after file download has begun, bits may be dropped and the quality of the presentation is adversely affected.

Therefore, with streaming media files, the content must typically be specific to each type of client at the targeted bit rate. In addition, the streaming media server is occupied for the real time duration of the media clip, and the presentation may experience degradation based upon the amount of latency in the network.

SUMMARY OF THE INVENTION

Briefly, in the present invention, rather than interpreting container objects that contain references to other objects that must be retrieved by the client opening multiple connections with various servers, and rather than specifying the streaming of data in a single access request, the present invention provides for transmission of data as a stream of objects. In particular, in response to a user or application request for a file, the client issues a request for the file in the form of a sequence of desired objects. The request is presented to the server as a single request that includes a list of multiple objects to be returned to the client.

On the server side, the request is pulled together according to what the client has requested. The requested objects are then sent together in a single stream to the client. To accomplish this, the server analyzes the request to locate the particular objects.

Objects that are available locally to the server are simply added to the outgoing stream, however, the server may also need to query back end file servers and other sources for objects that may be located at other computers in the network. The server then assembles these objects together and provides them to the client in a single object stream.

In one implementation of the invention, typically the default implementation, the server may analyze the reqeust and assemble objects based upon a predefined order, such as specified by an object map file located at the server.

In another implementation of the invention, the server may assemble objects "on-the-fly", based upon client-specific criteria. The present invention thus also permits the mixture of different objects in an object stream, depending upon the particular client or client request. The assembly of object streams may thus occur dynamically based upon any number of client-specific criteria, such as the objects already available to the client, the communication channel bandwidth, the desired presentation quality, client buffer capability, or other parameters associated with the client or the communications channel.

For example, the server may maintain a log of objects already sent to the client, and send only those objects which are not already available at the client computer.

The client may also specify an object class together with information that enables the server to determine which member object of the class is to be placed in the stream.

Such information may include the communication bandwidth, graphical resolution, physical location, or other information which varies from client to client.

The server may also send objects of a particular quality targeted to particular clients. The selection of objects may depend upon client parameters such as observed network latency in real time or desired object quality.

The system may also include buffering, so that the rendering of the set of objects may be delayed until a sufficient amount of data is received at the client.

BRIEF DESCRIPTIONS OF THE DRAWINGS

The foregoing and other objects, features and advantages of the invention will be apparent from the

following more particular description of preferred embodiments and the drawings in which like reference characters refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.

Fig. 1 is a block diagram of a computer network employing the present invention.

Fig. 2 is a schematic flow diagram of one embodiment of the present invention.

Fig. 3 illustrates how a server dynamically assembles an object stream in response to a client request.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Illustrated in Fig. 1 is a block diagram of a general computer network 21. A plurality of computers 13, 15, 17 are coupled across a communication channel 11 for communication amongst each other. Various subsets of the computers may themselves form a local area network (LAN) or other local network 13, 15. Each of the various local networks are coupled through a respective router 12a, 12b to channel 11. This enables communication from one local network to another across the channel 11 to form what is known as an "internet". In the preferred embodiment, the present invention is employed on what has become known as the Internet (an international computer network linking an estimated 35 million people to approximately 4.8 million host computers or information sources).

In the preferred embodiment the computers 13, 15, 17 or digital processors employing the present invention are of the PC or mini computer type, or the like, having

processing capabilities of the Intel XX386 processing chip or better. The communication channel 11 is a typical telephone line or other transmission/communication cable handling a 28,800 baud data rate or the like.

A sequence of steps are undertaken by the computers 13, 15, 17 to transfer data in the form of a stream of objects according to the present invention. For example, a given client computer 13a may issue a request for computer data to another computer 17, which acts as a server.

Referring to Fig. 2, the client 13a is a computer that executes an application (or other user interaction) for which certain data needs to be made present. In steps 100 and 102, the client receives an object stream request from the application that includes a global identification of an object map which indicates certain objects existing in the network 21 that the client application program seeks. In particular, the object stream request includes a list, or linear sequence of objects identified a global object identification number. The client 13a transmits the initial request to the server 17, which enters state 200 to transfer back a global identification of the object map listing subject objects.

The client next determines whether the object map is stored locally. Thus, the client 13a checks multiple local memories such as hardware caches, working memory, CD-Rom's and local network memories for the object map in state 108.

If the object map is found locally, then the client analyzes the object map. If the object map is not found locally, then the client requests the object map from the server in state 106.

In response to this request, the server enters states 202, 203 and 204 to (i) initialize a log of object identifications for this client, (ii) initialize a steady

state connection with the client, and (iii) transmit the object map identified by the client 13a.

The client 13a then analyzes the object map in state 108. This is accomplished by the client processing each object referred in on the object map, as indicated by the analyze loop of states 110,112 and 114.

For each such object, the client first determines, in state 110, whether the object is in local cache. If not, then the client 13a adds the identification of the object to a request block. As long as the block is not full, this loop continues with the client adding an identification of each object not found in local cache in state 112.

When the block is full in state 114, the client transmits a request to the server for the block of objects as a list of object identifications.

Upon receipt of this request (i.e., a block of object indentifications), the server 17 then initiates the assembly of a data stream and compiles the stream of objects based on (i) the sequence of requested objects and/or (ii) quality of the objects.

To accomplish this the server constructs blocks of objects to form the data stream, in states 206 through 214. In constructing the blocks, the server 17 maintains a log of objects being transmitted to fulfill the client's request. Specifically, in states 206 and 208, for each object in the block, the server 17 first determines from the log whether the object has previously been transmitted to the particular client 13a. If so, the server 17 enters state 214 to prevent that object from being placed in the current block. Therefore, states 110 and 212 are entered only for the objects that the client is actually in need of. In state 210, then, the server only fetches objects from remote servers which are actually needed by the client 13a. This provides a significant performance advantage, especially where the objects must be obtained elsewhere in

the network 21. As such, the server 17 constructs blocks of data and hence compiles the stream of data for the client 13a in real time, i.e., on the fly, without duplication of any one object throughout the total data stream.

On the receiving end, the client 13a receives the object stream in state 116. More accurately, the data of the object is then delivered to the requesting application of the client for further processing and use.

In summary, for each such object request by the client 13a, an object streaming type communication from the server 17 to client 13a is performed. In particular, a request for a sequence of non-local objects is made by the client 13a and transmitted to the server 17. In turn, the server 17 initializes a log of objects according to object identifications, and then fulfills the request for objects by transmitting the requested objects, in sequence order, which have not previously been transmitted to that client 13a as indicated by the log.

It should be understood that the objects may be computer data structures of various types and formats. The objects may, for example, be compiled in any number of ways within the object oriented computing model well known in the art. For example, objects may include text, graphics, audio, video, and other types of digitized information. Furthermore, objects may be complete data files or only portions of such files. In addition, the objects themselves may be classes that consist of a number of objects grouped together. The object request must then typically include information to specify which member of the object class is desired by the client 13a.

For example, an object class may consist of various versions of a particular graphic object. The selected version may depend upon the desired quality of the final graphical rendering of the object desired by the client

computer 13a. Quality may also have other meaning such as bandwidth, graphical resolution, number of colors, available client memory cache size, and other class criteria that depend upon the type of client computer 13a.

In addition, object classes may depend upon various other client-specific information such as domains, for example. In this scenario, when the client computer 13a is located in one area of the country, such as Massachusetts, a different object may be returned than when the client 13b is located in California, although each of the clients 13a, 13b actually requested the same global object.

Fig. 3 is a diagram illustrating how an example object stream 300 may be assembled by the streaming servers 17, and in particular showing how the object stream does not have to originate from a single source or a single file.

Here the client 13a requests and receives a particular object map 301 consisting of a list of object identifications such as the list (ID1,ID4,ID7,ID6,ID2, ID3), where each object identification IDx indicates a global address for a particular object. According to the process already described in connection with Fig. 2, the client 13a first creates a request block 302 taking into account any local objects 303 which it may already have available. In the particular illustrated example, the client 13a already has local objects (O1, O6) available locally.

After compiling the request block 302, the request block 302 is sent to the streaming server 17. Streaming server 17 receives the request block 302 and then assembles a stream block 310a for the client 13a. It should be understood that other stream blocks 310b may also be constructed for other clients 13b at the same time as the block being constructed for client 13a.

For example, assuming a first time interaction between the client 13a and server 17 in a given stream, the server

17 typically has a default data stream order regardless of user interaction on the client 18 side.

In a first modification, the server 17 may have available certain information concerning the client. Because the server 17 may compose the data stream on-the-fly, the default stream order may be changed in accordance with prior history of requests made on the server 17. That is, on the server processor, an analysis of multiple prior usage of server objects by other clients is made. The server 17 changes the default objects stream 300 order to the closest substitution (i.e., object map) based on demographics of clients 13a having prior server data/object usage. To accomplish such an analysis, a neural network may be employed.

In yet another modification, the streaming server 17 may create the stream block 310a from information that is known about the specific client 13a.

For example, the server 17 may maintain a log 311a of objects that have already been provided to client 13a as well as any available local objects 312 local to the server 17. In the illustrated example the log 311a indicates objects (ID1,ID6) as already having been provided to client 13a. In addition, the available local objects 312 include (O4,O12).

It should be understood, as previously described, that a particular object such as object O4 may actually consist of a class definition, as illustrated, wherein a number of objects comprise the class. For example, object 04 here is actually an object class (O4a,Ob4,...O4x). The streaming server 17 thus also receives together with the object identification request block 302 information as to which particular member of class O4 is appropriately provided to the client 13a.

The streaming server 17 then assembles the stream block 310a as illustrated, which includes all of the

objects that the client 13a has requested. In the illustrated example this includes objects (O4a, O7, O2, O12, O3). After assembly of the stream block 310a the streaming server 17 then provides the stream block 310a as a single object stream 300 to the client 13a.

During assembly of the stream block 310a the streaming server 17 may not have all the necessary objects available in the local object list 312. In such instances the streaming server 17 must query other remote server computers 15a, 15b connected to the network 21 in order to locate the objects. This is done in a manner which is well known in the art by the streaming server 17 making requests of the remote computers 15a, 15b to provide their respective objects that they have made available. In Fig. 3, objects (O7, O2, O4) are located at computer 15a and object (O3) at computer 15b.

An identical object map may be operated on in a different manner by server 17 for client 13b. In particular, although the object map 301b is the same as the objects map 301a, because a different list of object 303b is available to client 13b, the request block 302b created by client 13b will have different object identification numbers (ID4, ID6, ID3). Furthermore, the client parameter(s) provided with the request block by client 13b may very well be different for that provided by client 13a. Thus, an object of a particular quality may be targeted to client 13b which is different than as that supplied to client 13a. For example, when clients 13a and 13b request that object O4 be provided to them, client 13a may actually receive object O4a and client 13b may receive object O4b, despite the fact that the reference O4 was a common global object identification.

The object classes may also be defined as bandwith selectable objects. In particular, the resulting data stream 300 may be assembled based upon observed client

bandwidth availability. Therefore, depending on a periodically calculated data transfer rate, the client 13a or server 17 may choose to request or transmit a data stream of different objects. That is, for a given requested object 04, a specific version 04a, 04b...04x may be selected for transfer from the server 17 to the client 13a as a function of available bandwidth. This function is termed "bandwidth scalability" of the object stream.

In another possible implementation, "object specific compression" is provided by the server, such that on an object by object basis, the object data stream 300 may be compressed one object at a time depending upon client criteria. In the preferred embodiment, the server 17 determines which compressed object version to include in the object data stream 300 at the time of compilation.

The client 13a also manages the amount of data being delivered, i.e., throughput to a client 13a. In particular, this is useful to determine whether there is enough data being timely transferred; that is, whether data is being consumed on the client 13a end faster than the server 17 is delivering the requested objects.

In the preferred embodiment, the client 13a builds a map of uncompressed data consumption. The map tells how fast data is being consumed (used by the client 13a application). The client then measures the throughput (client receipt) of data in real time and contrasts that with the formulated map. Based on the comparison, the client 13a is able to determine how much of the object stream data 300 should be read by a buffer 320a at a time. Thus, the client 13a effectively maps the physical compressed object data stream 300 and logical consumption of data at each point in time.

The client 13a continually monitors the real data throughput versus data consumption. The client 13a wants the delivery-to-consumption ratio to be greater than one so

that the throughput (supply) is keeping up with the consumption (demand). When the delivery-to-consumption ratio is less than one, there is more data being consumed than the amount of data being delivered, such that there is a so-called "buffer debt" on the client 13a side. In that case, the transmission of data needs to take advantage of pause points in the object data stream 300, so that for a period of time, data is not being transmitted over the communication channel 11. In turn, the buffer 320a is allowed to fill up with the requested data and thus decrease or solve the "buffer debt", to assist with proper real time delivery of objects.

The pause points may be pre-defined by the author of the object content, or the pause points may be determined on the fly in accordance with the client's ability to consume data.

In the preferred embodiment this latter implementation is accomplished as follows. The client 13a at each time point, t, computes object data consumption. A running average of throughput such as number of bytes received divided by total time in seconds is employed. An adaptive running average or weighted average or the like may also be used to compute the data consumption. This is also known as the physical throughput at a given time, i, (i.e., (pt_i).

The total logical data (tld) optimally needed at a point in time t is calculated as follows:

$$tld = \sum_{i=o}^{t} rate\ map(i)$$

Buffer debt is then calculated as follows:

$$buffer\ debt = \sum_{i=t}^{end} (tld(i) - pt_i)$$

The client 13a then calculates the buffer debt from time to time. For a buffer debt greater than 0 the client calculates a maximum wait time

maxwait = buffer debt ÷ physical throughput

which equals the number of seconds of pausing needed to rectify the buffer debt. At each wait point or pause point in the object data stream 300, the client 13a will then wait a minimum of the maxwait time or the maximum time allowed at that wait point. For a buffer debt of less than zero, the server 17 transmission of data is ahead of the consumption and thus no pausing during the transmission of the object data stream 300 is warranted.

EQUIVALENTS

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

For example, the log maintained by the server 17 for preventing duplication of objects in the transmitted object data stream 300 to the requesting client may be implemented with tables, cache memory and the like. In the case of caching, a sparse representation of the most recent transmitted objects is maintained in the log. Other caching or log implementations are suitable and are understood to be in the purview of one skilled in the art.

Another example is the term "local to the client". "Local" means in various memories including hard drives, cache memories, CD's and other working memories in the local network involving the client 13a.

CLAIMS

1. In a computer network having a plurality of digital processors loosely coupled to a communication channel for communication among the digital processors, a method of transmitting data from one digital processor to a second digital processor comprising the steps of:

providing a server processor;

providing a requesting processor;

coupling a communication channel between the server processor and requesting processor to enable communication between the server processor and requesting processor;

in the requesting processor, forming a request for a desired sequence of objects;

transmitting the formed request across the communication channel from the requesting processor to the server processor;

in the server processor, in response to receipt of the request, assembling and transmitting, across the communication channel to the requesting processor, a data stream based on the desired sequence of objects, such that a set of objects in a defined order is transmitted in the data stream from the server processor to the requesting processor.

2. A method as claimed in Claim 1 wherein the step of assembling and transmitting a data stream includes:

in the server processor, recording an indication of objects being transmitted to the requesting processor in response to the request; and

based on the recording, preventing plural and subsequent transmission of an object indicated on the

recording by deleting from the data stream objects indicated on the recording such that the transmitted set of objects is formed only of objects which have not been previously transmitted to the requesting processor in response to the request as indicated in the recording.

3. A method as claimed in Claim 1 wherein the step of assembling and transmitting a data stream includes:

in the server processor for each of certain objects, providing multiple versions of the object;

for each of the certain objects, in one of the server processor and requesting processor, determining one version of the object to be optimal for transmission in terms of available bandwidth of the communication channel; and

using the determined version of the object in the set of objects transmitted in the data stream.

4. A method as claimed in Claim 1 wherein the step of forming a request in the requesting processor includes:

for each object in the desired sequence, determining whether the object is locally stored; and

omitting from the request those objects determined to be locally stored but maintaining sequence ordering of the objects in the request.

5. A method as claimed in Claim 1 further including the step of monitoring a rate at which the requesting processor uses requested objects such that rate at which the requesting processor receives requested objects transmitted from the server processor is sufficiently fast to prevent the data stream from

lagging behind the requesting processor use of requested objects.

6. A method as claimed in Claim 1 wherein the step of assembling and transmitting a data stream includes:

in the server processor for each of certain objects, providing multiple versions of the object;

for each of the certain objects, in one of the server processor and requesting processor, determining one version of the object to be optimal for transmission to the client in terms of available client criteria,; and

using the determined version of the object in the set of objects transmitted in the data stream.

7. A method as claimed in claim 6 wherein the client criteria is one of object quality, bandwidth, graphic resolution, or client location.

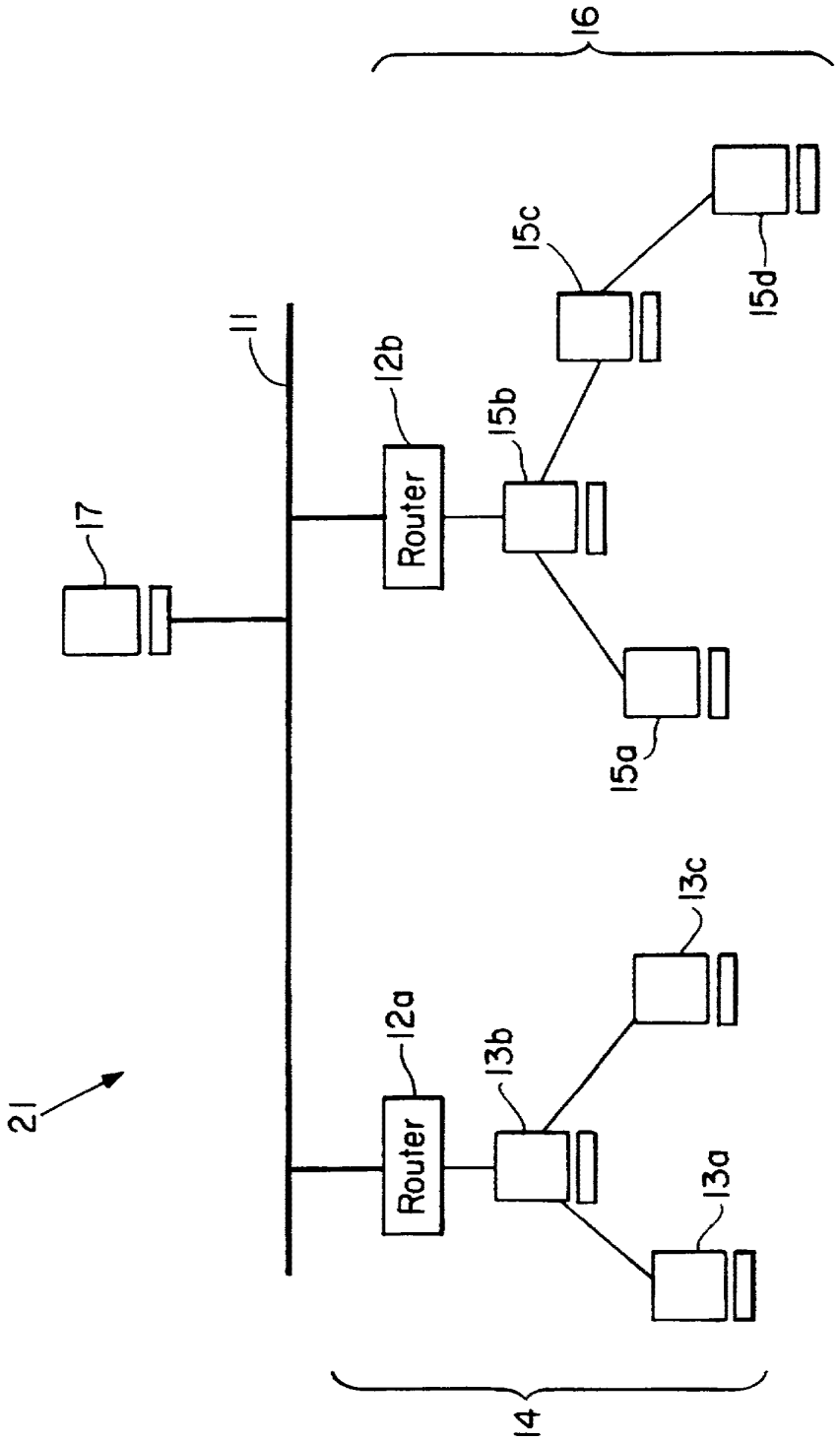

FIG. 1

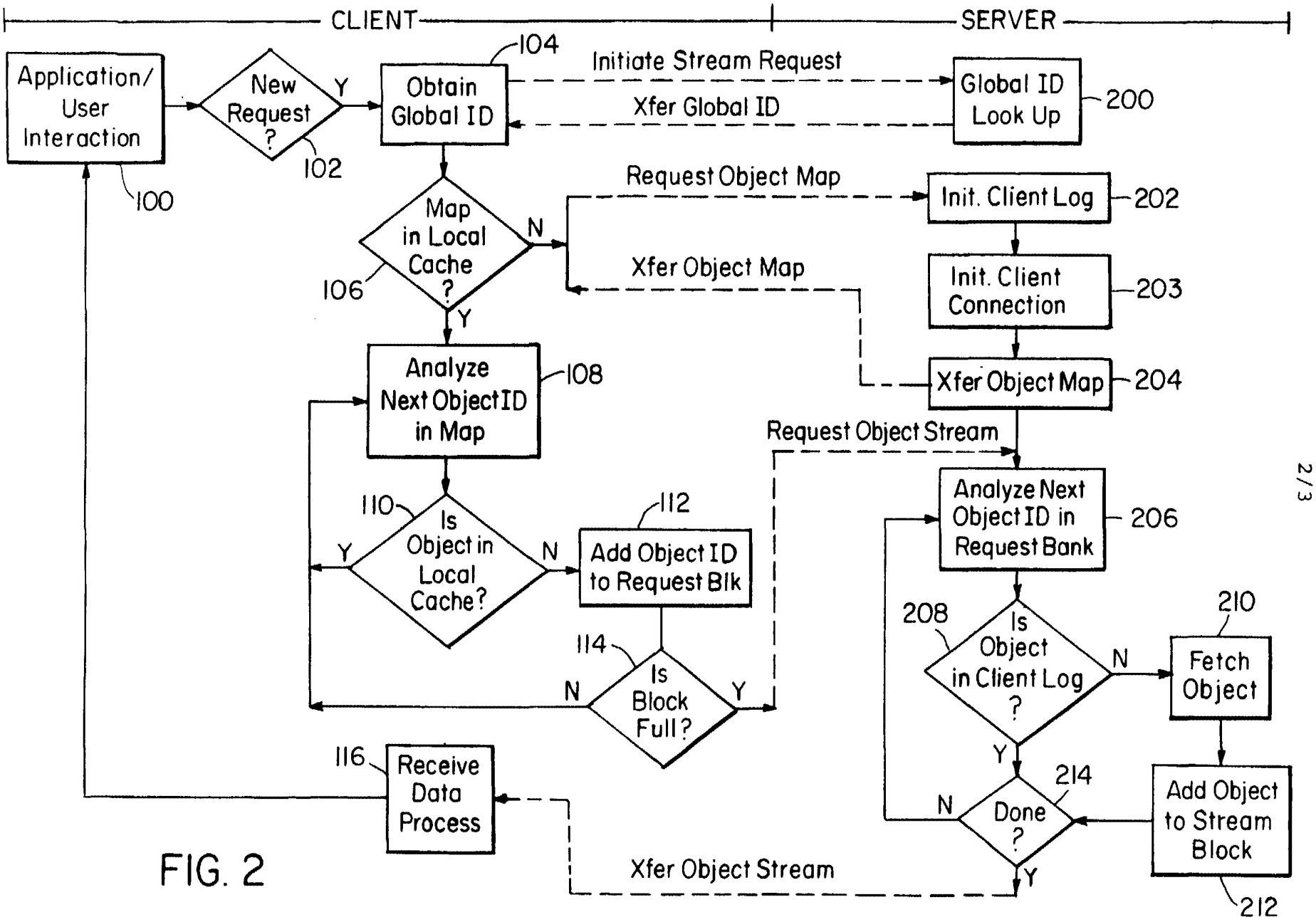
CLIENT
SERVER
Application/ User Interaction
100
New Request ?
102
Y
104
Obtain Global ID
Initiate Stream Request
Xfer Global ID
Global ID Look Up
200
Map in Local Cache ?
106
N
Y
Request Object Map
Xfer Object Map
Init. Client Log
202
Init. Client Connection
203
Xfer Object Map
204
Analyze Next ObjectID in Map
108
Request Object Stream
Analyze Next Object ID in Request Bank
206
110
Is Object in Local Cache?
112
Add Object ID to Request Blk
114
Is Block Full?
208
Is Object in Client Log ?
210
Fetch Object
214
Done ?
Add Object to Stream Block
212
116
Receive Data Process
Xfer Object Stream

FIG. 2

SUBSTITUTE SHEET (RULE 26)

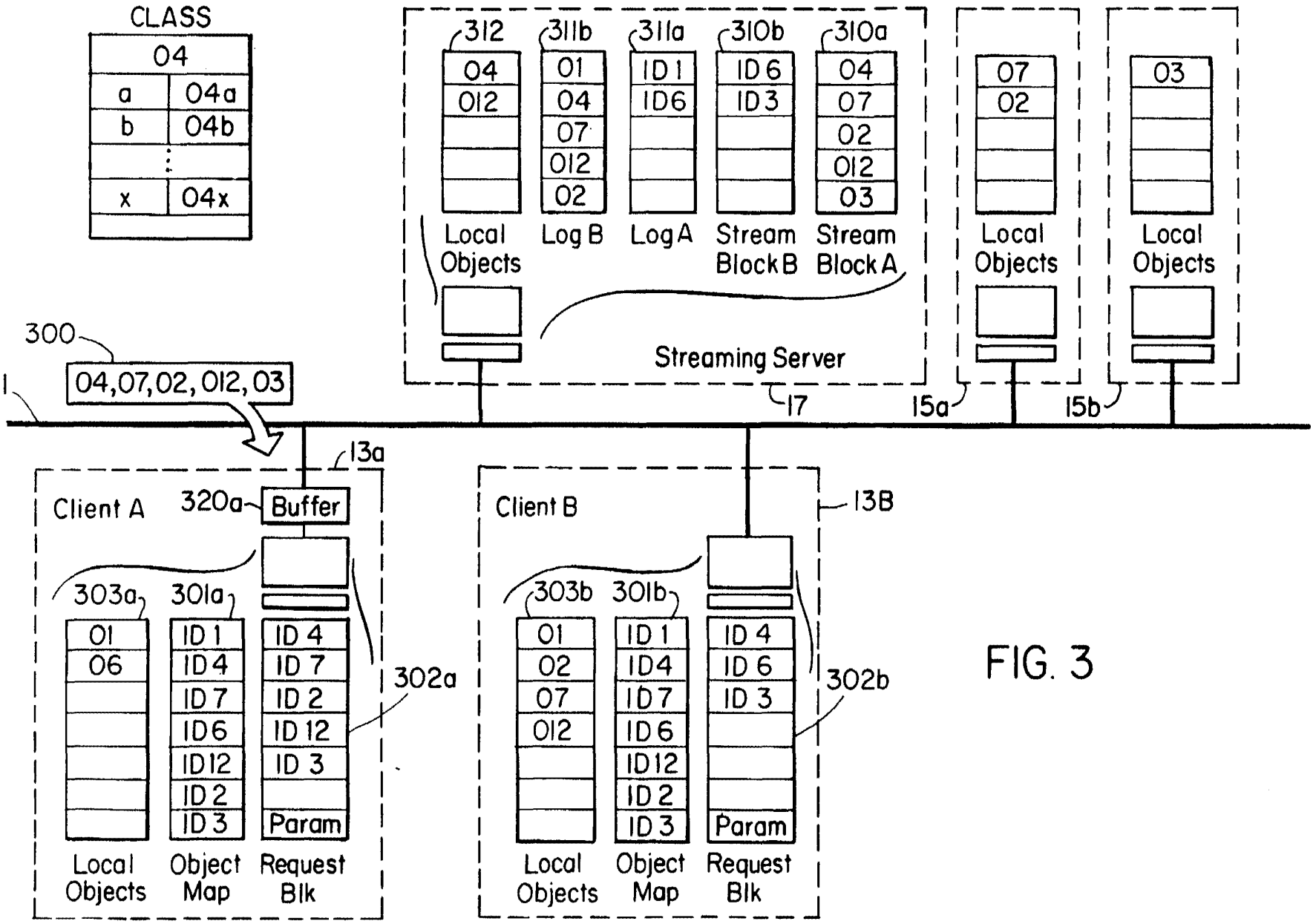

FIG. 3

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/069,450	**10/19/2023 10:53:31 PM ET**	**9401-00279**

Title of Invention

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8508	FILED BY	Blake Scheffey
PATENT CENTER #	63038846	FILING DATE	12/21/2022
CUSTOMER #	70560	FIRST NAMED INVENTOR	DAVID F. BRUECK
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Brett Carlson

Documents

TOTAL DOCUMENTS: 53

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
9401-00279_PetitionWithdrawIssue.pdf	2	Petition to Withdraw from Issue	20 KB
9401-00279_RCE.pdf	3	Request for Continued Examination (RCE)	681 KB
IDS4_101923.pdf	8	Information Disclosure Statement (IDS) Form (SB08)	599 KB
IDS1_101923_Final.pdf	31	Information Disclosure Statement (IDS) Form (SB08)	296 KB

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IDS2_101923_Final.pdf	19	Information Disclosure Statement (IDS) Form (SB08)	233 KB

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IDS3_101923_Final.pdf	9	Information Disclosure Statement (IDS) Form (SB08)	169 KB

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FPD4_EP0695094B1.pdf	11	Foreign Reference	532 KB
FPD6_EP1641271A2.pdf	17	Foreign Reference	400 KB
FPD2_WO1997044942A2.pdf	24	Foreign Reference	892 KB
FPD5_EP0711077A2.pdf	22	Foreign Reference	1287 KB
FPD1_DE10101075A1.pdf	14	Foreign Reference	787 KB
9401-00279_NPL2.pdf	86	Non Patent Literature	657 KB
9401-00279_NPL5.pdf	85	Non Patent Literature	746 KB
9401-00279_NPL3.pdf	86	Non Patent Literature	865 KB
9401-00279_NPL4.pdf	85	Non Patent Literature	863 KB
9401-00279_NPL1.pdf	166	Non Patent Literature	1070 KB
9401-00279_NPL7.pdf	82	Non Patent Literature	982 KB
9401-00279_NPL6.pdf	79	Non Patent Literature	884 KB

9401-00279_NPL9.pdf	96	Non Patent Literature	1701 KB
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9401-00279_NPL32_Final.pdf	62	Non Patent Literature	744 KB
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9401-00279_NPL39_Final.pdf	662	Non Patent Literature	15717 KB

9400-00279_NPL34_Final.pdf	78	Non Patent Literature	818 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
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9401-00279_NPL22_Final.pdf	516BB15DF1E652A1DA24D14113815057A892C0D3E6A8F9D57 458C4E07A06E290D991E0BB81CFDA8832DF62B054F9B7CD27 32B9D8F945DE679AFE96BAF8A2B184
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9401-00279_NPL30.pdf	37E44F3A688EC98643048135EDB66376A308E6F1F660A78B44 5366E82EE06646C4A22EB8EA7D6FE8372CB5243C96F2D0BF7 3A1835EE1FED3F2D1FF96FD023FE1
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9401-00279_NPL29_Final.pdf	133234642802208 2339F0945294ABAB0DAB06E40AE3270A25D 004B37E9DFDC179E7F8084BF1F764C84D5452213703EC1940A B62EA4035072E8B6236FC1309F09
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9401-00279_NPL36_Final.pdf	35863A94D5017E0685E44D1D6C9FD7D264028366BF884B359C AF39BCA8287B9E94B0AC55A8C9928EF165193764E6A0C2348 8DB864F225584EE83A78D5E8CB510
9401-00279_NPL32_Final.pdf	5D25E18C1A047F7F0D4DC2679828AD3D78CA0BBBE9C8263A C6ABB3B9E02AEE3085CD64657E1D14F286CD9C0349544C533 7FA5F7E635927A11774DB9A92CE71F9
9401-00279_NPL37.pdf	673AADAEC86F20600F203E97A5ACD9E4D01E93B06EA9E930 D408FE37677B35976DAA4076CE8221022A9C6A594B2247E2E4 16E6B83C11F6F4307114E6C60E2130
9401-00279_NPL41.pdf	FB98D4C0A6C4ED2D221FA5155EE69FD59A66CB6331E46EFC FB465540B85B8D7EF844872C02B9729E6ECBF5574FFBBCFDE 95A2E81598DE9B4096BA28E4D417235

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9400-00279_NPL34_Final.pdf	CC487ED3B2B85A84A8946A986CA71C833DAE90266458F1EF4CF470B93BC226CE90F20EA723B01E3400EDC73C30189358857DB2697DB500B0DE48C63B4C2FB95D

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.:	18/069,450	Examiner:	Chirag R. Patel
First Named Inventor:	David F. Brueck	Art Unit:	2454
Filed:	December 21, 2022	Conf. No.:	8508
Docket No.:	9401-00279	Cust. No.:	70560
Title:	**APPARATUS, SYSTEM, AND METHOD FOR MULTI-BIRTRATE CONTENT STREAMING**		

PETITION TO WITHDRAW FROM ISSUE PURSUANT TO 37 C.F.R. § 1.313(c)(2)

Mail Stop Petition
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

We hereby petition to withdraw the above-identified application from issue pursuant to 37 C.F.R. § 1.313(c)(2) and MPEP § 1308. Specifically, we respectfully request that the Commissioner withdraw the above-identified application from issue to permit consideration of the Request for Continued Examination in compliance with § 1.114 and the Information Disclosure Statement filed concurrently herewith.

The issue fee in this application was timely paid on October 12, 2023. On information and belief, one or more other parties filed several Petitions for Inter Partes Review of issued patents that are related to this application on the following day, October 13, 2023. The Information Disclosure Statement submitted herewith includes copies of the Petitions and any art cited therein that is not already of record. We therefore respectfully petition to withdraw the above-identified application from issue so that the Examiner may consider the accompanying RCE and IDS.

The petition fee described in 37 C.F.R. § 1.17(h) and the RCE fee described in 37 C.F.R. § 1.17(e) are submitted herewith. If there are any issues in processing that payment or if any additional fees are required, please consider this as a request and petition for any needed relief

and/or as authorization to charge Deposit Account No. 602406 for any fee that may be due. Please also consider this as a request for an extension of time, if any such extension is needed.

If a telephone conversation would assist in any way, the undersigned would welcome a telephone call to 602.344.9885 or an email to brett@kwlaw.co.

Respectfully submitted,

KW LAW, LLP

Dated: October 19, 2023

By: /BRETT A. CARLSON/
Brett A. Carlson
Reg. No. 39,928

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

U.S.PATENTS Remove

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	140	6697072		Mar. 26, 2001	Russell	
	141	6697819		Jul. 30, 2001	Boudreau	
	142	6701528		Jan. 26, 2000	Arsenault	
	143	6710822		Feb. 15, 1999	Walker	
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	162	6765878		Mar. 28, 2000	Carlson	
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	164	6771652		Nov. 23, 1999	Aydemir	
	165	6771703		Jun. 30, 2000	Oguz	
	166	6772375		Dec. 22, 2000	Banga	
	167	6785288		Jul. 25, 1996	Enns	
	168	6788882		Apr. 17, 1998	Geer	
	169	6789106		Feb. 2, 2001	Eyer	
	170	6792449		Jun. 28, 2001	Colville	
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	173	6820233		Jul. 14, 2000	Johansson	
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	180	6870573		Jan. 22, 1999	Fuller	
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Examiner Initial*	Cite No	Publication Number	Kind Code1	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear

If you wish to add additional U.S. Published Application citation information please click the Add button.	Add	
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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
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EXAMINER SIGNATURE			
Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-10-19
Name/Print	Brett Carlson	Registration Number	39928

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/069,450	**10/19/2023 10:53:31 PM ET**	**9401-00279**

Title of Invention

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8508	FILED BY	Blake Scheffey
PATENT CENTER #	63038846	AUTHORIZED BY	Brett Carlson
CUSTOMER #	70560	FILING DATE	12/21/2022
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	DAVID F. BRUECK

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 6960	**E20230IM54227025**	**Blake Scheffey**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1830	PROCESSING FEE, EXCEPT IN PROVISIONAL APPLICATIONS	140.00	1	140.00
1801	REQUEST FOR CONTINUED EXAMINATION (RCE) - 1ST REQUEST (SEE 37 CFR 1.114)	1360.00	1	1360.00
			TOTAL AMOUNT:	**$1,500.00**

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	18069450
	Filing Date	2022-12-21
	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	1	Internet Archive Affidavit, Nathaniel E Frank-White for URLs ("SMIL") (335 pages)	☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	18069450
	Filing Date	2022-12-21
	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

CERTIFICATION STATEMENT

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OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-10-23
Name/Print	Brett Carlson	Registration Number	39928

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/069,450	**10/23/2023 08:18:04 PM ET**	**9401-00279**

Title of Invention

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8508	FILED BY	Blake Scheffey
PATENT CENTER #	63061835	FILING DATE	12/21/2022
CUSTOMER #	70560	FIRST NAMED INVENTOR	DAVID F. BRUECK
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Brett Carlson

Documents

TOTAL DOCUMENTS: 7

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
9401-00279_NPL15_pp51-90.pdf	40	Non Patent Literature	21286 KB
9401-00279_NPL15_pp91-130.pdf	40	Non Patent Literature	22046 KB
9401-00279_NPL15_pp1-50.pdf	50	Non Patent Literature	23671 KB
9401-00279_NPL15_pp171-210.pdf	40	Non Patent Literature	11606 KB
9401-00279_NPL15_pp131-170.pdf	40	Non Patent Literature	19539 KB

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9401-00279_IDS_102323.pdf	4	Information Disclosure Statement (IDS) Form (SB08)	598 KB

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DOCUMENT	MESSAGE DIGEST(SHA-512)
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9401-00279_NPL15_pp1-50.pdf	72277496D8650D53327B0564715DCF7D0C411DEB7B73A2F77DD211D5CD877B95CA4FC36F4299B2509CF8284E30D4492ED29A9CF45FE6D720C623B442CFA7E37C
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9401-00279_IDS_102323.pdf	87FBBC86602C11C61A30D3D7D00A132B74F181150340B55E80E6ECA4A0DACA789233B6C32714375449011F2448A0B38919742DE167775E4D9CB9A75F12D13889

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New Applications Under 35 U.S.C. 111

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National Stage of an International Application under 35 U.S.C. 371

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New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/069,450	12/21/2022	DAVID F. BRUECK	9401-00279	8508

70560 7590 10/27/2023

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

EXAMINER	
PATEL, CHIRAG R	

ART UNIT	PAPER NUMBER
2454	

NOTIFICATION DATE	DELIVERY MODE
10/27/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

dish@kwlaw.co
ipdept@dish.com
uspto@dockettrak.com

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

In re Application of	:	
BRUECK et al.	:	
Application No. 18/069,450	:	
Filed: 21 Dec 2022	:	DECISION ON PETITION
For: APPARATUS, SYSTEM, AND	:	
METHOD FOR MULTI-BITRATE	:	
CONTENT STREAMING	:	

This is a decision on the petition filed October 19, 2023 under 37 CFR 1.313(c)(2), to withdraw the above-identified application from issue after payment of the issue fee.

The petition is **GRANTED**.

The above-identified application is withdrawn from issue for consideration of a submission under 37 CFR 1.114 (request for continued examination). *See* 37 CFR 1.313(c)(2).

Petitioner is advised that the issue fee paid on October 12, 2023 in the above-identified application cannot be refunded. If, however, the above-identified application is again allowed, petitioner may request that it be applied towards the issue fee required by the new Notice of Allowance.[1]

Telephone inquiries should be directed to Irvin Dingle at (571) 272-3210.

This matter is being referred to Technology Center AU 2454 for processing of the Request for Continued Examination under 37 CFR 1.114 and for consideration of the concurrently filed Information Disclosure Statement (IDS).

/Irvin Dingle/
Irvin Dingle
Lead Paralegal Specialist, OPET

[1] The request to apply the issue fee to the new Notice may be satisfied by completing and returning the new Issue Fee Transmittal Form PTOL-85(b), which includes the following language thereon: Commissioner for Patents is requested to apply the Issue Fee and Publication Fee (if any) or re-apply any previously paid issue fee to the application identified above. Petitioner is advised that, whether a fee is indicated as being due or not, the Issue Fee Transmittal Form **must** be completed and timely submitted to avoid abandonment. Note the language in bold text on the first page of the Notice of Allowance and Fee(s) Due (PTOL-85).

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	18069450
	Filing Date	2022-12-21
	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	1	DISH Technologies et al. v. IFIT Health & Fitness, Case 1:23-cv-00963-GBW, "Defendant IFIT Health and Fitness, Inc.'s Motion to Dismiss the First Amended Complaint Pursuant to Fed. R. Civ. P. 12(b)(6)" dated October 27, 2023 (3 pages).	☐
	2	DISH Technologies et al. v. IFIT Health & Fitness, Case 1:23-cv-00963-GBW, "Opening Brief in Support of Defendant IFIT's Motion to Dismiss Plaintiffs' First Amended Complaint" dated October 27, 2023 (30 pages).	☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-10-31
Name/Print	Brett Carlson	Registration Number	39928

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/069,450	**10/31/2023 06:09:44 PM ET**	**9401-00279**

Title of Invention

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8508	FILED BY	Blake Scheffey
PATENT CENTER #	63128041	FILING DATE	12/21/2022
CUSTOMER #	70560	FIRST NAMED INVENTOR	DAVID F. BRUECK
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Brett Carlson

Documents

TOTAL DOCUMENTS: 3

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
9401-00279_IDS_103123.pdf	4	Information Disclosure Statement (IDS) Form (SB08)	598 KB
9401-00279_IDS103123_NPL1_Final.pdf	3	Non Patent Literature	1237 KB
9401-00279_IDS103123_NPL2_Final.pdf	30	Non Patent Literature	20878 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
9401-00279_IDS_103123.pdf	3A6E1A257E61DB7BBB814D859BC8B46BB3DFA91D0B0CB81139F533DA01DDC1F62B336A41E4BC9BC4EE5C3506E8800C661253355DDF7C98975DDE3CBE12D7DAC0
9401-00279_IDS103123_NPL1_Final.pdf	ADB8B5716AD37A751F70515FCBF2F26C3032617351608CCD02A1B872DA0899A60BF93CC3A8324F095EF203FFDB8A96C6945C474B61DB509C7964E5E9736B4A7F
9401-00279_IDS103123_NPL2_Final.pdf	AB19D16217C0EC53038E515EDA0883E3C2B27A622E0A8F1FFA166C5F1333C3DCFB30EE0FD7BAACAE41A6D257FCC8CE3F1310125E9520FD87DECB5BCE548AA6CE

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/069,450	**11/06/2023 05:05:58 PM Z ET**	**9401-00279**

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APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8508	FILED BY	Blake Scheffey
PATENT CENTER #	63173128	FILING DATE	12/21/2022
CUSTOMER #	70560	FIRST NAMED INVENTOR	DAVID F. BRUECK
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Brett Carlson

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
9401-00279_IDS_110623.pdf	5	Information Disclosure Statement (IDS) Form (SB08)	598 KB
9401-00279_IDS110623_NPL1.pdf	7	Non Patent Literature	686 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
9401-00279_IDS_110623.pdf	89643696ED5A6219CE27B425F697D37A727C5A50B194699D75 964F392647CEDA04204BD3842F0BCF069B6227A1BFE4850526

	295989DB630DDB45F1DBC28BBE1D
9401-00279_IDS110623_NPL1.pdf	50E9CA72BCE35243E92559B1F15F1EB795E16ECD296A9BCAE073973A41AED819BD48F69947E43C0EDD18E586B1BB7DFD488C386EAE0FEBAAE851A1A392513698

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Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6389473	B1	2002-05-14	Carmel et al.	
	2	6006241	A	1999-12-21	Purnaveja et al.	
	3	5907683	A	1999-05-25	Engelsiepen et al.	
	4	5991306	A	1999-11-23	Burns et al.	
	5	6711622	B1	2004-03-23	Fuller et al.	
	6	5519438	A	1996-05-21	Elliott et al.	
	7	5719786	A	1998-02-17	Nelson et al.	
	8	5914711	A	1999-06-22	Mangerson et al.	

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	Attorney Docket Number	9401-00279

	9	5490247	A	1996-02-06	Tung et al.	
	10	6014694	A	2000-01-11	Aharoni et al.	
	11	6084885	A	2000-07-04	Scott	
	12	6085221	A	2000-07-04	Graf	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] ¡	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
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	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	1	Civanlar et al. "A practical system for MPEG-2 based video-on-demand over ATM packet networks and the WWW." Signal Processing: Image Communication 8, at 221-27, 1996.	☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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OR

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☐ See attached certification statement.

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☒ A certification statement is not submitted herewith.

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Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-11-06
Name/Print	Brett Carlson	Registration Number	39928

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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	1	20030055995	A1	2003-03-20	Ala-Honkola	

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	Attorney Docket Number	9401-00279

	1	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00147, "Petition for Inter Partes Review of U.S. Patent 10,757,156 Challenging Claims 1-17 Under 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42.1 et seq." dated November 7, 2023 (85 pages).	☐
	2	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00146, "Petition for Inter Partes Review of U.S. Patent 10,469,555 Challenging Claims 1, 3-5, 7-11, 13-20, and 22-27 Under 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42.1 et seq." dated November 7, 2023 (86 pages).	☐
	3	Fielding et al., "Hypertext Transfer Protocol -- HTTP/1.1," The Internet Society, dated June 1999 (152 pages).	☐
	4	"Enforcement Complaint of DISH DBS Corporation ET AL.," Investigation No. 337-TA-1265 (Enforcement Proceeding) dated September 11, 2023 (43 pages).	☐
	5	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00147, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 10,757,156" executed November 2, 2023 (97 pages).	☐

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	Application Number	18069450
	Filing Date	2022-12-21
	First Named Inventor	David F. Brueck
	Art Unit	2454
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OR

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-11-09
Name/Print	Brett Carlson	Registration Number	39928

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/069,450	**11/09/2023 07:29:41 PM Z ET**	**9401-00279**

Title of Invention

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8508	FILED BY	Blake Scheffey
PATENT CENTER #	63213331	FILING DATE	12/21/2022
CUSTOMER #	70560	FIRST NAMED INVENTOR	DAVID F. BRUECK
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Brett Carlson

Documents

TOTAL DOCUMENTS: 6

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
9401-00279_IDS_110923.pdf	4	Information Disclosure Statement (IDS) Form (SB08)	598 KB
9401-00279_NPL1_110923.pdf	85	Non Patent Literature	838 KB
9401-00279_NPL2_110923.pdf	86	Non Patent Literature	863 KB
9401-00279_NPL3_110923.pdf	152	Non Patent Literature	1934 KB
9401-00279_NPL4_110923_Final.p	43	Non Patent Literature	6419 KB

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9401-00279_NPL5_110923.pdf	97	Non Patent Literature	1894 KB

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9401-00279_IDS_110923.pdf	A4CBEBDE90DF5178AE0FB334321AB0DA0A76FFD5526468CA ECB9EA791A9DB4463363E7AC953D8D2597DC00E9B0374A559 C97FA86B60B7A2C5198010561BFA256
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/069,450	**11/16/2023 05:12:17 PM Z ET**	**9401-00279**

Title of Invention

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8508	FILED BY	Blake Scheffey
PATENT CENTER #	63286730	FILING DATE	12/21/2022
CUSTOMER #	70560	FIRST NAMED INVENTOR	DAVID F. BRUECK
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Brett Carlson

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9401-00279_IDS111623_NPL1_Final.pdf	96	Non Patent Literature	1143 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
9401-00279_IDS_111623.pdf	08E399332BB2987F4748F08139ED882CD36AA1BAE337C45F21

	2C6D91AD851316B2294C1F6ED8DF283F134C7E7766AA4CAB C259FDF19D9FC4D72059E4CA36369C
9401- 00279_IDS111623_NPL1_Final .pdf	D2EA4E7BF6BA6298DF9DCF26F58027C520EFA89D310070D1E ACB2F7E6DC1488995488D4A65C2E12098D9EC89DA413062D3 1A6475CCE9ABEBC3BD884DF30090B2

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First Named Inventor	David F. Brueck
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Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-11-16
Name/Print	Brett Carlson	Registration Number	39928

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70560 7590 11/30/2023

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

EXAMINER	
PATEL, CHIRAG R	
ART UNIT	PAPER NUMBER
2454	

DATE MAILED: 11/30/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/069,450	12/21/2022	DAVID F. BRUECK	9401-00279	8508

TITLE OF INVENTION: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$1200.00	$0	02/29/2024

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

70560 7590 11/30/2023

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/069,450	12/21/2022	DAVID F. BRUECK	9401-00279	8508

TITLE OF INVENTION: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$1200.00	$0	02/29/2024

EXAMINER	ART UNIT	CLASS-SUBCLASS
PATEL, CHIRAG R	2454	709-219000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via the USPTO patent electronic filing system ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/069,450	12/21/2022	DAVID F. BRUECK	9401-00279	8508

70560 7590 11/30/2023

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

EXAMINER	
PATEL, CHIRAG R	

ART UNIT	PAPER NUMBER
2454	

DATE MAILED: 11/30/2023

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 18/069,450	Applicant(s) BRUECK et al.	
	Examiner CHIRAG R PATEL	Art Unit 2454	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to October 19, 2023.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 11-30 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 10/19/23 x4, 10/23/23, 10/31/23, 11/6/23, 11/9/23, 11/16/23.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/CHIRAG R PATEL/
Primary Examiner, Art Unit 2454

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/09/2023	06/29/2023	11/17/2023						
	1	✓	-	-						
	2	✓	-	-						
	3	✓	-	-						
	4	✓	-	-						
	5	✓	-	-						
	6	✓	-	-						
	7	✓	-	-						
	8	✓	-	-						
	9	✓	-	-						
	10	✓	-	-						
1	11	✓	=	=						
2	12	O	=	=						
3	13	O	=	=						
4	14	O	=	=						
5	15	O	=	=						
6	16	O	=	=						
7	17	O	=	=						
8	18	O	=	=						
9	19	O	=	=						
10	20	O	=	=						
11	21	O	=	=						
12	22	✓	=	=						
13	23	O	=	=						
14	24	O	=	=						
15	25	O	=	=						
16	26	O	=	=						
17	27	O	=	=						
18	28	O	=	=						
19	29	O	=	=						
20	30	O	=	=						

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

CPC - Searched*		
Symbol	Date	Examiner
H04L47/30, H04L65/80, H04L47/263, H04L47/10	03/09/2023	C.P.

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
PE2E Search	03/08/2023	C.P.
Google Patents - Scholar	03/08/2023	C.P.
IP.COM	03/08/2023	C.P.
Inventor - Double Patent Search	03/08/2023	C.P.
Reviewed references cited in IPR and IDS	11/17/2023	C.P.

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H04L	H04L47/30, H04L65/80, H04L47/263, H04L47/10	06/29/2023	C.P.

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

CPC						
Symbol					**Type**	**Version**
H04L	/	65	/	70	F	2022-05-01
H04L	/	47	/	801	I	2013-01-01
H04L	/	47	/	12	I	2013-01-01
G06F	/	16	/	71	I	2019-01-01
G06F	/	16	/	183	I	2019-01-01
H04N	/	7	/	24	I	2013-01-01
H04N	/	21	/	23439	I	2013-01-01
H04N	/	21	/	4331	I	2013-01-01
H04N	/	21	/	84	I	2013-01-01
H04N	/	21	/	8456	I	2013-01-01
H04L	/	65	/	80	I	2013-01-01
H04L	/	65	/	61	I	2022-05-01
H04L	/	65	/	65	I	2022-05-01
H04L	/	65	/	1101	I	2022-05-01
H04L	/	67	/	60	I	2022-05-01
H04L	/	67	/	568	I	2022-05-01
H04L	/	67	/	02	I	2013-01-01
H04L	/	65	/	1069	I	2013-01-01
H04N	/	21	/	2662	I	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	17 November 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20231117

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04L	/	65	/	70

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	17 November 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20231117

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		10	9	19	18	28								
	2	1	11	10	20	19	29								
	3	2	12	11	21	20	30								
	4	3	13	12	22										
	5	4	14	13	23										
	6	5	15	14	24										
	7	6	16	15	25										
	8	7	17	16	26										
	9	8	18	17	27										

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	17 November 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20231117

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4760442		Jul. 10, 1995	O'Connell	
	2	4761684		Nov. 14, 1986	Clark	
	3	4816905		Apr. 30, 1987	Tweedy	
	4	4862264		Dec. 23, 1986	Wells	
	5	4931950		Jun. 4, 1990	Isle	
	6	4949169		Oct. 27, 1989	Lumelsky	
	7	4949248		Jul. 15, 1988	Caro	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	8	4963995		Dec. 27, 1988	Lang	
	9	5014125		May. 5, 1989	Pocock	
	10	5019900		Nov. 14, 1986	Clark	
	11	5025457		Apr. 21, 1989	Ahmed	
	12	5043885		Aug. 8, 1989	Robinson	
	13	5050161		Dec. 4, 1989	Golestani	
	14	5057932		Dec. 27, 1988	Lang	
	15	5088107		Oct. 27, 1989	Piasecki	
	16	5089885		Nov. 14, 1986	Clark	
	17	5109281		Feb. 6, 1991	Kobori	
	18	5119474		Jun. 16, 1989	Beitel	
	19	5130792		Feb. 1, 1990	Tindell	
	20	5132964		Mar. 17, 1988	Esaki	

	21	5132992		Jan. 7, 1991	Yurt	
	22	5164839		Dec. 27, 1988	Lang	
	23	5168353		Dec. 21, 1990	Walker	
	24	5172413		Dec. 20, 1990	Bradley	
	25	5208665		Aug. 20, 1987	McCalley	
	26	5208810		Oct. 10, 1990	Park	
	27	5214768		Nov. 1, 1989	Martin	
	28	5231599		Dec. 1, 1988	Peters	
	29	5245430		Feb. 8, 1990	Nishimura	
	30	5247347		Sep. 27, 1991	Litteral	
	31	5253275		Jan. 7, 1991	Yurt et al	
	32	5262875		Apr. 30, 1992	Mincer	
	33	5274758		Jun. 16, 1989	Beitel	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	34	5307456		Dec. 4, 1990	MacKay	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-10-19
Name/Print	Brett Carlson	Registration Number	39928

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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	Filing Date	2022-12-21
	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	1	DISH Technologies et al. v. IFIT Health & Fitness, Case 1:23-cv-00963-GBW, "Defendant IFIT Health and Fitness, Inc.'s Motion to Dismiss the First Amended Complaint Pursuant to Fed. R. Civ. P. 12(b)(6)" dated October 27, 2023 (3 pages).	☐
	2	DISH Technologies et al. v. IFIT Health & Fitness, Case 1:23-cv-00963-GBW, "Opening Brief in Support of Defendant IFIT's Motion to Dismiss Plaintiffs' First Amended Complaint" dated October 27, 2023 (30 pages).	☐

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Examiner Signature	/CHIRAG R PATEL/	Date Considered	11/17/2023

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

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Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-10-31
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First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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	1	20030055995	A1	2003-03-20	Ala-Honkola	

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	1	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00147, "Petition for Inter Partes Review of U.S. Patent 10,757,156 Challenging Claims 1-17 Under 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42.1 et seq." dated November 7, 2023 (85 pages).	☐
	2	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00146, "Petition for Inter Partes Review of U.S. Patent 10,469,555 Challenging Claims 1, 3-5, 7-11, 13-20, and 22-27 Under 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42.1 et seq." dated November 7, 2023 (86 pages).	☐
	3	Fielding et al., "Hypertext Transfer Protocol -- HTTP/1.1," The Internet Society, dated June 1999 (152 pages).	☐
	4	"Enforcement Complaint of DISH DBS Corporation ET AL.," Investigation No. 337-TA-1265 (Enforcement Proceeding) dated September 11, 2023 (43 pages).	☐
	5	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00147, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 10,757,156" executed November 2, 2023 (97 pages).	☐

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	1	6061504		Oct. 27, 1995	Tzelnic	
	2	6085193		Sep. 29, 1997	Malkin	
	3	6098082		Jul. 15, 1996	Gibbon	
	4	6098096		Dec. 9, 1996	Tsirigotis	
	5	6104334		Dec. 31, 1997	Allport	
	6	6104441		Apr. 29, 1998	Wee	
	7	6108382		Feb. 6, 1998	Gringeri	

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	8	6111567		Apr. 3, 1997	Savchenko	
	9	6118450		Apr. 3, 1998	Proehl	
	10	6118817		Mar. 14, 1997	Wang	
	11	6119154		Jul. 14, 1995	Weaver	
	12	6120149		Oct. 31, 1997	Hosoi	
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	18	6144375		Aug. 14, 1998	Jain	
	19	6148005		Oct. 9, 1997	Paul	
	20	6151632		Mar. 14, 1997	Chaddha	

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	21	6154489		Mar. 30, 1998	Kleider	
	22	6154600		Aug. 6, 1996	Newman	
	23	6154771		Jun. 1, 1998	Rangan	
	24	6161137		Mar. 31, 1997	Ogdon	
	25	6161201		Feb. 26, 1998	Payne	
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	34	6219339		Feb. 20, 1998	Doshi	
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	36	6236395		Feb. 1, 1999	Sezan	
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	45	6281940		Mar. 31, 1999	Sciammarella	
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	47	6292466		Dec. 13, 1995	Droz	
	48	6292512		Jul. 6, 1998	Radha	
	49	6292880		Apr. 15, 1998	Mattis	
	50	6304295		Sep. 18, 1998	Krishnamurthy	
	51	6308222		Jun. 3, 1996	Krueger	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-10-19
Name/Print	Brett Carlson	Registration Number	39928

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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Application Number	18069450
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First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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	Examiner Name	Chirag R. Patel
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	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	1	Civanlar et al. "A practical system for MPEG-2 based video-on-demand over ATM packet networks and the WWW." Signal Processing: Image Communication 8, at 221-27, 1996.	☐

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Name/Print	Brett Carlson	Registration Number	39928

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.B/

Bibliographic Data

Application No: 18/069,450

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /CHIRAG R PATEL/ Examiner's Signature | Initials

Title: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/21/2022	709	2454	9401-00279
RULE			

APPLICANTS

DISH Technologies L.L.C., Englewood, CO, UNITED STATES

INVENTORS

DAVID F. BRUECK, SARATOGA SPRINGS, UT, UNITED STATES

MARK B. HURST, CEDAR HILLS, UT, UNITED STATES

R. DREW MAJOR, OREM, UT, UNITED STATES

CONTINUING DATA

This application is a CON of 17962231 10/07/2022 PAT 11677798

17962231 is a CON of 16876579 05/18/2020 PAT 11470138

16876579 is a CON of 16004056 06/08/2018 PAT 10659513

16004056 is a CON of 15414025 01/24/2017 PAT 9998516

15414025 is a CON of 14719122 05/21/2015 PAT 9571551

14719122 is a CON of 14106051 12/13/2013 PAT 9071668

14106051 is a CON of 13617114 09/14/2012 PAT 8612624

13617114 is a CON of 12906940 10/18/2010 PAT 8402156

12906940 is a CON of 11673483 02/09/2007 PAT 7818444

11673483 is a CIP of 11116783 04/28/2005 PAT 8868772

11116783 has PRO of 60566831 04/30/2004

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

01/17/2023

STATE OR COUNTRY

UNITED STATES

ADDRESS

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014
UNITED STATES

FILING FEE RECEIVED

$7,160

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	31	client-side SAME adaptive ADJ bit$2rate near2 streaming	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:03 PM
L2	1145	client SAME adaptive ADJ bit$2rate near2 streaming	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:03 PM
L3	0	client SAME adaptive ADJ bit$2rate near2 streaming AND @ad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:15 PM
L4	0	adaptive ADJ bit$2rate near2 streaming AND @ad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:15 PM
L5	12	adaptive ADJ bit$2rate AND @ad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:15 PM
L6	73	BRUECK ADJ DAVID.in.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:20 PM
L7	2524	adaptive ADJ streaming WITH client	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:26 PM
L8	4	adaptive ADJ streaming WITH client AND @ad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:26 PM
L9	36	adaptive ADJ streaming WITH client-side	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:28 PM
L10	147	dash SAME client-side	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:32 PM
L11	259	("10469554"|"10469555"|"10757156"|"10951680"|"11470138"|"20010013128"|"20010047423"|"20020002708"|"20020029274"|"20020044528"|"20020073167"|"20020091840"|"20020097750"|"20020131496"|"20020144276"|"20020152317"|"20020152318"|"20020156912"|"20020161898"|"20020161908"|"20020161911"|"20020169926"|"20020170062"|"20020174434"|"20020176418"|"20020178330"|"20020188745"|"20030005455"|"20030009578"|"20030014684"|"20030018966"|"20030021166"|"20030021282"|"20030055995"|"20030061305"|"20030065803"|"20	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 04:00 PM

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		303"|"7719985"|"776080 1"|"7779135"|"778839 5"|"7797439"|"7817985" |"7818444"|"7925781"|" 7974200"|"8036265"|"8 370514"|"8402156"|"85 21836"|"8612624"|"868 3066"|"8686066"|"8711 701"|"8818127"|"88687 72"|"8880721"|"934449 6"|"9407564"|"9462074").PN.					
L12	82	L11 AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 05:06 PM
L13	0	client WITH request WITH bitstream WITH (bandwidth capability) AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 10:52 PM
L14	21	client WITH request WITH bitstream WITH (bandwidth capability)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 10:52 PM
L15	10	("11470138" "10659513" "9998516" "9571551" "9071668" "8612624" "8402156" "7818444" "8868772").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 11:04 PM
L16	2	("20050055425" "7369610").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 01:28 PM
L17	3	("20050055425" "7369610" "20020087717").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 01:42 PM
L18	1	("6389473").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 07:48 PM
L19	1099	client WITH select$3 WITH bit$2rate	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 07:58 PM
L20	455	client WITH select$3 WITH bit$2rate SAME stream	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 07:58 PM
L21	2	client WITH select$3 WITH bit$2rate SAME stream AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 07:58 PM
L22	1	L21 AND ((H04L47/30 OR H04L65/80 OR H04L47/263 OR H04L47/10).cpc.)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 08:00 PM
L23	114	client WITH select$3 WITH bit$2rate WITH content WITH server	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 08:00 PM
L24	725	client WITH select$3 WITH bit$2rate AND adaptive near3	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 08:00 PM

		stream$3					
L25	2	client WITH select$3 WITH bit$2rate AND adaptive near3 stream$3 AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 08:01 PM
L26	71	adaptive ADJ streaming AND @ad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 08:02 PM
L27	0	adaptive ADJ streaming AND select$3 WITH bit$2rate AND @ad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 08:02 PM
L28	1	adaptive ADJ streaming AND select$3 WITH bit$2rate AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 08:02 PM
L29	0	("56683104").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 09:57 AM
L30	0	client WITH select$3 WITH bit$2rate near3 streamlet	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 10:24 AM
L31	1	client WITH select$3 WITH bit$2rate WITH streamlet	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 10:24 AM
L32	35	adaptive near3 bitrate WITH selection WITH client	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 02:14 PM
L33	8	((H04L47/30 OR H04L65/80 OR H04L47/263 OR H04L47/10).cpc.) AND select$3 near3 streamlet WITH bitrate	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 02:19 PM
L34	2	("6490627" "20030152036").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 09:48 PM
L35	52	client WITH request$3 WITH bit$2rate AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 09:56 PM
L36	0	client WITH request$3 WITH streamlet AND bit$2rate AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 09:57 PM
L37	8	client WITH request$3 WITH streamlet AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 09:57 PM
L38	81	client WITH request$3 WITH streamlet AND bit$2rate	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 09:57 PM
L39	18	client WITH request$3 WITH segments AND bit$2rate AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 09:58 PM
L40	63	segment WITH stream	(US-PGPUB; USPAT;	OR	ON	ON	2023/03/08

		WITH (chunk sement) WITH bit$2rate	USOCR; EPO)				10:05 PM
L41	0	segment WITH stream WITH (chunk sement) WITH bit$2rate AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 10:07 PM
L42	6	"2003009581"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 11:08 PM
L43	8	"2003009581"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); EPO)	OR	ON	ON	2023/03/08 11:08 PM
L44	17	"2003009581"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; DERWENT)	OR	ON	ON	2023/03/08 11:09 PM
L45	2	("20040172478").pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; DERWENT)	OR	ON	ON	2023/03/08 11:22 PM
L46	48	http ADJ get near3 request near4 client AND stream$3 AND @rlad<"20040930"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/09 12:32 AM

L47	51	multi$2pass near2 encod$3 WITH stream	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/09 02:16 PM
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L49	6497	multi$2pass AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/09 02:17 PM
L50	64	multi$2pass near2 encod$3 AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/09 02:17 PM
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L57	0	"2002075482"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/11/16 10:29 PM
L58	9	"2002075482"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/11/16 10:29 PM
L59	5	("6848004").pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/11/16 10:45 PM
L60	5	("6161137").pn.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO;	OR	ON	ON	2023/11/16 11:43 PM

			JPO; DERWENT; IBM_TDB)				
L61	1	("7529806").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/11/17 12:12 AM
L62	2	("9407564").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/11/17 08:53 AM
L63	1	("10951680").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/11/17 08:56 AM
L64	1	("7529806").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/11/17 02:22 PM
L65	1	("8868782").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/11/17 02:56 PM
L66	1	("8868772").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/11/17 02:57 PM
L67	0	L54 AND version near3 (segment file) WITH client near3 request$3	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/11/17 03:03 PM
L68	5	L54 AND version WITH client near3 request$3	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/11/17 03:03 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	8	((H04L47/30 OR H04L65/80 OR H04L47/263 OR H04L47/10).cpc.) AND select$3 near3 streamlet WITH bitrate	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:19 PM
N2	0	client WITH select$3 near3 streamlet WITH bitrate AND @rlad<"20040930"	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:23 PM
N3	0	client WITH select$3 near3 streamlet WITH bitrate	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:23 PM
N4	1	client WITH select$3 WITH streamlet SAME bitrate	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:23 PM
N5	253	request$3 near3 streamlet	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:24 PM
N6	101	request$3 near3 streamlet WITH client	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:24 PM
N7	10	request$3 near3 streamlet WITH client AND @ad<"20040930"	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:24 PM
N8	0	request$3 near3 streamlet WITH client AND bit$2rate AND @ad<"20040930"	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:25 PM
N9	0	request$3 near3	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08

		streamlet AND bit$2rate AND @ad<"20040930"					02:25 PM
N10	3	request$3 near3 (streamlet chunk) AND bit$2rate AND @ad<"20040930"	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:25 PM
N11	53	((H04L47/30 OR H04L65/80 OR H04L47/263 OR H04L47/10).cpc.) AND N6	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:47 PM
N12	53	((H04L47/30 OR H04L65/80 OR H04L47/263 OR H04L47/10).cpc.) AND request$3 near3 streamlet WITH client	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:52 PM
N13	8	((H04L47/30 OR H04L65/80 OR H04L47/263 OR H04L47/10).cpc.) AND select$3 near3 streamlet WITH bitrate	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/29 09:44 AM
N14	0	((H04L47/30 OR H04L65/80 OR H04L47/263 OR H04L47/10).cpc.) AND select$3 near3 streamlet SAME bitrate near2 copies	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/29 09:44 AM

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

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	Filing Date	2022-12-21
	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	1	Claim Chart Against U.S. Pat. No. 9,407,564 ("'564 patent") "Microsoft Windows Media Technologies" as described by Birney, "Intelligent Streaming" (May 2003) ("Birney")	☐
	2	IPR2024-00043 filed on U.S. Patent 11,677,798	☐
	3	IPR2024-00044 filed on U.S. Patent 11,470,138	☐
	4	IPR2024-00045 filed on U.S. Patent 10,469,554	☐
	5	IPR2024-00046 filed on U.S. Patent 10,951,680	☐
	6	IPR2024-00047 filed on U.S. Patent 9,407,564	☐
	7	IPR2024-00048 filed on U.S. Patent 8,868,772	☐
	8	Declaration of Dr. Henry Houh including Curriculum Vitae ("Houh") in IPR2024-00043	☐
	9	Declaration of Dr. Henry Houh including Curriculum Vitae ("Houh") in IPR2024-00044	☐
	10	Declaration of Dr. Henry Houh including Curriculum Vitae ("Houh") in IPR2024-00045	☐
	11	Declaration of Dr. Henry Houh including Curriculum Vitae ("Houh") in IPR2024-00046	☐

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	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	12	Declaration of Dr. Henry Houh including Curriculum Vitae (“Houh”) in IPR2024-00047	☐
	13	Declaration of Dr. Henry Houh including Curriculum Vitae (“Houh”) in IPR2024-00048	☐
	14	337-TA-1265 ITC September 11, 2023 Enforcement Complaint	☐
	15	Internet Archive Affidavit, Nathaniel E Frank-White for URLs ("SMIL")	☐
	16	"Synchronized Multimedia Integration Language (SMIL 2.0) (“SMIL2.0”)"	☐
	17	U.S. Provisional Application No. 60/041,770 (Ogdon)	☐
	18	"Exhibit 4 - DECLARATION OF DR. HENRY HOUH, PH.D. IN SUPPORT OF AYLOPREMIUM LTD AND AYLO BILLING LIMITED’S RESPONSE TOPLAINTIFFS’ MOTION FOR PRELIMINARY INJUNCTION (DC Utah, Case No. 2:23-cv-552-BSJ)"	☐
	19	Houh Exhibit A - CV of Henry H. Houh	☐
	20	Houh Exhibit B - List of Materials Considered	☐
	21	Houh Exhibit C - U.S. Patent No. 10,469,554	☐
	22	Houh Exhibit D - U.S. Patent No. 11,470,138	☐

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	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	23	Houh Exhibit E - U.S. Patent No. 11,677,798	☐
	24	Houh Exhibit F - U.S. Patent No. 8,868,772	☐
	25	Houh Exhibit G - U.S. Patent No. 9,407,564	☐
	26	Houh Exhibit H - U.S. Patent No. 10,951,680	☐
	27	Houh Exhibit I - Claim Chart of U.S. Patent No. 10,469,554 and Ogdon	☐
	28	Houh Exhibit J - Claim Chart of U.S. Patent No. 10,469,554 and Shteyn	☐
	29	Houh Exhibit K - Claim Chart of U.S. Patent No. 11,470,138 and Ogdon	☐
	30	Houh Exhibit L - Claim Chart of U.S. Patent No. 11,470,138 and Shteyn	☐
	31	Houh Exhibit M - Claim Chart of U.S. Patent No. 11,677,798 and Ogdon	☐
	32	Houh Exhibit O - Claim Chart of U.S. Patent No. 8,868,772 and Ogdon	☐
	33	Houh Exhibit P - Claim Chart of U.S. Patent No. 8,868,772 and Shteyn	☐

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	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	34	Houh Exhibit Q - Claim Chart of U.S. Patent No. 9,407,564 and Ogdon	☐
	35	Houh Exhibit R- Claim Chart of U.S. Patent No. 9,407,564 and Shteyn	☐
	36	Houh Exhibit S - Claim Chart of U.S. Patent No. 10,951,680 and Ogdon	☐
	37	Houh Exhibit T - Claim Chart of U.S. Patent No. 10,951,680 and Shteyn	☐
	38	Wu, Dapeng et al., Streaming Video over the Internet: Approaches and Directions, IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 11, NO. 3, MARCH 2001.	☐
	39	RealNetworks Production Guide with RealOne Player (2002)	☐
	40	RealSystem G2 Production Guide (1998)	☐
	41	Darwin Streaming Server (1999)	☐
	42	Houh Exhibit N - Claim Chart of U.S. Patent No. 11,677,798 and SHTEYN	☐
	43		☐
	44		☐

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	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	45		☐
	46		☐
	47		☐

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Examiner Signature	/CHIRAG R PATEL/	Date Considered	11/17/2023

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	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-10-19
Name/Print	Brett Carlson	Registration Number	39928

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First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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	1	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00146, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 10,469,555" executed October 24, 2023 (96 pages).	☐

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Examiner Signature	/CHIRAG R PATEL/	Date Considered	11/17/2023

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Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-11-16
Name/Print	Brett Carlson	Registration Number	39928

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.T./

PTO/SB/08a (01-10)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] ¡	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

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	Attorney Docket Number	9401-00279

	1	Internet Archive Affidavit, Nathaniel E Frank-White for URLs ("SMIL") (335 pages)	☐

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Examiner Signature	/CHIRAG R PATEL/	Date Considered	11/17/2023

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-10-23
Name/Print	Brett Carlson	Registration Number	39928

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6988235		Mar. 2, 2000	Brown	
	2	6990512		Mar. 19, 2001	Major	
	3	6992981		Jan. 11, 2001	Morikawa	
	4	7003794		Jun. 27, 2000	Arye	
	5	7020087		Jan. 13, 2003	Steinberg	
	6	7024480		Nov. 9, 2000	Weik	
	7	7031700		Nov. 14, 2001	Weaver	

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	8	7042898		Oct. 14, 1997	Blightman	
	9	7043560		Jun. 19, 2001	Coulombe	
	10	7046805		Mar. 20, 2001	Fitzhardinge	
	11	7046910		Nov. 20, 1998	Chen	
	12	7051110		Dec. 20, 1999	Hagai	
	13	7054949		Jan. 19, 2001	Jennings	
	14	7065250		Sep. 18, 1998	Lennon	
	15	7073028		Jun. 12, 2001	Lango	
	16	7073127		Jul. 1, 2002	Zhao	
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	18	7107532		Aug. 29, 2001	Billmaier	
	19	7111044		Jul. 17, 2002	Lee	
	20	7124164		Apr. 17, 2001	Chemtob	

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	21	7133451		Mar. 5, 2001	Kim	
	22	7133881		Apr. 29, 2002	Sirivara	
	23	7155531		Jun. 12, 2001	Lango	
	24	7174512		Dec. 1, 2000	Martin	
	25	7176957		25-May-04	Ivashin	
	26	7177642		Jul. 3, 2001	Sanchez Herrero	
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	29	7190670		Oct. 4, 2002	Varsa	
	30	7200857		Jun. 9, 2000	Rodriguez	
	31	7237254		Mar. 29, 2000	Omoigui	
	32	7257407		Mar. 26, 2003	Dacosta	
	33	7293280		Jul. 8, 1999	Gupta	

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	34	7301944		Oct. 24, 1997	Redmond	
	35	7308487		Dec. 12, 2000	Dansie et al.	
	36	7310678		Jul. 28, 2000	Gunaseelan	
	37	7313236		Apr. 9, 2003	Amini	
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	39	7324523		Mar. 26, 2003	Dacosta	
	40	7325199		Oct. 4, 2000	Reid	
	41	7363228		Sep. 18, 2003	Wyss	
	42	7376747		Dec. 20, 2000	Hartop	
	43	7401351		Dec. 14, 2000	Boreczky	
	44	7463736		Feb. 27, 2002	Tagashira	
	45	7526565		Apr. 3, 2003	Amini	
	46	7529541		Jun. 25, 2001	Cho	

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	47	7529806		5-May-09	Shetyn	
	48	7536469		Dec. 10, 2004	Chou	
	49	7555464		Mar. 1, 2006	Candelore	
	50	7558472		Aug. 22, 2001	Locket	
	51	7567746		Mar. 19, 2003	Saeki	
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	56	7733830		Oct. 14, 2002	Curcio	
	57	7761609		Jan. 20, 2005	Srinivasan	
	58	7779135		Apr. 26, 2002	Hudson	
	59	7788395		Feb. 14, 2007	Bowra	

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	60	7873040		Aug. 20, 2007	Karlsgodt	
	61	7934159		Feb. 19, 2004	Rahman	
	62	8091112		Feb. 28, 2001	Elliot	
	63	8135852		Mar. 27, 2002	Nilsson	
	64	8209429		Jul. 19, 2001	Jacobs	
	65	8321584		Apr. 4, 2003	Dobbins	
	66	8370514		Apr. 28, 2005	Hurst	
	67	8402156		Apr. 30, 2004	Brueck	
	68	8612624		Apr. 30, 2004	Frueck	
	69	8667158		Jan. 25, 2003	Jin	
	70	8683066		Aug. 6, 2007	Hurst	
	71	8868772		Apr. 30, 2004	Major	
	72	8880721		Apr. 28, 2005	Hurst	

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			☐

EXAMINER SIGNATURE			
Examiner Signature	/CHIRAG R PATEL/	Date Considered	11/17/2023

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Attorney Docket Number	9401-00279

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Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-10-19
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UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/069,450	11/30/2023 05:04:06 PM Z ET	9401-00279

Title of Invention

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8508	FILED BY	Brett Carlson
PATENT CENTER #	63445100	AUTHORIZED BY	-
CUSTOMER #	70560	FILING DATE	12/21/2022
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	DAVID F. BRUECK

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 5538	E2023ATH07146144	Brett Carlson

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1806	SUBMISSION OF AN INFORMATION DISCLOSURE STATEMENT	260.00	1	260.00
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This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18069450
	Filing Date	2022-12-21
	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	1	iFIT, Inc., FreeMotion Fitness, Inc., and NordicTrack, Inc. (Appellants) v. United States International Trade Commission (Appellee) and DISH DBS Corporation; DISH Technologies, L.L.C.; Sling TV L.L.C. (Intervenors), Appeal from the United States International Trade Commission in Investigation No. 337-TA-1265, "Appellants' Opening Brief (Non-Confidential Version)" filed November 21, 2023 (89 pages).	☐

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☒ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-11-30
Name/Print	Brett Carlson	Registration Number	39928

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/069,450	**11/30/2023 05:04:06 PM Z ET**	**9401-00279**

Title of Invention

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8508	FILED BY	Brett Carlson
PATENT CENTER #	63445100	FILING DATE	12/21/2022
CUSTOMER #	70560	FIRST NAMED INVENTOR	DAVID F. BRUECK
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	-

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
IDS.pdf	4	Information Disclosure Statement (IDS) Form (SB08)	598 KB
NPL.pdf	89	Non Patent Literature	1139 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
IDS.pdf	062CD282207040CF452D3A7F9EA0A35A97B99BC8C9B666638 901695423AC1433040A132E8A215DF07EA2C6DC4CC1FDF24E 185968EF0088211752OC9F844950E3

NPL.pdf

FF97426ABE35061A3F2740015B5C7FA81CE23C2ED3F431C4E5C4C831402BF044452928F30112A09DA32666E0E56221CF69AA047425FAB408D18F499DAEAB7E48

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/069,450	12/21/2022	DAVID F. BRUECK	9401-00279	8508

70560 7590 12/22/2023

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

EXAMINER	
PATEL, CHIRAG R	

ART UNIT	PAPER NUMBER
2454	

NOTIFICATION DATE	DELIVERY MODE
12/22/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

dish@kwlaw.co
ipdept@dish.com
uspto@dockettrak.com

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

Application No. : 18069450
Applicant : Brueck
Filing Date : 12/21/2022
Date Mailed : 12/22/2023

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.

The informalities requiring correction are indicated in the attachment(s). If the informality pertains to the abstract, specification (including claims) or drawings, the informality must be corrected with an amendment in compliance with 37 CFR 1.121 (or, if the application is a reissue application, 37 CFR 1.173). Such an amendment may be filed after payment of the issue fee if limited to correction of informalities noted herein. See Waiver of 37 CFR 1.312 for Documents Required by the Office of Patent Publication, 1280 Off. Gaz. Patent Office 918 (March 23, 2004). In addition, if the informality is not corrected until after payment of the issue fee, for purposes of 35 U.S.C. 154(b)(1)(iv), "all outstanding requirements" will be considered to have been satisfied when the informality has been corrected. A failure to respond within the above-identified time period will result in the application being ABANDONED.

See attachment(s).

A copy of this notice MUST be returned with the reply. Please address response to "Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450".

/Chris Harmon/
Publication Branch
Office of Data Management
(571) 272-4200

Application No. 18069450

IDENTIFICATION OF APPLICATION DEFICIENCIES IN APPLICATION FILED ON OR AFTER SEPTEMBER 16, 2012

[X] Applicant must provide legible text for the following item(s).

- [X] Specification filed 12/21/2022, page(s) 26-28.
- [ ] Claims filed , claim(s) .
- [ ] Other: .

[ ] Applicant must provide missing information on the following page(s) of the specification by amending the specification to add the missing text. No new matter may be added.
Page/line no(s).

[ ] The specification refers to one or more applications by attorney docket number and does not show the U.S. application number(s). Applicant must supply the U.S. application number in place of each attorney docket number.
Page/line no(s).

[ ] Applicant must provide an Abstract of the Disclosure.

[ ] The Application Data Sheet (ADS dated) does not supply the inventor's city and/or does not supply the inventor's U.S. state and/or does not supply the inventor's country. Applicant must submit a signed, in accordance with 37 CFR 1.76(e) and 1.33(b), application data sheet that corrects this deficiency. To be in compliance with 37 CFR 1.76, the corrected application data sheet must identify the information being changed by using underlining for additions and strikethroughs or brackets for deletions.

[ ] Other:

The response to this notice should contain only amended papers, as the waiver of 37 CFR 1.312 is limited to corrections of documents specifically requested in the notice.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/069,450	12/21/2022	DAVID F. BRUECK	9401-00279	8508

70560 7590 01/24/2024

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

EXAMINER	
PATEL, CHIRAG R	

ART UNIT	PAPER NUMBER
2454	

NOTIFICATION DATE	DELIVERY MODE
01/24/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

dish@kwlaw.co
ipdept@dish.com
uspto@dockettrak.com

Corrected ***Notice of Allowability***	**Application No.** 18/069,450	**Applicant(s)** BRUECK et al.	
	Examiner CHIRAG R PATEL	**Art Unit** 2454	**AIA (FITF) Status** No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the printer rush on January 18, 2024.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 11-30 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 11/30/23.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/CHIRAG R PATEL/
Primary Examiner, Art Unit 2454

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

CPC - Searched*		
Symbol	Date	Examiner
H04L47/30, H04L65/80, H04L47/263, H04L47/10	03/09/2023	C.P.

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
PE2E Search	03/08/2023	C.P.
Google Patents - Scholar	03/08/2023	C.P.
IP.COM	03/08/2023	C.P.
Inventor - Double Patent Search	03/08/2023	C.P.
Reviewed references cited in IPR and IDS	11/17/2023	C.P.

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H04L	H04L47/30, H04L65/80, H04L47/263, H04L47/10	06/29/2023	C.P.

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

CPC						
Symbol					**Type**	**Version**
H04L	/	65	/	70	F	2022-05-01
H04L	/	47	/	801	I	2013-01-01
H04L	/	47	/	12	I	2013-01-01
G06F	/	16	/	71	I	2019-01-01
G06F	/	16	/	183	I	2019-01-01
H04N	/	7	/	24	I	2013-01-01
H04N	/	21	/	23439	I	2013-01-01
H04N	/	21	/	4331	I	2013-01-01
H04N	/	21	/	84	I	2013-01-01
H04N	/	21	/	8456	I	2013-01-01
H04L	/	65	/	80	I	2013-01-01
H04L	/	65	/	61	I	2022-05-01
H04L	/	65	/	65	I	2022-05-01
H04L	/	65	/	1101	I	2022-05-01
H04L	/	67	/	60	I	2022-05-01
H04L	/	67	/	568	I	2022-05-01
H04L	/	67	/	02	I	2013-01-01
H04L	/	65	/	1069	I	2013-01-01
H04N	/	21	/	2662	I	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	22 January 2024	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20240122

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04L	/	65	/	70

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454 (Primary Examiner)	22 January 2024 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		10	9	19	18	28								
	2	1	11	10	20	19	29								
	3	2	12	11	21	20	30								
	4	3	13	12	22										
	5	4	14	13	23										
	6	5	15	14	24										
	7	6	16	15	25										
	8	7	17	16	26										
	9	8	18	17	27										

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	22 January 2024	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20240122

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/09/2023	06/29/2023	11/17/2023	01/22/2024					
	1	✓	-	-	-					
	2	✓	-	-	-					
	3	✓	-	-	-					
	4	✓	-	-	-					
	5	✓	-	-	-					
	6	✓	-	-	-					
	7	✓	-	-	-					
	8	✓	-	-	-					
	9	✓	-	-	-					
	10	✓	-	-	-					
1	11	✓	=	=	=					
2	12	O	=	=	=					
3	13	O	=	=	=					
4	14	O	=	=	=					
5	15	O	=	=	=					
6	16	O	=	=	=					
7	17	O	=	=	=					
8	18	O	=	=	=					
9	19	O	=	=	=					
10	20	O	=	=	=					
11	21	O	=	=	=					
12	22	✓	=	=	=					
13	23	O	=	=	=					
14	24	O	=	=	=					
15	25	O	=	=	=					
16	26	O	=	=	=					
17	27	O	=	=	=					
18	28	O	=	=	=					
19	29	O	=	=	=					
20	30	O	=	=	=					

Bibliographic Data

Application No: 18/069,450

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /CHIRAG R PATEL/ Examiner's Signature | Initials

Title: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/21/2022	709	2454	9401-00279
RULE			

APPLICANTS

DISH Technologies L.L.C., Englewood, CO, UNITED STATES

INVENTORS

DAVID F. BRUECK, SARATOGA SPRINGS, UT, UNITED STATES

MARK B. HURST, CEDAR HILLS, UT, UNITED STATES

R. DREW MAJOR, OREM, UT, UNITED STATES

CONTINUING DATA

This application is a CON of 17962231 10/07/2022 PAT 11677798

17962231 is a CON of 16876579 05/18/2020 PAT 11470138

16876579 is a CON of 16004056 06/08/2018 PAT 10659513

16004056 is a CON of 15414025 01/24/2017 PAT 9998516

15414025 is a CON of 14719122 05/21/2015 PAT 9571551

14719122 is a CON of 14106051 12/13/2013 PAT 9071668

14106051 is a CON of 13617114 09/14/2012 PAT 8612624

13617114 is a CON of 12906940 10/18/2010 PAT 8402156

12906940 is a CON of 11673483 02/09/2007 PAT 7818444

11673483 is a CIP of 11116783 04/28/2005 PAT 8868772

11116783 has PRO of 60566831 04/30/2004

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

01/17/2023

STATE OR COUNTRY

UNITED STATES

ADDRESS

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014
UNITED STATES

FILING FEE RECEIVED

$7,160

PTO/SB/08a (01-10)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18069450
	Filing Date	2022-12-21
	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

/C.R.P/	1	iFIT, Inc., FreeMotion Fitness, Inc., and NordicTrack, Inc. (Appellants) v. United States International Trade Commission (Appellee) and DISH DBS Corporation; DISH Technologies, L.L.C.; Sling TV L.L.C. (Intervenors), Appeal from the United States International Trade Commission in Investigation No. 337-TA-1265, "Appellants' Opening Brief (Non-Confidential Version)" filed November 21, 2023 (89 pages).	☐

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EXAMINER SIGNATURE

Examiner Signature	/CHIRAG R PATEL/	Date Considered	01/22/2024

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☒ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2023-11-30
Name/Print	Brett Carlson	Registration Number	39928

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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PATENT AND TRADEMARK OFFICE

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Alexandria, VA 22313 - 1450
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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/069,450	**02/01/2024 06:46:10 PM Z ET**	**9401-00279**

Title of Invention

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8508	FILED BY	BLAKE SCHEFFEY
PATENT CENTER #	64180259	AUTHORIZED BY	Brett Carlson
CUSTOMER #	70560	FILING DATE	12/21/2022
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	DAVID F. BRUECK

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 6960	**E202421I46499791**	**BLAKE SCHEFFEY**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1820	REQUEST FOR CONTINUED EXAMINATION (RCE)- 2ND AND SUBSEQUENT REQUEST (SEE 37 CFR 1.114)	2000.00	1	2000.00
			TOTAL AMOUNT:	**$2,000.00**

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/30EFS (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	18/069,450	Filing Date	2022-12-21	Docket Number (if applicable)	9401-00279	Art Unit	2454
First Named Inventor	David F. Brueck			Examiner Name	Chirag R. Patel		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☐ Amendment/Reply
- ☒ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☐ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No _____

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

☐ Applicant Signature

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Signature of Registered U.S. Patent Practitioner			
Signature	/Brett A. Carlson/	Date (YYYY-MM-DD)	2024-02-01
Name	Brett A. Carlson	Registration Number	39928

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

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4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 June 2002 (20.06.2002)

PCT

(10) International Publication Number
WO 02/49343 A1

(51) International Patent Classification[7]: H04N 5/00, 7/24

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(22) International Filing Date:
14 December 2001 (14.12.2001)

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(26) Publication Language: English

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0108094.4 30 March 2001 (30.03.2001) GB
PCT/GB01/05090
19 November 2001 (19.11.2001) GB

(71) Applicant *(for all designated States except US)*: **BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY** [GB/GB]; 81 Newgate Street, London, EC1A 7AJ (GB).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **LEANING, Anthony, Richard** [GB/GB]; G07/B81, Adastral Park, Martlesham Heath, Ipswich, Suffolk IP5 3RE (GB). **WHITING, Richard, James** [GB/GB]; G07/B81, Adastral Park, Martlesham Heath, Ipswich, Suffolk IP5 3RE (GB).

(74) Agent: **LLOYD, Barry, George, William**; BT Group Legal Services, Intellectual Property Dept., Holborn Centre, 8th Floor, 120 Holborn, London EC1N 2TE (GB).

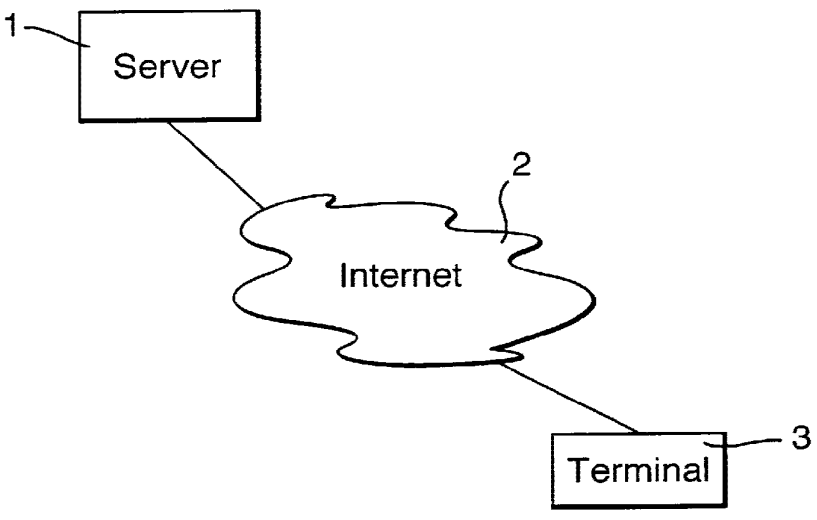
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

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.

(54) Title: TRANSMISSION AND RECEPTION OF AUDIO AND/OR VIDEO MATERIAL



(57) Abstract: Delivery of recorded audio or video material over a telecommunications link (2) from a server (1) to a terminal (3) is accomplished by dividing the material into a sequence of sub-files each of which is independently requested by the terminal, which thereby has control of the rate of delivery. Provision may be made for switching between alternative sub-file sets representing alternative delivery modes of data rates.

WO 02/49343 A1

Transmission and Reception of Audio and/or Video Material

The present invention is concerned with the delivery, over a telecommunications link, of digitally coded material for presentation to a user.

In known systems of this type, a special server – often called a "streamer", controls delivery of material to a user terminal. Often, in the server, an item of material to be transmitted is stored as a single file; though U.S. patent 5 610 841 describes a video server which stores the material segmented into "media segment files". Another such system is described in published European patent application EP-A-669 587, where network congestion is accommodated by the terminal monitoring the contents of its receive buffer and, where appropriate, requesting the server to adjust its video data rate.

According to one aspect of the invention there is provided a terminal for playing audio or video material which is stored on a remote server as a set of files representing successive temporal portions of the said material, the terminal comprising:

a telecommunications interface for communication with the server;

a buffer for receiving the files from the telecommunications interface;

means for playing the contents of the buffer; and

control means responsive to the state of the buffer to generate request messages for further files for replenishment of the buffer.

In another aspect, the invention provides a method of transmitting digitally coded audio or video material comprising:

partitioning the material into a plurality of discrete files each representing successive temporal portions of the said material;

storing the files at a first station; and

at a second station –

a) transmitting to the first station requests for successive respective ones of the files;

b) receiving the files; and

c) decoding the files for replay of the material.

Other, optional, aspects of the invention are set out in the sub-claims.

Some embodiments of the present invention will now be described, with reference to the accompanying drawings, in which:

Figure 1 is a diagram illustrating the overall architecture of the systems to be described;

Figure 2 is a block diagram of a terminal for use in such a system;

Figure 3 shows the contents of a typical index file;

Figure 4 is a timing diagram illustrating a modified method of sub-file generation; and

Figure 5 is a diagram illustrating a modified architecture.

The system shown in Figure 1 has as its object the delivery, to a user, of digitally coded audio signals (for example, of recorded music or speech) via a telecommunications network to a user terminal where the corresponding sounds are to be played to the user. However, as will be discussed in more detail below, the system may be used to convey video signals instead of, or in addition to, audio signals. In this example, the network is the internet or other packet network operating in accordance with the Hypertext Transfer Protocol (see RFCs 1945/2068 for details), though in principle other digital links or networks can be used. It is also assumed that the audio signals have been recorded in compressed form using the ISO MPEG-1 Layer III standard (the "MP3 standard"); however it is not essential to use this particular format. Nor, indeed, is it necessary that compression be used, though naturally it is highly desirable, especially if the available bit-rate is restricted or storage space is limited. In Figure 1, a server 1 is connected via the internet 2 to user terminals 3, only one of which is shown. The function of the server 1 is to store data files, to receive from a user terminal a request for delivery of a desired data file and, in response to such a request, to transmit the file to the user terminal via the network. Usually such a request takes the form of a first part indicating the network delivery mechanism (e.g. http:// or file:// for the hypertext transfer protocol or file transfer protocol respectively) followed by the network address of the server (e.g. www.server 1.com) suffixed with the name of the file that is being requested. Note that, in the examples given, such names are, for typographical reasons, shown with the "//" replaced by "\\".

In these examples, the use of the hypertext transfer protocol is assumed; this is not essential, but is beneficial in allowing use of the authentication and security features (such as the Secure Sockets Layer) provided by that protocol.

Conventionally, a server for delivery of MP3 files takes the form of a so-called streamer which includes processing arrangements for the dynamic control of the rate at which data are transmitted depending on the replay requirements at the user terminal, for the masking of errors due to packet loss and, if user interaction is allowed, the control of the flow of data between server and client; here however the server 1 need contain no such provision. Thus it is merely an ordinary "web server".

The manner in which the data files are stored on the server 1 will now be explained. Suppose that an MP3-format file has been created and is to be stored on the server. Suppose that it is a recording of J. S. Bach's Toccata and Fugue in D minor (BWV565) which typically has a playing time of 9 minutes. Originally this would have been created as a single data file, and on a conventional streamer would be stored as this one single file. Here, however, the file is divided into smaller files before being stored on the server 1. We prefer that each of these smaller files is of a size corresponding to a fixed playing time, perhaps four seconds. With a compressed format such as MP3 this may mean that the files will be of different sizes in terms of the number of bits they actually contain. Thus the Bach file of 9 minutes duration would be divided into 135 smaller files each representing four seconds' playing time. In this example these are given file names which include a serial number indicative of their sequence in the original file, for example:

000000.bin
000001.bin
000002.bin
000003.bin
.
.
000134.bin

The partitioning of the file into these smaller sub-files may typically be performed by the person preparing the file for loading onto the web server 1. (The expression "sub-files" is used here to distinguish them from the original file containing the whole recording: it should however be emphasised that, as far as the server is concerned, each "sub-file" is just a file like any other file). The precise manner of their creation will be described more fully below. Once created, these sub-files are uploaded onto the server in a conventional manner just like any other file being loaded onto a web server. Of course the filename could also contain characters identifying the particular recording (the sub-file could also be "tagged" with additional information – when you play an MP3 file you get information on the author, copyright etc), but in this example the sub-files are stored on the server in a directory or folder specific to the particular recording - e.g. mp3_bwv565. Thus a sub-file, when required, may be requested in the form:

http:\\www.server1.com/mp3_bwv565/000003.bin

where "www.server1.com" is the URL of the server 1.

It is also convenient for the person preparing the sub-files for loading onto the server to create, for each recording, a link page (typically in html format) which is also stored on the server (perhaps with filename mp3_bwv565/link.htm), the structure and purpose of which will be described later.

It is also convenient that the web server stores one or more (html) menu pages (e.g. menu.htm) containing a list of recordings available, with hyperlinks to the corresponding link pages.

Turning now to the terminal, this may typically take the form of a conventional desktop computer, with, however, additional software for handling the reception of the audio files discussed. If desired, the terminal could take the form of a handheld computer, or even be incorporated into a mobile telephone. Thus Figure 2 shows such a terminal with a central processor 30, memory 31, a disk store 32, a keyboard 33, video display 34, communications interface 35, and audio interface ("sound card") 36. For video delivery, a video card would be fitted in place of, or in addition to, the card 36. In the disk store are programs which may be retrieved into the memory 31 for execution by the processor 30, in the usual manner. These programs include a communications program 37 for call-up and display of html pages - that is, a "web browser" program such as Netscape Navigator or Microsoft Explorer, and a further program 38 which will be referred to here as "the player program" which provides the functionality necessary for the playing of audio files in accordance with this embodiment of the invention. Also shown is a region 39 of the memory 31 which is allocated as a buffer. This is a decoded audio buffer containing data waiting to be played (typically the playout time of the buffer might be 10 seconds). The audio interface or sound card 36 can be a conventional card and simply serves to receive PCM audio and convert it into an analogue audio signal, e.g. for playing through a loudspeaker. Firstly, we will give a brief overview of the operation of the terminal for the retrieval and playing of the desired recording when using the HTTP and an embedded or "plugin" client

1. The user uses the browser to retrieve and display the menu page menu.htm from the server 1.

2. The user selects one of the hyperlinks within the menu page which causes the browser to retrieve from the server, and display, the link page for the desired recording - in this example the file mp3_bwv565_link.htm. The actual display of this page is unimportant (except that it may perhaps contain a message to reassure the user that the system is working correctly). What is important about this page is that it contains a command (or "embed tag") to invoke in the processor 30 a secondary process in which the player program 37 is executed. The invocation of a secondary process in this manner is well-known practice (such a process is known in Netscape systems as a "plug-in" and in Microsoft systems as "ActiveX"). Such commands can also contains parameters to be passed to the secondary process and in the system of Figure 1 the command contains the server URL of the recording, which, for the Bach piece, would be http:\\www.server1.com/mp3_bwv565.

3. The player program 37 includes an MP3 decoder, the operation of which is, in itself, conventional. Of more interest in the present context are the control functions of the program which are as follows.

4. The player program, having received the URL, adds to this the filename of the first sub-file, to produce a complete address for the sub-file - i.e. www.server1.com/mp3_bwv565/000000.bin. It will be observed that this system is organised on the basis that the sub-files are named in the manner indicated above, so that the terminal does not need to be informed of the filenames. The program constructs a request message for the file having this URL and transmits it to the server 1 via the communications interface 35 and the internet 2. (Processes for translating the URL into an IP address and for error reporting of invalid, incomplete or unavailable URLs are conventional and will not therefore be described). We envisage that the player program would send the requests directly to the communications interface, rather than via the browser. The server responds by transmitting the required sub-file.

5. The player program determines from the file the audio encoding used in this sub-file and decodes the file back to raw PCM values in accordance with the relevant standard (MP3 in this example), making a note of the play time of this sub-file. Generally an audio file contains an identifier at the beginning of the file which states the encoding used. The decoded audio data is then stored in the audio buffer 38.

6. The player program has a parameter called the playout time T_p. In this example it is set at 10 seconds (it could be made user-selectable, if desired). It determines the degree of buffering that the terminal performs.

7. The player program increments the filename to 000001.bin and requests, receives, decodes and stores this second sub-file as described in (4) and (5) above. It repeats this process until the contents of the buffer reach or exceed the playout time T_p. Note that it is not actually essential that the decoding occurs before the buffer but it simplifies matters as since the audio is decoded back to raw PCM then the duration of the buffered material is then explicitly known. It simplifies the control of the audio buffer if each of the sub-files is the same audio playback size.

8. Having reached the playout threshold T_p the decoded data are sent from the buffer to the audio interface 36 which plays the sound through a loudspeaker (not shown).

9. Whilst playing the sounds as in (8) above, the player program continually monitors the state of buffer fullness and whenever this falls below T_p it increments the filename again and

obtains a further sub-file from the server. This process is repeated until a "file not found error" is returned.

10. If, during this process, the buffer becomes empty, the player program simply ceases playing until further data arrives.

The sub-file naming convention used here, of a simple fixed length sequence of numbers starting with zero, is preferred as it is simple to implement, but any naming convention can be used provided the player program either contains (or is sent) the name of the first sub-file and an algorithm enabling it to calculate succeeding ones, or alternatively is sent a list of the filenames.

It will have been observed that the system described above offers the user no opportunity to intervene in the replay process. Nor does it offer any remedy for the possibility of buffer underflow (due for example to network congestion). Therefore a second, more sophisticated embodiment of the invention, now to be described, offers the following further features:

a) the server stores two or more versions of the recording, recorded at different compression rates (for example at compressions corresponding to (continuous) data rates of 8, 16, 24 and 32 kbit/s respectively) and the player program is able to switch automatically between them.

b) the player program displays to the user a control panel whereby the user may start the playing, pause it, restart it (from the beginning, or from the point at which it paused), or jump to a different point in the recording (back or forward).

Note that these features are not interdependent, in that user control could be provided without rate-switching, or vice versa.

In order to provide for rate switching, the person preparing the file for loading onto the server prepares several source files - by encoding the same PCM file several times at different rates. He then partitions each source file into sub-files, as before. These can be loaded onto the server in separate directories corresponding to the different rate, as in the following example structure, where "008k", "024k" in the directory name indicates a rate of 8 kbit/s or 24 kbit/s and so on.

He also creates an index file (e.g. index.htm) the primary purpose of which is to provide a list of the data rates that are available.

Directory	Subdirectory	Filename
mp3_bwv565	none	link.htm index.htm
mp3_bwv565	008k_11_m	000000.bin 000001.bin 000002.bin 000003.bin . . 000134.bin
mp3_bwv565	016k_11_m	000000.bin 000001.bin 000002.bin 000003.bin . . 000134.bin
mp3_bwv565	018k_11_s	000000.bin 000001.bin 000002.bin 000003.bin . . 000134.bin
mp3_bwv565	024k_11_s	000000.bin 000001.bin 000002.bin 000003.bin . . 000134.bin
mp3_bwv565	032k_11_s	000000.bin 000001.bin 000002.bin 000003.bin . . 000134.bin

Note that because the length of a sub-file corresponds, as explained earlier, to a fixed length of time, the number of sub-files is the same for each directory. The subdirectory names comprise the data rate in kbit/s (three digits) plus the letter "k"; in this example indications of the audio sampling rate (11.025 kHz) and a mono-stereo flag are appended, for verification purposes.

The index file would thus contain a statement of the form :

<!-- Audio = "024k_11_s 032k_11_s 018k_11_s 016k_11_m 008_11_m" -->

(The <!--...--> simply indicates that the statement is embedded as a comment in an html file (or a simple text file could be used)). A typical index file is shown in Figure 3 where other information is included: LFI is the highest sub-file number (i.e. there are 45 sub-files) and SL is the total playing time (178 seconds). "Mode" indicates "recorded" (as here) or "live" (to be discussed below). The other entries are either self-explanatory, or standard html commands.

Initially the player program will begin by requesting, from the directory specified in the link file, the index file, and stores locally a list of available data rates for future reference. (It may explicitly request this file or just specify the directory: most servers default to index.htm if a filename is not specified.) It then begins to request the audio sub-files as described earlier, from the first-mentioned "rate" directory in the index file – viz. 024k_11_s (or the terminal could override this by modifying this to a default rate set locally for that terminal). The process from then on is that the player program measures the actual data rate being received from the server, averaged over a period of time (for example 30 seconds). It does this by timing every URL request; the transfer rate achieved (number of bits per second) between the client and server is determined. The accuracy of this figure improves as the number of requests goes up. The player maintains two stored parameters which indicate, respectively, the current rate, and the measured rate.

The initiation of a rate change is triggered:

a) if the buffer ever empties AND the measured rate is less than the current rate AND the measured Buffer Low Percentage exceeds a Step Down Threshold (as described below), reduce the current rate; (changing at a time when the buffer is already empty is advantageous as the sound card is not playing anything and it may be necessary to reconfigure it if the audio sampling rate, stereo–mono setting or bit width (number of bits per sample) has changed).

b) if the measured rate exceeds not only the current rate but also the next higher rate for a given period of time (e.g. 120 seconds: this could if desired be made adjustable by the user) increase the current rate

The Buffer Low Percentage is the percentage of the time that the buffer contents represent less than 25% of the playout time (i.e. the buffer is getting close to being empty). If the Step Down Threshold is set to 0% then when the buffer empties the system always steps down when the other conditions are satisfied. Setting the Step Down Threshold to 5% (this is our preferred default value) means that if the buffer empties but the measured Buffer Low Percentage is greater than 5% it will not step down. Further buffer empties will obviously cause this measured rate to increase and will

eventually empty the buffer again with a Buffer Low Percentage value exceeding 5% if the rate can not be sustained. Setting the value to 100% means the client will never step down.

The actual rate change is effected simply by the player program changing the relevant part of the sub-file address for example, changing "008k" to "024k" to increase the data rate from 8 to 24 kbit/s, and changing the current rate parameter to match. As a result, the next request to the server becomes a request for the higher (or lower) rate, and the sub-file from the new directory is received, decoded and entered into the buffer. The process just described is summarised in the following flowchart:

User	Terminal	Server
Select Menu page		
	Request http:\\server1.com/menu.htm	
		Send http:\\server1.com /menu.htm
	Display menu.htm	
Select item from Menu (Bach)		
	Extract hyperlink URL from menu.htm (mp3_bwv565/link.htm)	
	Request http:\\server1.com/ mp3_bwv565/link.htm	
		Send http:\\server1.com/ mp3_bwv565/link.htm
	Display link.htm	
	Execute secondary process (player program) specified in link.htm with parameters specified in link.htm (http:\\server1/mp3_bwv565)	
	Set Stem to that specified	
	Set URL = Stem + "index.htm"	
	Request this URL	
		Send requested file
	Set Rate List to rates specified in index.htm Set LFI to value specified in index.htm	
	Set StemC = Stem + "/" + RateList(item 1) Set CurrentRate = rate specified in RateList (item 1) Set RateU = next higher rate in list or zero if none Set StemU = Stem + "/" + item in rate list corresponding to this rate; Set RateD = next lower rate in list or zero if none Set StemD = Stem + "/" + item in rate list corresponding to this rate;	

User	Terminal	Server
	Set Current Subfile = 000000.bin	
	J1: Set URL = StemC + Current Subfile	
	Request this URL	
		If requested subfile exists, Send requested subfile; otherwise send error message
	If error message received, Stop	
	Decode received subfile	
	Write to buffer	
	J1A: If Buffer Fullness > Tp seconds go to Step J3	
	J2: Increment Current Subfile	
	Go to Step J1	
	J3: Begin/continue playing of buffer contents via sound card	
	J4: If Buffer Fullness < Tp seconds go to Step J2	
	If BufferFullness = 0 AND Mrate < CurrentRate AND BufferLow% > Td go to Stepdown	
	If MRate > NextRate AND NextRate <> 0 goto Stepup	
Input of user commands	If UserCommand = Pause then: Stop reading from buffer; Loop until Usercommand = Resume; go to J3	
	If UserCommand = Jump(j%)then: Clear buffer; Set CurrentSubfile = Integer[(LFI+1)*j/100]; go to Step J1	
	Go to Step J1A	
	Stepup: Clear Buffer Set RateD = RateC Set StemD = StemC Set RateC = RateU Set StemC = StemU Set RateU = next higher rate in list or zero if none Set StemU = Stem + "/" + item in rate list corresponding to this rate Go to Step J1A	
	Stepdown: Clear Buffer Set RateU = RateC Set StemU = StemC Set RateC = RateD	

User	Terminal	Server
	Set StemC = StemD Set RateD = next lowerr rate in list or zero if none Set StemD = Stem + "/" + item in rate list corresponding to this rate Go to Step J1A	

The user control is implemented by the user being offered on the screen the following options which he can select using the keyboard or other input device such as a mouse:

a) Start: implement the numbered steps given above, from step 4. Whether, when a recording is first selected, it begins to play automatically, or requires a Start instruction from the user, is optional; indeed, if desired, the choice may be made by means of an additional "autoplay" parameter in the link file.

b) Pause: implemented by an instruction to the MP3 decoder to suspend reading data from the buffer;

c) Resume: implemented by an instruction to the MP3 decoder to resume reading data from the buffer;

d) Jump: implemented by the user indicating which part of the recording he wishes to jump to - for example by moving a cursor to a desired point on a displayed bar representing the total duration of the recording; the player then determines that this point is x % along the bar and calculates the number of the next sub-file needed, which is then used for the next request. In the Bach example with 125 sub-files then a request to play from a point 20% into the recording would result in a request for the 26th sub-file - i.e. 000025.bin. It will be apparent that this calculation is considerably simplified if each sub-file corresponds to the same fixed duration. We prefer, in the case of the jump, to suspend decoding and clear the buffer so that the new request is sent immediately, but this is not actually essential.

Alternatively, the user may be presented with a list of text labels or indices which may be selected (e.g. by means of a mouse) to initiate a jump. This might be implemented as follows:

The index.htm file held by the terminal, in memory, contains lines of the form (assuming that this information is embedded as comments within the document.

<-- !Odbits: Index = "0:01:44 Wireless" -->.

where where "Odbits:" is a keyword indicating to the player program that the following text is to be processed by a program, "Index" indicates the function that the player program is to

perform, and the text with the quotation marks consists of the time (hours:minutes:seconds) from the beginning of the recording at which playing is to commence.

The player program reads the index.htm file and if it recognises an index command it generates a message ("an event") to the link.htm page which contains commands (typically written in Javascript) to handle such an event by displaying the labels at a desired place on the displayed page and respond to selection of those commands by generating a jump (containing the corresponding time) to the player program.

It is of interest to discuss further the process of partitioning the original file into sub-files. First, it should be noted that if (as in the first version described above), there is no expectation that a sub-file will be followed by a sub-file other than that which immediately follows it in the original sequence, then it matters little where the boundaries between the sub-files are located. In that case the sub-file size can be a fixed number of bits, or a fixed playing time length (or neither of these) - the only real decision is how big the sub-files should be. Where jumps are envisaged (in time, or between different data rates) there are other considerations. Where, as with many types of speech or audio coding (including MP3), the signal is coded in frames, a sub-file should contain a whole number of frames. In the case of rate switching, it is, if not actually essential, highly desirable that the sub-file boundaries are the same for each rate, so that the first sub-file received for a new rate continues from the same point in the recording that the last sub-file at the old rate ended. To arrange that every sub-file should represent the same fixed time period (e.g. the 4 seconds mentioned above) is not the only way of achieving this, but it is certainly the most convenient. Note however that, depending on the coding system in use, the requirement that a sub-file should contain a whole number of frames may mean that the playing duration of the sub-files does vary slightly. Note that in this embodiment of the invention, the available data rates, though they use different degrees of quantisation, and differ as to whether they encode in mono or stereo, all use the same audio sampling rate and in consequence the same frame size. Issues that need to be addressed when differing frame sizes are used are discussed below.

As for the actual sub-file length, excessively short sub-files should preferably be avoided because (a) they create extra network traffic in the form of more requests, and (b) on certain types of packet networks - including IP networks – they are wasteful in that they have to be conveyed by smaller packets so that overhead represented by the requesting process and the packet header is proportionately greater. On the other hand, excessively large sub-files are disadvantageous in requiring a larger buffer and in causing extra delay when starting play and/or when jumps or rate changes are invoked. A sub-file size of between 30% and 130% of the playout time, or preferably around half the playout time (as in the examples given above), is found to be satisfactory.

The actual process of converting the sub-files can be implemented by means of a computer programmed in accordance with the criteria discussed. Probably it will be convenient to do this on a separate computer, from which the sub-files can be uploaded to the server.

Another refinement that can be added is to substitute a more complex sub-file naming convention so as to increase security by making it more difficult for an unauthorised person to copy the sub-files and offer them on another server. One example is to generate the filenames using a pseudo-random sequence generator, e.g. producing filenames of the form :

0130254613464367753454313 4.bin

9454345234543453345213 4565.bin

...

In this case the player program would include an identical pseudo-random sequence generator. The server sends the first filename, or a "seed" of perhaps four digits, and the generator in the player can then synchronise its generator and generate the required sub-file names in the correct sequence.

In the above example of rate-switching, all the data rates used had the same frame size, specifically they used MP3 coding of PCM audio sampled at 11.025 KHz and a (PCM) frame size of 1152 samples. If it is desired to accomplish rate switching between MP3 (or other) recordings having different frame sizes, problems arise due to the requirement that a sub-file should contain a whole number of frames, because the frame boundaries do not then coincide. This problem can be solved by the following modified procedure for creating the sub-files. It should be noted particularly that this procedure can be used in any situation where rate switching is required and is not limited to the particular method of delivery discussed above.

Figure 4 shows diagrammatically a sequence of audio samples, upon which successive four-second segments are delineated by boundary marks (in the figure) B1, B2 etc. At 11.025 KHz, there are 44,100 samples in each segment.

1. Encode the audio, starting at boundary B1, frame by frame, to create an MP3 sub-file, continuing until a whole number of frames having a total duration of at least four seconds has been encoded. With a frame size of 1152 samples, four seconds corresponds to 38.3 frames, so a sub-file S1 representing 39 frames will actually be encoded, representing a total duration of 4.075 seconds.

2. Encode the audio, in the same manner, starting at boundary B2.

3. Repeat, starting each time at a 4-second boundary, so that in this way a set of overlapping sub-files is generated for the whole audio sequence to be coded. The last segment (which may well be

shorter than four seconds) has of course nothing following it, and is padded with zeroes (i.e. silence).

Coding of the other data rates using different frame sizes proceeds in the same manner.

At the terminal, the control mechanisms are unchanged, but the decoding and buffering process is modified :

1. Receive sub-file S1;
2. Decode sub-file S1;
3. Write into the buffer only the first four seconds of the decoded audio samples (discard the remainder);
4. Receive sub-file S2;
5. Decode sub-file S2;
6. Write into the buffer only the first four seconds of the decoded audio samples;
7. Continue with sub-file S3 etc..

In this way, it is ensured that the sub-file sets for all rates have sub-file boundaries which correspond at the same points in the original PCM sample sequence.

Thus, each four-second period except the last is, prior to encoding, "padded" with audio samples from the next four-second period so as to bring the sub-file size up to a whole number of MP3 frames. If desired, the padding samples could be taken from the end of the preceding four-second period instead of (or as well as) the beginning of the following one.

Note that the MP3 standard allows (by a scheme known as "bit reservoir") certain information to be carried over from one audio frame to another. In the present context, while this is acceptable within a sub-file, it is not acceptable between sub-files. However, since naturally the standard does not allow such carry-over at the end or beginning of a recording, this problem is easily solved by encoding each sub-file separately, as if it were a single recording.

Changes of sampling rate (and indeed switching between mono and stereo operation) have some practical implications for operation of the audio interface 36. Many conventional sound cards, although capable of operation at a range of different settings, require re-setting in order to change sampling rate, and necessarily this causes an interruption in its audio output. Thus in a further modification, we propose that the sound card could be run continuously at the highest sampling rate envisaged. When the player program is supplying, to the buffer, data at a lower sampling rate, this data is then up-sampled to this highest rate before or after the buffer. Similarly, if the card is always operated in stereo mode, decoded mono signals can be fed in parallel so feed both the left and right channels of the sound card input. Again, if the number of bits per sample of

the decoded signal is lower than expected by the card, the number of bits can be increased by padding with zeros.

Recollecting that the criteria discussed earlier for automatic data rate switching downwards envisaged a rate reduction only in cases of buffer underflow (involving therefore interruptions in the output), we note that with this modification such interruption can be avoided and therefore it is preferable to employ a criterion which anticipates underflow and avoids it in the majority of cases. In this case the first of the three AND conditions mentioned above (namely, that the buffer is empty) would be omitted.

Another feature that may be provided in the context of the system described is the display of visual information such as subtitles, or still pictures (in the nature of a slide show) to accompany the sound.

This might be implemented as follows:

(a) the document (link.htm) being displayed contains formatting information specifying the location in the page at which the visual information is to appear;

(b) the file index.htm contains lines of the form (assuming that this information is embedded as comments with the document.

<!-- Odbits: Subtitle = "0:1:01 Subtitle text" -->

<!-- Odbits: Image = "0:2:04 http:// ...../picture.jpg" -->

where "Odbits:" is a keyword indicating to the player program that the following text is to be processed by a program, "Subtitle" or "Image" indicates the function that the player program is to perform, and the text with the quotation marks consists of the time (hours:minutes:seconds) from the beginning of the recording at which the corresponding display is to commence, followed by the actual subtitle or the URL of the desired image, as the case may be.

(c) the player program computes the actual time, being the product of the current subfile index and the subfile length, incremented by the time the current subfile has been playing.

(d) the player program compares the actual time with the times embedded in the index.htm file and in the event of a match returns a message to the link.htm page (which invoked the player originally). Such a message is referred to as an "event". How the link.htm page handles the event is at the discretion of the person writing the link.htm page. Typically

(e) for a subtitle, the link.htm page contains executable commands (typically written in Javascript) which respond to the event by reading the subtitle text from the index.htm file and displaying it at the desired place.

(f) for an image, the link.htm page contains such commands to respond to the event by reading the URL of the image from the index.htm file, generating a request message for

downloading the image file having that URL and displaying it at the desired place on the page. This downloading could occur at the time that the image is required: alternatively the user could be offered the option of having the image files pre-loaded. If he accepts this option then the player program would, prior to any audio replay, download all the image files listed and store them in a local cache.

The same principle may be applied to the delivery of video recordings, or of course, video recordings with an accompanying sound track. In the simpler version, where there is only one recording, the system differs from the audio version only in that the file is a video file (e.g. in H.261 or MPEG format) and the player program incorporates a video decoder. The manner of partitioning the file into sub-files is unchanged.

As in the audio case, there may be two or more recordings corresponding to different data rates, selected by the control mechanism already described. Also one can provide additional recordings corresponding to different replay modes such as fast forward or fast reverse which can be selected by an extension of the user control facilities already described. Again, a systematic convention for file and directory naming can be followed so that the player program can respond to - for example – a fast forward command by amending the sub-file address.

The delivery of video recordings does however have further implications for file partitioning if switching or jumps are to be permitted. In the case of recordings where each frame of a picture is coded independently, it is sufficient that a sub-file contains a whole number of frames of a picture. If compression involving inter-frame techniques is in use, however, the situation is more complex. Some such systems (for example the MPEG standards) generate a mixture of independently coded frames ("intra-frames") and predictively coded frames; in this case each sub-file should preferably begin with an intra-frame.

In the case of inter-frame coding systems such as the ITU H.261 standard, which do not provide for the frequent, regular inclusion of intra-frames, this is not possible. This is because – taking rate-switching as an example, if one were to request sub-file n of a higher bit rate recording followed by sub-file n+1 of a lower bit-rate recording, the first frame of the lower bit-rate sub-file would have been coded on an inter-frame basis using the last decoded frame of sub-file n of the lower rate recording, which of course the terminal does not have at its disposal – it has the last decoded frame of sub-file n of the higher rate recording. Thus serious mistracking of the decoder would occur.

In the case of switching between normal play and a fast play mode, the situation is in practice slightly different. On fast forward play at, for example, 5 times normal speed, one

encodes only every 5th frame. In consequence the inter-frame correlation is much reduced and inter-frame coding becomes unattractive, so one would generally prefer to encode a fast play sequence as intra-frames. Switching from normal to fast then presents no problem, as the intra-frames can be decoded without difficulty. However, when reverting to normal play, the mistracking problem again occurs because the terminal is then presented with a predictively coded frame for which it does not have the preceding frame.

In either case the problem can be solved by using the principle described in our international patent application No. WO98/26604 (issued in USA as patent 6,002,440). This involves the encoding of an intermediate sequence of frames which bridges the gap between the last frame of the preceding sequence and the first frame of the new sequence.

The operation of this will now be described in the context of fast forward operation (fast rewind being similar but in reverse). In this example we assume that a 9 minute video sequence has been encoded at 96kbit/s according to the H.261 standard, and again at 5 times normal rate entirely at H.261 infra-frames, and that the resulting files have each been partitioned into four-second sub-files. Here, four seconds refers to the duration of the original video signal, not to the fast forward playing time. Following a naming convention similar to that employed above, the sub-files might be:

Directory	Subdirectory	Filename
mpg_name	096k_x1	000000.bin
		000001.bin
		...
		000134.bin
	096k_x5	000000.bin
		...
		000134.bin

where "name" is a name to identify the particular recording, "x1" indicates normal rate and "x5" indicates five times normal rate – i.e. fast forward.

To switch from normal play to fast forward is only necessary for the player program to modify the sub-file address to point to the fast forward sequence – e.g.

Request mpg_ name/096k_x1/000055.bin

is followed by

Request mpg_name/096K_x5/000056.bin

In order to construct the bridging sequences for switching back to normal play it is necessary to construct a bridging sub-file for each possible transition. As described in our international patent application mentioned above, a sequence of three or four frames is generally

sufficient for bridging, so a simple method of implementation is to construct bridging sub-files of only 4 frames duration – e.g.

Directory	Subdirectory	Filename
mpg_name	096K_5>1	0000001.bin
		...
		000133.bin

So that the switching is accomplished by a series of requests such as:

Request mpg_name/096k_x5/000099.bin

Request mpg_name/096k_5>1/000099.bin

Request mpg_name/096k_x1/000100.bin

The bridging sub-file is generated as follows:

- Decode the fast forward sequence to obtain a decoded version of the last frame of sub-file 99, (at 25 frames per second this will be frame 100,000 of the original video signal).
- Decode the normal sequence to obtain a decoded version of the first frame of sub-file 100 (i.e. frame 100,001). Re-encode this one frame four times using H.261 inter-frame coding based on the decoded frame 100,000 as the initial reference frame.
- Thus, when the decoder has decoded the fast forward sub-file, followed by the bridging sub-file it will have reconstructed frame 100,000 correctly and will be ready to decode the normal (x1) frames. Incidentally, the reason that one encodes the same frame several times in this procedure is that doing so merely once, would produce poor picture quality due to the quantisation characteristics of H.261.

Exactly the same process could be used for rate-switching (albeit that now bridging sub-files are required in both directions). However, it will be observed that, as described, the bridging sub-file results in a freezing of the picture for a period of four frames – i.e. (at 25 frames per second) 160ms. In switching from fast to normal play this is acceptable – indeed one would probably choose to clear the buffer at this point. It may or may not be subjectively acceptable on rate-switching. An alternative therefore would be to construct a four-second bridging sequence. The request series would then look like:

mpg_ name/096k_x1/000099.bin

mpg_ name/096/128_x1/000100.bin

mpg_ name/128k_x1/000101.bin

The bridging sub-file would in that case be constructed either by recoding the fifth decoded frame of the decoded 128kbit/s sequence four times starting with decoded 96kbit/sframe 100,000 as the reference frame, or coding the first four frames of the decoded 128kbit/s sequence starting with decoded 96kbit/s frame 100,000 as the reference frame. In both cases the remaining 96 frames of the bridging sub-file would be a copy of the 128kbit/s sub-file.

The files to be delivered have been referred to as "recordings". However, it is not necessary that the entire audio or video sequence should have been encoded – or even exist – before delivery is commenced. Thus a computer could be provided to receive a live feed, to code it using the chosen coding scheme, and generate the sub-files "on the fly" and upload them to the server, so that, once a few sub-files are present on the server, delivery may commence.

One application of this delivery system would be for a voice-messaging system, as illustrated in Figure 5 where the server 1, network 2 and terminal 3 are again shown. A voice-messaging interface 4 serves to receive telephone calls, for example via the public switched telephone network (PSTN) 5, to record a message, encode it, partition it into sub-files, and upload them to the server 1, where they can be accessed in the manner described earlier. Alternatively a second interface 6 could be provided, operating in a similar manner to the terminal 3 but controlled remotely via the PSTN by a remote telephone 5, to which the replayed audio signals are then sent.

The same system can be used for a live audio (or video) feed. It is in a sense still "recorded" - the difference being primarily that delivery and replay commence before recording has finished, although naturally there is an inherent delay in that one must wait until at least one sub-file has been recorded and loaded onto the server 1.

The system can proceed as described above, and would be quite satisfactory except for the fact that replay would start at the beginning whereas what the user will most probably want is for it to start now - i.e. with the most recently created sub-file.

With a lengthy audio sequence one may choose to delete the older sub-files to save on storage: with a continuous feed (i.e. 24 hours a day) this will be inevitable and moreover one would need to reuse the sub-file names (in our prototype system we use 000000.bin to 009768.bin and then start again at 000000.bin), so that the older sub-files are constantly overwritten with the new ones. A simple method of ensuring delivery starting with the most recent sub-file would be to include in the index file an extra command instructing the player program to start by requesting the appropriate sub-file. This however has the disadvantage that the index file has to be modified very frequently - ideally every time a new sub-file is created. Therefore we propose a method whereby the player program scans the server to find the starting sub-file, as follows. In the index file, the

Mode parameter is set to "live" to trigger the player program to invoke this method. LFI is set to indicate the maximum number of sub-files that may be stored - say 9768. The method involves the following steps and presupposes that (as is conventional) each sub-file's "last modified" time and date has been determined. When using the HTTP protocol this can be achieved using a HEAD request which results not in delivery of the requested sub-file but only of header information indicating the time that the sub-file was written to the server, or zero if the sub-file does not exist. This time is represented below as GetURL(LiveIndex) where LiveIndex is the sequence number of the sub-file in question. Comments are preceded by "//".

```
1       LFI = 9768 // read from the index.htm file

        LiveIndex = LFI / 2
        StepSize = LFI / 2
        LiveIndexModifiedAt = 0;  // the beginning of time.

10      ThisIndexWasModifiedAt = GetURL(LiveIndex);

20      If (StepSize = 1)
        {
         // LiveIndexModifiedAt contains the time the file was written or 0 if no file
         // has been found. LiveIndex contains the index.
         goto 30
        }

        StepSize = StepSize / 2

        if (ThisIndexWasModifiedAt > LiveIndexModifiedAt)
        {
         LiveIndexModifiedAt = ThisIndexWasModifiedAt;
         LiveIndex = LiveIndex + StepSize
        }
        else
        {
         LiveIndex = LiveIndex - StepSize
        }
        Goto 10

30      FINISH
```

Having found the LiveIndex it is prudent to step back the Tp (playout time) and start to make the requests to fill the audio buffer from there. Playing may commence in the normal way.

Once the recording has actually finished, the index file can if desired be modified to set Mode to "recorded", and any length parameters.

If desired the player program could check periodically to see whether the index file has changed from "live" to "recorded" mode and if so to switch to "recorded" mode playing.

A simpler and much faster method of the identification of the "latest" sub-file will now be described, assuming, first of all, a single continuous sub-file numbering sequence.

1. Terminal issues a HEAD request for the first sub-file (e.g. 000000.bin).

2. The server replies by sending the header of this file and includes the date and time the file was last modified (MODTIME) and the date and time at which this reply was sent (REPLYTIME) (both of these are standard http. fields).

3. The terminal calculates the elapsed time (ELTIME) by subtracting the two (ELTIME = REPLYTIME – MODTIME), and divides this by the playing duration of a sub-file (4 seconds, in these examples) to obtain LIVEINDEX = ELTIME/4.

4. The terminal calculates the filename of the sub-file having this index.

5. The terminal issues a HEAD request with this filename and if necessary each subsequent filename until it receives zero (file not found) whereupon it regards the latest sub-file which is found as the "Current sub-file".

6. The terminal begins requesting files, starting at point J1: of the flowchart given earlier.

This method is considerably faster than that described above for the cyclically numbered sub-files. Note that older sub-files may still be deleted, to reduce storage requirement, as long as the starting sub-file is kept. The method can however be modified to accommodate filename re-use (cyclic addresses), but would require:

(i) That the starting sub-file name (e.g. 000000.bin) is <u>not</u> re-used so that it is always available to supply the header information at Step 2. Thus, with wrapping at 009768.bin, sub-file 009768.bin would be followed by sub-file 000001.bin.

(ii) The calculated LIVEINDEX at Step 3 is taken Modulo 9768 (i.e. the remainder when ELTIME/4 is divided by 9768).

(iii) Sub-file deletion always leads the creation of new sub-files so that a few file-names between the newest sub-file and the oldest undeleted sub-file do not exist, in order that the expected "file not found" response occurs at Step 5.

There may be a danger of the playing operation running slightly faster or slower than the recording operation. To guard against the former it may be arranged that the player program

checks each sub-file it receives to ascertain whether it is marked with a later time than the previous one: if not the sub-file is discarded and repeated requests made (perhaps three times) followed by a check of the index file if these requests are unsuccessful.

If the playing lags behind the recording process this can be identified by the player program occasionally checking the server for the existence of a significant number of sub-files more recent than those currently being requested, and if such sub-files do exist, initiating a "catching up" process - e.g. by regularly discarding a small amount of data.

CLAIMS

1. A terminal for playing audio or video material which is stored on a remote server as a set of files representing successive temporal portions of the said material, the terminal comprising:
a telecommunications interface for communication with the server;
a buffer for receiving the files from the telecommunications interface; and
means for playing the contents of the buffer;
characterised by control means operable to determine the addresses of further files to be requested and operable in response to the state of the buffer to generate request messages, containing such addresses, for further files for replenishment of the buffer.

2. A terminal according to claim 1 arranged in operation to decode the files before storing them in the buffer.

3. A terminal according to claim 1 or 2 including means operable to generate a series of trial requests to identify the most recent file and to commence decoding starting with the identified sub-file.

4. A terminal according to claim 1, 2 or 3 for use with a server storing a plurality of sets of files, which sets correspond to respective different delivery modes, the terminal including:
means operable to effect mode switching by providing that subsequent request messages shall request files from a set different from the set to which the immediately preceding request related.

5. A terminal according to claim 4 for use with a server in which at least some of said sets of files correspond to respective different data rates, in which:
the terminal includes means for monitoring the received data rate;
the mode switching means is operable, in the event that the measured rate is below that needed for the set to which the currently requested file belongs, to provide that subsequent said request messages shall request files from a set corresponding to a lower data rate.

6. A terminal according to claim 4 or 5 for use with a server in which at least some of said sets of files correspond to respective different data rates, in which:
the terminal includes means for monitoring the received data rate;
the mode switching means is operable, in the event that the measured rate is sufficient to support delivery of files of a higher data rate than that of the set to which the currently requested file

belongs, to provide that subsequent said request messages shall request files from a set corresponding to a higher data rate.

7. A terminal according to claim 4, 5 or 6 for use with a server in which at least some of said sets of files correspond to respective different playing modes, in which:
the terminal includes means to receive commands from a user of the terminal to perform said mode switching from a current playing mode to a desired playing mode corresponding to that command; and
the mode switching means is operable, upon receipt of the command, to provide that subsequent said request messages shall request files from a set corresponding to said desired playing mode.

8. A terminal according to any one of claims 1 to 7 for use in a method according to any one of claims 19 to 22, in which the terminal is operable upon receipt of a file to decode it and to discard that part of the decoded material which corresponds to said initial part of the following portion.

9. A terminal according to any one of claims 4 to 7 for use with a server storing said material in the form of video recordings, at least some of said files having been encoded using, for at least some frames thereof, inter-frame coding, in which the terminal is arranged in operation, before generating the request message for a file from a different set, to generate a request message for a file for correction of decoder tracking.

10. A terminal according to any one of the preceding claims in which the files are allocated addresses according to a predetermined algorithm and the terminal includes means operable for a said request message to calculate, in accordance with said algorithm, an address for inclusion in the request message.

11. A method of transmitting digitally coded audio or video material comprising:
partitioning the material into a plurality of discrete files each representing successive temporal portions of the said material;
storing the files at a first station; and
at a second station –

a) transmitting to the first station requests for successive respective ones of the files;
b) receiving the files; and
c) decoding the files for replay of the material.

12. A method according to claim 11 in which the material is stored in a buffer and the request messages are generated in dependence on the state of the buffer.

13. A method according to claim 12 in which the material is stored in the buffer after decoding.

14. A method according to claim 11, 12 or 13, including, at the second station, generating a trial request for a first file, receiving from the first station a reply including data representing the original time of the first file and the time of said reply, and estimating from these data an estimated identity of the most recent file at the first station.

15. A method according to claim 11, 12, 13 or 14 including generating, at the second station, a series of trial requests to identify the most recent file at the first station and commencing said decoding starting with the identified file.

16. A method according to any one of claims 11 to 15 including storing a plurality of sets of files, which sets correspond to respective different delivery modes, and including, at the second station, effecting mode switching by providing that subsequent request messages shall request files from a set different from the set to which the immediately preceding request related.

17. A method according to claim 16 in which at least some of said sets of files correspond to respective different data rates, including:
monitoring the received data rate at the second station; and
in the event that the measured rate is below that needed for the set to which the currently requested field belongs, performing mode switching to provide that subsequent said request messages shall request files from a set corresponding to a lower data rate.

18. A method according to claim 16 or 17 in which at least some of said sets of files correspond to respective different data rates, including:
monitoring the received data rate at the second station; and
in the event that the measured rate is sufficient to support delivery of files of a higher data rate than that of the set to which the currently requested file belongs, performing mode switching to provide that subsequent said request messages shall request files from a set corresponding to a higher data rate.

19. A method according to claim 16, 17 or 18 in which at least some of said sets of files correspond to respective different playing modes, in which:

the second station includes means to receive commands from a user of the second station to perform said mode switching from a current playing mode to a desired playing mode corresponding to that command; and

the mode switching means is operable, upon receipt of the command, to provide that subsequent said request messages shall request files from a set corresponding to said desired playing mode.

20. A method according to any one of claims 11 to 19 in which said material is audio material, in which:

a) the files are encoded using an audio coding method having a frame structure;

b) the step of partitioning the material into a plurality of discrete files comprises notionally dividing the material into a plurality of temporal portions and generating each said file, other than the last, by coding one respective temporal portion and an initial part of the following portion such that the portions together represent a whole number of frames;

c) after decoding, that part of the decoded material which corresponds to said initial part of the following portion is discarded.

21. A method according to any one of claims 11 to 19 in which said material is audio material, in which:

a) the files are encoded using an audio coding method having a frame structure;

b) the step of partitioning the material into a plurality of discrete files comprises notionally dividing the material into a plurality of temporal portions and generating at least some of said files by coding one respective temporal portion and so much of the end of the immediately preceding temporal portion and/or the beginning of the immediately following temporal portion as to constitute with said one respective said temporal portion, a whole number of frames of said frame structure; and

c) after decoding, that part of the decoded material which corresponds to said end of the immediately preceding temporal portion and/or beginning of the immediately following temporal portion is discarded.

22. A method according to claim 20 or 21 in which said sets comprise a first set and a second set for which the frame length is different from that used for encoding the second set, and the division into temporal portions is the same for both sets.

23. A method according to claim 20, 21 or 22 when dependent on claim 13 in which that part of the decoded material which corresponds to said initial part of the following portion is not stored in the buffer.

24. A method according to claim 16 or any one of claims 17 to 23 when dependent on claim 16 in which said material is in the form of video recordings, at least some of said files having been encoded using, for at least some frames thereof, inter-frame coding, and including, at the second station, before generating the request message for a file from a different set, generating a request message for a file for correction of decoder tracking.

25. A method according to any one of claims 11 to 24 in which the files are allocated addresses according to a predetermined algorithm, the method including calculating, at the second station in accordance with said algorithm, an address for inclusion in a request message.

26. A method according to claim 25 in which the algorithm generates the addresses in accordance with a key, including the step of transmitting the key to the second station for use in calculating the addresses.

27. A method according to claim 26 in which the algorithm generates the addresses in accordance with a pseudo-random sequence.

28. A method according to claim 27 in which the algorithm generates the addresses in accordance with a pseudo-random sequence and the key is a seed value for setting the start point of the pseudo-random sequence.

29. A method according to any one of claims 11 to 28 including, at the second station, the steps of:

(a) receiving from the first station a list containing times and data defining actions to be performed at those times;

(b) computing a time, relative to the beginning of the material, represented by the current playing point;

(c) comparing the computed time with the times in the list and, in the event of a match generating a command containing the respective data for initiation of the action.

30. A method according to claim 29 in which the actions include the display of a subtitle.

31. A method according to claim 29 or 30 in which the actions include the display of an image.

32. A method according to claim 31 including transmitting to the first station a request for images identified by the said data, and storing the images at the second station until required for display.

Fig.1.

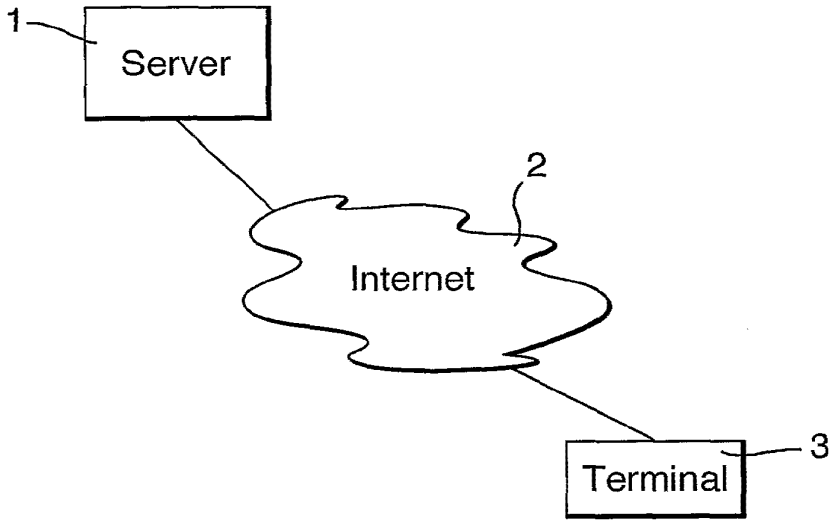


Fig.2.

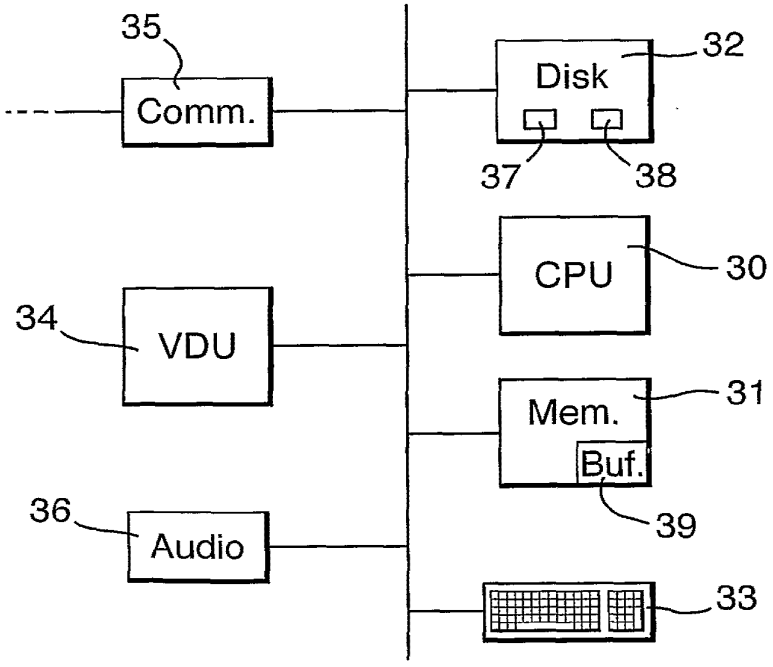


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Fig.3.

```
<html>
<head>

<!-- Odbits: Mode = "recorded" -->
<!-- Audio = "mp3-024k_11_s mp3-032k_11_s mp3-018k_11_s mp3-016k_11_m
mp3-008k_11_m" -->
<!-- LFI = "44" -->
<!-- SL = "178" -->
<!-- Title = "Toccata and Fugue in D minor" -->
<!-- Author = "J.S. Bach" -->
<!-- Created = "6 Nov 2000" -->
<!-- Copyright = "© 1999" -->
<!-- Comments = "One of Bach's many organ works." -->
</head>
<body>
An announcement to appear on the display
</body>
</html>
```

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Fig.4.

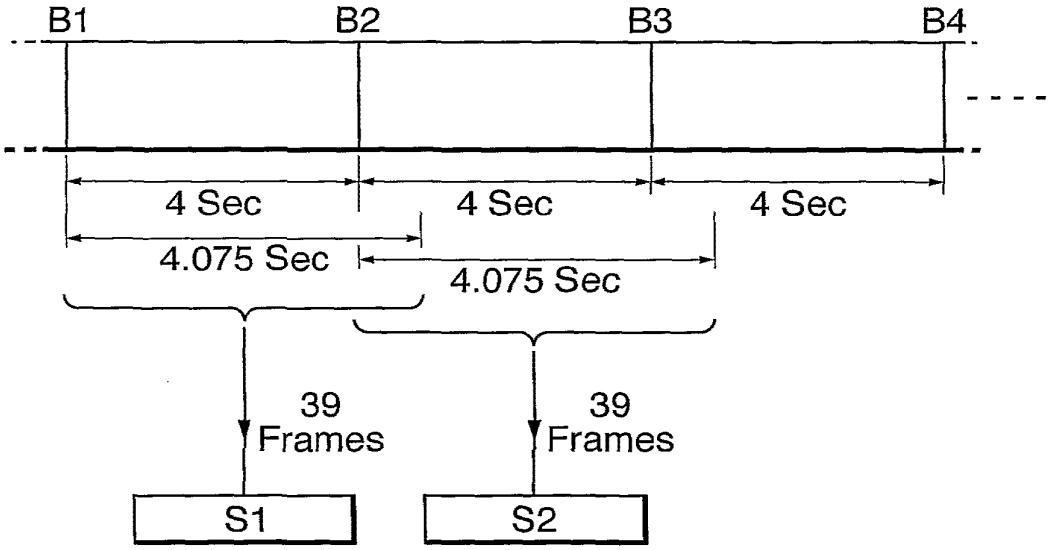
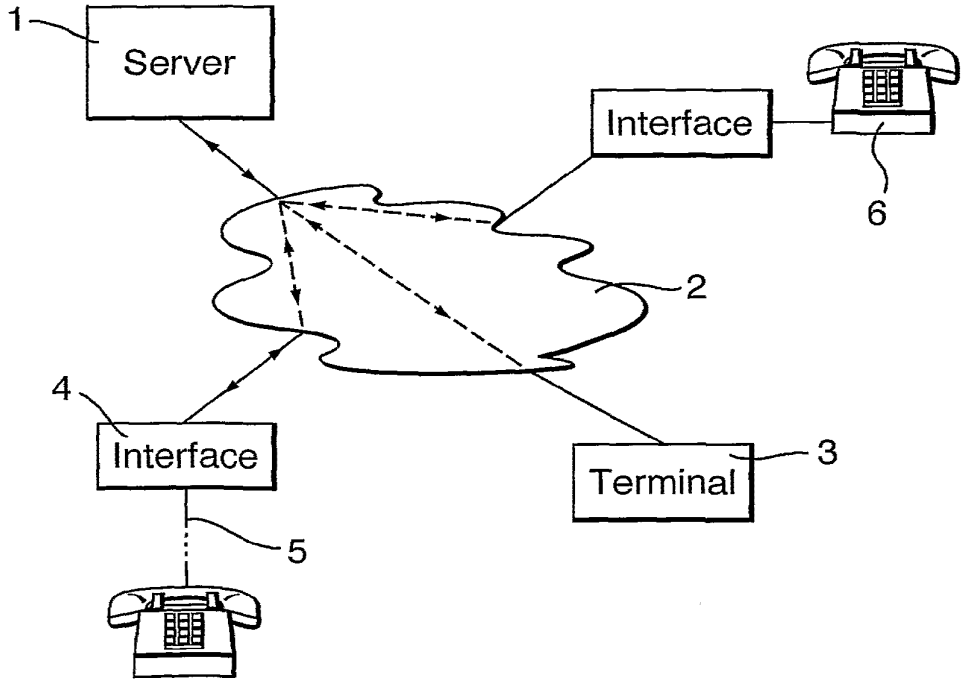

B1
B2
B3
B4
4 Sec
4 Sec
4 Sec
4.075 Sec
4.075 Sec
39 Frames
39 Frames
S1
S2

Fig.5.


1
Server
Interface
6
2
4
Interface
Terminal
3
5

INTERNATIONAL SEARCH REPORT

Inte ıal Application No
PCT/GB 01/05543

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N5/00 H04N7/24

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)
IPC 7 H04N H04L

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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	EP 0 669 587 A (AT & T CORP) 30 August 1995 (1995-08-30)	1-9, 11-19, 24,25, 29-32
A	abstract	10, 20-23, 26-28
	column 18, line 31 -column 21, line 13	
Y	US 5 610 841 A (DOI SHINZO ET AL) 11 March 1997 (1997-03-11)	1-9, 11-19, 24,25, 29-32
	abstract column 9, line 40 -column 13, line 59	
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 March 2002	27/03/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Giannotti, P

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Page 826 of 1422

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2

INTERNATIONAL SEARCH REPORT

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Inte al Application No
PCT/GB 01/05543

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			WO	0042773 A1	20-07-2000
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			JP	2000515692 T	21-11-2000
			WO	9722201 A2	19-06-1997
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(71) Applicant: NARRATIVE COMMUNICATIONS CORP. [US/US]; 204 Second Avenue, Waltham, MA 02154 (US).

(72) Inventors: KLIGER, Scott, A.; 18 Jacob Amsden Road, Westborough, MA 02581 (US). MIDDLETON, Thomas, M., III; 25 Burditt Avenue, Hingham, MA 02043 (US). WHITE, Gregory, T.; 31 Old Billerica Road, Bedford, MA 01730 (US).

(74) Agents: WAKIMURA, Mary, Lou et al.; Hamilton, Brook, Smith & Reynolds, P.C., Two Militia Drive, Lexington, MA 02173 (US).

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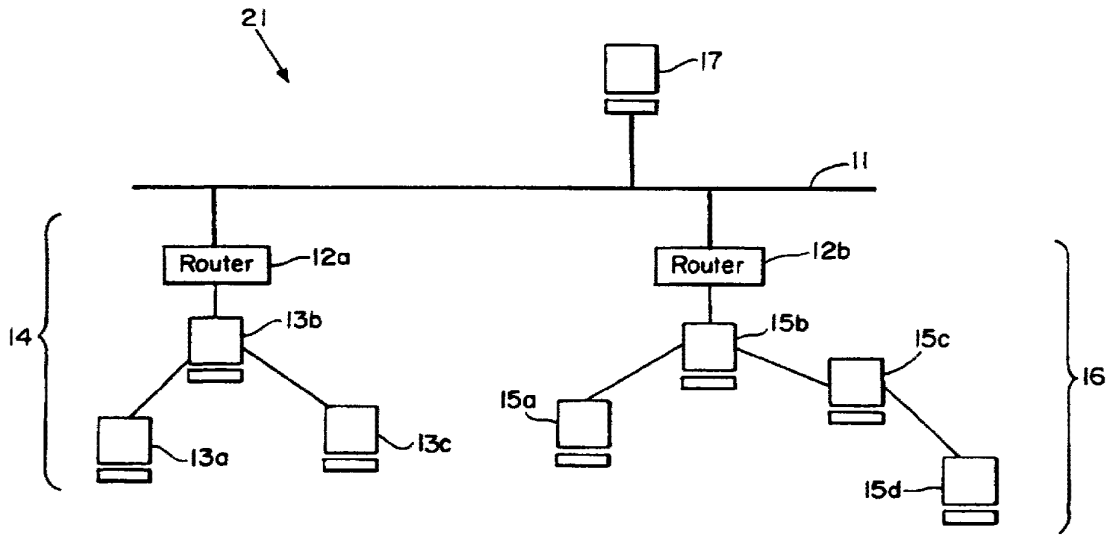

(57) Abstract

In a distributed computing environment, a data stream is formed of a sequence of requested objects. The defined order of the sequence of objects is determined from a client request for data. The order may be a default order, or, alternatively, the server may track client criteria to determine the order. For example, the server (17) may track objects previously transmitted in the stream to the client (13) such that there is no duplication of objects. In other instances, the server may select an object from a class of objects, depending upon object quality, bandwidth, client location, and other client-specific criteria. The server compiles and transmits the object data stream in real-time (on-the-fly) based on the criteria. Buffering of data with pausing to rectify buffer debt is provided by the client.

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COMPUTER METHOD AND APPARATUS FOR OBJECT STREAMING

REFERENCE TO CO-PENDING APPLICATION

This application claims the benefit of a United States Provisional Application Serial No. 60/018,256 filed May 24, 1996.

BACKGROUND

"Distributed computing" makes use of a computer network formed out of one or more computers loosely coupled together to allow processes on different computers to communicate with each other and to provide services for each other. One of the most common paradigms of distributed computing is known as the "client-server model", in which consumers of services are called "clients", and make requests of service providers, called "servers".

In object oriented distributed computing, there is a notion of computer entities called "objects". Each object comprises a particular state and a set of defined behaviors. The state is represented by data maintained by the object. The behavior is specified in terms of operations that the object can perform with the operations, typically realized by executable code. Conceptually, the data and the code are inextricably bound together in the object. Objects may be "persistent", that is, they may continue to exist even though they are inactive or the computer on which they exist has failed or has been turned off. Further, objects may issue requests for services to other objects as well as supply services.

Typically, data is held in linear files on a server. When a client requests that data or a part thereof, a connection is formed between the data source (server) and delivery (client) point.

In the prior art there are in general two different types of servers. The first, known as a web server, typically stores data files of a number of different types. Web servers typically communicate with clients over a network such as the Internet using the well known TCP/IP protocol. The second type of server, known as a streaming media server, stores and transmits media files of various types.

More particularly, the web servers presently in use typically store data files in a format known as Hyper Text Markup Language(HTML). HTML permits the web servers to handle container files which reference other files of varying formats. Using HTML, a given web document may include content information in various formats and may also refer to other files by including reference information known as a Uniform Reference Locator (URL). URL's specify the location of remote servers at which files referenced in the HTML file may be located.

Upon receipt of an HTML file from the original web server, a client then must access each document referenced from its source. Each such request typically requires a full cycle of communication with a remote server, including opening a connection socket with the remote server, requesting that the file be transferred, waiting for the file to download, closing the connection, and then, finally parsing the file. To render a given web page may therefore require many such cycles.

The other type of server, known as a streaming media server, has been developed to be particularly suited for multimedia of various types. Such servers may handle single data types, such as a RealAudio™ file, or may

include mixed media types, in formats such as NetShow™ (RealAudio™ is a trademark of Progressive Networks, Inc., and NetShow™ is a trademark of Microsoft Corporation). In any event, media files are typically laid out in a linear fashion in a single file. Thus, when the client requests a file from a streaming server, a socket is simply opened and delivery of data is begun.

The client may perform a caching or buffering operation prior to actual play back of the media file. This ensures that the media file is played back to the user of the client computer in a continuous stream. In particular, the client may calculate in advance an amount of data that it must have on hand prior to actually beginning to render the media file, so that the user has an impression of continuous delivery of the media.

In such a linear streaming server, files may be formatted in advance with a specific communication transfer bandwidth in mind. For example, a Real Audio file may have been compressed for receipt at a baud rate such as 14.4 kilo bits per second (kbps). Another file would be made available for optimum playback at 28.8 kbps. These different file formats provide for allowances in playing back data such that it is rendered in a continuous fashion at the respective rates.

In streaming media server, the connection remains open with the server during the full duration of the play back of the file. Thus, for example, even on a high speed network connection such as a T1 line, if the media file is a ten minute audio file, then the connection will remain open for ten minutes, even though the available information transfer rate on a T1 line is much greater than the audio bandwidth.

In addition, one other disadvantage of streaming media servers is that they typically implement a lossy type of compression algorithm. Thus, if network traffic increases

after file download has begun, bits may be dropped and the quality of the presentation is adversely affected.

Therefore, with streaming media files, the content must typically be specific to each type of client at the targeted bit rate. In addition, the streaming media server is occupied for the real time duration of the media clip, and the presentation may experience degradation based upon the amount of latency in the network.

SUMMARY OF THE INVENTION

Briefly, in the present invention, rather than interpreting container objects that contain references to other objects that must be retrieved by the client opening multiple connections with various servers, and rather than specifying the streaming of data in a single access request, the present invention provides for transmission of data as a stream of objects. In particular, in response to a user or application request for a file, the client issues a request for the file in the form of a sequence of desired objects. The request is presented to the server as a single request that includes a list of multiple objects to be returned to the client.

On the server side, the request is pulled together according to what the client has requested. The requested objects are then sent together in a single stream to the client. To accomplish this, the server analyzes the request to locate the particular objects.

Objects that are available locally to the server are simply added to the outgoing stream, however, the server may also need to query back end file servers and other sources for objects that may be located at other computers in the network. The server then assembles these objects together and provides them to the client in a single object stream.

In one implementation of the invention, typically the default implementation, the server may analyze the reqeust and assemble objects based upon a predefined order, such as specified by an object map file located at the server.

In another implementation of the invention, the server may assemble objects "on-the-fly", based upon client-specific criteria. The present invention thus also permits the mixture of different objects in an object stream, depending upon the particular client or client request. The assembly of object streams may thus occur dynamically based upon any number of client-specific criteria, such as the objects already available to the client, the communication channel bandwidth, the desired presentation quality, client buffer capability, or other parameters associated with the client or the communications channel.

For example, the server may maintain a log of objects already sent to the client, and send only those objects which are not already available at the client computer.

The client may also specify an object class together with information that enables the server to determine which member object of the class is to be placed in the stream.

Such information may include the communication bandwidth, graphical resolution, physical location, or other information which varies from client to client.

The server may also send objects of a particular quality targeted to particular clients. The selection of objects may depend upon client parameters such as observed network latency in real time or desired object quality.

The system may also include buffering, so that the rendering of the set of objects may be delayed until a sufficient amount of data is received at the client.

BRIEF DESCRIPTIONS OF THE DRAWINGS

The foregoing and other objects, features and advantages of the invention will be apparent from the

following more particular description of preferred embodiments and the drawings in which like reference characters refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.

Fig. 1 is a block diagram of a computer network employing the present invention.

Fig. 2 is a schematic flow diagram of one embodiment of the present invention.

Fig. 3 illustrates how a server dynamically assembles an object stream in response to a client request.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Illustrated in Fig. 1 is a block diagram of a general computer network 21. A plurality of computers 13, 15, 17 are coupled across a communication channel 11 for communication amongst each other. Various subsets of the computers may themselves form a local area network (LAN) or other local network 13, 15. Each of the various local networks are coupled through a respective router 12a, 12b to channel 11. This enables communication from one local network to another across the channel 11 to form what is known as an "internet". In the preferred embodiment, the present invention is employed on what has become known as the Internet (an international computer network linking an estimated 35 million people to approximately 4.8 million host computers or information sources).

In the preferred embodiment the computers 13, 15, 17 or digital processors employing the present invention are of the PC or mini computer type, or the like, having

processing capabilities of the Intel XX386 processing chip or better. The communication channel 11 is a typical telephone line or other transmission/communication cable handling a 28,800 baud data rate or the like.

A sequence of steps are undertaken by the computers 13, 15, 17 to transfer data in the form of a stream of objects according to the present invention. For example, a given client computer 13a may issue a request for computer data to another computer 17, which acts as a server.

Referring to Fig. 2, the client 13a is a computer that executes an application (or other user interaction) for which certain data needs to be made present. In steps 100 and 102, the client receives an object stream request from the application that includes a global identification of an object map which indicates certain objects existing in the network 21 that the client application program seeks. In particular, the object stream request includes a list, or linear sequence of objects identified a global object identification number. The client 13a transmits the initial request to the server 17, which enters state 200 to transfer back a global identification of the object map listing subject objects.

The client next determines whether the object map is stored locally. Thus, the client 13a checks multiple local memories such as hardware caches, working memory, CD-Rom's and local network memories for the object map in state 108.

If the object map is found locally, then the client analyzes the object map. If the object map is not found locally, then the client requests the object map from the server in state 106.

In response to this request, the server enters states 202, 203 and 204 to (i) initialize a log of object identifications for this client, (ii) initialize a steady

state connection with the client, and (iii) transmit the object map identified by the client 13a.

The client 13a then analyzes the object map in state 108. This is accomplished by the client processing each object referred in on the object map, as indicated by the analyze loop of states 110,112 and 114.

For each such object, the client first determines, in state 110, whether the object is in local cache. If not, then the client 13a adds the identification of the object to a request block. As long as the block is not full, this loop continues with the client adding an identification of each object not found in local cache in state 112.

When the block is full in state 114, the client transmits a request to the server for the block of objects as a list of object identifications.

Upon receipt of this request (i.e., a block of object indentifications), the server 17 then initiates the assembly of a data stream and compiles the stream of objects based on (i) the sequence of requested objects and/or (ii) quality of the objects.

To accomplish this the server constructs blocks of objects to form the data stream, in states 206 through 214. In constructing the blocks, the server 17 maintains a log of objects being transmitted to fulfill the client's request. Specifically, in states 206 and 208, for each object in the block, the server 17 first determines from the log whether the object has previously been transmitted to the particular client 13a. If so, the server 17 enters state 214 to prevent that object from being placed in the current block. Therefore, states 110 and 212 are entered only for the objects that the client is actually in need of. In state 210, then, the server only fetches objects from remote servers which are actually needed by the client 13a. This provides a significant performance advantage, especially where the objects must be obtained elsewhere in

the network 21. As such, the server 17 constructs blocks of data and hence compiles the stream of data for the client 13a in real time, i.e., on the fly, without duplication of any one object throughout the total data stream.

On the receiving end, the client 13a receives the object stream in state 116. More accurately, the data of the object is then delivered to the requesting application of the client for further processing and use.

In summary, for each such object request by the client 13a, an object streaming type communication from the server 17 to client 13a is performed. In particular, a request for a sequence of non-local objects is made by the client 13a and transmitted to the server 17. In turn, the server 17 initializes a log of objects according to object identifications, and then fulfills the request for objects by transmitting the requested objects, in sequence order, which have not previously been transmitted to that client 13a as indicated by the log.

It should be understood that the objects may be computer data structures of various types and formats. The objects may, for example, be compiled in any number of ways within the object oriented computing model well known in the art. For example, objects may include text, graphics, audio, video, and other types of digitized information. Furthermore, objects may be complete data files or only portions of such files. In addition, the objects themselves may be classes that consist of a number of objects grouped together. The object request must then typically include information to specify which member of the object class is desired by the client 13a.

For example, an object class may consist of various versions of a particular graphic object. The selected version may depend upon the desired quality of the final graphical rendering of the object desired by the client

computer 13a. Quality may also have other meaning such as bandwidth, graphical resolution, number of colors, available client memory cache size, and other class criteria that depend upon the type of client computer 13a.

In addition, object classes may depend upon various other client-specific information such as domains, for example. In this scenario, when the client computer 13a is located in one area of the country, such as Massachusetts, a different object may be returned than when the client 13b is located in California, although each of the clients 13a, 13b actually requested the same global object.

Fig. 3 is a diagram illustrating how an example object stream 300 may be assembled by the streaming servers 17, and in particular showing how the object stream does not have to originate from a single source or a single file.

Here the client 13a requests and receives a particular object map 301 consisting of a list of object identifications such as the list (ID1,ID4,ID7,ID6,ID2, ID3), where each object identification IDx indicates a global address for a particular object. According to the process already described in connection with Fig. 2, the client 13a first creates a request block 302 taking into account any local objects 303 which it may already have available. In the particular illustrated example, the client 13a already has local objects (O1, O6) available locally.

After compiling the request block 302, the request block 302 is sent to the streaming server 17. Streaming server 17 receives the request block 302 and then assembles a stream block 310a for the client 13a. It should be understood that other stream blocks 310b may also be constructed for other clients 13b at the same time as the block being constructed for client 13a.

For example, assuming a first time interaction between the client 13a and server 17 in a given stream, the server

17 typically has a default data stream order regardless of user interaction on the client 18 side.

In a first modification, the server 17 may have available certain information concerning the client. Because the server 17 may compose the data stream on-the-fly, the default stream order may be changed in accordance with prior history of requests made on the server 17. That is, on the server processor, an analysis of multiple prior usage of server objects by other clients is made. The server 17 changes the default objects stream 300 order to the closest substitution (i.e., object map) based on demographics of clients 13a having prior server data/object usage. To accomplish such an analysis, a neural network may be employed.

In yet another modification, the streaming server 17 may create the stream block 310a from information that is known about the specific client 13a.

For example, the server 17 may maintain a log 311a of objects that have already been provided to client 13a as well as any available local objects 312 local to the server 17. In the illustrated example the log 311a indicates objects (ID1,ID6) as already having been provided to client 13a. In addition, the available local objects 312 include (O4,O12).

It should be understood, as previously described, that a particular object such as object O4 may actually consist of a class definition, as illustrated, wherein a number of objects comprise the class. For example, object 04 here is actually an object class (O4a,Ob4,...O4x). The streaming server 17 thus also receives together with the object identification request block 302 information as to which particular member of class O4 is appropriately provided to the client 13a.

The streaming server 17 then assembles the stream block 310a as illustrated, which includes all of the

objects that the client 13a has requested. In the illustrated example this includes objects (O4a, O7, O2, O12, O3). After assembly of the stream block 310a the streaming server 17 then provides the stream block 310a as a single object stream 300 to the client 13a.

During assembly of the stream block 310a the streaming server 17 may not have all the necessary objects available in the local object list 312. In such instances the streaming server 17 must query other remote server computers 15a, 15b connected to the network 21 in order to locate the objects. This is done in a manner which is well known in the art by the streaming server 17 making requests of the remote computers 15a, 15b to provide their respective objects that they have made available. In Fig. 3, objects (O7, O2, O4) are located at computer 15a and object (O3) at computer 15b.

An identical object map may be operated on in a different manner by server 17 for client 13b. In particular, although the object map 301b is the same as the objects map 301a, because a different list of object 303b is available to client 13b, the request block 302b created by client 13b will have different object identification numbers (ID4, ID6, ID3). Furthermore, the client parameter(s) provided with the request block by client 13b may very well be different for that provided by client 13a. Thus, an object of a particular quality may be targeted to client 13b which is different than as that supplied to client 13a. For example, when clients 13a and 13b request that object O4 be provided to them, client 13a may actually receive object O4a and client 13b may receive object O4b, despite the fact that the reference O4 was a common global object identification.

The object classes may also be defined as bandwith selectable objects. In particular, the resulting data stream 300 may be assembled based upon observed client

bandwidth availability. Therefore, depending on a periodically calculated data transfer rate, the client 13a or server 17 may choose to request or transmit a data stream of different objects. That is, for a given requested object 04, a specific version 04a, 04b...04x may be selected for transfer from the server 17 to the client 13a as a function of available bandwidth. This function is termed "bandwidth scalability" of the object stream.

In another possible implementation, "object specific compression" is provided by the server, such that on an object by object basis, the object data stream 300 may be compressed one object at a time depending upon client criteria. In the preferred embodiment, the server 17 determines which compressed object version to include in the object data stream 300 at the time of compilation.

The client 13a also manages the amount of data being delivered, i.e., throughput to a client 13a. In particular, this is useful to determine whether there is enough data being timely transferred; that is, whether data is being consumed on the client 13a end faster than the server 17 is delivering the requested objects.

In the preferred embodiment, the client 13a builds a map of uncompressed data consumption. The map tells how fast data is being consumed (used by the client 13a application). The client then measures the throughput (client receipt) of data in real time and contrasts that with the formulated map. Based on the comparison, the client 13a is able to determine how much of the object stream data 300 should be read by a buffer 320a at a time. Thus, the client 13a effectively maps the physical compressed object data stream 300 and logical consumption of data at each point in time.

The client 13a continually monitors the real data throughput versus data consumption. The client 13a wants the delivery-to-consumption ratio to be greater than one so

that the throughput (supply) is keeping up with the consumption (demand). When the delivery-to-consumption ratio is less than one, there is more data being consumed than the amount of data being delivered, such that there is a so-called "buffer debt" on the client 13a side. In that case, the transmission of data needs to take advantage of pause points in the object data stream 300, so that for a period of time, data is not being transmitted over the communication channel 11. In turn, the buffer 320a is allowed to fill up with the requested data and thus decrease or solve the "buffer debt", to assist with proper real time delivery of objects.

The pause points may be pre-defined by the author of the object content, or the pause points may be determined on the fly in accordance with the client's ability to consume data.

In the preferred embodiment this latter implementation is accomplished as follows. The client 13a at each time point, t, computes object data consumption. A running average of throughput such as number of bytes received divided by total time in seconds is employed. An adaptive running average or weighted average or the like may also be used to compute the data consumption. This is also known as the physical throughput at a given time, i, (i.e., (pt_i).

The total logical data (tld) optimally needed at a point in time t is calculated as follows:

$$tld = \sum_{i=o}^{t} rate\ map(i)$$

Buffer debt is then calculated as follows:

$$buffer\ debt = \sum_{i=t}^{end} (tld(i) - pt_i)$$

The client 13a then calculates the buffer debt from time to time. For a buffer debt greater than 0 the client calculates a maximum wait time

maxwait = buffer debt ÷ physical throughput

which equals the number of seconds of pausing needed to rectify the buffer debt. At each wait point or pause point in the object data stream 300, the client 13a will then wait a minimum of the maxwait time or the maximum time allowed at that wait point. For a buffer debt of less than zero, the server 17 transmission of data is ahead of the consumption and thus no pausing during the transmission of the object data stream 300 is warranted.

EQUIVALENTS

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

For example, the log maintained by the server 17 for preventing duplication of objects in the transmitted object data stream 300 to the requesting client may be implemented with tables, cache memory and the like. In the case of caching, a sparse representation of the most recent transmitted objects is maintained in the log. Other caching or log implementations are suitable and are understood to be in the purview of one skilled in the art.

Another example is the term "local to the client". "Local" means in various memories including hard drives, cache memories, CD's and other working memories in the local network involving the client 13a.

CLAIMS

1. In a computer network having a plurality of digital processors loosely coupled to a communication channel for communication among the digital processors, a method of transmitting data from one digital processor to a second digital processor comprising the steps of:

providing a server processor;

providing a requesting processor;

coupling a communication channel between the server processor and requesting processor to enable communication between the server processor and requesting processor;

in the requesting processor, forming a request for a desired sequence of objects;

transmitting the formed request across the communication channel from the requesting processor to the server processor;

in the server processor, in response to receipt of the request, assembling and transmitting, across the communication channel to the requesting processor, a data stream based on the desired sequence of objects, such that a set of objects in a defined order is transmitted in the data stream from the server processor to the requesting processor.

2. A method as claimed in Claim 1 wherein the step of assembling and transmitting a data stream includes:

in the server processor, recording an indication of objects being transmitted to the requesting processor in response to the request; and

based on the recording, preventing plural and subsequent transmission of an object indicated on the

recording by deleting from the data stream objects indicated on the recording such that the transmitted set of objects is formed only of objects which have not been previously transmitted to the requesting processor in response to the request as indicated in the recording.

3. A method as claimed in Claim 1 wherein the step of assembling and transmitting a data stream includes:

in the server processor for each of certain objects, providing multiple versions of the object;

for each of the certain objects, in one of the server processor and requesting processor, determining one version of the object to be optimal for transmission in terms of available bandwidth of the communication channel; and

using the determined version of the object in the set of objects transmitted in the data stream.

4. A method as claimed in Claim 1 wherein the step of forming a request in the requesting processor includes:

for each object in the desired sequence, determining whether the object is locally stored; and

omitting from the request those objects determined to be locally stored but maintaining sequence ordering of the objects in the request.

5. A method as claimed in Claim 1 further including the step of monitoring a rate at which the requesting processor uses requested objects such that rate at which the requesting processor receives requested objects transmitted from the server processor is sufficiently fast to prevent the data stream from

lagging behind the requesting processor use of requested objects.

6. A method as claimed in Claim 1 wherein the step of assembling and transmitting a data stream includes:

in the server processor for each of certain objects, providing multiple versions of the object;

for each of the certain objects, in one of the server processor and requesting processor, determining one version of the object to be optimal for transmission to the client in terms of available client criteria,; and

using the determined version of the object in the set of objects transmitted in the data stream.

7. A method as claimed in claim 6 wherein the client criteria is one of object quality, bandwidth, graphic resolution, or client location.

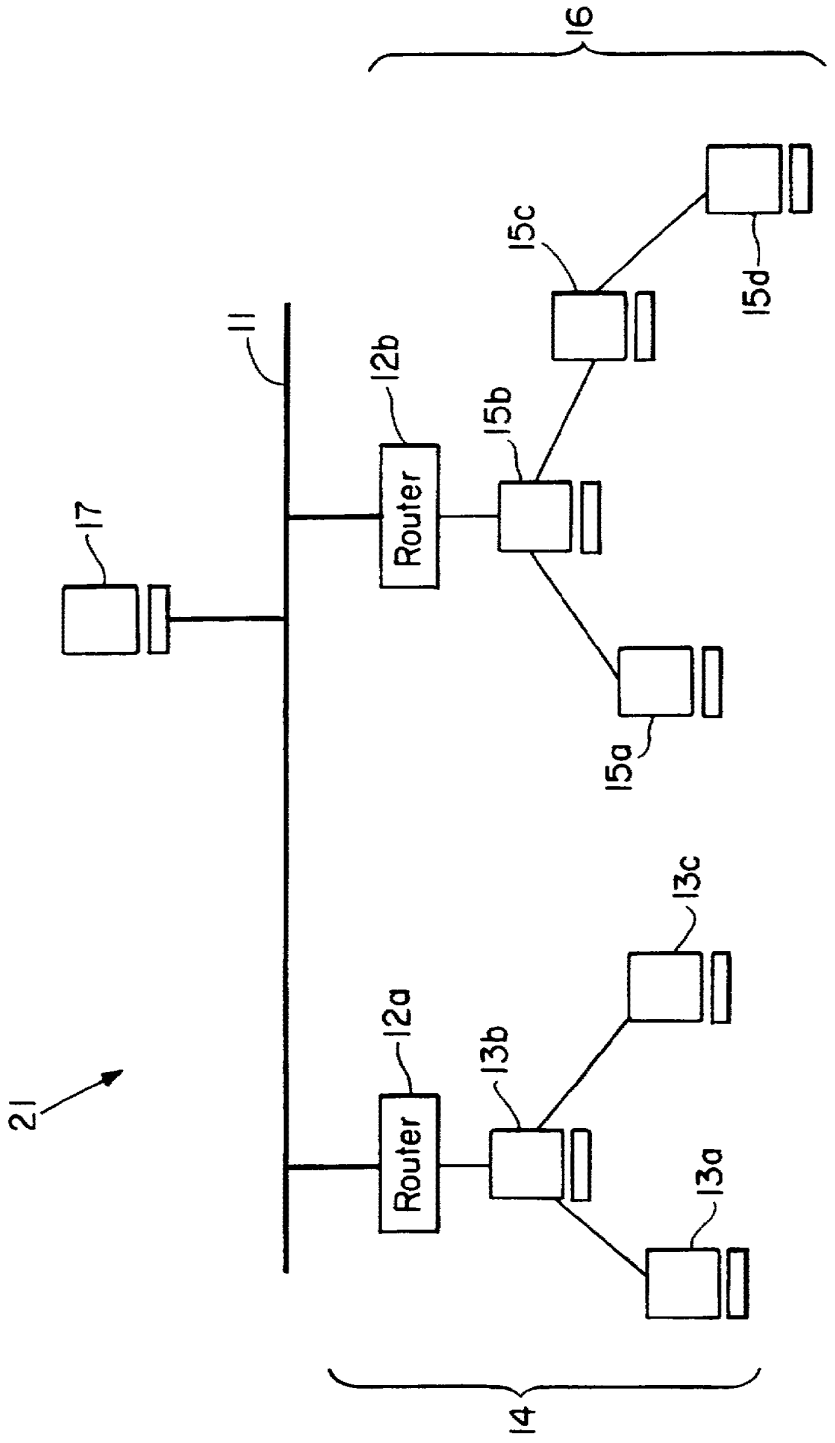

FIG. 1

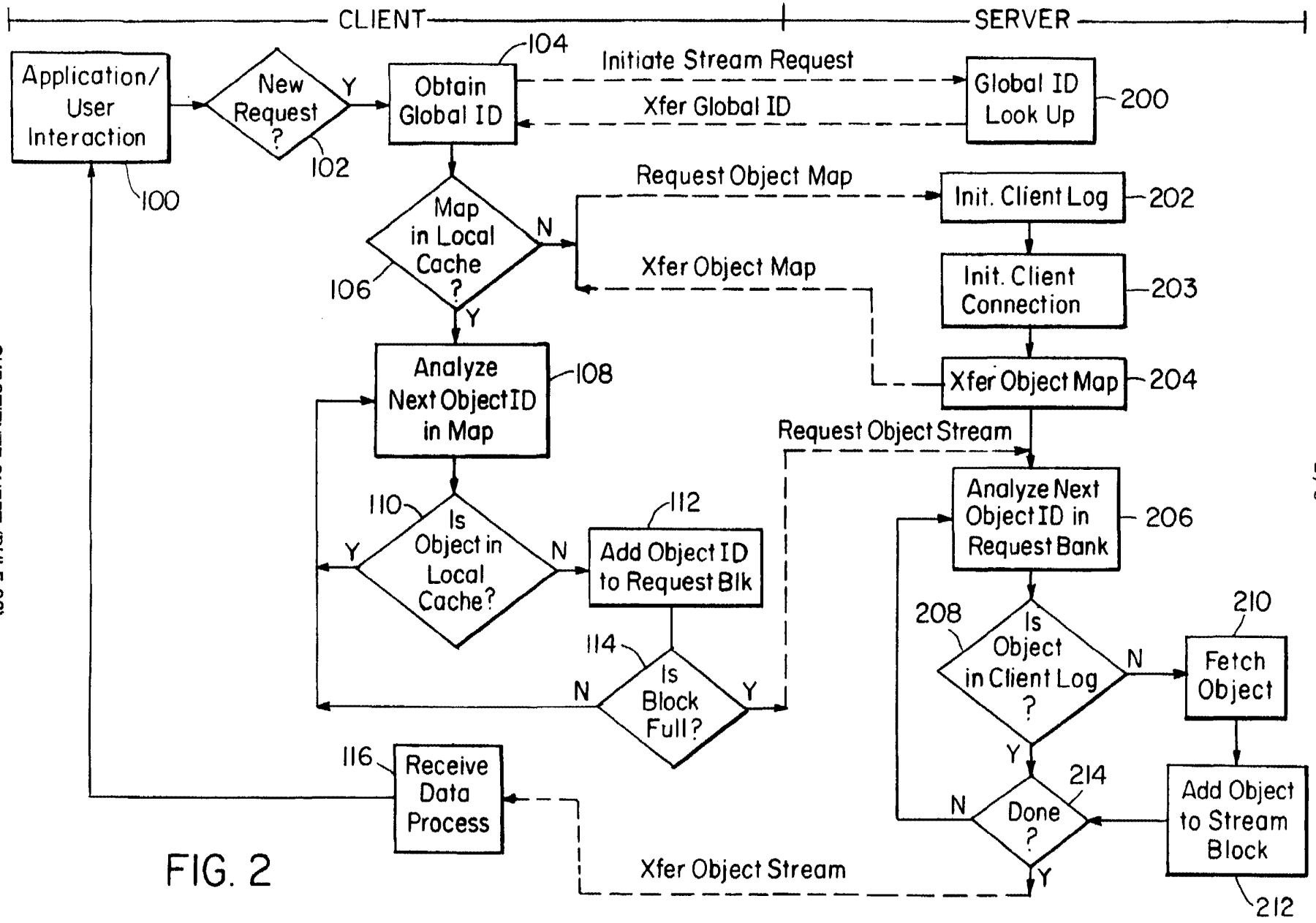

FIG. 2

Aylo Exhibit 1008

SUBSTITUTE SHEET (RULE 26)

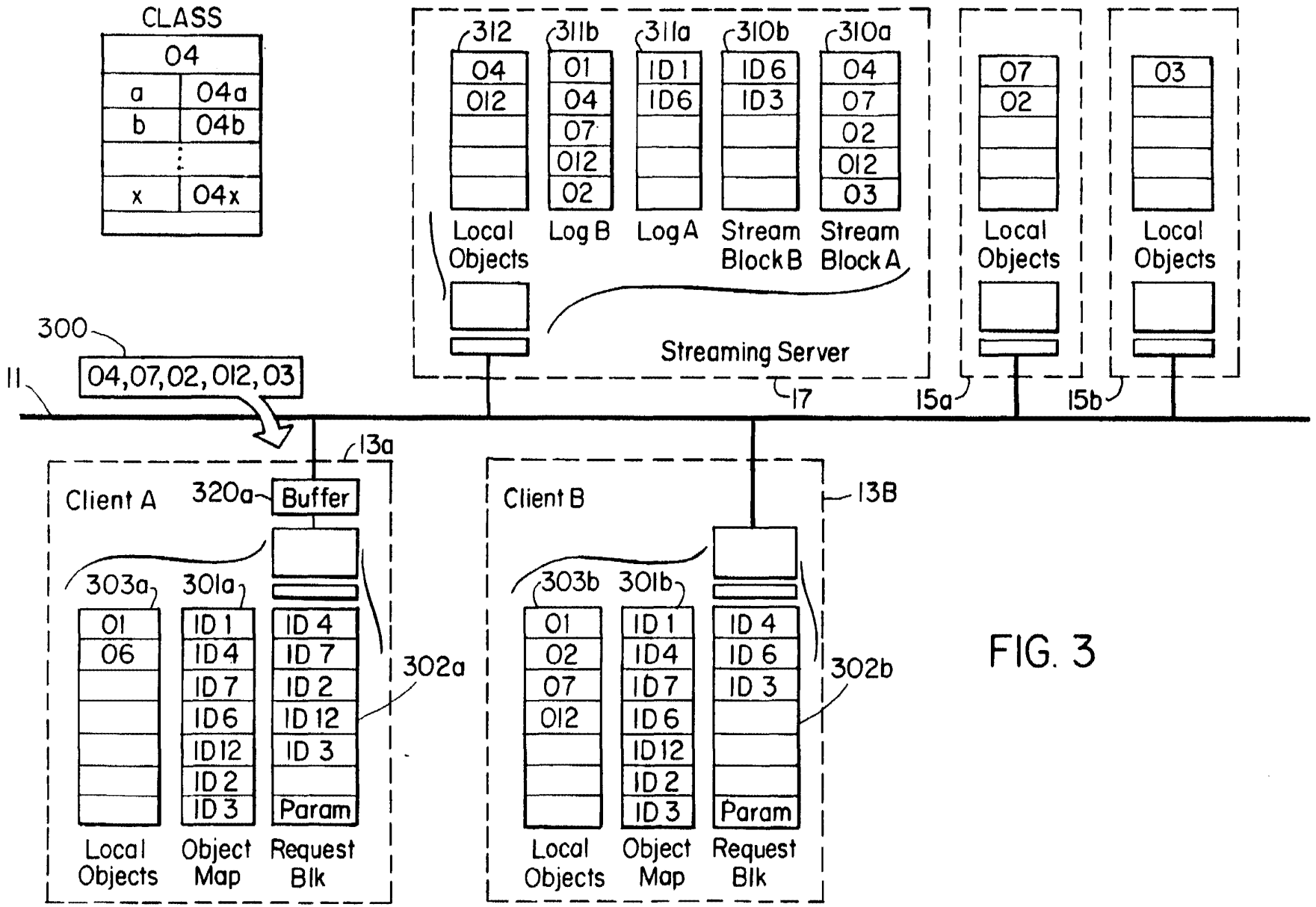

FIG. 3

Aylo Exhibit 1008

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

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Title of Invention

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Application Information

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CUSTOMER #	70560	FIRST NAMED INVENTOR	DAVID F. BRUECK
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Brett Carlson

Documents

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DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
9401-00279_RCE_02012024.pdf	3	Request for Continued Examination (RCE)	681 KB
FR3_WO1997044942A2.pdf	24	Foreign Reference	1608 KB
FR1_WO2002049343A1.pdf	35	Foreign Reference	2366 KB
FR2_WO2002075482A2_Final.pdf	143	Foreign Reference	16093 KB
NPL3_IPR2024-00514.pdf	87	Non Patent Literature	1020 KB
NPL2_IPR2024-00513.pdf	81	Non Patent Literature	1086 KB
NPL1_IPR2024-00512.pdf	89	Non Patent Literature	1027 KB
NPL4_IPR2024-00515.pdf	82	Non Patent Literature	986 KB
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NPL6_IPR2024-00517.pdf	88	Non Patent Literature	1297 KB
NPL7_IPR2024-00518.pdf	86	Non Patent Literature	1506 KB
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NPL18_HouhDeclaration_516.pdf	87	Non Patent Literature	2117 KB
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Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
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(71) Applicant *(for all designated States except US)*: **ANYSTREAM, INC.** [US/US]; 21335 Signal Hill Plaza, Sterling, VA 20164 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **ALLEN, Geoff** [—/US]; Sterling, VA (US). **GEYER, Steve** [—/US]; Herndon, VA (US). **GARDNER, Alan** [—/US]; Bethesda, MD (US). **MCELRATH, Rod** [—/US]; Centreville, VA (US). **RAMSEY, Timothy** [—/US]; Chantilly, VA (US). **FARMER, William** [—/US]; Boxborough, MA (US).

(74) Agent: **ABRAMSON, Ronald**; Hughes Hubbard & Reed LLP, One Battery Park Plaza, New York, NY 10004-1482 (US).

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(54) Title: SYSTEM AND METHOD FOR DISTRIBUTING STREAMING MEDIA

(57) Abstract: A high-performance, adaptive and scalable system for distributing streaming media, in which processing into a plurality of output formats is controlled in a real-time distributed manner, and which further incorporates processing improvements relating to workflow management, video acquisition and video preprocessing. The processing system may be used as part of a high-speed content delivery system in which such streaming media processing is conducted at the edge of the network, allowing video producers to supply improved live streaming experience to multiple simultaneous users independent of the users' individual viewing device, network connectivity, bit rate and supported streaming formats. Methods by which such system may be used to commercial advantage are also described.

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SYSTEM AND METHOD FOR DISTRIBUTING STREAMING MEDIA

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims benefit of the following U.S. provisional patent application serial numbers: 60/276,756 (filed March 16, 2001), 60/297,563 and 60/297,655 (both filed June 12, 2001), and also claims benefit of U.S. nonprovisional patent application serial no. 10/076,872, entitled "A GPI Trigger Over TCP/IP for Video Acquisition," filed February 12, 2002. All of the above-mentioned applications, commonly owned with the present application, are hereby incorporated by reference herein in their entirety.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to the fields of computer operating systems and process control, and more particularly to techniques for command and control of a distributed process system. The present invention also relates to the fields of digital signal processing, and more particularly to techniques for the high-performance digital processing of video signals for use with a variety of streaming media encoders. This invention further relates to the field of distribution of streaming media. In particular, the invention allows content producers to produce streaming media in a flexible and scalable manner, and preferably to supply the streaming media to multiple simultaneous users through a local facility, in a manner that tailors the delivery stream to the capabilities of the user's system, and provides a means for the local distributor to participate in processing and adding to the content.

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Description of the Related Art

As used in this specification and in the claims, "Streaming media" means distribution media by which data representing video, audio and other communication forms, both passively viewable and interactive, can be processed as a steady and continuous stream. Also relevant to certain embodiments described herein is the term "edge," which is defined as a location on a network within a few network "hops" to the user (as the word "hop" is used in connection with the "traceroute" program), and most preferably (but not necessarily), a location within a single network connection hop from the end user. The "edge" facility could be the local point-of-presence (PoP) for modem and DSL users, or the cable head end for cable modem users. Also used herein is the term "localization," which is the ability to add local relevance to content before it reaches end users. This includes practices like local advertising insertion or watermarking, which are driven by demographic or other profile-driven information.

Streaming media was developed for transmission of video and audio over networks such as the Internet, as an alternative to having to download an entire file representing the subject performance, before the performance could be viewed. Streaming technology developed as a means to "stream" existing media files on a computer, in, for example, ".avi" format, as might be produced by a video capture device.

A great many systems of practical significance involve distributed processes. One aspect of the present invention concerns a scheme for command and control of such distributed processes. It is important to recognize that the principles of the present invention have extremely broad potential application. An example of a distributed process is the process of preparing streaming media for mass distribution to a large audience of users based on a media feed, for example a live analog video

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feed. However, this is but one example of a distributed processing system, and any number of other examples far removed from media production and distribution would serve equally well for purposes of illustration. For example, a distributed process for indexing a large collection of digital content could be used as a basis for explanation, and would fully illustrate the same fundamental principles about to be described herein in the context of managing a distributed process for producing and distributing streaming media.

One prior art methodology for preparing streaming video media for distribution based on a live feed is illustrated in **Fig. 1A**. Video might be acquired, for example, at a camera (**102**). The video is then processed in a conventional processor, such as a Media 100® or Avid OMF® (**104**). The output of such a processor is very high quality digital media. However, the format may be incompatible with the format required by many streaming encoders. Therefore, as a preliminary step to encoding, the digital video must (in the case of such incompatibility) be converted to analog in D-A converter (**106**), and then redigitized into .avi or other appropriate digital format in A-D converter (**108**). The redigitized video is then simultaneously processed in a plurality of encoders (**110 – 118**), which each provide output in a particular popular format and bit rate. (In a video on demand environment, the encoding would occur at the time requested, or the content could be pre-stored in a variety of formats and bit rates.) Alternately, as shown in **Fig. 1B**, the analog video from **106** may be routed to a distribution amplifier **107**, which creates multiple analog distribution streams going to separate encoder systems (**110 - 118**), each with its own capture card (or another intermediary computer) (**108A - 108E**) for A to D conversion.

To serve multiple users with varying format requirements, therefore, requires the typical prior art system to simultaneously transmit a plurality of signals in

different formats simultaneously. A limited menu, corresponding to the encoders (**110 - 118**) available, is presented to the end user (**124**). The end user is asked to make a manual input (click button, check box, etc.) to indicate to Web server (**120**), with which user (**124**) has made a connection over the Internet (**122**), the desired format (Real Media, Microsoft Media, Quicktime, etc.), as well as the desired delivery bit rate (e.g., 28.8K, 56K, 1.5M, etc.). The transmission system then serves the format and speed so selected.

The problems with the prior art approach are many, and include:

- None of the available selections may match the end users' particular requirements.
- Converting from digital to analog, and then back to digital, degrades signal quality.
- Simultaneous transmission in different formats needlessly consumes network bandwidth.
- There is no ability to localize either formats or content, i.e., to tailor the signal to a particularized local market.
- There is no means, after initial system setup, to reallocate resources among the various encoders.
- Conventional video processing equipment does not lend itself to automated adaptation of processing attributes to the characteristics of the content being processed.
- Single point failure of an encoder results in complete loss of an output format.
- Because of bandwidth requirements and complexity, the prior art approach cannot be readily scaled.

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Because Internet streaming media users view the stream using a variety of devices, formats and bit rates, it is highly probable that the user will have a sub-optimal experience using currently existing systems.

The video producer, in an effort to make the best of this situation, chooses a few common formats and bit rates, but not necessarily those optimal for a particular viewer. These existing solutions require the video producer to encode the content into multiple streaming formats and attempt to have a streaming format and bit rate that matches the end user. The user selects the format closest to their capability, or goes without if their particular capability is not supported. These solutions also require the producers to stream multiple formats and bit rates, thereby consuming more network bandwidth.

Similar problems beset other distributed processing situations in which resources may be statically allocated, or at least not allocated in a manner that is responsive in real time to actual processing requirements.

In the area of video processing, considerable technology has developed for capturing analog video, for example, from a video camera or videotape, and then digitizing and encoding the video signal for streaming distribution over the Internet.

A number of encoders are commercially available for this purpose, including encoders for streaming media in, for example, Microsoft® Media, Real® Media, or Quicktime® formats. A given encoder typically contains facilities for converting the video signal so as to meet the encoder's own particular requirements.

Alternatively, the video stream can be processed using conventional video processing equipment prior to being input into the various encoders.

However, source video typically comes in a variety of standard formats, and the available encoders have different characteristics insofar as their own handling of

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video information is concerned. Generally, the source video does not have characteristics that are well-matched for presentation to the encoders.

The problems with the prior art approaches include the following:

(a) Streaming encoders do not supply the processing options required to create a video stream with characteristics well-tailored for the viewer. The video producer may favor different processing options depending on the nature of the video content and the anticipated video compression. As an example, the producer of a romantic drama may favor the use of temporal smoothing to blur motion, resulting in a video stream with a fluid appearance that is highly compressible in the encoding. With a different source, such as a sporting event, the producer may favor processing that discards some of the video information but places very sharp "stop-action" images into each encoded frame. The streaming encoder alone is unable to provide these different image-processing choices. Furthermore, the producer needs to use a variety of streaming encoders to match those in use by the end-user, but each encoder has a different set of image processing capabilities. The producer would like to tailor the processing to the source material, but is unable to provide this processing consistently across all the encoders.

(b) Currently available tools for video processing do not provide all the required image processing capability in an efficient method that is well-suited for real-time conversion and integration with an enterprise video production workflow.

To date, few investigators have had reason to address the problem of controlling image quality across several streaming video encoding applications. Those familiar with streaming video issues are often untrained in signal or image processing. Image processing experts are often unfamiliar with the requirements and constraints associated with streaming video for the Internet. However, the foregoing

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problems have become increasingly significant with increased requirements for supported streaming formats, and the desire to be able to process a large volume of video materially quickly, in some cases in real time. As a result, it has become highly desirable to have processing versatility and throughput performance that is superior to that which has been available under prior art approaches.

In the area of streaming media, existing methods of processing and encoding streaming media for distribution, as well as the architecture of current systems for delivering streaming media content, have substantial limitations.

Limitations of Current Processing and Encoding Technology

Internet streaming media users view the streams that they receive using a variety of devices, formats and bit rates. In order to operate a conventional streaming encoder, it is necessary to specify, before encoding, the output format (e.g., Real® Media, Microsoft® Media, Quicktime®, etc.), as well as the output bit rate (e.g., 28.8K, 56K, 1.5M, etc.).

In addition to simple streaming encoding and distribution, many content providers also wish to perform some video preprocessing prior to encoding. Some of the elements of such preprocessing include format conversion from one video format (e.g., NTSC, YUV, etc.) to another, cropping, horizontal scaling, sampling, deinterlacing, filtering, temporal smoothing, filtering, color correction, etc. In typical prior art systems, these attributes are adjusted through manual settings by an operator.

Currently, streaming encoders do not supply all of the processing options required to create a stream with characteristics that are optimal for the viewer. For example, a video producer may favor different processing options depending on the nature of the video content and the anticipated video compression. Thus, the producer of a romantic drama may favor the use of temporal smoothing to blur motion,

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resulting in a video stream with a fluid appearance that is highly compressible in the encoding. With a different source, such as a sporting event, the producer may favor processing that discards some of the video information but places very sharp "stop-action" images into each encoded frame. The streaming encoder alone is unable to provide these different image-processing choices. Furthermore, the producer needs to use a variety of streaming encoders to match those in use by the end-user, but each encoder has a different set of image processing capabilities. The producer would like to tailor the processing to the source material, but is unable to provide this processing consistently across all the encoders.

Equipment, such as the Media 100® exists to partially automate this process. Currently available tools for video processing, such as the Media 100, do not provide all the required image processing capability in an efficient method that is well-suited for real-time conversion and integration with an enterprise video production workflow. In some cases, the entire process is essentially bypassed, going from a capture device directly into a streaming encoder.

In practice, a sophisticated prior art encoding operation, including some video processing capability, might be set up as shown in **Fig. 1A**. Video might be acquired, for example, at a camera (102). The video is then processed in a conventional processor, such as a Media 100® or Avid OMF® (104). The output of such a processor is very high quality digital media. However, the format may be incompatible with the format required by many streaming encoders. Therefore, as a preliminary step to encoding, the digital video must be converted to analog in D-A converter (106), and then redigitized into .avi or other appropriate digital format in A-D converter (108). The redigitized video is then simultaneously processed in a plurality of encoders (110 – 118), which each provide output in a particular popular

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format and bit rate (in a video on demand environment, the encoding would occur at the time requested, or the content could be pre-stored in a variety of formats and bit rates). To serve multiple users with varying format requirements, therefore, requires the typical prior art system to simultaneously transmit a plurality of signals in different formats. A limited menu, corresponding to the encoders (110 - 118) available, is presented to the end user (124). The end user is asked to make a manual input (click button, check box, etc.) to indicate to Web server (120), with which user (124) has made a connection over the Internet (122), the desired format (Real Media, Microsoft Media, Quicktime, etc.), as well as the desired delivery bit rate (e.g., 28.8K, 56K, 1.5M, etc.). The transmission system then serves the format and speed so selected.

The problems with the prior art approach are many, and include:

- None of the available selections may match the end users' particular requirements.
- Converting from digital to analog, and then back to digital, degrades signal quality.
- Simultaneous transmission in different formats needlessly consumes network bandwidth.
- There is no ability to localize either formats or content, i.e, to tailor the signal to a particularized local market.
- There is no means, after initial system setup, to reallocate resources among the various encoders.
- Conventional video processing equipment does not lend itself to automated adaptation of processing attributes to the characteristics of the content being processed.

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- Single point failure of an encoder results in complete loss of an output format.
- Because of bandwidth requirements and complexity, the prior art approach cannot be readily scaled.

Limitations of Prior Art Delivery Systems

Because Internet streaming media users view the stream using a variety of devices, formats and bit rates, it is highly probable that the user will have a sub-optimal experience using currently existing systems. This is a result of the client-server architecture used by current streaming media solutions which is modeled after the client-server technology that underpins most networking services such as web services and file transfer services. The success of the client-server technology for these services causes streaming vendors to emulate client-server architectures, with the result that the content producer, representing the server, must make all the choices for the client.

The video producer, forced into this situation, chooses a few common formats and bit rates, but not necessarily those optimal for a particular viewer. These existing solutions require the video producer to encode the content into multiple streaming formats and attempt to have a streaming format and bit rate that matches the end user. The user selects the format closest to their capability, or goes without if their particular capability is not supported. These solutions also require the producers to stream multiple formats and bit rates, thereby consuming more network bandwidth. In addition, this model of operation depends on programmatic control of streaming media processes in a larger software platform.

The television and cable industry solves a similar problem for an infrastructure designed to handle TV production formats of video and audio. In their solution, the

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video producer supplies a single high quality video feed to a satellite distribution network. This distribution network has the responsibility for delivering the video to the network affiliates and cable head ends (the "edge" of their network). At this point, the affiliates and cable head ends encode the video in a format appropriate for their viewers. In some cases this means modulating the signal for RF broadcast. At other times it is analog or digital cable distribution. In either case, the video producer does not have to encode multiple times for each end-user format. They know the user is receiving the best quality experience for their device and network connectivity because the encoding is done at the edge by the "last mile" network provider. The last mile is typically used to refer to the segment of a network that is beyond the edge. Last mile providers in the case of TV are the local broadcasters, cable operators, DSS providers, etc. Because the last mile provider operates the network, they know the conditions on the network at all time. They also know the end user's requirements with great precision, since the end user's requirements are dependent in part on the capabilities of the network. With that knowledge about the last mile network and end user requirements, it is easy for the TV providers to encode the content in a way that is appropriate to the viewer's connectivity and viewing device. However, this approach as used in the television and cable industry has not been used with Internet streaming.

Fig. 10 represents the existing architecture for encoding and distribution of streaming media across the Internet, one using a terrestrial Content Delivery Network (CDN), the other using a satellite CDN. While these are generally regarded as the most sophisticated methods currently available for delivering streaming media to broadband customers, a closer examination exposes important drawbacks.

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In the currently existing model as shown in **Fig. 10**, content is produced and encoded by the Content Producer (1002) at the point of origination. This example assumes it is pre-processed and encoded in RealSystem, Microsoft Windows Media, and Apple QuickTime formats, and that each format is encoded in three different bit rates, 56Kbps, 300Kbps, and 600Kbps. Already, nine individual streams (1004) have been created for one discrete piece of content, but at least this much effort is required to reach a reasonably wide audience. The encoded streams (1005) are then sent via a satellite- (1006) or terrestrial-based CDN (1008) and stored on specially designed edge-based streaming media servers at various points of presence (PoPs) around the world.

The PoPs, located at the outer edge of the Internet, are operated by Internet Service Providers (ISPs) or CDNs that supply end users (1024) with Internet connections of varying types. Some will be broadband connections via cable modem (1010, 1012), digital subscriber line (DSL) (1014) or other broadband transmission technology such as ISDN (1016), T-1 or other leased circuits. Non-broadband ISPs (1018, 1020) will connect end users via standard dial-up or wireless connections at 56Kbps or slower. Encoded streams stored on the streaming servers are delivered by the ISP or CDN to the end user on an as-requested basis.

This method of delivery using edge-based servers is currently considered to be an effective method of delivering streaming media, because once they are stored on the servers, the media files only need to traverse the "last mile" (1022) between the ISP's point of presence and the consumer (1024). This "last mile" delivery eliminates the notoriously unpredictable nature of the Internet, which is often beset with traffic overloads and other issues that cause quality of service problems.

The process illustrated in **Fig. 10** is the most efficient way to deliver streaming media today, and meets the needs of *narrowband* consumers who are willing to accept spotty quality in exchange for free access to content. However, in any successful *broadband* business model, consumers will pay for premium content and their expectations for quality and consistency will be very high. Unfortunately the present architecture for delivering streaming media places insurmountable burdens on everyone in the value chain, and stands directly in the way of attempts to develop a viable economic model around broadband content delivery.

In contrast, the broadcast television industry has been encoding and delivering premium broadband content to users for many years, in a way that allows all stakeholders to be very profitable. Comparing the distribution models of these two industries will clearly demonstrate that the present architecture for delivering broadband content over the Internet is fundamentally upside down.

Fig. 11 compares the distribution model of television with the distribution model of streaming media.

Content producers (1102) (wholesalers), create television programming (broadband content), and distribute it through content distributors to broadcasters and cable operators (1104) (retailers), for sale and distribution to TV viewers (1106) (consumers). Remarkably, the Internet example reveals little difference between the two models. In the Internet example, Content Producers (1112) create quality streaming media, and distribute it to Internet Service Providers (1114), for sale and distribution to Internet users (1116). So how can television be profitable with this model, while content providers on the Internet struggle to keep from going out of business? The fact that television has been more successful monetizing the advertising stream provides part of the answer, but not all of it. In fact, if television

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was faced with the same production and delivery inefficiencies that are found in today's streaming media industry, it is doubtful the broadcast industry would exist as it does today. Why?

The primary reason can be found in a more detailed comparison between the streaming media delivery model described in **Fig. 10**, and the time-tested model for producing and delivering television programming to consumers (**Fig. 12**). The similarities are striking. These are, after all, nothing more than two different approaches to what is essentially the same task - delivering broadband content to end users. But it is the differences that hold the key to why television is profitable and streaming media is not.

Fig. 12 follows the delivery of a single television program. In this example, the program is encoded by the content producer (1202) into a single, digital broadband MPEG-2 stream (1204). The stream (1205) is then delivered via satellite (1206) or terrestrial broadcast networks (1208) to a variety of local broadcasters, cable operators and Direct Broadcast Satellite (DBS) providers around the country (1210a-1210d). Those broadcasters receive the single MPEG-2 stream (1205), then "re-encode" it into an "optimal" format based on the technical requirement of their local transmission system. The program is then delivered to the television viewer (1224) over the last-mile (1222) cable or broadcast television connection.

Notice that the format required by end users is different for each broadcaster, so the single MPEG-2 stream received from the content provider must be re-encoded into the appropriate optimal format prior to delivery to the home. Broadcasters know that anything other than a precisely optimized signal will degrade the user experience and negatively impact their ability to generate revenue. Remember, it's the broadcaster's function as a retailer to sell the content in various forms to viewers

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(analog service, digital service, multiple content tiers, pay-per-view, etc) - and poor quality is very difficult to sell.

Comparing Both Delivery Models

Even a quick analysis at this point shows some important similarities between the broadcast and streaming media models. In both models, end users (consumers) require widely varying formats based on the requirements of their viewing device. For example, in the broadcast model (**Fig. 12**), customers of CATV Provider (a), have a digital set-top box at their TV that requires a 4Mbps CBR digital MPEG-2 stream. CATV Provider (c) subscribers need a 6MHz analog CATV signal. DBS (b) subscribers receive a 3-4Mbps VBR encoded digital MPEG-2 stream, and local broadcast affiliate viewers (d) must get a modulated RF signal over the air. This pattern of differing requirements is consistent across the industry.

End users in the Internet model (**Fig. 10**) likewise require widely varying formats based on the requirements of their viewing device and connection, but here the variance is even more pronounced. Not only do they need different formats (Real, Microsoft, QuickTime, etc.), they also require the streams they receive to be optimized for different spatial resolutions (picture size), temporal resolutions (frame rate) and bit rates (transmission speed). Furthermore, these requirements fluctuate constantly based on network conditions across the Internet and in the last-mile.

While end users in both models require different encoded formats in order to view the same content, what is important is the difference in how those requirements are satisfied. In the current model, Streaming media is encoded at the source, where nothing is known about the end user's device or connection. Broadcasters encode locally, where the signal can be optimized fully according to the requirements of the end user.

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Lowest common denominator

To receive an "optimal" streaming media experience, end users must receive a stream that has been encoded to the specific requirements of their device, connection type, and speed. This presents a significant challenge for content producers, because in the current streaming media model, content is encoded at the source in an effort to anticipate what the end-user might need - even though from this vantage point, almost nothing is known about the specific requirements of the end user. Exacerbating the problem is the fact that format and bandwidth requirements vary wildly throughout the Internet, creating an unmanageable number of "optimum" combinations.

This "guessing game" forces content producers to make a series of compromises in order to maximize their audience reach, because it would require prohibitive amounts of labor, computing power, and bandwidth to produce and deliver streams in all of the possible formats and bit rates required by millions of individual consumers. Under these circumstances, content producers are compelled to base their production decisions on providing an "acceptable" experience to the widest possible audience, which in most cases means producing a stream for the lowest common denominator (LCD) set of requirements. The LCD experience in streaming media is the condition where the experience of *all* users is defined by the requirements of the least capable.

One way to overcome this limitation is to produce more streams, either individually or through multiple bit rate encoding. But since it is logistically and economically impossible to produce enough streams to meet all needs, the number of additional streams produced is usually limited to a relatively small set in a minimal number of bit rates and formats. This is still a lowest common denominator solution, since this limited offering forces end users to select a stream that represents the least

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offensive compromise. Whether it's one or several, LCD streams almost always result in a sub-optimal experience for viewers, because they rarely meet the optimum technical requirements of the end user's device and connection.

Consider the following example.

Assume a dial-up Internet access customer wants to receive a better streaming media experience, and decides to upgrade to a broadband connection offered by the local cable company through a cable modem. The technical capabilities of the cable plant, combined with the number of shared users on this customer's trunk, allow him to receive download speeds of 500Kbps on a fairly consistent basis. In the present streaming media model of production and delivery (**Fig. 10**), the content provider has made the business decision to encode and deliver streaming media in three formats, each at 56Kbps, 300Kbps, and 600Kbps. Already its obvious that this customer will not be receiving an "optimal" experience, since the available options (56Kbps, 300Kbps, and 600Kbps) do not precisely match his actual connection speed. Instead, he will be provided the next available option - in this case, 300Kbps. This is an LCD stream, because it falls at the bottom of the range of available options for this customer's capabilities (300Kbps - 600Kbps). In the present content encoding and delivery architecture, nearly everyone who views streaming media receives an LCD stream, or worse.

What could be worse than receiving an LCD stream? Consider the following.

Continuing the above example, assume that for some reason (flash traffic, technical problems, temporary over-subscription, etc.) the available bandwidth in the last mile falls, dropping the customer's average connection speed to 260Kbps. Although the cable company is aware of this change, there is nothing they can do about adjusting the parameters of the available content, since content decisions are

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made independently by the producer way back at the point of origination, while use and allocation of last-mile bandwidth are business decisions made by the broadband ISP based on technological and cost constraints. This makes the situation for our subscriber considerably worse. If he were watching a stream encoded precisely for a 260Kbps connection, the difference in quality would hardly be noticeable. But in the above example, he is now watching a 300K stream that is being forced to drop to 260K. This best-effort technique, also known as scaling or stream-thinning, is an inelegant solution that results in a choppy, unpredictable experience.

What else could be worse than receiving an LCD stream?

Receiving no stream at all. Some end user requirements are so specialized that content producers choose to ignore those users altogether. Wireless streaming provides an excellent example. There are many different types of devices with many different form factors (color depth, screen size, etc.). Additionally, there is tremendous variability in bandwidth as users move throughout the wireless coverage area. With this amount of variance in end user requirements, content producers can't even begin to create and deliver optimized streams for all of them, so content producers are usually forced to ignore wireless altogether. This is an unfortunate consequence, since wireless users occupy the prime demographic for streaming media. They are among the most likely to use it, and the best situated to pay for it.

The only way to solve all of these problems is to deliver a stream that is encoded to match the requirements of each user. Unfortunately, the widely varying conditions in the last mile can never be adequately addressed by the content provider, located all the way back at the point of origination.

But broadcasters understand this. In the broadcast model (**Fig. 12**), content is encoded into a single stream at the source, then delivered to local broadcasters who

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encode the signal into the optimum format based on the characteristics of the end user in the last mile. This ensures that each and every user enjoys the highest quality experience allowed by the technology. It is an architecture that is employed by every broadcast content producer and distributor, whether they are a cable television system, broadcast affiliate or DBS provider, and it leverages a time-tested, proven delivery model: encode the content for final delivery at the point of distribution, the edge of the network, where everything is known about each individual customer.

For broadcasters, it would be impractical to do it any other way. Imagine if each of the thousands of broadcasters and cable operators in this country demanded that the content provider send them a separate signal optimized for their specific, last-mile requirements. Understandably, the cost of content would rise far above the ability of consumers to pay for it. This is the situation that exists today in the model for streaming media over the Internet, and it is both technically and economically upside-down.

Business Aspects

A comparable analysis applies to the business aspects of distributing streaming media. **Fig. 13** provides some insight into the economics of producing and delivering rich media content, both television and broadband streaming media.

In the broadcast model shown in **Fig. 13**, costs are incurred by the content producer (1302), since the content must be prepared and encoded prior to delivery. Costs are also incurred in the backbone, since transponders must be leased and/or bandwidth must be purchased from content distributors (1304). Both of these costs are paid by the content provider. On the local broadcaster or cable operator's segment (1306), often referred to as the "last-mile", revenue is generated. Of course, a fair portion of that revenue is returned to the content provider sufficient to cover costs and

generate profit. Most importantly, in the broadcast model, both costs and revenue are distributed evenly among all stakeholders. Everyone wins.

While the economic model of streaming broadband media on the Internet is similar, distribution of costs and revenue is not. In this mode, virtually all costs - production, preparation, encoding, and transport - are incurred by the content producer (1312). The only revenue generated is in the last-mile (1316), and it is for access only. Little or no revenue is generated from the content to be shared with the content producer (1312). Why?

Some experts blame the lack of profitability in the streaming media industry on slow broadband infrastructure deployment. But this explanation confuses the cause with the effect. In the present model it is too expensive to encode content, and too expensive to deliver it. Regardless of how big the audience gets, content providers will continue to face a business decision that has only two possible outcomes, both bad: either create optimal streams for every possible circumstance, increasing production and delivery costs exponentially; or create only a small number of LCD streams, greatly reducing the size of the audience that can receive a bandwidth-consistent, high-quality experience.

For these reasons, it will never be economically feasible to produce sufficient amounts of broadband and wireless streaming media content that is optimized for a sufficiently large audience using the present model. And as long as it remains economically impossible to produce and deliver it, consumers will always be starved for high-quality broadband content. All the last-mile bandwidth in the world will not solve this problem. The present invention addresses the limitations of the prior art.

The following are further objects of the invention:

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- To provide a distribution mechanism for streaming media that delivers a format and bit rate matched to the user's needs.
- To make streaming media available to a wider range of devices by allowing multiple formats to be created in an economically efficient manner.
- To reduce the bandwidth required for delivery of streaming media from the content provider to the local distributor.
- To provide the ability to insert localized content at the point of distribution, such as local advertising.
- To provide a means whereby the distributor may participate financially in content-related revenue, such as by selling premium content at higher prices, and/or inserting local advertising.
- To provide a processing regime that avoids unnecessary digital to analog conversion and reconversion.
- To provide a processing regime with the ability to control attributes such as temporal and spatial scaling to match the requirements of the content.
- To provide a processing regime in which processing steps are sequenced for purposes of increased computational efficiency and flexibility.
- To provide a processing system in which workflow can be controlled and processing resources allocated in a flexible and coordinated manner.
- To provide a processing system that is scalable.
- To provide a processing regime that is automated.

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Finally, it is a further object of the present invention to provide a method for taking source video in a variety of standard formats, preprocessing the video, converting the video into a selectable variety of encoded formats, performing such processing on a high-performance basis, including real time operation, and providing, in each output format, video characteristics that are well matched to the content being encoded, as well as the particular requirements of the encoder.

BRIEF SUMMARY OF THE INVENTION

The foregoing and other objects of the invention are accomplished with the present invention. In one embodiment, the present invention reflects a robust, scalable approach to coordinated, automated, real-time command and control of a distributed processing system. This is effected by a three-layer control hierarchy in which the highest level has total control, but is kept isolated from direct interaction with low-level task processes. This command and control scheme comprises a high-level control system, one or more local control systems, and one or more "worker" processes under the control of each such local control system, wherein, a task-independent representation is used to pass commands from the high-level control system to the worker processes, each local control system is interposed to receive the commands from the high level control system, forward the commands to the worker processes that said local control system is in charge of, and report the status of those worker processes to the high-level control system; and the worker processes are adapted to accept such commands, translate the commands to a task-specific representation, and report to the local control system the status of execution of the commands.

In a preferred embodiment, the task-independent representation employed to pass commands is an XML representation. The commands passed to the worker

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processes from the local control system comprise commands to start the worker's job, kill the worker's job, and report on the status of the worker job. The high-level control system generates the commands that are passed down through the local control system to the worker processes by interpreting a job description passed from an external application, and monitoring available resources as reported to it by the local control system. The high-level control system has the ability to process a number of job descriptions simultaneously.

In an alternate embodiment, one or more additional, distributed, high-level control systems are deployed, and portions of a job description are assigned for processing by different high-level control systems. In such embodiment, one high-level control system has the ability to take over the processing for any of the other of said high-level control systems that might fail, and can be configured to do so automatically.

Regarding the video processing aspects of the invention, the foregoing and other objects of the invention are achieved by a method whereby image spatial processing and scaling, temporal processing and scaling, and color adjustments, are performed in a computationally efficient sequence, to produce video well matched for encoding. In one embodiment of the invention, efficiencies are achieved by separating horizontal and vertical scaling, and performing horizontal scaling prior to field-to-field correlations, optional spatial deinterlacing, temporal field association or temporal smoothing, and further efficiencies are achieved by performing spatial filtering after both horizontal and vertical resizing.

Other objects of the invention are accomplished by additional aspects of a preferred embodiment of the present invention, which provide a dynamic, adaptive edge-based encoding™ to the broadband and wireless streaming media industry. The

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present invention comprises an encoding platform that is a fully integrated, carrier-class solution for automated origination- and edge-based streaming media encoding. It is a customizable, fault tolerant, massively scalable, enterprise-class platform. It addresses the problems inherent in currently available streaming media, including the issues of less-than-optimal viewing experience by the user and excessive consumption of network bandwidth.

In one aspect, the invention involves an encoding platform with processing and workflow characteristics that enable flexible and scalable configuration and performance. This platform performs image spatial processing and rescaling, temporal processing and rescaling, and color adjustments, in a computationally efficient sequence, to produce video well matched for encoding, and then optionally performs the encoding. The processing and workflow methods employed are characterized in their separation of overall processing into two series of steps, one series that may be performed at the input frame rate, and a second series that may be performed at the output frame rate, with a FIFO buffer in between the two series of operations. Furthermore computer coordinated controls are provided to adjust the processing parameters in real time, as well as to allocate processing resources as needed among one or more simultaneously executing streaming encoders.

Another aspect of the present invention is a distribution system and method which allows video producers to supply improved live streaming experience to multiple simultaneous users independent of the users' individual viewing device, network connectivity, bit rate and supported streaming formats by generating and distributing a single live Internet stream to multiple edge encoders that convert this stream into formats and bit rates matched to that for each viewer. This method places the responsibility for encoding the video and audio stream at the edge of the network

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where the encoder knows the viewer's viewing device, format, bit rate and network connectivity, rather than placing the burden of encoding at the source where they know little about the end user and must therefore generate a few formats that are perceived to be the "lowest common denominator".

In one embodiment of the present invention, referred to as "edge encoding," a video producer generates a live video feed in one of the standard video formats. This live feed enters the Source Encoder, where the input format is decoded and video and audio processing occurs. After processing, the data is compressed and delivered over the Internet to the Edge Encoder. The Edge Encoder decodes the compressed media stream from its delivery format and further processes the data by customizing the stream locally. Once the media has been processed locally, it is sent to one or more streaming codecs for encoding in the format appropriate to the users and their viewing devices. The results of the codecs are sent to the streaming server to be viewed by the end users in a format matched to their particular requirements.

The system employed for edge encoded distribution comprises the following elements:

- an encoding platform deployed at the point of origination, to encode a single, high bandwidth compressed transport stream and deliver it via a content delivery network to encoders located in various facilities at the edge of the network;
- one or more edge encoders, to encode said compressed stream into one or more formats and bit rates based on the policies set by the content delivery network or edge facility;

- an edge resource manager, to provision said edge encoders for use, define and modify encoding and distribution profiles, and monitor edge-encoded streams; and
- an edge control system, for providing command, control and communications across collections of said edge encoders.

A further aspect of the edge encoding system is a distribution model that provides a means for local network service provider to participate in content-related revenue in connection with the distribution to user of streaming media content originating from a remote content provider. This model involves performing streaming media encoding for said content at said service provider's facility; performing, at the service provider's facility, processing steps preparatory to said encoding, comprising insertion of local advertising; and charging a fee to advertisers for the insertion of the local advertising. Further revenue participation opportunities for the local provider arise from the ability on the part of the local entity to separately distribute and price "premium" content.

The manner in which the invention achieves these and other objects is more particularly shown by the drawings enumerated below, and by the detailed description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The following briefly describes the accompanying drawings:

Figs. 1A and **1B** are functional block diagrams depicting alternate embodiments of prior art distributed systems for processing and distributing streaming media.

Fig. 2 is a functional block diagram shows the architecture of a distributed process system which is being controlled by the techniques of the present invention.

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Fig. 3A is a detailed view of one of the local processing elements shown in **Fig. 2**, and **Fig. 3B** is a version of such an element with sub-elements adapted for processing streaming media.

Fig. 4 is a logical block diagram showing the relationship among the high-level "Enterprise Control System," a mid-level "Local Control System," and a "worker" process.

Fig. 5 is a diagram showing the processing performed within a worker process to translate commands received in the format of a task-independent language into the task-specific commands required to carry out the operations to be performed by the worker.

Fig. 6 is a flow chart showing the generation of a job plan for use by the Enterprise Control System.

Figs, 7A and **7B** are flow charts representing, respectively, typical and alternative patterns of job flow in the preferred embodiment.

Fig. 8 is a block diagram showing the elements of a system for practicing the present invention.

Fig. 9 is a flow chart depicting the order of processing in the preferred embodiment.

Fig. 10 represents the prior art architecture for encoding and distribution of streaming media across the Internet.

Fig. 11 compares the prior art distribution models for television and streaming media.

Fig. 12 depicts the prior art model for producing and delivering television programming to consumers.

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Fig. 13 represents the economic aspects of prior art modes of delivering television and streaming media.

Fig. 14 represents the architecture of the edge encoding platform of the present invention.

Fig. 15 represents the deployment model of the edge encoding distribution system.

Fig. 16 is a block diagram representing the edge encoding system and process.

Fig. 17 is a block diagram representing the order of video preprocessing in accordance with an embodiment of the present invention.

Fig. 18 is a block diagram depicting workflow and control of workflow in the present invention.

DETAILED DESCRIPTION OF THE INVENTION

A preferred embodiment of the workflow aspects of the invention is illustrated in **Figs. 2 - 7**, and is described in the text that follows. A preferred embodiment of the video processing aspects of the invention is illustrated in **Figs. 8** and **9**, and is described in the text that follows. A preferred embodiment of the edge-encoded streaming media aspects of the invention is shown in **Figs. 14 - 18**, and is described in the text that follows. Although the invention has been most specifically illustrated with particular preferred embodiments, its should be understood that the invention concerns the principles by which such embodiments may be constructed and operated, and is by no means limited to the specific configurations shown.

COMMAND AND CONTROL SYSTEM

In particular, the embodiment for command and control that is discussed in greatest detail has been used for processing and distributing streaming media. The

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inventors, however, have also used it for controlling a distributed indexing process for a large collection of content -- an application far removed from processing and distributing streaming media. Indeed, the present invention addresses the general issue of controlling distributed processes, and should not be understood as being limited in any way to any particular type of class of processing.

In general, the technique by which the present invention asserts command and control over a distributed process system involves a logically layered configuration of control levels. An exemplary distributed process system is shown in block diagram form in **Fig. 2.** The figure is intended to be representative of a system for performing any distributed process. The processing involved is carried out on one or more processors, **220**, **230**, **240**, etc. (sometimes referred to as "local processors", though they need not in fact be local), any or all of which may themselves be multitasking. A application (**201**, **202**) forwards a general purpose description of the desired activity to a Planner **205**, which generates a specific plan in XML format ready for execution by the high-level control system, herein referred to as the "Enterprise Control System" or "ECS" **270** (as discussed below in connection with an alternate embodiment, a system may have more than one ECS). The ECS itself runs on a processor (**210**), shown here as being a distinct processor, but the ECS could run within any one of the other processors in the system. Processors **220**, **230**, **240**, etc. handle tasks such as task **260**, which could be any processing task, but which, for purposes of illustration, could be, for example, a feed of a live analog video input. Other applications, such as one that merely monitors status (e.g., User App **203**), does not require the Planner, and, as shown in **Fig. 2**, may communicate directly with the ECS **270**. The ECS stores its tasks to be done, and the dependencies between those tasks, in a relational database (**275**). Other applications (e.g. User App. **204**) may

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bypass the ECS and interact directly with database **275**, for example, an application that queries the database and generates reports.

Fig. 3A shows a more detailed block diagram view of one of the processors (**220**). Processes running on this processor include a mid-level control system, referred to as the "Local Control System" or "LCS" **221**, as well as one or more "worker" processes **W1**, **W2**, **W3**, **W4**, etc. Not shown are subprocesses which may run under the worker processes, consisting of separate or third-party supplied programs or routines. In the streaming media production example used herein (shown alternatively in **Fig. 3B**), there could be a video preprocessor worker **W1** and further workers **W2**, **W3**, **W4**, etc., having as subprocesses vendor-specific encoders, such as (for example) streaming encoders for Microsoft® Media, Real® Media, and/or Quicktime®.

In the example system, the output of the distributed processing, even given a single, defined input analog media stream, is highly variable. Each user will have his or her own requirements for delivery format for streaming media, as well as particular requirements for delivery speed, based on the nature of the user's network connection and equipment. Depending on the statistical mix of users accessing the server at any given time, demand for the same media content could be in any combination of formats and delivery speeds. In the prior art (**Figs. 1A, 1B**), processors were dedicated to certain functions, and worker resources such as encoders could be invoked on their respective processors through an Object Request Broker mechanism (e.g., CORBA). Nevertheless, the invocation itself was initiated manually, with the consequence that available encodings were few in number and it was not feasible to adapt the mix of formats and output speeds being produced in order to meet real time traffic needs.

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The present invention automates the entire control process, and makes it responsive automatically to inputs such as those based on current user loads and demand queues. The result is a much more efficient, adaptable and flexible architecture able reliably to support much higher sustained volumes of streaming throughput, and to satisfy much more closely the formats and speeds that are optimal for the end user.

The hierarchy of control systems in the present invention is shown in **Fig. 4**. The hierarchy is ECS (**270**) to one of more LCS processes (**221**, etc.) to one or more worker processes (**W1**, etc.).

The ECS, LCS and workers communicate with one another based on a task-independent language, which is XML in the preferred embodiment. The ECS sends commands to the LCS which contain both commands specific to the LCS, as well as encapsulated XML portions that are forwarded to the appropriate workers.

The ECS **270** is the centralized control for the entire platform. Its first responsibility is to take job descriptions specified in XML, which is a computer platform independent description language, and then break each job into its component tasks. These tasks are stored in a relational database (**275**) along with the dependencies between the tasks. These dependencies include where a task can run, what must be run serially, and what can be done in parallel. The ECS also monitors the status of all running tasks and updates the status of the task in the database. Finally, the ECS examines all pending tasks whose preconditions are complete and determines if the necessary worker can be started. If the worker can be started, the ECS sends the appropriate task description to the available server and later monitors the status returning from this task's execution. The highest priority job is given a

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worker in the case where this worker is desired by multiple jobs. Further, the ECS must be capable of processing a plurality of job descriptions simultaneously.

Each server (**220**, **230**, **240**, etc.) has a single LCS. It receives XML tasks descriptions from the ECS **270** and then starts the appropriate worker to perform the task. Once the task is started, it sends the worker its task description for execution and then returns worker status back to the ECS. In the unlikely situation where a worker prematurely dies, the LCS detects the worker failure and takes the responsibility for generating its own status message to report this failure and sending it to the ECS.

The workers shown in **Figs. 3A** and **3B** perform the specific tasks. Each worker is designed to perform one task such as a Real Media encode or a file transfer. Each class of worker (preprocessing, encoders, file transfer, mail agents, etc.) has an XML command language customized to the task they are supposed to perform. For the encoders, the preferred embodiment platform uses the vendor-supplied SDK (software development kit) and adds an XML wrapper around the SDK. In these cases, the XML is designed to export all of the capability of the specific SDK. Because each encoder has different features, the XML used to define a task in each encoder has to be different to take advantage of features of the particular encoder. In addition to taking XML tasks descriptions to start jobs, each worker is responsible for returning status back in XML. The most important status message is one that declares the task complete, but status messages are also used to represent error conditions and to indicate the percentage complete in the job.

In **Figs. 2**, **3A** and **3B**, each worker is also connected via scalable disk and I/O bandwidth **295**. As viewed from the data perspective, the workers form a data pipeline where workers process data from an input stream and generate an output

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stream. Depending on the situation, the platform of the preferred embodiment uses in-memory connections, disk files, or network based connections to connect the inter-worker streams. The choice of connection depends on the tasks being performed and how the hardware has been configured. For the preferred embodiment platform to scale up with the number of processors, it is imperative that this component of the system also scale. For example, a single 10Mbit/sec. Ethernet would not be very scalable, and if this were the only technology used, the system would perform poorly as the number of servers is increased.

The relational database **275** connected to the ECS **270** holds all persistent state on the operation of the system. If the ECS crashes at any time, it can be restarted, and once it has reconnected to the database, it will reacquire the system configuration and the status of all jobs running during the crash (alternately, as discussed below, the ECS function can be decentralized or backed up by a hot spare). It then connects to each LCS with workers running, and it updates the status of each job. Once these two steps are complete, the ECS picks up each job where it left off. The ECS keeps additional information about each job such as which system and worker ran the job, when it ran, when it completed, any errors, and the individual statistics for each worker used. This information can be queried by external applications to do such things as generate an analysis of system load or generate a billing report based on work done for a customer.

Above the line in **Fig. 2** are the user applications that use the preferred embodiment platform. These applications are customized to the needs and workflow of the video content producer. The ultimate goal of these applications is to submit jobs for encoding, to monitor the system, and to set up the system configuration. All

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of these activities can either be done via XML sent directly to the system or indirectly by querying the supporting relational database **275**.

The most important applications are those that submit jobs for encoding. These are represented in **Fig. 2** as User App. **201** and User App. **202**. These applications are the most likely to designate a file to encode, the specification of a live input source, or a title, and some manner of determining the appropriate processing to perform (usually called a "profile"). The profile can be fixed for a given submission, or it can selected directly by name, or it may be inferred from other information (such as a category of "news", or "sports").

Once all of the appropriate information has been collected, it is sent to the Planner **205** and a job description is constructed. The Planner **205** takes the general-purpose description of the desired activity from the user application and generates a very specific plan ready for execution by the ECS **270**. This plan will include detailed task descriptions for each task in the job (such as the specific bit-rates, or whether the input should be de-interlaced). Since the details of how a job should be described vary from application to application, multiple Planners must be supported. Since the Planners are many, and usually built in conjunction with the applications they support, they are placed in the application layer instead of the platform layer.

Fig. 2 shows two other applications. User App. **203** is an application that shows the user status of the system. This could be either general system status (what jobs are running where) or specific status on jobs of interest to users. Since these applications do not need a plan, they connect directly to the ECS **270**. User App. **204** is an application that bypasses ECS **270** altogether, and is connected to the relational database **275**. These types of applications usually query past events and generate reports.

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The LCS is a mid-level control subsystem that typically executes as a process within local processors **220**, **230**, **240**, etc., although it is not necessary that LCS processes be so situated. Among the tasks of the LCS are to start workers, kill worker processes, and report worker status to the ECS, so as, in effect, to provide a "heartbeat" function for the local processor. The LCS must also be able to catalog its workers and report to the ECS what capabilities it has (including parallel tasking capabilities of workers), in order for the ECS to be able to use such information in allocating worker processing tasks.

Fig. 5 depicts processing of the control XML at the worker level. Here an incoming command **510** from the LCS (for example, the XML string `<blur>4</blur>` is received by worker **W2** via TCP/IP sockets **520**. Worker **W2** translates the command, which up to this point was not task specific, into a task-specific command required for the worker's actual task, in this case to run a third-party streaming encoder. Thus (in the example being shown), the command is translated into the task-specific command **540** from the encoder's API, i.e., "`SetBlur(4)`".

As noted above, the present invention is not limited to systems having one ECS. An ECS is a potential point of failure, and it is desirable to ameliorate that possibility, as well as to provide for increased system capacity, by distributing the functions of the ECS among two or more control processes. This is done in an alternate embodiment of the invention, which allows, among other things, for the ECS to have a "hot spare".

The following describes the functions of the ECS and LCS, the protocols and formats of communications from the user application to the ECS, and among the ECS, LCS and workers, and is followed by a description of notification and message formats employed in the preferred embodiment.

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ENTERPRISE CONTROL SYSTEM (ECS)

Job Descriptions

In an effort to make individual job submissions as simple as possible, the low-level details of how a job is scheduled is generally hidden from the end user. Instead, the user application (e.g., **201**) simply specifies (for example) a video clip and desired output features, along with some related data, such as author and title. This job description is passed to a Planner (**205**), which expands the input parameters into a detailed plan—expressed in MML—for accomplishing the goals. See **Fig. 6**. (Alternately, the user could submit the MML document to Planner **205** directly).

Job Plans

All encoding activity revolves around the concept of a job. Each job describes a single source of content and the manner in which the producer wants it distributed. From this description, the Planner **205** generates a series of tasks to convert the input media into one or more encoded output streams and then to distribute the output streams to the appropriate streaming server. The encoded output streams can be in different encoded formats, at different bit rates and sent to different streaming servers. The job plan must have adequate information to direct all of this activity.

Workers

Within the platform of the preferred embodiment, the individual tasks are performed by processes known as workers. Encoding is achieved through two primary steps: a preprocessing phase performed by a prefilter worker, followed by an encoding phase. The encoding phase involves specialized workers for the various streaming formats. Table 1 summarizes all the workers used in one embodiment.

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Worker Name	Function	Description
prefilter (specialized workers for individual live-capture stations have names of the form "lc<N>pp", such as lc1pp.)	preprocessing	Preprocesses a video file or live video capture (from camera or tape deck), performing enhancements such as temporal smoothing. This phase is not always strictly required, but should be performed to guarantee that the input files are in an appropriate format for the encoders.
Microsoft	Encoding	Encodes .avi files into Microsoft streaming formats.
Real	Encoding	Encodes .avi files into Real streaming formats.
Quicktime	Encoding	Encodes .avi files into Quicktime streaming formats.
Fileman	file management	Moves or deletes local files. Distributes files via FTP.
Anymail	e-mail	Sends e-mail. Used to send notifications of job completion or failure.

Table 1 - Workers

Scheduling

The job-plan MML uses control tags in order to lay out the order of execution of the various tasks. A skeleton framework would look as shown in Listing A.

```
<job>
        <priority>2</priority>
        <title>My Title</title>
        <author>J. Jones</author>
        <notify>
                <condition>failure</condition>
                <plan>
                        . . . some worker action(s) . . .
                </plan>
        </notify>
        <plan>
                . . . some worker action(s) . . .
        </plan>
</job>
```

Listing A

The optional <notify> section includes tasks that are performed after the tasks in the following <plan> are completed. It typically includes email notification of job completion or failure.

Each <plan> section contains a list of worker actions to be taken. The actions are grouped together by job control tags that define the sequence or concurrency of

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the actions: <parallel> for actions that can take place in parallel, and <serial> for actions that must take place in the specified order. If no job-control tag is present, then <serial> is implied.

A typical job-flow for one embodiment of the invention is represented in Listing B.

```
<job>
        <priority>2</priority>
        <title>My Title</title>
        <author>J. Jones</author>
        <notify>
                <condition>failure</condition>
                <plan>
                        <anymail>
                                . . . email notification . . .
                        </anymail>
                </plan>
        </notify>
        <plan>
                <prefilter>
                        . . . preprocessing . . .
                </prefilter>
                <parallel>
                        <microsoft>
                                . . . Microsoft encoding . . .
                        </microsoft>
                        <real>
                                . . . Real encoding . . .
                        </real>
                        <quicktime>
                                . . . Quicktime encoding . . .
                        </quicktime>
                </parallel>
                <parallel>
                        <fileman>
                                . . . FTP of Microsoft files . . .
                        </fileman>
                        <fileman>
                                . . . FTP of Real files . . .
                        </fileman>
                        <fileman>
                                . . . FTP of Quicktime reference file . . .
                        </fileman>
                        <fileman>
                                . . . FTP of Quicktime stream files . . .
                        </fileman>
                </parallel>
        </plan>
</job>
```

Listing B

Graphically, this job flow is depicted in **Fig. 7A**. In **Fig. 7A**, each diamond represents a checkpoint, and execution of any tasks that are "downstream" of the checkpoint will not occur if the checkpoint indicates failure. The checkpoints are performed after every item in a <serial> list.

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Due to the single checkpoint after the parallel encoding tasks, if a single encoder fails, none of the files from the successful encoders are distributed by the fileman workers. If this were not the desired arrangement, the job control could be changed to allow the encoding and distribution phases to run in parallel. The code in Listing C below is an example of such an approach.

```
<job>
        <priority>2</priority>
        <title>My Title</title>
        <author>J. Jones</author>
        <notify>
                <condition>failure</condition>
                <plan>
                        <anymail>
                                . . . email notification . . .
                        </anymail>
                </plan>
        </notify>
        <plan>
                <prefilter>
                        . . . preprocessing . . .
                </prefilter>
                <parallel>
                        <serial>
                                <microsoft>
                                        . . . Microsoft encoding . . .
                                </microsoft>
                                <fileman>
                                        . . . FTP of Microsoft files . . .
                                </fileman>
                        </serial>
                        <serial>
                                <real>
                                        . . . Real encoding . . .
                                </real>
                                <fileman>
                                        . . . FTP of Real files . . .
                                </fileman>
                        </serial>
                        <serial>
                                <quicktime>
                                        . . . Quicktime encoding . . .
                                </quicktime>
                                <parallel>
                                        <fileman>
                                                . . . FTP of Quicktime reference
                                                file . . .
                                        </fileman>
                                        <fileman>
                                                . . . FTP of Quicktime stream files
                                                . . .
                                        </fileman>
                                </parallel>
                        </serial>
                </parallel>
        </plan>
</job>
```

Listing C

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The resulting control flow is shown in **Fig. 7B**. In this job flow, the Microsoft and Real files will be distributed even if the Quicktime encoder fails, since their distribution is only dependent upon the successful completion of their respective encoders.

Job Submission Details

For a job description to be acted upon, it must be submitted to the Enterprise Control System **270**. In the typical configuration of the preferred embodiment platform, the Planner module **205** performs this submission step after building the job description from information passed along from the Graphical User Interface (GUI); however, it is also possible for user applications to submit job descriptions directly. To do this, they must open a socket to the ECS on port 3501 and send the job description, along with a packet-header, through the socket.

The Packet Header

The packet header embodies a communication protocol utilized by the ECS and the local control system (LCS) on each processor in the system. The ECS communicates with the LCSs on port 3500, and accepts job submissions on port 3501. An example packet header is shown in Listing D below.

```
<packet-header>
        <content-length>5959</content-length>
        <msg-type>test</msg-type>
        <from>
                <host-name>dc-igloo</host-name>
                <resource-name>submit</resource-name>
                <resource-number>0</resource-number>
        </from>
        <to>
                <host-name>localhost</host-name>
                <resource-name>ecs</resource-name>
                <resource-number>0</resource-number>
        </to>
</packet-header>
```

Listing D

<content-length>

Valid Range: Non-negative integer.

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Function: Indicates the total length, in bytes—including whitespace—of the data following the packet header. This number must be exact.

<message-type>

Valid Values: "test"

Function: test

<from>

This section contains information regarding the submitting process.

<host-name>

Valid Values: A valid host-name on the network, including "localhost".

Function: Specifies the host on which the submitting process is running.

<resource-name>

Valid Values: "submit"

Function: Indicates the type of resource that is communicating with the ECS.

<resource-number>

Valid Range: Non-negative integer, usually "0"

Function: Indicates the identifier of the resource that is communicating with the ECS. For submission, this is generally 0.

<to>

This section identifies the receiver of the job description, which should always be the ECS.

<host-name>

Valid Values: The hostname of the machine on which the ECS is running. If the submission process is running on the same machine, then "localhost" is sufficient.

<resource-name>

Valid Values: "ecs"

Function: Indicates the type of resource that is receiving the message. For job submission, this is always the ECS..

<resource-number>

Valid Range: 0

Function: Indicates the resource identifier for the ECS. In the current preferred embodiment, this is always 0.

<job> Syntax

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As described above, the job itself contains several sections enclosed within the <job> . . . </job> tags. The first few give vital information describing the job. These are followed by an optional <notify> section, and by the job's <plan>.

<priority>

Valid Range:	1 to 3, with 1 being the highest priority
Restrictions:	Required.
Function:	Assigns a scheduling priority to the job. Tasks related to jobs with higher priorities are given precedence over jobs with lower priorities.

<title>

Valid Values:	Any text string, except for the characters '<' and '>'
Restrictions:	Required.
Function:	Gives a name to the job.

<author>

Valid Values:	Any text string, except for the characters '<' and '>'
Restrictions:	Required.
Function:	Gives an author to the job.

<start-time>

Format:	yyyy-mm-dd hh:mm:ss
Restrictions:	Optional. The default behavior is to submit the job immediately.
Function:	Indicates the time at which a job should first be submitted to the ECS's task scheduler.

<period>

Range:	Positive integer
Restrictions:	Only valid if the <start-time> tag is present.
Function:	Indicates the periodicity, in seconds, of a repeating job. At the end of the period, the job is submitted to the ECS's task scheduler.

<notify>

The <notify> section specifies actions that should be taken after the main job has completed. Actions that should be taken when a job successfully completes can simply be included as the last step in the main <plan> of the <job>. Actions that should be taken irregardless of success, or only upon failure, should be included in this

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section. In one embodiment of the invention, email notifications are the only actions supported by the Planner.

	<condition>	
	Valid Values:	always, failure
5	Restrictions:	Required.
	Function:	Indicates the job completion status which should trigger the actions in the <plan> section.
	<plan>	
	Valid Values:	See specification of <plan> below
10	Restrictions:	Required.
	Function:	Designates the actual tasks to be performed.

<plan> Syntax

15 The <plan> section encloses one or more tasks, which are executed serially. If a task fails, then execution of the remaining tasks is abandoned. Tasks can consist of individual worker sections, or of multiple sections to be executed in parallel. Because of the recursive nature of tasks, a BNF specification is a fairly exact way to describe them.

20 task ::= serial_section | parallel_section | worker_task
serial_section ::= '<serial>' task* '</serial>'
parallel_section ::= '<parallel>' task* '</parallel>'
worker_task ::= '<' worker_name '>' worker_parameter* '</' worker_name '>'
25 worker_name ::= ('microsoft', 'real', 'quicktime', 'prefilter', 'anymail', 'fileman', 'lc' N 'pp')
worker_parameter ::= '<' tag '>' value '</' tag '>'

The individual tags and values for the worker parameters will be specified 30 further on.

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The set of worker names is defined in the database within the workertype table. Therefore, it is very implementation specific and subject to on-site customization.

The Mail Worker

Name: anymail
Executable: anymail.exe

As its name suggests, the mail worker's mission is the sending of email. In on embodiment of the invention, the ECS supplies the subject and body of the message in the `<notify>` section.

`<smtp-server>`
Valid Values: Any valid SMTP server name.
Restrictions: Required.
Function: Designates the SMTP server from which the email will be sent.

`<from-address>`
Valid Values: A valid email address.
Restrictions: Required.
Function: Specifies the name of the person who is sending the email.

`<to-address>`
Valid Values: One or more valid email addresses, separated by spaces, tabs, commas, or semicolons.
Restrictions: Required.
Function: Specifies the email recipient(s)

`<subject>`
Valid Values: Any string.
Restrictions: Required.
Function: Specifies the text to be used on the subject line of the email.

`<body>`
Valid Values: Any string.
Restrictions: Required.
Function: Specifies the text to be used as the body of the email message.

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<mime-attach> (Mime Attachments)

Restrictions: Optional.

Anymail is capable of including attachments using the MIME standard. Any number of attachments are permitted, although the user should keep in mind that many mail servers will truncate or simply refuse to send very large messages. The mailer has been successfully tested with emails up to 20 MB, but that should be considered the exception rather than the rule. Also remember that the process of attaching a file will increase its size, as it is base-64 encoded to turn it into printable text. Plan on about 26% increase in message size.

<compress>

Restrictions:	Optional. Must be paired with <content-type> application/x-gzip</content-type>.
Valid Values:	A valid file or directory path. The path specification can include wildcards and environment-variable macros delimited with percent signs (e.g., %BLUERELEASE%). The environment variable expansion is of course dependent upon the value of that variable on the machine where Anymail is running.
Function:	Indicates the file or files that should be compressed using tar/gzip into a single attachment named in the <file-name> tag.

<file-name>

Restrictions:	Required.
Valid Values:	A valid file path. The path specification can include environment variable macros delimited with percent signs (e.g., %BLUERELEASE%). The environment variable expansion is of course dependent upon the value of that variable on the machine where Anymail is running.
Function:	Indicates the name of the file that is to be attached. If the <compress> tag is present, this is the target file name for the compression.

<content-type>

Restrictions:	Required.
Valid Values:	Any valid MIME format specification, such as the following "text/plain; charset=us-ascii" or "application/x-gzip".
Function:	Indicates the format of the attached file. This text is actually inserted in the attachment as an indicator to the receiving mail application.

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Anymail Example

The example in Listing E sends an email with four attachments, two of which are compressed.

```
<anymail>
        <smtp-server>smtp.example.com</smtp-server>
        <from-address>sender@example.com</from-address>
        <to-address>receiver@example.com</to-address>
        <subject>Server Logs</subject>
        <body>
Attached are your log files.

Best regards,

J. Jones.
        </body>

        <mime-attach>
                <compress>%BLUERELEASE%/logs</compress>
                <file-name>foo.tar.gz</file-name>
                <content-type>application/x-gzip</content-type>
        </mime-attach>

        <mime-attach>
                <compress>%BLUERELEASE%/frogs</compress>
                <file-name>bar.tar.gz</file-name>
                <content-type>application/x-gzip</content-type>
        </mime-attach>

        <mime-attach>
                <file-name>%BLUERELEASE%\apps\AnyMail\exmp.xml</file-
name>
                <content-type>text/plain; charset=us-ascii</content-
type>
        </mime-attach>

        <mime-attach>
                <file-name>%BLUERELEASE%\apps\AnyMail\barfoo.xml</file-
name>
                <content-type>text/plain; charset=us-ascii</content-
type>
        </mime-attach>

</anymail>
```

Listing E

The File Manager

Name: fileman

Executable: fileman.exe

The file manager performs a number of file-related tasks, such as FTP transfers and file renaming.

```
<command>
```

Valid Values: "rename-file", "delete-file", "get-file", "put-file"

Restrictions: Required.

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Function: Designates the action that the file manager will perform. Table 2 summarizes the options.

Command	Description
rename-file	Renames or moves a single local file.
delete-file	Deletes one or more local files.
get-file	Retrieves a single remote file via FTP.
put-file	Copies one or more local files to a remote FTP site.

Table 2. File Manager Commands

<src-name> (Source File Name)

Valid Values: A valid file path. With some tags, the path specification can include environment variable macros delimited with percent signs (e.g., %BLUERELEASE%), and/or wildcards. The environment variable expansion is of course dependent upon the value of that variable on the machine where Anymail is running.

Restrictions: Required. May occur more than once when combined with some commands.

Function: Designates the file or files to which the command should be applied. Table 3 summarizes the options with various commands.

Command	Environment Variable Expansion	Wildcards	Occur Multiple Times
rename-file	No	no	no
delete-file	Yes	yes	yes
get-file	No	no	no
put-file	Yes	yes	yes

Table 3. File Manager Command Options

<dst-name> (Destination File Name)

Valid Values: A *full* file path or directory, rooted at /. With the *put-file* command, any missing components of the path will be created.

Restrictions: Required for all but the delete-file command.

Function: Designates the location and name of the destination file. For put-file, the destination must be a directory when multiple source files—through use of a pattern or multiple src-name tags—are specified.

<newer-than> (File Age Upper Limit)

Format: dd:hh:mm

Restrictions: Not valid with get-file or rename-file.

Function: Specifies a upper limit on the age of the source files. Used to limit the files selected through use of wildcards. Can be used in combination with <older-than> to restrict file ages to a range.

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<older-than> (File Age Lower Limit)

Format:	dd:hh:mm
Restrictions:	Not valid with get-file or rename-file.
Function:	Specifies an lower limit on the age of the source files. Used to limit the files selected through use of wildcards. Can be used in combination with <newer-than> to restrict file ages to a range.

<dst-server> (Destination Server)

Valid Values:	A valid host-name.
Restrictions:	Required with put-file or get-file.
Function:	Designates the remote host for an FTP command.

<user-name>

Valid Values:	A valid username for the remote host identified in <dst-server>.
Restrictions:	Required with put-file or get-file.
Function:	Designates the username to be used to login to the remote host for an FTP command.

<user-password>

Valid Values:	A valid password for the username on the remote host identified in <dst-server>.
Restrictions:	Required with put-file or get-file.
Function:	Designates the password to be used to login to the remote host for an FTP command.

Fileman Examples

The command in listing F will FTP all log files to the specified directory on a remote server.

```
<fileman>
        <command>put-file</command>
        <src-name>%BLUERELEASE%/logs/*.log</src-name>
        <dst-name>/home/guest/logs</dst-name>
        <dst-server>dst-example</dst-server>
        <user-name>guest</user-name>
        <user-password>guest</user-password>
</fileman>
```

Listing F

The command in Listing G will transfer log files from the standard log file directory as well as a back directory to a remote server. It uses the <newer-than> tag to select files that from the last 10 days only.

```
<fileman>
        <command>put-file</command>
        <src-name>%BLUERELEASE%/logs/*.log</src-name>
```


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```
        <src-name>%BLUERELEASE%/logs/back/*.log</src-name>
        <dst-name>/home/guest/logs</dst-name>
        <dst-server>dst-example</dst-server>
        <user-name>guest</user-name>
        <user-password>guest</user-password>
        <newer-than>10:0:0</newer-than>
</fileman>
```

Listing G

The command in Listing H deletes all log files and backup log files (i.e., in the backup subdirectory) that are older than 7 days.

```
<fileman>
        <command>delete-file</command>
        <src-name>%BLUERELEASE%/logs/*.log</src-name>
        <src-name>%BLUERELEASE%/logs/backup/*.log</src-name>
        <older-than>7:0:0</older-than>
</fileman>
```

Listing H

The Preprocessor

Name: prefilter, or lc1pp, lc2pp, etc. Each live-capture worker must have a unique name.
Executable: prefilter.exe

The preprocessor converts various video formats—including live capture—to .avi files. It is capable of performing a variety of filters and enhancements at the same time.

All preprocessor parameters are enclosed with a `<preprocessor>` section. A typical preprocessor job would take the form shown in Listing I:

```
<prefilter>
<preprocess>
. . . .preprocessing parameters . . .
</preprocess>
<prefilter>
```

Listing I

`<input-file>`

Valid Values:	File name of an existing file.
Restrictions:	Required.
Function:	Designates the input file for preprocessing, without a path. For live capture, this value should be "SDI".

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<input-directory>

Valid Values:	A full directory path, such d:\media.
Restrictions:	Required.
Function:	Designates the directory where the input file is located. In the user interface, this is the "media" directory.

<output-file>

Valid Values:	A valid file name.
Restrictions:	Required.
Function:	Designates the name of the preprocessed file.

<output-directory>

Valid Values:	A full directory path.
Restrictions:	Required.
Function:	Designates the directory where the preprocessed file should be written. This directory must be accessible by the encoders.

<skip>

Valid Values:	yes, **no**
Function:	This tag indicates that preprocessing should be skipped. In this case, an output file is still created, and it is reformatted to .avi, if necessary, to provide the proper input format for the encoders.

<trigger>

<start>

<type>

Valid Values: DTMF, TIME, NOW, IP, TIMECODE

<comm-port>

Min / Default /Max:	1 / **1** / 4
Restrictions:	This parameter is only valid with a <type>DTMF</type>.

<duration>

Min / Default /Max:	0 / **[none]** / no limit
Restrictions:	This parameter is only valid with a <type>NOW<type>.
Function:	Indicates the length of time that the live capture should run. In a recent embodiment, this parameter has been removed and the *NOW* trigger causes the capture to start immediately.

<baud-rate>

Min / Default /Max:	2400 / **9600** / 19200
Restrictions:	This parameter is only valid with a <type>DTMF<type>.

<dtmf>

Valid Values:	A valid DTMF tone of the form 999#, where "9" is any digit.
Restrictions:	This parameter is only valid with a <type>DTMF<type>.

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<time>

Valid Values: A valid time in the format hh:mm:ss.

Restrictions: This parameter is only valid with a <type>TIME<type>.

<date>

Valid Values: A valid date in the format mm/dd/yyyy.

Restrictions: This parameter is only valid with a <type>TIME<type>.

<port>

Min / Default / Max: 1 / 1 / 65535

Restrictions: This parameter is only valid with a <type>IP<type>.

<timecode>

Valid Values: A valid timecode in the format hh:mm:ss:ff.

Restrictions: This parameter is only valid with a <type>TIMECODE<type>.

<stop>

<type>

Valid Values: DTMF, TIME, NOW, IP, TIMECODE (in a recent embodiment, the NOW trigger is replaced by DURATION.)

<comm-port>

Min / Default /Max: 1 / 1 / 4

Restrictions: This parameter is only valid with <type>DTMF</type>.

<duration>

Min / Default /Max: 0 / [none] / no limit

Restrictions: This parameter is only valid with a <type>NOW</type> or <type>DURATION</type>

Function: Indicates the length of time that the live capture should run.

<baud-rate>

Min / Default /Max: 2400 / 9600 / 19200

Restrictions: This parameter is only valid with a <type>DTMF<type>.

<dtmf>

Valid Values: A valid DTMF tone of the form 999*, where "9" is any digit.

Restrictions: This parameter is only valid with a <type>DTMF<type>.

<time>

Valid Values: A valid time in the format hh:mm:ss.

Restrictions: This parameter is only valid with a <type>TIME<type>.

<date>

Valid Values: A valid date in the format mm/dd/yyyy.

Restrictions: This parameter is only valid with a <type>TIME<type>.

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<port>

Min / Default / Max: 1 / 1 / 65535

Restrictions: This parameter is only valid with a <type>IP<type>.

<timecode>

Valid Values: A valid timecode in the format hh:mm:ss:ff.

Restrictions: This parameter is only valid with a <type>TIMECODE<type>.

<capture>

<video-mode>

Valid Values: **ntsc**, pal

<channels>

Valid Values: **mono**, stereo

<version>

Valid Values: 1.0

<name>

Valid Values: basic

<video>

<destination>

The upper size limit (<width> and <height>) is uncertain: it depends on the memory required to support other preprocessing settings (like temporal smoothing). The inventors have successfully output frames at PAL dimensions (720 x 576).

<width>

Min / Default / Max: 0 / [none] / 720

Restrictions: The width must be a multiple of 8 pixels. The .avi file writer of the preferred embodiment platform imposes this restriction. There are no such restrictions on height.

Function: The width of the output stream in pixels.

<height>

Min / Default / Max: 0 / [none] / 576

Function: The height of the output stream in pixels.

<fps> (Output Rate)

Min / Default / Max: 1 / [none] / 100

Restrictions: This must be less than or equal to the input rate in seconds.

Currently, this must be an integer. It may be generalized into a floating-point quantity.

Function: The output frame rate in seconds. The preprocessor will create this rate by appropriately sampling the input stream (see "Temporal Smoothing" for more detail).

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<temporal-smoothing>

<amount>

Min / Default / Max : 1 / **1** / 6

Function: This specifies the number of input frames to average when constructing an output frame, ***regardless of the input or output frame rates***. The unit of measurement is always ***frames***, where a frame may contain two fields, or may simply be a full frame.

Restrictions: Large values with large formats make a large demand for BlueICE memory.

Examples: With fields, a value of *2* will average the data from 4 fields, unless single-field mode is on, in which case only 2 fields will contribute. In both cases 2 frames are involved. If the material is not field-based, a value of *2* will average 2 frames.

<single-field>

Valid Values: on, **off**

Function: This specifies whether the system will use all the fields, or simply every upper field. Single Field Mode saves considerable time (for certain formats) by halving the decode time.

<crop>

This section specifies a cropping of the input source material. The units are always pixels of the input, and the values represent the number of rows or columns that are "cut-off" the image. These rows and columns are discarded. The material is rescaled, so that the uncropped portion fits the output format. Cropping can therefore stretch the image in either the x- or y-direction.

<left>

Min / Default / Max: **0** / **0** / <image width - 1>

<right>

Min / Default / Max: **0** / **0** / <image width - 1>

<top>

Min / Default / Max: **0** / **0** / <image height - 8>

<bottom>

Min / Default / Max: **0** / **0** / <image height - 8>

<inverse-telecine>

Valid Values: yes, **no**

Restrictions: Ignored in one embodiment of the invention.

<blur>

Valid Values: **custom**, smart

Function: Defines the type of blurring to use.

<custom-blur>

Min / Default / Max: 0.0 / **0.0** / 8.0

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Restrictions: Only valid in combination with <blur>custom</blur>. The vertical part of the blur kernel size is limited to approximately 3 BlueICE node widths. It fails gracefully, limiting the blur kernel to a rectangle whose width is 3/8 of the image height (much more blurring than anyone would want).

Function: This specifies the amount of blurring according to the Gaussian Standard Deviation in thousandths of the image width. Blurring degrades the image but provides for better compression ratios.

Example: A value of *3.0* on a 320x240 output format blurs with a standard deviation of about 1 pixel. Typical blurs are in the 0-10 range. A small blur, visible on a large format, may have an imperceptible effect on a small format.

<noise-reduction>

<brightness>

Min / Default / Max: 0 / **100** / 200

Function: Adjusts the brightness of the output image, as a percent of normal. The adjustments are made in RGB space, with R, G and B treated the same way.

<contrast>

Min / Default / Max: 0 / **100** / 200

Function: Adjusts the contrast of the output image, as a percent of normal. The adjustments are made in RGB space, with R, G and B treated the same way.

<hue>

Min / Default / Max: -360 / **0** / 360

Function: Adjusts the hue of the output image. The adjustments are made in HLS space. Hue is in degrees around the color wheel in R-G-B order. A positive hue value pushes greens toward blue; a negative value pushes greens toward red. A value of 360 degrees has no effect on the colors.

<saturation>

Min / Default / Max: 0 / **100** / 200

Function: Adjusts the saturation of the output image. The adjustments are made in HLS space. Saturation is specified as a percent, with 100% making no change.

<black-point>

Luminance values less than <point> (out of a 0-255 range) are reduced to 0. Luminance values greater than <point>+<transition> remain unchanged. In between, in the transition region, the luminance change ramps linearly from 0 to <point>+<transition>.

<point>

Min / Default / Max: 0 / **0** / 255

<transition>

Min / Default / Max: 1 / **1** / 10

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<white-point>

Luminance values greater than <point> (out of a 0-255 range) are increased to 255. Luminance values less than <point>-<transition> remain unchanged. In between, in the transition region, the luminance change ramps linearly from <point>-<transition> to 255.

<point>

Min / Default / Max: 0 / 255 / 255

<transition>

Min / Default / Max: 1 / 1 / 10

<gamma>

The Gamma value changes the luminance of mid-range colors, leaving the black and white ends of the gray-value range unchanged. The mapping is applied in RGB space, and each color channel c independently receives the gamma correction. Considering c to be normalized (range 0.0 to 1.0), the transform raises c to the power 1/gamma.

Min / Default / Max: 0.2 / 1.0 / 5.0

<watermark>

Specification of a watermark is optional. The file is resized to <width> x <height> and placed on the input stream with this size. The watermark upper left corner coincides with the input stream upper left corner by default, but is translated by <x><y> in the coordinates of the input image. The watermark is then placed on the input stream in this position. There are two modes: "composited" and "luminance". The watermark strength, normally 100, can be varied to make the watermark more or less pronounced.

The watermark placement on the input stream is only conceptual. The code actually resizes the watermark appropriately and places it on the output stream. This is significant because the watermark is unaffected by any of the other preprocessing controls (except fade). To change the contrast of the watermark, this work must be done ahead of time to the watermark file.

Fancy watermarks that include transparency variations may be make with Adobe® Photoshop®, Adobe After Effects®, or a similar program and stored in .psd format that supports alpha.

The value of "luminance mode" is that the image is altered, never covered. Great looking luminance watermarks can be make with the "emboss" feature of Photoshop or other graphics programs. Typical embossed images are mostly gray, and show the derivative of the image.

<source-location>

Valid Values: A full path to a watermark source file on the host system. Valid file extensions are .psd, .tga, .pct, and .bmp.
Restrictions: Required.

<width>

Min / Default / Max: 0 / [none] / (unknown upper limit)

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<height >

Min / Default / Max: 0 / **[none]** / (unknown upper limit)

<x>

Min / Default / Max: -756 / 0 / 756

<x-origin>

Valid Values: **left, right**

<y>

Min / Default / Max: -578 / 0 / 578

<y-origin>

Valid Values: **top, bottom**

<mode>

Valid Values: **composited,** luminance

Function: In "composited" mode, the compositing equation is used to blend the watermark (including alpha channel) with the image. For images with full alpha (255) the watermark is completely opaque and covers the image. Pixels with zero alpha are completely transparent, allowing the underlying image to be seen. Intermediate values produce a semi-transparent watermark. The <strength> parameter modulates the alpha channel. In particular, opaque watermarks made without alpha can be adjusted to be partially transparent with this control.

"Luminance" mode uses the watermark file to control the brightness of the image. ***A gray pixel in the watermark file does nothing in luminance mode***. Brighter watermark pixels increase the brightness of the image. Darker watermark pixels decrease the brightness of the image. The <strength> parameter modulates this action to globally amplify or attenuate the brightness changes. If the watermark has an alpha channel, this also acts to attenuate the strength of the brightness changes pixel-by-pixel. The brightness changes are made on a channel-by-channel basis, using the corresponding color channel in the watermark. Therefore, colors in the watermark *will* show up in the image (making the term "luminance mode" a bit of a misnomer).

<strength>

Min / Default / Max: 0 / **100** / 200

<fade-in>

Min / Default / Max: 0.0 / **0.0** / 10.0

Restriction: The sum of <fade-in> and <fade-out> should not exceed the length of the clip. Fading is disallowed during DV capture.

Function: Fade-in specifies the amount of time (in seconds) during which the stream fades up from black to full brightness at the beginning of the stream. Fading is the last operation applied to the stream and affects everything, including the watermark. Fading is always a linear change in image brightness with time.

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<fade-out>

Min / Default / Max: 0.0 / 0.0 / 10.0

Restriction: The sum of <fade-in> and <fade-out> should not exceed the length of the clip. Fading is disallowed during DV capture.

Function: Fade-out specifies the amount of time (in seconds) during which the stream fades out to black to full brightness at the end of the stream. Fading is the last operation applied to the stream and affects everything, including the watermark. Fading is always a linear change in image brightness with time.

<audio>

<sample-rate>

Min / Default / Max: 8000 / [none] / 48000

<channels>

Valid Values: mono, stereo

<low-pass>

Min / Default / Max: 0.0 / 0.0 / 48000.0

<high-pass>

Min / Default / Max: 0.0 / 0.0 / 48000.0

Restrictions: Not supported in one embodiment of the invention.

<volume>

<type>

Valid Values: none, adjust, normalize

<adjust>

Min / Default / Max: 0.0 / 50.0 / 200.0

Restrictions: Only valid with <type>adjust</type>.

<normalize>

Min / Default / Max: 0.0 / 50.0 / 100.0

Restrictions: Only valid with <type>normalize</type>.

<compressor>

<threshold>

Min / Default / Max: -40.0 / 6.0 / 6.0

<ratio>

Min / Default / Max: 1.0 / 20.0 / 20.0

<fade-in>

Min / Default / Max: 0.0 / 0.0 / 10.0

Restriction: The sum of <fade-in> and <fade-out> should not exceed the length of the clip. Fading is disallowed during DV capture.

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Function:	Fade-in specifies the amount of time (in seconds) during which the stream fades up from silence to full sound at the beginning of the stream. Fading is always a linear change in volume with time.

`<fade-out>`

Min / Default / Max:	0.0 / 0.0 / 10.0
Restriction:	The sum of `<fade-in>` and `<fade-out>` should not exceed the length of the clip. Fading is disallowed during DV capture.
Function:	Fade-out specifies the amount of time (in seconds) during which the stream fades out to silence to full volume at the end of the stream. Fading is always a linear change in volume with time.

Encoder Common Parameters

`<meta-data>`

The meta-data section contains information that describes the clip that is being encoded. These parameters (minus the `<version>` tag) are encoded into the resulting clip and can be used for indexing, retrieval, or information purposes.

`<version>`

Valid Values:	"1.0" until additional versions are released.
Restrictions:	Required.
Function:	The major and minor version (e.g., 1.0) of the meta-data section format. In practice, this parameter is ignored by the encoder.

`<title>`

Valid Values:	Text string, without '<' or '>' characters.
Restrictions:	Required.
Function:	A short descriptive title for the clip. If this field is missing, the encoder generates a warning message.

`<description>`

Valid Values:	Text string, without '<' or '>' characters.
Restrictions:	Optional.
Function:	A description of the clip.

`<copyright>`

Valid Values:	Text string, without '<' or '>' characters.
Restrictions:	Optional.
Function:	Clip copyright. If this field is missing, the encoder generates a warning message.

`<author>`

Valid Values:	Text string, without '<' or '>' characters.
Restrictions:	Required.
Function:	Designates the author of the clip. In one embodiment of the invention, the GUI defaults this parameter to the username of the job's submitter. If this field is missing, the Microsoft and Real encoders generate a warning message.

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<rating>

Valid Values: "General Audience", "Parental Guidance", "Adult Supervision", "Adult", "G", "PG", "R", "X"
Restrictions: Optional.
Function: Designates the rating of the clip. In one embodiment of the invention, submit.plx sets this parameter to "General Audience".

<monitor-win> (Show Monitor Window)

Valid Values: yes, no
Restrictions: Optional.
Function: Indicates whether or not the encoder should display a window that shows the encoding in process. For maximum efficiency, this parameter should be set to no.

<network-congestion>

The network congestion section contains hints for ways that the encoders can react to network congestion.

<loss-protection>

Valid Values: **yes**, no
Function: A value of *yes* indicates that extra information should be added to the stream in order to make it more fault tolerate.

<prefer-audio-over-video>

Valid Values: **yes**, no
Function: A value of *yes* indicates that video should degrade before audio does.

The Microsoft Encoder

Name: microsoft
Executable: msencode.exe

The Microsoft Encoder converts .avi files into streaming files in the Microsoft-specific formats.

<src> (Source File)

Valid Values: File name of an existing file.
Restrictions: Required.
Function: Designates the input file for encoding. This should be the output file from the preprocessor.

<dst> (Destination File)

Valid Values: File name for the output file.

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Restrictions: Required.
Function: Designates the output file for encoding. If this file already exists, it will be overwritten.

<encapsulated>

Valid Values: true, false
Function: Indicates whether the output file uses Intellistream. If the MML indicates multiple targets and <encapsulated> is false, an Intellistream is used and a warning is generated.

<downloadable>

Valid Values: yes, no
Function: Indicates whether a streaming file can be downloaded and played in its entirety.

<recordable>

This tag is not valid for Microsoft. The one embodiment of the invention GUI passes a value for it into the Planner, but the encoder ignores it.

<seekable>

Valid Values: yes, no
Function: Indicates whether the user can skip through the stream, rather than playing it linearly.

<max-keyframe-spacing>

Min / Default / Max: 0.0 / 8.0 / 200.0
Function: Designates that a keyframe will occur at least every <max-keyframe-spacing> seconds. A value of 0 indicates natural keyframes.

<video-quality>

Min / Default / Max: 0 / 0 / 100
Restrictions: Optional.
Function: This tag is used to control the trade-off between spatial image quality and the number of frames. 0 refers to the smoothest motion (highest number of frames) and 100 to the sharpest picture (least number of frames).

<target>

The target section is used to specify the settings for a single stream. The Microsoft Encoder is capable of producing up to five separate streams. The audio portions for each target must be identical.

<name>

Valid Values: 14.4k, 28.8k, 56k, ISDN, Dual ISDN, xDSL\Cable Modem, xDSL.384\Cable Modem, xDSL.512\Cable Modem, T1, LAN
Restrictions: Required.

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<video>

The video section contains parameters that control the production of the video portion of the stream. This section is optional: if it is omitted, then the resulting stream is audio-only.

<codec>

Valid Values:	**MPEG4V3**, Windows Media Video V7, Windows Media Screen V7
Restrictions:	Each codec has specific combinations of valid bit-rate and maximum FPS.
Function:	Specifies the encoding format to be used.

<bit-rate>

Min / Default / Max:	10.0 / **[none]** / 5000.0
Restrictions:	Required.
Function:	Indicates the number of kbits per second at which the stream should encode.

<max-fps>

Min / Default / Max:	4 / **5** / 30
Function:	Specifies the maximum frames per second that the encoder will encode.

<width>

Min / Default / Max:	80 / **[none]** / 640
Restrictions:	Required. Must be divisible by 8. Must be identical to the width in the input file, and therefore identical for each defined target.
Function:	Width of each frame, in pixels.

<height>

Min / Default / Max:	60 / **[none]** / 480
Restrictions:	Required. Must be identical to the height in the input file, and therefore identical for each defined target.
Function:	Height of each frame, in pixels.

<audio>

The audio section contains parameters that control the production of the audio portion of the stream. This section is optional: if it is omitted, then the resulting stream is video-only.

<codec>

Valid Values:	Windows Media Audio V7, **Windows Media Audio V2**, ACELP.net
Function:	Indicates the audio format to use for encoding.

<bit-rate>

Min / Default / Max:	4.0 / **8.0** / 160.0
Function:	Indicates the number of kbits per second at which the stream should encode.

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<channels>

Valid Values:	**mono**, stereo
Function:	Indicates the number of audio channels for the resulting stream. A value of *stereo* is only valid if the incoming file is also in stereo.

<sample-rate>

Min / Default / Max:	4.0 / **8.0** / 44.1
Restrictions:	Required.
Function:	The sample rate of the audio file output in kHz.

The Real Encoder

Name: real

Executable: rmencode.exe

The Real Encoder converts .avi files into streaming files in the Real-specific formats.

<src> (Source File)

Valid Values:	File name of an existing file.
Restrictions:	Required.
Function:	Designates the input file for encoding. This should be the output file from the preprocessor.

<dst> (Destination File)

Valid Values:	File name for the output file.
Restrictions:	Required.
Function:	Designates the output file for encoding. If this file already exists, it will be overwritten.

<encapsulated>

Valid Values:	***true***, *false*
Restrictions:	Optional
Function:	Indicates whether the output file uses SureStream.

<downloadable>

Valid Values:	*yes*, *no*
Restrictions:	Optional
Function:	Indicates whether a streaming file can be downloaded and played in its entirety.

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<recordable>

Valid Values: *yes, no*

Restrictions: Optional

Function: Indicates whether the stream can be saved to disk.

<seekable>

This tag is not valid for Real. The GUI in one embodiment of the invention passes a value for it into the Planner, but the encoder ignores it.

<max-keyframe-spacing>

Min / Default / Max: 0.0 / 8.0 / 200.0

Function: Designates that a keyframe will occur *at least* every <max-keyframe-spacing> seconds. A value of 0 indicates natural keyframes.

<video-quality>

Valid Values: **normal**, smooth motion, sharp image, slide show

Function: This tag is used to control the trade-off between spatial image quality and the number of frames. How does this relate to the MS <video-quality> measurement

<encode-mode>

Valid Values: VBR, **CBR**

Function: Indicates constant (CBR) or variable bit-rate (VBR) encoding.

<encode-passes>

Min / Default / Max: 1 / **1** / 2

Function: A value of 2 enables multiple pass encoding for better quality compression.

<audio-type>

Valid Values: voice, voice with music, **music**, stereo music

<output-server>

Restrictions: This section is optional.

<server-name>

Function: Identify the server

<stream-name>

Function: Identify the stream

<server-port>

Min / Default / Max: 0 / **[none]** / 65536

<user-name>

Function: Identify the user

<user-password>

Function: Store the password

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<target>

The target section is used to specify the settings for a single stream. The Microsoft Encoder is capable of producing up to five separate streams. In one embodiment of the invention, the audio portions for each target must be identical.

<name>

Valid Values:	14.4k, 28.8k, 56k, ISDN, Dual ISDN, xDSL\Cable Modem, xDSL.384\Cable Modem, xDSL.512\Cable Modem, T1, LAN
Restrictions:	Required.

<video>

The video section contains parameters related to the video component of a target bit-rate. This section is optional: if it is omitted, then the resulting stream is audio-only.

<codec>

Valid Values:	RealVideo 8.0, RealVideo G2, **RealVideo G2 with SVT**
Restrictions:	Each codec has specific combinations of valid bit-rate and maximum FPS.
Function:	Indicates the encoding format to be used for the video portion.

<bit-rate>

Min / Default / Max:	10.0 / **[none]** / 5000.0
Restrictions:	Required.
Function:	Indicates the number of kbits per second at which the video portion should encode.

<max-fps>

Min / Default / Max:	4 / **[none]** / 30
Restrictions:	Optional.
Function:	Specifies the maximum frames per second that the encoder will encode.

<width>

Min / Default / Max:	80 / **[none]** / 640
Restrictions:	Required. Must be divisible by 8. Must be identical to the width in the input file, and therefore identical for each defined target.
Function:	Width of each frame, in pixels.

<height>

Min / Default / Max:	60 / **[none]** / 480
Restrictions:	Required. Must be identical to the height in the input file, and therefore identical for each defined target.
Function:	Height of each frame, in pixels.

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<audio>

The audio section contains parameters that control the production of the audio portion of the stream. This section is optional: if it is omitted, then the resulting stream is video-only.

<codec>

Valid Values:	**G2**
Function:	Specifies the format for the audio portion. In one embodiment of the invention, there is only one supported codec.

<bit-rate>

Min / Default / Max:	4.0 / 8.0 / 160.0
Function:	Indicates the number of kbits per second at which the stream should encode.

<channels>

Valid Values:	**mono**, stereo
Function:	Indicates the number of audio channels for the resulting stream. A value of *stereo* is only valid if the incoming file is also in stereo.

<sample-rate>

Min / Default / Max:	4.0 / 8.0 / 44.1
Restrictions:	Required.
Function:	The sample rate of the audio file output in kHz.

The Quicktime Encoder

Name: quicktime
Executable: qtencode.exe

The Quicktime Encoder converts .avi files into streaming files in the Quicktime-specific formats. Unlike the Microsoft and Real Encoders, Quicktime can produce multiple files. It produces one or more stream files, and if <encapsulation> is true, it also produces a reference file. The production of the reference file is a second step in the encoding process.

<input-dir> (Input Directory)

Valid Values:	A full directory path, such as *//localhost/media/ppoutputdir*.
Restrictions:	Required.

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Function: Designates the directory where the input file is located. This is typically the preprocessor's output directory.

`<input-file>`

Valid Values: A simple file name, without a path.

Restrictions: Required, and the file must already exist.

Function: Designates the input file for encoding. This should be the output file from the preprocessor.

`<tmp-dir> (Temporary Directory)`

Valid Values: A full directory path.

Restrictions: Required.

Function: Designates the directory where Quicktime may write any temporary working files.

`<output-dir> (Output Directory)`

Valid Values: A full directory path.

Restrictions: Required.

Function: Designates the directory where the stream files should be written.

`<output-file> (Output File)`

Valid Values: A valid file name.

Restrictions: Required.

Function: Designates the name of the reference file, usually in the form of `<name>`.qt. The streams are written to files of the form `<name>.<target>`.qt.

`<ref-file-dir> (Reference File Output Directory)`

Valid Values: An existing directory.

Restrictions: Required.

Function: Designates the output directory for the Quicktime reference file.

`<ref-file-type> (Reference File Type)`

Valid Values: **url**, alias.

Restrictions: Optional.

`<server-base-url> (Server Base URL)`

Valid Values: A valid URL.

Restrictions: Required if `<encapsulation>` is *true* and `<ref-file-type>` is *url* or missing

Function: Designates the URL where the stream files will be located. Required in order to encode this location into the reference file.

`<encapsulated> (Generate Reference File)`

Valid Values: *true*, *false*

Restrictions: Optional

Function: Indicates whether a reference file is generated.

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<downloadable>

Valid Values: *yes, no*

Restrictions: Optional

Function: Indicates whether a streaming file can be downloaded and played in its entirety.

<recordable>

Valid Values: *yes, no*

Restrictions: Optional

Function: Indicates whether the stream can be saved to disk.

<seekable>

Valid Values: *yes, no*

Restrictions: Optional

Function: Indicates whether the user can skip through the stream, rather than playing it linearly.

<auto-play>

Valid Values: *yes, no*

Restrictions: Optional

Function: Indicates whether the file should automatically play once it is loaded.

<progressive-download>

Valid Values: *yes, no*

Restrictions: Optional

<compress-movie-header>

Valid Values: *yes, no*

Restrictions: Optional

Function: Indicates whether the Quicktime movie header should be compressed to save space. Playback of compressed headers requires Quicktime 3.0 or higher.

<embedded-url>

Valid Values: A valid URL.

Restrictions: Optional

Function: Specifies a URL that should be displayed as Quicktime is playing.

<media>

A media section specifies a maximum target bit-rate and its associated parameters. The Quicktime encoder supports up to nine separate targets in a stream.

<target>

Valid Values: 14.4k, 28.8k, 56k, Dual-ISDN, T1, LAN

Restrictions: Required. A warning is generated if the sum of the video and audio bit-rates specified in the media section exceeds the total bit-rate associated the selected target.

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Function: Indicates a maximum desired bit-rate.

<video>

The video section contains parameters related to the video component of a target bit-rate.

<bit-rate>

Min / Default / Max: 5.0 / **[none]** / 10,000.0

Restrictions: Required.

Function: Indicates the number of kbits per second at which the video portion should encode.

<target-fps>

Min / Default / Max: 1 / **[none]** / 30

Restrictions: Required.

Function: Specifies the desired frames per second that the encoder will attempt to achieve.

<automatic-keyframes>

Valid Values: *yes*, *no*

Function: Indicates whether automatic or fixed keyframes should be used

<max-keyframe-spacing>

Min / Default / Max: 0.0 / **0.0** / 5000.0

Function: Designates that a keyframe will occur *at least* every <max-keyframe-spacing> seconds. A value of 0 indicates natural keyframes

<quality>

Min / Default / Max: 0 / **10** / 100

Function: This tag is used to control the trade-off between spatial image quality and the number of frames. 0 refers to the smoothest motion (highest number of frames) and 100 to the sharpest picture (least number of frames).

<encode-mode>

Valid Values: **CBR**

Function: Indicates constant bit-rate (CBR) encoding. At some point, variable bit-rate (VBR) may be an option.

<codec>

This section specifies the parameters that govern the video compression/decompression.

<type>

Valid Values: ***Sorenson2***

Function: Indicates whether automatic or fixed keyframes should be used.

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<faster-encoding>

Valid Values: fast, slow
Function: Controls the mode of the Sorenson codec that increases the encoding speed at the expense of quality.

<frame-dropping>

Valid Values: yes, no
Function: A value of yes indicates that the encoder may drop frames if the maximum bit-rate has been exceeded.

<data-rate-tracking>

Min / Default / Max: 0 / **17** / 100

Function: Tells the Sorenson codec how closely to follow the target bit-rate for each encoded frame. Tracking data rate tightly takes away some ability of the codec to maintain image quality. This setting can be dangerous as a high value my prevent a file from playing in bandwidth-restricted situations due to bit-rate spikes.

<force-block-refresh>

Min / Default / Max: 0 / **0** / 50

Function: This feature of the Sorenson coded is used to add error checking codes to the encoded stream to help recovery during high packet-loss situations. This tag is equivalent to the <loss-protection> tag, but with a larger valid range.

<image-smoothing>

Valid Values: yes, no
Function: This tag turns on the image de-blocking function of the Sorenson decoder to reduce low-bit-rate artifacts.

<keyframe-sensitivity>

Min / Default / Max: 0 / **50** / 100

<keyframe-size>

Min / Default / Max: 0 / **100** / 100

Function: Dictates the percentage of "normal" at which a keyframe will be created.

<width>

Min / Default / Max: 80 / **[none]** / 640

Restrictions: Required. Must be divisible by 8. Must be identical to the width in the input file, and therefore identical for each defined target.

Function: Width of each frame, in pixels.

<height>

Min / Default / Max: 60 / **[none]** / 480

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Restrictions: Required. Must be identical to the height in the input file, and therefore identical for each defined target.

Function: Height of each frame, in pixels.

<audio>

<bit-rate>

Min / Default / Max: 4.0 / **[none]** / 10000.0

Restrictions: Required.

Function: Indicates the number of kbits per second at which the stream should encode.

<channels>

Valid Values: **mono**, stereo

Function: Indicates the number of audio channels for the resulting stream. A value of *stereo* is only valid if the incoming file is also in stereo.

<type>

Valid Values: **music**, voice

Function: Indicates the type of audio being encoded, which in turn affects the encoding algorithm used in order to optimize for the given type.

<frequency-response>

Min / Default / Max: 0 / **5** / 10

Function: This tag is used to pick what dynamic range the user wants to preserve. Valid values are *0* to *10* with *0* the default. *0* means the least frequency response and *10* means the highest appropriate for this compression rate. Adding dynamic range needlessly will result in more artifacts of compression (chirps, ringing, etc.) and will increase compression time

<codec>

<type>

Valid Values: **QDesign2**, Qualcomm, IMA4:1

Function: Specifies the compression/decompression method for the audio portion.

<sample-rate>

Valid Values: 4, 6, 8,**11.025**,16, 22.050, 24, 32, 44.100

Function: The sample rate of the audio file output in kHz.

<attack>

Min / Default / Max: 0 / **50** / 100

Function: This tag controls the transient response of the codec. Higher settings allow the codec to respond more quickly to instantaneous changes in signal energy most often found in percussive sounds.

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<spread>	
Valid Values:	**full**, half
Function:	This tag selects either full or half-rate encoding. This overrides the semiautomatic kHz selection based on the <frequency-response> tag.
<rate>	
Min / Default / Max:	0 / **50** / 100
Function:	This tag is a measure of the tonal versus *noise-like* nature of the input signal. A lower setting will result in clear, but sometimes metallic audio. A higher setting will result in warmer, but nosier audio..
<optimize-for-streaming>	
Valid Values:	yes, **no**
Function:	This tag selects either full or half-rate encoding. This overrides the semiautomatic kHz selection based on the <frequency-response> tag.

LOCAL CONTROL SYSTEM (LCS)

The Local Control System (LCS) represents a service access point for a single computer system or server. The LCS provides a number of services upon the computer where it is running. These services are made available to users of the preferred embodiment through the Enterprise Control System (ECS). The services provided by the LCS are operating system services. The LCS is capable of starting, stopping, monitoring, and communicating with workers that take the form of local system processes. It can communicate with these workers via a bound TCP/IP socket pair. Thus it can pass commands and other information to workers and receive their status information in return. The status information from workers can be sent back to the ECS or routed to other locations as required by the configuration or implementation. The semantics of what status information is forwarded and where it is sent reflects merely the current preferred embodiment and is subject to change. The exact protocol and information exchanged between the LCS and workers is covered in a separate section below.

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Process creation and management are but a single form of the operating system services that might be exported. Any number of other capabilities could easily be provided. So the LCS is not limited in this respect. As a general rule, however, proper design dictates keeping components as simple as possible. Providing this basic capability, which is in no way tied directly to the task at hand, and then implementing access to other local services and features via workers provides a very simple, flexible and extensible architecture.

The LCS is an internet application. Access to the services it provides is through a TCP/IP socket. The LCS on any given machine is currently available at TCP/IP port number 3500 by convention only. It is not a requirement. It is possible to run multiple instances of the LCS on a single machine. This is useful for debugging and system integration but will probably not be the norm in practice. If multiple instances of the LCS are running on a single host they should be configured to listen on unique port numbers. Thus the LCS should be thought of as the single point of access for services on a given computer.

All LCS service requests are in the form of XML communicated via the TCP/IP connection. Note, that the selection of the TCP/IP protocol was made in light of its ubiquitous nature. Any general mechanism that provides for inter-process communication between distinct computer systems could be used. Also the choice of XML, which is a text-based language, provides general portability and requires no platform or language specific scheme to martial and transmit arguments. However, other markup, encoding or data layout could be used.

ECS / LCS Protocol

In the currently preferred embodiment, the LCS is passive with regard to establishing connections with the ECS. It does not initiate these connections, rather

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when it begins execution it waits for an ECS to initiate a TCP/IP connection. Once this connection is established it remains open, unless explicitly closed by the ECS, or it is lost through an unexpected program abort, system reboot or serious network error, etc. Note this is an implementation issue rather than an architecture issue. Further, on any given computer platform an LCS runs as a persistent service. Under Microsoft WindowsNT/2000 it is a system service. Under various versions of Unix it runs as a daemon process.

In current embodiments, when an LCS begins execution, it has no configuration or capabilities. Its capabilities must be established via a configuration or reconfiguration message from an ECS. However, local default configurations may be added to the LCS to provide for a set of default services which are always available.

LCS Configuration

When a connection is established between the ECS and the LCS, first thing received by the LCS should be either a configuration message or a reconfiguration message. The XML document tag `<lcs-configuration>` denotes a configuration message. The XML document tag `<lcs-reconfiguration>` denotes a reconfiguration message. These have the same structure and differ only by the XML document tag. The structure of this document can be found in Listing 1.

```
<lcs-configuration>
   <lcs-resource-id>99</lcs-resource-id>
   <log-config>0</log-config>
   <resource>
      <id>1</id>
      <name>fileman</name>
      <program>fileman.exe</program>
   </resource>
   <resource>
      <id>2</id>
      <name>prefilter</name>
      <program>prefilter.exe</program>
   </resource>
...
</lcs-configuration>
```

Listing 1

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There is a C++ class implemented to build, parse and validate this XML document. This class is used in both the LCS and the ECS. As a rule, an <lcs-configuration> message indicates that the LCS should maintain and communicate any pending status information from workers that may have been or still be active when the configuration message is received. An <lcs-reconfiguration> message indicates that the LCS should terminate any active workers and discard all pending status information from those workers.

Upon receiving an <lcs-configuration> message, the LCS discards its old configuration in favor of the new one. It then sends back one resource-status message, to indicate the availability of the resources on that particular system. Availability is determined by whether or not the indicated executable is found in the 'bin' sub-directory of the directory indicated by a specified system environment variable. At present only the set of resources found to be available are returned in the resource status message. Their <status> is flagged as 'ok'. See example XML response document, Listing 2 below. Resources from the configuration, not included in this resource-status message, are assumed off-line or unavailable for execution.

```
<resource-status>
   <status>ok</status>
   <resource-id>0</resource-id>
   <resource-id>1</resource-id>
   <resource-id>2</resource-id>
      ...
</resource-status>
```

Listing 2

As previously stated, in the case of the an <lcs-configuration> message, after sending the <resource-status> message, the LCS will then transmit any pending status information for tasks that are still running or may have completed or failed before the ECS connected or reconnected to the LCS. This task status information is in the form

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of a <notification-message>. See Listing 3 below for an example of a status indicating that a worker failed. The description of notification messages which follows this discussion provides full details.

```
<notification-message>
  <date-time>2001-05-03 21:07:19</date-time>
  <computer-name>host</computer-name>
  <user-name>J. Jones</user-name>
  <task-status>
    <failed></failed>
  </task-status>
  <resource-id>1</resource-id>
  <task-id>42</task-id>
</notification-message>
```

Listing 3

In the case of an <lcs-reconfiguration> command, the LCS accepts the new configuration, and it sends back the <resource-status> message. Then it terminates all active jobs, and deletes all pending notification messages. Thus a reconfiguration messages acts to clear away any state from the LCS, including currently active tasks. The distinction between these two commands provides for a mechanism for the ECS to come and go and not lose track of the entire collection of tasks being performed across any number of machines. In the even that the connection with an ECS is lost an LCS will always remember the disposition of its tasks, and dutifully report that information once a connection is re-established with an ECS.

LCS Resource Requests

All service requests made of the LCS are requested via <resource-request> messages. Resource requests can take three forms: 'execute', 'kill' and 'complete'. See XML document below in Listing 4. The <arguments> subdocument can contain one or more XML documents. Once the new task or worker is created and executing, each of these documents is communicated to the new worker.

```
<resource-request>
   <task-id> </task-id>
   <resource-id> </resource-id>
   <action> execute | kill | complete </action>
   <arguments>
        [xml document or documents containing task parameters]
   </arguments>
```


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```
</resource-request>
```

Listing 4

Execute Resource Request

A resource request action of 'execute' causes a new task to be executed. A process for the indicated resource-id is started and the document or documents contained in the `<arguments>` subdocument are passed to that worker as individual messages. The data passed to the new worker is passed through without modification or regard to content.

The LCS responds to the 'execute' request, with a notification message indicating the success or failure condition of the operation. A 'started' message indicates the task was successfully started. A 'failed' message indicates an error was encountered. The following XML document (Listing 5) is a example of a 'started'/'failed' message, generated in response to a 'execute' request.

```
<notification-message>
   <date-time>2001-05-03 21:50:59</date-time>
   <computer-name>host</computer-name>
   <user-name>J. Jones</user-name>
   <task-status>
      <started></started> or <failed></failed>
   </task-status>
   <resource-id>1</resource-id>
   <task-id>42</task-id>
</notification-message>
```

Listing 5

If an error is encountered in the process of executing this task, the LCS will return an appropriate 'error' message which will also contain a potentially platform specific description of the problem. See the table below. Notification messages were briefly described above and are more fully defined in their own document. Notification messages are used to communicate task status, errors, warnings, informational messages, debugging information, etc. Aside from `<resource-status>` messages, all other communication to the ECS is in the form of notification messages. The table below (Listing 6) contains a description of the 'error' notification messages

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generated by the LCS in response to a 'execute' resource request. For an example of the dialog between an ECS and LCS see the section labeled ECS/LCS Dialogue Examples.

```
error-messages
error AME_NOTCFG        Error, Media Encoder not configured
error   AME_UNKRES      Media Encoder unknown resource (^1)
error AME_RESSTRT       Error, worker failed to start (^1, ^2)
```

Listing 6

These responses would also include any notification messages generated by the actual worker itself before it failed. If during the course of normal task execution a worker terminates unexpectedly then the LCS generates the following notification message (Listing 7), followed by a 'failed' notification message.

```
error-messages
error   AME_RESDIED    Error, worker terminated without cause (^1, ^2).
```

Listing 7

An 'execute' resource request causes a record to be established and maintained within the LCS, even after the worker completes or fails its task. This record is maintained until the ECS issues a 'complete' resource request for that task.

"Insertion strings" are used in the error messages above. An insertion string is indicated by the '^' character followed by a number. These are markers for further information. For example, the description of the AME_UNKRES has an insertion string which would contain a resource-id.

Kill Resource Request

A resource request action of 'kill' terminates the specified task. A notification message is returned indicating that the action was performed regardless of the current state of the worker process or task. The only response for a 'kill' resource request is a 'killed' message. The example XML document (Listing 8) is an example of this response.

```
<notification-message>
   <date-time>2001-05-03 21:50:59</date-time>
```


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```
      <computer-name>host</computer-name>
      <user-name>J. Jones</user-name>
      <task-status>
         <killed></killed>
      </task-status>
      <resource-id>1</resource-id>
      <task-id>42</task-id>
   </notification-message>
```

Listing 8

Complete Resource Request

A resource request action of 'complete' is used to clear job status from the LCS. The task to be completed is indicated by the task-id. This command has no response. If a task is running when a complete arrives, that task is terminated. If the task is not running, and no status is available in the status map, no action is taken. In both cases warnings are written to the log file. See the description of the 'execute' resource-request for further details on task state.

ECS/LCS Dialogue Examples

As described above, the LCS provides a task independent way of exporting operating system services on a local computer system or server to a distributed system. Communication of both protocol and task specific data is performed in such a way as to be computer platform independent. This scheme is task independent in that it provides a mechanism for the creation and management of task specific worker processes using a mechanism that is not concerned with the data payloads delivered to the system workers, or the tasks they perform.

In the following example the XML on the left side of the page is the XML transmitted from the ECS to the LCS. The XML on the right side of the pages is the response made by the LCS to the ECS. The example shows the establishment of an initial connection between an ECS and LCS, and the commands and responses exchanged during the course of configuration, and the execution of a worker process. The intervening text is commentary and explanation.

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Example 1:

A TCP/IP connection to the LCS is established by the ECS. It then transmits a <lcs-configuration> message (see Listing 9).

```
<lcs-configuration>
   <lcs-resource-id>99</lcs-resource-id>
   <log-config>0</log-config>
   <resource>
      <id>1</id>
      <name>fileman</name>
      <program>fileman.exe</program>
   </resource>
   <resource>
      <id>2</id>
      <name>msencode</name>
      <program>msencode.exe</program>
   </resource>
</lcs-configuration>
```

Listing 9

The LCS responds (Listing 10) with a <resource-status> message thus verifying a configuration, and signaling that both resource 1 and 2 are both available.

```
<resource-status>
   <status>ok</status>
   <config-status>configured</config-status>
   <resource-id>1</resource-id>
   <resource-id>2</resource-id>
</resource-status>
```

Listing 10

The ECS transmits a <resource-request> message (Listing 11) requesting the execution of a resource, in this case, resource-id 1, which corresponds to the fileman (file-manager) worker. The document <doc> is the data intended input for the fileman worker.

```
<resource-request>
   <task-id>42</task-id>
   <resource-id>1</resource-id>
   <action>execute</action>
   <arguments>
      <doc>
         <test></test>
      </doc>
   </arguments>
</resource-request>
```

Listing 11

The LCS creates a worker process successfully, and responds with a started message (Listing 12). Recall from the discussion above that were this to fail one or more error messages would be generated followed by a 'failed' message.

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```
<notification-message>
   <date-time>2001-05-03 21:33:01</date-time>
   <computer-name>host</computer-name>
   <user-name>J. Jones</user-name>
   <task-status>
        <started></started>
   </task-status>
   <resource-name>fileman</resource-name>
   <resource-id>1</resource-id>
   <task-id>42</task-id>
</notification-message>
```

Listing 12

Individual worker processes generate any number of notification-messages of their own during the execution of their assigned tasks. These include but are not limited to, basic status messages indicating the progress of the task. The XML below (Listing 13) is one of those messages.

```
<notification-message>
   <date-time>2001-05-03 21:33:01</date-time>
   <computer-name>host</computer-name>
   <user-name>J. Jones</user-name>
   <task-status>
      <pct-complete>70</pct-complete>
      <elapsed-seconds>7</elapsed-seconds>
   </task-status>
   <resource-name>fileman</resource-name>
   <resource-id>1</resource-id>
   <task-id>42</task-id>
</notification-message>
```

Listing 13

All worker processes signify the successful or unsuccessful completion of a task, with similar notification-messages. If any worker process aborts or crashes a failure is signaled by the LCS.

Upon completion of a task the LCS signals the worker process to terminate (Listing 14). If the worker process fails to self terminate within a specific timeout period the worker process is terminated by the LCS.

```
<notification-message>
   <date-time>2001-05-03 21:33:44</date-time>
   <computer-name>host</computer-name>
   <user-name>J. Jones</user-name>
   <task-status>
      <success></success>
   </task-status>
   <resource-name>fileman</resource-name>
   <resource-id>1</resource-id>
   <task-id>42</task-id>
</notification-message>
```


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```
Listing 14
```

Upon completion of a task by a worker process, regardless of success or failure, the ECS will then complete that task with a `<resource-request>` message (Listing 15). This clears the task information from the LCS.

```
<resource-request>
   <task-id>42</task-id>
   <resource-id>1</resource-id>
   <action>complete</action>
</resource-request>

Listing 15
```

At this point the task is concluded and all task state has been cleared from the LCS. This abbreviated example shows the dialogue that takes place between the ECS and the LCS, during an initial connection, configuration and the execution of a task. It is important to note however that the LCS is in no way limited in the number of simultaneous tasks that it can execute and manage, this is typically dictated by the native operating system its resources and capabilities.

Example 2:

This example (Listing 16) shows the interchange between the ECS and LCS, if the ECS were to make an invalid request of the LCS. In this case, an execute request with an invalid resource-id given. The example uses a resource-id of 3, and assume that the configuration from the previous example is being used. It only contains two resources, 1 and 2. Thus resource-id 3 is invalid and an incorrect request.

```
<resource-request>
   <task-id>43</task-id>
   <resource-id>3</resource-id>
   <action>execute</action>
   <arguments>
      <doc>
         <test></test>
      </doc>
   </arguments>
</resource-request>

Listing 16
```


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A resource request for resource-id 3 is clearly in error. The LCS responds with an appropriate error, followed by a 'failed' response for this resource request (Listing 17).

```
<notification-message>
   <date-time>2001-05-04 08:55:46</date-time>
   <computer-name>host</computer-name>
   <user-name>J. Jones</user-name>
   <error>
      <msg-token>AME_UNKRES</msg-token>
      <msg-string>Media Encoder unknown resource
(3)</msg-string>
      <insertion-string>3</insertion-string>
      <source-file>lcs.cpp</source-file>
      <line-number>705</line-number>
      <compile-date>May  3 2001 21:29:08</compile-date>
   </error>
   <resource-id>3</resource-id>
   <task-id>43</task-id>
</notification-message>


<notification-message>
   <date-time>2001-05-04 08:55:46</date-time>
   <computer-name>host</computer-name>
   <user-name>J. Jones</user-name>
   <task-status>
      <failed></failed>
   </task-status>
   <resource-id>3</resource-id>
   <task-id>43</task-id>
</notification-message>
```

Listing 17

As before, the ECS will always complete a task with a 'complete' resource request (Listing 18). Thus clearing all of the state for this task from the LCS.

```
<resource-request>
   <task-id>43</task-id>
   <resource-id>3</resource-id>
   <action>complete</action>
</resource-request>
```

Listing 18

Message Handling

The following describes the message handling system of the preferred embodiment. It includes definition and discussion of the XML document type used to define the message catalog, and the specification for transmitting notification messages from a worker. It discusses building the database that contains all of the messages, descriptions, and (for errors) mitigation strategies for reporting to the user.

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Message catalog:

- Contains the message string for every error, warning, and information message in the system.
- Every message is uniquely identified using a symbolic name (token) of up to 16 characters.
- Contains detailed description and (for errors and warnings) mitigation strategies for each message.
- Stored as XML, managed using an XML-aware editor (or could be stored in a database).
- May contain foreign language versions of the messages.

Notification Messages:

- Used to transmit the following types of information from a worker: errors, warnings, informational, task status, and debug.
- A single XML document type is used to hold all notification messages. The XML specification provides elements to handle each specific type of message.
- Each error/warning/info is referenced using the symbolic name (token) that was defined in the message catalog. Insertion strings are used to put dynamic information into the message.

Workers must all follow the defined messaging model. Upon beginning execution of the command, the worker sends a task status message indicating "started working". During execution, the worker may send any number of messages of various types. Upon completion, the worker must send a final task status message indicating either "finished successfully" or "failed". If the final job status is "failed", the worker is expected to have sent at least one message of type "error" during its execution.

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The Message Catalog

All error, warning, and informational messages are defined in a message catalog that contains the mapping of tokens (symbolic name) to message, description, and resolution strings. Each worker will provide its own portion of the message catalog, stored as XML in a file identified by the .msgcat extension. Although the messages are static, insertion strings can be used to provide dynamic content at run-time. The collection of all .msgcat files forms the database of all the messages in the system.

The XML document for the message catalog definition is defined in Listing 19:

```
DTD:
<!ELEMENT msg-catalog (msg-catalog-section*)>
<!ELEMENT msg-catalog-section (msg-record+)>
<!ELEMENT msg-record (msg-token, msg-string+, description+, resolution*)>
<!ELEMENT msg-token (#PCDATA)>
<!ELEMENT msg-string (#PCDATA)>
<!ATTLIST msg-string language (English|French|German) "English">
<!ELEMENT description (#PCDATA)>
<!ATTLIST description language (English|French|German) "English">
<!ELEMENT resolution (#PCDATA)>
<!ATTLIST resolution language (English|French|German) "English">

<msg-catalog-section>
   <msg-record>
      <msg-token></msg-token>
      <msg-string language="English"></msg-string>
      <msg-string language="French"></msg-string>
      <msg-string language="German"></msg-string>
      …
      <description language="English"></description>
      <description language="French"></description>
      <description language="German"></description>
      …
      <resolution language="English"></resolution>
      <resolution language="French"></resolution>
      <resolution language="German"></resolution>
      …
   </msg-record>
   …
</msg-catalog-section>

Listing 19
```

msg-catalog-section

XML document containing one or more <msg-record> elements.

msg-record

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Definition for one message. Must contain exactly one `<msg-token>`, one or more `<msg-string>`, one or more `<description>`, and zero or more `<resolution>` elements.

`msg-token`

The symbolic name for the message. Tokens contain only numbers, upper case letters, and underscores and can be up to 16 characters long. All tokens must begin with a two-letter abbreviation (indicating the worker) followed by an underscore. Every token in the full message database must be unique.

`msg-string`

The message associated with the token. The "language" attribute is used to specify the language of the message (English is assumed if the "language" attribute is not specified). When the message is printed at run-time, insertion strings will be placed wherever a "^#" (caret followed by a number) appears in the message string. The first insertion-string will be inserted everywhere "^1" appears in the message string, the second everywhere "^2" appears, etc. Only 9 insertion strings (1-9) are allowed for a message.

`description`

Detailed description of the message and its likely cause(s). Must be provided for all messages.

`resolution`

Suggested mitigation strategies. Typically provided only for errors and warnings.

An example file defining notification messages specific to the file manager is shown in Listing 20:

```
<msg-catalog-section>

   <!--  ***************************************************  -->
   <!--  *                FILE MANAGER SECTION             *  -->
   <!--  *                                                 *  -->
   <!--  * These messages are specific to the File Manager.  *  -->
   <!--  * All of the tokens here begin with "FM_".        *  -->
   <!--  ***************************************************  -->
```


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```
<msg-record>
<msg-token>FM_CMDINVL</msg-token>
<msg-string>Not a valid command</msg-string>
<description>This is returned if the FileManager gets a command that it
does not understand.</description>
<resolution>Likely causes are that the FileManager executable is out of
date, or there was a general system protocol error. Validate that the install
on the machine is up to date.</resolution>
</msg-record>

<msg-record>
<msg-token>FM_CRDIR</msg-token>
<msg-string>Error creating subdirectory '^1'</msg-string>
<description>The FileManager, when it is doing FTP transfers will create
directories on the remote machine if it needs to and has the privilege. This
error is generated if it is unable to create a needed directory.</description>
<resolution>Check the remote file system. Probably causes are
insufficient privilege, full file system, or there is a file with the same name
in the way of the directory creation.</resolution>
</msg-record>

<msg-record>
<msg-token>FM_NOFIL</msg-token>
<msg-string> No file(s) found matching '^1'</msg-string>
<description>If the filemanager was requested to perform an operation on'
a collection of files using a wildcard operation and this wild card evaluation
results in NO files being found. This error will be generated.</description>
<resolution>Check your wild carded expression.</resolution>
</msg-record>

<msg-record>
<msg-token>FM_OPNFIL</msg-token>
<msg-string> Error opening file '^1', ^2</msg-string>
<description>Filemanager encountered a problem opening a file. It
displays the name as well as the error message offered by the operating
system.</description>
<resolution>Check the file to make sure it exists and has appropriate
permissions. Take your cue from the system error in the message.</resolution>
</msg-record>

<msg-record>
<msg-token>FM_RDFIL</msg-token>
<msg-string> Error reading file '^1', ^2</msg-string>
<description>Filemanager encountered a problem reading a file. It
displays the name as well as the error message offered by the operating
system.</description>
<resolution>Check the file to make sure it exists and has appropriate
permissions. Take your cue from the system error in the message.</resolution>
</msg-record>

<msg-record>
<msg-token>FM_WRFIL</msg-token>
<msg-string>Error writing file '^1', ^2</msg-string>
<description>Filemanager encountered a problem writing a file. It
displays the name as well as the error message offered by the operating
system.</description>
<resolution>Check to see if the file system is full. Take your cue from
the system error in the message.</resolution>
</msg-record>

<msg-record>
<msg-token>FM_CLSFIL</msg-token>
<msg-string> Error closing file '^1', ^2</msg-string>
<description>Filemanager encountered a problem closing a file. It
displays the name as well as the error message offered by the operating
system.</description>
<resolution>Check to see if the file system is full. Take your cue from
the system error in the message.</resolution>
</msg-record>

<msg-record>
<msg-token>FM_REMOTE</msg-token>
<msg-string> Error opening remote file '^1', ^2</msg-string>
```


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```
      <description>Encountered for ftp puts. The offending file name is listed,
the system error is very confusing. It is the last 3 to 4 lines of the FTP
protocol operation. Somewhere in there is likely a clue as to the problem. Most
probably causes are: the remote file system is full; there is a permission
problem on the remote machine and a file can't be created in that
location.</description>
      <resolution>Check the remote file system. Probably causes are
insufficient privilege, full file system, or there is a file with the same name
in the way of the directory creation.</resolution>
   </msg-record>

   <msg-record>
      <msg-token>FM_GET</msg-token>
      <msg-string> Error in ftp get request, src is '^1', dest is '^2'</msg-
string>
      <description>This error can be generated by a failed ftp get request.
Basically, it means there was either a problem opening and reading the source
file, or opening and writing the local file. No better information is
available.</description>
      <resolution>Check both file paths, names etc. Possible causes are bad or
missing files, full file systems, insufficient privileges.</resolution>
   </msg-record>
```

Listing 20

Similar XML message description files will be generated for all of the workers in the system. The full message catalog will be the concatenation of all of the worker `.msgcat` files.

Notification Messages

There are 5 message types defined for our system:

- Error
- Warning
- Information
- Task Status
- Debug

All error, warning, and information messages must be defined in the message catalog, as all are designed to convey important information to an operator. Errors are used to indicate fatal problems during execution, while warnings are used for problems that aren't necessarily fatal. Unlike errors and warnings that report negative conditions, informational messages are meant to provide positive feedback from a running system. Debug and task status messages are not included in the message

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catalog. Debug messages are meant only for low-level troubleshooting, and are not presented to the operator as informational messages are. Task status messages indicate that a task started, finished successfully, failed, or has successfully completed some fraction of its work.

The XML document for a notification message is defined in Listing 21:

```
<notification-message>
   <date-time></date-time>
   <computer-name></computer-name>
   <user-name></user-name>
   <resource-name></resource-name>
   <resource-id></resource-id>
   <task-id></task-id>

plus one of the following child elements:
   <error>
      <msg-token></msg-token>
      <msg-string></msg-string>
      <insertion-string></insertion-string>  (zero or more)
      <source-file></source-file>
      <line-number></line-number>
      <compile-date></compile-date>
   </error>

   <warning>
      <msg-token></msg-token>
      <msg-string></msg-string>
      <insertion-string></insertion-string>  (zero or more)
      <source-file></source-file>
      <line-number></line-number>
      <compile-date></compile-date>
   </warning>

   <info>
      <msg-token></msg-token>
      <msg-string></msg-string>
      <insertion-string></insertion-string>  (zero or more)
      <source-file></source-file>
      <line-number></line-number>
      <compile-date></compile-date>
   </info>

   <debug>
      <msg-string></msg-string>
      <source-file></source-file>
      <line-number></line-number>
      <compile-date></compile-date>
   </debug>

   <task-status>
      <started/>  or
      <success/>  or
      <failed/>   or
      <killed/>   or
      <pct-complete></pct-complete>
      <elapsed-seconds></elapsed-seconds>
   </task-status>

</notification-message>
```

Listing 21

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`date-time`

When the event that generated the message occurred, reported as a string of the form YYYY-MM-DD HH:MM:SS.

`computer-name`

The name of the computer where the program that generated the message was running.

`user-name`

The user name under which the program that generated the message was logged in.

`resource-name`

The name of the resource that generated the message.

`resource-id`

The id number of the resource that generated the message.

`task-id`

The id number of the task that generated the message.

`error`

Indicates that the type of message is an error, and contains the sub-elements describing the error.

`warning`

Indicates that the type of message is a warning (contains the same sub-elements as `<error>`).

`info`

Indicates that the type of message is informational (contains the same sub-elements as `<error>` and `<warning>`).

`debug`

Indicates that this is a debug message.

`task-status`

Indicates that this is a task status message.

`msg-token (error, warning, and info only)`

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The symbolic name for the error/warning/info message. Tokens and their corresponding message strings are defined in the message catalog.

`msg-string`

The English message text associated with the token, with any insertion strings already placed into the message. This message is used for logging purposes when the message database is not available to look up the message string.

`insertion-string`

A string containing text to be inserted into the message, wherever a "^#" appears in the message string. There can be up to 9 instances of `<insertion-string>` in the error/warning/info element; the first insertion-string will be inserted wherever "^1" appears in the message string stored in the database, the second wherever "^2" appears, etc.

`source-file`

The name of the source file that generated the message. C++ workers will use the pre-defined __FILE__ macro to set this.

`line-number`

The line number in the source file where the message was generated. C++ workers will use the pre-defined __LINE__ macro to set this.

`compile-date`

The date that the source file was compiled. C++ workers will use the pre-defined __DATE__ and __TIME__ macros.

`started (task-status only)`

If present, indicates that the task was started.

`success (task-status only)`

If present, indicates that the task finished successfully. Must be the last message sent from the worker.

`failed (task-status only)`

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If present, indicates that the task failed. Typically at least one <error> message will have been sent before this message is sent. Must be the last message sent from the worker.

killed (task-status only)

If present, indicates that the worker was killed (treated the same as a <failed> status). Must be the last message sent from the worker.

pct-complete (task-status only)

A number from 0 to 100 indicating how much of the task has been completed.

elapsed-seconds (task-status only)

The number of seconds that have elapsed since work started on the task.

Worker Messaging Interface

The worker will generate error, warning, status, info, and debug messages as necessary during processing. When the worker is about to begin work on a task, a <task-status> message with <started> must be sent to notify that the work has begun. This should always be the first message that the worker sends; it means "I received your command and am now beginning to act on it". Once the processing has begun, the worker might generate (and post) any number of error, warning, informational, debug or task status (percent complete) messages. When the worker has finished working on a task, it must send a final <task-status> message with either <success> or <failed>. This indicates that all work on the task has been completed, and it was either accomplished successfully or something went wrong. Once this message is received, no further messages are expected from the worker.

For job monitoring purposes, all workers are requested to periodically send a <task-status> message indicating the approximate percentage of the work completed and the total elapsed (wall clock) time since the start of the task. If the total amount of

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work is not known, then the percent complete field can be left out or reported as zero. It is not necessary to send `<task-status>` messages more often than every few seconds.

Building the Message Database

The following discussion explains how to add local messages to the database containing all of the messages, and how to get them into the NT (or other appropriate) Event Log correctly.

Building a Worker Message Catalog

This section explains how to build the message catalog for workers.

1. Build a message catalog file containing all of the error/warning/info messages that the worker generates (see section 2 above for the XML format to follow). The file name should contain the name of the worker and the .msgcat extension, and it should be located in the same source directory as the worker code. For example, Anyworker.msgcat is located in Blue/apps/anyworker. The .msgcat file should be checked in to the CVS repository.
2. So that message tokens from different workers do not overlap, each worker must begin their tokens with a unique two- or three-letter prefix. For example, all of the Anyworker message tokens begin with "AW_". Prefix definitions can be found in Blue/common/messages/worker_prefixes.txt -- make sure that the prefix chosen for the worker is not already taken by another worker.
3. Once the worker .msgcat file is defined, it is necessary to generate a .h file containing the definition of all of the messages. This is accomplished automatically by a utility program. The Makefile for the worker should be modified to add 2 lines like the following (use the name of the worker in question in place of "Anyworker"):

```
Anyworker_msgcat.h: Anyworker.msgcat
        $(BUILD_MSGCAT_H) $@ $**
```

It is also advisable to add this .h file to the "clean" target in the Makefile:

```
clean:
        -$(RM) Anyworker_msgcat.h $(RMFLAGS)
```


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4. The .h file contains the definition for a MESSAGE_CATALOG array, and constant character strings for each message token. The MESSAGE_CATALOG is sent to the Notify::catalog() function upon worker initialization. The constants should be used for the msg-token parameter in calls to Notify::error(), Notify::warning(), and Notify::info(). Using these constants (rather than explicitly specifying a string) allows the compiler to make sure that the given token is spelled correctly.
5. After creating the .msgcat file, it should be added to the master message catalog file. An ENTITY definition should be added at the top of the file containing the relative path name to the worker .msgcat file. Then, further in the file, the entity should be included with *&entity-name*. This step adds the messages to the master message catalog that is used to generate the run-time message database and the printed documentation.

Using the Notify Interface

This section explains how to send notification messages from a worker. These functions encapsulate the worker messaging interface described in section 4 above. To use them, the appropriate header file should be included in any source file that includes a call to any of the functions.

When the worker begins work on a task, it must call

```
Notify::started();
```

to send a task-started message. At the same time, the worker should also initialize the local message catalog by calling

```
Notify::catalog(MESSAGE_CATALOG);
```

During execution, the worker should report intermediate status every few seconds by calling

```
Notify::status (pct_complete);
```

where pct_complete is an integer between 0 and 100. If the percent complete cannot be calculated (if the total amount of work is unknown), Notify::status() should still be

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called every few seconds because it will cause a message to be sent with the elapsed time. In this case, it should set the percent complete to zero.

If an error or warning is encountered during execution, use

```
Notify::error (IDPARAMS, token, insertion_strings);
Notify::warning (IDPARAMS, token, insertion_strings);
```

Where `token` is one of the character constants from the msgcat.h file, and `insertion_strings` are the insertion strings for the message (each insertion string is passed as a separate function parameter). The worker may send multiple error and warning messages for the same task.

IDPARAMS is a macro which is defined in the notification header file, Notify.h. The IDPARAMS macro is used to provide the source file, line number, and compile date to the messaging system.

Informational messages are used to report events that a system operator would be interested in, but that are not errors or warnings. In general, the ECS and LCS are more likely to send these types of messages than any of the workers. If the worker does generate some information that a system operator should see, the form to use is

```
Notify::info (IDPARAMS, token, insertion_strings);
```

Debug information can be sent using

```
Notify::debug (IDPARAMS, debug_level, message_string);
```

The debug function takes a `debug_level` parameter, which is a positive integer. The debug level is used to organize debug messages by importance: level 1 is for messages of highest importance, larger numbers indicate decreasing importance. This allows the person performing debugging to apply a cut-off and only see messages below a certain level. Any verbose or frequently sent messages that could adversely affect performance should be assigned a level of 5 or larger, so that they can be ignored if necessary.

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When the worker has finished executing a task, it must call either

```
Notify::finished (Notify::SUCCESS);
```

or

```
Notify::finished (Notify::FAILED);
```

This sends a final status message and indicates that the worker will not be sending any more messages. If the status is FAILED, then the worker is expected to have sent at least one error message during execution of the task.

Using the XDNotifMessage Class

For most workers, the interface defined in Notify.h will be sufficient for all messaging needs. Other programs (like the LCS and ECS) will need more detailed access to read and write notification messages. For these programs, the XDNotifMessage class has been created to make it easy to access the fields of a notification message.

The XDNotifMessage class always uses some existing XmlDocument object, and does not contain any data members other than a pointer to the XmlDocument. The XDNotifMessage class provides a convenient interface to reach down into the XmlDocument and manipulate `<notification-message>` XML documents.

VIDEO PROCESSING

Regarding the video processing aspects of the invention, **Fig. 8** is a block diagram showing the one possible selection of components for practicing the present invention. This includes a camera **810** or other source of video to be processed, an optional video format decoder **820**, video processing apparatus **830**, which may be a dedicated, accelerated DSP apparatus or a general purpose processor (with one or a plurality of CPUs) programmed to perform video processing operations, and one or

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more streaming encoders **841**, **842**, **843**, etc., whose output is forwarded to servers of other systems **850** for distribution over the Internet or other network.

Fig. 9 is a flowchart showing the order of operations employed in one embodiment of the invention.

Video source material in one of a number of acceptable formats is converted (**910**) to a common format for the processing (for example, YUV 4:2:2 planar). To reduce computation requirements, the image is cropped to the desired content (**920**) and scaled horizontally (**930**) (the terms "scaled", "rescaled", "scaling" and "rescaling" are used interchangeably herein with the terms "sized", "resized", "sizing" and "resizing"). The scaled fields are then examined for field-to-field correlations (**940**) used later to associate related fields (**960**). Spatial deinterlacing optionally interpolates video fields to full-size frames (**940**). No further processing at the input rate is required, so the data are stored (**950**) to a FIFO buffer.

When output frames are required, the appropriate data is accessed from the FIFO buffer. Field association may select field pairs from the buffer that have desirable correlation properties (temporal deinterlacing) (**960**). Alternatively, several fields may be accessed and combined to form a temporally smoothed frame (**960**). Vertical scaling (**970**) produces frames with the desired output dimensions. Spatial filtering (**980**) is done on this small-format, lower frame-rate data. Spatial filtering may include blurring, sharpening and/or noise reduction. Finally color corrections are applied and the data are optionally converted to RGB space (**990**).

This embodiment supports a wide variety of processing options. Therefore, all the operations shown, except the buffering (**950**), are optional. In common situations, most of these operations are enabled.

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Examining this process in further detail, it is noted that the material is received as a sequence of video fields at the input field rate (typically 60Hz). The processing creates output frames at a different rate (typically lower than the input rate). The algorithm shown in **Fig. 9** exploits the fact that the desired encoded formats normally have lower spatial and temporal resolution than the input.

In this process, as noted, images will be resized (as noted above, sometimes referred to as "scaled") and made smaller. Resizing is commonly performed through a "geometric transformation", whereby a digital filter is applied to an image in order to resizing it. Filtering is done by convolving the image pixels with the filter function. In general these filters are two-dimensional functions.

The order of operations is constrained, insofar as vertical scaling is better performed after temporal (field-to-field) operations, rather than before. The reason is that vertical scaling changes the scan lines, and because of interlacing, the scan data from any given line is varied with data from lines two positions away. If temporal operations were performed after such scaling, the result would tend to produce undesirable smearing.

If, as is conventionally done, image resizing were to be performed with a two-dimensional filter function, vertical and horizontal resizing would be performed at the same time – in other words, the image would be resized, both horizontally and vertically, in one combined operation taking place after the temporal operations (**960**).

However, simple image resizing is a special case of "geometric transformations," and such resizing may be separated into two parts: horizontal resizing and vertical resizing. Horizontal resizing can then be performed using a one-dimensional horizontal filter. Similarly, vertical resizing can also be performed with a one-dimensional vertical filter.

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The advantage of separating horizontal from vertical resizing is that the horizontal and vertical resizing operations can be performed at different times. Vertical resizing is still performed (**970**) after temporal operations (**960**) for the reason given above. However, horizontal resizing may be performed much earlier (**930**), because the operations performed to scale a horizontal line do not implicate adjacent lines, and do not unacceptably interfere with later correlations or associations.

Computational requirements are reduced when the amount of data to be operated upon can be reduced. Cropping (**920**) assists in this regard. In addition, as a result of separating horizontal from vertical resizing, the horizontal scaling (**930**) can be performed next, resulting in a further computational efficiency for the steps that follow, up to the point where such resizing conventionally would have been performed, at step **970** or later. At least steps **940**, **950** and **960** derive computational benefit from this ordering of operations. Furthermore, performing horizontal resizing prior to performing temporal operations (**960**) provides the additional benefit of being able to use a smaller FIFO buffer for step **950**, with a consequent saving in memory usage.

Furthermore, considerable additional computational efficiency results from performing both horizontal (**930**) and vertical (**970**) scaling before applying spatial filters (**980**). Spatial filtering can is often computationally expensive, and considerable benefit is derived from performing those operations after the data has been reduced to the extent feasible.

The embodiment described above allows all the image processing required for high image quality in the streaming format to be done in one continuous pipeline. The algorithm reduces data bandwidth in stages (horizontal, temporal, vertical) to minimize computation requirements.

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Video is successfully processed by this method from any one of several input formats and provided to any one of several streaming encoders while maintaining the image quality characteristics desired by the video producer. The method is efficient enough to allow this processing to proceed in real time on commonly available workstation platforms in a number of the commonly used processing configurations. The method incorporates enough flexibility to satisfy the image quality requirements of the video producer.

Video quality may be controlled in ways that are not available through streaming video encoders. Video quality controls are more centralized, minimizing the effort otherwise required to set up different encoders to process the same source material. Algorithmic efficiency allows the processing to proceed quickly, often in real time.

DISTRIBUTING STREAMING MEDIA

Regarding the distributing streaming media aspects of the invention, a preferred embodiment is illustrated in **Figs. 14 - 18**, and is described in the text that follows. The present invention seeks to deliver the best that a particular device can offer given its limitations of screen size, color capability, sound capability and network connectivity. Therefore, the video and audio provided for a cell phone would be different from what a user would see on a PC over a broadband connection. The cell phone user, however, doesn't expect the same quality as they get on their office computer; rather, they expect the best the cell phone can do.

Improving the streaming experience requires detailed knowledge of the end user environment and its capabilities. That information is not easily available to central streaming servers; therefore, it is advantageous to have intelligence at a point

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in the network much closer to the end user. The Internet community has defined this closer point as the "edge" of the network. Usually this is within a few network hops to the user. It could be their local point-of-presence (PoP) for modem and DSL users, or the cable head end for cable modem users. For purposes of this specification and the following claims, the preferred embodiment for the "edge" utilizes a location on a network that is one connection hop from the end user. At this point, the system knows detailed information on the users' network connectivity, the types of protocols they are using, and their ultimate end devices. The present invention uses this information at the edge of the network to provide an improved live streaming experience to each individual user.

A complete Agility Edge deployment, as shown in **Fig. 14** consists of:

1. An Agility Enterprise™ encoding platform

The Agility Enterprise encoding platform (1404) is deployed at the point of origination (1403). Although it retains all of its functionality as an enterprise-class encoding automation platform, its primary role within an Agility Edge deployment is to encode a single, high bandwidth MPEG-based Agility Transport Stream™ (ATS) (1406) and deliver it via a CDN (1408) to Agility Edge encoders (1414) located in various broadband ISPs at the edge of the network.

2. One or more Agility Edge encoders

The Agility Edge encoders (1414) encode the ATS stream (1406) received from the Agility Enterprise platform (1404) into any number of formats and bit rates based on the policies set by the CDN or ISP (1408). This policy based encoding™ allows the CDN or ISP (1408) to match the output streams to the requirements of the end user. It also opens a wealth of opportunities to add local relevance to the content with techniques like digital watermarking, or local ad insertion based on end user

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demographics. Policy based encoding can be fully automated, and is even designed to respond dynamically to changing network conditions.

3. An Agility Edge Resource Manager

The Agility Edge Resource Manager (1410) is used to provision Agility Edge encoders (1414) for use, define and modify encoding and distribution profiles, and monitor edge-encoded streams.

4. An Agility Edge Control System

The Agility Edge Control System (1412) provides for command, control and communications across collections of Agility Edge encoders (1414).

Fig. 15 shows how this fully integrated, end-to-end solution automatically provides content to everyone in the value chain.

The content producer (1502) utilizes the Agility Enterprise encoding platform (1504) to simplify the production workflow and reduce the cost of creating a variety of narrowband streams (1506). That way, customers (1512) not served by Agility Edge Encoders (1518) still get best-effort delivery, just as they do throughout the network today. But broadband and wireless customers (1526) served by Agility Edge equipped CDNs and ISPs (1519) will receive content (1524) that is matched to the specific requirements of their connection and device. Because of this, the ISP (1519) is also much better prepared to offer tiered and premium content services that would otherwise be impractical. With edge-based encoding, the consumer gets higher quality broadband and wireless content, and they get more of it.

Turning to **Fig. 16**, which depicts an embodiment of Edge Encoding for a video stream, processing begins when the video producer (1602) generates a live video feed (1604) in a standard video format. These formats, in an appropriate order of preference, may include SDI, DV, Component (RGB or YUV), S-Video (YC),

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Composite in NTSC or PAL. This live feed (1604) enters the Source Encoder (1606) where the input format is decoded in the Video Format Decoder (1608). If the source input is in analog form (for example, Component, S-Video, or Composite), it will be digitized into a raw video and audio input. If it is already in a digital format (for example, SDI or DV), the specific digital format will be decoded to generate a raw video and audio input.

From here, the Source Encoder (1606) performs video and audio processing (1610). This processing may include steps for cropping, color correction, noise reduction, blurring, temporal and spatial down sampling, the addition of a source watermark or "bug", or advertisement insertion. Additionally, filters can be applied to the audio. Most of these steps increase the quality of the video and audio. Several of these steps can decrease the overall bandwidth necessary to transmit the encoded media to the edge. They include cropping, noise reduction, blurring, temporal and spatial down sampling. The use of temporal and spatial down sampling is particularly important in lowering the overall distribution bandwidth; however, it also limits the maximum size and frame rate of the final video seen by the end user. Therefore, in the preferred embodiment, its settings are chosen based on the demands of the most stringent edge device.

The preferred embodiment should have at least a spatial down sampling step to decrease the image size and possibly temporal down sampling to lower the frame rate. For example, if the live feed is being sourced in SDI for NTSC then it has a frame size of 720x486 at 29.97 frames per second. A common high quality Internet streaming media format is at 320x240 by 15 frames a second. By using spatial and temporal down sampling to reduce the SDI input to 320x240 by 15 frames per second lowers the number of pixels (or PELs) that must be compressed to 10% of the original

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requirement. This would be a substantial savings to video producer and content delivery network.

Impressing a watermark or "bug" on the video stream allows the source to brand their content before it leaves their site. Inserting ads into the stream at this point is equivalent to national ad spots on cable or broadcast TV. These steps are optional, but add great value to the content producer.

Once video and audio processing is finished, the data is compressed in the Edge Format Encoder (1612) for delivery to the edge devices. While any number of compression algorithms can be used, the preferred embodiment uses MPEG1 for low bit rate streams (less than 2 megabits/second) and MPEG2 for higher bit rates. The emerging standard MPEG4 might become a good substitute as commercial versions of the codec become available. Once compressed, the data is prepared for delivery over the network (1614), for example, the Internet.

Many different strategies can be used to deliver the streaming media to the edge of the network. These range from point to point connections for limited number of Edge devices, working with third party supplies of multicast networking technologies, to contracting with a Content Delivery Network (CDN). The means of delivery, which are outside the scope of this invention, are known to those of ordinary skill in the art.

Once the data arrives at the Edge Encoder (1616), the media stream is decoded in the Edge Format Decoder (1618) from its delivery format (specified above), and then begins local customization (1620). This customization is performed using the same type of video and audio processing used at the Source Encoder (1606), but it has a different purpose. At the source, the processing was focused on preparing the media for the most general audience and for company branding and national-style ads. At

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the edge in the Edge Encoder (1616), the processing is focused on customizing the media for best viewing based on knowledge of local conditions and for local branding and regional or individual ad insertion. The video processing steps common at this stage may include blurring, temporal and spatial down sampling, the addition of a source watermark or "bug", and ad insertion. It is possible that some specialized steps would be added to compensate for a particular streaming codec. The preferred embodiment should at least perform temporal and spatial down sampling to size the video appropriate for local conditions.

Once the media has been processed, it is sent to one or more streaming codecs (1622) for encoding in the format appropriate to the users and their viewing devices. In the preferred embodiment, the Viewer Specific Encoder (1622) of the Edge Encoder (1616) is located one hop (in a network sense) from the end users (1626). At this point, most of the users (1626) have the same basic network characteristics and limited viewing devices. For example, at a DSL PoP or Cable Modem plant, it is likely that all of the users have the same network speed and are using a PC to view the media. Therefore, the Edge Encoder (1616) can create just two or three live Internet encoding streams using Viewer Specific Encoders (1622) in the common PC formats (at the time of this writing, the commonly used formats include Real Networks, Microsoft and QuickTime). The results of the codecs are sent to the streaming server (1624) to be viewed by the end users (1626).

Edge encoding presents some unique possibilities. One important one is when the viewing device can only handle audio (such as a cell phone). Usually, these devices are not supported because it would increase the burden on the video producer. Using Edge Encoders, the video producer can strip out the video leaving only the

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audio track and then encode this for presentation to the user. In the cell phone example, the user can hear the media over the earpiece.

The present invention offers many advantages over current Internet Streaming Media solutions. Using the present invention, video producers have a simplified encoding workflow because they only have to generate and distribute a single encoded stream. This reduces the video producers' product and distribution costs since they only have to generate and distribute a single format.

While providing these cost reductions, the present invention also improves the end user's streaming experience, since the stream is matched to that particular user's device, format, bit rate and network connectivity. The end user has a more satisfying experience and is therefore more likely to watch additional content, which is often the goal of video producers.

Further, the network providers currently sell only network access, such as Internet access. They do not sell content. Because the present invention allows content to be delivered at a higher quality level than is customary using existing technologies, it becomes possible for a network provider to support premium video services. These services could be supplied to the end user for an additional cost. It is very similar to the television and cable industry that may have basic access and then multiple-tiered premium offerings. There, a basic subscriber only pays for access. When a user gets a premium offering, their additional monthly payment is used to supply revenue to the content providers of the tiered offering, and the remainder is additional revenue for the cable provider.

The present invention also generates unique opportunities to customize content based on the information the edge encoder possesses about the end user. These opportunities can be used for localized branding of content or for revenue

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generation by insertion of advertisements. This is an additional source of revenue for the network provider. Thus, the present invention supports new business models where the video producers, content delivery networks, and the network access providers can all make revenues not possible in the current streaming models.

Moreover, the present invention reduces the traffic across the network, lowering network congestion and making more bandwidth available for all network users.

Pre-Processing Methodology of the Present Invention

One embodiment of the invention, shown in **Fig. 17**, takes source video (1702) from a variety of standard formats and produces Internet streaming video using a variety of streaming media encoders. The source video (1702) does not have the optimum characteristics for presentation to the encoders (1722). This embodiment provides a conversion of video to an improved format for streaming media encoding. Further, the encoded stream maintains the very high image quality supported by the encoding format. The method in this embodiment also performs the conversion in a manner that is very efficient computationally, allowing some conversions to take place in real time.

As shown in **Fig. 17**, Video source material (1702) in one of a number of acceptable formats is converted to a common format for the processing (1704) (for example, YUV 4:2:2 planar). The algorithm shown in **Fig. 17** exploits the fact that the desired encoded formats normally have lower spatial and temporal resolution than the input. The material is received as a sequence of video fields at the input field rate (1703) (typically 60Hz). The processing creates output frames at a different rate (1713) (typically lower than the input rate).

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The present invention supports a wide variety of processing options. Therefore, all the operations shown in **Fig. 17** are optional, with the preferred embodiment using a buffer (1712). In a typical application of the preferred embodiment, most of these operations are enabled.

To reduce computation requirements, the image may be cropped (1706) to the desired content and rescaled horizontally (1708). The rescaled fields are then examined for field-to-field correlations (1710) used later to associate related fields. Spatial deinterlacing (1710) optionally interpolates video fields to full-size frames. No further processing at the input rate (1703) is required, so the data are stored to the First In First Out (FIFO) buffer (1712).

When output frames are required, the appropriate data is accessed from the FIFO buffer (1712). Field association may select field pairs (1714) from the buffer that have desirable correlation properties (temporal deinterlacing). Alternatively, several fields may be accessed and combined to form a temporally smoothed frame (1714). Vertical rescaling (1716) produces frames with the desired output dimensions. Spatial filtering (1718) is done on this small-format, lower frame-rate data. Spatial filtering (1718) may include blurring, sharpening and/or noise reduction. Finally, color corrections are applied and the data are optionally converted (1720) to RGB space.

This embodiment of the invention allows all the image processing required for optimum image quality in the streaming format to be done in one continuous pipeline. The algorithm reduces data bandwidth in stages (horizontal, temporal, vertical) to minimize computation requirements.

Content, such as video, is successfully processed by this embodiment of the invention from any one of several input formats and provided to any one of several

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streaming encoders while maintaining the image quality characteristics desired by the content producer. The embodiment as described is efficient enough to allow this processing to proceed in real time on commonly available workstation platforms in a number of the commonly used processing configurations. The method incorporates enough flexibility to satisfy the image quality requirements of the video producer.

Video quality may be controlled in ways that are not available through streaming video encoders. Video quality controls are more centralized, minimizing the effort otherwise required to set up different encoders to process the same source material. Algorithmic efficiency allows the processing to proceed quickly, often in real time.

Fig. 18 shows an embodiment of the workflow aspect of the present invention, whereby the content provider processes streaming media content for purposes of distribution. In this embodiment, the content of the streaming media (1801) is input to a preprocessor (1803). A controller (1807) applies control inputs (1809) to the preprocessing step, so as to adapt the processing performed therein to desired characteristics. The preprocessed media content is then sent to one or more streaming media encoders (1805), applying control inputs (1811) from the controller (1807) to the encoding step so as to adapt the encoding performed therein to applicable requirements, and to allocate the resources of the processors in accordance with the demand for the respective one or more encoders (1805).

The Benefits of Re-encoding vs. Transcoding

It might be tempting to infer that edge-based encoding is simply a new way of describing the process of transcoding, which has been around nearly as long as digital video itself. But the two processes are fundamentally different. Transcoding is a single-step conversion of one video format into another, and re-encoding is a two-step

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process that requires the digital stream to be first decoded, then re-encoded. In theory, a single step process should provide better picture quality, particularly when the source and target streams share similar characteristics. But existing streaming media is burdened by a multiplicity of stream formats, and each format is produced in a wide variety of bandwidths (speed), spatial (frame size) and temporal (frame rate) resolutions. Additionally, each of the many codecs in use throughout the industry have a unique set of characteristics that must be accommodated in the production process. The combination of these differences completely erases the theoretical advantage of transcoding, since transcoding was never designed to accommodate such a wide technical variance between source and target streams. This is why in the streaming environment, re-encoding provides format conversions of superior quality, along with a number of other important advantages that cannot be derived from the transcoding process.

Among those advantages is *localization*, which is the ability to add local relevance to content before it reaches end users. This includes practices like local ad-insertion or watermarking, which are driven by demographic or other profile driven information. Transcoding leaves no opportunity for adding or modifying this local content, since its singular function is to directly convert the incoming stream to a new target format. But re-encoding is a two-step process where the incoming stream is decoded into an intermediate format prior to re-encoding. Re-encoding from this intermediate format eliminates the wide variance between incoming and target streams, providing for a cleaner conversion over the full range of format, bit rate, resolution, and codec combinations that define the streaming media industry today. Re-encoding is also what provides the opportunity for localization.

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The Edge encoding platform of the present invention takes full advantage of this capability by enabling the intermediate format to be pre-processed prior to re-encoding for deliver to the end user. This pre-processing step opens a wealth of opportunities to further enhance image quality and/or add local relevance to the content – an important benefit that cannot be accomplished with transcoding. It might be used, for example, to permit local branding of channels with a watermark, or enable local ad insertion based on the demographics of end users. These are processes routinely employed by television broadcasters and cable operators, and they will become increasingly necessary as broadband streaming media business models mature.

The Edge encoding platform of the present invention can extend these benefits further. Through its distributed computing, parallel processing architecture, Agility Edge brings both the flexibility and the power to accomplish these enhancements for all formats and bit-rates simultaneously, in an unattended, automatic environment, with no measurable impact on computational performance. This is not transcoding. It is true edge-based encoding, and it promises to change the way broadband and wireless streaming media is delivered to end users everywhere.

The Benefits of edge-based encoding

Edge-based encoding provides significant benefits to everyone in the streaming media value chain: content producers, CDNs and other backbone bandwidth providers, ISPs and consumers.

A. *Benefits for Content Producers*

1. *Reduces backbone bandwidth transmission costs.*

The current architecture for streaming media requires content producers to produce and deliver multiple broadband streams in multiple formats and bit rates, then

transmit all of them to the ISPs at the edge of the Internet. This consumes considerable bandwidth, resulting in prohibitively high, and ever increasing transmission costs. Edge-based encoding requires only one stream to traverse the backbone network regardless of the widely varying requirements of end users. The end result is an improved experience for everyone, along with dramatically lower transmission costs.

2. *Significantly reduces production and encoding costs.*

In the present architecture, the entire cost burden of preparing and encoding content rests with the content producer. Edge-based encoding distributes the cost of producing broadband streaming media among all stakeholders, and allows the savings and increased revenue to be shared among all parties. Production costs are lowered further, since content producers are now required to produce only one stream for broadband and wireless content delivery. Additionally, an Agility Edge deployment contains an Agility Enterprise encoding platform, which automates all aspects of the streaming media production process. With Agility Enterprise, content producers can greatly increase the efficiency of their narrowband streaming production, reducing costs even further. This combination of edge-based encoding for broadband and wireless streams, and enterprise-class encoding automation for narrowband streams, breaks the current economic model where costs rise in lock-step with increased content production and delivery.

3. *Enables nearly limitless tiered and premium content services.*

Content owners can now join with CDNs and ISPs to offer tiered content models based on premium content and differentiated qualities of service. For example, a content owner can explicitly dictate that content offered for free be encoded within a certain range of formats, bit rates, or spatial resolutions. However,

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they may give CDNs and broadband and wireless ISPs significant latitude to encode higher quality, revenue-generating streams, allowing both the content provider and the edge service provider to share in new revenue sources based on tiered or premium classes of service.

4. *Ensures maximum quality for all connections and devices.*

Content producers are rightly concerned about maintaining quality and ensuring the best viewing experience, regardless of where or how it is viewed. Since content will be encoded at the edge of the Internet, where everything is known about the end users, content may be matched to the specific requirements of those users, ensuring the highest quality of service. Choppy, uneven, and unpredictable streams associated with the mismatch between available content and end user requirements become a thing of the past.

5. *Enables business model experimentation.*

The freedom to experiment with new broadband streaming media business models is significantly impeded in the present model, since any adjustments in volume require similar adjustments to human resources and capital expenditures. But the Agility Edge platform combined with Agility Enterprise decouples the linear relationship between volume and costs. This provides content producers unlimited flexibility to experiment with new business models, by allowing them to rapidly scale their entire production and delivery operation up or down with relative ease.

6. *Content providers and advertisers can reach a substantially larger audience.*

The present architecture for streaming media makes it prohibitively expensive to produce broadband or wireless content optimized for a widespread audience, and the broadband LCD streams currently produced are of insufficient quality to enable a viable business model. But edge-based encoding will make it possible to provide

optimized streaming media content to nearly everyone with a broadband or wireless connection. Furthermore, broadband ISPs will finally be able to effectively deploy last-mile IP multicasting, which allows even more efficient mass distribution of real-time content.

B. Benefits for Content Delivery Networks (CDNs)

1. *Provides new revenue streams.*

Companies that specialize in selling broadband transmission and content delivery are interested in providing additional value-added services. The Agility Edge encoding platform integrates seamlessly with existing Internet and CDN infrastructures, enabling CDNs to efficiently offer encoding services at both ends of their transmission networks.

2. *Reduces backbone transmission costs.*

CDNs can deploy edge-based encoding to deliver more streams at higher bit rates, while greatly reducing their backbone costs. Content producers will contract with Agility Edge-equipped CDNs to more efficiently distribute optimized streams throughout the Internet. Since edge-based encoding requires only one stream to traverse the network, CDNs can increase profit by significantly reducing their backbone costs, even after passing some of the savings back to the content producer.

C. Benefits for Broadband and Wireless ISPs

1. *Enables nearly limitless tiered and premium content services.*

Just as cable and DBS operators do with television, ISPs can now offer tiered content and business models based on premium content and differentiated qualities of service. That's because edge-based encoding empowers ISPs with the ability to package content based on their own unique technical requirements and business goals. It puts control of final distribution into the hands of the ISP, which is in the best

position to know how to maximize revenue in the last-mile. And since edge-based encoding allows content providers to substantially increase the amount and quality of content provided, ISPs will now be able to offer customers with more choices than ever before. Everyone wins.

2. *Maximizes usage of last-mile connections.*

Last-mile bandwidth is an asset used to generate revenue, just like airline seats. Therefore, bandwidth that goes unused is a lost revenue opportunity for ISPs. The ability to offer new tiered and premium content opens a multitude of opportunities for utilizing unused bandwidth to generate incremental revenue. Furthermore, optimizing content at the edge of the Internet eliminates the need to pass-through multiple LCD streams generated by the content provider, which is done today simply to ensure an adequate viewing experience across a reasonably wide audience. Because the ISP knows the precise capabilities of their last-mile facilities, they can reduce the number of last-mile streams passed through, while creating new classes of service that optimally balance revenue opportunities in any given bandwidth environment.

3. *Enables ISPs to employ localized IP-multicasting over last-mile bandwidth for live events.*

Unlike television, the Internet is a one-to-one medium. This is one of its greatest strengths. But for live events, where a large audience wishes to view the same content at the same time, this one-to-one model presents significant obstacles. Among the technologies developed to overcome those obstacles, IP multicasting has been developed. IP multicasting attempts to simulate the broadcast model, where one signal is sent to a wide audience, and each audience member "tunes in" to the signal if desired. Unfortunately, the nature of the Internet works against IP multicasting. Currently, streaming media must traverse the entire Internet, from the origination

point where it is encoded, through the core of the Internet and ultimately across the last-mile to the end user. The Internet's core design, with multiple router hops, unpredictable latencies and packet loss, makes IP multicasting across the core of the Internet a weak foundation on which to base any kind of a viable business model. Even a stable, premium, multicast enabled backbone is still plagued by the LCD problem. But by encoding streaming media content at the edge of the Internet, an IP multicast must only traverse the last mile, where ISPs have far greater control over the transmission path and equipment, and bandwidth is essentially free. In this homogenous environment, IP multicasting can be deployed reliably and predictably, opening up an array of new business opportunities that require only modest amounts of last-mile bandwidth.

D. Benefits for consumers

1. *Provides improved streaming media experience across all devices and connections.*

Consumers today are victims of the LCD experience, where rarely anyone receives content optimized for the requirements of their connection or device, if it is created for their device at all. The result is choppy, unpredictable quality that makes for an unpleasant experience. Edge-based encoding solves that problem by making it technically and economically feasible to provide everyone with the highest quality streaming media experience possible.

2. *Gives consumers a greater selection of content*

Edge-based encoding finally makes large-scale production and delivery of broadband and wireless content economically feasible. This will open up the floodgates of premium content, allowing consumers to enjoy a wide variety of programming that would not be available otherwise. More content will increase consumer broadband adoption, and increased broadband adoption will fuel the

availability of even more content. Edge-based encoding will provide the stimulus for mainstream adoption of broadband streaming media content.

E. Benefits for wireless providers and consumers

1. *Provides an optimal streaming media experience across all wireless devices and connections.*

Wireless devices present the biggest challenge for streaming media providers. There are many different transmission standards (TDMA, CDMA, GSM, etc.), each with low bandwidth and high latencies that vary wildly as users move within their coverage area. Additionally, there are many different device types, each with its own set of characteristics that must be taken into account such as screen size, color depth, etc. This increases the size of the encoding problem exponentially, making it impossible to encode streaming media for a wireless audience of any significant size. To do so would require encoding an impossible number of streams, each one optimized for a different service provider, different technologies, different devices, and at wildly varying bit rates. However, within any single wireless service provider's system, conditions tend to be significantly more homogeneous. With edge-based encoding the problem nearly disappears, since a service provider can optimize streaming media for the known conditions within their network, and dynamically adjust the streaming characteristics as conditions change. Edge-based encoding will finally make the delivery of streaming media content to wireless devices an economically viable proposition.

Technological Advantages of the Present Invention

The Edge encoding platform of the present invention is a true carrier-class, open architecture, software-based system, built upon a foundation of open Internet standards such as TCP/IP and XML. As with any true carrier-class solution, the

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present invention is massively scalable and offers mission-critical availability through a fault-tolerant, distributed architecture. It is fully programmable, customizable, and extensible using XML, enterprise-class databases and development languages such as C, C++, Java and others.

The elements of the present invention fit seamlessly within existing CDN and Internet infrastructures, as well as the existing production workflows of content producers. They are platform- and codec-independent, and integrate directly with unmodified, off-the-shelf streaming media servers, caches, and last mile infrastructures, ensuring both forward and backward compatibility with existing investments. The present invention allows content producers to achieve superior performance and video quality by interfacing seamlessly with equipment found in the most demanding broadcast quality environments, and includes support for broadcast video standards including SDI, DV, component analog, and others . Broadcast automation and control is supported through RS-422, SMPTE time code, DTMF, contact closures, GPIs and IP-triggers.

The present invention incorporates these technologies in an integrated, end-to-end enterprise- and carrier-class software solution that automates the production and delivery of streaming media from the earliest stages of production all the way to the edge of the Internet and beyond.

Conclusion

Edge-based encoding of streaming media is uniquely positioned to fulfill on the promise of ubiquitous broadband and wireless streaming media. The difficulties in producing streaming media in multiple formats and bit rates, coupled with the explosive growth of Internet-connected devices, each with varying capabilities, demands a solution to dynamically encode content closer to the end user on an as-

needed basis. Edge-based encoding, when coupled with satellite- and terrestrial-based content delivery technologies, offers content owners unprecedented audience reach while providing consumers with improved streaming experiences, regardless of their device, media format or connection speed. This revolutionary new approach to content encoding finally enables all stakeholders in the streaming media value chain, content producers, CDNs, ISPs and end-user customers, to capitalize on the promise of streaming media in a way that is both productive and profitable.

It is apparent from the foregoing that the present invention achieves the specified objects, as well as the other objectives outlined herein. While the currently preferred embodiments of the invention have been described in detail, it will be apparent to those skilled in the art that the principles of the invention are readily adaptable to a wide range of other distributed processing systems, implementations, system configurations and business arrangements without departing from the scope and spirit of the invention.

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We claim:

1. A system for real-time command and control of a distributed processing system, comprising:
   - a high-level control system;
   - one or more local control systems; and
   - one or more "worker" processes under the control of each such local control system; wherein,
     - a task-independent representation is used to pass commands from said high-level control system to said worker processes;
     - each local control system is interposed to receive the commands from said high level control system, forward the commands to the worker processes that said local control system is in charge of, and report the status of said worker processes that it is in charge of to said high-level control system; and
     - said worker processes are adapted to accept such commands, translate such commands to a task-specific representation, and report to the local control system in charge of said worker process the status of execution of the commands.

2. A system having a plurality of high-level control systems as described in claim 1, wherein a job description describes the processing to be performed, portions of said job description are assigned for processing by different high-level control systems, each of said high-level control systems having the ability to take over processing for any of the other of said high-level control

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systems that might fail, and can be configured to take over said processing automatically.

3. A method for performing video processing, comprising:
   - separating the steps of horizontal and vertical scaling, and
   - performing horizontal scaling prior to any of (a) field-to-field correlations, (b) spatial deinterlacing, (c) temporal field association or (d) temporal smoothing.

4. The method of claim 3, further comprising performing spatial filtering after both horizontal and vertical resizing.

5. A method for performing video preprocessing for purposes of streaming distribution, comprising:
   - separating the steps of said video processing into a first group to be performed at the input field rate, and a second group to be performed at the output field rate;
   - performing the steps of said first group;
   - buffering the output of said first group of steps in a FIFO buffer; and
   - performing, on data taken from said FIFO buffer, the steps of said second group of steps.

6. A system for an originating content provider to distribute streaming media content to users, comprising:
   - an encoding platform deployed at the point of origination, to encode a single, high bandwidth compressed transport stream and deliver said

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stream via a content delivery network to encoders located in facilities at the edge of the network;

- one or more edge encoders, to encode said compressed stream into one or more formats and bit rates based on the policies set by said content delivery network or edge facility;
- an edge resource manager, to provision said edge encoders for use, define and modify encoding and distribution profiles, and monitor edge-encoded streams; and
- an edge control system, for providing command, control and communications across collections of said edge encoders.

7. A method for a local network service provider to customize for its users the distribution of streaming media content originating from a remote content provider, comprising:
   - performing streaming media encoding for said content at said service provider's facility;
   - determining, through said service provider's facility, the connectivity and encoding requirements and demographic characteristics of the user; and
   - performing, at said service provider's facility, processing steps preparatory to said encoding, so as to customize said media content, including one or more steps from the group consisting of:
     - inserting local advertising,
     - inserting advertising targeted to the user's said demographic characteristics,

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- inserting branding identifiers, performing scaling to suit the user' s said connectivity and encoding requirements,
- selecting an encoding format to suit the user's said encoding requirements,
- adjusting said encoding process in accordance with the connectivity of the user, and
- encoding in accordance with a bit rate to suit the user's said encoding requirements.

8. A method for a local network service provider to participate in content-related revenue in connection with the distribution to user of streaming media content originating from a remote content provider, comprising:

- performing streaming media encoding for said content at said service provider's facility;
- performing, at said service provider's facility, processing steps preparatory to said encoding, comprising insertion of local advertising;
- charging a fee for the insertion of said local advertising.

9. A method for a local network service provider to participate in content-related revenue in connection with the distribution to user of streaming media content originating from a remote content provider, comprising:

- performing streaming media encoding for said content at said service provider's facility;
- identifying a portion of said content as premium content;
- charging the user an increased fee for access to said premium content.

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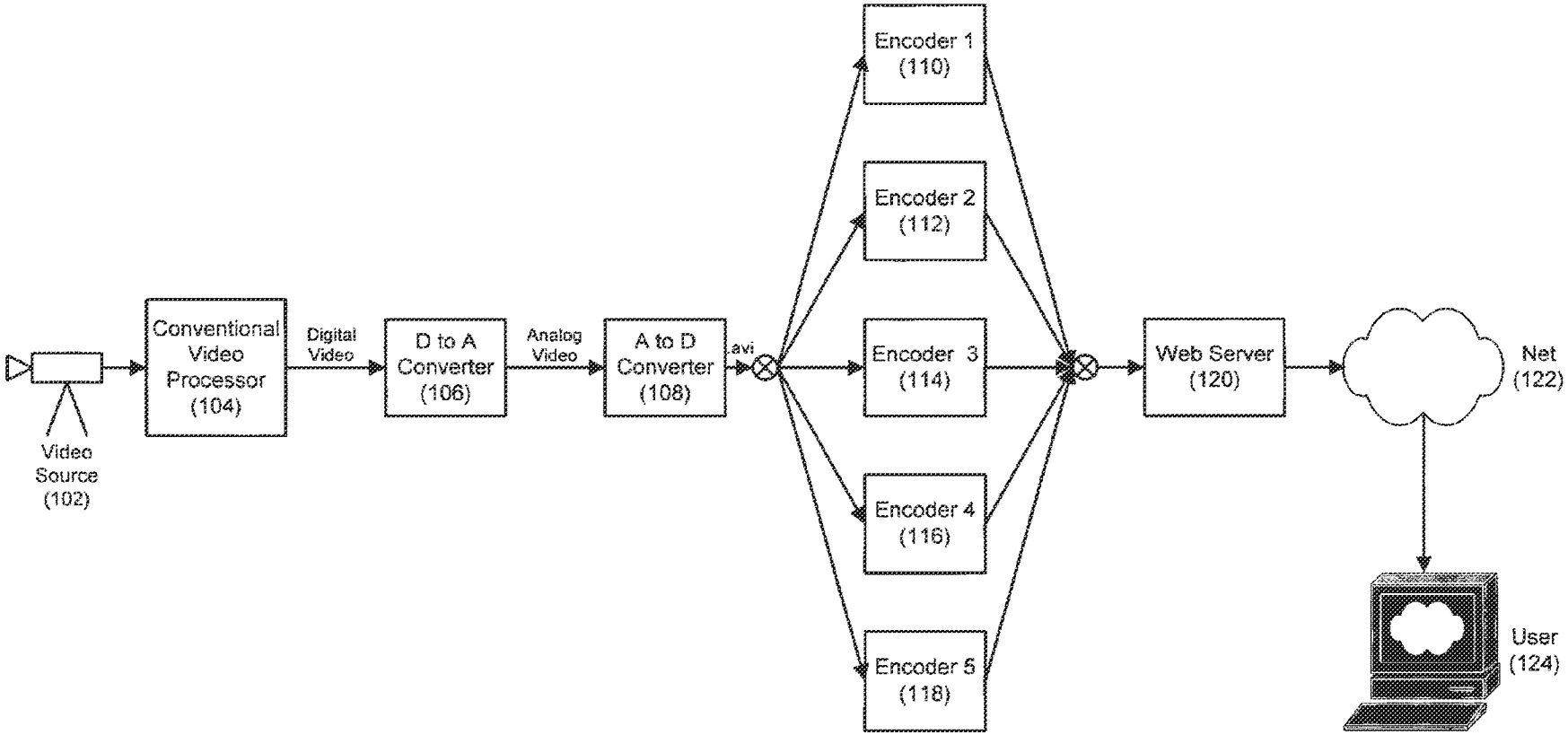

Fig. 1A (prior art)

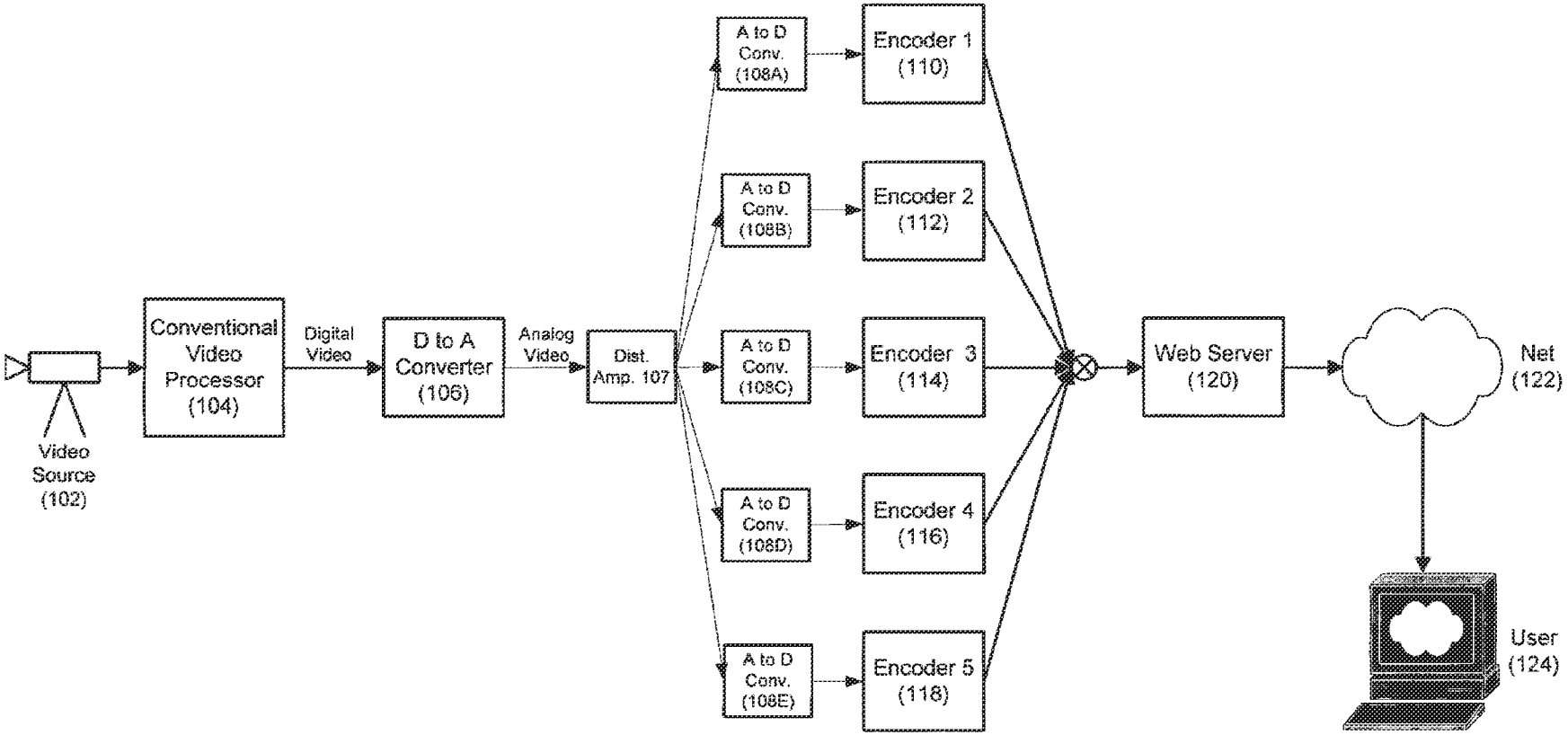

Fig. 1B (prior art)

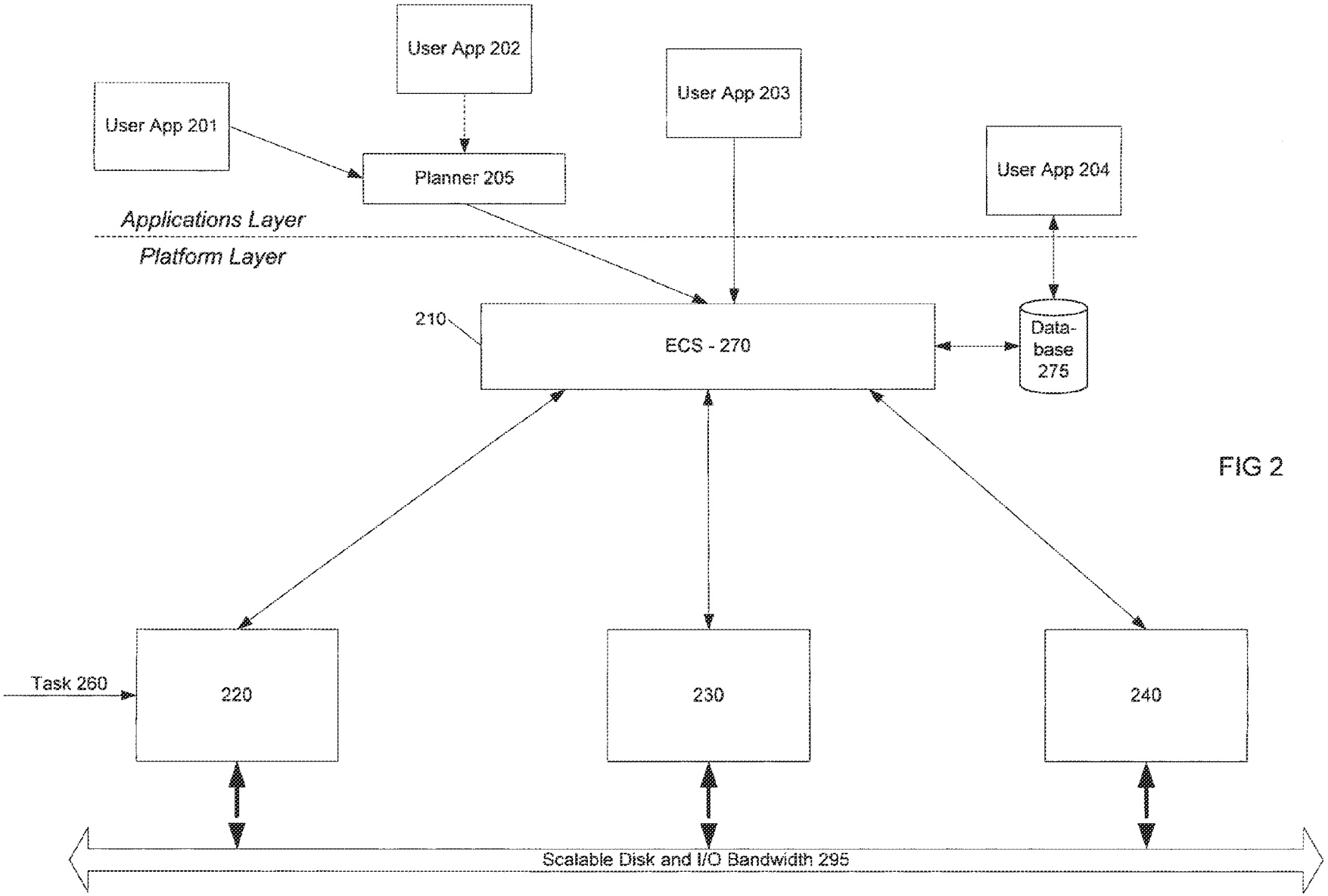
User App 202
User App 201
User App 203
User App 204
Planner 205
Applications Layer
Platform Layer
210
ECS - 270
Data-base 275
Task 260
220
230
240
Scalable Disk and I/O Bandwidth 295

FIG 2

Aylo Exhibit 1005

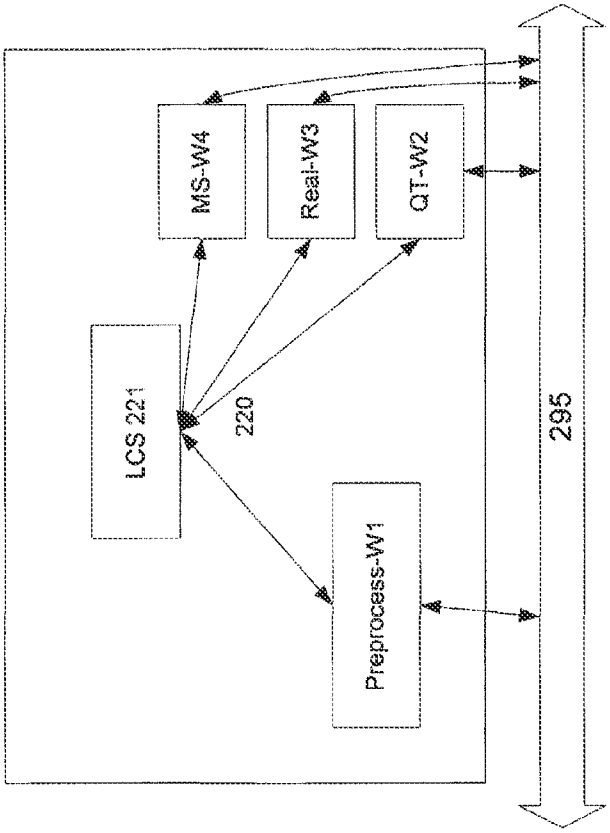

Fig 3B

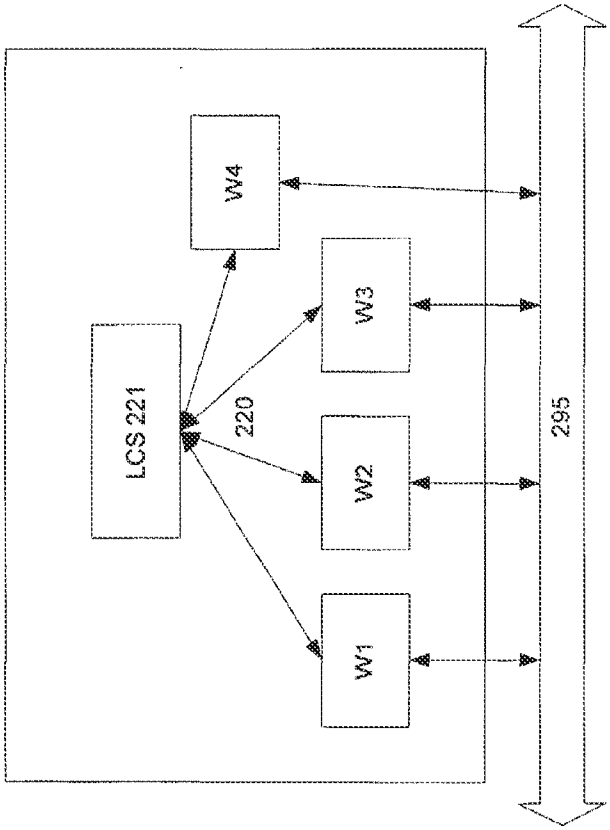

Fig 3A

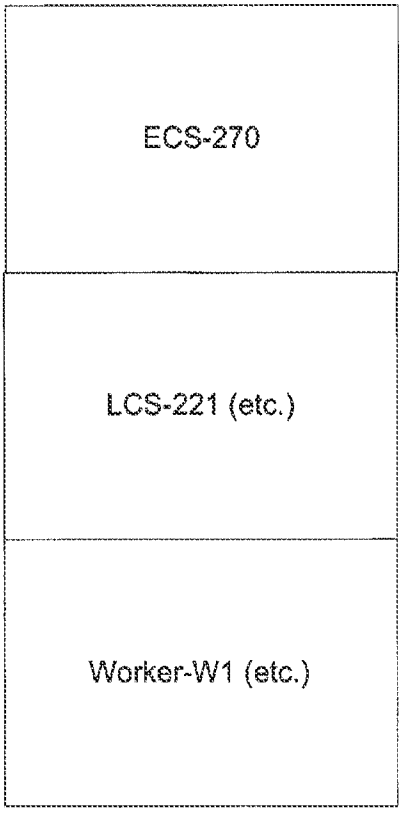

Fig. 4

Aylo Exhibit 1005

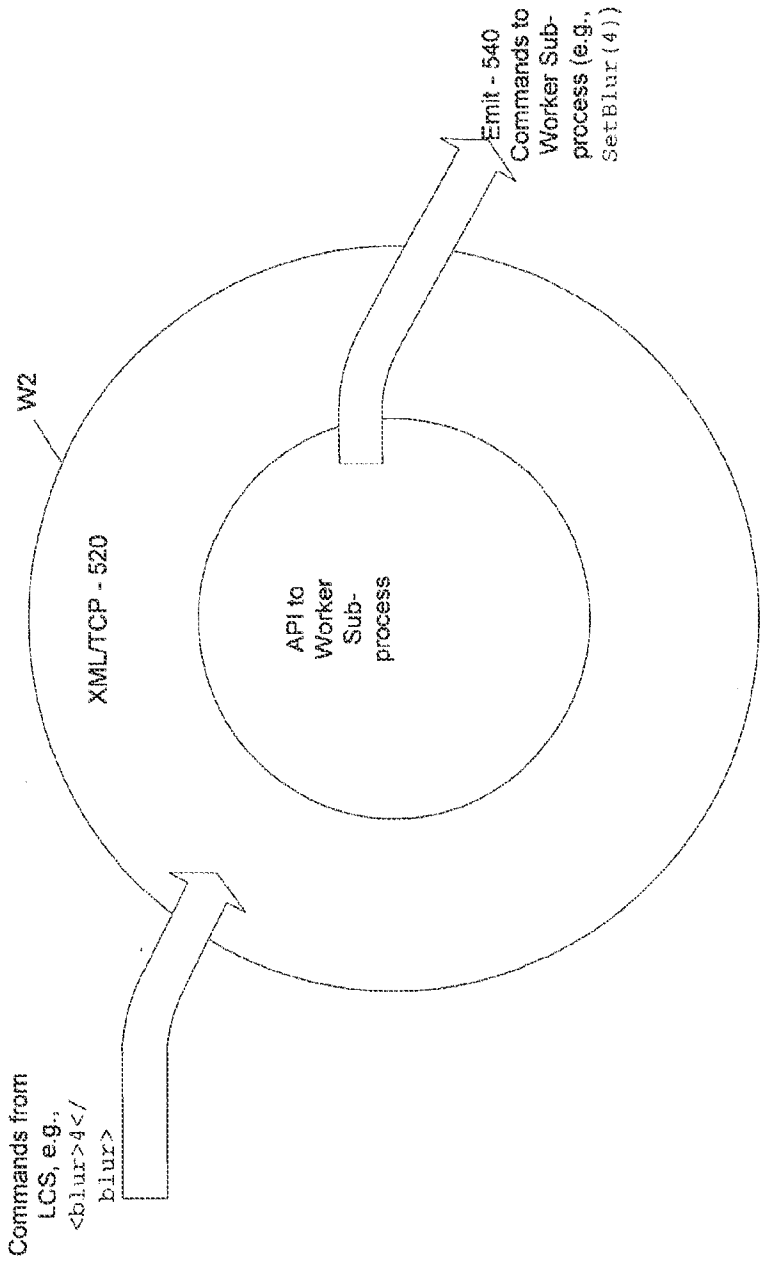

Fig. 5

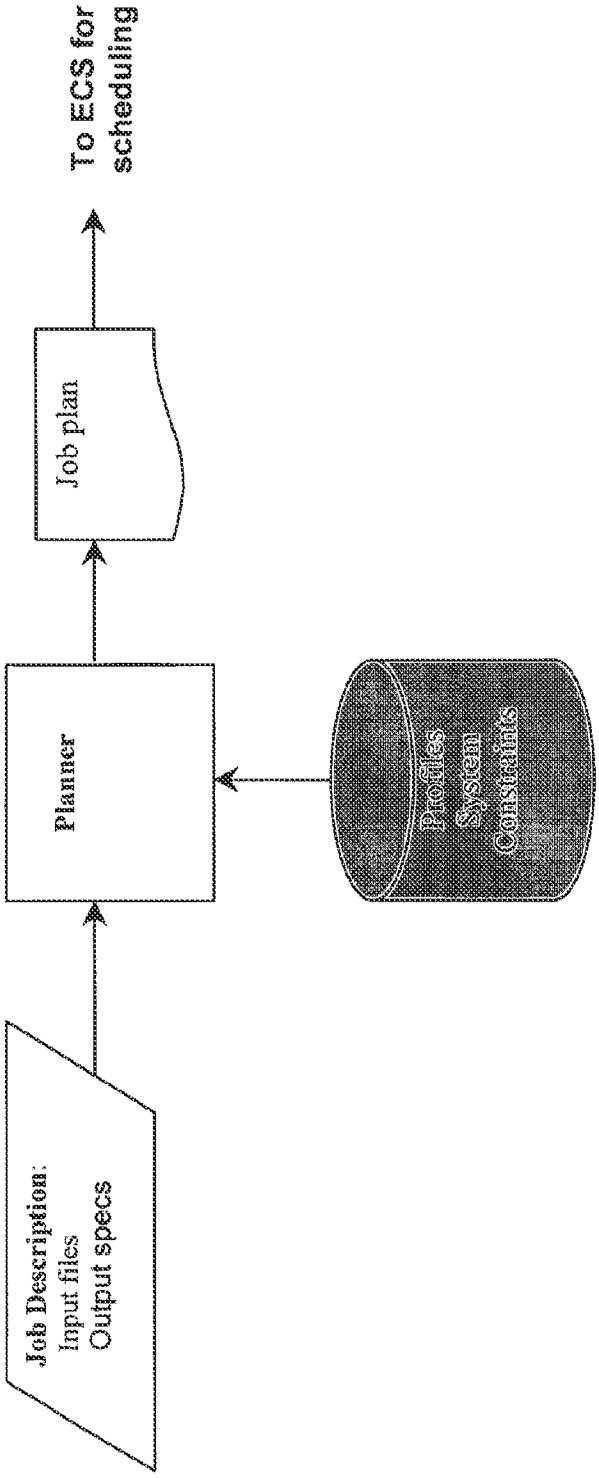
Job Description:
Input files
Output specs
Planner
Profiles
System
Constraints
Job plan
To ECS for
scheduling

Fig. 6

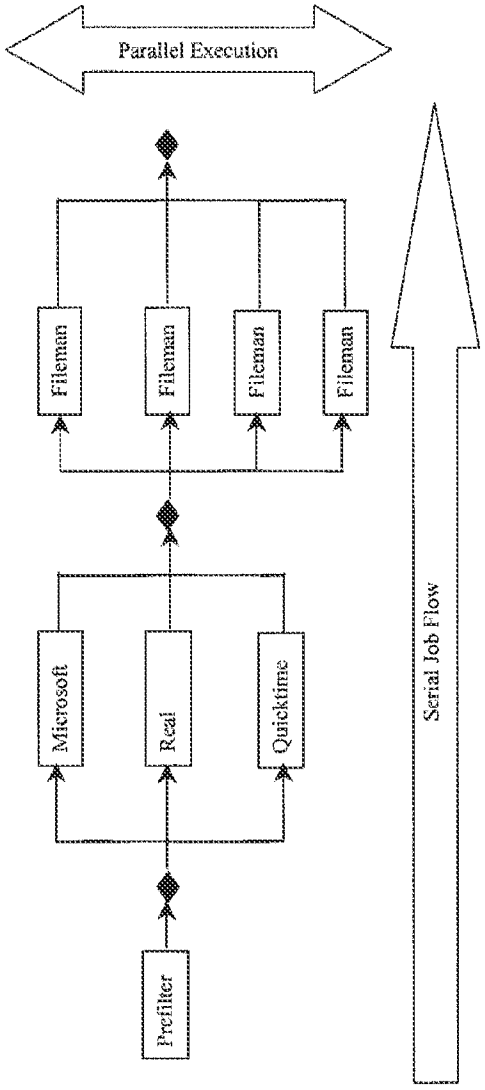
Parallel Execution
Fileman
Fileman
Fileman
Fileman
Microsoft
Real
Quicktime
Prefilter
Serial Job Flow

Fig. 7A

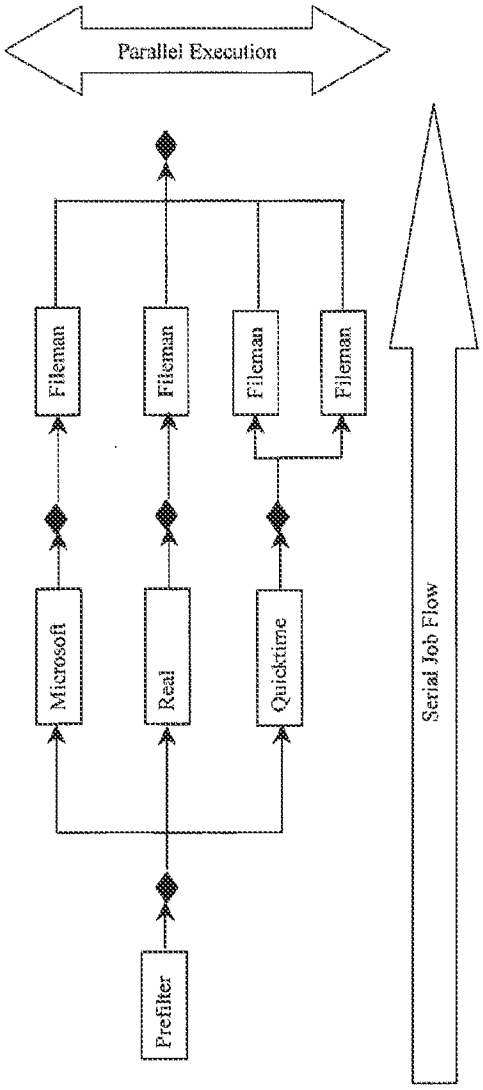
Parallel Execution
Fileman
Fileman
Fileman
Fileman
Microsoft
Real
Quicktime
Prefilter
Serial Job Flow

Fig. 7B

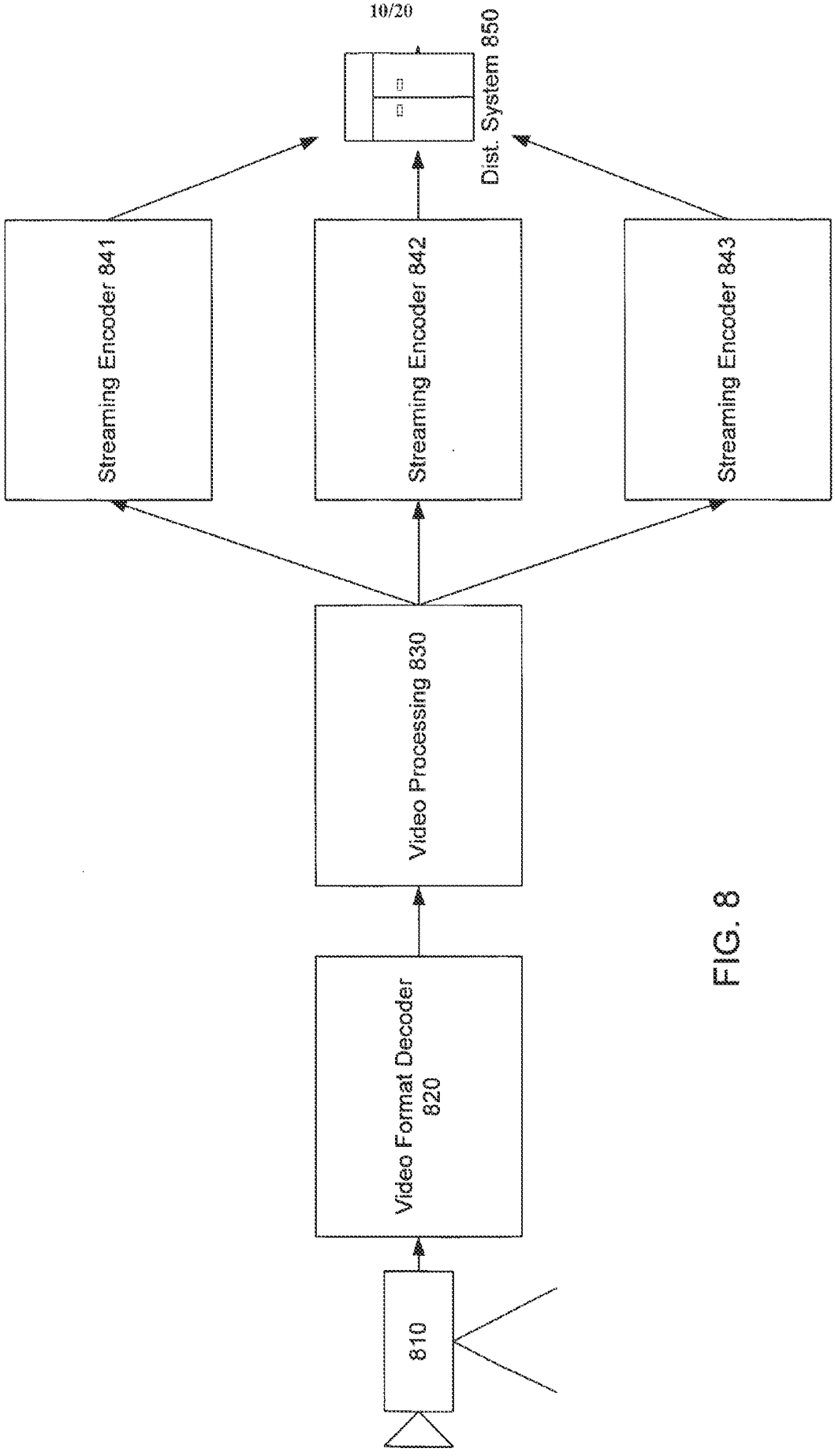

FIG. 8

Page 990 of 1422

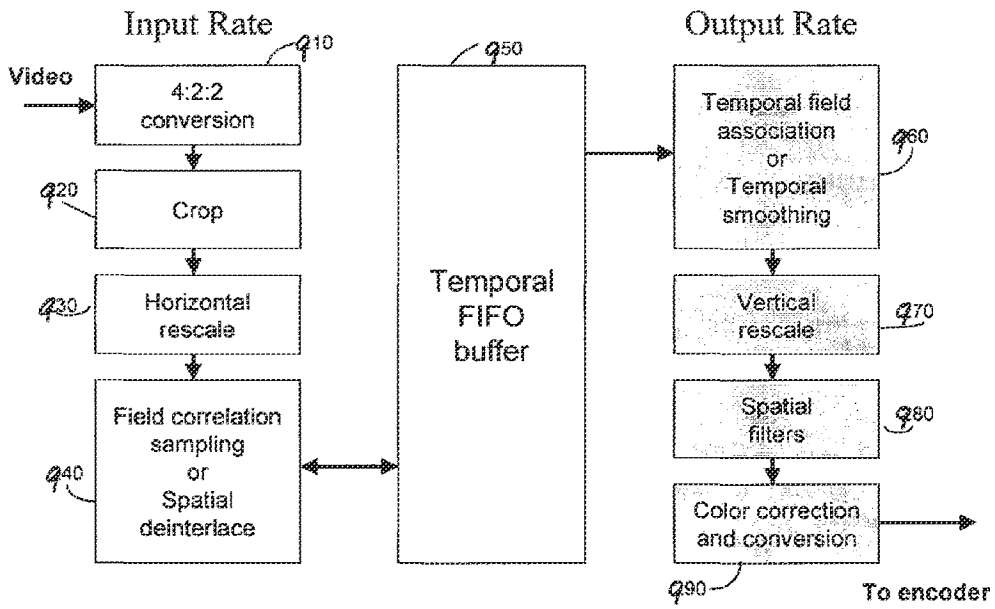
Input Rate
Output Rate
Video
4:2:2 conversion
Crop
Horizontal rescale
Field correlation sampling or Spatial deinterlace
Temporal FIFO buffer
Temporal field association or Temporal smoothing
Vertical rescale
Spatial filters
Color correction and conversion
To encoder
910
920
930
940
950
960
970
980
990

FIG. 9

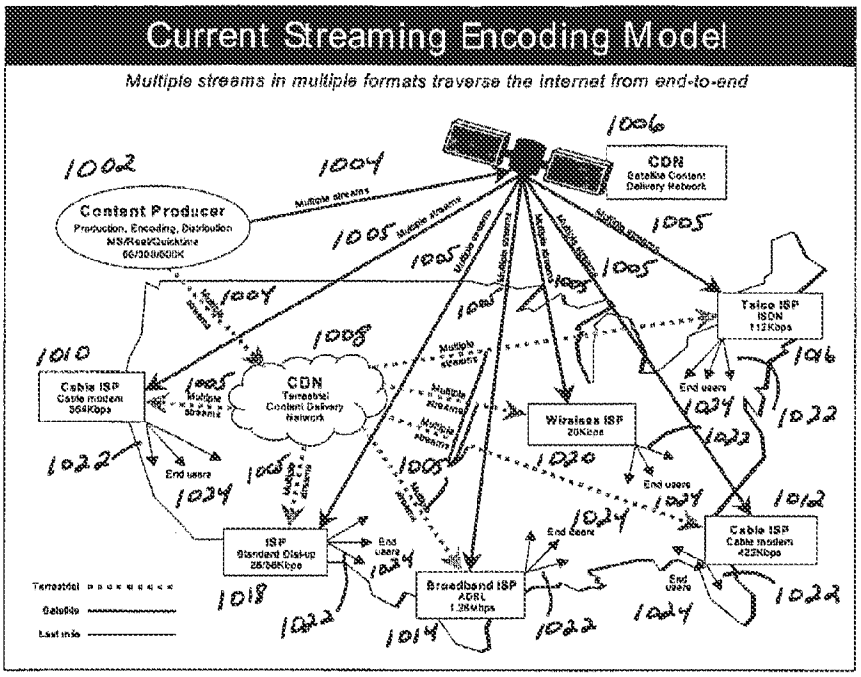

Figure 10 (prior art)

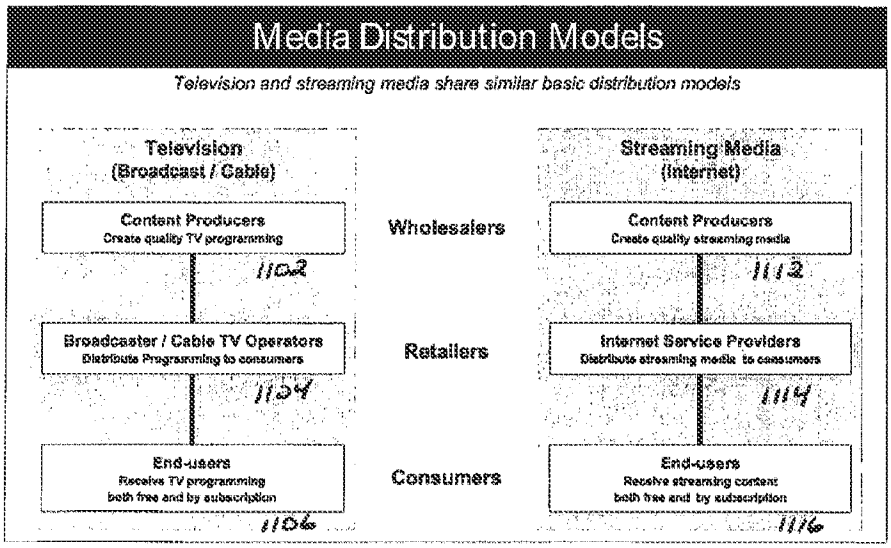

Fig. 11 (prior art)

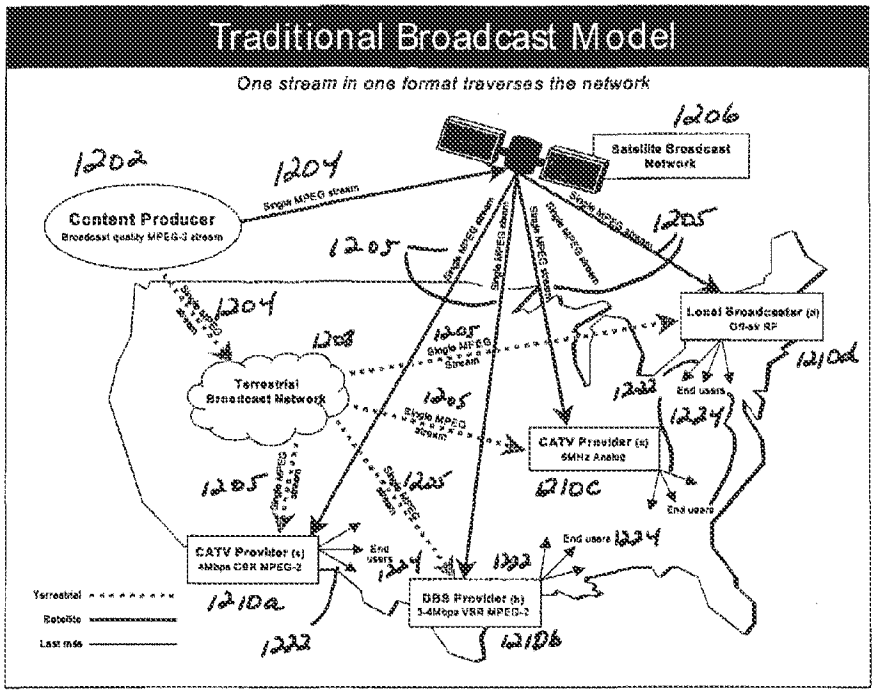

Fig. 12 (prior art)

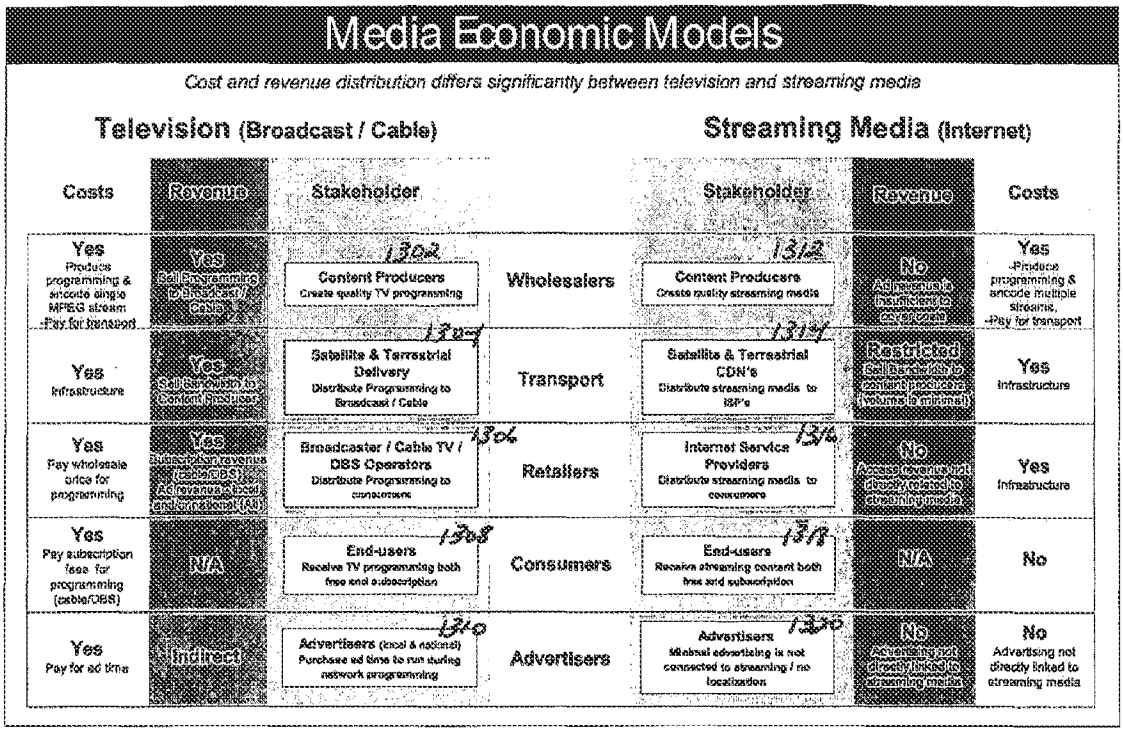

Fig. 13 (prior art)

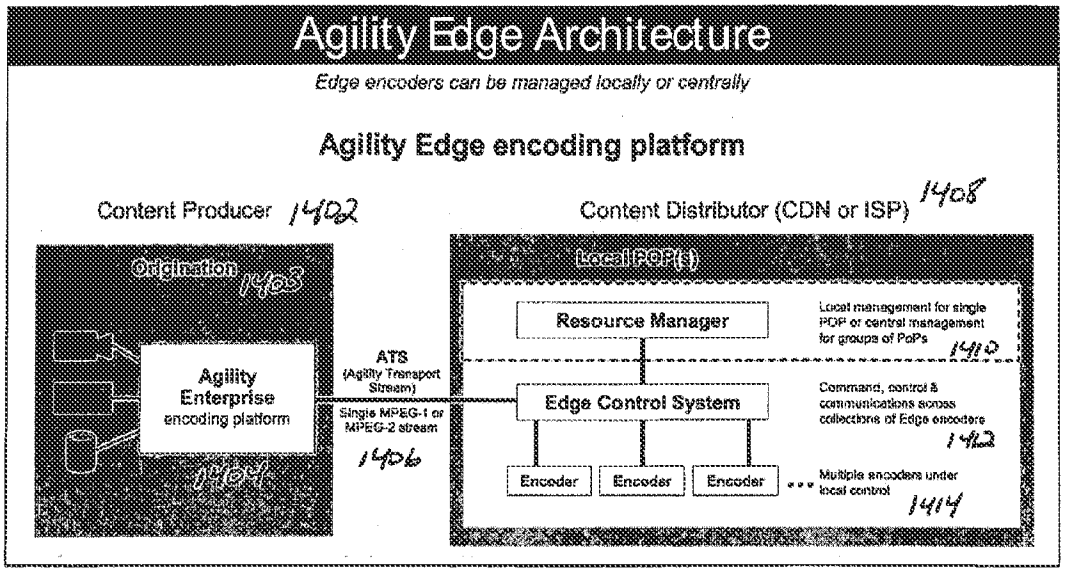
Agility Edge Architecture
Edge encoders can be managed locally or centrally
Agility Edge encoding platform
Content Producer 1402
Content Distributor (CDN or ISP) 1408
Origination 1403
Agility Enterprise encoding platform
1404
ATS (Agility Transport Stream)
Single MPEG-1 or MPEG-2 stream
1406
Local POP(s)
Resource Manager
Local management for single POP or central management for groups of PoPs
1410
Edge Control System
Command, control & communications across collections of Edge encoders
1412
Encoder
Encoder
Encoder
Multiple encoders under local control
1414

Fig. 14

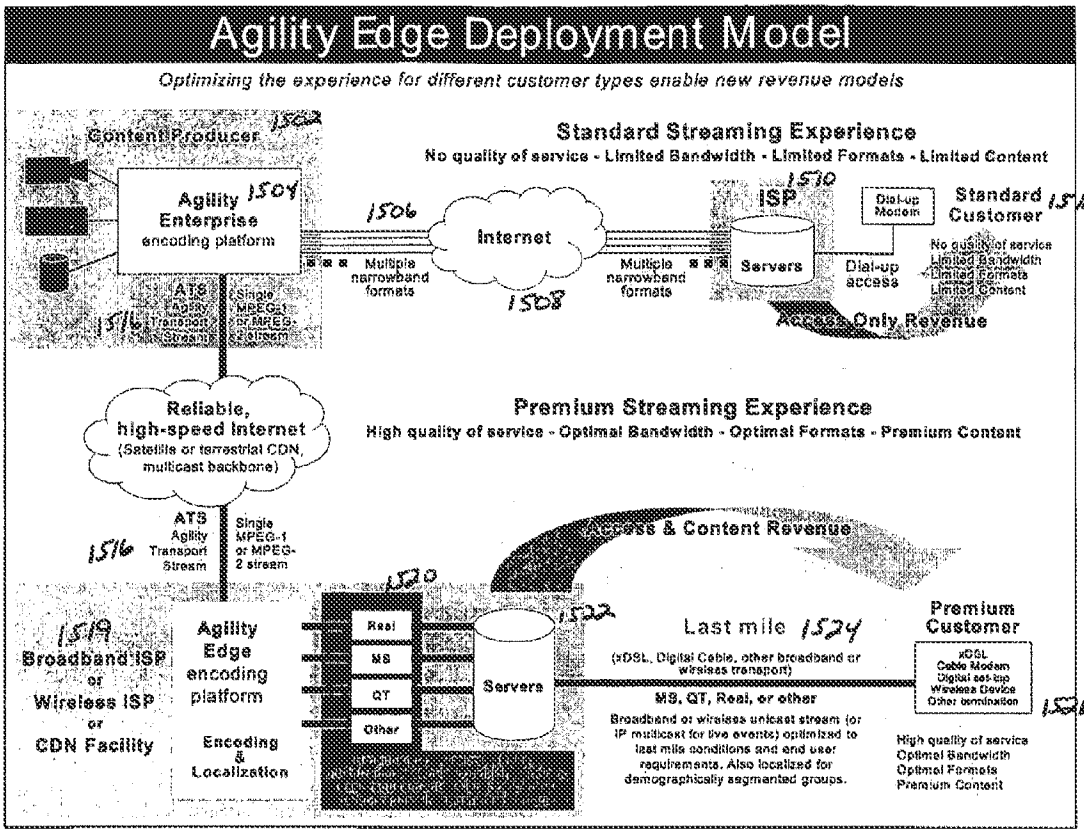
Agility Edge Deployment Model
Optimizing the experience for different customer types enable new revenue models
Content Producer
1502
Agility Enterprise encoding platform
1504
1506
Internet
1508
Multiple narrowband formats
Multiple narrowband formats
ISP
1510
Servers
Dial-up Modem
Dial-up access
Standard Customer
1512
No quality of service
Limited Bandwidth
Limited Formats
Limited Content
Access Only Revenue
ATS Agility Transport Stream
1516
(Single MPEG-1 or MPEG-2 stream)
Standard Streaming Experience
No quality of service - Limited Bandwidth - Limited Formats - Limited Content
Reliable, high-speed Internet
(Satellite or terrestrial CDN, multicast backbone)
Premium Streaming Experience
High quality of service - Optimal Bandwidth - Optimal Formats - Premium Content
ATS Agility Transport Stream
1516
Single MPEG-1 or MPEG-2 stream
Access & Content Revenue
1520
1519
Broadband ISP or Wireless ISP or CDN Facility
Agility Edge encoding platform
Encoding & Localization
Real
MS
QT
Other
Servers
1522
Last mile 1524
(xDSL, Digital Cable, other broadband or wireless transport)
MS, QT, Real, or other
Broadband or wireless unicast stream (or IP multicast for live events) optimized to last mile conditions and end user requirements. Also localized for demographically segmented groups.
Premium Customer
xDSL
Cable Modem
Digital set-top
Wireless Device
Other combination
1526
High quality of service
Optimal Bandwidth
Optimal Formats
Premium Content

Fig. 15

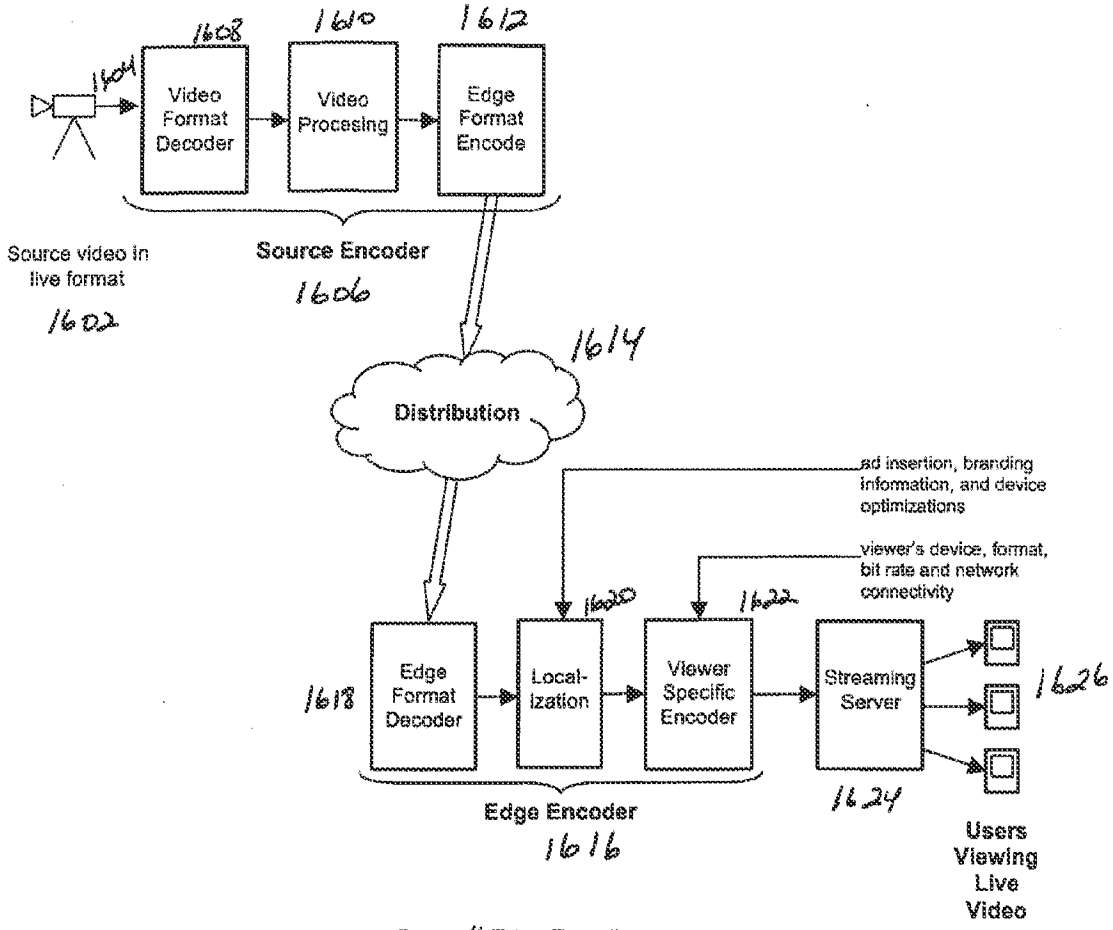

Figure 16 Edge Encoding

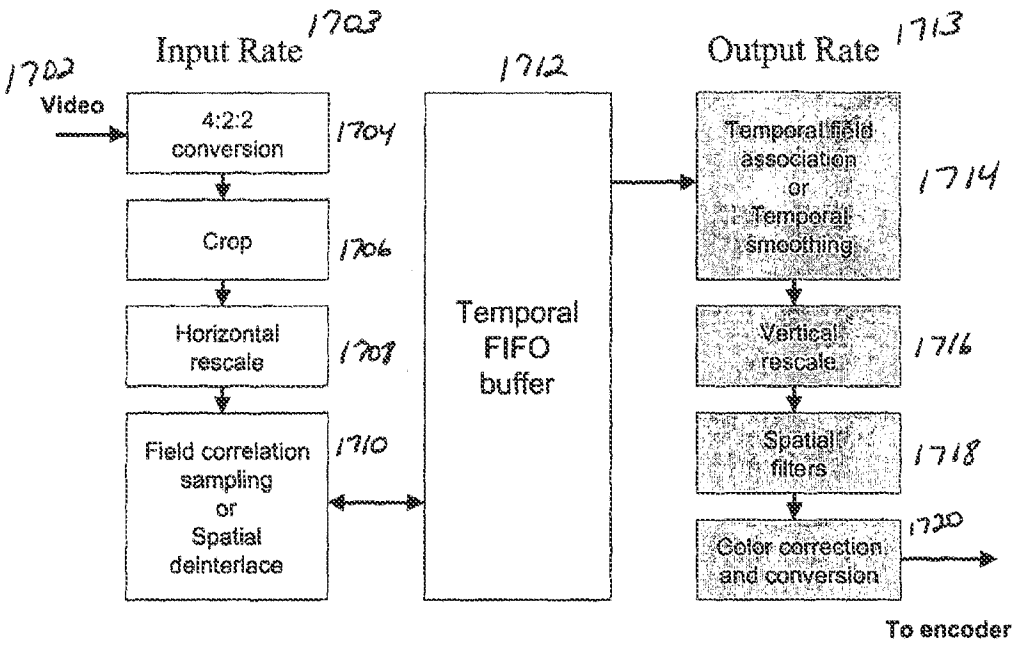

Fig. 17 — Video Preprocessing Flowchart

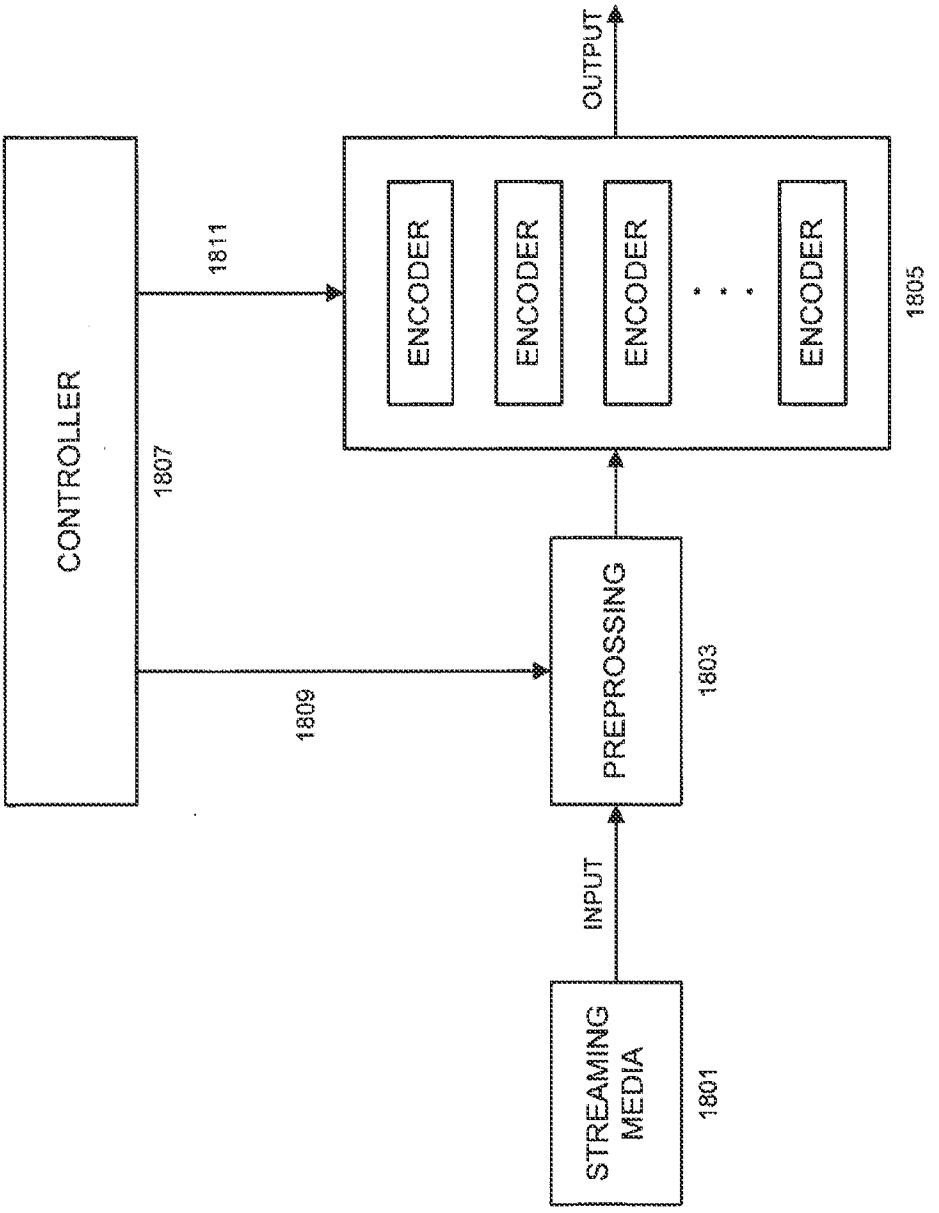
STREAMING MEDIA
1801
INPUT
PREPROSSING
1803
CONTROLLER
1807
1809
1811
ENCODER
ENCODER
ENCODER
ENCODER
1805
OUTPUT

Figure 18

PTO/SB/08a (01-22)
Approved for use through 05/31/2024. OMB 0651-0031
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(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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	1	6848004	B1	2005-01-25	Chang et al.	
	2	6002440	A	1999-12-14	Dalby et al.	
	3	6637031	B1	2003-10-21	Philip A. Chou	

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	Application Number	18069450
	Filing Date	2022-12-21
	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	1	20020049343	WO	A1	2002-06-20	Leaning et al.		☐
	2	20020075482	WO	A2	2002-09-26	Allen et al.		☐
	3	1997004942	WO	A2	1997-11-27	Kliger et al.		☐

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	1	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00512, "Petition for Inter Partes Review of U.S. Patent No. 11,470,138" executed January 30, 2024 (89 pages).	☐
	2	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00513, "Petition for Inter Partes Review of U.S. Patent No. 10,757,156" executed January 30, 2024 (81 pages).	☐
	3	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00514, "Petition for Inter Partes Review of U.S. Patent No. 10,469,554" executed January 30, 2024 (87 pages).	☐
	4	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00515, "Petition for Inter Partes Review of U.S. Patent No. 10,469,555" executed January 30, 2024 (82 pages).	☐
	5	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00516, "Petition for Inter Partes Review of U.S. Patent No. 10,951,680" executed January 30, 2024 (85 pages).	☐
	6	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00517, "Petition for Inter Partes Review of U.S. Patent No. 11,677,798" executed January 30, 2024 (88 pages).	☐

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	Application Number	18069450
	Filing Date	2022-12-21
	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	7	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00518, "Petition for Inter Partes Review of U.S. Patent No. 9,407,564" executed January 30, 2024 (86 pages).	☐
	8	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00519, "Petition for Inter Partes Review of U.S. Patent No. 8,868,772" executed January 30, 2024 (85 pages).	☐
	9	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00512, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 11,470,138" executed January 29, 2024 (89 pages).	☐
	10	"Synchronized Multimedia Integration Language (SMIL 2.0)" dated August 7, 2001 (364 pages).	☐
	11	United States International Trade Commission In the Matter of: Certain Fitness Devices, Streaming Components Thereof, and Systems Containing Same (Investigation No. 337-TA-1265), "Initial Determination on Violation of Section 337 and Recommended Determination on Remedy and Bond" dated September 9, 2022 (269 pages).	☐
	12	United States International Trade Commission In the Matter of: Certain Fitness Devices, Streaming Components Thereof, and Systems Containing Same (Investigation No. 337-TA-1265), "Enforcement Complaint of DISH DBS Corporation ET AL." dated September 11, 2023 (43 pages).	☐
	13	Internet Archive Affidavit, Nathaniel E Frank-White for URLs ("SMIL") (335 pages broken into six parts - pages 1-50, 51-90, 91-130, 131-170, 171-210, and 211-335).	☐
	14	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00513, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 10,757,156" executed January 29, 2024 (85 pages).	☐
	15	The Internet Society "Hypertext Transfer Protocol -- HTTP/1.1" dated June 1999 (152 pages).	☐
	16	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00514, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 10,469,554" executed January 28, 2024 (87 pages).	☐
	17	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00515, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 10,469,555" executed January 28, 2024 (82 pages).	☐

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	Application Number	18069450
	Filing Date	2022-12-21
	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	18	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00516, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 10,951,680" executed January 29, 2024 (87 pages).	☐
	19	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00517, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 11,470,138" executed January 28, 2024 (94 pages).	☐
	20	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00518, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 9,407,564" executed January 29, 2024 (93 pages).	☐
	21	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00519, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 8,868,772" executed January 29, 2024 (99 pages).	☐

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Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2024-02-01
Name/Print	Brett Carlson	Registration Number	39928

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.:	18/069,450	Confirm. No.:	8508
Inventor:	David F. Brueck	Art Unit:	2454
Filed:	December 21, 2022	Examiner:	Chirag R. Patel
Docket No.:	9401-00279	Customer No.:	70560
Title:	**APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING**		

AMENDMENT AND RESPONSE TO
NOTICE TO FILE CORRECTED APPLICATION PAPERS

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

This is an amendment filed in response to the Notice to File Corrected Application Papers mailed December 22, 2023. Please enter the following amendments under 37 C.F.R. § 1.112(b)(1), or any other appropriate section.

AMENDMENTS TO THE SPECIFICATION begin on page 2 of this paper; and

REMARKS begin on page 5 of this paper.

AMENDMENTS TO THE SPECIFICATION

Please replace paragraphs 0098-0105 (pages 26-28) of the originally-filed specification with the following:

[0098] FIG. 9 is a schematic flow chart diagram illustrating one embodiment of a method 900 for viewing a plurality of streamlets in accordance with the present invention. The method 900 starts and an agent controller module 702 is provided 904 and associated with a viewer 708 and provided with a staging module 709. The agent controller module 702 then requests 906 a streamlet 304 from the streamlet cache module 704. Alternatively, the agent controller module 702 may simultaneously request 906 a plurality of streamlets 304 the streamlet cache module 704. If the streamlet is stored 908 locally in the streamlet cache 710, the streamlet cache module 704 retrieves 910 the streamlet 304 and sends the streamlet to the agent controller module 702. Upon retrieving 910 or receiving a streamlet, the agent controller module 702 makes 911 a determination of whether or not to shift to a higher or lower quality stream 202. This determination will be described below in greater detail with reference to FIG. 10.

[0099] In one embodiment, the staging module 709 then arranges 912 the streamlets 304 into the proper order, and the agent controller module 702 delivers 914 the streamlets to the viewer 708. In a further embodiment, delivering 914 streamlets 304 to the end user comprises playing video and or audio streamlets on the viewer 708. If the streamlets 304 are not stored 908 locally, the streamlet request is passed to the network controller module 706. The network controller module 706 then requests 916 the streamlet 304 from the web server 116. Once the streamlet 304 is received, the network controller module 706 passes the streamlet to the streamlet cache module 704. The streamlet cache module 704 archives 918 the streamlet. Alternatively, the streamlet cache module 704 then archives 918 the streamlet and passes the streamlet to the agent controller module 702, and the method 900 then continues from operation 910 as described above.

[0100] Referring now to FIG. 10, shown therein is a schematic flow chart diagram illustrating one embodiment of a method 1000 for requesting streamlets 304 within an adaptive-rate shifting content streaming environment in accordance with the present invention. The method 1000 may

be used in one embodiment as the operation 911 of FIG. 9. The method 1000 starts and the agent controller module 702 receives 1004 a streamlet 304 as described above with reference to FIG. 9. The agent controller module 702 then monitors 1006 the receive time of the requested streamlet. In one embodiment, the agent controller module 702 monitors the time intervals A between successive receive times for each streamlet response. Ordering of the responses in relation to the order of their corresponding requests is not relevant.

[0101] Because network behavioral characteristics fluctuate, sometimes quite suddenly, any given Δ may vary substantially from another. In order to compensate for this fluctuation, the agent controller module 702 calculates 1008 a performance ratio r across a window of n samples for streamlets of playback length S. In one embodiment, the performance ratio *r* is calculated using the equation:

$$r = S\frac{n}{\sum_{i=1}^{n}\Delta_i}.$$

[0102] Due to multiple simultaneous streamlet processing, and in order to better judge the central tendency of the performance ratio r, the agent controller module 702 may calculate a geometric mean, or alternatively an equivalent averaging algorithm, across a window of size *m*, and obtain a performance factor φ:

$$\varphi_{current} = \left(\prod_{j=1}^{m} r_j\right)^{\frac{1}{m}}$$

[0103] The policy determination about whether or not to upshift 1010 playback quality begins by comparing $\varphi_{current}$ with a trigger threshold Θ_{up}. If $\varphi_{current} \geq \Theta_{up}$, then an up shift to the next higher quality stream may be considered 1016. In one embodiment, the trigger threshold Θ_{up} is determined by a combination of factors relating to the current read ahead margin (i.e. the amount of contiguously available streamlets that have been sequentially arranged by the staging module 709 for presentation at the current playback time index), and a minimum safety margin. In one embodiment, the minimum safety margin may be 24 seconds. The smaller the read ahead margin, the larger Θ_{up} is to discourage upshifting until a larger read ahead margin may be established to withstand network disruptions. If the agent controller module 702 is able to sustain 1016 upshift quality, then the agent controller module 702 will upshift 1017 the quality and subsequently request higher quality streams. The determination of whether use of the higher quality stream is sustainable 1016 is made by comparing an estimate of the higher quality

stream's performance factor, φ_{higher}, with Θ_{up}. If $\varphi_{higher} \geq \Theta_{up}$ then use of the higher quality stream is considered sustainable. If the decision of whether or not the higher stream rate is sustainable 1016 is "no," the agent controller module 702 will not attempt to upshift 1017 stream quality. If the end of the stream has been reached 1014, the method 1000 ends 1016.

[0104] If the decision on whether or not to attempt upshift 1010 is "no", a decision about whether or not to downshift 1012 is made. In one embodiment, a trigger threshold Θ_{down} is defined in a manner analogous to Θ_{up}. If $\varphi_{current} > \Theta_{down}$ then the stream quality may be adequate, and the agent controller module 702 does not downshift 1018 stream quality. However, if $\varphi_{current} \leq \Theta_{down}$, the agent controller module 702 does downshift 1018 the stream quality. If the end of the stream has not been reached 1014, the agent controller module 702 begins to request and receive 1004 lower quality streamlets and the method 1000 starts again. Of course, the above described equations and algorithms are illustrative only, and may be replaced by alternative streamlet monitoring solutions.

[0105] The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

REMARKS

This is a full and timely response to the Notice mailed on December 22, 2023 requesting a more legible version of the text originally appearing on pages 26-28 of the specification. No changes are made from the original text; this response simply provides a more legible version of the same originally-filed text. Support for any amendments can therefore be found in our originally-filed specification and its parents. No new matter has been added.

If any issues remain with this application, the undersigned would welcome a telephone call to 602-344-9885 to discuss further amendment, if appropriate. Recognizing that Internet communications are not secure, I hereby authorize the USPTO to communicate with the undersigned and other practitioners of record in accordance with 37 CFR 1.33 and 37 CFR 1.34 concerning any subject matter of this application via video conferencing, instant messaging, or electronic mail. I understand that a copy of these communications will be made of record in the application file. (MPEP 502.03). Without limiting the foregoing, we specifically consent to the use of email to exchange proposed amendments or other draft documents.

If any time extension, fee or other action is required to consider this response or any accompanying documents or to otherwise prevent abandonment, please consider this as a request for an extension of time, as a petition for any needed relief, and/or as authorization to charge Deposit Account No. 60-2406 for any fees that may be due.

Respectfully submitted,

KW Law, LLP

Dated: February 22, 2024

By: /Brett A. Carlson /
Brett A. Carlson
Reg. No. 39,928
brett@kwaw.co

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/069,450	**02/22/2024 03:53:04 PM Z ET**	**9401-00279**

Title of Invention

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8508	FILED BY	BLAKE SCHEFFEY
PATENT CENTER #	64415430	FILING DATE	12/21/2022
CUSTOMER #	70560	FIRST NAMED INVENTOR	DAVID F. BRUECK
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Brett Carlson

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
9401-00279_RNTCAP_022224-APP.TEXT.docx	5	Application body structured text document	27 KB
Warning: The automatic document description has been replaced. Text decorations have been removed. Text decorations have been removed.			
9401-00279_RNTCAP_022224.pdf	5	Auxiliary PDF of Application	68 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
9401-00279_RNTCAP_022224-	F0A73D86BB19ABE3A9458EE09C493899E730C99D530C5349C

APP.TEXT.docx	C9A3BAFD32B6EF5A12459D09588F8B01DFEC3CF911A4B6499420C1114030D0CA3B067BA5312E94D
9401-00279_RNTCAP_022224.pdf	8B1D106CAC4B8E818C98C6820DF2E54E9C3ABEEC7030C521D91F6DA2ACF57481FF8813A32730E692C4B3378A3A82C2FC4719893261BF9F25197ACF21F07CEEC4

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

70560 7590 03/25/2024

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

EXAMINER
PATEL, CHIRAG R

ART UNIT	PAPER NUMBER
2454	

DATE MAILED: 03/25/2024

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/069,450	12/21/2022	DAVID F. BRUECK	9401-00279	8508

TITLE OF INVENTION: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$1200.00	$0	06/25/2024

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

70560 7590 03/25/2024

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/069,450	12/21/2022	DAVID F. BRUECK	9401-00279	8508

TITLE OF INVENTION: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$1200.00	$0	06/25/2024

EXAMINER	ART UNIT	CLASS-SUBCLASS
PATEL, CHIRAG R	2454	709-219000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via the USPTO patent electronic filing system ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/069,450	12/21/2022	DAVID F. BRUECK	9401-00279	8508

70560 7590 03/25/2024

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

EXAMINER	
PATEL, CHIRAG R	

ART UNIT	PAPER NUMBER
2454	

DATE MAILED: 03/25/2024

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013).
https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to:

1) law enforcement, in the event that the system of records indicates a violation or potential violation of law;
2) a federal, state, local, or international agency, in response to its request;
3) a contractor of the USPTO having need for the information in order to perform a contract;
4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record;
5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record;
6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations;
7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals;
8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c));
9) the Office of Personnel Management (OPM) for personnel research purposes; and
10) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Notice of Allowability	Application No. 18/069,450	Applicant(s) BRUECK et al.	
	Examiner CHIRAG R PATEL	Art Unit 2454	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the IDS filed on February 1, 2024.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 11-30 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 2/1/24.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/CHIRAG R PATEL/
Primary Examiner, Art Unit 2454

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/09/2023	06/29/2023	11/17/2023	01/22/2024	03/13/2024				
	1	✓	-	-	-	-				
	2	✓	-	-	-	-				
	3	✓	-	-	-	-				
	4	✓	-	-	-	-				
	5	✓	-	-	-	-				
	6	✓	-	-	-	-				
	7	✓	-	-	-	-				
	8	✓	-	-	-	-				
	9	✓	-	-	-	-				
	10	✓	-	-	-	-				
1	11	✓	=	=	=	=				
2	12	O	=	=	=	=				
3	13	O	=	=	=	=				
4	14	O	=	=	=	=				
5	15	O	=	=	=	=				
6	16	O	=	=	=	=				
7	17	O	=	=	=	=				
8	18	O	=	=	=	=				
9	19	O	=	=	=	=				
10	20	O	=	=	=	=				
11	21	O	=	=	=	=				
12	22	✓	=	=	=	=				
13	23	O	=	=	=	=				
14	24	O	=	=	=	=				
15	25	O	=	=	=	=				
16	26	O	=	=	=	=				
17	27	O	=	=	=	=				
18	28	O	=	=	=	=				
19	29	O	=	=	=	=				
20	30	O	=	=	=	=				

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

CPC						
Symbol					**Type**	**Version**
H04L	/	65	/	70	F	2022-05-01
H04L	/	47	/	801	I	2013-01-01
H04L	/	47	/	12	I	2013-01-01
G06F	/	16	/	71	I	2019-01-01
G06F	/	16	/	183	I	2019-01-01
H04N	/	7	/	24	I	2013-01-01
H04N	/	21	/	23439	I	2013-01-01
H04N	/	21	/	4331	I	2013-01-01
H04N	/	21	/	84	I	2013-01-01
H04N	/	21	/	8456	I	2013-01-01
H04L	/	65	/	80	I	2013-01-01
H04L	/	65	/	61	I	2022-05-01
H04L	/	65	/	65	I	2022-05-01
H04L	/	65	/	1101	I	2022-05-01
H04L	/	67	/	60	I	2022-05-01
H04L	/	67	/	568	I	2022-05-01
H04L	/	67	/	02	I	2013-01-01
H04L	/	65	/	1069	I	2013-01-01
H04N	/	21	/	2662	I	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	12 March 2024	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20240312

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04L	/	65	/	70

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner) (Date)	**Total Claims Allowed:** 20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454 (Primary Examiner) 12 March 2024 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		10	9	19	18	28								
	2	1	11	10	20	19	29								
	3	2	12	11	21	20	30								
	4	3	13	12	22										
	5	4	14	13	23										
	6	5	15	14	24										
	7	6	16	15	25										
	8	7	17	16	26										
	9	8	18	17	27										

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	12 March 2024	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20240312

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

CPC - Searched*		
Symbol	Date	Examiner
H04L47/30, H04L65/80, H04L47/263, H04L47/10	03/09/2023	C.P.

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

Search Notes		
Search Notes	**Date**	**Examiner**
PE2E Search	03/08/2023	C.P.
Google Patents - Scholar	03/08/2023	C.P.
IP.COM	03/08/2023	C.P.
Inventor - Double Patent Search	03/08/2023	C.P.
Reviewed references cited in IPR and IDS	11/17/2023	C.P.
IPR2024-00043 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,470,138 on March 11, 2024	03/11/2024	C.P.
IPR2024-00043 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,677,798 on March 11, 2024	03/11/2024	C.P.
PR2024-00044 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,470,138 on March 11, 2024	03/11/2024	C.P.
IPR2024-00043, -00044, -00045, -00046, -00047, -00048, Reviewed Patent Owner's Preliminary Responses under 35 U.S.C. § 313 AND 37 C.F.R. § 42.107 on March 12, 2024	03/11/2024	C.P.
IPR2024-00048 Reviewed Petition for Inter Partes Review of U.S. Patent No. 8,868,772 on March 12, 2024	03/12/2024	C.P.
IPR 2024-00512 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,470,138 on March 12, 2024	03/12/2024	C.P.
PR2024-00517 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,470,138 on March 12, 2024	03/12/2024	C.P.
PR2024-00517 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,677,798 on March 12, 2024	03/12/2024	C.P.
IPR2024-00519 Reviewed Petition for Inter Partes Review of U.S. Patent No. 8,868,772 on March 12, 2024	03/12/2024	C.P.
Reviewed all references and IPR listed on IDS filed on February 1, 2024	03/13/2024	C.P.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H04L	H04L47/30, H04L65/80, H04L47/263, H04L47/10	06/29/2023	C.P.

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	31	client-side SAME adaptive ADJ bit$2rate near2 streaming	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:03 PM
L2	1145	client SAME adaptive ADJ bit$2rate near2 streaming	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:03 PM
L3	0	client SAME adaptive ADJ bit$2rate near2 streaming AND @ad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:15 PM
L4	0	adaptive ADJ bit$2rate near2 streaming AND @ad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:15 PM
L5	12	adaptive ADJ bit$2rate AND @ad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:15 PM
L6	73	BRUECK ADJ DAVID.in.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:20 PM
L7	2524	adaptive ADJ streaming WITH client	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:26 PM
L8	4	adaptive ADJ streaming WITH client AND @ad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:26 PM
L9	36	adaptive ADJ streaming WITH client-side	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:28 PM
L10	147	dash SAME client-side	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 03:32 PM
L11	259	("10469554"|"10469555"|"10757156"|"10951680"|"11470138"|"20010013128"|"20010047423"|"20020002708"|"20020029274"|"20020044528"|"20020073167"|"20020091840"|"20020097750"|"20020131496"|"20020144276"|"20020152317"|"20020152318"|"20020156912"|"20020161898"|"20020161908"|"20020161911"|"20020169926"|"20020170062"|"20020174434"|"20020176418"|"20020178330"|"20020188745"|"20030005455"|"20030009578"|"20030014684"|"20030018966"|"20030021166"|"20030021282"|"20030055995"|"200300613	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 04:00 PM

		05"|"20030065803"|"20 030067872"|"20030067 875"|"20030072376"|"2 0030081582"|"2003009 3790"|"20030107994"|" 20030135631"|"200301 35863"|"20030140159"| "20030151753"|"20030 152036"|"20030154239 "|"20030195977"|"2003 0204519"|"2003020460 2"|"20030233464"|"200 30236904"|"200302369 06"|"20040003101"|"20 040010613"|"20040030 547"|"20040030599"|"2 0040030797"|"2004003 1054"|"20040049780"|" 20040054551"|"200400 71209"|"20040083283"| "20040093420"|"20040 103444"|"20040117427 "|"20040136327"|"2004 0143672"|"2004016805 2"|"20040170392"|"200 40179032"|"200401996 55"|"20040202109"|"20 040220926"|"20040221 088"|"20040260701"|"2 0040260827"|"2004026 7956"|"20050015509"|" 20050033855"|"200500 55425"|"20050066063"| "20050076136"|"20050 084166"|"20050108414 "|"20050120107"|"2005 0123058"|"2005017761 8"|"20050185578"|"200 50188051"|"200502040 46"|"20050207569"|"20 050251832"|"20050262 257"|"20060010003"|"2 0060059223"|"2006007 5446"|"20060080718"|" 20060130118"|"200601 33809"|"20060165166"| "20060168290"|"20060 206246"|"20060236219 "|"20060277564"|"2006 1068295"|"2007002470 5"|"20070030833"|"200 70067480"|"200700793 25"|"20070094405"|"20 070204310"|"20070280 255"|"20080022343"|"2 0080028428"|"2008003 7527"|"20080046939"|" 20080056373"|"200800						

		86570"|"20080104647"|"20080120330"|"20080120342"|"20080133766"|"20080162713"|"20080184688"|"20080195744"|"20080205291"|"20080219151"|"20080222235"|"20080263180"|"20080281803"|"20090043906"|"20090055471"|"20090055547"|"20090210549"|"20100098103"|"20100262711"|"20110307545"|"20150058496"|"4535355"|"5168356"|"5267334"|"5404446"|"5414455"|"5424455"|"5544318"|"5687095"|"5732183"|"57685627"|"5841432"|"5867230"|"5933603"|"5941951"|"5953506"|"5966015"|"5966025"|"5996025"|"6003030"|"6091775"|"6091777"|"6112239"|"6122660"|"6154744"|"6172672"|"6181867"|"6185736"|"6195680"|"6292383"|"6292834"|"6366614"|"6374289"|"6389473"|"6449719"|"6486803"|"6490627"|"6498897"|"6510553"|"6574591"|"6604118"|"6618752"|"6625643"|"6637031"|"6665726"|"6708213"|"6721723"|"6731600"|"6757796"|"6760772"|"6766407"|"6795863"|"6845107"|"6850965"|"6859839"|"6874015"|"6968387"|"6976090"|"7047307"|"7054365"|"7054774"|"7054911"|"7075986"|"7093001"|"7096271"|"7099954"|"7116894"|"7174385"|"7194549"|"7240100"|"7260640"|"7274740"|"7295520"|"7310678"|"7325073"|"7328243"|"7330908"|"7334044"|"7349358"|"7349976"|"7369610"|"7376747"|"7386627"|"7391717"|"7408984"|"7412531"|"7477688"|"7523181"|"7536469"|"7546355"|"7558869"|"7577750"|"7593333"|"7599307"|"760					

		9652"|"7653735"|"7707303"|"7719985"|"7760801"|"7779135"|"7788395"|"7797439"|"7817985"|"7818444"|"7925781"|"7974200"|"8036265"|"8370514"|"8402156"|"8521836"|"8612624"|"8683066"|"8686066"|"8711701"|"8818127"|"8868772"|"8880721"|"9344496"|"9407564"|"9462074").PN.					
L12	82	L11 AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 05:06 PM
L13	0	client WITH request WITH bitstream WITH (bandwidth capability) AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 10:52 PM
L14	21	client WITH request WITH bitstream WITH (bandwidth capability)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 10:52 PM
L15	10	("11470138" "10659513" "9998516" "9571551" "9071668" "8612624" "8402156" "7818444" "8868772").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/06 11:04 PM
L16	2	("20050055425" "7369610").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 01:28 PM
L17	3	("20050055425" "7369610" "20020087717").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 01:42 PM
L18	1	("6389473").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 07:48 PM
L19	1099	client WITH select$3 WITH bit$2rate	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 07:58 PM
L20	455	client WITH select$3 WITH bit$2rate SAME stream	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 07:58 PM
L21	2	client WITH select$3 WITH bit$2rate SAME stream AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 07:58 PM
L22	1	L21 AND ((H04L47/30 OR H04L65/80 OR H04L47/263 OR H04L47/10).cpc.)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 08:00 PM
L23	114	client WITH select$3 WITH bit$2rate WITH content WITH server	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 08:00 PM
L24	725	client WITH select$3	(US-PGPUB; USPAT;	OR	ON	ON	2023/03/07

		WITH bit$2rate AND adaptive near3 stream$3	USOCR; EPO)				08:00 PM
L25	2	client WITH select$3 WITH bit$2rate AND adaptive near3 stream$3 AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 08:01 PM
L26	71	adaptive ADJ streaming AND @ad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 08:02 PM
L27	0	adaptive ADJ streaming AND select$3 WITH bit$2rate AND @ad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 08:02 PM
L28	1	adaptive ADJ streaming AND select$3 WITH bit$2rate AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/07 08:02 PM
L29	0	("56683104").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 09:57 AM
L30	0	client WITH select$3 WITH bit$2rate near3 streamlet	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 10:24 AM
L31	1	client WITH select$3 WITH bit$2rate WITH streamlet	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 10:24 AM
L32	35	adaptive near3 bitrate WITH selection WITH client	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 02:14 PM
L33	8	((H04L47/30 OR H04L65/80 OR H04L47/263 OR H04L47/10).cpc.) AND select$3 near3 streamlet WITH bitrate	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 02:19 PM
L34	2	("6490627" "20030152036").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 09:48 PM
L35	52	client WITH request$3 WITH bit$2rate AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 09:56 PM
L36	0	client WITH request$3 WITH streamlet AND bit$2rate AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 09:57 PM
L37	8	client WITH request$3 WITH streamlet AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 09:57 PM
L38	81	client WITH request$3 WITH streamlet AND bit$2rate	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 09:57 PM
L39	18	client WITH request$3 WITH segments AND bit$2rate AND	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 09:58 PM

		@rlad<"20040430"					
L40	63	segment WITH stream WITH (chunk sement) WITH bit$2rate	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 10:05 PM
L41	0	segment WITH stream WITH (chunk sement) WITH bit$2rate AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 10:07 PM
L42	6	"2003009581"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/08 11:08 PM
L43	8	"2003009581"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); EPO)	OR	ON	ON	2023/03/08 11:08 PM
L44	17	"2003009581"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; DERWENT)	OR	ON	ON	2023/03/08 11:09 PM
L45	2	("20040172478").pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; DERWENT)	OR	ON	ON	2023/03/08 11:22 PM
L46	48	http ADJ get near3	(US-PGPUB; USPAT;	OR	ON	ON	2023/03/09

		request near4 client AND stream$3 AND @rlad<"20040930"	USOCR; EPO)				12:32 AM
L47	51	multi$2pass near2 encod$3 WITH stream	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/09 02:16 PM
L48	0	multi$2pass near2 encod$3 WITH stream AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/09 02:16 PM
L49	6497	multi$2pass AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/09 02:17 PM
L50	64	multi$2pass near2 encod$3 AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/09 02:17 PM
L52	0	multi$2pass near2 encod$3 AND streamlet AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/09 02:17 PM
L53	0	adaptive near3 bitrate WITH selection WITH client AND @rlad<"20040430"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/03/09 04:42 PM
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			PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
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L63	1	("10951680").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2023/11/17 08:56 AM
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L75	1	("8,868,772").pn.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/03/13 11:19 AM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	8	((H04L47/30 OR H04L65/80 OR H04L47/263 OR H04L47/10).cpc.) AND select$3 near3 streamlet WITH bitrate	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:19 PM

N2	0	client WITH select$3 near3 streamlet WITH bitrate AND @rlad<"20040930"	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:23 PM
N3	0	client WITH select$3 near3 streamlet WITH bitrate	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:23 PM
N4	1	client WITH select$3 WITH streamlet SAME bitrate	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:23 PM
N5	253	request$3 near3 streamlet	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:24 PM
N6	101	request$3 near3 streamlet WITH client	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:24 PM
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N8	0	request$3 near3 streamlet WITH client AND bit$2rate AND @ad<"20040930"	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:25 PM
N9	0	request$3 near3 streamlet AND bit$2rate AND @ad<"20040930"	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:25 PM
N10	3	request$3 near3 (streamlet chunk) AND bit$2rate AND @ad<"20040930"	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:25 PM
N11	53	((H04L47/30 OR H04L65/80 OR H04L47/263 OR H04L47/10).cpc.) AND N6	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/08 02:47 PM
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Bibliographic Data

Application No: 18/069,450

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /CHIRAG R PATEL/ Examiner's Signature | Initials

Title: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/21/2022	709	2454	9401-00279
RULE			

APPLICANTS

DISH Technologies L.L.C., Englewood, CO, UNITED STATES

INVENTORS

DAVID F. BRUECK, SARATOGA SPRINGS, UT, UNITED STATES

MARK B. HURST, CEDAR HILLS, UT, UNITED STATES

R. DREW MAJOR, OREM, UT, UNITED STATES

CONTINUING DATA

This application is a CON of 17962231 10/07/2022 PAT 11677798

17962231 is a CON of 16876579 05/18/2020 PAT 11470138

16876579 is a CON of 16004056 06/08/2018 PAT 10659513

16004056 is a CON of 15414025 01/24/2017 PAT 9998516

15414025 is a CON of 14719122 05/21/2015 PAT 9571551

14719122 is a CON of 14106051 12/13/2013 PAT 9071668

14106051 is a CON of 13617114 09/14/2012 PAT 8612624

13617114 is a CON of 12906940 10/18/2010 PAT 8402156

12906940 is a CON of 11673483 02/09/2007 PAT 7818444

11673483 is a CIP of 11116783 04/28/2005 PAT 8868772

11116783 has PRO of 60566831 04/30/2004

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

01/17/2023

STATE OR COUNTRY

UNITED STATES

ADDRESS

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014
UNITED STATES

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$7,160

PTO/SB/08a (01-22)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6848004	B1	2005-01-25	Chang et al.	
	2	6002440	A	1999-12-14	Dalby et al.	
	3	6637031	B1	2003-10-21	Philip A. Chou	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20030055995	A1	2003-03-20	Pekka Ala-Honkola	
	2	20040093420	A1	2004-05-13	Jonathan Bailey Gamble	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18069450
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	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	1	20020049343	WO	A1	2002-06-20	Leaning et al.		☐
	2	20020075482	WO	A2	2002-09-26	Allen et al.		☐
	3	1997004942	WO	A2	1997-11-27	Kliger et al.		☐

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00512, "Petition for Inter Partes Review of U.S. Patent No. 11,470,138" executed January 30, 2024 (89 pages).	☐
	2	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00513, "Petition for Inter Partes Review of U.S. Patent No. 10,757,156" executed January 30, 2024 (81 pages).	☐
	3	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00514, "Petition for Inter Partes Review of U.S. Patent No. 10,469,554" executed January 30, 2024 (87 pages).	☐
	4	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00515, "Petition for Inter Partes Review of U.S. Patent No. 10,469,555" executed January 30, 2024 (82 pages).	☐
	5	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00516, "Petition for Inter Partes Review of U.S. Patent No. 10,951,680" executed January 30, 2024 (85 pages).	☐
	6	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00517, "Petition for Inter Partes Review of U.S. Patent No. 11,677,798" executed January 30, 2024 (88 pages).	☐

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

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	Application Number	18069450
	Filing Date	2022-12-21
	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	7	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00518, "Petition for Inter Partes Review of U.S. Patent No. 9,407,564" executed January 30, 2024 (86 pages).	☐
	8	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00519, "Petition for Inter Partes Review of U.S. Patent No. 8,868,772" executed January 30, 2024 (85 pages).	☐
	9	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00512, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 11,470,138" executed January 29, 2024 (89 pages).	☐
	10	"Synchronized Multimedia Integration Language (SMIL 2.0)" dated August 7, 2001 (364 pages).	☐
	11	United States International Trade Commission In the Matter of: Certain Fitness Devices, Streaming Components Thereof, and Systems Containing Same (Investigation No. 337-TA-1265), "Initial Determination on Violation of Section 337 and Recommended Determination on Remedy and Bond" dated September 9, 2022 (269 pages).	☐
	12	United States International Trade Commission In the Matter of: Certain Fitness Devices, Streaming Components Thereof, and Systems Containing Same (Investigation No. 337-TA-1265), "Enforcement Complaint of DISH DBS Corporation ET AL." dated September 11, 2023 (43 pages).	☐
	13	Internet Archive Affidavit, Nathaniel E Frank-White for URLs ("SMIL") (335 pages broken into six parts - pages 1-50, 51-90, 91-130, 131-170, 171-210, and 211-335).	☐
	14	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00513, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 10,757,156" executed January 29, 2024 (85 pages).	☐
	15	The Internet Society "Hypertext Transfer Protocol -- HTTP/1.1" dated June 1999 (152 pages).	☐
	16	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00514, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 10,469,554" executed January 28, 2024 (87 pages).	☐
	17	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00515, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 10,469,555" executed January 28, 2024 (82 pages).	☐

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C. R. P./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18069450
	Filing Date	2022-12-21
	First Named Inventor	David F. Brueck
	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	18	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00516, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 10,951,680" executed January 29, 2024 (87 pages).	☐
	19	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00517, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 11,470,138" executed January 28, 2024 (94 pages).	☐
	20	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00518, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 9,407,564" executed January 29, 2024 (93 pages).	☐
	21	AYLO Freesites LTD v. DISH Technologies L.L.C., Inter Partes Review No. IPR2024-00519, "Declaration of Henry Houh, Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 8,868,772" executed January 29, 2024 (99 pages).	☐

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EXAMINER SIGNATURE

Examiner Signature	/CHIRAG R PATEL/	Date Considered	03/13/2024

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2024-02-01
Name/Print	Brett Carlson	Registration Number	39928

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/069,450	12/21/2022	DAVID F. BRUECK	9401-00279	8508

70560 7590 04/10/2024

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

EXAMINER
PATEL, CHIRAG R

ART UNIT	PAPER NUMBER
2454	

NOTIFICATION DATE	DELIVERY MODE
04/10/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

dish@kwlaw.co
ipdept@dish.com
uspto@dockettrak.com

Corrected ***Notice of Allowability***	**Application No.** 18/069,450	**Applicant(s)** BRUECK et al.	
	Examiner CHIRAG R PATEL	**Art Unit** 2454	**AIA (FITF) Status** No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the printer rush on April 3, 2024.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 11-30 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 10/19/23.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☑ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/CHIRAG R PATEL/
Primary Examiner, Art Unit 2454

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

Examiner Comment

The information disclosure statement filed October 19, 2023 fails to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because it lists the incorrect application number as these number refer to a foreign patent document. It has been placed in the application file, but the information referred to therein has not been considered as to the merits as the application numbers are incorrect. Applicant is advised that the date of any re-submission of any item of information contained in this information disclosure statement or the submission of any missing element(s) will be the date of submission for purposes of determining compliance with the requirements based on the time of filing the statement, including all certification requirements for statements under 37 CFR 1.97(e). See MPEP § 609.05(a).

As courtesy, examiner has filled out an 892 form and supplied the suggested foreign patent documents for the incorrect application numbers to make it part of official record. If these application numbers were not intended, applicants are welcome to a file a corrected IDS.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chirag R Patel whose telephone number is (571)272-7966. The examiner can normally be reached on Monday to Friday from 8:00AM to 4:30PM. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenton Burgess, can be reached on 571-272-3949. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pairdirect.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll free).

/Chirag R Patel/
Primary Examiner, Art Unit 2454

Notice of References Cited	Application/Control No. 18/069,450	Applicant(s)/Patent Under Reexamination BRUECK et al.	
	Examiner CHIRAG R PATEL	Art Unit 2454	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Name	CPC Classification	US Classification
	A					
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Country	Name	CPC Classification
	N	WO-03027876-A1	2003-04-03	WO	INGRAHAM R	G06F15/16
	O	WO-03003760-A2	2003-01-09	WO	ALLEN A	H04L12/5695
	P	WO-2004036824-A1	2004-04-29	WO	CURCIO I	H04L65/1083
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in YYYY-MM-DD format are publication dates. Classifications may be US or foreign.

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

CPC						
Symbol					**Type**	**Version**
H04L	/	65	/	70	F	2022-05-01
H04L	/	47	/	801	I	2013-01-01
H04L	/	47	/	12	I	2013-01-01
G06F	/	16	/	71	I	2019-01-01
G06F	/	16	/	183	I	2019-01-01
H04N	/	7	/	24	I	2013-01-01
H04N	/	21	/	23439	I	2013-01-01
H04N	/	21	/	4331	I	2013-01-01
H04N	/	21	/	84	I	2013-01-01
H04N	/	21	/	8456	I	2013-01-01
H04L	/	65	/	80	I	2013-01-01
H04L	/	65	/	61	I	2022-05-01
H04L	/	65	/	65	I	2022-05-01
H04L	/	65	/	1101	I	2022-05-01
H04L	/	67	/	60	I	2022-05-01
H04L	/	67	/	568	I	2022-05-01
H04L	/	67	/	02	I	2013-01-01
H04L	/	65	/	1069	I	2013-01-01
H04N	/	21	/	2662	I	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	04 April 2024	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20240404

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04L	/	65	/	70

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	04 April 2024	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20240404

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		10	9	19	18	28								
	2	1	11	10	20	19	29								
	3	2	12	11	21	20	30								
	4	3	13	12	22										
	5	4	14	13	23										
	6	5	15	14	24										
	7	6	16	15	25										
	8	7	17	16	26										
	9	8	18	17	27										

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	04 April 2024	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office Part of Paper No.: 20240404

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

CPC - Searched*		
Symbol	Date	Examiner
H04L47/30, H04L65/80, H04L47/263, H04L47/10	03/09/2023	C.P.

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

Search Notes		
Search Notes	**Date**	**Examiner**
PE2E Search	03/08/2023	C.P.
Google Patents - Scholar	03/08/2023	C.P.
IP.COM	03/08/2023	C.P.
Inventor - Double Patent Search	03/08/2023	C.P.
Reviewed references cited in IPR and IDS	11/17/2023	C.P.
IPR2024-00043 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,470,138 on March 11, 2024	03/11/2024	C.P.
IPR2024-00043 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,677,798 on March 11, 2024	03/11/2024	C.P.
PR2024-00044 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,470,138 on March 11, 2024	03/11/2024	C.P.
IPR2024-00043, -00044, -00045, -00046, -00047, -00048, Reviewed Patent Owner's Preliminary Responses under 35 U.S.C. § 313 AND 37 C.F.R. § 42.107 on March 12, 2024	03/11/2024	C.P.
IPR2024-00048 Reviewed Petition for Inter Partes Review of U.S. Patent No. 8,868,772 on March 12, 2024	03/12/2024	C.P.
IPR 2024-00512 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,470,138 on March 12, 2024	03/12/2024	C.P.
PR2024-00517 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,470,138 on March 12, 2024	03/12/2024	C.P.
PR2024-00517 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,677,798 on March 12, 2024	03/12/2024	C.P.
IPR2024-00519 Reviewed Petition for Inter Partes Review of U.S. Patent No. 8,868,772 on March 12, 2024	03/12/2024	C.P.
Reviewed all references and IPR listed on IDS filed on February 1, 2024	03/13/2024	C.P.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H04L	H04L47/30, H04L65/80, H04L47/263, H04L47/10	06/29/2023	C.P.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/09/2023	06/29/2023	11/17/2023	01/22/2024	03/13/2024	04/04/2024			
	1	✓	-	-	-	-	-			
	2	✓	-	-	-	-	-			
	3	✓	-	-	-	-	-			
	4	✓	-	-	-	-	-			
	5	✓	-	-	-	-	-			
	6	✓	-	-	-	-	-			
	7	✓	-	-	-	-	-			
	8	✓	-	-	-	-	-			
	9	✓	-	-	-	-	-			
	10	✓	-	-	-	-	-			
1	11	✓	=	=	=	=	=			
2	12	O	=	=	=	=	=			
3	13	O	=	=	=	=	=			
4	14	O	=	=	=	=	=			
5	15	O	=	=	=	=	=			
6	16	O	=	=	=	=	=			
7	17	O	=	=	=	=	=			
8	18	O	=	=	=	=	=			
9	19	O	=	=	=	=	=			
10	20	O	=	=	=	=	=			
11	21	O	=	=	=	=	=			
12	22	✓	=	=	=	=	=			
13	23	O	=	=	=	=	=			
14	24	O	=	=	=	=	=			
15	25	O	=	=	=	=	=			
16	26	O	=	=	=	=	=			
17	27	O	=	=	=	=	=			
18	28	O	=	=	=	=	=			
19	29	O	=	=	=	=	=			
20	30	O	=	=	=	=	=			

Bibliographic Data

Application No: 18/069,450

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /CHIRAG R PATEL/ Examiner's Signature | Initials

Title: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/21/2022	709	2454	9401-00279
RULE			

APPLICANTS

DISH Technologies L.L.C., Englewood, CO, UNITED STATES

INVENTORS

DAVID F. BRUECK, SARATOGA SPRINGS, UT, UNITED STATES

MARK B. HURST, CEDAR HILLS, UT, UNITED STATES

R. DREW MAJOR, OREM, UT, UNITED STATES

CONTINUING DATA

This application is a CON of 17962231 10/07/2022 PAT 11677798

17962231 is a CON of 16876579 05/18/2020 PAT 11470138

16876579 is a CON of 16004056 06/08/2018 PAT 10659513

16004056 is a CON of 15414025 01/24/2017 PAT 9998516

15414025 is a CON of 14719122 05/21/2015 PAT 9571551

14719122 is a CON of 14106051 12/13/2013 PAT 9071668

14106051 is a CON of 13617114 09/14/2012 PAT 8612624

13617114 is a CON of 12906940 10/18/2010 PAT 8402156

12906940 is a CON of 11673483 02/09/2007 PAT 7818444

11673483 is a CIP of 11116783 04/28/2005 PAT 8868772

11116783 has PRO of 60566831 04/30/2004

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

01/17/2023

STATE OR COUNTRY

UNITED STATES

ADDRESS

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014
UNITED STATES

FILING FEE RECEIVED

$7,160

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
3 April 2003 (03.04.2003)

PCT

(10) International Publication Number
WO 03/027876 A1

(51) International Patent Classification[7]: G06F 15/16

(21) International Application Number: PCT/US02/30874

(22) International Filing Date:
26 September 2002 (26.09.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/325,483 26 September 2001 (26.09.2001) US

(71) Applicants and
(72) Inventors: **REYNOLDS, Jodie, Lynn** [US/US]; 728 King Way, Folsom, CA 95630 (US). **INGRAHAM, Robert, Walter** [US/US]; 127 Honey Cook Circle, Folsom, CA 95630 (US).

(74) Agents: **GALLENSON, Mavis, S.** et al.; Ladas & Parry, Suite 2100, 5670 Wilshire Boulevard, Los Angeles, CA 90036-5679 (US).

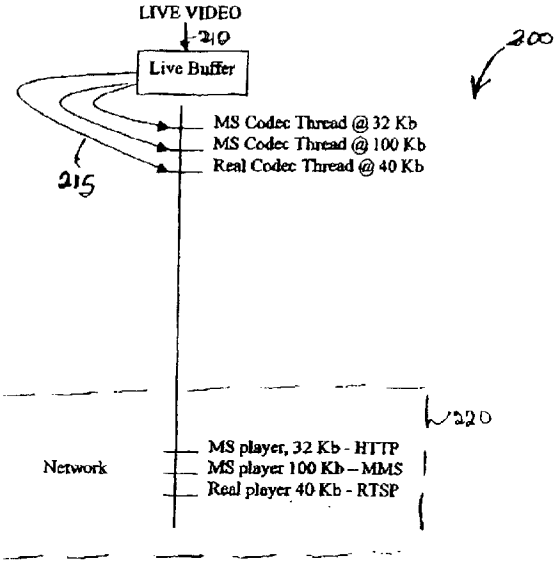
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

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.

(54) **Title:** SYSTEM AND METHOD FOR COMMUNICATING MEDIA SIGNALS



(57) **Abstract:** A media streaming system for streaming media signals is provided. The media streaming system takes a library of separate and distinct CODECs (145) that are provided as a searchable CODEC library and used in determining specific characteristics in the media signal to identify similar sections of the signal. The media streaming system uses a computer implemented intelligence system, such as an intelligence mechanism to learn and capture the unique charateristics of a signal as the signal is being streamed (150). The media streaming system also compresses and decompresses the media signal as the signals are streamed from a source media (100) to a destination device (130, 135, 140).

WO 03/027876 A1

SYSTEM AND METHOD FOR COMMUNICATING MEDIA SIGNALS

RELATED APPLICATION

This application is a non-provisional application of "Reynolds et al. a provisional application entitled "System and Method for Communicating Media Signals" attorney docket number ID-PAT-001PR1, application number 60/325,483, filed on September 26, 2001.

FIELD

This disclosure relates to a system and method for communicating media signals between source and destination devices. More specifically, it relates to a system and method for compressing and decompressing streaming and static media signals for efficiently communicating those signals between source and destination devices using artificial intelligence mechanism.

BACKGROUND

The ability to efficiently communicate streaming and static media between remotely located devices is a significant need that has emerged exponentially with the advent of networked communications such as the Internet. This need has been recently addressed with substantial development resources on a worldwide scale.

The term "media" is herein intended to mean information that may be communicated in the form of a signal from a source device to a destination device for use by the destination device; and, where used herein, media is generally contemplated to comprise either streaming or static media signals. For the purpose of this disclosure, the term "use" as applied to a destination device's operation on media signals is intended to include playing (e.g. sounds, images, video), processing (e.g. telemetry data), or any other use or operation that is the intended purpose of the media signal.

The terms "streaming media" are herein intended to mean media signals that comprise information intended to be communicated to and used by a destination device in a temporal, streaming fashion. The term "streaming" as applied to streaming media signals is herein intended to include signals communicated and processed in a continuous manner over time, or signals that may be

signals communicated and processed in a continuous manner over time, or signals that may be communicated in a series of discrete packets, pieces, or blocks that are interrelated and may be thereafter used by the destination device in a continuous, interrelated fashion. Examples of streaming media signals for the purpose of this disclosure therefore include, without limitation, the following types of media: video, audio, audio combined with video, and data strings such as temporal telemetry. The terms "streaming media" are most typically used by reference to digitized forms of data representing the subject media.

The terms "static media" are herein intended to generally mean media that is not "streaming" as defined above. Static media signals are of the type that generally may be communicated and are intended to be used as a single packet, block, or piece. Static media therefore may include for example, without limitation the following: a discrete image, an individual and relatively temporally short video clip, a sound or sound bite, or a piece or block of information such as telemetry information. It is contemplated, however, that such a "single piece" of static media may be of sufficient magnitude to consist of a plurality of smaller pieces or sub-parts, such as for example regions or pixels of an overall image, individual frames that together form a video clip, digital bits that together comprise a sound, a group of sounds that comprise a sound bite, or bits of information that together comprise a larger block of information.

Streaming media generally includes data files that are significantly larger than static media files, and also often represent many more variables over the temporal communication of such files than experienced with most static media files. Therefore, the ability to efficiently compress streaming media for appropriate communication to destination devices for use is often a much more complex and difficult to achieve goal. Accordingly, much of this disclosure is provided by reference specifically to streaming media communication, and the present invention has been observed to provide significant benefits for such communication. However, where streaming media is specifically referenced herein with respect to this background, and further with respect to the many benefits of the present invention herein disclosed, static media is also further contemplated where appropriate according to one of ordinary skill.

Many different "type-specific" media systems have been in use for quite a long time for transmitting specific types (e.g. video, audio, image, voice, etc.) of streaming and static media signals between sources and remote destinations. Typical examples of such type-specific media systems include television transmission systems, telephone line systems, and radio transmission systems, and every television, telephone, and radio is therefore a receiving device for media. Accordingly, the needs

for efficient communication of streaming and static media touch upon many diverse communications industries, including for example the telephone, television, movie, music, and more recently interactive gaming industries.

Moreover, many medial communications systems, including the various long-standing type-specific systems, are also "format specific", wherein the subject media signals are communicated in a particular format such that the source, transmission channel, and destination device must be specifically compliant to work within that format. Examples of format specific media systems include for example encoded cable television systems that work only for certain types of media and only delivered in particular encoded formats from the cable carrier. Therefore, these systems, in hardware and software, are generally dedicated to only the type and format of media to be provided by the content provider.

Society's needs have outpaced the abilities of these dedicated, content-specific and format-specific systems. In particular, these dedicated systems are not structured to accommodate the ever increasing client demand, real-time, for specified streaming media. Still further, technology developments in the recently interconnected world has tempted the palate of society for the ability to pull, receive, push, and send multiple types of media in multiple formats using one device. Moreover, content providers need to be able to deliver many different media signals to many different types of devices in their clients' offices, living rooms, and hands. Individuals and corporations also desire to communicate with each other using various different formats and using various different respective devices.

Accordingly, a significant industry has emerged for delivering streaming and static media over the centralized network of the Internet. Content delivery companies are currently delivering a wide range of streaming media, from live horse racing and entertainment to medical telemetry and education, over the Internet, and in video and audio formats. According to one published report from DFC Intelligence, video streaming on the Internet grew 215 percent in 2000 to over 900 million total streams accessed. This includes broadband streams, which made up almost 29 percent of total accesses. This same report also estimates that as much as 15 percent of available stream inventory is now being exploited with in-stream advertising. In another report published by Internet researcher Jupiter Media Metrix, business spending alone on streaming video technology will balloon from one-hundred forty million (US$140M) US dollars in 2000 to nearly three billion (US$3B) US dollars by 2005 as companies turn to electronic interaction in communicating with employees, consumers and other businesses.

Still further, the population explosion and increasing number of people transmitting on these systems has severely impacted the available bandwidth for available information. Therefore, the ability to stream media efficiently, using limited bandwidth resources and limited available transmission speeds, is of increased societal importance.

Compression/Decompression Algorithms ("CODECS")

In view of the exponential demand for communicating the different types of media, various compression/decompression systems ("CODEC(s)") have been developed over many years, and have in particular become the recent topic of significant research and development. Specific types of CODECS and systems for managing the operation of CODECS with respect to communicating streaming and static media signals have been developed for specific types of media, including for example still-frame images such as graphics and photographs, and streaming media.

Image CODECS

Various different types of static media CODECS have been developed, and a wide variety of these CODECS are widely known and used. One specific type of static media that has been the topic of particular attention includes images (though a long series of interrelated image frames such as in video context is generally treated as streaming media due to more complex variables, e.g. size and temporal relationship between frames, that significantly impact appropriate compression/decompression needs). Examples of static media CODECing is therefore herein exemplified by reference to certain specific types of conventional image CODEC technologies and methods.

The two most common file formats for graphic images on the world wide web are known as "GIF" and "JPEG" formats, generally considered the respective standards for drawings (e.g. line art) and photographs, and are further described together with other image compression modalities for the purpose of further understanding as follows.

"JPEG" is an acronym for "Joint Photographic Experts Group", and is a graphic image file that complies with ISO standard 10918. Commonly used for photograph compression/decompression, a JPEG file is created by choosing from a range of compression qualities, or, as has also been described, by choosing from one of a suite of compression algorithms. In order to create a JPEG file, or convert

an image from another format to JPEG, the quality of image that is desired must be specified. In general, because the highest quality results in the largest file, a trade-off may then be made, as chosen by the user, between image quality and image size. The JPEG mode of compression generally includes 29 distinct coding processes although a JPEG implementer may not use them all. A JPEG image is typically given a name suffix ".jpg".

"GIF" is an acronym for "Graphics Interchange Format", and is generally considered the de facto standard form of drawing image compression/decompression for Internet communication. GIF formatting uses a compression algorithm known as the LZW algorithm, which was developed by Abraham Lempel, Jacob Ziv, and Terry Welch and made commercially available by Unisys Corporation (though in general such algorithm has been made publicly available without requiring fee-bearing licenses). More specifically, a "LZW" compression algorithm takes each input sequence of bits of a given length (e.g. 12 bits) and creates an entry in a table, sometimes called a "dictionary" or "codebook", for that particular bit pattern. The entry consists of the pattern itself and a shorter code. As input is read, any pattern that has been read before results in the substitution of the shorter code, effectively compressing the total amount of input to something smaller. Earlier approaches, known as LZ77 and LZ78, did not include the look-up table as part of the compressed file. However, the more recent LZW algorithm modality does include the table in the file, and the decoding program that decompresses the file for viewing is able to build the table itself using the algorithm as it processes the encoded input. The GIF format uses the 2D raster data type (associated with display screens using raster lines) and is encoded in binary.

Two versions of GIF formats include GIF 87a, and more recently GIF89a that allows for "animated GIF" file creation, or short sequences of images within a single GIF file that are played in sequence to present movement or change in the image (either in an endless loop or through a progression that reaches an end). GIF89A also allows for, and also for "interlaced GIF", which is a GIF image that arrives and is displayed by the receiver first as a fuzzy outline of an image that is gradually replaced by seven successive waves of bit streams that fill in the missing lines until full resolution is reached. Interlaced GIF allows, for example, a viewer using 14.4 Kbps and 28.8 Kbps modems to observe a briefer wait-time before certain information in a subject image may be processed, such as for example to make decisions (e.g. to click on the image to execute an operation such as a link).

By presenting waves of resolution filling image sequences, interlaced GIF is similar to "Progressive JPEG", which describes an image created using the JPEG suite of compression algorithms

that will "fade in" in successive waves. While the progressive JPEG is often observed to be more appealing way to deliver an image at modem connection speeds, users with faster connections may not likely notice a difference.

"PNG" or "Portable Network Graphics" format has been more recently developed for image compression and that, in time, has been publicized to replace the GIF format for Internet use (though not generally the JPEG format allowing size/quality trade-offs). This format has been developed for public consumption and development. Similar to GIF, PNG is considered a "lossless" compression format, and therefore all image information is restored when a compressed file is decompressed during viewing. However, PNG formatted files are generally intended to be from 10 to 30 percent more compressed than with a GIF format. Further aspects of PNG file formats are provided as follows: (i) color transparency may not be limited to only one color, but the degree of transparency may be controlled ("opacity"); (ii) "interlacing" of images is improved versus standard GIF; (iii) "gamma correction" is enabled, allowing for "tuning" of images in terms of color brightness required by specific display manufacturers; (iv) images can be saved using true color, palette, and gray-scale formats similar to GIF; and (v) "animation" is generally not supported, though PNG is generally considered extensible and therefore software may be layered to provide for such scriptable image animation.

"TIFF" is an acronym for "Tag Image File Format", and is a common format for exchanging raster graphics (or "bitmap") images between application programs, such as for example graphics used for scanner images. A TIFF file is usually given a name suffix of ".tif" or ".tiff", and had generally been developed in the mid-1980's with the support of Adobe Software, Microsoft, and Hewlett-Packard. TIFF files can be in any of several classes, including gray scale, color palette, or RGB full color, the descriptions and differences of which are further developed elsewhere herein this disclosure. TIFF files may also include files with JPEG, LZW, or CCITT Group 4 standard run-length image compression, which are also further described elsewhere herein. As one of the most common graphic image formats, TIFF files are typically used in desktop publishing, faxing, 3-D applications, and medical imaging applications.

Video CODECS

Video compression has been the topic of intense development for various applications, including, for example: pre-recorded video (e.g. "video-on-demand"), teleconferencing, and live video (e.g. broadcasts). "Desk-top" computers, wireless devices, conventional televisions, and high

definition televisions are examples of the different types of receiving devices that an efficient video compression system must serve.

In general, video CODEC algorithms operate on either or both of an individual, frame-by-frame basis, and/or on a "temporal compression" basis wherein each frame is the most common video compression algorithms in conventional use are based on several mathematic principles, including the following: Discrete Cosine Transforms ("DCT"), Wavelet Transforms and Pure Fractals.

"Discrete Cosine Transforms" or "DCT's" are by far the most popular transforms used for image compression applications . In general, DCT is a technique for representing waveform data as a weighted sum of cosines. The DCT is similar to the discrete Fourier transform: it transforms a signal or image from the spatial domain to the frequency domain. The DCT helps separate the image into parts (or spectral sub-bands) of differing importance (with respect to the image's visual quality). Reasons for its popularity include not only good performance in terms of energy compaction for typical images but also the availability of several fast algorithms. DCTs are used in two international image/video compression standards, JPEG and MPEG.

"Wavelet transforms" are generally mathematical algorithms that convert signal data into a set of mathematical expressions that can then be decoded by a destination receiver device, such as for example in a manner similar to Fourier transform. Wavelets have been observed to enhance recovery of weak signals from noise, and therefore images processed in this manner can be enhanced without significant blurring or muddling of details. For this reason, wavelet signal processing has been particularly applied to X-ray and magnetic-resonance images in medical applications. In Internet communications, wavelets have been used to compress images to a greater extent than is generally possible with other conventional methods. In some cases, the wavelet-compressed image can be as small as about 25 percent the size of a similar quality image using the more familiar JPEG format, which is discussed in further detail elsewhere in this disclosure. Thus, for example, a photograph that requires 200Kb and takes a minute to download in JPEG format may require only 50Kb and take only 15 seconds to download in wavelet-compressed format. A wavelet-compressed image file is often given a name suffix ".wif", and either the receiver (e.g. Internet browser on a computer receiver) must support these format specific files, or a plug-in program will be required to read such file.

Fractal image compression is a modern technique of lossy image coding that provides several improvements over existing Fourier series compression schemes. Edge depiction is improved since, when modeled as a step function, edges require a large number of Fourier series terms to properly depict. Other advantages of fractals include fast decoding time and scale independence. Fractal

compression is based on Mandelbrot sets which take advantage of a self similar, scaling dependent, statistical feature of nature (Mandelbrot, 1983). Fractal compression and decompression involves a clustering approach to find regions which show the same characteristics as a sample region independent of rotation and scale. The fractal image compresses images as recursive equations and instructions about how to reproduce them. The equations describe the image in terms of the relationships between its components. The reduction in storage need is due to the fact that fractal compression saves equations and instructions instead of a pixel representation of the image.

"MPEG" is an acronym for Moving Picture Experts Group and has come to be used synonymously with certain evolving video and audio compression standards promulgated therefrom. In general, to use MPEG video files, a personal computer is required with sufficient processor speed, internal memory, and hard disk space to handle and play the typically large MPEG file, usually given the name suffix ".mpg". A specified MPEG viewer or client software that plays MPEG files must be available on the client system, and generally can be downloaded shareware or versions of commercial MPEG players from various sites on the Web. The modes of operation for MPEG formatted media are herein described by reference to these sequentially evolved standards as follows.

More specifically, MPEG-1 standard was designed for coding progressive video generally at a transmission rate of about 1.5Mbps. This was generally designed for the specific application for Video-CD and CD-I media. MPEG-1 audio layer-3 ("MP3") has also evolved from early MPEG work. "MPEG-2" is a standard generally designed for coding interlaced images at transmission rates above 4 Mbps, and was generally intended for use with digital TV broadcast and digital versatile disk. Though it is generally observed that many MPEG-2 players can handle MPEG-1 data as well, the opposite is not generally observed to be true and MPEG-2 encoded video is generally incompatible with MPEG-1 players. Yet another progressive standard, "MPEG-3", has also been proposed for use with high definition television ("HDTV"), though in general MPEG-3 has merged with MPEG-2 which is generally believed to meet the HDTV requirements. Finally, an "MPEG-4" standard has also been most recently developed and is intended to provide a much more ambitious standard to address speech and video synthesis, fractal geometry, and computer visualization, and has further been disclosed to incorporate artificial intelligence in order to reconstruct images.

MPEG-1 and –2 standards define techniques for compressing digital video by factors varying from 25:1 to 50:1. This compression is achieved according to these standards generally using five different compression techniques: (i) discrete cosine transform (DCT), which is a frequency-based transform; (ii) "quantization", which is a technique for losing selective information, e.g. lossy

prediction", wherein some images are predicted from the pictures immediately preceding and following the image.

Further more detailed examples of commercially available video compression technologies include: Microsoft Media Player™ (available from Microsoft Corporation), RealPlayer™ or RealSystem G2™ (commercially available from Real Networks™), Apple's QuickTime™ (commercially available from Sorenson™); and "VDO". The Microsoft Media Player™ is generally believed to apply the MPEG standard of CODEC for compression/decompression, whereas the others have been alleged to use proprietary types of CODECS. Standard compression algorithms, such as MPEG4, have made their way into the hands of developers who are building embedded systems for enterprise streaming, security, and the like.

One example of a more recent effort to provide streaming video solutions over Wireless and IP networks has been publicized by a company named Emblaze Systems (LSE:BLZ). This company has disclosed certain technology that is intended for encoding and playback of live and on-demand video messages and content on any platform: PC's, PDA's, Video cell phones and Interactive TV. Emblaze Systems is believed to be formerly GEO Interactive Media Group. The following Published International Patent Applications disclose certain streaming media compression technologies that is believed to be related to Emblaze Systems to the extent that GEO Interactive Media Group is named as "Assignee": WO9731445 to Carmel et al.; and WO9910836 to Carmel. The disclosures of these references are herein incorporated in their entirety by reference thereto.

Another company that has published CODEC technology that is intended to improve communication of streaming media for wireless applications is Packetvideo™ Corporation, more specifically intending to communicate streaming video to cellular phones. In addition, they are believed to be promoting CODEC technology that is intended to track temporal scalability and signal error resistance in order to protect video and audio streams from the hazards of the wireless environment. U.S. Patent No. 6,167,092 to Lengwehasatit discloses further examples of certain streaming media compression/decompression technology that are believed to be associated with Packetvideo as the named "Assignee" on the face of this Patent reference. The disclosure of this patent reference is herein incorporated in its entirety by reference thereto.

Another prior reference discloses CODEC technology that is intended to provide a cost effective, continuously adaptive digital video system and method for compressing color video data for moving images. The method involves capturing an analog video frame and digitizing the image into a preferred source input format for compression using a combination of unique lossy and lossless digital

Another prior reference discloses CODEC technology that is intended to provide a cost effective, continuously adaptive digital video system and method for compressing color video data for moving images. The method involves capturing an analog video frame and digitizing the image into a preferred source input format for compression using a combination of unique lossy and lossless digital compression techniques including sub-band coding, wavelet transforms, motion detection, run length coding and variable length coding. The system includes encoder and decoder (CODEC) sections, generally disclosed to use a "Huffman" encoder, for compression and decompression of visual images to provide high compression that is intended to provide good to excellent video quality. The compressed video data provides a base video layer and additional layers of video data that are multiplexed with compressed digital audio to provide a data stream that can be packetized for distribution over inter or intranets, including wireless networks over local or wide areas. The CODEC system disclosed is intended to continuously adjust the compression of the digital images frame by frame in response to comparing the available bandwidth on the data channel to the available bandwidth on the channel for the previous frame to provide an output data stream commensurate with the available bandwidth of the network transmission channel and with the receiver resource capabilities of the client users. The compression may be further adjusted by adjustment of the frame rate of the output data stream.

Further more detailed examples of CODEC systems that are intended for use at least in part for streaming video communication are disclosed in the following U.S. Patent Nos.: 6,081,295 to Adolph et al.; 6,091,777 to Guetz et al.; 6,130,911 to Lei; 6,173,069 B1 to Daly et al.; 6,263,020 B1 to Gardos et al.; 6,272,177 to Murakami et al.; and 6,272,180 B1 to Lei. The disclosures of these references are herein incorporated in their entirety by reference thereto.

Most if not all prior streaming video compression methodologies look to the extremely complex mathematical tools within such CODECS, and subtle changes to them, to carry "one size fits all" video over public and private networks of all types, from ultra-low bandwidth networks such as that found in wireless networks, to satellite communications to ultra-high speed fiber optic installations. Among the various conventional methods of compression, there are generally user-definable parameters, including tradeoffs between image size, frame rate, color depth, contrast, brightness, perceived frame quality, buffer length, etc. Further, within the algorithms themselves there are numerous non-user definable qualities and weighted calculations. It is up to the developers to set these one time for one "general" interest, and then package and ship the product.

However, while the video streaming market continues to grow rapidly, the world has not chosen one standard for compression as no one algorithm is ideal for all video sources, destinations, or transmission modalities. While a first CODEC may be best for one type of signal, or for a first portion of a signal (e.g. frame or scene comprising a series of frames), another second CODEC may be best for another type of signal, or even another second portion of the same signal. Still further, one CODEC may be best suited for compression/decompression of a particular streaming signal among send, receive, and transmission devices in a communications network; another second CODEC may be better suited than the first for the same streaming media signal but for another set of communication device parameters. For example, some video streams may deliver color to handheld devices while other video streams can take advantage of the loss of pixels in a black and white transmission to a cellular phone to increase frame rate. Required sound quality, frame rates, clarity, and buffering tolerance all decidedly impact the compression algorithm of choice for optimized video and audio delivery across multiple platforms.

In fact, certain communication device parameters may be sufficiently transient during the streaming media transmission such that an initially appropriate CODEC for an initial set of parameters may be rendered less efficient than another CODEC due to changes in those parameters during the same streamed signal transmission. Examples of such transient parameters include, without limitation: available band width in the data transmission channel, available memory or processing power in either the send or receiving devices, and dedicated display resolution/window in the receiving device (e.g. minimizing windows on a screen). These problems are compounded exponentially by a vast number of iterations of different combinations of such factors that may differentiate one CODEC from another as being most efficient for compression, decompression, and delivery of a specific streaming media signal along a particular communications device system.

As CODEC systems are "format-specific", source and destination devices must be "pre-configured" to communicate media signals between each other according to common, specific compression/decompression modalities, else transcoders must be used. However, even if conventional transcoders are used, constraints in the communication system (e.g. source, transmission channel, destination device) are not generally considered and the communication may be significantly faulty. For the purpose of further illustration, Figures 1A and 1B show two different schematic representations of conventional methods for communicating media between source 110 -120 and destination devices 130 -140. These illustrations specifically exemplify streaming video communication, though other media forms may be represented by similar systems.

It has been observed that CODEC algorithms can generally be modified for a specific application and then perform better than a similar unmodified set over that limited example. However, this generally must be done either for a series of frames, or ideally, for each individual frame. Some DCT based algorithms have as many as two billion mathematical operations occurring for each frame at higher resolutions and lower perceived quality. This is entirely too much math for average machines, even commercial servers, to perform thirty to sixty times in a single second. This is the reason for the advent of the dedicated compression board or ASIC.

Audio CODECS

In addition to society's recent interests in improving video compression, audio compression has likewise been the topic of significant efforts also for various live or pre-recorded applications, including audio broadcast, music, transmission synchronized with video, live interactive voice (e.g. telephone). Any and all of these audio compression applications must be compatible with a wide range of client-side receiver/players, such as on a multitude of handheld or desk-top devices having widely varied capabilities and operating parameters.

Conventional audio CODECS generally comprise several different types, a few of which are herein briefly summarized for the purpose of illustration.

"Code Excited Linear Prediction" or "CELP" is a type of speech compression method using waveform CODECS that use "Analysis-by-Synthesis" or "AbS" within the excitation-filter framework for waveform matching of a target signal. CELP-based CODECS have recently evolved as the prevailing technique for high quality speech compression, and has been published to transmit compressed speech of toll-quality at data rates nearing as low as about 6 kbps. However, at least one publication discloses that the quality of CELP coded speech is reduced significantly for bit rates at or below 4 kbps.

"Vocoders" are speech CODECS that are not based on the waveform coding scheme, but rather use a quantized parametric description of the target input speech to synthesize the reconstructed output speech. Vocoders have been disclosed to deliver better speech quality at low bit-rates, such as about 4 kbps, and have been developed for such applications. Low bit rate vocoders use the periodic characteristics of voiced speech and the "noise-like" characteristics of stationary unvoiced speech for speech analysis, coding and synthesis. Some early versions of vocoders (e.g. federal standard 1015 LPC-10, use a time-domain analysis and synthesis method. However, most of the more recent versions,

which at least one publication labels "harmonic coders", utilize a harmonic spectral model for voiced speech segments.

Notwithstanding the previous description of certain specific speech compression techniques, a vast number of speech CODECs and standards have been developed by industry and managed by industry and nonprofit groups. Examples of such groups include without limitation the following, and their standards are often used as reference types of CODECS: the European Telecommunications Standards Institute ("ETSI"); the Institute of Electrical and Electronics Engineers ("IEEE"); and the International Telecommunication Union Telecommunications Standards Sector ("ITU-T"), formerly the "CCITT".

One more recently disclosed method and apparatus for hybrid coding of speech, specified at 4 Kbps, encodes sppech for communication to a decoder for reproduction of the speech where the speech signal is classified into three types: (i) steady state voiced or "harmonic"; (ii) stationary unvoiced; and (iii) "transitory" or "transition" speech. A particular type of coding scheme is used for each class. Harmonic coding is used for steady state voiced speech, "noise-like" coding is used for stationary unvoiced speech, and a special coding mode is used for transition speech, designed to capture the location, the structure, and the strength of the local time events that characterize the transition portions of the speech. The compression schemes are intended to be applied to the speech signal or to the LP residual signal.

Another recently disclosed method and arrangement for adding a new speech encoding method to an existing telecommunication system is also summarized as follows. A CODEC is introduced into a speech transmitting transceiver of a digital telecommunications system in order to use a "new" CODEC and an "old" CODEC in parallel in the system. A CODEC is selected by implementing a handshaking procedure between transceivers where a speech encoding method is implemented in all transceivers and previously used in the telecommunications system concerned. The handshaking is used at the beginning of each connection. At the beginning of a phone call and after handover, the method checks whether both parties can also use the new speech encoding. The handshaking messages have been selected so that their effect on the quality of speech is minimal, and yet so that the probability of identifying the messages is maximal.

Still another relatively recent reference discloses a tunable perceptual weighting filter for tandem CODECS intended for use in speech compression. Specific filter parameters are tuned to provide improved perfromance in tandeming contexts. More specifically, the parameters used are 10th

order LPC predictor coefficients. This system is specified to use "Low-Delay Excited Linear Predictive" CODECS, or "LD-CELP".

Further more detailed examples of streaming audio communications systems using CODECS such as according to the examples just described are provided in the following US Patent references: 6,144,935 to Chen et al.; 6,161,085 to Haavisto et al.; and 6,233,550 to Gersho. The disclosures of these references are herein incorporated in their entirety by reference thereto.

Artificial Intelligence ("AI") and Neural Networks with CODECS

Various systems and methods have been recently disclosed that are intended to integrate artificial intelligence ("AI") or neural networks with the compression and decompression of streaming media signals.

The terms "artificial intelligence" are herein intended to mean the simulation of human intelligence processes by computer systems, including learning (the acquisition of information and rules for using the information), reasoning (using the rules to reach approximate or definite conclusions), and self-correction. Particular applications of AI include "expert systems", which are computer programs that simulate judgment and behavior of a human or organization that has expert knowledge and experience in a particular field. Typically, expert systems contain a knowledge base to each particular situation that is described to the program, and can be enhanced with additions to the knowledge base or to the set of rules.

The terms "neural network" are herein intended to mean a system of programs and data structures that approximates the operation of the human brain, usually involving a large number of processors operating in parallel, each with its own small sphere of knowledge and access to data in its local memory. Typically, a neural network is initially trained or fed large amounts of data and rules about data relationships, after which a program can tell the network how to behave in response to an external stimulus (e.g. input information). In making determinations, neural networks use several principles, including without limitation gradient-based training and fuzzy logic. Neural networks may be further described in terms of knowledge layers, generally with more complex networks having deeper layers. In "feedforward" neural network systems, learned relationships about data can "feed forward" to higher layers of knowledge. Neural networks can also learn temporal concepts and have been widely used in signal processing and time series analysis. Other published applications of neural

networks include oil exploration data analysis, weather prediction, the interpretation of nucleotide sequences in biology labs, and the exploration of models of thinking and consciousness.

The terms "fuzzy logic" are herein intended to mean an approach to computing based upon "degrees of truth" rather than "Boolean logic" which operates within only a true/false (or "binary", as 1 or 0) domain. Fuzzy logic was first advanced by Dr. Lotfi Zadeh of the University of California at Berkeley in the 1960's in relation to work on a problem of computer understanding of natural language, which is not easily translated into absolute Boolean logic terms. Fuzzy logic often does include the cases of 0 and 1 as extreme cases of truth, but also includes the various states of truth in between (e.g. a determination of that the state of being is at some threshold, such as 0.98, may assists in making a decision to assign a 1 with an acceptably low occurrence of error in an operation).

One example of a previously disclosed streaming media compression/decompression system intended to use with artificial intelligence through a neural network uses a Radon transform in order to compress data such as video data. Several previously disclosed AI and/or neural network systems are intended to use AI and/or neural networks for the purpose of error correction during use of certain specified lossless compression CODECS. For example, a learning system is employed to determine a difference between what was received by a receiver after compression and transmission and what is predicted to have been received at the transmission end. That difference is processed as learning to modify the tuning of the CODEC for an additional transmission.

Another example of a disclosed method and device is intended to extrapolate past signal-history data for insertion into missing data segments in order to conceal digital speech frame errors. The extrapolation method uses past-signal history that is stored in a buffer. The method is implemented with a device that is disclosed to utilize a finite-impulse response ("FIR"), multi-layer, feed-forward, artificial neural network that is trained by back-propagation for one-step extrapolation of speech compression algorithm ("SCA") parameters. Once a speech connection has been established, the speech compression algorithm device begins sending encoded speech frames. As the speech frames are received, they are decoded and converted back into speech signal voltages. During the normal decoding process, pre-processing of the required SCA parameters will occur and the results stored in the past-history buffer. If a speech frame is detected to be lost or in error, then extrapolation modules are executed and replacement SCA parameters are generated and sent as the parameters required by the SCA. In this way, the information transfer to the SCA is intended to be transparent, and the SCA processing continues as usual. This disclosure alleges that the listener will not normally notice that a

speech frame has been lost because of the smooth transition between the last-received, lost, and next-received speech frames.

Further more detailed examples of systems that are intended to use artificial intelligence and/or neural networks in systems for media compression and/or decompression, generally relating to media type-specific CODEC methods (e.g. speech, video), are variously disclosed in the following U.S. Patent References: 5,005,206 to Naillon et al.; 5,041,916 to Yoshida et al.; 5,184,218 to Gerdes; 5,369,503 to Burel et al.; 5,598,354 to Fang et al.; 5,692,098 to Kurdziel; 5,812,700 to Fang et al.; 5,872,864 to Imade et al.; 5,907,822 to Prieto, Jr.; and 6,216,267 to Mitchell. Still further examples are provided in the following Published International Patent Applications: WO 01/54285 to Rising; EPO 0372608 A1 to Naillon et al.. The disclosures of all these references cited in this paragraph are herein incorporated in their entirety by reference thereto.

Other disclosures of CODEC systems using feedback or other systems for operating CODECS for use in processing a variety of streaming media signals, but that are not believed to specifically use the labels "AI" or "neural networks", are disclosed in the following U.S. Patent Nos.: 6,072,825 to Betts et al.; 6,182,034 B1 to Malvar; 6,253,165 B1 to Malvar; 6,256,608 B1 to Malvar. The disclosures of these references are herein incorporated in their entirety by reference thereto.

Notwithstanding the significant advancements in CODEC algorithms themselves, and despite prior intended uses of AI and other feedback systems for operating CODECS in order to improve compression efficiencies in communication, there is still a need for significant improvement in the ability to efficiently provide a wide variety of streaming media signals to a wide variety of destination receiver devices over a wide variety of transmission channels with varied bandwidths and communication protocols.

There is still a need to incorporate AI and/or neural networks to apply an appropriate CODEC for communication of a streaming media signal based upon a variety of parameters, including without limitation one or more of the following: (a) the automated choosing of an appropriately optimized CODEC from a library of available CODECS of different types and operation, including in particular based upon an intelligent knowledge of the chosen CODEC's operation compared to the other CODEC's operation and/or against a standard, (b) a pre-trained and/or iteratively learned knowledge of the particular CODEC's operation within a given set of operating parameters representative of the existing situation; and (c) a tuning of the appropriate CODEC based upon an intelligent knowledge of

its operation with respect to either or both of the existing situation or a test situation with reference parameters.

In particular, there is still a need for such an intelligent CODEC system that bases an applied CODEC upon an existing situation that is defined by one or more of the following: parameters of the streaming media signal itself; parameters of the transmission channel capabilities and constraints; and parameters of the receiver device capabilities and constraints.

Still further, there is also still a need for such an intelligent CODEC system that operates based upon an intelligent knowledge with respect to all of these operations and situational parameters in order to optimize the appropriate compression, transmission, decompression, and playing of the subject streaming media signal.

Conventional Transcoders for Streaming Media

Also of recent interest in the field of streaming media communication is providing intercommunication between the wide array of "format-specific" encoding systems in present use. An existing field of various different format-specific systems and pre-encoded content has created a widely fragmented ability to process encoded content, resulting in a significant quagmire of compatibility issues between content providers and client users. If one client desires to see or hear streaming content from a particular source and that content must be put through a CODEC for compression, a compatible CODEC must be used on the client side for decompression to enjoy the signal. Unfortunately, source content is often married to only a few, and often only one, specific CODEC schemes. Therefore, if a client requests such encoded content (or if the source desires to push the encoded content to a particular client), one of two criteria must be met: (1) the client must download or otherwise possess the format-specified CODEC (decoder); or (2) the source media must be put through a "transcoder" in order to decode the source media from the first format into a second format that is compatible with the client's device/system. The term "transcoder" is herein intended to mean a system that converts a media signal from one encoded (i.e. compressed) format to another.

Various techniques for transcoding one media format into another have been previously disclosed. Figure 1C shows one illustrative example of the general process that is characteristic of many known transcoding techniques. More specifically, a request 159 is first received from a particular type of device or player for content that exists in an initial, uncompatible format. According to the specific example shown in Figure 1C, a request 159 from a Microsoft Media™ Player for Real™ Video Content is received. As the content is specifically requested, the content is decoded from the

initial format (e.g. Real-encoded format), and is then "re-encoded" into the appropriate format for the requesting player (e.g. Microsoft Media™ format). This re-encoded media is then served to the requesting client for decoding within the resident system of that player.

This conventional system has significant scalability limitations, in that simultaneous feeds on multiple channels for multiple clients must be supported by an equal number of transcoders. For example, Figure 1D shows a schematic implementation of the conventional transcoding technique just described as it manages four simultaneous stream requests from four Microsoft Media Players, wherein the requested content is initially encoded in Real™ format. The system architecture necessary to support the four encoders 151 - 154 and four decoders 155 - 158 requires significant computing resources. For example, it is believed that each encoder 151 - 154 provided in the example requires a computer having a 600 MHz (e.g. Pentium™ III) having 128 Mbytes of RAM available, or dual 400 MHz processors (e.g. Pentium II) with 256 Mb available RAM. It is further believed that each decoder 155 – 158 needs a 233 MHz machine (e.g. Pentium™ II) having 64 Mb of available RAM. So, four such streams requires the equivalent of a Quad 900 Xeon (available from Compaq, Hewlett Packard, Dell and IBM, estimated to cost at the time of this disclosure about $9K retail). This is for four simultaneous streams – society is presently demanding thousands upon thousands of simultaneous streams.

There is still a need for a transcoder system that efficiently converts multiple format-specifically encoded streaming media signals into multiple other formats using minimal computing resources and in a cost-efficient manner.

Parameters Affecting Media Communication

For the purpose of further illustrating the many variables that may impact the choice of an appropriate CODEC in order to communicate a particular streaming media signal to a desired target, the following is a brief summary of various different types of streaming video formats and processing systems. It is believed that these different systems each generally require different types of compression modalities (e.g. CODECS) in order to optimize communication and playing of streaming media signals in view of available transmission speeds and bandwidth, as well as receiver processing parameters.

Although certain specific types of communications formats and systems are further herein described in detail, the following Table 1 provides a summary of a significant cross-section of the

various different communications systems and transmission carriers currently available or disclosed in view of available speed or bandwidth.

TABLE 1: Data Rates of Various Communications Carrier systems

Technology	Speed	Physical Medium	Application
GSM mobile telephone service	9.6 to 14.4 Kbps	RF in space (wireless)	Mobile telephone for business and personal use
High-Speed Circuit-Switched Data service (HSCSD)	Up to 56 Kbps	RF in space (wireless)	Mobile telephone for business and personal use
Regular telephone service (POTS)	Up to 53 Kbps	Twisted pair	Home and small business access
Dedicated 56Kbps on Frame Relay	56 Kbps	Various	Business e-mail with fairly large file attachments
DS0	64 Kbps	All	The base signal on a channel in the set of Digital Signal levels
General Packet Radio System (GPRS)	56 to 114 Kbps	RF in space (wireless)	Mobile telephone for business and personal use
ISDN	BRI: 64 Kbps to 128 Kbps PRI: 23 (T-1) or 30 (E1) assignable 64-Kbps channels plus control channel; up to 1.544 Mbps (T-1) or 2.048 (E1)	BRI: Twisted-pair PRI: T-1 or E1 line	BRI: Faster home and small business access PRI: Medium and large enterprise access
IDSL	128 Kbps	Twisted-pair	Faster home and small business access
AppleTalk	230.4 Kbps	Twisted pair	Local area network for Apple devices; several networks can be bridged; non-Apple devices can also be connected
Enhanced Data GSM Environment (EDGE)	384 Kbps	RF in space (wireless)	Mobile telephone for business and personal use
Satellite	400 Kbps (DirecPC and others)	RF in space (wireless)	Faster home and small enterprise access
Frame relay	56 Kbps to 1.544 Mbps	Twisted-pair or coaxial cable	Large company backbone for LANs to ISP ISP to Internet infrastructure
DS1/T-1	1.544 Mbps	Twisted-pair, coaxial cable, or optical fiber	Large company to ISP ISP to Internet infrastructure
Universal Mobile Telecommunications Service (UMTS)	Up to 2 Mbps	RF in space (wireless)	Mobile telephone for business and personal use (available in 2002 or later)
E-carrier	2.048 Mbps	Twisted-pair, coaxial cable, or optical fiber	32-channel European equivalent of T-1
T-1C (DS1C)	3.152 Mbps	Twisted-pair, coaxial cable, or optical fiber	Large company to ISP ISP to Internet infrastructure
IBM Token Ring/802.5	4 Mbps (also 16 Mbps)	Twisted-pair, coaxial cable, or optical fiber	Second most commonly-used local area network after Ethernet
DS2/T-2	6.312 Mbps	Twisted-pair, coaxial cable, or optical fiber	Large company to ISP ISP to Internet infrastructure
Digital Subscriber Line (DSL)	512 Kbps to 8 Mbps	Twisted-pair (used as a digital, broadband medium)	Home, small business, and enterprise access using existing copper lines
E-2	8.448 Mbps	Twisted-pair, coaxial cable, or optical fiber	Carries four multiplexed E-1 signals
Cable modem	512 Kbps to 52 Mbps (see "Key and explanation" below)	Coaxial cable (usually uses Ethernet); in some systems, telephone used for upstream requests	Home, business, school access
Ethernet	10 Mbps	10BASE-T (twisted-pair); 10BASE-2 or -5 (coaxial cable); 10BASE-F (optical fiber)	Most popular business local area network (LAN)
IBM Token Ring/802.5	16 Mbps (also 4 Mbps)	Twisted-pair, coaxial cable, or optical fiber	Second most commonly-used local area network after Ethernet
E-3	34.368 Mbps	Twisted-pair or optical fiber	Carries 16 E-1 signals
DS3/T-3	44.736 Mbps	Coaxial cable	ISP to Internet infrastructure Smaller links within Internet infrastructure

OC-1	51.84 Mbps	Optical fiber	ISP to Internet infrastructure Smaller links within Internet infrastructure
High-Speed Serial Interface (HSSI)	Up to 53 Mbps	HSSI cable	Between router hardware and WAN lines Short-range (50 feet) interconnection between slower LAN devices and faster WAN lines
Fast Ethernet	100 Mbps	100BASE-T (twisted pair); 100BASE-T (twisted pair); 100BASE-T(optical fiber)	Workstations with 10 Mbps Ethernet cards can plug into a Fast Ethernet LAN
Fiber Distributed-Data Interface (FDDI)	100 Mbps	Optical fiber	Large, wide-range LAN usually in a large company or a larger ISP
T-3D (DS3D)	135 Mbps	Optical fiber	ISP to Internet infrastructure Smaller links within Internet infrastructure
E-4	139.264 Mbps	Optical fiber	Carries 4 E3 channels Up to 1,920 simultaneous voice conversations
OC-3/SDH	155.52 Mbps	Optical fiber	Large company backbone Internet backbone
E-5	565.148 Mbps	Optical fiber	Carries 4 E4 channels Up to 7,680 simultaneous voice conversations
OC-12/STM-4	622.08 Mbps	Optical fiber	Internet backbone
Gigabit Ethernet	1 Gbps	Optical fiber (and "copper" up to 100 meters)	Workstations/networks with 10/100 Mbps Ethernet plug into Gigabit Ethernet switches
OC-24	1.244 Gbps	Optical fiber	Internet backbone
SciNet	2.325 Gbps (15 OC-3 lines)	Optical fiber	Part of the vBNS backbone
OC-48/STM-16	2.488 Gbps	Optical fiber	Internet backbone
OC-192/STM-64	10 Gbps	Optical fiber	Backbone
OC-256	13.271 Gbps	Optical fiber	Backbone

Comments & Key for Table:

(i)The term "Kbps" as the abbreviation for "thousands of bits per second." In international English outside the U.S., the equivalent usage is "kbits s^{-1}" or "kbits/s".
(ii) Engineers use *data rate* rather than *speed*, but speed (as in "Why isn't my Web page getting here faster?") seems more meaningful for the less technically inclined.
(iii) Relative to data transmission, a related term, bandwidth or "capacity," means how wide the pipe is and how quickly the bits can be sent down the channels in the pipe. These "speeds" are aggregate speeds. That is, the data on the multiple signal channels within the carrier is usually allocated by channel for different uses or among different users.

Key: (i) "T" = T-carrier system in U.S., Canada, and Japan....(ii) "DS"= digital signal (that travels on the T-carrier or E-carrier)...(iii) "E" = Equivalent of "T" that uses all 8 bits per channel; used in countries other than U.S. Canada, and Japan....(iv) "OC" = optical carrier (Synchronous Optical Network) "STM" = Synchronous Transport Modules (see Synchronous Digital Heirarchy). (v) Only the most common technologies are shown. (vi) "Physical medium" is stated generally and doesn't specify the classes or numbers of pairs of twisted pair or whether optical fiber is single-mode or multimode. (vii) The effective distance of a technology is not shown. (viii) There are published standards for many of these technologies.

Cable modem note: The upper limit of 52 Mbps on a cable is to an ISP, not currently to an individual PC. Most of today's PCs are limited to an internal design that can accommodate no more than 10 Mbps (although the PCI bus itself carries data at a faster speed). The 52 Mbps cable channel is subdivided among individual users. Obviously, the faster the channel, the fewer channels an ISP will require and the lower the cost to support an individual user.

Internet Carrier Systems

Communication of streaming video via the Internet may take place over a variety of transmission modalities, including for example digital subscriber lines ("DSL"), "T1" lines, cable modem, plain old telephone service ("POTS") dial-up modem, and wireless carriers. While a description of the many different wireless transmission modalities is treated separately herein, a

summary of various of these other transmission modes is herein provided immediately below for the purpose of further illustration as follows.

The terms "POTS" or "plain old telephone service", or "dial-up", as applied to communications transmission channels, are herein interchangeably used. These terms are intended to mean "narrow-band" communication that generally connects end users in homes or small businesses to a telephone company office over copper wires that are wound around each other, or "twisted pair". Traditional phone service was created to let you exchange voice information with other phone users via an analog signal that represents an acoustic analog signal converted into an electrical equivalent in terms of volume (signal amplitude) and pitch (frequency of wave change). Since the telephone company's signaling is already set up for this analog wave transmission, it's easier for it to use that as the way to get information back and forth between your telephone and the telephone company. Therefore, dial-up modems are used to demodulate the analog signal and turn its values into the string of 0 and 1 values that is called digital information. Because analog transmission only uses a small portion of the available amount of information that could be transmitted over copper wires, the maximum amount of data that you can receive using ordinary modems is about 56 Kbps. The ability of your computer to receive information is constrained by the fact that the telephone company filters information that arrives as digital data, puts it into analog form for your telephone line, and requires your modem to change it back into digital. In other words, the analog transmission between your home or business and the phone company is a bandwidth bottleneck.

With "ISDN", or "Internet subscriber digital network", which some consider to be a limited precursor to DSL, incoming data rates up to about 128 Kbps may be achieved for some end user clients.

A "DSL" or "digital subscriber line" is generally defined as a "broadband" transmission carrier for communicating high-bandwidth communication over ordinary copper telephone lines. Many different types of DSL services have been disclosed, having generally varied data rates and intended applications. Though further discussion is herein provided about certain of these DSL types, the following Table 2 provides a summary of information for certain of these DSL types for the purpose of further developing an overview understanding:

TABLE 2: Types of known DSL services.

DSL Type	Description	Data Rate Downstream; Upstream	Distance Limit	Application
IDSL	ISDN Digital Subscriber Line	128 Kbps	18,000 feet on 24 gauge wire	Similar to the ISDN BRI service but data only (no voice on the same line)
CDSL	Consumer DSL from Rockwell	1 Mbps downstream; less upstream	18,000 feet on 24 gauge wire	Splitterless home and small business service; similar to DSL Lite
DSL Lite (same as G.Lite)	"Splitterless" DSL without the "truck roll"	From 1.544 Mbps to 6 Mbps downstream, depending on the subscribed service	18,000 feet on 24 gauge wire	The standard ADSL; sacrifices speed for not having to install a splitter at the user's home or business
G.Lite (same as DSL Lite)	"Splitterless" DSL without the "truck roll"	From 1.544 Mbps to 6 Mbps, depending on the subscribed service	18,000 feet on 24 gauge wire	The standard ADSL; sacrifices speed for not having to install a splitter at the user's home or business
HDSL	High bit-rate Digital Subscriber Line	1.544 Mbps duplex on two twisted-pair lines; 2.048 Mbps duplex on three twisted-pair lines	12,000 feet on 24 gauge wire	T1/E1 service between server and phone company or within a company; WAN, LAN, server access
SDSL	Symmetric DSL	1.544 Mbps duplex (U.S. and Canada); 2.048 Mbps (Europe) on a single duplex line downstream and upstream	12,000 feet on 24 gauge wire	Same as for HDSL but requiring only one line of twisted-pair
ADSL	Asymmetric Digital Subscriber Line	1.544 to 6.1 Mbps downstream; 16 to 640 Kbps upstream	1.544 Mbps at 18,000 feet; 2.048 Mbps at 16,000 feet; 6.312 Mpbs at 12,000 feet; 8.448 Mbps at 9,000 feet	Used for Internet and Web access, motion video, video on demand, remote LAN access
RADSL	Rate-Adaptive DSL from Westell	Adapted to the line, 640 Kbps to 2.2 Mbps downstream; 272 Kbps to 1.088 Mbps upstream	Not provided	Similar to ADSL
UDSL	Unidirectional DSL proposed by a company in Europe	Not known	Not known	Similar to HDSL
VDSL	Very high Digital Subscriber Line	12.9 to 52.8 Mbps downstream; 1.5 to 2.3 Mbps upstream; 1.6 Mbps to 2.3 Mbps downstream	4,500 feet at 12.96 Mbps; 3,000 feet at 25.82 Mbps; 1,000 feet at 51.84 Mbps	ATM networks; Fiber to the Neighborhood

Typically published data rates for DSL service, which may vary depending upon distance from the central office of the offering service company, includes rates up to 6.1 Mbps (theoretically published at 8.448 Mbps), which is believed to enable continuous transmission of motion video, audio, and 3-D effects. More typical individual connections provide from 512 Kbps to 1.544 Mbps downstream and about 128 Kbps upstream. A DSL line can carry both data and voice signals and the data part of the line is continuously connected. DSL has been anticipated in some publications to replace ISDN in many areas and to compete with cable modem for multimedia communication to homes and businesses. DSL operates purely within the digital domain and does not require change into analog form and back. Digital data is transmitted to destination computers directly as digital data and this allows the phone company to use a much wider bandwidth for forward transmission. Meanwhile, if

a client user chooses, the signal can be separated so that some of the bandwidth is used to transmit an analog signal so that a telephone and computer may be used on the same line and at the same time.

Most DSL technologies require that a signal splitter be installed at a home or business, requiring the expense of a phone company visit and installation. However, it is possible to manage the splitting remotely from the central office. This is known as splitterless DSL, "DSL Lite," G.Lite, or Universal ADSL (further defined below) and has recently been made a standard. Several modulation technologies are used by various kinds of DSL, although these are being standardized by the International Telecommunication Union (ITU). Different DSL modem makers are using either Discrete Multitone Technology (DMT) or Carrierless Amplitude Modulation (CAP). A third technology, known as Multiple Virtual Line (MVL), is another possibility.

A variety of parameters of DSL operation are variable and affect the effective data rates that can be achieved. DSL modems generally follow the data rate multiples established by North American and European standards. In general, the maximum range for DSL without a repeater is 5.5 km (18,000 feet). As distance decreases toward the telephone company office, the data rate increases. Another factor is the gauge of the copper wire. The heavier 24 gauge wire carries the same data rate farther than 26 gauge wire. For destination devices beyond the 5.5 kilometer range, DSL may still be provided, though only generally if the respective phone company provider has extended the local loop with optical fiber cable.

To interconnect multiple DSL users to a high-speed network as a "backbone", the telephone company uses a Digital Subscriber Line Access Multiplexer ("DSLAM"). Typically, the DSLAM connects to an asynchronous transfer mode ("ATM") network that can aggregate data transmission at gigabit data rates. At the other end of each transmission, a DSLAM demultiplexes the signals and forwards them to appropriate individual DSL connections.

"ADSL" or "Asymmetric Digital Subscriber Line" is the form of DSL that will become most familiar to home and small business users. ADSL is called "asymmetric" because most of its two-way or "duplex" bandwidth is devoted to the downstream direction, sending data to the user. Only a small portion of bandwidth is available for upstream or user-interaction messages. However, most Internet and especially graphics- or multi-media intensive Web data need lots of downstream bandwidth, but user requests and responses are small and require little upstream bandwidth. Using ADSL, up to 6.1 megabits per second of data can be sent downstream and up to 640 Kbps upstream. The high downstream bandwidth means that a telephone line may carry motion video, audio, and 3-D images to destination computers or television displays. In addition, a small portion of the downstream bandwidth

can be devoted to voice rather data, and phone conversations may be carried without requiring a separate line. Unlike a similar service over "cable" television lines, ADSL does not compete for bandwidth with neighbors in a given area. In many cases, your existing telephone lines will work with ADSL. In some areas, they may need upgrading.

"CDSL" or "Consumer DSL" is a trademarked version of DSL, to be made available by Rockwell Corporation, that is somewhat slower than ADSL (1 Mbps downstream, generally predicted to be lower upstream) but has the advantage that a "splitter" does not need to be installed at the user's end. Hardware may be required to carry CDSL by local phone companies to homes or businesses. CDSL uses its own carrier technology rather than DMT or CAP ADSL technology.

Various companies have worked with telephone companies in developing a standard and easier installation version of ADSL, called "G.Lite", that is believed to be under deployment at the time of this disclosure. "G.Lite" or "DSL Lite" (also known as "splitterless ADSL", and "Universal ADSL") is believed to be essentially a slower ADSL that doesn't require splitting of the line at the user end but manages to split it for the user remotely at the telephone company, which is believed to lower costs. G.Lite, officially ITU-T standard G-992.2, is published to provide a data rate from 1.544 Mbps to 6 Mpbs downstream and from about 128 Kbps to about 384 Kbps upstream. At least one publication has predicted G.Lite to become the most widely installed form of DSL.

"HDSL" or "High bit-rate DSL" is believed to be the earliest variation of DSL to be widely used for wideband digital transmission within a corporate site and between the telephone company and a customer. The main characteristic of HDSL is that it is symmetrical: an equal amount of bandwidth is available in both directions. For this reason, the maximum data rate is generally lower than for ADSL. HDSL can carry as much on a single wire of twisted-pair as can be carried on a T1 line in North America or an E1 line in Europe (up to about 2.32 Mbps).

"IDSL" or "ISDN DSL" is somewhat of a misnomer since it's really closer to ISDN data rates and service at about 128 Kbps than compared with the much higher rates generally associated with ADSL.

"RADSL" or "Rate-Adaptive DSL" is an ADSL technology to be made available from Westell company in which software is able to determine the rate at which signals can be transmitted on a given customer phone line and adjust the delivery rate accordingly. Westell's "FlexCap2™" version system uses RADSL to deliver from about 640 Kbps to about 2.2 Mbps downstream and from about 272 Kbps to about 1.088 Mbps upstream over an existing line.

"SDSL" or "Symmetric DSL" is similar to HDSL with a single twisted-pair line, carrying about 1.544 Mbps (U.S. and Canada) or about 2.048 Mbps (Europe) each direction on a duplex line. It's symmetric because the data rate is the same in both directions.

"UDSL" or "Unidirectional DSL" is a proposal from a European company, and is generally believed to provide a unidirectional version of HDSL.

"VDSL" or "Very high data rate DSL" is believed to be a technology under development that promises much higher data rates over relatively short distances, for example between about 51 and about 55 Mbps over lines up to about 1,000 feet or about 300 meters in length. At least one publication has predicted that VDSL may emerge somewhat after ADSL is widely deployed and co-exist with it. The transmission technology (CAP, DMT, or other) and its effectiveness in some environments is not yet determined. A number of standards organizations are working on it.

"x2/DSL" is modem from 3Com that supports 56 Kbps modem communication but is upgradeable through new software installation to ADSL when it becomes available in the user's area. At least one publication cites 3Com as describing this technology to be "the last modem you will ever need."

A "T1" transmission line is generally considered a "broadband" carrier and is defined as a type of "T-carrier" system, which is believed to have been first introduced by the Bell System in the U.S. in the 1960's as the first successful system that supported digitized voice transmission. The T-carrier system is entirely digital, using pulse code modulation and time-division multiplexing. Voice signals are typically sampled at about 8,000 times a second and each sample is digitized into an 8-bit word. With 24 channels digitized at the same time, a 192-bit frame, representing 8-bit words on each of 24 channels, is thus transmitted about 8,000 times a second. Each frame is separated from the next by a single bit, resulting in a 193-bit block. The T-1's published data rate of 1.544 Mbps generally represents the 192 bit frame, and the 1-bit signaling bit, multiplied by 8,000.

A T-1 system typically uses 4 wires and provides duplex capability, with two wires dedicated for receiving and two for sending at the same time. The T-1 digital stream includes 24, 64 Kbps channels that are multiplexed, wherein the standard 64 Kbps channel is based on the bandwidth required for a voice conversation. The four wires were originally a pair of twisted pair copper wires, but more recent systems provide coaxial cable, optical fiber, digital microwave, and other carrier technologies. The number and use of the channels may be varied from the standard guidelines.

The original transmission rate (1.544 Mbps) for T-1 lines is in common use today in Internet service provider ("ISP") connections to the Internet. Another level, the T-3 line, is published to

provide 44.736 Mbps, and is also commonly used by Internet service providers. Another commonly used service is "fractional T-1", which is the rental of some portion of the 24 channels in a T-1 line, with the other channels unused.

Display Capabilities/Constraints & Related Standards

Various different types of receiver display capabilities may also significantly impact the appropriate CODEC modality for efficiently communicating particular streaming media signals for display by the receiver. A brief summary of certain examples to illustrate such varied display parameters (e.g. resolution, clarity, color, depth, size, type/format-specific) is provided for a better understanding as follows.

One parameter that is highly variable between different types and makes of streaming media receiver devices, and therefore that may have significant impact on the appropriate CODEC to be used, is the range of colors that may be expressed by a display device, or "palette". A standard "browser-safe" palette, which may be accommodated by most software for Internet-based streaming media display, may include for example about 216 colors, though for web-based streaming media the computer display capability as well as the browser software capability must be understood.

With respect to computer display technology, a color is set for each individual pixel or addressable illumination element on the screen. Each pixel has a red, green, and blue (RGB) component. By specifying the amount of intensity for each of these components, a distinct color is given to that pixel. A "true color" display generally defines the color of a pixel on a display screen using a 24-bit value, allowing the possibility of up to 16,777,216 possible colors. The number of bits used to define a pixel's color shade is called the "bit-depth". True color is sometimes referred to as "24-bit color", though many modern color display systems offer a 32-bit color mode. An extra byte, called the "alpha channel", is typically used for control and special effects information. A "gray scale" (composed of discrete shades of gray) display setting is generally defined as having N bits of depth where N represents the saturation of black within the pixel. If N=1, the image is not called gray scale but instead monochrome, or black and white, as the bit can only be on or off and can contain no shading information.

Common computer resolutions include for example and without limitation the following:

(i) VGA or Video Graphics Array capable of displaying 640x480 pixels in 16 colors or 320x240 pixels in 256 colors in a 4:3 aspect ratio;

(ii) SVGA or Super Video Graphics Array capable of 800x600x6 bits/pixel (16 colors) or 650x480x8 bits/pixel (256 colors). SVGA was created by the Video Electronics Association (VESA); and

(iii) XGA (v1-4) or eXtended Graphics Array capable of 1024x768 pixels at 32,768 colors.

Additional standards have been added such as SXGA, defining pixel sizes above 1960x1440 and color depths of 32 bits/pixel and higher.

In the event that a larger range of colors (or palette) is used by a media signal than a particular display or browser can handle, most browsers are typically adapted to "dither" the colors, which is herein intended to mean that the browser will find colors within its palette that it can substitute for any color that is outside of its palette. To further illustrate the wide range of different system display capabilities, systems using WindowsTM (commercially available from Microsoft Corporation) and MacintoshTM (commercially available from Apple Corporation) based operating systems do not have identical palettes; within the usual 256 color palette, 216 are common to both types of browsers, whereas 40 are different and therefore require dithering by a browser operating within one of the systems if an image signal is communicated to that type of system in a format specified by the other.

Many different technologies also exist with respect to how a visual display is enabled from electronic information. The terms "VDT" or "Video Display Terminals" are generally used within the computer industry and are herein intended to be used interchangeably with simple references to "display". With respect to computer terminal use, VDT's comprise a computer output surface and projecting mechanism that shows text and graphic images to the computer user. VDT's may use a variety of specific display technologies, including for example cathode ray tubes ("CRTs"), liquid crystal displays ("LCDs"), light-emitting diodes ("LEDs"), gas plasma, or other image projection technology. The display is usually considered to include the screen or projection surface and the device that produces the information on the screen. In some computers, the display is packaged in a separate unit or "monitor", or the display may be fully integrated in a single unit with the computer processor.

With respect to LCD's in particular, this technology generally requires minimal volume and physical depth compared to other VDT's, and therefore is typically used in laptop computers and cellphone/PDA's. LCD's consume much less power than LED and gas–display VDT's because they work on the principle generally of blocking light rather than emitting it. An LCD may be either

"passive matrix" or "active matrix", which is also known as "thin film transistor" or "TFT" display. The passive matrix LCD has a grid of conductors with pixels located at each intersection in the grid. A current is sent across two conductors on the grid to control the light for any pixel. An active matrix has a transistor located at each pixel intersection, requiring less current to control the luminance of a pixel. For this reason, the current in an active matrix display can be switched on and off more frequently, improving the screen refresh time and therefore efficacy for higher speeds of streaming media (e.g. action video). Some passive matrix LCD's have dual scanning, in that they scan the grid twice with current in the same time as one scan in earlier versions; however, the active matrix is still generally considered to be the superior technology of the two. Reflective color display technology—the integration of color filters into passive-matrix display construction—is a low-power, low-cost alternative to active-matrix technology. Because they reflect ambient light, reflective LCDs deliver particularly high performance during use outside in daylight. Various different display technologies, and therefore transmission formats, have also been specifically developed for television viewing. Thus several different standards have evolved for television transmission, and their differences may significantly impact the nature and extent of compression desired (and therefore the choice of a particular CODEC) for communicating streaming media signals in television environs. These standards include in particular and without limitation: standard definition television ("SDTV"); and high definition television ("HDTV").

"SDTV" or "standard definition television" and "HDTV" or "high definition television" are the two categories of display formats for digital television ("DTV") transmissions, which are becoming the standard. These formats provide a picture quality similar to digital versatile disk ("DVD"), and are summarized relative to their similarities and differences as follows.

HDTV provides a higher quality display, with a vertical resolution display from about 720p to at least about 1080i and an aspect ratio (the width to height ratio of the screen) of generally 16:9, for a viewing experience similar to watching a movie. In comparison, SDTV has a range of lower resolutions and no defined aspect ratio. New television sets will be either HDTV-capable or SDTV-capable, with receivers that can convert the signal to their native display format. SDTV, in common with HDTV, using the MPEG-2 file compression method in a manner that generally reduces a digital signal from about 166 Mbps to about 3 Mbps. This allows broadcasters to transmit digital signals using existing cable, satellite, and terrestrial systems. MPEG-2 uses the lossy compression method, which means that the digital signal sent to the television is compressed and some data is lost, but this lost data may or may not affect how the human eye views the picture. Both the ATSC and DVB standards selected

MPEG-2 for video compression and transport. The MPEG-2 compression standard is elsewhere herein described in further detail.

Because a compressed SDTV digital signal is smaller than a compressed HDTV signal, broadcasters can transmit up to five SDTV programs simultaneously instead of just one HDTV program, otherwise known as "multicasting". Multicasting is an attractive feature because television stations can receive additional revenue from the additional advertising these extra programs provide. With today's analog television system, only one program at a time can be transmitted. Note that this use of the term "multicasting" is distinct from its use in streaming video where it involves using special addressing techniques.

When the United States decided to make the transition from analog television to DTV, the Federal Communications Commission decided to let broadcasters decide whether to broadcast SDTV or HDTV programs. Most have decided to broadcast SDTV programs in the daytime and to broadcast HDTV programs during prime time broadcasting. Both SDTV and HDTV are supported by the Digital Video Broadcasting (DTV) and Advanced Television Systems Committee (ATSC) set of standards.

HDTV as a television display technology provides picture quality similar to 35 mm. movies with sound quality similar to that of today's compact disc (further with respect to audio quality, HDTV receives, reproduces, and outputs Dolby Digital 5.1). Some television stations have begun transmitting HDTV broadcasts to users on a limited number of channels. HDTV generally uses digital rather than analog signal transmission. However, in Japan, the first analog HDTV program was broadcast on June 3, 1989. The first image to appear was the Statue of Liberty and the New York Harbor. It required a 20 Mhz channel, which is why analog HDTV broadcasting is not feasible in most countries.

HDTV provides a higher quality display than SDTV, with a vertical resolution display from 720p to 1080i. The *p* stands for *progressive scanning*, which means that each scan includes every line for a complete picture, and the *i* stands for *interlaced scanning* which means that each scan includes alternate lines for half a picture. These rates translate into a frame rate of up to 60 frames per second, twice that of conventional television. One of HDTV's most prominent features is its wider aspect ratio (the width to height ratio of the screen) of 16:9, a development based on a research-based belief that the viewer's experience is enhanced by screens that are wider. HDTV pixel numbers range from one to two million, compared to SDTV's range of 300,000 to one million. New television sets will be either HDTV-capable or SDTV-capable, with receivers that can convert the signal to their native display format.

In the United States, the FCC has assigned broadcast channels for DTV transmissions. In SDTV formats, DTV makes it possible to use the designated channels for multiple signals at current quality levels instead of single signals at HDTV levels, which would allow more programming with the same bandwidth usage. Commercial and public broadcast stations are currently deciding exactly how they will implement their use of HDTV.

Simulcast is the simultaneous transmission of the same television program in both an analog and a digital version using two different channels or frequencies. At the end of the DTV transition period, it is believed by that analog transmission will be substantially replaced such that current analog channels will be used solely for DTV. The extra channels that were used for digital broadcasting may for example then be auctioned and used for more television channels or other services such as datacasting. Simulcast is also used for the transmission of simultaneous television and Internet services, the transmission of analog and digital radio broadcasts, and the transmission of television programs in different screen formats such as the traditional format and the wide screen format. Simulcast broadcasting is used worldwide.

The transition to DTV is not an easy or inexpensive transition. For a television station to transmit DTV programming, it must build its DTV facilities, but a station must have revenue to build these facilities. Simulcast allows stations to continue receiving revenues from traditional analog programming and also gain extra revenues from the extra digital programming. Another obstacle in the transition to DTV is lack of interest among consumers. The need for special equipment is prohibiting viewers from seeing the difference between digital and analog programs, which is also slowing down public enthusiasm for DTV.

The equipment needed for operating DTV depends on whether terrestrial, cable, or satellite services are used as the transmission channel/carrier. In any event, and according to known or anticipated systems, it is generally believed that consumers will, at a minimum, have to purchase a converter to view DTV transmissions on their old television sets. In addition, consumers that use terrestrial services or antennas to receive television signals need an antenna equipped for digital signals. A consumer located in mountainous terrain in an ATSC-compliant country may not be able to receive terrestrial-based digital signals because of multipath effects. This is common even with today's analog television system. In DVB compliant countries, terrain does not affect the reception of digital signals. Satellite users are already enjoying DTV broadcasting, but a larger satellite dish might be needed to view HDTV programming.

A "set-top" box is herein defined as a device that enables a television set to become a user interface to the Internet and also enables an analog television set to receive and decode DTV broadcasts. DTV set-top boxes are sometimes called receivers. It is estimated that 35 million homes will use digital set-top boxes by the end of 2006, the estimated year ending the transition to DTV.

A typical digital set-top box contains one or more microprocessors for running the operating system, usually Linux or Windows CE, and for parsing the MPEG transport stream. A set-top box also includes RAM, an MPEG decoder chip, and more chips for audio decoding and processing. The contents of a set-top box depend on the DTV standard used. DVB-compliant set-top boxes contain parts to decode COFDM transmissions while ATSC-compliant set-top boxes contain parts to decode VSB transmissions. More sophisticated set-top boxes contain a hard drive for storing recorded television broadcasts, for storing downloaded software, and for other applications provided by the DTV service provider. Digital set-top boxes can be used for satellite and terrestrial DTV but are used mostly for cable television. A set-top box price ranges from $100 for basic features to over $1,000 for a more sophisticated box.

In the Internet realm, a set-top box often really functions as a specialized computer that can "talk to" the Internet - that is, it contains a Web browser (which is really a Hypertext Transfer Protocol client) and the Internet's main program, TCP/IP. The service to which the set-top box is attached may be through a telephone line as, for example, with Web TV or through a cable TV company like TCI.

To take advantage of Dolby Digital 5.1 channel for satellite broadcasts, a satellite receiver that provides a Dolby Digital output is necessary. For cable users, all digital set-top boxes are equipped with a Dolby Digital two-channel decoder. To use 5.1 channel sound, a 5.1 channel-compliant set-top box is needed or an external 5.1 channel decoder unit.

The most dramatic demonstration of digital television's benefits is through a high-end HDTV, because of the larger screen, wider aspect ratio and better resolution. Like most new technologies, however, HDTV is expensive. Nevertheless, less expensive digital TVs provide a markedly improved viewing experience over regular TV, and for those who choose to retain their old sets, even the addition of a set-top converter will deliver a discernibly improved picture and sound.

The FCC's schedule for transition to DTV proposes that everyone in the U.S. should have access to DTV by 2002 and that the switch to digital transmission must be completed either by 2006 or when 85% of the households in a specific area have purchased digital television sets or set-top converters.

In the early 1990s, European broadcasters, consumer equipment manufacturers, and regulatory bodies formed the European Launching Group (ELG) which launched a "DVB" or "Digital Video Broadcasting" project in order to introduce DTV throughout Europe. DVB is intended to provide an open system as opposed to a closed system. Closed systems are content-provider specific, not expandable, and optimized only for the system they were developed for. An open system, such as DVB, allows the subscriber to choose different content providers and allows integration of PCs and televisions. DVB systems are intended to be optimized for television, but as well as supporting home shopping and banking, private network broadcasting, and interactive viewing. DVB is intended to open the possibilities of providing crystal-clear television programming to television sets in buses, cars, trains, and even hand-held televisions. DVB is also promoted as being beneficial to content providers because they can offer their services anywhere DVB is supported regardless of geographic location. They can also expand their services easily and inexpensively and ensure restricted access to subscribers reducing lost revenues due to unauthorized viewing. Today, the DVB Project consists of over 220 organizations in more than 29 countries worldwide and DVB broadcast services are available in Europe, Africa, Asia, Australia, and parts of North and South America

Format-Specific Media

Various different formats for the streaming media signals themselves are also herein summarized by way of non-limiting example to also provide a further understanding of how CODECS may vary for a particular case.

"DVD" is an acronym for "digital versatile disc" is generally defined as a relatively recent optical disc technology that holds up to about 4.7 Gigabytes of information on one of its two sides, or enough for a movie about 133 minutes long on average. With two layers on each of its two sides, it may hold up to 17 Gigabytes of video, audio, or other information, compared to current CD-ROM discs of approximately the same physical size that hold about 600Mbytes (DVD holds more than about 28 times the information). DVD players are required to play DVD's, though they will also play regular CD-ROM discs. DVDs can be recorded in any of three general formats variously optimized for: (i) video (e.g. continuous movies); (ii) audio (e.g. long playing music); and (iii) or a mixture (e.g. interactive multimedia presentations). The DVD drive has a transfer rate somewhat faster than an 8-speed CD-ROM player. DVD format typically uses the MPEG-2 file and compression standard, which has about 4-times the resolution of MPEG-1 images and can be delivered at about 60 interlaced fields

per second where two fields constitute one image (MPEG-1 delvers about 30 non-interlaced frames per second. MPEG-2 and -1 standards are elsewhere herein defined in more detail. Audio quality on DVD is comparable to that of current audio compact discs.

"DVD-Video" is the name typically given for the DVD format designed for full-length movies and is a box that will work with a television set. "DVD-ROM" is a name given to the player that is believed by some to be the future replacement to CD-ROM drives in computers, as these newer drives are intended to play both regular CD-ROM discs as well as DVD-ROM discs. "DVD-RAM" is the name given to writeable versions of DVDs. "DVD-Audio" is the name typically given to players designed to replace the compact disc player.

"VHS" is an acronym for "Video Home System" and is generally defined as a magnetic videotape cartridge format, typically a half-inch wide, developed for home use with the ability to record and playback analog video and audio signals. VHS has become a popular format and the de facto standard for home movie distribution and reproduction mainly due to its pervasive presence and recordability. VHS stores signals as an analog format on a magnetic tape using technology similar to that of audiocassettes. The tapes are played back and recorded on using VHS video cassette recorders (VHS VCRs). VHS tapes store up to around two hours of video typically, although some VCRs are able to record to them at a slower speed allowing up to six or even eight hours of recording per tape.

The VHS format outputs a little over 200 lines of horizontal resolution. This compares to DVDs that output over 500 lines of horizontal resolution. Technically and perceptually, VHS is a format that has been surpassed by other formats, including for example DVD, S-VHS, Hi-8 and others. However, VHS remains a pervasive means for viewing video, and VHS tapes are still easily found across the country and around the world everywhere from movie rental stores to grocery stores making then easily accessible.

"CD" is an acronym for "compact disc" and is generally defined as small, portable, round medium for electronically recording, storing, and/or playing audio, video, text, and other information in digital form. Initially, CD's were only read-only; however, newer versions allow for recording as well (e.g. "CD-RW").

"Super audio compact disc" or "SACD" is a high resolution audio CD format that, together with DVD-Audio ("DVD-A"), are the two formats competing to replace the standard audio CD (though most of the industry generally is backing DVD-A, with a general exception believed to be Philips and Sony). SACD, like DVD-A, offers 5.1 channel surround sound in addition to 2-channel stereo. Both formats improve the complexity of sound by increasing the bit rate and the sample rate, and can be

played on existing CD players, although generally only at quality levels similar to those of traditional CDs. SACD uses Direct Stream Digital ("DSD") recording, which is published as being proprietary to Sony, that converts an analog waveform to a 1-bit signal for direct recording, instead of the pulse code modulation ("PCM") and filtering used by standard CDs. DSD uses lossless compression and a sampling rate of about 2.8 MHz to improve the complexity and realism of sound. SACD may also include additional information, such as text, graphics, and video clips.

Also for the purpose of further understanding, Internet-based communications also have particular protocols for communication that must be accommodated by a streaming media communications system using the Internet "superhighway". These protocols, in particular with respect to streaming media communication, are briefly summarized immediately below for the purpose of providing a more detailed understanding.

With respect to Internet communication, streaming media signals are generally communicated in digital format via data packets. The terms "packets" are herein intended to mean units of data that are routed between an origin and a destination via the Internet or any other packet-switched network. More specifically, when a file is sent, the protocol layer of the communications system (e.g. TCP layer of TCP/IP based system) divides the file into chunks of efficient size for routing. Each of these packets is separately numbered and includes the Internet address of the destination. The individual packets for a given file may travel different routs through the Internet. When they have all arrived, they are reassembled into the original file, for example by the TCP layer at the receiving end. A packet-switching scheme is an efficient way to handle transmissions on a connectionless network such as the Internet. An alternative scheme, circuit-switched, is used for networks allocated generally for voice connections. In circuit-switching, lines in the network are shared among many users as with packet-switching, but each connection generally requires the dedication of a particular path for the duration of the connection.

Wireless Communications & the WAP Gateway

Of equal importance to the contemporary age of the Internet, the age of wireless communications has significantly extended society's ability to interact outside of the fixed confines of the home and office, allowing our remote communications to break free from the umbilical cords of wires and cables. For example, in 2000, the number of mobile subscribers grew by close to 50%.

However, wireless communications systems, protocols, and enabling technologies have developed in a significantly fragmented, "format-specific" market on a world-wide scale. This is particularly true in comparing systems in wide use in the United States as compared to the rest of the world. Therefore, much effort has been expended in overcoming compatibility issues between format-specific systems and between the related wireless devices operating on different platforms. For the purpose of further understanding wireless communication as it is later related to the present invention, the following is a brief overview of significant technologies, systems, and protocols used in the wireless communication industry.

In general, the progression of wireless communications systems for cellular telephones is colloquially given the terms "1G", "2G", "2.5G", and "3G", representing respectively first generation, second generation, and so-on. Initial systems were purely analog, known as the 1G phones and systems. However, with rapid growth, available bandwidth for cellular phone use quickly eroded, giving way to digital signal processing in the 2G, which significantly widened the available bandwidth and ability for complex signal processing for advanced telecommunications. However, as demand progressed for wireless Internet access, so went the technology development from 2G phones (generally not Internet enabled), to 2.5G and 3G (progressively more enabled). As will be further developed immediately below, the systems, protocols, and enabling technologies thus have developed toward a concentrated focus in bringing the 2.5G and 3G modes to industry and consumers.

In general, there are four major digital wireless networks based upon 2G technology: time division multiple access ("TDMA"), code division multiple access ("CDMA"), Global System for Mobile communication ("GSM") and cellular digital packet data ("CDPD"). These are briefly herein described as follows.

Time division multiple access ("TDMA") is a technology used in digital cellular telephone communication that divides each cellular channel into three time slots in order to increase the amount of data that can be carried. TDMA is used by Digital-American Mobile Phone Service (D-AMPS), Global System for Mobile communication ("GSM"), and Personal Digital Cellular ("PDC). However, each of these systems implements TDMA in a somewhat different and incompatible way. An alternative multiplexing scheme to TDMA and FDMA (frequency division multiple access) is code division multiple access ("CDMA").

Code division multiple access ("CDMA") refers to any of several protocols used in 2G and 3G wireless communications. As the term implies, CDMA is a form of multiplexing that allows numerous signals to occupy a single transmission channel, optimizing the use of available bandwidth. the

technology is used in ultra-high-frequency (UHF) cellular telephone systems in the 800 MHz to 1.9 GHz bands. CDMA uses analog-to-digital conversion (ADC) in combination with spread spectrum technology. Audio input is first digitized into binary elements. The frequency of the transmitted signal is then made to vary according to a defined pattern (code), so it can be intercepted only by a receiver whose frequency response is programmed with the same code, so it follows exactly along with the transmitter frequency. There are trillions of possible frequency-sequencing codes, thus enhancing privacy and making cloning difficult. The CDMA channel is nominally 1.23 MHz wide. CDMA networks use a scheme called "soft handoff', which minimizes signal breakup as a handset passes from one cell to another. The combination of digital and spread spectrum modes supports several times as many signals per unit bandwidth as analog modes. CDMA is compatible with other cellular technologies; this allows for nationwide roaming.

The original CDMA, also known as CDMA One, was standardized in 1993 and is considered a 2G technology that is still common in cellular telephones in the U.S. One version of cdmaOne, IS-95A, is a protocol that employs a 1.25 MHz carrier and operates in RF bands at either 800 MHz or 1.9 GHz; this supports data rates of up to 14.4 Kbps. Another version, IS-95B, is capable of supporting speeds of up to 115 Kbps by bundling up to eight channels.

More recent CDMA varieties, CDMA2000 and wideband CDMA offer data speeds many times faster. CDMA2000, also known as IMT-CDMA Multi-Carrier or IS-136, is a CDMA version of the IMT-2000 standard developed by the International Telecommunications Union (ITU). The CDMA2000 standard is a 3G technology that is intended to support data communications at speeds ranging from 144Kbps to 2 Mbps. Companies that have developed versions of this standard include Ericsson and Qualcomm corporations. Wideband CDMA, or "WCDMA", is an ITU standard derived from CDMA that is also known as IMT-2000 direct spread. WCDMA is a 3G technology intended to support data rates of up to 2Mbps for local area access, or 384 Kbps for wide area access, and supports mobile/portable voice, images, data, and video communications at these speeds. WCDMA digitizes input signals and transmits the digitized output in coded, spread-spectrum mode over a 5 MHz wide carrier – a much broader range than the 200 KHz wide narrowband CDMA.

The Global System for Mobile communication ("GSM") is a digital mobile telephone system that is widely used in Europe and other parts of the world; this system uses a variation of "TDMA" (introduced immediately below) and is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). GSM digitizes, compresses, and then sends data down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 Mhz

or 1800 MHz frequency band. At the time of this disclosure, GSM is generally considered the wireless telephone standard in Europe, and has been published to have over 120 million users worldwide and is available in 120 countries. At least one company in the United States, American Personal Communications (SprintTM subsidiary), is using GSM as the technology for a broadband personal communications services ("PCS"). PCS are telecommunications services that bundle voice communications, numeric and text messaging, voice-mail and various other features into one device, service contract and bill. PCS are most often carried over digital cellular links. This service is planned to have more than 400 base stations for various compact mobile handsets that are being made by manufacturers such as Ericsson, Motorola, and Nokia corporations; these devices generally include a phone, text pager, and answering machine. GSM is part of an evolution of wireless mobile telecommunications that includes High-Speed Circuit-Switched Data (HCSD), General Packet Radio System (GPRS), Enhanced Data GSM Environment (EDGE), and Universal Mobile Telecommunications Service (UMTS).

Cellular Digital Packet Data ("CDPD") is a wireless standard providing two-way, 19.2 kbps packet data transmission over existing cellular telephone channels.

Several different protocols have also been put into use for communicating over the various wireless networks. Various specific such protocols are briefly introduced as follows.

"X.25" is a packet-based protocol, principally used at the time of this disclosure in Europe and adapted as a standard by the Consultative Committee for International telegraph and Telephone (CCITT). X.25 is a commonly used network protocol that allows computers on different public networks (e.g. CompuServe, Tymnet, or TCP/IP network) to communicate through an intermediary computer at the network layer level. X.25's protocols correspond closely to the data-link and physical-layer protocols defined in the Open Systems Interconnection ("OSI").

"OSI" is a model of network architecture and a suite of protocols (a protocol stack) to implement it, developed by ISO in 1978 as a framework for international standards in heterogeneous computer network architecture. The OSI architecture is split between seven layers, from lowest to highest: (1) physical layer; (2) data link layer; (3) network layer; (4) transport layer; (5) session layer; (6) presentation layer; and (7) application layer. Each layer uses the layer immediately below it and provides a service to the layer above. In some implementations, a layer may itself be composed of sub-layers.

General Packet Radio Services ("GPRS") is a packet-based wireless communication service that promises data rates from 56 to 114 Kbps and continuous connection to the Internet for mobile phone

and computer users. The higher data rates will allow users to take part in video conferences and interact with multimedia Web sites and similar applications using mobile handheld devices as well as notebook computers. GPRS is based on Global System for Mobile ("GSM") communication and will complement existing services such as circuit-switched cellular phone connections and the Short Message Service ("SMS"). SMS is a message service offered by the GSM digital cellular telephone system. Using SMS, a short alphanumeric message (160 alphanumeric characters) can be sent to a mobile phone to be displayed there, much like in an alphanumeric pager system. The message is buffered by the GSM network until the phone becomes active.

The packet-based service of GPRS is publicized to cost users less than circuit-switched services since communication channels are being used on a shared-use, as-packets-are-needed basis rather than dedicated only to one user at a time. It is also intended to make applications available to mobile users because the faster data rate means that middleware currently needed to adapt applications to the slower speed of wireless systems will no longer be needed. As GPRS becomes widely available, mobile users of a virtual private network ("VPN") will be able to access the private network continuously rather than through a dial-up connection. GPRS is also intended to complement "Bluetooth", a standard for replacing wired connections between devices with wireless radio connections. In addition to the Internet Protocol ("IP"), GPRS supports X.25 protocol. GPRS is also believed to be an evolutionary step toward Enhanced Data GSM Environment ("EDGE") and Universal Mobile Telephone Service ("UMTS").

Universal Mobile Telecommunications Service ("UMTS") is intended to be a 3G, broadband, packet-based transmission of text, digitized voice, video, and multimedia at data rates up to 2 Mbps. UMTS is also intended to offer a consistent set of services to mobile computer and phone users no matter where they are located in the world. This service is based upon the GSM communication standard, and is endorsed by major standards bodies and manufacturers, and is the planned standard for mobile users around the world by 2002. Once UMTS is fully implemented, computer and phone users can be constantly attached to the Internet as they travel.

Enhanced digital GSM enterprise ("EDGE")service is a faster version of the Global System for Mobile (GSM) wireless service, designed to deliver data at rates up to 384 Kbps and enable the delivery of multimedia and other broadband applications to mobile phone and computer users. The EDGE standard is built on the existing GSM standard, using the same time-division multiple access (TDMA) frame structure and existing cell arrangements. EDGE is expected to be commercially

available in 2001. It is regarded as an evolutionary standard on the way to Universal Mobile Telecommunications Service (UMTS).

Wireless Application Protocol ("WAP") is a specification for a set of communication protocols to standardize the way that wireless devices such as cellular telephones and radio transceivers, can be used for Internet access, including e-mail, the World Wide Web, newsgroups, and Internet Relay Chat ("IRC"). While Internet access has been possible prior to WAP, different manufactures have used "format-specific" technologies. WAP enables devices and service systems to intercooperate.

In most recent times, much effort has been expended to merge the fields of wireless communications and the Internet in order to bridge the gap of cords, wires, and cables that had before separated the "information superhighway" from reaching people on wireless devices. Such technology merger has developed for example within the home and office network setting itself, where wireless infrared and radio frequency communications systems have been developed for interfacing equipment within a "wireless" office or home. Another substantial effort has also been underway to communicate and share information with more remote wireless devices, such as cell phones and personal digital assistants ("PDA's").

PDA's are typically small, mobile devices that may be "hand-held" and usually contain limited processors and display screens for managing, storing, and displaying telephone books, calendars, calculator, and the like. Recently available PDA's have been made "wireless enabled", either by having wireless modems embedded within the PDA itself, or by coupling to wireless modem "plug-ins" such as a cell phone. Wireless enabled PDA's are also generally "Internet enabled" with limited "browser" capability allowing the PDA to communicate with server devices over the Internet. Examples of commercially available wireless "enabled" PDA's include the Palm VII (from Palm, Inc.), and the iPAQ™ (from Compaq, Inc.). These PDA's include a Windows CE™ operating system that provides the limited browser capability and screen display for content. These phones have processing capabilities from about 33 MHz to about 220 MHz and varied screen display capabilities, such as for example 320 x 240 pixel screen displays.

Similarly, cellular phones themselves have also been recently rendered "Internet enabled", also with limited browser capability and screens to display content. Examples of "Internet enabled" cellular phones include, for example: Sanyo SCP-4000™, Motorola *i1000plus*™, among a wide range of others; this wide field represents hundreds of different processing and display capabilities.

In either the case of the PDA or the cellular phone that is "Internet-enabled", compatibility with the Internet protocols of communication must be achieved. In general, wireless communications take

place over a wireless applications protocol ("WAP"), whereas communications over the Internet proceed according to one of several different protocols, the most common being Transmission Control Protocol/Internet Protocol ("TCP/IP"). Therefore, a WAP Gateway, as shown in Figure 1E, forms a bridge between the world of the Internet (or any other IP packet network) and the wireless phone/data network, which are fundamentally different in their underlying technologies. The gateway, in essence, does the interpretation between these two distinct entities, allowing the consumer to use their cell phone or hand held computing device (e.g. PDA) to access the Internet wirelessly.

However, streaming media that is formatted for transmission to higher power computing devices such as desk-top computers having significant display capabilities is not generally compatible for receipt and viewing on these devices that have severely limited processing and display functionality. Particular "format-specific" compression schemes have been developed for use specifically with only these devices, and only specific media content may be transmitted to these devices in those formats.

There is still a need for a streaming media communications system that is adapted to transmit a wide variety of streaming media signals in appropriate formats to be played by wireless devices such as cellular phones and PDA's having unique constraints, such as, for example, limited and variable processing, memory, and display capabilities.

SUMMARY OF THE INVENTION

The present invention addresses and overcomes the various limitations, inefficiencies, resource limitations, and incompatibilities of prior known methods for streaming media communication, and is provided in various beneficial modes, aspects, embodiments, and variations as follows.

The present invention according to one embodiment is a streaming media communications system that uses a computer implemented intelligence system, such as artificial intelligence, in a network system, such as a neural network, to communicate a streaming media signal between a transmission device and at least one destination device.

The present invention according to another embodiment is a system for communicating a streaming media signal between a transmission device and a plurality of destination devices each having different media signal processing capabilities.

The present invention according to another embodiment is a streaming media communications system that is adapted to communicate a streaming media signal from a single transmission device and

at least one destination device over a plurality of different transmission channels, each having a different transmission capability or constraints with respect to communicating the streaming media signal.

The invention according to another embodiment is a neural network incorporating an artificial intelligence implementation that is adapted to be trained in an adaptive learning process with respect to the ability of a streaming media compression system's ability to compress a streaming media signal at a source into a compressed representation of the streaming media signal, transmit the compressed representation over a transmission channel to a destination device, and decompress the compressed representation into a decompressed representation of the streaming media signal which is adapted to be played by the destination device.

The invention according to another embodiment is a system for compressing streaming media signals according to a CODEC that is used at least in part based upon at least one parameter affecting communication of the streaming media signals. According to one aspect of this mode, the CODEC is used according to at least one of the following parameters: a previously learned behavior of the CODEC with respect to another reference signal, a previously learned behavior of the CODEC with respect to a prior attempt at compressing or decompressing the same streaming media signal, a comparison of the CODEC's operation with respect to the streaming media signal against a reference algorithm compression of the streaming media signal, a learned constraint of the transmission channel, and a learned constraint of the destination device. In one beneficial embodiment, the CODEC is used based upon more than one of these parameters, and in still a further beneficial variation is used based upon all of the parameters.

The invention according to another embodiment is a system for compressing streaming media signals using a CODEC library that is adapted to store multiple CODECS of different types and operations, and that is adapted to be searched and accessed by a network system, such as a neural network, in order to provide an appropriate CODEC from the CODEC library for use in compressing the input streaming media signal into a compressed representation for transmission to a destination device.

The invention according to another embodiment is a CODEC operating system that is adapted to interface with a CODEC Library and also with a neural network in order to use the neural network in a process, such as an artificial intelligence process, to choose an appropriate CODEC from the CODEC library and use the chosen CODEC for compressing the streaming media signal into a compressed representation of the streaming media signal for transmission to a destination device.

According to one aspect, the CODEC library is adapted to receive and store a new CODEC such that the new CODEC may be interfaced with the neural network in order to be chosen and applied to compress the streaming media signal as provided.

The invention according to another embodiment is a destination agent that is adapted to be stored by a destination device for use in decompressing a compressed representation of a streaming media signal. The destination agent is adapted to communicate with a remotely located, compressed streaming media transmission system in order receive and play streaming media signals therefrom. In a particularly beneficial aspect, the software agent is adapted to deliver information about the destination device to the compressed streaming media transmission system, and is also adapted to receive and decode certain encoded streaming media signals from the compressed streaming media transmission system.

The invention according to another embodiment is a system for communicating a streaming media signal having a destination agent that is adapted to be stored within a destination device for decompressing a compressed representation of a streaming media signal into a decompressed representation that may be played by the destination device.

According to one aspect of this embodiment, the destination agent has a diagnostic agent and also a decompression agent. The diagnostic agent is adapted to determine a value for at least one parameter of the destination device related to the capability for processing, storage, or display. The decompression agent is adapted to apply a CODEC decompressor to decompress the compressed representation of the streaming media signal into the decompressed representation using a CODEC based at least in part upon the value of the at least one parameter.

According to another aspect, the destination agent comprises a software agent. In one variation, the software agent is embedded within the destination device. In another variation, the software agent is adapted to be loaded onto the destination device at least in part by a remotely located source that is adapted to deliver the compressed representation of the streaming media signal to the destination device.

The invention according to another embodiment is a transcoder for trancoding streaming media signals between at least one initial format and at least one transcoded format. The transcoder includes a single thread for each of several streaming media signals.

The invention according to another embodiment is a video-on-demand streaming media system incorporating the embodiments shown in the Figures and otherwise described herein.

The invention according to another embodiment is a mobile telephone communications system incorporating the embodiments shown in the Figures and otherwise described herein.

The invention according to another embodiment is an interactive gaming system incorporating the embodiments shown in the Figures and otherwise described herein.

The invention according to another embodiment incorporates the various modes, embodiments, aspects, features, and variations herein disclosed above and elsewhere to static media, as well as to media that is stored locally after processing (e.g. compressing) and not transmitted.

BRIEF DESCRIPTION OF THE FIGURES

Figures 1A-B show schematic block diagrams representing two respective variations of prior media communications systems using conventional CODEC systems.

Figures 1C-D show schematic block diagrams representing two respective variations of prior media transcoder systems.

Figure 1E shows a schematic block flow diagram of the various interrelated components in a prior WAP gateway communications system.

Figures 2-3 show schematic block diagrams of the transcoder system of one embodiment of the present invention during two respective modes of use.

Figures 4A-5 show block flow diagrams in various detail, respectively, of a media communications system according one embodiment of the invention.

Figure 6 shows a schematic block flow diagram of various interrelated components of a "video-on-demand" streaming video communications system according one embodiment of the invention.

Figure 7 shows a schematic block flow diagram of various interrelated components of a wireless streaming video communications system according to one embodiment of the present invention.

Figure 8 shows a schematic block flow diagram of various interrelated components of a WAP gateway media communications system according one embodiment of the present invention.

Figure 9 shows a schematic block flow diagram of various interrelated components of a wireless communications system during backhauling according to one particular mode of use of the media communications system of an embodiment the present invention.

Figure 10 shows a schematic block flow diagram of various interrelated components of an interactive gaming communications system and set-top TV browsing of one embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The present invention as illustrated variously through the embodiments below (and by reference to the Figures) provides a media communications system that includes a compression system, a delivery system, and a decompression system, and in another aspect includes a transcoder system. In general, the combination of these individual sub-systems provides a capability to efficiently transcode media between multiple encoding formats, in addition to customize the compression, delivery, and decompression of randomly selected streaming media signals based upon a large array of system parameters as variables. These variables include for example, without limitation, parameters related to the following: the source video signal, the source transmitting device, the transmission modality, and the destination device. The compression, delivery, and decompression of a media signal is thus customized to be optimally efficient for a given, and changing, environment of use. As a result, a wide range of complex streaming media signals may be communicated with a level of efficiency and range of device compatibility that is significantly improved over other known systems.

Notwithstanding the benefits of the overall streaming media communication system herein described, each sub-system described also independently provides beneficially useful results for streaming media communication. The various subsystems themselves, and the various iterations of combinations of these sub-systems apparent to one of ordinary skill based at least in part upon this disclosure, are also contemplated within the scope of the invention. In addition, various aspects of the overall communication system, as well as of each sub-system described, are also contemplated as useful for other applications other than specifically for streaming media communication in particular. Therefore, where apparent to one of ordinary skill, such additional applications are further contemplated within the scope of the invention, despite the particularly useful modes applied to improved streaming media communication.

Transcoder

A video/audio transcoder 200 is provided according to the invention that enables one incoming video source 210 to be streamed across multiple formats 215 (for example MPEG4, Real Video™, and QuickTime™) from one device without human intervention. The transcoder 200 according to the present embodiment provides substantially greater functionality at a fraction of the price of other

commercially available transcoder systems. Moreover, because the system works "on-the-fly," pre-compressing of the video source 210 is significantly diminished.

More specifically, the transcoder 200 system and method according to the invention is adapted to transcode digitized media originating from any compressed or uncompressed format to be reproduced into any other compressed format -- on demand, real-time. The system 200 and method also enables efficient, simultaneous processing of multiple streams 215 of differing data from a multiplicity of different compressed or uncompressed formats into a multiplicity of different compressed formats.

The transcoder 200 of the present embodiment is herein described in an overall system by way of illustration by reference to Figure 3. As shown, a first player initially makes a connection to a server 300 that houses the transcoder 200. The player format (e.g., Microsoft Media), connection speed (e.g., 32 Kbps) and protocol (HTTP) are identified. The server 300 pulls the live or pre-encoded video into a "live buffer" or "cache" 310 and encodes it as digitized but nearly uncompressed data (e.g., AVI or MPEG2). The server 300 then loads an appropriate CODEC thread (e.g. Microsoft Media™) at the connection speed (e.g. 32 Kbps). Next, the server 300 loads a HTTP/MS player thread that serves the first client Then, a second stream is requested by a client using M/S Player at 100Kbps with MMS. The server loads the appropriate MS CODEC thread at the appropriate 100 Kbps rate. Then, the server 300 loads an MMS/MS player thread to serve the second client. Then, a third stream is requested by a client using Real Player at 40 Kbps with RTSP. The server 300 loads the appropriate Real CODEC thread at the appropriate 40 Kbps rate. Then, the server 300 loads an RTSP/Real player thread to serve the third client. Again, this illustration is exemplary, and other specific CODECS may be suitable substitutes, as well as other bit-rates, etc.

In order to provide still a further understanding of the present transcoder embodiment, Figure 3 shows the transcoder 200 by way of further example as applied to serve multiple different video streams to different clients.

In brief, the present transcoder 200 shown and described uses "thread" communications instead of "IPC" or "Inter Processor Communications" that are used according to many conventional transcoding techniques. For the purpose of this transcoder 200 description, the term "thread" is herein intended to mean an encapsulation of the flow of control in a program. Single-threaded programs are those that only execute one path through their code "at a time". Multithreaded programs may have several threads running through different code paths "simultaneously". In a typical process in which multiple threads exist, zero or more threads may actually be running at any one time. This depends on

the number of CPUs the computer on which the process is running, and also on how the threads system is implemented. While a machine or system with a number of n CPUs may be adapted to run no more than n threads in parallel, the threading operation according to the present transcoder invention may give the appearance of running many more than *n* "simultaneously" by sharing the CPUs among threads.

The transcoder 200 provides abstract APIs, and therefore the CODEC is accessed without the (much larger) native encoder overhead. Buffering 310 is created as a function of client pull for different video streams. Moreover, the transcoder 200 of the invention utilizes a network architecture – a single thread for each different connection, combining clients into same thread if they are at they are within the buffered segment of the same content. The transcoder's 200 use of threads in the manner herein shown and described is considered highly beneficial because a context switch between two threads in a single process is believed to be considerably cheaper (processing/memory/IO) than using a context switch between two processes. In addition, the fact that all data except for stack and registers are shared between threads makes them a natural vehicle for implementing tasks that can be broken down into subtasks that can be run cooperatively.

While various specific architectures may be built around the transcoder 200 embodiments just described in order to achieve particularly desired results on a case-by-case basis. However, for the purpose of further illustration, the following is an example of a more detailed system using the transcoder 200 described. The transcoder 200 is provided adapted to support a large number of simultaneous customer streams, each with differing formats. In particular, such system may support more than 5000 simultaneous streams, and in some circumstances more than 7000 simultaneous customer streams, each with differing video formats. Still further, the transcoder 200 may be implemented to convert any of a wide number of video sources to a format uniquely appropriate or required for many different individual clients each having differing needs. In one particular example, a transcoder 200 as herein described may be implemented to support such high demand simultaneously on any of the following formats: MPEG 1; MPEG 2; MPEG 4; Motion JPEG; AVI; H.261; H.263; H.263 +; RealVideo™; G-8; QuickTime™; Shockwave Flash™; Indeo Cinepak™; ASF.

It is further contemplated that the transcoder 200 may be adapted in an overall communication system to be compliant with all existing and soon anticipated fixed and mobile terminals and devices. Moreover, the transcoder 200 may be implemented to adapt output stream format variables to dynamically accommodate the channel and platform conditions of each client. Still further, the system incorporating the transcoder is adapted to support load balancing servers and routers for multi-

transcoder installations. Accordingly, it is believed that the transcoder 200 of the present invention delivers significantly greater functionality for significantly lower cost than other prior transcoding techniques and systems.

As described above, various different system architectures may incorporate the transcoder 200 of the invention without departing from the scope of the invention. However, more details of a particular architecture that is believed to suitably provide the beneficial level of support just described includes the following aspects: (i) dual P3-933 processor; (ii) any variant of Unix OS; (iii) 512 MB RAM; Redundant Firewire or Gigabit Ethernet; Redundant Power Supplies. Such system may be provided in a rack mounted configuration, or otherwise to suit a particular need.

The following aspects of the transcoder 200 of the invention should be contemplated as broadly beneficial, both independently and in various combinations as is apparent to one of ordinary skill based at least in part from this disclosure.

A system and method is provided for utilizing asynchronous software thread communication in both user and kernel space to perform efficient transcoding on multiprocessor and/or distributed computing platforms (such as clustering). It has been observed that this method is more efficient than utilizing traditional IPC methods to implement the transcoder. A shared library of CODEC algorithms is created and used to access the various CODEC algorithms, thereby incurring a lower processing overhead as well as lower memory utilization than that required by the traditional combined encoder functionality such as that used in the majority of commercial encoders. Of particular benefit, common threads may be used for multiple connections, and in fact even a single thread may be used for every individual connection using the present transcoder.

A system and method is also provided for combining multiple clients to be served by the same thread (for efficiency) whenever the same content is demanded and dynamic buffers (caches) can accommodate all of the data points demanded.

Media Compression and Delivery System

A data compression and delivery system 400 and method is also provided according to the invention for real time dynamic data signal processing for optimal reproduction of approximations of original media data over a given set of constraints. This system 400 and method is illustrated schematically by way of block flow diagrams in Figures 4A and 5. Further description of the various

beneficial features and operation of this system is provided as follows by way of exemplary embodiments generally incorporating by reference the description provided by these Figures 4A-5.

Figure 4 A ia a block diagram illustration of one embodiment of the data compression and delivery system 400 of the present invention. As shown in Figure 4A, the data compression and delivery system 400 comprises media module 405, dynamic player module 407, image processor 410, baseline snapshot module 415, classifier 417, quality of standard (QoS) module 420, network layer input module 425 and network output layer module 430. The system 400 further comprises a neural network processing module 440, timer 435, CODEC library module 445, dynamic client request module 450, ICMP module 455, device and network parameters measurement module 460 and delivery and transmit module 465.

In one embodiment, the system 400, resident at a server node(s), processes incoming uncompressed or previously compressed data. The system 400 employs neural networks 440 with artificial intelligence to monitor the incoming data to determine a plurality of key characteristics of each data segment. The system 400 correlates the incoming data characteristics with libraries 445 of pre-developed self-referencing experientially learned rules of the patterns in a scene in a sequence of frames in the input signal (e.g., a video signal) and with externally imposed constraints to optimally choose a preferred commercially available compression/decompression algorithm (e.g. CODEC) for each segment of the data. The system 400 then sets up an extensive array of usage controls, parameters and variables to optimize the chosen algorithm. Choice of algorithm and set up of parameters and variables will dynamically vary with each segment of incoming data depending upon the characteristics of the data as well as the evolving optimization process itself. The set of possible algorithms is numerous, limited only by availability and other commercial considerations. Each segment of data is encoded and compressed in the above manner and then served to a communications channel.

The compression system 400 just described is particularly useful as a streaming media compression engine, which, based upon information from the available CODEC's and the streaming media delivery system, performs frame-by-frame analysis of the incoming video using another artificially intelligent neural network 440. The system 400 then chooses the most appropriate compression format and configures the compression parameters for optimal video compression based on the best quality as measured by , in one embodiment, a selection of a peak signal to noise ratio from the underlying system environment. The result is the "optimal" video and audio service for the device and conditions present.

A more specific account of the artificial intelligence/neural network 440 aspect of this system as applied to streaming media signals is provided as follows. Initially, a library of separate and distinct CODECs are added to the system as a searchable CODEC library 445. Additional libraries of relevant reference information are also provided, including: a Network Transport Standards (NTS) library 443; and a Quality-of-Service (QoS) library 447. Then, a video (media source) is introduced either in a digitized or non-digitized format (AD conversion is used) via image processor 410. Image processor 410 then decompresses the source (if required) and employs various standard image processing algorithms used for "cleaning-up" the source image(s). The resultant source media is then passed to the baseline snapshot 415 repository where it will be used as a "perfect gold standard" for later comparison. Simultaneously, this resultant source media is also fed to the classifier 417.

The classifier 417 analyzes the source media for temporal, spatial and logical features for the purpose of creating source media sub-segments which exhibit similar combinations of temporal, spatial and logic features. "Similar" is defined to mean a contiguous sub-segment of the source media that contains common temporal, spatial and logic features that would lend themselves to a particular encoding/compression algorithm (as found in the CODEC library 445). This source media sub-segment (or, in one embodiment, a group of contiguous video and audio frames) is referred to as a "scene".

The neural network process 440 then operates upon this scene by employing CODECs from the CODEC library 445 to compress the scene. The internal configuration of each CODEC are manipulated/changed in accordance with inputs obtained from the NTS library 443, QoS library 447, Timer Process 435, Network Input Layer 425, ICMP agent 455 and the Device and Network Parameter measurement agent 460. The compressed scene is then decompressed and a comparison is made against the Baseline Snapshot 415 using a quality measurement made by the quality standard process 420. In one embodiment of the present invention, the Quality Standard Process 420 employs a peak signal noise ration (PSNR) algorithm in order to perform the comparison of the decompressed scene against the baseline snapshot of the source media. The comparison process is repeated with various CODECs from the CODEC library 445 until the Neural Network Process 440 is satisfied with the quality of the resultant compressed scene, within the constraints of the inputs received from the NTS library 443, QoS library 447, Timer process 435, Network Input Layer 425, ICMP Agent 455 and the Device and Network Parameter Measurement Agent 460. Finally, the resultant compressed scene is sent to the Network Layer Output 430 which transports the compressed scene to the Client using an appropriate Network Transport protocol and QoS algorithm.

The above process is repeated until the entire source media has been transmitted to the Client or until the process is aborted due to various possible conditions which may include: a Client request to abort, network transport failure, Client hardware failure, etc.

The NTS library 443 is a repository of network transport services that are selected and used by the Network layer output 430 to transport compressed source media to the Client and by the Network Layer Input 425 to receive information from the Client. The selection is based upon qualitative and quantitative inputs received from the Network Layer Input 425, ICMP agent 445 and the Device and Network Parameter Measurement agent 460.

The QoS library 447 is a repository of quality of service algorithms that are selected and used by the network layer output 430 to transport compressed source media to the Client. The selection is based upon qualitative and quantitative inputs received from the Network Layer Input 425, ICMP agent 455 and the Device and Network Parameter Measurement agent 460.

The ICMP agent 455 generates inputs to the neural network process 440 that dynamically provides it with the quantitative and qualitative characteristics of the transport in use between the processor and the client. In one embodiment of the present invention, the ICMP protocol is used for this purpose.

The Device and Network Parameters Measurement agent 460 generates inputs to the neural network process 440 that dynamically provides it with the qualitative and quantitative characteristics of the client's environment. In one embodiment of the present invention, these client environment characteristics include central processing unit (CPU) capacity, network interface characteristics, storage capacity and media rendering devices capabilities.

Still referring to Figure 4A, the Network Layer Input 425 provides inbound (originating from the client) network transport services. The Network Layer Output 430 provides outbound (originating from the processor) network transport services. The Timer Process 435 provides a way for the user of the invention to limit the maximum amount of time that the Neural Network Process 440 will spend in processing a given source media.

Figure 4B is a block diagram illustration of one embodiment of a CODEC selection scheme of the neural network processing module 440 of one embodiment of the present invention. The neural network processing module 440 shown in Figure 4B comprises a video frame selection module 475, CODEC parameters module 480, input layer module 485 , hidden layers 486 – 487 and output module 488. In one embodiment of the present invention, a CODEC representative signal suitable to be used as

a reference baseline signal for incoming signals to the neural network processing module 440 is generated by the neural network processing module 440. In one embodiment, the classifier 417 determines which scenes in segments of an incoming video signal represents the best scene in light of the available parameters of the underlying CODEC. A list of standards are used by the neural network processing module 440 to determine which scene in the signal represents the best scene. In one embodiment, the Neural Network Process 440 samples a number of pixels in a particular frame of video to determine changes in the number of pixels in that particular frame vis-à-vis the pre-determined parameters of the video signal. In another embodiment, significant motion changes in a particular scene in the video signal may be used as the baseline reference scene ("best scene") for subsequent incoming video.

In one embodiment of the present invention, the neural network processing module 440 takes a segment of video from the classifier 417 as an input and subsequently takes a sample of this input to derive enough information that characterizes the video signal. For example, in the scheme illustrated in Figure 4B, the Neural Network Process 440 takes a window snap-shot (e.g., a 176 X 144 pixel window) to examine. It is advantageous for the Neural Network Process 440 to look at the center of the sample window to generate enough information about the video signal. In one embodiment of the present invention, the Neural Network Process 440 uses a minimum of 8 frames to generate the requisite information about the video signal. Information from the sample window is presented with the particular CODEC parameters from parameter module 480 to the input layer 485.

The input layer 485 is coupled to a plurality of hidden layers 486 – 487 via a plurality of neurons with each connection forming either a strong or weak synoptic link from one neuron to the other. In one embodiment, each CODEC supported by the neural network processing module 440 is provided with its own neural network to process the CODEC specific parameters that come with the particular CODEC. The Neural Network Process 440 generates the "best" video signal through a round-robin like process referred to as a "bake-off" from the plurality of CODECs processed during a video sampling capture period. In processing the best video representation from incoming signals, each of the corresponding neural networks for each of the CODECS generates the best representative sample from the hidden layers 486 – 487 and feed the signal to the output module 488. In one embodiment of the present invention, the output data set of the best CODEC from each class of CODECS being processed by the Neural Network Process 440 has two possibilities. The first being the Neural Network Process 440 submitting the best results for each CODEC to the output module 488 to a "bake-off" neural network of the plurality of "best" samples for each of the plurality of CODECS which in

turn generates the winning best CODEC from the plurality of best CODECS. The bake-off neural network is smaller and faster than the neural networks that handle the processing of the CODECS.

In a second processing scheme, the Neural Network Process 440 may implement a genetic algorithm processing of the best CODECS generated by the plurality of CODECS. The genetic algorithm follows the same statistical selection approach of a marble game. Thus, instead of feeding the winning output CODEC from the various neural networks into a "bake-off" neural network, a genetic algorithm processing may be applied to feed the output module 488 from the various neural networks into a bucket and picking the best CODEC representation from a collection of scenes at the end of the source media, for example, a movie, etc. In one embodiment of the present invention, the Neural Network Process 440 uses a combination of forward and backward propagating algorithm to process the CODECS.

Referring back to Figure 4A, for the purpose of providing a further understanding of this artificial intelligence process, the following example of one particular application is provided. It is to be appreciated that the features and operation of the system provided by this exemplary application are to be considered as broadly descriptive of the neural network 440 aspect for data compression and delivery according to the invention. Other applications may be made and fall within the scope of the invention.

A video content provider installs the system of the present invention on its server. Sample videos are introduced to the system in order to perform an initial AI process as described above. A complex matrix of CODEC characterizations, e.g. for each bit rate, pattern of video, etc., is created to be drawn from later. Next, a client end-user connects to the content provider system in order to view a video M. The communication system of the invention residing on the server delivers a software agent to the client's device, thus enabling the client to connect to the communication system in order to deliver device-specific information and receive the appropriate compressed signal with decompression CODEC for playing. Next, the AI system begins loading the video M as a streaming signal into a buffer for the purpose of choosing the appropriate CODEC for each frame and compressing each frame appropriately for transmission. The time period of the buffer depends upon multiple variables, principally the processing power of the system, and may be generally for example approximately 15 seconds for systems having appropriate capability for pre-recorded but uncompressed video media. Within the buffer, each frame is compared against each CODEC according to the "types" of sequences pre-tested in matrix as depicted in the diagram.

Next, the system 400 looks at end-user parameters, e.g. screen resolution, memory available, via information received from the software agent in the client's device. The most appropriate CODEC is then chosen and configured/tuned for optimal performance by setting certain variables within the CODEC to fixed quantities (e.g. based on comparing source video vs. patterns in past, transmission channel capabilities or constraints, and destination device capabilities or constraints). The process just described is generally done frame-by-frame by the classifier 417, but the CODECS are compared for temporal compression efficiency such that the process for each frame contemplates other leading and lagging frames. Once the appropriate CODEC is chosen and tuned for each frame (or block of frames where appropriately determined automatically by the system), the delivery system reports to the client agent and delivers the tuned CODEC ahead of the corresponding frame(s) to be decompressed and played.

It is to be appreciated that the neural network 440 of this system 400 continuously learns and remembers the performance and operation of the CODECS within the CODEC library 445, and continuously uses its learning to improve the compression efficiency of the input media signal. The process of running a signal frame through the library, modifying CODEC operating parameters, comparing compression performance by the compare logic 525 (Figure 5) against reference standard compression, and running the loop again with further modifications, is an iterative 550 (Figure 5) one that generally continues to improve compression efficiency. In fact, compression with one or more CODECS in the library 445 may reach improved levels better than the reference compression algorithm(s).

Nevertheless, when time constraints 435 (Figure 4A) are present (such as in real-time push or pull demand for the streaming media content), this process must eventually be stopped at some point so that a particular frame or series of frames being processed may be compressed 575 and delivered 580 to the destination without unacceptable delay by timer 435. Then, the next frame or series may be operated upon by the neural network 440 within the CODEC operating system. These endpoints may be defined by reaching a predetermined desired result, such as for example but without limitation: (i) reaching a predetermined percentage (%) compression efficiency, such as for example as compared to the reference standard; or (ii) reaching a predetermined or imposed time limit set on the process, such as for example according to a time related to the buffer time (e.g. 15 seconds); or (iii) the earlier occurrence of either (i) or (ii). In any event, though an endpoint is reached for choosing the appropriate CODEC and performing the compression 575 and delivery 580 operations, this does not mark an endpoint for the neural network 440 training which continues. The information that is gathered through

each loop in the process is stored 550. When subsequent similar frames or system constraint parameters in an incoming frame are encountered 545 in the future, the stored information is remembered and retrieved by the neural network 440 for improving compression 575 and delivery 580 efficiency.

While many different communication protocols are contemplated, one particular embodiment which is believed to be beneficial uses a "full duplex network stack" protocol, which allows for bi-directional communication between the server and the client device. Again, while other protocols may be appropriate for a particular application, the full duplex system is preferred.

The system 400 just described addresses the difficulties encountered with previously known CODEC systems by utilizing the streaming media delivery architecture to overcome latency issues and the embedded neural network 440 to overcome speed concerns. The system 400 is then able to reconfigure the algorithms used for compression in the neural network 440, the goal being to achieve optimum results every time over any network configuration.

A wide variety of CODECS may be used within the CODEC library 445 according to the overall compression systems and methods just described, though beneficial use of any particular CODEC according to the invention contemplates such CODEC taken either alone or in combination with other CODECS. For example, an appropriate CODEC library 445 may include one or more of the following types of CODECS: (i) block CODECS (e.g. MPEG versions, such as Microsoft Media™ or QuickTime™); (ii) fractal CODECS; and (iii) wavelet CODECS (e.g. Real™). According to another aspect, an appropriate CODEC library 445 may include one or more of the following types of CODECS: (i) motion predictive CODECS; and (ii) still CODECS. Still further, the CODEC library 445 may contain one or more of the following: (i) lossy CODECS; and (ii) lossless CODECS.

In one embodiment of the present invention, all of these different types of CODECS may be represented by the CODEC library 445 according to the invention; and, more than one particular CODEC of a given type may be included in the library. Or, various combinations of these various types may be provided in order to achieve the desired ability to optimize compression of a streaming media communication over a wide range of real-time variables in the signal itself, transmission channel constraints, or destination device constraints. Still further, an additional highly beneficial aspect of the invention allows for new CODECS to be loaded into the library 445 and immediately available for use in the neural network 440 compression/delivery system 400. Nevertheless, one particular example of a CODEC library 445 which is believed to be beneficial for use in optimally communicating a wide range of anticipated streaming media signals, and of particular benefit for image signals, includes the

following specific CODECS: MPEG versions 1, 2, and 4 (e.g. Microsoft Media™ and QuickTime™); DUCK TruMotion™; ON2; Real Media™; MJPEG: H.261; H.263; H.263+; GIF; JPEG; JPEG2000; BMP; WBMP; DIVX.

The following are further examples of various aspects of the compression system and method just described that should be considered as broadly beneficial, both independently and in various combinations as is apparent to one of ordinary skill based at least in part on this disclosure. Further examples of such broad aspects are elsewhere provided in the "Summary of the Invention" as well as in the appended claims.

Use of neural networks 440 with artificial intelligence to achieve the various CODEC operations described is broadly and uniquely beneficial. In particular, a system and method is provided for pre-processing 410 of source data determined by application of learned responses to the signal quality, data content and format of the data. A system and method is provided for processing each unit (e.g. frame or block of frames) of source data by selection and application of a suitable CODEC (from a set of all available CODECS in the CODEC library 445) dependent upon observed characteristics of the source data and application of past-learned responses to compressing similar data. A system and method is provided for processing each unit of source data by setting a multiplicity of compression characteristics within a chosen compression algorithm to optimize capture and preservation of the original data integrity. Still further, each or all of the aforementioned signal processing steps is applied to each unique, sequential unit of signal data, e.g., signal clip, video frame, or individual packet as appropriate.

It is further contemplated that a CODEC management system 400 according to the invention provides a system and method for image processing that is adapted to normalize original source data/images as well as to resize and resample original data to fit the specification of the neural network processing module 440. An ability to serve any transmission or recording channel with a single system and with any source data stream is also provided. Moreover, the various systems and methods herein described, individually and beneficially in combination, are provided with compatibility to any connection or connectionless protocol, including but not limited to TCP, UDP, WTP/WDP, HTTP, etc.

The invention as herein shown and described also allows for highly beneficial applications for accelerating the learning rate of neural networks 440 while minimizing the data storage requirements to implement said networks. Different classes of data streams each have unique characteristics that require substantially greater processing by neural networks 440. For example, video data streams differ by prevalence and degree of motion, color contrast, and pattern and visibility of details. Greater

processing requires longer times to reach optimal functionality. Greater processing also requires more predictive library storage, often growing to unlimitedly large sizes. For real-time neural network processing, processing time and storage can be minimized to greatly increase functionality by providing pre-developed predictive libraries characteristic of the class of data stream.

Accordingly, the following are examples of aspects of the pre-trained neural network 440 aspects of the invention that should be appreciated as broadly beneficial, both independently and in combination (including in combination with other embodiments elsewhere herein shown and described). A system and method is provided that creates and uses artificial intelligence in a neural network 440 and pre-trains that intelligent network for use in solving a problem, which problem may be for example but not necessarily limited to streaming media compression according to a particular beneficial aspect of the invention. A system and method is also provided for subdividing the universe of problems to be solved into useful classes that may be processed according to a learned history by the intelligent network.

An intelligent streaming media delivery system and method is also provided according to the invention that manages content transmission based on end-user capabilities and transmission channel constraints, such as for example, but without limitation, available transmission speeds or bandwidth, and Internet congestion. The data compression and delivery system 400 utilizes a computer implemented intelligence process, such as an artificial intelligence process based on a neural network to analyze aspects of the connection (including without limitation differing bit rates, latencies, transmission characteristics and device limitations) to make modifications in the compression methodology and to manage Quality of Service ("QoS") 420 issues. Compressed, digital, restorable and/or decompressible data streams may be therefore delivered to a multiplicity of different local and/or remote devices via a multiplicity of transmission mediums characterized by differing capabilities. In addition, a decompression system is provided for reproducing the decompressed data at the terminal device.

In one beneficial embodiment, a terminal device establishes a link with the system resident on a server node(s). Except for software normally required to establish communications, the terminal device might not initially have resident software embedded therein associated with the present system. Upon linking the terminal device to the server node, the system transmits a software agent to the terminal device that cooperates with other software modules on the server-side that together form the overall delivery system. The software agent informs the system of the terminal device configuration and processing capacities for decompressing and displaying the data. The software agent also reports

certain relevant information to the system of the characteristics of the communication channel between the terminal and the server. Such information includes, without limitation: latency, bandwidth, and signal path integrity. Based upon terminal device configuration and real time updates of channel characteristics and capabilities, the system actively manages transmission of the compressed data stream by varying parameters such as buffer length, transmitted bit rate, and error correction. The system also feeds operating conditions to the compression system to dynamically alter encoding and compression settings to optimize delivery of the data. The delivery software agent resident on the terminal device decompresses the data stream that is composed of segment-by-segment variations in compression/decompression algorithm and settings thereof. Dependent upon the terminal device configuration, and especially for very thin clients, instructions may be refreshed on a segment-by-segment basis for each decompression algorithm and encoding setting combination. Instructions for decompressing may also be kept resident if appropriate to the terminal device.

The software agent described for transmission to and operation by the destination device is therefore also considered a highly beneficial aspect of the compression/delivery systems and methods described. By delivering the software agent to the device from the source, a wide range of existing destination devices may be used for communication according to methods that may include variable uses of one or more algorithms or other operations at the transmission source. In other words, the destination devices may not be required to be "format-specific" players as is required by much of the conventional streaming and static media communication systems. Also, by providing the destination agent with a diagnostic capability, diagnostic information may be gathered at the destination device and transmitted back to the source in a format that is compliant for use by the source in its neural network process for achieving the proper CODEC operation for a given set of circumstances.

The use of a client-side agent to supply quality of service information including client-side device data and communication channel status in real time is therefore also believed to be broadly beneficial beyond the specific applications and combinations of other aspects of the invention also herein provided. In addition, the processing of each unit of compressed, transmission-ready data to accommodate client-side device and real-time communication channel conditions is also broadly contemplated as having broad-reaching benefits. Still further, a system and method is described that provides instructions to a client-side agent to enable decompression of each sequential, uniquely compressed unit of data. Therefore, another broad benefit of the invention provides a destination device (such as from the transmission source as herein described for the particular embodiments) with a CODEC that is adapted to decompress a compressed representation of an original media signal into a

decompressed representation based upon variable parameters related to at least one of the following: aspects of the original media signal, transmission channel constraints, and destination device constraints. In another broad aspect, the destination device is adapted to use a CODEC that is chosen from a library of CODECS based upon a parameter related to an aspect of the original media signal.

The systems and methods herein described are also considered applicable to the signal processing of each unique, sequential unit of signal data, e.g., signal clip, video frame, or individual packet as appropriate. In addition, the system and its various sub-systems may also be purely software that must be loaded into each appropriate device, or it may be embedded in a host hardware component or chip, e.g. on the server side, or in certain circumstances, on the client side (e.g. various aspects of the destination agent), or for example may be stored such as in flash memory.

The various aspects of the media compression system and method just described are considered beneficial for use according to a wide range of known and soon anticipated media communication needs, including for example according to the various communications devices, communication/transmission channel formats and standards, and media types and formats elsewhere herein described (e.g. in the "Background" section above).

However, for the purpose of further understanding, Figure 6 shows a schematic view of the overall streaming media communications system 600 as specifically applied to "video-on-demand" aspects according to one embodiment of the present invention, wherein many different end users 610 – 620 at many different locations may request and receive, real-time (e.g. without substantial delay), pre-recorded video from a remote source. Further to the information provided in Figure 6, at least one specific implementation of the media communication system 600 delivers the following types of video at the following bit-rates (denotes compressed representations of original signals that are convertible by a destination device to decompressed representations having no or insubstantial loss as observed by the eye of the typical human observer): VHS-format video as low as about 250Kbs; DVD-format video at about 400 Kbps; and HDTV-format video at about 900Kbps. According to these speeds, it is believed that video-on-demand may be provided by telephone carriers over resident transmission line channels, such for example over existing DSL lines 630 - 640.

However, as available bandwidth and mass communication continue to present issues, it is believed that even greater efficiencies may be achieved resulting in delivery of compressed representations of these types of video signals at even lower bit rates. Again, as elsewhere herein described, the compression efficiencies of the invention are closely related to and improve as a function of the processing power made available to the neural network 440, and the neural network's 440

continued learning and training with respect to varied types of media. These resources may even make more remarkable compression efficiencies achievable without modification to the fundamental features of the present invention.

Therefore, the following are further examples of transmission rates for certain compressed video signals that are believed to be desirable and achievable according to one embodiment of the invention: VHS-format video as low as about 200Kbps, more preferably as low as about 150Kbps, and still more preferably as low as about 100Kbps; DVD-format video as low as about 350Kbps, more preferably as low as about 300Kbps, and still more preferably as low as about 250Kbps; and HDTV-format video as low as about 800Kbps, and still more preferably as low as about 700 Kbps.

Moreover, at least one implementation of the media communications system 400 of one embodiment of the invention delivers 20-24 frames/sec color video at a transmission rate of 7 Kbps. This is believed to enable substantial advances in communication of streaming media signals via to wireless destination devices via the WAP Gateway, as is further developed elsewhere hereunder.

It is also to be appreciated that, while video communication has been emphasized in this disclosure, other types of streaming or static media are also contemplated. For example, at least one implementation of the compression and delivery embodiments has been observed to provide substantially CD-quality sound (e.g. via compressed representations of original signals that are convertible by a destination device to decompressed representations having no or insubstantial loss as observed by the ear of the typical human observer) at a bit-rate of about 24 Kbps. At these rates, audiophile-quality sound may be delivered for playing over dial-up modems. However, with further regard to available resource commitment and extent of neural network training, it is further contemplated that the invention is adapted to deliver CD-quality sound at speeds as low as about 20Kbps, and even as low as about 15 Kbps or even 10Kbps.

Wireless Audio Communications System

It is further contemplated that the streaming media communication system of the invention has particularly useful applications within wireless audio communications networks, and in particular cellular telephony networks. Therefore, Figures 7 and 8 schematically show, with respectively increasing amounts of detail, streaming media communications systems 700 and 800 respectively specifically applied to wireless audio communications systems according to certain specific, respective embodiments of the present invention. While particular devices, system parameters, or arrangements

of communicating devices shown are believed to be beneficial in the overall application of the invention, they are not to be considered limiting and may be suitably replaced with other substitutes according to one of ordinary skill based upon this disclosure. The various wireless communications systems 700 and 800, standards, and protocols referenced elsewhere in this disclosure are thus incorporated into this section for the purpose of integration with the various aspects of compression, delivery, decompression, and transcoding according to one embodiment of the invention.

Combination of the communications system 400 of one embodiment of the present invention with the other components of a cellular communications network allows for the enhanced compression, delivery, and decompression according to the invention to manifest in an increased quality of service for wireless audio communications. Improvements in cellular communications according to the invention include, without limitation, the following examples: increasing available bandwidth, extending range of reception, and providing graceful degradation while maintaining connectivity during periods of low signal quality or reception levels.

More specifically, cellular telephony signals are characterized by relatively high degrees of variability, due for example to the roaming positions of clients, and limited cell ranges, atmospheric conditions, and significantly limited and changing available bandwidths over daily use cycles. Therefore, a self-optimizing CODEC management system according to the present invention is particularly well suited to adjust the appropriate communications and compression modalities to the changing environment. At the very least, the increase in compression efficiency and resulting decrease in bandwidth used for given signals is a valuable achievement as wireless channel traffic continues to congest.

In one particular regard, the increased compression efficiency according to the present invention is well applied to improving bandwidth issues during "soft hand-offs" between cells, as illustrated in Figure 9. During cellular phone communications, whenever a transmitter or receiver migrates between cell coverage zones, communications bandwidth requirements and resultant costs are increased by systemic requirement to "pass off" active communications between cells. The act of passing off the communication results in a "backhaul" channel from the previously active cellular transmitter to a central office for forwarding to a newly active cellular transmitter. The backhaul channel represents a significant use of bandwidth. Savings will result from increased compression. As Figure shows, such "backhauling" may include a doubling (media sent back from first cell being left and resent to second cell for transmission) or even a quadrupling (overlapping communication from both first and second cells) in the bandwidth used for communicating a particular signal.

The media communications system 400 of the present invention may recognize when backhaul is occurring, such as according to the transmission channel diagnostics provided in the software agent(s), and may respond by adjusting the degree of compression to compensate.

WAP Video Gateway

With a particular view of the rapid growth observed and predicted in the wireless or mobile Internet, embodiments of the present invention contemplate application of the intelligent compression/delivery/ decompression embodiments in combination with WAP Gateway functionality.

A system and method is therefore also provided according to the invention for encoding, compressing and transmitting complex digital media (e.g., video pictures) via bandwidth-constrained wireless communications systems utilizing Wireless Applications Protocol (WAP). In one embodiment, data is processed by the system, resident at a server node(s), employing neural networks with artificial intelligence. Sample segments of data are captured from the input stream and processed to comply with requirements unique to the class of clients. As is described in detail above, the system correlates the continuously varying digital data streams' characteristics with libraries of pre-developed experientially learned rules and with externally imposed constraints to optimally choreograph the coherence, continuity and detail of the data as ultimately received, decoded and presented at the client interface.

A gateway provided with the added functionality of the streaming media communications system herein described is shown schematically in Figure 8. According to the WAP gateway system 830 , a client agent is provided that is adapted to run on a variety of platforms, and requires no specialized hardware to decode the video streams. According to use of the streaming media delivery system of the invention elsewhere herein described, the viewer of the WAP device maintains constant communication with the system server upstream, such that the user-side client 825 may provide the encoding platform with relevant information for streaming media communication, including without limitation: available screen size, processing power, client operating system and browser version, connection speed and latency, thereby allowing the streaming media delivery system to tailor the stream to each individual client it "talks" to. Accordingly, an AI driven server 830 incorporating the AI compression as herein described may be combined with a WAP Gateway 830, combining the necessary WAP to TCP/IP protocol (or other protocol, e.g. dual server stack) translation with a Video and Audio Server 835 employing compression, delivery, and decompression systems and methods

herein described. The WAP Gateway 830 may further include a video transcoder, such as for example incorporating the transcoder systems and methods herein described. An appropriate host architecture according to this system (not shown) generally includes a rack mount system running Linux OS with a modified WAP Gateway 830 or as a software plug-in to existing servers.

This WAP gateway system 830 may be further provided in a Master/Slave relationship as another beneficial aspect of the overall streaming media delivery architecture (applicable to other delivery systems other than specifically wireless). Various content distribution networks, such as available through Akamai and Inktomi, have capitalized on the concept of improving data delivery over the Internet by using "smart caching" on servers which reside on the borders of the Internet. Such a Master/Slave relationship is maintained by the present system wherein a Master Server resides at the source of the content to be delivered and Slave Servers reside on the borders. These servers communicate "intelligently" to optimize the content delivery over the Internet and reduce latency, bandwidth and storage requirements, improving the overall quality of the video/audio stream to the end-user and decreasing the cost of media delivery to the content provider.

The WAP gateway 830 of the present invention supports continued growth in mobile communications, as large telecommunications operators are transitioning to multi-service broadband networks, and as the number of subscribers to the mobile Internet continues to expand rapidly. In particular, mobile communications is a broad class of systems and protocols, each having its own constraints and needs for interacting devices to communicate streaming media. The Gateway 830 in a particularly beneficial aspect may support a variety of "2G" systems with upgradability for upcoming "2.5G" and "3G" network technologies (numerical progression of systems generally represents progression of Internet-enabled capabilities).

The following Table 3 provides examples of known mobile communication standards, and provides certain related information used by the AI system of the present invention for optimizing communication of streaming media amongst the field of mobile destination devices as media players:

Table 3: Existing/Soon Anticipated Mobile Communications Standards

MODE	**BAUD RATE (generally)**
GSM (2G)	9.6 Kbps
CDMA	9.6 Kbps
TDMA	14.4 Kbps
CDPD	14.4 Kbps

iMODE	128 Kbps
GPRS	144 Kbps
WCDMA or CDMA2000	144 Kbps to 2 Mbps
GSM (3G)	2 Mbps

In addition, the present invention is particularly beneficial in its ability to stream a wide variety of media signals to various different types of wireless communications devices. Examples of wireless communications devices that are appropriate for use with the streaming media communications systems and methods of the invention, and which the systems and methods support interchangeably, are provided in the following Table 4:

Table 4: Examples of Internet-enabled PDA's

DEVICE	MAKE	SPEED	MEMORY	SCREEN DEPTH	SCREEN SIZE	MODEM TYPE	CONNECT SPEED
iPAQ	Compaq	206 MHz	16-64 Mb	12 b/pixel color	320x240	External (e.g. CDPD)	9600-14.4 Kbps
PalmVII	Palm	33 MHz	4 -16Mb	4 b/pixel b/w 8 b/pixel color		Internal	14.4 Kbps
Handspring	Palm	33 MHz	4 -16Mb	4 b/pixel b/w; 8 b/pixel color		External	14.4 Kbps
Blackberry	Research-In-Motion	33 MHz	4 Mb	2 b/pixel b/w		Internal	9.6-14.4 Kbps
Jornada	HP	133 MHz	16-32 Mb	18 b/pixel	320x240	External	9.6-14.4 Kbps

Casseopeia ▪▪▪▪▪▪▪▪▪	Casio	150 Mhz	16-31 Mb	12 b/pixel	320x240	External	9.6-14.4 Kbps

Various specific examples are described later below that provide observations of actual wireless Internet applications of the invention as herein described. Such examples include use of a CODEC library according to varied parameters associated with at least the following (without limitation): destination wireless communication device; transmission channel; communications protocol; and the respective streaming media signals themselves. The various particular features of the systems and methods used according to these examples are contemplated as further defining independently beneficial aspects of the invention.

Shared Interactive Environment

A system and method is also provided according to the invention for enabling real-time remote client interaction with a high-definition, multi-dimensional, multi-participant simulated environment without the need for significant client-side processing capacity. More specifically, Figure 10 shows an overall streaming media communication system as applied to shared interactive gaming according to the invention.

This system includes: (i) a proxy server; (ii) graphics rendering capabilities; (iii) a client software agent for feedback of client inputs to the game; (iv) a client software agent for supporting the delivery system of the invention; and (v) streaming from the server to the client. It is contemplated that for multiple clients, which typically represent shared interactive gaming by design, multiple components as just described are provided to support each client.

The interactive gaming embodiments contemplate implementation of data compression and delivery embodiments with devices that are also destination devices for compressed signals from other like, remotely located device systems. This arrangement is broadly beneficial, such as for example in further interactive media implementations such as video conferencing and the like. Accordingly, each remote system is both a source and a destination device, and sends and receives agents between it and other remote systems.

Destination Device

Although the communications systems of the present invention enables communication of streaming media signals to a wide variety of destination devices, a further contemplated feature of the invention provides a remote receiver to be housed as a destination device/player by client users. This set-top player may be adapted to serve at least one, though preferably multiple ones, and perhaps all, of the following: Video on Demand (VOD); Music on Demand (MOD); Interactive Gaming on Demand (IGOD); Voice Over Internet Protocol ("VoIP"), any technology providing voice telephony services over IP connections; Television Web Access; Digital Video Recording to record, pause, and playback live television; e-mail; chat; a DVD player; and other applications apparent to one of ordinary skill. All of this may be delivered to existing televisions in the comfort of users' own homes. Moreover, clients utilizing this box, or other systems interfacing with the communications system of the invention, may receive DVD quality video and surround sound over cable and DSL connections.

EXAMPLES

For the purpose of further illustrating the highly beneficial results that may be achieved according to the invention, the following are examples of specific embodiments that have been used for different types of streaming media communication, including observed results with pertinent discussion. These examples illustrate communication the same pre-recorded video over different transmission channels and to different destination devices, wherein the pre-recorded video has the following originating properties: 720lines of resolution and 32bits of color information, an originating file size of about 1.4Gigabytes.

Example 1

An "iPAQ" model 3650 hand-held PDA (commercially available from Compaq, Inc. for approximately $500 at the time of this disclosure) was provided. The PDA was interfaced with a 14.4 Kbps (max) wireless CDPD modem ("AirCard 300" wireless external modem, commercially available from Sierra Wireless for approximately $200 at the time of this disclosure) using an extension assembly (iPAQ™ PCMCIA expansion sleeve from Compaq, Inc.) with a PCMCIA card slot that couples to the wireless modem. The iPAQ™ used is generally characterized as having the following processing parameters: 206 MHz processor; 32 Mb memory; 12 b/pixel color; 240X320 screen dimensions; PocketPC™ operating system version 3.0 from Microsoft Corp. and stereo sound. The iPAQ™ was

connected to the Internet in San Francisco, California via the interfaced CDPD modem over the AT&T cellular wireless carrier system at a connection bandwidth of about 13.3Kbit/sec. A server located in San Jose, California (approximately 50mi away) was contacted by the PDA employing the http and rtsp protocols, and the PDA was used to initiate a request for a pre-recorded video having the following originating properties: 720lines of resolution and 32bits of color information, the originating file size was 1.4Gigabytes. Within about seven seconds, a compressed approximation of the pre-recorded video was received, decompressed, and displayed by the PDA on the PDA's screen. The entire video was seen at 240x320x12bpp resolution in full motion without observable delays or defects.

Example 2

A "Jornada™" model 548 hand-held PDA (commercially available from HP, Inc. for approximately $300 at the time of this disclosure) was provided. The PDA was interfaced with a 9.6 Kbps (max) wireless CDMA phone ("Motorola i85s" wireless external digital cellular phone, commercially available from Motorola authorized vendors for approximately $200 at the time of this writing) using adaptor cables (Motorola and HP RS-232 standard interface cables from Motorola and HP.) that couple the phone and PDA together to form a wireless modem. The Jornada model PDA device used is generally characterized as having the following processing parameters: 133 MHz processor; 32 Mb memory; 12 b/pixel color; 240X320 screen dimensions; PocketPC™ operating system version 3.0 from Microsoft Corp. and stereo sound. The Jornada™ was connected to the Internet in Newark, NJ via the interfaced CDMA phone/modem over the Nextel digital cellular wireless carrier system at a connection bandwidth of 8Kbit/sec. A server -located in San Jose, California (approximately 2900mi away) was contacted by the PDA employing the http and WDP protocols, and the PDA was used to initiate a request for a pre-recorded video having the following originating properties: 720lines of resolution and 32bits of color information, the originating file size was 1.4Gigabytes. Within about seven seconds, a compressed approximation of the pre-recorded video was received, decompressed, and displayed by the PDA on the PDA's screen. The entire video was seen at 176x120x8bpp in full motion without observable delays or defects.

Example 3

A "Set-top Box" model st850 book PC (commercially available from MSI, Inc. for approximately $300 at the time of this writing) was provided. The Set-top Box was interfaced with a 10 Mbps (max) ethernet/802.11 connection using CAT5 ethernet cables (Generic) that couple the Set-top Box to a broadband connection (DS3). The Set-top Box used is generally characterized as having the following processing parameters: 400 MHz processor; 64 Mb memory; 32 b/pixel color; 720 lines of screen resolution; Windows CE operating system version 2.11 from Microsoft Corp. and AC3 digital 6 channel surround-sound. The Set-top Box was connected to the Internet in Newark, NJ via the interfaced shared DS3 connection over the Alter.Net Internet Backbone at a connection bandwidth of 376Kbit/sec. A server located in San Jose, California (approximately 2900mi away) was contacted by the Set-top Box employing the http and rtsp protocols, and the Set-top Box was used to initiate a request for a pre-recorded video having the following originating properties: 720lines of resolution and 32bits of color information, the originating file size was 1.4Gigabytes. Within
About nine seconds, a compressed approximation of the pre-recorded video was received, decompressed, and displayed by the Set-top Box on a commercially available reference monitor's (Sony) screen. The entire video was seen at 720linesx32bpp in full motion without observable delays or defects.

While various particular embodiments have been herein shown and described in great detail for the purpose of describing the invention, it is to be appreciated that further modifications and improvements may be made by one of ordinary skill based upon this disclosure without departing from the intended scope of the invention. For example, various possible combinations of the various embodiments that have not been specifically described may be made and still fall within the intended scope of the invention. According to another example, obvious improvements or modifications may also be made to the various embodiments and still fall within the intended scope of this invention.

What is claimed is:

1. A system for processing a media signal, comprising:

a searchable CODEC library that is adapted to store a plurality of separate and unique CODECS and also to be accessed by and searched by at least one of an artificial intelligence (AI) system and an operating system, such that each CODEC stored in the CODEC library may be individually located and accessed for use by at least one of the AI system and operating system in order to compress the media signal for transmission from a source to a destination device.

2. The system of Claim 1, wherein the CODEC library comprises at least one CODEC that is of at least one of the following three types of CODECS: block CODECS; fractal CODECS; and wavelet CODECS.

3. The system of Claim 2, wherein the CODEC library comprises:
a first CODEC of a first type on the three types, and
a second CODEC of a second type of the three types.

4. The system of Claim 3, wherein the CODEC library comprises:
a first CODEC of a first type of the three types,
a second CODEC of a second type of the three types; and
a third CODEC of a third type of the three types.

5. The system of Claim 4, wherein the CODEC library comprises:
a first CODEC that is a motion predictive CODEC; and
a second CODEC that is a still CODEC.

6. The system of Claim 5, wherein the CODEC library comprises:
a first CODEC that is a lossy CODEC; and
a second CODEC that is a lossless CODEC.

7. The system of Claim 1, further comprising:

a registry associated with the CODEC library and that is searchable in order to search and locate a particular CODEC within the CODEC library.

8. A system for communicating a media signal from a source to a destination device over a transmission channel, comprising:

a destination agent that is adapted to be used by the destination device to communicate with the source and to receive a compressed representation of the media signal from the source and to decompress the compressed representation into a decompressed representation of the media signal such that the decompressed representation may be stored or used by the destination device.

9. The system of Claim 8, wherein the destination agent comprises:

a diagnostic agent that is adapted to provide diagnostic information for transmission to a neural network associated with the source, which diagnostic information represents an ability of the destination device to receive, store, process, or display the media signal; and

a decompression agent that is adapted to decompress the compressed representation of the media signal into the decompressed representation of the signal to be stored or played by the destination device.

10. The system of Claim 9, wherein the destination agent further comprises:

a decompression agent that is adapted to receive a compressed representation of the media signal and also to receive a CODEC decompressor associated with the compressed representation of the signal from the delivery system, and that is adapted to use the CODEC decompressor to decompress the compressed representation of the signal into a decompressed representation of the signal to be stored or played by the destination device.

11. The system of Claim 10, wherein the destination agent is adapted to be stored and operated for decompressing and playing a media signal on a plurality of different destination devices each having different capabilities for decompressing, storing, or playing the media signal.

12. The system of Claim 11, wherein the destination agent is adapted to decompress a plurality of different compressed representations of the media signal by using different CODEC decompressors that are each associated with a corresponding different CODEC compressor used to compress the signal.

13. The system of Claim 12, wherein the destination agent is adapted to decompress the compressed representation of the media using a CODEC that is provided based upon at least one of the following parameters: a computer implemented previously learned behavior of the CODEC with

respect to a reference media signal, a computer implemented previously learned behavior of the CODEC with respect to a prior attempt at compressing or decompressing the same media signal, a comparison of the CODEC's operation with respect to the media signal against a reference algorithm compression of the media signal, a learned constraint of the transmission channel, and a learned constraint of the destination device.

14. The system of Claim 13, wherein the destination agent is adapted to interchangeably use a block CODEC, a fractal CODEC, or a wavelet CODEC.

15. A system for communicating a media signal from a source to a destination device over a transmission channel, comprising:

a CODEC that is adapted to compress the media signal for optimized transmission along the communications channel and decompression by the destination device, wherein the compression is done by the CODEC based upon at least one of the following parameters: a previously learned behavior of the CODEC with respect to another reference signal, a previously learned behavior of the CODEC with respect to a prior attempt at compressing or decompressing the same media signal, a comparison of the CODEC's operation with respect to the media signal against a reference algorithm compression of the media signal, a learned constraint of the transmission channel, and a learned constraint of the destination device.

16. The system of Claim 15, wherein the CODEC is adapted to compress the media signal into n different compressed representations of the media signal that are adapted to be transmitted to the destination device at n unique bit rates, respectively.

17. The system of Claim 15, further comprising:

a searchable quality of service (QoS) library associated with the CODEC and that is adapted to be used by at least one of an artificial intelligence system or an operating system in order to determine an appropriate use of the CODEC with respect to the media signal based upon at least one QoS standard stored in the QoS standards library.

18. A system for processing a media signal, comprising:

a CODEC operating system that is adapted to interface with a CODEC library and also with an artificial intelligence (AI) system in order to use the AI system to identify an appropriate CODEC from the library and to process the media signal with the CODEC.

19. The system of Claim 18, further comprising:

at least one CODEC associated with the CODEC operating system for use in processing the media signal based at least in part upon an operation by the CODEC operating system.

20. The system of Claim 19, further comprising:

a searchable CODEC library that is associated with the CODEC operating system and that is adapted to store a plurality of separate and unique CODECS, wherein the CODEC operating system is adapted to cooperate with the searchable CODEC library and also with the AI system in order to determine an appropriate CODEC stored in the CODEC library for use in processing the media signal.

21. The system of Claim 20, further comprising:

a searchable network transport standards library associated with the CODEC operating system and that is adapted to be used by at least one of an AI system or the CODEC operating system in order to determine an appropriate use of a CODEC with respect to the media signal based upon at least one network transport standard stored in the network transport standards library.

22. The system of Claim 21, further comprising:

a searchable quality of standard (QoS) library associated with the CODEC operating system and that is adapted to be used by at least one of an AI system or the operating system in order to determine an appropriate use of a CODEC with respect to the media signal based upon at least one QoS standard stored in the QoS standards library.

23. The system of Claim 22, further comprising:

a destination agent that is associated with the CODEC operating system and is adapted to be used by a destination device to communicate with a source also associated with the CODEC operating system to receive a compressed representation of the media signal from the source and to decompress the compressed representation into a decompressed representation of the media signal such that the decompressed representation may be stored or used by the destination device.

24. A system for processing a media signal, comprising:

a destination device that is adapted to communicate with a source and to receive a compressed representation of the media signal from the source, and that includes a CODEC that is adapted to decompress the compressed representation into a decompressed representation based upon at least one of the following parameters: a previously learned behavior of the CODEC with respect to another reference signal, a previously learned behavior of the CODEC with respect to a prior attempt at compressing or decompressing the same media signal, a comparison of the CODEC's operation with respect to the media signal against a reference algorithm compression of the media signal, a learned constraint of the transmission channel, and a learned constraint of the destination device.

25. The system of claim 24, wherein the media signal is adapted to be used according to an original format according to an original set of parameters, and the destination device is adapted to process and display the decompressed representation of the media signal in another format according to another set of parameters that are different than the original set of parameters, such that the destination device is incapable of processing and displaying the media signal in the original format according to the original set of parameters.

26. The system of claim 25, wherein the CODEC is adapted to compress the media signal into n different compressed representations of the media signal that are adapted to be transmitted to the destination device at n unique bit rates, respectively.

27. The system of claim 26, wherein the n different compressed representations are adapted to be transmitted at least at n substantially different transmission rates that are distinguished based upon at least one of the following parameters: different transmission system standards; different destination device standards; and different media type standards.

28. A system for processing a media signal, comprising:

a CODEC that is adapted to perform at least one of compression or decompression on the media signal; and

an artificial intelligence (AI) system that is adapted to operate in conjunction with the CODEC in order to tune the operation of the CODEC with respect to the media signal, wherein the AI system is adapted to learn a behavior of the CODEC with respect to at least one parameter affecting the CODEC's operation, and also to modify the operation of at least one of the AI system

itself or the CODEC based upon the learned behavior in order to increase the ability to provide the CODEC in an appropriate form for optimally compressing or decompressing the media signal.

29. The system of claim 28, wherein the CODEC comprises a discrete cosine transform CODEC.

30. The system of claim 29, wherein the CODEC comprises a fractal CODEC.

31. The system of claim 30, wherein the CODEC comprises a wavelet CODEC.

32. The system of claim 31, wherein the CODEC comprises a lossy CODEC.

33. The system of claim 32, wherein the CODEC comprises a substantially lossless CODEC.

34. The system of claim 33, further comprising:

a searchable CODEC library that is adapted to store a plurality of separate and unique CODECS,

wherein the CODEC is adapted to be stored in the searchable CODEC library, and the AI system is adapted to cooperate with the CODEC library in order to locate and access the CODEC so that the AI system may perform at least one operation with respect to the CODEC.

35. A system for processing a media signal, comprising:

a CODEC library that is adapted to store a plurality of separate and unique CODECS;

an artificial intelligence (AI) system associated with the CODEC library and that is adapted to perform an operation with respect to the CODEC library in order to determine an appropriate CODEC from the plurality of CODECS for use in processing the media signal;

a CODEC operating system associated with the CODEC library and also the AI system and that is adapted to control the operation of the AI system with respect to the CODEC library;

a source system that is adapted to compress the media signal based upon a CODEC from the CODEC library and based upon an operation of the AI system;

a destination system that is adapted to communicate with the source system and to receive a compressed representation of the media signal from the source system and decompress the compressed representation into a decompressed representation for use by the destination system; and

a communications system associated with the source system and also with the destination system so that the source system is adapted to transmit the compressed representation of the media signal to the destination system, and the destination system is adapted to receive the compressed representation and also to appropriately decompress the compressed representation into the decompressed representation for storage or use by the destination system.

36. The system of claim 35, further comprising:

a searchable network transport standards library associated with the AI system and also with the CODEC operating system and that is adapted to be used by the AI system in order to determine an appropriate CODEC from the CODEC library for processing the media signal based upon at least one network transport standard stored in the network transport standards library.

37. The system of claim 36, further comprising:

a searchable QoS standards library associated with the AI system and also with the CODEC operating system that is adapted to be used by the AI system in order to determine an appropriate CODEC from the CODEC library for processing the media signal based upon at least one QoS standard stored in the QoS standards library.

38. The system of claim 37, wherein the AI system is adapted to determine an appropriate use of a CODEC from the CODEC library for processing the media signal based upon at least one of the following parameters: a previously learned behavior of the CODEC with respect to another reference signal, a previously learned behavior of the CODEC with respect to a prior attempt at compressing or decompressing the same media signal, a comparison of the CODEC's operation with respect to the media signal against a reference algorithm compression of the media signal, a learned constraint of the transmission channel, and a learned constraint of the destination device.

39. A system for communicating a media signal between a source and n unique destination devices each having a unique ability to process the media signal, wherein n is an integer that is equal to or greater than one, comprising:

a compression system associated with the source and which is adapted to compress the media signal into n uniquely compressed representations of the media signal,

wherein each of the n uniquely compressed representations is adapted to be transmitted from the source to a unique one of the n destination devices, and is adapted to be decompressed by the respective destination device into a unique one of n decompressed representations of the media signal to be played by the respective destination device.

40. The system of claim 39, wherein the compression system further comprises:

a searchable CODEC library that is associated with the compression system and that is adapted to store a plurality of separate and unique CODECS, wherein the compression system is

adapted to compress the media signal into each of the n uniquely compressed representations based at least in part upon at least one CODEC stored by the CODEC library.

41. The system of claim 40, wherein the compression system further comprises:

a searchable network transport standards library associated with the compression system and that is adapted to be used by the compression system in order to determine at least one appropriate CODEC for compressing the media signal into the n uniquely compressed representations based upon at least one network transport standard stored in the network transport standards library.

42. The system of claim 41, wherein the compression system further comprises:

a searchable QoS standards library associated with the compression system and that is adapted to be used by the compression system in order to determine at least one appropriate CODEC from the CODEC library for compressing the media signal into the n uniquely compressed representations based upon at least one QoS standard stored in the QoS standards library.

43. The system of claim 42, further comprising:

a destination agent that is associated with the compression system and is adapted to be used by each of the n unique destination devices to communicate with the source, so that each of the n destination devices may receive a unique one of the n compressed representation of the media signal from the source system and to use an appropriate CODEC at least in part based upon a CODEC used by the compression system to create the respective compressed representation so that the respective destination device may appropriately decompress the respective compressed representation into an appropriate one of the decompressed representations of the media signal that may be stored or used by the respective destination device.

44. The system of claim 43, wherein the compression system is adapted to compress the media signal into each of the n different compressed representations based at least in part upon at least one of the following parameters: a previously learned behavior of at least one CODEC with respect to another reference signal, a previously learned behavior of at least one CODEC with respect to a prior attempt at compressing or decompressing the same media signal, a comparison of at least one CODEC's operation with respect to the media signal against a reference algorithm compression of the media signal, a learned constraint of at least one transmission channel, and a learned constraint of at least one destination device.

45. A system for communicating n uniquely compressed representations of a media signal from at least one source to a common receiver, comprising:

a destination device that is adapted to communicate with the at least one source and to receive each of the n uniquely compressed representations from the at least one source, wherein the destination device is further adapted to decompress each of the n uniquely compressed representations into n decompressed representations of the media signal and to play each of the n decompressed representations.

46. A system for communicating a media signal from a source to a destination device over a transmission channel, comprising:

a compression system that is adapted to receive information about a parameter of the transmission channel and to compress the media signal into a compressed representation of the media signal by using a compression technique that is based at least in part upon the parameter information.

47. A system for communicating n unique media signals between a source and a destination, comprising:

a compression system that is adapted to receive information about a parameter of the media signal and to compress the media signal into a compressed representation of the media signal by using a compression technique that is based at least in part upon the parameter information.

48. A system for compressing a media signal from a source for transmission to a destination device, comprising:

a compression system that is adapted to compress the media signal into a compressed representation of the media signal based upon at least one of a transmission channel constraint, a destination channel constraint, or a comparison of a parameter of the media signal against a prior compression operation of the compression system.

49. A system for decompressing a compressed media signal received from a source at a destination device, wherein the destination device is adapted to receive a compressed representation of the media signal from the source and also a decompression instruction from the source such that the destination device is adapted to decompress the compressed representation into a decompressed representation of the media signal based at least in part on the instruction.

50. A method for constructing a neural network for use in compressing media signals, comprising:

providing a plurality of CODECS; and

pre-learning at least one parameter associated with each CODEC's compression performance with respect to a predetermined type of media signal in a manner.....; and

remembering each pre-learned parameter in a manner such that at least a particular one of the CODECs may be chosen in the future to compress a particular new media signal based upon the pre-learned parameter of the particular CODEC.

51. The method of claim 50, further comprising:

forming a CODEC library with the plurality of CODECS;

compressing at least one predetermined type of a test media signal with each CODEC in the CODEC library;

automatically learning at least one parameter related to each CODEC's performance in compressing the at least one predetermined type of test media signal;

automatically remembering each such learned parameter in a manner such that a particular media signal to be compressed.

52. A system for communicating a media signal between a source and a destination at least in part over a wireless transmission channel, wherein a compressed representation is

a compression system that is adapted to compress the media signal into a compressed representation of the media signal that is further adapted to be transmitted to a wireless destination device over a wireless carrier; and

a neural network that uses artificial intelligence to optimize the compression of the media signal by the compression system by learning at least one of the following parameters: a constraint of the wireless destination device, a constraint of the wireless transmission carrier, and a comparison of a parameter of the media signal against a prior compression operation of the compression system.

53. A system for compressing a media signal for transmission from a wireless source to a destination device.

54. A system for compressing a media signal into a compressed representation of the media signal for transmission to a wireless destination device.

55. A system for decompressing a compressed representation of a media signal into a decompressed representation of the media signal at a destination device, wherein the compressed representation is received from a source over a wireless carrier at the destination device.

56. A system for communicating a media signal over an IP network between a source and a destination device, wherein a compressed representation of the media signal is transmitted from the source to the destination device over the IP network.

57. A system for compressing a media signal into a compressed representation of the media signal, such that the compressed representation of the media signal may be transmitted from a source to a destination device over an IP network.

58. A system for decompressing a compressed representation of a media signal into a decompressed representation of the media signal, wherein the compressed representation is received at a destination device from a source over an IP network.

59. A method for communicating a media signal over an IP network, comprising:

using artificial intelligence to determine the most appropriate CODEC from a plurality of available CODECS for compressing and decompressing the media signal, wherein the appropriate CODEC is determined based upon at least one of the following parameters: a previously learned behavior of the CODEC with respect to another reference signal, a previously learned behavior of the CODEC with respect to a prior attempt at compressing or decompressing the same media signal, a comparison of the CODEC's operation with respect to the media signal against a reference algorithm compression of the media signal, a learned constraint of the transmission channel, and a learned constraint of the destination device.

60. The method of Claim 59, wherein the system is adapted to communicate a streaming media signal over the IP network.

61. A system for communicating an audio signal between a source and a destination over a transmission channel, wherein the audio signal is compressed to form a compressed representation of the audio signal that may be transmitted over the transmission channel to the destination device

so that the destination device may decompress the compressed representation into a decompressed representation for storage or use by the destination device.

62. The system of Claim 62, wherein the system is adapted to communicate a streaming audio signal.

63. A system for compressing an audio signal into a compressed representation of the audio signal for transmission from a source to a destination device over a transmission channel.

64. A system for decompressing a compressed representation of an audio signal at a destination device for storage or use by the destination device, wherein the compressed representation is received by the destination device from a source over a transmission channel.

65. A method for communicating a streaming audio signal from a source to a destination device over a transmission channel, comprising:

delivering CD-quality music from the source to the destination device over the transmission channel at a transmission rate that is as low as about 25 Kbps.

66. The method of claim 65, wherein the CD-quality music is delivered by compressing a source audio signal into a compressed representation and delivering the compressed representation over the transmission channel to the destination device at the transmission rate, wherein the compressed representation may be decompressed by the destination device into a decompressed representation that is substantially CD-quality representation of the original audio signal that may be stored or played by the destination device.

67. A system for communicating a video signal between a source and a destination over a transmission channel, wherein the streaming video signal is compressed into a compressed representation that may be transmitted from the source to the destination device over the transmission channel and decompressed into a decompressed representation by the destination device for storage or playing by the destination device.

68. A system for communicating a streaming video signal between a source and a destination, comprising:

a media processing module;

a dynamic player module;

an image processor;

a baseline snapshot module;

a signal classifier;

a plurality of CODECS dependent neural networks processors;

a CODECS library;

a network layer input module;

a network layer output module; and

a timer.

69. The system of Claim 68, further comprising a dynamic client request processing module.

70. The system of Claim 69, further comprising a device and network parameters measurement module.

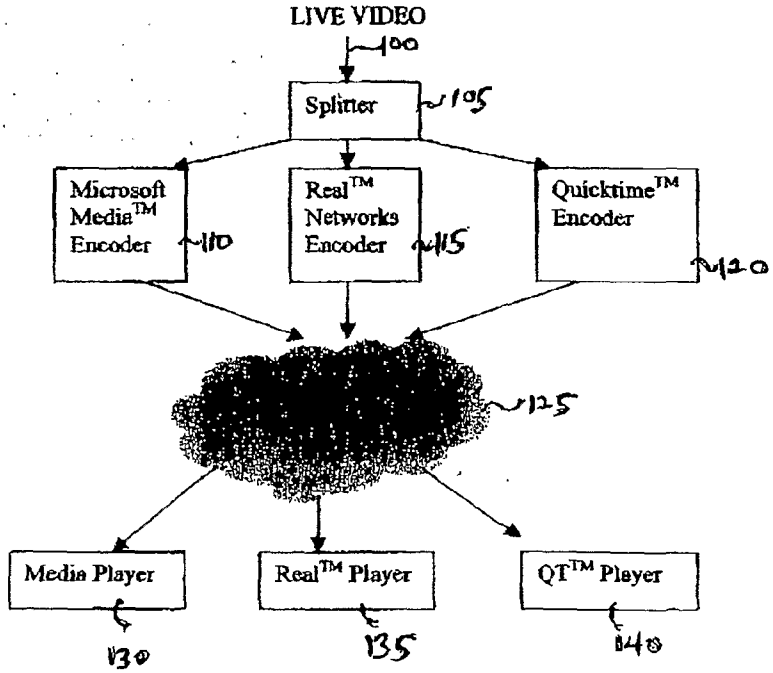


FIGURE 1A
(PRIOR ART)

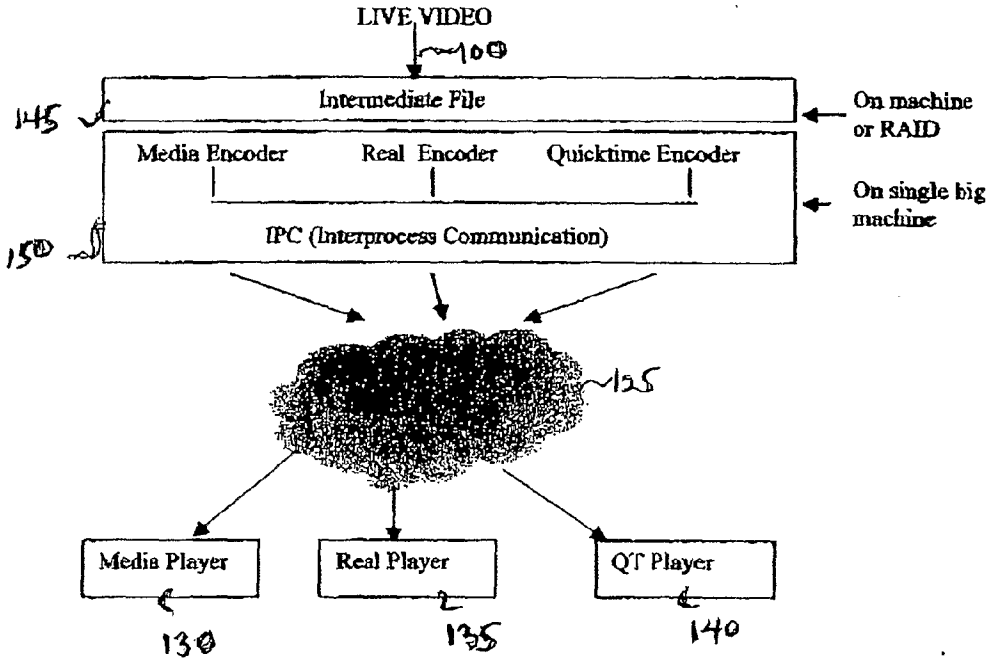


FIGURE 1B
(PRIOR ART)

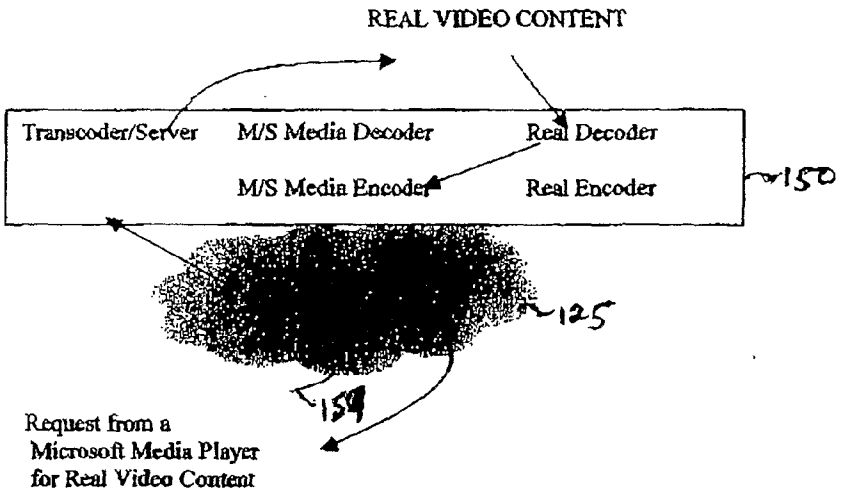


FIG. 1C
(PRIOR ART)

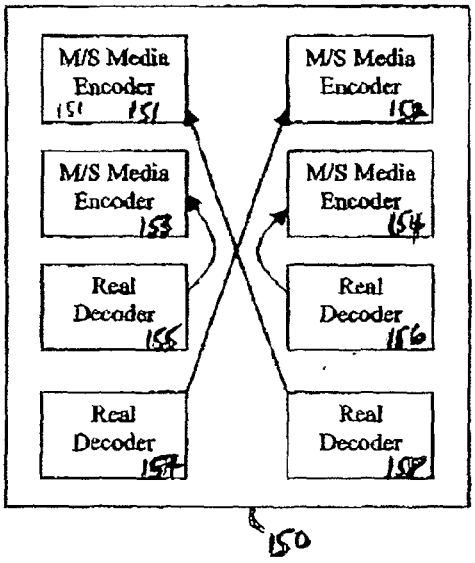


FIGURE 1D
(PRIOR ART)

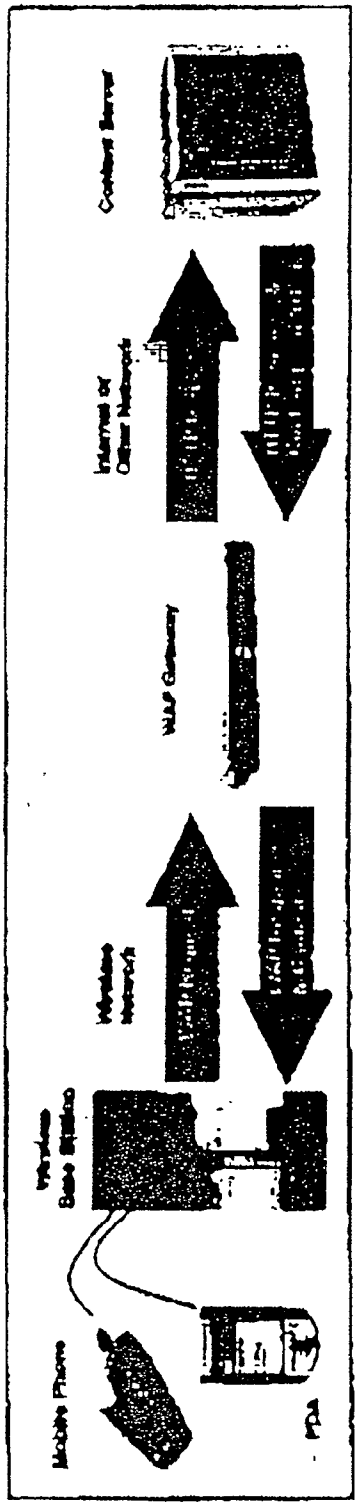


FIGURE 1E
(Prior Art)

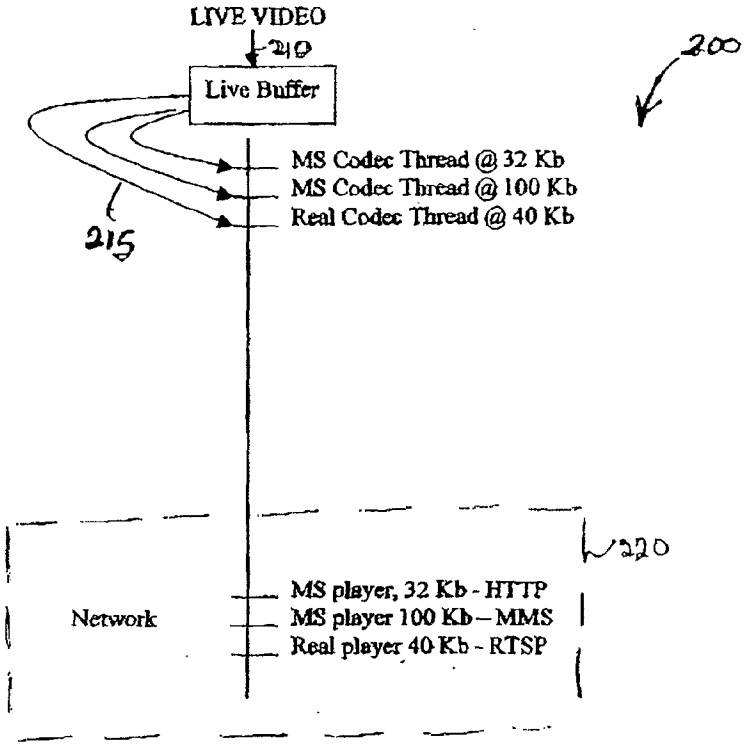

LIVE VIDEO
210
200
Live Buffer
MS Codec Thread @ 32 Kb
MS Codec Thread @ 100 Kb
Real Codec Thread @ 40 Kb
215
220
Network
MS player, 32 Kb - HTTP
MS player 100 Kb – MMS
Real player 40 Kb - RTSP

FIGURE 2

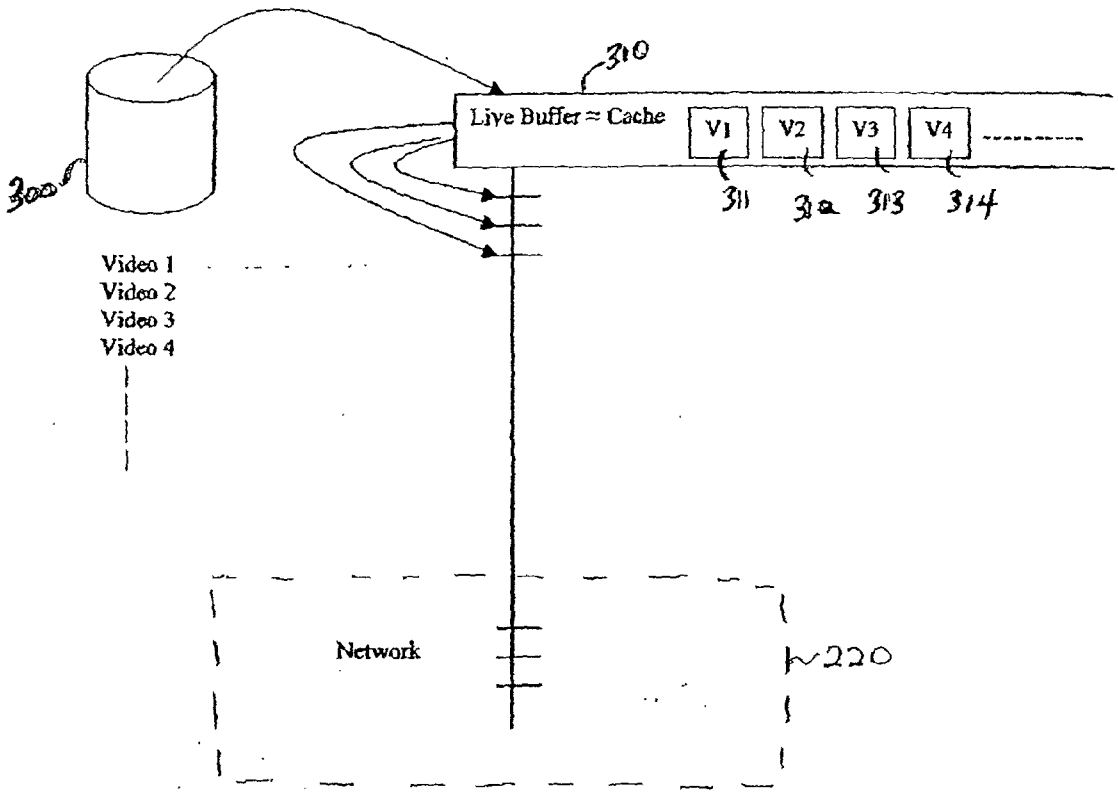

310
Live Buffer ≈ Cache
V1
V2
V3
V4
300
311
312
313
314
Video 1
Video 2
Video 3
Video 4
Network
220

FIGURE 3

FIGURE 4A

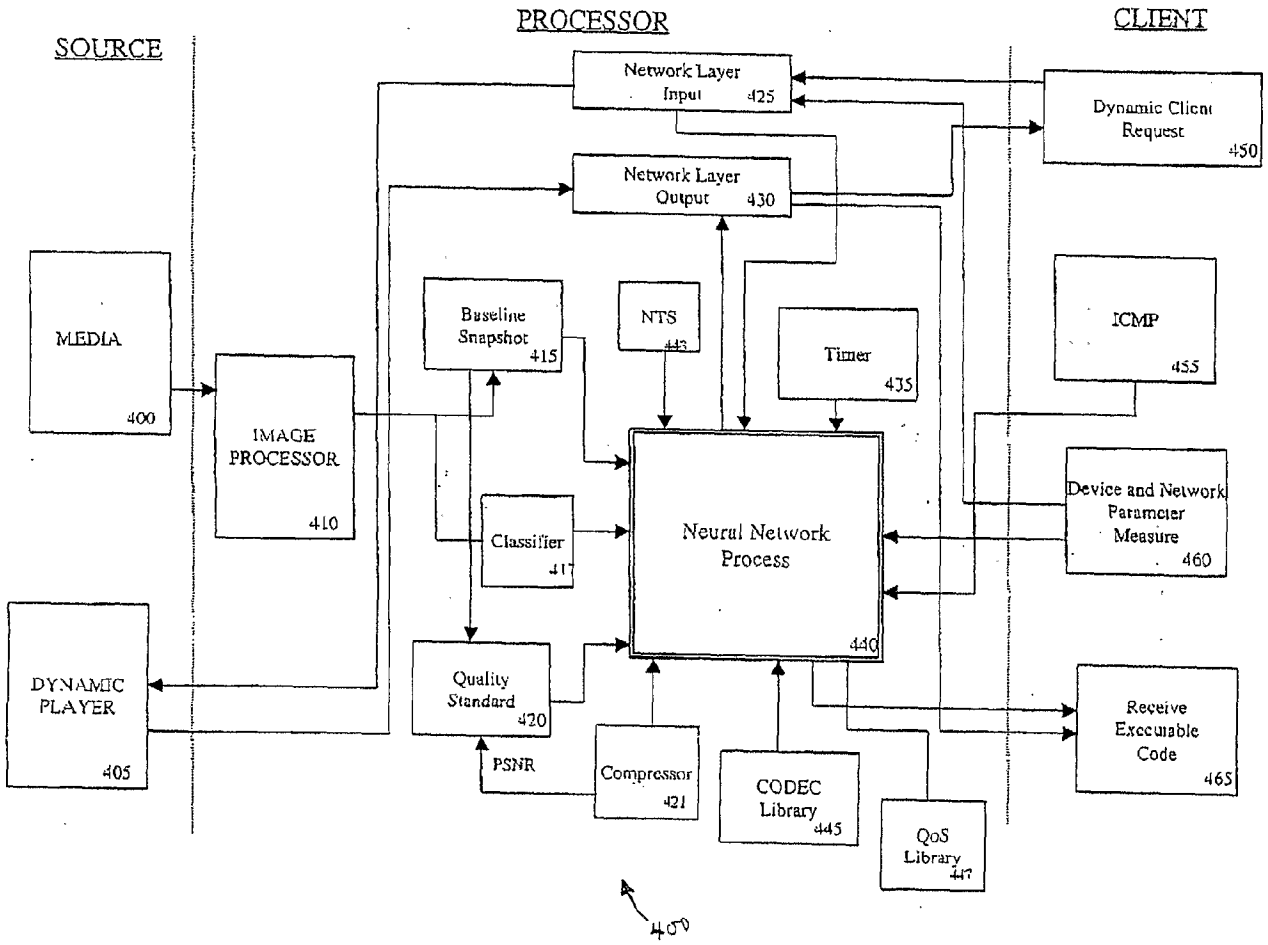

SOURCE
PROCESSOR
CLIENT
Network Layer Input 425
Dynamic Client Request 450
Network Layer Output 430
MEDIA 400
IMAGE PROCESSOR 410
Baseline Snapshot 415
NTS 443
Timer 435
ICMP 455
Classifier 417
Neural Network Process 440
Device and Network Parameter Measure 460
DYNAMIC PLAYER 405
Quality Standard 420
PSNR
Compressor 421
CODEC Library 445
QoS Library 447
Receive Executable Code 465
400

FIGURE 4B

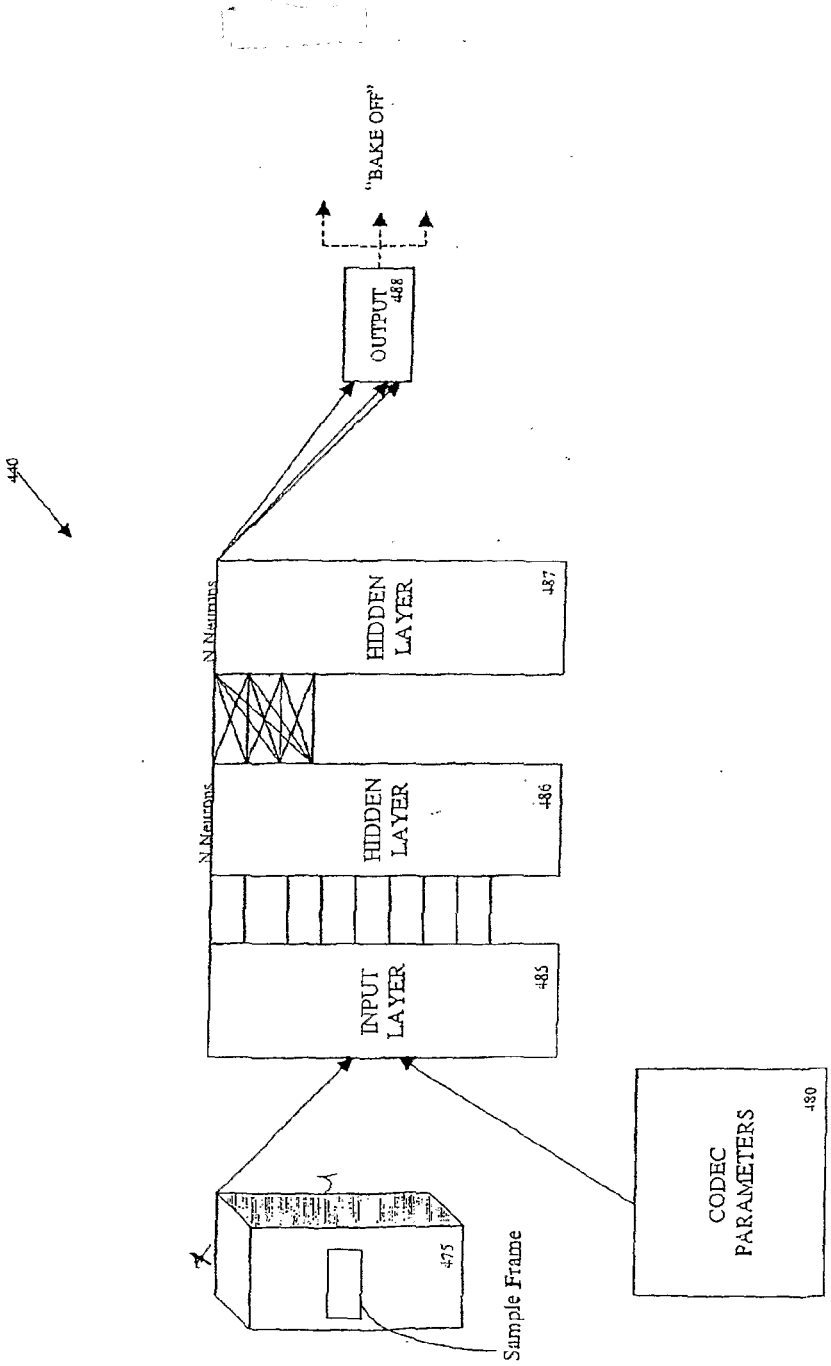
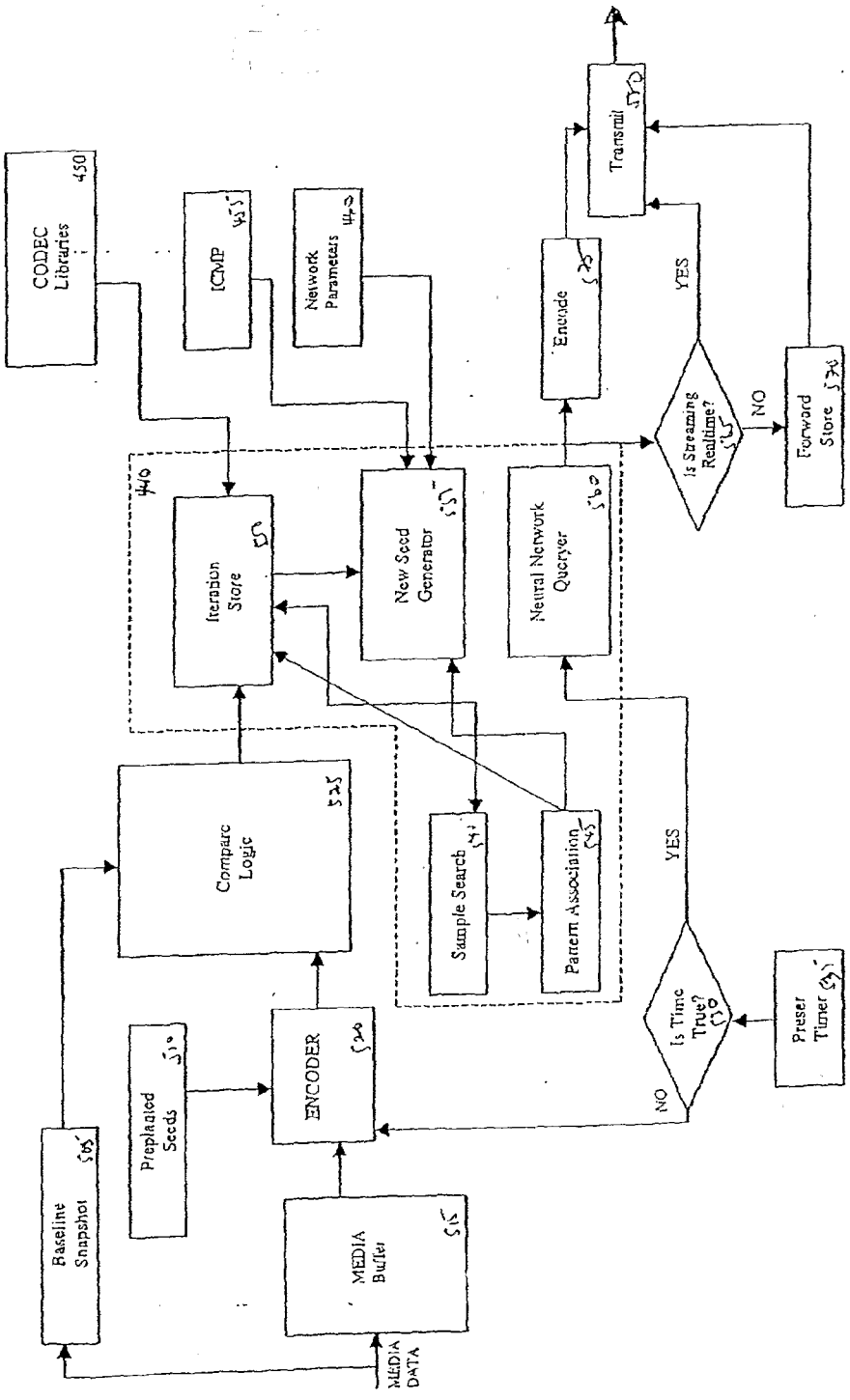

440
"BAKE OFF"
OUTPUT
488
HIDDEN LAYER
487
N Neurons
HIDDEN LAYER
486
N Neurons
INPUT LAYER
485
CODEC PARAMETERS
480
475
Sample Frame

FIGURE 5


CODEC Libraries
450
ICMP
Network Parameters
Transmit
Encode
YES
Is Streaming Realtime?
NO
Forward Store
Iteration Store
New Seed Generator
Neural Network Querver
Compare Logic
Sample Search
Pattern Association
YES
Is Time True?
Preset Timer
NO
Baseline Snapshot
Preplaied Seeds
ENCODER
MEDIA Buffer
MEDIA DATA

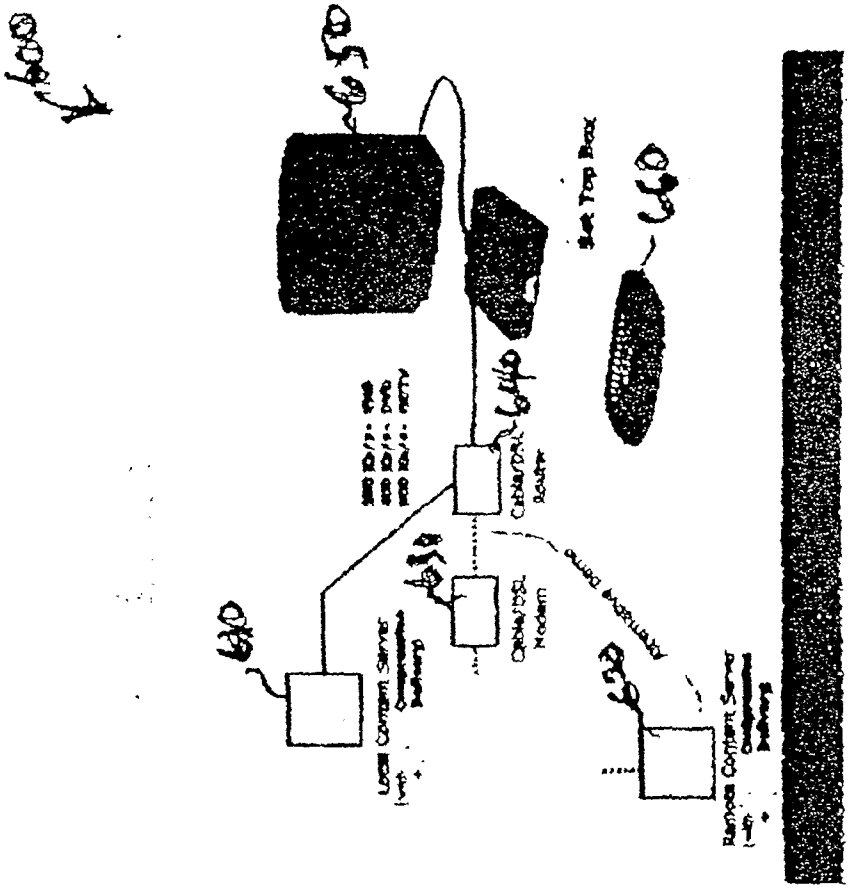

600
650
660
640
630
620
Set Top Box
Cable/DSL Modem
Cable/DSL Router
Local Content Server
Remote Content Server

FIGURE 6

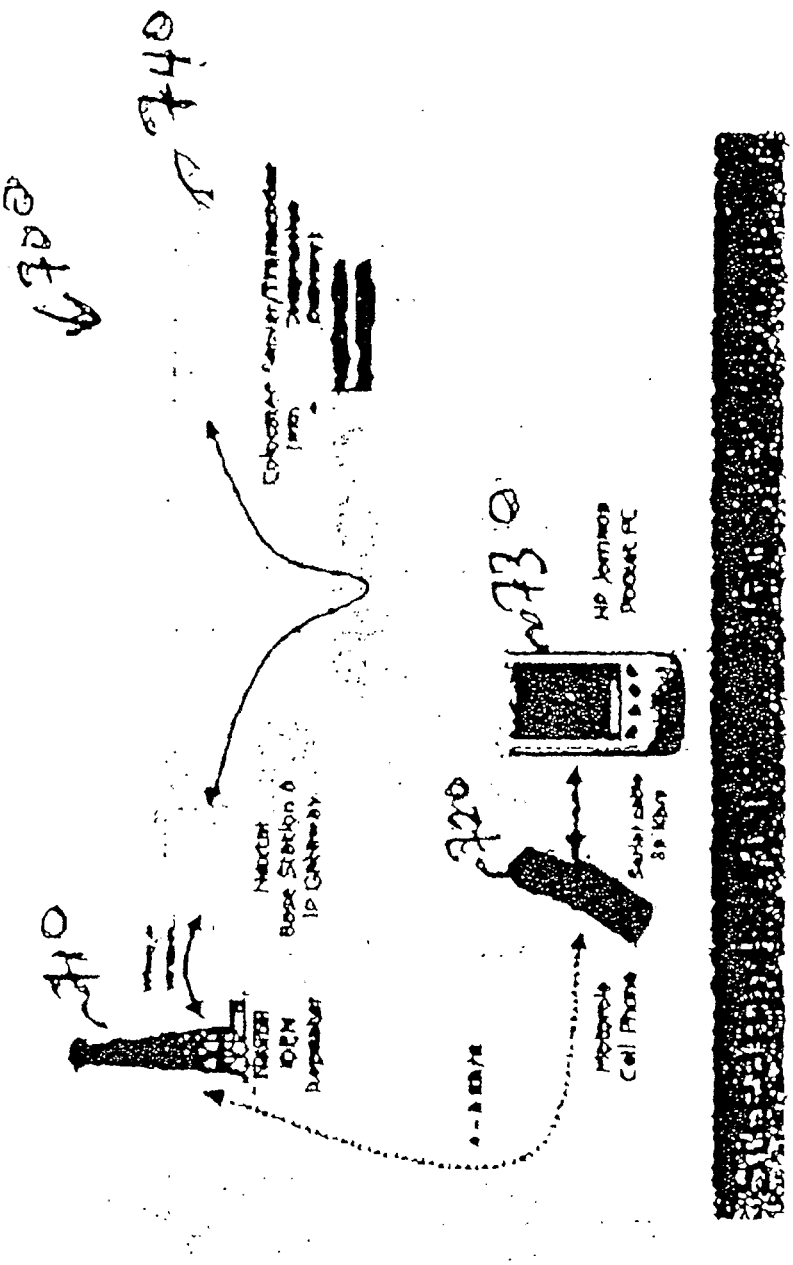


FIGURE 7

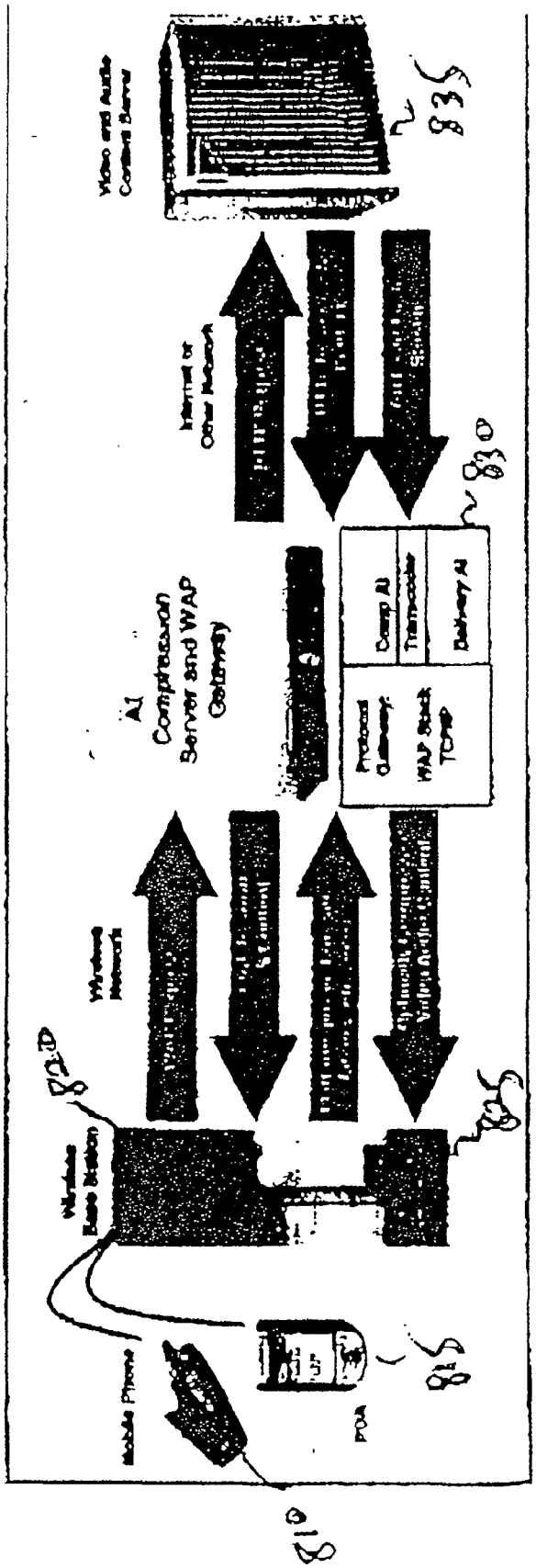
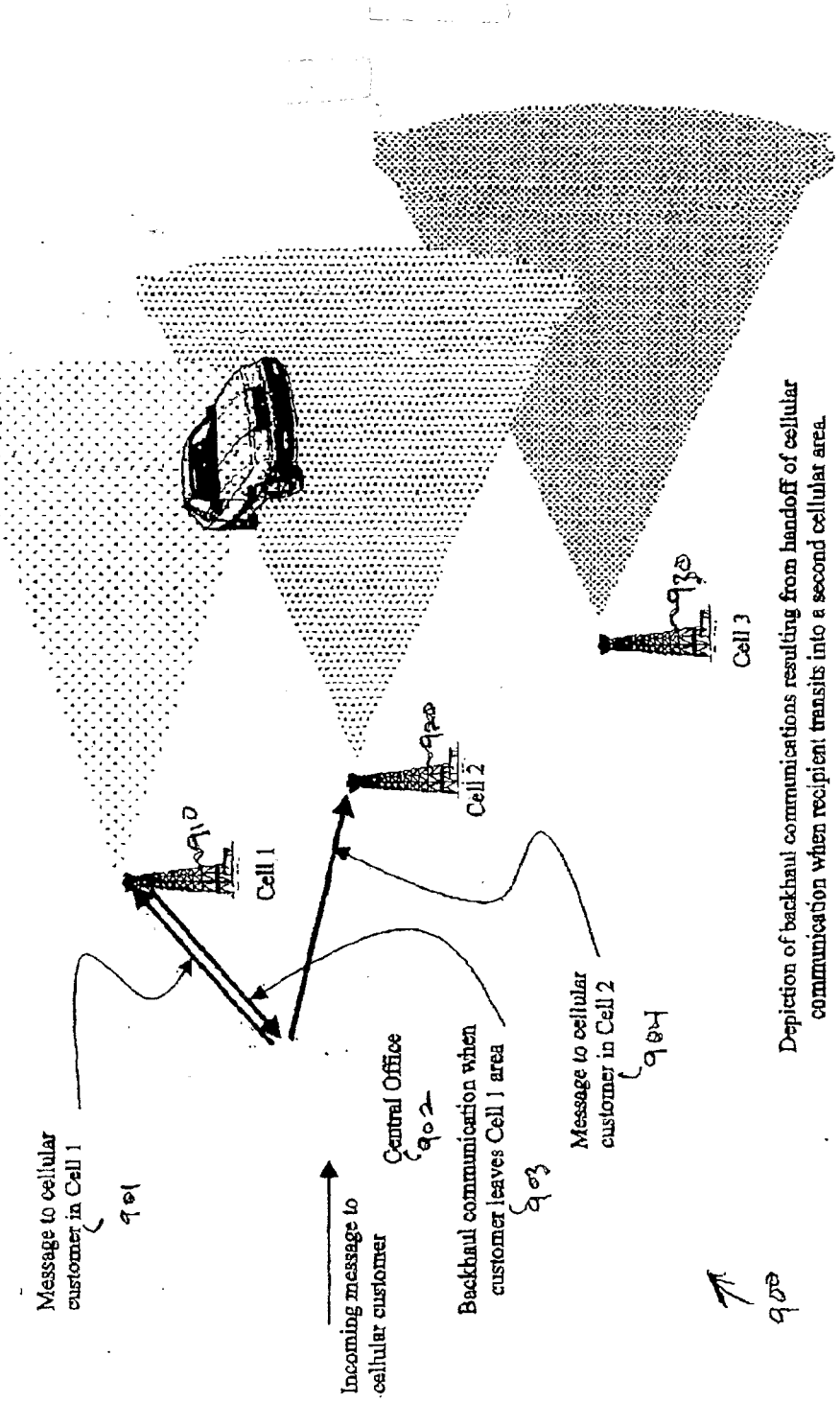
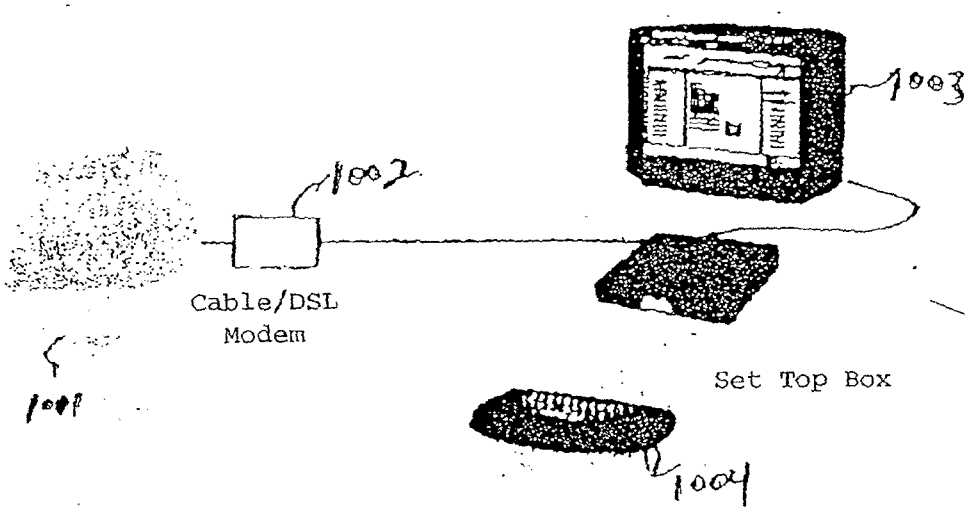

Video and Audio Content Server
835
Internet or Other Network
830
AI Compression Server and WAP Gateway
Protocol Gateway
WAP Stack TCMP
Decomp AI
Transcoder
Delivery AI
Wireless Network
820
Wireless Base Station
825
Mobile Phone
PDA
815
810
800

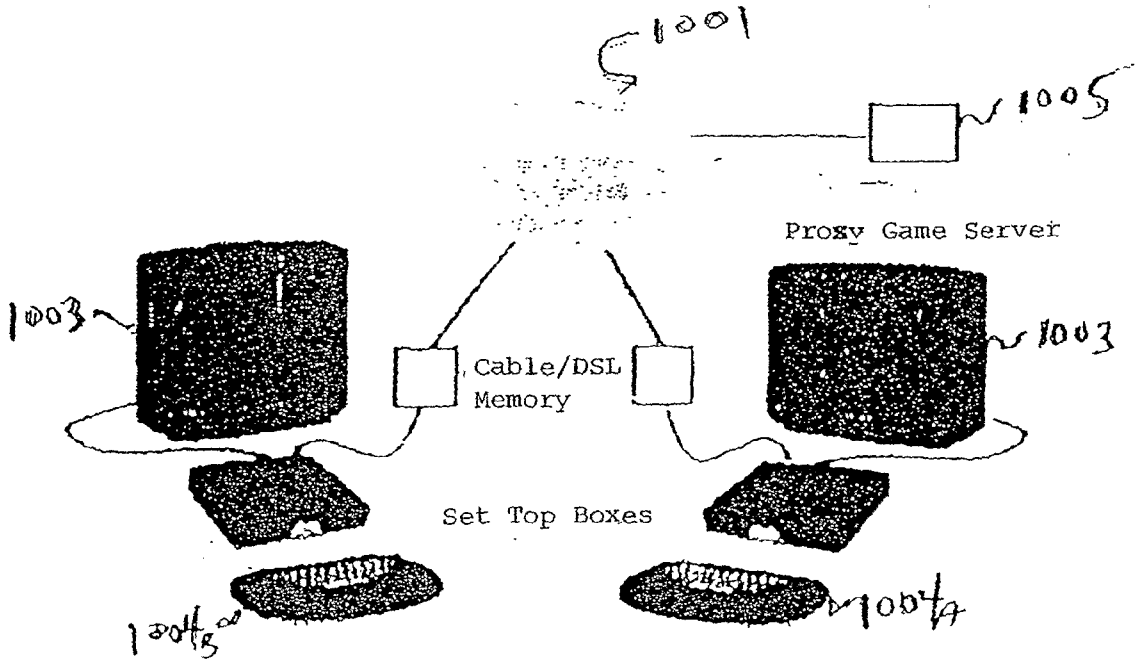
FIGURE 8

FIG. 9


Message to cellular customer in Cell 1
901
Cell 1
910
Cell 2
920
Cell 3
930
Incoming message to cellular customer
Central Office
902
Backhaul communication when customer leaves Cell 1 area
903
Message to cellular customer in Cell 2
904
Depiction of backhaul communications resulting from handoff of cellular communication when recipient transits into a second cellular area.
900



Browsing via the Set Top Box



Interactive Gaming

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US02/30874

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G06F 15/16
US CL : 709/231,232,217-219,250,220; 704/243

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. : 709/231,232,217-219; 345/335,327

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,195,692 B1 (HSU) 27 Febuary 2001, column 5 lines 4-19,	1-69
Y	US 6,243,676 B1 (WITTEMAN) 5 June 2001, column 7 line 55-col 8 line 56,	1-69
Y	US 6,115,755 A (KRISHAN) 5 September 2000, column 3 lines 19-45, column 4 lines 54-67	1-69
Y	US 6,085,236 A (LEA) 4 July 2000, column 18 lines 9-20, col 26 line 59-column 27 line 4,	1-69

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 December 2002 (10.12.2002)	15 JAN 2003
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703)305-3230	Authorized officer Mark Powell Telephone No. 703-305-9703

Form PCT/ISA/210 (second sheet) (July 1998)

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Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4760442		Jul. 10, 1995	O'Connell	
	2	4761684		Nov. 14, 1986	Clark	
	3	4816905		Apr. 30, 1987	Tweedy	
	4	4862264		Dec. 23, 1986	Wells	
	5	4931950		Jun. 4, 1990	Isle	
	6	4949169		Oct. 27, 1989	Lumelsky	
	7	4949248		Jul. 15, 1988	Caro	

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	8	4963995		Dec. 27, 1988	Lang	
	9	5014125		May. 5, 1989	Pocock	
	10	5019900		Nov. 14, 1986	Clark	
	11	5025457		Apr. 21, 1989	Ahmed	
	12	5043885		Aug. 8, 1989	Robinson	
	13	5050161		Dec. 4, 1989	Golestani	
	14	5057932		Dec. 27, 1988	Lang	
	15	5088107		Oct. 27, 1989	Piasecki	
	16	5089885		Nov. 14, 1986	Clark	
	17	5109281		Feb. 6, 1991	Kobori	
	18	5119474		Jun. 16, 1989	Beitel	
	19	5130792		Feb. 1, 1990	Tindell	
	20	5132964		Mar. 17, 1988	Esaki	

	21	5132992		Jan. 7, 1991	Yurt	
	22	5164839		Dec. 27, 1988	Lang	
	23	5168353		Dec. 21, 1990	Walker	
	24	5172413		Dec. 20, 1990	Bradley	
	25	5208665		Aug. 20, 1987	McCalley	
	26	5208810		Oct. 10, 1990	Park	
	27	5214768		Nov. 1, 1989	Martin	
	28	5231599		Dec. 1, 1988	Peters	
	29	5245430		Feb. 8, 1990	Nishimura	
	30	5247347		Sep. 27, 1991	Litteral	
	31	5253275		Jan. 7, 1991	Yurt et al	
	32	5262875		Apr. 30, 1992	Mincer	
	33	5274758		Jun. 16, 1989	Beitel	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

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	35	5313454		Apr. 1, 1992	Bustini	
	36	5325525		Apr. 4, 1991	Shan	
	37	5341477		Feb. 24, 1989	Pitkin	
	38	5359593		Aug. 26, 1993	Derby	
	39	5361096		Feb. 27, 1991	Ohki	
	40	5408448		Oct. 8, 1993	Carman	
	41	5408465		Jun. 21, 1993	Gusella	
	42	5410326		Dec. 4, 1992	Goldstein	
	43	5414644		Nov. 24, 1993	Seaman	
	44	5422674		Dec. 22, 1993	Hooper	
	45	5428782		Sep. 28, 1989	White	
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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	47	5440334		Feb. 1, 1993	Walters	
	48	5442389		Dec. 28, 1992	Blahut	
	49	5455910		Jan. 6, 1993	Johnson	
	50	5463422		Oct. 13, 1993	Simpson	
	51	5467413		May. 20, 1993	Barrett	
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(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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(71) Applicant *(for all designated States except US)*: **NOKIA CORPORATION** [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **CURCIO, Igor, D.D.** [IT/FI]; Hatanpään valtatie 12 C 57, FIN-33100 Tampere (FI). **LUNDAN, Miikka** [FI/FI]; Männikönkatu 4 A 7, FIN-33820 Tampere (FI).

(74) Agent: **FORSSÉN & SALOMAA OY**; Eerikinkatu 2, FIN-00100 Helsinki (FI).

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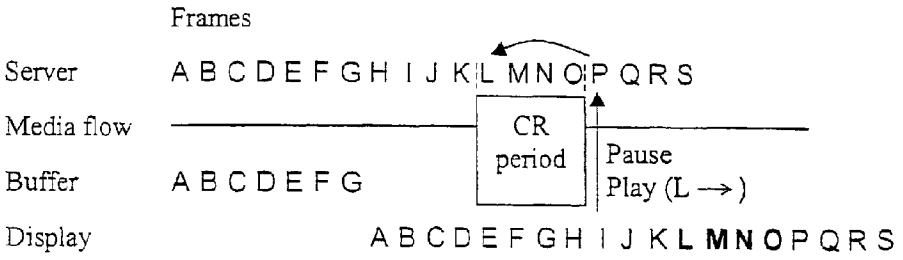

(57) Abstract: The invention relates to a method for streaming of media from a streaming server (111) to a mobile client device (101) over an air-interface, wherein, after a cell reselection, the method comprises requesting the streaming server (111) to resend streaming media which the mobile client device (101) was not able to receive due to the cell reselection.

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STREAMING MEDIA

FIELD OF THE INVENTION

The invention relates to streaming of media from a streaming server to a mobile client device over an air-interface.

BACKGROUND OF THE INVENTION

A packet switched streaming service PSS is currently being standardized for mobile environment by 3GPP (3rd Generation Partnership Project). An example of a communications system capable of streaming media (streaming video and/or audio) is shown in Figure 1. The system comprises a streaming server 111 which is coupled to an IP-network (Internet Protocol) 104. The IP-network 104 may be, for example, the Internet or a service provider operator's intranet (an intranet network belonging to the operator's domain). The IP-network 104 is coupled to a core network 103 of a mobile communications network via a G_i interface. The mobile communications network also has a radio access network (RAN) 102 coupled to the core network 103. The radio access network 102 provides mobile communications devices 101 with access to the mobile communications network over an air-interface. Said access may be provided either by circuit switched means (circuit switched voice or data call) or packet switched means or both. In the following, GPRS (General Packet Radio Service) is used as an example of a packet switched means to communicate over the air-interface. Concerning GPRS, the generic term radio access network (RAN) is considered to comprise base (transceiver) stations (BS) and base station controllers (BSC).

In streaming media a sequence of 'moving images' (i.e. video) or sound (i.e. audio) or a sequence of 'moving images' together with sound (i.e. multimedia) is sent in a compressed form from the streaming server 111 to a mobile communications device 101 (hereinafter referred to as a client device 101). In contrast to the

technique in which an entire media file has to be arrived at the client before it can be played, the streaming technique enables sending of media (video and/or audio) from the streaming server 111 to the client device 101 in a continuous manner and playing of the media as it arrives at the client.

When media is streamed in cellular mobile communications systems such as the system presented in Figure 1, new problems specific to the mobile environment arise. These problems are mostly due to the different restrictions of mobile systems. One such problem arises in a cell reselection (i.e. handover) situation presented in Figure 2.

In Figure 2, a first base station BS1 of the radio access network 102 serves the area of a first cell 201 whereas a second base station BS2 of the radio access network 102 serves the area of a second cell 202. Before cell reselection, the client device 101 is served by the first base station BS1, i.e. the client device 101 has an active radio link with the first base station BS1. This situation is shown on the left side of the Figure 2. After the cell reselection, the client device 101 is served by the second base station BS2. The radio link with the first base station BS1, shown by a dotted line, is dropped. This situation is shown on the right side of the Figure 2.

The cell reselection (CR) can be divided in three periods in time:

a) Pre-CR period
b) CR period
c) Post-CR period.

During the pre-CR period, received signal quality in the first cell weakens and the client device 101 starts cell reselection signaling. The client device 101 is able to receive streaming media via the first base station BS1 during that period. During the CR period, the actual cell reselection is performed. The client device 101 can

not receive streaming media during that period. During the post-CR period, the client device 101 is able to receive streaming media via the second base station BS2.

The cell reselection may cause a long break in service. For example, a cell reselection (CR period) in a case where GPRS is used as radio bearer may take up to 30-40 seconds. This will affect an ongoing streaming session. For example, part of the packets carrying streaming media may be lost and/or freezing of the played media may occur at the client device 101. If the streaming media comprises a video stream, the freezing means that a still image will appear and stay for a period of time on a client device display before the streaming media is again received and can be played again. If the streaming media comprises an audio stream, the freezing means that no sound is played back (i.e. silence) until the CR period is over.

Accordingly, there is a need to find appropriate means for reducing the effects of cell reselection on an ongoing streaming session.

SUMMARY OF THE INVENTION

According to a first aspect of the invention, there is provided a method for streaming of media from a streaming server to a mobile client device over an air-interface, wherein the method comprises:
requesting the streaming server to send streaming media which the mobile client device is not able to receive due to a cell reselection.

A request requesting the streaming server to send the streaming media may be sent from the mobile client device to the streaming server before or after the mentioned cell reselection.

The mentioned request is not limited to requesting to send only the media which

the mobile client device is (or was) not able to receive due to the cell reselection (during a cell reselection period). In an embodiment, the request may be construed such that what is actually requested is: resending of a portion of a media content not received as well as sending any remaining portion of the media content.

The term media is considered to mean either video or audio or another media, such as still image, or any combination thereof, i.e multimedia.

Preferably, a resending request is sent in response to the cell reselection. The re-sending request is preferably an application layer request sent between a mobile client device application and a streaming server application.

In a preferred embodiment, the streaming server is requested to send at an increased speed for a determined period of time in order to increase at the client device a degree of fullness of a temporary store, such as a buffer, in which the streaming media is temporarily stored before playback. Preferably, this is done by by requesting the streaming server to switch from sending a higher bit rate media stream to sending a lower bit rate media stream at an increased speed. The higher and lower bit rate streams are preferably provided by a multi-rate codec.

According to a second aspect of the invention, there is provided a mobile client device for receiving streaming media from a streaming server over an air-interface, the mobile client device comprising:
means for requesting the streaming server to send streaming media which the mobile client device is not able to receive due to a cell reselection.

Preferably, the air-interface couples said mobile client device to a mobile communications network. The mobile client device preferably comprises a cellular mobile phone.

According to a third aspect of the invention, there is provided a streaming server

for sending streaming media to a mobile client device over an air-interface, the streaming server comprising:
means for receiving a request requesting the streaming server to send streaming media which the mobile client device is not able to receive due to a cell reselection; and
means for acting upon the received request.

According to a fourth aspect of the invention, there is provided a system comprising a streaming server and a mobile client device, for streaming of media from the streaming server to the mobile client device over an air-interface, the system comprising, at the mobile client device:
means for requesting the streaming server to send streaming media which the mobile client device is not able to receive due to a cell reselection, the system further comprising, at the streaming server:
means for receiving the request; and
means for acting upon the received request.

According to a fifth aspect of the invention, there is provided a computer program executable in a mobile client device, the computer program comprising:
program code for causing the mobile client device to request the streaming server to send streaming media which the mobile client device is not able to receive due to a cell reselection.

According to a sixth aspect of the invention, there is provided a computer program executable in a streaming server, the computer program comprising:
program code for causing the streaming server to receive a request requesting the streaming server to send streaming media which the mobile client device is not able to receive due to a cell reselection; and
program code for acting upon the received request.

Dependent claims contain preferable embodiments of the invention. The subject

matter contained in dependent claims relating to a particular aspect of the invention is also applicable to other aspects of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 shows a communications system capable of streaming media;

Figure 2 shows a cell reselection situation in the communications system of Figure 1;

Figure 3 shows a client device buffer in a situation in which the client device buffer is shorter than the time that cell reselection takes;

Figure 4 shows a client device buffer in a situation in which the client device buffer is longer than the time that cell reselection takes;

Figure 5 shows another illustration of the situation which is behind Figure 4;

Figure 6 shows preferred action in a preferred embodiment of the invention;

Figure 7 illustrates a preferred embodiment of the invention;

Figure 8 illustrates a preferred embodiment of the invention;

Figure 9 shows a client device according to a preferred embodiment of the invention;

Figure 10 shows a streaming server according to a preferred embodiment of the

invention; and

Figure 11 illustrates three ways of sending messages according to preferred embodiments of the invention.

DETAILED DESCRIPTION

The system shown in Figure 1 can also be used in the preferred embodiments of the invention (the same applies to Figure 2). Accordingly, the system comprises a streaming server 111 which is coupled to an IP-network 104. The IP-network 104 may be, for example, the Internet or a service provider operator's intranet. The IP-network 104 is coupled to a core network 103 of a mobile communications network via a G_i interface. The mobile communications network also has a radio access network (RAN) 102 coupled to the core network 103. The radio access network 102 provides mobile communications devices 101 with access to the mobile communications network over an air-interface. Said access may be provided either by circuit switched means (circuit switched voice or data call) or packet switched means or both. In the following, GPRS (General Packet Radio Service) is used as an example of a packet switched means to communicate over the air-interface.

In order to better understand the preferred embodiments of the invention, let us consider the following example.

In this example, a mobile communications device 101 (again referred to as a client device 101) has established a streaming session with the streaming server 111 when being served by the first base station BS1. In this example and in the following description, mostly a video streaming session is considered. However, a corresponding consideration applies to an audio streaming session as well as to a multimedia (e.g. video with audio) streaming session.

RTSP (Real Time Streaming Protocol) protocol is used in the streaming session

setup. Once the session has been established, the streaming itself may be performed (i.e. media flow may be sent) according to RTP (Real time Transport Protocol) or another protocol. However, if it is desired to make a change in the established session, this will again be done by using RTSP.

At the beginning of the established streaming session, the received streaming media (media flow), transmitted in packets (or frames), is buffered (i.e. temporarily stored) in a buffer at the client device (hereinafter referred to as a client device buffer). When the client device buffer is full, playing (playback) of the streaming media is started at one end of the buffer while the buffer is continuously filled at the other end with received streaming media. Therefore, the buffer should remain nearly full during normal operation of the system.

The client device now undergoes a cell reselection from the first cell 201 to the second cell 202 (Fig. 2). It is to be noted that, although the radio access network (RAN) 102 is illustrated in Figure 2 by a single cloud only, it may comprise different radio access networks. It may comprise a GPRS (GPRS-only) RAN, a 3G (third generation) RAN or a combination thereof. The first cell 201 (served by the base station BS1) and the second cell 202 (served by the base station BS2) may therefore be, for example, cells of the GPRS RAN or 3G RAN. Accordingly, the cell reselection (handover) can occur, for example, between base stations belonging to GPRS RAN, between base stations belonging to 3G RAN or between a base station belonging to GPRS RAN and a base station belonging to 3G RAN.

The client device 101 can not receive streaming media during the CR period. Therefore, when the CR period begins the client device buffer starts emptying because the buffer content is further played while the continuous filling is stopped. Depending on the size of the client device buffer, two different cases can be identified:

i) The client device buffer (in time) is shorter than the time that cell reselection

takes, i.e. the time to empty a full client device buffer is shorter than the CR period,

ii) The client device buffer (in time) is longer than the time that cell reselection takes, i.e. the time to empty a full client device buffer is longer than the CR period.

In the first case (Figure 3), the buffer will become totally empty during the CR period. Since the buffer becomes empty, the client device 101 has no media to play anymore. Therefore, the client device 101 starts rebuffering. Rebuffering can be started during the post-CR period. In order to get the rebuffering started the client device 101 can use an RTSP PAUSE/PLAY method. In this method, the client device 101 first sends an RTSP PAUSE message to the streaming server 111. The PAUSE message will cause the server 111 to pause sending of the media flow. Subsequently, the client device 101 sends an RTSP PLAY message which requests the streaming server 111 to start resending the streaming media from the last received frame onwards. Rebuffering starts when the client again starts receiving the streaming media. When the client device buffer is full, playing of the streaming media is restarted from the last received frame onwards. In the meantime, the last received frame is shown as a still image on a client device display. However, in spite of the drawback of showing a still image, no packets are effectively lost since the media flow which is not received at the client device during the CR period is resent from the server 111 to the client device 101 after the CR period.

In the second case (Figure 4), the whole content of the buffer has not been played during the CR period. Therefore, the buffer only becomes partially empty during the CR period, i.e. there is still streaming media (DATA) in the buffer when the CR period ends. During the post-CR period (after the CR period) playing of the streaming media stored in the buffer before the CR period (i.e. DATA*) is further continued at one end of the buffer while the other end is filled with the streaming

media received after the CR period (i.e. DATA**). If nothing is done, DATA* will eventually end and playing is continued with the first frame of data DATA**. No still image is shown. However, the first frame of DATA** is not the frame that should be played right after the last frame of DATA*. Since the client device 101 could not receive streaming media during the CR period it has not even received the frame that should be showed after the last frame of DATA*. There exists a temporal gap in the buffered media. As a result, the client device 101 will skip showing the sequence of streaming media (video) which could not be received due to the cell reselection Concerning an audio stream, the same effect occurs, i.e. the client device 101 will skip playing sound which could not be received.

The second case is further illustrated with the aid of Figure 5. It is to be noted that Figure 5 only shows a very simplified case. The time is considered to flow from left to right in Figure 5. The streaming media sequence that the server sends comprises video frames A-S. The frames are received at the client device and buffered before playing. The playing of the media starting from frame A starts when the buffer is full (i.e. when the frames A-G have been stored in the buffer), the frames (moving video picture) are subsequently shown on a client device display. The buffering of the frames following frame G is not shown in Figure 5 for clarity reasons.

The media flow from the server to the client device is not possible during the CR period. Therefore, the client device does not receive the frames L-O. Otherwise, the media flow is perfectly received at the client device. Now that the the CR period is shorter than the buffer size, the showing of the frame (frame K) last received before the CR period will be followed by the showing of the frame (frame P) first received after the CR period. Video frames L-O are not shown at all. Concerning an audio stream, the same effect occurs, i.e. the user hears a pause and a temporal gap in the sound.

There exists two type of frames: intra frames and inter frames. The intra frames

contain all necessary information of an image whereas inter-frames only contain changes or predicted changes compared to a previous image. The previous image may be an intra frame or an inter frame. Therefore, if the frame P is an intra frame the shown picture only warps ahead in time from frame K to frame P. In this case the frames L-O are not simply shown to the user. But if the frame P is an inter frame severe distortion in the shown (moving) picture is likely to occur before the next intra frame is received and played.

A preferred embodiment of the invention as shown in Figure 6 concentrates on the above mentioned problem relating to the second case. In this embodiment, the buffer is longer than the duration of the CR period. Therefore, the buffer does not become totally empty during the CR period but only partially empty. It is to be noted that Figure 6 only shows a very simplified case. The time is considered to flow from left to right in Figure 6. The streaming media sequence that the server sends comprises frames A-S. The frames are received at the client device and buffered before playing. The playing of the media starting from frame A starts when the buffer is full, the frames (moving video picture) are subsequently shown on a client device display. The buffering of the frames following frame G is not shown in Figure 6 for clarity reasons. The media flow from the server to the client device is not possible during the CR period. Therefore, the client device does not receive the frames L-O. Otherwise, the media flow is perfectly received at the client device.

When the CR period is over the client device knows exactly what is the last frame that it has received before the CR period (i.e. during the pre-CR period). In this embodiment it is frame K. The client device then requests, right after the CR period has been ended, the streaming server to start resending the streaming media from the last received frame onwards. Upon receiving the request the streaming server starts resending the media flow. The first frame to be sent is in this embodiment frame L. Any frames sent and received after the CR period but before the resending has started (possibly some frames starting from frame P) are

ignored by the client device. When the streaming media (of frames A-K) stored in the buffer before the CR period ends, then the playing is continued with the first frame (frame L) of the resent streaming media received after the CR period. Therefore, no discontinuity in the shown video picture should appear to the user. In Figure 6, the resent video frames L-O which would have otherwise failed to have been received at the client device are shown in bold font. Correspondingly, concerning an audio stream, the streaming server is requested to start resending the audio stream at a point at which reception has been stopped in the client device. No discontinuity in playback should appear.

In practice, the resending request can be performed by the RTSP PAUSE/PLAY method. In this method, the client device first sends, after the CR period has been ended, an RTSP PAUSE message to the streaming server. The PAUSE message will cause the server to pause sending of the media flow. However, the playing of the streaming media received at the client device is not paused unless the buffer gets empty (which should not be the case). Subsequently, the client device sends an RTSP PLAY message to the streaming server 111. The PLAY message contains information on the starting point of the resending. At the end of the CR period the client device knows the time of the last received frame. Based on that, the client device determines the starting point before sending the PLAY message. The PLAY message causes the server to start resending.

An example of the PAUSE message is as follows:

```
PAUSE rtsp://example.com/foo RTSP/1.0
CSeq: 6
Session: 354832
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The PAUSE message informs the server that a change is coming. An example of the subsequently sent PLAY message is as follows:

PLAY rtsp://example.com/foo RTSP/1.0
CSeq: 7
Session: 354832
Range: npt=28.00-

The message field 'Range' tells the starting point of resending. In this example, the starting point is 28 seconds from the start of the streaming media sequence. In relation to the embodiment shown in Figure 6, this point would be exactly the time of frame L in the streaming media sequence.

In the embodiment just described, the frames (packets) that were lost during the CR period will be resent from the server to the client devide. Also, since the buffer size is longer than the duration of the CR period, no interruption in the shown video picture should appear and the user experience is maximized.

However, as the case is such that during normal streaming the degree of fullness of the buffer does not change, since the buffer is emptied (played) at the same rate as it is filled, this may cause an additional problem. In the embodiment just described, after the cell reselection, the client device buffer stays emptier than before, for the reasons as described in the foregoing. Therefore if, for example, a new cell reselection is to be performed in a near future, the emptier buffer may cause the same drawback as discussed in connection with the first case above (i.e. the case in which the client device buffer was shorter than the time that cell reselection takes).

A preferred embodiment of the invention concentrates on the above identified problem. In this embodiment, to ensure smooth behaviour of the shown video picture (correspondingly: played sound), the client device buffer is filled after the CR period, for a period of time, at a higher rate than it is emptied (played). This period may be called a filling period. When the filling period is over the buffer is full again and normal streaming in which the buffer is filled at the same rate as

emptied is resumed.

It is to be noted that normally raising the degree of fullness of the buffer would require the playing to be paused. In the present embodiment, playing is not paused but the degree of fullness of the buffer can still be raised due to the clever buffer management in which the buffer is filled, during playing, at a rate higher than the playing rate.

To raise the degree of fullness of the buffer without pausing the playback, the client device, in this embodiment, requests the server to switch to sending a lower bit rate streaming media sequence, but to use in the actual sending the same transmission bit rate (hereinafter referred to as an original transmission bit rate) as before. In order to reach the original transmission bit rate the client device requests the server to speed up the transmission of the lower bit rate sequence by a speeding factor. Speeding up the transmission bit rate causes more data to be written in the buffer than read out from the buffer. Therefore, the degree of fullness of the buffer increases as desired.

In other words, the server is asked to switch from sending the original sequence encoded at a first bit rate to sending a new corresponding sequence encoded at a second bit rate lower than the first bit rate and to increase the transmission bit rate of the new sequence in order to reach the original transmission bit rate (bandwidth). It is to be noted that the bit rate at which a media stream is encoded (and will be decoded) is a different concept than the transmission bit rate. The bit rate at which the media stream has been encoded has an effect on the picture quality. If the media stream has been encoded at a higher bit rate, this means that more bits have been used in encoding compared to encoding at a lower bit rate. This typically results in a better picture quality. The transmission bit rate, on the other hand, is the bit rate at which the media stream is actually sent and it depends on the available bandwidth.

The request to switch to sending a lower bit rate sequence and to speed up the transmission bit rate can be delivered by using the RTSP PAUSE/PLAY method. When the client device desires to fill the client device buffer during the post-CR period, it first sends a PAUSE message, corresponding to the one presented already in the preceding description, to the server to indicate that a change is coming. Subsequently it generates a PLAY message and sends it to the server.

An example of such a PLAY message is as follows:

PLAY rtsp://example.com/foo RTSP/1.0
CSeq: 7
Session: 354832
Range: npt=28.00-40.00
Bandwidth: 20000
Speed: 1.5

This message contains two optional message fields, namely 'Bandwidth' and 'Speed' to be understood at the client device and streaming server. These fields are already specified as optional fields by the IETF (Internet Engineering Task Force) in the standard RFC 2326 (Real Time Streaming Protocol).

The message field 'Bandwidth' tells the server to change into sending a lower bit rate sequence (here: a sequence whose bit rate is 20 kbps) and the message field 'Speed' tells the server to speed up the sending by a speeding factor (here: 1.5). The message field 'Range' tells the starting point and stopping point in the streaming media sequence in time units (calculated from the beginning of the streaming media sequence(s)).

The PLAY message shown would suit for an example in which the server initially sends a 30 kbps bit rate sequence at an original transmission bit rate of 30 kbps and in which the server, in order to fill the buffer, is desired to switch into sending

a sequence whose bit rate is 20 kbps and to speed up the sending at a speeding factor 1.5 to reach the original transmission bit rate of 30 kbps during a 12 seconds filling period (i.e. between the time instants of 28 and 40 seconds of the media sequence).

If the client knows the possible bit rate options (they are typically communicated from the server to the client during session setup, for example, with the aid of a 200 OK response to an RTSP DESCRIBE message) it can calculate the speeding factor needed to reach the original bitrate using the following formula:

$$speeding\ factor = \frac{original\ transmission\ bit\ rate}{new\ transmission\ bit\ rate}$$

When the buffer is full, the client device sends another RTSP PAUSE and PLAY message pair to the server. An example of the PLAY message is as follows:

PLAY rtsp://example.com/foo RTSP/1.0
CSeq: 67
Session: 354832
Range: npt=40.00-
Bandwidth: 30000
Speed: 1.0

This exemplary message requests the server to start sending the (original) 30 kbps bit rate media sequence (Bandwidth: 30000) at the original transmission bit rate 30 kbps (Speed: 1.0) starting from the time instant 40 seconds of the media sequence (Range: npt=40.00-).

The client device can calculate the length of the buffer filling period using the following formulas:

$$filling\ period = \frac{LowSeqTime}{speeding\ factor}$$

wherein

$$LowSeqTime = (BufferSize - BufferData) \cdot \frac{original\ transmission\ bit\ rate}{original\ transmission\ bit\ rate - new\ transmission\ bit\ rate}$$

In these formulas, *LowSeqTime* indicates the duration of the lower bit rate sequence playing time in the client device, *BufferSize* indicates the size of the buffer in seconds and *BufferData* indicates the data left in the buffer in seconds.

The filling of the buffer is illustrated in Figure 7. It is to be noted that Figure 7 only shows a very simplified case. All delays, for example, have been ignored. The time is considered to flow from left to right in Figure 7. It can be seen that the buffer starts emptying when the CR period starts. Upon receiving the first PLAY message the server switches to sending a media sequence having a lower bit rate (here: 20 kbps) and speeds up the sending by a speeding factor (here again: 1.5). Since the speeding factor is 1.5, the buffer filling takes twice the time that the emptying period lasted. For example, if the emptying period lasted for 25 seconds, the filling period should be 50 seconds with this speeding factor. When the buffer is full the second PLAY message is sent and the server switches to sending the original media sequence having a higher bit rate (here: 30 kbps) and continues sending at the original transmission bit rate.

In the foregoing, it has been described that, for example, a video stream typically comprises both intra and inter frames, wherein the intra frames are 'independent frames' containing all necessary information of an image whereas inter-frames only contain changes or predicted changes compared to a previous image. In the following preferred embodiment of the invention, the timing of the switch from the lower bit rate sequence to the original bit rate sequence is more closely de-

scribed with this respect.

In this embodiment the purpose is to time, whenever possible, the switch from the lower bit rate sequence to the original bit rate sequence to take place at the point of an intra frame of the original bit rate sequence (or, more generally, at the point of an intra frame of the sequence to which the sending is switched). In this way, prediction errors and/or jumps in media (frame) flow can be avoided. Figure 8 illustrates this embodiment. It is to be noted that Figure 8 only shows a simplified case. The time is considered to flow from left to right in Figure 8. In this embodiment, the first switch from the original bit rate sequence to the lower bit rate sequence is effected at point 28 seconds with the aid of a first PAUSE/PLAY message pair.

As illustrated in Figure 8, the position of intra frames in the original bit rate sequence may differ from the ones of the lower bit rate sequence. However, based on:

- the time required to totally fill the buffer, i.e. '*filling period*',
- the time distance of two adjacent intra frames in the original sequence, i.e. an intra frame rate, '$IFrameTime_{Original}$', and
- the time at which the first switch from the original bit rate sequence to the lower bit rate sequence is effected, i.e. '*SwitchTime*',

it can be calculated a suitable point in time for swiching back to the original bit rate sequence. The parameter '$IFrameTime_{Original}$' can be calculated in the client device from the original bit rate sequence before switching to the lower bit rate sequence. The calculation of the suitable point in time for swiching back to the original bit rate sequence can be performed using the following formula:

$$SeqChangeTime = IFrameTime_{Original} * \left\lfloor \frac{SwitchTime + filling\ period}{IFrameTime_{Original}} \right\rfloor$$

In this formula, '*SeqChangeTime*' indicates the point in time for swiching back to the original bit rate sequence and the brackets indicate a *floor*-function (or *trunc*-function) which truncates the fractional part of the value computed in the brackets. For example, if the time required to totally fill the buffer, i.e. '*filling period*' is 16 seconds, the time at which the first switch is effected, i.e. '*SwitchTime*' is 28 seconds and the time difference between two adjacent intra frames in the original sequence, i.e. '$IFrameTime_{Original}$' is 5 seconds, then the point in time for swiching back to the original bit rate sequence is 40 seconds (*SeqChangeTime*=5*floor((28+16)/5) = 40 s). Accordingly, the second PAUSE/PLAY message pair is sent at point 40 seconds, as indicated in Figure 8. In this embodiment, the starting point and stopping point to be placed in the message field 'Range' of the PLAY message are 28 seconds and 40 seconds, respectively.

It is to be noted that, due to the intra frame rate, it might not in all cases be possible to totally fill the buffer. For example, in the example just described, it would have taken 4 seconds more to totally fill the buffer. However, the formula gives the closest suitable intra frame to the buffer filling period.

In another embodiment, it may well be that, at the point of the last received frame before the CR period, there is not an intra frame in the lower bit rate media sequence. In this embodiment, the starting point of the resending request is adjusted by a necessary amount of frames (or time) backwards such that there will be an intra frame in the lower bit rate sequence at the starting point. In this case, a set of last received frames before the CR period, which belong to a time period subsequent to the starting point, are ignored at the client device in order to guarantee a continuous playback.

In another embodiment of the invention, the switches between two different bit rate sequences are performed without the timing method(s) just described. In this embodiment, the first switching point (from higher to lower bit rate sequence) is directly determined by the last received frame and the second switching point (from lower to higher bit rate sequence) is directly determined by the the time required to totally fill the buffer (*'filling period'*). The switching points can therefore end up being at the point of an intra or inter frame. Should a switching point end up being at the point of an inter frame (for example a P-frame), a small prediction error may occur in the played media, however, in this embodiment, the buffer can be totally filled.

Another way to perform switching is to use so called "switch frames". These are frames which contain "difference" information between corresponding frames in different bit rate sequences. In this embodiment, a bridge and switch between the two sequences is performed with the aid of these frames using the difference information.

Figure 9 shows a client device 101 according to a preferred embodiment of the invention. The client device may be a mobile station of a cellular radio telephone network. The client device 101 comprises a processing unit MCU, a radio frequency part RF, and a user interface UI. The radio frequency part RF and the user interface UI are coupled to the processing unit MCU. The user interface UI typically comprises a display, one or more speaker and a keyboard (not shown) with the aid of which a user can use the device 101.

The processing unit MCU comprises a processor (not shown), a memory 210 and computer software. The software has been stored in the memory 210. The aforementioned client device buffer 240 is also comprised in the memory 210. The processor controls, in accordance with the software, the operation of the client device 101, such as receiving of the streaming media sent from the server 111 and sending of requests to the server 111 via the radio frequency part RF, reading and

writing of received streaming media (video and/or audio) in the buffer 240, and presenting of the received streaming video on the display and audio on the one or more speaker of the user interface UI. A suitable size of the buffer (in time) can be, for example, 1.5 or 2 times the maximum (or average) CR period time.

The software comprises a streaming client software application 220 (hereinafter referred to as client software 220), a protocol stack 230 for implementing the necessary protocol layers such as an RTP layer, an RTSP layer, an SDP (Session Description Protocol) layer, a TCP layer (Transmission Control Protocol), an IP layer and, below the IP-layer, lower protocol layers. In addition, the software comprises as a part of the client software 220 a media player for playing the received media.

The processor generates, based on the client software 220 the aforementioned PAUSE and PLAY messages and sends them to the server 111 via the radio frequency part RF. The processor also performs, based on the client software 220, the necessary calculations relating to the speeding factor, relating to the buffer filling period and relating to the suitable point in time for swiching from a lower bit rate sequence back to the original bit rate sequence.

The generation and sending of the resending request (PLAY message) and other appropriate action is triggered by a cell reselection event occurred in the mobile client device 101. The event can be detected by the client software 220 by reception of an asynchronous message from an API (Application Programming Interface) provided by the lower layers of the protocol stack 230. Alternatively or in addition, the event can be detected by monitoring the buffer level, i.e. the degree of fullness of the client device buffer 240. In this case, if the buffer 240 does not receive data for a certain amount X of time (depending on the implementation, the parameter X can be defined as a constant value, and it is a threshold for the client software 220 to understand that the cell reselection event has occurred), and if the client device 101 afterwards starts to receive data after a certain variable amount

Y of time (wherein Y > X, and Y is the real duration of the CR period), then the client can trigger the action described in this description.

Figure 10 shows a streaming server 111 according to a preferred embodiment of the invention. The streaming server 111 comprises a processing unit CPU, a first memory 310, an IP network interface 350, and a second memory 360. The first memory 310, the IP network interface 350, and the second memory 360 are coupled to the processing unit CPU.

The processing unit CPU controls, in accordance with computer software stored in the first memory 310, the operation of the streaming server 111, such as processing of requests received from the client device 101 and the sending of pre-recorded media streams, stored in the second memory (disk) 360, to the client device 101 via the IP network interface 350.

The software comprises a streaming server software application 320 (hereinafter referred to as server software 320), a protocol stack 330 for implementing the necessary protocol layers such as an RTP layer, an RTSP layer, an SDP layer, a TCP layer, an IP layer and lower protocol layers.

The PAUSE and PLAY messages sent from the client device 101 are received via the IP network interface 350. A processor (not shown) of the processing unit CPU processes the messages according to the server software 320 and the protocol stack 330 and takes appropriate action.

The present invention provides means for reducing the effects of cell reselection on an ongoing streaming session. It is to be noted that, according to preferable embodiments of the invention, a request for resending (e.g. a PLAY message) is sent on the application layer, i.e. between the client software application 220 and the server software application 320. Preferably RTSP over TCP (Transmission Control Protocol) or RTSP over another reliable protocol is used in transferring

application layer requests from the client device to the streaming server. The reception of the messages at the streaming server can therefore basically be guaranteed.

Although it has been described that the cell reselection would be performed between two base stations, it should be noted that a cell reselection can be performed also between two sectors of one and the same base station. Also, it should be noted that depending on the implemention, it may well be that separate messages (PAUSE messages) pausing the sending of streaming media are not needed. In an alternative embodiment, both to stop sending streaming media and to start resending streaming media is caused by a single appropriate message.

Further, in relation to the buffer filling embodiment, it has been described in the foregoing that when the server switches to sending a lower bit rate sequence, the original transmission bit rate would be maintained. However, in an alternative embodiment of the invention, a transmission bit rate higher than the original transmission bit rate is used during the filling period in order to fill the buffer more quickly. In this embodiment, it is assumed that a larger bandwidth can be requested by the mobile client device and that a larger bandwidth is actually available in the radio access network.

Further, in relation to the buffer filling embodiment, the bandwidth information of the sequence can be sent to the streaming server 111 also by other means than the RTSP field 'Bandwidth' (for example, by requesting a specific sequence encoded at a bitrate known to the client device 101). In this case, the field 'Bandwidth' is not used, the fields 'Speed' and 'Range' are recalculated according to the actual known sequence bit rate.

It is possible that the network (air-interface) bandwidth changes during the buffer filling period. If the client device 101 supports bandwidth adaptation that involves bit stream switching, the client device 101 should pause the buffer filling (with an

RTSP PAUSE message) before sending a bandwidth adaptation message to the streaming server 111. After the bandwidth adaptation operations are over, the client device can start the buffer filling again and recalculate the 'Bandwidth', 'Speed' and 'Range' values according to the bit rate and timing information of the new media stream.

Also, in relation to the buffer filling embodiment, it should be noted that, in an alternative embodiment, the second PAUSE/PLAY messages are not sent at all but the switch back to sending the original media sequence at the original transmission bit rate will be performed automatically by the server based on the stopping point information contained in the first PLAY message.

The resending request mentioned in the various embodiments of the invention may, in certain cases, actually be a sending request. One such case is considered as an alternative embodiment of the invention. In this embodiment, the client device (101) knowing beforehand that a cell reselection is going to occur in a very near future sends a PAUSE message to the streaming server (111) before the beginning of the cell reselection period (i.e. during the pre-CR period). Sending of the PAUSE message is triggered by a cell reselection initiation event notified to the client software 220 by means of the lower layer API. The PAUSE message causes the streaming server 111 to stop sending the streaming media. When the CR-period is over, the client device 101 then sends a PLAY message causing the streaming server to start sending at the point at which sending was stopped before the CR period. Playing of the streaming media is not stopped at the client device 101 in between, and if the client device buffer 240 has been selected to be longer in time than the time that cell reselection takes, the buffer 240 does not become totally empty during cell reselection and the user does not experience any jumps or interruption in playback. The PLAY message may contain a request to send at an increased speed in order to increase the degree of fullness of the buffer 240.

In yet another embodiment, the mobile client device 101 sends, before the

CR period, to the streaming server 111 an appropriate message requesting the streaming server 111 to stop sending the streaming media and to start sending again at a suitable point in time after the CR period. Sending of the message is triggered, during the pre-CR period, by a cell reselection initiation event notified to the client software 220 by means of the lower layer API. The mobile client device 101, knowing approximately the time that the cell reselection is going to take, estimates a suitable point in time at which it is again able to receive data. It inserts this information to the message so as to prevent the streaming server 111 from starting to send again too early.

An example of the above mentioned message is as follows:

PLAY rtsp://example.com/foo RTSP/1.0
CSeq: 7
Session: 354832
Range: npt=28.00-40.00; **time=19970123T153600Z**
Bandwidth: 20000
Speed: 1.5

This is an RTSP PLAY message having a header field 'Time'. The value of that field schedules the start of the "future" sending of the streaming media.

Figure 11 illustrates (especially relating to the buffer filling embodiments) the following three ways in which messages may be sent:

Case 1: The first PAUSE and PLAY messages are sent after the CR period. The second PAUSE and PLAY messages are sent when the buffer 240 is full.

Case 2: The first PAUSE message is sent before the CR period. The associated PLAY message is sent after the CR period. The second PAUSE and PLAY messages are sent when the buffer 240 is full.

Case 3: The first PAUSE message is sent before the CR period. The associated PLAY message is sent after the PAUSE message but before the CR period. The second PAUSE and PLAY messages are sent when the buffer 240 is full.

The sending of the second PAUSE message is not necessary, if the first PLAY message contains a closed 'Range' field.

Particular implementations and embodiments of the invention have been described. It is clear to a person skilled in the art that the invention is not restricted to details of the embodiments presented above (e.g. message names and message field names), but that it can be implemented in other embodiments using equivalent means without deviating from the characteristics of the invention. The scope of the invention is only restricted by the attached patent claims.

CLAIMS:

1. A method for streaming of media from a streaming server (111) to a mobile client device (101) over an air-interface, wherein the method comprises:

   requesting the streaming server (111) to send streaming media which the mobile client device (101) is not able to receive due to a cell reselection.

2. A method according to claim 1, wherein the streaming server is provided with a starting point at which to start sending.

3. A method according to claim 1, wherein streaming server (111) sends the streaming media which the mobile client device (101) is not able to receive due to said cell reselection as well as a remaining portion of streaming media in response to the request.

4. A method according to claim 1, wherein the cell reselection comprises a cell reselection period during which the mobile client device (101) is not able to receive streaming media, the method comprising:

   sending from the mobile client device (101) to the streaming server (111), after the cell reselection period, a resending request which requests the streaming server (111) to resend streaming media which the mobile client device (101) was not able to receive during the cell reselection period.

5. A method according to claim 4, wherein the resending request is generated according to RTSP protocol (Real Time Streaming Protocol).

6. A method according to claim 4, wherein the resending request is implemented by an RTSP PAUSE/PLAY message pair.

7. A method according to claim 1, wherein the streaming media is temporarily stored in a temporary store (240), such as a buffer, at the client device (101)

before playing.

8. A method according to claim 7, wherein the temporary store (240) has a size longer in time than a cell reselection period.

9. A method according to claim 7, wherein the streaming server is requested to send streaming media at a rate higher than the playing rate of that media so as to increase a degree of fullness of the temporary store (240).

10. A method according to claim 9, wherein a bandwidth or desired transmission bit rate with speeding factor is communicated to the streaming server (111) in a request.

11. A method according to claim 9, wherein the streaming media is stored at the mobile client device (101) at a rate higher than the playing rate.

12. A method according to claim 9, wherein the streaming server (111) is subsequently requested to resume an original configuration.

13. A method according to claim 7, wherein a degree of fullness of the temporary store (240) decreases during the cell reselection, and the streaming server is requested to send the not received streaming media although the temporary store (240) has not become totally empty, and said requesting is performed without pausing playback at the mobile client device (101).

14. A method according to claim 1, wherein the streaming server has a set of media streams available for transmission in which the same media content has been encoded at different bit rates.

15. A method according to claim 14, wherein information on the available set of media streams is beforehand communicated to the mobile client device (101)

in a streaming session setup.

16. A method according to claim 15, wherein the streaming server (111) is requested to switch from sending a higher bit rate media stream to sending a lower bit rate media stream at an increased speed.

17. A method according to any preceding claim, wherein the streaming media comprise one of the following: a video stream, an audio stream, another stream of single media, a multimedia stream.

18. A method according to any preceding claim, wherein the streaming server (111) sends streaming media to the mobile client device (101) via a mobile communications network.

19. A method according to any preceding claim, wherein the mobile communications network comprises a mobile packet radio network, such as a GPRS (General Packet Radio Service) network.

20. A method according to any preceding claim, wherein said cell reselection is performed between two base stations (BS1, BS2) which are selected from a group comprising: base stations belonging to a GPRS system, base stations belonging to a third generation mobile communications system.

21. A mobile client device (101) for receiving streaming media from a streaming server (111) over an air-interface, the mobile client device (101) comprising:

means (220, 230, MCU) for requesting the streaming server (111) to send streaming media which the mobile client device (101) is not able to receive due to a cell reselection.

22. A streaming server (111) for sending streaming media to a mobile client device (101) over an air-interface, the streaming server (111) comprising:

means (350) for receiving a request requesting the streaming server (111) to send streaming media which the mobile client device (101) is not able to receive due to a cell reselection; and

means (320, 330, CPU) for acting upon the received request.

23. A system comprising a streaming server (111) and a mobile client device (101), for streaming of media from the streaming server (111) to the mobile client device (101) over an air-interface, the system comprising, at the mobile client device (101):

means (220, 230, MCU) for requesting the streaming server (111) to send streaming media which the mobile client device (101) is not able to receive due to a cell reselection, the system further comprising, at the streaming server (111):

means (350) for receiving the request; and

means (320, 330, CPU) for acting upon the received request.

24. A computer program executable in a mobile client device (101), the computer program comprising:

program code for causing the mobile client device (101) to request the streaming server (111) to send streaming media which the mobile client device (101) is not able to receive due to a cell reselection.

25. A computer program executable in a streaming server (111), the computer program comprising:

program code for causing the streaming server (111) to receive a request requesting the streaming server (111) to send streaming media which the mobile client device (101) is not able to receive due to a cell reselection; and

program code for acting upon the received request.

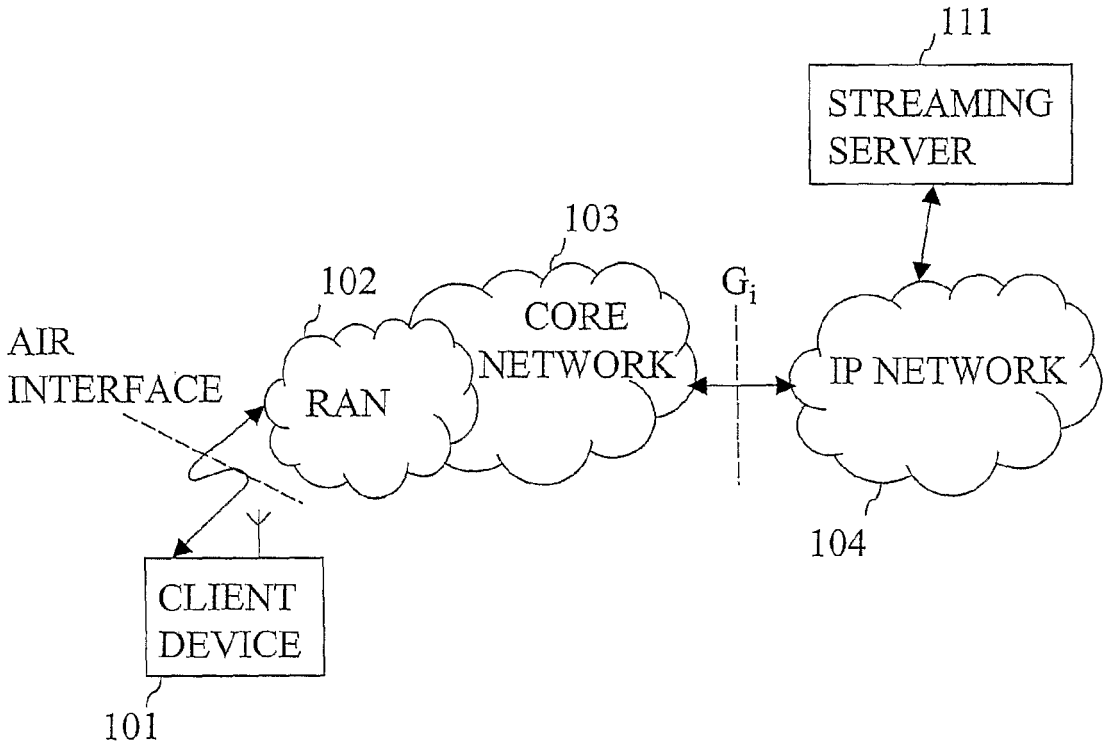
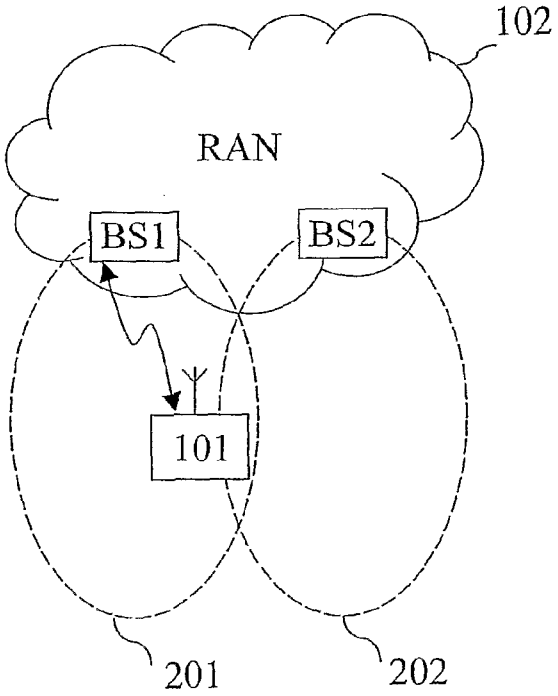

111
STREAMING SERVER
103
102
CORE NETWORK
G_i
AIR INTERFACE
RAN
IP NETWORK
104
CLIENT DEVICE
101

FIG. 1

BEFORE CELL RESELECTION:



AFTER CELL RESELECTION:

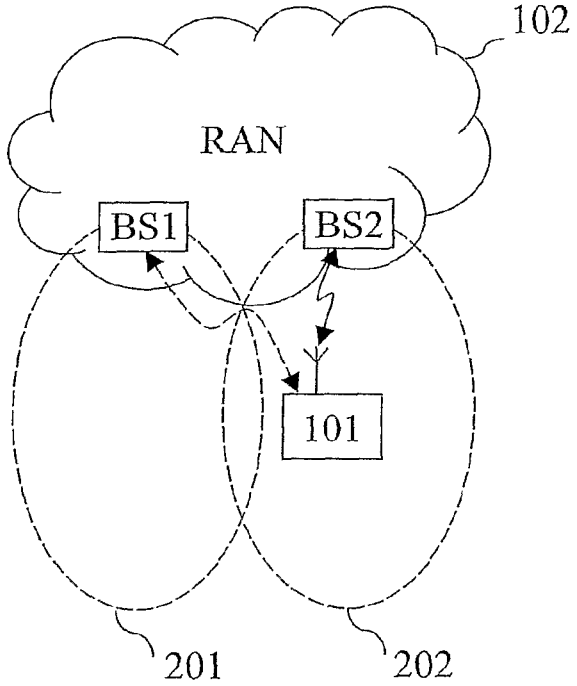


FIG. 2

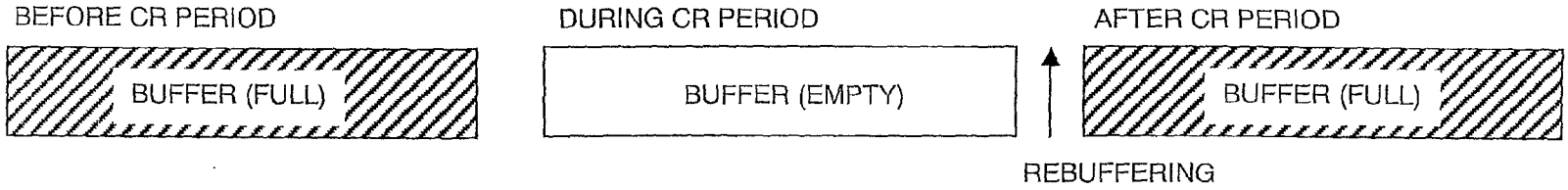

BEFORE CR PERIOD
BUFFER (FULL)
DURING CR PERIOD
BUFFER (EMPTY)
AFTER CR PERIOD
BUFFER (FULL)
REBUFFERING

FIG. 3

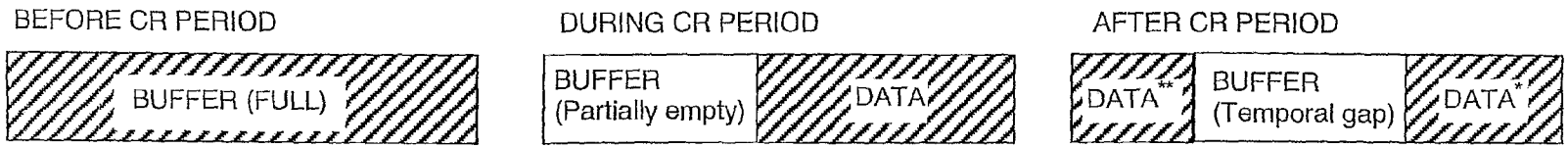

BEFORE CR PERIOD
BUFFER (FULL)
DURING CR PERIOD
BUFFER
(Partially empty)
DATA
AFTER CR PERIOD
DATA**
BUFFER
(Temporal gap)
DATA*

FIG. 4

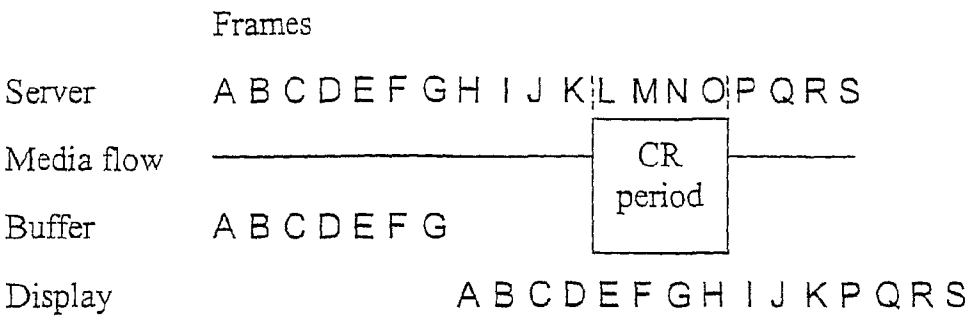

Frames
Server
A B C D E F G H I J K L M N O P Q R S
Media flow
CR period
Buffer
A B C D E F G
Display
A B C D E F G H I J K P Q R S

FIG. 5

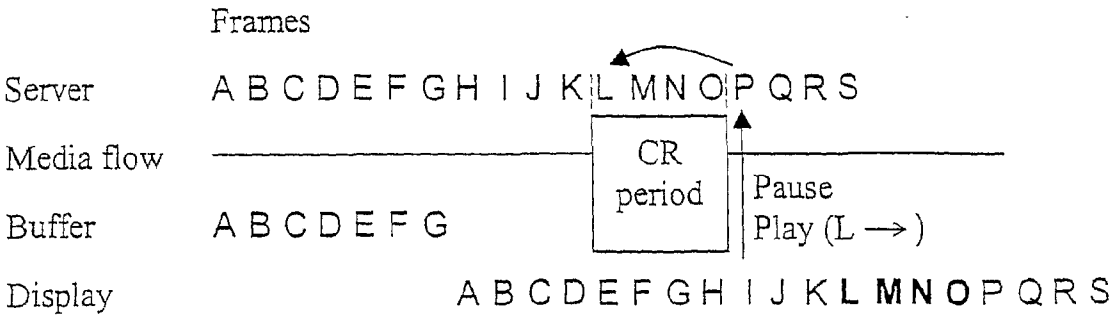

Frames
Server
A B C D E F G H I J K L M N O P Q R S
Media flow
CR period
Pause
Play (L →)
Buffer
A B C D E F G
Display
A B C D E F G H I J K L M N O P Q R S

FIG. 6

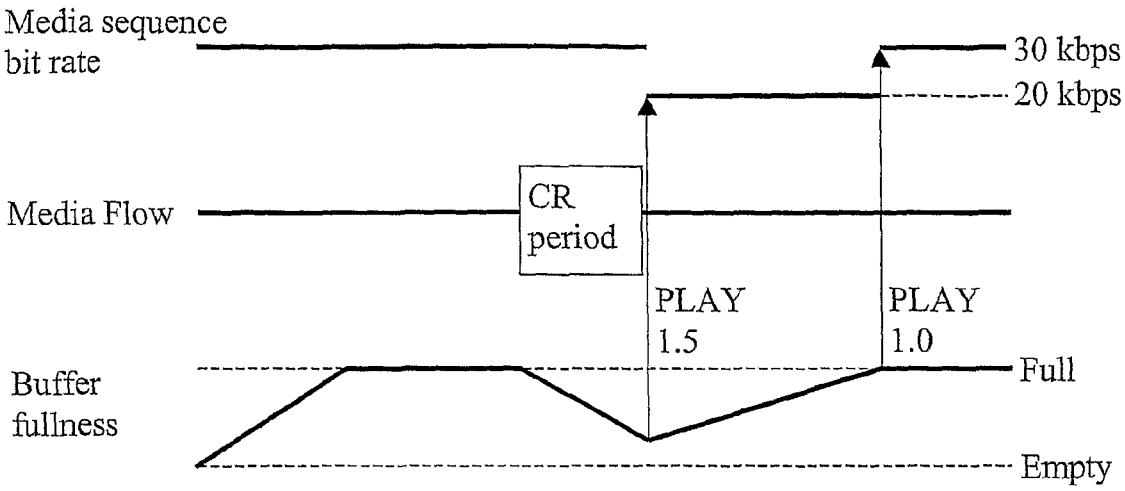

Media sequence bit rate
30 kbps
20 kbps
Media Flow
CR period
PLAY 1.5
PLAY 1.0
Buffer fullness
Full
Empty

FIG. 7

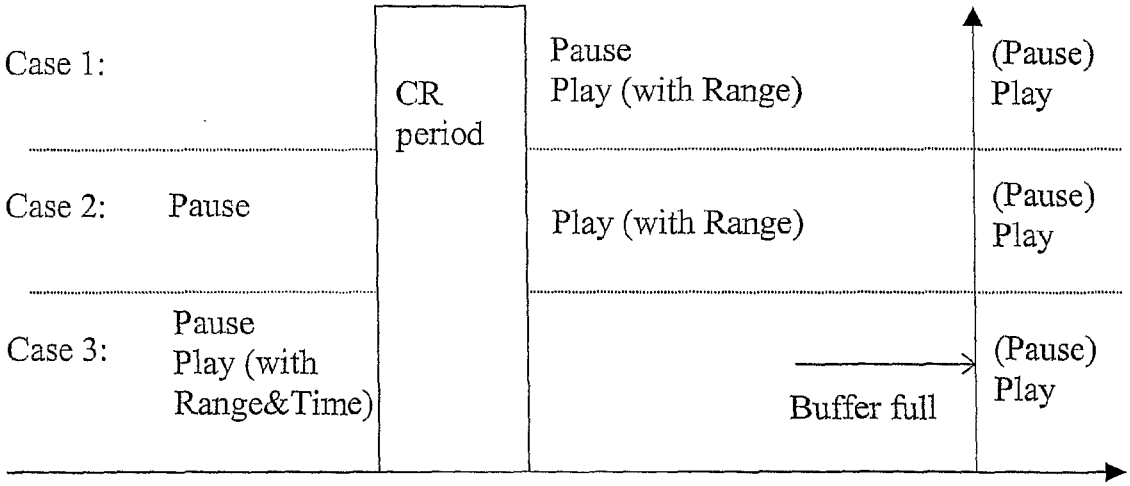

Case 1:
CR period
Pause
Play (with Range)
(Pause) Play
Case 2:
Pause
Play (with Range)
(Pause) Play
Case 3:
Pause
Play (with Range&Time)
Buffer full
(Pause) Play
time

FIG. 11

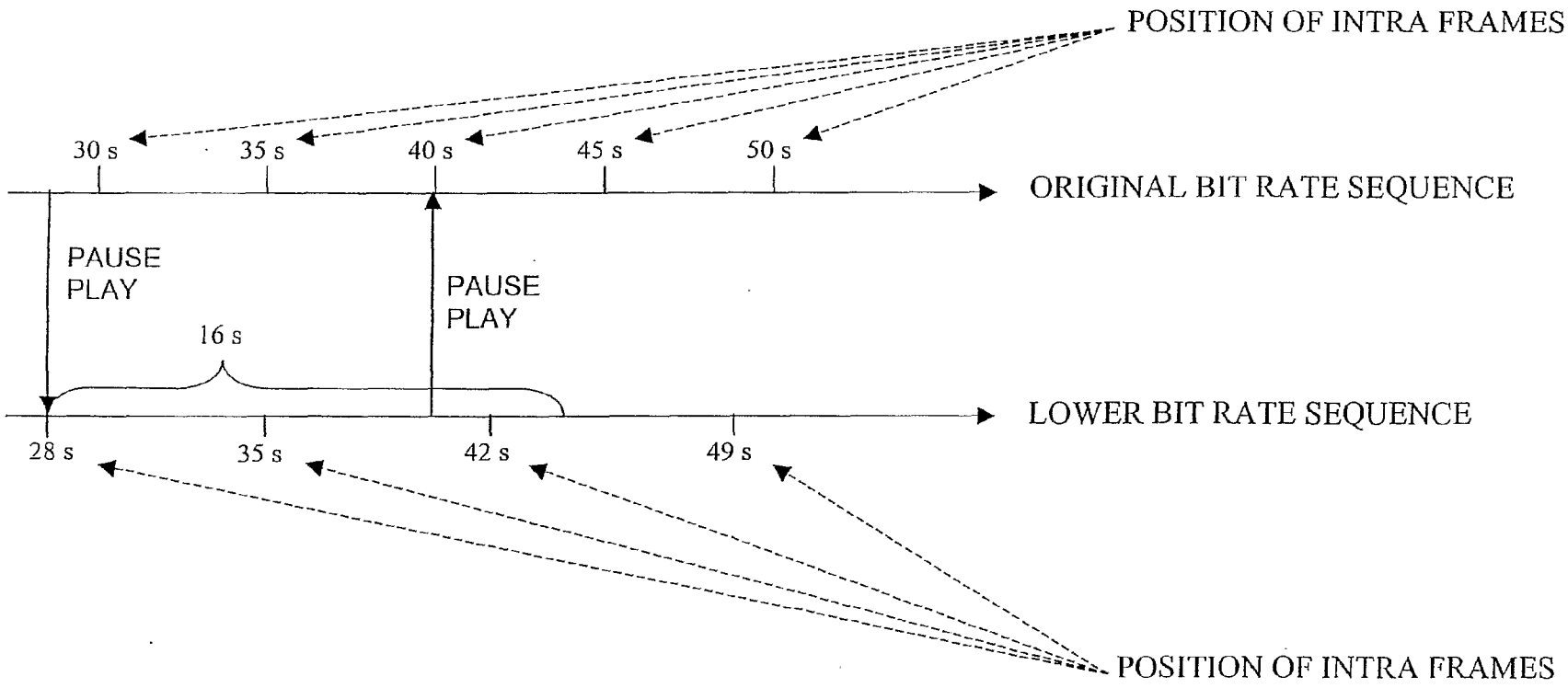

POSITION OF INTRA FRAMES
30 s
35 s
40 s
45 s
50 s
ORIGINAL BIT RATE SEQUENCE
PAUSE
PLAY
PAUSE
PLAY
16 s
LOWER BIT RATE SEQUENCE
28 s
35 s
42 s
49 s
POSITION OF INTRA FRAMES

FIG. 8

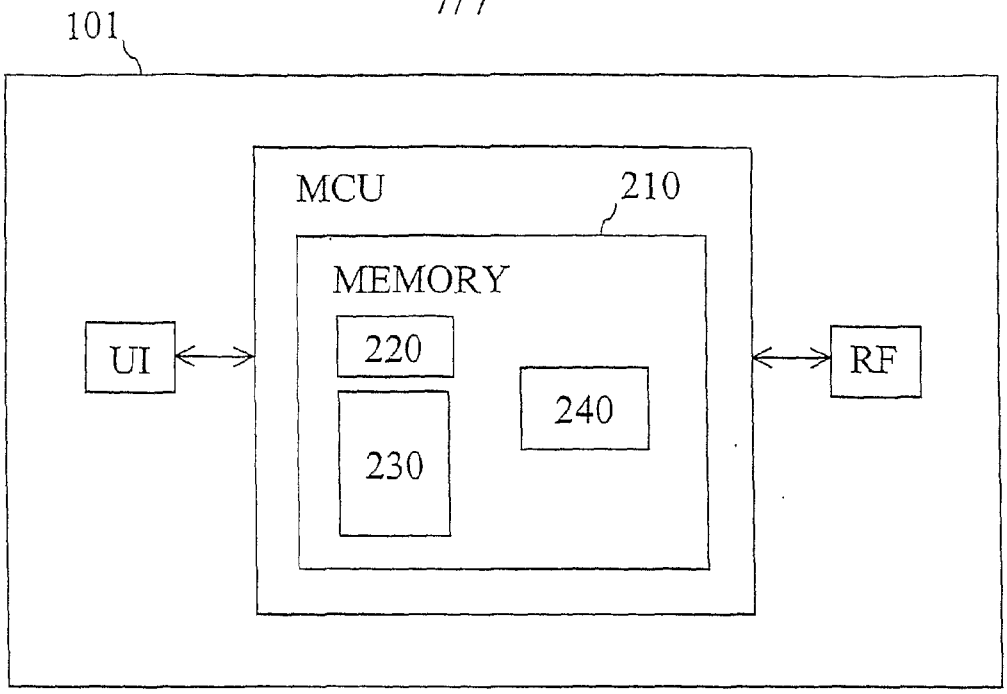

101
MCU
210
MEMORY
220
230
240
UI
RF

FIG. 9

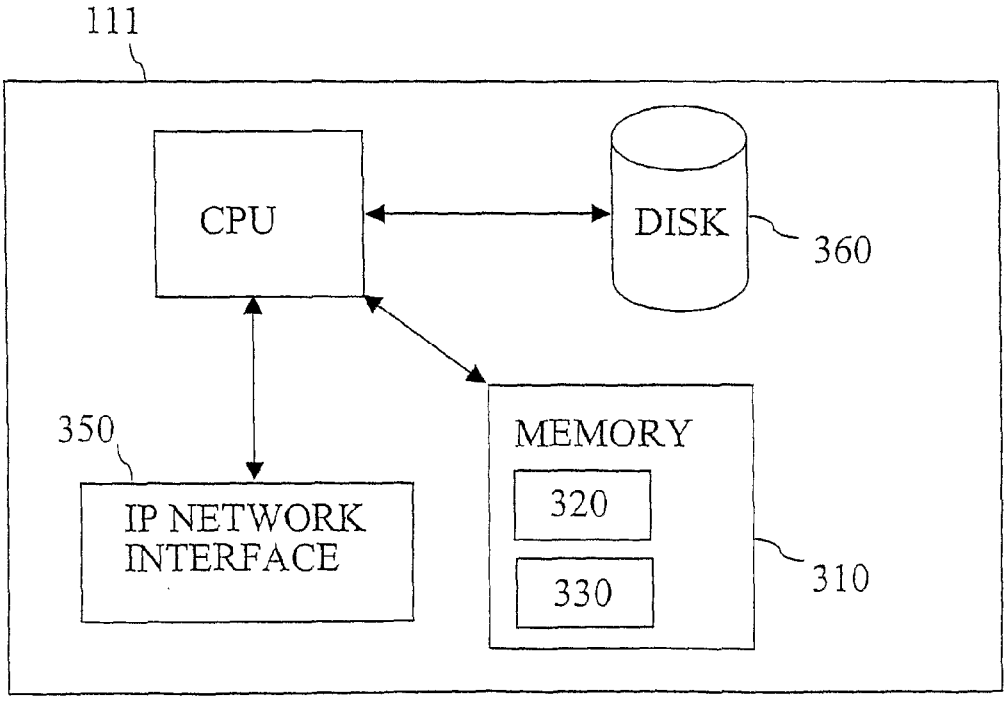

111
CPU
DISK
360
350
IP NETWORK INTERFACE
MEMORY
320
330
310

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 03/00752

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 9/06
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)

IPC7: H04L, H04Q, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	US 2003009576 A1 (APOSTOLOPOULOS, J.G. ET AL), 9 January 2003 (09.01.03), paragraphs [0009] - [0011]; figures 8-11	1-25
A	3GPP TS 26.233 V5.0.0: 3rd Generation Partnership project; Technical Specification Group Services and System Aspects; Transparent end-to-end packet switched streaming service (PSS); General description (Release 5), March 2002, pages 1-12, see section 4, "Usage scenarios" and section 5, "General service architecture".	1-25

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 December 2003	16 -12- 2003
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Fredrik Blomqvist /OGU Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 0130090 A2 (TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)), 26 April 2001 (26.04.01), page 2, line 29 - page 4, line 19 -- --------	1-25

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(71) Applicant: **BURST.COM** [US/US]; 613 Fourth Street, Suite 201, Santa Rosa, CA 95404 (US).

(72) Inventor: **ALLEN, Arthur, Douglas**; 1322 Isabelle Avenue, Mountain View, CA 94040 (US).

(74) Agents: **SWISS, Gerald, F.** et al.; BURNS, DOANE, SWECKER & MATHIS, L.L.P., P.O. BOX 1404, Alexandria, VA 22313-1404 (US).

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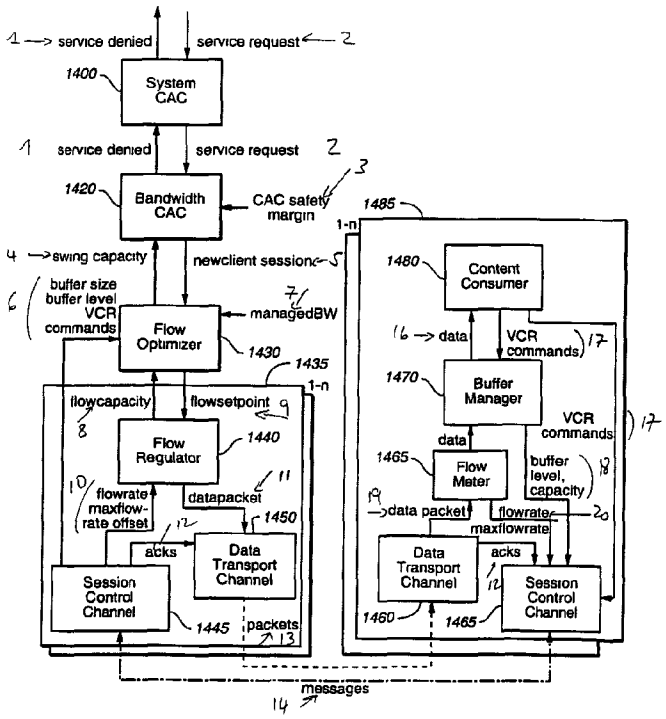
(54) Title: METHOD FOR CONNECTION ACCEPTANCE CONTROL AND RAPID DETERMINATION OF OPTIMAL MULTI-MEDIA CONTENT DELIVERY OVER NETWORKS



(57) Abstract: A method of bandwidth allocation for delivery of stored digital content from at least one server device to at least one client device by way of a network is disclosed. The method begins by prescribing a control variable which represents a target flow rate from the server device to each client device. Next, time-varying constraints on the flow rate of the content are determined. A cost function of the control variable for each client is determined. The cost function corresponds to a maximized value of the control variable. Finally, bandwidth is prescribed to each client based upon the value of the control variable maximized by the cost function. In this respect, the method achieves optimal allocation of bandwidth between the server and the respective clients.

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METHOD FOR CONNECTION ACCEPTANCE CONTROL AND RAPID DETERMINATION OF OPTIMAL MULTI-MEDIA CONTENT DELIVERY OVER NETWORKS

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention relates to the field of delivery of multimedia content over a variety of networks. More specifically, it pertains to multimedia servers which service many clients simultaneously for the delivery of multimedia content which is used and played back at each client. It addresses methods for determining optimal delivery rates to each client and methods for determining whether new clients may be accepted without diminishing the quality of service to existing clients.

Status of the Prior Art

[0002] In the history of multimedia program delivery, some in the industry have long advocated the use of large client-side buffers and faster-than-real-time content delivery over a network as offering the best of all worlds: a jitter-free viewing experience and a cost-effective utilization of the network resources at hand. Few systems, however, go very far in addressing how to schedule clients or a method for accepting new clients. Real-time systems, often known as streaming systems, can schedule new clients in a very simple manner -- if sufficient bandwidth remains for the added real-time stream, then the client may be accepted. However, such systems do not maximize the number of simultaneous clients. On the other hand, faster than real-time delivery, sometimes known as store-and-forward systems, opens up the possibility for more flexible scheduling procedures to control and optimize the number of simultaneous clients while ensuring a high level of quality of service.

[0003] The methods for such call acceptance and flow modulation that have been proposed in the prior art have been largely ad-hoc and also incomplete. These have been ad-hoc in the sense that there has been no guiding rationale for their selection from among many possible and potentially superior alternatives. The methods have also been incomplete insofar as they did not address the question of whether any given incoming request for service should be accepted or denied. Video-on-demand systems, or more generally, any system in which a multimedia server is designed to serve multiple clients over a network to deliver bounded content, can benefit from the use of such flow modulation techniques and call acceptance procedures.

Optimal Content Flow Modulation

[0004] One time-honored way of designing methods of the class required here is to re-cast the problem to be solved as an optimization problem, in which one seeks to maximize a designated value function moment-by-moment, subject to a set of real-world operational constraints which will typically vary over time. Accordingly, given a set of clients and associated sessions, an optimal delivery procedure continuously establishes content flow rates from the content server to each of its clients so as to maximize aggregate value according to the governing value function.

[0005] This approach holds several advantages: 1) optimization problems are well understood, and are tractable by a large and diverse collection of computational methods; 2) if it exists, a global solution that is obtained is arguably optimal by construction, and thus superior or equal to all other.

[0006] The present invention teaches the method of optimizing two particular value functions:

1) total data delivered (maximize throughput).

2) total delivery charges (maximize charges).

[0007] The first value function does not distinguish one customer from another and will deliver as much data as possible from server to clients irrespective of the characteristics of the latter. The second value function favors the service of high paying customers. It can easily be seen that the first function is a special case of the second one whereby all clients are charged equally.

[0008] As will be seen in this disclosure, optimizing for these functions and identifying the necessary constraints requires a new and unique perspective that is specifically designed for the multimedia environment. Moreover, the disclosed methods are specifically designed to account for and accommodate real-world scenarios of today's networks. Consequently many variations of the method are presented to accommodate various scenarios.

SUMMARY OF THE INVENTION

Call/Connection Acceptance Control (CAC)

[0009] A CAC procedure is responsible for deciding whether a candidate for service can be accommodated without jeopardizing sessions already in progress at the present time or at some time in the future; failing that it must decide whether a service request should be queued for a time or rejected.

Flow Modulation

[0010] Flow modulation methods are those portions of the system which manage the communication and data flow between the server and the clients. Collectively, these methods provide the multimedia data to the client and provide the server with the information about the state of the transmission, playback, user status and network status. These parameters are further used by the present invention in the CAC procedures. In fact, as will be shown, the proposed CAC procedures are tightly integrated with the flow modulation methods.

Adaptation to Variations in Network Capacity

[0011] Operational constraints may change over time. For instance, one might elect to vary the total bandwidth available for multimedia content delivery according to the time of day. Alternatively, exogenous data flows on the network may cause unexpected disturbances by usurping available bandwidth and impeding the delivery of data along established session channels. The content delivery strategy of the present invention includes the ability to adapt to scheduled as well as unexpected disturbances so as to minimize unwanted disruptions of services.

Burst Transmissions Provide the Opportunity to Adapt

[0012] The present invention, due to it's faster-than-realtime transmissions (also know as burst transmissions), which are realized by use of high-bandwidth networks and large client cache or intermediate storage, provides an opportunity to adapt to changing network conditions. In contrast real-time (streaming) systems are essentially designed for worst-case scenarios: each client must be assumed to constantly use the complete real-time playback bandwidth. Such a system is unable to adapt to any derivation from this scenario. For example, take the simple case where the total server bandwidth is 100% utilized by all clients playing back the streaming video. Should any network condition change, such as a temporary

decrease in available bandwidth over the network, then one or more clients' playback is interrupted, and the system can not recover from such a condition until the bandwidth is regained. Even worse if a single client presses pause either that unused bandwidth must remain reserved and no more clients can be accepted, or that paused client is pushed out in order to service the new client. In essence little or no CAC procedure may be implemented.

[0013] In contrast the present invention burst transmits portions of a program and immediately 'gets ahead of itself', thus allowing headroom for a myriad of methods to intelligently handle new clients, client interactivity and possible network fluctuations.

[0014] Methods are taught for optimally determining the flow rate to each client. Methods are also taught for accepting or rejecting new clients; these call-acceptance methods are tightly coupled with said flow rate modulation methods. A series of constraint expressions are presented which govern the methods for determining the flow rates and acceptance of new clients. Linear programming techniques are used to optimally solve these expressions. Various embodiments are presented including scenarios for multiple-rate tariffs, and time-of-day bandwidth variations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] These as well as other features of the present invention will become more apparent upon reference to the drawings wherein:

Figure 1 depicts the flow of control and/or data between the different stations of a content delivery session;

Figure 2 illustrates the Entity Data Model;

Figure 3 geometrically illustrates the linear programming problem statement;

Figure 4a geometrically illustrates an expansion of the flow optimization problem statement;

Figure 4b geometrically illustrates the method for rapid determination of flow rates to maximize flow;

Figure 5 illustrates a method for implementing flow modulation to maximize flow;

Figure 6 illustrates a method for implementing flow modulation for maximized charges;

Figure 7 illustrates typical content flow;

Figure 8 illustrates typical server swing capacity;

Figure 9 illustrates a method for call-acceptance and control (CAC);

Figure 10 illustrates planned constraints on maximum flow;

Figure 11 illustrates a method for call-acceptance and control (CAC) with scheduled flow changes;

Figure 12 illustrates stratification of services;

Figure 13 illustrates a method for call-acceptance and control (CAC) for maximal charge;

Figure 14 is a system block diagram for a system implementing the present optimization of client bandwidth;

Figure 15 is a flowchart showing an algebraic method for calculating the optimization of client bandwidth;

Figure 16 is a flowchart showing an algebraic method for calculating the optimization of client costs; and

Figure 17 illustrates optimized viewing of a live event.

DETAILED DESCRIPTION OF THE INVENTION

Data & Control Flows (Figure 1)

[0016] Figure 1 depicts the flow of control and/or data between the different stations of a content delivery session. As shown a client attempts a connection 100 and manifests itself to the Content Selection subsystem by means of a low bandwidth control channel (not shown). Next the client is authenticated and a selection is made 110, typically with the aid of browser software. If the client is not authenticated, it is dismissed from the system 120. If the client has been authenticated and a program selected for viewing then the rate of service is set at this point 130, perhaps according to the selection that was made, or some contractual stipulation. The client is now placed on the service queue of the CAC subsystem 140. A client that is made to wait too long will eventually balk 150. Assuming this does not occur, the CAC subsystem 140 will eventually allocate a channel to the client and open a session 160. Control now devolves upon the Content Flow Modulator (not shown) which starts the flow of content from server to client 170. Subsequent capacity changes, whether predictable or not, may force an abrupt termination of a session in progress 180. Otherwise the session runs to completion 190.

Entity Data Model (Figure 2, listing, table)

[0017] The entities entering into our discussion are depicted in Figure 2. Client 200 maintains certain data associated with this entity; as shown but not labeled, which includes without limitation, status, id and costOfService. The other entities also each include unlabeled but depicted data. The diagram further depicts the relationship between each entity. As shown, client 200 is assigned a session 240. Client 200 employs a channel 210. Client 200 selects contentSelection 230. Session 240 delivers content through channel 210. Server 220 modulates channel 210. Server 200 contains contentSelection 210. Server 220 accepts, defers or denies client 200 and contentSelection 230 is associated with session 240.

[0018] Furthermore Figure 2 depicts the various one-to-many relationships. Each client 200 employs one channel 210. Client 200 may or may not receive one of channel 210, as depicted by the 0/1 notation. Similarly, client 200 may or may not receive a session 240. However, whenever client 200 does receive a session 240, it will always receive a channel 210 since channel 210 and session 240 are allocated as a pair. One or more (N) of client 200 may select one of contentSelection 230. And server 220 contains one or more (N) of contentSelection 230. Each one of contentSelection 230 is associated with 0-N of session 240. Each session 240 delivers content through one of channel 210. And server 220 modulates one or more (N) of channel 210.

[0019] A more detailed list of each entity of Fgure 2, and each one's associated description, data elements and function calls is listed below. This listing closely resembles that of object-oriented programming. As such, 'methods' represent the ability to obtain or modify data, while 'attributes' represent data which is directly associated with that particular entity. The listing also includes information relating to one embodiment wherein software programming specifics are disclosed, such as

a variable type (double, int and so forth) and more. The present invention is not limited to such an embodiment and other implementations are possible without deviating from the scope and intent of the present invention. The listing, however detailed, is merely illustrative of the data and functions which are used in the equations and methods described herein.

[0020] Consequently, data and functions from this listing, associated with the various entities, will be used in forthcoming equations, flowcharts and methods. The reader is directed to this listing as reference when reading such equations and examining such drawings.

--- start of entity data model detailed listing ---

Model: Untitled 1 (public)

Contains:

client, session, channel, server, contentSelection.

Component: client (public Class/Interface)

Comment:

A client entity stands for a client presently requesting or receiving service.

Methods:

public static **lookup (id: in int) : client**

public **GetId () : const int&**

public **SetId (val : in int&)**

public **GetCostOfService () : const double&**

public **SetCostOfService (val : in double&)**

Attributes:

private **status: client < int >**

Specifies whether or not a client has been allocated a channel and session.

private **id: int**

Integer-valued identifier that is unique to the client (primary key). Can be obtained from a monotonically increasing counter.

private **costOfService: double**

Dollar charge per Mbyte. This value is the same for all customers under flow optimization. Under cost/charge optimization may be an integer value reflective of the rank; the higher the rank the higher the charge.

Has:

public **selected: contentSelection**

public **assigned a: session**

public **employs: channel**

Component: session (public Class/Interface)

Comment:

A session entity holds various state information about the service being received by an associated customer.

public **GetCurrentPosition () : const double&**

public **SetCurrentPosition (val : in double&)**

public **GetPayloadToGo () : const double&**

public **SetPayloadToGo (val : in double&)**

public **GetStatus () : const int&**

public **SetStatus (val : in int&)**

public **GetMinimumFlowRate () : const double&**

public **SetMinimumFlowRate (val : in double&)**

public **GetFlowRateRange () : const double&**

public **SetFlowRateRange (val : in double&)**

public **GetMaxFlowRate () : const double&**

public **SetMaxFlowRate (val : in double&)**

Attributes:

private **playTimeToGo: double**

Indicates the minutes remaining in the viewing experience. Initialized to contentSelectiont.playTime (see below).

private **currentPosition: double**

Pointer into media content from which content is being delivered.

private **payloadToGo: double**

The amount of media content (in Mbytes) as yet undelivered by the server. Does not include any content presently stored in the client-side buffer.

private **status: int**

Indicates whether sesion is active or paused.

private **minimumFlowRate: double**

This is the minimum flow from server to client required to ensure uninterrupted service over the remaining playTime. Has a value of zero if playloadToGo is zero. Given by (payloadToGo * 8)/(playTimeToGo *60)

private **flowRateRange: double**

Specifies the effective range over which the channel content flow serving a session is constained without consideration for interactions with other flows. Equals maxFlowRate - minimumFlowRate

private **maxFlowRate: double**

Effective maximum bound on flow as expressed in formula (8) which must be re-evaluated periodically.

Has:

public **delivers content through: channel**

Component: channel (public Class/Interface)

Comment:

A channel represents the network resources from server to client associated with an ongoing session, encompassing the client-side buffer if any, and its level.

public **GetBufferLevel () : const double&**

public **SetBufferLevel (val : in double&)**

public **GetFlowRate () : const double&**

public **SetFlowRate (val : in double&)**

public **GetMaxFlowRate () : const double&**

public **SetMaxFlowRate (val : in double&)**

Attributes:

private **bufferSize: double**

Capacity of the client-side buffer (or equivalent)

private **bufferLevel: double**

Current buffer level in MBytes of stored content.

private **flowRate: double**

Flow rate through channel specified by the relevant optimizing flow modulator.

private **maxFlowRate: double**

This value represents the maximum possible flow rate from the server to an individual client over its "channel". This value reflects restrictions on flow that pertain to an individual client. It may be determined by factors such as the bandwidth of client's link to the network, or a limit imposed administratively to ensure balanced network utilization.

Component: server (public Class/Interface)

Comment:

Entity representing the media server and its CAC and flow modulation activities.

public **GetFlowRate () : const double&**

public **SetFlowRate (val : in double&)**

public **GetMaxMinFlowRate[] () : const double&**

public **SetMaxMinFlowRate[] (val : in double&)**

Attributes:

private **maxFlowRate: double**

Maximum possible content flow that is allocated to the server by the network.

private **flowRate: double**

Aggregate content flow rate, summed over all sessions and their associated channels.

private **cac_flowSafetyMargin: double**

Tunable safety margin used by the CAC algorithm to protect sessions-in-progress from being affected by changes in available network bandwidth.

private **maxMinFlowRate[]: double**

Applies when N rate tariffs exist. This array holds the maximum floor level for each category of service. The value for the costliest category N is stored in maxMinFlowRate[N-1], and for the least costliest in maxMinFlowRate[0]. It is the relative magnitude of these ascending values that matters, not their absolute value. Thus the actual maximum floor flow rate for category k is given by server.maxFlowRate * (server.maxMinFlowRate[k-1] /server.maxMinFlowRate[N-1]). Similarly, the maximum floor flow rate for category N is server.maxFlowRate.

Has:

public **contains: contentSelection**

public **modulates: channel**

Component: contentSelection (public Class/Interface)

Comment:

Entity represents a video/sound clip or other bounded unit of content. A continuous data feed does not qualify.

Attributes:

private **averagePlayRate: double**

The average rate at which media content is consumed by the client, as computed by dividing the (payload * 8) by the (playTime * 60)

private **playTime: double**

Duration of play of the media content in minutes.

private **payLoad: double**

total size of the content in Mbytes.

Has:

public **is associated with: session**

--- end of entity data model detailed listing ---

The following table summarizes the highlights of the previous detailed description of each entity in Figure 2.

TABLE 1

Entity	**Description**
client 200	Each client is denoted by an associated unique integer index $_{Id}$. The set of active clients is denoted by $\mathbf{S}_{ActiveClients}$. The set of deferred clients is denoted by $\mathbf{S}_{QdClients}$. Incoming clients are expected to select the content they wish to view prior to being queued for dispatch by the CAC sub-system, which requires knowledge of the client's bandwidth requirements, duration of play, and cost of service, all of which may vary according to the selection.

server 220	Servers sit astride a network and can deliver media content through the network to their clients up to a designated maximum flow rate. The server is responsible for accepting or rejecting clients, launching sessions and associated channels for the former, and modulating content flows over all channels in an optimal manner.
channel 210	A channel represents the data path between the server and the client. The channel buffer is typically located near or within the clients viewing station. The flow of content through the channel is set by the flow modulator sub-system.
contentSelection 230	A server will typically act as a repository for media content, which it can deliver to clients upon demand. For our purposes, media content is characterized by its payload and the play duration, which together imply the ***averagePlayRate*** = (payload*8)/(playTime *60). The averagePlayRate is none other than the streaming rate imposed by real-time just-in-time streaming algorithms.
session 240	Every session represents an instance of media content delivery to an associated client over a designated channel. The ***playTimeToGo*** indicates the time remaining before the content is fully played out to the client. The ***payloadToGo*** is the amount of content data as yet undelivered to the channel. A session terminates when this value reaches zero, at which time ***playTimeToGo*** may still be large, according to the capacity, the level of the channel buffer, and the media play rate.

Constraints On Content Flow

[0021] Before referring to more Figures, it is imperative to establish some formulas and problem statements which are used in the methods which follow.

[0022] The flow of content between entities is subject to the following constraints at all times. Buffer levels are always expressed in Mbytes and data rates in Mbits/sec.

(1)$\Sigma_{\text{i } \epsilon \text{ SactiveClients}}$ (client.lookup(i).channel.flowRate) < = server.maxFlowRate
The sum of all channel flows cannot exceed the imposed maximum throughput capacity of the server.

(2)client.lookup(i).channel.flowRate < = client.lookup(i).channel.maxFlowRate for all $\mathbf{i} \epsilon \Sigma_{\text{activeClients}}$

The data path from server to client is subject to its own constriction.

(3)client.lookup(i).channel.flowRate < =(client.lookup(i).channel.bufferSize - client.lookup(i).channel.bufferLevel)* 8/60 + client.lookup(i).session.mediaContent.averagePlayRate, for all $\mathbf{i} \epsilon \Sigma_{\text{activeClients,}}$

The channel buffer is never allowed to overflow.

(4)client.lookup(i).channel.flowRate < = client.lookup(i).session.payloadToGo * 8/60

for all $i \in \Sigma_{activeClients,}$

Content that does not exist cannot be delivered. (Constraint 1 will ordinarily prevail except at the very end of a session.)

[0023] The constraints listed above are straightforward applications of common sense in relation to the flow of data through constricted channels, out of finite data sources, and into and out of bounded buffers. By contrast, the following constraint, which imposes a minimum channel flow rate instead of a maximum, is less obvious. The minimum value, termed the ***minFlowRate*** is set to the flow rate which, if sustained over the balance of the play time to go (***playTimeToGo***), ensures that all required content will be available when needed -- and no sooner -- until all content is played out. This floor value can be calculated for $i \in \Sigma_{activeClients}$ by the formula:

(5)client.lookup(i).session minFlowRate =(client.lookup(i).session.payloadToGo * 8)/ (client.lookup(i).session.playTimeToGo * 60)

Accordingly, the flow rate on the right-hand-side is termed the just-in-time (JIT) flow rate (f^{JIT}).

Thus:

(6)client.lookup(i).channel.flowRate >= client.lookup(i).session.minFlowRate
for all $i \in \Sigma_{activeClients}$

[0024] The variable constraint bounds (i.e. the values to the right of the inequality symbol) of equations 1 - 4 and 6 are re-evaluated on a periodic basis (e.g. once per second) prior to the execution of the CAC procedure and optimizer. In

particular, the ***minFlowRate*** value starts out at the beginning of a session equal to the streaming rate. By construction the ***minFlowRate*** rate never exceeds this initial value so long as constraint 6 is honored. In fact, constraint 5 implies that the ***minflowRate*** value must be a diminishing function of time that may hold its value for a time but never rises. As seen from equation 6, the actual data rate of the channel, ***flowRate***, is always greater than or equal to the ***minFlowRate***. By design, and virtue of the fact the present invention uses faster-than-realtime transmissions, the system quickly gets ahead of itself and ensures that after initial conditions, the ***minFlowRate*** is always equal to or less than the real-time rate and that it continues to decrease. As we shall see, the CAC procedure exploits this monotonic characteristic of the minimum flow rate over time.

[0025] Constraints 2, 3 and 4 are of like kind, each specifying an upper bound on individual channel flows. Whereas the bound for constraint 2 is typically a constant, the bounds on 3 and 4 will vary over time. Nevertheless, only one of the three bounds is effective at any given time, namely the one with the smallest bound value, given by:

(7) client.lookup(i).session.maxFlowRate = minimum of

1) client.lookup(i).channel.maxFlowRate,

2) (client.lookup(i).channel.bufferSize - client.lookup(i).channel.bufferLevel)*

8/60 + client.lookup(i).session.mediaContent.averagePlayRate,

3) client.lookup(i).session.payloadToGo * 8/60

Consequently, formulas 2, 3, and 4 can be consolidated into a single constraint, the bound for which is computed at every scan to be the smallest bound of associated constraints 2, 3 and 4.

(8) client.lookup(i).channel.flowRate < = client.lookup(i).session.maxFlowRate,

whereby for all $\mathbf{i} \in \Sigma_{\text{activeClients}}$, maxflowRate is given by equation (7).

At any one time, individual channel flows are constrained over a range, as follows:

(9) client.lookup(i).session.flowRateRange =
client.lookup(i).session.maxFlowRate - client.lookup(i).session.minimumFlowRate

Value Functions

[0026] The value functions introduced previously can be expressed mathematically as linear functions of channel flows, as follows:

Optimizing Throughput (Maximal Flow)

(10) value $= \Sigma_{\text{i} \in \text{SactiveClients}}$ client.lookup(i).channel.flowRate)

Optimizing Charges (Maximal Charges)

(11) value $= \Sigma_{\text{i} \in \text{SactiveClients}}$ (client.lookup(i).channel.flowRate * client.lookup(i).costOfService)

Optimization Problem Statement (Figure 3)

[0027] The optimization problem, which in one embodiment is strictly throughput and in another case is charge, can be stated simply as follows:

Find values for

client.lookup(i).channel.flowRate for all $i \in \Sigma_{activeClients}$

constrained by inequalities 1 through 5, such that the value obtained by evaluating expression 10 or 11 assumes a maximum.

[0028] Both of these problem formulations are examples of Linear Programming for which a number of well-known and generally effective computational solutions exist. In linear programming one seeks to optimize a linear cost function of variable **x**

(12) $c*x = c_1*x_1 + \ldots + c_n*x_n$

subject to a set of linear inequality constraints

(13) $A*x <= b$

where $x^T = (x_1,\ldots,x_n)$, $c = (c_1,\ldots,c_n)$ are the state variable & cost vectors, A is an n-by-m matrix, $b^T = (b_i,\ldots b_m)$ is the constraint vector, and the operator '*' stands for matrix or scalar multiplication.

[0029] Figure 3 is introduced as illustrative of the problem statement and the general methods of the prior art, and is not incorporated as an element of the invention.

[0030] The linear programming problem as well as its solution can best be understood with the aid of geometry. Figure 3, depicting a 2-dimensional Cartesian problem space, inequality constraints (13) define a convex hull H 310 over which a search for an optimum value of $\mathbf{x} = (x_1,x_2)$ is permitted to range. The cost vector **c** 350 defines an infinite family of equal cost lines (hyper-planes) which lie orthogonal to **c**. Three examples of such lines are shown in L_1 360, L_2 365, and L_3 370., each of progressively higher value. The supreme value of the cost function is obtained by sliding along **c** 350 till one can go no further, in this instance toward vertex V_4 340 of hull H 310. Many well-known methods (e.g. the Simplex Method) work roughly in this fashion, exploiting the fact that at least one optimum point must be at a vertex. In particular, the Simplex method algorithm begins by finding a vertex (e.g. V_2 320), and then moves along a sequence of vertices (e.g. V_3 330, V_4 340) improving itself each time until no further improvement is possible & the summit is reached.

[0031] Let us suppose instead that V_3 330 were placed along L_3 370 along with V_4 340. According to prior art methods, V_3 330 and V_4 340 are the two possible solutions, but the equally valuable points in between them are not. As we shall soon see, the problem of throughput optimization (6) falls in this category.

[0032] While vertex V_1 300 does not factor into this description, it is depicted in Figure 3 for completeness.

Flow Modulation

Methods for Maximal Flow

The following sections detail two embodiments to optimize total data flow.

Overview (Figure 4-a)

[0033] Figure 4-a depicts a scenario involving two flows. The convex hull is in this instance bounded by line segments L1, L2, L3, L4 and L5. L6 is a boundary used in a different embodiment, however the present embodiment uses L5 and not L6. Flow f_2 can range over the interval separating line segments L1 from L3, namely f_2^{MIN} and f_2^{MAX}; the range is depicted as f_2^{RANGE}. Flow f_1 can range over the interval between lines L2 and L4, namely f_1^{MIN} and f_1^{MAX}, and depicted as f_1^{RANGE}. The sum of flows f_1 and f_2 is constrained to lie inside of line segment L5 which, by construction, is always orthogonal to the cost vector $\mathbf{C_f}$. Cost vector $\mathbf{C_e}$ is also illustrated but used in a distinct embodiment. In the present embodiment only $\mathbf{C_f}$ is used. In the illustrated example of the present embodiment, the constraint on total flow is set to 5, and is therefore low enough to cause L5 to intersect L3 and L4. This would not have been true had the value chosen had been 10 instead of 5. With L5 safely out of contention, the convex hull would instead be a simple rectangle bounded by L1 through L4, thereby permitting both flows to assume their respective maxima without interference. In practice operational constraints exist intrinsically or are imposed from the outside so as to ensure cost effective sharing of potentially costly network resources.

[0034] Supposing Figure 4 to be correct, the well-known methods would select vertex $V_{3\text{-}5}$, which lies at the intersection of L3 and L5, or $V_{4\text{-}5}$, which lies at the intersection of L4 and L5. These solutions, though optimal, are undesirable for the present invention as they fail to spread available bandwidth over all channels as fairly as would a centrally located interior point of L5. For this reason, two alternative optimization methods are taught, which are adapted to the particular needs of this problem and ensure a fairer allocation of constrained bandwidth among all channels.

Iterative Procedure (Figure 5)

[0035] In order to optimize use of all available bandwidth, the following general method is used, with the details illustrated in Figure 5. This method is a solution for the problem illustrated in Figure 4-a, which geometrically illustrates the optimization problem in the limited case of two flows, f1 and f2. The following description expands the problem to an arbitrary number of clients (and therefore flows) and presents a method for solving this optimization problem.

[0036] Referring to Figure 5, in step 500, values are calculated for the ***session maxFlowRate*** and ***session.minFlowRate*** for each client as per the minimum and maximum constraint bound expressions in equations 6 and 8, respectively. This step correlates to the determination of $f_1$min, $f_1$max, $f_2$min and $f_2$max from Figure 4-a.

[0037] The difference between these two yields the ***session.flowRateRange*** of each client. Thus:

$$session.flowRateRange = session\ maxFlowRate - session.minimumFlowRate$$

[0038] In step 505, the active clients are sorted in an ascending fashion based upon their **session.*flowRateRange***. As will be shown this critical step facilitates allocation of the remaining server bandwidth as evenly as possible among all active channels, thus maximizing the number of channels that benefit by use of the total server bandwidth. An arbitrary assignment of remaining bandwidth is likely to saturate the server before all channels have been assigned extra bandwidth, thereby favoring certain channels on an ad-hoc basis. This step correlates to keeping the solution in bounds of the space delinated by line segments L1-L5 of Figure 4-a.

[0039] In step 510, each client's channel flow rate is set to the ***session mimimumFlowRate***.

[0040] By doing so, it is ensured that the minimum flow constraint is met for each session and that the minimum flow rate is a non-increasing function of time, which is critical to the proper functioning of the CAC procedure. This portion of the process also ensures that the solution, starting from the vertex in Figure 4-a as defined by the intersection of L1 and L2, moves generally in the direction of vector c_f . All clients are also marked as unprocessed.

[0041] In the next step, 520, ***server.flowRate*** is set to the sum of each active client's **session.flowRate.**

[0042] Next, the following is iterated over all clients in sorted sequence (during any given iteration the selected client is given by its ***id***) by performing steps 530 through 570. In step 530 evaluating the following expressions test for possible server saturation:

delta = (server.maxFlowRate - server.flowRate) / (qty of un-processed clients)
range = client.lookup(***id***).session.maxFlowRate -
client.lookup(***id***).session.flowRate

[0043] If ***range*** is greater then ***delta***, this implies that the server can be saturated in this iteration by allocating ***delta*** to all unprocessed clients (step 540).

[0044] On the other hand, the 'no' path for step 530 implies that the server is not saturated and that the present client (given by ***id***) will saturate first. Accordingly, in 550 the ***delta*** variable is set as follows:

delta = range

[0045] To again correlate this process back to the geometry of Figure 4-a, server saturation is indicated when the solution which is being sought in the direction of vector c_f goes beyond line segment L5.

[0046] Next, the flow rate is incremented for all unprocessed clients by ***delta***, causing client ***id*** to saturate.

[0047] In step 560 the server flow rate is adjusted accordingly:

server.flowRate = server.flowRate + delta * (qty of unprocessed clients)

In step 570 the client given by ***id***, now saturated, is marked as processed.

Algebraic Procedure (Figures 4-b and 15) By Interpolation

[0048] Referring to Figure 4-b, the iterative method described in the previous section begins its search for a maximum from vertex V_{min} along the direction shown by line C_1. In contrast, the present method follows the diagonal line segment L_{diag} of the rectangle bounded by lines L1 through L4, starting at vertex V_{min} and ending at point $V_{3\text{-}4}$.

[0049] Provided it exists, the intersection between L_{diag} and L5, indicated by V_f, is optimal on the same basis as any other point lying along the intersection of L5 with the rectangle bounded by L1 through L4, as previously discussed.

[0050] Whenever L5 does not intersect this rectangle, the optimal solution is given by vertex V3-4 at which f1 and f2 both assume their respective maxima.

[0051] In the first instance, the coordinates for point V_f can be obtained by elementary vector geometry and algebraic manipulation, as follows:

First, we define a number of abbreviations,

f_k^{min} represents client.lookup(k).session.minimum flow rate

f_k^{range} represents client.lookup(k).session.flow rate range

f_{svf}^{max} represents server.maxflowrate

We seek scale factor x such that the vector sum of $(f_1^{min} \ldots f_n^{min}) + x\ (f_1^{range} \ldots f_n^{range})$ intersects an equi-cost hyperplace for capacity c. The point of intersection is obtained by solving equation:

$$(f_1^{min} + \ldots + f_n^{min}) + x(f_1^{range} + \ldots + f_n^{range}) = c$$

Solving for x, we obtain:

$$x = [f_{svr}^{max} - (f_1^{min} + \ldots + f_n^{min})]/(f_1^{range} + \ldots + f_n^{range})$$

where $f_{svr}^{max} - (f_1^{min} + \ldots + f_n^{min})$ represents the unused bandwidth beyond the minimum allocation for each session. For any given session, the optimal flow rate is given by:

$$f_i = f_i^{min} + x\, f_i^{range}, \text{ if } x < 1,$$

or

$$f_i = f_i^{min} + f_i^{range}, \text{ if } x > 1$$

[0052] This solution by interpolation is interesting by virtue of the great efficiency of the calculation, and the fact that no session saturates ($x >= 1$) unless all sessions saturate. In contrast, the previous method entails considerably more computational effort, and tends to saturate sessions with the lowest reserve capacity.

[0053] A block diagram for this algorithm is depicted in Figure 15. Block 1500 establishes the maxim and minima for each flow. For each flow the minimum is subtracted from the maximum to obtain the range. Available Bandwidth is calculated in block 1520, as the difference between the aggregate flow capacity and the sum of flow minima. Factor x is calculated next in block 1540, and tested against 1 in block 1650. Flow rates for each session are computed in block 1560 if x is less than 1, or 1570 in the contrary case.

A Method for Maximal Charge

[0054] The following sections detail one embodiment to optimize the total monetary charges within the system. The second method is algebraic in nature, and thus very efficient.

Overview (Figure 4-a)

[0055] Referring back to Figure 4-a, cost vector C_c lies orthogonal to line L6, which intersects the convex hull at the vertex formed by the intersection of lines L4 and L5, namely $V_{4\text{-}5}$. This cost vector, and the optimal point that it implies, favors flow f1 over flow f2 . In this example, as the cost of service for f1 equals 2, thus exceeding the cost of service of 1 set for f2 . As the number of flows grow to exceed the number of distinct categories of service (and associated costs of service) the unique optimal solution, depicted in Figure 4 for the case where every flow has a distinct cost of service, no longer applies. Once again a plurality of flows within a service category vie for bandwidth which a method should endeavor to distribute evenly. This method is derived from the previous one, and optimizes one cost category after another, starting with the most costly and ending with the least costly, or when all available capacity is allocated.

An Iterative Search Procedure (Figure 6)

[0056] Let the service categories be denoted by k= 1...N, where k also denotes the cost of service.

[0057] Let $C_1...C_N$ be the partition of $S_{activeClients}$ that places all clients with cost of service k in set C_k. Partition sets C_k can be ordered to form sequence SeqC = $C_N...C_1$.

[0058] Figure 6 depicts the method for implementing the method to maximize the cost of service (service charge).

[0059] This method is nearly identical to the iterative procedure used to maximize flow. The principle difference stems from the partitioning of clients according to their category (cost) of service: clients charged most are allocated bandwidth preferentially. This is accomplished by adding another level of iteration around the method of Figure 5. The inner iteration (steps 650 through 680) functions exactly as before, with the difference that its actions are limited to the clients belonging to the given service category ***k*** (i.e. $C_{k)}$. This difference also holds true of step 640 which sorts category ***k*** clients according to their flow ranges prior to entry in the bandwidth-allocating inner loop. The outer loop proceeds down a sorted sequence of service categories SeqC (generated in step 630), starting with the category generating the greatest revenue to the service provider. Given a fairly static set of service categories, this sort need be performed only when the categories undergo change. Steps 670, 675 and 680 are identical to their counterparts in the method of Figure 5 (i.e. 570, 575 and 580).

[0060] The net effect of this method is preferential allocation of bandwidth according to category of service, and equitable treatment of clients within the same category of service.

An Iterative Algebraic Procedure (Figure 16)

[0061] The algebraic method used to maximize bandwidth (Figures 4b and 15) can be viewed as a special case of cost optimization in which all costs are equal. By construction, all sessions belonging to a given category, starting with the most expensive category, and ending with the least, and updating available bandwidth after each step in sequence, we obtain an iterative algebraic method that scales much better than the preceding method.

[0062] A block diagram for this algorithm is depicted in Figure 16. Block 1600 establishes the maxima and minima for each flow. For each flow, the minimum is subtracted from the maximum to obtain the range. In block 1610, every session flow is assigned the minimum allowed value, which value will apply by default should the iterative procedure run out of bandwidth before all categories can be considered. Block 1620 computes the initial value for available bandwidth, as the difference between the aggregate flow capacity and the sum of flow minima.

[0063] Flow values are obtained for each cost category in order of decreasing cost within blocks 1640 through 1675. Factor x is calculated next in block 1540, and tested against 1 in block 1650. Flow rates for each sessions of the category under consideration are computed in block 1660 if x is less than 1, or 1670 in the contrary case. In the former case there is no more bandwidth to allocated to the sessions in the category under consideration.

Call Acceptance Control (CAC)

CAC for Maximal Flow Overview (Figures 7-8)

[0064] The CAC procedure applicable to this flow optimization relies on the essential step of accepting a new client if and only if the added load induced thereby does not compromise service to existing clients or the new one. This critical step could not be accomplished without the close integration with previously- described flow-modulation methods of Figures 5, 6, 15 and 16.

[0065] According to the previous discussion, the minimum flow rate is the minimum sustained flow rate that guarantees that the associated viewer will not be subject to interruptions in service due to a shortfall of content from the media server. It follows that whenever data is being delivered at a rate in excess of the minimum flow rate, a downward adjustment toward the minimum level could be accommodated as needed to surrender bandwidth to any newcomer.

[0066] Figure 7 depicts content flow over a channel for the course of a typical session, and also how data is delivered under real-time streaming D. The amount of content delivered is the same in either case, but the manner of delivery differs considerably. A session is launched at time 0 as the network is lightly loaded, and the optimizer sets an accordingly high flow rate. Another client emerges at the end of interval 700, causing a downward adjustment to the flow rate over interval B, as available bandwidth is shared between two sessions. During both of these intervals the minimum flow rate 720 drops quickly, as data accumulates in the client's media buffers. At the end of interval B, a massive influx of clients necessitates that flow be dropped to the minimum flow rate, which now lies substantially below the streaming rate D and is held until all data is delivered at the end of interval C. Note that the minimum flow rate, shown as element 720, diminishes monotonically over time.

[0067] The ***server swing capacity*** is defined as the difference between the maximum capacity of the server and the total minimum flow rates for all active clients. Therefore:

(14) swingCapacity =

server.maxFlowRate - $\Sigma_{\text{i } \epsilon \text{ SactiveClients}}$ (client.lookup(i).session.minFlowRate)

[0068] Given the monotonic decreasing nature of session minimum flow rates, server swing capacity can readily be seen to be a *monotonic increasing* function of time over the intervals separating client admissions, at which point it undergoes a drop as a new load is taken on. This all-important characteristic implies the following:

Any client admitted for service based on the present value of swing capacity is guaranteed to have sufficient bandwidth at its disposal over the entire future course of the session.

[0069] Figure 8 depicts the server swing capacity 800 over the course of the sessions illustrated in Figure 7. Swing capacity rises quickly over intervals A & B as data is delivered at high flow rates over the network. It holds steady over interval C when all channels flow at their minimum rate then jumps at the end of C before resuming its monotonic rise once again.

Procedure (Figure 9)

[0070] In this procedure, which executes on a periodic basis, queued clients awaiting bandwidth are scanned in FIFO order. For each one, the required bandwidth is computed as per the client's prior content selection. If the available swing capacity (reduced by a safety margin) exceeds the amount required, then the client is activated and swing capacity is adjusted accordingly. Otherwise, two possible cases are considered: 1) under the *FirstFit* embodiment, the procedure

continues scanning clients to the end of the queue, activating clients whose requirements can be met; 2) under the *FIFO* embodiment, the procedure ends with the first candidate client whose requirements cannot be met.

[0071] In step 900, available server swing capacity is evaluated according to the formula

swingCapacity =

server.maxFlowRate - $\Sigma_{\text{i } \epsilon \text{ SactiveClients}}$ (client.get(i).session.minimumFlowRate)

The bandwidth requirement for client *id* in Step 920 is obtained as follows:

required_bandwidth = client.lookup(*id*).contentSelection.averagePlayRate

The predicate evaluated in Step 940 is given by the expression:

(required_bandwidth < = swingCapacity - server.cac_flowSafetyMargin)

[0072] In step 950, client activation entails allocation of a session and a channel, and insertion in the set of active clients eligible for bandwidth allocation by the optimal flow modulator.

[0073] In step 960 the swing capacity is diminished by the amount reserved for the activated client:

swingCapacity = swingCapacity - required_bandwidth;

Responding to Variations in Network Capacity (Maximal Flow)

[0074] In the CAC procedure for maximal flow, a safety margin was introduced, namely *server.cac_flowSafetyMargin*, to provide the means for ensuring that the server's swing capacity will never fall below a minimal threshold value.

[0075] According to this procedure, the following inequality always holds true:
(15) swingCapacity >= server.cac_flowSafetyMargin

[0076] In the previous discussion, a server's swing capacity provided the basis for determining whether or not a prospective client should be allocated bandwidth.

[0077] By holding *server.cac_flowSafetyMargin* in reserve, the CAC algorithm forces delivery of content at faster than real-time rates among accepted clients, even under the heaviest load. The net effect is to apply upward pressure on client side buffer levels, thus promoting continuous accumulation of content and a jitter-free viewing experience once a session is under way.

[0078] In another embodiment, server swing capacity can also be interpreted as specifying the *maximum* amount by which the *server.maxFlowRate* constraint can be dropped without affecting service, should such an adjustment prove necessary due, for instance, to an influx of exogenous network traffic that diminishes the amount available for multi-media services. Parameter *server.cac_flowSafetyMargin* can thus be set so as to *guarantee a minimum capacity to tighten the constraint on maximum server flow* in response to unexpected load changes that affect the server's ability to service its existing clients as well as new ones.

Anticipating Scheduled Variations in Network Capacity (Maximal Flow)

Overview (Figure 10)

[0079] Figure 10 depicts how the constraint on maximum flow might be allowed to vary according to the time of day, day of the week, and so forth, in expectation of time-varying traffic flow levels extrapolated from past experience, traffic flow models, etc. Maximum flow rate 1000 can be seen to vary based upon the time of

day. In practice, defining the right-hand-side of inequality constraint 1 as a time-dependent expression can impose such time-varying capacities. According to the previous description, the optimizer, which executes on a periodic basis, will automatically seek new flow levels for every active session as the constraint varies. There is, however, no guarantee that an acceptable operating point will be found for all sessions (i.e. one that respects the minimal and maximum constraints on session channel flow). One such example is the case where the server is loaded to the limit and total capacity is curtailed in excess of the aforementioned safety margin. Should such a situation arise the only recourse may well be the termination of a number of established sessions (i.e. load shedding).

[0080] The goal is to eliminate service disruptions of this sort by allowing the CAC procedure to look ahead into the future, and accept new clients only if these can be accommodated without any compromise in service in the midst of *previously anticipated changes* in available network capacity. The following CAC procedure generalizes the previous one: before accepting a client, the test on swing capacity is repeated over a sequence of time segments that cover the proposed viewing period.

Definitions -

Let:

(16) t_end(i) = client.lookup(i).session.playTimeToGo + t_now

Let server.maxFlowRate(t) be server flow capacity as a function of time, as exemplified in Figure 10.

[0081] Let $Seq_T(t\_now)$ = advancing sequence of future times, lead by t_now, when server.maxFlowRate(t) undergoes a step change. For instance, at 9:15 in Figure 10 this sequence reads as follows: 9:15, 9:30, 11:30, 13:30, 6:30, 7:30.

[0082] The server swing capacity at a future time t is computed according to the capacity and worst-case client flows at time t.

(17) swingCapacity(t) = server.maxFlowRate(t) -

$$\Sigma_{t\_end(i) > t} \text{(client.lookup(i).session.minFlowRate)}$$

[0083] It is noteworthy that the worst-case client flows at time t are expressed in terms of the present minimum flow rates, which cannot increase over time, but might hold steady. Finally, a predicate is defined that tests whether a prospective customer will cause swing capacity to be exceeded at some time t, as follows:

```
(18) boolean client_fits(i ,t) {

        if(client.lookup(i).contentSelection.averagePlayRate <=

            swingCapacity(t) - server.cac_flowSafetyMargin)

            return true;

      else return false;
        }
```

Procedure (Figure 11)

[0084] This procedure is an adaptation of the first, which has been extended to consider swing capacity at times in the future when capacity undergoes scheduled changes. Before accepting a client, its minimal bandwidth requirement (which by construction of the flow modulator will never increase over time) is checked against *projected swing capacity* at points in time when total available capacity undergoes scheduled step changes, provided these times fall within the proposed content viewing period. A candidate is activated only if all tests succeed.

[0085] Step 1100 builds a sequence of time values (SeqT) at which step capacity changes are scheduled to occur. The first element of this sequence is t_now, representing the present.

[0086] Beyond step 1100 the queue of waiting clients is scanned in FIFO order, yielding a candidate designated by ***id*** at each iteration.

[0087] The bandwidth requirement for client ***id*** in Step 1120 is obtained as follows:

required_bandwidth = client.lookup(***id***).contentSelection.averagePlayRate

[0088] The worst-case end time for content flow to ***id*** is obtained according to the content selected, as follows:

t_end = t_now + client.lookup(***id***).selected.playTime

[0089] Steps 1130 through 1150 are executed within an iteration for each time point t in SeqT falling between t_now and t_end. This iteration is ended in step 1130 if t exceeds the time window of interest, or in step 1150 if the supply of scheduled capacity changes is exhausted.

[0090] For each time value, step 1140 compares required bandwidth to projected swing capacity.

Projected swing capacity at time t is:

$$\text{swingCapacity}(t) = \text{server.maxFlowRate}(t) - \sum_{t\_end(i) > t} (\text{client.lookup}(i).\text{session.minimumFlowRate})$$

[0091] Note that only active clients whose t_end times occur after t are considered in the sum of minimum flow rates.

[0092] The predicate expression used in step 1140 at time t is thus:

(required_bandwidth < = swingCapacity(t) - server.cac_flowSafetyMargin)

Step 1160 performs the same actions as step 660 in the previous CAC flowchart

[0093] The first CAC process is a special case of the present one, in which the set of step change times to server.maxFlowRate is empty (i.e. server.maxFlowRate is constant), and $Seq_T(t\_now) == t\_now$.

[0094] In preparing $Seq_T(t\_now)$, one need only consider future times that will pass before the longest possible content is played out if started at t_now. In order to sidestep problems associated with rollover (at midnight, year 2000, etc.), time is best expressed as a monotonically increasing value (e.g. seconds since Jan 1 1990).

CAC for Maximal Charges

Overview (Figure 13)

[0095] Previously, a method for flow modulation was presented that maximizes charges to clients with active sessions. The CAC embodiment presented previously was not sufficient as it does not consider the cost of service as a basis for connection acceptance. As a result, it may turn away higher paying customers while granting service to lower paying ones, thereby defeating the purpose for this particular embodiment. Therefore, another embodiment is defined which offers the following features:

1. Awaiting clients are serviced in order of their respective service categories, higher paying clients first.

2. Once accepted, a client is guaranteed to receive acceptable service irrespective of its service category.

3. Under heavy load conditions higher paying customers are more likely to be accepted than lower paying ones.

4. Lower paying customers will no be starved for service when higher paying ones enjoy a surplus.

5. Available bandwidth is not thrown away needlessly while clients are being denied service.

[0096] The first objective is easily met by dividing the client queue into as many bands as there are service categories, resulting in a banded queue. Bands are ordered within the queue according to their service categories, with the costliest category in front. As prospective clients arrive and make their selection they are placed in their respective queue band according to their service category (which may be set contractually, according to content selection, etc.).

[0097] Our second objective is met by employing a procedure patterned after those presented previously & offering the same guarantee. Toward our third and fourth objectives we propose dividing total available bandwidth in as many strata as there are service categories. As depicted in Figure 12, two service categories are shown, Premium and Basic, each entailing an associated cost of service. A prospective client is accepted only if there is sufficient swing capacity available within its given service category. The swing capacity for a given category is given by the smaller of 1) the difference between its maximum floor flow rate (corresponding to the top of the stratum for the service category) and the sum of the minimum rates of all active sessions in its category or below, and 2) available swing capacity overall. Finally, our fifth objective is met by allowing the flow optimizer to function freely subject to its operational constraints. The imposed ceilings on call acceptance by category relate to *minimum flow rates*, which merely impose a floor on *actual flow rates*. For example, basic clients might well consume all available bandwidth 300 in the absence of any premium customers, yet could be throttled back toward their floor flow rates (which together cannot exceed 200 in this example) at any time should any premium customer suddenly demand service. In contrast, premium customers could consume the entire 300

bandwidth. As lower paying customers appear these would be admitted to the degree that their quota on minimum flow is not exceeded (i.e. 200) and the availability of swing capacity on the system.

Procedure (Figure 13)

[0098] The present procedure requires a number of ancillary definitions, which follow:

Let the service categories be denoted by k= 1...N, where k also denotes the cost of service.

Let server.maxMinFlowRate[k-1] be the top of the stratum for service category k. Note that server.maxMinFlowRate [N-1] = server.maxFlowRate.

Let S_K be the set of active client indices with a service category *equal to or less than* k. Note that S1 is contained in S2, S2 is contained in S3, and so forth, and that $S_N = S_{activeClients}$.

Let swingCapacity(k) denote available swing capacity for service category k. By construction:

(19) swingCapacity(k) = minimum of:
(server. maxMinFlowRate [k-1] - $\Sigma_{i \in Sk}$(client.lookup(i).session.minFlowRate)),
(server.maxFlowRate - $\Sigma_{i \in SactiveClients}$ (client.lookup(i).session.minFlowRate)))

[0099] Referring to Figure 13, this method is used for CAC when multiple rate tariffs are in effect, and there is a desire to maximize economic returns to the service provider while offering acceptable service to all.

[00100] All waiting clients are scanned in FIFO sequence. The actions taken in Steps 1320 and 1360 are identical to those described in connection with earlier CAC flowcharts.

[00101] Step 1340 evaluates a predicate expression that tests whether the required bandwidth can be accommodated without exceeding the lesser of 1) swing capacity available to the client's category of service, and 2) total available swing across all categories of service. The latter factor could be determinative if all available bandwidth were allocated to high paying customers, leaving lower paying ones such as the proposed client unable to draw from their unfilled quota.

Let us suppose that candidate client ***id*** belongs to rate category ***k***.

We define the swing capacity available in rate category ***k*** as:

swingCapacity(***k***) = least of:

(server.maxMinFlowRate[k-1] - $\Sigma_{\text{i in Sk}}$ (client.lookup(i).session.minimumFlowRate))

and

(server.maxFlowRate - $\Sigma_{\text{i } \epsilon \text{ SactiveClients}}$ (client.lookup(i).session.minimumFlowRate))

The predicate expression invoked by step 1340 can now be written as follows:

(required_bandwidth < = swingCapacity(***k***) - server.cac_flowSafetyMargin)

[00102] This algorithm processes queued clients in band sequence, and within every band in FIFO order. If the predicate evaluates to true, the client is activated. Otherwise two possible cases are considered: 1) under the *FirstFit* embodiment, the procedure continues scanning clients to the end of the banded queue, activating clients whose requirements can be met; 2) under the *FIFO* embodiment, the procedure ends with the first candidate client whose requirements cannot be met. Many other variations on these two embodiments might also be considered.

Anticipating Scheduled Variations in Network Capacity (Maximal Charge)

Overview

[00103] The procedure applicable to optimization of delivery charges is obtained by blending elements of the CAC method depicted in Figure 13 into the method depicted in Figure 11, which applies without change. To understand how this might work it may be useful to visualize a version of Figure 10 stratified along its length in the manner of Figure 8. As the maximum flow level undergoes a step change, so too do the widths of its constituent strata in equal proportion.

Procedure

[00104] As previously mentioned, the CAC method (Figure 11) applies to this circumstance also, provided we alter the definition of two routines, (17) and (18), upon which that procedure relies, yielding (20) and (21), and adopt the banded queue organization outlined in the previous section.

[00105] The server swing capacity at a future time t is computed according to the capacity and worst-case client flows at time t.

(20) swingCapacity(k, t) = minimum of (

(server.maxFlowRate(t) * (server.maxMinFlowRate[k-1] /server.maxMinFlowRate[N-1])

$\Sigma_{\text{i c Sk \& (t\_end(i) > t)}}$ (client.lookup(i).session.minFlowRate)),

(server.maxFlowRate - $\Sigma_{\text{i e SactiveClients \& (t\_end(i) > t)}}$ (client.lookup(i).session.minFlowRate)))

Finally, we define a predicate that tests whether a prospective customer will cause swing capacity to be exceeded at some time t, as follows:

```
(21) boolean client_fits(i ,t) {
        k = client.lookup(i).costOfService;
        if(client.lookup(i).contentSelection.averagePlayRate <=
                        swingCapacity(k,t) - server.cac_flowSafetyMargin)
                return true;
        else return false;
    }
```

System Description

[00106] Referring to Figure 14, a block diagram illustrating a preferred embodiment for a system implementing the methods presented herein is shown.

[00107] Block 1485 depicts plurality of network-based client computers that receive data from a server over the course of a session. Every client sessions has an associated session block 1435 within the server by means which a flow rate of content from client to server is effected and regulated to a given flow rate set-point. The flow optimizer 1430 manages bandwidth utilization across all sessions that have been admitted by the system call admission control (CAC) and the bandwidth call admission control blocks, labeled 1400 and 1420 respectively. Specifically, the flow optimizer 1430 modulates the flow rate set-point of every active session so as to optimize aggregate flow or, more generally, cost.

Call Admission Control

[00108] Whenever a client contacts a server requesting service, the server must determine whether or not to admit the client. This admission function is performed in two separate phases. The system call admission control block 1400 considers whether or not sufficient internal resources exist to support the request.

Toward this end, the system CAC 1400 estimates the needs of the prospective client with respect to a set of limited system resources such as I/O bandwidth, cache memory, open files, threads, etc. A request is denied if any required resource cannot be obtained. In the contrary case, the request is passed on to the Bandwidth CAC, which tests if the client fits and admits or rejects the client accordingly. The swing capacity is computed by the flow optimizer 1430 on a periodic basis according to equations (14) and (17) as appropriate. The managed bandwidth must reflect the true capacity of the attached network and the adapters leading thereto. This parameter should not be set arbitrarily high to prevent rejection of client requests. Doing so will cause the system to admit calls that cannot be properly handled, thereby diminishing the quality of the viewing experience.

[**00109**] Having admitted a client, block 1430 creates a client session block 1435, which then begins to converse with its client-resident counterpart, 1480) during their launch phase. Thereafter, the flow optimizer 1430 assumes control, and modulates flow over the session until either all content is delivered, or a failure to deliver is detected, or one of a number of VCR-like stream control events intervene (e.g. pause, rewind, fast-forward).

Server and Client Session Control Blocks

[**00110**] Data Transport Channel 1450 is responsible for transporting data packets originating from the flow regulator 1440 within the server to the former's peer entity 1460 within the client. The mode of communication between the peer entities may be connection-oriented (e.g. TCP, which delivers a byte stream in order, without duplication or loss) or datagram-oriented (e.g. UDP). Best-efforts datagram service is typically enhanced with acknowledgements to facilitate rapid recovery from occasional packet loss, out-of-sequence delivery, and duplication.

[00111] Peered session control channels 1445 and 1465 permit configuration and status data, together with miscellaneous commands, to be sent from client to server and vice-versa. A reliable connection-oriented transport service is typically employed for this purpose (e.g. TCP). Data and commands alike are multiplexed over this channel in the service of other entities within the clients or server. Thus, a datagram-oriented data transport channel 1460 within a client 1485 might employ the session control channel to ferry selective acknowledgements to its peer in the server. Similarly, the flow meter 1465 within the client 1485 forwards the measured flow rate to the associated flow regulator 1440 within the server.

[00112] The flow regulator 1440 obtains content data from a cache or disk, at the current offset into the content file, which it forwards as packets to the data transfer channel 1450. The size and/or pacing of the packets are determined by the flow regulator 1440 in order to achieve the flow rate set-point imposed by the flow optimizer 1430. The flow regulator 1440 is also responsible for determining the channel flow capacity to the client, which is the least of a configured value obtained from the client and a measured value. Toward this end, during the launch phase, the flow regulator 1440 might send content data packets to the client flow meter 1475 in a series of packet trains at progressively higher peak flow rates ending with the configured maximum flow rate, if any. The highest measured flow rate reported by the client flow meter 1475 is accepted as the flow rate capacity, which is posted for use by the flow optimizer 1430. Subsequently, the flow regulator 1440 will compare the flow rate set-point with the flow rates reported by the flow meter 1465, and down grade capacity as needed should the measured flow rate fall consistently fall below the requested flow rate. Whenever such a downgrading occurs, the flow regulator 1440 will test for subsequent

relaxation of a transient constriction by means of the aforementioned series of packet trains in which the peak packet flow rate exceeds the delivered flow rate.

[00113] The buffer manager 1470 accepts data from the flow meter 1465, which data is retained until it is consumed or passed over the content consumer 1480. The buffer will typically be implemented as a ring buffer in memory or on disk. The write cursor will lag the read cursor by a no less than a specifiable time interval so as to permit rewinds of acceptable scope without requiring selective data re-retrieval from the server.

Flow Optimizer 1430

[00114] The flow optimizer 1430 assumes control over a session once it has been launched, and its channel capacity has been determined. Subsequently, it modulates the flow rate set-point of every session such as to optimize aggregate flow or charges across all active sessions, subject to a variety of min/max constraints on sessions flows, and a maximum constraint on aggregate session flow, as previously discussed.

[00115] The flow optimizer 1430 continues to modulate session flow until all content has been delivered, or one of a number of session anomalies intervene, as follows:

[00116] A downgraded session flow capacity drops below the minimum session flow rate. The session is dropped by the optimizer 1430 as a solution involving this channel does not exist. The user is forced to apply for re-admission, with the option of accepting slower than real-time delivery at the present encoding rate, or accepting a degraded viewing experience at a reduced encoding rate better adapted to the presently available bandwidth.

[00117] A pause VCR command is received from the client. Flow to the client can continue until the client-side buffer is topped off, after which time flow drops to zero. The session is permanently dropped should the pause persists too long. Until that time, the CAC safety margin is temporarily increased by the jit (Just-In-Time) flow rate of the paused session. In this way the session can be resumed without the need for re-admission and the jit bandwidth is made available to currently sessions so long as the pause persists.

[00118] A VCR Jump-Forward command is received from the client. This action is problematic as it causes the just-in-time flow rate (calculated at the new forward offset) to increase, in violation of the assumptions of the CAC algorithm. It must be noted that this violation will occur even if the content that is sought has already been delivered to the client-side buffer. One workable policy is to force the client to apply for re-admission at the forward offset and with a suitably modified buffer level.

[00119] A VCR Jump-Backward (Rewind) command is received. This action may entail the need for re-transmission of content, as previously discussed. The just-in-time flow rate will decrease as per the new position and adjusted buffer contents.

Tunable Minimum Constraint

[00120] A parameterized family of minimum flow constraints can be defined as follows:

(22)

wherein: $f_k(t)$ = Target content flow rate for session k;

$f_k^{JIT}(t)$ = Just-in-time flow rate for session k;

(RHS of Equation (5))

β = Burst tuning factor (positive or zero); and

$f_k^{min}(t)$ = Minimum (reserved) flow rate for session k.

[00121] This family converges on $f_k(t) >= f_k^{JIT}(t)$ when β approaches 0. A β value of .1, for example, ensures a minimum flow rate that exceeds the JIT flow rate by 10%. Thus, non-zero values of β force early delivery of content to a player's media buffer, with beneficial effects on the viewing experience.

Alternative Call Admission Control

[00122] The traditional CAC algorithm compares the flow rate requirement of a prospective client with the unused bandwidth (obtained by subtracting the aggregate flow target from the server flow capacity) and grants service if unused bandwidth is not exceeded. This procedure may break down as the optimizer causes all available bandwidth to be used if it can, thereby reducing unused bandwidth to zero in the best case, even when a new client could be accommodated with a healthy margin to spare.

[**00123**] Nevertheless, a simple variation on this idea can be used. Available bandwidths can be defined as the difference between server flow capacity and the sum of minimum flow rates for each session computed according to (22) as follows:

(23) $f_{available} = f_{Svr}^{max} - (f_1^{min} + \ldots + f_n^{min})$

wherein: $f_{available}$ = Available bandwidth

f_{Svr}^{max} = Server aggregate flow capacity; and

f_n^{min} = Minimum (reserved) flow rate for session n.

[**00124**] Service is granted if the computed minimum flow rate of the prospective client is less than available bandwidth even when unused bandwidth is zero.

Toward a Tunable QOS

[**00125**] In the preceding discussion it is assumed that all clients share the same value of β. One might also consider a scheme whereby a client receives a β value according to the class/cost of service that client has signed up for: the greater the cost (and expected quality of service, or QOS) the greater the value of β.

[**00126**] Instead of maximizing charges by the methods described above, a variation on the algorithm to maximize flow is considered whereby the reserve flow computation for every session takes into account the individual β value of the associated client. In this fashion a single algorithm can serve either end. The optimizer first ensures that every session receives its required minimum bandwidth (which would now typically depend on β and elapsed session time) before allocating any excess bandwidth more or less evenly to all by interpolation. (According to Figure 15.)

[**00127**] The scheme is simpler computationally than the iterative interpolation method shown in Figure 16; it is also arguably more fair and stable with respect tot he allocation of available bandwidth.

Deadline-Driven Content Distribution

[**00128**] In delivering viewable or audible content to a player, the optimization algorithm imposes a minimum flow rate that ensures that all content is delivered by the implied deadline, which is the last moment of a play session. Notwithstanding, the optimizer attempts to deliver content earlier according to bandwidth availability within the server taken as a whole. A similar, though far simpler scenario arises relative to the distribution of content from an optimized server to a target device, whenever the delivery must be accomplished by a designated time, or equivalently, within a given elapsed time, and when overlapped non-blocking consumption of the content at a fixed rate is not required.

[**00129**] One example concerns the application where a session bundle comprises a session associated with the featured program together with sessions for every advertisement scheduled to interrupt the feature program at a designated time. Each session is endowed with a separate media buffer, which, in the case of ads, would typically be large enough to accommodate the ad in full, thereby permitting a seamless transition to the ad at the appointed time.

[**00130**] In adapting the optimizer to the needs of content distribution we must revisit the formulation of the flow constraints, as follows:

1. Media buffers are not of a concern, let alone buffer overflow, and it can be assumed that all content received is saved away in a file on disk, or in memory awaiting further use.

2. For these same reasons, the value of β may be zero, at which the minimum flow rate equals the just-in-time rate obtained by dividing the content as yet undelivered by the time till deadline:

(24) $f_k^{JIT}(t_k) = L_k^{TOGO}/(T_k - t_k)$

wherein: L_k^{TOGO} = Content to go for session k, i.e., as yet undelivered by the server at time t, (client.lookup (k).session.payloadToGo).

Given the arbitrary format of the file to be distributed, T no longer signifies the "duration of play" at the average play rate (averagePlayRate); rather, T represents the elapsed time to the deadline measured at the moment the delivery session was launched, and t represents the elapsed time since session launch.

Session Bundles

[00131] A session bundle is a set of sessions that flow along a shared channel, and are thus subject to an aggregate flow constraint equal to the capacity of the shared channel. One important application of session bundles is connected with ad insertion.

[00132] It is not enough to treat each of the constituent sessions as independent with respect to the flow optimizer, for this practice might well result in session flow targets that do not exceed channel capacity when considered singly, yet exceed this same shared capacity when summed together.

[00133] A solution to this problem involves two distinct steps:

1. The sessions bundle is treated as a virtual session by the server optimizer, subject to the minimum flow constraint obtained by summation of the individual session minima, and a maximum constraint that is the least of (a) the sum of the least of constraints (3) and (4) for each session, and (b) the shared

channel capacity client.lookup(k).channel.maxFlowRate (f_k^{cap}). The flow optimizer then generates an aggregate flow target for all channels virtual sessions by interpolation, using:

(25) $Cost(t) = f_1(t)+..+f_n(t)$

[00134] The cost vector in this instance is the n-dimensional unit vector, where n is the number of active clients.

(26) $c=(1, 1,....,1)$

[00135] Now it is possible to have an achievable aggregate flow target for the session bundle k that we must apportion optimally among the constituent sessions. Fortunately for us, our interpolation procedure of Figure 15 can be applied again to the sessions in our bundle, but where the aggregate flow target generated above replaces the aggregate flow constraint f_{svr}^{max}

Specifically:

For every flow f_{ki}, within session bundle k, the optimal flow rate is obtained by interpolation between minimum and maximum session flows:

(27) $f_{ki}^{opt} = f_{ki}^{min} + \alpha * (f_{ki}^{max} - f_{ki}^{min})$

(28) $\alpha = [(f_K^{bundle} - f_{k1}^{min} + ...f_{kn}^{min})]/[(f_{k1}^{max} - f_{k2}^{min}) + + (F_{kn}^{max} - f_{kn}^{min})]$

and the value of f_k^{bundle} is obtained from a higher level optimization in which session bundle k is treated as a virtual session for which:

(29) $f_k^{min} = f_{k1}^{min} + ... + f_{kn}^{min}$

(30) $f_k^{max} = \min(f_{k1}^{max} + .. + f_{kn}^{max}, f_k^{cap})$

It must be noted that session bundles are typically dynamic in nature, outliving many if not all of their constituent sessions. Before a session is added to the bundle two CAC decisions must be reached:

(1) establish bandwidth availability within the bundle; and

(2) bandwidth availability within the server.

Relationship to Adaptive Rate Control

[**00136**] The flow optimization methods should be viewed as constituting the lowest and perhaps only the first of many supervisory control layers to sit astride all streaming sessions, which comprise their own hierarchical stack of control functions; rate adaptive control sitting above a flow rate regulator which relies on a transport entity.

[**00137**] Channel capacity is known to vary widely over time. A capacity drop to below the minimum reserve flow rate is problematic as it causes the latter to rise in violation of its monotonicity assumption. In a server with available bandwidth to spare such a rise can be accommodated by the flow optimizer (by bumping the session's minimum flow reservation to the higher value) provided the flow deficit can be made up in the near term by draining pre-delivered content from the media buffer. Should either of these resources approach depletion, stream degradation to a lesser bit-rate or frame rate may be the only viable option short of a pause. Whether up or down, any rate change is a change to *fe*, which must be preceded by change to session's reserve flow rate allocation by the optimizer.

[00138] As can be seen, the optimizer and rate adapter must be integrated with care. One possible approach would be to modify a rate adapter such that it renegotiates its proposed *fe* value with the flow optimizer prior to effecting the rate change it deems appropriate based on information provided by the flow regulator. Rate increases might well be subject to deferral under heavy load conditions, awaiting bandwidth availability. The opposite is true of rate flow decreases: these would be forestalled as long as possible by the optimizer on a system that is not fully loaded, as previously discussed.

Live Events

[00139] Referring to Figure 17, the method of the present application can be extended to the optimization of "live", time-shifted "near-live" events, and cascaded delivery, wherein one server delivers content to another while the latter accepts clients for the same content. The extension assumes the following characteristics of the server and the live performance:

1. The performance is of a fixed duration T known in advance, encoded at an average rate *fe*, with a projected content payload of *fe*T*;

2. The origin server at the point of injection delays the stream by a small dwell time T^{DWELL} on the order of seconds (e.g. 10). Notwithstanding, the delayed content is available for early delivery to mirrored servers and players with the aim of providing these with a modicum of isolation from network jitter affecting the timely delivery of the live video frames.

3. Throughout the live event, captured content is stored in a file, thereby permitting late joiners to view the "live event" starting from any point between the present and the event start time;

4. At the conclusion of the live event, the encoded content, now fully captured to a file, is available for viewing over the balance of the admission window (e.g., 60 minutes in Figure 17).

[00140] The optimisation of live events and video on demand (VOD) differ principally in one respect, namely in the formulation of the server content underflow constraint.

For VOD, this constraint is

(31)

$L_k^{TOGO}(t)$ is initialised to the content size (*fe*T*) at that start of play, and decremented as content is delivered to the client. Δt is the time interval between successive periodic optimizations (e.g. 1 second). In practice this constraint rides

well above other operative maximum flow constraints (e.g. buffer overflow, channel capacity) until the very last calculation of the session flow target by the optimiser.

[00141] For a live stream, this constraint must additionally reflect the fact that content is streaming into the server (where it builds up), even as the server streams it out toward clients, and that the latter activity cannot possibly overtake the former.

[00142] Referring to Figure 17, (which illustrates how optimised live streams behave) line L1 depicts the build-up of freshly captured content to the server. Line L2, which is delayed (time-shifted) relative to L1 by the dwell time T^{DWELL}, represents the live performance as cast and viewable by clients. One such client is admitted at time A and joins the live session at the live moment B. The dashed curved line linking points B and C shows a plausible build-up of content in the client's media buffer in advance of play, as the viewer continues its advance along line L2. Past point C the top of the media buffer tracks the live capture stream and thenceforth advances along line L1. In this instance, the time shift between the live performance as cast (L2) and the live performance as captured (L1) imposes a maximum on the amount of content that could ever accumulate in a client media buffer, irrespective of its actual capacity.

[00143] Another client, admitted at time t=10, is interested in viewing the live stream from the beginning without missing anything. As before, the dashed line joining 10 and D depicts a plausible build-up of content in the client's media buffer in advance of play, as the viewer continues its advance along line L3, which is time-shifted by $(10+T^{DWELL})$ minutes relative to L1. The greater time shift (now between L1 and L3) permits more extensive pre-buffering of "near live" content.

[00144] The present constraints do not impose suitable flow limits at and beyond points C and D when the client delivery streams finally links up with the live capture stream, in the live moment. Consequently the optimiser may propose flow targets that cannot be realized.

[00145] Accordingly, the following modification for use in connection with live or cascaded streams is made:

(32) $f_k(t) <= [(L_k^{TOGO}(t) - Live^{TOGO}(t)] / \Delta t$

for a live event delivered at flow rate *fe*, we have

(33) $Live^{TOGO}(t) = \max(fe*(T-T^{DWELL}-t), 0)$

[00146] $Live^{TOGO}(t)$ is the span between projected content size *fe* **T* (level line L0 in Figure 17) and the content capture level line L1, whereas $L_k^{TOGO}(t)$ is the gap between L0 (i.e., *fe* * *T*) and the dashed curved line representing the content level delivered to the media buffer. The latter must always exceed the former. As the two approach one another this constraint takes effect, causing $L_k^{TOGO}(t)$ to always exceed $Live^{TOGO}(t)$ as it decreases at rate *fe*.

[00147] Viewers joining late and willing to see the live performance with some delay relative to the live case enjoy higher potential levels of isolation from network disturbances, and thus QOS, by virtue of their greater effective buffer capacity. By the same token, such viewers afford the optimizer greater latitude to optimize the flow of VOD and "live" content across load fluctuations, thereby enhancing server capacity. Viewers that wish to experience the live event in "real-time" nevertheless benefit by a modestly enhanced QOS conferred by a dwell time's worth of content in their buffers.

Summary

[00148] A method and system for call/connection acceptance and flow modulation for network delivery of video/audio programming is thus provided. Although several embodiments have been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made without departing from the spirit of the invention or the scope of the claims.

CLAIMS:

1. A method of bandwidth allocation for delivery of stored digital content from at least one server device to at least one client device by way of a network, the method comprising the steps of:

a) prescribing a control variable which represents a target flow rate from the server device to each client device;

b) determining time-varying constraints on the flow rate of the content;

c) determining a cost function of the control variables for all clients; and

d) prescribing bandwidth to all clients based upon the value of the control variables that maximize the cost function.

2. The method of Claim 1 wherein step (d) comprises performing periodic computations to update the value of the control variable such that the bandwidth can be continuously allocated to each client.

3. The method of Claim 2 wherein a new client is accepted by:

i) determining an admission capacity of the bandwidth;

ii) admitting a prospective client if the clients minimum allowed value of the control variable is less than the admission capacity; and

iii) wherein a client admitted for service is guaranteed to have sufficient content flow over the entire session.

4. The method of Claim 3 wherein:

The admission capacity equals a server swing capacity reduced by a predetermined safety margin which may be zero, the swing capacity equaling the difference between the server flow capacity and the sum of the minimum allowed flow rate for all clients.

5. The method of Claim 4 wherein the minimum allowed value of the control variable is initialized to the average consumption rate.

6. The method of Claim 4 wherein the minimum allowed value of the control variable is initialized to the average consumption rate multiplied by a factor greater than one.

7. The method of Claim 4 wherein the server flow capacity varies in a step-wise function over time according to a predetermined schedule and the method of accepting a new client further comprises:

i) determining a sequence of future step changes of server flow capacity;

ii) determining at each time in the sequence of future step changes the value for a future worst swing case capacity, the worst case swing capacity being obtained from the server flow capacity at the time by subtracting an extrapolated present minimum allowed flow rate for all active clients that are potentially active in the future;

iii) admitting a prospective client if a minimum allowed value of the control variable is less than the capacity obtained from the sequence and the present capacity;

iv) whereby a new client can be admitted without compromising the service to existing clients in the presence of previously scheduled server flow capacity changes and all clients accumulate content in their buffers to the extent of their respective buffer capacity.

8. The method according to Claim 7 wherein the method of accepting a new client further comprises:

i) partitioning the available bandwidth into partitions representing a prescribed service charge;

ii) determining a maximum-minimum capacity for a service charge to be the maximum allowed sum of all minimum allowed flow rates for all clients incurring an equal or lesser service charge, the maximum-minimum capacity equaling the sum of bandwidth allocations for all service charges less than or equal to the service charge;

iii) determinating a service-charge-specific swing capacity for a given service charge as the difference between the maximum-minimum capacity for the service charge and the sum of all minimum allowed flow rates for all clients incurring the service charge or a lesser service charge;

iv) determining the server swing capacity to be the server flow capacity minus a margin and minus the sum of the minimum allowed flow rate for all clients; and

v) determining the service-charge-specific capacity to be the least of the server swing capacity and the charge specific swing capacity.

9. The method of Claim 8 wherein the method of accepting a new client further comprises:

i) determining the sequence of future times of step changes to server flow capacity over a proposed consumption period;

ii) determining for each time in the sequence of future times, the future worst-case value for the service-charge-specific capacity, the worst case value being obtained by using the extrapolated present minimum allowed flow rate of all presently active clients that are potentially active at the time in the future; and

iii) admitting a client incurring a given service charge if the minimum flow rate of the client is less than the capacity obtained from the sequence and the present service-charge-specific capacity.

10. The method of Claim 3 wherein step (b) comprises determining time-varying constraints wherein:

i) an aggregate flow rate for all clients does not exceed a predetermined server flow capacity;

ii) the flow rate from the server to the client does not exceed a maximum allowed flow rate for the client;

iii) the flow rate to the client will never cause a buffer of the client to overflow;

iv) the flow rate to the client stops when the content is exhausted; and

v) the flow rate from the sever will never be less than the client's minimum allowed flow rate which may vary over time and may be zero.

11. The method of Claim 10 wherein the maximum allowed flow rate to the client is given by the minimum of one selected from the following:

i) a client flow rate ceiling;

ii) the flow rate required to fill the client buffer before the next periodic computation; and

iii) the flow rate required to complete the delivery of the content before the next periodic computation.

12. The method of Claim 11 wherein:

i) the minimum allowed client flow rate cannot increase over time, but may decrease such that the initial value of the control rate is no less than the average consumption rate;

ii) the control variable for the client is always greater than or equal to the current minimum allowed client flow rate; and

iii) the client buffer will never underflow until the content is fully consumed at the average consumption rate.

13. The method of Claim 12 wherein the minimum client flow rate is the product of the constant content flow rate from the client to the server that causes the last piece of content to be delivered at the last possible moment as the client buffer is being drained at the average consumption rate, with a factor greater or equal to one.

14. The method of Claim 13 wherein the minimum client flow rate is initialized to the average consumption rate.

15. The method of Claim 13 wherein the minimum client flow rate is initialized to the average consumption rate multiplied by a factor greater than one.

16. The method of Claim 13 further comprising the step of calculating the minimum client flow rate periodically.

17. The method of Claim 1 wherein the cost function represents an aggregate flow rate and is the sum of the flow rates for all clients.

18. The method of Claim 1 wherein the cost function represents a service charge and is the sum of the client flow rates multiplied by the client's cost of service.

19. The method of Claim 18 wherein:

step (a) comprises:

i) determining a maximum allowed flow rate and a minimum allowed flow rate for each client;

ii) determining a flow rate range for each client as the difference between the maximum allowed flow rate and the minimum allowed flow rate; and

iii) initializing a current flow rate for each client as the minimum allowed flow rate and summing the flow rate into the total server flow rate; and

step (d) comprises:

i) computing remaining server bandwidth as the difference between the maximum server flow capacity and the total server flow rate; and

ii) allocating remaining server bandwidth to remaining clients wherein all clients with a given cost of service receive bandwidth equally to the extent of their respective ranges, and no client with a given cost of service being allocated bandwidth unless all clients with a higher cost of service have received their maximum possible allocation of bandwidth.

20. The method of Claim 17 wherein step (a) prescribing the control variable comprises:

i) forming a hyperplane of control variables that aggregate to the maximum allowed aggregate flow rate;

ii) computing a first vector of minimum allowed client flow rates;

iii) computing a second vector of maximum allowed client flow rates;

iv) determining a multi-dimensional shape of which an interior diagonal spans the first and second vectors; and

v) finding a solution of control variables at the point of intersection between the diagonal and the hyperplane.

21. The method of Claim 20 wherein step (v) comprises finding a solution of control variables at the second vector if there is no point of intersection between the diagonal and the hyperplane.

22. The method of Claim 17 wherein step (a) comprises:

i) computing the sum of the minimum allowed flow rates to all active clients;

ii) computing the sum of the flow rate ranges for all active clients;

iii) computing the difference between the maximum allowed aggregate flow rate and the sum of the minimum;

iv) computing a factor as the ratio of the difference over the sum of the ranges;

v) if the factor exceeds 1, the control variable is set to the maximum allowed client flow rate; and

vi) if the factor is less than 1, computing the control variable by multiplying the client range by the factor and then adding the result to the minimum allowed client flow rate.

23. The method of Claim 17 wherein:

step (a) comprises:

i) determining the maximum allowed flow rate and minimum allowed flow rate for each client;

ii) determining the flow rate range for each client as the difference between the maximum flow rate and the minimum flow rate; and

iii) initializing the control variable for each client as said minimum allowed flow rate and summing the flow rate into a total server flow rate; and

step (d) comprises:

i) computing remaining server bandwidth as the difference between the maximum server flow capacity and the total server flow rate; and

ii) allocating remaining server bandwidth to remaining clients to the extent of their respective ranges.

24. The method of Claim 23 wherein the step of allocating remaining server bandwidth further comprises the clients receiving the bandwidth equally to the extent of their respective ranges.

25. The method of Claim 17 wherein the maximized value of the control variable can be determined by:

i) determining a maximimum and minimum flow rate for each client;

ii) determining a range between the maximimum and mininmum flow rates in order to find a flow rate range;

iii) determining available bandwidth by finding the difference between an aggregate flow capacity and a sum of the minimum flow rate;

iv) determining a flow variable by dividing the unused bandwidth by the flow rate range;

v) prescribing the control variable to be the minimum flow rate added to the flow rate range if the flow varible is less than one or prescribing the control variable to be the minimum flow rate added to the flow rate range corrected by the flow variable if the flow favorable is greater than one such that the control variable is easily calculated for each client.

26. The method of Claim 17 wherein at least one session is a session bundle and:

1) the minimum flow constraint is computed as the sum of the minimum flow rate constraints for all bundled sessions;

2) the maximum flow constraint is the least of 1) the sum of the maximum individual flow rate constraints of each session and 2) the flow capacity of the channel shared among the bundled sessions; and

3) the target flow rate is computed for the session is apportioned among the bundled constituent sessions.

27. The method of Claim 26 wherein the bundled session is an advertisement.

28. A system for allocating bandwidth between a server device and at least one client device, the system comprising:

a call acceptance module operative to receive an incoming request for service;

a flow regulator configured to deliver content at a modulated target flow rate, the content being delivered between the server device and a respective client device when a call is accepted by the call acceptance module; and

a flow optimizer configured to modulate the target flow rate of the flow regulator in order to optimize the aggregate flow of content.

29. The system of Claim 28 wherein the flow optimizer is configured to modulate the flow rate of the flow regulator in order to optimize charges for the content.

30. The system of Claim 29 wherein the flow regulator is configured to deliver the modulated flow rate of content in response to the control variable.

31. The system of Claim 28 wherein the flow optimizer is configured to determine a control variable which corresponds to an optimized flow rate.

32. The system of Claim 31 wherein the flow optimizer is configured to generate a cost function of the control variable that corresponds to a maximized value of the control variable.

33. The system of Claim 28 wherein the flow regulator is configured to deliver the modulated flow rate of content in response to the control variable.

34. The system of Claim 28 wherein the flow optimizer is configured to determine a maximized value of the control variable by:

i) determining a maximum and minimum flow rate for each client;

ii) determining a range between the maximum and minimum flow rates in order to find a flow rate range;

iii) determining unused bandwidth by finding the difference between an aggregate flow capacity and a sum of the minimum flow rate;

iv) determining a flow variable by dividing the unused bandwidth by the flow rate range;

v) prescribing the control variable to be the minimum flow rate added to the flow rate range if the flow variable is less than one or prescribing the control variable to be the minimum flow rate added to the flow rate range corrected by the flow variable if the flow favorable is greater than one such that the control variable is easily calculated for each client.

35. The system of Claim 33 wherein the call acceptance module is configured to accept a call based upon the value of the control variable.

36. A method of bandwidth allocation for delivery of stored digital content from at least one server device to at least one client device by way of a network, the method comprising the steps of:

a) prescribing a control variable which represents a target flow rate from the server to each client device based upon the amount of buffer of the client;

b) determining time-varying constraints on the flow rate of the content;

c) determining a cost function of the control variables for all clients in response to the size of the client's buffer; and

d) prescribing bandwidth to all clients based upon the value of the control variables that maximized the cost function.

37. A method for apportioning a given total flow rate (bandwidth) among a plurality of sessions for clients, the method comprising the steps of:

a) computing a sum of minimum flow rate constraints for each session;

b) computing a sum of flow rate ranges for all active clients;

c) computing a difference between the given total flow rate and a sum of the flow rate minima;

d) computing a factor as the ratio of the difference over the sum of the flow rate ranges;

e) if the factor exceeds 1, setting the flow rate to the maximum allowed client flow rate; and

f) if the factor is less than 1, computing the flow rate by multiplying the client range by the factor and then adding the result to the minimum allowed client flow rate.

38. The method of Claim 37 wherein the clients are distinguished by their cost of service and bandwidth is apportioned to clients iteratively, the amount apportioned to each client in a cost category is the amount remaining from prior allocations to clients in higher cost categories.

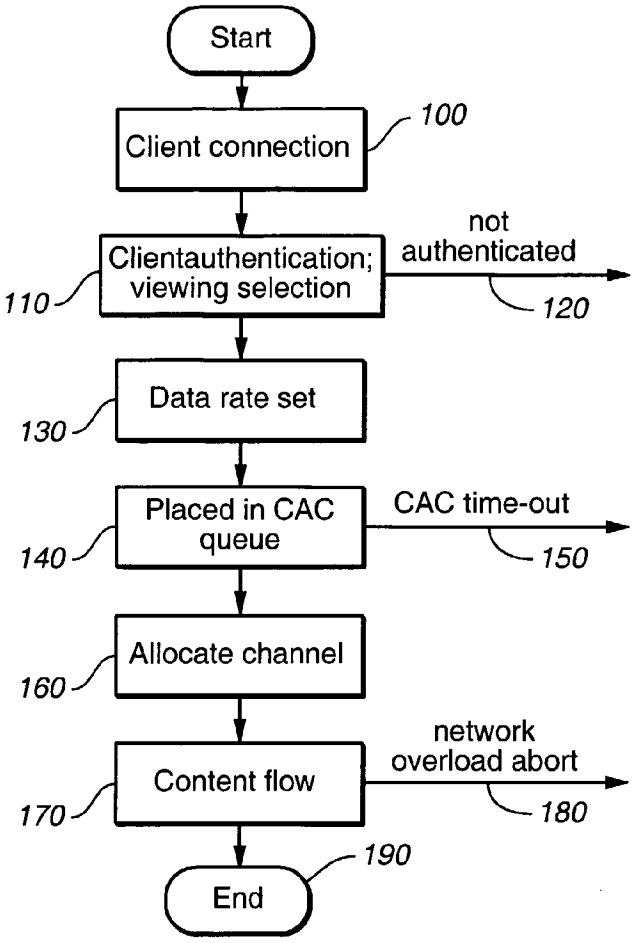
Start
Client connection
100
Clientauthentication; viewing selection
not authenticated
110
120
Data rate set
130
Placed in CAC queue
CAC time-out
140
150
Allocate channel
160
Content flow
network overload abort
170
180
End
190

FIG._1

SUBSTITUTE SHEET (RULE 26)

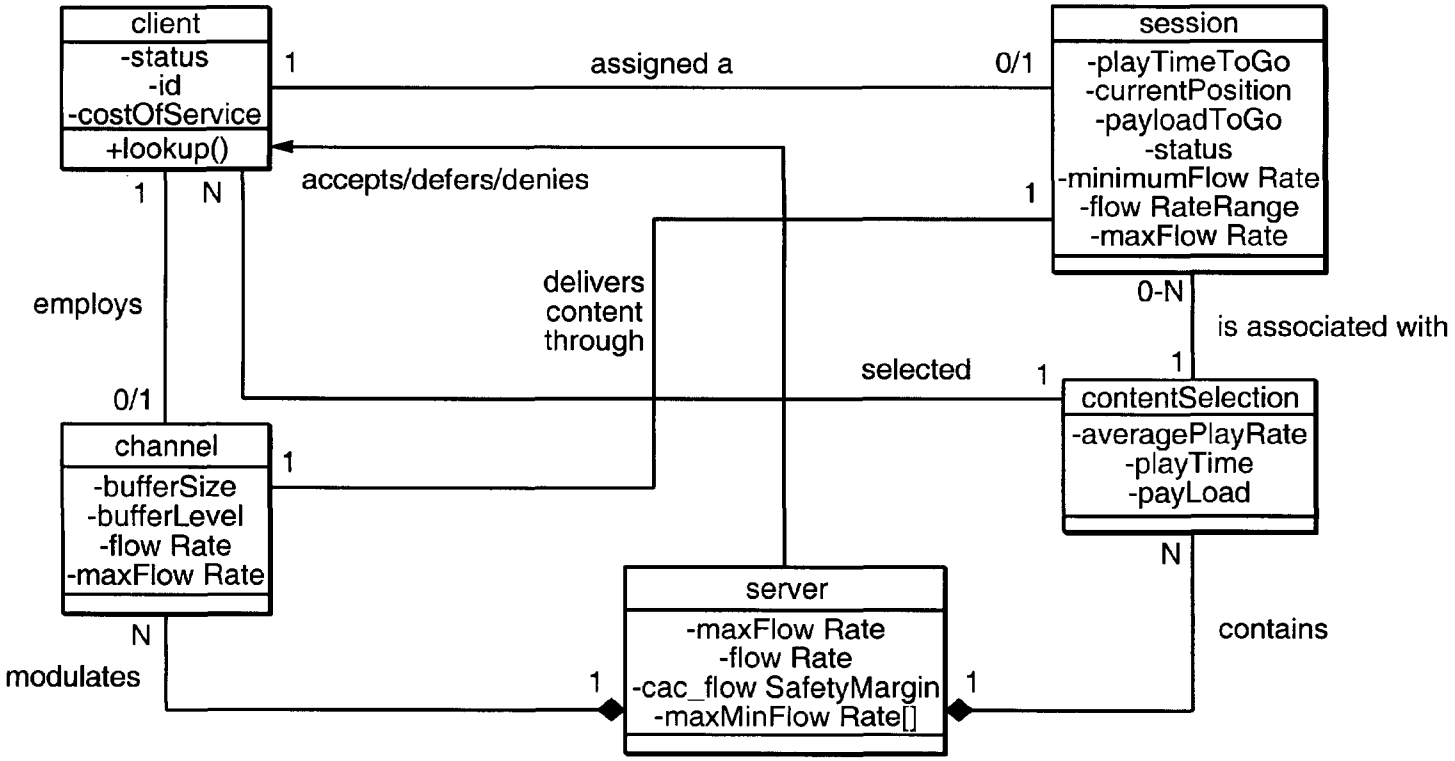

FIG._2

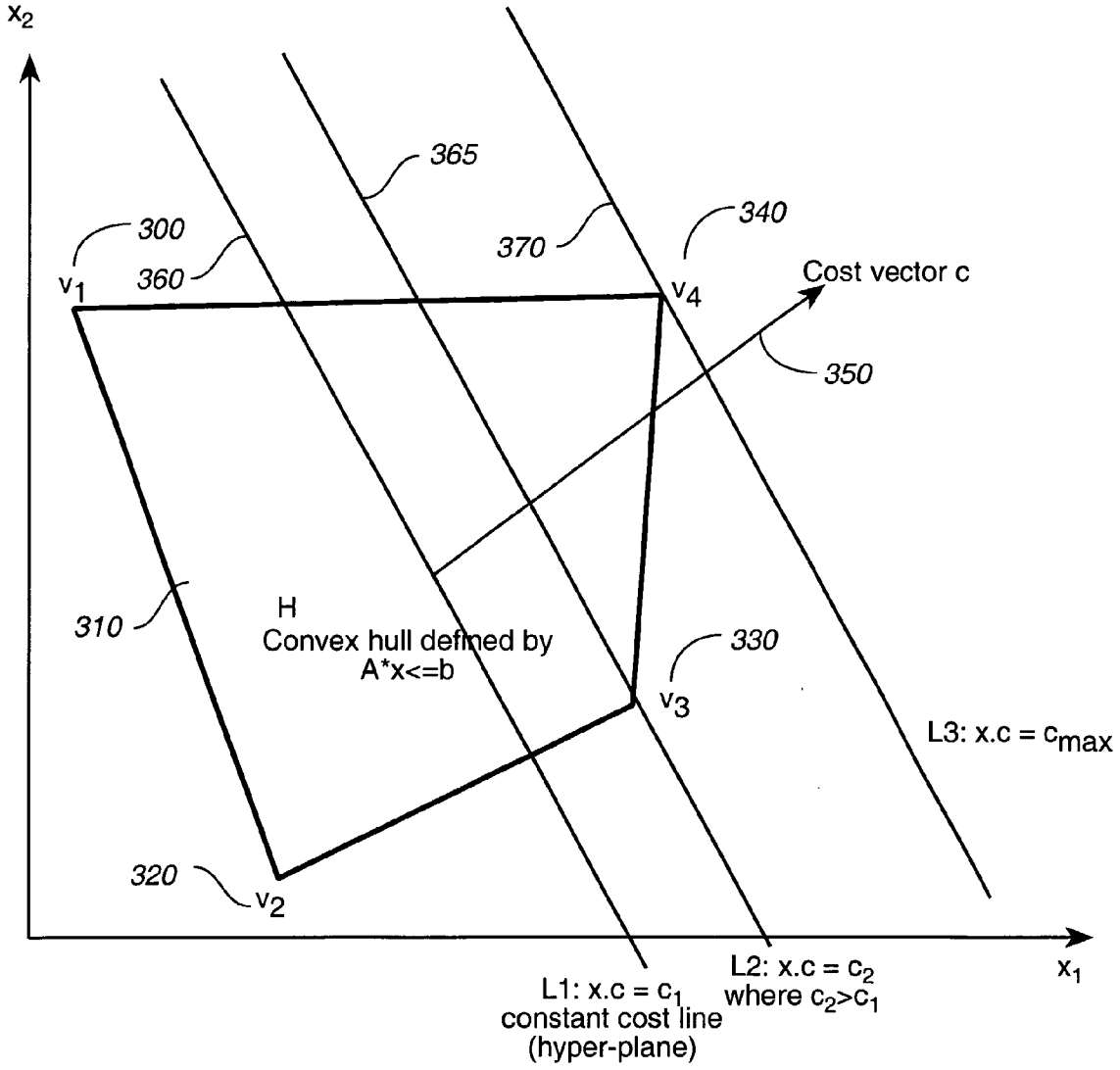
x2
365
300
360
370
340
v1
v4
Cost vector c
350
310
H
Convex hull defined by
A*x<=b
330
v3
L3: x.c = cmax
320
v2
x1
L1: x.c = c1
constant cost line
(hyper-plane)
L2: x.c = c2
where c2>c1

FIG._3

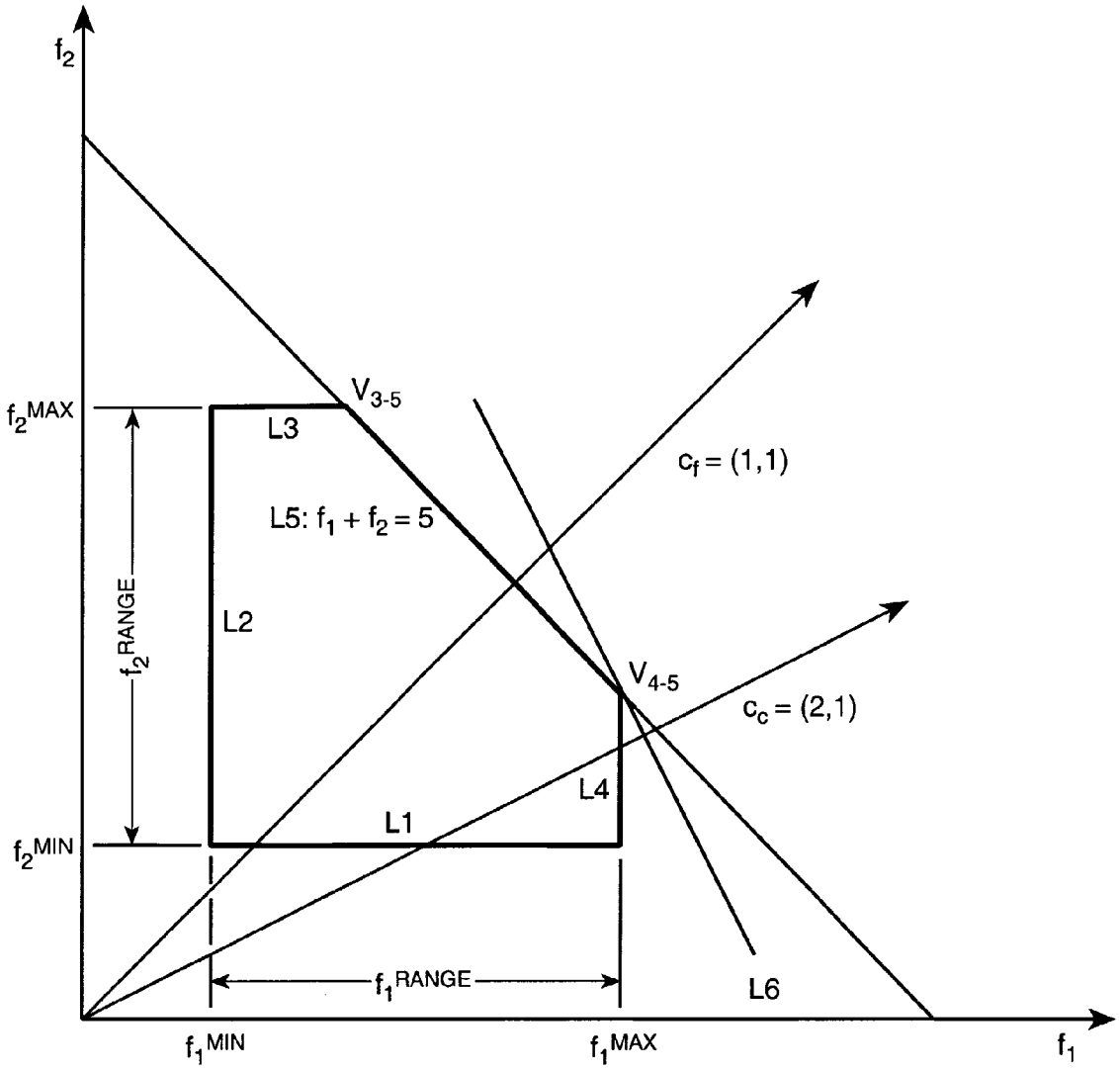
f_2
f_2^{MAX}
f_2^{MIN}
f_2^{RANGE}
V_{3-5}
L3
L5: $f_1 + f_2 = 5$
L2
V_{4-5}
L4
L1
f_1^{RANGE}
f_1^{MIN}
f_1^{MAX}
f_1
$c_f = (1,1)$
$c_c = (2,1)$
L6

FIG._4a

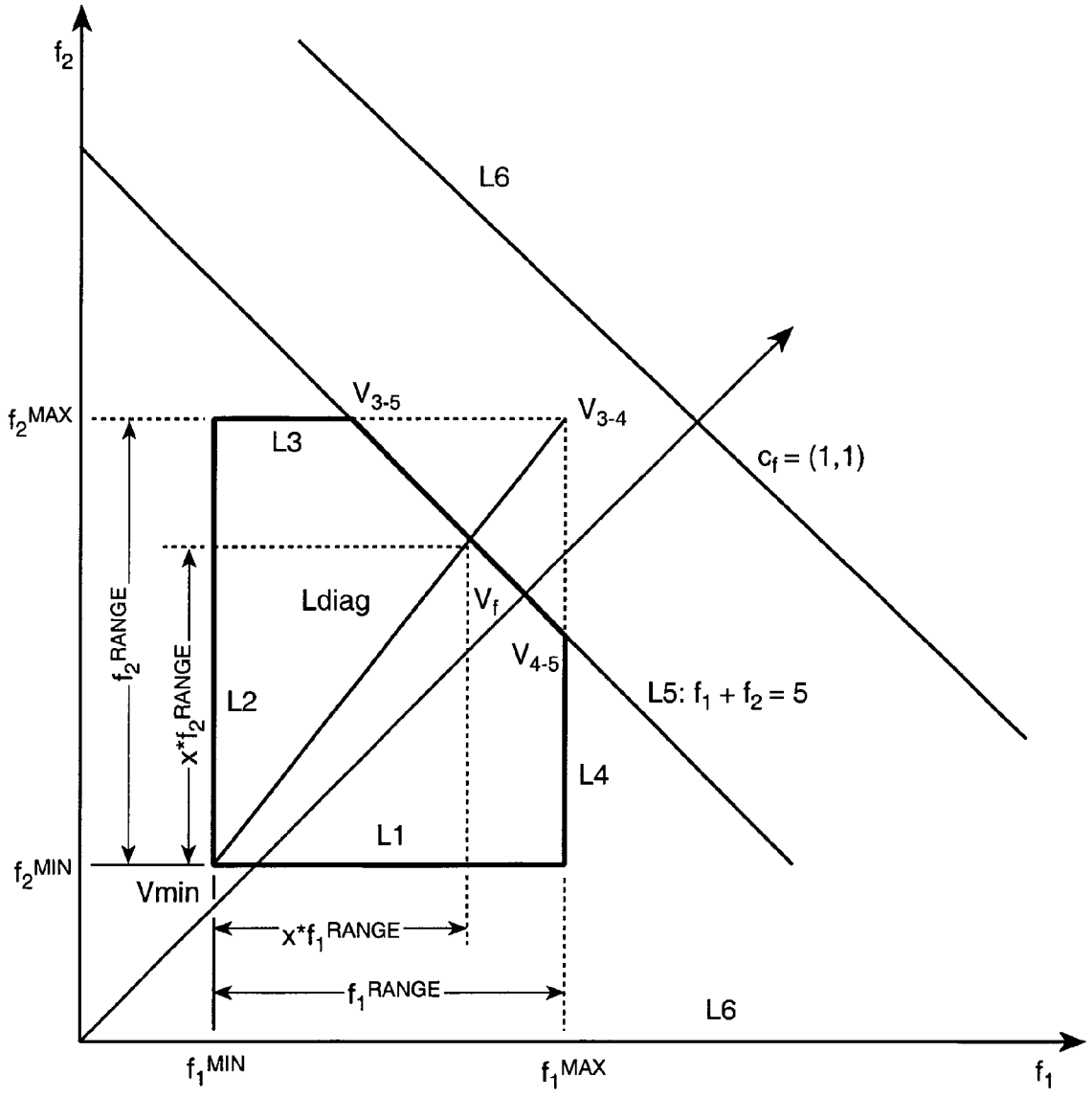
f2
L6
f2MAX
V3-5
V3-4
L3
cf = (1,1)
Ldiag
Vf
f2 RANGE
x*f2 RANGE
V4-5
L2
L5: f1 + f2 = 5
L4
L1
f2MIN
Vmin
x*f1 RANGE
f1 RANGE
L6
f1MIN
f1MAX
f1

FIG._4b

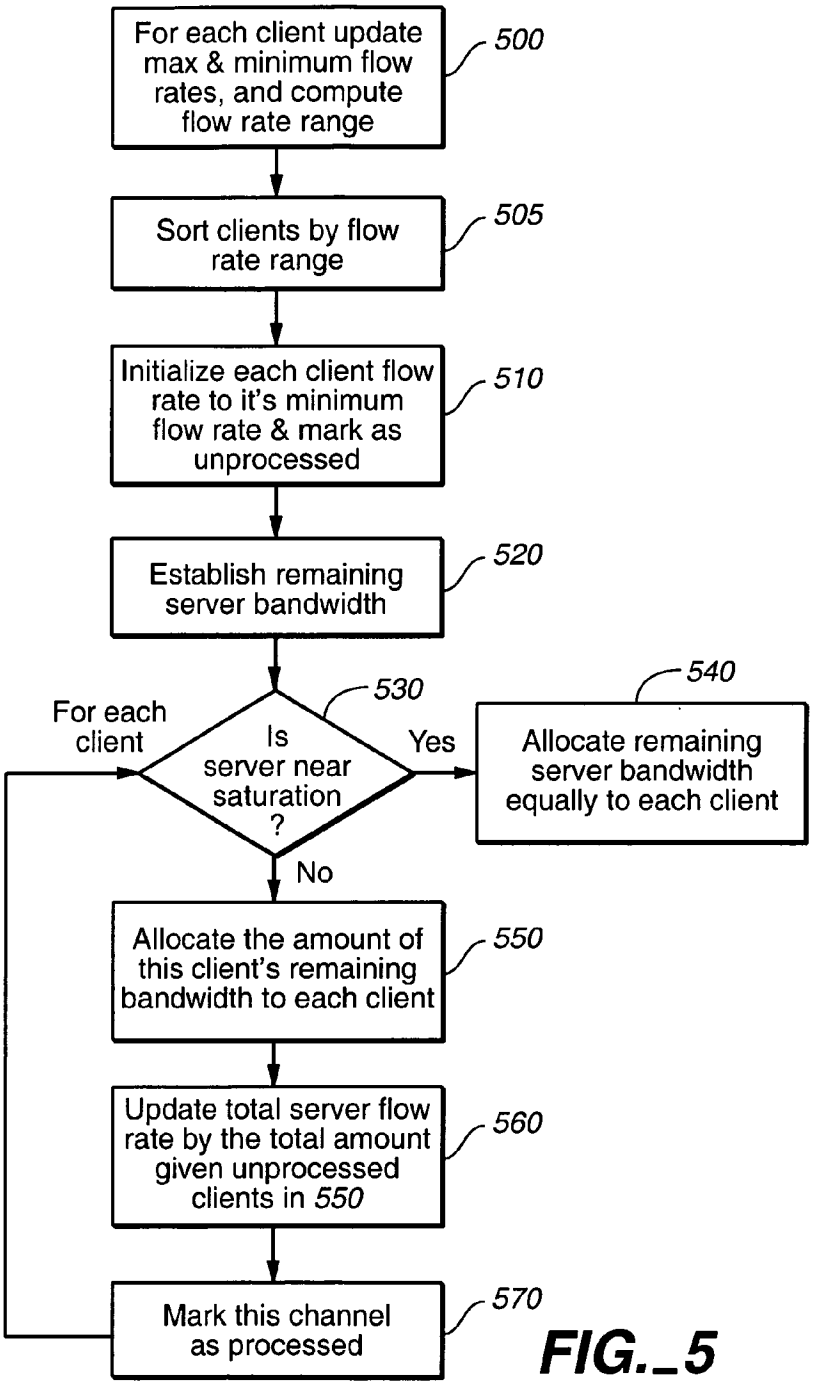
For each client update max & minimum flow rates, and compute flow rate range
500
Sort clients by flow rate range
505
Initialize each client flow rate to it's minimum flow rate & mark as unprocessed
510
Establish remaining server bandwidth
520
For each client
Is server near saturation ?
530
Yes
Allocate remaining server bandwidth equally to each client
540
No
Allocate the amount of this client's remaining bandwidth to each client
550
Update total server flow rate by the total amount given unprocessed clients in 550
560
Mark this channel as processed
570

FIG._5

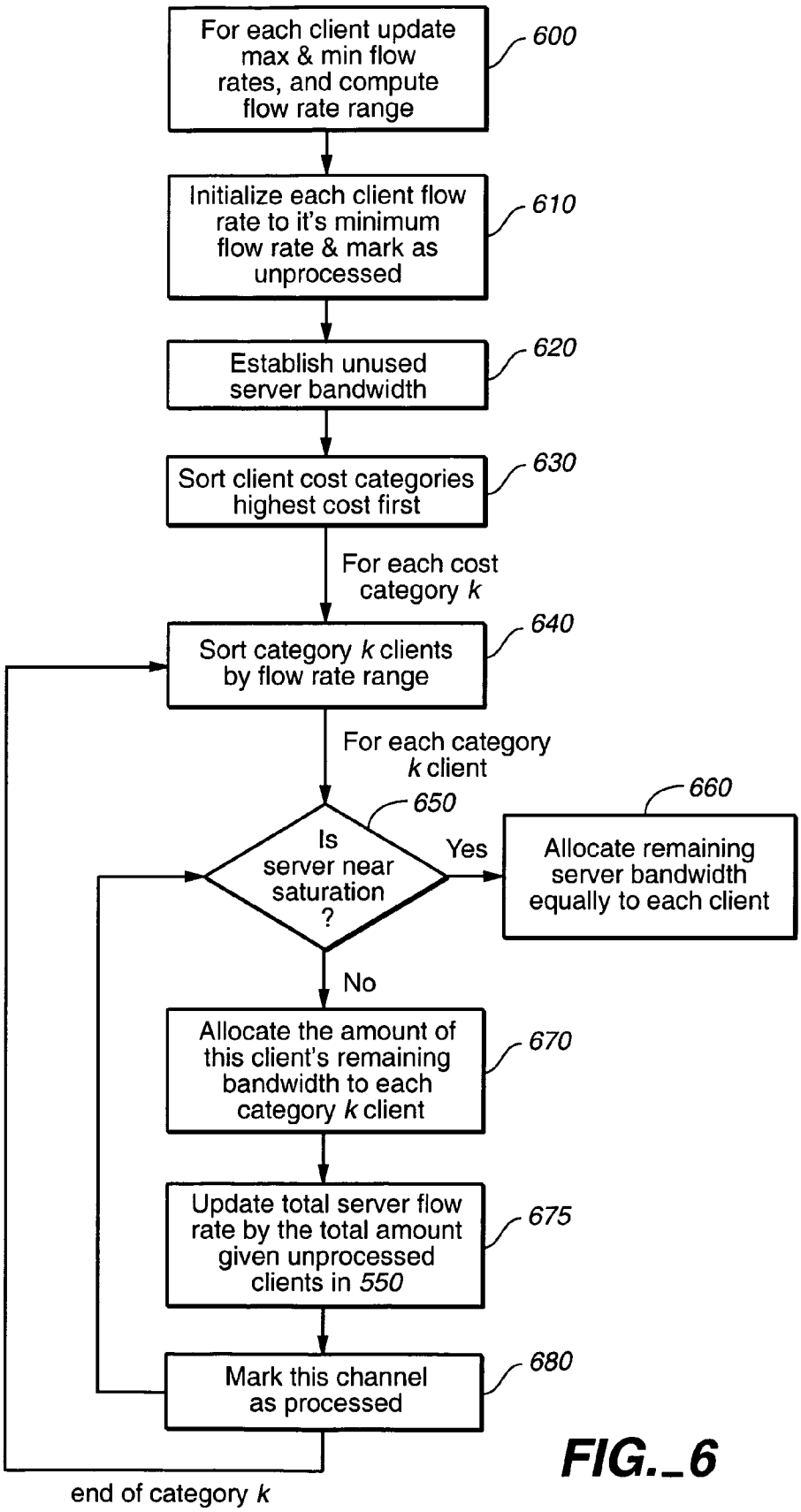
For each client update max & min flow rates, and compute flow rate range
600
Initialize each client flow rate to it's minimum flow rate & mark as unprocessed
610
Establish unused server bandwidth
620
Sort client cost categories highest cost first
630
For each cost category k
Sort category k clients by flow rate range
640
For each category k client
650
Is server near saturation ?
Yes
660
Allocate remaining server bandwidth equally to each client
No
Allocate the amount of this client's remaining bandwidth to each category k client
670
Update total server flow rate by the total amount given unprocessed clients in 550
675
Mark this channel as processed
680
end of category k

FIG._6

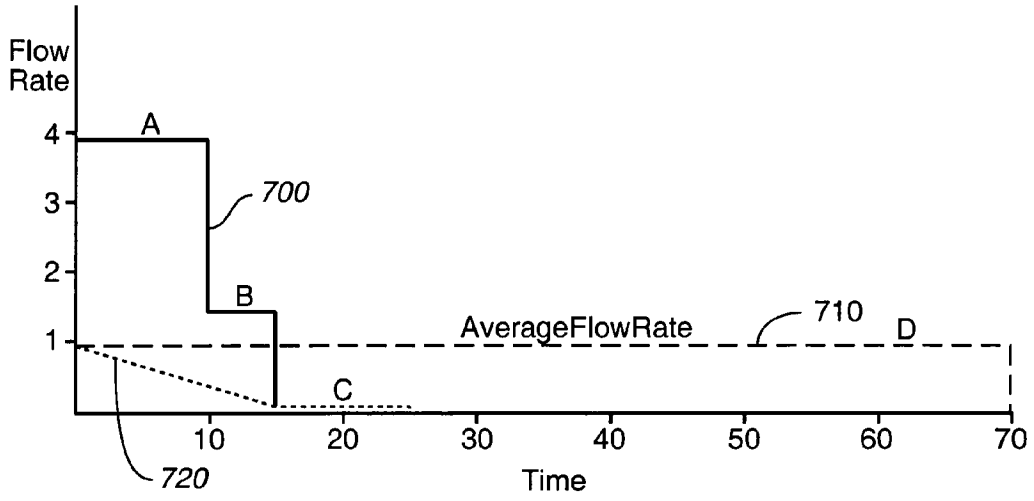
Flow Rate
4
3
2
1
A
B
C
D
700
710
720
AverageFlowRate
10
20
30
40
50
60
70
Time

FIG._7

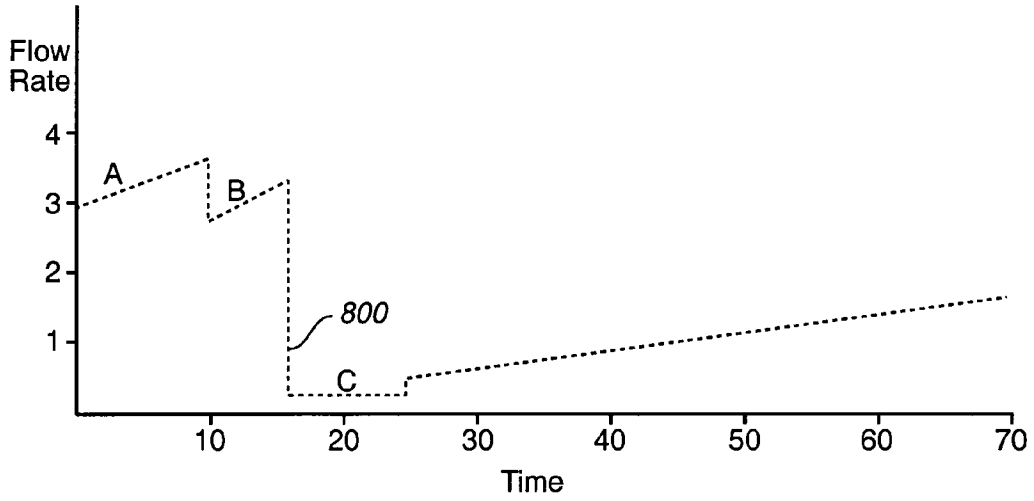
Flow Rate
4
3
2
1
A
B
C
800
10
20
30
40
50
60
70
Time

FIG._8

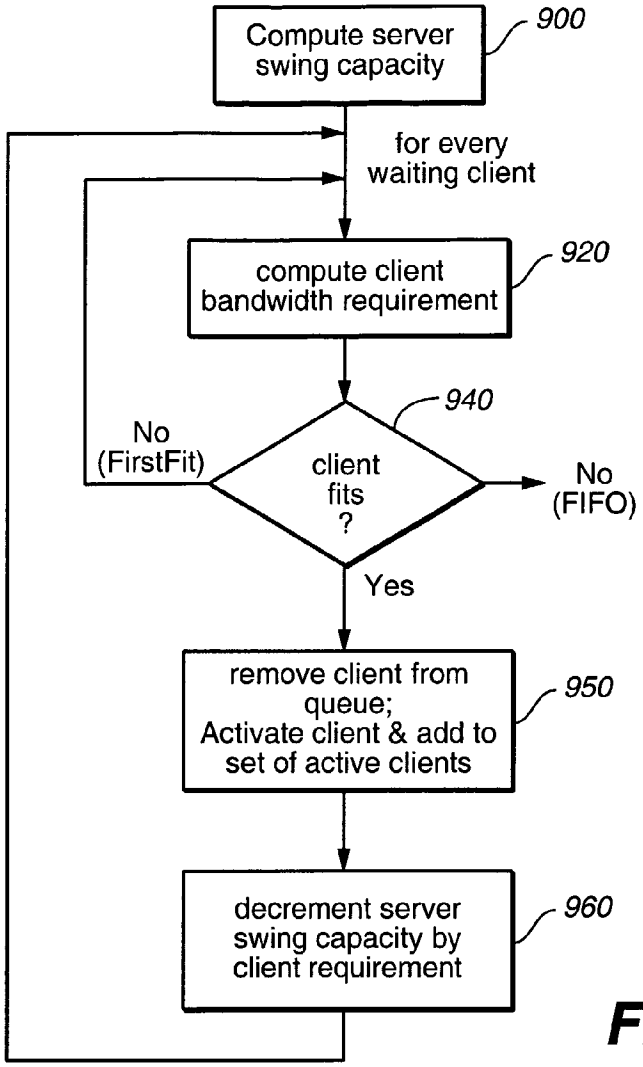
Compute server swing capacity
900
for every waiting client
compute client bandwidth requirement
920
940
No (FirstFit)
client fits ?
No (FIFO)
Yes
remove client from queue; Activate client & add to set of active clients
950
decrement server swing capacity by client requirement
960

FIG._9

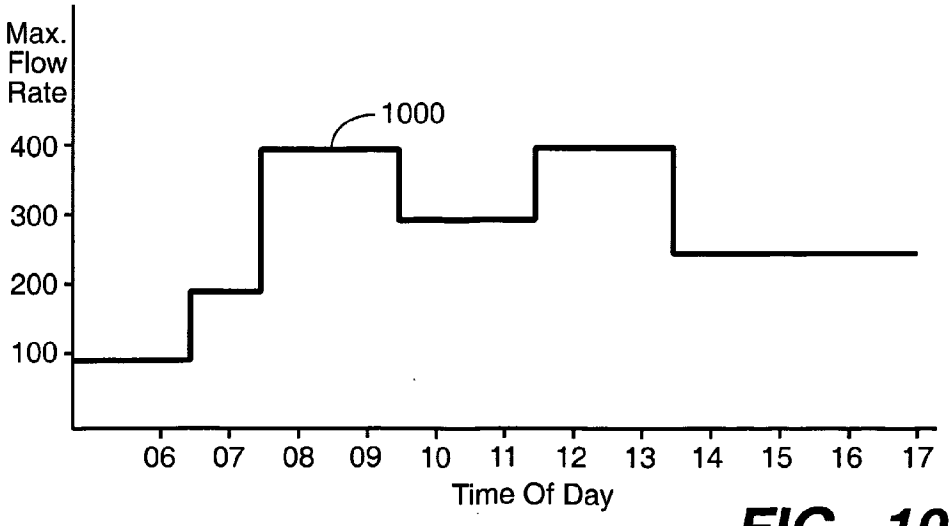
Max. Flow Rate
400
300
200
100
1000
06
07
08
09
10
11
12
13
14
15
16
17
Time Of Day

FIG._10

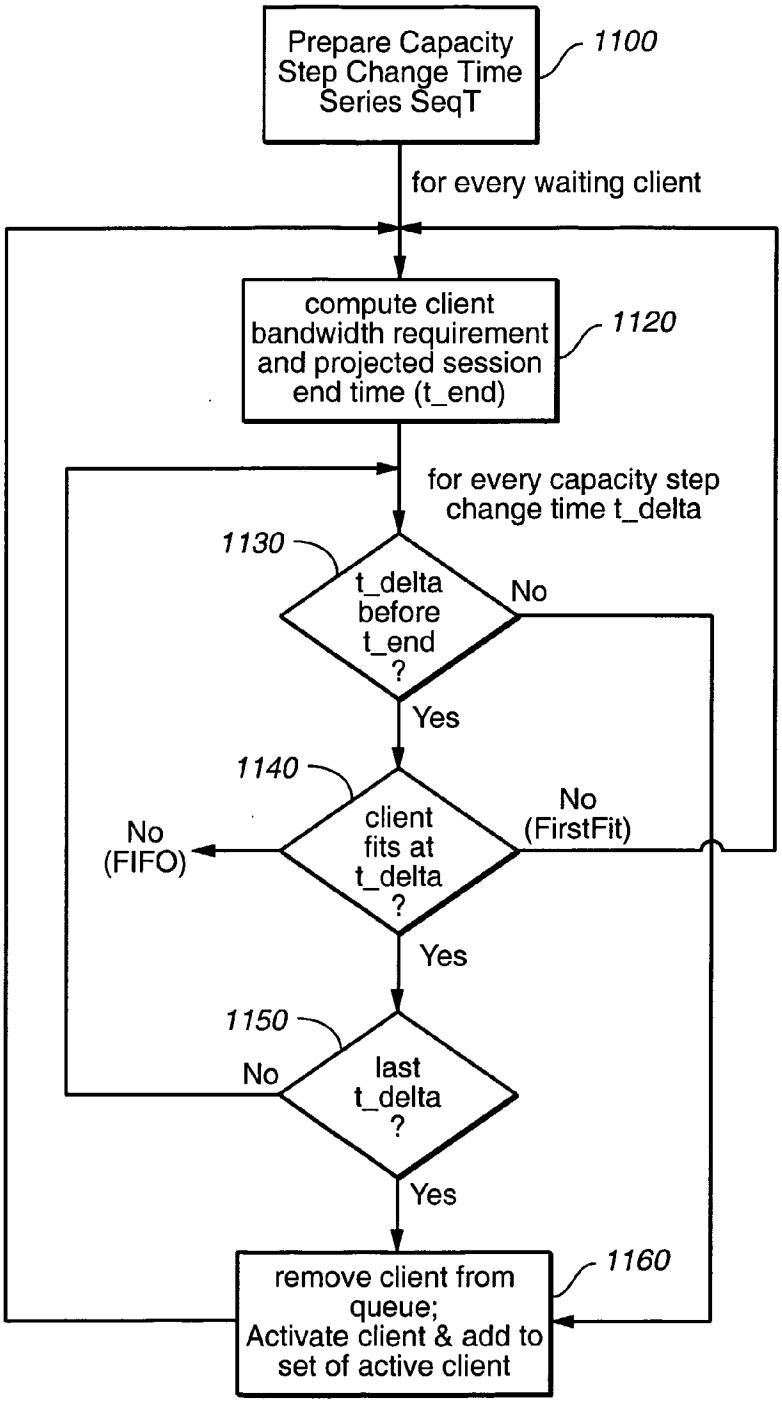
Prepare Capacity Step Change Time Series SeqT
1100
for every waiting client
compute client bandwidth requirement and projected session end time (t_end)
1120
for every capacity step change time t_delta
1130
t_delta before t_end ?
No
Yes
1140
client fits at t_delta ?
No (FIFO)
No (FirstFit)
Yes
1150
last t_delta ?
No
Yes
remove client from queue; Activate client & add to set of active client
1160

FIG._11

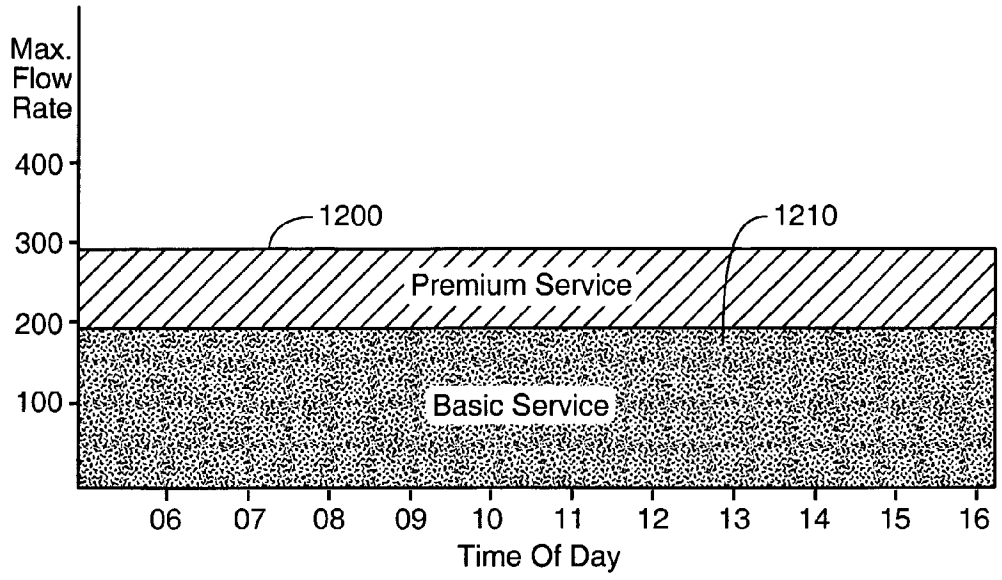
Max.
Flow
Rate
400
300
200
100
1200
1210
Premium Service
Basic Service
06
07
08
09
10
11
12
13
14
15
16
Time Of Day

FIG._12

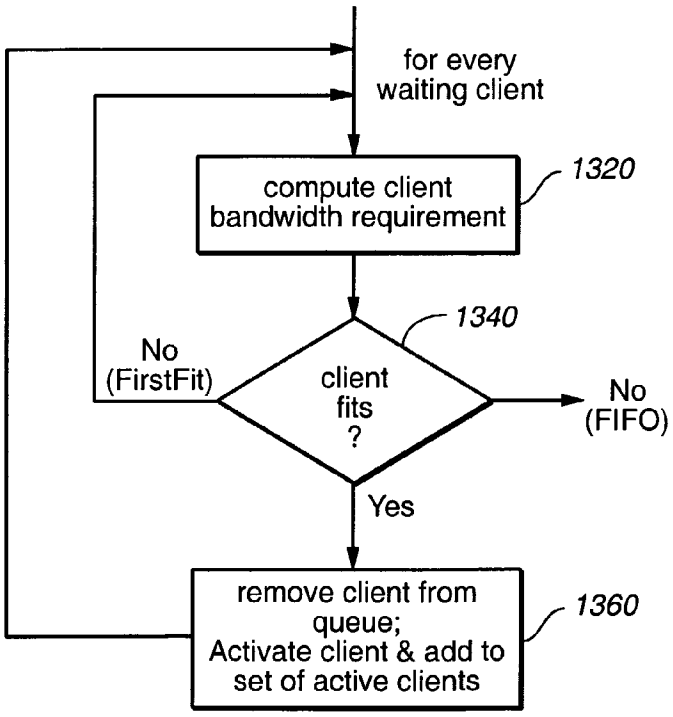
for every
waiting client
compute client
bandwidth requirement
1320
1340
No
(FirstFit)
client
fits
?
No
(FIFO)
Yes
remove client from
queue;
Activate client & add to
set of active clients
1360

FIG._13

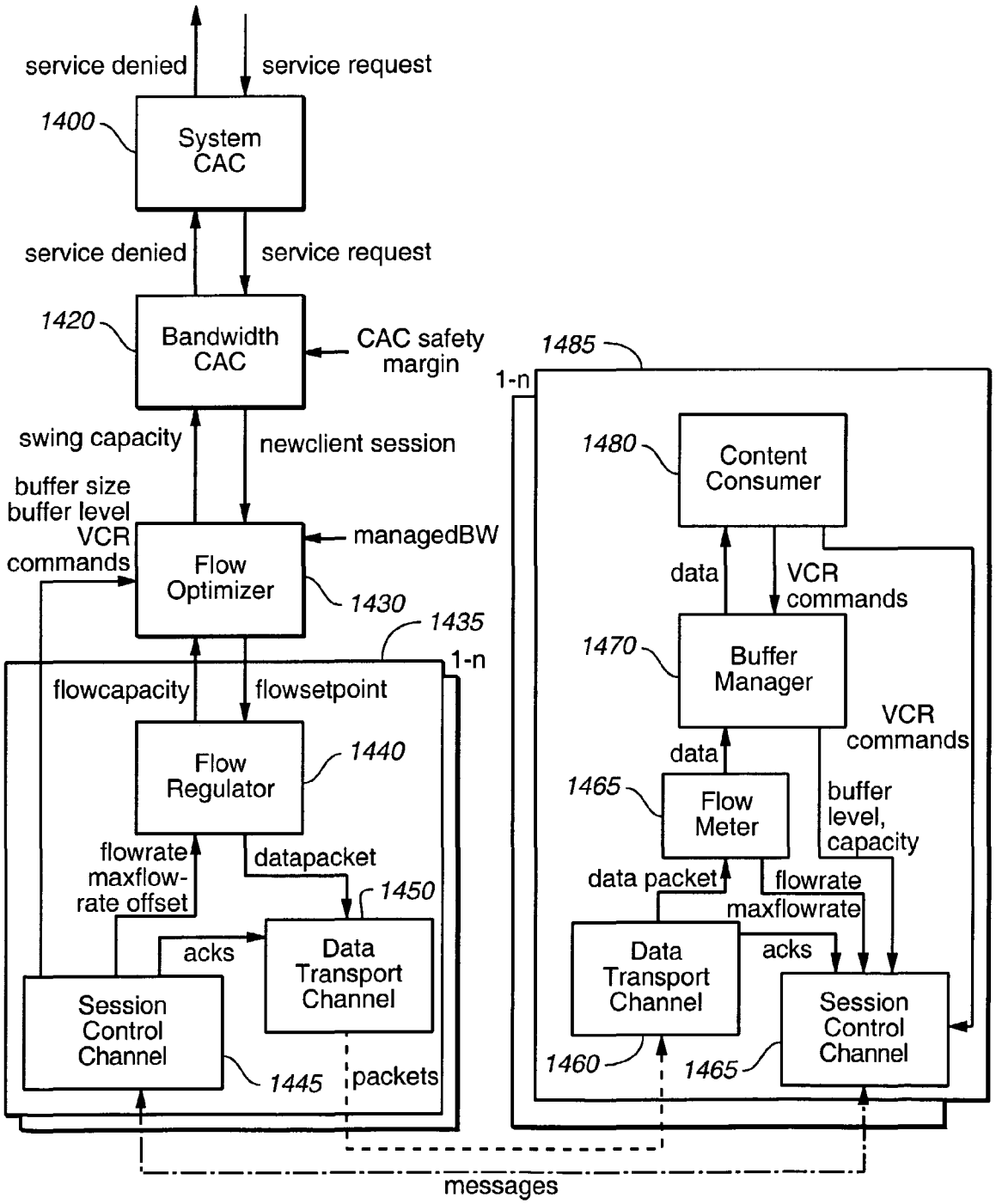
service denied
service request
1400
System CAC
service denied
service request
1420
Bandwidth CAC
CAC safety margin
swing capacity
newclient session
buffer size
buffer level
VCR commands
Flow Optimizer
managedBW
1430
1435
1-n
flowcapacity
flowsetpoint
Flow Regulator
1440
flowrate maxflow-rate offset
datapacket
1450
acks
Data Transport Channel
Session Control Channel
1445
packets
1485
1-n
1480
Content Consumer
data
VCR commands
1470
Buffer Manager
VCR commands
data
1465
Flow Meter
buffer level, capacity
data packet
flowrate maxflowrate
Data Transport Channel
acks
Session Control Channel
1460
1465
messages

FIG._14

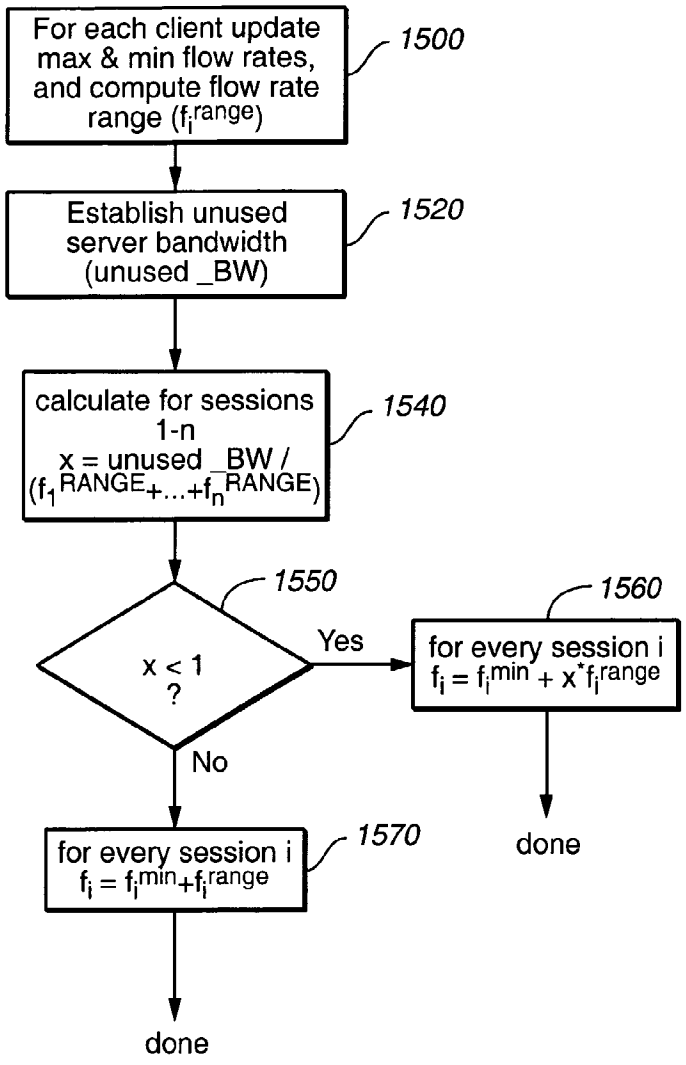
For each client update max & min flow rates, and compute flow rate range (f_i^{range})
1500
Establish unused server bandwidth (unused _BW)
1520
calculate for sessions 1-n x = unused _BW / (f_1^{RANGE}+...+f_n^{RANGE})
1540
1550
x < 1 ?
Yes
1560
for every session i $f_i = f_i^{min} + x^* f_i^{range}$
done
No
for every session i $f_i = f_i^{min} + f_i^{range}$
1570
done

FIG._15

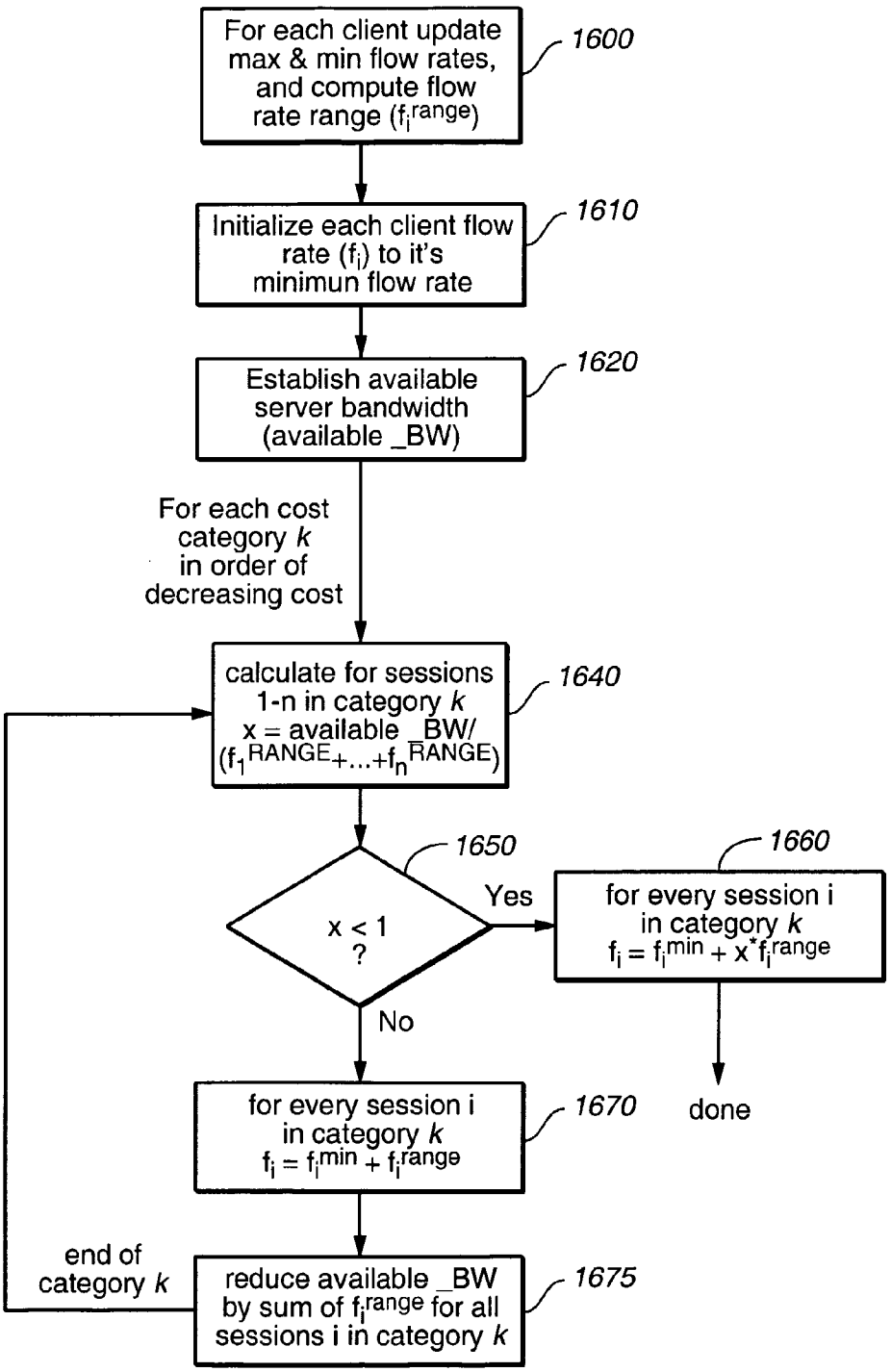
For each client update max & min flow rates, and compute flow rate range (f_i^{range})
1600
Initialize each client flow rate (f_i) to it's minimun flow rate
1610
Establish available server bandwidth (available _BW)
1620
For each cost category *k* in order of decreasing cost
calculate for sessions 1-n in category *k* x = available _BW/ (f_1^{RANGE}+...+f_n^{RANGE})
1640
1650
x < 1 ?
Yes
1660
for every session i in category *k* $f_i = f_i^{min} + x^* f_i^{range}$
done
No
for every session i in category *k* $f_i = f_i^{min} + f_i^{range}$
1670
end of category *k*
reduce available _BW by sum of f_i^{range} for all sessions i in category *k*
1675

FIG._16

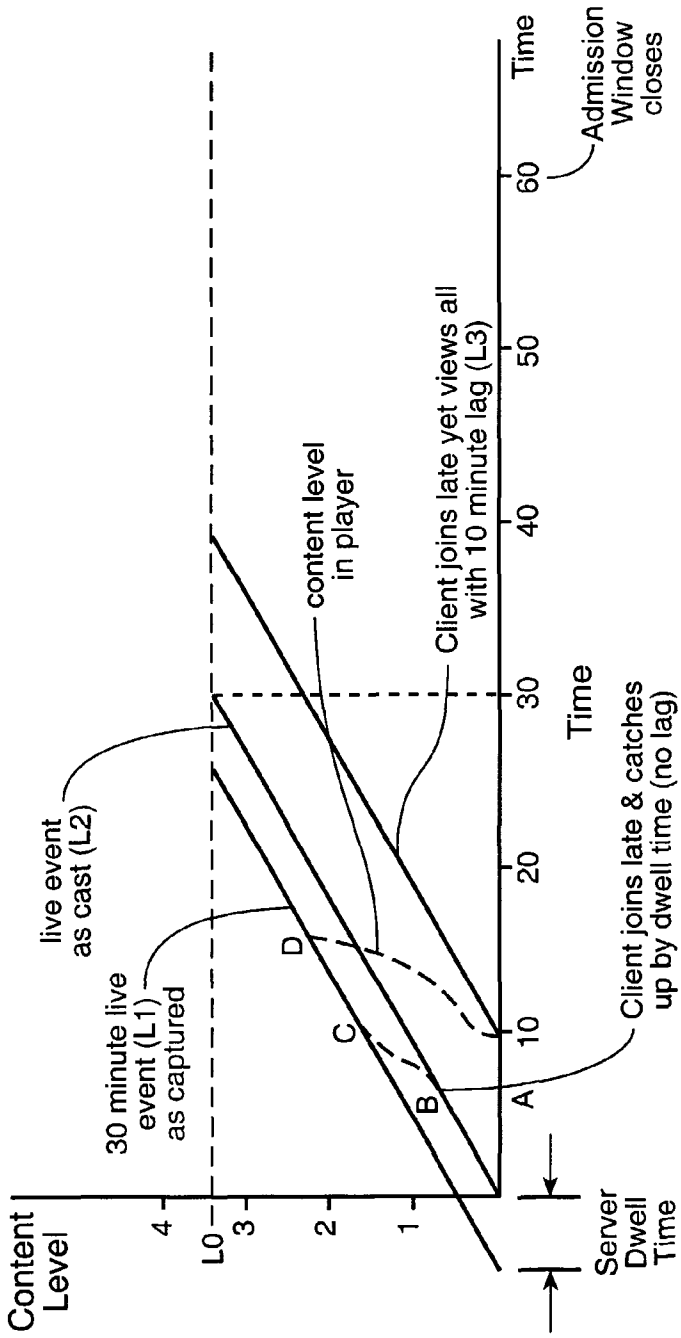
Content Level
4
3
2
1
L0
live event as cast (L2)
30 minute live event (L1) as captured
D
C
B
A
content level in player
Client joins late yet views all with 10 minute lag (L3)
Client joins late & catches up by dwell time (no lag)
10
20
30
40
50
60
Time
Time
Admission Window closes
Server Dwell Time

FIG._17

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

70560 7590 03/25/2024

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/069,450	12/21/2022	DAVID F. BRUECK	9401-00279	8508

TITLE OF INVENTION: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$1200.00	$0	06/25/2024

EXAMINER	ART UNIT	CLASS-SUBCLASS
PATEL, CHIRAG R	2454	709-219000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 KW Law, LLP
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: DISH Technologies L.L.C.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Englewood, CO

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ☒ Issue Fee ❑ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via the USPTO patent electronic filing system ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 602406

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Brett Carlson/ Date April 12, 2024

Typed or printed name Brett Carlson Registration No. 39928

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/069,450	**04/12/2024 07:13:52 PM Z ET**	**9401-00279**

Title of Invention

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8508	FILED BY	BLAKE SCHEFFEY
PATENT CENTER #	65080253	FILING DATE	12/21/2022
CUSTOMER #	70560	FIRST NAMED INVENTOR	DAVID F. BRUECK
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Brett Carlson

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
9401-00279_IFT_041224.pdf	1	Issue Fee Payment (PTO-85B)	143 KB
9401-00279_MFA_041224.pdf	2	Maintenance Fee Address Change	236 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
9401-00279_IFT_041224.pdf	65646EC26EB06581B8AA23F1E08DA036F74FFD47162D24009E E6BDD0C0259AD26BF7B93F050813D2288D91D3290E121458F C688C120E2713BCEC40169DDE8329

9401-00279_MFA_041224.pdf D90B66F92EB303389C89859EB5CBBCFEC6264E72BB5504C2E17B0B5E4DD8A184312O914B4E4C87526576B0B18AC117C60AAFC0C2B2C603E9605227A11EFB3E22

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: MFEE.C.AD
Document Description: Maintenance Fee Address Change

PTO/SB/47 (11-21)
Approved for use through 11/30/2024. OMB 0651-0016
U.S. Patent and Trademark Office; U.S. Department of Commerce
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

"FEE ADDRESS" INDICATION FORM

Address to:
Mail Stop Maintenance Fee
Director of the United States
Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

-OR-

Fax to: 571-273-6500

INSTRUCTIONS: The issue fee must have been paid for application(s) listed on this form. In addition, only an address represented by a Customer Number can be established as the fee address for maintenance fee purposes (hereafter, fee address). A fee address should be established when correspondence related to maintenance fees should be mailed to a different address than the correspondence address for the application.
When to check the first box below: If you have a Customer Number to represent the fee address.
When to check the second box below: If you have no Customer Number representing the desired fee address, in which case a completed Request for Customer Number (PTO/SB/125) must be attached to this form. For more information on Customer Numbers, see section 403 of the Manual of Patent Examining Procedure (MPEP).

For the following listed application(s), please recognize as the "Fee Address" under the provisions of 37 CFR 1.363 the address associated with:

☑ Customer Number 000197

OR

☐ The attached Request for Customer Number (PTO/SB/125) form.

PATENT NUMBER (if known)	APPLICATION NUMBER
	18/069,450

Completed by (check one):

☐ Applicant/Inventor

/Brett A. Carlson/
Signature

☑ Attorney or agent of record 39,928 (Reg. No.)

Brett A. Carlson
Typed or printed name

☐ Assignee of record of the entire interest. See 37 CFR 3.71. Statement under 37 CFR 3.73(b) (Form PTO/SB/96) is enclosed or was filed on _____ (Date)

480-241-8219
Requester's telephone number

April 12, 2024
Date

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. If the assignee is a juristic entity, this form must be signed by a patent practitioner (attorney or agent) of record. Submit multiple forms if more than one signature is required (see below*).

☐ *Total of _____ PTO/SB/47 forms are submitted

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0016. Public burden for this form is estimated to average 5 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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Document Code:WFEE

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Refund Accounting Date:04/15/2024

Effective Date	Sale Item Reference Number	Refund Total
04/15/2024	18069450	$1,200.00

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method	Account Number
I20244ED31577413	1501	UTILITY APPL ISSUE FEE	$1,200.00	Visa	**********6960

United States Patent and Trademark Office

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Sale Adjustment Accounting Date:04/15/2024

Effective Date	Sale Accounting Date	Sale Item Reference Number
04/15/2024	04/15/2024	18069450

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method
I20244ED31577413	1501	UTILITY APPL ISSUE FEE	$1,200.00	Visa

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Document Code:WFEE

User :Brian Curran

Sale Accounting Date:04/15/2024

Sale Item Reference Number	Effective Date
18069450	04/12/2024

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method
I20244EE13295303	1501	UTILITY APPL ISSUE FEE	$1,200.00	Credit Card

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/069,450	12/21/2022	DAVID F. BRUECK	9401-00279	8508

70560 7590 04/24/2024

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

EXAMINER	
PATEL, CHIRAG R	

ART UNIT	PAPER NUMBER
2454	

NOTIFICATION DATE	DELIVERY MODE
04/24/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

dish@kwlaw.co
ipdept@dish.com
uspto@dockettrak.com

Corrected ***Notice of Allowability***	**Application No.** 18/069,450	**Applicant(s)** BRUECK et al.	
	Examiner CHIRAG R PATEL	**Art Unit** 2454	**AIA (FITF) Status** No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the printer rush on April 12, 2024.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 11-30 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 12/21/22.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/CHIRAG R PATEL/
Primary Examiner, Art Unit 2454

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/09/2023	06/29/2023	11/17/2023	01/22/2024	03/13/2024	04/04/2024	04/18/2024		
	1	✓	-	-	-	-	-	-		
	2	✓	-	-	-	-	-	-		
	3	✓	-	-	-	-	-	-		
	4	✓	-	-	-	-	-	-		
	5	✓	-	-	-	-	-	-		
	6	✓	-	-	-	-	-	-		
	7	✓	-	-	-	-	-	-		
	8	✓	-	-	-	-	-	-		
	9	✓	-	-	-	-	-	-		
	10	✓	-	-	-	-	-	-		
1	11	✓	=	=	=	=	=	=		
2	12	O	=	=	=	=	=	=		
3	13	O	=	=	=	=	=	=		
4	14	O	=	=	=	=	=	=		
5	15	O	=	=	=	=	=	=		
6	16	O	=	=	=	=	=	=		
7	17	O	=	=	=	=	=	=		
8	18	O	=	=	=	=	=	=		
9	19	O	=	=	=	=	=	=		
10	20	O	=	=	=	=	=	=		
11	21	O	=	=	=	=	=	=		
12	22	✓	=	=	=	=	=	=		
13	23	O	=	=	=	=	=	=		
14	24	O	=	=	=	=	=	=		
15	25	O	=	=	=	=	=	=		
16	26	O	=	=	=	=	=	=		
17	27	O	=	=	=	=	=	=		
18	28	O	=	=	=	=	=	=		
19	29	O	=	=	=	=	=	=		
20	30	O	=	=	=	=	=	=		

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

CPC - Searched*		
Symbol	Date	Examiner
H04L47/30, H04L65/80, H04L47/263, H04L47/10	03/09/2023	C.P.

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

Search Notes		
Search Notes	**Date**	**Examiner**
PE2E Search	03/08/2023	C.P.
Google Patents - Scholar	03/08/2023	C.P.
IP.COM	03/08/2023	C.P.
Inventor - Double Patent Search	03/08/2023	C.P.
Reviewed references cited in IPR and IDS	11/17/2023	C.P.
IPR2024-00043 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,470,138 on March 11, 2024	03/11/2024	C.P.
IPR2024-00043 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,677,798 on March 11, 2024	03/11/2024	C.P.
PR2024-00044 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,470,138 on March 11, 2024	03/11/2024	C.P.
IPR2024-00043, -00044, -00045, -00046, -00047, -00048, Reviewed Patent Owner's Preliminary Responses under 35 U.S.C. § 313 AND 37 C.F.R. § 42.107 on March 12, 2024	03/11/2024	C.P.
IPR2024-00048 Reviewed Petition for Inter Partes Review of U.S. Patent No. 8,868,772 on March 12, 2024	03/12/2024	C.P.
IPR 2024-00512 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,470,138 on March 12, 2024	03/12/2024	C.P.
PR2024-00517 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,470,138 on March 12, 2024	03/12/2024	C.P.
PR2024-00517 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,677,798 on March 12, 2024	03/12/2024	C.P.
IPR2024-00519 Reviewed Petition for Inter Partes Review of U.S. Patent No. 8,868,772 on March 12, 2024	03/12/2024	C.P.
Reviewed all references and IPR listed on IDS filed on February 1, 2024	03/13/2024	C.P.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H04L	H04L47/30, H04L65/80, H04L47/263, H04L47/10	06/29/2023	C.P.

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

CPC						
Symbol					**Type**	**Version**
H04L	/	65	/	70	F	2022-05-01
H04L	/	47	/	801	I	2013-01-01
H04L	/	47	/	12	I	2013-01-01
G06F	/	16	/	71	I	2019-01-01
G06F	/	16	/	183	I	2019-01-01
H04N	/	7	/	24	I	2013-01-01
H04N	/	21	/	23439	I	2013-01-01
H04N	/	21	/	4331	I	2013-01-01
H04N	/	21	/	84	I	2013-01-01
H04N	/	21	/	8456	I	2013-01-01
H04L	/	65	/	80	I	2013-01-01
H04L	/	65	/	61	I	2022-05-01
H04L	/	65	/	65	I	2022-05-01
H04L	/	65	/	1101	I	2022-05-01
H04L	/	67	/	60	I	2022-05-01
H04L	/	67	/	568	I	2022-05-01
H04L	/	67	/	02	I	2013-01-01
H04L	/	65	/	1069	I	2013-01-01
H04N	/	21	/	2662	I	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	18 April 2024	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20240418

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04L	/	65	/	70

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	18 April 2024	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20240418

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/069,450	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		10	9	19	18	28								
	2	1	11	10	20	19	29								
	3	2	12	11	21	20	30								
	4	3	13	12	22										
	5	4	14	13	23										
	6	5	15	14	24										
	7	6	16	15	25										
	8	7	17	16	26										
	9	8	18	17	27										

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	18 April 2024	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18/069450
Filing Date	
First Named Inventor	David F. Brueck
Art Unit	
Examiner Name	
Attorney Docket Number	9401-00279

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7577750	B2	2009-08-18	Shen et al.	
	2	6195680	B1	2001-02-27	Goldszmidt et al.	
	3	6449719	B1	2002-09-10	Baker	
	4	7369610	B2	2008-05-06	Xu et al.	
	5	7408984	B2	2008-08-05	Lu et al.	
	6	7523181	B2	2009-04-21	Swildens et al.	
	7	6976090	B2	2005-12-13	Ben-Shaul et al.	
	8	7240100	B1	2007-07-03	Wein et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18/069450
	Filing Date	
	First Named Inventor	David F. Brueck
	Art Unit	
	Examiner Name	
	Attorney Docket Number	9401-00279

	9	6850965	B2	2005-02-01	Allen	
	10	7334044	B1	2008-02-19	Allen	
	11	7760801	B2	2010-07-20	Ghanbari et al.	
	12	7099954	B2	2006-08-29	Li et al.	
	13	6760772	B2	2004-07-06	Zou et al.	
	14	7054911	B1	2006-05-30	Lango et al.	
	15	7797439	B2	2010-09-14	Cherkasova et al.	
	16	7477688	B1	2009-01-13	Zhang et al.	
	17	7054774	B2	2006-05-30	Batterberry et al.	
	18	5168356		1992-12-01	Acampora et al.	
	19	7818444	B2	2010-10-19	Brueck et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18/069450
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	Examiner Name	
	Attorney Docket Number	9401-00279

	20	7599307	B2	2009-10-06	Seckni et al.	
	21	7093001	B2	2006-08-15	Yang et al.	
	22	6874015	B2	2005-03-29	Kaminsky et al.	
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	25	5,768,527 ~~57685627~~		1998-06-16	Zhu et al.	
	26	7274740	B2	2007-09-25	van Beek et al.	
	27	7546355	B2	2009-06-09	Kalnitsky	
	28	7174385	B2	2007-02-06	Li	
	29	7376747	B2	2008-05-20	Hartop	
	30	7719985	B2	2010-05-18	Lee et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.P.P/

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	First Named Inventor	David F. Brueck
	Art Unit	
	Examiner Name	
	Attorney Docket Number	9401-00279

	31	7349358	B2	2008-03-25	Hennessey et al.	
	32	7194549	B1	2007-03-20	Lee et al.	
	33	6374289	B2	2002-04-16	Delaney et al.	
	34	7325073	B2	2008-01-29	Shao et al.	
	35	7609652	B2	2009-10-27	Kellerer et al.	
	36	6795863	B1	2004-09-21	Doty, Jr.	
	37	7817985	B2	2010-10-19	Moon	
	38	7788395	B2	2010-08-31	Bowra et al.	
	39	7536469	B2	2009-05-19	Chou et al.	
	40	7412531	B2	2008-08-12	Lango et al.	
	41	7295520	B2	2007-11-13	Lee et al.	

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	First Named Inventor	David F. Brueck
	Art Unit	
	Examiner Name	
	Attorney Docket Number	9401-00279

	42	7054365	B2	2006-05-30	Kim et al.	
	43	6122660		2000-09-19	Baransky et al.	
	44	7391717	B2	2008-06-24	Kiemets et al.	
	45	7260640	B1	2007-08-21	Kramer et al.	
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	47	6618752	B1	2003-09-09	Moore et al.	
	48	6721723	B1	2004-04-13	Gibson et al.	
	49	6859839	B1	2005-02-22	Zahorjan et al.	
	50	7779135	B2	2010-08-17	Hudson et al.	
	51	7593333	B2	2009-09-22	Li et al.	
	52	5953506		1999-09-14	Kalra et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.B/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18/069450
	Filing Date	
	First Named Inventor	David F. Brueck
	Art Unit	
	Examiner Name	
	Attorney Docket Number	9401-00279

	53	6091775		2000-07-18	Hibi et al.	
	54	6091777		2000-07-18	Guetz et al.	
	55	6195680		2001-02-27	Goldszmidt et al.	
	56	6366614		2002-04-02	Pian et al.	
	57	6389473		2002-05-14	Carmel et al.	
	58	6486803	B1	2002-11-26	Luby et al.	
	59	6490627		2002-12-03	Kalra et al.	
	60	6510553		2003-01-21	Hazra	
	61	6574591		2003-06-03	Kleiman et al.	
	62	6604118		2003-08-05	Klleiman et al.	
	63	6731600		2004-05-04	Patel et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18/069450
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	Art Unit	
	Examiner Name	
	Attorney Docket Number	9401-00279

	64	5732183		2004-05-04	Graham	
	65	6968387		2005-11-22	Lanphear	
	66	7075986		2006-07-11	Girod et al.	
	67	7096271		2006-08-22	Omoigui et al.	
	68	7349976		2008-03-25	Glaser et al.	
	69	7408984	B2	2008-08-05	Lu et al.	
	70	4535355		1985-08-13	Arn et al.	
	71	8036265	B1	2011-10-11	Reynolds et al.	
	72	5687095		1997-11-11	Haskell et al.	
	73	7116894	B1	2006-10-03	Chatterton	
	74	7328243	B2	2008-02-05	Yaeger et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.B.P./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	First Named Inventor	David F. Brueck
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	Examiner Name	
	Attorney Docket Number	9401-00279

	75	7330908	B2	2008-02-12	Jungek	
	76	7653735	B2	2010-01-26	Mandato et al.	
	77	8612624	B2	2013-12-17	Brueck et al.	
	78	8868772	B2	2014-10-21	Major et al.	
	79	8402156	B2	2013-03-19	Brueck et al.	
	80	8370514	B2	2013-02-05	Hurst et al.	
	81	8880721	B2	2014-11-04	Hurst et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18/069450
	Filing Date	
	First Named Inventor	David F. Brueck
	Art Unit	
	Examiner Name	
	Attorney Docket Number	9401-00279

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	Attorney Docket Number	9401-00279

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That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☒ See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/BRETT A. CARLSON/	Date (YYYY-MM-DD)	2022-12-21
Name/Print	Brett A. Carlson	Registration Number	39928

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Bibliographic Data

Application No: 18/069,450

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /CHIRAG R PATEL/ Examiner's Signature | Initials

Title: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/21/2022	709	2454	9401-00279
RULE			

APPLICANTS

DISH Technologies L.L.C., Englewood, CO, UNITED STATES

INVENTORS

DAVID F. BRUECK, SARATOGA SPRINGS, UT, UNITED STATES

MARK B. HURST, CEDAR HILLS, UT, UNITED STATES

R. DREW MAJOR, OREM, UT, UNITED STATES

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First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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Application Number	18069450
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Art Unit	2454
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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	Application Number	18/069450
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	First Named Inventor	David F. Brueck
	Art Unit	
	Examiner Name	
	Attorney Docket Number	9401-00279

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	Examiner Name	
	Attorney Docket Number	9401-00279

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/069,450	05/21/2024	11991234	9401-00279	8508

70560 7590 05/01/2024

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

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Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Center (https://patentcenter.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

INVENTOR(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional inventors):

DAVID F. BRUECK, SARATOGA SPRINGS, UT;
MARK B. HURST, CEDAR HILLS, UT;
R. DREW MAJOR, OREM, UT;

APPLICANT(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional applicants):

DISH Technologies L.L.C., Englewood, CO

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APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/069,450	**05/20/2024 05:45:19 PM Z ET**	**9401-00279**

Title of Invention

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	11991234
CONFIRMATION #	8508	FILED BY	BLAKE SCHEFFEY
PATENT CENTER #	65600415	FILING DATE	12/21/2022
CUSTOMER #	70560	FIRST NAMED INVENTOR	DAVID F. BRUECK
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Brett Carlson

Documents

TOTAL DOCUMENTS: 19

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
NPL1_IPRPetition_798.pdf	84	Non Patent Literature	560 KB
NPL3_IPRPetition_138.pdf	81	Non Patent Literature	555 KB
NPL6_IPRPetition_554.pdf	83	Non Patent Literature	748 KB
NPL2_MotionforJoinder_798.pdf	14	Non Patent Literature	927 KB
9401-00279_IDS_052024.pdf	5	Information Disclosure Statement (IDS) Form (SB08)	1234 KB
NPL4_MotionforJoinder_138.pdf	14	Non Patent Literature	907 KB

NPL5_IPRPetition_156_Final.pdf	76	Non Patent Literature	866 KB
NPL13_IPR2024-00045_ID.pdf	44	Non Patent Literature	530 KB
NPL9_IPRPetition_680.pdf	83	Non Patent Literature	664 KB
NPL11_IPR2024-00043_ID.pdf	49	Non Patent Literature	691 KB
NPL10_IPRPetition_772_Final.pdf	85	Non Patent Literature	2308 KB
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Attorney Docket Number	9401-00279

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	1	fuboTV Media Inc. v. DISH Technologies L.L.C., "Petition for Inter Partes Review of U.S. Patent No. 11,677,798" dated May 13, 2024 (84 pages).	☐
	2	fuboTV Media Inc. v. DISH Technologies L.L.C., "Motion for Joinder Under 35 U.S.C. § 315(c), 37 C.F.R. §§ 42.22, and 42.122(b)" for U.S. Patent No. 11,677,798 dated May 13, 2024 (14 pages).	☐
	3	fuboTV Media Inc. v. DISH Technologies L.L.C., "Petition for Inter Partes Review of U.S. Patent No. 11,470,138" dated May 13, 2024 (81 pages).	☐
	4	fuboTV Media Inc. v. DISH Technologies L.L.C., "Motion for Joinder Under 35 U.S.C. § 315(c), 37 C.F.R. §§ 42.22, and 42.122(b)" for U.S. Patent No. 11,470,138 dated May 13, 2024 (14 pages).	☐
	5	fuboTV Media Inc. v. DISH Technologies L.L.C., "Petition for Inter Partes Review of U.S. Patent No. 10,757,156" dated May 17, 2024 (76 pages).	☐
	6	fuboTV Media Inc. v. DISH Technologies L.L.C., "Petition for Inter Partes Review of U.S. Patent No. 10,469,554" dated May 13, 2024 (83 pages).	☐
	7	fuboTV Media Inc. v. DISH Technologies L.L.C., "Petition for Inter Partes Review of U.S. Patent No. 10,469,555" dated May 13, 2024 (83 pages).	☐
	8	fuboTV Media Inc. v. DISH Technologies L.L.C., "Petition for Inter Partes Review of U.S. Patent No. 9,407,564" dated May 17, 2024 (85 pages).	☐
	9	fuboTV Media Inc. v. DISH Technologies L.L.C., "Petition for Inter Partes Review of U.S. Patent No. 10,951,680" dated May 13, 2024 (83 pages).	☐
	10	fuboTV Media Inc. v. DISH Technologies L.L.C., "Petition for Inter Partes Review of U.S. Patent No. 8,868,772" dated May 17, 2024 (85 pages).	☐
	11	Aylo Freesites LTD v. DISH Technologies L.L.C., IPR2024-00043, Patent No. 11,677,798, "Decision Granting Institution of Inter Partes Review" dated April 16, 2024 (49 pages).	☐

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	Art Unit	2454
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	9401-00279

	12	Aylo Freesites LTD v. DISH Technologies L.L.C., IPR2024-00044, Patent No. 11,470,138, "Decision Granting Institution of Inter Partes Review" dated April 16, 2024 (44 pages).	☐
	13	Aylo Freesites LTD v. DISH Technologies L.L.C., IPR2024-00045, Patent No. 10,469,554, "Decision Granting Institution of Inter Partes Review" dated April 16, 2024 (44 pages).	☐
	14	Aylo Freesites LTD v. DISH Technologies L.L.C., IPR2024-00046, Patent No. 10,951,680, "Decision Granting Institution of Inter Partes Review" dated April 16, 2024 (48 pages).	☐
	15	Aylo Freesites LTD v. DISH Technologies L.L.C., IPR2024-00047, Patent No. 9,407,564, "Decision Denying Institution of Inter Partes Review" dated April 16, 2024 (25 pages).	☐
	16	Aylo Freesites LTD v. DISH Technologies L.L.C., IPR2024-00048, Patent No. 8,868,772, "Decision Denying Institution of Inter Partes Review" dated April 16, 2024 (24 pages).	☐
	17	Aylo Freesites LTD v. DISH Technologies L.L.C., IPR2024-00146, Patent No. 10,469,555, "Decision Granting Institution of Inter Partes Review" dated April 25, 2024 (46 pages).	☐
	18	Aylo Freesites LTD v. DISH Technologies L.L.C., IPR2024-00147, Patent No. 10,757,156, "Decision Denying Institution of Inter Partes Review" dated April 25, 2024 (25 pages).	☐

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Examiner Signature		Date Considered	

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18069450
Filing Date	2022-12-21
First Named Inventor	David F. Brueck
Art Unit	2454
Examiner Name	Chirag R. Patel
Attorney Docket Number	9401-00279

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Brett Carlson/	Date (YYYY-MM-DD)	2024-05-20
Name/Print	Brett Carlson	Registration Number	39928

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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18/069,450	12/21/2022	DAVID F. BRUECK	9401-00279	8508

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KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

EXAMINER	
PATEL, CHIRAG R	

ART UNIT	PAPER NUMBER
2454	

NOTIFICATION DATE	DELIVERY MODE
05/21/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

dish@kwlaw.co
ipdept@dish.com
uspto@dockettrak.com

APPLICATION NO.	ISSUE DATE	PATENT NO.
18/069,450	21-May-2024	11991234

KW LAW LLP (Dish Technologies L.L.C.)
6122 N 7th St Suite D
Phoenix, AZ 85014

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