Link Characteristics Information conveyance

MOBOPTS IETF #65

J. Zhang, S. Park, J. Korhonen,
P. Sarolahti

Introduction

- Prelimenary results from two different sets of simulations utilizing explicit LCI delivery
- Using TCP as the example transport
- Simulation 1
  - LCI delivered as a part of MIP6 signaling and applied to TCP (a Quick-start like variant)
- Simulation 2
  - LCI delivered after the hand-off and used to re-trigger TCP Quick-start
- These are the first experiments...

Quick-Start Challenges

- Deployment to the Internet unlikely to happen soon
  - Deployment to operator networks / private intranets less unlikely
- IP tunnels “hide” QS requests
- Buggy firewalls/NATs can drop packets with unknown IP option
  - As of today, there are lots of them!

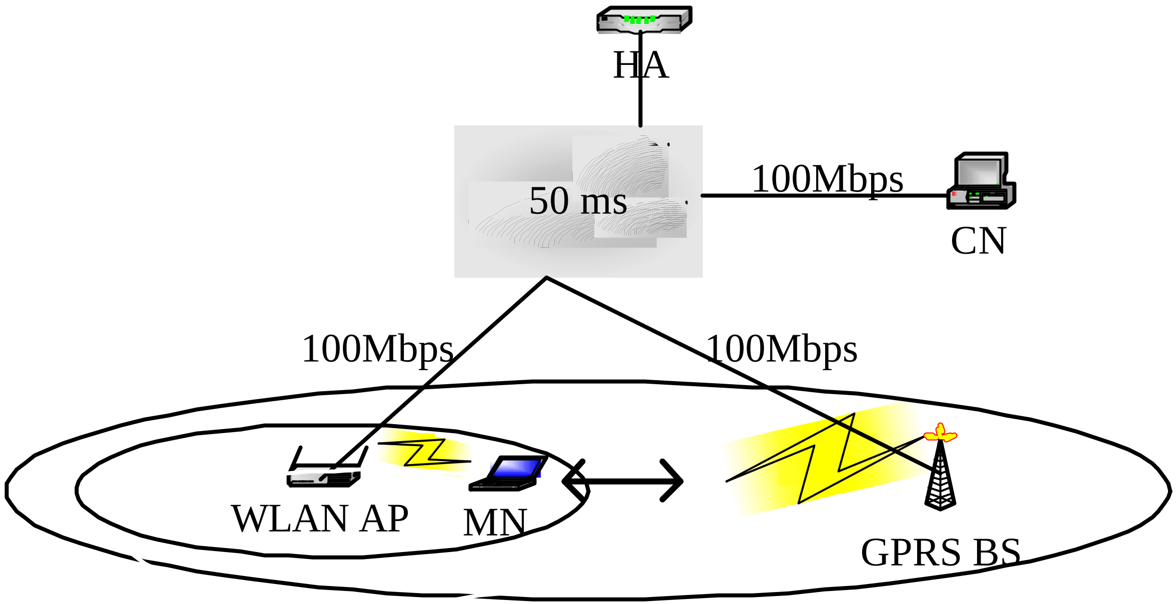
Simulation 1

- ”TCP Quick-Adjust (QA) by Utilising Access Link Characteristic Information”
- An extension of TCP Quick-Start (QS)
  - Adjusts and sets *maxcwnd* & *cwnd* to both directions
- An algorithm of utilizing the explicit link characteristic information (LCI) for TCP

Assumptions:

- The LCI is of the bottleneck link of the whole path.
- The LCI notification is timely.

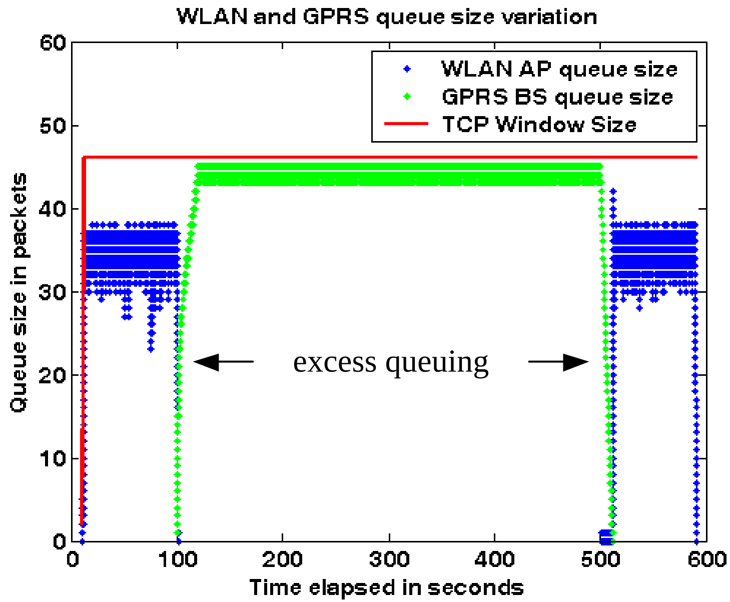
Simulation Scenario



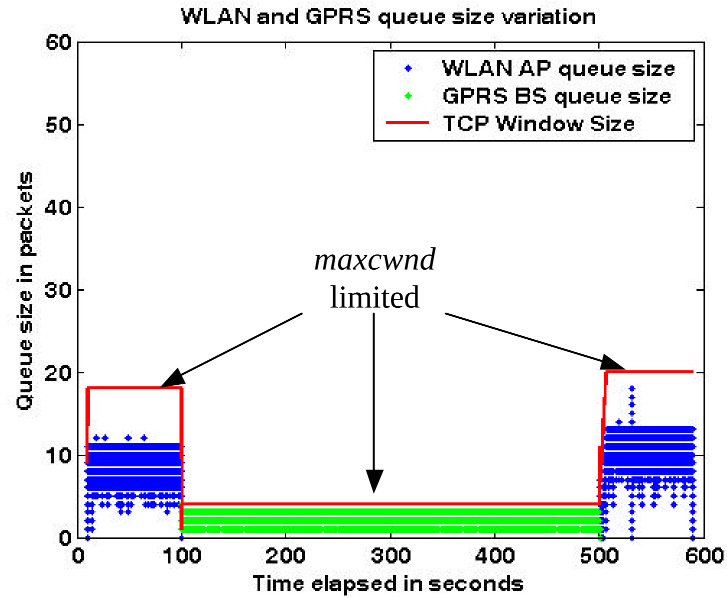
- An MN moving between WLAN (set to 1Mbps) and GPRS (set to 40.2/13.4kbps).
- FTP data transfer from CN to MN.
- Mobile IPv6 is used for mobility management and LCI transportation.

Evaluation Results

-- WLAN AP and GPRS BS Downlink Queue Length Variation



Normal TCP SACK

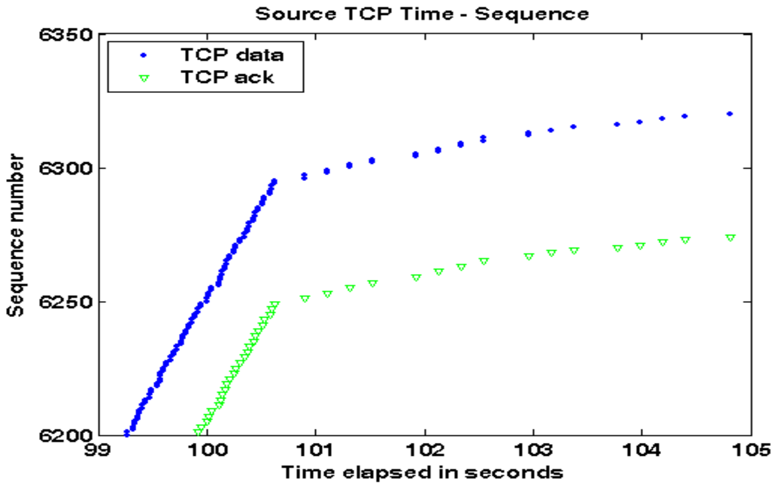


TCP SACK + QA

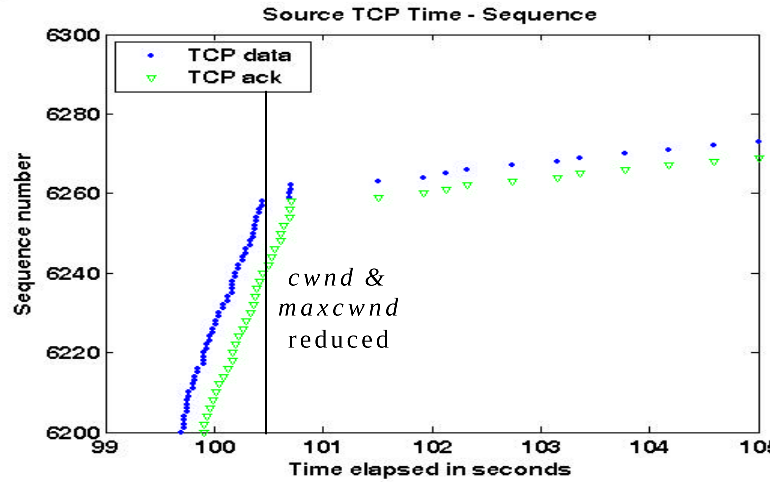
	WLAN Throughput	GPRS Throughput
Normal TCP SACK	772.8 kbps	33.9 kbps
TCP Quick-Adjust	772.9 kbps	33.2 kbps

Evaluation Results (Cont.)

-- TCP Trace on WLAN => GPRS Handover



TCP SACK: WLAN->GPRS src TCP



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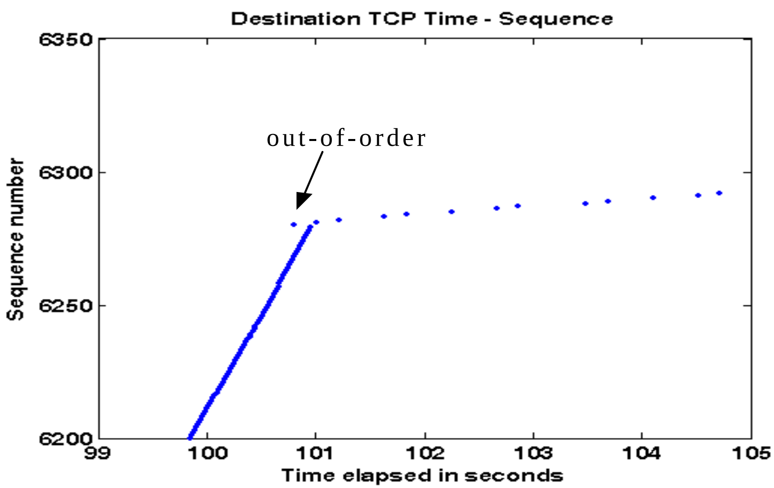
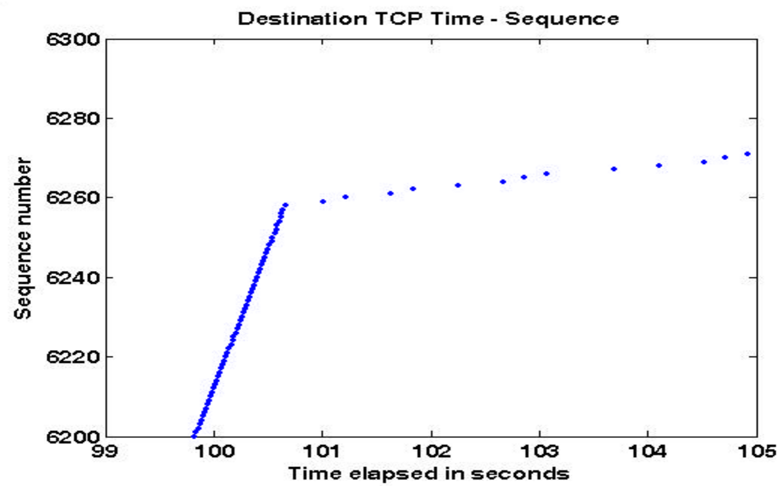


TCP SACK: WLAN->GPRS dst TCP



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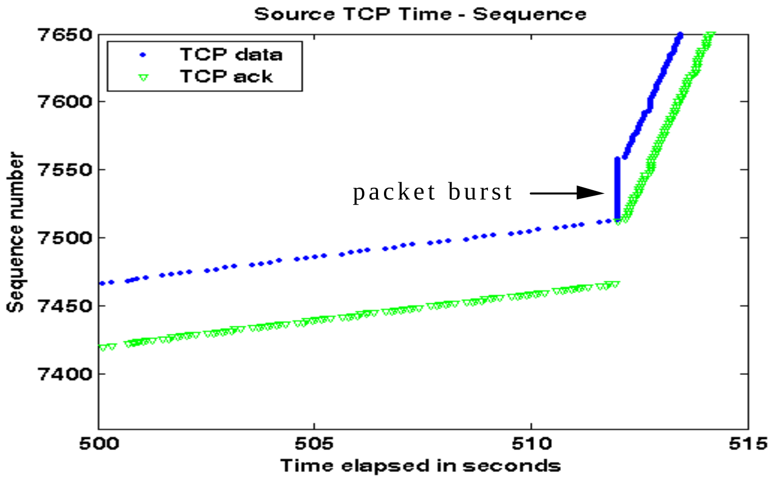
Evaluation Results (Cont.)

-- TCP Trace on GPRS => WLAN Handover



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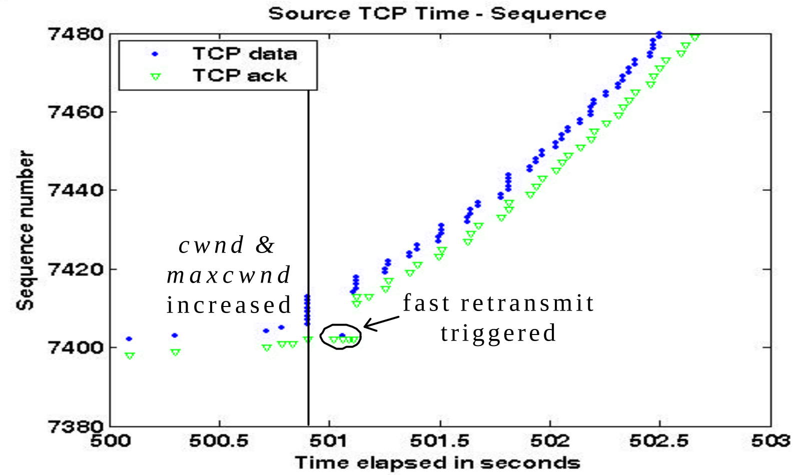
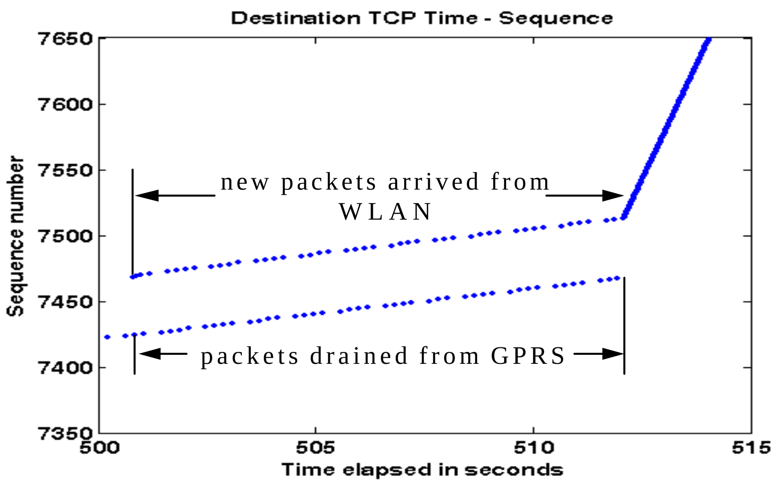
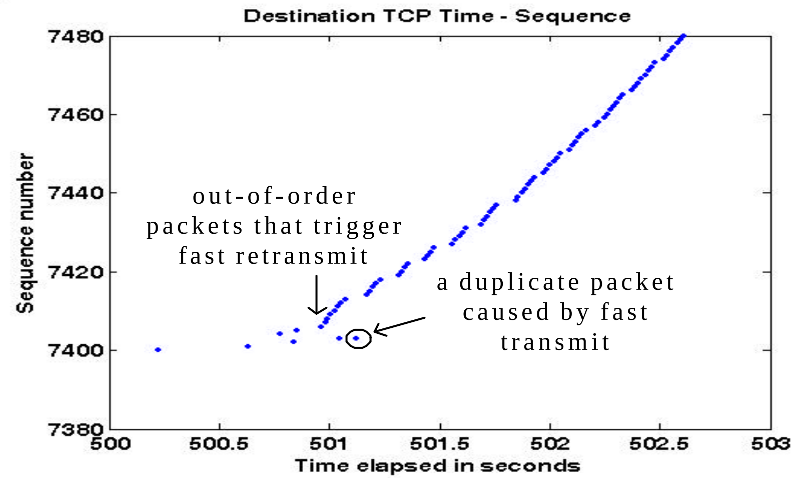


TCP SACK + QA: GPRS->WLAN src TCP



TCP SACK: GPRS->WLAN dst TCP



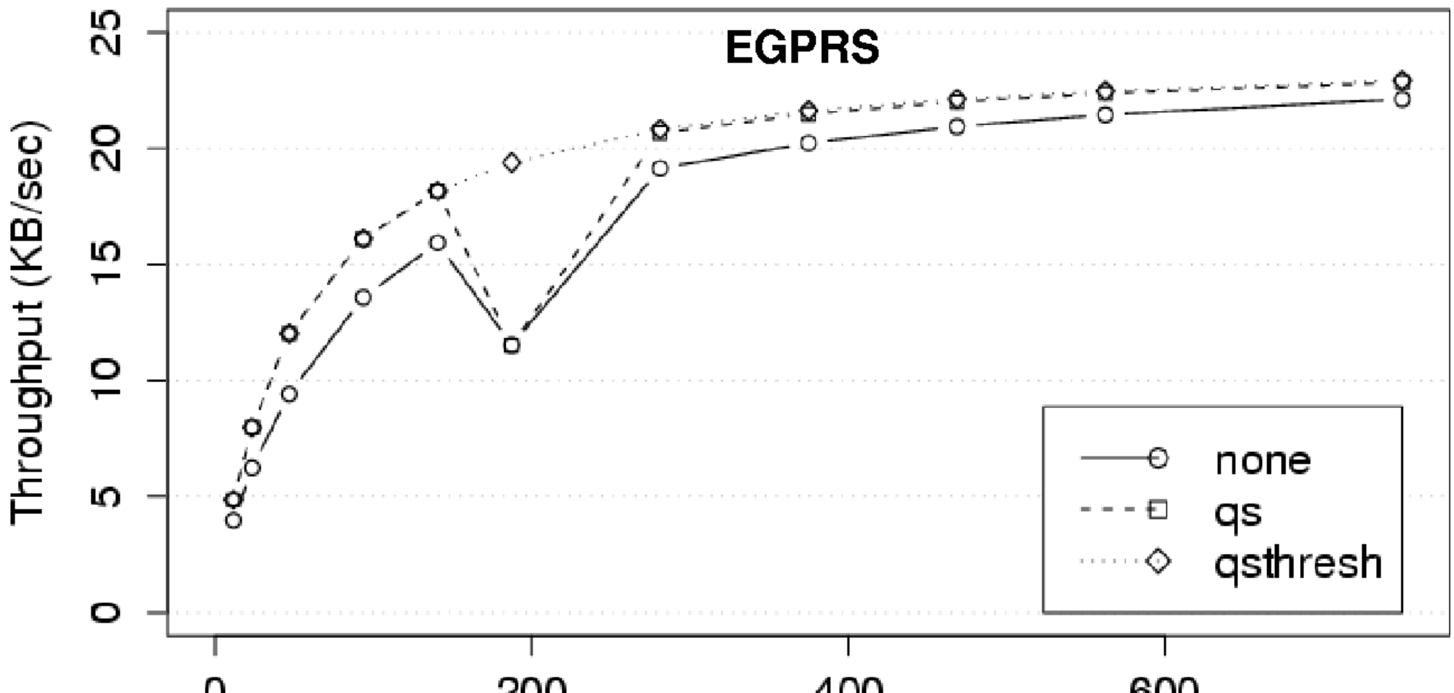
TCP SACK + QA: GPRS->WLAN dst TCP

Simulation 2: TCP and Vertical Hand-offs

- Somewhat similar network setup as in simulation 1 (WLAN 5Mbps/20ms, EGPRS 200Kbps/600ms)
- TCP congestion window is adjusted rather slowly
  - Slow-start in beginning: double congestion window in one RTT
  - Congestion avoidance: increase congestion window by one in one RTT
  - Packet loss => window is halved
- After hand-off, new path can have different capacity than earlier had
  - *Congestion window could be far off from it should be*
- *As a result:*
  - *Too large congestion window => many packets are lost*
  - *Too small congestion window => wireless link is utilized inefficiently*

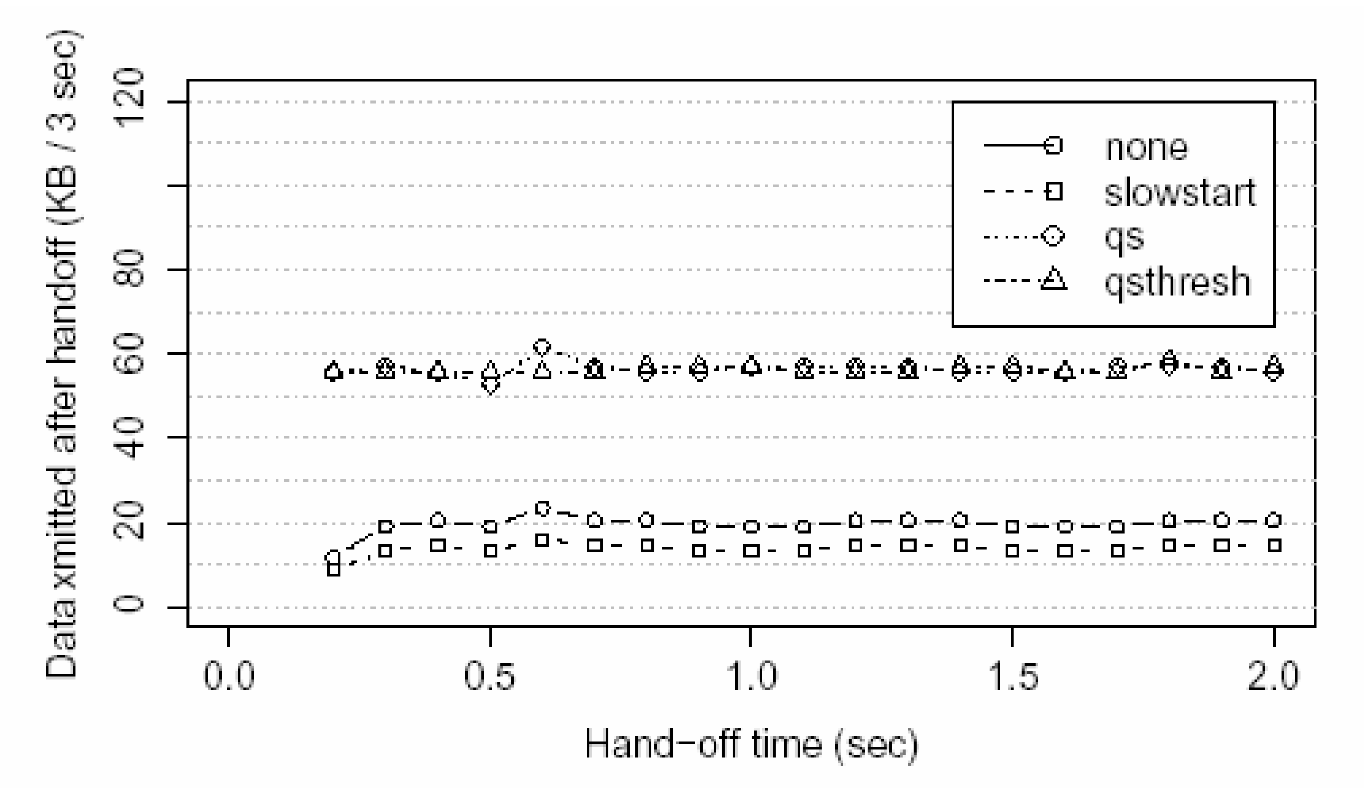
Performance in Connection Start-up

- Connection performance on different TCP file sizes
- Qsthresh: set TCP congestion window and slow-start threshold based on QS
- Default slow-start threshold leads to packet losses
  - TCP congestion control feed-back is “late” by one RTT



Hand-off Performance

- Break-before-make / Wireless LAN to EGPRS
- *With QS, capacity of new path is resolved immediately*
- *Normal TCP converges slowly to new capacity*



Conclusions and Next Steps

- Link characteristics is often essential part of the path characteristics
  - Exact information is hard to get immediately after a ho
  - LCI is more likely a good guess when the change is significant
- Our simulations indicated that LCI delivery can expedite the transport adaptation to new link
- Similar approaches can be used to enhance other transport protocols, such as SCTP, DCCP, RTP/RTCP etc.
- Further work & simulations on delivering notification on ’significant’ Delay and/or Bandwidth changes (and possibly ho type)
- The gathering and delivery methods of the bottleneck link characteristic information need further investigations

Questions and stuff?