RPR MAC Data Transport & Buffering

Pankaj K Jha
Cypress Semiconductor
pkj@cypress.com
• Dissimilar Bandwidth Allocation
  – Allocate Bandwidth for different flows at different nodes
• Upstream packet bursting when guaranteed bandwidth flows are not present (on a packet-by-packet basis).
• Provide a way for guaranteeing bandwidth so RSVP and other L3 Models work
• Per-node Traffic Policing and Shaping
• Support for same CoS Levels as Diff-serv and MPLS.
• Security in RPR Networks
Different Customers need different Bandwidth Sizes & Guarantees
- **Corporate clients:** guaranteed high-bandwidth IP usage during day
- **Local ISP:** web traffic, high/guaranteed bandwidth, best effort
- **Campus:** best effort, some guaranteed high bandwidth for videoconferencing, etc.
- **Financial institutions:** guaranteed high-bandwidth IP usage

RPR must provide a way for guaranteeing bandwidth

RSVP, Diff-serv, and other L2/L3 models for QoS/CoS should not be broken/voided by RPR MAC, else RPR MAC will not succeed

Any RPR MAC with less than 8 priority levels (true for Diff-serv, MPLS, etc.) will fail this compliance.

Intranets must be secure, and Extranets should be authenticated
Bandwidth Allocation at a Node

• Nodes need guaranteed bandwidth for different traffic flows
• L3 requests & reserves Bandwidth (using RVSP, etc.) at different nodes for different flows
• A node, or other upstream node may still send over-provisioned High & Low Priority Data.
• RPR MAC cannot always allow Upstream Transit High Priority Data to go through
• RSVP & other L3 models break down if if High Priority Upstream Transit Data is always given Priority
At Node C

- Incoming packets are received by RPR MAC
- Traffic policing & shaping logic for Node Traffic as well as Transit Traffic
- Node Reserved Bandwidth Traffic + Incoming Reserved Transit Traffic given Priority over other Packets.
- Bandwidth at a Node: $A_b = T_b - R_b$ (A: Available, T: Total, R: Reserved)
Node Bandwidth Management

• Different Nodes have different Bandwidth needs
• “Fair and Equal Allocation” to all Nodes is not desirable
• Node’s own reserved bandwidth needs to hold valid
• Incoming High/Low Transit Traffic must give way to any Reserved Traffic
• Policing & Shaping at every Node
• For a Node MAC, “complaining” to Upstream Node about Congestion is not enough
• At the same time, Usage Notification to Upstream Node prevents Bursting by Upstream Nodes
**Traditional CoS & QoS**

- **Ethernet MAC doesn’t force any CoS - leaves it to L2/L3**
  - Ethernet, therefore, doesn’t preclude Diff-serv, MPLS, Int-serv/RSVP, etc.

- **RPR MAC must have built-in CoS to coordinate Transit/Transmit Traffic**
  - Must decide extent of CoS for RPR MAC.
  - Just two levels for CoS will break all Diff-serv & MPLS CoS Assignments.

- **RPR MAC should support 8 CoS Levels.**

- **RPR MAC doesn’t need to have built-in processing for all CoS**
  - Leave Scheduling optionally to System so newer Scheduling Techniques can be used in Future.
• Even with Transit Buffer operations, Transit Data travels most of RPR MAC blocks
  • System Interfaces are Full-duplex at Full Speed
  • Little Penalty in sending Data across & have system analyze & send it back
  • Leave flexibility in QoS and Traffic Engineering for Future Developments.
  • Have Minimal Transit Buffer in MAC

• Option to send ALL packets to System, if a user wants to do all Traffic Management with his Queuing/scheduling Logic.
  • Doesn’t Inhibit Future Developments in Traffic Management
  • At RPR, we should design MAC protocol, not a Chip Architecture
- Up to 8 Priority Levels. All Need Not Be Processed by MAC
- MAC Allows Merging of Priority Levels
- MAC Passes Remaining Packets to System
All Network Operations should be able to go across Rings
Bandwidth reservations are made by L3 across rings
L3 protocols aren’t necessarily aware of Ring Structure(s)
RPR MAC shouldn’t preclude reservations across rings
Each Node (ring or bridge) manages Bandwidth Allocation
Bandwidth & Priority Management

- Total Bandwidth of a Tx Link = $T_b$
- Node Bandwidth Reserved (through RSVP, etc.) = $RN_b$
- Upstream Traffic Bandwidth reserved (through RSVP, etc.) = $RU_b$
- Available Bandwidth $A_b = T_b - RN_b - Ru_b$
- Node Reservations get highest Priority, followed by Transit
- 8 Priority Levels supported. RPR MAC doesn’t need to have on-chip Logic for all these Levels within the device
- Priority Merging. A Few Priority Levels can be merged into one.
- **Bursting (over-provisioned cases):** If no Packet from Upstream/Node for Reserved Bandwidth present, Node may use unused bandwidth for other Packets
- Non-conforming Packets are sent to System
• Usage Notification in advance not a Method for per-Packet Traffic Allowance from Upstream Node
• Node tells Upstream Neighbor about any Reservations.
• Upstream may burst at Full Speed, if it chooses.
• At the time of Upstream Data Arrival, if Node doesn’t have Reserved Bandwidth Packet, the Burst Succeeds
• MAC sends non-conforming Packets to System Buffers for Later Delivery
• Congestion Notifications sent later by System on Buffer Overflow, etc.
• Larger Buffers and Longer Timeouts Help in Delaying Congestion Notification Triggers
Security in RPR Networks

- Each Intranet must be Secure
- Security within MAC would allow Native Packets Transport without any Encryption
- Service Provider (SP) Equipment may Provide Security
- No Mixing of Intranet Data
- VLAN Field (16 bits): VLAN ID (12-bit) and Priority (3-bit) within MAC
- Broadcast and Multicast Packets only affect Controlled Networks, not entire MAN/WAN.
- Access to a VLAN through Proven VLAN Registration Protocols
Different Nodes have different Bandwidth needs

“Fair and Equal Allocation” to all Nodes is not Desirable

Support for 8 priority levels to Match Diff-serv and MPLS

Policing & Shaping at every Node

Congestion Notification not a Method for Traffic Allowance from Upstream Node

Instead, Upstream Node bursts at Full Speed.

System Buffers non-conforming Packets for Later Delivery

Security through Integrated VLAN ID