

Mobile Throughput Guidance Exposure

- Requirements and reference architecture for Mobile Throughput Guidance Exposure ([draft-sprecher-mobile-tg-exposure-req-arch](#))
- Mobile Throughput Guidance Inband Signaling Protocol ([draft-flinck-mobile-throughput-guidance](#))
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 - Nurit Sprecher, Hannu Flinck and Swaminathan Arunachalam / Nokia Networks
 - Kevin Smith and Guenter Klas / Vodafone

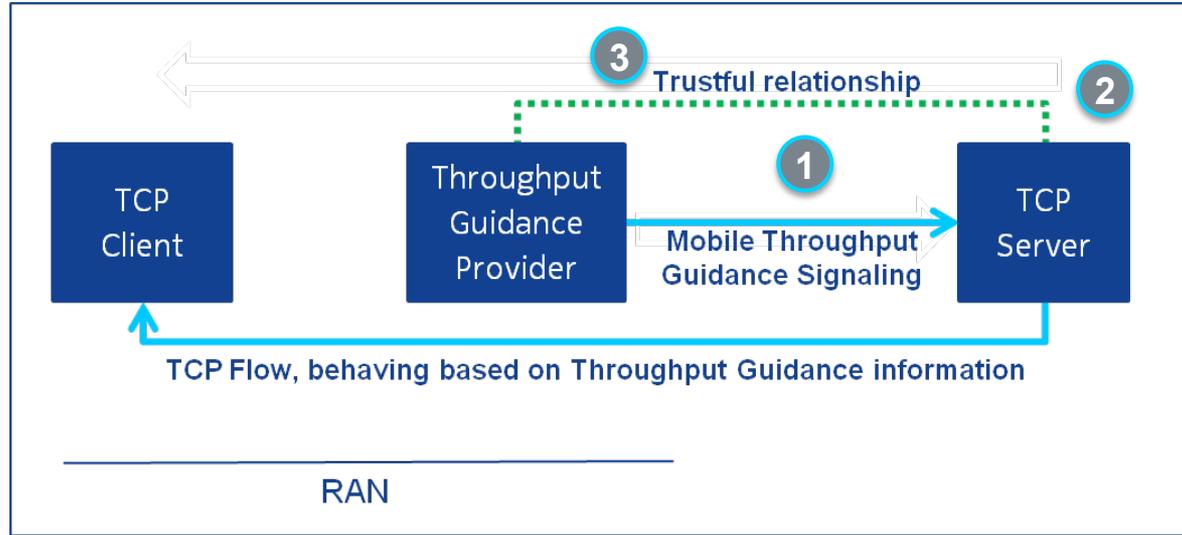
Problem Statement

- TCP may not be able to adapt fast enough to rapidly-varying conditions in radio access network (RAN)
 - Available capacity can vary by an order of magnitude within seconds
 - Changes in radio channel conditions, devices entering/leaving network
 - Non-congestive packets losses
- TCP's inability to adapt leads to under-utilization of precious radio resources and bloat
- Also leads to sub-optimal user experience

Solution Principles

- Cellular network can provide near real-time Throughput Guidance (TG) information about capacity available on the radio downlink interface
- TCP server can use this information to inform congestion control decisions
 - Selecting Initial Window size, deciding cwnd value during congestion avoidance, reducing cwnd value when radio conditions deteriorate
- Applications can use the same information
 - Select video rate that matches network's resources

Throughput Guidance Solution Architecture



- 1** Throughput Guidance per user is sent to the TCP video server
- 2** The information can be used to assist TCP congestion control decisions and also to ensure that the application-level coding matches the estimated capacity at the radio downlink
- 3** A trustful relationship is established between the TG provider and the TCP server

Requirements [1 of 2]

- Solution shall work with TCP and HTTPS
- TG shall provide real-time expected available bandwidth in radio downlink
 - Configurable granularity: per TCP flow, per user/bearer
- Solution shall not require changes to TCP clients
- TCP server should consider the TG information only as a hint

Security Requirements [2 of 2]

- Throughput guidance is considered confidential information and it should be provided in a secure way
- A trustful relationship should be formed between the TG Provider and the TCP server
 - The TCP server shall be able to authenticate the identity of the TG Provider
 - The TCP server shall be able to check the integrity of the TG information
 - It should be possible to configure the required security level

Strawman Architecture Realization

- TCP in-band signaling is used as the throughput guidance exposure mechanism (utilizing TCP options) , since it:
 - Is a generic solution, which works with HTTPS
 - Is Application agnostic
 - Does not require a separate interface, reference value, or correlation mechanism, and can keep up (in real time) with the rapid changes in the underlying radio link throughput.
- TCP server sets $cwnd = RTT * TG$
- Upon loss, server reverts to standard TCP until loss is recovered

Google and Nokia – trial outcome

Network & Application metrics

Trial Environment : LTE live radio network

The network level metrics show an average improvement between 30-60%

TCP ROUND-TRIP TIME
55-70%

TCP RETRANSMISSIONS
30-45%

Mean Client Throughput
20-35%

TCP Packet Loss
35%-50%

click-to-play time reduction

5-20%

Average video resolution improvement

5-20%

Video format change frequency reduction

10%-25%

The application level metrics show an average improvement between 10-15%



Open discussion

- Q & A
- Possible WG activity

Thank You!