

# Cross-Layer Analysis of Noise and Cross-traffic on Wi-Fi Streaming

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Cosener's House 8th - 9th July 2010

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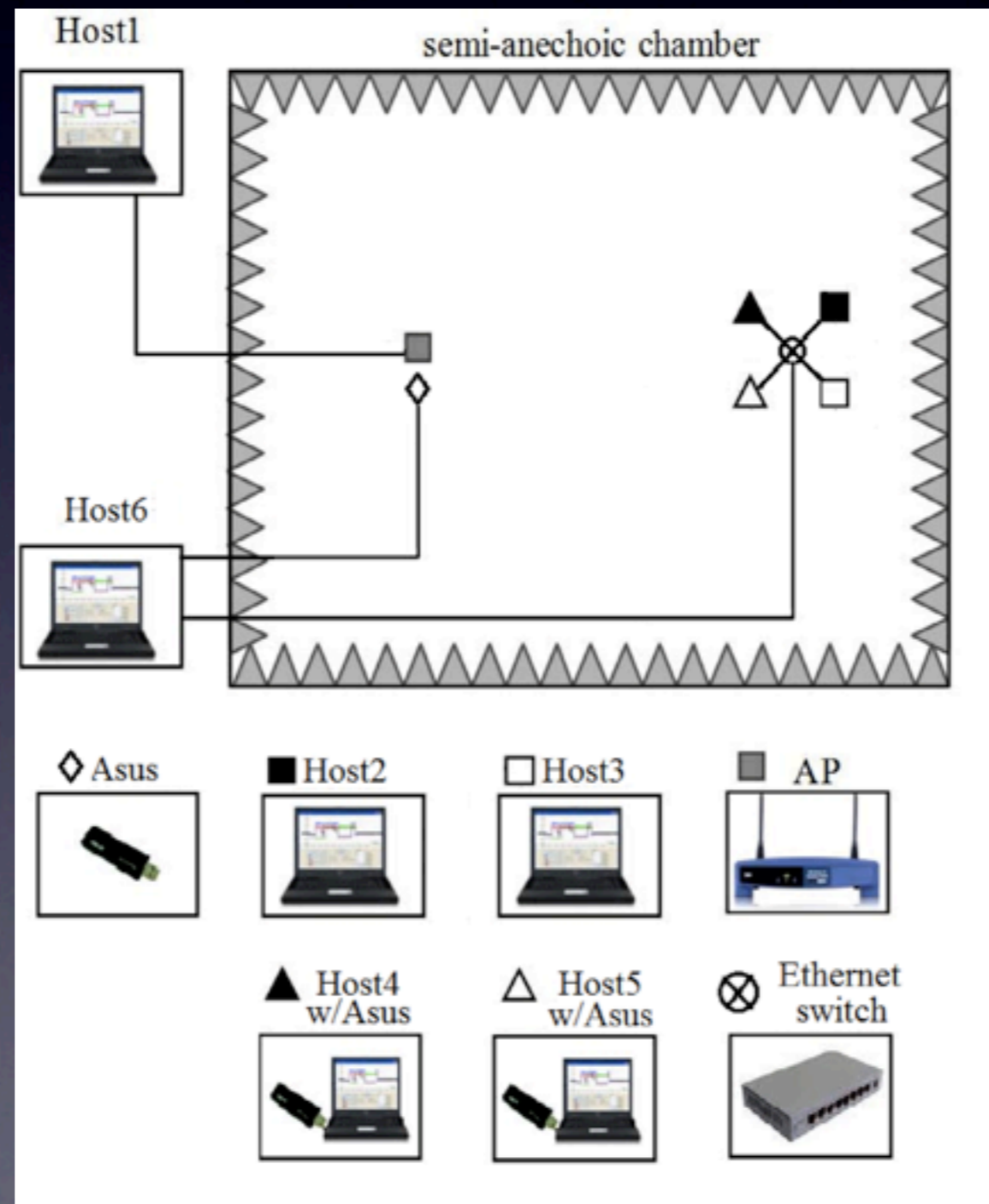
# Outline

- Aim
- Experiments:
  - Cross traffic Effect on UDP streaming
  - Noise Effect on TCP streaming
- Pitfalls
- Model predicting streaming time
- Conclusions

# Aim

- Wireless networks suffer due to noise
- How noise affects the video streaming time
- How cross traffic affects the video quality
- Experimental approach

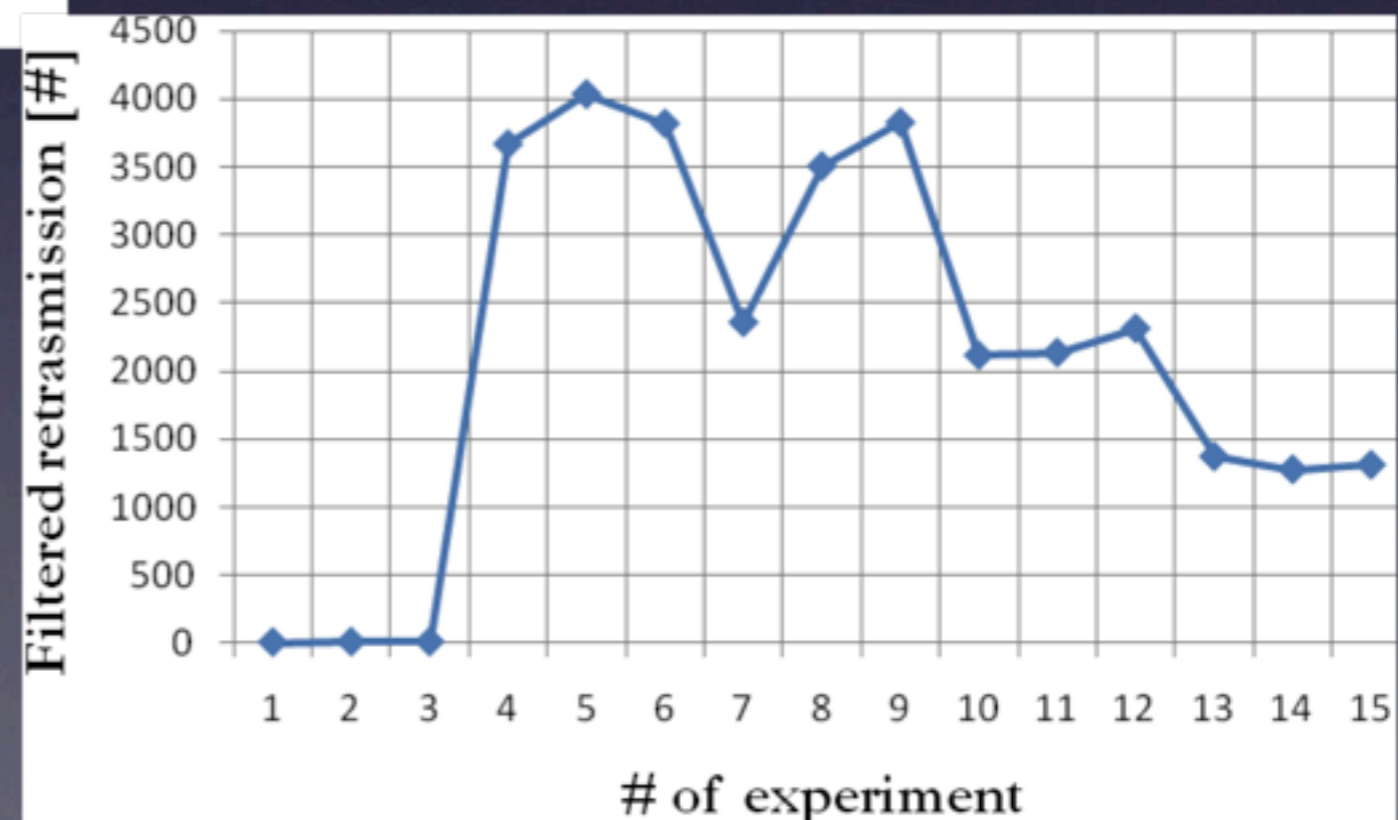
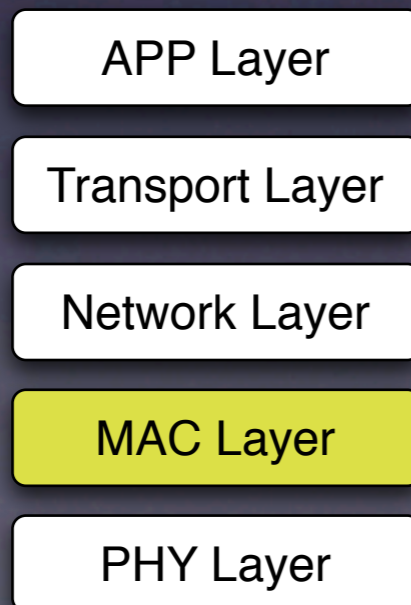
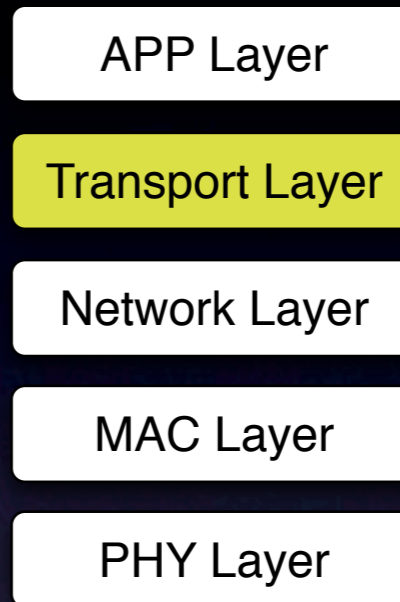
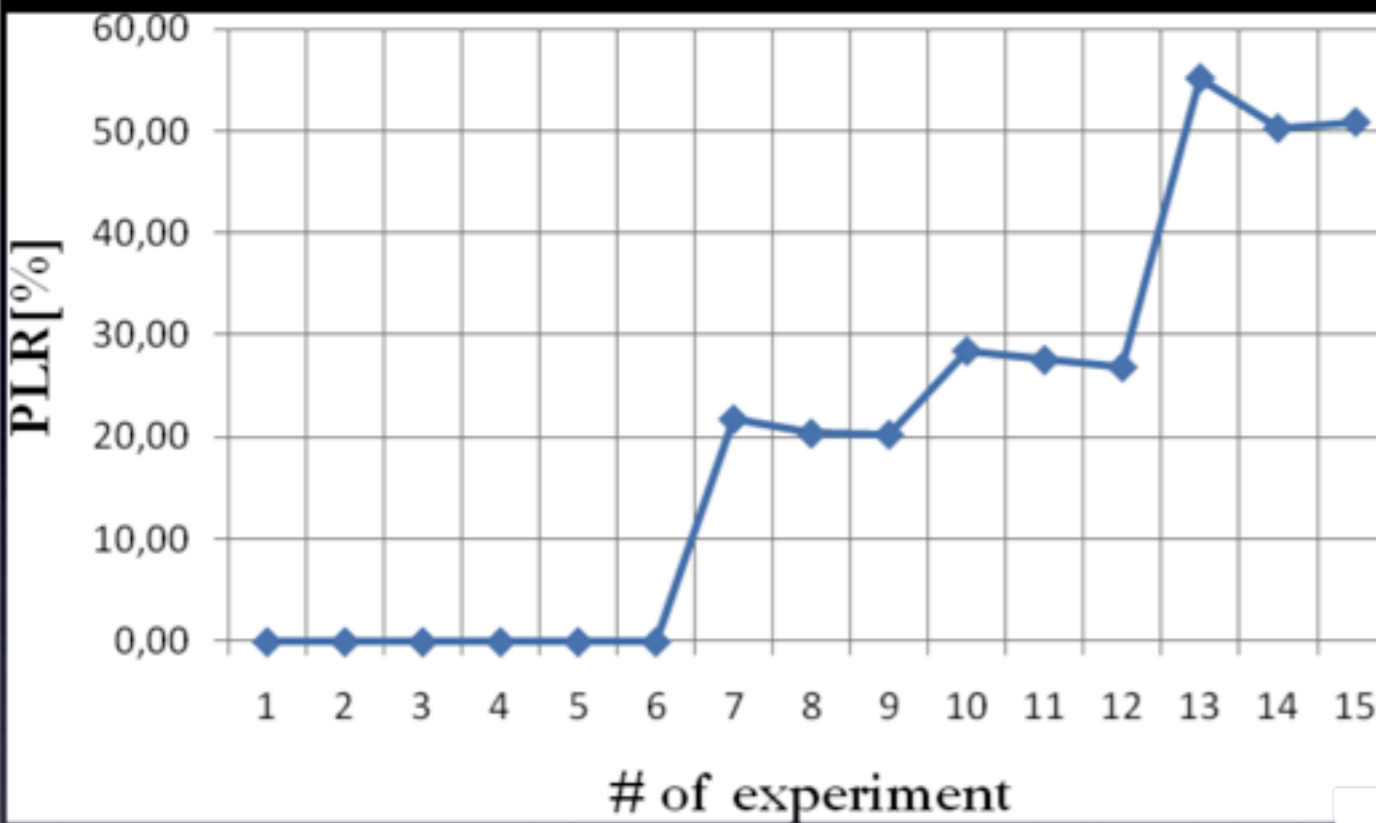
# Cross traffic Effect on UDP streaming



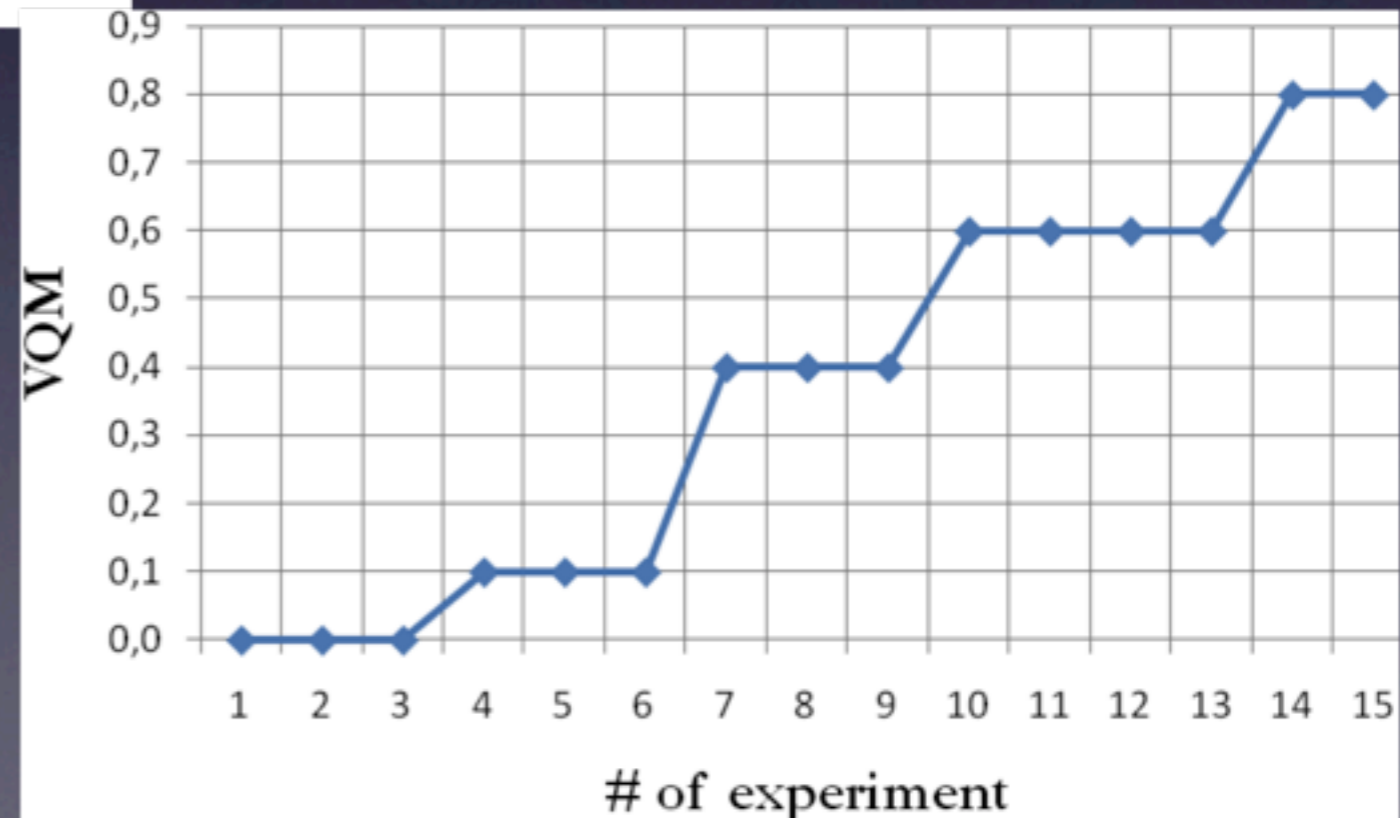
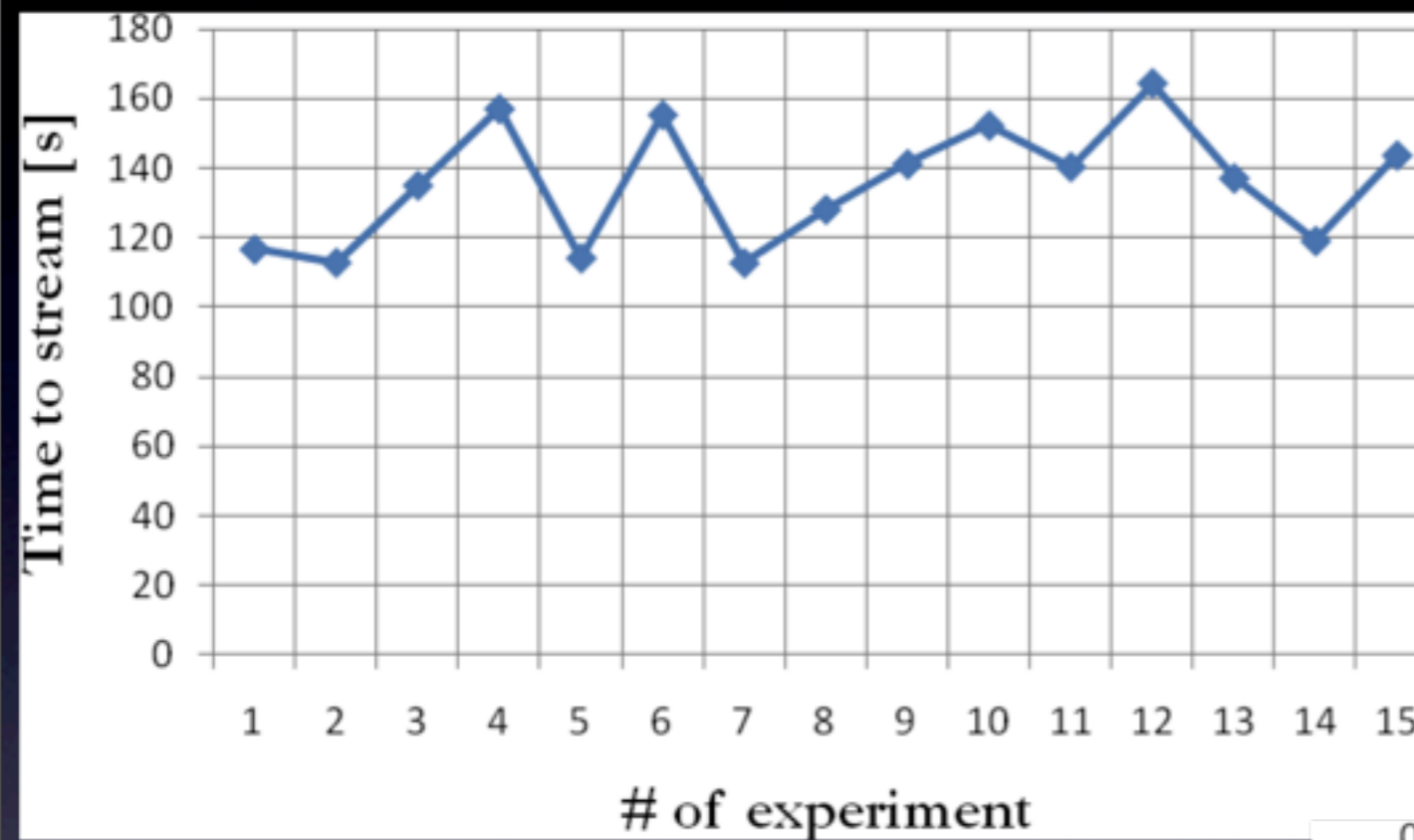
# Experiments

Index (#)	Bit Rate	Packet Size	Video Bitrate	VQM
1	0	0	Low	0
2	0	0	Medium	0
3	0	0	High	0
4	20	1400	Low	0.1
5	20	1400	Medium	0.1
6	20	1400	High	0.1
7	20	512	Low	0.4
8	20	512	Medium	0.4
9	20	512	High	0.4
10	40	1400	Low	0.6
11	40	1400	Medium	0.6
12	40	1400	High	0.6
13	40	512	Low	0.8
14	40	512	Medium	0.8
15	40	512	High	0.8

# Packet Loss - Retransmissions



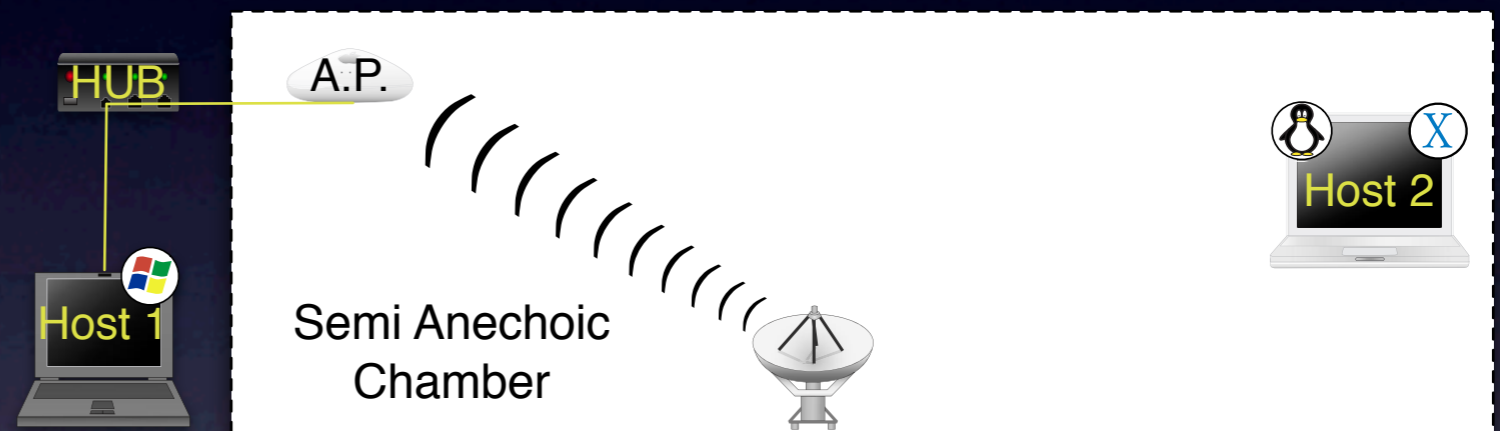
# Time to stream - VQM



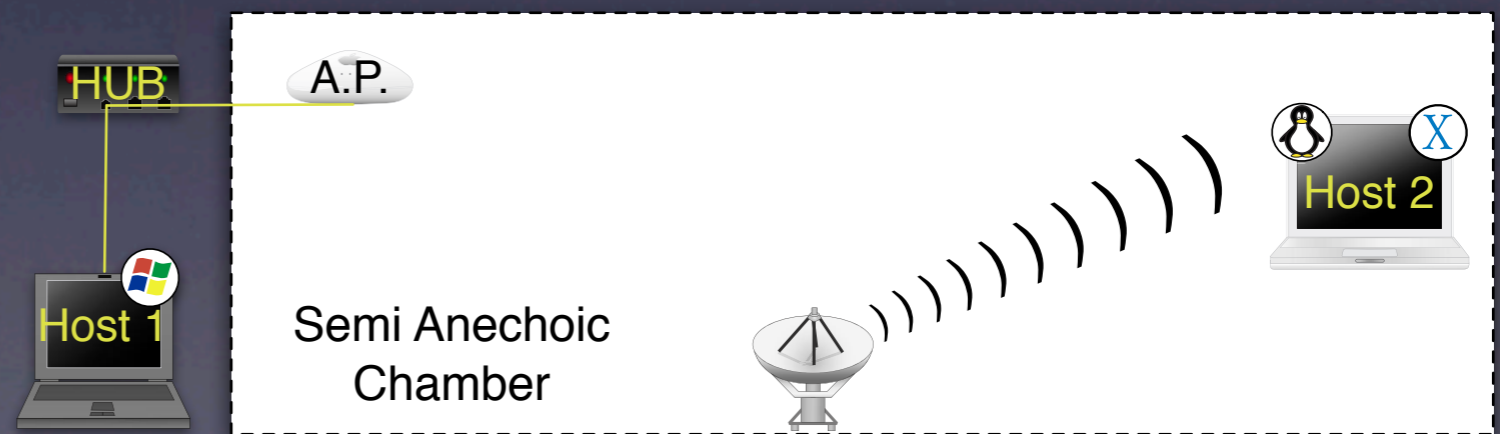


# Noise Effect on TCP streaming

Scenario 1



Scenario 2



# TCP Results:

## Aim AP

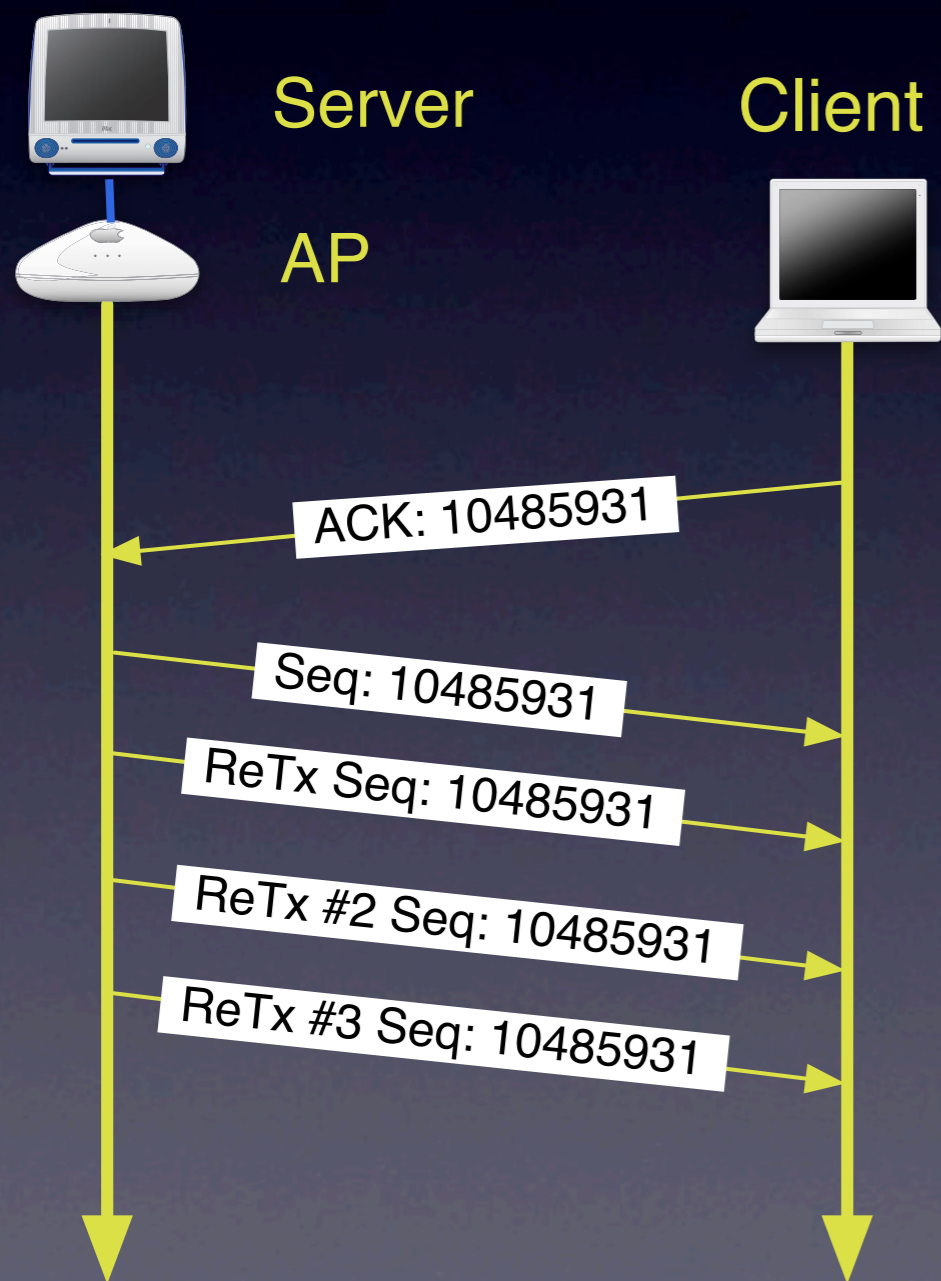
SNR@AP (dB)	32	29.5	27	22
MAC ReTx from Server	187	192	396	3033
Streaming time (s)	6.4	92.9	145.3	164.1

# Pitfalls

SNR@AP (dB)	32	29.5	27	22
TCP ReTx from Server (Client VP)	0	<b>3</b>	0	38
TCP Lost Segments (Client VP)	4	<b>3</b>	6	7

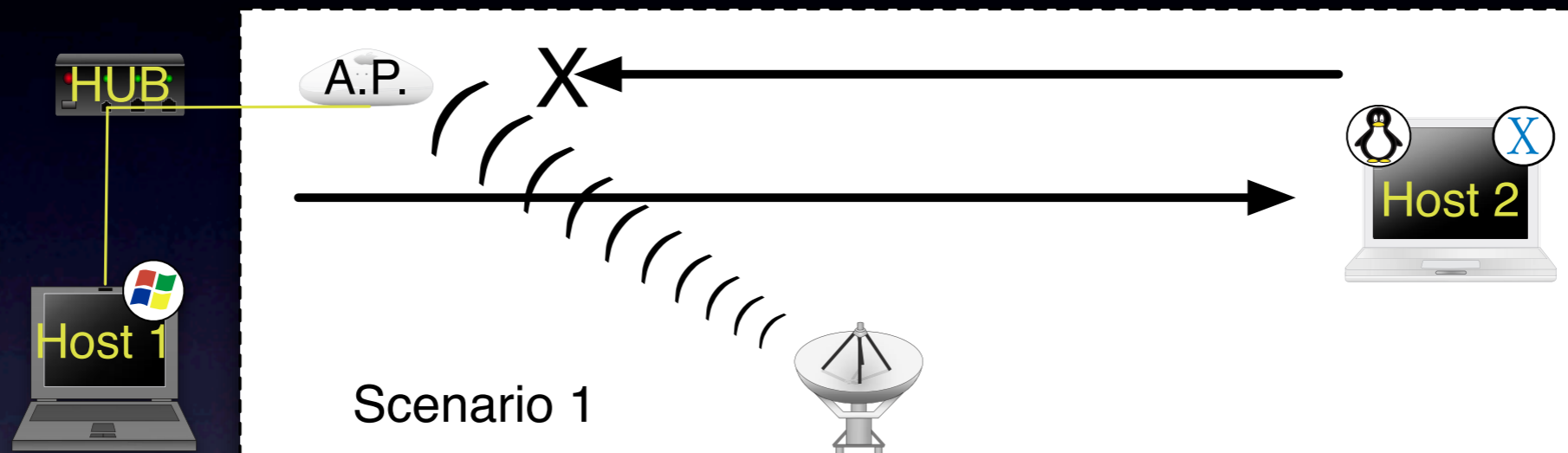
- Wireshark can mislead to wrong conclusions

# Effects of Noise on Streaming



- Frames from client have difficulty being received.

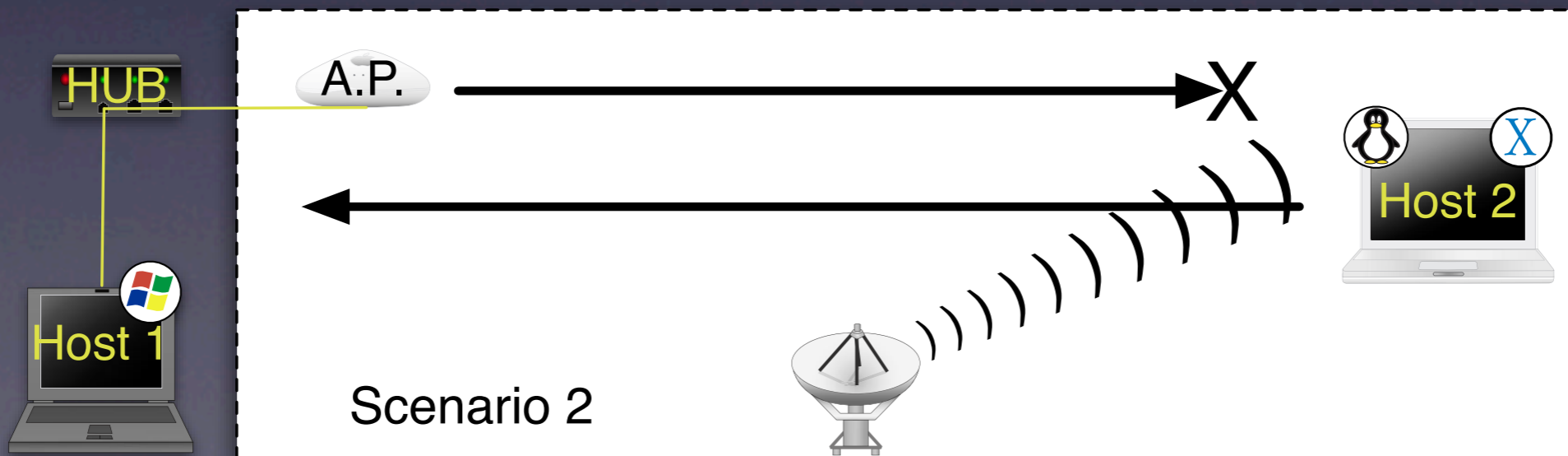
# TCP Duplicate ACKs

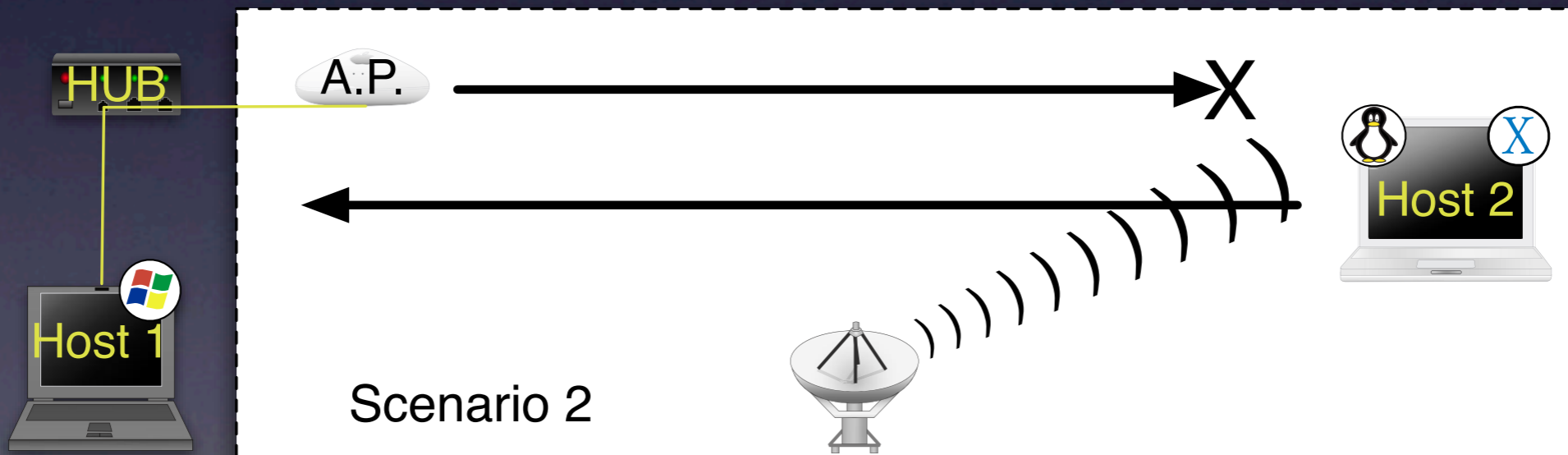
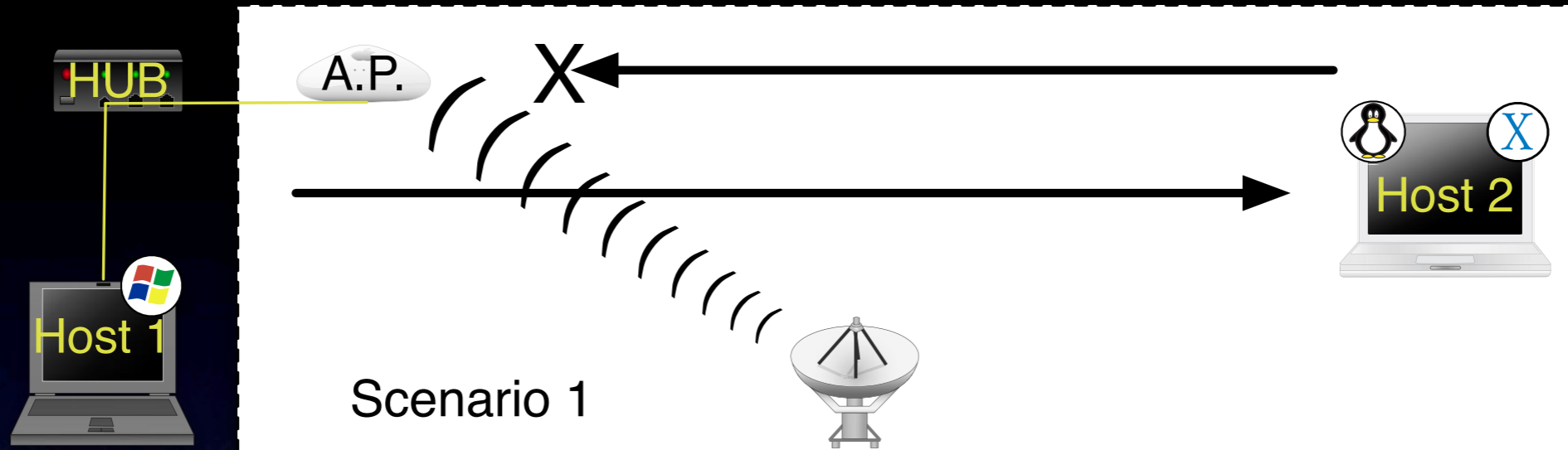


SNR (dB)	32	29.5	27	22
TCP DUP ACKs from client (Asus VP)	121	8107	29584	20091
TCP Dup ACKs from client (Server VP)	0	0	3	156

# TCP Results: Aim Client

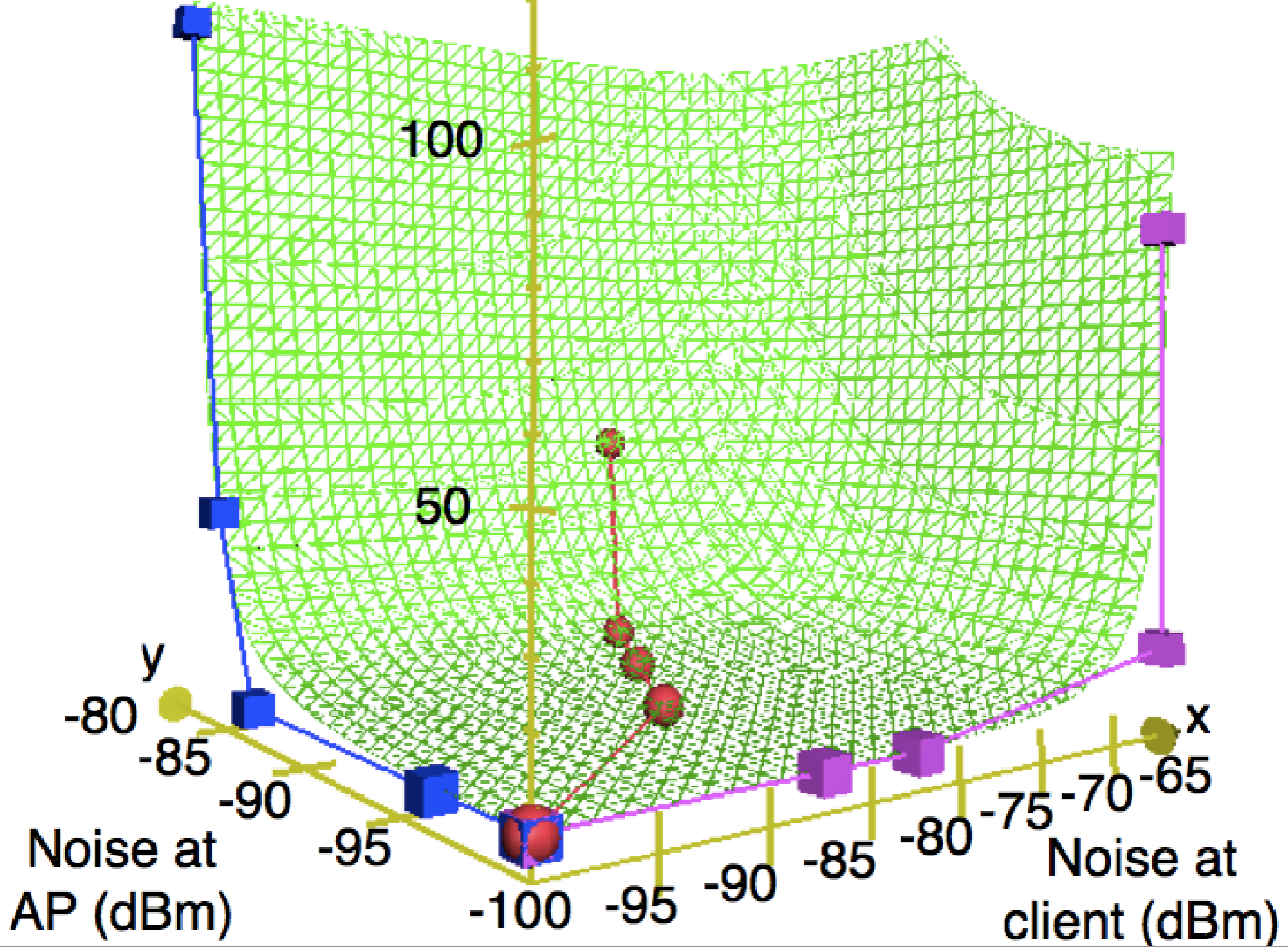
SNR@client (dB)	No noise	45.3	40.3	24.3	23.8
TCP ReTx from Server (Server VP)	0	0	0	108	387
TCP ReTx from Server (Client VP)	0	0	0	17	158





$$z = a * e^{\beta * 10^{x/10}} * e^{*10^{y/10}}$$

Streaming  
Time (s)





# Conclusions

- How to do cross layer measurement
- VQM dependence on PLR
- PLR dependence on cross traffic rate and packet size
- Only with heavy PLR, does video quality decrease
- Analysed interactions of protocols at different layers
- Examined relationship of SNR at client and AP

Thank You