Bridging over RPR

Jim Kao, AuroraNetics, Inc.
Gunes Aybay, Riverstone Networks
Necdet Uzun, AuroraNetics, Inc.

Why bridging is important?

- Carriers/ILECs want to build Layer-2 transport networks – easier to deploy and manage
- Transparent LAN services is prime driver for bandwidth demand
- There is still non-IP traffic out there!
- We are 802!

802.1D Bridge Functions

- The Forwarding Process,

  which forwards received frames that are to be relayed to other Bridge Ports, filtering frames on the basis of information contained in the Filtering Database and on the state of the Bridge Ports.

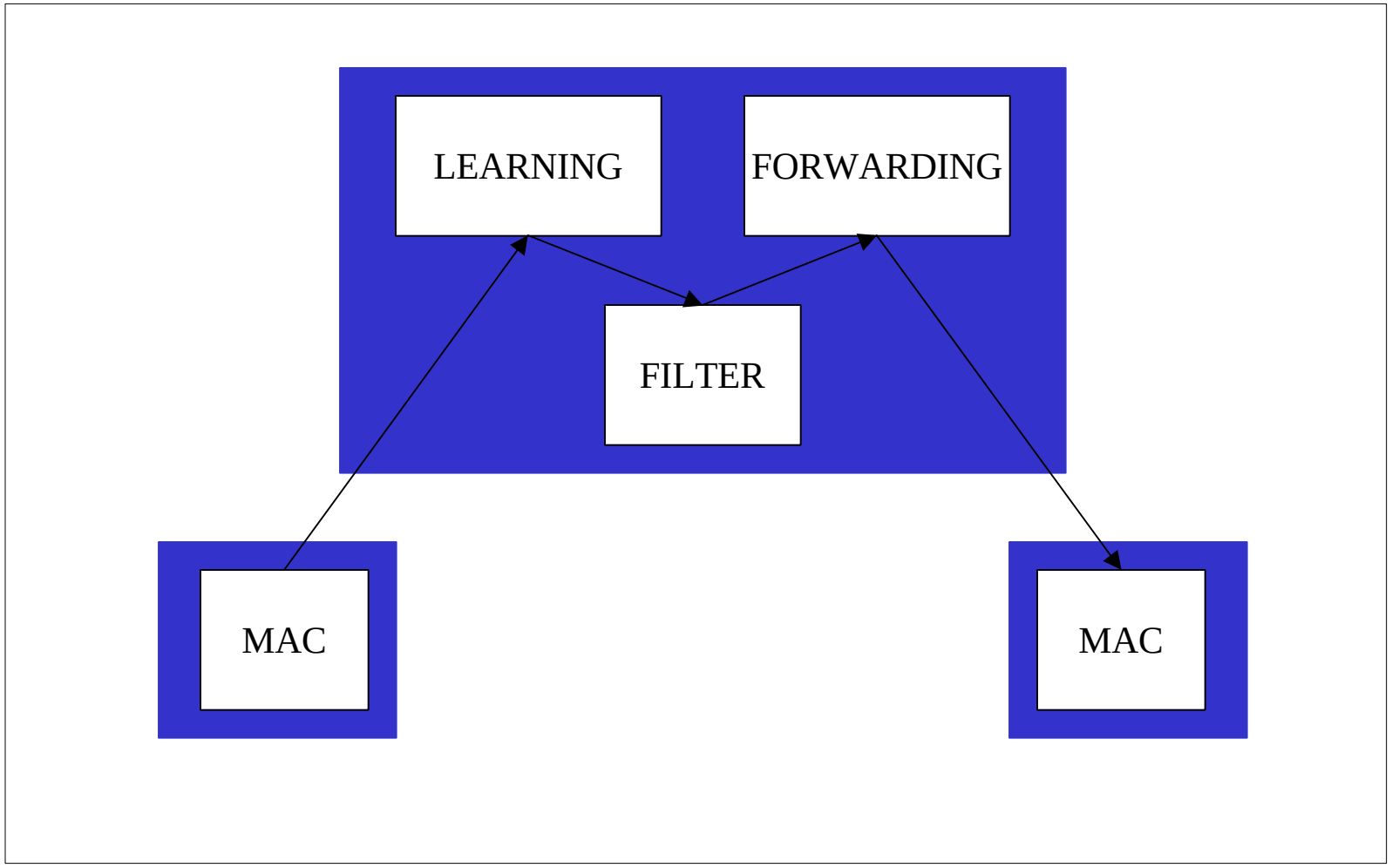
- The Learning Process,

  which by observing the source addresses of frames received on each Port, updates the Filtering Database, conditionally on the Port state.

- The Filtering Database,

  which holds filtering information and supports queries by the Forwarding Process as to whether frames with given values of the destination MAC address field should be forwarded to a given Port.

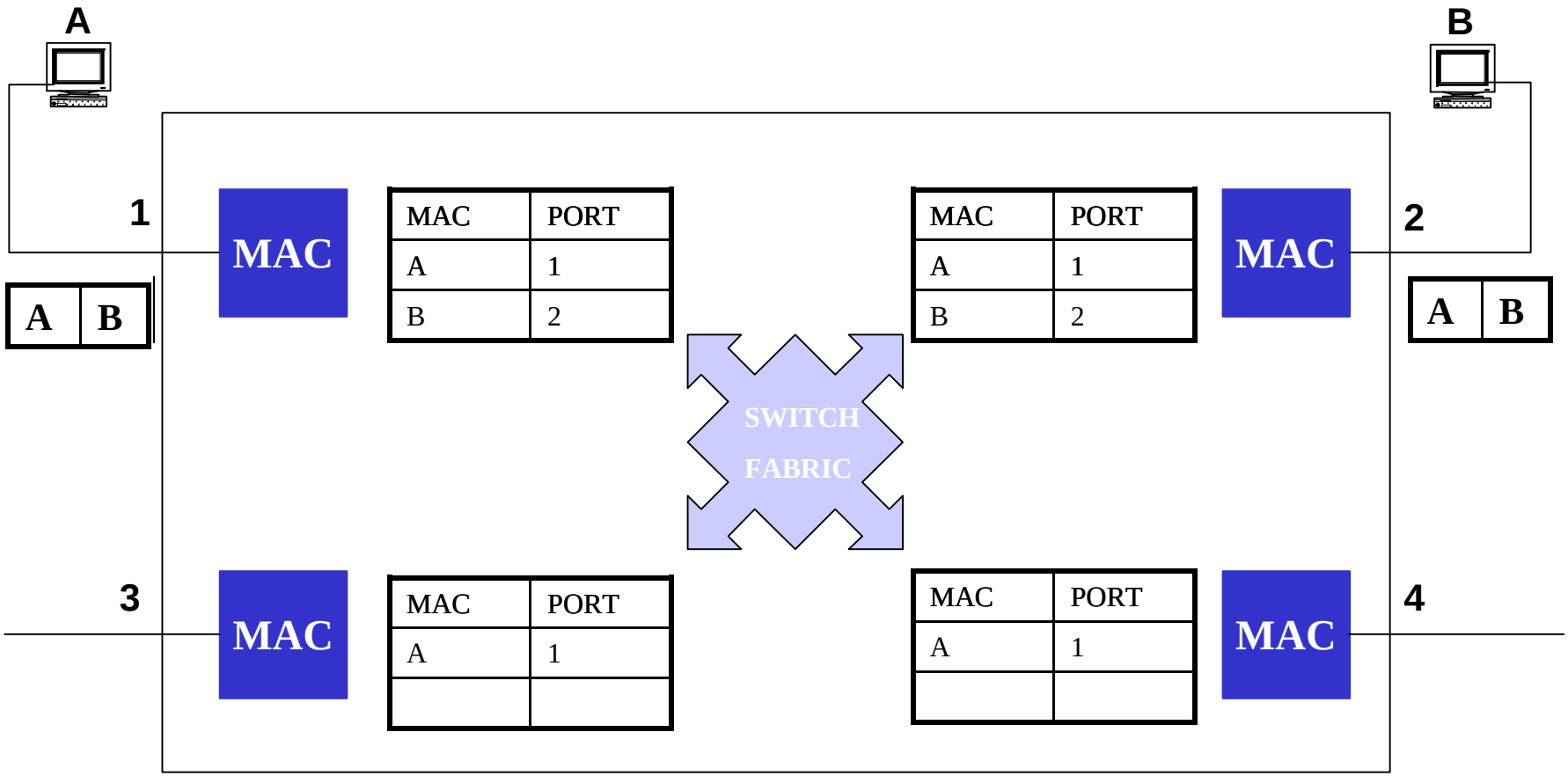
802.1D Bridge Block Diagram



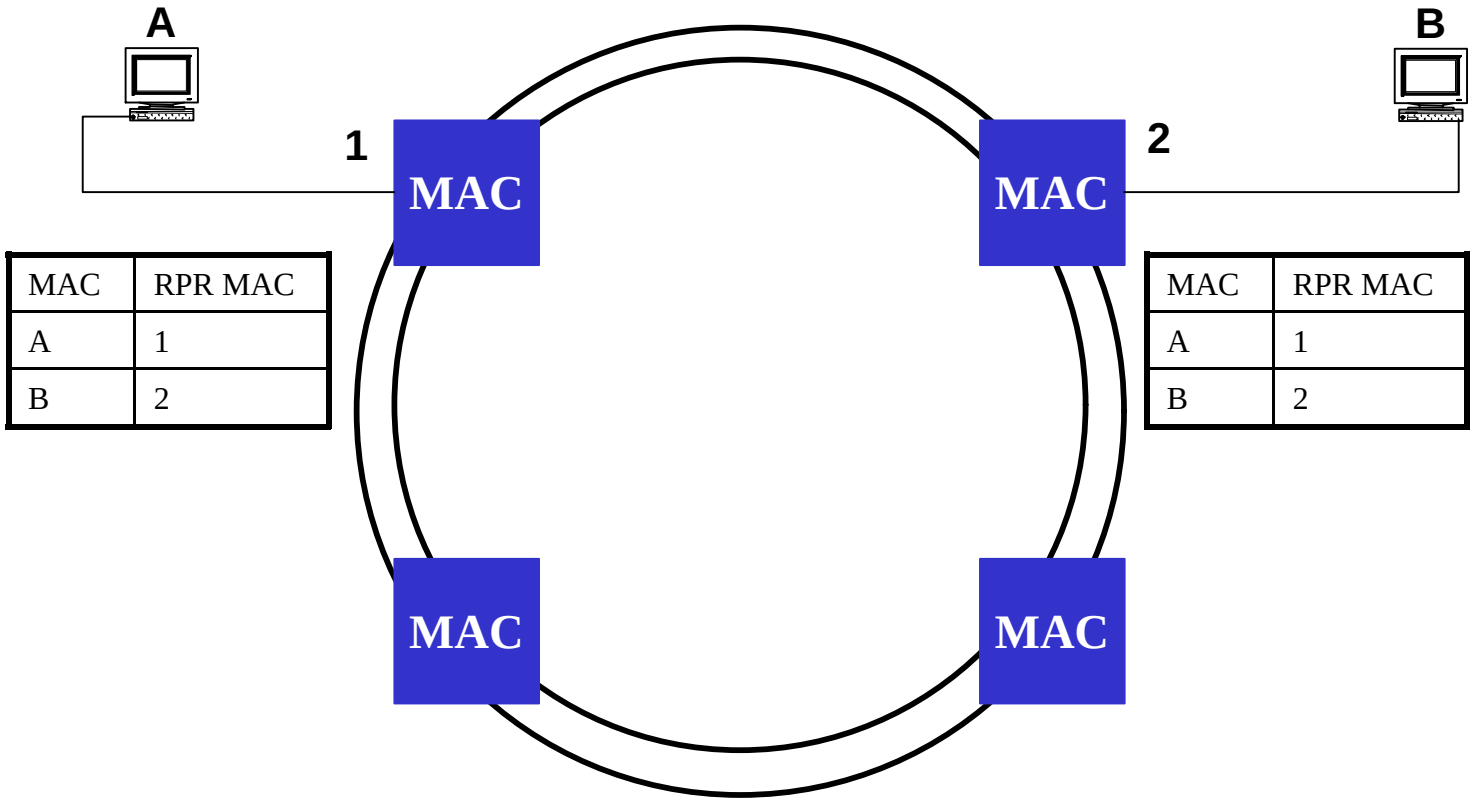
RPR Issues with 802.1D

- Cooperate with Spanning Tree Protocol
- Unknown unicast MAC learning algorithm
- Ring selection to provide maximum spatial reuse for bridge traffic on dual ring
- No frame misordering
- No frame duplication
- Layer 3 routing to coexist with Layer 2 bridging

How does an Ethernet Switch Work?



RPR is a “Distributed Switch”



MAC	RPR MAC
A	1
B	2

MAC	RPR MAC
A	1
B	2

Packet Format Issues

- Transparent Bridge
  - Keep the original Ethernet DA and SA in the RPR header
  - Keep the original Ethernet payload as the RPR payload
- Encapsulation Bridge
  - Encapsulate RPR header with new RPR SA and DA
  - Keep the original Ethernet frame as RPR payload

Transparent Bridge

- Requires a large MAC table
  - RPR MAC keeps track of all MAC addresses in the network
  - External RAM is required
    - MAC address could be up to 256K per port in current MAN switches
  - DA/SA lookup is needed for all transit packets at line speed
  - RPR MAC is making a bridging decision!
- MAC table must be shared between east and west RPR MACs
  - MACs learned from inner ring could be used by outer ring
  - Otherwise, packets with unknown MAC addresses need to be sent to both rings
- Need a bit in the header to discriminate between unknown and known MAC addresses

Encapsulation Bridge

- Need to encapsulate the original packet
  - Additional RPR SA, DA overhead in the packet
  - A bigger Maximum allowable RPR frame size is required to avoid segmentation
  - Additional type field in RPR header is required to identify encapsulation bridging packets
- No External RAM is required
  - Don‘t need to learn MAC addresses outside of the ring
- Complexity is left outside of the MAC

RPR Encapsulation Bridge

- It will not require to establish a spanning tree between RPR bridges over RPR ring (sub-optimal ?)
- RPR bridge port is a static forwarding port and will not join STP to dynamically change its port state
- A learning MAC packet is required for the unknown MAC address learning

Learning MAC Packet

- A reserved broadcast MAC address to indicate a learning MAC packet
- For an unknown MAC packet, it will be encapsulated in a learning MAC packet before flooding RPR ring
- RPR MAC will copy the learning MAC packet and forward it to 802.1D bridge

Packet Forwarding from RPR Ring

- RPR MAC
  - DA lookup. If matched, strip the packet from ring and forward it to 802.1D bridge.
  - SA lookup. If matched, strip the packet from ring.
  - If it is a learning MAC packet, copy it to the 802.1D bridge and forward it to the ring.
  - This is the same as basic RPR MAC function!

Packet Forwarding from RPR Ring

- 802.1D Bridge
  - Unknown or expired SA of the original source
    - then learn SA of the ingress RPR bridge and the port number of the Mate.
  - Learning MAC packet
    - If it is a known DA, bridge the packet to the other port.
    - If it is an unknown DA, flood the packet to all bridge ports in forwarding state.
  - Unicast packet
    - If it is a known DA, bridge the packet to the other port
    - If it is an unknown DA, flood the packet

Packet Forwarding to RPR Ring

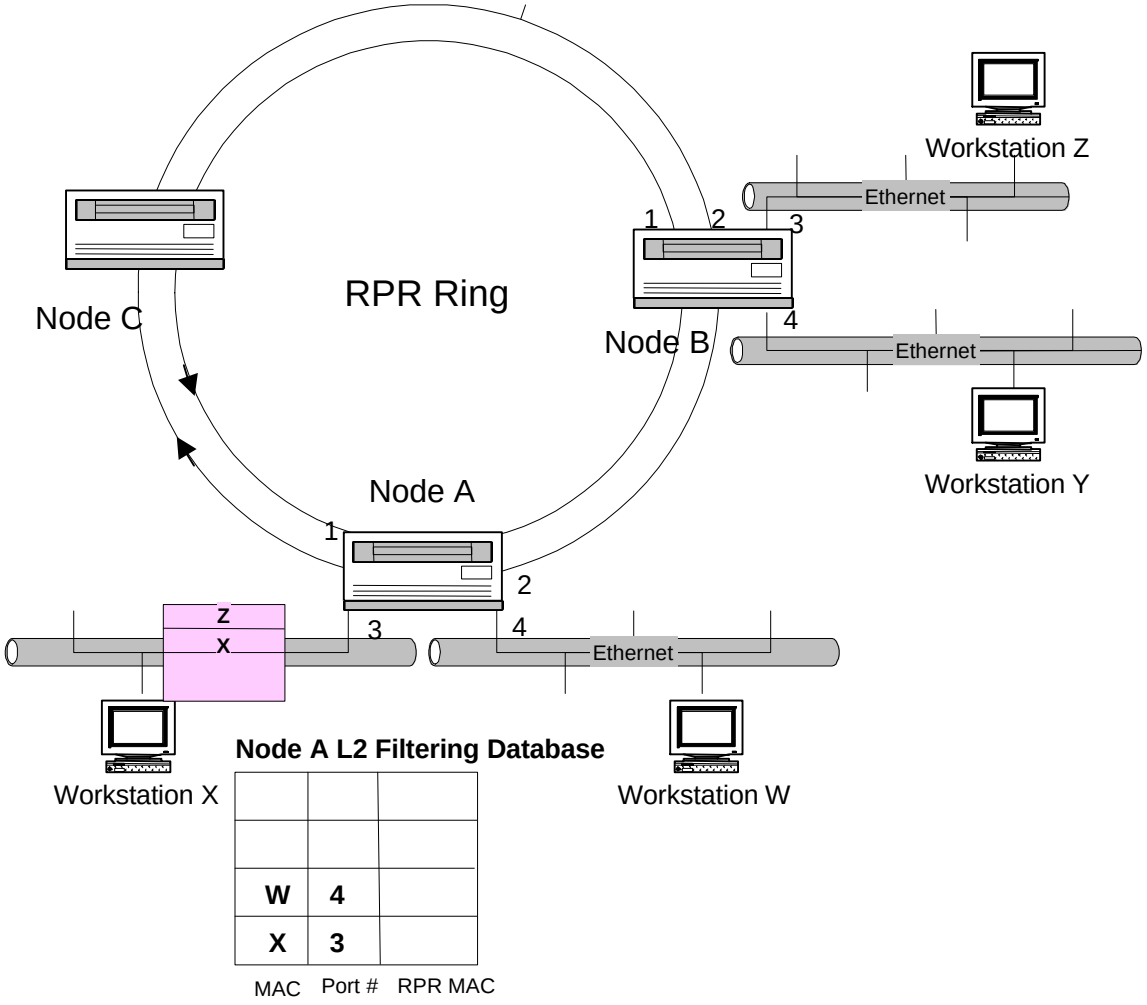
- For a bridged packet
  - If DA of final destination is known
    - Obtain DA of RPR bridge node for this final destination from filtering database
    - Based on RPR DA select the ring
    - Encapsulate the RPR header and send the packet to ring
  - If DA of final destination is unknown
    - Encapsulate the packet to be a learning MAC packet
    - Send the packet to the ring

RPR Bridge MAC Learning

Node B L2 Filtering Database

Z	**3**	
Y	**4**	

MAC Port # RPR MAC



Node A L2 Filtering Database

W	**4**	
X	**3**	

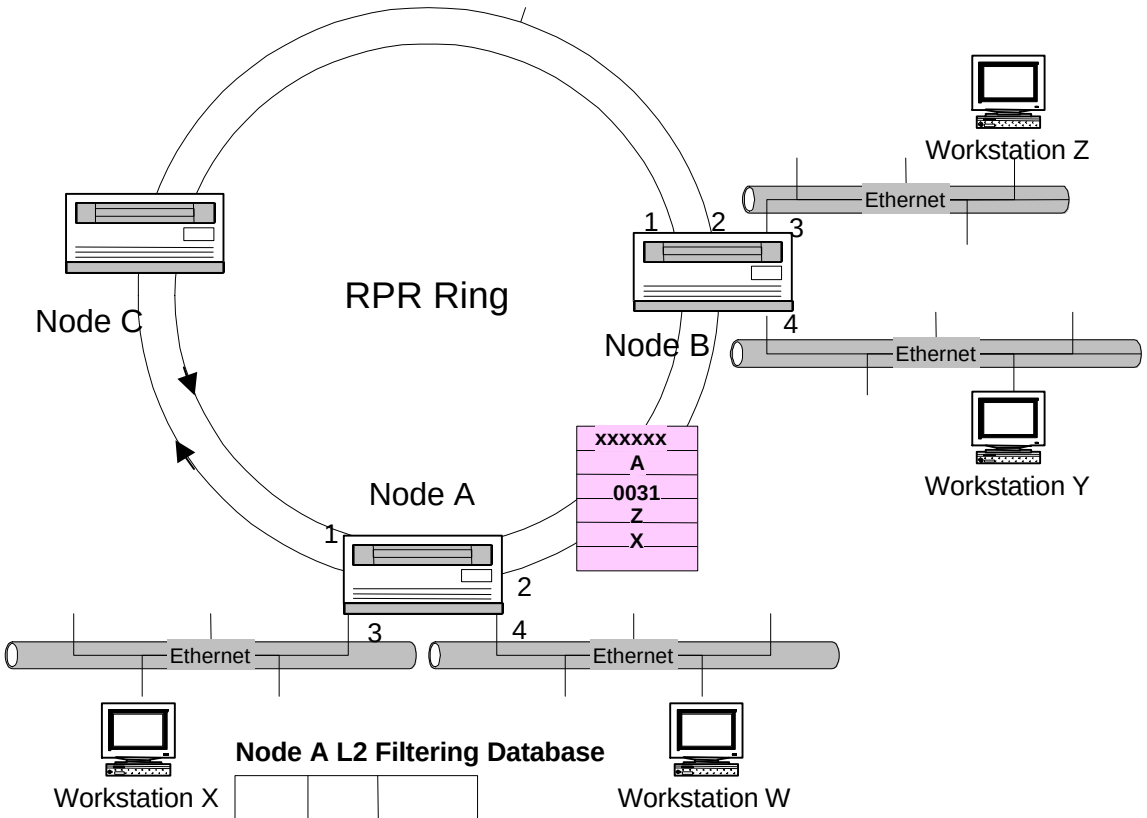
MAC Port # RPR MAC

RPR Bridge MAC Learning

Node B L2 Filtering Database

Z	**3**	
Y	**4**	

MAC Port # RPR MAC



Node A L2 Filtering Database

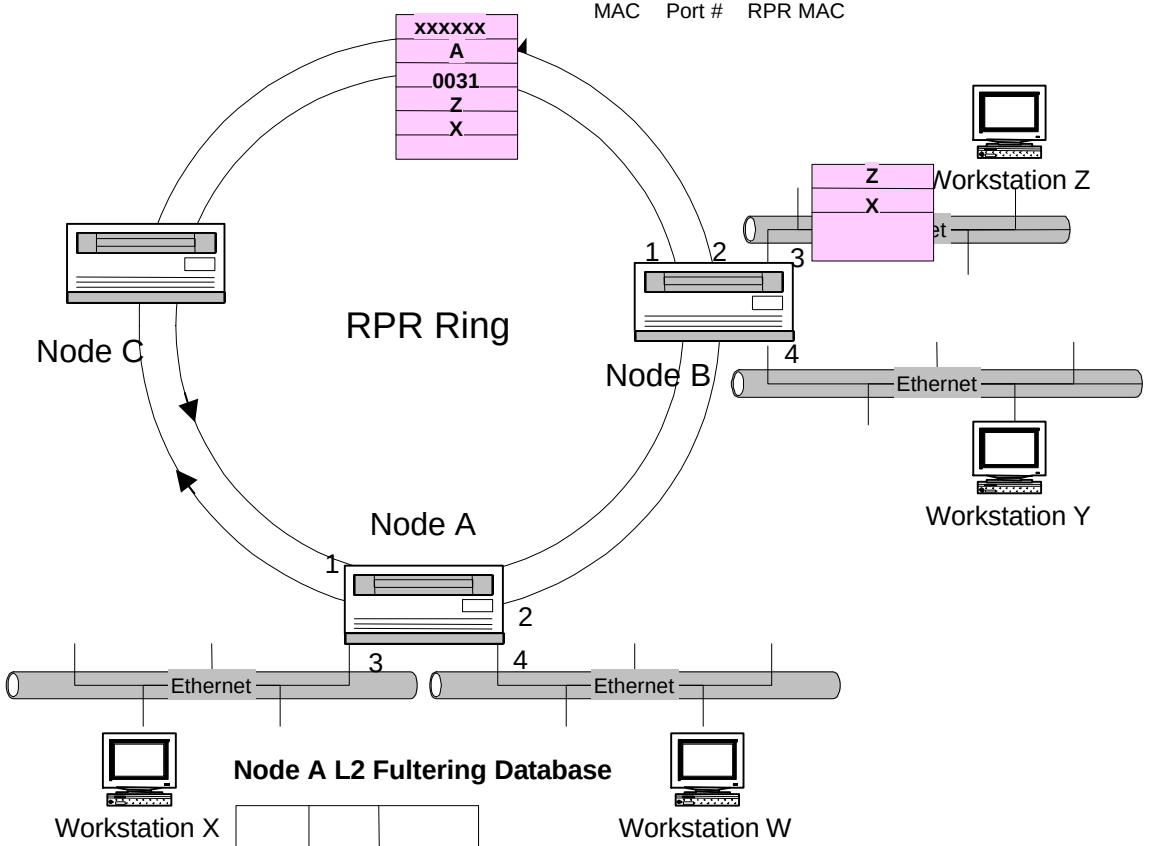
W	**4**	
X	**3**	

MAC Port # RPR MAC

RPR Bridge MAC Learning

Node B L2 Filtering Database

MAC	Port #	RPR MAC
X	1	A
Z	3	
Y	4	



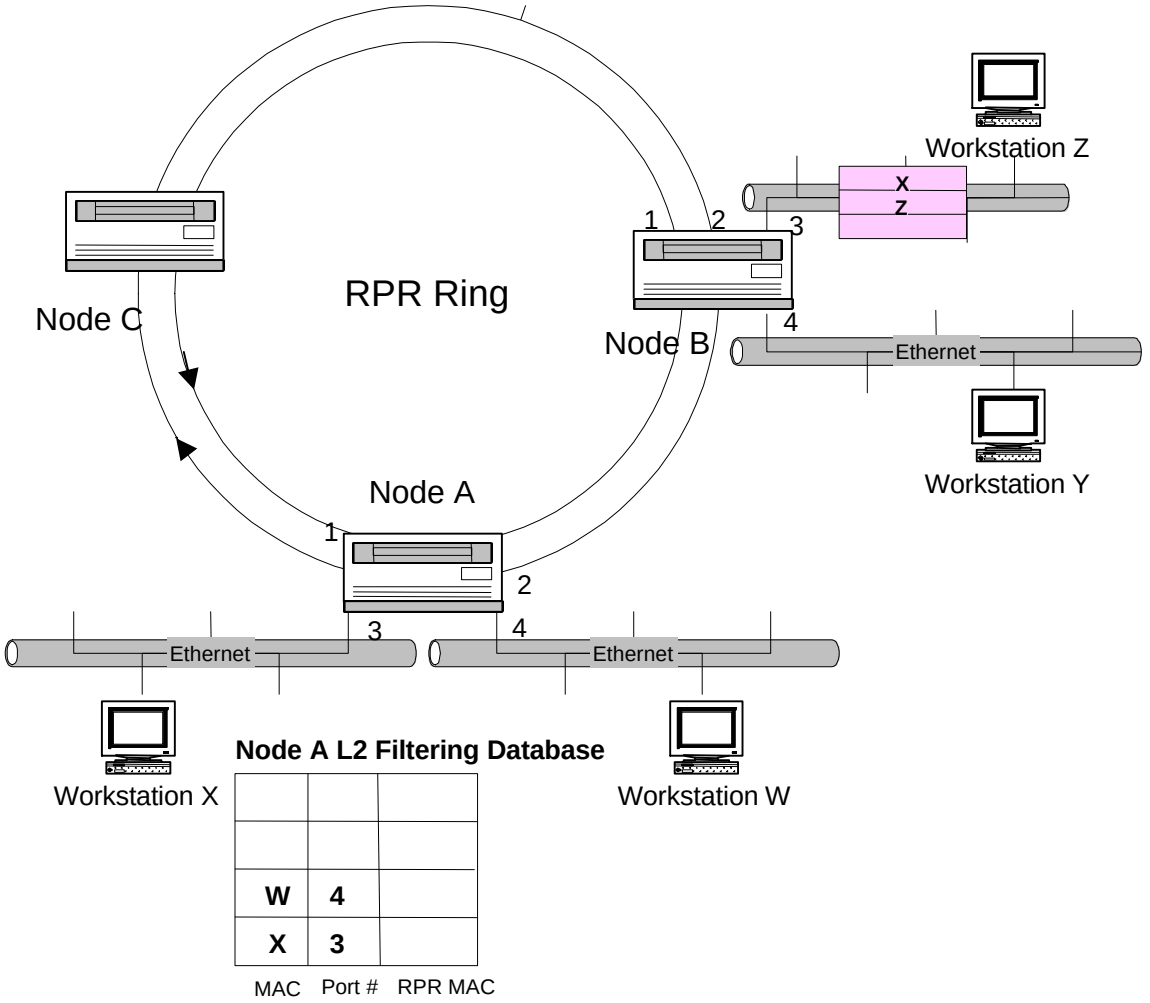
Node A L2 Fultering Database

MAC	Port #	RPR MAC
W	4	
X	3	

RPR Bridge MAC Learning

Node B L2 Filtering Database

MAC	Port #	RPR MAC
X	1	A
Z	3	
Y	4	



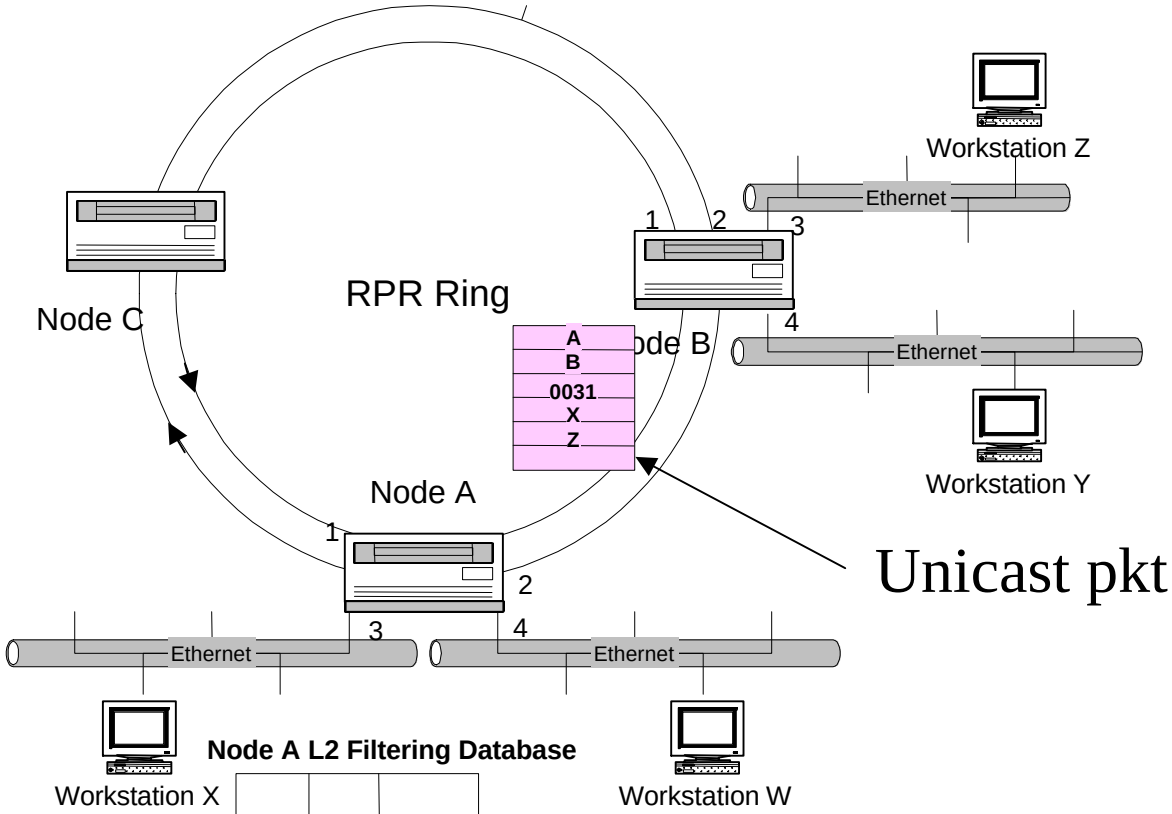
Node A L2 Filtering Database

MAC	Port #	RPR MAC
W	4	
X	3	

RPR Bridge MAC Learning

Node B L2 Filtering Database

MAC	Port #	RPR MAC
X	1	A
Z	3	
Y	4	



Node A L2 Filtering Database

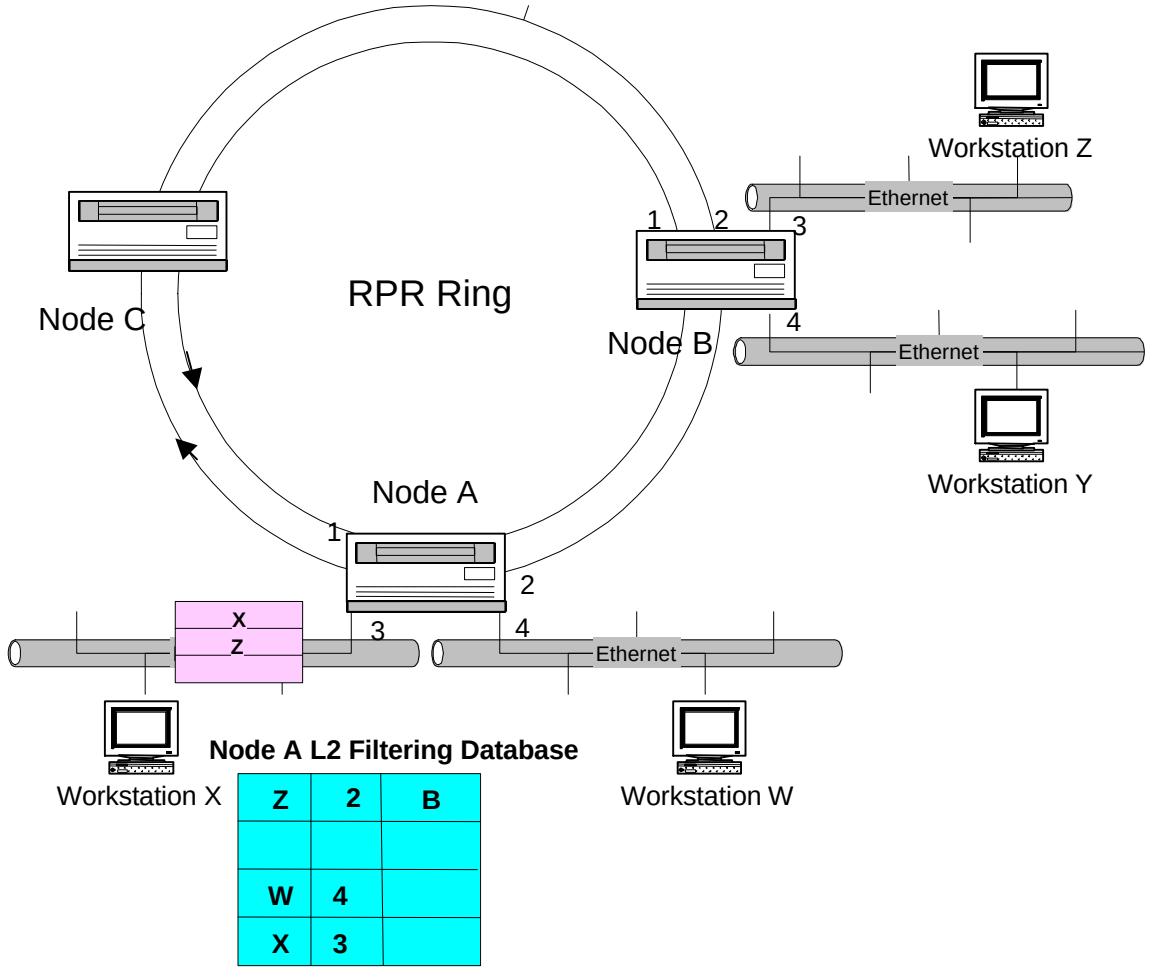
MAC	Port #	RPR MAC
W	4	
X	3	

RPR Bridge MAC Learning

Node B L2 Filtering Database

X	**1**	**A**
Z	**3**	
Y	**4**	

MAC Port # RPR MAC



Node A L2 Filtering Database

Z	**2**	**B**
W	**4**	
X	**3**	

MAC Port # RPR MAC

Conclusions

- Encapsulation bridging provides the simplest solution for RPR
- Define a MAC address for learning packets
- Define a protocol field for encapsulation bridge traffic
- Work with 802.1D team to resolve any compatibility problems