Time and timing issues within the wireless application home environment

Time and Timing Issues within the Wireless Application Home Environment

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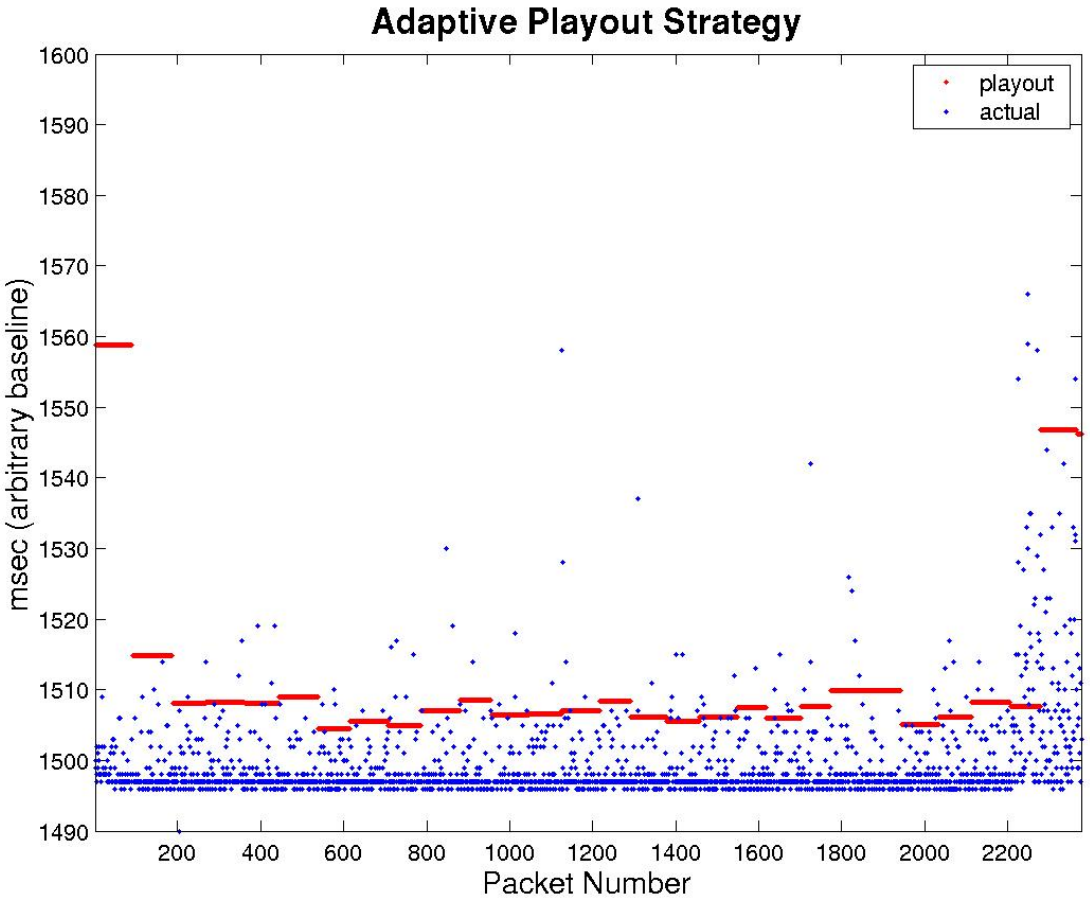
Outline

- Background Research
- Time & Timing within IP Multimedia Applications
  - Voice & Video over IP
  - Streaming
  - Gaming
- Challenges of Wireless Ubiquity
  - VoIP / Wireless speaker scenario
  - Delivering NTP over wireless
- Conclusions

Background Research VoIP .. again

- 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

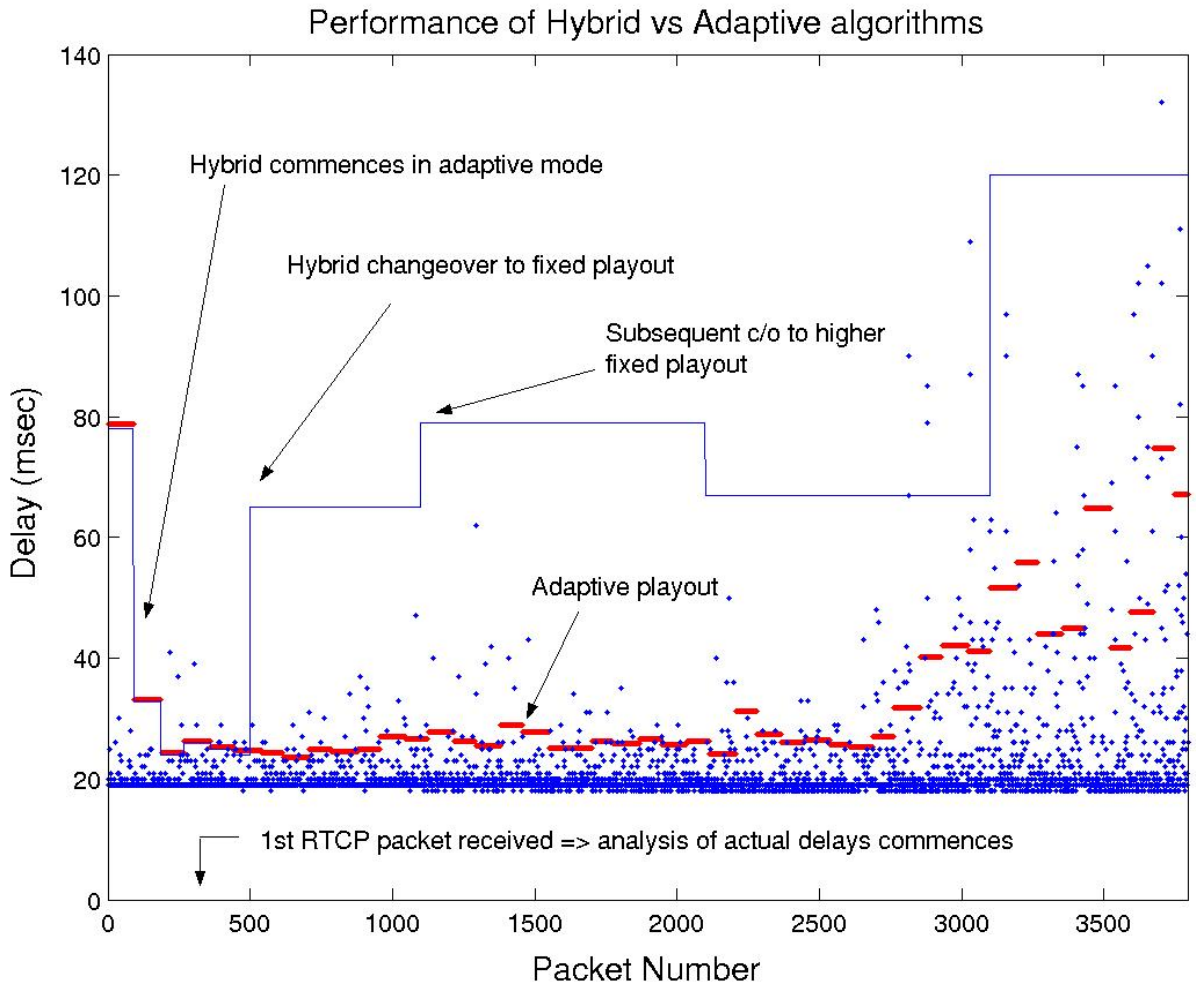
Adaptive Jitter Buffering



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



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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*** *?*
  - *Require Synchronised Time* ***across*** *hosts*

Detectability and Acceptability Thresholds for lip synch ETSI STQ

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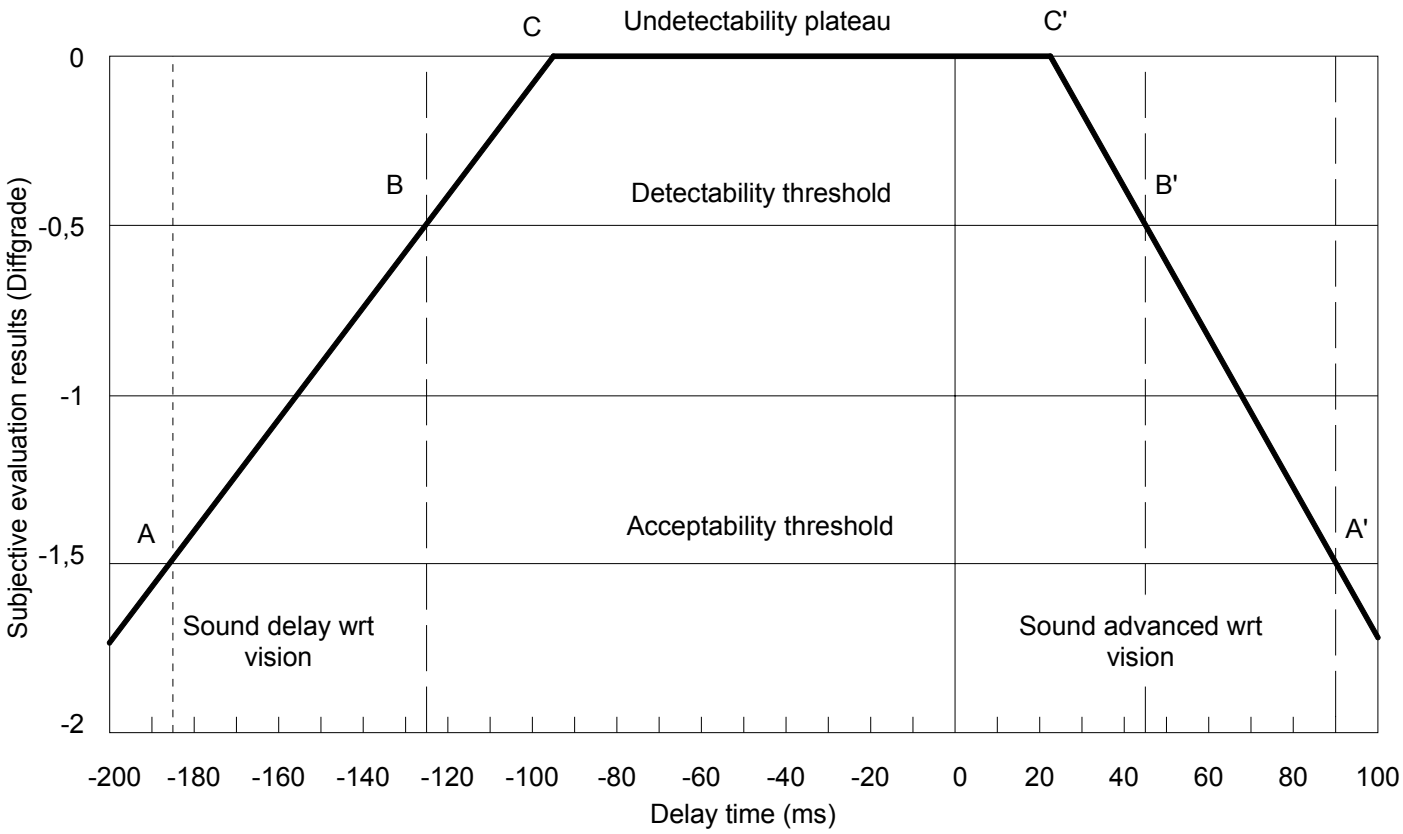

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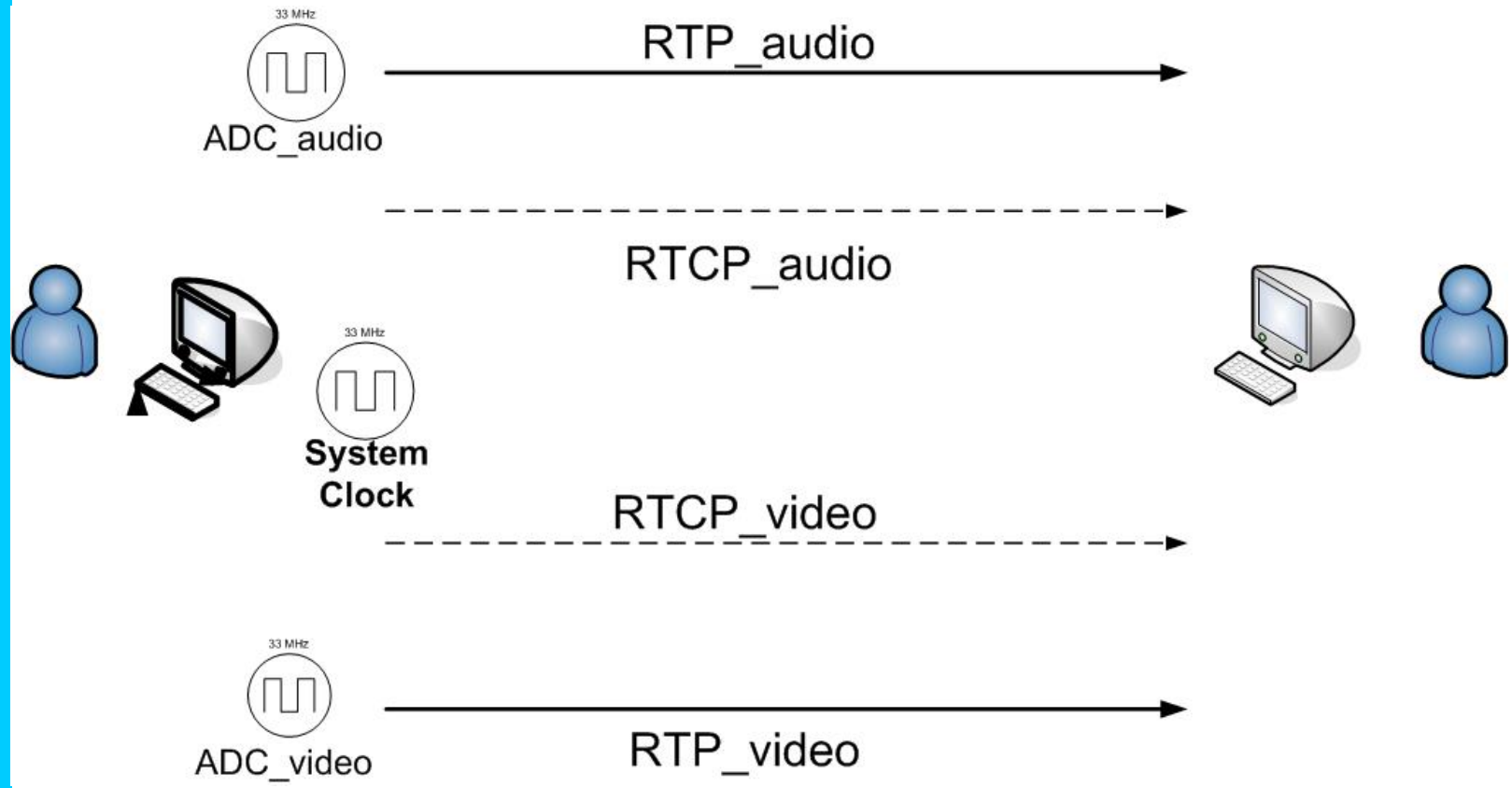
Lip Synch via RTCP SR



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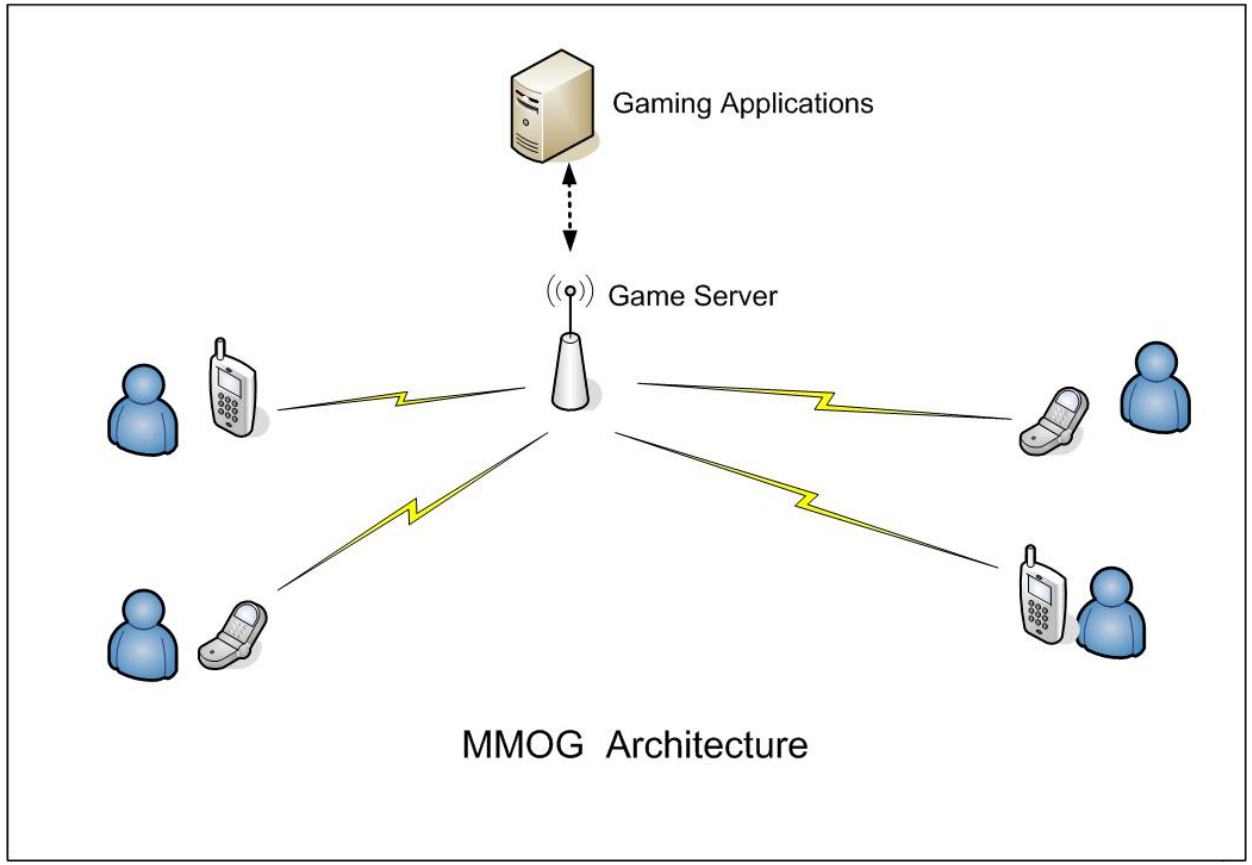
Benefits of Synchronised Time

- VoIP / Video over IP
  - Precise Delay Information
  - Improved QoS (E-Model analysis)
- Gaming
  - MMOG market growth
  - Equalisation of delays
  - *Levels the playing pitch for all participants*

Synch Time for MMOG



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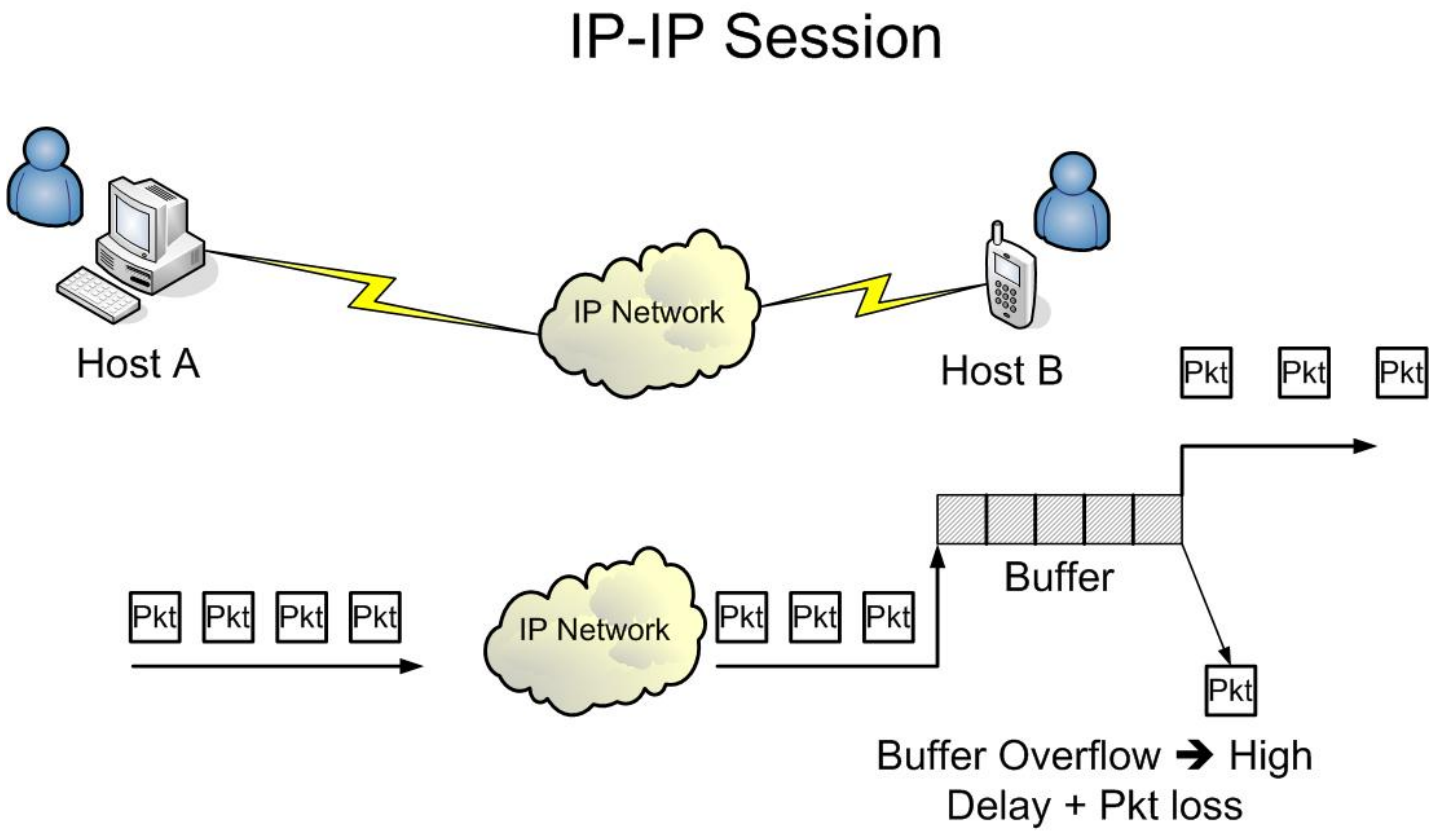
Synchronised Timing

- NTP synchronises *system* clocks
- *Media* clocks are often separate subsystem
- Multiplicity of clocks introduces complexity
- Skew in VoIP Terminals / Gateways
  - Increasing delay ➔ QoS issue
  - Buffer overflow/underfill ➔ Pkt loss/discontinuity ➔QoS issue
- Similar problems for Gaming
  - Delay & Packet Loss
- Streaming
  - Pkt loss rather than delay key issue

Timing 'Skew' for IP Multimedia



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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 Ubiquity

- Rapid growth in both Home & Office wireless LANs
  - IEEE 802.11 a/b/g/e
- Demand for similar IP Multimedia applications over wireless networks
  - Voice and Video over IP
  - Streaming
  - Gaming

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Wireless Challenges

- Most wired LAN networks are Fast/Gigabit Switched Ethernet
  - Little/No contention & Overprovisioned (so far)
  - Reasonably deterministic
  - Switches can be QoS enabled (often not reqd)
  - WAN provides challenges
- Wireless (802.11) LAN
  - A return to contention based LAN networks
    - CSMA CA
  - Relatively low bandwidth
  - Significant delay & jitter at DLL
    - QoS challenges

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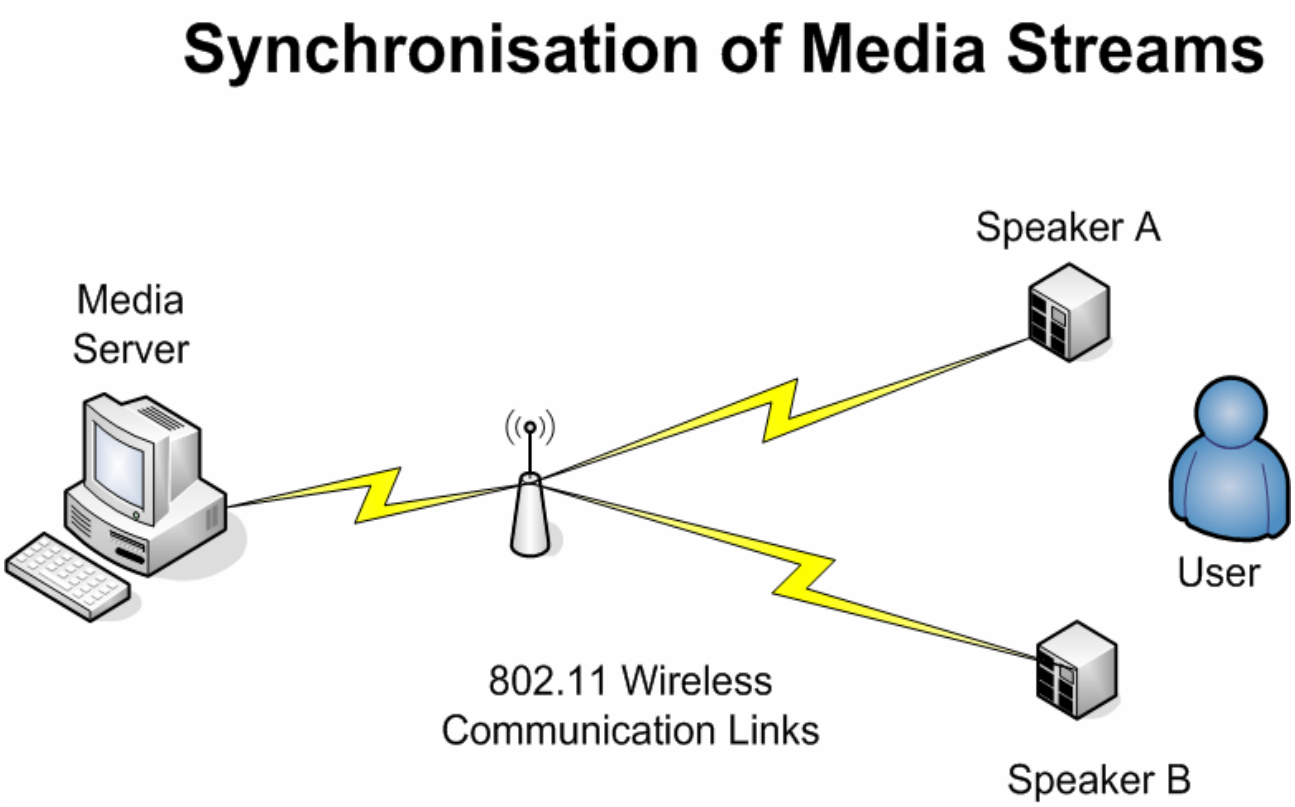
Wireless Challenges

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

Wireless Streaming



Wireless Streaming

- Playout from speakers A & B needs to be very tightly synchronised
- Impact of delay difference (Haas Effect)
  - $\Delta T < 30$ msec
    - Sensory inhibition
      - Only hear the 1st
      - Brain processes ΔT to determine sound source
  - $\Delta T > 30$ 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
- Skew between media clocks A & B will cause cumulative misalignment over time
  - 100 ppm = 60 msec over 10 minutes

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Wireless Challenges

- Have outlined benefits of synchronised time to **wired** applications such as VoIP/gaming/streaming
- Benefits in **wireless** environment are even greater due to significantly greater delay jitter / non determinism
  - Wireless streaming to > 1 media sink has extra requirement for synchronisation

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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: very noticeable impact
    - May raise awareness of benefits?