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# Encapsulation Bridging and 802.17

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# Outline

- 802.17 Bridging
- 802.17 Compatibility Requirements
- 802.1D Bridging Architecture Model
- 802.17 MAC Model
- 802.17 Bridging Alternatives
- Transparent Bridging
- Issues with Bridging in MAC Entity
- Encapsulation Bridging
- Bridging between 802.3 and 802.17 End Stations
- Conclusions

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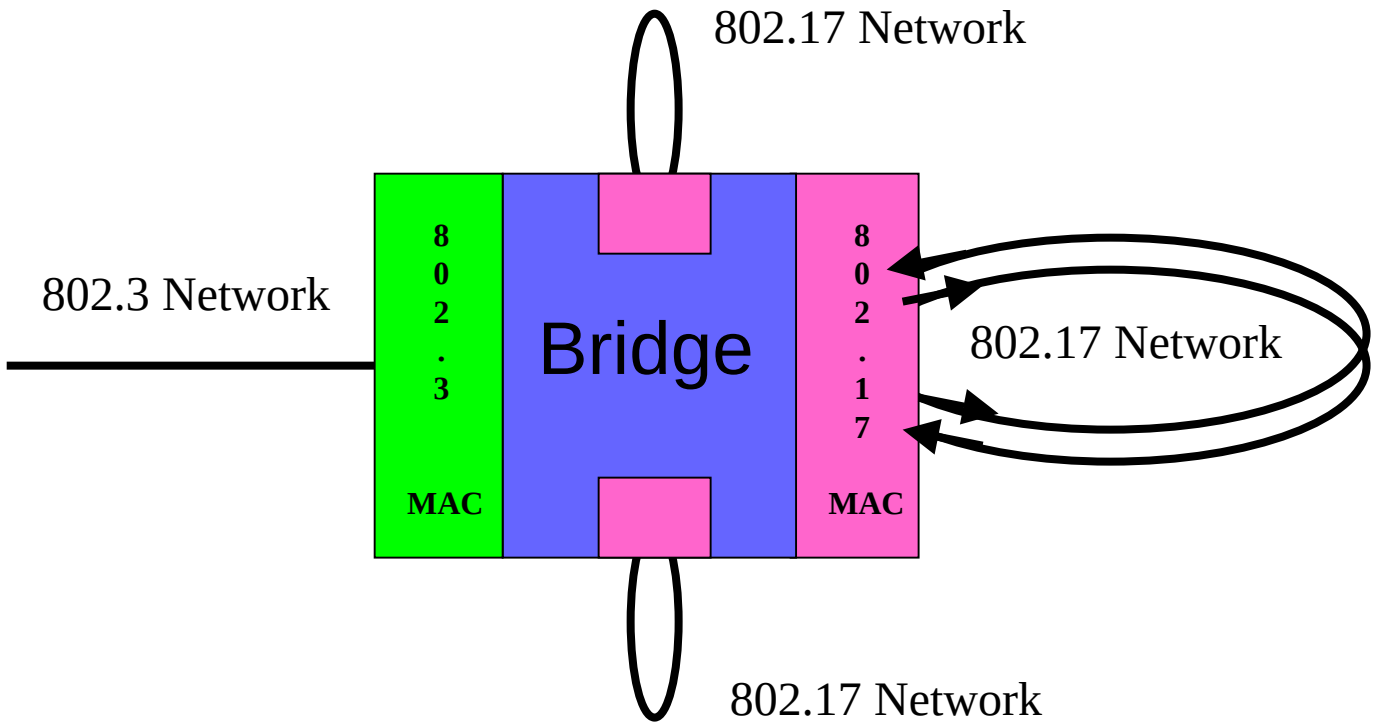
# 802.17 Bridging



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# Bridging Compatibility Requirements (excerpt from 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.

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# 802 Architecture

- IEEE 802.1D Standard - Media Access Control Bridges (**Scope**)
  - Specifies an architecture and protocol for the interconnection of IEEE 802 LANs below the MAC Service boundary
  - Interconnection of stations of different MAC types
  - Positions the bridging function within an architectural description of the MAC Sublayer

** Note – Internal model of operation is intended for describing the functionality and not intended to contsrain real implementations of a MAC bridge; these may adopt any internal model of operation compatible with externally visible behavior the standard specifies.

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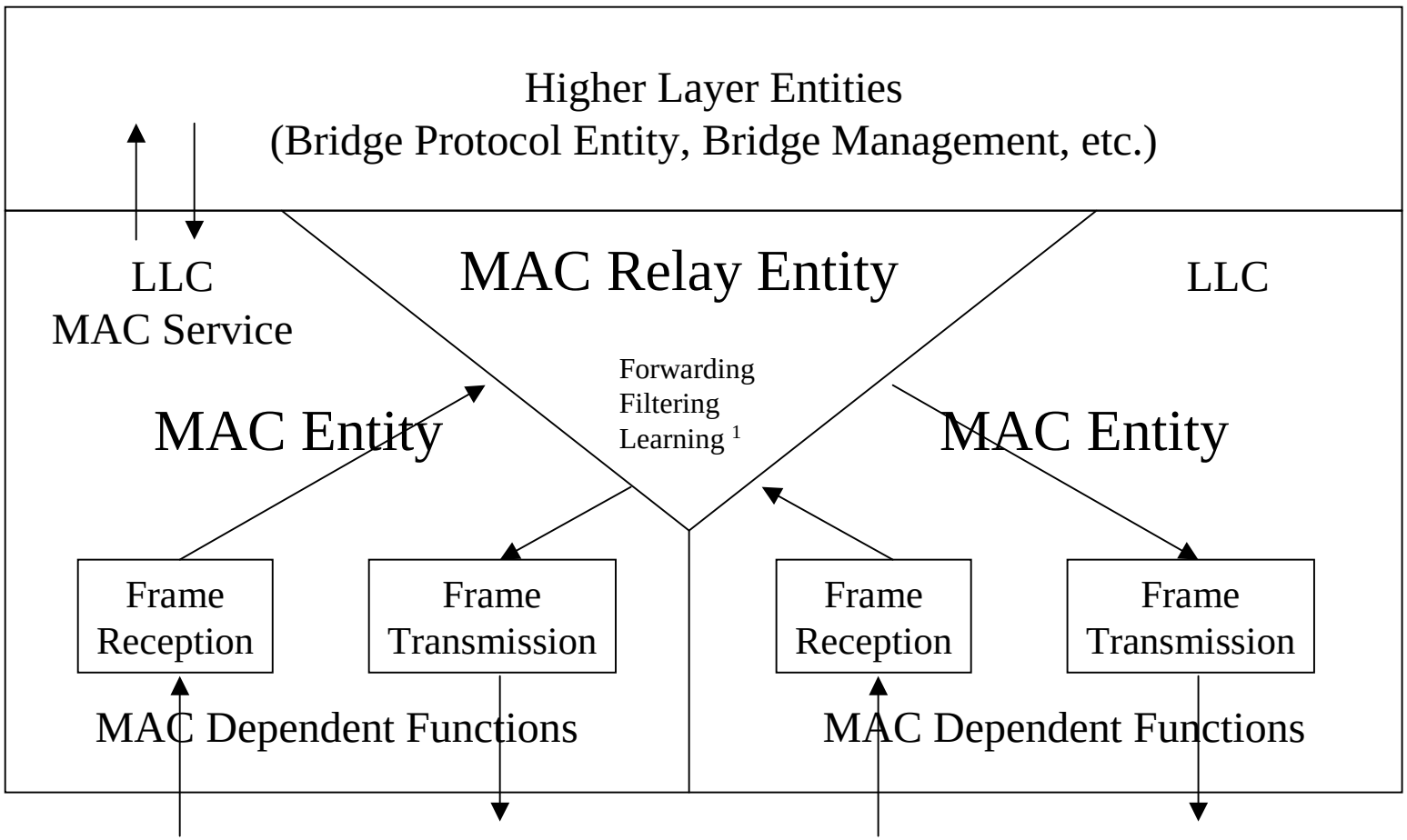
# 802.1D Bridge Architecture Model




1. Internal Sublayer Service

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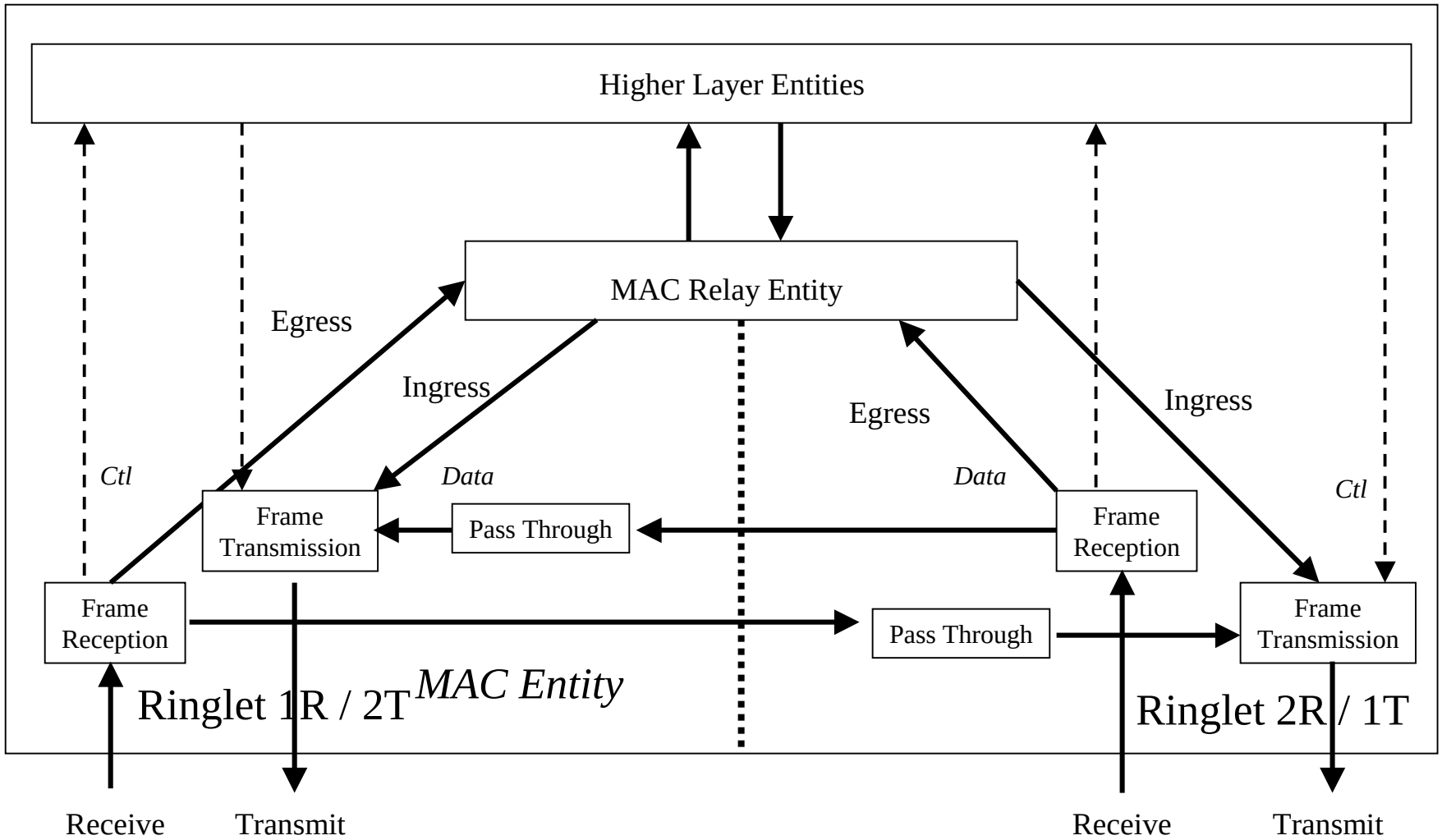
# 802.17 MAC Model



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# Bridging Presentations from July Meeting

- Bridging over RPR (ga_tbridg_01.pdf) – Kao, Aybay, Uzun
  - **Recommend** Encapsulation Bridging is simplest solution for RPR
  - Encapsulation Bridging function done in the MAC Relay Entity
- Bridging Packet Walkthroughs (hp_brdg_02.pdf) – Hui, Peng, Bassias
  - Transparent/Single/Double Encapsulation Bridging
  - Transparent – Bridging done in MAC Entity
  - Single – Bridging done in the MAC Entity
  - Double – Bridging done in the MAC Relay Entity (**Recommended**)
  - Ethernet Service with Encapsulated Bridge – Bridging done in the MAC Relay Entity

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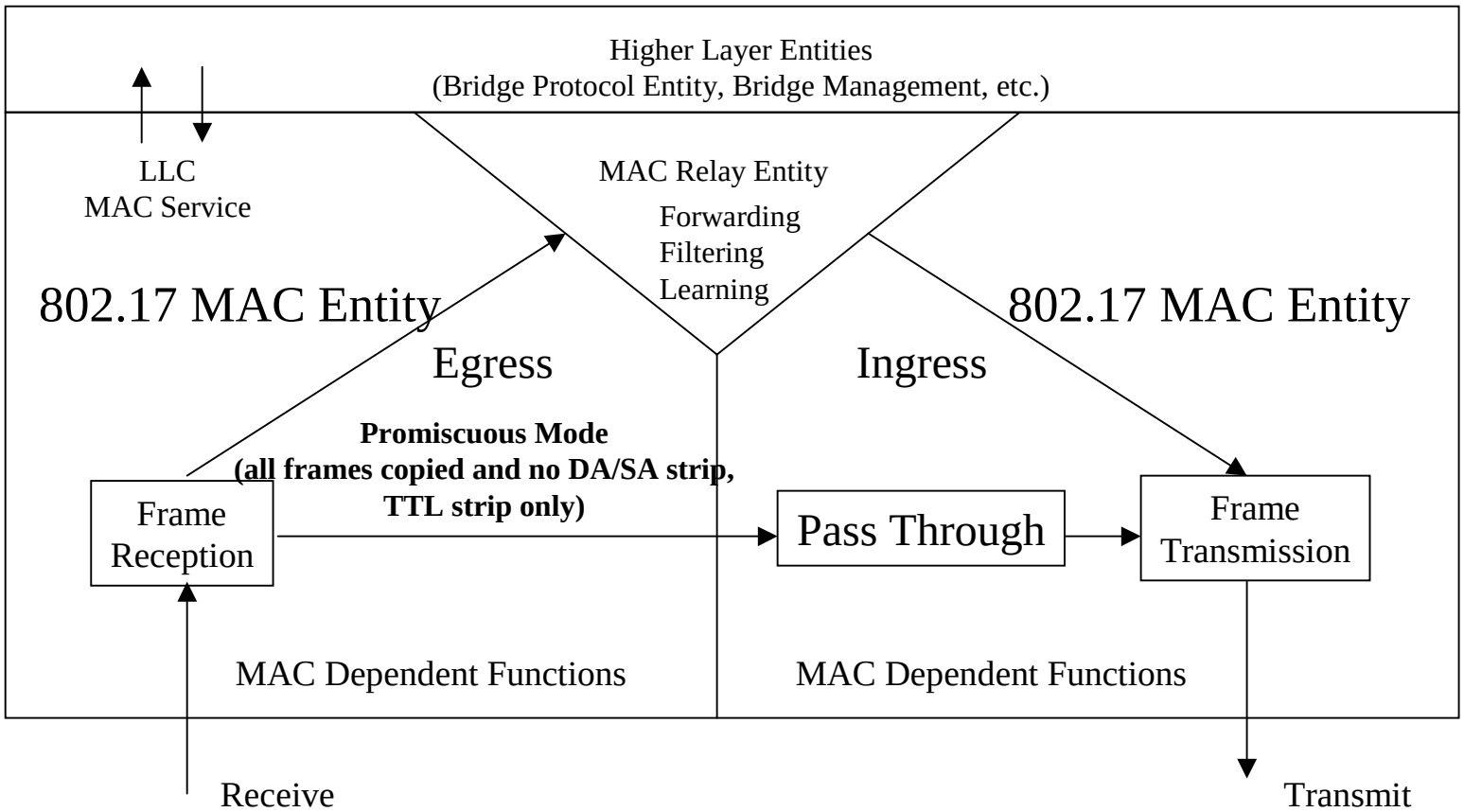
# 802.17 Bridging Alternatives

- Bridging in the MAC Entity or MAC Relay?
  - Defines whether 802.17 MACd/MACs header addresses are “on-ring” only or can be “off-ring”.
- What are the implications of different bridging models?
  - Transparent Bridging (Bridge FDB in MAC Relay – Promiscuous mode).
  - Transparent Bridging (Bridge FDB in the MAC Entity)
  - Encapsulation Bridging (Bridge FDB in MAC Entity)
  - Encapsulation Bridging (Bridge FDB in MAC Relay)
- How to handle bridging between 802.17 and 802.1 end stations?

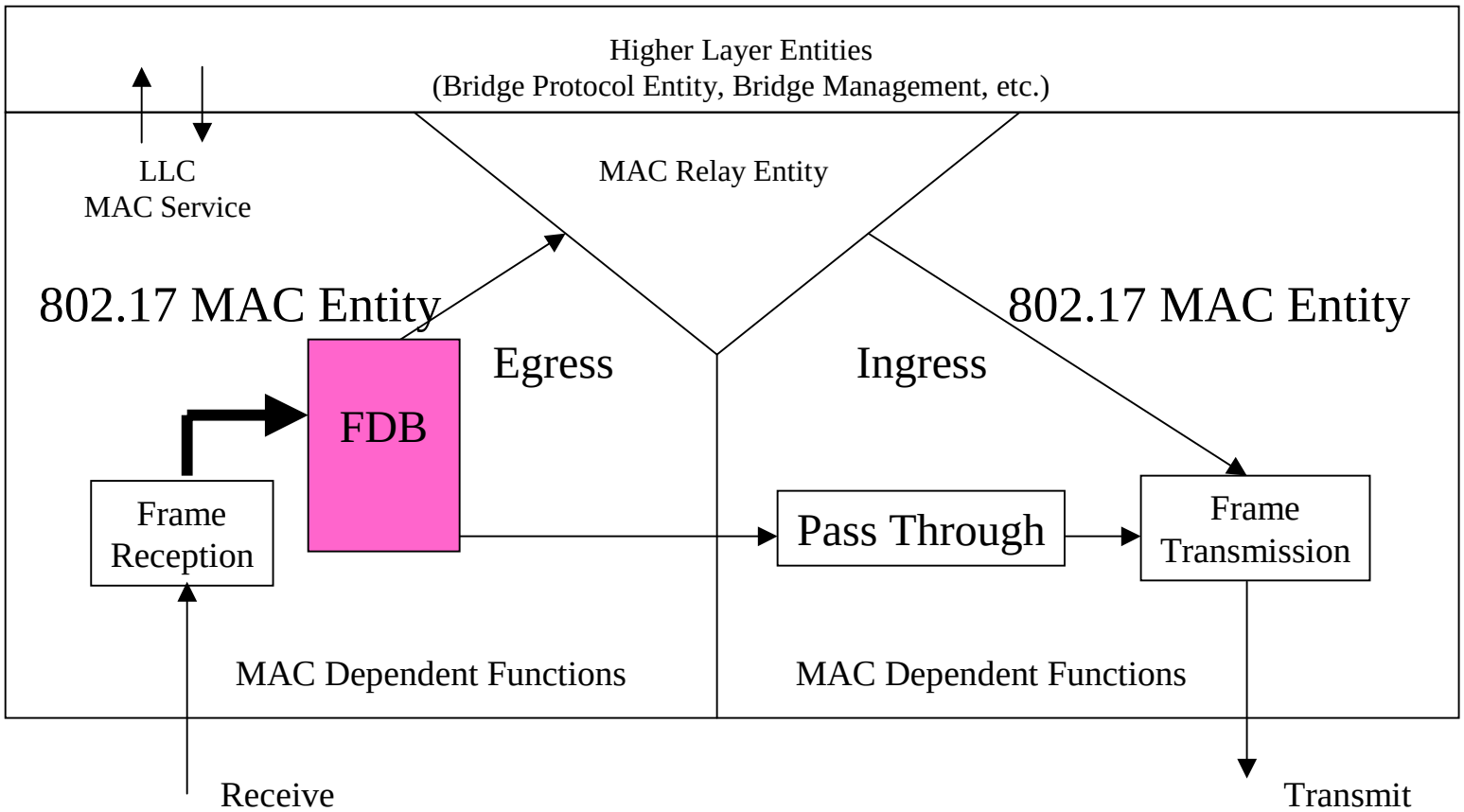
# Transparent Bridging with Promiscuous Mode

Extremely Bandwidth Inefficient (no spatial reuse)
Problems with packet loops formed by the ring



# Transparent Bridging w/FDB in MAC Entity

Significant Complexity, Not Scaleable, Not always Required, Problems due to Forced Aging!!



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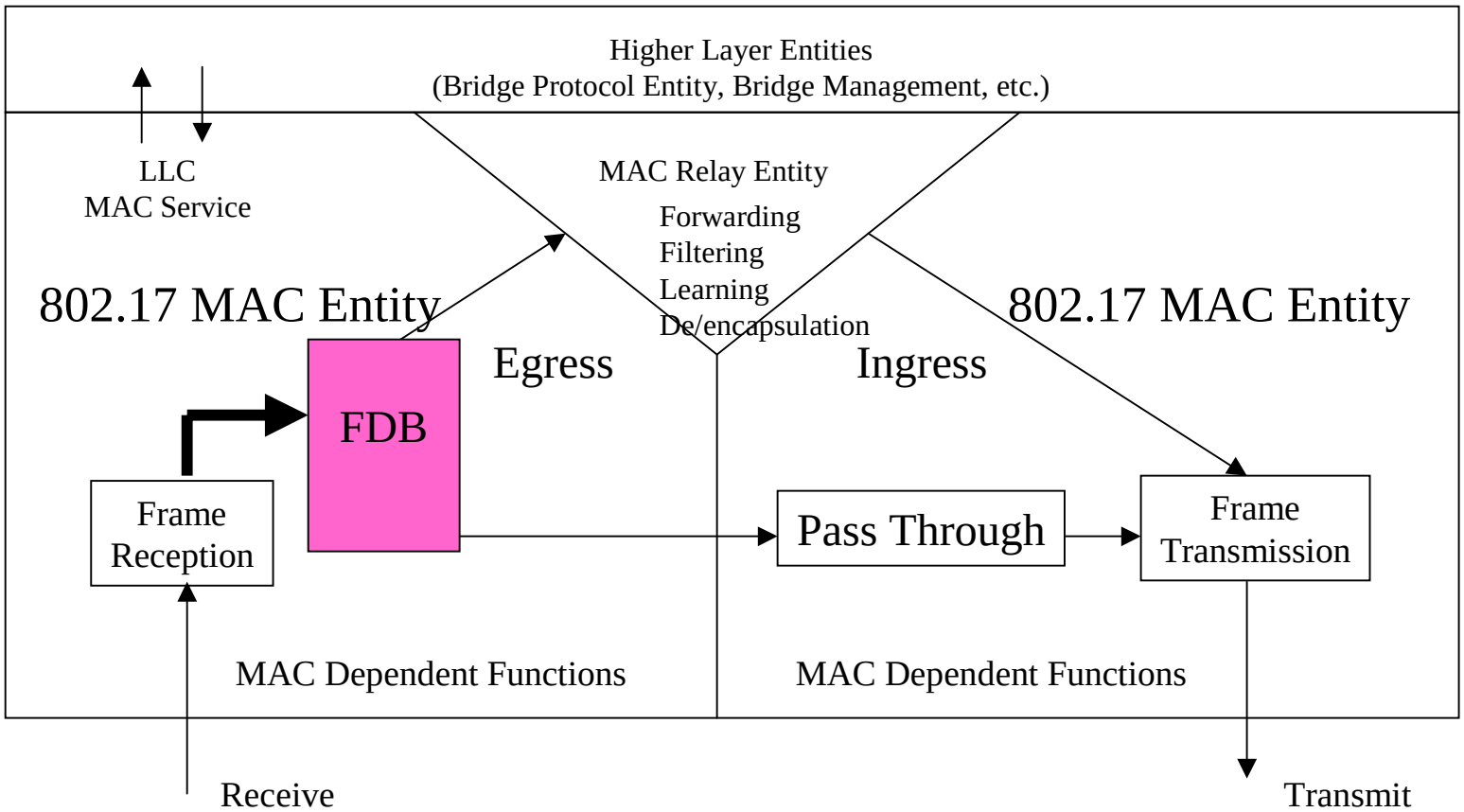
# Encapsulation Bridging w/FDB in MAC Entity

Issues same as identified w/transparent bridging, additional complexity and overhead of encapsulation



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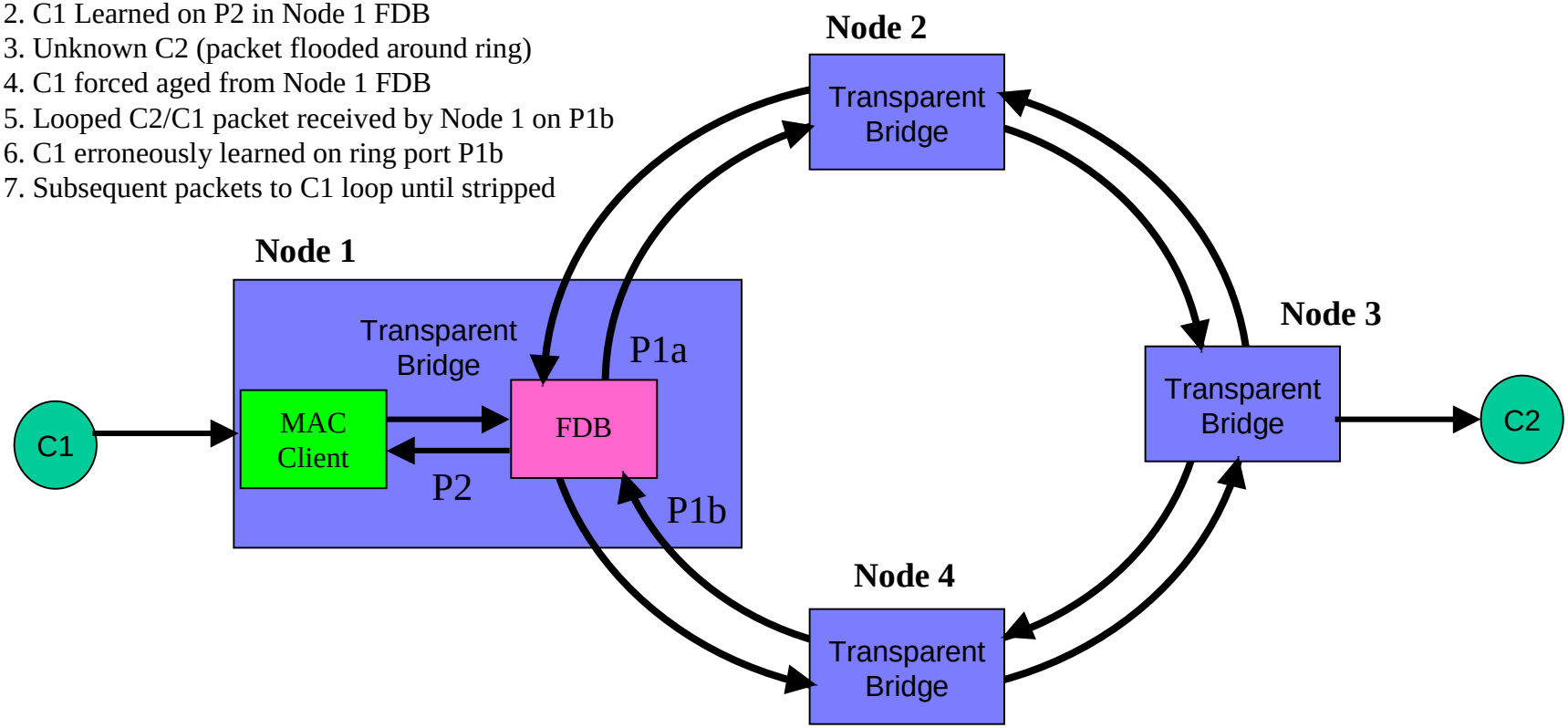
# Issues with FDB in MAC Entity
# Erroneous learning during forced aging

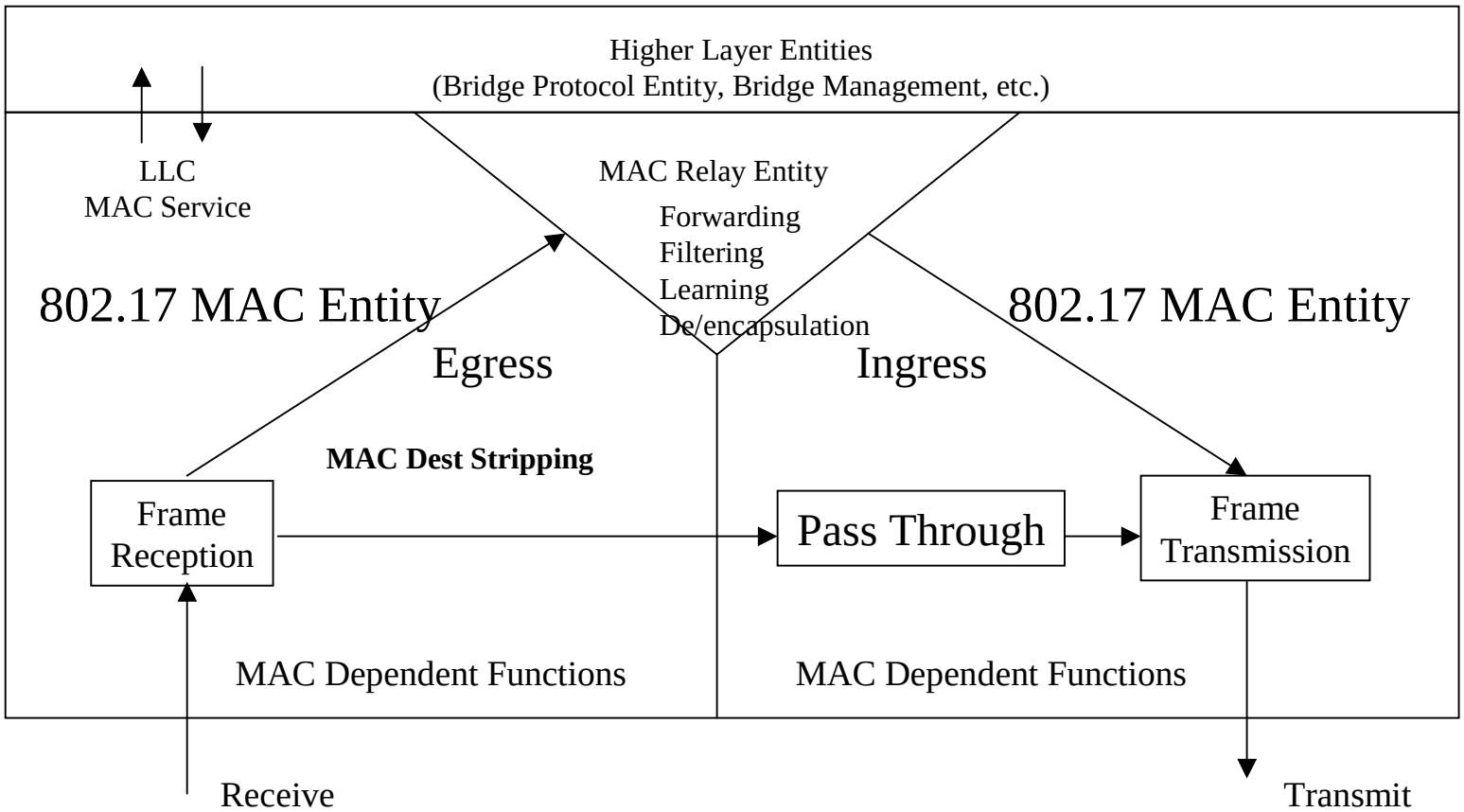
1. Packet Sent From C1 to C2
2. C1 Learned on P2 in Node 1 FDB
3. Unknown C2 (packet flooded around ring)
4. C1 forced aged from Node 1 FDB
5. Looped C2/C1 packet received by Node 1 on P1b
6. C1 erroneously learned on ring port P1b
7. Subsequent packets to C1 loop until stripped




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

# Encapsulation Bridging with FDB in MAC Relay

## Addresses Transparent Bridging Issues
## Bridging Complexity located in the MAC Relay



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# Encapsulation Bridging in MAC Relay /1

- Encapsulation bridging is performed in the MAC Relay function.
- RPR Station MAC addresses are local to an 802.17 ring
  - The MAC entity copies frames to the upper layer based on either an exact match of frame's $MAC_D$ with the receiving 802.17 station's MAC address and all broadcast/multicast frames.
  - Frames where $MAC_D$ is not the receiving station's MAC address are not stripped and passed through to the ringlet transmitter. (provided TTL has not expired or $MAC_S$ = receiving 802.17 station address, otherwise frame is stripped and discarded)
  - A single 802.17 station's MAC address is not propagated in the 802.17 header across multiple rings.

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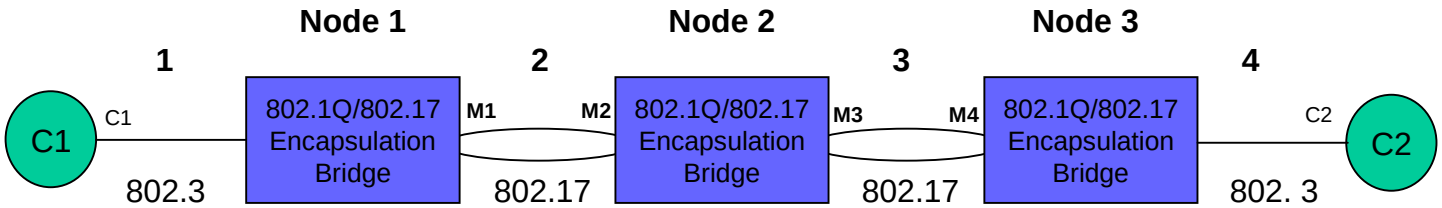
# Encapsulation Bridging in MAC Relay /2

- Egress Path Processing
  - Receive frames are copied/stripped or copied/not-stripped based on the above addressing rules.
  - RPR MAC addresses are de-encapsulated by MAC relay entity. RPR $MAC_S$ is learned and bound to Client $MAC_S$ in the FDB.
  - Client $MAC_D$ is looked up in the FDB to determine destination interface. If known, RPR $MAC_D$ from FDB is added to the RPR encapsulation header, and unicast to the destination interface. If unknown, the packet is flooded to all interfaces (except ringlets associated with incoming ring interface).
  - The source station's MAC address is added to $MAC_S$ of the RPR encapsulation header.
- Ingress Path Processing
  - MAC relay entity adds the RPR interface MAC address to the frame's MACs in the RPR encapsulation header.

# Encapsulation Bridging over RPR - Example




**Packet from C1 to C2**

Encapsulation Header

| | RPR DA | RPR SA | 802.3 DA | 802.3SA |
|---|---|---|---|---|
| 1 | | | C2 | C1 |
| 2 | Bcast | M1 | C2 | C1 |
| 3 | Bcast | M3 | C2 | C1 |
| 4 | | | C2 | C1 |

**Packet from C2 to C1**

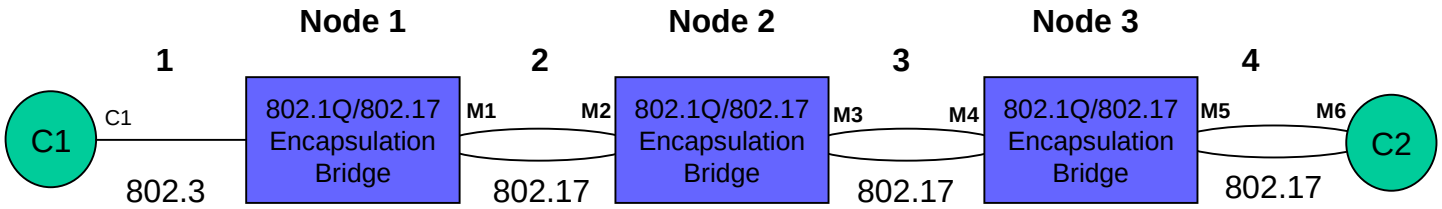
Encapsulation Header

| | RPR DA | RPR SA | 802.3 DA | 802.3 SA |
|---|---|---|---|---|
| 4 | | | C1 | C2 |
| 3 | M3 | M4 | C1 | C2 |
| 2 | M1 | M2 | C1 | C2 |
| 1 | | | C1 | C2 |

Bridge Table at Node 2
C1 learned RPR DA/SA – M2/M1
C2 Unknown

Bridge Table at Node 2
C1 – RPR DA/SA - M2/M1
C2 – learned RPR DA/SA – M3/M4

# Bridging between 802.3 and 802.17 End Stations




**Packet from C1 to C2**

Encapsulation Header

| | RPR DA | RPR SA | 802.3 DA | 802.3 SA |
|---|---|---|---|---|
| 1 | | | C2 | C1 |
| 2 | Bcast | M1 | C2 | C1 |
| 3 | Bcast | M3 | C2 | C1 |
| 4 | Bcast | M5 | C2 | C1 |

**Packet from C2 to C1**

Encapsulation Header

| | RPR DA | RPR SA | 802.3 DA | 802.3 SA |
|---|---|---|---|---|
| 4 | M5 | M6 | C1 | C2 |
| 3 | M3 | M4 | C1 | C2 |
| 2 | M1 | M2 | C1 | C2 |
| 1 | | | C1 | C2 |

Bridge Table at Node 2
C1 learned RPR DA/SA – M2/M1
C2 Unknown

Bridge Table at Node 2
C1 – RPR DA/SA – M2/M1
C2 – learned RPR DA/SA – M3/M4

# Conclusions

- Encapsulation Bridging allows bridging function to be performed outside the 802.17 MAC Entity
  - Compatible with 802 architecture, 802.1D, and 802.1q
  - Supports bridging of 802.3 frames over 802.17
  - Supports bridging between 802.3 and 802.17 end stations
  - 802.17 header addresses do not extend beyond the local ring
  - Simplifies MAC definition and implementation
  - Single encapsulation header is sufficient, no need for a double