
Delay Measurement Challenges in Mobile Access Networks

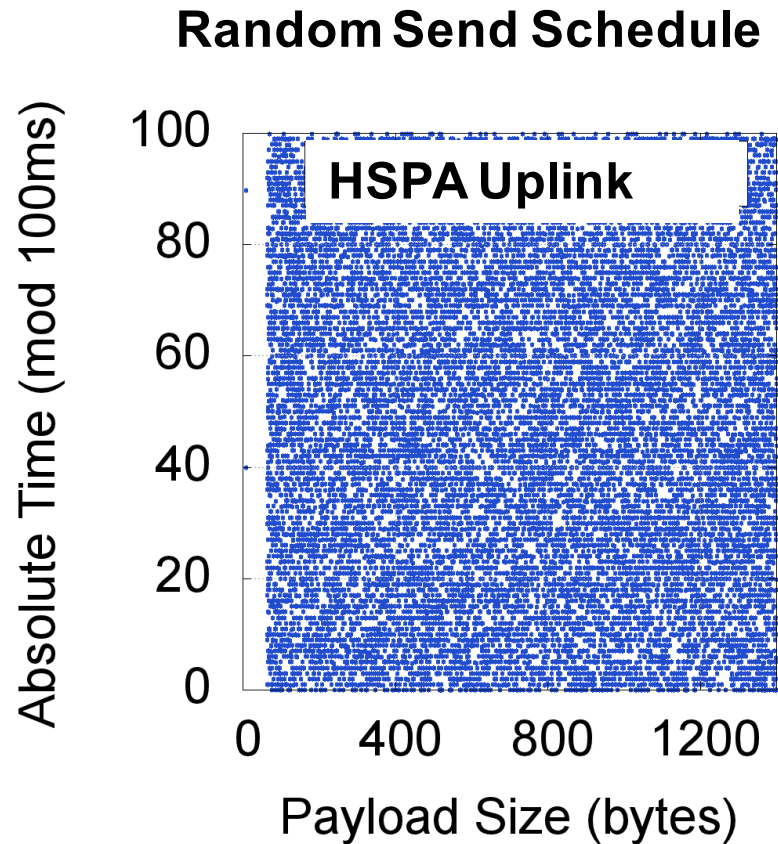
Joachim Fabini, Tanja Zseby
TU Wien

AIMS 2016

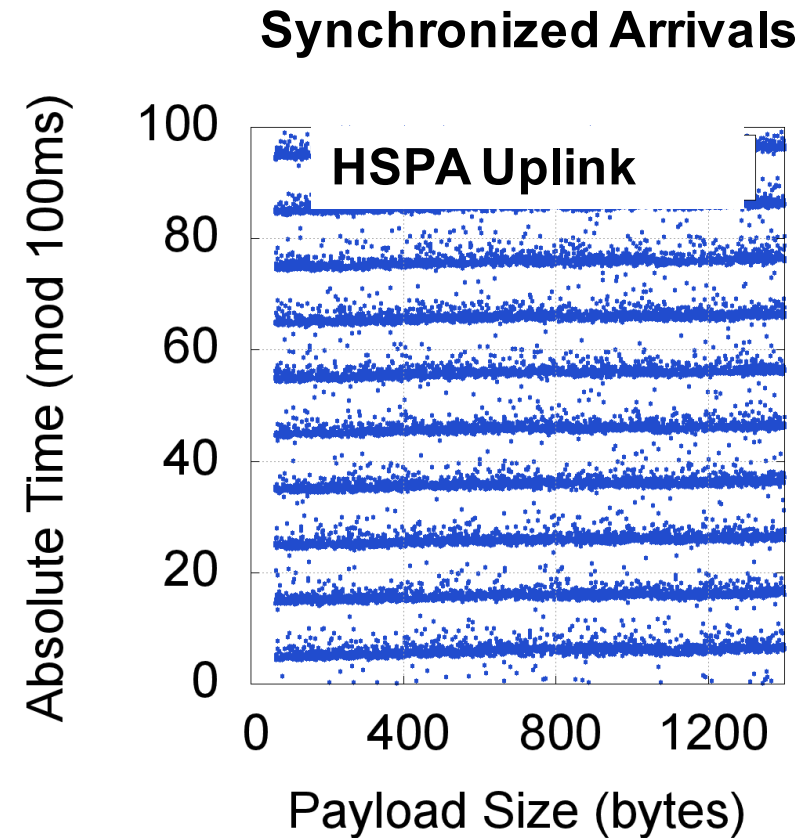
Problem Statement

- Motivation: Smart Grid Communication
 - Use of cellular access networks
 - But strict latency requirements
- Past (RFC 2330): State-less history-less network behavior
- Now: “Reactive” Cellular Access Networks
 - Demand-driven resource allocation
 - Time-slotted operation
- Examples: HSPA, LTE
 - Time slotting
 - Higher capacity for active users
- Problem: repeatable measurements
 - Same patterns → different results
 - Concatenated paths → results biased by first segment

Packets in Cadence



(a) Send time (client)

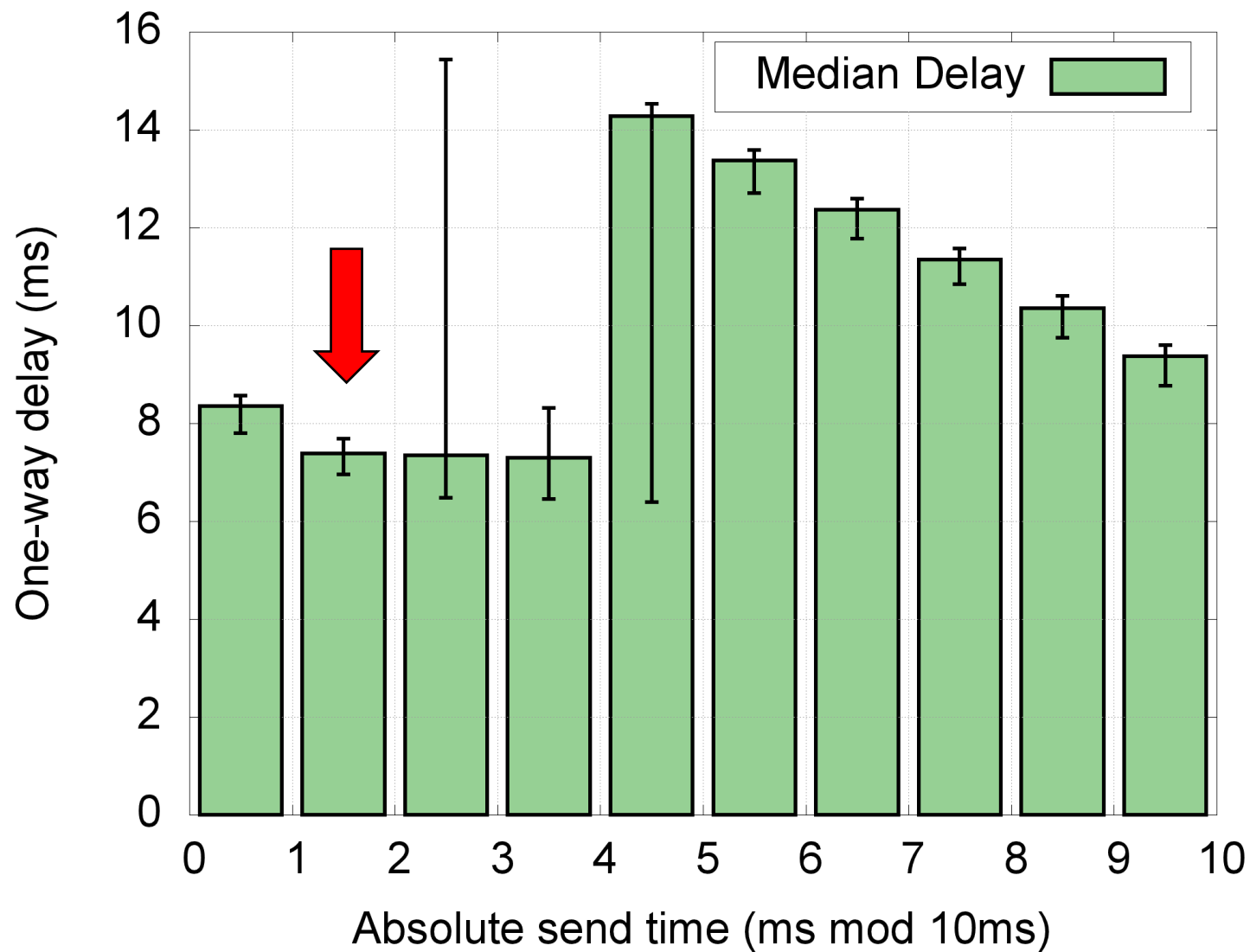


(b) Receive time (server)

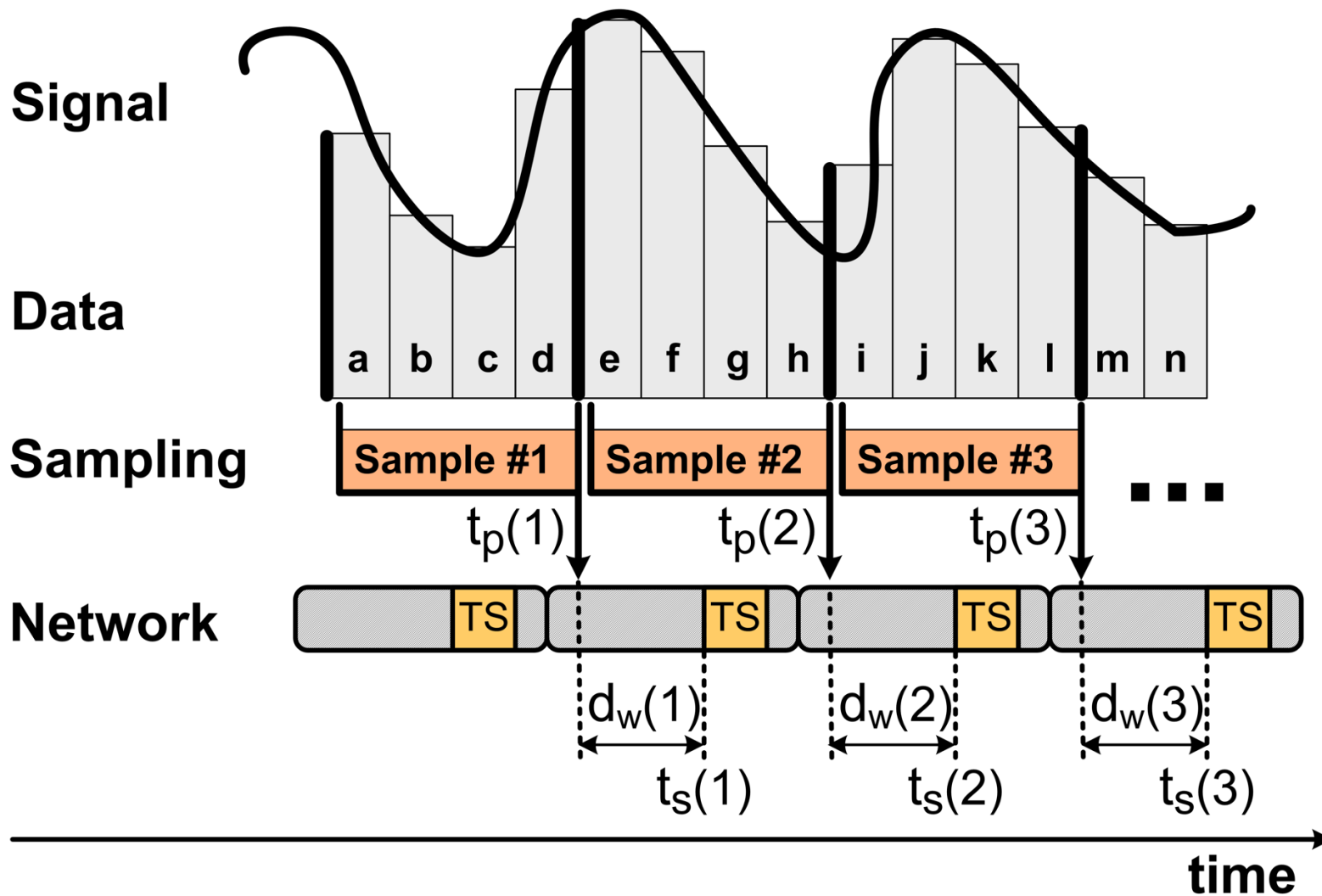
➔ network period of 10 ms

Fabini, Zseby, Hirschbichler: "Representative Delay Measurements (RDM): Facing the Challenge of Modern Networks," I 8th International Conference on Performance Evaluation Methodologies and Tools, ICST, Brussels, Belgium, 2014

Delay Dependence on Absolute Send Time (LTE)

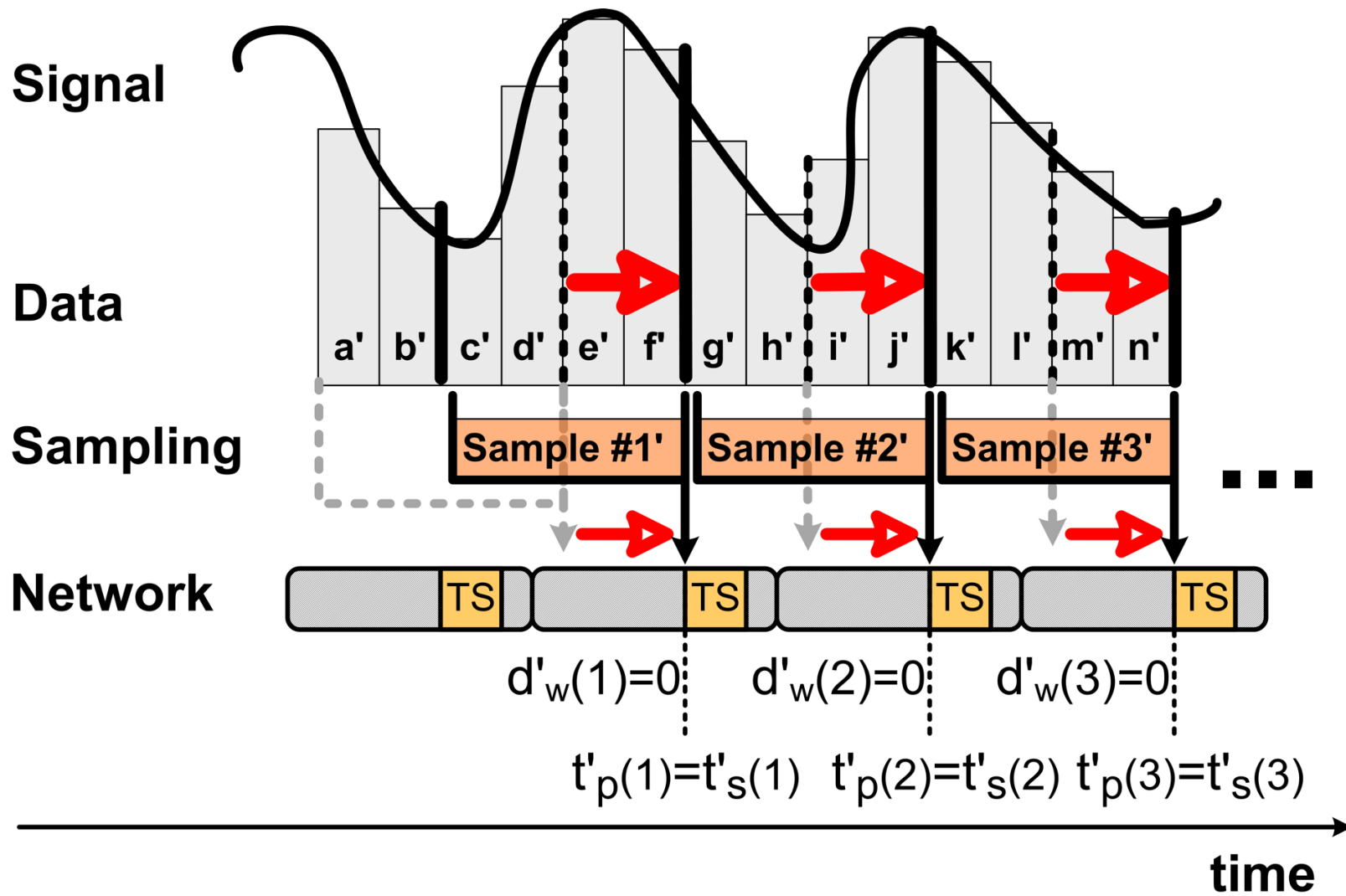


Suboptimal Sampling

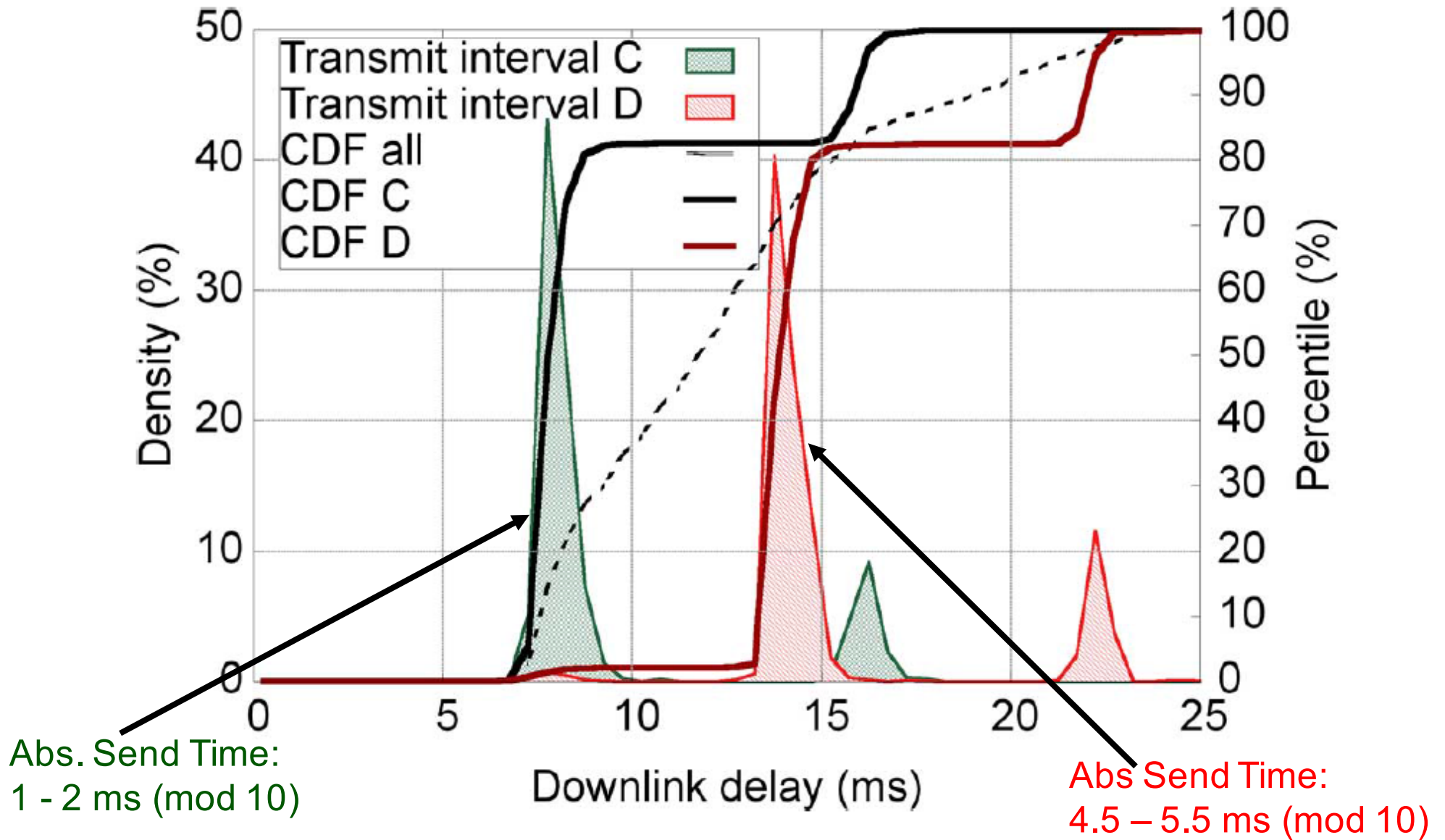


Fabini, Zseby, "The Right Time: Reducing Effective End-to-End Delay in Time-Slotted Packet-Switched Networks," *IEEE/ACM Transactions on Networking*, 2015.

Optimized Sampling

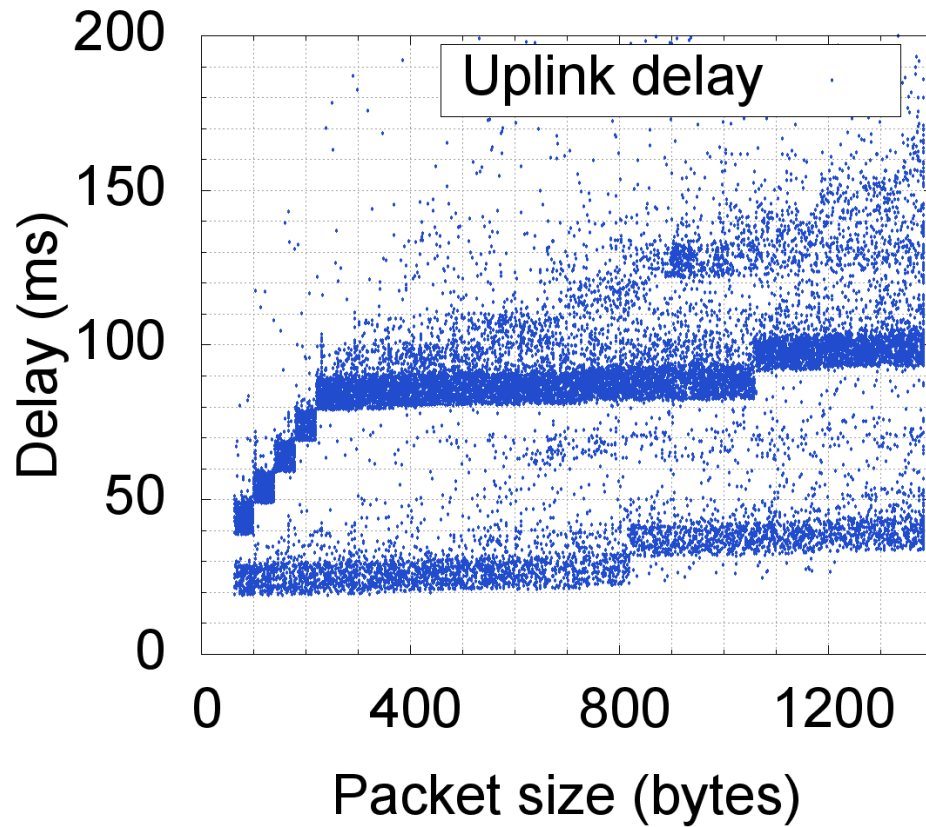


LTE Delay

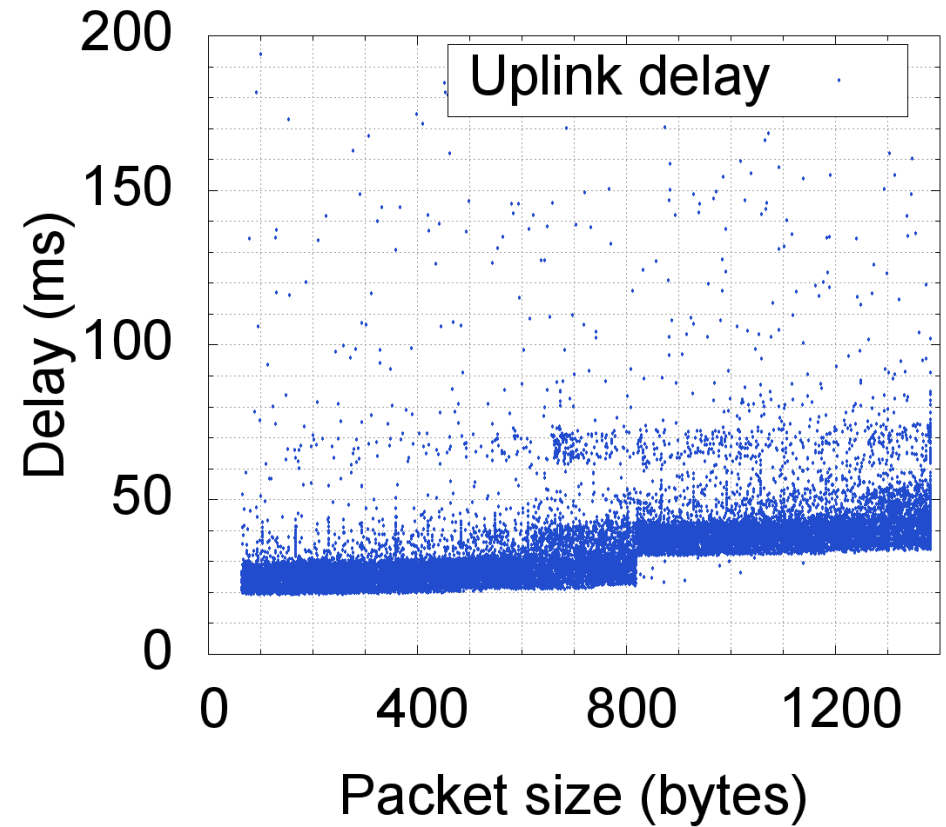


Rate Dependence (HSPA)

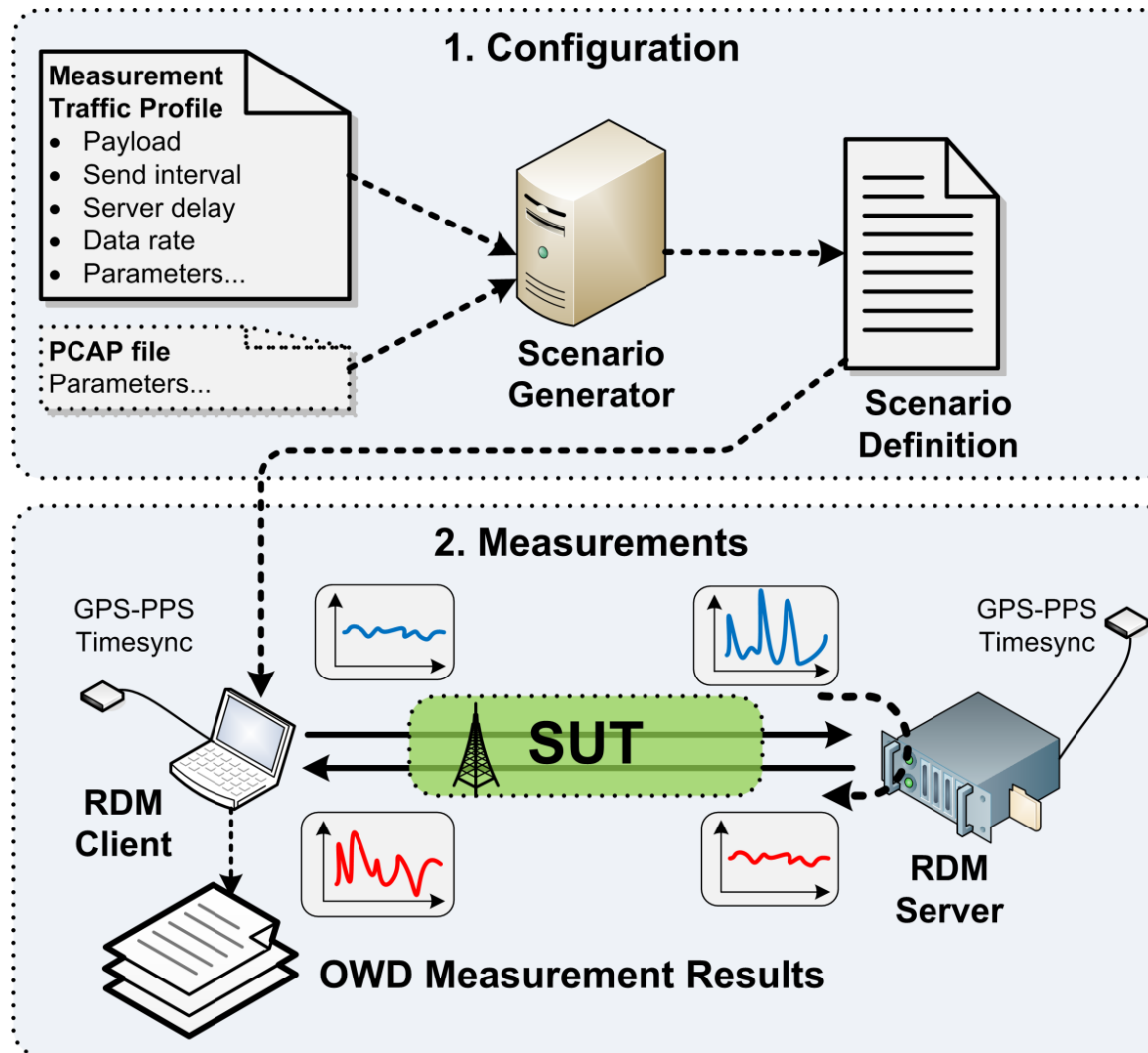
Low Bit Rate Scenario



High Bit Rate Scenario



Representative Delay Measurements (RDM)



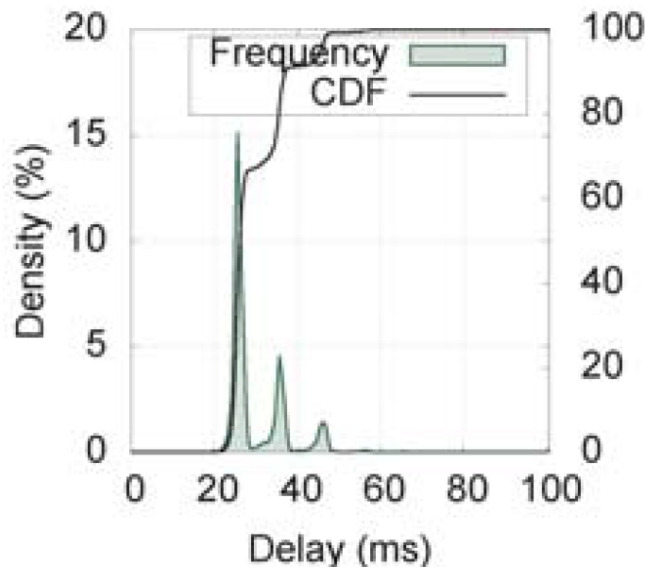
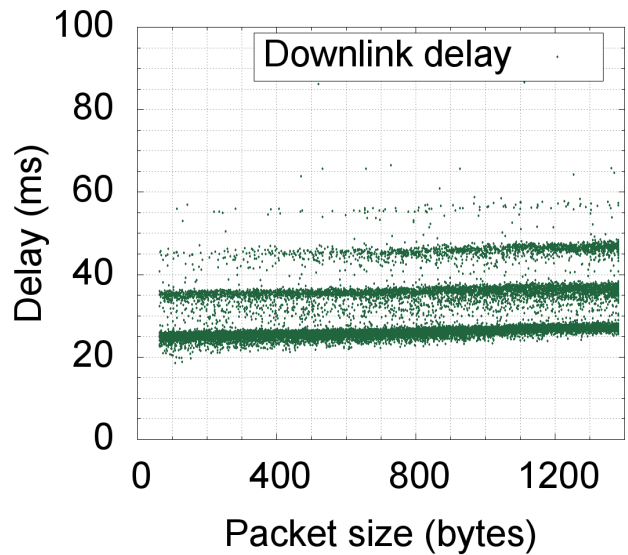
Fabini, Zseby, Hirschbichler: "Representative Delay Measurements (RDM): Facing the Challenge of Modern Networks," *8th International Conference on Performance Evaluation Methodologies and Tools, ICST, Brussels, Belgium, 2014*

RDM

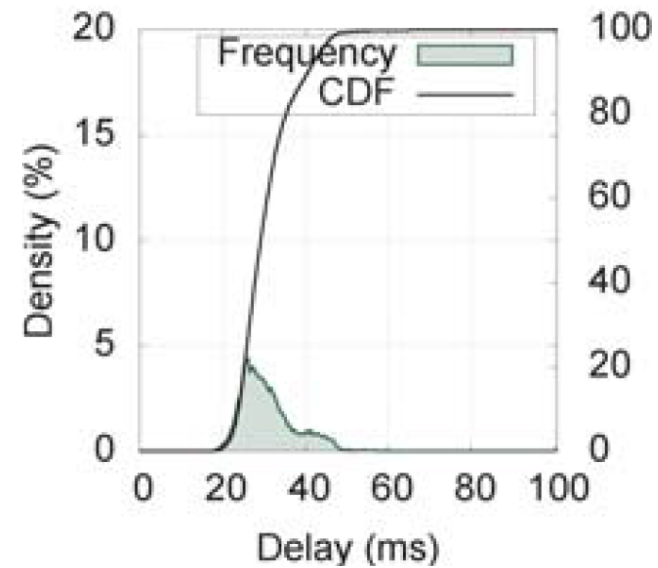
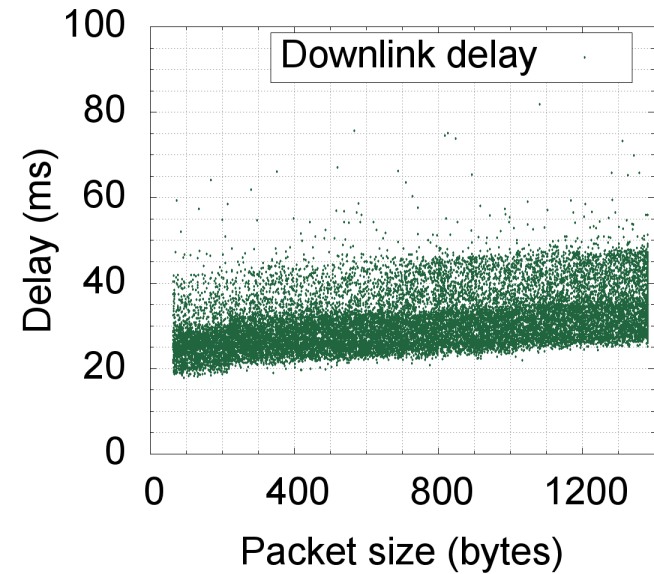
- Scenario concept
 - Different network loads
 - Highly compressed packet payload → preventing optimizers to further compress packet
- Check for reactive network behavior
 - Identical scenario definitions
 - Multiple subsequent test runs
- Detecting
 - Reactive network behavior (e.g. load dependence)
 - Optimizers (compressed vs. non-compressed)
- Time slotting → Randomness regeneration
 - Server delays packet before reflecting it

Randomness Regeneration (HSPA)

RFC 2330 compliant



Server regenerated randomness



Conclusion

- Networks have evolved
 - Stateful, load dependence, history, time-slotting, ...
- RFC 2330 conformant measurements
 - Impaired repeatability for cellular access networks
 - Influence to concatenated paths
- ➔ RFC 7312: Advanced Stream and Sampling Framework for IPPM
 - Influence of Packet length, payload type
 - Influence of history (rate, inactivity)
 - Randomness cancellation
- RDM Tool implements ideas from RFC 7312
 - Stream Description (RFC7312 Options)
 - Randomness Regeneration

Thank You!



Open PhD Position at TU Wien

- 3 year position, full time
- Topic: Network Traffic Analysis, Security
- Contact: tanja.zseby@tuwien.ac.at