CCID5: An implementation of the BBR Congestion Control algorithm for DCCP

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https://www.ietf.org/id/draft-romo-iccrg-ccid5-00.txt

Introduction

Background

Target

Extend DCCP with a new CC algorithm -> BBR

Motivation

- All the current standardized algorithms for DCCP (CCID2, CCID3, CCID4) are loss-based
- Application to multipath scenarios where the latency difference among paths is a key factor -> Use BBR within MP-DCCP.

  https://datatracker.ietf.org/doc/html/draft-amend-tsvwg-multipath-dccp-05

  https://datatracker.ietf.org/doc/html/draft-amend-tsvwg-multipath-framework-mpdccp-01
- Proven result of BBR for TCP: low latency, high bandwidth and avoidance of buffer bloating

Progress

Development

- BBR v1->CCID5 (for DCCP) -> Within the Linux kernel 4.14 -> available as open source. https://github.com/telekom/mp-dccp/blob/master/net/dccp/ccids/ccid5.c
- **Challenge: Due to the unreliable nature of DCCP all functions related to ACK generation and processing are part of the CCID definition.**

Standardization

- Adopt existing and mature (TCP) BBR as a new CCID profile for DCCP.

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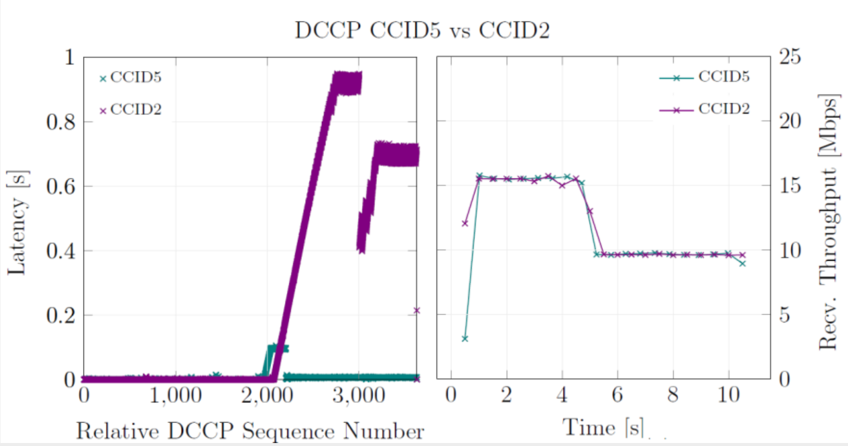
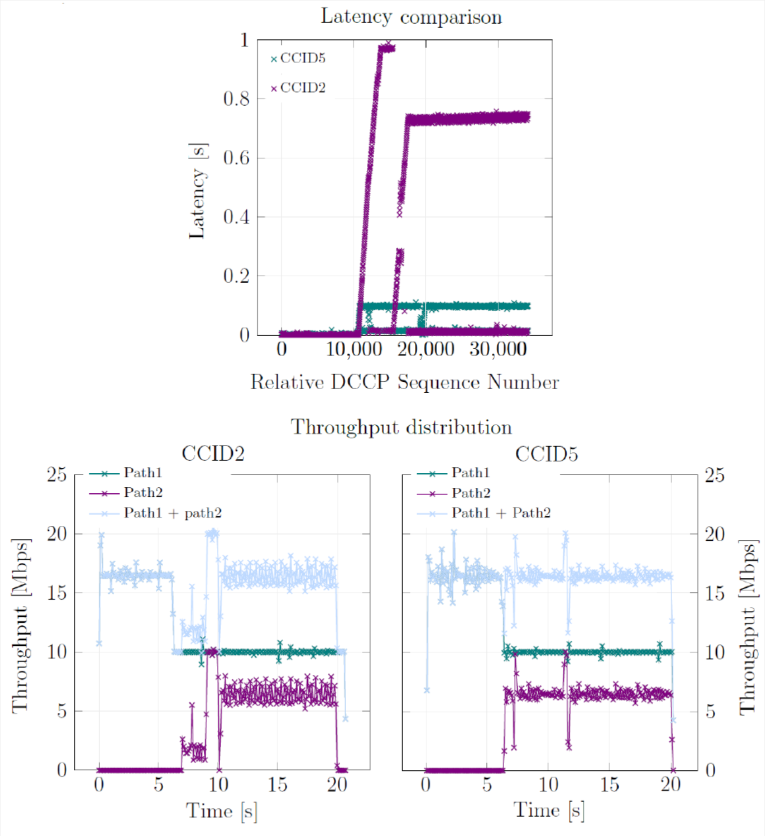
Early results

Single Path



- CCID5 shows significant improvement in terms of latency for both: single and multipath scenarios, when a BW limitation is imposed in the path
- In the multipath scenario, CCID5 also improves the scheduling performance
- **Conceptual basis of TCP BBR as well as existing studies and results are valid for DCCP**

Multi Path – UDP traffic over MP-DCCP

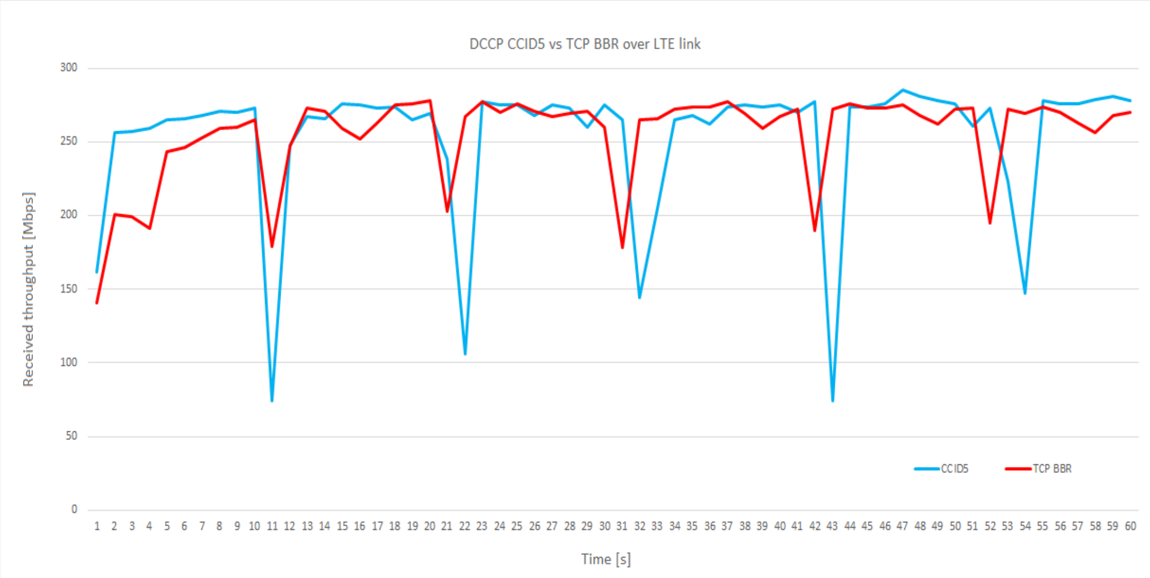


Further details can be found at: https://dl.acm.org/doi/10.1145/3472305.3472322

Clash of BBR requirements and DCCP features

➢ Tests in live network

- Deeper BW drops were found for CCID5 on ProbeRTT phase



➢ Analysis

- **BBR requirement:** Restauration of cwnd when leaving probeRTT phase
- **DCCP feature:** The big change in the cwnd requires a synchronization of the Sequence and ACK validity windows [RFC4340 section 7.5]

```
                         Client                                          Server
                       ----------                                      ----------
                           |                                                |
                           |                                                |
Trigger Seq window         |                                                |
Feature negotiation        |------ Change L(Sequence Window, 1024)------>|
                           |                                                |
                           |                                                |
Update local               |<----- Confirm R(Sequence Window, 1024)------|
ACK window                 |                                                |
                           |                                                |
```

- **The problem: The probeRTT phase duration acquires a latency dependency** -> The synchronization extends its duration at least one RTT

Clash of BBR requirements and DCCP features

➢ Temporary solution

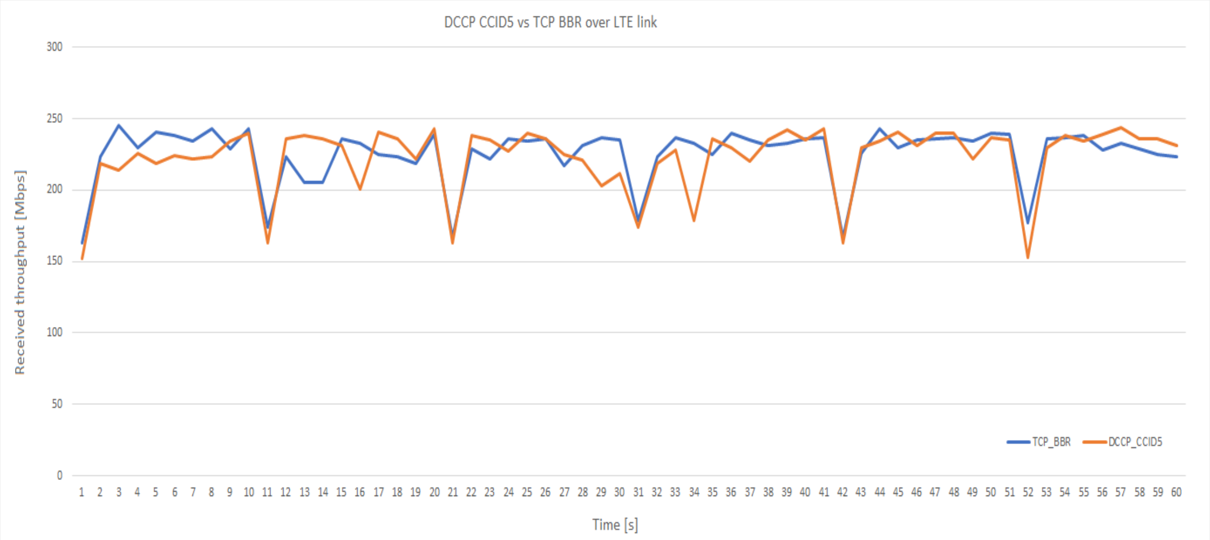
- Pro-active update of local values even if the confirmation has not been received yet (feature negotiation not finished)

```
                   Client                                          Server
                 ----------                                      ----------
                     |                                               |
Trigger Seq window   |                                               |
Feature negotiation  |------ Change L(Sequence Window, 1024)------>|
                     |                                               |
      Update local   |                                               |
        ACK window   |                                               |
                     |                                               |
                     |<----- Confirm R(Sequence Window, 1024)------|
                     |                                               |
                     |                                               |
```

New or enhanced feature for Sequence Window negotiation in DCCP required?

➢ Tests in live network

- After applying the change, the depth of the BW drops in CCID5 is reduced -> results comparable to BBR TCP



Conclusion

- **Adopt existing and mature (TCP) BBR as a new CCID profile**
  - All simulation and verification from TCP are kept valid for DCCP
  - Main differences come from the unreliable nature of DCCP -> ACK definition

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- **What would be the right please to discuss the Sequence window negotiation problem (slides 4 and 5)?**

  ICCRG OR TSVWG ?