Computer Science 7
Computer Networks and
Communication Systems

FRIEDRICH-ALEXANDER
UNIVERSITÄT
ERLANGEN-NÜRNBERG
FACULTY OF ENGINEERING

Satellite Internet Performance Measurements

IETF104 maprg, Prague

Jörg Deutschmann, Kai-Steffen Hielscher, Reinhard German
Chair of Computer Science 7 (Computer Networks and Communication Systems)
Friedrich-Alexander University of Erlangen-Nürnberg

March 28, 2019

Supported by:

Federal Ministry
for Economic Affairs
and Energy

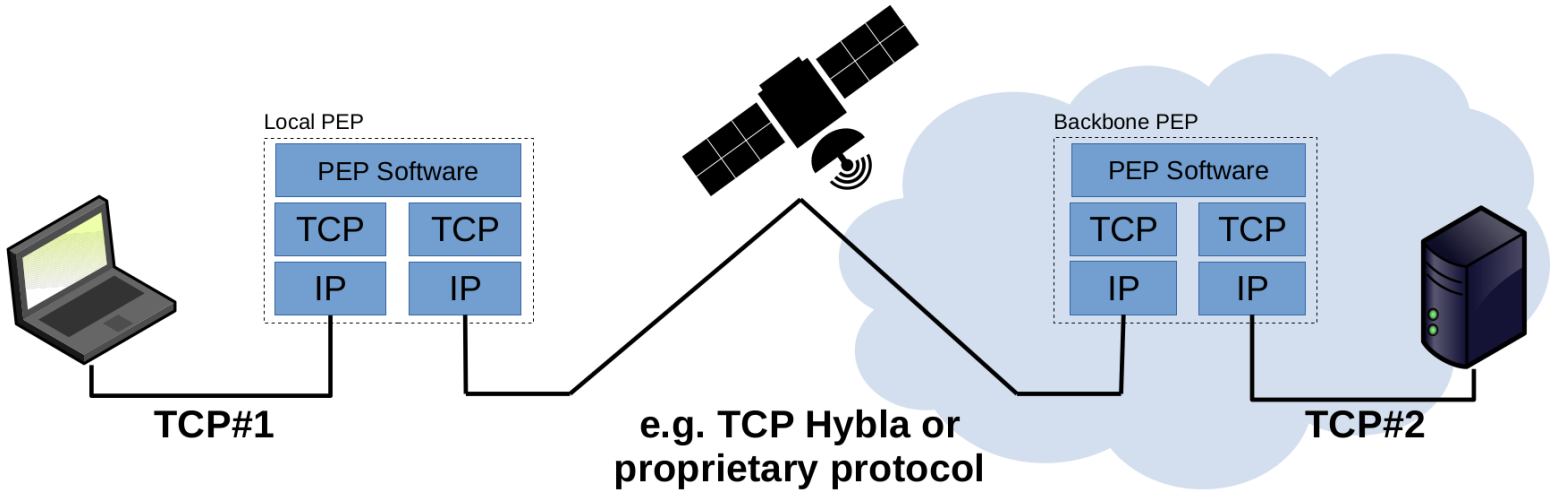
on the basis of a decision
by the German Bundestag

DLR

satinternet.com

Introduction

- Geostationary satellites → RTT > 600ms
- Performance Enhancement Proxies (→ Split TCP) not applicable for
  - Flows within VPN tunnels
  - QUIC (Nicolas Kuhn @ IETF103)



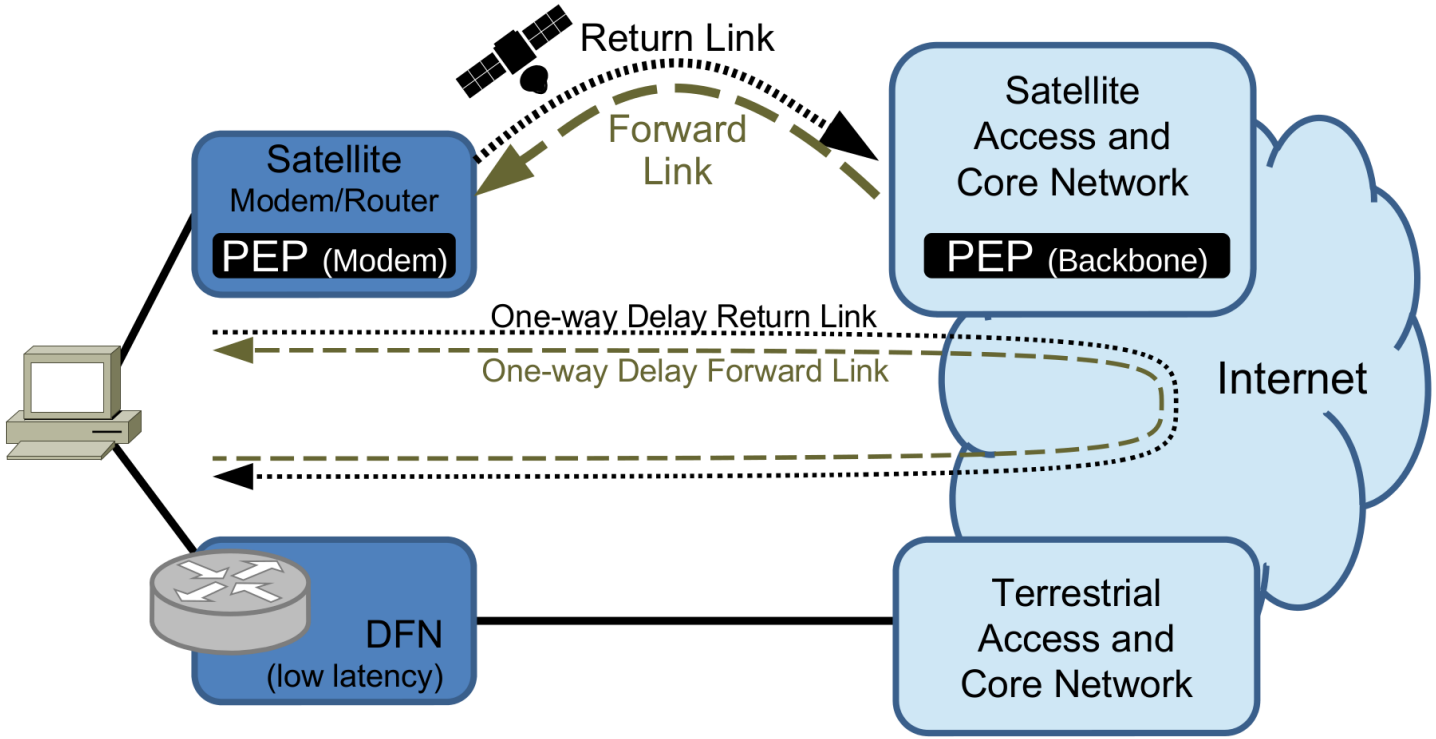
Introduction

- Three operators across Europe
  - No IPv6 support

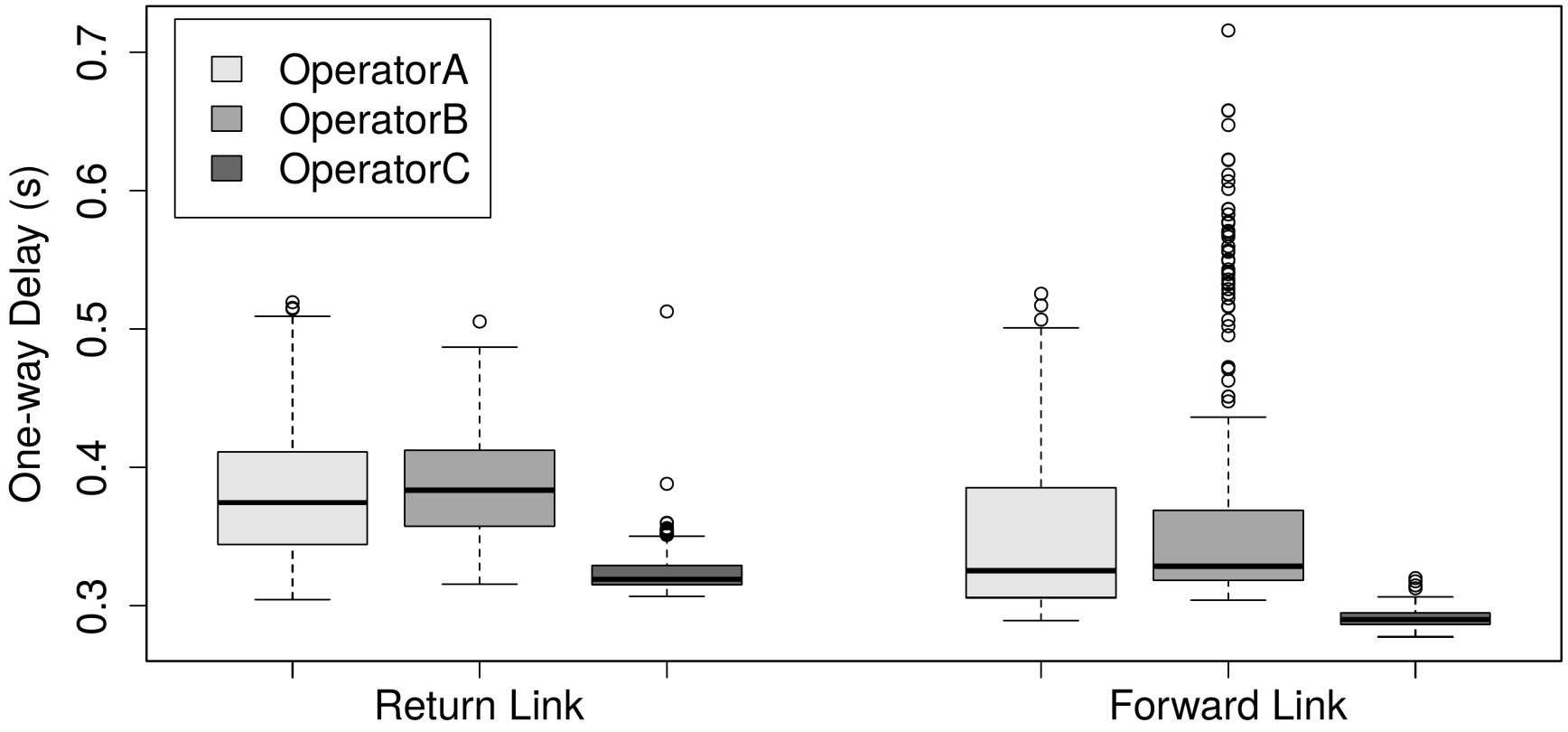
- Black-box testing with active measurements
  - One-way UDP delays
  - (Bulk data transfers)
  - Page load times
    - HTTP/TCP
    - HTTP/TCP in OpenVPN UDP tunnels
    - QUIC

One-way UDP delays

- 1-byte UDP packets sent in 1 second intervals
- Same physical host for sending and receiving packets



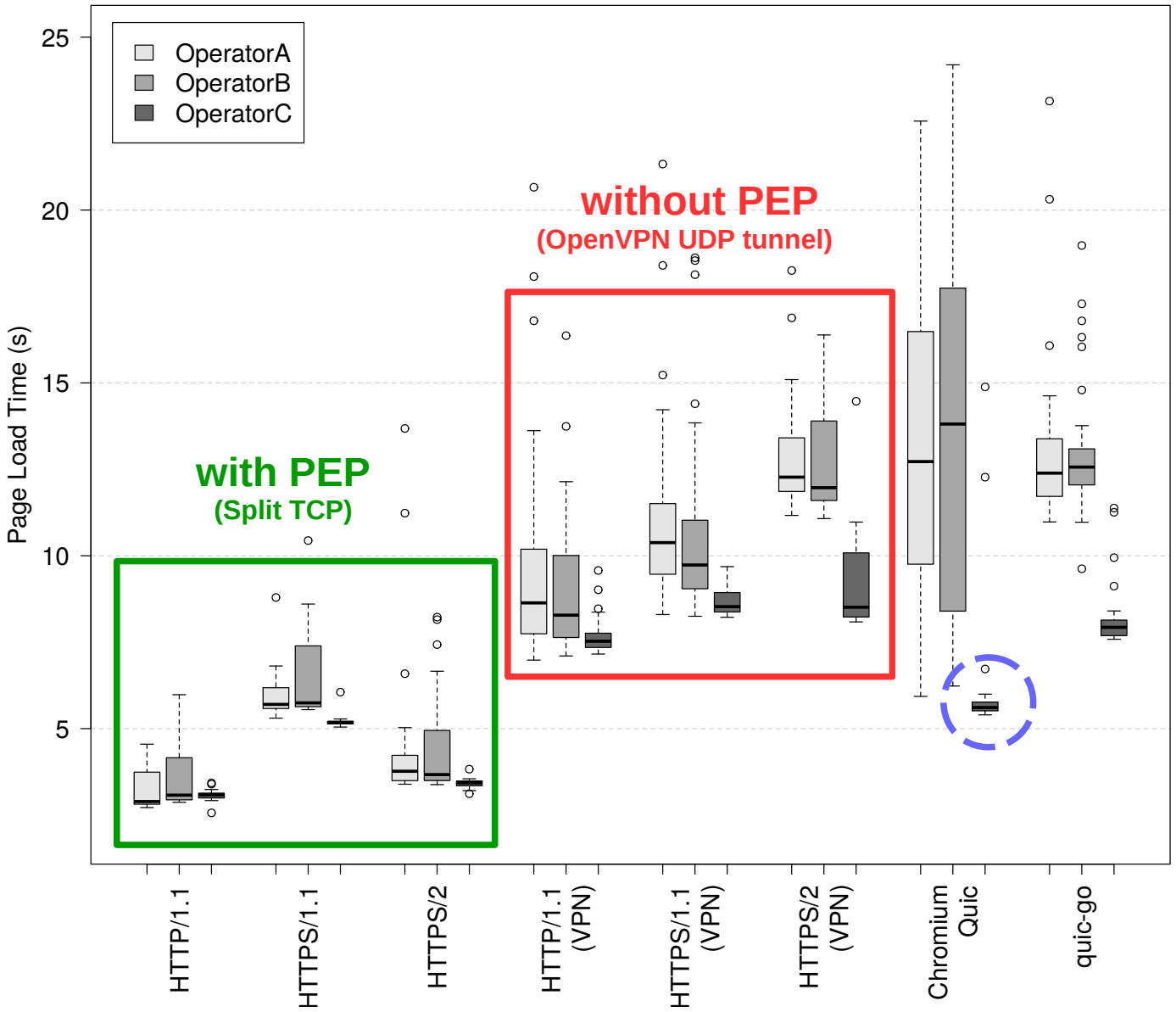
One-way UDP delays



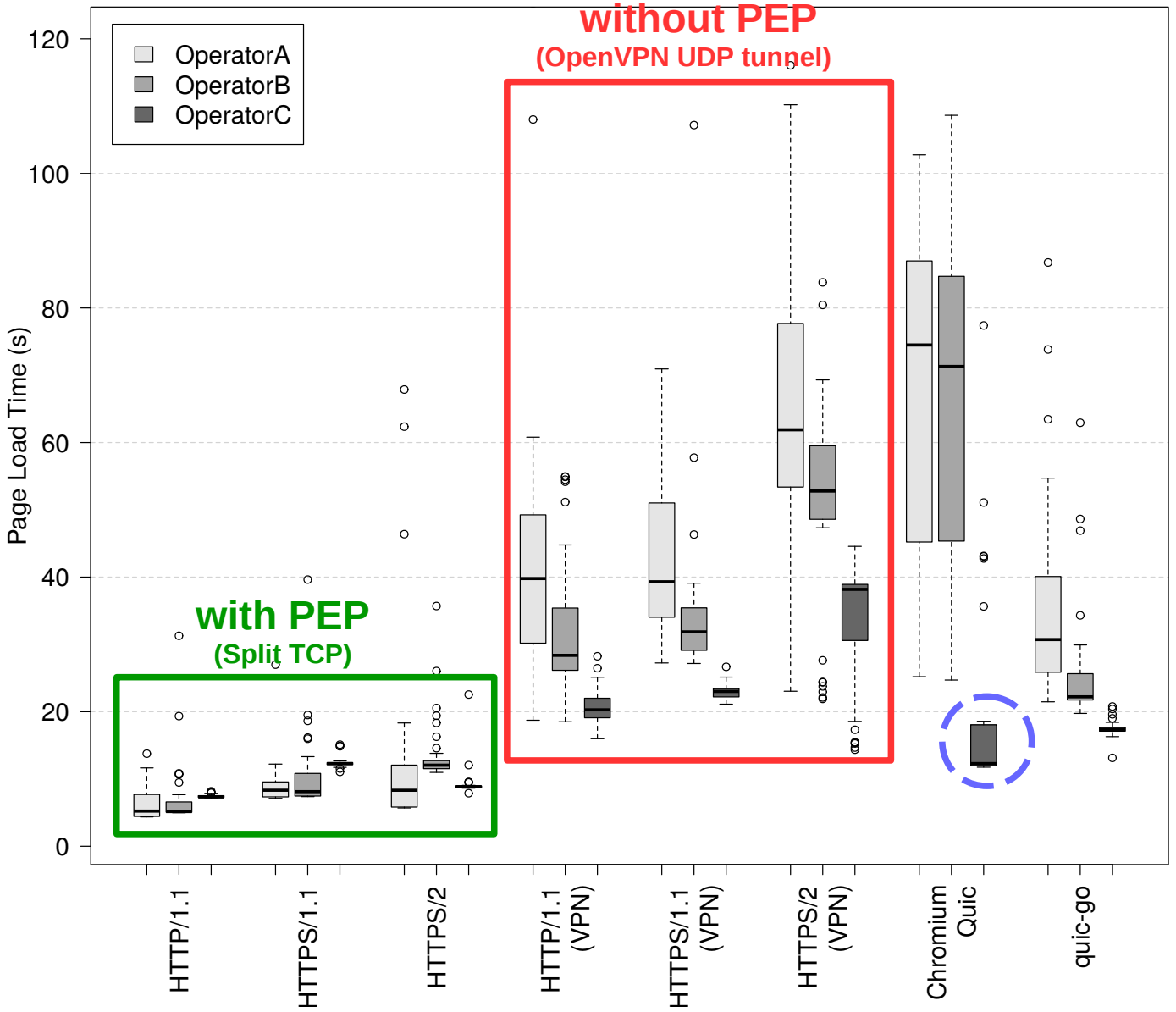
Page load times

- Protocols
  - HTTP/1.1, HTTPS/1.1 and HTTPS/2 with TLS1.2
  - Google QUIC version 43 (Q043)
    - Chromium QUIC, git commit `19eaae6`, Sept. 2018
    - quic-go, git commit `ffdfa1f`, August 2018
- OpenVPN (2.4.4) UDP tunnels to disable PEPs
- First-time access to static websites
  - Small website: 34 objects, 4 kB to 400 kB, total size 1.4 MB
  - Large website: 34 objects, 4 kB to 4 MB, total size 10 MB
- HTTP server Apache 2.4.29 (with `mod_http2`), no Server Push, no Stream Prioritization, no Domain Sharding
- Google Chrome browser 69.0.3497.100
- Selenium Chromedriver 2.41.578700

PLT – small website

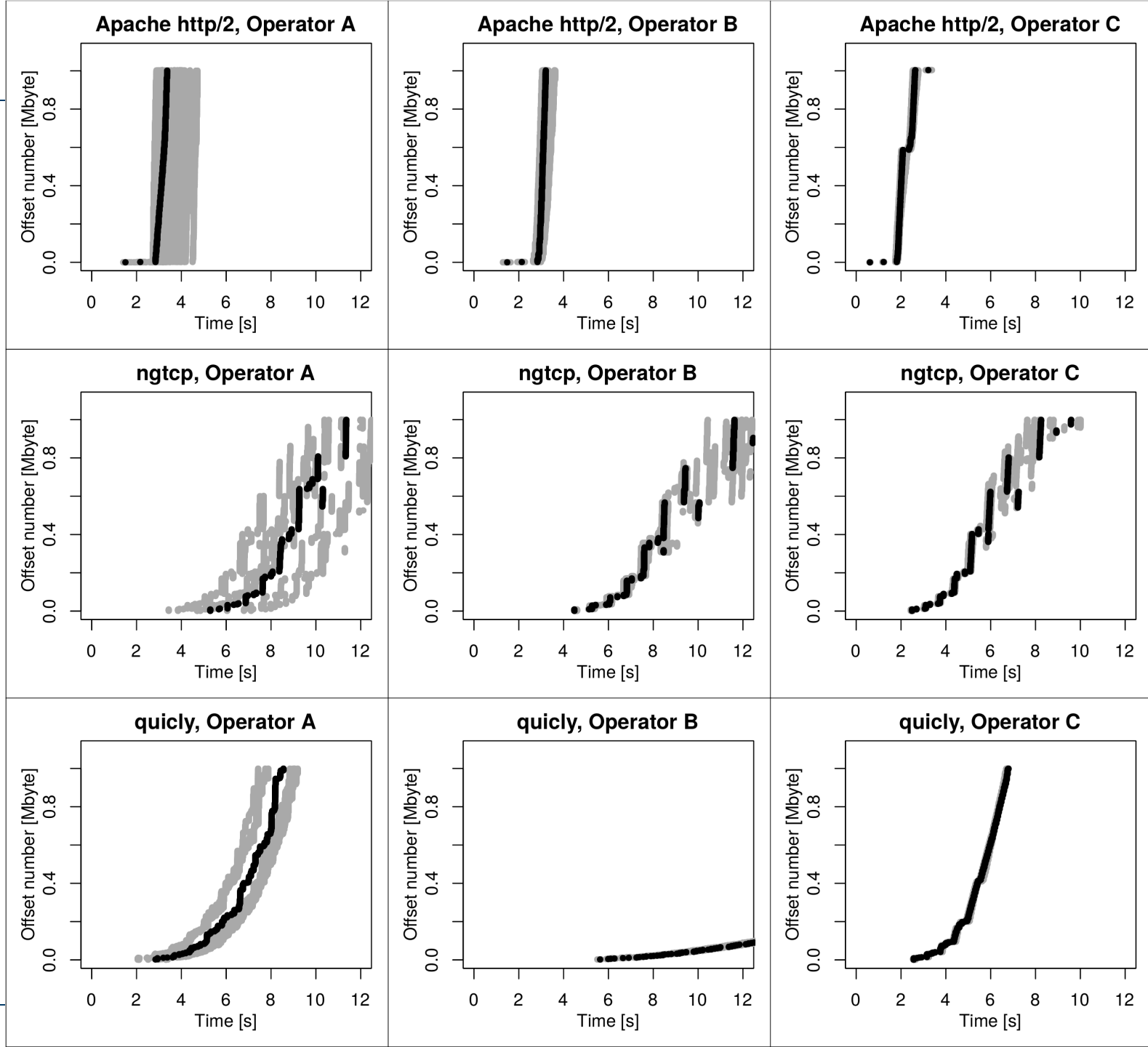


PLT – large website



Work in progress

- 1 Mbyte object, single stream



Conclusion

- HTTP(S) TCP traffic benefits from PEPs
- UDP delays and performance varies among operators
- QUIC can perform better than HTTP+TCP+OpenVPN UDP, but seems to depend on UDP delay variation
- Performance only a matter of BDP?
  - 100 Mbit/s 60ms RTT vs. 10 Mbit/s 600ms RTT
  - `netem delay 300ms 20ms distribution normal`

Future work

- Detailed analysis of performance differences
- Other tunnel protocols, parameters, congestion controls, ...

Computer Science 7
Computer Networks and
Communication Systems

FRIEDRICH-ALEXANDER
UNIVERSITÄT
ERLANGEN-NÜRNBERG
FACULTY OF ENGINEERING

Thank you for your attention! Questions?

Further information: "Satellite Internet Performance Measurements"

International Conference on Networked Systems 2019 (NetSys 2019)

joerg.deutschmann@fau.de