MP-DCCP

for enabling transfer of UDP/IP traffic over multiple data paths in multi-connectivity networks

draft-amend-tsvwg-multipath-dccp-02
draft-amend-tsvwg-multipath-framework-mpdccp-01
draft-amend-tsvwg-dccp-udp-header-conversion-01

IETF 105 Meeting, TSVWG, Montreal, July 2019

LIFE IS FOR SHARING.

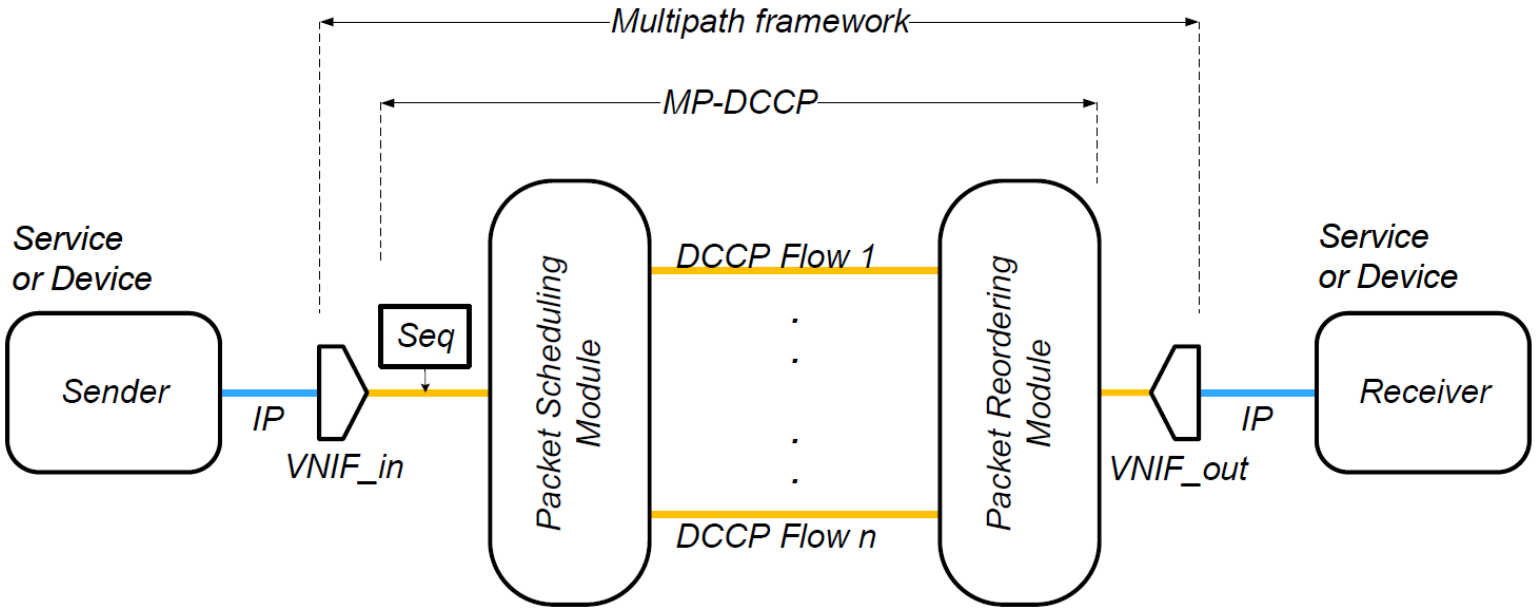
MOTIVATION SUMMARIZED

- 3GPP ATSSS and Hybrid Access require multipath network protocols, currently both relying on proprietary inflexible solutions or standardized MP-TCP only
- The UDP share increases because of QUIC

→ A multipath solution for UDP, complementing the standardized MP-TCP, is required and adressed in this proposal

Detailed motivation can be found in IETF104 presentation: https://datatracker.ietf.org/meeting/104/materials/slides-104-tsvwg-sessb-43-markus-amend-multipath-dccp-00

SOLUTION: MP-DCCP FOR UDP MULTIPATH TRANSMISSION



https://tools.ietf.org/html/draft-amend-tsvwg-multipath-dccp-02

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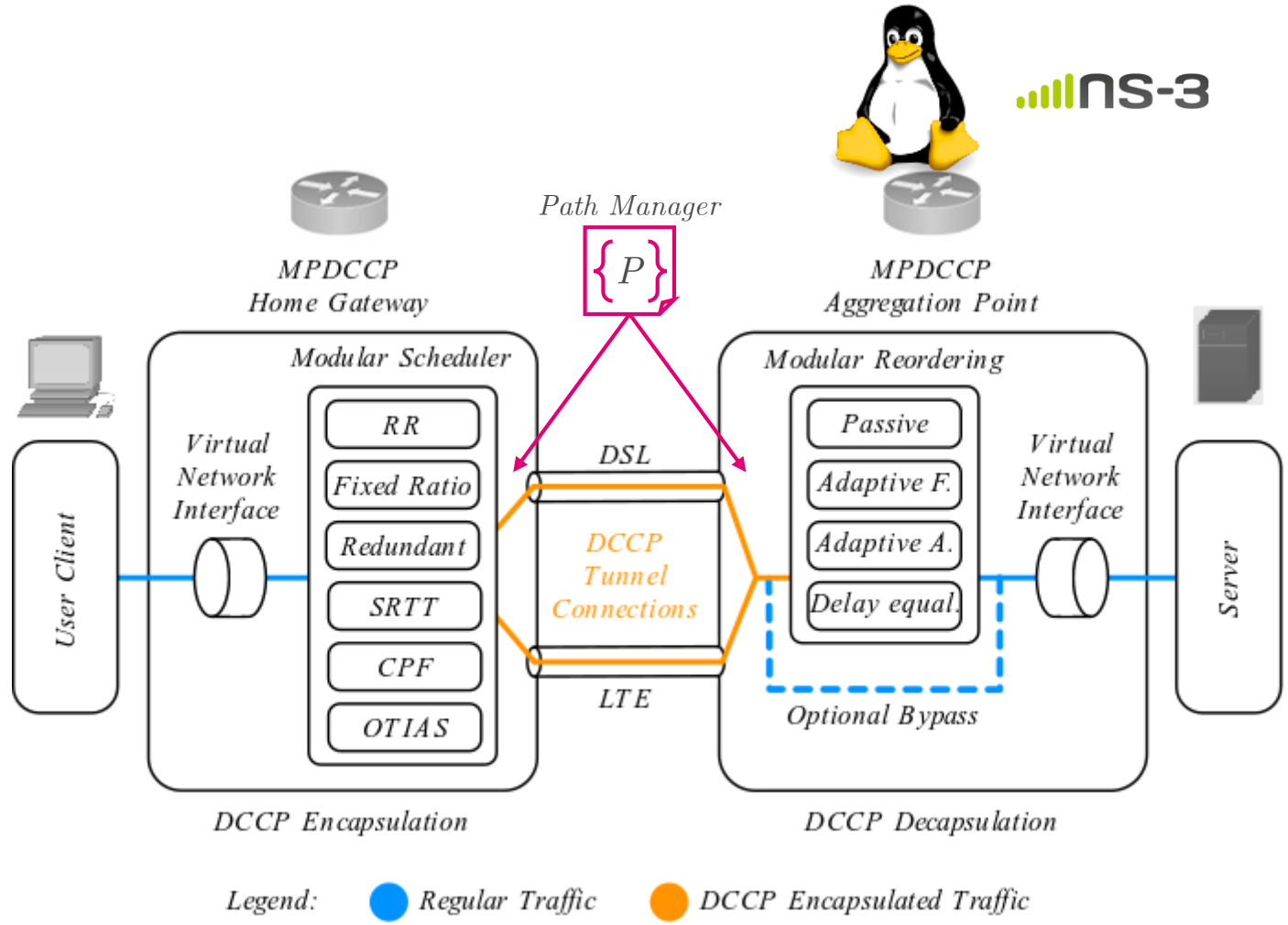
ANALYSIS AND RESULTS – TESTBED AND NS3 SIMULATIONS

Prototype is available inside Linux Kernel and ns-3 for residential and mobile use case each

- support seamless handover and path aggregation
- modular scheduler for distributing traffic
- modular re-assembly to compensate latency differences
- modular path manager to establish DCCP flows dynamically
- DCCP-UDP conversion to connect through non-DCCP aware middleboxes

→ Analysis Objective – test the ability of the framework to improve/maintain QoS/QoE on volatile paths



https://arxiv.org/pdf/1907.04567.pdf

IETF105 ICCRG presentation with more results

WORK SINCE IETF 104

Mainly worked on implementation and gathering results, minor updates to all relevant draft documents

https://tools.ietf.org/html/draft-amend-tsvwg-multipath-dccp-02

https://tools.ietf.org/html/draft-amend-tsvwg-multipath-framework-mpdccp-01

https://tools.ietf.org/html/draft-amend-tsvwg-dccp-udp-header-conversion-01

→ Update all: spelling, formatting, available at github 1, 2, 3

→ Update MP-DCCP draft: requirement section added

Next Steps

→ Add detailed specification of required multipath header option inside the MP-DCCP draft

→ Consider feedback on dccp-udp-header-conversion draft regarding UDP options

→ Align further the drafts with the 3GPP and BBF requirements

SWITCHING AND AGGREGATION– NS3, UDP TRAFFIC

Switching Mechanism

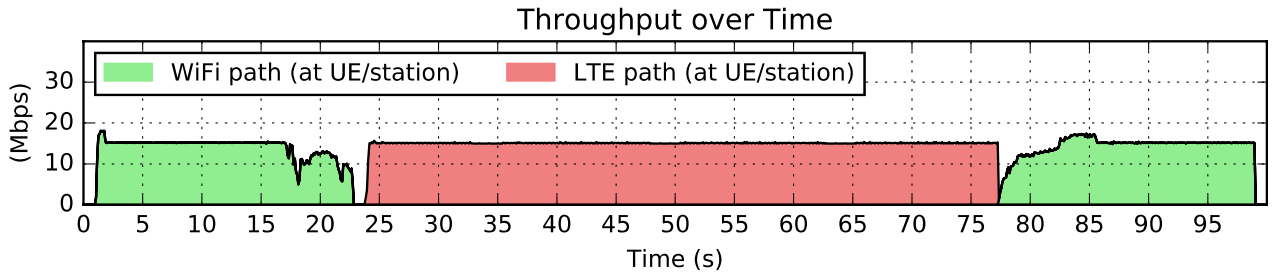
- Single path scheduler is used (meaning no splitting)
- WiFi path is prioritized over the LTE path
- Condition for PKT-push: CWND > in-flight
- All packets are pushed onto first available path (only)

→ When WiFi is available, push all onto WiFi path

Aggregation Mechanism

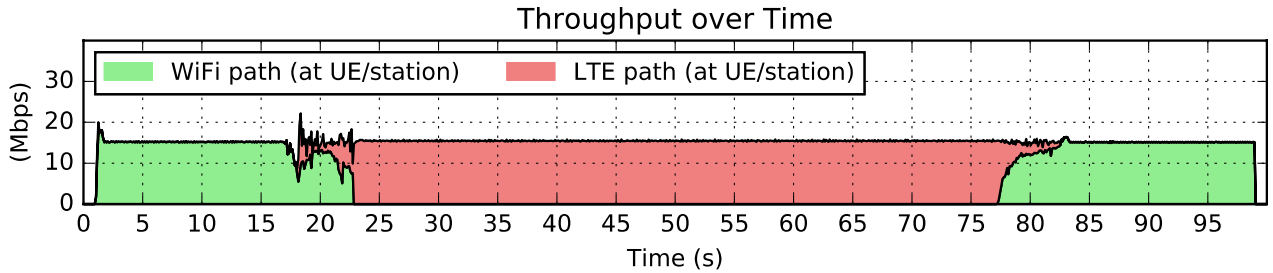
- Cheapest path first scheduler is used (will aggregate)
- WiFi path is prioritized over the LTE path
- Condition for PKT-push: CWND > in-flight
- Fill WiFi window first, then fill LTE window (if needed)

→ When WiFi is sufficient, only WiFi is used



After detecting the physical loss, stream is handed over to cellular without connectivity brea

When WiFi returns, stream is handed over to Wi-Fi again



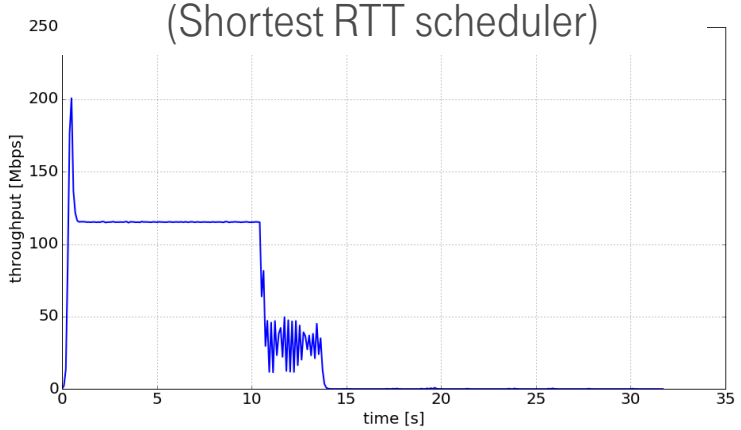
Additionaly to the scenario on top, using path aggregation combined with path prioritzation

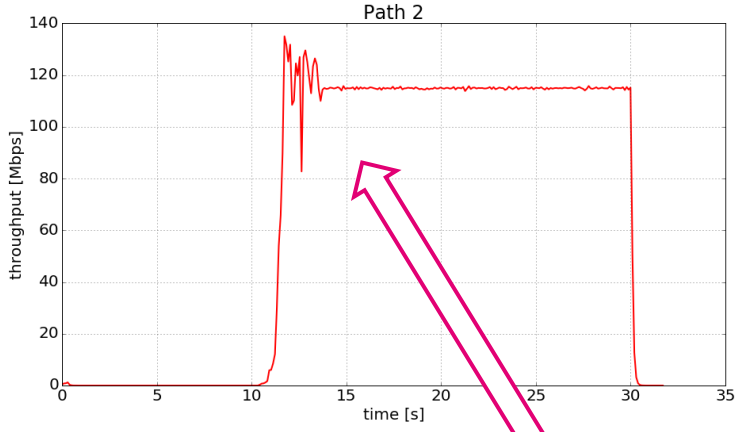
on WiFi enables a smooth handover, keeping QoS stable

TESTBED RESULTS – UDP IN A HANDOVER, AGGREGATION MODE

Latency triggered smooth handover

(Shortest RTT scheduler)





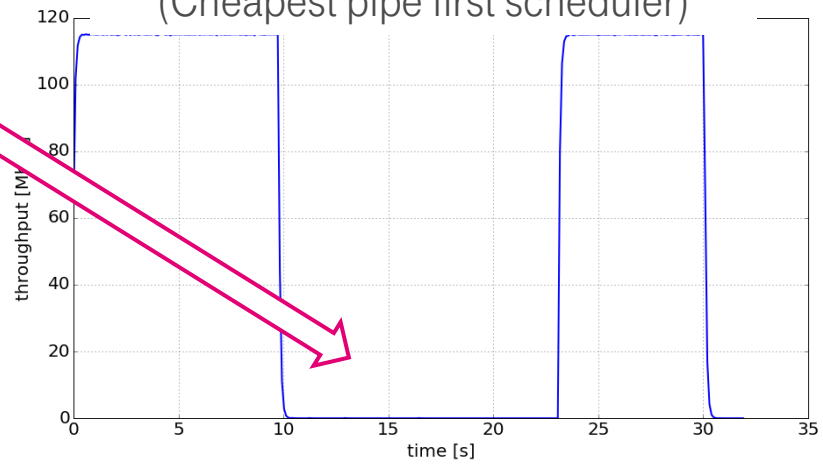
Path usage: a break in cheapest path (immediately visible at sender) at 10s, path back up at 23s

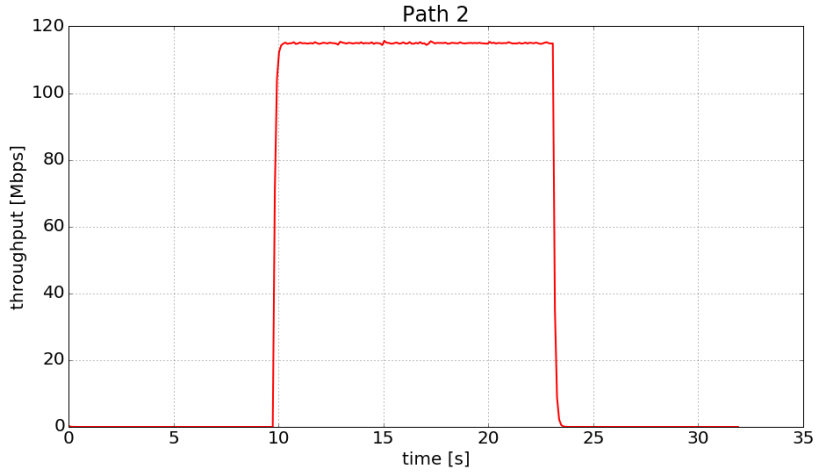
Path latencies 10ms/40ms

Latency change on path 1 to 90ms

Connectivity loss triggered handover

(Cheapest pipe first scheduler)



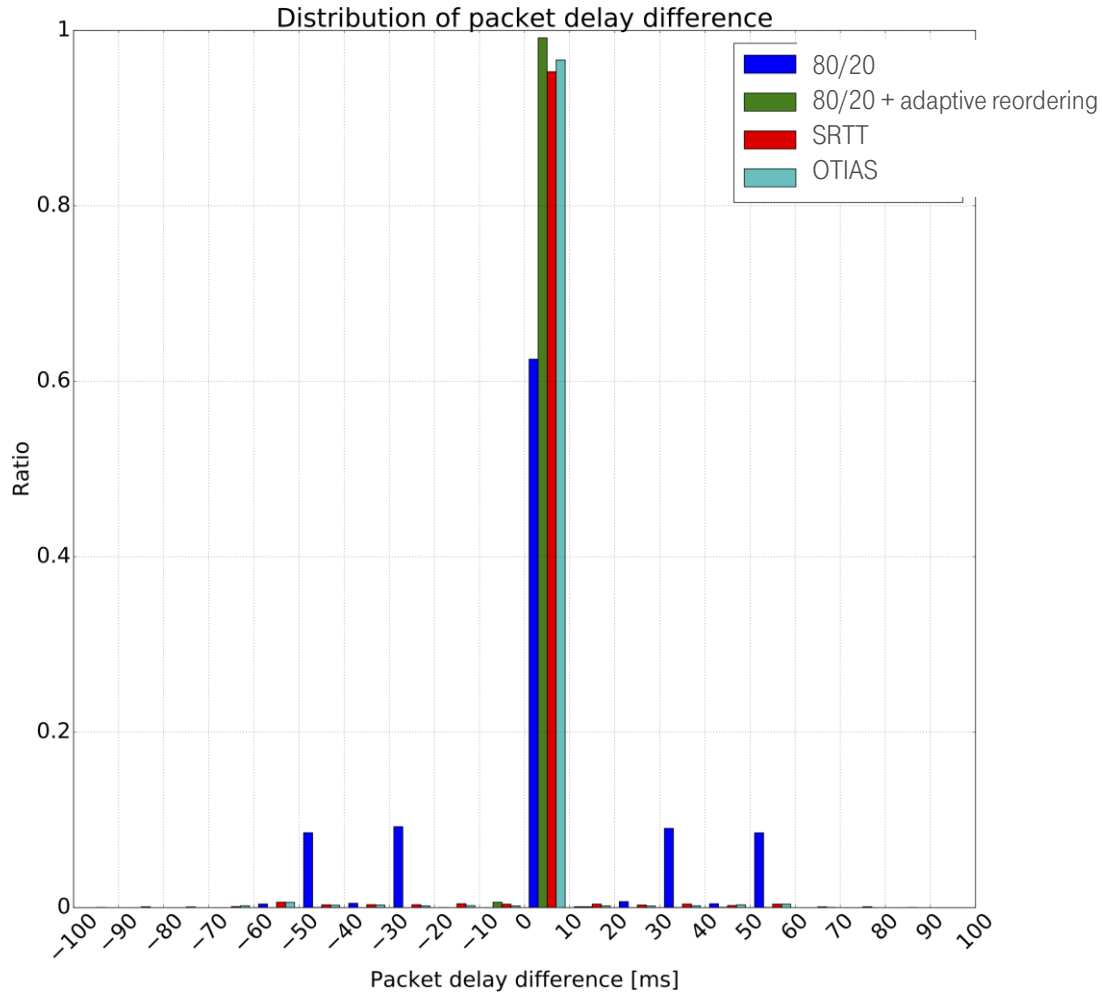


MANAGING PACKET DELAY VARIATION USING SCHEDULING OR REORDERING

- Supression of packet delay variation can be achieved using intelligent scheduling or receiver side re-ordering
- Re-ordering based on MP-DCCP sequencing information can be applied using static thresholds or adaptive threshold after which missing packets are ignored
- Scheduling algorithms use DCCP-originated path delay information to schedule the traffic on the path providing smaller latency (‘srtt’) and additionally considering send buffer (‘otias’)

→ Delay variation is mostly removed as consequence of that

→ However best results can be achieved with re-ordering on receiver side



CONCLUSION

The prototype implementation and simulation show very good first results according to the demands of Steering, Switching and Splitting of 3GPP ATSSS and BBF Hybrid Access.

UDP/IP traffic can be transmitted in switching or aggregation scenario

Further investigation of congestion controlled UDP flows required

To become an option for being included into 3GPP Rel. 17 a MP-DCCP based architecture need to be WG adopted until end of next year (IETF109).

Discussions with operators and vendors have been initiated but additional support is always welcome.

Drafts require further action to get some maturity, make your points at Github: MP-DCCP, Framework, DCCP/UDP conversion

Please use tsvwg@ietf.org or markus.amend@telekom.de to get in touch with us.

Further documents

Paper with detailed results: https://arxiv.org/pdf/1907.04567.pdf

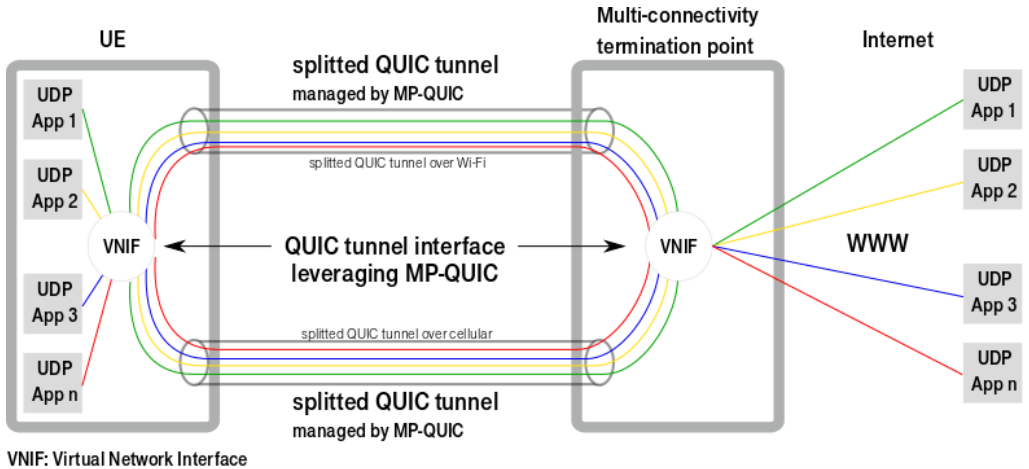
IETF 104 presentation: https://datatracker.ietf.org/meeting/104/materials/slides-104-tsvwg-sessb-43-markus-amend-multipath-dccp-00

IETF 105 ICCRG presentation: https://datatracker.ietf.org/meeting/105/materials/slides-105-iccrg-multipath-dccp-framework-00

BACKUP

WHY NOT USE MP-QUIC INSTEAD OF MP-DCCP?

MP-QUIC is a reliable and end-to-end encrypted protocol. Its application for enabling multipath transfer for UDP/QUIC traffic only works as QUIC tunnel, managed by MP-QUIC.



- **Useless encryption is applied and requires resources**
  - UDP as guest: Turns UDP into reliable transmission ☹
    - QUIC as guest: Encryption over Encryption, otherwise like TCP below ☹☹
  - TCP as guest: TCP's CC + reliable in-order delivery over outer QUIC's CC + reliable in-order delivery ☹☹☹

REQUIRED (MP-)QUIC ADAPTATIONS

In case MP-QUIC shall become an alternative for ATSSS and Hybrid Access like network architectures, it would require a paradigm change:

→ Configurable encryption for

- reducing the useless overhead in case of QUIC over MP-QUIC over trusted network paths
- designing a MP-QUIC ↔ QUIC converter

→ Deal with unreliable traffic to some extent and remove at least the reliable and in-order delivery feature

- Unreliable traffic support requires a complete re-work of current MP-QUIC framework, which bases on QUICs reliable and in-order delivery.