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(54) **TIME SYNCHRONIZATION OF VIDEO AND DATA INSIDE A MOBILE DEVICE**

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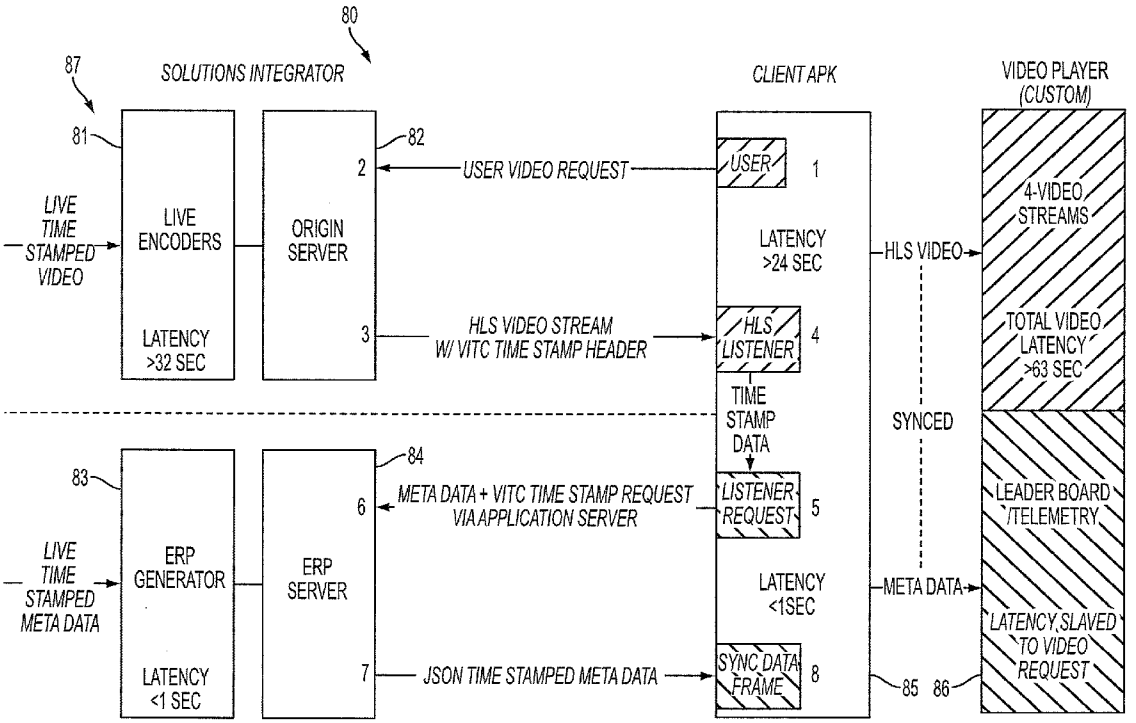
CPC ***H04N 5/04*** (2013.01); ***H04N 21/8547*** (2013.01); ***H04N 21/242*** (2013.01); ***H04N 21/4307*** (2013.01); ***H04N 7/0882*** (2013.01); ***H04N 7/025*** (2013.01)

(57) **ABSTRACT**

A video player tablet, or a mobile device includes a processor configured to receive live video and audio data from a communication network and format the video and audio data for display on the tablet. The processor is also configured to receive live meta-data from the communication network and format the meta-data for display on the same tablet. The processor is further configured to select the meta-data, and time synchronize the selected meta-data with the video and audio data for simultaneous display on the tablet, or mobile device.



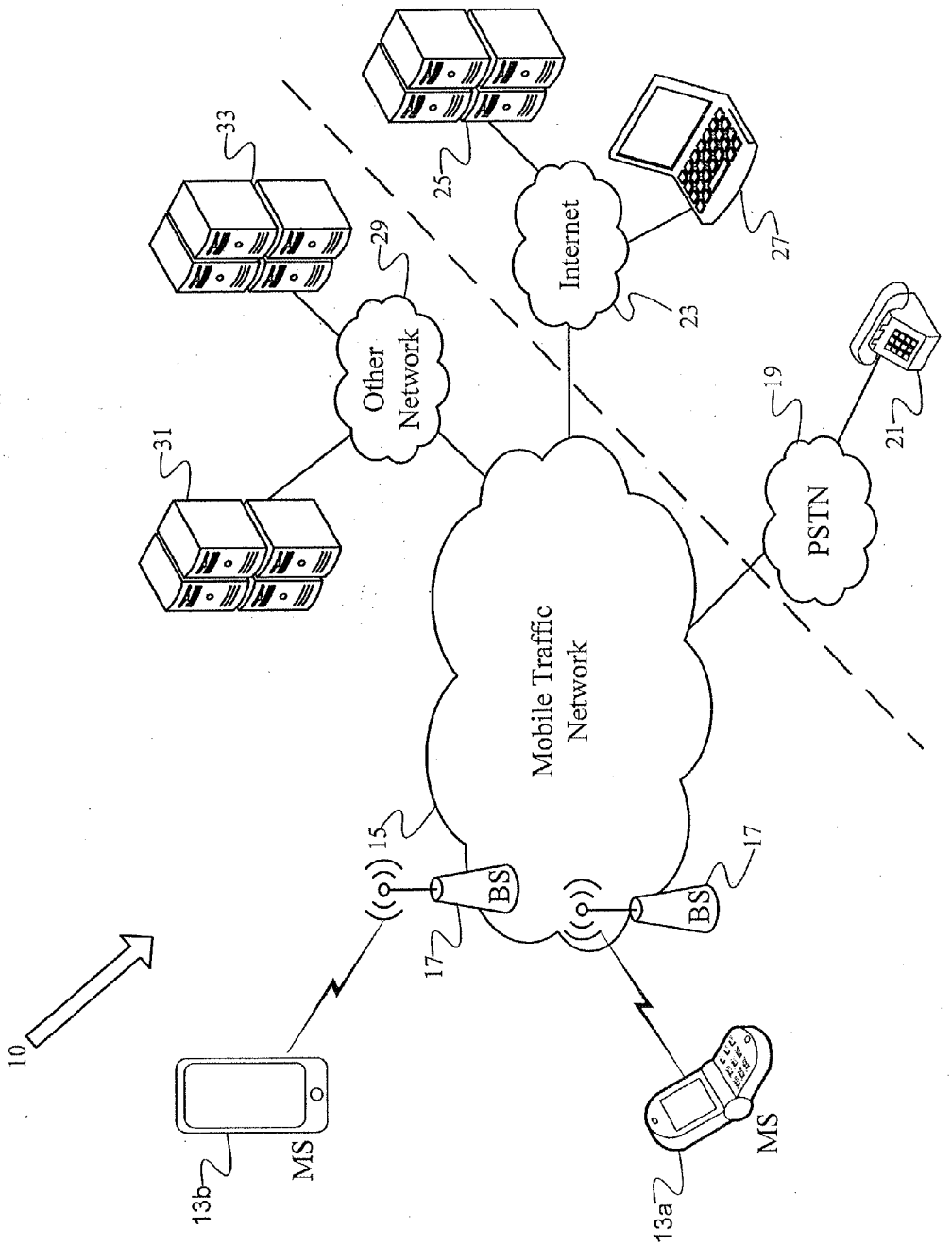

10
13b
MS
13a
MS
15
17
BS
17
BS
Mobile Traffic Network
31
Other Network
29
33
25
Internet
23
27
PSTN
19
21

FIG. 1

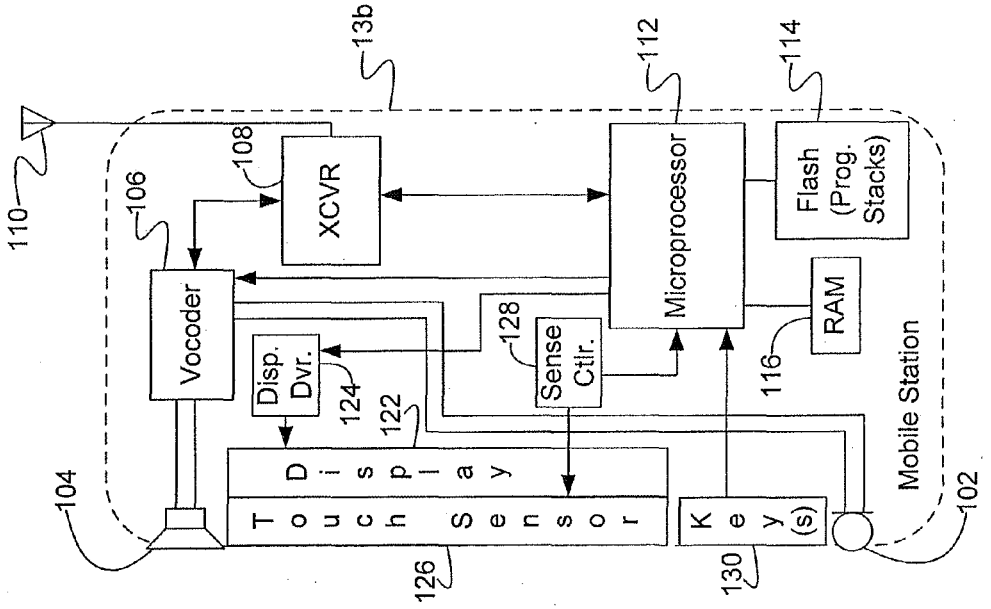

13b
110
106
108
XCVR
Vocoder
Microprocessor
112
114
Flash (Prog. Stacks)
RAM
116
128
Sense Ctlr.
Disp. Dvr.
124
122
Display
Touch Sensor
126
Key(s)
130
104
102
Mobile Station

FIG. 3

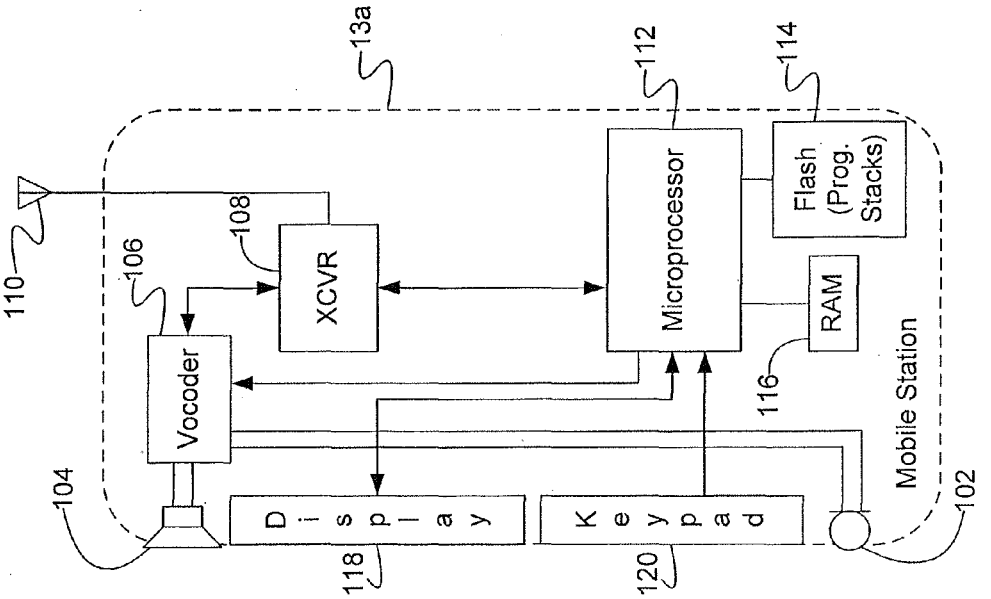

13a
110
106
108
XCVR
Vocoder
Microprocessor
112
114
Flash (Prog. Stacks)
RAM
116
Display
118
Keypad
120
104
102
Mobile Station

FIG. 2

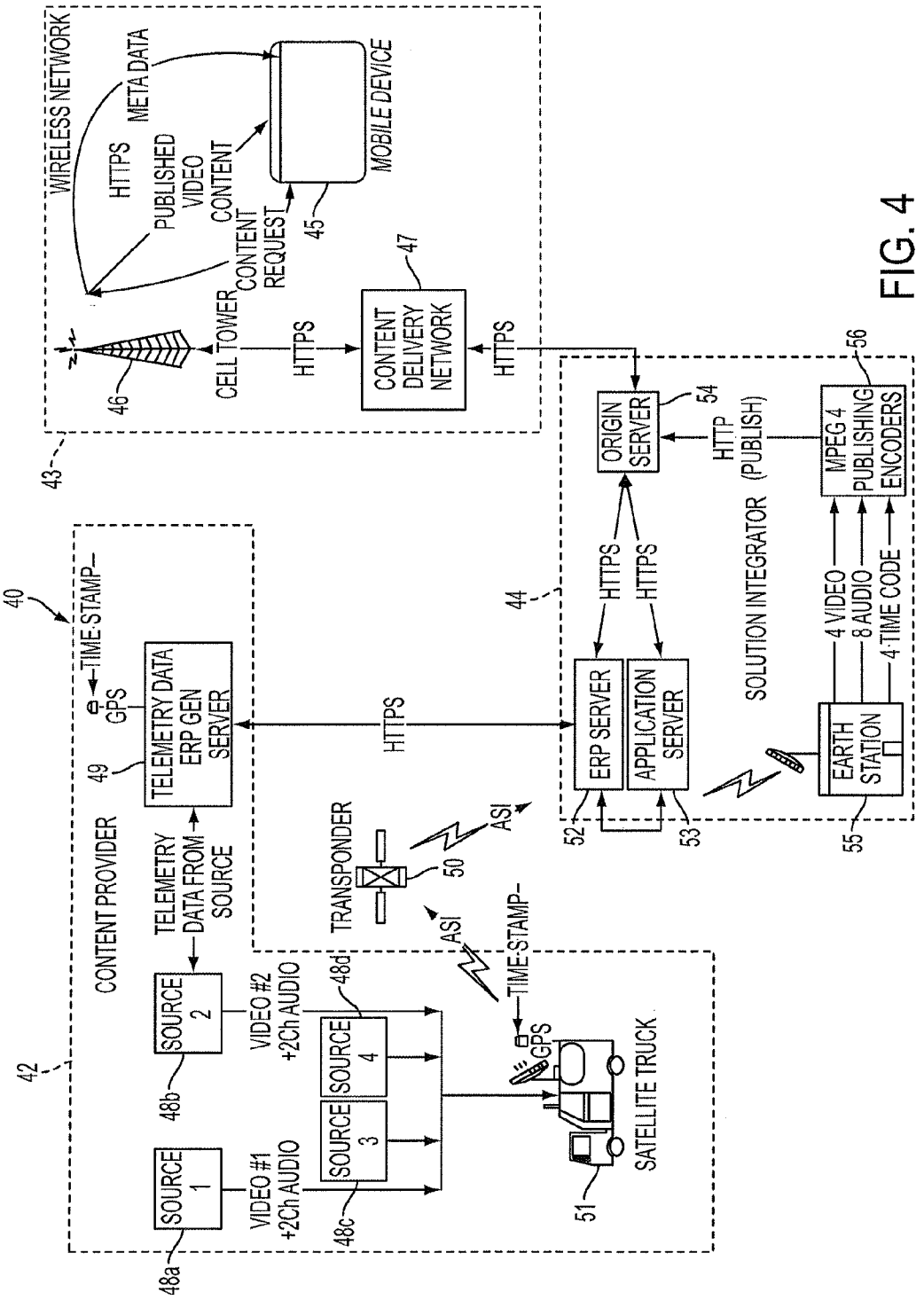

WIRELESS NETWORK
HTTPS
PUBLISHED VIDEO CONTENT
META DATA
CONTENT REQUEST
MOBILE DEVICE
45
47
46
CELL TOWER
HTTPS
CONTENT DELIVERY NETWORK
HTTPS
43
40
TIME-STAMP-
GPS
49
TELEMETRY DATA ERP GEN SERVER
HTTPS
44
HTTPS
HTTPS
ORIGIN SERVER
54
HTTP (PUBLISH)
MPEG 4 PUBLISHING ENCODERS
56
ERP SERVER
APPLICATION SERVER
SOLUTION INTEGRATOR
4 VIDEO
8 AUDIO
4 TIME CODE
EARTH STATION
52
53
55
CONTENT PROVIDER
TELEMETRY DATA FROM SOURCE
TRANSPONDER
50
ASI
ASI
TIME-STAMP-
42
SOURCE 2
48b
VIDEO #2 +2Ch AUDIO
48d
SOURCE 4
SOURCE 3
48c
SOURCE 1
48a
VIDEO #1 +2Ch AUDIO
GPS
SATELLITE TRUCK
51

FIG. 4

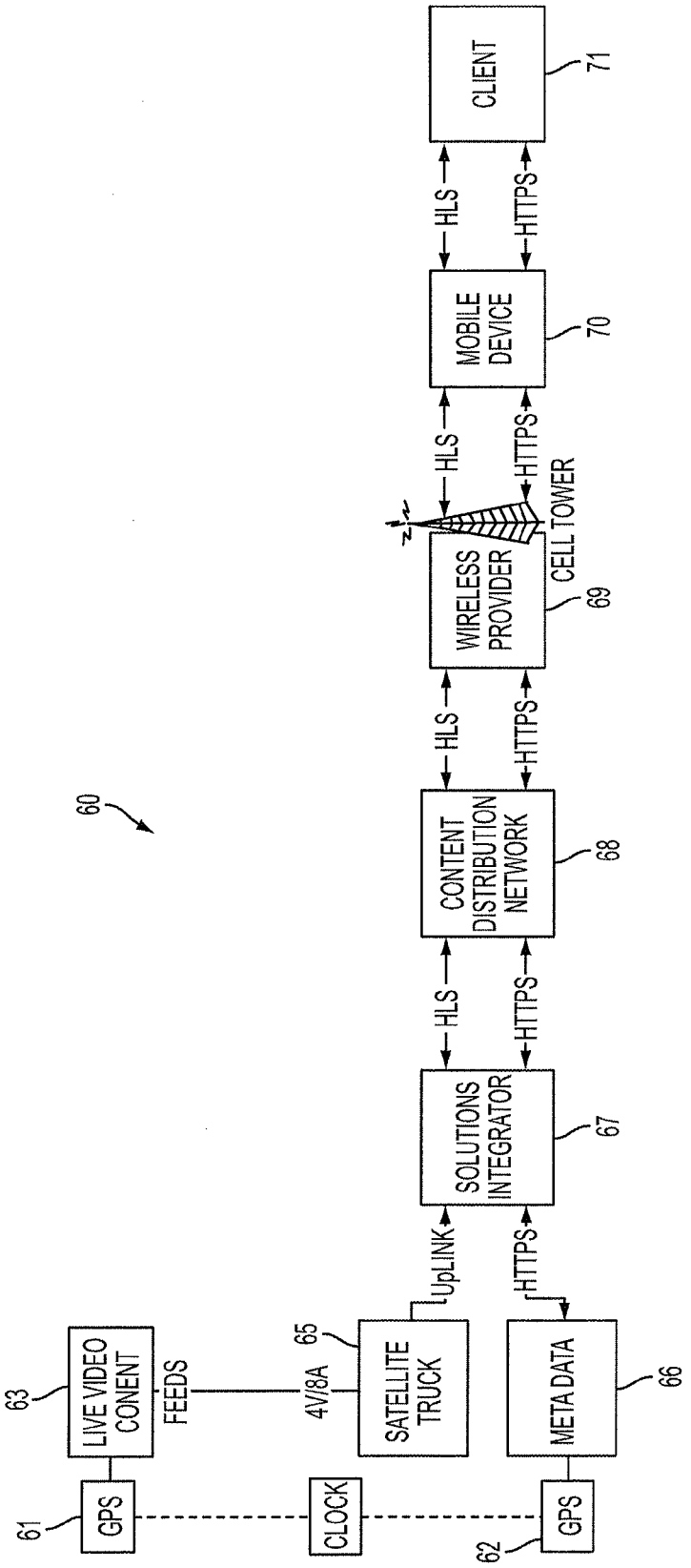

60
61
GPS
63
LIVE VIDEO CONENT
FEEDS
CLOCK
4V/8A
65
SATELLITE TRUCK
UpLINK
HTTPS
62
GPS
META DATA
66
SOLUTIONS INTEGRATOR
67
HLS
HTTPS
CONTENT DISTRIBUTION NETWORK
68
HLS
HTTPS
WIRELESS PROVIDER
69
CELL TOWER
HLS
HTTPS
MOBILE DEVICE
70
HLS
HTTPS
CLIENT
71

FIG. 5

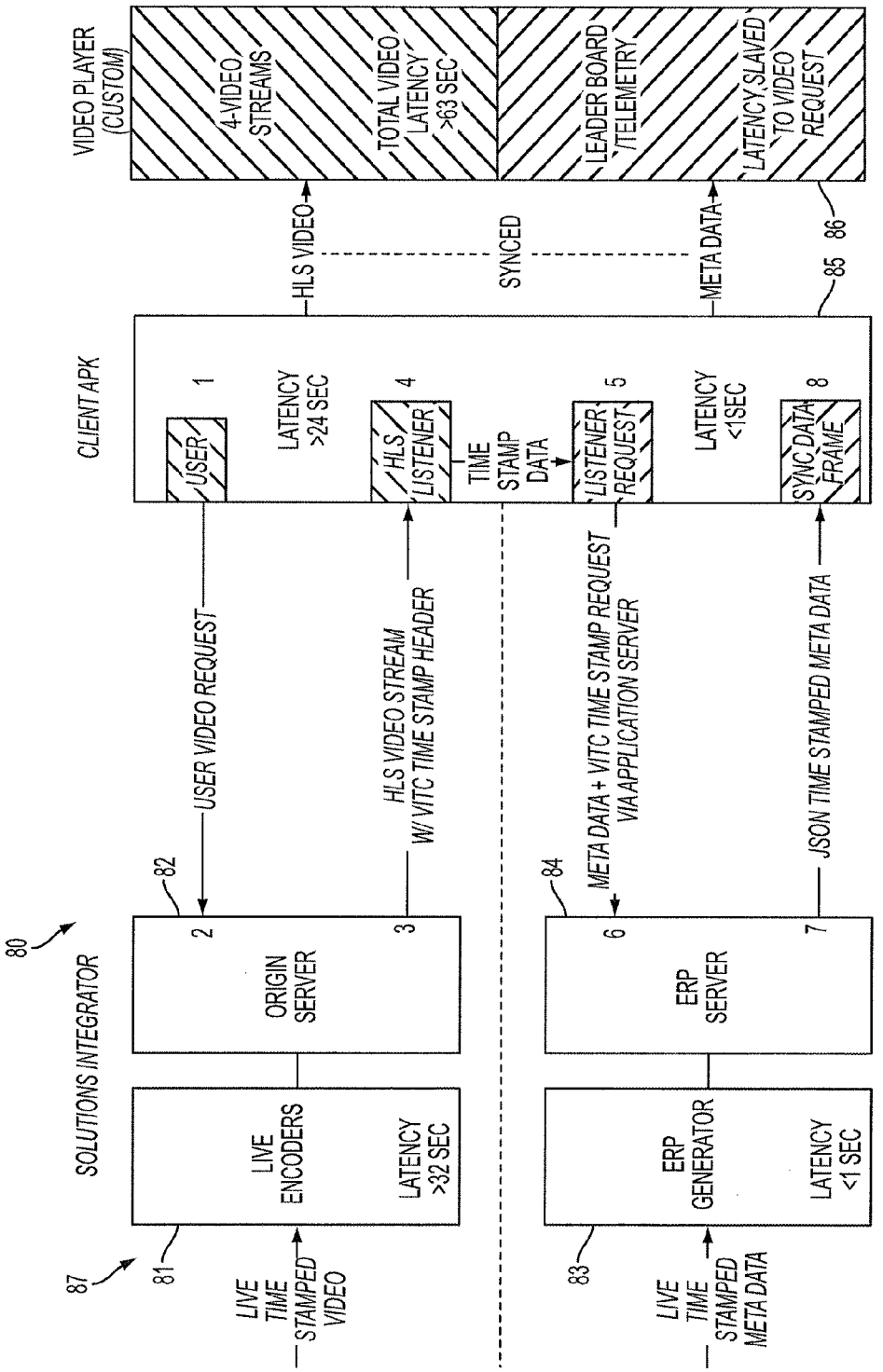

VIDEO PLAYER (CUSTOM)
4-VIDEO STREAMS
TOTAL VIDEO LATENCY >63 SEC
LEADER BOARD /TELEMETRY
LATENCY SLAVED TO VIDEO REQUEST
HLS VIDEO
SYNCED
META DATA
86
85
CLIENT APK
USER
1
LATENCY >24 SEC
4
HLS LISTENER
TIME STAMP DATA
5
LISTENER REQUEST
LATENCY <1SEC
8
SYNC DATA FRAME
USER VIDEO REQUEST
HLS VIDEO STREAM W/ VITC TIME STAMP HEADER
META DATA + VITC TIME STAMP REQUEST VIA APPLICATION SERVER
JSON TIME STAMPED META DATA
80
SOLUTIONS INTEGRATOR
82
2
ORIGIN SERVER
3
84
6
ERP SERVER
7
87
81
LIVE ENCODERS
LATENCY >32 SEC
LIVE TIME STAMPED VIDEO
83
ERP GENERATOR
LATENCY <1 SEC
LIVE TIME STAMPED META DATA

FIG. 6

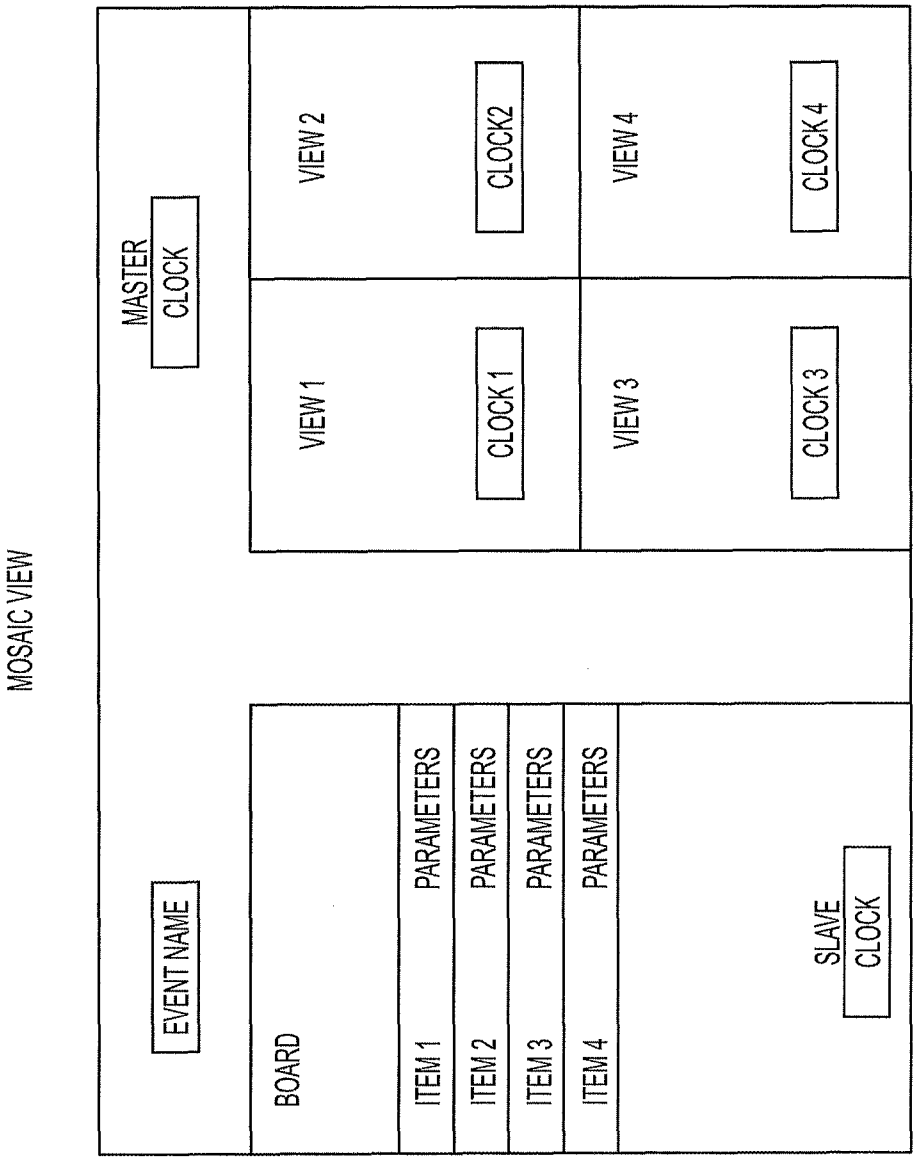

MOSAIC VIEW
EVENT NAME
MASTER
CLOCK
BOARD
ITEM 1
PARAMETERS
ITEM 2
PARAMETERS
ITEM 3
PARAMETERS
ITEM 4
PARAMETERS
SLAVE
CLOCK
VIEW 1
CLOCK 1
VIEW 2
CLOCK2
VIEW 3
CLOCK 3
VIEW 4
CLOCK 4

FIG. 7

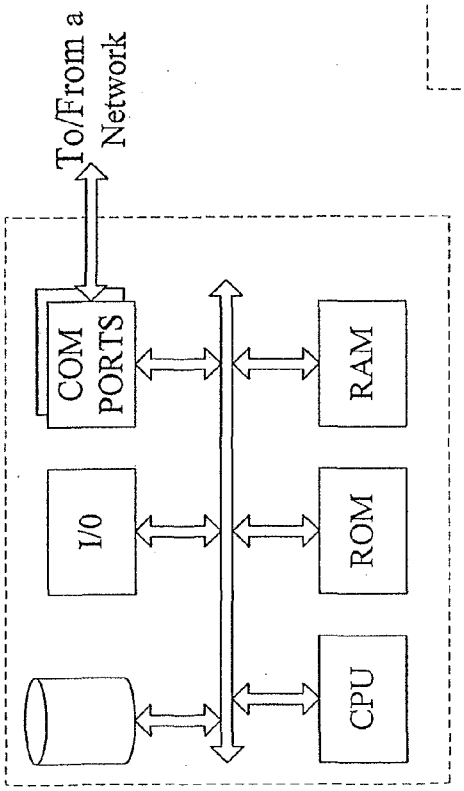

To/From a Network
COM PORTS
I/0
CPU
ROM
RAM

FIG. 8

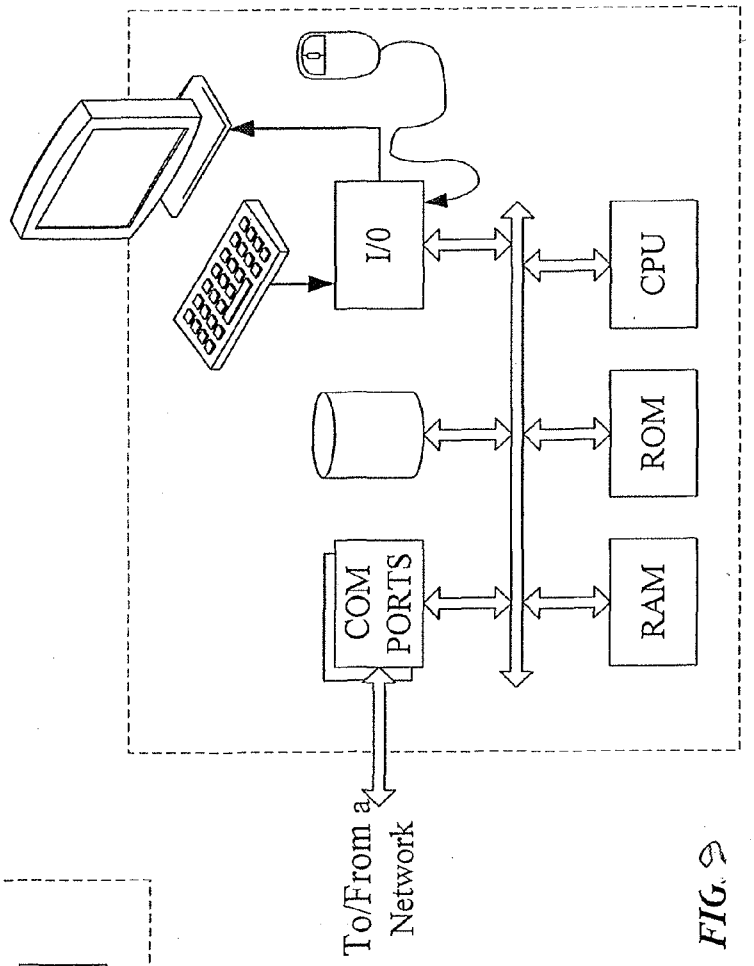

To/From a Network
COM PORTS
I/0
CPU
ROM
RAM

FIG. 9

TIME SYNCHRONIZATION OF VIDEO AND DATA INSIDE A MOBILE DEVICE

BACKGROUND

[0001] In recent years, mobile communication services have expanded and increased in popularity around the world. Many advanced networks offer wireless mobile communication service for voice calls, mobile phone messaging services (e.g., text and/or multimedia) and data communications. The data services, for example, enable surfing the world wide web, e.g., via a browser. The speeds of the data communications services have steadily increased as service providers have migrated the networks to newer generation technologies with broadband data communication capabilities, and the mobile stations have steadily advanced to take advantage of the new network technologies. The data communication capabilities of the mobile stations and the broadband data communication services offered by the networks enable users to perform more and more tasks and to access a rapidly expanding variety of content, all from their mobile stations. Examples of mobile station content items include, without limitation, media, games, messaging, social networks, stores, and any other applications or information for use on a mobile phone or on a tablet computer.

[0002] Referring to tablet computers, or simply tablets, these devices differentiate themselves from mobile phones in that they are larger than mobile phones and are used mainly for viewing published content from the Internet, such as video and news. Mobile developers today are increasingly creating applications for use on tablets. These applications are usually supplied through online distribution, rather than traditional methods of boxed software or direct sales from software vendors. These suppliers, knows as "app stores", provide centralized catalogues of software from the operating system (OS) supplier or device manufacturer, and allow easy installation and updates via network communication. The app store is often shared with smartphones that use the same operating system.

[0003] It may be desirable to provide a mobile device, such as a tablet, with a capability of receiving multiple sources of live information that are related to each other, but are published and processed at different rates. For example, it may be desirable for a user to view video that is streamed live from the Internet to a client player using HTTP Live Streaming (also known as HLS) communications protocol. Furthermore, it may be desirable for the same user to simultaneously view other information, such as meta-data, that provides additional information related to the HLS video. Assembling meta-data and HLS video (for example), in which each is published and processed at a different rate and perhaps from different sources, for simultaneous display, in real-time has not as yet been implemented.

[0004] Hence, a need exists for improved technologies for synchronizing information (for example, HLS video and meta-data) that is published and processed at different rates, so that a viewer may comprehend the multiple information displayed on a mobile device, or a tablet.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The drawing figures depict one or more implementations in accord with the present teachings, by way of example only, not by way of limitation. In the figures, like reference numerals refer to the same or similar elements.

[0006] FIG. **1** is a high-level functional block diagram of an example of a system of a network/devices that provides various communications for mobile devices and supports an example of a system for synchronizing different types of data received by a mobile device (or mobile station).

[0007] FIG. **2** is a high-level functional block diagram of an exemplary non-touch type mobile device, as may utilize a system for synchronizing different types of data received by a mobile device, similar to the system shown in FIG. **1**.

[0008] FIG. **3** is a high-level functional block diagram of an exemplary touch screen type mobile device, as may utilize a system for synchronizing different types of data received by a mobile device, similar to the system shown in FIG. **1**.

[0009] FIG. **4** is a high-level functional block diagram of an example of a system of a network that provides communications for mobile stations and supports an example of a system for delivering different types of data to an end user, in which the data is obtained from different sources viewing a live event, and synchronizing the data, so that the user can view the data in a comprehensive and orderly manner.

[0010] FIG. **5** is simplified functional block diagram of an example of a system of a network that provides live video and audio data of a live event to a user of a mobile device and also provides meta-data of the live event to the user in a synchronized manner for viewing and listening.

[0011] FIG. **6** is a functional block diagram of a client application disposed in a video player that communicates with multiple servers and allows the client to select time stamped video data and, in response, to receive meta-data that is synchronized to the selected time stamped video data.

[0012] FIG. **7** is an example of a display on a video player showing a mosaic view of four different videos of a live event and meta-data of multiple parameters that are related to the four different videos of the live event.

[0013] FIG. **8** is a simplified functional block diagram of a computer that may be configured as a host or server, for example, to function as a server in the system of FIG. **1**.

[0014] FIG. **9** is a simplified functional block diagram of a personal computer or other work station, terminal device, or computer tablet.

DETAILED DESCRIPTION OF EXAMPLES

[0015] In the following detailed description, numerous specific details are set forth by way of examples in order to provide a thorough understanding of the relevant teachings. However, it should be apparent that the present teachings may be practiced without such details. In other instances, well known methods, procedures, components, and/or circuitry have been described at a relatively high-level, without detail, in order to avoid unnecessarily obscuring aspects of the present teachings.

[0016] The various methods and systems disclosed herein relate to acquisition of multiple paths of steaming content to a mobile device, such as a smartphone or a tablet. The acquisition of the multiple paths of streaming content includes assembling and displaying the different streaming content in a synchronous manner. For example, video, audio and meta-data may be transmitted from a sports venue via different communication paths and at different rates. The video and audio may originate from a content provider or origin server that provides service to another server. The meta-data, however, may be provided to the other server by a server that is different from the content provider/origin server. The origin

and meta-data servers may be located more than a mile from each other, although they both may be streaming content that is related to the same venue.

[0017] Using an example of a sports venue, the video and audio may be transmitted via a satellite network, while the meta-data may be transmitted via Internet Protocol (IP) packet data communications using terrestrial data communication transport media. A solutions integrator, which may act as an origin server, may receive the digital streams from a content provider. The solutions integrator may then ingest, process and encode HD (high definition) video and audio signals to MPEG-HLS or MPEG-DASH streaming protocols. Meta-data may also be ingested utilizing a server and packetized to .Extensible Markup Language (.XML) or .Java Script Object Notation (.JSON) type identifier frames. These signals traditionally do not transmit as a single cohesive stream, where timing or time stamping are wrapped into a control header of the transport stream packet ID (PID).

[0018] As will be described, as an example, the video and audio data and the meta-data are both time stamped with consistent (e.g., GPS) timing protocols. In this manner, each respective data is time-tagged to the same timing signature, even though each respective data transmits from different physical locations. As a result, the video and audio data are time synchronized to the meta-data, so that all the data may be displayed in a mobile device (a smartphone or a tablet) in correct time sync.

[0019] Reference is now made in detail to the examples illustrated in the accompanying drawings and discussed below. FIG. **1** illustrates a system **10** offering a variety of mobile communication services, including synchronization methods for mobile device users, or mobile station users. The example shows simply two mobile stations (MSs) **13***a* and **13***b* as well as a mobile communication network **15**. The stations **13***a* and **13***b* are examples of mobile stations that may be used for the synchronization method. However, the communication network provides similar communications for many other similar users, as well as for mobile devices/users that do not participate in the synchronization method. The network **15** provides mobile wireless communication services to those stations as well as to other mobile stations (not shown), for example, via a number of base stations (BSs) **17**. The present techniques may be implemented in any of a variety of available mobile networks **15** and/or on any type of mobile station compatible with such a network **15**. The drawing shows only a very simplified example of a few relevant elements of network **15** for purposes of discussion here.

[0020] The wireless mobile communication network **15** might be implemented as a network conforming to the long term evolution (LTE) standard, the code division multiple access (CDMA) IS-95 standard, the 3rd Generation Partnership Project 2 (3GPP2) wireless IP network standard or the Evolution Data Optimized (EVDO) standard, the Global System for Mobile (GSM) communication standard, a time division multiple access (TDMA) standard or other standards used for public mobile wireless communications. The mobile stations **13***a* and **13***b* are capable of communications through network **15**, using the synchronization method, typically, or a variety of other methods/services. The exemplary devices **13***a* and **13***b* are capable of data communications through the network **15** and the users thereof typically have subscribed to data service through the networks.

[0021] The network **15** allows users of the mobile stations, such as **13***a* and **13***b* (and other mobile stations not shown), to initiate and receive telephone calls to each other as well as through the public switched telephone network (PSTN) **19** and telephone stations **21** connected to the PSTN. The network **15** typically offers a variety of data services via a global network (e.g., the Internet **23**), such as downloads, web browsing, email, etc. The mobile stations **13***a* and **13***b* may receive and execute applications written in various programming languages, as described later.

[0022] Mobile stations, like **13***a* and **13***b*, may take the form of portable handsets, smart-phones, personal digital assistants, or tablets although they may be implemented in other form factors. Program applications, including an application to assist in the synchronization method, may be configured to execute on many different types of mobile stations. For example, a mobile station application may be written to execute on a binary runtime environment for mobile (BREW-based) mobile station, a Windows Mobile based mobile station, Android, iOS iPhone or iPad, Java Mobile, or RIM based mobile station such as a BlackBerry, or the like. Some of these types of devices may employ a multi-tasking operating system.

[0023] The mobile communication network **15** may be implemented by a number of interconnected networks. Hence, the overall network **15** may include a number of radio access networks (RANs), as well as regional ground networks interconnecting a number of RANs and a wide area network (WAN) interconnecting the regional ground networks to core network elements. A regional portion of network **15**, such as that serving mobile stations **13**, may include one or more RANs and a regional circuit and/or packet switched network and associated signaling network facilities.

[0024] Physical elements of a RAN operated by one of the mobile service providers or carriers, include a number of base stations represented in the example by the base stations (BSs) **17**. Although not separately shown, such a base station **17** may include a base transceiver system (BTS), which may communicate via an antennae system at the site of the base station and over the airlink with one or more of the mobile stations **13***a* and **13***b*, when the mobile stations are within range. Each base station may include a BTS coupled to several antennae mounted on a radio tower within a coverage area often referred to as a "cell." The BTS is the part of the radio network that sends and receives RF signals to/from the mobile stations that are served by the base station **17**, including in the example mobile stations **13***a* and **13***b*. Later generation mobile networks utilize wireless access elements, each referred to as an eNodeB, to provide functions similar to those of a base station; but for convenience, the discussion here will generally include eNodeBs and other network wireless access devices under the general term base station.

[0025] The radio access networks may also include a traffic network represented generally by the cloud at **15**, which carries the user communications and data for the mobile stations between the base stations **17** and other elements with, or through which the mobile stations communicate. It will be understood that the various network elements may communicate with each other and other networks (e.g., a PSTN **19** and the Internet **23**) either directly or indirectly.

[0026] Although not shown, the provider or carrier may also operate a number of systems that provide ancillary functions in support of the communications services and/or application services provided through network **15**, and those elements may communicate with other nodes or elements in system **10** via one or more private IP type packet data net-

works (sometimes referred to as an Intranet), i.e., a private network. Examples of such systems may include one or more application servers and related authentication servers.

[0027] A mobile station may communicate over the air with base station **17** and through traffic network **15** for various video and audio, and meta-data communications. If the mobile service carrier offers the synchronization service, the service may be hosted on a synchronization server **31**, for communication via network **15**. Alternatively, programming for the synchronization service may be distributed across multiple components of system **10**. For a given service, including the synchronization service, an application program within a mobile station **13***a* or **13***b* may be considered as a 'client' and programming at server **31** may be considered as the 'server' application for the particular service. Two additional servers are shown, namely, server **33** communicating through network **29**, and server **25** communicating through the Internet **23**. As part of the synchronization service, server **25** may provide one type of data, for example, audio and video data of a live event; a second type of data for example, meta-data of the same event, may be provided by server **31**. Both types of data may flow to a mobile device **13***b* through one or more networks, for example, network **29**, Internet **23** and/or mobile traffic network **15**. The manner in which both of these types of data are synchronized for viewing by a user of mobile device **13***b* is described later.

[0028] Associated synchronization events under consideration here may be delivered to touch screen type mobile stations, as well as to non-touch type mobile stations. Hence, mobile station (MS) **13***a* is shown as a non-touch type mobile station and mobile station (MS) **13***b* is shown as a touch screen type mobile station. Implementation of the synchronization service may involve some execution of programming in the mobile stations, as well as implementation of user input/output functions and data communications through network **15** from the mobile stations.

[0029] It may be useful to consider the functional elements/aspects of two exemplary mobile stations **13***a* and **13***b*, at a high-level.

[0030] For purposes of such a discussion, FIG. **2** is a block diagram illustration of an exemplary non-touch type mobile station **13***a*. Although the mobile station **13***a* may be a smartphone or may be incorporated into another device, such as a personal digital assistant (PDA) or the like, for discussion purposes, the illustration shows the mobile station **13***a* is in the form of a handset. The handset embodiment of the mobile station **13***a* functions as a normal digital wireless telephone station. For that function, the station **13***a* includes a microphone **102** for audio signal input and a speaker **104** for audio signal output. The microphone **102** and speaker **104** connect to voice coding and decoding circuitry (vocoder) **106**. For a voice telephone call, for example, the vocoder **106** provides two-way conversion between analog audio signals representing speech or other audio and digital samples at a compressed bit rate compatible with the digital protocol of wireless telephone network communications or voice over packet (e.g., Internet Protocol) communications.

[0031] For digital wireless communications, the handset **13***a* also includes at least one digital transceiver (XCVR) **108**. Today, the handset **13***a* would be configured for digital wireless communications using one or more of the common network technology types. The concepts discussed here encompass embodiments of mobile station **13***a* utilizing any digital transceivers that conform to current or future developed digital wireless communication standards. The mobile station **13***a* may also be capable of analog operation via a legacy network technology.

[0032] The transceiver **108** provides two-way wireless communication of information, such as vocoded speech samples and/or digital information, in accordance with the technology of network **15**. The transceiver **108** also sends and receives a variety of signaling messages in support of the various audio and data services provided via the mobile station **13***a* and the communication network. Each transceiver **108** connects through radio frequency (RF) transmit and receive amplifiers (not separately shown) to an antenna **110**.

[0033] The example mobile station **13***a* includes a display **118** for displaying messages, menus or the like, call related information dialed by the user, calling party numbers, etc. A keypad **120** enables dialing digits for voice and/or data calls as well as generating selection inputs, for example, as may be keyed-in by the user based on a displayed menu or as a cursor control and selection of a highlighted item on a displayed screen. The display **118** and keypad **120** are the physical elements providing a textual or graphical user interface. Various combinations of the keypad **120**, display **118**, microphone **102** and speaker **104** may be used as the physical input output elements of the graphical user interface (GUI), for multimedia (e.g., audio and/or video) communications. Of course other user interface elements may be used, such as a trackball, as in some types of PDAs or smart phones.

[0034] In addition to normal telephone and data communication related input/output (including message input and message display functions), the user interface elements also may be used for display of menus and other information to the user and user input of selections. For example, the user may view a live event on display **118** of mobile device **13***a*. The user may select, by way of keypad **120**, specific audio and video data for listening and viewing by way of speaker **104** and display **118**, respectively. In addition, the user may select specific meta-data associated with the audio and video data. The manner in which the audio and video data together with the meta-data are synchronized will be described later.

[0035] A microprocessor **112** serves as a programmable controller for the mobile station **13***a*, in that it controls all operations of the mobile station **13***a* in accord with programming that it executes, for all normal operations, and for operations involved in the synchronization procedure under consideration here. In the example, the mobile station **13***a* includes flash type program memory **114**, for storage of various "software" or "firmware" program routines and mobile configuration settings, such as mobile directory number (MDN) and/or mobile identification number (MIN), etc. The mobile station **13***a* may also include a non-volatile random access memory (RAM) **116** for a working data processing memory. Of course, other storage devices or configurations may be added to or substituted for those in the example. In a present implementation, the flash type program memory **114** stores firmware such as a boot routine, device driver software, an operating system, call processing software and vocoder control software, and any of a wide variety of other applications, such as client browser software and short message service software. The memories **114**, **116** also store various data, such as telephone numbers and server addresses, downloaded data such as multimedia content, and various data input by the user. Programming stored in the flash type program memory **114**, sometimes referred to as "firmware," is loaded into and executed by microprocessor **112**.

[0036] As outlined above, the mobile station **13***a* includes a processor, and programming stored in the flash memory **114** configures the processor so that the mobile station is capable of performing various desired functions, including the functions involved in the synchronization technique. Such functions may include time-stamping audio and video data of a live event; time-stamping meta-data that is associated with the same event; and several handshake communications between the mobile station and different servers across the network. These functions are described later.

[0037] FIG. **3** is a block diagram illustration of an exemplary touch screen type mobile station **13***b*. Although possibly configured somewhat differently, at least logically, a number of the elements of the exemplary touch screen type mobile station **13***b* are similar to the elements of mobile station **13***a*, and are identified by like reference numbers in FIG. **3**. For example, the touch screen type mobile station **13***b* includes a microphone **102**, speaker **104** and vocoder **106**, for audio input and output functions, much like in the earlier example. The mobile station **13***b* also includes at least one digital transceiver (XCVR) **108**, for digital wireless communications, although the handset **13***b* may include an additional digital or analog transceiver. The concepts discussed here encompass embodiments of the mobile station **13***b* utilizing any digital transceivers that conform to current or future developed digital wireless communication standards. As in the station **13***a*, the transceiver **108** provides two-way wireless communication of information, such as vocoded speech samples and/or digital information, in accordance with the technology of network **15**. The transceiver **108** also sends and receives a variety of signaling messages in support of the various audio and data services provided via mobile station **13***b* and the communication network. Each transceiver **108** connects through RF transmit and receive amplifiers (not separately shown) to an antenna **110**. The transceiver may also support various types of mobile messaging services, such as short message service (SMS), enhanced messaging service (EMS) and/or multimedia messaging service (MMS).

[0038] As in the example of station **13***a*, a microprocessor **112** serves as a programmable controller for the mobile station **13***b*, in that it controls all operations of the mobile station **13***b* in accord with programming that it executes, for all normal operations, and for operations involved in the synchronization procedure under consideration here. In the example, mobile station **13***b* includes flash type program memory **114**, for storage of various program routines and mobile configuration settings. The mobile station **13***b* may also include a non-volatile random access memory (RAM) **116** for a working data processing memory. Of course, other storage devices or configurations may be added to or substituted for those in the example. Hence, as outlined above, the mobile station **13***b* includes a processor; and programming stored in the flash memory **114** configures the processor so that the mobile station is capable of performing various desired functions, including in this case the functions involved in the synchronization technique.

[0039] In the example of FIG. **2**, the user interface elements include a display and a keypad. The mobile station **13***b* (of FIG. **3**) may have a limited number of keys **130**, but the user interface functions of the display and keypad are replaced by a touchscreen display arrangement. At a high level, a touchscreen display is a device that displays information to a user and detects occurrence and location of a touch on the area of the display. The touch may be an actual touch of the display device with a finger, stylus or other object, although at least some touchscreens may also sense when the object is in close proximity to the screen. Use of a touchscreen display as part of the user interface enables a user to interact directly with the information presented on the display.

[0040] Hence, the exemplary mobile station **13***b* includes a display **122**, which the microprocessor **112** controls via a display driver (disp. dvr.) **124**, to present visible outputs to the device user. The mobile station **13***b* also includes a touch/position sensor **126**. The sensor **126** is relatively transparent, so that the user may view the information presented on the display **122**. A sense circuit (sense ctlr.) **128** senses signals from elements of the touch/position sensor **126** and detects occurrence and position of each touch of the screen formed by display **122** and sensor **126**. The sense circuit **128** provides touch position information to microprocessor **112**, which may correlate that information to information currently displayed via display **122**, to determine the nature of a user input via the screen.

[0041] The display **122** and touch sensor **126** (and possibly one or more keys **130**, if included) are the physical elements providing the textual and graphical user interface for mobile station **13***b*. The microphone **102** and speaker **104** may be used as additional user interface elements, for audio input and output, including with respect to some synchronization functions for the user delivered via the mobile station. The synchronization aspects, highlighted previously with respect to mobile station **13***a*, apply similarly to mobile station **13***b* and will be described later in greater detail.

[0042] It will be understood that the structure and operation of the mobile stations **13***a* and **13***b*, as outlined above, are describe by way of example only.

[0043] Referring now to FIG. **4**, a synchronization method is incorporated in a system, generally designated as **40**, providing various communications to a mobile device **45**, in which the mobile device (or mobile station) is shown as part of a wireless network **43**. The wireless network also includes a cell tower **46** and a content delivery network **47**. It will be appreciated that mobile device **45** may be similar to any of the mobile stations discussed above and likely is a tablet that may be similar to mobile station **13***b* shown in FIG. **1**. The tablet allows a user to view a display including live video (for example) and meta-data in the form of text (for example). In addition, cell tower **46** and content delivery network **47** may be similar to base station **17** and mobile traffic network **15**, respectively, both shown in FIG. **1**.

[0044] Other portions of system **40** include a content provider **42** and a solutions integrator **44**. Each is described below.

[0045] The content provider **42**, in the example shown in FIG. **4**, is configured to provide video and audio data of an event occurring in real time and provide telemetry data (meta-data) including several parameters changing during the event. For example, the event may be an Indianapolis Car Race; the video and audio data may be multiple video/audio streams of race cars and drivers, as they are imaged at different locations on the race track; and the telemetry data (meta-data) may include varying parameters regarding the status of each car and driver in the race. Such parameters may include, for example, lap number, car speed and acceleration, tire pressure, etc. In a car race, there may be as many as 50 different parameters that are available for monitoring of each race car, in order to assess how well the driver is performing during any interval of the race.

[0046] Returning to content provider **42**, the example shows four video/audio streams provided from four different imaging sources, namely sources **48***a*-**48***d*. Any number of imaging sources may be available, for example, in which a different imaging source may be a camera positioned inside a race car (used as an example for explanation purpose). As shown, each source provides one video stream and two channels of audio associated with the respective video. The video streams are transmitted to a satellite truck **51** that is located adjacent the event (Indy Race, for example). The truck **51** is configured to receive the video and audio streams and transmit the same to a transponder disposed in a satellite **50**. The transmission may be in the form of an asynchronous serial interface (ASI) format, which streams data carrying an MPEG transport stream (MPEG-TS). Generally the ASI signal is a final product of video compression techniques. The truck **51** and satellite **50** are shown by way of example of one form of video and audio data communication technologies for communicating multiple video and audio streams, although other equipment may be used in place of the truck, and/or other non-satellite communication media may be used.

[0047] Furthermore, content provider **42** includes an Enhanced Result Protocol (ERP) generator server **49** which is configured to receive telemetry data (meta-data) from the multiple sources **48***a*-**48***d*. By way of example, telemetry is widely used in motor car racing, allowing race engineers to interpret data collected during a race and use it to properly tune a race car for optimal performance. Examples of measurements on a race car may include accelerations in three axes, temperature readings, wheel speed and suspension displacement. Also included may be readings to determine driver performance and vehicle performance. These parameters, referred to herein as meta-data, may be picked up by various sensors distributed around the race car, and may even be located on the driver himself. Data from these multiple sensors may be transmitted by wireless mechanisms, such as radio, or infrared systems, optical links, or GSM (global systems for mobile) communication networks. Accordingly, sources **48***a*-**48***d* may include audio/video data, meta-data, or both types of data. The ERP generator server extracts meta-data parameters that may be of interest to the end user, who is viewing the race and data using mobile device **45**. The extracted meta-data is formatted by the ERP generator server **49** into a Hypertext Transfer Protocol Secure (HTTPS) communications protocol for secure communication over the network. The server **49** transmits the HTTPS formatted meta-data to a solution integrator **44**. Such meta-data may include speed and acceleration of a particular race car.

[0048] In the example depicted in FIG. **4**, system **40** includes solution integrator **44**. The solution integrator **44** includes an ERP server **52**, an Application server **53**, and an origin server **54**. Also included in the solutions integrator **44** is an Earth station **55** and one or more encoders, such as MPEG 4 Publishing Encoders **56** as shown. These elements are now described separately below.

[0049] The solutions integrator **44** publishes the video imagery, related audio and meta-data that are received from the content provider **42** onto the content delivery network **47** for presentation to users/consumers of the content via mobile devices such as device **45**. The Earth station **55** receives the video and audio data as a downlink from the transponder in satellite **50**; the video and audio data are then encoded by the MPEG 4 Publishing Encoders **56**. The video and audio data are streamed to the origin server **54** in an HTTP communications format, which may or may not be in a secure HTTPS format, depending, for example, on the content being streamed.

[0050] The ERP server **52** receives the meta-data from ERP generator server **49** in HTTPS communication format. It will be appreciated that the ERP server is shown as an example particular to the system shown in FIG. **4**. The ERP server **52** may be optional in another example of synchronization techniques, because the origin server **54** may communicate directly with the ERP generator server **49**. In the example of FIG. **4**, the ERP server acts as an intermediary between the ERP generator server and the origin server. A function of the ERP server may be to filter and eliminate contents of meta-data that are race-sensitive, in that the contents may provide advantages to other race cars participating in the race. An example is tire temperature or tire pressure information of a competitor in the race.

[0051] The origin server **54** as configured in the example of system **40** receives the meta-data that is sent from the content provider **42**. The origin server **54** begins the process by streaming video content with timecode to the content delivery network on command from the mobile device. Simultaneously, the mobile device **45** then sends a request to the application server **53**. The application server **53** receives this request with the time code call out, then sends back to the mobile device **45** the corresponding meta-data in the play list, with the exact timecode signature. The origin server **54** then transmits both the video/audio stream and the meta-data to the content delivery network **47**. The timing between the two types of data is further described below with respect to FIG. **6**. It will be appreciated that, as used herein, the origin server **54** is a server transfers data to other servers that are physically located closer to end users requesting the data in a network communication system. For example, origin server **54** may be an Internet server provider (ISP) that transfers HTTPS formatted data to a local content delivery network **47**, which in turn delivers data to cell tower **46**. The mobile device **45** receives both the video/audio stream in an HTTPS Live Streaming (HLS)-based media streaming communications protocol and the meta-data in an HTTPS communications protocol. The Application server **53** satisfies time synchronization requirements between a client application residing in mobile device **45** and the solution integrator **44**. These time synchronization requirements are described further below.

[0052] An external clock or GPS timing system is added to the ERP generator server **49** in the content provider **42**, as shown in FIG. **4**. The ERP generator server **49** is responsible for inserting the time data into the meta-data field. The time data may be in the form of a header, or the time data may be inserted within a packet. The external clock timing may be used in place of a Network Time Protocol (NTP), the latter configured as a networking protocol for clock synchronization between computer systems over packet-switched, variable-latency data networks. The meta-data is then transmitted in an HTTPS communications protocol to the solutions integrator **44**. It will be appreciated that the meta-data may now include a packetized .XML or .JSON type identifier frames.

[0053] In addition, an external clock or GPS timing system is added to the video transmission point, or the satellite uplink truck **51**, shown as an example for explanation purpose. The purpose of the GPS timing system is to time stamp each video/audio channel at the video transmission point. The time stamp may be in a format defined by the Society of Motion Picture and Television Engineers (SMPTE) as a Vertical

Interval Timecode (VITC) time code (for example). The SMPTE time code is measured in hours, minutes, seconds and frames per second. The video/audio and the VITC time code are transmitted via a satellite network to solution integrator **44** (for example).

[0054] It will now be appreciated that the two external clocks or GPS based timing systems may be locked to the same satellite reference source. These two clocks now become the source master time for the entire system **40**. Two clocks locked to the same reference source are preferred over a single clock, because the physical geographical location of the video/audio transmission point and the geographical location of the meta-data server may be up to a mile apart within the same venue (Indy race in the example used above).

[0055] The solutions integrator **44** is configured to ingest the time stamped meta-data over IP into a process or origin type server system, namely, into the origin server **54** (for example). In addition, the solutions integrator **44** is configured to ingest the video, audio and VITC time code. The video is decoded and processed from an embedded signal. The solutions integrator then begins the MPEG 4 encoding process with the satellite integrated receiver/decoder (IRD) video, audio and VITC time code. The encoded video is then published to the content delivery network **47** (for example) via IP utilizing the HLS, smooth stream, or DASH encoding techniques with a time stamp wrapper.

[0056] Two time stamps now exist in system **40**, one associated with the HLS video/audio (for example, the VITC time stamp header) and the other associated with the meta-data (for example, the .JSON time stamp). Latency issues may also exist, for example, due to ingesting and processing the video/audio and the meta-data. These issues may be taken into account by system **40**, and in particular may be solved by the client application resident in mobile device **45** and the application server **53** resident in solution integrator **44**. The latency issues are now explained below.

[0057] The mobile device **45**, by way of a client application, is configured to request video and audio streaming data from the wireless content delivery network **47**, using the cell tower **46** as an intermediary. The video and audio streaming data begins to flow to the mobile device **45** after the solution integrator **44** receives the video request from the user. The video and audio request may specify a particular video source or multiple video sources, for example, multiple imagers in the cars participating in the Indy car race. The video and audio streaming data includes a time stamped header for each video and audio channel streamed from the multiple sources in content provider **42**.

[0058] The client application in mobile device **45** is configured to view the video and audio stream with the VITC time stamp header. At this point, the VITC time stamp is deemed to be the master time for synchronization, once the video stream locks in the VITC time code. The client application software in mobile device **45** is then configured to request the corresponding meta-data which has the same time code reference generated by the ERP generator server **49**. The application server **53**, which resides in the solution integrator **44**, is configured to receive the request from the client application software and begin sending the meta-data with the corresponding .JSON time stamp via the ERP server **52** in the solution integrator **44**. The .JSON time stamp is now slaved to the master time generated by the VITC time code. The meta-data with the .JSON time stamp is now also transmitted to the mobile device **45** by way of the content delivery network **47**. The meta-data with the .JSON time stamp and the video/audio data with the VITC time stamp are both decoded inside the mobile device **45**. The meta-data (the slave) is now synchronized to the video/audio data (the master). Both types of data are assembled in the mobile device **45** via the client application software that resides within the mobile device, for appropriate presentation on the device's display.

[0059] Referring to FIG. **5**, another example is provided of a system, generally designated as **60**, for providing synchronization of different types of data that are streamed from two different locations for use by a mobile device, such as the tablet shown in FIG. **1** as MS **13***b*, the latter operating in system **10**. As shown in FIG. **5**, a live 'video' content provider **63** feeds multiple live video/audio data stream, by way of a satellite truck **65**. The provider **63** may be implemented by appropriate sources similar to those in FIG. **4**. By way of example regarding FIG. **5**, four video channels and eight audio channels are available for transmission by an RF uplink to a satellite from satellite truck **65**. The video data from each channel is separately time stamped by an accurate clock, such as a GPS clock **61**. In this example, source(s) of the content provider **63** apply the time stamp from GPS clock **61**, e.g. in the form of a VITC time stamp. Although the audio/video data is shown delivered from a satellite truck **65** by an uplink (RF) it will be appreciated that the audio/video data may be delivered by another server providing HTTPS protocol communication.

[0060] Separately, meta-data is transmitted by the same content provider or another content provider, namely, meta-data provider **66**. The meta-data provider may be any server, such as server **31**, or server **33**, or server **25** delivering data as shown in FIG. **1** in system **10**. The meta-data is time stamped by another accurate clock, such as a GPS clock **62**, e.g. as a .JSON time stamp.

[0061] A server (for example, a solutions integrator **67**) receives the video/audio data as an RF downlink from the satellite truck **65** and separately receives the meta-data as an HTTPS formatted signal, e.g. via a terrestrial network providing IP packet data transport. The video/audio data are processed and published as HD video and audio signals, using MPEG coding, for example, to provide HLS formatted signals. The server also receives the meta-data and processes and publishes the meta-data as HTTPS formatted signals. Both types of signals contain accurate time stamps.

[0062] A wireless provider **69** is configured to receive the video/audio HLS formatted signals and the meta-data HTTPS formatted signals through a content distribution network **68**, in which the latter is capable of communicating with the solutions integrator **67**. As used herein, a content distribution network may be used to deliver an entire website, including dynamic, static and streaming content using one or multiple servers in many different locations. Depending on traffic and the number of nodes, the network's algorithms select the best delivery directions avoiding bottlenecks.

[0063] Finally, the mobile device **70** (for example, a video player device, as shown in FIG. **7**), which includes a client application program **71**, communicates with the content distribution network **68** by way of the wireless provider **69**. The client application program **71** is configured to display the video/audio HLS formatted signals on a display of mobile device **70**. The time stamp associated with the video/audio HLS formatted signals are also displayed on the mobile device **70** (for example, the video player device). The user then requests, via the client application program, desired

meta-data that corresponds to a time that is similar to the time stamp associated with the video/audio formatted signals. The request is communicated through the content distribution network **68** and to the solutions integrator **67** (a server). The solutions integrator is configured to transmit the requested meta-data to the user, based on the requested time stamp from the mobile device **70**. More details of the flow of data between the mobile device and the multiple servers providing time stamped data (audio/video and meta-data) are provided next with reference to the flow of data shown in FIG. **6**.

[0064] Thus, an example has been provided of a system that synchronizes two different types of data, for example, video/audio data and meta-data, within a mobile device for viewing by an end user. Each type of data includes an accurate time stamp. The latency associated with one type of data is different from the latency associated with the other type of data. These two types of data are conventionally not viewable together on a mobile device. The present example, however, combines the two types of data so that they display appropriately on a mobile device in correct time synchronization.

[0065] Using the client application **71**, the user selects a desired time that is associated with one type of data, for example, a time stamp corresponding to a video being viewed on the mobile device. The client application **71** is configured to request meta-data that corresponds to the selected time. A remote server communicating with the mobile device is also configured to start streaming the meta-data corresponding to the requested time stamp. Thus, the time code associated with first type of data (for example, video data) becomes the master clock and the time code associated with the second type of data (for example, meta-data) becomes the slave clock. As the terms imply, the slave clock is slaved to the master clock. The user now, advantageously, may view two types of data that normally are not viewable together because of their disparate latencies.

[0066] Turning next to FIG. **6**, there is shown a block diagram of a system **80** for synchronizing two different types of data that are streamed at different rates with different latencies within a system such as system **10**, system **40**, or system **60**. By way of example only, system **80** depicts features that are similar to the features described with respect to system **40**. As shown, system **80** includes a solutions integrator **87** (or more generally, a server capable of receiving two types of signals, namely, RF video/audio signals and HTTPS signals, processing both types of signals, and publishing both types of signals as HTTPS data). Also included in system **80** is a mobile device, for example, a video player tablet **86** and a client application program **85** that resides within the video player tablet.

[0067] The top portion of FIG. **6** includes encoders **81** coupled to an origin server **82**; the bottom portion of FIG. **6** includes an ERP generator **83** and an ERP server **84**. The components **81**, **82** and **84** are part of the solutions integrator **87** (corresponding to the partitioning shown at **44** in FIG. **4**). Again, the partitioning is intended for explanation purposes only. As shown, the encoders **81** receive live, time stamped video/audio data and convert the same into an MPEG stream with a VITC time stamp header. The coded data is sent to the origin server **82**, which publishes the data as an HLS video stream with a VITC time stamp header. The ERP generator **83** extracts various parameters as live meta-data which is time stamped. The meta-data is sent to the ERP server **84** which processes the data and publishes the data in an HTTPS communications format.

[0068] In the example shown in FIG. **6**, the origin server **82** publishes the HLS video stream with the VITC time stamp headers, whereas the ERP server **84** publishes the meta-data with the .JSON time stamps. It will be appreciated, however, that the time stamps may be other time stamps than the VITC time stamps, or the .JSON time stamps. These specific time stamps are provided as examples only.

[0069] The operation sequence between the client application **85** and the solutions integrator **87** will now be described by referring to the sequence of numbers (**1** through **8**) shown in FIG. **6**:

[0070] 1. The user, by way of the video player **86**, initiates a video request of one or more channels of video/audio for viewing a live event on the device display.

[0071] 2. The origin server **82** receives the request from the client application **85** of the device **86**.

[0072] 3. The origin server **82** begins streaming HLS video of the live event with the VITC time stamp header to the client application **85**. Each video channel includes its own VITC time stamp.

[0073] 4. The client application receives the HLS video with the time stamp information for viewing the desired channels on the video player **86**.

[0074] 5. Upon viewing the live video from one or more video sources (or channels) of the live event, the user initiates a request for meta-data that is associated with the VITC time stamp of a particular video channel on the display of the video player. The latency or transaction time of the meta-data between the client and the server is less than 2 seconds. The latency of the video between when the user requests a video and when the video is shown on the display is approximately 63 seconds. This is due to the down linking, encoding, publishing and decoding of the video. The ERP Server **84** buffers the delay with the meta-data time stamp. The video becomes the master clock of when the corresponding meta-data arrives at the application.

[0075] 6. The ERP server **84** receives from the application server **53** the request for meta-data with the VITC time stamp.

[0076] 7. In response to the request, the ERP server **84** transmits the meta-data with a corresponding .JSON time stamp of the live event.

[0077] 8. The client application receives the meta-data having the corresponding time stamp and displays the meta-data on the video player. The meta-data is now related to the video being watched on the video player, as the meta-data is now synchronized to the video channel.

[0078] If meta-data goes missing (or is corrupted due to a connection or collection error) for a long period of time, the video continues to play. The leader board and telemetry data waits in place holding the last value until the next valid data is read. The application does not crash, but simply stands by for the next packet. In some embodiments, once the system determines that a predetermined period (for example, several seconds) has elapsed from receipt of the last valid data without receipt of new valid data, an indication is provided on the display that the data has not been recently refreshed, as well as perhaps the length of time from receipt of the last valid data.

[0079] Over time, the viewer views time stamped audio/video data and separately time stamped meta-data. Both types of data are now closely related in time. So long as the viewer makes no other audio/video selection from a specific source and makes no other meta-data selection from another specific source (or time stamp), both types of data continue to be

streamed for display on the video player. When the viewer makes a change on the video player, the handshaking interchange or flow shown in FIG. **6** is repeated anew.

[0080] Referring now to FIG. **7**, an example of a mosaic view on a video player is shown, which includes four views of four respective channels of live video of an event. For example, the event may be an Indy car race, and the four channels may include live videos of four of the drivers inside their respective vehicles. If desired, fewer than four views may be selected by the user, although more views/videos may be available. Each view includes its own clock on display.

[0081] The meta-data is shown displayed on the board section of the video player as items 1 through 4, in which each item includes several parameters. For example, items 1 through 4 may be the names of four race drivers in the event. The parameters may include text data of such items that are transmitted as telemetry data indicating status and performance associated with each car and driver. For a race example, these parameters may include tire pressure, car RPM, number of laps completed, etc. of each car. The meta-data includes a clock at the bottom of the board, and the video section includes a clock that is displayed at the top of the display. The clock of the video section is the clock whose time is selected by the viewer and, thus, is the maser clock, whereas the clock displayed at the bottom of the board is the slave clock. It will be appreciated that the two clocks will typically not be identical in time, but will likely be very close in time. The clocks (master and slave) continue to run unabated, based on the time stamped streamed audio/video data and the time stamped streamed meta-data. If the user selects view **2** (for example) the clock **2** becomes the master clock and the slave clock is slaved to clock **2**. If the user selects clock **4** (for example), then clock **4** becomes the master clock and the slave clock is slaved to clock **4**.

[0082] It will now be appreciated that due to the different types of data in the Indy car race (for example) which are available for viewing on the video player, each type of data has its own latency and update rate. For example, FIG. **6** shows that the live MPEG encoders may reach a latency that is greater than 32 seconds and the total latency in the video/audio data stream may be greater than 63 seconds. The meta-data, on the other hand, includes a latency that is less than a total of 2 seconds. Thus, in order to meaningfully be able to watch four cars speeding down a race course and, in addition, be able to associate performance and status parameters with each respective car, the meta-data must be synchronized to the video data. The examples provided herein described how such synchronization may be accomplished.

[0083] As shown by the above discussion, functions relating to the synchronization service may be implemented on computers connected for data communication via the components of a packet data network, operating as the various servers and/or client mobile stations, as shown in FIG. **1**. Examples of client mobile stations have been discussed above, e.g. with reference to FIGS. **2** and **3**. Although special purpose devices may be used, devices implementing server or network database functions or the like also may be implemented using one or more hardware platforms intended to represent a general class of data processing device commonly used to run "server" programming so as to implement the synchronization functions discussed above, albeit with an appropriate network connection for data communication. Most sports application systems in HLS encompass the meta-data as part of the video broadcast via a video graphic overlay inside the video. This synchronization technique can be used for any sporting event that has a unique video and meta-data source that do not follow the same path of transmission.

[0084] A general-purpose computer typically comprises a central processor or other processing device, an internal communication bus, various types of memory or storage media (RAM, ROM, EEPROM, cache memory, disk drives etc.) for code and data storage, and one or more network interface cards or ports for communication purposes. The software functionalities involve programming, including executable code as well as associated stored data, e.g., files used for the synchronization service. The software code is executable by the general-purpose computer that functions as a server and/or that functions as a mobile device or other terminal device. In operation, the code is stored within the general-purpose computer platform. At other times, however, the software may be stored at other locations and/or transported for loading into the appropriate general-purpose computer system or mobile station. Execution of such code by a processor of the computer platform or mobile platform enables the platform to implement the methodology for synchronization, in essentially the manner performed in the implementations described and illustrated herein.

[0085] FIGS. **8** and **9** provide functional block diagram illustrations of general purpose computer hardware platforms. FIG. **8** illustrates a network, or host computer platform, as may typically be used to implement a server, including network control **31** (FIG. **1**). FIG. **9** depicts a computer with user interface elements, as may be used to implement a personal computer or other type of work station or terminal device, although the computer of FIG. **9** may also act as a server if appropriately programmed. It is believed that the general structure and general operation of such equipment, as shown in FIGS. **8** and **9**, are self-explanatory from the high-level illustrations.

[0086] A server, for example, includes a data communication interface for packet data communication. The server also includes a central processing unit (CPU), in the form of one or more processors, for executing program instructions. The server platform typically includes an internal communication bus, program storage and data storage for various data files to be processed and/or communicated by the server, although the server often receives programming and data via network communications. The hardware elements, operating systems and programming languages of such servers are conventional in nature. Of course, the server functions may be implemented in a distributed fashion on a number of similar platforms, to distribute the processing load.

[0087] A computer type user terminal device, such as a PC or tablet computer, similarly includes a data communication interface CPU, main memory and one or more mass storage devices for storing user data and the various executable programs (see FIG. **9**). A mobile device type user terminal may include similar elements, but will typically use smaller components that also require less power, to facilitate implementation in a portable form factor. The various types of user terminal devices will also include various user input and output elements. A computer, for example, may include a keyboard and a cursor control/selection device such as a mouse, trackball, joystick or touchpad; and a display for visual outputs. A microphone and speaker enable audio input and output. Some smartphones include similar but smaller input and output elements. Tablets and other types of smartphones utilize touch sensitive display screens, instead of

separate keyboard and cursor control elements. The hardware elements, operating systems and programming languages of such user terminal devices also are conventional in nature.

[0088] Hence, aspects of the synchronization methods outlined above may be embodied in programming. Program aspects of the technology may be thought of as "products" or "articles of manufacture" typically in the form of executable code and/or associated data that is carried on or embodied in a type of machine readable medium. "Storage" type media include any or all of the tangible memory of the computers, processors or the like, or associated modules thereof, such as various semiconductor memories, tape drives, disk drives and the like, which may provide non-transitory storage at any time for the software programming. All or portions of the software may at times be communicated through the Internet or various other telecommunication networks. Such communications, for example, may enable loading of the software from one computer or processor into another. Thus, another type of media that may bear the software elements includes optical, electrical and electromagnetic waves, such as used across physical interfaces between local devices, through wired and optical landline networks and over various air-links. The physical elements that carry such waves, such as wired or wireless links, optical links or the like, also may be considered as media bearing the software. As used herein, unless restricted to non-transitory, tangible "storage" media, terms such as computer or machine "readable medium" refer to any medium that participates in providing instructions to a processor for execution.

[0089] Hence, a machine readable medium may take many forms. Non-volatile storage media include, for example, optical or magnetic disks, such as any of the storage devices in any computer(s) or the like, such as may be used to implement the aspects shown in the drawings. Volatile storage media include dynamic memory, such as main memory of such a computer platform. Common forms of computer-readable media therefore include for example: a floppy disk, a flexible disk, hard disk, magnetic tape, any other magnetic medium, a CD-ROM, DVD or DVD-ROM, any other optical medium, punch cards paper tape, any other physical storage medium with patterns of holes, a RAM, a PROM and EPROM, a FLASH-EPROM, any other memory chip or cartridge. Many of these forms of non-transitory computer readable media may be involved in carrying one or more sequences of one or more instructions to a processor for execution.

[0090] While the foregoing has described what are considered to be the best mode and/or other examples, it is understood that various modifications may be made therein and that the subject matter disclosed herein may be implemented in various forms and examples, and that the teachings may be applied in numerous applications, only some of which have been described herein. It is intended by the following claims to claim any and all applications, modifications and variations that fall within the true scope of the present teachings.

[0091] Unless otherwise stated, all measurements, values, ratings, positions, magnitudes, sizes, and other specifications that are set forth in this specification, including in the claims that follow, are approximate, not exact. They are intended to have a reasonable range that is consistent with the functions to which they relate and with what is customary in the art to which they pertain.

[0092] The scope of protection is limited solely by the claims that now follow. That scope is intended and should be interpreted to be as broad as is consistent with the ordinary meaning of the language that is used in the claims when interpreted in light of this specification and the prosecution history that follows and to encompass all structural and functional equivalents. Notwithstanding, none of the claims are intended to embrace subject matter that fails to satisfy the requirement of Sections 101, 102, or 103 of the Patent Act, nor should they be interpreted in such a way. Any unintended embracement of such subject matter is hereby disclaimed.

[0093] Except as stated immediately above, nothing that has been stated or illustrated is intended or should be interpreted to cause a dedication of any component, step, feature, object, benefit, advantage, or equivalent to the public, regardless of whether it is or is not recited in the claims.

[0094] It will be understood that the terms and expressions used herein have the ordinary meaning as is accorded to such terms and expressions with respect to their corresponding respective areas of inquiry and study except where specific meanings have otherwise been set forth herein. Relational terms such as first and second and the like may be used solely to distinguish one entity or action from another without necessarily requiring or implying any actual such relationship or order between such entities or actions. The terms "comprises," "comprising," or any other variation thereof, are intended to cover a non-exclusive inclusion, such that a process, method, article, or apparatus that comprises a list of elements does not include only those elements but may include other elements not expressly listed or inherent to such process, method, article, or apparatus. An element proceeded by "a" or "an" does not, without further constraints, preclude the existence of additional identical elements in the process, method, article, or apparatus that comprises the element.

[0095] The Abstract of the Disclosure is provided to allow the reader to quickly ascertain the nature of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In addition, in the foregoing Detailed Description, it can be seen that various features are grouped together in various embodiments for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the claimed embodiments require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter lies in less than all features of a single disclosed embodiment. Thus the following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separately claimed subject matter.

What is claimed is:

1. A synchronization method for a mobile station, the method comprising:

receiving, by a processor in the mobile station, a first type of data from a mobile communication network, the first type of data associated with a live event occurring remotely from the mobile station, and the first type of data published on the mobile communication network at a first time that is later than a live occurrence time of the event;

receiving, by the processor, a second type of data from the mobile communication network, the second type of data associated with the live event, and the second type of data published on the mobile communication network at a second time that is later than a live occurrence time of the event, and the second time is closer than the first time to the live occurrence time of the event;

requesting, by the processor, the first type of data published at the first time;

configuring, by the processor, the first type of data for display by the mobile station, the first type of data having a first time stamp;

requesting, by the processor, the second type of data, in which a second time stamp of the second type of data corresponds to the first time stamp of the first type of data; and

configuring, by the processor, the second type of data for display with the first type of data, by the mobile station, in which the second time stamp of the second type of data corresponds to the first time stamp.

2. The method of claim **1** wherein:

time stamping the first type of data includes combining timing data from a first clock with the first type of data, and

time stamping the second type of data includes combining timing data from a second clock with the second type of data.

3. The method of claim **2** wherein the first clock and the second clock are derived from at least one Global Positioning System (GPS) timing system.

4. The method of claim **1** wherein:

the first type of data includes at least one video and audio data stream that is published in a Hypertext Transfer Protocol (HTTP) live streaming (HLS) communication format, and

the second type of data includes text data defined as meta-data that is published in an HTTP format.

5. The method of claim **4** wherein:

time stamping the first type of data includes inserting a vertical interval time code (VITC) time stamp header in the at least one video and audio data stream, and

time stamping the second type of data includes inserting a Java script object notation (JSON) time stamp in the meta-data.

6. The method of claim **5** wherein:

time stamping the first type of data is performed by a server communicating on the mobile communications network, and

time stamping the second type of data is performed by another server communicating on the mobile communications network.

7. The method of claim **1** wherein:

configuring the first type of data enables displaying at least one channel of video and audio data, in response to a first user selection, and

configuring the second type of data enables displaying meta-data related to the at least one channel of video and audio data, in response to a second user selection.

8. The method of claim **7** further including the steps of:

selecting a second time stamp for the meta-data, by the user, that is close in time to a first time stamp associated with the video and audio data;

requesting from the mobile communication network, by the processor, the meta-data with the second time stamp; and

receiving, by the processor, the meta-data with the second time stamp.

9. The method of claim **1** wherein:

receiving the first and second types of data from the mobile communication network includes loading a client application program in the mobile station for:

requesting the first type of data, and

requesting the second type of data, after requesting the first type of data.

10. The method of claim **9** wherein the client application program includes the steps of:

time synchronizing the second type of data to the first type of data; and

displaying the first and second types of data on the mobile station.

11. A client application for a mobile station, embodied in a non-transitory machine readable medium, in which the client application configures the mobile station to execute functions, including the functions to:

receive, from a content distribution network, HLS video and audio of a live event;

receive, from the content distribution network, meta-data related to the live event;

display on the mobile station a first time clock associated with the HLS video and audio of the live event;

request, from the content distribution network, the meta-data at a time similar to a time shown on the first time clock; and

receive, from the content distribution network, the meta-data with a second time clock associated with the meta-data, indicating time for the meta-data that is similar to the time shown on the first time clock.

12. The client application of claim **11** wherein:

receiving the HLS video and audio includes receiving a time stamp with the HLS video and audio; and

receiving the meta-data includes receiving another time stamp with the meta-data;

wherein each respective time stamp represents a respective time of occurrence of an event at the live event.

13. The client application of claim **12** wherein:

the time stamp in the HLS video and audio includes a VITC formatted time clock, and

the time stamp in the meta-data includes a JSON formatted time clock.

14. The client application of claim **11** wherein the first and second time clocks are obtained from at least one Global Positioning System (GPS) timing system.

15. The client application of claim **11** wherein the function to request the meta-data includes functions to:

transmit to the content distribution network, the time shown on the first time clock, and

receive from the content distribution network, the meta-data with the second time clock.

16. A video player mobile device comprising:

a wireless transceiver;

a display; and

a processor, wherein the processor is configured to:

receive video data from a communication network via the wireless transceiver and format the video data for output on the display of the mobile device,

receive meta-data from the communication network via the wireless transceiver and format the meta-data for output on the display of the mobile device together with the video output, and

communicate with a server via the wireless transceiver and the communication network to select the meta-data that is time synchronized to the video data for simultaneous display on the mobile device.

17. The video player of claim **16** further including:

a memory coupled to the processor; and

a client application stored in the memory, wherein execution of the client application by the processor configures the mobile station to respond to a user selection of a time associated with the video data,

wherein the processor is further configured to request, from the communication network, the meta-data in response to the user selection of the time.

18. The video player of claim **17** further including:

a transmitter configured to transmit the request, to the communication network, of the time associated with the video data, and

a receiver configured to receive, from the communication network, the meta-data at a time similar to the time associated with the video data.

19. The video player of claim **16** wherein:

the video data includes a time stamp, and

the meta-data includes another time stamp.

20. The video player of claim **19** wherein:

the time stamp of the video data and the time stamp of the meta-data are derived from at least one GPS timing system.

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