CHAPTER 1

IEEE 802.17b: Spatially aware bridging over RPR

1.1 Overview

This clause specifies an optional sublayer of the MAC that supports efficient bandwidth utilization, via spatial reuse, for applications on RPR that involve bridging clients. Spatial reuse is the concurrent transfer of independent traffic on non-overlapping portions of a ringlet.

1.1.1 Terminology

The following terms have special meaning within the context of this standard.

directed transmission: The transmission of a frame by a source station to a designated (unicast) destination address on the ring.

undirected transmission: The transmission of a frame by a source station to all stations on the ring. The frame is flooded over the ring.

remote address: A MAC address of a client that is not resident on the ring. An off-ring address.

1.1.2 Architecture overview

The optional sublayer specified by this clause will be referred to as a spatially aware sublayer/shim (SAS). The basic operation of the SAS will associate a remote address and optional accompanying VLAN identifier with a RPR station MAC that provides an attachment interface to the client identified by the remote address. This

association will be used to support directed transmissions over the ring when the requested client destination address is a remote address.

Consequently, with SAS, learned addresses use directed transmission over the ring (via unicast target addressing), rather than undirected transmissions over the ring (via flooding indicators).

SAS supports one of the key features of RPR, specifically bandwidth efficiency, that can distinguish it from other network interconnects. Design strategies employed by SAS increase effective bandwidth utilization beyond those of a broadcast ring, when IEEE 802.1 packet switching technologies are used over the ring.

1.2 Spatially aware sublayer (SAS) reference model

The media access control (MAC) service and reference model described in section 6.1 is adhered to. Figure1 provides an illustration of the SAS within the RPR layer model and its relationship to the open systems interconnect (OSI) reference model. The spatially aware sublayer are specified by this clause.

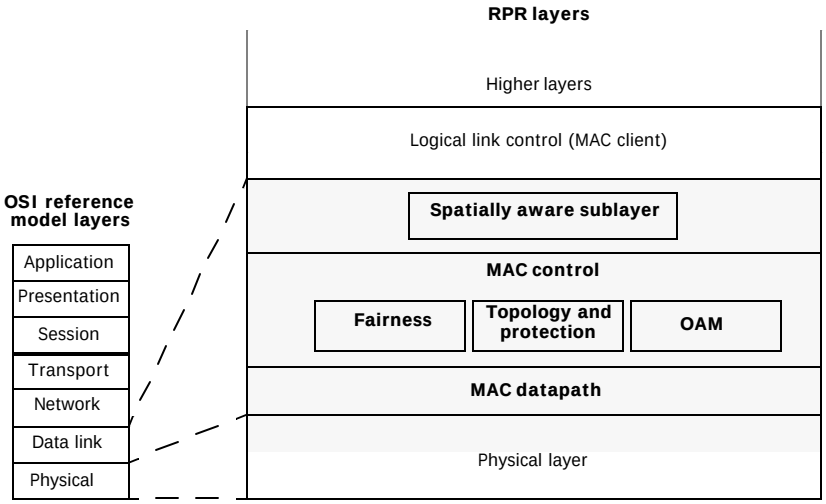

FIGURE 1. RPR service and reference model relationship to the ISO/IEC OSI reference model

The MAC service interface (as described in 6.4) provides service primitives used by MAC clients to exchange data with one or more peer clients, or to transfer local control information between the MAC and MAC client.

1.3 Principles of operation

This section establishes the principles of operation of the SAS. The principal elements of the SAS operation are:

a) Frame transmission mode (i.e., directed or undirected).

b) Associating remote addresses and VID with local RPR addresses.

c) Maintenance of the information required to make frame transmission mode decisions.

d) Management of the above.

1.3.1 Frame transmission

Frames submitted to the SAS by a MAC client are observed. The transmission modes supported are directed and undirected.

Directed transmission describe frame transmissions where the target address of a frame being dispatched over RPR is a unicast station address on the ring, and flooding of the frame does not occur. Only the targeted RPR station will process the frame.

Undirected transmission describe frame transmissions where a target station to process the transmitted frame is unknown. The frame is consequently flooded over the ring. Under normal operations, all stations on the ring will process such frames.

Transmission mode decisions are made based on:

a) The destination MAC address carried in a received frame.

b) The VID associated with the received frame.

c) The information contained in the SAS filtering database for that MAC address and VID.

If a RPR MAC address is associated with the received client destination MAC address and VID, then directed transmission is used. Specifically, the *da* field in the *rprHeader* will be populated with the RPR MAC address. The *fi* sub field of the *extendedControl* field is set to FI_NONE.

If a RPR MAC address is not found (i.e., is not associated with the received client destination MAC address and VID), then undirected transmission is used. Specifically, the *da* field in the *rprHeader* will be populated with a special reserved RPR group address. The *fi* sub field of the *extendedControl* field is set to FI_UNDIR or FI_BIDIR.

1.3.1.1 MAC service support

The MAC service interface is described in section 6.4.

The SAS shall observe and potentially amend the MA_DATA service request primitives from a MAC client. The SAS may observe the MA_CONTROL service request primitives.

Figure2 and Figure 3 provide a typical illustrations of how SAS will observe a MA_DATA service request primitive and amend it prior to dispatch to the MAC control sublayer.

Figure2 assumes that the client destination address has been learned. This results in a directed transmission.

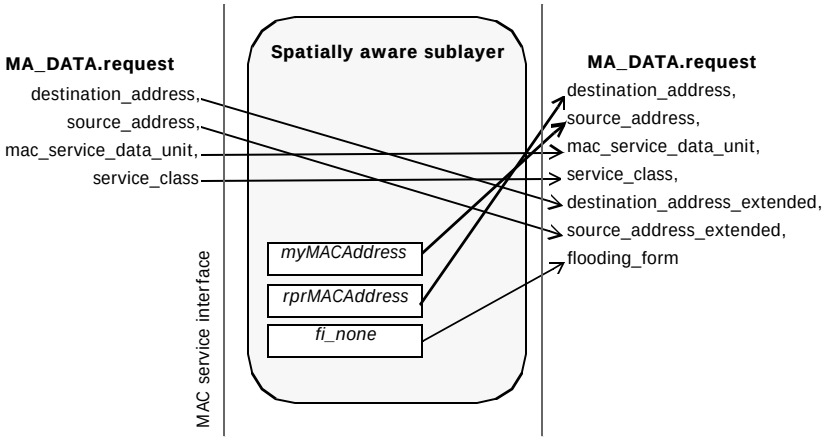

FIGURE 2. SAS and service data request - directed transmission

Figure3 assumes that the client destination address has not been learned. This results in a undirected transmission.

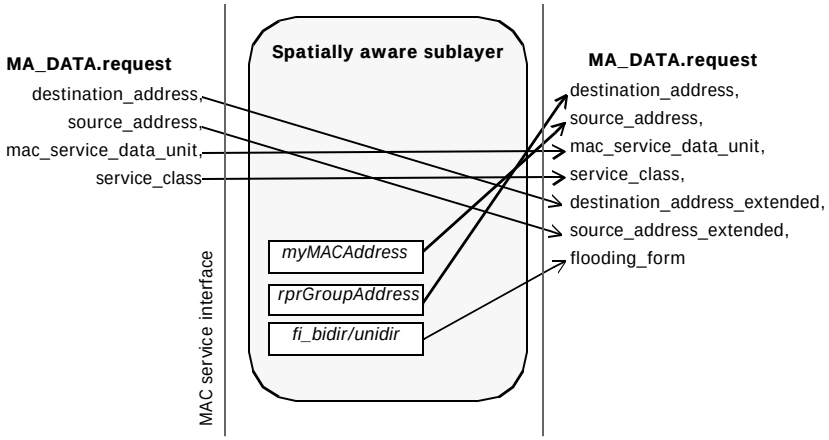

FIGURE 3. SAS and service data request - undirected transmission

The SAS shall observe the MA_DATA service indication primitives destined to a MAC client.

Observation of the following MA_DATA service indication parameters will be used by SAS to associate client MAC addresses and optional VID with the RPR MAC address providing the attachment:

- source_address
- mac_service_data_unit (to extract VID if present)
- source_address_extended

1.3.2 Learning process

The learning process used by SAS observes the source MAC address and VID of received frames along with the source RPR MAC address sourcing the client frame. It records such information in the filtering database. It shall create or update a dynamic filtering entry, if and only if:

a) The source address field of the frame denotes a specific end station (i.e., is not a group MAC address), and

b) The resulting number of entries would not exceed the capacity of the filtering database, and

c) The destination address found in the *rprHeader* field is the special RPR reserved group address, or

d) The destination address found in the *rprHeader* is a unicast MAC address and the flooding indication field is set to FI_NONE.

If the filtering database is already filled up to its capacity, but a new entry would otherwise be made, then an existing entry may be removed to make room for the new entry.

1.3.3 Filtering database

The SAS filtering database supports queries by the frame transmission process as to whether received client frames, with a given destination MAC address and VID, are to be directed to a designated RPR MAC address. It contains filtering information in the form of filtering entries that are either:

a) Static, and explicitly configured by management action; or

b) Dynamic, and automatically entered into the filtering database. This operation is similar to the normal operation of the bridge relay filtering database operations.

Two entry types are used to represent static filtering information. The static filtering entry represents static information in the filtering database for individual and for group MAC Addresses. It allows administrative control of:

c) Forwarding of frames with particular destination addresses and VIDs; and

d) The inclusion in the filtering database of static filtering information, and use of this information.

The filtering database shall contain entries of the static filtering entry type.

The static VLAN registration entry represents all static information in the filtering database for VLANs. It allows administrative control of:

e) Forwarding of frames with particular VIDs; and

f) The inclusion in the filtering database of dynamic VLAN membership information, and use of this information.

The filtering database may contain entries of the static VLAN registration entry type.

Static filtering information can be added, modified, or removed from the filtering database only under explicit management control. It shall not be automatically removed by any ageing mechanism. Management of static filtering information may be carried out by use of the remote management capability specified in clause X.

A single entry type is used to represent dynamic filtering information. Dynamic filtering entries are used to specify the RPR MAC address on which individual client

MAC addresses have been learned. They are created and updated by the learning process (1.3.2), and are subject to ageing and removal by the filtering database.

Static and dynamic filtering entries comprise

g) A remote MAC address specification,

h) A VLAN identifier (VID),

i) A local target RPR MAC address associated with the remote MAC address specifiation and VID.

There are no standardized constraints on the size of the filtering database in an implementation for which conformance to this standard is claimed. The PICS Proforma requires the following to be specified for a given implementation:

j) The total number of entries (static filtering entries, and dynamic filtering entries) that the implementation of the filtering database can support.

1.3.3.1 Static filtering entries

A static filtering entry specifies

a) A remote MAC address specification, comprising
    1) An individual MAC address; or
    2) A group MAC address; or
    3) All group addresses, for which no more specific static filtering entry exists; or
    4) All unregistered group addresses, for which no more specific static filtering entry exists.
b) The VID of the VLAN to which the static filtering information applies.
c) A local target RPR MAC address specification associated with a remote destination MAC address and accompanying VID.

1.3.3.2 Static VLAN registration entries

A Static VLAN registration entry specifies

a) The VID of the VLAN to which the static filtering information applies;
b) A local target RPR MAC address specification associated with the VID.

A separate static VLAN registration entry with a distinct RPR MAC address may be created for each VLAN from which frames are received by the frame transmission process.

1.3.3.3 Dynamic filtering entries

A dynamic filtering entry specifies

a) An individual MAC address;

b) The VID of the VLAN to which the dynamic filtering information applies.

c) A local target RPR MAC address specification associated with a remote destination MAC address and accompanying VID.

Dynamic filtering entries are created and updated by the learning process (1.3.2). They shall be automatically removed after a specified time (i.e., ageing time) has elapsed since the entry was created or last updated. No more than one dynamic filtering entry shall be created in the filtering database for a given combination of MAC address and VID.

Dynamic filtering entries cannot be created or updated by management.

The ageing out of dynamic filtering entries ensures that end stations that have been moved to a different part of the bridged network will not be permanently prevented from receiving frames. It also takes account of changes in the active topology of the bridged network that can cause end stations to appear to move from the point of view of the bridge.

The ageing time may be set by management. A range of applicable values and a recommended default is specified in Table1. This is suggested to remove the need for explicit configuration in most cases. If the value of ageing time can be set by management, the SAS shall have the capability to use values in the range specified, with a granularity of 1 second.

TABLE 1. Ageing time parameter value

Parameter	Recommended default value	Range
Ageing time	300.0s	10.0-1 000 000.0s

1.3.3.4 Flushing database entries

The SAS filtering database shall clear all dynamic filtering entries whenever a ring topology change is detected. This will ensure that RPR stations that have been moved or are no longer accessible will not be permanently prevented from receiving frames.

The SAS shall observe MA_CONTROL service indication primitives dispatched by the MAC. Observation of the *opcode* parameter of the MA_CONTROL service indication primitive will be used to determine if the dynamic filtering entries should be removed from the filtering database. If the *opcode* parameter has a value of TOPO_CHANGE or PROT_CHANGE, then the dynamic filtering entries are removed.

1.3.3.5 Permanent database

The permanent database provides fixed storage for a number of static filtering entries. The filtering database shall be initialized with the filtering database entries contained in this fixed data store.

Entries may be added to and removed from the permanent database under explicit management control. Changes to the contents of static filtering entries in the permanent database do not affect frame transmission operations until such a time as the filtering database is re-initialized.

NOTE — This aspect of the permanent database can be viewed as providing a "boot image" for the filtering database, defining the contents of all initial entries, before any dynamic filtering information is added.