Resilient Packet Ring Motivation (& MAC)

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Applications Driven Demand For Bandwidth

Current "Bandwidth" Driven Applications

- Web-Servers: Hosting
- Web-Based: Distance Learning
- Web-Casting and Web-Based meetings
- (10/100)M Ethernet access

New & Emerging "Bandwidth" Driven Applications

- Web-Casting as Broadcasting Services
- Storage Area Networks (SANs)
- Video-on-Demand
- Web-TV: Movies and Entertainment
- Video Streaming: Video Mail
- Interactive TV
- Web-Based: Interactive Gaming

Long-Haul DWDM: Decade of Exuberance!

L-H: DWDM Networks – Current Excess Capacity!

Optical Networks: Long-Haul DWDM Multi-Lambda (l) Nets
Offering huge surplus of Bandwidth …
Service Providers: CapEX sharply Lower, but holding steady
And, promises to pick up … ?

Metro DWDM: Decade of Neglect!

L-H DWDM Networks – Current Excess Capacity!

Metro DWDM Networks – Currently under served Market!

Metro DWDM – Need Efficient Multi-Services Network … Technology and Standard – Such as the IEEE 802.17 (RPR)

Metro "Access" Networks: Decade of In-Action!

Metro DWDM Networks –
Currently under served market!

Metro Access Networks – Need for Bandwidth!

Need Efficient Multi-Services Network …
Technology and Standard like IEEE 802.17 (RPR)

Metro Access Networks: New Opportunities!

RPR: High-Speed, Multi-Services Network

The Background

“Media” always … tightly coupled to “Services”:

- **Cable-TV, Satellite-TV, Broadcast-TV …**
- **Gov’t regulations as well as tariff structures … are strongly linked!**

The “New and Emerging” Services:

Delivering next-generation broadband services:

- **Voice (TDM, VoIP)**
- **Data (Ethernet, IP)**
- **Video (CATV like)**

RPR is a “Disruptive” Technology

RPR: Driving Next-Generation Multi-Services

RPR ➔ A true multimedia network:

- **RPR delivers highly optimized and efficient carrier-class network solution for voice, data, and video today**
- **Completing, not competing, technology**
- **RPR: the best "use" of Ethernet/SONET/CATV**

RPR Business Value

Incremental revenues:

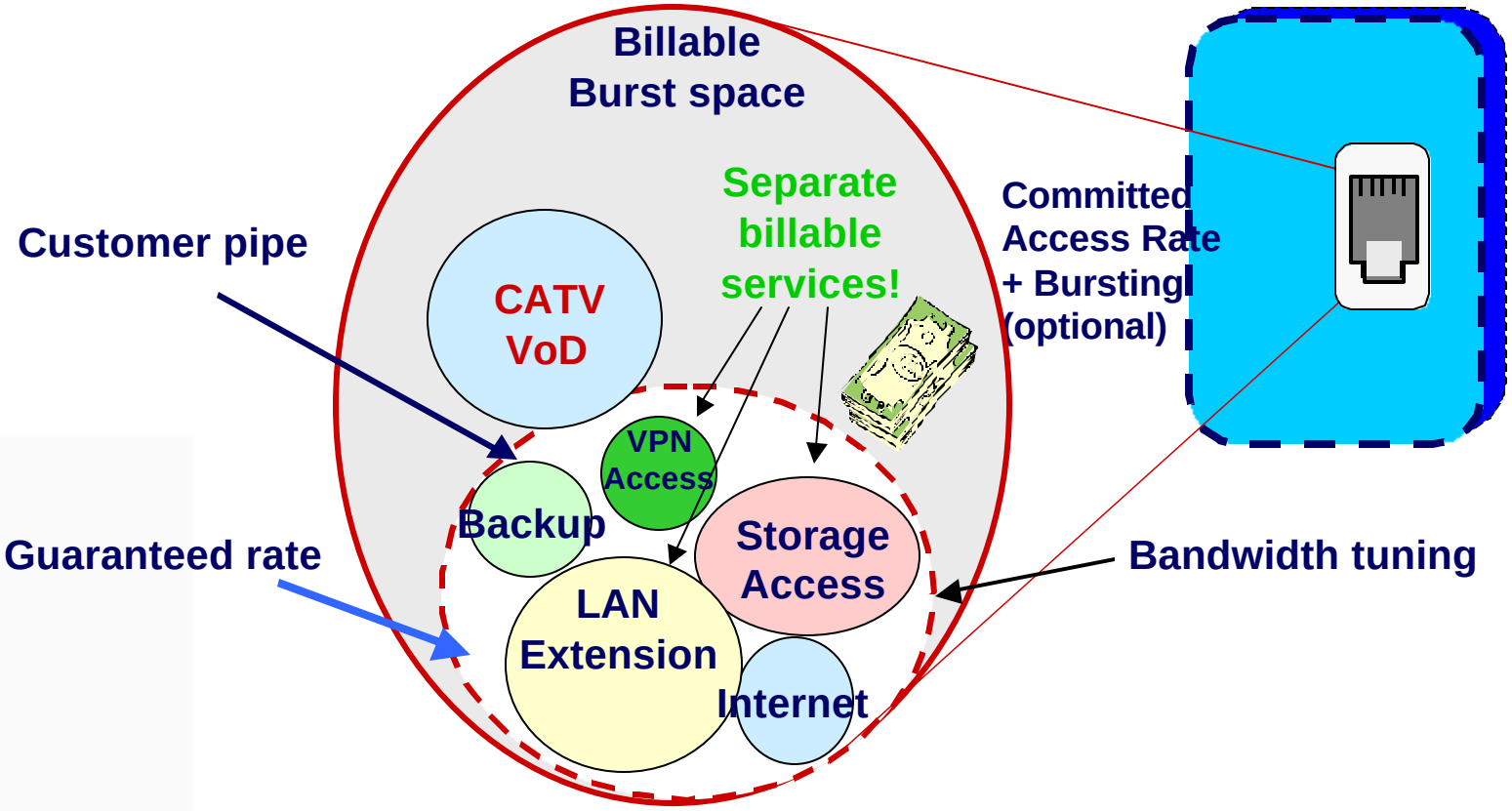
- Liquid Bandwidth
- Fairness
- CapEx and OpEx savings
- Service velocity

RPR Resiliency and Power

Carrier-Class Reliability:

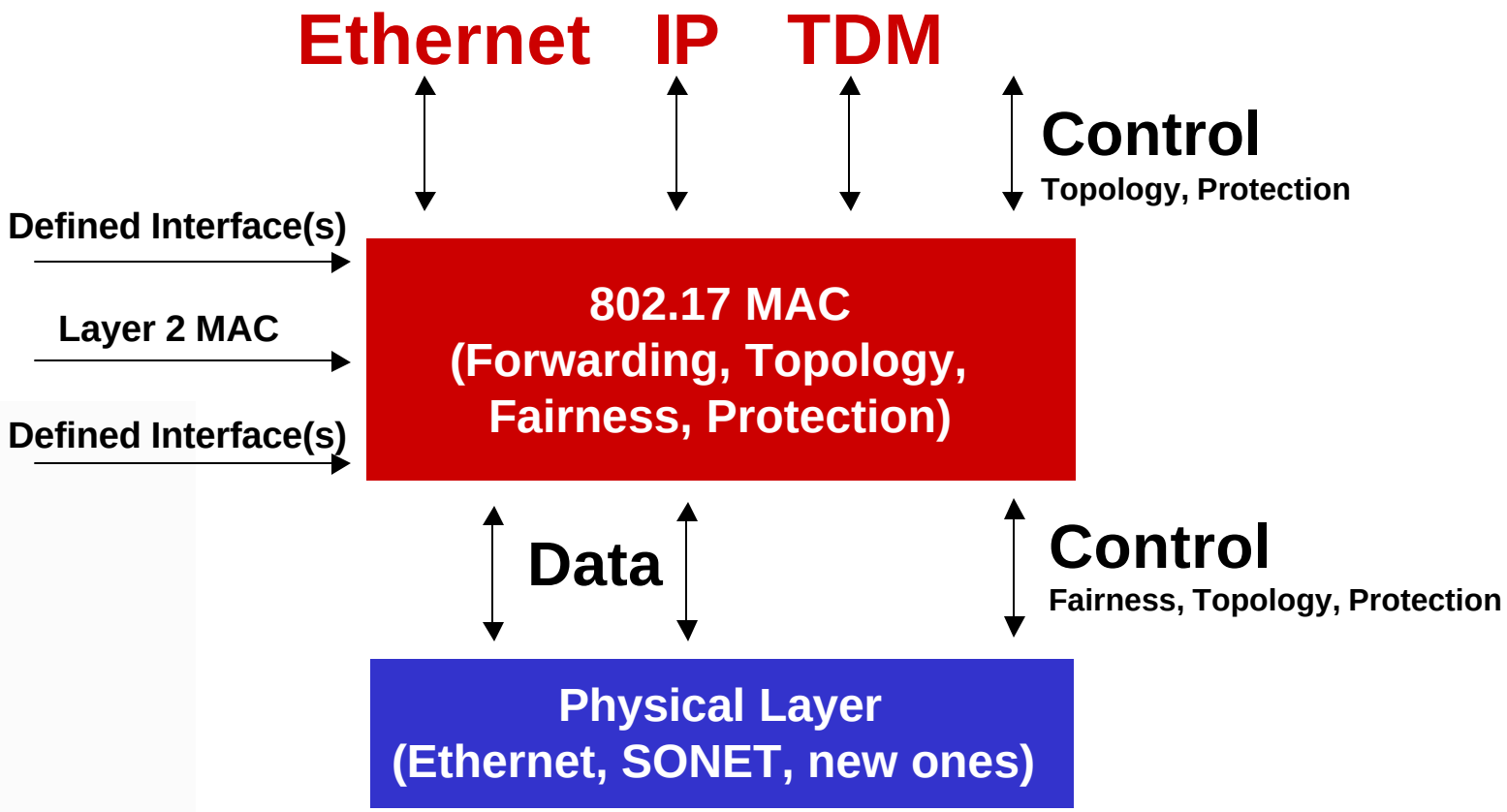
- Fast (<50ms) link protection mechanism
- Support for scalable ring topology
- Support for multicast/broadcast

New RPR Enabled Services: Bandwidth!



Giving each customer multiple Service Level Agreement options.
Giving Service Providers flexible (billable) service offerings

RPR MAC: A Layer-2 Protocol



What's Does a MAC Do?

- **Functions:**
  - **Frame formatting**
  - **Channel/media arbitration**

- **Service independent**

  Unaware of the higher layer client

- **Physical layer agnostic**
  - **802.17 will reference PHYs**
  - **Sonet & Ethernet PHYs have been mentioned**

802.17 MAC Characteristics

- Targeted at MAN rings
- Carrier/service provider environments
  - Deterministic services (SLA)
  - Optimal BW utilization
  - Resilience:

    High availability, service restoration and protection support
  - 90+% of applications will be in the metro (at least initially)

802.17 MAC Characteristics (Cont)

- Fair (proportional, not equal) access shared ring medium
  - Incoming traffic and transit traffic contend for capacity of the egress link of the MAC
  - Congestion control mechanism
- Transit path is an extension of the medium
  - Minimizes jitter and latency for transit traffic
  - Not loosing packets in transit
- Destination removal
  - Spatial reuse >> optimal (re)use of link bandwidths
- Efficient multicast and broadcast

Metro Networks: RPR the Optimal Solution

SONET

Dominant today

- Expensive
- Inefficient for data
- Coarse & difficult provisioning

10GE

Cheap bandwidth

- No Resiliency
- No consistent QoS
- No Support for TDM Services

For More Information on RPR

- **General information:** www.RPRAlliance.org
- **RPR Alliance resource center:** http://www.rpralliance.com/articles/RPRResourceCenter.pdf
- **White papers:** http://www.rpralliance.com/index.cfm?action=technology_white
- **FAQ:** http://www.rpralliance.com/index.cfm?action=technology_faq
- **Articles:** http://www.rpralliance.com/index.cfm?action=news_articles
- **Press releases:** http://www.rpralliance.com/index.cfm?action=news_pr
- **Newsletter:** http://www.rpralliance.com/articles/NewsletterJan03.pdf

RPR Bridging Operations Overview

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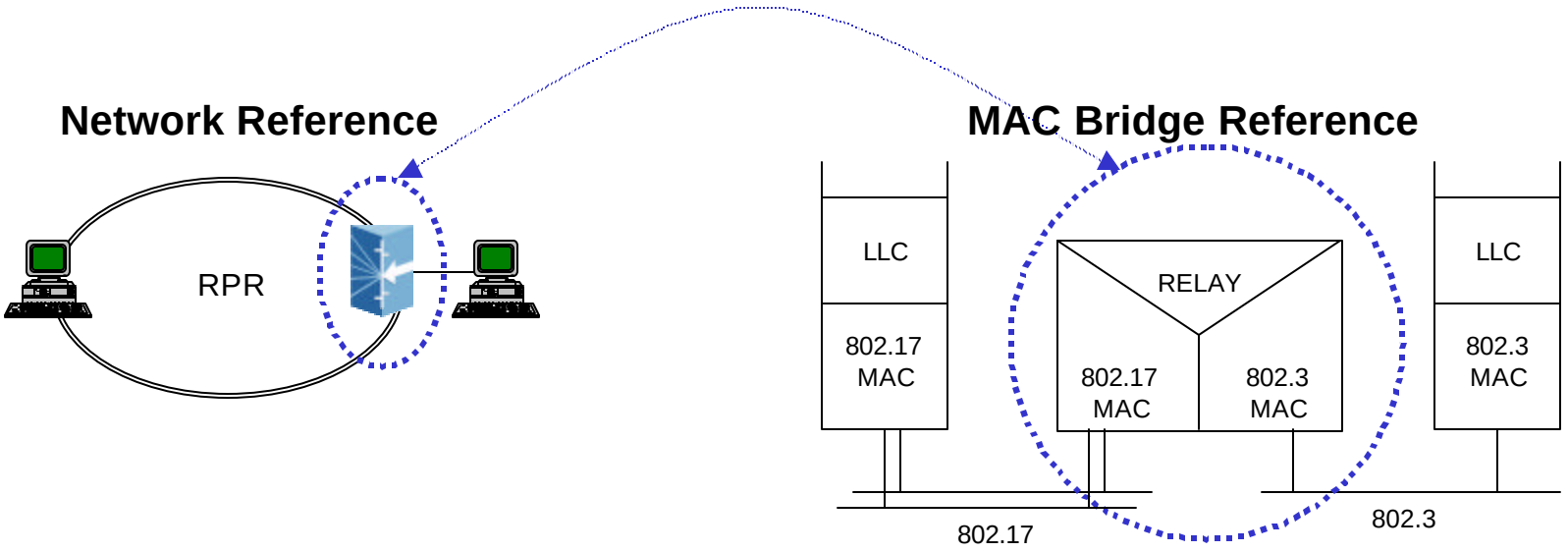
Terminology

- Remote address
  - An address that is not found on the ring
- Local address
  - An address that can be found on the ring
  - A local address of the ring
- Flood
  - A transmission mechanism that ensures all RPR stations see a transmitted frame once

RPR Bridge Reference Example



RPR Frame Transmission Rules

- LLC Clients
  - Frames with remote destination addresses are flooded
  - Frames with destination group address bit set are broadcast
  - Frames with local destination addresses are unicast
- Bridge Relay Clients
  - All frames are flooded

RPR Frame Reception Rules

- LLC Clients receive:
  - Frames with group address bit set in the destination address (depending on filtering)
  - Frames where destination address matches station
- Bridge relay client receive:
  - Flooded frames only

802.1D/Q MAC Service Support

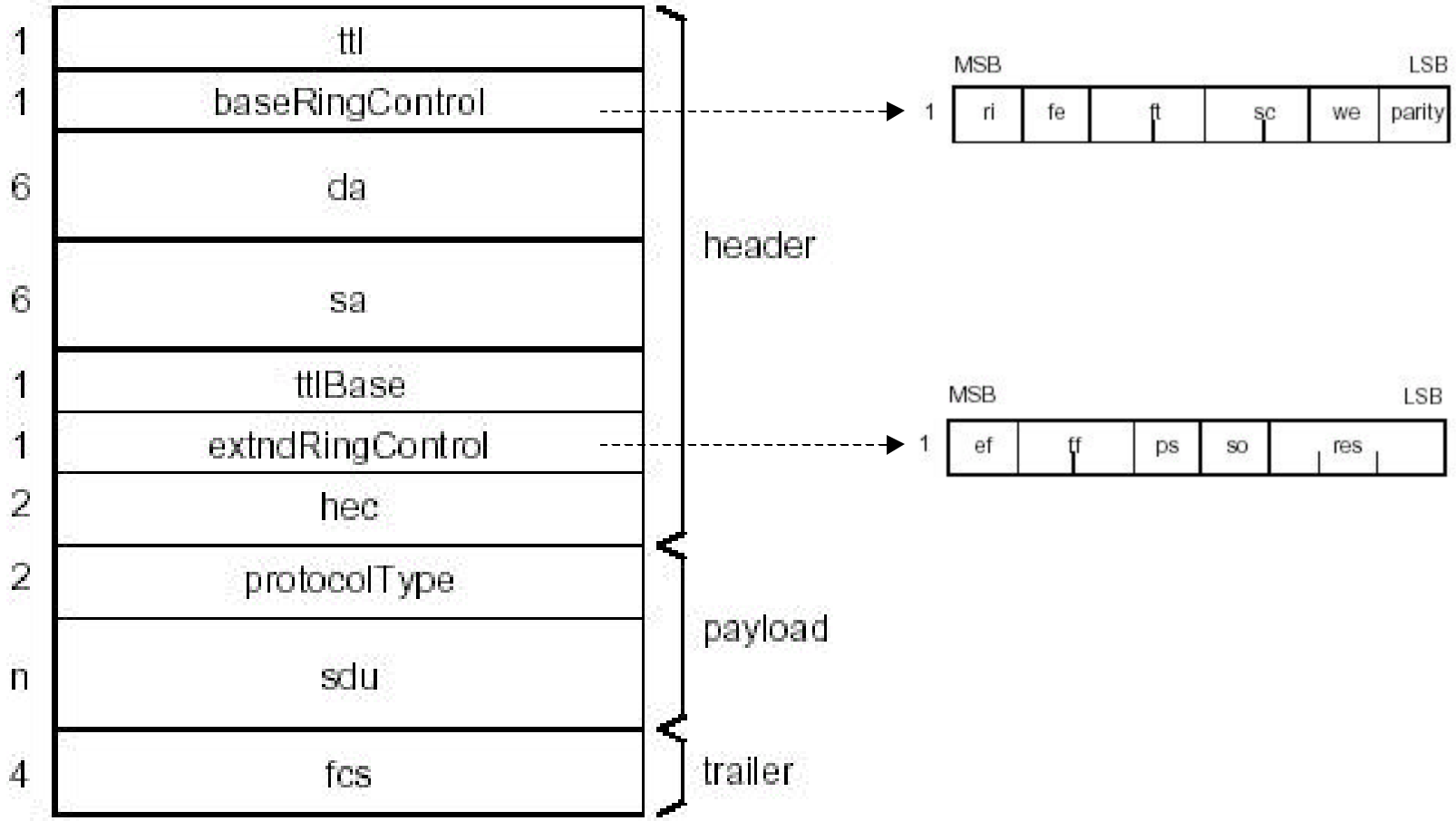
- RPR MAC support a frame transmission type where:
  - Duplication of user data frames is not permitted
  - Reordering of frames with a given destination address, source address, and user priority associated with the VLAN is not permitted
- Aforementioned requirements supported by:
  - Checking (and verifying) transit frame distance to transmitting source station
  - Invocation of frame purging technique whenever the ring image has changed

Basic/Enhanced (802.1D/Q) Bridge Functionality

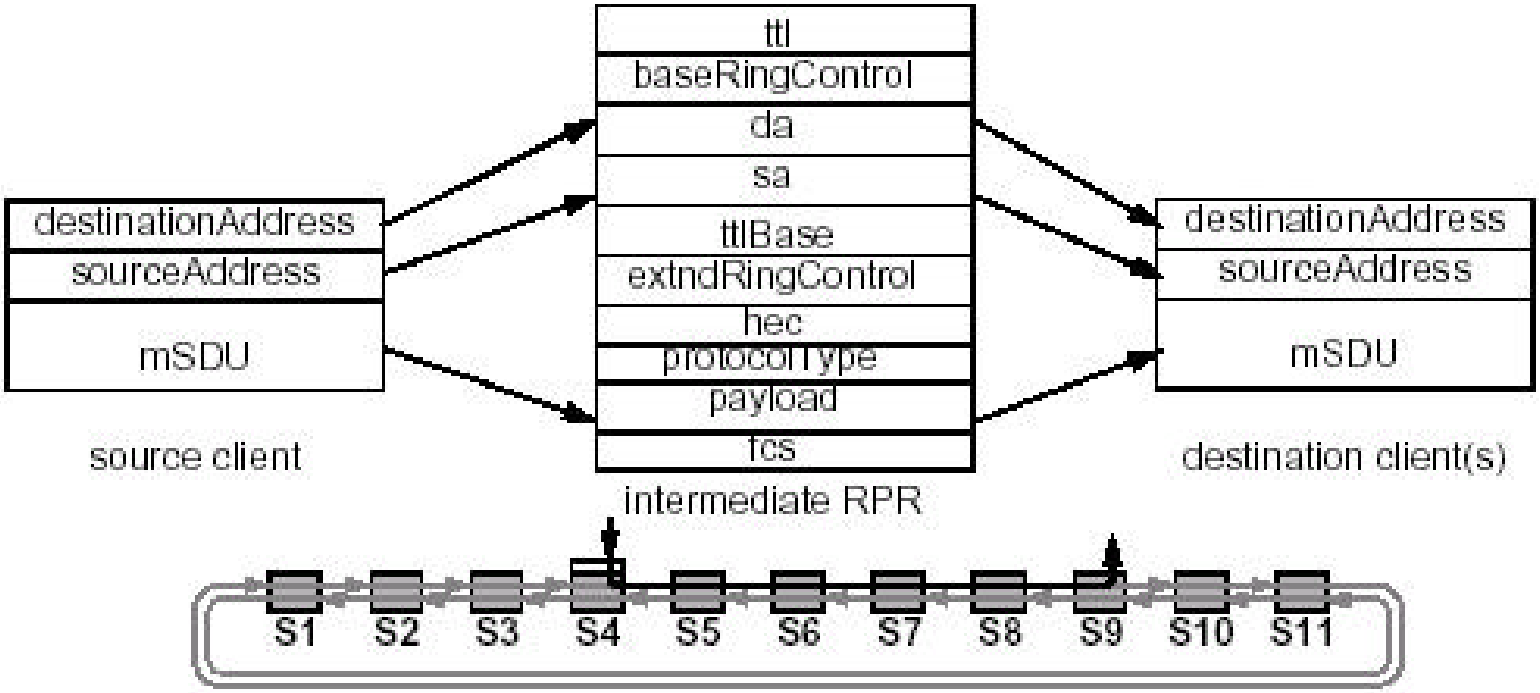
	Basic Transparent Bridging	Enhanced Transparent Bridging
802.1D/Q compliance	√	√
Local ring traffic spatial reuse	√	√
Transparent bridging traffic spatial reuse	×	√
Other traffic spatial reuse (e.g., multicast handling)	×	√

Backup

RPR Data Frame Format



Station Unicast Frame Transmission



Bridged Frame Transmission