Buffer Splitting for Efficient Transport over Asymmetric Paths

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Asymmetric Paths

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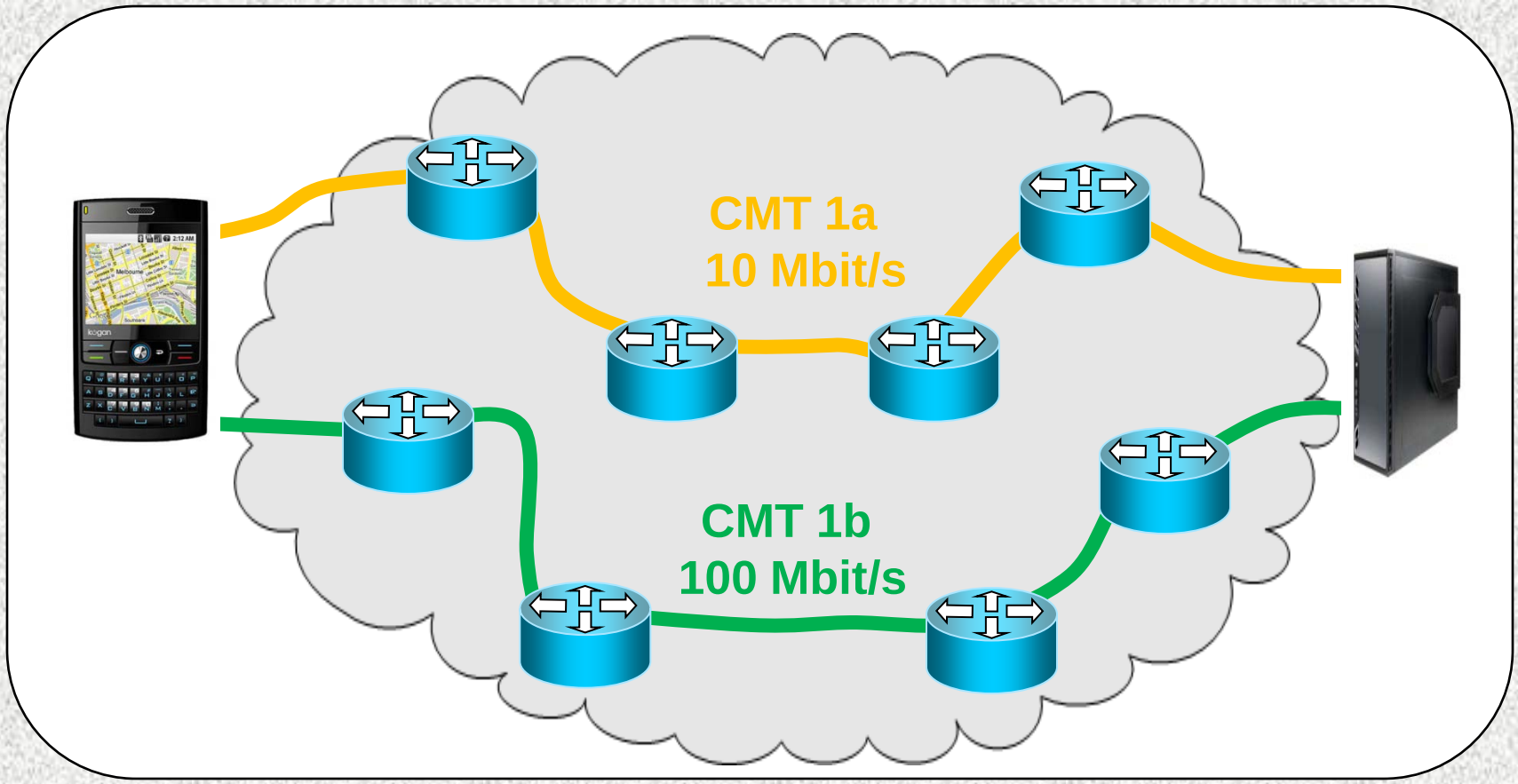
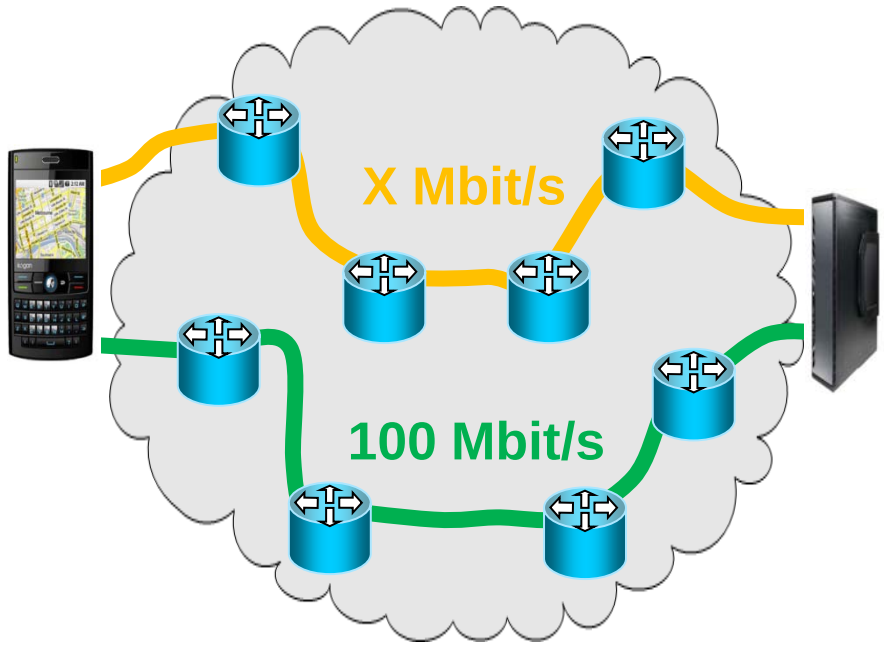
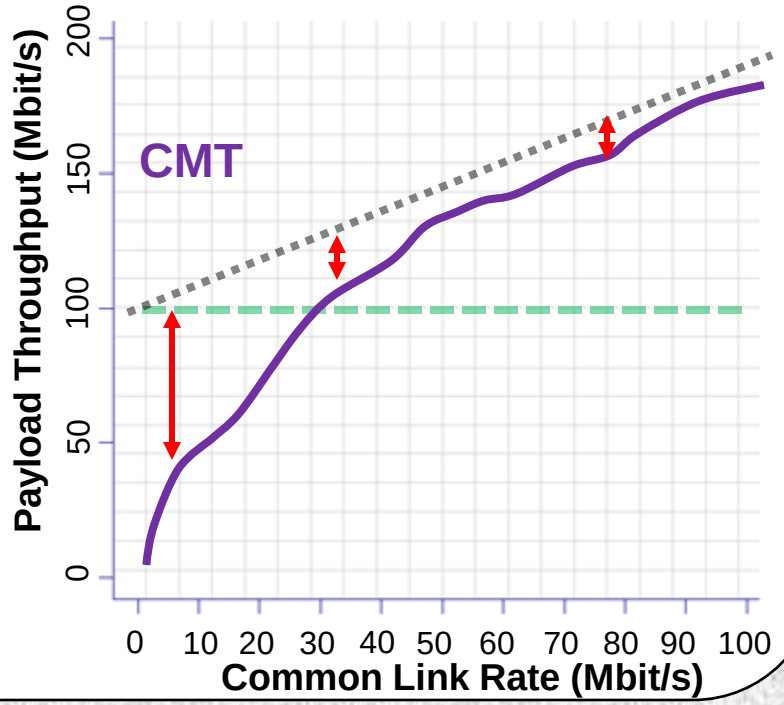


- Expecting a CMT-performance of ~110 Mbit/s

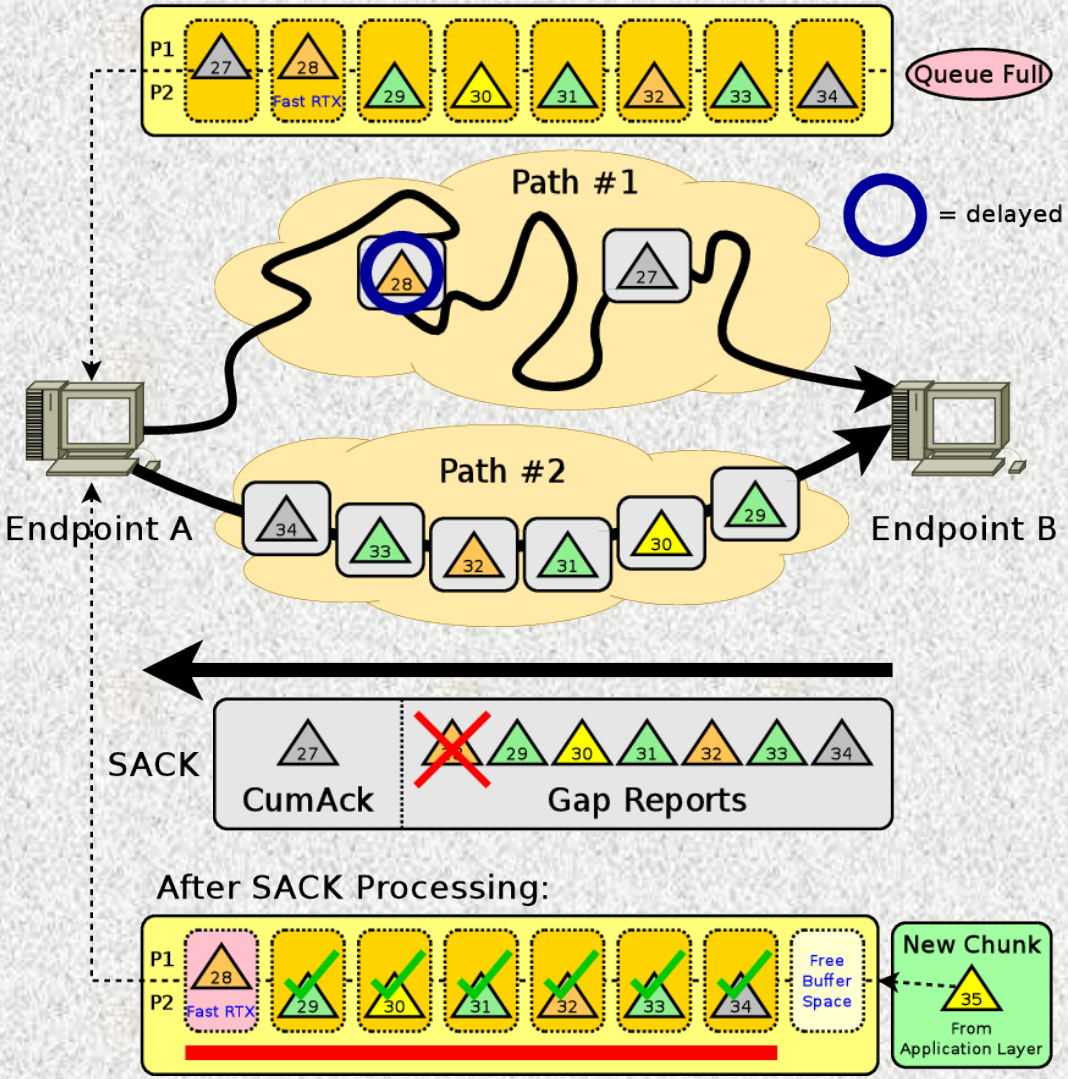
Asymmetric Paths



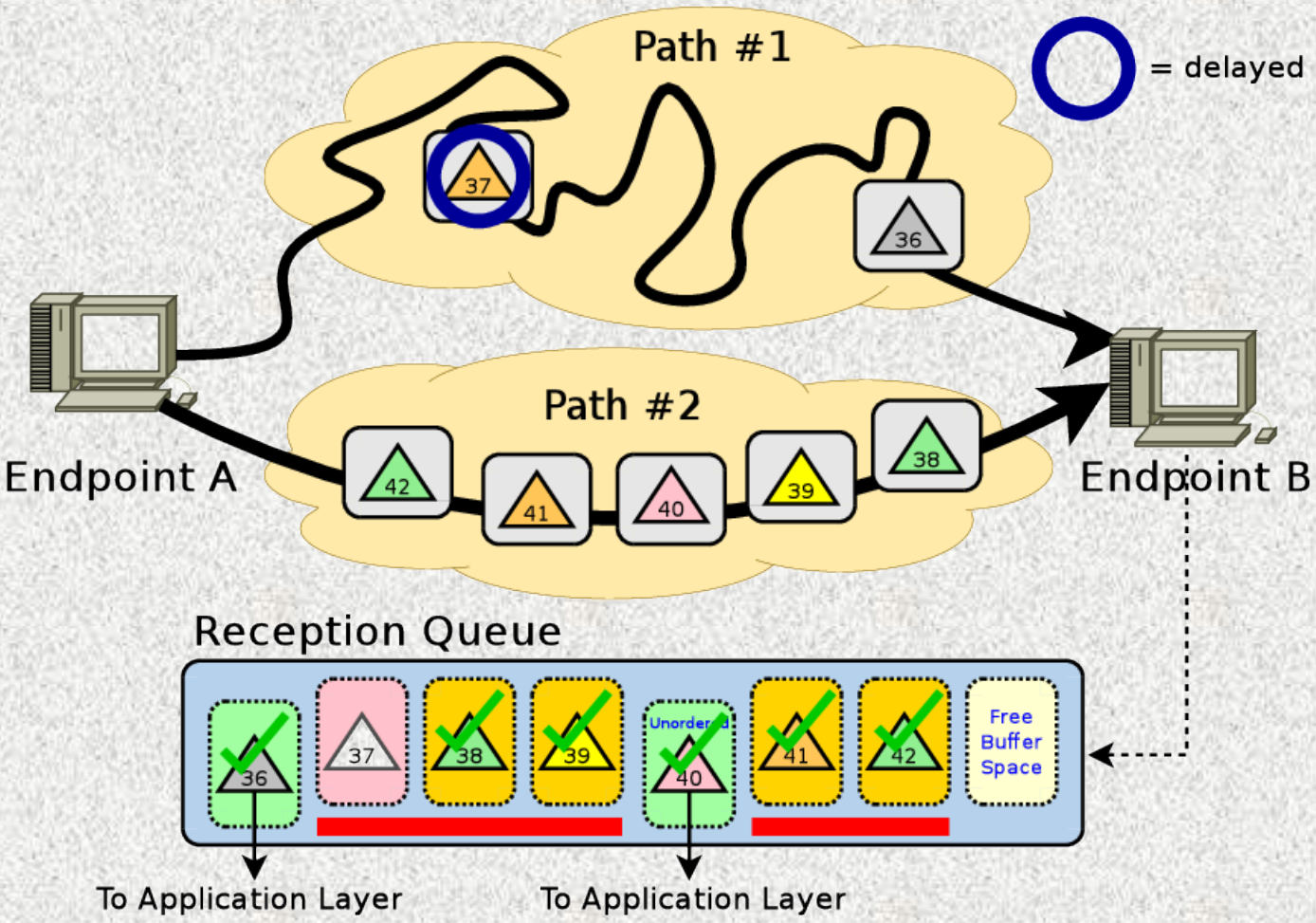


- Throughput not increased as expected
- Even worse for highly asymmetric paths:
  Throughput for CMT less than just using the faster path alone
- Just combining two or more asymmetric paths does not work well! Why?

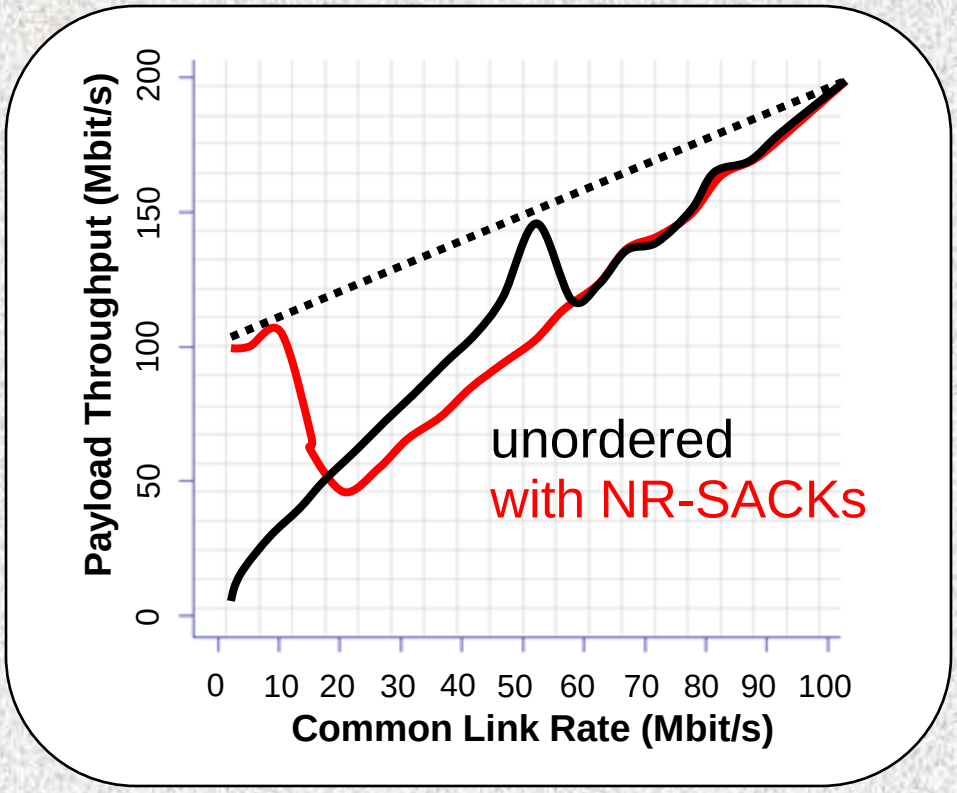
Sender Buffer Blocking



Receiver Buffer Blocking



Transport over Asymmetric Paths – Test of Known Approaches



- Non-Revokable SACK (NR-SACK) alone does not solve the issues
- Our approach: **decoupling the buffers of the flows**
- **“Receiver Buffer Splitting” and “Sender Buffer Splitting”**

Transport over Asymmetric Paths –
Test: Sender Buffer Size **greater** than Receiver Buffer Size

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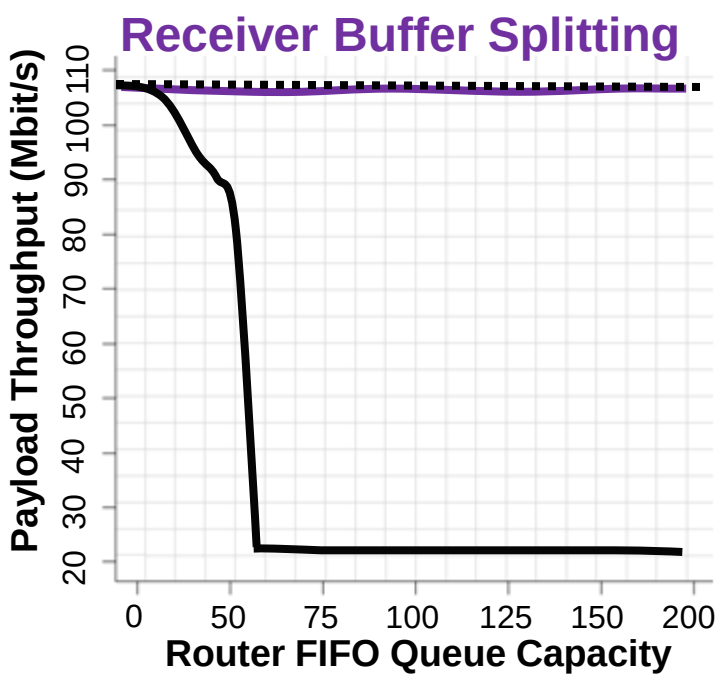
100 Mbit/s + 10 Mbit/s



- unordered
- NR-SACKs
- Simulation scenario : Variable router buffer size
- Sender Buffer Size = 250.000 bytes
- Receiver Buffer Size = 125.000 bytes

The growing number of **outstanding** messages on the slow path "fills" the calculated receiver buffer!

- Buffer cannot provide sufficient space for messages on the fast path
- The sender expects the receiver side to run out of memory
- Decoupling the calculation and doing it for each flow solves this issue

Transport over Asymmetric Paths –
Test: Sender Buffer Size **less** than Receiver Buffer Size

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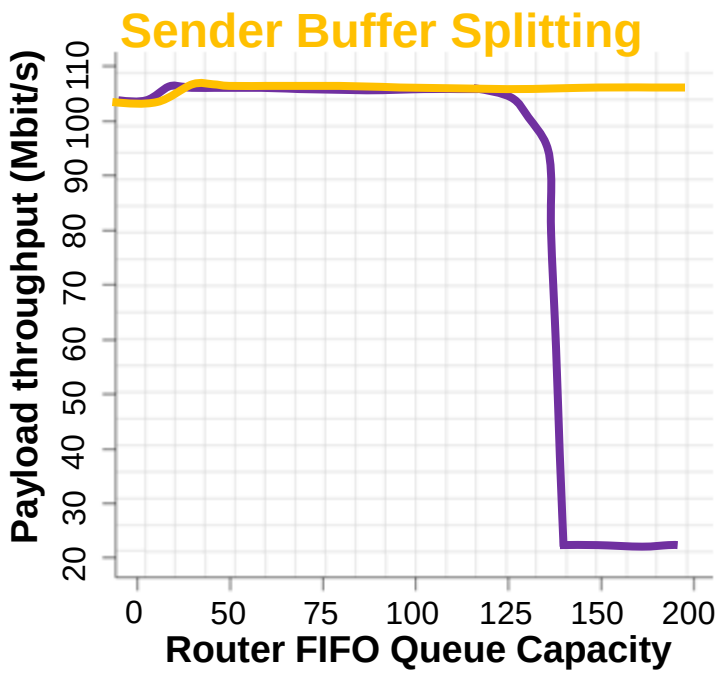
100 Mbit/s + 10 Mbit/s



- unordered
- NR-SACKs
- Simulation scenario : Variable router buffer size
- Sender Buffer Size = 125.000 bytes
- Receiver Buffer Size = 250.000 bytes

The scenario turns!

- Mechanism working for host and network protection slows down the link
- “Sender Buffer Splitting” solves the sender side blocking
- Applying **Sender** and **Receiver Buffer Splitting** simultaneously solves the detected “Buffer Blocking” in all cases

Transport over Asymmetric Paths – Applying Buffer Splitting

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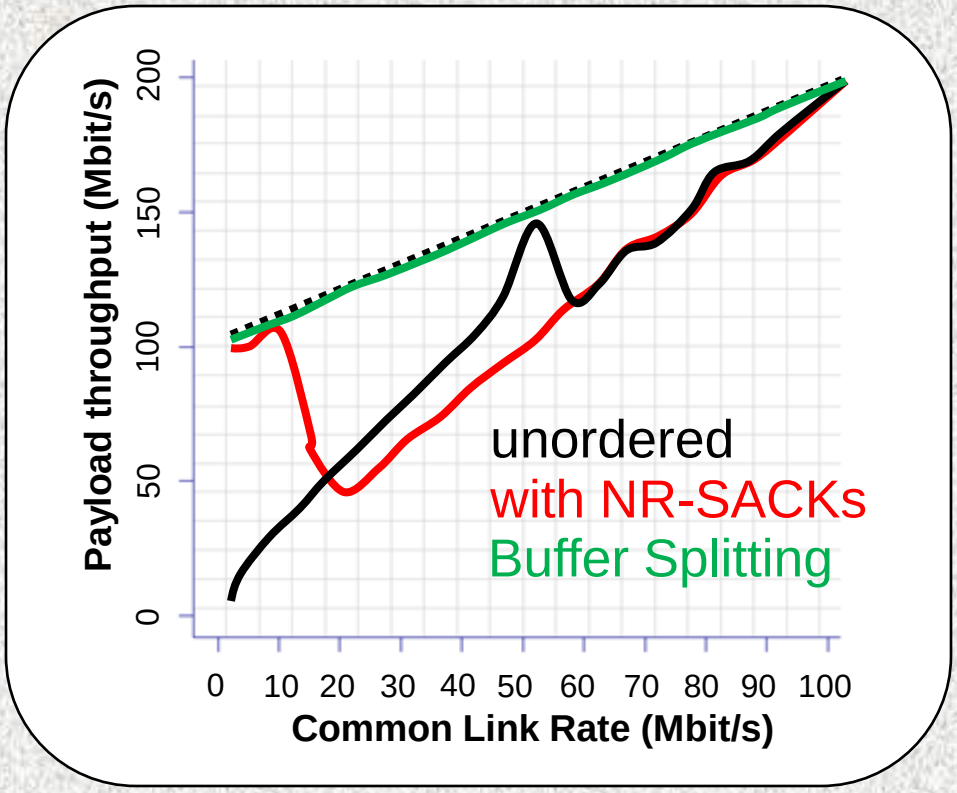

- Our approach "**decoupling the buffers of the flows**" works for**:**
  - **asymmetric bandwidth**
  - **asymmetric error rate**
  - **asymmetric delay**

Conclusion and Future Work

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- Asymmetric paths lead to Buffer Blocking problems
- Our solution: decoupling buffers by Buffer Splitting
  - Sender Buffer Splitting
  - Receiver Buffer Splitting
- In combination with NR-SACK:
  - Significant performance improvement
  - To be published in [Globecom2010]
    - Including more features
    - Also considering fairness on shared bottlenecks (CMT/RP-SCTP)
- Contribution into IETF standardization
  - Internet Draft [draft-tuexen-tsvwg-sctp-multipath]
  - Presented at the 78th IETF Meeting in Maastricht