



XMPP

XEP-0286: Mobile Considerations on LTE Networks

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This document provides background information for XMPP implementors concerned with mobile devices operating on an LTE cellular network.

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1 Introduction

XMPP as a protocol was designed before the wide spread adoption of mobile devices, and is often cited as not being very mobile friendly as a result. However, this mostly stems from undocumented lore and outdated notions of how XMPP works. As the Internet and protocol design have changed to be more accommodating for mobile, so has XMPP.

This XEP aims to provide useful background knowledge of mobile handset behavior, and those considerations that client and server designers can take to ensure that bandwidth and battery are used efficiently.

2 Overview

The two major constraints on mobile devices are power and bandwidth. With the wide spread proliferation of 3G and LTE technologies, mobile bandwidth and speeds have become broadly comparable to broadband. However, they are still relatively expensive compared to traditional wired networks, and therefore conserving them is still desirable. This XEP mostly focuses on LTE as it already has a very wide deployment and will only continue to further replace 3G technologies.

3 Compression

XML, and by extension XMPP, is known to be highly compressible. Compression of XMPP data can be achieved with the DEFLATE algorithm ([RFC 1951](http://tools.ietf.org/html/rfc1951)¹) via TLS compression ([RFC 3749](http://tools.ietf.org/html/rfc3749)²) or [Stream Compression \(XEP-0138\)](https://xmpp.org/extensions/xep-0138.html)³ (which also supports other compression algorithms). A description of the security implications of stream compression is beyond the scope of this document (See [RFC 3749](http://tools.ietf.org/html/rfc3749)⁴ or [Stream Compression \(XEP-0138\)](https://xmpp.org/extensions/xep-0138.html)⁵ for more information), but the author does not recommend using TLS compression with XMPP (or in general). If compression must be used, stream level compression should be implemented instead, and the compressed stream should have a full flush performed on stanza boundaries to help prevent chosen plaintext attacks. While this may mitigate some of the benefits of compression by raising compression ratios, in a large, real world deployment, network traffic was still observed to decrease by a factor of 0.58 when enabling [Stream Compression \(XEP-0138\)](https://xmpp.org/extensions/xep-0138.html)⁶ with ZLIB compression.

While the CPU cost of compression may directly translate to higher power usage, it is vastly

¹RFC 1951: DEFLATE Compressed Data Format Specification version 1.3 <<http://tools.ietf.org/html/rfc1951>>.

²RFC 3749: Transport Layer Security Protocol Compression Methods <<http://tools.ietf.org/html/rfc3749>>.

³XEP-0138: Stream Compression <<https://xmpp.org/extensions/xep-0138.html>>.

⁴RFC 3749: Transport Layer Security Protocol Compression Methods <<http://tools.ietf.org/html/rfc3749>>.

⁵XEP-0138: Stream Compression <<https://xmpp.org/extensions/xep-0138.html>>.

⁶XEP-0138: Stream Compression <<https://xmpp.org/extensions/xep-0138.html>>.

outweighed by the benefits of reduced network utilization, especially on modern LTE networks which use a great deal more power per bit than 3G networks as will be seen later in this document. However, CPU usage is also not guaranteed to rise due to compression. In the aforementioned deployment of stream compression, a *decrease* in CPU utilization by a factor of 0.60 was observed, presumably due to reductions in TLS and packet handling overhead. Therefore CPU time spent on compression (for ZLIB, at least; other algorithms were not tested) can be considered negligible.

Supporting compression and performing a full flush on stanza boundaries is recommended for mobile devices.

4 Power Consumption

While the wide spread adoption of LTE has dramatically increased available bandwidth on mobile devices, it has also increased power consumption. According to one study, early LTE devices consumed 5–20% more power than their 3G counterparts ⁷. On some networks that support the legacy SVLTE (Simultaneous Voice and LTE) or CSFB (Circuit-switched fallback) instead of the more modern VoLTE (Voice Over LTE) standard, this number would (presumably) be even higher.

XMPP server and client implementers, bearing this increased power usage in mind, and knowing a bit about how LTE radios work, can optimize their traffic to minimize network usage. For the downlink, LTE user equipment (UE) utilizes Orthogonal Frequency Division Multiplexing (OFDM), which is somewhat inefficient ⁸. On the uplink side a different technology, Single-carrier frequency division multiple access (SC-FDMA) is used, which is slightly more efficient than traditional OFDM, slightly offsetting the fact that broadcasting requires more power than receiving. LTE UE also implements a Discontinuous reception (DRX) mode in which the hardware can sleep until it is woken by a paging message or is needed to perform some task. LTE radios have two power modes: RRC_CONNECTED and RRC_IDLE. DRX is supported in both of these power modes. By attempting to minimize the time which the LTE UE state machine spends in the RRC_CONNECTED state, and maximize the time it stays in the DRX state (for RRC_CONNECTED and RRC_IDLE), we can increase battery life without degrading the XMPP experience. To do so, the following rules should be observed:

4.1 Transmit no data

Whenever possible, data that is not strictly needed should not be transmitted (by the server or client). Supporting [Client State Indication \(XEP-0352\)](#) ⁹ is recommended. Most importantly, XMPP pings should be kept as far apart as possible and only used when necessary. Server

⁷LTE Smartphone measurements <http://networks.nokia.com/system/files/document/lte_measurement_s_final.pdf>

⁸A Close Examination of Performance and Power Characteristics of 4G LTE Networks <[doi:10.2307/6362307](https://doi.org/10.2307/6362307)>

⁹XEP-0352: Client State Indication <<https://xmpp.org/extensions/xep-0352.html>>.

operators are encouraged to set high ping timeouts, and client implementors are advised to only send pings when absolutely necessary to prevent the server from closing the socket.

4.2 When transmitting, transmit as much as you can

If one is on 3G, transmitting a small amount of data will cause the radio to enter FACH mode which is significantly cheaper than its high power mode. On LTE radios, however, transmitting small amounts of data is vastly more expensive per bit due to the higher tail-time (the time it takes for the radio to change state) of approximately 11 seconds¹⁰. On LTE radios, one should transmit as much data from the client as possible when the radio is already on (eg. by placing messages in a send queue and executing the queue as a batch when the radio is on). Similarly, when data is being received from the server, the mobile devices radio is already in a high power state and therefore any data that needs to be sent to the server should be transmitted. These rules also apply to server operators: If the server receives data, the phones radio is already on, therefore you should flush any pending data as soon as possible after receiving data from a client.

5 Notable Extensions

This section provides pointers to other documents which may be of interest to those developing mobile clients, or considering implementing optimizations for them in servers.

[Stream Compression \(XEP-0138\)](https://xmpp.org/extensions/xep-0138.html)¹¹ provides stream level compression.

[Entity Capabilities \(XEP-0115\)](https://xmpp.org/extensions/xep-0115.html)¹² provides a mechanism for caching, and hence eliding, the disco#info requests needed to negotiate optional features.

[Roster Versioning \(XEP-0237\)](https://xmpp.org/extensions/xep-0237.html)¹³ provides a relatively widely deployed extension for reducing roster fetch sizes.

[Stream Management \(XEP-0198\)](https://xmpp.org/extensions/xep-0198.html)¹⁴ allows the client to send and receive smaller keep-alive messages, and resume existing sessions without the full handshake. This is useful on unstable connections.

[Client State Indication \(XEP-0352\)](https://xmpp.org/extensions/xep-0352.html)¹⁵ allows clients to indicate to the server that they are inactive, allowing the server to optimize and reduce unnecessary traffic.

[Push Notifications \(XEP-0357\)](https://xmpp.org/extensions/xep-0357.html)¹⁶ implements push notifications (third party message delivery), which are often used on mobile devices and highly optimized to conserve battery. Push notifications also allow delivery of notifications to mobile clients that are currently offline (eg. in an XEP-0198 "zombie" state).

¹⁰A Close Examination of Performance and Power Characteristics of 4G LTE Networks <[doi:2307636.2307658](https://doi.org/10.2307/658)>

¹¹XEP-0138: Stream Compression <<https://xmpp.org/extensions/xep-0138.html>>.

¹²XEP-0115: Entity Capabilities <<https://xmpp.org/extensions/xep-0115.html>>.

¹³XEP-0237: Roster Versioning <<https://xmpp.org/extensions/xep-0237.html>>.

¹⁴XEP-0198: Stream Management <<https://xmpp.org/extensions/xep-0198.html>>.

¹⁵XEP-0352: Client State Indication <<https://xmpp.org/extensions/xep-0352.html>>.

¹⁶XEP-0357: Push Notifications <<https://xmpp.org/extensions/xep-0357.html>>.

[Message Archive Management \(XEP-0313\)](#) ¹⁷ lets clients fetch messages which they missed (eg. due to poor mobile coverage and a flaky network connection).

6 Acknowledgements

This XEP was originally written by Dave Cridland, and parts of his original work were used in this rewrite. Thanks to Atlassian (HipChat) for allowing me to release numbers from their XMPP compression deployment.

7 Security Considerations

This document introduces no new security considerations.

8 IANA Considerations

This document requires no interaction with the Internet Assigned Numbers Authority (IANA).

9 XMPP Registrar Considerations

No namespaces or parameters need to be registered with the XMPP Registrar as a result of this document.

¹⁷XEP-0313: Message Archive Management <<https://xmpp.org/extensions/xep-0313.html>>.