

Allowing Errors in Speech over Wireless LANs

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Outline

- Motivation
- Related Work
- System model
- Design
- Evaluation
- Conclusions

Motivation

- Wireless
 - Erroneous channel
 - Retransmissions
 - Congestion
- Voice
 - Significant error concealment available
 - Improve capacity and maintain quality

Related Work

- Voice encoding improvements
 - Bit rate, error correction, error and loss concealment
- Additional protection
 - Redundant transmissions, retransmissions, packet size, wireless data rate
- UDP Lite [Larzon 99]
 - Partial UDP checksum
 - Requires lower layer support
 - Wireless usage not examined

System Model

- Digitized Voice
- IEEE 802.11
- Gilbert Error Model

Voice over IP

- Encoder/decoder
 - Bit stream
 - Packetization
- Quality
 - Delay, jitter, loss

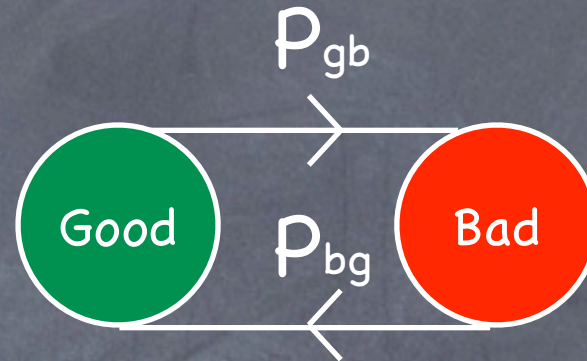
Encoder	Bit Rate
G.711	64 kbps
G.723.1	5.3, 6.3 kbps

IEEE 802.11

- Distributed Coordination Function (DCF)
 - RTS-CTS-Data-ACK
 - Data-ACK
- MAC layer retransmission
 - Collisions and errors
 - Up to 7 times

Gilbert Error Model

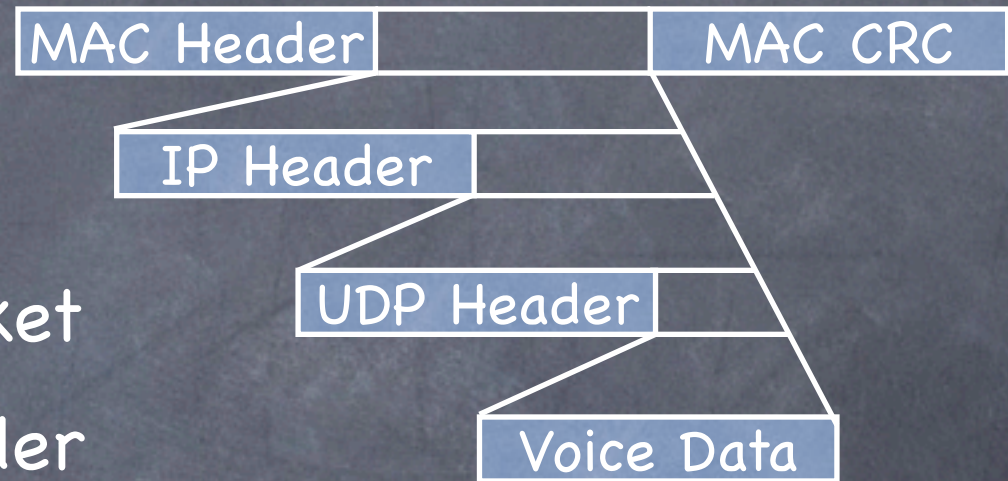
- Two state Markov model
- Bursty errors
- Experimentally determined values
 - Average (Avg)
 - Noise Limited (NL)
 - Interference Limited (IL)
 - Frequency Selective Fading Limited (FSFL)



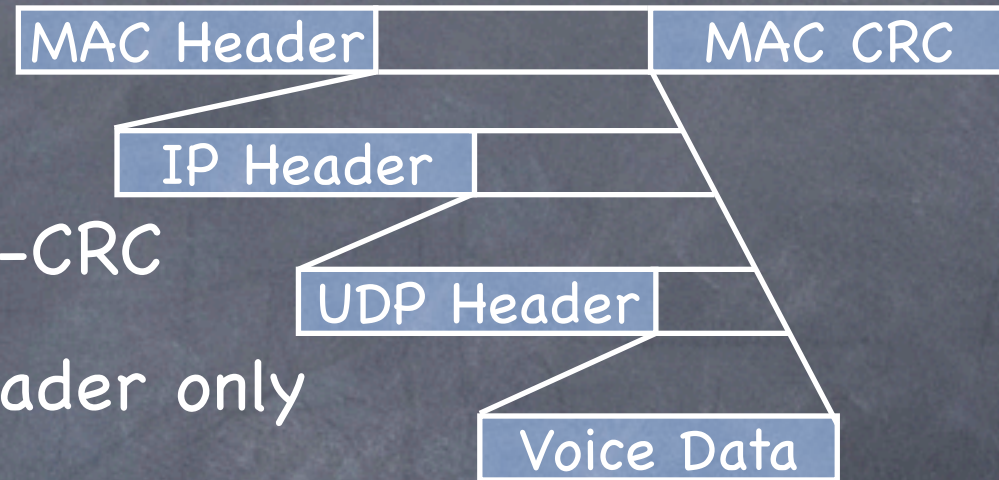
Model	ABER
Avg	1%
NL	1%
IL	8%
FSFL	0.3%

Design – CRCs and Checksums

- Protection methods
- MAC CRC: Entire packet
- IP checksum: IP header
- UDP checksum
 - Headers + payload or disabled
- Typical CRC = T-CRC

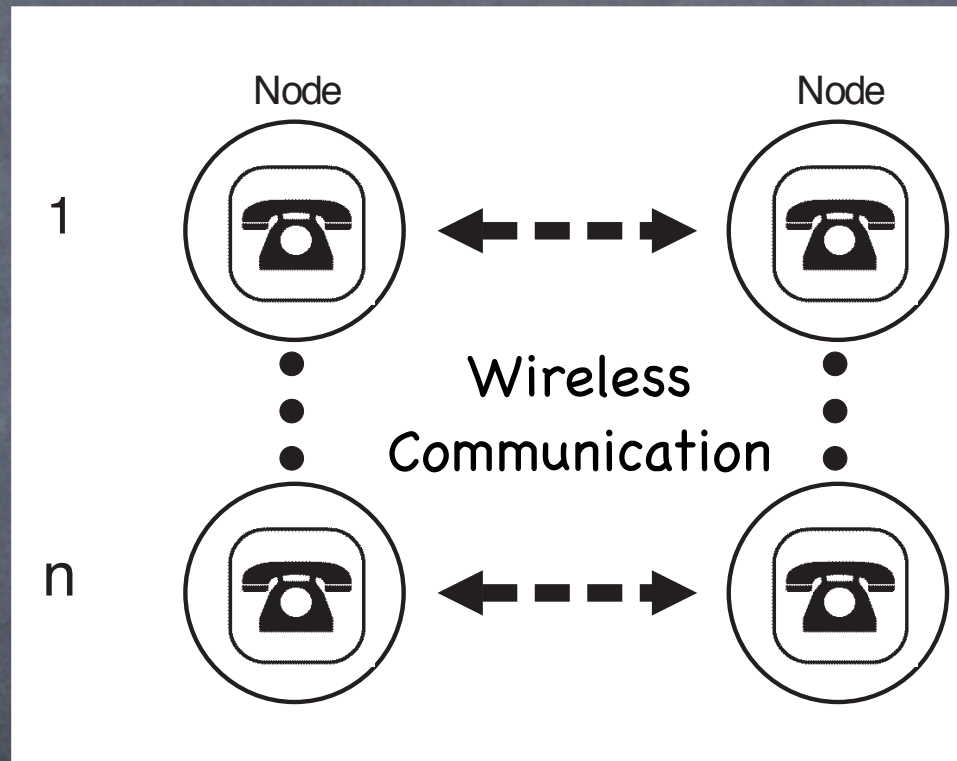


New Designs



- MAC Header CRC = M-CRC
 - MAC CRC - MAC header only
 - UDP checksum off
- Entire Header CRC = E-CRC
 - MAC CRC - All headers
 - UDP checksum off

Experiments



Network Topology

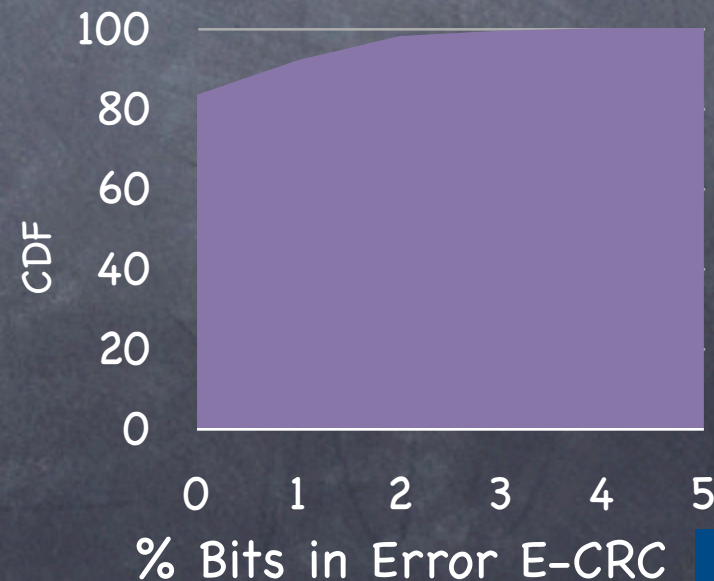
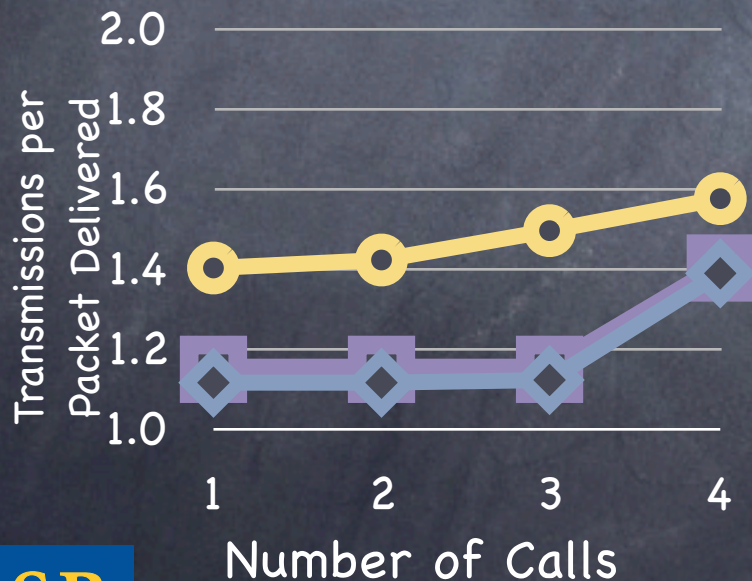
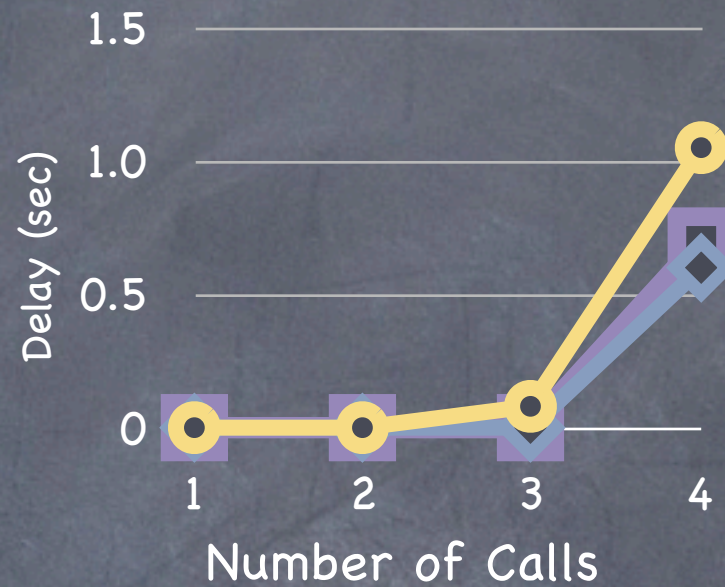
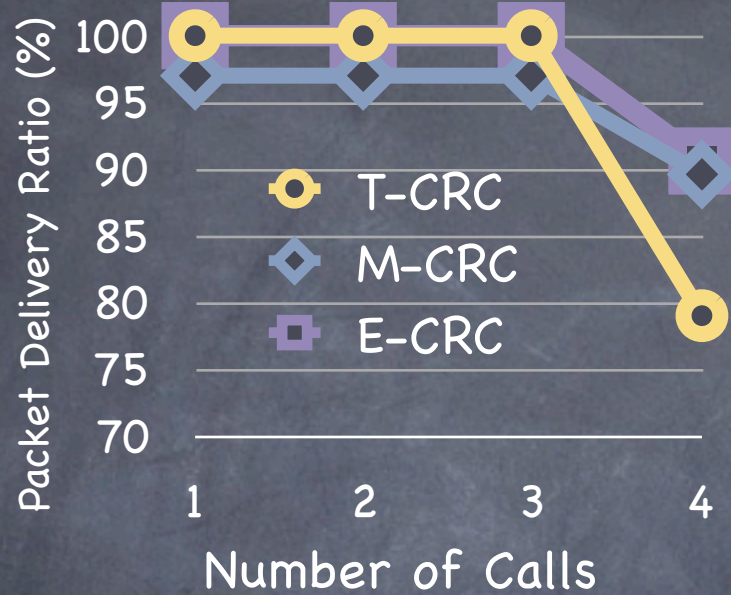
Voice Traffic

Encoding	Bit Rate	Voice per Packet	Bytes per Packet
G.723.1	6.3 kbps	30 ms	24
G.711	64 kbps	20 ms	160
G.711	64 kbps	25 ms	200
G.711	64 kbps	30 ms	240
G.711	64 kbps	35 ms	280
G.711	64 kbps	40 ms	320

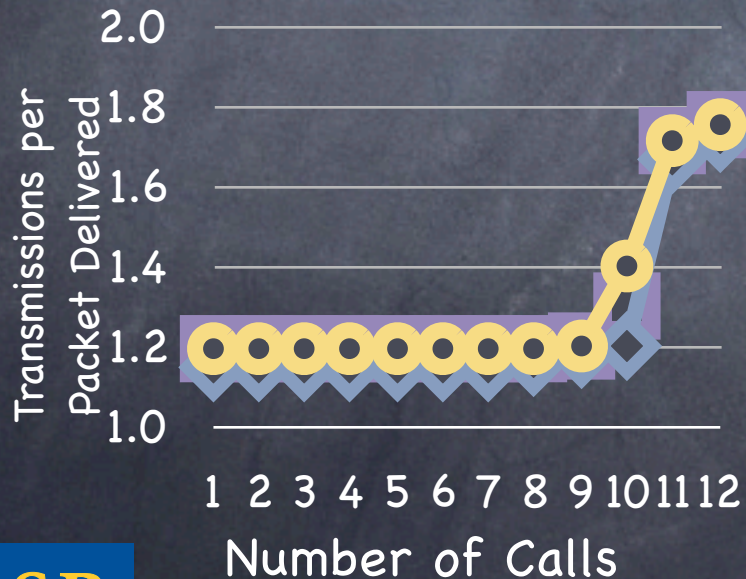
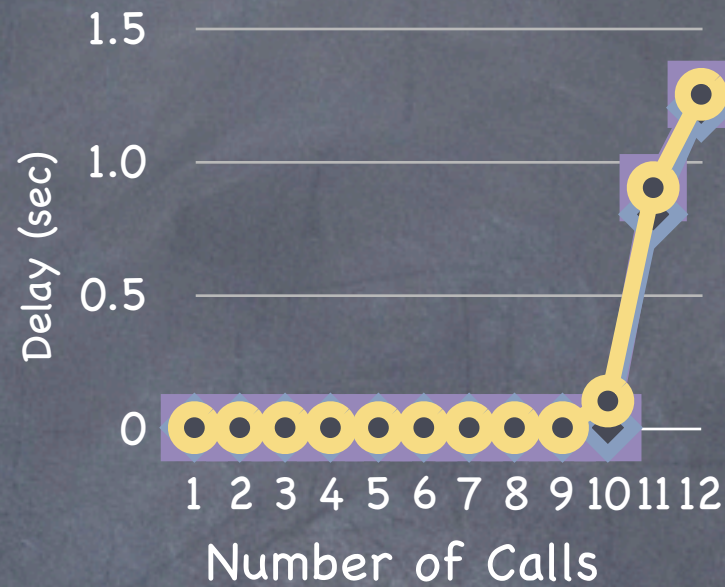
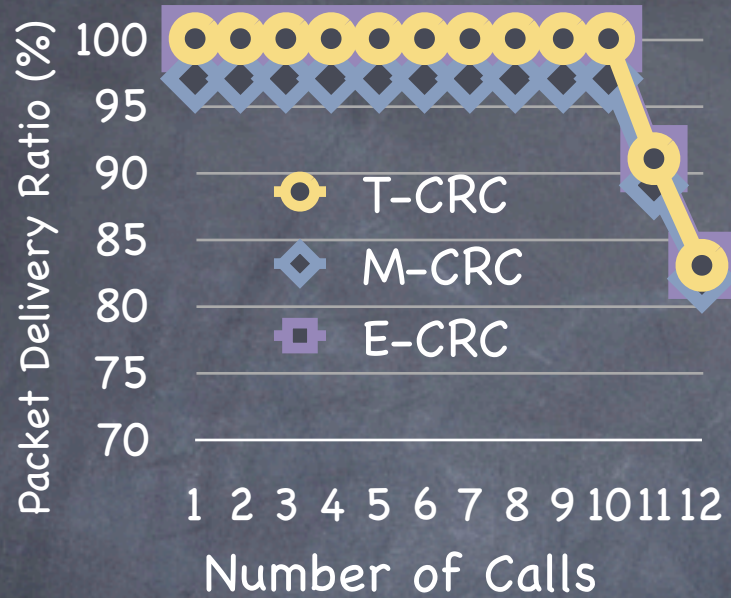
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General Results

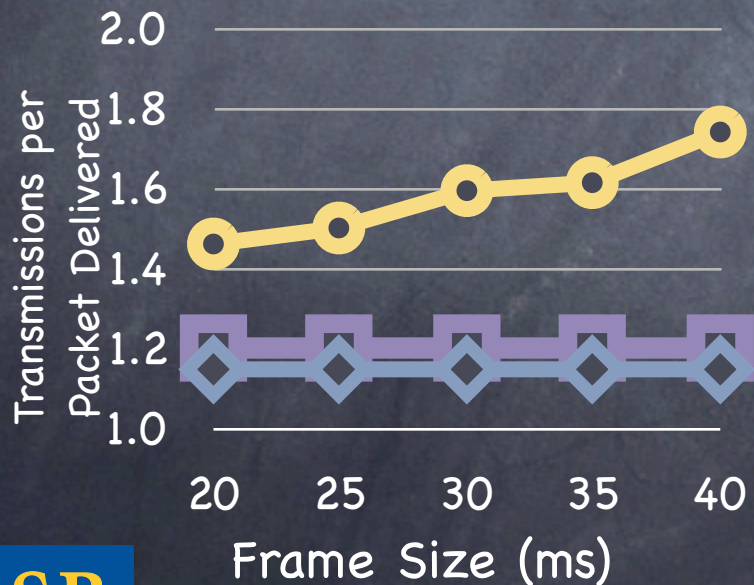
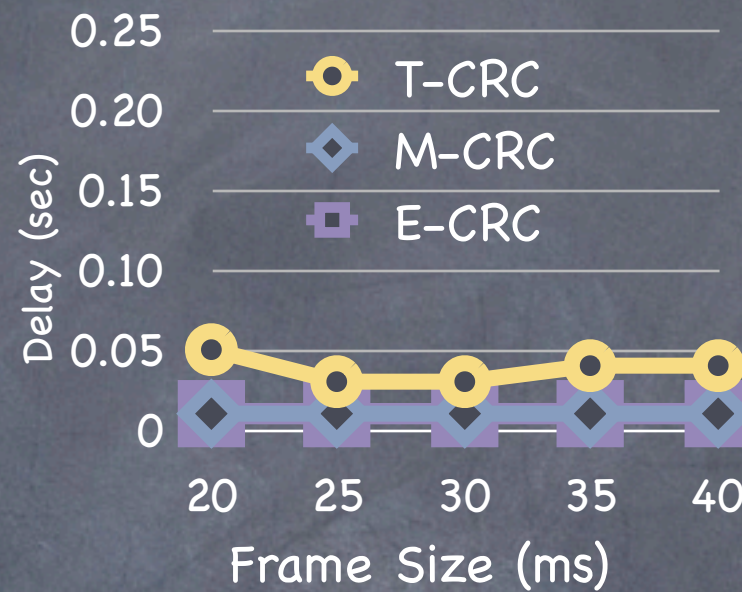
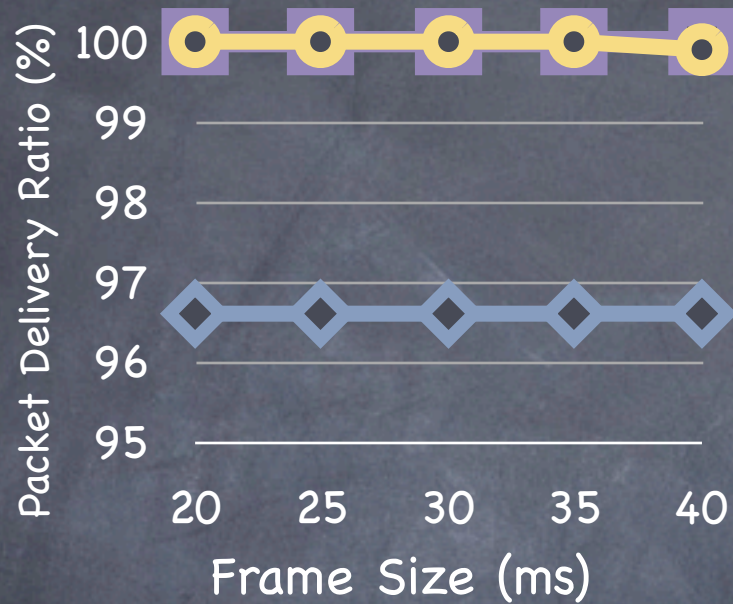


Efficient Voice Encoder



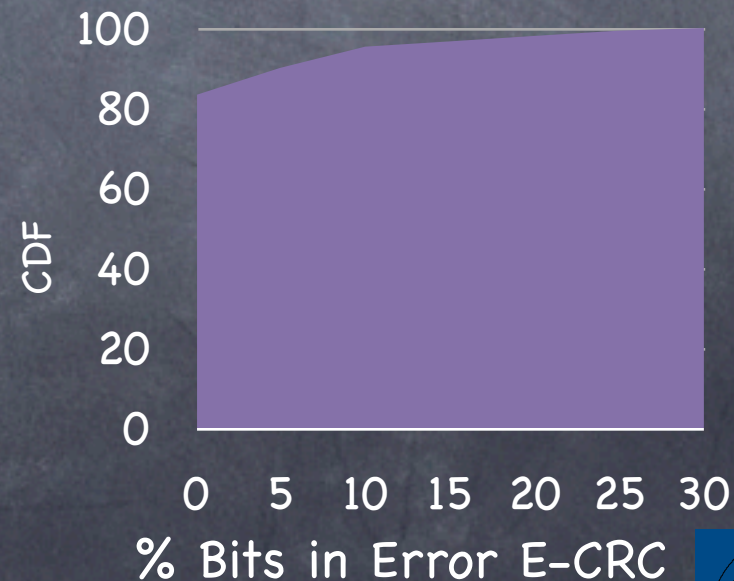
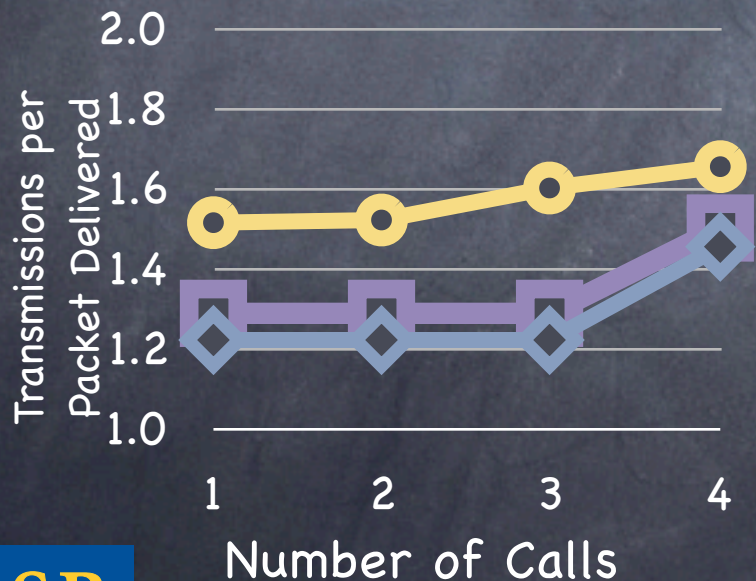
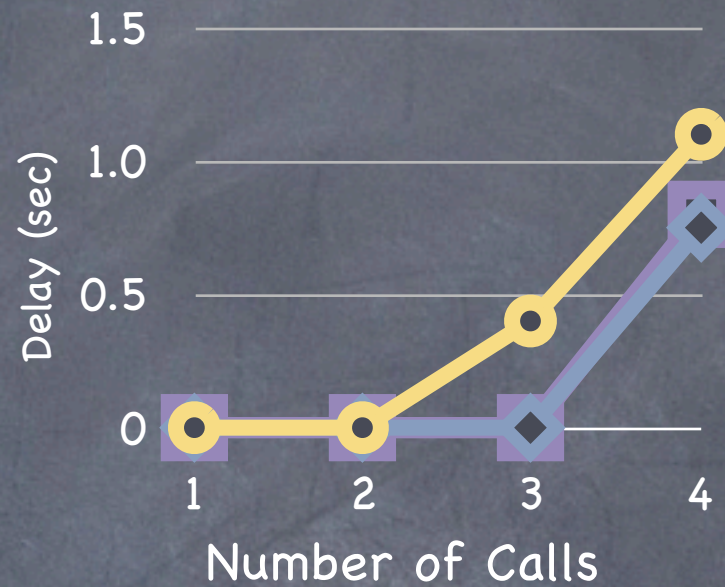
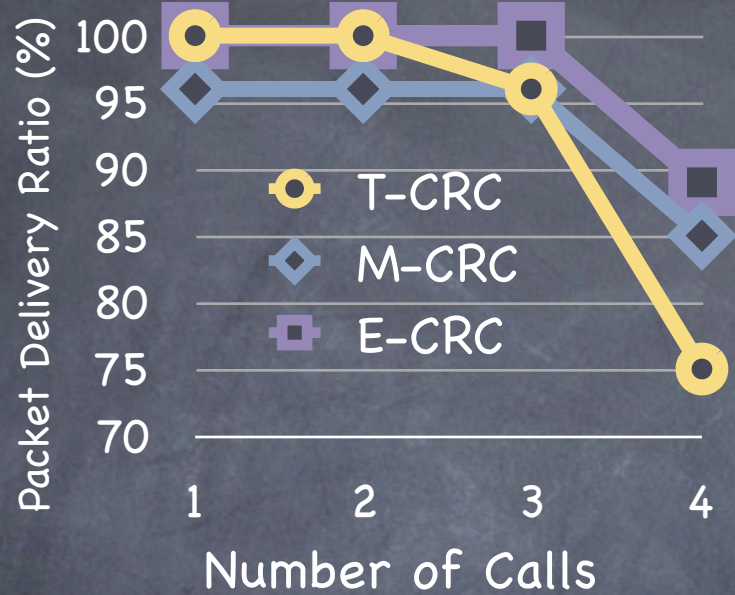
G.723.1
6.3 kbps

Voice Frame Size



G.711
3 Calls

Harsh Wireless Conditions - IL



Conclusions

- Allowing bit errors results in
 - Lower delay
 - More capacity
 - Acceptable call quality
- Future work
 - User studies
 - Multihop networks
 - Video and other multimedia

Questions?

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