

An Isochronous Reservation Scheme for Bandwidth Guaranteed MAC in Residential Ethernet

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Jin Seek Choi, Hanyang Univ./KOREF

jinseek@hanyang.ac.kr

Seong-Soon Joo, ETRI

ssjoo@etri.re.kr

Outline

- Backgrounds
- What are technical challenges?
- What is the Bandwidth Guaranteed MAC.
- Proposed Isochronous Reservation scheme for Bandwidth Guaranteed MAC protocol.
- Conclusions

Background

- Objectives of Residential Ethernet
 - **Precise synchronization** to multiple Audio-Video devices
(Bounded Jitter for End-point synchronization)
 - **Low-latency** for interactive Audio-Video service
(Bounded latency)
 - **Low cost, Plug&Play**
- Challenges for Residential Ethernet
 1. Queuing/Sequencing – Prioritizes different levels of traffic
 2. Synchronous Control – delivery isochronous frame

Background - What are the problems?

- **Queuing/Sequencing**

- When network can be overloaded, however,
 - network discourages over-rating priority by
 - Making priority relative to other traffic may not be aware of the traffic load
 - Queuing may not provide definite guarantee service (may be able to provide weak statistical assurance)
 - This is because there is no overload control
- Sol) need **Admission Control** for overload control and to reserve the resources along the entire path from the talker to the listener(s).

- **Synchronous control** can deliver isochronous frame with a deterministic low latency and low jitter

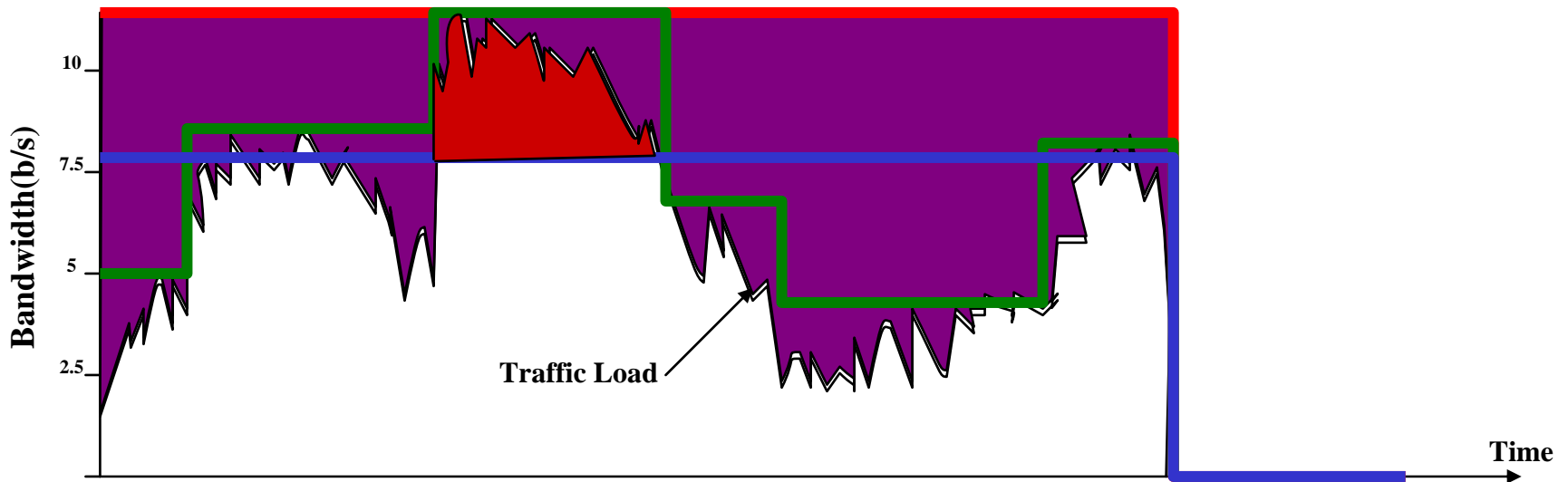
- Only if the network resources (bandwidth, in particular) are available at each link.
- Sol) need **Bandwidth Guaranteed MAC** to guarantee the packet delivery over each link

What is Technical Challenge?

- **Admission controller** reserves bandwidth every isochronous cycle
 - If capacity is available then the bridge reserves the bandwidth and allocates an isochronous channel number.
 - The reserved bandwidth is preserved for the connection until released
 - The source can utilize up to the bandwidth per isochronous cycle.
 - ❖ May adopt 802.1Q GARP protocol to provide Residential Ethernet BW registration, although the favorite now is to do a subset of RSVP at layer 2.
- ***So there isn't much invention to do!***
 - Reservation are at peak rate. So it may lead to significant wastage.
 - High priority class can be affected from ill behaving traffic.
 - QoS can not be guaranteed during short term duration.

Problems in Isochronous Transmission

- Maximum Reservation
 - Bandwidth Waste
- Average reservation
 - Overflow & Congestion
- Dynamic Reservation
 - Efficient & overload control



What is Bandwidth Guaranteed MAC?

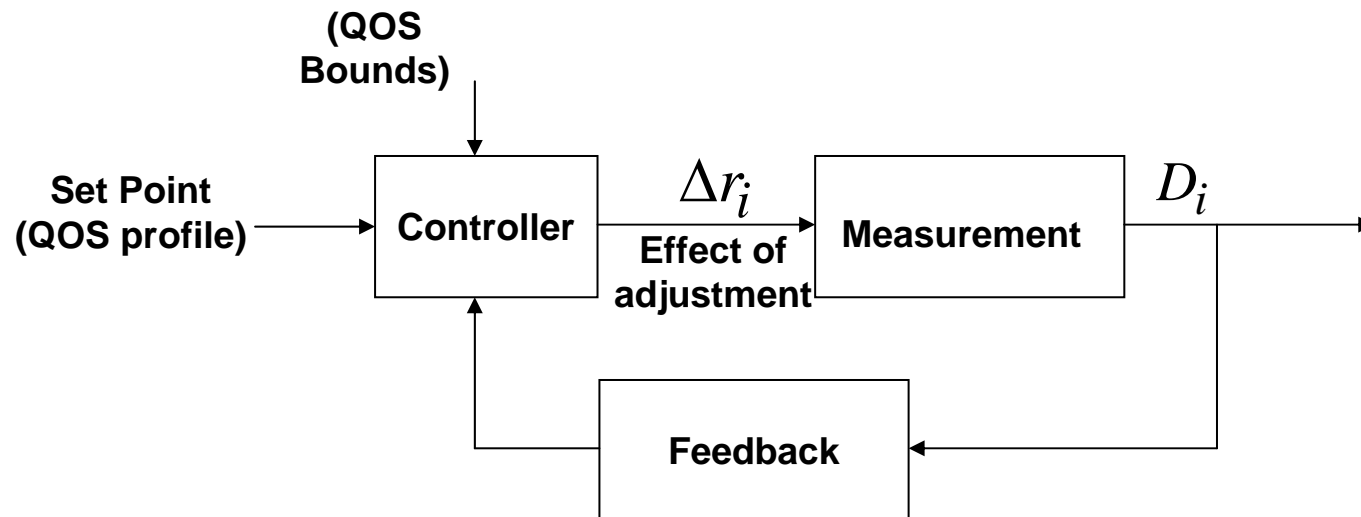
- **Bandwidth guaranteed MAC preserves the packet delivery**
 - MAC protocol can coordinate a pair of nodes in order to transmit and receive for isochronous traffic
 - Multiple of isochronous traffic can be shared efficiently
 - High priority class can be protected from ill behaving traffic **i.e., guarantee isochronous traffic**
- In “Static condition”
 - At ingress point: to prevent client that exceeds contract from interfering with QOS of other clients
 - Within network: to utilize the unused resources
- In “Dynamic condition”
 - to renegotiate incoming traffic during the transfer
 - to regenerate the profile after perturbation between nodes, but not by reservation processes
 - Out-of-profile/Excess/Non-conformant

Isochronous Reservation

- **The changes needed in Residential Ethernet MAC protocol**
 - Proposal to implement Bandwidth Guaranteed MAC
 - Reserve isochronous slots per cycle as much as utilizing the unused resources
 - Negotiate incoming traffic during the transfer at each link
 - Add feedback control to prevent client that exceeds contract from interfering with QOS of other clients
- We propose an isochronous reservation scheme based on feedback control for Bandwidth Guaranteed MAC protocol
 - To reserve isochronous slots (Isochronous reservation),
 - By using Link-by-link short-term feedback control
(cf. Admission Control: End-to-end long-term overload control)

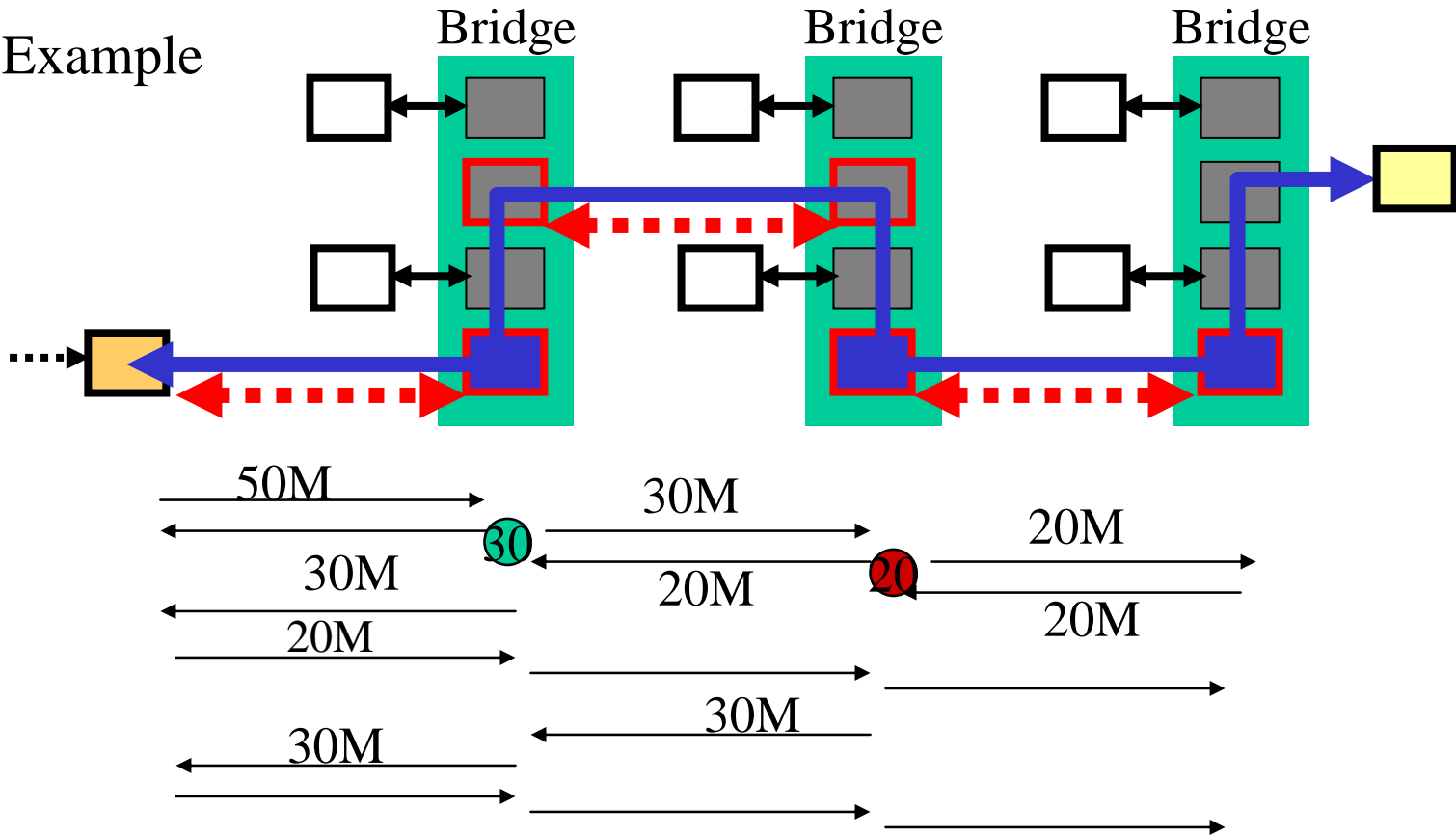
Feedback Control based QoS Mechanism

- Main drawback of Admission Control (GARP or RSVP) is that the set of parameters is generally statistically configured, thereby resulting in an inefficient utilization of the network resources. However, without admission control, it is not feasible to satisfy QoS guarantees at all time without regulating the traffic arrivals. **Feedback mechanism** permits **to resolve overload or QoS violation** by reducing the sending rate of a source when an acknowledgement control packet is marked with the congestion. Feedback mechanisms can be an efficient choice to traffic policing for dynamically regulating traffic arrivals.



Example

- Example



Admission control: reserve 25Mbps/100Mbps along the path

Isochronous reservation: reserve isochronous slots per cycle over each link

Implementation of this Proposal (I)

- Synchronous control
 - Admission Control for bandwidth reservation (long-term average)
 - Isochronous Connection request
 - Isochronous Connection acknowledgement
 - Isochronous reservation for slot reservation (short-term average)
 - Synchronous frame
 - Isochronous frame

Implementation of this Proposal (II)

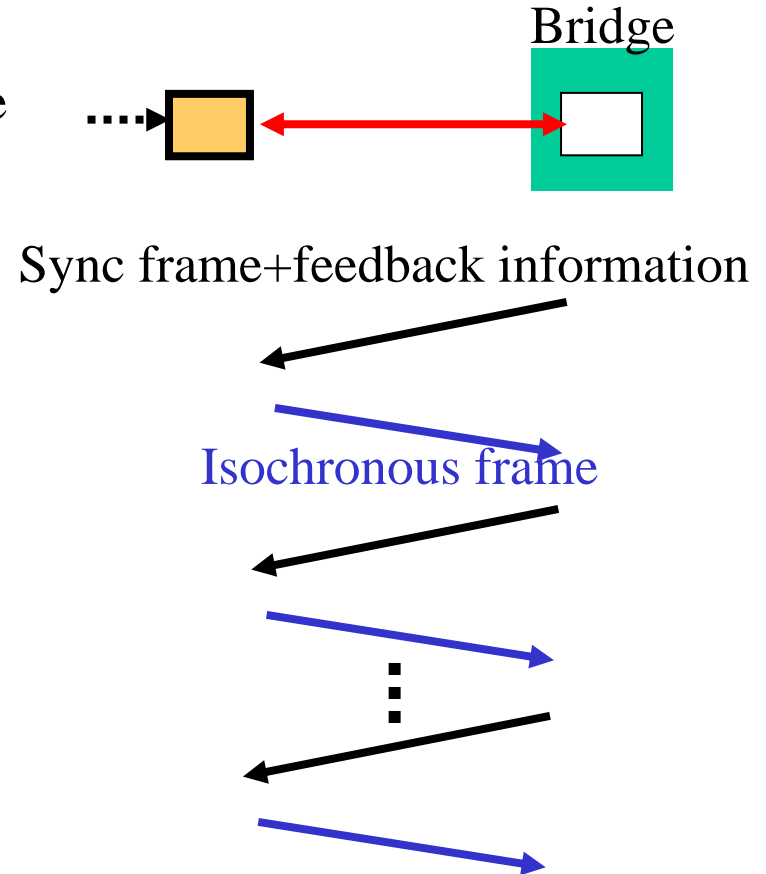
- isochronous reservation for slot reservation

- Isochronous Reservation frame

- transmit Cyclic within Sync Frame
 - include Feedback control information of the scheduler to talkers for isochronous reservation.
 - Feedback control information includes Bandwidth status or next available slot number

- Isochronous frame

- Transmit audio/video traffic
 - Adjust transmission rate based on bandwidth status of the bridge



Conclusion

- We Add an **isochronous reservation** scheme for Bandwidth Guaranteed MAC
 - Isochronous reservation for client
 - Receive feedback control information through Sync Frame and
 - Forward traffic to bridge for isochronous reservation
 - Isochronous reservation for bridge
 - Adjust isochronous transmission rate based on bandwidth status of the bridge
 - Send feedback control information through Sync Frame