Performance Evaluation of WebSocket Protocol for Implementation of Full-Duplex Web Streams

Oleg Bilovus

Università degli Studi di Salerno

1st Scalability Research Forum

WebSocket

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We will talk about WebSockets and compare its performance with TCP Socket. But, before diving into analyzing the performance we need to understand why we needed WebSockets and what they are.

Outline

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Background
HTTP polling
HTTP long polling
Streaming

WebSocket protocol
Definition
Handshake
Frame
API

Performance vs TCP Socket
Performance Evaluation
WebSocket sequence diagram
Network traffic
Data Transfer Time

Conclusion

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- *Historically*, creating web applications that need bidirectional communication between a client and a server has required an abuse of HTTP to poll the server for updates while sending upstream notifications as distinct HTTP calls.

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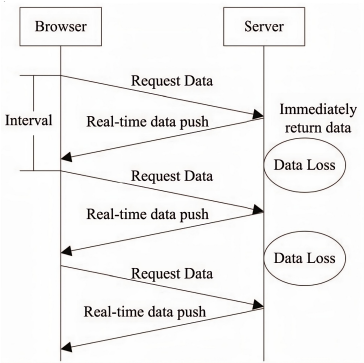
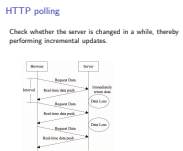
Check whether the server is changed in a while, thereby performing incremental updates.





A client can send data and ask for data at the same time. But, if client has no data and server has no data, a request and response will still be generated with all the HTTP headers and thus wasting resources.No real-time data because while the client waits, an event could occur and the client will know about it only when the timeout expires.

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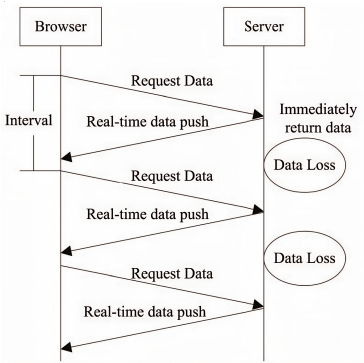

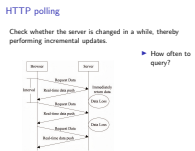

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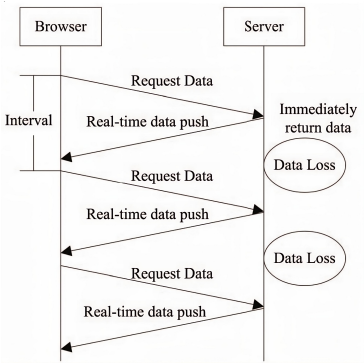

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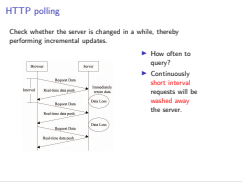

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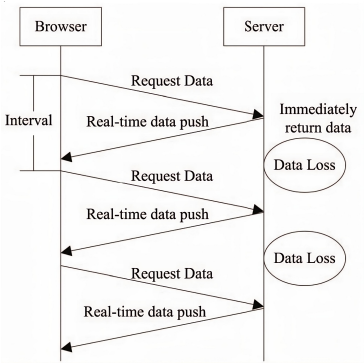

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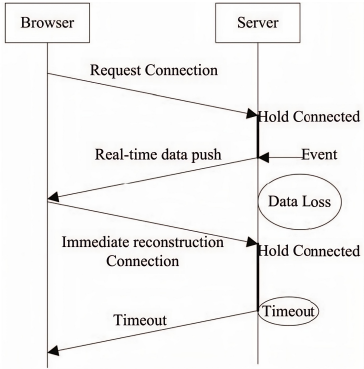
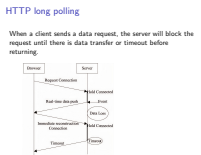
HTTP long polling

When a client sends a data request, the server will block the request until there is data transfer or timeout before returning.





Can hold the connection up to a certain time, after that a timeout is exceeded and need a new connection.No bidirectional because the client may only send data the first time, but then it will only receive until a timeout and another request is made.In the normal polling we could have bidirectional because the interval was shorter.

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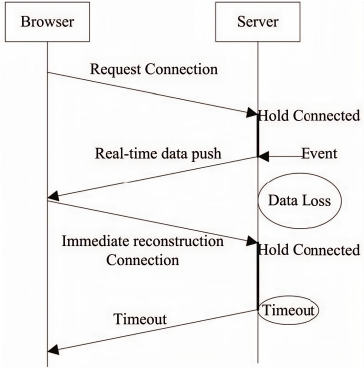

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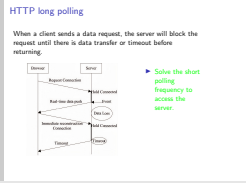

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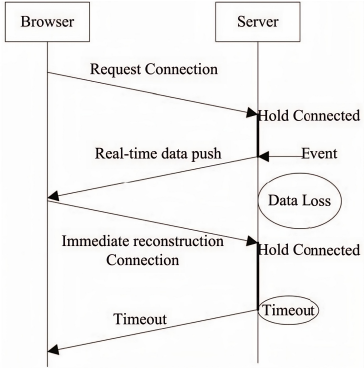

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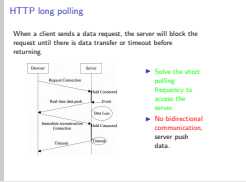

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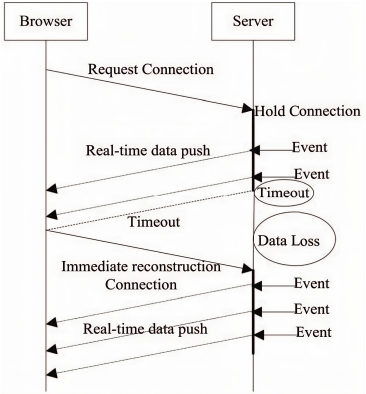

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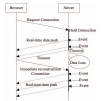

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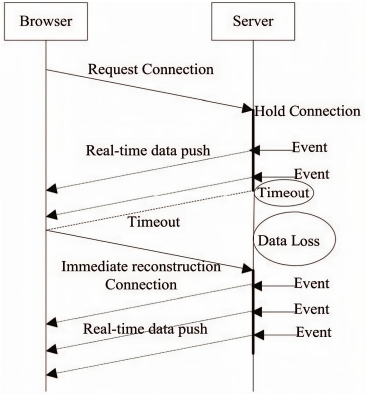

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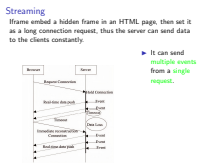

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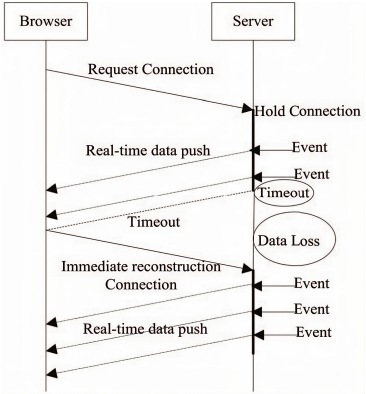

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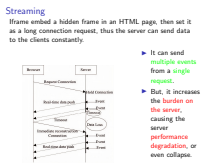

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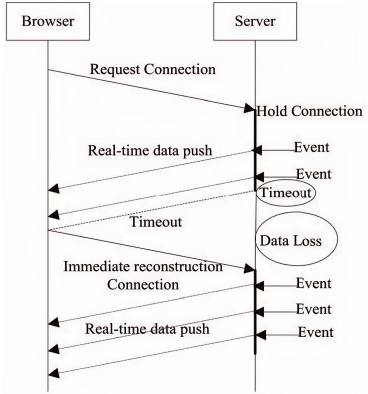

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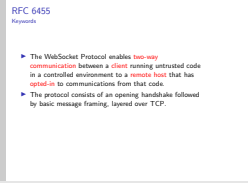

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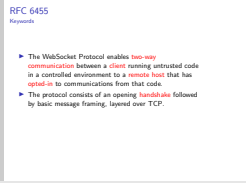

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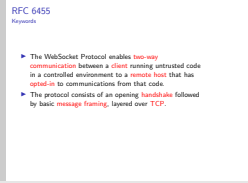

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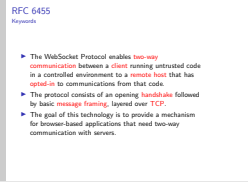

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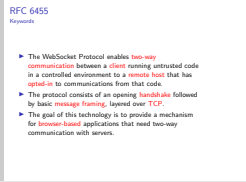

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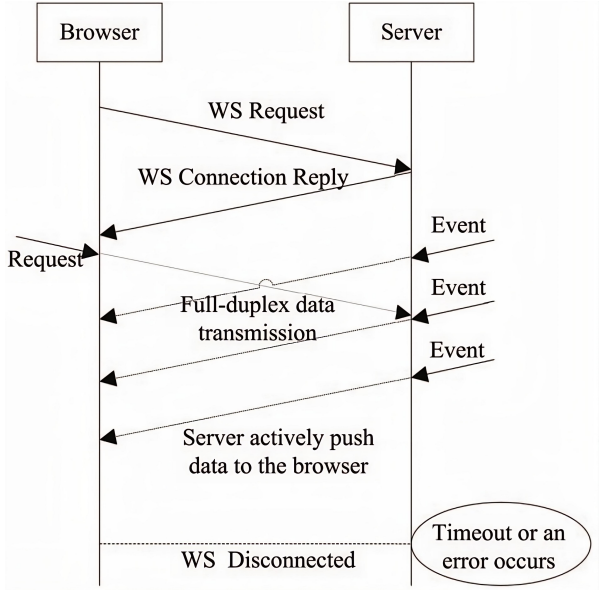

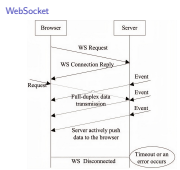

There is the initial handshake, after that, client and server can send and receive data at any moment without further interaction.There is no timeout. If it disconnects, it is because of an error and to establish the connection, the handshake has to be done again.

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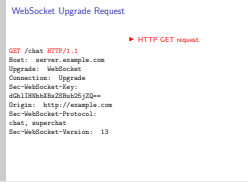

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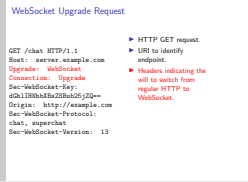

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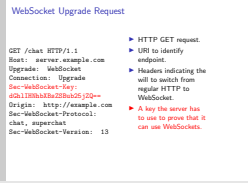

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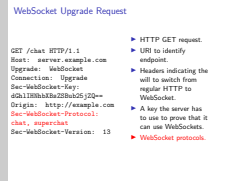

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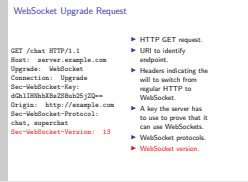

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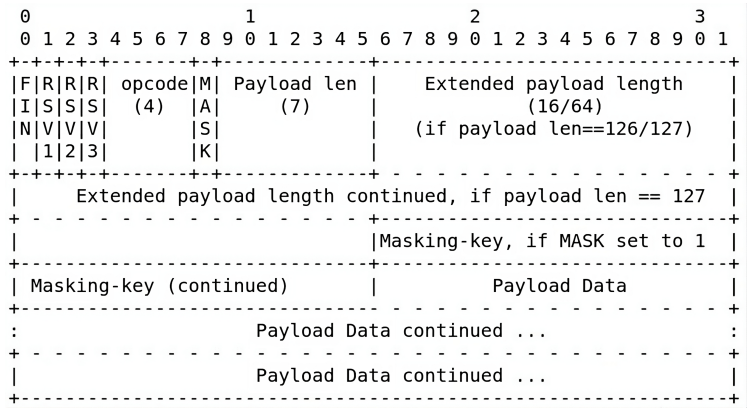

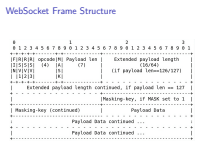

We will not go into the details because it is out of the scope of this presentation and, as mentioned earlier, the added overhead to the payload data is minimal.

WebSocket API

The API is defined by its states of readiness, responses to a networking or messaging event.

Callback	Description
`onopen`	invoked when WebSocket `session is established`, signalizes that the protocol is ready to transfer payload data
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Outline

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Background
HTTP polling
HTTP long polling
Streaming

WebSocket protocol
Definition
Handshake
Frame
API

Performance vs TCP Socket
Performance Evaluation
WebSocket sequence diagram
Network traffic
Data Transfer Time

Conclusion

We will now try to evaluate the WebSocket performance compared to the raw TCP Socket.

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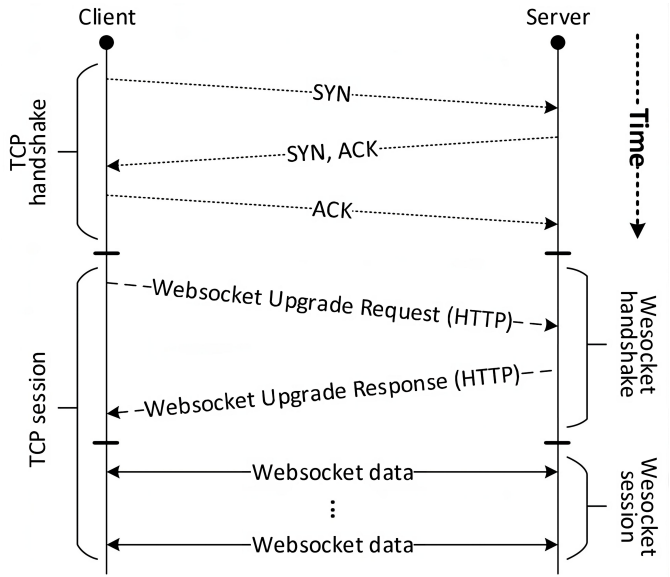
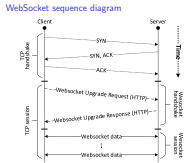
WebSocket sequence diagram





WebSocket stay on top of TCP which means it will always add more overhead than the raw TCP Socket, but WebSocket is easier to use in a web environment.

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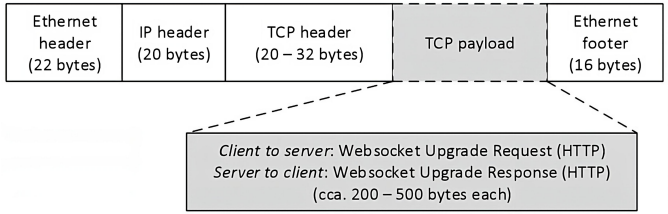

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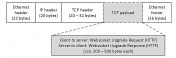

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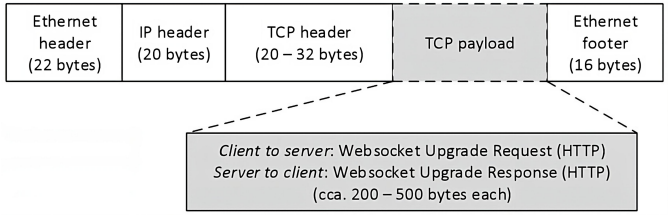

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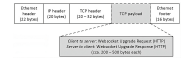

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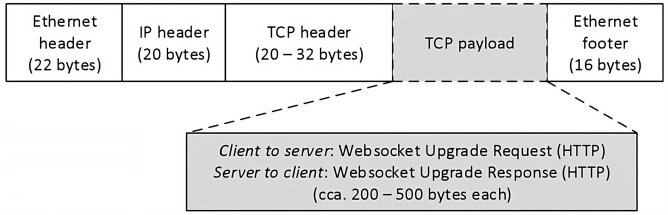

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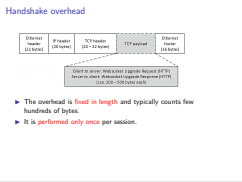

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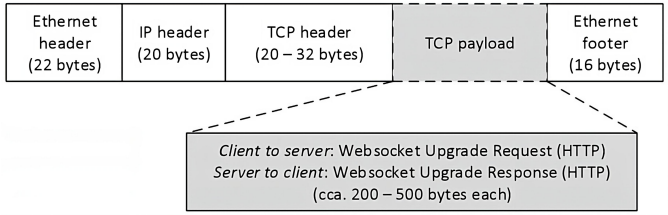

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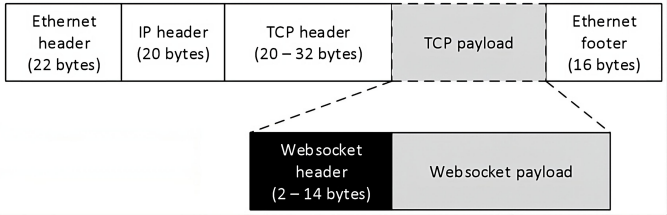

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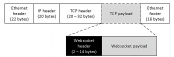

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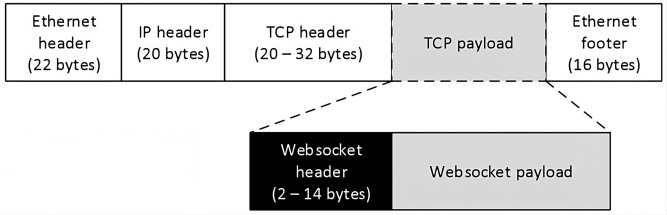

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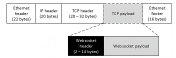

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- With WebSocket, the TCP Payload consists of both data and Frame header.
- This relation can be written as:

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$$P_{WS} = data + H \tag{2}$$

where:

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$data$ = data to send
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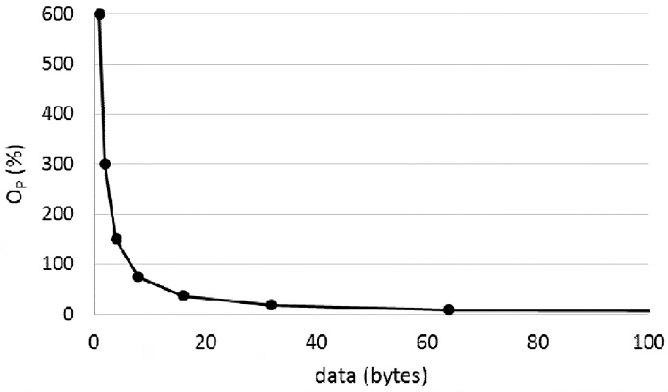

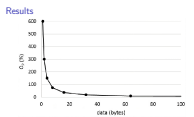

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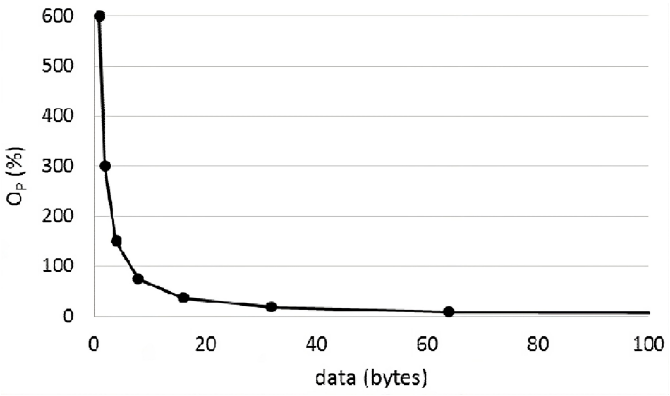

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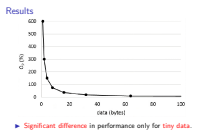

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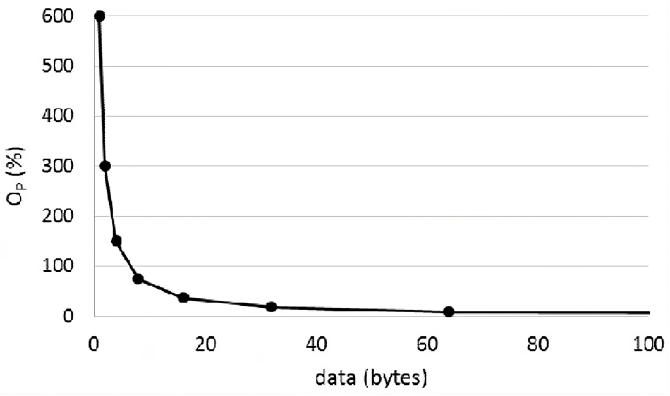

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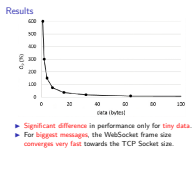

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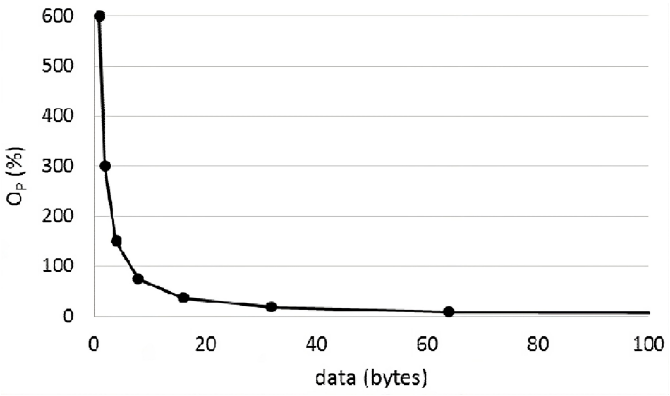

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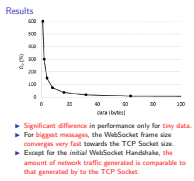

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Environment configuration

	Client	Server
Hardware	CPU: AMD Turion II P520 RAM: 6 GB	CPU: AMD Athlon X2 5000 RAM: 5 GB
OS	Windows 8 64-bit	Windows 8 64-bit
Network	1000BASE-T (Gigabit Ethernet, **host machines directly connected** using UTP Cat5 Ethernet cable)	
TCP implementation	*java.net.Socket* (Java JDK 1.7)	*java.net.Socket* (Java JDK 1.7)
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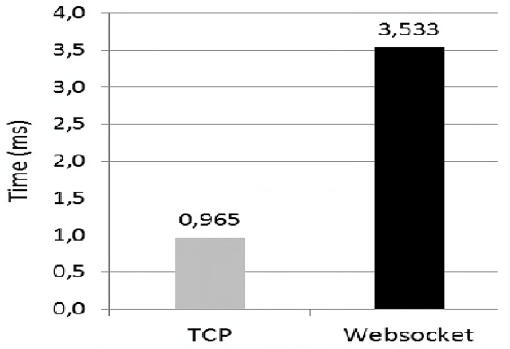

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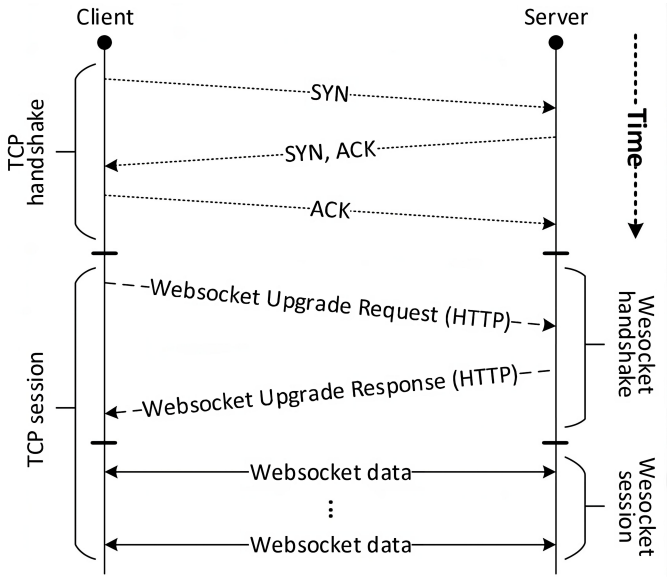

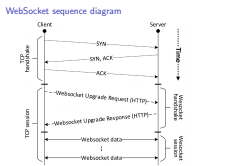

WebSocket stay on top of TCP which means it will always add more overhead than the raw TCP Socket, but WebSocket is easier to use in a web environment.

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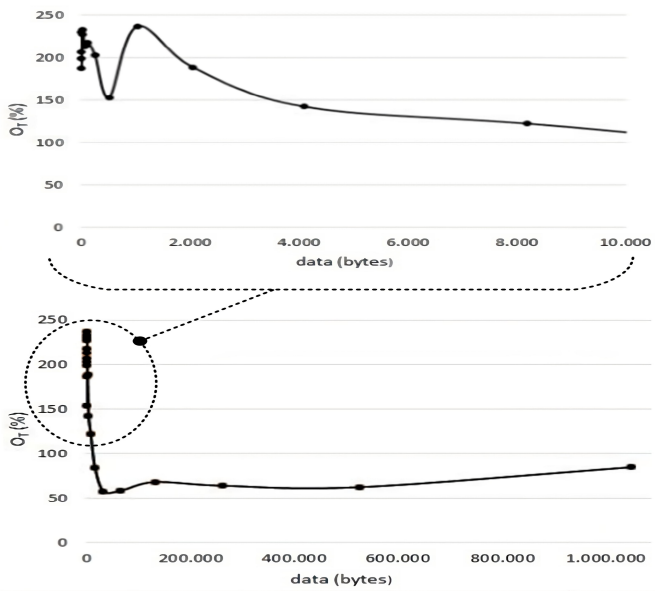

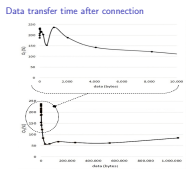

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Streaming
WebSocket protocol
Definition
Handshake
Frame
API
Performance vs TCP Socket
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