802.17 Bridging

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Outline

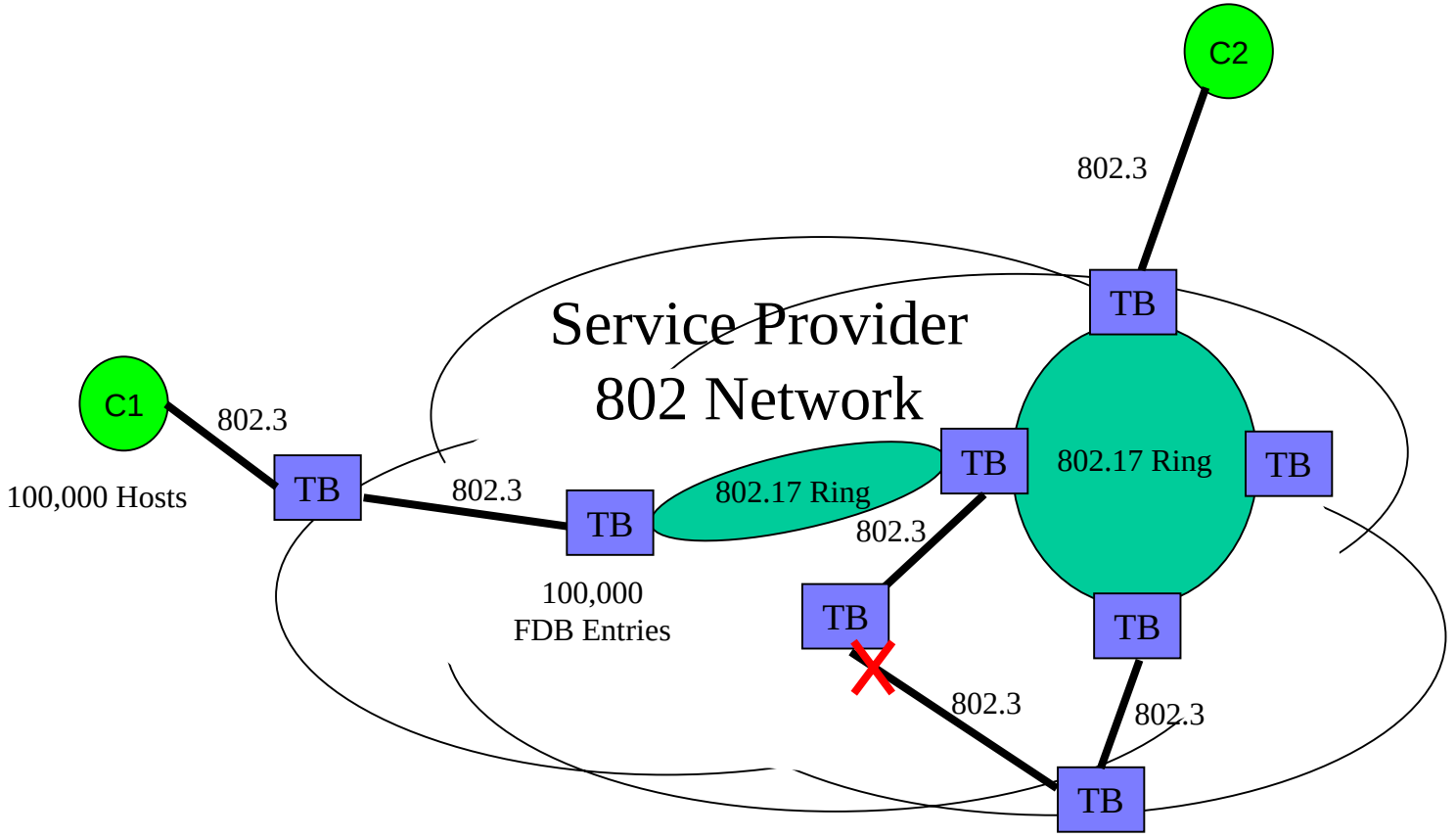
- Transparent / Encapsulation Bridging Paradigms
- Bridging Requirements
- Reference Models
- Transparent Bridging Alternatives
- Packet Walkthrough Examples

Bridging Paradigms

- Transparent Bridging
  - MAC service parameters 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

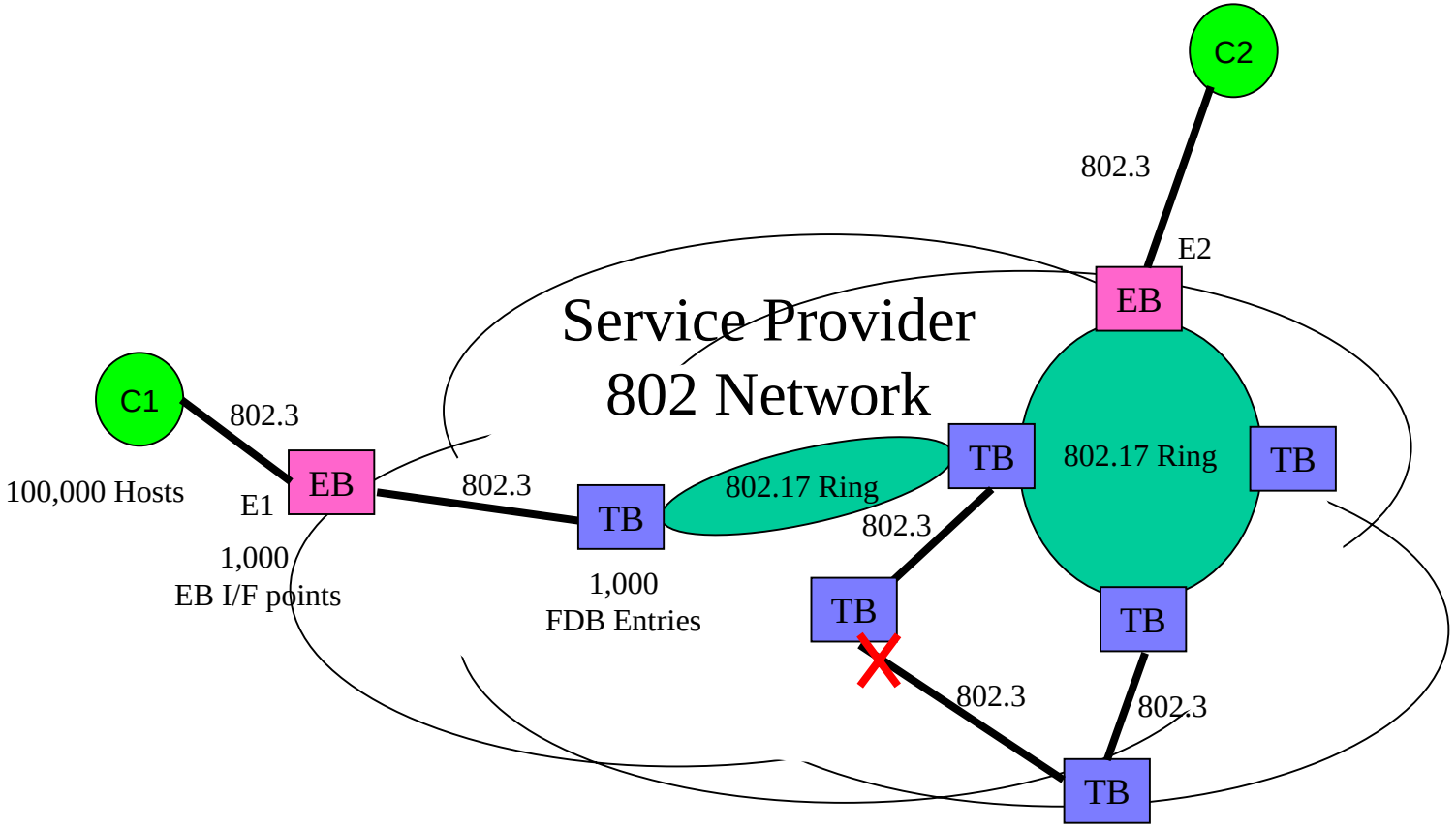
- Encapsulation Bridging
  - MAC service parameters are encapsulated by the MAC bridging relay and require a compatible de-encapsulation function at the terminating bridge. The resulting encapsulated PDU can be transparently bridged across intermediate networks.

Transparent Bridging



C1 / C2 MAC addresses seen across entire Service provider 802 network

Encapsulation Bridging

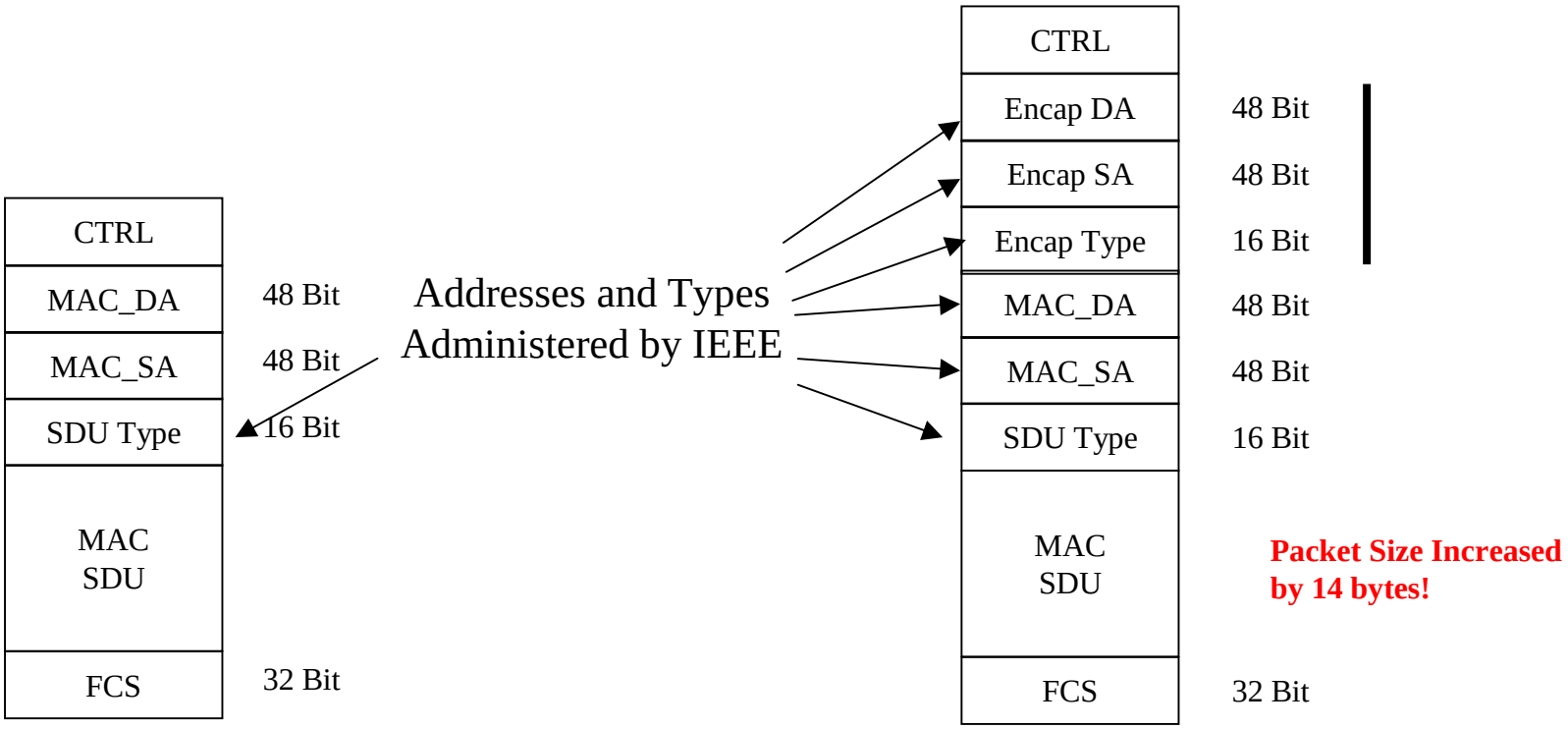


C1 / C2 MAC addresses hidden from service provider 802 network

Transparent & Encapsulated Bridged PDU's

Transparent Bridged PDU

Encapsulated Bridged PDU



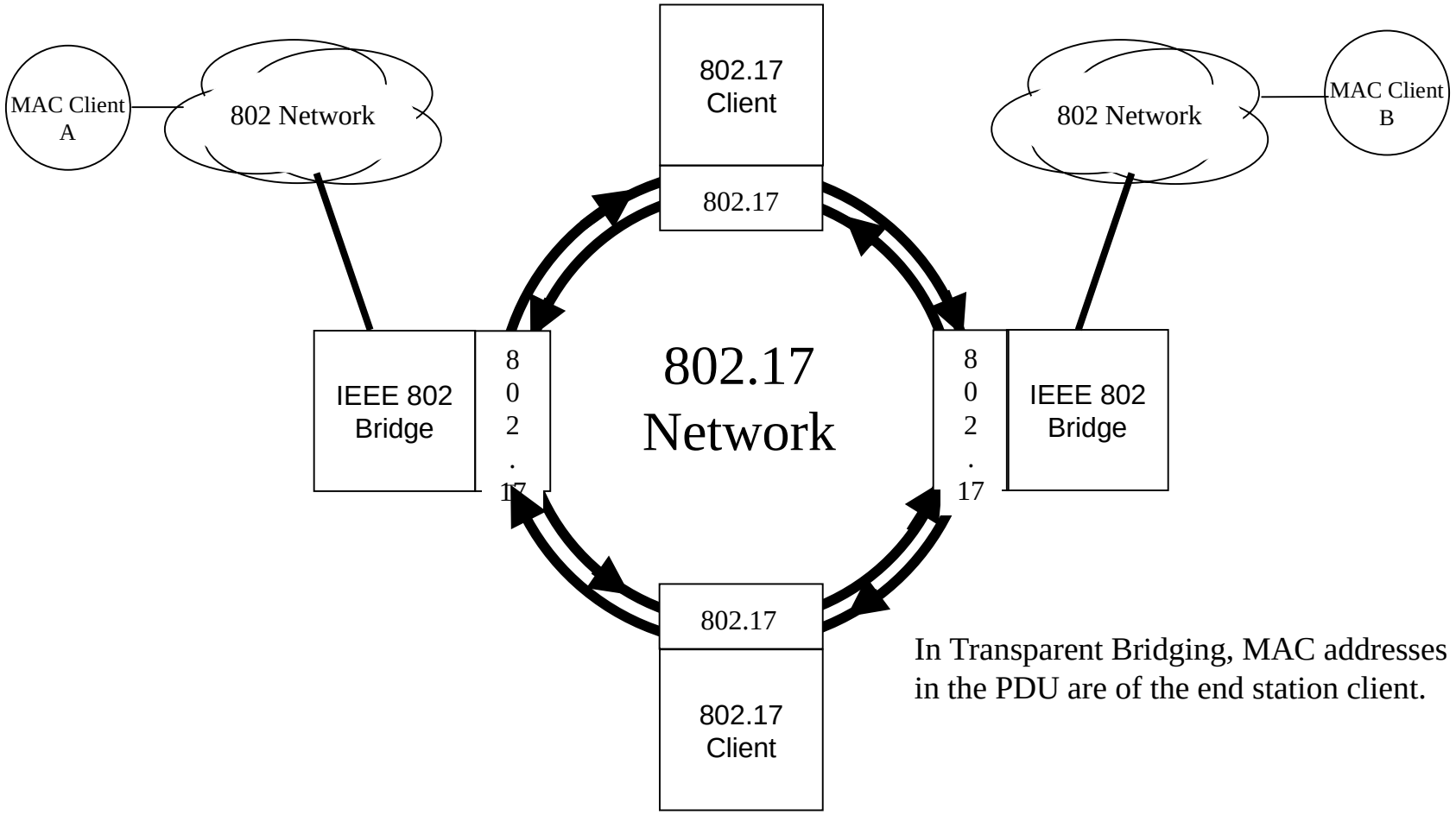
Encapsulated bridged PDU pushes address/type information of transparent bridged PDU into the MAC SDU and is delineated by the encapsulating type

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.

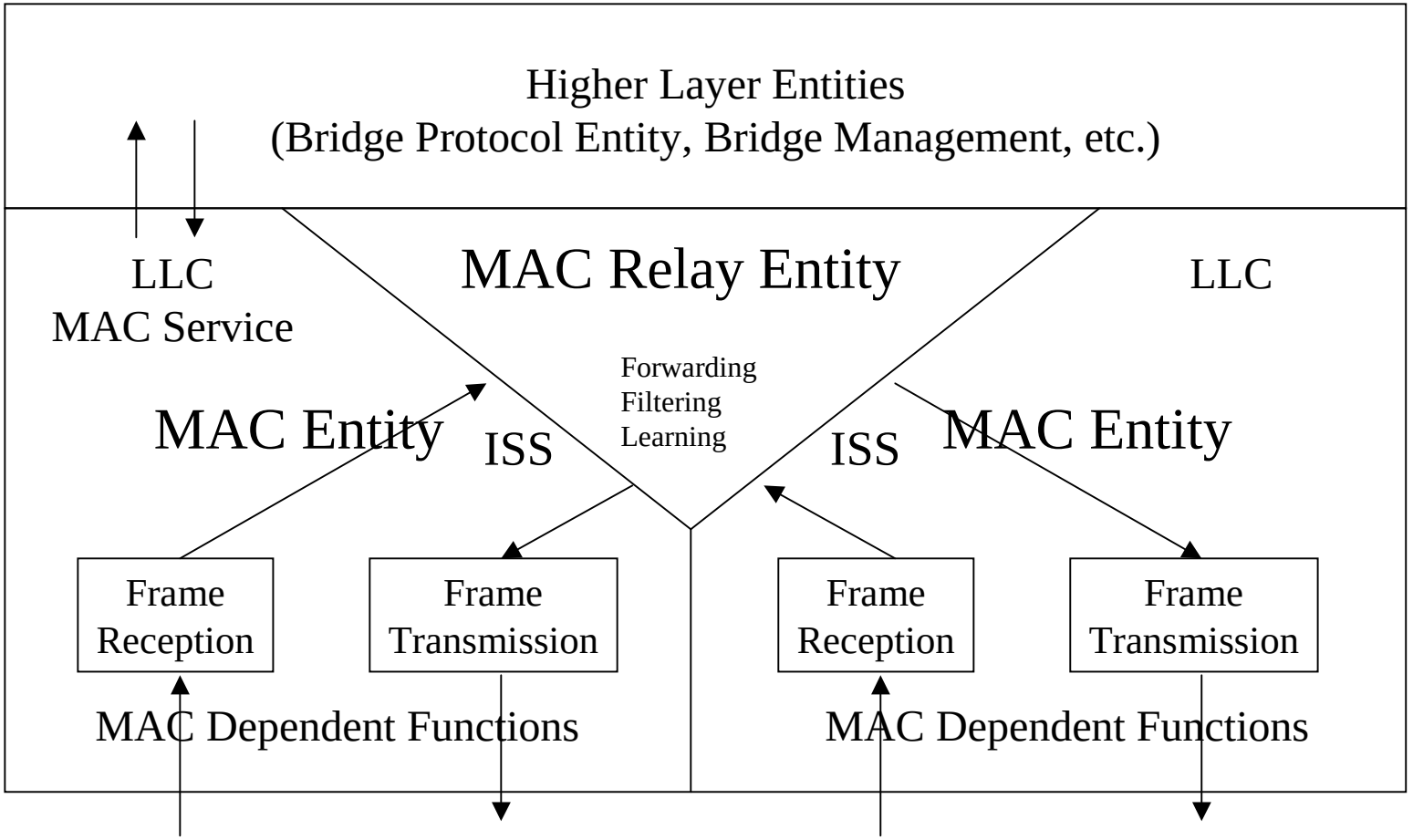
- Spatial Reuse of Unicast Traffic
  - Motion 7 Pass 89/1/4 - Requirement: The MAC shall support destination removal for uni-cast packets during normal operation.

802.17 Bridge Model



In Transparent Bridging, MAC addresses in the PDU are of the end station client.

802.1D MAC Bridge Architecture Model

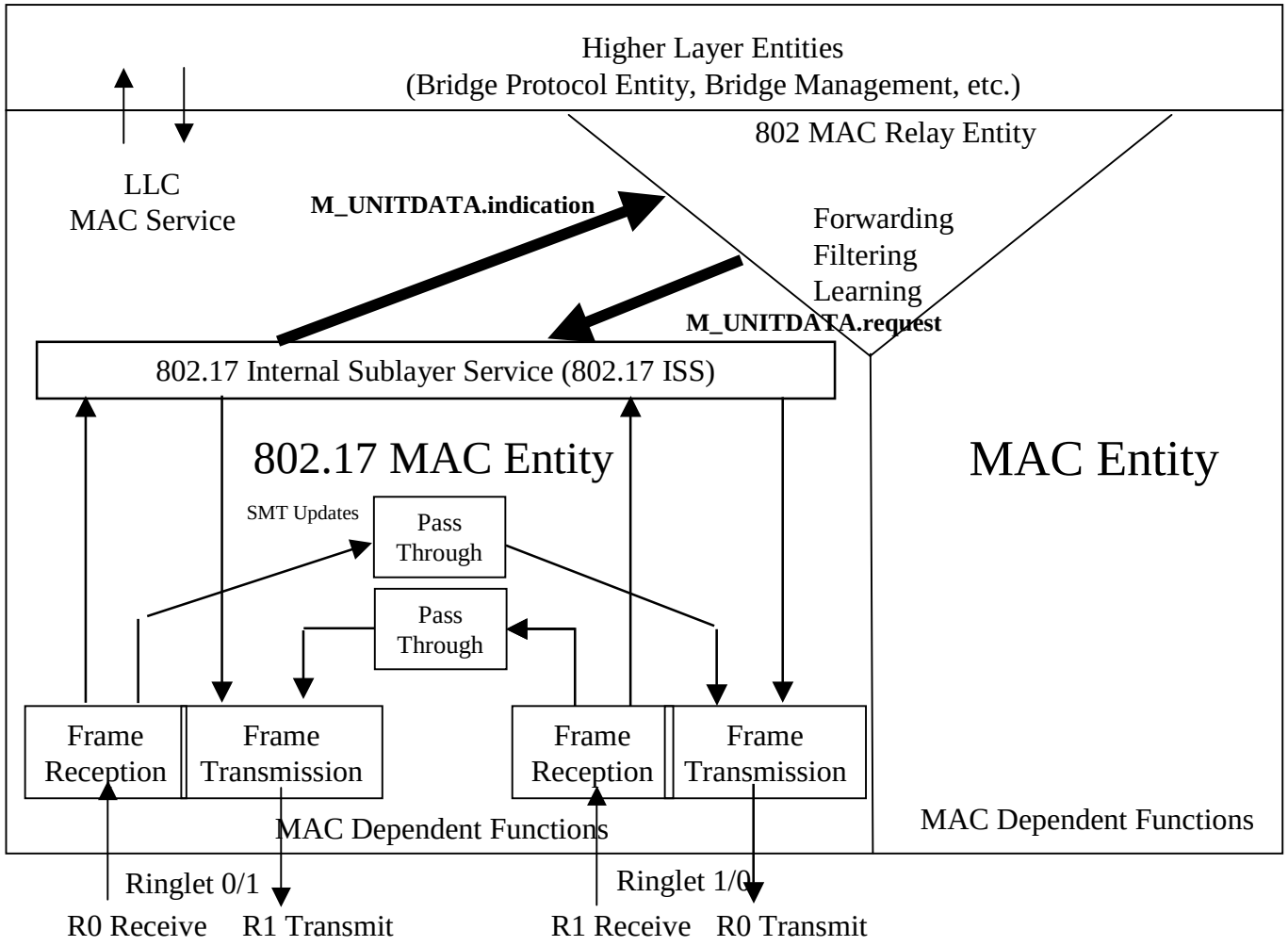


802 / 802.1D Architecture

- Internal Sublayer Service (ISS) conforms to MAC Service definition [IEEE 802.1d/q]
  - The MAC Service provides for the transparent transfer of data between MAC Service users. It makes invisible to these MAC Service users the way in which supporting communications resources are utilized to achieve this transfer, except when the MAC Service provider supports the MAC Service user specifying Routing Information.

- Support of ISS by Specific MAC Procedures [802.1d, 6.5]
  - Includes support by existing MAC (802.3, 802.4, 802.5, FDDI, etc).
  - Tx/Rx data encapsulation/decapsulation of ISS parameters to MAC frame is part of existing procedures.

802.1D/Q MAC Bridge Model w/802.17 MAC



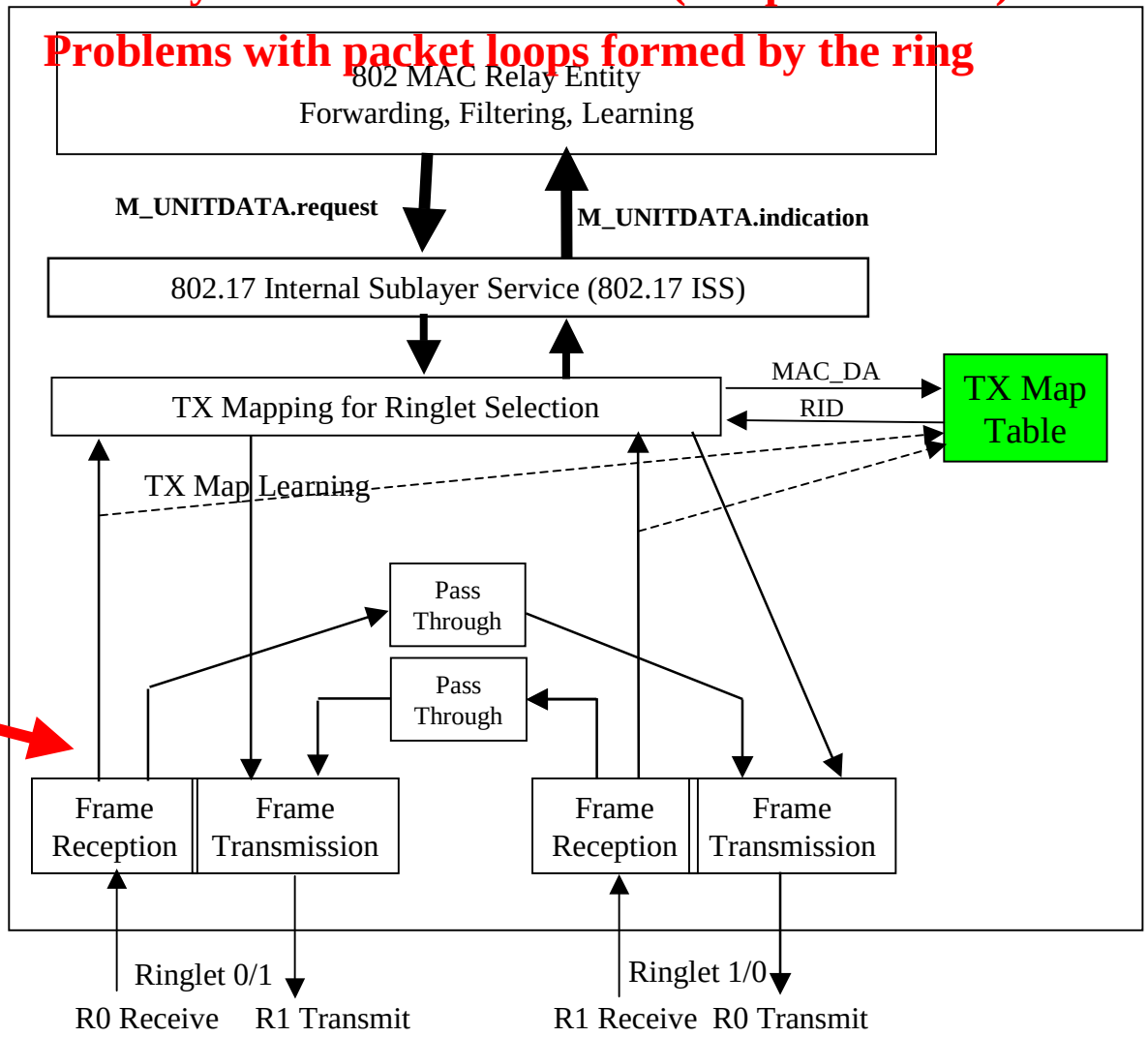
Transparent Bridging Alternatives

- 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)

Problems with packet loops formed by the ring

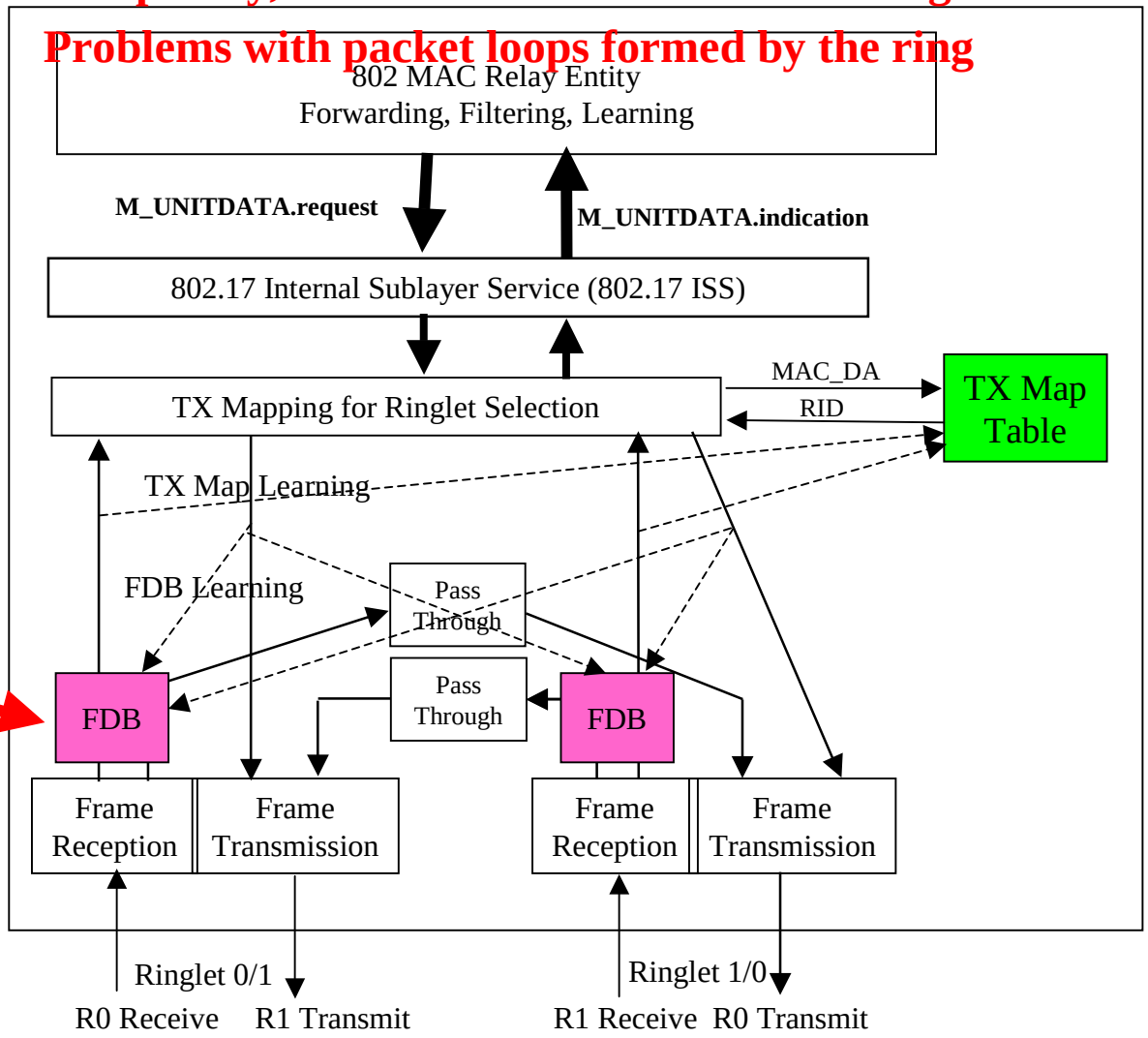


Gratutitous Copy (all received frames copied and no DA/SA strip, TTL strip only)

Transparent Bridging w/ FDB in Pass-through Path

Complexity, Performance Issues w/cut-through

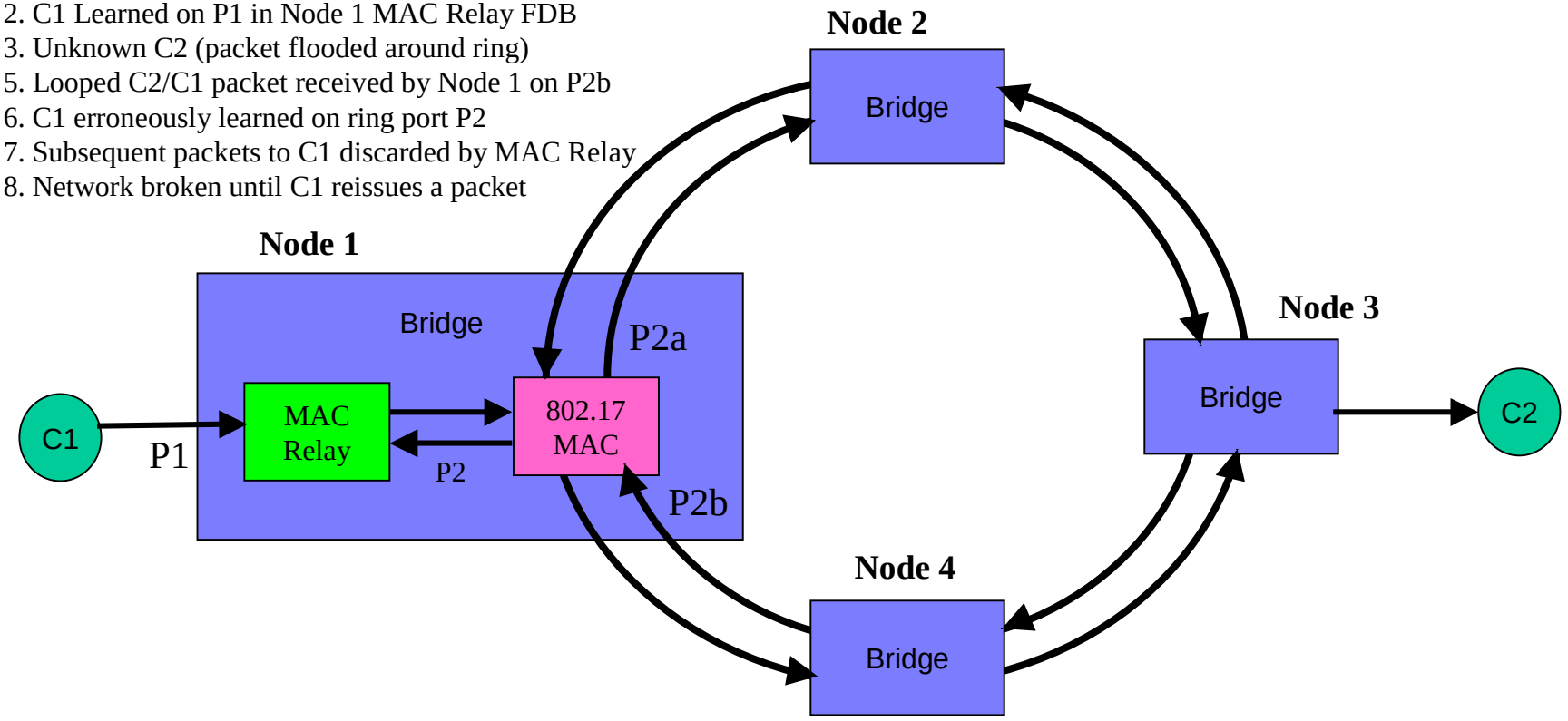
Problems with packet loops formed by the ring



Copy/Strip frames which match in FDB. Copy/no-strip frames which do not match)

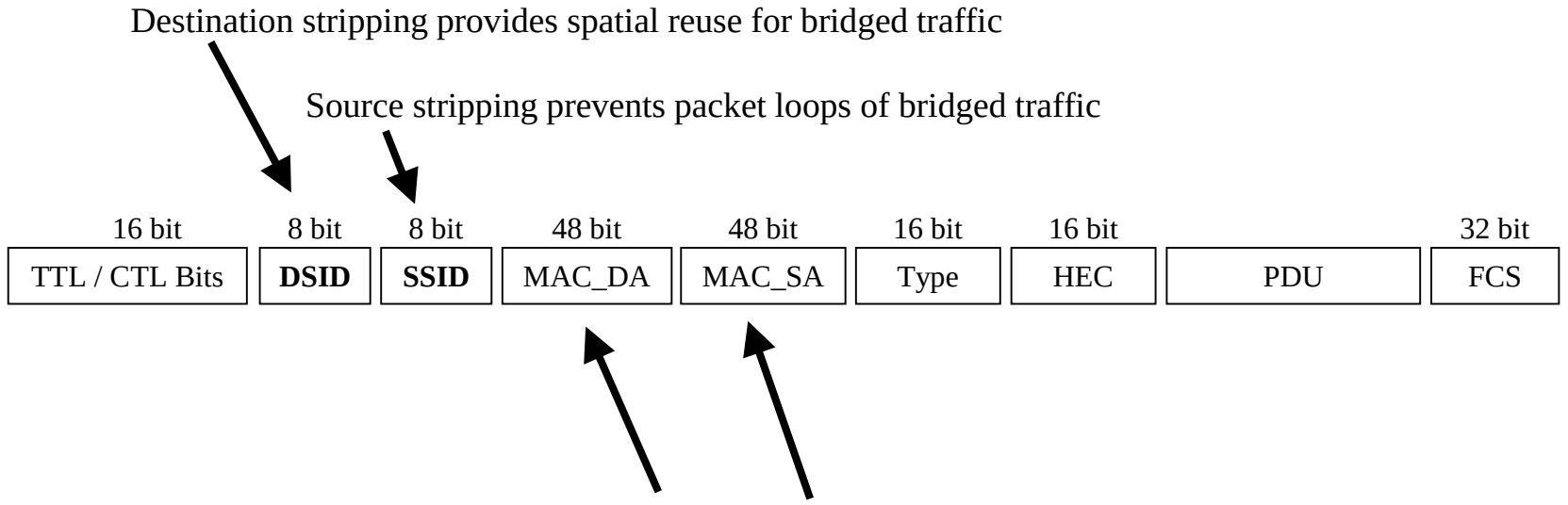
Issue with Packet Looping on Ring Results in Erroneous bridge learning

1. Packet Sent From C1 to C2
2. C1 Learned on P1 in Node 1 MAC Relay FDB
3. Unknown C2 (packet flooded around ring)
5. Looped C2/C1 packet received by Node 1 on P2b
6. C1 erroneously learned on ring port P2
7. Subsequent packets to C1 discarded by MAC Relay
8. Network broken until C1 reissues a packet



Solution – Source stripping ensures looped packets don't adversely affect bridge forwarding tables.

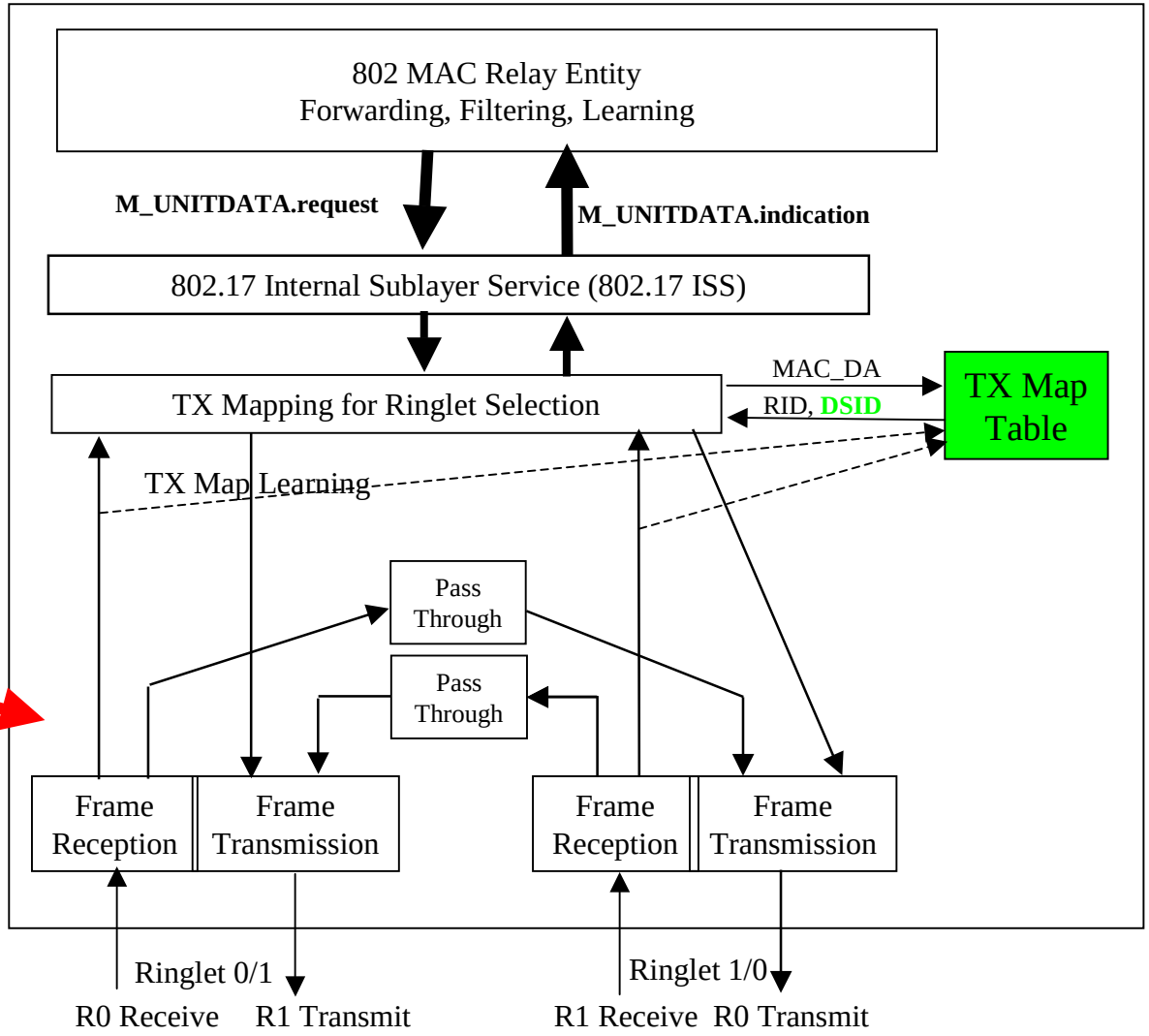
Source / Destination Station ID in 802.17 Frame



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

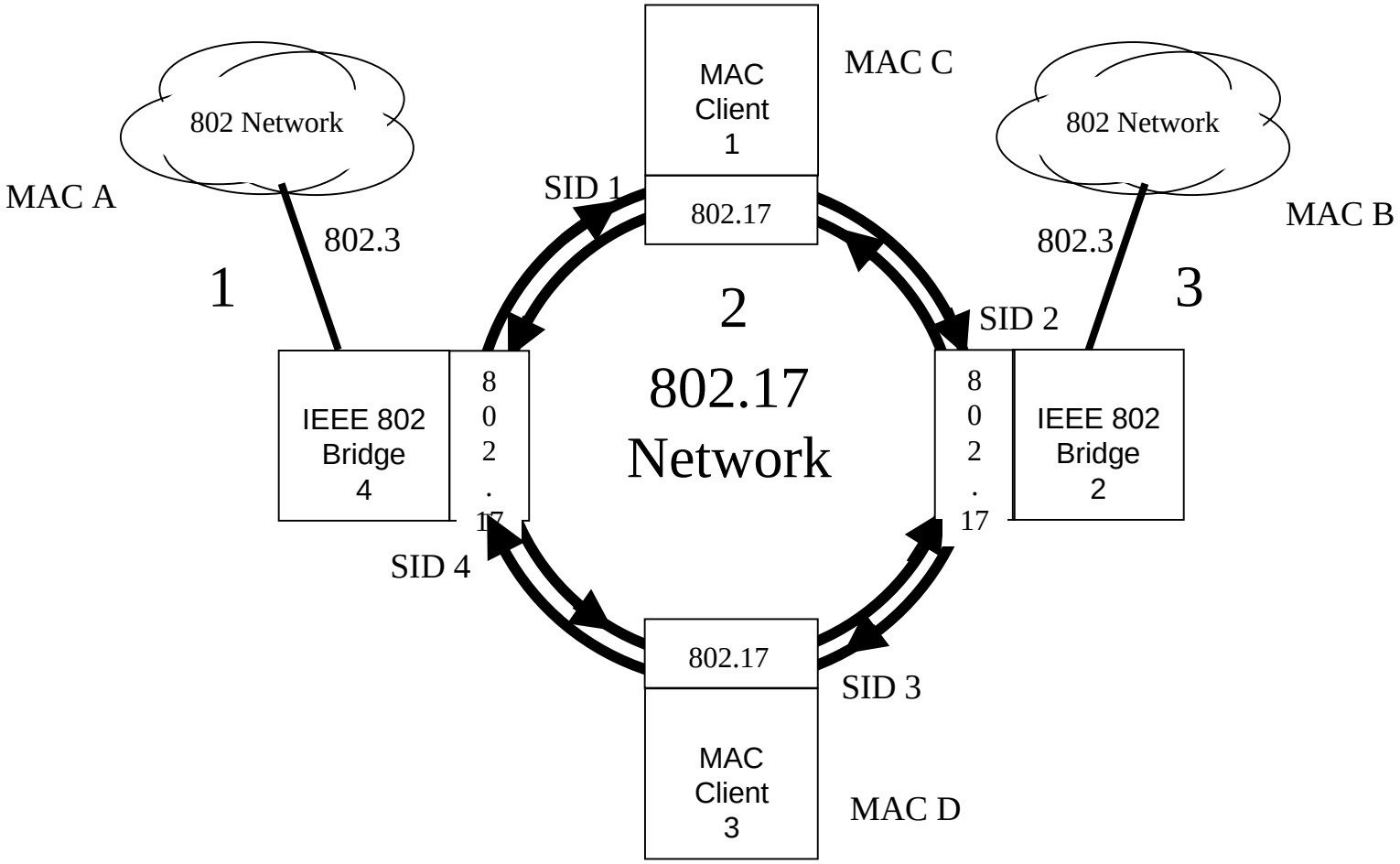
802.17 Clients can still strip frames based on their MAC Address

Transparent Bridging w/ DSID SSID Stripping



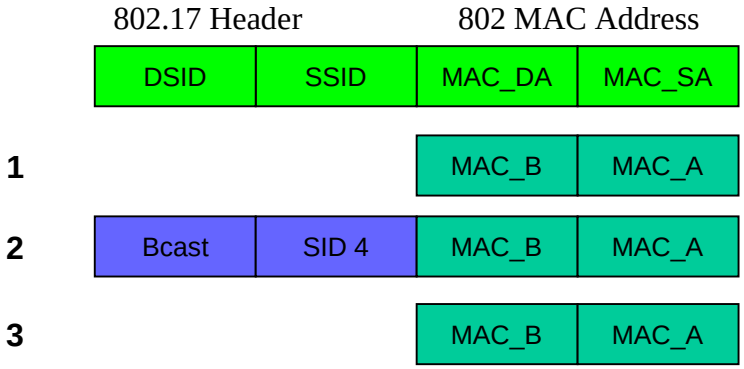
Copy/Strip frames when match on DSID. Pass-through frames which do not match DSID)

Examples – Reference Network

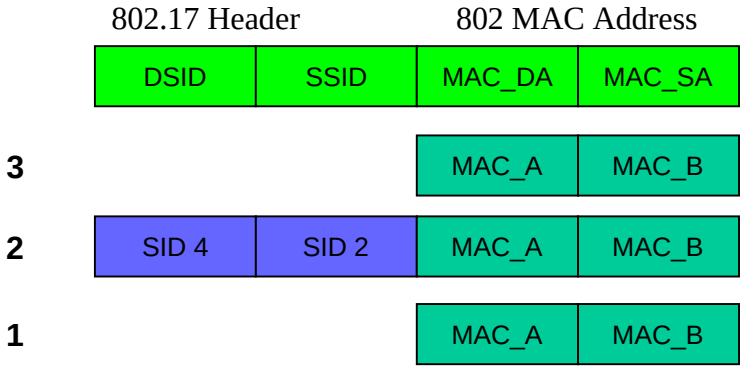


Example 1 – Packet bridged between two 802.3 end stations across 802.17 ring (1 to 3)

Packet from MAC_A to MAC_B



Packet from MAC_B to MAC_A



1. Packet forwarded from MAC_A to station 4

2. 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

3. Packet flooded by station 2 to MAC_B

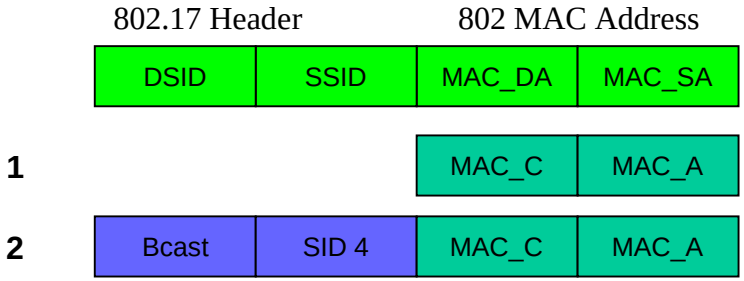
3. Packet forwarded from MAC_B to station 2

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

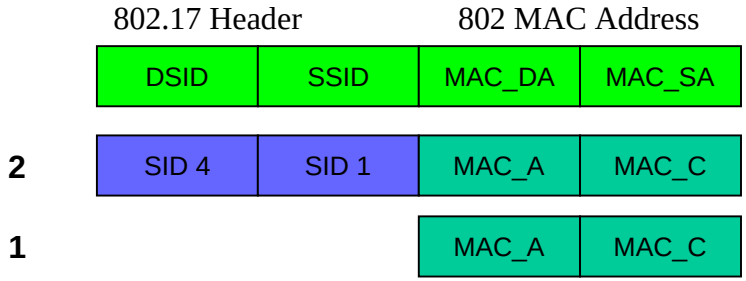
1. Packet forwarded from Station 4 to MAC_A

Example 2 – Packet bridged between 802.3 and 802.17 end stations (1 to 2)

Packet from MAC_A to MAC_C



Packet from MAC_C to MAC_A



1. Packet forwarded from MAC_A to station 4

2. 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 received by station 1 and stripped from the ring
Packet either TTL stripped or source stripped from the ring.

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

1. Packet forwarded from station 4 to MAC_A

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. Spatial reuse would be maintained for client-client, bridge-client flows, and not maintained for client-bridge flows.

Example 3 – Packet forwarded between two 802.17 end stations on same ring (2 to 2)

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

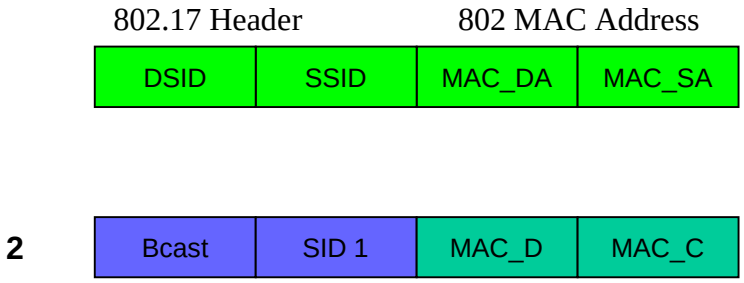
2. MAC_D unknown in Station 1 mapping table
Packet Flooded to all Stations on Ring.
All bridges would copy the packet up to their bridging Entity.
Bridging entity would discard the packet if it determines
MAC_C & MAC_D are learned on the same port.
SID 1 / MAC_C learned in Station 2,4 mapping table.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

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

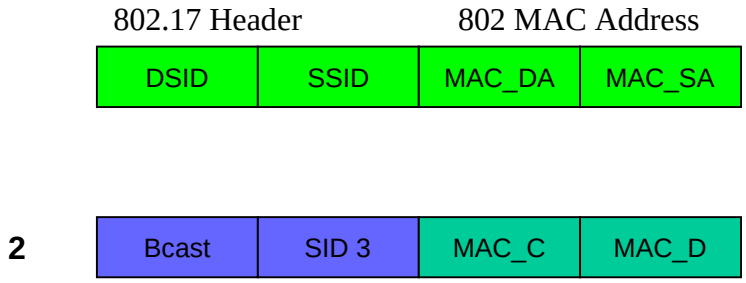
Example 4 – Packet forwarded between two 802.17 end stations on same ring (2 to 2)

802.17 Client Stations not required to implement TX Mapping Table

Packet from MAC_C to MAC_D



Packet from MAC_D to MAC_C



2. 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.

2. 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/bridge-client flows.

Distribution of Station ID's

- Masterless distributed algorithm part of topology discovery/update.
  - Every RPR Station maintains a unique 48-bit MAC address
  - During Topology discovery or topology updates, 48-bit unique station MAC addresses are used by the algorithm 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 shall 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).

Conclusions

- DSID/SSID optimizes transparent bridging across ring media
- Reduces transparent bridging overhead by 12 bytes vs. full 14byte encapsulation header
- Do not have to standardize .1d in .1d type field with 802
- Does not preclude adding encapsulation bridging for network scaleability
- DSID optional for routers/clients directly attached to ring
- Masterless topology discovery algorithm performs unique station ID assignment for plug-play

Thank You!