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Volodymyr Kazymyr, Andrii Mokrohuz, Mykola Moshel

MINIMAL HTTP HEADER FOR TRAFFIC CRITICAL APPLICATIONS

Urgency of the research. *Every year amount of different mobile devices has been growing. Mobile devices are not only smartphones, laptops and tablets. Many single board computers appeared alongside with IoT (internet of things) direction, which allows connecting anything to the Internet. Amount of mobile devices exceeded amount of desktop computers in 2013. Amount of traffic which mobile devices transfer per month was 7*1018 bytes in 2016. This number will only grow and will reach 10.8 * 1018 bytes in 2017. There is no distinction between web applications for mobile devices and desktop computers anymore. Amount of the web applications have been growing every year as well.*

Target setting. *We propose to use minimum possible configuration of the HTTP header to decrease the data transferred between client and server software applications. This can be useful especially for mobile devices, which work over 3G and 4G networks with limited battery life. Theoretical minimum header configuration was compared against real data, which has been obtained during the experiment. The results of the comparison give us the information about possibility of decreasing HTTP traffic. The fact that text and image information headers are the biggest tells us to concentrate the attention on these two types of information.*

Actual scientific researches and issues analysis. *Many scientists from all over the world try to come up with different solutions to improve transmission of HTTP traffic in mobile networks. HTTP is scalable application layer protocol which allows high flexibility in terms of data transferring. HTTP is easy to use; it is supported by popular programming languages. Developers choose to use HTTP for creation of different purpose applications. Mostly HTTP is used for creation of web application and application which work in the Internet. With development of 3G and 4G networks, IoT (Internet of Things) gains its popularity, thus many devices can be communicate over the Internet.*

Uninvestigatigated parts of general matters defining. *There are many directions to decrease amount of HTTP traffic. However, investigation of headers of HTTP is not considered as one of the methods of decreasing amount of the HTTP traffic.*

The research objective. *We decided to concentrate our attention on HTTP headers to address the issue of HTTP traffic growth. Previous researches have shown that HTTP header can contain unnecessary data, which can be eliminated [3]. In the paper, we compare theoretically possible minimum configuration of HTTP header with HTTP headers received during the experiment. Many of previous researches are concentrated on HTTP protocol itself. However, we concentrate our attention on data, which is transferred using HTTP. We used web debugging tool to investigate the HTTP header.*

The statement of basic materials. *Under minimal HTTP header configuration, we understand amount of bytes required to deliver the information over HTTP. According to previous researches, HTTP/1.1 is the most popular version of the HTTP, which is used nowadays. All data captured during our experiment was transferred and received over HTTP/1.1 as well. Request and response message formats differ from each other.*

Conclusions. *In the paper, we identified the minimal HTTP header configuration, which can still be used to transfer valid HTTP messages. Our experimental data shows that header of the real HTTP traffic exceeds the minimal configuration of HTTP header.*

However, we understand, that not every type of application, which work via HTTP, require a small HTTP header. Nevertheless, applications, which are installed and running on the mobile devices require additional attention to the amount of an HTTP traffic transferred.

Key words*: HTTP; information; mobile device; protocol.*

Urgency of the research. Every year amount of different mobile devices has been growing. Mobile devices are not only smartphones, laptops and tablets. Many single board computers appeared alongside with IoT (internet of things) direction, which allows connecting anything to the Internet. Amount of mobile devices exceeded amount of desktop computers in 2013. Amount of traffic which mobile devices transfer per month was 7*1018 bytes in 2016 [1]. This number will only grow and will reach 10.8 * 1018 bytes in 2017 [1]. There is no distinction between web applications for mobile devices and desktop computers anymore. Amount of the web applications have been growing every year as well.

Mobile devices' hardware is relatively powerful nowadays. One board computers or even smartphones usually have four cores processors and couple gigabytes of RAM. These allow performing all kind of tasks by mobile devices. However, the battery life of a mobile device can be limiting factor which influences on performance of mobile devices. The cost of 3G or 4G networks also makes usage of mobile devices expensive, when big volume of traffic is involved.

Target setting. HTTP is one of the most popular application layer protocols in the Internet [2]. Thus, investigation of HTTP traffic is a priority in the paper. Header of HTTP response or request can potentially carry not necessary information. This information creates overhead and can be relatively big and cannot be neglected. Header size can reach 13.88 % while sending text information and 5.46 % for image information [3].

In the paper we propose to use minimum possible configuration of the HTTP header to decrease the data transferred between client and server software applications. This can be useful especially for mobile devices, which work over 3G and 4G networks with limited battery life. Theoretical minimum header configuration was compared against real data, which has been obtained during the experiment. The results of the comparison give us the information about possibility of decreasing HTTP traffic. The fact that text and image information headers are the biggest tells us to concentrate the attention on these two types of information.

Actual scientific researches and issues analysis. Many scientists from all over the try to come up with different solutions to improve transmission of HTTP traffic in mobile networks. HTTP is scalable application layer protocol which allows high flexibility in terms of data transferring. HTTP is easy to use; it is supported by popular programming languages. Developers choose to use HTTP for creation of different purpose applications. Mostly HTTP is used for creation of web application and application which work in the Internet. With development of 3G and 4G networks, IoT (Internet of Things) gains its popularity, thus many devices can be communicate over the Internet.

R. Chandran and S. Manoharan investigated some web application in New Zealand and they found out that despite of the fact that compression is available for HTTP 22 % of the web sites does not use compression. Moreover, 52 % of the sites explicitly prevent caching by supplying directives such as no-store or expiry times in the past [4].

There are many methods how to decrease HTTP traffic one of them is compression of HTTP traffic. Timothy J. McLaughlin considered drawbacks and benefits of HTTP traffic compression. His experiments show average 27 % byte reduction is possible for the average web site [5]. Compression is supported by almost all modern web browsers and web servers, however sometimes it is not used as it was shown by R. Chandran and S. Manoharan. Moreover, browsers are not the only clients which exist. Developers need to write their own applications, which can use HTTP(S), so compression is not supported by default by these clients and developers need to implement it.

Ali Sehati and Majid Ghaderi looked into the problem of decreasing of a web page load time. They created WebPro a proxy based solution and confirmed that it provides delay reduction form 5 % to 51 % for a verity of web sites [6]. According to the experiment's results they have improved we browsing on mobile devices. They improved user experience, however their solution does not decrease the amount of traffic transferred between a client and a server. Despite the fact that user experience using web on mobile devices has been improved, the price of the traffic transferred stays the same in case of 3G and 4G networks.

According to the ICT report the price of mobile networks varies between 4.7 $ in Australia and 85 $ in the USA per 500 MB of data. In Ukraine 500 MB of data cost 13.5 $ [7]. HTTP is the most popular application layer protocol in the internet [2]. Amount of data transferred by mobile devices grows every year. Thus, the task of decreasing the amount of traffic transferred without losing useful data has become very important nowadays.

There are many methods how performance of HTTP can be improved, for instance:

- Minimize number of HTTP redirects
- Reduce roundtrip times
- Eliminate unnecessary resources
- Cache resources on the client
- Compress assets during transfer
- Eliminate unnecessary request bytes
- Parallelize request and response processing
- Apply protocol-specific optimizations

The research objective. We decided to concentrate our attention on HTTP headers to address the issue of HTTP traffic growth. Previous researches have shown that HTTP header can contain unnecessary data, which can be eliminated [3]. In the paper, we compare theoretically possible minimum configuration of HTTP header with HTTP headers received during the experiment. Many of previous researches are concentrated on HTTP protocol itself. However, we concentrate our attention on data, which is transferred using HTTP. We used web debugging tool to investigate the HTTP header [8].

The statement of basic materials. Under minimal HTTP header configuration, we understand amount of bytes required to deliver the information over HTTP. According to previous researches, HTTP/1.1 is the most popular version of the HTTP, which is used nowadays [2]. All data captured during our experiment was transferred and received over HTTP/1.1 as well. Request and response message formats differ from each other. Request format is presented on the Fig. 1.

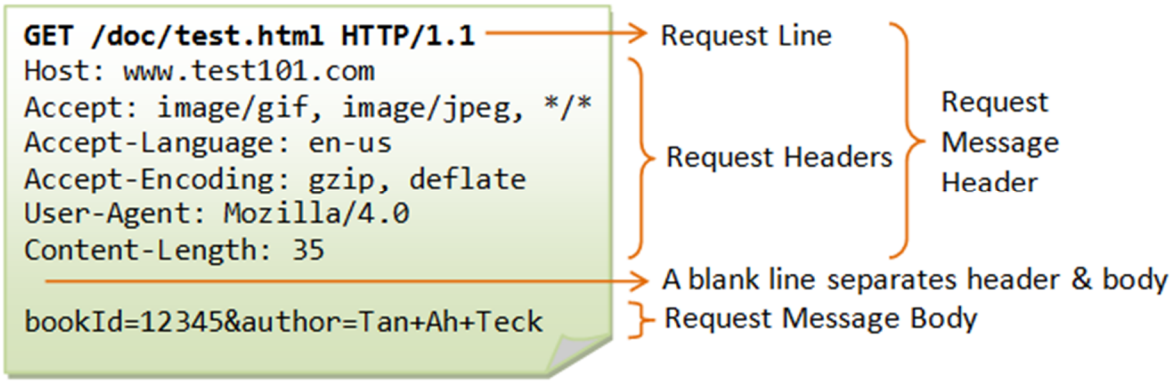

Fig. 1. HTTP request format [9]

The HTTP response format is presented on Fig. 2. Fig. 1 and Fig. 2 do not represent the minimum header required. According to the RFC 2616 [10] the most common form of Request-URI is that used to identify a resource on an origin server or gateway. In this case the absolute path of the URI MUST be transmitted (see section 3.2.1, abs path) as the Request-URI, and the network location of the URI (authority) MUST be transmitted in a Host header field. For example, a client wishing to retrieve the resource above directly from the origin server would create a TCP connection to port 80 of the host "www.w3.org" and send the lines:

GET /pub/WWW/TheProject.html HTTP/1.1
Host: www.w3.org

These two lines presented above we can define as a minimal HTTP request header configuration. The amount of bytes required is 24 + resource path + host.

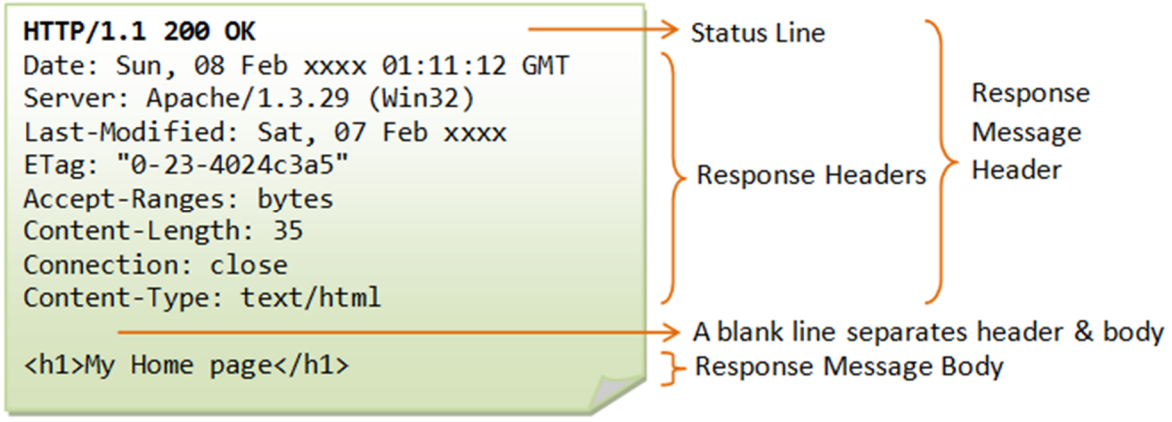

Fig. 2. HTTP response format [9]

In the section 6 of RFC 2616 [11] required lines for HTTP header response are the next:
Status-Line = HTTP-Version SP Status-Code SP Reason-Phrase CRLF
Server can also transfer additional header fields presented on the Fig. 3 [11].

```
response-header = Accept-Ranges           ; Section 14.5
                | Age                     ; Section 14.6
                | ETag                    ; Section 14.19
                | Location                ; Section 14.30
                | Proxy-Authenticate      ; Section 14.33

                | Retry-After             ; Section 14.37
                | Server                  ; Section 14.38
                | Vary                    ; Section 14.44
                | WWW-Authenticate        ; Section 14.47
```

Fig. 3. HTTP response header fields [11]

From stated above the minimal amount of bytes required to represent minimal response header can be **18 bytes.**

We needed some real traffic from different web applications, which use HTTP(S). Thus, we set up an experiment to gather HTTP packets. HTTP packets contains useful for user data and some technical data to make packet deliverable to its destination. Fiddler web debugging tool [8] was used to collect the http traffic on user's computers. Users' PCs were running Windows 7, 8.1 or 10. There were no special rules for experiment. Users lunched the Fiddler application on their computers and were acting as usual during working day (7 hours). Traffic has been provided by users from Ukraine and the United Kingdom. More than 30 000 HTTP packets were captured during the experiment. This experiment was not targeting to capture any specific type of data. We are interested in headers of HTTP packets and types of data, which was transferred by the applications.

Table 1

Amount of HTTP packets

Data type	Amount of packages
Text	23028
Image	7592
Sound	96
Video	8
Total	30724

Text and image HTTP packets are the most transferable data types in the internet which is also confirmed by Pengcheng Jiang; Fang Liu; Huan Wang; Chenyu Li in the research of HTTP traffic [12]. Moreover, the size of the HTTP header in the packets for image and text data is relatively big as it can be seen on Fig. 4.

Most information transferred in text format via HTTP protocol. Sometimes HTTP headers contain information, which can be removed so the client or server still can receive a HTTP message.

We calculated average HTTP header size for text type of information and it is 890 bytes. For image type of information, transferred via HTTP, the average header's size is 1007 bytes.

This numbers exceeds minimal header configuration of the HTTP header which was defined for request 24 + resource path + host and for response 18 bytes.

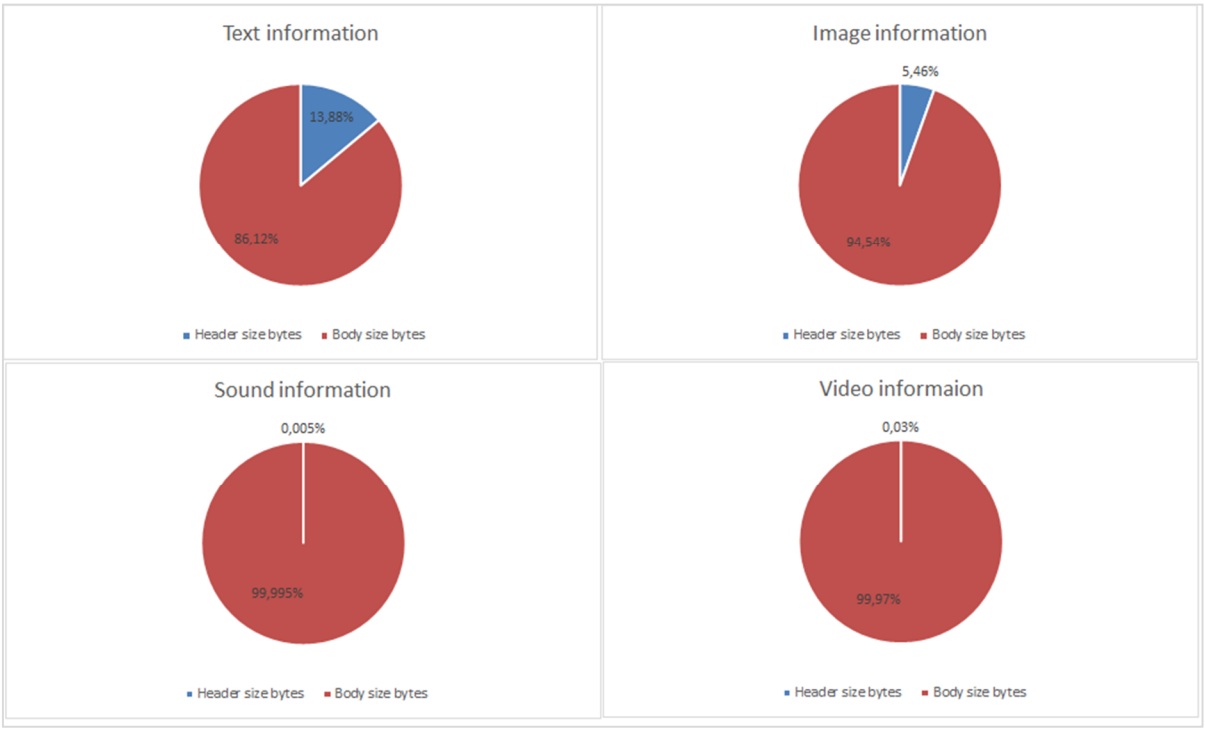

Fig. 4. Ratio of packets' body size to header size by type of information

Conclusions and propositions. In the paper, we identified the minimal HTTP header configuration, which can still be used to transfer valid HTTP messages. Our experimental data shows that header of the real HTTP traffic exceeds the minimal configuration of HTTP header.

However, we understand, that not every type of application, which work via HTTP, require a small HTTP header. Nevertheless, applications, which are installed and running on the mobile devices require additional attention to the amount of an HTTP traffic transferred.

Future work can be carried out in the way of designing an algorithm and piece of software, which allow reducing size of the HTTP header for traffic critical applications. Traffic critical applications are the application, which rely on battery life and work over wireless networks like 3G, 4G etc., where the cost of traffic is high.

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Володимир Казимир, Андрій Мокрогуз, Микола Мошель

МІНІМАЛЬНИЙ РОЗМІР ЗАГОЛОВКУ HTTP ДЛЯ ДОДАТКІВ

Протокол рівня додатків HTTP забезпечує дуже високу масштабованість і може використовуватися для передачі будь-якого типу інформації між клієнтом і сервером. HTTP має заголовок відповіді / запиту, який може бути розширений відповідно до технічної інформації, яку потрібно передати від клієнта до сервера. Ця інформація може бути зайвою для передачі в кожному запиті / відповіді. У статті ми визначили мінімальну конфігурацію заголовка відповіді / запиту, що зменшити об'єм технічної інформації. Мобільні пристрої мають обмежені ресурси, такі як заряд батареї акумулятора і передача даних через мобільні мережі, що може бути дорогим у випадку 3G або 4G. Додаткові витрати на трафік слід уникати або зменшувати, коли використовуються мобільні пристрої. Ми провели експеримент для збору запитів / відповідей HTTP та визначення різниці між загальним заголовком HTTP запиту / відповіді та мінімальною теоретичною конфігурацією заголовка.

Ключові слова: *HTTP; інформація; мобільний пристрій; протокол.*

Владимир Казимир, Андрей Мокрогуз, Николай Мошель

МИНИМАЛЬНЫЙ РАЗМЕР ЗАГОЛОВКА HTTP ДЛЯ ПРИЛОЖЕНИЙ

Протокол уровня приложений HTTP обеспечивает очень высокую масштабируемость и может использоваться для передачи любого типа информации между клиентом и сервером. HTTP имеет заголовок ответа / запроса, который может быть расширен в соответствии с технической информации, которую нужно передать от клиента к серверу. Эта информация может быть лишней для передачи в каждом запросе / ответе. В статье мы определили минимальную конфигурацию заголовка ответа / запроса чтобы уменьшить объем технической информации. Мобильные устройства имеют ограниченные ресурсы, такие как заряд батареи аккумулятора и передача данных через мобильные сети, может быть дорогим в случае 3G или 4G. Дополнительных расходы на передачу данных следует избегать или уменьшать, когда используются мобильные устройства. Мы провели эксперимент для сбора запросов / ответов HTTP и определения разницы между общим заголовком HTTP запроса / ответа и минимальной теоретической конфигурацией заголовка.

Ключевые слова*: HTTP; информация; мобильное устройство; протокол.*

Kazymyr Volodymyr – Doctor of Technical Sciences, Professor, Chernihiv National University of Technology (95 Shevchenka Str., 14027 Chernihiv, Ukraine).
Казимир Володимир Вікторович – доктор технічних наук, професор, Чернігівський національний технологічний університет (вул. Шевченка, 95, м. Чернігів, 14027, Україна).
Казимир Владимир Викторович – доктор технических наук, профессор, Черниговский национальный технологический университет (ул. Шевченко, 95, г. Чернигов, 14027, Украина).
E-mail: vvkazymyr@gmail.com

Mokrohuz Andrii – PhD student, Chernihiv National University of Technology (95 Shevchenka Str., 14027 Chernihiv, Ukraine).
Мокрогуз Андрій Олександрович – аспірант, Чернігівський національний технологічний університет (вул. Шевченка, 95, м. Чернігів, 14027, Україна).
Мокрогуз Андрей Александрович – аспирант, Черниговский национальный технологический университет (ул. Шевченко, 95, г. Чернигов, 14027, Украина).
E-mail: myworkingadr@gmail.com

Moshel Mykola – Doctor of Technical Sciences, Professor, Chernihiv National University of Technology (95 Shevchenka Str., 14027 Chernihiv, Ukraine).
Мошель Микола Васильович – доктор технічних наук, професор, Чернігівський національний технологічний університет (вул. Шевченка, 95, м. Чернігів, 14027, Україна).
Мошель Николай Васильевич – доктор технических наук, профессор, Черниговский национальный технологический университет (ул. Шевченко, 95, г. Чернигов, 14027, Украина).

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