

Transmitting Scalable Video with Unequal Error Protection over 802.11b/g

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Outline

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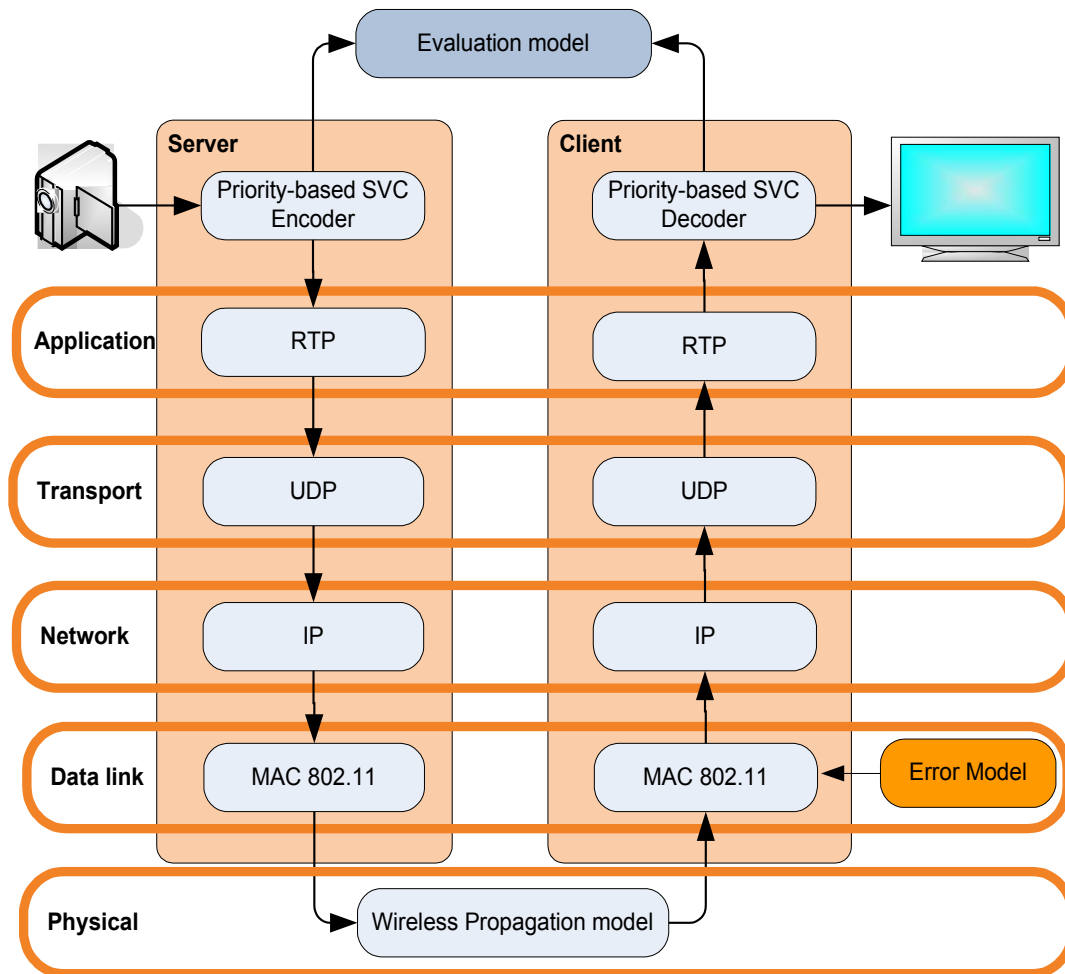


Project Description

- Vrije Universiteit Brussel, ETRO
 - Specialized in video coding techniques
 - Development of new coding techniques
 - Artesis University College of Antwerp
 - Specialized in network simulations
 - Wireless communications
- This research:
Study the behaviour of a specific video streaming application in a wireless environment using network simulations

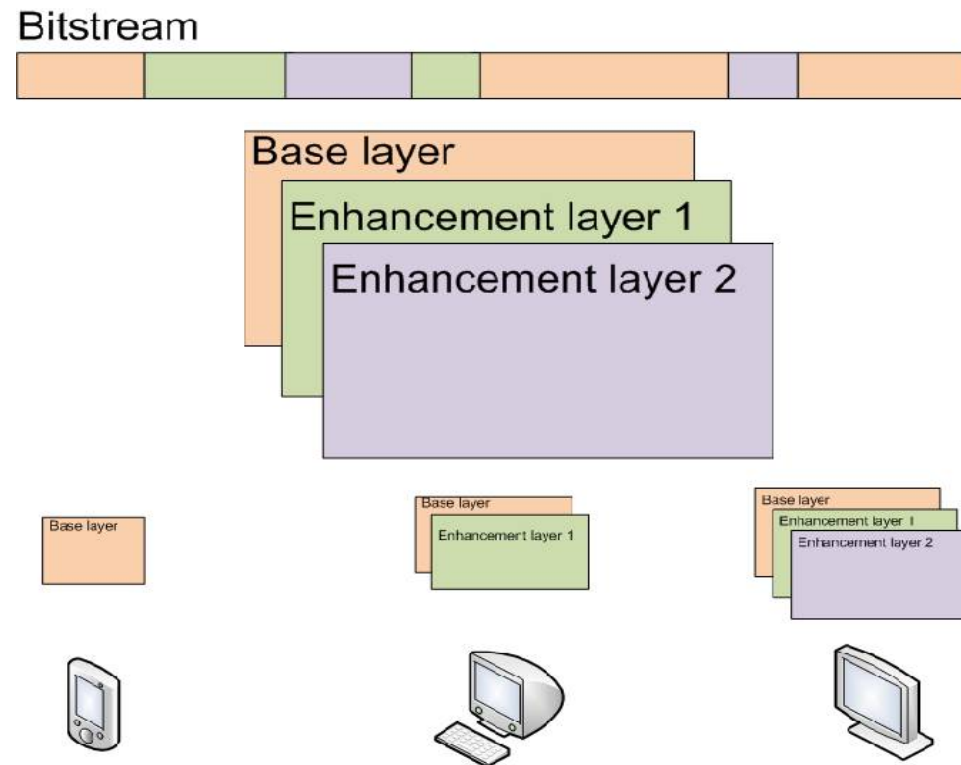


System Architecture

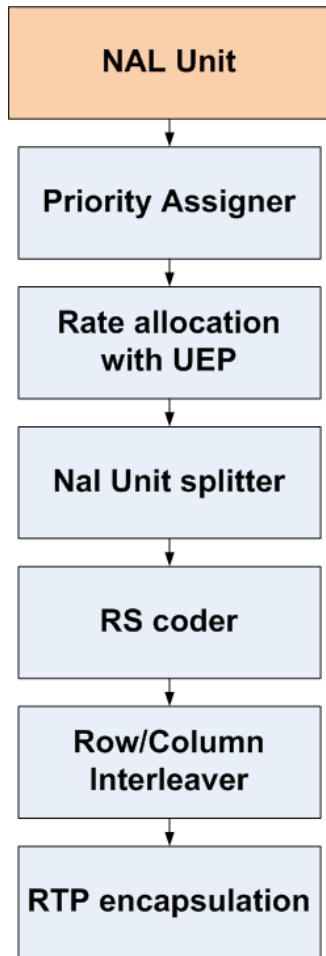


Scalable Video Coding

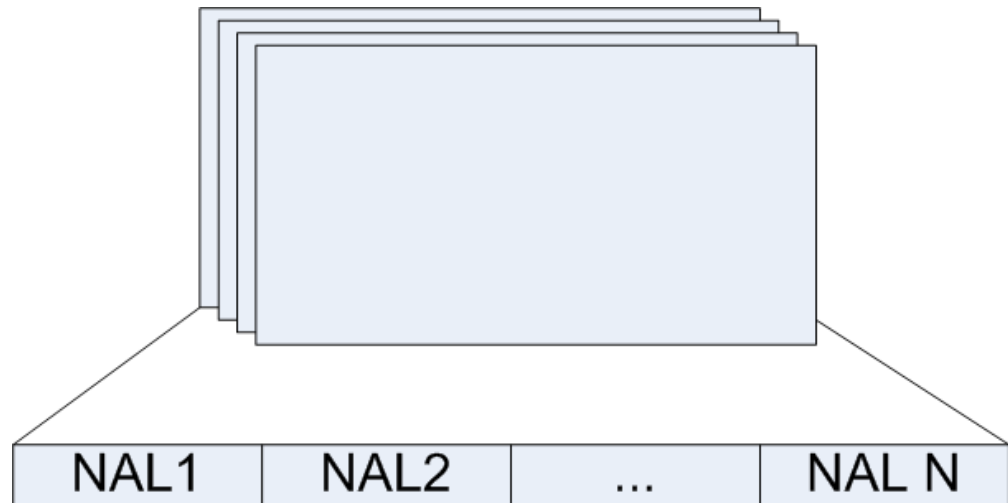
- Client – server
 - One server
 - Many types of clients
- Client selects stream quality
 - Base layer
 - Enhancement layer(s)
- Server sends customized streams



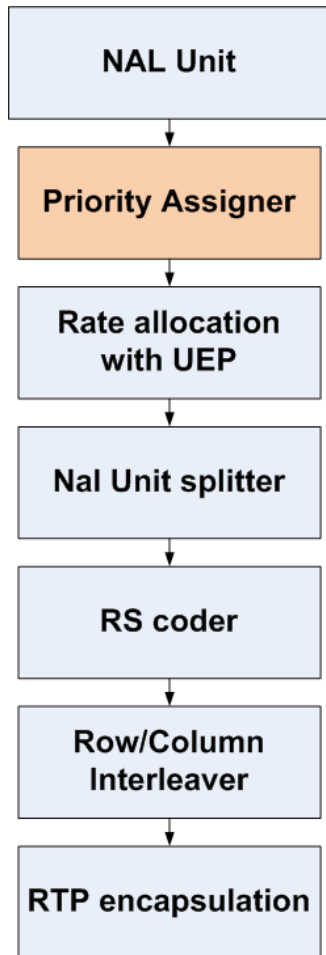
Priority-Based Error Protection for the Scalable Extension of H.264/AVC



- Extra logical layer
- Supports network transmissions



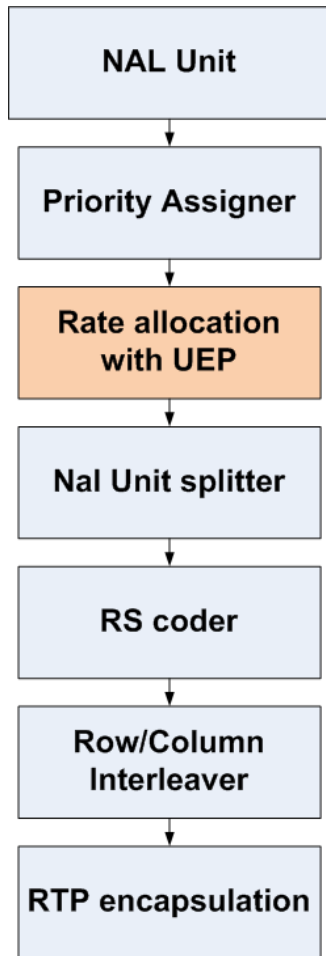
Priority-Based Error Protection for the Scalable Extension of H.264/AVC



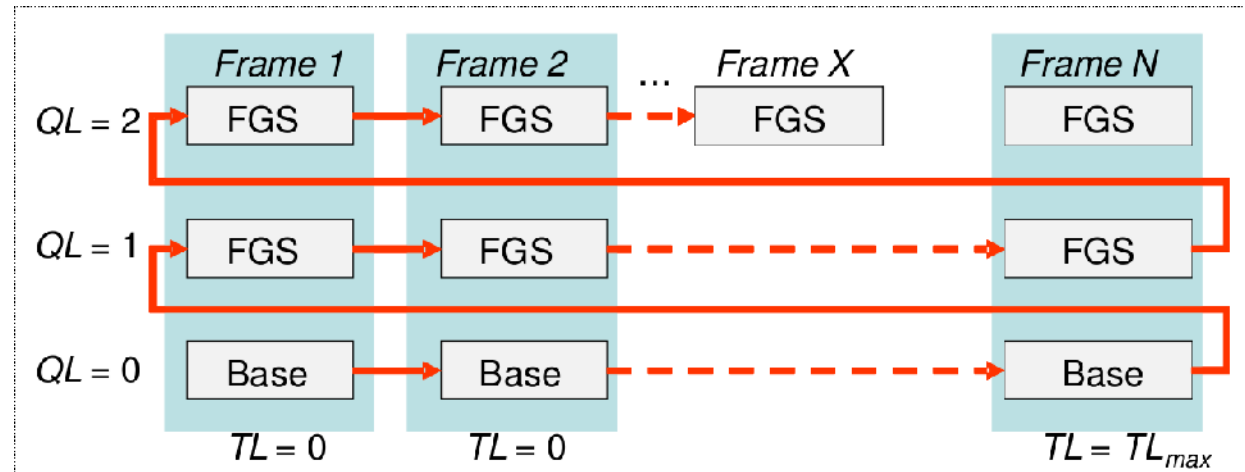
- Assigns a priority based on the NAL
 - Quality layer
 - Temporal layer



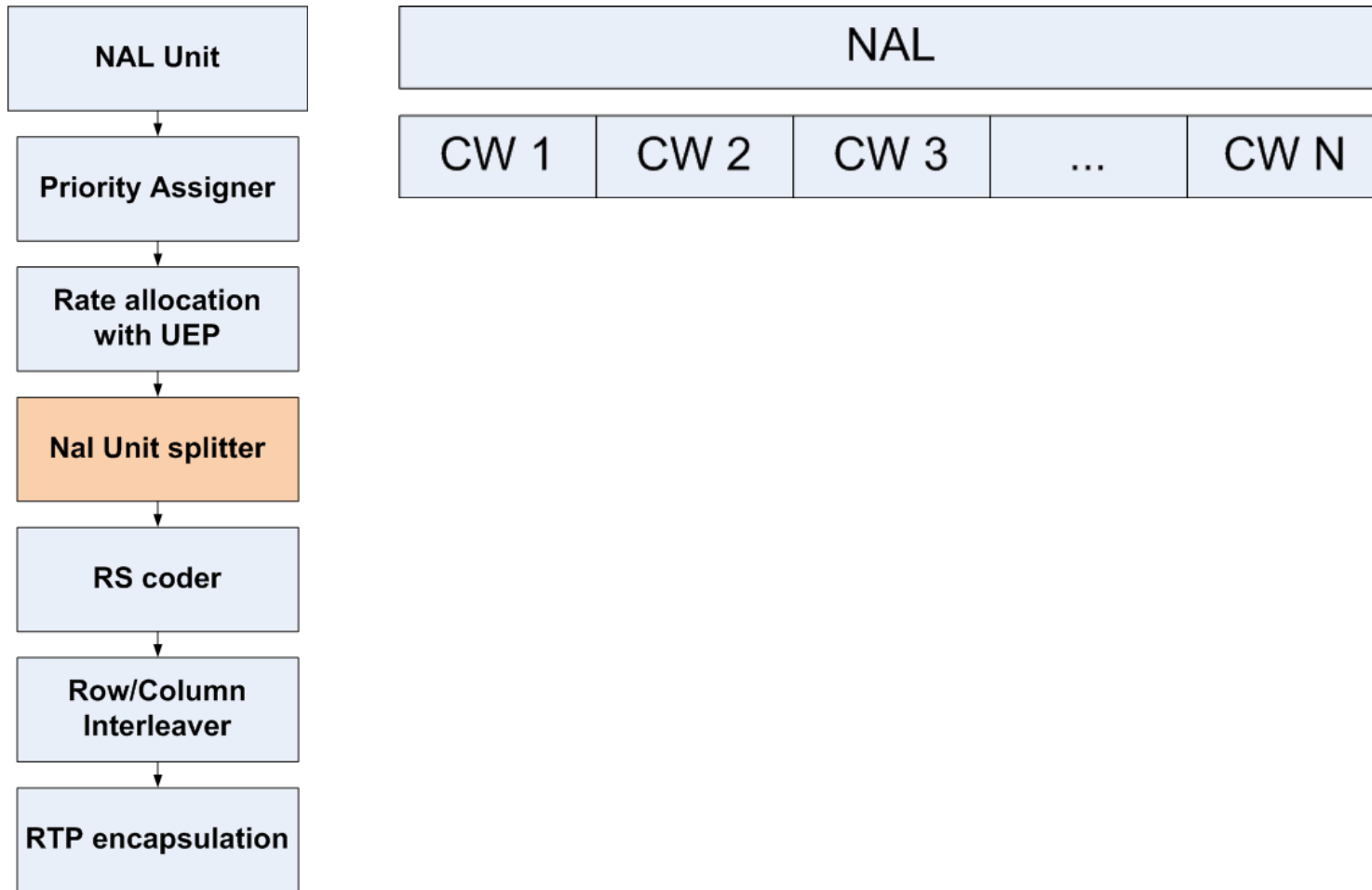
Priority-Based Error Protection for the Scalable Extension of H.264/AVC



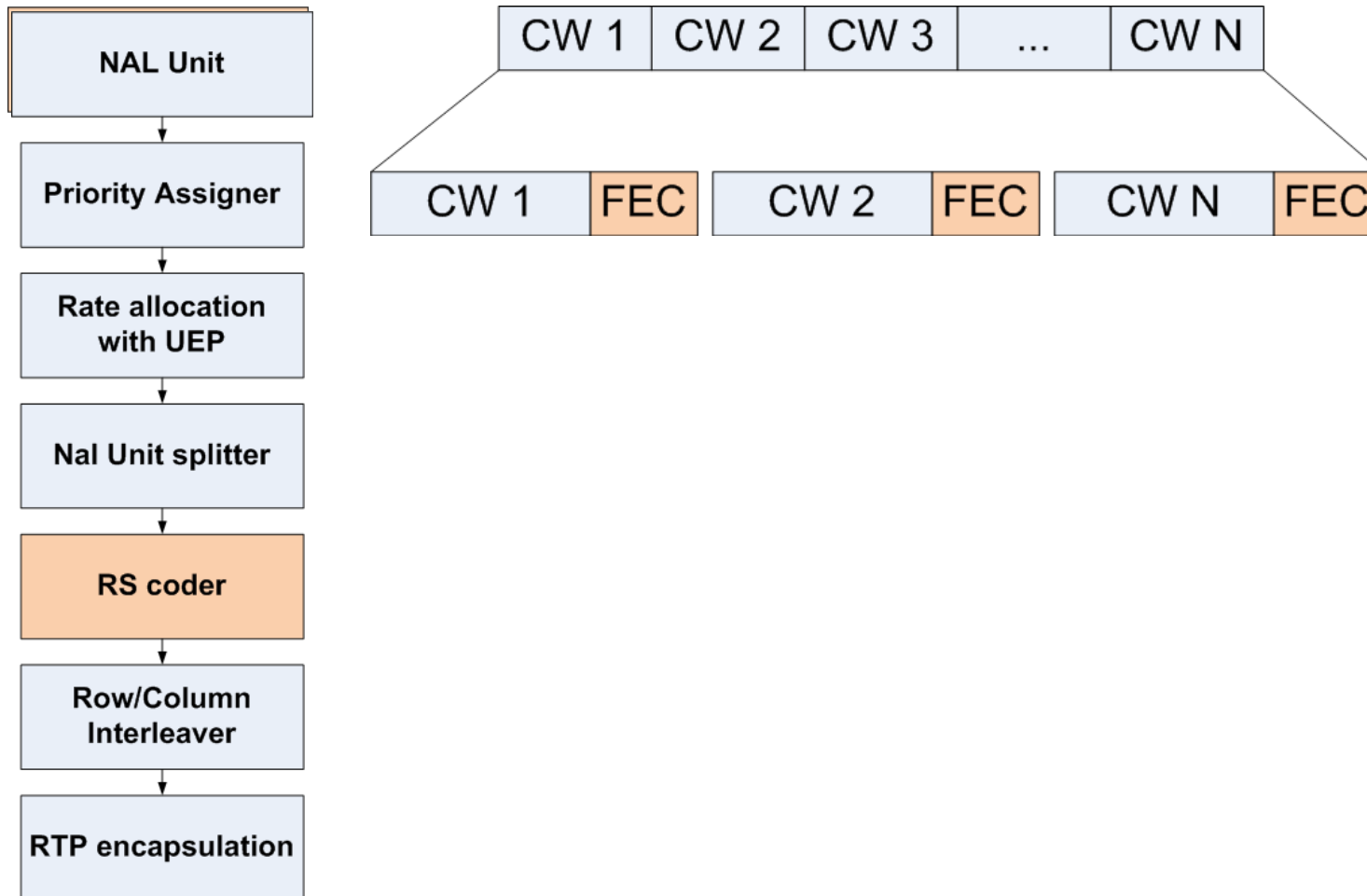
- Coding rate of a GOP
- Average loss on the network channel
- Maximum loss on the network channel



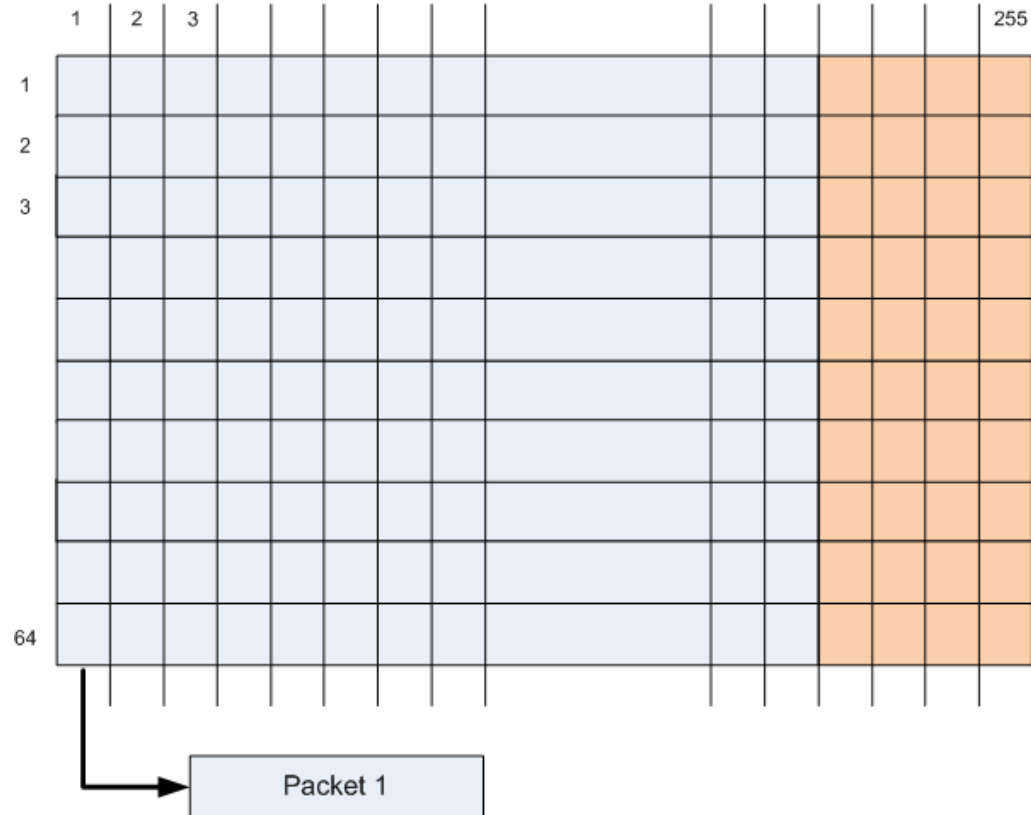
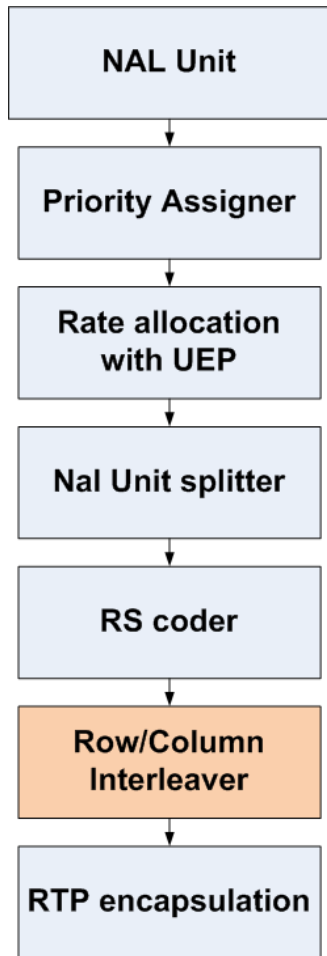
Priority-Based Error Protection for the Scalable Extension of H.264/AVC



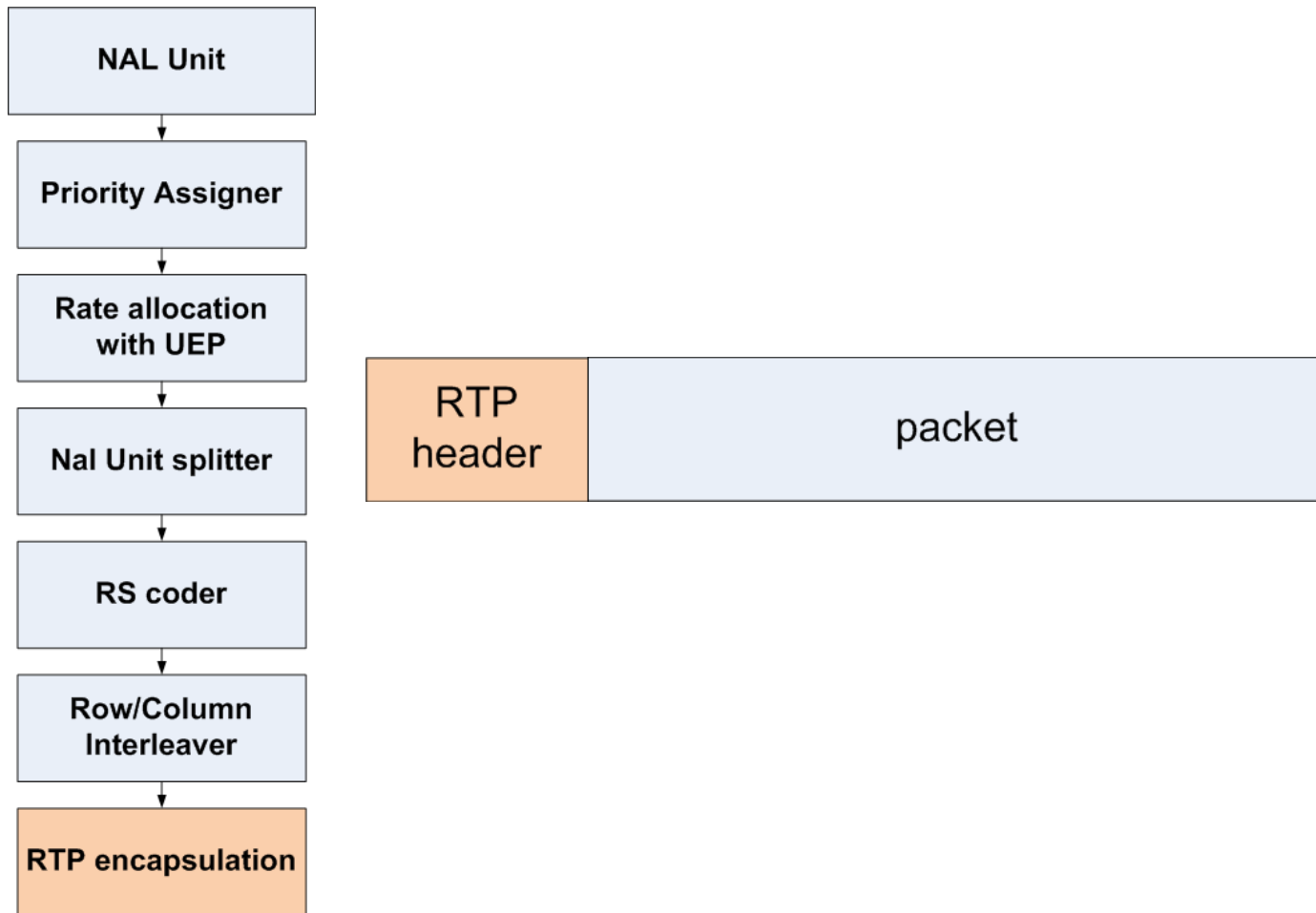
Priority-Based Error Protection for the Scalable Extension of H.264/AVC



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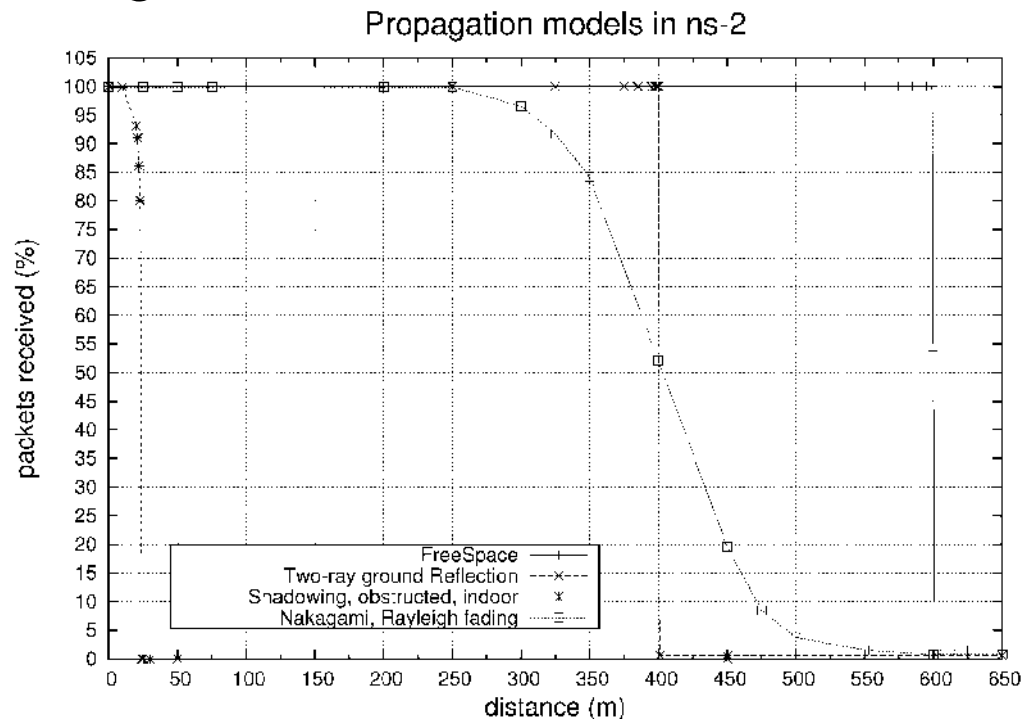
Network Simulations

- NS-2
- Physical layer
 - Freespace model
 - Two-way ground reflection model
 - Shadowing model
 - Nakagami model
- 802.11 data link layer
 - Overhead, ARQ
- UDP Lite



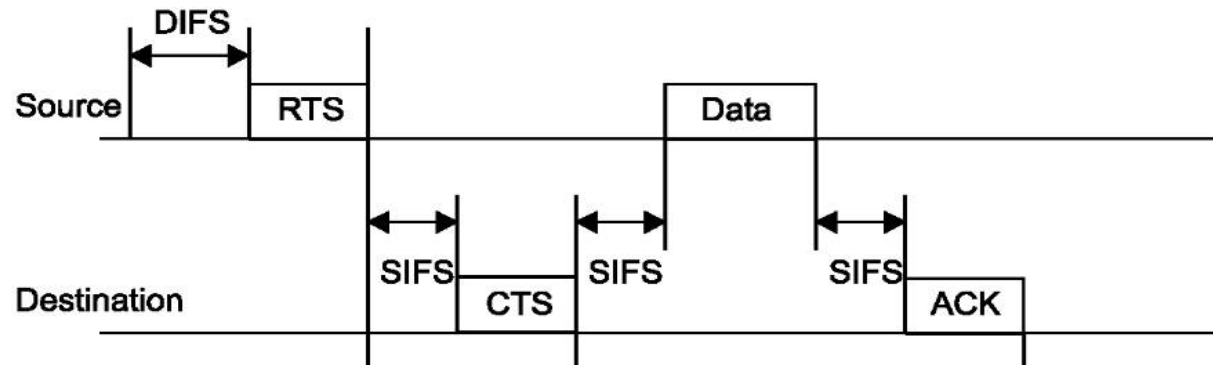
Physical Layer

- Freespace model & Two-Ray Ground Reflection model based on Line-Of-Sight propagation
- Shadowing and Nakagami models add statistical model to simulate random fading.



802.11 Datalink Layer

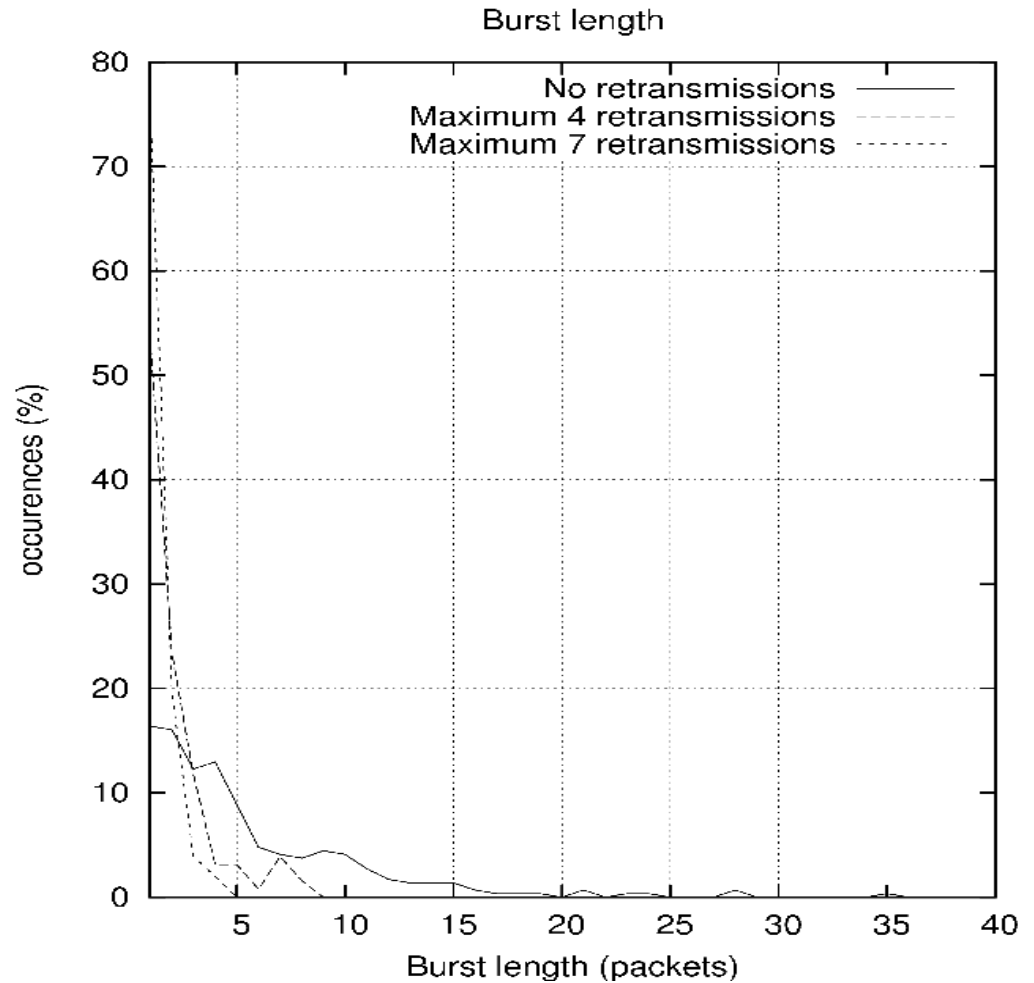
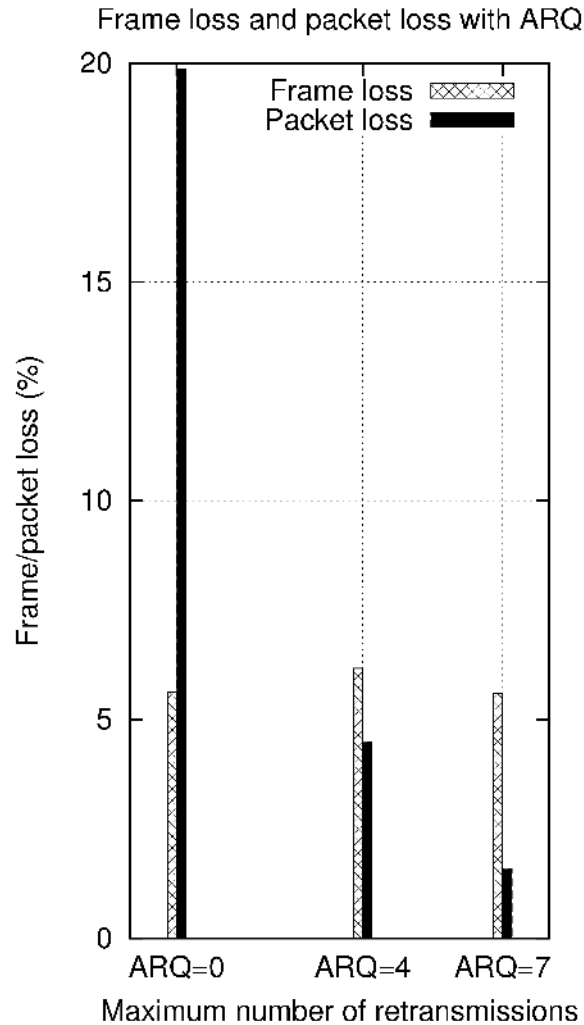
- Analysis of the system revealed a huge protocol overhead (~193%)
 - Future version of the encoder will be optimized
 - ARQ – Automatic Retransmission Request
 - DIFS: DCF Interframe Space
 - SIFS: Short Interframe Space
 - RTS: Request To Send
 - CTS: Clear To Send
 - ACK: Acknowledge



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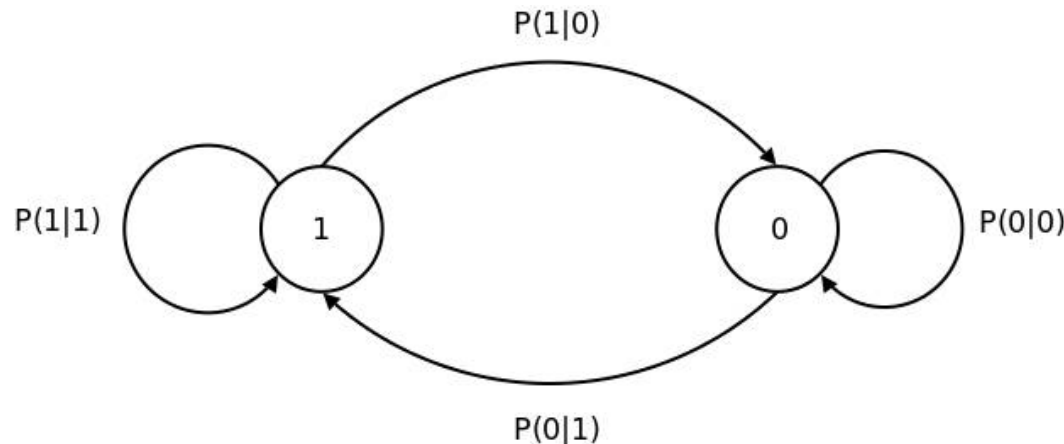


ARQ – Simulation Results



Bursty Error Model – Markov Chain

- Two-state Markov chain
 - Based on existing study [1]



[1] Khayam, S.A., Karande, S., Radha, H., & Loguinov, D. (2003). Performance analysis and modeling of errors and losses over 802.11b LANs for high-bit-rate real-time multimedia. *Signal Processing: Image communication*, 18., pp 575-595, 2003.



Simulation Results

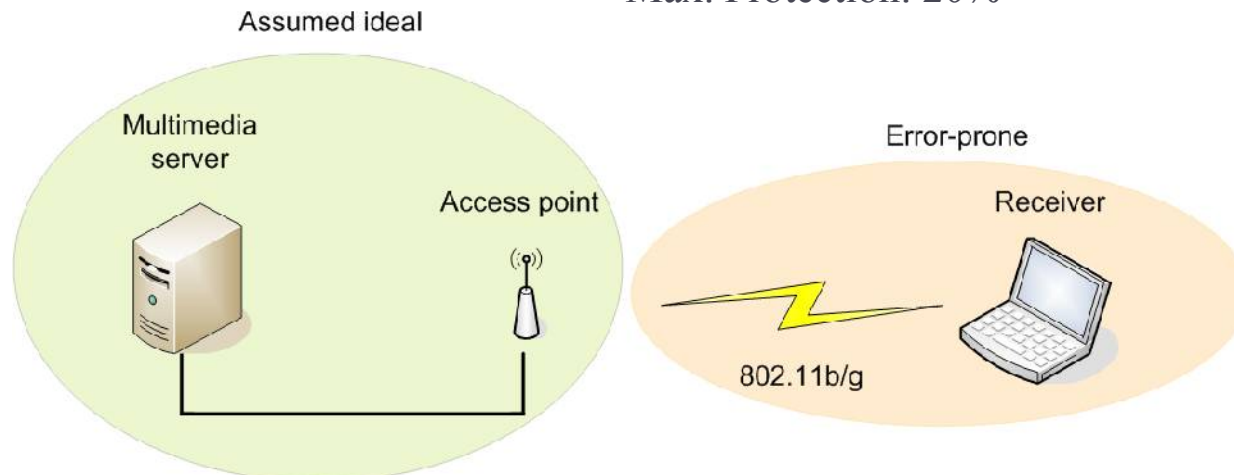
- Scenario 1: Football

Network settings:

- IEEE Standard: 802.11g
- Bandwidth: 54Mbps
- Actual throughput: 1.04Mbps

Video coding settings

- Sequence: Football
- Frames encoded: 180 frames
- Frame Rate: 30 fps
- Coding rate: 750Kbps
- Avg. Protection: 10%
- Max. Protection: 20%

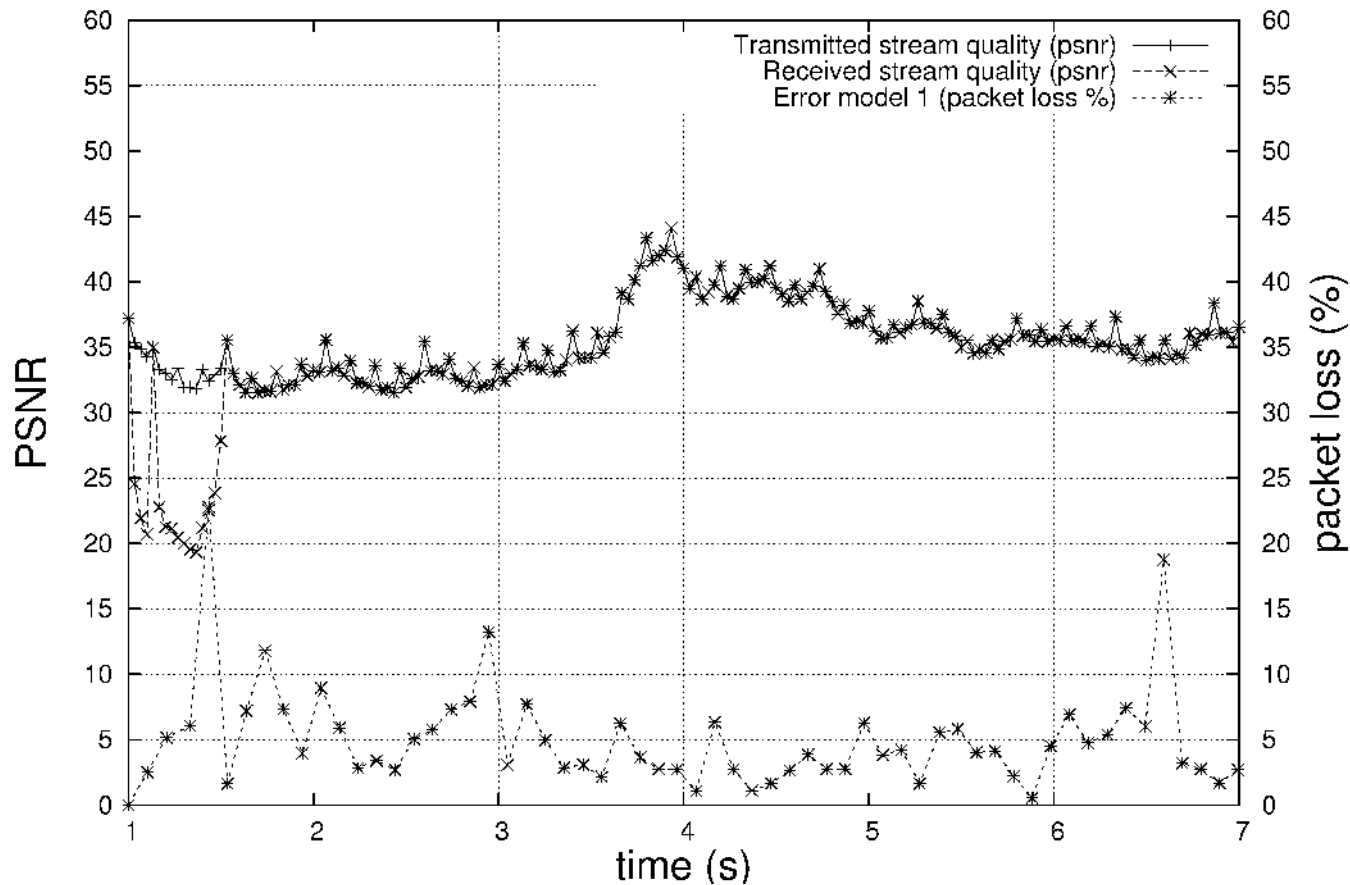


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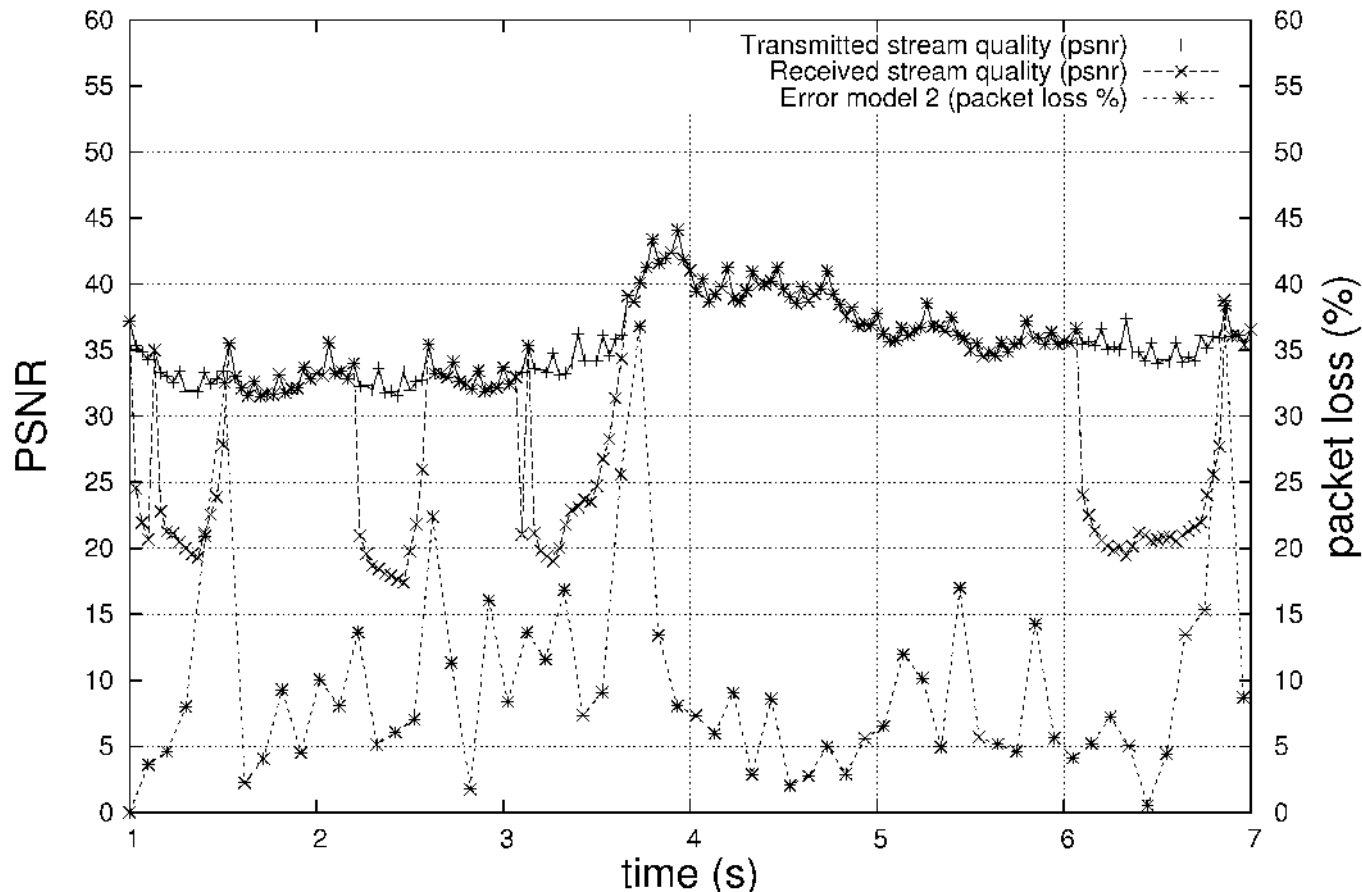
Simulation Results

Scenario 2a: Video quality over moderate distorted wireless link



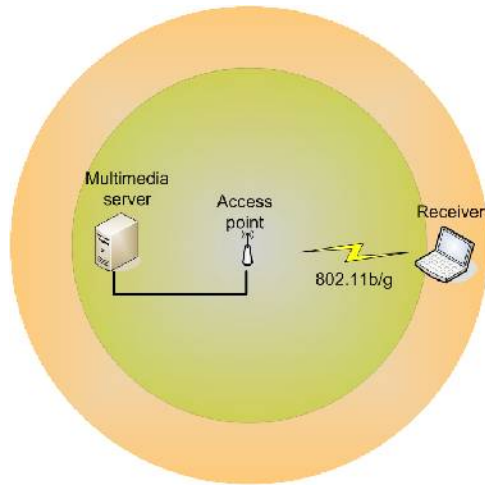
Simulation Results

Scenario 2b: Video quality over heavily distorted wireless link

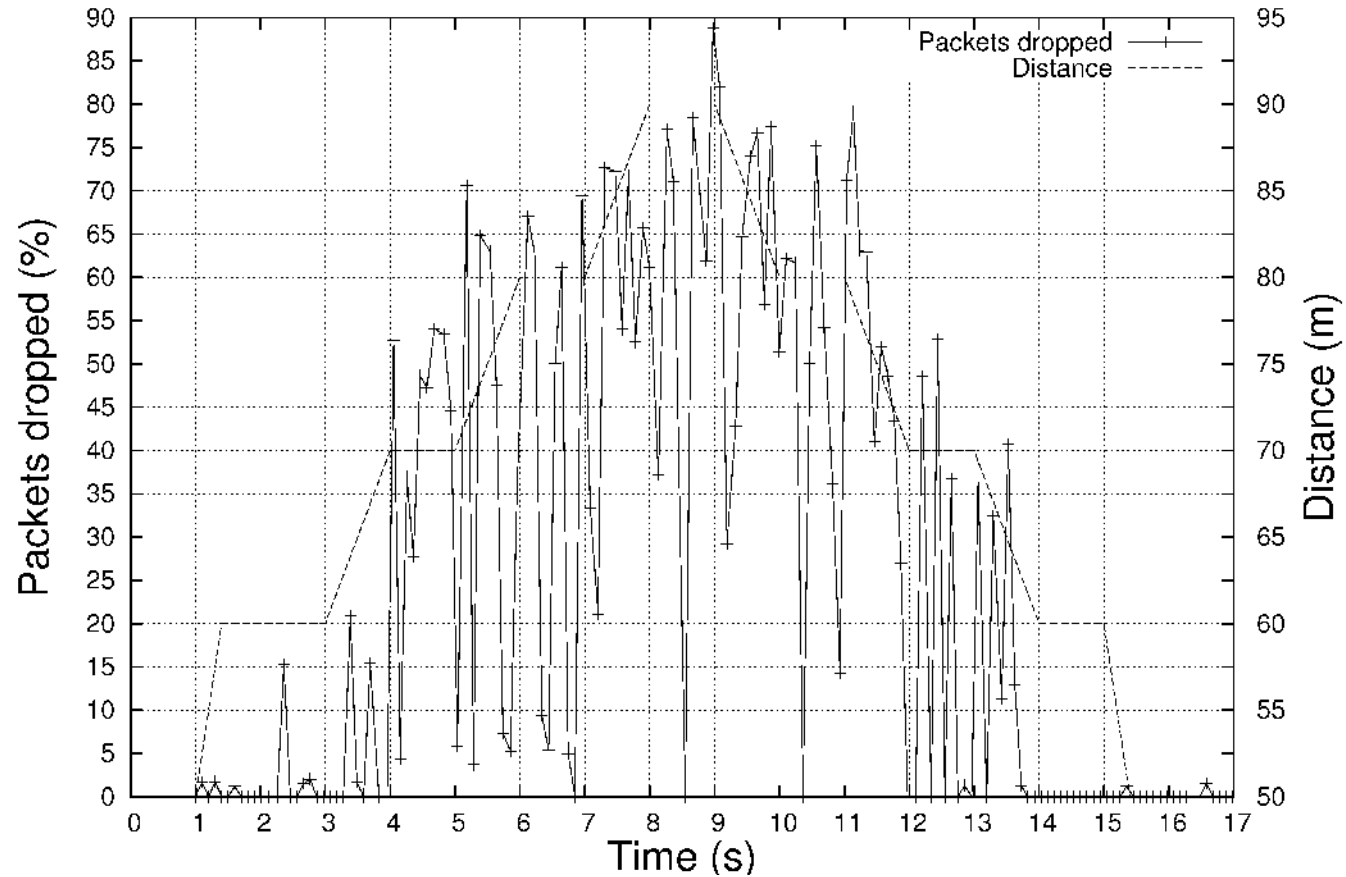


Simulation Results

- Scenario 2: Mobility



Packet loss in function of distance



Conclusion

- Complete system “simulated” from Video coding layer to PHY
- Simulation results provided some system guidelines
 - ARQ recovers a lot of transmission errors
 - No high losses in standard scenarios
 - UDP lite
 - Decoder has excellent results as long as the actual packet loss is lower than the protected packet loss.
 - No graceful degradation at the boundaries of signal reception

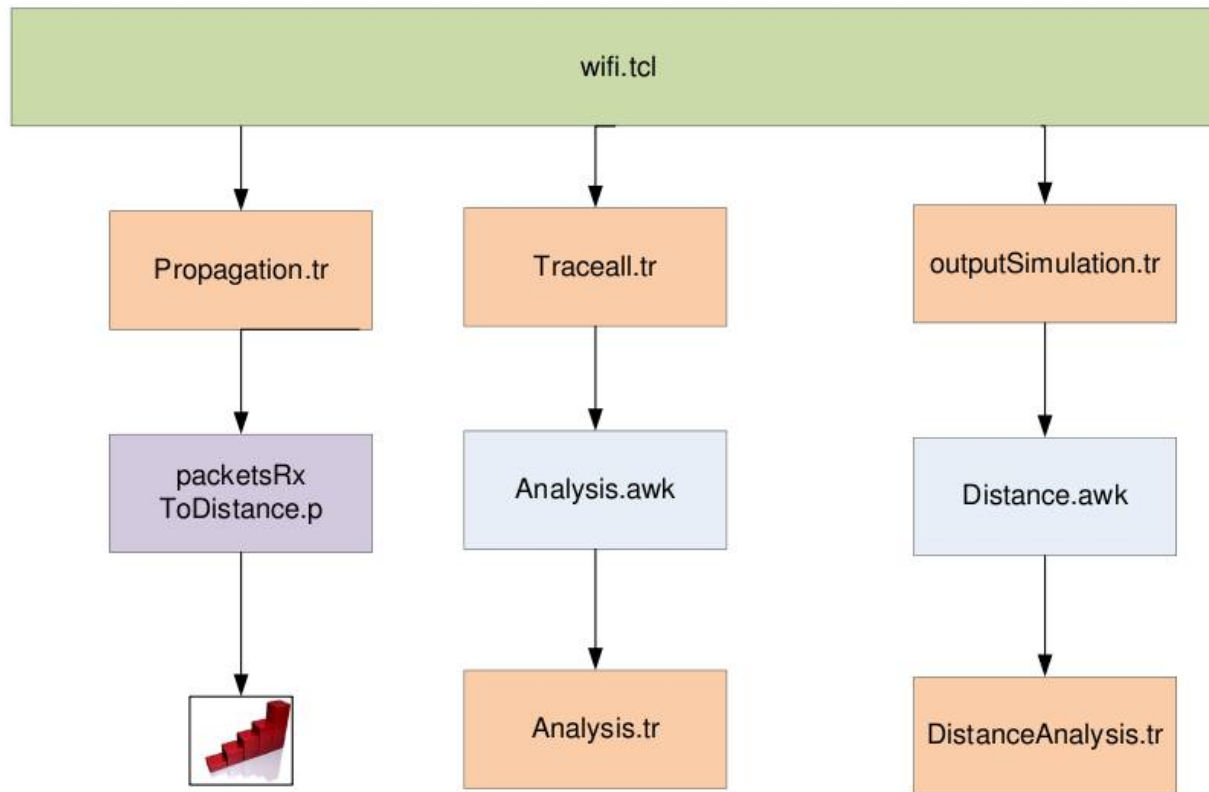


Q&A

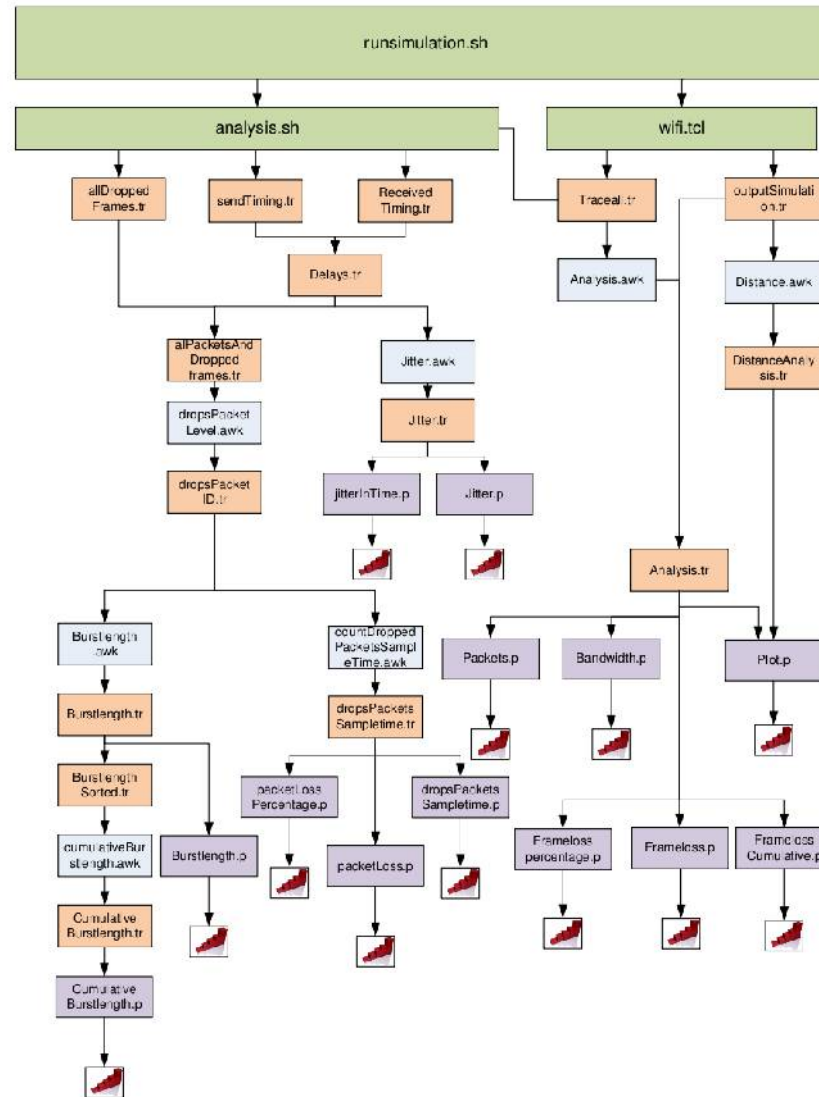
Any Questions?



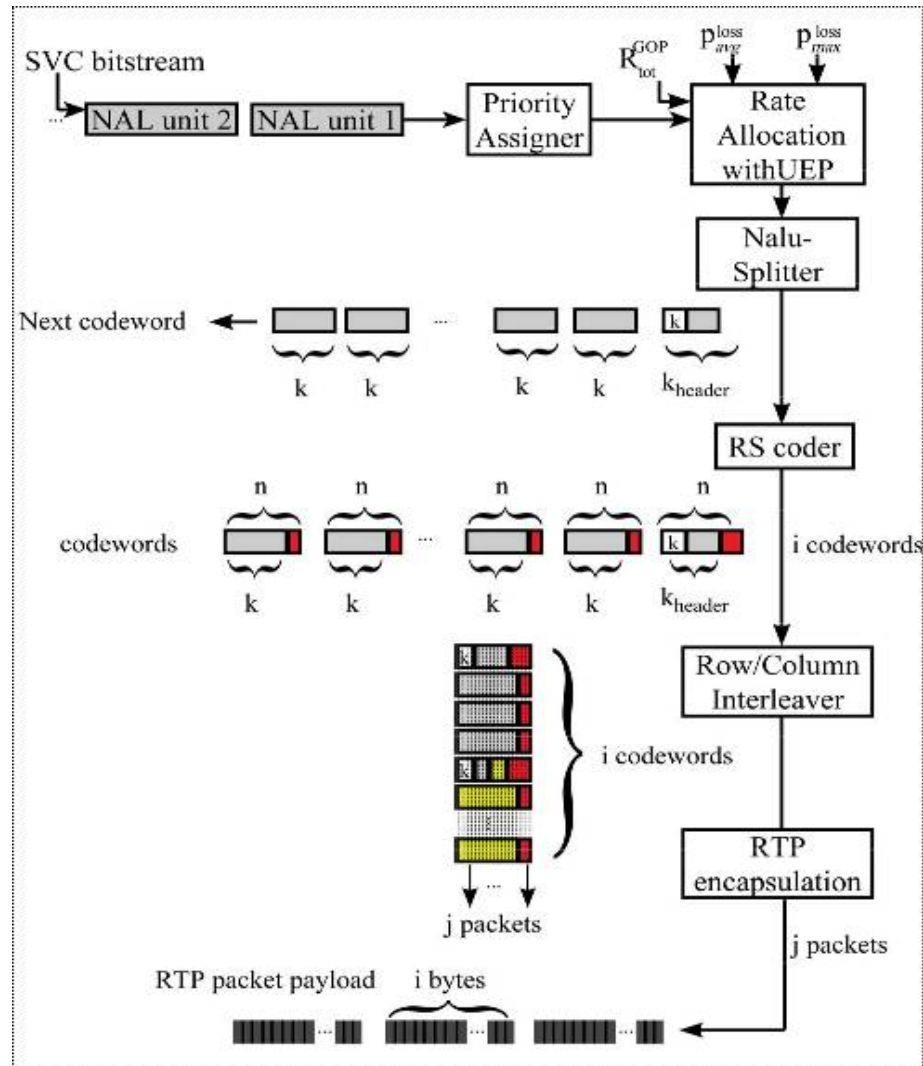
Extra slides: Software Structure



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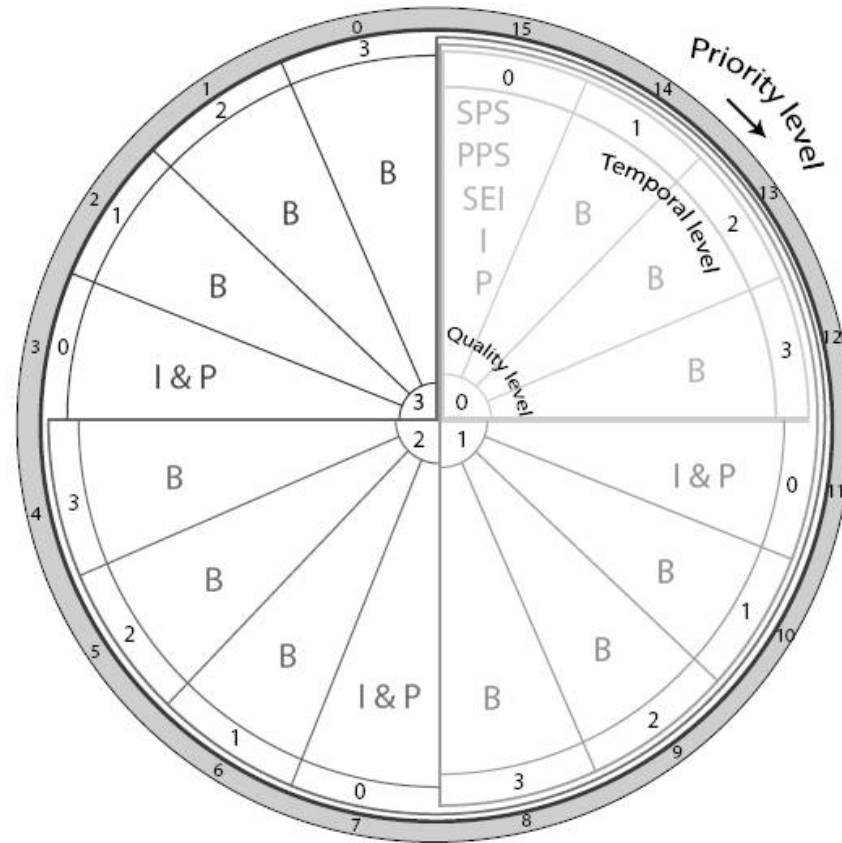
Extra slides: UEP



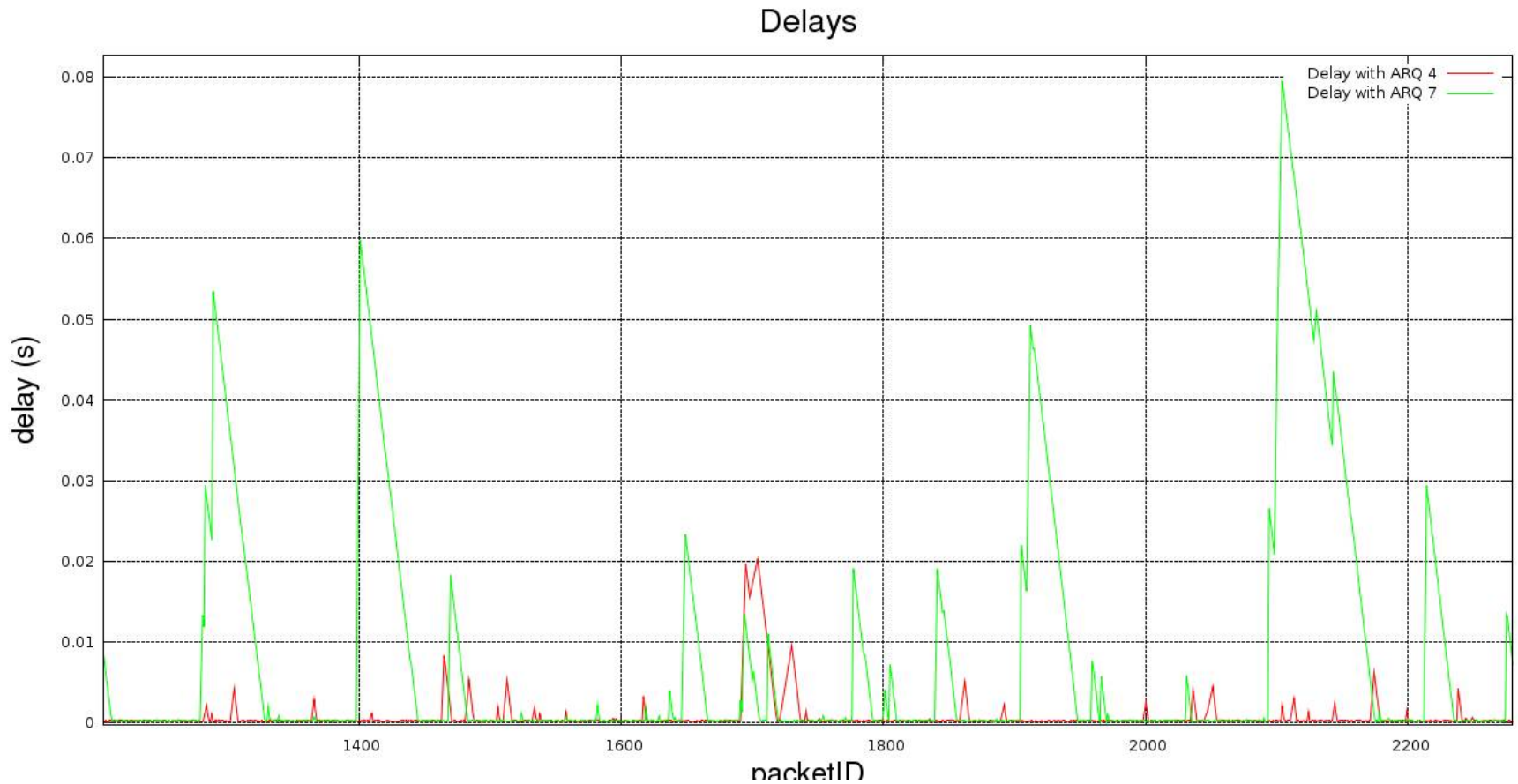
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Extra slides: UEP



Extra slides: Delays



Extra slides: Jitter

