Ring Span Bandwidth Management in RPR

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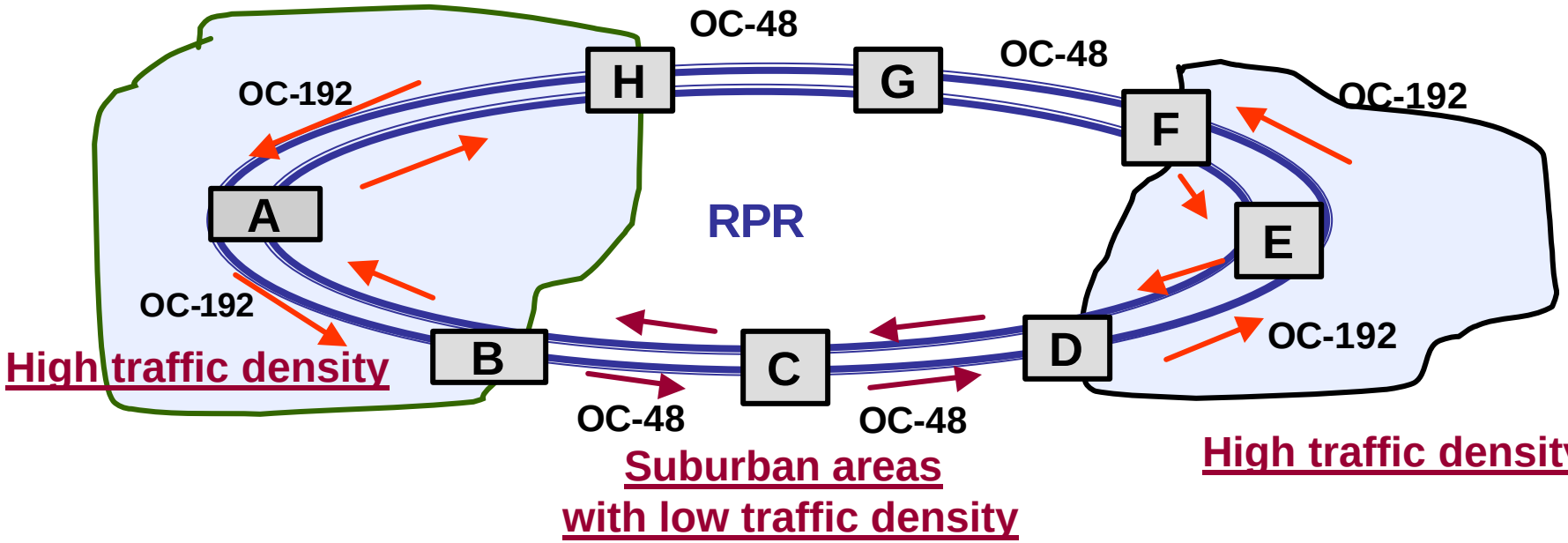
Different BW on RPR Spans



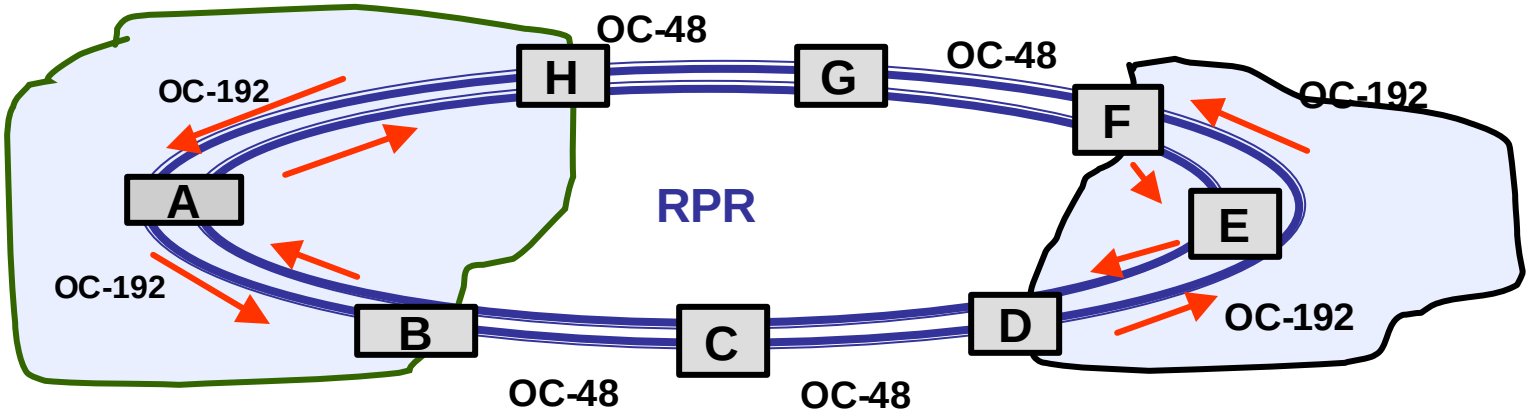
- In a mid/large Metro Area, only few Regions may have High BW Needs
- High concentration of high BW customers in select areas
- A cost-effective solution would be to only upgrade high density areas
- Huge savings in Labor & Cost
- SP more willing to upgrade only required nodes
- Customers can afford BW increase, as SP can pass Savings

SONET/SDH Networks

- SONET/SDH networks provide “circuit-switched” paths inside which packets travel
- In both UPSR & BLSR configurations, full bandwidth allocated all around the ring.
- Traditional SONET/SDH Networks require ALL Nodes to be upgraded to a higher speed

RPR Networks

- A Unicast Packet terminates at a Destination Node
- Both Rings are used for Packet Transport
- “H-A-B” and “D-E-F” High-bandwidth Traffic within their Local Segments.
- “B” and “H” Nodes terminate/strip OC-192 packets.
- Other packets sent by “B” and “H” at B-C and H-G Link Speeds
- Different Rates doesn’t change Packet Transport Behavior
- SONET Framing only provides an Envelope for Packet Transport



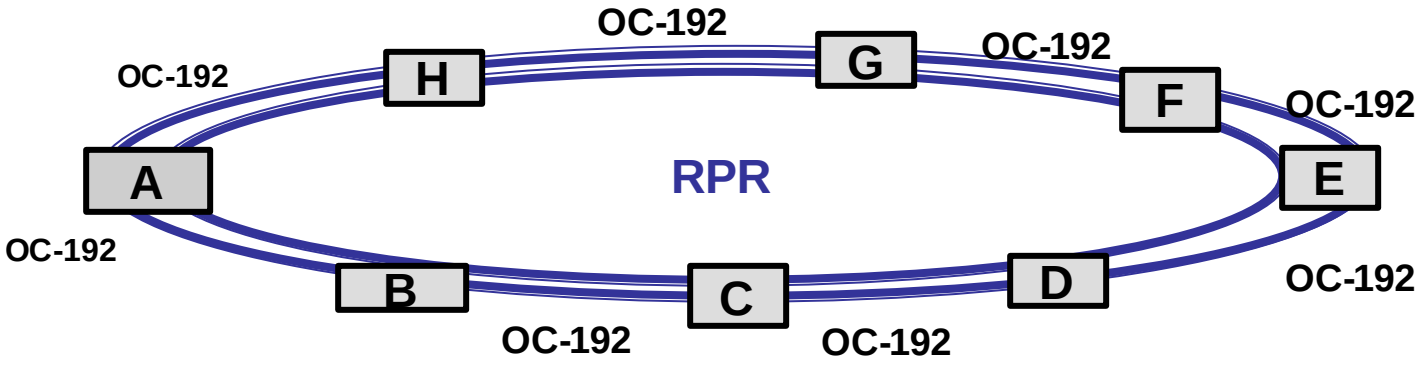
Determining RPR Support for Span BW Management

RPR MAC Design for supporting different Span Bandwidth

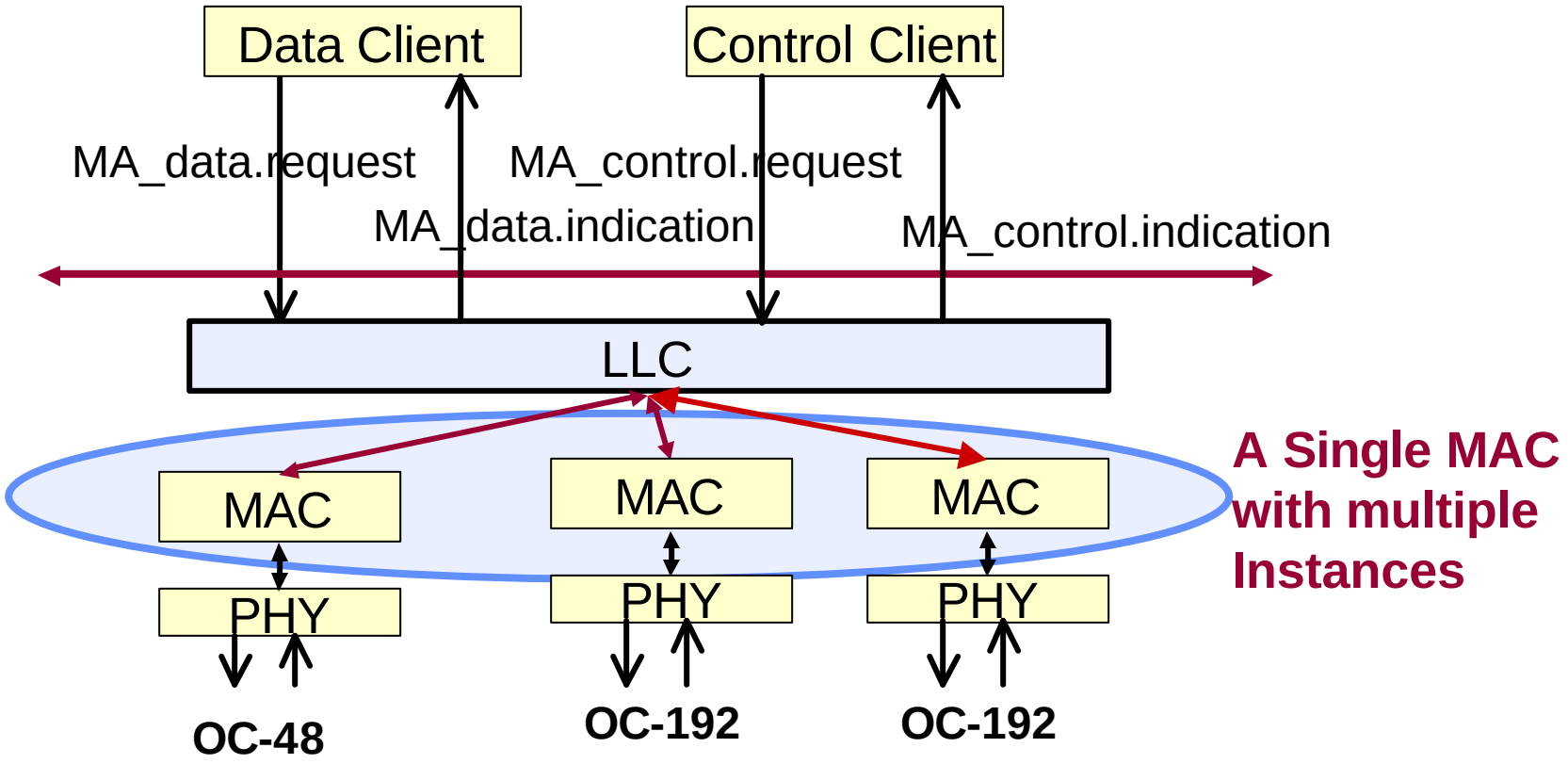
- **Network Topology and L2 Models for Span BW Management**
  - MAC configuration
  - Topology Discovery with BW Information Propagation
- **Physical and MAC Layer Architecture**
  - PHY Layer
  - MAC sublayer
  - LLC Interface
- **Design Complexity Issues**
  - Transparent Operation in case of Homogeneous Networks (all segments of same speed and type)
  - Clear Partitioning of PHY and MAC layers for Heterogeneous Networks
  - Operation with minimal complexity in Line Cards

Network Model for Span BW

- Network Topology and BW Models remain unchanged.
- Consider a OC-192 Homogeneous Ring (Same Bandwidth)
- RPR MAC should allow Nodes to Reserve Bandwidth to support RSVP and other “Leased Line” type Applications
- Topology advertises available “remaining” Bandwidth
- Node BW Allocation: Say Links H-G, G-F, B-C, and C-D have 7.5G worth BW Allocated, with only 2.5G available
- Network view: this situation is same as an RPR with Span BW of OC-192 & OC-48 Mix



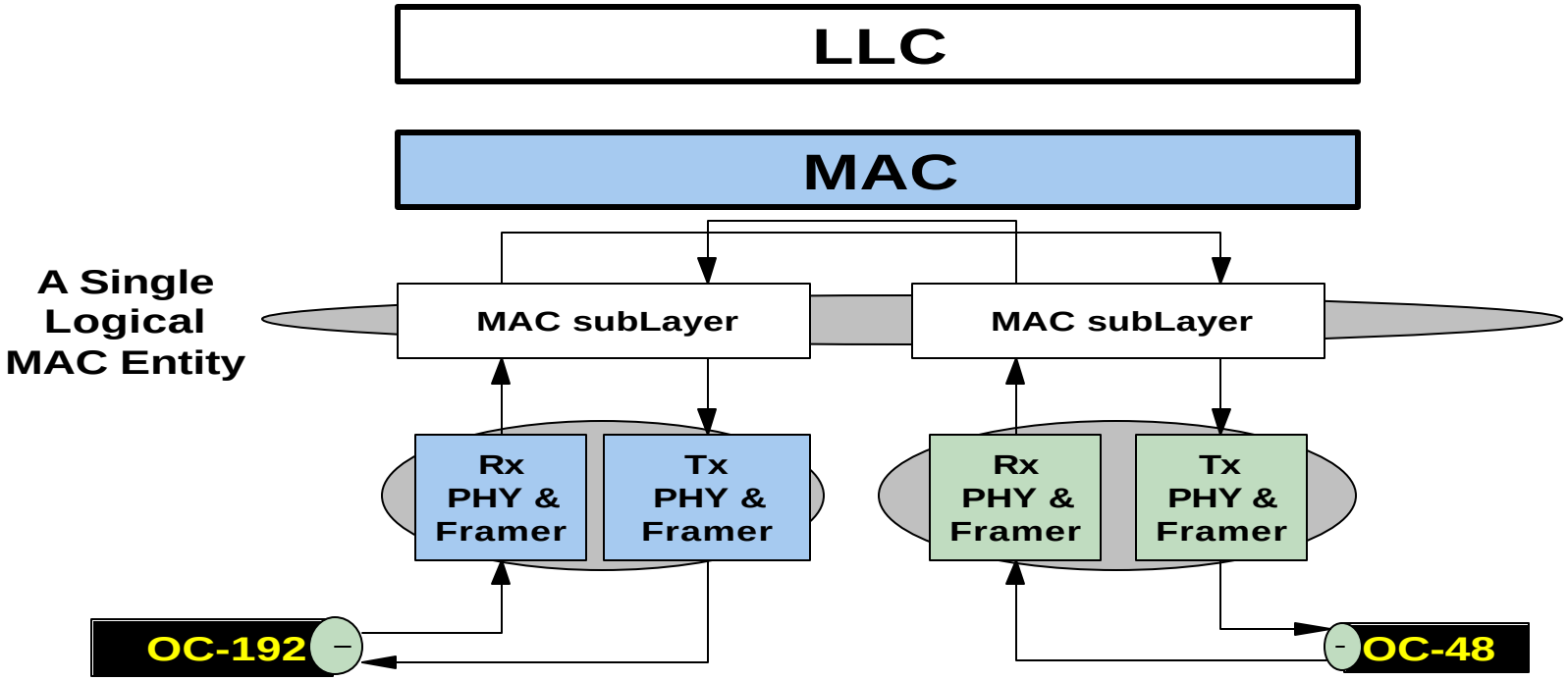
RPR MAC Model



- **A Unified MAC Interface for different Links.**
- **Network Interfaces transparent to MAC Clients**
- **With this model, it's possible to support multiple Links**

MAC Model for Different Span BW

- A MAC Sub-layer provides a unified interface to MAC client
- Individual (logical) MACs handle Tx/Rx links.
- BW Difference treated by MAC as a Reserved BW by Node.



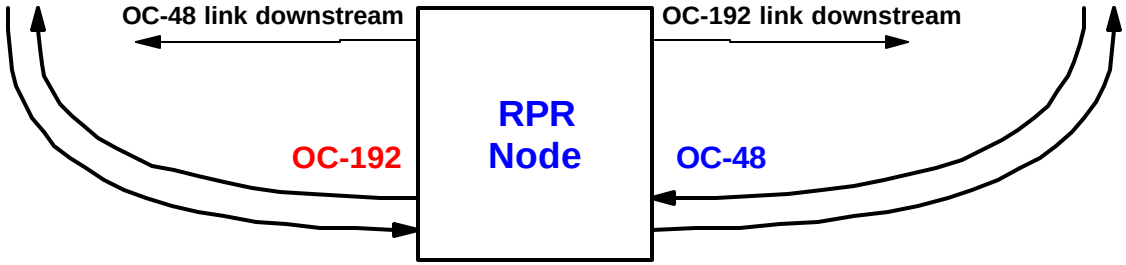
BW Advertisement

Homogeneous Networks (same BW on all Spans)

- Link Bandwidth (Link Bandwidth on either Side): B_L
- Reserved Bandwidth by Node Applications: B_N
- Available Bandwidth: $B_A = B_L - B_N$
- Bandwidth advertised to upstream Nodes: B_A

Heterogeneous Networks (different BW across Spans)

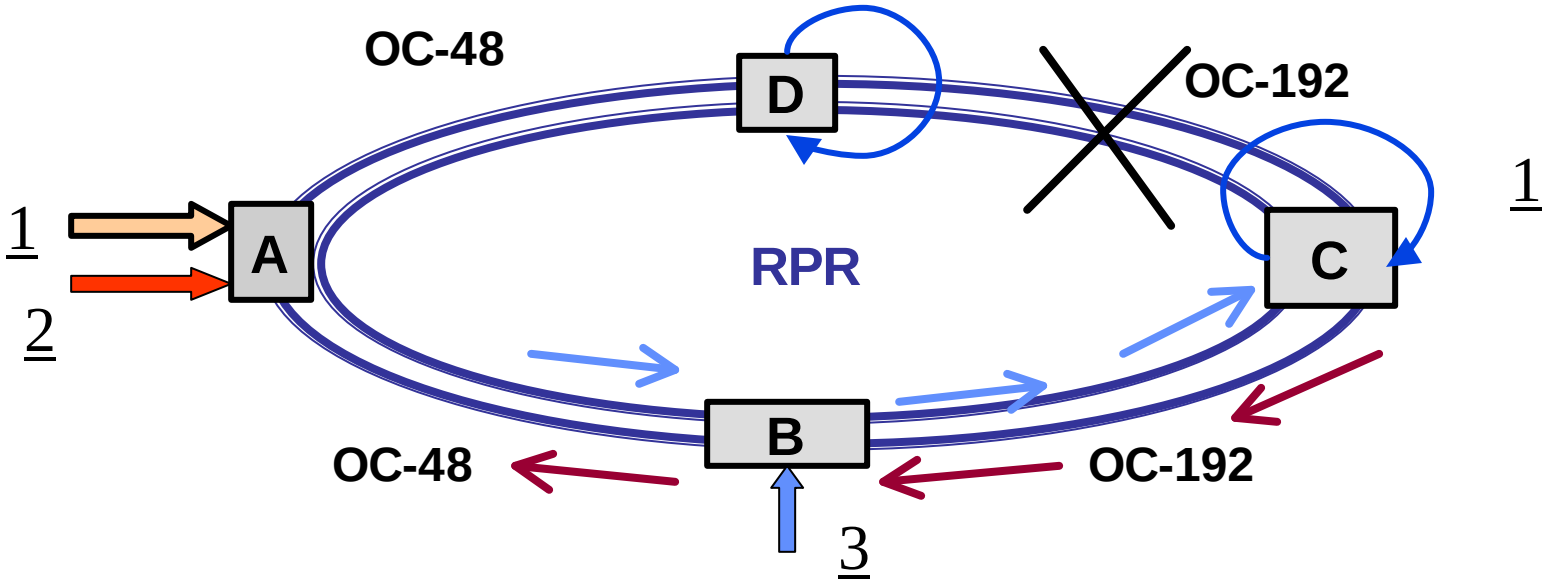
- Link Bandwidth (Link Bandwidth on the other Side): B_L
- Everything else same as before: $B_A = B_L - B_N$



RPR MAC Model

- A MAC Sub-layer provides a unified interface to MAC client(s)
- Individual (logical) MACs handle Tx/Rx links.
- Lower part of MAC sub-layer manages different MACs.
- This approach may allow existing Hardware to try out RPR

Fault Recovery & Restoration



- Bandwidth for Fault Recovery & Restoration limited to lowest Link Bandwidth
- Topology Notification methods advertise Maximum Bandwidth for Fault Recovery/Restoration

Conclusion

- RPR should allow support for different Span Bandwidths
- No need to have SONET/SDH Network Restrictions
- Opaque nature of RPR networks (O-E-O) could easily support multiple rate spans
- Take Advantage of Packet Transport Nature of RPR Networks
- RPR Networks with different Traffic Patterns in Segments
- Incremental Upgrade Path for Providers and Subscribers