

QUIC Over In-sequence Paths with Different Characteristics draft-kuhn-quic-4-sat-00

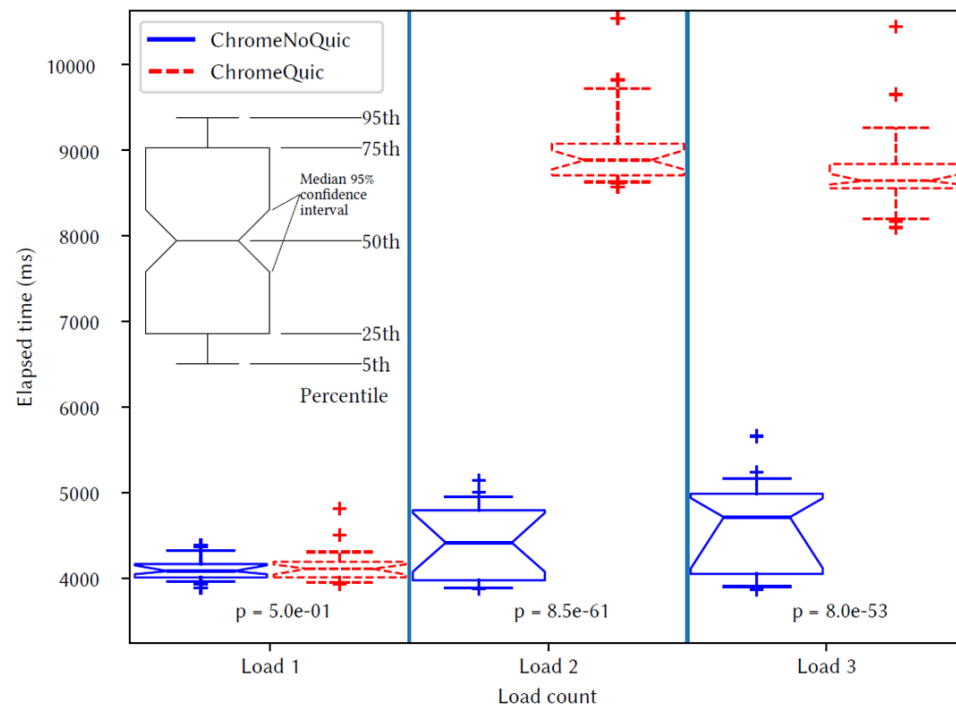
Nicolas Kuhn, Emile Stephan, John Border, Gorrry Fairhurst

Why a « QUIC for SATCOM » draft ?

- Performance issues of QUIC over GEO SATCOM link

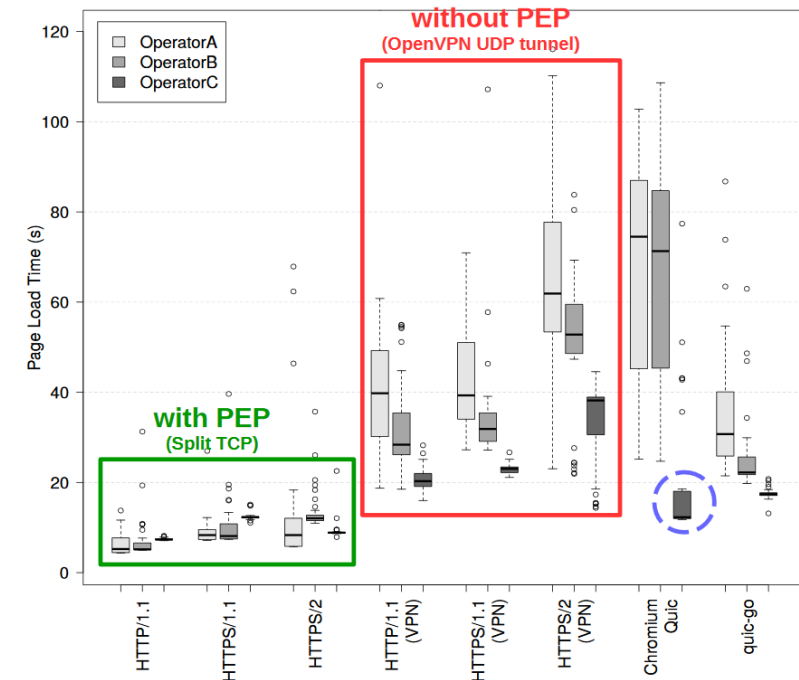
Google QUIC performance over a public SATCOM access

Ludovic Thomas, Emmanuel Dubois Nicolas Kuhn and Emmanuel Lochin
International Journal of Satellite Communications and Networking



Satellite Internet Performance Measurements

Jörg Deutschmann, Kai-Steffen Hielscher, Reinhard German
International Conference on Networked Systems 2019 (NetSys 2019)



Operating over a path with a large BDP

GEO-satellite based systems characteristics:

- Large propagation delay
- (sometimes) a high loss-rate (mobile users or users behind a Wi-Fi link)
 - **Most SATCOM systems are Quasi-Error Free (rain fades losses happen in very few specific regions)**
- Radio resource management (techniques similar to cellular mobile or DOCSIS cable networks, but differing to accommodate the satellite propagation delay)
- (sometimes) a high asymmetry (capacity, one-way delay)

More information in RFC2488 “Enhancing TCP Over Satellite Channels using Standard Mechanisms”

In-sequence paths with different charact

- Satellite systems: point-to-point links or TV broadcast
 - Use as an access technology for remote locations
 - Backup and rapid deployment of new services
 - Transit networks
 - Backhaul of various types of IP networks
 - Satellite: IP network segment one part of the end-to-end path
- User traffic can experience a path that includes:
 - Satellites capacity (long delay link)
 - With a wide variety of other network technologies (Ethernet, cable modems, WiFi, cellular, radio links, etc)

Improving QUIC 4 SATCOM

- Getting up to speed
 - E.g. tuning the IW
- Reliability
 - E.g. FEC ?
- Maximum window
 - E.g. adapt to the important number of in-flights packets
- ACK ratio
 - E.g. tell the remote endpoint to send compound acknowledgments less frequently
- *Others ?*

Improving QUIC 4 SATCOM – Getting up to speed

- Client and servers use GO-QUIC
 - <https://github.com/lucas-clemente/quic-go>
 - Modified to support the download of objects in sequence or in parallel
- QUIC parameters for SATCOM

Layer	Parameter	Default	H-BDP1	Unit
Connection	DefaultMaxCongestionWindowPackets	1000	2500	packets
	InitialCongestionWindow	32	120	tcpMSS
	MaxTrackedSkippedPackets	10	50	packets
	MaxTrackedSentPackets	2 500	10 000	packets
	MinPacingDelay	100	10	microsec
Stream	InitialMaxStreamData	512	6000	KB
	DefaultMaxReceiveStreamFlowControlWindow	6	12	MB

Improving QUIC 4 SATCOM – Getting up to speed

- Object size
 - short (40 KB), medium (290 KB), long (4 MB), large (66 MB)
- Cases

Case	Objet	How much objects	Mode
1	Short	10	Seq
2	Short	10	Par
3	Med	10	Seq
4	Med	10	Par
5	Long	10	Seq
6	Long	10	Par
7	Large	2	Seq
8	Large	2	Par
9	All	31	Seq +Par

Improving QUIC 4 SATCOM – Getting up to speed

- RTT : 600ms

Object	Mode	Default	H-BDP1	(H-BDP1 - Default)/Default
Short: 10x40KB	Seq	7,65	7,63	0%
	Par	3,65	2,55	-30%
Med 10x 292KB	Seq	11,13	10,18	-9%
	Par	5,20	4,10	-21%
Long 10x4149KB	Seq	31,57	20,77	-34%
	Par	21,36	10,80	-49%
Large 2x66.390KB	Seq	61,74	27,88	-55%
	Par	60,17	26,62	-56%
All 31 Obj: 111.211KB	All	51,03	24,31	-52%

- RTT : 100ms

Obj	Mode	Default	H-BDP1	(H-BDP1 - Default)/Default
Short: 10x40KB	Seq	1,44	1,40	-3%
	Par	,64	,54	-16%
Med 10x 292KB	Seq	2,58	2,78	8%
	Par	1,10	,96	-13%
Long 10x4149KB	Seq	9,12	8,45	-7%
	Par	7,65	7,50	-2%
Large 2x66.390KB	Seq	23,42	23,25	-1%
	Par	23,19	23,06	-1%
All 31 Obj: 111.211KB	All	19,55	19,34	-1%

- Increasing IW helps in reducing object download time
- No major issue / gain for lower RTT

Improving QUIC 4 SATCOM – Getting up to speed & Maximum Window

- Second optimized version of QUIC without increased IW

Layer	Parameter	Default	H-BDP1	H-BDP2	Unit
Connection	DefaultMaxCongestionWindowPackets	1000	2500	2500	packets
	InitialCongestionWindow	32	120	32	tcpMSS
	MaxTrackedSkippedPackets	10	50	50	packets
	MaxTrackedSentPackets	2 500	10 000	10 000	packets
	MinPacingDelay	100	10	10	microsec
Stream	InitialMaxStreamData	512	6000	6000	KB
	DefaultMaxReceiveStreamFlowControlWindow	6	12	12	MB

Improving QUIC 4 SATCOM – Getting up to speed & Maximum Window

- RTT : 600ms

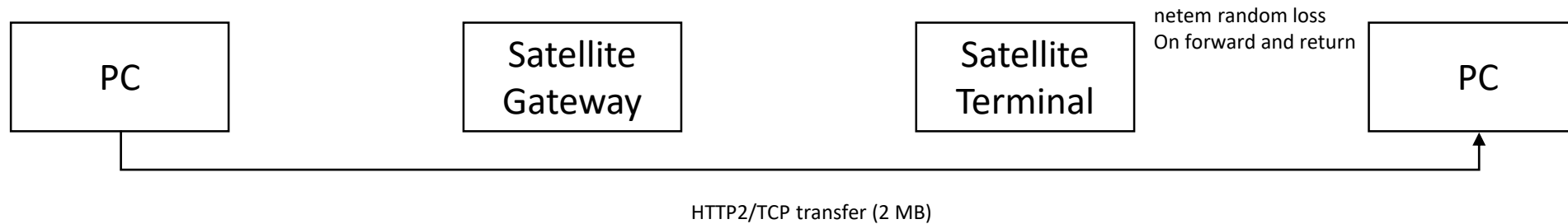
Object	Mode	Default	H-BDP2	(H-BDP2 - Default)/Default
Short: 10x40KB	Seq	7,65	7,45	-3%
	Par	3,65	2,54	-30%
Med 10x 292KB	Seq	11,13	10,91	-2%
	Par	5,20	4,08	-21%
Long 10x4149KB	Seq	31,57	20,77	-34%
	Par	21,36	10,78	-50%
Large 2x66.390KB	Seq	61,74	29,35	-52%
	Par	60,17	26,79	-55%
All 31 Obj: 111.211KB	All	51,03	26,16	-49%

- RTT : 100ms

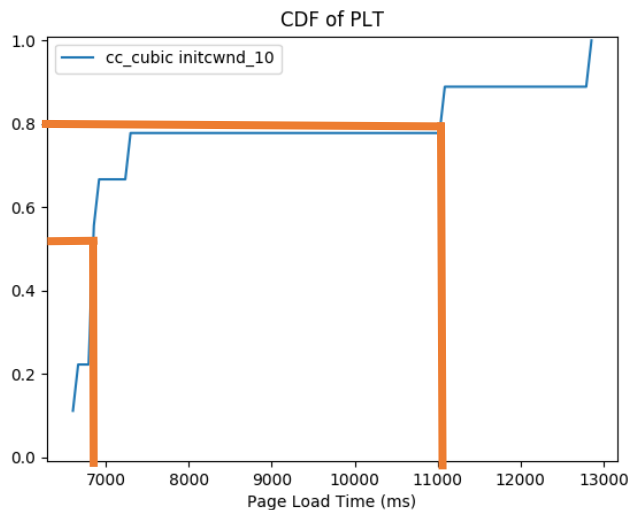
Obj	Mode	Default	H-BDP2	(H-BDP2 - Default)/Default
Short: 10x40KB	Seq	1,44	1,39	-4%
	Par	,64	,54	-16%
Med 10x 292KB	Seq	2,58	4,00	55%
	Par	1,10	,95	-13%
Long 10x4149KB	Seq	9,12	8,46	-7%
	Par	7,65	7,49	-2%
Large 2x66.390KB	Seq	23,42	23,43	0%
	Par	23,19	23,23	0%
All 31 Obj: 111.211KB	All	19,55	19,52	0%

- Increasing IW is not the only solution helps in reducing object download time
- Other parameters matter!

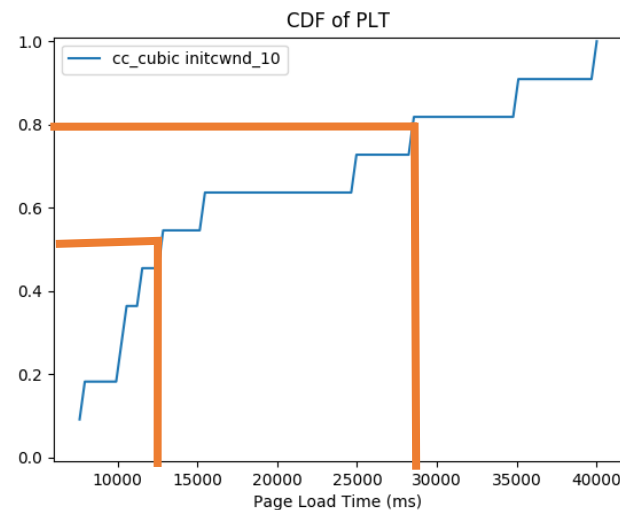
Improving QUIC 4 SATCOM – Reliability



PLT without congestion without losses



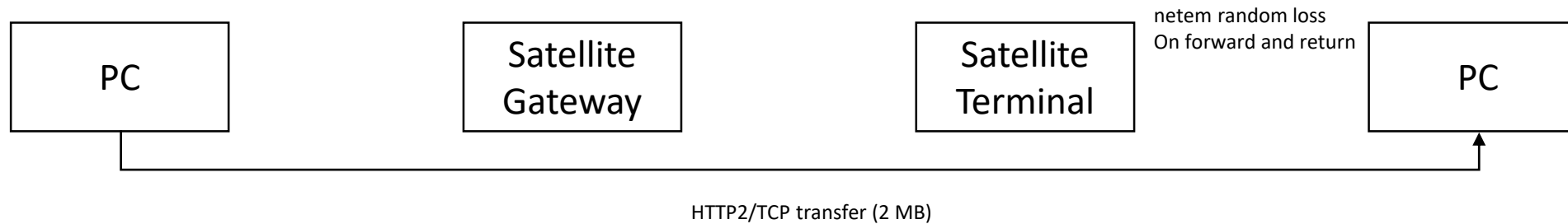
PLT without congestion with losses



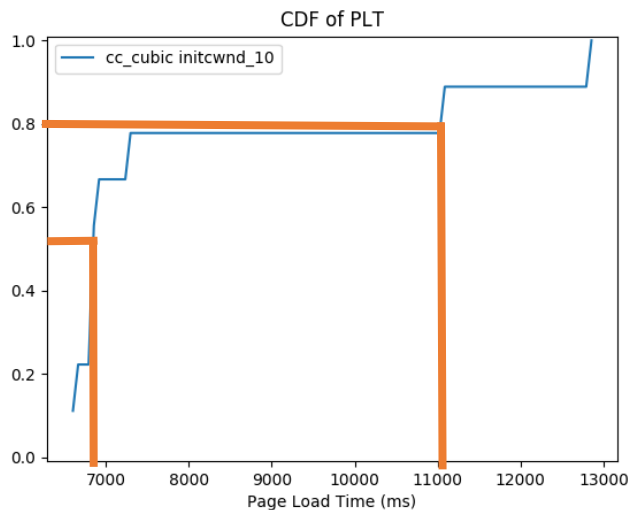
1% losses induces

- 5 seconds increase (median)
- 18 seconds increase (80%)

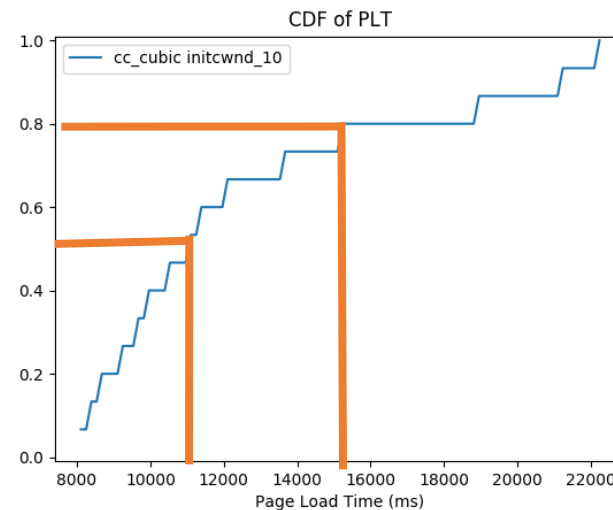
Improving QUIC 4 SATCOM – Reliability



PLT without congestion without losses



PLT with congestion without losses



Congestion induces

- 4 seconds increase (median)
- 5 seconds increase (80%)

Discussion

- Early work on QUIC parametrization for SATCOM
- Need further investigations
- QUIC parametrization activity can be relevant for other use-cases