

802.17 Bridging

Robert Castellano, Jedai Broadband Networks

Outline

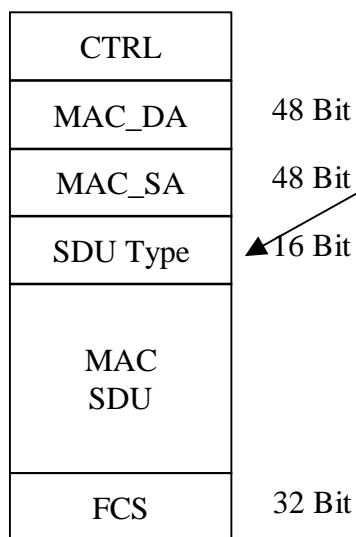
- Transparent / Encapsulation Bridging Paradigms
- Bridging Requirements
- Reference Models
- Transparent Bridging Alternatives
- Packet Walkthrough Examples

Bridging Paradigms

- Transparent Bridging
 - MAC service primitives from the MAC relay entity are mapped directly onto the LAN medium by the MAC Entity
 - Service Primitives : Source Address, Destination Address, User Priority, MAC SDU
- Encapsulation Bridging
 - MAC service primitives are encapsulated by the MAC bridging relay and require a compatible de-encapsulation function at the terminating bridge. The resulting encapsulated PDU can be transparently bridged across intermediate networks.

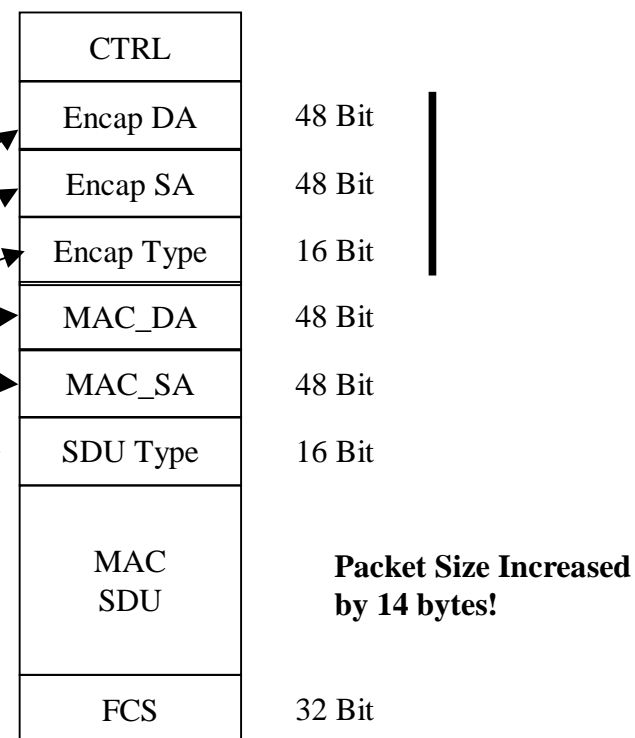
Transparent vs Encapsulated Bridged PDU's

Transparent PDU



Addresses and Types
Administered by IEEE

Encapsulated PDU

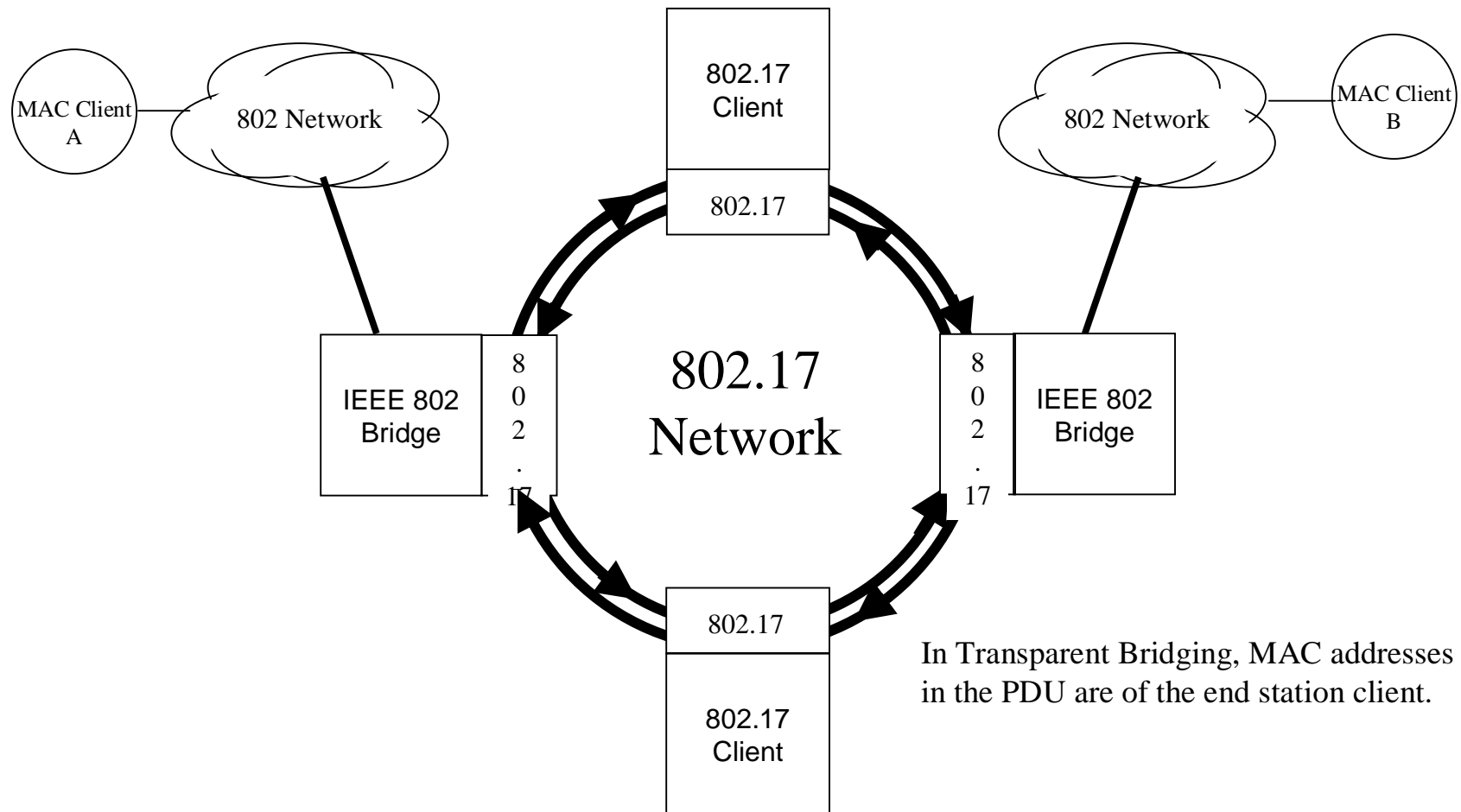


Encapsulated PDU pushes address/type information of transparent PDU into The MAC SDU and is delineated by the encapsulating type

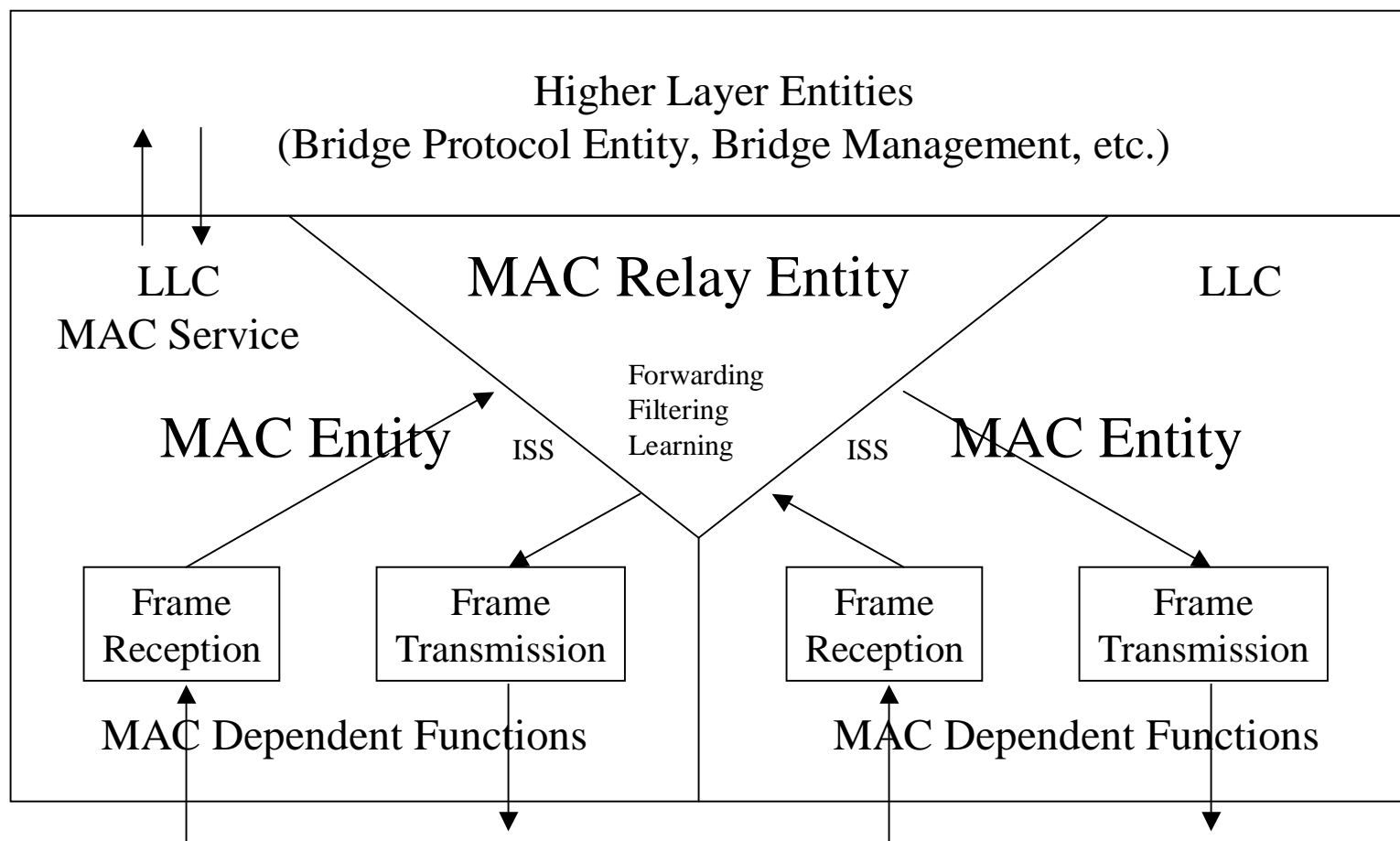
Bridging Requirements

- 5 Criteria
 - 802 Overview and Architecture
 - Compatible with relevant portions of 802.1d, 802.1q, and 802.1f
 - Allow for simple mapping between 802.3 frames and RPR frames and vice versa.
- Spatial Reuse of Unicast Traffic
 - Motion 7 Pass 89/1/4 - Requirement: The MAC shall support destination removal for uni-cast packets during normal operation.

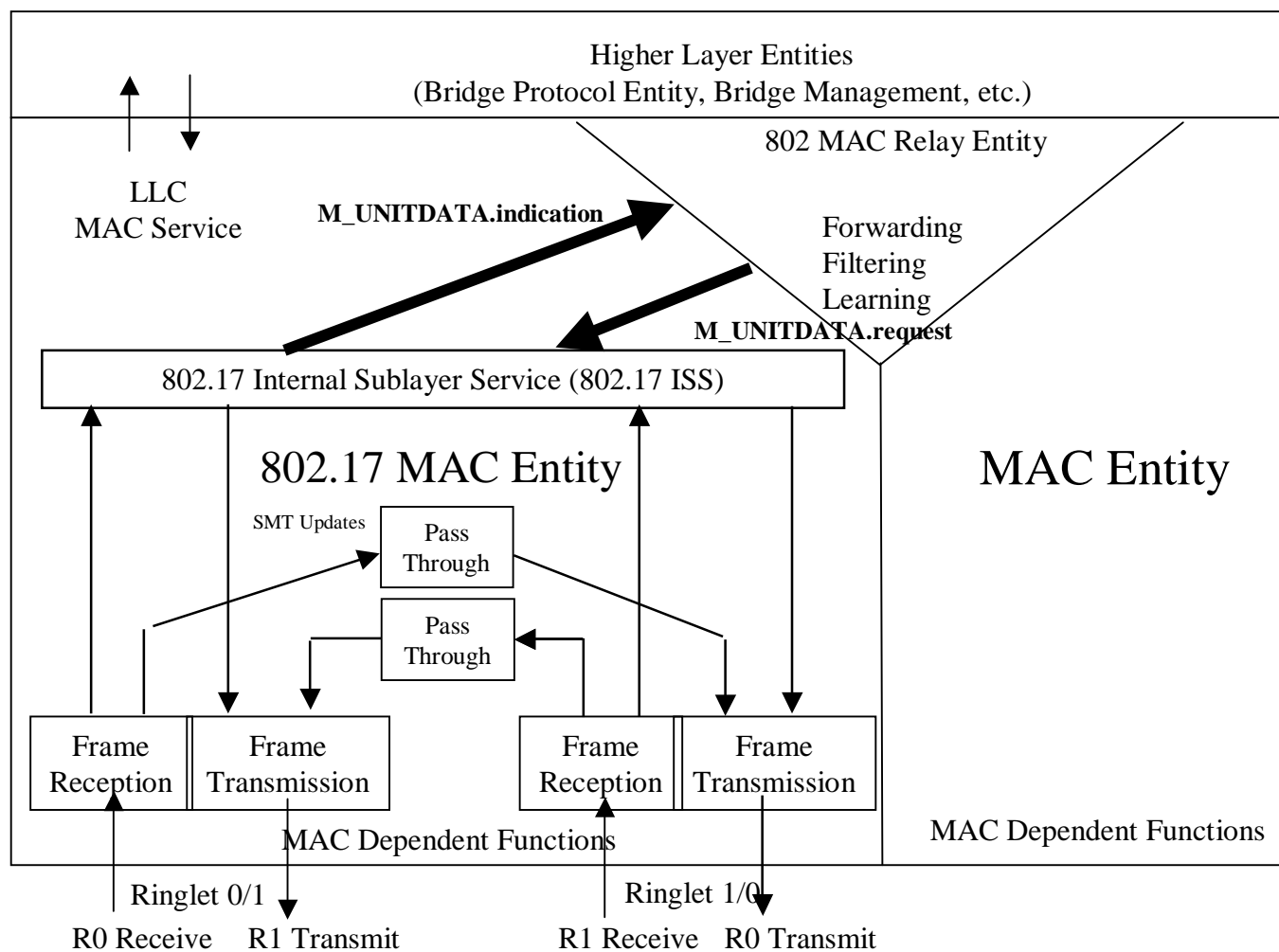
802.17 Bridge Model



802.1D MAC Bridge Architecture Model



802.1D/Q MAC Bridge Model w/802.17 MAC

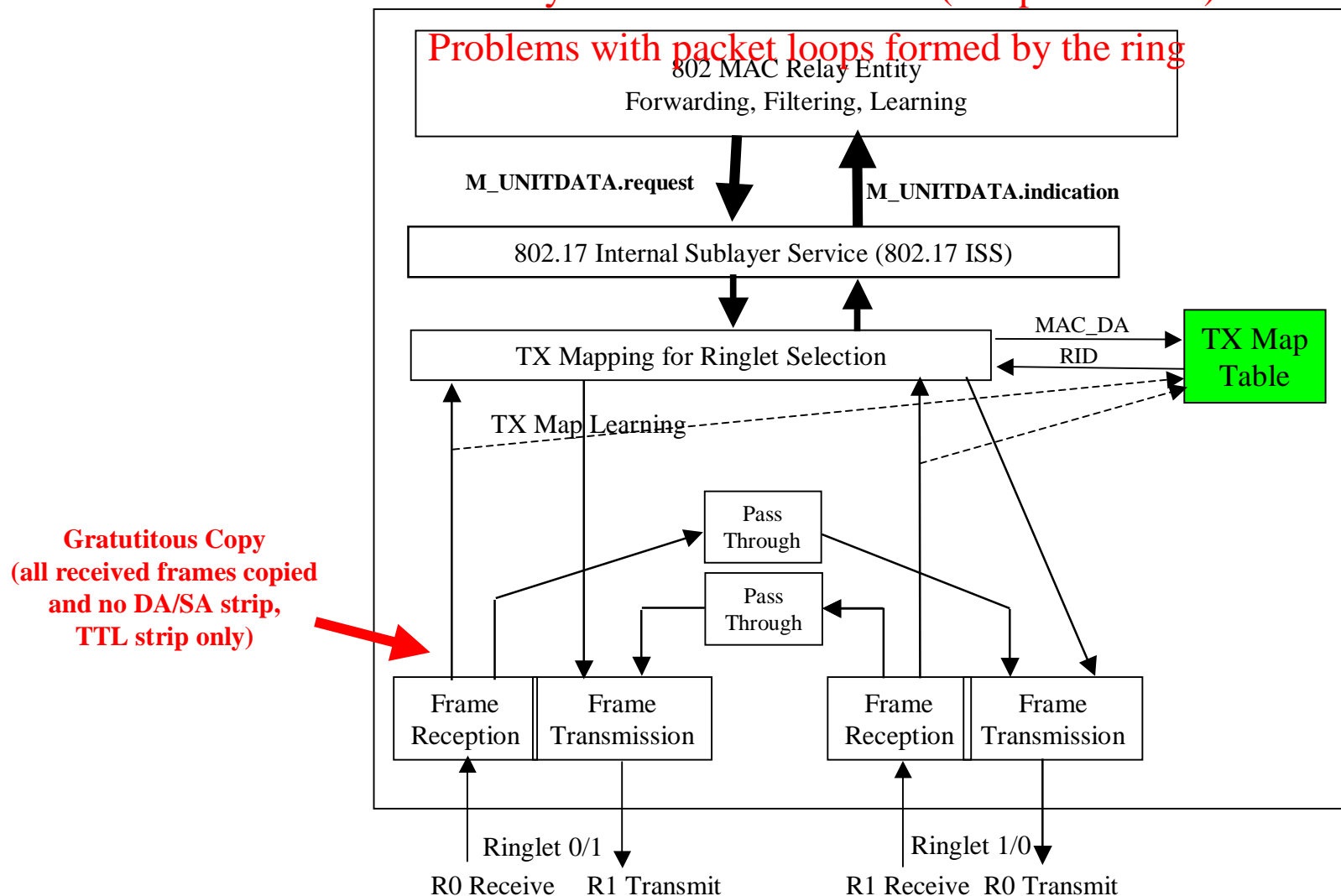


Transparent Bridging Alternatives

- Gratuitous Copying
 - Bridges copy all frames from ring w/no strip (TTL only strip)
 - No Spatial Reuse
- Transit Path FDB
 - Preserves Spatial Reuse
 - Requires large CAM in receive/pass-through path
 - Performance Concerns (particularly cut-through)
- Destination / Source Stripping via unique (DSID/SSID)
 - Mapping function in transmit MAC procedure appends unique DSID/SSID to frame
 - Preserves Spatial Reuse
 - Frame stripped based on a unique match of frame DSID or SSID

Transparent Bridging w/ Gratuitous Copy

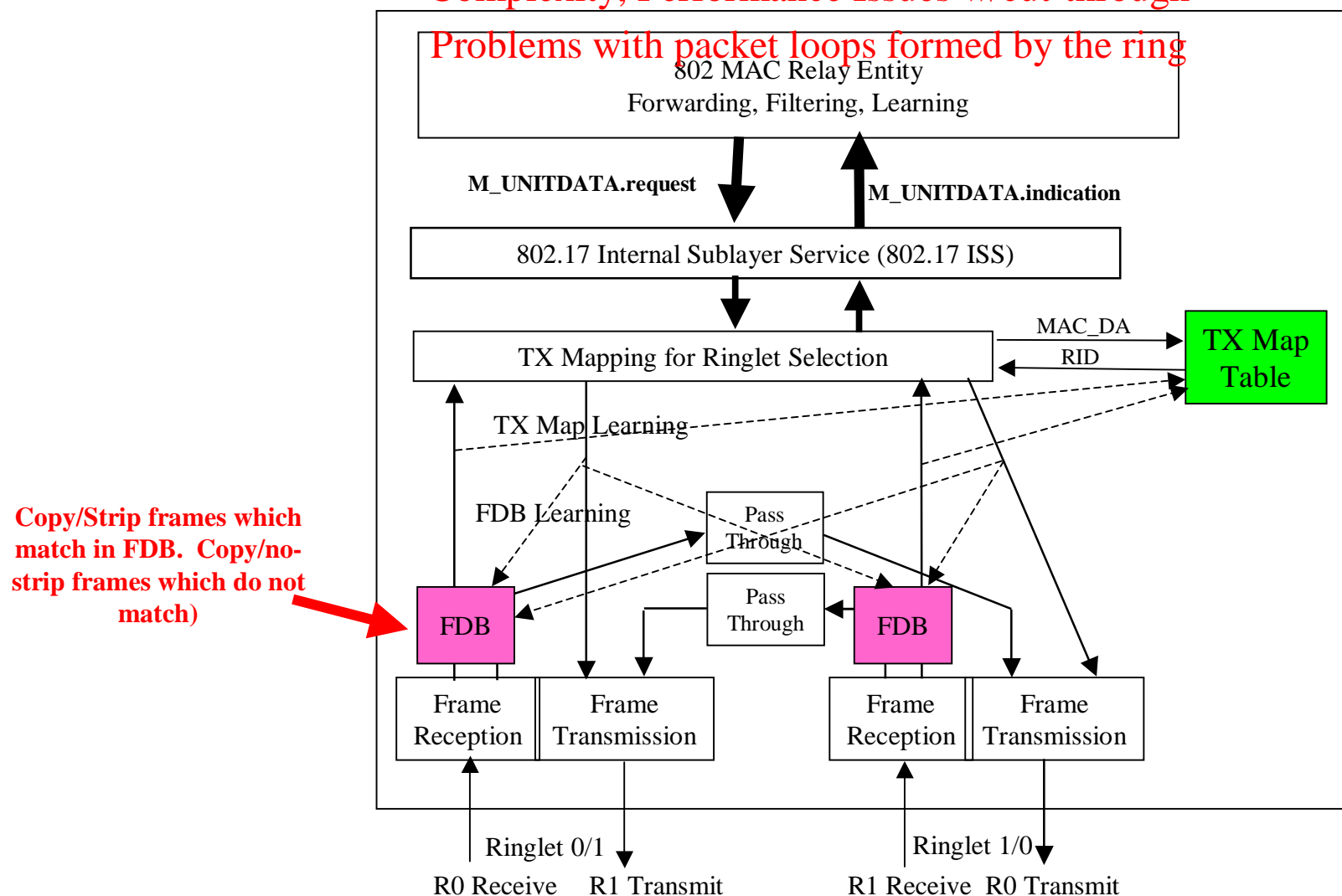
Extremely Bandwidth Inefficient (no spatial reuse)



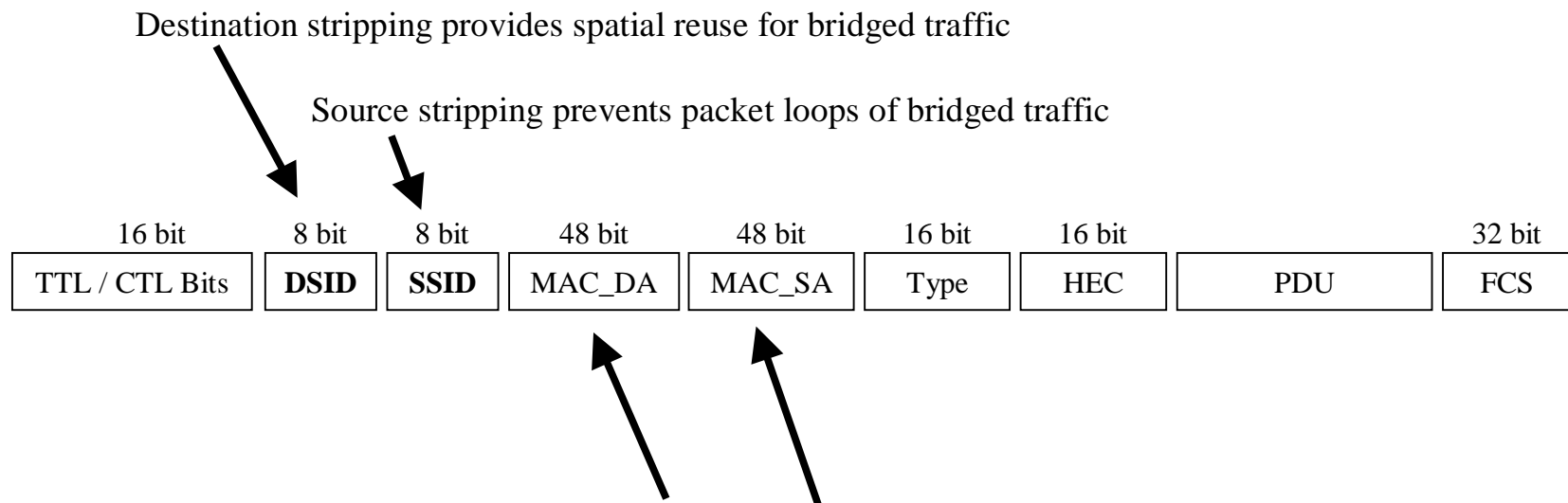
Transparent Bridging w/ FDB in Pass-through Path

Complexity, Performance Issues w/cut-through

Problems with packet loops formed by the ring



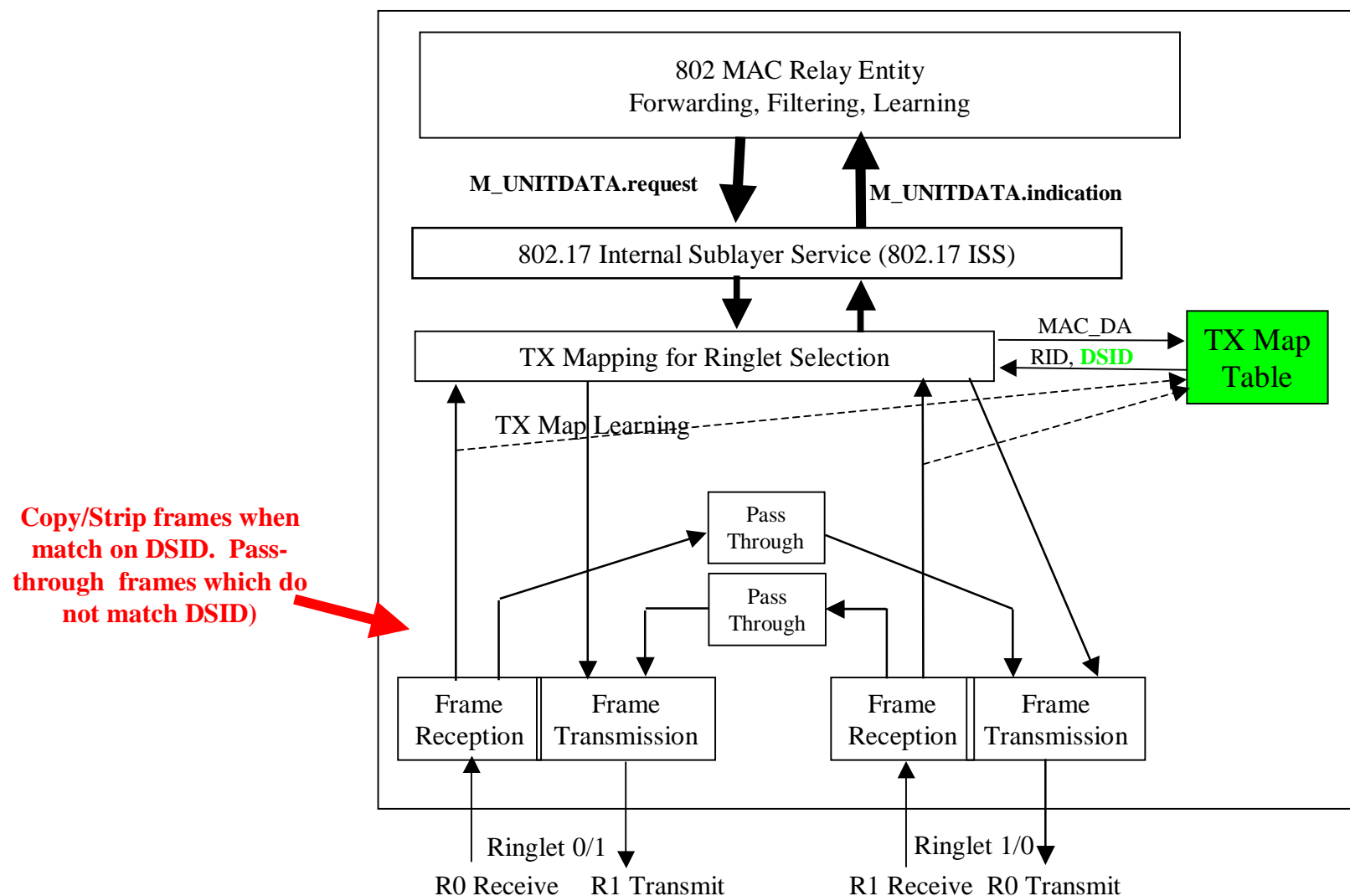
Source / Destination Station ID in 802.17 Frame



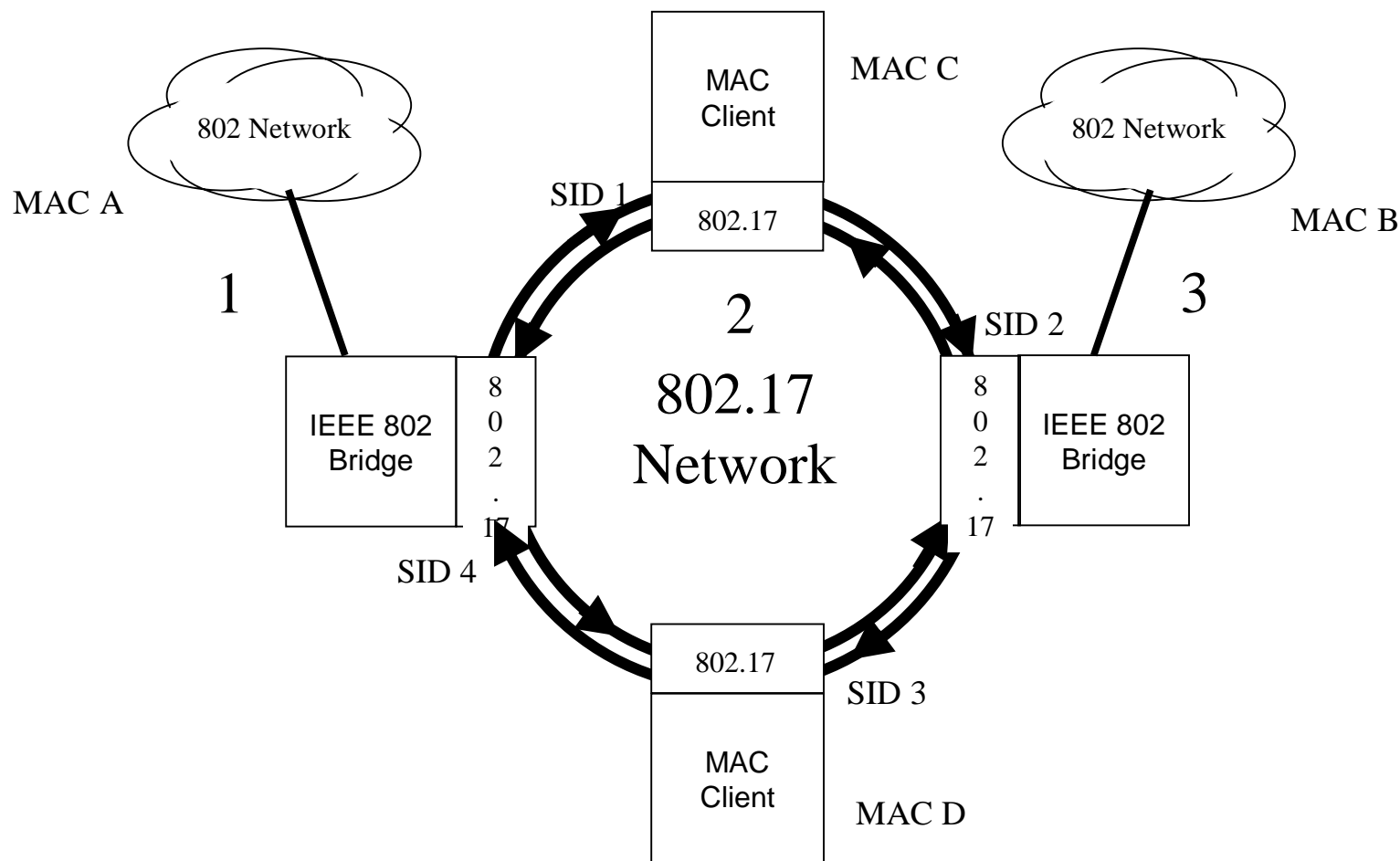
DSID value of FF indicates a broadcast frame
SSID value of FF indicates Null DSID/SSID

802.17 Clients can still strip frames based on their MAC Address

Transparent Bridging w/ FDB in Pass-through Path



Examples – Reference Network



Example 1 – Packet bridged between two 802.3 end stations across 802.17 ring

Packet from MAC_A to MAC_B

802.17 Header		802 MAC Address	
DSID	SSID	MAC_DA	MAC_SA
1		MAC_B	MAC_A
	Bcast	MAC_B	MAC_A
	SID 4	MAC_B	MAC_A
2		MAC_B	MAC_A
3		MAC_B	MAC_A

Packet from MAC_B to MAC_A

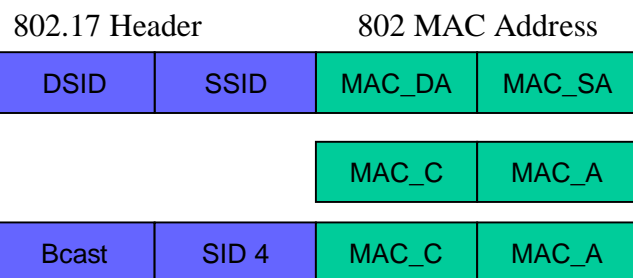
802.17 Header		802 MAC Address	
DSID	SSID	MAC_DA	MAC_SA
3		MAC_A	MAC_B
	SID 4	MAC_A	MAC_B
	SID 2	MAC_A	MAC_B
2		MAC_A	MAC_B
1		MAC_A	MAC_B

MAC_B unknown in Station 4 mapping table
 Packet Flooded to all Stations on Ring
 SID 4 / MAC_A learned in Station 1-3 mapping table
 Packet either TTL stripped or source stripped from the ring

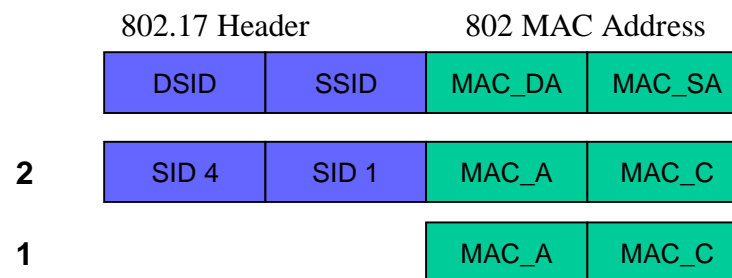
MAC_A/ SID 4 Resolved in Station 2 mapping table
 Packet unicast from station 2 to station 4 and stripped at station 4

Example 2 – Packet bridged between 802.3 and 802.17 end stations

Packet from MAC_A to MAC_C



Packet from MAC_C to MAC_A



MAC_C unknown in Station 4 mapping table
 Packet Flooded to all Stations on Ring
 SID 4 / MAC_A learned in Station 1-3 mapping table
 Packet either TTL stripped or source stripped from the ring

MAC_A/ SID 4 Resolved in Station 1 mapping table
 Packet unicast from station 1 to station 4 and stripped at station 4

Note – In the above packet scenario C to A, the client C could alternatively transmit the frame with a DSID of *Bcast* in lieu of the client implementing the DSID Mapping table. All bridges on the ring would do a gratuitous copy. While spatial reuse would not be maintained for flows originating from the client to the bridge, they would be maintained for flows originating from the bridge.

Example 3 – Packet forwarded between two 802.17 end stations on same ring

Packet from MAC_C to MAC_D

802.17 Header		802 MAC Address	
DSID	SSID	MAC_DA	MAC_SA

2

Bcast	SID 1	MAC_D	MAC_C
-------	-------	-------	-------

Packet from MAC_D to MAC_C

802.17 Header		802 MAC Address	
DSID	SSID	MAC_DA	MAC_SA

1

SID 1	SID 3	MAC_C	MAC_D
-------	-------	-------	-------

MAC_D unknown in Station 1 mapping table
 Packet Flooded to all Stations on Ring.
 All bridges would copy the packet up to their bridging Entity. Bridging entity would discard the packet if it determines MAC_C & MAC_D are learned on the same port.
 SID 1 / MAC_C learned in Station 2,4 mapping table.
 Frame shall be stripped from the ring when received at station 3 based on a match of the destination MAC address.

MAC_C/ SID 1 Resolved in Station 3 mapping table
 Packet unicast from station 3 to station 1 and stripped at station 1

Example 4 – Packet forwarded between two 802.17 end stations on same ring

802.17 Client Stations do not implement TX Mapping Table

Packet from MAC_C to MAC_D

802.17 Header		802 MAC Address	
DSID	SSID	MAC_DA	MAC_SA

2

Bcast	SID 1	MAC_D	MAC_C
-------	-------	-------	-------

Packet from MAC_D to MAC_C

802.17 Header		802 MAC Address	
DSID	SSID	MAC_DA	MAC_SA

2

Bcast	SID 3	MAC_C	MAC_D
-------	-------	-------	-------

Station 1 sets DSID to Bcast address
 Packet Flooded to all Stations on Ring.
 All bridges would copy the packet up to their bridging
 Entity. SID 1 / MAC_C learned in Station 1-3 mapping table.
 Frame shall be stripped from the ring when received
 at station 3 based on a match of the destination MAC address.

802.17 MAC configured for null station ID's

Station 3 transmits frame with Bcast DSID
 Station 1 strips packet based on MAC_C
 or SSID or TTL strip if not dest stripped

Note – In the above scenario, spatial reuse is maintained even when the DSID
 is set to the Bcast identifier due to intended client stripping the frame based on an
 exact match of the MAC destination address. Spatial reuse is maintained for client-client flows.

Distribution of Station ID's

- Every RPR Station maintains a unique 48-bit MAC address
- During Topology discovery or topology updates, 48-bit unique MAC addresses are used to validate and assign unique 8-bit station ID's.
- The update process is defined such that any potential duplicate station ID's that may arise are reassigned during the update process.
- If a station ID is reassigned, all devices on the ring need to flush any associated mapping table entries.

Station ID Distribution Algorithm

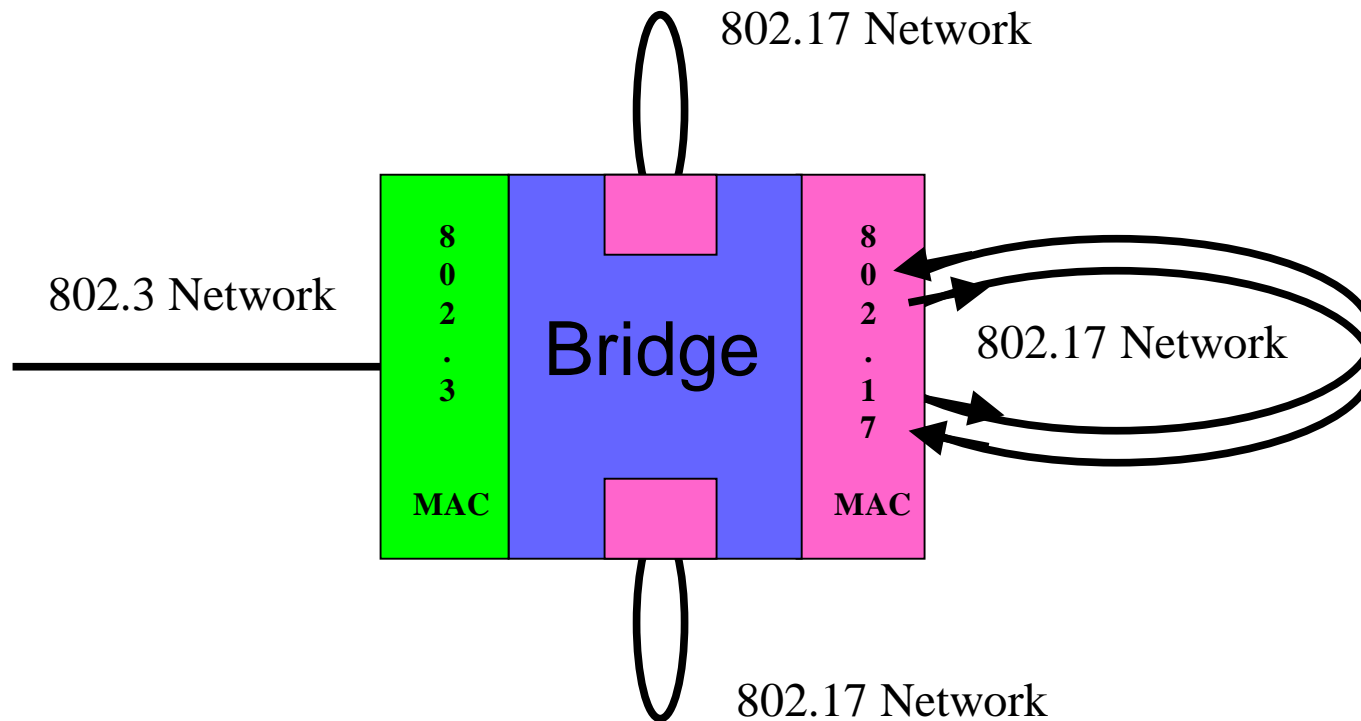
- Topology discovery messages are sent station-station around ring.
- Each station appends its MAC address/station ID to the message and ensures no other MAC addresses utilize the same station ID. If a duplicate is detected, the station reassigns the station with the smaller of the two MAC addresses to the null station ID. A station having its station ID set to null in the discover message must be reassigned.
- Once the topology message has completed an entire cycle around ring, the discovery phase is complete.
- Following discovery, the topology packet cycles again assigning the previously unassigned station IDs.

Support of Spanning Tree Protocol and BPDUs

- 802.17 ring appears as a single STP domain to the bridges attached to the ring.
- BPDUs transmitted by a station on the ring must be received by all bridge stations on the ring (BPDUs are flooded via a DSID value of Bcast in the 802.17 frame header).

The End!!

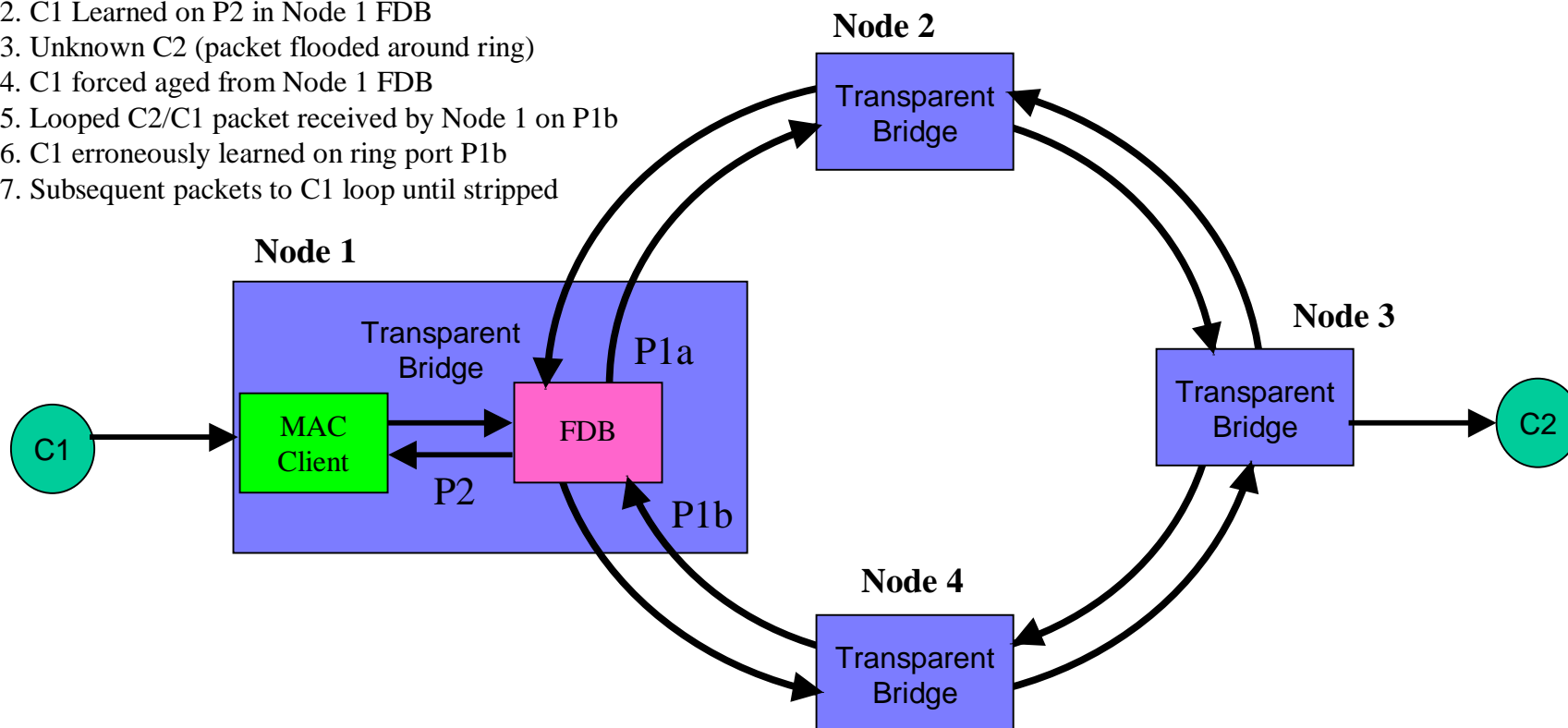
802.17 Bridging



Issues with FDB in MAC Entity

Erroneous learning during forced aging

1. Packet Sent From C1 to C2
2. C1 Learned on P2 in Node 1 FDB
3. Unknown C2 (packet flooded around ring)
4. C1 forced aged from Node 1 FDB
5. Looped C2/C1 packet received by Node 1 on P1b
6. C1 erroneously learned on ring port P1b
7. Subsequent packets to C1 loop until stripped



Solution – Source Stripping needs to be invoked based on Local 802.17 station addresses and not transient addresses in FDB.