Spatial Aware Sublayer
Interop via Explicit Header Bit

Robert Castellano

Introduction

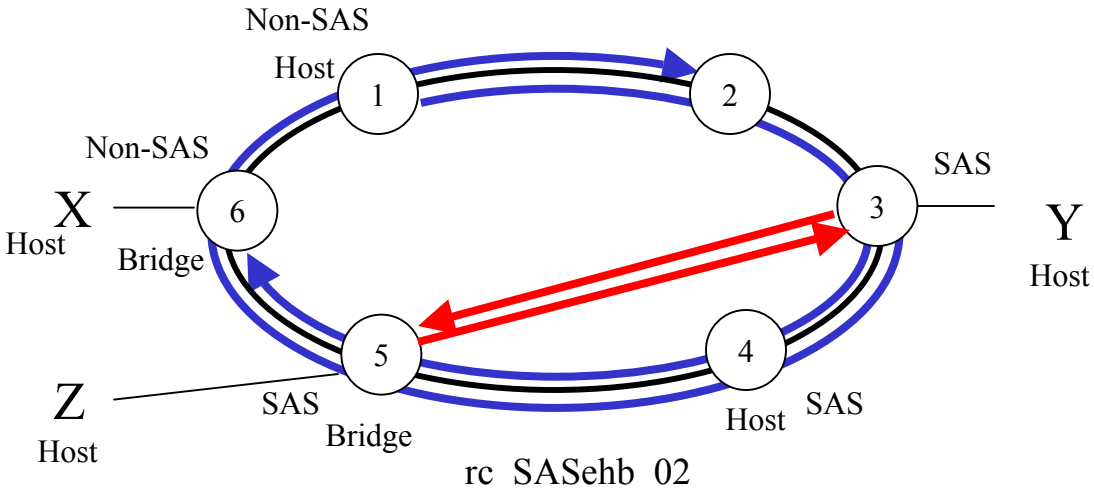
- Spatially Aware Sublayer (SAS) performs spatial reuse enhancements by selectively directing (not flooding) remote unicast and multicast traffic.

- Spatially Aware Sublayer (SAS) needs to be backwards compatible with 802.17 implementations which do not implement SAS

802.17 Backward Compatibility Requirements

- SAS needs to conform to bridging compatibility rules in 802.17, Annex F.
- Conformance to Annex F requires SAS to flood remote unicast traffic whenever it is intended for a remote host sitting behind a 802.17 bridge.

- Example - Why SAS must flood remote unicast traffic to 802.17 station
  - Station 1 and 6 are 802.17 stations. Station 3, 4 and 5 have SAS.
  - Station 3 must flood all remote unicast traffic (either remote SA or DA) that is not transmitted to a remote SAS.
  - If station 3 does not flood remote frames to station 1, results in bridging network issues described in 802.17 Annex F.



SAS Backwards Compatibility

- Backwards Compatibility requires SAS to know when it is sending unicast frames to a remote MAC address which is associated with a .17 bridge station having a SAS entity vs. non-SAS entity.

Proposed Compatibility Alternatives

- Three Proposals for 802.17 Compatibility
  - Reserved Group Address
  - Topology DB and ATD
  - Explicit Header Bit (EHB)

- All 3 proposals are similar in respect that each performs selective SDB learning during reception based on whether the receive frame originated from a SAS capable station or not.
- All 3 proposals use different methods to discover whether other stations on the ring support SAS.

Explicit Header Bit Method (EHB)

Explicit Header Bit Method (EHB)

- Define one of the 3 reserved bits in the extended frame header to indicate whether a frame originated from a SAS capable station or not. (aka. frame.SAS bit)
  - frame.SAS == 1 indicates frame originated from SAS capable station
  - frame.SAS== 0 indicates frame originated from non-SAS capable station
  - frame.SAS is always set by the MAC when SAS is enabled.
  - Additionally, EHB method also allows SAS to be implemented in the client.
  - In order to support client based SAS requires SAS parameter be included as an optional parameter to the MAC service interface.

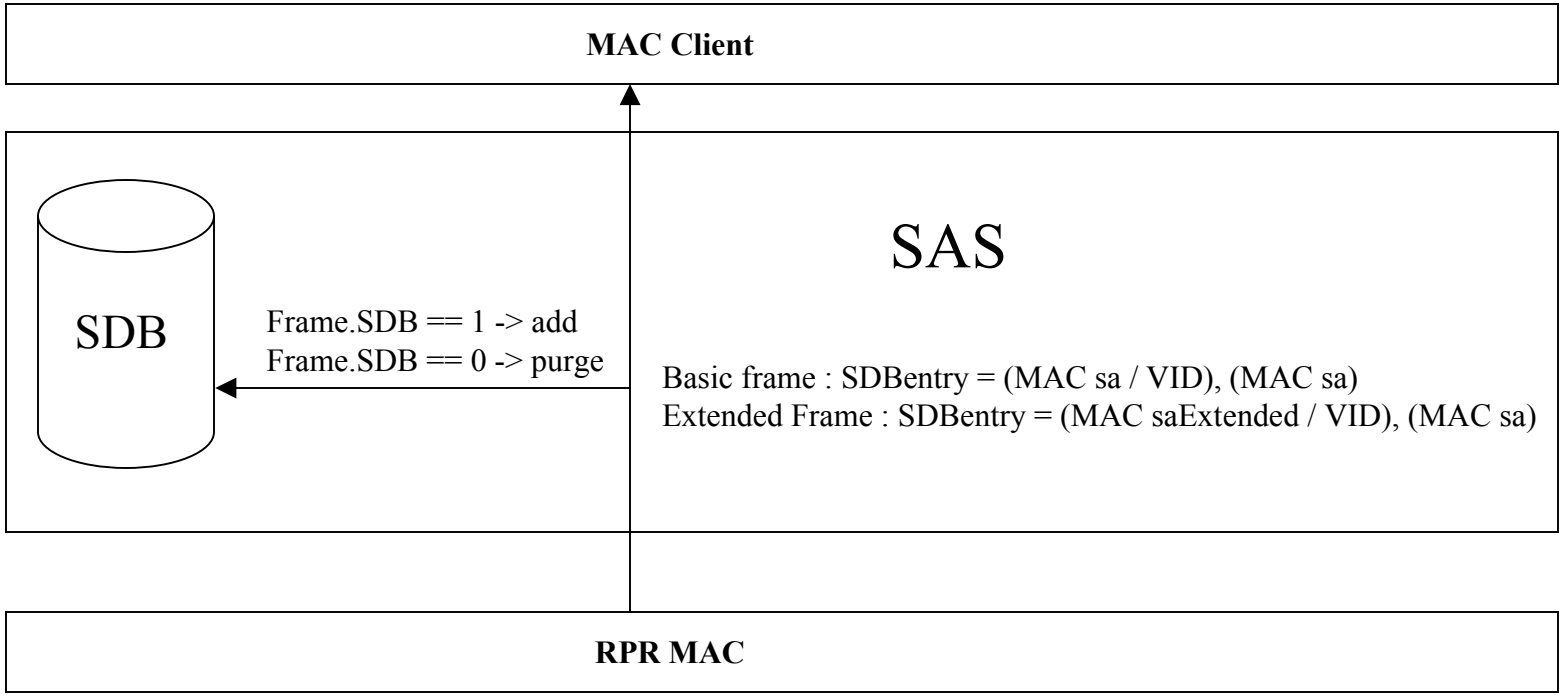
Explicit Header Bit Method (EHB)

- Definition of one of the reserved bits as frame.SAS bit is backwards compatible with 802.17
  - 802.17 currently defines these reserve bits as 0.
  - Reserve bit is both backwards compatible and interoperable with 802.17 MACs.
  - Frame.sas from 802.17 MACs will always be interpreted as non-SAS
  - 802.17 MACs would ignore the frame.SAS bit in frames received from SAS MACs

EHB Selective Learning

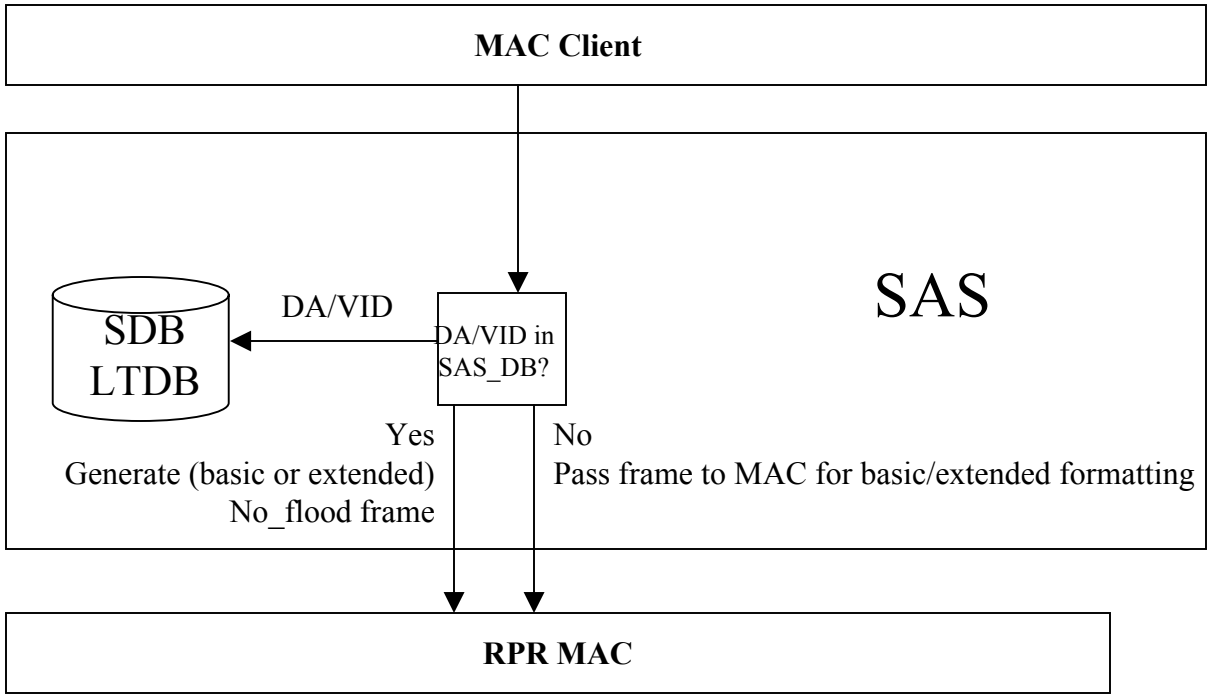
- Selective SDB learning in EHB is performed in the following manner
  - Frame.sas == 1 -> SDB Update
    Otherwise Remove SDB Entry
- Simple learning and purging of SDB entries.

EHB Selective SAS Learning



Bit in extended header method / 1

– Local-Local / Local-Remote identification and handling performed by SAS.



EHB in comparison to the attributes of RGA and Topology Methods

General Issues

- Independent VLAN Learning of Local Frames
- Need for an additional Source Station DB
- Complexity
- Purging of stale SDB entries on change from SAS to non-SAS.

EHB/RGA vs. Topology Methods

- Topology Method requires inclusion and exchange of SAS station capability in the topology messages.
  - RGA and EHB does not require SAS capability to be exchanged through topology
- Topology Method requires an additional source station DB (SSDB) in addition to SDB to be maintained in the receive datapath.
  - RGA and EHB only requires SDB
- Topology Method requires two lookups during the selective lookup. The first to lookup frame.SA for SAS capability. The second to do the associative SDB learn
  - RGA and EHB only require a single lookup

EHB/Topology vs. RGA

- RGA method ties learning of SAS capability to specific frame formats and types (I.e. basic and extended frames).
  - EHB and Topology learning is not tied to frame formats

- RGA does not support SDB learning from SAS capable stations transmitting using basic frame format. This prevents local-local frames having VIDs from being learned by the SDB. Local-remote basic frames from SAS capable stations also cannot be supported.
  - EHB and Topology methods can support learning of basic frames. This includes learning of local frames to support IVL, and learning of local-remote basic frames.

EHB/Topology vs. RGA

- RGA incorrectly resolves extended unicast frames from an 802.17 host as a SAS capable host.
  - EHB and Topology are able to properly discern extended unicast frames from a 802.17 host as SAS non-capable.

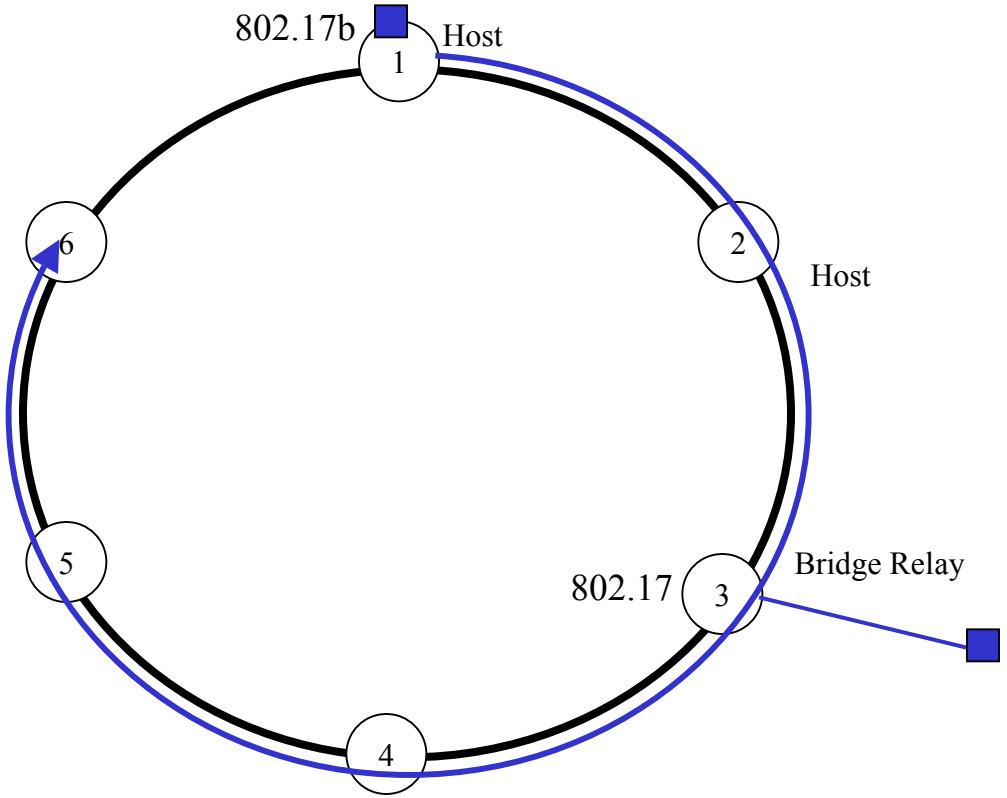
Selective Learning Comparison

	RGA	Topology	EHB
Does not require exchange of SAS parameters through Topology	Yes	No	Yes
Does not require an Associative or Relative Lookup during receive or maintaining a SAS state database in receive path (requires double lookup)	Yes	No	Yes
SDB learning occurs independent of basic/extended/local frame formats	No	Yes	Yes
Correctly resolve extended unicast from 802.17 host.	No	Yes	Yes
Ability to perform IVL of local frames	No	Yes	Yes
Purge SDB entries on change from SAS to non-SAS	?	Yes	Yes

Backup

Support of basic frame format from locally originated 802.17b hosts

EHB gives SAS the ability to transmit using basic frame format from local hosts to a remote station as is currently supported by 802.17.

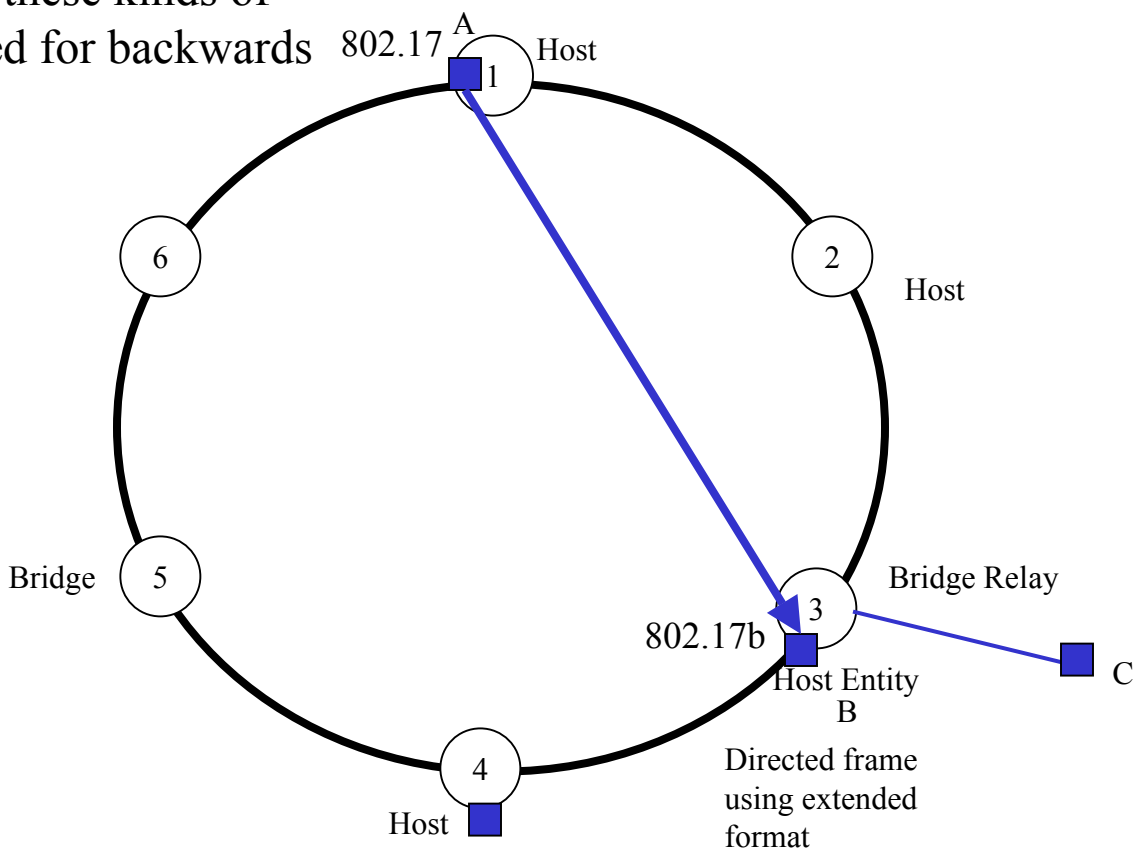


The MAC address method requires these host originated frames to be transmitted using extended frame format.

Resolve unicast extended frames from non-SAS hosts

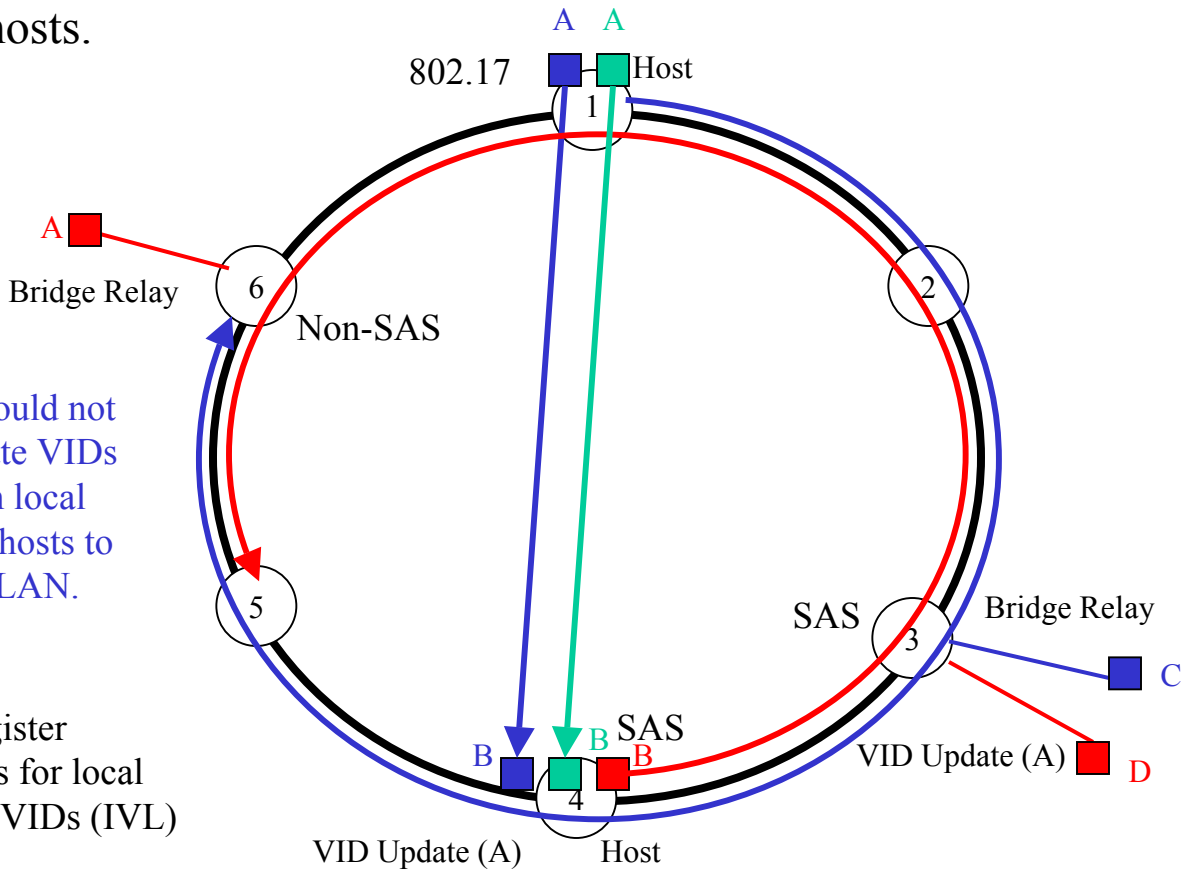
EHB gives SAS the ability to properly identify extended unicast frames originating from Non-SAS hosts. Proper handling of these kinds of transmissions should be required for backwards compatibility with 802.17.

The MAC address method incorrectly registers the Non-SAS host A as SAS capable. This causes the SAS entity at 3 to misdirect frames from C transmitted to A.



Update VID associations from local frames

EHB gives SAS the ability to update VID associations from frames transmitted by local hosts. SAS extends the number of VLANs supported by 802.17 hosts.



The MAC address method would not be able to automatically update VIDs received in basic frames from local 802.17 hosts limiting 802.17 hosts to supporting a single default VLAN.

SAS must be able to register independent SAS entries for local frames having different VIDs (IVL)

MAC Address Method / 1

- Selective Learning Rules

  (DA == RPR_reserved_group_address) /* Learn saExtended / VID */

  || (EF == 1 && FI==FI_NONE) /* Learn saExtended /VID */

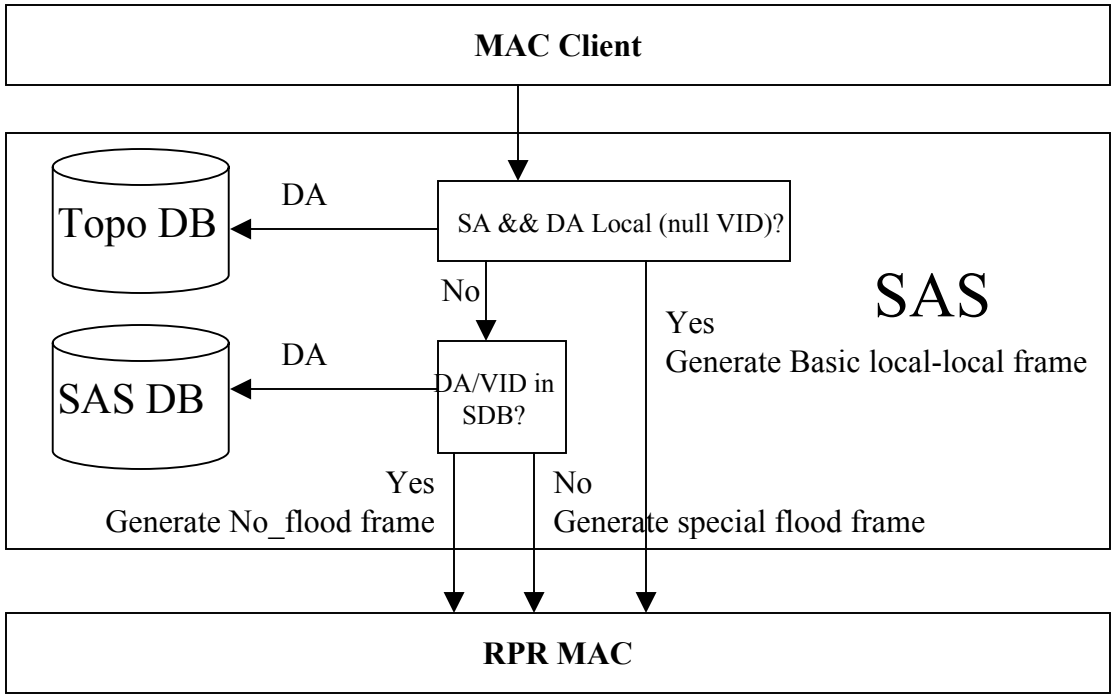
- Determining SAS layer support in local-local frames is ambiguous.
- SAS selective learning in a local SA to remote DA frame reception is difficult to make.
- To only learn for the first simple rule (DA == RPR_reserved_address) will result in SAS MAC addresses never being learned in certain network situations, producing persistent network flooding conditions.
  - A remote SAS MAC address will not be learned if it starts sending extended frames to a remote MAC address if SAS learning algorithm does not use rule 2.

MAC Address Method / 2

- Address look up on *saExtended / VID* (*SA / VID*) should be done for reception of every frame in order to compare associated SA with frame.SA. If associative SA does not match frame.SA, then the entry must either be updated or purged. Frame is entry is updated with new associative SA if learning is permitted, and entry is purged if it is not.

MAC Address Method / 3

– SAS needs to determine when to format transmit frames with a (DA == RPR_group_address) vs. basic frame format for local-local transmissions.



Topology Discovery Method

- Selective Learning Rules

  /* Support of SAS by each station is exchanged during topology discovery and populated into the SAS DB */

  SAS(SA) && EF==1 /* Learn saExtended / VID */

  || SAS(SA) && EF==0 /* Learn SA / VID */

- Requires extra associative lookup on SA to determine whether an entry should/should not be learned.
- In transmit direction, frames not in SAS_DB (may be??) directly sent to the MAC where the MAC determines whether the frame is unicast or flooded. This simplifies the SAS layer by relieving it from having to identify and format local-local frames.
- Address look up on *saExtended / VID* (*SA / VID*) should be done for reception of every frame in order to compare associated SA with frame.SA. If associative SA does not match frame.SA, then the entry must either be updated or purged.

Bit in extended header method / 1

- Define SAS bit as one of the reserved extended frame bits.
  - Frame.SAS bit set to 1 if SAS layer is implemented by the 802.17 MAC else SAS bit set to 0.
  - The setting of this bit is hard coded by the MAC.
- Learn Address

  (frame.SAS==1 && EF==1 /* Learn saExtended / VID */

  || (frame.SAS==1 && EF==0 /* Learn SA / VID */

- Address look up on *saExtended / VID* (*SA / VID*) should be done for reception of every frame in order to compare associated SA with frame.SA. If associative SA does not match frame.SA, then the entry must either be updated or purged.