

DATA BANDWIDTH MANAGEMENT SYSTEM AND METHOD

FIELD OF THE INVENTION

The present invention relates to a data bandwidth management system and method. The system and method are particularly suited, but not limited to the management and allocation of data bandwidth to mobile prepaid subscribers and will be described in this context.

BACKGROUND ART

The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.

"Always on" or "24/7" Internet data access is generally available in markets where majority of telecommunication carrier subscribers prefer mobile data post-paid plans. Subscribers of such post-paid plans generally do not mind paying more per month to have unlimited Internet data access or a data usage capped at a large size, for example >2 Gigabytes (GB).

However, providing "always on" Internet or data connection has remained a challenge for telecommunications carriers in markets dominated by users who prefer "prepaid plans" (or "pay-as-you-go" plans). In these markets, users are less willing to pay a relatively larger subscription fee for internet access. Another variation to the pay-per-specified time model may be a daily "always on" access to selected web resources including websites such as FacebookTM, TwitterTM, and YouTubeTM.

As cost is an important concern for prepaid plan users, a challenge for telecommunications carriers is to deliver Internet connection at relatively lower "sachet" price points - yet providing prepaid plan users an "always on" experience. While this may be possible for certain client devices (e.g. "feature

phones" and Blackberry smartphones) which are efficient in terms of consuming data bandwidth, it is typically difficult to implement such "sachet" price points for more recent smartphones models which allow multiple programs (or more colloquially known as "apps"). These smartphone models require relatively higher data bandwidth. There is thus a need to capture the market of these smartphone users by providing these with certain flexibility in controlling and adjusting their data bandwidth usage so as to implement such "sachet" price points.

Presently, while it is possible for prepaid plan users to control data bandwidth and monitor their bandwidth usage to some extent, known control mechanisms in place are generally between a few fixed bandwidths levels and require conscious manual control by the user of the smartphone. Although such control mechanisms are better than the relatively coarser 'throttle'- 'de-throttle' all-or-nothing approaches (i.e. data access may only be switched from an "all"- maximum data bandwidth, to a "nothing"- no data bandwidth), such control which is typically administered by the service provider, there exist a need to improve such bandwidth control mechanism to provide seamless experience to prepaid subscribers below a certain price point. There also exists a need to provide feedback to users on the suitability of their data service plan usage.

SUMMARY OF THE INVENTION

In accordance with an aspect of the present invention there is a system for managing and allocating data bandwidth to a client device comprising a monitoring and traffic management module disposed within the client device, the monitoring and traffic management module arranged to monitor data usage on the client device; and a data traffic manager operable to allocate data bandwidth to the client device and receive a request from the monitoring and traffic management module; the request comprising an instruction to the data traffic manager to allocate a suitable data bandwidth to the client device depending on data usage.

The monitoring and traffic management module in the client device provides for real time monitoring and more accurate analysis of an individual's data usage profile in order for a service provider to make suitable recommendations and provide an overall seamless experience to the individual.

Preferably the system comprises a default mode wherein the data profile corresponds to a throttled data bandwidth of more than 100 kilobits per second.

Preferably, upon detection by the monitoring and traffic management module that the client device is being started/restarted, recently turned active from an idle mode or experiences a spike in CPU usage, the monitoring and traffic management module is operable to send a request to instruct the data traffic manager to allocate the maximum available data bandwidth to the client device for a pre-determined period of time, after which the data bandwidth allocated to the client device returns to the default mode. Such pre-determined period of time is set to allow for the proper loading/re-loading of various startup services, initial processes and "apps".

In accordance with another aspect of the present invention there is a system for determining a suitable Internet data connection for a pre-paid subscriber comprising a monitoring and traffic management module disposed within a client device of the pre-paid subscriber, the monitoring and traffic management module arranged to determine and analyse the Internet activity of the prepaid subscriber based on the usage of the client device on a real-time basis to generate a user profile; and a data traffic manager comprising a plurality of Internet data connection types; each Internet data connection type comprising at least a prioritized set of web resources; wherein the monitoring and traffic management module is operable to send a request to the data traffic manager; the request comprising an instruction to the data traffic manager to load an Internet data connection type from a plurality of Internet data connection types depending on the user profile of the pre-paid

subscriber.

Preferably, the user profile of the prepaid subscriber is maintained on an independent third party server.

Preferably, the set of web resources are prioritized using weights assigned based on the frequency of the web resources visited by the pre-paid subscriber for a pre-determined period of time.

Preferably, the monitoring and traffic management module is operable to continuously monitor the pre-paid subscriber's Internet activity.

Preferably, the monitoring and traffic management module is arranged to provide recommendation on suitable type(s) of data profile based on the user profile.

Preferably, the monitoring and traffic management module is operable to monitor at least one of the following:- operating system activity, central processing usage (CPU), type/quality of data connection, and the actual bandwidth usage of particular processes and apps.

In accordance with a third aspect of the present invention, there is provided a method for managing and allocating data bandwidth to a client device comprising the following steps:-

- a. monitoring data usage on the client device by a monitoring and traffic management module disposed within the client device;
- b. sending a request from the monitoring and traffic management module to a data traffic manager to allocate data bandwidth to the client device;
- c. the request comprising an instruction to the data traffic manager to allocate a suitable data bandwidth to the client device depending on data usage of the client device.

Preferably, the method comprises a default mode wherein the data profile corresponds to a throttled data bandwidth of more than 100 kilobits per

second.

Preferably, the monitoring and traffic management module detects that the client device is being started/restarted, recently turned active from an idle mode or experiences a spike in CPU usage and sends a request to instruct the data traffic manager to provide maximum available data bandwidth to the client device for a pre-determined period of time, after which the data bandwidth allocated to the client device returns to the default mode.

In accordance with a fourth aspect of the present invention, there is provided a method for determining a suitable Internet data connection for a pre-paid subscriber comprising:-

- a. determining and analyzing Internet activity of the pre-paid subscriber on a real time basis by a monitoring and traffic management module disposed within a client device;
- b. generating a user profile based on the usage of the client device to generate a user profile;
- c. sending a request from the monitoring and traffic management module to a data traffic manager to allocate data bandwidth to the client device, the data traffic manager comprising a plurality of Internet data connection types, each Internet data connection type comprising at least a prioritized set of web resources;
- d. the request comprising an instruction to the data traffic manager to load an Internet data connection type from a plurality of Internet data connection types depending on the user profile of the pre-paid subscriber.

Preferably, the data profile of the pre-paid subscriber is maintained on an independent third party server.

Preferably, the set of web resources are prioritized using weights assigned based on the frequency of the web resources visited by the pre-paid subscriber for a pre-determined period of time.

Preferably, the monitoring and traffic management module further operates to continuously monitor the pre-paid subscriber's Internet activity.

Preferably, the monitoring and traffic management module further provides recommendation on suitable type(s) of data profile based on the user profile.

Preferably, the monitoring and traffic management module further operates to monitor at least one of the following:- operating system activity, CPU usage, type/quality of data connection, and actual bandwidth consumption.

In accordance with a fifth aspect of the present invention, there is a client device installed with software thereon, the software executable to perform any of the method of the third and fourth aspects of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic representation of a system in accordance with an embodiment of the present invention; and

Fig. 2 is a schematic representation of a system in accordance with another embodiment of the present invention.

Other arrangements of the invention are possible and, consequently, the accompanying drawings are not to be understood as superseding the generality of the preceding description of the invention.

PREFERRED EMBODIMENTS OF THE INVENTION

The inventors had carried out studies on different types of smartphones and realized that different operating system platforms (such as iOSTM, AndroidTM)

are in-built with different internal network optimization tools. These optimization tools prioritize certain dedicated software applications (colloquially known as 'apps'), data packets, and activities performed by a user over other apps, data packets, and activities depending on factors such as the smartphone's CPU power consumption, bandwidth requirement of certain processes and apps, and/or existing data Internet connection quality (whether via Wi-Fi, LTE, 2G, or 3G etc.). A smartphone operating system will typically provide a coarse form of optimization on usage of the phone's available data bandwidth so as to ensure the best user experience possible. In other words, generally voice calls, push notifications for messaging app will be prioritized over app updates. For such activities considered to be of higher priority, all available bandwidth for the activities will be utilized. However, such type of optimization is generally not suitable for prepaid subscribers who wish to pay less for consuming less bandwidth; because this form of optimization assumes that the maximum allowable bandwidth is offered to the user at most times, e.g., at full 3G or LTE speeds. .

Based on certain studies, the inventors further note that the bandwidth usage of a user who performs certain activities including catch-up videos, music streaming, media downloads versus another user who merely surfs, chats and occasionally access social media such as FacebookTM, and TwitterTM when tagged or mentioned is about twenty times more. Hence, the present invention should at least segment users between heavy usage category and the casual usage category.

In accordance with an embodiment of the present invention there is a system 10 for managing data bandwidth provided to a client device 12 comprising:-

a monitoring and traffic management module 14 disposed within the client device 12, the monitoring and traffic management module 14 arranged to monitor data usage on the client device 12; and a data traffic manager 16 operable to allocate data bandwidth to the client device 12 and receive a request 20 from the monitoring and traffic management module 14; the request 20 comprising an instruction to the data traffic manager to provide a

suitable data bandwidth to the client device 12 depending on the data usage.

The client device 12 may be any computer device capable of accessing Internet (World Wide Web or WWW) via various means including and/or wired data services and wireless services such as but not limited to GPRS, EDGE, 2G, 3G, LTE, 4G, Wi-Fi, etc. The monitoring and traffic management module 14 may be a 'plug and play' device such as a USB dongle or a dedicated software application installable/installed on client device 12. The monitoring and traffic management module 14 may further be integrated within the client device 12 as a hardware or software module.

Monitoring and traffic management module 14 is operable to be in data communication with the data traffic manager 16. Data traffic manager 16 is operable to process requests 20 originating from the monitoring and traffic management module 14 to allocate suitable data bandwidth to the client device 12.

Data traffic manager 16 may be within a proxy gateway server for connection to the Internet. The data traffic manager 16 comprises a bandwidth adjuster 22 and a deep packet inspector 24. Bandwidth adjuster 22 is arranged to receive at least one request 20 for allocating suitable bandwidth to the client device 12 based on the request. Deep packet inspector 24 is arranged to provide periodic or random peeks into the data traffic of client device 12 in order to suitably determine the data profile of the user of the client device 12 based on whether the user of the client device 12 is surfing casually, voice calling over data, messaging, downloading media, peer-to-peer media sharing (torrenting), downloading or updating apps, just to name a few.

The requests 20 are likely via one or more Application Programming Interfaces (or APIs) or similar. The requests 20 are mostly real-time connectivity means. Other forms of connectivity may also be in the form of simple text or Short Messaging Service (SMS), Unstructured Supplementary Service Data (USSD) messages or any other form of an electronic signal/message for such a purpose.

The monitoring and traffic management module 14 is configured or arranged to monitor one or more of the following activities that consume data bandwidth:-

Internet access by software applications in the client device 12;

Operating system processes and activities;

Central Processing Unit (CPU) boot-up and usage; and/or

Quality of data connection (e.g. speed of connection measurable via latency, ping times; whether on EDGE/3G/LTE etc.)

And in cases where allowed by the operating system, actual data bandwidth consumption.

Based on the monitoring of these activities, the monitoring and traffic management module 14 will send requests 20 to data traffic manager 16 based on the following set of rules:-

Maximum bandwidth (de-throttle) to be made available to the client device 12 where one of the following happens:-

- When software application(s) installed on client device 12 that requires heavy refreshing and syncing with cloud-based servers has been activated or just turned active again (after being idle for quite some time);
- When software application(s) installed on client device 12 spikes in terms of CPU usage, suggesting renewed activity or the need for downloading or uploading of heavy files and media.
- When the client device 12 has just been restarted or turned active again after being in idle mode for some time. In such cases, the client device 12 will be refreshing or synchronizing contact details, schedules, tasks and notes. It may also fetch emails, check notifications, etc; and

- When the IP address of the client device 12 has changed. Change in IP address suggests a recently awakened client device 12 or a client device 12 that just got back its Internet connection. In such cases, the client device 12 will be refreshing or synchronizing contact details, schedules, tasks and notes. It may also fetch emails, check notifications, etc.

In addition to sending request 20, the monitoring and traffic management module 14 may be operable to be in data communication with the data traffic manager 16 to verify and check the user preference (based on data obtained from the data usage of the user) generated by the deep packet inspector 24 in the event where the deep packet inspector 24 is required. Once verified, the monitoring and traffic management module 14 sends a request 20 to de-throttle (allocate maximum bandwidth), throttle (allocate a pre-determined capped bandwidth), and/or verify the checked user preference back to the data traffic manager 16. Upon receiving the request 20 and upon verification, the data traffic manager 16 may de-throttle (allocate maximum bandwidth), throttle (allocate a pre-determined capped bandwidth), and/or prioritize certain web resources (data packets, URLs etc.) based on the user preference. Each user preference may be stored in a central server 26.

The monitoring and traffic management module 14 may be arranged to provide recommendation on different services, data plan or stock-keeping units deemed suitable for the user of the client device 12 based on the verified user preference. For example, if the monitoring and traffic management module 14 detects frequent video sharing activity, it will recommend a data service that prioritizes such type of usage access to the user, while throttling or de-prioritizing all other traffic, including other media streams, such as those unrelated to the sharing of video.

Recommendations may be in the form of a push alert notification displayed on the screen of the client device 12, such as an alert notification to the user to consider turning off all auto synchronization which may consume unnecessary bandwidth while on a relatively low bandwidth mode (e.g. 3G as opposed to

Wi-Fi). Another example may be in the form of displaying an on screen message upon detection by the monitoring and traffic management module 14 that the user is accessing a heavy bandwidth usage activity such as file sharing in a relatively low bandwidth mode which is not recommended.

Examples of different services, data plan or stock-keeping units are as follows:-

- a. Full speed Internet (3G, 4G, LTE) at a higher Committed Information Rate (CIM) and an MIR (Maximum Information Rate) at much more than 100 kilobits per second (kbps), and typically in the 1-2 Mbps range for 3G and 5-20 Mbps for LTE connection;
- b. Prioritization of data bandwidth or traffic for selected software applications access to the Internet over others if user is deemed to prefer access to these selected software applications over others;
- c. Prioritization of data bandwidth or traffic for selected Internet resources, e.g. games over others if user is deemed to prefer access to these Internet resources over others; and
- d. Prioritization of data bandwidth or traffic for selected media data type traffic, e.g. voice calls, photo sharing, messaging software applications, notifications over others.

The monitoring and traffic management module 14 is further able to determine the software application(s) activated, the time of day the software application(s) is/are activated, and the frequency of usage of these software application(s). The monitoring and traffic management module 14 is also able to ascertain CPU usage and in certain cases, actual bandwidth consumption.

The invention will now be described in the context of a prepaid subscriber of a telecommunications system 10 having a smartphone 12 as client device, with a monitoring and traffic management 'app' (Traffic App) 14 installed on the smartphone 12.

Upon launching the Traffic App 14, the Traffic App 14 monitors the data

usage/activities of the smartphone 12 in the context of the Internet connection and generates a user profile/user preference data based on such activities. The Traffic App 14 also monitors the existing data service plan that the prepaid subscriber has subscribed to and sends an instructing request 20 to the data traffic manager 16 to begin serving this type of plan. For example, if a "Video Sharing Plan" is chosen by the prepaid subscriber, the data traffic manager 16 will proceed to prioritize traffic exchange with certain URLs or IP addresses such as Vine™ or Instagram™ to the subscriber over other activities performed by the subscriber. Once traffic exchange is detected, the Traffic App 14 will alert the data traffic manager 16 via its API connectivity 21 and the data traffic manager 16 will proceed accordingly.

The Traffic App 14 continues to monitor the activities and will make recommendations if the current data plan is not ideal for the type of Internet activity. If required, Deep packet inspector 24 is activated to provide periodic or random peeks into the data traffic of client device 12 although it is to be appreciated that it is the Traffic App 14 which determines and analyses the prepaid subscriber's behaviour and Internet activity generally. This is a conscious choice as a deep packet inspector 24 at the telecommunications network level has limited customization capability and would not approximate the accuracy of analysis capable at the individual client device 12 level. Further, the data traffic manager 16 is generally less adaptive and requires more set-up time to conform to a subscriber's preferred type of service. The data traffic manager 16 also has limited capability, if at all, in profiling every subscriber. A key advantage of the use of Traffic App 14 at the client device 12 level is to minimize dependence on the telecommunications system 10 to do the customization work for its millions of subscribers by placing the burden of analysis and customization on the Traffic App 14. The data traffic manager 16 is arranged to simply take instructions from the Traffic App 14, including throttle, dethrottle, prioritize traffic with certain URLs, deprioritize others, prevent torrenting, etc.

The discussion above explains how based on a specific plan or consumer

preference, the Traffic App 14 will prioritize internet traffic. Concurrently, the Traffic App 14 constantly monitors and updates its profile of the prepaid subscriber, learning over time the internet activities (apps and URLs) most important to him. Hence, it is not always necessary for the subscriber to be prompted to make an explicit choice. If for instance the Traffic App 14 notes through learning over time, specific URLs which are important to the subscriber, example, a prepaid subscriber frequently checks his news via Google News, the Traffic App 14 notes the same and when the subscriber visits news.google.com, the Traffic App 14 will prioritize this traffic through known Quality of Service (QOS) techniques.

The Traffic App 14 may optionally take into consideration how much of the implied target megabytes (MB) usage daily a user has consumed, and will then, relax the MIB (de-throttle) for internet activities and URLs important to the subscriber. It constantly calculates usage and check if the telecommunication system 10 target MB usage allowance can accommodate a de-throttling or increase of the MIR. We note that the telecommunications provider or Mobile Network Operator, in order to be profitable, must manage a subscriber's (daily and "peak hour") bandwidth consumption vis-a-vis how much it charges for the data service.

As an optional feature, a subscriber's historical and behavioural profile may be arranged to be kept and maintained by a third party server service provider 30. In such an arrangement, the historical and behavioural profile is not resident at the telecommunications system 10 or the data traffic manager 16. This means that a subscriber can change his account within the telecommunications system 10 (e.g., change mobile-phone MSISDN) and be able to access and restore his original profile if required. A social network account such as FacebookTM or a GmailTM account may be used as an unifying ID.

A subscriber may have multiple profiles per account. He might like to do this if he has several client devices 12, for instance, an iPhoneTM, an iPadTM, and an AndroidTM device. As each of such client device 12 behaves differently as far

as data consumption is concerned, it is therefore important to know the client device 12 being used so that proper recommendations could be made if required.

An added advantage of the approach is that the prepaid subscriber can switch to another telecommunications system, or go on roaming mode, and if that particular telecommunications system is enabled with the present invention or has a data traffic manager compatible with the system 10 of the present invention, the subscriber can use the same profile he has always used.

In another embodiment, where like numerals reference like parts, there is a system 10 for determining a suitable Internet data connection for a prepaid subscriber comprising a monitoring and traffic management module 14 disposed within a client device 12 of the prepaid subscriber, the monitoring and traffic management module 14 arranged to determine and analyse the Internet activity of the pre-paid subscriber on a real-time basis based on the usage of the client device 12 to generate a user profile 18; and a data traffic manager 16 comprising a plurality of Internet data connection types; each Internet data connection type comprising at least a prioritized set of web resources; wherein the monitoring and traffic management module 14 is operable to send a request 20 to the data traffic manager 16; the request 20 comprising an instruction to the data traffic manager 16 to load an Internet data connection type from a plurality of Internet data connection types depending on the user profile 18 of the pre-paid subscriber. The user profile 18 may be generated by using the data obtained to determine user preference as described in the earlier embodiment.

In the embodiment, the system 10 is a mobile network operator or Internet service provider. The Traffic Manager 16 may be within the mobile network operator or Internet service provider.

It is to be understood that the above embodiments have been provided only by way of exemplification of this invention, and that further modifications and improvements thereto, as would be apparent to persons skilled in the relevant

art, are deemed to fall within the broad scope and ambit of the present invention described herein. It is further to be understood that features from one or more of the described embodiments may be combined to form further embodiments.

The Claims Defining the Invention are as Follows:

1. A system for managing and allocating data bandwidth to a client device comprising:-

a monitoring and traffic management module disposed within the client device, the monitoring and traffic management module arranged to monitor data usage on the client device; and

a data traffic manager operable to allocate data bandwidth to the client device and receive a request from the monitoring and traffic management module; the request comprising an instruction to the data traffic manager to allocate a suitable data bandwidth to the client device depending on data usage.

2. A system according to claim 1, wherein in default mode the data profile corresponds to a throttled data bandwidth more than 100 kilobits per second.

3. A system according to claim 2, wherein upon detection by the monitoring and traffic management module that the client device is being started/restarted, recently turned active from an idle mode or experiences a spike in CPU usage, the monitoring and traffic management module is operable to send a request to instruct the data traffic manager to provide maximum available data bandwidth to the client device for a pre-determined period of time, after which the data bandwidth allocated to the client device returns to the default mode.

4. A system for determining a suitable Internet data connection for a pre-paid subscriber comprising:-

a monitoring and traffic management module disposed within a client device of the pre-paid subscriber, the monitoring and traffic management module arranged to determine and analyse the Internet activity of the pre-paid subscriber on a real time basis based on the usage of the client device to generate a user profile; and

a data traffic manager comprising a plurality of Internet data connection types;

each Internet data connection type comprising at least a prioritized set of web resources;

wherein the monitoring and traffic management module is operable to send a request to the data traffic manager; the request comprising an instruction to the data traffic manager to load an Internet data connection type from a plurality of Internet data connection types depending on the user profile of the pre-paid subscriber.

5. A system according to claim 4, wherein the user profile of the pre-paid subscriber is maintained on an independent third party server.

6. A system according to claim 4, wherein the set of web resources are prioritized using weights assigned based on the frequency of the web resources visited by the pre-paid subscriber for a pre-determined period of time.

7. A system according to claim 4, wherein the monitoring and traffic management module is operable to continuously monitor the pre-paid subscriber's Internet activity.

8. A system according to claim 4, wherein the monitoring and traffic management module is arranged to provide recommendation on suitable type(s) of data profile based on the user profile.

9. A system according to claim 4, wherein the monitoring and traffic management module is operable to monitor at least one of the following:- operating system activity, CPU usage, type/quality of data connection, and actual bandwidth consumption.

10. A method for managing and allocating data bandwidth to a client device comprising the following steps:-

a. monitoring data usage on the client device by a monitoring and traffic

management module disposed within the client device;

b. sending a request from the monitoring and traffic management module to a data traffic manager to allocate data bandwidth to the client device;

c. the request comprising an instruction to the data traffic manager to allocate a suitable data bandwidth to the client device depending on data usage of the client device.

11. The method according to claim 10 wherein in default mode, the data profile corresponds to a throttled data bandwidth of more than 100 kilobits per second.

12. The method according to claim 11 wherein the monitoring and traffic management module detects that the client device is being started/restarted, recently turned active from an idle mode or experiences a spike in CPU usage and sends a request to instruct the data traffic manager to provide maximum available data bandwidth to the client device for a pre-determined period of time, after which the data bandwidth allocated to the client device returns to the default mode.

13. A method for determining a suitable Internet data connection for a pre-paid subscriber comprising:-

a. determining and analyzing Internet activity of the pre-paid subscriber on a real time basis by a monitoring and traffic management module disposed within a client device;

b. generating a user profile based on the usage of the client device;

c. sending a request from the monitoring and traffic management module to a data traffic manager to allocate data bandwidth to the client device, the data traffic manager comprising a plurality of Internet data connection types, each Internet data connection type comprising at least a prioritized set of web resources;

d. the request comprising an instruction to the data traffic manager to load an Internet data connection type from a plurality of Internet data connection

types depending on the user profile of the pre-paid subscriber.

14. The method according to claim 13 wherein the data profile of the pre-paid subscriber is maintained on an independent third party server.

15. The method according to claim 13 wherein the set of web resources are prioritized using weights assigned based on the frequency of the web resources visited by the pre-paid subscriber for a pre-determined period of time.

16. The method according to claim 13 wherein the monitoring and traffic management module further operates to continuously monitor the pre-paid subscriber's Internet activity.

17. The method according to claim 13 wherein the monitoring and traffic management module further provides recommendation on suitable type(s) of data profile based on the user profile.

18. The method according to claim 13 wherein the monitoring and traffic management module further operates to monitor at least one of the following:- operating system activity, CPU usage, type/quality of data connection, and actual bandwidth consumption.

19. A client device installed with software thereon, the software executable to perform the steps according to any of claims 10 to 18.