802.17 Bridging

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Outline

- Bridging Requirements
- Simple Bridging
- Bridging with Destination Stripping
- Reference Models
- Common Frame Format / TX/RX Procedures
- Interoperability Examples
- Flooding Issues
- Why DSID/SSID is important to 802.17
- Recommendations
- References

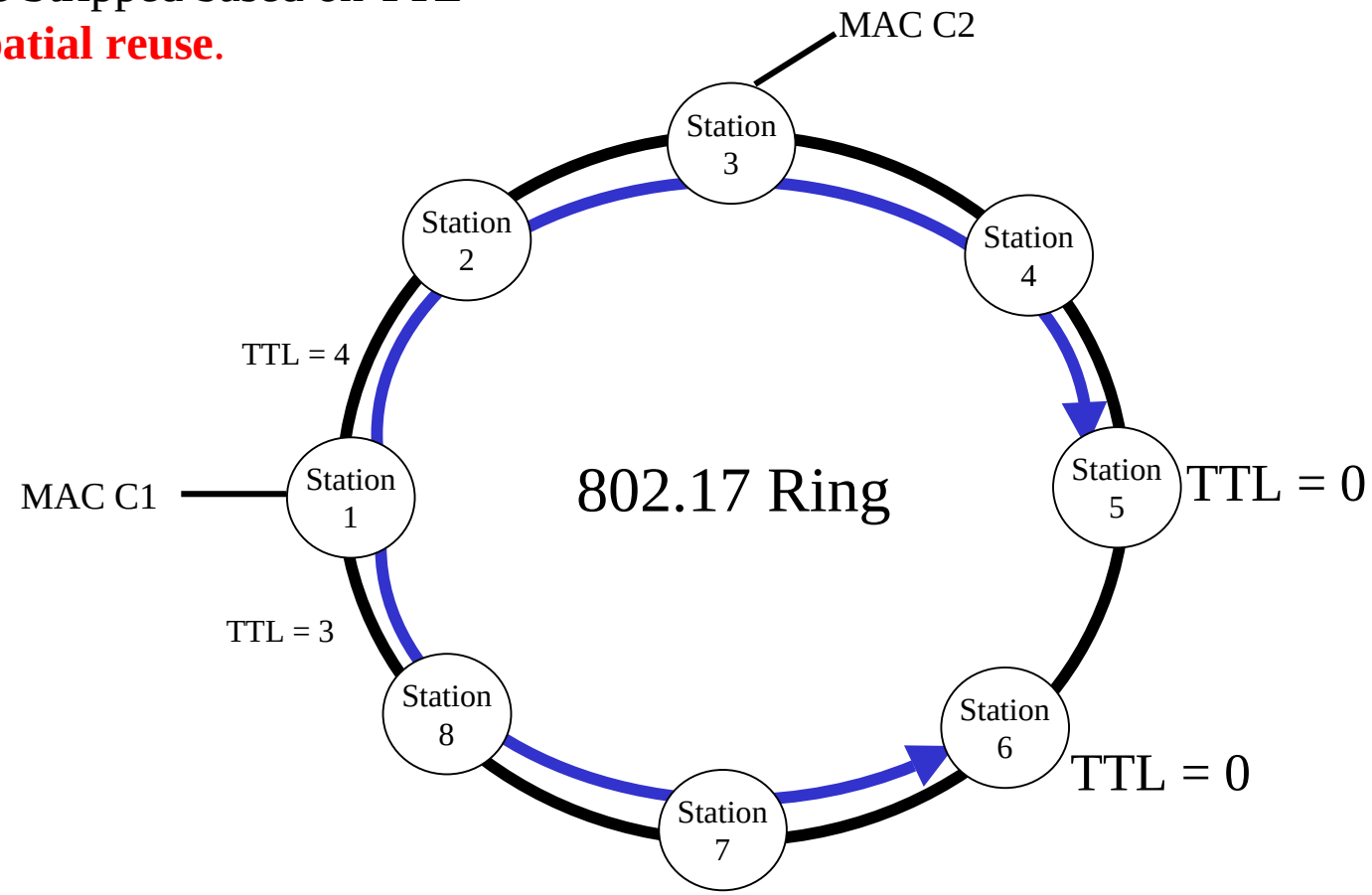
Bridging Requirements

- 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.

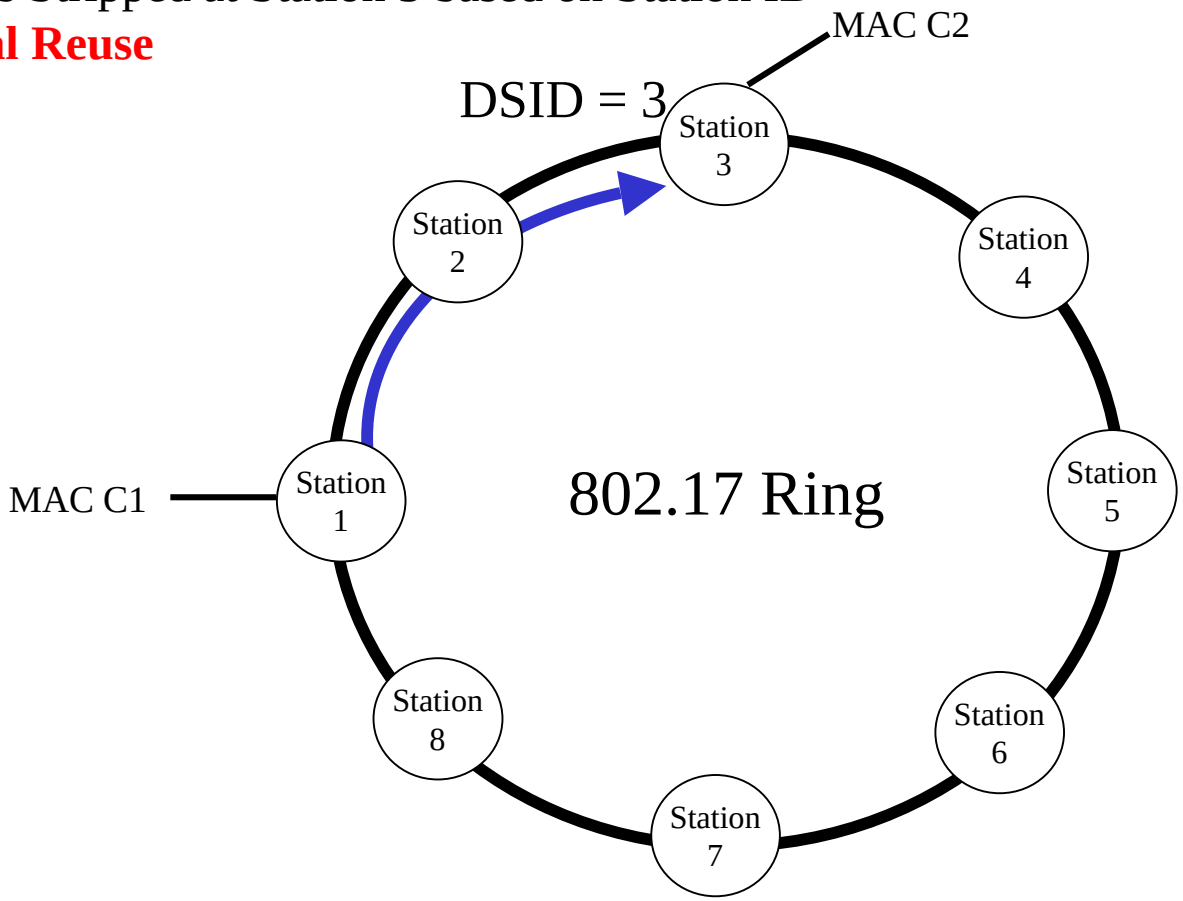
Simple Bridging

Unicast Frame Transmitted from C1 to C2
All frames flooded to every station on the ring.
Frame Stripped based on TTL
No spatial reuse.



SID Proposal
Bridging w/Destination Stripping

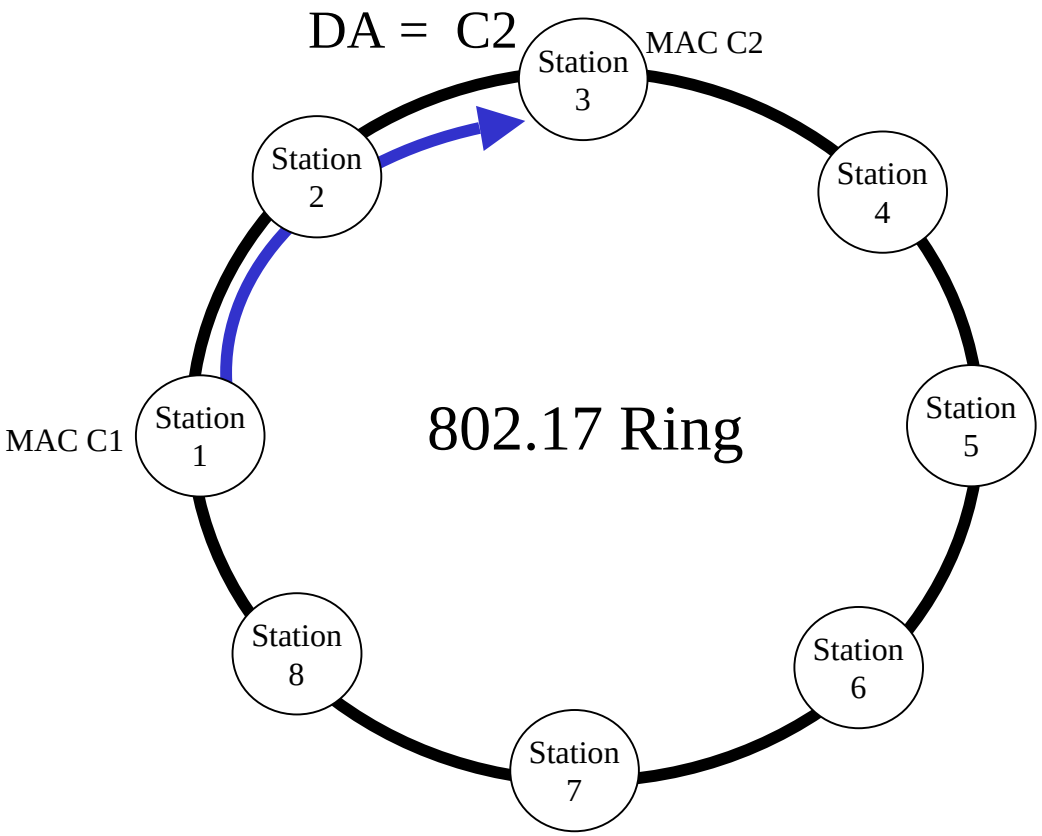
Unicast Frame Transmitted from C1 to C2
Frame directed to intended destination
Frames Stripped at Station 3 based on Station ID
Spatial Reuse



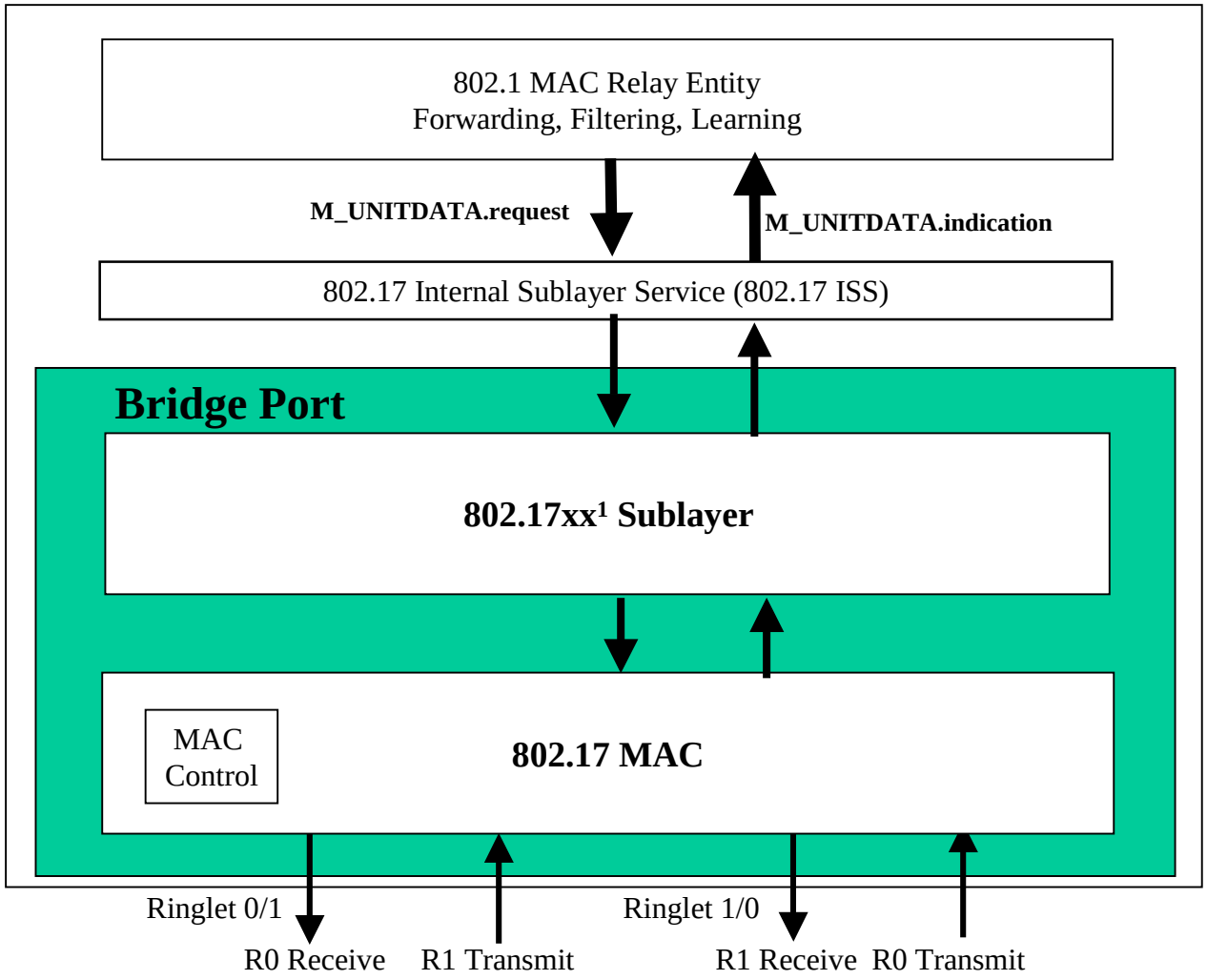
SID Proposal
implications on 802.17 end station

Unicast Frame Transmitted from C1 to C2
Frame Stripped at Station 3 based on destination MAC address

Spatial Reuse

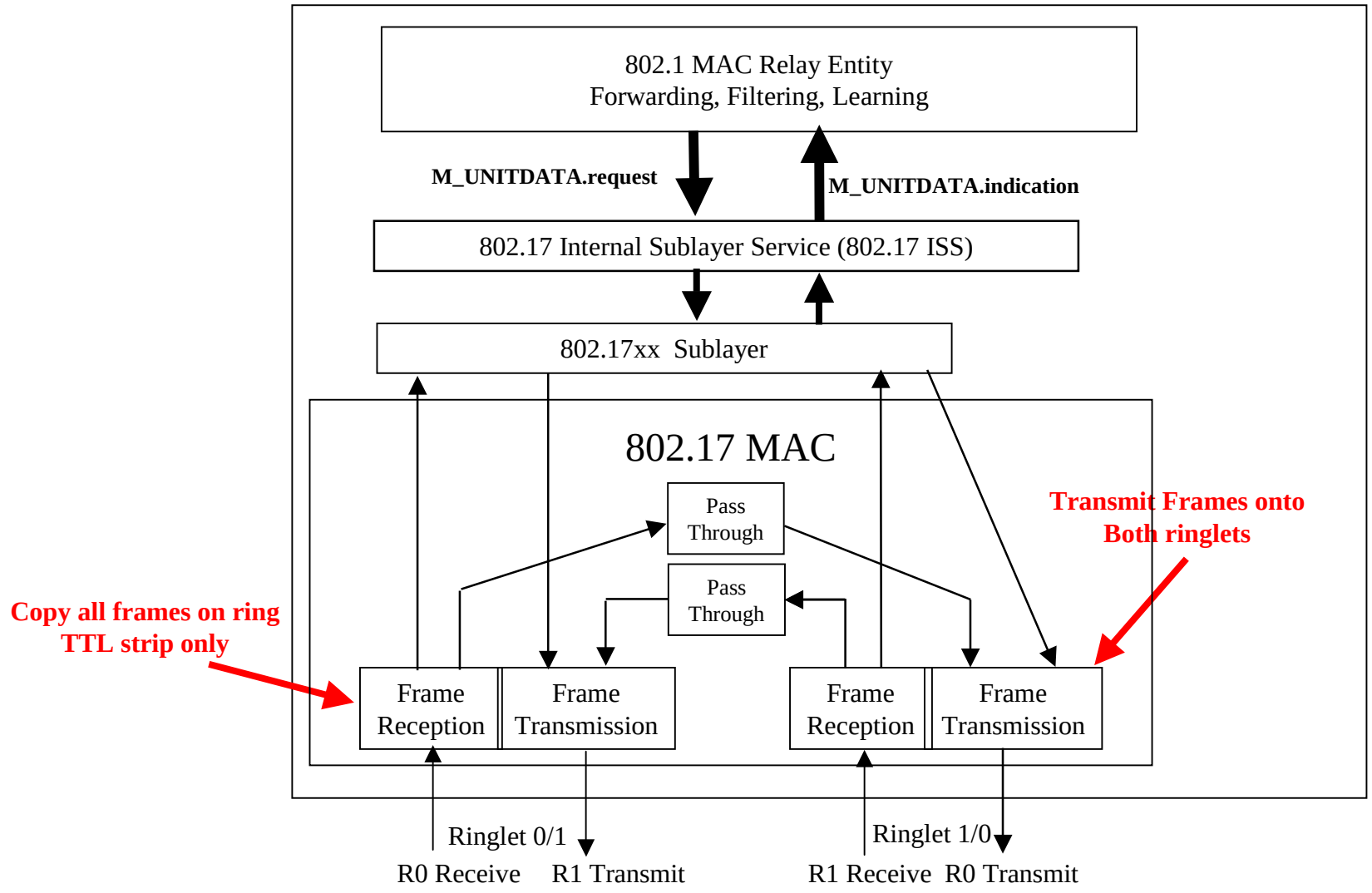


802.17 MAC in 802.1D Bridge Architectural Model

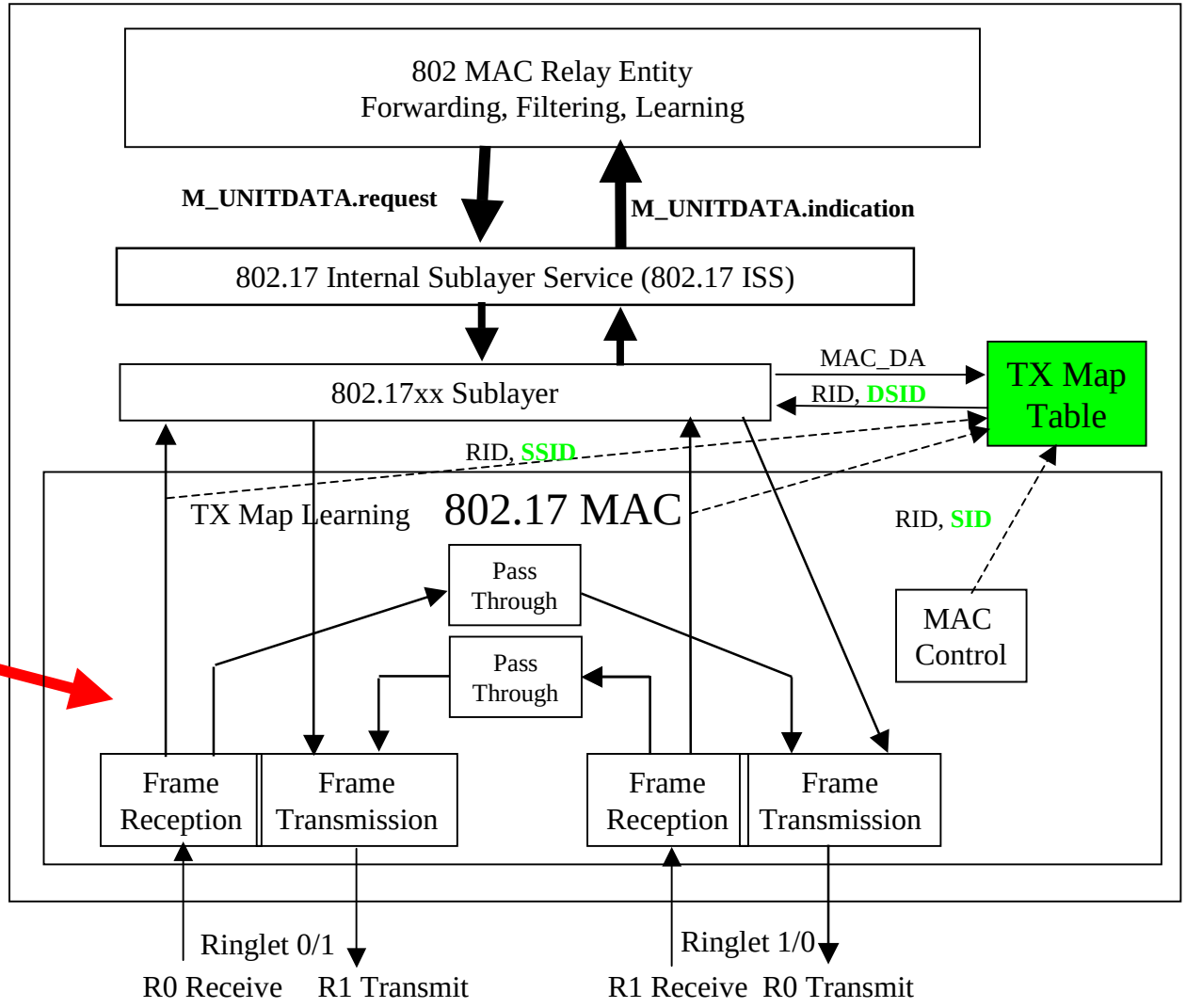


1. Sublayer above the MAC providing certain services specific to the ring. Concept similar to 802.3ad.

Transparent Bridging w/ Simple Bridge



Transparent Bridging w/ DSID SSID Stripping



Copy/Strip frames when match on DSID, Copy all others)

Comparison of Darwin Routed vs. Bridged PDUs for spatial reuse

Routed PDU with Spatial Reuse

CTRL	
MAC_DA	48 Bit
MAC_SA	48 Bit
SDU Type	16 Bit
MAC SDU	
FCS	32 Bit

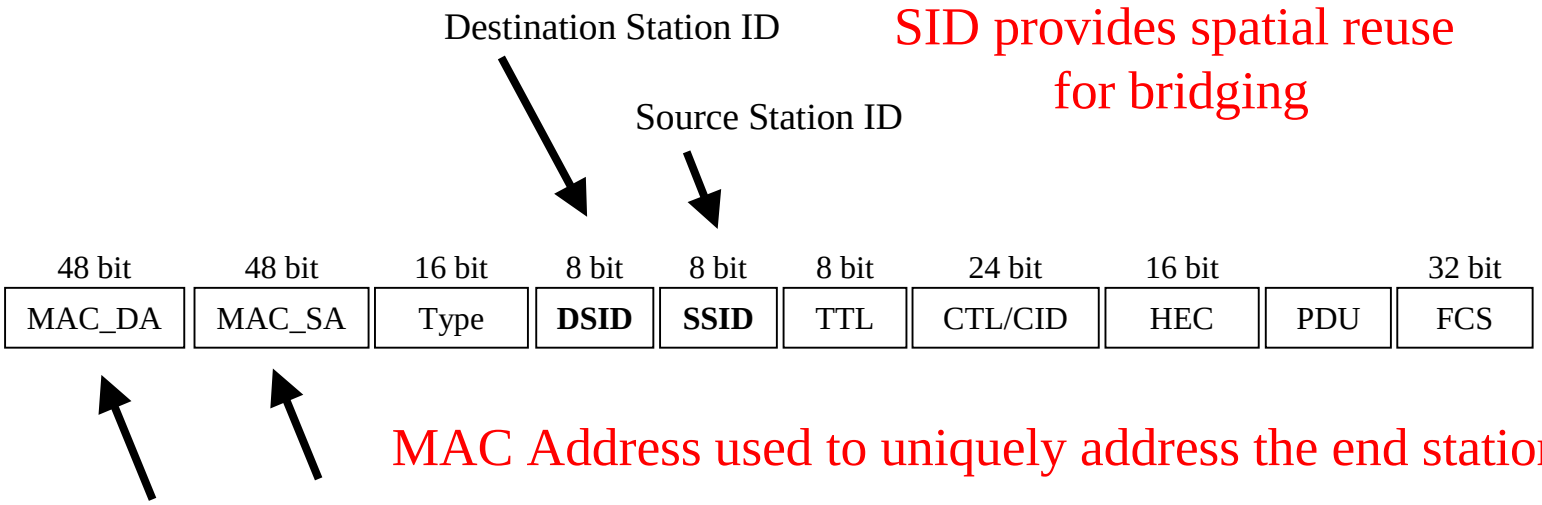
Encapsulated Bridged PDU with spatial reuse

Bridge 802.17 Packet needs to add 14 bytes more overhead than the routed equivalent to achieve same level of spatial reuse as routed packet.

CTRL	
Encap MAC DA	48 Bit
Encap MAC SA	48 Bit
Encap Type	16 Bit
MAC_DA	48 Bit
MAC_SA	48 Bit
SDU Type	16 Bit
MAC SDU	
FCS	32 Bit

Additional 14 byte overhead is required To achieve the network scaleability benefits of encapsulation bridging (double encapsulation).

Low overhead Common Frame Format



802.17 End Stations can still strip frames based on their MAC Address

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

Common frame format provides interoperability between end stations (routers) and bridges on an 802.17 ring.

Common Frame Procedures

- Destination Stripping type Bridges

  Transmission

  – Encapsulate a frame DSID based on the MAC_DA for all frames being transmitted onto the ring. Frame transmitted onto single ringlet.
  – DSID set to B_cast address for all broadcast/multicast/unknown traffic. Frame transmitted onto both ringlets.
  – SSID set to the transmitting station's station address
  – Perform DSID aging

  Reception

  – Copy/Strip frame if DSID matches station address
  – Copy frame of all other receive/transit frames to MAC relay for learning and forwarding
  – Learn all DSID in mapping table.

Common Frame Procedures

- Simple type Bridges

  Transmission

  – DSID set to B_cast address for all traffic.
  – SSID set to the transmitting station's station address
  – Frame transmitted onto both ringlets

  Reception

  – Copy/Strip frame if DSID matches station address
  – Copy all other receive/transit frames to MAC relay for learning and forwarding

Common Frame Procedures

- 802.17 End Stations

  Transmission

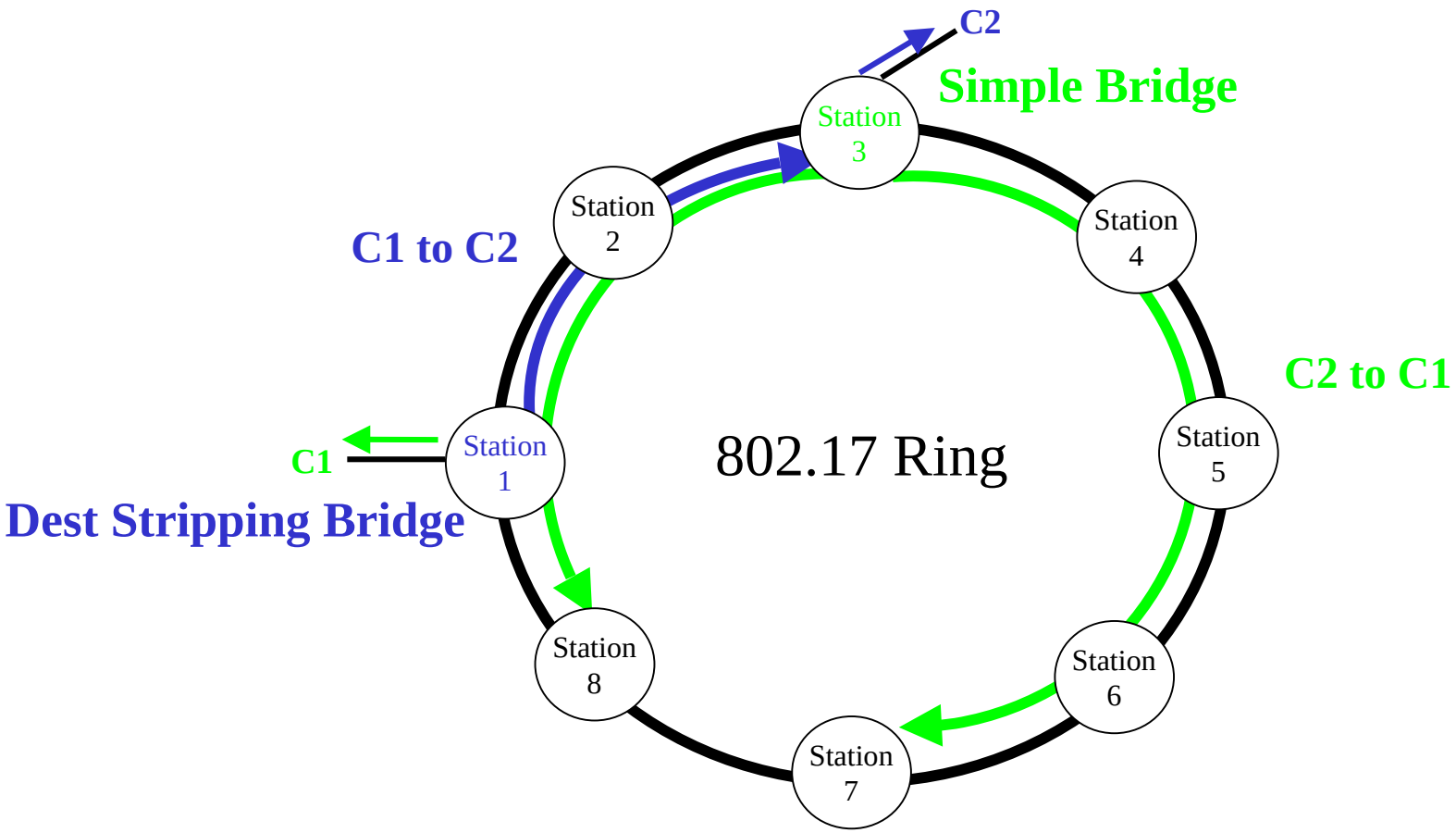
  – DSID set to B_cast address for all traffic.
  – SSID set to the transmitting station's station address
  – Frame transmitted onto both ringlets

  Reception

  – Copy/Strip frame if DSID or MAC destination address matches station address
  – Copy frame if broadcast/multicast

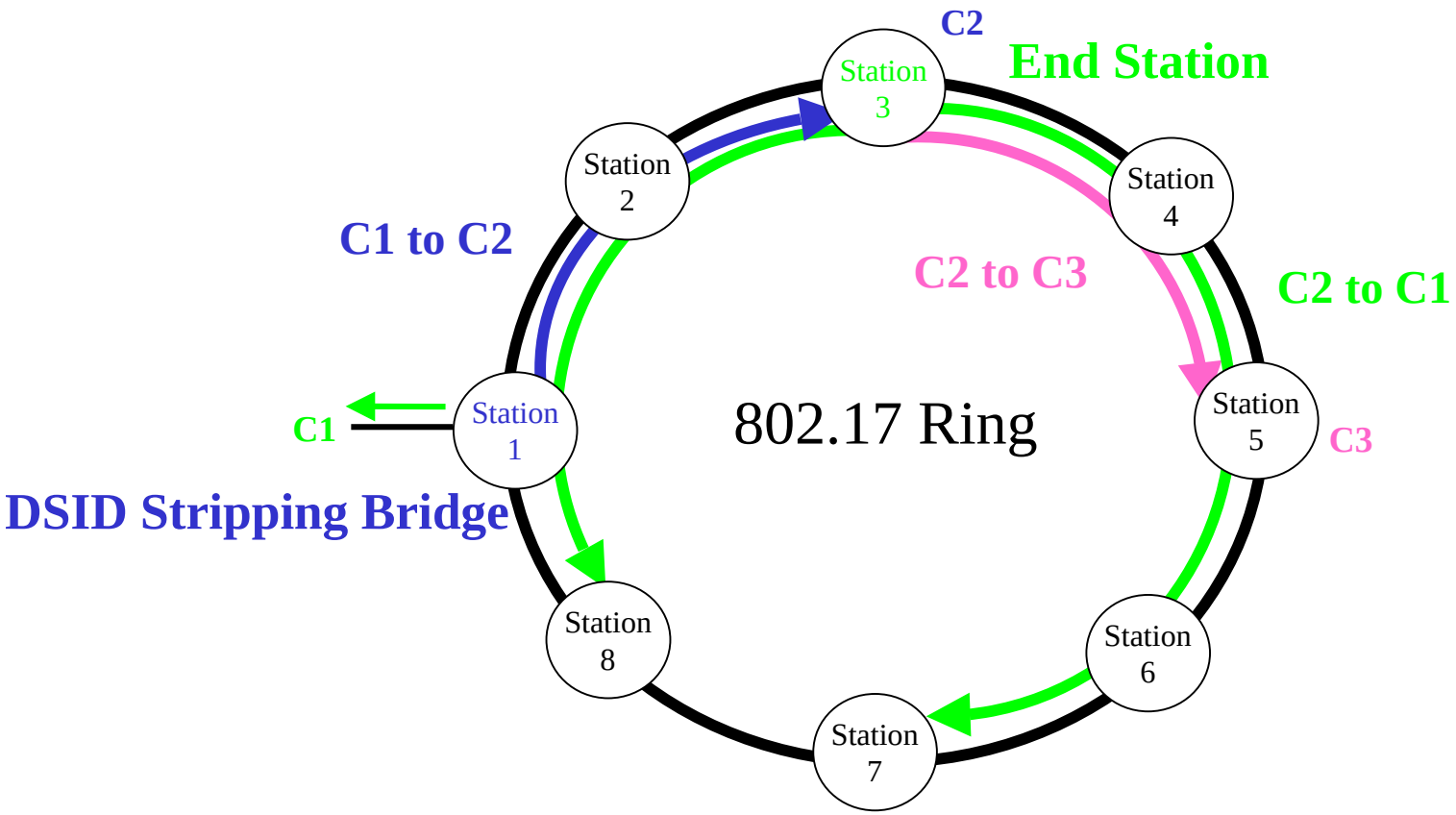
Interoperability
Simple Bridge / DSID Stripping Bridge

C1 to C2 – Spatial Reuse (DSID)
C2 to C1 – Frame Flooded



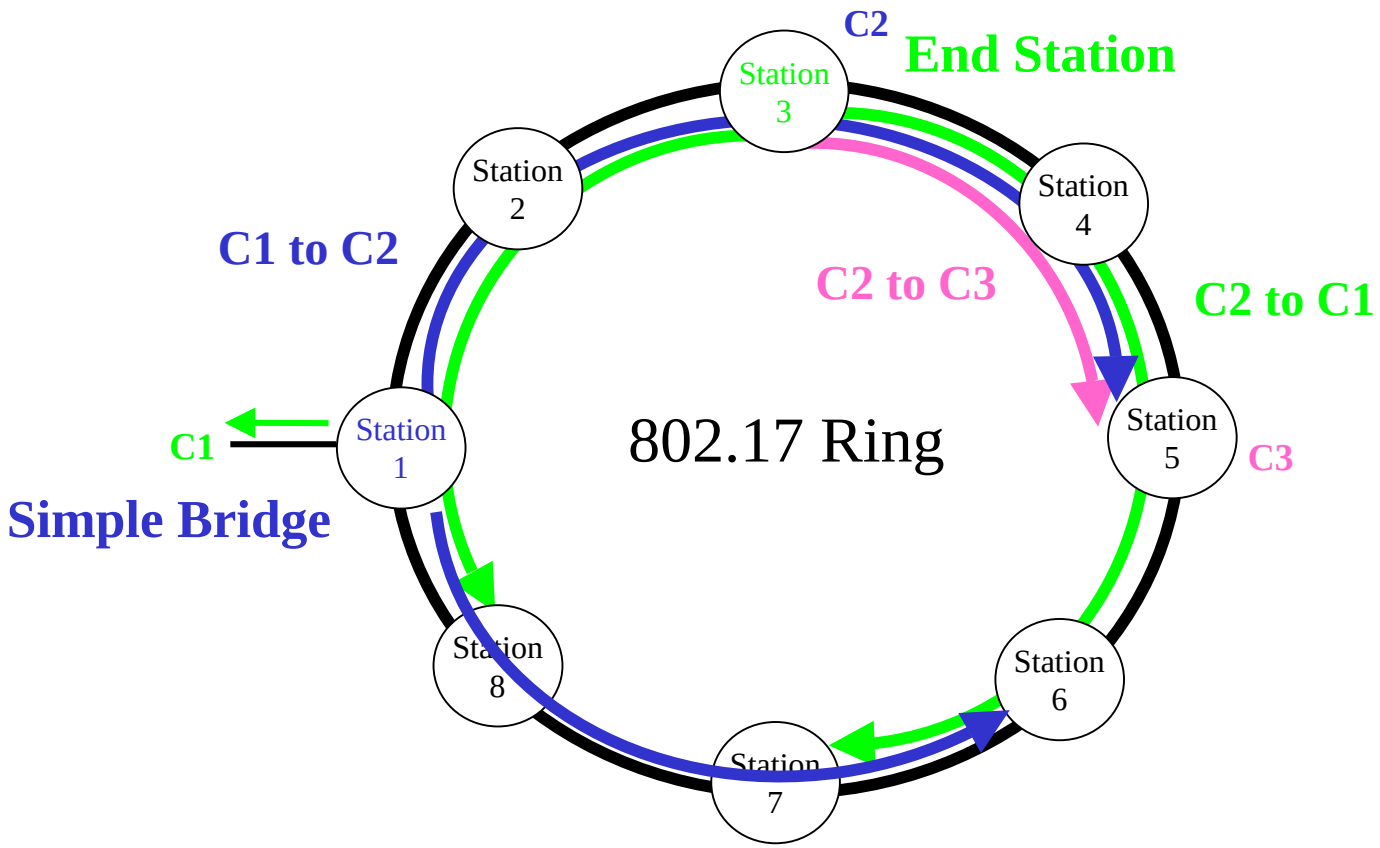
Interoperability
End Station / DSID Stripping Bridge

C1 to C2 – Spatial Reuse (DSID)
C2 to C1 – Frame Flooded
C1 to C3 – Spatial Reuse (MAC DA)



Interoperability
End Station / Simple Bridge

C1 to C2 – Frame Flooded
C2 to C1 – Frame Flooded
C2 to C3 – Spatial Reuse



Bridging Correctness Requirements

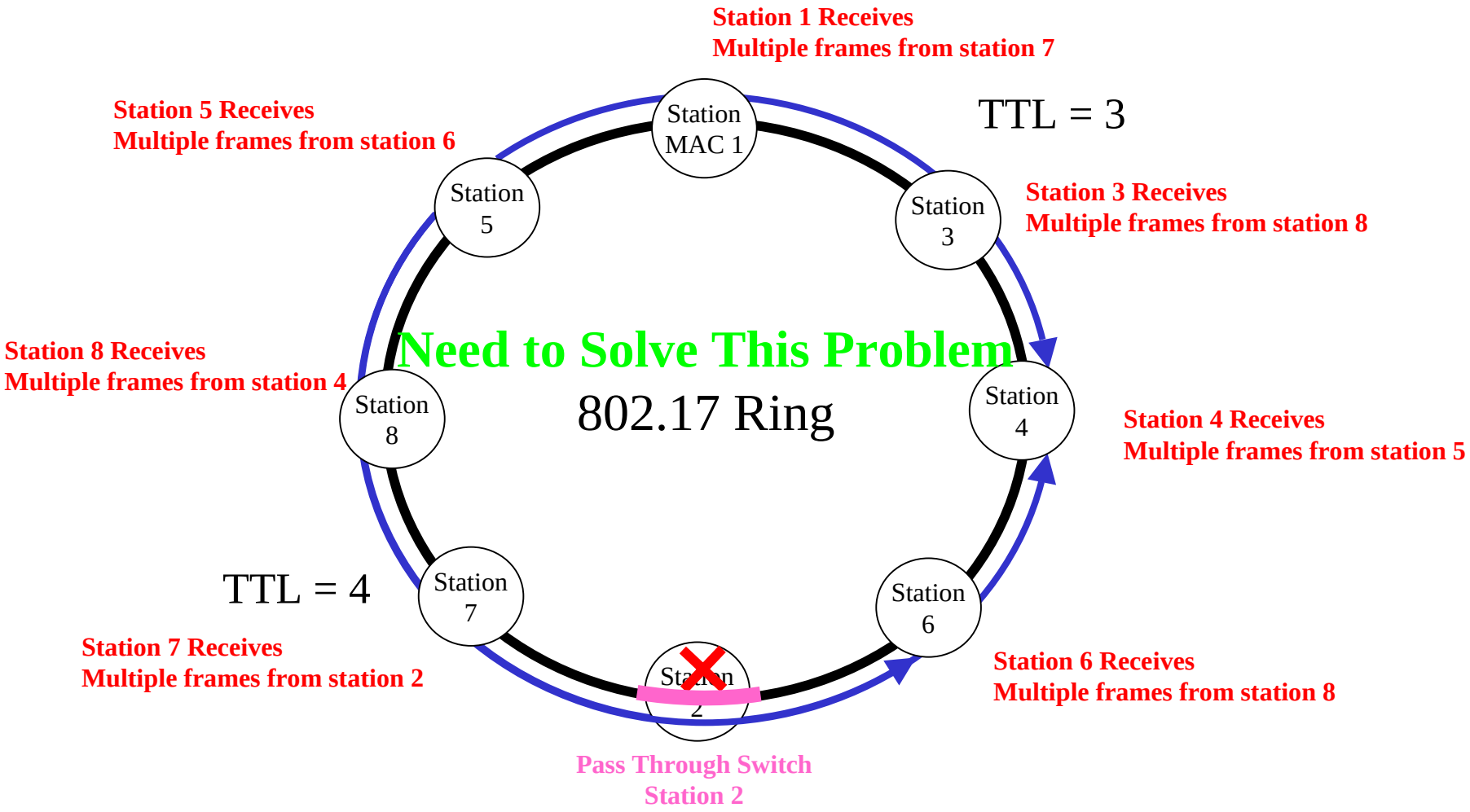
- 802.17 Operation needs to be robust to station adds/moves/changes
  - Needs to be robust to sub ms reconfigurations
  - 802.17 operation shall not broken by reconfigurations and cross connects made at the optical level (ie. optical cross connects and optical switches).
  - 802.17 operation shall not result in frame duplication. (802.1D section 6.3.4, “MAC service does not permit duplication of frames”).
  - 802.17 operation shall not result in traffic loss exceeding 50ms during network reconfiguration

TTL Stripping needs careful attention
Bridging correctness affected by topology changes

- Adding a station(s) results in traffic loss until new topology converges

- Removing a station(s) results in multiple copies being received until new topology converges

Flooding / TTL Stripping
Coherency Affected by Topology Changes

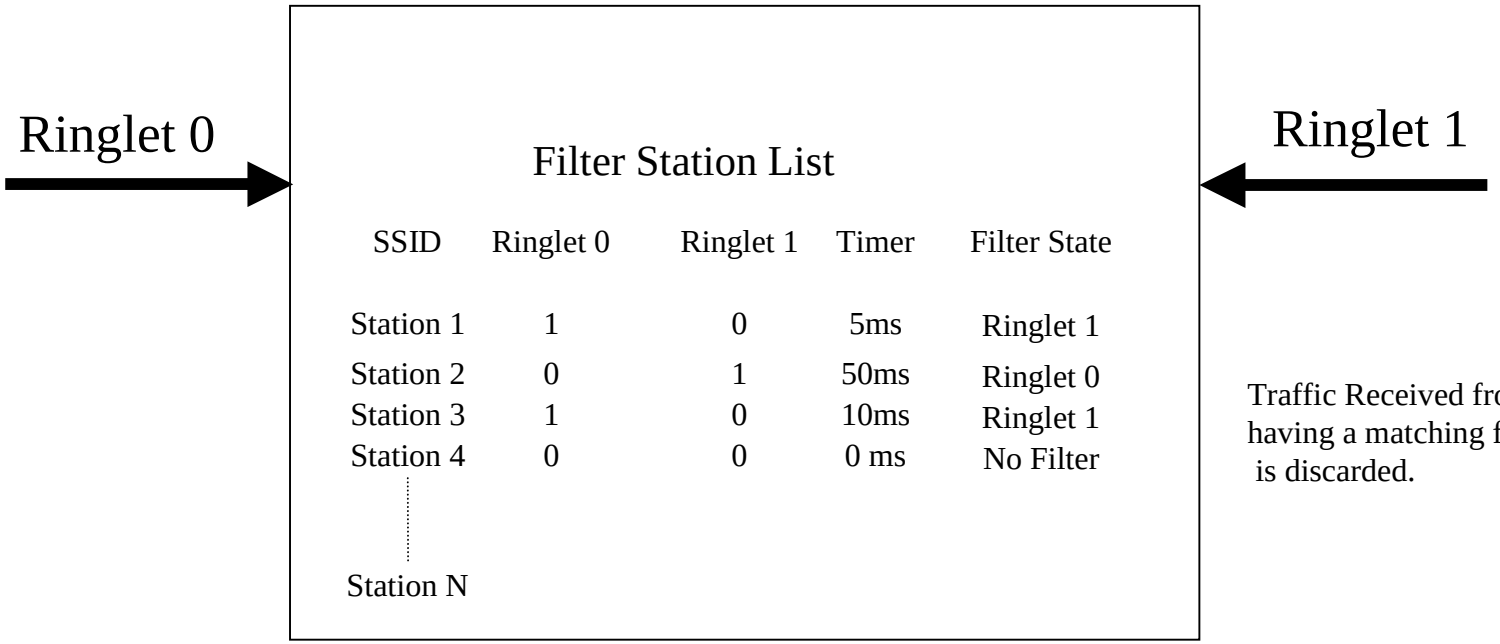


Maintaining Coherency during Topology Changes Possible Solutions

- Topology Discovery and Station Initialization Procedures
  - Stations must recognize and manage neighbor changes
  - Adds complexity to topology algorithm and initialization procedures

- Selective source station ID filtering (Bridges)
  - Filtering done based on station ID. Does not rely on TTL stripping
  - Station keeps track of transmissions received on both ringlets
  - If station ID x is received on ringlet 0, then it filters traffic received from station ID x on ringlet 1 and vice versa
  - Each station maintains a 50ms timer to allow traffic to be received on the other ringlet due to protection switch
  - TTL can be set to MAX_TTL

SSID Filtering
Addresses Bridging Correctness



Traffic Received from ringlet having a matching filter state is discarded.

Why DSID/SSID Important to 802.17?

- SID Proposal – Spatial Reuse for Bridged Networks
- SID Proposal - Common low overhead (2 octet) frame format for Bridges/Routers
- SID Proposal – Addresses bridging correctness requirements
- **Darwin** – Routed networks have a distinct spatial reuse advantage over bridged networks.
- **Darwin** – Special frame format (Encapsulation PDU) required for 802.17 bridging adds 14 more octets overhead than routed PDU to gain spatial reuse.
- **Darwin** – Encapsulation PDU poses interoperability problems between 802.17 routers and other 802 end stations connected through 802.17 bridges. Encapsulation PDU should not be required to transmit across a single LAN. Does not preserve MAC service defintion, [802.1D, 6.2a]

Darwin puts bridged 802.17 networks at a disadvantage to routed networks.

SID Frame overcomes these deficiencies!!

Conclusions

- Common Frame Format forward compatible with Destination Stripping
  - Supports Simple Bridging for compatibility with 802.1D/Q bridging
  - Meets the 5 Criteria / 802.17 Technical Motion Requirements for spatial reuse
  - Supports Interworking Simple / Destination Stripping Bridges / Routers / End Stations
  - Reduces transparent bridging overhead by 12 bytes vs. full 14byte encapsulation header
  - Encapsulation bridging frame format can be supported for network scaleability
  - Minimal impact to routers/clients directly attached to ring

- Topology discovery algorithm performs unique station ID assignment
  - Station ID assignment can be done manually or via topology discovery

Recommendations to 802.17 WG

- Incorporate DSID/SSID into 802.17 frame format to support simple bridging and provide forward compatibility with destination stripping bridging
- Define Station ID Assignment Algorithm used by all 802.17 type stations
- Define a robust method addressing the flooding / stripping issues.

Draft Proposal - 802.17 Bridging, Castellano, rc_brdgdraft_01, January 2002

References

- 802.17 Bridging, rc_brdgdraft_01, January 2002
- 802.17 Bridging, R. Castellano et.al, rc_bridge, November 2001
- 802.17 MAC Compatibility with 802.1D/Q, M. Holness et. al., mh_brcom, November 2001
- Draft Proposal for Resilient packet ring access method & physical layer specifications, David James editor, dvj_RprDraft, November 2001
- Encapsulation Bridging and 802.17, R. Castellano, rc_ebridge, September 2001
- RPR Bridging Compliance, M. Holness, September 2001
- ANSI/IEEE 802.1D 1998 edition [ISO/IEC 15802-3: 1998]

Thank You!