

IPTV performance monitoring in broadband access networks



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Lund University

- Founded in 1666, Lund University is today one of the largest, oldest and broadest universities in Scandinavia and is consistently ranked among the world's top 100 universities.
- With eight faculties, the University's activities cover education and research in engineering, science, law, social sciences, economics, medicine, humanities, theology, fine arts, music and drama.
- Around 46 000 students study at the University, which has about 6 000 employees.

Dept. of Electrical and Information Technology (EIT)



- High-quality research in a variety of areas in electrical engineering and computer science, ranging from pure theoretical research to applied projects in close collaboration with industry.
- The Dept. of EIT is the major academic platform for local Swedish industry in the telecommunications area.

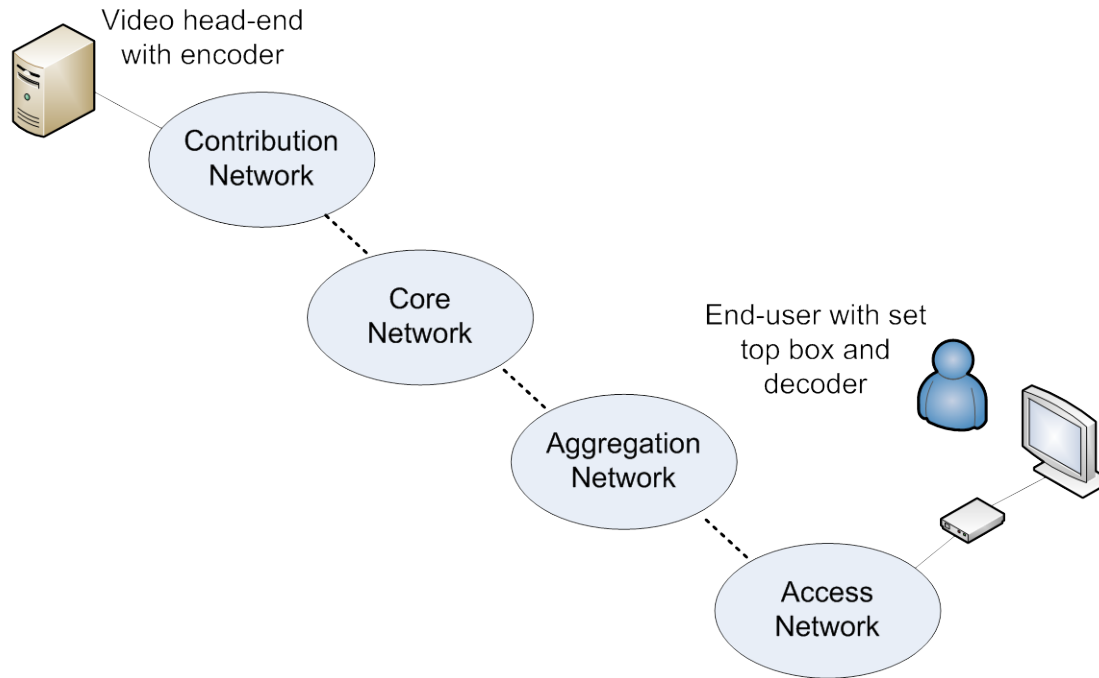


Broadband communications research group

- The Broadband Communications group at EIT focuses on broadband access and core networks, on all layers.
- The research areas are applied signal processing, DSL systems, and network design.
- System-centric approach, where the system functionality and maintenance is the main focus.
- The research is performed in close cooperation with Swedish and International industrial partners.



High quality TV over Internet



IPTV: One operator, usually multicast.
OTT Video: Several operators, unicast.

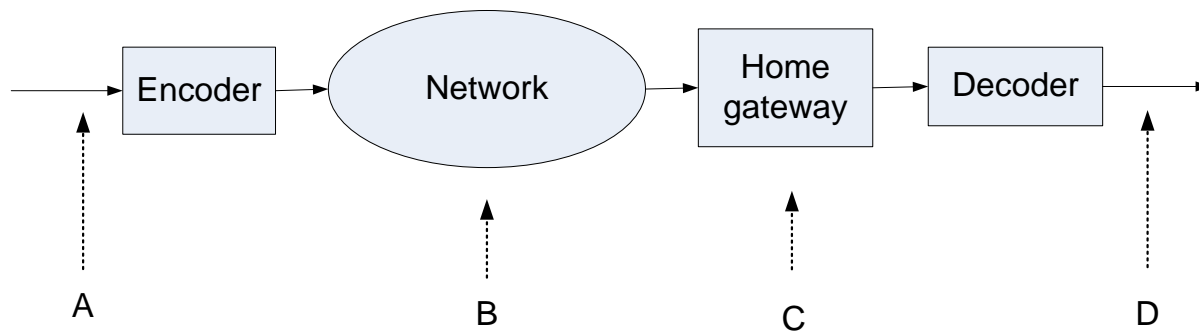


Quality of Experience Requirements

- IPTV standardisation
 - Mean time between visible errors more than four hours
 - Maximum one error second per hour for SDTV
 - Maximum one error second per four hours for HDTV
- High quality demands, in particular for OTT Video.



Video quality monitoring



- Measurement point A has access to the original video sequence.
- Measurement point B is inside the networks (core, aggregation, access) and has access to IP packets via the routers.
- In Measurement point C, the application layer information is available.
- In Measurement point D, the encoded video sequence can be monitored.



Video quality prediction methods

- Full-reference methods
 - Have access to the original video and network measurements
- Reduced-reference methods
 - Have access to some information about the original video and network measurements
- No-reference methods
 - Have only access to network measurements

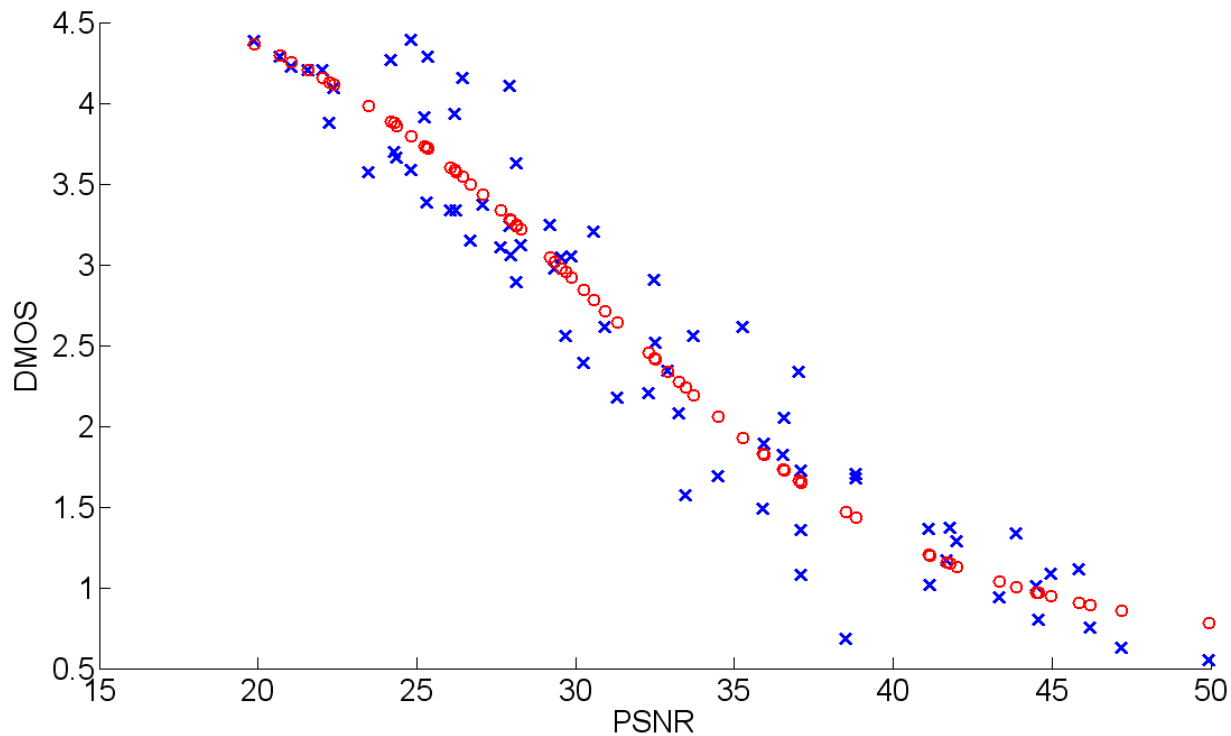


Quality assessment

- Subjective quality assessment
 - A group of viewers are asked to watch a set of video clips and rate the image quality.
 - Mean Opinion Score (MOS)
- Objective quality assessment
 - Objective quality metrics are designed to characterize the video quality and predict viewer MOS.
 - Uses a model to predict the MOS.



Example: DMOS v. PSNR



DMOS: Differential Mean Opinion Score; PSNR: Peak Signal to Noise Ratio;

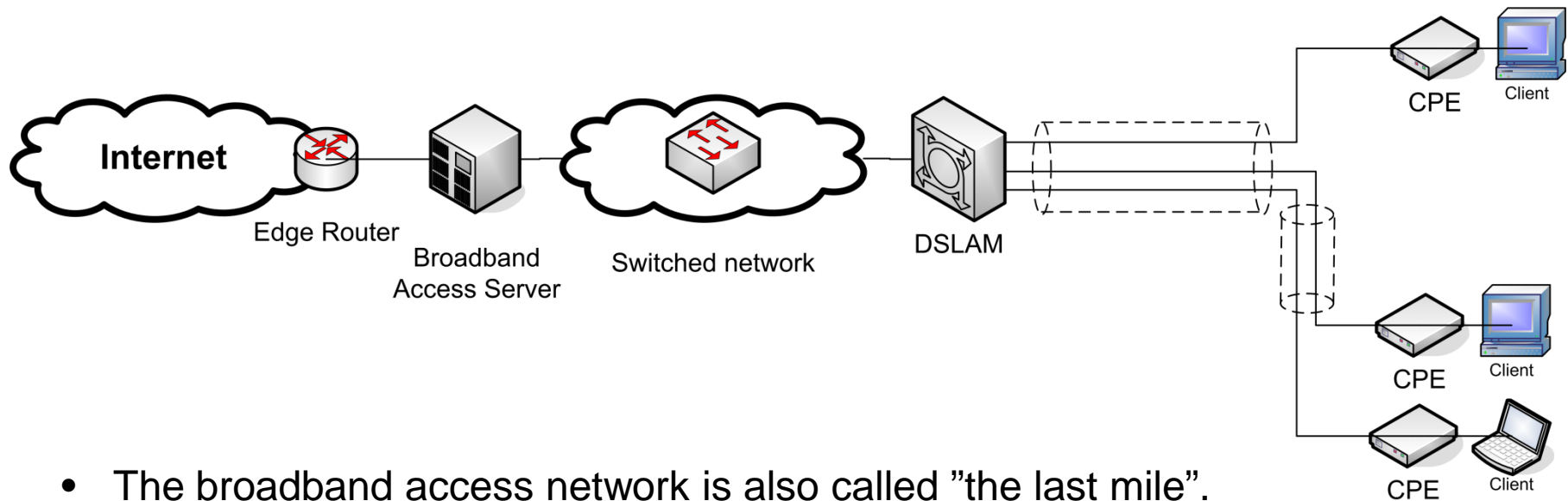


Quality impairments

- Packet loss
 - More than 0.1% packet loss, the QoE decreased considerably (Kooij, 2006)
- Latency
 - Affects mainly channel zapping
 - Latencies more than 0.5 seconds are not tolerable to the viewers (Hemminger, 2005)
- Jitter
 - Must be removed by buffering, causing delay



Broadband access networks



- The broadband access network is also called "the last mile".
- Most IPTV is delivered over xDSL networks.
- No caching or other network functions can compensate for disturbances in the access networks.



Quality impairments over DSL

- One non-recoverable bit error on DSL causes the loss of one IP packet.
- Typical DSL bit-error rate is 10^{-7} which can produce a visible error every few minutes (Asghar, 2009)
- Impulse noise, which is a non-stationary stochastic type of noise that is induced due to electromagnetic interference from domestic sources and external events, can be the most disturbing (Begen, 2008).

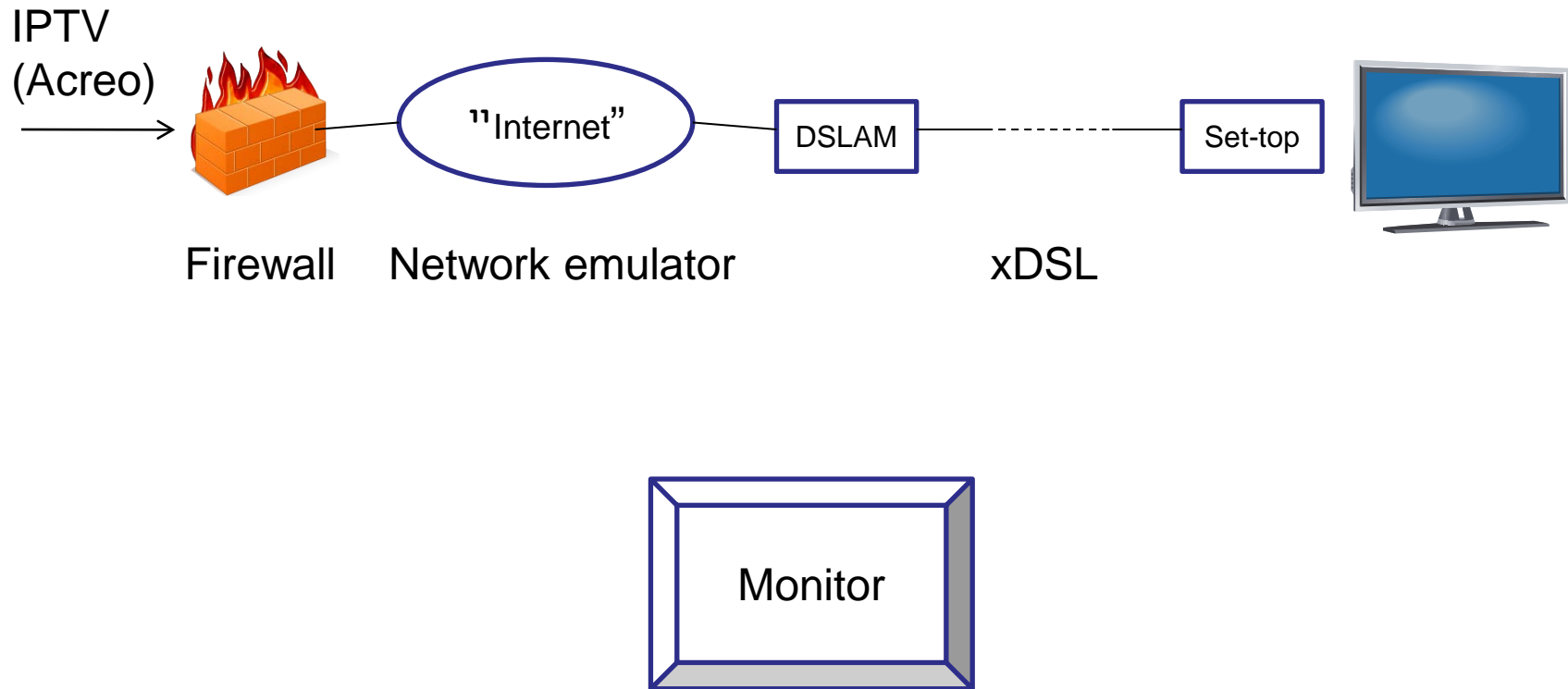


Research issues in R2D2

- The effect of xDSL disturbances on packet loss
 - How does physical layer disturbance models map to packet layer disturbance models?
- Real-time monitoring of video QoE
 - IP-layer monitoring in routers
 - Physical layer monitoring in DSLAMs

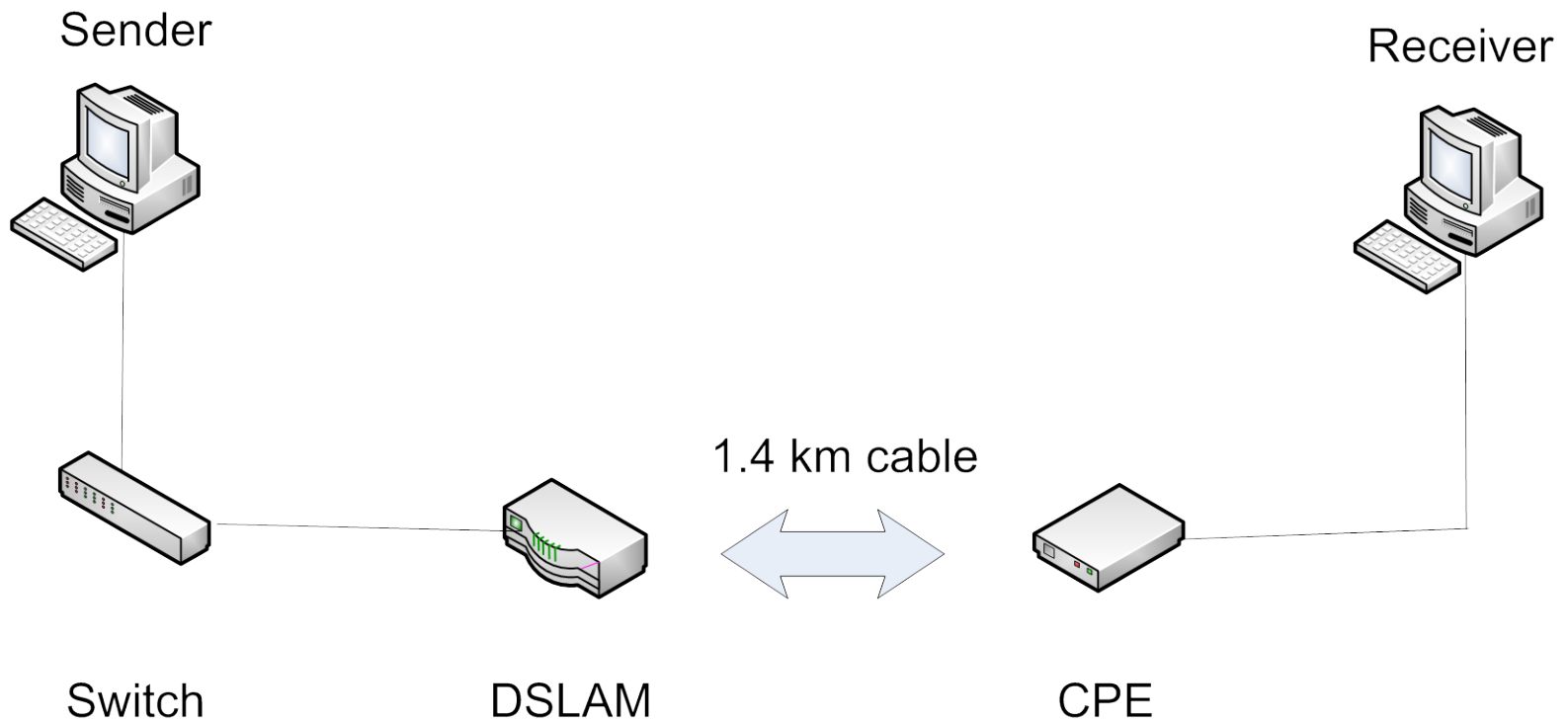


IPTV lab





Experiments



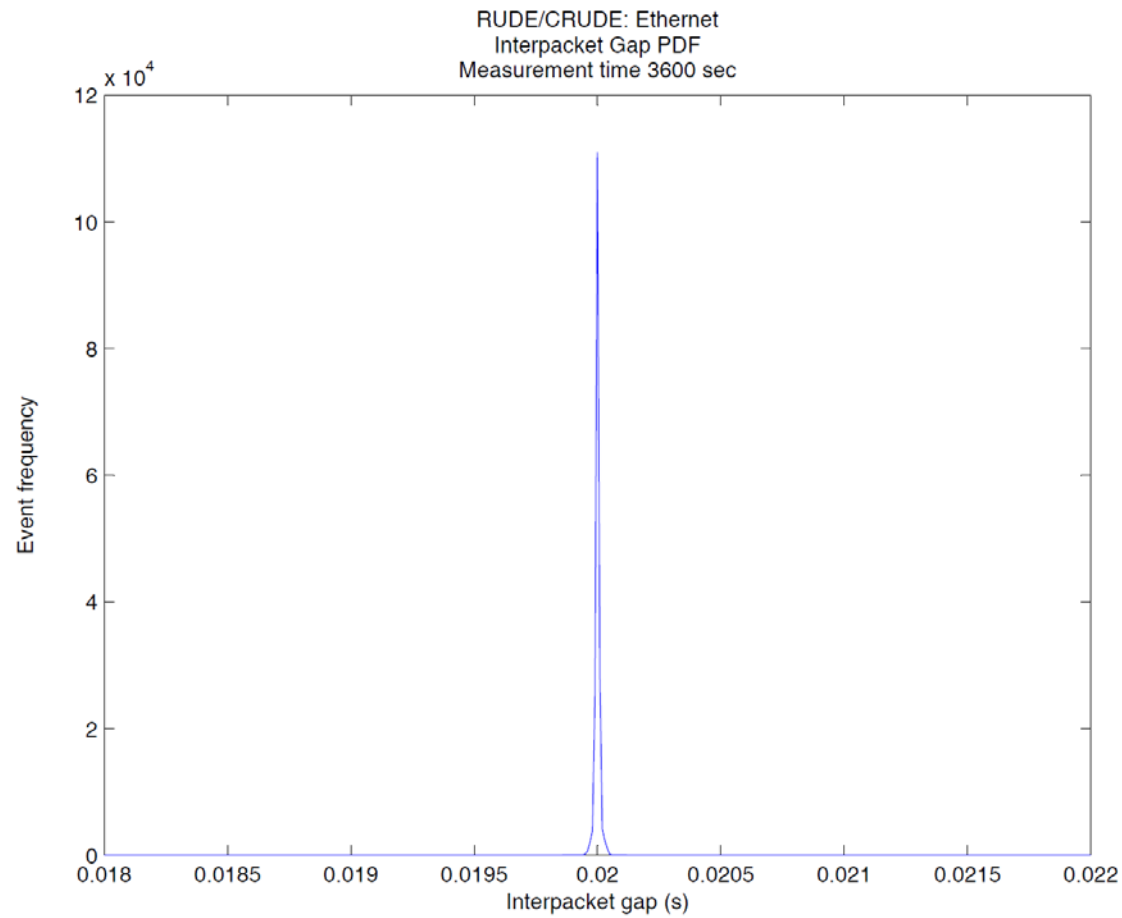


Experiments

- D-ITG (Distributed Internet Traffic Generator) is a platform capable to produce traffic at packet level accurately replicating appropriate stochastic processes for inter-departure times and packet size using various distributions.
- RUDE/CRUDE is a UDP transmitter and receiver. You can control the traffic generation process, keep track of time-stamping, sequence numbers and so on.
- Realistic noise will be introduced on the DSL layer.

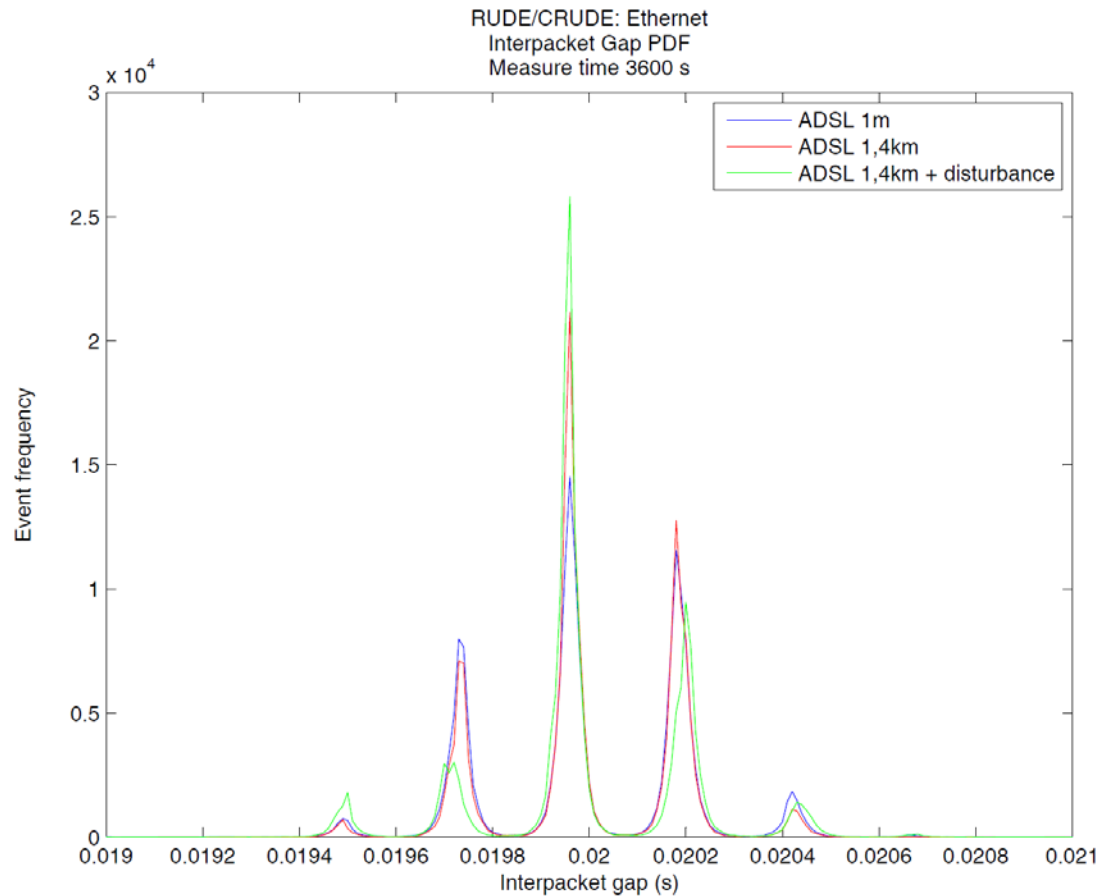


Some initial results





Some initial results





Conclusions

- High quality TV over Internet (IPTV and OTT Video) requires accurate quality monitoring and prediction.
- The last mile, that is the broadband access network, will always be a weak part of the video distribution chain.
- Disturbances on the physical layer will affect the packet loss and jitter.
- Accurate quality models are required in the monitoring and control systems.