

A computer program product, a bundling proxy system and a method for processing requests for web content

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A computer program product, a bundling proxy system and a method for processing requests for web content

Field of the invention

The invention relates generally to data processing and more particularly to retrieving of web content.

Background art

In the following, with web content we mean any content that is loaded from the Internet in bursts. In particular, web content may include at least one dynamic web page that is a web page that is prepared with fresh information (content and/or layout) for each individual viewing. A web content, in contrast to a static web page, changes with the time (news content, for example), the user (preferences in a session, for example), the user interaction (user selections, for example), the context (parametric customization, for example), or any combination thereof.

A web content is normally loaded at a terminal to a browser piece by piece. First, a description of the dynamic page, such as a Hypertext Markup Language (HTML) page is loaded. The browser parses the HTML page and submits then separate requests for each piece that with the description of the dynamic page thus form the dynamic content. Currently, it is normal that a single web content contains some 30 - 100 web objects that must be loaded, not rarely from different locations. The web objects may include images, advertisement banners, flash animations etc.

The energy consumption of a terminal that is loading a web content is usually higher during the loading as compared with the terminal in its idle state, that is, when the user is reading the web content that already has been loaded.

In addition, it may be that the loading itself takes longer than expected, in particular when some of the web objects cannot be retrieved. Even if the web objects could be retrieved, it may be that they must be retrieved from a remote server which is prone to increase the duration of the retrieval, especially if the

retrieving is carried out over a slow link that may be a wireless link.

There are some methods that can be used to reduce energy consumption during loading of web contents. In the GPRS
5 standard, the wireless terminal loading a dynamic content should enter in idle state after a predetermined time has lapsed, if the requested content is not being transmitted to the terminal. Since transforming the terminal to the idle state requires some signalling. Some mobile phone models are believed (cf. Network
10 Efficiency Task Force Fast Dormancy Best Practices, GSM Association, May, 2010) to enter a sleep state aggressively in order to extend battery life and minimize network congestion but may cause signal load problems in the operator network.

RRC state transition model has remained rather unchanged through
15 several releases, namely, Rel. 99, Rel. 05 and Rel. 06. Perala et al. present in "Theory and practice of RRC state transitions in UMTS networks", in Proc. Fifth IEEE Broadband Wireless Access Workshop (BWA), co-located with IEEE GLOBECOM 2009, Hawaii, USA, November-December 2009 a methodology to discover RRC
20 configuration parameters without operator involvement or cooperation, which shows how the operator network settings may differ drastically from each other.

Feng Qian et al. in "Characterizing Radio Resource Allocation for 3G Networks", in ACM Internet Measurement Conference (IMC)
25 2010, Melbourne, Australia, and Feng Qian et al. in "TOP: Tail Optimization Protocol for Cellular Radio Resource Allocation" in IEEE ICNP 2010, Kyoto Japan characterize the impact of operational state machine settings and show that tail time period matching the in- activity timer value before a state
30 demotion. During a tail time, a UE still occupies transmission channels and its radio power consumption is kept at the corresponding level of the state, even through there is no traffic transmitted during the period.

Signals Research Group shows in "Reducing the impact of
smartphone- generated signaling traffic while increasing the
battery life of the phone through the use of network
optimization techniques" (May 2010) how signaling traffic
5 generated by smartphones affects battery life and causes network
congestion.

In addition to the Fast Dormancy Best Practices paper,
"Understanding Smartphone Behavior in the Network" by Nokia
Siemens Networks Smart labs (2011) also discusses the timer
10 problem and shows that fast dormancy is one of the solutions,
which forces devices to hop back to low power consumption state
quickly to save energy and reduce traffic load.

Objective of the invention

It is an objective of the invention to reduce energy consumption
15 at a terminal when a web content is to be loaded and in addition
to enable improving the speed of the retrieval Of the web
content.

This objective can be met with a computer program product
according to claim 1, with a bundling proxy system according to
20 claim 6 and with a method for processing requests for web
contents according to claim 11.

The dependent claims describe various inventive aspects of the
computer program product, bundling proxy system and method.

Summary of the invention

25 A computer program product stored on a computer-readable medium
is adapted, when executed in a processor, to process a request
for a web content so that, when it receives a request for a web
content from a terminal, it first retrieves a description of the
web content (step a), then retrieves web objects of the web
30 content (step b), and then returns the description and retrieved
web objects to the terminal in a bundle (step c).

A bundling proxy system is configured to process a request for a
web content so that, when it receives a request for a web

content from a terminal, the bundling proxy system first retrieves a description of the web content (step a), then retrieves web objects of the web content (step b), and then returns the description and retrieved web objects to the terminal in a bundle (step c).

A method for processing a request for a web content received from a terminal comprises the steps of first retrieving a description of the web content (step a), then retrieving web objects of the web content (step b), and then returning the description and retrieved web objects to the terminal in a bundle (step c).

Advantages of the invention

Because the description of the web content and also the web objects of the web content are returned to the terminal in a bundle, the terminal does not need to receive the contents of the web content piece by piece but can receive them in one go. The inventors have perceived this to increase the power efficiency at a wireless terminal surprisingly much.

Since the receiving state of the terminal can now be sustained over a longer period of time, the terminal does not need to switch a number of times between an active state and an idle state like defined in PDP context specification. In the case of normal fetching the terminal is highly possible to only stay in the active state rather than switch between two states.

Consequently, the excess signalling that also consumes energy at the terminal when the terminal is switched between active (radio on) and idle (radio off) states may be better avoided.

In addition, since the terminal is now actually receiving the bundle when it is in the receiving state (radio on), there is no need to keep the terminal in the receiving state before the transmission of the bundle is to be started and after the bundle has been transmitted. Consequently, the time during which the terminal is in receiving state may be shortened as compared with the solution employed in certain mobile phone models.

The computer program product, the system and the method can advantageously be implemented as follows:

- 5 - When a web browser on a terminal sends a request for a web content, the request is received by a local bundling proxy which is configured to send a bundling request to a remote bundling proxy.
- The remote bundling proxy, upon receiving the bundling request, performs steps a) to c) in such a manner that the bundle is received by the local bundling proxy.
- 10 - The local bundling proxy delivers first the description of the web content to the web browser, and then, upon the web browser requesting for web objects of the web content, transmits these web objects to the web browser locally on the terminal.
- 15 Since now the web objects that are required for the web content are already present at the terminal, they can be delivered to the web browser very fast since there is no need to retrieve them any more from the Internet. Correspondingly, for this kind of transmission locally at the terminal the terminal does not
20 need to communicate with the network at this stage any more.

According to an advantageous embodiment of the computer program product, of the system, and of the method, the local bundling proxy may be configured to interoperate with the web browser through internet protocol stacks at the terminal. In this
25 manner, the local bundling proxy forms a sort of virtual proxy at the terminal and can be used with a normal web browser so that no customization of the web browser is necessary.

According to a second aspect of the computer program product, the system and the method, the remote bundling proxy can be
30 adapted to interoperate directly with a web browser of the terminal in such a manner that upon receiving a request for a web content from a terminal, the remote bundling proxy performs the steps a) to c) and returns the bundle to the terminal.

With this kind of configuration, the performance requirements for the terminal may be kept lower.

Advantageously, the bundle contains the web objects in a compressed state. In particular, they can be in a compressed archive such as in a ZIP or TAR file in particular.

The size of the bundle can be used to estimate the size of required data transfer for the web content. This may enable new services, such as, when the user is billed for data transmission volume, he or she can now decide whether or not to download a certain web content.

The estimated size of required data transfer can be used to allocate wireless network bandwidth between terminals in the wireless network. In this manner, the network operator can get an overview how much data transfer capacity a particular user will need very soon. The network operator may use this information to optimise current bandwidth usage and ensure that the required level for quality-of-service for the terminal can be met.

In a sense, the remote proxy can be understood to work as a virtual browser that is used for retrieving the description and the web objects. The virtual browser can produce information that is useful for network capacity planning or for the user to decide whether or not to load a certain web content.

List of drawings

In the following, the invention is described in more detail with reference to the examples in the attached drawings, of which:

FIG 1 illustrates the protocol stack of the terminal, remote bundling proxy and web server; and

FIG 2 illustrates the signalling between the terminal, remote bundling proxy and web server.

The same reference numerals refer to same components in both FIG.

Detailed description

FIG 1 illustrates certain protocol stacks of a terminal 10, a remote bundling proxy 120 and a web server 140.

5 The terminal 10 is an internet-capable terminal that can be a wireless communication device, such as (but not limited to) a smart phone, a tablet computer or a notebook. In particular, a wireless communication device may use any IEEE 802.11 wireless local area networking standard. The wireless communication device does not need to use a wireless local area networking
10 standard but can be used to connect to a wireless wide area network, wireless metropolitan area network, wireless mesh network, and/or wireless personal area network. Instead of this or in addition, the wireless communication device may be used to connect to one or more wireless communication networks such as
15 (but not limited to) GSM, GPRS, EDGE, UMTS or LTE.

Alternatively or in addition to being wireless, the terminal 10 can be a wired communication device.

The protocol stack of the terminal 10 comprises a media access layer 101. The media access layer reflects the method of
20 connection to the wireless or wired network.

Web browser 102 at the terminal 10 uses the Hypertext Transport Protocol (HTTP) 103 which communicates over Transfer Control Protocol (TCP) 105 that is carried on Internet Protocol (IP) 107.

25 Local bundling proxy 112 at the terminal 10 has an IP stack that is being illustrated in FIG 1 as IP stacks 117, 118. The local bundling proxy 112 also has a TCP stack that is being illustrated as TCP stacks 115, 116. And it has a HTTP stack 113 and a bundle protocol stack 114.

30 The remote bundling proxy 120 in the network has 1 MAC stack 121, an IP stack that is being illustrated as IP stacks 127, 128, and a TCP stack that is being illustrated as TCP stacks

125, 126. And it has a bundle protocol stack 124 and a HTTP stack 123.

Web server 140 comprises a MAC stack 141, an IP stack 147, a TCP stack 145 and a HTTP stack 143.

5 It must be understood that the web server 140, the remote bundling proxy 120, and even the terminal 10 may in reality comprise a large number of each of the stacks: In practice they comprise the protocol stacks shown in FIG 1 for each of the connections that may be very many, especially at the web server
10 140 and at the remote bundling proxy 120.

The remote bundling proxy 120 retrieves data from the network, in particular from the Internet, and sends to the user. The remote bundling proxy 120 does not deliver the data to the terminal 10 as it receives it from the web content servers, or
15 its cache, but collects data in a larger chunk, bundle, and sends it in such bundles. This helps a terminal 10 to remain in low power mode while the remote bundling proxy 120 gathers the data.

The main benefit of the remote bundling can be achieved at
20 terminals 10 that are mobile communication devices. The remote bundling may be very attractive in particular for users that are using mobile communication devices that are operable on rechargeable batteries. This kind of mobile communication devices cannot be used when the rechargeable battery is empty.
25 This is of particular importance not only in many developing countries such as in many parts of the African continent but also in rural areas of developed countries especially during and after winter storms.

We have a lot of measurements of how energy is consumed on a
30 mobile communication device. The key result is that the most energy efficient way is to always use the radio connection at its full speed if possible.

Thus, for a web proxy service to be most useful to an end user, it needs to follow this principle. Sending data as it comes will not enable the radio to enter sleep mode and thus will consume much more energy. Prior proxy services seem to fail to
5 understand this fundamental observation.

The remote bundling proxy 120 only sends data to the terminal 10 in larger bundles. While gathering a bundle, the terminal 10 and its radio receiver can remain in a sleep mode and conserve energy. Simple data compression or the use of caching only helps
10 a little, while our concept of bundling data together provides a huge benefit.

Our invention achieves a significant reduction in energy consumption compared with the Opera Mini browser that is a system with a dedicated client side software. Opera Mini uses
15 compression between the end device and Opera's own servers (proxies) but they do not use the bundle concept for optimized data delivery.

Amazon Silk is a full fledged client-server system, a proprietary technology that does not use the bundle concept in
20 optimized data delivery. Zipproxy is web proxy that compresses the whole HTTP communication and requires a client side software. The main idea here is simply to compress data.

Blaast, the new Aalto spin-off is based on a thin-client concept where the end device is simple and most of the processing is
25 done on the network servers.

All the related work we have found is based on a client side software and does not consider how the data delivery to the terminal or mobile communication device can be optimized with regard to the operation of the radio hardware, in particular the
30 sleep mode.

1. The whole concept of bundling data together in larger batches instead of sending it as it comes to the proxy. We have an

existing implementation of this technology and have made measurements of its performance.

2. The current concept is based on an explicit signalling between the proxy and the mobile device, requiring additional software on the user device, similar to the competition. The second claim is that we can implement our concept also without client-side support, enabling a dramatically better deployment.

The benefits we can show are huge, going up to 70%, even higher in terms of reduction in energy consumption. As the benefits also affect the network operator due to lower and optimized data transmission, even network operators would be interested to use this technology.

In FIG 2, the signalling between the terminal, remote bundling proxy and web server is illustrated in more detail.

Web browser 102 at terminal 10 sends HTTP request K201. The terminal 10 has been configured to use as proxy for all HTTP requests the local bundling proxy 112.

Therefore, the local bundling proxy 112 receives the HTTP request K201 and sends to remote bundling proxy 120 a request K203 that is a HTTP request with the same contents as in HTTP request K201 but with an additional bundling header field.

The remote bundling proxy 120 receives the request K203 and sends to a web server 140 as HTTP request K205 the same request without the additional bundling header field.

The web server responds with a HTTP Reply 200 OK message K207 that comprises the description of the web content. Then the remote bundling proxy 120 parses the description of the web content and sends requests K209 for web objects if they are included in the web content. The web server 140 sends the web objects in messages K211 one by one.

In step 200 the remote bundling proxy 120 checks if there is only one web object.

If yes, it compresses the web object if needed, such as when by compression the size of the web object can be reduced above a predefined threshold. Then the remote bundling proxy 120 sends a normal HTTP reply to the local bundling proxy 112.

- 5 If no, the web objects are bundled and compressed, such as by zipping them to one ZIP file. Then the remote bundling proxy 120 sends a HTTP reply with Bundle K213 to the local bundling proxy 112. Instead of zipping, TAR files can be used as well. ZIP may work better as an example of making a package. It is however
10 clear that any other compression or packing arrangement can be used. For example, the use of data compression as typically done together with ZIP is not necessary. ZIP may be used in non-compressing mode to save time and energy.

15 In step 250 the local bundling proxy 112 unbundles the bundle if necessary.

Then the local bundling proxy 112 transmits to the web browser the first web object (message K215). When the web browser sends requests (K217) for the following web objects that may exist, the local bundling proxy 112 does not need to retrieve these web
20 objects from the web server 140 nor from the remote bundling proxy 120 but it has them already. Therefore, it can send the web objects as HTTP replies to the web browser 102 until the last HTTP reply 219 has been transmitted.

If there is any web object that is not included in the bundle,
25 the web browser 102 may request it by sending a HTTP request K221 to the local bundling proxy 112. The local bundling proxy 112 requests it from the remote bundling proxy 120 (request K223) which in turn requests it from the web server 140 (request K225).

30 The web server 140 returns the web object (reply K227) to the remote bundling proxy 120 that in turns returns it to the local bundling proxy 112 (reply K229) that replies to the web browser 102 (reply K231).

The local proxy at the terminal 10 can be implemented as a browser plugin-application which is a very simple manner to market the product and for users to install the product. At least in the mobile browser of Firefox can be installed such
5 plugin/add-on extensions.

Especially in the cases mentioned in the paragraph above, at the terminal 10 end the IP and TCP stacks 107, 118 and 105, 116, respectively could in FIG 1 be illustrated as one box only.

At the terminal 10, the browser 102 and the local proxy 112 may
10 communicate over the HTTP layer. In particular if the invention is implemented as a plugin-application, there is no need for the browser 102 and the local proxy 112 to communicate over the IP stack.

In some occasions, it is important for the terminal 10 (i.e. for
15 the browser 102 or the local bundling proxy 112) to forward cookies to the remote bundling proxy 120 because many web pages require that cookies are used. The signaling between the local bundling proxy 112 and the remote bundling proxy forwards cookies that are required the web content from the terminal 10
20 to the remote bundling proxy 120.

Since the terminal 10 does not need to retrieve each single web object separately, the uplink transmission can be reduced very much, because many (even all) HTTP requests are submitted instead by the terminal 10 by the remote bundling proxy 120.

25 Because, currently, each terminal 10 sending many HTTP requests uplink may be estimated to consume a considerable share of the bandwidth available in a wireless network.

The invention is not to be understood to be limited in the attached patent claims but must be understood to encompass all
30 their legal equivalents.

Currently, the computer program product, the bundling proxy system and the method for processing requests for web content are most relevant for high-end mobile devices that are often

called "smart phones" and that include web browsing capabilities. The term "mobile communication device" used in this patent application is nevertheless not limited to these devices but is intended to include any other mobile device that
5 is dependent on a battery and that is configured to use wireless communication. Non-limiting examples of such devices include tablet computers, notepads/notebooks, personal digital assistants (PDAs) and feature phones.

Claims:

1. A computer program product stored on a computer-readable medium and adapted, when executed in a processor, to process a request for a web content so that, when a request (K201, K203) for a web content is received from a terminal (10),
 - a) a description of the web content (K205, K207) is retrieved;
 - b) web objects of the web content (K 209, K211) are retrieved; and
 - 10 c) description and retrieved web objects are returned to the terminal (10) in a bundle (K213).
2. A computer program product according to claim 1, **wherein:**
 - 15 d) a first part of the computer program product is located at a local bundling proxy (112) which is stored on the terminal (10) and a second part of the computer program product is stored on a remote bundling proxy (120);
 - e) the first part of the computer program product is configured to interoperate with a web browser (102) at the terminal (10) in such a manner that when the web browser
20 (102) sends a request (K201) for a web content, the request (K201) is received by the local bundling proxy (112) which is configured to send a bundling request (K203) to the remote bundling proxy (120);
 - f) the second part of the computer program product is
25 configured to cause the remote bundling proxy (120), upon receiving the bundling request (K203), to perform steps a) to c) in such a manner that the bundle (K213) is received by the local bundling proxy (112);
 - g) the first part of the computer program product is
30 configured to cause the local bundling proxy (112) to:

gi) deliver first the description (K215) of the web content to the web browser (102); and

gii) upon the web browser (102) requesting for web objects of the web content, to transmit (K217, K219) the web objects to the web browser locally on the terminal.

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10 3. A computer program product according to claim 2, wherein the first part of the computer program product is configured to interoperate with the web browser (102) through internet protocol stacks (107, 117) at the terminal (10).

15 4. A computer program product according to claim 1, wherein the computer program product is located on a remote bundling proxy that is adapted to interoperate directly with a web browser of the terminal (10) in such a manner that upon receiving a request for a web content from a terminal, the computer program product performs steps a) to c) and returns the bundle to the terminal (10).

20 5. A computer program product according to any one of claims 1 to 4, wherein the bundle (K213) contains the web objects in a compressed state.

6. A bundling proxy system (112, 120) that is configured to process a request for a web content so that, when it receives a request (K201, K203) for a web content from a terminal (10),

25 a) the bundling proxy system retrieves a description of the web content (K205, K207);

b) the bundling proxy system retrieves web objects of the web content (K 209, K211); and

30 c) the bundling proxy system returns the description and retrieved web objects to the terminal (10) in a bundle (K213).

7. A bundling proxy system according to claim 6, **wherein:**

d) a first part of the system is a local bundling proxy (112) on the terminal (10) and a second part of the system is a remote bundling proxy (120);

5 e) the first part of system is configured to interoperate with a web browser (102) at the terminal (10) in such a manner that when the web browser (102) sends a request (K201) for a web content, the request (K201) is received by the local bundling proxy (112) which is configured to send a bundling request (K203) to the remote bundling proxy
10 (120);

f) the second part of the system is configured to cause the remote bundling proxy (120), upon receiving the bundling request (K203), to perform steps a) to c) in such a manner that the bundle (K213) is received by the local bundling
15 proxy (112);

g) the first part of the system is configured to cause the local bundling proxy (112) to:

gi) deliver first the description (K215) of the web content to the web browser (102); and

20 gii) upon the web browser (102) requesting for web objects of the web content, to transmit (K217, K219) the web objects to the web browser locally on the terminal.

8. A bundling proxy system according to claim 7, wherein the
25 first part of the system is configured to interoperate with the web browser (102) through internet protocol stacks (107, 117) at the terminal (10).

9. A bundling proxy system according to claim 6, wherein the system is a remote bundling proxy that is adapted to
30 interoperate directly with a web browser of the terminal (10) in such a manner that upon receiving a request for a web content from a terminal, the computer program product performs steps a) to c) and returns the bundle to the terminal (10).

10. A bundling proxy system according to any one of claims 6 to 9, wherein the bundle (K213) contains the web objects in a compressed state.

11. A method for processing a request (K201, K203) for a web
5 contents from a terminal (10), comprising the steps of:

a) retrieving a description of the web content (K205, K207);

b) retrieving web objects of the web content (K 209, K211);
and

10 c) returning the description and retrieved web objects to the terminal (10) in a bundle (K213).

12. A method according to claim 11, wherein the method is implemented with a computer program product according to any one of claims 1 to 5 or with a system according to any one of claims
15 6 to 10.

13. A method according to claim 11 or 12, wherein: the size of the bundle is used to estimate the size of required data transfer for the web content.

14. A method according to claim 13, wherein: the estimated size
20 of required data transfer is used to allocate wireless network bandwidth between terminals in the wireless network.

15. A method according to any of claims 11 to 14, wherein in the method, a virtual browser is used for retrieving the description and the web objects.

Abstract

A computer program product, a bundling proxy system and a method for processing requests for web content

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A computer program product stored on a computer-readable medium is adapted, when executed in a processor, to process a request for a web content so that, when a request (K201, K203) for a web content is received from a terminal (10),

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a) a description of the web content (K205, K207) is retrieved;

b) web objects of the web content (K 209, K211) are retrieved; and

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c) description and retrieved web objects are returned to the terminal (10) in a bundle (K213).

The patent application has an independent patent claim also for a bundling proxy system and a method for processing requests for web content.

FIG 2

FIG 1



