

PREDICTIVE BUFFERING FOR STREAMING VIDEO IN 3G NETWORKS

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Curcio

PROBLEM STATEMENT

- 22% of mobile broadband in the US is YouTube [MobileTrends, 2011].
 - [note] <http://m.youtube.com> uses RTSP instead of HTTP based progressive download.
- Problems with 3G connectivity:
 - Mobility (fading, interference, cell loading, handovers) → affects available throughput

STREAMING

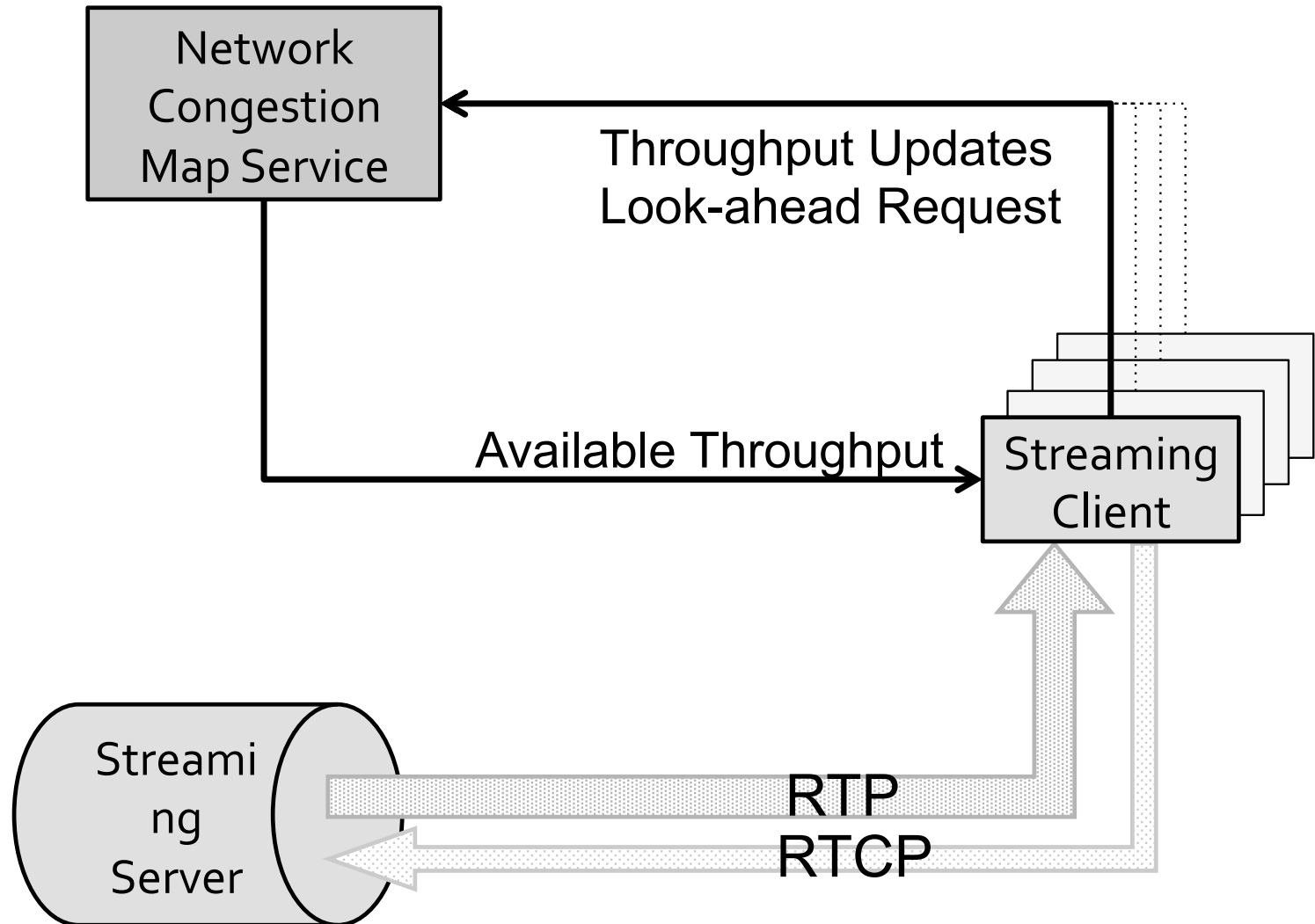
- If there is loss of connectivity
 - Pre-buffer, typically, ~5 to 10s
 - May be insufficient in the case of 3G
 - Rate-switching usually happens after disruption is detected

ATT COVERAGE MAP

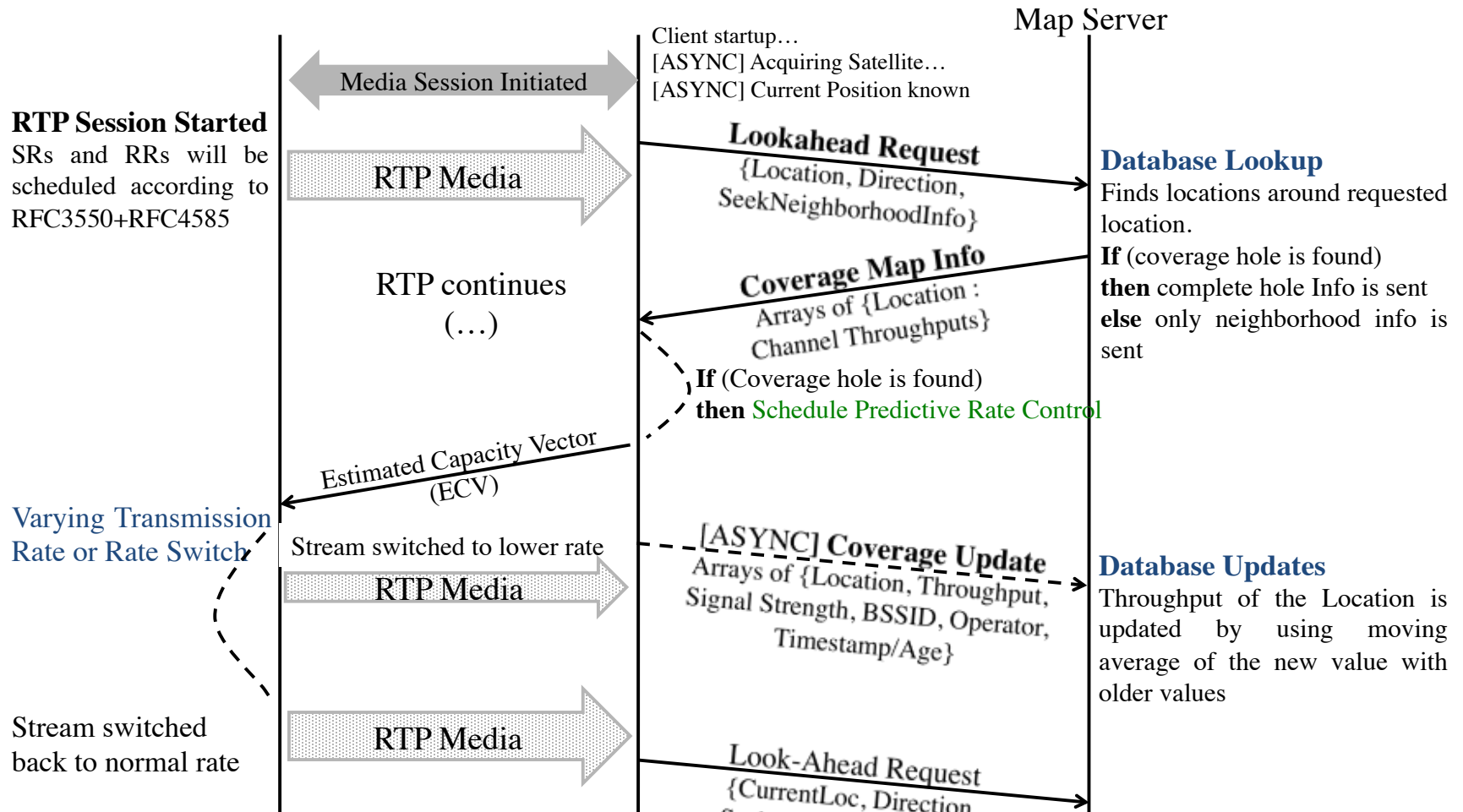


<http://www.wireless.att.com/coverageviewer/>

ARCHITECTURE



SIGNALING

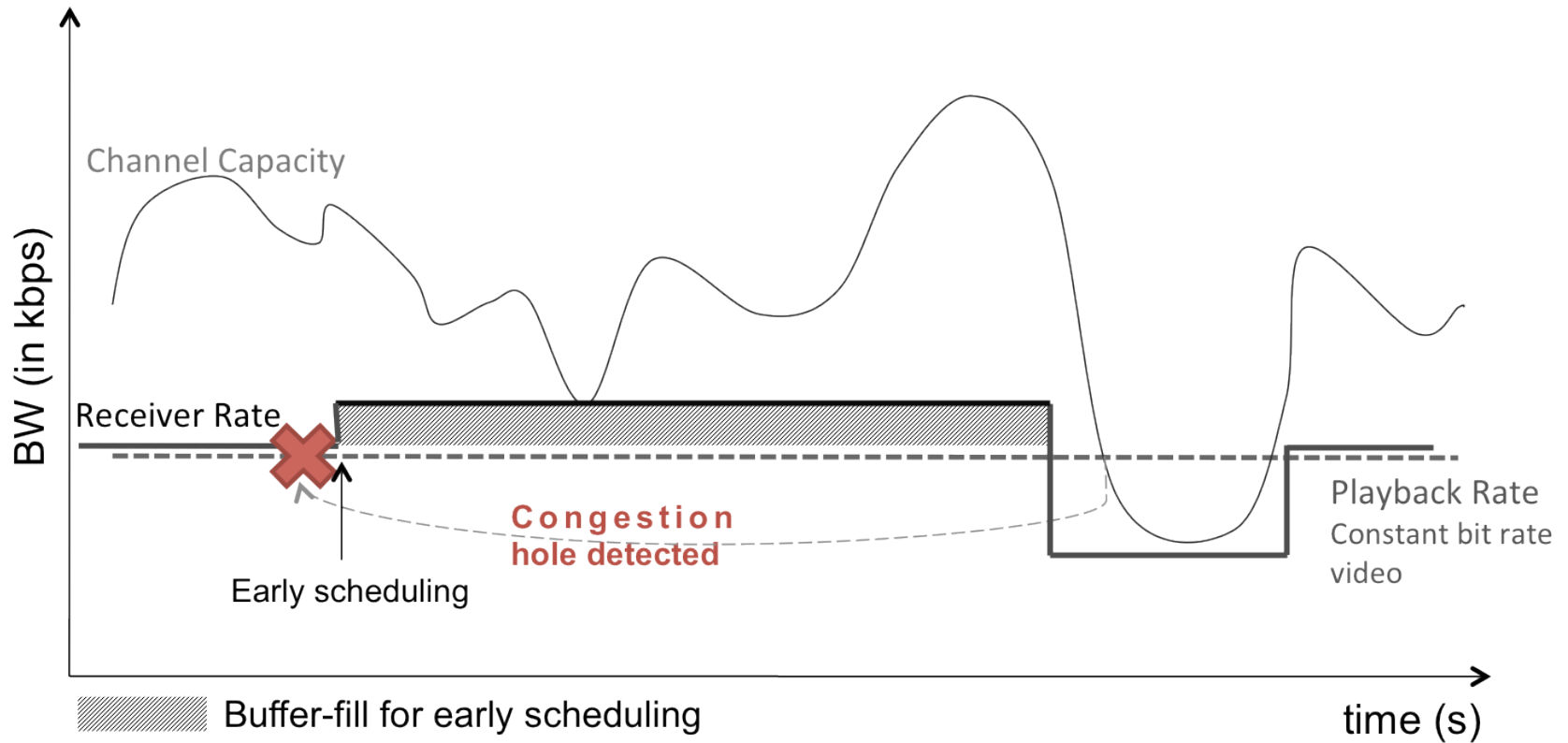


Alternative: RTSP **SPEED** parameter

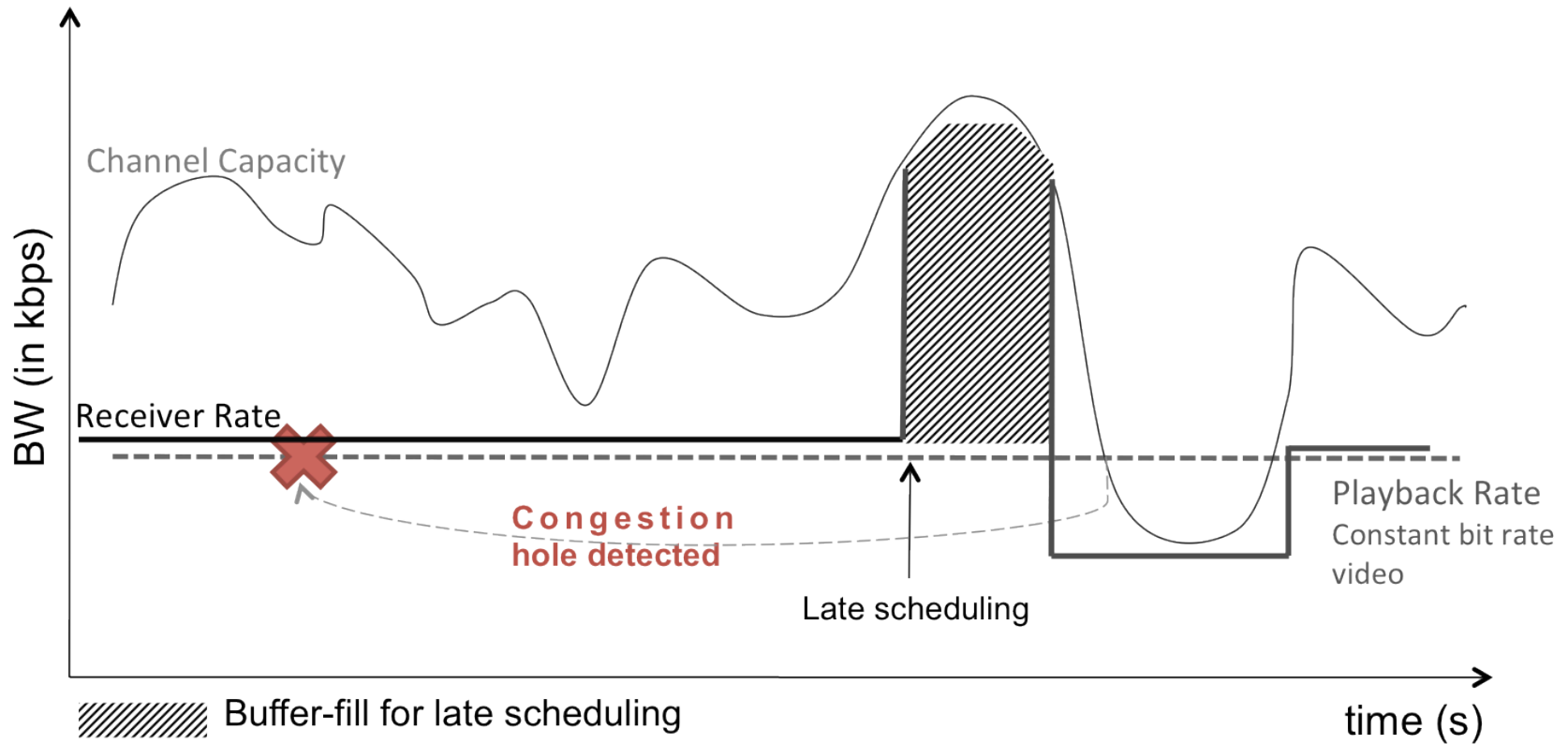
LOOK-AHEAD

- Known travel route
 - Client can calculate maximum size of pre-buffer for the whole trip.
- Area look ahead
 - Client can only calculate optimum buffer for the known outages
 - Client subscribe to locations with poor connectivity for updates

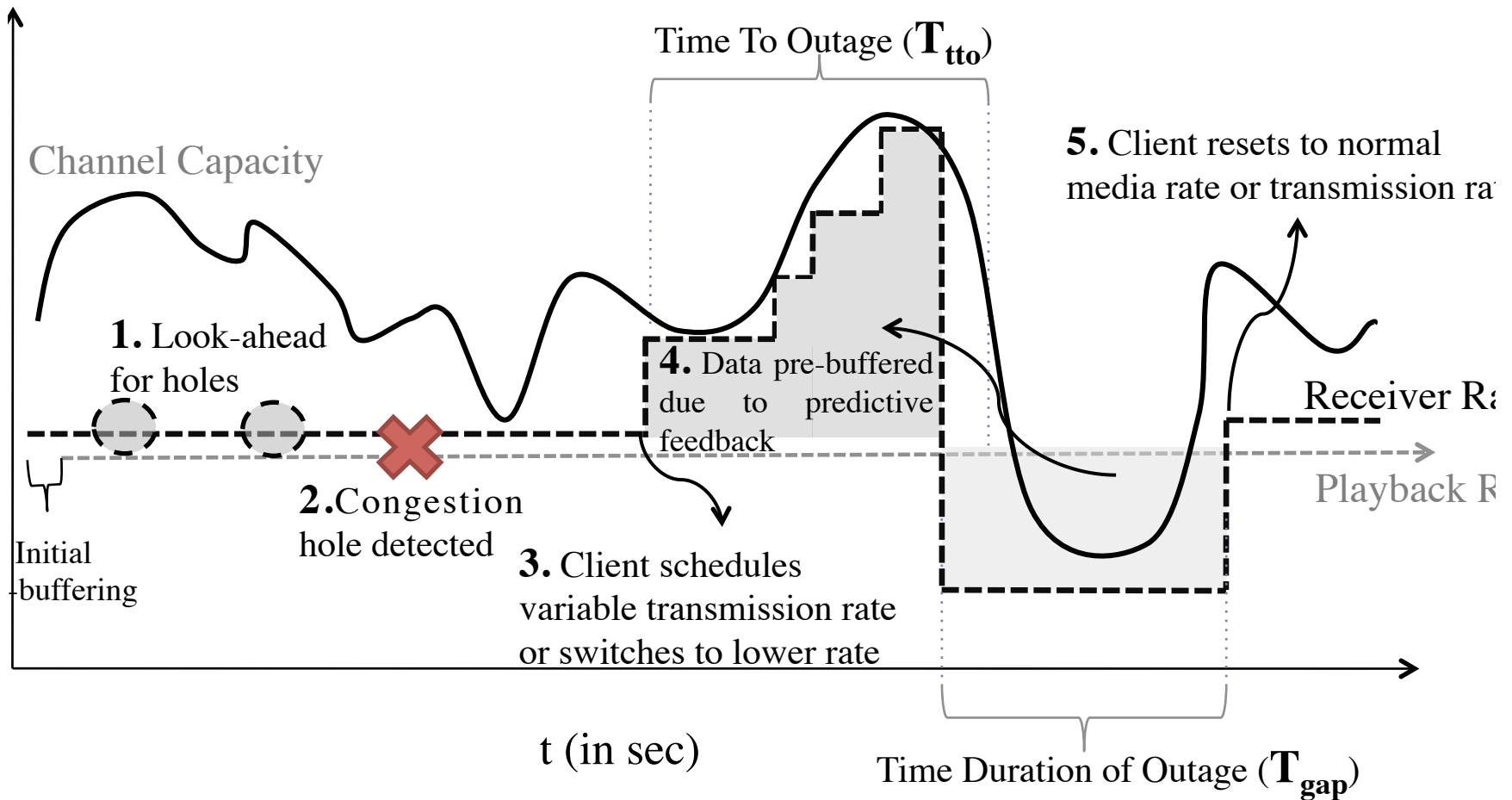
EARLY SCHEDULING



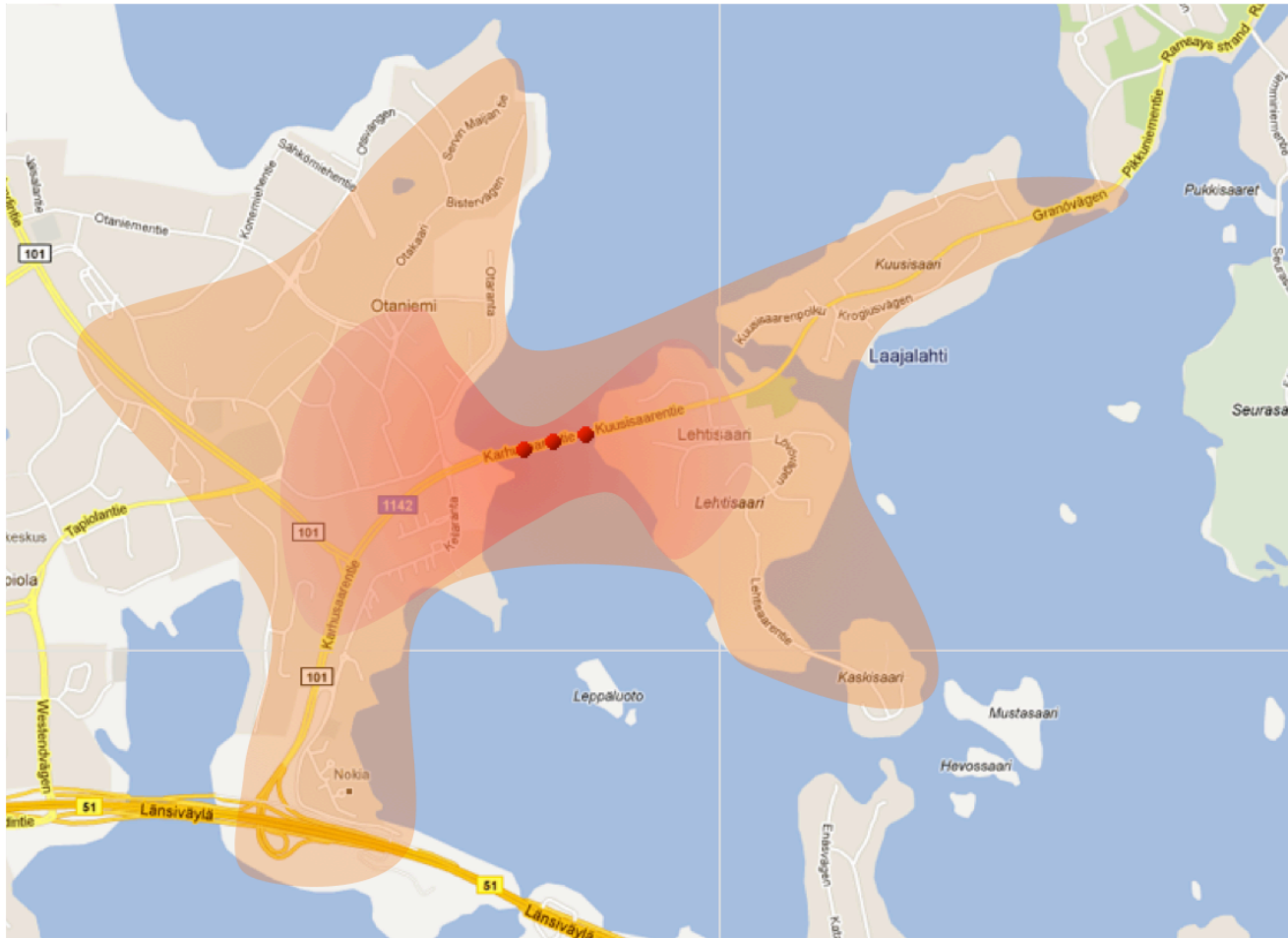
LATE SCHEDULING



CLIENT OPERATION



CALCULATE IMPACT OF COVERAGE HOLE

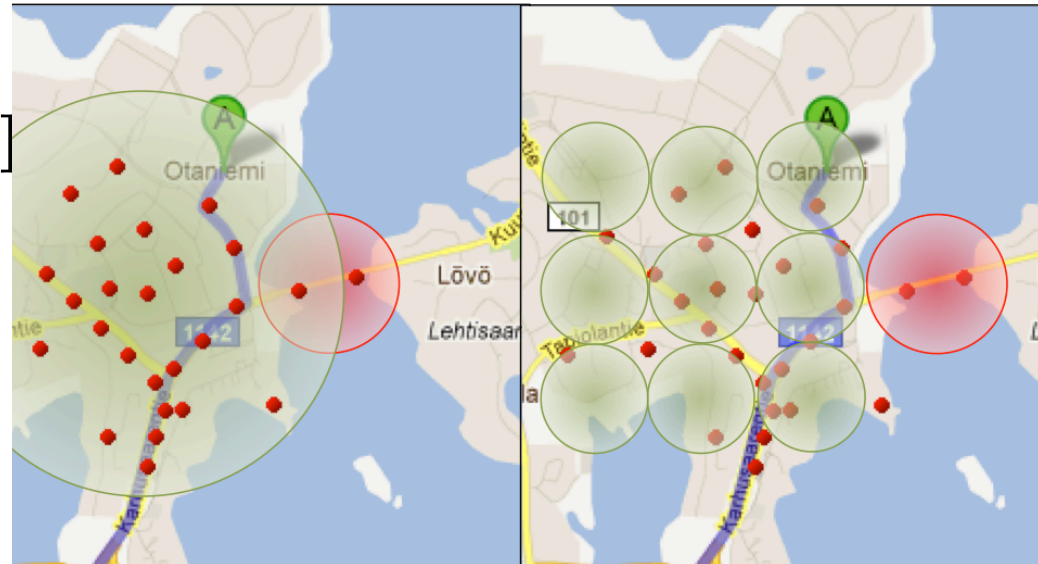


function(speed, location)

GROUPING OF THROUGHPUT VALUES

- Calculate STDEV for each region [1,3]
- Calculate AVERAGE/median for each region [2]
- Definition of region
 - Areas with similar throughput

This is out-of-scope of the paper

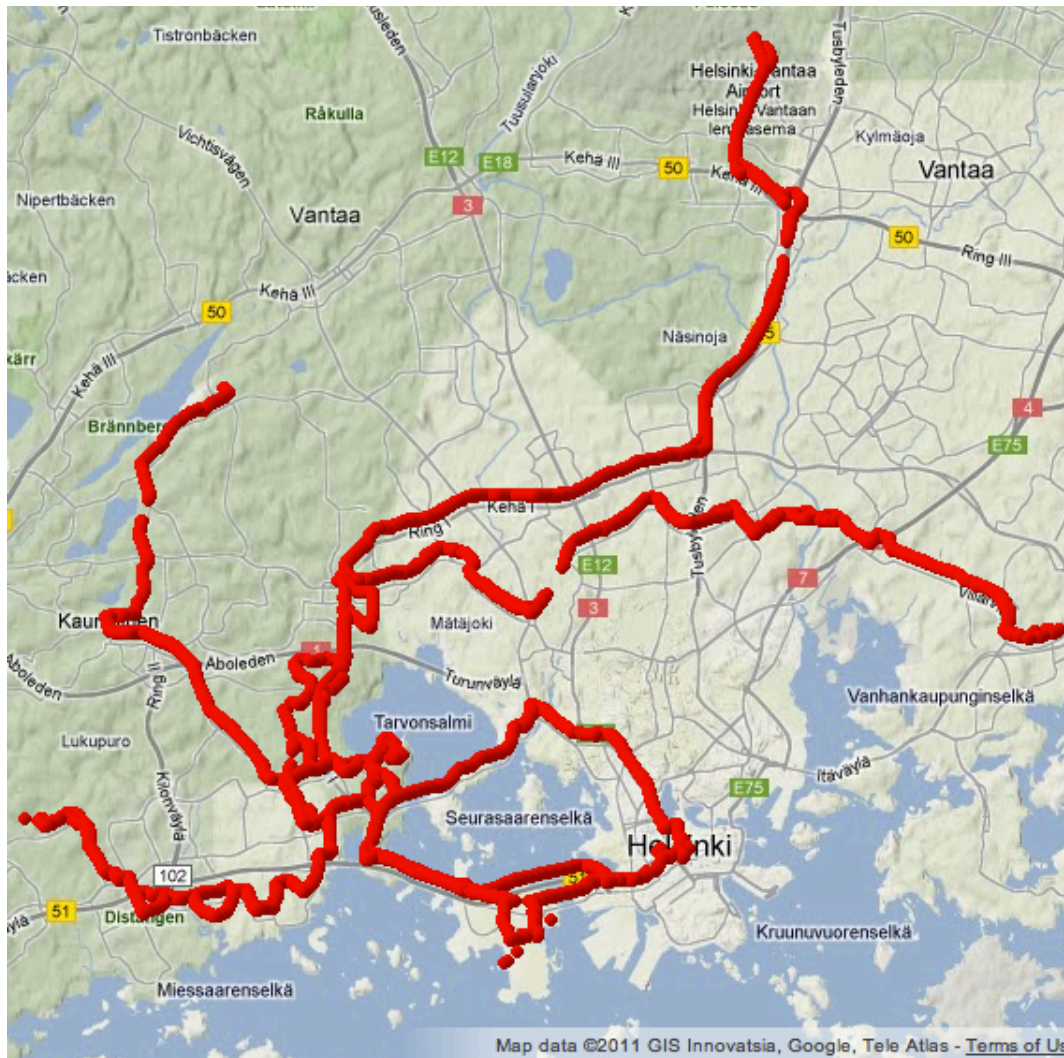


Use K-means square algorithm
Grouping based on throughput

PROTOCOL DESIGN AND IMPLEMENTATION

- HTTP between Coverage Map Server and client
 - REpresentational State Transfer (REST) APIs
 - JSON encoded responses
- How to throttle the rate
 - Dictionary of {time, throughput}
 - RTSP Speed parameter
- Gstreamer using x264 and JRTPLib
- PostgreSQL, C++

HELSINKI BUS ROUTES

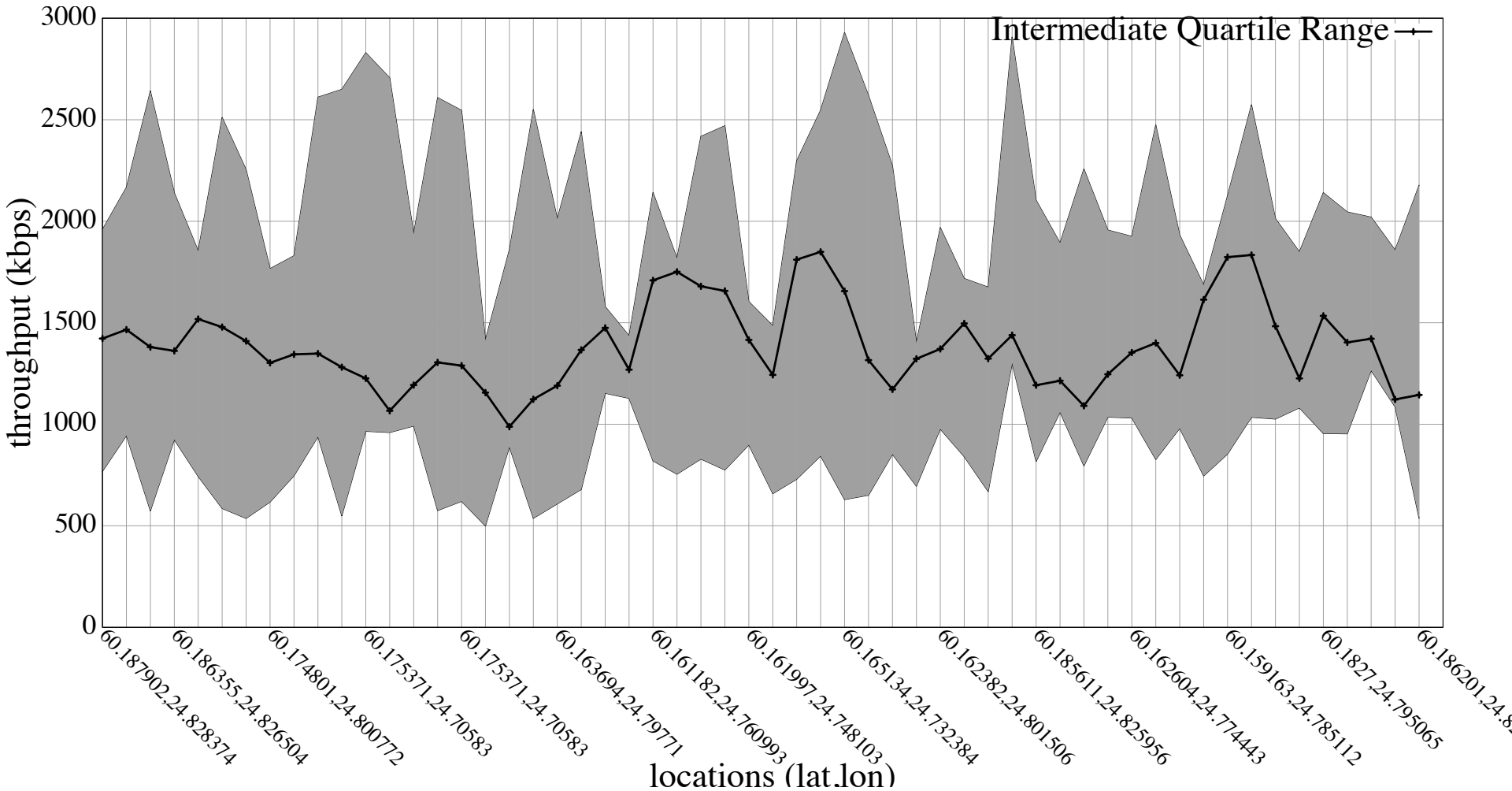


Second half of 2010
~400,000 updates

- 40-50 bus rides
- Walking around the city/campus

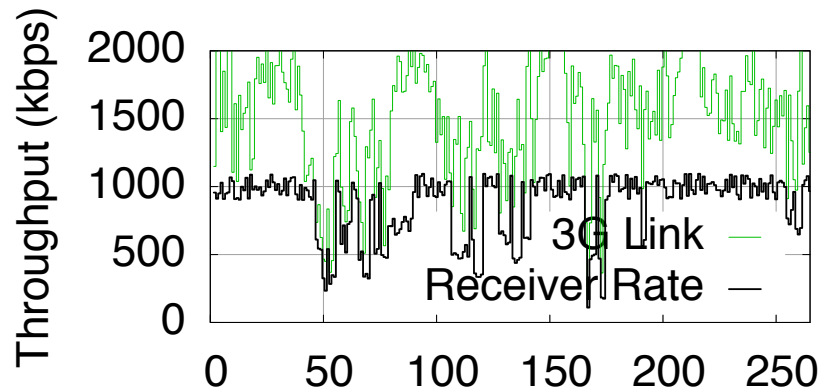
Map data ©2011 Google - [Terms of Use](#)

BANDWIDTH ALONG A TRAVEL ROUTE

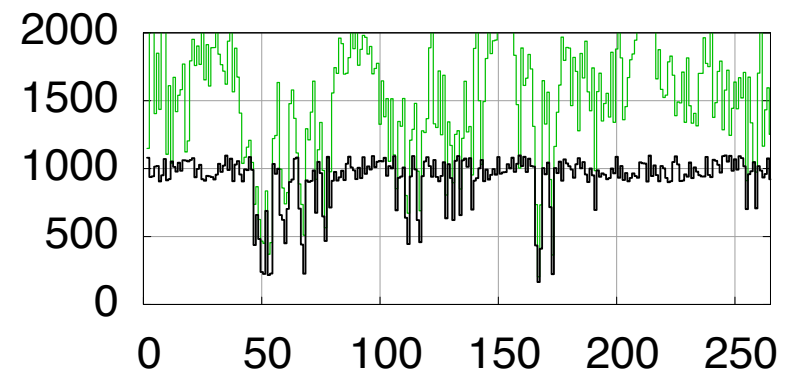


PERFORMANCE ANALYSIS

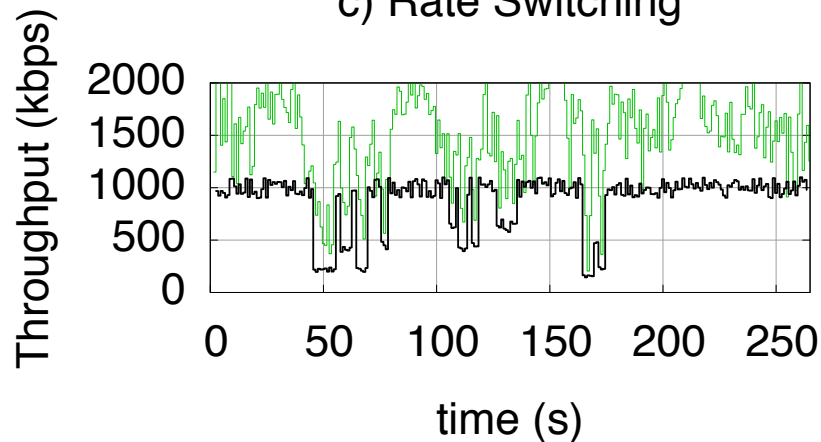
a) No Adaptation



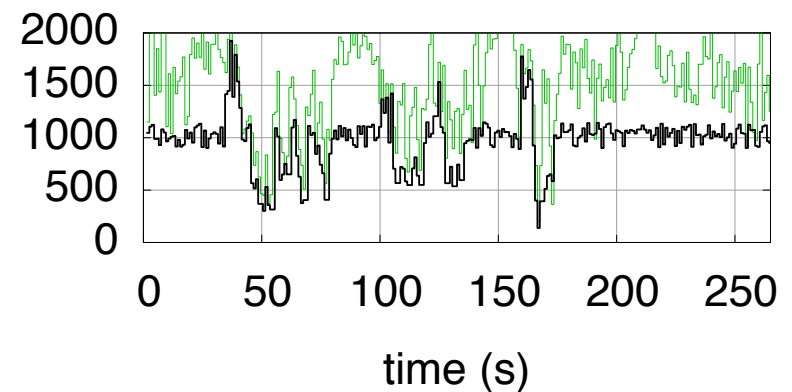
b) Omniscient



c) Rate Switching



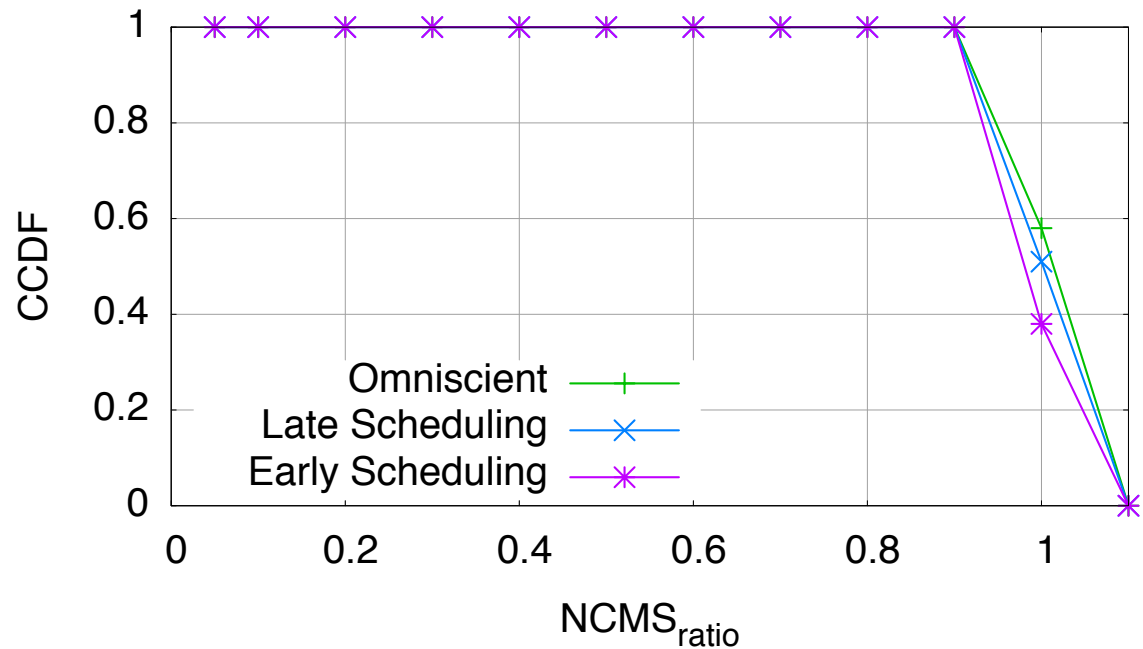
d) Late Scheduling



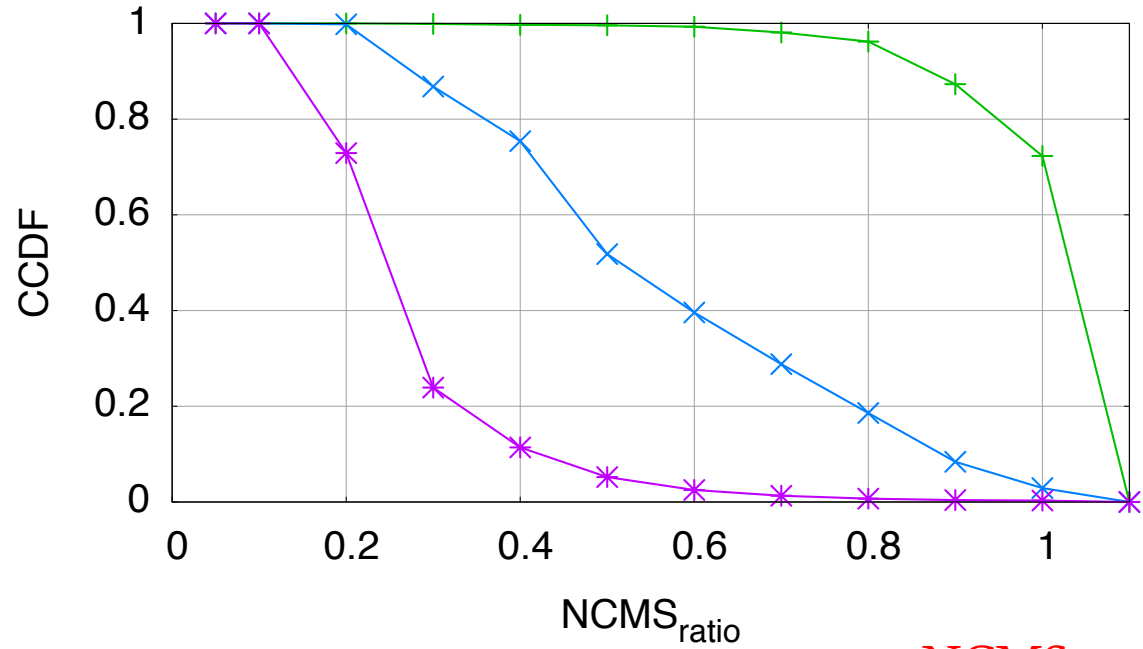
VIDEO QUALITY

- Average PSNR over multiple runs
- No adaptation: 27.5
- Omniscient: 43.12
- Rate-switching: 42.75
- Late-switching: 48.43

At t=1h



At t=8h



NCMS_{ratio} = Response / Actual

CONCLUSIONS

- We find that the information provided by coverage map service is suitable for
 - Predictive rate-switching
 - Predictive pre-buffering
- Future Work: Integrate with a DASH system