TCP in 5G mmWave networks

Time and path diversity

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Objective

Evaluate **MP-TCP** on mmWave + LTE networks
- What is the best combination of paths?
- Which congestion control (CC) algorithm to use?

mmWaves and TCP

**Challenges: blockage and high variability**

Example: throughput over time in NLOS condition

- Exploit **path diversity** with multi-connectivity
- **Design** goals of MP-TCP
  1. Improve throughput
  2. Be fair with other TCP flows
  3. Avoid congestion
- **Congestion control algorithms**
  - **Coupled** – OLIA, BALIA – the congestion window of all the paths are **dependent** on each other (NewReno based)
  - **Uncoupled** – each path is **independent**, any TCP CC (e.g., CUBIC) can be used

Multipath TCP

**Path choice**

**Dashed vs solid lines** at large distance, **mmWave 28 GHz + LTE** performs better than mmWave 28 GHz + mmWave 73 GHz

A **reliable subflow** with low bandwidth helps more than a high capacity, unreliable path

**CC algorithms**

**Red vs blue lines** the uncoupled CC with CUBIC performs better than coupled BALIA. BALIA may perform worse than the single path TCP

State of the art CC algorithms do **not** meet the **MP-TCP design goals** in a mmWave scenario

Performance evaluation

Evaluate **MP-TCP** on mmWave + LTE networks

- **What is the best combination of paths?**
- **Which congestion control (CC) algorithm to use?**

References

[1] M. Polese, R. Jana, M. Zorzi, *TCP in 5G mmWave Networks: Link Level Retransmissions and MP-TCP*, accepted for presentation at the 2017 IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS)

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