Scalable Feedback Control for Multicast Video Distribution in the Internet

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Problems of multicast for congestion

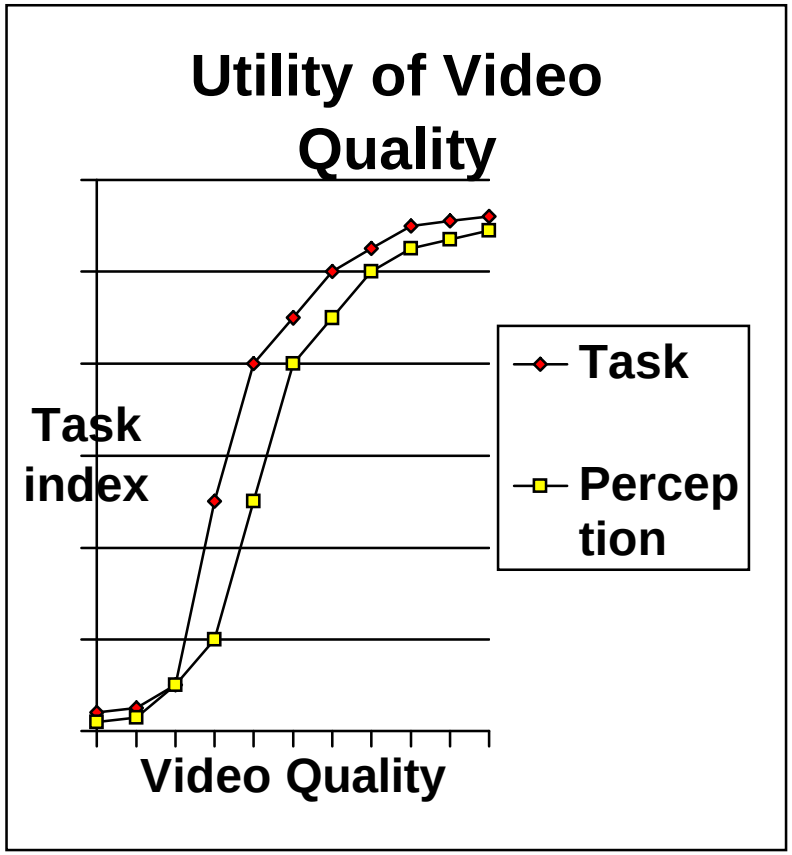
- Over-allocation of Resources at Switching Nodes (processing/bandwidth)
- Large Numbers of Receivers
  - » Implosion Problem for Congestion Notifications
  - » Processing overload at sender

Characterisitics of Video

- Relatively High Bandwidth - 15 KBit/s and up
- Constant Packet Generation
- Long Lifetime
- Adjustable Rate
- Minimum Quality Threshold

Minimum Quality Threshold

- Minimum quality level of video necessary for adequate task performance
- “Satisfaction” shifted to right of performance



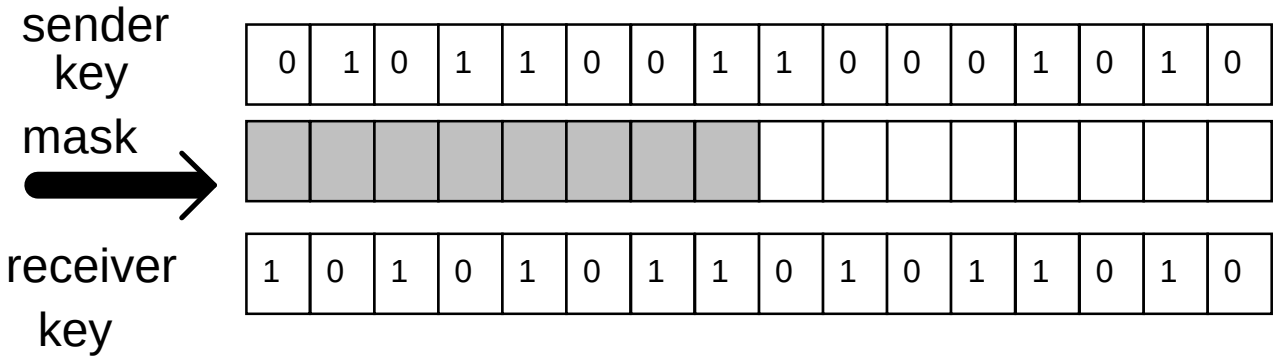
The Algorithm

- Receivers discover state of network from incoming packet stream
- Sender continuously polls receivers to discover worst network state seen
- Sender adjusts rate according to reported state and “policy”

Measuring State at the Receivers

- Separation of measurement from reporting - receiver can select appropriate measure for subnetwork (Loss, Delay, Congestion Bits)
- Generic States - UNLOADED, LOADED, CONGESTED

Polling the Receivers (1)



- Sender generates random fixed size key and a mask indicating significant bits
- Receiver generates random key and compares under mask
- If they match and local measured state is worse than sender advertised state, return response to sender
- Wins due to logarithmic probability of matching against sample size

Polling the Receivers (2)

- Key, mask and state sent in every data packet, to guarantee reliability.
- Mask increased every two rtts till mask covers whole key or CONGESTED response seen
- Scalable discovery of rtt by drawing from response period weighted by size of group.
- Analysis indicates scaling to over 10,000 receivers with 16 bit key
- Logarithmic relationship between round of first response against size of group allows estimation of group size from repsonses
- Full epoch takes 32 worst case rtt, but reduced by jumpstarting mask by estimated knowledge of group size

Policy decision as to response

- Appropriate response to congestion is application and user specific
- Suggested linear increase/multiplicative decrease
- However, response may depend on number in CONGESTED state
- When at minimum bandwidth and still CONGESTED then users must either get more bandwidth or desist.

Implementation

- Implemented over RTP inside of IVS from Inria
- Tested within the MICE project - users fill out form which is then mailed back

Rate Adjustment

- Quantisation level adjustment within H.261 standard
- Picture rate
- Loss based metering
- Rate reduction when 10% suffer congestion.

Results

- 90% of users believe that conference quality has improved.
- Effectively audio is prioritised over video

Future Work

- Polling scheme investigated for use in other multicast applications
  - » Shared Editor by Mark Handley
  - » Reliable multicast
- IVS to be improved and enhanced

Conclusion

- Demonstrated timely response whilst scalable for large groups
- Feasability of “good citizen” video over Internet with no support from network