Annex F

(normative)

Editors' Notes: *To be removed prior to final publication.*

Draft Proposal D0.3 changes for Enhanced Bridging. All added text is identified via diff-marks. Deleted text is denoted via strike-through text.

Comments from BAH review, 7/2/02

1. ~~Editor's note the current draft proposal does not include a write-up on flooding, and does not cover frame format changes and requirements. These will be separate draft submissions to be reviewed by the BAH and working group. [E]~~ Done.

2. ~~Update draft major issues covered by this and other proposals. (need to get the list of issues that are being addressed, by current BAH submissions. DVJ to supply). [E]~~ done.

3. Figure Caption text and headings should only have 1st word capitalized. [E]

4. "Bridging" is capitalized in various sections where it should be lower case. [E]

5. Need new LI,NumberedList2 format templates : alphabetic labeling as opposed to numeric (dvj to supply new P format). [E]

6. Run spell check to catch typos such as "unicst". [E]

7. ~~Fill out references Figure.B.1.??? [E]~~ done.

8. Editorial note to the editor regarding internal document references to 802.17 vs. using RPR MAC or some other term. [E]

9. pg 286, line 26 - "conformance with the Bridging specifications.", include reference. [E]

10. Figure F.1 - Separate the two illustrations in the figure to two separate figures. Include end stations attached to bridges to the appropriate model. Redraw ring based on recommended editorial conventions. Need to determine the graphical representation for bridges vs. end stations on the ring. [E - separate figures, T - include end stations in reference model]

11. Figure F.6 - Redraw this figure using accepted reference model figures from other parts of the draft. DVJ to supply the revised figure. This figure must be reviewed by Marc H. [E, could be T implications]

Editors' Notes: *To be removed prior to final publication.*

Comments from BAH review, 7/2/02, continued

12. Table F.1 - Show the mapping of User priority to Class A,B,C traffic on the ring. Mapping should presently go in as an issue, since group has not discussed. Remove all the other MAC priority mappings. This table should be in a common or generic section of the document. [T - mapping, E - remove other priorities and relocate]

13. "Non-Local" terminology usage. Should we use "non-local" or "remote" as the term for a device that is not local to the ring. Should include in editorial issues/comments up front in the document [E]

14. ~~Remove indent. Pg 284, line17; pg 284, line 24 [E]~~ done

15. Harmonize Basic/Enhanced bridging model text so that we can readily see the things they have in common. Add the appropriate notations to indicate where Basic and Enhanced have things in common. Frame reception is one area where both are in common. [E]

16. ~~Remove "Note on Flooding" - pg 293, line8 and pg 301, line 40. Replace with reference to the flooding clause F.7. [E]~~ done.

17. Figure F.8 - Redraw figure based on editorial convention for drawing rings. Also need to determine editorial conventions/nomenclature for identifying VLANs. Check 802.1Q document. Is Red/Blue VLAN appropriate for the example. [E]

~~18. Clause F.4.1 - Should the spatial reuse sublayer include priority as part of the ringlet selection decision criteria? What is the motivation/reasoning behind using the VLAN as a parameter in the station mapping algorithm and the associated references? Need to include discussion on IVL/SVL and/or appropriate references to 802.1S / 802.1Q. [T] 19. Include an editorial comment regarding the CID parameter "presently not defined in any standard" in section F.4.2. [T]~~ done.

~~20. pg 301, lines 20, 24. Remove reference to destination address in the "frame header" and reference "the frame". [T]~~ done.

~~21. Clause F.4.3 Pg 301 Revise transmission rules, items 1-4 (lines 23 - 38) to describe the following cases: Unicast Known, multicast known, unknown (unicast/multicast), broadcast. [E/T]~~ done.

802.1D and 802.1Q Bridging Conformance

Editors' Notes: *To be removed prior to final publication.*

References:
None.

Definitions:
None.

Abbreviations:
None.

Revision History:

Draft 0.1, February 2002	*Initial draft document for RPR WG review.*
Draft 0.2, April 2002	*Draft 0.2 for TF review, based on comments to Draft 0.1.*
Draft 0.3, June 2003	*Draft 0.3 for TF review, based on comments to Draft 0.2.*

Editors' Notes: *To be removed prior to final publication.*

Major Issues:

1) There was a comment for 802.17 access priority in Table F.3.4 to follow the access encoding used by 802.3. The BAH needs to look at this.
2) ~~Anytime unicast traffic is destination stripped by one station and replicated by others to their bridging relay, there is an issue with persistent bridged network flooding.~~ This is addressed by basic bridging text.
3) Section F.2.1 describes FCS being calculated over RPR header, addresses, and payload. FCS is just calculated over the payload (section 8.3.6).
4) ~~Need proposed text for unidirectional / bidirectional flooding~~ This is addressed by the flooding text.
5) ~~Need proposed text for minimizing frame duplication and packet misordering~~ This is addressed by the flooding text.
6) ~~Need proposed text to support source stripping for bridged frames~~ This is addressed by the flooding text.
7) ~~Need proposed text for spatial reuse of bridged traffic~~ This is addressed by this draft.
8) Need to confirm with 802.1 regarding usage of additional parameters in MA request/indication primitives.

F.1 Bridging Overview

This section of the draft is not intended to define a new bridging specification. The purpose of this Annex is to ensure and demonstrate the 802.17 MAC definition conforms to Transparent and VLAN Bridging, and defines how the 802.17 MAC fits into the bridging architectural model as defined in the IEEE 802.1D and 802.1Q standards respectively.

All types of IEEE 802 Local Area Networks (or LANs) can be interconnected using MAC bridges. Each individual LAN consists of devices attached to the LAN having the same MAC type. The bridged LAN created allows for the inter-connection of stations attached to separate LANs to operate as if they were attached to a single LAN, although they are in fact attached to separate LANs. A transparent MAC bridge operates below the MAC service boundary, and is transparent to protocols operating above this boundary, in the logical link control (LLC) sublayer or network layer (ISO/IEC 7498-1: 1994 1). The presence of one or more MAC bridges can lead to differences in the quality of service (QOS) provided by the MAC sublayer; it is only because of such differences that MAC bridge operation may not be fully transparent.

A bridged LAN can provide for:

1) The interconnection of stations attached to LANs of different MAC types;
2) An effective increase in the physical extent, the number of permissible attachments, or the total performance of a LAN;
3) Partitioning of the physical LAN for administrative or maintenance reasons.

The MAC bridge standard IEEE Std 802.1D-1990 (subsequently republished as ISO/IEC 15802-3:1998 [IEEE Std 802.1D, 1998 Edition]) specifies an architecture and protocol for the interconnection of IEEE802 LANs below the MAC service boundary. Within this context, the RPR network defines a ring topology forming a broadcast media where specific access control mechanisms are employed by the MAC in order to achieve frame delivery and spatial reuse on the ring media. The RPR MAC entity defines basic and enhanced functions within the MAC for optimizing traffic on the ring, providing two levels of spatial reuse for unicast traffic, as illustrated in bridging network reference model of figure F.1. Support of the basic model by the RPR MAC is required. Support of the enhanced functions by the RPR MAC is optional.

The basic model provides spatial reuse of unicast traffic between end stations which are local to the 802.17 ring. Traffic between a local end station and a non local end station (via a single bridge), or two non local end stations (via a pair of bridges) is always flooded on the ring. Traffic passing through a bridge between the ring and another end station is always flooded. This ensures that integrity of the bridges' forwarding databases are preserved. Special rules are required when basic end stations local to the ring perform destination stripping of unicast traffic. In this case, basic end stations must be able to determine if the frame was sourced by a local end station or basic bridge on the ring. Traffic from a local end station can be stripped, whereas traffic from a basic bridge cannot. A special flooding indicator in the frame is used by the local end station to determine whether or not it can destination strip the frame.

The enhanced bridging model provides spatial reuse of unicast and multicast traffic for both local and bridged traffic on the ring. Unicast traffic between an enhanced end station and bridge, or two enhanced bridges is always destination stripped on the ring. This provides the maximum level of spatial reuse when bridges attach to the ring. Special rules are also required by enhanced devices performing destination stripping of unicast or multicast traffic to ensure proper learning and forwarding behavior of bridges attached to the ring. Enhanced devices shall also support coexistence with basic devices on the ring. In this case enhanced devices shall follow the same rules as a basic device when transmitting/receiving traffic to/from basic devices.

The RPR MAC entity appears as a single interface to the 802 bridging relay. This means the RPR ring media and the collection of stations which attach to the ring appears to the 802 bridge relay as a single loop free broadcast media. The RPR MAC ensures that a frame is delivered to the intended RPR station (in the case of a known unicast) or is delivered to all stations (in the cast of a multicast, broadcast or unknown frame). The RPR MAC also ensures that only a single copy of a frame is delivered to the 802.17 internal sublayer service within each station. RPR MAC procedures ensure that duplicate copies of a frame are not transferred to the 802.17 internal sublayer service (ISS). This includes scenarios where the ring is in a normal operating configuration, or frames are being wrapped or steered during a ring failure. Since the RPR ring behaves as a loop free broadcast media, spanning tree protocol is not required on the 802.17 ring when the ring attaches to a loop free network. Spanning tree protocol is required over an RPR ring when multiple 802 networks attached to multiple 802.17 stations forming loops through the 802.17 network. The RPR MAC entity provides LLC services to support the bridge protocol entity and other higher layer protocol users.

In order to support transparent bridging of 802 traffic and maintain the spatial reuse property of the ring, the RPR MAC service interface performs the following functions : simple mapping of 802 traffic to the RPR frame format, transport of 802 traffic across the RPR physical medium, and delivery of 802 traffic to either the MAC relay or intended 802.17 client at the RPR MAC service interface. The mapping function performed by the RPR MAC service interface shall conform to the interface between a MAC entity and MAC relay, and preserve the filtering services and other requirements for bridged LANs as specified in ISO/IEC 10038 [IEEE Std 802.1D, 1998 Edition], and ISO/IEC [IEEE Std 802.1q, 1998 Edition]. These services include:

1) Maintaining the bridge architecture;
2) Maintaining the nature of filtering services in bridged LANs;
3) Maintaining the extensions specified by IEEE P802.1Q to allow MAC bridges to support the definition and management of virtual LANS (VLANs);
4) Maintaining the provision of filtering services that support the dynamic definition and establishment of groups in a LAN environment, and the filtering of frames by Bridges such that frames addressed to a given group are forwarded only on those LAN segments that are required in order to reach the members of that group;
5) Supporting the registration protocol that is required in order to provide dynamic multicast filtering services;
6) Supporting management services and operations that are required in order to support administration of dynamic multicast filtering services;
7) Maintaining the provision of expedited traffic capabilities, to support the transmission of time-critical information in a LAN environment;
8) Maintaining the concept of traffic classes and the effect on the operation of the forwarding process of supporting multiple traffic classes in bridges;
9) Maintaining the spanning tree algorithm and protocol;
10) Maintaining the generic attribute registration protocol (GARP);
11) Maintaining the GARP multicast registration protocol (GMRP);

The MAC Bridging reference model for 802.17 is shown in Figure F.1. The bridging reference model supports stations on the Ring acting as 801.1D or 802.1Q MAC Bridges, while the 802.17 ring acts as the shared media. The bridging conformance model requires the integrity of 802.17 attached bridges and their associated bridged networks are maintained when there are a mixture of bridges and end stations on the ring. In the general bridged network case, end stations which are local to the ring may be transmitting to other end stations which are also local to the ring, or to non-local end stations (via attached bridges). Non-local end stations may also be transmitting to end stations which are local to the ring (via a single bridge) or end stations which are non-local (via a pair of bridges). Stations acting as bridges may be configured to do so through the appropriate Layer Management function.

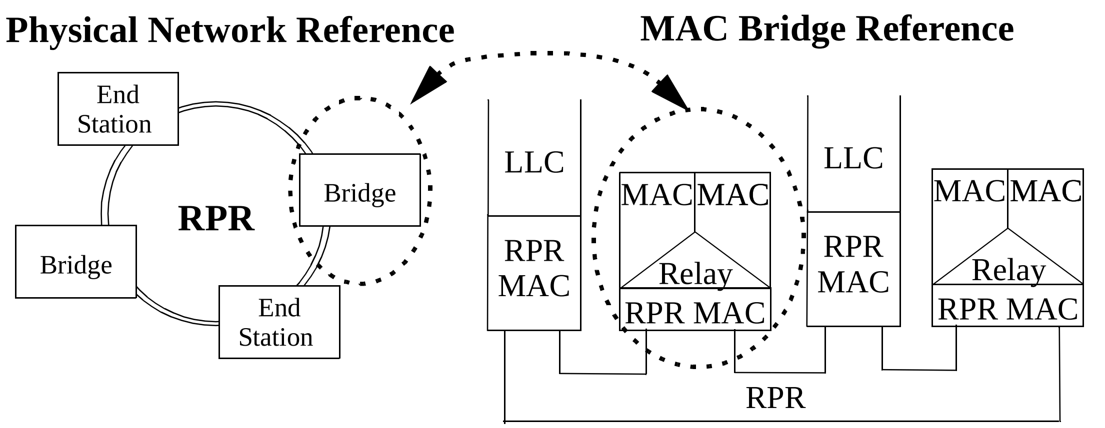

Figure F.1—Bridge Architecture Reference

The 802.17 MAC conformance to the aforementioned Bridging standards[1] can be achieved with the following 802.17 MAC capabilities:

1) The 802.17 MAC must provide an Internal Sub-Layer Service (ISS), which is used to interface with the Bridging Relay Entity. The ISS will conform to Section 6.4 of the IEEE Std 802.1D and Section 7.1 of the IEEE Std 802.1Q, when appropriate.
2) The 802.17 MAC must be able to communicate with the Bridge Protocol Entity via the LLC sub-layer, in conformance with the Bridging specifications.
3) The 802.17 MAC must be able to receives frames from the Ring (i.e., shared media) and determine whether they need to be bridged or not.
4) The 802.17 MAC must be able to transmit bridged frames appropriately over the 802.17 shared media. This includes handling of unknown unicast, broadcast, and multicast frames.
5) The 802.17 MAC transmission/reception rules shall allow end stations and bridges to coexist on the ring,

[1] IEEE 802.1D and 802.1Q Standards.

F.2 Architectural model of a bridge

The RPR MAC conforms to the architectural model of a bridge as defined by IEEE 802.1D. The component LANs are interconnected by means of MAC bridges; each port of a MAC bridge connects to a single LAN. Figure B.2 illustrates the architecture of such a bridge. The RPR MAC entity and its associated dual-ring interface fits within the context of the port definition of the bridge architecture model.

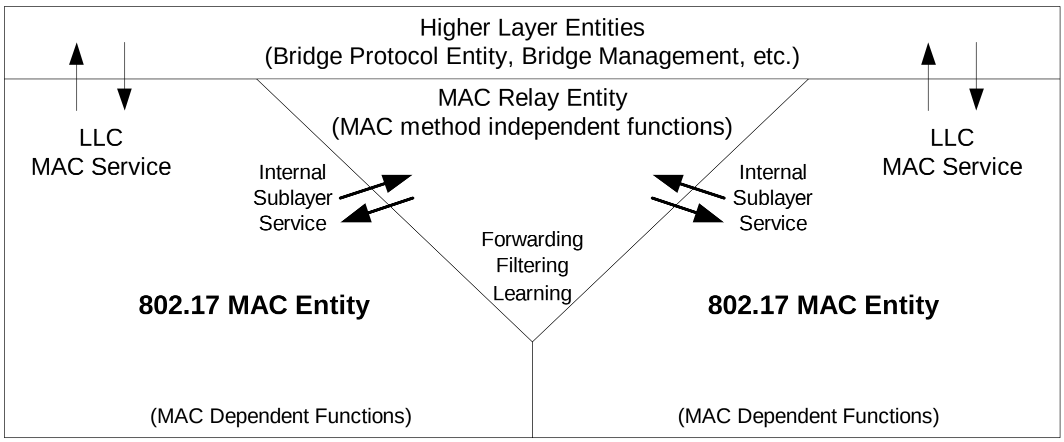

Figure F.2—Bridge Architecture Model

A bridge consists of:

1) A MAC relay entity that interconnects the bridge's ports;
2) At least two ports;
3) Higher layer entities, including at least a bridge protocol entity.

F.2.1 MAC relay entity

The MAC relay entity handles the MAC method independent functions of relaying frames between bridge ports, filtering frames, and learning filtering information. It uses the internal sublayer service provided by the separate MAC entities for each port. Frames are relayed between ports attached to different LANs.

F.2.2 Ports

Each bridge port transmits and receives frames to and from the LAN to which it is attached. An individual MAC entity permanently associated with the port provides the internal sublayer service used for frame transmission and reception. The 802.17 MAC entity handles all the MAC method dependent functions (MAC protocol and procedures).

F.2.3 Higher layer entities

The bridge protocol entity handles calculation and configuration of bridged LAN topology.

The bridge protocol entity and other higher layer protocol users, such as bridge management (IEEE 802.1D, Clause 7.1.3) and GARP application entities including GARP participants (IEEE 802.1D, Clause 12), make use of logical link control procedures. These procedures are provided separately for each port, and use the MAC service provided by the individual MAC Entities.

F.3 Basic Bridging Model Overview

The MAC reference model for basic bridging is illustrated in Figure F.3. All devices must provide support for the basic bridging model. The basic bridging model provides compatibility with 802.1D/802.1Q without having to implement the Spatial Reuse Control Sublayer and station ID mapping tables associated with Enhanced bridging. These devices flood bridge traffic submitted by the MA/ISS/EISS to the 802.17 MAC onto the ring. The resulting frame is placed on the medium and received by all other stations on the ring via the flooding algorithm. Basic bridge traffic shall be encoded with a basic flooding indicator signifying that other devices shall not strip the frame from the ring until all stations receive a copy of the flooded frame. Local end stations which are transmitting to another local end station on the ring shall not encode the basic flooding indicator. This allows traffic between a pair of local end stations to be destination stripped.

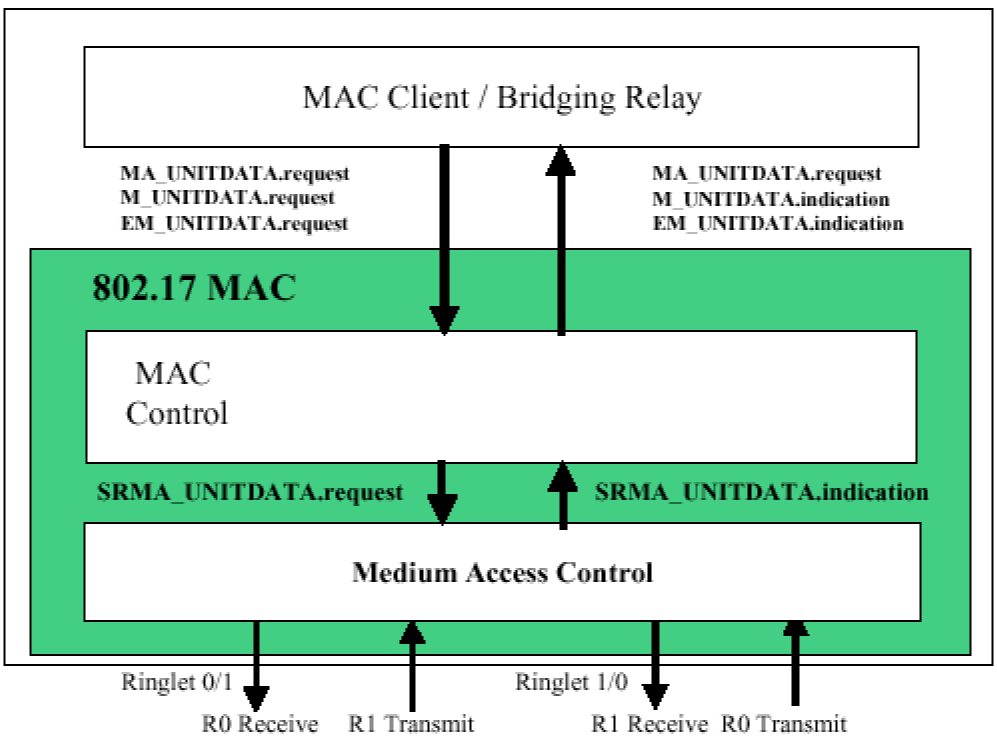

Figure F.3—802.17 Basic Bridging MAC Reference Model

F.3.1 802.17 MAC Internal Sub-Layer Service

> ***Editors' Notes:*** *To be removed prior to final publication.*
>
> *Attached is the original draft D0.3 description of the ISS/EISS sub-layer service. The description here needs to be revised to account for changes in the basic bridging compliance model.*

The ISS is provided by a MAC Entity to communicate with the MAC Relay Entity. The interface for this sub-layer is predefined in the 802.1D and 802.1Q standards. The 802.17 MAC will adhere to these specifications.

F.3.1.1 802.17 MAC Support of Internal Sub-Layer Service

The 802.17 MAC access method is specified in the draft. Clause 8 specifies the MAC frame structure, and Clause 5 specifies the MAC method.

On receipt of a MA_UNITDATA.request primitive, the local 802.17 MAC Entity performs Transmit Data Encapsulation, assembling the RPR frame using the parameters supplied as specified below.

On receipt of an RPR frame by Receive Media Access Management, the MAC frame is passed to the Reconciliation sub-layer which disassembles the RPR frame into parameters, as specified below, that are supplied with the MA_UNITDATA.indication primitive.

The **frame_type** parameter takes only the value *user_data_frame* and is not explicitly encoded in MAC frames.

The **mac_action** parameter takes only the value *request_with_no_response* and is not explicitly encoded in MAC frames.

The **destination_address** parameter is either the address of an individual MAC entity (end station) or a group of MAC entities. The destination_address parameter is the MAC address of the intended destination entity, independent of whether the entity is local or non-local (bridged) to the ring.

The **source_address** parameter is the individual address of the source MAC entity (end station). The source_address parameter is the MAC address of the originating entity, independent of whether the source entity is local or non-local (bridged) to the ring.

The **mac_service_data_unit** parameter is the service user data.

The **user_priority** parameter provided in a data request primitive is not encoded in the MAC frame. The user_priority parameter provided in a data indication primitive takes the value of the Default User Priority parameter for the Port through which the MAC frame was received.

The **access_priority** parameter provided in a data request primitive is derived by a fixed MAC mapping. The fixed mapping is depicted in Table F.3.4. The values shown are not modifiable my management or other means.

The **frame_check_sequence** parameter is encoded in the FCS field of the MAC frame. The FCS is computed as a function of the destination address, source address, length, RPR Header, and data fields. If a

MA_UNITDATA.request primitive is not accompanied by this parameter, it is calculated in accordance with Annex G of this draft.

Figure F.4 shows the mapping of the MA-UNITDATA.request primitive parameters to the MAC frame fields, and the mapping of the MAC frame fields to the MA-UNITDATA.indication primitive parameters

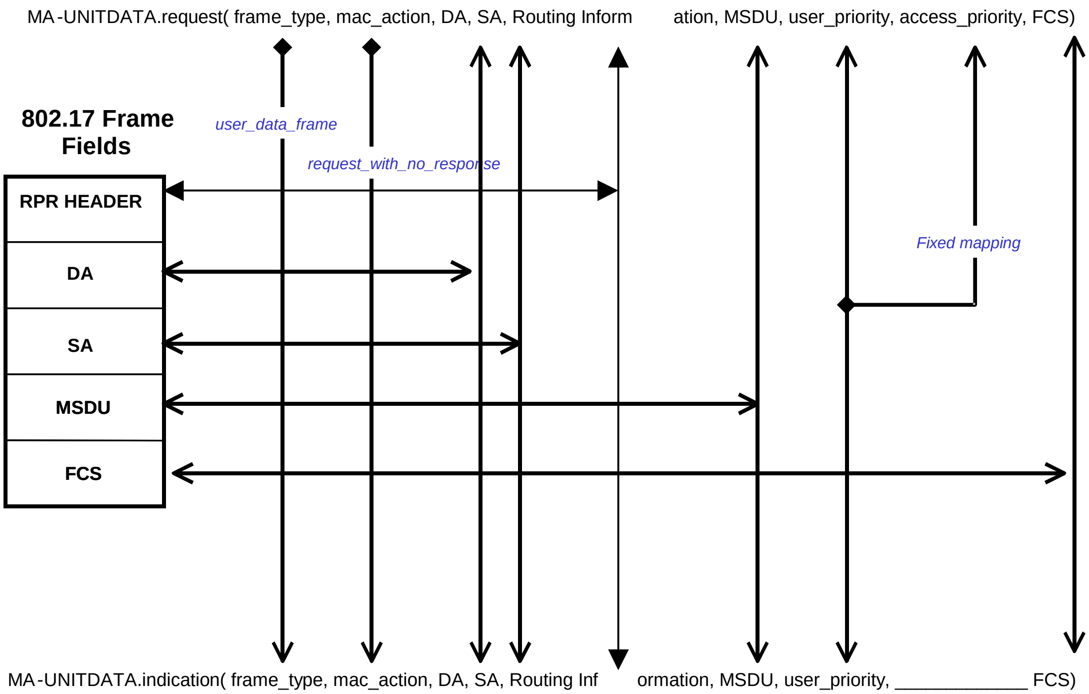

Figure F.4—Mapping of MAC Service Primitives

F.3.1.2 802.17 MAC Support of Enhanced Internal Sub-Layer Service

An Enhanced Internal Sub-Layer Service (E-ISS) is derived from the Internal Sub-Layer Service (ISS, defined in ISO/IEC 15802-3, 6.4) by augmenting that specification with elements necessary to the operation of the tagging and un-tagging functions of the MAC Bridge. The E-ISS provided by the MAC will conform to IEEE Std 802.1Q, clause 7.1.

Figure F.5 shows the mapping of the EM-UNITDATA.request primitive parameters to the MAC frame fields, and the mapping of the MAC frame fields to the EM-UNITDATA.indication primitive parameters.

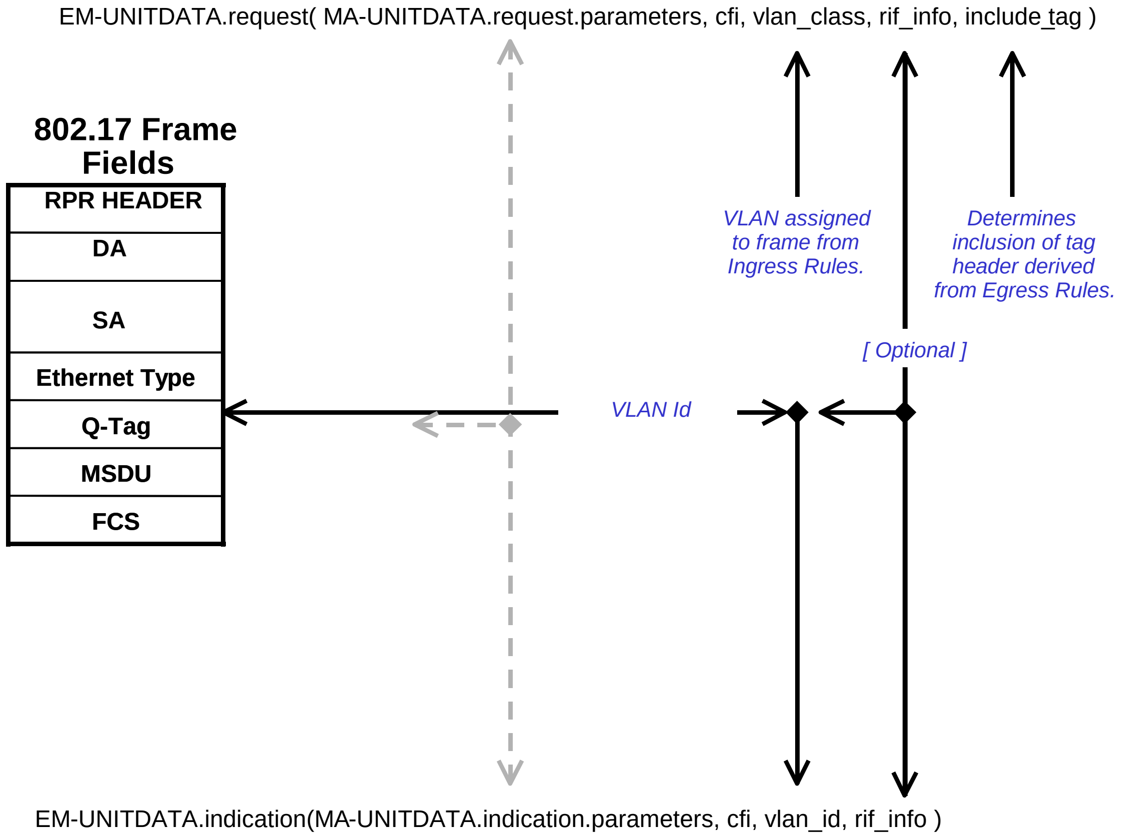

Figure F.5—Mapping of Enhanced MAC Service Primitives

F.3.2 Frame Transmission

The individual MAC entity associated with each bridge port transmits frames submitted to it by the MAC relay entity.

Relayed frames for transmission by the forwarding process are submitted to the MAC ISS. The M_UNITDATA.request primitive associated with such frames conveys the values of the client MAC source and destination address fields received in the corresponding M_UNITDATA.indication primitive.

LLC protocol data units (PDUs) are submitted by the LLC as a user of the MAC service provided by the bridge port. Frames transmitted to convey such PDUs carry the individual client MAC address of the port in the source address field. All LLC PDUs are submitted by the MAC client to the MAC. The MAC in turn performs the same MAC destination address to frame mapping as described for frames submitted to the MAC by the bridge relay entity.

All bridged frames (non-local unicast, broadcast, multicast) are transmitted subject to the following MAC transmission procedures. The values of the frame_type and mac_action parameters of the corresponding M_UNIT-DATA. request primitive shall be user_data_frame and request_with_no_response, respectively (6.5).

1) For all non-local unicast frames, broadcast, multicast, the *basic_flooding_indicator* is set in the frame. The resulting frame is flooded to all stations using one of the prescribed flooding methods for bridge traffic. (clause F.7).
2) The RPR *source_station_ID* (SSID) in the transmitted frame, should be set to the transmitting station's source station ID. This parameter is used to invoke source stripping at the receiver.

~~**Note on flooding** - A separate section TBD, shall define the flooding algorithm. The flooding algorithm shall ensure all stations on the ring receive a copy of the frame with minimal duplication, misordering, and loss.~~

F.3.2.1 802.17 MAC Transmission of Bridged Frames

Editors' Notes: *To be removed prior to final publication.*

This section provides the original draft D03 description of bridging transmission rules. This is replaced with the above description that includes the revisions to the basic bridging model.

~~Bridge relayed frames are submitted for transmission by the Bridging Forwarding Process. The Service request primitive associated with such a frame conveys the values of the source and destination address fields received in the Service indication primitive. Refer to Figure 1-2 and Figure 1-3 for the mappings.~~

~~Bridged frames with a Multicast and Broadcast destination address are broadcast around the RPR.~~

~~Bridged frames with a destination address of a station on the RPR (i.e., a known destination address) is forwarded to the station using internal 802.17 MAC topology and steering tables.~~

~~Bridged frames with an unknown destination address (e.g., a destination address not matching a RPR station address) are flooded over the RPR.~~

F.3.3 Frame Reception

The individual MAC entity associated with each bridge port examines all frames received on the RPR ringlet to which it is attached. The value of the RPR *destination_station_ID* and *flooding_indicator* in the MAC frame determines the frame reception rules. The *flooding_indicator* is *true* (*set)* if either the *basic_flooding_indicator* or *enhanced_flooding_indicator* is *true (set)*.

1) If the *flooding_indicator* is set, the frame is copied to the station's ISS. The frame is stripped in accordance with the flooding algorithm (clause F.7).
2) If the RPR *destination_Station_ID* matches the receiving station's address, the frame is stripped from the ring and copied to the station's ISS/EISS.
3) If the *destination_Station_ID* does not match the receiving station's address and the *flooding_indicator* or *enhanced_flooding_indicator* is not set, then the frame is not copied to the station's ISS/EISS.

All error-free received frames are passed to the RPR ISS give rise to M_UNITDATA indication primitives which shall be handled as follows:

Note - A frame that is in error, as defined by the relevant MAC specification, is discarded by the MAC entity without giving rise to any M_UNITDATA indication; see 6.4.

The RPR ISS provides the M_UNITDATA indication primitive, frame_type and mac_action parameter values of user_data_frame and request_with_no_response respectively to the learning and forwarding processes in the MAC relay entity.

Frames with other values of frame_type and mac_action parameters (e.g., request_with_response and response frames), shall not be submitted to the forwarding process. They may be submitted to the learning process.

Frames with a frame_type of user_data_frame and addressed to the bridge port as an end station shall be submitted to LLC. Such frames carry either the individual MAC address of the port or a group address associated with the port (7.12) in the destination address field. Frames submitted to LLC can also be submitted to the learning and forwarding processes, as specified above.

Frames addressed to a bridge port as an end station, and relayed to that bridge port from other bridge ports in the same bridge by the forwarding process, shall also be submitted to LLC.

No other frames shall be submitted to LLC.

F.3.3.1 802.17 MAC Handling of Frames to be Bridged

Editors' Notes: *To be removed prior to final publication.*

This section provides the original draft D03 description of bridging receive rules. This is replaced with the above description that includes the revisions to the basic bridging model.

~~The 802.17 MAC transit data path needs to incorporate logic to determine whether the received frame should be:~~

~~a) Dropped. The frame is stripped from the Ring and passed to a MAC client.~~
~~b) Discarded. The frame is stripped from the Ring and not passed to any MAC client. The frame is discarded.~~
~~c) Passed Through. The frame is passed to the tandem buffer and dispatched to the outgoing Ringlet.~~
~~d) Replicated. The frame is replicated prior to the transit path drop point. One copy of the frame is Passed Through, and the other copy is Dropped.~~

~~Figure F.6 depicts a simplified diagram of the 802.17 MAC transit data path. Refer to Clause 6 of the 802.17 Draft for a complete description of the 802.17 MAC transit path.~~

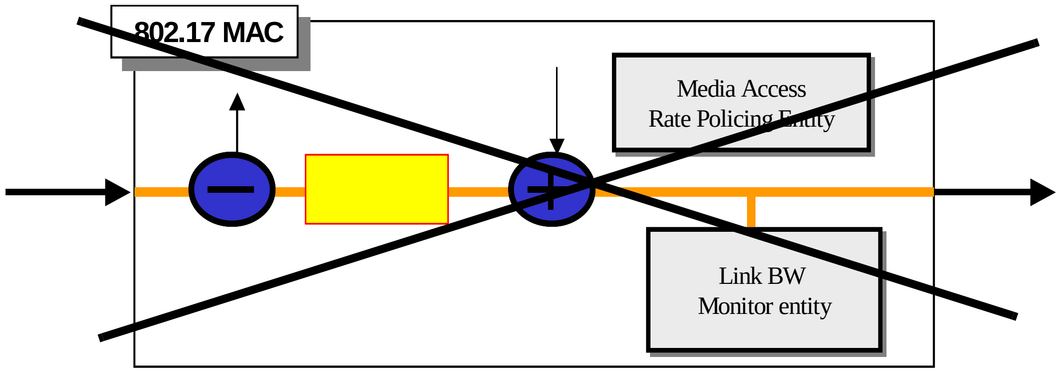

Figure F.6—Simplified 802.17 MAC Transit Path

~~When Bridging is provisioned on the RPR station, the Layer Management Element sets a state used by the 802.17 MAC transit path to indicate that Bridging is configured. The Drop/Discard point in the 802.17 MAC transit path needs to incorporate the following logic:~~

a) ~~If the Destination Address (DA) associated with the received frame matches the RPR Station's MAC address, and Bridging is configured on the Station, the frame is Dropped and passed to the MAC Relay Entity.~~

b) ~~If the DA of the received frame is not that of the RPR Station, and Bridging is configured on the Station, the frame is Replicated.~~

> ~~***Editors' Notes:*** *To be removed prior to final publication.*~~
>
> ~~*Anytime unicast traffic is dropped by one station and replicated by others to their bridging relay, we have an issue with persistent flooding. Upcoming BAH proposals need to address this issue.*~~

~~The aforementioned logic is an extension of the RPR MAC reception rules outlined in Clause 6 of the 802.17 Draft.~~

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F.3.4 Priority Mapping

Editors' Notes: *To be removed prior to final publication.*

There was a comment for 802.17 access priority to follow the access encoding used by 802.3 The resolution to this comment is BAH needs to look at this. Need to define how the User priority maps in to the 802.17 MAC service classes.

Table F.1—Outbound Access Priorities

User Priority	Outbound Access Priority per MAC method	
	802.3	802.17
0	0	0
1	0	1
2	0	2
3	0	3
4	0	4
5	0	5
6	0	6
7	0	7

F.4 Enhanced Bridging Model Overview

The MAC reference model for enhanced bridging is illustrated in Figure F.7. The RPR MAC consists of a MAC entity which provides the media access control functions to the pair of ringlets (ringlet0/ringlet1) of the RPR ring. The MAC communicates with the MAC client using the MA_unitdata.request and MA_unitdata.indication service primitives. The MAC communicates with the bridge relay using the M_unitdata.request, M_unitdata.indication, EM_unitdata.request, and EM_unitdata.indication primitives. In addition, the MAC supports the spatial reuse control sublayer (SRCS) which performs the spatial reuse control functions associated with the 802.17 media. The spatial reuse control sublayer provides the station and ringlet selection functions required to support spatial reuse while maintaining compatibility with 802.1D/802.1Q compliant bridges attached to the ring. The SRCS resides below the MSAP and supports the MA/ISS/EISS service interfaces to the MAC client and bridge relay.

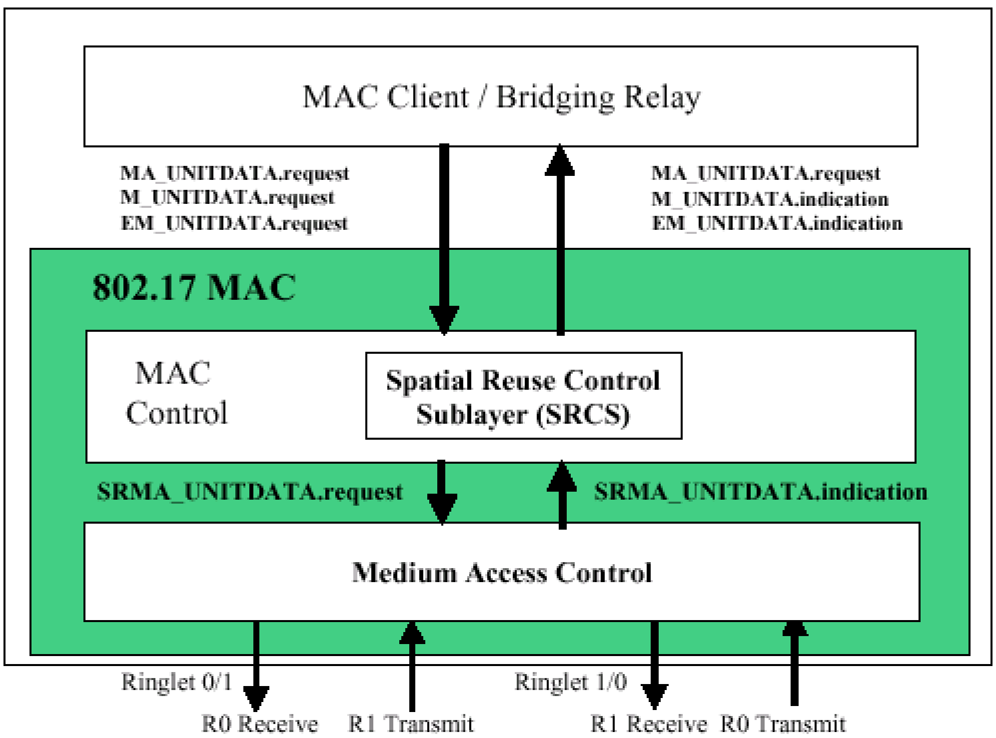

Figure F.7—802.17 Enhanced Bridging MAC Reference Model

F.4.1 Spatial Reuse Control Sublayer - Model of operation

The spatial reuse control sublayer provides the station and ringlet selection functions required to support spatial reuse of unicast and multicast traffic. The SRCS control sublayer contains a mapping function which is used to determine the destination ringlet and station Ids based on the end station destination MAC address and 802.1Q VLAN parameters (IEEE Std 802.1Q, 1998). The destination station identifier (DSID) and source station identifier (SSID) are specific identifiers in the transmitted frame which are used to determine how traffic is to be stripped from the ring. Inclusion of the VLAN parameters in the mapping algorithm provides general support for 802.1Q VLAN traffic, and support for disparate VLAN scenarios in which traffic destined to the same destination MAC address and different VIDs traverse through different stations on the ring. An example of this scenario may occur when the bridged network topology is using Multiple Spanning Tree protocol (IEEE draft P802.1s/D12 April 2002).

Figure F.8 below, provides an example of how unicast flows on the ring would operate when different VLANs between end station pairs traverse through different stations on the ring. In Figure F.8, end station 1 is LAN attached to bridge station A, and end station 2 is LAN attached to bridge stations B,C. Bridge stations A, B, C, are all attached to the same ring. End station 1 and end station 2 communicate via two separate VLANs, red and blue. Traffic on the red VLAN traverses stations A and B. Traffic on the blue VLAN traverses stations A and C. The mapping function in station A shall distinguish between unicast traffic in the red and blue VLANs destined for end station 2 and encode the corresponding DSID values in the transmitted frames. Station A shall encode unicast traffic to end station 2 in the red VLAN with station B's DSID and unicast traffic to end station 2 in the blue VLAN with station C's DSID. MAC frame reception rules are such that only the bridge relays of stations A and B see the unicast traffic between end stations 1 and 2 on the red VLAN, and bridge relay of stations A and C see the unicast traffic between end stations 1 and 2 on the blue VLAN. Unicast traffic passing through the MAC transit path of intermediate stations (frames with a differing unicast DSID) shall not copy this traffic to their associated bridge relay. Consequently, bridge relays of intermediate stations shall not see unicast frames intended for a particular station on the ring.

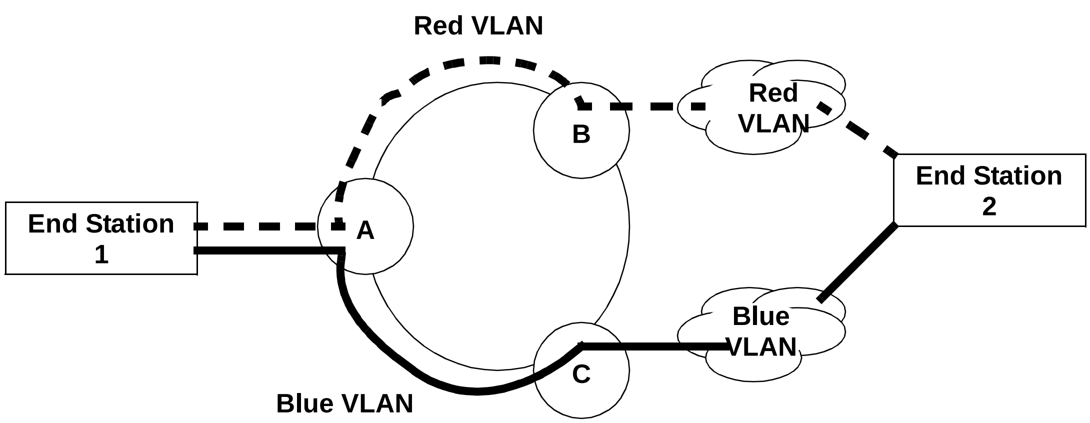

Figure F.8—Spatial reuse of spatially separate VLANs

The spatial reuse control sublayer encodes a DSID and SSID in the RPR frame. These are passed to the medium access control layer using the SRMA_unitdata.request primitive. The DSID is used to by the destination station to strip the frame from the ring. The SSID is used by the destination station to update its mapping table with the end station MAC source address, SSID, and VLAN information in received frames. This information is passed by medium access control layer to the SRCS using the SRMA_unitdata.indication primitive. This information is used by the source station when transmitting to a known destination station. The SRCS manages the learning and aging of mapping table entries to ensure that mapping table entries do not become stale with changes in network topology. The SRCS also ensures that unicast frames which are intended to be destination stripped are properly transmitted on the ring, in order to maintain the integrity of learning operations for 802.1D/802.1Q bridges attached to the ring. In general, intermediate bridges seeing unicast traffic from station 1 to station 2, must also see traffic from station 2 to station 1. Scenarios where an intermediate bridge sees unicast traffic from one state and not the other adversely affects the bridge's learning process. The enhanced frame transmission/reception rules prevent this scenario by intermediate bridges not receiving known unicast traffic destined for another station on the ring. Broadcast and unknown traffic is encoded with the flooding indicator and is received by all bridge relays on the ring using the flooding algorithm.

Multicast bridge traffic can also achieve spatial reuse. Multicast traffic transmitted by a source station, traverses the ring and is stripped by the farthest station in the multicast group. Intermediate stations copy the multicast traffic from the ring to their respective bridging relays. The transmitting station encodes the station ID of the multicast station in the group which is intended to strip the frame from the ring. Multicast traffic shall have the flooding indicator set, indicating that intermediate stations shall copy the frame. Intermediate stations shall receive all frames having the flooding indicator set and pass to their bridge relay.

The SRCS sublayer supports both basic and enhanced bridging models. In the basic model, all bridge traffic is flooded (all stations including intermediate ones receive a copy). In the enhanced model, known unicast traffic is only received by the intended receiver (intermediate stations do not receive a copy). Stations implementing the basic model, not only must flood all their bridge traffic, all response traffic intended for end stations behind a basic bridge station must also be flooded. Stations supporting the enhanced bridging model, need to properly interoperate with stations implementing the basic model. This ensures consistency across all stations on the ring for traffic sourced by the basic devices and traffic sourced by the enhanced devices. Enhanced bridge stations are able to identify traffic originating from basic devices and adjust their mapping table learning process such that all response frames are flooded. This occurs by having a unique indication of traffic that is flooded by basic devices that is distinct from traffic which is flooded by enhanced devices. One method for ensuring that traffic to basic devices is always flooded is by inhibiting learning of SIDs/MAC bindings in the SRCS mapping table of frames marked with the basic flooding indicator. The default rule for the SRCS mapping table is unknown entries are always flooded.

The model of operation described above is simply a basis for describing the spatial reuse control functionality within the MAC. It is in no way intended to constrain real implementations of the MAC or the MAC client layer; these may adopt any internal model of operation compatible with the externally visible behavior that this standard specifies. Conformance of equipment to this standard is purely in respect of observable protocol.

F.4.2 SRCS Mapping Table

The SRCS maintains a mapping table for mapping egress frames received from the bridge relay on to the ring. The purpose of the mapping table is to resolve the destination station identifier (DSID) from the MAC destination address and 802.1Q VLAN parameters. Mapping table entries are created dynamically through a learning process from traffic received by the MAC and copied to its associated bridge relay. The mapping table format and procedure for resolving and learning MAC/VID entries follows the format and procedures outlined in (IEEE Std 802.1Q-1998, clauses 6.4 and 8.11.7) whereby VIDs are first resolved to an FID, and the MAC destination address and FID pair are used to search the station mapping table during the transmission and learning processes. During the transmission process, the station mapping table is searched to resolve the DSID. If a mapping table entry is not found during the transmission process, the transmitted frame is flooded. Frames which are copied to the bridge relay during the receive process, the station mapping table is updated with the MAC source address, FID, and SSID paramerters derived from the received frame.

The binding allocation of VIDs to FIDs in the station mapping table shall follow the same set of VID to FID allocations made in the station's bridge relay filtering database. The VID to FID allocations in the SRCS are configurable through the MAC layer management entity, and may be directly configured by the bridge management control function per the allocations defined in the bridge VLAN Learning Constraints managed (802.1Q, clause 12.10.3).

F.4.3 Mapping of UNITDATA.request/indication primitives to 802.17 frame format

The following figure illustrates the mapping of the UNITDATA.request / UNITDATA.indication primitives to the MAC frame format.

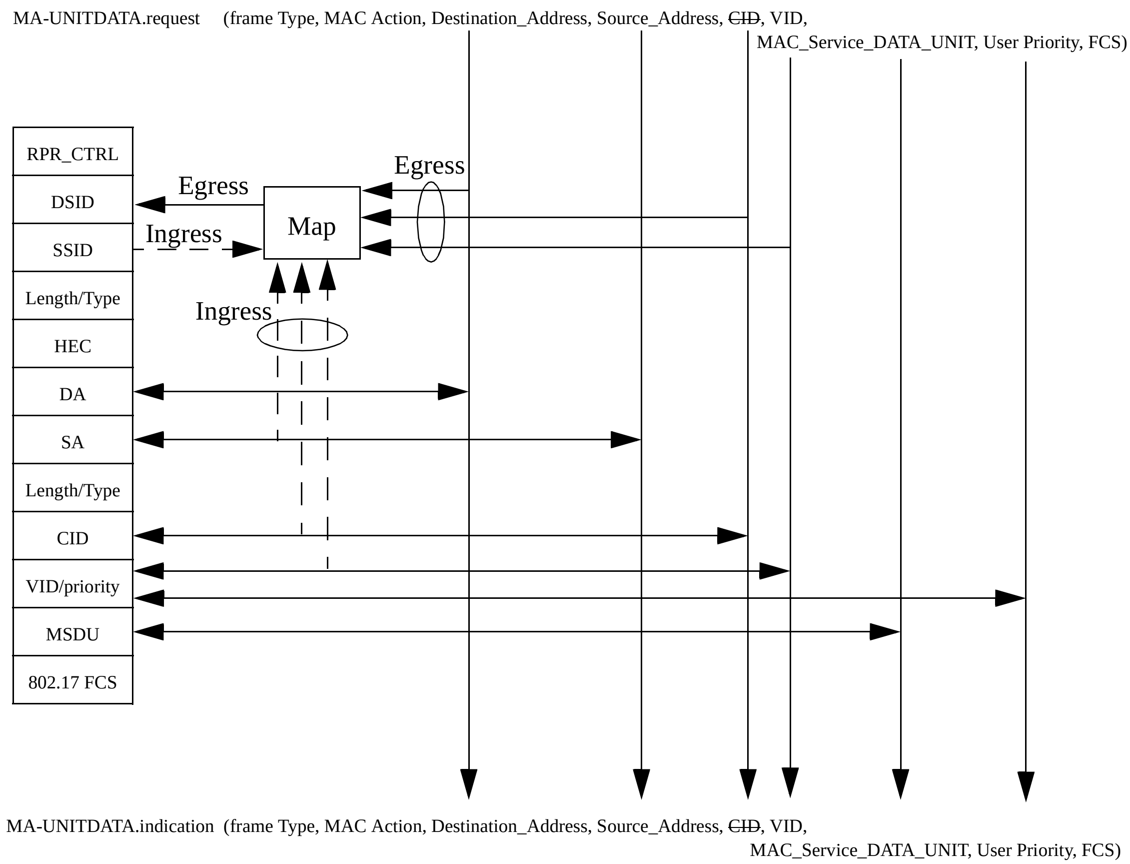

Figure F.9—UNITDATA request/indication primitive mapping

On receipt of an M_UNITDATA.request primitive, the local MAC Entity performs Transmit Data Encapsulation, assembling a frame using the parameters supplied as specified below (clause 5). On receipt of a MAC frame by Receive Media Access Management, the MAC frame is passed to Receive Data Decapsulation, which validates the FCS and disassembles the frame, as specified below, into the parameters that are supplied with an M_UNITDATA.indication primitive (clause 5).

The **frame_type** parameter takes only the value user_data_frame and is not explicitly encoded in MAC frames.

The **mac_action** parameter takes only the value request_with_no_response and is not explicitly encoded in MAC frames.

The **destination_address** parameter is encoded in the destination address field of the MAC frame (clause 8).

The **source_address** parameter is encoded in the source address field of the MAC frame (clause 8).

The number of octets in the mac_service_data_unit parameter is encoded in the length field of the MAC frame (clause 8), and the octets of data are encoded in the data field (clause 8).

The **user_priority** parameter provided in a data request primitive is encoded in corresponding priority bits of the RPR control header of the transmitted frame. The user_priority parameter provided in a data indication primitive takes the value of the corresponding priority bits of the RPR control header of the received frame.

The **HEC** of the MAC frame is computed as a function of the DSID, SSID, length/type, and RPR header control fields of the transmitted frame.

~~The **CID** parameter is an optional parameter indicating a customer separation identifier and is encoded in the CID field of the MAC frame. The CID parameter is indicated by the length/type field of the MAC frame.~~

The **VID** parameter is an optional parameter indicating a 802.1Q VLAN identifier and is encoded in the VID field of the MAC frame. The VID parameter is indicated by the length/type field of the MAC frame.

The MAC_frame_check_sequence of the MAC frame is re-computed as a function of the ~~CID~~, VID, and MAC_Service_Data_Unit (clause ?.?.?).

The **frame_check_sequence** parameter in the MA_UNITDATA.request is defined as an unspecified value, signaling the underlying MAC to regenerate the FCS. The FCS in the MA_UNITDATA.indication is set to either valid or invalid based on whether the FCS of the receive frame is valid/invalid.

The **DSID** of the MAC frame is a function of mapping the destination_address, ~~optional CID~~, and optional VID parameters through the SRCS transmit mapping table (see clause F.4.2 for mapping table specifics). If the destination_address, ~~CID~~, VID parameters resolve to an unknown or broacast address the *enhanced_flooding_indication* is set to *true* in the frame.

The **SSID** of the MAC frame is computed based on the transmitting station's station ID.

NOTE 1—IEEE Std 802.3, 1998 Edition, describes the use of either a Length or an Ethernet protocol type in its frame

format; however, the text of this subclause has yet to be revised to describe the use of Ethernet protocol types.

F.4.4 Frame transmission

The individual MAC entity associated with each bridge port transmits frames submitted to it by the bridge relay entity.

Relayed frames for transmission by the forwarding process are submitted to the ISS. The M_UNITDATA.request primitive associated with such frames conveys the values of the client MAC source and destination address fields received in the corresponding M_UNITDATA.indication primitive.

LLC protocol data units (PDUs) are submitted by the LLC as a user of the MAC service provided by the bridge port. Frames transmitted to convey such PDUs carry the individual client MAC address of the port in the source address field. All LLC PDUs are submitted by the MAC client. The SRCS in turn performs the same MAC destination address to RPR *destination_station_ID* and *destination_address* mapping as described below for frames submitted by the bridge relay entity.

Each frame is transmitted subject to the following procedure associated with the RPR MAC. The values of the frame_type and mac_action parameters of the corresponding M_UNIT-DATA. request primitive shall be user_data_frame and request_with_no_response, respectively (6.5).

The end station MAC destination address and VID (if present) is used by the SRCS control mapping function to determine the DSID in the transmitted frame. The mapping table search function shall yield one of the following results:

1) Known unicast - The associated *DSID* and *ringletID* are extracted from the table. The RPR *destination_station_ID* is included in the RPR frame. The *enhanced_flooding_indicator* is set to *false*. and the packet is transmitted on the ringlet based on the associated *ringletID*.
2) Known multicast - The associated *DSID(s)* and *ringletID(s)* are extracted from the table. The RPR *destination_station_ID* is included in the RPR frame. The *enhanced_flooding_indicator* is set to *true*. and the packet is transmitted on the ringlet(s) based on the associated *ringletID*(s). A multicast frame may be transmitted on either one or both ringlets depending on whether unidirectional or bidirectional transmission is used.
3) Unknown unicast, unknown multicast - If the end station MAC destination address and VID (optional) is not found in the mapping table, the *enhanced_flooding_indicator* is set to *true*, and the resulting frame is flooded on the ring (clause F.7).
4) Broadcast - The *enhanced_flooding_indicator* is set to *true*, and the resulting frame is flooded on the ring (clause F.7).

The SSID in the transmitted frame, should be set to the transmitting station's source station identifier.

F.4.5 Frame reception

The individual MAC entity associated with each bridge port examines all frames received on the RPR ringlet to which it is attached. The RPR *destination_station_ID* and *flooding_indicator* in the RPR frame determines the frame reception rules. The *flooding_indicator* is *true* (*set)* if either the *basic_flooding_indicator* or *enhanced_flooding_indicator* is *true (set)*.

1) If the *flooding_indicator* is set, the frame is copied to the station's ISS. The frame is stripped in accordance with the flooding algorithm (see Note below).
2) If the RPR *destination_Station_ID* matches the receiving station's address, the frame is stripped from the ring and copied to the station's ISS/EISS.
3) If the *destination_Station_ID* does not match the receiving station's address and the *flooding_indicator* is not set, then the frame is not copied to the station's ISS/EISS.

All error-free received frames passed to the ISS give rise to M_UNITDATA indication primitives which shall be handled as follows:

A frame that is in error, as defined by the relevant MAC specification, is discarded by the MAC entity without giving rise to any M_UNITDATA indication; see 6.4.

All frames copied by the receiving station to the ISS (not having the *basic_flooding_indicator* set) results in the SRCS updating its mapping table with the client MAC source address, its associated ~~CID~~/VID (if available), and the RPR *source_station_ID* address from the RPR frame. This entry replaces any previous entry in the table having the same MAC source address/~~CID~~/VID value. This ensures the mapping table is updated with the most recent station ID associated with the MAC address. If the *basic_flooding_indicator* is set, no update is made by the SRCS to the mapping table. The ISS provides the M_UNITDATA indication primitive, frame_type and mac_action parameter values of user_data_frame and request_with_no_response respectively to the learning and forwarding processes in the bridge relay entity.

Frames with other values of frame_type and mac_action parameters (e.g., request_with_response and response frames), shall not be submitted to the forwarding process. They may be submitted to the learning process.

Frames with a frame_type of user_data_frame and addressed to the bridge port as an end station shall be submitted to LLC. Such frames carry either the individual MAC address of the port or a group address associated with the port (7.12) in the destination address field. Frames submitted to LLC can also be submitted to the learning and forwarding processes, as specified above.

Frames addressed to a bridge port as an end station, and relayed to that bridge port from other bridge ports in the same bridge by the forwarding process, shall also be submitted to LLC.

No other frames shall be submitted to LLC.

F.4.6 Aging of Station Ids from mapping table

Stations may temporarily not be reachable due to end station moves, or changes in the network topology. Entries in the station ID mapping table must have an aging timer. When the timer expires, entries are removed allowing frames with aged entries to be retransmitted to all stations on the ring. This allows traffic to reach stations which may be in new portions of the network, which were not reachable due to outdated mapping table entries. The default value of the *aging_timer* can be configured through the LME.

Bridge stations that are participating in Spanning Tree Protocol [IEEE Std 802.1D, 1998 Edition] shall also use the time out information signaled in Configuration BPDUs and the Forwarding Delay value to affect aging of mapping table entries. Bridge station receiving a STP Configuration BPDU advancing its forwarding delay value shall also broadcast an RPR forward_delay control message on the ring. All stations receiving the *forward_delay* control message advance their aging timers on SRCS mapping table entries. The default value of the *forward_delay* value is also set through the LME.

F.5 802.17 End Stations

802.17 End Stations shall support either the basic or enhanced bridging models depending on whether they implement the SRCS. Support for the SRCS is optional. If the end station supports the SRCS, it shall use the enhanced procedures outlined in section F.4. If the end station does not support SRCS, it shall use the basic procedures outlined in section F.3. In either case, basic or enhanced end stations shall have the ability to employ destination stripping of unicast/multicast traffic when transmitting to other end stations on the ring using the following procedures.

F.5.1 Basic End Stations

In addition to the supporting the procedures outlined in section F.3, the basic end station shall support the following modifications to its transmission rules:

1) If the end station MAC destination address is found in the local topology image, the destination MAC address is set in the RPR frame, and the frame is unicast on the ring.
2) If the end station MAC destination address is not found in the local topology image, the *basic_flooding_indication* is set to *true*, and the frame is flooded on the ring.

F.5.2 Enhanced End Stations

In addition to the supporting the procedures outlined in section F.4, the enhanced end station shall support the following modifications to its transmission rules:

1) If the end station MAC destination address is found in the local topology image, the destination MAC address is set in the RPR frame, and the frame is unicast on the ring.
2) If the end station MAC destination address is not found in the local topology image, the DSID is encoded based on the resolving the destination_MAC_address/VID in its mapping table.

F.6 Bridge Protocol Entity Interactions

The MAC will provide a MAC sub-layer that will conform to Section 2.2.2 of IEEE 802.2 Std.

F.7 Flooding

Editors' Notes: *To be removed prior to final publication.*

Separate text from the flooding sub-group will be incorporated to describe flooding of bridge traffic replacing the original draft 0.3 writeup (below).

F.7.1 Flooding Packet over 802.17

~~An 802.17 MAC floods a packet of the 802.17 shared media, by replicating and dispatching the packet(s) over both directions of the Ring. The TTL field, found in the RPR header, is set such that each station on the Ring only sees the packet once. Figure F.10 illustrates the operation of flooding a packet over the RPR. During protection events, flooding procedures should follow recommendations in clause 11.2.3~~.

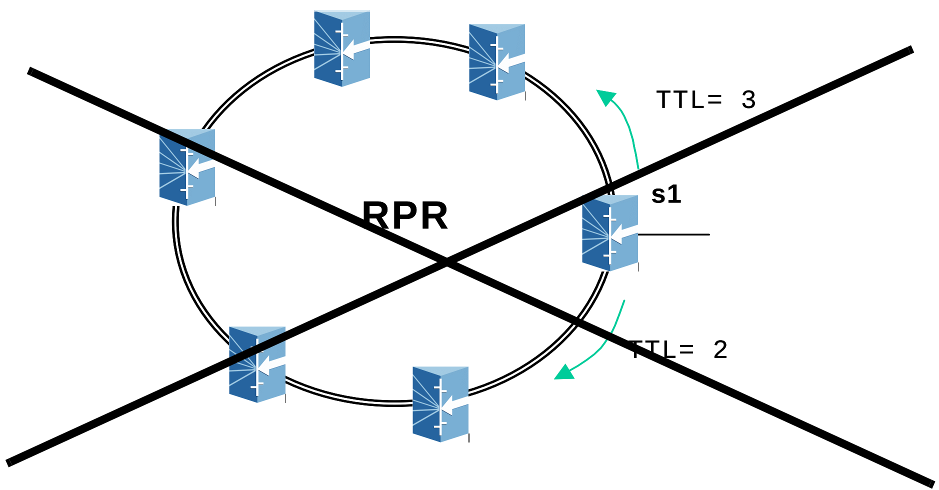

Figure F.10—Flooding Packets over RPR

F.8 RPR Frame Format Encoding

Editors' Notes: *To be removed prior to final publication.*

This section provides information on frame format encoding parameters that are used to support basic and enhanced bridging. The logical form of these parameters are used in the main body of Annex F. This subsection identifies how the logical parameters could be mapped onto the various frame format encodings proposed by the BAH subgroup. This section is strictly for illustrative purposes and will be removed once a particular frame encoding scheme is adopted. Other encoding variants are possible.

Table 0.1—Frame format encoding

Logical parameter	8 bit SID Encoding TTL stripping of flood traffic	48 bit SID Encoding TTL stripping of flood traffic	8 bit SID Encoding DSID stripping of flood traffic	48 bit SID Encoding DSID stripping of flood traffic
Basic Flood Indicator	0xFFh	0xFDFFFFh	MSB (DSID), MSB (SSID) = 11b	Octet 0/LSB (DSID), Octet 0/ LSB(SSID) = 11b
Enhanced Flood Indicator	0xFEh	RAC assigned multicast address	MSB (DSID), MSB (SSID) = 10b	Octet 0/LSB (DSID), Octet 0/ LSB(SSID) = 10b
DSID	1 - 253d	RAC assigned 48-bit Unicast address	1 - 127	RAC assigned 48-bit Unicast address
SSID	1 - 253d	RAC assigned 48-bit Unicast address	1 - 127	RAC assigned 48-bit Unicast address
Multicast Indicator	I/G Bit of destination MAC address	I/G Bit of destination MAC address	MSB (DSID), MSB (SSID) = 10b	Octet 0/LSB (DSID), Octet 0/ LSB(SSID) = 10b