the audio information channel device 23 so indicating. In response, the audio information channel device 23 inserts control information into the audio and playback timing information, which will be referred to as a "resynchronize" command. In addition, the audio information channel device 23 will begin transmitting audio information for the next track, with timing information to enable it to be played immediately. The resynchronize command can also enable playback of a track to be cancelled before it has been played. Details of these operations will be described below.

[0038] As noted above, there may be multiple synchrony groups in the network audio system 10, and further that, for example, a zone player 11(n) may operate both as a master device 21 or a slave device 22(g) in one synchrony group, and as the audio information channel device 23 providing audio and playback timing information and clock timing information for another synchrony group. An illustrative arrangement of this will be described in connection with FIG. 2A. With reference to FIG. 2A, that FIG. depicts elements of two synchrony groups, identified by reference numerals 20(1) and 20(2), respectively. For clarity, FIG. 2A does not show a number of elements, the presence of which would be evident from FIGS. 1 and 2 as described above. For example, FIG. 2A does not depict the audio information sources from which audio information is obtained for the synchrony groups or the audio reproduction devices that are used to produce sound for the master and slave devices, which are depicted in both FIGS. 1 and 2. In addition, FIG. 2A does not depict arrows that represent control information provided by the respective master devices to the slave devices in the respective synchrony groups, or to the audio information channel devices that provide audio and timing information for the respective synchrony groups, which are depicted in FIG. 2. In addition, FIG.2A does not depict the arrows that represent the clock timing information provided by the audio information channel devices to the respective members of the respective synchrony groups, which are also depicted in FIG. 2. As will be noted below, however, FIG. 2A does depict arrows representing the audio and playback timing information provided by the respective audio information channel devices for the respective synchrony groups 20(1), 20(2), to the master and slave devices comprising the respective synchrony groups 20(1), 20(2).

[0039] Each synchrony group 20(1), 20(2) comprises elements of a number of zone players. A functional block diagram of a zone player will be described below in connection with FIG. 3. Synchrony group 20(1) includes a master device 21(1) and "K" slave devices 22(1)(1) through 22(K)(1) (the index "1" in reference numeral 21(1) and the last index in reference numeral 22(1)(1) through 21(K)(1) corresponds to the index of the synchrony group 20(1) to which they belong) utilize zone players 11(1) and 11(K+1) respectively. Similarly, synchrony group 20(2) includes a master device 21(2) and "L" slave devices 22(1)(2) through 22(L)(2) that utilize zone players 11(K+2) through 11(K+L+2). In the illustrative arrangement depicted in FIG. 2A, both synchrony groups 20(1) and 20(2) are controlled by the user interface module 13, which can provide control information to, and receive status information from, the master devices 21(1) and 21(2) independently. It will be appreciated that separate user interface modules may be provided to provide control information to, and receive status information from, the respective master devices 21(1),21(2).

[0040] As noted above, the slave device 22(1)(2) in synchrony group 20(2) utilizes zone player 11(K+3). In the illustrative

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arrangement depicted in FIG. 2A, the audio information channel device 23(1) that provides audio and playback timing information to the master and slave devices 21(1), 22(1)(1),..., 22(K)(1) of synchrony group 20(1) also utilizes zone player 11(K+3). As noted above, this may occur if, for example, the audio information source that is to provide audio information to be played by the synchrony group 20(1) is connected to the zone player 11(K+3). Thus, when the master device 21(1) of synchrony group 20(1) exchanges channel device control information with the audio information channel device 23(1), it is effectively exchanging channel device control information with the zone player 11(K+3). Similarly, when the master and slave devices 21(1), 22(1)(1),..., 22(K)(1) of synchrony group 20(1) receive audio and playback timing information, as well as clock timing information, from the audio information channel device 23(1), they are effectively receiving the information from the zone player 11(K+3). FIG.2A depicts a multi-headed arrow representing audio and playback timing information transmitted by the zone player 11(K+3), as audio information channel device 23(1), to the master and slave devices 21(1), 22(1)(1),...,11(K)(1) comprising synchrony group 20(1).

[0041] On the other hand, in the illustrative arrangement depicted in FIG. 2A, the synchrony group 20(2) utilizes a zone player 11(K+L+3) as its audio information channel device 23(2). As with synchrony group 20(1), when the master device 21(2) of synchrony group 20(2) exchanges channel device control information with the audio information channel device 23(2), it is effectively exchanging channel device control information with the zone player 11(K+L+3). Similarly, when the master and slave devices 21(2), 22(1)(2),..., 22(L)(2) of synchrony group 20(2) receive audio and playback timing information, as well as clock timing information, from the audio information channel device 23(2), they are effectively receiving the information from the zone player 11(K+L+3). FIG. 2A depicts a multi-headed arrow representing audio and playback timing information transmitted by the zone player 11(K+3) as audio information channel device 23(2) to the master and slave devices 21(2), 22(1) (2),..., 22(L) (2) comprising synchrony group 20(2).

[0042] In the illustrative arrangement depicted in FIG. 2A, zone player 11(K+L+3), which is the audio information channel device 23(2) for synchrony group 20(2), is not shown as being either a master or a slave device in another synchrony group. However, it will be appreciated that zone player 11(K+L+3) could also be utilized as the master device or a slave device for another synchrony group. Indeed, it will be appreciated that the zone player that is utilized as the audio information channel device for synchrony group 20(2) may also be a zone player that is utilized as the master device 21(1) or a slave device 22(1) (1),..., 22(K)(1) in the synchrony group 20(1).

[0043] A zone player 11(n) that is utilized as a member of one synchrony group may also be utilized as the audio information channel device for another synchrony group if the audio information source that is to supply the audio information that is to be played by the other synchrony group is connected to that zone player 11(n). A zone player 11(n) may also be utilized as the audio information channel device for the other synchrony group if, for example, the audio information source is an audio information source 16(m) (FIG.1) that is connected to the network 12 or an audio information source that is available over a wide area network such as the Internet. The latter may occur if, for example, the zone player 11(n) has sufficient processing power to operate as the audio information channel device and it is in an optimal location in the network 12, relative to the zone players comprising the other synchrony group (that is the synchrony group for which it is operating as audio information channel device) for providing the audio and playback timing information to the members of the other synchrony group. Other circumstances under which the zone player 11(n) that is utilized as a member of one synchrony group may also be utilized as the audio information channel device for another synchrony group will be apparent to those skilled in the art.

[0044] As was noted above, the master device 21 for a synchrony group 20 may be migrated from one zone player 11(n) to another zone player 11 (n'). As was further noted above, the audio information channel device 23 for a synchrony group 20 may be migrated from one zone player 11(n) to another zone player 11(n'). It will be appreciated that the latter may occur if, for example, the audio information source that provides the audio program for the synchrony group is not connected to the zone player 11(n) that is operating as the audio information channel device 23, but instead is one of the audio information sources 16(m) connected to the network 12 or a source available over a wide area network such as the Internet. Operations performed during a migration of an audio information channel device 23 from one zone player 11(n) to another zone player 11(n') will generally depend on the nature of the audio information that is being channeled by the audio information channel device 23. For example, if the audio information source provides streaming audio, the zone player 11(n) that is currently operating as the audio information channel device 23 for the synchrony group 20, can provide the following information to the other zone player 11(n') that is to become the audio information channel device 23 for the synchrony group 20:

(a) the identification of the source of the streaming audio information,
(b) the time stamp associated with the frame that the zone player 11(n) is currently forming, and
(c) the identifications of the zone players that are operating as the master device 21 and slave devices 22(g) comprising the synchrony group 20.

After the zone player 11(n') receives the information from the zone player 11(n), it will begin receiving the streaming

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audio from the streaming audio information source identified by the zone player I 11(n), assemble the streaming audio information into frames, associate each frame with a time stamp, and transmit the resulting audio and playback timing information over the network 12. The zone player 11(n') will perform these operations in the same manner as described above, except that, instead of using the time indicated by its digital to analog converter clock 34 directly in generating the time stamps for the frames, the initial time stamp will be related to the value of the time stamp that is provided by the zone player 11(n) (reference item (b) above), with the rate at which the time stamps are incremented corresponding to the rate at which its (that is, the zone player 11(n')'s) clock increments. In addition, the zone player 11(n') will notify the zone players that are operating as the master device 21 and slave devices 22(g) of the synchrony group 20 that it is the new audio information channel device 23 for the synchrony group 20, and provide the multi-cast address that it will be using to multi-cast the audio and playback timing information, as well as its unicast network address. After the members of the synchrony group 20 receive the notification from the zone player 11(n') indicating that it is the new audio information channel device 23 for the synchrony group 20, they will receive the audio and playback timing information from the zone player 11(n') instead of the zone player 11(n), using the multi-cast address provided by the zone player 11(n'). In addition, they can utilize the zone player 11(n')'s unicast network address to obtain current time information therefrom. It will be appreciated that the zone player 11(n') will determine its current time in relation to the time stamp that is provided by the zone player 11(n) (reference item (b) above) or the current time information that it received from the zone player 11(n) using the SNTP protocol as described above.

[0045] Generally similar operations can be performed in connection with migrating the audio information channel device from one zone player 11(n) to another zone player 11(n') if the audio information is from one or more audio information files, such as may be the case if the audio information comprises MP3 or WAV files that are available from sources such as sources 16(m) connected to the network 12 or over from sources available over a wide area network such as the Internet, except for differences to accommodate the fact that the audio information is in files. In that case, the zone player 11(n) that is currently operating as the audio information channel device 23 for the synchrony group 20 can provide the following information to the zone player 11(n') that is to become the audio information channel device 23 for the synchrony group 20:

(d) a list of the audio information files containing the audio information that is to be played;
(e) the identification of the file for which the zone player 11(n) is currently providing audio and playback timing information, along with the offset into the file for which the current item of audio and playback timing information is being generated and the time stamp that the zone player 11(n) is associating with that frame, and
(f) the identifications of the zone players that comprise the master device 21 and slave devices 22(g) comprising the synchrony group 20.

After the zone player 11(n') receives the information from the zone player 11(n), it will begin retrieving audio information from the file identified in item (e), starting at the identified offset. In addition, the zone player 11(n') can assemble the retrieved audio information into frames, associate each frame with a time stamp and transmit the resulting audio and playback timing information over the network 12. The zone player 11(n') will perform these operations in the same manner as described above, except that, instead of using the time indicated by its digital to analog converter clock 34 directly in generating the time stamps for the frames, the value of the initial time stamp will be related to the time stamp that is provided by the zone player 11(n) (reference item (e) above), with the rate at which the time stamps are incremented corresponding to the rate at which its (that is, the zone player 11(n') 's) clock increments. In addition, the zone player 11(n') will notify the zone players that are operating as the master device 21 and slave devices 22(g) of the synchrony group 20 that it is the new audio information channel device 23 for the synchrony group 20, and provide the multi-cast address that it will be using to multi-cast the audio and playback timing information, as well as its unicast network address. After the members of the synchrony group 20 receive the notification from the zone player 11(n') indicating that it is the new audio information channel device 23 for the synchrony group 20, they will receive the audio and playback timing information from the zone player I 11(n') instead of the zone player I 11(n), using the multi-cast address provided by the zone player 11(n'). In addition, they can utilize the zone player 11(n')'s unicast network address to obtain current time information therefrom. It will be appreciated that the zone player I 11(n') will determine its current time in relation to the time stamp that is provided by the zone player 11(n) (reference item (b) above) or the current time information that it received from the zone player 11(n) using the SNTP protocol as described above. The zone player 11(n') will process successive audio information files in the list that it receives from the zone player 11(n) (reference item (d)).

[0046] Operations performed by the zone players 11(n) and 11(n') in connection with migration of the audio information channel device 23 for other types of audio information will be apparent to those skilled in the art. In any case, preferably, the zone player 11(n) will continue operating as an audio information channel device 23 for the synchrony group 20 for at least a brief time after it notifies the zone player 11(n') that it is to become audio information channel device for the synchrony group, so that the zone player 11(n') will have time to notify the zone players in the synchrony group 20 that it is the new audio information channel device 23 for the synchrony group.

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[0047] Before proceeding further in describing operations performed by the network audio system 10, it would be helpful to provide a detailed description of a zone player 11(n) constructed in accordance with the invention. FIG. 3 depicts a functional block diagram of a zone player 11(n) constructed in accordance with the invention. All of the zone players in the network audio system 10 may have similar construction. With reference to FIG. 3, the zone player 11(n) includes an audio information source interface 30, an audio information buffer 31, a playback scheduler 32, a digital to analog converter 33, an audio amplifier 35, an audio reproduction device interface 36, a network communications manager 40, and a network interface 41, all of which operate under the control of a control module 42. The zone player 11(n) also has a device clock 43 that provides timing signals that control the general operations of the zone player 11(n). In addition, the zone player 11(n) includes a user interface module interface 44 that can receive control signals from the user interface module 13 (FIGS. 1 and 2) for controlling operations of the zone player 11(n), and provide status information to the user interface module 13.

[0048] Generally, the audio information buffer 31 buffers audio information, in digital form, along with playback timing information. If the zone player 11(n) is operating as the audio information channel device 23 (FIG. 2) for a synchrony group 20, the information that is buffered in the audio information buffer 31 will include the audio and playback timing information that will be provided to the devices 21 and 22(g) in the synchrony group 20. If the zone player 11(n) is operating as the master device 21 or a slave device 22(g) for a synchrony group, the information that is buffered in the audio information buffer 31 will include the audio and playback timing information that the zone player 11(n) is to play.

[0049] The audio information buffer 31 can receive audio and playback timing information from two sources, namely, the audio information source interface 30 and the network communications manager 40. In particular, if the zone player 11(n) is operating as the audio information channel device 23 for a synchrony group 20, and if the audio information source is a source 14(n)(s) connected to the zone player I 11(n), the audio information buffer 31 will receive and buffer audio and playback timing information from the audio information source interface 30. On the other hand, if the zone player 11(n) is operating as the audio information channel device 23 for a synchrony group 20, and if the audio information source is a source 16(m) connected to the network 12, or a source available over the wide area network, the audio information buffer 31 will receive and buffer audio and playback timing information from the network communications manager 40. It will be appreciated that, if the zone player 11(n) is not a member of the synchrony group, the zone player 11(n) will not play this buffered audio and playback timing information.

[0050] On yet another hand, if the zone player 11(n) is operating as the master device 21 or a slave device 22(g) in a synchrony group, and if the zone player 11(n) is not also the audio information channel device 23 providing audio and playback timing information for the synchrony group 20, the audio information buffer 31 will receive and buffer audio and playback timing information from the network communications manager 40.

[0051] The audio information source interface 30 connects to the audio information source(s) 14(n)(s) associated with the zone player 11(n). While the zone player 11(n) is operating as audio information channel device 23 for a synchrony group 20, and if the audio information is to be provided by a source 14(n)(s) connected to the zone player 11(n), the audio information source interface 30 will selectively receive audio information from one of the audio information source(s) 14(n)(s) to which the zone player is connected and store the audio information in the audio information buffer 21. If the audio information from the selected audio information source 14(n)(s) is in analog form, the audio information source interface 30 will convert it to digital form. The selection of the audio information source 14(n)(s) from which the audio information source interface 30 receives audio information is under control of the control module 42, which, in turn, receives control information from the user interface module through the user interface module interface 44. The audio information source interface 30 adds playback timing information to the digital audio information and buffers the combined audio and playback timing information in the audio information buffer 21.

[0052] More specifically, as noted above, the audio information source interface 30 receives audio information from an audio information source 14(n)(s), converts it to digital form if necessary, and buffers it along with playback timing information in the audio information buffer 21. In addition, the audio information source interface 30 will also provide formatting and scheduling information for the digital audio information, whether as received from the selected audio information source 14(n)(s) or as converted from an analog audio information source. As will be made clear below, the formatting and scheduling information will control not only playback by the zone player 11(n) itself, but will also enable other zone players 11(n'), 11(n"),... that may be in a synchrony group for which the zone player 11(n) is the master device, to play the audio program associated with the audio information in synchrony with the zone player 11(n).

[0053] In one particular embodiment, the audio information source interface 30 divides the audio information associated with an audio work into a series of frames, with each frame comprising digital audio information for a predetermined period of time. As used herein, an audio track may comprise any unit of audio information that is to be played without interruption. On the other hand, an audio program may comprise a series of one or more audio tracks that are to be played in succession. It will be appreciated that the tracks comprising the audio program may also be played without interruption, or alternatively playback between tracks maybe interrupted by a selected time interval. FIG. 4 schematically depicts an illustrative framing strategy used in connection with one embodiment of the invention for a digital audio stream comprising an audio work. More specifically, FIG.4 depicts a framed digital audio stream 50 comprising a sequence of

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frames 51(1) through 51(F) (generally identified by reference numeral 51(f)). Each frame 51(f), in turn, comprises a series of audio samples 52(f)(1) through 52(f)(S) (generally identified by reference numeral 52(f)(s)) of the audio track. Preferably all of the frames will have the same number "S" of audio samples, although it will be appreciated from the following that that is primarily for convenience. On the other hand, it will be appreciated that, the number of audio samples may differ from "S"; this may particularly be the case if the frame 51(f) contains the last audio samples for the digital audio stream for a particular audio work. In that case, the last frame 51(F) will preferably contain samples 52(F)(1) through 52(F)(x), where "x" is less than "S." Generally, it is desirable that the number of samples be consistent among all frames 51(f), and in that case padding, which will not be played, can be added to the last frame 51(F).

[0054] Associated with each frame 51(f) is a header 55(f) that includes a number of fields for storing other information that is useful in controlling playback of the audio samples in the respective frame 51(f). In particular, the header 55(f) associated with a frame 51(f) includes a frame sequence number field 56, an encoding type field 57, a sampling rate information field 58, a time stamp field 60, an end of track flag 61, and a length flag field 62. The header 55(f) may also include fields (not shown) for storing other information that is useful in controlling playback. Generally, the frame sequence number field 56 receives a sequence number "f" that identifies the relative position of the frame 51(f) in the sequence of frames 51(1)..51(f)...51(F) containing the digital audio stream 50. The encoding type field 57 receives a value that identifies the type of encoding and/or compression that has been used in generating the digital audio stream. Conventional encoding or compression schemes include, for example, the well-known MP3 and WAV encoding and/or compression schemes, although it will be appreciated that other schemes may be provided for as well. The sampling rate information field 58 receives sampling rate information that indicates the sampling rate for the audio samples 52(f)(s). As will be apparent to those skilled in the art, the sampling rate determines the rate at which the zone player 11(n) is to play the audio samples 52(f)(s) in the frame, and, as will be described below, determines the period of the digital to analog converter clock 34.

[0055] The condition of the end of work flag 61 indicates whether the frame 51(f) contains the last digital audio samples for the audio track associated with the framed digital audio work 50. If the frame 51(f) does not contain the audio samples that are associated with the end of the digital audio stream 50 for a respective audio work, the end of work flag will be clear. On the other hand, if the frame 51(f) does contain the audio samples that are associated with the end of the digital audio stream 50 for a respective audio work, the end of work flag 61 will be set. In addition, since the number of valid audio samples 52(F)(s) in the frame 51(F), that is, the samples that are not padding, may be less than "S," the default number of audio samples in a frame 51(f), the length flag field 62 will contain a value that identifies the number of audio samples in 52(F)(s) in the last frame 51(F) of the audio work 50. If, as noted above, the frames have a consistent number "S" of samples, the samples 52(F)(x+1) through 52(F)(S) will contain padding, which will not be played.

[0056] The time stamp field 60 stores a time stamp that identifies the time at which the zone player 11(n) is to play the respective frame. More specifically, for each frame of a framed digital audio stream 50 that is buffered in the audio information buffer 21, the audio information source interface 30, using timing information from the digital to analog converter clock 34, will determine a time at which the zone player 11(n) is to play the respective frame, and stores a time stamp identifying the playback time in the time stamp field 60. The time stamp associated with each frame will later be used by the playback scheduler 32 to determine when the portion of the digital audio stream stored in the frame is to be coupled to the digital to analog converter 33 to initiate play back. It will be appreciated that the time stamps that are associated with frames in sequential frames 51(1), 51(2),..., 51(F), will be such that they will be played back in order, and without an interruption between the sequential frames comprising the digital audio stream 50. It will further be appreciated that, after a time stamp has been determined for the first frame, stored in frame 51(1), of a digital audio stream 50, the audio information source interface 30 can determine time stamps for the subsequent frame 51(2), 51(3),...., 51 (F) in relation to the number of samples "S" in the respective frames and the sample rate. The time stamps will also preferably be such that frames will be played back after some slight time delay after they have been buffered in the audio information buffer 21; the purpose for the time delay will be made clear below.

[0057] Returning to FIG. 3, in addition to dividing the digital audio information into frames, the audio information source interface 30 also aggregates and/or divides the frames 51(f) as necessary into packets, each of which will be of a length that would fit into a message for transmission over the network, and associates each packet with a packet sequence number. For example, if a packet will accommodate multiple frames 51(f), 51(f+1),... 51(f+y-1), it will aggregate them into a packet and associate them with a packet number, for example p(x). If the entire frames 51(f) and 51(f+y-1) was accommodated in packet p(x), where "x" is the sequence number, which will occur if the size of a packet is an exact multiple of the frame size, the next packet, p(x+1) will begin with frame 51(f+y) and will include frames 51(f+y),..., 51(f+2y-1). Subsequent packets p(x+2),.... will be formed in a similar manner. On the other hand, if the packet length will not accommodate an exact multiple of the frame size, the last frame in the packet will be continued at the beginning of the next packet.

[0058] If the audio information source interface 30 is aware of track boundaries, which may be the case if the tracks are divided into files, the packets will reflect the track boundaries, that is, the packets will not contain frames from two tracks. Thus, if the last frames associated with a track are insufficient to fill a packet, the packet will contain padding

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from the last frame associated with the track to the end of the packet, and the next packet will begin with the first frames associated with the next track.

[0059] In one embodiment, the audio information source interface 30 stores the packets in the audio information buffer 31 in a ring buffer. As is conventional, a ring buffer includes a series of storage locations in the buffer. Each entry will be sufficient to store one packet. Four pointers are used in connection with the ring buffer, a first pointer pointing to the beginning of the ring buffer, a second pointer pointing to the end of the ring buffer, an third "write" pointer pointing to the entry into which a packet will be written and a fourth "read" pointer pointing to the entry from which packet will be read for use in playback. When a packet is read from the ring buffer for playback, it will be read from the entry pointed to by the read pointer. After the packet has been read, the read pointer will be advanced. If the read pointer points beyond the end of the ring buffer, as indicated by the end pointer, it will be reset to point to the entry pointed to by the beginning pointer, and the operations can be repeated.

[0060] On the other hand, when the audio information source interface 30 stores a packet in the ring buffer, first determine whether the entry pointed to by the write pointer points to the same entry as the entry pointed to by the read pointer. If the write pointer points to the same entry as the entry pointed to by the read pointer, the entry contains at least a portion of a packet that has not yet been read for playback, and the audio information source interface 30 will delay storage of the packet until the entire packet has been read and the read pointer advanced. After the read pointer has been advanced, the audio information source interface 30 can store the packet in the entry pointed to by the write pointer. After the packet has been stored, the audio information source interface 30 will advance the write pointer. If the write pointer points beyond the end of the ring buffer, as indicated by the end pointer, it will be reset to point to the entry pointed to by the beginning pointer, and the operations can be repeated.

[0061] As noted above, the zone player 11(n) can operate both as an audio information channel device 23 and a member of the synchrony group 20 of which it is a member. In that case, the audio information buffer 31 can contain one ring buffer. On the other hand, the zone player 11(n) can operate as an audio information channel device 23 for one synchrony group 20(1) (FIG. 2A) and a member of another synchrony group 20(2). In that case, the audio information buffer 31 would maintain two ring buffers, one for the audio and timing information associated with synchrony group 20(1), and the other for the audio and timing information associated with synchrony group 20(2). It will be appreciated that, in the latter case, the zone player 11(n) will only use the audio and timing information that is associated with synchrony group 20(2) for playback.

[0062] The playback scheduler 32 schedules playback of the audio information that is buffered in the audio information buffer 31 that is to be played by the zone player 11(n). Accordingly, under control of the playback scheduler 32, the digital audio information that is buffered in the audio information buffer 21 that is to be played by the zone player 11(n) is transferred to the digital to analog converter 33 for playback. As noted above, if the zone player 11(n) is operating as an audio information channel device 23 for a synchrony group 20 for which it is not a member, the playback scheduler 32 will not schedule the digital audio information that is to be played by that synchrony group 20 for playback. The playback scheduler 32 only schedules the digital audio information, if any, that is buffered in the audio information buffer 31 that is associated with a synchrony group for which the zone player 11(n) is a member, whether as master device 21 or a slave device 22(g).

[0063] Essentially, the playback scheduler 32 makes use of the read pointer associated with the circular buffer that contains the audio and playback timing information that is to be played by the zone player 11(n). The playback scheduler 32 retrieves the packet information from the entry of the ring buffer pointed to by the read pointer, and then advances the ring pointer as described above. The playback scheduler 32 determines the boundaries of the frames in the packet and uses the time stamps in the time stamp fields 60 associated with the respective frame 51(f), along with timing information provided by the zone player 11(n)'s digital to analog converter clock 34, to determine when the respective frame is to be transferred to the digital to analog converter 33. Generally, when the time stamp associated with a buffered digital audio information frame corresponds to the current time as indicated by the digital to analog converter clock 34, the playback scheduler 32 will enable the respective frame to be transferred to the digital to analog converter 33.

[0064] The digital to analog converter 33, also under control of the digital to analog converter clock 34, converts the buffered digital audio information to analog form, and provides the analog audio information to the audio amplifier 35 for amplification. The amplified analog information, in turn, is provided to the audio reproduction devices 15(n)(r) through the audio reproduction device interface 36. The audio reproduction devices 15(n)(r) transform the analog audio information signal to sound thereby to provide the audio program to a listener. The amount by which the audio amplifier 35 amplifies the analog signal is controlled by the control module 42, in response to volume control information provided by the user through the user interface module 13.

[0065] The network communications manager 40 controls network communications over the network 12, and the network interface 41 transmits and receives message packets over the network 12. The network communications manager 40 generates and receives messages to facilitate the transfer of the various types of information described above in connection with FIG. 2, including the channel device control information, slave device control information, audio and playback timing information and the audio information channel device's clock timing information. In connection with the

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channel device control information and the slave device control information, the network communications manager 40 will generate messages for transfer over the network 12 in response to control information from the control module 42. Similarly, when the network communications manager 40 receives messages containing channel device control information and slave device control information, the network communications manager will provide the information to the control module 42 for processing.

[0066] With regards to the audio information channel device's clock timing information, as noted above, the master device 21 and slave devices 22(g) of the synchrony group 20 obtain the clock timing information from the audio information channel device 23 using the well-known SNTP. If the zone player 11(n) is operating as the audio information channel device 23 for a synchrony group, during the SNTP operation, it will provide its current time, particularly a current time as indicated by its digital to analog converter clock 34. On the other hand, if the zone player 11(n) is operating as the master device 21 or slave device 22(g) of a synchrony group 20, it will receive the clock timing information from the audio information channel device 23. After the respective device 21, 22(g) has obtained the audio information channel device's clock timing information, it will generate a differential time value AT representing the difference between the time T indicated by its digital to analog converter clock 34 and the current time information from the audio information channel device 23. The differential time value will be used to update the time stamps for the frames of the digital audio stream 50 (FIG. 4) that are received from the audio information channel device.

[0067] With regards to the audio and playback timing information, operations performed by the network communications manager 40 will depend on whether

(i) the audio and playback timing information has been buffered in the audio information buffer 31 for transmission, as audio information channel device 23, over the network 12 to the master device 21 and/or slave devices 22(g) of a synchrony group, or

(ii) the audio and playback timing information has been received from the network 12 to be played by the zone player 11(n) as either the master device 21 for a synchrony group or a slave device in a synchrony group.

[0068] It will be appreciated that the network communications manager 40 may be engaged in both (i) and (ii) contemporaneously, since the zone player 11(n) may operate both as the audio information channel device 23(1) for a synchrony group 20(1) (reference FIG. 2A) of which it is not a member, and a member of another synchrony group 20(2) for which another zone player 11(n') is the audio information channel device 23(2). With reference to item (i) above, after a packet that is to be transmitted has been buffered in the respective ring buffer, the network communications manager 40 retrieves the packet, packages it into a message and enables the network interface 41 to transmit the message over the network 12. If the control module 42 receives control information from the user interface module 13 (if the master device 21 is also the audio information channel device 23 for the synchrony group 20) or from the master device (if the master device 21 is not the audio information channel device 23 for the synchrony group 20) that would require the transmission of a "resynchronize" command as described above, the control module 42 of the audio information channel device 23 enables the network communications manager 40 to insert the command into a message containing the audio and playback timing information. Details of the operations performed in connection with the "resynchronize" command will be described below. As noted above, the "resynchronize" command is used if the user enables a synchrony group to terminate the playback of a track that is currently being played, or cancel playback of a track whose playback has not begun.

[0069] On the other hand, with reference to item (ii) above, if network interface 41 receives a message containing a packet containing frames of audio and playback timing information that the zone player 11(n) is to play either as a master device 21 or a slave device for a synchrony group 20, the network interface 41 provides the audio and playback timing information to the network communications manager 40. The network communications manager 40 will determine whether the packet contains a resynchronize command and, if so, notify the control module 42, which will enable operations to be performed as described below. In any case, the network communications manager 40 will normally buffer the various frames comprising the audio and playback timing information in the audio information buffer 31, and in that operation will generally operate as described above in connection with the audio information source interface 30. Before buffering them, however, the network communications manager 40 will update their time stamps using the time differential value described above. It will be appreciated that the network communications manager 40 will perform similar operations whether the messages that contain the packets were multi-cast messages or unicast messages as described above

[0070] The updating of the time stamps by the master device 21 and the slave devices 22(g) in the synchrony group 20 will ensure that they all play the audio information synchronously. In particular, after the network communications manager 40 has received a frame 51(f) from the network interface 41, it will also obtain, from the digital to analog converter clock 34, the zone player 11(n)'s current time as indicated by its digital to analog converter clock 34. The network communications manager 40 will determine a time differential value that is the difference between the slave device's current clock time, as indicated by its digital to analog converter 34, and the audio information channel device's time as indicated by the audio information channel device's clock timing information. Accordingly, if the master or slave

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device's current time has a value T_S and the audio information channel device's current time, as indicated by the clock timing information, has a value T_C, the time differential value $\Delta T=T_S-T_C$. If the current time of the master or slave device in the synchrony group 20, as indicated by its digital to analog converter clock 34, is ahead of the audio information channel device's clock time as indicated by the clock timing information received during the SNTP operation, the time differential value will have a positive value. On the other hand, if the master or slave device's current time is behind the audio information channel device's clock time, the time differential value ΔT will have a negative value. If the zone player 11(n) obtains clock timing information from the audio information channel device 23 periodically while it is a member of the synchrony group 20, the network communications manager 40 can generate an updated value for the time differential value AT when it receives the clock timing information from the audio information channel device 23, and will subsequently use the updated time differential value.

[0071] The network communications manager 40 uses the time differential value AT that it generates from the audio information channel device timing information and zone player 11(n)'s current time to update the time stamps that will be associated with the digital audio information frames that the zone player 11(n) receives from the audio information channel device. For each digital audio information frame that is received from the audio information channel device, instead of storing the time stamp that is associated with the frame as received in the message in the audio information buffer 21, the network communications manager 40 will store the updated time stamp with the digital audio information frame. The updated time stamp is generated in a manner so that, when the zone player 11(n), as a member of the synchrony group plays back the digital audio information frame, it will do so in synchrony with other devices in the synchrony group.

[0072] More specifically, after the zone player 11(n)'s network interface 41 receives a message containing a packet that, in turn, contains one or more frames 51(f), it will provide the packet to the network communications manager 40. For each frame 51(f) in the packet that the network communications manager 40 receives from the network interface 41, the network communications manager 40 will add the time differential value AT to the frame's time stamp, to generate the updated time stamp for the frame 51(f), and store the frame 51(f), along with the header 55(f) with the updated time stamp in the audio information buffer 31. Thus, for example, if a frame's time stamp has a time value T_F, the network communications manager 40 will generate an updated time stamp T^U_F having a time value $T^U_F=T_F+\Delta T$. Since time value T^U_F according to the slave device's digital to analog converter clock 34 is simultaneous to the time value T_F according to the audio information channel device's digital to analog converter clock 34, the zone player 11(n) device will play the digital audio information frame at the time determined by the audio information channel device 23. Since all of the members of the synchrony group 20 will perform the same operations, generating the updated time stamps T^U_F for the various frames 51(f) in relation to their respective differential time values, all of the zone players 11(n) in the synchrony group 20 will play them synchronously. The network communications manager 40 will generate updated time stamps T^U_F for all of the time stamps 60 in the packet, and then store the packet in the audio information buffer 31.

[0073] It will be appreciated that, before storing a packet in the audio information buffer 21, the network communications manager 40 can compare the updated time stamps T^U_F associated with the frames in the packet to the slave device's current time as indicated by its digital to analog converter clock 34. If the network communications manager 40 determines the time indicated by the updated time stamps of frames 51(f) in the packet are earlier than the zone player's current time, it can discard the packet instead of storing it in the audio information buffer 21, since the zone player 11(n) will not play them. That is, if the updated time stamp has a time value T^U_F that identifies a time that is earlier than the zone player's current time T_S as indicated by the zone player's digital to analog converter clock 34, the network communications manager 40 can discard the packet.

[0074] If the zone player 11(n) is operating as the master device 21 of a synchrony group 20, when the user, through the user interface module 13, notifies the zone player 11(n) that another zone player 11(n') is to join the synchrony group 20 as a slave device 22(g), the control module 42 of the zone player 11(n) enables the network communications manager 40 to engage in an exchange of messages, described above in connection with FIG. 2, to enable the other zone player 11(n') to join the synchrony group 20 as a slave device. As noted above, during the message exchange, the messages generated by the network communications manager 40 of the zone player 11(n) will provide the network communications manager of the zone player 11(n') that is to join the synchrony group 20 with information such as the multi-cast address being used by the audio information channel device 23 that is providing the audio program to the synchrony group 20, as well as a unicast network address for the audio information channel device 23. After receiving that information, the network communications manager and network interface of the zone player 11(n') that is to join the synchrony group 20 can begin receiving the multi-cast messages containing the audio program for the synchrony group, engage in SNTP transactions with the audio information channel device 23 to obtain the latter's current time, and also enable the audio information channel device 23 to send the zone player 11(n') frames 51(f) that it had previously broadcast using the unicast message transmission methodology as described above.

[0075] On the other hand, if the network communications manager 40 and network interface 41 of the zone player 11(n) receive a message over the network 12 indicating that it is to become a slave device 22(g) of a synchrony group for which another zone player 11(n') is the master device, the network communications manager 40 for zone player

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11(n) will provide a notification to the control module 42 of zone player 11(n). Thereafter, the control module 42 of zone player 11(n) can enable the network communications manager 40 of zone player 11(n) to perform the operations described above to enable it to join the synchrony group 20.

[0076] As noted above, the user, using user interface module 13, can enable the synchrony group to terminate playback of a track of an audio program that is currently being played. After playback of a track that is currently being played has been terminated, playback will continue in a conventional manner with the next track that has been buffered in the audio information buffer 31. It will be appreciated that that could be the next track that is on the original play list, or a previous track. In addition, the user can enable the synchrony group 20 to cancel playback of a track that it has not yet begun to play, but for which buffering of packets has begun in the synchrony group 20. Both of these operations make use of the "resynchronize" command that the master device 21 of the synchrony group 20 can enable the audio information channel device 23 to include in the multi-cast message stream that it transmits to the synchrony group 20. Generally, in response to receipt of the resynchronize command, the members of the synchrony group 20 flush the ring buffer containing the packets that they are to play in the future. In addition, if the members of the synchrony group provide separate buffers for their respective digital to analog converters 33, the members will also flush those buffers as well. After the audio information channel device transmits a packet containing the resynchronize command:

(i) in the case of the use of the resynchronize command to terminate playing of a track that is currently being played, the audio information channel device 23 will begin multi-casting packets for the next track, to begin play immediately, and will continue through the play list in the manner described above; and

(ii) in the case of the use of the resynchronize command to cancel play of a track for which buffering has begun, but which is to be played in the future, the audio information channel device 23 will begin multi-casting packets for the track after the track that has been cancelled, to be played beginning at the time the cancelled track was to begin play, and will also continue through the play list in the manner described above.

It will be appreciated that,

(a) in the first case (item (i) directly above), the resynchronize command can enable the read pointer to be set to point to the entry in the circular buffer into which the first packet for the next track will be written, which will correspond to the entry to which the write pointer points, but

(b) in the second case (item (ii) directly above), the resynchronize command can enable the write pointer for the circular buffer to be set to point to the entry that contains the first packet for the track whose play is being cancelled.

It will further be appreciated that, if a track is cancelled for which buffering has not begun, the resynchronize command will generally not be necessary, since the audio information channel device 23 for the synchrony group 20 need only delete that track from the play list.

[0077] Operations performed in connection with use of the resynchronize command to cancel playback of a track that is currently being played will be described in connection with Packet Sequence A below, and operations performed in connection with the use of the resynchronize command to cancel playback of a track that is has not yet begun to play, but for which buffering of packets has begun, will be described in connection with Packet Sequence B below.

Packet Sequence A

[0078]

(A1.0) [packet 57]
(A1.1) [continuation of frame 99]
(A1.2) [frame 100, time = 0:00:01, type = mp3 audio]
(A1.3) [frame 101, time = 0:00:02, type = mp3 audio]
(A1.4) [frame 102, time = 0:00:03, type = mp3 audio]

(A2.0) [packet 58]
(A2.1) [continuation of frame 102]
(A2.2) [frame 103, time = 0:00:04, type = mp3 audio]
(A2.3) [frame 104, time = 0:00:05, type = mp3 audio]
(A2.4) [frame 105, time = 0:00:06, type = mp3 audio]

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(continued)

(A3.0) [packet 59]
(A3.1) [continuation of frame 105]
(A3.2) [frame 106, time = 0:00:07, type = mp3 audio]
(A3.3) [frame 107, time = 0:00:08, type = mp3 audio]
(A3.4) [frame 108, time = 0:00:09, type = mp3 audio]
(A4.0) [packet 60]
(A4.1) [continuation of frame 108]
(A4.2) [frame 109, time = 0:00:10, type = mp3 audio]
(A4.3) [Resynchronize command]
(A4.4) [Padding, if necessary]

(A5.0) [packet 61]
(A5.1) [frame 1, time = 0:00:07, type = mp3 audio]
(A5.2) [frame 2, time = 0:00:08, type = mp3 audio]
(A5.3) [frame 3, time = 0:00:09, type = mp3 audio]
(A5.4) [frame 4, time = 0.00.10, type = mp3 audio]

(A6.0) [packet 62]
(A6.1) [continuation of frame 4]
(A6.2) [frame 5, time = 0:00:11, type = mp3 audio]
(A6.3) [frame 6, time = 0:00:12, type = mp3 audio]
(A6.4) [frame 7, time = 0:00:13, type = mp3 audio]

[0079] Packet Sequence A comprises a sequence of six packets, identified by packet 57 through packet 62, that the audio information channel device 23 multi-casts in respective messages to the members of a synchrony group 20. It will be appreciated that the series of messages that the audio information channel device 23 may multi-cast to the synchrony group 20 may include a messages prior to the packet 57, and may also include messages after packet 62. Each packet comprises a packet header, which is symbolized by lines (A1.0), (A2.0),...(A6.0) in Packet Sequence A, and will generally also include information associated with at least a portion of a frame. In the packets represented in Packet Sequence A, each packet includes information associated with a plurality of frames. Depending on the lengths of the packets, each packet may contain information associated with a portion of a frame, an entire frame, or multiple frames. In the illustration represented by Packet Sequence A, it is assumed that each packet may contain information associated with multiple frames. In addition, it is assumed that a packet does not necessarily contain information associated with an integral number of frames; in that case, a packet may contain information associated with a portion of a frame, and the next packet will contain the information associated with the rest of a frame.

[0080] The frames and associated header playback timing information contained in the various packets are symbolized by lines (A1.1), (A1.2),..., (A1.4), (A2.1),.... (A6.4) of Packet Sequence A. Thus, for example, line (A1.2) of packet 57 represents the one-hundredth frame, that is, frame 51(100) (reference FIG.4), of the track whose audio information is being transmitted in the sequence of packets that includes packet 57. The frame 51 (100) is to be played at an illustrative time, according to the audio information channel device's digital to analog converter clock, of "time=0:00:01," and the frame is encoded and/or compressed using the well-know MP3 encoding and compression methodology. In that case, the legend "time = 0:00:01" represents the time stamp that would be included in field 60 (FIG. 4) of the header associated with the frame 50(100) as multi-cast by the audio information channel device for the synchrony group. It will be appreciated that the playback time and encoding/compression methodology will be referred in the header 55(100) that is associated with the frame 51(100). It will also be appreciated that the header may also contain additional information as described above.

[0081] Similarly, line (A1.3) of packet 57 represents the one-hundred and first frame, that is, frame 51(101), of the track whose audio information is being transmitted in the sequence of packets that includes packet 57. The frame 51(101) is to be played at an illustrative time, according to the audio information channel device's digital to analog converter clock, of "0:00:02," and the frame is also encoded and/or compressed using the MP3 encoding and compression methodology. Line (A1.4) of packet 57 represents similar information, although it will be appreciated that, depending on the length of packet 57, the line may not represent the information for an entire frame 51(102) and/or its associated header. If the length of packet 57 is not sufficient to accommodate the information for the entire frame 51(102) and/or associated header, the information will continue in packet 58, as represented by line (A2.1) in Packet Sequence A. Similarly, if the

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length of packet 56 was not sufficient to contain the information for an entire frame 51(99) preceding frame 51(100), packet 57 (lines (A1.0) through 1.4) may contain any information from frame 51 (99) that packet 56 was unable to accommodate.

[0082] As noted above, when the master device 21 or a slave device 22(g) in the synchrony group 20 receives the packet 57, its respective network communications manager 40 will update the time stamps associated with the various frames 51(f) as described above before buffering the respective frames in the respective audio information buffer 31.

[0083] Packets 58 and 59 contain information that is organized along the lines described above in connection with packet 57.

[0084] Packet 60 also contains, as represented by lines (A4.1) and (A4.2), information that is organized along the lines of the information represented by lines (Ax.1) and (Ax.2) ("x" equals an integer) described above in connection with packets 57 through 59. On the other hand, packet 60 contains a resynchronize command, as represented by line (A4.3). Packet 60 also may contain padding, as represented by line 4.4, following the resynchronize command. As noted above, the master device 21 of a synchrony group 20 will enable the audio information channel device 23 that is providing audio information to the synchrony group 20 to multi-cast a message containing the resynchronize command when it receives notification from the user interface module 13 that the user wishes to cancel playback of a track that is currently being played. In the example depicted in Packet Sequence A, as will be described below, the audio information channel device 23 receives notification from the master device 21 that the user wishes to cancel playback of a track at a time corresponding to "time = 0:00:07" according to its digital to analog converter clock 34, and, in line (A4.3) of packet 60 it will provide the resynchronize command, followed by padding, if necessary.

[0085] As will be apparent from examining lines (A3.1) through (A3.4) of packet 59 and lines (A4.1) and (A4.2) of packet 60, although the audio information channel device 23 has received the notification from the synchrony group's master device 21 to multi-cast the resynchronize command at a time corresponding to "time = 0:00:07" according to the clock time indicated by its digital to analog converter clock 34, it (that is, the audio information channel device 23) has already multi-cast messages containing frames that are to be played at that time and subsequently. That is, the audio information channel device 23 has, multi-cast in packet 59, frames 51(106) through 51(108) that contain time stamps "time = 0:00:07," "time = 0:00:08" and "time = 0:00:09," respectively, and, in packet 60, in addition to the continuation of frame 51(108), frame 51(109) that contains time stamp "time = 0:00:10." (It will be appreciated that the times indicated by the illustrative time stamps are for illustration purposes only, and that in an actual embodiment the time stamps may have different values and differentials.)

[0086] As noted above, the audio information channel device 23 multi-casts a message containing a packet that, in turn, contains the resynchronize command when it receives the notification from the master device 21 to do so. In the example depicted in Packet Sequence A, the packet will be multi-cast when the audio information channel device's digital to analog converter clock time corresponds to"0:00:07." Subsequently, two things happen. In one, aspect, when the master device 21 and slave devices 22(g) receive the packet that contains the resynchronize command, they will stop playing the audio program that they are playing.

[0087] In addition, the audio information channel device 23 will begin transmitting frames containing audio information for the next track, including therewith time stamps immediately following the digital to analog converter clock time at which the packet including the resynchronize command was transmitted. Accordingly, and with further reference to Packet Sequence A, the audio information channel device 23 will multi-cast a message containing packet 61. As indicated above, packet 61 contains, as represented in lines (A5.1) through (A5.3), frames 51(1) through 51(3), which are the first three frames of the next track of the audio program that is to be played. It is also compressed and encoded using the MP3 encoding and compression scheme, and it is accompanied by time stamps "time = 0:00:07," "time = 0:00:08" and "time = 0:00:10." As noted above, the time stamp "time=0:00:07" corresponds to the clock time at which the audio information channel device 23 multi-casts the resynchronize command, and, when the master device 21 and slave devices 22(g) receive these frames, they would be expected to begin playing them very shortly, if not immediately after the audio information channel device 23 multi-casts the message containing the packet that, in turn, contains the resynchronize command. Packet 61 also includes at least a portion of the next frame, that is, frame 51(4), for that track. In addition, Packet Sequence A depicted above further includes a subsequent packet, namely, packet 62, that contains any necessary continuation of frame 51 (4), as well as three subsequent frames. If any additional packets are required for the track, as well as for subsequent tracks, they can be multi-cast in a similar manner.

[0088] As further noted above, the resynchronize command can also be used to cancel playing of one or more tracks for which playback has begun. This will be illustrated in connection with Packet Sequence B :

Packet Sequence B

[0089]

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(B1.0) [packet 157]
(B1.1) [continuation of frame 99]
(B1.2) [frame 100, time = 0:00:01, type = mp3 audio]
(B1.3) [frame 101, time = 0:00:02, type = mp3 audio]
(B1.4) [frame 102, time = 0:00:03, type = mp3 audio]

(B2.0) [packet 158]
(B2.1) [continuation of frame 102]
(B2.2) [frame 103, time = 0:00:04, type = mp3 audio]
(B2.3) [frame 104, time = 0:00:05, type = mp3 audio]
(B2.4) [frame 105, time = 0:00:06, type = mp3 audio]

(B3.0) [packet 159]
(B3.1) [continuation of frame 105]
(B3.2) [frame 106, time = 0:00:07, type = mp3 audio]
(B3.3) [track boundary notification]
(B3.4) [Padding, if necessary]

(B4.0) [packet 160]
(B4.1) [frame 1, time = 0:00:08, type = mp3 audio]
(B4.2) [frame 2, time = 0:00:09, type = mp3 audio]
(B4.3) [frame 3, time = 0:00:10, type = mp3 audio]

(B5.0) [packet 161]
(B5.1) [continuation of frame 3]
(B5.2) [frame 4, time = 0:00:11, type = mp3 audio]
(B5.3) [Resynchronize, after packet 159]
(B5.4) [Padding, if necessary]

(B6.0) [packet 162]
(B6.1) [frame 1, time = 0:00:08, type = mp3 audio]
(B6.2) [frame 2, time = 0:00:09, type = mp3 audio]
(B6.3) [frame 3, time = 0:00:10, type = mp3 audio]
(B6.4) [frame 4, time = 0:00:11, type = mp3 audio]

(B7.0) [packet 163]
(B7.1) [continuation of frame 4]
(B7.2) [frame 5, time = 0:00:12, type = mp3 audio]
(B7.3) [frame 6, time = 0:00:13, type = mp3 audio]
(B7.4) [frame 7, time = 0:00:14, type = mp3 audio]

[0090] Packet Sequence B comprises a series of seven packets, identified by packet 157 through 163 , that the audio information channel device 23 multi-casts to the members of a synchrony group 20. As with Packet Sequence A, it will be appreciated that the series of packets that the audio information channel device 23 may multi-cast to the synchrony group 20 may include packets prior to the packet 157, and may also include packets after packet 162. Each packet comprises a packet header, which is symbolized by lines (B1.0), (B2.0),... (B7.0) in Packet Sequence B. As in Packet Sequence A, each packet will also generally include information associated with at least a portion of a frame 51(f) along with its associated frame 55(f). As in the packets represented in Packet Sequence A, each packet includes information associated with a plurality of frames. Depending on the lengths of the packets, each packet may contain information associated with a portion of a frame, an entire frame, or multiple frames. Further, as with Packet Sequence A, it is assumed that each packet may contain information associated with multiple frames. In addition, it is assumed that a packet does not necessarily contain information associated with an integral number of frames; in that case, a packet

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may contain information associated with a portion of a frame, and the next packet will contain the information associated with the rest of a frame.

[0091] The structures of the packets represented by Packet Sequence B are similar to those described above in connection with Packet Sequence A, and will not be repeated here. Generally, Packet Sequence B illustratively contains a sequence of packets that represent at least portions of three tracks that may have been selected from, for example, a play list. In particular, packets 157 through 159 represent frames from a portion of one track, packets 160 and 161 represent frames from a second track and packets 162 and 163 represent frames from a third track. The play list indicated that the first, second and third tracks were to be played in that order. With particular reference to Packet Sequence B, it should be noted that line (B3.3) indicates that packet 159 includes an indication that that packet contains the last frame for the track, and line (B3.4) provides for padding to the end of the packet. The first frame of the next track begins in packet 160.

[0092] In connection with the use of the resynchronize command to cancel playback of a track, at least a portion of which the audio information channel device 23 has multi-cast to the members of the synchrony group, packet 161, in line (B5.3) represents a resynchronize command that indicates that resynchronization is to occur after packet 159, that is, immediately after the packet that contains the last frame of the first of the three tracks represented by the packets in Packet Sequence B. It should be noted that the resynchronize command is in the packet 161, while the resynchronization is to occur at packet 160, that is, the synchrony group is to not play the track starting with packet 160, but instead is to begin playing the track frames for which begin with the next packet, that is, packet 162. As with Packet Sequence A, in Packet Sequence B the audio information channel device 23, in packet 162 and 163, multi-casts frames whose time stamps indicate that they are to be played when the frames that were multi-cast in packets 160 and 161 were to be played. By use of the resynchronize command and specifying a packet in this manner, the audio information channel device can cancel playback of a track for which playback has not yet begun.

[0093] It will be appreciated that the resynchronize command is generally not necessary for cancelling play back of a track that the audio information channel device 23 has not started multi-casting to the synchrony group 20, since the audio information channel device 23 itself can re-order the play list to accommodate the cancellation.

[0094] The invention provides a number of advantages. In particular, the invention provides a network audio system in which a number of devices share information can reproduce audio information synchronously, notwithstanding the fact that packets, which may contain digital audio information, transmitted over the network to the various zone players connected thereto may have differing delays and the zone players operate with independent clocks. Moreover, although the invention has been described in connection with audio information, it will be appreciated that the invention will find utility in connection with any type of isochronous information for which synchrony among devices is desired. The system is such that synchrony groups are created and destroyed dynamically, and in such a manner as to avoid requiring a dedicated device as the master device.

[0095] It will be appreciated that a number of changes and modifications may be made to the network audio system 10 as described above. For example, although the invention has been described as providing that the audio information channel device 23 provides digital audio information to the members synchrony group 20 that has been encoded using particular types of encoding and compression methodologies, it will be appreciated that the audio information channel device 23 can provide digital audio information to various members of the synchrony group 20 that have been encoded and compressed using different types of encoding and compression methodologies, and, moreover, for which different sampling rates have been used. For example, the audio information channel device 23 may provide digital audio information to the master device 21 and slave devices 22(1) through 22(g_1) using the MP3 methodology at a specified sampling rate, the digital audio information for the same program to slave devices 22(g_1+1) through 22(g_2) using the WAV methodology at one specified sampling rate, and to slave devices 22(g_2+1) through 22(G) using the WAV methodology at another specified sampling rate. In that case, the audio information channel device 23 can specify the particular encoding and compression methodology that has been used in the encoding type field 57 associated with each frame and the sampling rate in the sampling rate field 58. Moreover, since the encoding and compression type and sampling rate are specified for each frame, the encoding and compression type and sampling rate can be changed from frame to frame. The audio information channel device 23 may use different multi-cast addresses for the different encoding and compression types and sampling rates, but it will be appreciated that that would not be required.

[0096] It will be appreciated that two advantages of providing that the encoding and compression methodology and the sampling rate is provided on a frame-by-frame basis, instead of on, for example, a track-by-track basis, is that that would facilitate a slave device joining the synchrony group 20 at a frame mid-track, without requiring, for example, the master device 21 or the audio information channel device 23 to notify it of the encoding and compression methodology or the sampling rate.

[0097] Another modification is that, instead of the network communications manager 40 of a member of a synchrony group 20 generating the updated time stamp T^u_F for a digital audio information frame by adding the time differential value AT to the time stamp T_F associated with a frame, the network communications manager 40 may instead generate the updated time stamp T^U_F by subtracting the differential time value AT from the member's current time T_S as indicated

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by the member's digital to analog converter clock 34 at the time at which the digital audio information is received. It will be appreciated, however, that there may be variable time delays in processing of messages by the slave device's network communications manager 40, and so it may be preferable to generate the time differential value AT using the time stamp T_F provided by the audio information channel device 23.

[0098] In addition, instead of the network communications manager 40 of a member of a synchrony group generating an updated time stamp to reflect the difference between the times indicated by the member's digital to analog converter clock and the audio information channel device's digital to analog converter clock, the network communications manager 40 can generate the time differential value AT and provide it to the member's playback scheduler 32. In that case, the member's network communications manager 40 can store each digital audio information frame along with the time stamp T_F as received from the master device in the audio information buffer 21. The playback scheduler 32 can utilize the time differential value ΔT, and the time stamps T_F associated with the digital audio information frames, to determine when the respective digital audio information frames are to be played. In determining when a digital audio information frame is to be played, the playback scheduler can add the time differential value to the time stamp T_F associated with the digital audio frame, and enable the digital audio frame to be coupled to the digital to analog converter 33 when the time indicated by the sum corresponds to the current time as indicated by the slave device's digital to analog converter clock 34. Alternatively, when the member's digital to analog converter clock 34 updates its current time T_S, the playback scheduler can generate an updated current time T'_S by subtracting the differential time value AT from the current time T_S, and using the updated current time T'_S to determine when to play a digital audio information frame.

[0099] As described above, the members of a synchrony group 20 periodically obtain the audio information channel device's current time value and uses the current time value that it receives from the audio information channel device to periodically update the time differential value AT that it uses in updating the time stamps associated with the various frames. It will be appreciated that, if the digital to analog converter clock(s) associated with the member(s) of a synchrony group 20 are ensured to have the same rate as the digital to analog converter clock, a member need only obtain the current time value from the audio information channel device once, at the beginning of playback.

[0100] As another alternative, if the zone players are provided with digital to analog converter clock 34 whose time and rate can be set by an element such as the network communications manager 40, when a zone player 11(n) is operating as a member of a synchrony group 20, its network communications manager 40 can use the various types of timing information that it receives from the audio information channel device 23, including the current time information and the playback timing information indicated by the time stamps that are associated with the various frames 51(f) comprising the audio and playback timing information that it receives, to adjust the synchrony group member's digital to analog converter clock's time value and/or the clock rate that it uses for playback.

[0101] If the clock's time value is to be adjusted, when the synchrony group member's network communications manager 40 initially receives the current time information from the audio information channel device 23 for the synchrony group 20, the network communications manager 40 can set the synchrony group member's digital to analog converter clock 34 to the current time value as indicated by the audio information channel device's current time information. The network communications manager 40 can set the clock 34 to the current time value indicated by the audio information channel device's current time information once, or periodically as it receives the current time information.

[0102] Alternatively or in addition, the synchrony group member's network communications manager 40 can use one or both of the current time information and/or the playback timing information in the time stamps associated with the respective frames 51(f) to adjust the clock rate of the clock 34 that it uses for playback. For example, when the synchrony group member's network communications manager 40 receives a frame 51(f_X) having a time stamp having a time value T_{fx}, it can generate the updated time value $T^U_{fx} = T_{fx} + \Delta T$ as described above, and store the frame with the time stamp with the updated time value in the audio information buffer 30. In addition, since both the number of samples in a frame and the sampling rate, which determines the rate at which the frame is to be played, are known to the network communications manager 40, it can use that information, along with the updated time value T^U_{Fx} that is to be used for frame 51(f_X) to generate an expected updated time value T^E_{fx+1}, that is expected for the updated time stamp of the next frame 51(f_{x+1}). After the synchrony group member's network communications manager 40 receives the next frame 51(f_{x+1}), it can generate the updated time value T^U_{fx+1} and compare that value to the expected updated time value T^E_{fx+1}. If the two time values do not correspond, or if the difference between them is above a selected threshold level, the clock that is used by the audio information channel device 23 to generate the time stamps is advancing at a different rate than the synchrony group member's digital to analog converter clock 34, and so the network communications manager 40 can adjust the rate of the digital to analog converter clock 34 to approach that of the clock used by the audio information channel device 23 so that the differential time value AT is constant. On the other hand, if the two time values do correspond, then the time differential value AT is constant, or the difference is below a threshold level, and the network communications manager 40 need not change the clock rate of the digital to analog converter clock 34. It will be appreciated that, if the clock rate is to be adjusted, the rate adjustment can be fixed, or it can vary based on, for example, the difference between the updated time value T^U_{fx+1}, and the expected

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updated time value T^{E}_{fx+1}.

[0103] It will also be appreciated that, if no rate adjustment is performed for one frame 51 (f_{X+1}), the synchrony group member's network communications manager 40 can generate an expected updated time value T^{E}_{fx+2} that is expected for the updated time stamp of the next frame 51(f_{X+2}) using the updated time value T^{U}_{Fx} determined for frame 51(f_X), along with the number of samples in a frame and the sampling rate, and compare the expected updated time value T^{E}_{fx+2} to the updated time value T^{U}_{fx+2} that it generates when it receives frame 51(f_{X+2}). At that point, if the network communications manager 41 determines that two time values do not correspond, or if the difference between them is above a selected threshold level, it can adjust the rate of the digital to analog converter clock 34. Similar operations can be performed if no rate adjustment is performed for several successive frames 51(f_{X+1}), 51(f_{X+2}),.... This will accommodate the possibility that the rate differential between the clock 34 and the clock used by the audio information channel device 23 in generating the time stamps have rates that differ by an amount sufficiently small that it cannot be detected using time stamps of two or more successive frames.

[0104] Instead or in addition to adjusting the clock rate as described above, the synchrony group member's network communications manager 40 can perform similar operations in connection with adjusting the clock rate in connection with the current time information that it receives from the audio information channel device 23.

[0105] Furthermore, although the network audio system 10 has been described such that the master device 21 of a synchrony group 20 can, in response to control information provided thereto by a user through the user interface module 13, provide a notification to a zone player 11(n) that it is to become a member of its synchrony group 20 as a slave device 22(g), it will be appreciated that the user interface module 13 can provide the notification directly to the zone player 11(n) that is to become a member of the synchrony group 20. In that case, the zone player 11(n) can notify the master device 21 that it is to become a slave device 22(g) in the synchrony group 20, after which the master device 21 can provide information regarding the synchrony group 20, including the multi-cast and unicast addresses of the audio information channel device and other information as described above.

[0106] Similarly, although the network audio system 10 has been described such that the master device 21 of a synchrony group 20 can, in response to control information provided thereto by a user through the user interface module 13, provide a command to a slave device 22(g) to enable the slave device 22(g) to adjust its volume, it will be appreciated that the user interface module 13 can provide control information directly to the slave device 22(g) to enable the slave device 22(g) to adjust its volume.

[0107] In addition, although the network audio system 10 has been described such that each frames 51(f) is associated with a frame sequence number (reference field 56, FIG. 4), it will be appreciated that, if the packets described above in connection with Packet Sequence A and Packet Sequence B are provided with packet sequence numbers, the frame sequence numbers need not be provided, since the packet sequence numbers can suffice for defining the frame sequencing.

[0108] Furthermore, although the network audio system 10 has been described such that the zone players 11(n) are provided with an audio amplifier 35 for amplifying the analog signal provided by the respective digital to analog converters 33, it will be appreciated that a zone player may be provided that does not itself include an audio amplifier. In that case, the analog signal may be coupled to an external amplifier for amplification as necessary before being provided to the audio reproduction device(s) 15(n)(r). It will be appreciated that a single zone player 11(n) may be provided with multiple audio amplifiers and audio reproduction device interfaces, and, if necessary, multiple digital to analog converters 33, to provide audio programs for corresponding numbers of synchrony groups.

[0109] Similarly, although the zone players 11(n) have been described such that they may be connected to one or more audio information sources, it will be appreciated that an audio information source may form part of and be integrated into a zone player 11(n). For example, a zone player may include a compact disk player, cassette tape player, broadcast radio receiver, or the like, that has been integrated into it. In addition, as noted above, an individual zone player 11(n) may be connected to multiple audio information sources and may contemporaneously operate as the audio information channel device 23 for multiple synchrony groups.

[0110] In addition, although FIG. 1 shows the network audio system 10 as including one user interface module 13, it will be appreciated that the system 10 may include a plurality of user interface modules. Each user interface module be useful for controlling all of the zone players as described above, or alternatively one or more of the user interface modules may be useful for controlling selected subsets of the zone players.

[0111] Moreover, it will be appreciated that, although the invention has been described in connection with audio information, it will be appreciated that the invention will find utility in connection with any type of information for which synchrony among devices connected to a network is desired.

[0112] As noted above, while a zone player 11(n) is operating as audio information channel device 23 for a synchrony group 20, when the zone player 11(n)'s audio information source interface 30 or network communications manager 40 stores digital audio information frames based on audio information from an audio information source 14(n)(s) in the audio information buffer 31, it will provide time stamps for the respective frames to schedule them for playback after some time delay after they have been buffered in the audio information buffer 31. The delay is provided so that, for other zone

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players 11(n'), 11(n''),... that are operating as members of a synchrony group, there will be sufficient time for the audio and playback timing information to be transferred over the network 12 to those other zone players 11(n'), 11(n''),... so that it can be processed and played by them at the appropriate time as described above. The time period that is selected for the time delay may be fixed or variable, and in either case may be based on a number of factors. If the time period selected for the time delay is fixed, it may be based on, for example, factors such as an estimate of the maximum latency in the network 12, the estimated maximum loading of the various components comprising the zone players 11(n), and other estimates as will be appreciated by those skilled in the art.

[0113] The time delay may be the same for audio information from all types of audio information sources, and may be constant over the entire period that the synchrony group 20 is playing an audio work. Alternatively, different time delays may be utilized based on various criteria. For example, if the audio information is to be played independently of information associated with other types of media, the time delay may be selected to be relatively long, on the order of a significant fraction of a second, or longer. On the other hand, if the audio information is to be played contemporaneously with, for example, video information, which may be supplied by, for example, a video disk, video tape cassette, over cable, satellite, or broadcast television, which may not be buffered or which may be displayed independently of the network audio system 10, it may be undesirable to provide for such a lengthy delay, since the time delay of the audio playback, in relation to the video display, may be noticeable. In that case, the zone player 11(n) may provide for a much shorter time delay. In one embodiment, the time delay provided for audio information to be played concurrently with video information is selected to be generally on the order of fifty milliseconds, which would barely, if at all, be perceptible to someone viewing the video. Other desirable time delays for information from other types of sources will be apparent to those skilled in the art.

[0114] As yet a further possibility, the zone player 11(n), when operating as an audio information channel device 23 for a synchrony group 20, can dynamically determine the time delay based on a number of conditions in the network audio system 10, including, for example, the message transfer latency in network 12, the loading of microprocessors or other components that are used in the various zone players 11(n'), 11(n''),... that may comprise a synchrony group 20, as well as other factors. For example, if the audio information channel device 23 determines that the latency in the network 12 has increased beyond a selected threshold, the audio information channel device 23 can adjust the delay to increase the likelihood that the members of the synchrony group 20 will be able to receive the packets and process the frames so that they will be able to play them at the appropriate times. Similarly, if the audio information channel device 23 is notified that a member of the synchrony group 20 to which it provides audio information requires additional time to receive and process the frames that it transmits, the audio information channel device 23 can adjust the delay accordingly. It will be appreciated that, to reduce or minimize possible discontinuities in the audio playback by the members of the synchrony group, the audio information channel device 23 can, instead of adjusting the time delay during a particular audio track, adjust the time delay between tracks, during silent periods of a track or otherwise as will be appreciated by those skilled in the art. In addition, the audio information channel device 23 can use conventional audio compression methodologies to facilitate a speeding up and/or slowing down of playback of an audio track while it is in the process of providing additional time delay. Generally, the members of the synchrony group 20 can provide notifications to the audio information channel device 23 if they determine that they will need an additional time delay, and the audio information channel device 23 can adjust the time delay in accordance with the notifications from the members of the synchrony group 20.

[0115] It will be appreciated that a system in accordance with the invention can be constructed in whole or in part from special purpose hardware or a general purpose computer system, or any combination thereof, any portion of which may be controlled by a suitable program. Any program may in whole or in part comprise part of or be stored on the system in a conventional manner, or it may in whole or in part be provided in to the system over a network or other mechanism for transferring information in a conventional manner. In addition, it will be appreciated that the system may be operated and/or otherwise controlled by means of information provided by an operator using operator input elements (not shown) which may be connected directly to the system or which may transfer the information to the system over a network or other mechanism for transferring information in a conventional manner.

[0116] The foregoing description has been limited to a specific embodiment of this invention. It will be apparent, however, that various variations and modifications may be made to the invention, with the attainment of some or all of the advantages of the invention. It is the object of the appended claims to cover these and such other variations and modifications as come within the true spirit and scope of the invention.

[0117] The following numbered clauses set out further exemplary embodiments of the present invention.

1. A system comprising plurality of devices, one of the devices operating as a task source device and at least one other device operating as a member of a synchrony group, A. the task source device being configured to distribute a series of tasks to the synchrony group, each task being associated with a time stamp indicating a time, relative to a clock maintained by the task source device, at which the devices comprising the synchrony group are to execute the respective task; B each member device being configured to: (i) periodically obtain from the task source device

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an indication of a current time value indicated by the task source device's clock, and (ii) determine, from the time stamp associated with each respective task and a time differential value representing a difference between the current time value indicated by the task source device's clock, and a current time value indicated by its respective clock, a time, relative to its respective clock, at which it is to execute the task.

2. A system as defined in clause 1 in which the synchrony group comprises a plurality of member devices.

3. A system as defined in clause 2 in which each device comprising a, member of the synchrony group is further configured to execute each task that it receives from the task source device at the determined time, thereby to facilitate execution by them of respective tasks in the series in respective timing relationships relative to the time indicated by the task source device's clock.

4. A system as defined in clause 3 in which the member devices are configured to execute respective tasks in synchrony.

5. A system as defined in clause 2 in which one of the member devices operates as a master device for the synchrony group, any other member devices comprising respective slave devices, the master device being configured to perform at least one type of synchrony group management operation in connection with the member devices comprising the synchrony group.

6. A system as defined in clause 5 further including a user interface module configured to control the master device's performance of said at least one type of synchrony group management operation, the master device being further configured to provide status information relating to the status of the synchrony group to the user interface module.

7. A system as defined in clause 6 in which the status information includes identifications of the devices comprising the synchrony group.

8. A system as defined in clause 6 in which the status information includes an identification of the task currently being executed.

9. A system as defined in clause 5, the system comprising at least one additional device, in which, in one type of synchrony group management operation, the master device is configured to enable the at least one additional device to join the synchrony group as a slave device.

10. A system as defined in clause 9 in which the task source device is configured to distribute tasks to the member devices using a selected multi-cast transmission methodology, the member devices being configured to buffer the tasks until they are to be executed, and further in which, when the at least one additional device joins the synchrony group as a slave device, the task source device is enabled to transmit at least one previously distributed task to the slave device using a selected unicast transmission methodology.

11. A system as defined in clause 5 in which, in at least one type of synchrony group management operation, the master device is configured to enable the task source device to join the synchrony group as a slave device, the task source device continuing to operate as the task source device for the synchrony group.

12. A system as defined in clause 5 in which, in at least one type of synchrony group management operation, the master device is configured to enable a slave device to disengage from the synchrony group, the disengaged slave device thereafter not being a member device in the synchrony group.

13. A system as defined in clause 5 in which, in at least one type of synchrony group management operation, the master device is configured to control the series of tasks to be distributed by the task source device.

14. A system as defined in clause 5 in which, in at least one type of synchrony group management operation, the master device is further configured to control execution by the member devices of the tasks that have been distributed by the task source device.

15. A system as defined in clause 14 in which the series of tasks includes a series of task sequences with each task sequence including a sub-set of the series of tasks, and further in which in at least one type of synchrony group management operation, the master device is configured to enable the member devices to terminate execution of a task sequence that is currently being executed.

16. A system as defined in clause 15 in which, in the synchrony group management operation enabling the member devices to terminate execution of a task sequence that is currently being executed, the master device enables the task source device to distribute a command to enable the member devices to terminate execution of the task sequence, the member devices being configured to, after receiving the command, terminate execution of the task sequence.

17. A system as defined in clause 14 in which the series of tasks includes a series of task sequences with each task sequence including a sub-set of the series of tasks, and further in which at least one type of synchrony group management operation, the master device is configured to enable the member devices to cancel execution of a task sequence that has been previously distributed, but for which execution has not begun.

18. A system as defined in clause 17 in which, in the synchrony group management operation enabling the member devices to cancel execution of a task sequence that has been previously distributed but for which execution has not begun, the master device enables the task source device to distribute a command to enable the member devices to cancel execution of the task sequence, the member devices being configured to, after receiving the command,

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cancel execution of the task sequence.

19. A system as defined in clause 5 in which, in at least one type of synchrony group management operation, the member device operating as the master device is configured to enable the master device to migrate from one member device to another member device in the synchrony group.

20. A system as defined in clause 5 in which, in at least one type of synchrony group management operation, the master device is configured to enable the task source device to migrate from one device to another device in the system.

21. A system as defined in clause 20 in which

A. the device operating as the task source device is configured to, after being enabled to migrate the task source device to said other device, provide migration information to the other device, the migration information including a source for information respecting the tasks to be distributed, timing information relative to the clock maintained by the task source device and identifications of the member devices,

B. the other device being configured to, after receiving the migration information,

i. distribute the series of tasks to the synchrony group, each task being associated with a time stamp indicating a time, relative to the timing information that it receives from the device operating as the task source device, at which the devices comprising the synchrony group are to execute the respective task, and

ii. notify the members of the synchrony group that it is to thereafter operate as the task source device.

22. A system as defined in clause 21 in which the information respecting the tasks that are to be distributed is a source of streaming information, the other device being configured to, after receiving the migration information, assemble the streaming information into tasks and associate each task with a said time stamp.

23. A system as defined in clause 21 in which the information respecting the tasks that are to be distributed is in a file identified in the migration information, the other device being configured to obtain information from the identified file, assemble the information into tasks and associate each task with a said time stamp.

24. A system as defined in clause 23 in which the information respecting the tasks that are to be distributed begins at an offset, identified in the migration information, into the identified file, the other device being configured to assemble the information from a position in the file associated with the identified offset.

25. A system as defined in clause 23 in which the information respecting the tasks that are to be distributed is in a series of files identified in the migration information, the other device being configured to obtain information from successive files in the series assemble the information into tasks and associate each task with as said time stamp.

26. A system as defined in clause 1 in which the task source device is further configured to distribute the tasks using a selected multi-cast message transmission methodology.

27. A system as defined in clause 1 in which the task source device is configured to provide, associated with at least one task, a time stamp indicating a task execution time later than the time currently indicated by the clock maintained by the task source device.

28. A system as defined in clause 27 in which the task source device is configured to select the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one task distributed by the task source device can be executed by the member devices at the time indicated by the time stamp.

29. A system as defined in clause 28 in which the task source device is configured to select the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one task distributed by the task source device can be distributed to the member devices for execution at the time indicated by the time stamp.

30. A system as defined in clause 27 in which task source device is configured to obtain information associated with the tasks from at least two types of information sources, the task source device being further configured to select, for each task the delay interval between the time indicated by the time stamp and the current time based on the information source type that is associated with the respective task.

31. A system as defined in clause 1 in which at least one member device is further configured to adjust its clock rate in relation to a clock rate value maintained by the task source device's clock.

32. A system as defined in clause 31 in which the at least one member device is configured to adjust its clock rate in relation to time stamps associated with respective ones of the tasks received from the task source device.

33. A system as defined in clause 1 in which at least one other device operates as a task source device configured to distribute tasks to a second synchrony group, the device operating as the task source device for the first synchrony group also operating as a member device of a second synchrony group.

34. A system as defined in clause 1 in which at least one member device comprises:

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A. a task receiving module configured to receive the series of tasks,
B. a current time retrieval module configured to obtain, from the task source device, the current time value as indicated by the task source's clock;
C. an execution time determination module configured to determine, from the time stamp associated with each respective task and a time differential value representing a difference between the current time value obtained by the current time retrieval module and a current time value indicated by a clock maintained by the device, a time, relative to the member device's respective clock at which the task is to be executed; and
D. a task execution module configured to execute each respective task at the time determined by the execution time determination module.

35. A system as defined in clause 34 further including a control module for controlling execution of commands received by said interface module.
36. A system as defined in clause 35 in which the at least one member device further comprises a buffer configured to buffer tasks that the task receiving module receives from the task source device until they are to be executed, the task execution module being configured to execute the buffered tasks at the times determined by the execution time determination module.
37. A system as defined in clause 36 in which the series of tasks includes a series of task sequences with each task sequence including a subset of the series of tasks, the interface module being further configured to receive task execution control commands for controlling task execution, the control module being configured to, in response to receipt of at least one task execution control command for controlling task execution, enable the task execution module to terminate execution of a task sequence currently being executed, being configured to not execute subsequent tasks in the task sequence that have been buffered.
38. A system as defined in clause 37 in which the control module is configured to enable the task execution module to resume execution of at least one task associated with a subsequent task sequence at a time determined by the execution time determination module.
39. A system as defined in clause 36 in which the series of tasks includes a series of task sequences with each task sequence including a subset of the series of tasks, the interface module being further configured to receive task execution control commands for controlling task execution, the control module being configured to, in response to receipt of at least one task execution control command to cancel execution of a task sequence for which at least one task has been buffered but for which execution has not begun, enable the task execution module to not execute tasks from that task sequence that have been buffered.
40. A system as defined in clause 39 in which the control module is configured to enable the task execution module to resume execution of at least one task associated with a task sequence subsequent to the task sequence for which at least one task has been buffered but for which execution has not begun.
41. A system as defined in clause 34 in which the member device includes:

A. a migration information receiving module configured to receive migration information from the task source device, the migration information including a source for information respecting the tasks to be distributed, timing information relative to the clock maintained by the task source device and identifications of the member devices of the synchrony group, and
B. a migration control module configure to, after the migration information has been received.,

i. distribute the series of tasks to the synchrony group, each task being associated with a time stamp indicating a time, relative to the timing information that it receives from the device operating as the task source device, at which the devices comprising the synchrony group are to execute the respective task, and
ii. notify the members of the synchrony group that it is to thereafter operate as the task source device.

42. A system as defined in clause 41 in which the information respecting the tasks that are to be distributed is a source of streaming information, the migration control module being configured to, after the migration information has been received, assembling the streaming information into tasks and associate each task with a said time stamp.
43. A system as defined in clause 41 in which the information respecting the tasks that are to be distributed is in a file identified in the migration information, the migration control module being configured to obtain information from the identified file, assemble the information into tasks and associate each task with a said time stamp.
44. A system as defined in clause 43 in which the information respecting the tasks that are to be distributed begins at an offset, identified in the migration information, into the identified file, the migration control module being configured to assemble the information from a position in the file associated with the identified offset.
45. A system as defined in clause 43 in which the information respecting the tasks that are to be distributed is in a series of files identified in the migration information, the migration control module being configured to obtain infor-

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mation from successive files in the series assemble the information into tasks and associate each task with as said time stamp.

46. A system as defined in clause 34 in which the member device further includes a clock rate adjustment module configured to adjust the member device's clock rate in relation to a clock rate value maintained by the task source device's clock.

47. A system as defined in clause 46 in which the clock rate adjustment module is configured to adjust the clock rate in relation to time stamps associated with respective ones of the tasks received from the task source device.

48. A system as defined in clause 1 in which the task source device comprises:

A. a task acquisition module configured to obtain respective ones of the tasks;

B. a task execution time determination module configured to determine a time at which each respective task is to be executed, and to associate the respective task with a time stamp indicating its execution time;

C. a task transmission module configured to transmit the series of tasks to said at least one other device; and

D. an execution control command generation module configured to, in response to a predetermined event, enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to modify the execution sequence of the tasks transmitted thereto.

49. A system as defined in clause 48 in which the task transmission module is configured to utilize a selected multi-cast transmission methodology.

50. A system as defined in clause 48 in which the predetermined event comprises input indicia provided by an operator.

51. A system as defined in clause 50 in which, in response to said predetermined event, the execution control command generation module is configured to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to control execution of at least one task in relation to the time the predetermined event occurs.

52. A system as defined in clause 51 in which, in response to said predetermined event, the execution control command generation module is configured to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to terminate execution of a task that it is currently executing and/or to not execute at least one task that is to be executed subsequent to the predetermined event.

53. A system as defined in clause 51 in which the series of tasks includes a series of task sequences with each task sequence including a sub-set of the series of tasks, the execution control command generation module being configured to, in response to said predetermined event,

(i) enable the task transmission module to insert into the series of tasks transmitted by the task transmission module, a command enabling the at least one other device to terminate execution of the currently executing task and/or to not execute at least one subsequent task, if any, in the task sequence including the currently executing task; and

(ii) enable

(a) the task execution time determination module to provide that time stamps associated with tasks of task sequences subsequent to the task sequence currently being executed will reflect the termination and/or non-execution of tasks from the task sequence of the task that is currently being executed, and

(b) the task transmission module to transmit the tasks of the subsequent task sequences to the at least one other device.

54. A system as defined in clause 53 in which the task transmission module is configured to insert a command to enable the at least one other device to not execute all tasks in the task sequence subsequent to the terminated and/or non-executed task.

55. A system as defined in clause 48 in which, in response to said predetermined event, the execution control command generation module is configured to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to control execution of a task in relation to the task's position in the series of tasks.

56. A system as defined in clause 55 in which, in response to said predetermined event, the execution control command generation module is configured to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to cancel execution of a task in relation to the task's position in the series of tasks.

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57. A system as defined in clause 55 in which, in response to said predetermined event, the execution control command generation module is configured to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to cancel execution of a previously-transmitted task in relation to the task's position in the series of tasks.

58. A system as defined in clause 57 in which, in response to said predetermined event, the execution control command generation module is configured to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to cancel execution of a previously-transmitted task, in relation to the task's position in the series of tasks, for which execution has not begun.

59. A system as defined in clause 55 in which the series of tasks includes a series of task sequences with each task sequence including a sub-set of the series of tasks, the execution control command generation module being configured to, in response to said predetermined event,

(i) enable the task transmission module to insert into the series of tasks transmitted by the task transmission module, a command enabling the at least one other device to cancel execution of a task sequence for which execution has not begun; and
(ii) enable

(a) the task execution time determination module to provide that time stamps associated with tasks of task sequences subsequent to the task sequence whose execution was cancelled will reflect the cancellation, and
(b) the task transmission module to transmit the tasks of the subsequent task sequences to the at least one other device.

60 A system as defined in clause 1 in which the task source device comprises:

A. a task acquisition module configured to obtain respective ones of the tasks;
B. a task execution time determination module configured to determine a time at which each respective task is to be executed, and to associate the respective task with a time stamp indicating its execution time;
C. a task transmission module configured to transmit the series of tasks to said at least one other device; and
D. a task source device migration control module configured to, in response to a predetermined event, provide migration information to another device, the migration information including a source for information respecting the tasks to be distributed, timing information relative to the clock maintained by the task source device and identifications of the member devices of the synchrony group.

61. A system as defined in clause 60 in which the task source device is configured to provide, associated with at least one task, a time stamp indicating a task execution time later than the time currently indicated by the clock maintained by the task source device.

62. A system as defined in clause 61 in which the task source device is configured to select the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one task distributed by the task source device can be executed by the member devices at the time indicated by the time stamp.

63. A system as defined in clause 62 in which the task source device is configured to select the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one task distributed by the task source device can be distributed to the member devices for execution at the time indicated by the time stamp

64. A system as defined in clause 62 in which task source device is configured to obtain information associated with the tasks from at least two types of information sources, the task source device being further configured to select, for each task the delay interval between the time indicated by the time stamp and the current time based on the information source type that is associated with the respective task.

65. A device for executing a series of tasks provided by a task source at times specified by the task source in relation to a clock maintained by the task source, the device comprising

A. an interface module configured to receive the series of tasks, each task being associated with a time stamp, each time stamp indicating a time value relative to a time indicated a clock maintained by the task source, at which the device is to execute the respective task;
B. a current time retrieval module configured to obtain, from the task source, a current time value as indicated by the task source's clock;
C. an execution time determination module configured to determine, from the time stamp associated with each

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respective task and a time differential value representing a difference between the current time value obtained by the current time retrieval module and a current time value indicated by a clock maintained by the device, a time, relative to the device's respective clock, at which the task is to be executed; and

D. a task execution module configured to execute each respective task at the time determined by the execution time determination module.

66. A device as defined in clause 65 further including a control module for controlling execution of commands received by said interface module.

67. A device as defined in clause 65 further comprising a buffer configured to buffer tasks that the interface module has received until they are to be executed, the task execution module being configured to execute the buffered tasks at the times determined by the execution time determination module.

68. A device as defined in clause 67 in which the series of tasks includes a series of task sequences with each task sequence including a subset of the series of tasks, the interface module being further configured to receive task execution control commands for controlling task execution, the control module being configured to, in response to receipt of at least one task execution control command for controlling task execution, enable the task execution module to terminate execution of a task sequence currently being executed, being configured to not execute subsequent tasks in the task sequence that have been buffered.

69. A device as defined in clause 68 in which the control module is configured to enable the task execution module to resume execution of at least one task associated with a subsequent task sequence at a time determined by the execution time determination module.

70. A device as defined in clause 69 in which the series of tasks includes a series of task sequences with each task sequence including a subset of the series of tasks, the interface module being further configured to receive task execution control commands for controlling task execution, the control module being configured to, in response to receipt of at least one task execution control command to cancel execution of a task sequence for which at least one task has been buffered but for which execution has not begun, enable the task execution module to not execute tasks from that task sequence that have been buffered.

71. A device as defined in clause 70 in which the control module is configured to enable the task execution module to resume execution of at least one task associated with a task sequence subsequent to the task sequence for which at least one task has been buffered but for which execution has not begun.

72. A device as defined in clause 66, the control module being configured to, in response to receipt of a command to become a member of a synchrony group, enable the interface module to receive tasks for execution by the task execution module.

73. A device as defined in clause 72 in which the control module is configured to, in response to receipt of a command to become a member of a synchrony group, enable the interface module to receive tasks currently being transmitted using a selected multi-cast transmission methodology, and further to retrieve at least one previously distributed task using a selected unicast transmission methodology.

74. A device as defined in clause 65 in which the control module is configured to, in receipt of a command to disengage from a synchrony group, disable the interface module from receiving tasks and the task execution module from executing previously received tasks that have not yet been executed.

75. A device as defined in clause 65 further comprising a user interface module interface module configured to receive control information from a user interface module, the control module being configured to enable selected operations to be performed in response to the control information.

76. A device as defined in clause 75 in which, in response to control information to enable another device to become a member of the device's synchrony group, the control module enables the interface module to transmit a command to the other device to enable the other device to become a member of the synchrony group.

77. A device as defined in clause 75 in which, in response to control information to enable another device that is a member of the device's synchrony group to disengage from the synchrony group, the control module enables the interface module to transmit a command to the other device to enable the other device to disengage from the synchrony group.

78. A device as defined in clause 75 in which, in response to control information to enable the task source to begin operating, the control module performs selected operations to enable the task source to begin operating.

79. A device as defined in clause 78, the device also operating as the task source, the device including a task generator module configured to, under control of the control module, obtain information from which the tasks are to be generated and generate the tasks.

80. A device as defined in clause 79 in which the interface module is further configured to transmit the tasks to at least one other device.

81. A device as defined in clause 79 in which the device is not the task source, the control module being configured to enable the interface module to transmit a command to enable the task source to operate.

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82. A device as defined in clause 81 in which tasks are divided into a series of task sequences, and, in response to receipt of control information enabling execution of a sequence of tasks currently being executed to be terminated, the control module is configured to enable the interface module to transmit a command to enable the task source to insert a resynchronize command in the series of tasks associated with the task sequence to enable termination of execution of the task sequence.

83. A device as defined in clause 81 in which tasks are divided into a series of task sequences, and, in response to receipt of control information enabling execution of a sequence of tasks at least a portion of which have been received, but which are not being executed, the control module is configured to enable the interface module to transmit a command to enable the task source to insert a resynchronize command in the series of commands to disable execution of the task sequence.

84. A device as defined in clause 75 in which the control module is configured to enable the user interface module interface module to transmit status information to the user interface module.

85. A device as defined in clause 84 in which the status information includes the execution status of at least one task.

86. A device as defined in clause 65 further including:

A. a migration information receiving module configured to receive migration information from the task source device, the migration information including a source for information respecting the tasks to be distributed, timing information relative to the clock maintained by the task source device and identifications of the member devices of the synchrony group, and

B. a migration control module configured to, after the migration information has been received.,

i. distribute the series of tasks to the synchrony group, each task being associated with a time stamp indicating a time, relative to the timing information that it receives from the device operating as the task source device, at which the devices comprising the synchrony group are to execute the respective task, and

ii. notify the members of the synchrony group that it is to thereafter operate as the task source device.

87. A device as defined in clause 86 in which the information respecting the tasks that are to be distributed is a source of streaming information, the migration control module being configured to, after the migration information has been received, assembling the streaming information into tasks and associate each task with a said time stamp.

88. A device as defined in clause 86 in which the information respecting the tasks that are to be distributed is in a file identified in the migration information, the migration control module being configured to obtain information from the identified file, assemble the information into tasks and associate each task with a said time stamp.

89. A device as defined in clause 88 in which the information respecting the tasks that are to be distributed begins at an offset, identified in the migration information, into the identified file, the migration control module being configured to assemble the information from a position in the file associated with the identified offset.

90. A device as defined in clause 89 in which the information respecting the tasks that are to be distributed is in a series of files identified in the migration information, the migration control module being configured to obtain information from successive files in the series assemble the information into tasks and associate each task with as said time stamp.

91. A device as defined in clause 65 further including a clock rate adjustment module configured to adjust the member device's clock rate in relation to a clock rate value maintained by the task source device's clock.

92. A task source device for distributing a series of tasks for execution by at least one other device at respective execution times, the task source device comprising:

A. a task acquisition module configured to obtain respective ones of the tasks;

B. a task execution time determination module configured to determine a time at which each respective task is to be executed, and to associate the respective task with a time stamp indicating its execution time;

C. a task transmission module configured to transmit the series of tasks to said at least one other device; and

D. an execution control command generation module configured to, in response to a predetermined event, enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to modify the execution sequence of the tasks transmitted thereto.

93. A task source device as defined in clause 92 in which the task transmission module is configured to utilize a selected multi-cast transmission methodology.

94. A task source device as defined in clause 92 in which the predetermined event comprises input indicia provided by an operator.

95. A task source device as defined in clause 94 in which, in response to said predetermined event, the execution

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control command generation module is configured to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to control execution of at least one task in relation to the time the predetermined event occurs.

96. A task source device as defined in clause 95 in which, in response to said predetermined event, the execution control command generation module is configured to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to terminate execution of a task that it is currently executing and/or to not execute at least one task that is to be executed subsequent to the predetermined event.

97. A task source device as defined in clause 95 in which the series of tasks includes a series of task sequences with each task sequence including a sub-set of the series of tasks, the execution control command generation module being configured to, in response to said predetermined event,

(i) enable the task transmission module to insert into the series of tasks transmitted by the task transmission module, a command enabling the at least one other device to terminate execution of the currently executing task and/or to not execute at least one subsequent task, if any, in the task sequence including the currently executing task; and
(ii) enable

(a) the task execution time determination module to provide that time stamps associated with tasks of task sequences subsequent to the task sequence currently being executed will reflect the termination and/or non-execution of tasks from the task sequence of the task that is currently being executed, and
(b) the task transmission module to transmit the tasks of the subsequent task sequences to the at least one other device.

98. A task source device as defined in clause 97 in which the task transmission module is configured to insert a command to enable the at least one other device to not execute all tasks in the task sequence subsequent to the terminated and/or non-executed task.

99. A task source device as defined in clause 92 in which, in response to said predetermined event, the execution control command generation module is configured to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to control execution of a task in relation to the task's position in the series of tasks.

100. A task source device as defined in clause 99 in which, in response to said predetermined event, the execution control command generation module is configured to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to cancel execution of a task in relation to the task's position in the series of tasks.

101. A task source device as defined in clause 99 in which, in response to said predetermined event, the execution control command generation module is configured to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to cancel execution of a previously-transmitted task in relation to the task's position in the series of tasks.

102. A task source device as defined in clause 101 in which, in response to said predetermined event, the execution control command generation module is configured to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to cancel execution of a previously-transmitted task, in relation to the task's position in the series of tasks, for which execution has not begun.

103. A task source device as defined in clause 99 in which the series of tasks includes a series of task sequences with each task sequence including a sub-set of the series of tasks, the execution control command generation module being configured to, in response to said predetermined event,

(i) enable the task transmission module to insert into the series of tasks transmitted by the task transmission module, a command enabling the at least one other device to cancel execution of a task sequence for which execution has not begun; and
(ii) enable

(a) the task execution time determination module to provide that time stamps associated with tasks of task sequences subsequent to the task sequence whose execution was cancelled will reflect the cancellation, and
(b) the task transmission module to transmit the tasks of the subsequent task sequences to the at least one other device.

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104. A task source device for distributing a series of tasks for execution by at least one other device at respective execution times, the task source device comprising:

A. a task acquisition module configured to obtain respective ones of the tasks;
B. a task execution time determination module configured to determine a time at which each respective task is to be executed, and to associate the respective task with a time stamp indicating its execution time, the task execution time determination module being configured to provide, associated with at least one task, a time stamp indicating a task execution time later than the time currently indicated by a clock maintained by the task source device; and
C. a task transmission module configured to transmit the series of tasks to said at least one other device.

105. A system as defined in clause 104 in which the task source device is configured to select the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one task distributed by the task source device can be executed by the member devices at the time indicated by the time stamp.
106. A system as defined in clause 105 in which the task source device is configured to select the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one task distributed by the task source device can be distributed to the member devices for execution at the time indicated by the time stamp
107. A system as defined in clause 104 in which task source device is configured to obtain information associated with the tasks from at least two types of information sources, the task source device being further configured to select, for each task the delay interval between the time indicated by the time stamp and the current time based on the information source type that is associated with the respective task.
108. A task source device for distributing a series of tasks for execution by at least one other device, the task source device comprising:

A. a task acquisition module configured to obtain respective ones of the tasks;
B. a task execution time determination module configured to determine a time at which each respective task is to be executed, and to associate the respective task with a time stamp indicating its execution time;
C. a task transmission module configured to transmit the series of tasks to said at least one other device; and
D. a task source device migration control module configured to, in response to a predetermined event, provide migration information to another device, the migration information including a source for information respecting the tasks to be distributed, timing information relative to the clock maintained by the task source device and identifications of the member devices of the synchrony group.

109. A method of operating a system comprising plurality of devices, one of the devices operating as a task source device and at least one other device operating as a member of a synchrony group,

A. the task source device being enabled to distribute a series of tasks to the synchrony group, each task being associated with a time stamp indicating a time, relative to a clock maintained by the task source device, at which the devices comprising the synchrony group are to execute the respective task;
B each member device being enabled to:

(i) periodically obtain from the task source device an indication of a current time value indicated by the task source device's clock, and
(ii) determine, from the time stamp associated with each respective task and a time differential value representing a difference between the current time value indicated by the task source device's clock, and a current time value indicated by its respective clock, a time, relative to its respective clock, at which it is to execute the task.

110. A method as defined in clause 109 in which the synchrony group comprises a plurality of member devices.
111. A method as defined in clause 110 in which each device comprising a member of the synchrony group is further enabled to execute each task that it receives from the task source device at the determined time, thereby to facilitate execution by them of respective tasks in the series in respective timing relationships relative to the time indicated by the task source device's clock.
112. A method as defined in clause 111 in which the member devices are enabled to execute respective tasks in synchrony.
113. A method as defined in clause 110 in which one of the member devices operates as a master device for the

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synchrony group, any other member devices comprising respective slave devices, the master device being enabled to perform at least one type of synchrony group management operation in connection with the member devices comprising the synchrony group.

114. A method as defined in clause 113 further including a user interface module enabled to control the master device's performance of said at least one type of synchrony group management operation, the master device being further enabled to provide status information relating to the status of the synchrony group to the user interface module.

115. A method as defined in clause 114 in which the status information includes identifications of the devices comprising the synchrony group.

116. A method as defined in clause 114 in which the status information includes an identification of the task currently being executed.

117. A method as defined in clause 113, the method comprising at least one additional device, in which, in one type of synchrony group management operation, the master device is enabled to enable the at least one additional device to join the synchrony group as a slave device.

118. A method as defined in clause 117 in which the task source device is enabled to distribute tasks to the member devices using a selected multi-cast transmission methodology, the member devices being enabled to buffer the tasks until they are to be executed, and further in which, when the at least one additional device joins the synchrony group as a slave device, the task source device is enabled to transmit at least one previously distributed task to the slave device using a selected unicast transmission methodology.

119. A method as defined in clause 113 in which, in at least one type of synchrony group management operation, the master device is enabled to enable the task source device to join the synchrony group as a slave device, the task source device continuing to operate as the task source device for the synchrony group.

120. A method as defined in clause 113 in which, in at least one type of synchrony group management operation, the master device is enabled to enable a slave device to disengage from the synchrony group, the disengaged slave device thereafter not being a member device in the synchrony group.

121. A method as defined in clause 113 in which, in at least one type of synchrony group management operation, the master device is enabled to control the series of tasks to be distributed by the task source device.

122. A method as defined in clause 113 in which, in at least one type of synchrony group management operation, the master device is further enabled to control execution by the member devices of the tasks that have been distributed by the task source device.

123. A method as defined in clause 122 in which the series of tasks includes a series of task sequences with each task sequence including a sub-set of the series of tasks, and further in which in at least one type of synchrony group management operation, the master device is enabled to enable the member devices to terminate execution of a task sequence that is currently being executed.

124. A method as defined in clause 123 in which, in the synchrony group management operation enabling the member devices to terminate execution of a task sequence that is currently being executed, the master device enables the task source device to distribute a command to enable the member devices to terminate execution of the task sequence, the member devices being enabled to, after receiving the command, terminating execution of the task sequence.

125. A method as defined in clause 122 in which the series of tasks includes a series of task sequences with each task sequence including a sub-set of the series of tasks, and further in which at least one type of synchrony group management operation, the master device is enabled to enable the member devices to cancel execution of a task sequence that has been previously distributed, but for which execution has not begun.

126. A method as defined in clause 125 in which, in the synchrony group management operation enabling the member devices to cancel execution of a task sequence that has been previously distributed but for which execution has not begun, the master device enables the task source device to distribute a command to enable the member devices to cancel execution of the task sequence, the member devices being enabled to, after receiving the command, cancel execution of the task sequence.

127. A method as defined in clause 113 in which, in at least one type of synchrony group management operation, the member device operating as the master device is enabled to enable the master device to migrate from one member device to another member device in the synchrony group.

128. A method as defined in clause 113 in which, in at least one type of synchrony group management operation, the master device is enabled to perform the step of enabling the task source device to migrate from one device to another device in the system.

129. A method as defined in clause 128 in which

A. the device operating as the task source device is enable to perform the step of, after being enabled to migrate the task source device to said other device, providing migration information to the other device, the migration

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information including a source for information respecting the tasks to be distributed, timing information relative to the clock maintained by the task source device and identifications of the member devices,
B. the other device is enabled to, after receiving the migration information, perform the steps of

i. distributing the series of tasks to the synchrony group, each task being associated with a time stamp indicating a time, relative to the timing information that it receives from the device operating as the task source device, at which the devices comprising the synchrony group are to execute the respective task, and
ii. notifying the members of the synchrony group that it is to thereafter operate as the task source device.

130. A method as defined in clause 129 in which the information respecting the tasks that are to be distributed is a source of streaming information, the other device being enabled to, after receiving the migration information, perform the steps of assembling the streaming information into tasks and associating each task with a said time stamp.

131. A method as defined in clause 129 in which the information respecting the tasks that are to be distributed is in a file identified in the migration information, the other device being enabled to perform the steps of obtaining information from the identified file, assembling the information into tasks and associating each task with a said time stamp.

132. A method as defined in clause 131 in which the information respecting the tasks that are to be distributed begins at an offset, identified in the migration information, into the identified file, the other device being enabled to perform the step of assembling the information from a position in the file associated with the identified offset.

133. A method as defined in clause 131 in which the information respecting the tasks that are to be distributed is in a series of files identified in the migration information, the other device being enabled to perform the step of obtaining information from successive files in the series assemble the information into tasks and associate each task with as said time stamp.

134. A method as defined in clause 109 in which the task source device is further enabled to distribute the tasks using a selected multi-cast message transmission methodology.

135. A method as defined in clause 109 in which the task source device is enabled to perform the step of providing, provide, associated with at least one task, a time stamp indicating a task execution time later than the time currently indicated by the clock maintained by the task source device.

136. A method as defined in clause 135 in which the task source device is enabled to perform the step of selecting the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one task distributed by the task source device can be executed by the member devices at the time indicated by the time stamp.

137. A method as defined in clause 136 in which the task source device is enabled to perform the step of selecting the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one task distributed by the task source device can be distributed to the member devices for execution at the time indicated by the time stamp

138. A method as defined in clause 135 in which task source device is enabled to perform the steps of obtaining information associated with the tasks from at least two types of information sources, and selecting, for each task, the delay interval between the time indicated by the time stamp and the current time based on the information source type that is associated with the respective task.

139. A method as defined in clause 109 in which at least one member device is further enabled to perform the step of adjusting its clock rate in relation to a clock rate value maintained by the task source device's clock.

140. A method as defined in clause 139 in which the at least one member device is enabled to perform the step of adjusting its clock rate in relation to time stamps associated with respective ones of the tasks received from the task source device.

141. A method as defined in clause 109 in which at least one other device operates as a task source device enabled to distribute tasks to a second synchrony group, the device operating as the task source device for the first synchrony group also operating as a member device of a second synchrony group.

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142. A method as defined in clause 109 including, within a member device,

A. a task receiving step of receiving the series of tasks,
B. a current time retrieval step of obtaining, from the task source device, the current time value as indicated by the task source's clock;
C. an execution time determination step of determining, from the time stamp associated with each respective task and a time differential value representing a difference between the current time value obtained during the current time retrieval step and a current time value indicated by a clock maintained by the device, a time, relative to the member device's respective clock at which the task is to be executed; and
D. a task execution step of executing each respective task at the time determined during the execution time determination step.

143. A method as defined in clause 142 further including a control step for controlling execution of commands received during the task receiving step

144. A method as defined in clause 143 in which the at least one member device further comprises a buffer configured to buffer tasks received from the task source device during the task receiving step until they are to be executed, the task execution step including the step of executing the buffered tasks at the times determined during the execution time determination step.

145. A method as defined in clause 144 in which the series of tasks includes a series of task sequences with each task sequence including a subset of the series of tasks, the task receiving step being further enabled to receive task execution control commands for controlling task execution, the control step including the step of, in response to receipt of at least one task execution control command for controlling task execution, controlling the task execution step to terminate execution of a task sequence currently being executed, and further to not execute subsequent tasks in the task sequence that have been buffered.

146. A method as defined in clause 145 in which the control step includes the step of enabling the task execution step to resume execution of at least one task associated with a subsequent task sequence at a time determined during the execution time determination step.

147. A method as defined in clause 144 in which the series of tasks includes a series of task sequences with each task sequence including a subset of the series of tasks, the task receiving step including the step of receiving task execution control commands for controlling task execution, the control step including the step of, in response to receipt of at least one task execution control command to cancel execution of a task sequence for which at least one task has been buffered but for which execution has not begun, providing that tasks from that task sequence that have been buffered not be executed.

148. A method as defined in clause 147 in which the control step includes the step of enabling execution to resume of at least one task associated with a task sequence subsequent to the task sequence for which at least one task has been buffered but for which execution has not begun.

149. A method as defined in clause 142 in which the member device performs:

A. migration information receiving step of receiving migration information from the task source device, the migration information including a source for information respecting the tasks to be distributed, timing information relative to the clock maintained by the task source device and identifications of the member devices of the synchrony group, and
B. a migration control step of, after the migration information has been received.,

i. distributing the series of tasks to the synchrony group, each task being associated with a time stamp indicating a time, relative to the timing information that it receives from the device operating as the task source device, at which the devices comprising the synchrony group are to execute the respective task, and
ii. notifying the members of the synchrony group that it is to thereafter operate as the task source device.

150. A method as defined in clause 149 in which the information respecting the tasks that are to be distributed is a source of streaming information, the migration control step includes the steps of, after the migration information has been received, assembling the streaming information into tasks and associating each task with a said time stamp.

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151. A method as defined in clause 149 in which the information respecting the tasks that are to be distributed is in a file identified in the migration information, the migration control step including the steps of obtaining information from the identified file, assembling the information into tasks and associating each task with a said time stamp.

152. A method as defined in clause 151 in which the information respecting the tasks that are to be distributed begins at an offset, identified in the migration information, into the identified file, the migration control step including the step of assembling the information from a position in the file associated with the identified offset.

153. A method as defined in clause 151 in which the information respecting the tasks that are to be distributed is in a series of files identified in the migration information, the migration control step including the steps of obtaining information from successive files in the series assemble the information into tasks and associating each task with as said time stamp.

154. A method as defined in clause 142 in which the member device is further enabled to perform a clock rate adjustment step including the step of adjusting the member device's clock rate in relation to a clock rate value maintained by the task source device's clock.

155. A method as defined in clause 154 in which the clock rate adjustment step includes the step of determining adjust the clock rate in relation to time stamps associated with respective ones of the tasks received from the task source device.

156. A method as defined in clause 109 including, within a task source device,

A. a task acquisition step of obtaining respective ones of the tasks;
B. a task execution time determination step of determining a time at which each respective task is to be executed, and to associate the respective task with a time stamp indicating its execution time;
C. a task transmission step of transmitting the series of tasks to said at least one other device; and
D. an execution control command generation step of, in response to a predetermined event and during the task transmission step, the insertion into the series of tasks transmitted by the task transmission module of a command to enable the at least one other device to modify the execution sequence of the tasks transmitted thereto.

157. A method as defined in clause 156 in which the task transmission step includes the step of utilizing a selected multi-cast transmission methodology.

158. A method as defined in clause 156 in which the predetermined event includes the step of receiving input indicia provided by an operator.

159. A method as defined in clause 158 in which the execution control command generation step includes the step of enabling, in response to said predetermined event and during the task transmission step, the insertion into the series of tasks of a command to enable the at least one other device to control execution of at least one task in relation to the time the predetermined event occurs.

160. A method as defined in clause 159 in which, the execution control command generation step includes the step of enabling, in response to said predetermined event and during the task transmission step, the insertion into the series of tasks of a command to enable the at least one other device to terminate execution of a task that it is currently executing and/or to not execute at least one task that is to be executed subsequent to the predetermined event.

161. A method as defined in clause 159 in which the series of tasks includes a series of task sequences with each task sequence including a sub-set of the series of tasks, the execution control command generation step including the steps of, in response to said predetermined event,

(i) enabling during the task transmission step the insertion, into the series of tasks, of a command enabling the at least one other device to terminate execution of the currently executing task and/or to not execute at least one subsequent task, if any, in the task sequence including the currently executing task; and
(ii) enabling

(a) during the task execution time determination step, that time stamps associated with tasks of task se-

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quences subsequent to the task sequence currently being executed will reflect the termination and/or non-execution of tasks from the task sequence of the task that is currently being executed, and
(b) during the task transmission step, the transmission of the tasks of the subsequent task sequences to the at least one other device.

162. A method as defined in clause 161 in which the task transmission step includes the step of inserting a command into the task sequence to enable the at least one other device to not execute all tasks in the task sequence subsequent to the terminated and/or non-executed task.

163. A method as defined in clause 159 in which the execution control command generation step include the step of enabling, in response to said predetermined event and during the task transmission step, the insertion into the series of tasks of a command to enable the at least one other device to control execution of a task in relation to the task's position in the series of tasks.

164. A method as defined in clause 163 in which the execution control command generation step includes the step of, in response to said predetermined event and during the task transmission step, the insertion into the series of tasks of a command to enable the at least one other device to cancel execution of a task in relation to the task's position in the series of tasks.

165. A method as defined in clause 163 in which the execution control command generation step includes the step of enabling, in response to said predetermined event and during the task transmission step, the inserting into the series of tasks of a command to enable the at least one other device to cancel execution of a previously-transmitted task in relation to the task's position in the series of tasks.

166. A method as defined in clause 165 in which, the execution control command generation step includes the step of, in response to said predetermined event and during the task transmission step, the insertion into the series of tasks of a command to enable the at least one other device to cancel execution of a previously-transmitted task, in relation to the task's position in the series of tasks, for which execution has not begun.

167. A method as defined in clause 163 in which the series of tasks includes a series of task sequences with each task sequence including a sub-set of the series of tasks, the execution control command generation step including the steps of, in response to said predetermined event,

(i) enabling, during the task transmission step, the insertion, into the series of tasks, of a command enabling the at least one other device to cancel execution of a task sequence for which execution has not begun; and
(ii) enabling

(a) during the task execution time determination step, that time stamps associated with tasks of task sequences subsequent to the task sequence whose execution was cancelled will reflect the cancellation, and
(b) during the task transmission step, the transmission of the tasks of the subsequent task sequences to the at least one other device.

168. A method as defined in clause 109 in which the task source device is enabled to perform

A. a task acquisition step of obtaining respective ones of the tasks;
B. a task execution time determination step of determining a time at which each respective task is to be executed, and to associate the respective task with a time stamp indicating its execution time;
C. a task transmission step of transmitting the series of tasks to said at least one other device; and
D. a task source device migration control step of, in response to a predetermined event, providing migration information to another device, the migration information including a source for information respecting the tasks to be distributed, timing information relative to the clock maintained by the task source device and identifications of the member devices of the synchrony group.

169. A method as defined in clause 109 in which the task source device is enabled to perform the step of providing, associated with at least one task, a time stamp indicating a task execution time later than the time currently indicated by the clock maintained by the task source device.

170. A method as defined in clause 169 in which the task source device is enabled to perform the step of selecting

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the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one task distributed by the task source device can be executed by the member devices at the time indicated by the time stamp.

171. A method as defined in clause 170 in which the task source device is enabled to perform the step of selecting the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one task distributed by the task source device can be distributed to the member devices for execution at the time indicated by the time stamp

172. A method as defined in clause 169 in which task source device is enabled to perform the step of obtaining information associated with the tasks from at least two types of information sources, and selecting for each task the delay interval between the time indicated by the time stamp and the current time based on the information source type that is associated with the respective task.

173. A method of operating a device for executing a series of tasks provided by a task source at times specified by the task source in relation to a clock maintained by the task source, the method including

A. a task receiving step of receiving the series of tasks, each task being associated with a time stamp, each time stamp indicating a time value relative to a time indicated a clock maintained by the task source, at which the device is to execute the respective task;
B. a current time retrieval module of obtaining, from the task source, a current time value as indicated by the task source's clock;
C. an execution time determination step of determining, from the time stamp associated with each respective task and a time differential value representing a difference between the current time value obtained during the current time retrieval step and a current time value indicated by a clock maintained by the device, a time, relative to the device's respective clock, at which the task is to be executed; and
D. a task execution module step of executing each respective task at the time determined during the execution time determination step.

174. A method as defined in clause 173 further including a control step for controlling execution of commands received by said interface module.

175. A method as defined in clause 174 further comprising a buffer configured to buffer tasks that have been received until they are to be executed, the task execution step including the step of executing the buffered tasks at the times determined during the execution time determination step.

176. A method as defined in clause 175 in which the series of tasks includes a series of task sequences with each task sequence including a subset of the series of tasks, the interface module being further enabled to receive task execution control commands for controlling task execution, the control module being enabled to, in response to receipt of at least one task execution control command for controlling task execution, enable the task execution module to terminate execution of a task sequence currently being executed, being enabled to not execute subsequent tasks in the task sequence that have been buffered.

177. A method as defined in clause 176 in which the control step includes the step of enabling task execution to resume execution with at least one task associated with a subsequent task sequence at a time determined during the execution time determination step.

178. A method as defined in clause 175 in which the series of tasks includes a series of task sequences with each task sequence including a subset of the series of tasks, the task receiving step including the step of receiving task execution control commands for controlling task execution, the control step, in response to receipt of at least one task execution control command to cancel execution of a task sequence for which at least one task has been buffered but for which execution has not begun, including the step of providing that task execution not including execution of tasks from that task sequence that have been buffered.

179. A method as defined in clause 178 in which the control step includes the step of enabling task execution to resume execution of at least one task associated with a task sequence subsequent to the task sequence for which at least one task has been buffered but for which execution has not begun.

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180. A method as defined in clause 173, the control step including the step of, in response to receipt of a command to become a member of a synchrony group, receiving tasks during the task receiving step for execution during the task execution step.

181. A method as defined in clause 180 in which the control step includes the step of, in response to receipt of a command to become a member of a synchrony group, enable the task receiving step to include the step of receiving tasks currently being transmitted using a selected multi-cast transmission methodology, and further to include the step of retrieving at least one previously distributed task using a selected unicast transmission methodology.

182. A method as defined in clause 173 in which the control step includes the steps of, in receipt of a command to disengage from a synchrony group, disabling the receipt of tasks and the execution of previously-received tasks that have not yet been executed.

183. A method as defined in clause 173 further comprising a user interface module control information receiving step of receiving control information from a user interface module, the control step including the step of enabling selected operations to be performed in response to the control information.

184 A method as defined in clause 183 in which, in response to control information to enable another device to become a member of the device's synchrony group, the control step includes the step of transmitting a command to the other device to enable the other device to become a member of the synchrony group.

185. A method as defined in clause 183 in which, in response to control information to enable another device that is a member of the device's synchrony group to disengage from the synchrony group, the control module enables the interface module to transmit a command to the other device to enable the other device to disengage from the synchrony group.

186. A method as defined in clause 185 in which, in response to control information to enable the task source to begin operating, the control step includes the step of performing selected operations to enable the task source to begin operating.

187. A method as defined in clause 186, the device also operating as the task source, the method including a task generation steps of, under control of the control step, obtaining information from which the tasks are to be generated and generating the tasks.

188. A method as defined in clause 187 further including the step of transmitting the tasks to at least one other device.

189. A method as defined in clause 187 in which the device is not the task source, the control step including the step of enabling the transmission of a command to enable the task source to operate.

190. A method as defined in clause 189 in which tasks are divided into a series of task sequences, and, in response to receipt of control information enabling execution of a sequence of tasks currently being executed to be terminated, the control step includes the step of transmitting a command to enable the task source to insert a resynchronize command in the series of tasks associated with the task sequence to enable termination of execution of the task sequence.

191. A method as defined in clause 189 in which tasks are divided into a series of task sequences, and, in response to receipt of control information enabling execution of a sequence of tasks at least a portion of which have been received, but which are not being executed, the control step includes the step of transmitting a command to enable the task source to insert a resynchronize command in the series of commands to disable execution of the task sequence.

192. A method as defined in clause 174 in which the control step includes the step of transmitting status information to the user interface module.

193. A method as defined in clause 192 in which the status information includes the execution status of at least one task.

194. A method as defined in clause 173 in which the member device performs:

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A. migration information receiving step of receiving migration information from the task source device, the migration information including a source for information respecting the tasks to be distributed, timing information relative to the clock maintained by the task source device and identifications of the member devices of the synchrony group, and
B. a migration control step of, after the migration information has been received.,

i. distributing the series of tasks to the synchrony group, each task being associated with a time stamp indicating a time, relative to the timing information that it receives from the device operating as the task source device, at which the devices comprising the synchrony group are to execute the respective task, and
ii. notifying the members of the synchrony group that it is to thereafter operate as the task source device.

195. A method as defined in clause 194 in which the information respecting the tasks that are to be distributed is a source of streaming information, the migration control step includes the steps of, after the migration information has been received, assembling the streaming information into tasks and associating each task with a said time stamp.

196. A method as defined in clause 194 in which the information respecting the tasks that are to be distributed is in a file identified in the migration information, the migration control step including the steps of obtaining information from the identified file, assembling the information into tasks and associating each task with a said time stamp.

197. A method as defined in clause 196 in which the information respecting the tasks that are to be distributed begins at an offset, identified in the migration information, into the identified file, the migration control step including the step of assembling the information from a position in the file associated with the identified offset.

198. A method as defined in clause 196 in which the information respecting the tasks that are to be distributed is in a series of files identified in the migration information, the migration control step including the steps of obtaining information from successive files in the series assemble the information into tasks and associating each task with as said time stamp.

199. A method as defined in clause 173 in which the member device is further enabled to perform a clock rate adjustment step including the step of adjusting the member device's clock rate in relation to a clock rate value maintained by the task source device's clock.

200. A method as defined in clause 199 in which the clock rate adjustment step includes the step of determining adjust the clock rate in relation to time stamps associated with respective ones of the tasks received from the task source device.

201. A method of operating a device for distributing a series of tasks for execution by at least one other device at respective execution times, the method comprising:

A. a task acquisition step of obtaining respective ones of the tasks;
B. a task execution time determination step of determining a time at which each respective task is to be executed, and to associate the respective task with a time stamp indicating its execution time;
C. a task transmission step of transmitting the series of tasks to said at least one other device; and
D. an execution control command generation step of, in response to a predetermined event and during the task transmission step, the insertion into the series of tasks transmitted by the task transmission module of a command to enable the at least one other device to modify the execution sequence of the tasks transmitted thereto.

202. A method as defined in clause 201 in which the task transmission step includes the step of utilizing a selected multi-cast transmission methodology.

203. A method as defined in clause 201 in which the predetermined event includes the step of receiving input indicia provided by an operator.

204. A method as defined in clause 203 in which the execution control command generation step includes the step of enabling, in response to said predetermined event and during the task transmission step, the insertion into the series of tasks of a command to enable the at least one other device to control execution of at least one task in relation to the time the predetermined event occurs.

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205. A method as defined in clause 204 in which, the execution control command generation step includes the step of enabling, in response to said predetermined event and during the task transmission step, the insertion into the series of tasks of a command to enable the at least one other device to terminate execution of a task that it is currently executing and/or to not execute at least one task that is to be executed subsequent to the predetermined event.

206. A method as defined in clause 203 in which the series of tasks includes a series of task sequences with each task sequence including a sub-set of the series of tasks, the execution control command generation step including the steps of, in response to said predetermined event,

(i) enabling during the task transmission step the insertion, into the series of tasks, of a command enabling the at least one other device to terminate execution of the currently executing task and/or to not execute at least one subsequent task, if any, in the task sequence including the currently executing task; and
(ii) enabling

(a) during the task execution time determination step, that time stamps associated with tasks of task sequences subsequent to the task sequence currently being executed will reflect the termination and/or non-execution of tasks from the task sequence of the task that is currently being executed, and
(b) during the task transmission step, the transmission of the tasks of the subsequent task sequences to the at least one other device.

207. A method as defined in clause 206 in which the task transmission step includes the step of inserting a command into the task sequence to enable the at least one other device to not execute all tasks in the task sequence subsequent to the terminated and/or non-executed task.

208. A method as defined in clause 201 in which the execution control command generation step include the step of enabling, in response to said predetermined event and during the task transmission step, the insertion into the series of tasks of a command to enable the at least one other device to control execution of a task in relation to the task's position in the series of tasks.

209. A method as defined in clause 208 in which the execution control command generation step includes the step of, in response to said predetermined event and during the task transmission step, the insertion into the series of tasks of a command to enable the at least one other device to cancel execution of a task in relation to the task's position in the series of tasks.

210. A method as defined in clause 208 in which the execution control command generation step includes the step of enabling, in response to said predetermined event and during the task transmission step, the inserting into the series of tasks of a command to enable the at least one other device to cancel execution of a previously-transmitted task in relation to the task's position in the series of tasks.

211. A method as defined in clause 210 in which, the execution control command generation step includes the step of, in response to said predetermined event and during the task transmission step, the insertion into the series of tasks of a command to enable the at least one other device to cancel execution of a previously-transmitted task, in relation to the task's position in the series of tasks, for which execution has not begun.

212. A method as defined in clause 208 in which the series of tasks includes a series of task sequences with each task sequence including a sub-set of the series of tasks, the execution control command generation step including the steps of, in response to said predetermined event,

(i) enabling, during the task transmission step, the insertion, into the series of tasks, of a command enabling the at least one other device to cancel execution of a task sequence for which execution has not begun; and
(ii) enabling

(a) during the task execution time determination step, that time stamps associated with tasks of task sequences subsequent to the task sequence whose execution was cancelled will reflect the cancellation, and
(b) during the task transmission step, the transmission of the tasks of the subsequent task sequences to the at least one other device.

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213. A method of operating a device for distributing a series of tasks for execution by at least one other device at respective execution times, the method comprising:

A. a task acquisition step of obtaining respective ones of the tasks;
B. a task execution time determination step of determining a time at which each respective task is to be executed, and to associating the respective task with a time stamp indicating its execution time, the task execution time determination step including the step of providing, associated with at least one task, a time stamp indicating a task execution time later than the time currently indicated by a clock maintained by the task source device; and
C. a task transmission step of transmitting the series of tasks to said at least one other device.

214. A method as defined in clause 213 in which the task execution time determination step includes the step of selecting the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one task distributed by the device can be executed by at least one other device at the time indicated by the time stamp.

215. A method as defined in clause 214 in which the task execution time determination step includes the step of selecting the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one task distributed by the device can be distributed to other devices over a network for execution by the other devices at the time indicated by the time stamp.

216. A method as defined in clause 213 in which task acquisition step includes the step of obtaining information associated with the tasks from at least two types of information sources, the task execution time determination step including the step of selecting, for each task the delay interval between the time indicated by the time stamp and the current time based on the information source type that is associated with the respective task.

217. A method of operating a device for distributing a series of tasks for execution by at least one other device, the method comprising:

A. a task acquisition module configured to obtain respective ones of the tasks;
B. a task execution time determination module configured to determine a time at which each respective task is to be executed, and to associate the respective task with a time stamp indicating its execution time;
C. a task transmission module configured to transmit the series of tasks to said at least one other device; and
D. a task source device migration control module configured to, in response to a predetermined event, provide migration information to another device, the migration information including a source for information respecting the tasks to be distributed, timing information relative to the clock maintained by the task source device and identifications of the member devices of the synchrony group.

218. A computer program product for use in connection with a computer to provide a device for executing a series of tasks provided by a task source at times specified by the task source in relation to a clock maintained by the task source, the computer program product comprising a computer-readable medium having encoded thereon:

A. an interface module configured to enable the computer to receive the series of tasks, each task being associated with a time stamp, each time stamp indicating a time value relative to a time indicated a clock maintained by the task source, at which the device is to execute the respective task;
B. a current time retrieval module configured to enable the computer to obtain, from the task source, a current time value as indicated by the task source's clock;
C. an execution time determination module configured to enable the computer to determine, from the time stamp associated with each respective task and a time differential value representing a difference between the current time value obtained by the current time retrieval module and a current time value indicated by a clock maintained by the device, a time, relative to the device's respective clock, at which the task is to be executed; and
D. a task execution module configured to enable the computer to execute each respective task at the time determined by the execution time determination module.

219. A computer program product as defined in clause 218 further including a control module for enabling said computer to control execution of commands received by the interface module.

220. A computer program product as defined in clause 219 further comprising a buffer module configured to enable the computer to buffer tasks received by the interface module until they are to be executed, the task execution

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module being configured to enable the computer to execute the buffered tasks at the times determined by the execution time determination module.

221. A computer program product as defined in clause 220 in which the series of tasks includes a series of task sequences with each task sequence including a subset of the series of tasks, the interface module being further configured to enable the computer to receive task execution control commands for controlling task execution, the control module being configured to enable the computer to, in response to receipt of at least one task execution control command for controlling task execution, enable the task execution module to terminate execution of a task sequence currently being executed, being configured to enable the computer to not execute subsequent tasks in the task sequence that have been buffered.

222. A computer program product as defined in clause 220 in which the control module is configured to enable the computer to enable the task execution module to resume execution of at least one task associated with a subsequent task sequence at a time determined by the execution time determination module.

223. A computer program product as defined in clause 219 in which the series of tasks includes a series of task sequences with each task sequence including a subset of the series of tasks, the interface module being further configured to enable the computer to receive task execution control commands for controlling task execution, the control module being configured to enable the computer to, in response to receipt of at least one task execution control command to cancel execution of a task sequence for which at least one task has been buffered but for which execution has not begun, enable the task execution module to not execute tasks from that task sequence that have been buffered.

224. A computer program product as defined in clause 223 in which the control module is configured to enable the computer to enable the task execution module to resume execution of at least one task associated with a task sequence subsequent to the task sequence for which at least one task has been buffered but for which execution has not begun.

225. A computer program product as defined in clause 219, the control module being configured to enable the computer to, in response to receipt of a command to become a member of a synchrony group, enable the interface module to receive tasks for execution by the task execution module.

226. A computer program product as defined in clause 225 in which the control module is configured to enable the computer to, in response to receipt of a command to become a member of a synchrony group, enable the interface module to receive tasks currently being transmitted using a selected multi-cast transmission methodology, and further to retrieve at least one previously distributed task using a selected unicast transmission methodology.

227. A computer program product as defined in clause 219 in which the control module is configured to enable the computer to, in receipt of a command to disengage from a synchrony group, disable the interface module from receiving tasks and the task execution module from executing previously received tasks that have not yet been executed.

228. A computer program product as defined in clause 219 further comprising a user interface module interface module configured to receive control information from a user interface module, the control module being configured to enable the computer to enable selected operations to be performed in response to the control information.

229. A computer program product as defined in clause 228 in which, in response to control information to enable another device to become a member of the device's synchrony group, the control module enables the interface module to transmit a command to the other device to enable the other device to become a member of the synchrony group.

230. A computer program product as defined in clause 228 in which, in response to control information to enable another device that is a member of the device's synchrony group to disengage from the synchrony group, the control module enables the interface module to transmit a command to the other device to enable the other device to disengage from the synchrony group.

231. A computer program product as defined in clause 228 in which, in response to control information to enable the task source to begin operating, the control module performs selected operations to enable the task source to

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begin operating.

232. A computer program product as defined in clause 231, the device also operating as the task source, the device including a task generator module configured to enable the computer to, under control of the control module, obtain information from which the tasks are to be generated and generate the tasks.

233. A computer program product as defined in clause 232 in which the interface module is further configured to enable the computer to transmit the tasks to at least one other device.

234. A computer program product as defined in clause 232 in which the device is not the task source, the control module being configured to enable the computer to enable the interface module to transmit a command to enable the task source to operate.

235. A computer program product as defined in clause 234 in which tasks are divided into a series of task sequences, and, in response to receipt of control information enabling execution of a sequence of tasks currently being executed to be terminated, the control module is configured to enable the computer to enable the interface module to transmit a command to enable the task source to insert a resynchronize command in the series of tasks associated with the task sequence to enable termination of execution of the task sequence.

236. A computer program product as defined in clause 234 in which tasks are divided into a series of task sequences, and, in response to receipt of control information enabling execution of a sequence of tasks at least a portion of which have been received, but which are not being executed, the control module is configured to enable the computer to enable the interface module to transmit a command to enable the task source to insert a resynchronize command in the series of commands to disable execution of the task sequence.

237. A computer program product as defined in clause 228 in which the control module is configured to enable the computer to enable the user interface module interface module to transmit status information to the user interface module.

238. A computer program product as defined in clause 237 in which the status information includes the execution status of at least one task.

239. A computer program product as defined in clause 218 further including:

A. a migration information receiving module configured to enable the computer to receive migration information from the task source device, the migration information including a source for information respecting the tasks to be distributed, timing information relative to the clock maintained by the task source device and identifications of the member devices of the synchrony group, and
B. a migration control module configured to enable the computer to, after the migration information has been received.,

i. distribute the series of tasks to the synchrony group, each task being associated with a time stamp indicating a time, relative to the timing information that it receives from the device operating as the task source device, at which the devices comprising the synchrony group are to execute the respective task, and
ii. notify the members of the synchrony group that it is to thereafter operate as the task source device.

240. A computer program product as defined in clause 239 in which the information respecting the tasks that are to be distributed is a source of streaming information, the migration control module being configured to enable the computer to, after the migration information has been received, assemble the streaming information into tasks and associate each task with a said time stamp.

241. A computer program product as defined in clause 239 in which the information respecting the tasks that are to be distributed is in a file identified in the migration information, the migration control module being configured to enable the computer to obtain information from the identified file, assemble the information into tasks and associate each task with a said time stamp.

242. A computer program product as defined in clause 241 in which the information respecting the tasks that are to be distributed begins at an offset, identified in the migration information, into the identified file, the migration control

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module being configured to enable the computer to assemble the information from a position in the file associated with the identified offset.

243. A computer program product as defined in clause 241 in which the information respecting the tasks that are to be distributed is in a series of files identified in the migration information, the migration control module being configured to enable the computer to obtain information from successive files in the series assemble the information into tasks and associate each task with as said time stamp.

244. A computer program product as defined in clause 218 further including a clock rate adjustment module configured to enable the computer to adjust the member device's clock rate in relation to a clock rate value maintained by the task source device's clock.

245. A computer program product as defined in clause 244 in which the clock rate adjustment module is configured to enable the computer to adjust the clock rate in relation to time stamps associated with respective ones of the tasks received from the task source device.

246. A computer program product for use in connection with a computer to provide a task source device for distributing a series of tasks for execution by at least one other device at respective execution times, the computer program product comprising a computer readable medium having encoded thereon:

A. a task acquisition module configured to enable the computer to obtain respective ones of the tasks;
B. a task execution time determination module configured to enable the computer to determine a time at which each respective task is to be executed, and to associate the respective task with a time stamp indicating its execution time;
C. a task transmission module configured to enable the computer to transmit the series of tasks to said at least one other device; and
D. an execution control command generation module configured to enable the computer to, in response to a predetermined event, enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to modify the execution sequence of the tasks transmitted thereto.

247. A computer program product as defined in clause 246 which the task transmission module is configured to enable the computer to utilize a selected multi-cast transmission methodology.

248. A computer program product as defined in clause 246 in which the predetermined event comprises input indicia provided by an operator.

249. A computer program product as defined in clause 246 in which, in response to said predetermined event, the execution control command generation module is configured to enable the computer to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to control execution of at least one task in relation to the time the predetermined event occurs.

250. A computer program product as defined in clause 249 in which, in response to said predetermined event, the execution control command generation module is configured to enable the computer to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to terminate execution of a task that it is currently executing and/or to not execute at least one task that is to be executed subsequent to the predetermined event.

251. A computer program product as defined in clause 249 in which the series of tasks includes a series of task sequences with each task sequence including a sub-set of the series of tasks, the execution control command generation module being configured to enable the computer to, in response to said predetermined event,

(i) enable the task transmission module to insert into the series of tasks transmitted by the task transmission module, a command enabling the at least one other device to terminate execution of the currently executing task and/or to not execute at least one subsequent task, if any, in the task sequence including the currently executing task; and
(ii) enable

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(a) the task execution time determination module to provide that time stamps associated with tasks of task sequences subsequent to the task sequence currently being executed will reflect the termination and/or non-execution of tasks from the task sequence of the task that is currently being executed, and
(b) the task transmission module to transmit the tasks of the subsequent task sequences to the at least one other device.

252. A computer program product as defined in clause 251 in which the task transmission module is configured to enable the computer to insert a command to enable the at least one other device to not execute all tasks in the task sequence subsequent to the terminated and/or non-executed task.

253. A computer program product as defined in clause 246 in which, in response to said predetermined event, the execution control command generation module is configured to enable the computer to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to control execution of a task in relation to the task's position in the series of tasks.

254. A computer program product as defined in clause 253 in which, in response to said predetermined event, the execution control command generation module is configured to enable the computer to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to cancel execution of a task in relation to the task's position in the series of tasks.

255. A computer program product as defined in clause 254 in which, in response to said predetermined event, the execution control command generation module is configured to enable the computer to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to cancel execution of a previously-transmitted task in relation to the task's position in the series of tasks.

256. A computer program product as defined in clause 255 in which, in response to said predetermined event, the execution control command generation module is configured to enable the computer to enable the task transmission module to insert into the series of tasks transmitted by the task transmission module a command to enable the at least one other device to cancel execution of a previously-transmitted task, in relation to the task's position in the series of tasks, for which execution has not begun.

257. A computer program product as defined in clause 253 in which the series of tasks includes a series of task sequences with each task sequence including a sub-set of the series of tasks, the execution control command generation module being configured to enable the computer to, in response to said predetermined event,

(i) enable the task transmission module to insert into the series of tasks transmitted by the task transmission module, a command enabling the at least one other device to cancel execution of a task sequence for which execution has not begun; and
(ii) enable

(a) the task execution time determination module to provide that time stamps associated with tasks of task sequences subsequent to the task sequence whose execution was cancelled will reflect the cancellation, and
(b) the task transmission module to transmit the tasks of the subsequent task sequences to the at least one other device.

258. A computer program product for use in connection with a computer to provide a task source device for distributing a series of tasks for execution by at least one other device at respective execution times, the computer program product comprising a computer readable medium having encoded thereon:

A. a task acquisition module configured to enable the computer to obtain respective ones of the tasks;
B. a task execution time determination module configured to enable the computer to determine a time at which each respective task is to be executed, and to associate the respective task with a time stamp indicating its execution time, the task execution time determination module being configured to enable the computer to provide, associated with at least one task, a time stamp indicating a task execution time later than the time currently indicated by a clock maintained by the task source device; and
C. a task transmission module configured to enable the computer to transmit the series of tasks to said at least one other device.

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259. A computer program product as defined in clause 258 in which the task execution time determination module is configured to enable the computer to select the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one task distributed by the task source device can be executed by the member devices at the time indicated by the time stamp.

260. A computer program product as defined in clause 259 in which the task execution time determination module is configured to enable the computer to select the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one task distributed by the task source device can be distributed to the member devices for execution at the time indicated by the time stamp.

261. A computer program product as defined in clause 258 in which task acquisition module is configured to enable the computer to obtain information associated with the tasks from at least two types of information sources, the task execution time determination module being configured to enable the computer to select, for each task the delay interval between the time indicated by the time stamp and the current time based on the information source type that is associated with the respective task.

262. A computer program product for use in connection with a computer to provide a task source device for distributing a series of tasks for execution by at least one other device, the computer program product comprising a computer readable medium having encoded thereon:

A. a task acquisition module configured to enable the computer to obtain respective ones of the tasks;
B. a task execution time determination module configured to enable the computer to determine a time at which each respective task is to be executed, and to associate the respective task with a time stamp indicating its execution time;
C. a task transmission module configured to enable the computer to transmit the series of tasks to said at least one other device; and
D. a task source device migration control module configured to enable the computer to, in response to a pre-determined event, provide migration information to another device, the migration information including a source for information respecting the tasks to be distributed, timing information relative to the clock maintained by the task source device and identifications of the member devices of the synchrony group.

263. A system comprising a plurality of devices,

A one device being enabled to operate as a task source device, the task source device being enabled to transmit a series of tasks to the other devices, each task being associated with execution time information;
B. at least one device being enabled to operate as a task execution device, the task execution device being enabled to receive the series of tasks from the network and executing each respective task at a time in relation to the timing information associated with the respective task; and
C. one device being enabled to operate as a control device, the control device being enabled to control operations of the task source device and the task execution device.

264. A system as defined in clause 263 in which the device that is enabled to operate as the control device is also enabled to operate as a task execution device.

265. A system as defined in clause 263 in which the device that is enabled to operate as the control device is also enabled to operate as the task source device.

266. A system as defined in clause 263 in which the device that is enabled to operate as the task source device is also enabled to operate as a task execution device.

267. A system for facilitating processing of data by device operating as a member of a synchrony group, synchronously with a clock maintained by a data source device that provides the data to the synchrony group,

A. the data source device being configured to divide the data into a series of frames for distribution to the synchrony group, each frame being associated with a time stamp indicating a time, relative to a clock maintained by the data source device, at which the devices comprising the synchrony group are to process the frame;
B each member device in the synchrony group being configured to:

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(i) periodically obtain from the data source device an indication of a current time value indicated by the data source device's clock;
(ii) receive the series of frames from the data source device;
(iii) determine, from the time stamp associated with each respective frame and a time differential value representing a difference between the current time value indicated by the data source device's clock, a current time value indicated by the member device's respective clock, a time, relative to the member device's respective clock, at which the member device is to process the frame; and
(iv) process the respective frame at the determined time.

268. A system as defined in clause 267 in which at least one frame comprises audio data, each member device, while processing each frame, producing sound represented by the respective frame.

269. A system as defined in clause 267 comprising a plurality of member devices, the member devices processing each frame synchronously in relation to the clock maintained by the data source device so that they all produce sound represented by the respective frame synchronously.

270. A system as defined in clause 269 in which the data source device is configured to provide time stamps for at least two successive frames so that the member devices will play them with a selected time interval therebetween.

271. A system as defined in clause 270 in which the time interval is zero.

272. A system as defined in clause 269 in which one of the member devices operates as a master device for the synchrony group, any other member devices comprising respective slave devices, the master device being configured to perform at least one type of synchrony group management operation in connection with the member devices comprising the synchrony group.

273. A system as defined in clause 272 in which the master device is further configured to provide status information relating to the status of the synchrony group to the user interface module.

274. A system as defined in clause 273 in which the status information includes identifications of the devices comprising the synchrony group.

275. A system as defined in clause 273 in which each frame is associated with a frame sequence, each frame sequence comprising at least one frame, the frame or frames comprising each frame sequence being associated with an audio track, each audio track being associated with an identifier, the status information including the identification of the audio track currently being played.

276. A system as defined in clause 272, the system comprising at least one additional device, in which, in one type of synchrony group management operation, the master device is configured to enable the at least one additional device to join the synchrony group as a slave device.

277. A system as defined in clause 276 in which the data source device is configured to distribute frames to the member devices using a selected multi-cast transmission methodology, the member devices being configured to buffer the frames until they are to be played, and further in which, when the at least one additional device joins the synchrony group as a slave device, the data source device is enabled to transmit at least one previously distributed frame to the slave device using a selected unicast transmission methodology.

278. A system as defined in clause 272 in which, in at least one type of synchrony group management operation, the master device is configured to enable the data source device to join the synchrony group as a slave device, the data source device continuing to operate as the data source device for the synchrony group.

279. A system as defined in clause 272 in which, in at least one type of synchrony group management operation, the master device is configured to enable a slave device to disengage from the synchrony group, the disengaged slave device thereafter not being a member device in the synchrony group and not playing frames distributed by the data source device.

280. A system as defined in clause 272 in which, in at least one type of synchrony group management operation, the master device is configured to control the series of frames to be distributed by the data source device.

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281. A system as defined in clause 280 in which each frame is associated with a frame sequence, each frame sequence comprising at least one frame, the frame or frames comprising each frame sequence being associated with an audio track, the master device being configured to control the frames to be distributed by the data source device on a track-by-track basis.

282. A system as defined in clause 281 in which, in at least one type of synchrony group management operation, the master device is further configured to control playback by the member devices of the frames associated with the respective audio tracks that have been distributed by the data source device in response to control information from the user interface module.

283. A system as defined in clause 282 in which, in response to control information from the user interface module to facilitate control of playback by the member devices, the master device is configured to enable the data source device to distribute a playback control command to the member devices.

284. A system as defined in clause 283 in which a playback control command enables the member devices to terminate playback of a track that is currently being played back.

285. A system as defined in clause 284 in which the playback control command enables the member devices to terminate playback of a track with a frame subsequent to a frame currently being played.

286. A system as defined in clause 283 in which the playback control command enables the member devices to cancel playback of a track at least one of whose frames has been previously distributed, but for which playback has not begun.

287. A system as defined in clause 272 in which, in at least one type of synchrony group management operation, the member device operating as the master device is configured to enable the master device to migrate from itself to another member device in the synchrony group.

288. A system as defined in clause 272 in which, in at least one type of synchrony group management operation, the master device is configured to enable the data source device to migrate from one device to another device in the system.

289. A system as defined in clause 288 in which

A. the device operating as the data source device is configured to, after being enabled to migrate the data source device to said other device, provide migration information to the other device, the migration information including a source for information respecting the frames to be distributed, timing information relative to the clock maintained by the data source device and identifications of the member devices,
B. the other device being configured to, after receiving the migration information,

i. distribute the series of frames to the synchrony group, each frame being associated with a time stamp indicating a time, relative to the timing information that it receives from the device operating as the data source device, at which the devices comprising the synchrony group are to execute the respective frame, and
ii. notify the members of the synchrony group that it is to thereafter operate as the data source device.

290. A system as defined in clause 289 in which the information respecting the frames that are to be distributed is a source of streaming information, the other device being configured to, after receiving the migration information, assemble the streaming information into frames and associate each frame with a said time stamp.

291. A system as defined in clause 289 in which the information respecting the frames that are to be distributed is in a file identified in the migration information, the other device being configured to obtain information from the identified file, assemble the information into frames and associate each frame with a said time stamp.

292. A system as defined in clause 291 in which the information respecting the frames that are to be distributed begins at an offset, identified in the migration information, into the identified file, the other device being configured to assemble the information from a position in the file associated with the identified offset.

293. A system as defined in clause 291 in which the information respecting the frames that are to be distributed is

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in a series of files identified in the migration information, the other device being configured to obtain information from successive files in the series assemble the information into frames and associate each frame with as said time stamp.

294. A system as defined in clause 267 in which the data source device is further configured to distribute the frames using a selected multi-cast message transmission methodology.

295. A system as defined in clause 267 in which the data source device is configured to provide, associated with at least one frame, a time stamp indicating a frame execution time later than the time currently indicated by the clock maintained by the data source device.

296. A system as defined in clause 295 in which the data source device is configured to select the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one frame distributed by the data source device can be executed by the member devices at the time indicated by the time stamp.

297. A system as defined in clause 296 in which the data source device is configured to select the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one frame distributed by the data source device can be distributed to the member devices for execution at the time indicated by the time stamp

298. A system as defined in clause 295 in which data source device is configured to obtain information associated with the frames from at least two types of information sources, the data source device being further configured to select, for each frame the delay interval between the time indicated by the time stamp and the current time based on the information source type that is associated with the respective frame.

299. A system as defined in clause 267 in which at least one member device is further configured to adjust its clock rate in relation to a clock rate value maintained by the data source device's clock.

300. A system as defined in clause 299 in which the at least one member device is configured to adjust its clock rate in relation to time stamps associated with respective ones of the frames received from the data source device.

301. A system as defined in clause 267 in which at least one other device operates as a data source device configured to distribute frames to a second synchrony group, the device operating as the data source device for the first synchrony group also operating as a member device of a second synchrony group.

302. A system as defined in clause 267 in which at least one member device comprises:

A. an interface module configured to receive the series of frames, each frame being associated with a time stamp, each time stamp indicating a time value relative to a time indicated a clock maintained by the data source, at which the device is to process the respective frame;
B. a current time retrieval module configured to obtain, from the data source, a current time value as indicated by the data source's clock;
C. an processing time determination module configured to determine, from the time stamp associated with each respective frame and a time differential value representing a difference between the current time value obtained by the current time retrieval module and a current time value indicated by a clock maintained by the device, a time, relative to the device's respective clock, at which the frame is to be processed; and
D. a frame processing module configured to process each respective frame at the time determined by the processing time determination module.

303. A system as defined in clause 302 in which the at least one frame comprises audio data, each member device, while processing each frame, producing a signal representing sound represented by the respective frame.

304. A system as defined in clause 302 further including a control module for controlling execution of commands received by said interface module.

305. A device as defined in clause 304 further comprising a buffer configured to buffer frames that the interface module has received until they are to be processed, the frame processing module being configured to process the

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buffered frames at the times determined by the processing time determination module.

306. A system as defined in clause 305 in which the each frame is associated with a track, each track including at least one frame, the interface module being further configured to receive playback control commands for controlling processing of tracks, the control module being configured to execute at least one playback control command controlling track processing.

307. A system as defined in clause 306 in which at least one type of playback control command enables the control module to, in turn, enable the frame processing module to terminate playback of a track that is currently being played back.

308. A system as defined in clause 307 in which the playback control command enables the control module to terminate playback of a track with a frame subsequent to a frame currently being played.

309. A system as defined in clause 306 in which the playback control command enables the control module to cancel playback of a track at least one of whose frames has been previously distributed, but for which playback has not begun.

310. A system as defined in clause 306 in which the control module is configured to enable the frame processing module to resume processing of at least one frame associated with a subsequent track at a time determined by the processing time determination module.

311. A system as defined in clause 302 in which the member device includes:

A. a migration information receiving module configured to receive migration information from the task source device, the migration information including a source for information respecting the tasks to be distributed, timing information relative to the clock maintained by the task source device and identifications of the member devices of the synchrony group, and
B. a migration control module configure to, after the migration information has been received.,

i. distribute the series of tasks to the synchrony group, each task being associated with a time stamp indicating a time, relative to the timing information that it receives from the device operating as the task source device, at which the devices comprising the synchrony group are to execute the respective task, and
ii. notify the members of the synchrony group that it is to thereafter operate as the task source device.

312. A system as defined in clause 311 in which the information respecting the frames that are to be distributed is a source of streaming information, the migration control module being configured to, after the migration information has been received, assembling the streaming information into frames and associate each frame with a said time stamp.

313. A system as defined in clause 311 in which the information respecting the frames that are to be distributed is in a file identified in the migration information, the migration control module being configured to obtain information from the identified file, assemble the information into frames and associate each frame with a said time stamp.

314. A system as defined in clause 313 in which the information respecting the frames that are to be distributed begins at an offset, identified in the migration information, into the identified file, the migration control module being configured to assemble the information from a position in the file associated with the identified offset.

315. A system as defined in clause 313 in which the information respecting the frames that are to be distributed is in a series of files identified in the migration information, the migration control module being configured to obtain information from successive files in the series assemble the information into frames and associate each frame with as said time stamp.

316. A system as defined in clause 302 in which the member device further includes a clock rate adjustment module configured to adjust the member device's clock rate in relation to a clock rate value maintained by the data source device's clock.

317. A system as defined in clause 316 in which the clock rate adjustment module is configured to adjust the clock rate in relation to time stamps associated with respective ones of the frames received from the data source device.

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318. A system as defined in clause 267 in which the data source device comprises:

A. a frame acquisition module configured to obtain respective ones of the frames;
B. a frame execution time determination module configured to determine a time at which each respective frame is to be executed, and to associate the respective frame with a time stamp indicating its execution time;
C. a frame transmission module configured to transmit the series of frames to said at least one other device; and
D. an execution control command generation module configured to, in response to a predetermined event, enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to modify the execution sequence of the frames transmitted thereto.

319. A system as defined in clause 318 in which at least one frame comprises audio data, each member device, while processing each frame, producing generating a signal representing sound represented by the respective frame.

320. A system as defined in clause 318 in which the frame transmission module is configured to utilize a selected multi-cast transmission methodology.

321. A system as defined in clause 318 in which the predetermined event comprises input indicia provided by an operator.

322. A system as defined in clause 321 in which, in response to said predetermined event, the execution control command generation module is configured to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to control execution of at least one frame in relation to the time the predetermined event occurs.

323. A system as defined in clause 322 in which, in response to said predetermined event, the execution control command generation module is configured to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to terminate execution of a frame that it is currently executing and/or to not execute at least one frame that is to be executed subsequent to the predetermined event.

324. A data source device as defined in clause 323 in which the series of frames includes a series of frame sequences with each frame sequence including a sub-set of the series of frames, the execution control command generation module being configured to, in response to said predetermined event,

(i) enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module, a command enabling the at least one other device to terminate execution of the currently executing frame and/or to not execute at least one subsequent frame, if any, in the frame sequence including the currently executing frame; and
(ii) enable

(a) the frame execution time determination module to provide that time stamps associated with frames of frame sequences subsequent to the frame sequence currently being executed will reflect the termination and/or non-execution of frames from the frame sequence of the frame that is currently being executed, and
(b) the frame transmission module to transmit the frames of the subsequent frame sequences to the at least one other device.

325. A system as defined in clause 324 in which the frame transmission module is configured to insert a command to enable the at least one other device to not execute all frames in the frame sequence subsequent to the terminated and/or non-executed frame.

326. A system as defined in clause 267 in which, in response to said predetermined event, the execution control command generation module is configured to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to control execution of a frame in relation to the frame's position in the series of frames.

327. A system as defined in clause 326 in which, in response to said predetermined event, the execution control command generation module is configured to enable the frame transmission module to insert into the series of

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frames transmitted by the frame transmission module a command to enable the at least one other device to cancel execution of a frame in relation to the frame's position in the series of frames.

328. A system as defined in clause 326 in which, in response to said predetermined event, the execution control command generation module is configured to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to cancel execution of a previously-transmitted frame in relation to the frame's position in the series of frames.

329. A system as defined in clause 328 in which, in response to said predetermined event, the execution control command generation module is configured to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to cancel execution of a previously-transmitted frame, in relation to the frame's position in the series of frames, for which execution has not begun.

330. A system as defined in clause 327 in which the series of frames includes a series of frame sequences with each frame sequence including a sub-set of the series of frames, the execution control command generation module being configured to, in response to said predetermined event,

(i) enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module, a command enabling the at least one other device to cancel execution of a frame sequence for which execution has not begun; and
(ii) enable

(a) the frame execution time determination module to provide that time stamps associated with frames of frame sequences subsequent to the frame sequence whose execution was cancelled will reflect the cancellation, and
(b) the frame transmission module to transmit the frames of the subsequent frame sequences to the at least one other device.

331. A system as defined in clause 267 in which the data source device comprises:

A. a frame acquisition module configured to obtain respective ones of the frames;
B. a frame execution time determination module configured to determine a time at which each respective frame is to be executed, and to associate the respective frame with a time stamp indicating its execution time;
C. a frame transmission module configured to transmit the series of frames to said at least one other device; and
D. a data source device migration control module configured to, in response to a predetermined event, provide migration information to another device, the migration information including a source for information respecting the frames to be distributed, timing information relative to the clock maintained by the data source device and identifications of the member devices of the synchrony group.

332. A system as defined in clause 331 in which the data source device is configured to provide, associated with at least one frame, a time stamp indicating a frame execution time later than the time currently indicated by the clock maintained by the data source device.

333. A system as defined in clause 332 in which the data source device is configured to select the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one frame distributed by the data source device can be executed by the member devices at the time indicated by the time stamp.

334. A system as defined in clause 333 in which the data source device is configured to select the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one frame distributed by the data source device can be distributed to the member devices for execution at the time indicated by the time stamp

335. A system as defined in clause 333 in which data source device is configured to obtain information associated with the frames from at least two types of information sources, the data source device being further configured to select, for each frame the delay interval between the time indicated by the time stamp and the current time based on the information source type that is associated with the respective frame.

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336. A device for processing a series of frames of data provided by a data source at times specified by the data source in relation to a clock maintained by the data source, the device comprising

A. an interface module configured to receive the series of frames, each frame being associated with a time stamp, each time stamp indicating a time value relative to a time indicated a clock maintained by the data source, at which the device is to process the respective frame;
B. a current time retrieval module configured to obtain, from the data source, a current time value as indicated by the data source's clock;
C. an processing time determination module configured to determine, from the time stamp associated with each respective frame and a time differential value representing a difference between the current time value obtained by the current time retrieval module and a current time value indicated by a clock maintained by the device, a time, relative to the device's respective clock, at which the frame is to be processed; and
D. a frame processing module configured to process each respective frame at the time determined by the processing time determination module.

337. A device as defined in clause 336 in which the frame comprises audio data, each member device, while processing each frame, producing a signal representing sound represented by the respective frame.

338. A device as defined in clause 336 further including a control module for controlling execution of commands received by said interface module.

339. A device as defined in clause 336 further comprising a buffer configured to buffer frames that the interface module has received until they are to be processed, the frame processing module being configured to process the buffered frames at the times determined by the processing time determination module.

340. A device as defined in clause 339 in which the each frame is associated with a track, each track including at least one frame, the interface module being further configured to receive playback control commands for controlling processing of tracks, the control module being configured to execute at least one playback control command controlling track processing.

341. A device as defined in clause 340 in which at least one type of playback control command enables the control module to, in turn, enable the frame processing module to terminate playback of a track that is currently being played back.

342. A device as defined in clause 341 in which the playback control command enables the control module to terminate playback of a track with a frame subsequent to a frame currently being played.

343. A device as defined in clause 340 in which the playback control command enables the control module to cancel playback of a track at least one of whose frames has been previously distributed, but for which playback has not begun.

344. A device as defined in clause 340 in which the control module is configured to enable the frame processing module to resume processing of at least one frame associated with a subsequent track at a time determined by the processing time determination module.

345. A device as defined in clause 338, the control module being configured to, in response to receipt of a command to become a member of a synchrony group, enable the interface module to receive frames for processing by the frame processing module.

346. A device as defined in clause 345 in which the control module is configured to, in response to receipt of a command to become a member of a synchrony group, enable the interface module to receive frames currently being transmitted using a selected multi-cast transmission methodology, and further to retrieve at least one previously distributed frame using a selected unicast transmission methodology.

347. A device as defined in clause 346 in which the control module is configured to, in receipt of a command to disengage from a synchrony group, disable the interface module from receiving frames and the frame processing module from processing previously received frames that have not yet been processed.

348. A device as defined in clause 336 further comprising a user interface module interface module configured to

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receive control information from a user interface module, the control module being configured to enable selected operations to be performed in response to the control information.

349. A device as defined in clause 348 in which, in response to control information to enable another device to become a member of the device's synchrony group, the control module enables the interface module to transmit a command to the other device to enable the other device to become a member of the synchrony group.

350. A device as defined in clause 349 in which, in response to control information to enable another device that is a member of the device's synchrony group to disengage from the synchrony group, the control module enables the interface module to transmit a command to the other device to enable the other device to disengage from the synchrony group.

351. A device as defined in clause 348 in which, in response to control information to enable the data source to begin operating, the control module performs selected operations to enable the data source to begin operating.

352. A device as defined in clause 351, the device also operating as the data source, the device including a frame generator module configured to, under control of the control module, obtain information from which the frames are to be generated and generate the frames.

353. A device as defined in clause 342 in which the interface module is further configured to transmit the frames to at least one other device.

354. A device as defined in clause 343 in which the device is not the data source, the control module being configured to enable the interface module to transmit a command to enable the data source to operate.

355. A device as defined in clause 354 in which each frame is associated with a track, each track including at least one frame, and, in response to receipt of control information enabling processing of a track currently being processed to be terminated, the control module is configured to enable the interface module to transmit a command to enable the data source to insert a resynchronize command in the series of frames associated with the track to enable termination of processing of the track.

356. A device as defined in clause 354 in which each frame is associated with a track, each track including at least one frame, and, in response to receipt of control information enabling processing of a track at least a portion of which has been received, but for which processing has not begun, the control module is configured to enable the interface module to transmit a command to enable the data source to insert a resynchronize command in the series of commands to disable processing of the track.

357. A device as defined in clause 344 in which the control module is configured to enable the user interface module interface module to transmit status information to the user interface module.

358. A device as defined in clause 357 in which the status information includes the processing status of at least one frame.

359. A device as defined in clause 336 further including:

A. a migration information receiving module configured to receive migration information from the data source device, the migration information including a source for information respecting the frames to be distributed, timing information relative to the clock maintained by the data source device and identifications of the member devices of the synchrony group, and
B. a migration control module configured to, after the migration information has been received.,

i. distribute the series of frames to the synchrony group, each frame being associated with a time stamp indicating a time, relative to the timing information that it receives from the device operating as the data source device, at which the devices comprising the synchrony group are to execute the respective frame, and
ii. notify the members of the synchrony group that it is to thereafter operate as the data source device.

360. A device as defined in clause 359 in which the information respecting the frames that are to be distributed is a source of streaming information, the migration control module being configured to, after the migration information

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has been received, assembling the streaming information into frames and associate each frame with a said time stamp.

361. A device as defined in clause 359 in which the information respecting the frames that are to be distributed is in a file identified in the migration information, the migration control module being configured to obtain information from the identified file, assemble the information into frames and associate each frame with a said time stamp.

362. A device as defined in clause 361 in which the information respecting the frames that are to be distributed begins at an offset, identified in the migration information, into the identified file, the migration control module being configured to assemble the information from a position in the file associated with the identified offset.

363. A device as defined in clause 361 in which the information respecting the frames that are to be distributed is in a series of files identified in the migration information, the migration control module being configured to obtain information from successive files in the series assemble the information into frames and associate each frame with as said time stamp.

364. A device as defined in clause 336 further including a clock rate adjustment module configured to adjust the member device's clock rate in relation to a clock rate value maintained by the data source device's clock.

365. A data source device for distributing a series of frames for execution by at least one other device at respective execution times, the data source device comprising:

A. a frame acquisition module configured to obtain respective ones of the frames;
B. a frame execution time determination module configured to determine a time at which each respective frame is to be executed, and to associate the respective frame with a time stamp indicating its execution time;
C. a frame transmission module configured to transmit the series of frames to said at least one other device; and
D. an execution control command generation module configured to, in response to a predetermined event, enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to modify the execution sequence of the frames transmitted thereto.

366. A data source device as defined in clause 365 in which the frame transmission module is configured to utilize a selected multi-cast transmission methodology.

367. A data source device as defined in clause 365 in which the predetermined event comprises input indicia provided by an operator.

368. A data source device as defined in clause 367 in which, in response to said predetermined event, the execution control command generation module is configured to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to control execution of at least one frame in relation to the time the predetermined event occurs.

369. A data source device as defined in clause 368 in which, in response to said predetermined event, the execution control command generation module is configured to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to terminate execution of a frame that it is currently executing and/or to not execute at least one frame that is to be executed subsequent to the predetermined event.

370. A data source device as defined in clause 368 in which the series of frames includes a series of frame sequences with each frame sequence including a sub-set of the series of frames, the execution control command generation module being configured to, in response to said predetermined event,

(i) enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module, a command enabling the at least one other device to terminate execution of the currently executing frame and/or to not execute at least one subsequent frame, if any, in the frame sequence including the currently executing frame; and
(ii) enable

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(a) the frame execution time determination module to provide that time stamps associated with frames of frame sequences subsequent to the frame sequence currently being executed will reflect the termination and/or non-execution of frames from the frame sequence of the frame that is currently being executed, and
(b) the frame transmission module to transmit the frames of the subsequent frame sequences to the at least one other device.

371. A data source device as defined in clause 370 in which the frame transmission module is configured to, insert a command to enable the at least one other device to not execute all frames in the frame sequence subsequent to the terminated and/or non-executed frame.

372. A data source device as defined in clause 362 in which, in response to said predetermined event, the execution control command generation module is configured to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to control execution of a frame in relation to the frame's position in the series of frames.

373. A data source device as defined in clause 372 in which, in response to said predetermined event, the execution control command generation module is configured to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to cancel execution of a frame in relation to the frame's position in the series of frames.

374. A data source device as defined in clause 371 in which, in response to said predetermined event, the execution control command generation module is configured to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to cancel execution of a previously-transmitted frame in relation to the frame's position in the series of frames.

375. A data source device as defined in clause 374 in which, in response to said predetermined event, the execution control command generation module is configured to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to cancel execution of a previously-transmitted frame, in relation to the frame's position in the series of frames, for which execution has not begun.

376. A data source device as defined in clause 371 in which the series of frames includes a series of frame sequences with each frame sequence including a sub-set of the series of frames, the execution control command generation module being configured to, in response to said predetermined event,

(i) enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module, a command enabling the at least one other device to cancel execution of a frame sequence for which execution has not begun; and
(ii) enable

(a) the frame execution time determination module to provide that time stamps associated with frames of frame sequences subsequent to the frame sequence whose execution was cancelled will reflect the cancellation, and
(b) the frame transmission module to transmit the frames of the subsequent frame sequences to the at least one other device.

377. A data source device for distributing a series of frames for execution by at least one other device at respective execution times, the data source device comprising:

A. a frame acquisition module configured to obtain respective ones of the frames;
B. a frame execution time determination module configured to determine a time at which each respective frame is to be executed, and to associate the respective frame with a time stamp indicating its execution time, the frame execution time determination module being configured to provide, associated with at least one frame, a time stamp indicating a frame execution time later than the time currently indicated by a clock maintained by the data source device; and
C. a frame transmission module configured to transmit the series of frames to said at least one other device.

377. A system as defined in clause 377 in which the data source device is configured to select the delay interval

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between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one frame distributed by the data source device can be executed by the member devices at the time indicated by the time stamp.

379. A system as defined in clause 378 in which the data source device is configured to select the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one frame distributed by the data source device can be distributed to the member devices for execution at the time indicated by the time stamp

380. A system as defined in clause 377 in which data source device is configured to obtain information associated with the frames from at least two types of information sources, the data source device being further configured to select, for each frame the delay interval between the time indicated by the time stamp and the current time based on the information source type that is associated with the respective frame.

381. A data source device for distributing a series of frames for execution by at least one other device, the data source device comprising:

A. a frame acquisition module configured to obtain respective ones of the frames;
B. a frame execution time determination module configured to determine a time at which each respective frame is to be executed, and to associate the respective frame with a time stamp indicating its execution time;
C. a frame transmission module configured to transmit the series of frames to said at least one other device; and
D. a data source device migration control module configured to, in response to a predetermined event, provide migration information to another device, the migration information including a source for information respecting the frames to be distributed, timing information relative to the clock maintained by the data source device and identifications of the member devices of the synchrony group.

382. A method for operating a system to facilitate processing of data by device operating as a member of a synchrony group, synchronously with a clock maintained by a data source device that provides the data to the synchrony group, the method including the steps of

A. enabling the data source device being to divide the data into a series of frames for distribution to the synchrony group, each frame being associated with a time stamp indicating a time, relative to a clock maintained by the data source device, at which the devices comprising the synchrony group are to process the frame;
B enabling each member device in the synchrony group to:

(i) periodically obtain from the data source device an indication of a current time value indicated by the data source device's clock;
(ii) receive the series of frames from the data source device;
(iii) determine, from the time stamp associated with each respective frame and a time differential value representing a difference between the current time value indicated by the data source device's clock, a current time value indicated by the member device's respective clock, a time, relative to the member device's respective clock, at which the member device is to process the frame; and
(iv) process the respective frame at the determined time.

383. A method as defined in clause 382 in which at least one frame comprises audio data, each member device, while processing each frame, being enabled to generate a signal representing sound represented by the respective frame.

384. A method as defined in clause 382, the system comprising a plurality of member devices, the method including the steps of enabling the member devices to process each frame synchronously in relation to the clock maintained by the data source device so that they all produce sound represented by the respective frame synchronously.

385. A method as defined in clause 384 including the step of enabling the data source device to provide time stamps for at least two successive frames so that the member devices will play them with a selected time interval therebetween.

386. A method as defined in clause 385 in which the time interval is zero.

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387. A method as defined in clause 382 in which one of the member devices operates as a master device for the synchrony group, any other member devices comprising respective slave devices, the method including the step of enabling the master device to perform at least one type of synchrony group management operation in connection with the member devices comprising the synchrony group.

388. A method as defined in clause 387, the method including the step of enabling the master device to perform at least one type of synchrony group management operation in response to control information provided thereto by a user interface module.

389. A method as defined in clause 388 further including the step of enabling the master device to provide status information relating to the status of the synchrony group to the user interface module.

390. A method as defined in clause 389 in which the status information includes identifications of the devices comprising the synchrony group.

391. A method as defined in clause 389 in which each frame is associated with a frame sequence, each frame sequence comprising at least one frame, the frame or frames comprising each frame sequence being associated with an audio track, each audio track being associated with an identifier, the status information including the identification of the audio track currently being played.

392. A method as defined in clause 388 the method comprising at least one additional device, in which, in one type of synchrony group management operation, the master device is configured to enable the at least one additional device to join the synchrony group as a slave device.

393. A method as defined in clause 392 in which the data source device is configured to distribute frames to the member devices using a selected multi-cast transmission methodology, the member devices being configured to buffer the frames until they are to be played, the method including the step of, when the at least one additional device joins the synchrony group as a slave device, the enabling the data source device to transmit at least one previously distributed frame to the slave device using a selected unicast transmission methodology.

394. A method as defined in clause 387 in which, in at least one type of synchrony group management operation, the method includes the step of enabling the master device to enable the data source device to join the synchrony group as a slave device, the data source device continuing to operate as the data source device for the synchrony group.

395. A method as defined in clause 387 in which, in at least one type of synchrony group management operation, the method includes the step of enabling the master device to enable a slave device to disengage from the synchrony group, the disengaged slave device thereafter not being a member device in the synchrony group and not playing frames distributed by the data source device.

396. A method as defined in clause 387 in which, in at least one type of synchrony group management operation, the method includes the step of enabling the master device to control the series of frames to be distributed by the data source device.

397. A method as defined in clause 387 in which each frame is associated with a frame sequence, each frame sequence comprising at least one frame, the frame or frames comprising each frame sequence being associated with an audio track, the method including the step of enabling the master device being configured to control the frames to be distributed by the data source device on a track-by-track basis.

398. A method as defined in clause 387 in which, in at least one type of synchrony group management operation, the method includes the step of enabling the master device to control playback by the member devices of the frames associated with the respective audio tracks that have been distributed by the data source device in response to control information from the user interface module.

399. A method as defined in clause 387 in which, in response to control information from the user interface module to facilitate control of playback by the member devices, the method includes the step of enabling the master device to enable the data source device to distribute a playback control command to the member devices.

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400. A method as defined in clause 399 in which a playback control command enables the member devices to terminate playback of a track that is currently being played back.

401. A method as defined in clause 399 in which the playback control command enables the member devices to terminate playback of a track with a frame subsequent to a frame currently being played.

402. A method as defined in clause 399 in which the playback control command enables the member devices to cancel playback of a track at least one of whose frames has been previously distributed, but for which playback has not begun.

403. A method as defined in clause 387 in which, in at least one type of synchrony group management operation, the method includes the step of enabling the member device operating as the master device to enable the master device to migrate from itself to another member device in the synchrony group.

404. A method as defined in clause 403 in which, in at least one type of synchrony group management operation, the method includes the step of enabling the master device to enable the data source device to migrate from one device to another device in the system.

405. A method as defined in clause 404 in which

A. the device operating as the data source device is enable to perform the step of, after being enabled to migrate the data source device to said other device, providing migration information to the other device, the migration information including a source for information respecting the frames to be distributed, timing information relative to the clock maintained by the data source device and identifications of the member devices,
B. the other device is enabled to, after receiving the migration information, perform the steps of

i. distributing the series of frames to the synchrony group, each frame being associated with a time stamp indicating a time, relative to the timing information that it receives from the device operating as the data source device, at which the devices comprising the synchrony group are to execute the respective frame, and
ii. notifying the members of the synchrony group that it is to thereafter operate as the data source device.

406. A method as defined in clause 405 in which the information respecting the frames that are to be distributed is a source of streaming information, the other device being enabled to, after receiving the migration information, perform the steps of assembling the streaming information into frames and associating each frame with a said time stamp.

407. A method as defined in clause 405 in which the information respecting the frames that are to be distributed is in a file identified in the migration information, the other device being enabled to perform the steps of obtaining information from the identified file, assembling the information into frames and associating each frame with a said time stamp.

408. A method as defined in clause 407 in which the information respecting the frames that are to be distributed begins at an offset, identified in the migration information, into the identified file, the other device being enabled to perform the step of assembling the information from a position in the file associated with the identified offset.

409. A method as defined in clause 407 in which the information respecting the frames that are to be distributed is in a series of files identified in the migration information, the other device being enabled to perform the step of obtaining information from successive files in the series assemble the information into frames and associate each frame with as said time stamp.

410. A method as defined in clause 382 including the step in which the data source is further configured to distribute the frames using a selected multi-cast message transmission methodology, the device being enabled to receive the frames using the selected multi-cast message transmission methodology.

411. A method as defined in clause 382 in which the data source device is enabled to perform the step of providing, provide, associated with at least one frame, a time stamp indicating a frame execution time later than the time currently indicated by the clock maintained by the data source device.

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412. A method as defined in clause 411 in which the data source device is enabled to perform the step of selecting the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one frame distributed by the data source device can be executed by the member devices at the time indicated by the time stamp.

413. A method as defined in clause 411 in which the data source device is enabled to perform the step of selecting the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one frame distributed by the data source device can be distributed to the member devices for execution at the time indicated by the time stamp

414. A method as defined in clause 411 in which data source device is enabled to perform the steps of obtaining information associated with the frames from at least two types of information sources, and selecting, for each frame, the delay interval between the time indicated by the time stamp and the current time based on the information source type that is associated with the respective frame.

415. A method as defined in clause 382 in which at least one member device is further enabled to perform the step of adjusting its clock rate in relation to a clock rate value maintained by the data source device's clock.

416. A method as defined in clause 415 in which the at least one member device is enabled to perform the step of adjusting its clock rate in relation to time stamps associated with respective ones of the frames received from the data source device.

417. A method as defined in clause 382 in which at least one other device operates as a data source device configured to distribute frames to a second synchrony group, the method including the steps of enabling the device to operate both as the data source device for the first synchrony group and also operating as a member device of a second synchrony group.

418. A method as defined in clause 382 including, within a member device,

A. a frame receiving step of receiving the series of frames,
B. a current time retrieval step of obtaining, from the data source device, the current time value as indicated by the frame source's clock;
C. an execution time determination step of determining, from the time stamp associated with each respective frame and a time differential value representing a difference between the current time value obtained during the current time retrieval step and a current time value indicated by a clock maintained by the device, a time, relative to the member device's respective clock at which the frame is to be executed; and
D. a frame execution step of executing each respective frame at the time determined during the execution time determination step.

419. A method as defined in clause 418 further including a control step for controlling execution of commands received during the frame receiving step

420. A method as defined in clause 419 in which the at least one member device further comprises a buffer configured to buffer frames received from the data source device during the frame receiving step until they are to be executed, the frame execution step including the step of executing the buffered frames at the times determined during the execution time determination step.

420. A method as defined in clause 420 in which the series of frames includes a series of frame sequences with each frame sequence including a subset of the series of frames, the frame receiving step being further enabled to receive frame execution control commands for controlling frame execution, the control step including the step of, in response to receipt of at least one frame execution control command for controlling frame execution, controlling the frame execution step to terminate execution of a frame sequence currently being executed, and further to not execute subsequent frames in the frame sequence that have been buffered.

422. A method as defined in clause 421 in which the control step includes the step of enabling the frame execution step to resume execution of at least one frame associated with a subsequent frame sequence at a time determined during the execution time determination step.

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423. A method as defined in clause 420 in which the series of frames includes a series of frame sequences with each frame sequence including a subset of the series of frames, the frame receiving step including the step of receiving frame execution control commands for controlling frame execution, the control step including the step of, in response to receipt of at least one frame execution control command to cancel execution of a frame sequence for which at least one frame has been buffered but for which execution has not begun, providing that frames from that frame sequence that have been buffered not be executed.

424. A method as defined in clause 423 in which the control step includes the step of enabling execution to resume of at least one frame associated with a frame sequence subsequent to the frame sequence for which at least one frame has been buffered but for which execution has not begun.

425. A method as defined in clause 418 in which the member device performs:

A. migration information receiving step of receiving migration information from the data source device, the migration information including a source for information respecting the frames to be distributed, timing information relative to the clock maintained by the data source device and identifications of the member devices of the synchrony group, and
B. a migration control step of, after the migration information has been received.,

i. distributing the series of frames to the synchrony group, each frame being associated with a time stamp indicating a time, relative to the timing information that it receives from the device operating as the data source device, at which the devices comprising the synchrony group are to execute the respective frame, and
ii. notifying the members of the synchrony group that it is to thereafter operate as the data source device.

426. A method as defined in clause 425 in which the information respecting the frames that are to be distributed is a source of streaming information, the migration control step includes the steps of, after the migration information has been received, assembling the streaming information into frames and associating each frame with a said time stamp.

427. A method as defined in clause 425 in which the information respecting the frames that are to be distributed is in a file identified in the migration information, the migration control step including the steps of obtaining information from the identified file, assembling the information into frames and associating each frame with a said time stamp.

428. A method as defined in clause 427 in which the information respecting the frames that are to be distributed begins at an offset, identified in the migration information, into the identified file, the migration control step including the step of assembling the information from a position in the file associated with the identified offset.

429. A method as defined in clause 427 in which the information respecting the frames that are to be distributed is in a series of files identified in the migration information, the migration control step including the steps of obtaining information from successive files in the series assemble the information into frames and associating each frame with as said time stamp.

430. A method as defined in clause 418 in which the member device is further enabled to perform a clock rate adjustment step including the step of adjusting the member device's clock rate in relation to a clock rate value maintained by the data source device's clock.

431. A method as defined in clause 430 in which the clock rate adjustment step includes the step of determining adjust the clock rate in relation to time stamps associated with respective ones of the frames received from the data source device.

432. A method as defined in clause 382 of operating a device for distributing a series of frames for execution by at least one other device at respective execution times, the method comprising:

A. a frame acquisition step of obtaining respective ones of the frames;
B. a frame execution time determination step of determining a time at which each respective frame is to be executed, and to associate the respective frame with a time stamp indicating its execution time;
C. a frame transmission step of transmitting the series of frames to said at least one other device; and
D. an execution control command generation step of, in response to a predetermined event and during the

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frame transmission step, the insertion into the series of frames transmitted by the frame transmission module of a command to enable the at least one other device to modify the execution sequence of the frames transmitted thereto.

433. A method as defined in clause 432 in which the frame transmission step includes the step of utilizing a selected multi-cast transmission methodology.

434. A method as defined in clause 432 in which the predetermined event includes the step of receiving input indicia provided by an operator.

435. A method as defined in clause 434 in which the execution control command generation step includes the step of enabling, in response to said predetermined event and during the frame transmission step, the insertion into the series of frames of a command to enable the at least one other device to control execution of at least one frame in relation to the time the predetermined event occurs.

436. A method as defined in clause 435 in which, the execution control command generation step includes the step of enabling, in response to said predetermined event and during the frame transmission step, the insertion into the series of frames of a command to enable the at least one other device to terminate execution of a frame that it is currently executing and/or to not execute at least one frame that is to be executed subsequent to the predetermined event.

437. A method as defined in clause 434 in which the series of frames includes a series of frame sequences with each frame sequence including a sub-set of the series of frames, the execution control command generation step including the steps of, in response to said predetermined event,

(i) enabling during the frame transmission step the insertion, into the series of frames, of a command enabling the at least one other device to terminate execution of the currently executing frame and/or to not execute at least one subsequent frame, if any, in the frame sequence including the currently executing frame; and
(ii) enabling

(a) during the frame execution time determination step, that time stamps associated with frames of frame sequences subsequent to the frame sequence currently being executed will reflect the termination and/or non-execution of frames from the frame sequence of the frame that is currently being executed, and
(b) during the frame transmission step, the transmission of the frames of the subsequent frame sequences to the at least one other device.

438. A method as defined in clause 437 in which the frame transmission step includes the step of inserting a command into the frame sequence to enable the at least one other device to not execute all frames in the frame sequence subsequent to the terminated and/or non-executed frame.

439. A method as defined in clause 435 in which the execution control command generation step include the step of enabling, in response to said predetermined event and during the frame transmission step, the insertion into the series of frames of a command to enable the at least one other device to control execution of a frame in relation to the frame's position in the series of frames.

440. A method as defined in clause 439 in which the execution control command generation step includes the step of, in response to said predetermined event and during the frame transmission step, the insertion into the series of frames of a command to enable the at least one other device to cancel execution of a frame in relation to the frame's position in the series of frames.

441. A method as defined in clause 439 in which the execution control command generation step includes the step of enabling, in response to said predetermined event and during the frame transmission step, the inserting into the series of frames of a command to enable the at least one other device to cancel execution of a previously-transmitted frame in relation to the frame's position in the series of frames.

442. A method as defined in clause 441 in which, the execution control command generation step includes the step of, in response to said predetermined event and during the frame transmission step, the insertion into the series of frames of a command to enable the at least one other device to cancel execution of a previously-transmitted frame,

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in relation to the frame's position in the series of frames, for which execution has not begun.

443. A method as defined in clause 439 in which the series of frames includes a series of frame sequences with each frame sequence including a sub-set of the series of frames, the execution control command generation step including the steps of, in response to said predetermined event,

(i) enabling, during the frame transmission step, the insertion, into the series of frames, of a command enabling the at least one other device to cancel execution of a frame sequence for which execution has not begun; and
(ii) enabling

(a) during the frame execution time determination step, that time stamps associated with frames of frame sequences subsequent to the frame sequence whose execution was cancelled will reflect the cancellation, and
(b) during the frame transmission step, the transmission of the frames of the subsequent frame sequences to the at least one other device.

444. A method as defined in clause 382 in which the data source device is enabled to perform

A. a frame acquisition step of obtaining respective ones of the frames;
B. a frame execution time determination step of determining a time at which each respective frame is to be executed, and to associate the respective frame with a time stamp indicating its execution time;
C. a frame transmission step of transmitting the series of frames to said at least one other device; and
D. a data source device migration control step of, in response to a predetermined event, providing migration information to another device, the migration information including a source for information respecting the frames to be distributed, timing information relative to the clock maintained by the data source device and identifications of the member devices of the synchrony group.

445. A method as defined in clause 382 in which the data source device is enabled to perform the step of providing, associated with at least one frame, a time stamp indicating a frame execution time later than the time currently indicated by the clock maintained by the data source device.

446. A method as defined in clause 445 in which the data source device is enabled to perform the step of selecting the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one frame distributed by the data source device can be executed by the member devices at the time indicated by the time stamp.

447. A method as defined in clause 446 in which the data source device is enabled to perform the step of selecting the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one frame distributed by the data source device can be distributed to the member devices for execution at the time indicated by the time stamp.

448. A method as defined in clause 445 in which data source device is enabled to perform the step of obtaining information associated with the frames from at least two types of information sources, and selecting for each frame the delay interval between the time indicated by the time stamp and the current time based on the information source type that is associated with the respective frame.

449. A method of enabling a device to process a series of frames of data provided by a data source at times specified by the data source in relation to a clock maintained by the data source, the device comprising

A. an interface step of receiving the series of frames, each frame being associated with a time stamp, each time stamp indicating a time value relative to a time indicated a clock maintained by the data source, at which the device is to process the respective frame;
B. a current time retrieval step of obtaining, from the data source, a current time value as indicated by the data source's clock;
C. an processing time determination step of determining, from the time stamp associated with each respective frame and a time differential value representing a difference between the current time value obtained during the current time retrieval step and a current time value indicated by a clock maintained by the device, a time, relative to the device's respective clock, at which the frame is to be processed; and

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D. a frame processing step of processing each respective frame at the time determined during the processing time determination step.

450. A method as defined in clause 449 in which at least one frame comprises audio data, each member device, while processing said at least one frame, generating a signal representing sound represented by the respective frame.

451. A method as defined in clause 449 further including a control step for controlling execution of commands received by said device.

452. A method as defined in clause 451 further comprising a buffer configured to buffer frames that the interface module has received until they are to be processed, the frame processing step including the step of processing the buffered frames at the times determined during the processing time determination step.

453. A method as defined in clause 451 in which the each frame is associated with a track, each track including at least one frame, the interface module being further configured to receive playback control commands for controlling processing of tracks, the method including the step of enabling the control module to execute at least one playback control command controlling track processing.

454. A method as defined in clause 453 including the step of, in response to at least one type of playback control command, enabling the control module to, in turn, enable the frame processing module to terminate playback of a track that is currently being played back.

455. A method as defined in clause 454 including the step of, in response to the playback control command, enabling the control module to terminate playback of a track with a frame subsequent to a frame currently being played.

456. A method as defined in clause 452 including the step of, in response to the playback control command, enabling the control module to cancel playback of a track at least one of whose frames has been previously distributed, but for which playback has not begun.

457. A method as defined in clause 453 including the step of enabling the control module to enable the frame processing module to resume processing of at least one frame associated with a subsequent track at a time determined by the processing time determination module.

458. A method as defined in clause 449 including the step of enabling the control module to, in response to receipt of a command to become a member of a synchrony group, enable the interface module to receive frames for processing by the frame processing module.

459. A method as defined in clause 458 including the step of enabling the control module to, in response to receipt of a command to become a member of a synchrony group, enable the interface module to receive frames currently being transmitted using a selected multi-cast transmission methodology, and further to retrieve at least one previously distributed frame using a selected unicast transmission methodology.

460. A method as defined in clause 449 including the step of enabling the control module to, in receipt of a command to disengage from a synchrony group, disable the interface module from receiving frames and the frame processing module from processing previously received frames that have not yet been processed.

461. A method as defined in clause 449, further including the steps of receiving control information from a user interface module, and enabling the control module to enable selected operations to be performed in response to the control information.

462. A method as defined in clause 461 including the step of, in response to control information to enable another device to become a member of the device's synchrony group, enabling the control module to enable the interface module to transmit a command to the other device to enable the other device to become a member of the synchrony group.

463. A method as defined in clause 461 including the step of, in response to control information to enable another device that is a member of the device's synchrony group to disengage from the synchrony group, enabling the control module to enable transmission of a command to the other device to enable the other device to disengage

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from the synchrony group.

464. A method as defined in clause 461 including the step of, in response to control information to enable the data source to begin operating, enabling the control module to perform selected operations to enable the data source to begin operating.

465. A method as defined in clause 464, the device also operating as the data source, the method including a frame generator step of, under control of the control module, obtaining information from which the frames are to be generated and generating the frames.

466. A method as defined in clause 465 further comprising the step of transmitting the frames to at least one other device.

467. A method as defined in clause 465 in which the device is not the data source, the method including the step of enabling the control module to enable transmission of a command to enable the data source to operate.

468. A method as defined in clause 467 in which each frame is associated with a track, each track including at least one frame, and, in response to receipt of control information enabling processing of a track currently being processed to be terminated, the method including the step of enabling the control module to enable transmission of a command to enable the data source to insert a resynchronize command in the series of frames associated with the track to enable termination of processing of the track.

469. A method as defined in clause 467 in which each frame is associated with a track, each track including at least one frame, and, in response to receipt of control information enabling processing of a track at least a portion of which has been received, but for which processing has not begun, the method including the step of enabling the control module to enable transmission of a command to enable the data source to insert a resynchronize command in the series of commands to disable processing of the track.

470. A method as defined in clause 451 further including the step of enabling the control module to enable the user interface module interface module to transmit status information to the user interface module.

471. A method as defined in clause 470 in which the status information includes the processing status of at least one frame.

472. A method as defined in clause 469 in which the member device performs:

A. migration information receiving step of receiving migration information from the data source device, the migration information including a source for information respecting the frames to be distributed, timing information relative to the clock maintained by the data source device and identifications of the member devices of the synchrony group, and
B. a migration control step of, after the migration information has been received.,

i. distributing the series of frames to the synchrony group, each frame being associated with a time stamp indicating a time, relative to the timing information that it receives from the device operating as the data source device, at which the devices comprising the synchrony group are to execute the respective frame, and
ii. notifying the members of the synchrony group that it is to thereafter operate as the data source device.

473. A method as defined in clause 472 in which the information respecting the frames that are to be distributed is a source of streaming information, the migration control step includes the steps of, after the migration information has been received, assembling the streaming information into frames and associating each frame with a said time stamp.

474. A method as defined in clause 472 in which the information respecting the frames that are to be distributed is in a file identified in the migration information, the migration control step including the steps of obtaining information from the identified file, assembling the information into frames and associating each frame with a said time stamp.

475. A method as defined in clause 474 in which the information respecting the frames that are to be distributed begins at an offset, identified in the migration information, into the identified file, the migration control step including

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the step of assembling the information from a position in the file associated with the identified offset.

476. A method as defined in clause 474 in which the information respecting the frames that are to be distributed is in a series of files identified in the migration information, the migration control step including the steps of obtaining information from successive files in the series assemble the information into frames and associating each frame with as said time stamp.

477. A method as defined in clause 449 in which the member device is further enabled to perform a clock rate adjustment step including the step of adjusting the member device's clock rate in relation to a clock rate value maintained by the data source device's clock.

478. A method as defined in clause 477 in which the clock rate adjustment step includes the step of determining adjust the clock rate in relation to time stamps associated with respective ones of the frames received from the data source device.

479. A method of operating a device for distributing a series of frames for execution by at least one other device at respective execution times, the method comprising:

A. a frame acquisition step of obtaining respective ones of the frames;
B. a frame execution time determination step of determining a time at which each respective frame is to be executed, and to associate the respective frame with a time stamp indicating its execution time;
C. a frame transmission step of transmitting the series of frames to said at least one other device; and
D. an execution control command generation step of, in response to a predetermined event and during the frame transmission step, the insertion into the series of frames transmitted by the frame transmission module of a command to enable the at least one other device to modify the execution sequence of the frames transmitted thereto.

480. A method as defined in clause 479 in which at least one frame comprises audio data.

481. A method as defined in clause 479 in which the frame transmission step includes the step of utilizing a selected multi-cast transmission methodology.

482. A method as defined in clause 479 in which the predetermined event includes the step of receiving input indicia provided by an operator.

483. A method as defined in clause 482 in which the execution control command generation step includes the step of enabling, in response to said predetermined event and during the frame transmission step, the insertion into the series of frames of a command to enable the at least one other device to control execution of at least one frame in relation to the time the predetermined event occurs.

484. A method as defined in clause 483 in which, the execution control command generation step includes the step of enabling, in response to said predetermined event and during the frame transmission step, the insertion into the series of frames of a command to enable the at least one other device to terminate execution of a frame that it is currently executing and/or to not execute at least one frame that is to be executed subsequent to the predetermined event.

485. A method as defined in clause 482 in which the series of frames includes a series of frame sequences with each frame sequence including a sub-set of the series of frames, the execution control command generation step including the steps of, in response to said predetermined event,

(i) enabling during the frame transmission step the insertion, into the series of frames, of a command enabling the at least one other device to terminate execution of the currently executing frame and/or to not execute at least one subsequent frame, if any, in the frame sequence including the currently executing frame; and
(ii) enabling

(a) during the frame execution time determination step, that time stamps associated with frames of frame sequences subsequent to the frame sequence currently being executed will reflect the termination and/or non-execution of frames from the frame sequence of the frame that is currently being executed, and

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(b) during the frame transmission step, the transmission of the frames of the subsequent frame sequences to the at least one other device.

486. A method as defined in clause 485 in which the frame transmission step includes the step of inserting a command into the frame sequence to enable the at least one other device to not execute all frames in the frame sequence subsequent to the terminated and/or non-executed frame.

487. A method as defined in clause 479 in which the execution control command generation step include the step of enabling, in response to said predetermined event and during the frame transmission step, the insertion into the series of frames of a command to enable the at least one other device to control execution of a frame in relation to the frame's position in the series of frames.

488. A method as defined in clause 487 in which the execution control command generation step includes the step of, in response to said predetermined event and during the frame transmission step, the insertion into the series of frames of a command to enable the at least one other device to cancel execution of a frame in relation to the frame's position in the series of frames.

489. A method as defined in clause 487 in which the execution control command generation step includes the step of enabling, in response to said predetermined event and during the frame transmission step, the inserting into the series of frames of a command to enable the at least one other device to cancel execution of a previously-transmitted frame in relation to the frame's position in the series of frames.

490. A method as defined in clause 489 in which, the execution control command generation step includes the step of, in response to said predetermined event and during the frame transmission step, the insertion into the series of frames of a command to enable the at least one other device to cancel execution of a previously-transmitted frame, in relation to the frame's position in the series of frames, for which execution has not begun.

491. A method as defined in clause 488 in which the series of frames includes a series of frame sequences with each frame sequence including a sub-set of the series of frames, the execution control command generation step including the steps of, in response to said predetermined event,

(i) enabling, during the frame transmission step, the insertion, into the series of frames, of a command enabling the at least one other device to cancel execution of a frame sequence for which execution has not begun; and
(ii) enabling

(a) during the frame execution time determination step, that time stamps associated with frames of frame sequences subsequent to the frame sequence whose execution was cancelled will reflect the cancellation, and
(b) during the frame transmission step, the transmission of the frames of the subsequent frame sequences to the at least one other device.

492. A method of operating a device for distributing a series of frames for execution by at least one other device at respective execution times, the method comprising:

A. a frame acquisition step of obtaining respective ones of the frames;
B. a frame execution time determination step of determining a time at which each respective frame is to be executed, and to associating the respective frame with a time stamp indicating its execution time, the frame execution time determination step including the step of providing, associated with at least one frame, a time stamp indicating a frame execution time later than the time currently indicated by a clock maintained by the data source device; and
C. a frame transmission step of transmitting the series of frames to said at least one other device.

493. A method as defined in clause 492 in which at least one frame comprises audio data.

494. A method as defined in clause 492 in which the frame execution time determination step includes the step of selecting the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one frame distributed by the device can be executed by at least one other device at the time indicated by the time stamp.

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495. A method as defined in clause 494 in which the frame execution time determination step includes the step of selecting the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one frame distributed by the device can be distributed to other devices over a network for execution by the other devices at the time indicated by the time stamp.

496. A method as defined in clause 492 in which frame acquisition step includes the step of obtaining information associated with the frames from at least two types of information sources, the frame execution time determination step including the step of selecting, for each frame the delay interval between the time indicated by the time stamp and the current time based on the information source type that is associated with the respective frame.

497. A method of operating a device for distributing a series of frames for execution by at least one other device, the method comprising:

A. a frame acquisition module configured to obtain respective ones of the frames;
B. a frame execution time determination module configured to determine a time at which each respective frame is to be executed, and to associate the respective frame with a time stamp indicating its execution time;
C. a frame transmission module configured to transmit the series of frames to said at least one other device; and
D. a data source device migration control module configured to, in response to a predetermined event, provide migration information to another device, the migration information including a source for information respecting the frames to be distributed, timing information relative to the clock maintained by the data source device and identifications of the member devices of the synchrony group.

498. A method as defined in clause 497 in which at least one frame comprises audio data.

499. A computer program product for use in connection with a computer to provide a device for processing a series of frames of data provided by a data source at times specified by the data source in relation to a clock maintained by the data source, the computer program product comprising a computer-readable medium having encoded thereon

A. an interface module configured to enable the computer to receive the series of frames, each frame being associated with a time stamp, each time stamp indicating a time value relative to a time indicated a clock maintained by the data source, at which the device is to process the respective frame;
B. a current time retrieval module configured to enable the computer to obtain, from the data source, a current time value as indicated by the data source's clock;
C. an processing time determination module configured to enable the computer to determine, from the time stamp associated with each respective frame and a time differential value representing a difference between the current time value obtained by the current time retrieval module and a current time value indicated by a clock maintained by the device, a time, relative to the device's respective clock, at which the frame is to be processed; and
D. a frame processing module configured to enable the computer to process each respective frame at the time determined by the processing time determination module.

500. A computer program product as defined in clause 499 in which at least one frame comprises audio data, the computer, while processing said frame, generating a signal representing sound represented by the respective frame.

501. A computer program product as defined in clause 499 further including a control module a control module for enabling said computer to control execution of commands received by the interface module.

502. A computer program product as defined in clause 501 further comprising a buffer configured to enable the computer to buffer frames that the interface module has received until they are to be processed, the frame processing module being configured to enable the computer to process the buffered frames at the times determined by the processing time determination module.

503. A computer program product as defined in clause 502 in which the each frame is associated with a track, each track including at least one frame, the interface module being further configured to enable the computer to receive playback control commands for controlling processing of tracks, the control module being configured to enable the computer to execute at least one playback control command controlling track processing.

504. A computer program product as defined in clause 503 in which at least one type of playback control command

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enables the control module to, in turn, enable the frame processing module to terminate playback of a track that is currently being played back.

505. A computer program product as defined in clause 504 in which the playback control command enables the control module to terminate playback of a track with a frame subsequent to a frame currently being played.

506. A computer program product as defined in clause 503 in which the playback control command enables the control module to cancel playback of a track at least one of whose frames has been previously distributed, but for which playback has not begun.

507. A computer program product as defined in clause 503 in which the control module is configured to enable the computer to enable the frame processing module to resume processing of at least one frame associated with a subsequent track at a time determined by the processing time determination module.

508. A computer program product as defined in clause 501, the control module being configured to enable the computer to, in response to receipt of a command to become a member of a synchrony group, enable the interface module to receive frames for processing by the frame processing module.

509. A computer program product as defined in clause 508 in which the control module is configured to enable the computer to, in response to receipt of a command to become a member of a synchrony group, enable the interface module to receive frames currently being transmitted using a selected multi-cast transmission methodology, and further to retrieve at least one previously distributed frame using a selected unicast transmission methodology.

510. A computer program product as defined in clause 501 in which the control module is configured to enable the computer to, in receipt of a command to disengage from a synchrony group, disable the interface module from receiving frames and the frame processing module from processing previously received frames that have not yet been processed.

511. A computer program product as defined in clause 501 further comprising a user interface module interface module configured to receive control information from a user interface module, the control module being configured to enable the computer to enable selected operations to be performed in response to the control information.

512. A computer program product as defined in clause 511 in which, in response to control information to enable another device to become a member of the device's synchrony group, the control module enables the interface module to transmit a command to the other device to enable the other device to become a member of the synchrony group.

513. A computer program product as defined in clause 511 in which, in response to control information to enable another device that is a member of the device's synchrony group to disengage from the synchrony group, the control module enables the interface module to transmit a command to the other device to enable the other device to disengage from the synchrony group.

514. A computer program product as defined in clause 511 in which, in response to control information to enable the data source to begin operating, the control module performs selected operations to enable the data source to begin operating.

515. A computer program product as defined in clause 514, the device also operating as the data source, the device including a frame generator module configured to enable the computer to, under control of the control module, obtain information from which the frames are to be generated and generate the frames.

516. A computer program product as defined in clause 515 in which the interface module is further configured to enable the computer to transmit the frames to at least one other device.

517. A computer program product as defined in clause 515 in which the device is not the data source, the control module being configured to enable the computer to enable the interface module to transmit a command to enable the data source to operate.

518. A computer program product as defined in clause 517 in which each frame is associated with a track, each

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track including at least one frame, and, in response to receipt of control information enabling processing of a track currently being processed to be terminated, the control module is configured to enable the computer to enable the interface module to transmit a command to enable the data source to insert a resynchronize command in the series of frames associated with the track to enable termination of processing of the track.

519. A computer program product as defined in clause 517 in which each frame is associated with a track, each track including at least one frame, and, in response to receipt of control information enabling processing of a track at least a portion of which has been received, but for which processing has not begun, the control module is configured to enable the computer to enable the interface module to transmit a command to enable the data source to insert a resynchronize command in the series of commands to disable processing of the track.

520. A computer program product as defined in clause 517 in which the control module is configured to enable the computer to enable the user interface module interface module to transmit status information to the user interface module.

521. A computer program product as defined in clause 520 in which the status information includes the processing status of at least one frame.

522. A computer program product as defined in clause 499 further including:

A. a migration information receiving module configured to enable the computer to receive migration information from the data source device, the migration information including a source for information respecting the frames to be distributed, timing information relative to the clock maintained by the data source device and identifications of the member devices of the synchrony group, and
B. a migration control module configured to enable the computer to, after the migration information has been received.,

i. distribute the series of frames to the synchrony group, each frame being associated with a time stamp indicating a time, relative to the timing information that it receives from the device operating as the data source device, at which the devices comprising the synchrony group are to execute the respective frame, and
ii. notify the members of the synchrony group that it is to thereafter operate as the data source device.

523. A computer program product as defined in clause 522 in which the information respecting the frames that are to be distributed is a source of streaming information, the migration control module being configured to enable the computer to, after the migration information has been received, assemble the streaming information into frames and associate each frame with a said time stamp.

524. A computer program product as defined in clause 522 in which the information respecting the frames that are to be distributed is in a file identified in the migration information, the migration control module being configured to enable the computer to obtain information from the identified file, assemble the information into frames and associate each frame with a said time stamp.

525. A computer program product as defined in clause 524 in which the information respecting the frames that are to be distributed begins at an offset, identified in the migration information, into the identified file, the migration control module being configured to enable the computer to assemble the information from a position in the file associated with the identified offset.

526. A computer program product as defined in clause 524 in which the information respecting the frames that are to be distributed is in a series of files identified in the migration information, the migration control module being configured to enable the computer to obtain information from successive files in the series assemble the information into frames and associate each frame with as said time stamp.

527. A computer program product as defined in clause 499 further including a clock rate adjustment module configured to enable the computer to adjust the member device's clock rate in relation to a clock rate value maintained by the data source device's clock.

528. A computer program product as defined in clause 527 in which the clock rate adjustment module is configured to enable the computer to adjust the clock rate in relation to time stamps associated with respective ones of the

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frames received from the data source device.

529. A computer program product for use in connection with a computer to provide a data source device for distributing a series of frames for execution by at least one other device at respective execution times, the computer program product comprising a computer readable medium having encoded thereon:

A. a frame acquisition module configured to enable the computer to obtain respective ones of the frames;
B. a frame execution time determination module configured to enable the computer to determine a time at which each respective frame is to be executed, and to associate the respective frame with a time stamp indicating its execution time;
C. a frame transmission module configured to enable the computer to transmit the series of frames to said at least one other device; and
D. an execution control command generation module configured to enable the computer to, in response to a predetermined event, enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to modify the execution sequence of the frames transmitted thereto.

530. A computer program product as defined in clause 529 in which at least one frame comprises audio data.

531. A computer program product as defined in clause 529 in which the frame transmission module is configured to enable the computer to utilize a selected multi-cast transmission methodology.

532. A computer program product as defined in clause 529 in which the predetermined event comprises input indicia provided by an operator.

533. A computer program product as defined in clause 529 in which, in response to said predetermined event, the execution control command generation module is configured to enable the computer to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to control execution of at least one frame in relation to the time the predetermined event occurs.

534. A computer program product as defined in clause 533 in which, in response to said predetermined event, the execution control command generation module is configured to enable the computer to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to terminate execution of a frame that it is currently executing and/or to not execute at least one frame that is to be executed subsequent to the predetermined event.

535. A computer program product as defined in clause 533 in which the series of frames includes a series of frame sequences with each frame sequence including a sub-set of the series of frames, the execution control command generation module being configured to enable the computer to, in response to said predetermined event,

(i) enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module, a command enabling the at least one other device to terminate execution of the currently executing frame and/or to not execute at least one subsequent frame, if any, in the frame sequence including the currently executing frame; and
(ii) enable

(a) the frame execution time determination module to provide that time stamps associated with frames of frame sequences subsequent to the frame sequence currently being executed will reflect the termination and/or non-execution of frames from the frame sequence of the frame that is currently being executed, and
(b) the frame transmission module to transmit the frames of the subsequent frame sequences to the at least one other device.

536. A computer program product as defined in clause 535 in which the frame transmission module is configured to enable the computer to insert a command to enable the at least one other device to not execute all frames in the frame sequence subsequent to the terminated and/or non-executed frame.

537. A computer program product as defined in clause 529 in which, in response to said predetermined event, the

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execution control command generation module is configured to enable the computer to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to control execution of a frame in relation to the frame's position in the series of frames.

538. A computer program product as defined in clause 537 in which, in response to said predetermined event, the execution control command generation module is configured to enable the computer to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to cancel execution of a frame in relation to the frame's position in the series of frames.

539. A computer program product as defined in clause 537 in which, in response to said predetermined event, the execution control command generation module is configured to enable the computer to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to cancel execution of a previously-transmitted frame in relation to the frame's position in the series of frames.

540. A computer program product as defined in clause 539 in which, in response to said predetermined event, the execution control command generation module is configured to enable the computer to enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module a command to enable the at least one other device to cancel execution of a previously-transmitted frame, in relation to the frame's position in the series of frames, for which execution has not begun.

541. A computer program product as defined in clause 537 in which the series of frames includes a series of frame sequences with each frame sequence including a sub-set of the series of frames, the execution control command generation module being configured to enable the computer to, in response to said predetermined event,

(i) enable the frame transmission module to insert into the series of frames transmitted by the frame transmission module, a command enabling the at least one other device to cancel execution of a frame sequence for which execution has not begun; and
(ii) enable

(a) the frame execution time determination module to provide that time stamps associated with frames of frame sequences subsequent to the frame sequence whose execution was cancelled will reflect the cancellation, and
(b) the frame transmission module to transmit the frames of the subsequent frame sequences to the at least one other device.

542. A computer program product for use in connection with a computer to provide a data source device for distributing a series of frames for execution by at least one other device at respective execution times, the computer program product comprising a computer readable medium having encoded thereon:

A. a frame acquisition module configured to enable the computer to obtain respective ones of the frames;
B. a frame execution time determination module configured to enable the computer to determine a time at which each respective frame is to be executed, and to associate the respective frame with a time stamp indicating its execution time, the frame execution time determination module being configured to enable the computer to provide, associated with at least one frame, a time stamp indicating a frame execution time later than the time currently indicated by a clock maintained by the data source device; and
C. a frame transmission module configured to enable the computer to transmit the series of frames to said at least one other device.

543. A computer program product as defined in clause 542 in which the data is audio data.

544. A computer program product as defined in clause 542 in which the frame execution time determination module is configured to enable the computer to select the delay interval between the time indicated by the time stamp and the current time so to be sufficient to provide that the at least one frame distributed by the data source device can be executed by the member devices at the time indicated by the time stamp.

545. A computer program product as defined in clause 544 in which the frame execution time determination module is configured to enable the computer to select the delay interval between the time indicated by the time stamp and

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the current time so to be sufficient to provide that the at least one frame distributed by the data source device can be distributed to the member devices for execution at the time indicated by the time stamp.

546. A computer program product as defined in clause 542 in which frame acquisition module is configured to enable the computer to obtain information associated with the frames from at least two types of information sources, the frame execution time determination module being configured to enable the computer to select, for each frame the delay interval between the time indicated by the time stamp and the current time based on the information source type that is associated with the respective frame.

547. A computer program product for use in connection with a computer to provide a data source device for distributing a series of frames for execution by at least one other device, the computer program product comprising a computer readable medium having encoded thereon:

A. a frame acquisition module configured to enable the computer to obtain respective ones of the frames;
B. a frame execution time determination module configured to enable the computer to determine a time at which each respective frame is to be executed, and to associate the respective frame with a time stamp indicating its execution time;
C. a frame transmission module configured to enable the computer to transmit the series of frames to said at least one other device; and
D. a data source device migration control module configured to enable the computer to, in response to a predetermined event, provide migration information to another device, the migration information including a source for information respecting the frames to be distributed, timing information relative to the clock maintained by the data source device and identifications of the member devices of the synchrony group.

548. A computer program product as defined in clause 547 in which the data is audio data.

Claims

1. A playback device (21) comprising:

a network interface (41) configured to receive an audio stream from a source device (14(n)(s); 16(m)) over a network (12);
an audio reproduction device interface (36) configured to output the audio stream from one or more audio reproduction devices (15(n)(r));
a user interface module interface (44) configured to transmit, via the network interface (41), to a user interface module (13), status information pertaining to a status of a synchrony group (20), wherein the playback device (21) is a member of the synchrony group (20) along with at least one additional zone playback device (11(n)).

2. A playback device (21) according to claim 1, wherein the status information comprises an identification of members of the synchrony group (20).

3. A playback device (21) according to claim 2, wherein the status information further comprises an identification of said playback device (21) as being a master member of the synchrony group (20).

4. A playback device (21) according to claim 2 or claim 3, wherein the status information further comprises an identification of said at least one additional zone playback device (11(n)) as being a slave member of the synchrony group (20).

5. A playback device (21) according to any of claims 1 to 4, wherein the status information further comprises an identification of the audio that is currently being played by members of the synchrony group (20).

6. A playback device (21) according to any of claims 1 to 5, wherein the status information further comprises an identification of audio that is scheduled to be played by the members of the synchrony group (20).

7. A playback device (21) according to any of claims 1 to 6, wherein the user interface module interface (44) is further configured to transmit status information, via the network interface (41), to one or more additional user interface modules.

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8. A playback device (21) according to any of claims 1 to 7, wherein the playback device (21) further comprises an audio information channel device (23), the audio information channel device (23) being configured to transmit the audio stream, via the network interface (41), to said at least one additional zone playback device (11(n)) in the synchrony group (20).

9. A method of controlling audio playback, comprising:

receiving, by a network interface (41), an audio stream from a source device (14(n)(s); 16(m)) over a network (12);
outputting, via an audio reproduction device interface (36), the audio stream from one or more audio reproduction devices (15(n)(r));
transmitting, by a user interface module interface (44) and via the network interface (41) to a user interface module (13), status information pertaining to a status of a synchrony group (20), wherein the playback device (21) is a member of the synchrony group (20) along with at least one additional zone playback device (11(n)).

10. A method according to claim 9, wherein the status information comprises an identification of members of the synchrony group (20).

11. A method according to claim 10, wherein the status information further comprises an identification of said playback device (21) as being a master member of the synchrony group (20).

12. A method according to claim 10 or claim 11, wherein the status information further comprises an identification of said at least one additional zone playback device (11(n)) as being a slave member of the synchrony group (20).

13. A method according to any of claims 9 to 12, wherein the status information further comprises an identification of the audio that is currently being played by members of the synchrony group (20).

14. A method according to any of claims 9 to 13, wherein the status information further comprises an identification of audio that is scheduled to be played by the members of the synchrony group (20).

15. A method according to any of claims 9 to 14, wherein the method further comprises transmitting status information, by the user interface module interface (44) and via the network interface (41), to one or more additional user interface modules.

16. A method according to any of claims 9 to 15, wherein the method further comprises transmitting, by an audio information channel device (23) of the playback device (21), and via the network interface, the audio stream to said at least one additional zone playback device (11(n)) in the synchrony group (20).

17. A computer program comprising a set of instructions which, when executed by a processor, or a set of processors, of a playback device (21), causes the playback device (21) to perform the method according to any of claims 9 to 16.

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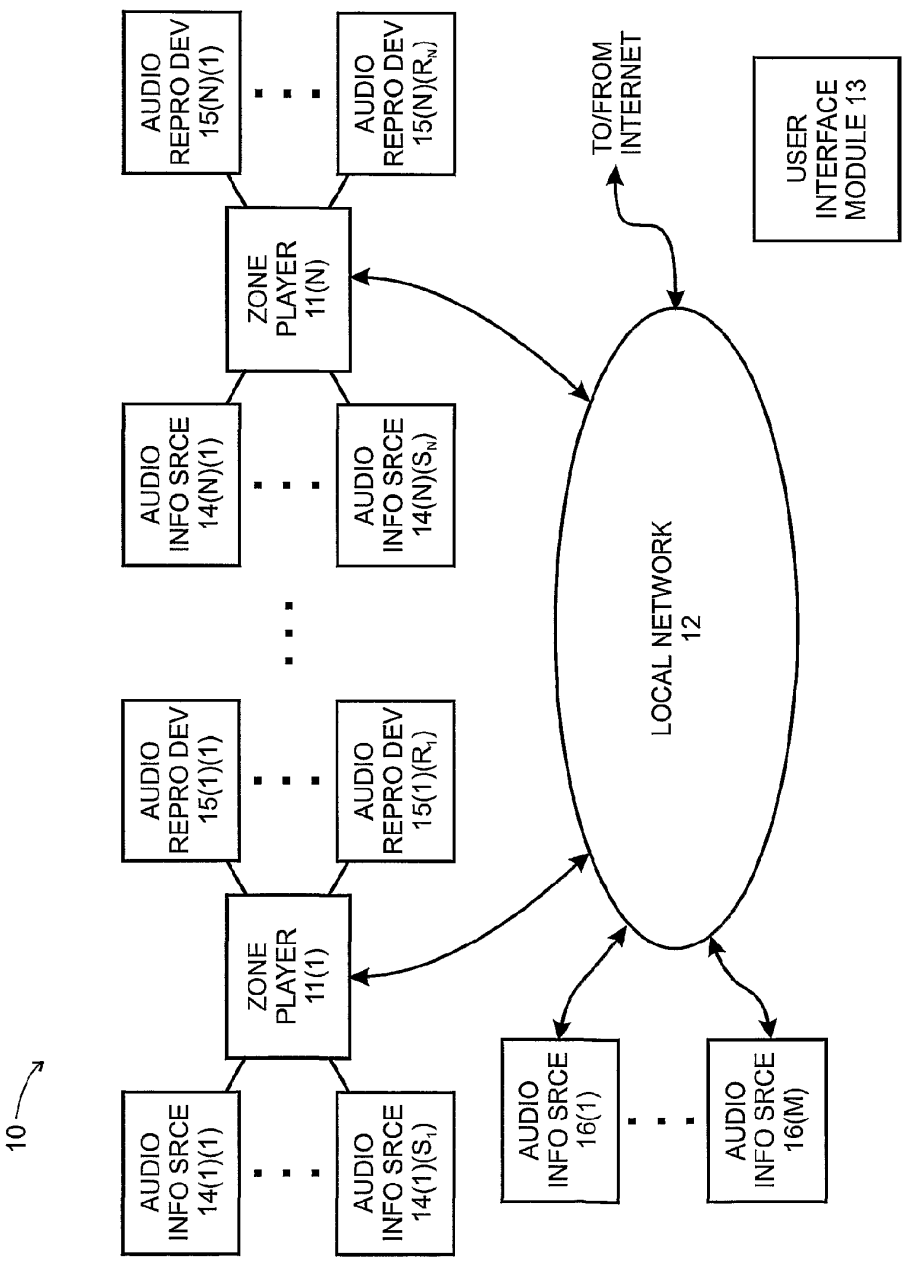
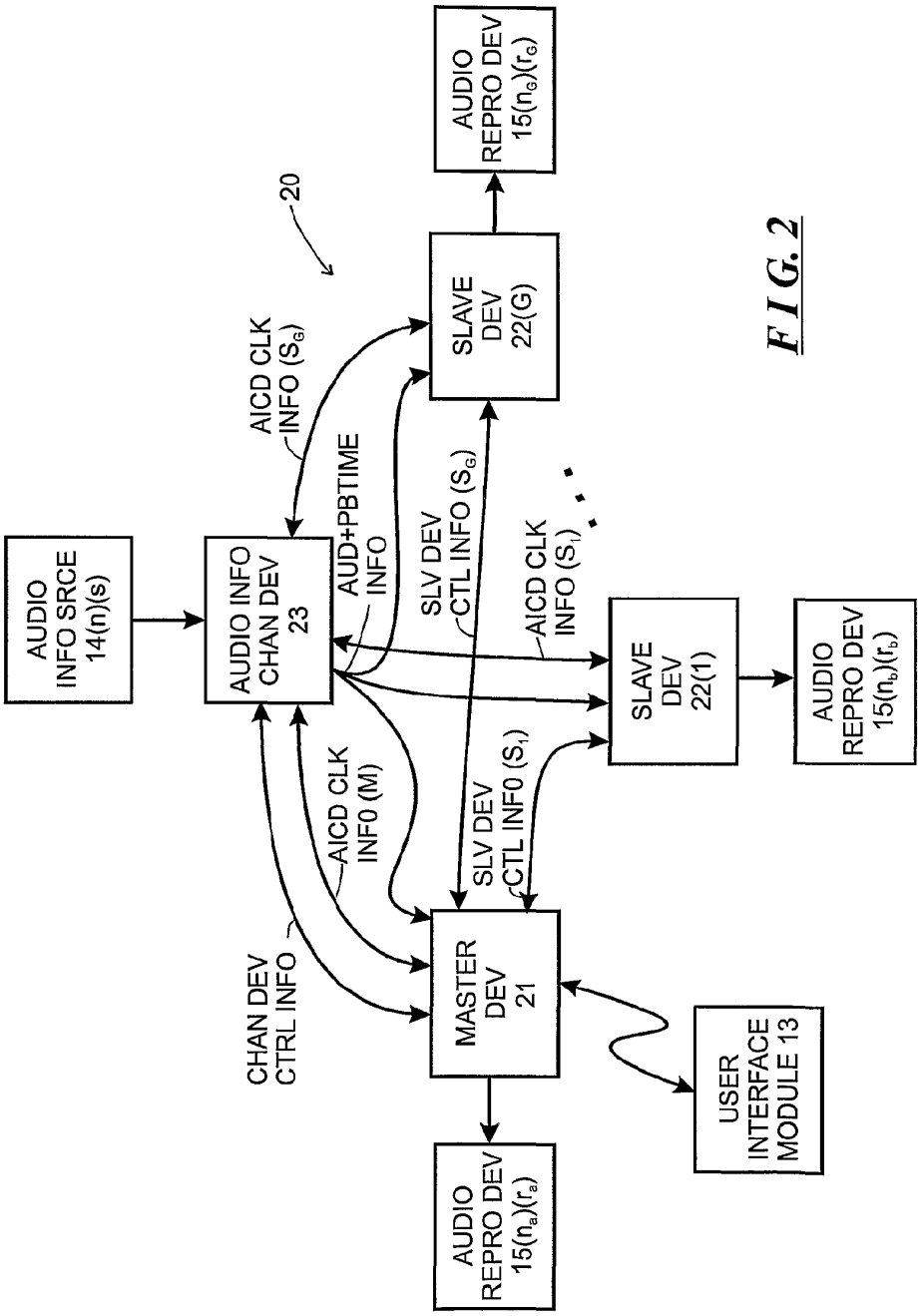

10
AUDIO INFO SRCE 14(1)(1)
AUDIO INFO SRCE 14(1)(S_1)
AUDIO REPRO DEV 15(1)(1)
AUDIO REPRO DEV 15(1)(R_1)
ZONE PLAYER 11(1)
AUDIO INFO SRCE 14(N)(1)
AUDIO INFO SRCE 14(N)(S_N)
AUDIO REPRO DEV 15(N)(1)
AUDIO REPRO DEV 15(N)(R_N)
ZONE PLAYER 11(N)
LOCAL NETWORK 12
TO/FROM INTERNET
USER INTERFACE MODULE 13
AUDIO INFO SRCE 16(1)
AUDIO INFO SRCE 16(M)

FIG. 1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20
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AUD+PBTIME INFO
SLV DEV CTL INFO (S_G)
AICD CLK INFO (S_1)
SLAVE DEV 22(G)
AUDIO REPRO DEV 15(n_G)(r_G)
SLAVE DEV 22(1)
AUDIO REPRO DEV 15(n_b)(r_b)
AICD CLK INF0 (M)
SLV DEV CTL INF0 (S_1)
CHAN DEV CTRL INFO
MASTER DEV 21
USER INTERFACE MODULE 13
AUDIO REPRO DEV 15(n_a)(r_a)

FIG. 2

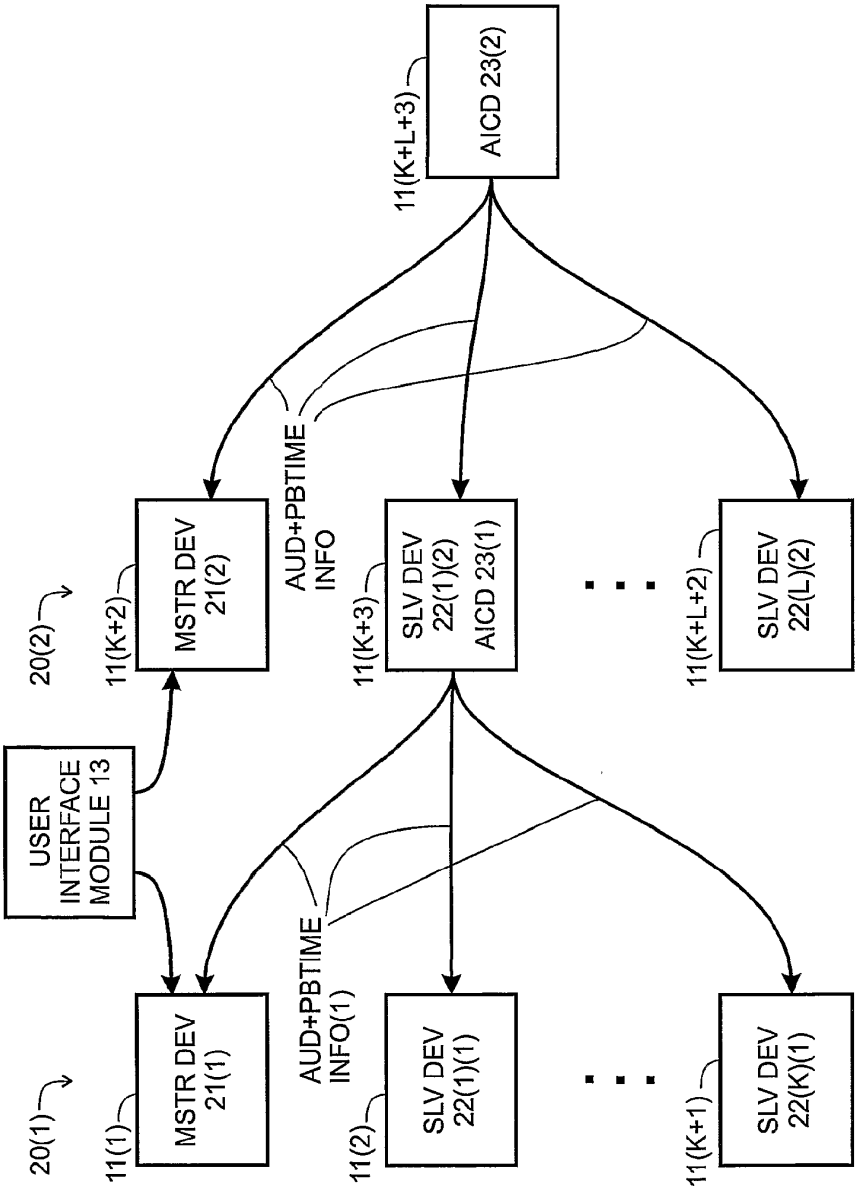

FIG. 2A

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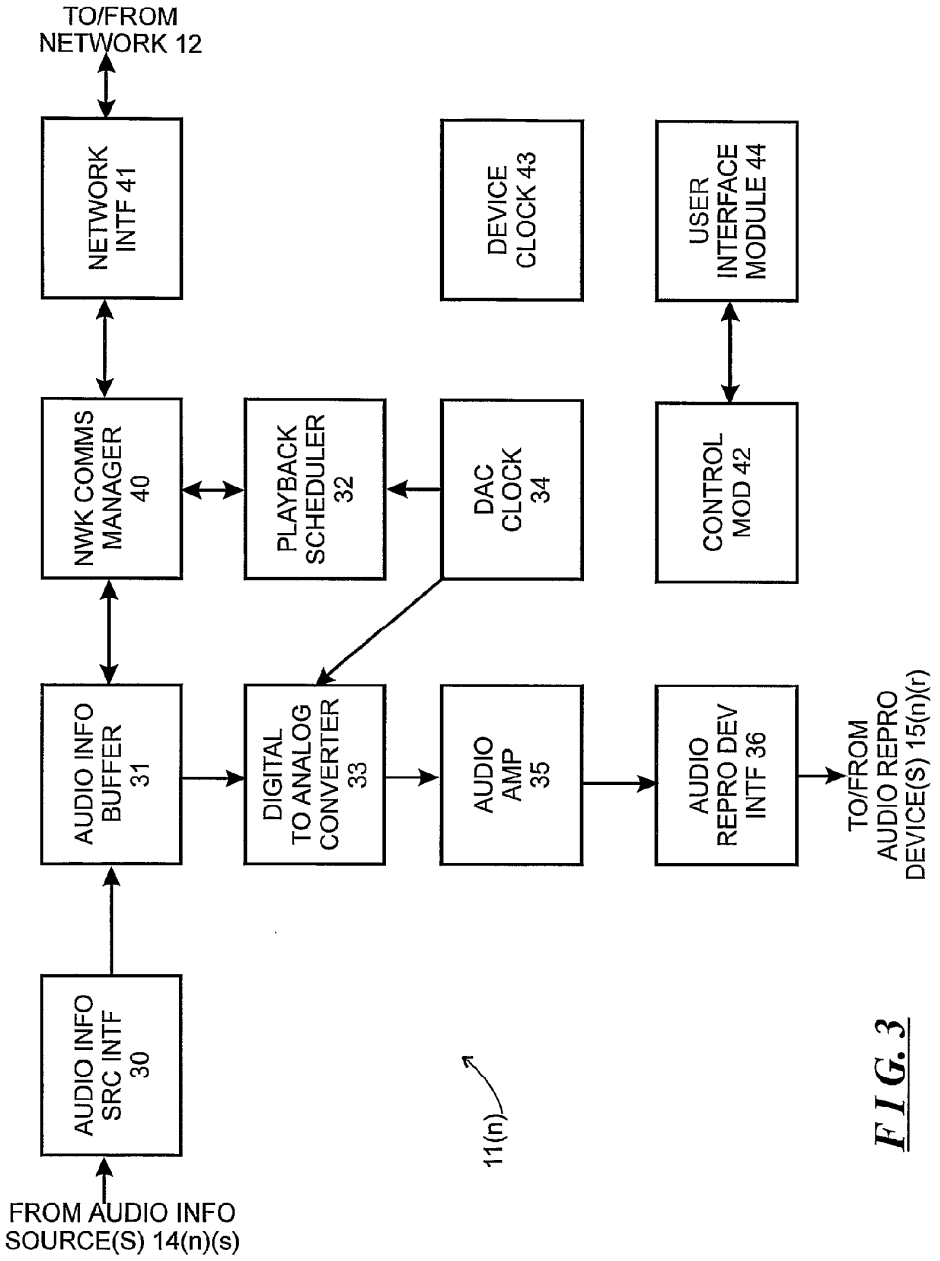
TO/FROM NETWORK 12
NETWORK INTF 41
DEVICE CLOCK 43
USER INTERFACE MODULE 44
NWK COMMS MANAGER 40
PLAYBACK SCHEDULER 32
DAC CLOCK 34
CONTROL MOD 42
AUDIO INFO BUFFER 31
DIGITAL TO ANALOG CONVERTER 33
AUDIO AMP 35
AUDIO REPRO DEV INTF 36
TO/FROM AUDIO REPRO DEVICE(S) 15(n)(r)
AUDIO INFO SRC INTF 30
11(n)
FROM AUDIO INFO SOURCE(S) 14(n)(s)

FIG. 3

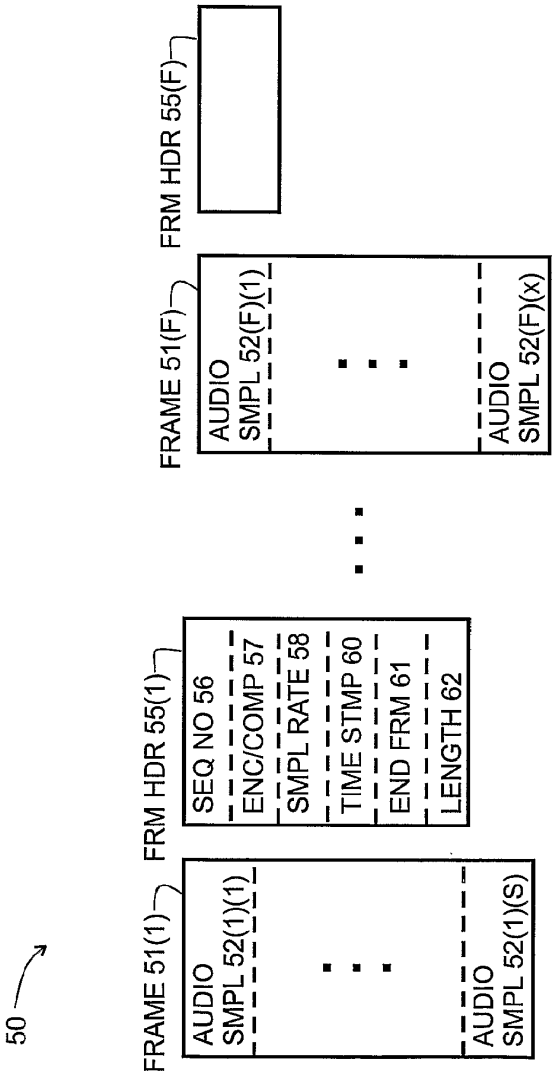

FIG. 4

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Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 13 18 4747

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2003/023741 A1 (TOMASSETTI STEPHEN ROBERT [US] ET AL) 30 January 2003 (2003-01-30) * paragraph [0031] - paragraph [0043] * * paragraph [0064] - paragraph [0068] *	1-17	INV. G06F15/16 G06F9/48
X	US 2002/188762 A1 (TOMASSETTI STEPHEN ROBERT [US] ET AL) 12 December 2002 (2002-12-12) * paragraph [0033] - paragraph [0045] *	1-17	
A	GB 2 284 327 A (INTEL CORP [US]) 31 May 1995 (1995-05-31) * the whole document *	1-17	
A	GEROLD BLAKOWSKI ET AL: "A Media Synchronization Survey: Reference Model, Specification, and Case Studies", IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS, IEEE SERVICE CENTER, PISCATAWAY, US, vol. 14, no. 1, 1 January 1996 (1996-01-01), XP011054418, ISSN: 0733-8716 * the whole document *	1-17	TECHNICAL FIELDS SEARCHED (IPC) G06F
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A	US 2002/168938 A1 (CHANG CHIN-CHI [TW]) 14 November 2002 (2002-11-14) * the whole document *	1-17	
A	US 2002/194309 A1 (CARTER HARRY NICK [US] ET AL) 19 December 2002 (2002-12-19) * the whole document *	1-17	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 February 2014	Meyer-Vitali, André

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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D : document cited in the application
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& : member of the same patent family, corresponding document

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Page 640 of 1434

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EUROPEAN SEARCH REPORT

Application Number
EP 13 18 4747

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A	EP 1 122 931 A2 (SHARP KK [JP]) 8 August 2001 (2001-08-08) * the whole document * -----	1-17	
			TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 February 2014	Meyer-Vitali, André

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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Page 641 of 1434

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 18 4747

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

20-02-2014

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		JP 2002517035 A	11-06-2002
		WO 9961985 A1	02-12-1999
EP 1122931 A2	08-08-2001	DE 60118269 T2	19-10-2006
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		JP 4475827 B2	09-06-2010
		JP 2001251360 A	14-09-2001
		US 6778493 B1	17-08-2004

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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(43) Date of A Publication 31.05.1995

(21) Application No 9416276.5

(22) Date of Filing 08.08.1994

(30) Priority Data
(31) 08159857 (32) 29.11.1993 (33) US

(51) INT CL[6]
H04L 7/10

(52) UK CL (Edition N)
H4P PPF

(56) Documents Cited
EP 0234861 A2 EP 0059821 A1

(58) Field of Search
UK CL (Edition M) H4P PPF PPS PSB
INT CL[5] H04L 7/00 7/10 12/56
ONLINE DATABASES : WPI,INSPEC.

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(72) Inventor(s)
Gunner Danneels

(74) Agent and/or Address for Service
Potts, Kerr & Co
15 Hamilton Square, BIRKENHEAD, Merseyside, L41 6BR, United Kingdom

(54) Synchronizing multiple independent data streams in a networked computer system

(57) Multiple independent data streams 318 transferred across a communication medium from a server computer system 310, 312 to a client computer system 320, 322 are synchronised by 1) capturing information into a data packet, the capturing step being performed by the server system; 2) storing time information into the data packet, the time information indicating when the capturing step is complete; 3) transferring the data packet to the client system across the communication medium; 4) initializing a virtual server system clock if the data packet is a first data packet in the data stream; 5) retrieving the time information from the data packet; 6) comparing the time information with the virtual server system clock; and 7) processing the information in the data packet if the time information indicates a time equal to a time indicated by the virtual server system clock. The present invention further includes the steps of: 1) scheduling processing of the information in the data packet if the time information indicates a time later than a time indicated by the virtual server system clock; and 2) discarding the data packet if the time information indicates a time earlier than a time indicated by the virtual server system clock.

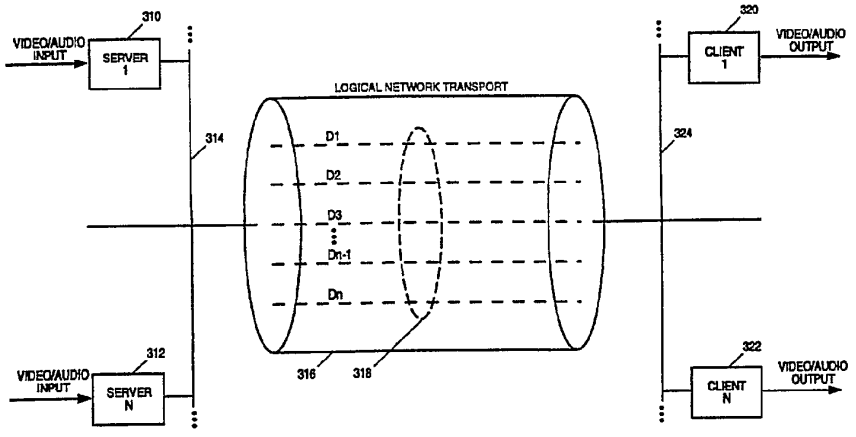

FIG.3

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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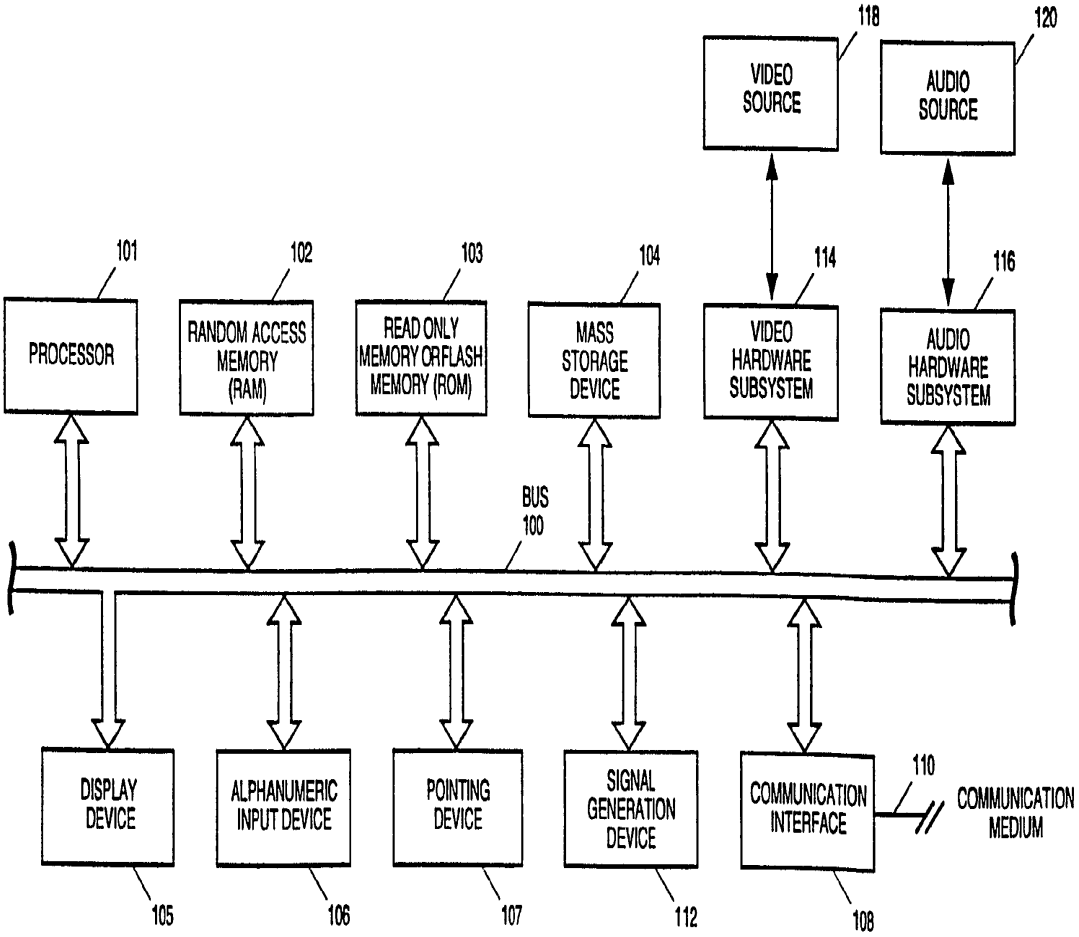

118
120
VIDEO SOURCE
AUDIO SOURCE
101
102
103
104
114
116
PROCESSOR
RANDOM ACCESS MEMORY (RAM)
READ ONLY MEMORY OR FLASH MEMORY (ROM)
MASS STORAGE DEVICE
VIDEO HARDWARE SUBSYSTEM
AUDIO HARDWARE SUBSYSTEM
BUS 100
DISPLAY DEVICE
ALPHANUMERIC INPUT DEVICE
POINTING DEVICE
SIGNAL GENERATION DEVICE
COMMUNICATION INTERFACE
110
COMMUNICATION MEDIUM
105
106
107
112
108

FIG.1

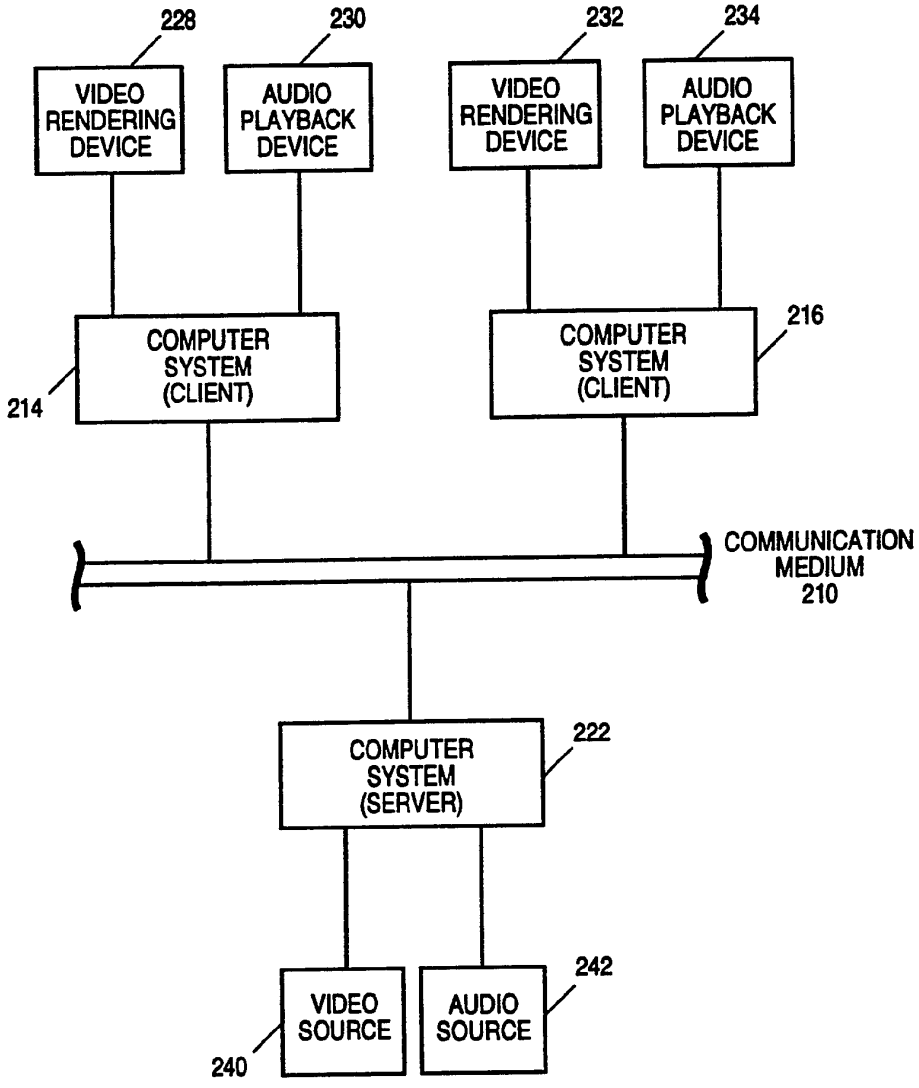

228
230
232
234
VIDEO RENDERING DEVICE
AUDIO PLAYBACK DEVICE
VIDEO RENDERING DEVICE
AUDIO PLAYBACK DEVICE
COMPUTER SYSTEM (CLIENT)
214
COMPUTER SYSTEM (CLIENT)
216
COMMUNICATION MEDIUM 210
COMPUTER SYSTEM (SERVER)
222
VIDEO SOURCE
240
AUDIO SOURCE
242

FIG.2

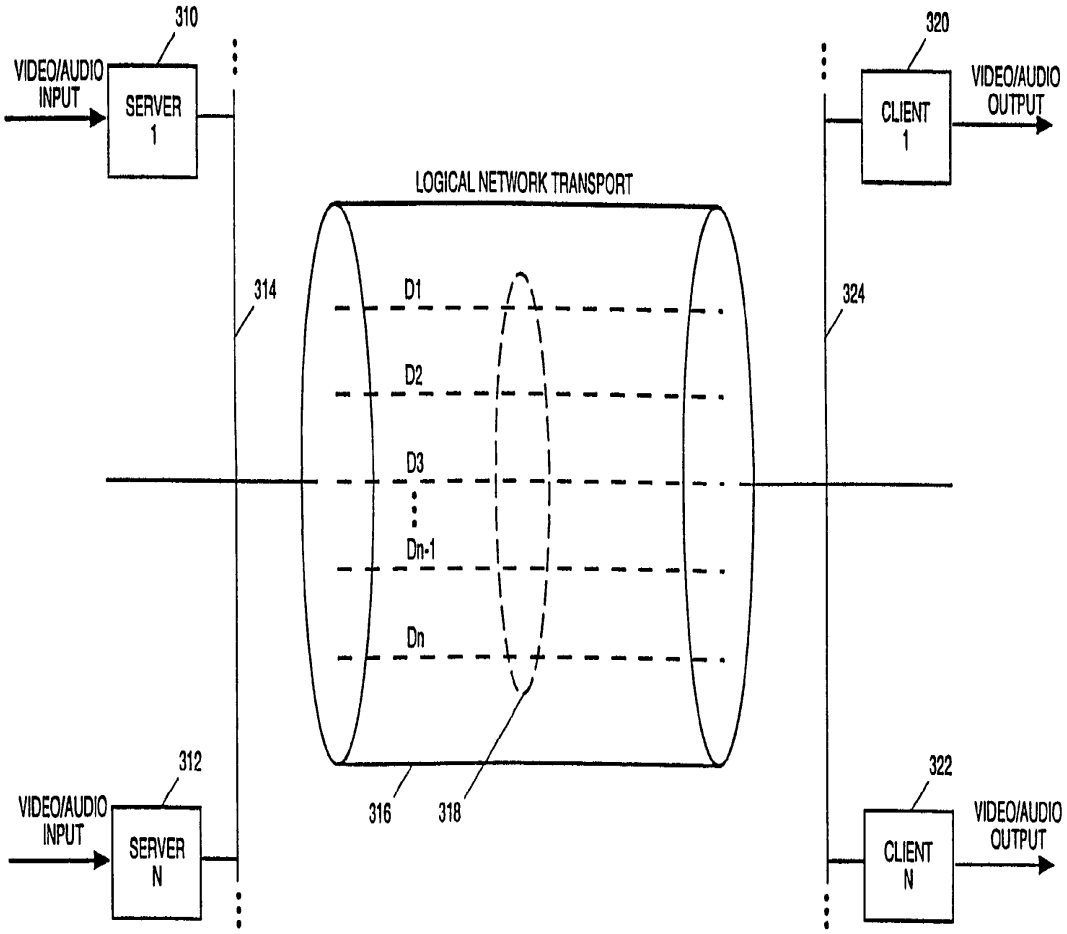
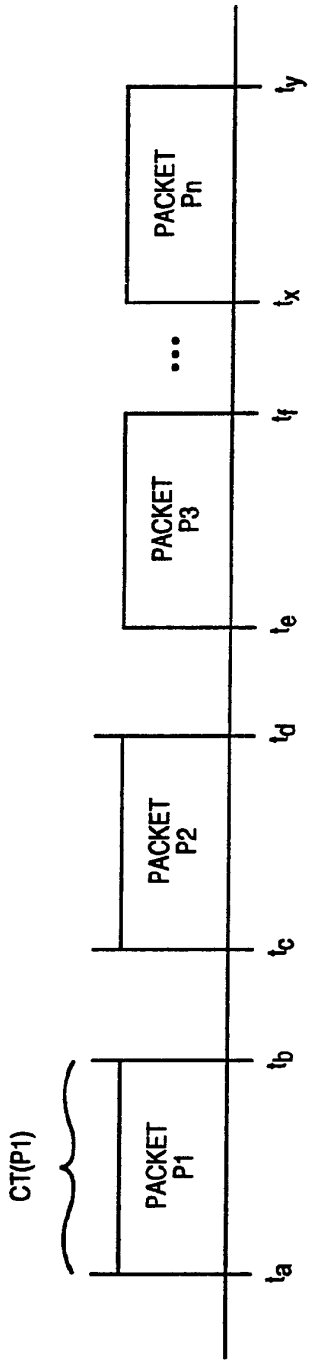

310
VIDEO/AUDIO INPUT
SERVER 1
320
CLIENT 1
VIDEO/AUDIO OUTPUT
LOGICAL NETWORK TRANSPORT
314
324
D1
D2
D3
Dn-1
Dn
316
318
312
VIDEO/AUDIO INPUT
SERVER N
322
CLIENT N
VIDEO/AUDIO OUTPUT

FIG.3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PACKET P1
PACKET P2
PACKET P3
PACKET Pn
t_a
t_b
t_c
t_d
t_e
t_f
t_x
t_y
$t_b = t_a + CT(P1)$
$t_a = t_b - CT(P1)$

FIG.4

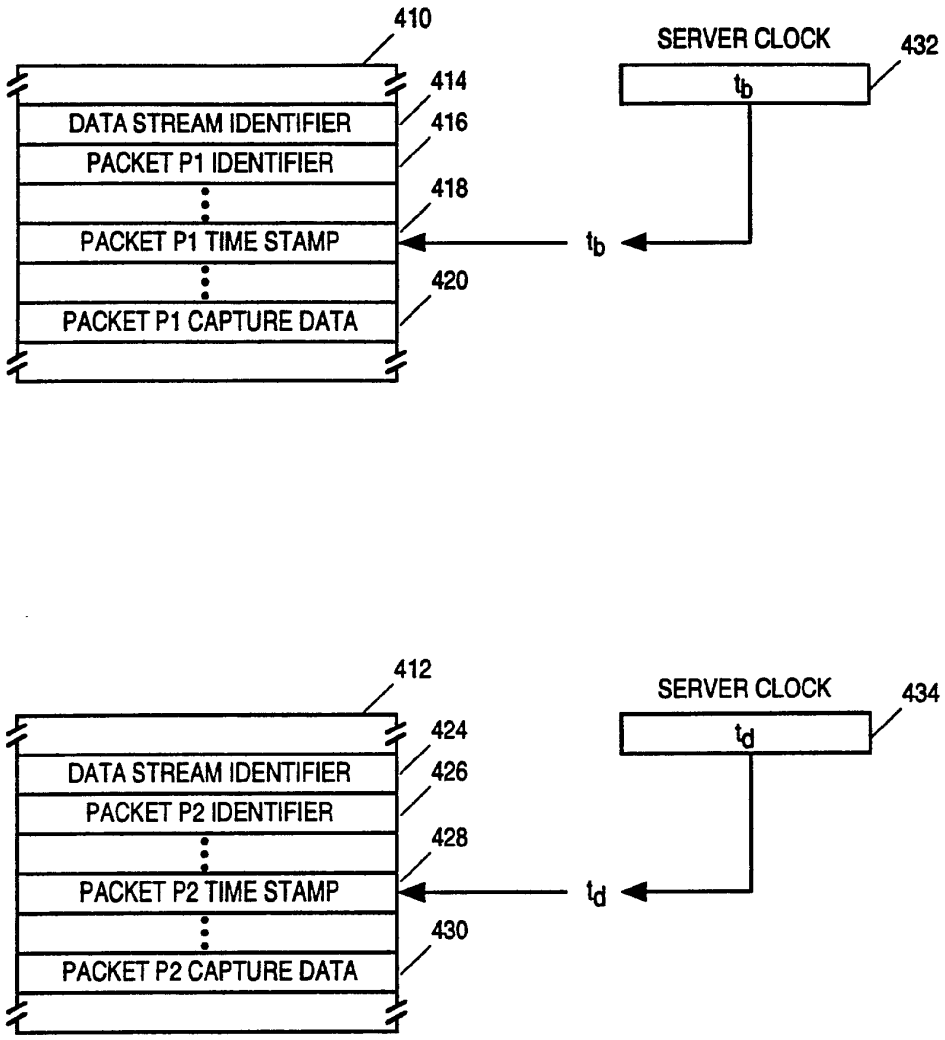
410
SERVER CLOCK
432
414
DATA STREAM IDENTIFIER
416
PACKET P1 IDENTIFIER
418
PACKET P1 TIME STAMP
t_b
420
PACKET P1 CAPTURE DATA
412
SERVER CLOCK
434
424
DATA STREAM IDENTIFIER
426
PACKET P2 IDENTIFIER
428
PACKET P2 TIME STAMP
t_d
430
PACKET P2 CAPTURE DATA

FIG.5

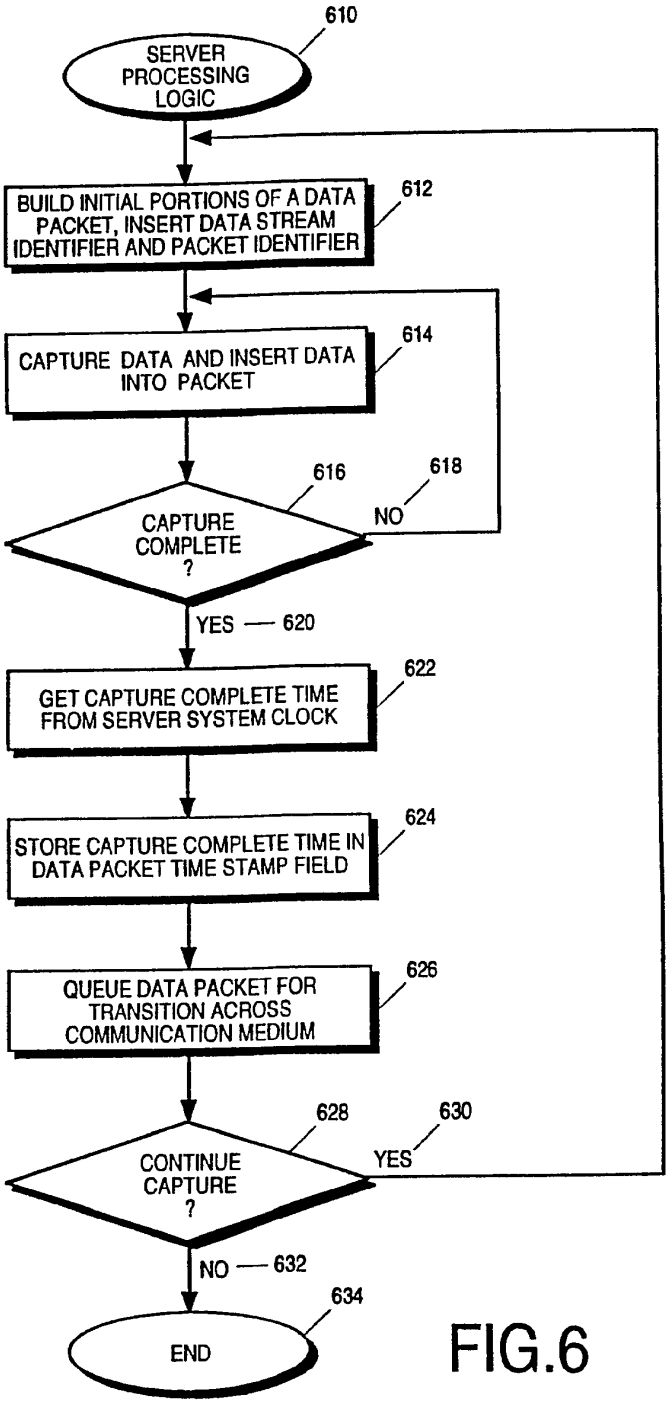
610
SERVER PROCESSING LOGIC
BUILD INITIAL PORTIONS OF A DATA PACKET, INSERT DATA STREAM IDENTIFIER AND PACKET IDENTIFIER
612
CAPTURE DATA AND INSERT DATA INTO PACKET
614
CAPTURE COMPLETE ?
616
NO
618
YES — 620
GET CAPTURE COMPLETE TIME FROM SERVER SYSTEM CLOCK
622
STORE CAPTURE COMPLETE TIME IN DATA PACKET TIME STAMP FIELD
624
QUEUE DATA PACKET FOR TRANSITION ACROSS COMMUNICATION MEDIUM
626
CONTINUE CAPTURE ?
628
YES
630
NO — 632
END
634

FIG.6

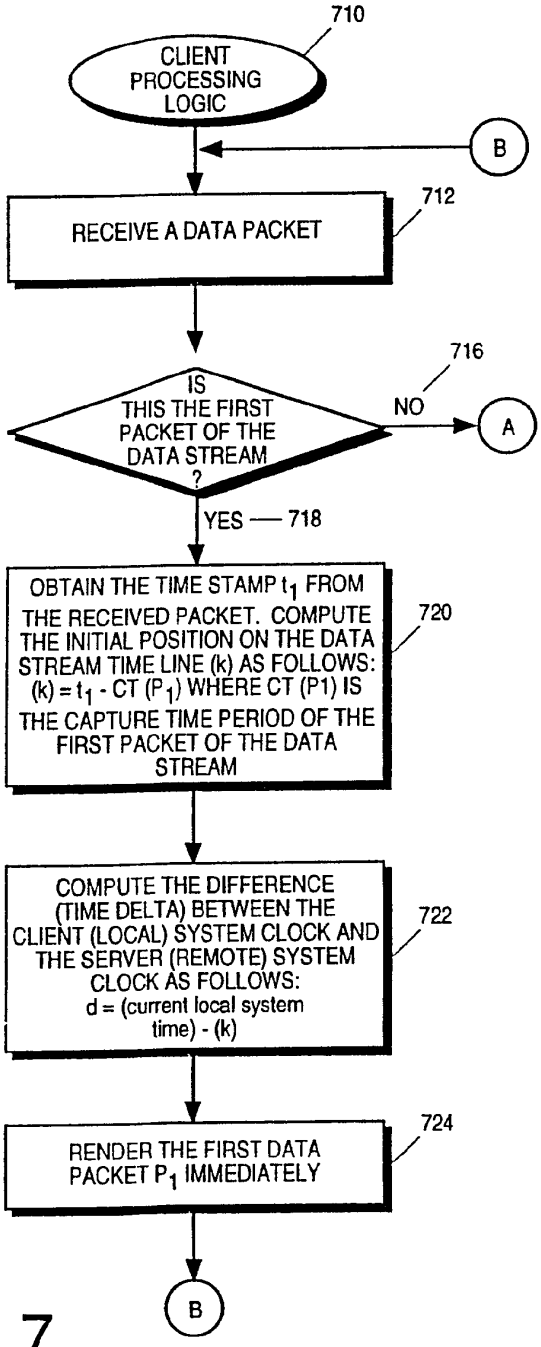
710
CLIENT PROCESSING LOGIC
B
712
RECEIVE A DATA PACKET
716
IS THIS THE FIRST PACKET OF THE DATA STREAM ?
NO
A
YES — 718
OBTAIN THE TIME STAMP t_1 FROM THE RECEIVED PACKET. COMPUTE THE INITIAL POSITION ON THE DATA STREAM TIME LINE (k) AS FOLLOWS: $(k) = t_1 - CT(P_1)$ WHERE CT (P1) IS THE CAPTURE TIME PERIOD OF THE FIRST PACKET OF THE DATA STREAM
720
COMPUTE THE DIFFERENCE (TIME DELTA) BETWEEN THE CLIENT (LOCAL) SYSTEM CLOCK AND THE SERVER (REMOTE) SYSTEM CLOCK AS FOLLOWS: d = (current local system time) - (k)
722
RENDER THE FIRST DATA PACKET P_1 IMMEDIATELY
724
B

FIG.7

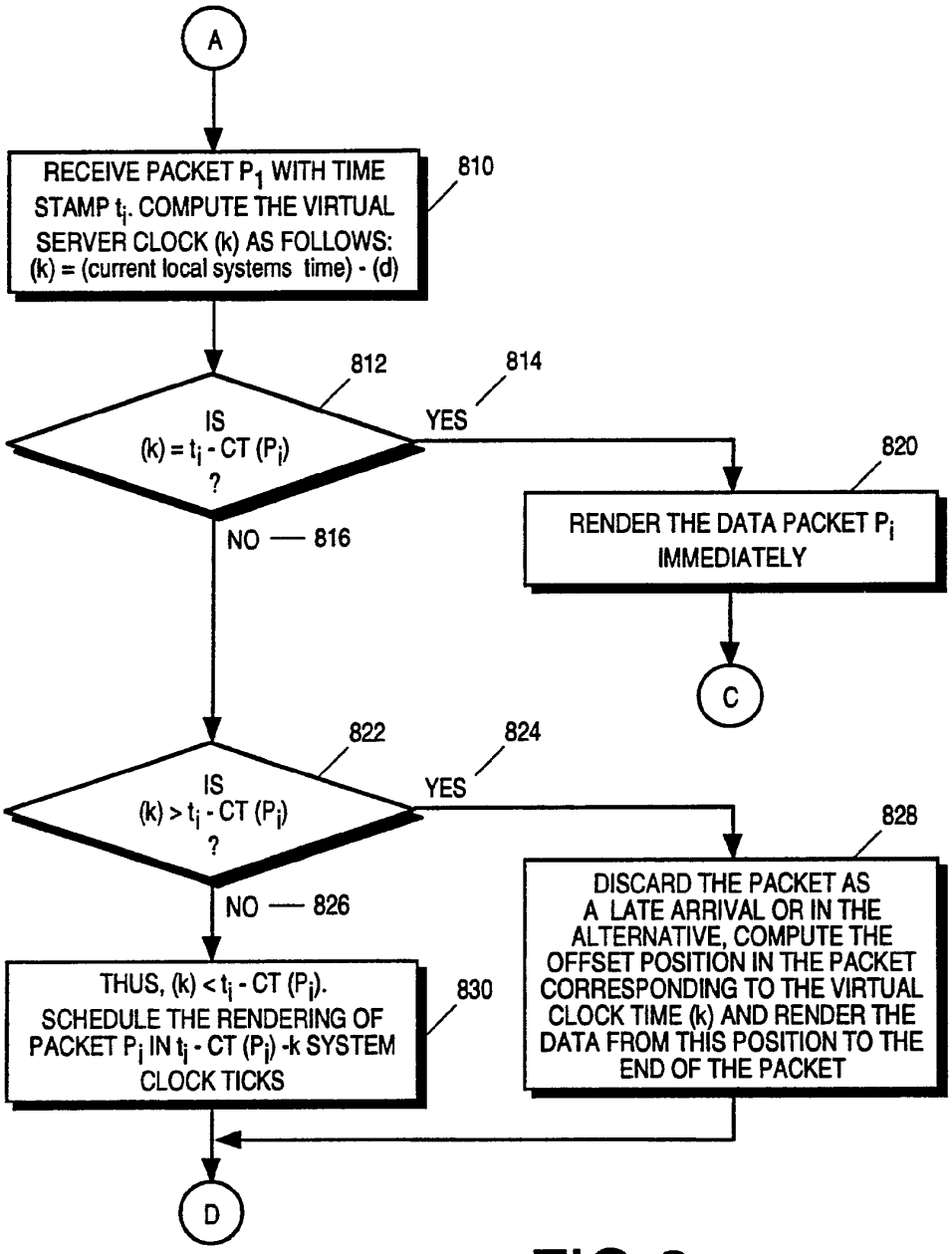
A
RECEIVE PACKET P_1 WITH TIME STAMP t_i. COMPUTE THE VIRTUAL SERVER CLOCK (k) AS FOLLOWS: (k) = (current local systems time) - (d)
810
812
814
IS (k) = t_i - CT (P_i) ?
YES
820
RENDER THE DATA PACKET P_i IMMEDIATELY
NO — 816
C
822
824
IS (k) > t_i - CT (P_i) ?
YES
828
DISCARD THE PACKET AS A LATE ARRIVAL OR IN THE ALTERNATIVE, COMPUTE THE OFFSET POSITION IN THE PACKET CORRESPONDING TO THE VIRTUAL CLOCK TIME (k) AND RENDER THE DATA FROM THIS POSITION TO THE END OF THE PACKET
NO — 826
THUS, (k) < t_i - CT (P_i). SCHEDULE THE RENDERING OF PACKET P_i IN t_i - CT (P_i) -k SYSTEM CLOCK TICKS
830
D

FIG.8

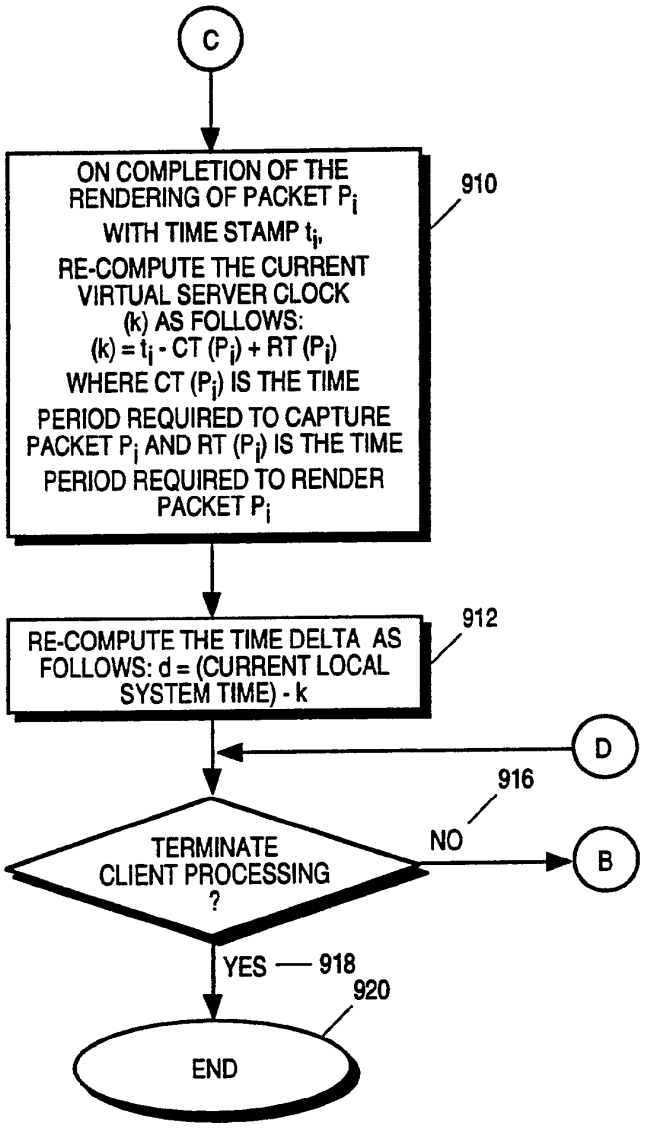
C
ON COMPLETION OF THE RENDERING OF PACKET P_i WITH TIME STAMP t_i, RE-COMPUTE THE CURRENT VIRTUAL SERVER CLOCK (k) AS FOLLOWS: $(k) = t_i - CT(P_i) + RT(P_i)$ WHERE $CT(P_i)$ IS THE TIME PERIOD REQUIRED TO CAPTURE PACKET P_i AND $RT(P_i)$ IS THE TIME PERIOD REQUIRED TO RENDER PACKET P_i
910
RE-COMPUTE THE TIME DELTA AS FOLLOWS: d = (CURRENT LOCAL SYSTEM TIME) - k
912
D
916
TERMINATE CLIENT PROCESSING ?
NO
B
YES
918
920
END

FIG.9

A METHOD AND APPARATUS FOR SYNCHRONIZING MULTIPLE INDEPENDENT DATA STREAMS IN A NETWORKED COMPUTER SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the field of a networked computer system. Specifically, the present invention relates to the transfer and synchronization of multiple data streams across a computer network or various types of communication media.

2. Description of Related Art

In a networked computer system, it is often necessary to send multiple streams of data to a remote network site. Typically, the streams of data must be processed in the correct order and synchronized with respect to each data stream. For example, audio and video streams in a teleconferencing application must be synchronized to provide the correct relationship between the audio and video data. Conventional systems implement data streams as a plurality of data packets that can be independently transferred across a network. Currently, packetized data streams may be synchronized by interleaving the data packets that make up the streams in such a way that the packets are sent to the network in synchronized order. This interleaving method has several drawbacks. First, not all networks can guarantee an in-order delivery of data packets. The synchronization between data streams may be lost by a network that randomly delays the transfer of a data packet. Secondly, even if in-order delivery of packets is guaranteed, the interleaving method does not allow synchronization of data streams where the data

stream cannot be sent in a single interleaved stream. For example, where the data streams are sent on different network channels, two different network addresses, or on different networks, the data streams cannot be sent in a single interleaved stream. In other situations, multiple originators or producers of data streams (i.e. servers) may exist on a network. In this case, data streams from a single server must be synchronized with respect to each other; but, synchronization from one server to another may not be required. In other situations it may be necessary to mix a set of data streams originated by multiple servers into one unified data stream for delivery to a client network node. For example, instead of two servers each sending an audio and video stream to a client node for processing, it may be more efficient to mix the audio signals into a unified stream which then must be synchronized with both video streams. Conventional systems are incapable of providing these multiple levels of data stream synchronization.

Thus, a better method for synchronizing multiple independent data streams in a networked computer system is needed.

SUMMARY OF THE INVENTION

The present invention is an apparatus and method for synchronizing multiple independent data streams in a networked computer system. In a computer network having a plurality of computer systems coupled by a communication medium, one of the plurality of computer systems being a server system, a different one of the plurality of computer systems being a client system, a method for synchronizing a data stream transferred from the server system to the client system, the method comprising the steps of: 1) capturing information into a data packet, the capturing step being performed by the server system; 2) storing time information into the data packet, the time information indicating when the capturing step is complete; 3) transferring the data packet to the client system across the communication medium; 4) initializing a virtual server system clock if the data packet is a first data packet is the data stream; 5) retrieving the time information from the data packet; 6) comparing the time information with the virtual server system clock; and 7) processing the information in the data packet if the time information indicates a time equal to a time indicated by the virtual server system clock. The present invention further includes the steps of: 1) scheduling processing of the information in the data packet if the time information indicates a time later than a time indicated by the virtual server system clock; and 2) discarding the data packet if the time

information indicates a time earlier than a time indicated by the virtual server system clock.

It is therefore an advantage of the present invention to provide a means and method for time stamping packets of a data stream. It is a further advantage of the present invention to provide a means and method for synchronizing data streams arriving from one server and providing them to a client in the same time sequence as they were captured. It is a further advantage of the present invention to provide a data stream synchronization means and method wherein data streams may take independent paths across a network. It is a further advantage of the present invention to provide a means and method for mixing a plurality of data streams for playback in one unified stream.

These and other advantages of the present invention are fully described in the following detailed description of the preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram illustrating the computer system hardware used in the preferred embodiment.

Figure 2 illustrates a typical network environment in which the present invention operates.

Figure 3 illustrates a multiple server, multiple client network environment.

Figure 4 illustrates a time line with associated data packets of a data stream.

Figure 5 illustrates the data structure of a data packet.

Figures 6 through 9 are flow charts illustrating the processing logic of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is an apparatus and method for synchronizing multiple independent data streams in a networked computer system. In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the invention. However, it will be apparent to one of ordinary skill in the art that these specific details need not be used to practice the present invention. In other circumstances, well known structures, materials, circuits, and interfaces have not been shown or described in detail in order to not unnecessarily obscure the present invention.

Referring now to Figure 1, a block diagram of the computer system hardware used in the preferred embodiment is illustrated. The computer system used in the preferred embodiment comprises a Bus 100 for communicating information between computer system components. These components coupled to Bus 100 include Processor 101. Processor 101 may be implemented as any of a variety of commonly available microprocessors such as the 386 brand, i486 brand, or Pentium brand microprocessors manufactured by Intel Corporation, Santa Clara, California. The Intel, 386, i486, and Pentium marks are trademarks of Intel Corporation. It will be apparent of ordinary skill in the art that other equivalent processors may be used with the present invention. Other system components include Random Access Memory (RAM)

102, Read Only Memory (ROM) 103, and mass storage device or disk drive 104. The computer system of the preferred embodiment also includes a display device 105 coupled to the Bus 100 for displaying information to a computer user, an alphanumeric input device 106 coupled to the Bus 100 for communicating information and command selections to the Processor 101, a pointing device or cursor control device 107 coupled to the Bus 100 for communicating information and command selections to Processor 101, and a signal generation device 112 coupled to the Bus 100 for communicating command selections to the Processor 101. Display device 105 may be a liquid crystal device, a cathode ray tube, or other suitable display device. Alphanumeric input device 106 is typically an alphanumeric or function key keyboard. Pointing device or cursor control device 107 is typically a mouse, trackball, or stylus device allowing the computer user to dynamically signal the two dimensional movement of a visible symbol (i.e., cursor) on the display screen of display device 105. Many implementations of the cursor control device 107 are well known in the art including trackball systems, mouse systems, joy sticks, stylus, or special keys on the alphanumeric input device 106 capable of signaling movement in a given direction. Signal generation device 112 is typically implemented as a button or switch located on or near the cursor control device 107.

The computer system used in the preferred embodiment includes a communication interface 108 coupled to Bus 100. Communication

interface 108 is also coupled to a communication medium 110. Communication interface 108 provides a means for the computer system to communicate with a network of other computer systems. A variety of networks or communication media are well known in the art. These communication media 110 include well known Local Area Networks (LAN) such as Ethernet, Wide Area Networks (WAN), telephone modem links, or other well known and conventional computer networking technology.

The computer system of the preferred embodiment also includes video hardware subsystem 114 and audio hardware subsystem 116 both coupled to Bus 100. A video source 118, such as a video camera or video tape player, is coupled to video hardware subsystem 114. An audio source 120, such as a microphone or audio tape player, is coupled to audio hardware subsystem 116. Video hardware subsystem 114 provides a means by which the computer system of the preferred embodiment may receive video signals and convert the video signals for transfer to other system components as a stream of digital video information via Bus 100. Similarly, audio hardware subsystem 116 provides a means by which the present invention may receive audio signals and convert the audio signals to a stream of digital audio information for transfer to other system components via Bus 100. In a similar manner, the video data streams provided by video hardware subsystem 114 and the audio data streams provided by audio hardware

subsystem 116 may be transferred under control of Processor 101 to other networked computer systems via communication interface 108 and communication medium 110. The present invention provides a means and method for synchronizing these data streams in a networked computer system. Except as described herein, the configuration and interconnection of computer system components as illustrated in Figure 1 are well known to those of ordinary skill in the art.

Referring now to Figure 2, a typical environment in which the present invention operates is illustrated. The present invention operates in an environment comprising a set of computer systems linked in a network topology by a communication medium 210. It will be apparent to those of ordinary skill in the art that any arbitrary number of computer systems may be so linked. In the example network environment illustrated in Figure 2, each computer system 214, 216 and 222 is shown coupled to communication medium 210. Each of these computer systems comprise components such as those illustrated in Figure 1. Computer systems 214 and 216 may be coupled to video rendering devices, such as a display, and audio playback devices. Computer system 222 may be coupled to a video source and an audio source. For example, computer system 214 is coupled to video rendering device 228 and audio playback device 230. Similarly, computer system 222 is coupled to video source 240 and audio source 242. It is not necessary for each computer system coupled to

communication medium 210 to have video rendering devices, video sources, audio playback devices, and/or audio sources connected to them. In a variety of configurations, computer systems coupled to communication medium 210 may independently be coupled to a video source or rendering device and an audio source or playback device, a video source only, an audio source only, or neither a video source or audio source. A single video source or audio source may also be shared between two computer systems. In any of these configurations, the video source provides a stream of video data which a computer system may provide to other computer systems via communication medium 210. Similarly, an audio source provides a steam of audio data which may be provided to other computer systems via communication medium 210. It will be apparent to one of ordinary skill in the art that data types other than video or audio may equivalently be supported.

A computer system on which video or audio data steams originate is called a server for the data streams. In the example of Figure 2, computer system 222 is a server. When acting as a server, computer system 222 receives video signals via video source 240 and audio signals via audio source 242 and converts these signals to video and audio data streams, which are provided to other computer systems via communication medium 210. These data streams are transferred on communication medium 210 by server 222 and transported to remote computer systems such as computer system 214 and 216. Any remote

computer system receiving data streams from a server and rendering or playing the data to a local user is known as a client system for the data streams. Thus, in general, a server system is an originator of data streams and a client system is a receiver or consumer of data streams. The client system is responsible for synchronizing the data streams arriving from a server and for rendering the data streams to a local user in the same time sequence as the data streams were captured by the server system. It is not essential to the present invention that the data streams from the server arrive on the same network media. It is only important that the data streams are provided in some way to a client computer system via a communication medium. The client system may then synchronize the data streams and render them to a local user using the technique taught herein.

Although the example illustrated in Figure 2 shows a single server system 222, the present invention is applicable to network environments wherein multiple servers and multiple clients exist on the network at one time. A multiple server, multiple client network configuration is illustrated in Figure 3.

Referring to Figure 3, servers 310 and 312 are coupled to clients 320 and 322 via communication medium 314, 316 and 324. A portion of network medium 316 is blown up in Figure 3 to illustrate the multiple independent data streams 318 concurrently being transferred across network medium 316 from servers 310 and 312 to clients 320 and 322.

Each data stream of data streams 318 consist of a sequence of data packets. Each data packet comprises a portion of information captured by a server system. This information may represent a captured video image, or portion thereof, a captured audio representation or any other collection of information that may be represented as binary information. In a typical implementation, the video hardware subsystem of a server system captures a video image and creates a sequence of data packets that are transferred across network 316 as one of data streams 318. Similarly, other data streams of data steams 318 are generated by other server systems. In the synchronization process of the present invention, the client system seeks to establish the same time line or synchronization for rendering the data packets as was present during the capturing of the data packets performed by the corresponding server system. In this manner, the client system is able to render information in a manner corresponding to the way the information was captured by a server system. This synchronization can occur regardless of the manner by which the information is transferred between the server and client systems. Moreover, the present invention can be used to synchronize data streams with respect to each other. In this manner, a video stream may be synchronized with an audio stream and rendered by a client system appropriately. Further details of the synchronization process of the present invention follow.

Referring now to Figure 4, data packets P_1 to P_n are shown on a time line. Data packets P_1 through P_n represent the data packets of a data stream such as data stream D_1 illustrated in Figure 3. Each packet comprises information collected or captured during a time frame defined by a beginning capture time and an ending capture time. For example, referring to Figure 4, packet P_1 comprises information captured between time t_a and time t_b. A function CT defines the capture time for a particular packet of a data stream. As illustrated in Figure 4, the capture time for packet P_1, CT (P_1) is defined as the time period between t_a and t_b. In one embodiment of the present invention, the capture time for each data packet of a data stream is identical and preset to some fixed value. In an alternative embodiment of the present invention, the capture time for each data packet of a data stream may be different. Thus, function CT is used to determine the capture time for a particular data packet. As indicated by the equations in Figure 4, the ending capture time, t_b, may be determined by knowing the beginning capture time, t_a, and the capture time CT (P_1). Similarly, the beginning capture time, t_a, may be determined if the ending capture time, t_b, and the capture time CT (P_1) is known. Similar computations may be performed for each data packet P_1 through P_n of a data stream.

In support of the synchronization process of the present invention, a time stamp is applied to each data packet of a data stream. When a server computer system captures data into data packets, the server

stamps its system clock time into each packet of the data stream. In the preferred embodiment, this time stamp represents the system clock time at the data packet ending capture time. Thus, for the example illustrated in Figure 4, the time stamp applied to packet P_1 is t_b. The computer system clock is assumed to be a monotonically increasing count of the system clock ticks. Thus, CT (P_1) equals the number of system clock ticks between t_a and t_b. Each data packet generated by a server is stamped with the ending capture time of the packet. Thus, packet P_2 is stamped with time t_d, packet P_3 is stamped with time t_f, and packet P_n is time stamped with time t_y. In this manner, each data packet of a data stream is referenced to a unique position on a data stream time line, such as the one illustrated in Figure 4. Each data packet is thereby associated with a fixed moment in time on the server system clock.

Referring now to Figure 5, the data structure of two data packets 410 and 412 are illustrated. In the example of Figure 4, data packet 410 corresponds to packet P_1 and data packet 412 corresponds to packet P_2.

Each data packet in a data stream comprises a data steam identifier 414, a packet identifier 416, a packet time stamp 418, and packet capture data 420 as illustrated in Figure 5. Data stream identifier 414 uniquely identifies the data stream of which the data packet is a member. The data stream identifier 414 may include an encoded value representing the source of capture data 420 or the identity of the server that generated the data packet 410. It will be apparent to one of ordinary

skill in the art that other means for uniquely identifying a particular data stream may be employed and encoded into data stream identifier 414. Packet identifier 416 is used to uniquely identify a particular data packet within a data stream identified by data stream identifier 414. In the preferred embodiment, packet identifier 416 is a consecutively numbered sequence integer that defines a particular data packet's relative position in a data stream relative to other data packets in the data stream. Packet time stamp 418 is a binary value corresponding to the time at which the capture of capture data 420 was completed by a server system. For the example illustrated in Figure 4, capture for packet P1 was completed at time t_b. Referring again to Figure 5, the time t_b is present on the server system clock 432 at the time capture is complete for packet P1. During the process of building packet P1, a server system captures data into region 420 of packet 410. When capture for this packet is complete, the time from server clock 432 is retrieved and stored in time stamp field 418. For the example of data packet P1, the time in server clock 432 will be t_b. Having completed the generation of packet 410, the server system queues packet 410 for transmission across a communication medium and begins to generate the next data packet 412 in the data stream. In this case, the data stream identifier 424 will be the same as data stream identifier 414 in the previous data packet 410. Packet identifier 426 will uniquely identify data packet 412. A new set of capture data will be stored in capture data

region 430. When capture for data packet 412 is complete, the server clock 434 is read and the capture complete time (t_d) is stored in time stamp field 428. In this manner, a server system generates a data stream of data packets with a time stamp in each data packet that defines a capture data time line for the data stream.

Referring now to Figure 6, a flowchart illustrates the processing logic of the server system. The server processing starts by building the initial portions of a data packet (processing block 612). The data stream identifier, the packet stream identifier, and any other initial fields of the data packet are filled in processing block 612. The server system captures data and inserts the data into the data packet in processing block 614. For example, digitized video information may be stored into the capture data area 420 of the data packet in processing block 614. The capture and storage of data into the data packet continues until either a predetermined time period has elapsed or the capture data area 420 of the data packet is full. When this occurs, capture is complete and processing path 620 is taken. If capture is not complete, processing path 618 is taken and the data capture process continues at processing block 614.

Once capture is complete, the capture complete time is read from the server system clock in processing block 622. The capture complete time is stored in the data packet in time stamp field 418 in processing block 624. The data packet is queued for transmission across the

communication medium in processing block 626. As long as the capture process is not terminated, processing path 630 is taken to processing block 612 where a new data packet is generated. Processing for the server system terminates through processing path 632 at end bubble 634.

In the synchronization process of the present invention, the client system seeks to establish the same data packet time line for rendering the data packet that was established by the server system during the capture process. Because the transfer of data packets across the communication medium may occur at any arbitrary time or in any arbitrary sequence, the client system must rebuild the data stream into the same form and synchronization as the data stream generated by the server system.

Referring now to Figures 7 through 9, the processing logic for the client system is illustrated. Referring now to Figure 7, the client system receives a data packet in processing block 712. If this data packet is the first packet received by the client system for this data stream, processing path 718 is taken to processing block 720. Otherwise, processing path 716 is taken to the bubble labeled A and illustrated in Figure 8.

In processing block 720, the time stamp t1 is retrieved from the received first data packet. The virtual server clock or the initial position on the data stream time line (k) is computed in processing block 720. The value (k) is a variable residing in and maintained by the client system that represents the virtual clock of the server system. The

variable (k) represents the value of the server system's clock at the current position in the rendered data stream. The value of (k) is initially set to the time stamp of the first data packet (t_1) less the capture time period of the first data packet of the data stream, CT (P_1). Another value (d) is computed in processing block 722. The variable (d) contains a time delta representing the difference between the client system clock and the virtual server system clock represented by the variable (k). The value of (d) is computed as the difference between the client's current local system time and the virtual server system clock (k). The values in variables (k) and (d) are used extensively during the synchronization process of the present invention as will be described in more detail below.

Once the initial processing for the first data packet is completed, the first data packet P_1 is rendered by the client's system in processing block 724. Rendering a data packet comprises extracting the capture data contained in the data packet and converting the data to a form suitable for transfer to an appropriate output device, such as a display device, a print device, an audio device, or other device compatible with the type of information contained in the data packet. Means and methods for rendering data from a data packet are well known to those of ordinary skill in the art.

On completion of the rendering step in processing block 724, processing control loops back to the top of the processing flow

illustrated in Figure 7 at the bubble labeled B. The next data packet is received in processing block 712. In this case, this data packet will not be the first data packet in the data stream. Therefore, processing path 716 is taken to the bubble labeled A illustrated in Figure 8.

Referring now to Figure 8, the capture system processing logic continues at the bubble labeled A. The next packet received in processing block 712 (P_i) contains time stamp t_i. The value of the virtual server clock (k) is computed in processing block 810. The virtual server clock (k) is set to the client current local system time less the time delta (d). The value of (k) now represents the current position on the data stream time line. The time stamp t_i is used to determine where on this time line the received packet P_i should be placed. The beginning capture time for packet P_i is computed and used for this process. The beginning capture time of packet P_i is the time stamp value t_i less the capture time CT of packet P_i. If the virtual server clock (k) is equal to the starting capture time of packet P_i, processing path 814 is taken to processing block 820 where packet P_i is immediately rendered. Processing for this packet then continues at the bubble labeled C illustrated in Figure 9. If, however, the virtual server clock is not equal to the starting capture time of packet P_i, processing path 816 is taken to decision block 822. If the virtual server clock (k) is greater than the starting capture time of packet P_i, processing path 824 is taken to processing block 828. In this case, the current position in the data

stream time line has already passed the position corresponding to this data packet. Thus, the packet P_i is discarded as a late arrival.

In an alternative embodiment, a portion of a single packet is discarded while the remainder of the packet is rendered. The starting capture time of packet P_i can be used to generate an offset into the packet that corresponds to the virtual sever clock time (k). If the number of samples in the packet is known or if the starting capture time of a subsequent packet is known, the offset into the current packet is generated as an interpolation of these values with the virtual server clock time (k). In this manner, the offset into the packet corresponding to (k) is computed. The portion of the packet P_i from the starting capture time to the offset value is discarded. The portion of packet P_i from the offset value to the and of the packet is rendered.

Processing then continues at the bubble labeled D illustrated in Figure 9. If the virtual server clock is less than the start capture time of packet P_i, processing path 826 is taken to processing block 830 where the rendering of packet P_i is scheduled for a future time corresponding to a number of client system clock ticks in advance of the current time. This future time is computed as a number of client system clock ticks equal to time stamp t_i less the capture time CT of packet P_i less virtual server clock value (k). Means and methods for scheduling the execution of an event at a particular time in a computer is well known to those of

ordinary skill in the art. Processing for the client system continues at the bubble labeled D illustrated in Figure 9.

Referring now to Figure 9, client processing logic continues at the bubble labeled C. On completion of the rendering of packet P_i with a time stamp t_i, the current virtual server clock (k) is recomputed in processing block 910. The value of the virtual server clock (k) is set to the time stamp t_i less the capture time CT of packet P_i plus the time required to render RT packet P_j. The time required to render a packet is represented by the function RT (P_1). The time delta (d) is recomputed in processing block 912. Time delta (d) is set to the client current local system time less the value of a virtual server clock (k). If client processing is selected to continue, processing path 916 is taken to the bubble labeled B illustrated in Figure 7 where the next data packet of the data stream is received. If client processing is selected for termination, processing path 918 is taken and capture processing terminates at end bubble 920.

The process of the present invention described above maintains the virtual server clock (k) and ensures that data packets are rendered by the client system at the same time with respect to the virtual server clock as they were captured. The virtual server clock variable (k) is efficiently maintained in the present invention in that (k) is not updated on every local system clock tick. Rather, a time delta (d) is maintained as the difference between the client local system clock and the virtual server

clock (k). Therefore, as the local system clock is updated, the virtual server clock (k) is also updated. The offset between the clocks is recalculated for each correctly rendered packet to avoid clock skew introduced if the local client clock runs slightly faster or slower than the server system clock.

The process of the present invention described above details an effective method of synchronization of a data stream arriving from one server. The same basic process may be used if there are multiple servers supplying data streams to a single client system. In one case, the streams from one server must be synchronized, but no synchronization is required between streams from different servers. In this case, the client system maintains a set of virtual clock offsets d_1 to d_n, one for each server. In addition, a virtual server clock value k_i is maintained for each server system. When a data packet arrives from a particular server, that server's virtual clock, k_i, is calculated from the correct offset d_j. When a packet is finished rendering, the virtual clock offset d_j for that particular server is updated in a manner similar to the process described above.

In some environments, it is necessary to mix a set of data streams into one unified stream for playback. For example, instead of two servers each sending an audio and video stream to a client for rendering, it may be more efficient to mix the audio into a unified stream which then must be synchronized with both video streams. In this case, the

client system must maintain a set of virtual clock offsets for more than one server. The mixed audio stream must preserve the time stamps from all of the originating servers. Therefore, the time stamp of a packet in the mixed stream is a set of server identifiers and time stamp pairs. The decision to render a packet is now made as a consensus of whether the time stamps for each of the servers is ahead of or behind the virtual clock value for that server. A mixed data packet is scheduled for rendering at a time which satisfies one or more of the virtual clocks. When a mixed packet has been rendered, the virtual clock offsets for all of the servers contributing to the mixed packet are updated.

Thus, an apparatus and method for synchronizing multiple independent data streams in a networked computer system is disclosed. Although the present invention is described herein with reference to a specific preferred embodiment, many modifications and variations therein will readily occur to those of ordinary skill in the art. Accordingly, all such variations and modifications are included within the intended scope of the present invention as defined by the following claims.

CLAIMS

1. In a computer network having a plurality of computer systems coupled by a communication medium, one of said plurality of computer systems being a server system, a different one of said plurality of computer systems being a client system, a method for synchronizing a data stream transferred from said server system to said client system, said method comprising the steps of:

capturing information into a data packet, said capturing step being performed by said server system;

storing time information into said data packet, said time information indicating when said capturing step is complete;

transferring said data packet to said client system across said communication medium;

initializing a virtual server system clock if said data packet is a first data packet is said data stream;

retrieving said time information from said data packet;

comparing said time information with said virtual server system clock; and

processing said information in said data packet if said time information indicates a time equal to a time indicated by said virtual server system clock.

2. The method as claimed in claim 1 further including the step of:

scheduling processing of said information in said data packet if said time information indicates a time later than a time indicated by said virtual server system clock.

3. The method as claimed in claim 1 further including the step of:

discarding said data packet if said time information indicates a time earlier than a time indicated by said virtual server system clock.

4. The method as claimed in claim 1 further including the steps of:

calculating an index into said information in said data packet corresponding to a value in said virtual server system clock;

discarding a first portion of said data packet from a beginning position in said data packet to a position in said data packet indicated by said index; and

processing a second portion of said data packet from a position in said data packet indicated by said index to an ending position of said data packet.

5. In a computer network having a plurality of computer systems coupled by a communication medium, one of said plurality of computer systems being a server system, a different one of said plurality of computer systems being a client system, a method for synchronizing

data streams transferred from said server system to said client system, said method comprising the steps of:

capturing information into a first set of data packets, said capturing step being performed by said server system;

capturing information into a second set of data packets, said capturing step being performed by said server system;

storing time information into said first set of data packets, said time information indicating when said capturing step is complete;

storing time information into said second set of data packets, said time information indicating when said capturing step is complete;

transferring said first set of data packets to said client system across said communication medium in a first data stream;

transferring said second set of data packets to said client system across said communication medium in a second data stream;

initializing a virtual server system clock if a data packet is a first data packet is a data stream;

retrieving said time information from data packets of said first set or said second set of data packets;

comparing said time information with said virtual server system clock; and

processing said information from data packets of said first set or said second set of data packets if said time information indicates a time equal to a time indicated by said virtual server system clock.

6. The method as claimed in claim 5 further including the step of:

scheduling processing of said information from data packets of said first set or said second set of data packets if said time information indicates a time later than a time indicated by said virtual server system clock.

7. The method as claimed in claim 5 further including the step of:

discarding data packets of said first set or said second set of data packets if said time information indicates a time earlier than a time indicated by said virtual server system clock.

8. The method as claimed in claim 5 further including the steps of:

calculating an index into said information in data packets of said first set or said second set of data packets corresponding to a value in said virtual server system clock;

discarding a first portion of data packets of said first set or said second set of data packets from a beginning position in said data packets to a position in said data packets indicated by said index; and

processing a second portion of data packets of said first set or said second set of data packets from a position in said data packets indicated by said index to an ending position of said data packets.

9. The method as claimed in claim 1 wherein said information captured in said data packet comprises either video or audio information.

10. The method as claimed in claim 5 wherein said information captured in said first set of data packets comprises video information and said information captured in said second set of data packets comprises audio information.

11. In a computer network having a plurality of computer systems coupled by a communication medium, one of said plurality of computer systems being a server system, a different one of said plurality of computer systems being a client system, an apparatus for synchronizing a data stream transferred from said server system to said client system, said apparatus comprising:

means for capturing information into a data packet, said means for capturing residing in said server system;

means for storing time information into said data packet, said time information indicating when said means for capturing is finished;

means for transferring said data packet to said client system across said communication medium;

means for initializing a virtual server system clock if said data packet is a first data packet is said data stream;

means for retrieving said time information from said data packet;

means for comparing said time information with said virtual server system clock; and

means for processing said information in said data packet if said time information indicates a time equal to a time indicated by said virtual server system clock.

12. The apparatus as claimed in claim 11 further including:

means for scheduling processing of said information in said data packet if said time information indicates a time later than a time indicated by said virtual server system clock.

13. The apparatus as claimed in claim 11 further including:

means for discarding said data packet if said time information indicates a time earlier than a time indicated by said virtual server system clock.

14. The apparatus as claimed in claim 11 further including:

means for calculating an index into said information in said data packet corresponding to a value in said virtual server system clock;

means for discarding a first portion of said data packet from a beginning position in said data packet to a position in said data packet indicated by said index; and

means for processing a second portion of said data packet from a position in said data packet indicated by said index to an ending position of said data packet.

15. In a computer network having a plurality of computer systems coupled by a communication medium, one of said plurality of computer systems being a server system, a different one of said plurality of computer systems being a client system, an apparatus for synchronizing data streams transferred from said server system to said client system, said apparatus comprising:

means for capturing information into a first set of data packets, said means for capturing residing in said server system;

means for capturing information into a second set of data packets, said means for capturing residing in said server system;

means for storing time information into said first set of data packets, said time information indicating when said means for capturing is finished;

means for storing time information into said second set of data packets, said time information indicating when said means for capturing is finished;

means for transferring said first set of data packets to said client system across said communication medium in a first data stream;

means for transferring said second set of data packets to said client system across said communication medium in a second data stream;

means for initializing a virtual server system clock if a data packet is a first data packet is a data stream;

means for retrieving said time information from data packets of said first set or said second set of data packets;

means for comparing said time information with said virtual server system clock; and

means for processing said information from data packets of said first set or said second set of data packets if said time information indicates a time equal to a time indicated by said virtual server system clock.

16. The apparatus as claimed in claim 15 further including:

means for scheduling processing of said information from data packets of said first set or said second set of data packets if said time information indicates a time later than a time indicated by said virtual server system clock.

17. The apparatus as claimed in claim 15 further including:

means for discarding data packets of said first set or said second set of data packets if said time information indicates a time earlier than a time indicated by said virtual server system clock.

18. The apparatus as claimed in claim 15 further including:

means for calculating an index into said information in data packets of said first set or said second set of data packets corresponding to a value in said virtual server system clock;

means for discarding a first portion of data packets of said first set or said second set of data packets from a beginning position in said data packets to a position in said data packets indicated by said index; and

means for processing a second portion of data packets of said first set or said second set of data packets from a position in said data packets indicated by said index to an ending position of said data packets.

19. The apparatus as claimed in claim 11 wherein said information captured in said data packet comprises either video or audio information.

20. The apparatus as claimed in claim 15 wherein said information captured in said first set of data packets comprises video information and said information captured in said second set of data packets comprises audio information.

21. A computer network having a plurality of computer systems, substantially as hereinbefore described, with reference to the accompanying drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report) 34	Application number GB 9416276.5
Relevant Technical Fields (i) UK Cl (Ed.M) H4P (PPF, PSB, PPS) (ii) Int Cl (Ed.5) H04L 7/10, 7/00, 12/56	Search Examiner J P Coules Date of completion of Search 21 September 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASES : WPI, INSPEC	Documents considered relevant following a search in respect of Claims :- 1-21

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
A	EP 0234861 A2	(AMERICAN TELEPHONE AND TELEGRAPH CO) see Figure 11, page 28	1,5,11,15
A	EP 0059821 A1	(FOUR DEE AKTIEBOLOG) see time marker clock 20	1,5,11,15

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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Espacenet

Bibliographic data: JP2003037585 (A) — 2003-02-07

NETWORK SYSTEM, OUTPUT DEVICE, AND METHOD FOR SYNCHRONIZING NETWORK SYSTEM

Inventor(s): FUJINAMI YASUSHI ± (FUJINAMI YASUSHI)

Applicant(s): SONY CORP ± (SONY CORP)

Classification: **- international:** ***G06F1/14; G06F13/00; H04B1/20; H04L12/28; H04L12/413; H04L7/00; H04N7/62; H04S3/00;*** *H04J3/06; H04L12/56;* (IPC1-7): G06F1/14; G06F13/00; H04L7/00

- cooperative: **G06F1/14**; **H04B1/205**; **H04L12/2803**; **H04L12/2807**; **H04L12/2838**; **H04L47/28**; **H04N21/4305**; **H04S3/008**; H04J3/0638

Application number: JP20010224983 20010725

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Also published as: JP3591493 (B2) EP1320213 (A1) EP1320213 (A4) US2004010727 (A1) TW577231 (B) more

Abstract of JP2003037585 (A)

PROBLEM TO BE SOLVED: To provide a clock synchronized between reproducing devices con nected to the digital network. SOLUTION: A clock is transmitted to a sink device group like speakers 5 (5-1 to 5-5) connected to a network 1 and a display 6. And also this network system is equipped with a clock source 2 which transmits time information per prescribed time, a contents source 4 which provides the contents for the sink device group through the network 1, and a controller 3 which provides for the contents source 4 the delay time based on the network delay when the content data are transmitted to the sink device group and the decode delay in the sink device group when reproducing the contents.

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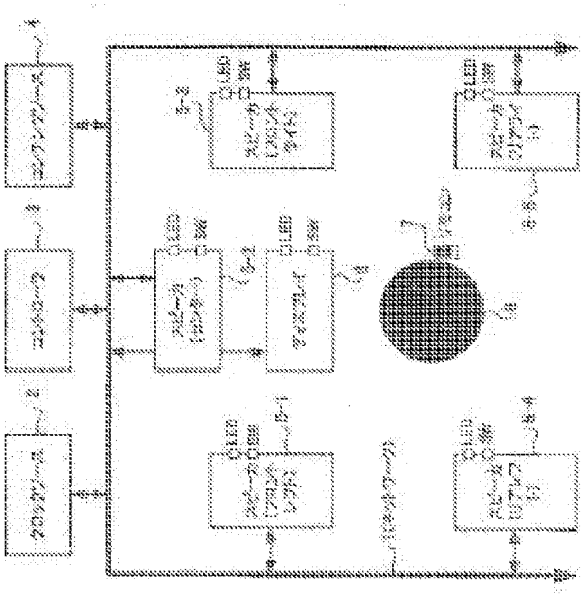

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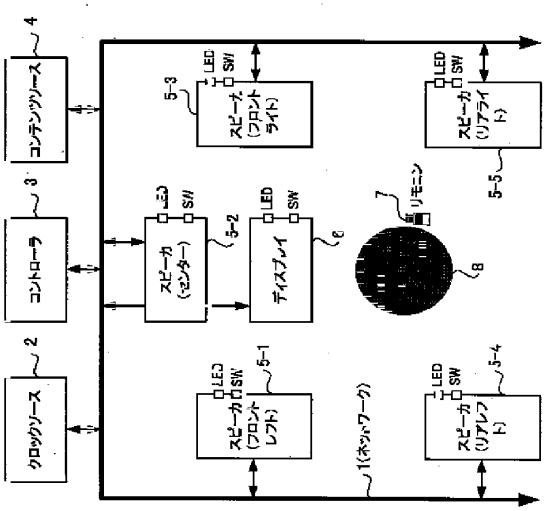
Ｆターム(参考)　5B089 GA23 JB11 KA12 KB04 KE10
5K047 AA18 DD02 GG01 GG06

(54)【発明の名称】　ネットワークシステム、出力機器、およびネットワークシステムの同期方法

(57)【要約】
【課題】　ディジタルネットワークに接続された各再生機器の間において、クロックと位相の同期をとる。
【解決手段】　ネットワーク１に接続されるスピーカ５(５－１～５－５)やディスプレイ６等のシンク機器群に対してクロックを送信すると共に所定時間ごとに時刻情報を送信するクロックソース２と、このシンク機器群に対してネットワーク１を介してコンテンツを提供するコンテンツソース４と、コンテンツを再生するにあたり、コンテンツデータがシンク機器群に送られるときのネットワークディレイとシンク機器群におけるデコードディレイとに基づく遅延時間をコンテンツソース４に対して提供するコントローラ３とを備えた。



【特許請求の範囲】
【請求項１】　複数の機器がディジタルネットワークに接続されるネットワークシステムであって、
前記複数の機器に対してクロックを配信すると共に時刻情報を配信するクロック配信手段と、
前記クロック配信手段により配信された前記クロックおよび前記時刻情報に基づき、各々の機器においてクロックを調整するクロック調整手段と、
前記ディジタルネットワーク上をストリームが通信される際に生じるネットワークディレイを考慮して前記複数の機器に対してディレイ補正を施すディレイ補正手段とを備えたことを特徴とするネットワークシステム。
【請求項２】　前記ディレイ補正手段は、前記複数の機器が前記ストリームに関する変換に際して生じる変換ディレイを考慮してディレイ補正を施すことを特徴とする請求項１記載のネットワークシステム。
【請求項３】　前記ディレイ補正手段は、前記機器が置かれた位置によって生じるディレイ補正を含むことを特徴とする請求項１記載のネットワークシステム。
【請求項４】　ディジタルネットワークに接続されるシンク機器群に対してクロックを送信するクロックソースと、
前記ディジタルネットワークに接続される前記シンク機器群に対して当該ディジタルネットワークを介してコンテンツを提供するコンテンツソースと、
前記コンテンツを再生するにあたり、コンテンツデータが前記シンク機器群に送られるときのネットワークディレイと当該シンク機器群におけるデコードディレイとに基づく遅延時間を前記コンテンツソースに対して提供するコントローラとを備えたことを特徴とするネットワークシステム。
【請求項５】　前記クロックソースは、前記シンク機器群に対して所定時間ごとに時刻情報を送信することを特徴とする請求項４記載のネットワークシステム。
【請求項６】　前記コンテンツソースは、前記コントローラから提供された前記遅延時間に基づく遅延情報メッセージを作成し、コンテンツデータに伴って前記シンク機器群に対して配信することを特徴とする請求項４記載のネットワークシステム。
【請求項７】　ディジタルネットワークに接続され、当該ディジタルネットワークを介して提供されるコンテンツデータをデコードする出力機器であって、
前記ディジタルネットワークを介して受信した基準時刻信号に基づいてクロックを再生するクロック再生手段と、
前記ディジタルネットワークを介して受信した前記コンテンツデータに対して必要なディレイを施し、デコードして出力するストリーム再生手段とを備えたことを特徴とする出力機器。
【請求項８】　内部にて用いられるクロックを発振するクロック発振手段とを更に備え、
前記クロック再生手段は、受信された前記基準時刻信号と前記クロック発振手段からの出力の値とを比較して、当該クロック発振手段の発振周波数を調整することにより、前記クロックを再生することを特徴とする請求項７記載の出力機器。
【請求項９】　前記ストリーム再生手段は、前記コンテンツデータに伴って受信される当該コンテンツデータを出力すべき時刻情報から、自らのデコードディレイ時間を考慮してデコードを開始することを特徴とする請求項７記載の出力機器。
【請求項１０】　ディジタルネットワークに接続される複数の機器にて入力または出力の同期をとるためのネットワークシステムの同期方法であって、
前記複数の機器に対してクロックと共に時刻情報を配信し、
配信される前記クロックと前記時刻情報とに基づいて、共通な時計を前記複数の機器で動作させ、
ネットワークディレイおよび前記複数の機器における変換ディレイを考慮して前記時計の時刻を用いた入力タイミングまたは出力タイミングを当該複数の機器に使用し、
使用された前記入力タイミングまたは前記出力タイミングと各々の機器における変換ディレイとに基づいて、当該各々の機器における変換を開始することを特徴とするネットワークシステムの同期方法。
【請求項１１】　前記入力タイミングまたは前記出力タイミングは、前記ネットワークディレイの最大時間に、前記複数の機器における前記変換ディレイの最大時間を加えて決定されることを特徴とする請求項１０記載のネットワークシステムの同期方法。
【請求項１２】　ディジタルネットワークに接続される複数の機器にて出力の同期をとるためのネットワークシステムの同期方法であって、
前記ディジタルネットワークを介してクロックと共に時刻情報を受信し、
受信した前記クロックおよび前記時刻情報に基づいてクロックを調整し、
コンテンツデータと共に当該コンテンツデータの再生を開始する時刻を示す情報を受信し、
受信した前記情報に基づき、前記コンテンツデータをデコードする際に生じるディレイに基づいてデコードの開始タイミングを決定し、
決定した前記開始タイミングによりデコードを開始して前記コンテンツデータを再生することを特徴とするネットワークシステムの同期方法。
【請求項１３】　前記ディジタルネットワークを介してコンテンツソースとしてのネットワークアドレスの指定を受け、
前記ネットワークアドレスに対してなされるディレイの

指示に基づいて前記開始タイミングを決定することを特徴とする請求項１２記載のネットワークシステムの同期方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、複数の機器を備えたネットワークシステム等に係り、特に、ネットワークに接続された複数の機器において同期をとるネットワークシステム等に関する。

【０００２】

【従来の技術】近年、通信ネットワークが企業、学校、家庭に浸透しつつ有り、このインフラを利用してオーディオビデオのコンテンツを配信しようという試みがなされている。　これをもう一歩進めて、家庭内のオーディオビデオの配線をネットワークで置き換えることが当然考えられる。しかしながら、新しい技術分野であるために、未だ充分な検討が行われていなかった。

【０００３】家庭内のオーディオビデオの配線を通信ネットワークで置き換えることは、例えばＤＶＤ(Digital Versatile Disk)、ディスプレイ、スピーカなどをそれぞれ通信ネットワークに接続することを意味する。例えば、ＤＶＤを再生すると、ディジタル通信ネットワークを介してディスプレイ、スピーカからそれぞれ動画と音声が出力されるということになる。

【０００４】

【発明が解決しようとする課題】しかしながら、現在の通信ネットワークでは、その上を流れるデータにおいて、配信されるタイミングが保証されないという問題点がある。即ち、複数の入出力機器間の入出力位相関係(時間的前後関係)にて、現在のディジタルネットワークでは、伝送遅延が固定ではないことから、十分に小さい位相誤差で出力されるという保証がない。また、ディジタル通信ネットワークを介した場合に、アナログ接続に比べて遅延の絶対値が大きくなる。かかる場合、上記の例では、ＤＶＤから発信されたコンテンツにおいて、ディスプレイや複数存在するスピーカに到着する時刻がまちまちになってしまう。これをそのまま再生すると、結果としてまちまちなタイミングで再生が行われることになる。

【０００５】これは、即ち、アナログケーブルで接続されていた場合に実現されていた出力信号の同期が達成されないということになる。ディジタルネットワーク化によるメリットは数多く存在するが、ディスプレイとスピーカ、あるいはスピーカ同士の出力位相、更にはマイクとカメラの入力位相を合わせることが出来なければ、家庭内におけるオーディオビデオの配線をディジタル通信ネットワークで置き換えることは困難となる。

【０００６】本発明は、以上のような技術的課題を解決するためになされたものであって、ディジタルネットワークに接続された各機器の間において、クロックを同期させると共に、入出力位相を一致させることを主たる目的とする。

【０００７】

【課題を解決するための手段】かかる目的のもと、本発明は、複数の機器がディジタルネットワークに接続されるネットワークシステムであって、複数の機器に対してクロックを配信すると共に時刻情報を配信するクロック配信手段と、配信されたクロックおよび時刻情報に基づき各々の機器においてクロックを調整するクロック調整手段と、ディジタルネットワーク上をストリームが通信される際に生じるネットワークディレイ、複数の機器がストリームに関する変換に際して生じる変換ディレイを考慮して複数の機器に対してディレイ補正を施すディレイ補正手段とを備えたことを特徴としている。

【０００８】また、本発明が適用されるネットワークシステムは、ディジタルネットワークに接続されるシンク機器群に対してクロックを送信するクロックソースと、このシンク機器群に対してディジタルネットワークを介してコンテンツを提供するコンテンツソースと、コンテンツを再生するにあたり、コンテンツデータがシンク機器群に送られるときのネットワークディレイとシンク機器群におけるデコードディレイとに基づく遅延時間をコンテンツソースに対して提供するコントローラとを備えたことを特徴としている。

【０００９】ここで、このクロックソースは、シンク機器群に対して所定時間ごとに時刻情報を送信することを特徴とすれば、位相調整の前提として、クロックを同期させることができる点で好ましい。また、このコンテンツソースは、コントローラから提供された遅延時間に基づく遅延情報メッセージを作成し、コンテンツデータに伴ってシンク機器群に対して配信することを特徴とすれば、各シンク機器群では、自らのデコードディレイを考慮してデコードを開始することで、シンク機器群の間における再生タイミングを合わせることが可能となる。

【００１０】他の観点から把握すると、本発明は、ディジタルネットワークに接続され、このディジタルネットワークを介して提供されるコンテンツデータをデコードする出力機器であって、ディジタルネットワークを介して受信した基準時刻信号に基づいてクロックを再生するクロック再生手段と、ディジタルネットワークを介して受信したコンテンツデータに対して必要なディレイを施し、デコードして出力するストリーム再生手段とを備えたことを特徴としている。

【００１１】ここで、内部にて用いられるクロックを発振するクロック発振手段とを更に備え、クロック再生手段は、受信された基準時刻信号とクロック発振手段からの出力の値とを比較して、クロック発振手段の発振周波数を調整することにより、クロックを再生することを特徴とすることができる。

【００１２】一方、本発明を方法のカテゴリから把える

と、本発明は、ディジタルネットワークに接続される複数の機器にて入力または出力の同期をとるためのネットワークシステムの同期方法であって、複数の機器に対してクロックと共に時刻情報を配信し、配信されるクロックと時刻情報とに基づいて、共通な時計を複数の機器で動作させ、ネットワークディレイおよび複数の機器におけるデコードディレイやエンコードディレイ等の変換ディレイを考慮して時計の時刻を用いた入力タイミングまたは出力タイミングを複数の機器に使用し、使用された入力タイミングまたは出力タイミングと各々の機器における変換ディレイとに基づいて、各々の機器における変換を開始することを特徴とすることができる。

【００１３】また、本発明は、ネットワークに接続されるシンク機器にて適用される発明として把握できる。即ち、本発明におけるネットワークシステムの同期方法は、ディジタルネットワークを介してクロックと共に時刻情報を受信し、受信したクロックおよび時刻情報に基づいてクロックを調整し、コンテンツデータと共にコンテンツデータの再生を開始する時刻を示す情報を受信し、受信した情報に基づき、コンテンツデータをデコードする際に生じるディレイに基づいてデコードの開始タイミングを決定し、決定した開始タイミングによりデコードを開始してコンテンツデータを再生することを特徴としている。

【００１４】

【発明の実施の形態】以下、添付図面に示す実施の形態に基づいて本発明を詳細に説明する。図１は、本実施の形態におけるネットワークシステムの全体像を示した構成図である。図１に含まれる各機器は、ネットワーク１により相互に接続されている。リスニングポジション８は、特定の機器ではないが、このネットワークシステムにおけるユーザの存在位置を模式的に示したものである。ユーザは、リスニングポジション８にて操作用のリモコン７を用いてネットワークシステムに対する指令を行うことができる。

【００１５】ネットワーク１には、システムにクロックを供給するクロックソース２、システム全体を制御するコントローラ３、コンテンツデータ(信号)を送り出すコンテンツソース４、ユーザに対して音声信号を供給する５つのスピーカ５(５－１～５－５)、ユーザに対し映像信号を供するディスプレイ６、の各入出力機器が接続されている。ここで、ディスプレイ６とスピーカ５とを、コンテンツソース４に対して(コンテンツ)シンク機器群と呼ぶことができる。また、各スピーカ５は、図１に示すような位置、即ち、フロントレフト(５－１)、センター(５－２)、フロントライト(５－３)、リアレフト(５－４)、リアライト(５－５)の各位置に設置されている。各スピーカ５およびディスプレイ６は、各々ＬＥＤとプッシュスイッチを備えており、ＬＥＤを用いたユーザへの働きかけとプッシュスイッチによるユーザからの反応を得ることができる。

【００１６】図２は、クロックソース２における第１の構成例を示した図である。この第１の構成例におけるクロックソース２は、クロック発振器１１、カウンタ１２、タイマ１３、ラッチ１４、およびネットワークインタフェース１５を備えており、このネットワークインタフェース１５を介してネットワーク１と接続されている。クロック発振器１１の出力はカウンタ１２とタイマ１３に各々入力される。カウンタ１２の出力(時刻信号)はラッチ１４に入力される。またラッチ１４の出力はネットワークインタフェース１５に入力される。更に、タイマ１３の出力(トリガ信号)は、ラッチ１４のラッチ信号端子とネットワークインタフェース１５の送信信号端子に入力されている。クロックソース２は、ネットワーク１によって相互に接続された機器に対し、このような構成を用いてクロックを送信している。

【００１７】図３は、クロックソース２における第２の構成例を示した図である。この第２の構成例におけるクロックソース２は、クロック発振器２１、カウンタ２２、タイマ２３、およびラッチ２４を備えている。またクロックソース２は、制御装置としてのＣＰＵ２５、ＲＯＭ２７、ＲＡＭ２８を備えており、ネットワークインタフェース２６を介してネットワーク１と接続されている。このＣＰＵ２５とＲＯＭ２７、ＲＡＭ２８は、システムバス２０により相互に接続されたマイクロコンピュータを構成している。また、ネットワークインタフェース２６はシステムバス２０に接続されている。クロック発振器２１の出力はカウンタ２２とタイマ２３に入力される。カウンタ２２の出力(時刻信号)はラッチ２４に入力される。ラッチ２４の出力はシステムバス２０に接続されている。またタイマ２３の出力(トリガ信号)はラッチ２４のラッチ信号端子とＣＰＵ２５の割り込み端子に入力される。クロックソース２は、ネットワーク１によって相互に接続された機器に対し、このような構成を用いてクロックを送信している。

【００１８】図４は、図１に示したコントローラ３の構成を説明するための図である。本実施の形態におけるコントローラ３は、ＣＰＵ３１、ＲＯＭ３２、およびＲＡＭ３３を備えており、これらはシステムバス３４により相互に接続されてマイクロコンピュータを構成している。また、コントローラ３は、システムバス３４に接続されるネットワークインタフェース３５を備え、このネットワークインタフェース３５を介してネットワーク１と接続されている。またコントローラ３はリモコン受光部３６を有しており、リモコン受光部３６はシステムバス３４に接続されている。このコントローラ３は、図１のシステム全体を制御する役割を担っており、具体的な制御は、システムの構成の設定や、システムの動作(コンテンツの再生)の制御等である。特に本実施の形態では、コンテンツ再生時におけるディレイの設定が機能と

して重要である。

【００１９】図５は、図１に示したコンテンツソース４の構成を説明するための図である。本実施の形態におけるコンテンツソース４は、ネットワーク１に接続された機器に、ネットワーク１を経由して、コンテンツストリームを供給している。図５に示すように、コンテンツソース４は、ＣＰＵ４１、ＲＯＭ４２、およびＲＡＭ４３を備えており、これらはシステムバス４４により相互に接続されマイクロコンピュータを構成している。また、コンテンツソース４は、ネットワークインタフェース４５を介してネットワーク１と接続されている。ネットワークインタフェース４５はシステムバス４４に接続されている。

【００２０】更に、本実施の形態におけるコンテンツソース４は、クロック発振器４６とカウンタ４７を備えている。クロック発振器４６の出力はカウンタ４７に入力されている。クロック発振器４６とカウンタ４７はそれぞれシステムバス４４に接続されている。また、コンテンツソース４は、ハードディスク装置４８、ビットストリーム解析器４９、バッファ５０を備えている。ハードディスク装置４８は、自身に格納されているコンテンツストリームをビットストリーム解析器４９に入力している。ビットストリーム解析器４９の出力はバッファ５０に入力され、その出力はシステムバス４４に供給されている。また、ハードディスク装置４８およびビットストリーム解析器４９は、それぞれシステムバス４４に接続されている。

【００２１】尚、コンテンツソース４は、デコーダを持たないためデコードディレイという値には意味は無いが、デコードディレイとして０を持っている。このデコードディレイ値は、ＲＯＭ４２に記録され、ＣＰＵ４１から読み出すことができるようになっている。また、コンテンツソース４は、自身の種別を知っており、その種別は「コンテンツソース」である。この種別はＲＯＭ４２に記録され、ＣＰＵ４１から読み出すことができるようになっている。本実施の形態における種別として、ディスプレイ６は「ディスプレイ型」、各スピーカ５は「モノラルスピーカ型」の種別を持つものとする。この他にも、例えば「ステレオスピーカ型」、「ディスプレイ＋ステレオスピーカ一体型」、「スーパーウーファー型」、「オーディオソース型」などの種別が考えられる。

【００２２】コンテンツソース４は、内部にクロックの再生機能を持ち、クロックソース２から供給される基準時刻信号からクロックを再生している。また、コントローラ３の制御を受けて、内部に蓄えているコンテンツストリームを供給している。このとき、コントローラ３から指定されるディレイ値と再生したクロックから、ストリームにタイムスタンプを付加する機能を備えている。

【００２３】図６は、図１に示したスピーカ５（５－１～５－５）の構成を説明するための図である。この図６に示す構成は、図１に示す５本のスピーカ５（５－１～５－５）の全てに共通しており、これらは同一の内部構造（および動作）を備えている。スピーカ５は、ＣＰＵ５１、ＲＯＭ５２、およびＲＡＭ５３を備えており、これらはシステムバス５４により相互に接続されマイクロコンピュータを構成している。また、スピーカ５は、システムバス５４に接続されているネットワークインタフェース５５を介して、ネットワーク１と接続されている。

【００２４】このスピーカ５は、システムバス５４に接続されるクロック発振器５６とカウンタ５７とを備えており、このクロック発振器５６の出力はカウンタ５７に入力されている。更に、スピーカ５は、バッファ５９、タイムスタンプ抽出器６０、デコーダ６１、アンプ６２、およびスピーカ６３を備えている。スピーカ５を流れるストリームデータは、システムバス５４からバッファ５９、タイムスタンプ抽出器６０を経てデコーダ６１に入力されてデコードされる。デコーダ６１の出力は、アンプ６２を経てスピーカ６３により、音声信号に変換されて出力される。タイムスタンプ抽出器６０、デコーダ６１、およびアンプ６２は、各々システムバス５４に接続されている。このデコーダ６１の内部は、後述するＭＰＥＧデコーダの構成をなしている。具体的にはデマルチプレクサ、オーディオバッファ、オーディオデコーダで構成されている。

【００２５】スピーカ５は、更に、ボタン/ＬＥＤ操作器５８を備えている。ＣＰＵ５１は、システムバス５４経由で、ボタン/ＬＥＤ操作器５８のボタンが押されたか否かの情報を読み出すことができる。また、ＣＰＵ５１は、システムバス５４経由でボタン/ＬＥＤ操作器５８におけるＬＥＤの点滅を制御することができる。

【００２６】ここで、スピーカ５は、自身のデコーダ６１におけるデコードディレイを知っている。ここでデコードディレイとは、デコーダ６１にデータが入力されてからデコードされたデータが出力されるまでの時間であり、各種のディレイである変換ディレイの中で代表的なものである。このデコードディレイ値はＲＯＭ５２に記録され、ＣＰＵ５１から読み出すことができるようになっている。また、スピーカ５は自身の種別を知っており、このスピーカ５の種別は「モノラルスピーカ」である。この種別はＲＯＭ５２に記録され、ＣＰＵ５１から読み出すことができるようになっている。

【００２７】スピーカ５にて実行される動作は大きく３つに分けられる。この３つの動作とは、（１）クロックの再生、（２）ユーザインタフェース対応、（３）ストリームの再生、である。これらの動作は、ＣＰＵ５１上で動作するタスクと、それぞれ必要な構成要素とが組み合わされて成り立っている。なお、ＣＰＵ５１上で動作するこれらの３つのタスクは、ＣＰＵ５１で動作するマルチタスクオペレーティングシステムの上で独立に動作してい

るものとする。

【００２８】上述した第１の動作である、(1)クロックの再生、では、クロックソース２から発信された基準時刻信号により、スピーカ５の内部にクロックが再生される。第２の動作である、(2)ユーザインタフェース対応、では、例えばコントローラ３の指示により内部のＬＥＤを発光させ、内部のボタンが押されたか否かの情報をコントローラ３に戻す動作がなされる。第３の動作である、(3)ストリームの再生、では、受け取ったコンテンツデータに必要なディレイが施され、デコードして出力される。

【００２９】図7は、図１に示したディスプレイ６の構成を説明するための図である。このディスプレイ６の内部構成は、図６で説明したスピーカ５の内部構成に、ＯＳＤ(On Screen Display)８２、表示装置８３を加えたものとして把握することができる。即ち、図7に示すディスプレイ６は、ＣＰＵ７１、ＲＯＭ７２、およびＲＡＭ７３を備えており、これらはシステムバス７４により相互に接続されマイクロコンピュータを構成している。また、ディスプレイ６は、システムバス７４に接続されているネットワークインタフェース７５を介して、ネットワーク１と接続されている。

【００３０】このディスプレイ６は、それぞれシステムバス７４に接続されているクロック発振器７６とカウンタ７７を備えており、クロック発振器７６の出力は、カウンタ７７に入力されている。更に、ディスプレイ６はバッファ７９、タイムスタンプ抽出器８０、デコーダ８１、ＯＳＤ８２、および表示装置８３を備えている。ディスプレイ６を流れるストリームデータは、システムバス７４からバッファ７９、タイムスタンプ抽出器８０を経てデコーダ８１に入力されてデコードされる。デコーダ８１からの出力は、ＯＳＤ８２の出力と混合された後に、表示装置８３に表示される。このタイムスタンプ抽出器８０、デコーダ８１およびＯＳＤ８２は、それぞれシステムバス７４に接続されている。尚、デコーダ８１の内部は、後述するＭＰＥＧデコーダの構成をなしている。具体的にはデマルチプレクサ、ビデオバッファ、ビデオデコーダで構成されている。

【００３１】また、ディスプレイ６は、ボタン/ＬＥＤ操作器７８を備えている。ＣＰＵ７１は、システムバス７４経由でボタンが押されたか否かの情報を読み出すことができる。また、ＣＰＵ７１は、システムバス７４経由でＬＥＤの点滅を制御することができる。ディスプレイ６は自身のデコーダ８１におけるデコードディレイを知っている。ここでデコードディレイとは、デコーダ８１にデータが入力されてから、デコードされたデータが出力されるまでの時間である。このデコードディレイ値はＲＯＭ７２に記録され、ＣＰＵ７１から読み出すことができるようになっている。また、ディスプレイ６は、自身の種別を知っている。ディスプレイ６の種別は「ディスプレイ」である。この種別はＲＯＭ７２に記録され、ＣＰＵ７１から読み出すことができるように構成されている。

【００３２】ディスプレイ６の行う動作は大きく３つに分けられる。この３つの動作とは、スピーカ５の動作と同様であり、(1)クロックの再生、(2)ユーザインタフェース対応、(3)ストリームの再生、である。これらの動作は、ＣＰＵ７１上で動作するタスクと、それぞれ必要な構成要素とが組み合わされて成り立っている。なお、ＣＰＵ７１上で動作するこれらの３つのタスクは、ＣＰＵ７１で動作するマルチタスクオペレーティングシステムの上で独立に動作しているとする。

【００３３】この(1)クロックの再生、とは、クロックソース２から発信された基準時刻信号により、ディスプレイ６の内部にクロックを再生することである。(2)ユーザインタフェース対応、とは、例えばコントローラ３の指示により内部のＬＥＤを発光させ、内部のボタンが押されたか否かの情報をコントローラ３に戻すことである。(3)ストリームの再生、とは、受け取ったコンテンツデータに必要なディレイを施した後、デコードして出力することである。

【００３４】次に、本実施の形態が適用されるネットワークシステムの全体の動作について説明する。図１に示すクロックソース２は、ネットワーク１で相互に接続された機器に対して、クロックを送信している。より具体的には、一定時間ごとの時刻情報(ここでは基準時刻信号'Ｔｓ')を送信している。但し、この時刻情報の送信は、必ずしも決まった時間間隔である必要はなく、所定時間ごとに送信されるものとすることができる。クロックの受信側(スピーカ５(５－１～５－５)、ディスプレイ６、コンテンツソース４)では、受け取った基準時刻情報と内部発振回路の出力の値とが比較されて、内部発振回路の発振周波数が調整され、クロックが再現される。

【００３５】図１に示すコントローラ３は、システム構成を設定している。この動作は、コントローラ３の指示に従いディスプレイ６にて表示されるメッセージや、コントローラ３の指示に従い各スピーカ５が発光させるＬＥＤに反応して、ユーザが各スピーカ５の持つスイッチを押す事により達成される。また、コントローラ３は、ストリーム再生を制御している。この動作は、コントローラ３の指示に従い、コンテンツソース４がストリームを出力し、各スピーカ５およびディスプレイ６がストリームをデコードすることにより行われる。また、コントローラ３の指示により各スピーカ５の音声出力を調整することも行われる。

【００３６】次に、クロックソース２が行うクロック配信について説明する。ここでは、図２および図３に示した２種類の構成のそれぞれに対して説明を行う。まず、図２に示すクロックソース２の動作を説明する。ここで

クロック発振器１１の発振周波数を'Ｕ'［Ｈｚ］とする。クロック発振器１１で発信されたクロックは、カウンタ１２とタイマ１３のそれぞれに入力される。カウンタ１２は、入力されたクロックにより自身のカウンタ１２をインクリメントし、時刻情報'Ｔ'を生成する。入力されるクロックが'Ｕ'［Ｈｚ］であるため、時刻情報'Ｔ'は'Ｕ'［Ｈｚ］の周波数でインクリメントされる。カウンタ１２の出力(時刻情報'Ｔ')は、ラッチ１４に入力される。ラッチ１４は、ラッチ信号が入力された時に入力信号をラッチして出力する。ラッチ信号が入力されない場合には、直前にラッチした信号が保持される。

【００３７】タイマ１３は、入力されたクロックを計数し、あらかじめ設定された設定値'Ｓ'ごとにトリガ信号を出力している。ここで、タイマ１３への入力クロックは'Ｕ'［Ｈｚ］であるので、トリガ信号は'Ｓ／Ｕ'［秒］ごとに出力される。言い換えると、トリガ信号の周期は'Ｓ／Ｕ'［秒］、あるいはトリガ信号の周波数は'Ｕ／Ｓ'［Ｈｚ］となる。タイマ１３から出力されるトリガ信号は、ラッチ１４のラッチ信号端子に入力されると同時に、ネットワークインタフェース１５の送信信号端子に入力される。

【００３８】ラッチ１４は、ラッチ信号端子にタイマ１３からのトリガ信号が入力された時点で、カウンタ１２から入力されている時刻信号'Ｔ'をホールドして出力する。ラッチ１４の出力は、次のラッチ信号が入力されるまで変化しない。この値を基準時刻信号'Ｔｓ'とする。送信信号端子にトリガ信号を受け取ったネットワークインタフェース１５は、入力されているラッチ１４の出力信号'Ｔｓ'を読み取り、ブロードキャストパケットに格納してネットワーク１に送り出す。ブロードキャストパケットは宛先を指定しないために、ネットワーク１に接続されている各機器に到着する。

【００３９】次に、図３に示すクロックソース２の動作を説明する。ここでクロック発振器２１の発振周波数を'Ｕ'［Ｈｚ］とする。クロック発振器２１で発信されたクロックは、カウンタ２２とタイマ２３のそれぞれに入力される。カウンタ２２は、入力されたクロックにより自身のカウンタをインクリメントして時刻情報'Ｔ'を生成する。入力されるクロックが'Ｕ'［Ｈｚ］であるため、時刻情報'Ｔ'は、'Ｕ'［Ｈｚ］の周波数でインクリメントされる。カウンタ２２の出力(時刻情報'Ｔ')はラッチ２４に入力される。ラッチ２４は、ラッチ信号が入力された時に入力信号をラッチして出力する。ラッチ信号が入力されない場合には、直前にラッチした信号が保持される。

【００４０】タイマ２３は、入力されたクロックを計数し、あらかじめ設定された設定値'Ｓ'ごとにトリガ信号を出力している。ここでタイマ２３への入力クロックは'Ｕ'［ＨＩｚ］であるので、トリガ信号は'Ｓ／Ｕ'［秒］ごとに出力される。言い換えると、トリガ信号の周期は'Ｓ／Ｕ'［秒］、あるいはトリガ信号の周波数は'Ｕ／Ｓ'［Ｈｚ］となる。タイマ２３から出力されるトリガ信号は、ラッチ２４のラッチ信号端子に入力されると同時にＣＰＵ２５の割り込み端子に入力される。ラッチ２４は、ラッチ信号端子にタイマ２３からのトリガ信号が入力された時点で、カウンタ２２から入力されている時刻信号'Ｔ'をホールドして出力する。ラッチ２４の出力は、次のラッチ信号が入力されるまで変化しない。この値を基準時刻信号'Ｔｓ'とする。

【００４１】割り込み端子にトリガ信号を受け取ったＣＰＵ２５は、システムバス２０を介して、ラッチ２４の値、即ち基準時刻信号'Ｔｓ'を読み出す。さらにＣＰＵ２５は、システムバス２０経由でネットワークインタフェース２６に指令し、ネットワーク１に接続されている各機器に対して、ラッチ２４から読み出した基準時刻信号'Ｔｓ'を送信させる。ネットワークインタフェース２６は、ＣＰＵ２５から受け取った指令に従い、基準時刻信号'Ｔｓ'をブロードキャストパケットに格納して、ネットワーク１に送り出す。ブロードキャストパケットは宛先を指定しないために、ネットワーク１に接続されている各機器に到着する。尚、ＣＰＵ２５は、ＲＯＭ２７に蓄えられているプログラムによりＲＡＭ２８を利用して動作している。

【００４２】図８は、クロック配信におけるクロックソース２の動作を説明するための図である。ここでは、横軸に時刻をとり、縦軸はそれぞれの信号の値が割り当てられている。クロック発振器１１(あるいはクロック発振器２１)は、'Ｕ'［Ｈｚ］の周波数で発信している。カウンタ１２(あるいはカウンタ２２)の出力、即ち時刻情報'Ｔ'は、同じく'Ｕ'［Ｈｚ］の周波数でインクリメントされる。図８の横軸の原点'ｔ０'をタイマ１３(あるいはタイマ２３)のトリガ信号が出力された時刻にとり、その時点での時刻情報'Ｔ'を'Ｔ０'とする。

【００４３】次のトリガ信号は、時刻'ｔ０'からクロック'Ｕ'の周波数で周期'Ｓ'だけ計数した時刻'ｔ１'に出力され、この時の時刻情報'Ｔ'は'Ｔ０＋Ｓ'となる。このとき、同時に時刻情報'Ｔ'はラッチ１４(あるいはラッチ２４)によりラッチされ、基準時刻信号'Ｔｓ'は'Ｔ０＋Ｓ'となる。その後、トリガ信号は'Ｕ'の周波数でクロック周期'Ｓ'ごとに出力され、基準時刻情報'Ｔｓ'はそれぞれ'Ｔ０＋２Ｓ'、'Ｔ０＋３Ｓ'と変化して行く。基準時刻信号'Ｔｓ'は、トリガ信号が発生する度にネットワーク１に対してブロードキャストされる。

【００４４】次に、クロック再生の動作について、スピーカ５(５－１～５－５)を例に挙げて説明する。このクロック再生は、コンテンツソース４およびディスプレイ６においても実行される。ここで「クロックの再生」とは、クロックソース２から送られたクロックをクライアント機器内部で再び発生させることを示している。

【００４５】通常状態において、図６に示すクロック発

振器５６の出力はカウンタ５７に入力され、カウンタ５７は、入力されたクロックにより自身のカウンタをインクリメントして時刻情報'Ｔｔ'を生成する。ＣＰＵ５１は、バス５４を経由してカウンタ５７の値(時刻情報'Ｔｔ')を読み込むことができる。時刻情報'Ｔｔ'は、ＣＰＵ５１により読み出され、デコードのタイミング調整に使用される。クロック発振器５６は可変周波数発振器であり、ＣＰＵ５１がシステムバス５４を経由して指示を行うことにより、発振周波数を一定の範囲で変化させることができる。また、ＣＰＵ５１は、システムバス５４を経由して、カウンタ５７に所望の値を設定することができる。

【００４６】クロックソース２からの基準時刻信号'Ｔｓ'は、例えば一定時刻ごとに受信され、その際、ＣＰＵ５１は、以下で説明する時計合わせのタスクを実行する。カウンタ５７は、クロック発振器５６の自走クロックで時刻情報'Ｔｔ'を生成する。クロックソース２の発信した基準時刻信号'Ｔｓ'は、スピーカ５のネットワークインタフェース５５で受信される。ネットワークインタフェース５５は、ＣＰＵ５１に基準時刻信号'Ｔｓ'の到着を伝える。ＣＰＵ５１では、この信号により時計合わせのタスクが起動される。

【００４７】図９は、クロック再生における時刻合わせの処理を説明するためのフローチャートである。ＣＰＵ５１は、まず、ネットワークインタフェース５５に到着した基準時刻信号'Ｔｓ'を読み出す(ステップ１０１)。その後、カウンタ５７から時刻情報'Ｔｔ'を読み出す(ステップ１０２)。次に、基準時刻信号'Ｔｓ'と時刻信号'Ｔｔ'の差分を計算し('Ｔｓ'－'Ｔｔ')、変数 'ｄｉｆｆ'に代入する(ステップ１０３)。ＣＰＵ５１は、'ｄｉｆｆ'の絶対値と定数ｋを比較し(ステップ１０４)、'ｄｉｆｆ'の絶対値の方が大きいと判断された場合には、'Ｔｓ'の値をカウンタ５７に代入して(ステップ１０５)、処理を終了する。ステップ１０４にて'ｄｉｆｆ'の絶対値の方が大きいと判断されなかった場合には、ステップ１０６に進む。

【００４８】ステップ１０６にて、ＣＰＵ５１は、'ｄｉｆｆ'の値が０(ゼロ)であるか否かを確認し、'ｄｉｆｆ'の値が０でない場合にはステップ１０７へ進み、'ｄｉｆｆ'の値が０である場合には処理を終了する。ステップ１０７にて、ＣＰＵ５１は、'ｄｉｆｆ'の値と０(ゼロ)とを比較し、'ｄｉｆｆ'の値が０(ゼロ)より大きいと判断された場合('Ｔｓ'＞'Ｔｔ')にはステップ１０９に進み、そうでない('Ｔｓ'＜'Ｔｔ')と判断された場合にはステップ１０８へ進む。ステップ１０８において、ＣＰＵ５１は、クロック発振器５６に対して発振周波数を遅くするよう指令した後、処理を終了する。また、ステップ１０９においてＣＰＵ５１は、クロック発振器５６に対して発振周波数を速くするよう指令した後、処理を終了する。

【００４９】以上のようなＣＰＵ５１のタスクにより、受信した基準時刻信号'Ｔｓ'と内部時刻情報'Ｔｔ'の差が大きい場合には受信した基準時刻信号'Ｔｓ'を内部時刻カウンタに代入し、内部時刻情報'Ｔｔ'が少し進んでいる時にはクロックを遅くし、また内部時刻情報'Ｔｔ'が少し遅れている時にはクロックを速める。これらの動作により、基準時刻信号'Ｔｓ'にあわせた内部時刻情報'Ｔｔ'を再生することができる。尚、上記の例では、クロック配信に際してブロードキャスト通信を使用したが、ユニキャスト(一対一通信)の通信を用いることも可能である。

【００５０】次に、コントローラ３を中心に行われるシステム構成設定の動作について説明する。図１０および図１１は、ネットワーク１に各機器が接続された直後からの処理を示したフローチャートである。図１０に示すように、まず、コントローラ３は、物理的にネットワーク１に接続されて電源が投入されると、ネットワーク１への接続を確認する。即ち、図４に示すコントローラ３のＣＰＵ３１は、まず、ネットワークインタフェース３５に対してネットワーク１に接続したことを確認させる(ステップ２０１)。そして、ネットワーク１に接続したと判断されるとステップ２０３に進み、ネットワーク１に接続したと判断されない場合にはステップＳ２０１に戻って確認を繰り返す(ステップ２０２)。

【００５１】ステップ２０３において、ＣＰＵ３１は、「応答リクエストメッセージ」を作成し、ネットワークインタフェース３５に指令して、ネットワーク１に対して送信させる。この「応答リクエストメッセージ」は所定の文字列で構成されている。ネットワークインタフェース３５は、ＣＰＵ３１から受け取った指令に従い、「応答リクエストメッセージ」をブロードキャストパケットに格納してネットワーク１に送り出す。ブロードキャストパケットは、宛先を指定していないために、「応答リクエストメッセージ」はネットワーク１に接続されている各機器に到着する。「応答リクエストメッセージ」を受け取った各機器は、自身の種別およびデコードディレイ値を返答する。種別およびデコードディレイ値は各機器のＲＯＭに記録されている。例えばスピーカ５において、このメッセージはネットワークインタフェース５５に到着し、ＣＰＵ５１は、このメッセージを解読して、ＲＯＭ５２から種別とデコードディレイを読み取り、「応答」メッセージを作成し、ネットワークインタフェース５５に指令してコントローラ３に対して送信させる。各機器の返答したメッセージは、ネットワークインタフェース３５で受信され、ネットワークインタフェース３５は、ＣＰＵ３１にメッセージの到着を伝える。

【００５２】ステップ２０４においてメッセージが到着していると判断される場合には、コントローラ３のＣＰＵ３１は、ステップ２０５に進む。メッセージが到着していないと判断された時には、ステップ２０８に進む。

ステップ２０５において、ＣＰＵ３１は、ネットワークインタフェース３５に到着したメッセージを読み出す。その後、ＣＰＵ３１は、読み出したメッセージが各機器から返答された所定の「応答」であるかどうかを確認する(ステップ２０６)。所定の「応答」であった場合にはステップ２０７へ進む。所定の「応答」ではなかった場合には、ステップ２０８へ進む。

【００５３】ステップ２０７において、ＣＰＵ３１は、受け取った「応答」をＲＡＭ３３に置かれた機器データベースに記録する。図１２は、機器データベースの構造を示した図である。機器データベースの先頭には、登録されているエントリの数が記録され、引き続いて、エントリの数だけ各機器のレコードが記録されている。機器のレコードには、その機器をネットワーク上で特定するためのネットワークアドレス、種別、役割、デコードディレイがそれぞれ記録される。「応答」を機器データベースに記録する際には、まず、エントリ数を１だけインクリメントする。そして、新しいレコードをリストの終りに追加する。その後、新しく追加したレコードに対して、受け取った「応答」の送り先の機器を特定するためのネットワークアドレス、種別、デコードディレイを記録する。役割の項はシステム構成設定動作の後半で記録される。

【００５４】ステップ２０８において、ＣＰＵ３１では、ステップ２０３の「応答リクエストメッセージ」を送信してから、所定の時間が経過したかどうかが判断される。所定時間が経過したと判断された場合には、図１１に示すステップ２１０に進む。まだ所定時間が経過していないと判断された場合には、ステップ２０４に戻って、これまでの動作を繰り返す。

【００５５】図１１に示すステップ２１０において、ＲＡＭ３３に置かれている機器データベースの内容は、図１３に示すような内容になっており、そのエントリの数は7となっている。7つあるレコードの内訳としては、まず、ディスプレイ６を示すネットワークアドレスを持ち、種別がディスプレイとなっているレコードが置かれる。また、５つのスピーカ５(５－１～５－５)の各々を示すネットワークアドレスを持ち、種別がモノラルスピーカとなっているレコードが計５つ置かれている。最後に、コンテンツソース４を示すネットワークアドレスを持ち、種別がコンテンツソースとなっているレコードが置かれている。尚、レコードの順番は一例として示したものであり、図１３に示す順番になるものと決まっているものではない。

【００５６】ステップ２１０において、ＣＰＵ３１は、ＲＡＭ３３に置かれている機器データベースから種別がディスプレイとなっているものを探す。この例では、図１３に示すように、最初に記録されているレコードの種別がディスプレイとなっている。ＣＰＵ３１は、最初のレコードに記録されているネットワークアドレスを持つ機器がディスプレイであることを認識する。その後、ＣＰＵ３１は、「システムを設定開始する」旨のメッセージを作成し、ネットワーク１経由でディスプレイ６に指令して表示させる(ステップ２２０)。前のステップにてディスプレイ手段を持つ機器としてディスプレイ６を認識したので、ＣＰＵ３１は、直接、ディスプレイ６(を示すネットワークアドレスを持つ機器)に対して指令を行う。具体的には、ＣＰＵ３１は、メッセージを作成し、ネットワークインタフェース３５に指令してディスプレイ６に対して送信させる。ディスプレイ６では、図７に示すネットワークインタフェース７５がメッセージを受信し、ＣＰＵ７１によってそのメッセージが読み取られて解読され、ＯＳＤ８２に指令してメッセージを出力して表示装置８３に表示させる。

【００５７】次に、コントローラ３のＣＰＵ３１により「フロントレフト」が指定される(ステップ２３０)。即ち、「フロントレフトの位置に有るスピーカのスイッチを押して下さい」という旨のメッセージが作成され、ネットワーク１を経由してディスプレイ６に表示される。

【００５８】その後、コントローラ３は、「ＬＥＤ点滅／ボタン待ち」を指令するメッセージを作成し、ＲＡＭ３３に置かれている機器データベースから種別がモノラルスピーカになっている機器の全て(スピーカ５(５－１～５－５))に対して送出する。この「ＬＥＤ点滅／ボタン待ち」のメッセージを受信した機器は、ＬＥＤを点滅させ（ステップ２３１)、ボタンが押されることを待ち受ける。スピーカ５においては、このメッセージはネットワークインタフェース５５に到着し、ＣＰＵ５１はこのメッセージを解読して、ボタン/ＬＥＤ操作器５８に指令してＬＥＤを点滅させる。またＣＰＵ５１は、ボタン/ＬＥＤ操作器５８にてボタンが押されたことを探知したら、コントローラ３に返答を返すべく、待ち受ける。

【００５９】ユーザは、ＬＥＤの点滅しているスピーカ５(５－１～５－５)の中から、フロントレフトの位置にあたるスピーカ５－１のスイッチを押す。スピーカ５－１では、ボタンを押されたことをボタン/ＬＥＤ操作器５８が感知し、ＣＰＵ５１に伝える。ＣＰＵ５１は、「ボタン押下」のメッセージを作成し、ネットワークインタフェース５５に指令してコントローラ３に対して送信させる。コントローラ３のＣＰＵ３１は、ステップ２３２にて「ボタン押下」のメッセージが受信されるまで待ち(ステップ２３２)、受信するとスピーカ５－１のＬＥＤを消灯する(ステップ２３３)。

【００６０】その後、ＣＰＵ３１は、ネットワークインタフェース３５からメッセージを読み出し、「ボタン押下」メッセージ発信元のネットワークアドレスを読み取り、ＲＡＭ３３に記録されている機器データベースのレコードの中で、ネットワークアドレスが一致するもの、即ち、図１３の例では第２番目のレコードを探し出し、

該当するレコードの役割のフィールドに「フロントレフト」の属性を書き込んで設定する(ステップ２３４)。最後にＣＰＵ３１は、役割のフィールドの内容、ここでは「フロントレフト」の属性を記述した「役割メッセージ」を作成し、ネットワーク１を経由して「ボタン押下」メッセージの発信元に送り返す(ステップ２３５)。「ボタン押下」メッセージの発信元(ここではスピーカ５－１)は、「役割メッセージ」を受信し、役割(ここでは「フロントレフト」の属性)を取り出してＲＡＭ５３に格納する。即ち、このメッセージは、ネットワークインタフェース５５に到着し、ＣＰＵ５１は、このメッセージを解読して、ＲＡＭ５３に記録する。以上のようなステップ２３０からステップ２３５の操作によって、「フロントレフト」の位置に設置されたスピーカ５はスピーカ５－１であるということがコントローラ３の機器データベースに記録される。また、スピーカ５－１は、自身の役割(ここではフロントレフト)を知り、自身のＲＡＭ５３に記録する。

【００６１】以下同様に、ステップ２４０からステップ２４５の操作により「フロントライト」、ステップ２５０からステップ２５５の操作により「センター」、ステップ２６０からステップ２６５の操作により「リアレフト」、ステップ２７０からステップ２７５の操作により「リアライト」のそれぞれの位置に設置されたスピーカ５を知ることができる。更に、各スピーカ５(５－２～５　５)は、自身の役割を知り自身のＲＡＭ５３に記録する。

【００６２】最後に、コントローラ３のＣＰＵ３１は「システム設定が終了した」という旨のメッセージを作成し、ネットワーク１経由でディスプレイ６に指令して表示させる(ステップ２８０)。以上の手順により、物理的な配置とネットワーク１上でのアドレスの対応をとることができる。尚、ここでは説明しなかったが、ディスプレイ６が複数、存在する場合には、ディスプレイ６が持つボタン/ＬＥＤ操作器７８、あるいはリモコン７と画面表示などを用いて、上記と同様の設定を行うことができる。

【００６３】次に、スピーカ５(５－１～５－５)のデコーダ６１やディスプレイ６のデコーダ８１にて構成されるＭＰＥＧデコーダについて説明する。図１４は、ＭＰＥＧ２システム(ISO13818‐1)に準拠したデコーダシステムの概略を示した図である。図１４に示すデコーダシステムでは、ストリーム入力９１からストリームが入力され、デマルチプレクサ９２にてビデオストリームとオーディオストリームとに振り分けられる。ビデオストリームは、ビデオバッファ９３に入力され、所定のディレイ時間を経過した後にビデオデコーダ９４に入力され、デコードされてビデオ出力９７から出力される。オーディオストリームは、オーディオバッファ９５に入力され、所定のディレイ時間を経過した後にオーディオデコーダ９６に入力され、デコードされてオーディオ出力９８から出力される。

【００６４】図１５は、ＭＥＰＧデコーダに供給されるデータフォーマットの一例を示した図である。このフォーマットは、ＭＰＥＧ２の多重化ビットストリーム(ProgramStream)として規定されているものである。図１５に示すように、多重化ビットストリームは、１つ以上のパック(PACK)で構成され、各パックは１つ以上のパケット(PACKET)で構成される。パックの先頭にはパックヘッダ(PACK HEADER)が配置され、このパックヘッダにはパックの開始点を示すパックスタートコード(PACK START CODE)、ＳＣＲ(System Clock Reference)およびＭＵＸ ＲＡＴＥが配置されている。ＳＣＲは、その最後のバイトがデマルチプレクサ９２に入力される時刻を表わしている。ＭＵＸ ＲＡＴＥは、転送レートを示すものである。

【００６５】図１５に示す例においては、パックヘッダに続いて、ビデオパケット(VIDEO PACKET)とオーディオパケット(AUDIO PACKET)とが配置されている。これらのパケットの先頭にもパケットヘッダが配置され、これらのパケットヘッダは、ビデオまたはオーディオのパケットの開始点を表すビデオパケットスタートコード(VIDEO PACKET START CODE)またはオーディオパケットスタートコード(AUDIO PACKETSTART CODE)と、ビデオまたはオーディオデータのデコード(表示)開始時刻を示すＤＴＳ(Ｖ)(ＰＴＳＶ(ＰＴＳｖｉｄｅｏ))またはＤＴＳ(Ａ)(ＰＴＳＡ(ＰＴＳａｕｄｉｏ))が配置されている。そして、この各パケットヘッダの次に、ビデオデータあるいはオーディオデータが配置されている。尚、これらＳＣＲ、ＰＴＳ(ＰＴＳＶまたはＰＴＳＡ)などのタイミングデータは、９０ｋＨｚの周波数からなるクロックのカウント値で表わされ、３３ビットの有効数字を有している。更に、システム表現のための簡略モデル化を行っているため、デコードにかかる時間は０となっている。このためデコード開始時刻と表示開始時刻が等しい。

【００６６】図１６は、ＳＣＲとＰＴＳＶ(ＰＴＳｖｉｄｅｏ)、ＳＣＲとＰＴＳＡ(ＰＴＳａｕｄｉｏ)の関係を示した図である。パックヘッダがデマルチプレクサ９２を通過した時刻がｔ１であり、該当するパックに含まれるビデオとオーディオの表示時間がそれぞれｔ２とｔ３となる。ここでは、ＳＣＲからＰＴＳａｕｄｉｏまでの時間をΔＴａとし、ＳＣＲからＰＴＳｖｉｄｅｏまでの時間をΔＴｖとしている。ΔＴａとΔＴｖは、エンコード時に決まる任意の時間である。該当するパックがデマルチプレクサ９２に入力される時刻がＳＣＲであり、該当するパックに含まれるビデオデータとオーディオデータは、それぞれビデオバッファ９３とオーディオバッファ９５で所定の時間、遅延するために、そのデコード(表示)開始時刻はＳＣＲより遅くなる。また、一般的にビデオバッファ９３での遅延はオーディオバッファ９５

での遅延より大きいため、同じタイミングでデマルチプレクサ９２を通過した場合でも、ビデオのデコード(表示)時刻はオーディオのデコード(表示)開始時刻より遅くなる。尚、前述したように、デコードにかかる時間は０であるので、ここでの遅延は、それぞれビデオバッファ９３とオーディオバッファ９５で発生している。

【００６７】次に、本実施の形態におけるディレイ補償の考え方について説明する。コントローラ３は、コンテンツの再生を行うにあたり、Δｔを設定してコンテンツソース４に知らせる。コンテンツソース４は、コンテンツデータの送信時刻に対して、Δｔだけ遅らせた時刻にコンテンツの出力されるべき時刻を設定してコンテンツデータを送り出す。コンテンツのシンク機器群(スピーカ５(５－１～５－５)、ディスプレイ６)では、受け取ったコンテンツデータを指定された時刻に出力する。

【００６８】Δｔは、コンテンツソース４からコンテンツのシンク機器群(スピーカ５(５－１～５－５)、ディスプレイ６)に、コンテンツデータが送られた時のネットワークディレイ(通信ディレイ)のうち最大となる時間と、コンテンツのシンク機器群(スピーカ５(５－１～５－５)、ディスプレイ６)の実際のデコードディレイのうち最大となる時間とを加えたものである。場合によっては、マージンを増やすために幾分かの余裕を加える場合がある。また、この２つ以外の要因によるディレイを加える場合もある。例えば、サブネットをまたぐ場合のルーターのディレイ等が考えられる。

【００６９】更に、Δｔの値はシンク機器群の組み合わせによって変化することがある。即ち、コンテンツのシンク機器群の組み合わせが変化すると、その中での最大のネットワークディレイと最大のデコードディレイは変化する可能性がある。シンク機器群の組み合わせによってΔｔをその都度変えて制御する場合と、システム内で起こり得る最大のネットワークディレイと最大のデコードディレイとを用いて、即ち、Δｔの最大値を見積もってそれを使用する場合の二つの方法が考えられる。

【００７０】図１７は、本実施の形態におけるディレイを説明するための図である。コンテンツソース４がストリーム先頭に対する発信を開始した時刻をｔ１０とする。ｔ１０に最大の通信ディレイ(ネットワークディレイ)を加えた時刻をｔ１１とする。コンテンツソース４から発信されたコンテンツデータは、遅くともｔ１１までには全てのコンテンツのシンク機器群(スピーカ５(５－１～５－５)、ディスプレイ６)に到着している。即ち、通信のディレイに関しては、配信時刻から再生時刻を最大の通信ディレイだけ遅らせることで補償可能である。

【００７１】次に、ｔ１１に最大のデコードディレイを加えた時刻、即ち、ｔ１０にΔｔを加えた時刻をｔ１２とする。ＭＰＥＧ系の多重化ストリームの場合には、デコード開始とはビットストリームの処理開始、即ちデマルチプレクス開始ということになる。このため、時刻ｔ１２は、該当するビットストリームのＳＣＲが対応することになる。図１６に示した数値を当てはめて考えると、デコーダではｔ１２がＳＣＲの時刻となるから、オーディオの出力開始時刻ＰＴＳａｕｄｉｏは、ｔ１２にΔＴａを加えた時刻ｌ２０となり、ビデオの出力開始時刻ＰＴＳｖｉｄｅｏは、ｔ１２にΔＴｖを加えた時刻ｔ２２となる。

【００７２】ここで、実際のデコードディレイを考える。ディスプレイ６のデコーダ８１のデコードディレイをＤｖ、スピーカ５のデコーダ６１のデコードディレイをＤａとすると、ｔ２０にオーディオを出力するためには、ｌ２０よりＤａだけさかのぼった時刻ｌ２１にオーディオのデコードを開始する必要がある。また、同様に、ｔ２２にビデオを出力するためには、ｔ２２からＤｖだけさかのぼった時刻ｔ２３にビデオのデコードを開始する必要がある。

【００７３】このとき、ΔＴａあるいはΔＴｖが非常に小さく与えられたとすると、ｔ２０あるいはｔ２２はｔ１２に限りなく近付くので、ｔ２１あるいはｔ２３はｔ１２からデコードディレイ分さかのぼった時刻になる。このため、ｔ１２から最大のデコードディレイ分をさかのぼった時刻が、ｔ１１の後になっていれば良い。繰り返すと、ｔ１１までデコード開始を待てばネットワークによるディレイは無視できる。更に、見かけ上のデコード開始時刻(ｔ１２、ＳＣＲ)を、ｔ１１から実際のデコードディレイにおける最大のものだけ遅らせることにより、デコードディレイの影響も無視できるようになる。このために、Δｔには最大のデコードディレイが加算されている。

【００７４】次に、ストリーム再生動作について説明する。図１にて、ユーザがリモコン７を使用して、再生モードの指定をコントローラ３に対して与えた場合を考える。ここではディスプレイ６とスピーカ５(５－１～５－５)を使用するサラウンド再生を指定したものとする。このとき、リモコン信号は、コントローラ３のリモコン受光部３６で受信される。リモコン受光部３６は、ＣＰＵ３１に対して再生モード指定のコマンドを伝える。ＣＰＵ３１は、ＲＡＭ３３に記録されている機器データベースを参照し、シンク機器(スピーカ５(５－１～５－５)、ディスプレイ６)から、デコードディレイの最大値を選び出し、更に、予め決まっているネットワークのディレイをＲＯＭ３２から読み出して加算し、Δｔとする。

【００７５】ここで、ユーザがリモコン７を使用して、コンテンツ再生の命令をコントローラ３に対して与えた場合を考える。このリモコン信号は、コントローラ３のリモコン受光部３６で受信される。リモコン受光部３６は、ＣＰＵ３１にコンテンツ再生のコマンドを伝える。ＣＰＵ３１は、ＲＡＭ３３に記録されている機器データ

ベースを参照して、コンテンツソースを探し出す。ここではコンテンツソース４を発見し、ネットワークアドレスを得る。コントローラ３は、コンテンツソース４に対して「コンテンツ再生開始」のメッセージを送出する。このとき、Δｔの値も同時に与える。また、通常では、ここでコンテンツの指定がなされる。

【００７６】即ち、ＣＰＵ３１は、「コンテンツ再生開始メッセージ」を作成し、その中でΔｔを指定する。そして、ＣＰＵ３１は、ネットワークインタフェース３５に指令して、「コンテンツ再生開始メッセージ」をコンテンツソース４に対して送信させる。この「コンテンツ再生開始メッセージ」は、所定の文字列で構成される。

【００７７】コントローラ３は、今回のシンク機器群（スピーカ５（５－１～５－５）、ディスプレイ６）に対して、コンテンツソース４からのコンテンツデータを再生するように指示する。即ち、ＣＰＵ３１は、「コンテンツソース指定メッセージ」を作成し、その中でコンテンツソース４のネットワークアドレスを指定する。ＣＰＵ３１は、ネットワークインタフェース３５に指令して、今回のシンク機器群（スピーカ５（５－１～５－５）、ディスプレイ６）に対して、一つづつ順番に「コンテンツソース指定メッセージ」を送信させる。この「コンテンツソース指定メッセージ」は、所定の文字列で構成される。

【００７８】同時に、コントローラ３は、今回のシンク機器群の中で、スピーカ５群（スピーカ５　１～５　５）に対してボリュームを設定する。即ち、ＣＰＵ３１は、「ボリューム設定メッセージ」を作成し、その中でボリュームの値を指定する。ＣＰＵ３１は、ネットワークインタフェース３５に指令して、シンク機器群の中の指定されたシンク機器であるスピーカ５（５－１～５－５）に対して、一つづつ順番に「ボリューム設定メッセージ」を送信させる。この「ボリューム設定メッセージ」は、所定の文字列で構成されている。

【００７９】次に、コンテンツソース４の動作について説明する。コンテンツソース４は、「コンテンツ再生開始メッセージ」を受信する。即ち、ネットワークインタフェース４５にメッセージが到着し、ＣＰＵ４１はこのメッセージを解読し、Δｔの値を受け取ると共に、コンテンツの再生を開始する。まず、ＣＰＵ４１は、ハードディスク装置４８に対して所定のコンテンツの出力を指示する。ハードディスク装置４８から出力したストリームは、ビットストリーム解析器４９にて解析され、先頭のＳＣＲの値が読み出される。ＳＣＲの数値はＣＰＵ４１によって読み出され、ストリームはそのままバッファ５０へ進む。

【００８０】このとき、コンテンツソース４での時刻情報'Ｔｔ'が'Ｔ１０'、ストリーム先頭のＳＣＲの値が'Ｓ１０'であったとする。即ち、ビットストリームの'Ｓ１０'の値を持つタイムスタンプが、スピーカ５におけるデコーダ６１内の図示せぬデマルチプレクサ、あるいはディスプレイ６のデコーダ８１内の図示せぬデマルチプレクサにて処理される時刻'Ｔ１２'は、現在時刻'Ｔ１０'にコントローラ３より与えられた'Δｔ'を加えた時刻となる。

Ｔ１２＝Ｔ１０＋Δｔ

コンテンツソース４のＣＰＵ４１は、「タイムスタンプオフセットメッセージ」を作成し、'Ｓ１０'の値と'Ｔ１２'の値を指定する。ＣＰＵ４１は、ネットワークインタフェース４５に指令して、「タイムスタンプオフセットメッセージ」をネットワーク１にブロードキャストする。これにより、全てのシンク機器は、ＭＰＥＧ２のタイムスタンプと'クロック'の関係を知ることになる。

【００８１】コンテンツソース４のＣＰＵ４１は、ネットワークインタフェース４５に指定して、バッファ５０の内容（ストリーム）をネットワーク１にブロードキャストさせる。ここではネットワーク１に対してブロードキャストするが、ユニキャスト（一対一通信）でも構わない。その際には、コントローラ３が、シンク機器の一覧をコンテンツソース４に伝える必要が有り、コンテンツソース４は、その一覧データに従ってデータを送信する。

【００８２】次に、本実施の形態におけるスピーカ５の動作について説明する。スピーカ５のＣＰＵ５１は、コントローラ３の発信した「コンテンツソース指定メッセージ」のメッセージを受け取る。ＣＰＵ５１は、コンテンツソースとして指定されたネットワークアドレスをＲＡＭ５３に格納する。スピーカ５は、コントローラ３の指示により、コンテンツソース４からのコンテンツデータを待ち受ける。このメカニズムにより、同一ネットワーク上に、コンテンツソースとシンク機器の組み合わせが複数存在することができる。

【００８３】また、スピーカ５のＣＰＵ５１は、コントローラ３の発信した「ボリューム設定メッセージ」のメッセージを受け取る。ＣＰＵ５１はアンプ６２に対してボリュームを設定する。更にスピーカ５は、コンテンツソース４の発信した「タイムスタンプオフセットメッセージ」を受け取る。この「タイムスタンプオフセットメッセージ」は、コンテンツデータに伴って送られるものであり、スピーカ５は、予めコンテンツソース４からのコンテンツデータを待ち受けていたので、このメッセージを受け入れた。この「タイムスタンプオフセットメッセージ」からＭＰＥＧのタイムスタンプと時刻情報の関係が判る。スピーカ５のＣＰＵ５１は、差分オフセット値＝Ｓ１０－Ｔ１２を計算する。これによりスピーカ５での時刻情報'Ｔｔ'にオフセット値を加えることで、ＭＰＥＧの時計であるところのＳＴＣ（システムタイムクロック）の値を計算することができる。また、ＭＰＥＧ系のタイムスタンプからオフセットを減じることで、時刻情報'Ｔｔ'の値を求めることができる。

【００８４】スピーカ５は、コンテンツソース４の発信したストリームを受け取り、バッファ５９に入力する。バッファ５９に入ったストリームは、タイムスタンプ抽出器６０を経てデコーダ６１に入力される。ＣＰＵ５１は、タイムスタンプ抽出器６０からＳＣＲとＰＴＳａｕｄｉｏを読み出す。また、ＣＰＵ５１はデコードディレイＤａの値を知っている。デコーダ６１にはデコードディレイがあるために、名目上の出力開始時刻からＤａだけさかのぼって(前に)デコードを開始する必要がある。この調整を行うために、スピーカ５のＣＰＵ５１は以下の処理を行う。

【００８５】まず、Ｔ１２からＤａだけさかのぼった時刻をＴ１１(実際のデマルチプレクス開始時刻)とする。ストリームの最初のＰＴＳａｕｄｉｏ(名目上のオーディオデコード/表示開始)をＴ２０とし、Ｔ２０からＤａだけさかのぼった時刻をＴ２１とする。即ちＴ１２は名目上のデマルチプレクス開始時刻であり、Ｔ１１はデコードディレイの分、前倒しにした実際のデマルチプレクス開始時刻となる。また、Ｔ２０は、ストリームの最初のＰＴＳａｕｄｉｏにおける名目上のデコード(表示)開始時刻であり、Ｔ２１はデコードディレイの分、前倒しにした実際のデコード開始時刻となる。ＣＰＵ５１はカウンタ５７から再生された時刻情報'Ｔｔ'を読み出し、時刻がＴ１１に等しくなった時点でデマルチプレクスを開始する。引き続いて時刻がＴ２１になった時点でデコードを開始する。これにより、Ｔ２０にオーディオの出力を開始することができる。

【００８６】次に、本実施の形態におけるディスプレイ６の動作について説明する。ディスプレイ６のＣＰＵ７１は、コントローラ３の発信した「コンテンツソース指定メッセージ」のメッセージを受け取る。ＣＰＵ７１は、コンテンツソースとして指定されたネットワークアドレスをＲＡＭ７３に格納する。ディスプレイ６は、コントローラ３の指示により、コンテンツソース４からのコンテンツデータを待ち受ける。この仕掛けにより、同一ネットワーク上に、コンテンツソースとシンク機器の組み合わせが複数存在することができる。

【００８７】ディスプレイ６は、コンテンツソース４の発信した「タイムスタンプオフセットメッセージ」を受け取る。この「タイムスタンプオフセットメッセージ」は、コンテンツデータに伴って送られるものであり、ディスプレイ６は、予めコンテンツソース４からのコンテンツデータを待ち受けていたのでこのメッセージを受け入れた。この「タイムスタンプオフセットメッセージ」からＭＰＥＧのタイムスタンプと時刻情報の関係が判る。ディスプレイ６のＣＰＵ７１は、差分オフセット値＝Ｓ１０－Ｔ１２を計算する。これによりディスプレイでの時刻情報'Ｔｔ'にオフセット値を加えることで、ＭＰＥＧの時計であるところのＳＴＣ(システムタイムクロック)の値を計算することができる。また、ＭＰＥＧ系のタイムスタンプからオフセットを減じることで、時刻情報'Ｔｔ'の値を求めることができる。

【００８８】ディスプレイ６は、コンテンツソース４の発信したストリームを受け取り、バッファ７９に入力する。バッファ７９に入ったストリームは、タイムスタンプ抽出器８０を経てデコーダ８１に入力する。ＣＰＵ７１は、タイムスタンプ抽出器８０からＳＣＲとＰＴＳｖｉｄｅｏを読み出す。また、ＣＰＵ７１はデコードディレイＤｖの値を知っている。デコーダ８１にはデコードディレイがあるために、名目上の出力開始時刻からＤｖだけさかのぼって(前に)デコードを開始する必要がある。この調整を行うために、ディスプレイ６のＣＰＵ７１は以下の処理を行う。

【００８９】まず、Ｔ１２からＤｖだけさかのぼった時刻をＴ１１(実際のデマルチプレクス開始時刻)とする。ストリームの最初のＰＴＳｖｉｄｅｏ(名目上のビデオデコード/表示開始)をＴ２２とし、Ｔ２２からＤｖだけさかのぼった時刻をＴ２３とする。即ちＴ１２は名目上のデマルチプレクス開始時刻であり、Ｔ１１はデコードディレイの分、前倒しにした実際のデマルチプレクス開始時刻となる。また、Ｔ２２はストリームの最初のＰＴＳｖｉｄｅｏにおける名目上のデコード(表示)開始時刻であり、Ｔ２３はデコードディレイの分、前倒しにした実際のデコード開始時刻となる。ＣＰＵ７１は、カウンタ７７から再生された時刻情報'Ｔｔ'を読み出し、時刻がＴ１１に等しくなった時点でデマルチプレクスを開始する。引き続いて時刻がＴ２３になった時点でデコードを開始する。これにより、Ｔ２２にビデオの出力を開始することができる。

【００９０】最後に、位置補償の方法について説明する。上記の例では、Δｔの要素として、ネットワークによるディレイとデコードディレイの二つを考えたが、このほかにもスピーカ５(５－１～５－５)の位置によるディレイ調整が考えられる。例えば、スピーカ５－４がスピーカ５－５より１．７メートルだけリスニングポジション８に近いとする。音速はおよそ３４０メートル毎秒なので、１．７メートルの距離を進むのに約５ミリ秒かかる。即ち、スピーカ５－４とスピーカ５－５を同時に発した音は、スピーカ５－４からの音が５ミリ秒だけ早くリスニングポジション８に到達する。これを補償するために、スピーカ５－４に対して５ミリ秒のディレイを加えるという方法がある。言い換えれば、スピーカ５－４だけが１．７メートルだけリスニングポジション８に近い場合に、スピーカ５－４以外のスピーカに対して５ミリ秒だけ早く出力させるということになる。

【００９１】本実施の形態では、かかる方法にも対応することが可能である。具体的には、上記例においてΔｔを計算する際に、「ネットワークディレイの最大値」と「デコードディレイの最大値」に加えて「位置補償ディレイの最大値」を加算する。即ち、上記例よりもΔｔは

５ミリ秒だけ大きくなる。また、コントローラ３は、スピーカ５－４に対して０ミリ秒のディレイを指示し、スピーカ５－４以外のスピーカに対して５ミリ秒の前倒しを指示する。このとき、コントローラ３から発信される「コンテンツソース指定メッセージ」によって指定されたネットワークアドレスに基づいて、シンク機器毎にディレイの指示を受けることが可能である。また、コントローラ３のＣＰＵ３１により各スピーカ５の「位相補償ディレイ設定メッセージ」が作成され、各スピーカ５に送られることで、シンク機器毎にディレイを指示するように構成することも可能である。

【００９２】図１８は、位置補償ディレイの最大値を考慮した場合のディレイを説明するための図である。コンテンツソース４は、コンテンツの送り出し時刻ｔ１０に対してΔｔを加え、名目上のデマルチプレクス開始時刻としてｔ１２を指定する。リアレフトであるスピーカ５－４では、最初のＳＣＲにあたるｔ１２から”デコードディレイＤａ＋０ミリ秒”だけさかのぼった時刻ｔ１１にデマルチプレクスを開始し、最初のＰＴＳａｕｄｉｏにあたるｔ２０から”デコードディレイＤａ＋０ミリ秒”だけさかのぼった時刻ｔ２１にデコードを開始する。これによって、ｔ２０に音声出力することができる。

【００９３】スピーカ５－４以外のスピーカ５では、最初のＳＣＲにあたるｔ１２から”デコードディレイＤａ＋５ミリ秒”だけさかのぼった時刻ｔ３１にデマルチプレクスを開始し、最初のＰＴＳａｕｄｉｏにあたるｔ２０から”デコードディレイＤａ＋５ミリ秒”だけさかのぼった時刻ｔ３２にデコードを開始する。するとｔ２０から５ミリ秒前に音声出力することができる。即ち、これらの操作によりスピーカ５－４以外のスピーカ５からの出力は、スピーカ５－４からの出力よりも５ミリ秒だけ早く出力することができる。このようにしてスピーカ位置の補償が可能となる。

【００９４】以上、詳述したように、本実施の形態では、まず、ソース機器とシンク機器における動作クロックの関係(結びつき)について対策を施している。即ち、両者のクロックが非同期である場合、両者のデータ処理速度、即ち同一サンプル数に対する処理時間が異なるため、結果として二つの機器の間に存在するバッファには破綻(アンダーフロー、オーバーフロー)をきたすことになる。本実施の形態では、クロックの配信を行い、受信した基準時刻信号と内部時刻情報との差が大きい場合には受信した基準時刻信号を内部時刻カウンタに代入し、内部時刻情報が進んでいるときにはクロックを遅くし、遅れているときにはクロックを速めるように構成した。これによって、ディジタルネットワークに接続された機器におけるクロックの同期をとることが可能となる。

【００９５】また、ネットワークに接続された複数の入出力機器間の位相(タイミング)の関係について、ディジタルネットワークでは伝送遅延が固定ではないことから、十分に小さい位相誤差にて出力されるという保証が無い。また、アナログ接続に比べて遅延の絶対値が大きくなる。しかしながら、本実施の形態によれば、まず、上記のように、同じ時計を各機器で動作させ、入出力タイミングをその時計の時刻で指定することで、位相情報(入出力時刻/タイミング)配信を行っている。また、ネットワーク(通信)ディレイと末端機器におけるデコードディレイを考慮し、コンテンツの再生に際して生じるディレイ分を補正するように構成した。これによって、理想状態で位相を合わせた上で実際の位相調整を行うことが可能となる。

【００９６】尚、本実施の形態にて説明したデコードディレイに代表される変換ディレイには、例えば、サンプリング周波数変換、ノイズフィルタ、また、サラウンド機能を通した場合のディレイ等の各種ディレイを含むことができる。また、本実施の形態では、ストリームを再生して出力するデコーダを備える出力機器を中心に説明したが、例えば、ディジタルカメラやマイク、リモコン操作等を行うスイッチ等、各種入力機器がディジタルネットワークに接続された態様に対しても適用することができる。かかる態様の場合には、エンコードしてストリームを生成する際に生じるエンコードディレイを考慮し、位相の同期が図られる。

【００９７】

【発明の効果】以上説明したように、本発明によれば、ディジタルネットワークに接続された各機器の間において、同期をとることが可能となる。

【図面の簡単な説明】

【図１】　本実施の形態におけるネットワークシステムの全体像を示した構成図である。

【図２】　クロックソースにおける第１の構成例を示した図である。

【図３】　クロックソースにおける第２の構成例を示した図である。

【図４】　図１に示したコントローラの構成を説明するための図である。

【図５】　図１に示したコンテンツソースの構成を説明するための図である。

【図６】　図１に示したスピーカの構成を説明するための図である。

【図７】　図１に示したディスプレイの構成を説明するための図である。

【図８】　クロック配信におけるクロックソースの動作を説明するための図である。

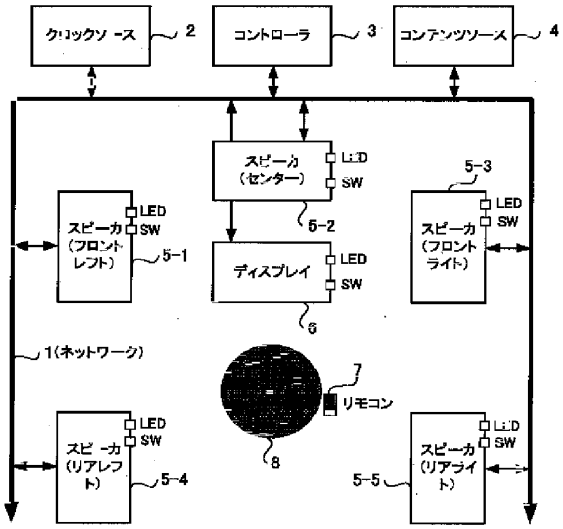
【図９】　クロック再生における時刻合わせの処理を説明するためのフローチャートである。

【図１０】　ネットワークに各機器が接続された直後からの処理を示したフローチャートである。

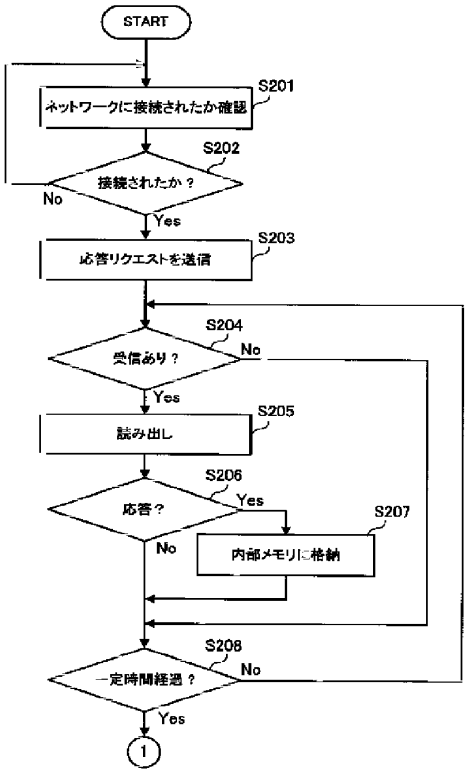
【図１１】　ネットワークに各機器が接続された直後からの処理を示したフローチャートである。

【図１２】　機器データベースの構造を示した図である。
【図１３】　コントローラのＲＡＭに置かれている機器データベースの内容を示した図である。
【図１４】　ＭＰＥＧ２システム(ISO13818 - 1)に準拠したデコーダシステムの概略を示した図である。
【図１５】　ＭＥＰＧデコーダに供給されるデータフォーマットの一例を示した図である。
【図１６】　ＳＣＲとＰＴＳＶ(ＰＴＳｖｉｄｅｏ)、ＳＣＲとＰＴＳＡ(ＰＴＳａｕｄｉｏ)の関係を示した図である。
【図１７】　本実施の形態におけるディレイを説明するための図である。
【図１８】　位置補償ディレイの最大値を考慮した場合のディレイを説明するための図である。
【符号の説明】
１…ネットワーク、２…クロックソース、３…コントローラ、４…コンテンツソース、５(５－１～５－５)…スピーカ、６…ディスプレイ、１１…クロック発振器、１２…カウンタ、１３…タイマ、１４…ラッチ、１５…ネットワークインタフェース、２０…システムバス、２１…クロック発振器、２２…カウンタ、２３…タイマ、２４…ラッチ、２５…ＣＰＵ、２６…ネットワークインタフェース、３１…ＣＰＵ、３２…ＲＯＭ、３３…ＲＡＭ、３４…システムバス、３５…ネットワークインタフェース、４１…ＣＰＵ、４４…システムバス、４５…ネットワークインタフェース、４６…クロック発振器、４７…カウンタ、４８…ハードディスク装置、４９…ビットストリーム解析器、５０…バッファ、５１…ＣＰＵ、５４…システムバス、５５…ネットワークインタフェース、５６…クロック発振器、５７…カウンタ、５９…バッファ、６０…タイムスタンプ抽出器、６１…デコーダ、７１…ＣＰＵ、７５…ネットワークインタフェース、７６…クロック発振器、７７…カウンタ、７９…バッファ、８０…タイムスタンプ抽出器、８１…デコーダ

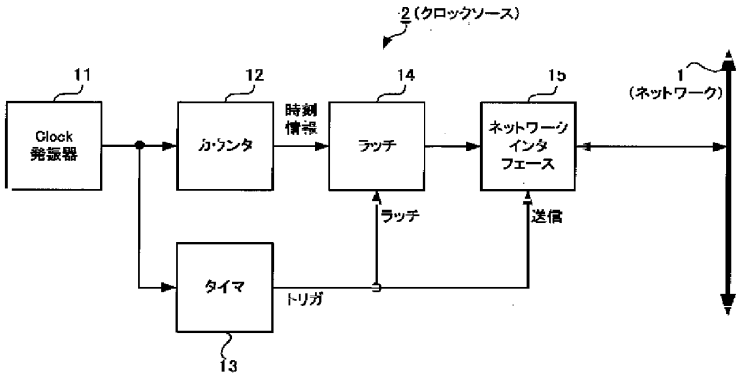
【図１】



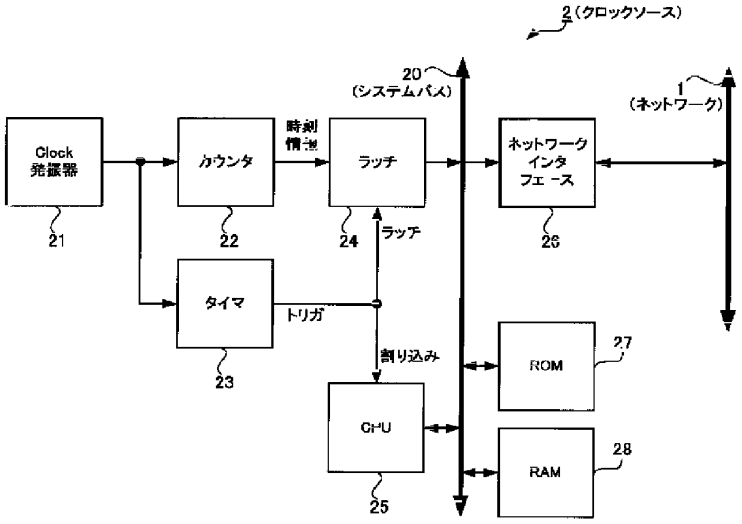
【図１０】



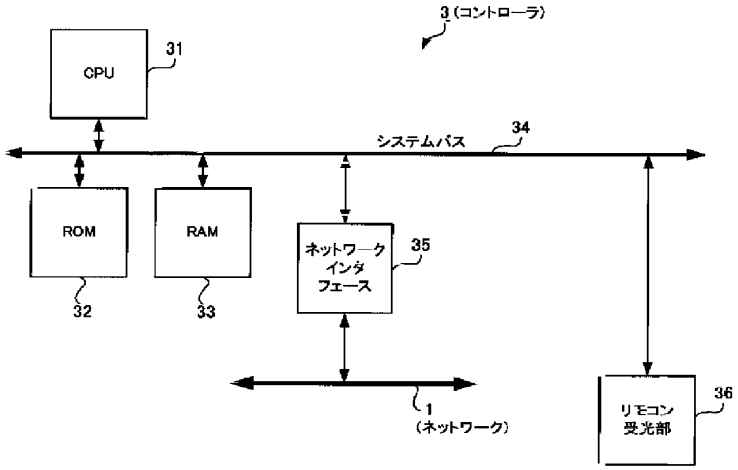
【図２】


2（クロックソース）
11
12
14
15
1
（ネットワーク）
Clock
発振器
カウンタ
時刻
情報
ラッチ
ネットワーク
インタ
フェース
ラッチ
送信
タイマ
トリガ
13

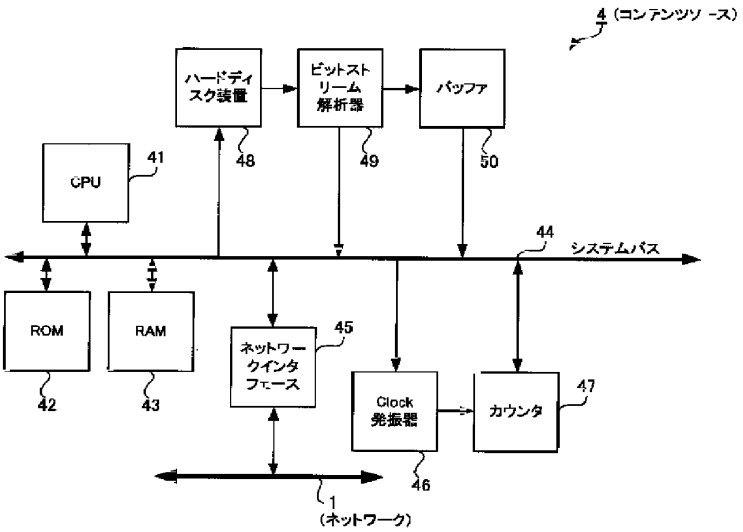
【図３】


2（クロックソース）
20
（システムバス）
1
（ネットワーク）
Clock
発振器
カウンタ
時刻
情報
ラッチ
ネットワーク
インタ
フェース
21
22
24
ラッチ
26
タイマ
トリガ
割り込み
ROM
27
CPU
RAM
28
23
25

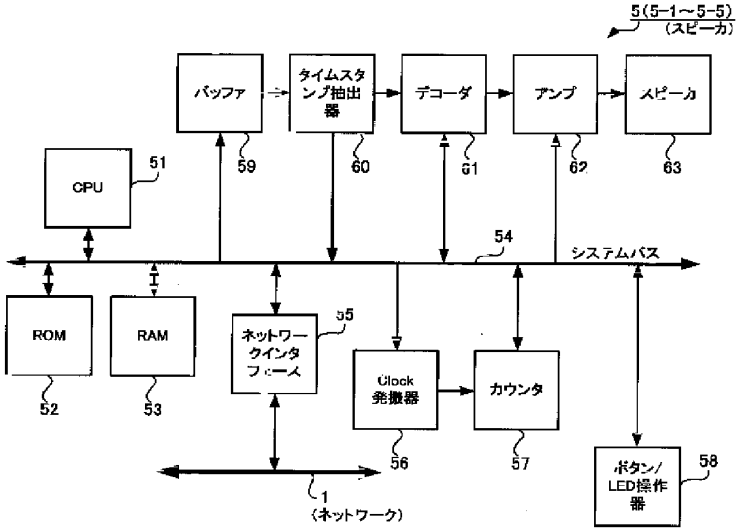
【図４】


3（コントローラ）
CPU
31
システムバス
34
ROM
RAM
ネットワークインタフェース
35
32
33
1
（ネットワーク）
リモコン受光部
36

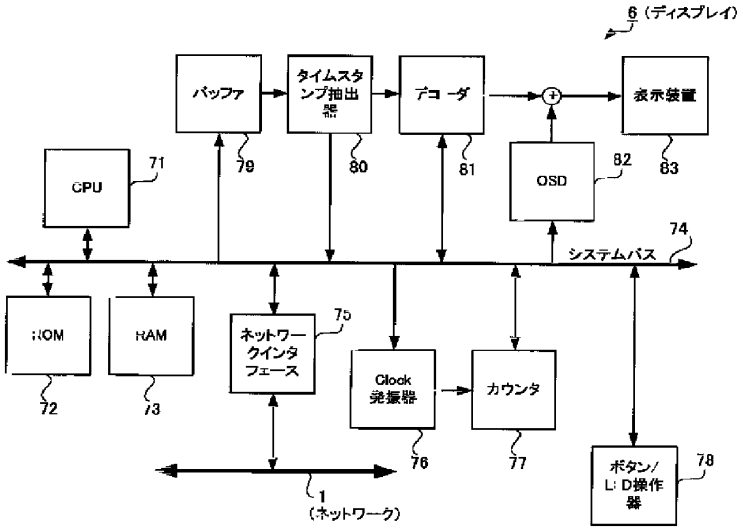
【図５】


4（コンテンツソース）
ハードディスク装置
ビットストリーム解析器
バッファ
48
49
50
CPU
41
44
システムバス
ROM
RAM
ネットワークインタフェース
45
Clock発振器
カウンタ
47
42
43
46
1
（ネットワーク）

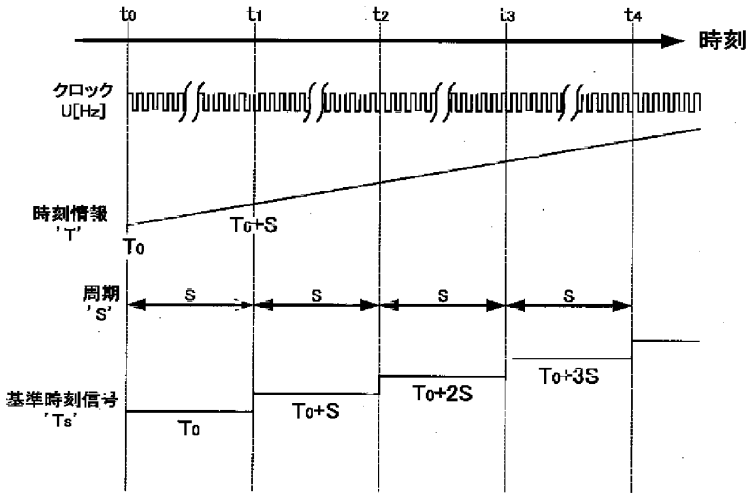
【図６】


5(5-1～5-5)
(スピーカ)
バッファ
タイムスタンプ抽出器
デコーダ
アンプ
スピーカ
59
60
61
62
63
CPU
51
54
システムバス
ROM
RAM
ネットワークインタフェース
55
Clock発振器
カウンタ
52
53
56
57
ボタン/LED操作器
58
1
(ネットワーク)

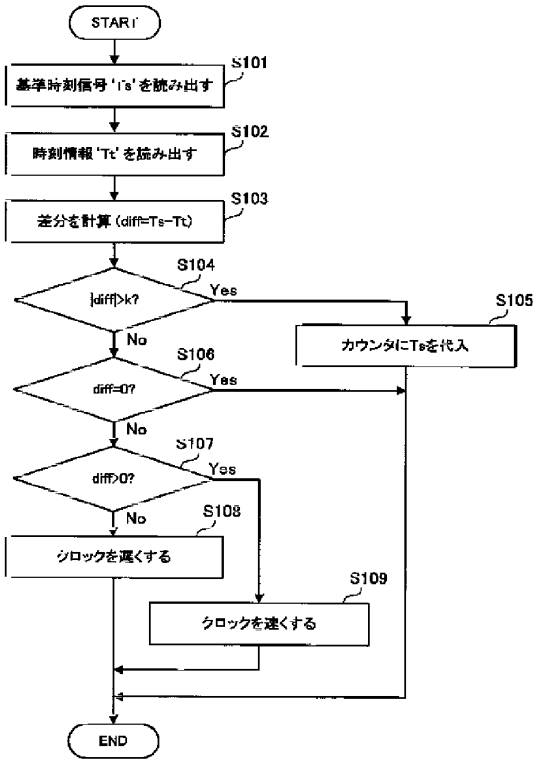
【図７】


6 (ディスプレイ)
バッファ
タイムスタンプ抽出器
デコーダ
表示装置
79
80
81
83
CPU
71
OSD
82
74
システムバス
ROM
RAM
ネットワークインタフェース
75
Clock発振器
カウンタ
72
73
76
77
ボタン/LED操作器
78
1
(ネットワーク)

【図８】



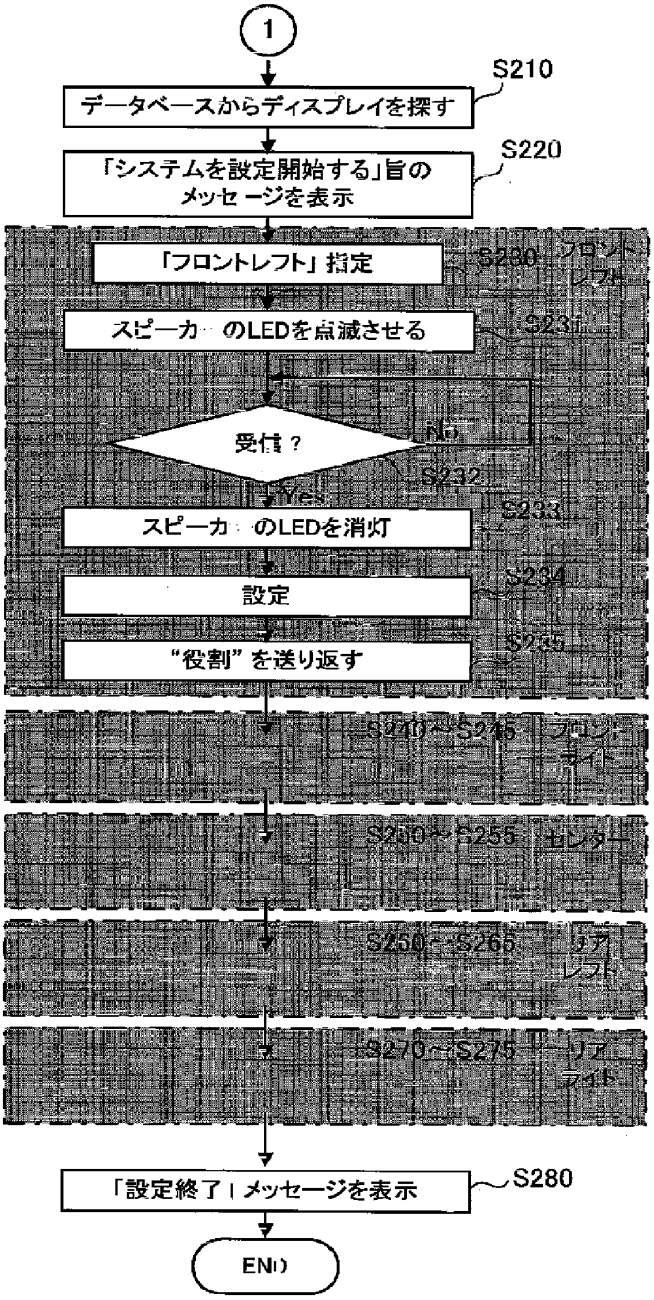
【図９】



【図１２】

エントリ数		N
第1番目	ネットワークアドレス	xxx.xxx.xxx.xxx
	種別	ディスプレイ
	役割	—
	デコードディレイ	xx.x
第2番目	ネットワークアドレス	xxx.xxx.xxx.xxx
	種別	モノラルスピーカ
	役割	—
	デコードディレイ	xx.x
第3番目	ネットワークアドレス	xxx.xxx.xxx.xxx
	種別	モノラルスピーカ
	役割	—
	デコードディレイ	xx.x

【図11】

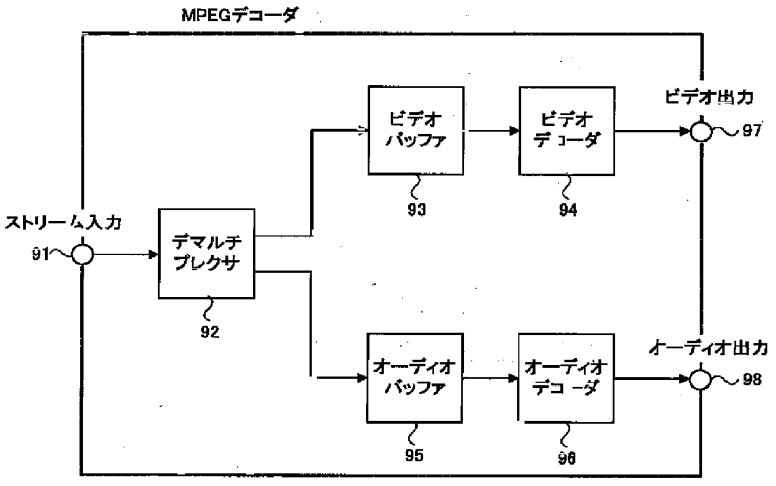

1
S210
データベースからディスプレイを探す
S220
「システムを設定開始する」旨のメッセージを表示
「フロントレフト」指定
S230
フロントレフト
スピーカのLEDを点滅させる
S231
受信？
No
S232
Yes
スピーカのLEDを消灯
S233
設定
S234
"役割"を送り返す
S235
S240～S245
フロントライト
S250～S255
センター
S260～S265
リアレフト
S270～S275
リアライト
「設定終了」メッセージを表示
S280
END

【図１３】

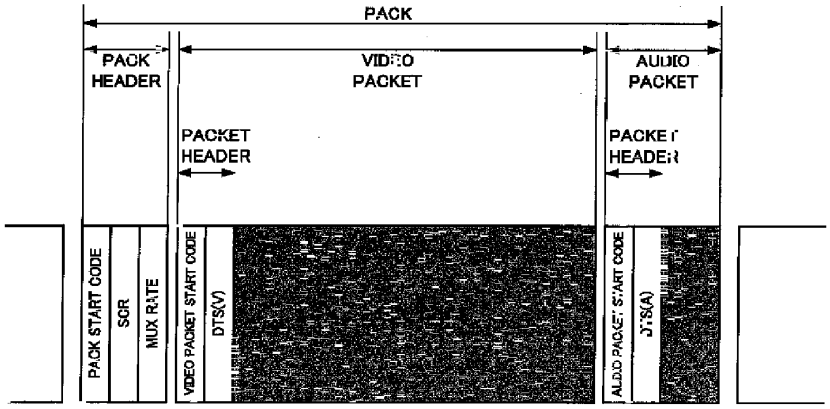
エントリ数	7

ネットワークアドレス	種別	役割	デコードディレイ	(参考)
xxx.xxx.xxx.xxx	ディスプレイ	—		(ディスプレイ 6)
xxx.xxx.xxx.xxx	モノラルスピーカ	—		(スピーカ 5-1)
xxx.xxx.xxx.xxx	モノラルスピーカ	—		(スピーカ 5-2)
xxx.xxx.xxx.xxx	モノラルスピーカ	—		(スピーカ 5-3)
xxx.xxx.xxx.xxx	モノラルスピーカ	—		(スピーカ 5-4)
xxx.xxx.xxx.xxx	モノラルスピーカ	—		(スピーカ 5-5)
xxx.xxx.xxx.xxx	コンテンツソース	—		(コンテンツソース 4)

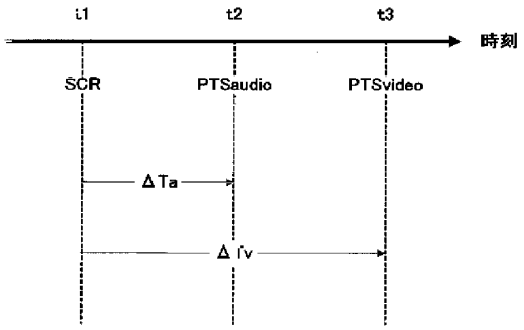
【図１４】



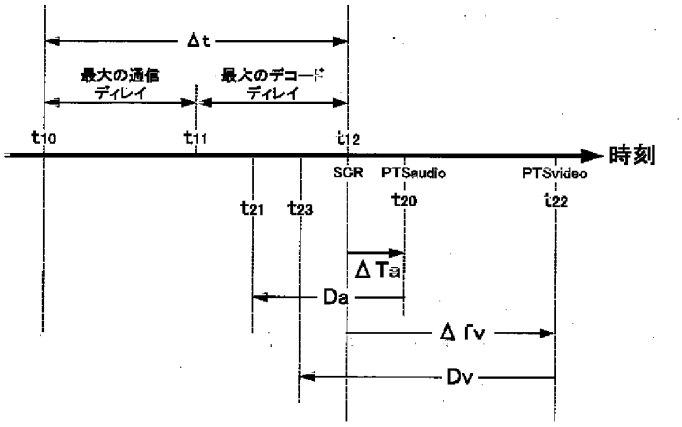
【図15】


PACK
PACK HEADER
VIDEO PACKET
AUDIO PACKET
PACKET HEADER
PACKET HEADER
PACK START CODE
SCR
MUX RATE
VIDEO PACKET START CODE
DTS(V)
AUDIO PACKET START CODE
DTS(A)

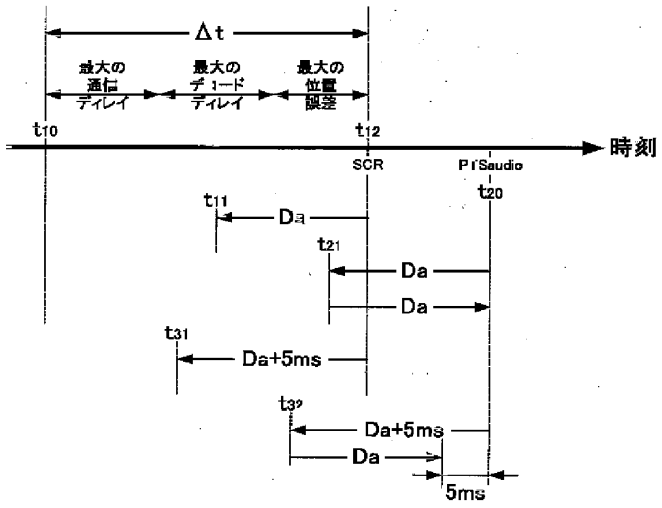
【図16】


t1
t2
t3
時刻
SCR
PTSaudio
PTSvideo
ΔTa
ΔTv

【図17】


Δt
最大の通信ディレイ
最大のデコードディレイ
t10
t11
t12
時刻
SCR
PTSaudio
PTSvideo
t21
t23
t20
t22
ΔTa
Da
ΔTv
Dv

【図18】


Δt
最大の通信ディレイ
最大のデコードディレイ
最大の位置誤差
t10
t12
時刻
SCR
PTSaudio
t20
t11
Da
t21
Da
Da
t31
Da+5ms
t39
Da+5ms
Da
5ms

Espacenet

Bibliographic data: JP2003101958 (A) — 2003-04-04

METHOD AND DEVICE FOR SYNCHRONOUS REPRODUCTION

Inventor(s): IDE KENICHI ± (IDE KENICHI)

Applicant(s): TOSHIBA CORP ± (TOSHIBA CORP)

Classification: **- international:** ***H04B1/16; H04L7/00; H04N5/93;***
(IPC1-7): H04B1/16; H04L7/00; H04N5/93
- cooperative:

Application number: JP20010287375 20010920

Priority number(s): JP20010287375 20010920

Also published as: JP3544963 (B2)

Abstract of JP2003101958 (A)

PROBLEM TO BE SOLVED: To synchronize information synchronized with each other such as a moving picture and sound accompanying the moving picture in different devices and to reproduce the information without transmitting information about reproducing time. SOLUTION: A maximum estimation value of the total delay time including the transmission delay time of data and a processing delay time needed for decoding processing, etc., is defined as delayMax. A value Period larger than the delayMax is defined, and a reproduction start reference point is provided on a time base with an interval Period. An alpha is defined by (Period-delayMax), and the section between the reproduction start reference point and the Alpha is defined as a transmission commenceable section. A transmitting side device starts to transmit data within the transmission commenceable section.; After the data reach a receiving side device, the existence range of a time R when the data can be reproduced after being subjected to processing such as decoding is limited to a range existing after a transmission start time S and up to the first reproduction start reference point to come after passing the transmission commenceable section. The transmitting side device and the receiving side device individually start reproduction by taking the reproduction start reference point P0 as a reference.

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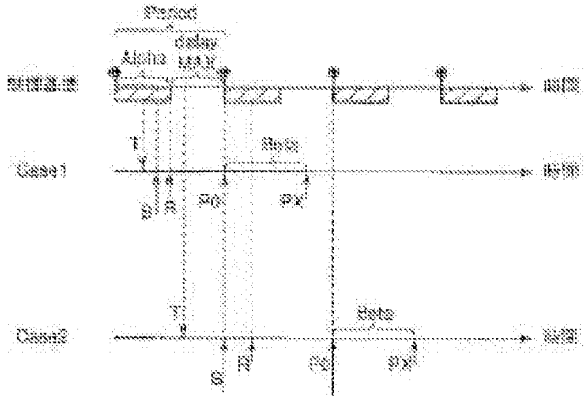

[illegible]
[illegible]
T [illegible]
S [illegible]
R [illegible]
P0 [illegible]
PX [illegible]
Period [illegible]
delayMax [illegible]
Alpha =Period−delayMax
Beta [illegible]

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（P2003－101958A）
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Ｈ０４Ｂ　1/16		Ｈ０４Ｌ　7/00	Ｚ	５Ｋ０４７
Ｈ０４Ｌ　7/00		Ｈ０４Ｎ　5/93	Ａ	５Ｋ０６１

審査請求　有　　請求項の数18　ＯＬ　（全 10 頁）

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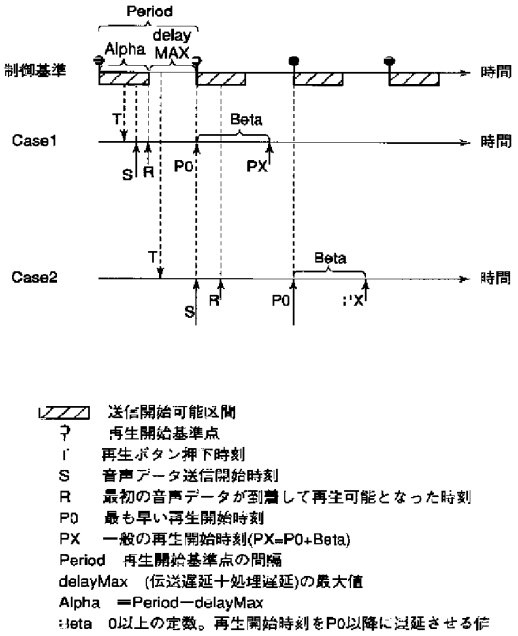
Ｆターム(参考)　5C053 FA24 GB21 JA01 JA22 JA26
KA24 LA05 LA06 LA20
5K047 AA03 AA18 BB01 DD01 DD02
JJ08 MM23
5K061 AA15 EF06

(54)【発明の名称】　同期再生のための方法および装置

(57)【要約】
【課題】再生時刻に関する情報を送信することなく、動画とそれに付随する音声のように互いに同期した情報を異なる機器で同期して再生する。
【解決手段】データの伝送遅延時間と復号処理などに要する処理遅延時間を含む合計の遅延時間の最大見積もり値をdelayMaxとする。そして、delayMaxよりも大きい値Periodを定め、間隔Periodで時間軸上に再生開始基準点を設ける。また、Alphaを（Period － delayMax）と定め、前記再生開始基準点からAlphaの区間を送信開始可能区間とする。送信側機器は送信開始可能区間内にデータ送信を開始する。このデータが受信側機器に届いた後、復号などの処理を経て再生可能になる時刻Ｒの存在範囲は送信開始時刻Ｓ以降で、送信開始可能区間経過後に最初に到来する再生開始基準点までの範囲に限定される。この再生開始基準点をＰＯを基準として、送信側機器および受信側機器がそれぞれ再生を開始する。



送信開始可能区間
再生開始基準点
Ｔ　再生ボタン押下時刻
Ｓ　音声データ送信開始時刻
Ｒ　最初の音声データが到着して再生可能となった時刻
Ｐ0　最も早い再生開始時刻
ＰＸ　一般の再生開始時刻(PX=P0+Beta)
Period　再生開始基準点の間隔
delayMax　(伝送遅延＋処理遅延)の最大値
Alpha　=Period－delayMax
Beta　0以上の定数。再生開始時刻をP0以降に遅延させる値

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【特許請求の範囲】

【請求項１】　第一のデータの再生を行いかつ同期して再生すべき第二のデータを通信路を介して送信する第一の機器と前記第一の機器から送信された第二のデータを受信して再生する第二の機器との間で、前記第一および第二のデータの再生タイミングを同期させるための同期再生方法であって、

前記第二のデータの送信は、前記第二のデータを送信してから受信側で再生可能になるまでの最大遅延時間に所定の送信開始可能区間を加えた時間間隔で時間軸上に一意に定められる複数の基準点の内、いずれかの基準点から始まる送信開始可能区間内に開始し、

前記第一および第二のデータの再生は、前記第二のデータの送信を開始した送信開始可能区間後の最初の基準点を基に開始することを特徴とする同期再生方法。

【請求項２】　前記第二のデータの送信を開始する前に、前記第一の機器と前記第二の機器との間で、前記第一および第二の機器がそれぞれ前記基準点を定める時間軸の時刻基準となる時計を同期させる同期処理を実行することを特徴とする請求項１記載の同期再生方法。

【請求項３】　前記第一のデータは動画データであり、前記第二のデータは音声データであることを特徴とする請求項１記載の同期再生方法。

【請求項４】　前記第一のデータは音声データであり、前記第二のデータは動画データであることを特徴とする請求項１記載の同期再生方法。

【請求項５】　前記第一および第二のデータの再生は、前記第二のデータの送信を開始した送信開始可能区間後の最初の基準点から予め定められた時間が経過した時点で開始することを特徴とする請求項１記載の同期再生方法。

【請求項６】　前記通信路は、無線通信路であることを特徴とする請求項１記載の同期再生方法。

【請求項７】　第一のデータの再生を行いかつ同期して再生すべき第二のデータの再生開始を指示する再生開始コマンドを通信路を介して送信する第一の機器と前記第一の機器から送信された再生開始コマンドに応答して前記第二のデータの再生を行う第二の機器との間で、前記第一および第二のデータの再生タイミングを同期させるための同期再生方法であって、

前記再生開始コマンドの送信は、前記再生開始コマンドを送信してから受信側で前記再生開始コマンドに応答した再生処理を開始可能になるまでの最大遅延時間に所定の送信開始可能区間を加えた時間間隔で時間軸上に一意に定められる複数の基準点の内、いずれかの基準点から始まる送信開始可能区間内に開始し、

前記第一および第二のデータの再生は、前記再生開始コマンドの送信を開始した送信開始可能区間後の最初の基準点を基に開始することを特徴とする同期再生方法。

【請求項８】　前記再生開始コマンドの送信を開始する前に、前記通信路を介して前記第一の機器から前記第二の機器に前記第二のデータの送信を開始することを特徴とする請求項７記載の同期再生方法。

【請求項９】　第一のデータの再生を行いかつ同期して再生すべき第二のデータを通信路を介して送信する第一の機器と前記第一の機器から送信された第二のデータを受信して再生する第二の機器とを含む同期再生システムであって、

前記第一の機器は、

前記第二のデータを送信してから受信側で再生可能になるまでの最大遅延時間に所定の送信開始可能区間を加えた時間間隔で時間軸上に一意に定められる複数の基準点の内、いずれかの基準点から始まる送信開始可能区間内に、前記第二のデータの送信を開始する手段と、前記第二のデータの送信を開始した送信開始可能区間後の最初の基準点を基に、前記第一のデータの再生を開始する手段とを具備し、

前記第２の機器は、

前記第二のデータを受信する手段と、

前記時間間隔で時間軸上に一意に定められた前記複数の基準点を管理し、前記受信した第二のデータの再生開始可能後の最初の基準点を基に、前記第二のデータの再生を開始する手段とを具備することを特徴とする同期再生システム。

【請求項１０】　第一のデータの再生を行いかつ同期して再生すべき第二のデータの再生開始を指示する再生開始コマンドを通信路を介して送信する第一の機器と前記第一の機器から送信された再生開始コマンドに応答して前記第二のデータの再生を行う第二の機器とを含む同期再生システムであって、

前記第一の機器は、

前記再生開始コマンドを送信してから受信側で前記再生開始コマンドに応答した再生処理を開始可能になるまでの最大遅延時間に所定の送信開始可能区間を加えた時間間隔で時間軸上に一意に定められる複数の基準点の内、いずれかの基準点から始まる送信開始可能区間内に、前記再生開始コマンドの送信を開始する手段と、

前記再生開始コマンドの送信を開始した送信開始可能区間後の最初の基準点を基に、前記第一のデータの再生を開始する手段とを具備し、

前記第二の機器は、

前記再生開始コマンドを受信する手段と、

前記時間間隔で時間軸上に一意に定められる前記複数の基準点を管理し、前記再生開始コマンドに応答して再生処理が開始可能になった後の最初の基準点を基に、前記第二のデータの再生を開始する手段とを具備することを特徴とする同期再生システム。

【請求項１１】　第一のデータの再生を行いかつ同期して再生すべき第二のデータを通信路を介して受信側の装置に送信可能な再生装置であって、

前記第二のデータを送信してから受信側で再生可能になるまでの最大遅延時間に所定の送信開始可能区間を加えた時間間隔で時間軸上に一意に定められる複数の基準点の内、いずれかの基準点から始まる送信開始可能区間内に、前記第二のデータの送信を開始する手段と、
前記第二のデータの送信を開始した送信開始可能区間後の最初の基準点を基に、前記第一のデータの再生を開始する手段とを具備することを特徴とする再生装置。
【請求項１２】　第一のデータを再生する送信側装置から通信路を介して送信される第二のデータを受信して再生する再生装置であって、
前記第二のデータを送信してから受信側で再生可能になるまでの最大遅延時間に所定の送信開始可能区間を加えた時間間隔で時間軸上に一意に定められる複数の基準点の内、いずれかの基準点から始まる送信開始可能区間内に前記送信側装置によって送信が開始された前記第二のデータを受信する手段と、
前記時間間隔で時間軸上に一意に定められた前記複数の基準点を管理し、前記受信した第二のデータの再生開始可能後の最初の基準点を基に、前記第二のデータの再生を開始する手段とを具備することを特徴とする再生装置。
【請求項１３】　第一のデータの再生を行いかつ同期して再生すべき第二のデータの再生開始を指示する再生開始コマンドを通信路を介して受信側の装置に送信可能な再生装置であって、
前記再生開始コマンドを送信してから受信側で前記再生開始コマンドに応答した再生処理を開始可能になるまでの最大遅延時間に所定の送信開始可能区間を加えた時間間隔で時間軸上に一意に定められる複数の基準点の内、いずれかの基準点から始まる送信開始可能区間内に、前記再生開始コマンドの送信を開始する手段と、
前記再生開始コマンドの送信を開始した送信開始可能区間後の最初の基準点を基に、前記第一のデータの再生を開始する手段とを具備することを特徴とする再生装置。
【請求項１４】　第一のデータを再生する送信側装置から通信路を介して送信される再生開始コマンドに応答して、前記第一のデータと同期して再生すべき第二のデータを再生する再生装置であって、
前記再生開始コマンドを送信してから受信側で前記再生開始コマンドに応答した再生処理を開始可能になるまでの最大遅延時間に所定の送信開始可能区間を加えた時間間隔で時間軸上に一意に定められる複数の基準点の内、いずれかの基準点から始まる送信開始可能区間内に前記送信側装置が送信を開始した前記再生開始コマンドを受信する手段と、
前記時間間隔で時間軸上に一意に定められる前記複数の基準点を管理し、前記再生開始コマンドに応答して再生処理が開始可能になった後の最初の基準点を基に、前記第二のデータの再生を開始する手段とを具備することを特徴とする再生装置。
【請求項１５】　コンピュータに第一のデータを再生させ且つ前記第一のデータと同期して再生すべき第二のデータを通信路を介して受信側の装置に送信させるコンピュータプログラムであって、
前記第二のデータを送信してから受信側で再生可能になるまでの最大遅延時間に所定の送信開始可能区間を加えた時間間隔で時間軸上に一意に定められる複数の基準点の内、いずれかの基準点から始まる送信開始可能区間内に、前記第二のデータの送信を前記コンピュータに開始させる手順と、
前記第二のデータの送信を開始した送信開始可能区間後の最初の基準点を基に、前記第一のデータの再生を前記コンピュータに開始させる手段とを具備することを特徴とするコンピュータプログラム。
【請求項１６】　第一のデータを再生する送信側装置から通信路を介して送信される第二のデータをコンピュータに再生させるコンピュータプログラムであって、
前記第二のデータを送信してから受信側で再生可能になるまでの最大遅延時間に所定の送信開始可能区間を加えた時間間隔で時間軸上に一意に定められる複数の基準点の内、いずれかの基準点から始まる送信開始可能区間内に前記送信側装置によって送信が開始された前記第二のデータを前記コンピュータに受信させる手順と、
前記時間間隔で時間軸上に一意に定められた前記複数の基準点を前記コンピュータに管理させ、前記受信した第二のデータの再生開始可能後の最初の基準点を基に、前記第二のデータの再生を前記コンピュータに開始させる手順とを含むことを特徴とするコンピュータプログラム。
【請求項１７】　コンピュータに第一のデータを再生させ且つ前記第一のデータと同期して再生すべき第二のデータの再生開始を指示する再生開始コマンドを通信路を介して受信側の装置に送信させるコンピュータプログラムであって、
前記再生開始コマンドを送信してから受信側で前記再生開始コマンドに応答した再生処理を開始可能になるまでの最大遅延時間に所定の送信開始可能区間を加えた時間間隔で時間軸上に一意に定められる複数の基準点の内、いずれかの基準点から始まる送信開始可能区間内に、前記再生開始コマンドの送信を前記コンピュータに開始させる手順と、
前記再生開始コマンドの送信を開始した送信開始可能区間後の最初の基準点を基に、前記第一のデータの再生を前記コンピュータに開始させる手順とを具備することを特徴とするコンピュータプログラム。
【請求項１８】　第一のデータを再生する送信側装置から通信路を介して送信される再生開始コマンドに応答して、コンピュータに前記第一のデータと同期して再生すべき第二のデータを再生させるコンピュータプログラム

であって、
前記再生開始コマンドを送信してから受信側で前記再生開始コマンドに応答した再生処理を開始可能になるまでの最大遅延時間に所定の送信開始可能区間を加えた時間間隔で時間軸上に一意に定められる複数の基準点の内、いずれかの基準点から始まる送信開始可能区間内に前記送信側装置が送信を開始した前記再生開始コマンドを前記コンピュータに受信させる手順と、
前記時間間隔で時間軸上に一意に定められる前記複数の基準点を前記コンピュータに管理させ、前記再生開始コマンドに応答して再生処理が開始可能になった後の最初の基準点を基に、前記第二のデータの再生を前記コンピュータに開始させる手順とを具備することを特徴とするコンピュータプログラム。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は例えば動画データと音声データのように同期して再生する必要がある第一及び第二のデータを再生するための方法および装置に関し、特に第一及び第二のデータを互いに異なる機器で同期して再生するための方法および装置に関する。
【０００２】
【従来の技術】動画データ、音声データのようなストリームデータを送信側機器から受信側機器へ伝送して、予め定められた時刻に処理させる方法としては、例えば特開平１１　３１７７４８号公報に開示された手法に見られるように、送信するデータに処理されるべき時刻情報を付加して送信し、受信側では受信したデータに含まれる処理すべき時刻の到来を待ってデータを処理する方法が知られている。
【０００３】
【発明が解決しようとする課題】しかし、上記手法ではデータを処理すべき時刻を示すタイムスタンプをデータの他に送信する必要があった。このため、データを送信する手順やデータ形式とあわせて、データを処理すべき時刻を示すタイムスタンプについてもそれを送信する手順や形式が定められている必要がある。よって、これらが定められていない通信規約を用いる場合には適用できないという問題があった。
【０００４】本発明は上述の事情を考慮してなされたもので、再生時刻に関する情報を送信することなく、動画とそれに付随する音声のように互いに同期した情報を異なる機器で同期して再生することが可能な方法および装置を提供することを目的とする。
【０００５】
【課題を解決するための手段】上述の課題を解決するため、本発明は、第一のデータの再生を行いかつ同期して再生すべき第二のデータを通信路を介して送信する第一の機器と前記第一の機器から送信された第二のデータを受信して再生する第二の機器との間で、前記第一および第二のデータの再生タイミングを同期させるための同期再生方法であって、前記第二のデータの送信は、前記第二のデータを送信してから受信側で再生可能になるまでの最大遅延時間に所定の送信開始可能区間を加えた時間間隔で時間軸上に一意に定められる複数の基準点の内、いずれかの基準点から始まる送信開始可能区間内に開始し、前記第一および第二のデータの再生は、前記第二のデータの送信を開始した送信開始可能区間後の最初の基準点を基に開始することを特徴とする。
【０００６】このように、最大遅延時間に所定の送信開始可能区間を加えた時間間隔で予め時間軸上に複数の基準点を定め、これら複数の基準点の内のいずれかの基準点から始まる送信開始可能区間内に第二のデータの送信を開始することで、次の基準点以前に第二のデータが受信側で再生可能になることを保証することができる。よって、送信側と受信側が予め定められた同一の規則で複数の基準点それぞれの時刻を定めるだけで、再生時刻に関する情報を何等送信することなく、動画とそれに付随する音声のように互いに同期した情報を異なる機器で同期して再生することが可能となる。
【０００７】
【発明の実施の形態】以下、図面を参照して本発明の実施の形態を説明する。図１には、本発明の一実施形態に係る同期再生システムが示されている。この同期再生システムは音声が付随した動画データを再生するシステムであり、図１に示すように２台の機器から構成されている。第一の機器（送信側機器）１１は動画データおよびそれに付随する音声データが記録されている記憶装置を備え、動画データを再生してディスプレイ上に再生すると同時に、第二の機器（受信側機器）１４に通信路１３を介して音声データを送信する。この第一の機器１１は例えば携帯情報端末、ビデオプレーヤ、パーソナルコンピュータなどの電子機器から構成される。一方、第二の機器１４は、音声データの受信部と受信した音声データを再生する機構を備えており、第一の機器１１から受信した音声データを再生する。この第二の機器１４も第一の機器１１と同様に様々な電子機器として実現できるが、その典型的な一例としてはヘッドフォンである。
【０００８】このシステムでは通信路１３として無線通信路が用いられており、例えばＢｌｕｅｔｏｏｔｈ（２．４ＧＨｚ　ＩＳＭ帯を用いる短距離無線通信方式）を用いることによって動画表示を行う機器と音声の再生を行う機器とを無線接続することによって、便利な視聴システムを実現している。
【０００９】ここで、第一の機器１１で再生される動画データの呈示と第二の機器１４で再生される音声データの発音を同期させることによっていわゆるリップシンク(lipsync)を実現したいと考える。
【００１０】次に、上記の要求を実現するために必要な技術的要素について説明する。動画データとそれに付随

する音声データは、それらをディジタルデータとして取り込む際に、互いの時間関係を保存することが既に行われている。例えばパーソナルコンピュータ上の音声つき動画データの形式として用いられているＡＶＩ形式（Audio Video Interleave Format）では、動画および音声のメディア毎に、サンプリングレートが記録されており、かつ、記録されている各々のメディアの再生開始時刻が一致しているという仕組みになっている。このため、各々の再生を同時に開始し、かつ、各々のメディアの再生速度を、単一の時計あるいは正確に同期した時計とサンプリングレートに従って決めることによって、リップシンク（lip sync）を保つことができる仕組みになっている。

【００１１】また、複数のメディアの再生を同期させる他の方法としては、インターネット上のストリーミング伝送で用いられるＲＴＰ（Real time Transfer Protocol,インターネット上で動画,音声などのメディアデータを送受信するための方式。IETFのRFC1889等で規格化されている。）に見られるように、一群のメディアデータ毎にタイムスタンプを付与すると共にサンプリングレートに関する情報を付与するなどの方法も用いられている。

【００１２】このように、互いに同期して再生されるべき複数のメディアデータを同期して再生するためには、進み方が正確な時計と例えばメディアデータの呈示開始時刻を一致させる手段が必要である。

【００１３】ここで本発明が解決しようとする状況では、動画および音声データは異なる機器上で再生される。そこで、前述の要件を満たすためには、各々の機器の時計間で時刻の同期をとり、さらに、各々のメディアデータの再生開始時刻を２台の機器同上で示し合わせることが必要となる。

【００１４】まず、時刻の同期をとる件については、例えばＮＴＰ（Network Time Protocol、インターネット上で計算機同士の時刻あわせを行うための方式。IETFのRFC1305等で規格化されている。）と呼ばれる時刻合わせ方式を用いることで実現可能である。あるいは、例えば特開２０００－３３２８０２号公報に開示されているように、時刻情報を送信側機器から受信側機器へ送り、受信側機器の時計を送信側機器に合わせることによっても実現可能である。これら２例の他にも、方式によって実現可能な時刻あわせの精度が異なるものの、様々な時刻あわせ手法が知られており、これらの内の任意の手法を用いることが可能である。

【００１５】次に、再生開始時刻を示しあわせる件については、本実施形態では次のような方法を使用する。

【００１６】本実施形態では再生開始時刻に関する情報を機器間で伝送せずに、再生開始時刻を合わせることが特徴である。まず、前提条件として以下の条件を設ける。

前提条件：

・２台の機器１１，１４の時計は互いに同期している。

・送信側機器１１から受信側機器１４へ最初のメディアデータを送信する時刻Ｓを送信側機器１１は制御できる。

・送信側機器１１から受信側機器１４へのメディアデータ送信から、受信されたデータが再生されるまでの所要時間delayMax(伝送遅延、メディアデータのデコード処理などに必要な処理遅延時間を含む)の最大値を見積もり可能。

【００１７】上記の前提条件の下で、以下に示す方法によって再生開始時刻を同期させる。

同時刻に再生を開始する方法：送信側機器１１および受信側機器１４がメディアデータ、例えば動画と音声データを再生開始可能な時刻（再生開始基準点）は、予め定められた離散的な時刻に限る。各々の時刻の間隔はPeriod (= Alpha + delayMax)とする。Period, Alpha, delayMaxの定義は以下の通りである。

【００１８】

・delayMax　(伝送遅延+処理遅延)の最大見積もり値

・Period　再生開始基準点の間隔

・Alpha　(= Period - delayMax)

送信側機器１１がメディアデータを受信側機器１４へ送信開始する時刻Ｓは、各再生開始基準点以降Alphaの区間内に限る。すなわち、送信側機器１１および受信側機器１４ではそれぞれ同一の規則を用いて、互いに同期した時間軸上にPeriodの間隔で再生開始基準点を定める処理が行われる。そして、送信側機器１１から受信側機器１４への音声データの送信は、いずれかの再生開始基準点からAlphaの区間内に開始される。つまりAlphaが送信開始可能区間となる。

【００１９】図２は図１に示した各々の機器のシステム構成図である。まず、送信側機器１１について説明する。送信側機器１１は、図示のように、動画/音声記憶部２１、動画/音声分離部２２、動画復号部２３、動画一時記憶部２４、動画表示部２５、送信データ一時記憶部２６、音声データ送信部２７、制御部２８、時刻管理部２９、および制御データ送受信部２Ａから構成されている。

【００２０】動画/音声記憶部２１には送信側機器１１で再生される動画データと受信側機器１４で再生される音声データが記憶されている。これらのデータはたとえば前述のＡＶＩ形式で保存されており、動画と音声の対応関係を知るために必要な情報とともに記憶されている。また、一般に動画や音声のデータは圧縮されて保存されることが多く、本実施形態の場合も適当な形式で圧縮された上でＡＶＩ形式で保管されているものとする。

【００２１】動画/音声分離部２２は動画/音声記憶部２１から読み込まれたＡＶＩ形式の動画/音声データを動画データと音声データに分離する。動画復号部２３は圧

縮形式の動画データを復号して動画表示部２５で表示可能な形式に変換する。動画一時記憶部２４は復号された動画データを、表示される時点に達するまでの間、一時的に記憶する。一般に動画の復号処理は時間がかかるため、予め復号処理を行って動画一時記憶部２４に保存しておくことによって、表示すべき時刻の到来時に即座に表示することが可能になる。

【００２２】動画表示部２５は動画一時記憶部２４に記憶されている動画データを制御部２８からの指示に従って表示する。送信データ一時記憶部２６は音声データが送信されるべき時刻が来るまでの間、一時的に音声データを記憶する。音声データ送信部２７はＢｌｕｅｔｏｏｔｈなどの無線通信インタフェースを用いて受信側機器１４へ音声データを送信する。

【００２３】制御データ送受信部２AはＢｌｕｅｔｏｏｔｈなどの無線通信インタフェースを介して受信側機器１４との間で制御情報をやりとりする。時刻管理部２９は受信側機器１４の時刻と同期した時刻を刻み、動画再生や音声データの送信の基準となる時刻情報を提供する。受信側機器１４の時刻との同期は制御部２８および制御データ送受信部２Aと連携して前述のＮＴＰ方式などの時刻合わせ手順を実行することで行う。

【００２４】制御部２８は送信側機器１１全体の連携制御を行う。制御部２８は例えば汎用ＣＰＵとＲＡＭ，ＲＯＭで構成されるマイクロコンピュータとして実現することが可能である。また、制御部２８以外の前述した機能モジュールも基本的にマイクロコンピュータにその動作を行わせる形での実現が可能である。

【００２５】受信側機器１４は、図示のように、音声データ受信部２Ｂ、音声復号部２Ｃ、音声データ一時記憶部２Ｄ、音声再生部２Ｅ、制御部２Ｆ、制御データ送受信部２Ｇ、時刻管理部２Ｈから構成されている。

【００２６】音声データ受信部２Ｂは送信側機器１１から送信された音声データを受信する。音声復号部２Ｃは圧縮されている音声データの復号を行い、音声再生部２Ｅで再生可能な形式に変換する。

【００２７】音声データ一時記憶部２Ｄは復号した音声データを再生すべき時刻に達するまでの間、一時的に保存する。一般に音声データは圧縮された形式で伝送される場合が多く、復号には時間がかかるため、予め復号を行って音声データ一時記憶部２Ｄに記憶しておくことによって、再生時刻の到来時に即座に発音させることが可能になる。

【００２８】時刻管理部２Ｈは送信側機器１１の時刻と同期した時刻を刻み、音声データの再生の基準となる時刻情報を提供する。送信側機器１１の時刻との同期は制御部２Ｆおよび制御データ送受信部２Ｇと連携して送信側機器１１と前述のＮＴＰ方式などの時刻合わせ手順を実行することで行う。制御部２Ｆは受信側機器１４全体の連携制御を行う。制御部２Ｆは例えば汎用ＣＰＵとＲＡＭ，ＲＯＭで構成されるマイクロコンピュータとして実現することが可能である。また、制御部２Ｆ以外の前述した機能モジュールも基本的にマイクロコンピュータにその動作を行わせる形での実現が可能である。

【００２９】次に、図３を用いて本実施形態のシステムの動作の概要を説明する。受信側機器１４は通常は待機モードで動作しており、送信側機器１１からの電源ＯＮ指示を受けて待機モードから通常の動作モードへ移行する。待機中は電力消費が非常に低い状態であり、電源ＯＮ指示のみに反応することが可能である。ユーザが送信側機器１１の操作パネル１２の電源オンボタンを操作することにより（Ｓ３８）、電源ＯＮ指示（Ｓ３１）が送信側機器１１から受信側機器１４に送信される。電源ＯＮの後、双方の機器１１，１４は通信路確立処理（Ｓ３２）を行う。

【００３０】次に、時刻あわせ処理（Ｓ３３）を前述のＮＴＰ方式などにより行う。送信側機器１１と受信側機器１４との間の時刻あわせが完了すると、送信側機器１１および受信側機器１４でそれぞれ上述の送信開始可能区間および再生開始基準点が設定されて同期再生を行うための準備が行われる。

【００３１】ユーザが送信側機器１１の操作パネル１２の再生ボタンを押下すると（Ｓ３９）、送信側機器１１では音声データの送信と動画データの再生が行われる。受信側機器１４では受信した音声データの再生が行われる。これらの動作は動画と音声の同期をとるために本発明で提案する手法に従って行われる。この処理の詳細については図４で後述するが、基本的には、送信側機器１１から受信側機器１４への音声データの送信は送信開始可能区間内でのみ開始され、そして、送信側機器１１および受信側機器１４それぞれにおける動画データおよび音声データの再生は、音声データが送信開始された送信開始可能区間後の最初の再生開始基準点を基準とすることにより、同時に開始されることになる。

【００３２】ユーザが操作パネル１２の電源ＯＦＦボタンを押下すると（Ｓ４０）、通信路切断および電源ＯＦＦ処理が行われ、受信側機器１３は待機状態に移行し、送信側機器１１は電源ＯＦＦ状態になる。

【００３３】次に図４を用いて本実施形態の特徴とする同期再生の方法を説明する。

【００３４】データの伝送遅延時間と復号処理などに要する処理遅延時間を含む合計の遅延時間の最大見積もり値をdelayMaxとする。このdelayMaxの値は、予め測定を行うことによって決められる値である。そして、delayMaxよりも大きい値Periodを定め、間隔Periodで時間軸上に再生開始基準点を設ける。また、Alphaを（Period－delayMax）と定め、前記再生開始基準点からAlphaの区間を送信開始可能区間とする。これらの情報は予め決めておくことにより、容易に双方の機器で再生開始基準点の周期を一致させることが可能である。例えば、delayM

axが100msecである場合にPeriodを200msecに定め、200msecの整数倍の時刻を再生開始基準点とするという具合である。時刻合わせを行っているので、双方の機器で各再生開始基準点の時刻は一致する。

【００３５】ここで、図４中のCase1およびCase2の場合を例にあげ、送信開始時刻および再生開始時刻の決め方を説明する。

【００３６】Case1は、送信開始可能区間内の時刻Ｔにユーザが再生ボタンを押下した場合を示している。この場合は、直ちにデータの送信を開始する。図では時刻Ｓで送信している。このデータが受信側機器１４に届いた後、復号などの処理を経て再生可能になる時刻をＲとすれば、前述のdelayMaxの定義からＲの存在範囲は時刻Ｓ以降で、前記送信開始可能区間経過後に最初に到来する再生開始基準点までの範囲に限定される。この再生開始基準点をＰ０とするとＰ０は送信側機器１１においても、受信側機器１４においても一意に定まる。送信側機器１１においては送信開始時刻を把握しているため自明であり、受信側機器１４においてはＲの存在範囲から時刻Ｒ以降の最初の再生可能基準点をＰ０と判断すれば良い。要するに、受信側機器１４では受信データの再生が可能になってから最初の再生開始基準点がＰ０である。

【００３７】そこで、Ｐ０に予め定めた値Betaを加算した時刻ＰＸも一意に定まり、時刻ＰＸに両方の機器で再生を開始することによって、再生開始時刻を一致させることができる。Betaは０以上の値が可能であるが、０にした場合にユーザの再生ボタン押下に対する反応が一番速い。

【００３８】Case2は、送信可能区間外の時刻Ｔにユーザが再生ボタンを押下した場合を示している。この場合は、データの送信開始は時刻Ｔの直後に到来する送信開始可能区間まで待たされる。送信開始可能区間の到来と共に時刻Ｓにデータの送信を開始する。なお、データの送信開始はこの送信開始可能区間内であれば良い。受信側１４でデータが再生可能になる時刻Ｒの存在範囲は、時刻Ｓ以降で、時刻Ｓが含まれる送信開始可能区間経過後の最初の再生開始基準点までの範囲に限定される。この再生開始基準点をＰ０とするとP0は送信側機器１１においても受信側機器１４においても一意に定まる。送信側機器１１においては送信開始時刻を把握しているため自明であり、受信側機器１４においてはＲの存在範囲から時刻R以降の最初の再生可能基準点をP0と判断すれば良い。そこで、Ｐ０に予め定めた値Betaを加算した時刻ＰＸも一意に定まり、時刻ＰＸに両方の機器で再生を開始することによって、再生開始時刻を一致させることができる。Betaの値はCase1の場合と同様、０の場合にユーザの再生ボタン押下に対する反応が一番速い。

【００３９】なお、Beta＝０とした場合には、Case1の場合のユーザの再生ボタン押下から再生開始までの最大遅延はPeriodとなり、Case2の場合のユーザの再生ボタン押下から再生開始までの最大遅延は(delayMax+Period)となる。

【００４０】次に図５のフローチャートを用いて、再生開始ボタン押下時の送信側機器１１の処理手順を説明する。

【００４１】ユーザが再生ボタンを押すと図５に示す処理が起動される。Step51では現在の時刻を取得する。これは送信側機器１１の時刻管理部２９に問い合わせを行うことにより行う。次にStep52に進み、現在、送信開始可能区間の内部であるか否かを判定する。送信開始可能区間に関する情報は時刻管理部２９が保持している。ここで、現在、送信開始可能区間の内部である場合にはStep53に進み、直ちに音声データの送信処理を起動する。引き続きStep54に進み、動画再生準備処理を起動した後、処理を終了する。動画再生準備処理では圧縮されている動画データの復号を表示に先行して行い、動画一時記憶部２４に蓄積する。この段階では表示は行われない。動画表示部２５への表示開始は、後述する動画データ再生開始判定処理の中で起動される。Step52で送信開始可能区間外と判定された場合はStep55に進み、既定の時間待機した後にStep51へ進み、再度、前述の処理を行う。

【００４２】次に図６のフローチャートを用いて、動画データ再生開始判定処理について説明する。

【００４３】この処理は図５のStep54から起動される。まず、Step61では現在の時刻を取得する。次にStep62に進み、現在、再生開始可能時刻（Ｐ０）に達しているか否かを判定する。再生開始可能時刻（Ｐ０）に関する情報は時刻管理部29が保持している。ここで、現在、再生開始可能時刻（Ｐ０）に達している場合はStep63へ進み、動画データの再生処理を起動する。Step62で再生開始時刻に達していないと判定された場合はStep64へ進み、既定の時間待機した後Step61へ進み、再度、前述の処理を行う。Step63で起動された動画データの再生処理では、時刻管理部２９の刻む時刻と動画データのフレームレートに従って再生を行う。

【００４４】次に、図７を用いて受信側機器１４における音声データの再生開始処理について説明する。この処理は例えば、最初の音声データを受信した時に起動される。Step71では現在の時刻を取得する。次にStep72に進み、現在、再生開始時刻（Ｐ０）に達しているかを判定する。再生開始時刻に達している場合はStep73へ進み、音声データの再生処理を起動する。Step72で再生開始時刻に達していないと判定された場合はStep74へ進み、既定の時間待機した後Step71へ進み、再度、前述の処理を行う。Step73で起動された音声データの再生処理では、時刻管理部２Ｈの刻む時刻と音声データのサンプリングレートに従って再生を行う。

【００４５】このように、本方式によれば送信開始時刻に関する情報を伝送路を介して送らなくとも、再生指示

から再生までの遅延時間が高々(delayMax+Period)で、同時に再生を開始することが可能になる。再生開始タイミングを揃えることで、後は、動画データおよび音声データそれぞれのサンプリングレートに従って再生処理を行うことで、リップシンク（lip sync）を保つことができる。

【００４６】なお、以上の説明では、音声データの送信開始を送信開始可能区間内に限定したが、これに代えて、送信側機器１１から受信側機器１４に対して再生開始を指示するための再生開始コマンドの送信開始時刻を、送信開始可能区間内に限定してもよい。つまり、音声データについては例えば再生開始ボタンが押された時点で送信し始めておき、再生開始コマンドの送信は、最初の送信開始可能区間で開始する。なお、この場合、delayMaxは、再生開始コマンドの送信を開始してから受信側機器１４がその再生開始コマンドに応答して再生処理を開始可能となるまでの最大時間となり、これは再生開始コマンドの伝送遅延時間とそのコマンド解釈処理などに要する処理遅延時間を含む合計の遅延時間の最大見積もり値として規定される。また、この場合には、音声データを記憶した記憶装置を受信側機器１４に用意しておくことも可能となる。他の点については音声データの送信開始タイミングを制御する場合と全く同じ方法が用いられる。

【００４７】また、上記の例では動画データを送信側機器１１で再生し、動画データと同期再生すべき音声データを送信側機器１１から受信側機器１４に送信したが、これとは逆に、音声データを送信側機器１１で再生し、音声データと同期再生すべき動画データを送信側機器１１から受信側機器１４に送信しても良い。この再生システムの一例を図８に示す。

【００４８】図８のシステムでは、携帯型オーディオプレイヤ１０１は、動画データおよびそれに付随する音声データが記録されている記憶装置を備えており、音声データを再生してイヤホン１０３から出力すると共に、携帯型ＬＣＤなどの表示装置１０２に無線通信路を介して動画データを送信する。

【００４９】また、本実施形態の同期再生方法は、同期再生する必要がある２つの動画データ同士を２つの異なる機器で再生する場合や、同期再生する必要がある２つの音声データ同士を２つの異なる機器で再生する場合にも適用可能である。２つの音声データを２つの異なる機器で同期再生するシステムの一例を図９に示す。

【００５０】図９のシステムは、ＤＶＤプレイヤ２０１を用いた視聴システムであり、ＤＶＤプレイヤ２０１によって再生される動画データはＴＶなどのモニタ２０３に表示される。またＤＶＤプレイヤ２０１から出力される複数チャネルの音声データはオーディオアンプ２０２に送られる。オーディオアンプ２０２はメインのＬ，Ｒチャネルの音声データを再生してＬ，Ｒのフロントスピーカ２０４，２０５から再生すると共に、サラウンド用のＬ，Ｒチャネルの音声データを無線通信路などを介してＬ，Ｒのバックスピーカシステム２０６，２０７に送信する。オーディオアンプ２０２とバックスピーカシステム２０６，２０７にそれぞれ本実施形態の方法を適用することで、音声データ同士の同期再生を容易に実現することが出来る。

【００５１】また、本実施形態の同期再生方法で使用する送信側機器および受信側機器それぞれの機能はすべてコンピュータプログラムによって実現することができるので、そのコンピュータプログラムが記憶されたコンピュータ読み取り可能な記憶媒体を通じてそのコンピュータプログラムを通常のコンピュータに導入して実行するだけで、本実施形態と同様の効果を容易に得ることが出来る。

【００５２】また、本発明は、上記実施形態に限定されるものではなく、実施段階ではその要旨を逸脱しない範囲で種々に変形することが可能である。例えばPeriodは常に一定である必要はなく、delayMaxよりも長ければ、予め決められたパターンで変化させるようにしても良い。同様に、Alphaの値も一定である必要はなく、予め決められたパターンで変化させるようにしても良い。また、delayMaxの値を通信環境に合わせて最適化する仕組みなどを用意することで、delayMaxの値も可変にすることが可能となる。

【００５３】更に、上記実施形態には種々の段階の発明が含まれており、開示される複数の構成要件における適宜な組み合わせにより種々の発明が抽出され得る。例えば、実施形態に示される全構成要件から幾つかの構成要件が削除されても、発明が解決しようとする課題の欄で述べた課題が解決でき、発明の効果の欄で述べられている効果が得られる場合には、この構成要件が削除された構成が発明として抽出され得る。

【００５４】

【発明の効果】以上説明したように、本発明によれば、再生時刻に関する情報を送信することなく、動画とそれに付随する音声のように互いに同期した情報を異なる機器で同期して再生することが可能となる。

【図面の簡単な説明】

【図１】本発明の一実施形態に係る再生システムの構成の一例を示すブロック図。

【図２】同実施形態の再生システムを構成する送信側機器と受信側機器それぞれの構成を示すブロック図。

【図３】同実施形態の再生システムの動作を示す図。

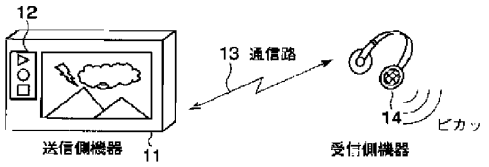
【図４】同実施形態の再生システムにおける同期再生処理のタイミングを説明するための図。

【図５】同実施形態の再生システムにおける再生開始ボタン押下時の送信側機器の処理手順を示すフローチャート。

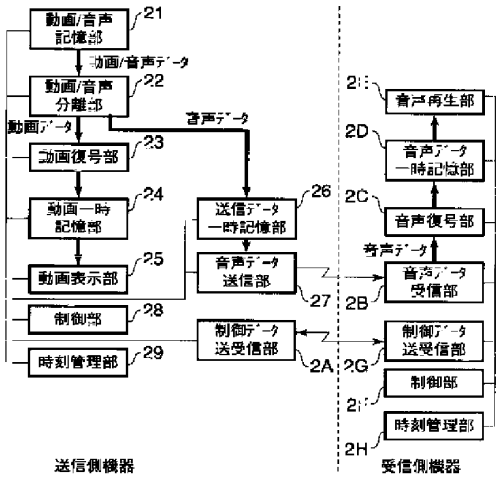
【図６】同実施形態の再生システムにおける送信側機器

の動画データ再生開始判定処理の手順を示すフローチャート。
【図７】同実施形態の再生システムにおける受信側機器の音声データ再生開始判定処理の手順を示すフローチャート。
【図８】本発明の一実施形態に係る再生システムの他の構成の一例を示すブロック図。
【図９】本発明の一実施形態に係る再生システムのさらに他の構成の一例を示すブロック図。
【符号の説明】
１１…送信側機器
１２…操作パネル
１３…通信路
１４…受信側機器
２１…動画/音声記憶部
２２…動画/音声分離部
２３…動画復号部
２４…動画一時記憶部
２５…動画表示部
２６…送信データ一時記憶部
２７…音声データ送信部
２８…制御部
２９…時刻管理部
２Ａ…制御データ送受信部
２Ｂ…音声データ受信部
２Ｃ…音声復号部
２Ｄ…音声データ一時記憶部
２Ｅ…音声再生部
２Ｆ…制御部
２Ｇ…制御データ送受信部
２Ｈ…時刻管理部

【図１】



【図２】



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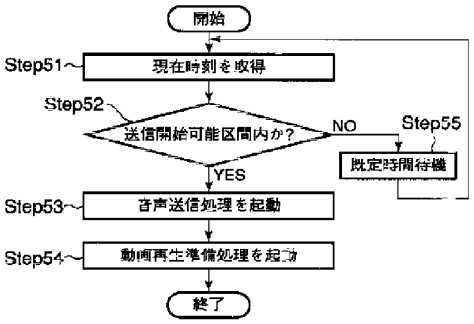

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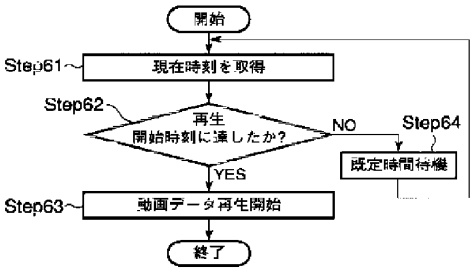
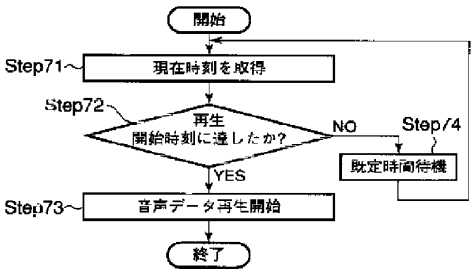


【図７】



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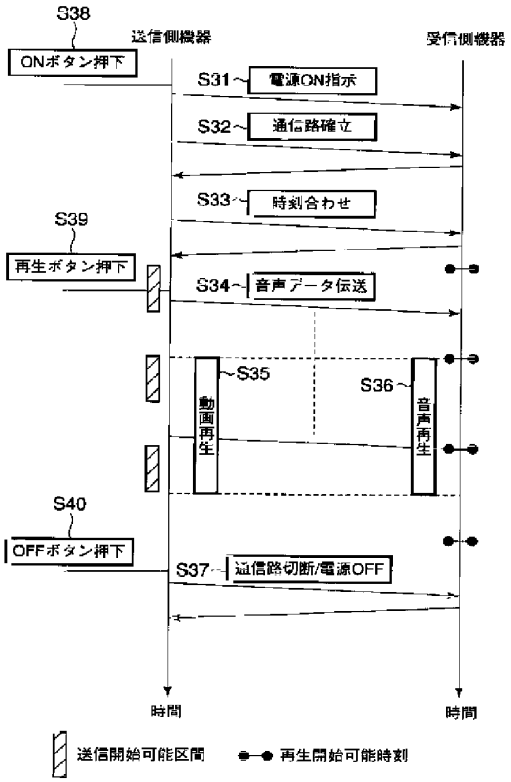
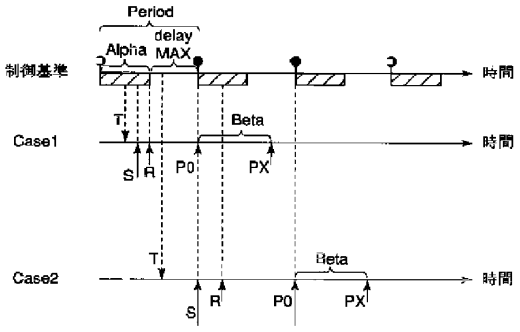
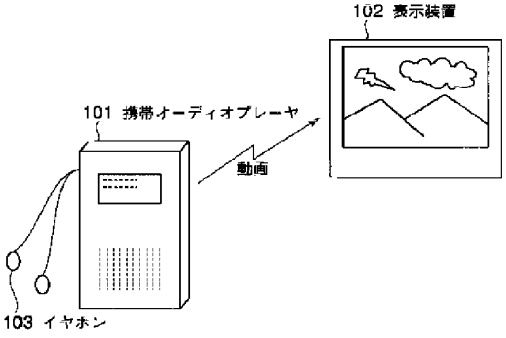


【図4】



送信開始可能区間
P 再生開始基準点
T 再生ボタン押下時刻
S 音声データ送信開始時刻
R 最初の音声データが到着して再生可能となった時刻
P0 最も早い再生開始時刻
PX 一般の再生開始時刻(PX=P0+Beta)
Period 再生開始基準点の間隔
delayMax (伝送遅延+処理遅延)の最大値
Alpha =Period−delayMax
Beta 0以上の定数。再生開始時刻をP0以降に遅延させる値

【図8】



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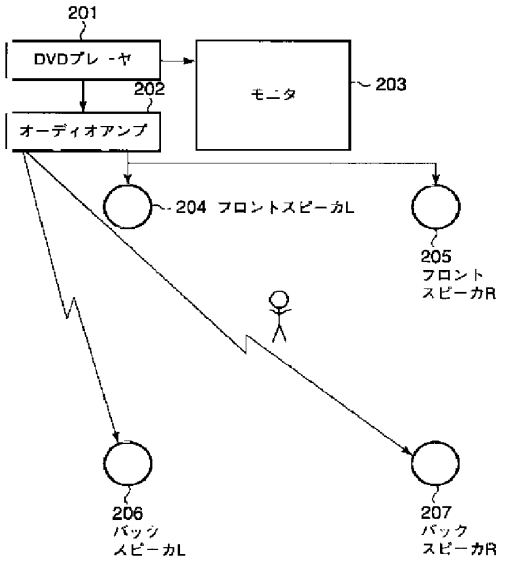

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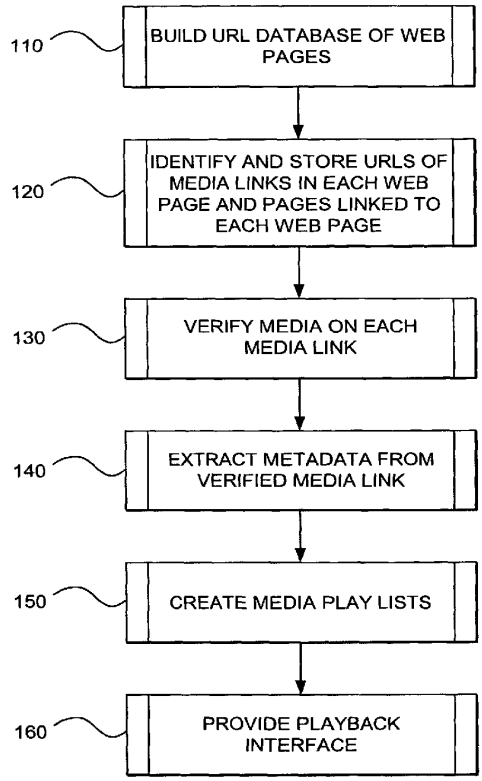
[Continued on next page]

(54) Title: STREAMING MEDIA SEARCH AND PLAYBACK SYSTEM



(57) Abstract: A method is provided for playing back media from a network. The method includes receiving a search criteria from a network enabled device. The method further includes accessing a database comprising a plurality of network addresses, where the database associates each address with one or more classes of information. The addresses in the database each access a media network resource. The method further includes selecting at least one address in the database using the search criteria, and signaling the selected address to the network enabled device. The method also includes controlling the network enabled device so as to automatically access and play back the media resource of the selected address.

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STREAMING MEDIA SEARCH AND PLAYBACK SYSTEM

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to the field of streaming media content search and playback over a network. In particular, the invention relates to a computer system that enables a continuous streaming media playback from a distribution of sites available over a network such as the Internet.

Description of the Related Art

Computers currently can access streaming media on the Internet. Streaming media available on the Internet include, for example, music, video clips such as movie trailers, home movies, and animation.

Users locate streaming media on the Internet by manually selecting links. Typically, users browse the media sites that contain numerous sub-links. Users sometimes select through a chain of links to locate a desired media on a media link. Once located, the desired media link may or may not contain the desired media.

Some services provide media search engine capabilities. Users may enter a search request for selected media creations by an artist. The media search engine then displays links to categories and/or sub-links of media that are determined to match one or more criteria in the search request set forth by the user. The determination of which links should be displayed in response to the search request is dependent on the algorithm used in by the search engine. Typically, links displayed to users of current search engines are not subject to a determination of the quality or availability of the media associated with the media links. Further, the search results are outputted to the user as a display of links for the user's selection.

Many Internet streaming media outlets provide a limited number of source nodes. The sites can be unreliable when the number of users accessing the site become congested.

SUMMARY OF THE INVENTION

An embodiment of the invention includes a method for playing back media from network. The method comprises receiving a search criteria from a network enabled device. The method further includes accessing a database comprising a plurality of network addresses, where the database associating each address with one or more classes of information. Each address accesses a media network resource. The method further includes selecting at least one address in the database using the search criteria, signaling the selected address to the network enabled device, and controlling the network enabled device so as to automatically access and play back the media resource of the selected address.

Another embodiment includes a method for playing back media from a network. The method includes receiving a request for media playback from a network enabled device. Further, accessing a database comprising a plurality of network addresses, where each address accessing a media network resource. The method also includes identifying at least two addresses from the database, signaling each identified address to the network enabled device, and controlling the network enabled device to access and automatically play back the media network resources of each of the signaled addresses.

In another embodiment, a computer system is provided for playing back media from a network. The computer system comprises a network enabled device comprising a media playback component. A database is included that comprises a plurality of addresses, where each address locates a media network resource on the network. The database includes one or more classes of information associated with each address in the plurality of addresses. The system also includes a network server module that is coupleable to the network enabled device and to the database. The network server module is able to receive a search request from the terminal that specifies one or more criterias. The network server module selects an address from the database that is associated with a class of information that matches the search criteria. The network server module signals the address to the network enabled device to cause the device to access the media network resource, and to signal media

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playback component to load the media network resource after the device accesses the media network resource.

In another embodiment, a computer system is provided for playing back media from a network. The computer system includes a network enabled platform comprising a media playback component. A database includes a plurality of addresses, where each address locates a media network resource on the network. Each address accesses a media network resource. The embodiment further includes a network server module coupleable to the network enabled device and to the database. The network server receives a request for media playback from the network enabled device, selects multiple addresses from the database, and signal the multiple addresses to the network enabled device. The network server module control a media playback component on the network enabled device to use the addresses to automatically access and play back the media network resource associated with the addresses.

In another embodiment, a network enabled device is configured to playback media from a network. The network enabled device is coupleable over the network to a database that includes a plurality of addresses. Each address locates a media network resource on the network. The network enabled device includes a user-interface to prompt for a search request. The network interface signals the request to a network server module that is communicatable with the database, and receives one or more addresses in the database that match the search request. The network enabled device includes a media playback component that is configured to be programmatically controlled by the network server module to automatically load the media network resources located by the addresses that match the search request.

In another embodiment, a network enabled device is configured to playback media from a network. The network enabled device is coupleable over the network to a database comprising a plurality of addresses. Each address locates a media network resource on the network. The network enabled device comprises a user-interface including a plurality of user-interactive features, including a first user-interactive feature that prompts to receive a search request for media playback. A network interface signals the request to a network server module upon the first user-interactive feature receiving the

search request for media playback. The network interface is communicatable with the database to receive one or more addresses in the database that match the search request. A network playback component is configured to be programmatically controllable by the network server module to automatically load the media network resource associated with each address signaled to the network enabled device upon accessing the media network resource. A playback of the media playback component being controllable by one or more control user-interactive features.

An embodiment includes a system that provides media from a network to a terminal having a media playback component. The system includes a first network site and a second network site, where each network site locates one or more media network resources. Each media network resource is locatable on the network by a corresponding address that accesses the media network resource. A network server module is coupleable to the terminal through the network. The network server module identifies a first media network resource from the first network site and a second media network resource from the second network site. The network server module signals the corresponding address of the first media network resource to the terminal with control signals to cause the playback component to automatically load the first media network resource. The network server module automatically signals the corresponding address of the second media network resource to the terminal with control signals to cause the playback component to automatically load the second media network resource.

Another embodiment provides a media playback system for the Internet. The system includes an end terminal having a media playback component. A web server module is coupleable to the end terminal through the Internet. The web server module has access to one or more media web resources on a first web site, and to one or more media web resources on a second web site. The web server module signals a first link to a first media web resource on the first web site, and a second link to a second media web resource on the second web site. The web server module provides control signals to the end terminal to cause the end terminal to access and load the first media web resource and the second media web resource into the media playback component.

One or more of the embodiments may include a database that stores links to each of the plurality of media web resources, the web server module identifying the first link and the second link from the database.

Another embodiment includes a media playback system for the Internet. The system includes a terminal having a media playback component and a user-interface.

A web server module is coupleable to the user terminal through the Internet. The web server module has access to a plurality of links, where each link locates a media web resource. The plurality of links are accessible on a plurality of web sites. The web server module signals the plurality of links to the user terminal in a designated order to cause the terminal to load the media web resource located by each of the plurality of links into the media playback component. The embodiment also includes a database that stores the plurality of links. The database is accessible to signal the plurality of links to the web server module in the designated order. The user-interface signals one or more inputs from a user to the web server module. The one or more inputs direct the web server to alter the designated order in which the database signals the plurality of links to the web server module.

Another embodiment includes a system that provides media play-back on a network. The system includes a terminal that is coupleable to the network. A play-list module is coupleable to the terminal. The play-list module stores a first play-list signaled from the terminal. The first play-list includes a plurality of network addresses. A first network address locates a first media network resource on a first network site, and a second network address locates a second media network resource on a second network site. A network server module is coupleable to the terminal and to the play-list module. The network server module signals the first play-list to the terminal. The network server module controls the terminal to cause the terminal to access the media network resource associated with each network address in the first play-list, and to automatically load each respective media network resources into the media playback component.

Another embodiment includes a method for providing media to a terminal coupled to a network, where the terminal includes a media playback

component. A terminal is programmatically directed to access a first network site in the plurality of network sites. The media playback component on the terminal is caused to automatically load a first media web resource located at the first network site to playback a first media. The terminal is programmatically directed to access a second network site in the plurality of network sites. The media playback component on the terminal is caused to automatically load a second media web resource located at the second network site to playback a second media.

Another embodiment includes a method to provide media to a terminal coupled to the Internet. A database is accessed that stores a plurality of links, where each link opening a corresponding media web resource. A first link is selected from the database, the first link being located on a first network site. Next, a second link is selected from the database, the second link being located in a second network site. The second network site is external to the first network site. Then, the selected links are signaled to a media playback component on the terminal to sequentially access the media web resources associated with the selected links. The media playback component on the terminal is automatically signaled to load each of the media web resource accessed from the selected links so as to playback a media corresponding to each media web resource.

Another embodiment includes a system to share media playback from a network between a plurality of terminals. The plurality of terminals include a first terminal and a second terminal. The system includes a play-list component locatable on the network by a selectable link. The play-list component identifies a plurality of links to form a play-list, where each link in the play-list locating a media file on the network. The system includes a network server module that signals the plurality of links that form the play-list to the first terminal. The network server module receives a signal to transmit the selectable link to a second terminal to enable the second terminal to locate the play-list module.

In another embodiment, a method is provided to locate web resources on the Internet. A web site is accessed to identify a plurality of links using a web browser component. The web site can be automatically or programmatically accessed. Each of the plurality of links are selectable to open a corresponding

web resource of a specified data type on the web site. The plurality of links are made available to a plurality of Internet enabled devices that select one or more of the links.

Another embodiment includes a system to locating web resources on the Internet. The system includes a web browser component, and a database. A search module controls the web browser component to access at least one web site. The search module controls the web browser component to identify a plurality of links to media web resources at the web site. Each of the plurality of links are selectable to open a media web resource. The search module stores the plurality of links in the database.

Another embodiment includes a method to locate web resources on the Internet. A database that stores a plurality of links is accessed, the plurality of links being selectable to open a corresponding web media resources. Metadata information is programmatically identified about the web media resource corresponding to each of the plurality of links. The plurality of links are made accessible to a plurality of Internet enabled devices. The plurality of Internet enabled devices elect one or more of the links to open the corresponding media web resource.

Another embodiment includes a method to locate web resources on the Internet. A database is accessed that includes a plurality of links to media web resources. Each of the plurality of links are programmatically verified to open a corresponding web media resource. Each verified link is accessible to a plurality of Internet enabled devices that select one or more of the links to open the corresponding media web resource.

Another embodiment includes a system to locate web resources on the Internet. The system includes a first indexed data structure comprising a plurality of links. A media playback component is coupleable to the database. The media playback component loads each of the plurality of links to verify whether the link is selectable to open a media web resource. A second indexed data structure stores each verified link in the plurality of links. The second indexed data structure is available to the plurality of Internet enabled devices.

Another embodiment includes a method to providing links for use in a media search engine. A plurality of internal links on a network site are

identified. The network site makes a network resource of a specific data type accessible for a network enabled device. The internal links that are selectable to open the network resource of the specific data type are extracted. The external link is stored in a database. One or more of the links are automatically signaled to a media playback component in response to receiving a search requests from the network enabled device.

Another embodiment includes a method to provide links for use in a media search engine. The method includes a) receiving from a first indexed data structure a first external link to a first network site; b) initializing a second data structure to be empty;
c) determining if the first network site contains at least one internal link; d) storing the at least one internal link contained on the first network site that is not in the first indexed data structure and not in the second indexed data structure as another external link in the first indexed data structure; e) identifying the internal links contained on the first network site that are selectable to open a network resource of a specific data type or types; f) moving the first external link from the first indexed data structure to the second indexed data structure; and g) repeating steps a) through f) until the first indexed data structure is empty.

Another embodiment includes a computer system to search for links to streaming media playback on a network, the network being accessible to a network enabled device. The system includes a metacrawler to locate one or more media sites in directories containing streaming media. A media search module coupled to be signaled the one or more directories from the metacrawler. The media search module identifies a plurality of media links for the media sites. Each of the plurality of media links are selectable to open streaming media network resource. A metadata extraction module accesses each media link identified by the media search engine to extract metadata about the identified media link. A database comprising the plurality of media links identified by the media search engine, and the metadata is extracted about each identified media link. The database enables the network enabled device to access the plurality of media links.

An embodiment includes a rating system for rating media network resources on a network that is coupleable to a plurality of terminals. The rating system includes a database having a plurality of addresses. Each address locates a corresponding media network resource on the network. A network server module is coupleable to the plurality of terminals. The network server module accesses the database to signal one or more addresses from the database to the plurality of terminals. A rating module is coupleable to the plurality of terminals. The rating module receives a rating input from each of the plurality of terminals. The rating module associates the rating input with a selected address in the database.

In another embodiment, a rating system is provided to rate media network resources on a network. The rating system includes a database comprising a plurality of addresses that each locate a corresponding media network resource on the network. The database includes one or more classes of information associated with each of the plurality of addresses. A network server module is coupleable to the plurality of terminals. The network server module communicates with each of the plurality of terminals to receive a search request. The network server module signals the database to retrieve one or more addresses from the database in response to the search request. The retrieved addresses are associated with a class of information matching the search request. A rating module is coupleable to the plurality of terminals. The rating module receives a rating input from each of the plurality of terminals. The rating module associates the rating input with a selected address in the database.

Another embodiment includes a rating system for rating media network resources available over a network. The media network resources are located on the network by a plurality of terminals. The rating system includes a database that stores a plurality of addresses. Each address locates a corresponding media network resource on the network. The database includes a rating associated with each of the plurality of addresses. A network server module is coupleable to each of the plurality of terminals. The network server module accesses the database to signal one or more addresses from the database to the plurality of terminals. A rating module is coupleable to each of the plurality of terminals. The rating module receives a rating input from one of the terminals for each of

the plurality of addresses in the database. In response to receiving the rating input from one of the plurality of terminals for a selected address in the database, the rating module accesses the database and reconfigures the rating associated with the selected address. A play-list module accesses the addresses to select one or more combinations of addresses. The play-list module signals the play-list to the network server module as addresses to be signaled to one or more of the plurality of terminals.

In a variation, the address may be selected by the play-list module based on a criteria stored with the address in the database. Examples of criterias include rankings, reflecting preferences of users on terminals after playing back media located by the respective addresses. Other criterias that can be used to select addresses include metadata information, such as artist name and media title. For example, the search request may specify a ranking as one of the criterias. The play-list module then sorts the database for the ranking in selecting the addresses.

Another embodiment includes a method for ranking media sources on a network. The method includes accessing a database that stores a plurality of addresses. Each address locates a media resource on the network and each address is associated with a rating. A selected address from the database is signaled to a terminal coupled to the network. A rating input is received from the terminal after signaling the selected address to the terminal. The rating is associated for the selected address is adjusted in response to receiving the rating input.

Another embodiment includes a method for ranking media sources on a network. A database is accessed that stores a plurality of addresses. Each address locates a media resource on the network and each address is associated with a rating. A combination of addresses are selected to form a play-list. The play-list is signaled to a terminal coupled to the network. A ranking is received from the terminal after signaling the addresses in the play-list to the terminal. The rating is adjusted for each address signaled to the terminal from the play-list in response to receiving the ranking.

Another embodiment includes a method that ranks media sources on a network. A database that stores a plurality of addresses is accessed. Each

address locates a media resource on the network, and each address is associated with a rating. A selected address is signaled from the database to a terminal coupled to the network. A ranking is received from the terminal after the selected address is signaled to the terminal. The rating associated for the selected address is adjusted in response to receiving the ranking.

Another embodiment includes a network enabled device that comprises a media playback component. The media playback component is configured to communicate with a network-side module to receive a first plurality of links. Each of the first plurality of links locate a media file on a network. A web browser component is configured to receive a second plurality of links. Each of the second plurality of links hosts a media file located by one of the first plurality of links. The web browser component displays the web site for each of the second plurality of links when the media playback component plays back media from the media file being hosted by web site being displayed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a flow process describing an embodiment of the invention.

FIG. 2 is a block diagram illustrating an architecture for use with an embodiment of the invention.

FIG. 3 is a block diagram illustrating a back end architecture, under an embodiment of the invention.

FIG. 4 is a block diagram illustrating a media search and playback system, under an embodiment of the invention.

FIG. 5 is a block diagram illustrating components on an end terminal receiving control information from a server-side module, under an embodiment of the invention.

FIG. 6 is a flow chart illustrating a system for forming a search database of media resources accessible on a network, under an embodiment of the invention.

FIG. 7 is a flow chart illustrating a system for forming a search database of media resources accessible on a network, under an embodiment of the invention.

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FIG. 8 is a flow chart for verifying records in a search database of media resources, under an embodiment of the invention.

FIG. 9 is a flow chart for extracting metadata about a media resource associated with a site on a network, under an embodiment of the invention.

FIG. 10 is a flow chart for forming play-lists for end users of a system under an embodiment of the invention.

FIG. 11 is a flow chart for receiving user input in response to playing back media resources from a search database, under an embodiment of the invention.

FIG. 12 is a block diagram of a media playback system including a rating feature, under an embodiment of the invention.

FIG. 13 is a flow chart describing user input to a user interface for a media playback system, under an embodiment of the invention.

FIG. 14 is a flow chart describing a rating system, under an embodiment of the invention.

FIG. 15 illustrates an exemplary structure for a database to maintain updated records on ratings for addresses containing media resources, under an embodiment of the invention.

FIG. 16 is a flow chart for creating play-lists using rating information, under an embodiment of the invention.

FIG. 17 is a flow chart for programmatically categorizing media files, under an embodiment of the invention.

FIG. 18 is a flow chart for creating personalized play-lists of streaming media files available in a network, under an embodiment of the invention.

FIG. 19 illustrates a distributed playback architecture, under an embodiment of the invention.

FIG. 20 illustrates a block diagram of a messaging application, under an embodiment of the invention.

FIG. 21 illustrates a user-interface for use with a media search and playback system, under an embodiment of the invention.

FIG. 22 includes another user-interface displaying an instance of the web browser while media is being played back, under an embodiment of the invention.

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DETAILED DESCRIPTION

A. System Overview

According to an embodiment, a system is provided comprising a media search engine. The media search engine may be used to create a database of links to media files. The links may be structured according to predefined categories and/or user-defined search criteria. A client terminal includes a media player to automatically access one or more media files using the corresponding links. The media player then plays back media contained on the media files.

Among other advantages of the invention, the user terminal accesses media files at various sites on a network, without requiring users to manually select media links. For example, user-terminals may output music to a user by automatically accessing one or more Internet sites containing media files. The music is outputted without requiring users' to view and select links to sites containing the media.

In contrast to embodiments of the invention, using other systems to search for Internet files containing media can be a distracting and time-consuming experience for an end user. In many instances, such a search will yield a series of links on a directory or web search page. A user may have to click on each individual link, one at a time, to play each individual media file. The selected media file may be broken and unavailable to deliver media content. Even if the number of broken links is not high, the user must still click on the links one at a time to activate each media file, providing at best a stop-and-go experience.

In one embodiment of the invention, a user terminal is able to receive continuous media streaming from multiple sites on the Internet. Multiple sites may be accessible to enable the user terminal to receive streaming media without any interaction required from an end user other than signaling a request to receive streaming media. The user terminal automatically accesses media links containing media using a media playback component.

The media playback component may be controlled by one or more server-side modules. In one embodiment, the media playback component on the user terminal interacts with one or more play-lists generated by server side modules. The play-lists contain media links for the media playback application. The media links may be structured or ordered in the play-lists. The play-lists may be generated automatically by back-end modules and/or manually by editors. The play-lists may also be generated by end users.

The media playback component may also interact with one or more server side search modules to access media links on the network. The media links may be automatically selected based on, for example, a search criteria from the end user.

Embodiments of the invention provide a system to search and playback media accessible over a network. In one embodiment, a media search engine is provided to enable users to request media output based on a criteria set forth in a search request. The media search engine is able to efficiently locate streaming media on the network that matches criteria set forth in a search request. The system provides continuous playback of media found on multiple sites of the network. For example, a user may specify a search based on a specified artist. The system locates one or more sites on the Internet containing media files from the specified artist. The system enables the user terminal to automatically and continuously play back media creations available on the Internet sites.

Further, a backend system under an embodiment of the invention minimizes possibilities of broken links and mismatched search results. The backend system may also be used to perform manual and/or programmatic quality check of the media associated with each link.

Further, a search engine under an embodiment of the invention employs an Internet web browser software component on the back-end to perform searches and indexing of web resources. The Internet web browser component may be a configured or modified commercially available web browser component. Server-side modules may combine to control the browser in locating media links and media sites containing media content. As a result, the media search engine under this embodiment is efficiently implemented, using existing resources on the back-end system.

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Among other advantages, embodiments of the invention enable streaming media from multiple media links to be automatically played to users. Embodiments of the invention also employ a scalable and distributed architecture. Scalability in this sense means that the service is available to a large (thousands or more) audience of simultaneous listeners or viewers while minimizing bottlenecks caused by congestion. Another advantage of a distributed architecture is that the unavailability of one media site, or of one or more media on the media site, does not preclude the user terminal from receiving media from another site. As a result, users are ensured a continuous listening or viewing experience.

Further, streaming media may be continuously outputted to users from multiple sites on the Internet based on personalized criteria set forth by users. The criteria may be set forth in one or more requests by an end user. The end user may experience media continuously outputted from multiple sites, based on only one request from the end user. This allows a user to request media through actions such as clicking requests through a user-interface.

An embodiment of the invention enables users to share streaming media experiences with other end users. For example, users may share play-lists containing links to multiple Internet sites. This enables individuals to create media programs of streaming media using multiple sites on the Internet. For example, play-lists may be shared among end users using a host web site, or e-mails.

B. Search and Playback System

A user terminal may transmit a search request from an end user to one or more modules on a server. A client side playback module, one or more server-side modules, or a combination of client and server side modules combine to access the user terminal to a site on the Internet that contains media content immediately available for loading and playback. The response to the search request is media output through the user terminal. The media content is outputted from the user terminal without any additional action on the part of the end user after the initial search request. Once media from one site is completed, the playback module automatically enables the user terminal to access and

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playback media located on another Internet site. As a result, an embodiment enables the user terminal to output continuous streaming media to an end user, where the media outputted is accessed from multiple Internet sites.

Embodiments of the invention may be implemented on the Internet. Other embodiments may be implemented on any network that carries digital information, such as local-area networks (LANs), Wide Area Networks (WAN), Extranets, Intranets, Internet, and wireless networks, or networks utilizing wireless transmissions. An example of a network for use with an embodiment of the invention includes a network operating under a transmission control protocol/Internet protocol (TCP/IP). Embodiments of the invention may also be employed on proprietary WANs, such as America Online™. Thus, discussion of embodiments employed on the Internet are exemplary, and equally applicable to other types of networks described above.

A system for use with an embodiment includes a network enabled device, a network server module and a database. The network enabled device includes a device having components to couple to a network such as the Internet. The network enabled device includes a communication port and processor, and may also include memory and a display. The communication port may be a physical port, such as a connector extending a modem connection. The communication port may also be a wireless port, such as those configured to transmit and receive radio frequency data communications. Examples of network enabled devices include personal computers, handheld devices such as those operating Windows CE™ or Palm™ operating systems, and cellular phones with Internet capabilities such as Sprint PCS™ systems. Other examples of network enabled devices include smart appliances, such as systems including speakers and a processor to receive communications from the network.

The network enabled device may include a media playback component. The media playback component includes an application that plays back streaming media files. Examples of commercially available media playback components include Real Network Player™, Apple Quicktime Player™, and Microsoft Windows Media Player™.

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In an embodiment, network server module includes server-side modules that communicate to the network enabled device through the communication port. The network modules may be coupleable to the network enabled device through a network such as the Internet. Alternatively, the network server module may exist on the terminal. The network server module may, for example, access a database on the network from the terminal. Still further, the network server module may exist on both the terminal and on a server on the network. Specifically, the network server module may comprise network-side code, executed on the terminal through a client application. For example, the network server module may includes applets or Java script delivered to the user terminal for execution of processes and functions, as disclosed herein.

The database stores a plurality of addresses. Each address locates a media network resource. The media network resource includes files that can be loaded into the media playback component to output media. As used herein, media refers to a combination of audio and/or video. Video media may include a collection of images assembled together in an animated fashion to resemble motion or action. Examples of video media include movie clips, recordings from video recorders, and animation such as cartoons. Still further, media may include a collection of still images and graphic presentations that are combined with audio media. Other examples of media include dynamic or animated pictures or text on a web page.

In one implementation, the media files may be loaded and played back to output music or music videos. As another example, media files may include video or animation with story-lines, plots, characters and resemble conventional television or radio programming. Other examples include movie clips, home movies, movie trailers, or highlights from sporting events.

As used herein, a module includes a program, a subroutine, a portion of a program, a software component or a hardware component capable of performing a stated task or function. A module can exist on a hardware component such as a server independently of other modules, or a module can exist with other modules on the same server or client terminal, or within the same program.

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The network server module is coupleable to the network enabled device to exchange communications, and to access the database. The network enabled device provides a search request, including a search criteria. The search criteria includes any condition specified by the user to identify some of media files from other media files in the database. Examples of search criterias include titles, artist names, data types, user preferential ratings, quality, and duration.

The network server module selects at least one address from the database based on the search criteria. The identified addresses are signaled to the network enabled device. The network server module may communicate with the media playback component to cause the media playback component to playback the media resource located by the address.

FIG. 1 illustrates a process for use with a system to search for and playback Internet streaming media, under an embodiment of the invention. In one application, the process is performed on architectures described and illustrated with FIGS. 2 and 3. While the process is described with reference to an integral system, one or more steps described with FIG. 1 may be performed independently of other steps. Similarly, components and modules used to perform steps in FIG. 1 may also be implemented in different systems and architectures. Further, steps mentioned with FIG. 1 may be performed concurrently with one other, or in an order different than shown in FIG. 1.

In step 110, a system builds a database of addresses. An address may include a Universal Resource Locations (URL) for network and Internet sites. A media site include, for example, a web site that allows web users to access streaming media. In other embodiments, the media site may locate network media resources on other types of networks. The media sites may be located through a media search engine, as described elsewhere in this application. An exemplary process for identifying media sites under an embodiment of the invention is provided with FIG. 4.

Each media site may provide access to media through one or more media links available at the site or through other means. The media links identify web resources having media content. These web resources may include a file of arbitrary type. Examples of file types include Multipurpose Internet Mail Extension (MIME) types such as MOV, JPEG, or RAM. The file is

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available for loading, browsing or playback on the World Wide web. Each media link may be either an internal or external link relatively to that particular media sites. An internal media link on a web-site may correspond to a URL that identifies a web resource located on the web domain, host, property or server of that site. An external media link on a media site identifies a web resource that is not located on web domain, host, property or server of that media site.

In step 120, the system identifies and stores in a database media links (URLs) for each media site. An exemplary process for identifying and storing media links on individual media site stored in a database of media site is provided with FIG. 5.

In step 130, each media link is verified. The media link is verified to contain media that is available for playback for users. Thus, broken links, inoperational or unavailable media are precluded from being verified.

In step 140, metadata information is extracted from each media link. Preferably, metadata information is extracted from each verified media link. In an embodiment, metadata may also be added to a list or database of extracted metadata. Additional metadata may be added using, for example, manual interactive editing and an editor interface (see for example, editor interface module 275 in FIG. 2). Examples of metadata information include (with an exemplary data structure type associated with each media link in parenthetical): identification (Integer), author (String), duration (String), media URL (URL), source web site (URL), media type (Integer), rating (Real number), number of votes (Integer), verification status (Boolean), edited status (Boolean), genre type (Index into a genre database table), play-list genre status (Boolean), mix (index into mixes database table), play-list mix status (Boolean), mood (index into moods database table), description (String), clip broadcast quality (integer), image size for videos (integer, integer), and play-list mood status (Boolean). One or more of these types of metadata may be extracted from the media links or from the actual media file. For example, a media link to a web resource may be extracted for identification, duration, author, and source web site. Similarly, one or more of these types of metadata may be added to the extracted metadata information. For example, genre type and description information may be added to the extracted metadata information.

In step 150, the system creates media play-lists using media database for predefined categories. In an embodiment, verified media links are structured into play-lists, such as described with FIG. 10.

In some embodiments, links to streaming media commercials may be inserted into the play-lists in various locations between media clips. These commercials are targeted to the audience likely to listen to the media available on the play-list. The commercial may be produced and broadcast from distributed sources, or from web server module. Other examples of streaming media that can be included with play-lists includes news items and weather reports.

In step 160, a playback interface is provided. The playback interface causes the media player component on the user terminal to play media associated with media links in each play-list. The playback interface may include features to manipulate play-lists, or to switch between play-lists. For example, the playback interface may allow for a user to skip media or web resources until a preferred media or web resource is located. The playback interface is a software or hardware application that is executed on the user terminal. The playback interface may be packaged as a web application, dynamically accessible through a web server module, or be packaged as a desktop software application.

In an embodiment, a playback interface module includes a streaming media clips rating system that allows users to rate each clip as it is played back. The back-end module rating system uses these votes to generate rated play-lists that are available through the playback Interface for playback.

Further, the playback interface module may include a system to allow users to send Internet e-mail notifications to one or more e-mail addressees regarding a media clip, or to send continuous streaming media programs containing multiple media clips from multiple network sources. Recipients may initiate the playback module by selecting one or more links contained in the e-mail. Selecting a link from the e-mail initiates the play back module on that recipient's terminal, causing the play back module to play back the media clip or the programming referred to by the sender.

The playback interface includes user interface elements that allow users to define and execute search criteria for media playback.

FIG. 2 is a block diagram illustrating an architecture of a system 200, under an embodiment of the invention. The system is shown to link a user terminal 210 with media that is accessible on the Internet 220, including the World Wide web 215. Other embodiments of the invention may operate with different types of networks.

The user terminal 210 includes any network enabled multimedia computing platform. In particular, user terminal 210 includes any Internet enabled multimedia computing platform. Examples of computing systems for user terminal 210 include personal computers (PC), personal digital assistants (PDA), smart phones, and Internet enabled televisions and radios, and other devices. The multimedia capability is manifested in the availability of a steaming multimedia playback software and or hardware component. Internet enabling means that the platform can access information over the Internet. In an embodiment, user terminal 210 runs the media location and playback interface module 270 that is accessible over the Internet. A communication channel 212, such as a phone line, wireless medium, or DSL line, is used to couple the user terminal 210 to the Internet. Alternatively, the playback module may be preinstalled on the client terminal. Under both configurations the playback module access media play-lists that are stored on an Internet web server.

A back-end database management system 245 is provided to maintain information used in providing media searching and playback to user terminal 210. The database management system 245 receives information from modules, including server-side modules that communicate with user terminal 210. In an embodiment, modules used to provide media search and playback capabilities to user terminal 210 include a media search module 230, an automatic verification and extraction module 255, an editor module 250, a play-list generator module 260, and a web server module 270. The modules may communicate with an interface of user terminal 210.

Under an embodiment, this communication is implemented using media play-lists on the web server module 270.

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The modules may also communicate with software applications or components on the user terminal, such as a web browser application or a Streaming Media player component in a manner that will be described below.

In an embodiment, media search module 230 includes a media directories meta-crawler module 234 and a media search engine 238. The meta-crawler module 234 and the media search engine 238 may be operated independently and concurrently of one another. The meta-crawler module 234 conducts a general search of the Internet 220 to locate media sites. Media sites may include web pages that are likely to contain web resources, media links to web resources, or links to other web pages that have such media links and/or web resources. The meta-crawler module 234 adds the address or location of each found media site to a media site table 243 maintained by database management system 245. The media site table 243 may list media sites that identify a URL for each web page located by meta-crawler 234.

In one embodiment, the entire media site table 243 is programmatically generated by meta-crawler module 234, without any manual or interactive human input. In other embodiments, an editor module 232 may interface with database management system 245 to manually input a URL for one or more of the media sites into the media site table 243. Another embodiment may substitute editor module 232 for meta-crawler 234, so that the media subdirectory manually receives a URL for each media site.

The media search engine 238 accesses the media site table 243 maintained by database management system 245. The media search engine 238 identifies media links to web resources on each media site provided in the media site table 243. In an embodiment, media search engine 238 contacts each site in the media site table 243 to locate media links. The media search engine 238 then stores the addresses of each media link in the database management system 245. In an embodiment, a URL of each media link is stored in a portion of a media and metadata table 247.

An automatic media verification and metadata extraction (AMVME) module 240 accesses the portion of media and metadata table 247 that contains URLs to the media or media links. The AMVME module 240 verifies each media link in media and metadata table 247. The media links are verified to

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contain web resources matching a criteria defining media. For example, each media link may be verified to contain a combination of audio or video, rather than be only a text document. In addition, the media links are verified as available for playback by users, to avoid broken or old links being maintained by database management system 245.

The AMVME module 240 also extracts metadata from the web resource associated with each media link in the media and metadata table 247. Preferably, AMVME module 240 extracts metadata from verified media links. The AMVME module 240 may automatically visit each media link on the Internet to extract metadata information, as well as verification information. The metadata extracted pertains to information available from the web resource or about the web resource on the media link. Examples of metadata that may be extracted by media extraction module 255 include information such as the author, duration, name, description text, broadcasting and playback quality of the media content and frame size and display resolution for images, video and home movie clips. For example, a media link may be associated with a web resource that is an audio media. Metadata that may be extracted from the media creation may include the artist name, the name of the media creation, length and audio/video quality. In an embodiment, media extraction module 255 also verifies that the media is available for playback from the media site. The AMVME module 240 may accesses database management system 245 to store verification and metadata information in media and metadata table 247.

In an embodiment, a metadata editor interface 275 is included in the system 200. The metadata interface 275 accepts manual entry from an editor pertaining to metadata of the web resource associated with each media link. The metadata interface module 275 may access one or more media links in the media and metadata table 247 to allow manual inspection of each web resource for metadata information. An editor operating metadata interface module 275 transmits a media streaming request to have the media of the web resource replayed for inspection on a terminal. The metadata editor interface 275 then allows for additional metadata to be stored in media and metadata table 247. Preferably, the additional metadata information includes metadata that is not programmatically available from the media link containing the web resource.

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For example, metadata editor interface 275 may be used to add information to media and metadata table 247 information such as genre of the web resource, description of the web resource, and system predefined information, such as mood and mix, that are found applicable by the editor to the web resource.

A play-list generator module 260 generates a plurality of play-lists based on information in the database management system 245. In an embodiment, play-list generator 260 accesses media and metadata list 247 for URLs to media contained on stored media links. The play-list generator module 260 may create play-lists 284 from predefined categories characterized by information stored in the database system for media links and metadata stored in table 247. Play-lists 284 are stored on web server module 270.

Under one embodiment, the web server module 270 includes a media location and playback application. The user terminal 210 interfaces with the media location and playback application through the Internet. For example, web server module 270 makes the media location and playback application available on a web site. The user can launch the media location and playback application by clicking a link on the web site. Under another embodiment, the playback application is pre-installed on the user terminal.

The playback application accesses the web server module 270 to load media play-lists that are stored on it. In an embodiment, the playback application reads Media URLs and Metadata stored in one or more play-lists. This information is used to playback continuous media from the play-lists to the user. A web page or network site hosting the media file being played back may also be displayed as an instance of a web browser on the network enabled device. For example, audio media may be played back while the user is presented with a web page hosting the audio playback (see FIG. 22 and accompanying disclosure).

The media location and playback application may output or playback media processed by the back-end system and stored in the media and metadata table 247 upon receiving a request from user terminal 210. For example, under an embodiment, music may be outputted from user terminal 210 continuously in a manner that resembles a jukebox, Disk Jockey Mix or a radio station.

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An interface of the user terminal 210 enables users to skip playback of media clips, or to switch categories. For example, a user on user terminal 210 may select to hear Jazz programming, and then switch to a genre of classical music. One or more features of a user-interface may be used to enable users to make selections (see FIG. 21 and accompanying text). The user may also control playback settings such as volume, pause, seek and retrieve additional media clip information, skip songs, or replay certain songs being automatically played. The user may also control and/or customize the creation of play-lists using the interface. For example, one musical play-list may include a combination of genres, such jazz and classical songs.

In an embodiment, the media location and playback application programmatically controls a streaming media multimedia software or hardware component to perform the actual streaming of the media digital bits to the user terminal's multimedia output device (such as video display and speakers hardware) . The media location and playback application contains functionality that responds to software events generated by the streaming media component. For example, a playback error generated by the streaming component may result in the application instructing the component to play another media file. In another example, the application determines and initiates playback of a media clip in response to the component reporting that the currently playing media has finished. The application may contain user interface elements that allow users to issue media playback commands. These commands are dispatched by the application to the component that implements the playback command for the currently played media.

In an embodiment, the media location and playback application works in combination with functional commands provided to the user via a web based software application. A user-interface may be provided to enable the user to select the function commands at the software application. An example of a user-interface is provided below, with FIG. 21 and accompanying text.

In an embodiment, a categorization module 290 accesses media and metadata table 247 to add metadata and to categorize media associated with media links in media and metadata table 247. The automatic process generates metadata such as music genre by consulting with information stored in other

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records in media and metadata table 247. For example, the module can automatically set the genre metadata information for all media creations available in the table, for a given artists, according to genre metadata entered for one or more media creations by the same artists. This process greatly contributes the efficiency and scalability of the back-end system.

FIG. 3 is high-level system software components diagram for the system 300, under an embodiment of the invention. The diagram shows how software components may be written, deployed and interact to provide the functionality described by system 200. The components of system 200 may be described as a three-tier architecture. Components are written to spec and deployed to a backend tier, a middle tier, and a front tier. The backend tier includes the database management system 245. The database management system 245 includes a database 345 and a backend interface module 355. The backend interface module 355 may be provided with, for example, a Microsoft SQL Server system (MS SQL).

The middle tier includes modules that communicate with backend interface module 355. The middle tier may include a media sites manager 360 and a media manager 365 software components. The media sites manager 360 and the media manager 365 each independently communicate with backend interface module 355. The media sites manager 360 components exposes a programmatic interface 362 to communicate with modules and components in the front tier. The media manager 365 includes a first media manager interface 366 and a second media manager interface 368.

The front tier includes a media site module 330 and a media module 340. The media site module 330 communicates with site interface 362. The media site module 340 communicates with the first and second media manager interfaces 366 and 368. The first and second media manager interfaces 366 and 368 communicate with the media module 340. The media site module 330 includes a front-end interface 332 to a directory meta-crawler 310 and a media search engine 312 modules. The media site module 340 includes a front-end interface 342 to the media search engine 312, an editor interface module 314, and an automatic verification module 316. The directory meta-crawler 310 crawls Internet media directories web sites. The links to media web sites are

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handed over to the MediaSite module 330 for storage in the database. The media search engine 312 searches for media links on web sites provided by the MediaSite module 330, these links are transferred through Interface 342 on the Media module 340 for storage in the database module 345.

The editor interface module 314 obtains media link for editing from the Media module 340, using Interface 342 and loads the media for editorial playback from the Internet. The editors provide metadata for media that are added to the database by the Media module 340.

The verification module 316 examines media files or web resources accessed through each media link and updates metadata regarding media availability in the database using Media module 340. This module also extracts metadata from Internet media and updates this in the database using Media module 340. The module queries the database for a batch of media records using the Media module 340 and automatically verifies and extracts metadata for the Internet media represented by these records.

With respect to communications from the backend tier to the front-end tier, database management system 345 of the backend tier provides records to the system 300. Each record or record set is disconnected from tables or databases of record(s). Disconnected records are transmitted from the backend tier to the front-end tier as active database objects (ADO) Disconnected record sets.

With respect to communications from the front-end tier to the backend tier, each disconnected record can be updated in the database by any components on any tier. Updated records are transmitted to the database management system 345 in the form of record set update operations. In an embodiment, directory meta-crawler 310 sends URLs to be added to records in database 345 to media site module 330 using an asynchronous method calls. The media search engine 312 transmits to media site module 330 using a get search method call for batch sites of URLs. The media search engine 312 uses an asynchronous method call to add media links and metadata associated with media links.

The components and all tiers expose programmatic interfaces that contain callable methods using the MS DCOM (distributed component object

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model) software component technology. Communication between the tiers is also implemented using method calls on these components. The components are deployed in front, middle and back tier hardware systems. Alternatively, The components may be developed and deployed using the MS COM+ components technology. Using this technology, a COM+ In Memory Database system (IMDB) proxies and caches tables of the back-end database module 245. This process speeds up the search and editorial process. COM+ services such Queued Components may used to implement asynchronous method calls exposed on Interfaces 362 and 366.

C. Media Search Engine

Embodiments of the invention locate web resources on a network such as the Internet. In one embodiment, a network browser identifies a plurality of links to one or more network sites. The links are each selectable to open a network resource of a specified data type. The identified links are then made available to network enabled devices that can select one or more of the links.

As used herein, a network browser is software that performs core functions that include (i) loading network resources; (ii) parsing, translating and laying out network resources, and (iii) displaying the network resources. The network browser includes an application programmable interface (API). An embodiment of the invention employs the network browser on a back end to locate the network resources of the specified data type. One advantage of this embodiment is that the web browser is employed on the back end programmatically, rather than through manual interaction with an editor or other user.

A network browser may include a shell, an API, and a processing module. A component of the network browser includes the API and the processing module. For Internet applications, the processing module may include, for example, a MSHTM or DLL module. The network browser component performs functions that include loading a network resource, as well as parsing, translating, and laying out the network resource.

In an Internet application, a web browser component may be used to locate resources of a specified data type. The web browser component may be a

portion of a commercially available browser. For example, the web browser component for use with an embodiment of the invention may be a reconfigured Netscape Navigator™ or Internet Explorer™ browser.

In an embodiment, the web browser component is programmatically controlled through the API of the web browser to access the web resource for the plurality of links. The web browser may be programmatically controlled to bypass the shell of the web browser. For example, the API may be used to instruct the web browser to ignore the shell, or to detach the functionality of the shell. The remaining web browser component then identifies the links to the specified data types. The result is that the web browser component accesses the web resources of the plurality of links to identify the data types of the resources on the links while ignoring data such as images and sound.

In another embodiment, a search module controls the web browser component to access a web site. The search module controls the web browser component to identify a plurality of links to media web resources at the web site. Each of the plurality of links identified by the web browser component are selectable to open a media web resource. The search module stores the plurality of links in the database.

In another embodiment, a database includes a plurality of links to media web resources. The plurality of links are programmatically verified to determine whether each link opens a corresponding media web resource. The verified link are made available to a plurality of Internet enabled devices that select one or more of the links to open the corresponding media web resource.

The links may be verified on the back end using a media player, including a commercially available media player. For example, each link that needs to be verified may be programmatically loaded through an API of the media player. The response provided by the media player to the link determines whether the links are verified.

In another embodiment, the media player may be programmed to identify metadata from the media web resource of each link. The metadata may then be stored in a database associated with the link.

Among other advantages, embodiments enable network links to files of a particular data type to be rapidly accumulated and stored in a database. Each

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of the links are selectable to open a file on the network. The files may enable a terminal to play back media. In an embodiment, the addresses access media files that can be loaded into the media playback component of the user terminal. The files can be stored in the database with information that characterizes the files associated with the links. Thus, the links may be characterized by, for example, metadata information, and one or more classes of information.

In addition, embodiments enable each link in the database to be programmatically verified, so that there are no broken or unavailable links in the database. Still further, some metadata information may be programmatically identified from each media file. In contrast, existing systems verify links manually, employing interactive users to perform the manual functions. Existing systems also extract metadata information manually.

FIG. 4 illustrates a block diagram in which system 200 receives a search request 203 and provides a response 209. In an embodiment, system 200 processes the search request 203 using the web server module 270 and the media and metadata database 247. The end terminal 210 signals the search request 203 to web server module 270. The web server module 270 accesses the media and metadata database 247 to retrieve one or more URLs matching the search request. The web server module 270 signals the response containing the retrieved URLs to the media playback component 211 of end terminal 210.

In an embodiment, the search request 203 includes one or more criterias that specify a selection of URLs from media and metadata database 247. The criterias may correspond to parameters in media and metadata database 247. The table 249 illustrates a data structure of media and metadata database 247. The table 249 includes a URL list comprising a plurality of URLs. Each URL provides direct access to a web resource containing media. Each URL is characterized by one or more parameters that correspond to metadata information about the web resource associated with the URL. As an example, table 249 provides parameters as being genre (G), data type (DT), category (C), web resource identity, and one or more play-lists (PLAY1, PLAY2, PLAY3).

The genre data is a broad class identifier of the media creation comprising the web resource of the respective URL. For music, the genre may include rock, classical, and jazz. For movies, the genre may correspond to

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romance, comedy, horror etc. The genre may be identified either programmatically, or through an editor interface. One genre may be associated with one or more URLs in table 249. In the example provided, URL1-URL7 are in either one of three genres, G1, G2, and G3. Alternatively, several genres may be associated with one URL.

The data type parameter corresponds to the MIME characteristic of the web resource associated with the URL. The category parameter may correspond to a sub-class of a genre. For example, in music, a category may correspond to soft rock. In movies, a category may correspond to the time-period of the movie. The table 249 illustrates an example in which the category is unique to the genre. Thus, a web resource of one genre is not in the same category as a web resource of another genre. As an example, URL1 and URL3 are in the same category, as are URL2 and URL5. However, no other URLs are in the same category.

Other metadata information that may be included in media and metadata database 247 include identifier information. The identifier information identifies the web-resource. The identifier may provide name of a specific media creation, as well as an artist or author of the media creation.

In an embodiment, media and metadata database 247 includes play-list information as parameters of metadata information. The play-lists may be identified in any one of several ways. For example, the play-lists may be identified by a unique name or other identifier. The play-lists may be identified by another parameters, such as genre or category type. A Boolean data type may be associated between each URL and each play-lists.

The criterias of the search request 203 specify one or more parameters to media and metadata database 247. For example, search request 203 may include criterias corresponding to one or more of a genre, category, play-list, or identifier. In an embodiment, web server module 270 accesses media and metadata database 247 for URLs that have all of the parameters set forth in the search criteria.

The web server module 270 retrieves the URLs matching the criterias of the search request. The response 209 is signaled to the media play-back component 211. The response includes one or more URLs. It is noted that

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when play-lists are requested, additional URLs multiple play-lists are provided. The response 209 may also include metadata information. For example, the response 209 may signal to end terminal 210 the duration of the web resource for each URL, the artist, the history, etc.

The web server module 270 further signals control information 207 to access the URL provided in the response 209. The control information 207 causes end terminal 210 to load the web resource for the media playback component 211. Thus, the media playback component automatically loads the web resources associated with each URL included in response 209. The experience provided to end user 210 is that media is outputted in response to inputting a search request. This is in contrast to other systems in which the user is provided links to media sites containing web resources matching the search criteria.

As an example, a user may specify a media creation from a specific category. For example, the user may input a search request for "nature sounds". The web server module 210 accesses media and metadata database 247 for parameters that match "nature sounds". In one application, a play-list is located that is pre-programmed to provide URLs to web resources containing nature sounds. The response 209 then comprises one or more play-lists, each containing multiple URLs to web resources containing nature sounds. In another application, a category parameter or sub-parameter is searched for "nature sounds". The response 209 may include one or more URLs that are not pre-programmed into play-lists. The response 209 may provide URLs to media playback component 211 one at a time, in groups (such as in play-lists), or all at once.

In an embodiment, categorization module 280 may be used to programmatically create one or more parameters such as illustrated by table 249. The parameters may be determined, by for example, identifying metadata information on the media site hosting the URL.

FIG. 5 is a block diagram illustrating the media playback component 211 being controlled by one or more modules of system 200, under an embodiment of the invention. The web server module 270 signals control information to an application program interface 276 of the media playback

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component 211. The control information may be provided by the media locator and playback application of the web server module 270. The web server module 270 signals commands, with one or more URLs corresponding to media resources selected to be signaled to the user terminal 210. As an example, commands from web server module 270 may be instructions that use each URL as an arguments. Examples of commands that control the media playback component include play(URL) and pause (URL).

As an optional feature, web server module 270 may also signal control information to a web browser component 213 of user terminal 210. The control information may be in the form of commands to access and display a web site associated with the media resource. The commands may be provided to an application program interface 279 of the web browser component 213. This allows the system 200 to display the web site associated with the media resource selected to be played back on user terminal 210. Thus, user terminal 210 may play back media from the media resource while displaying the web site where the media resource is located. One advantage of this embodiment is that it allows users to receive media playback from the media resource in one medium, such as audio, while providing images, audio text, or media not associated with the media resource. Thus, users can listen to songs from media resources signaled to user terminal 210, while viewing banner ads on the web site where the media resource is located.

Each URL signaled from web server module 270 has a network protocol. For media resources, and specifically audio files, types of protocols include "HTTP" protocol, "PNM" protocol (RealNetworks, having .RM extensions), or "RTSP" protocol (having .RAM extensions). The URLs signaled by web server module 270 include the protocol at an initial portion of the string forming the URL. Preferably, for HTTP protocol files, the string portion corresponding to "HTTP" is replaced with "PNM". This adjustment prevents playback component 211 from failing as a result of a bug in the media playback component, particularly if the playback component 211 is a RealNetworks Player™.

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The web server module 270 may be either a network-side module, client side module, or a combination of both. In either embodiment, web server module 270 may access the database directly or indirectly.

FIG. 6 illustrates a process for a component of an Internet media search module, under an embodiment of the invention. A process such as described with FIG. 6 may be used to build a database of media sites, where each media site includes media links and/or links to other media sites. In an embodiment, the process of FIG. 6 is applicable to meta-crawler module 234 in system 200 (FIG. 2).

The process of FIG. 6 is a backend operation that is unobservable to a user of the user terminal. Preferably, the flow process of FIG. 6 is an automatic or programmatically controlled process, conducted periodically. For example, media links may be identified and stored under a flow process such as shown by FIG. 6 every few days or weeks. The duration between executions of the flow process of FIG. 6 maybe referred to as an idle period.

The process of FIG. 6 provides for extracting URLs of media sites from a web pages directory. Examples of a web directory for use with an embodiment of the invention includes directories on web sites such as Yahoo.com® and Lycos.com®. The flow process of FIG. 6 is a backend operation that is unobservable to a user of user terminal 210. Preferably, the flow process of FIG. 6 is an automatic or programmatically controlled process that does not require human interaction.

In step 410, a directory home page is added to a searched-pages data structure. The searched-pages data structure maintains. A similarly structured parsed-pages data structure is also maintained to hold URL of pages already processed by the module. The parsed-pages data structure indicates whether a home page web directory was previously parsed by the process. The searched-pages and parsed- pages data structures are keyed or indexed by URL and they support querying for existence of a given URL in them. Examples of keyed or indexed data structures include database tables and hashtables.

In step 410, the parsed-pages data structure is empty, indicating that the directory home pages in the searched-page data structure have not been parsed.

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In step 420, a determination is made as to whether the searched-pages data structure is empty. If the determination is affirmative, the flow process is done. This occurs when the process has parsed all the Internal web pages in the directory. If the determination is negative, a current page link is called from the searched-pages data structure in step 430. The current page is then loaded into memory and parsed. Parsing means loading and reading the HTML source (or equivalent) code of the web page so its content is accessible and in a machine-readable format.

In an embodiment, the page is parsed using an HTML parser component. An example of an HTML parser is a web browser. Thus, the current page may be parsed using a web Browser component. Specifically, step 440 of the process may be implemented using an application program interface (API) that is exposed by the web Browser component. In this context, the web Browser component is configured and used in a back-end server process with no visible presentation area or end user. It is configured not to load or render media at the web page so that the loading is more efficient. The configuration may occur through the API.

In an embodiment, the web browser is configured to parse web pages efficiently by, for example, automatically excluding a presentation layer from being displayed. Further, the web browser may be programmatically configured to not load or parse information that is not critical to the search function. For example, the web browser component can be configured to not load media data found on web pages.

In step 440, all links to media sites on the currently parsed-page are determined using the parser. The HTML parser API allows access to the page document object model. In step 450, all new external page links are added to the media sites database. An example of a web-page data structure is provided with media site database table 243 (FIG. 2). The database stores the URL of the media sites and not the sites themselves. New external page links implies media sites that are not already indexed or present in the media site database.

In step 460, all URLs also link to internal links found on the currently parsed page are added to the web pages data structure, provided that the URL in question is (i) not already existing in the searched pages data structure and (ii)

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not already existing in the parsed pages data structure. In step 470, the currently parsed page is moved to the parsed pages data structure, and the flow process returns to step 420. This process adds the URL of all the media sites indexed by the directory to the media sites database.

FIG. 7 illustrates another component of an Internet media search module, under an embodiment of the invention. A process such as described with FIG. 7 may be used to identify and store media links to web resources that are accessible from one or more web site. The process of FIG. 7 may be used in conjunction with a process such as described with FIG. 4. In an embodiment, the process of FIG. 7 is applicable to media search engine 238 in system 200 (FIG. 2).

In an embodiment, the flow process of FIG. 7 is a backend operation that is unobservable to a user of the user terminal. Preferably, the flow process of FIG. 7 is an automatic or programmatically controlled process, conducted periodically. For example, media links may be identified and stored under a flow process such as shown by FIG. 7 every few days or weeks. The duration between executions of the flow process of FIG. 7 maybe referred to as an idle period.

The flow process of FIG. 7 assumes access to a media sites database store. The database includes URLs to each media site. An exemplary database of media sites includes media sites and metadata table 243, described with FIG. 2. Each record contains a URL field for media site and a field indicating the last date, if any that the process described in FIG. 5 lastly processed the web site at the URL in the URL field. Reference to a media site that is parsed implies that the media site was programmatically examined for media links to web resources, and for links to other media sites using a process such as the one described in FIG 5.

In step 510, MIME types are determined for web resources. Examples of MIME types that can be selected for step 510 include JPEG, MOV, RAM and WAVE.

In step 515, a record for a media site is fetched or received from the database. A condition of the media site received is that the media site was not parsed by the process described here during the idle period. This condition may

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be specified by checking, for example, the date field associated with the record. For example, a date field may indicate when the media site was previously parsed.

A determination is made in step 520 as to whether a record and a URL was received in step 515. If no URL was received, the system interprets that all media sites in the database have already been parsed during the idle period. If a URL is received, the system in step 525 adds the URL of the media site to a URLs data structure of media sites to be processed. The URL data structure of unparsed media sites may be indexed or keyed. For example, the URL data structure may be a list, or a hashtable software data-structure.

In step 526, the last search field of the record fetched in step 515 is updated with the current date to indicate that the media site is parsed. In an embodiment, the field corresponds to a date in which the last parsing occurred.

In step 530, a URL in the date structure of unparsed media sites is fetched or received. If in step 535, a determination is made that the URL data structure is empty, the system returns to step 515. As will be further described, the flow process returns to step 515 only when step 570 is completed. If a determination is made that the URL data structure is not empty. Thus, steps 510-545 allow the flow process to distinguish between when a media site is being parsed for the first time, or has been previously parsed by the process during the idle period.

In step 545, media links on the media site fetched in step 530 are extracted from the HTML code of the page fetched in step 530. The media links are associated with web resources on that media site. In step 545, the media resources may be in any MIME format recognizable as media. In an embodiment, the currently parsed page is parsed using an HTML parser. An example of an HTML parser is a web browser. Thus, the media links may be extracted using a web browser. Specifically, the media links may be extracted using an application program interface (API) provided by a web browser software or hardware component. The web browser may be configured to perform this task efficiently by, for example, excluding a presentation layer. Further, the web browser may be programmatically configured to not load or parse information that is not critical to the search function. For example, the

browser component may be configured to not load media data found on web pages.

In step 550, new media links on each media site that match the MIME format specified in step 510 are added to a database. New media links refers to media links that do not already existing in the database from, for example, a previous execution of the flow process. In step 555, metadata is extracted from each new media link found in step 550. The metadata may also be stored in the database, with a reference to the URL the media that the metadata refers to. An exemplary database is provided with media and metadata table 247 (FIG. 2). An example of metadata is the URL of the web Page that provided a link for each media URL.

In step 560, the URLs of all new internal media site links on the media site currently being parsed are added to the URL data structure. New internal media site links refers to URLs of media sites that do not already exit in the URL data structure and that are not in the parsed URL data structure.

In step 570, the currently parsed page is removed from the URL data structure and added to the parsed URL data structure. The flow process returns to step 530.

D. Verification and Extraction Flow Processes

FIG. 8 illustrates a flow process that verifies and extracts metadata from Internet streaming media files. While media links are specified, other embodiments of the invention may employ the flow process of FIG. 8 within a system that incorporates verification and extraction of any content or resource associated with links stored in a database. A specific application employs a process such as described with FIG. 4 in the system 200. In the system 200, flow process of FIG. 8 may be performed by the AMVME module 240.

In step 610, a module operating the flow process of FIG. 8 fetches or receives an unverified URL from a database. An example of such a database is provided by media and metadata table 247 (FIG. 2). The unverified URL corresponds to a media link on a media site stored in a database such as the media site database 243 (FIG. 2).

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In step 620, a determination is made as to whether a URL for a media link is present. If the URL to the media link is not present, the module assumes all media links have been determined as being verified, and the process is done.

If a URL exists, the module in step 630 loads the URL into an Internet multimedia playback software component and programmatically control the component to provide metadata embedded in the media file. In response to this request, the component loads some or the entire file over the Internet and provides the process with this information. In step 640, a determination is made as to whether the media or web resource associated with the URL was successfully loaded over the Internet by the module. If the determination is that media was not loaded, then in step 650 the URL associated with the media link is marked as unavailable and verified. The media is marked as verified to prevent the process from revisiting it once it already extracted metadata for it and verified it. The availability mark assists the flow processes described in FIG. 9 and FIG. 10. The determination may be in the negative if, for example, the media link is old and no longer contains a media file that is available for playback through its URL, or if the media link contains content other than what is designated as media.

In an embodiment, the process may use an availability rating for each media. Under such schema, each media is assumed to have the maximum availability score. For media that are currently not available for playback, step 650 may lower the score by one. The system may consider the media as unavailable if its score is below a predefined threshold. This process is useful since Internet streaming media availability may vary according to factors such as web server load and the time of day or year.

If the media is loaded, then in step 660 the media metadata is extracted from the playback component. Examples of metadata that can be extracted in this step include-artist name, playback duration, playback quality, frame size etc.

In step 670, extracted metadata is stored in a database with the associated URL of the media link that was presently verified. In step 680, the URL of the media link presently verified is marked as verified in the database. The flow process then returns to step 610.

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FIG. 9 illustrates a process for interactively adding metadata to URLs of media stored in a database. In an embodiment, the database may correspond to verified URLs of media links determined in FIG. 8. For example, a process such as shown by FIG. 9 may be performed on information stored by AMVME module 240 in media and metadata table 243. The process of FIG. 9 may be performed by a module interface, such as editor interface 275 (FIG. 2).

In step 710, an unedited media record is fetched or received by an interface module from a database. The unedited record may be one or more categories of metadata and other information about a media link, media site, or web resource. In an embodiment, the unedited media information includes a URL to a media link, as well as metadata extracted programmatically, such as described with FIG. 8. In step 720, a determination is made as to whether a record was received. If no record is received in step 720, the flow process assumes there are no unedited records remaining in the database, and the process is done. If a record is received, the in step 730 the interface module is updated with the record received. This may correspond to displaying the record fields to the editor operating the editor interface.

In step 740, the web resource associated with the record received is loaded into an Internet multimedia playback software component. Preferably, the software component is programmatically constructed and controlled by the module interface. The software component plays back the media to the editor. The editor is able to experience the media played back from the web resource associated with the media link. The editor is able to determine metadata information regarding the web resource. For example, the editor may determine mood, genre, quality, appropriate mix name, and description of a web resource such as an audio media creation or a home movie clip. In an embodiment, the editor controls playback of media located by the search engine on the network side, such as by pausing and playing media back through an editor interface.

In step 745, a determination is made as to whether the record received also includes previously determined metadata. The previously determined metadata may be extracted programmatically in another process, such as described with FIG. 8. If the determination is made that the record received does not contain extracted metadata information, then in step 750 the editor

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interface automatically extract metadata from the web resource associated with the URL of the record. To accomplish this step, the editor interface may access another module that automatically extracts certain types of metadata information. For example, the editor interface may forward the record to AMVME module 240 (FIG. 3) that performs a flow process such as shown by FIG. 8.

Once metadata is included with the record, then a determination is made in step 760 that the editor operating the interface module may choose to save the auto-extracted metadata already included with the record in the database. If the determination to step 760 is negative, then in step 765 the editor updates media information with editor provided metadata using input elements on the editorial software user interface. Once the determination in step 760 is positive, the record is marked as edited and updated in step 770. Then, all the newly added metadata for the media record is updated to the database. The process then continues from step 710 for the next unedited media. The media is marked as edited so it won't be included for editing in the process.

FIG. 10 illustrates a process for generating a play-list. The flow process of FIG. 10 assumes that play-lists names are predetermined and stored in a database. Each play-list is identifiable by its name. For example, classic music, jazz and rock. The play-lists include records of media links. In an embodiment, a record includes at least a URL to a streaming media that is categorized in a database as belonging to the play-list name. In step 810, a play-list name is received from the play-lists database. In step 820, a determination is made as to whether a play-list name was received. If the determination is negative, the system assumes it produced play-lists for all play-lists names, and the flow process is done. This process is routinely executed to add all newly added media to the appropriate play-lists.

In step 830, media records that match search criteria are fetched from the media database. The criteria is that each record play-list record field must match the current play list name obtained in step 810 and that the 'in-play-list' record field for the play list name has False value. In step 840, a play-list is generated to include all media stored at the records fetched is step 830. The new play-list contains one record entry for each fetched media record. Preferably,

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each play list record includes media URL and metadata information that is obtained from the media database record.

In step 850, the media records called in step 840 are labeled as being in the "in- play-list" for the current play-list name. This is achieved by setting the "in-play-list" value for the media database record to true for the appropriate play-list name.

In step 860, the generated play-list is made available to a server-side module, such as web server module 270 (FIG. 2). As an example, the play-lists may be stored, copied or appended to be made available on the web server module. Once the play-lists are available on a server-side module, media URLs and metadata stored in the play-lists is made available to the user terminal so that the user terminal may customize media output available from the play-list. Specifically, one or more playback applications that run on the user terminal may read the play-lists, access media links on the play-lists, continually play-back streaming media from media URLs in the play-list and present media metadata to users for further interaction. The play-list may also be configured to provide access to a client-side media player component that uses a URL of a media link to load and play the media associated through it. Additionally, users may further modify and edit play-lists to create personalized media programming. Further, play-lists may be dynamically generated by a web application in response to a request for media playback made on the user terminal.

FIG. 11 is a flow process for software or hardware application that enables a user terminal to playback streaming media programming determined by play-lists. An embodiment described below assumes that play-lists are available for the process, and that play-lists are identifiable by play-list names. For example, the play-lists may be dynamically generated by the play-list module, in response to a search criteria signaled from a user terminal. The play-lists may also be manually generated by editors on the network side. The play-lists may be predetermined by, for example, a process described with FIG. 10. The playback component can access the play-list without any direct interaction with server side modules.

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In an embodiment, the flow process employs a streaming media player component installed on the user terminal. The media player may be preexisting on the user terminal. Examples of media players for use with an embodiment include RealNetwork Player™, Microsoft Windows Media Player™, and Apple QuickTime™. The application described in the process may be web based or installed on the user terminal.

In step 910, an application interface for a media player on the user terminal is provided.

In step 920, a default play-list name is selected from a list of play-lists. In an embodiment, a database of play-lists is stored on or accessible through the web server module 270. The play-list generator module creates and stores play-list on the web server module to provide the interface with the user terminal 210 and media player stored thereon. Each play-list may store two or more media links, and preferably a plurality of media links.

In step 930, one or more play-lists for the current play-list name are loaded. In step 940, media is presented and played-back on the user terminal. To playback media, server-side modules may provide the media player with URLs to media links that are stored in each play-list. Each play-list may include one or more media link URLs and media metadata. The user terminal then accesses the URL and loads the web resource associated with that media link into a streaming media playback component on the user terminal. Media playback on the user terminal includes outputting, for example, audio and/or video stored in digital format on web resources associated with a media link. In embodiments where the web resources include video media, the step described may dynamically adjust the interface size and the playback component that will handle the actual playback according to the media clip metadata.

Under an embodiment of the invention, the media playback component continuously plays back media by (i) accessing a first site on the network and playing back media from the first site, (ii) then automatically accessing a second site and playing back media from the second site. The media sites may be provided by play-lists which that are made accessible to the media playback component. The sequence for automatically and continuously playing back media may be repeated for each media link included in the play-list. The play-

lists may include hundreds of media links, thus allowing the media play back component to automatically and continuously play back media using numerous sites on a network. As a result, a user is able to experience continuous media play back for hours at a time.

The user terminal also includes an interactive interface to affect the media being played back. An end user on the user terminal may choose to manipulate media playback through one or more commands that may be inputted through the application interactive interface or presentation layer.

In step 945, a determination is made as to whether an event occurred. If an event occurred, the flow process determines the event. The flow process may determine the event that occurred sequentially or concurrently. Preferably, the flow process is configured to receive media playback event from the streaming media playback component. If the event is to skip the currently played media, then a determination in step 960 causes a corresponding action of the media being skipped, and the process step returning to step 940. If the process received a playback error event, or an playback error event, then a determination in step 965 causes the flow process to return to step 940 to playback media from the next web resource of the play-list or play-list name.

If a user quits the application, or signals to quit, then a determination in step 970 causes the flow process to be done. In step 975, a user may choose to view a new media web site while media is being played back on the user terminal. Then in step 980, the media web site is opened in a new Internet window, preferably using the client side web browser.

In step 982, a determination is made as to whether the action selected by the user on the user terminal is to send an e-mail message to one or more e-mail addresses that allow the receiver(s) to playback the current media and the current play-list played by the sender at the time of the event. A user may send either an e-mail containing the URL, the play-list, the play-list name or a URL link. When the message receiver clicks on the link, his terminal will execute the media playback application and will start playing back the media and the play-lists played at the time of the message-sending event. If the determination is positive, then in step 984 the user terminal prompts the user for an one or more e-mail addresses, and then prompts the user to transmit the e-mail. The user

need not have an e-mail client software application for the operation to succeed. The e-mail may be directed to terminals having a streaming media playback component and Internet access.

Preferably, the e-mail message is directed to a user having a user terminal that communicates with server-side modules so that the recipient user terminal is automatically plays back media from the transmitted media link received upon the e-mail being opened. Thus, server side modules may receive addresses from the terminal and act as the source of the email addressed to one or more recipients.

In step 986, a determination is made as to whether a user wishes to rate a media played back from the media links. If the determination is positive, then the user is prompted to rate the media in step 988. A rating value is transmitted to a backend web rating system application using the Internet. This operation is part of the service rating system that includes server side modules that produce, in combination with this operation, top and bottom rating media in each media category.

Step 990 illustrates other exemplary actions that may be received from a user on the user terminal interfacing with the playback application. For example, user actions may correspond to pausing media playback, adjusting volume, picture controls, size, seeking within the media, etc. In step 992, playback settings are changed according to user input. In an embodiment, the flow process returns to step 945 to check for another event if any of the determinations in step 982-992 are negative.

E. Rating System for Media Play Back

An embodiment of the invention includes a rating system with a media search and playback system. The rating system allows users to listen or view media segments available over the Internet according to a rating. In addition, users participate in determining rating media segments by providing a rating input after listening or viewing a media clip. The ratings may be used as a category, similar to other categories such as genres or categories.

FIG. 12 illustrates an architecture for use with the rating system, under an embodiment of the invention. The rating system 1000 may be employed

with, for example, the system 200 (FIG. 2). The rating system 1000 may include or cooperate with components of a system such as described with FIG. 2 to enable the user view and/or select media clips from play-lists. The generated play-lists may contain a list of links to media on the Internet. Selection of media clips by the user causes media to be played back to the user over the user terminal.

The rating system 1000 includes a backend database management component 1045. The database management component 1045 maintains organizational data structures such as tables that describe rating information for media clips. The media clips include Internet streaming audio or video. The rating information may be in the form of values such as, for example, total votes counted. In an embodiment, database management component 1045 maintains records that comprise meta information on each media clip including the URL to the media clip, the current rating of the media clip, and the total votes for that media clip.

A user 1010 on a user terminal interacts with a web-based playback interface 1020. As an example, play-back interface 1020 outputs play-lists 1018, 1022 to the user. The media clips in each play-lists may be outputted automatically, or displayed for the selection of the user. The play-back interface 1020 may also display to the user genre field 1016 or category field 1014 of the selected media clip, or play-list 1018, 1022. The playback interface 1020 includes features to enable a user on the user terminal to make entries or selections regarding preferences and opinions, as well as other types of information. The user may also view ratings stored on backend database 1045. The user may enter selections by, for example, using icons or other display features. The user may make entries by, for example, inputting text or voice. FIG. 12 illustrates a rating selection component 1012 as a feature of play-back interface 1020. As an example, the rating selection component 1012 allows users to rate a media output between a scale of 1 to 5.

A user 1010 may input a rating to play-back interface 1020. The rating is signaled from play-back module 1020 to a rating module 1030. In an embodiment, rating module 1030 maintains a tally for each media clip. The tally compiles ratings received from play-back module 1020. The ratings may

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be received from more than one user and/or user terminal. The tally may be implemented through a protocol that enables the rating module 1030 to organize media clips according to an order. The organization of the media clips may correspond to a user preferential list, where preferred media clips are, for example, listed together or listed before less preferred clips. The rating module 1030 may also determine a genre, category, or other organization information through selections or entries received from the play-back module 1020. The selections may be tallied through any protocol, such as summation, averages, weighted averages and moving averages. In another embodiment, the rating module 1030 may maintain a text field to store user comments regarding each media clip.

In an embodiment, the rating component 1030 updates the rating information maintained in the database management component 1045. For example, the rating component 1030 may update values of the current rating and total votes for each media link.

A play-list generator 1040 generates play-lists based on rating information maintained in the database management component 1045. The play-list generator 1040 may signal to retrieve or receive records for each media clip. The play-list generator 1040 then automatically generates one or more play-list 1042. As previously discussed, each play-list is a list of media links. In an embodiment, the play-lists 1042 are generated according to the current rating and/or rating for each media clip. The generated play-lists are provided by the play-list generator 1040 for the play-back interface 1030.

The user 1010 may choose to listen to play-lists containing media clips rated according to one or more criteria. The play-lists may also be organized according to other factors, such as genre and category.

FIG. 13 is a flow chart that allows a user to listen to media clips that are rated according to one or more criteria. In step 1110, the user is provided a user-interface that allows users to receive media sorted according to one or more categories. The categories correspond to genres, such as type of music etc.

In step 1120, the user selects a category from the options presented by the user-interface. In response to the selection, the user terminal is provided

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one or more play-list in step 1130. The play-list received by the user-terminal matches the category or genre selected by the user. Further, play-lists contain predetermined media links to media clips. The media clips in each of the play-lists are determined according to a rating system, using a system such as described by FIG. 12. The predetermined play-list may correspond to a play-list generated by play-list generator 1040 (FIG. 12). Once the play-list is received by the user terminal, the flow process returns to step 1120.

In step 1140, media clips are played back on the user terminal. The media clips are played back consecutively and automatically, so that the user experiences continuous media playback. For example, the play-lists may contain numerous media creations from a selected genre. The media creations may be determined for the play-list according to a rating formula. The user is provided the media creations of the selected genre continuously, so that the user's media experience resembles listening to an album.

FIG. 14 illustrates a flow process for updating a rating of a media clip, under an embodiment of the invention. In step 1210, a module is provided a rating event. The rating event is a rating for a particular media clip, having an associated URL. The rating from the user is predefined from a closed set. For example, the user may provide a rating from 1 to 5.

In step 1220, a record is located for the media clip that was currently rated. The record may be stored in a database, and include the media link for the media clip, the current rating of the media clip, and the votes received for that media clip. In an embodiment, the record may include more than one URL associated with the media clip that was rated. In an embodiment, the record is maintained in database management component 1045 (FIG. 12).

In step 1230, a rating field for the media record is updated. The rating field may correspond to the current rating of a media clip. A module such as the rating module 1030 may update the rating field in database management component 1045 (FIG. 12). The media record is updated to determine a new rating. In one embodiment, the new rating is an averaged based formula. The formula may also be weighted. An example of a formula to determine a rating, under an embodiment of the invention is:

Newrating= 1/(n+1) (N*(old rating)+user provided rating)

N is the total number of votes received, and newrating ranges between 0 and a maximum value.

In step 1240, record for the media clip rated is further updated to add an additional vote to the field for votes received. The flow process then returns to step 1210.

FIG. 15 illustrates an exemplary structure for a database to maintain updated records on ratings and votes tallied. The table may associate values corresponding number of votes, rating, and other information to a media link containing a media clip.

FIG. 16 illustrates a flow process for generating media clips into play-lists according to a rating criteria. Play-lists including a rating criteria are referred to as rated play-lists. The flow process assumes known categories for media clips. The flow process also assumes a rating for rated media clips, and the number of media clips in a rated play-list. The flow process may be used with any of the aforementioned embodiments.

In step 1410, a next category may be fetched from a database containing the different categories of media clips. In step 1420, the system makes a determination as to whether a category was received. If no category is received, the system assumes that there are no more media categories to be rated.

In step 1430, a new play-list is created for a current category. In step 1440, up to N rated media clips from a database of rated media clips are added to the play-list. Preferably, N is a constant in the flow process. Then in step 1450, an old play-list is deleted, and the new play-list is saved. The new play-list may be saved in a format that follows predefined protocol so that the play-list and its contents are accessible to a streaming media play back interface. The flow process then returns to step 1410.

FIG. 17 illustrates a flow process for programmatically categorizing media files. The process assumes a database containing metadata associated with media clips. The metadata includes metadata provided by a human editor. For example, the metadata may pertain to categories such as genre, mood and atmosphere.

In step 1510, a record is retrieved from the database. The record is retrieved with metadata information containing a first type of metadata information and a second type of metadata information. As an example, the first type of metadata information may correspond to a genre of music, and the second type of metadata information may correspond to an artist. In step 1520, a determination is made as to whether a record was received. If the determination is negative, then the process assumes that all media clips have been categorized.

If the determination in step 1520 is positive, then all records in the database having the first type of metadata information are retrieved in step 1530. In step 1540, all records retrieved in step 1530 are updated to include the second type of metadata information. As an example, all records belonging to a particular artist (first type of metadata information) or given additional metadata information of a particular genre (second type of metadata information). The process then returns to step 1510 to retrieve another record.

In one embodiment, the second type of metadata information is a genus category, and the first type of metadata information is a species of the first type of metadata information. Once the first record is known to have the a particular species and genus, the genus may be determined and stored for all records having the same species.

F. Personalized Media Playback

FIG. 18 is a flow process to create personalized play-lists of streaming media files available on the Internet (or other networks). The play-lists may be personalized by users on user-terminals.

In step 1610, a user chooses to add a URL of a selected media clip to a personal favorite play-list. In step 1620, the flow process adds the URL (and metadata) of the selected media clip to a user terminal store for user persistent information, such as an Internet cookie. The persistent data store is then accessible for the web-based play back application on the user terminal.

In step 1630, the user selects to play back media clips from that user's favorite play-list. In step 1640, the system reads back the media clips from the persisted data store. In step 1650, the system plays media clips using a URL

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associated with each media clip. The cookie may also provide additional URLs. Thus, multiple media clips may be played continuously from different sites on the Internet.

The user may edit the play-list, change an order of the play-list, or delete selections from the play-list. The user may designate certain play-lists as personal, so as to identify the play-list with that user's terminal. Alternatively, the play-list may be stored on a network server and accessed using the media location and playback module. Users may access their personal play-lists from any one of a plurality of terminals that have access to the system.

G. Distributed Architecture

An implementation under an embodiment provides a distributed architecture in which a user terminal accesses media resources from a plurality of network sites. In a network such as the Internet, the user terminal accesses multiple web sites to playback media locates as files on those web sites.

A network site includes any network location having internal links. Embodiments of the invention access network sites providing links to media files and/or other network sites. A web site refers to a network site on the Internet. Examples of web sites include web pages, including web pages with HTML links to other web sites, to media files, and to other types of files.

The distributed architecture inverts conventional media distribution paradigms. Numerous streaming media files can be streamed to an individual user terminal continuously from throughout the Internet using the embodiment of the distributed playback architecture. The distribution architecture is scalable to provide thousands or millions of streaming media files to user terminals. The users can then play media files located throughout the Internet in a continuous manner from the numerous Internet sites.

FIG. 19 illustrates a distributed playback architecture, under an embodiment of the invention. A user terminal 1710 has access to N network sites that provide access to media, also referred to here as media sites. The N media sites 1722 via web server module 1770. The media sites 1722 each have one or more links to media web resources. The links are represented by URLs 1-N. The web server module 1770 can load the media resources onto a media

playback component of user terminal 1710. Once loaded, the media resources are played back by a media playback component on user terminal 1710.

In an embodiment, the media sites 1722 correspond to different locations on a network such as the Internet. For example, media sites may have different Internet addresses, including different domains. Each media site provides direct access to a media network resource. This implies that a URL (or link) to one of the media sites accesses the media network resource for playback without accessing another internal URL (or link).

In an embodiment, web server module 1770 signals multiple URL links to user terminal 1710. The media playback component of user terminal 1710 accesses each link to playback the media resource. The URLs are selected for media playback so as to output media from user terminal 1710 according to a predetermined program.

In an embodiment, the program is selected or defined from a search request of user. For example, a search request may designate a category for media output, such as a genre and artist. All URLs containing media from that artist and genre may be gathered and signaled from web server module 1770 to user terminal 1710. The URLs may be provided in any order, such as random, etc. or a chronological order of the artist.

In another embodiment, a program may be provided by one or more play-lists. Each play-list in the program may be generated by, for example, a play-list generator 1040 (FIG. 12). The play-lists may be personalized for the user of the end terminal 1710. For example, play-lists may be generated for preferences and profiles specified by the user of user terminal 1710. As another example, a user may couple to the Internet, prompting web server module 1770 to automatically signal one or more play-lists containing the URLs to user terminal 1710. Still, other embodiments provide for URLs to web resources, or play-lists containing the URLs to be randomly provided to user terminal 1710.

Among other advantages, the distributed architecture permits simultaneous playback of, for example, thousands or millions of multiple streams which do not congregate on a single point. This avoids congestion arising under examples of the current media paradigms. This ensures that the embodiment of our distributed architecture may "scale," or permit the

simultaneous playback of, for example, thousands or millions of simultaneous streams. Further, the quality of the user experience is not affected by scaling a system under the distributed architecture embodiment.

In contrast, conventional broadcasting employs one radio or television signal to broadcast to listeners or viewers. Media files disseminated over the Internet today may be distributed in a manner which is somewhat similar in that the media file is located on a single server (or small group of servers) which is accessed by potentially large number of Internet users. As a result, the experience of the users may diminish due to the limited ability of current systems to scale.

This distributed playback architecture, the delivery of streaming media through this playback architecture, in combination with the search functionality performed by the back-end module, and the rating and personalization features of the playback client terminal module permits the creation of a broadcasting system that is personalized by an end user. A personal broadcasting system permits each individual user to create media programs which can be sent to, for example, thousands or millions or other users who can simultaneously play different programming combinations using a distribution of Internet (or other network) sites.

An example of a distributed architecture playback system includes wireless devices that are communicatable to a network containing media resources. For example, media playback component 1710 may be loaded onto a wireless access protocol (WAP) enabled device. Examples of WAP enabled devices include handheld computes and cell phones. The WAP enabled device may use a wireless communication network to access network server module 1770. The WAP enabled device may also include output features, such as speakers or a display screen. The WAP enabled device accesses media sites 1722 by control of network server module 1770. The WAP enabled device then plays back media from the media sites 1722. The WAP enabled device may then be used to simulate a portable radio.

As another example, an automobile may be equipped with a wireless device. The wireless device accesses multiple media sites on a network such as the Internet to and provide playback of media clips. For example, the user may

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select to hear music from a favorite play-list using the WAP enabled device in the automobile.

H. Messaging Applications

FIG. 20 is a diagram illustrating a messaging application, under an embodiment of the invention. The messaging application enables the user to share a media playback experience with other users having access to the network.

FIG. 20 assumes the messaging application is operated on a network such as the Internet. In the embodiment, a network interface or network-side module is used to enable messaging, rather than a client messaging applications. Examples of messaging applications for use with embodiments include e-mails, which are delivered to a folder on a recipient's terminal. Other types of electronic messages include instant messages, which can be displayed or heard on the recipients terminal automatically upon arrival.

A messaging module 2080 receives a messaging request from a first user terminal (sender) 2010. The messaging module 2080 may be an application or portion of network server module 2070. The messaging request is entered by the user through the user-interface 1900, using for example, an e-mail selection field 1990.

The messaging module 2080 receives addresses to deliver messages to recipient terminals (recipient) 2020. The sender 2010 may manually signal the recipients address using entry methods such as keyboards, graphic user selection features, or audio commands. Alternatively, messaging module 2080 has access to network stored addresses for the specific user. The network stored messages are then selectable from a terminal by the user on the sender terminal 2010.

In response to a request from sender 2010, messaging module 2080 generates a message 2085 for the recipient. The request may also include the address of the intended recipient(s). The message 2085 is sent to all recipients 2020 specified by sender 2010. The contents of the message 2085 include a URL to the network server module 2070. In an embodiment, the URL in the message is packaged with arguments or other coding to identify a play-list

maintained on the network server module 2070. The URL may also be packaged with arguments to identify the specific song being played when the sender causes the message to be transmitted to the recipient. Alternatively, the URL may identify to the recipient the search request or criteria used by the sender.

The recipient may choose to return a message 2082 to signal messaging module 2080. In one embodiment, the content of the message is constructed so that once the message is opened, the user can select a link to a module that stores or maintains the play-list 2075. For Internet applications, the link is HTML formatted to include the URL of network server module 2070, and arguments to identify the play-list selected by sender 2010. Once network server module 2070 is accessed by the recipient 2020, arguments 2088 contained with the link identify the specific play-list 2075 experienced by sender 2010 when the request to send the message was made.

If the message is instant, the recipient 2020 can respond immediately to simultaneously share the experience of sender 2010. Alternatively, the recipient 2020 can be made to respond automatically upon the recipient 2020 receiving the message 2085, so as to enable sender 2010 and 2020 to simultaneously or concurrently share the same media playback.

The argument 2088 that is packaged with the link may also identify individual media clips, and/or an entire play-lists. The recipient 2020 is able to experience media playback from individual media clips selected by sender 2010.

In another embodiment, message 2085 is constructed so that once the message is opened, the user is automatically connected to network server module 2070. The message may be an e-mail, stored in a designated folder of recipient 2020. The e-mail may include an HTML formatted URL to cause the recipient's terminal to access and communicate with network server module 2070. The HTML formatted URL may also include code that causes the user terminal to automatically access network server module 2070 upon the e-mail being opened. The HTML formatted link may also include arguments to specify the play-list 2088 and/or media clip identified by the sender, as well as other parameters of the URL. Once the play-list or media clip is identified by

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network server module 2070, the recipient 2020 is able to share the media playback experience of the sender 2010. The sender 2010 can experience the media playback at the time sender 2010 requests the message to be sent.

In the embodiments shown, sender 2010 can select a media program that is signaled transmitted to recipient 2020 by messaging module 2080. The program may correspond to one or more play-lists, playing back multiple media resources. While sender 2010 is being played back the program, the sender 2010 can specify the address of recipient 2020 to messaging module 2080. The messaging module 2080 generate a message that includes a selectable link to enable the recipient to access the network server module 2070. Arguments or scripting contained with the URL identify the particular play-list being signaled to the sender 2010. Since the play-list is updated after every media resource is played back to sender 2010, recipient 2020 accesses the play-list at the selection being played back to the sender 2010. The play-list is then signaled to the sender 2010 and recipient 2020 simultaneously, or approximately thereabout. Alternatively, recipient 2020 accesses the play-list beginning with the media clip played back to sender 2010 when the sender 2010 selected to transmit the message to recipient 2020.

As an example, sender 2010 transmits a search request causing media, based on search criterias of a specific artist and a ranking. The network server module 2070 identifies URLs matching the search request and forms play-list 2075 for sender 2010. After reviewing the play-list 2075, the sender 2010 decides to share the media playback with a friend, recipient 2020, whom the sender believes would appreciate play-list 2075. The sender 2010 requests messaging module 2080 to transmit message 2085 to recipient 2020 by submitting the recipient's e-mail address to the messaging module 2080. The message 2085 sits on the recipient's terminal until accessed. The recipient 2020 selects message 2085 to access play-list 2075. Unless the messaging is nearly instantáneous, the recipient experiences media playback from the play-list 2075 when sender 2010 request message 2085 to be sent. Alternatively, sender 2010 may request the entire play-list 2075 to be transmitted to recipient 2020. In this way, sender 2010 and recipient 2020 may share a common interest in certain genres, category, artists etc. of media playback.

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I. User-Interface

FIG. 21 illustrates a user-interface 1900, under an embodiment of the invention. The user-interface 1900 may correspond to the play-back interface 1020, described with FIG. 10. Alternatively, the user-interface may be a terminal side component in communication with one or more server-side modules, such as for example web server module 1070 (FIG. 12).

In an embodiment such as shown by FIG. 12, user-interface 1900 includes a plurality of user-interactive features. The user-interactive features enable users to interact with the system 200 from the user terminal 210. Some of the plurality of user-interactive features allow users to submit search requests and other media requests for playback. Other control user-interactive features allow users to affect the play back of the media resources.

The user-interface 1900 may output to the user information, images, and/or audio that is different than the media resource being played back. For example, user-interface 1900 displays metadata information to the users about the media resource being played back. In addition, the user-interface 1900 enables users to, for example, view advertisement, receive electronic messages, and create and manage play-lists.

In an embodiment such as shown by FIG. 21, the user-interface 1900 includes a first menu field 1910, a second menu field 1920, and a third menu field 1930. The first menu field 1910 allows the user to select a first criteria for media resources that are to be played back. The second menu field 1920 allows the user to select a second criteria from a set of media resources matching the first criteria. The third menu field 1930 allows the user to select a third criteria from the a set of media resources matching both the first and second criteria. Each of the menu fields 1910-1930 may be in the form of click and drag-down menus.

The user-interface 1900 may also include a text field 1940. The text field 1940 allows users to enter a search criteria. The search criteria entered in text field 1940 may be combined with the search criterias of one or more menu fields 1910-1930 using a Boolean operation. Preferably, all search criterias are AND together into a single search criteria. For example, the search criteria

entered in text field 1940 may correspond to an artist name, or a title of a media creation.

In an embodiment, the user-interface 1900 provides features that prompt a user for input, such as for one more search criterias. The web server module 270 receives the search criteria(s) signaled from user terminal 210, and access media and metadata table 247. Each of the menu field 1910-1930 may also allow users to enter text field as the search criterias. The search criteria(s) are matched to URLs containing metadata having the same (or equivalent) criterias. For example, the search request may specify a genre, and a first name of an artist. Then, web access server 270 locates URLs to media resources having associated metadata information that identifies the media resource as being of the same genre, and as containing the same first name in the artist name metadata indexed data structure.

The web server module includes a feedback display portion 1950. The feedback display portion 1950 may signal information, messages, advertisement etc. to the end user. In an embodiment, feedback display portion 1950 displays metadata information about the media resource being played back. For example, a song of a particular genre and category may be played back. The display screen portion 1950 may display the title of the song, the artist name, a play-list associated with the song, a rating component of the song, and the song's duration. Information is read when the media playback component loads the media resource.

Other user-interactive features may also be included in user-interface 1900. In an embodiment, user-interface 1900 includes a play-list feature 1960. The play-list feature 1960 enables users to add a media creation to a play-list. The play-list feature 1960 may, as an example, be a selectable icon. Upon selecting the play-list feature 1960, a pop-up window (not shown) may be displayed allowing a user to name or select the play-list that will include the media resource being played. In this way, a user of user terminal 210 can provide input to create and manage play-lists, using systems such as described with FIG. 12 and 19.

The user-interface 1900 may include one or more control user-interactive features. The control user-interactive features may be in the form of

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selectable icons. A skip feature 1972 causes, for example, web server module 270 to signal a URL of another media creation to the media playback component. This causes the media playback component to start playing back a new media creation. A pause feature 1974 enables users to pause the media playback component from playing back the media resource. The pause feature 1974 may signal the media playback component directly, or cause the web server module to signal the command to the media playback component. Reselecting the pause feature 1974 then causes the media creation to be played back from the portion where playback was paused. Similarly, a seek feature 1976 may signal to seek or move to a specific instance of playback on the media resource. A volume feature 1978 signals the application program interface 276 (FIG. 5) to raise the volume of the media resource being played back.

The user-interface 1900 may also include a rating feature 1980. The rating feature 1980 may be in the form of multiple selectable icons, where the icons are arranged to correspond to a rating. For example, five icons may be provided to represent best to worst ratings. In an embodiment, the rating feature 1980 enables a user to rate a media resource during or after it is played back on the user terminal 210. With reference to an embodiment such as described with FIG. 12, the rating feature 1980 is used to prompt a user to signal a rating to rating component 1030 (FIG. 12). The rating feature 1980 may be a user response to a media clip played back on user terminal 210. The rating component 1030 receives the rating and modifies rating information associated with the URL that is stored in 1045. The rating information may then be provided to other users or user terminals. For example, the rating information may then be signaled to display portions 1950 of other user terminals 210 who select that media clip for playback.

The user-interface 1900 also includes a personal play-list feature 1985. The personal play-list feature includes iconic selection features, including an add icon 1987 to add a URL to a play-list, and a play icon 1989 to play a personal play-list. The add icon 1987 enables a user to signal play-list generator 1040 (FIG. 12) to add a URL to the personal play-list. The URL being added to the play-list may correspond to a media resource being played back on user terminal 210. The play icon 1989 may be selected to cause web server module

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1070 (FIG. 12) to signal URLs from the personal play-list to the media playback component of user terminal 210. In this way, user terminal 210 may select to have continuous media output from resources previously selected to be on a play-list.

The user-interface 1900 may also include an e-mail selection feature 1990. The e-mail selection feature 1990 may be iconic, to allow selection by the user upon the media playback. Once selected, an e-mail program on user terminal 210 may be launched. The e-mail program may be directed to open a new message, and attach the URL of the selected media resource.

FIG. 22 illustrates an embodiment in which user-interface 1900 is displayed on the desktop along a second window 2210 showing a web site 2212. The web site 2212 hosts the media file being played back. In this embodiment, web server module 1070 signals a media file URL to the media player component of the terminal. The web server module 1070 concurrently signals the web browser component 213 on the terminal another URL to the hosting web site. The web browser 213 opens the second window 2210 to display the web site while the media from the media file is being played back on the terminal. In this way, users are displayed the web site hosting the media file while media from the media file is played back. This allows the user to view, for example, banner ads, artist name and titles, and copyright information while media from the web site is being played back.

After the playback is complete for one media file, a URL to a next media file is signaled to the media player component on the terminal. The next URL may be determined by a sequence of a play-list, or by a result to a search term inputted from the user. If the URL of the next media file is hosted on a web site that is different than the preceding web site, then web server module 270 signals the URL of the next hosting web site to the web browser. The second window 2210 then displays a second web site 2212' that hosts the media file being played back. In this way, the second window 2210 displays only web sites hosting the media files being played back.

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J. Conclusion

The foregoing description of various embodiments of the invention has been presented for purposes of illustration and description. It is not intended to limit the invention to the precise forms disclosed. Many modifications and equivalent arrangements will be apparent.

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CLAIMS

What is claimed is:

1. A method for playing back media from a network, the method comprising:

receiving a search criteria from a network enabled device;

accessing a database comprising a plurality of network addresses, the database associating each address with one or more classes of information, each address accessing a media resource;

selecting at least one address in the database using the search criteria;

signaling the selected address to the network enabled device; and

controlling the network enabled device so as to automatically access and play back the media resource of the selected address.

2. The method of claim 1, wherein selecting at least one address in the database includes matching the search criteria with a parameter in the one or more classes of information associated with that address.

3. The method of claim 1, wherein accessing a database comprising a plurality of network addresses includes accessing a plurality of links to Internet sites, each link containing no other internal link.

4. The method of claim 3, wherein selecting at least one address in the database using the search criteria includes selecting a plurality of links in the database using the search criteria, signaling the selected plurality of links to the network enabled device, and programmatically controlling the network enabled device so as to automatically access and sequentially play back the media resource of each of the plurality of selected links in a designated order.

5. The method of claim 4, wherein controlling the network enabled device so as to automatically access and sequentially play back the media resource includes sequentially playing back the media resource of each of the plurality of selected links after accessing the respective selected link.

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6. The method of claim 3, wherein receiving a search criteria from a network enabled device includes receiving the search criteria corresponding to an artist name, and wherein selecting at least one address in the database using the search criteria includes selecting a plurality of links that are each associated with a class of information containing a parameter corresponding to the artist name.

7. The method of claim 3, wherein receiving a search criteria from a network enabled device includes receiving the search criteria corresponding to a title of a network media resource, and wherein selecting at least one address in the database using the search criteria includes selecting a plurality of links that are each associated with a class of information containing a parameter corresponding to the title of the network media resource.

8. The method of claim 2, wherein receiving a search criteria from a network enabled device includes receiving the search criteria corresponding to a musical category, and wherein selecting at least one address in the database using the search criteria includes selecting a plurality of links that are each associated with a class of information containing a parameter corresponding to the musical category.

9. A method for playing back media from a network, the method comprising:

receiving a request for media playback entered on a network enabled device;

accessing a database comprising a plurality of network addresses, each address accessing a media resource;

identifying at least two addresses from the database;

signaling each identified address to the network enabled device; and

controlling the network enabled device to access and automatically play back the media resources of each of the signaled addresses.

10. The method of claim 9, wherein controlling the network enabled device to access the media resources of the signaled links includes signaling a uniform resource locator for one or more of the media resources to a media playback

component to cause the network media resources of the signaled links to be accessed and played back on the network enabled device.

11. The method of claim 10, wherein receiving a request for media playback includes receiving the request for media playback from an Internet enabled device, and wherein the method further comprises signaling the uniform resource locator of the one or more media resources to a web browser component on the Internet enabled device to cause a web page to be displayed on the Internet enabled device while the media playback component plays back the media resource on the network enabled device.

12. The method of claim 11, wherein receiving a request for media playback from a network enabled device includes receiving a request for a play-list comprising a plurality of addresses, the play-list arranging the plurality of addresses so that the addresses are loaded by the media playback component in a designated order, wherein identifying at least two addresses in the database includes identifying the addresses in the play-list, and wherein controlling the network enabled device to access and automatically play back the media resources of the signaled addresses includes accessing and playing back each media resource in the play-list sequentially in the designated order.

13. The method of claim 12, wherein receiving a request for media playback from a network enabled device includes receiving a request for a program comprising multiple play-lists, each play-list being corresponding to a predetermined selection of media resources, wherein identifying at least two addresses includes identifying the addresses in each of the play-lists in the program, and wherein controlling the network enabled device to access and automatically playback the media resources of the signaled addresses includes accessing and playing back each media resource in a sequential order designated by the play-lists of the program.

14. A computer system for playing back media from a network, the computer system comprising:

a network enabled device comprising a media playback component;

a database comprises a plurality of addresses, each address locating a media resource on the network;

a network server module that communicates with the network enabled device and with the database, the network server module being able to receive a search request entered on the network enabled device that specifies one or more criterias, to select at least one address from the database that is associated with a class of information that matches the search criteria, and to cause the media playback component to load the media resource located by the selected address.

15. The computer system of claim 14, wherein the database stores one or more classes of information associated with each address in the plurality of addresses.

16. The computer system of claim 15, wherein the database is locatable by the network enabled device on the network.

17. The computer system of claim 15, wherein at least a portion of the database resides on the network enabled device.

18. The computer system of claim 14, wherein the network server module signals the selected address to the network enabled device to cause the media playback component to load the media resource located by the selected address.

19. The computer system of claim 18, wherein the network server module communicates with the network enabled device through the network.

20. The computer system of claim 14, wherein the network server module is located at least partially on the network enabled device and communicates with the database through the network.

21. The computer system of claim 14, wherein the network server module comprises a sequence of code that is signaled to the network enabled device from another device on the network, the sequence of code being executable on the network enabled device.

22. The computer system of claim 14, wherein the network enabled device comprises the media playback component, and wherein the network server module programmatically controls the media playback component of the network enabled device to playback the media resource.

23. The computer system of claim 14, wherein the network enabled device is a network enabled device selected from a group of devices consisting of a personal computer, a handheld computer, a smart network appliance, and a wireless Internet enabled device.

24. The computer system of claim 14, wherein the database comprises a plurality of links to Internet sites, wherein each link accesses a media resource without requiring another internal link.

25. The computer system of claim 14, wherein all or a portion of the database resides on the network enabled device.

26. The computer system of claim 14, wherein all or a portion of the database is accessible to the network enabled device over the network.

27. The computer system of claim 14, wherein the one or more classes of information for each address in the database include types of metadata selected from the group consisting of genre, title, and data format of the network resource.

28. The computer system of claim 14, wherein the media resource is a streaming media file that outputs a combination of at least video or audio once the media resource is loaded by the media playback component.

29. The computer system of claim 14, wherein the network includes the Internet, the network enabled device includes an Internet enabled device, each of the plurality of addresses includes links to a media web resource, and wherein the network server module signals control information to the Internet enabled device to cause the Internet enabled device to programmatically access each of a plurality of media web resources signaled to the network enabled device.

30. The computer system of claim 29, wherein the web server module signals control information to the media playback component and a web browser component of the Internet enabled device, to cause the media playback component of the network enabled device to programmatically load and playback the media web resource while the web browser displays a web page of a web site corresponding to the media web resource being played back.

31. A computer system for playing back media from a network, the computer system comprising:

a network enabled platform comprising a media playback component;

a database comprising a plurality of addresses, each address locating a media resource on the network, each address accessing a media resource; and

a network server module that coupleable to the media playback component and the database, the network server being able to receive a request for media playback from the network enabled device, to select multiple addresses from the database, to signal the multiple addresses to the network enabled device, and to control a media playback component on the network enabled device to use the addresses to automatically access and play back the media resource associated with the addresses.

32. The computer system of claim 31, wherein the network server module resides on the network.

33. The computer system of claim 31, wherein at least a portion of the network server module resides on the network enabled device.

34. The computer system of claim 31, wherein the network server module comprises a sequence of code that is signaled to the network enabled device from another device on the network, the sequence of code being executable on the network enabled device.

35. The computer system of claim 31, wherein the network enabled device is an Internet enabled device comprising the media playback component and a

network browser component, the database comprises a plurality of links to media web resources, wherein the network server module programmatically controls the media playback component of the Internet enabled device to access and playback the media web resource of each link signaled to the Internet enabled device.

36. The computer system of claim 31, wherein the network enabled device further comprises a web browser component, and wherein the network server module programmatically controls the web browser component to display a web page associated with the media web resource being played back.

37. The computer system of claim 31, further comprising a play-list module coupleable to the network server module, the play-list module generating a play-list based on one or more criterias designated by a user of the network enabled device, the play-list comprising a plurality of addresses that are signaled to the network enabled device in response to the request for media playback.

38. The computer system of claim 31, wherein the network enabled device is a terminal device selected from a group of devices consisting of a personal computer, a handheld computer, a wireless Internet enabled device, and a handheld computer.

39. The computer system of claim 31, wherein the database comprises a plurality of links to Internet sites, wherein each link accesses a media web resource and contains no other internal link.

40. The computer system of claim 31, wherein all or a portion of the database resides on the network enabled device.

41. The computer system of claim 31, wherein all or a portion of the database is accessible to the network enabled device over the network.

42. A network enabled device configured to playback media from a network, the network enabled device being coupleable over to a database

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comprising a plurality of addresses, each address locating a media resource on a network, the network enabled device comprising:

a user-interface to prompt for a search request;

a network interface to signal the request to a network server module that is communicatable with the database, and to receive one or more addresses in the database that match the search request; and

a media playback component being configured to be programmatically controllable by the network server module to automatically load the media resource associated with each address signaled to the network enabled device upon accessing the media resource.

43. The network enabled device of claim 42, wherein the user interface is controllable by the network server module after the network server module signals the response, the user-interface providing one or more prompts to enable an end user to control the media played back from the one or more media resources associated with the addresses signaled from the network server module.

44. The network enabled device of claim 42, wherein the user-interface prompts for a user to signal the network server module to immediately access a next address signaled to the network enabled device from the network server module.

45. The network enabled device of claim 44, wherein the user-interface prompts for the end user to signal the media playback component to repeat playing back a previously played media resource.

46. The network enabled device of claim 42, wherein the user interface prompts for a specific media resource from the media resources signaled from the network server module for playback, and to pause playback from the media resources signaled from the web server module.

47. The network enabled device of claim 42, wherein the network access component is a web browser residing on an Internet enabled device.

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48. The network enabled device of claim 42, wherein all or a portion of the database is accessible to the network enabled device over the network.

49. The network enabled device of claim 42, wherein all or a portion of the database resides on the network enabled device.

50. The network enabled device of claim 42, wherein the network device is Internet enabled, wherein the network interface signals the request to a web server module that is communicatable with the database to receive one or more links to web sites containing media web resources, the one or more links containing no internal links, and wherein the Internet enabled device further comprises a web browser component, the web browser component being controllable by the web server module to automatically access and display a web page associated with the media web resource being played back by the media playback component.

51. The network enabled device of claim 50, wherein the network interface includes a communication port between the network enabled device and the network.

52. A network enabled device configured to play back media from a network, the network enabled device being coupleable over the network to a database comprising a plurality of addresses, each address locating a media resource on the network, the network enabled device comprising:

a user-interface including a plurality of user-interactive features, a first user-interactive feature in the plurality of user-interactive features prompting to receive a search request for media playback;

a network interface that signals the request to a network server module upon the first user-interactive feature receiving the search request for media playback, the network interface being communicatable with the database to receive one or more addresses in the database that match the search request; and

a media playback component being configured to be programmatically controllable by the network server module to automatically load the media resource associated with each address signaled to the network

enabled device upon accessing the media resource, a playback of the media playback component being controllable by one or more control user-interactive features in the plurality of user-interactive features.

53. The network enabled device of claim 52, wherein the first user-interactive feature in the plurality of user-interactive features is selected from a group consisting of selectable icons, text-entry field, and menu items.

54. The network enabled device of claim 53, wherein the control user-interactive features are selected from a group of selectable icons having functions corresponding to skipping to a next address selected to be signaled to the network enabled device, pausing the media resource being played back; repeating the media resource previously played back, and stopping playback from the media playback component.

55. The network enabled device of claim 53, wherein the user-interface includes a plurality of user-interactive features to select a characteristic of a media playback from the media playback component.

56. The network enabled device of claim 55, wherein the user-interface features include the plurality of user-interactive features to select a genre, an artist, or a title of a network media resource for playback .

57. The network enabled device of claim 56, wherein the search request is composed by selecting one or more of the user-interactive features of the user-interface.

58. A method for sharing media playback on a first terminal coupled to a network with other terminals coupled to the network, the method comprising:

signaling a link in a play-list to the first terminal, the play-list including one or more links to media files on the network;

receiving a signal from the first terminal to message a second terminal while the first terminal is playing back media from one of the media files;

signaling the second terminal a selectable link to enable the second terminal to receive one or more links in the play-list; and

signaling the one or more links in the play-list to the second terminal upon the selectable link being selected by the second terminal.

59. The method of claim 58, wherein signaling the second terminal a selectable link includes messaging the second terminal the link to the play-list.

60. The method of claim 58, wherein signaling the second terminal a selectable link includes signaling a message to the second terminal that causes the second terminal to access the play-list once the message is opened.

61. The method of claim 58, wherein signaling the one or more links in the play-list to the second terminal includes signaling each link in the play-list to the first terminal and to the second terminal concurrently.

62. The method of claim 58, further comprising receiving the signal from the first terminal to message the second terminal while the first terminal is playing back media located by a link in the play-list, and causing the media playback component of the second terminal to load the media file being played by the first terminal.

63. The method of claim 58, wherein signaling a link to the second terminal that locates the play-list module includes signaling the link to include arguments that locate the address in the play-list corresponding to the media file being played back on the first terminal.

64. A system for sharing media playback from a network between a plurality of terminals, the plurality of terminals including a first terminal and a second terminal, the system comprising:

a play-list component locatable on the network by a selectable link, the play-list component identifying a plurality of links to form a play-list, each link in the play-list locating a media file on the network;

a network server module signaling the plurality of links that form the play-list to the first terminal, the network server module being able

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to receive a signal to transmit the selectable link to the second terminal to enable the second terminal to locate the play-list module.

65. The system of claim 64, wherein the network server module signals the plurality of links that form the play-list to the second terminal upon the selectable link being transmitted to the second terminal is selected.

66. The system of claim 64, wherein the messaging module transmits the selectable link as a content of a message.

67. The system of claim 64, wherein the play-list module transmits the selectable link with a corresponding message to the second terminal so that the selectable link is selected when the message opened.

68. The system of claim 65, wherein the play-list module identifies the plurality of links to form a plurality of play-lists, and wherein the messaging module transmits the selectable link with identifiers that identify the play-list being signaled to the first terminal.

69. The system of claim 68, wherein the messaging module transmits the selectable link with identifiers that identify the media file being played back on the first terminal.

70. The system of claim 69, wherein the network server module identifies the link in the play-list being played back on the first terminal and transmits the identified link with a remainder of the links in the play-list to the second terminal, so that the first terminal and the second terminal simultaneously playback the same media files while the links in the play-list are signaled to each of the first terminal and the second terminal.

71. A network enabled device comprising:

a media playback component configured to communicate with a network-side module to receive a first plurality of links, each of the first plurality of links locating a media file on a network;

a web browser component configured to receive a second plurality of links, each of the second plurality of links hosting a media file

located by one of the first plurality of links, the web browser component displaying the web site for each of the second plurality of links that corresponds to the media file being played back by the media playback component.

72. The network enabled device of claim 71, further comprising a user-interface including user-interactive features for controlling media output from media files located by the first plurality of links.

73. The network enabled device of claim 72, wherein the user-interface is displayed in a first window, and the web browser component displays the web site for each of the second plurality of links in a second window.

74. The network enabled device of claim 73, wherein the media playback component is configured to sequentially receive the first plurality of links from the network-side module, and the web browser displays the web sites hosting media files for each of the web sites in the sequence.

75. A system for playing back media from a network, the system comprising:

means for receiving a search criteria from a network enabled device;

means for accessing a database comprising a plurality of network addresses, the database associating each address with one or more classes of information, each address accessing a media resource;

means for selecting at least one address in the database using the search criteria;

means for signaling the selected address to the network enabled device; and

means for controlling the network enabled device so as to automatically access and play back the media resource of the selected address

76. A system for playing back media from a network, the system comprising:

means for receiving a request for media playback from a network enabled device;

means for accessing a database comprising a plurality of network addresses, each address accessing a media resource;

means for identifying at least two addresses from the database;

means signaling each identified address to the network enabled device; and

means for controlling the network enabled device to access and automatically play back the media resources of each of the signaled addresses.

77. A method to locate web resources on the Internet, the method comprising:

accessing a web site;

identifying a plurality of links using a web browser component, each of the plurality of links being selectable to open a corresponding web resource of a specified data type on the web site; and

making the plurality of links available to a plurality of Internet enabled devices that select one or more of the links.

78. The method of claim 77, further comprising arranging the plurality of links in a database that is accessible over the Internet to the plurality of Internet enabled devices.

79. The method of claim 78, further comprising identifying one or more classes of information about each of the plurality of links using a media playback component, and storing each of the plurality of links in association with the one or more classes of information.

80. The method of claim 79, further comprising making the one or more classes of information available to the plurality of Internet enabled devices.

81. The method of claim 77, wherein accessing a web site includes accessing a web site identified by a metacrawler.

82. The method of claim 77, wherein identifying a plurality of links includes identifying links that only access web resources including audio data types, video data types, or a combination of audio and video types.

83. The method of claim 77, wherein identifying a plurality of links using a web browser component includes reconfiguring a commercially available web browser.

84. The method of claim 77, wherein identifying a plurality of links using a web browser component includes programmatically controlling the web browser component through an application programmable interface of a web browser to access the web resource for each of the plurality of links.

85. The method of claim 84, wherein programmatically controlling the web browser through an application programmable interface includes programming the web browser to bypass a shell of the web browser.

86. The method of claim 85, wherein programmatically controlling the web browser through an application programmable interface includes programming the web browser to reduce functionality of the web browser in displaying and translating data structures on each web site.

87. The method of claim 84, wherein programmatically controlling the web browser component through an application programmable interface further comprises using the web browser component to parse a web page that provides access to each link in the plurality of links to identify the plurality of links programmatically.

88. The method of claim 77, further comprising verifying that each of the plurality of links are selectable to open the corresponding web resource of the specified data type upon being selected.

89. The method of claim 88, wherein verifying that each of the plurality of links are selectable includes verifying that the web resources of each available on the network.

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90. The method of claim 89, wherein verifying that each of the plurality of links are selectable to open the corresponding web resource of the specified data type includes loading each of the plurality of media web resources into a media playback component.

91. A system for locating web resources on the Internet, the system comprising:

a web browser component;

a database;

a search module that controls the web browser component to access at least one web site, the search module controlling the web browser component to identify a plurality of links to media web resources at the web site, each of the plurality of links being selectable to open a media web resource, the search module storing the plurality of links in the database.

92. The system of claim 91, wherein the search module signals an application programmable interface of the web browser an address of the web site so as to cause the web browser component to load and parse the web site for the plurality of links to media web resources.

93. The system of claim 91, wherein the search module signals an application programmable interface of the web browser an address of the web site so as to cause the web browser component to load and parse the web site for the plurality of links to media web resources without displaying the media web resources.

94. The system of claim 92, wherein the search module signals the application programmable interface of the web browser the address of the web site so as to cause the web browser component to load and parse the web site for the plurality of links to media web resources of a video data type, an audio data type, or a combination of the audio and video data types.

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95. The system of claim 94, wherein the search module causes the web browser component to load and parse the plurality of links to media web resources of data types including animation and/or still images

96. The system of claim 91, further comprising a metacrawler module to locate a plurality of web sites for the search module.

97. The system of claim 91, wherein the search module controls a media playback component to extract metadata about the media web resources of each of the plurality of links.

98. A method to locate web resources on the Internet, the method comprising:

accessing a database including a plurality of links, the plurality of links being selectable to open a corresponding web media resources;

programmatically identifying metadata information about the web media resource corresponding to each of the plurality of links; and

making the plurality of links accessible to a plurality of Internet enabled devices, the plurality of Internet enabled devices being able to select one or more of the links to open the corresponding media web resource.

99. The method of claim 98, wherein programmatically identifying metadata information about the web media resource corresponding to each of the plurality of links includes signaling each link to a media playback component so as to cause the media playback component to load the corresponding media resource.

100. The method of claim 99, wherein signaling each link to a media playback component includes loading streaming audio media into the media playback component for sound recordings.

101. The method of claim 99, wherein signaling each link to a media playback component includes loading streaming video media in the media playback component for video recordings, including video recording having sound.

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102. The method of claim 100, wherein signaling each link to a media playback unit includes determining at least one of a duration of the web media resource, and a title of the web media resource.

103. The method of claim 100, wherein signaling each link to a media playback unit includes determining a broadcast quality of a web media resource.

104. The method of claim 100, wherein signaling each link to a media playback unit includes determining an image size of a web media resource having video or image.

105. The method of claim 100, wherein signaling each link to a media playback unit includes determining at least one of an artist, a genre, and a data type of the web media resource.

106. The method of claim 98, further comprising manually extracting the metadata information after programmatically identifying the metadata information.

107. The method of claim 106, further comprising storing the identified and extracted metadata information with each of the plurality of links in a database, and then making the database available to the plurality of Internet enabled devices.

108. A method to locate web resources on the Internet, the method comprising:

accessing a database including a plurality of links to media web resources;

programmatically verifying whether each of the plurality of links opens a corresponding web media resource; and

making each verified link in the plurality of links accessible to a plurality of Internet enabled devices that select one or more of the links to open the corresponding media web resource.

109. The method of claim 108, wherein programmatically verifying whether each of the plurality of links opens a corresponding web media resource includes loading each link into a media playback component.

110. The method of claim 109, programmatically verifying whether each of the plurality of links opens a corresponding web media resource includes verifying each of the plurality of links makes available a web media resource for playback on one of the Internet enabled devices.

111. The method of claim 108, wherein programmatically verifying whether each of the plurality of links opens a corresponding web media resource includes loading each link into a web browser component

112. The method of claim 108, further comprising programmatically identifying metadata information about the web media resource corresponding to each of the plurality of links using the media playback component.

113. The method of claim 112, wherein programmatically identifying metadata information includes loading each of the verified links into the media playback component and then receiving editorial input about the web media resource loaded onto the media playback component.

114. A system for locating web resources on the Internet, the system being accessible by a plurality of Internet enabled devices, the system comprising:

a first indexed data structure comprising a plurality of links;

a media playback component coupleable to the database, the media playback component loading each of the plurality of links to verify whether the link is selectable to open a media web resource;

a second indexed data structure stores each verified link in the plurality of links, the second indexed data structure being available to the plurality of Internet enabled devices.

115. The system of claim 114, wherein the media playback component identifies one or more classes of information about the web media resource upon loading the link corresponding to the web media resource.

116. The system of claim 114, further comprising a search module that signals each of the plurality of links in the first indexed data structure to the media playback component, and wherein for each verified link, the search module signals the verified link to the second indexed data structure.

117. The system of claim 112, further comprising an editor interface to receive an editor input, the editor input including metadata information that was not identified from the media playback component loading the link.

118. The system of claim 117, further comprising an editor interface to receive an editor input, the editor input including metadata information identified from the media playback component loading the link.

119. The system of claim 118, further comprising an editor interface to receive an editor input, the editor input including metadata information identified from the media playback component loading the link, wherein the search module signals the metadata information about that verified link to the second indexed data structure, so that each verified link is associated with the corresponding metadata received from the editor input.

120. A method for providing links for use in a media search engine, the method comprising:

identifying a plurality of internal links on a network site;

determining whether the network site makes a network resource of a specific data type accessible for a network enabled device;

extracting the internal links that are selectable to open the network resource of the specific data type;

storing the external link in a database; and

automatically signaling one or more of the links to a media playback component in response to receiving a search request from the network enabled device.

121. The method of claim 120, wherein extracting the internal links that are selectable to open the network resource of the specific data type includes using a web browser component.

122. The method of claim 120, wherein determining whether the network site makes a network resource of a specific data type accessible for a network enabled device includes using a media playback component.

123. The method of claim 120, including extracting the internal links that are selectable to open the network resource of the specific data type for playing back media.

124. A method for providing links for use in a media search engine, the method comprising

a) receiving from a first indexed data structure a first external link to a first network site;

b) initializing a second data structure to be empty;

c) determining if the first network site contains at least one internal link; and

d) storing the at least one internal link contained on the first network site that is not in the first indexed data structure and not in the second indexed data structure as another external link in the first indexed data structure;

e) identifying the internal links contained on the first network site that are selectable to open a network resource of a specific data type or types;

f) moving the first external link from the first indexed data structure to the second indexed data structure; and

g) repeating steps a) through f) until the first indexed data structure is empty.

125. The method of claim 124, wherein prior to receiving from a first indexed data structure a first link to a first site, adding one or more of the first plurality of links to the first indexed data structure using an editor interface.

126. The method of claim 125, wherein prior to receiving from a first indexed data structure a first link to a first site, adding one or more of the first plurality of links to the first indexed data structure using a metacrawler.

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127. A computer system to search for links to streaming media playback on a network, the network being accessible to a network enabled device, the computer system comprising:

a metacrawler to locate one or more media sites containing streaming media;

a media search module coupled to the metacrawler be signaled the one or more media sites, the media search module being able to identify a plurality of media links located by the one or more media sites, each of the plurality of media links being selectable to open streaming media network resource;

a metadata extraction module that accesses each media link identified by the media search engine to extract metadata about the identified media link; and

a database comprising the plurality of media links identified by the media search engine, and the metadata extracted about each identified media link, the database enabling the network enabled device to access the plurality of media links.

128. The computer system of claim 127, wherein the metacrawler locates one or more media sites in media directories, each media directory comprising a plurality of media sites.

129. The computer system of claim 127, where the metadata extraction module comprises a media playback component that loads the streaming media network resource.

130. The computer system of claim 127, wherein the metadata extracted from each identified link is sorted in the database according to one or more classes of information.

131. The computer system of claim 130, wherein the metadata extracted is sorted into one or more classes of information selected from classes consisting of genre, sub-genre, artist, and title.

132. The computer system of claim 131, further comprising a verification module that verifies each media link identified by the media link module opens the corresponding streaming media network resource.

133. A computer system to search for links to streaming media playback on a network, the network being accessible to a network enabled device, the computer system comprising:

means for accessing a web site;

means for identifying a plurality of links using a web browser component, each of the plurality of links being selectable to open a corresponding web resource of a specified data type on the web site; and

making the plurality of links available to a plurality of Internet enabled devices that select one or more of the links.

134. A system for providing media from a network to a terminal, the terminal including a media playback component, the system comprising:

a first network site and a second network site, each network site locating one or more media network resources, each media network resource being locatable on the network by a corresponding address that accesses the media network resource; and

a network server module that communicates with the media playback component, the network server module identifying a first media network resource from the first network site and a second media network resource from the second network site, the network server module signaling the corresponding address of the first media network resource to the media playback component with control signals to cause the playback component to automatically load the first media network resource, the network server module automatically signaling the corresponding address of the second media network resource to the media playback component with control signals to cause the playback component to automatically load the second media network resource.

135. The system of claim 134, wherein the network server module signals the corresponding addresses of the first and second media network resource to the terminal with control signals to automatically playback the first media network resource and then the second media network resource on the terminal.

136. The system of claim 134, further comprising a database including the corresponding addresses of the one or more media network resources on each of the first and second network sites, wherein the network server module selects the first media network resource and the second media network resource from the database using a selection criteria.

137. The system of claim 134, wherein the network server module is coupleable to the user terminal through the network.

138. The system of claim 134, wherein the network server module is located on the user terminal.

139. The system of claim 136, wherein the database is coupleable to the user terminal through the network.

140. The system of claim 136, wherein the database is located on the user terminal.

141. The system of claim 136, wherein the database includes metadata about each of the media network resources, and wherein the network server module selects the first network media resource and the second network media resource using metadata associated with the corresponding address of the first media network resource and the second media network resource.

142. The system of claim 141, wherein the network server module identifies the first and second media network resources by matching a criteria signaled from the terminal to metadata information provided in the database.

143. The system of claim 134, wherein the network server module identifies the first media network resource and the second media network resource through a random selection.

144. The system of claim 134, wherein the network server module signals the first media network resource, the second media network resource, and other media network resources to the terminal in a predetermined order, the other media network resources being located on the first network site, the second network site, or an other network site.

145. The system of claim 144, wherein the network server module signals the terminal to access a next media network resource in the predetermined order automatically if any of the first media network resource, the second media network resource, or the other media network resources are unavailable.

146. The system of claim 134, wherein the first media network resource and the second media network resource are locatable over the Internet.

147. The system of claim 146, wherein the first media network resource includes an Internet addresses having a first domain, and the second media network resource includes an Internet address having a second domain.

148. The system of claim 134, wherein the first media network resource and the second media network resource include a combination of music and/or video.

149. The system of claim 134, wherein the corresponding addresses of the one or more media network resources on the first network site and on the second network site each contain no internal links.

150. A media playback system for the Internet, the system comprising:
an end terminal including a media playback component; and
a web server module coupleable to the end terminal through the Internet,
the web server module having access to one or more media web resources on a first web site, and to one or more media web resources on a second web site,
the web server module signaling a first link that locates a first media web resource on the first web site, and a second link

that locates a second media web resource on the second web site;

the web server module providing control signals to the end terminal to cause the end terminal to access and load the first media web resource and the second media web resource into the media playback component.

151. The system of claim 150, wherein the web server module provides control signals to the playback component of the end terminal to cause the end terminal to playback the first media web resource after loading the first media web resource, and to playback the second media web resource after loading the second media web resource.

152. The system of claim 151, wherein the end terminal includes a web browser, the web browser receiving the first link and the control signals from the web server module to cause the web server module to display a web page of the first web site concurrently while the first media web resource is being played back, the web browser receiving the second link and the control signals from the web server module to cause the web server module to display a web page of the second web site concurrently while the second web media resource is being played back.

153. A media playback system for the Internet, the system comprising:

a user terminal including a media playback component; and

a web server module coupleable to the user terminal through the Internet, the web server module having access to a plurality of web sites including a first web site and a second web site, each of the plurality of web sites including one or more media web resources, the web server module signaling a first link to a first media web resource on the first web site and a second link to a second media web resource on the second web site, the web server module providing control signals to the user terminal to cause the user terminal to access and load the first media web resource and the second media web resource; and

a database including links to each of the plurality of media web resources, the web server module identifying the first link and the second link from the database.

154. The system of claim 153, wherein each of the plurality of links in the database are selectable to open a corresponding media web resource in the plurality of media web resources.

155. The system of claim 154, wherein the database includes metadata about each of the plurality of media web resources, and wherein the web server module identifies the first link by using metadata associated with the first media web resource, and the web server module identifies the second link by using metadata associated with the second media web resource.

156. The system of claim 155, wherein the web server module identifies at least the first link by matching a criteria signaled from the terminal to metadata information in the database corresponding to the first media web resource.

157. The system of claim 155, wherein the web server module identifies at least the first link to the first media web resource and the second link to the second media web resource through a random selection.

158. The system of claim 153, wherein the web server module signals the terminal to access another media web resource automatically if an accessed media web resource is unavailable, the other media web resource being located on either the first web site, the second web site, or a third web site.

159. A media playback system for the Internet, the system comprising:
a terminal including a media playback component and a user-interface;
a web server module coupleable to the user terminal through the Internet, the web server module having access to a plurality of links, each of the plurality of links locating a media web resource, the plurality of links being accessible on a plurality of web sites, the web server module signaling the plurality of links to the user terminal in a designated order to cause the terminal to load the media web

resource located by each of the plurality of links into the media playback component; and

a database comprising the plurality of links, the database being accessible to signal the plurality of links to the web server module in the designated order;

wherein the user-interface signals one or more inputs from a user to the web server module, the one or more inputs directing the web server to alter the designated order in which the database signals the plurality of links to the web server module.

160. The system of claim 159, wherein the user-interface signals a first input from the user to skip a subsequent link in the designated order.

161. The system of claim 160, wherein the user-interface signals a second input from the user to cause the web server module to replace a first designated order with a second designated order.

162. The system of claim 161, wherein the first designated order includes a selection of links stored in the database belonging to a first category, and the second designated order includes a selection of links stored in the database belonging to a second category.

163. The system of claim 162, wherein the web server module selects at least some of the plurality of media web resources by matching a criteria signaled from the terminal to metadata information stored in the database, the metadata being sorted to correspond to one or more of the plurality links.

164. The system of claim 159, wherein the web server module randomly selects at least some of the plurality of links.

165. The system of claim 159, wherein the web server module signals another link in the plurality of links to the terminal to as to cause the terminal to access another media web resource automatically if an accessed media web resource is unavailable.

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166. A system for providing media play-back on a network, the system comprising:

a terminal coupleable to the network;

a play-list module coupleable to the terminal, the play-list module storing a first play-list signaled from the terminal, the first play-list comprising a plurality of network addresses, including a first network address that locates a first media network resource on a first network site, and a second network address that locates a second media network resource on a second network site;

a network server module coupleable to the terminal and to the play-list module, the network server module signaling the first play-list to the terminal, the network server module controlling the terminal to cause the terminal to access the media network resource associated with each network address in the first play-list, and to automatically load each respective media network resources into the media playback component.

167. The system of claim 166, wherein the play-list module receives and stores a plurality of play-lists from a plurality of terminals, each play-list comprising a plurality of network addresses, including a first network address that locates a first media network resource on a first network site, and a second network address that locates a second media network resource on a second network site, wherein the network server module responds to a request from a second terminal for a select play-list in the plurality of play-lists by signaling the plurality of network address in the select play-list to the second terminal.

168. The system of claim 167, wherein the media network resource located by each network address in one of the plurality of play-lists is loaded into a playback component on the requesting terminal to playback media having a combination of music and/or video.

169. A method for providing media to a terminal coupled to a network, the terminal comprising a media playback component, the method comprising:

programmatically directing the terminal to access a first network site in the plurality of network sites;

causing the media playback component on the terminal to automatically load a first media web resource located at the first network site to playback a first media;

programmatically directing the terminal to access a second network site in the plurality of network sites; and

causing the media playback component on the terminal to automatically load a second media web resource located at the second network site to playback a second media.

170. The method of claim 169, further comprising:

programmatically directing the terminal to access one or more additional network sites in the plurality of network sites; and

causing the media playback component on the terminal to automatically load each media web resource located on each of the one or more additional network sites so as to sequentially playback media from each of the network sites accessed by the media playback component.

171. The method of claim 170, wherein programmatically directing the terminal to access a first network site in the plurality of network sites includes loading a first web address for the first network site into a web browser component of the terminal, and wherein programmatically directing the terminal to access a second network site in the plurality of network sites includes loading a second web address for the second network site into the web browser component of the terminal.

172. The method of claim 169, wherein programmatically directing the terminal to access a second network site in the plurality of network sites includes programmatically directing the terminal to access the second network site having an address that is external to the first address.

173. The method of claim 169, wherein programmatically directing the terminal to access the first and second network sites in the plurality of network

sites includes programmatically directing a web browser component and the media playback component from a web server module coupled to the terminal via the network.

174. A method for providing media to a terminal coupled to the Internet, the method comprising:

accessing a database comprising a plurality of links, each link opening a corresponding media web resource;

selecting a first link from the database, the first link being located on a first network site;

selecting a second link from the database, the second link being located in a second network site, the second network site being external to the first network site;

signaling the selected links to a media playback component on the terminal to sequentially access the media web resources associated with the selected links; and

automatically signaling the media playback component on the terminal to load each of the media web resource accessed from the selected links so as to playback a media corresponding to each media web resource.

175. The method of claim 174, wherein accessing a database comprising a plurality of links to media web resources includes accessing the database comprising metadata information about the plurality of links, and selecting the first and second links from the database includes selecting the one or more links using the metadata information.

176. The method of claim 174, further comprising detecting if the media playback component fails to load one of the media web resource in the selected media web resources, and then signaling the media playback component to use another selected link from the database to load another media web resource.

177. The method of claim 175, further comprising detecting if the media playback component fails to playback a media corresponding to one of the media web resource in the selected media web resources, and then signaling the

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media playback component use another link to load another selected link from the database to load another media web resource.

178. A system for providing media to a terminal coupled to a network, the method comprising:

means for accessing a plurality of links, each link opening a corresponding media network resource;

selecting a first link from the database, the first link being located on a first network site;

selecting a second link from the database, the second link being located on a second network site;

means for sequentially accessing the media network resources associated with the selected links; and

means for automatically playing back media from the media network resources.

179. A rating system for rating media network resources on a network, the network being coupleable to a plurality of terminals, the rating system comprising:

a database comprising a plurality of addresses, each address locating a corresponding media network resource on the network;

a network server module coupleable to the plurality of terminals, the network server module being able to access the database to signal one or more addresses from the database to the plurality of terminals; and

a rating module coupleable to the plurality of terminals, the rating module being able to receive a rating input from each of the plurality of terminals, the rating module associating the rating input with a selected address in the database.

180. The rating system of claim 179, wherein the database includes a rating associated with each of the plurality of addresses

181. The rating system of claim 179, wherein the rating module accesses the database and reconfigures the rating associated with the selected address in response to receiving the rating input for the selected address.

182. The rating system of claim 179, wherein the database further includes one or more classes of information associated with each of the plurality of addresses.

183. The rating system of claim 179, further comprising a play-list module, the play-list module selecting a combination of the plurality of addresses to form a play-list, the network server module accessing the play-list to signal the combination of addresses to one or more of the terminals.

184. The rating system of claim 183, wherein the rating module receives the rating input from one or more of the terminals for each address that comprises the play-list signaled to that terminals.

185. The rating system of claim 183, wherein the rating module receives a play-list rating input for the play-list from one or more of the terminals receiving the play-list.

186. The system of claim 183, wherein the play-list module selects the combination of addresses using the rating associated with each address in the database.

187. The system of claim 183, wherein the play-list module selects the combination of addresses using the rating of each address in the database that share a same class of information.

188. The system of claim 187, wherein the same class of information is selected from a class group consisting of genre, sub-genre, title, and artist.

189. The system of claim 187, wherein the play-list module selects the combination of addresses using the rating of each address in the database that share two or more of the same classes of information, each same class of

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information being selected from a group consisting of genre, sub-genre, title, and artist.

190. The rating system of claim 179, wherein the rating associated with each of the plurality of addresses is a ranking, including a maximum ranking and a minimum ranking.

191. The rating system of claim 190, wherein the rating module receives the ranking from one of the terminals, accesses an existing ranking from the database, and uses an averaging formula to reconfigure the ranking in the database.

192. The rating system of claim 191, wherein the averaging formula is a weighted average.

193. The rating system of claim 191, wherein the averaging formula is a moving average.

194. A rating system for rating media network resources on a network, the network being coupleable to a plurality of terminals, the rating system comprising:

a database comprising a plurality of addresses, each address locating a corresponding media network resource on the network, the database including one or more classes of information associated with each of the plurality of addresses;

a network server module coupleable to the plurality of terminals, the network server module communicating with each of the plurality of terminals to receive a search request, the network server module signaling the database to retrieve one or more addresses from the database in response to the search request, the retrieved addresses being associated with a class of information matching the search request; and

a rating module coupleable to the plurality of terminals, the rating module being able to receive a rating input from each of the plurality

of terminals, the rating module associating the rating input with a selected address in the database.

195. The rating system of claim 194, wherein the network module signals the database to retrieve one or more addresses from the database in response to the search request by matching a criteria in the search request with a parameter included with the one or more classes of information.

196. The rating system of claim 195, wherein the one or more classes of information stored in the database with the plurality of addresses is a rating.

197. The rating system of claim 194, wherein the search request also includes a rating standard that selects addresses in the database using a rating associated with each address.

198. A rating system for rating media network resources available over a network, the media network resources being located on the network by a plurality of terminals, the rating system comprising:

a database comprising a plurality of addresses, each address locating a corresponding media network resource on the network, the database including a rating associated with each of the plurality of addresses;

a network server module coupleable to each of the plurality of terminals, the network server module being able to access the database to signal one or more addresses from the database to the plurality of terminals;

a rating module coupleable to each of the plurality of terminals, the rating module being able to receive a rating input from one of the terminals for each of the plurality of addresses in the database, wherein in response to receiving the rating input from one of the plurality of terminals for a selected address in the database, the rating module accesses the database and reconfigures the rating associated with the selected address; and

a play-list module, the play-list module accessing the addresses to select one or more combinations of addresses, each combination of addresses forming a play-list, wherein the play-list module signals

the play-list to the network server module as addresses to be signaled to one or more of the plurality of terminals.

199. The rating system of claim 198, wherein the play-list module forms the play-list by using the ranking of the addresses in the database.

200. The rating system of claim 198, wherein the play-list module forms the play-list by arranging each address in the play-list in a designated order so that the addresses in the play-list are accessed by the one or more terminals in the designated order.

201. The rating system of claim 199, wherein the designated order is determined by a ranking of each of the addresses in the play-list relative to rankings of the other addresses in the play-list.

202. The rating system of claim 200, wherein the designated order is determined by arranging each of the addresses in the play-list according to a ranking from highest to lowest.

203. The rating system of claim 198, wherein the database further includes one or more classes of information associated with each of the plurality of addresses, and the play-list module forms a plurality of play-lists using the one or more classes of information.

204. The rating system of claim 198, wherein the play-list module forms a plurality of play-lists by arranging a combination of addresses in the plurality of addresses together in one play-list, wherein the combination of addresses share a same parameter of the one or more classes of information.

205. The rating system of claim 199, wherein the play-list module arranges the addresses in the play-list according to an order determined by a ranking of each of the addresses forming the play-list.

206. A method for ranking media sources on a network, the method comprising:

accessing a database comprising a plurality of addresses, each address locating a media resource on the network and each address being associated with a rating;

signaling a selected address from the database to a terminal coupled to the network;

receiving a rating input from the terminal after signaling the selected address to the terminal; and

adjusting the rating associated for the selected address in response to receiving the rating input.

207. The method of claim 206, wherein adjusting the rating associated for the selected address in response to receiving the rating input includes averaging the rating input with an existing rating for the selected address in the database.

208. The method of claim 207, wherein averaging the rating input with an existing rating includes implementing a weighted average between the rating input and the existing rating.

209. The method of claim 206, further comprising signaling one or more selected addresses to a plurality of terminals coupled to the network, and receiving a rating input from each of the plurality of the terminals after signaling the one or more selected addresses to the terminal.

210. The method of claim 209, further comprising adjusting the rating associated for each of the one or more selected addresses in response to receiving a rating input from each terminal by calculating a weighted average reflecting an aggregate of the plurality of terminals.

211. The method of claim 206, wherein each address locates a music source on the Internet.

212. The method of claim 206, wherein the rating input corresponds to a ranking.

213. A method for ranking media sources on a network, the method comprising:

accessing a database comprising a plurality of addresses, each address locating a media resource on the network and each address being associated with a rating;

selecting a combination of addresses to form a play-list;

signaling the play-list to a terminal coupled to the network;

receiving a ranking from the terminal after signaling the one or more of the addresses in the play-list to the terminal; and

adjusting the rating of each address signaled to the terminal from the play-list in response to receiving the ranking.

214. The method of claim 213, wherein selecting a combination of addresses for a play-list includes selecting multiple addresses from the database that share one or more classes of information.

215. The method of claim 213, wherein selecting a combination of addresses for a play-list includes arranging each address in the play-list in an order, the order being determined by the ranking of each address in the play-list.

216. A method for ranking media sources on a network, the method comprising:

accessing a database comprising a plurality of addresses, each address locating a media resource on the network and each address being associated with a rating;

signaling a selected address from the database to a terminal coupled to the network;

receiving a ranking from the terminal after signaling the selected address to the terminal; and

adjusting the rating associated for the selected address in response to receiving the ranking.

217. The method of claim 216, wherein each address locates a music source.

218. The method of claim 216, wherein each address locates a video or animation source.

219. A rating system for rating media network resources available over a network, the media network resources being located on the network by a plurality of terminals, the rating system comprising:

means for accessing a database comprising a plurality of addresses, each address locating a media resource on the network and each address being associated with a rating;

means for signaling a selected address from the database to a terminal coupled to the network;

means for receiving a ranking from the terminal after signaling the selected address to the terminal; and

means for adjusting the rating associated for the selected address in response to receiving the ranking.

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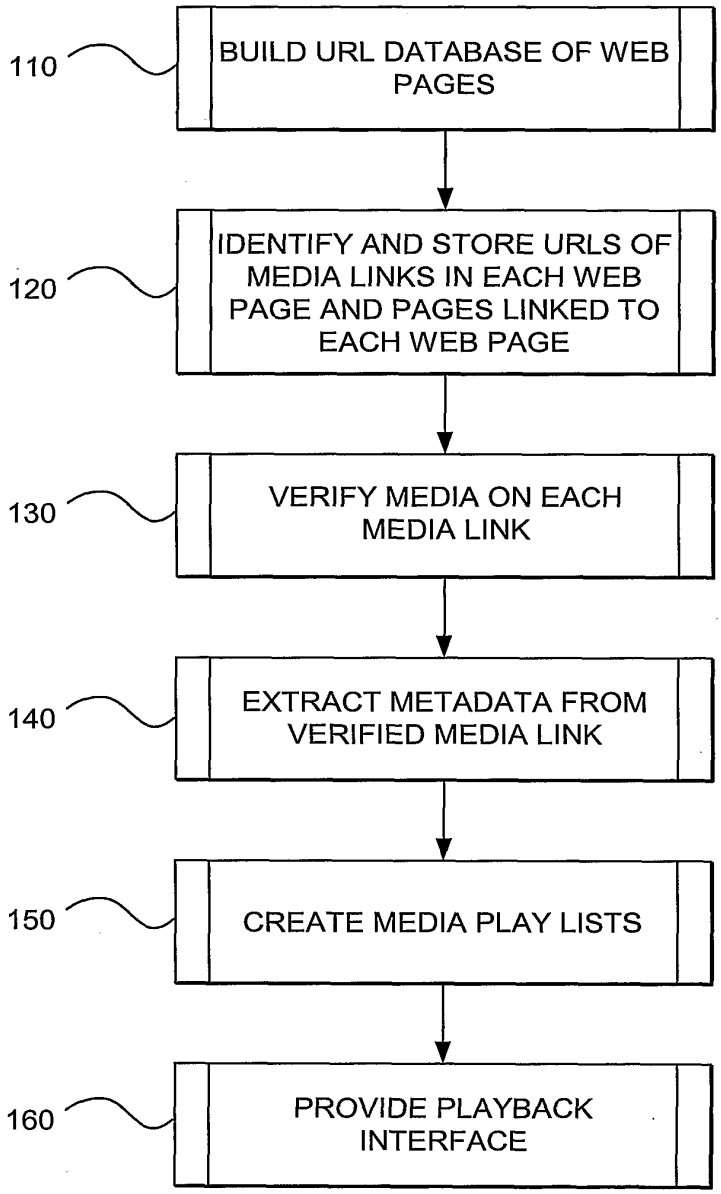
110
BUILD URL DATABASE OF WEB PAGES
120
IDENTIFY AND STORE URLS OF MEDIA LINKS IN EACH WEB PAGE AND PAGES LINKED TO EACH WEB PAGE
130
VERIFY MEDIA ON EACH MEDIA LINK
140
EXTRACT METADATA FROM VERIFIED MEDIA LINK
150
CREATE MEDIA PLAY LISTS
160
PROVIDE PLAYBACK INTERFACE

FIG. 1

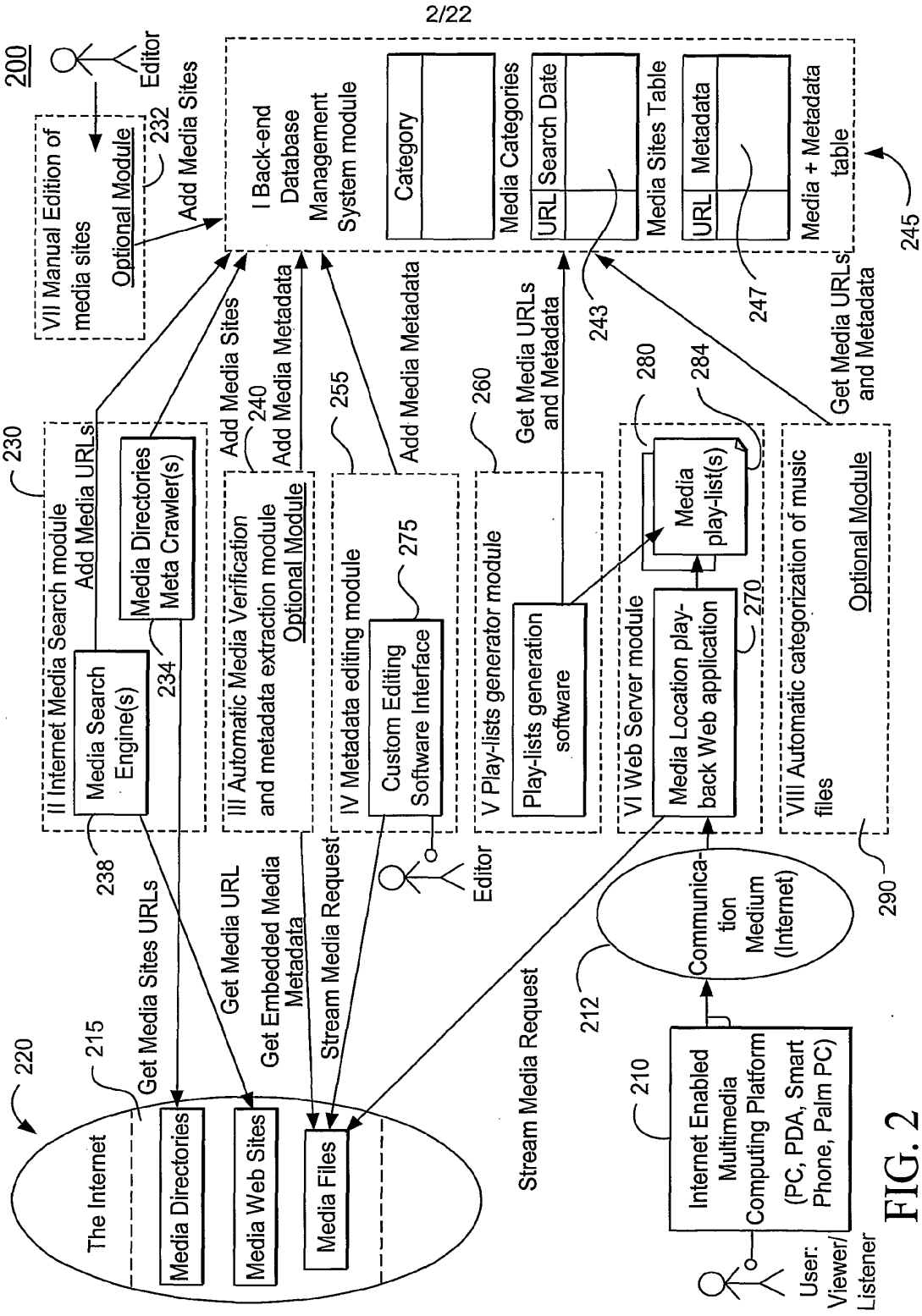
200
Editor
VII Manual Edition of media sites
Optional Module
232
Add Media Sites
I Back-end Database Management System module
Category
Media Categories
URL
Search Date
Media Sites Table
URL
Metadata
Media + Metadata table
245
247
243
230
II Internet Media Search module
Add Media URLs
Media Search Engine(s)
234
Media Directories
Meta Crawler(s)
238
Add Media Sites
240
Add Media Metadata
III Automatic Media Verification and metadata extraction module
Optional Module
255
Add Media Metadata
IV Metadata editing module
Custom Editing Software Interface
275
Editor
260
Get Media URLs and Metadata
V Play-lists generator module
Play-lists generation software
280
284
VI Web Server module
Media play-list(s)
Media Location play-back Web application
270
VIII Automatic categorization of music files
Optional Module
Get Media URLs and Metadata
290
Get Media Sites URLs
Get Media URL
Get Embedded Media Metadata
Stream Media Request
Stream Media Request
212
Communica-tion Medium (Internet)
220
215
The Internet
Media Directories
Media Web Sites
Media Files
210
Internet Enabled Multimedia Computing Platform
(PC, PDA, Smart Phone, Palm PC)
User: Viewer/ Listener

FIG. 2

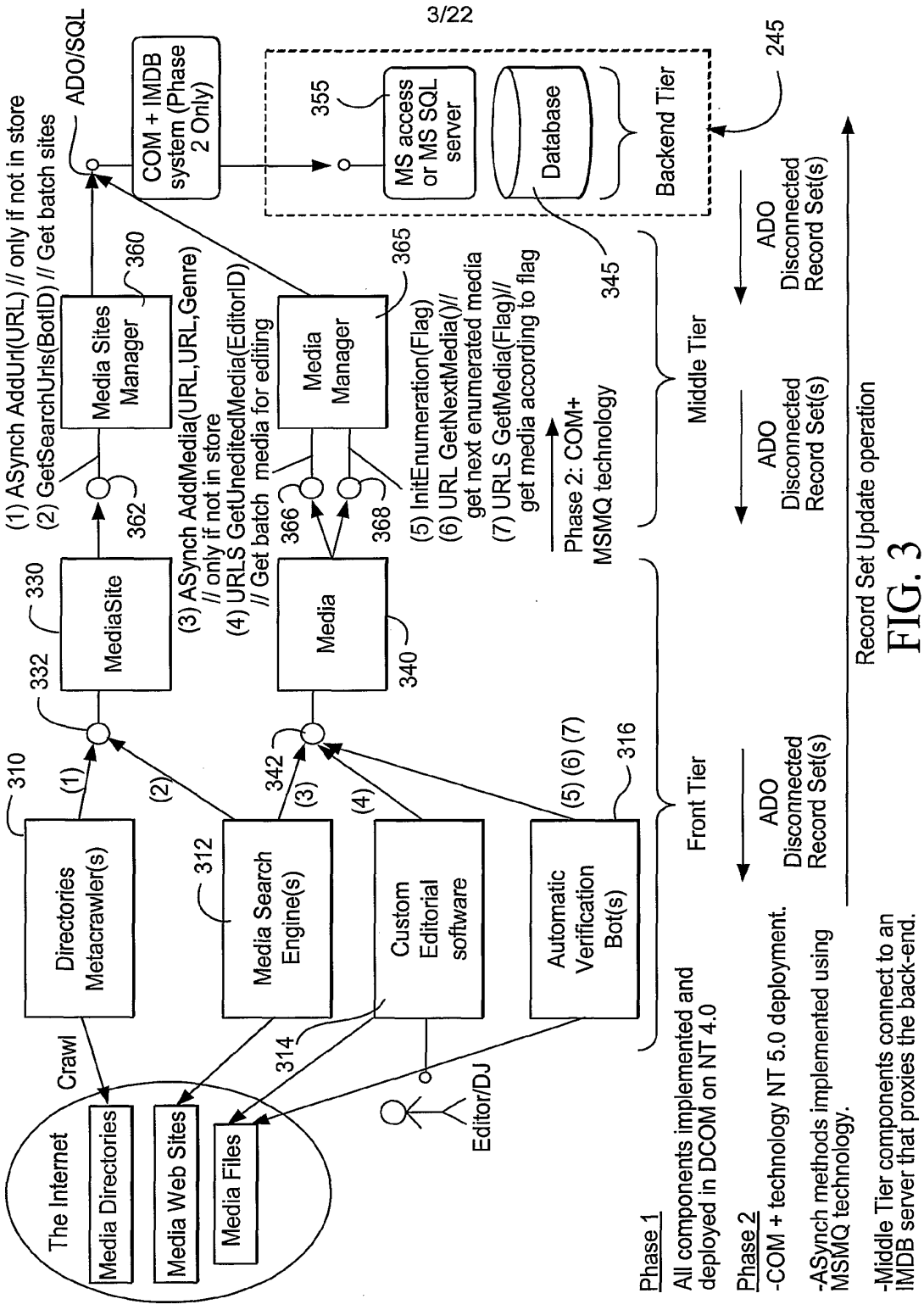
The Internet
Media Directories
Media Web Sites
Media Files
Crawl
Directories Metacrawler(s)
Media Search Engine(s)
Custom Editorial software
Editor/DJ
Automatic Verification Bot(s)
310
312
314
316
(1)
(2)
(3)
(4)
(5) (6) (7)
332
MediaSite
330
342
Media
340
362
Media Sites Manager
360
366
368
Media Manager
365
(1) ASynch AddUrl(URL) // only if not in store
(2) GetSearchUrls(BotID) // Get batch sites
(3) ASynch AddMedia(URL,URL,Genre) // only if not in store
(4) URLS GetUneditedMedia(EditorID) // Get batch media for editing
(5) InitEnumeration(Flag)
(6) URL GetNextMedia()// get next enumerated media
(7) URLS GetMedia(Flag)// get media according to flag
Phase 2: COM+ MSMQ technology
345
ADO/SQL
COM + IMDB system (Phase 2 Only)
355
MS access or MS SQL server
Database
Backend Tier
245
Front Tier
Middle Tier
ADO Disconnected Record Set(s)
ADO Disconnected Record Set(s)
ADO Disconnected Record Set(s)
Record Set Update operation
Phase 1
All components implemented and deployed in DCOM on NT 4.0
Phase 2
-COM + technology NT 5.0 deployment.
-ASynch methods implemented using MSMQ technology.
-Middle Tier components connect to an IMDB server that proxies the back-end.

FIG. 3

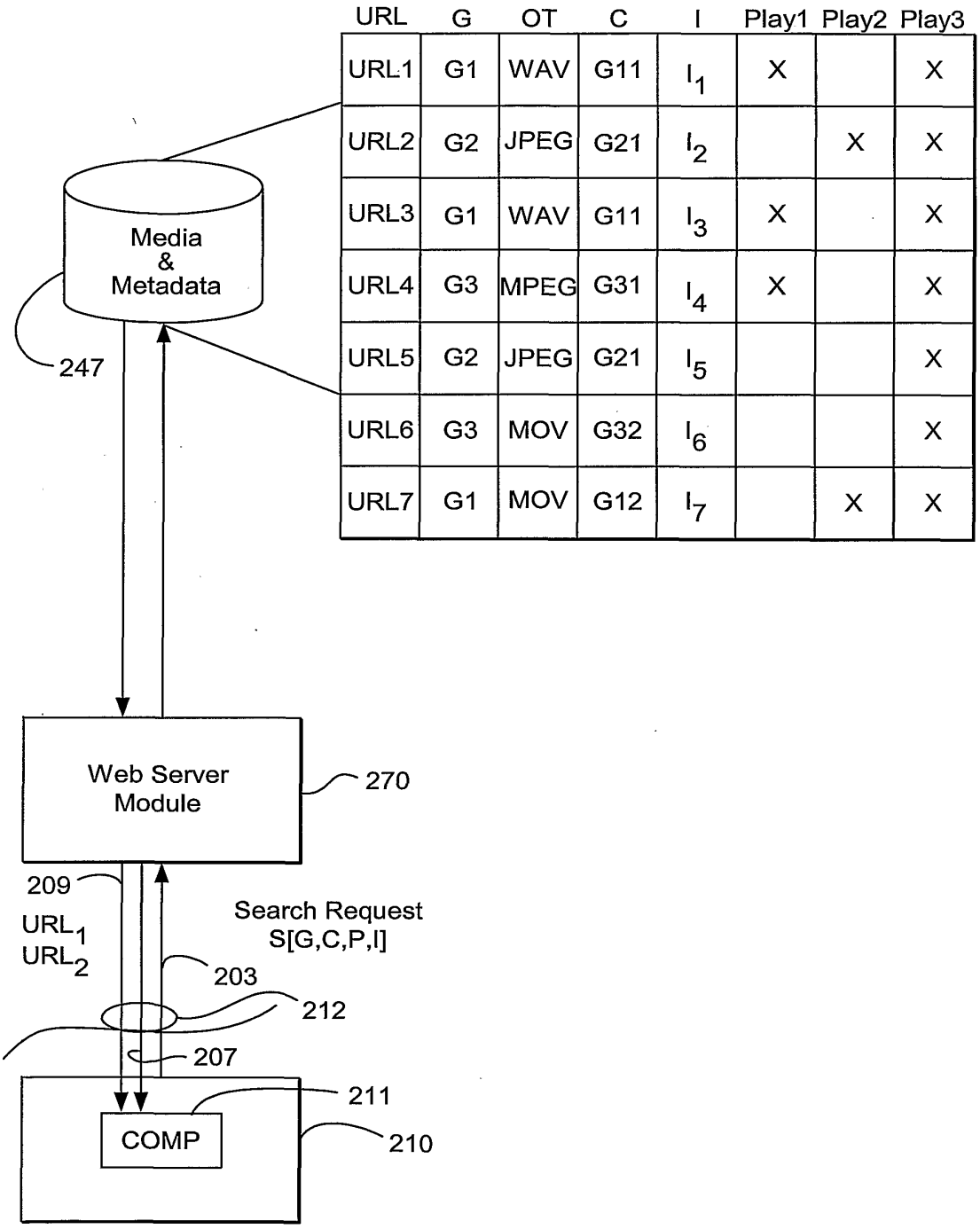
URL G OT C I Play1 Play2 Play3
URL1 G1 WAV G11 I_1 X X
URL2 G2 JPEG G21 I_2 X X
URL3 G1 WAV G11 I_3 X X
URL4 G3 MPEG G31 I_4 X X
URL5 G2 JPEG G21 I_5 X
URL6 G3 MOV G32 I_6 X
URL7 G1 MOV G12 I_7 X X
Media & Metadata
247
Web Server Module
270
209
URL_1
URL_2
Search Request S[G,C,P,I]
203
212
207
211
COMP
210

FIG. 4

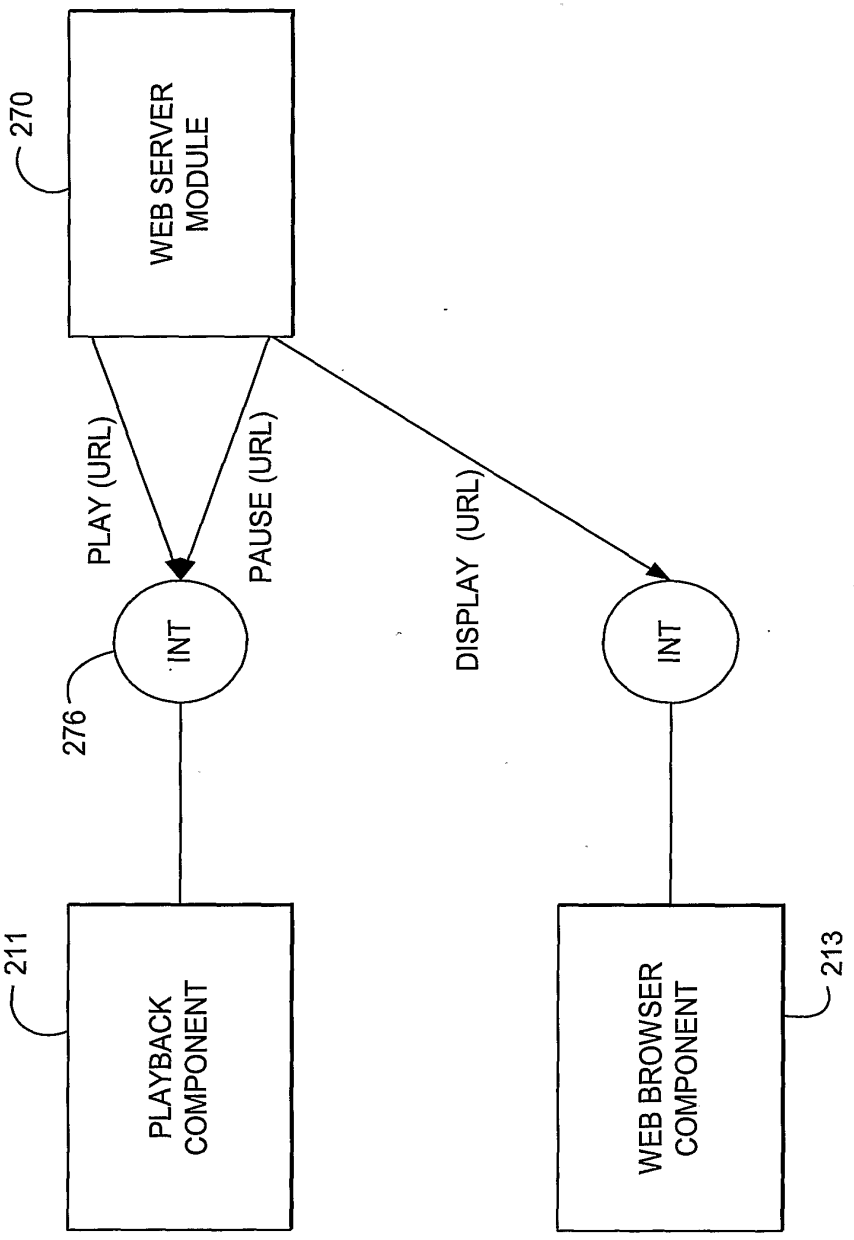
270
WEB SERVER MODULE
PLAY (URL)
PAUSE (URL)
DISPLAY (URL)
INT
276
INT
211
PLAYBACK COMPONENT
WEB BROWSER COMPONENT
213

FIG. 5

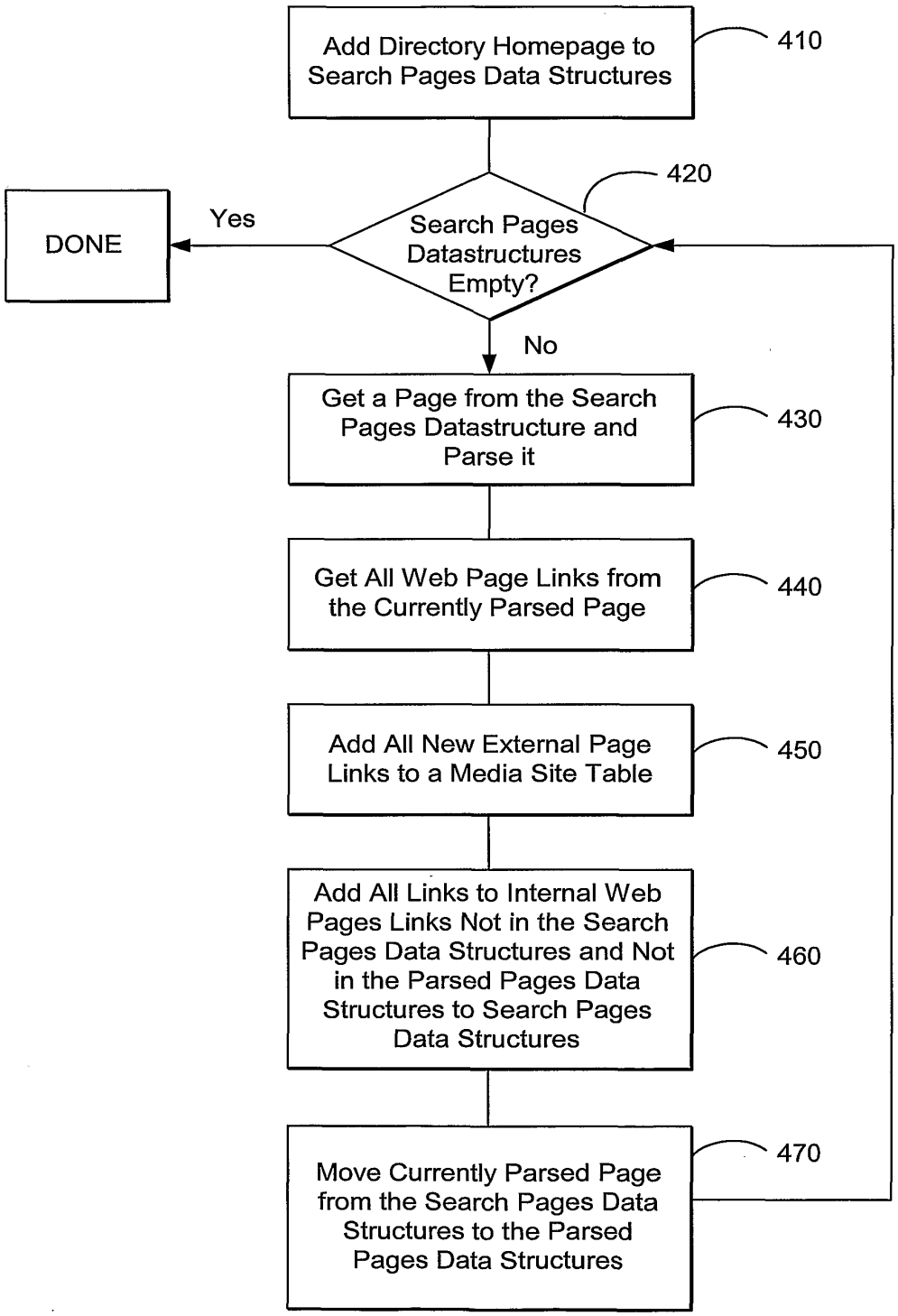
Add Directory Homepage to Search Pages Data Structures
410
Search Pages Datastructures Empty?
420
Yes
DONE
No
Get a Page from the Search Pages Datastructure and Parse it
430
Get All Web Page Links from the Currently Parsed Page
440
Add All New External Page Links to a Media Site Table
450
Add All Links to Internal Web Pages Links Not in the Search Pages Data Structures and Not in the Parsed Pages Data Structures to Search Pages Data Structures
460
Move Currently Parsed Page from the Search Pages Data Structures to the Parsed Pages Data Structures
470

FIG. 6

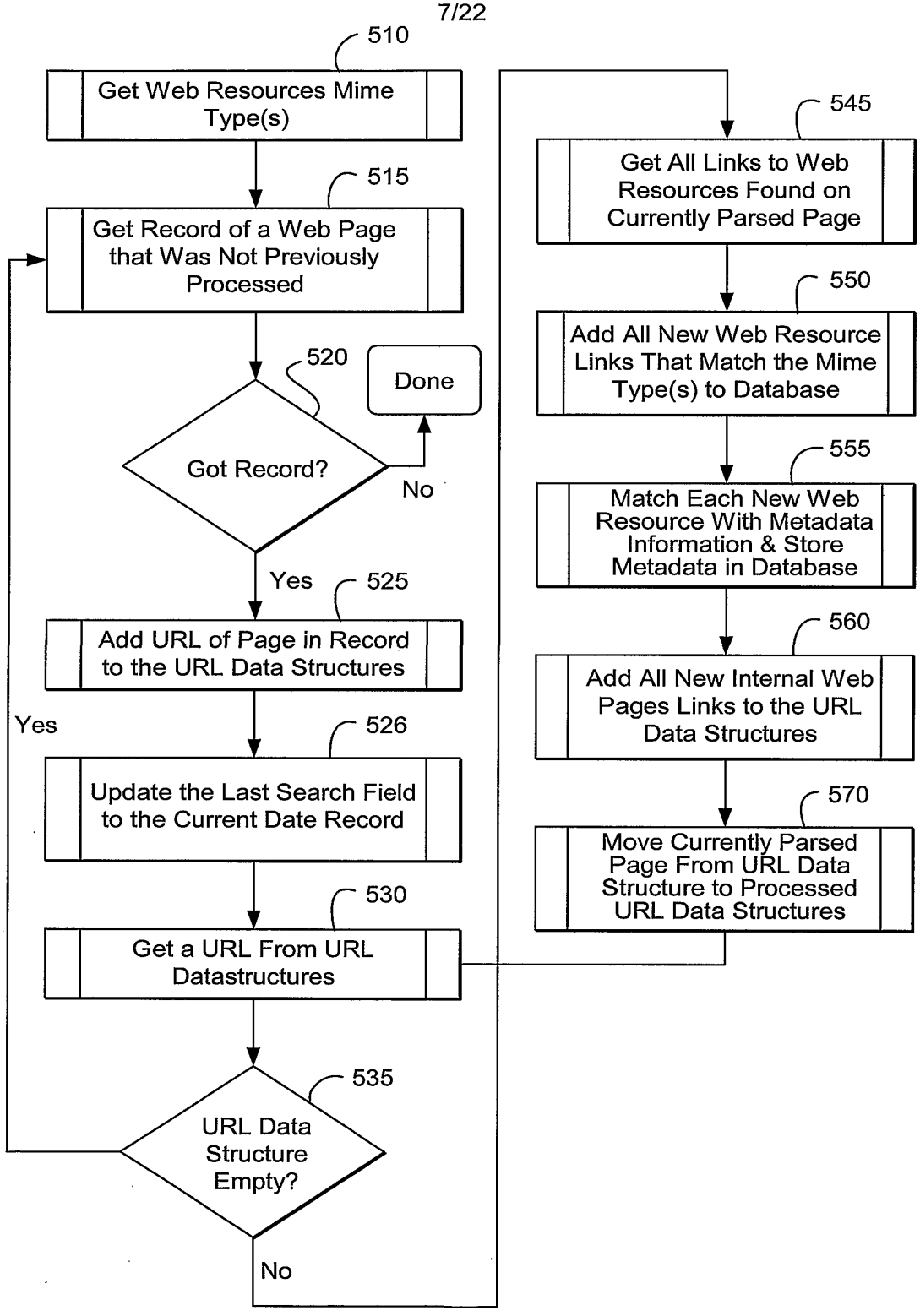

FIG. 7

SUBSTITUTE SHEET (RULE 26)

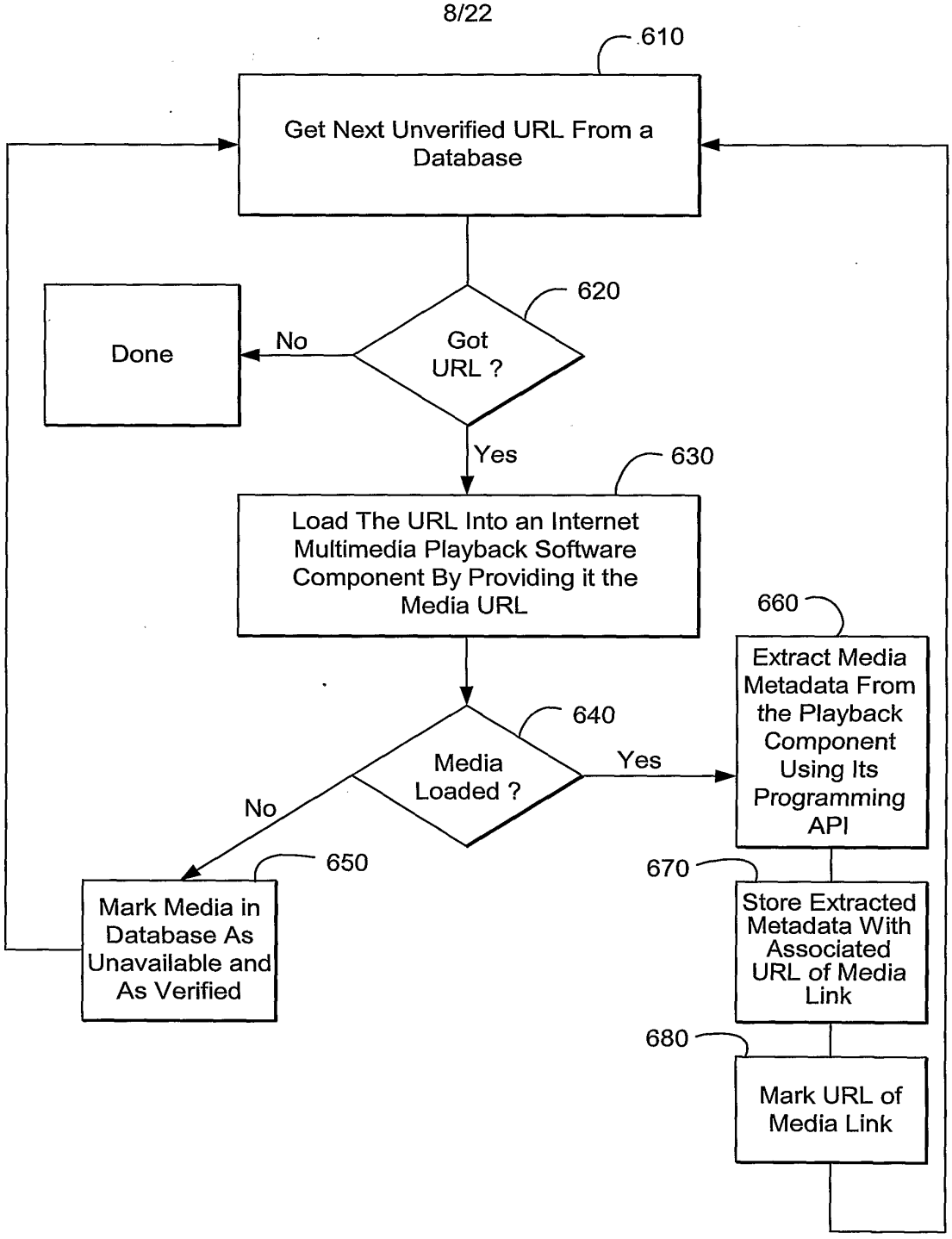
610
Get Next Unverified URL From a Database
620
Got URL ?
No
Done
Yes
630
Load The URL Into an Internet Multimedia Playback Software Component By Providing it the Media URL
640
Media Loaded ?
No
Yes
650
Mark Media in Database As Unavailable and As Verified
660
Extract Media Metadata From the Playback Component Using Its Programming API
670
Store Extracted Metadata With Associated URL of Media Link
680
Mark URL of Media Link

FIG. 8

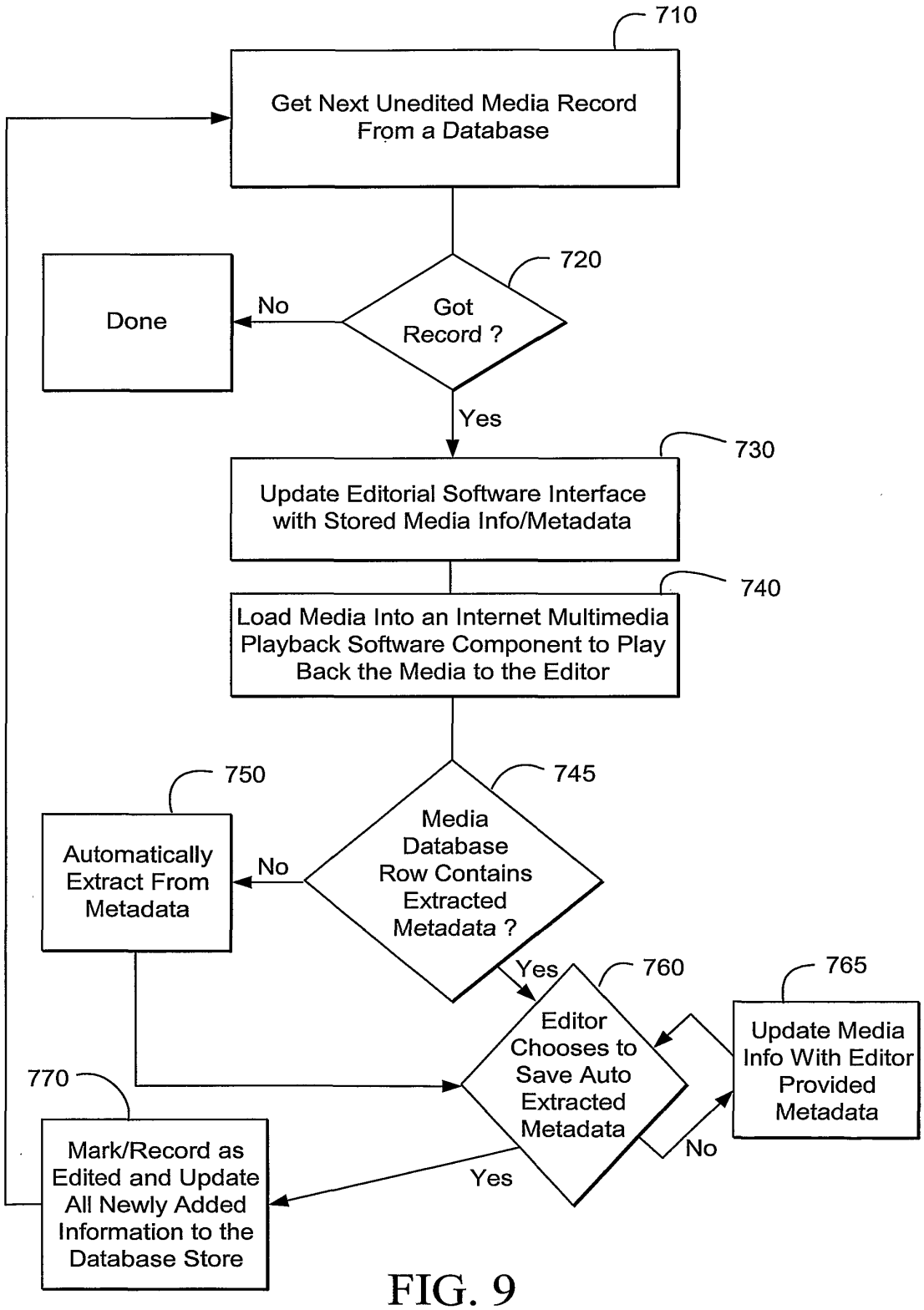
710
Get Next Unedited Media Record From a Database
720
Got Record ?
No
Done
Yes
730
Update Editorial Software Interface with Stored Media Info/Metadata
740
Load Media Into an Internet Multimedia Playback Software Component to Play Back the Media to the Editor
745
Media Database Row Contains Extracted Metadata ?
No
750
Automatically Extract From Metadata
Yes
760
Editor Chooses to Save Auto Extracted Metadata
765
Update Media Info With Editor Provided Metadata
No
Yes
770
Mark/Record as Edited and Update All Newly Added Information to the Database Store

FIG. 9

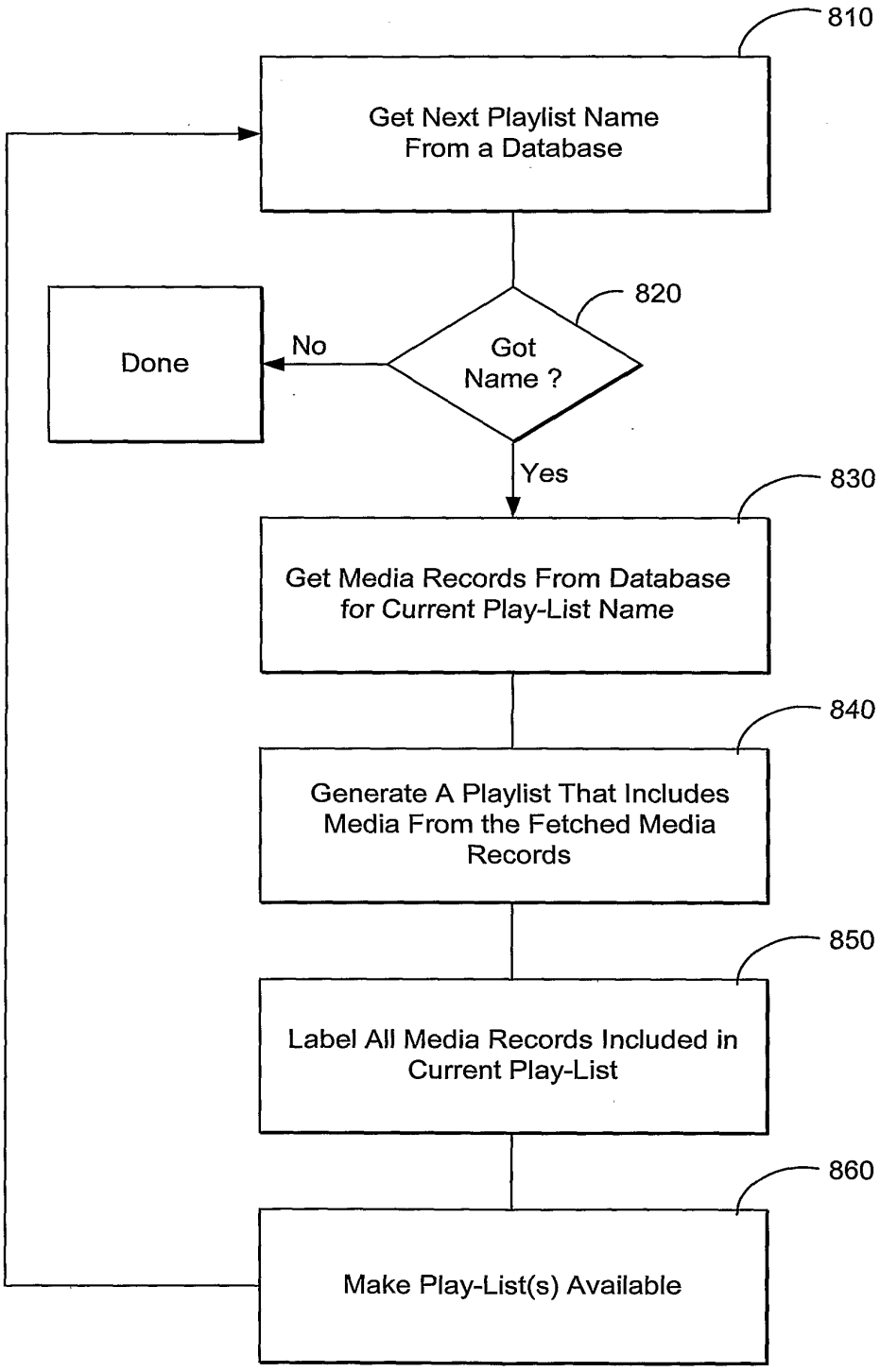
810
Get Next Playlist Name From a Database
820
Got Name ?
No
Done
Yes
830
Get Media Records From Database for Current Play-List Name
840
Generate A Playlist That Includes Media From the Fetched Media Records
850
Label All Media Records Included in Current Play-List
860
Make Play-List(s) Available

FIG. 10

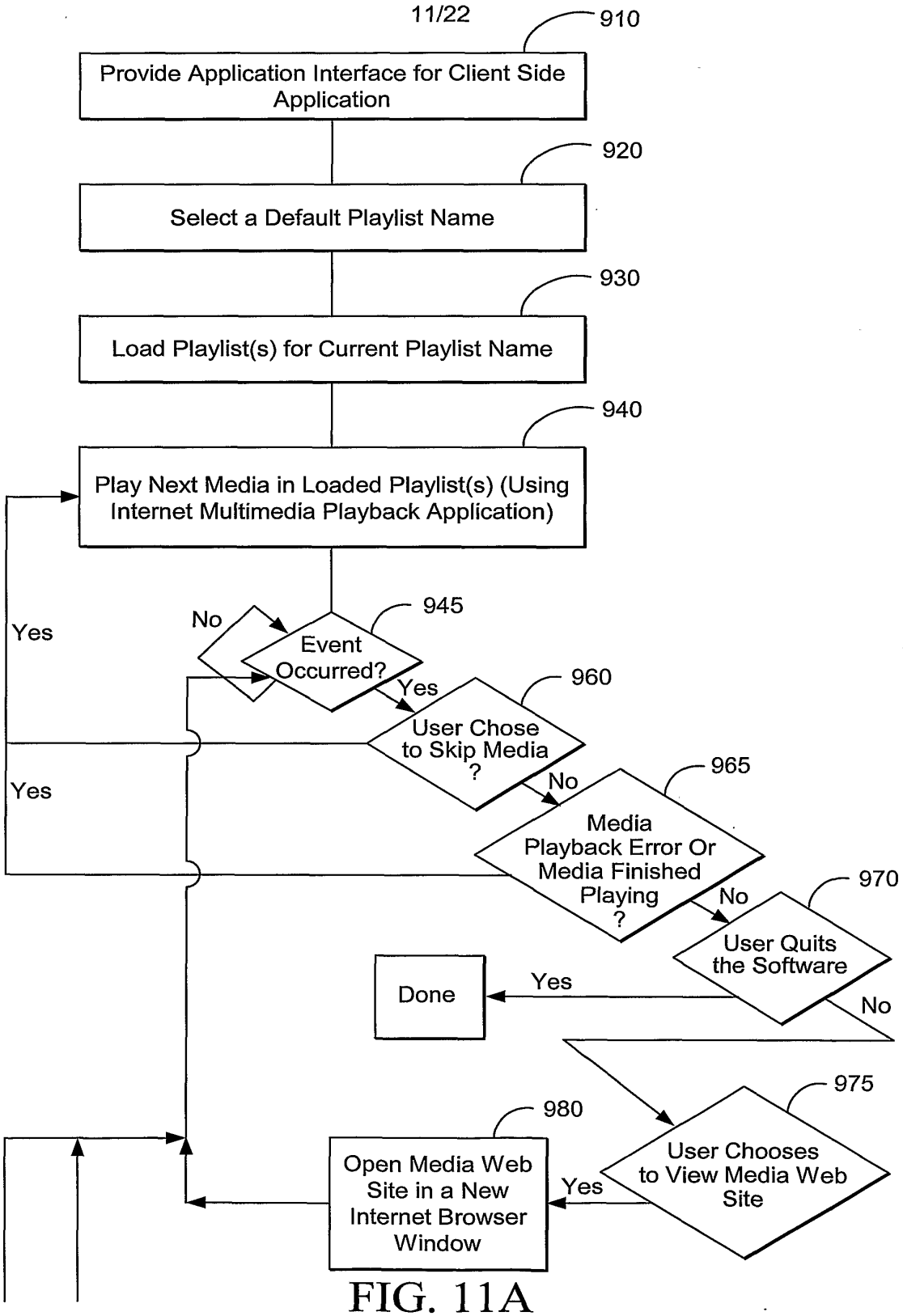
910
Provide Application Interface for Client Side Application
920
Select a Default Playlist Name
930
Load Playlist(s) for Current Playlist Name
940
Play Next Media in Loaded Playlist(s) (Using Internet Multimedia Playback Application)
945
Event Occurred?
No
Yes
960
User Chose to Skip Media ?
Yes
No
965
Media Playback Error Or Media Finished Playing ?
Yes
No
970
User Quits the Software
Yes
No
Done
975
User Chooses to View Media Web Site
Yes
980
Open Media Web Site in a New Internet Browser Window

FIG. 11A

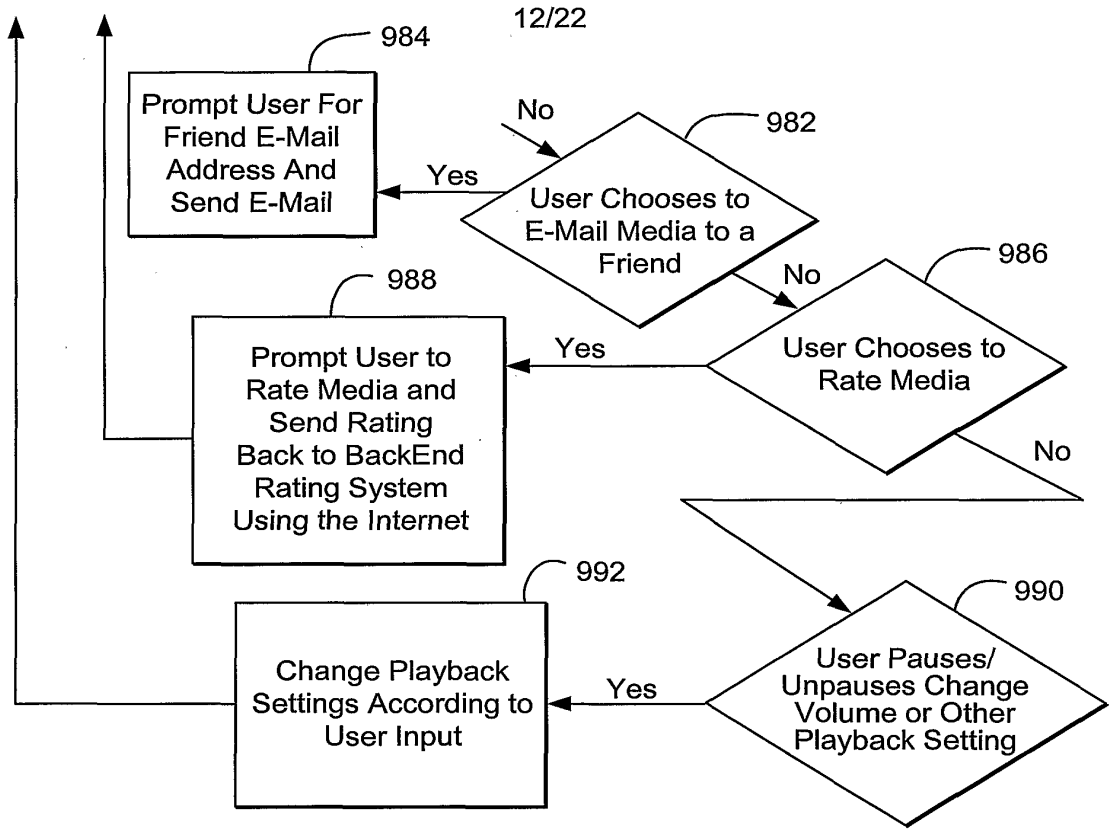
984
Prompt User For Friend E-Mail Address And Send E-Mail
No
Yes
982
User Chooses to E-Mail Media to a Friend
No
986
User Chooses to Rate Media
988
Prompt User to Rate Media and Send Rating Back to BackEnd Rating System Using the Internet
Yes
No
992
Change Playback Settings According to User Input
Yes
990
User Pauses/ Unpauses Change Volume or Other Playback Setting

FIG. 11B

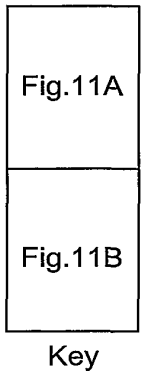
Fig.11A
Fig.11B
Key

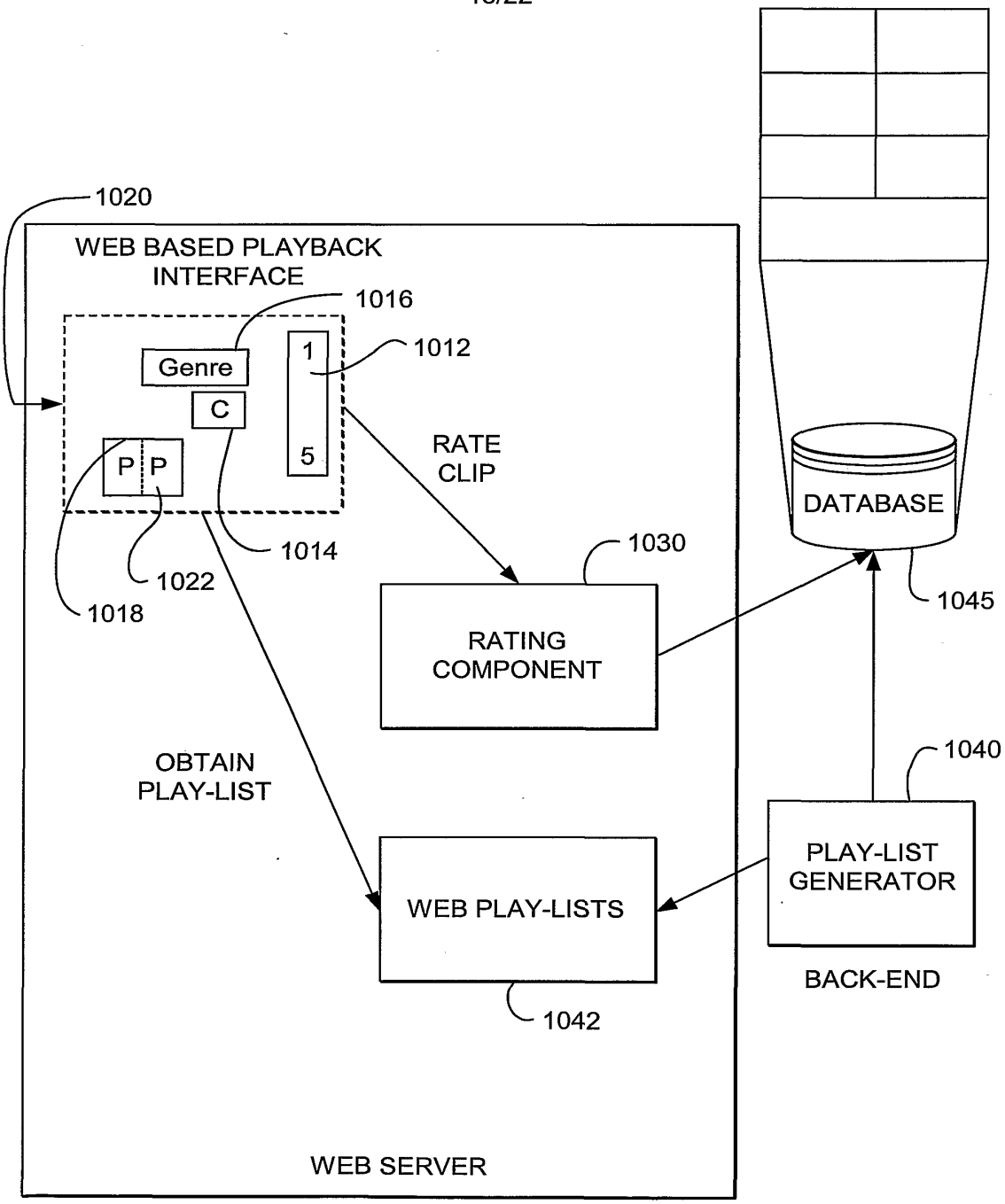
1020
WEB BASED PLAYBACK INTERFACE
1016
Genre
C
1
5
1012
P P
RATE CLIP
1014
1022
1018
1030
RATING COMPONENT
OBTAIN PLAY-LIST
WEB PLAY-LISTS
1042
WEB SERVER
DATABASE
1045
1040
PLAY-LIST GENERATOR
BACK-END

FIG. 12

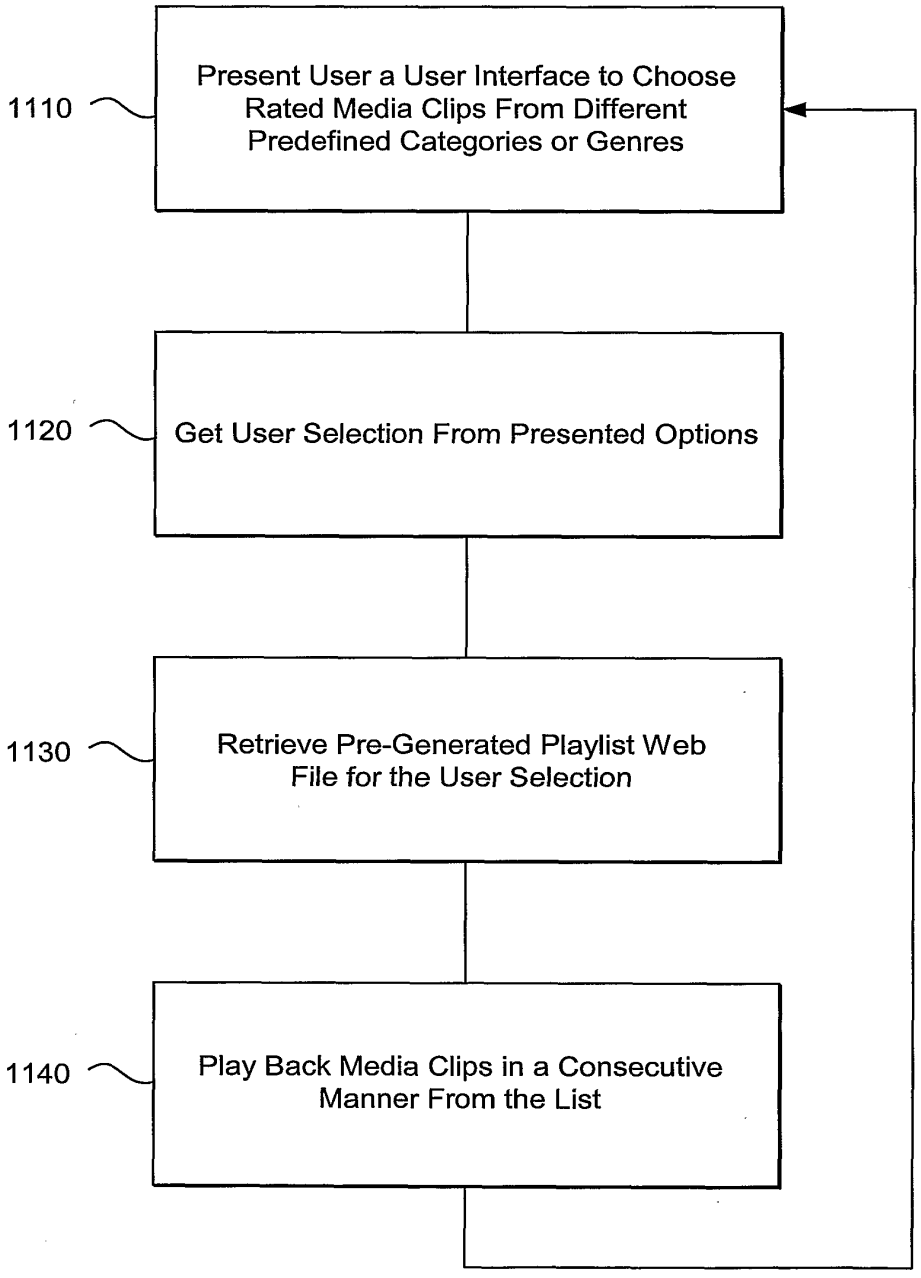
1110
Present User a User Interface to Choose Rated Media Clips From Different Predefined Categories or Genres
1120
Get User Selection From Presented Options
1130
Retrieve Pre-Generated Playlist Web File for the User Selection
1140
Play Back Media Clips in a Consecutive Manner From the List

FIG. 13

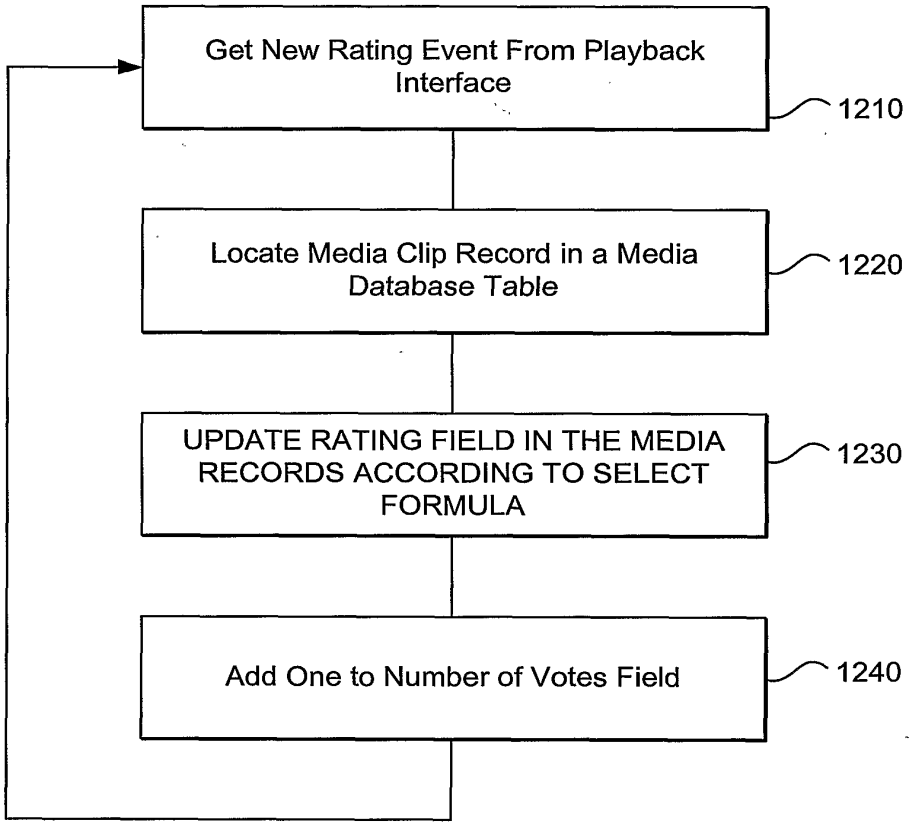

FIG. 14

MEDIA DATABASE TABLE

Media URL	Number of Votes	Rating	Additional Info
URL	O . . . N	O . . . Max Rating	

FIG. 15

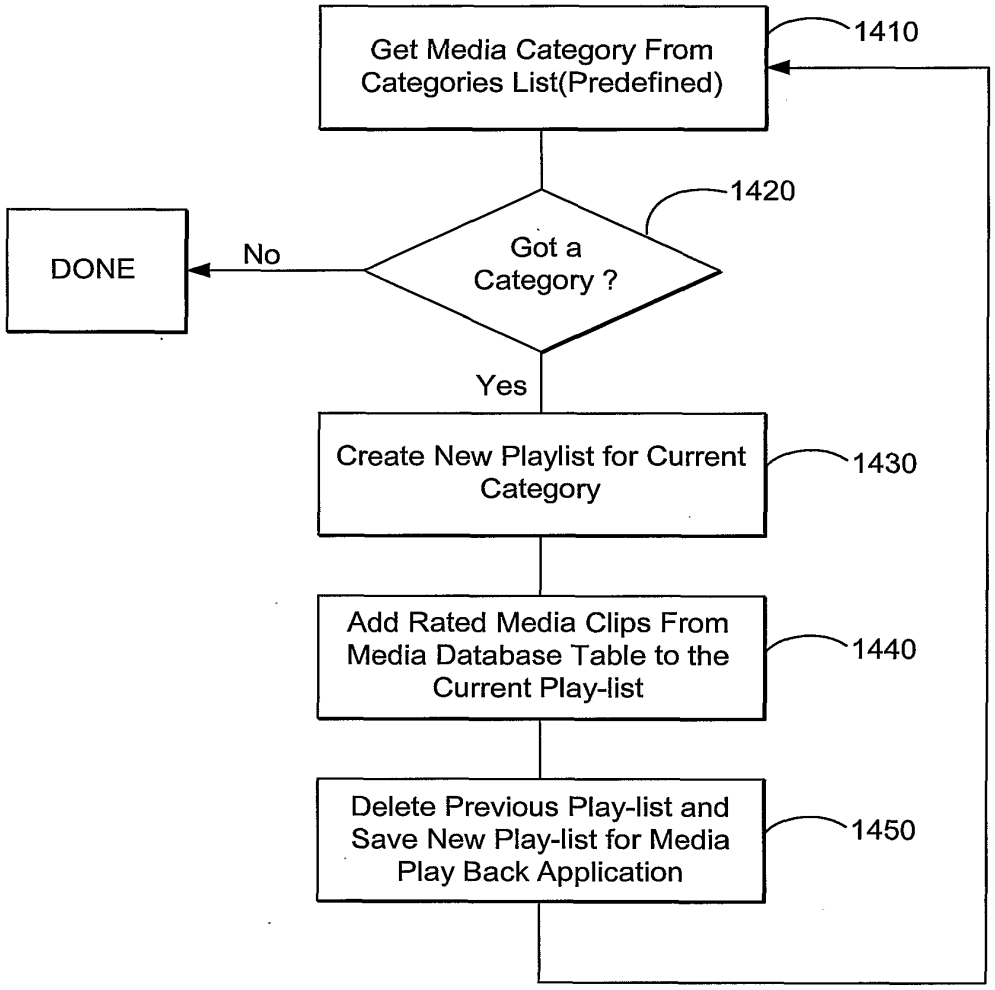
Get Media Category From Categories List(Predefined)
1410
1420
Got a Category ?
No
DONE
Yes
Create New Playlist for Current Category
1430
Add Rated Media Clips From Media Database Table to the Current Play-list
1440
Delete Previous Play-list and Save New Play-list for Media Play Back Application
1450

FIG. 16

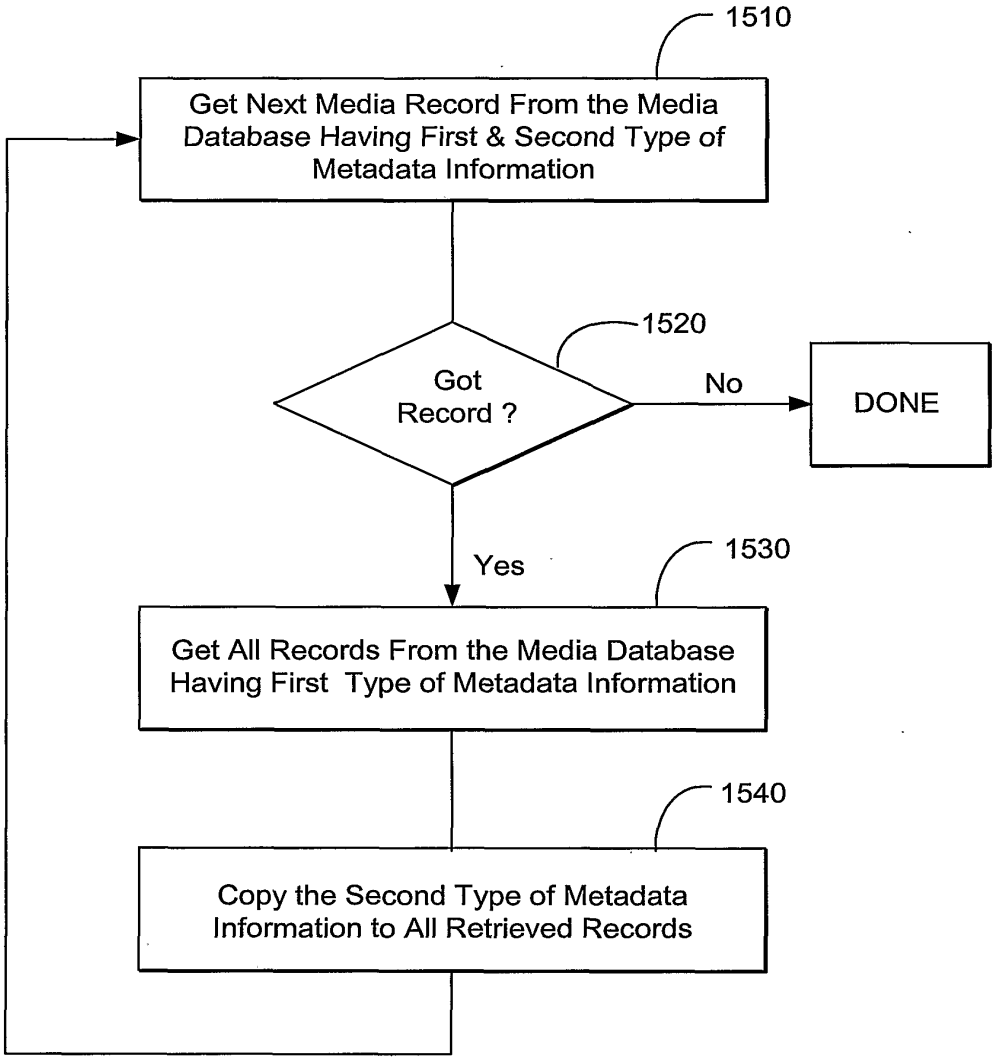
1510
Get Next Media Record From the Media Database Having First & Second Type of Metadata Information
1520
Got Record ?
No
DONE
Yes
1530
Get All Records From the Media Database Having First Type of Metadata Information
1540
Copy the Second Type of Metadata Information to All Retrieved Records

FIG. 17

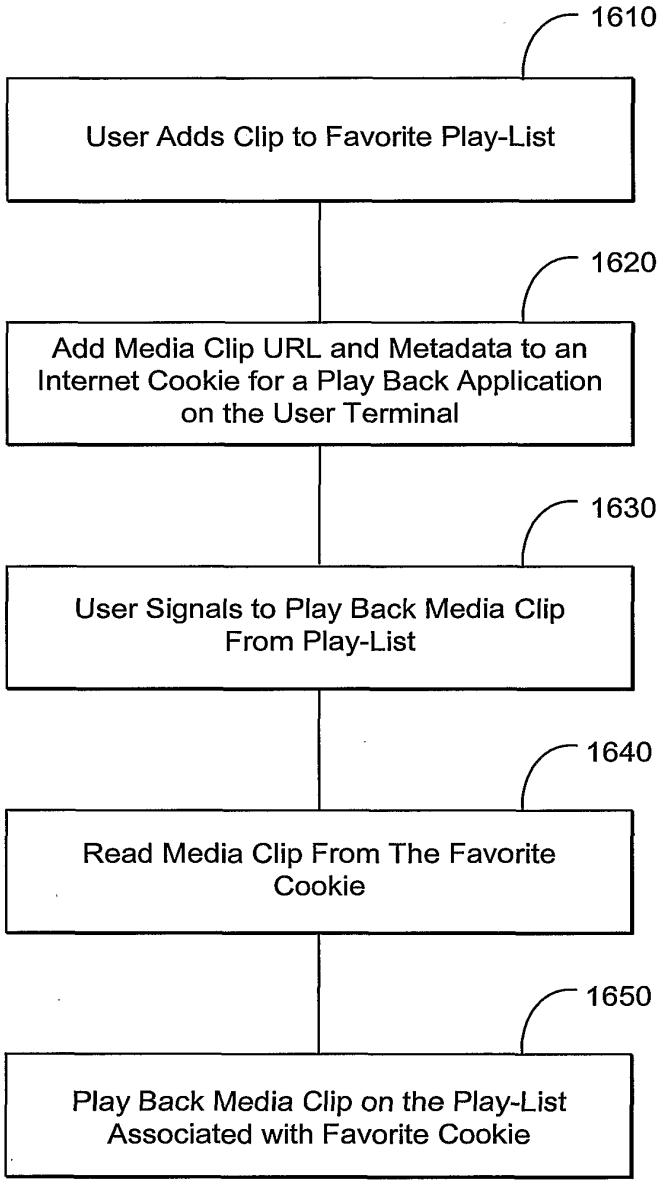
1610
User Adds Clip to Favorite Play-List
1620
Add Media Clip URL and Metadata to an Internet Cookie for a Play Back Application on the User Terminal
1630
User Signals to Play Back Media Clip From Play-List
1640
Read Media Clip From The Favorite Cookie
1650
Play Back Media Clip on the Play-List Associated with Favorite Cookie

FIG. 18

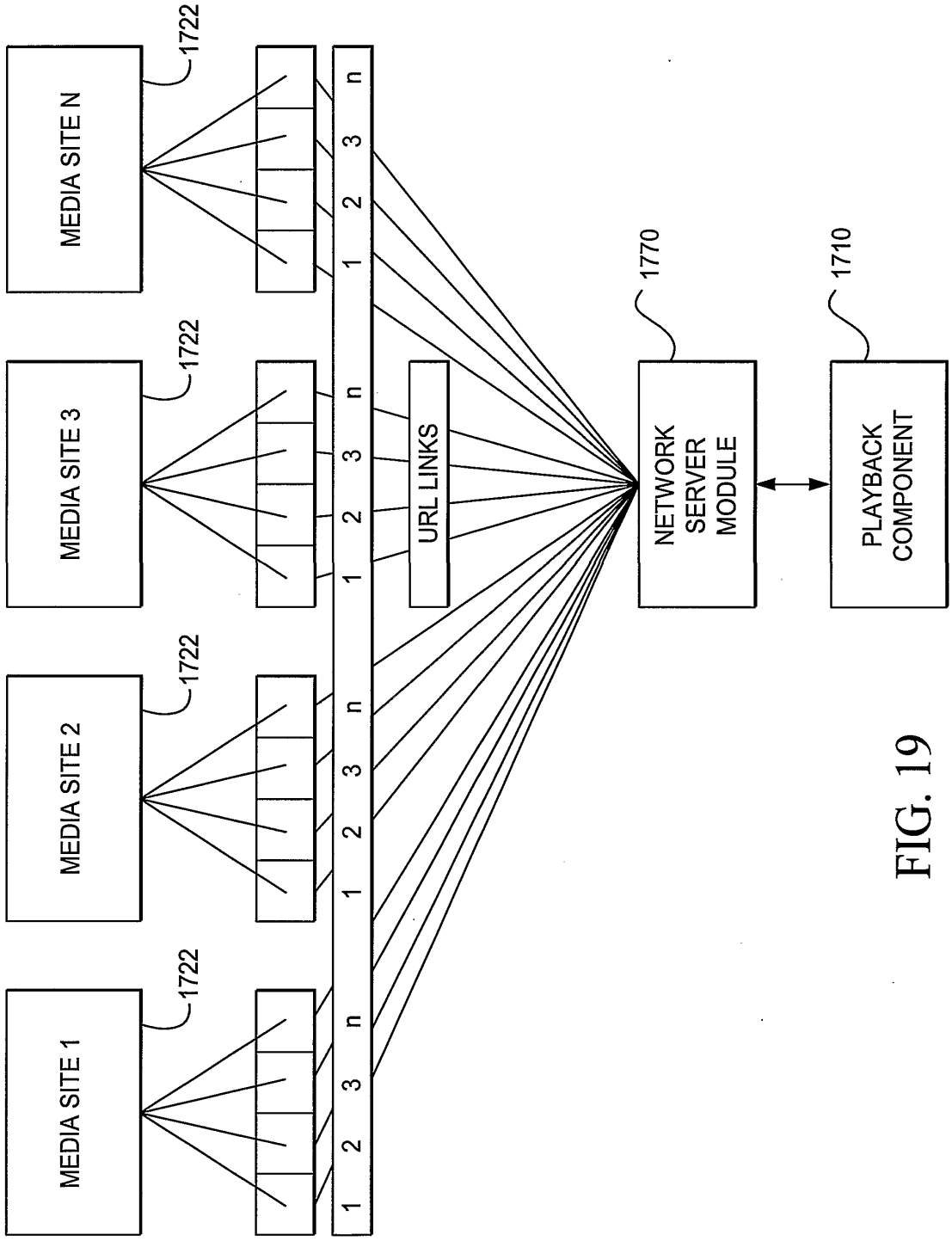
MEDIA SITE 1
MEDIA SITE 2
MEDIA SITE 3
MEDIA SITE N
1722
1 2 3 n
URL LINKS
NETWORK SERVER MODULE
1770
PLAYBACK COMPONENT
1710

FIG. 19

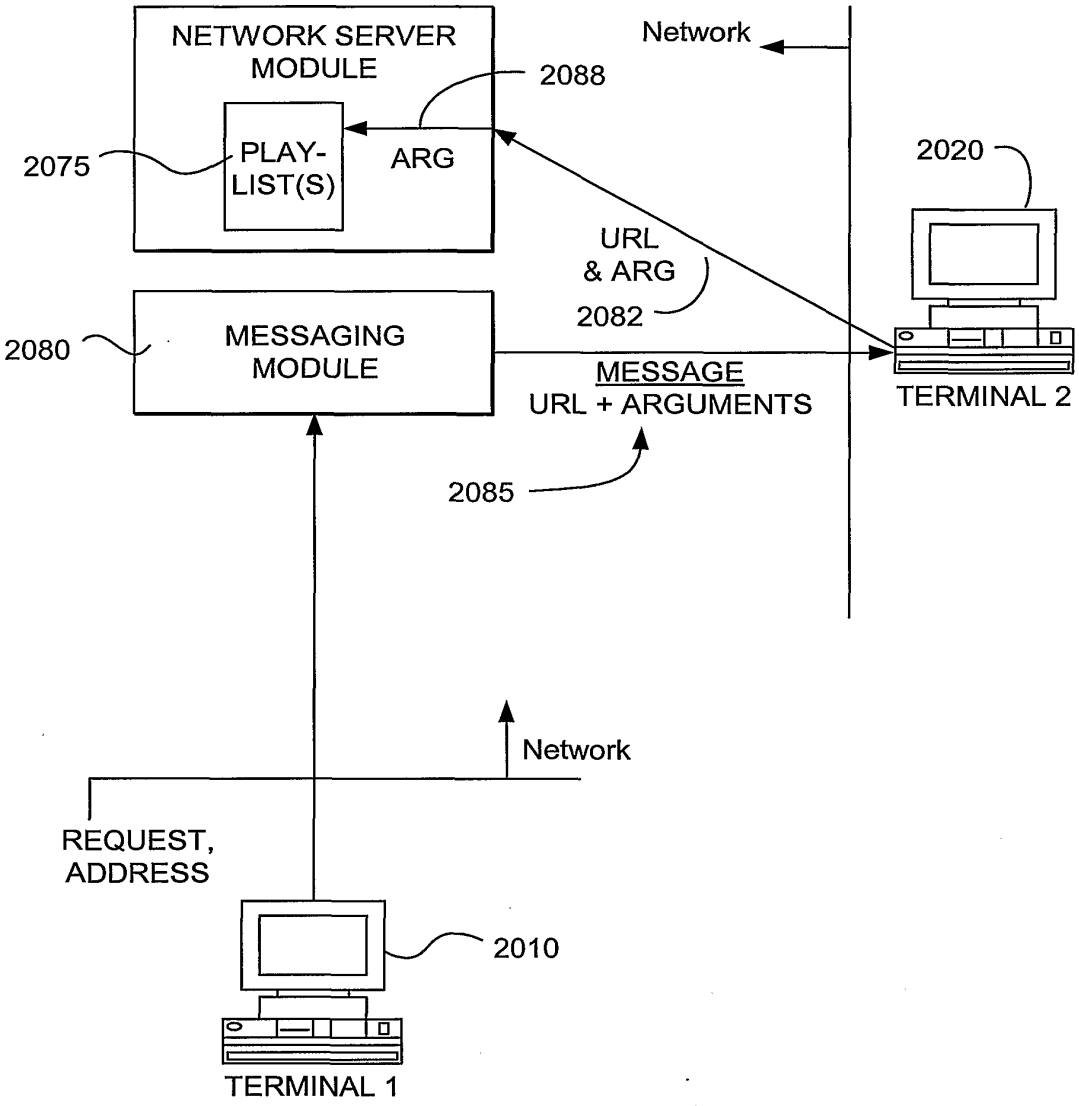
NETWORK SERVER MODULE
2088
Network
2075
PLAY-LIST(S)
ARG
2020
URL & ARG
2082
2080
MESSAGING MODULE
MESSAGE
URL + ARGUMENTS
TERMINAL 2
2085
Network
REQUEST, ADDRESS
2010
TERMINAL 1

FIG. 20

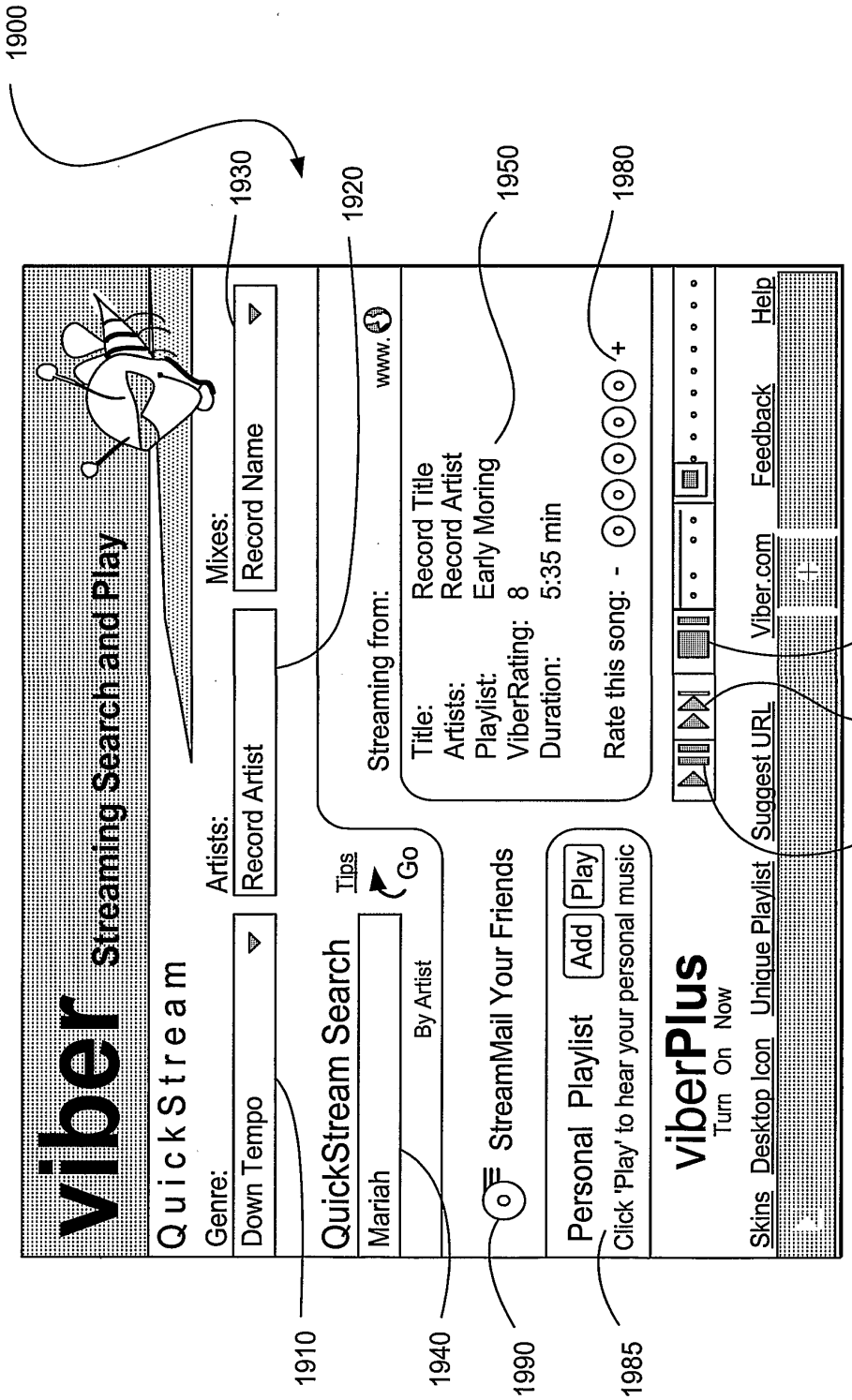
1900
viber Streaming Search and Play
QuickStream
Genre:
Down Tempo
Artists:
Record Artist
Mixes:
Record Name
1930
1920
QuickStream Search
Tips
Go
Mariah
By Artist
Streaming from:
www.
Title: Record Title
Artists: Record Artist
Playlist: Early Moring
ViberRating: 8
Duration: 5:35 min
1950
Rate this song: - +
1980
StreamMail Your Friends
Personal Playlist
Add
Play
Click 'Play' to hear your personal music
viberPlus
Turn On Now
Skins Desktop Icon Unique Playlist
Suggest URL
Viber.com
Feedback
Help
1910
1940
1990
1985
1974
1972
1976

FIG. 21

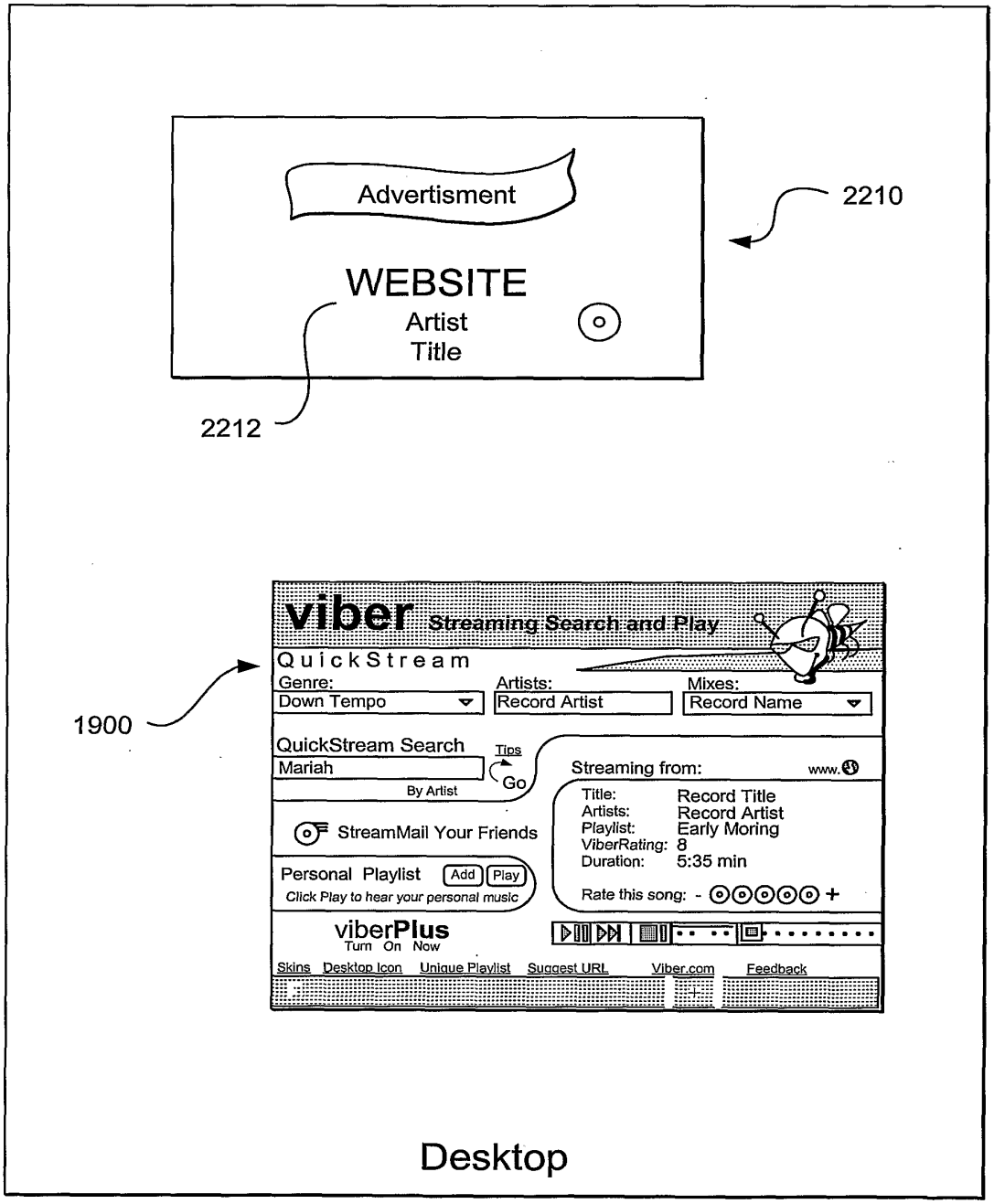
Advertisment
2210
WEBSITE
Artist
Title
2212
1900
viber Streaming Search and Play
QuickStream
Genre:
Down Tempo
Artists:
Record Artist
Mixes:
Record Name
QuickStream Search
Mariah
By Artist
Tips
Go
Streaming from:
www.
Title: Record Title
Artists: Record Artist
Playlist: Early Moring
ViberRating: 8
Duration: 5:35 min
Rate this song: -
StreamMail Your Friends
Personal Playlist
Add
Play
Click Play to hear your personal music
viberPlus
Turn On Now
Skins
Desktop Icon
Unique Playlist
Suggest URL
Viber.com
Feedback
Desktop

FIG. 22

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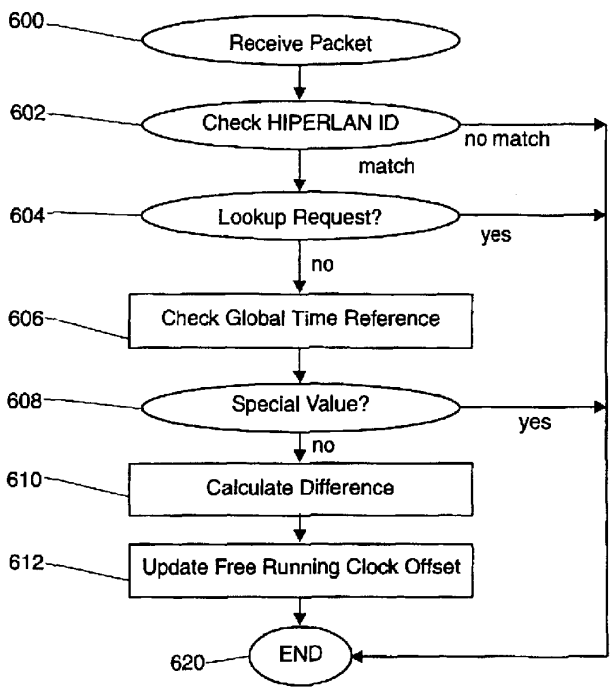
[Continued on next page]

(54) Title: MAINTAINING A GLOBAL TIME REFERENCE AMONG A GROUP OF NETWORKED DEVICES



(57) Abstract: Synchronization is maintained among a plurality of network devices (102,...) having local clocks. A first packet including global time reference (606) derived from local clock is broadcast from a first network device to other devices. The clocks of the network devices are adjusted. The difference between a free running clock and a first network global time reference is determined (610). A first network offset is calculated (612). Similarly, a second network offset is calculated to account for the difference between the free running clock and the second network global time reference.

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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

MAINTAINING A GLOBAL TIME REFERENCE AMONG A GROUP OF NETWORKED DEVICES

FIELD OF THE INVENTION

The present invention relates generally to networks of devices. More specifically, maintaining a global time reference in an ad hoc wireless network is disclosed.

BACKGROUND OF THE INVENTION

Wireless networks are becoming increasingly important as solutions for transferring data among devices that move, are located in a home, or are otherwise situated so that it is desirable to connect the devices without wires. Numerous physical and MAC layer solutions have been proposed. For example, a baseband ultra wideband wireless network is described in U.S. Patent Application No. 09/393,126 "Baseband Wireless Network for Isochronous Communication" by Aiello, et. al., which is herein incorporated by reference. An ultra wide band network transmits a signal that covers a very large portion of the frequency spectrum but transmits at a very low power in any individual frequency band.

Wireless networks are sometimes referred to as ad hoc networks because the network is comprised of devices that happen to be within the broadcast vicinity of the other devices in the network. Devices may join or leave the network as they are powered up or move out of range. A particular ad hoc network is described in the HIPERLAN Type 1, Functional Specification, ETS 300 652 published by the European Telecommunications Standards Institute. It is available at www.etsi.org.

Figure 1 is a block diagram illustrating a set of wireless devices that communicate together in a wireless ad hoc network. Video player 102 transmits an audio signal to speakers 106a, 106b, 106c and 106d. Video player 102 also transmits a video signal to screen 104. Screen 104 and speakers 106 may also transmit information to each other or to video player 102.

For an application such as the one shown in Figure 1, it is readily seen that synchronization among the various devices is important to achieve a desirable result. Different amounts of delay or jitter may exist in the signal paths between video player 102, speakers 106a and 106b, and screen 104. If the difference in delay is significant, then the

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video presentation shown on screen 104 may not be properly synchronized with the audio being played on the speakers. Even worse, if speaker 106a and speaker 106b are not properly synchronized, then the left and right stereo audio channels could become separated in time, resulting in an unpleasant audio experience. Thus, it would be useful if a method of synchronizing the devices in such a wireless network could be developed.

SUMMARY OF THE INVENTION

Accordingly, a system and method for maintaining a global time reference among a group of wireless devices participating in a wireless network is disclosed. It should be noted that the techniques described herein may also be applied to other networks including certain networks that transmit signals partially or wholly using wires, fiberoptic cables or other means. For the purposes of example, this specification will describe in detail a wireless network and in particular a wireless ad hoc network that uses the HIPERLAN standard. It should be appreciated that the invention is not limited to such a network and that the techniques described are applicable to many different types of networks.

In one embodiment, each device in a network maintains its own clock. Instead of designating the clock of one particular device as the master clock, each device transmits its own clock signal or part of its own clock signal when it sends a packet to other devices in the network. The devices receiving the packet read the clock signal and adjust their own clocks to the transmitted value. This clock adjustment is made in a manner that causes the clocks to smoothly approach a common value without oscillating in an unstable manner.

It should be appreciated that the present invention can be implemented in numerous ways, including as a process, an apparatus, a system, a device, a method, or a computer readable medium such as a computer readable storage medium or a computer network wherein program instructions are sent over optical or electronic communication links. Several inventive embodiments of the present invention are described below.

In one embodiment, synchronization is maintained among a plurality of network devices having local clocks that participate in a network. A first packet is broadcast from a first network device to other network devices that participate in the network. The first packet includes a global time reference derived from the local clock of the first network device. The clocks of the network devices that receive the first packet are adjusted to be closer to the local clock of the first network device.

In one embodiment, a first network local time reference and a second network local time reference are maintained for a device that participates in a first network and a second network. A free running clock is maintained on the device. The difference between the free running clock and a first network global time reference is determined. A first network offset is calculated to account for the difference between the free running clock and the first network global time reference. The difference between the free running clock and a second network global time reference is determined. A second network offset is calculated to account for the difference between the free running clock and the second network global time reference.

These and other features and advantages of the present invention will be presented in more detail in the following detailed description and the accompanying figures which illustrate by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be readily understood by the following detailed description in conjunction with the accompanying drawings, wherein like reference numerals designate like structural elements, and in which:

Figure 1 is a block diagram illustrating a set of wireless devices that communicate together in a wireless ad hoc network.

Figure 2 is a diagram illustrating in some detail how a channel may introduce delay and jitter into the timing of packets sent from a transmitter to a receiver.

Figure 3 is a diagram illustrating how the timestamp, referred to as the global time reference is inserted into a packet header.

Figure 4A is a diagram illustrating how the global time reference is split into a most significant part and a least significant part.

Figure 4B is a diagram illustrating a memory register that stores the free running clock. The free running clock is a 32 bit clock.

Figure 4C is a diagram illustrating a memory register that stores the free running clock offset.

Figure 5 is a diagram illustrating an embodiment where devices belong to two different ad hoc networks and a new device is joining one of the networks.

Figure 6 is a flow chart illustrating a process that a network device executes when a

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packet that includes a global time reference is received to determine whether to adjust the network device local time reference.

Figure 7A is a flow chart illustrating a process for including a global time reference in a packet.

Figure 7B is a flow chart illustrating a process executed by a receiver to prepare to update its free running clock offset.

DETAILED DESCRIPTION

A detailed description of a preferred embodiment of the invention is provided below. While the invention is described in conjunction with that preferred embodiment, it should be understood that the invention is not limited to any one embodiment. On the contrary, the scope of the invention is limited only by the appended claims and the invention encompasses numerous alternatives, modifications and equivalents. For the purpose of example, numerous specific details are set forth in the following description in order to provide a thorough understanding of the present invention. The present invention may be practiced according to the claims without some or all of these specific details. For the purpose of clarity, technical material that is known in the technical fields related to the invention has not been described in detail so that the present invention is not unnecessarily obscured.

Figure 2 is a diagram illustrating in some detail how a channel may introduce delay and jitter into the timing of packets sent from a transmitter to a receiver. Transmitter 200 sends packets in an isochronous manner. That is, each packet begins transmission at a regular interval. The difference in time between t_1, t_2, t_3, and t_4 is constant. Channel 202 introduces delay and jitter into the transmission so that Δ_1, Δ_2, Δ_3, and Δ_4 time delays are added to each of the times that the respective packets are received by the receiver 204. Thus, the evenly spaced transmitted packets are not evenly spaced when they are received.

So long as there is only one transmitter and one receiver, the inter packet timing can be corrected at the receiver if a timestamp is included at the beginning of each packet. The difference between each of the timestamps would indicate the correct relative time spacing of the packets enabling the receiver to reposition or perhaps even reorder the packets in time.

When there are more than two devices, then simply timestamping the packets will

not synchronize the display of data among the devices. It should also be noted that even when there are only two devices, the timestamp can adjust the relative spacing between packets but it does not facilitate making sure that events occur on the receiver at a specific time relative to an event occurring at the transmitter. Referring back to the example shown in Figure 1, even if packets sent from video player 102 to left and right speakers 106a and 106b are timestamped, there may still be a time offset between the left and right stereo channels. The timestamp on the packets only serves to enable each of the channels to correctly position in time the packets that it receives.

In order to synchronize the video or audio display of information received in packets over the wireless network or otherwise coordinate the use of information received from packets, a clock is maintained on each of the network devices that is in synchronization with the clocks on each of the other network devices.

In one embodiment, a clock is specified for each network device that needs to be correct only to about 5 parts per million. In order to maintain acceptable synchronization between all of the device clocks on the network, each time one of the devices transmits a packet, the device includes in the packet header at a well defined point the value or, as described below, part of the value of its clock. When the other devices receive that packet, they adjust each of their respective clocks toward the time indicated by the timestamp. As described below, in one embodiment, the time adjustment is implemented by calculating a clock offset and the clock offset is calculated by taking half the difference between the device clock and the timestamp.

Figure 3 is a diagram illustrating how the timestamp, referred to as the global time reference is inserted into a packet header. Packet header 300 includes a clock sync sequence 302. Clock sync sequence 302 is chosen to be an appropriate sequence to facilitate the receiver acquiring a clock signal used to sample the remainder of the packet. Frame sync sequence 304 is included next for the purpose of precisely identifying the beginning of encoded data in the packet. Thus, the end of the frame sync sequence precisely determines the beginning of a frame. Any number of well known frame sync sequences may be used. In one embodiment, a 13 bit Barker code is used. As soon as the frame sequence is sent, the transmitter records its local time reference.

It should be noted that ideally, the local time reference of the transmitter will agree with the local time reference kept at each of the devices participating in the network. If that

is the case, then each of the local time references actually is a global time reference because it is in agreement with every other local time reference in the system. For the purpose of this explanation, the local time reference that the transmitter records and then inserts in the packet will be referred to as the global time reference. That is because the transmitter asserts it to be the global time reference and it is the time that all receiving devices will adjust their own local time references toward. It should also be noted that each device considers its own local time reference to be the global time reference and asserts that its own local time reference is the global time reference it transmits a packet. Thus, each transmitting device asserts its local time reference as the global time reference when it includes its local time reference in a packet that it broadcasts to the other devices. Over time, as enough packets are sent, all of the local time references converge to the same global time and the broadcast global time reference results in only small, if any, changes by receiving devices.

Global time reference 306 is inserted in the packet after frame sync sequence 304. In the embodiment shown, the global time reference is inserted immediately after the frame sync sequence, but that is not required. The receiver notes its local time reference at the time when the frame sync sequence is detected and the frame sync sequence signal is asserted. The global time reference from the packet may be read immediately or it may be read much later, so long as it is compared to the time when the frame sync sequence signal is asserted. Thus, global time reference 306 may occur in the packet immediately following frame sync sequence 304 or may occur at a later point in the packet. The remainder of the packet 308 is then sent. The remainder of the packet will likely include further information for the packet header as well as finally the packet payload of data.

It should be noted that in one embodiment, the entire global time reference is not included in the packet. Instead, only the least significant bits, referred to as the least significant part, of the global time reference is included. It is sufficient to include just the least significant part of the global time reference so long as the difference between the clocks is less than the amount of time counted by the least significant part of the global time reference. This condition is met if the amount of drift between the clocks before an adjustment is made is not enough to move the clocks out of synchronization by more than the maximum amount of time that can be represented by the least significant part. In one embodiment, a 32 bit global time reference is used and the least significant part that is

transmitted with each packet is the least significant 12 bits of the 32 bit global time reference.

In the embodiment described above, the relative clock drift of the clocks being used is about 5 parts per million (ppm) and the clock rate is 1 MHz. The least significant part of the global time reference can count up to 2^{12} microseconds. Therefore, the clocks would need to be updated before a 2^{12} microsecond error could accumulate. For a 1 MHz clock with 5 ppm accuracy, the maximum time interval between updates would be on the order of about 5 minutes, depending on the method of updating used. Of course, the maximum time interval varies in different systems depending on the speed and accuracy of the clock and the number of bits transmitted with the least significant part of the clock. If more of the global time reference is provided in the least significant part, then the frequency of update is lower. For example, if 14 bits are used, then the least significant part of the global time reference can accurately represent a cumulative drift of up to 2^{14} microseconds. Assuming that the relative clock drift is unchanged, then updates would be required only one fourth as often.

One advantage of the described arrangement where the global time reference is included along with every packet sent by one of the devices participating in the network is that as the amount of network traffic increases, updates of the local time references occur more frequently. This decreases the variance among the local time references.

Figure 4A is a diagram illustrating how the global time reference is split into a most significant part and a least significant part. As mentioned above, the most significant part is, in one embodiment, 20 bits and the least significant part is 12 bits. The size of the least significant part may be increased to reduce the required frequency of updates at the cost of requiring more overhead for transmission. It should also be noted that, in addition to the least significant part being included in packets that are sent by each of the devices, periodically a MAC layer protocol prompts one or more of the devices to broadcast the entire global time reference, that is both the most significant part and the least significant part. In one embodiment, the global time reference is broadcast every 20 seconds. The reason for periodically broadcasting the entire global time reference is to allow for an error that occurred in one of the devices that changed the global time reference by more than the maximum time represented by the least significant part of the global time reference to be corrected.

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In different embodiments, the task of broadcasting the entire global time reference may be performed by either one or all of the devices participating in the network. For example, each device may be directed to broadcast the global time reference periodically. The periodic broadcast may be staggered. Alternatively, the MAC layer protocol may direct a designated device to broadcast the entire global time reference at certain intervals.

Figure 4B is a diagram illustrating a memory register that stores the free running clock. The free running clock is a 32 bit clock. As mentioned previously, in one embodiment, the clock is a 1 megahertz clock. In other embodiments, the clock rate may be set as desired. Preferably, the free running clock is read only. That is, adjustments to the global time reference are not written to the clock. Rather, a free running clock offset is defined such that the global time reference is equal to the sum of the free running clock plus the free running clock offset.

Figure 4C is a diagram illustrating a memory register that stores the free running clock offset. Like the free running clock, the free running clock offset is a 32 bit register. However, the free running clock offset may be written as well as read. Each time a global time reference is received from one of the other devices, the free running clock is adjusted so that the sum of the free running clock and the free running clock offset converges toward the global time reference specified by the broadcasting device.

In different embodiments, adjustments to the local time reference based on the received global time reference are made according to different schemes. In one embodiment, a linear adjustment to the local time reference is made based on the difference between the received global time reference and the local time reference. The adjustment may be represented by the equation:

$$\Delta FRCO=(GTR-LTR) * L.$$

Where ΔFRCO is the change in the free running clock offset. GTR is the global time reference received with a packet. LTR is the current value of the local time reference stored by the device. As mentioned above, after several packets are received and adjustments are made, the local time references stored on each of the devices will converge toward a single value and that value will be the global time reference. L is a linear factor that adjusts the amount that the free running clock offset is adjusted compared to the difference between the global time reference and the local time reference that is computed. In one embodiment, L is equal to .5 and the adjustment to the free running clock offset is equal to half the

difference between the received global time reference and the stored local time reference.

Adjustment schemes are used in different embodiments that make non-linear adjustments to the free running clock offset based on the difference between the global time reference and the local time reference. In one embodiment, the change to the free running clock offset is equal to a scaling factor times the square of the difference between the global time reference and the local time reference. Squaring the difference between the two references has the advantage of making greater changes to the free running clock offset if the difference between the global time reference and the local time reference is large. If the square of the difference is used, then the sign of the difference between the global time reference and the local time reference is computed and applied to the difference so that the free running clock offset is adjusted in the proper direction.

In another embodiment, another non-linear adjustment scheme is implemented to allow the system to be more robust. The difference between the global time reference and the local time reference is computed. If the difference is greater than a threshold, then no adjustment is made to the local time reference. If the difference is less than a threshold, then the adjustment is made. Thus, if one of the devices in the network malfunctions or a new device signing on to the network attempts to assert a global time reference that is incorrect and would perturb the global time reference agreed upon by the current devices in the network, that device's assertion of the global time reference may be ignored.

In some embodiments, the threshold test can be turned off under certain circumstances. For example, if more than a certain number of changes are rejected by a device, then the threshold function may be temporarily turned off. This would be appropriate since a device that is receiving a large number of global time references that differ from its local time reference by a great amount most likely is actually incorrect by a large amount. A counter may be used to count the number of recent times that the difference between a received global time reference and the local time reference exceeds the threshold. In one embodiment, the counter is programmed to only count global time references from unique sources so that a single inaccurate source broadcasting repeatedly will be ignored. Both the threshold and the number of times that the threshold must be exceeded to turn off the threshold test may be programmed or may be preset.

Figure 5 is a diagram illustrating an embodiment where devices belong to two different ad hoc networks and a new device is joining one of the networks. Devices 502,

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504, 506, and 508 all belong to a first ad hoc network 530. Device 508 along with devices 512 and 514 also belong to an ad hoc network 540. Device 522 is requesting to join network 530. As mentioned above, in one embodiment, the HIPERLAN protocol is utilized by the wireless ad hoc networks. In such an embodiment, each network has its own HIPERLAN ID. The HIPERLAN ID is included in packets sent by devices.

The two separate networks can have two separate independent clocks with a device such as device 508 that participates in both networks maintaining two separate clocks. More precisely, the device need only maintain a single free running clock and keep track of two free running clock offsets. Changes are applied to each of the respective free running clock offsets to keep track of the two different global times for the networks. Thus, device 508 may have a single free running clock but two registers used to calculate two different free running clock offsets to adjust the free running clock time to the global time of whichever network it is participating in at a given moment.

Other aspects of the HIPERLAN specification are used to facilitate the implementation of a global time reference shared among the devices of an ad hoc network. For example, the entire global time reference may be periodically broadcast using a Hello packet as described in the specification. The standard Hello procedure is modified to carry the full global time reference. The Hello procedure is described more fully in the HIPERLAN Type 1, Functional Specification, ETS 300 652 at 6.5.4 Neighbour Information Declaration. See also 6.1.14 Neighbour Information Base and 6.1.15 Hello Information Base.

As described above, a device may use the HIPERLAN ID to determine whether a packet belongs to its network and therefore whether to adjust its local time reference toward the global time reference specified in the packet. Also, a reserved network management ID may be used by devices joining the network. Network devices may be configured to ignore time references included in HIPERLAN lookup requests.

Various methods may be implemented to avoid a stable network global time reference from being perturbed by a new device. In one embodiment, new devices are instructed to provide a global time reference of all 0's which is a special value that is ignored by all network devices. Also, a new device is preferably configured to initially set its local time reference to equal a received global time reference instead of adjusting its local reference as described above. Specification of conventions for new devices, however,

does not protect against rogue devices that do not observe the correct conventions or devices that belong to other networks. For that reason, other procedures such as checking the HIPERLAN ID or rejecting certain large changes may also be implemented.

Figure 6 is a flow chart illustrating a process that a network device executes when a packet that includes a global time reference is received to determine whether to adjust the network device local time reference. The process starts at 600. In step 602, the HIPERLAN ID is checked. If there is no match, then the process ends at 620. If there is a match, then control is transferred to step 604 and it is determined whether the packet is a look up request. If the packet is a look up request, then the process ends at 620. If the packet is not a lookup request, then control is transferred to step 606 and the global time reference is checked. In step 608, it is determined whether the global time reference is a special value. If it is, then control is transferred to 620 and the process ends. If the global time reference is not a special value, then control is transferred to step 610 and the difference between the global time reference and the local time reference is calculated. Then, in step 612, the free running clock offset is updated. The free running clock may be updated according to any of the linear or nonlinear schemes described above or any other appropriate scheme. The process then ends at 620.

Figure 7A is a flow chart illustrating a process for including a global time reference in a packet. The process starts at 700 when a clock sync sequence is written. Next, in step 702, the frame sync sequence is written. As soon as the frame sync sequence is completed the local time reference of the transmitting device is read in step 704. This value will be inserted into the packet as the global time reference corresponding to the time that the frame sync sequence was finished. Next, in step 706, the global time reference is written into the packet. It should be noted that other steps may intervene between steps 704 and 706. The key point is that the global time reference is stored either immediately after or at some specific time after the frame sync sequence is completed so that the receiving device can compare its local time reference to the transmitted global time reference at a specific reference point.

Figure 7B is a flow chart illustrating a process executed by a receiver to prepare to update its free running clock offset. The process starts at 710 when the frame sync sequence is detected. The local time is immediately stored in step 712. It should be noted that although it is preferred that the local time be stored immediately, it is also possible to

store the local time at a set period of time after the assertion of the frame sync signal. Then, in step 714, the global time reference is read from the packet. In this manner, the transmitted global time and the local time are stored at a specific point in time referenced to the writing of the frame sync sequence and the detection of the frame sync sequence, respectively. In this manner, the local time reference and the global time reference can be compared and the free running clock offset can be appropriately adjusted.

Maintaining a global time reference in an ad hoc network has been disclosed. Each device maintains a local free running clock and a local free running clock offset, which together comprise a local time reference. Each free running clock is adjusted toward a received global time reference that is the local time reference of whatever device happens to be broadcasting. In this manner, eventually all of the local time references of devices in the network converge. A device may participate in more than one network by keeping track of one free running clock offset for each network.

Although the foregoing invention has been described in some detail for purposes of clarity of understanding, it will be apparent that certain changes and modifications may be practiced within the scope of the appended claims. It should be noted that there are many alternative ways of implementing both the process and apparatus of the present invention. Accordingly, the present embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalents of the appended claims.

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WHAT IS CLAIMED IS:

1. A method of maintaining synchronization among a plurality of network devices having local clocks that participate in a network comprising:

broadcasting a first packet from a first network device to other network devices that participate in the network wherein the first packet includes a global time reference derived from the local clock of the first network device; and

adjusting the clocks of the network devices that receive the first packet to be closer to the local clock of the first network device.

2. A method of maintaining synchronization among a plurality of network devices as recited in claim 1 further including:

broadcasting a second packet from a second network device to other network devices that participate in the network wherein the second packet includes a global time reference derived from the local clock of the second network device; and

adjusting the clocks of the other network devices network devices that receive the second packet to be closer to the local clock of the second network device.

3. A method of maintaining synchronization among a plurality of network devices as recited in claim 1 wherein the global time reference includes the least significant part of the local clock of the first network device and does not include the most significant part of the local clock of the first network device.

4. A method of maintaining synchronization among a plurality of network devices as recited in claim 3 wherein the most significant part of one of the network device local clocks is broadcast periodically and the most significant parts of all local clocks are conformed to the broadcast most significant part.

5. A method of maintaining synchronization among a plurality of network devices as recited in claim 1 wherein adjusting the clocks of the network devices that receive the first packet to be closer to the local clock of the first network device includes adjusting the clocks of the network devices according to a linear function of the difference between the unadjusted value of the clock being adjusted and the broadcast global time reference.

6. A method of maintaining synchronization among a plurality of network devices as recited in claim 1 wherein adjusting the clocks of the network devices that receive the first packet to be closer to the local clock of the first network device includes adjusting the

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clocks of the network devices by approximately one half the difference between the broadcast global time reference and the unadjusted value of the clock being adjusted.

7. A method of maintaining synchronization among a plurality of network devices as recited in claim 1 wherein adjusting the clocks of the network devices that receive the first packet to be closer to the local clock of the first network device includes adjusting the clocks of the network devices according to a nonlinear function of the difference between the unadjusted value of the clock being adjusted and the broadcast global time reference.

8. A method of maintaining synchronization among a plurality of network devices as recited in claim 7 wherein the nonlinear function of the difference between the unadjusted value of the clock being adjusted and the broadcast global time reference causes substantially no adjustment to the clock being adjusted when the difference between the unadjusted value of the clock being adjusted and the broadcast global time reference is greater than a maximum adjustable difference.

9. A method of maintaining synchronization among a plurality of network devices as recited in claim 1 wherein the global time reference is derived from the local clock of the first network device immediately after a frame synchronization portion of a packet is transmitted.

10. A method of maintaining synchronization among a plurality of network devices as recited in claim 1 wherein adjusting the clocks of the network devices that receive the first packet to be closer to the local clock of the first network device includes comparing the local clock of a receiving network device at the instant that frame synchronization is detected to the transmitted global time reference.

11. A method of maintaining synchronization among a plurality of network devices as recited in claim 1 wherein all data packets broadcast by any network device that participates in the network includes a global time reference derived from the local clock of the broadcasting network device so that as more data is transmitted, the local clocks of the receiving network devices are updated more frequently.

12. A method of maintaining a first network local time reference and a second network local time reference for a device that participates in a first network and a second network comprising:

maintaining a free running clock on the device;

determining the difference between the free running clock and a first network global

time reference;

calculating a first network offset to account for the difference between the free running clock and the first network global time reference;

determining the difference between the free running clock and a second network global time reference; and

calculating a second network offset to account for the difference between the free running clock and the second network global time reference.

13. A receiving network device configured to maintain synchronization with a transmitting network device comprising:

a receiving network device local clock;

an interface configured to receive a first packet from the transmitting network device wherein the first packet includes a global time reference derived from a transmitting network device local clock; and

a processor configured to adjust the receiving network device local clock to be closer to the transmitting network device local clock.

14. A receiving network device configured to maintain synchronization with a transmitting network device as recited in claim 13 wherein the receiving network device local clock includes a free running clock and a free running clock offset.

15. A transmitting network device configured to maintain synchronization with a receiving network device comprising:

a transmitting network device local clock;

an interface configured to transmit a first packet wherein the first packet includes a global time reference derived from the transmitting network device local clock and wherein the global time reference is used by the receiving network device to adjust the receiving network device local clock to be closer to the transmitting network device local clock.

16. A network of devices comprising:

a transmitting network device configured to transmit a first packet wherein the first packet includes a global time reference derived from a transmitting network device local clock; and

a receiving network device configured to receive the first packet from the transmitting network device and to adjust a receiving network device local clock to be closer to the global time reference.

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17. A network device comprising:

a free running clock;

a processor configured to:

determine the difference between the free running clock and a first network global time reference;

calculate a first network offset to account for the difference between the free running clock and the first network global time reference;

determine the difference between the free running clock and a second network global time reference; and

calculate a second network offset to account for the difference between the free running clock and the second network global time reference.

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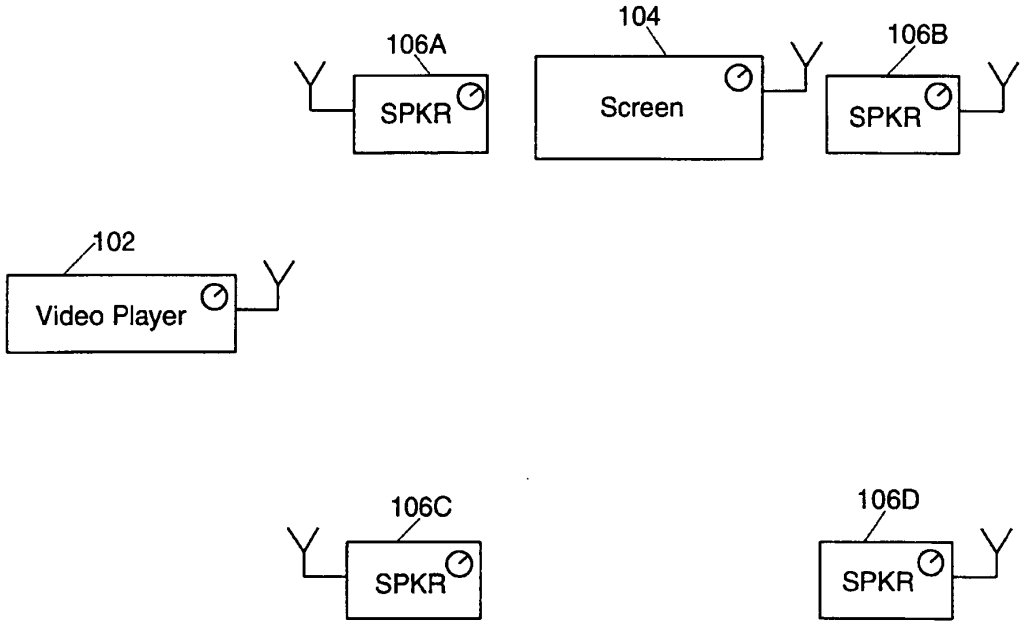
106A
SPKR
104
Screen
106B
SPKR
102
Video Player
106C
SPKR
106D
SPKR

FIG. 1

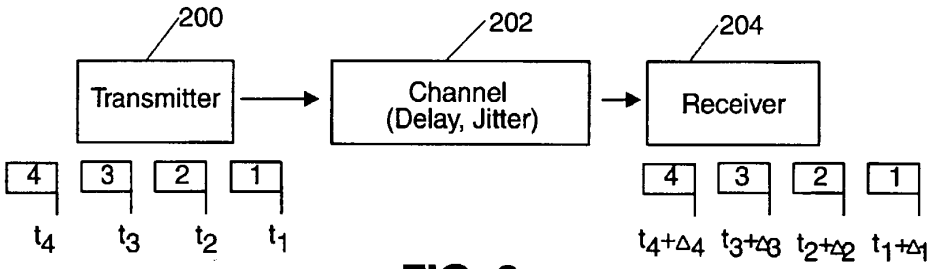

FIG. 2

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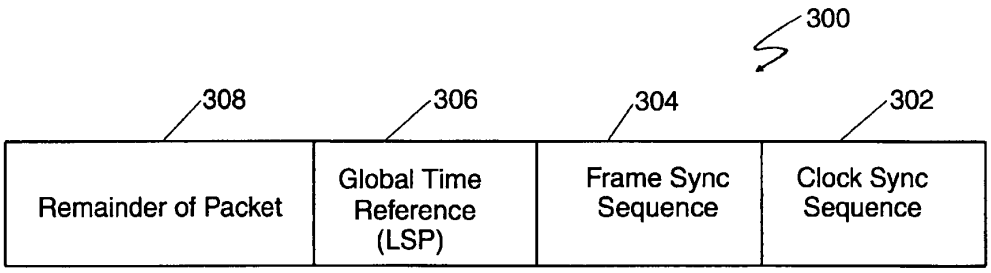

FIG. 3

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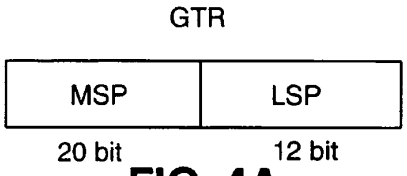


FIG. 4A

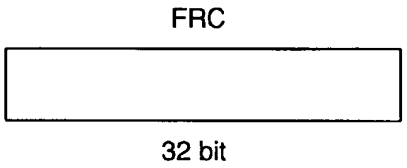
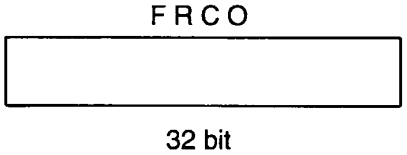


FIG. 4B



GTR = FRC + FRCO

FIG. 4C

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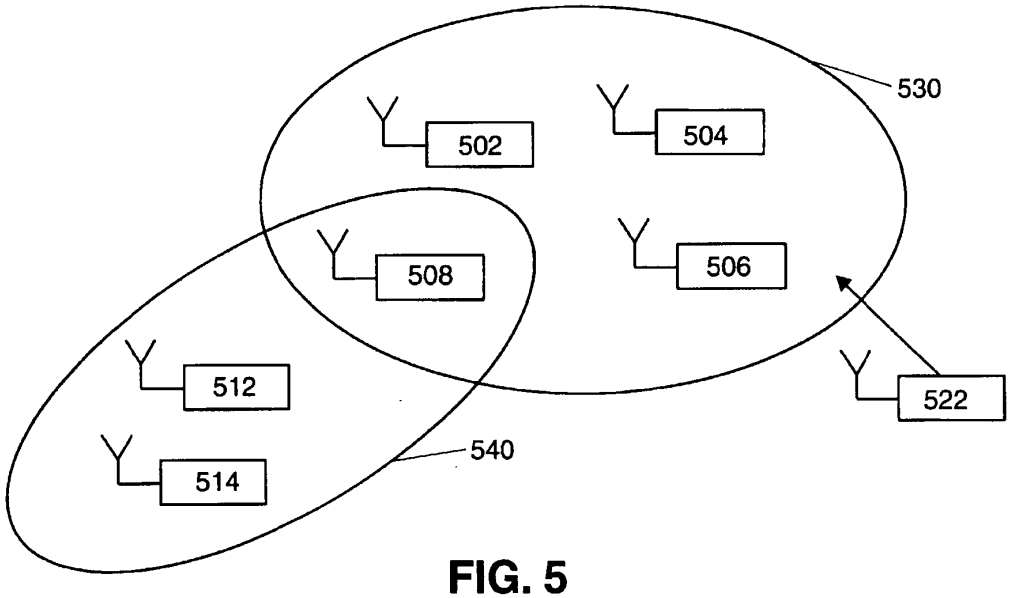

FIG. 5

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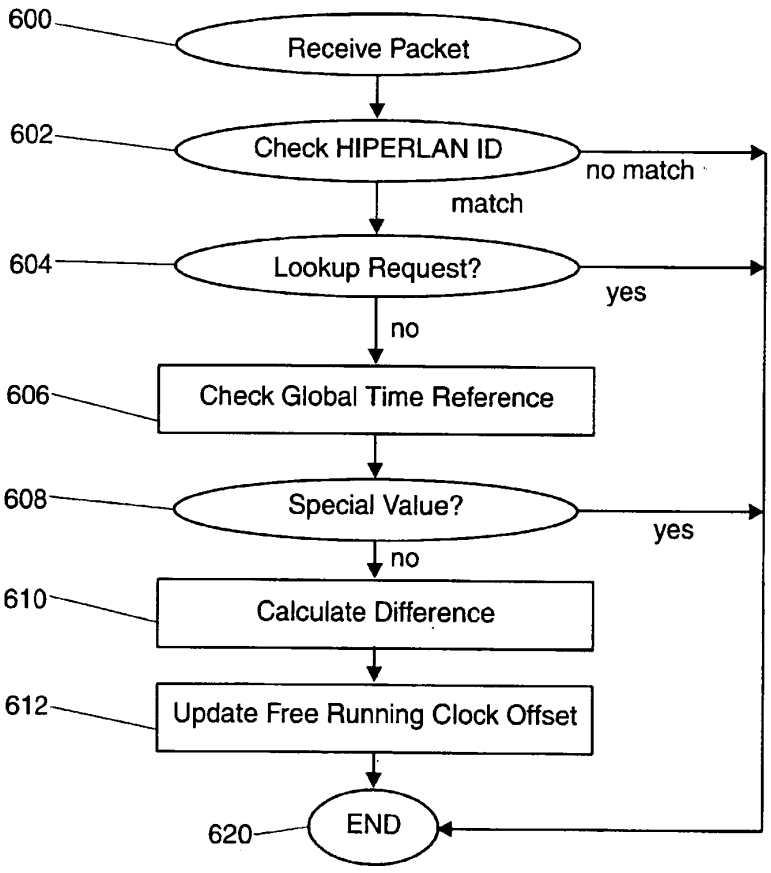

FIG. 6

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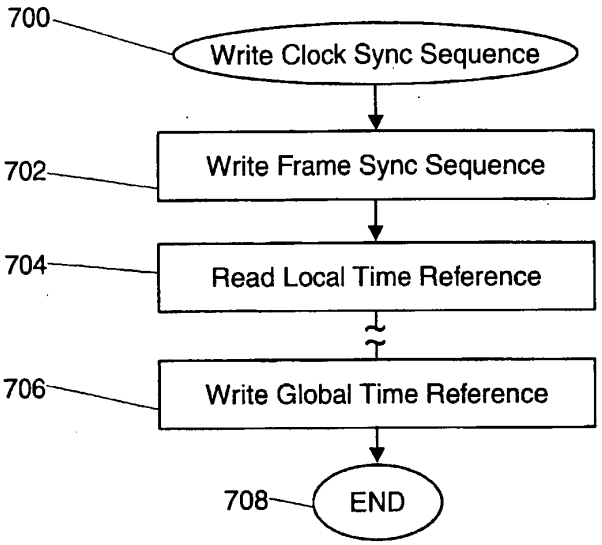

FIG. 7A

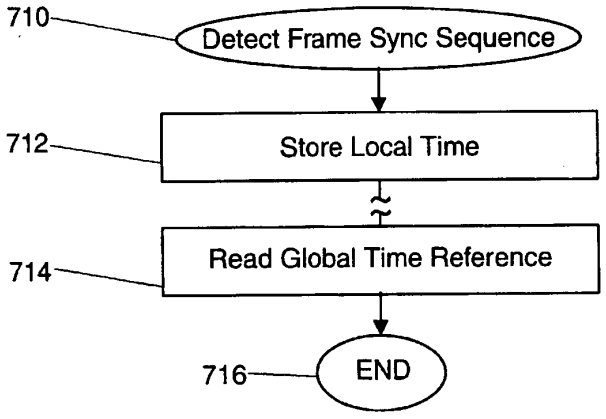

FIG. 7B

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US02/07082

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : H04J 3/06
US CL : 370/350, 432, 503, 516; 375/356; 455/265
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 370/350, 390, 432, 503, 516; 375/356; 455/208, 265; 709/248, 249

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST, WEST, IEEE, DIALOG

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y,P	US 5,334,975 A (WACHOB et al.) 02 August 1994, col. 1, lines 35-52, col. 2, lines 10-68, col. 3, lines 1-40.	1-17
Y,P	US 6,285,873 B1 (QUICK, Jr.) 04 September 2001, col. 4, lines 5-19, col. 6, lines 31-67, col. 7, lines 1-67, col. 8, lines 1-7, 54-63	1-17
Y,P	US 6,347,084 B1 (HULYALKAR et al.) 12 February 2002, col. 1, lines 37-48, 66-67, col. 2, lines 1-12, col. 6, lines 53-67, col. 7, lines 1-4, col. 8, lines 21-32, 43-64.	1-17

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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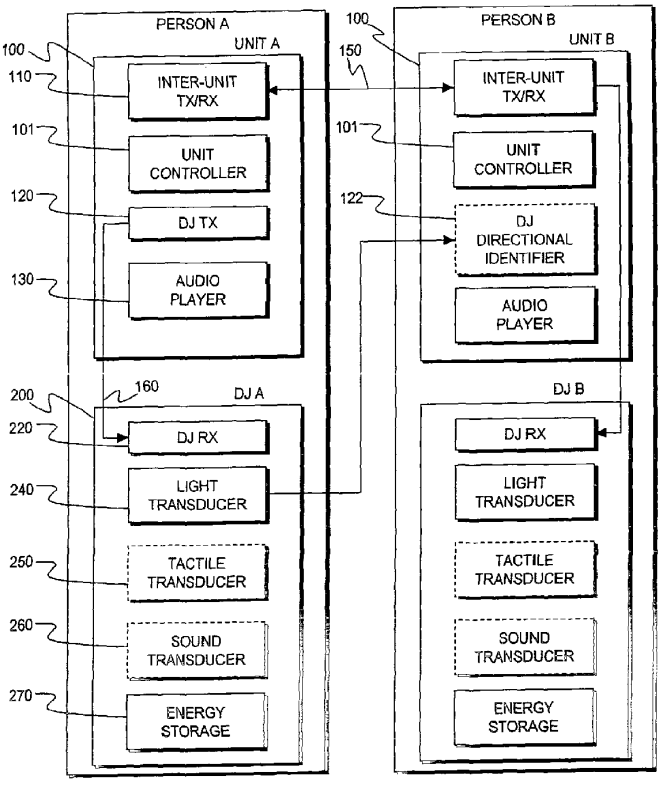
[Continued on next page]

(54) Title: LOCALIZED AUDIO NETWORKS AND ASSOCIATED DIGITAL ACCESSORIES



(57) Abstract: Individuals share music through portable audio devices that synchronously play music by transmitting music signals from one device to the other. Upon request, other individuals can join such a sharing group as a member, and these new members can either be accepted automatically, or through voting by existing group members. So that members of a group can converse, the fraction of ambient sound admitted by the earphones of the portable device can be manually set. In order to enhance the enjoyment of the music, wearable transducers, such as light emitting diodes, respond to signals related to the beat of the music. Signals can be automatically generated, or manually specified, and signals thereafter stored for playback with the music to which it is related. Wearable transducers associated with individuals at a large music event can be set to receive common signals such that the transducers respond in synchrony with one another

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LOCALIZED AUDIO NETWORKS AND ASSOCIATED DIGITAL ACCESSORIES

Cross Reference To Related Patent Applications

This application is related to and claims priority from Provisional Patent Application No. 60/378,415, filed May 6, 2002, titled "Localized Audio Networks and Associated Digital Accessories," and from Provisional Patent Application No. 60/388,887, filed June 14, 2002, titled " Localized Audio Networks and Associated Digital Accessories," and from Provisional Patent Application No. 60/452,230, filed March 4, 2003, titled " Localized Audio Networks and Associated Digital Accessories," the contents of each of which are incorporated herein by reference.

Technical Field

The present invention relates to localized wireless audio networks for shared listening of recorded music, and wearable digital accessories for public music-related display, which can be used in conjunction with one another.

Background

Portable audio players are popular consumer electronic products, and come in a variety of device formats, from cassette tape "boom boxes" to portable CD players to digital flash-memory and hard-disk MP3 players. While boom boxes are meant to make music to be shared among people, most of the portable audio players are designed for single person use. While some of this orientation to personal music listening is due to personal preference, other important considerations are the technical difficulties of reproducing music for open area listening with small, portable devices, as well as the social imposition of listening to music in public places with other people who do not wish to listen to the same music, or who are listening to different music that would interfere with one's own music.

There are numerous audio devices that are designed to allow the transfer of music from one portable audio device to another, especially through those that store music in the MP3 audio format. These devices suffer from two main difficulties: firstly, listeners still do not hear the music simultaneously, which is the optical manner to share music, and secondly, there are serious copyright issues associated with the transfer of music files. Thus, it would be preferable for the transfer of the music for simultaneous enjoyment, and which did not

result in a permanent transfer of the music files between the devices, so as not to infringe on the intellectual property rights of the music owners.

Given the sharing of music, listeners will on occasion want to purchase the music for themselves. In such case, it would be beneficial for the user to have a way to obtain the music with minimal effort. It would further be desirable for there to be a way to keep track of the person from whom the listener heard the music, so that the person could be in some way encouraged or compensated.

The earphones associated with a portable music player admit a relatively constant fraction of ambient sound. If listening to music with a shared portable music device, however, one might at times want to talk with a friend, and at times listen to music without outside audible distraction. In such case, it would be desirable to have an earphone for which the amount of external ambient sound could be manually set.

Furthermore, many people like to show their individual preferences, to exhibit themselves, and to demonstrate their group membership. Furthermore, music preferences and listening to music together are among the more important means by which individuals express their individual and group identities. It would be beneficial for there to be a way for individuals to express themselves through their music, and for groups of individuals listening to music together, to be able to demonstrate their group enjoyment of the music.

One means for a person to express their identity through motion would be through having wearable transducers wherein the transduction signal is related to the music. If the transducer were a light transducer, this would result in a display of light related to the music that was being listened to. It would be further beneficial if there were means by which a person could generate control signals for the transducer so that instead of a wholly artificial response to the music, the transducer showed a humanly interpreted display. It would be preferable if these signals could be shared between people along with music files, so that others could entertain or appreciate the light display so produced.

At popular music concerts, there is often a "light show" that pulsates in rough relation to the music. In contrast to the generally vigorous light show, the patrons at the concerts often have light bracelets or other such static displays which are used to join with the displays on the stage. It would be beneficial for there to be a way in which patrons could participate in the light show in order to enhance their enjoyment of the concert.

It is to the solution of these and other problems that the present invention is directed.

Summary of the Invention

It is an object of the present invention to provide users a means of listening to music together using mobile devices.

It is also an object of the present invention to provide users a means of choosing with whom to listen to music.

It is additionally an object of the present invention to provide users the ability to monitor the people that are listening together.

It is furthermore an object of the present invention to provide users a means of expressing their enjoyment of the music they are listening to through visual displays of wearable accessories.

It is yet another object of the present invention to provide users a means of demonstrating their identity with other people they are listening to music with.

It is still further an object of the present invention to provide users to provide users with means to choreograph the visual displays.

Additional objects, advantages and novel features of this invention shall be set forth in part in the description that follows, and will become apparent to those skilled in the art upon examination of the following specification or may be learned through the practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities, combinations, and methods particularly pointed out in the appended claims.

To achieve the foregoing and other objects and in accordance with the purposes of the present invention, as embodied and broadly described therein, the present invention is directed to a method for sharing music from stored musical signals between a first user with a first music player device and at least one second user with at least one second music player device. The method includes the step of playing the musical signals for the first user on the first music player device while essentially simultaneously wirelessly transmitting the musical signals from the first music player device to the at least one second music player device. The method additionally includes receiving the musical signals by the at least one second player device, such that the musical signals can be played on the at least one second player device essentially simultaneously with the playing of the musical signals on the first music player device. In this method, the first and the at least one second users are mobile and maintain less than a predetermined distance.

The present invention is also related to a system of music sharing for a plurality of users. The system includes a first sharing device and at least one second sharing device, each comprising a musical signal store, a musical signal transmitter, a musical signal receiver, and a musical signal player. Furthermore, the system comprises a broadcast user operating the first sharing device and at least one member user operating the at least one second sharing device. The broadcast user plays the musical signal for his own enjoyment on the first sharing device and simultaneously transmits the musical signal to the receiver of the at least one second sharing device of the at least one member user, on which the musical signal is played for the at least one member user. The broadcast user and the at least one member user hear the musical signal substantially simultaneously.

The present invention yet further is related to a wireless communications system for sharing audio entertainment between a first mobile device and a second mobile device in the presence of a non-participating third mobile device. The system includes an announcement signal transmitted by the first mobile device for which the second mobile device and the third mobile device are receptive. In addition, the system includes a response signal transmitted by the second mobile device in response to the announcement signal for which the first mobile device is receptive and for which the third mobile device is not receptive. Also, the system includes an identifier signal transmitted by the first mobile device to the second mobile device in response to the response signal, and which is not receptive to the third mobile device. Finally, the system includes a broadcast signal comprising audio entertainment that is transmitted by the first mobile device, and which is receptive by the second mobile device on the basis of the reception of the identifier signal.

The present invention additionally is related to an audio entertainment device. The device includes a signal store that stores an audio entertainment signal, a transmitter that can transmit the stored audio entertainment signal, a receiver that can receive the transmitted audio entertainment signal from a transmitter of another such device, and a player that can play audio entertainment from a member selected from the group of stored audio entertainment signals or audio entertainment signals transmitted from the transmitter of another such device.

The present invention yet still is related to a system for identifying a first device that introduces a music selection to a second device. The system includes a mobile music transmitter operated by the first device and a mobile music receiver operated by the second device. In addition, the system includes a music signal comprising the music selection transmitted by the transmitter and received by the receiver, an individual musical identifier

that is associated with the music selection, and an individual transmitter identifier that identifies the transmitter. The transmitter identifier and the individual music identifier are stored in association with each other in the receiver.

The present invention is still further related to an audio entertainment device. The device includes a wireless transmitter for the transmission of audio entertainment signals and a wireless receiver for the reception of the transmitted audio entertainment signals from a transmitter of audio entertainment signals. A first manually-separable connector for electrically connecting with an audio player allows transfer of audio entertainment signals from the player to the device. The device also includes a second connector for connecting with a speaker and a control to manually switch between at least three states. In the first state the speaker plays audio entertainment signals from the audio player and the transmitter does not transmit the audio entertainment signals. In the second state the speaker plays audio entertainment signals from the audio player and the transmitter essentially simultaneously transmits the audio entertainment signals. In the third state the speaker plays audio entertainment signals received by the receiver.

The present invention also still is related to a system for the sharing of stored music between a first user and a second user. The system includes a first device for playing music to the first user, comprising a store of musical signals. A first controller prepares musical signals from the first store for transmission and playing, and a first player takes musical signals from the first controller and plays the signals for the first user. A transmitter is capable of taking the musical signals from the controller and transmitting the musical signals via wireless broadcast. A second device for playing music to the second user comprises a receiver receptive of the transmissions from the transmitter of the first device, a second controller that prepares musical signals from the receiver for playing, and a second player that takes musical signal from the second controller and plays the signals for the second user. The first user and the second user hear the musical signals at substantially the same time.

The present invention also is related to an earphone for listening to audio entertainment allowing for the controlled reception of ambient sound by a user. The earphone includes a speaker that is oriented towards the user's ear and an enclosure that reduces the amount of ambient noise perceptive to the user. In addition, a manually-adjustable characteristic of the enclosure adjusts the amount of ambient sound perceptive to the user.

The present invention is further related to a mobile device for the transmission of audio entertainment signals. The mobile device includes an audio signal store for the storage

of the audio entertainment signals, and an audio signal player for the playing of the audio entertainment signals. The device also includes a wireless transmitter for the transmission of the audio entertainment signals and a transmitter control to manually switch between two states consisting of the operation and the non-operation of the audio transmitter.

The present invention yet still is related to a mobile device for the reception of digital audio entertainment signals. The mobile device includes an audio signal store for the storage of the digital audio entertainment signals and an audio receiver for the reception of external digital audio entertainment signals from a mobile audio signal transmitter located within a predetermined distance of the audio receiver. The device also includes a receiver control with at least a first state and a second state. An audio signal player plays digital audio entertainment signals from the audio signal store when the receiver control is in the first state, and plays digital audio entertainment signals from the audio receiver when the receiver control is in the second state.

The present invention furthermore relates to a method for the shared enjoyment of music from stored musical signals between a first user with a first music player device and at least one second user with at least one second music player device. The method includes the step of playing the musical signals for the first user on the first music player device while essentially simultaneously wirelessly transmitting synchronization signals from the first music player device to the at least one second music player device. The method also includes receiving the synchronization signals by the at least one second player device. The synchronization signals allow the musical signals on the at least one second player device to be played essentially simultaneously with the playing of the musical signals on the first music player device. The first and the at least one second users are mobile.

The present invention yet furthermore relates to a wireless communications system for sharing audio entertainment between a first mobile device and a second mobile device. The system includes a broadcast identifier signal transmitted by the first mobile device to the second mobile device. A personal identifier signal is transmitted by the second mobile device to the first mobile device. A broadcast signal comprising audio entertainment is transmitted by the first mobile device of which the second device is receptive. The first mobile device and the second mobile device have displays which can display the identifier signal that they receive and the second mobile device can play the audio entertainment from the broadcast signal that it receives.

The present invention also relates to a method for enhancing enjoyment of a musical selection. The method includes the steps of obtaining control signals related to the musical

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selection, transmitting the control signals wirelessly, receiving the control signals, and converting the control signals to a humanly-perceptible form.

The present invention further yet relates to a method for generating and storing control signals corresponding to musical signals. The method includes the steps of playing musical signals for a user and receiving manual input signals from the user that are produced substantially in synchrony with the music. The method also includes the steps of generating control signals from the input signals, and storing the control signals so that they can be retrieved with the musical signals.

The present invention still additionally relates to a wearable personal accessory. The accessory includes an input transducer taken from the group consisting of a microphone and an accelerometer. The transducer generates a time-varying input transduction signal. The accessory also includes a controller that accepts the input transduction signal, and generates an output transducer signal whose signal varies in amplitude with time. An output transducer receptive of the output transducer signal provides a humanly-perceptible signal. An energy source powers the input transducer, controller and output transducer.

The present invention also still relates to a wearable personal accessory controlled via wireless communications. The accessory includes a wireless communications receiver that is receptive of an external control signal. The accessory also includes a controller that accepts the external control signal and that generates a time-varying visual output transducer signal. A visual output transducer is receptive of the output transducer signal, and provides a humanly-perceptible visual signal. An energy store powers the receiver, controller and output transducer. The visual output transducer generates visually-perceptive output.

The present invention still further relates to a device for converting user tactile responses to stored music into a stored control signal. The device includes a player that plays stored music audible to the user and a manually-operated transducer that outputs an electrical signal. The transducer is actuated by the user in response to the music. A controller receives the electrical signal and outputs a control signal and a store receives the control signal and stores it.

The present invention furthermore relates to a music player that wirelessly transmits control signals related to the music, wherein the control signals control a wearable electronic accessory. The music player includes a store of music signal files and a controller that reads a musical signal file from the store and generates audio signals. The controller further generates the control signals. A transducer converts the audio signals into sound audible to

the user and a wireless transmitter transmits the control signal to the wearable electronic accessory.

The present invention yet relates to a music player that wirelessly transmits control signals related to the music, wherein the control signals control a wearable electronic accessory. The music player includes a store of music signal files and a second store of control signal files associated with the music signal files. A controller reads a musical signal file from the store and generates audio signals. The controller further reads an associated control signal file. A transducer converts the audio signals into sound audible to the user, and a wireless transmitter transmits the control signals from the associated control signal file to the wearable electronic accessory.

The present invention also relates to a system for exhibition of music enjoyment. The system includes a source of music signals, a controller that generates control signals from the music signals, and a transmitter of the control signals. The transmission of the control signals is synchronized with the playing of the music signals. In addition, the system includes a receiver of the control signals and a transducer that responds to the control signals.

The present invention further relates to a method for transferring a wearable-accessory control file stored on a first device to a second device in which an associated music file is stored. The method includes the steps of storing on the first device the name of the music file in conjunction with the control file with which it is associated and requesting by the second device of the first device for a control file stored in conjunction with the name of the music file. In addition, the method includes the step of transferring the control file from the first device to the second device. The control file is stored on the second device in conjunction with the name of the associated music file.

The present invention also relates to a device for transmitting control signals to a wearable accessory receptive of such control signals. The device includes a manually-separable input connector for connecting to an output port of an audio player. Audio signals are conveyed from the audio player to the device across the connector. The device also includes a controller for generating control signals from the audio signals and a transmitter for transmitting the control signals.

Brief Description Of The Drawings

Figure 1 is a schematic block diagram of a local audio network comprised of two linked audio units operated by two persons, and associated digital jewelry conveyed by the two persons.

Figure 2A is a schematic block diagram of a DJ with multiple independently controlled LED arrays.

Figure 2B is a schematic block diagram of a DJ with an LED array with independently controlled LEDs.

Figures 3A-C are schematic block diagrams of unit elements used in inter-unit communications.

Figure 4 is a schematic flow diagram of DJ entraining.

Figures 5A-B are schematic block diagrams of DJs associated with multiple people bound to the same master unit.

Figure 6 is a schematic block diagram of a cluster comprising a broadcast unit and multiple receive units, with an external search unit.

Figure 7 is a schematic diagram of a broadcast unit transmission.

Figure 8A is a schematic block diagram of audio units with self-broadcast so that audio output is highly synchronized.

Figure 8B is a schematic flow diagram for synchronous audio playing with multiple rebroadcast.

Figures 9A and 9B are schematic block diagrams of hierarchically-related clusters.

Figure 10 is a top perspective view of an earphone with manually adjustable external sound ports.

Figures 11 A and B are cross-sectional diagrams of a earpiece with an extender to admit additional ambient sound.

Figure 12A is a schematic diagram of a modular audio unit.

Figure 12B is a schematic diagram of modular digital jewelry.

Figure 12C is a schematic block diagram of a modular transmitter that generates and transmits control signals for digital jewelry from an audio player.

Figure 13A is a schematic cross-section through a search unit and a broadcast unit in which communications are provided via visible or infrared LED emission in search transmission mode.

Figure 13B is a schematic cross-section through a search unit and a broadcast unit n which communications are provided via a visible or infrared laser in search transmission mode.

Figure 13C is a schematic cross-section through a search unit and a broadcast unit in which communications are provided via visible or infrared emission from a digital jewelry element in broadcast transmission mode.

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Figure 13D is a schematic cross-section through a search unit and a broadcast unit in which communications are provided via contact in mutual transmission mode.

Figure 13E is a schematic cross-section through a search unit and a broadcast unit in which communications are provided via sonic transmissions in broadcast transmission mode.

Figure 13F is a schematic cross-section through a search unit and a broadcast unit in which communications are provided via radio frequency transmissions in broadcast transmission mode.

Figure 14A is a schematic block diagram of the socket configurations on the broadcast unit and the receive unit.

Figure 14B is a schematic block flow diagram of using IP sockets for establishing and maintaining communications between a broadcast unit and the receive unit, according to the socket diagram of Figure 14A.

Figure 15 is a schematic block diagram of the IP socket organization used with clusters comprising multiple members.

Figure 16 is a schematic block flow diagram of transfer of control between the broadcast unit and the first receive unit.

Figure 17 is a matrix of DJ and searcher preferences and characteristics, illustrating the matching of DJ and searcher in admitting a search to a cluster.

Figure 18A is a screenshot of an LCD display of a unit, taken during normal operation.

Figure 18B is a screenshot of an LCD display of a unit, taken during voting for a new member.

Figure 19 is a table of voting schemes for the acceptance of new members into a cluster.

Figure 20 is a time-amplitude trace of an audio signal automatically separated into beats.

Figure 21A is a block flow diagram of a neural network method of creating DJ transducer control signals from an audio signal as shown in Figure 20.

Figure 21B is a block flow diagram of a deterministic signal analysis method of creating DJ transducer control signals from an audio signal as shown in Figure 20.

Figure 21C is a schematic flow diagram of a method to extract fundamental musical patterns from an audio signal to create DJ control signals.

Figure 21D is a schematic flow diagram of an algorithm to identify a music model resulting in a time signature.

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Figure 22A is a top-view diagram of an audio unit user interface, demonstrating the use of buttons to create DJ control signals.

Figure 22B is a top-view diagram of a hand-pad for creating DJ control signals.

Figure 22C is a schematic block diagram of a set of drums used for creating DJ control signals.

Figure 23A is a schematic block flow diagram of the synchronized playback of an audio signal file with a DJ control signal file, using transmission of both audio and control signal information.

Figure 24 is a schematic block diagram of a DJ unit with associated input transducers.

Figure 25 is a schematic flow diagram indicating music sharing using audio devices, providing new means of distributing music to customers.

Figure 26 is a schematic diagram of people at a concert, in which DJs conveyed by multiple individuals are commonly controlled.

Figure 27 is a schematic block flow diagram of using a prospective new member's previous associations to determine whether the person should be added to an existing cluster.

Figure 28 is a block flow diagram indicating the steps used to maintain physical proximity between the broadcast unit and the receive unit via feedback to the receive unit user.

Figures 29A is a schematic block diagram of the connection of an Internet-enabled audio unit with an Internet device through the Internet cloud, using an Internet access point.

Figures 29B is a schematic block diagram of the connection of an Internet-enabled audio unit with an Internet device through the Internet cloud, with an audio unit directly connected to the Internet cloud.

Figure 30 comprises tables of ratings of audio unit users.

Figure 31 is tables of DJ, song and transaction information according to the methods of Figure 25.

Figure 32A is a schematic block diagram of maintaining privacy in open transmission communications.

Figure 32B is a schematic block diagram of maintaining privacy in closed transmission communication.

Figure 33 is a schematic block diagram of a hierarchical cluster, as in Figure 9A, in which communications between different units is cryptographically or otherwise restricted to a subset of the cluster members.

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Figure 34A is a schematic block flow diagram of the synchronization of music playing from music files present on the units 100.

Figure 34B is a schematic layout of a synchronization record according to Figure 34A.

Figure 35 is a schematic block diagram of DJ switch control for both entraining and wide-area broadcast.

Figure 36 is a schematic block diagram of mode switching between peer-to-peer and infrastructure modes.

Best Mode for Carrying-Out the Invention

Overview

Figure 1 is a schematic block diagram of a local audio network comprised of two linked audio units 100 operated by two persons, and associated digital jewelry 200 conveyed by the two persons. The persons are designated Person A and Person B, their audio units 100 are respectively Unit A and Unit B, and their digital jewelry 200 are denoted respectively DJ A and DJ B. In this patent specification, "DJ" is used to denote either the singular "digital jewel" or the plural "digital jewelry".

Each unit 100 is comprised of an audio player 130, and an inter-unit transmitter/receiver 110. In addition, each unit 100 comprises a means of communication with the digital jewelry, which can be either a separate DJ transmitter 120 (Unit A), or which can be part of the inter-unit transmitter/receiver 110 (Unit B). Furthermore, unit 100 can optionally comprise a DJ directional identifier 122, whose operation will be described below. Also, unit 100 will generally comprise a unit controller 101, which performs various operational and executive functions of intra-unit coordination, computation, and data transfers. The many functions of the controller 101 will not be discussed separately below, but will be described with respect to the general functioning of the unit 100.

In operation, Unit A audio player 130 is playing recorded music under the control of a person to be designated User A. This music can derive from a variety of different sources and storage types, including tape cassettes, CDs, DVDs, magneto-optical disks, flash memory, removable disks, hard-disk drives or other hard storage media. Alternatively, the audio signals can be received from broadcasts using analog (e.g. AM or FM) or digital radio receivers. Unit A is additionally broadcasting a signal through DJ transmitter 120, which is received by DJ 200 through a DJ receiver 220 that is worn or otherwise conveyed by User A.

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It should be noted that the audio signals can be of any sound type, and can include spoken text, symphonic music, popular music or other art forms. In this specification, the terms audio signal and music will be used interchangeably.

The DJ 200 transduces the signal received by the DJ receiver 220 to a form perceptible to the User A or other people near to him. This transduced form can include audio, visual or tactile elements, which are converted to their perceptible forms via a light transducer 240, and optionally a tactile transducer 250 or an audio transducer 260. The transducers 240, 250 and 260 can either directly generate the perceptible forms directly from the signals received by the DJ receiver 220, or can alternatively incorporate elements to filter or modify the signals prior to their use by the transducers.

When a second individual, User B, perceives the transduced forms produced by User A DJ 200, he can then share the audio signal generated by the audio player 130 of Unit A, by use of the inter-unit transmitter/receiver 110 of Unit A and a compatible receiver 110 of Unit B. Audio signals received by Unit B from Unit A are played using the Unit B audio player 130, so that User A and User B hear the audio signals roughly simultaneously. There are a variety of means by which the Unit B can select the signal of Unit A, but a preferred method is for there to be a DJ directional identifier 122 in Unit B, which can be pointed at the DJ of User A and which receives information needed to select the Unit A signal from the User A DJ, whose transduced signal is perceptible to User B.

Given the audio signal now being exchanged between Unit A and Unit B, User A and User B can experience the same audio signal roughly simultaneously. Within the spirit of the present invention, it is preferable for the two users to hear the audio signals within 1 second of one another, and more preferable for the users to hear the audio signals within 200 milliseconds of one another, and most preferable for the users to hear the audio signals within 50 milliseconds of one another. Furthermore, DJs 200 being worn by User A and User B can receive signals from their respective units, each emitting perceptible forms of their signals. Preferably, the transduced forms expressed by the DJs 200 are such as to enhance the personal or social experience of the audio being played.

Unit 100 Structure

Units 100 comprise a device, preferably of a size and weight that is suited for personal wearing or transport, which is preferably of a size and format similar to that of a conventional portable MP3 player. The unit can be designed on a "base" of consumer electronics products

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such as cell phones, portable MP3 players, or personal digital assistants (PDAs), and indeed can be configured as an add-on module to any of these devices.

In general, the unit 100 will comprise, in addition to those elements described in Figure 1, other elements such as a user interface (e.g. an LCD or OLED screen, which can be combined with a touch-sensitive screen, keypad and/or keyboard), communications interfaces (e.g. Firewire, USB, or other serial communications ports), permanent or removable digital storage, and other components.

The audio player 130 can comprise one or more modes of audio storage, which can include CDs, tape, DVDs, removable or fixed magnetic drives, flash memory, or other means. Alternatively, the audio can be configured for wireless transmission, including AM/FM radio, digital radio, or other such means. Output of the audio signal so generated can comprise wireless or wired headphones or wired or wireless external speakers.

It is also within the spirit of the present invention that the unit 100 can have only receive capabilities, without having separate audio information storage or broadcast capabilities. In concept, such a device can have as little user interface as an on/off button, a button to cause the unit 100 to receive signals from a new "host", and a volume control. Such devices can be very small and be built very inexpensively.

Unit 100 Audio Output

One of the goals of the present invention is to assist communications between groups of people. In general, with mobile audio devices, the music is listened to through headphones. Many headphones are designed so as to reduce to the extent possible the amount of sound which is heard from outside of the headphones. This, however, will have the general effect of reducing the verbal communications between individuals.

In order to avoid this potential problem, it is within the teachings of the present invention that headphones or earphones be provided that allow ambient sound, including a friend's voice, to be easily perceptible to the wearer of the headphones, and that such headphones can be provided that variably allow such sound to be accessible for the headphone's wearer. Such arrangement of the headphones can be obtained either through physical or electronic means. If through electronic means, the headphones can have a microphone associated with them, through which signals received are played back in proportion through the headphone speakers, said proportion being adjustable from substantially all sound being from the microphone to substantially no sound being from the microphone. This microphone can also be a part of a noise cancellation system, such that the

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phase of the playback is adjustable – if the phase is inverted relative to the ambient sound signal, then the external noise is reduced, whereas if the phase is coincident with the ambient sound signal, then the ambient sounds are enhanced.

Figure 10 is a top perspective view of an earphone 900 with adjustable external sound ports. A speaker element 940 is centrally located, and the outside circumferential surface is a rotatable sound shield 910 in which sound ports 930 are placed. The sound ports 930 are open holes to admit sound. Beneath the sound shield 930 is a non-rotatable sound shield in which fixed sound ports 920 are placed in a similar arrangement. As the sound shield 910 is rotated manually by the user, the sound ports 930 and the fixed sound ports 920 come into registration, so that open ports between sources of ambient noise and the outer ear chamber is created, increasing the amount of ambient sound that the user perceives.

Figures 11 A and B are cross-sectional diagrams of an earpiece with an extender 980 that admits additional ambient sound. In Figure 11A, the face of a speaker 960 with a cord 970 is covered with a porous foam block 950 that fits snugly into the ear. While some ambient sound is accessible to the ear through the foam block 950, the majority of the sound is input is impeded. In Figure 11B, the foam extender 980 is placed over the foam block 950 so that a formed shape at the distal end of the extender 980 fits snugly into the ear. A hollow cavity 982 can be allowed in the extender 980 so as to reduce the sound impedance from the speaker 960 to the ear. Ambient sound is allowed into the space between the speaker 960 and the distal end of the extender 980 (shown by the arrows).

Many other arrangements are allowed within the spirit of the present invention to allow ambient sound to more easily access the user's ear, including adjustable headphones or earplugs as in Figure 10, or accessories that can modify the structure of existing earphones and headphones, as in Figure 11B. Such effects can include increasing the number of apertures admitting ambient sound, increasing the size of an aperture (e.g. by adjusting the overlap between two larger apertures), changing the thickness or number of layers in the enclosure, or by placing a manually detachable cup that covers the earphone and ear channel so as to reduce ambient sound.

DJ 200 Transducers

DJs 200 will have a number of common elements, including communications elements, energy storage elements, and control elements (e.g. a manual ON/OFF switch or a switch to signal DJ entraining, as will be described below). In this section, the structure and function of transducers will be described.

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Light Transducers 240

The DJ 200 transducers are used to create perceptible forms of the signals received by the receiver 220. Light transduction can include the use of one or more light-emitting devices, which can conveniently be colored LEDs, OLEDs, LCDs, or electroluminescent displays, which can be supplemented with optical elements, including mirrors, lenses, gratings, and optical fibers. Additionally, motors, electrostatic elements or other mechanical actuators can be used to mechanically alter the directionality or other properties of the light transducers 240. There can be either a single device or an array of devices, and if more than a single device, can display in synchrony, or can be "choreographed" to display in a temporal and/or spatial pattern.

Figure 2A is a schematic block diagram of a DJ 200 with multiple independently controlled LED arrays, wherein the number of LED arrays is preferably between 2 and 8, and is even more preferably between 2 and 4. The signal received from unit 100 via the DJ receiver 220 is passed to a multi-port controller 242 with two ports 294 and 296 connected respectively with two separate arrays 290 and 292 of LEDs 246. These arrays 290 and 292 can be distinguished by spatial placement, color of emitted light, or the temporal pattern of LED illumination. The signal is converted via analog or digital conversion into control signals for the two arrays 290 and 292, which are illuminated in distinct temporal patterns.

It should be noted that the signal received by receiver 220 from the unit 100 can comprise either a signal already in the form required to specify the array and temporal pattern of LED 246 activity, or it can alternatively be converted from a differently formatted signal into temporal pattern signals. For example, the unit 100 can transmit a modulated signal whose amplitude specifies the intensity of LED light amplitude. For multiple LED arrays, signals for the different arrays can be sent together and decoded by the DJ receiver 220, such as through using time multiplexing, or transmission on different frequencies.

Alternatively, the signal could be not directly related to the transduction intensity, such as in the direct transmission of the audio signal being played by the unit 100. In such case, the controller 242 can modify the signal so as to generate appropriate light transduction signals. For example, low frequency bandpass filters could provide the signals for the first array 290, whereas high-frequency bandpass filters could provide the signals for the second array 292. Such filtering could be accomplished by either analog circuitry or digital software within a microprocessor in the controller 242. It is also within the spirit of the present

invention for the different arrays to respond differently to the amplitude of the signal within a frequency band or the total signal.

An alternative control of LED arrays is presented in Figure 2B, a schematic block diagram of a DJ 200 with an LED array with independently controlled LEDs. In this case, the control signal received by the receiver 200 is passed through a single-port, multiple ID controller 243 to a single array of LEDs, each responsive only to signals with a particular characteristic or identifier. One or more of the LEDs 246 can have the same identifier or be responsive to the same characteristic so as to constitute a virtual array of LEDs.

As mentioned above, the transduced light signal can alternatively or additionally comprise multi-element arrays, such as an LED screen. In such case, the signal received by the receiver 220 can be either a specification of image elements to be displayed on the LED screen, or can be as before, a signal unrelated to the light transduction output. For example, many audio players on computers (e.g. Windows Media player) come with pattern generators that are responsive to the frequency and amplitude of the audio signal. Such pattern generators could be incorporated into the controllers 242 or 243.

Alternatively, the light transducer 240 can be a single color illuminated panel, whose temporal pattern of illumination was similar to that of the LEDs of Figures 2A and 2B. In such case, users can partially cover the panel with opaque or translucent patterns, such as a dog or a skull or a representation of a favorite entertainer.

Whereas the receiver 220 and the light controllers 242 or 243 can be hidden from view, either behind the light transducers or separated from the transducers by a wire, for example, the light transducers are meant to be perceptible to other people. For this purpose, the light transducers can be fashioned into fashion accoutrements such as bracelets, brooches, necklaces, pendants, earrings, rings, hair clips (e.g. barrettes), ornamental pins, netting to be worn over clothing, belts, belt buckles, straps, watches, masks, or other objects. Additionally, the light transducers can be fashioned into clothing, such as arrays of lighting elements sewn onto the outside of articles of clothing such as backpacks, wallets, purses, hats, or shoes. For those articles of clothing that are normally washed, however, the lighting transducers and associated electronics will preferably be able to withstand cleaning agents (e.g. water or dry cleaning chemicals), or will be used in clothing such as scarves and hats that do not need to be washable.

It is also convenient for there to be modular lighting arrangements in which the configuration can easily changed by a user. One example of such a modular arrangement is a light pipe made of a flexible plastic cable or rod, at one or both ends of which is positioned

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a light source that directs light into the rod. At predetermined locations along the rod, the rod surface can be roughened so as to allow a certain amount of light to escape, on which transparent glass or plastic pieces can be clipped, and that are lighted when the pipe is lighted. Alternatively, the light can be uniformly smooth, and transparent pieces of roughly index of refraction matching material can be clipped onto the rod, allowing some fraction of the light to be diverted from the rod into the pieces. The light sources and associated energy sources used in such an arrangement can be relatively bulky and be carried in a backpack, pouch or other carrying case, and can brightly illuminate a number of separate items.

It should be noted that the transducers require an energy store 270, which is conveniently in the form of a battery. The size of the battery will be highly dependent on the transduction requirements, but can conveniently be a small "watch battery". It is also convenient for the energy store 270 to be rechargeable. Indeed, all of the electric devices of the present invention will need energy stores or generators of some sort, which can comprise non-rechargeable batteries, rechargeable batteries, motion generators that can convert energy from the motion of the user into electrical energy that can be used or stored, fuel cells or other such energy stores or converters as are convenient.

Sound Transducers 260

Sound transducers 260 can supplement or be the primary output of the audio player of the unit 100. For example, the unit 100 can wirelessly transmit the audio signal to DJ 200 comprising a wireless headphone sound transducer. This would allow a user to listen to the audio from the audio player without the need for wires connecting the headphones to the unit 100. Such sound transducers can comprise, for example, electromagnetic or piezoelectric elements.

Alternative to headphone or earphone audio production, external speakers, which can be associated with light transducers 240 or tactile transducers 250, can be used to enhance audio reproduction from external speakers associated with the unit 100. In addition or alternative to simple reproduction of the audio signal output by the audio player 130, the sound transducers 260 can play modified or accompanying signals. For example, frequency filters can be used to select various frequency elements from the music (for low bass), so as to emphasize certain aspects of the music. Alternatively, musical elements not directly output from the audio player 130 can be output to complete all instrumental channels of a piece of music, for example.

Tactile Transducers 250

DJs 200 can be configured with tactile transducers, which can provide vibrational, rubbing, or pressure sensation. As before, signals of a format that control these transducers can be sent directly from the DJ transmitter 120, or can be filtered, modified or generated from signals of an unrelated format that are sent from the transmitter 120. As before, the signal can be the audio signal from the audio player 130, which can, for example, be frequency filtered and possibly frequency converted so that the frequency of tactile stimulation is compatible with the tactile transducer. Alternatively, signals that are of the sort meant for light transduction can be modified so as to be appropriate for tactile transduction. For example, signals for light of a particular color can be used to provide vibrational transduction of a particular frequency, or light amplitudes can be converted into pressure values.

The tactile transducer can comprise a pressure cuff encircling a finger, wrist, ankle, arm, leg, throat, forehead, torso, or other body part. The tactile transducer can alternatively comprise a rubbing device, with an actuator that propels a tactile element tangentially across the skin. The tactile transducer can also alternatively comprise a vibrational device, with an actuator that drives an element normally to the skin. The tactile transducer can further alternatively comprise elements that are held fixed in relation to the skin, and which comprise moving internal elements that cause the skin to vibrate or flex in response to the movement of the internal element.

The tactile transducer can lack any moveable element, and can confer tactile sensation through direct electrical stimulation. Such tactile elements are best used where skin conductivity is high, which can include areas with mucus membranes.

Tactile transduction can take place on any part of the body surface with tactile sensation. In addition, tactile transduction elements can be held against the skin overlying bony structures (skull, backbone, hips, knees, wrists), or swallowed and conveyed through the digestive tract, where they can be perceived by the user.

Input Transducers

It should also be understood that the DJ 200 can comprise input transducers in order to create control signals from information or stimuli in the local environment. Figure 24 is a schematic block diagram of a DJ unit 200 with associated input transducers. The input-enabled DJ 1320 comprises energy storage 270, a controller 1322, output transducers 1324, a

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DJ receiver 220 and input transducers 1326. The input transducers 1326 can comprise one or more of a microphone 1328 and an accelerometer 1330.

In operation, the energy storage 270 provides energy for all other functions in the DJ 1320. The controller 1322 provides control signals for the output transducers 1324, which can comprise tactile transducers 250, sound transducers 260, and/or light transducers 240. Input to the controller can be provided via the input transducers 1326, optionally along with input from the DJ receiver 220.

For example, on a dance floor, the microphone 1328 can provide electrical signals corresponding to the ambient music. These signals can be converted into transducer 1324 control signals in a manner similar to that described below for the automatic generation of control signals according to Figures 21 A-C, as will be described below. This allows the use of the DJ functionality in the absence of an accompanying audio unit 100, expanding the applications of the DJ 200. An automatic gain filter can be applied so as to compensate for the average volume level – because the user can be close or far from the sources of ambient music and the music can vary in volume, the strength of the DJ 200 transduction can be normalized. In addition, it can also be preferable for there to be a manual amplitude control 1323, such as a dial or two position rocker switch, by which the average intensity of the DJ 200 control signals can be varied to suit the taste of the user. The amplitude control 1323 can operate through modulating the input transducer 1326 output or as an input to the controller 1322 as it generates the signals for the output transducers 1324.

Alternatively, the accelerometer 1330 can track the movement of the person wearing the DJ 100, such that a signal indicating acceleration in one direction can be converted by the controller 1322 into signals for a channel of output transducers 1324. The accelerometer 1330 can be outfitted with sensors for monitoring only a single axis of motion, or alternatively for up to three independent directions of acceleration. Thus, the controller 1322 can convert sensed acceleration in each direction into a separate channel, horizontal axes of acceleration could be combined into a single channel and the vertical axis into a second channel, or other such linear or non-linear combination of sensed acceleration can be combined in aesthetic fashion.

It is also within the spirit of the present invention that multiple input signals be combined by the controller 1322 to create control signals for aesthetic output from the output transducers 1324. For example, one channel can be reserved for control signals generated from accelerometer signals, another channel for control signals generated from microphone signals, and yet a third channel from control signals generated from DJ receiver 220 input. In

general, the information from the DJ receiver 220 and from the microphone 1328 will be of the same type (i.e. generated from audio signals), so that the most common configurations will be control signals from a combination of the microphone 1328 and accelerometer 1330, and signals from a combination of the DJ receiver 220 and the accelerometer 1330.

The input transducers 1326 can further comprise a light sensor, such that the DJ would mimic light displays in its environment, making it appear that the DJ is part of the activity that surrounds it. In this case, the controller 1322 would preferably generate control signals based on rapid changes in the ambient lighting, since it would be less aesthetic to have the DJ transducers provide constant illumination. Furthermore, slowly changing light (on the order of tens or hundreds of milliseconds) will be created naturally by the movement of the user, whereas changes in the lighting (e.g. strobes, laser lights, disco balls) will be of much faster change (on the order of milliseconds). Thus, to match the ambient dance lighting, it is aesthetic for the DJ 200 to respond most actively to ambient light that is changing in intensity a predetermined percentage in a predetermined time, wherein the predetermined percentage is at least 20% and the predetermined time is 20 milliseconds or less, and even more preferably for the predetermined percentage to be at least 40% and the predetermined time is 5 milliseconds or less.

Unit to Unit Communication

Units 100 transfer audio signals from the audio player in one unit 100 to the audio player 130 of another unit 100. Figures 3A-C are schematic block diagrams of unit 100 elements used in inter-unit communications. Each diagram presents communications between a Unit A and a Unit B, with Unit A transmitting audio signals to Unit B. Dashed connectors and elements indicate elements or transfers that are not being utilized in that unit 100, but are placed to indicate the equivalence of the transmitting and receiving units 100.

In Figure 3A, compressed audio signals (e.g. in MP3 format or MPEG4 format for video transfers, as described below) stored in a compressed audio storage 310 are transferred to a signal decompressor 302, where the compressed audio signal is converted into an uncompressed form suitable for audio output. In Unit A, this decompressed signal is passed both to the local speaker 300, as well as to the inter-unit transmitter/receiver 110. The Unit B inter-unit transmitter-receiver 110 receives the uncompressed audio signal, which is sent to its local speaker for output. Thus, both Unit A and Unit B play the same audio from the Unit A storage, in which uncompressed audio is transferred between the two units 100.

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In Figure 3B, compressed audio signals from the Unit A compressed audio storage 310 are sent both to the local signal decompressor 302 and to the inter-unit transmitter/receiver 110. The Unit A decompressor 302 conditions the audio signal so that it is suitable for output through the Unit A speaker 300. The compressed audio signal is sent via Unit A transmitter-receiver 110 to the Unit B transmitter/receiver 110, where it is passed to the Unit B decompressor 302 and thence to the Unit B speaker 300. In this embodiment, because compressed audio signals are transmitted between the units 100 transmitter/receivers 302, lower bandwidth communications means can be used in comparison with the embodiment of Figure 3A.

In Figure 3C, compressed audio signals from the Unit A compressed audio storage 310 are sent to the Unit A signal decompressor 302. These decompressed signals are sent to both the local speaker 300 as well as to a local compressor 330, which recompresses the audio signal to a custom format. In addition to decompressed audio signal input, the compressor also optionally utilizes information from a DJ signal generator 320, which generates signals to control DJ transducers 240, 250 and 260, which can be sent in conjunction with the audio signal. The signal generator 320 can include analog and/or digital filtering or other algorithms that analyze or modify the audio signals, or can alternatively take manually input transducer control signals input as described below. The custom compression can include multiplexing of the audio signals with the transducer control signals.

The custom compressed audio signals, are then passed to the Unit A inter-unit transmitter/receiver 110, which are then transferred to the Unit B inter-unit transmitter/receiver 110, and thence to the Unit B signal decompressor 302 and speaker 300.

Given the time delays in signal transfer between the units 100, custom compression that takes place in the sending unit, and any subsequent decompression that takes place in the receiving unit 100, it can be convenient to place a delay on the local (i.e. Unit A) speaker output of tens of milliseconds, so that both units 100 play the audio through their speakers at roughly the same time. This delay can include limited local digital storage between the local signal decompression and speaker 300 output.

Various hardware communications protocols will be discussed below with respect to unit-to-unit communications, but in general it is required that the distance between the units that must be maintained be preferably at least 40 feet, and more preferably at least 100 feet, and most preferably 500 feet, in order to allow units 100 sharing music to be able to move reasonably with respect to one another (e.g. for a user to go to the bathroom without losing contact), or to find each other in a large venue such as a shopping mall.

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Communications Protocols

Communication between the inter-unit transmitter/receivers 110 can involve a variety of protocols within the teachings of the present invention, and can include IP protocol-based transmissions mediated by such physical link layers as 802.11a, b or g, WDCT, HiperLAN, ultra-wideband, 2.5 or 3G wireless telephony communications, custom digital protocols such as Bluetooth or Millennial Net i-Beans. Indeed, it is not even necessary for the transmissions to be based on Internet protocol, and conventional analog radio-frequency or non-IP infrared transmissions are also within the spirit of the present invention. Each unit 100 will generally have both transmission and reception capabilities, though it is possible for a unit to have only reception capabilities. While the bandwidth of the broadcast is dependent on the compression of the audio signal, it is preferable for the transmission bandwidth to be larger than 100 kb/sec, and even more preferable for the transmission bandwidth to be greater than 250 kb/sec.

While the distance of transmission/reception is not bounded within the teachings of the present invention, it will generally be less than a few hundred meters, and often less than 50 meters. The distance of communication is limited in general by the amount of power required to support the transmission, the size of antennae supported by portable devices, and the amount of power allowed by national regulators of broadcast frequencies. Preferably, however, the range of transmission will be at least 10 meters, and even more preferably at least 30 meters, in order to allow people sharing communications to move some distance from one another without communications being lost.

The unit 100 is characterized generally by four sets of roughly independent characteristics: playing audio or not playing audio, transmitting or not transmitting, receiving or not receiving, searching or not searching.

Units 100 will often function in conditions with large numbers of other units 100 within the communications range. For example, in a subway car, a classroom, bicycling, or at a party, a unit 100 can potentially be within range of dozens of other units. A unit 100 that is playing audio from local compressed audio storage 310 can, at the user's prerogative, choose to broadcast this audio to other units 100. A unit 100 that is currently "listening" to a broadcast or is searching for a broadcast to "listen" to will require a specific identifier roughly unique to a broadcaster in order to select that broadcaster signal from among the other possible broadcasters. Some of the communications protocols listed above, such as those based on IP protocols, 2.5G or 3G wireless, or Bluetooth communications, have such

identifiers as part of the protocols. Custom radio frequency based protocols will require protocols to allow signals to be tagged with specific identifiers.

A unit 100 that is transmitting signals can, within the spirit of the present invention, be prevented from simultaneously receiving signals. Preferably, however, units 100 can both transmit and receive simultaneously. One example of the use of simultaneous transmission and reception is for a unit 100 that is receiving a signal to send a signal indicating its reception to the transmitting unit 100. This allows the transmitting unit to determine the number of units 100 that are currently receiving its broadcast. In return, this information could be sent, along with the audio signal, so that all of the users with units 100 receiving the broadcast can know the size of the current reception group. Alternatively, a user with a unit 100 that is currently broadcasting can be searching for other broadcasting units, so that the user can decide whether to continue broadcasting or whether to listen to the broadcast of another unit.

Unit to DJ Communication

Communication between the unit 100 and the DJ 200 can be either through the inter-unit transmitter/receiver 110, or through a separate system. In general, the requirement of the DJ 200 is for reception only, although it is permissible for the DJ 200 to include transmission capabilities (e.g. to indicate to the unit 100 when the DJ 200 energy storage 270 is near depletion).

The signals for which the DJ 200 is receptive is dependent on how the transduction control signals are generated. For example, for a controller 242 that incorporates a filter or modifier that takes the audio signal as its input, the DJ receiver 220 would receive all or a large fraction of the audio signal. In this case, the communication between the unit 100 and the DJ 200 would require a bandwidth comparable to that of inter-unit communication, as described above.

However, if the signals are either generated in the unit 100, or pre-stored along with the stored compressed audio signal, then the communications bandwidth can be quite modest. Consider a DJ 200 with 2 arrays 290 and 292 of LEDs 246, which flash with a frequency of no more than 10 Hertz, and that the LEDs are in either an ON or an OFF state, without intermediate amplitudes. In such case, the maximum bandwidth required would be only 20 bits/second, in addition to the DJ control signals.

The range of unit to DJ communications need not be far. In general, the unit 100 and the DJ 200 will be carried by the same user, so communications ranges of 10 feet can be

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adequate for many applications. Some applications (see below) can require, however, somewhat larger ranges. On the other hand, longer communications ranges will tend to confer the possibility of overlap and interference between two different units 100 to their respective DJs 200. In general, for the application of unit to DJ communications, it is preferable for the minimum range of communications to be at least 1 foot, and more preferably for the minimum range of communications to be at least 10 feet, and most preferably for the minimum range of communications to be at least 20 feet. Also, for the application of unit to DJ communications, it is preferable for the maximum range of communications to be no more than 500 feet, and more preferably for the maximum range of communications to be no more than 100 feet, and most preferably for the maximum range of communications to be no more than 40 feet. It should be noted that these communications ranges refer primarily to the transmission distance of the units 100, especially with regard to the maximum transmission distance.

Because there can be multiple unit 100/DJ 200 ensembles within a relatively short distance, communications between a unit 100 and a DJ 200 preferably comprise both a control signal as well as a unit identification signal, so that each DJ 200 receives its control signals from the correct unit 100. Because the unit 100 and the DJ 200 will not, in general, be purchased together, or that a user can buy a new unit 100 to be compatible with already owned DJs 200, it is highly useful to have a means of "entraining" a DJ 200 to a particular unit 100, called its "master unit", and a DJ 200 entrained to a master unit is "bound" to that unit.

Figure 4 is a schematic flow diagram of DJ entraining. To entrain a DJ 200, the DJ is set into entraining mode, preferably by a physical switch on the DJ 200. The master unit 100 to which the DJ 200 is to be entrained is then placed within communications range, and the unit 100 transmits through the DJ transmitter 120 an entraining signal that includes the master unit 100 identifier. Even should there be other units 100 transmitting in the vicinity, it is unlikely that they would be transmitting the entraining signal, so that entraining can often take place in a location with other active units 100. Verification that the entraining took place can involve a characteristic sequence of light output (for light transduction), audio output (for sound transduction) or motion (for tactile transduction). After verification, the DJ 100 is reset to its normal mode of operation, and will respond only to control signals accompanied by the identifier of its master unit 200.

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It should be noted that there can be multiple DJ's 200 bound to the same master unit 100. Thus, a single person can have multiple light transducing DJs 200, or DJs 200 of various modes (light, sound, tactile) transduction.

While DJs 200 will generally be bound to a master unit associated with the same person, this is not a requirement of the present invention. Figures 5A-B are schematic block diagrams of DJs 200 associated with multiple people bound to the same master unit. In Figure 5A, DJ A 200and DJ B 200 are both bound to the same DJ transmitter 120, even though DJ A 200 and DJ B 200 are carried by different persons. This is particularly useful if the control signals are choreographed manually or through custom means by one person, so that multiple people can then share the same control signals. Such a means of synchronization is less necessary if the DJ 200 control signals are transmitted between units 100 through the inter-unit transmitter/receiver 110 along with the audio signals. Furthermore, in this case, it is better for the range of unit-to-DJ communication to be in the range of the inter-unit communication described above.

In the case of sound transducers 260, the DJ B 200 can comprise a wireless audio earpiece, allowing users to share music, played on a single unit 100, privately. Consider Figure 5A, configured with sound transducers 260 (see, for example, Figure 1) in DJ A 200 and DJ B 200. Signals from the audio player 130 are transmitted by the DJ transmitter 120, where they are received by DJs 200 – DJ A and DJ B – that are carried by Person A and Person B, respectively. In this case, both persons can listen to the same music.

Figure 5B shows the operation of a wide-area broadcast unit 360, which is used primarily to synchronize control of a large number of DJs 200, such as might happen at a concert, party or rave. In this case, the audio player 130 is used to play audio to a large audience, many of whom are wearing DJs 200. In order to synchronize the DJ output, a relatively high-power broadcast transmitter 125 broadcasts control signals to a number of different DJs 200 carried by Person A, Person B and other undesignated persons. The entraining signal can be automatically sent on a regular basis (e.g. whenever music is not being played, such as between songs, or interspersed within compressed or decompressed songs) so that patrons or partygoers could entrain their DJs 200 to the broadcast unit 360. The broadcast unit 360 can also transmit inter-unit audio signals, or can only play the audio through some public output speaker that both Person A and Person B can enjoy.

Figure 26 is a schematic diagram of people at a concert, in which DJs 200 conveyed by multiple individuals are commonly controlled. At a concert venue 1370, music is produced on a stage 1372, and concert patrons 1376 are located on the floor of the venue.

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Many of the patrons have DJs 200 which are receptive to signals generated by a broadcast DJ controller 1374. The broadcast DJ controller creates signals as described below, in which the music is automatically converted into beats, where microphones are used to pick up percussive instruments, and/or where individuals use a hand-pad to tap out control signals. These control signals are either broadcast directly from the area of the broadcast DJ controller 1374, or alternatively are broadcast from a plurality of transmitters 1380 placed around the venue 1370, and which are connected by wires 1378 to the controller 1374 (although the connection can also be wireless within the spirit of the present invention). It should be understood that the protocol for transmitting DJ control signals can be limited either by hardware requirements or by regulatory standards to a certain distance of reception. Thus, to cover a sufficiently large venue, multiple transmitters can be necessary to provide complete coverage over the venue 1370. In general, it is preferable for the maximum transmission distance of transmission from the transmitters to be at least 100 feet, and more preferably at least 200 feet, and most preferably at least 500 feet, so as to be able to cover a reasonable venue 1370 size without needing too many transmitters 1380.

An alternative embodiment of unit 100 to DJ 200 communications is the use of radio frequency transmitters and receivers, such as those used in model airplane control, which comprise multi-channel FM or AM transmitters and receivers. These components can be very small (e.g. the RX72 receivers from Sky Hooks and Riggings, Oakville, Ontario, Canada), and are defined by the crystal oscillators that determine the frequency of RF communications. Each channel can serve for a separate channel of DJ control signals. In such cases, an individual can place a specific crystal in their audio unit 100, and entraining the DJ 200 is then carried out through the use of the same crystal in the DJ 200. Because of the large number of crystals that are available (e.g. comprising approximately 50 channels in the model aircraft FM control band), interference with other audio units 100 can be minimized. Furthermore, control of many DJs 200 within a venue, as described above, can take place by simultaneously transmitting over a large number of frequencies.

As described above, the wide-area broadcast transmitter 125 can transmit entriaing signals to which the DJs 200 can be set to respond. However, there are a number of other preferred means by which DJs 200 can be used to respond to control signals to which they have not been entrained. For example, the DJs 200 can be set to respond to controls signals to which they have not been entrained should there be no entrained control signals present (e.g. the corresponding unit 100 is not turned on).

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Figure 35 is a schematic block diagram of DJ 200 switch control for both entraining and wide-area broadcast. The DJ 200 comprises a three-way switch 1920. In a first state 1922, the DJ 200 is entrained to the current control signal as described above. Thereafter, in a second state 1924, the DJ 200 responds to control signals corresponding to the entraining signal encountered in the step 1922. In a third state 1926, the DJ 200 responds to any control signal for which its receiver is receptive, and can therefore respond to a wide-area broadcast, thereby providing the user with manual control over the operational state of the DJ 200. It should be noted that the switch 1920 can be any physical switch with at least three discreet positions, or can alternatively be any manual mechanism by which the user can specify at least three states, including a button presses that have a visible user interface or a voice menu.

Figure 12B is a schematic drawing of modular digital jewelry 201. The modular jewelry 201 is comprised of two components: an electronics module 1934 and a display module 1932. These modules 1934 and 1932 can be electrically joined or separated through an electronics module connector 1936 and a display module connector 1938. The value of the modular arrangement is that the electronics module 1934 comprises, in general, relatively expensive components, whose combined price can be many-fold that of the display module 1932. Thus, if a user wants to change the appearance of the jewelry 201 without having to incur the cost of additional electronics components such as the energy storage 270, receiver 220 or controller 1322, they can simply replace the display module 1932 with its arrangement of output transducers 1324 with an alternative display module 1933 with a different arrangement of output transducers 1325.

The transmitter for DJ 200 control signals has been previously discussed primarily in terms of its incorporation within a unit 100. It should be understood, however, that the transmitter can be used in conjunction with a standard audio player unrelated to unit-to-unit communications. Figure 12C is a schematic block diagram of a modular digital jewelry transmitter 143 that generates and transmits control signals from an audio player 131. The modular transmitter 143 is connected to the audio player 131 via audio output port 136 through the cable 134 to the audio input port 138 of the modular transmitter 143. The modular transmitter 143 comprises the the DJ transmitter 120, which can send unit-to-DJ communications. The output audio port 142 is connected to the earphone 901 via cable 146. The earphone 901 can also be a wireless earphone, perhaps connected via the DJ transmitter 120.

The audio output from the player 131 is split both to the earphone 901 and to the controller 241 (except, perhaps where the DJ transmitter transmits to a wireless earphone).

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The controller 241 automatically generates control signals for the DJ 200 in a manner to be described in detail below. These signals are then conveyed to the DJ transmitter 120. It should be understood that this arrangement has the advantage that the digital jewelry functionality can be obtained without the const of the components for the audio player 131, and in addition, that the modular transmitter 143 can then be used in conjunction with multiple audio players 131 (either of different types or as the audio players are lost or broken).

Inter-unit Audio Sharing

Overview

Inter-unit communication involves the interactions of multiple users, who may or may not be acquaintances of each other. That is, the users can be friends who specifically decide to listen to music together, or it can be strangers who share a transient experience on a subway train. The present invention supports both types of social interaction.

An important aspect of the present invention is the means by which groups of individuals join together. Figure 6 is a schematic block diagram of a cluster 700 of units 100, indicating the nomenclature to be used. The cluster 700 is comprised of a single broadcast unit 710, and its associated broadcast DJ 720, as well as one or more receive units 730 and their associated DJs 740. The broadcast unit 710 transmits music, while the receive unit 730 receives the broadcasted music. A search unit 750 and its associated search DJ 760 are not part of the cluster 700, and comprise a unit 100 that is searching for a broadcast unit 710 to listen to or a cluster 700 to become associated with.

It should be noted that many communications systems can be operated alternatively in two modes: one that supports peer-to-peer communications and one that requires a fixed infrastructure such as an access point. Figure 35 is a schematic block diagram of mode switching between peer-to-peer and infrastructure modes. A mode switch 1950 is made by the user, either manually, or automatically – for example, that the user chooses between different functions (listening or broadcasting, file transfers, browsing the Internet) and the system determine the optimal mode to use. A peer-to-peer mode 1952 is well configured for mutual communications between mobile units 100 that are within a predetermined distance, and is well-suited for short-range wireless communications and audio data streaming 1954. Alternatively, the mode switch 1950 enables an infrastructure mode 1956, which is of particular usefulness in gaining access to a wide area network such as the Internet, through

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which remote file transfer 1958 (e.g. downloading and uploading) and remote communications such as Internet browsing can be made through access points to the fixed network.local wireless audio streaming.

It should be noted, however, that certain communications systems, such as many modes of telephony, do not distinguish between mobile communications and communications through fixed access points, and that both file transfer 1958 and audio streaming 1954 can be available through the same mode. Even in those cases, however, it can be convenient to have two modes in order to make optimal use of the advantages of the different modes. In such cases, however, the two modes can alternatively be supported by multiple hardware and software systems within the same device – for example, for remote communications to be made through a telephony system (e.g. GSM or CDMA), while the local audio streaming 1954 can be made through a parallel communications system (e.g. Bluetooth or 802.11) – indeed, the two systems can operate simultaneously with one another.

Inter-unit Transmission Segmentation

Preferably, the broadcast unit 710 and the receive units 730 exchange information in addition to the audio signal. For example, each user preferably has indications as to the number of total units (broadcast units 710 and receive units 730) within a cluster, since the knowledge of cluster 700 sizes is an important aspect of the social bond between the users. This also will help search units 750 that are not part of the cluster determine which of the clusters 700 that might be within their range are the most popular.

The additional information shared between members of a cluster 700 would include personal characteristics that a person might allow to be shared (images, names, addresses, other contact information, or nicknames). For example, the broadcast unit 710 will preferably, along with the music, transmit their nickname, so that other users will be able to identify the broadcast unit 710 for subsequent interactions, and a nickname is significantly easier to remember than a numerical identifier (however, such numerical identifier can be stored in the unit 100 for subsequent searching).

Such additional information can be multiplexed along with the audio signal. For example, if the audio signal is transferred as an MP3 file, assuming that there is additional bandwidth beyond that of the MP3 file itself, the file can be broken into pieces, and can be interspersed with other information. Figure 7 is a schematic diagram of a broadcast unit 710 transmission 820. The transmission is comprised of separate blocks of information, each represented in the figure as a separate line. In the first line, a block code 800 is transmitted,

which is a distinctive digital code indicating the beginning of a block, so that a search unit 750 receiving from the broadcast unit 710 for the first time can effectively synchronize itself to the beginning of a digital block. Following the block code 800 is a MP3 block header 802, which indicates that the next signal to be sent will be from a music file (in this case an MP3 file). The MP3 block header 802 includes such information as is needed to interpret the following block of MP3 file block 804, including such information as the length of the MP3 block 804, and characteristics of the music (e.g. compression, song ID, song length, etc.) that are normally located at the beginning of a MP3 file. By interspersing this file header information at regular intervals, a user can properly handle music files that are first received in the middle of the transmission of an MP3 file. Next, the MP3 block 804 containing a segment of a compressed music file is received.

Dependent on the amount of music compression and the bandwidth of the inter-unit communications, other information can be sent, such as user contact information, images (e.g. of the user), and personal information that can be used to determine the "social compatibility" of the user with the broadcast unit 710 and the receive unit 730. This information can be sent between segments of MP3 files or during "idle" time, and is generally preceded by a block code 800, that is used to synchronize transmission and reception. Next, a header file is transmitted, which indicates the type of information to follow, as well as characteristics that will aid in its interpretation. Such characteristics could include the length of information, descriptions of the data, parsing information, etc. In Figure 7, an ID header 806 is followed by an ID block 808, which includes nicknames, contact information, favorite recording artists, etc. Later, an image header 810 can be followed by an image block with an image of the user. The image header 810 includes the number of rows and columns for the image, as well as the form of image compression.

It should be understood that the communications format described in Figure 7 is only illustrative of a single format, and that a large number of different formats are possible within the present invention. Also, the use of MP3 encoding is just an example, and other forms of digital music encoding are within the spirit of the present invention, and can alternatively comprise streaming audio formats such as Real Audio, Windows Media Audio, Shockwave streaming audio, QuickTime audio or even streaming MP3 and others. Furthermore, these streaming audio formats can be modified so as to incorporate means for transmitting DJ 200 control signals and other information.

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Transmitting Dynamic Data and Control Information

As described above, there are benefits to two-way communications between the broadcast unit 710 and the receive unit 730. There are many methods of carrying out this communication, even if the inter-unit transmitter/receiver 110 does not permit simultaneous transmission and reception. For example, additional transmission and reception hardware could be included in each unit 100. Alternatively, in the transmission 820 above, specific synchronization signals such as the block code 800 can be followed by specific intervals during which the inter-unit transmitter/receiver 110 that is transmitting switches into receive mode, while the inter-unit transmitter/receiver 110 that was receiving switches to transmit mode. This switch in communications direction can be for a specific interval, or can be mediated through conventional handshake methods of prior art communications protocols.

It should be noted that in addition to transfer of static information (e.g. identifiers, contact information, or images), dynamic information and control information can also be transferred. For example, the user at the receive unit 730 can be presented with a set of positive and negative comments (e.g. "Cool!" "This is awful!") that can be passed back to the broadcast unit 710 with the press of a button. Such information can be presented to the user of the broadcast unit 710 either by visual icon on, for example, an LCD screen, by a text message on this screen, or by artificial voice synthesis generated by the broadcast unit 710 and presented to the user in conjunction with the music.

Alternatively, the user of the receive unit 730 can speak into a microphone that is integrated into the receive unit 730, and the user voice can be sent back to the broadcast unit 710. Indeed, the inter-unit communications can serve as a two-way or multi-way communications method between all units 100 within range of one another. This two-way or multi-way voice communication can be coincident with that of the playing of the audio entertainment, and as such, it is convenient for there to be separate amplitude control over the audio entertainment and the voice communication. This can be implemented either as two separate amplitude controls, or alternatively as an overall amplitude control, with a second control that sets the voice communications amplitude as a ratio to that of the audio entertainment. In this latter mode, the overall level of audio output by the unit is relatively constant, and the user then selects only the ability to hear the voice communication over the audio entertainment.

In order to express their feelings and appreciation about the music they are hearing, users within a cluster 700 can also press buttons on their units 100 that will interrupt or

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supplement the control signals being sent to their respective DJs 200, providing light shows that can be made to reflect their feelings. For example, it can be that all lights flashing together (and not in synchrony with the music) can express dislike for music, whereas intricate light displays could indicate pleasure.

It is also possible to send control requests between units 710. For example, a receive unit 730 can make song requests (e.g. "play again", "another by this artist") that can show on the broadcast unit 710 user interface. Alternatively, the user of a receive unit 730 can request that control be switched, so that the receive unit 730 becomes the broadcast unit 710, and the broadcast unit 710 becomes a receive unit 730. Such requests, if accepted by the initial broadcast unit 710 user, will result in the memory storage of the identifier of the broadcast unit 710 being set in all units in the cluster 700 to that of the new broadcast unit 730. Descriptions of the communications resulting in such a transfer of control will be provided below.

Additionally, it is also possible for users of units 100 to privately "chat" with other users while they are concurrently receiving their audio broadcasts. Such chat can be comprised of input methods including keyboard typing, stylus free-form writing/sketching, and quickly selectable icons.

It should be understood that within the spirit of the present invention that the functional configuration can be supported by the extension of certain existing devices. For example, the addition of certain wireless transmitter and receiver, as well as various control and possibly display functionality to a portable audio player would satisfy some embodiments of the present invention. Alternatively, by the addition of music storage and some wireless transmitter and receiver functionality, a mobile telephone would also allow certain embodiments of the present invention. In such case, the normal telephony communications, perhaps supported by expanded 3G telephony capabilities, could serve to replace aspects of the IP communications described elsewhere in this specification.

IP Socket Communication Embodiments

A standard set of protocols for inter-unit communications is provided through IP socket communications, which is widely supported by available wireless communications hardware, including 820.11a, b and g (Wi-Fi). An embodiment of inter-unit communications is provided in Figures 14A-B. Figure 14A is a schematic block diagram of the socket configurations on the broadcast unit 710 and the receive unit 730.

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In the discussion below, transfer of the different messages and audio information are provided, generally but not always, through an Internet protocol. At the transport layer of such protocols, there will generally be used either a connectionless protocol or a connection-oriented protocol. Among the most common of these protocols are respectively the User Datagram Protocol (UDP) and the Transmission Control Protocol (TCP), and wherever these protocols are used below, it should be noted that any like protocol (connectionless or connection-oriented), or the entire class of protocol can generally be substituted in the discussion.

The broadcast unit 710, prior to the membership of the receive unit 730, broadcasts the availability of the broadcast on a broadcast 1050, which is generally a TCP socket. The annunciator 1050 broadcasts on a broadcast address with a predetermined IP address and port. The receive unit 730 has a client message handler 1060 that is also a TCP socket that is looking for broadcasts on the predetermined IP address and port. When it receives the broadcast, a handshake creates a private server message handler 1070 on a socket with a new address and port on the broadcast unit 710. The broadcast unit 710 and the receive unit 730 can now exchange a variety of different messages using the TCP protocol between the server message handler 1070 and the client message handler 1060. This information can comprise personal information about the users of the broadcaster unit 710 and the receive unit 730. Alternatively or additionally, the broadcast unit 710 can transfer a section of the audio signal that is currently being played, so that the user of the receive unit 730 can "sample" the music that is being played on the broadcast unit 710. It should be noted that, in general, the broadcast unit 710 continues its broadcast on the broadcast annunciator 1050 for other new members.

Once it is established that the broadcast unit 710 and the receiver unit 730 are mutually desirous of providing and receiving an audio broadcast, respectively, sockets optimized for broadcast audio are created both on the broadcast unit 710 and the receiver unit 730. These sockets will often be UDP sockets – on the broadcast unit 710, a multicast out socket 1080 and on the receiver unit 730, a multicast in socket 1090.

Figure 14B is a schematic block flow diagram of using IP sockets for establishing and maintaining communications between a broadcast unit 710 and the receive unit 730, according to the socket diagram of Figure 14A. In a step 1100, the broadcast annunciator 1050 broadcasts the availability of audio signals. In a step 1102, the receiver unit 730 searches for a broadcast annunciator 1050 on the client message handler 1060 socket. Once a connection is initiated in a step 1104, the broadcast unit 710 creates the message handler

socket 1070 in a step 1106, and the receiver unit 730 retasks the message handler socket 1060 for messaging with the broadcast unit 730. The broadcast annunciator 1050 continues to broadcast availability through the step 1100.

In a step 1110, the broadcast unit 710 and the receiver unit 730 exchange TCP messages in order to establish the mutual interest in audio broadcasting and reception. Should there not be mutual acceptance, then the system returns to the original state in which the broadcast unit 710 is transmitting the broadcast annunciation in the step 1100, and the receive unit 730 searches for broadcasts in the step 1102. Given that the receive unit 730 and the broadcast unit 710 will be within communications distance, and that the broadcast unit 710 is transmitting an annunciation for which the receive unit 730 is receptive, the broadcast unit 710 will be set into a state where it will not establish communications with the receive unit 730 in the step 1106. This can occur either by not creating the message socket in the step 1106 when connection is made with the receiver unit 730, or that the annunciator 1050 remains silent for a predetermined period, perhaps for a period of seconds.

If the broadcast unit 710 and the receiver unit 730 do mutually accept a multicasting relationship, the broadcast unit 710 creates the multicast out UDP socket 1080 in a step 1112 and the receiver unit 730 creates the multicast in UDP socket 1090 in the step 1114, and multicast audio transmission and reception is initiated in a step 1116. It should be noted that should the broadcast unit 710 already be multicasting audio to a receiver unit 730 prior to the step 1112, the multicast out socket 1080 is not created, but that the address of this existing socket 1080 is communicated to the new cluster member.

Given that a cluster can comprise many members, the system of Figures 14A-B must be able to expand to include multiple members. Figure 15 is a schematic block diagram of the IP socket organization used with clusters comprising multiple members. The broadcast unit 710 includes a broadcast annunciator 1050 indicating broadcast availability for new members. For each member in the cluster, the broadcast unit further comprises a message handler 1070 dedicated to the specific member, whose receive unit 730 in turn comprises a message handler 1060, generally in a one-to-one relationship. The broadcast unit comprises N messaging sockets 1070 for the N receive units of the cluster, while each member has only a single socket 1060 connected to the broadcast unit. Thus, when a member wishes to send a message to the other members of the cluster, the message is sent via the receive unit message handler 1060 to the broadcast unit message handler 1070, and which is then multiply sent to the other receive unit message handlers 1060. It is also within the teachings of the present invention for each member of the cluster to have direct messaging capabilities with each

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other member, assisted in the creation of the communications by the broadcast unit 710, which can share the socket addresses of each member of the cluster, such that each member can assure that it is making connections with other members of the cluster rather than units of non-members. The broadcast unit 710 also comprises a multicast out socket 1080 which transfers audio to individual receiver sockets 1090 on each of the members of the cluster.

Members of the cluster may come and go, especially since members will frequently move physically outside of the transmission range of the broadcast unit 710. In order for the broadcast unit 710 to determine the current number of members of its cluster, it is within the teachings of the present invention for the broadcast unit 710 to use the messaging sockets 1060 and 1070 to "ping" the receive units 730 from time to time, or otherwise attempt to establish contact with each member of the cluster 700. Such communications attempts will generally be done at a predetermined rate, which will generally be more frequent than once every ten seconds. Information about the number of members of a cluster can be sent by the broadcast unit 710 to the other members of the cluster, so that the users can know how many members there are. Such information is conveniently placed on a display on the unit (see, for example, Figures 18A-B).

Music Synchronization

It will be generally desirable that the synchronicity of the audio playback on the broadcast unit 710 and the receive units 730 be highly synchronized, preferably within 1 second (i.e. this provides a low level functionality of listening to music together), more preferably within 100 milliseconds (i.e. near-simultaneous sharing of music, but an observer would be able to hear – or see through DJ 200 visible cues – the non-synchronicity), and most preferably within 20 milliseconds of one another. In a simple embodiment of the present invention, all members of a cluster 700 must communicate directly with the broadcast unit 710, without any rebroadcast. In such cases, making playback on the two units 710 and 730 as similar as possible will tend to synchronize their audio production.

Figure 8A is a schematic block diagram of audio units 100 with self-broadcast so that audio output is highly synchronized. Two audio units 100 are depicted, including a broadcast unit 710 and a receive unit 730. The organization of audio unit 100 elements is chosen to highlight the self-broadcast architecture. The audio media 1500, which can be compressed audio storage 310, stores the audio signals for broadcast. The output port 1502, which can comprise the inter-unit transmitter/receiver 110, transmits a broadcast audio signal, provided by the audio media 1500. The audio media comprise a variety of different storage protocols

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and media, including mp3 files, .wav files, or .au files which are either compressed or uncompressed, monoaural or stereo, 8-bit, 16-bit or 24-bit, and stored on tapes, magnetic disks, or flash media. It should be understood that the spirit of the present invention is applicable to a wide variety of different audio formats, characteristics, and media, of which the ones listed above are given only by way of example. This broadcast audio signal transmitted from the output port 1502 is received at the input port 1504, which can also comprise aspects of the inter-unit transmitter/receiver 110. The signal so received is then played to the associated user via the audio output 1508.

It should be noted that the audio output is normally connected to the audio media 1500 for audio playing when the unit 710 is not broadcasting to a receive unit 730. In such case, there is no need for the audio signals to go to the output port 1502 and thence to the input port 1504. Indeed, even when broadcasting, the audio signal within the broadcast unit 710 can go both directly to the audio output 1508 as well as to be broadcast from the output port 1502.

However, in order to assure the synchronicity of the audio output on the broadcast unit 710 and the receive unit 730, the broadcast unit 710 can present all audio signal from the audio media 1500 for output on the output port 1502. The signal will be received not only on the receiver 730 input port 1504, but also on the input port 1504 of the broadcast unit 710. This can take place either through the physical reception of the broadcast audio signal on a radio frequency receiver, or through local feedback loops within the audio unit 100 (e.g. through employment of IP loopback addresses).

In the receive unit 730, the audio signal received at the input port 1504 goes directly to the audio output 1508, and the other elements of the unit 100 depicted are not active. In the broadcast unit 710, however, if means are used to transfer audio signal between the output port 1502 and the input port 1504 are utilized, and if such transfer means requires less time than that taken for transmitting signal from the output port 1502 of the broadcast unit 710 to the input port 1504 of the receive unit 730, then a delay means 1506 is introduced to provide a constant delay between the input port 1504 and the audio output 1508. This delay can comprise a digital buffer if the signal is digitally encoded, or an analog delay circuit if the signal is analog. Generally, the delay introduced into the audio playback will be a predetermined amount based on the characteristics of the unit hardware and software.

Alternatively, in the case of a digital signal, the delay can be variably set according to the characteristics of the communications system. For example, if there are IP-based communications between the units, the units can "ping" one another in order to establish the

time needed for a "round-trip" communications between the systems. Alternatively, each receive unit 730 of a cluster 700 can transmit to the broadcast unit 710 a known latency of the unit based on its hardware and transmission characteristics. It should be noted that in order to handle different delays between multiple members of a cluster, a delay can be introduced into both the broadcast unit 710 and the receive unit 730, should a new member to the cluster have a very long latency in communications.

Note that the delay 1506 can serve a second purpose, which is to buffer the music should there be natural interruptions in the connections between the members of the cluster 700 (for example, should the receive units 730 move temporarily outside of the range of the broadcaster unit 710). In such case, should enough audio signal be buffered in the delay 1506, there would not be interruption of audio signal in the receive unit 730. Even in such cases, however, in order to accommodate the differences in time to play audio between units and within a unit, the delays in the broadcast unit 710 can be larger than those in the receive unit 730.

If the music compression and the bandwidth of the inter-unit communications are large enough, it can be that the broadcast unit 710 will broadcast less than half of the time. This will generally allow the receive unit 730 to rebroadcast the information from an internal memory store, allowing the effective range of the broadcast signal to potentially double. This can allow, through multiple rebroadcasts, for a very large range even if each individual unit 100 has a small range, and therefore for a potentially large number of users to listen to the same music.

In order to synchronize those that listen to the music through first, second and Nth rebroadcast, a scheme for multi-broadcast synchronization is presented in Figure 8B, a schematic flow diagram for synchronous audio playing with multiple rebroadcast. In such a case, the cluster 700 is considered to be all units 100 that synchronize their music, whether from an original broadcast or through multiple rebroadcasts. In a first step 780, a unit 100 receives a music broadcast along with two additional data. The first data is the current "N", or "hop" of the broadcast it receives, where "N" represents the number of rebroadcasts from the original broadcast unit 710. Thus, a unit 100 receiving music from the original broadcast unit 710 would have an "N" of "1" (i.e. 1 hop), while a unit 100 that received from that receiving unit 100 would have an "N" of "2" (2 hops), and so on. A second piece of information would be the "largest N" that was known to a unit 100. That is, a unit 100 is in contact generally with all units 100 with which it either receives or transmits music, and each send the "largest N" with which it has been in contact.

In a second step 782, the unit 100 determines the duration between signals in the broadcasts it is receiving. Then, two actions are taken. In a step 786, the unit 100 rebroadcasts the music it has received, marking the music with both its "N" and the largest "N" it knows of (either from the unit from which it received its broadcast or from a unit to which it has broadcast).

Also, in a step 784, the music that has been received is played after a time equal to the duration between signals and the "largest N" minus the unit's "N". This will allow for all units 100 to play the music simultaneously. Consider, for example the original broadcast unit 710. It's "N" is "0", and its "largest N" is the maximum number of rebroadcasts in the network. It will store music for a period of "largest N" (equals "largest N" minus "0") times the duration of a rebroadcast cycle, and then play it. For a unit 100 at the furthest rebroadcast, it's "N" and "largest N" will be equal to one another, so that it will store music for no time (i.e. "largest N" minus "N" = 0), but will play it immediately. This will allow all units 100 in the cluster to play music simultaneously. The limitation, however, is that there is memory in each unit 100 to store the music for a sufficient period of time. The units 100 on the system, however, can transfer the amount of storage that is available with the other information, and the number of rebroadcasts can be limited to the amount of memory available within the units 100 that comprise the cluster 700.

As the size of this multi-broadcast cluster 700 changes, the "largest N" can vary, and it will take generally on the order of "largest N" steps for the system to register "largest N". In such cases, there can be temporary gaps in the music on the order of the duration between signals, which will generally be on the order of tens of milliseconds, but which can be longer.

It should be noted that the synchronization of music does not need to accompany the transfer of an actual music signal. Figure 34A is a schematic block flow diagram of the synchronization of music playing from music files present on the units 100. In this embodiment, in a step 1900, the broadcast unit establishes the presence or absence of the music file comprising the music signals to be played on the receive unit. The music file can be referenced either with respect to the name of the file (e.g. "Ooops.mp3"), or a digital identifier that is associated with the music file.

If the music file is not present, then transfer of the music file from the broadcast unit to the receive units can automatically proceed through a file transfer mechanism such as peer-to-peer transfer in a step 1904. If the file was already present, or if the file has been transferred, or alternatively, if the file transfer has begun and enough of the file is present to

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allow the simultaneous playing of music between the two units 100, transmission of synchronization signals between the two units 100 can commence in a step 1902.

These synchronization signals can comprise many different forms. For example, the synchronization signal can be the time stamp from the beginning of the music file to the current position of the music file being played on the broadcast unit. Alternatively, the broadcast unit can send the sample number that is currently being played on the broadcast unit 100. In order to allow receiving units to begin synchronous playing in the middle of a transmission from a broadcast unit, the synchronization signals will preferably include information about the song being played, such as the name of the file or the digital identifier associated with the file.

Transmission of this synchronization signal continues until the termination of the song, or until a manual termination (e.g. by actuating a Pause or Stop key) is caused (the frequency of transmission of the synchronization signal will be discussed below). At this point, the broadcast unit can send a termination, pause or other signal in a step 1906. Note that this method of synchronization can operate when the receiving unit establishes connection with the broadcast unit even in the middle of a song.

Figure 34B is a schematic layout of a synchronization signal record 1910 according to Figure 34A. The order and composition of the fields can vary according to the types of music files used, the means of establishing position, the use of digital jewelry, the desire for privacy, and more.

The position field 1912 (SAMPLE#) which contains an indicator of position in a music file – in this case the sample number within the file. The music file identifier field 1914 (SONGID) comprises a textual or numerical identifier of the song being played. The third field is the sample rate field 1916 (SAMPLERATE), and is primarily relevant if the position field 1912 is given in samples, which allows a conversion into time. Given that the same audio entertainment can be recorded or saved at different sample rates, this allows the conversion from a potentially relative position key (samples) to one independent of sample rate (time). The jewelry signal field 1918 (JEWELSIGNAL) is used to encode a digital jewelry 200 control signal for controlling the output of the digital jewelry 200, should the receiver unit be associated with jewelry 200. The order and composition of the fields can vary according to the types of music files used, the means of establishing position, the use of digital jewelry, the desire for privacy, and more.

The frequency with which the record 1910 is broadcast can vary. The time of reception of the record 1910 sets a current time within the song that can adjust the position of

the music playing on the receiver unit. It is possible for the record to be broadcast only once, at the beginning of the song, to establish synchronization. This, however, will not allow others to join in the middle of the music file. Furthermore, if the record 1910 is received or processed at different times for the single record, the music can be poorly synchronized. With multiple synchronization signals, the timing can be adjusted to account for the most advanced reception of the signal – that is, the music playing will be adjusted forward for the most advanced signal, but not be adjusted back for a more laggard signal.

If the record further contains a jewelry signal field 1918, the frequency with which the record 1910 should be sent should be comparable or faster than the rate with which these signals change, and should be preferably at least 6 times a second, and even more preferably at least 12 times a second. If less frequent record 1910 transmission is desired, then multiple jewel signal fields 1918 can be included in a single record 1910.

It should be noted that given units 100 of different design or manufacture, there can be different intrinsic delays between reception of music and/or synchronization signals and the playing of the music. Such delays can result from different speeds of MP3 decompression, different sizes of delay buffers (such as delay 1506), different speeds of handling wireless transmission, differing modes of handling music (e.g. directly from audio media 1500 to audio output 1508 on the broadcast unit, but requiring transmission through an output port 1502 and input port 1504 for the receiver unit), and more. In such cases, it is preferable for receiver units to further comprise a manual delay switch that can adjust the amount of delay on the receiver unit. This switch will generally have two settings: to increase the delay and to decrease the delay, and can conveniently be structured as two independent switches, a rocker switch, a dial switch or equivalent. It is useful for the increments of delay determined by the switch be adjustable so as to allow users to sense the music from the broadcast unit and the receiver unit as being synchronous, and it is preferable for the increments of delay to be less than 50 milliseconds, and even more preferable for the increments of delay to be less than 20 milliseconds, and most preferable for the units of delay to be less than 5 milliseconds.

Creation and Maintenance of Clusters

Search units 750 can be playing music themselves, or can be scanning for broadcast units 710. Indeed, search units 750 can be members of another cluster 700, either as broadcast unit 710 or receive unit 730. To detect a different cluster 700 in which it might desire membership, the search unit 750 can either play the music of the broadcast unit 710 to

the search unit 750 user, or it can scan for personal characteristics of the broadcast unit 710 user that are transmitted in the ID block 808. For example, a user can establish personal characteristic search criteria, comprising such criteria as age, favorite recording artists, and interest in skateboarding, and respond when someone who satisfies these criteria approaches.

Alternatively, the search unit 750 user can also identify a person whose cluster he wishes to join through visual contact (e.g. through perceiving the output of the person's light transducer 240).

Before a search unit 750 user can establish contact, it is preferable for a broadcast unit 710 user, or a receive unit 730 user, to provide permissions for others to join the cluster. For example, each unit 100 will generally be able to changeably set whether no one can join with their unit 100, whether anyone can join with their unit 100, or whether permission is manually granted for each user who wishes to join with their unit into a cluster. For a cluster 700, membership in the cluster can be provided either if any one member of the cluster 700 permits a search unit 750 user to join, or it can be set that all members of a cluster 700 need to permit other users to join, or through a variety of voting schemes. The permissions desired by each member will generally be sent between units 100 in a cluster as part of the ID block 808 or other inter-unit communications. Furthermore, these permissions can be used to establish the degree to which others can eavesdrop on a unit 100 transmission. This can be enforced either through the use of cryptography, which can only provide decryption keys as part of becoming a cluster 700 member, through provision of a private IP socket address or password, through standards agreed by manufacturers of unit 100 hardware and software, or by unit 100 users limiting the information that is sent through the ID block 808 through software control.

The search unit 750 user can then establish membership in the group in a variety of ways. For example, if the search unit 750 is scanning music or personal characteristics of the unit 100 user, it can alert the search unit 750 user about the presence of the unit 100. The search unit 750 user can then interact with the search unit 750 interface to send the unit 100 user a message requesting membership in the cluster 700, which can be granted or not. This type of request to join a cluster 700 does not require visual contact, and can be done even if the search unit 750 and cluster are separated by walls, floors, or ceilings.

Another method of establishing contact between a search unit 750 user and a cluster 700 member is for the search unit 750 user to make visual contact with the cluster 700 member. In such case that physical contact or physical proximity is easily made between the unit 100 of the cluster member and the search unit 750, digital exchange can be easily made

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either through direct unit 100 contact through electrical conductors, or through directional signals through infra-red LEDs, for example. For example, the search unit 750 user can point his unit 100 at the cluster 700 member unit, and then if the cluster member wishes the search unit 750 user to join the cluster, could point his unit 100 at the search unit 100, and with both pressing buttons, effect the transfer of IDs, cryptography keys, IP socket addresses or other information that allows the search unit 750 user to join the cluster 700.

Alternatively, the broadcast DJ 720 (or the receive DJ 740) can present digital signals through the light transducer. For example, most DJ 720 light transduction will be modulated at frequencies of 1-10 Hz, with human vision not being able to distinguish modulation at 50 Hz or faster. This means that digital signals can be displayed through the light transducer 240 at much higher frequencies (kHz) that will not perceived by the human eye, even while lower frequency signals are being displayed for human appreciation. Thus, the broadcast DJ 720 can receive a signal from the broadcast unit 710 DJ transmitter 120 containing information needed for a search unit 750 to connect to the broadcast unit's cluster 700. This information will be expressed by the light transducer 240 of the broadcast DJ 720 in digital format. The search unit 750 can have an optical sensor, preferably with significant directionality, that will detect the signal from the light transducer 240, so that the search unit 750 is pointed in the direction of the broadcast DJ 720, and the identifier information required for search unit 750 to become a member of cluster 700. This optical sensor serves as the DJ directional identifier 122 of Figure 1. At this point, if desired, the broadcast unit 710 user can determine if they want the search unit 750 user to join the cluster 700.

A summary of means to effect joining of a cluster is provided in Figures 13A through E, which display means for a search unit 750 to exchange information prior to joining a cluster 700 via a broadcast unit 710. It is also within the teachings of the present invention for the search unit 750 to institute communications with a receive unit 730 for the purposes of joining a cluster in a similar fashion, particularly since it may be difficult for a person outside of the cluster 700 to determine which of the cluster 700 members is the broadcast unit 710, and which is a receiver unit 730.

If should be noted in the Figures 13A-G that limited range and directionality are preferred. That is, there can be a number of broadcast units 710 within an area, and being able to select that one broadcast unit 710 whose cluster one wishes to join requires some means to allow the search unit 750 user to select a single broadcast unit 710 among many. This functionality is generally provided either by making a very directional communication between the two devices, or by depending on the physical proximity of the search unit 750

and the desired broadcast unit 710 (i.e. in a greatly restricted range, there will be fewer competing broadcast units 710). In the following description, the "broadcaster" denotes the user using the broadcast unit 710, and the "searcher" denotes the user using the search unit 750.

In the Figures 13A-G, the selection of the cluster by the searcher occurs in three ways, that will referred to as "search transmission mode", "broadcast transmission mode", and "mutual transmission mode", according to the entity that is conveying information. In search transmission mode, the searcher sends an ID via the search unit 750 to the broadcast unit 710. This ID can comprise a unique identifier, or specific means of communication (e.g. an IP address and port for IP-based communication). With this ID, the broadcast unit can either request the searcher to join, or can be receptive to the searcher when the searcher makes an undifferentiated request to join local units within its wireless range. In broadcast transmission mode, the broadcaster sends an ID via the broadcast unit 710 to the search unit 750. With this ID, the searcher unit can then make an attempt to connect with the broadcast unit 710 (e.g. if the ID is an IP address and port), or the search unit can respond positively to a broadcast from the broadcast unit 710 (e.g. from a broadcast annunciator 1050), wherein the ID is passed and checked between the units early in the communications process. Mutual transmission mode comprises a combination of broadcast transmission mode and search transmission mode, in that information and communication is two way between the broadcaster and the searcher.

Figure 13A is a schematic cross-section through a search unit 750 and a broadcast unit 710 in which communications are provided via visible or infrared LED emission in search transmission mode. On the right of the figure, a LED 1044 with an associated lens 1046 (the two of which can be integrated) transmits a directional signal from the unit case 1000. This light can optionally pass thorough a window 1048 that is transparent to the light. On the left of the figure, a lens element 1040 collects light through a broad solid angle and directs it onto a light sensing element 1042, which is conveniently a light-sensing diode or resistor. The directionality of the communication is conferred by the transmitting lens 1046 and the collecting lens 1040.

Alternatively, the LED 1044 can be replaced by a visible laser. Figure 13B is a schematic cross-section through a search unit 750 and a broadcast unit 710 in which communications are provided via a visible or infrared laser in search transmission mode. The search unit 750 comprises a diode laser 1041 that is conditioned by a lens 1043 to form a beam that is sensed by the light sensing element 1042 on the broadcast unit 710. Because a

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collimated laser beam can be difficult to aim with precision at a photosensing element carried by a person, the optics can comprise a two focus lens 1043 that has a portion that produces a collimated beam 1045, and a second portion that produces a diverging beam 1047. The collimated beam is used by the user of the search unit 750 as a guide beam to direct the pointing of the unit 750, while the divergent beam provides a spread of beam so that the human pointing accuracy can be relatively low. The means for creating the two focus lens 1043 can include the use of a lens with two different patterns of curvature across its surface, or the use of an initial diverging lens whose output intersects a converging lens across only a part of its diameter, where the light that encounters the second lens is collimated, and the light that does not encounter the second lens remains diverging. It is also within the teachings of the present invention for the lens to be slowly diverging without a collimating portion, such that the user does not get visible feedback of their pointing accuracy. In such case, the laser can emit infrared rather than visible wavelengths.

Figure 13C is a schematic cross-section through a search unit 750 and a broadcast unit 710 in which communications are provided via visible or infrared emission from a digital jewelry element 200 in broadcast transmission mode. The digital jewelry 200 is carried by the broadcaster on a chain 1033, with the digital jewelry 200 visible. The digital jewelry is emitting through a light transducer 1031 a high frequency signal multiplexed within the visible low frequency signal. The search unit 750 is pointed in the direction of the digital jewelry 200, and receives a signal through the light-sensing element 1042. This manner of communication is convenient because the searcher knows, via the presence of the visible signal on the digital jewelry 200, that the broadcaster is receptive to cluster formation.

Figure 13D is a schematic cross-section through a search unit 750 and a broadcast unit 710 in which communications are provided via contact in mutual transmission mode. In this case, the broadcast unit 710 and the search unit 750 both comprise a contact transmission terminus 1030, and electronic means by which contact transmission is performed. This means can operate either inductively (via an alternative current circuit), through direct electrical contact with alternating or direct current means, or other such means that involves a direct physical contact (indicated by the movement of the search unit 750 to the position of the unit depicted in dotted lines). The search unit 750 or the broadcast unit 710 can, via automatic sensing of the contact or manual control, initiate communications transfer. Given the mutuality of contact as well as the physical equivalence of the two units 710 and 750, information transfer is possible in both directions. It should be noted that in the case of direct

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current connection, the termini 1030 will comprise two contact points, both of which must make electrical contact in order for communications to occur.

Figure 13E is a schematic cross-section through a search unit 750 and a broadcast unit 710 in which communications are provided via sonic transmissions in broadcast transmission mode. The broadcaster (or receivers) will be listening to the audio information generally through headphones 1020 or earphones, all of which comprise speakers 1022 that, to one extent or another, leak sonic energy. The use of audio output devices as depicted in Figure 10 and Figures 11A and 11B that admit external sound, will also increase the amount of sound energy lost. This sound energy can be detected by the searcher via a directional speaker comprising a sound collector 1024 and a microphone 1026. This system requires that the sound output of the broadcast unit 710 and the receiver unit 750 also output an ID encoded in the sound. Such sound can be conveniently output at inaudible frequencies, such as 3000-5000 Hz, which carry sufficient bandwidth to encode short messages or identifiers (e.g. an IP address and port number can be carried in 5 bytes). Sound energy, especially at higher frequencies, can be quite directional, depending on the shape of the collector 1024 and the structure of the microphone 1024, allowing good directional selection by the searcher.

Figure 13F is a schematic cross-section through a search unit 750 and a broadcast unit 710 in which communications are provided via radio frequency transmissions in broadcast transmission mode. The radio frequency transmissions are not strongly directional (and for the purposes of the broadcast of audio information, are designed to be as directionless as possible). In order to distinguish a desired cluster 700 to join and an undesired cluster 700, a number of strategies can be employed. For example, the strengths of the various signals can be measured and the strongest chosen for connection. Alternatively, if there are multiple broadcast connections available, the search unit 750 can sequentially attempt a connection with each broadcast unit 710. When the attempt is made, the broadcast unit 710 can, prior to alerting the broadcaster of the attempted joining by a new member, cause the digital jewelry 200 associated with the broadcast unit 710 to visibly flash a characteristic signal. The searcher can then verify by pressing the appropriate button on the search unit 750 his desire to join the cluster 700 of the broadcast digital jewelry 200 that had just flashed. If the searcher decided not to join that cluster 700, the search unit 750 could search for yet another unit broadcast unit 750 within range, and attempt to join.

At any time, the members of a cluster 700 can share personal characteristics (nickname, real name, address, contact information, face or tattoo images, favorite recording artists, etc.) through selection of choices of the unit 100 interface, with all such characteristics

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or a subset thereof to be stored on the units 100. In order to assist cluster 700 members in determining whether or not to accept a person into their cluster 700, a search unit 750 member can display either the total number of people with whom he has shared personal characteristics, or he can alternatively allow the cluster members to probe his store of persons with whom personal characteristics have been stored to see whether a particular trusted person or group of common acquaintances are present therein. It is also within the spirit of the present invention for individuals to rate other individual members of their cluster, and such ratings can be collated and passed from person to person or cluster to cluster, and can be used for a cluster 700 to determine whether a search unit 750 person should be added to the cluster 700.

Figure 17 is a matrix of broadcaster and searcher preferences and characteristics, illustrating the matching of broadcaster and searcher in admitting a searcher to a cluster. A broadcaster preference table 1160 includes those characteristics that the broadcaster wishes to see in a new member of a cluster. These characteristics can include gender, age, musical "likes" and "dislikes", the school attended, and more. The searcher similarly has a preference table 1166. The searcher preference table 1166 and broadcaster preference table 1160 are not different in form, as the searcher will at another time function as the broadcaster for another group, and his preference table 1166 will then serve as the broadcaster preference table.

The broadcaster preference table 1160 can be automatically matched with a searcher characteristics table 1162. This table 1162 comprises characteristics of the searcher, wherein there will be characteristics that overlap in type (e.g. age, gender, etc.) which can then be compared with the parameters in the broadcaster preference table. This matching occurs during the period when the searcher is interrogating the cluster with interest in joining. Similarly, there is a broadcaster characteristics table 1164 indicating the characteristics of the broadcaster, which can be matched against the searcher preferences tale 1166.

The algorithm used in approving or disapproving of an accord between a preference table and a characteristics table can be varied and set by the user – whether by the broadcaster to accept new members into a cluster, or by a searcher to join a new cluster. For example, the user could require that the gender be an exact match, the age within a year, and the musical preferences might not matter. The user can additionally specify that an accord is acceptable if any one parameter matches, specify that an accord be unacceptable if any one parameter does not match, specify an accord be acceptable based on the overlap of a majority of the individual matches, or other such specification.

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It should be noted that the broadcaster preferences table 1160 and the broadcaster characteristics table 1164 (and likewise with the searcher tables 1162 and 1166) can be a single table, according to the notion that a person will prefer people who are like themselves. Each user could then express the acceptable range of characteristics of people with which to join as a difference from their own values. For example, the parameter "same" could mean that the person needs to match closely, whereas "similar" could indicate a range (e.g. within a year) and "different" could mean anyone. In this way, there would not be the burden on the user to define the preference table 1160 or 1166 in a very detailed manner.

In the case of a cluster, the transfer of information between the searcher and the cluster can, as mentioned above, involve not only the broadcaster, but also other members of the cluster (especially since the searcher may not know the identity of a cluster's broadcaster from external observation). The cluster can also make communal decisions about accepting a new member. That is, if there are 4 members of a cluster, and a searcher indicates an interest in joining the cluster, there can be voting among the members of a cluster regarding the acceptance of the new member. The procedure of voting will normally be done by messaging among the members, which can be assisted by structured information transfer as will be described below.

A number of such voting schemes are described in Figure 19, a table of voting schemes for the acceptance of new members into a cluster. The first column is the name of the rule, and the second column describes the algorithm for evaluation according to the rule. In the "BROADCASTER" rule, the broadcaster decides whether or not the new member will be accepted. The new member is accepted when the broadcaster indicates "yes" and is otherwise rejected.

In the "Majority" rule, the members are polled, and whenever a majority of the members vote either acceptance or rejection, the new member is accordingly accepted or rejected. It should be noted that this rule (as well as the rules to follow) depends on the broadcaster or other member of the cluster having knowledge of the number of members in the cluster, which will generally be the case (e.g. in an IP socket based system, the broadcaster can simply count the number of socket connections). Thus, if the number of members in a cluster is given as N_{mem}, as soon as $(N_{mem}/2) + 1$ members have indicated the same result, that result is then communicated to the broadcaster, the members and the prospective new member. If the number of members is even, and there is a split vote, the result goes according to the broadcaster's vote.

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According to the "Unanimous" rule, a new member is accepted only on unanimous decision of the members. Thus, the prospective new member is rejected as soon as the first "no" vote is received, and is accepted only when the votes of all members of the cluster are received, and all of the votes are positive.

The "Timed Majority" rule is similar to that of the "Majority" rule, except that a timer is started when the vote is announced, the timer being of a predetermined duration, and in a preferred embodiment, is indicated as a count down timer on the unit 100 of each member of the cluster 700. The vote is completed when $(N_{mem}/2)+1$ members vote with the same indication ("yes" or "no") if the timer has not completed its predetermined duration. If all of the members have voted, and the vote is a tie, the result goes in accordance with that of the broadcaster. If the timer has expired, and the vote has not been decided, the number of members that have voted is considered a quorum of number Q. If $(Q/2)+1$ members have voted in some fashion, that is the result of the vote. Otherwise, in the case of a tie, the result goes according to the vote of the broadcaster. If the broadcaster has not voted, the vote goes according to the first vote received.

The "Synchronized Majority" rule is similar to the Timed Majority rule, but instead of initiating the vote, and then waiting a predetermined period for members to vote, the vote is announced, and then there is a predetermined countdown period to the beginning of voting. The voting itself is very limited in time, generally for less than 10 seconds, and preferably for less than 3 seconds. Counting votes is performed only for the quorum of members that vote, and is performed according to the rules for the Timed Majority.

There are many different voting schemes consistent with creating, growing and maintaining clusters within the spirit of the present invention. For instance, in cases where there are close votes, the voting can be reopened for individuals to change their vote. In cases, members can request a new round of voting. Furthermore, the voting can be closed ballot, in which the votes of individuals are not known to the other members, or open voting, in which the identity of each member's vote is publicly displayed on each unit 100.

In addition, the voting can be supported and enhanced by information made available to each member through displays on the units 100. Figure 18A is a screenshot of an LCD display 1170 of a unit 100, taken during normal operation. The display 1170 is comprised of two different areas, an audio area 1172 and a broadcaster area 1174. The audio area 1172 includes information about the status of the audio output and the unit 100 operation, which can include battery status, the name of the performer, the title of the piece of music, the time the audio has been playing, the track number and more. The broadcaster area 1174 comprises

information about the status of the cluster 700. In the example given, the broadcaster area includes the number "5", which represents the number of people current in the cluster, the text "DJ", which indicates that the unit 100 on which the display 1170 is shown is currently the broadcaster of the cluster 700, and the text "OPEN", which indicates that the cluster is open for new members to join (the text "CLOSED" would indicate that no new members are being solicited or allowed).

Figure 18B is a screenshot of an LCD display 1170 of a unit 100, taken during voting for a new member. The audio area 1172 is replaced by a new member characteristics area 1176, in which characteristics of the prospective new member are displayed. Such characteristics can include the name (or nickname) of the prospective new member, their age, and their likes (hearts) and dislikes (bolts). In the broadcaster area 1174, the digit "3" indicates that there are three current members of the cluster 700, and an ear icon indicates that the current unit 100 is being used to receive from the broadcaster rather than being a broadcaster, and the name [ALI] indicates the name of the current broadcaster. The text "VOTE-MAJ" indicates that the current vote is being done according to the Majority rule. The broadcaster area 1174 and the new member characteristics areas 1176 provide the information needed by the existing member to make a decision about whether to allow the prospective new member to join.

The displays 1170 of Figures 18A-B are indicative only of the types of information that can be placed on a display 1170, but it should be appreciated that there are many pieces of information that can be placed onto the displays 1170 and that the format of the display can be very widely varied. Furthermore, there need not be distinct audio areas 1172 and broadcaster areas 1174, but the information can be mixed together. Alternatively, especially with very small displays 1170, the display 1170 can be made to cycle between different types of information.

It is also within the spirit of the present invention for individuals to rate other individual members of their cluster, and such ratings can be collated and passed from person to person or cluster to cluster, and can be used for a cluster 700 to determine whether a search unit 750 person should be added to the cluster 700. Figure 27 is a schematic block flow diagram of using a prospective new member's previous associations to determine whether the person should be added to an existing cluster.

In a step 1400, from a search unit 750, the prospective new member places an external communication request with an operational broadcast annunciator 1050 by a broadcast unit 710. In a step 1402, a temporary message connection is established through which

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information can be passed mutually between the search unit 750 and the broadcast unit 710. The broadcast unit 710 requests personal and cluster ID's from the search unit 750. The personal ID is a unique identifier that can be optionally provided to every audio unit 100, and which can further be optionally hard-encoded into the hardware of the unit 100. The cluster IDs represent the personal ID's of other units 100 with which the search unit 750 has been previously associated in a cluster. In a step 1406, the broadcast unit 710 matches the incoming personal IDs and cluster IDs with personal ID's and cluster IDs that are stored in the memory of the broadcast unit 710. If there exist a sufficient number of matches, which can be computed as a minimum number or as a minimum fraction of the IDs stored in the broadcast unit 710, the new member of the search unit 750 can be accepted into the cluster. In a step 1412, the search unit 750 can then store the ID of the broadcast unit 710 and the other members of the existing cluster 700 into his cluster IDs, and the broadcast unit 750 and the other receive units 730 of the cluster can then store the personal ID of the search unit 750 into their cluster IDs. If there does not exist a sufficient number or quality of matches, the broadcast unit 710 will reject the prospective new member, optionally send a message of rejection, and then close the socket connection (or other connection that had been created) between the broadcast unit 710 and the search unit 750. No new IDs are stored on either unit 710 or 750.

It is also within the spirit of the present invention for other information associated with the personal and cluster IDs to be shared and used in the algorithm for determining whether to accept or reject a prospective new member into a cluster 700. This information can include rating information, the duration of association with another cluster 700 (i.e. the longer the association, the more suitable the social connection of that person with the cluster 700 would have been), the size of the cluster 700 when the searcher was a member of a particular cluster 700, the popularity of a cluster 700 (measured by the number of cluster IDs carried by the broadcast unit 710), and more. The matching program, likewise, would weight the existence of a match by some of these quality factors in order to determine the suitability of the searcher to join the cluster.

While the comparisons can be made between a search unit 750 personal and cluster IDs and those from the broadcast unit 710, representing the personal experience of the owners of the respective units, it is also possible that the reputation or desirability of individuals with a given personal ID can be posted to or retrieved from trusted people. For example, two friends can swap the information of which IDs are to be trusted or not between two units 100, or alternatively, can be posted onto or retrieved from the Internet. For

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example, after a bad personal experience with a unit 100 with a personal ID of 524329102, a person could post that ID on the Internet to share with friends, so that the friends could avoid allowing that person to join, or avoid joining a cluster with that person.

It should be noted that publishing a list of personal IDs allows people to establish the breadth of their contacts. By posting their contacts on web sites, people can demonstrate their activity and popularity. This also encourages people to join clusters, in order to expand the number of people with whom they have been associated. Furthermore, the personal ID serves as a "handle" by which people can further communicate with one another. For example, on the Internet, a person can divulge a limited amount of information (e.g. an email address) that would allow other people with whom they have been in a cluster together to contact them.

It should be noted that the formation and maintenance of a cluster 700 requires the initial and continued physical proximity of the broadcast unit 710 and the receive unit 730. In order to help maintain such physical proximity conducive to cluster maintenance, feedback mechanisms can be used to alert the users to help them maintain the required physical proximity, as will be discussed below.

Figure 28 is a block flow diagram indicating the steps used to maintain physical proximity between the broadcast unit 710 and the receive unit 730 via feedback to the receive unit user. In a step 1530, the wireless connection between the broadcast unit 710 and the receive unit 730 is established. In a step 1532, the connection between the two units 710 and 730 is tested. There are a number of different means by which this testing can take place. For example, in IP-based communications, the receive unit 730 can from time to time – though generally less than every 10 seconds, and even more preferably less than every 1 second – use the "ping" function to test the presence and speed of connection with the broadcast unit 710. Alternatively, the receive unit 730 will be receiving audio signals wirelessly almost continuously from the broadcast unit 710, and a callback alert function can be instituted such that loss of this signal determined at a predetermined repeat time – which is conveniently less than 5 seconds, and even more preferably less than every 1 second – and which is then reported to the system.

While the methods above determine the absolute loss of a signal, they do not anticipate loss of signal. A method that does anticipate signal issues prior to loss is the measurement of signal strength. This can be done directly in the signal reception hardware by measuring the wireless signal induced current or voltage.

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In a step 1534, the results of the connection testing performed in the step 1532 is analyzed in order to determine whether the signal is adequate. It should be noted that a temporary loss of signal, lasting even seconds, may or may not be of importance. For example, the broadcast unit 710 user and receive unit 730 users could walk on opposite sides of a metallic structure, enter a building at different times, change their body posture such that the antennae are not optimally situated with respect to one another, etc. Thus, an algorithm is generally used to time average the results of the step 1532, with the results conveniently time averaged over a matter of seconds.

Whatever the results of the signal test of the step 1534, the step 1532 is continuously repeated as long as the connection between the broadcast unit 710 and the receive unit 730 is present. If the signal is deemed inadequate, however, feedback to that effect is provided to the receive unit 730 user in a step 1536. The user feedback can occur through a variety of mechanisms, including visual (flashing lights) and tactile (vibration) transducers, emanating either from the audio unit 100 or the digital jewelry 200. For example, the receiver unit 730 can send a signal to the associated digital jewelry 200 to effect a special sequence of light transducer output.

It is most convenient, however, for the audio output of the receiver unit 730 as heard by the user to be interrupted or overlain with an audio signal to alert the user to the imminent or possible loss of audio signal. This audio signal can include clicks, beeps, animal sounds, closed doors, or other predetermined or user selected signals heard over silence or the pre-existing signal, with the signal possibly being somewhat reduced in volume such that the combination of the pre-existing signal and the feedback signal is not unpleasantly loud.

It should be noted that the flow diagram of Figure 28 refers specifically to alerting the receive unit 730 user of potential communications issues. Such alerting can also be usefully transferred to or used by the broadcast unit 710. For example, with knowledge of the communications issues, the broadcast unit 710 user can move more slowly, make sure that the unit is not heavily shielding, that any changes in posture that could relate to the problems are reversed, etc. The broadcast unit 710 can perform communications tests (as in the step 1532) or analyze the tests to determine if the communications are adequate (as in the step 1534) – particularly through use of the messaging TCP channels. Given that there can be multiple receive units 730 connected to s single broadcast unit 710, it is generally preferable for the tests to be performed on the receive units 730, and problems to be communicated to the broadcast unit 710 – provided, however, that communications still exist for such communication.

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In order to overcome this deficiency, it is possible for the receiver unit 730 to communicate potential problems in communications to the broadcast unit 710 at an early indication. The broadcast unit 710 then starts a timer of predetermined length. If the broadcast unit 710 does not receive a "release" from the receive unit 730 before the timer has completed its countdown, it can then assume that communications with the receive unit 730 have been terminated, and it can then send feedback to the broadcast unit 710 user.

It is also within the teachings of the present invention for both the broadcast unit 710 and the receive unit 730 to independently monitor the connections with each other, and alert their respective users of communications problems.

It should be noted that the use of audio alerts can be used more generally within the user interface of the audio units 100. Thus, audio alerts can be conveniently used to inform the user of the joining of new members to the cluster 700, the initiation of communications with search units 750 outside of the group, the leaving of the group by existing cluster 700 members, the request by a receive unit 730 to become the broadcast unit 710, the transfer of cluster control from a broadcast unit 710 to a receive unit 730, and more. These alerts can be either predetermined by the hardware (e.g. stored on ROM), or can be specified by the user. Furthermore, it can be convenient for the broadcast unit 710 to temporarily transfer to new members of the cluster custom alerts, so that the alerts are part of the experience that the broadcast unit 710 user shares with the other members of the cluster. Such alerts would be active only as long as the receive units were members of the cluster 700, and then would revert back to the alerts present before becoming cluster members.

Cluster Hierarchy

A receive unit 730 can also be the broadcast unit 710 of a separate cluster 700 from the cluster 700 of which it is a member. This receive unit is called a broadcasting receiver 770. In such case, it is convenient for the receive units 730 that are associated with the broadcasting receiver 770 to become associated with the cluster 700 of which the broadcasting receiver 770 is a member. This can conveniently be accomplished in two different ways. In a first manner, the receive units 730 that are associated with the broadcasting receiver 770 can become directly associated with the broadcast unit 710, so that they are members only of the cluster 700, and are no longer associated with the broadcasting receiver 770. In a second manner, the receive units 730 associated with the broadcasting receiver 770 can remain primarily associated with the broadcasting receiver 770, as shown in Figures 9A and 9B, which are schematic block diagrams of hierarchically-related clusters. In

Figure 9A, the receive units 730 that are members of a sub-cluster 701 of which the broadcast unit is a broadcast receive unit 770, can receive music directly from the broadcast receive unit 710, while retaining their identification with the broadcasting receiver 770, such that if the broadcasting receiver 770 removes itself or is removed from the cluster 700, these receive units 730 similarly are removed from the cluster 700. In order to provide this form of hierarchical control, the sub-cluster 701 receive units 730 can obtain an identifier, which can be an IP socket address, from the broadcast receive unit 770, indicating the desired link to the broadcast unit 710. The sub-cluster receive units 730, however, maintain direct communications with the broadcast receive unit 770, such that on directive from the unit 770, they break their communications with the unit 710, and reestablish normal inter-unit audio signal communications with the broadcast receive unit 770. In an embodiment using IP addressing and communications, this can involve the maintenance of TCP messaging communications between the sub-cluster 701 receive units 730 with the broadcast receive unit 770, during the time that the sub-cluster 701 is associated with the cluster 700.

In Figure 9B, the receive units 730 of the sub-cluster 701 receive music directly from the broadcasting receiver 770, which itself receives the music from the broadcast unit 710. In such case, as the broadcasting receiver 770 is removed from the cluster 700, the receive units 730 of the sub-cluster 701 would also not be able to hear music from the cluster 700.

It would be apparent that such an arrangement can be hierarchically arranged, such that the receive unit 730 of the sub-cluster 701 can itself be the broadcast receiver 770 of another sub-cluster 701, and so forth. The advantage of this arrangement is that people that are associated with one another, forming a cluster 700, can move as a group from cluster to cluster, maintaining a separate identity.

It should be also noted that the configuration of communications between members of a hierarchical cluster can be variously arranged, not only as shown in Figures 9A and 9B. For example, every member of the cluster 700 can have a direct link between every other member of the cluster 700, such that no re-broadcast of messages needs to take place. Furthermore, given that there are different inter-unit communications (for example, messaging versus audio broadcast), it is within the teachings of the present invention that the configuration for the different modes of communication can be different – for example direct communications between the broadcast unit 710 for audio broadcast, but peer-to-peer communications between individual units for messaging.

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Maintaining Private Communications

In order to restrict membership in a cluster 700, either the information transfer must be restricted, such as by keeping private the socket IP addresses or passwords or other information that is required for a member to receive the signal, or the signal can be transmitted openly in encrypted form, such that only those members having been provided with the encryption key can properly decode the signal so sent. Both of these mechanisms are taught within the present invention, and are described at various points within this specification.

Figure 32A is a schematic block diagram of maintaining privacy in open transmission communications. In this case, the transmission is freely available to search units 750 in a step 1830, such as would occur with a digital RF broadcast, or through a multicast with open a fixed, public socket IP address available in certain transmission protocols. In this case, the broadcast audio signal or information signal is made in encrypted form, and membership in the cluster is granted through transfer of a decoding key in a step 1832.

Figure 32B is a schematic block diagram of maintaining privacy in closed transmission communication. In a step 1834, the broadcast unit 710 makes a closed transmission broadcast, such as through a socket IP address, that is not publicly available. In a step 1836, the broadcast unit 710 provides the private address to the search unit 750, which can now hear the closed transmission from the step 1834, which is not encrypted. Alternatively, or in addition to the provision of the private address in the step 1836, the establishment of the connection through the private, closed transmission is effected via a password provided in a step 1838. This password can, for example, be used in the step 1110 (e.g. see Figure 14B) to determine whether the broadcast unit 710 accepts the search unit 750 for audio multicasting.

In this section, the encryption of the musical signal and/or associated information about personal characteristics of members of the cluster 700 is described. The custom compressor 330 of the unit 100 can perform the encryption. In such a case, before joining a cluster, the search unit 750 can only receive some limited information, such as characteristics of the music being heard or some limited characteristics of the users in the cluster 700. If the search unit 750 user requests permission to join the cluster 700 and it is granted, the broadcast unit 710 can then provide a decryption key to the search unit 750 that can be used to decrypt the music or provide a private IP address for multicasting, as well as supply additional information about the current members of cluster 700.

It should be noted that in certain cases, it can be useful to have multiple forms of privacy protection. For example, a broadcast unit 710 can provide a search unit 750 access to audio signals and information for the cluster 700, but can reserve certain information based on encryption to only some members of the cluster 700. For example, if a group of friends comprise a cluster 700, and accept some new members into the cluster 700, access to more private information about the friends, or communications between friends, can be restricted on the basis of shared decryption keys.

Figure 33 is a schematic block diagram of a hierarchical cluster, as in Figure 9A, in which communications between different units is cryptographically or otherwise restricted to a subset of the cluster members. Thus, there are three types of communication that are used in the communication: channel A, which takes place between the members of the original cluster; channel B, which takes place between the members of the original cluster (mediated through the broadcast unit 710) and members of the sub-cluster 701; and channel C, which takes place between the members of the sub-cluster 701. Thus, a communications originating from the broadcast unit 710 can be directed either through channel A or channel B, and likewise, a communications originating from the broadcast receive unit 770 can be directed either at members only of the sub-cluster 701 through channel C, or to all members of the cluster 700 through both channels C and B, which is then communicated trough channel A.

A number of means can be used to maintain such independent channels. For example, separate socket communications can be established, and the originators of the communications can determine that information which is carried on each separate channel. For example, given an open transmission scheme such as digital RF signal, the information can be encoded with separate keys for the different channels of communication – thus, the cryptographic encoding determines each channel. A given unit 100 can respond to more than one encoding. Indeed, a channel identifier can be sent with each piece of information indicating the ID of the decoding key. If a unit 100 does not have the appropriate decoding key, then it is not privy to that channel communications.

Alternatively, if the communications is IP socket based, then each channel is determined by IP socket addresses. Furthermore, access to those addresses can be, for example, password controlled. Also, the socket communications can be broadcast so that any unit 100 can receive such broadcast, but that decoding of the broadcast can be mediated through cryptographic decoding keys.

It should be noted that there can be multiple forms of communication, which can comprise messaging communications using the TCP/IP protocols, versus multicasting using

UDP protocols, and also DJ 200 control signals using yet another protocol. The access to each of these communications can be controlled via different privacy hierarchies and techniques. For example, the audio multicasting will be available to all members within a cluster, while the messaging may retain different groupings of privacy (e.g. hierarchical), while the DJ control signals will generally be limited to communications between a given unit 100 and its corresponding DJs 200.

Broadcast Control Transfer

The dynamics of cluster 700 can be such that it will be desirable for a receive unit 730 to become the broadcast unit for the cluster. Such a transfer of broadcast control will generally require the acquiescence of the broadcast unit 710 user. To effect such a transfer, the user of the receiver unit 730 desiring such control will send a signal to the broadcast unit 710 expressing such intention. If the user of the broadcast unit 710 agrees, a signal is sent to all of the members of the cluster indicating the transfer of broadcast control, and providing the identifier associated with the receive unit 730 that is to become the broadcast unit 710. The broadcast unit 710 that is relinquishing broadcast control now becomes a receive unit 730 of the cluster 700.

It should be noted that the transfer of control as described above requires the manual transfer of control, such as actuation of a DJ switch. This switch can be limited to this function, or can be part of a menu system, in which the switch is shared between different functions. It is also within the spirit of the present invention that there be voice-activated control of the unit 100, in which the unit 100 further comprises a microphone for input of voice signals to a suitable controller within the unit 100, wherein the controller has voice-recognition capabilities.

In the case of a cluster 700 whose broadcast unit 710 is no longer broadcasting (e.g. it is out of range of the receive units 730, or it is turned off), the cluster can maintain its remaining membership by selecting one of the receive units 730 to become the new broadcast unit 710. Such a choice can happen automatically, for example by random choice, by a voting scheme, or by choosing the first receive unit 730 to have become associated with the broadcast unit 710. If the users of the cluster-associated units deem this choice to be wrong, then they can change the broadcast unit 710 manually as described above.

The receive unit 730 that is chosen to become the broadcast unit 710 of the cluster 700 will generally prompt its user of the new status, so that the newly designated broadcast unit 710 can make certain that it is playing music to the rest of the cluster 700. It can be

further arranged so that a newly-designated broadcast unit 710 will play music at random, from the beginning, or a designated musical piece in such case.

An embodiment of a transfer of broadcast control using IP socket communications protocols is described here. Figure 16 is a schematic block flow diagram of transfer of control between the broadcast unit 710 and the first receive unit 730. In a step 1130, the receive unit 730 requests broadcast control (designated here as "DJ" control). In a step 1132, the user of the broadcast unit 710 decides whether control will be transferred. The decision is then transferred back to the first receive unit 730 via the TCP messaging socket. If the decision is affirmative, the first receive unit 730 severs its UDP connection to the broadcast unit 710 multicast. The reason for this is to allow the receive unit 730 opportunity to prepare the beginning of its broadcast, if such time is required, and the user cannot both listen to the multicast as well as prepare its own audio selections, which occurs in a step 1136. In a step 1138, the receive unit 730 creates a multicast UDP socket with which it will later broadcast audio to other members of the cluster, while in a step 1140, the receive unit 730 creates a broadcast annunciator TCP socket with which to announce availability of the cluster, as well as to accept transfers of members from the broadcast unit 710 to itself as the new broadcast unit.

When the two new sockets (multicast and annunciator) are created, the receive unit 730 transmits the new socket addresses to the broadcast unit 710 in a step 1142. Since the other members of the cluster are guaranteed to be in contact with the broadcast unit, they can get addresses of the new, soon-to-be broadcast unit from the existing broadcast unit. In a step 1144, the original broadcast unit 710 transmits to the other cluster members (receive units 730 numbers 2-N) the addresses of the sockets on the receive 1 unit 730 that is now the new broadcast unit 710, and terminates its own multicast. The termination is performed here because the other receive units will be transferring to the new multicast, and because the original broadcast unit 710 is now becoming a receive unit 730 in the reconstituted cluster. In the step 1148, multicast of audio is now provided by the receive 1 unit 730 that has now become the new broadcast unit 710), and the original broadcast unit is listening to audio provided not by itself, but rather by the new broadcast unit.

In a step 1146, performed roughly synchronously with the step 1144, the original broadcast unit 710 transmits the socket addresses of the message handler TCP sockets of the other members of the cluster 700 (i.e. the receive units 730 numbers 2-N). In the subsequent step 1150, the original broadcast unit 710 and the receive units 730 numbers 2-N establish new messaging connections with the receive 1 unit 730 that is now the new broadcast unit

710. While there can be a set of criteria for the acceptance of a new member to a cluster, because the receive 1 unit 730 has received the message socket addresses of the other members of the cluster in the step 1144, the receive 1 unit 730 accepts new members with the socket addresses received. It should be noted that instead of socket addresses being the identifiers passed, the identifiers can also be unique machine IDs, random numbers, cryptograpically encoded numbers, or other such identifiers that can be transmitted from one member of the cluster to another.

It should be noted in certain embodiments, that there can be insufficient time for the new broadcast unit 710 to determine a set of music to broadcast to the members of its cluster. It is within the spirit of the present invention for a user to set a default collection of music that is broadcast when no other music has been chosen. This set of music can comprise one or more discrete audio files.

Audio and DJ Choreography

One of the attractions of the present invention is that it allows users to express themselves and share their expressions with others in public or semi-public fashion. Thus, it is highly desirable for users to be able to personalize aspects of both the audio programming as well as the displays of their DJs 200.

Audio

Audio personalization comprises the creation of temporally linked collections of separate musical elements in "sets." These sets can be called up by name or other identifier, and can comprise overlapping selections of music, and can be created either on the unit 100 through a visual or audio interface, or can be created on a computer or other music-enabled device for downloading to the unit 100.

In addition, the unit 100 or other device from which sets are downloaded can comprise a microphone and audio recording software whereby commentary, personal music, accompaniment, or other audio recordings can be recorded, stored, and interspersed between commercial or pre-recorded audio signals, much in the manner that a radio show host or "disc jockey" might alter or supplement music. Such downloads can be accessible from a variety of sources including Internet web sites and private personal computers.

Automatic Generation of DJ 200 Control Signals

In this section, we will describe the automatic and manual generation of control signals for the DJ 200 transducers. The control signals are generally made to correspond to

audio signals played on the units 100, although it is within the spirit of the present invention for such control signals to be made separate from audio signals, and to be displayed on the digital jewelry independently of audio signals played on the unit 100. Figure 20 is a time-amplitude trace of an audio signal automatically separated into beats. Beats 1180, 1182 and 1183 are denoted by vertical dashed and dotted lines and, as described below, are placed at locations on the basis of their rapid rise in low-frequency amplitude relative to the rest of the trace. As can be seen, the beats 1180 are generally of higher amplitude than the other beats 1182 and 1183, and represent the primary beats of a 4/4 time signature. The beat 1183 is of intermediate nature between the characteristics of the beats 1180 and 1182. It represents the third beat of the second measure. Overall, the audio signal thus displayed can be orally represented as ONE-two-Three-four-ONE-two-Three-four ("one" is heavily accented, and the "three" is more lightly accented), which is common in the 4/4 time signature.

Processing of this data can proceed via a number of different methods. Figure 21A is a block flow diagram of a neural network method of creating DJ 200 transducer control signals from an audio signal as shown in Figure 20. In a step 1200, audio data is received either at the unit 100 or the DJ 200. It should be noted that the creation of control signals from audio signals can, within the present invention, take place at either the unit 100 or the DJ 200, or even at a device or system not part of or connected to the unit 100 or DJ 200 (as will be described in more detail below). In an optional step 1202, the data is low pass filtered and/or decimated so that the amount of data is reduced for computational purposes. Furthermore, the data can be processed for automatic gain to normalize the data for recording volume differences. Furthermore, the automatic gain filtering can provide control signals of significant or comparable magnitude throughout the audio data.

In general, the creation of the audio signal depends on audio representing a period of time, which can be tens of milliseconds to tens of seconds, depending on the method. Thus, the audio data from the step 1202 is stored in a prior data array 1204 for use in subsequent processing and analysis. At the same time, the current average amplitude, computed over an interval of preferably less than 50 milliseconds, is computed in a step 1208. In broad outline, the analysis of the signal compares the current average amplitude against the amplitude history stored in the prior data analysis. In the embodiment of Figure 21A, the comparison takes places through neural network processing in a step 1206, preferably with a cascading time back propagation network which takes into account a slowly varying time signal (that is, the data in the prior data array changes only fractionally at each computation, with most of the data remaining the same). The use of prior steps of neural network processing in the

current step of neural network processing is indicated by the looped arrow in the step 1206. The output of the neural network is a determination whether the current time sample is a primary or a secondary beat. The neural network is trained on a large number of different music samples, wherein the training output is identified manually as to the presence of a beat.

The output of the neural network is then converted into a digital jewelry signal in a step 1210, in which the presence of a primary or secondary beat determines whether a particular light color, tactile response, etc., is activated. This conversion can be according to either fixed, predetermined rules, or can be determined by rules and algorithms that are externally specified. Such rules can be according to the aesthetics of the user, or can alternatively be determined by the specific characteristics of the transducer. For example, some transducers can have only a single channel or two or three channels. While light transducers will generally work well with high frequency signals, other transducers, such as tactile transducers, will want signals that are much more slowly varying. Thus, there can be algorithm parameters, specified for instance in configuration files that accompany DJ 200 transducers, that assist in the conversion of beats to transducer control signals that are appropriate for the specific transducer.

Figure 21B is a block flow diagram of a deterministic signal analysis method of creating DJ 200 transducer control signals from an audio signal as shown in Figure 20. The data is received in the step 1200. In this case, a running average over a time sufficient to remove high frequencies, and preferably less than 50 milliseconds, is performed in a step 1212. Alternatively, a low pass filter and/or data decimation as in the step 1202 can be performed.

In a step 1214, the system determines whether there has been a rise of X-fold in average amplitude over the last Y milliseconds, where X and Y are predetermined values. The value of X is preferably greater than two-fold and is even more preferably three-fold, while the value of Y is preferably less than 100 milliseconds and is even more preferably less than 50 milliseconds. This rise relates to the sharp rises in amplitude found in the signal at the onset of a beat, as shown in Figure 20 by the beat demarcations 1180, 1182, and 1183. If there has not been a rise meeting the criteria, the system returns to the step 1200 for more audio input.

If the signal does meet the criteria, it is checked to ensure that the rise in amplitude is not the "tail end" of a previously identified beat. For this, in a step 1216, the system determines whether there has been a previous beat in the past Z milliseconds, where Z is a predetermined value preferably less than 100 milliseconds, and even more preferably less

than 50 milliseconds. If there has been a recent beat, the system returns to the step 1200 for more audio input. If there has not been a recent beat, then a digital jewelry signal is used to activate a transducer. The level of transduction can be modified according to the current average amplitude which is determined in a step 1208 from, in this case, the running average computed in the step 1212.

The embodiment of Figure 21B provides transducer activation signals at each rapid rise in amplitude, with the activation signal modulated according to the strength of the amplitude. This will capture much of the superficial musical quality of the audio signal, but will not capture or express more fundamental patterns within the audio signal.

Figure 21C is a schematic flow diagram of a method to extract fundamental musical patterns from an audio signal to create DJ 200 control signals. In the step 1200, the audio data is received into a buffer for calculations. In a step 1220, a low pass filter is applied to remove high frequency signal. Such high frequency signals can alternatively be removed via decimation, running averages, and other means as set forth in the embodiments of Figures 21A and B. As in the embodiment of Figure 21B, beat onsets are extracted from the audio signal in the steps 1214 and 1216, and a current average amplitude is computed in a step 1208.

The amplitudes and times of the onsets of beats are placed into an array in a step 1222. From this array, a musical model is created in a step 1224. This model is based on the regularity of beats and beat emphasis – as seen in the amplitudes – that is independent of the beats and amplitudes in any one short section of music (corresponding, for instance, to a measure of music).

In general, music is organized into repeating patterns, as represented in a time signature such as 3/4, 4/4, 6/8 and the like. Within each time signature, there are primary and secondary beats. In general, the downbeat to a measure is the first beat, representing the beginning of the measure. The downbeat is generally the strongest beat within a measure, but in any given measure, another beat may be given more emphasis. Indeed, there will be high amplitude beats that may not be within the time signature whatsoever (such as an eighth note in ¾ time that is not on one of the beats). Thus, by correlating the beats to standard amplitude patterns, the output to the music model identifies the primary (down) beats, secondary beats (e.g. the third beat in 4/4 time) and the tertiary beats (e.g. the second and fourth beats in 4/4/ time).

Figure 21D is a schematic flow diagram of an algorithm to identify a music model, resulting in a time signature. In a step 1600, the minimum repeated time interval is

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determined, using the array of beat amplitude and onset 1222. This is, over a period of time, the shortest interval for a quarter note equivalent is determined, wherein the time signature beat frequency (i.e. the note value of the denominator of the time signature, such as 8 in 6/8) is preferably limited to between 4 per second and one every two seconds, and even more preferably limited to between 3 per second and 1.25 per second. This is considered the beat time.

From the array of beat amplitudes and onsets 1222, the average and maximum amplitudes over a time period of preferably 3-10 seconds is computed in a step 1604. For the beginning of the audio signal, shorter periods of time can be used, though they will tend to give less reliable DJ 200 control signals. Indeed, in this embodiment, the initial times of an audio signal will tend to follow audio signal amplitude and changes in amplitude more than fundamental musical patterns until the patterns are elicited.

In a step 1606, the amplitude of a beat is compared with the maximum amplitude determined in the step 1604. If the beat is within a percentage threshold of the maximum amplitude, wherein the threshold is preferably 50% and more preferably 30% of the maximum amplitude, the beat is designated a primary beat in a step 1612. In a step 1608, the amplitude of non-primary beats is compared with the maximum amplitude determined in the step 1604. If the beat is within a percentage threshold of the maximum amplitude, wherein the threshold is preferably 75% and more preferably 50% of the maximum amplitude, and the beat is greater than a predetermined fraction of the average amplitude, wherein the fraction is preferably greater than 40% and even more preferably greater than 70% of the average beat amplitude, the beat is designated a secondary beat in a step 1614. The remaining beats are denoted tertiary beats in the step 1610.

In a step 1616, the sequence of the three types of beats is compared with that of established time signatures, such as 4/4, 3/4, 6/8, 2/4 and others, each with their own preferred sequence of primary, secondary and tertiary beats, in order to determine the best fit. This best fit is identified as the time signature in a step 1618.

Returning to Figure 21C, the channels of the DJ are pre-assigned to four different beats in a step 1225. Thus, if there are four channels, each channel is given a separate assignment. With a smaller number of channels, a single channel is assigned multiple beats. Some beats can also be unassigned, thus not being represented in a DJ 200 transducer output. Thus, a high jewelry signal, medium jewelry signal, low jewelry signal and an amplitude dependent signal are each assigned to a channel for DJ 200 transduction.

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In a step 1226, a beat determined to be a primary/down beat is assigned to a high jewelry signal 1228. In a step 1230, a beat determined to be a secondary beat is assigned to a medium jewelry signal 1232. In a step 1234, a beat determined to be a tertiary beat is assigned to a low jewelry signal 1236. Beats which are then unassigned, and which will generally be beats that occur not within the music model of the step 1224 (e.g. rapid beats not falling on beats of the time signature) are then assigned in a step 1238 to an amplitude dependent (and not music model dependent) signal 1240.

It should be noted that the computations performed in the flow methods of Figures 21A-C may take time on the order of milliseconds, such that if the computations are made in real time during the playing of music, the activation of the transducers in the DJ 200 are "behind" in time relative to the audio playing of the corresponding music in the audio unit 100. This can be compensated for by carrying out the computations while the audio signal is still in buffers prior to being played in the unit 100, as is described above for numerous embodiments of the present invention. Thus, signals to the DJ 200 can then be made simultaneously with respect to the audio signal to which it corresponds.

It should be noted that many of the parameters described above can conveniently be affected by manual controls either on the DJ 200 or the unit 100 that transmits signals to the DJ 200. For example, if can be convenient for the user to be able to set, for a given DJ 200 response amplitude, the threshold audio amplitude level at which the output transducer (e.g. light transducer 240) responds, or to set the output transducer amplitude corresponding to a maximum audio amplitude, or to set the frequency bands for which different DJ 200 channels respond, or to set other similar parameters. The manual controls for such parameters can comprise dials, rocker switches, up/down button, voice or display menu choices, or other such controls as are convenient for users. Alternatively, these choices can be set on a computer or other user input device, for download onto the unit 100 or DJ 200.

A preferable means of setting the parameters is for the parameters to be stored in a configuration file that can be altered either on the unit 100, the DJ 200 or a computer, so that the same DJ 200 can take on different characteristics dependent on the configuration settings within the file. The configuration settings can then be optimized for a particular situation, or set to individual preference, and be traded or sold between friends or as commercial transactions, for instance over the Internet. For a most preferable use of these configuration files, each file with its set of configurations can be considered to represent a "mode" of operation, and multiple configuration files can be set on the DJ 200 or the unit 100, depending on where the automatic generation of control signals is performed. The user can

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then select from the resident configuration files, appearing to the user as different modes, for use of his system, and can change the mode at will. This can be arranged as a series of choices on a voice or display menuing system, as a list toggled through by pressing a single button, or through other convenient user interfaces.

Manual Generation of DJ 200 Control Signals

In the description above, the use of filtering and digital modification of audio signals can be used to create control signals for DJ 200 transducers 240, 250, and 260. In addition, manual choreography of DJ 200 signals can be accomplished. For example, buttons or other interface features (e.g. areas on a touch-screen) on the unit 100 can correspond to different arrays of transducers, such as the LED arrays 290 and 292 of Figure 2A. While playing the audio signal, the user can press the buttons, where pressing of the buttons can correspond to a control signal for a transducer being ON, and otherwise the signal can be off. To aid in choreography where rapid changes in transducers are desired, the audio can be played at less than normal speed.

Figure 22A is a top-view diagram of an audio unit 100 user interface 1250, demonstrating the use of buttons to create DJ 200 control signals. The interface 1250 comprises a display screen (e.g. LCD or oLED), which can display information to the user, such as shown in Figures 18 A-B. Standard music control buttons 1254 for playing, stopping, pausing, and rewinding allow the user to control the audio signal musical output. Buttons 1252 further control aspects of the music output, such as volume control, musical tracks, and downloading and uploading of music. The number of buttons 1252 is conveniently three as shown, but can be more or less than three.

In addition, buttons are provided to allow the user to input DJ 200 control signals, comprising a record button 1256, a first channel button 1258, a second channel button 1260 and a third channel button 1262. The channel buttons 1258, 1260 and 1262 are prominent and accessible, since the user will want to easily depress the buttons. A record button 1256 allows the user to activate the channel buttons 1258, 1260 and 1262, and has a low profile (even below the nominal surface of the interface 1250) so that it is not accidentally activated. The record button can serve various purposes, including recording into a permanent storage file the sequence of DJ control signals relative to music being played, or controlling the DJ transducers in realtime, synchronously with music being played on the audio unit 100.

Pressing the buttons 1258, 1260 and 1262 create DJ control signals for the corresponding channels. The number of buttons is conveniently three as shown, but can also

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be two or four or more buttons. If a telephone is being used as the unit 100, keys on the telephone keypad can alternatively be used. The channel buttons will generally be used with thumbs, and the buttons are spaced so that two of the buttons can be depressed with a single thumb, so that all three buttons can be activated with only two fingers. In is also convenient for the two secondary buttons 1260 and 1262 to be spaced more closely together, as it will be a preferred mode of operation that the secondary buttons be operated together from time to time.

To further aid in the choreography of the DJs 200, a separate "keyboard" with the number of keys related to the number of possible arrays can be used. The amplitude of the corresponding transducer signal can be modified either according to the pressure on the keys, according to the length of time that a key is depressed, or according to a foot pedal. Figure 22B is a top-view diagram of a hand-pad 1270 for creating DJ control signals. The hand-pad 1270 comprises a platform 1271, a primary transducer 1272, a secondary transducer 1274 and a tertiary transducer 1276. The platform 1271 has a generally flat top and bottom, and can conveniently be placed on a table, or held in the user's lap. The size of the platform is such that two hands are conveniently placed across it, being preferably more than 6 inches across, and even more preferably more than 9 inches across. The pressure transducers 1272, 1274 and 1276 respond to pressure by creating a control signal, with said control signal preferably capturing both the time and amplitude of the pressure applied to the corresponding transducer. The primary transducer 1272 creates a primary control signal, the secondary transducer 1274 creates a secondary control signal and the tertiary transducer 1276 creates a tertiary control signal. The sizes and placements of the transducers can be varied within the spirit of the present invention, but it is convenient for the primary transducer 1272 to be larger and somewhat separate from that of the other transducers 1274 and 1276. In one more method of user interaction, both hands can be rapidly and alternately used to make closely spaced control signals on the primary transducer 1272. In addition, it can be convenient on occasion for the user to activate both the secondary transducer 1274 and the tertiary transducer 1276 with different fingers on one hand, and thus these can be conveniently placed relatively near to one another. In general, while a single transducer will provide minimal function, it is preferable for there to be at least two transducers, and even more preferable that there be three transducers.

The control signals can be transferred to the audio unit 100 for playing and/or storage, or to the DJ 200 unit directly for playing, either wirelessly, or through wired communication. In addition, the hand-pad can also be configured to create percussive or other sounds, either

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directly through the incorporation of hollow chambers in the manner of a drum, or preferably by the synthesis of audio waveform signals that can be played through the audio unit 100 (and other audio units 100 participating in a cluster 700), or directly through speakers within the hand-pad 1270 or attached to the hand-pad 1270 through wired or wireless communications. Such audible, percussive feedback can aid the user in the aesthetic creation of control signals.

It is within the spirit of the present invention for the hand-pad to take on various sizes and configurations. For instance, it is also convenient for the hand-pad 1270 to be configured for the use of index and middle fingers, being of dimensions as small as two by four inches or less. Such a hand-pad is highly portable, and can be battery powered.

Additionally, DJ 200 control signals can also be manually generated live, during broadcast at a party, for example, by a percussionist playing a set of digital drums. Figure 22C is a schematic block diagram of a set of drums used for creating DJ control signals. The set of drums comprises four percussive instruments 1280, 1282, 1284 and 1286, which can include snare drums, foot drums, cymbals, foot cymbals and other percussive musical instruments, such as might be found with a contemporary musical "band". Microphones 1290 are positioned so as to receive audio input primarily from instruments to which they are associated. One microphone can furthermore be associated with multiple instruments, as with the drums 1282 and 1284. The microphones 1290 are connected with a controller 1292 that takes the input and creates DJ control signals therefrom. For example, the drums 1282 and 1284 can be associated with the primary channel, the drum 1280 can be associated with the secondary channel, and the drum 1286 can be associated with the tertiary channel. The association of the microphone input with the channel can be determined in many ways. For example, the jack in the controller 1292 to which each microphone 1290 attaches can correspond to a given channel. Alternatively, the user can associate the jacks in the controller to different channels, with such control being manual through a control panel with buttons or touch control displays, or even through prearranged "sets". That is, a set is a pre-arranged configuration of associations of microphones to channels, and thus a set can be chosen with a single choice that instantiates a group of microphone-channel associations.

In general, the inputs from the microphones 1290 will be filtered in frequency and also to enhance audio contrast. For instance, control signals can be arranged to be the highest when the low-frequency envelope is rising the quickest (i.e. the beat or sound onset). The algorithms for conversion of audio signal to DJ control signal can be pre-configured in the controller 1292, or can be user selectable.

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It should be noted that the methods and systems of Figures 22 A-C need to synchronize the control signals so generated with the audio files to which they correspond. This can be accomplished in many ways. For example, the first control signal can be understood to correspond to the first beat within the audio file. Alternatively, the audio unit 100 or other device that is playing the audio signal to which the control signal is to correspond can send a signal to the device that is creating the control signals indicating the onset of playing of the audio file. The control signal can then be related to the time from the onset of the audio file. In addition, with regards to this synchronization, the user manually inputting the control signals will always be listening to the music during the control signal input. If the device on which control signals are being input is the same as the device that is playing the music, a control signal input cam be easily related to the sound that is currently being played by the audio output – many such devices allow information to within less than a millisecond of what sample or time within the audio files is currently being output by the audio device. With the arrangement of the control signal input device being also an audio player, close calibration of the control signals and the audio output is easily accomplished.

DJ 200 Control Signal Files

The control signals can be in a variety of formats within the spirit of the present invention. Such formats include pairs of locations within the associated music file and the corresponding amplitudes of the various DJ channels, and pairs of locations and the amplitudes of those DJ channels which are different from before. The locations can be either time from the start of the song (e.g. in milliseconds) or in terms of sample number. If the location is given in terms of sample number, the sample rate of the music will generally also be provided, since the same song can be recorded at different sample rates, and the invariant in terms of location will generally be time from onset of the music.

Other formats include an amplitude stream, corresponding to each DJ channel, provided in a constant stream with a fixed sample rate, which may be equal to or different from that of the corresponding music file. This format can be stored, for example, as additional channels into the music file, such that one channel corresponds to monoaural sound, two channels correspond to stereo sound, three channels correspond to stereo sound and one channel of control signals, and additional channels correspond to stereo sound plus additional channels of DJ control signals. Another arrangement is to allow for only a small number of states of the transduction in the control signal, so that multiple channels of control signal can be multiplexed into a single transmitted channel for storage and transmission with

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the audio signal. For example, if the audio is stored as a 16-bit signal, 3 channels of 5 bit DJ 200 control signal could be stored in a single channel along side the one or two audio channels normally used.

It should be appreciated that these different control signal storage formats are largely interchangeable. For instance, as described above, control signals can be stored as if they are additional audio channels within a music file, but then be extracted from the file for separate transfer (e.g. over the Internet), and then be reintegrated into an audio file at the destination location.

It should be appreciated that there are a number of means by which DJ 200 control signals can be generated, either automatically or manually, and can include the use of devices other than the unit 100 that can have sophisticated digital or analog filtering and modification hardware and software. The control signals so created can be stored in files that are associated with the music files (e.g. MP3) that the control signals are meant to accompany. To aid in their distribution, particularly in reference to limitations on the commercial and private distribution of the corresponding music files, the signal files will generally be separate from the music files, and transferable between units 100 either through inter-unit communication mediated by the inter-unit transmitter/receiver 110, or alternatively through computers or computer networks to which the unit 100 can be connected.

The audio signals and the DJ control signals should also be well synchronized during playback. Figure 23 is a schematic block flow diagram of the synchronized playback of an audio signal file with a DJ control signal file, using transmission of both audio and control signal information. For purposes of convenience in discussion, the audio signal file will be called a "song file" and the "control signal file" will be called a "dance file." In a step 1300, the user is provided a list of song files for display, preferably on the display 1170. In a step 1302, the user then selects a song from the display to play. In a step 1304, the dance files that are associated with the selected song file from the step 1302 are displayed for the user. These song files can be either locally resident on the unit 100, or can alternatively be present on other audio units 100 to which the audio unit 100 is connected, as in a cluster, or can alternatively be on the Internet, if the audio unit 100 is connected to the Internet. If there is a dance file that has been previously preferred in association with the song file, this file can be more prominently displayed than other associated dance files.

In a step 1306, the user selects the dance file to play along with the song file. This association is stored in a local database of song file/dance file associations in a step 1307, to be later used in a subsequent step 1304, should such an association not have been previously

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made, or if the preferred association is different from the previously preferred association. If the dance file is not locally resident, it can be copied to the audio unit 100 to ensure that the dance file is available throughout the duration of the song file playback.

In a step 1308, a timer is initialized at the beginning of the song file playback. In the step 1310, the song file is played on the local unit 100, and is also streamed to the other units 100 within the cluster 700. The corresponding DJ control signal accompanies the streaming song, either multiplexed within the song file audio signal, on another streaming socket, or through other communications (e.g. a TCP socket) channels between the two units. In a step 1312, the time advances along with the playback of the music. In a step 1314, this timer information is used to obtain current control signals from the dance file – that is, the dance file is arranged so that at each moment, the status of the different transducer channels can be determined. The control signals to be streamed along with the song file information can be either the current status of each transducer, or alternatively, can only send changes from the current transducer state.

The matching of the files in the database of song file and dance file associations of the step 1307 can be performed both within a machine, but also over a local or wide area network. In such cases, the association can either be external to the file – that is, using the name of the file, that is available the normal system file routines – or can use information internal to one or both files. For example, the dance file can have stored within it a reference to the song to which it is associated, either as the name of the song file, the name and/or other characteristics of the song (such as the recording artist, year of publication, music publisher) or alternatively as a numerical or alphanumerical identifier associated with the song. Then, given a song file, the relationship of the dance file with the song file can be easily determined.

For ease in creating an association, it is convenient for the names of the song files and the associated dance files to have a relationship with one another that is easily understood by casual users. For example, given a song file with the name "oops.mp3", it is convenient for an associated dance file to share the same root (in this case "oops") with a different extension, creating for example the dance file name "oops.dnc". Because of the multiplicity of dance files that will often be associated with a particular song file, the root itself can be extended to allow for either a numerical or descriptive filename, which can be preferably done in conjunction with a known punctuation mark to separate the song file root from the dance file description, such as the file names "oops.david2.dnc" or "oops$wild.dnc". It is

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preferable to use a punctuation mark that is allowed within a range of different operating systems.

Dance files can be stored on the Internet or other wide area network in a store for access by users who want dance files associated with a particular song file. In such case, if the storage is through the root of the filename, the user, requesting dance files corresponding to "oops.mps" would then be returned the names of related files such as "oops$wild.dnc". If the dance file internally carries the relationship with "oops.mps" as described above, either through the name or other characteristics, or alternatively, through a numerical or alphanumerical identifier, it is preferable to store the information in a database on the storage computer or unit 100, so that it is not necessary to open the file each time for perusal of the dance file information. Thus, if the music file has a substantially unique identifier associated with it internally, it is also useful for the dance file to also have the same identifier associated internally as well. In such case, the identifier is conveniently used to reference both files within a database.

In operation, a remote user would request a dance file for a particular song file by providing the name of the song file, along possibly with other information about the song file, which could include the name of the choreographer, the number of channels of DJ 200 transduction, the specific brand or type of DJ 200, or other information. The database would then return a listing of the various dance file that met the criteria requested. The remote user would then choose one or more of the files to download to the remote computer, and then the database would retrieve the dance files from storage and then transmits the dance file over the wide area network. On the remote computer or unit 100, the dance file would become associated with the corresponding song file through means such as naming the dance file appropriately or making an association between the song file and the dance file in a database or indexing file. Alternatively, the dance file can be integrated into the song file as mentioned elsewhere within this specification.

It can be useful to preview a dance file for its desirability or suitability. Since the dance files can be retrieved from a wide area network such as the Internet, it is convenient for such an emulator to operate on a computer that may not be portable or have the proper transmitter that allows communications with a DJ 200. In such case, it is preferable to have an emulator which places an image or drawing of a DJ 200 on the screen, and which is provided the name of a song file and a dance file, and which then plays the song file through the audio of the computer and displays appropriate images or drawings of transducers being activated within the emulator image or drawing. The characteristics of the DJ 200 being

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emulated (e.g. colors of lights, frequency responses, levels of illumination, arrangement of lights, response to amplitude, etc.) can be simulated by a number of means. For example, the user can move slider controls, set checkboxes and radio boxes, enter numerical values, click-and-drag icons and use other standard user interface controls to make the DJ 200 operate as desired. Alternatively, manufacturers of DJ 200s can create configuration files (including, for example, bitmaps of photos of the actual DJ 200) that can be downloaded for this purpose (and which can also be used by prospective purchasers to view the "virtual" operation of the DJ 200 prior to purchase, for example, through an Internet merchant). The configuration files would contain the information necessary for the emulator to properly display the operation of the specific DJ.

Alternatively, as described above, the dance file information can be stored within the song file as, for example, another channel in place of an audio channel, or alternatively within MP3 header or other file information. In such case, the step 1307 would have the alternative function of looking through song files to find the song file with the particular desired embedded dance file within.

In addition to sending dance files from computers to units 100 or between units 100, the dance files can be streamed from unit 100 to unit 100 through the normal unit-to-unit communications, in the manners described above for audio communications. This is particularly convenient given that DJ 200 displays can be used to show group identification, and such displays can be more effective if the DJs for each user are nearly identical (which might not be the case if the users were using, for example, different dance files). The dance file control signal information can be transmitted in a variety of ways, including multiplexing the control signals into the same packets as the audio information as if it were a different audio channel, alternating packets of control signals with packets of the audio information, or broadcasting control signals on a different UDP socket as the audio. Alternatively, if the receiving unit has a copy of the dance file corresponding to the song file being transferred by unit-to-unit communication, the receiving unit can determine the current time being played, and to extract from the local dance file the control signals for the receiving unit DJ 200.

It should be known that most streaming protocols have relatively small data packets that are communicated, due to the fact that reception at the source is not guaranteed and it is not desirable to lose a large amount of information in any one stream. Thus, it is possible with smaller transmission buffers and higher data rates to send a single DJ control signal in each transmission. For example, with a buffer size of 600 bytes, and an audio rate of 22,050 Hz with two single byte channels, each transmission covers only about 12 milliseconds, and

any signal would therefore be at most 13 milliseconds from its correct time. Alternatively, each control signal can be accompanied by an offset in time from the beginning of the transmitted audio signal. Also, the time or packet number of each transmission buffer can be sent, as well as the time or packet number of the DJ audio signals, so that the audio unit 100 can compute the proper offset.

Stationary Transducers

DJs 200 that have been previously described are portable devices, usually associated with a particular user and unit 100. Figures 5A and 5B indicate the ways in which DJs 200 associated with multiple users can be controlled by a single unit 100.

It is also convenient for transducers to be non-portable and stationary. Consider, for example, a user who is at home listening to music. Instead of a DJ 200 worn by the user, the user can alternatively have a bank of lights or other transducers in fixed locations through the room that operate under the same or similar control signals as to which DJs respond. Such fixed transducers can operate at far higher power than portable DJs 200, and can each incorporate a large number of separate transducers.

Furthermore, in a party, concert or other large social gathering, the effects of portable DJs worn by guests can be supplemented by large transducers that are generally perceptible by most guests. For example, such transducers can include spark or smoke generators, strobe lights, laser painters, arrays of lights similar to Christmas light strings, or mechanical devices with visible (e.g. a flag waving device) or tactile effects (e.g. a machine that pounds the floor). In general, transducers for large gatherings will not communicate with a unit 100, but will be directed by a wide-area broadcast unit 360, as in Figure 5B.

Because of the large area over which such stationary transducers can operate, the communications between the unit 100 and the stationary transducers can be through wired rather than wireless transmission. Furthermore, there can be mixed communication, such as wireless transmission of control signals from a portable unit 100 to a stationary receiver, and thence wired transmission to one or multiple transducers.

Modular Configurations

In the embodiments above, the audio player 130 is directly integrated with the inter-unit and unit-to-DJ communications. This requires both a re-engineering of existing audio players (e.g. CD, MP3, MO and cassette players), and furthermore does not allow the communications functionality to be reused between players.

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An alternative embodiment of the present invention is to place the communications functions external to the audio playing functions, and to adjustably connect the two via the audio output port of the audio player. Figure 12A is a schematic diagram of a modular audio unit 132. Audio player 131 is a conventional audio player (e.g. CD or MP3 player) without the functionality of the present invention. Analog audio output is sent via audio output port 136 through the cable 134 to the audio input port 138 of the modular audio unit 132. The modular audio unit 132 comprises the inter-unit transmitter/receiver 110 and the DJ transmitter 120, which can send and receive inter-unit and unit-to-DJ communications in a manner similar to an audio unit 100. A switch 144 chooses between audio signals from the audio player 131 and from the inter-unit transmitter/receiver 110 for output to the output audio port 142 to the earphone 901 via cable 146 (the earphone 901 can also be a wireless earphone, wherein the output port 142 can be a wireless transmitter, which can also be a DJ transmitter 120). A convenient configuration for the switch 144 is a three way switch. In an intermediate position, the unit 132 acts simply as a pass-through, in which output from the audio player 131 is conveyed directly to the earphone 901, and the transmitter/receiver functions of the unit 132 do not operate. In another position, the unit 132 operates as a receiver, and audio from the inter-unit transmitter/receiver 110 is conveyed to the earphone 901.

When the combined system operates as a broadcast unit 710, audio input from the audio unit 131 is directed to the inter-unit transmitter/receiver 110 for transmission to receive units 730, as well as for output to the earphone 901 (which can be direct to the earphone 901 through the switch, or indirectly through the inter-unit transmitter/receiver 110).

When the combined system operates as a conventional audio player, the switch directs audio signals from the input port 138 directly through to the output port 142. In this mode of operation, it can be arranged for the audio output to traverse the modular audio unit 132 without the unit being powered up. In case there is a transmission delay to the receive unit 730 such that audio played locally through the earphone 901 and audio played remotely on the receive unit 730 are not in synchrony, the system can incorporate a time delay in the output port 142 such that the local and remote audio output play with a common time delay, and are thus in synchrony.

When the combined system operates as a receiver unit 730, audio input from the input port 138 is ignored, and signals to the audio output port are delivered solely through the inter-unit transmitter/receiver 110.

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It is convenient for the modular audio unit 132 to be able to operate independently of the associated audio player 131. In such a case, the unit 132 must have an independent energy store, such as one or more batteries, which can be rechargeable. In that case, the unit 132 has no audio signals locally to listen to through the earphone 901 or to transmit over the transmitter/receiver 110. However, the unit 132 can in that case receive external audio signals sent by other units 132 or units 100 for listening.

The audio player 131 can be placed in a backpack, purse, or other relatively inaccessible storage location, while the modular audio unit is, like a "remote control", accessible for interaction with other users.

Video

While the units 100 described above have comprised audio players 130, within the spirit of the present invention, such units can also comprise video or audio/visual players (both of which are referred to below as video players). Such video players would be used generally for different entertainment and educational purposes, not limited to films, television, industrial training and music videos. Such video enabled units can operate similarly to audio units, including the capability of sharing video signals, synchronously played, with nearby units through inter-unit communication, as well as the use of DJ's that can produce human-perceptible signals (such as light transduction for accompaniment of audio signals in music videos). It should be noted, however, that there is a larger bandwidth requirement for the inter-unit transmitter/receiver 110 for the communication of video signals as compared with audio signals. In the case of shared video, wire connections (e.g. FireWire) between two units can allow simultaneous viewing of a single video signal.

In addition, text, including language-selectable closed caption and video subtitling, can accompany such video, as well as chat or dubbing to allow the superposition of audio over the audio normally accompanying such video.

Music Distribution Using Audio Units

The music industry is suffering from reduced sales due to the advent of Internet-based music file sharing; in addition, the manufacturers of personal audio devices are bringing to market audio devices that can wirelessly transfer music files between the devices. Such sharing-enabled devices could significantly reduce the sales of music. Audio units of the present invention, however, can be used to provide new means of music distribution and thereby increase the sales of music.

Figure 25 is a schematic flow diagram indicating music sharing using audio devices, providing new means of distributing music to customers. Three entities are involved in the transactions – the DJ (operating a broadcast unit 710), the cluster member (operating a receive unit 730), and the music distributor, and their actions are tracked in separate columns. In this case, the term DJ is used to indicate the person operating a broadcast unit 710, and has no meaning with respect to a DJ unit 200. Indeed, the DJ unit 200 is a part of the system only inasmuch as it provides for heightened pleasure of the DJ and the member in enhancing their experience of the music. For the rest of this section, DJ will refer specifically to the person operating the broadcast unit 710.

In a first step 1340, the DJ registers with the distributor, who places information about the DJ into a database in a step 1342. Part of this information is a DJ identifier (the DJ ID), which is unique to the DJ, and which DJ ID is provided to the DJ as part of the registration process. This ID is stored in the unit 100 for later retrieval. The DJ at some later time broadcasts music of the type distributed by the distributor, in a step 1344. The broadcast of the music by the DJ can be adventitious (that is, without respect to the prior registration of the DJ with the distributor), or the distributor can provide the music to the DJ either free of charge, at a reduced charge, or free of charge for a limited period of time.

In a step 1346, the member becomes a part of the cluster 700 of which the DJ is the broadcaster broadcasting the distributor's music, and has thereby an opportunity to listen to the music. Along with the transfer of the audio signal of the music, in a step 1348, the DJ can send information about the song, which can include a numerical identifier of the music or album from which the music is derived. Furthermore, the DJ ID is provided to the member, and is associated with the music ID and stored in a database on the member unit 100 in a step 1350. In order to prevent this database from becoming too sizable, music IDs and DJ IDs can be purged from it on a regular basis (for example, IDs which are older than 60 or 120 days can be removed).

If the member requests purchase of the music from the distributor in a step 1352, in a step 1354, the distributor stores the member information, the music ID, and the DJ ID associated with the music (i.e. the person who introduced the member to the music). The distributor then completes the transaction with the member, providing a copy of the music in exchange for money, in a step 1356. As the member receives the music copy, he also becomes registered as a DJ as well in a step 1358. Thus, if the member now becomes the DJ of his own cluster, and introduces people to this music, he will also be known to the distributor as an introducer of the music.

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In a step 1360, the distributor provides points to the DJ who introduced the member to the music and facilitated the sale of the music. In a step 1362, the DJ accumulates points related to the sale of the music to the member, as well as points related to the sale of other music to other members. These points can at that point or later be redeemed for money, discounted music, free music, gifts, access to restricted activities (e.g. seats at a concert) or other such real or virtual objects of value to the DJ.

In a step 1364, the DJ is optionally further linked to the music and member for whom he has received points. If this member introduces the music to yet other members, who are induced to buy the music from the distributor, the DJ is further awarded points in a step 1366, given that the "chain" of members introduced directly or indirectly to the music includes the original DJ.

This set of interactions does not decrease music sales as does file sharing, but rather increases sales of music, as the DJ has incentives to encourage others to buy the music, and the offering of the music by the DJ through his broadcasts introduces music to people who may not have already had the opportunity to hear the music.

Figure 31 contains tables of DJ, song and transaction information according to the methods of Figure 25. A USER table 1810 comprises information about the USER, which can include the name of the person (Alfred Newman), their nickname/handle ("WhatMeWorry"), their email address (AEN@mad.com), and the machine ID of their unit 100 (B1B25C0). This information is permanently stored in the audio unit 100. A second set of information relates to music that the USER has heard while in other clusters 700 that the USER liked, and which is indicated as the USER's "wish list". This set of information includes a unique ID associated with the song (or other music or audio signal), which is transmitted by the broadcast unit 710 of the cluster 700. This information can alternatively or additionally include other information about the music, such as an album name, an artist name, a track number, or other such information that can uniquely identify the music of interest.

Along with each song ID is a DJ identifier, indicating the unique ID associated with the DJ who introduced the desired music to the USER. Additionally or alternatively, the information can comprise the DJ's email address, personal nickname/handle, name, or other uniquely identifying information.

The Wish List can either be permanent, or it can be that each song entry is dated, and that after a predetermined amount of time, which can be set by the user, the songs that are still on the Wish List are removed. It is also convenient that songs that are purchased

according to the methods of the present invention, such as Figure 25, are also removed from the list automatically.

A DISTRIBUTOR table 1812 comprises information about purchases made by USERS with the DISTRIBUTOR. The table 1812 has numerous records keyed according to unique USER identifiers, which in this case is the MAC ID of the unit 100. A single record from the table is provided, of which there can be hundreds of thousands or millions of such records stored.

The record can include contact information about the USER, including name, email address, or other business related information such as credit card number. In addition, each record comprises a list of all of the songs known to have been purchased through the DISTRIBUTOR, as identified by a unique song ID. In addition, the DJ associated with the purchase of the given song by the USER is also noted. This information was previously transmitted from the USER table 1810, which includes the associated DJ identifier along with the song identifier, at the time of purchase of the song. This association allows the DISTRIBUTOR to compensate the DJ for his part in introducing the USER to the song.

It should also be noted that such an arrangement of information allows the compensation, if desired, of the individual who introduced the DJ to the song, prior to the DJ introducing the USER to the song. For example, when the user purchased the song with song ID 230871C40, points were credited with the DJ whose ID is 42897DD. Looking in the record for the DJ 42897DD, one can determine whether there is another individual (DJ) associated with the purchase of the song 230871C40 by the DJ. If so, that individual can also receive compensation for the purchase of the song by the USER.

Use of Internet Connections

It is within the teachings of the present invention to allow normal Internet connections of the audio unit 100 with non-mobile devices connected with the Internet. Figure 29A is a schematic block diagram of the connection of an Internet-enabled audio unit 100 with an Internet device through the Internet cloud 1708, using an Internet access point 1704. An Internet-enabled audio unit 1700, unit A, is wirelessly connected to an audio unit 100, denoted unit B, as members in a cluster 700. The dashed line connecting the two units A and B indicates that the connection is wireless, whereas the solid connecting lines indicate wired connections. The unit A is connected to a wireless access point 1704, such as an 802.11 access point, which is connected to an Internet device 1706 via wired connections through the Internet cloud 1708.

Figure 29B is a schematic block diagram of the connection of an Internet-enabled audio unit 1702 with an Internet device through the Internet cloud, with an audio unit 1702 directly connected to the Internet cloud 1708. In this case the audio unit 1702 is capable of directly connecting to the Internet cloud 1708, and thence to the Internet device 1706, through a wired connection. This could be through a high speed connection (such as a twisted wire Ethernet connection) or through a lower speed connection (e.g. a serial port connection, or a dial-up modem).

The connection of the unit 1700 or unit 1702 is illustrated in Figure 30, tables of ratings of audio unit 100 users. As described above, members of a cluster can decide whether or not to admit a new member to the cluster using a variety of automatic or manual methods. One method of determining the suitability of a user to become a member of the cluster 700 is to determine the user's ratings by members of other clusters to which the user has previously been a member. In this case, the Internet device 1706 is a computer hosting a database, which can be queried and to which information can be supplied by the unit A (either 1700 or 1702). On the Internet device 1706 are stored ratings of units 100, as indicated by the table 1802. The left hand column is the primary key of the database, and is a unique identifier associated with each unit 100. This ID can be a numerical MAC ID, associated with the hardware and software of each unit 100, a unique nickname or word handle (e.g. "Jen412smash") associated with each audio unit user, or other such unique identifier.

The second and third columns, indicated as numbers with dollar signs, are the total summed positive ratings (column two) and the negative ratings (column three) registered with each user by another member of a cluster 700 with which the user has been associated, and in which the user was operating the broadcast unit 710. This rating can, for example, reflect the perceived quality of music provided by the user. The fourth and fifth columns are the total, summed ratings of the user by other members of clusters 700 with which the user has been associated, in which the user was the operator of a receive unit 730. This rating can, for example, indicate the good spirits, friendliness, dress or other characteristics of the user as perceived by other members of the cluster. The sixth column indicates the largest cluster 700 for which the user has been the broadcaster. This is a good indicator of a broadcaster's popularity, since a poor or unpopular broadcaster would not be able to attract a large group of members for a cluster.

There are many other characteristics that can be stored in such a database, and can also include IDs of other members of groups with which the user has been associated (so that members can accept new members who have been associated with friends of those in the

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cluster), specific music that the user has played (in order to determine musical compatibility), information on the individuals making each rating (in order to determine rating reliability), and gradations of ratings (rather than simply a positive or negative response).

The cluster members can access the ratings of the user requesting membership in the cluster 700 in order to determine their desirability and suitability. This would require a connection with the Internet device 1706 at the time that the user was requesting to join, and would preferably involve a wireless connection through an access point, as in Figure 29A. The information from the database on the device 1706 can either be displayed to the members of the cluster 700, or can be used by an automatic algorithm to determine whether the person can join.

The table 1800 represents the ratings of a cluster 700 of 5 total members (comprising a broadcaster with ID 12089AD, and four additional members with IDs E1239AC, F105AA3, B1B25C0, and ED5491B). The ratings are supplied by ED5491B (whose ID is preceded by a zero), and then specific ratings of each member are made. The DJ is indicated by a dollar sign preceding his ID. These ratings can be made by putting the nicknames/handles of the cluster members on a screen, and allowing the member to indicate positive or negative ratings by pressing one of two buttons. A plus in the first column indicates a positive response, and a minus sign indicates a negative response. These ratings can then be sent during either wired communications directly to the Internet device 1706 or via the access point 1704. It should be noted that the ratings, once made, can be stored on the unit 1700 or 1702 indefinitely, until connection with the Internet cloud 1708 can be made. As indicated by the arrow, the information for B1B25C0 can be added to the table 1802 -- in this case, by incrementing the value in the fourth column (a positive rating for a user who is not the broadcaster).

Other applications of connections to Internet devices 1706 include exchanging (via uploading and downloading) dance files with distant individuals, and obtaining music via downloading , which can include transactions with distributors similar to that seen in Figure 25. Such connections also allow the integration of other connectivity, such as telephone and messaging capabilities, expanding the usefulness and attractiveness of audio units 100.

Many Embodiments Within the Spirit of the Present Invention

It should be apparent to one skilled in the art that the above-mentioned embodiments are merely illustrations of a few of the many possible specific embodiments of the present invention. For example, the elements of a unit 100, including the inter-unit transmitter/receiver 110 protocol and hardware, the DJ transmitter 120 and the audio player

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130 can be chosen from a range of available technologies, and can be combined with user interface elements (keyboards, keypads, touch screens, and cursor buttons, without significantly affecting the operation of the unit 100. Furthermore, many different transducers can be combined into DJs 200, which can further comprise many decorative and functional pieces (e.g. belt clasps, functional watches, microphones, or wedding rings) within the spirit of the present invention. Indeed, the unit 100, itself, can comprise transducers 240, 250 or 260.

It should also be appreciated that communications protocols provide a nearly uncountable number of arrangements of communications links between units in a cluster, that the links can be of mixed software protocols (e.g. comprising both TCP and UDP protocols, and even non-IP protocols) over a variety of hardware formats, including DECT, Bluetooth, 802.11 a, b, and g, Ultra-Wideband, 3G/GPRS, and i-Beans, and that communications can include not only digital but also analog communications modes. Furthermore, communications between audio units and digital jewelry can further comprise analog and digital communications, and a variety of protocols (both customized as well as well-established IP protocols).

It is important, as well, to note that the inter-unit communication and the unit-to-DJ communication can operate and provide significant benefits independently of one another. For example, members listening to music together gain the benefits of music sharing, even without the use of DJs 200. Alternatively, an individual's appreciation of music and personal expression can be augmented through use of a DJ 200, even in the absence of music sharing. However, the combination of music sharing along with enhanced personal expression through a DJ 200 provides a synergistic benefit to all members sharing the music.

Numerous and varied other arrangements can be readily devised by those skilled in the art without departing from the spirit and scope of the invention. Moreover, all statements herein reciting principles, aspects and embodiments of the present invention, as well as specific examples thereof, are intended to encompass both structural and functional equivalents thereof. Additionally, it is intended that such equivalents include both currently known equivalents as well as equivalents developed in the future, i.e. any elements developed that perform the same function, regardless of structure.

In the specification hereof any element expressed as a means for performing a specified function is intended to encompass any way of performing that function. The invention as defined by such specification resides in the fact that the functionalities provided by the various recited means are combined and brought together in the manner which the

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specification calls for. Applicant thus regards any means which can provide those functionalities as equivalent as those shown herein.

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Claims

What is claimed is:

1. A method for sharing music from stored musical signals between a first user with a first music player device and at least one second user with at least one second music player device, comprising:

playing the musical signals for the first user on the first music player device while essentially simultaneously wirelessly transmitting the musical signals from the first music player device to the at least one second music player device; and

receiving the musical signals by the at least one second player device, wherein the musical signals can be played on the at least one second player device essentially simultaneously with the playing of the musical signals on the first music player device;

wherein the first and the at least one second users are mobile and maintain less than a predetermined distance.

2. The method of claim 1 wherein the predetermined distance is 40 feet.

3. The method of claim 1 wherein the predetermined distance is 100 feet.

4. The method of claim 1 wherein the predetermined distance is 500 feet.

5. The method of claim 1 wherein the transmitting and receiving involve the use of an Internet protocol.

6. The method of claim 5 wherein the Internet protocol uses a connection-less transport layer.

7. The method of claim 5 wherein the Internet protocol uses a link layer involving a protocol chosen from the group consisting of 802.11, Bluetooth, ultrawideband, HiperLAN and WDCT.

8. The method of claim 1 wherein the transmitting and receiving use analog radio frequency transmission.

9. The method of claim 1 wherein the transmitted music signals are digital.

10. The method of claim 9 wherein the transmitted digital music signals are compressed.

11. The method of claim 1 wherein the first music player device is carried by the first user.

12. The method of claim 1, additionally comprising displaying by the first user a humanly-perceptible light display that is roughly synchronized with the beat of the musical signals.

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13. The method of claim 1, additionally comprising communicating an identifier of the at least one second user to the first music player device, and indicating the identifier to the first user on a display located on the first music player device.

14. The method of claim 1, additionally comprising transferring a substantially unique music identifier of the musical signal wherein the personal identifier is stored on the at least one second music player device in association with the musical identifier.

15. The method of claim 14 wherein the user of the at least one second music player device retrieves the musical signal from a remote system by using the music identifier.

16. The method of claim 15 wherein the remote system is located on the Internet.

17. The method of claim 15, additionally comprising a substantially unique personal identifier of the first user wherein the personal identifier is transferred to the at least one second music player device and stored in association with the music identifier of the music transmitted by the first music player device to the at least one second music player device.

18. The method of claim 1, additionally comprising monitoring the strength of the musical signal received by the at least one second music player device and communicating with the at least one second user the strength of the musical signal.

19. A system of music sharing for a plurality of users, comprising:

a first sharing device and at least one second sharing device, each comprising a musical signal store, a musical signal transmitter, a musical signal receiver, and a musical signal player;

a broadcast user operating the first sharing device; and

at least one member user operating the at least one second sharing device, wherein the broadcast user plays the musical signal for his own enjoyment on the first sharing device and simultaneously transmits the musical signal to the receiver of the at least one second sharing device of the at least one member user, on which the musical signal is played for the at least one member user, wherein the broadcast user and the at least one member user hear the musical signal substantially simultaneously.

20. The system of claim 19, additionally comprising a manual switch on at least one second sharing device, wherein actuation of the switch causes the first sharing device to cease transmitting the musical signal and for the second sharing device to begin transmitting musical signal from the musical signal store of the second sharing device, wherein the broadcast user and the at least one member user hear the musical signal from the second sharing device substantially simultaneously.

21. The system of claim 19 wherein the first sharing device and the at least one second sharing device additionally comprise a substantially unique identifier, wherein the first sharing device communicates its substantially unique identifier to the at least one second sharing device and the at least one second sharing device communicates its substantially unique identifier to the first sharing device.

22. The system of claim 21, wherein the identifier includes a least one piece of information about the user of the sharing device taken from the group consisting of the name of the user, the nickname of the user, a numerical identifier, an alphanumerical identifier, the musical preferences of the user, the age of the user, and the educational institution that the user attends.

23. The system of claim 22 wherein the first sharing device and the at least one second sharing device additionally comprise a visual display on which the substantially unique identifiers which have been communicated to the respective device are displayed.

24. The system of claim 19 additionally comprising at least one requesting member user operating an at least one requesting sharing device, wherein the at least one requesting member user requests to receive transmission of the musical signal from the first sharing device.

25. The system of claim 24 wherein the at least one requesting sharing device is associated with a substantially unique identifier which is communicated by the requesting sharing device to the first sharing device and wherein the first sharing device additionally comprises a display on which the identifier is displayed.

26. The system of claim 25 wherein the broadcast user elects whether to transmit the musical signal from the first sharing device to the requesting sharing device.

27. The system of claim 25 wherein the broadcast user and the at least one member user elect through voting whether to transmit the musical signal from the first sharing device, wherein a majority vote is determinative.

28. The system of claim 25 wherein the broadcast user and the at least one member user elect through voting whether to transmit the musical signal from the first sharing device, wherein a unanimous vote is required for transmitting.

29. The system of claim 25 wherein the identifier of the requesting sharing device is compared with identifiers stored in the first device, such that the match of the identifier of the requesting sharing device with a stored identifier allows the first sharing device to transmit the musical signal to the requesting sharing device.

30. The system of claim 29 wherein the stored identifiers are retrieved from the Internet.

31. The system of claim 19 wherein the first sharing device additionally comprises a visual display.

32. The system of claim 31 wherein the visual display indicates the number of member users receiving the musical signal.

33. The system of claim 31 wherein the visual display can display whether the musical being played by the sharing device comes from the musical signal store of the same device, or from the musical signal store another sharing device.

34. The system of claim 19 wherein the first sharing device is mobile.

35. The system of claim 19 wherein the first sharing device is carried by the user.

36. The system of claim 19 wherein the first sharing device and at least one sharing device maintain less than a predetermined distance.

37. The system of claim 36 wherein the predetermined distance is 40 feet.

38. The system of claim 36 wherein the predetermined distance is 100 feet.

39. The system of claim 36 wherein the predetermined distance is 500 feet.

40. The system of claim 19, additionally comprising a substantially unique user identifier associated with the broadcast user and a substantially unique musical signal identifier associated with each musical signal, wherein the user identifier and the musical signal identifier are transmitted from the first sharing device to the at least one second sharing device and stored in association with one another on the at least one second sharing device.

41. A wireless communications system for sharing audio entertainment between a first mobile device and a second mobile device in the presence of a non-participating third mobile device, comprising:

an announcement signal transmitted by the first mobile device for which the second mobile device and the third mobile device are receptive;

a response signal transmitted by the second mobile device in response to the announcement signal for which the first mobile device is receptive and for which the third mobile device is not receptive;

an identifier signal transmitted by the first mobile device to the second mobile device in response to the response signal, and which is not receptive to the third mobile device; and

a broadcast signal comprising audio entertainment that is transmitted by the first mobile device, and which is receptive by the second mobile device on the basis of the reception of the identifier signal.

42. The system of claim 41 wherein the announcement signal is transmitted via an Internet protocol.

43. The system of claim 42 wherein the Internet protocol is a connection-oriented transport protocol.

44. The system of claim 43 wherein the connection-oriented protocol is TCP.

45. The system of claim 42 wherein the Internet protocol further comprises a link layer protocol selected from the group consisting of 802.11, Bluetooth, ultrawideband, HiperLAN and WDCT.

46. The system of claim 41 wherein the broadcast signal is transmitted via an Internet protocol.

47. The system of claim 46 wherein the Internet protocol is a connectionless transport protocol.

48. The system of claim 47 wherein the connectionless transport protocol is UDP.

49. The system of claim 46 wherein the Internet protocol further comprises a link layer protocol selected from the group consisting of 802.11, Bluetooth, ultrawideband, HiperLAN and WDCT.

50. The system of claim 41 wherein the broadcast signal is an analog radio frequency signal.

51. The system of claim 41 wherein the broadcast signal is transmitted via telephony.

52. The system of claim 41 wherein the broadcast signal is compressed.

53. The system of claim 52 wherein the compression is MP3.

54. The system of claim 41 wherein the broadcast signal is encrypted.

55. The system of claim 41 wherein the identifier signal is an IP socket address.

56. The system of claim 41 wherein the identifier signal is a decryption code.

57. The system of claim 41 wherein the identifier signal is a digital password.

58. The system of claim 41 wherein the announcement signal and the broadcast signal use different IP transport protocols.

59. The system of claim 41 additionally comprising a transfer signal that is transmitted by the first mobile device upon halting the transmission of its broadcast signal, and which transfer signal is receptive by the second mobile device, such that reception by the second mobile device causes the device to transmit a second broadcast signal comprising audio entertainment for which the first unit is receptive.

60 The system of claim 41 wherein the broadcast signal is transmitted via peer-to-peer communications.

61 The system of claim 60, additionally comprising a switch, wherein actuation of the switch causes the device to toggle between peer-to-peer communications and infrastructure-based communications.

62 The system of claim 41 wherein the broadcast signal is transmitted via infrastructure-based communications.

63. An audio entertainment device, comprising:

a signal store that stores an audio entertainment signal;

a transmitter that can transmit the stored audio entertainment signal;

a receiver that can receive the transmitted audio entertainment signal from a transmitter of another such device; and

a player that can play audio entertainment from a member selected from the group of stored audio entertainment signals or audio entertainment signals transmitted from the transmitter of another such device.

64. The device of claim 63 wherein the transmitter transmits to the receiver of the same device in order to play through the player of that device.

65. The device of claim 63 wherein the player can play audio entertainment from signals obtained from either the receiver or from the audio store.

66. The device of claim 63 additionally comprising a visual display that is perceptive to the user of the device, indicating information about the audio entertainment signal.

67. The device of claim 66 wherein a third device can receive the transmitted audio signal, wherein all such devices transmitting and receiving the same audio entertainment signal constitute a sharing group.

68. The device of claim 67 additionally comprising a substantially unique identifier that identifies the user of the device, wherein at least one device of the sharing group displays the identifier of the user of another device within the sharing group.

69. The device of claim 68 wherein the identifier includes a least one piece of information about the user taken from the group consisting of the name of the user, the nickname of the user, the musical preferences of the user, a numerical identifier, an alphanumerical identifier, the age of the user, or the educational institution that the user attends.

70. The device of claim 68 wherein the identifier is interspersed within the transmitted audio entertainment signal.

71. The device of claim 66 wherein the visual display can display the number of devices in the sharing group.

72. The device of claim 66 wherein the visual display can display whether the audio entertainment being played by a device comes from the audio store of the device of which the display is a part, or from another device.

73. The device of claim 63 wherein the second device provides information to the second user about the strength of the audio signal received by the receiver.

74. The device of claim 73 additionally comprising a visual display, wherein the signal strength information is provided in the visual display

75. The device of claim 73 wherein the signal strength information is provided secondary audio signals played substantially simultaneously with the audio entertainment signal through the player of the device.

76. The device of claim 63 wherein the signal store stores a compressed audio signal.

77. The device of claim 63 wherein the compressed audio signal is transmitted through the transmitter.

78. The device of claim 63 wherein the compressed audio signal is decompressed prior to being transmitted through the transmitter.

79. The device of claim 63 wherein the identifier is interspersed within the transmitted audio signal.

80. The device of claim 63 additionally comprising a delay circuit.

81. The device of claim 80 wherein the playing of the audio entertainment signal is delayed in each device so that the audio entertainment signal in all devices playing from the same stored audio entertainment signal is played substantially simultaneously.

82. The device of claim 63 additionally comprising a manual control with at least three states, wherein in the first state the player plays a stored audio entertainment signal and does not transmit the stored entertainment signal, wherein in the second state the player plays a stored audio entertainment signal and substantially simultaneously transmits the same audio entertainment signal, and wherein in the third state the player plays an audio entertainment signal received by the receiver.

83. The device of claim 63 wherein the ambient sound admitted by the earphone can be manually controlled.

84. The device of claim 63 additionally comprising a microphone wherein the device can transmit vocal sounds from the user of the device.

85. The device of claim 63 additionally comprising a manual control such that actuation transmits a message.

86. The device of claim 63 wherein the device can connect with the telephone network.

87. The device of claim 63 wherein the device is mobile and can be carried by a user.

88. The device of claim 63 additionally comprising a control signal transmitter that transmits control signals that controls a humanly-perceptible display in a wearable accessory.

89. The device of claim 88 wherein the control signal transmitter is the same as the transmitter that transmits stored audio entertainment signals.

90. The device of claim 88, additionally comprising a store of control signals.

91. The device of claim 88, additionally comprising a generator wherein the generator coverts stored audio entertainment signals into control signals.

92. An audio entertainment device comprising:

a wireless transmitter for the transmission of audio entertainment signals;

a wireless receiver for the reception of the transmitted audio entertainment signals from a transmitter of audio entertainment signals;

a first manually-separable connector for electrically connecting with an audio player, wherein the connector allows transfer of audio entertainment signals from the player to the device;

a second connector for connecting with a speaker; and

a control to manually switch between at least three states, wherein in the first state the speaker plays audio entertainment signals from the audio player and the transmitter does not transmit the audio entertainment signals, wherein in the second state the speaker plays audio entertainment signals from the audio player and the transmitter essentially simultaneously transmits the audio entertainment signals, and wherein in the third state the speaker plays audio entertainment signals received by the receiver.

93. The device of claim 92 wherein the first connector connects to the audio player through the audio output jack.

94. The device of claim 92 wherein the speaker is chosen from the group consisting of earphone and headphone.

95. The device of claim 92 wherein the device additionally comprises a control signal generator that converts audio entertainment signals into control signals that control a humanly-perceptible display in a wearable accessory.

96. The device of claim 92 additionally comprising a second transmitter that transmits control signals that control a humanly-perceptible display in a wearable accessory.

97. The device of claim 92 additionally comprising a display that indicates the state of the device.

98. The device of claim 92 wherein the receiver is receptive of the audio entertainment signals transmitted by the transmitter.

99. The device of claim 92 wherein the receiver is operational when the first connector is manually separated from the audio player.

100. A system for the sharing of stored music between a first user and a second user, comprising:

a first device for playing music to the first user, comprising a store of musical signals, a first controller that prepares musical signals from the first store for transmission and playing, a first player that takes musical signals from the first controller and plays the signals for the first user, and a transmitter, that is capable of taking the musical signals from the controller and transmitting the musical signals via wireless broadcast; and

a second device for playing music to the second user, comprising a receiver receptive of the transmissions from the transmitter of the first device, a second controller that prepares musical signals from the receiver for playing, and a second player that takes musical signal from the second controller and plays the signals for the second user;

wherein the first user and the second user hear the musical signals at substantially the same time.

101. The system of claim 100 wherein the store of musical signals comprises compressed digital audio files.

102. The system of claim 100 wherein the compressed digital audio files are in formats taken from the group consisting of mp3, wav, cda, wma, and au.

103. The system of claim 100 wherein the preparation of the musical signals by the first controller comprises decompression of compressed binary files.

104. The system of claim 100 wherein the transmitter transmits via an Internet protocol.

105. The system of claim 104 wherein the Internet protocol has a link level selected from the group consisting of 802.11, Bluetooth, ultrawideband, HiperLAN and WDCT.

106. The system of claim 100 wherein the first device is a telephone.

107. The system of claim 100 wherein the first device transmits compressed musical signals and the second controller decompresses the compressed musical signals received by the receiver.

108. The system of claim 100 wherein the transmitter additionally transmits an annunciator signal indicating the presence of a transmitter of musical signals.

109. The system of claim 100 wherein the second device receiver becomes receptive of transmissions from the first device by obtaining an identifier from the first device.

110. The system of claim 109 wherein the first device additionally comprises an associated visual transducer and the second device additionally comprises a visual receiver, wherein the visual transducer outputs a visual identifier signal that is received by the visual receiver.

111. The system of claim 109 wherein the first device additionally comprises a first electrical connector and the second device additionally comprises a second electrical connector, wherein the identifier is communicated via an electrical signal passed from the first electrical connector to the second electrical connector.

112. The system of claim 111 wherein the communication of the identifier signal occurs via an inductive coupling between the first connector and the second connector.

113. The system of claim 109 wherein the second device additionally comprises a microphone, wherein the identifier is communicated in an audio signal that is produced by the first player and which is received by the microphone.

114. The system of claim 109 wherein the identifier is transmitted by the transmitter and received by the receiver.

115. The system of claim 100 wherein the second device receiver becomes receptive of transmissions from the first device by transmitting an identifier to the first device.

116. The system of claim 115 wherein the second device additionally comprises a visual transducer and the first device additionally comprises a visual receiver, wherein the visual transducer outputs a visual identifier signal that is received by the visual receiver.

117. The system of claim 115 wherein the first device additionally comprises a first electrical connector and the second device additionally comprises a second electrical connector, wherein the identifier is communicated via an electrical signal passed from the second electrical connector to the first electrical connector.

118. The system of claim 117 wherein the communication of the identifier signal occurs via an inductive coupling between the first connector and the second connector.

119. The system of claim 115 wherein the first device additionally comprises a microphone, wherein the identifier is communicated in an audio signal that is produced by the second player and which is received by the microphone.

120. The system of claim 115 wherein the identifier is transmitted by the transmitter and received by the receiver.

121. The system of claim 100 wherein the first controller additionally generates control signals related to the musical signals.

122. The system of claim 121 wherein the store additionally comprises stored control signals that are used by the first controller.

123. The system of claim 121 wherein the controller generates control signals from the musical signals.

124. The system of claim 123 wherein the controller performs frequency analysis of the musical signals in order to generate the control signals.

125. The system of claim 121 wherein the first device additionally transmits the control signals to the second device using the first transmitter.

126. The system of claim 125 wherein the control signals and the musical signals transmitted by the first device are interspersed within a single digital stream.

127. The system of claim 125 wherein the control signals and the musical signals are transmitted in two digital streams.

128. The system of claim 121 wherein the first device additionally comprises a second transmitter that transmits control signals.

129. The system of claim 128 wherein the second transmitter uses an IP protocol.

130. The system of claim 129 wherein the Internet protocol uses a link layer selected from the group consisting of 802.11, Bluetooth, and ultrawideband.

131. The system of claim 121 wherein the second transmitter uses analog radio frequency transmissions.

132. The system of claim 100, additionally comprising a wearable accessory, comprising a control signal receiver that is receptive of control signals transmitted by the first device, an accessory controller that generates transducer signals from the received control signals, and a transducer that generates humanly-perceptive music accompaniment signals from the transducer signals.

133. The system of claim 132 wherein the music accompaniment signals are visual signals.

134. The system of claim 133 wherein the visual signals are generated by a light emitting diode

135. The system of claim 132 wherein the music accompaniment signals are tactile signals.

136. The system of claim 132 wherein the accessory controller performs frequency analysis on the received control signals.

137. The system of claim 132 wherein the wearable accessory additionally comprises a switch, wherein actuation of the switch causes the accessory to be receptive to an entraining signal from the first device, such that the accessory will accept signals from the first device.

138. An earphone for listening to audio entertainment allowing for the controlled reception of ambient sound by a user, comprising

a speaker that is oriented towards the user's ear;

an enclosure that reduces the amount of ambient noise perceptive to the user; and

a manually-adjustable characteristic of the enclosure that adjusts the amount of ambient sound perceptive to the user.

139. The earphone of claim 138 wherein the manually-adjustable characteristic is the size of apertures in the enclosure that admit ambient sound.

140. The earphone of claim 138 wherein the manually-adjustable characteristic is the number of apertures in the enclosure that admit ambient sound.

141. The earphone of claim 138 wherein the manually-adjustable characteristic is the surface area of the enclosure.

142. The earphone of claim 138 wherein the manually-adjustable characteristic is the thickness of the enclosure.

143. The earphone of claim 138, additionally comprising a spacer that attaches to the earphone and which increases the distance between the speaker and the user's ear.

144. The earphone of claim 138, additionally comprising a secondary enclosure that encloses the enclosure and the speaker, and which is detachable from the earphone.

145. A mobile device for the transmission of audio entertainment signals comprising

an audio signal store for the storage of the audio entertainment signals;

an audio signal player for the playing of the audio entertainment signals;

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an wireless transmitter for the transmission of the audio entertainment signals; and

a transmitter control to manually switch between two states consisting of the operation and the non-operation of the audio transmitter.

146. The device of claim 145 wherein the transmitter is connected to the audio jack of the audio signal player.

147. The device of claim 146 wherein the audio signal that is transmitted via the audio jack is subsequently divided between the transmitter and the headphone.

148. The device of claim 146 wherein the transmitter additionally comprises a second jack to which the earphone plug can connect, such that the insertion of the earphone plug into the second jack allows the audio signal to be heard in the earphone

149. A mobile device for the reception of digital audio entertainment signals comprising:

an audio signal store for the storage of the digital audio entertainment signals;

an audio receiver for the reception of external digital audio entertainment signals from a mobile audio signal transmitter located within a predetermined distance of the audio receiver;

a receiver control with at least a first state and a second state; and

an audio signal player that plays digital audio entertainment signals from the audio signal store when the receiver control is in the first state, and that plays digital audio entertainment signals from the audio receiver when the receiver control is in the second state.

150. The device of claim 149, additionally comprising a jack to which a listening device chosen from the group consisting of earphone and headphone can be connected.

151. A method for the shared enjoyment of music from stored musical signals between a first user with a first music player device and at least one second user with at least one second music player device, comprising:

playing the musical signals for the first user on the first music player device while essentially simultaneously wirelessly transmitting synchronization signals from the first music player device to the at least one second music player device; and

receiving the synchronization signals by the at least one second player device, wherein the synchronization signals allow the musical signals on the at least one second player device to be played essentially simultaneously with the playing of the musical signals on the first music player device;

wherein the first and the at least one second users are mobile.

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152. The method of claim 151 wherein the same musical signals are stored on the first music player device and the at least one second music player device.

153. The method of claim 152 wherein the musical signals are stored as compressed audio files.

154. The method of claim 151 wherein the synchronization signals comprise the current sample number being played on the first music player device.

155. The method of claim 154 wherein the synchronization signals further comprise the sample rate of the musical signal being played on the first music player device.

156. The method of claim 151 wherein the synchronization signals comprise the current time relative to the beginning of the musical signal being played on the first music player device.

157. The method of claim 151, additionally comprising transferring the musical signals from the first music player device to the at least one second music player device.

158. A wireless communications system for sharing audio entertainment between a first mobile device and a second mobile device, comprising:

a broadcast identifier transmitted by the first mobile device to the second mobile device;

a personal identifier transmitted by the second mobile device to the first mobile device; and

a broadcast signal comprising audio entertainment that is transmitted by the first mobile device of which the second device is receptive;

wherein the first mobile device and the second mobile device have displays which can display the identifier signal that they receive and the second mobile device can play the audio entertainment from the broadcast signal that it receives.

159. The system of claim 158 wherein the identifier signals are transmitted via an Internet protocol.

160. The system of claim 159 wherein the Internet protocol is a connection-oriented transport protocol.

161. The system of claim 159 wherein the Internet protocol further comprises a link layer protocol selected from the group consisting of 802.11, Bluetooth, ultrawideband, HiperLAN and WDCT.

162. The system of claim 158 wherein the broadcast signal is transmitted via an Internet protocol.

163. The system of claim 162 wherein the Internet protocol is a connectionless transport protocol.

164. The system of claim 162 wherein the Internet protocol further comprises a link layer protocol selected from the group consisting of 802.11, Bluetooth, ultrawideband, HiperLAN and WDCT.

165. The system of claim 158 wherein the broadcast signal is an analog radio frequency signal.

166. The system of claim 158 wherein the broadcast signal is transmitted via telephony.

167. The system of claim 158 wherein the broadcast signal is compressed.

168. The system of claim 158 wherein the broadcast signal is encrypted.

169. The system of claim 158, additionally comprising a transfer signal that is transmitted by the first mobile device upon halting the transmission of its broadcast signal, and which transfer signal is receptive by the second mobile device, such that reception by the second mobile device causes the device to transmit a second broadcast signal comprising audio entertainment for which the first unit is receptive.

170. The system of claim 158 wherein the broadcast signal is transmitted via peer-to-peer communications.

171. The system of claim 170 additionally comprising a switch, wherein actuation of the switch causes the device to toggle between peer-to-peer communications and infrastructure-based communications.

172. The system of claim 158 wherein the broadcast signal is transmitted via infrastructure-based communications.

173. The system of claim 158 wherein the personal identifier includes a least one piece of information about the user of the second mobile device taken from the group consisting of the name of the user, the nickname of the user, a numerical identifier, an alphanumerical identifier, the musical preferences of the user, the age of the user, and the educational institution that the user attends.

174. The system of claim 158 additionally comprising a third mobile device whose user requests to receive the broadcast signal and additionally comprising a requester identifier signal transmitted by the third mobile device to the first mobile device.

175. The system of claim 174 wherein the requester identifier signal is additionally transmitted by the third mobile device to the second mobile device.

176. The system of claim 174 wherein the requester identifier signal is additionally transmitted by the first mobile device to the second mobile device.

177. The system of claim 174 wherein the requester identifier is displayed on the display of the first mobile device.

178. The system of claim 174 wherein the third mobile device receives the broadcast signal without the affirmative action of the first mobile device.

179. The system of claim 174 wherein the third mobile device must receive the affirmative action of the first mobile device in order to receive the broadcast signal.

180. The system of claim 174 wherein the third mobile device must receive the affirmative action of the first mobile device and all other mobile devices receptive of the broadcast signal.

181. The system of claim 180 wherein the affirmative action is a unanimous vote.

182. The system of claim 180 wherein the affirmative action is a majority vote.

183. The system of claim 158, additionally comprising a substantially unique musical identifier related to the audio entertainment, wherein the musical identifier is transmitted by the first mobile device to the second mobile device in association with the broadcast signal, and the musical identifier is stored on the second mobile device in association with the broadcast identifier.

184. A system for identifying a first device that introduces a music selection to a second device, comprising:

a mobile music transmitter operated by the first device;

a mobile music receiver operated by the second device;

a music signal comprising the music selection transmitted by the transmitter and received by the receiver;

an individual musical identifier that is associated with the music selection; and

an individual transmitter identifier that identifies the transmitter, wherein the transmitter identifier and the individual music identifier are stored in association with each other in the receiver.

185. A method for enhancing enjoyment of a musical selection, comprising:

obtaining control signals related to the musical selection;

transmitting the control signals wirelessly;

receiving the control signals; and

converting the control signals to a humanly-perceptible form.

186. The method of claim 185 wherein the distance over which the control signals are transmitted has a minimum range of at least 1 foot.

187. The method of claim 185 wherein the distance over which the control signals are transmitted has a maximum range of less than 500 feet.

188. The method of claim 185 wherein the humanly-perceptible form is a visually-perceptible form.

189. The method of claim 185 wherein the humanly-perceptible form is a tactilely-perceptible form.

190. The method of claim 185 wherein the transmitting and receiving use radio frequency communications.

191. The method of claim 185 wherein the radio frequency communications use an Internet protocol.

192. The method of claim 185 wherein the Internet protocol involves a link layer chosen from the group consisting of 802.11, Bluetooth, ultrawideband, HiperLAN and WDCT.

193. The method of claim 185 wherein obtaining additionally comprises extracting the musical beat from the musical selection.

194. The method of claim 185 wherein obtaining additionally comprises retrieving the control signals from a store of control signals.

195. The method of claim 185 wherein the control signals are divided into multiple channels.

196. The method of claim 195 wherein the step of converting comprises a step of demultiplexing the control signals.

197. The method of claim 185 wherein the steps of transmitting and receiving are performed using means conveyed by a single person.

198. The method of claim 197 wherein the user is mobile.

199. The method of claim 185 wherein the step of transmitting is performed by a stationary user and the step of receiving is performed by a mobile user.

200. The method of claim 185 wherein the musical selection is provided by musicians in concert playing essentially simultaneously with obtaining control signals.

201. The method of claim 185 wherein the control signals are transmitted with a substantially unique identifier.

202. The method of claim 185 wherein the control signals control the appearance of a wearable device.

203. A method for generating and storing control signals corresponding to musical signals, comprising:

playing musical signals for a user;

receiving manual input signals from the user that are produced substantially in synchrony with the music;

generating control signals from the input signals; and

storing the control signals so that they can be retrieved with the musical signals.

204. The method of claim 203 wherein receiving comprises transducing tactile input from the user.

205. The method of claim 204 wherein the tactile input is produced using a user appendage selected from the group consisting of hand, finger and foot.

206. The method of claim 203 wherein receiving comprises transducing sound output produced by the user.

207. The method of claim 203 wherein storing comprises interleaving control signals within the musical signals.

208. The method of claim 203 wherein storing additionally comprises creating a digital file.

209. The method of claim 203 wherein storing additionally comprises associating the digital file with the musical signals.

210. A wearable personal accessory, comprising:

an input transducer taken from the group consisting of a microphone and an accelerometer, said transducer generating a time-varying input transduction signal;

a controller which accepts the input transduction signal, and which generates an output transducer signal whose signal varies in amplitude with time;

an output transducer receptive of the output transducer signal, and which provides a humanly-perceptible signal; and

an energy source for powering the input transducer, controller and output transducer.

211. The accessory of claim 210 wherein the accelerometer responds to the movements of the user in one axis of movement.

212. The accessory of claim 210 wherein the accelerometer responds to the movements of the user in more than one axis of movement.

213. The accessory of claim 210 wherein the controller performs automatic gain control on the signal from the input transducer.

214. The accessory of claim 210 wherein the output transducer is a light transducer.

215. The accessory of claim 214 wherein the output transducer comprises a light emitting diode.

216. The accessory of claim 214 wherein the output transducer comprises a liquid crystal display.

217. The accessory of claim 214 wherein the output transducer comprises an organic light emitting diode.

218. The accessory of claim 210 wherein the output transducer is a tactile transducer.

219. The accessory of claim 210 wherein the output transducer comprises a first and a second transduction element.

220. The accessory of claim 219 wherein the first transduction element responds preferentially to a first band of frequencies of the input transduction signal and the second transduction element responds preferentially to a second band of frequencies of the input transduction signal.

221. The accessory of claim 219 wherein the first transduction element responds preferentially to a first band of amplitudes of the input transduction signal and the second transduction element responds preferentially to a second band of amplitudes of the input transduction signal.

222. A wearable personal accessory controlled via wireless communications, comprising:

a wireless communications receiver, receptive of an external control signal;

a controller that accepts the external control signal and that generates a time-varying visual output transducer signal;

a visual output transducer that is receptive of the output transducer signal, and which provides a humanly-perceptible visual signal; and

an energy store for powering the receiver, controller and output transducer;

wherein the visual output transducer generates visually-perceptive output.

223. The accessory of claim 222 wherein the external control signal is a time-varying amplitude signal.

224. The accessory of claim 223 wherein the amplitude signal is analog.

225. The accessory of claim 223 wherein the amplitude signal is digital.

226. The accessory of claim 223 wherein the amplitude signal is substantially a musical signal.

227. The accessory of claim 226 wherein the controller performs frequency filtering of the external control signal.

228. The accessory of claim 226 wherein the controller determines the primary beat of the music.

229. The accessory of claim 228 wherein the primary beat of the music is determined according to the positions in the music where the amplitude rises at least a predetermined factor over less than a predetermined time.

230. The accessory of claim 222 wherein the external control signal is a digital signal of pairs comprising positions within the music and the amplitudes to which the output transducers are set at such times.

231. The accessory of claim 230 wherein the positions are chosen from the group of characteristics consisting of samples and times.

232. The accessory of claim 222 wherein the receiver is an analog radio frequency receiver.

233. The accessory of claim 232 wherein the analog radio frequency communications are at a frequency set by a crystal oscillator, wherein the crystal oscillator can be manually exchanged in order to change the frequency of operation.

234. The accessory of claim 222 wherein the receiver receives Internet protocol signals.

235. The accessory of claim 234 wherein the Internet protocol further comprises a link layer selected from the group consisting of Bluetooth, 802.11 and ultrawideband.

236. The accessory of claim 222 wherein the visual output transducer comprises a first light transducer and a second light transducer.

237. The accessory of claim 236 wherein the external control signal comprises a multiplexed first signal and second signal, and wherein the first signal relates to the first light transducer and the second signal relates to a second light transducer.

238. The accessory of claim 237 wherein the controller comprises at least two ports, wherein the first port relates to the first light generating element and the second port related to the second light generating element.

239. The accessory of claim 236 wherein the first light transducer responds preferentially to a first range of frequency in the musical signal, and the second light transducer responds preferentially to a second range of frequency in the musical signal.

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240. The accessory of claim 236 wherein the first light transducer responds preferentially to a first range of amplitude in the musical signal, and the second light transducer responds preferentially to a second range of amplitude in the musical signal.

241. The accessory of claim 222 wherein the visual output transducer comprises a light emitting diode.

242. The accessory of claim 222 wherein the visual output transducer comprises an organic light emitting diode.

243. The accessory of claim 222 wherein the visual output transducer comprises a liquid crystal display.

244. The accessory of claim 222 additionally comprising a tactile transducer responsive to the external control signal.

245. The accessory of claim 222 additionally comprising a sound transducer responsive to the external control signal.

246. The accessory of claim 222 wherein the external control signal additional comprises a digital identifier.

247. The accessory of claim 246 wherein the visual output transducer additionally provides an identifier signal that corresponds to the digital identifier, wherein such identifier signal is higher frequency than is humanly perceptible, and wherein the identifier signal is output substantially simultaneously with the humanly-perceptible visual signal.

248. The accessory of claim 222 additionally comprising a manually-separable electrical connection, wherein the connection connects the receiver to the controller.

249. The accessory of claim 222 additionally comprising a manually-separable electrical connection, wherein the connection connects the controller to the output transducer.

250. The accessory of claim 222 wherein the accessory functions as an accoutrement selected from the group consisting of a ring, a pendant, a hair clip, an earring, a necklace, a brooch, a belt buckle, watches, and a bracelet.

251. The accessory of claim 222 wherein the accessory is incorporated into an article of clothing selected from the group consisting of a backpack, a wallet, a purse, a hat and a shoe.

252. The accessory of claim 222 additionally comprising a manual control whose operation sets either a first state and a second state and wherein in the first state the accessory responds exclusively to external control signals comprising a substantially unique identifier.

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253. The accessory of claim 252 wherein the identifier to which the accessory responds in the first state is received by the receiver when the accessory is set to the second state.

254. The accessory of claim 253 additionally comprising a third state which is manually set, wherein in the third state, the accessory responds to external control signals in the absence of a substantially unique identifier.

255. A device for converting user tactile responses to stored music into a stored control signal, comprising:

a player that plays stored music audible to the user;

a manually-operated transducer that outputs an electrical signal, wherein the transducer is actuated by the user in response to the music;

a controller that receives the electrical signal and outputs a control signal; and

a store that receives the control signal and stores it.

256. The device of claim 255 wherein the control signal comprises a list of positions, wherein the positions are chosen from the set of characteristics consisting of samples and time relative to the beginning of the stored music.

257. The device of claim 255 wherein the control signal further comprises a list of amplitudes corresponding to the positions.

258. The device of claim 257 additionally comprising a second manually-operated transducer that outputs a second electrical signal, wherein the controller additionally receives the second electrical signal.

259. The device of claim 255 wherein the transducer comprises a musical drum operated by the user whose audible output is received by a microphone that generates the electrical signal received by the controller.

260. The device of claim 255 wherein the controller performs frequency filtering on the electrical signal.

261. The device of claim 255 wherein the transducer is a tactile transducer that is operated by an appendage of the user selected from the group consisting of finger, hand, and foot.

262. The device of claim 255 wherein the store is a file system and the control signal is stored as control file and the stored music is stored as a music file, wherein the control file and the music file are stored in association with each other.

263. The device of claim 255 wherein the control signals are stored in an interleaved fashion with the stored music.

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264. The device of claim 71 additionally comprising a visual display on which a visual representation of the control signals is displayed.

265. A music player that wirelessly transmits control signals related to the music, wherein the control signals control a wearable electronic accessory, comprising:

a store of music signal files;

a controller that reads a musical signal file from the store and generates audio signals and that further generates the control signals;

a transducer that converts the audio signals into sound audible to the user; and

a wireless transmitter that transmits the control signal to the wearable electronic accessory.

266. The player of claim 265 wherein the music signal files comprise compressed audio files.

267. The player of claim 265 wherein the controller performs frequency filtering of the external control signal.

268. The player of claim 265 wherein the controller determines the primary beat of the music.

269. The player of claim 268 wherein the primary beat of the music is determined according to the positions in the music where the amplitude rises at least a predetermined factor over less than a predetermined time.

270. The player of claim 265 wherein the control signals are pairs comprising positions within the music and the amplitudes to which the output transducers are set at such times.

271. The player of claim 265 wherein the positions are chosen from the set of characteristics consisting of samples and times.

272. The player of claim 265 wherein the transmitter is an analog radio frequency transmitter.

273. The player of claim 265 wherein the transmitter transmits according to an Internet protocol.

274. The player of claim 273 wherein the Internet protocol has a link layer selected from the group consisting of 802.11, Bluetooth, ultrawideband, HiperLAN and WDCT.

275. The player of claim 265 additionally comprising a visual transducer that generates visually-preceptive output in response to the control signal, wherein the visual transducer receives the control signal from the controller.

276. The player of claim 275 wherein the visual transducer is a light emitting diode.

277. The player of claim 275 wherein the visual transducer is a liquid crystal display.

278. The player of claim 265 additionally comprising a store of configuration files wherein the configuration files include parameters read by the controller that affect the generation of control signals from the musical signals.

279. A music player that wirelessly transmits control signals related to the music, wherein the control signals control a wearable electronic accessory, comprising:

a store of music signal files;

a second store of control signal files associated with the music signal files;

a controller that reads a musical signal file from the store and generates audio signals and that further reads an associated control signal file;

a transducer that converts the audio signals into sound audible to the user, and

a wireless transmitter that transmits the control signals from the associated control signal file to the wearable electronic accessory.

280. The player of claim 279 wherein the music signal files comprise compressed audio files.

281. The player of claim 279 wherein the transmitter is an analog radio frequency transmitter.

282. The player of claim 279 wherein the transmitter transmits according to an Internet protocol.

283. The player of claim 282 wherein the Internet protocol has a link layer selected from the group consisting of 802.11, Bluetooth, ultrawideband, HiperLAN and WDCT.

284. The player of claim 279 wherein the store of control information comprises at least one binary data file that relates to a single music signal file.

285. The player of claim 279 wherein the store of control information is interleaved with a related music signal file in binary data format.

286. The player of claim 279 additionally comprising a visual transducer that generates visually-preceptive output in response to the electrical control signal, wherein the visual transducer receives the electrical control signal from the controller.

287. A system for exhibition of music enjoyment, comprising:

a source of music signals;

a controller that generates control signals from the music signals;

a transmitter of the control signals, wherein the transmission of the control signals is synchronized with the playing of the music signals;

a receiver of the control signals; and

a transducer that responds to the control signals.

288. The system of claim 287 wherein the source of music signals are stored binary music files.

289. The system of claim 288 wherein the stored binary data files are compressed audio files.

290. The system of claim 288 wherein the music signals are stored on a medium selected from the group consisting of compact disk, digital video disk, hard disk drive, removable disks, flash memory, magneto-optical disk, and audio tape.

291. The system of claim 287 wherein the source of music signals are musicians playing live music.

292. The system of claim 287 wherein the receiver and transducer are worn by a user.

293. The system of claim 287 wherein the receiver and the transducer are physically separated from the transmitter by more than 5 feet.

294. The system of claim 287 wherein the transducer is a visual transducer that generates humanly-perceptible visual signals.

295. The system of claim 294 wherein the visual transducer is a light emitting diode

296. The system of claim 294 wherein the visual transducer is a liquid crystal display

297. The system of claim 287 wherein the transducer is a tactile transducer.

298. The system of claim 287 wherein the minimum range of the transmitter for which the receiver is receptive is at least 1 foot.

299. The system of claim 287 wherein the maximum range of the transmitter for which the receiver is receptive is less than 500 feet.

300. The system of claim 287 wherein the controller determines the primary beat of the music.

301. The system of claim 287 wherein the controller performs frequency filtering.

302. The system of claim 287, additionally comprising a second controller that is electrically connected to the receiver, and which generates transducer control signals from the control signals received by the receiver, wherein the transducer control signals directly control the transducer.

303. The system of claim 302 wherein the control signals are time-varying amplitude signals and wherein the second controller performs frequency filtering.

304. The system of claim 302 additionally comprising a switch that is electrically connected to the second controller such that actuation of the switch places the second controller into entraining mode, wherein the receiver becomes receptive of entraining signals from the transmitter.

305. The system of claim 304 wherein a receiver that is entrained will receive control signals other than from the transmitter in the absence of signals from the transmitter.

306. The system of claim 304 wherein additional actuation of the switch will allow reception of control signals by the receiver from a transmitter to which it is not entrained.

307. The system of claim 287 wherein the transmitter and receiver communicate via an Internet protocol.

308. The system of claim 287 wherein the transmitter and receiver communicate via digital radio frequency communications.

309. The system of claim 287 wherein the transmitter and receiver communicate via analog radio frequency communications.

310. The system of claim 309 wherein the analog radio frequency communications are at a frequency set by a crystal oscillator and wherein the crystal oscillator can be manually replaced.

311. The system of claim 287 additionally comprising a transferror for the transmission of music signals.

312. The system of claim 311 wherein the transmitter and the transferror are the same.

313. The system of claim 311 wherein the transmitter and the transferror are different, and communicate via different communications protocols.

314. The system of claim 287 additionally comprising a second receiver for the reception of music signals, wherein the music signals that are received are played by the music player.

315. A method for transferring a wearable-accessory control file stored on a first device to a second device in which an associated music file is stored, comprising:

storing on the first device the name of the music file in conjunction with the control file with which it is associated;

requesting by the second device of the first device for a control file stored in conjunction with the name of the music file; and

transferring the control file from the first device to the second device, wherein the control file is stored on the second device in conjunction with the name of the associated music file.

316. The method of claim 315 additionally comprising the step of extracting, wherein the control file is stored on the first device interspersed with the music file as a combined file, and the control file is extracted from the music file prior to being transferred to the second device.

317. The method of claim 315 wherein the requesting is performed over a wide area network.

318. The method of claim 315 wherein the name of the control file comprises the root of the name of the associated music file appended with a predetermined extension that is different from that of the music file.

319. The method of claim 315 wherein the control file and the associated music file both comprise the same substantially unique identifier.

320. A device for transmitting control signals to a wearable accessory receptive of such control signals, comprising:

a manually-separable input connector for connecting to an output port of an audio player, wherein audio signals are conveyed from the audio player to the device across the connector;

a controller for generating control signals from the audio signals; and

a transmitter for transmitting the control signals.

321. The device of claim 320 additionally comprising a second connector, wherein a portion of the audio signal conveyed to the device is conveyed to the second connector, and wherein an earphone can connect to the second connector.

322. The player of claim 320 wherein the controller performs frequency filtering of the audio signal.

323. The player of claim 320 wherein the controller determines the primary beat of the audio signal.

324. The player of claim 320 additionally comprising a visual transducer that generates visually-preceptive output in response to the control signals, wherein the visual transducer receives the control signals from the controller.

325. The system of claim 320 wherein the transmitter transmits via an Internet protocol.

326. The system of claim 320 wherein the transmitter transmits via digital radio frequency communications.

327. The system of claim 320 wherein the transmitter transmits via analog radio frequency communications.

328. The system of claim 327 wherein the analog radio frequency communications are at a frequency set by a crystal oscillator and wherein the crystal oscillator can be manually replaced.

329. The system of claim 320 wherein the transmitter additionally transmits the audio signal to wireless earphones.

Fig. 1

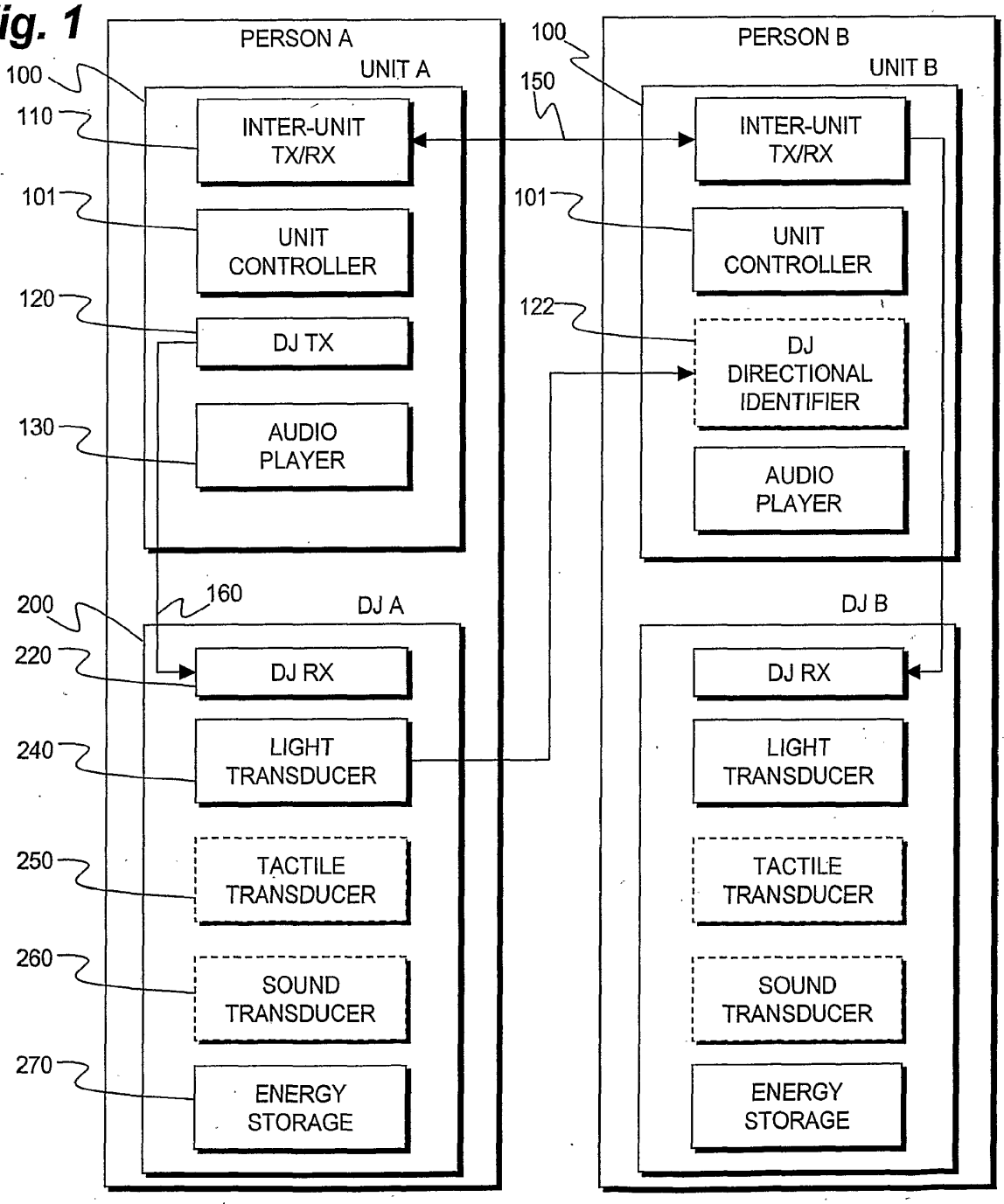

PERSON A
UNIT A
100
110
INTER-UNIT TX/RX
101
UNIT CONTROLLER
120
DJ TX
130
AUDIO PLAYER
160
200
DJ A
220
DJ RX
240
LIGHT TRANSDUCER
250
TACTILE TRANSDUCER
260
SOUND TRANSDUCER
270
ENERGY STORAGE
150
PERSON B
UNIT B
100
INTER-UNIT TX/RX
101
UNIT CONTROLLER
122
DJ DIRECTIONAL IDENTIFIER
AUDIO PLAYER
DJ B
DJ RX
LIGHT TRANSDUCER
TACTILE TRANSDUCER
SOUND TRANSDUCER
ENERGY STORAGE

Fig. 2A

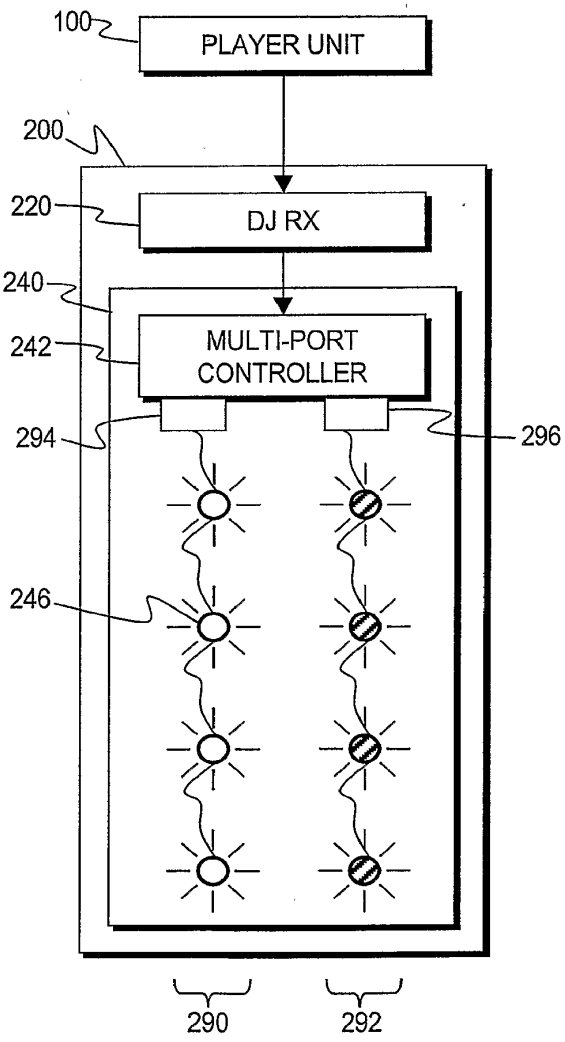

100
PLAYER UNIT
200
220
DJ RX
240
242
MULTI-PORT CONTROLLER
294
296
246
290
292

Fig. 2B

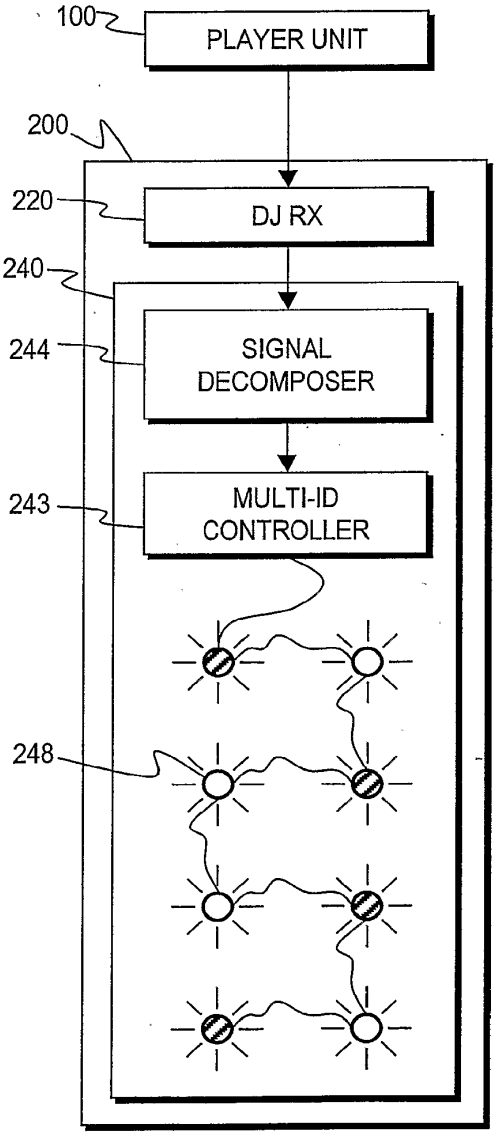

100
PLAYER UNIT
200
220
DJ RX
240
244
SIGNAL DECOMPOSER
243
MULTI-ID CONTROLLER
248

Fig. 3A

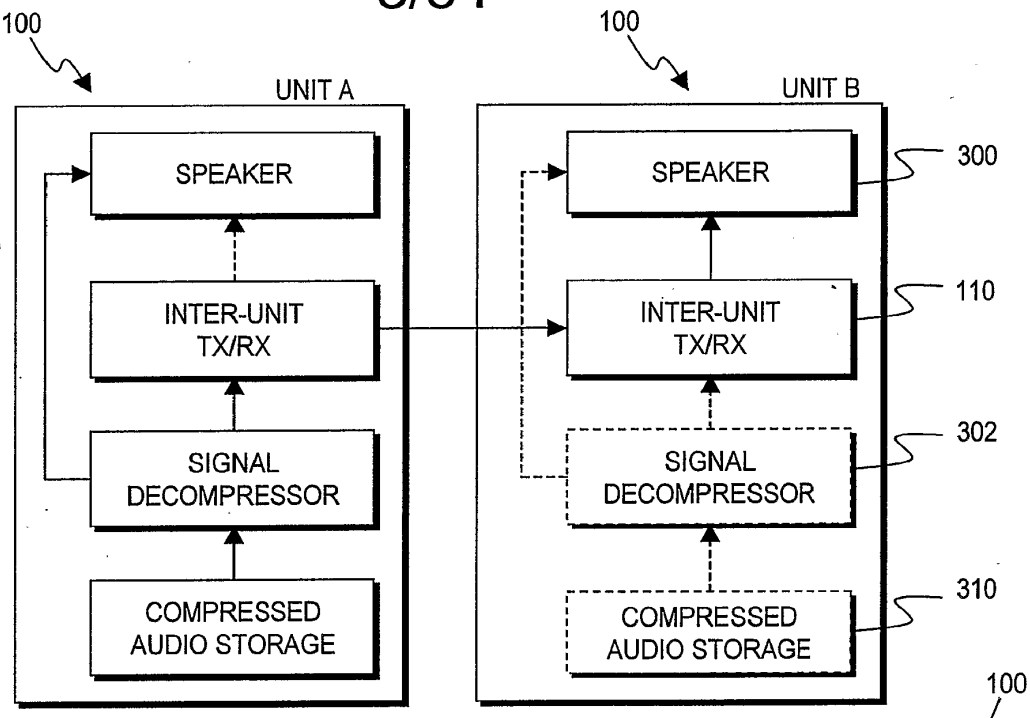

100
UNIT A
SPEAKER
INTER-UNIT TX/RX
SIGNAL DECOMPRESSOR
COMPRESSED AUDIO STORAGE
100
UNIT B
SPEAKER
INTER-UNIT TX/RX
SIGNAL DECOMPRESSOR
COMPRESSED AUDIO STORAGE
300
110
302
310

Fig. 3B

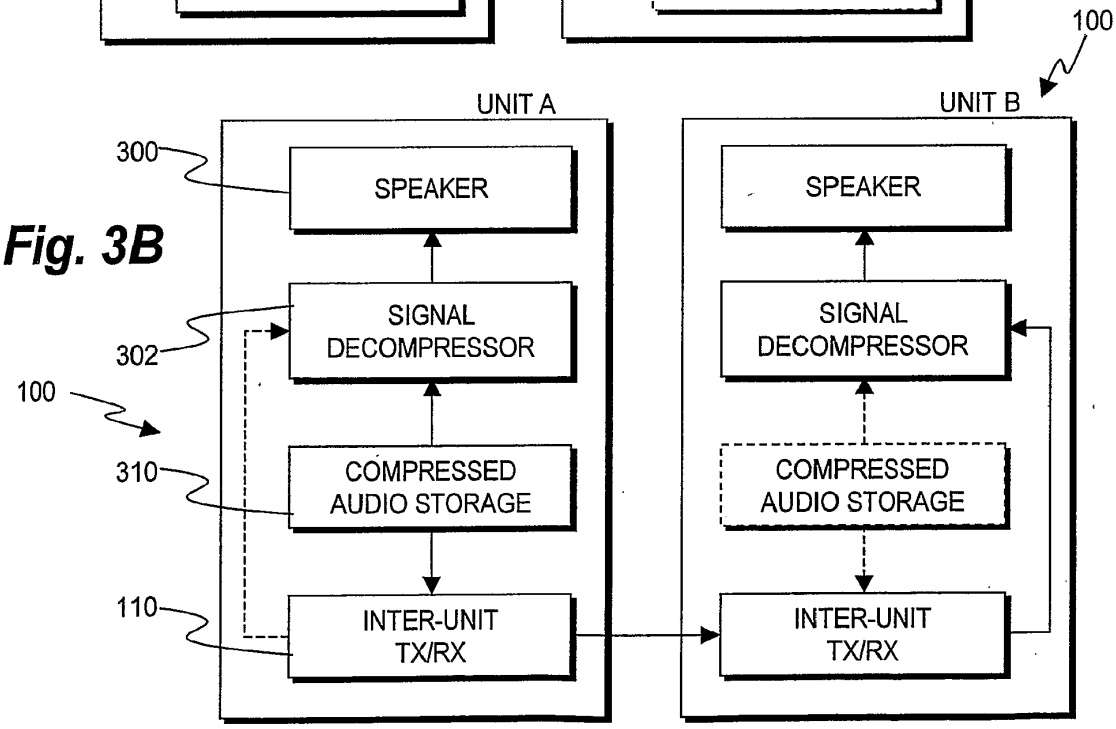

100
UNIT A
UNIT B
300
SPEAKER
SIGNAL DECOMPRESSOR
302
COMPRESSED AUDIO STORAGE
310
INTER-UNIT TX/RX
110

Fig. 3C

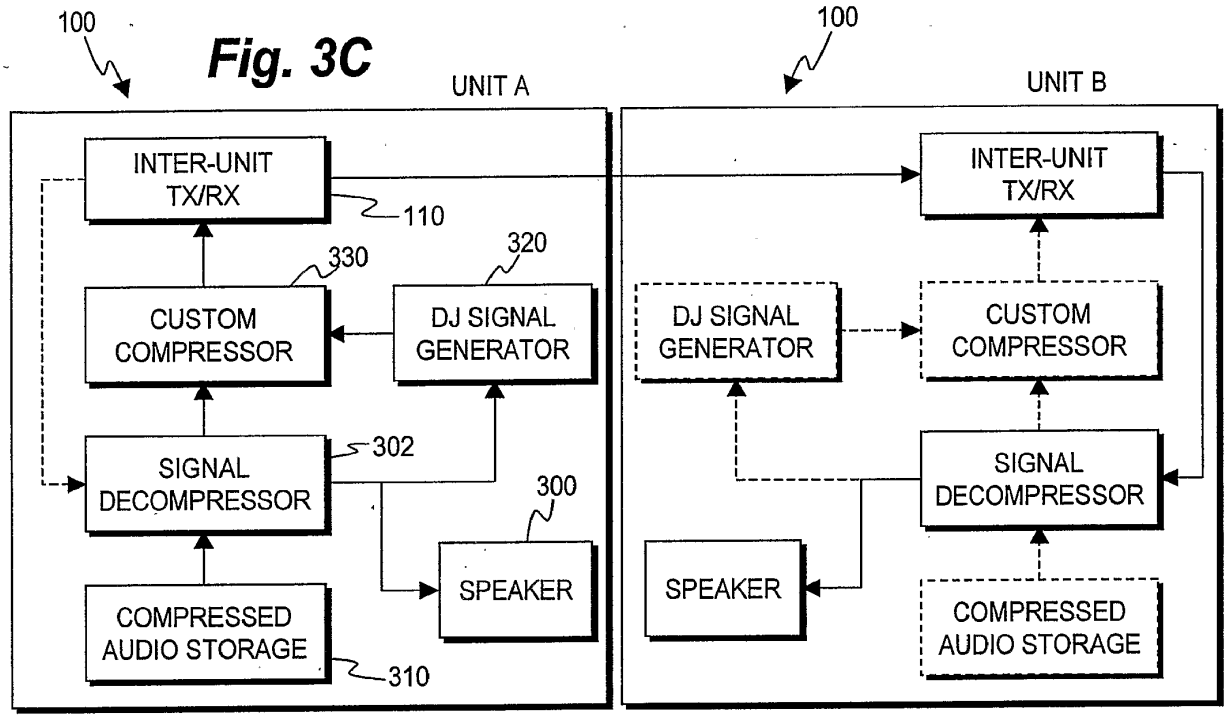

100
UNIT A
INTER-UNIT TX/RX
110
330
320
CUSTOM COMPRESSOR
DJ SIGNAL GENERATOR
SIGNAL DECOMPRESSOR
302
300
SPEAKER
COMPRESSED AUDIO STORAGE
310
100
UNIT B
INTER-UNIT TX/RX
DJ SIGNAL GENERATOR
CUSTOM COMPRESSOR
SIGNAL DECOMPRESSOR
SPEAKER
COMPRESSED AUDIO STORAGE

Fig. 4

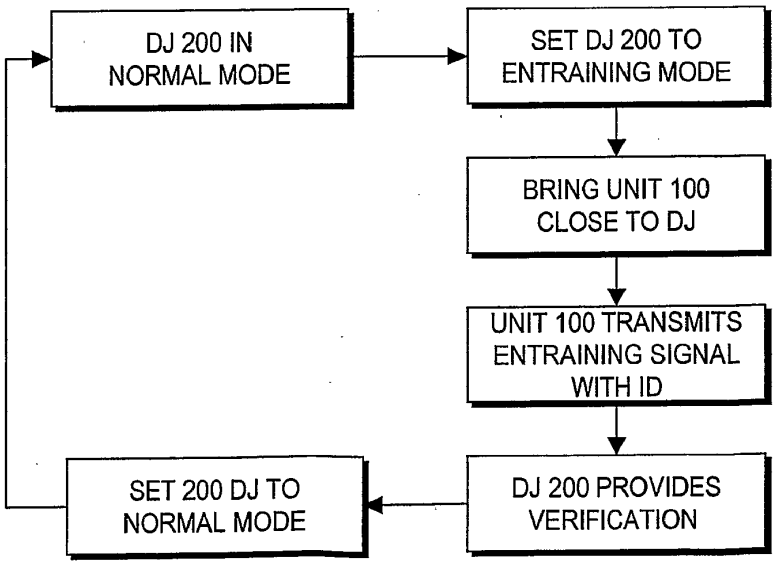

DJ 200 IN NORMAL MODE
SET DJ 200 TO ENTRAINING MODE
BRING UNIT 100 CLOSE TO DJ
UNIT 100 TRANSMITS ENTRAINING SIGNAL WITH ID
DJ 200 PROVIDES VERIFICATION
SET 200 DJ TO NORMAL MODE

Fig. 5A

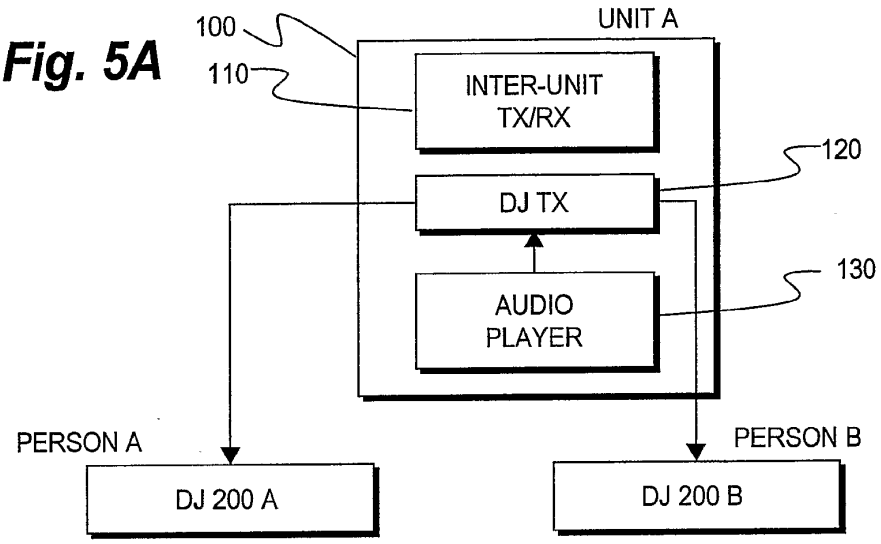

100
UNIT A
110
INTER-UNIT TX/RX
120
DJ TX
130
AUDIO PLAYER
PERSON A
PERSON B
DJ 200 A
DJ 200 B

Fig. 5B

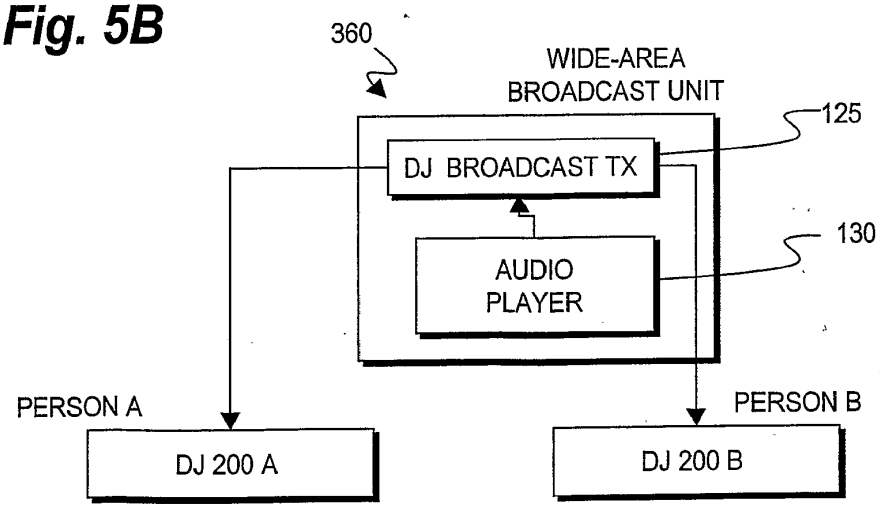

360
WIDE-AREA BROADCAST UNIT
125
DJ BROADCAST TX
130
AUDIO PLAYER
PERSON A
PERSON B
DJ 200 A
DJ 200 B

Fig. 6

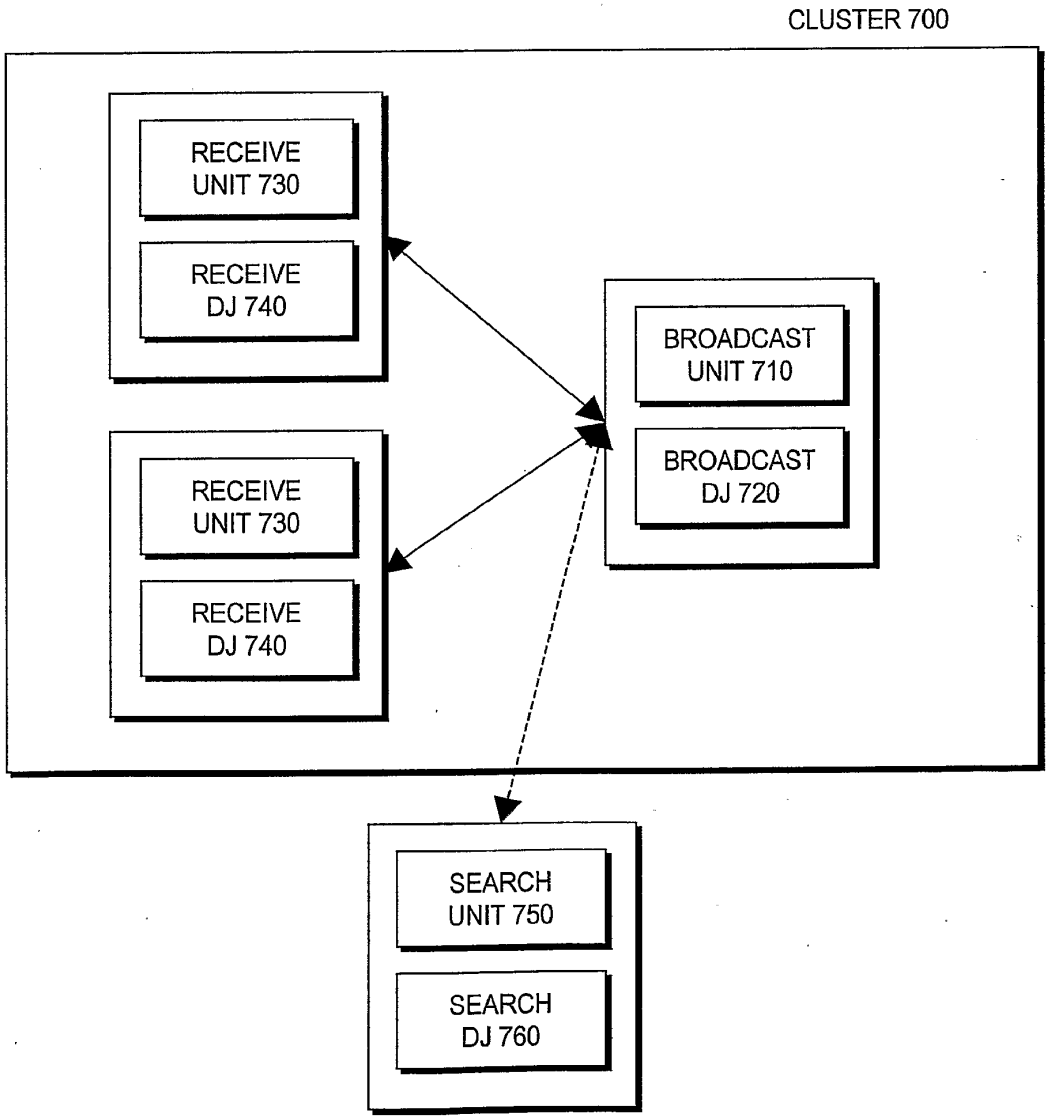

CLUSTER 700
RECEIVE UNIT 730
RECEIVE DJ 740
RECEIVE UNIT 730
RECEIVE DJ 740
BROADCAST UNIT 710
BROADCAST DJ 720
SEARCH UNIT 750
SEARCH DJ 760

Fig. 7

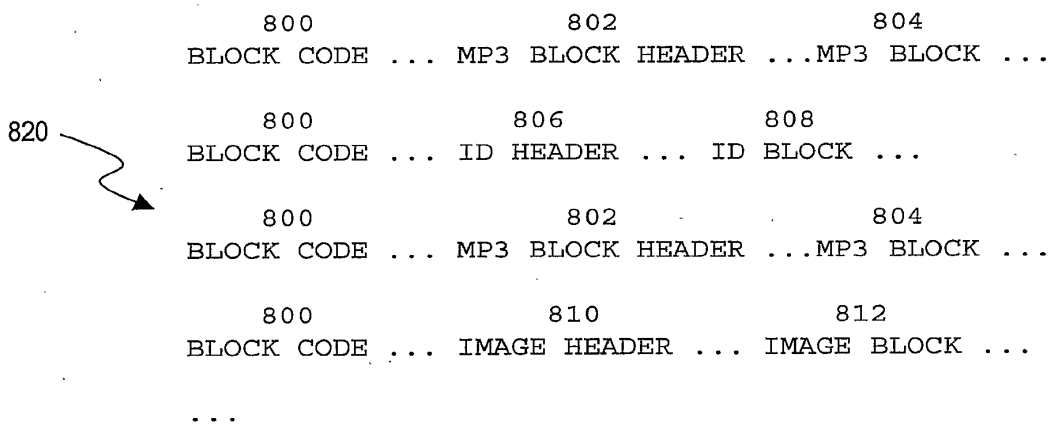

800
802
804
BLOCK CODE ... MP3 BLOCK HEADER ...MP3 BLOCK ...
820
800
806
808
BLOCK CODE ... ID HEADER ... ID BLOCK ...
800
802
804
BLOCK CODE ... MP3 BLOCK HEADER ...MP3 BLOCK ...
800
810
812
BLOCK CODE ... IMAGE HEADER ... IMAGE BLOCK ...
...

Fig. 36

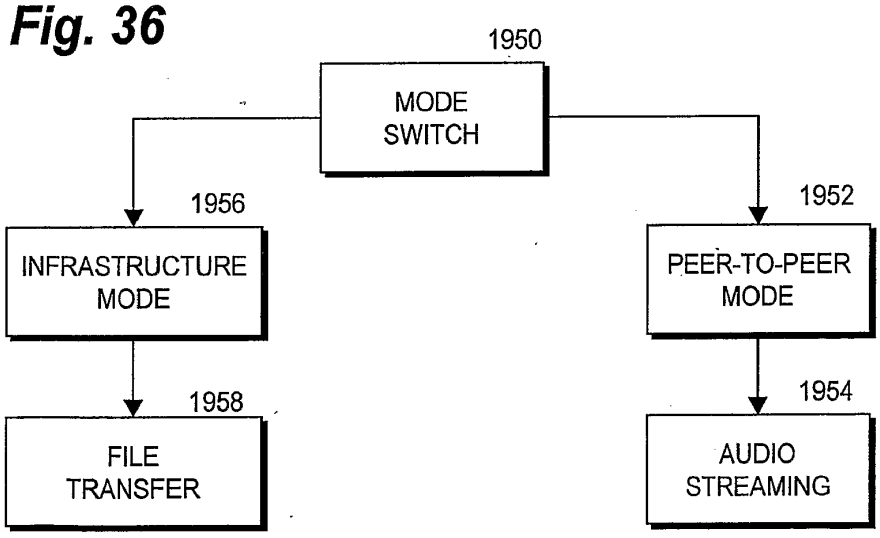

1950
MODE SWITCH
1956
INFRASTRUCTURE MODE
1952
PEER-TO-PEER MODE
1958
FILE TRANSFER
1954
AUDIO STREAMING

Fig. 8A

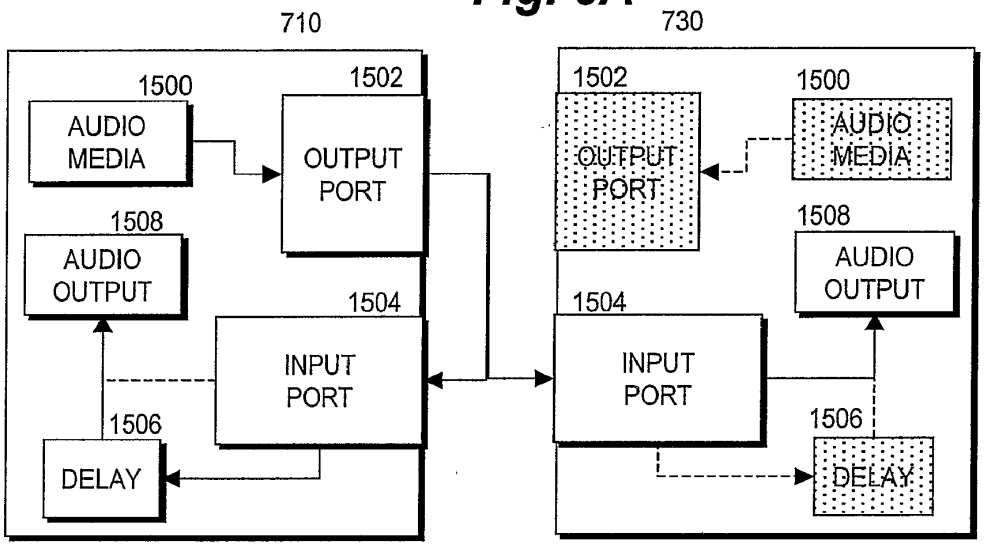

710
730
1500
AUDIO MEDIA
1502
OUTPUT PORT
1508
AUDIO OUTPUT
1504
INPUT PORT
1506
DELAY
1502
OUTPUT PORT
1500
AUDIO MEDIA
1508
AUDIO OUTPUT
1504
INPUT PORT
1506
DELAY

Fig. 8B

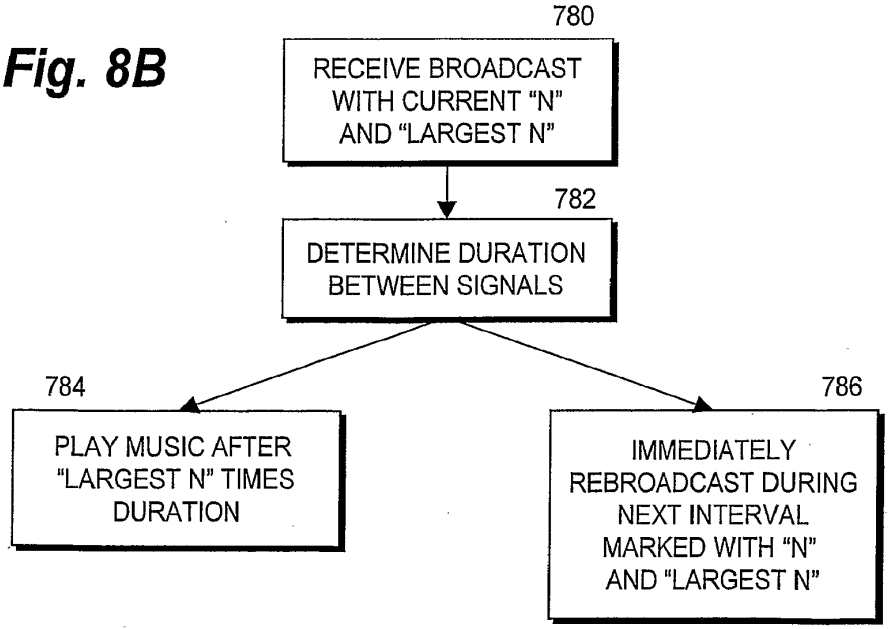

780
RECEIVE BROADCAST WITH CURRENT "N" AND "LARGEST N"
782
DETERMINE DURATION BETWEEN SIGNALS
784
PLAY MUSIC AFTER "LARGEST N" TIMES DURATION
786
IMMEDIATELY REBROADCAST DURING NEXT INTERVAL MARKED WITH "N" AND "LARGEST N"

Fig. 9A

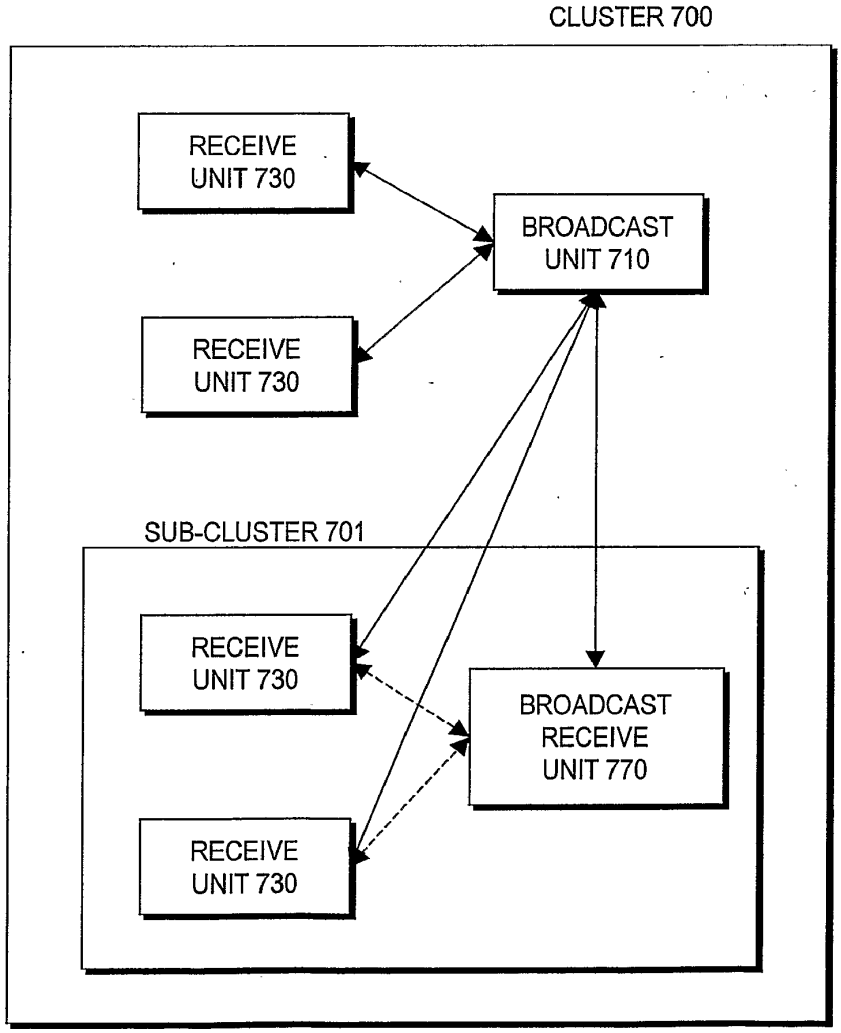
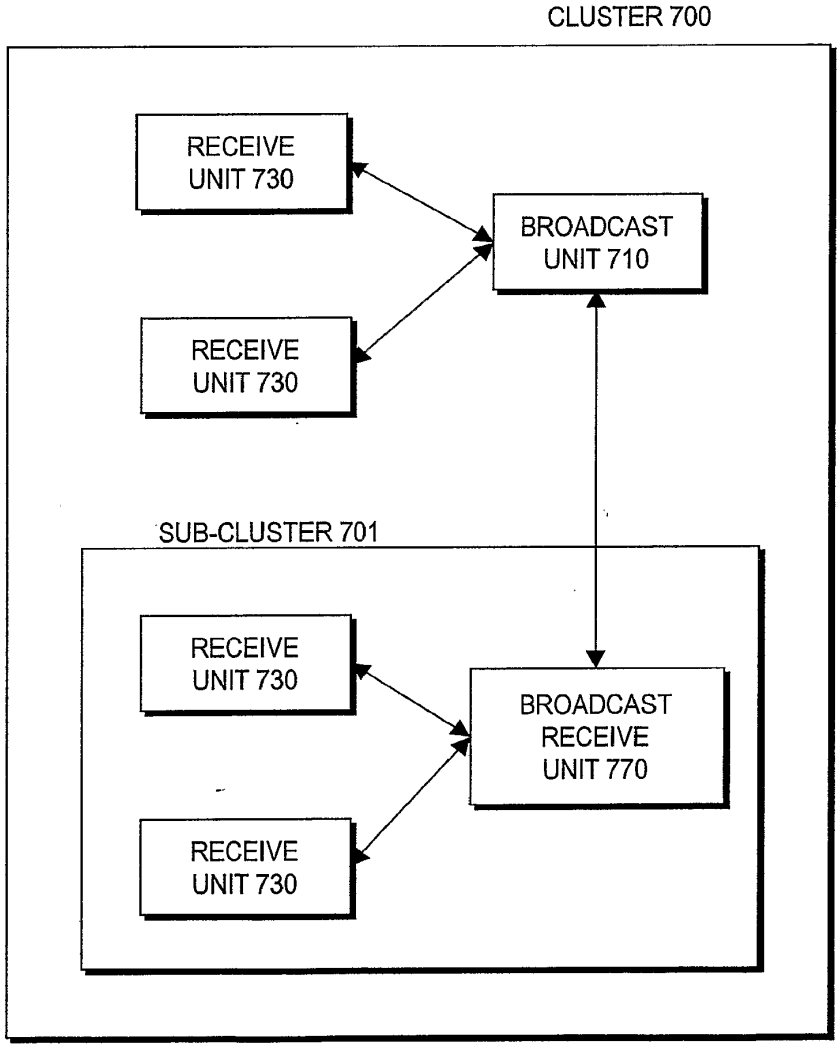

CLUSTER 700
RECEIVE UNIT 730
BROADCAST UNIT 710
RECEIVE UNIT 730
SUB-CLUSTER 701
RECEIVE UNIT 730
BROADCAST RECEIVE UNIT 770
RECEIVE UNIT 730

Fig. 9B


CLUSTER 700
RECEIVE UNIT 730
BROADCAST UNIT 710
RECEIVE UNIT 730
SUB-CLUSTER 701
RECEIVE UNIT 730
BROADCAST RECEIVE UNIT 770
RECEIVE UNIT 730