Fujitsu 802.17 Requirements

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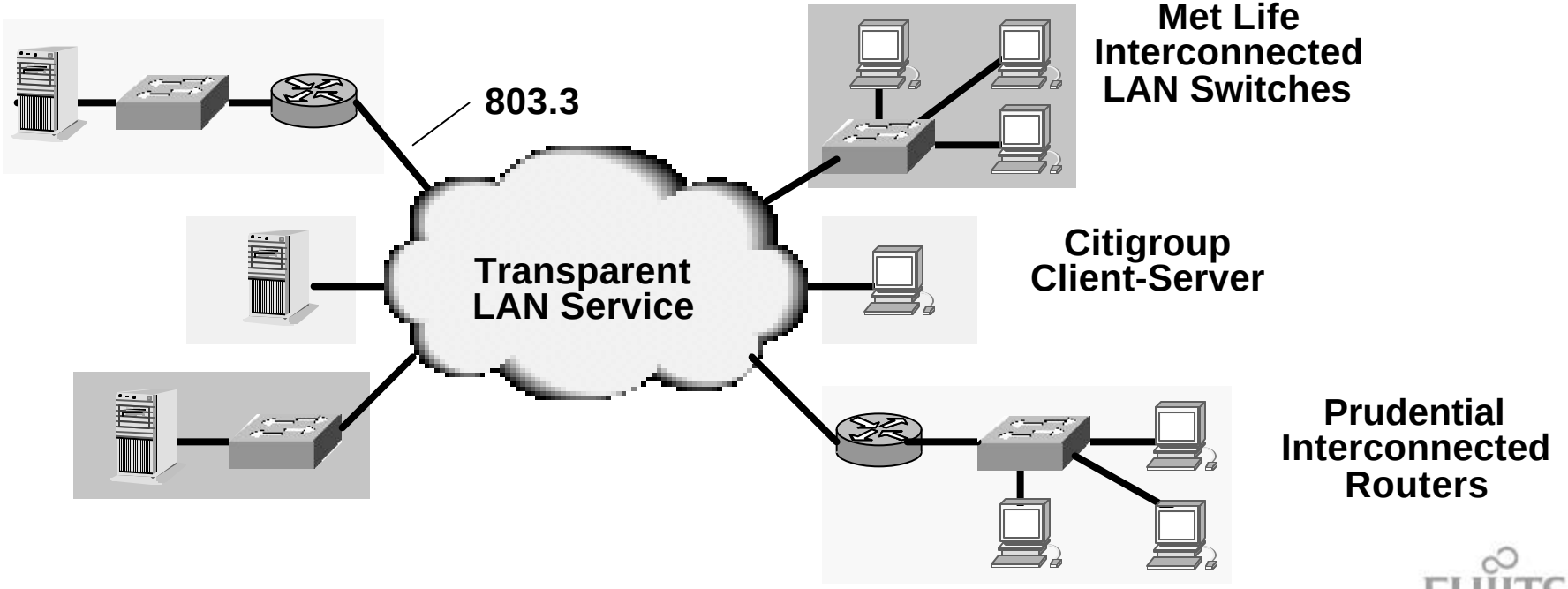
THE POSSIBILITIES ARE INFINITE

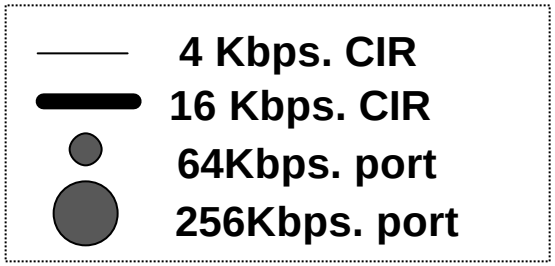
Transparent LAN Service

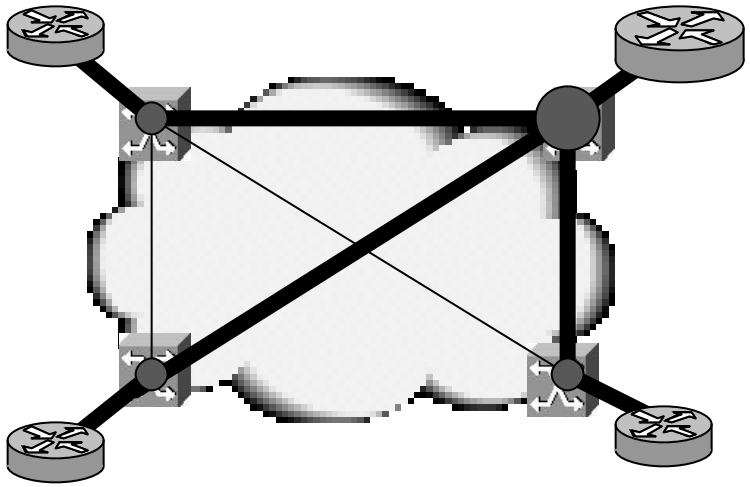
- users interconnected as if over Ethernet LAN
- LAN ‘private’ to each customer (customer separation)
- usual Ethernet features (VLAN, priority, flow control)



Frame Relay Service Model

- **Port-rate (per port)**
- **Committed Information Rate (per PVC)**
  - **Between N-1 and N(N-1)/2 Connections**





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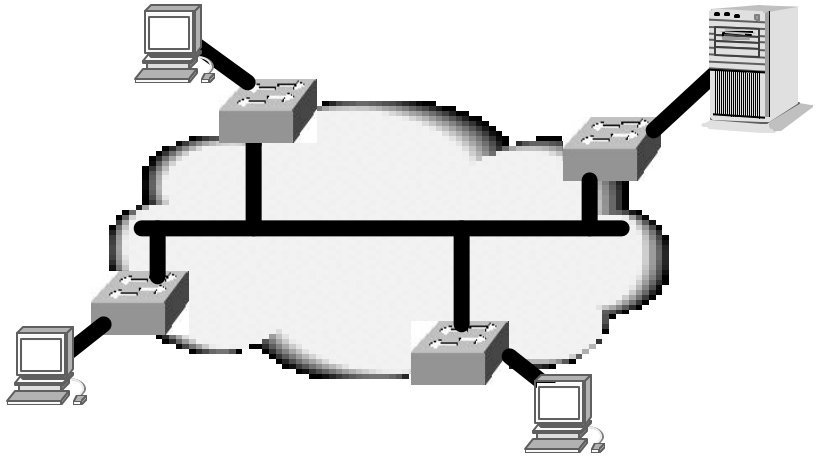
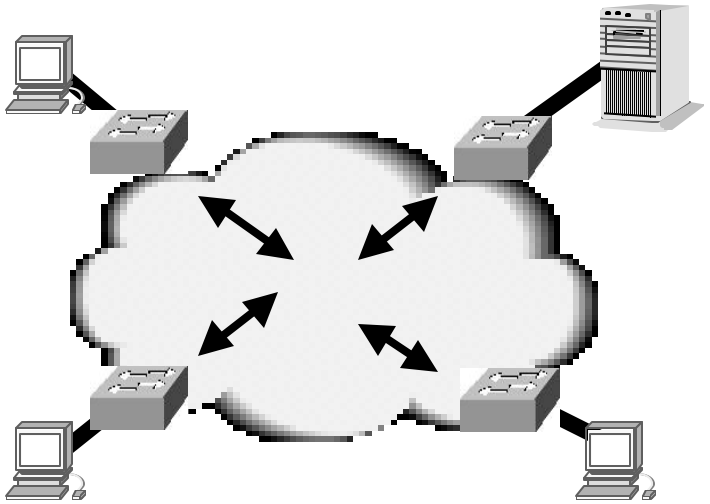
Aggregate-Rate Service Model

- Single aggregate rate shared among enterprise users
  - model as shared medium like collision-based Ethernet
- Provision one aggregate rate vs. many PVCs
- ‘Collision’ occurs when senders’ aggregate exceeds provisioned aggregate rate (per customer)
  - ‘collision’ does not abort transmission (as in Ethernet)
  - throttle heavy user(s) to reduce future ‘collisions’



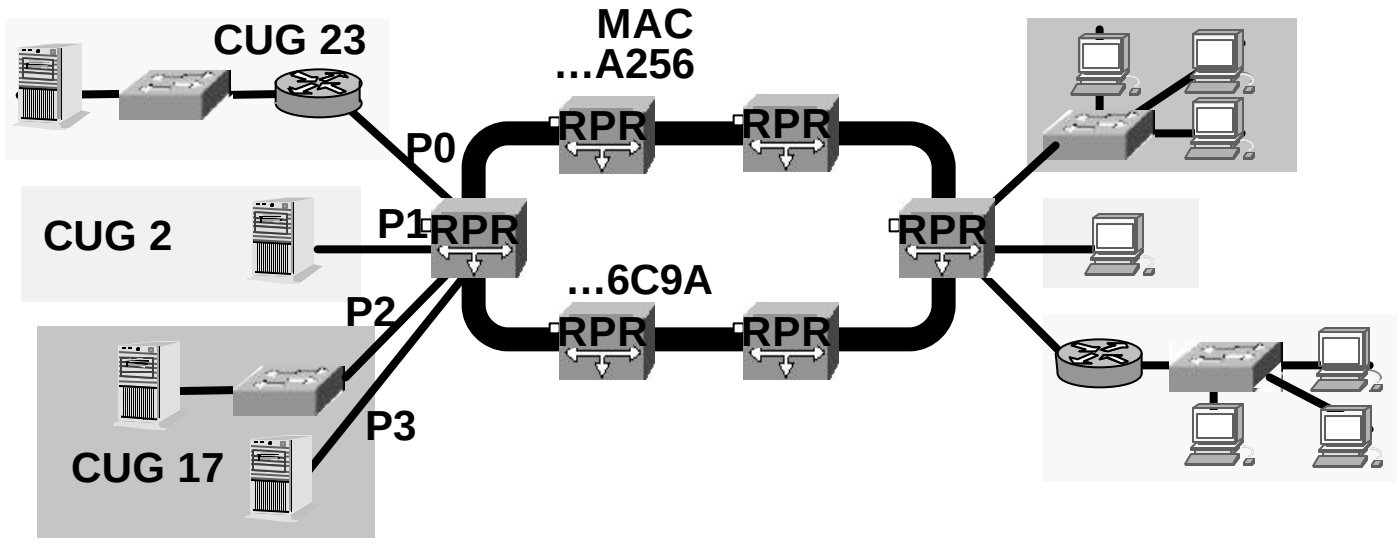
Best Effort Service Model

- No bandwidth guarantees
  - uses bandwidth available after guaranteed traffic
- Throttle heavy user(s) when congestion detected
  - do not penalize well-behaved users



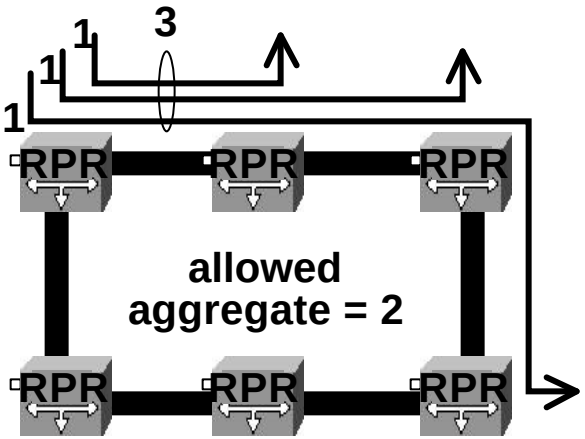
Transparent LAN Service over RPR

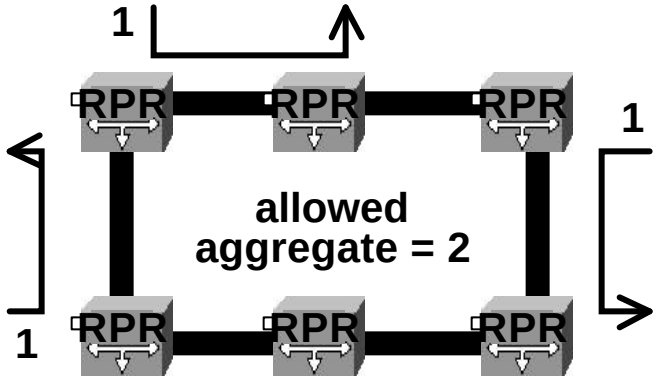
- User 802.3 encapsulated in 802.17
- Customer separation by Closed User Group (CUG)
- Customer port identified by MAC.PORT
  - Allow multiple ports of same CUG per 802.17 MAC@



Aggregate Rate Guarantee

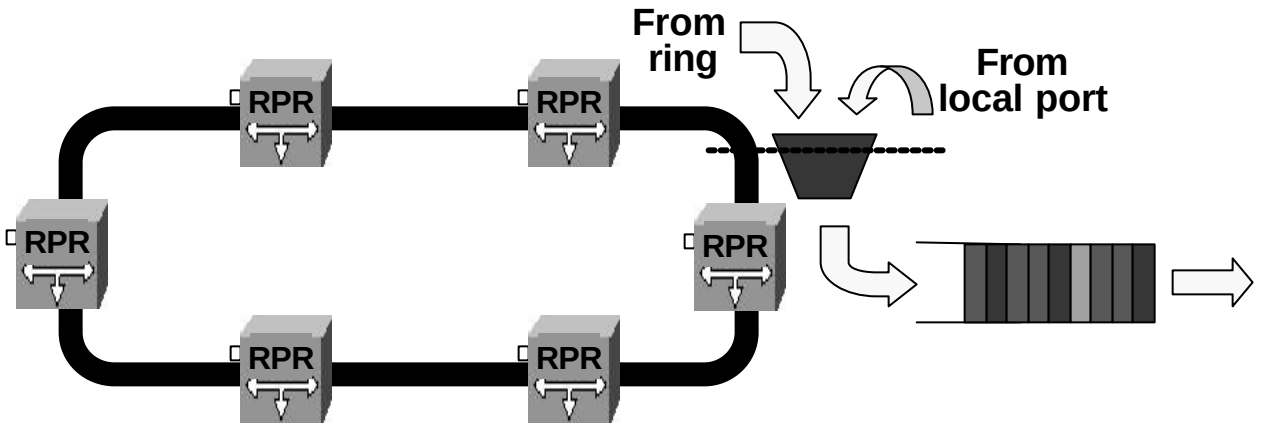
- **Rule: ‘provisioned aggregate’ exceeded on link implies ‘provisioned aggregate’ exceeded on ring**
  - **so monitor for ‘provisioned aggregate’ exceeded on link**
- **‘provisioned aggregate’ exceeded on ring is not detected if ‘provisioned aggregate’ not exceeded on link**
  - **but allowed as the resource commitment is unaffected**





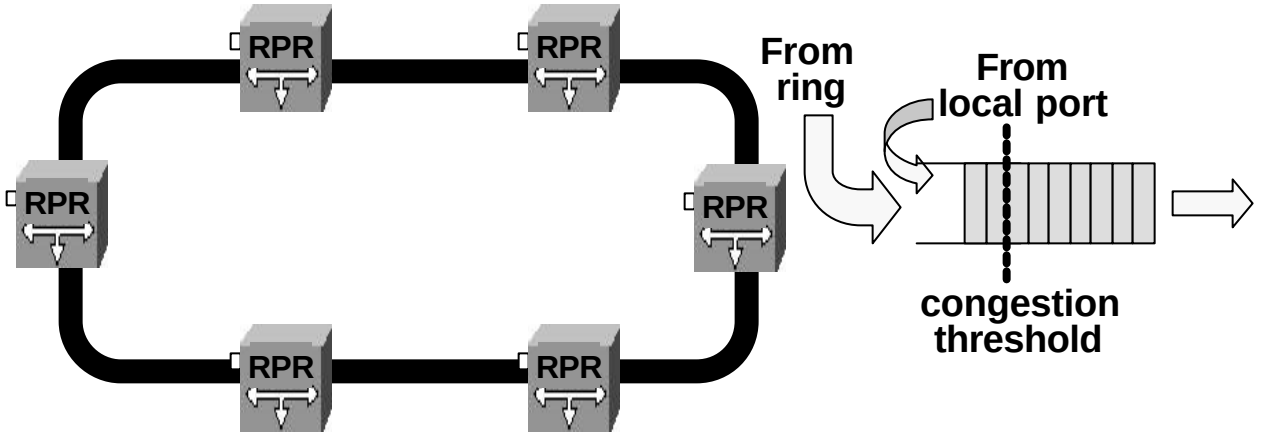
Aggregate Rate Guarantee Model

- **Leaky bucket *per CUG* on transit and local traffic**
  - **enforce aggregate rate**
- **Detect threshold crossing on leaky bucket**
  - **throttle individual sender within CUG**
  - **throttle alternatives**
    - **similar to 802.3 PAUSE (but unicast)**
    - **request to reduce ingress rate (followed by growth)**
- **Place frame on guaranteed-service queue**



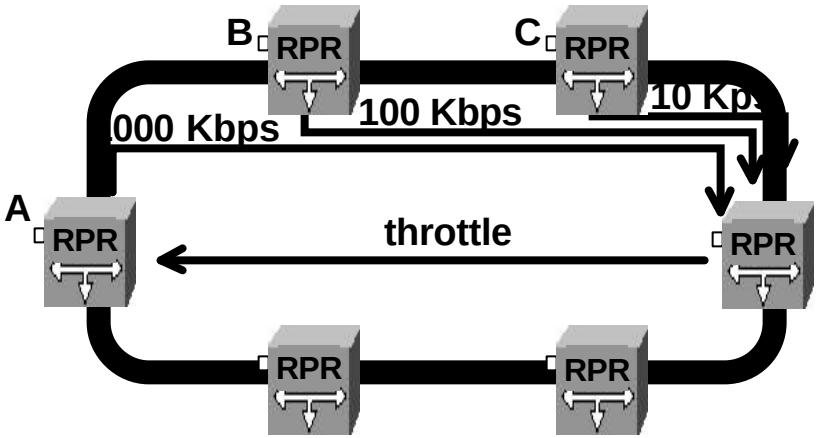
Best Effort Model

- Place frame on best-effort queue
  - Drop frame when buffer unavailable
- Detect threshold crossing
  - throttle individual sender to avoid buffer depletion



Choosing Source to Throttle

- Cache most active senders
  - including local ports
  - per CUG for guaranteed service
- Choose (e.g. rotation) among most active sources
  - Send THROTTLE control message to one source
  - THROTTLE other sources after time interval as needed



rate cache (per CUG)

sender	rate
A	1000
...	...
...	...
B	100
...	...
...	...

C

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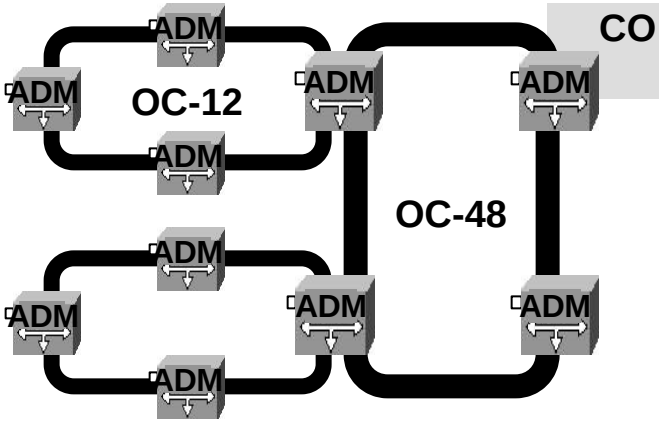
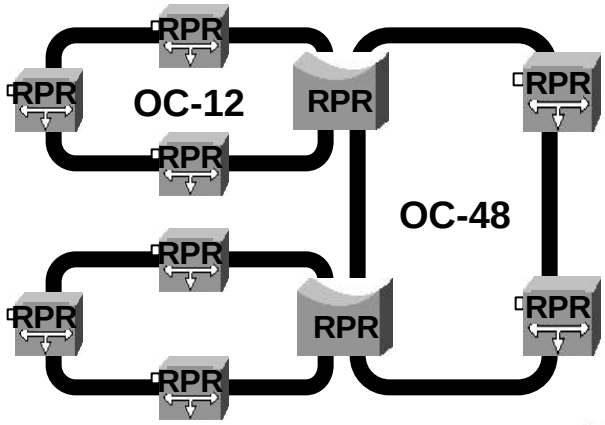
RPR Ring Interconnect

- **Hierarchical SONET ring topologies deployed today**
  - **Strong requirement to extend RPR across rings**
- **Tree topology sufficient since rings are protected**
  - **STP not required**
- **Assume RPR bridge inherits properties of 802.1D**
  - **make exceptions/additions as needed**



SONET ring hierarchy



RPR bridging

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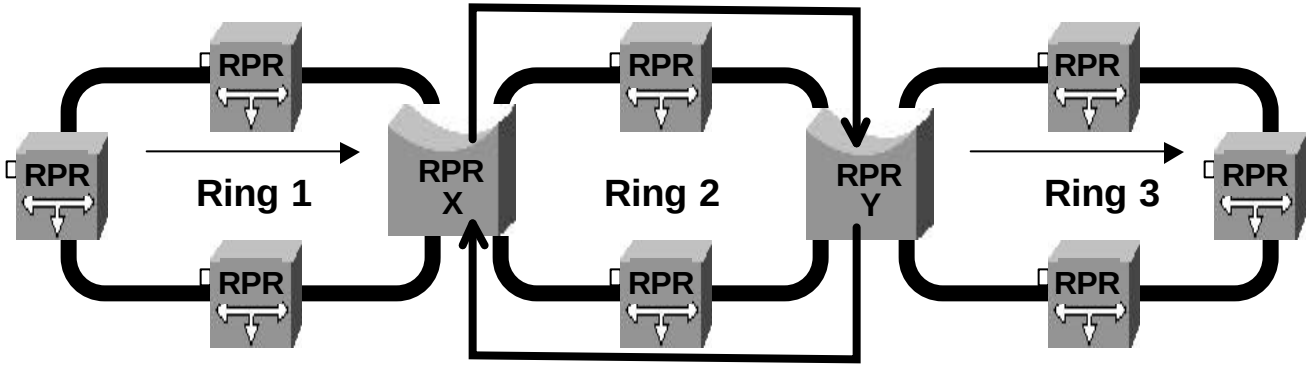
Stripping Broadcast Frames at Ring Ingress Bridge

- Broadcast frames stripped at source RPR node
- Bridge X forwards broadcast from ring 1 to ring 2
- Bridge X must strip frame after circulation
- Frame carries ingress Bridge ID for recognition

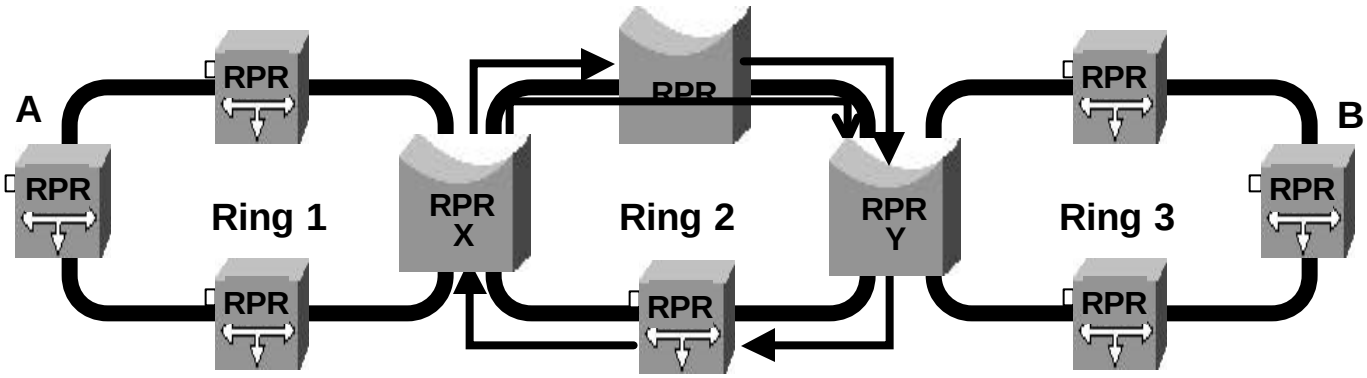


Caching Egress Bridge Identity

- **Bridge X can learn that**
  - **frames for destination B reached via ring 2**
    - **bridge X sends frame 'circulate to all bridges on ring'**

OR

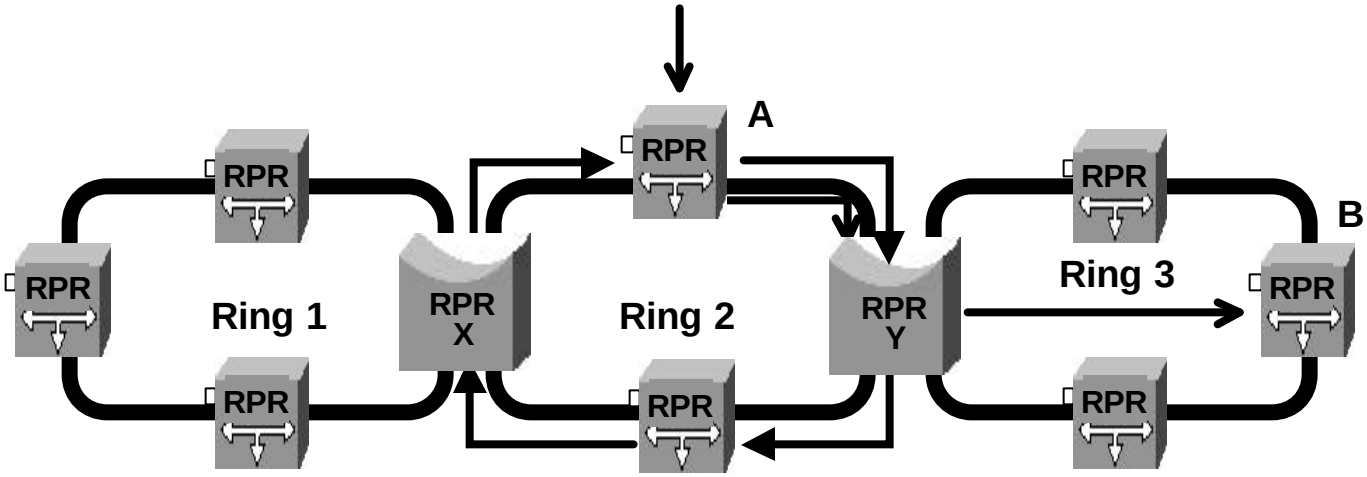
  - **frames for destination B reached via bridge Y**
    - **bridge X sends frame on ring 2 with Bridge Y ID**
- **Directed bridging allows spatial reuse**
  - **implies that MAC frame carries identity of egress bridge**



Caching Egress Bridge Identity at Source

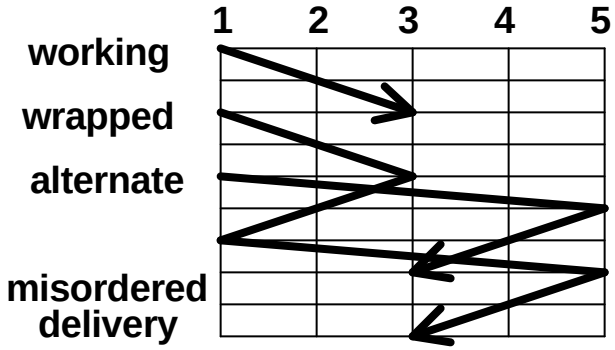
- **RPR host node A can**
  - **circulate frames for destination B (not on local ring)**

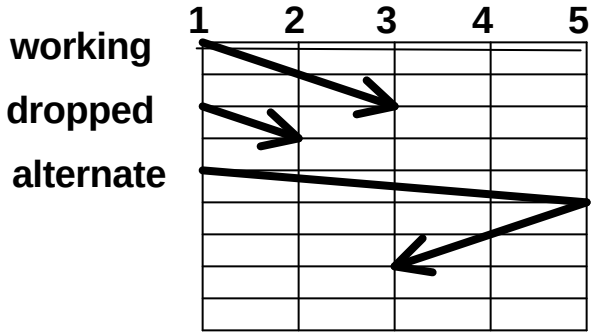
    OR
  - **direct frames for destination B to bridge Y**
- **Directed bridging allows spatial reuse**
  - **implies MAC frame carries identity of egress bridge**
  - **bridging is *not* transparent to host node**



Protection

- Steering -> dropped frames during recomputation
- Wrapping -> period of misorder on switchover
- Wrapping benefit when recomputation time is long
  - Our assumption that recomputation time is short
  - Failure notification broadcast speeds recomputation
- Steering preferred
  - appears generally simpler





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Frame Format

- **Generally consistent with GFP**
  - **Source / Destination MAC (802 MAC)**
  - **TTL (8 bits)**
  - **priority (3 bits)**
- **Additional or modified**
  - **Source / Destination Port Identifiers (8-bit)**
    - **4-bit GFP port insufficient**
  - **CUGID (16-bit)**
  - **Ingress / Egress bridge identifier (MAC@)**
    - **reserved value for ‘all bridges on ring’**

No Requirement for the Following

- **Jumbo Frames (encapsulate 802.3)**
- **TDM / circuit emulation (use SONET)**
- **Different link speeds between nodes**
- **Explicit support for 802.1D/Q**
  - **subscriber 802.3 traffic is encapsulated**
  - **RPR supports functions *analogous* to 802.1D/Q/p**
- **Spanning Tree Protocol (limit to tree topology)**

RPR Requirements

- **Physical Layer Mapping**
  - **OC-3 to OC-192 link rates**
  - **NxSTS-1 and NxSTS-3c Virtual Concatenation**
- **Interoperability within ring**
  - **standard not meaningful without node interoperability**
  - **essential for low-cost RPR hardware**
- **Interoperability between rings (bridging)**
- **Protection Protocol (steering if < 50ms.)**
- **Topology Protocol**
- **Guaranteed and Best-Effort Service Classes**

RPR Requirements

- **Customer separation**
  - **no data leakage among customers**
  - **dynamic registration of CUGs**
    - **analagous to VLAN registration (reuse GVRP)**
- **Bandwidth isolation among customers**
  - **absolute for guaranteed-service**
  - **approximate for best-effort**
- **Bandwidth management for Guaranteed Service**
  - **ingress policing of 'provisioned aggregate' per CUG**
  - **link policing per CUG (support aggregate-rate SLA)**
  - **rate threshold per CUG (congestion control)**
- **Congestion control**
  - **source rate cache (per CUG for guaranteed service)**
  - **PAUSE or source-rate reduction request**

Summary

- RPR supports aggregate-rate service model
  - significantly reduced provisioning
- Enforce aggregate-rate on ring by enforcing on link
- Source throttle for congestion control
  - sender rate caching
- Ring interconnection is key requirement
  - base is 802.1D but significant changes required
  - spanning tree not needed
- Reuse VLAN concepts for CUG