

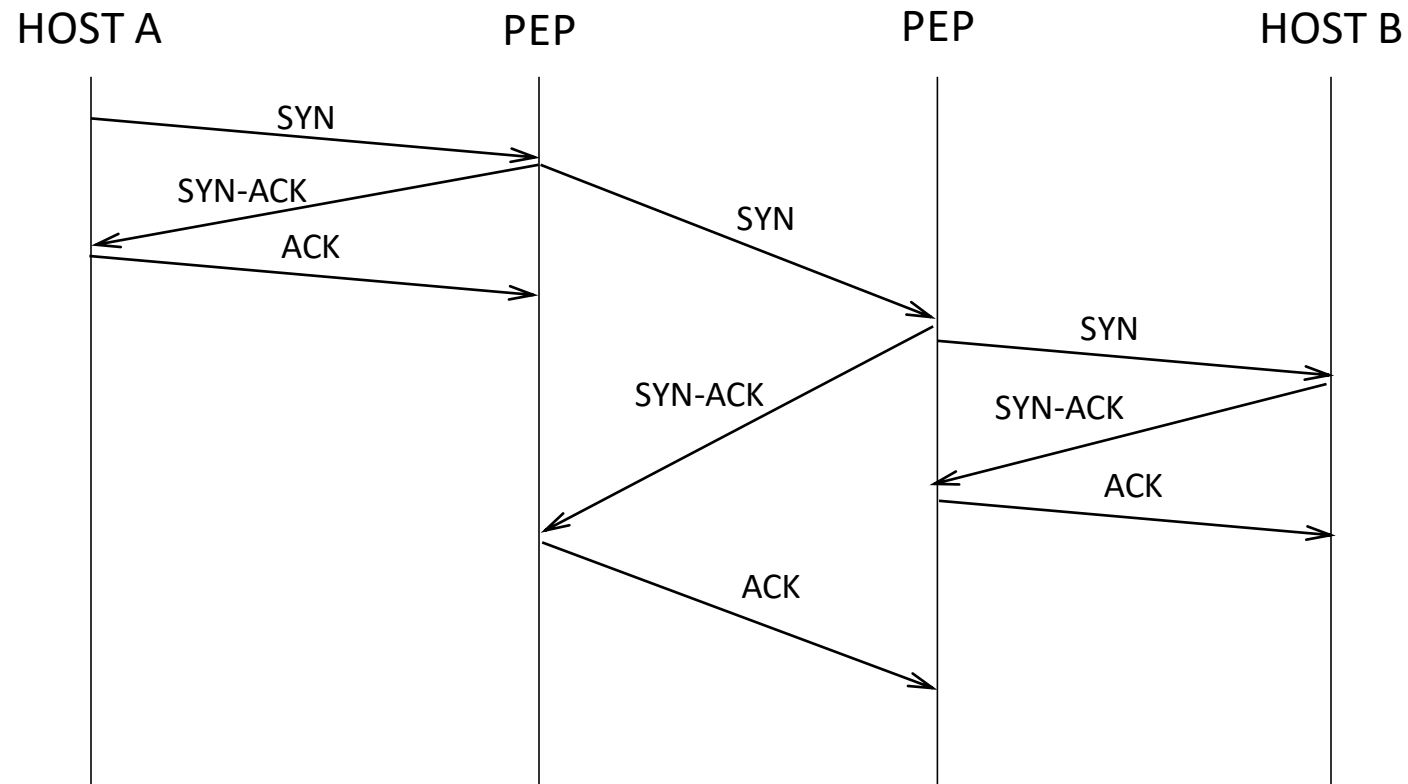
# Some experiments of MPTCP on satellite access



# Experiments of MPTCP on GEO satellite access

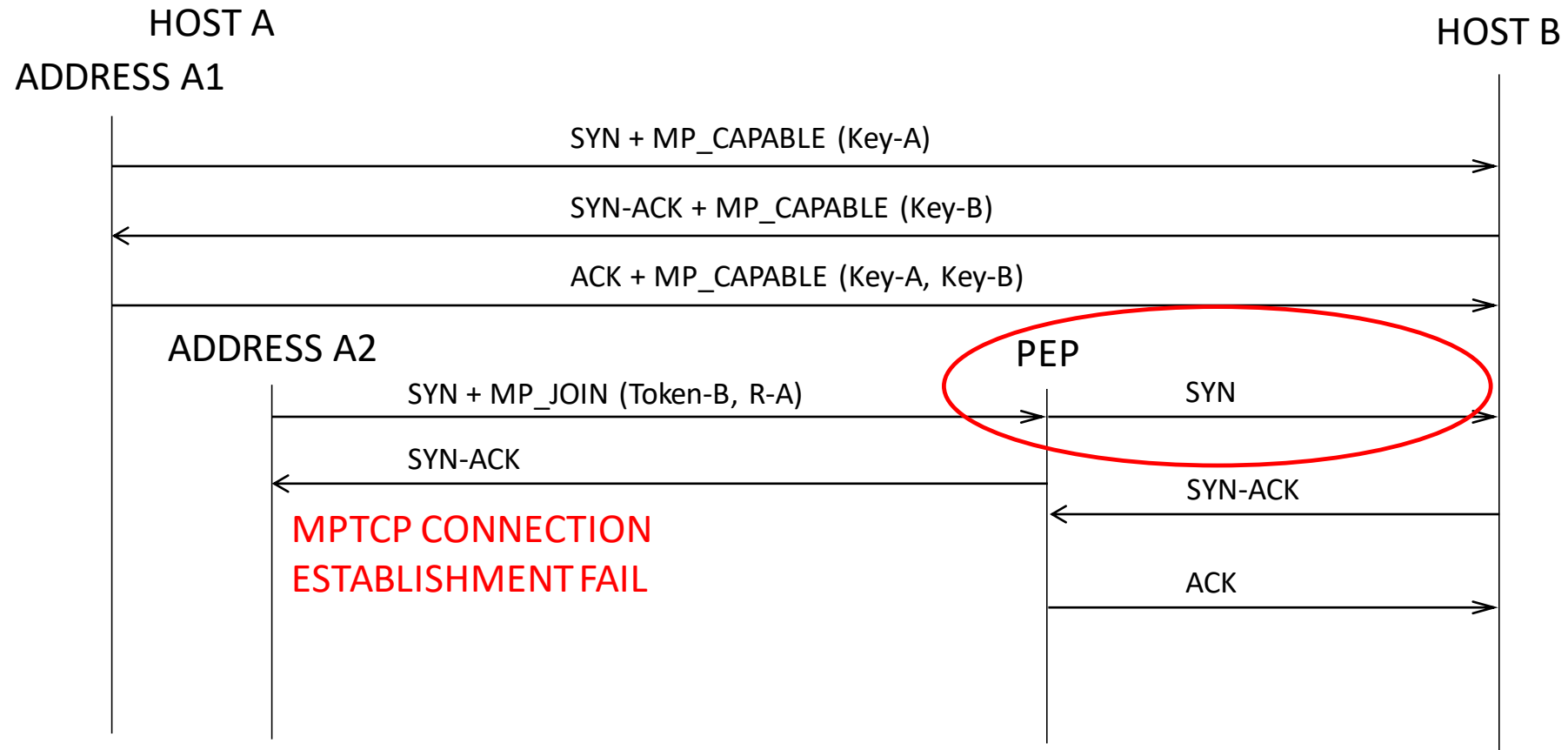
# Experiments of MPTCP on GEO satellite access

- SATCOM systems typically deploy TCP Proxy (PEP) [RFC3135]



# Experiments of MPTCP on GEO satellite access

- MPTCP connection establishment impacted by TCP Proxy

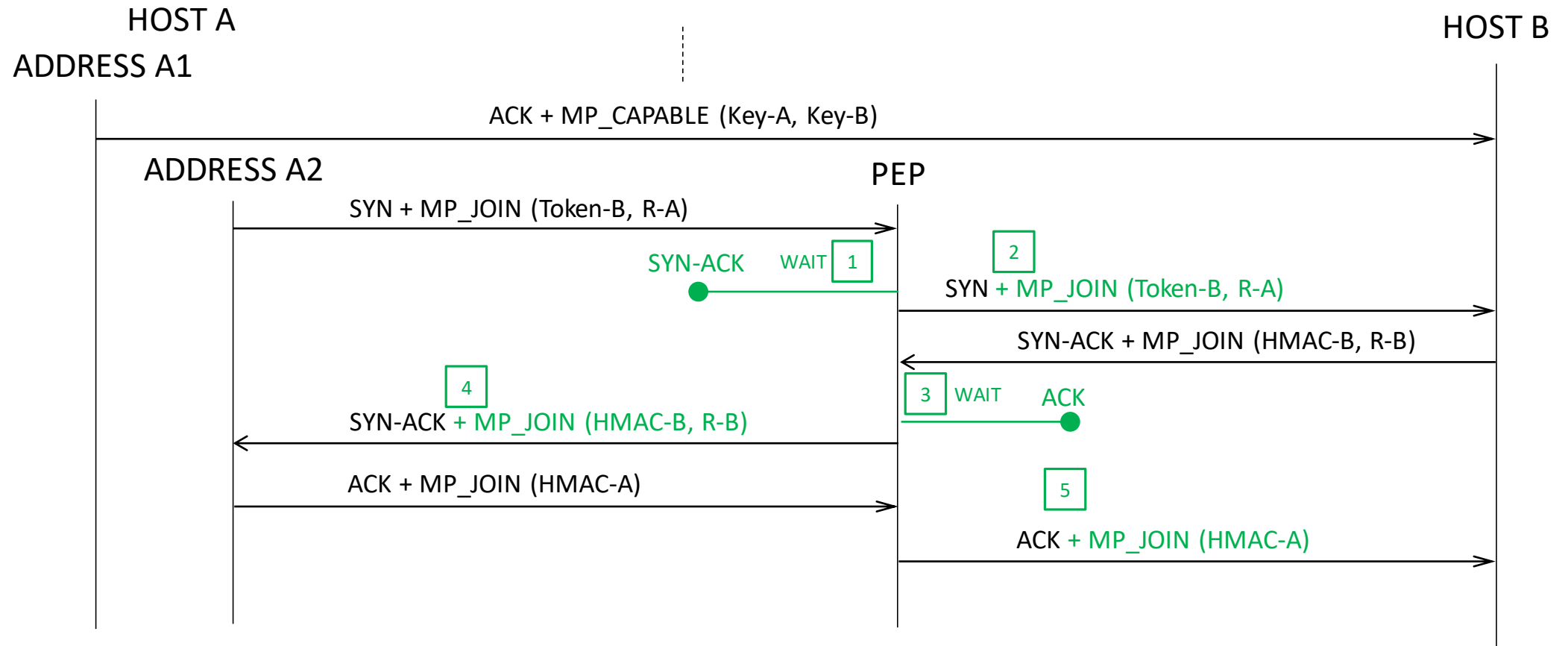


HMAC-A = HMAC(Key=(Key-A+Key-B), Msg=(R-A+R-B))

HMAC-B = HMAC(Key=(Key-B+Key-A), Msg=(R-B+R-A))

# Experiments of MPTCP on GEO satellite access

- Adaptation of the TCP Proxy (PEPSal) to enable MPTCP

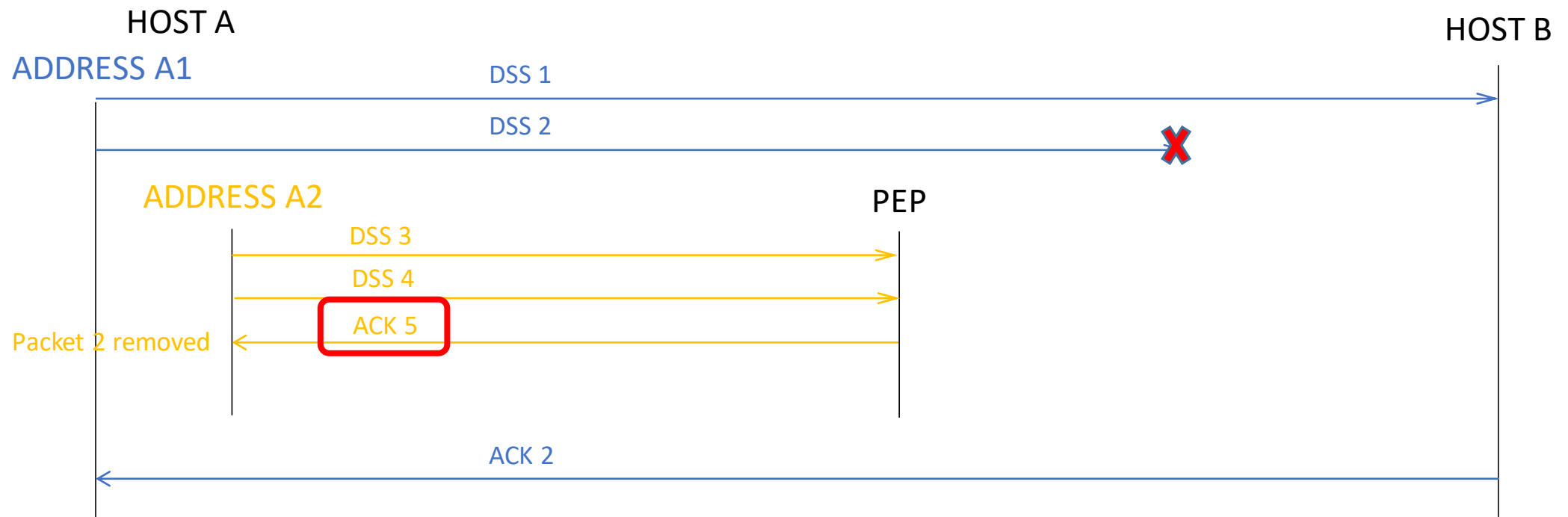


HMAC-A = HMAC(Key=(Key-A+Key-B), Msg=(R-A+R-B))

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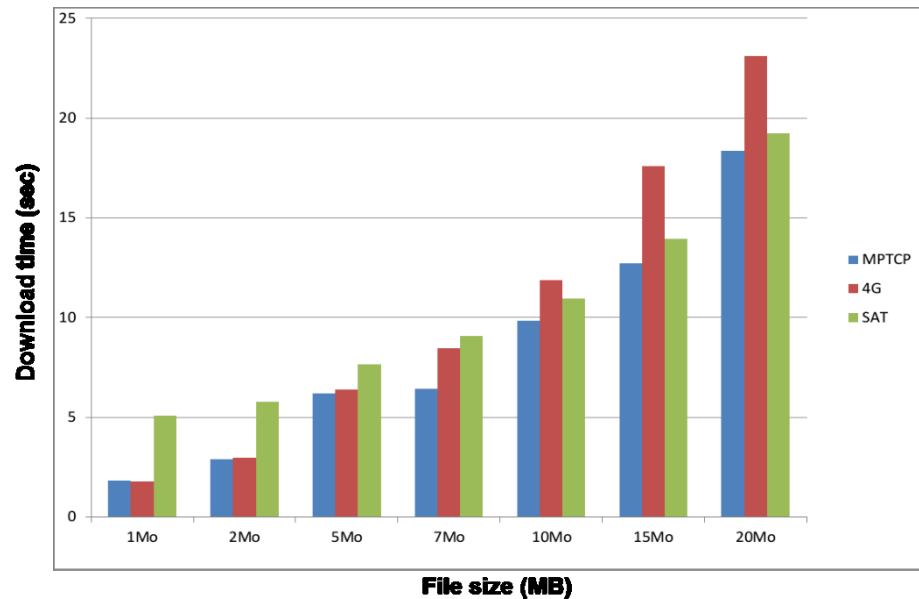
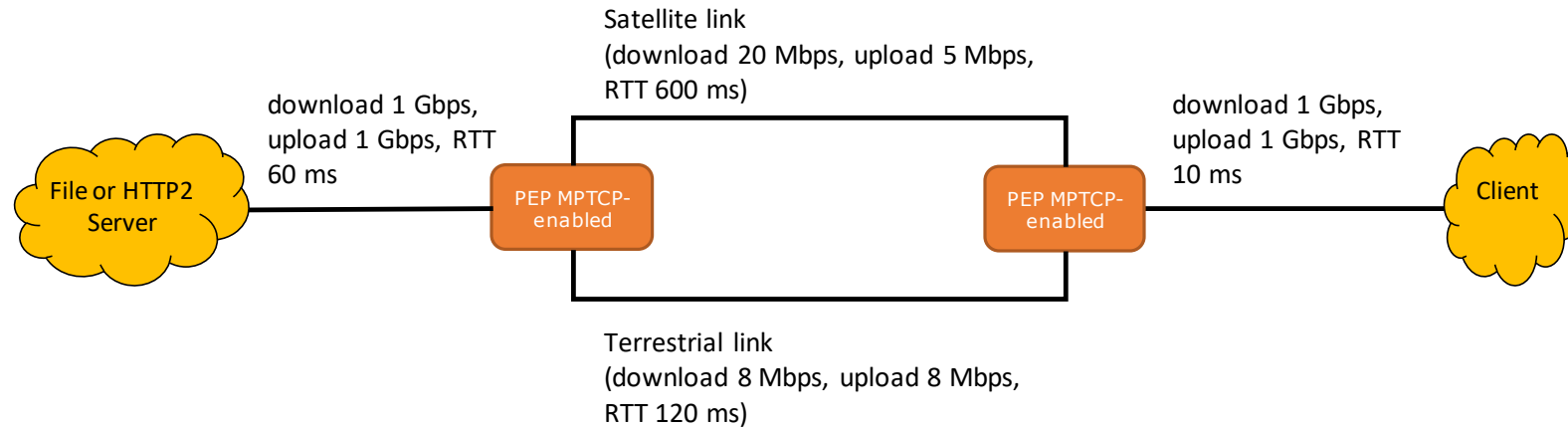
# Experiments of MPTCP on GEO satellite access

- TCP Proxy client : acknowledging at MPTCP level



- TCP proxy can be adapted to forward MPTCP “join” messages
- Further modifications required (issue on acknowledge level, receive buffer location, etc.)

# Experiments of MPTCP on GEO satellite access

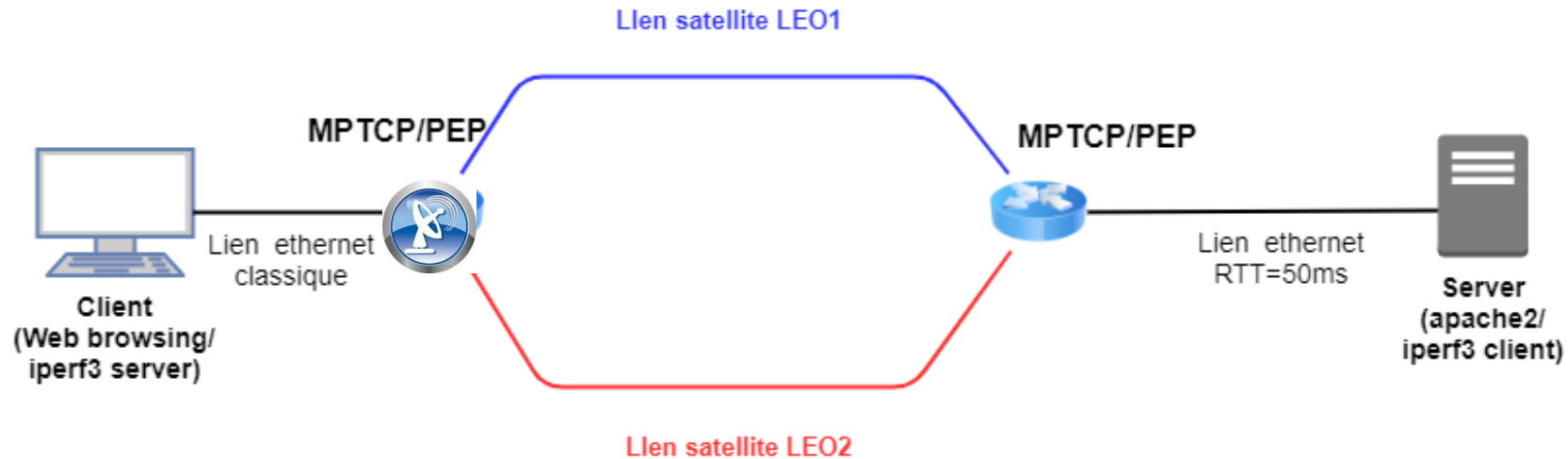


- Tests with a PEP MPTCP-enabled
- Despite the large asymmetry, MPTCP takes the best out of the cellular and SATCOM accesses (except for small files)

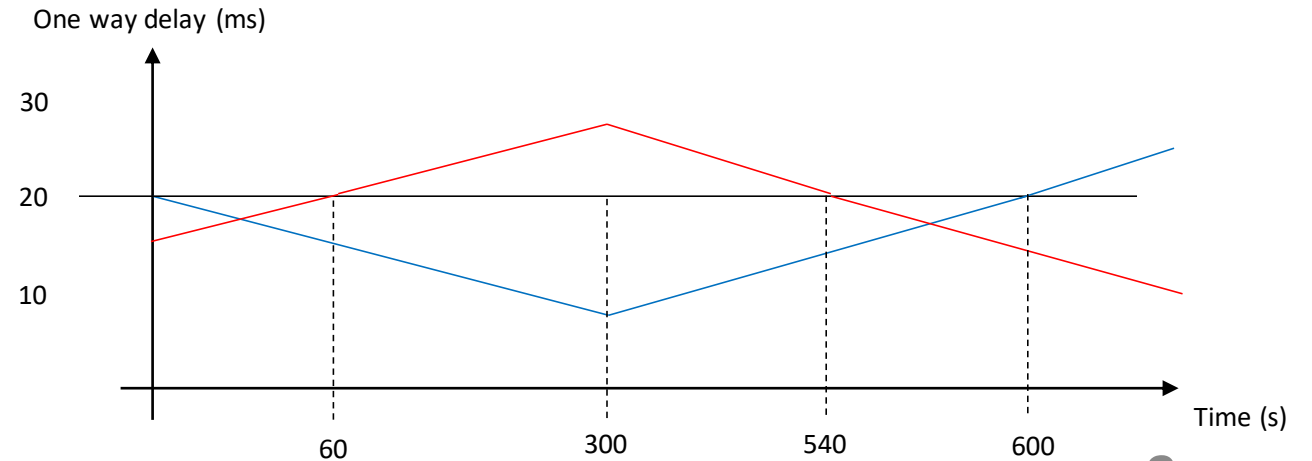
# Experiments of MPTCP on LEO satellite access



# Experiments of MPTCP on LEO satellite access

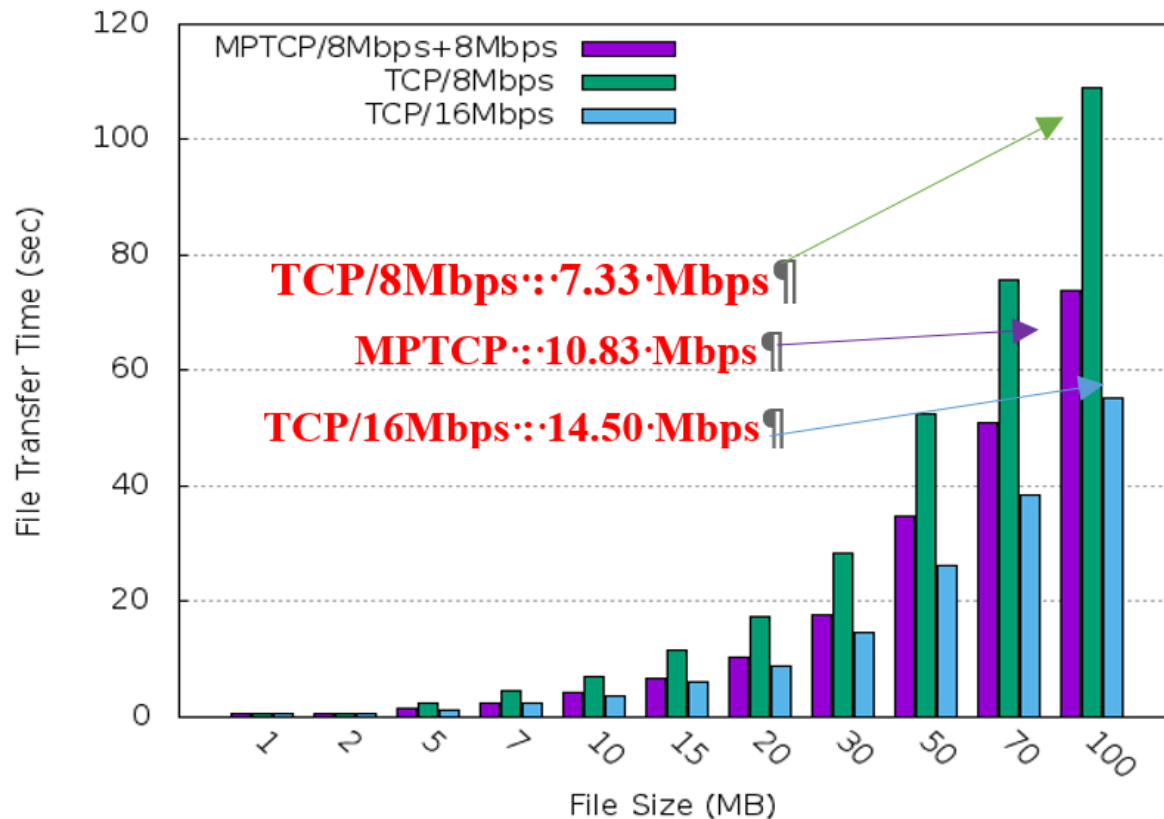


- Variable delay on the low-earth orbit satellites
- 8 Mbps or 16 Mbps on each satellite link
- Tests :
  - MPTCP (8 Mbps + 8 Mbps)
  - Single path TCP (8 Mbps)
  - Single path TCP (16 Mbps)

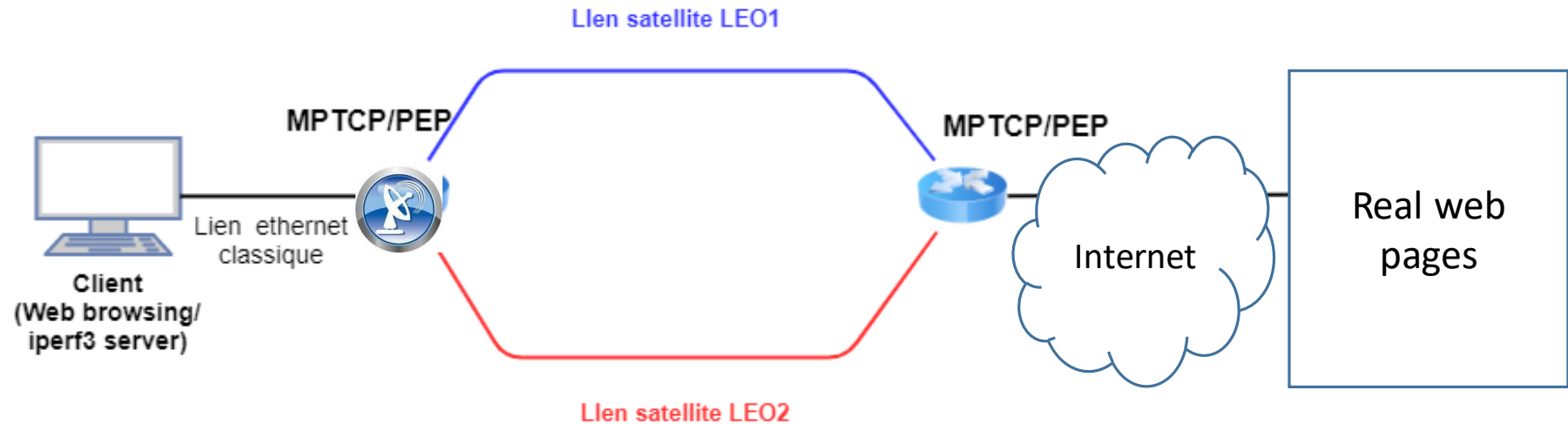


# Experiments of MPTCP on LEO satellite access

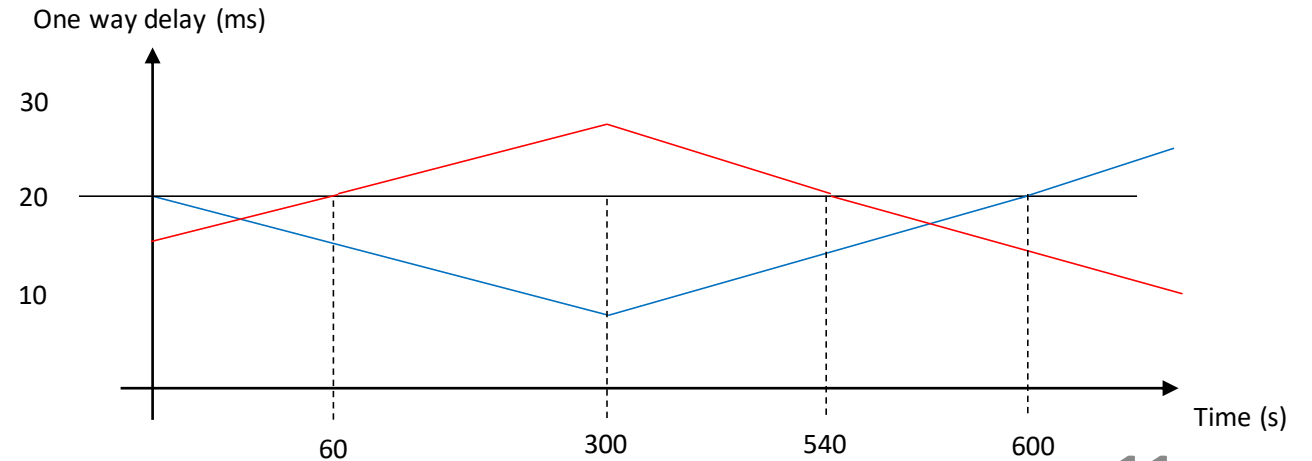
➤ MPTCP (8 Mbps + 8 Mbps) does not perform as good as TCP (16 Mbps)



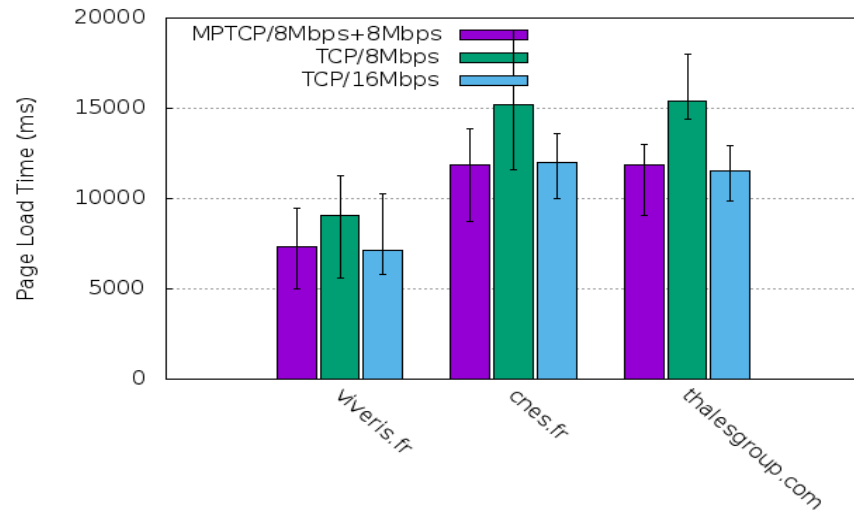
# Experiments of MPTCP on LEO satellite access



- Variable delay on the low-earth orbit satellites
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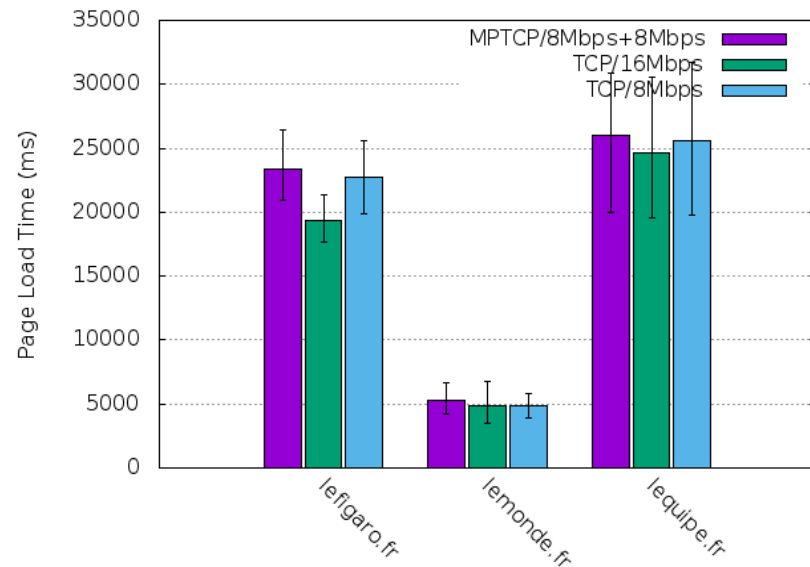
# Experiments of MPTCP on LEO satellite access



SITE	Size in MB	PROTO	Other domains
Viveris.fr	1.12	HTTP/2.0	3 en HTTP/2.0
Cnes.fr	8.42	HTTP/1.1	4 en HTTP/2.0
Thalesgroup.com	12.38	HTTP/1.1	8 en HTTP/2.0

- For pages with a low amount of redirections to other domains or in HTTP1.1
  - MPTCP (8 Mbps + 8 Mbps) performs as good as TCP (16 Mbps)

# Experiments of MPTCP on LEO satellite access



SITE	Size in MB	PROTO	Other domains
Lefigaro.fr	21.25	HTTP/2.0	32 en HTTP/2.0 et 1.1
Lemond.fr	1.51	HTTP/2.0	5 en HTTP/2.0
Lequipe.fr	3.48	HTTP/2.0	36 en HTTP/2.0 et 1.1

- For pages with lots of redirections or in HTTP2.0
  - MPTCP (8 Mbps +8 Mbps) performs as TCP (8 Mbps)
    - On-going investigations ...
  - TCP (16 Mbps) shows a lower PLT

# Conclusion of the experiments

- TCP Proxys block MPTCP traffic
- Adaptation of TCP Proxy is not simple
- Important web pages diversity makes it hard to compare MPTCP with TCP
  
- For those interested in SATCOM
  - Workshop on QUIC for high BDP network
  - Details : <https://trac.ietf.org/trac/ietf/meeting/wiki/106sidemeetings>
  - Time : 3pm30 – 4pm30 on Wednesday
  - Where : Bras Basah

# Open Source tools

- OpenBACH : open-source test orchestrator

<http://www.openbach.org/content/home.php>



- OpenSAND : open-source SATCOM emulator

<http://opensand.org/content/home.php>



- PEPSal : open-source PEP

- CESARS : CNES open plateforme for real satellite experiments

<https://entreprises.cnes.fr/fr/accueil-cesars>