Improving TCP performance on mmWave cellular networks

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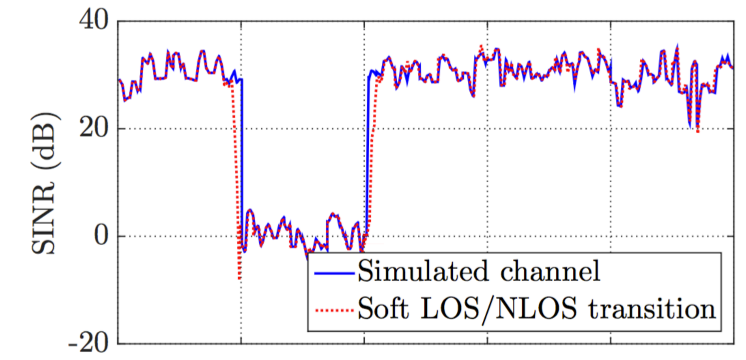
Objective

Improve the performance of TCP on mmWave links

- Most widely used transport protocol
- Designed in the 80s for wired networks
- Applications performance depends on TCP performance

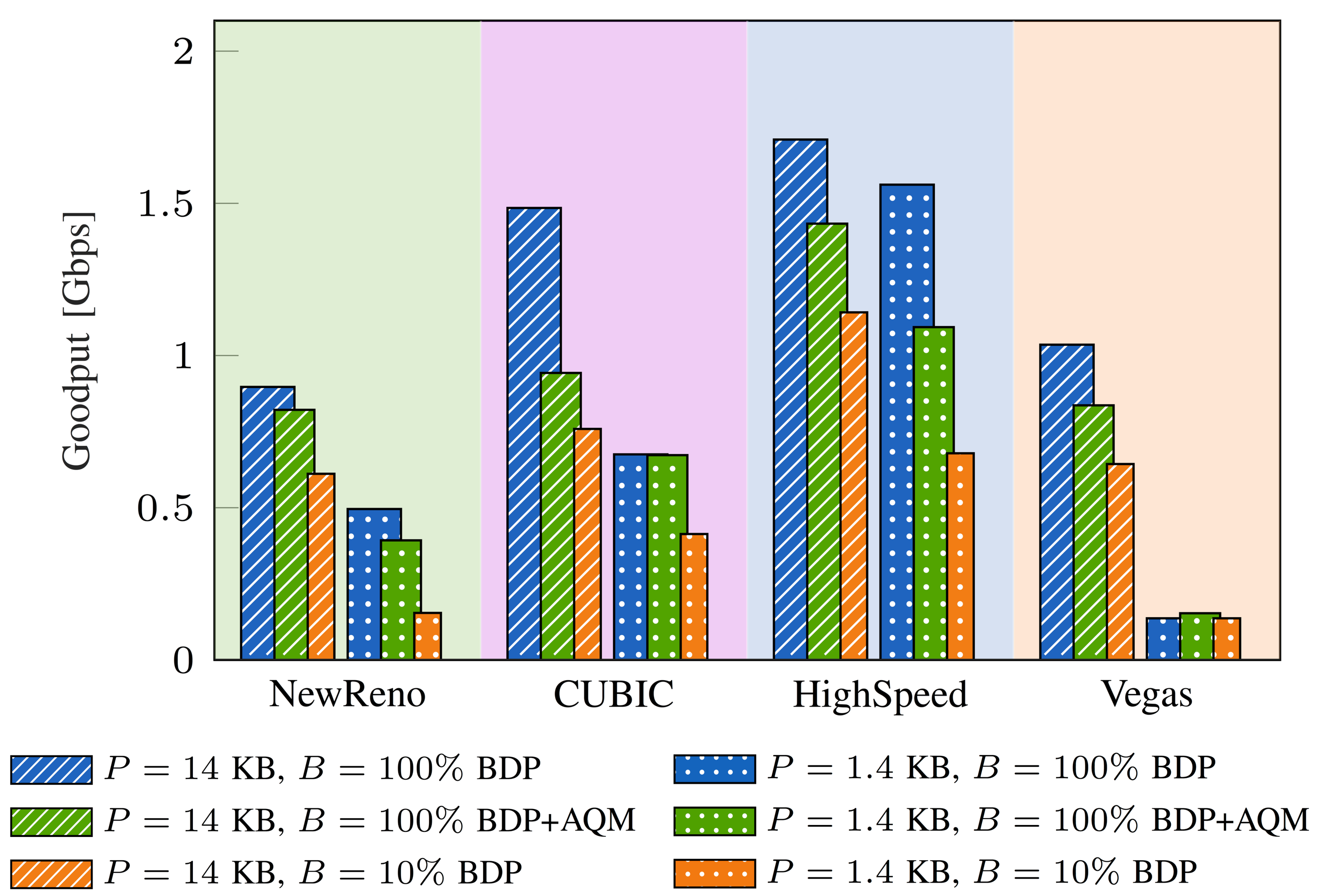
TCP issues at mmWaves



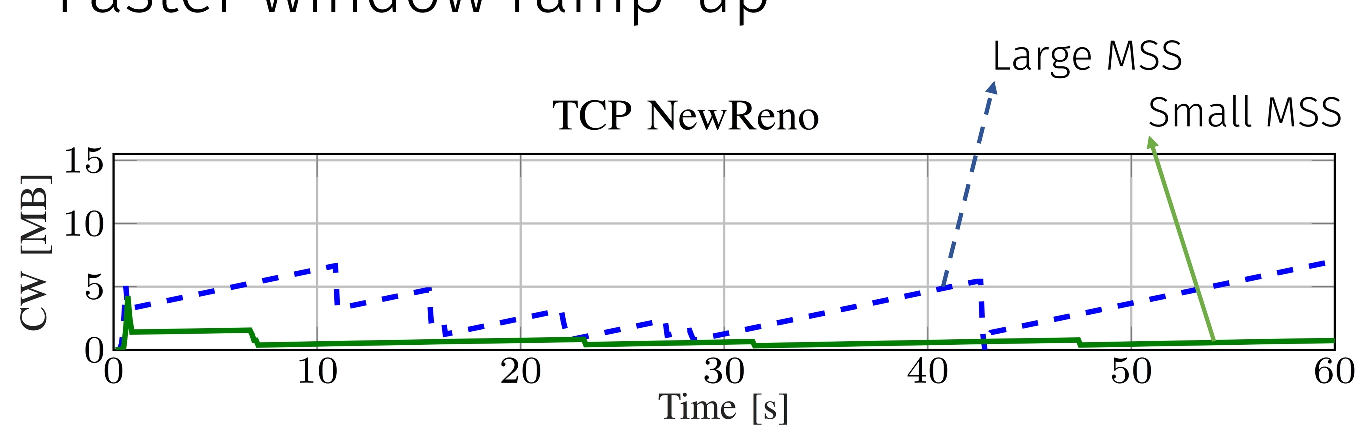
- Pathloss
- Blockage
- High rate variability

- Low link utilization
- Retransmission timeouts
- Bufferbloat

Large MSS



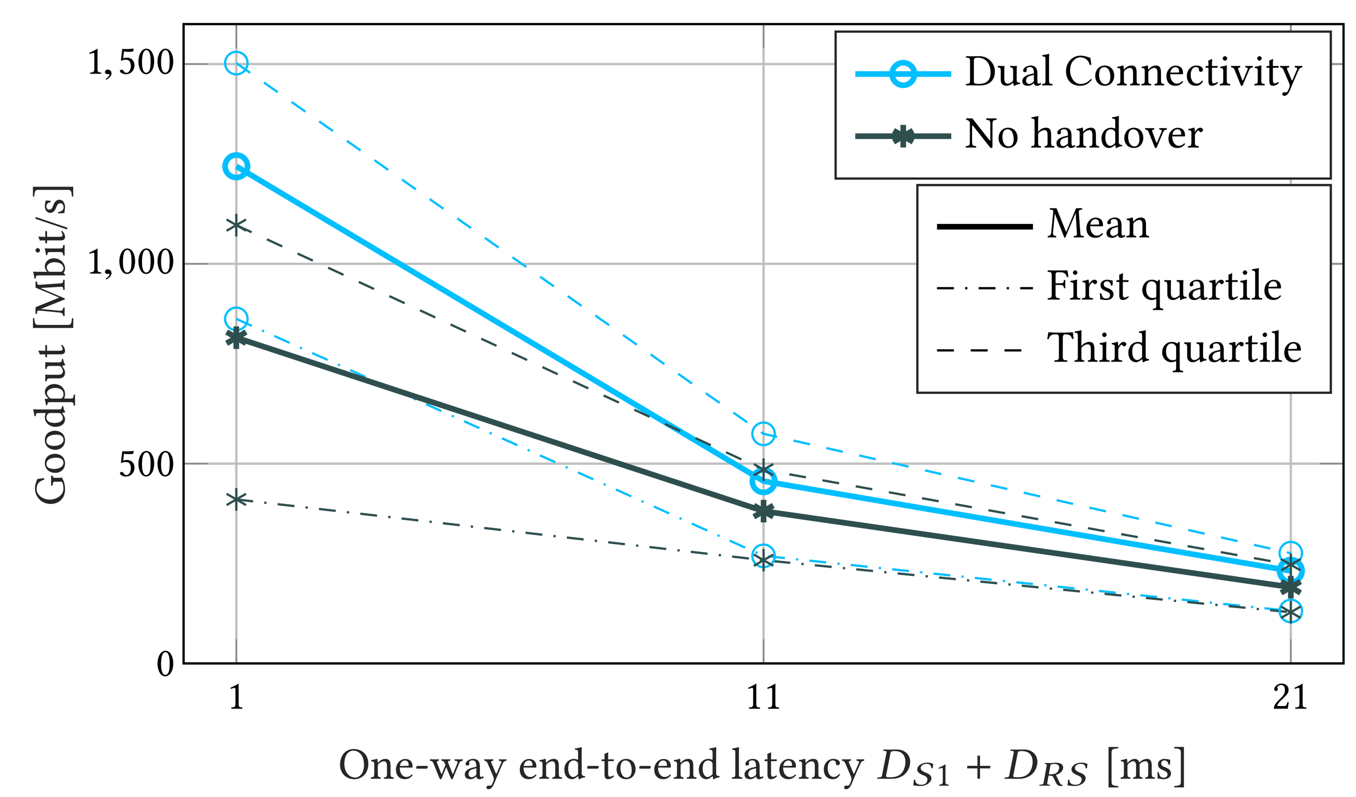
- Traditional networks use small MSS to match Ethernet MTU
- At mmWave frequencies, a large MSS yields a high throughput gain thanks to
  - Smaller headers overhead
  - Fewer ACKs in uplink
  - Faster window ramp-up



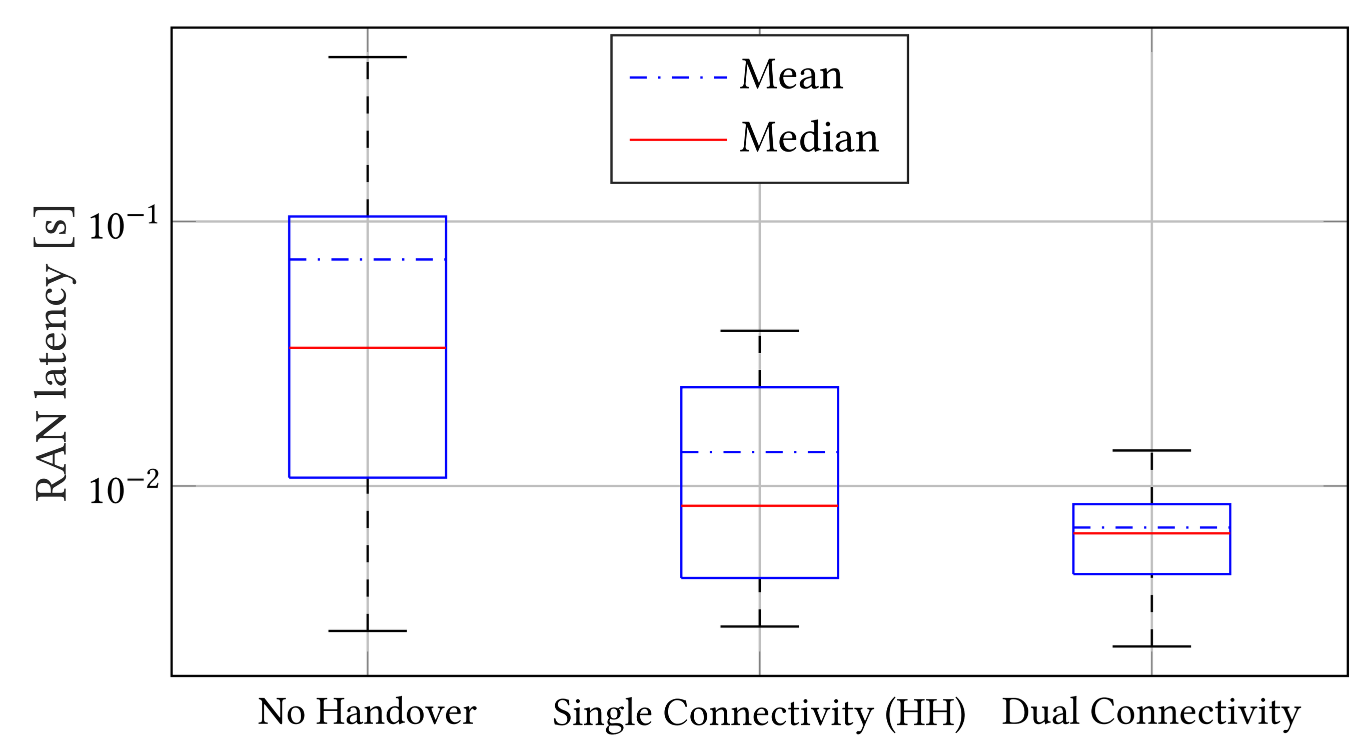
Zhang, Polese, Mezzavilla, Zhu, Rangan, Panwar, Zorzi, "Will TCP work in mmWave 5G cellular networks?", subm. to IEEE Com. Mag.

Dense networks

- Dense networks decrease NLOS probability
- Need for smart *mobility management* schemes



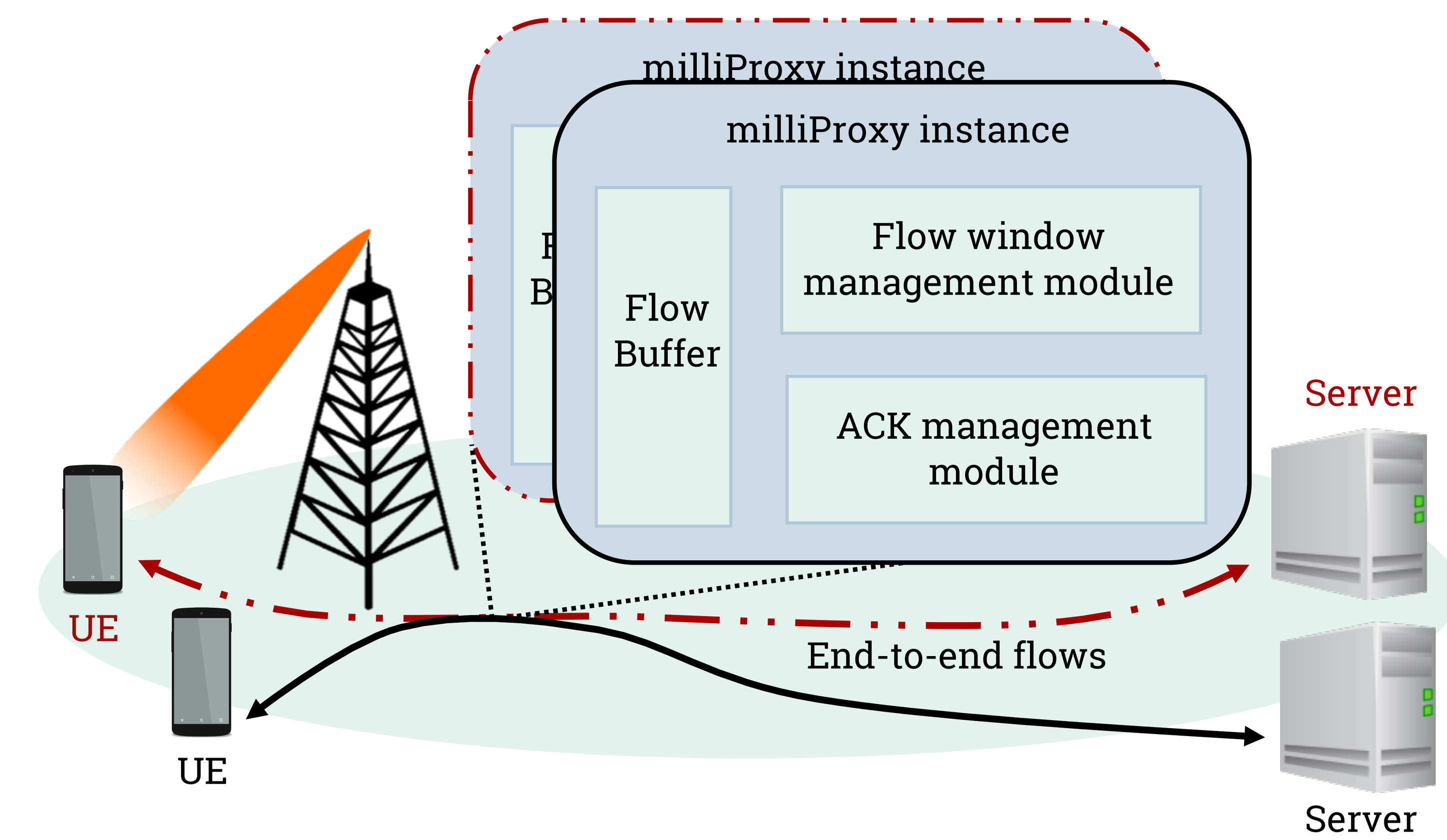
- High goodput (LOS yields higher PHY rate)



- Low latency (limited bufferbloating)

Polese, Mezzavilla, Rangan, Zorzi, "Mobility management for TCP in mmWave networks", in ACM mmNets 2017

Cross-layer TCP proxy



- Cross-layer information to change the advertised window in the ACKs
- MSS splitting

- ***Latency reduction*** up to 43x

$D_{S1} + D_{RS}$ [ms]	2	6	11	21
$B_{\mathrm{RLC}} = 10$ MB	11.8008	4.7547	2.5574	1.9888
$B_{\mathrm{RLC}} = 20$ MB	43.3299	11.5578	5.8104	3.6988

- ***Goodput gain*** up to 2.2x

$D_{S1} + D_{RS}$ [ms]	2	6	11	21
$B_{\mathrm{RLC}} = 10$ MB	1.1941	1.6875	1.7202	2.2430
$B_{\mathrm{RLC}} = 20$ MB	1.0135	1.1448	1.0765	1.9901

Polese, Zhang, Mezzavilla, Zhu, Rangan, Panwar, Zorzi, "milliProxy: a TCP proxy architecture for 5G mmWave cellular systems", in Asilomar SSC conf. 2017