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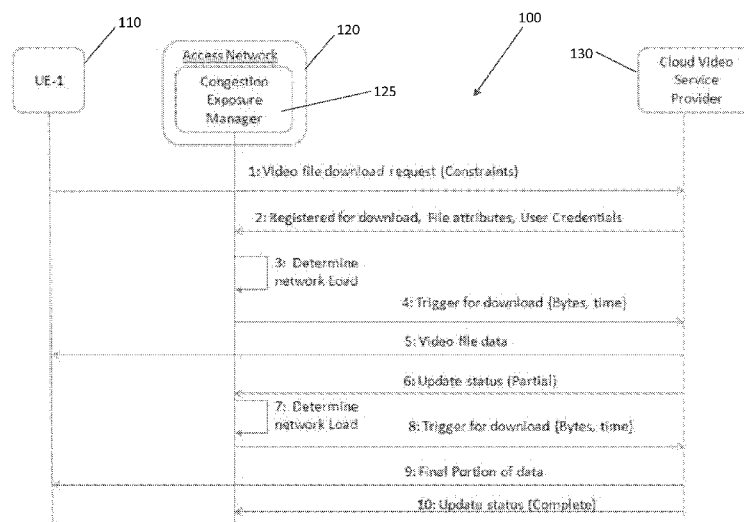


FIG. 1

(57) Abstract: Various communication systems may benefit from support for congestion exposure via cloud-based infrastructure for mobile users. A method may include receiving at least one of registered download, file attributes, or user equipment credentials from a service provider. The method may also include determining a cell-level network condition. The method may further include triggering a first download from a service provider to at least one user equipment.

Method and Apparatus to Support Congestion Exposure via Cloud-based
Infrastructure for Mobile Users

BACKGROUND:

Field:

[0001] Certain embodiments relate to congestion exposure in communication networks. More specifically, certain embodiments relate to a method and apparatus to manage congestion exposure via cloud-based infrastructure for mobile users.

Description of the Related Art:

[0002] Congestion exposure (CE) management may charge a user based on the congestion that the user is creating rather than strictly based on the number of bytes of data downloaded. This may be hard to explain to users because users of the network may not be aware of what is meant by network congestion, nor of when the congestion is happening in the network. If operators continue to provide simple service plans based on the amount of data that is being downloaded as a quota limit, then this puts restrictions on utilization of networks, and efficiency of mobile devices, such as smart phones, and users may settle down with alternative techniques for doing heavy download types activities.

[0003] Video streaming is one major example of traffic. The video streams that are delivered to the users are often conventionally throttled in some form by the middle box proxy in the mobile network. Even then, Quality of Experience (QoE), and network re-buffering are major concerns and affects the users. Video download is another popular service in the United States wherein movies are hosted by Cloud Video Service Provider (VSP) as stored as files in the cloud infrastructure. Standards like ULTRA VIOLET[®] and DLNA[®] are becoming popular in the consumer electronics industry, and

almost all conventional television, laptop computers or even mobile phones and tablet computer vendors have adopted these technologies as standards for distributing and viewing premium content.

[0004] The subscribers can download these file, and watch them later as an offline service on their devices or can share among their registered devices such as BIG TV™, BLU-RAY DISC™, etc. Currently, content providers cannot bring DVD™ or 3D types of video quality over the mobile network due to various limitations in the streaming.

[0005] Another, potential use case may be, that video files that are downloaded can be watched when the user is on an airplane, etc. The problem here, however, is that each movie file typically ranges from 500 MB to a couple of GB, depending upon the video bit rate and resolution of the movie content. When such downloads are made via a mobile infrastructure, the set quota for the user may become exhausted in only a few downloads.

[0006] In a further potential use case, penetration of smart phones enables video services to be managed and maintained by mobile operators. Existing video streaming techniques are solving portion of content distributions, however, network problems such as re-buffering and QoE are bigger tasks. Content providers, want to bring high quality content, and users are ready to pay, wait and watch the content on their personal mobile devices of their choice.

[0007] The cellular network and internet connection at home are the primary two choices for the consumer to get, view, or interact with internet services. For example, a user could download on mobile device, and locally transfer to BLU-RAY™ player or stream locally to BIG TV™. Operator hosted Content Delivery Network (CDN) may solve the problem for content that is cached, if the user remains at a certain location in the network. Caching at the core or at the radio network is only a partial solution. For movie rental companies, the content download pattern is different; caching only popular content may not solve the problem either. Also, caching only reduces the

number of hops but if everyone wants to perform video download at the same time, then the CDN problem is shifted towards a network congestion problem.

[0008] Furthermore, most tablet users download video files from a cloud-based rental service via Wi-Fi networks. This makes the mobile broadband network, such as 3GPP or LTE most often underutilized. Also, billing based on amount of data severely restricts the users to use mobile phones for such data intensive operations.

[0009] For a user/operator, the data tonnage and Radio Resource Management (RRM) may be the bigger problem but these networks are not utilized effectively for near-offline services.

[0010] More and more devices are connected to the Internet via mobile broadband and the common expectation is to allow all types of services that demand real-time, online, and offline services. If the mobile broadband places restrictions (e.g., throttles data), then utilization of the network and devices will be restricted, and indirectly this conventionally amounts to asking the user not to use mobile broadband.

SUMMARY:

[0011] According to a first embodiment, a method may include receiving at least one of registered download, file attributes, or user equipment credentials from a service provider. The method may also include determining a cell-level network condition corresponding to the at least one of registered download, file attributes, or user equipment credentials. The method may further include triggering a first download from a service provider to at least one user equipment based on the cell-level network conditions.

[0012] According to a second embodiment, an apparatus may include at least one processor and at least one memory including computer program code. Further, the at least one memory and the computer program code are

configured to, with the at least one processor, cause the apparatus at least to receive at least one of registered download, file attributes, or user equipment credentials from a service provider. Also, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus at least to determine a cell-level network condition corresponding to the at least one of registered download, file attributes, or user equipment credentials. Further, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus at least to trigger a first download from a service provider to at least one user equipment based on the cell-level network conditions.

[0013] According to a third embodiment, an apparatus may include receiving means for receiving at least one of registered download, file attributes, or user equipment credentials from a service provider. The apparatus may also include determining means for determining a cell-level network condition corresponding to the at least one of registered download, file attributes, or user equipment credentials. The apparatus may further include triggering means for triggering a first download from a service provider to at least one user equipment based on the cell-level network conditions.

[0014] According to a fourth embodiment, a non-transitory computer readable medium may be encoded with instruction that, when executed in hardware, perform a process. The process may include the method according to the first embodiment discussed above.

BRIEF DESCRIPTION OF THE DRAWINGS:

[0015] For proper understanding of the invention, reference should be made to the accompanying drawings, wherein:

[0016] Figure 1 illustrates a sequence of operation for performing a congestion exposure mechanism according to certain embodiments.

[0017] Figure 2 illustrates a content delivery network according to certain embodiments.

[0018] Figure 3 illustrates a block diagram of a system according to certain embodiments.

DETAILED DESCRIPTION:

[0019] Certain embodiments relate to congestion exposure in communication networks. More specifically, certain embodiments relate to methods and apparatuses to manage congestion exposure via cloud-based infrastructure for mobile users. Certain embodiments include a process wherein mobile operators, cloud video service provider (content distributors), and mobile users may benefit by providing a mechanism to allowing video content download and at the same time giving a solution which can improve network utilization and maximize the revenue for service providers.

[0020] Thus, certain embodiments may improve user experience and encourage mobile users to utilize the bandwidth for such service. Moreover, certain embodiments may provide an infrastructure support to deliver the content. In other words, in certain embodiments, a user may not need to be bothered by which network, service plan, or the like the user has. Instead, the user's device may be able to connect seamlessly and get the content.

[0021] Further, if the user already paid for a rental service, for example, in certain embodiments the content distributor and operator can work together to deliver the content to users.

[0022] Furthermore, the user may be made aware of the video download activity. Thus, in certain embodiments the user may develop a habit of downloading a video file, waiting, and then watching the file/video, as a lower-cost alternative to streaming.

[0023] Certain embodiments include a mechanism that can improve network utilization of mobile networks, and enable a new class of services. Operators/providers may utilize their network and make revenue share on the premium content. The mechanisms enable usage of mobile broadband networks to support offline type of service. The mechanism/process can be

compatible to all types of cellular technology (e.g., 3G, 4G). The mechanism can be standardized so that interoperability between content distributor and operator can be maintained globally.

[0024] In some example embodiments, there can be two aspects, first a registration process/mechanism wherein both cellular operators and Video Content service providers have established Service-level Agreements (SLAs) and there can be a mechanism that exists to exchange data and revenue for the amount of data being downloaded by users; second, user usage of the service, and for service usage how the cellular network and video content distributor can interact.

[0025] Registration can be a process wherein both cloud based Video content distributor and operator have peering agreement as part of Service-level Agreement (SLA). Certain embodiments work as follows; mobile operator network and cloud-based video content distributor can establish an SLA. Operators may get revenue share for the amount of data (or by some means) that is flowing through their network from Over-the-top (OTT) content providers. It can be up to the operator and video content distributor how they would like to get engaged in peering agreement. The agreement can be utilized to provide services for all types of content. The congestion exposure mechanism/manager 125 may be backward compatible and may work with all types of mobile network infrastructure. Therefore, the operator can be part of distribution of content, so that their underutilized bandwidth (e.g., 3G, 4G) can be more utilized resulting in more revenue.

[0026] Figure 1 illustrates a sequence of operation for performing a congestion exposure mechanism according to certain embodiments. In Figure 1, User Equipment (UE) 110 (shown as UE-1 in Fig. 1) may use applications such as, ULTRA VIOLET[®] complaint SONY[®] or REDBOX[™] or BLOCKBUSTER[®] or any other capable client application. A sequence of operations such as user authentication or subscription validation can be performed by the Cloud Video Service Provider (VSP) 130. Next, the UE 110 can perform common task

such as searching for movie directory, selecting one or more movies, doing payment (rental, or one-time payment etc.), and finally can be ready to download the purchased movie on his device. These tasks may require a sequence of message exchange, but for purposes of illustration only, one message is shown. The UE 110 can supply a Globally Unique Temporary Identifier (GUTI) as part of the message exchange to VSP 130, with which the VSP 130 can request the wireless access network 120 operator for congestion exposure manager 125. GUTI has been used as an identifier for illustration purposes only, there are other possible identifiers that can be used between the UE 110 and the wireless access network 120, that will help assist the wireless access network 120 to track down any congestion. Congestion exposure manager 125 may be configured to interact heavily with the network components, such as a Mobility Management Entity (MME) and an evolved Node B (eNodeB) and optionally with packet core network elements such as GGSN or EPC so that congestion exposure manager 125 can determine cell-level load on the network. There are several other deployment scenarios possible, but for illustrating purposes only, the congestion exposure manager 125 can be referred to as standalone.

[0027] Cloud service provider 130 may be configured to pass the unique identification that was received in Message-1 by UE 110, to the wireless access network 120 operator. VSP 130 may also be configured to supply other information such as the amount of download requested, time, and the like. For example, UE 110 may want to download a video file in less than 5 hours or 10 hours or 1 hour. Such conditions will help an operator of access network 120 to determine the priority level of the UE 110 request and to map the request to allowable congestion via congestion exposure manager 125.

[0028] Congestion exposure manager 125 may be configured to keep track of the available radio resources, and network conditions, and utilization of network at different point in network where UE 110 may be currently camped on most of the time, as shown in Figure 1, Message-2.

[0029] Access network 120 may be configured to perform the requested user video file when the network is available. Congestion exposure manager 125 may then send a message with allowable time and/or portion of the file that can be made for download as shown in Figure 1, Message-4.

[0030] Video server can then send the file to the UE 110 via an operator network infrastructure.

[0031] If the file size is larger or the amount of time that was scheduled by the access network 120 is not sufficient to download all the file size. The cloud service provider 130 can perform an update after the quantum is completed as shown in Figure 1, Message-6, and can make sure bandwidth is free for the next available download.

[0032] Congestion exposure manager 125 can continue to keep track of the available radio resources, network conditions, and utilization of network at different point in network where UE 110 may be currently camped on most of the time. The process of checking network availability can continue until UE 110 request is fully satisfied, such as when the download is completed.

[0033] Access network 120 can perform the requested user video file when the network is available. Congestion exposure manager 125 may then send a message with allowable time and/or portion of the file that can be made available for download.

[0034] Video server 130 can send the final portion of the data and can complete the process as shown in Figure 1, Message-9.

[0035] Video server 130 can send an update message and can request access network 120 to delete entry for video download from congestion exposure manager 125 as shown in Figure 1, Message-10.

[0036] Alternatively, in certain embodiments, certain embodiments may work both for Wi-Fi and cellular networks. When the user moves to Wi-Fi to cellular network or vice versa, the notification and update between cloud service provider 130 and cellular network 120 can make it efficient to manage resources.

[0037] In other embodiments, the wireless access network 120 can schedule these huge downloads when it has more internal resources, and also the wireless access network 120 can schedule such download over different time spacing. For example, UE 110 made a download request during the middle of the day, and would like to watch it during the night. Such scheduled downloads can be learned by predictive learning or by other means. All such attributes can be conveyed by the cloud video service provider 130 while making the request.

[0038] Certain embodiments enable cooperative scheduling for offline services which can greatly improve the utilization of the network.

[0039] Figure 2 illustrates a content delivery network according to certain embodiments. In Figure 2, CDN 200 may include a plurality of video servers 210. CDN 200 may be configured with video servers 210 deployed in multiple data centers in the Internet. Video servers 210 may be associated with a number of user equipment, such as smartphone 220, desktop computer 230, tablet computer 240, and/or laptop 250, shown here for illustrative purposes only. As described below, certain embodiments may be applied to use in CDN 200 or the like.

[0040] In other embodiments, the techniques described above can complement an existing CDN networks in the way shown in Fig. 2. As the CDN may not schedule for content, the CDN can simply deliver the data based on requests.

[0041] The embodiments described herein may enable usage of mobile broadband networks to support offline type of service. The embodiments may enable cloud-controlled delivery, thereby making the solutions seamless to work both in Wi-Fi and cellular network. The embodiments may overcome the limitation of CDN, and may avoid usage of complicated traffic management. The embodiments may enable congestion detection, management and usage of service, determination of loading of cells, mobility pattern of user, and other dynamic characteristics of the networks being used as input for detection of data tonnage during download of data. The

embodiments may allow UE 110 to get the same experience both in mobile broadband and in a fixed network for services. The embodiments, in certain cases, are implemented transparently from UE 110 side, as the changes can be application controlled, and can be backward compatible with any wireless network infrastructure.

[0042] Figure 3 illustrates a block diagram of a system according to certain embodiments. In one embodiment, a system may comprise several devices, such as, for example, network element 300, user equipment 325, and a Cloud VSP 350. Network element 300 may correspond to access network 120, shown in Figure 1. The system may comprise more than network element, user equipment, or Cloud VSP, although only one of each is shown for the purposes of illustration. Network element 300 may be an eNodeB. User equipment 325 may be any Internet-connected device, such as a tablet computer, mobile phone, smart phone, laptop computer, desktop computer, personal digital assistant (PDA) or the like. Cloud VSP 350 may be any video service provider, streaming service provider, or the like.

[0043] Each of the devices in the system may comprise at least one processor, respectively indicated as 310, 335, and 360. At least one memory may be provided in each device, and indicated as 315, 340, and 365, respectively. The memory may comprise computer program instructions or computer code contained therein. One or more transceiver 305, 330, and 355 may be provided, and each device may also comprise an antenna, respectively illustrated as 320, 345, and 370. Although only one antenna each is shown, many antennas and multiple antenna elements may be provided to each of the devices. Other configurations of these devices, for example, may be provided. For example, network element 300, user equipment 325, and Cloud VSP 350 may be additionally or solely configured for wired communication and in such a case antennas 320, 345, and 370 may illustrate any form of communication hardware, without being limited to merely an antenna.

[0044] Transceivers 305, 330, and 355 may each, independently, be a

transmitter, a receiver, or both a transmitter and a receiver, or a unit or device that may be configured both for transmission and reception.

[0045] Processors 310, 335, and 360 may be embodied by any computational or data processing device, such as a central processing unit (CPU), application specific integrated circuit (ASIC), or comparable device. The processors may be implemented as a single controller, or a plurality of controllers or processors.

[0046] Memories 315, 340, and 365 may independently be any suitable storage device, such as a non-transitory computer-readable medium. A hard disk drive (HDD), random access memory (RAM), flash memory, or other suitable memory may be used. The memories may be combined on a single integrated circuit as the processor, or may be separate therefrom. Furthermore, the computer program instructions may be stored in the memory and may be processed by the processors may be any suitable form of computer program code, for example, a compiled or interpreted computer program written in any suitable programming language.

[0047] The memory and the computer program instructions may be configured, with the processor for the particular device, to cause a hardware apparatus such as network element 300, user equipment 325, and Cloud VSP 350, to perform any of the processes described above (see, for example, Figure 1). Therefore, in certain embodiments, a non-transitory computer-readable medium may be encoded with computer instructions that, when executed in hardware, may perform a process, such as one of the processes described herein. Alternatively, certain embodiments of the invention may be performed entirely in hardware.

[0048] One having ordinary skill in the art will readily understand that the invention as discussed above may be practiced with steps in a different order, and/or with hardware elements in configurations which are different than those which are disclosed. Therefore, although the invention has been described based upon these preferred embodiments, it would be apparent to

those of skill in the art that certain modifications, variations, and alternative constructions would be apparent, while remaining within the spirit and scope of the invention. In order to determine the metes and bounds of the invention, therefore, reference should be made to the appended claims.

[0049] List of abbreviations:

[0050] CE	Congestion Exposure
[0051] CVC	Cloud based Video Content service distributor
[0052] UE	User Equipment
[0053] MME	Mobility Management Entity
[0054] CDN	Content Distribution Network

I CLAIM:

1. A method, comprising:
receiving at least one of registered download, file attributes, or user equipment credentials from a service provider;
determining a cell-level network condition corresponding to the at least one of registered download, file attributes, or user equipment credentials; and
triggering a first download from a service provider to at least one user equipment based on the cell-level network conditions.
2. The method of claim 1, further comprising:
receiving a first status update of a partial download from the service provider for the first download;
determining a subsequent cell-level network condition; and
triggering a second download from the service provider to the at least one user equipment.
3. The method of claim 1, wherein the service provider is a cloud-based video service.
4. The method of claim 1, further comprising:
receiving a second status update of a completed download from the service provider.
5. The method of claim 4, wherein the second status update comprises a request to delete the received at least one of registered download, file attributes, or user equipment credentials.
6. The method of claim 1, wherein the cell-level network is at least one of a wi-fi network, a cellular network, or a content delivery network.

7. The method of claim 1, wherein the cell-level network condition comprises available radio resources, network load, and network utilization at different points in the network where the user equipment is currently located.

8. The method of claim 1, wherein the second download is triggered only if the first download size or download time is insufficient to be completed during the first download from the service provider.

9. The method of claim 1, further comprising:
enabling cooperative scheduling of downloads for offline services to the user equipment from the service provider.

10. An apparatus, comprising:
at least one processor; and
at least one memory including computer program code,
wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus at least to
receive at least one of registered download, file attributes, or user equipment credentials from a service provider;
determine a cell-level network condition corresponding to the at least one of registered download, file attributes, or user equipment credentials; and
trigger a first download from a service provider to at least one user equipment based on the cell-level network conditions.

11. The apparatus of claim 10, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus at least to:

receive a first status update of a partial download from the service

provider for the first download;

determine a subsequent cell-level network condition; and

trigger a second download from the service provider to the at least one user equipment.

12. The apparatus of claim 10, wherein the service provider is a cloud-based video service.

13. The apparatus of claim 10, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus at least to:

receive a second status update of a completed download from the service provider.

14. The apparatus of claim 13 wherein the second status update comprises a request to delete the received at least one of registered download, file attributes, or user equipment credentials.

15. The apparatus of claim 10, wherein the cell-level network is at least one of a wi-fi network, a cellular network, or a content delivery network.

16. The apparatus of claim 10, wherein the cell-level network condition comprises available radio resources, network load, and network utilization at different points in the network where the user equipment is currently located.

17. The apparatus of claim 10, wherein the second download is triggered only if the first download size or download time is insufficient to be completed during the first download from the service provider.

18. The apparatus of claim 10, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus at least to:

enable cooperative scheduling of downloads for offline services to the user equipment from the service provider.

19. An apparatus, comprising:

receiving means for receiving at least one of registered download, file attributes, or user equipment credentials from a service provider;

determining means for determining a cell-level network condition corresponding to the at least one of registered download, file attributes, or user equipment credentials; and

triggering means for triggering a first download from a service provider to at least one user equipment based on the cell-level network conditions.

20. The apparatus of claim 19, further comprising:

receiving means for receiving a first status update of a partial download from the service provider for the first download;

determining means for determining a subsequent cell-level network condition; and

triggering means for triggering a second download from the service provider to the at least one user equipment.

21. The apparatus of claim 19, wherein the service provider is a cloud-based video service.

22. The apparatus of claim 19, further comprising:

receiving means for receiving a second status update of a completed download from the service provider.

23. The apparatus of claim 22, wherein the second status update comprises a request to delete the received at least one of registered download, file attributes, or user equipment credentials.

24. The apparatus of claim 19, wherein the cell-level network is at least one of a wi-fi network, a cellular network, or a content delivery network.

25. The apparatus of claim 19, wherein the cell-level network condition comprises available radio resources, network load, and network utilization at different points in the network where the user equipment is currently located.

26. The apparatus of claim 19, wherein the second download is triggered only if the first download size or download time is insufficient to be completed during the first download from the service provider.

27. The apparatus of claim 19, further comprising:
enabling means for enabling cooperative scheduling of downloads for offline services to the user equipment from the service provider.

28. A non-transitory computer readable medium encoded with instructions that, when executed in hardware, perform a process, the process comprising the method according to any one of claims 1-9.

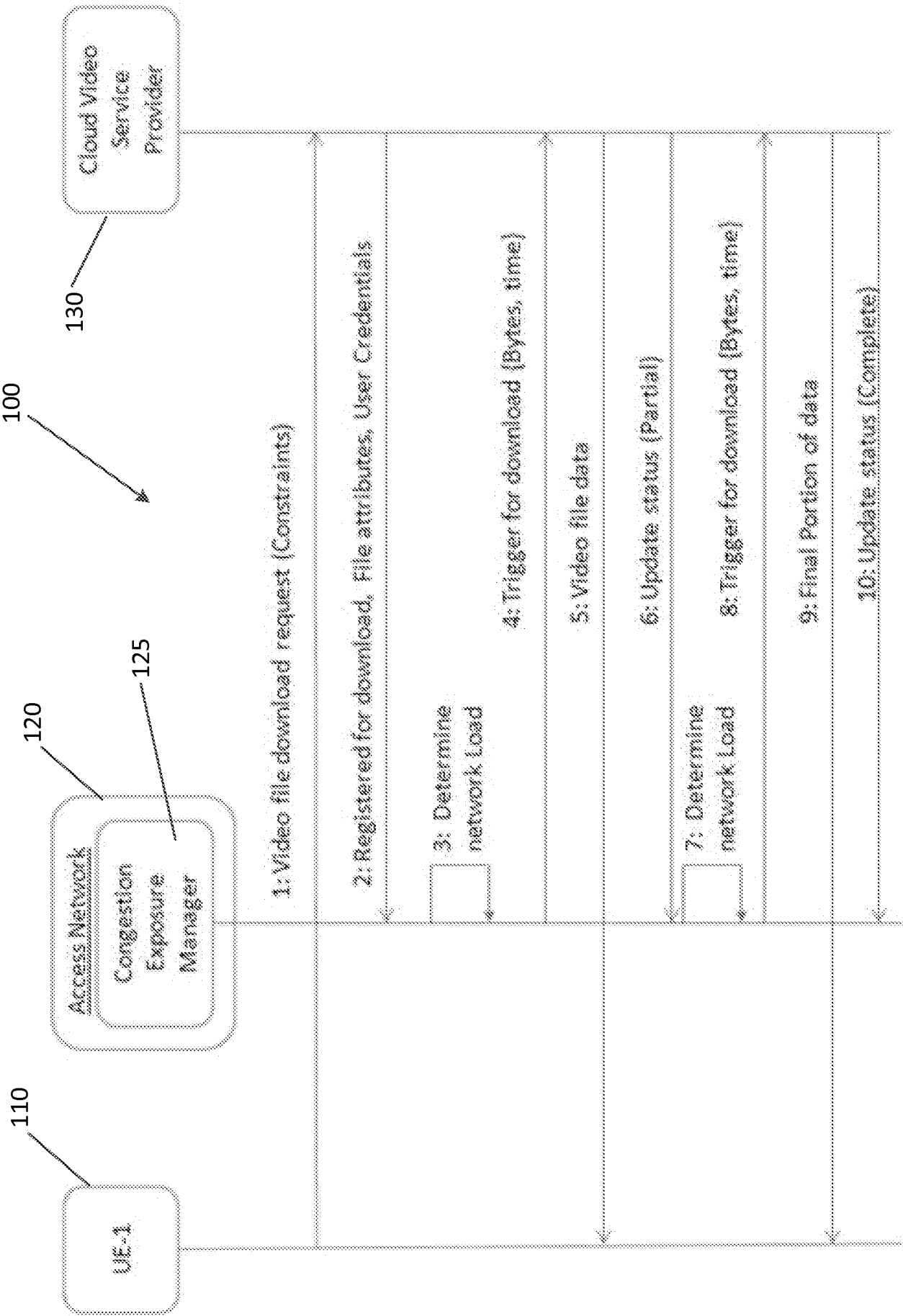


FIG. 1

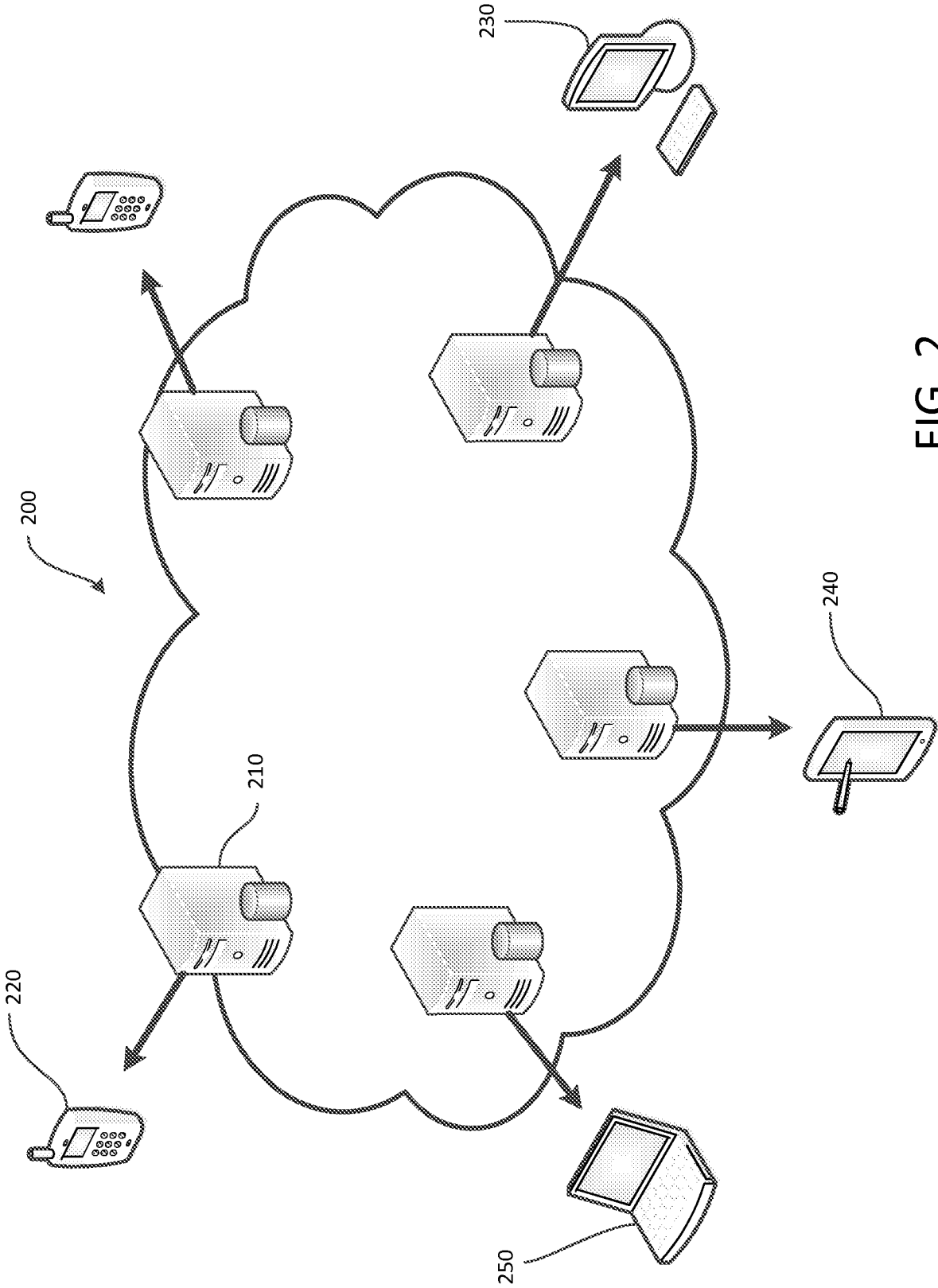


FIG. 2

3/3

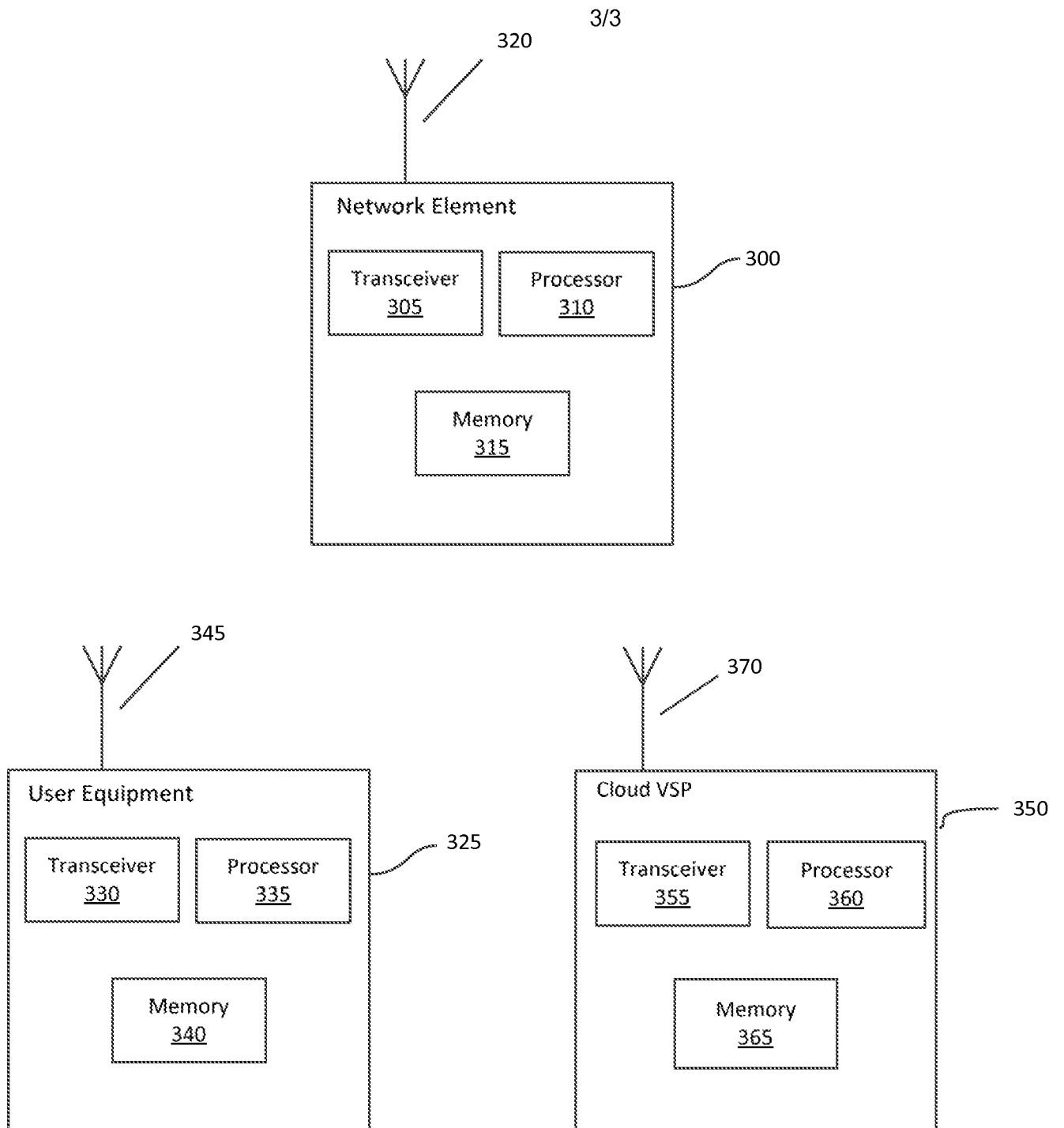


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2013/033673

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - H04B 7/00 (2013.01) USPC - 455/452.2 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(8) - H04B 7/00, 7/005, 7/24, 7/26 (2013.01) USPC - 455/422.1, 450, 452.1, 452.2 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched CPC-H04B 7/00, 7/005, 7/24, 7/26 (2013.01) Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Orbit, Google Patents, Google Scholar		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X		1, 3, 6, 7, 9, 10, 12, 15, 16, 18, 19, 21, 24, 25, 27, 28
---	US 2012/0064908 A1 (FOX et al) 15 March 2012 (15.03.2012) entire document	-----
Y		2, 4, 5, 8, 11, 13, 14, 17, 20, 22, 23, 26
Y	US 2012/0324052 A1 (PALEJA et al) 20 December 2012 (20.12.2012) entire document	2, 4, 5, 11, 13, 14, 20, 22, 23
Y	US 2012/0166574 A1 (HARVELL et al) 28 June 2012 (28.06.2012) entire document	2, 4, 5, 8, 11, 13, 14, 17, 20, 22, 23, 26
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