

draft-hdesineni-avt-avpf-ccm-pd-extn-00.txt

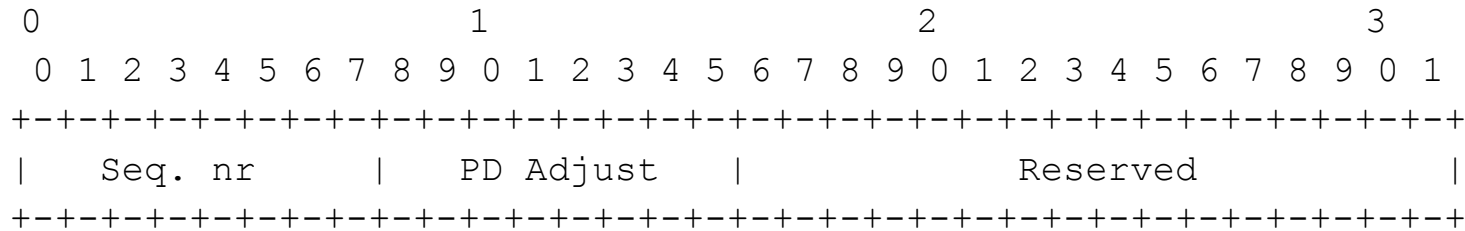
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What is the problem?

- For packet-switched multimedia services transported over time-varying and/or shared wireless channels
 - Rate and delay at which media packets are delivered can vary significantly due to link quality and loading conditions
- UMTS HSDPA and cdma2000 HRPD have single shared down/forward link
 - Delivery times can vary when
 - Link quality changes frequently (e.g., every 2+ seconds)
 - Terminal moves away from or toward the cell base station
 - To maintain low error rate, instantaneous link speed to terminal varies significantly with location, e.g., HSDPA: 68.5kbps to 14Mbps (204x); HRPD: 38.4kbps to 3.1Mbps (80x)
 - Sector is loaded
 - More multimedia users enter or set-up sessions in the cell
- The variations in delivery can degrade service quality for real-time multimedia applications
 - Introduces significant variation in end-to-end delay when in poor link conditions
 - Can exceed latency requirements of conversational services
 - Delayed packets are discarded because they do not meet play out constraints

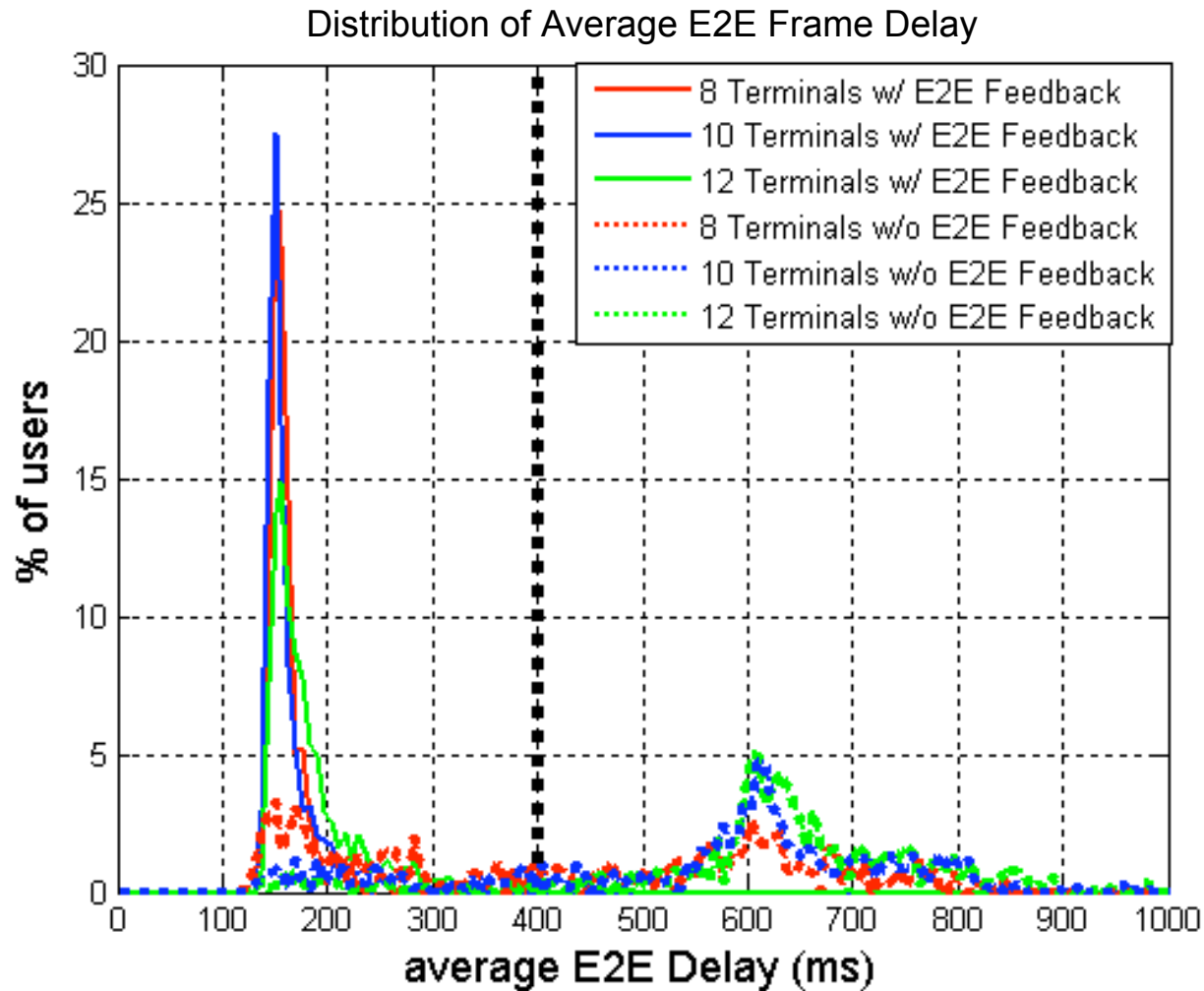
How are we solving it?

- Packet Delay Adjust Request (PDAR) message
 - Add to AVPF transport layer feedback messages
 - PD (packet delay) Adjust can be set from -1.28s to +1.27s
 - Negative value indicates how much earlier the receiver requests to receive the media packets
 - Positive value indicates how much later the receiver can receive the media packets



- Packet delay adjust allows the terminal to provide direct feedback on a parameter that has direct impact on play out of real-time media
 - Outer most loop in feedback control process
 - Controls E2E delay experienced by the receiver
 - Controls whether packets are played or discarded because they arrive too late for play out

Results: adapting to link speed and sector loading



For shared down/forward link, 57 cells, 8 packet-switched video telephony terminals per cell (total of 456 users), foreman clip at 7.5 fps

Results: adapting to link speed and sector loading ²

- Sending terminals adjust sending rate as follows:
 - Decrease rate when PDAR requires earlier arrival
 - May increase rate when PDAR can accept later arrival
- Without packet delay adjust request (PDAR) feedback messages, the average end-to-end delays seen by each user vary significantly (140-1000ms)
 - Some users experience E2E delays which are unacceptable for conversational services
 - Large # of users experience more than 600ms avg. E2E delay
- With PDAR feedback the encoders adjust their transmissions resulting in shorter E2E delay and tighter distribution among users
 - Most users experience around 150ms average end-to-end delay
 - Few experience more than 350ms
- User experience is less affected by link quality due to movement/changes in relative position of the user in the cell
- User experience is less affected by loading conditions
 - More graceful degradation in E2E delay as system is loaded

Open Issues

- Interest in WG to have this extended to multi-point scenarios?
- Align with structure of latest CCM draft: draft-wenger-avt-avpf-ccm-02.txt
- Are there other statistics in the extended RTCP reports (RFC 3611) that can be used instead?
 - Thus far have not found a good candidate
 - Welcoming suggestions
- Consider cases where changes in delay are not due to congestion of packets or changes in link speed
 - What can cause this?
 - How frequent and significant are these changes?
- Define as a statistic in new RTCP XR Report Block (according to RFC 3611, RTCP XR)?

Next Steps

- Is there enough interest in the Working Group to accept this draft?
- Merge with draft-wenger-avt-avpf-ccm-02.txt or define as an RTCP-XR Report Block?
- We appreciate the feedback provided on the AVT list. Thank you.

Comments from AVT List

- Multi-point scenarios (commenter: Stephan Wenger)
 - Can address this if there is interest from AVT WG
- Align with structure of draft-wenger-avt-avpf-ccm-02.txt (commenter: Stephan Wenger)
 - Will update this in next revision of draft
- RFC 3550: RTP
 - Receiver Report: interarrival jitter (commenter: David Oran)
 - Section 6.4.1 and A.8
 - Parameter requires taking the absolute value of the change in delay (unsigned metric that does not indicate whether to increase or decrease sender rate)
 - The jitter parameter only changes when the loading or link quality changes (only tracks transients and not sustained change in loading/link quality)
 - Receiver Report: Lost Packets (commenter: David Oran)
 - For wireless, packets can be lost due to transmission errors (not just delay)
 - Lost packet count is not an accurate indicator of delay
 - Can not provide feedback until packets are discarded because of excessive delay: will degrade service quality of real-time service (discarded packets and long delay)
 - PDAR allows for finer control before conditions get bad enough to cause discarded packets

Comments from AVT List ₂

- CCM draft: draft-wenger-avt-avpf-ccm-02.txt
 - TMMBR – Temporary Maximum Bit Rate Request (commenter: Roni Even)
 - More applicable to circuit-switched-type system where terminal is able to determine applicable data rate on link
 - Can not be used in packet-switched scheduler where bandwidth is not fixed/guaranteed
 - HSDPA/HRPD: Assigned bandwidth is dependent on link quality and cell loading
- How to address cases where changes in transmission delay are not due to congestion of packets or changes in link speed (commenter: Magnus Westerlund)
 - Investigating this more
 - What are the causes changes in delay that are non-congestion related?
 - How significant are the changes in delay?
 - How frequently do they happen?
 - Congested related delay for HSDPA/HRPD can vary between 10-1000ms

Comments from AVT List ₃

- RFC 3611: RTCP Extended Reports (RTCP XR)
 - Investigate whether can achieve this with other fields in RTCP XR (commenter: Magnus Westerlund)
 - Have not found a good candidate. Welcoming suggestions.
 - Extended Receiver Report: discard rate (commenter: David Oran)
 - Fraction of packets discarded due to late or early arrival since the beginning of reception
 - Must discard packets before sender is notified of a problem
 - Late feedback: service has already degraded because of discarded packets before sender is even notified of problem
 - If play out time of the receiver adapts to avoid discarding packets then the receiver can not request the sender to adapt its rate (improve transmission delay through low bandwidth link condition)
 - Since fraction is computed since the beginning of reception indicator carries history of past discarded packets
 - Over time this becomes a less accurate estimate of the current packet arrival conditions
 - Sender can not adapt as accurately to current variations in # discarded packets

Comments from AVT List ⁴

- Define delay adjustment as additional statistic to be reported by receiver (commenter: Colin Perkins)
 - Define as new Report Block for RTCP Extended Reports (RTCP XR, RFC 3611)?
 - Agreeable to the modeling this as a statistic/indicator
 - Investigating whether statistic can be fed back frequently enough for this application
 - 5 second restriction on feedback rate?
 - AVPF allows immediate feedback