Title: MANAGING DEVICE RESOURCES AND CONFIGURATION

Abstract: Disclosed are systems and methods for managing data use by a user device. In an embodiment, the resolution of media generation, media presentation, or both are altered to optimize the device's usage of data under a data allotment. In a further embodiment, the device may serve as a data conduit to a second device for reasons of improved resolution, improved battery life, or to optimize data allotment.

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MANAGING DEVICE RESOURCES AND CONFIGURATION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is related to U.S. Patent Applications (attorney docket numbers CS42446 and CS42447), filed on even date herewith, which applications are hereby incorporated by reference in their entireties.

TECHNICAL FIELD

[0002] The present disclosure is related generally to managing resources available to a device and, more particularly, to a system and method for managing data usage and battery usage.

BACKGROUND

[0003] Every computing device, whether embedded, mobile, or stationary, is the result of certain compromises made during design to support one or more functions or capabilities at a cost to one or more other functions or capabilities. Moreover, hardware and software limitations associated with current technologies such as screens, batteries, spectrum usage, etc., constrain such devices in other ways. As a result, most computing devices are subject to one or more constraints in communication, power, portability, or other dimensions.

[0004] Thus, for example, a portable communications device such as a smartphone may provide great portability at the cost of requiring a battery for power, limiting total continuous on-time usage. The same goal may also require limitations on screen size and hence on screen resolution. Similarly, a frequently used device may experience wireless communications blackouts or impediments due to imposition of a data allotment, e.g., within cellular, broadband, and other wireless contexts. Some devices may lack cellular or broadband capabilities but may have heightened resolution. In general, the compromises that are made in producing, configuring, or provisioning various devices may result in decreased user experience and usability.

[0005] It should be appreciated that any particular benefit is not a limitation on the scope of the disclosed principles or of the attached claims, except to the extent expressly recited in the claims. Additionally, the discussion of technology in this background section is merely reflective of inventor observations or considerations and is not an indication that the discussed technology represents actual prior art.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0006] While the appended claims set forth the features of the present techniques with particularity, these techniques, together with their objects and advantages, may be best
understood from the following detailed description taken in conjunction with the accompanying drawings of which:

[0007] Figure 1 is a schematic diagram of a mobile computing device such as a smartphone, cell phone, etc., within which embodiments of the disclosed principles may be implemented;

[0008] Figure 2 is a perspective front view of a mobile computing device such as that shown in Figure 1;

[0009] Figure 3 is a device and network diagram in accordance with an embodiment of the disclosed principles;

[0010] Figure 4 is a device and network diagram in accordance with an embodiment of the disclosed principles;

[0011] Figure 5 is a flowchart showing a process of data management in accordance with an embodiment of the disclosed principles;

[0012] Figure 6 is a flowchart showing an alternative process of data management in accordance with an embodiment of the disclosed principles; and

[0013] Figure 7 is a flowchart showing a process of data management in accordance with yet another embodiment of the disclosed principles.

DETAILED DESCRIPTION

[0014] Before providing a detailed discussion of the figures, a brief overview is given to guide the reader. Disclosed are systems and methods for managing data use by a user device. In an embodiment, the resolution of media generation, media presentation, or both are altered to optimize the device's usage of data under a data allotment. As the phrase is used herein, "data allotment" includes data allotments of various sizes, e.g., very small data allotments as well as very large or even unlimited data allotments. Moreover, a data allotment may be a single allotment or one of a series of periodic allotments, e.g., under a service contract with a data provider, potentially including a penalty for exceeding the allotment. A smartphone without affordable available data is not able to do the things that mark it as "smart," i.e., email, instant messaging, shopping, etc. In a further embodiment, the device may serve as a data conduit to a second device for reasons of improved resolution or improved battery life.

[0015] Turning now to a more detailed discussion in conjunction with the attached figures, techniques of the present disclosure are illustrated as being implemented in a suitable environment. The following description is based on embodiments of the disclosed principles
and should not be taken as limiting the claims with regard to alternative embodiments that are not explicitly described herein.

[0016] The schematic diagram of Figure 1 shows an exemplary device forming part of an environment within which aspects of the present disclosure may be implemented. In particular, the schematic diagram illustrates a user device 110 including several exemplary components. It will be appreciated that additional or alternative components may be used in a given implementation depending upon user preference, cost, and other considerations.

[0017] In the illustrated embodiment, the components of the user device 110 include a display screen 120, a camera 130, a processor 140, a memory 150, one or more video codecs 160, and one or more input components 170.

[0018] The processor 140 can be any of a microprocessor, microcomputer, application-specific integrated circuit, or the like. For example, the processor 140 can be implemented by one or more microprocessors or controllers from any desired family or manufacturer. Similarly, the memory 150 may reside on the same integrated circuit as the processor 140. Additionally or alternatively, the memory 150 may be accessed via a network, e.g., via cloud-based storage. The memory 150 may include a random-access memory (i.e., Synchronous Dynamic Random-Access Memory, Dynamic Random-Access Memory, RAMBUS Dynamic Random-Access Memory, or any other type of random-access memory device). Additionally or alternatively, the memory 150 may include a read-only memory (i.e., a hard drive, flash memory, or any other input type of memory device).

[0019] The information that is stored by the memory 150 can include program code associated with one or more operating systems or applications as well as informational data, e.g., program parameters, process data, etc. The operating system and applications are typically implemented via executable instructions stored in a non-transitory computer-readable medium (e.g., memory 150) to control basic functions of the electronic device 110. Such functions may include, for example, interaction among various internal components and storage and retrieval of applications and data to and from the memory 150.

[0020] The device 110 also includes a network-interface module 180 to provide wireless communications from and to the device 110. The network-interface module 180 may include multiple communications interfaces, e.g., for cellular, WiFi, broadband, and other communications. A power supply 190, such as a battery, is included for providing power to the device 110 and its components. In an embodiment, all or some of the internal components
communicate with one another by way of one or more shared or dedicated internal communication links 195, such as an internal bus.

[0021] Further with respect to the applications, these typically utilize the operating system to provide more specific functionality, such as file-system service and handling of protected and unprotected data stored in the memory 150. Although many applications may govern standard or required functionality of the user device 110, in many cases applications govern optional or specialized functionality, which can be provided, in some cases, by third-party vendors unrelated to the device manufacturer.

[0022] Finally, with respect to informational data, e.g., program parameters and process data, this non-executable information can be referenced, manipulated, or written by the operating system or an application. Such informational data can include, for example, data that are preprogrammed into the device 110 during manufacture, data that are created by the device 110, or any of a variety of types of information that is uploaded to, downloaded from, or otherwise accessed at servers or other devices with which the device 110 is in communication during its ongoing operation.

[0023] In an embodiment, the device 110 is programmed such that the processor 140 and memory 150 interact with the other components of the device 110 to perform a variety of functions. The processor 140 may include or implement various modules and execute programs for initiating different activities such as launching an application, transferring data, and toggling through various graphical user-interface objects (e.g., toggling through various icons that are linked to executable applications).

[0024] Figure 2 presents a simplified perspective illustration of an example user device 200 within which embodiments of the disclosed principles may be implemented. As shown, the user device 200 generally includes a body or case 201 that allows a user to hold and handle the device 200. In addition, the case 201 serves to protect the internal components of the device 200 and to provide an anchor for external interface ports and components such as headphone jacks and hardware buttons 202, 203, 204. The illustrated device 200 also includes a display screen 205, for displaying images, videos, and user-interface components.

[0025] Referring now to Figure 3, an example device environment 300 is shown with functional modules and equipment. In the example embodiment of Figure 3, a single user device 301 is associated with a data plan that provides access to one or more content providers 302, 303, 304, via, e.g., one or both of a cellular network and a broadband network. In an embodiment, the data plan is limited, for example, such that the accumulated use of
data by the device 301 is capped at a predetermined amount of data, e.g., within a given period, such as a month.

[0026] In use, the device 301 of Figure 3 includes a group 305 of one or more running applications 306, 307, 308. The one or more running application 306, 307, 308 are media applications in an embodiment. That is, the applications 306, 307, 308 primarily generate or consume media content. Examples of media applications include FACEBOOK(TM), NETFLIX(TM), and YOUTUBE(TM) (or a browser uploading to or downloading from any of these). The use of such applications is generally data intensive since media-content data sets are often very large.

[0027] The device 301 shown in Figure 3 operates via a devices system framework ("DSF") 309, described in greater detail below. Finally, the device 301 also runs a data-usage monitor module ("DUMM") 310 in an embodiment. As discussed in greater detail below, the DUMM 310 determines usage patterns and data requirements and executes configuration decisions based on needed and remaining data allotment, device resolution, device battery level, and so on. In yet another embodiment, the DUMM 310 resides outside the device 301.

[0028] As noted above, high speed 3G and LTE cellular data plans as well as most broadband plans come with a specified data allotment. Exceeding the data allotment often leads to significant bandwidth throttling (which may render the device essentially unusable for some purposes) or the imposition of significant charges for the excess data consumed. For this reason, mobile-device users often look for alternative data channels such as free Wi-Fi. However, when free Wi-Fi is not available, users have to use metered data connections if they need connectivity.

[0029] A typical mobile-device user (mobile devices including cell phones, smartphones, tablets, and so on) underestimates the rapidity or frequency with which he may exceed his plan's data allotment. This is in part due to the fact that users typically are unaware of the data requirements associated with current high-performance devices (e.g., higher screen resolution, support for faster networks and higher processing speeds). For example, YOUTUBE(TM) video provides content encoded at any of various resolutions such as low, medium, qHD, HD, full HD, and so on. The selection of the content to be streamed is dependent on the consumption device's capabilities. Since most smartphone devices have high-resolution screens, this content stream would be at a higher resolution, resulting in higher data usage. Similarly, the same points affect the data needed for uploading and sharing content.
Most users either curb their usage significantly as they near the data allotment or completely stop data usage as they near their limit for fear of incurring high charges. In either case, the user effectively forgoes the service they would have otherwise enjoyed. Similar behavior patterns are exhibited for capped household broadband services (unlimited high speed plans come with significant higher cost). Moreover, plans designated as "unlimited" often have bandwidth throttling after some data-usage limit is reached, rendering the service almost unusable for many purposes.

Often, household broadband service is shared among multiple devices owned by one or more respective owners, with different devices potentially providing different respective resolutions. For example, family data plans are shared by family members carrying different devices with different resolutions. While there may be provisions to specify a sub-limit for each device or user under a family data plan, effective utilization of the complete data plan is not usually achieved.

As will be appreciated from the foregoing, it is beneficial to allow a user to efficiently use his allotted data, both to maximize at least one or both of the amount and quality of content that can be experienced as well as to ensure that the user does not forfeit unused data allotment or exceed the data allotment and incur charges. In an embodiment, the user selects content to be viewed via an application. The application requests that the DSF provide it with device capabilities, and in particular, the device resolution and data connection type (Broadband, 2G, 3G, etc.). In turn, the DSF requests that the DUMM module provide session resolution ("ses_res") and connection type ("ses_bw"). In yet another embodiment, when DUMM determines that a user has sufficient data, it may suggest that the device use higher quality content as per channel capacity.

The DUMM computes the ses_res and ses_bw parameters dynamically for the session based on user-behavior patterns and remaining data allocation. In other words, instead of necessarily specifying the actual device resolution, the DUMM specifies a resolution that will allow the user to view the content without eventually exceeding his data allotment for the time period given his usage patterns. The DSF responds to the device capability request by providing the ses_res and ses_bw to the requesting application. The application then communicates to the server to obtain the desired content with the ses_res and ses_bw determined by the DUMM.

In another embodiment, the DUMM computes the ses_res and ses_bw parameters dynamically for the session based on current battery level of the device. In other words,
instead of necessarily specifying the actual device resolution, the DUMM specifies a
resolution that will allow the user to view the content without exhausting the battery. The
DSF responds to the device capability request by providing the ses_res and ses_bw to the
requesting application. The application then communicates to the server to obtain the desired
content with the ses_res and ses_bw determined by the DUMM.

[0035] Figure 4 shows an alternative arrangement 400 wherein multiple devices 301a,
301b, 301c share a single data plan. In the illustrated example, each device 301a, 301b, 301c
is essentially as shown in Figure 3. However, instead of the DUMM 310, the devices 301a,
301b, 301c include a Device DUMM Interface Module ("DDIM") 411a, 411b, 411c. Each
DDIM 411a, 411b, 411c shares device-capability information (resolution, bandwidth
supported, battery level) with a network-accessible DUMM 412. In particular, each DDIM
411a, 411b, 411c interacts with the DUMM 412 to get session resolution and connection type
(devl_ses_res, devl_ses_bw). Similarly, each DDIM 411a, 411b, 411c shares data-usage
statistics with the DUMM 412. Based on feedback, the DUMM 412 may readjust
devn_ses_res and devn_ses_bw in the same session. Each device 301a, 301b, 301c uses the
received devn_ses_res and devn_ses_bw to request the corresponding content from the
content server.

[0036] Similar to the scenario of a single user using a single device for a data plan, the
system shown in Figure 4 may also optimize data usage by overriding device or application
settings to use the device resolution specified by the DUMM 412. However, given that the
system shown in Figure 4 consists of multiple devices with various resolutions sharing a
single data plan, other approaches may also be considered. For example, each user may be
given a sub-limit within the subscribed data plan. In an embodiment, if the DUMM 412
determines that one device is not fully using its data sub-limit, then the DUMM 412 may
offer higher bandwidth or higher resolution content to another device which is also using
data.

[0037] As noted above, as different users use different devices, their usage is monitored
by the relevant device DDIM, and the usage is uploaded to the DUMM 412 located in the
cloud. The DUMM 412 coordinates and monitors data use by different users and devices to
generate usage patterns. Based on a high-usage pattern (e.g., one where the user or plan will
prematurely exhaust the data allotted), the DUMM 412 may degrade the data to or from each
device gracefully, such as by lowering resolution as discussed above. In an embodiment, a
user priority may be defined to provide different resolution content to different users. For
example, a parent's device may have a high priority such that it receives HD content, while a child's device may be degraded to qHD content.

[0038] With respect to uploading data from a particular device subject to an accumulated data limit, the DUMM 412, whether cloud-based or device-based, may throttle the user's upload and sharing behavior. In an example process, the DUMM 412 monitors the usage pattern and behavior of the user capturing and uploading media content with the device's default capabilities (e.g., default resolution).

[0039] If the DUMM 412 determines that the uploading and sharing behavior is, on average, consuming more data than would be appropriate to stay under the data allotment, then the DUMM 412 may execute data-usage reduction steps. Appropriate data-usage reduction steps may include, for example, instructing the device to capture media in a less data-consuming format, e.g., in qHD rather than HD, and recommending data compression of media content while uploading and sharing such content.

[0040] The flowchart of Figure 5 illustrates an exemplary process 500 of managing data use by a user device based on device resolution. At stage 501 of the process 500, the user device receives a user request associated with specific media content. The request may be pursuant to user activation of a hyperlink or other link to the media. The device's supported media resolution (e.g., screen resolution, processor-limited resolution, etc.) is detected at stage 502, and at stage 503 it is determined that the device is linked to the source of the desired media content via a channel which is constrained by an accumulated data-usage limit.

[0041] A usage pattern is calculated for the user and is used to derive a data-usage rate that would allow the user to avoid passing the accumulated data-usage limit at stage 504. Finally at stage 505, the media are transferred at a resolution in keeping with the derived data-usage rate.

[0042] It should be noted that a process akin to 500 may also be used to provide higher media resolution, e.g., an optimized resolution, such as when the default resolution for the consuming device or application is lower than what can be easily supported under the data allotment. The process of changing the resolution in either case may require technical formalities such as negotiating, handshaking, and so on, as will be appreciated by those of skill in the art.

[0043] The configuration of devices and systems shown in Figure 4 has been described in the context of multiple devices sharing a data plan. However, the illustrated architecture also supports a scenario of multiple co-located friends and family users using different devices
having individual data plans. In this scenario, the DUMM 412 may take a similar approach. The usage pattern of each user and his respective plan is uploaded to the DUMM 412 via the respective DDIMs. The DUMM 412 then determines whether one user has more data remaining under his data allotment while another user is prematurely coming close to the data allotment.

[0044] The DUMM 412 also determines if the relevant devices are co-located (to within the communication range of a short-range technology supported by both devices). If so, then the DUMM 412 sends a recommendation to both the devices to share data, wherein the device with more remaining data becomes the source of the data, and the other device becomes the data sink. The channel for transferring media from the first device to the second may be referred to as a data pipe. One technology usable to enable the recommended data sharing is Tethering (or Mobile Hotspot).

[0045] So by way of example, consider a father who has 500 MB of data left on his plan (under the cap), and his usage pattern shows that he will likely utilize only 100 MB before the data-limit period ends. If the DUMM 412 determines that a co-located son on a different data plan is running out of data, then it sends recommendation to the devices of the father and son recommending that they connect using Tethering so that the son can stream the data he wants to his device via his father's data connection.

[0046] Figure 6 is a flowchart showing an exemplary process 600 for managing data use between a first user device and a second user device. For the illustrated example, each device has a respective remaining data allotment, e.g., pursuant to a cellular or broadband data plan. At stage 601 of the process 600, the first user device receives a request for certain desired media content residing on a remotely located data source such as an Internet server. The request may be, for example, a result of a user selection on an interface of the device, such as "clicking" or selecting a hyperlink.

[0047] At stage 602, a DUMM associated with the device predicts that, using default settings, the remaining data allotment of the first device will be exhausted prior to the end of the data period associated with the remaining data allotment for the first device, however the remaining data allotment for the second device will not be exhausted prior to the end of its data period. In response, a data pipe is opened between the first user device and the second user device at stage 603. At stage 604, the remaining data allotment for the second device is shared with the first device via the data pipe, allowing the first device to access the desired
media. The desired media so obtained are presented to the user on the first user device at stage 605.

[0048] As noted above, in an embodiment the data usage of one or more devices may be managed to create a power-saving result for one device. An example 700 of such a process is shown in the flowchart of Figure 7. At stage 701 of the process 700, a first user device receives a user request for desired media content, e.g., via one of the mechanisms discussed above. The device determines at stage 702 that the available power remaining in the first device is not sufficient to complete the desired operation, and the power remaining in the first device is lower than the power remaining with respect to the second device. The available power may be, for example, battery power. In addition, the second device may be plugged into a power source such as a household electrical socket, in which case its available power is considered to be infinite.

[0049] At stage 703, a data pipe between the first user device and the second user device is opened, and the data connection of the first device is used by the second device at stage 704 to retrieve the desired media content. The desired media content is presented to the user via the second user device at stage 705.

[0050] In view of the many possible embodiments to which the principles of the present disclosure may be applied, it should be recognized that the embodiments described herein with respect to the drawing figures are meant to be illustrative only and should not be taken as limiting the scope of the claims. Therefore, the techniques as described herein contemplate all such embodiments as may come within the scope of the following claims and equivalents thereof.
CLAIMS

We claim:

1. A method of managing data use by a user device, the method comprising:
   receiving at the device a user request for desired media content;
   detecting the device's supported media resolution;
   determining whether the device is linked to a source of the desired media content via a wireless channel constrained by an accumulated data-usage limit.
   calculating a usage pattern of the user and deriving a data-usage rate that would allow the user to avoid passing the accumulated data-usage limit; and
   requesting and playing the desired media content at an optimized resolution that would result in data usage during playing of the desired media content that is less than or equal to the derived data-usage rate.

2. The method of claim 1 wherein the constrained wireless channel includes at least one of a broadband channel and a cellular channel.

3. The method of claim 1 wherein deriving a data-usage rate includes determining usage rates for one or more other users who share the accumulated data-usage limit.

4. The method of claim 1 wherein requesting and playing the desired media content at an optimized resolution entails retrieving the desired media content at a resolution that exceeds a default resolution of the user device or an application running thereon, the default resolution being less than or equal to the maximum resolution supportable by the user device or application.

5. The method of claim 1 wherein the optimized resolution is lower than the device's supported resolution.

6. The method of claim 1 wherein the optimized resolution is lower than the constrained channel capacity would allow.

7. The method of claim 1 wherein the optimized resolution is greater than a default resolution associated with an application for playing the desired content.
8. The method of claim 1 wherein the accumulated data-usage limit is a data plan limit under one or more service contracts.

9. The method of claim 1 further comprising increasing the device's use of cellular data relative to broadband data to allow optimal data use if it is determined that adequate data remains under the cellular data allotment.

10. The method of claim 1 wherein the user device is one of a plurality of devices on a single data plan.

11. The method of claim 1 wherein deriving a data-usage rate further comprises analyzing present battery capacity of the device and taking remedial action based on the battery capacity.

12. The method of claim 11 wherein the remedial action includes at least one of reducing the optimized resolution and switching to another device for presentation of the desired content.

13. The method of claim 12 wherein switching to another device for presentation of the desired content includes determining that the battery capacity of the other device is greater than the present battery capacity of the user device.

14. A method of optimizing resource usage with respect to a user device in connection with desired media content, the method comprising:
   determining that one or more device resources are constrained in connection with the device's usage of the desired media content;
   modifying one or more aspects of the device's behavior to avoid a resource usage rate during processing or presenting the desired media content that would lead to violating a usage constraint if maintained; and
   presenting the desired media content in accordance with the modified one or more aspects of the device's behavior.
15. The method of claim 14 wherein the one or more aspects of the device's behavior include presented media resolution, and wherein the modification of the one or more aspects include modifying the resolution at which the desired media content is presented.

16. The method of claim 15 wherein modifying the resolution at which the desired media content is presented includes decreasing the resolution relative to a default value.

17. The method of claim 15 wherein the one or more aspects of the device's behavior include presented media resolution, and wherein the modification of the one or more aspects include changing the device upon which the desired media content is presented.

18. The method of claim 14 wherein determining that one or more device resources are constrained in connection with the device's usage of the desired media content includes determining that the device battery power is lower than a predetermined threshold.

19. The method of claim 14 wherein determining that one or more device resources are constrained in connection with the device's usage of the desired media content includes determining that the device is data constrained.

20. The method of claim 19 wherein the constraint is relative to the device's use of one or both of cellular data and broadband data.

21. The method of claim 19 wherein the one or more device resources include one or both of device battery power and remaining data allotment.

22. A method of optimizing data usage with respect to a user device in connection with media content, the method comprising:

   determining that the device's usage of one or more data channels to upload the media content to one or more servers is constrained by a data allotment;
determining that uploading the media content to the one or more servers in the current device configuration would result in an extrapolated usage rate that would cause data usage to exceed the data allotment;

modifying one or more aspects of the device's behavior with respect to uploading; and

uploading the media content in accordance with the one or more modified aspects of the device's behavior.

23. The method of claim 22 wherein the one or more data channels include one or both of a cellular data channel and a broadband data channel.

24. The method of claim 22 wherein determining that uploading the media content to the one or more servers in the current device configuration would result in an extrapolated usage rate that would cause data usage to exceed the data allotment includes tracking prior user behavior with respect to media generation and uploading and predicting that a modification of that behavior is needed to avoid surpassing the data allotment.

25. The method of claim 22 wherein modifying one or more aspects of the device's behavior includes determining that generated media are likely to be uploaded and in response causing the media to be generated at a lowered resolution.

26. The method of claim 22 wherein modifying one or more aspects of the device's behavior includes determining that generated media are likely to be uploaded and in response compressing the generated media.

27. The method of claim 22 wherein determining that generated media are likely to be uploaded comprises determining that an application involved in generating the media is a social-media application.

28. A user computing device configured for data usage management, the device being subject to a data allotment, the device comprising:

   a media application running on the device;
a data-usage monitor module configured to determine one or more of device
data-usage patterns, remaining data allotment, device resolution, and device battery
level, and to generate a session data-usage configuration recommendation; and
a device system framework module linked to the application and to the data-
usage monitor module, the device system framework module being configured to
provide the session data-usage configuration recommendation to the application.

29. The user computing device of claim 28 wherein the session data-usage configuration
recommendation specifies a resolution that differs from a default resolution specified
by the application.

30. The user computing device of claim 28 wherein the session data-usage configuration
recommendation specifies a resolution that differs from a maximum resolution
supported by the device.

31. A method of optimizing data usage with respect to a first user device and a second
user device, the devices being subject to respective periodic data allotments pursuant
to respective service contracts, wherein each periodic data allotment includes an
upload allotment and a download allotment, the method comprising:

determining that the first device's usage of one or more data channels to
upload or download media content at a specified resolution would result in an
extrapolated usage rate that would cause data usage to exceed the data allotment
associated with the first device prior to expiration of the current period;

modifying one or more aspects of the devices' behavior with respect to
uploading or downloading data the media content by executing one of (1) modifying
the resolution at which the media are communicated, (2) modifying which of the first
or second devices to or from which the media are communicated, and (3) modifying
the device on which the media are presented; and

causing the media content to be communicated and presented in accordance
with the one or more modified aspects of the devices' behavior.
Figure 1
First user device receives a user request associated with specific media content

Determine supported media resolution for device

Determine that device is linked to source of desired content via a channel constrained by an accumulated data usage limit device

Calculate usage pattern for user, derive data usage rate to avoid passing the accumulated data usage limit

Transfer media at resolution in keeping with derived data usage rate

End
First user device receives request for certain desired media content

DUMM predicts data allotment of first device will be exhausted prior to data allotment for second device

Data pipe opened between the first user device and the second user device

Share remaining data allotment for the second device with the first device via the data pipe, allowing the first device to access the desired media

Desired media content is presented to the user on the first user device

End
First user device receives a user request associated with specific media content

Detect that power remaining in first device is lower than power remaining with respect to second device

Open data pipe between the first user device and the second user device

Use data connection of first device by second device to retrieve the desired media content

Present desired media content to the user via the second user device
## INTERNATIONAL SEARCH REPORT

### A. CLASSIFICATION OF SUBJECT MATTER
- H04W4/18
- H04W52/02
- HQ4W72/G4
- H04W72/12
- H04W76/04
- H04L29/06

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)
- H04W
- H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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**INTERNATIONAL SEARCH REPORT**

**Box No. II**  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

<table>
<thead>
<tr>
<th>Reason</th>
<th>Claims Nos.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>because they relate to subject matter not required to be searched by this Authority, namely:</td>
</tr>
<tr>
<td>2.</td>
<td>because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:</td>
</tr>
<tr>
<td>3.</td>
<td>because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 64(a).</td>
</tr>
</tbody>
</table>

**Box No. III**  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See additional sheet

<table>
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<th>Reason</th>
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<tbody>
<tr>
<td>1.</td>
<td>All required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.</td>
</tr>
<tr>
<td>2.</td>
<td>All searchable claims could be searched without effort justifying an additional fee. This Authority did not invite payment of additional fees.</td>
</tr>
<tr>
<td>3.</td>
<td>Only some of the required additional search fees were timely paid by the applicant, this international search report covers 0% of claims searched (Article 18-30(completely); 31(partially) paid, specifically claims Nos.:</td>
</tr>
<tr>
<td>4.</td>
<td>No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-16, 18-30(completely); 31(partially).</td>
</tr>
</tbody>
</table>

**Remark on Protest**

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- Initial additional search fees were accompanied by the applicant's protest but the applicable protest was not timely filed in accordance with the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-16, 18-3Q (completely) ; 31 (partially)
   Lowering the resolution of media in order to save battery life

2. claims: 17 (completely) ; 31 (partially)
   Transferring a media session to another device in case resources of a mobile device are not adequate.
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
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<tbody>
<tr>
<td>US 2013166391 Al</td>
<td>27-06-2013</td>
<td>CN 104025557 A</td>
<td>03-09-2014</td>
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<td>EP 2798821 Al</td>
<td>05-11-2014</td>
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<td>JP 2015509236 A</td>
<td>26-03-2015</td>
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<td>KR 20140108565 A</td>
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<td>WD 2013101828 Al</td>
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