QUIC performance

QUIC and Satellite

Open Stakeholder Meeting
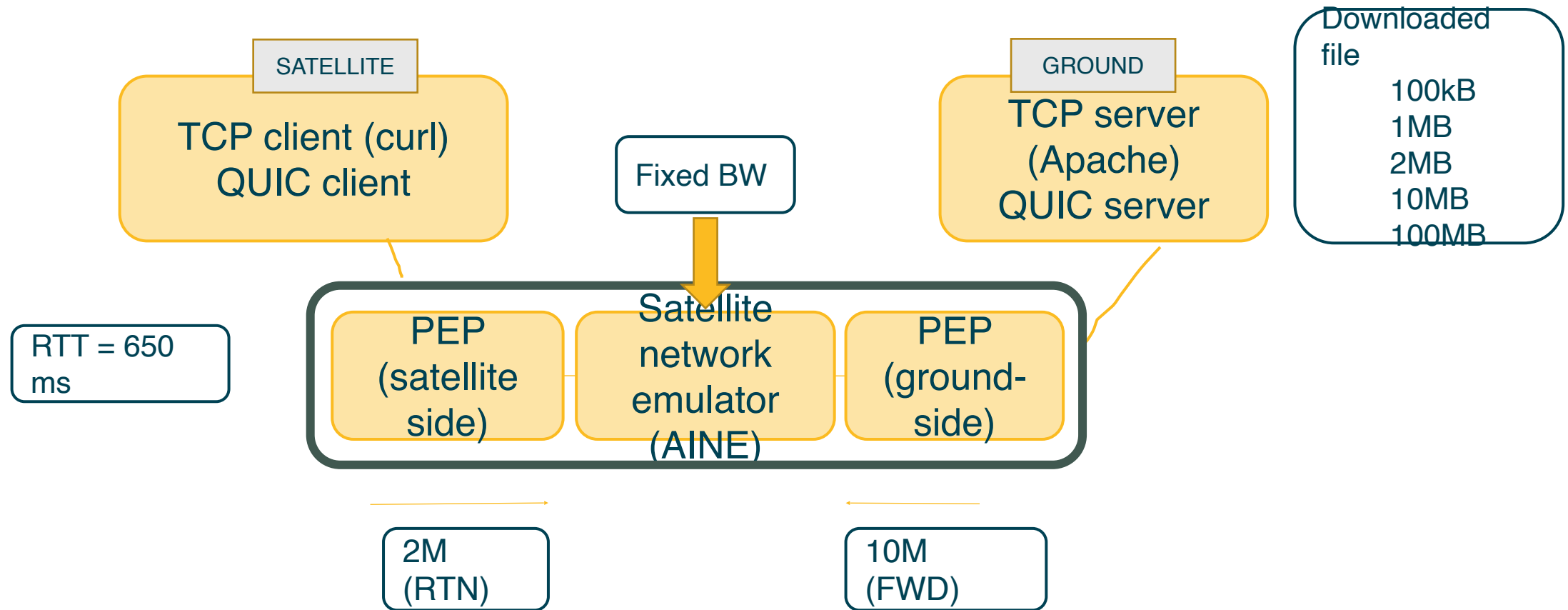
Lorena Albiol, Indra Sistemas, lalbiol@indra.es

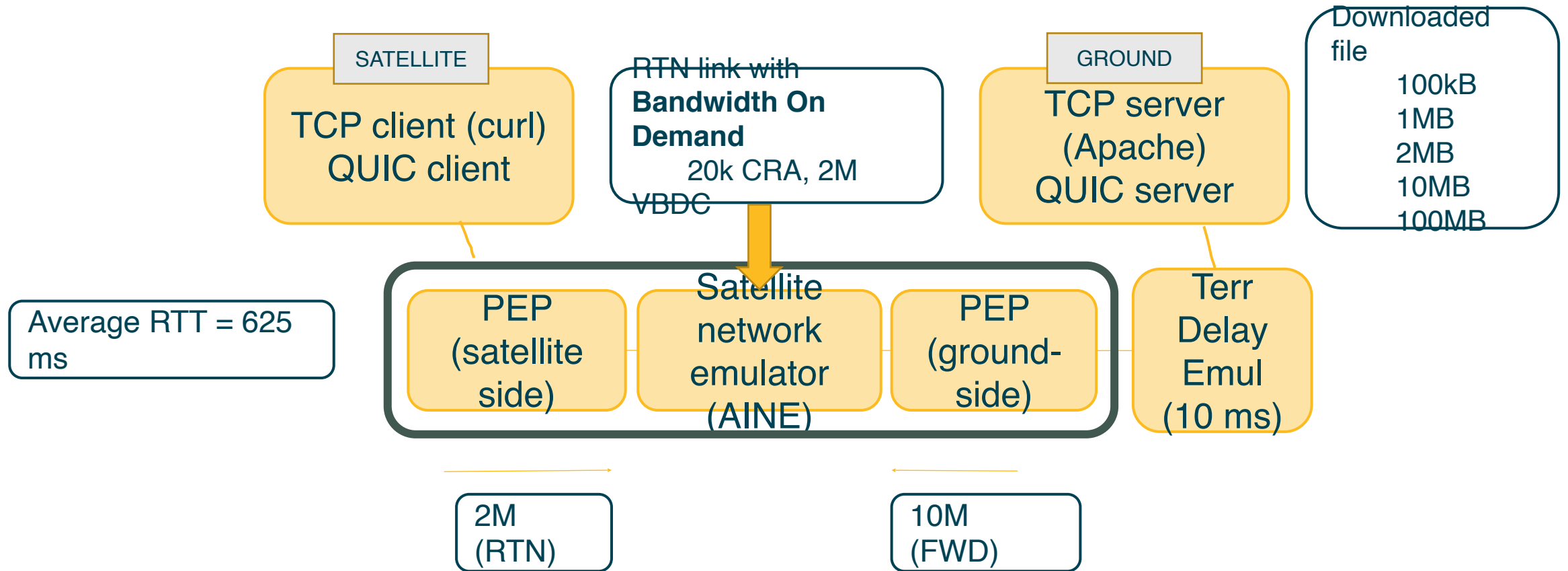04/11/2020

Performance Evaluation Test bed – Fixed BW (1)

SATELLITE

TCP client (curl)
QUIC client

Fixed BW

GROUND

TCP server
(Apache)
QUIC server

Downloaded file
- 100kB
- 1MB
- 2MB
- 10MB
- 100MB

RTT = 650 ms

Satellite network emulator (AINE)

PEP (satellite side)

PEP (ground-side)

2M (RTN)

10M (FWD)

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Performance Evaluation Test bed – BoD (1)

SATELLITE

TCP client (curl)
QUIC client

RTN link with
Bandwidth On Demand
20k CRA, 2M VBDC

GROUND

TCP server (Apache)
QUIC server

Downloaded file
100kB
1MB
2MB
10MB
100MB

Average RTT = 625 ms

PEP (satellite side)

Satellite network emulator (AINE)

PEP (ground-side)

Terr Delay Emul (10 ms)

2M (RTN)

10M (FWD)

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QUIC Performance with a short file transfer

Effects of connection set-up and initial congestion window

100kB File Download Time (s)

Legend: QUIC - quicly, TCP TLSv1.3 No-PEP, Commercial PEP, PEPSal

Annotations on chart: QUIC, TCP, TCP & PEPs

X-axis categories: BoD, Fixed delay

quicly, March 2020, IETF draft-27
https://github.com/uoaerg/quicly
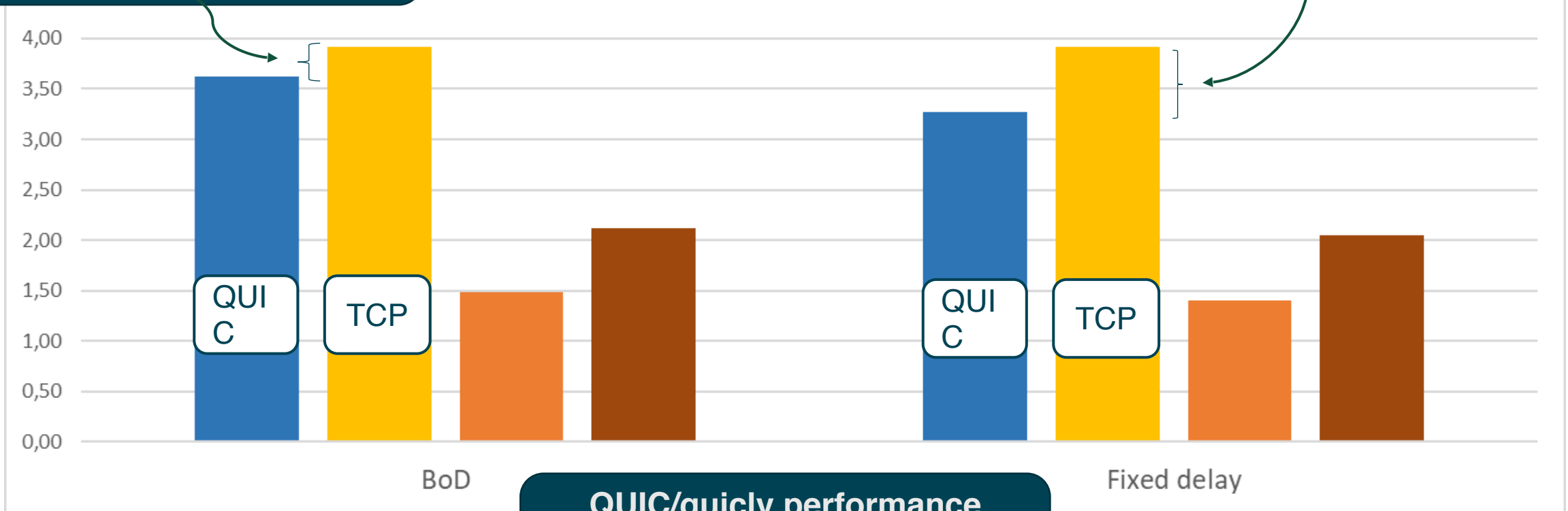
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QUIC Performance with a short file transfer

But initial QUIC packet is larger. This is noticeable with BoD.

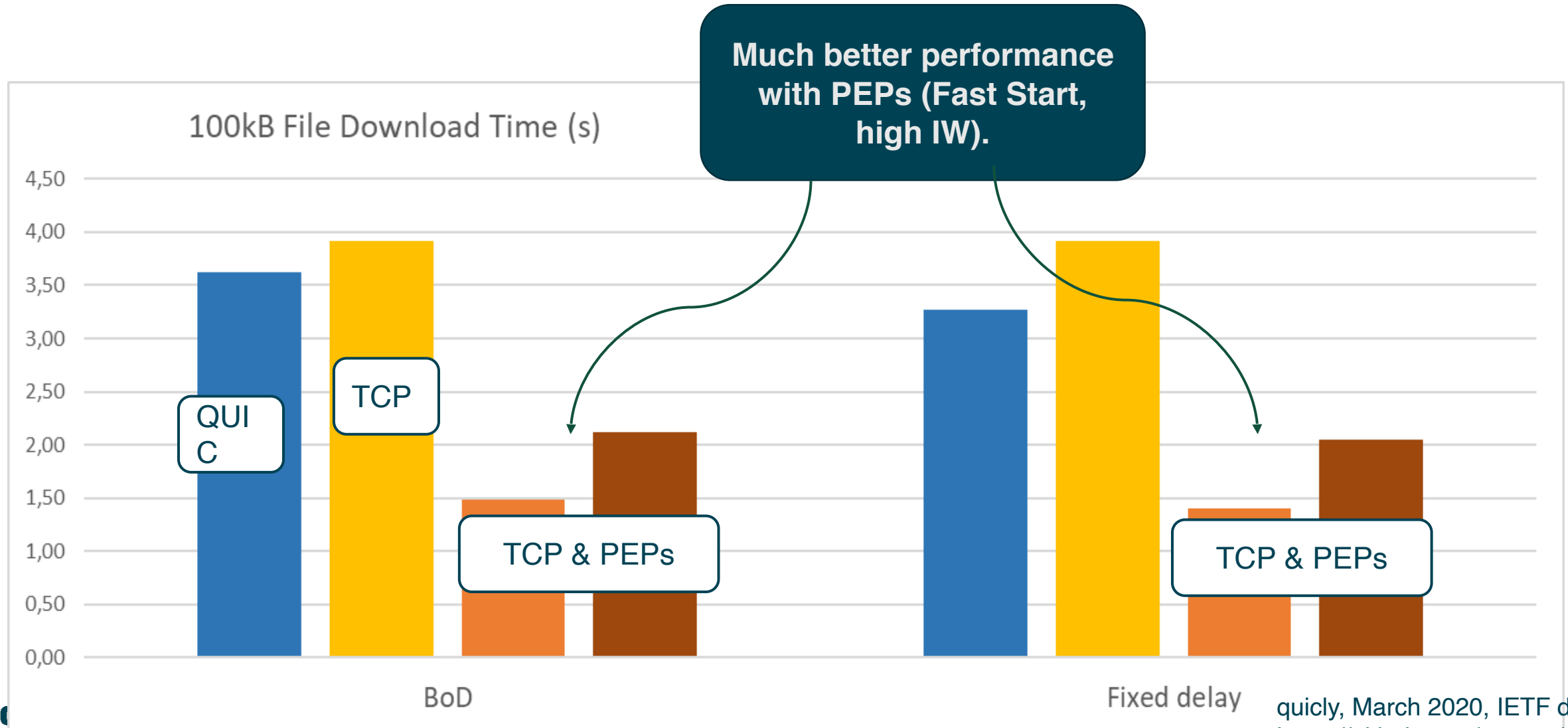**QUIC supports 1-RTT connection set-up**
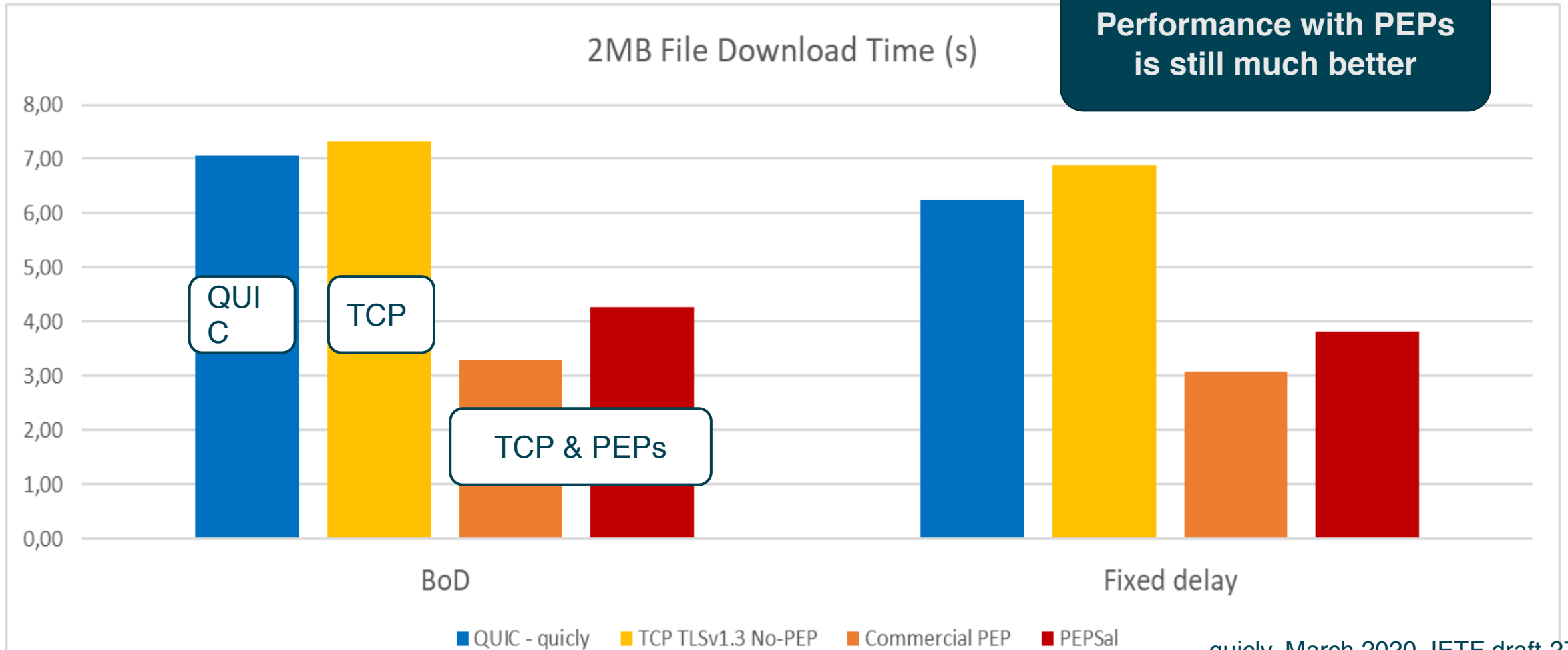
100kB File Download Time (s)

| QUIC | TCP |
| BoD |

| QUIC | TCP |
| Fixed delay |

4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00

QUIC/quicly performance similar to TCP NewReno with TLSv1.3

quicly, March 2020, IETF draft-27
https://github.com/uoaerg/quicly

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QUIC Performance with a short file transfer

Much better performance with PEPs (Fast Start, high IW).

100kB File Download Time (s)

QUIC

TCP

TCP & PEPs

TCP & PEPs

BoD

Fixed delay

quicly, March 2020, IETF draft-27
https://github.com/uoaerg/quicly

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QUIC Performance with a medium file transfer

2MB File Download Time (s)

Performance with PEPs is still much better

QUIC
TCP
TCP & PEPs

Legend: QUIC - quicly | TCP TLSv1.3 No-PEP | Commercial PEP | PEPSal

BoD   Fixed delay

quicly, March 2020, IETF draft-27
https://github.com/uoaerg/quicly

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QUIC Performance with a long file transfer
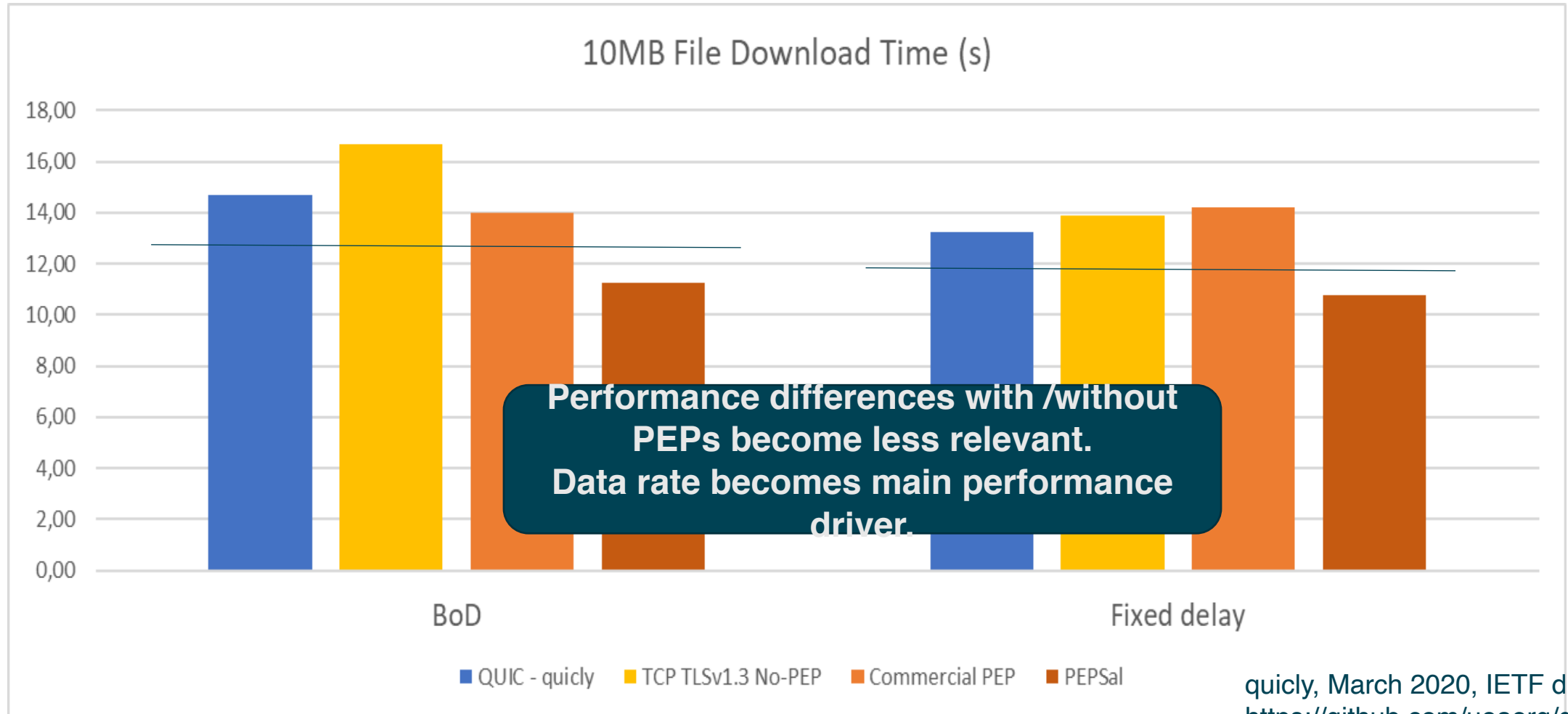
10MB File Download Time (s)

Performance differences with /without PEPs become less relevant.
Data rate becomes main performance driver.

BoD

Fixed delay

■ QUIC - quicly   ■ TCP TLSv1.3 No-PEP   ■ Commercial PEP   ■ PEPSal

quicly, March 2020, IETF draft-27
https://github.com/uoaerg/quicly

Performance tests with Chromium IETF QUIC

Chromium QUIC, IETF draft-29, retrieved 3/06/2020 (https://www.chromium.org/quic/playing-with-qui

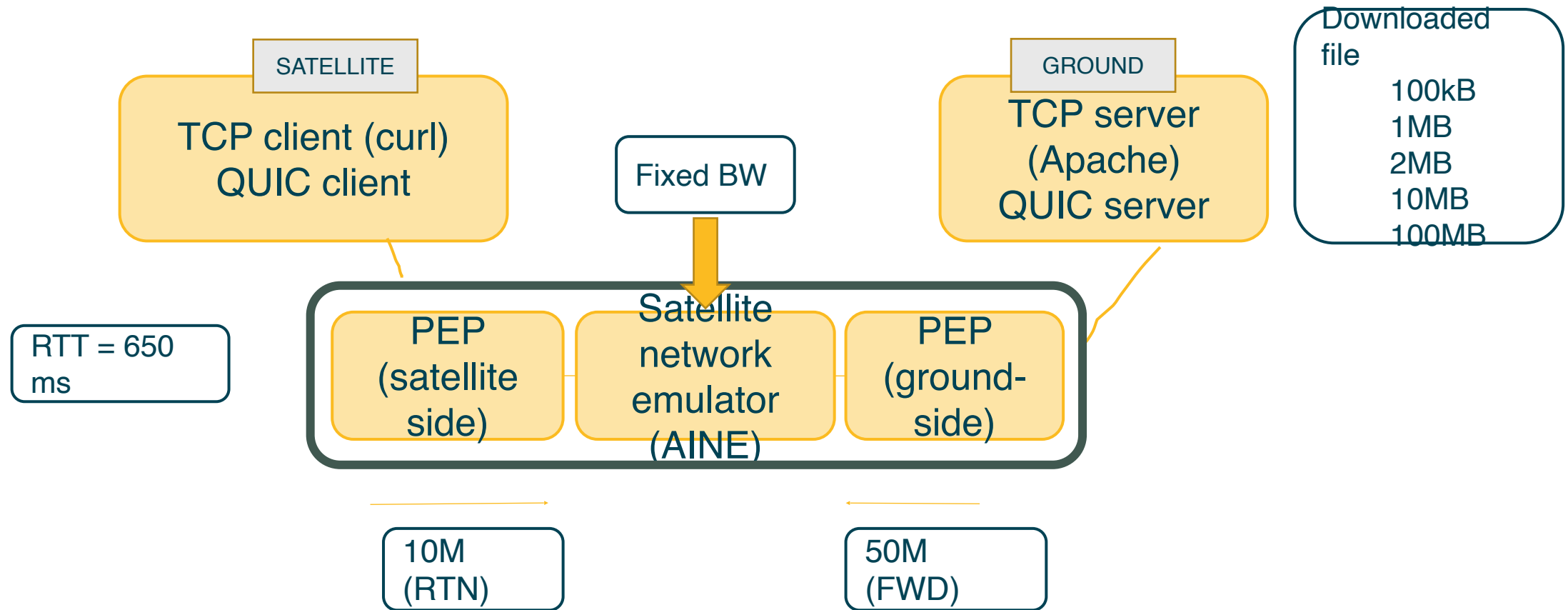# Performance tests with Chromium IETF QUIC

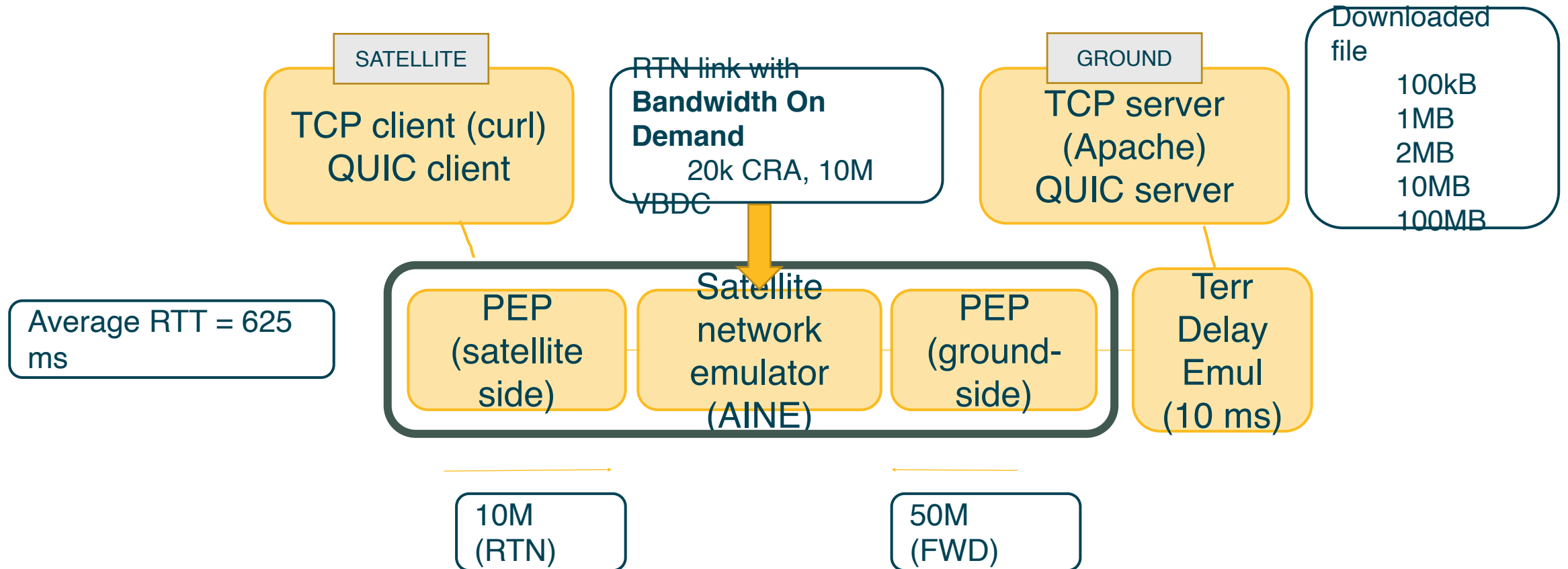**10MB File Download Time (s)**
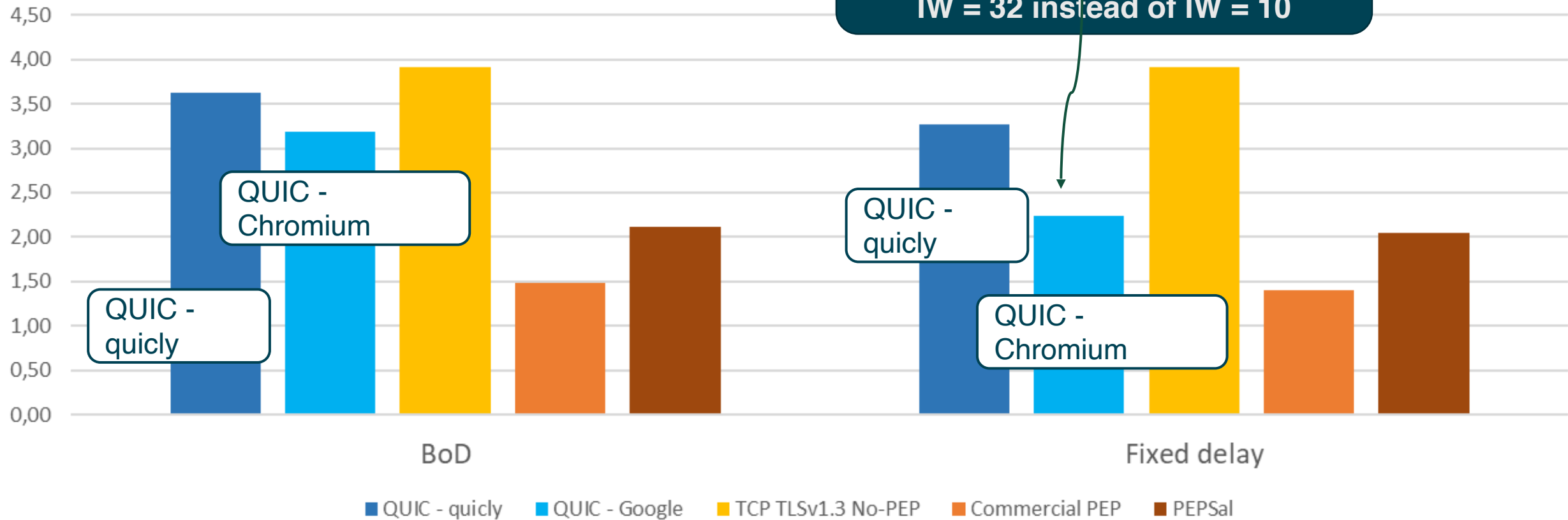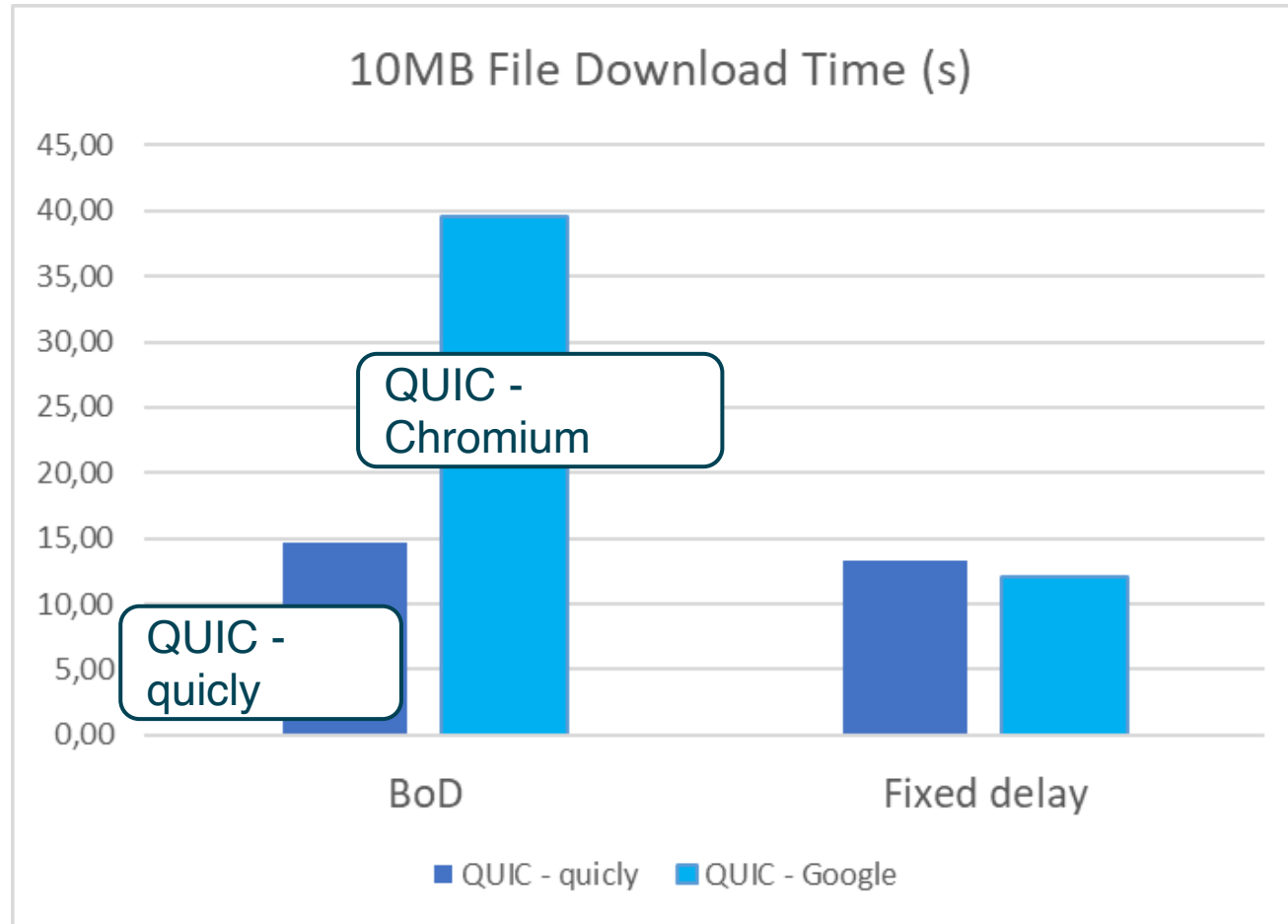
- **Performance problems of Chromium QUIC implementation with BoD**
  - Hybrid Fast Start feature
  - Does not work well with more variable RTT of BoD scenario
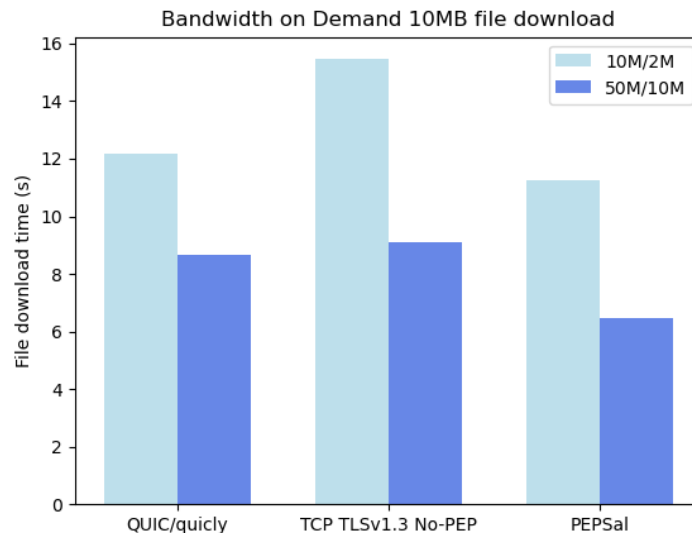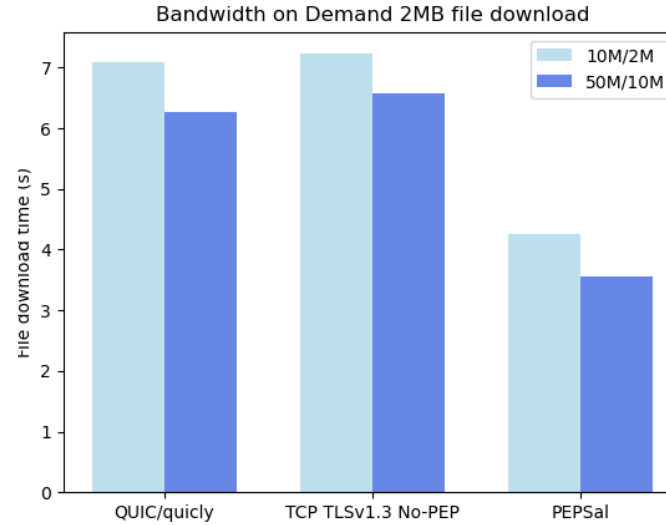   - Premature entry into congestion avoidance

Chromium QUIC, IETF draft-29, retrieved 3/06/2020 (https://www.chromium.org/quic/playing-with-quic)

Performance Evaluation Test bed – Fixed BW (2)

SATELLITE

TCP client (curl)
QUIC client

Fixed BW

GROUND

TCP server
(Apache)
QUIC server

Downloaded file
- 100kB
- 1MB
- 2MB
- 10MB
- 100MB

RTT = 650 ms

PEP (satellite side)

Satellite network emulator (AINE)

PEP (ground-side)

10M (RTN)

50M (FWD)

Performance Evaluation Test bed – BoD (2)

SATELLITE

TCP client (curl)
QUIC client

RTN link with **Bandwidth On Demand**
20k CRA, 10M VBDC

GROUND

TCP server (Apache)
QUIC server

Downloaded file

100kB
1MB
2MB
10MB
100MB

Average RTT = 625 ms

PEP (satellite side)

Satellite network emulator (AINE)

PEP (ground-side)

Terr Delay Emul (10 ms)

10M (RTN)

50M (FWD)

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QUIC Performance – 50M/10M scenario

Bandwidth on Demand 100kB file download

Bandwidth on Demand 2MB file download

Bandwidth on Demand 10MB file download
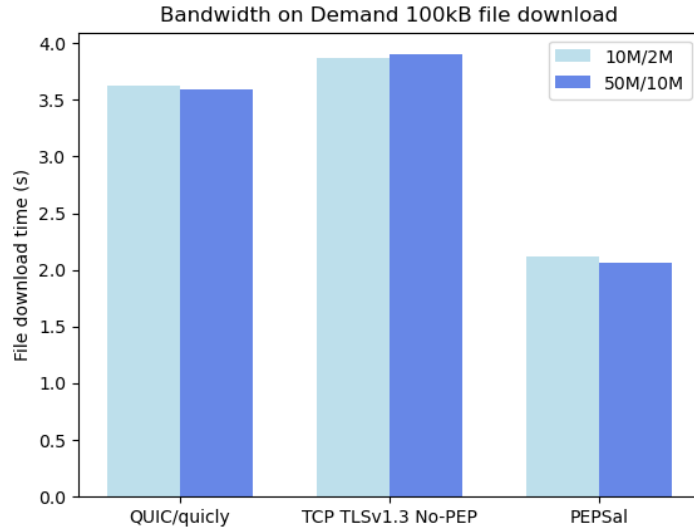
Similar considerations as for the Small scenario

Flow control disabled (QUIC) or tuned parameters (TCP)

Effects of higher bandwidth become more relevant for ≥ 10MB

QUIC performance conclusions

- **QUIC performance similar to TCP / NewReno (with connection start-up improvements)**

- **Scenarios with PEPs provide much better performance for short to medium file sizes**

  - **Typical of web browsing**

- **Non-standard QUIC congestion control features may need to be tuned for satellite (Hybrid Fast Start)**

  - **QUIC provides increased flexibility to optimize congestion control**

  - **May be dangerous for scenarios that are not the main target**

- **Impact of QUIC flow control on performance >> for further study**

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