Time and Timing Issues for IP Based Multimedia

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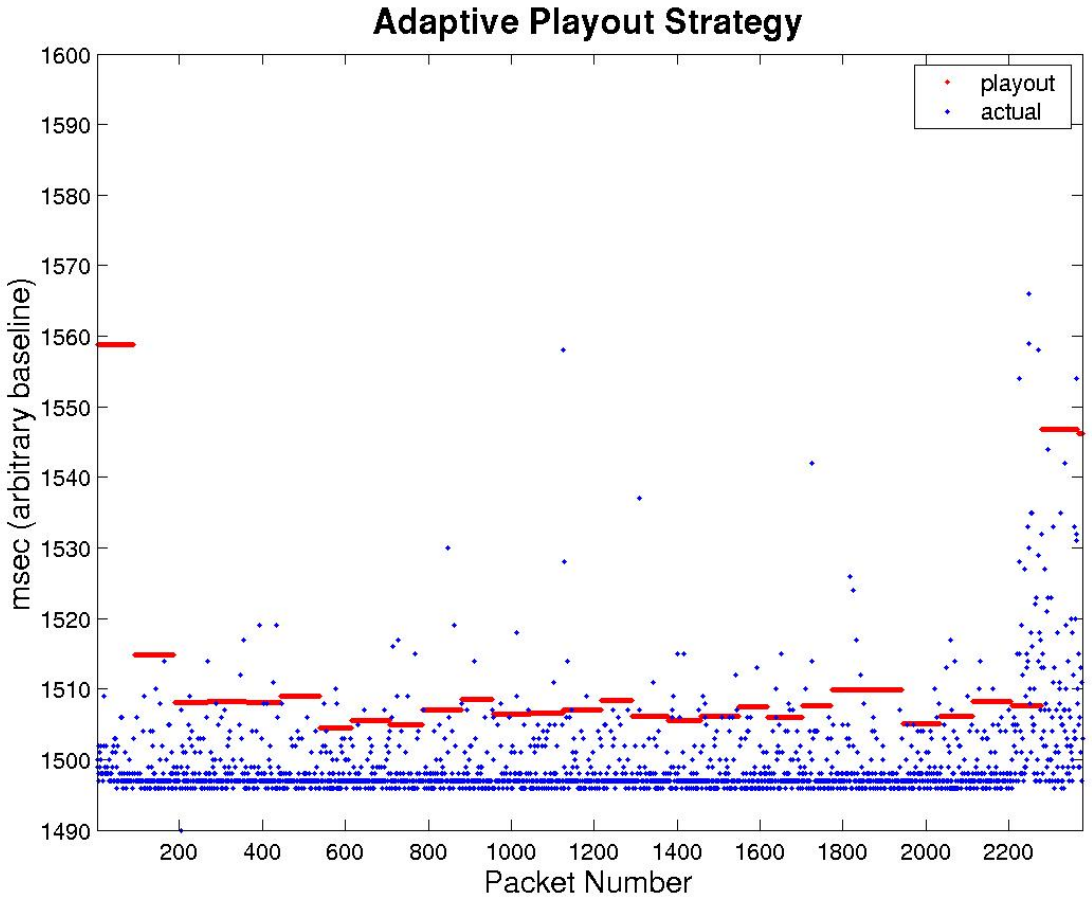
Outline

- Time & Timing within IP Multimedia Applications
  - Voice & Video over IP
  - Streaming
  - Media Mixer
  - Gaming
- Challenges of Wireless Ubiquity
  - Wireless speaker scenario
  - Delivering NTP over wireless
- Conclusions

Background Research VoIP

- VoIP : Adaptive Jitter Buffer Algorithms
  - Jitter buffer absorbs packet arrival jitter
  - Adaptive buffer tracks network
    - Implemented via silence period adjustment
      - QoS impact unknown
    - No Time Synch between endpoints
    - No knowledge of actual M2E delay
      - Adjustments often unnecessary in context of acceptable M2E delay

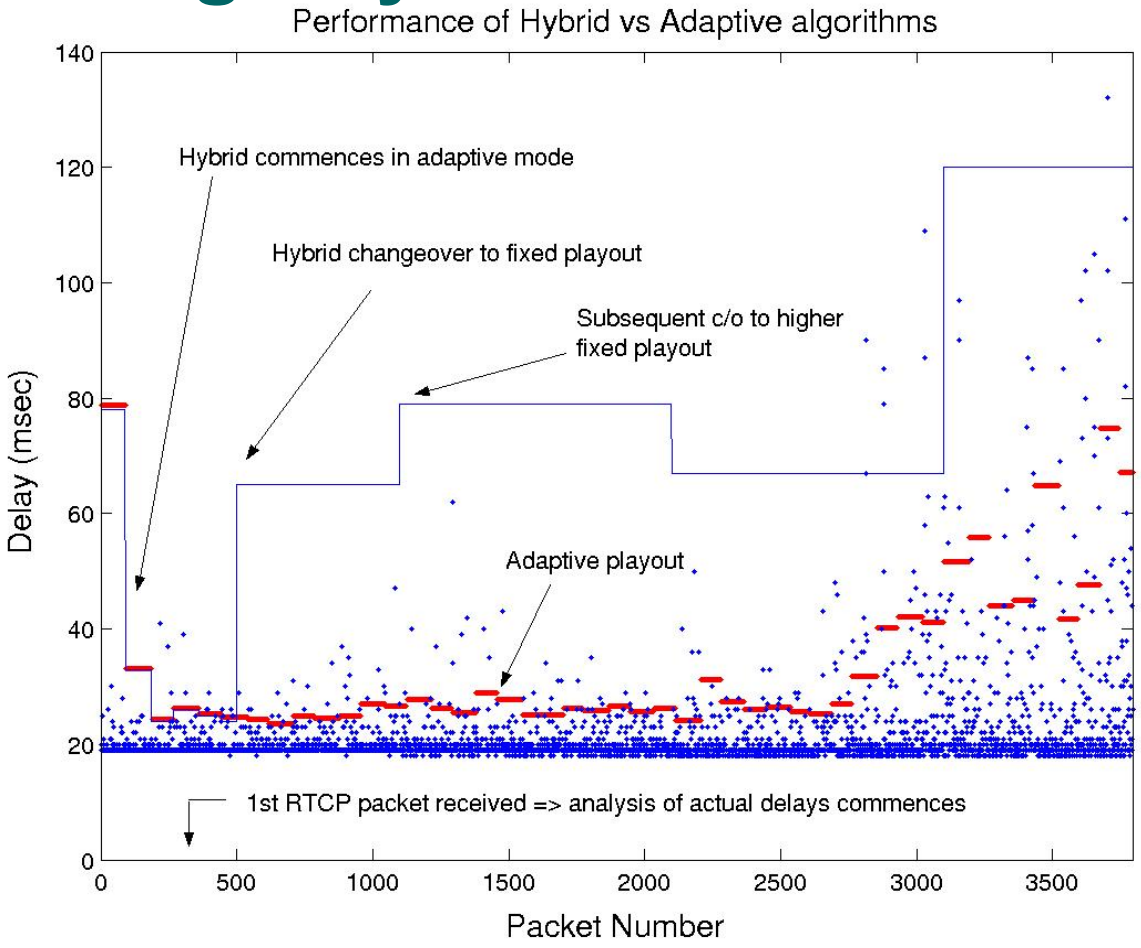
Adaptive Jitter Buffering



Hybrid Playout Algorithm

- Hybrid Algorithm
  - Based on synchronised time across different hosts
  - Minimise late loss at expense of increased delay
  - ITU-T E-Model
    - Net gain in user-satisfaction R-factor
  - Added (unquantified) benefit of reduced silence period distortion
  - Synchronised time provided by NTP
  - Precise delay info facilitated by RTCP SR packets

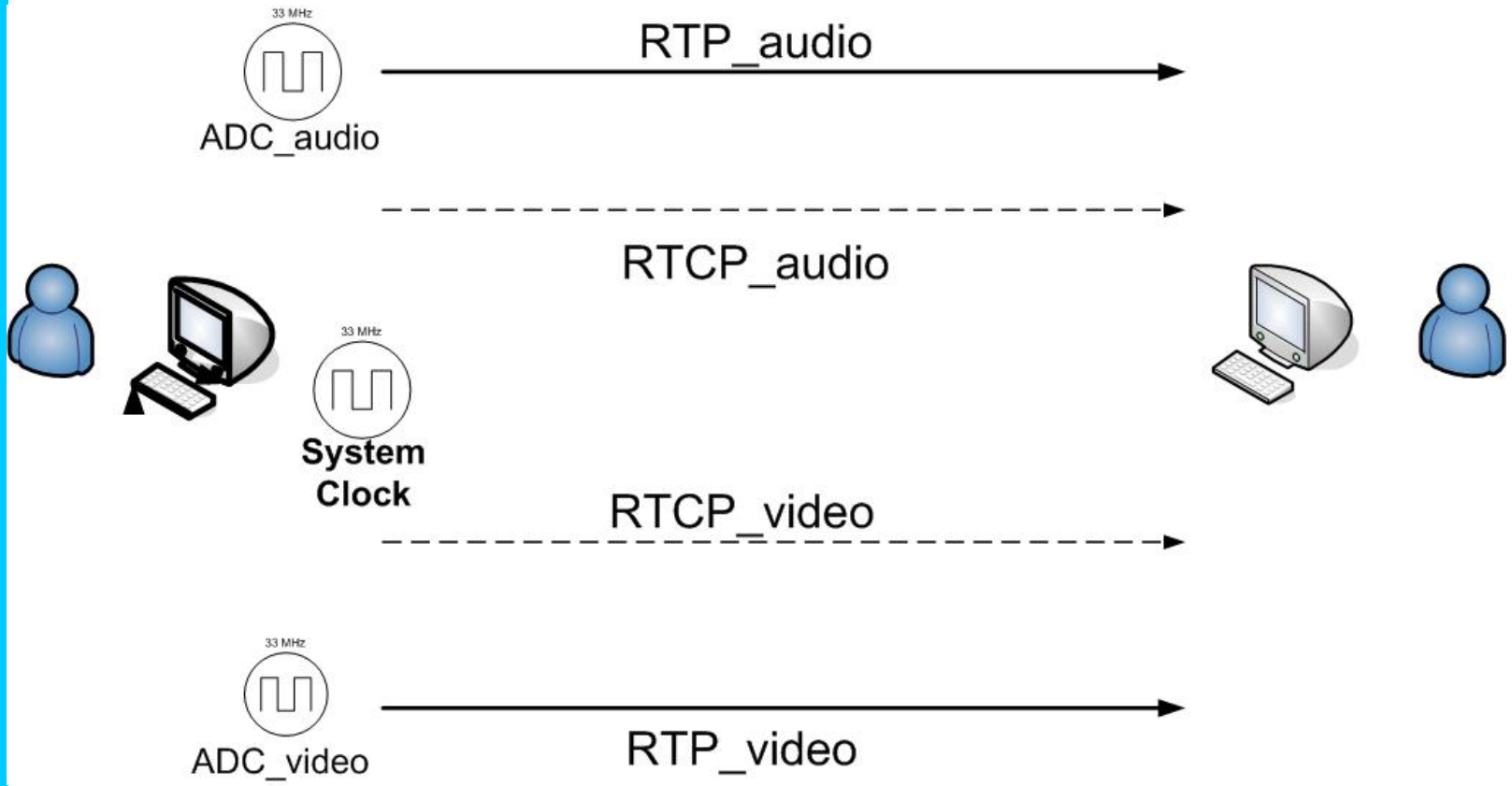
Hybrid Alg.: Synchronised Time



RTP & RTCP

- RTP useful for intra-stream synchronisation (reconstruction)
- RTCP SR useful for inter-stream synch for different streams eg lip-synch *from same host*
  - *Synch Time across hosts not reqd*
- *What if we want to synch different media streams **from different hosts** ?*
  - *Eg Media Mixer scenario*
  - *Require Synchronised Time **across** hosts*

Lip Synch via RTCP SR



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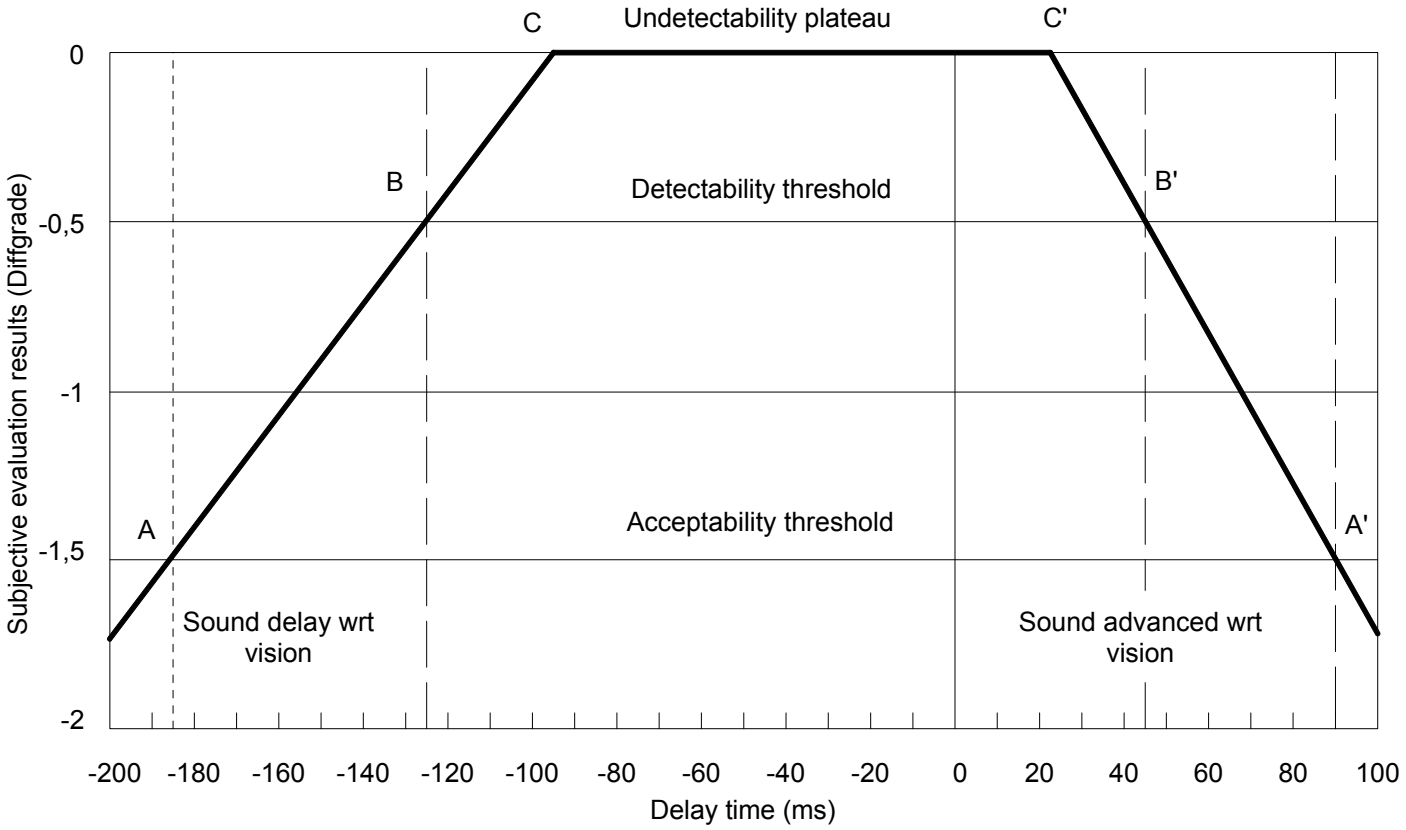
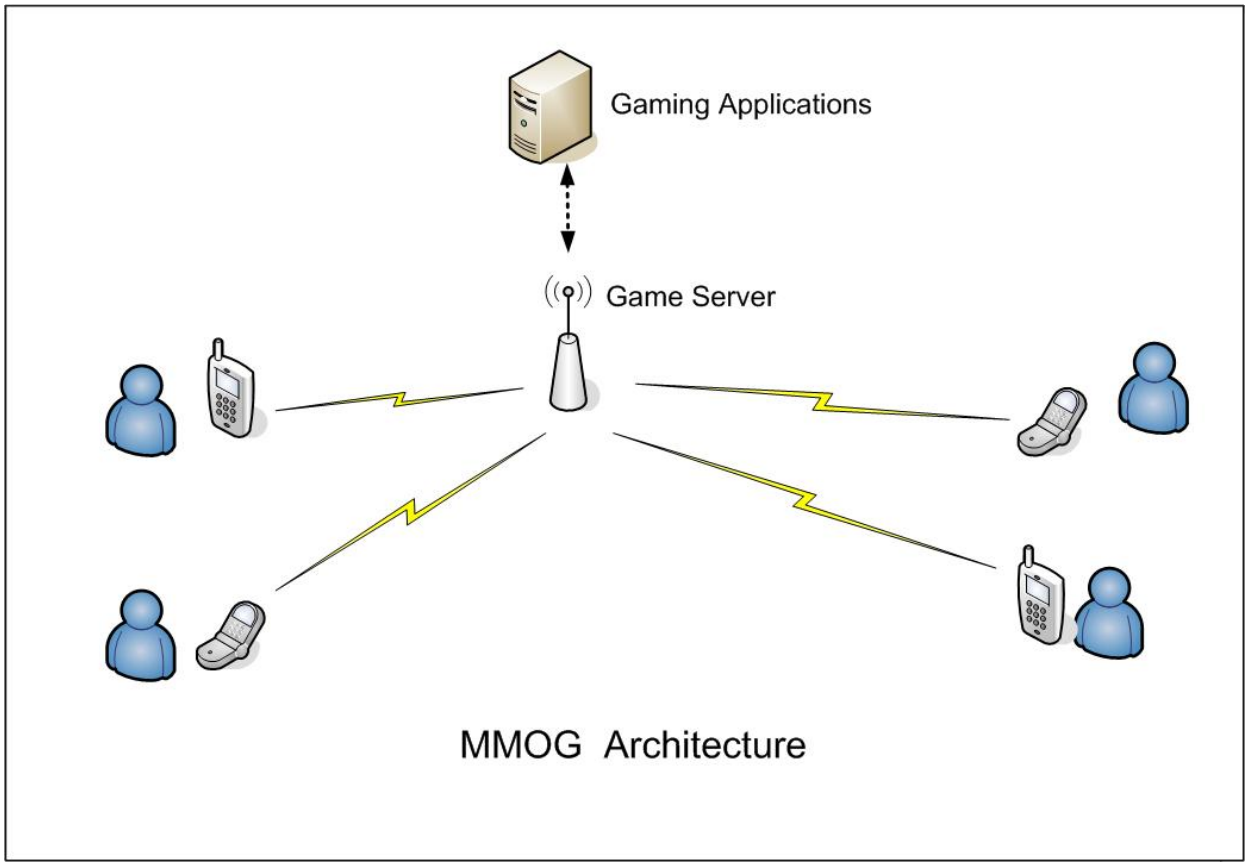
Detectability and Acceptability Thresholds for lip synch ETSI STQ



Synch Time for MMOG



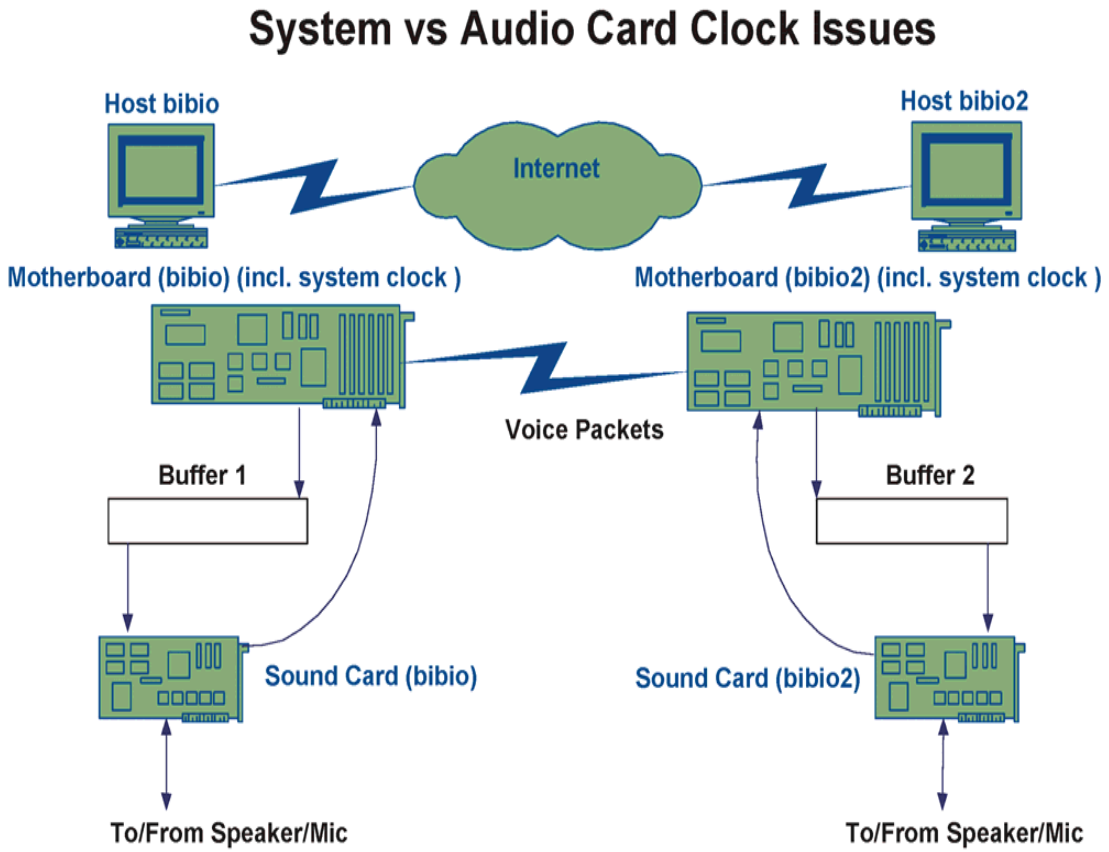
Benefits of Synchronised Time

- VoIP / Video over IP
  - Precise Delay Information
    - Improved QoS (E-Model analysis)
- Media Mixer
  - Alignment of media across different hosts
- Gaming
  - MMOG market growth
  - Facilitates equalisation of delays where useful
    - *Levels the playing pitch for all participants*

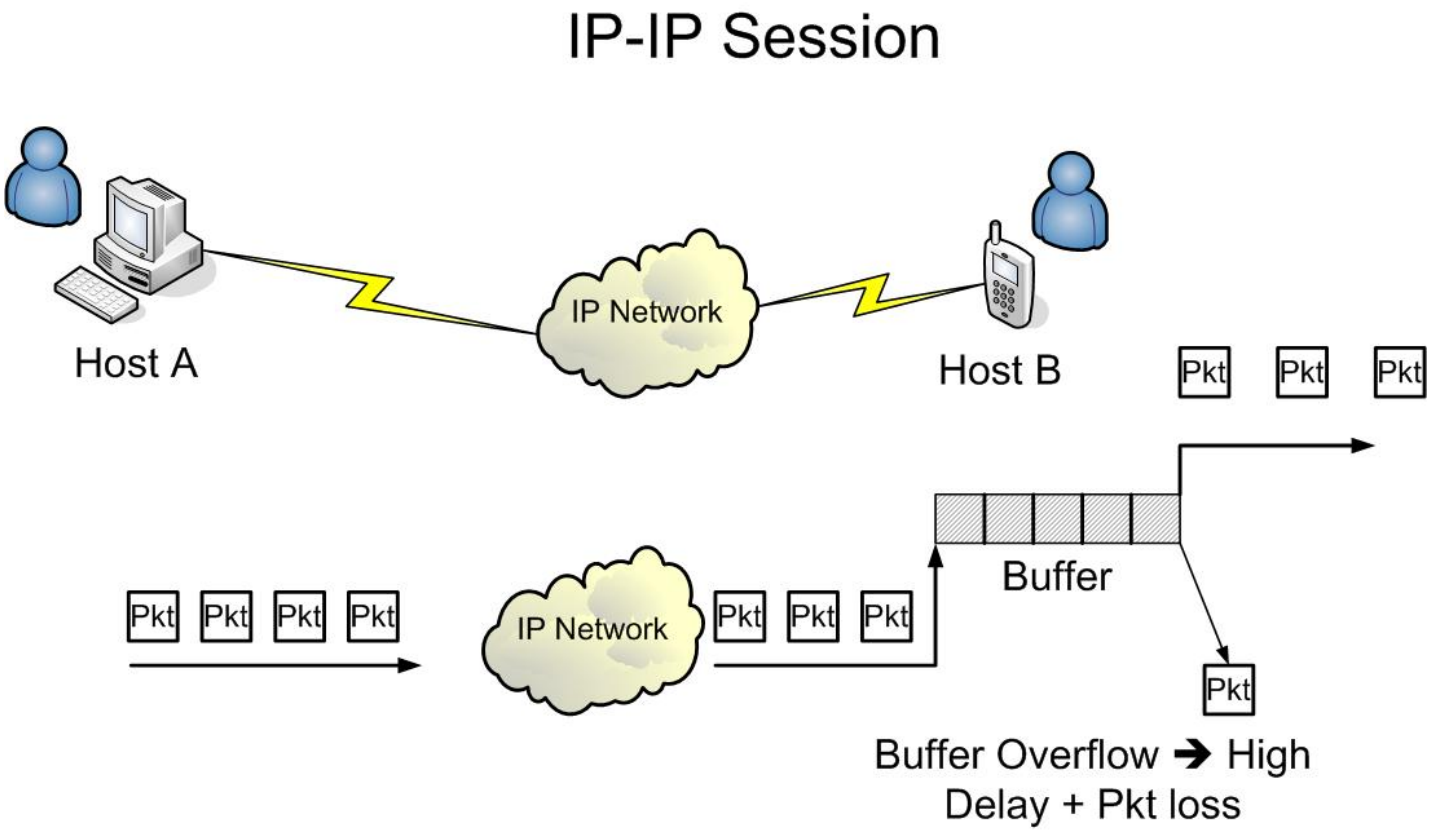
Synchronised Timing

- NTP synchronises *system* clocks
- *Media* clocks are often separate subsystem
- Multiplicity of clocks introduces complexity
- VoIP Terminals / Gateways
  - Delay and Packet Loss
- Gaming
  - Delay & Packet Loss
- Media Mixer
  - Cumulative misalignment (if initially aligned)
- Streaming
  - Pkt loss rather than delay key issue

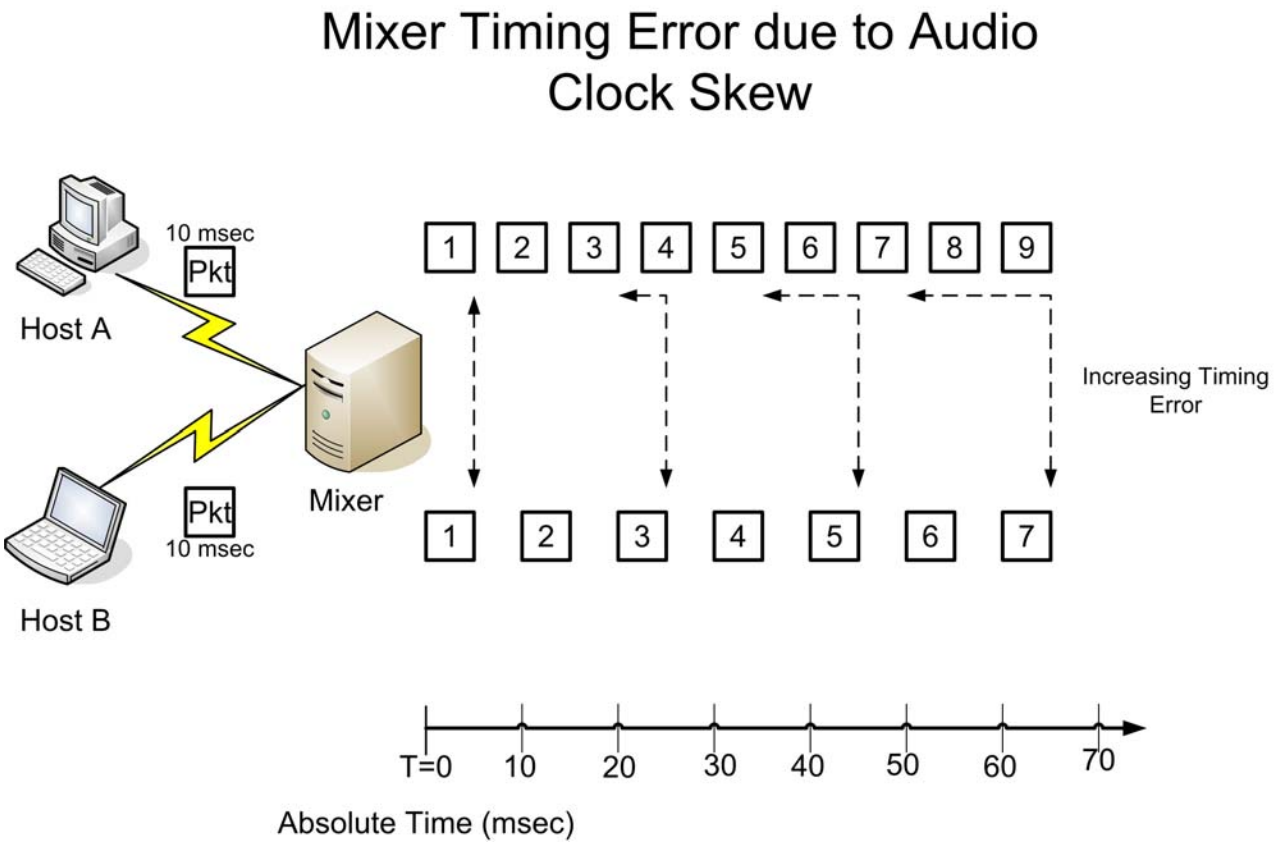
System v Media Clocks



Timing 'Skew' for IP Multimedia



Media Clock Skew : Mixer



Skew Solutions in wired world

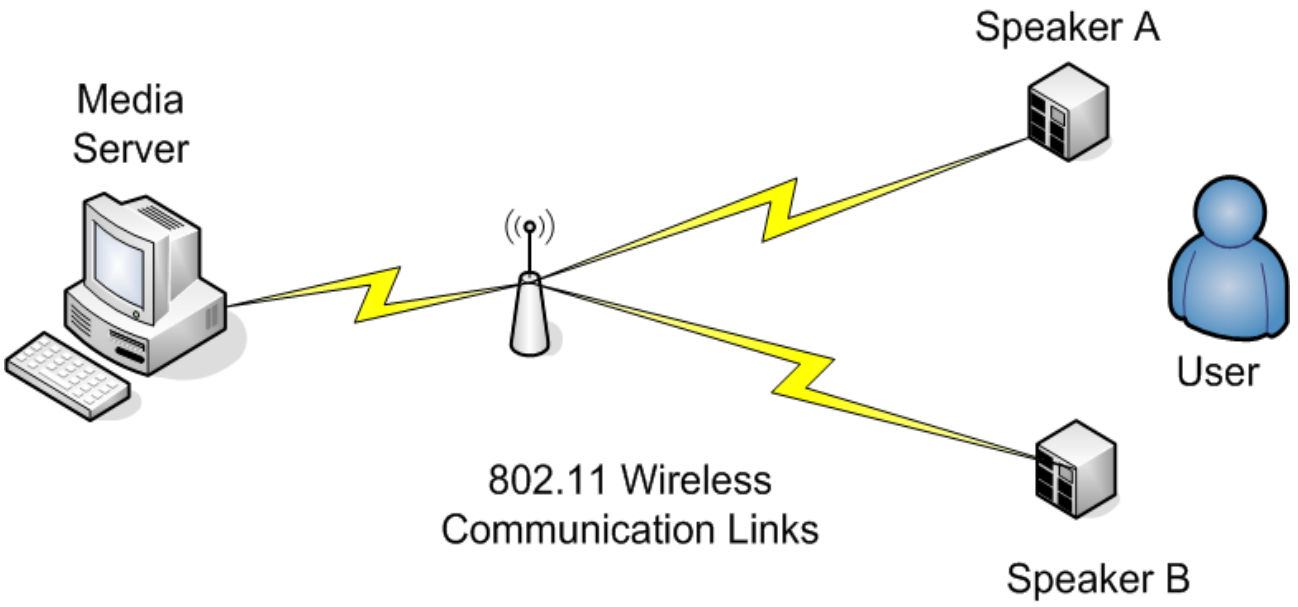
- Various skew detection and compensation mechanisms
  - Low level buffer monitoring to determine skew
- Patented NTP/RTCP approach
  - Based on Synchronised time
    - Independent benefits

Wireless Challenges

- Increased delay/jitter due to
  - Contention level & Signal degradation/interference
- Additional problems for
  - VoIP .. buffer/delay management
  - Gaming .. buffer/delay management /delay equalisation
  - Mixers … buffer/delay mgt & stream alignment
  - Streaming
    - Buffer management
    - Stream Alignment for multiple parallel streams
      - Wireless Speakers

Wireless Speakers

Synchronisation of Media Streams



Wireless Streaming

- Playout from speakers A & B needs to be very tightly synchronised
- Approx impact of delay difference (Haas Effect)
  - ΔT < 30 msec
    - Sensory inhibition
      - Only hear the 1st
      - Brain processes ΔT to determine sound source
  - ΔT > 30 msec
    - Two distinct sounds heard .. Echo
  - Both undesirable!

Cause of ΔT

- Delays to speaker A and B may be very different due to 802.11 characteristics
  - Need to synchronise streams at start
    - ➔ Synch Time reqd
- Skew between media clocks A & B will cause cumulative misalignment over time
  - 100 ppm = 60 msec over 10 minutes
    - ➔ Synch Timing reqd

NTP in Wireless Environment

- Presents greater challenges
  - NTP operation is based on symmetric networks
  - Wireless networks can be very asymmetric
    - 802.11 'Reliability' will lead to NTP offset errors
    - Server & Path diversity in NTP design
      - Helps identify/eliminate servers on asymm links
      - 802.11 provides common weak link
  - What about 'new' 802.11 e
    - QoS over 802.11

Wireless QoS via 802.11e

- Default Best Effort `ping`
  - 13 packets transmitted, 13 packets received, 0% packet loss round-trip min/avg/max/stddev = 2.485/16.492/31.758/11.551 ms
- QoS Enabled `ping`
  - 12 packets transmitted, 12 received, 0% packet loss, time rtt min/avg/max/mdev = 2.458/3.705/6.478/1.119 ms
  - Cf http://forums.star-os.com/showthread.php?t=6974
- Much lower delay and jitter..but
- What happens when QoS channel is abused?

Conclusion

- Strong awareness of benefits of synch timing
- Less awareness of benefits of synch time
- Does the user currently care ?
  - Wired IP world :
    - QoS seen as acceptable ?
      - Other more pressing problems in network and terminals
  - Wireless IP world
    - Benefits of synch time more significant
    - Wireless speaker: time & timing critical
    - May raise awareness of benefits?

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Thanks to NPL…

Questions?