SMig: A Stream Migration Extension For HTTP/2

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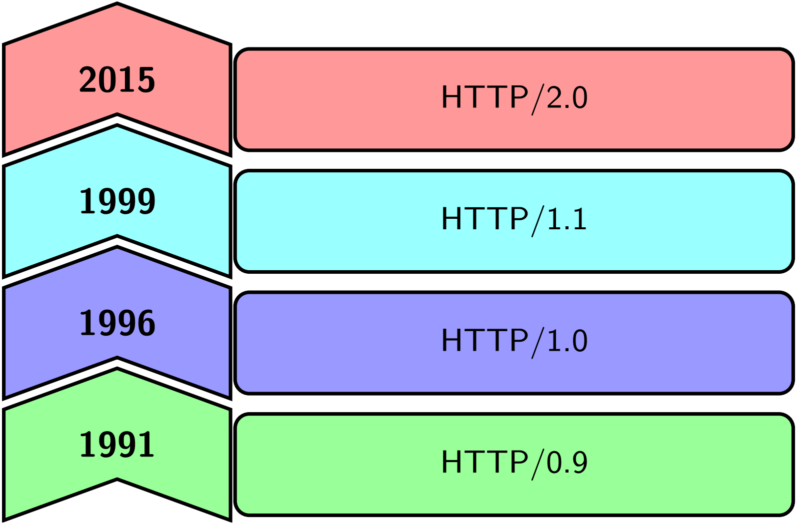
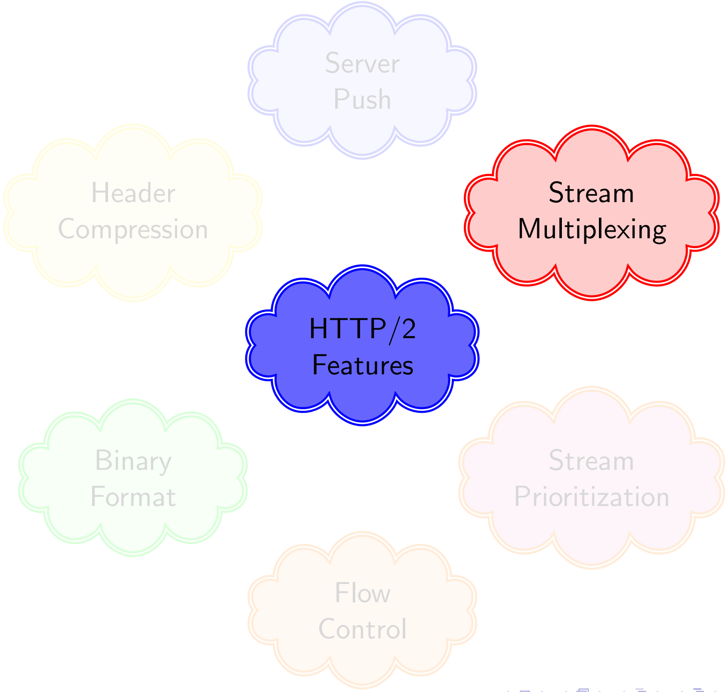
HTTP is Evolving

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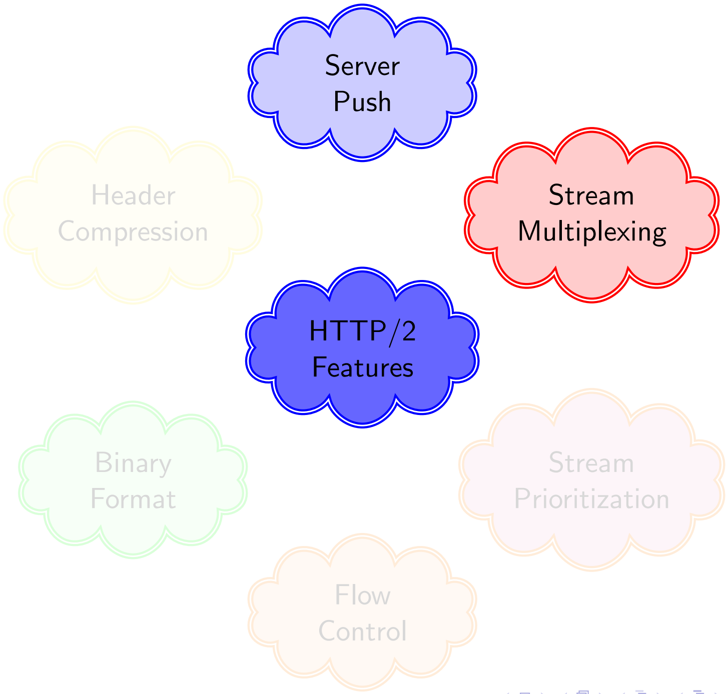
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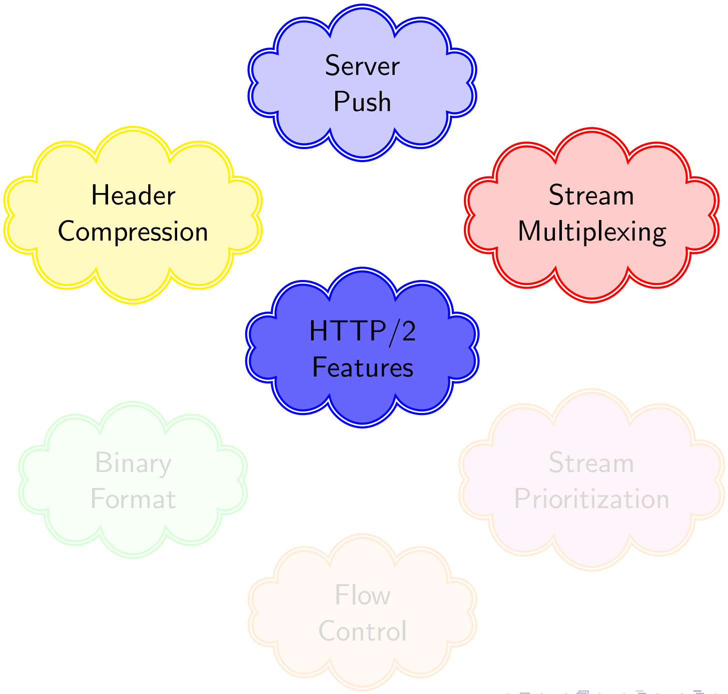
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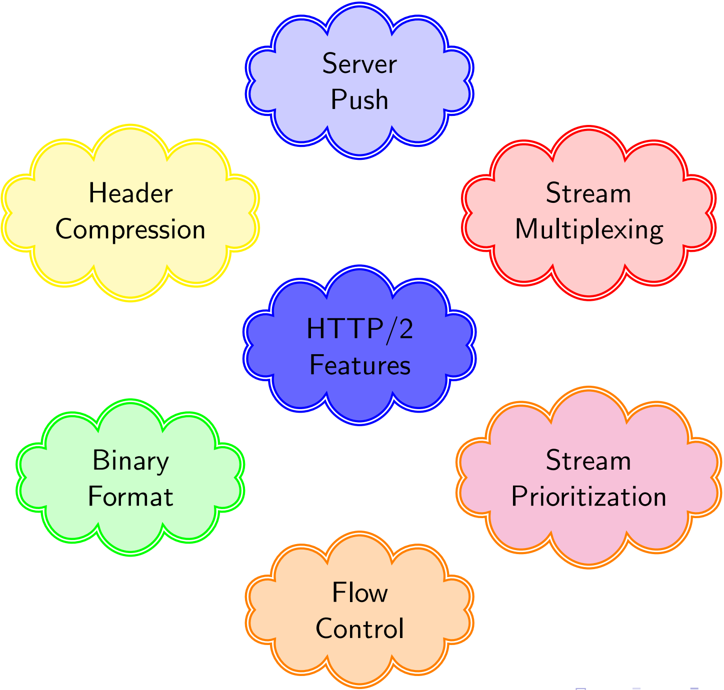
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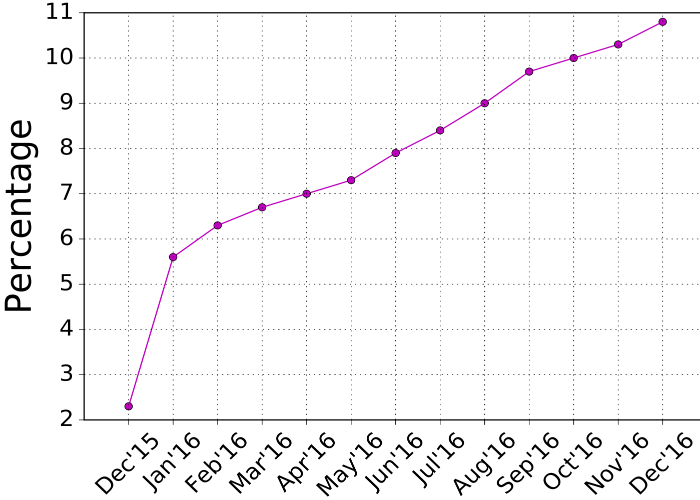
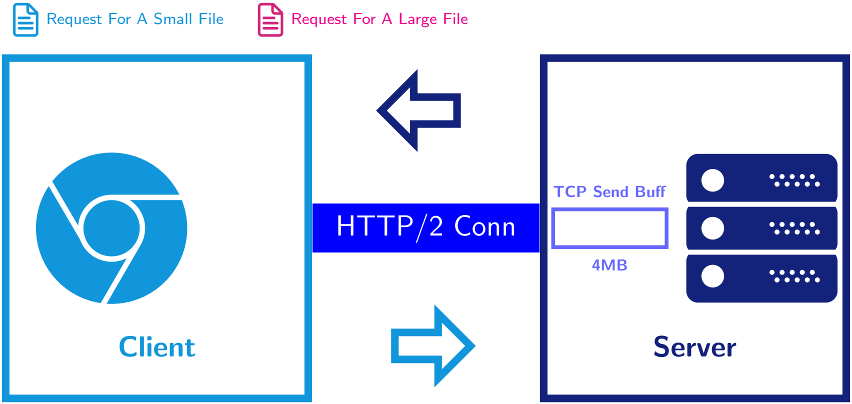
Http/2 is Gaining Popularity

According to W3Techs, by Dec 2016, 10.8% of the top 10 million websites are using HTTP/2.



Motivations of SMig: Sender-side HoLB Problem



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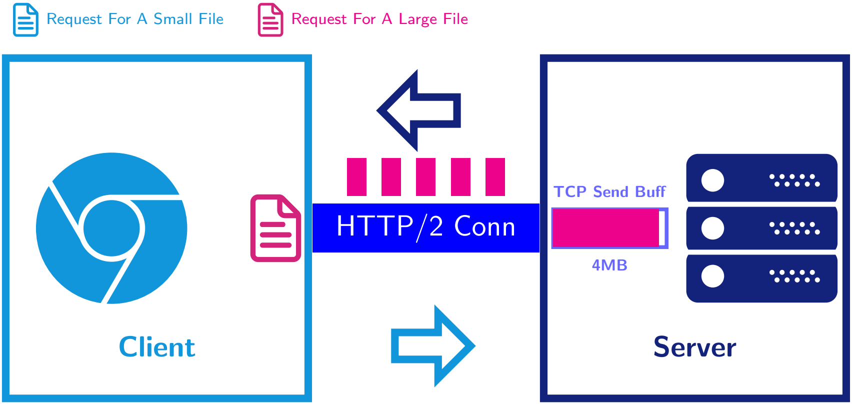

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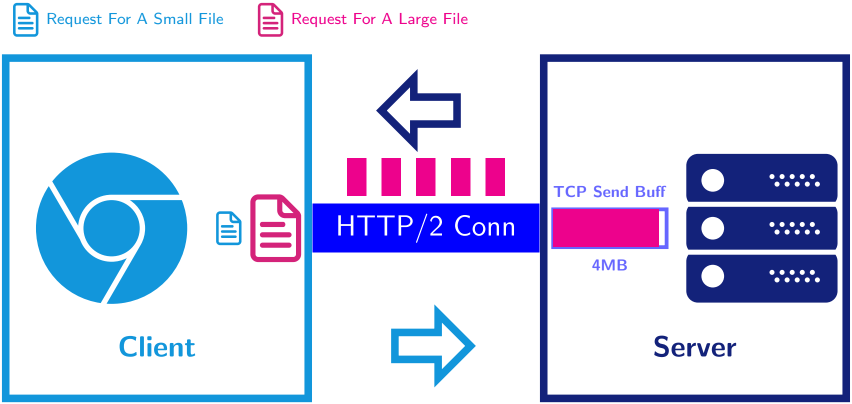

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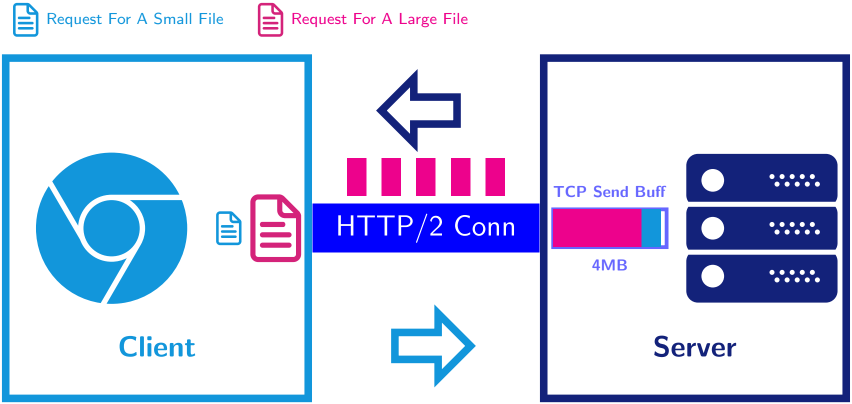

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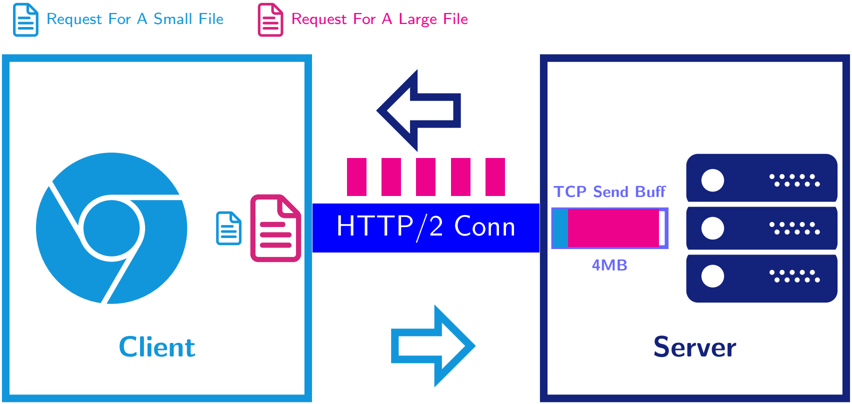

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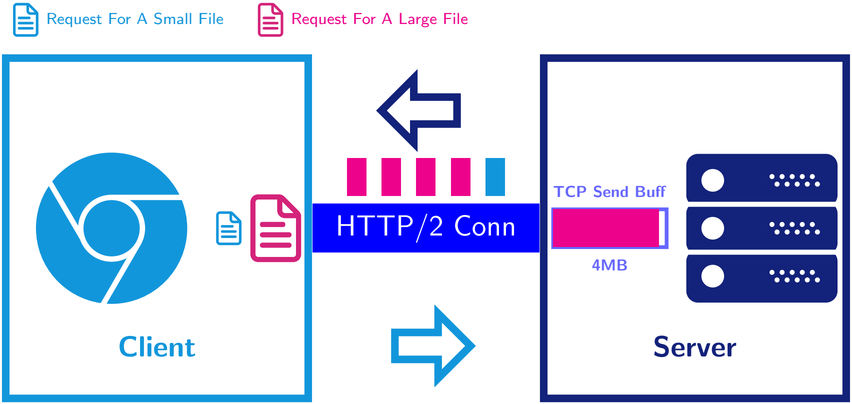

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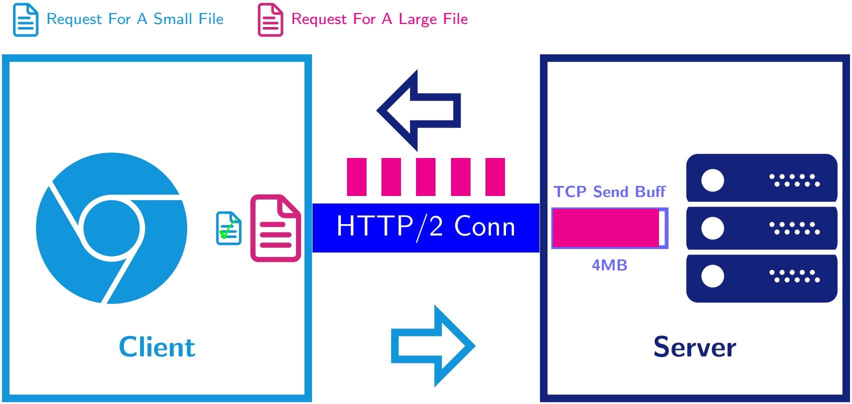

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Table: Download Time for 10KB file (10Mbps BW, 50ms RTT)

Concurrent Download	HTTPS(HTTP/1.1)	HTTP/2
No	0.05	0.05
Yes	0.14	8.40

HoLB increases the small file download time by up to 70x, compared to HTTP/1.1!

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HoLB frequently happens in the real world (see paper for measurements)

Motivations of SMig: How to Handle Sender-side HoLB?

Start With Separate Conns? → Response size is **Unknown** before request

Stream Prioritization? → No help for HoLB in **TCP** layer

Our Solution: migrate an on-going stream of large file transfer to an idle connection.

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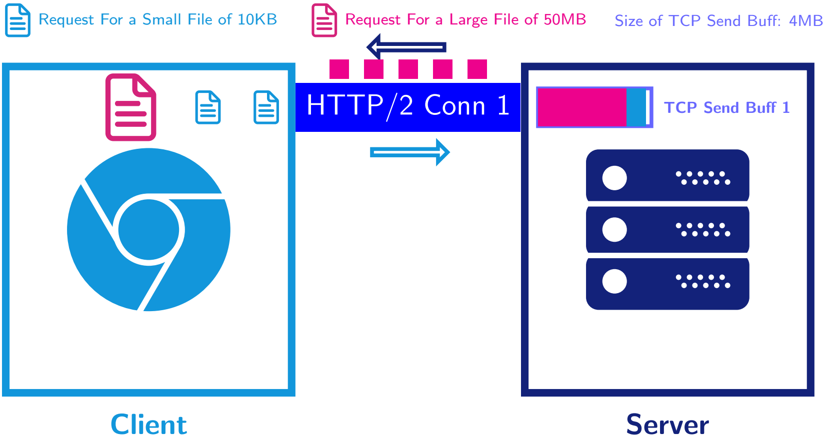
Stream Migration: migrate an on-going stream from one HTTP/2 connection to another.



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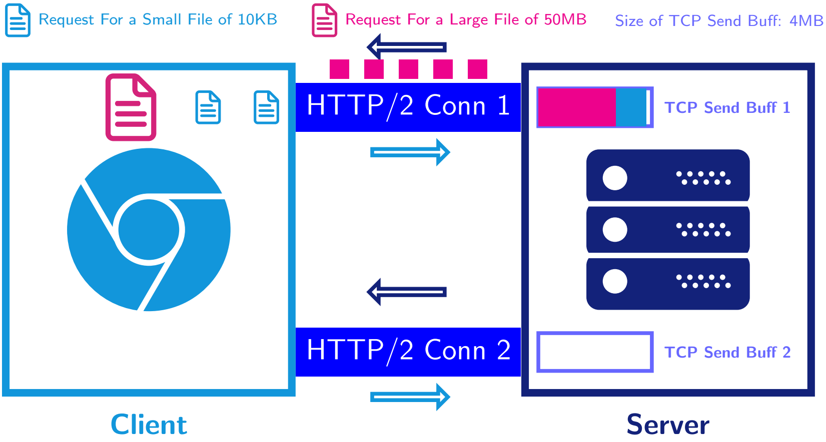

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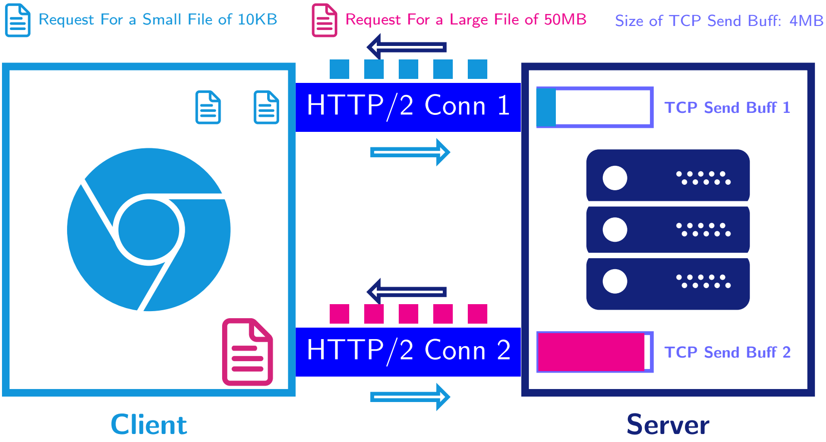

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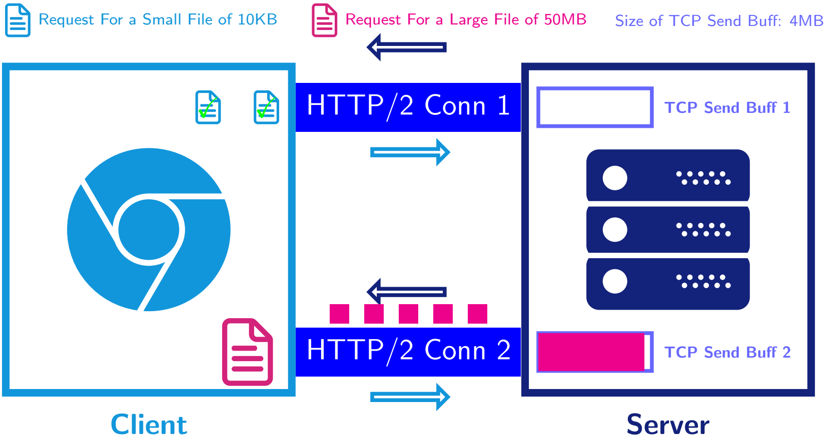

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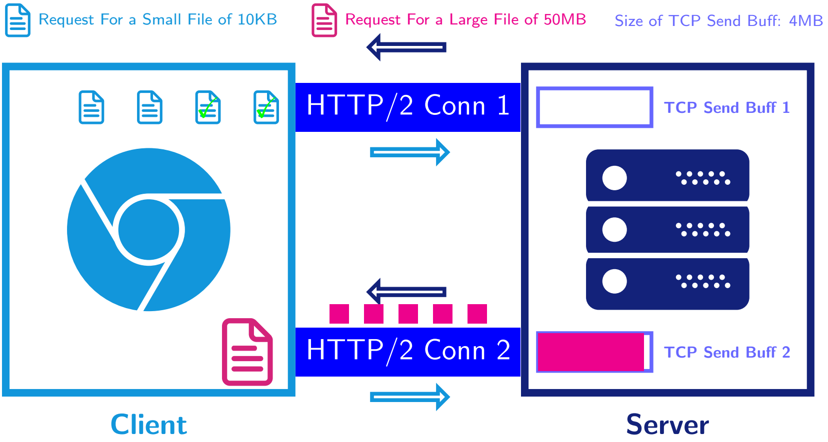

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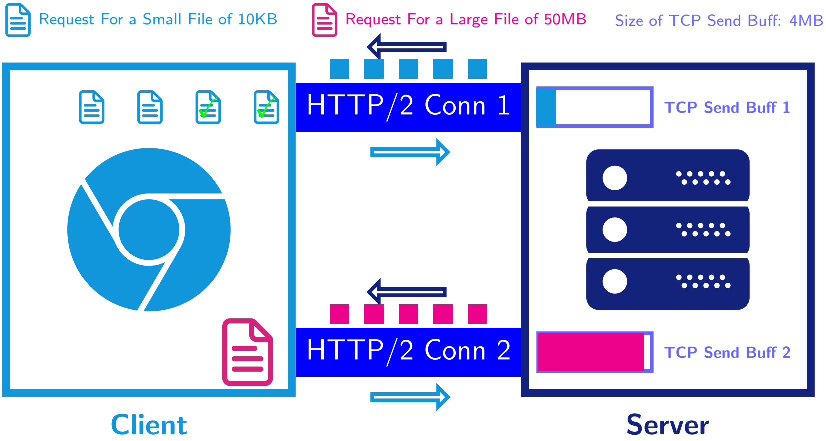

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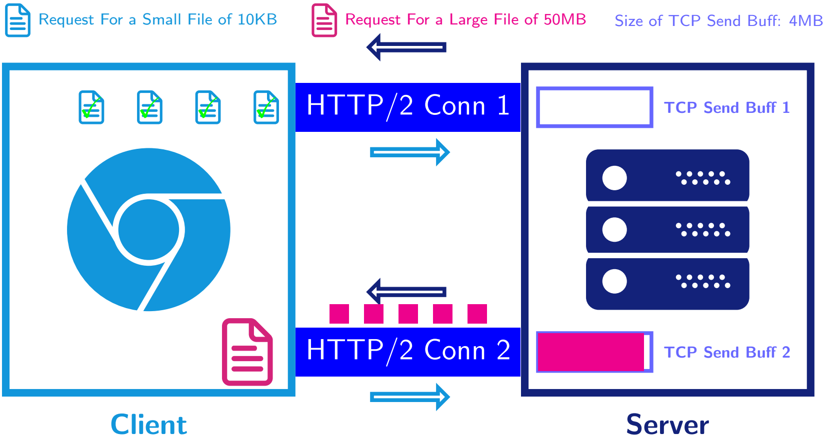
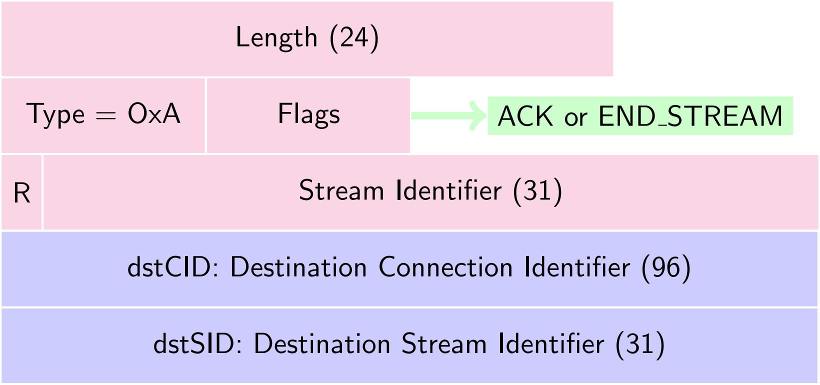


Design of Smig: Migration Frame

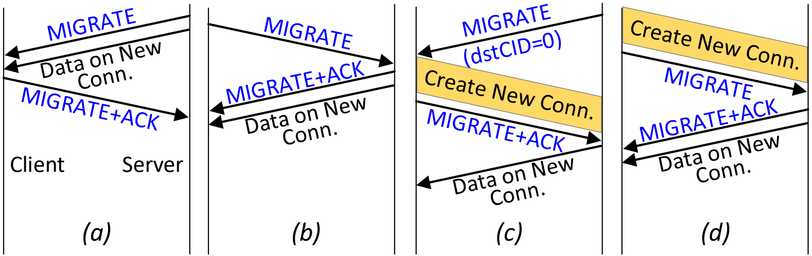
Migration Frame expresses the intent of initiating a stream migration.

The flags ensure correct cross-connection ordering of frames (details in the paper).



Design of Smig: Migration Scenarios

A migration can be initiated by either a client or server. If no idle connection exists, SMig will create a new one.



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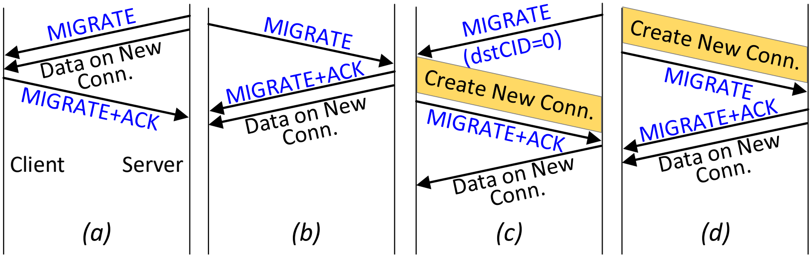

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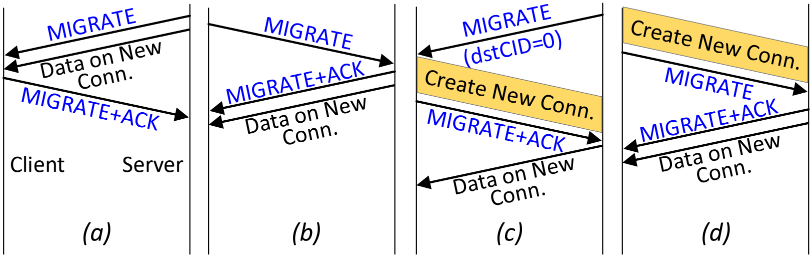

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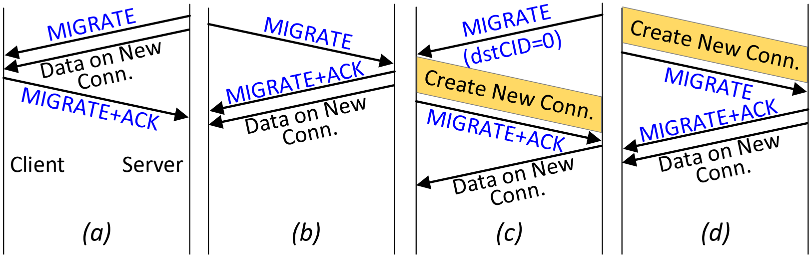

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Other Design Considerations (Details in the Paper)

SMig incurs low overhead for migration in common usage scenarios.

SMig strategically manages idle connections to strike a balance between resource usage and performance.

Various migration policies can be applied (examples shown soon).

SMig can work with HTTP/2 server push.

No new security vulnerability is introduced by SMig.

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Implementation of SMig

Component	PL	LOC	OS Platforms
HTTP/2 Client and Server	C++	7.5K	Linux/OS X

Component	PL	LOC	OS Platforms
SMig extension	C++	1K	Linux/OS X

Evaluation of SMig: Experimental Setup

Client & Server Setting

Node	OS	CPU	Memory
Client	OS X 10.10	2.7GHz Intel Core i5 CPU	8GB
Server	Ubuntu 14.04	3GHz Intel Core2 Duo E8400 CPU	4GB

Network Setting

Type	Network Type
Wired	An emulated 10Mbps link with 50ms RTT
Cellular	A commercial LTE network

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Evaluation Methodology

Workload: concurrent small & large file downloads (10 KB vs. 50 MB) in four scenarios. SMig migrates the large file.

NoMig: SMig is disabled

MigSW: server initiates the migration for the large file once it receives its request.

MigSP: server initiates the migration after sending 100KB response data (for chunked mode encoding).

MigCP: client initiates the migration once it receives the response header.

Evaluation: Small File Download Time over Wired Network

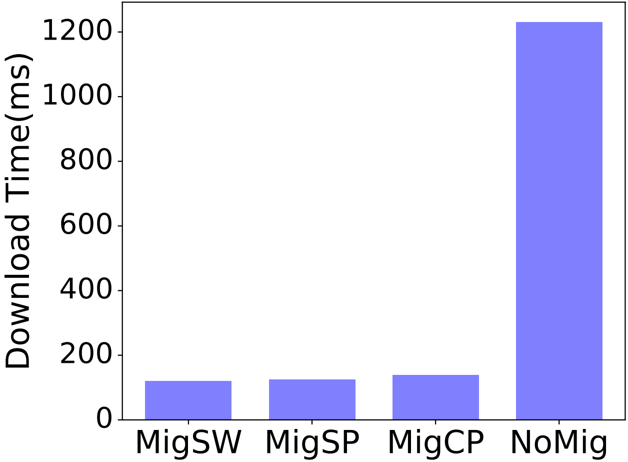

Figure: SMig's Impact on Small File Download (Wired)

Evaluation: Small File Download Time over LTE

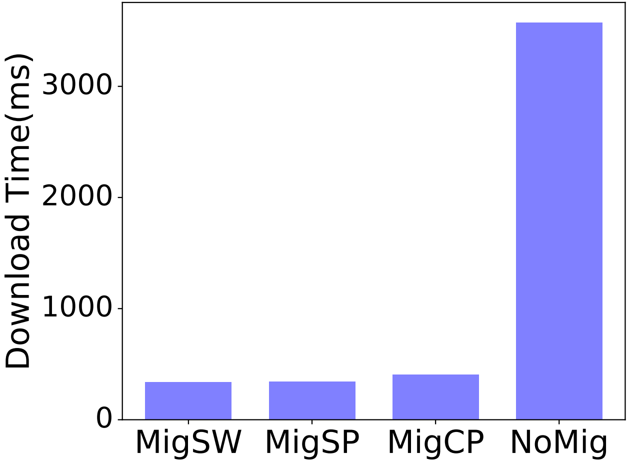

Figure: SMig's Impact on Small File Download (Cellular)

Evaluation: Impact of Migration on Large File Download Time

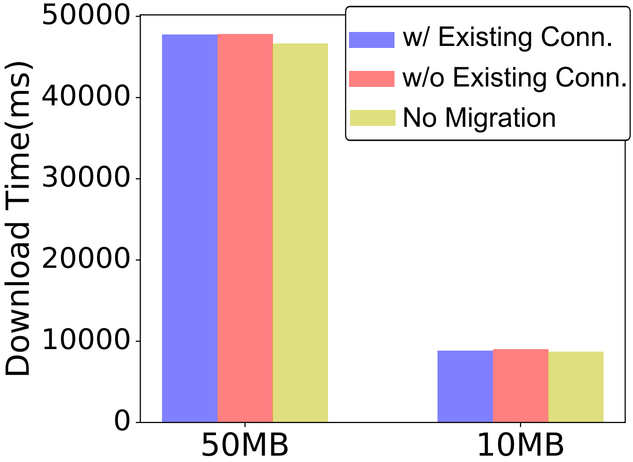

Figure: SMig's Impact on Large File Download(Wired)

Summary

SMig: an HTTP/2 extension allowing a client or server to migrate an on-going HTTP/2 stream from one connection to another.

SMig eliminates sender-side HoLB. It reduces the delay-sensitive file download time by up to 99% when concurrent transfers occur.

SMig brings other benefits and usage scenarios (see the paper for details).

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Q&A

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