

ELEN627 Lecture 5

- Review of last class
- Speech Coding
- Transmitting audio packets

Audio Transmission

- Data rates not very high
 - Within 8 KBytes/sec
- Where is the difficulty?
- Delay guarantees are difficult!!
 - Audio quality very susceptible to delays
- Delays in current Internet highly variable
- What happens on packet loss?
 - Retransmission takes more time

Tolerating packet loss

- Audio quality suffers on packet losses
 - Less forgiving than video
- Important to compensate for packet losses
- Two options
 - Packet Retransmission - ARQ
 - Forward Error Correction - FEC

Retransmission

- Too many Delays
 - one RTT to figure out packet loss at the receiver
 - one RTT to inform sender
 - one RTT for retransmission
 - With RTT = 60ms, delay = 180ms
- Audio Delay Tolerance within 250ms

Forward Error Correction

- Allow redundancy in transmitting data
- On packet loss, reconstruct lost data from other packets
- Example: send a parity packet for every k data packets
 - A Packet loss can be tolerated in $k+1$ packets
 - No need for retransmissions
- Delay = time to receive $k+1$ packets
 - Larger k = longer delays, less redundancy

Packet losses

- Why do packet losses happen?
 - Network congestion
- FEC increases sender's data rate
- Should we increase data rate when network is congested?
- What happens when everyone employs FEC?

FEC, data rates

- FEC incurs less delay in tolerating packet loss than ARQ
- FEC increases data rates
 - When universally employed increases packet loss
- Employ FEC without increasing data rates
- Find the optimal data rate
 - Apply FEC without increasing that rate

FEC and packet losses

- Packet losses typically happen in a burst
 - Simple $k/k+1$ codes not enough
- FEC needs to tolerate bursty losses
- Redundant packet needs to be far away from original packet
 - Otherwise, both packets may be lost
 - Can't be too far because of delay constraints

FEC and audio

- Apply different levels of speech encoding
- Encode original data at higher quality
 - Such as ADPCM at 24-32Kb/s
- Send redundant data at lower quality
 - Say, Lower bitrate ADPCM at 8 kb/s
- Attach redundant copy along with a later data packet
 - Keep the number of packets the same
 - To reduce the overhead

FEC performance

- At very low loss rates, FEC doesn't provide any benefit
- At the same data rate, possible to get better quality
 - Send original data at a higher data rate
- At low-medium loss rates, FEC is necessary
 - Quality better than ARQ-based schemes
- FEC beneficial even at Low data rates