802.11 BSS Bridging

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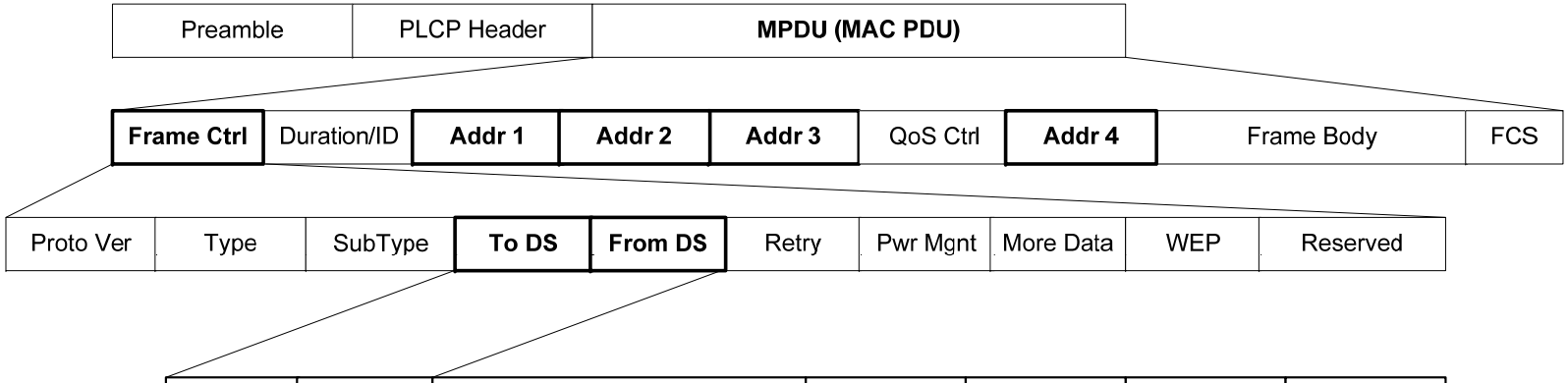
The issue

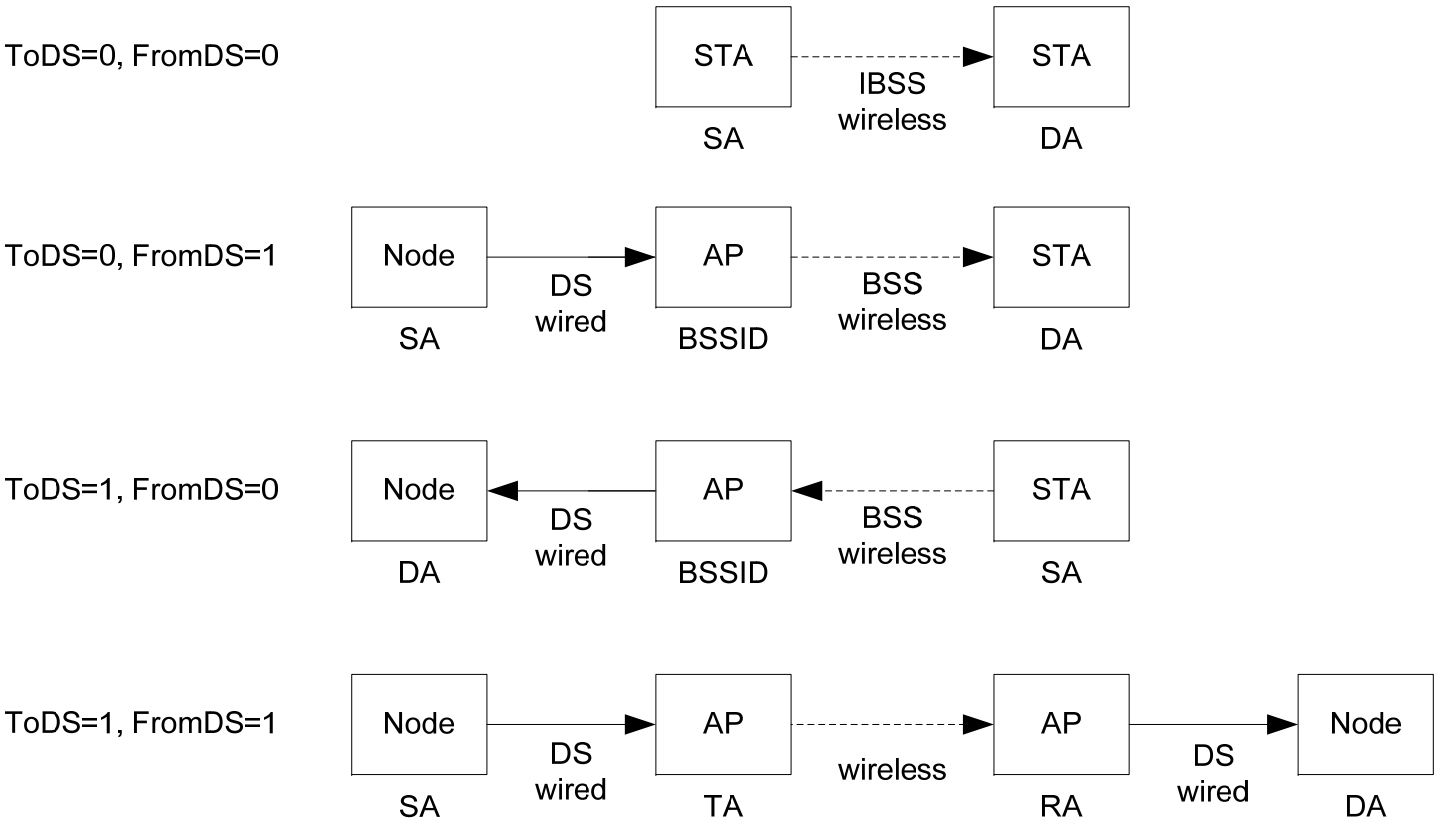
- 802.11 STA devices are end devices that do **not** bridge to external networks. This:
  - limit the topology of 802.11 BSS to “stub networks”
  - do not allow a (STA-)AP-STA wireless link to be used as a connecting path (backbone) between other networks
- Partial solutions exist to overcome this lack of bridging functionality but these solutions are:
  - proprietary only
  - limited to certain type of traffic
  - or/and based on Layer 3 (such IP Multicast to MAC Multicast translation, NAT - Network Address Translation)
- This contribution describes an architecture/protocol proposal to standardize STA bridging at L2

Reminder: 802.11 Frame Addressing



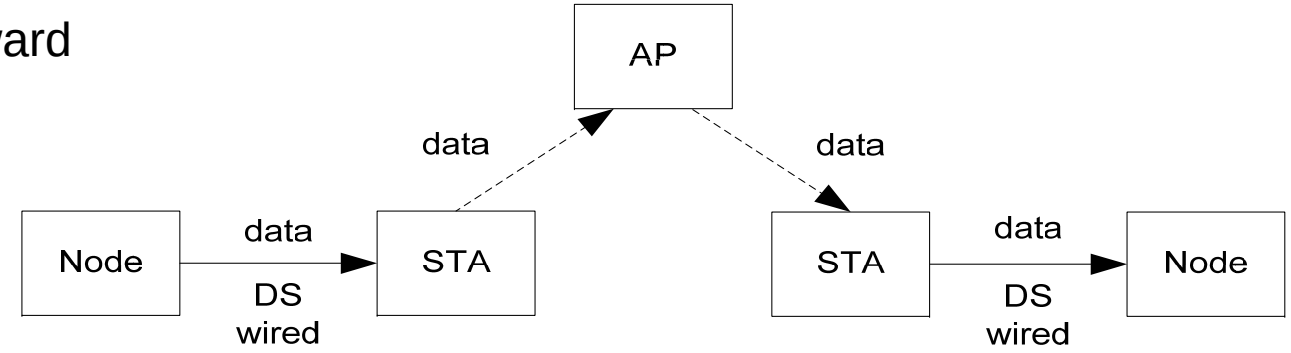
To DS	From DS	Meaning	Addr 1	Addr 2	Addr 3	Addr 4
0	0	STA to STA traffic in an IBSS and QSTA-to-QSTA traffic in a QBSS	DA	SA	BSSID	NA
0	1	AP-to-STA traffic in a BSS	DA	BSSID	SA	NA
1	0	STA-to-AP traffic in a BSS	BSSID	SA	DA	NA
1	1	WDS traffic between APs	RA	TA	DA	SA

Reminder: 802.11 Transmission Type

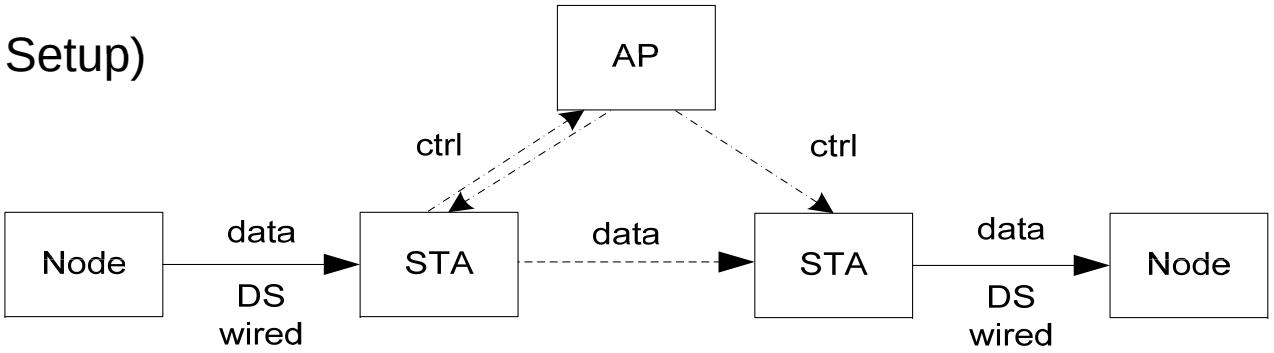


Reminder: AP-SF and DLS Modes

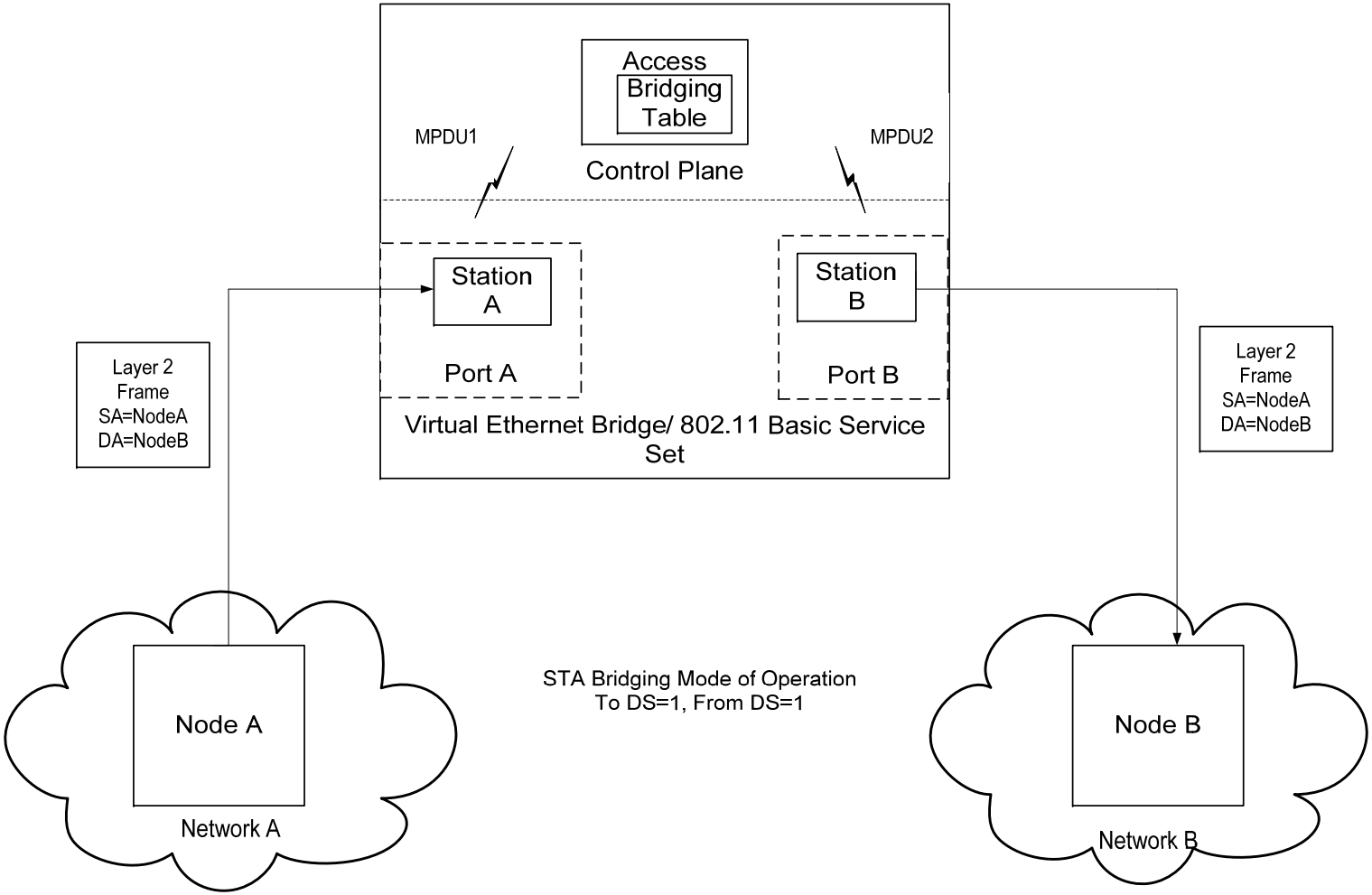
"AP Store & Forward



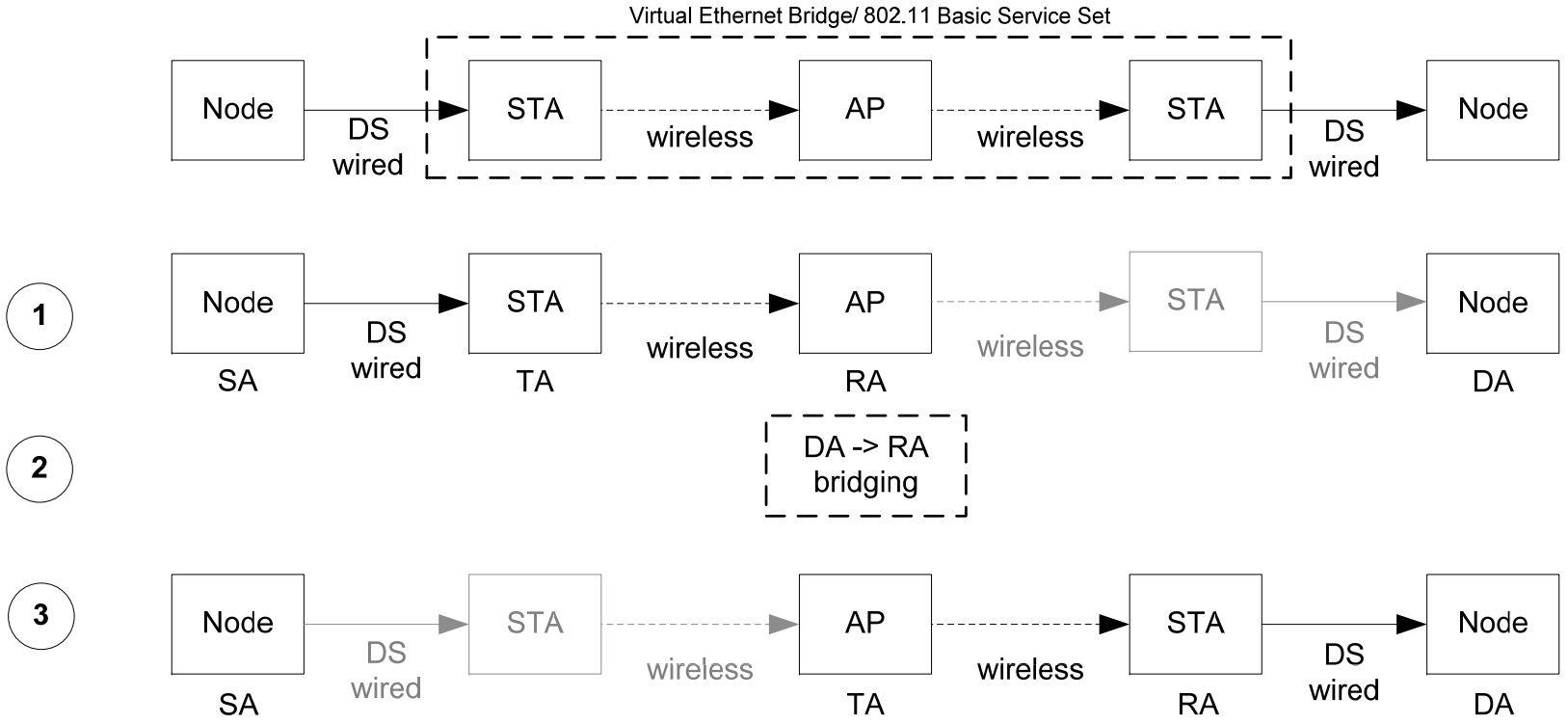
"DLS - Direct Link Setup)



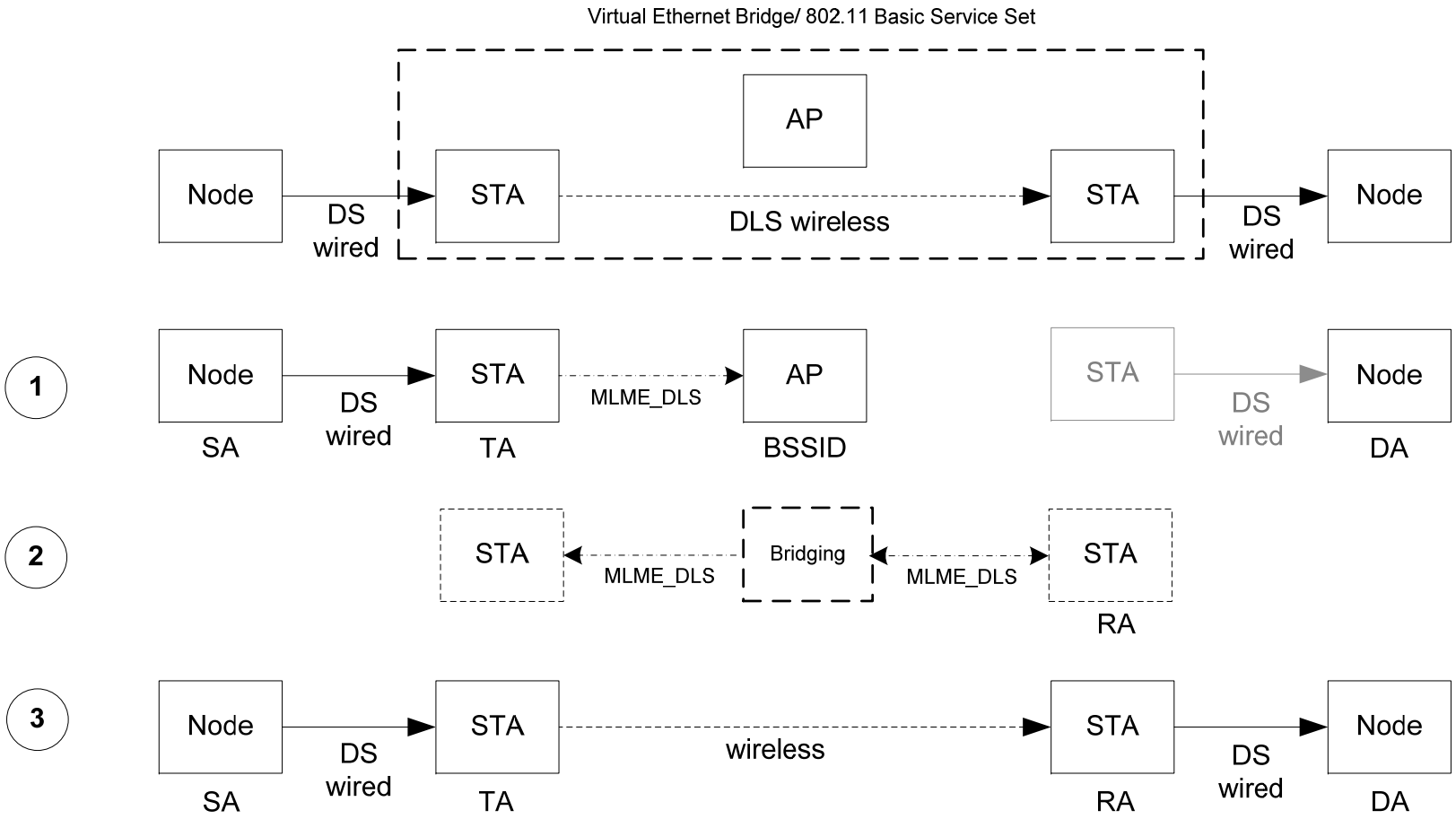
BSS Bridging Model



New AP Bridging Traffic Type



New DLS Bridging Traffic Type

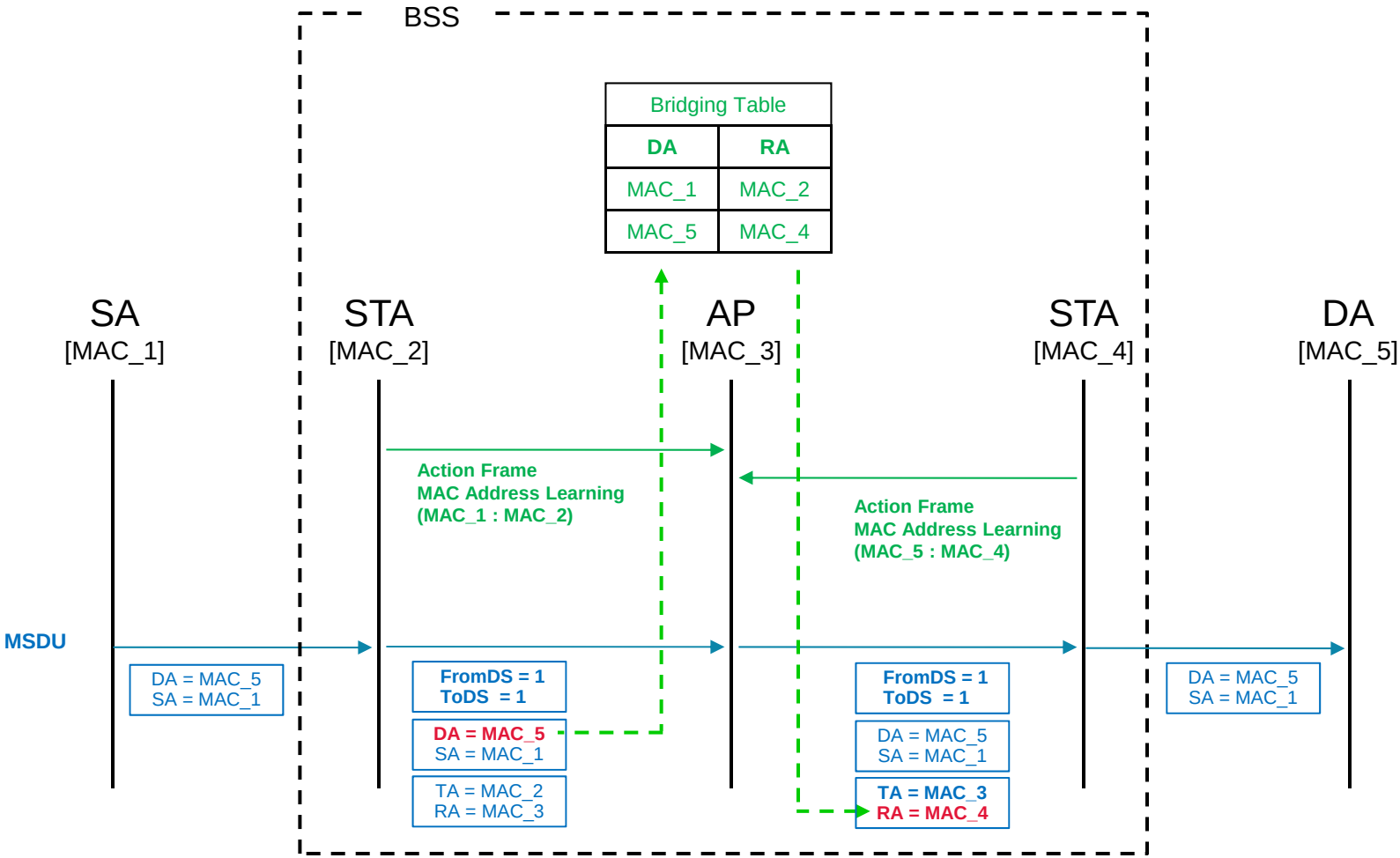


BSS Bridging

- The whole BSS is modeled as a distributed bridge overlaying the 802.11 protocol
  - AP acts as the Bridge's Control Plane
  - STAs act as Bridge Ports

- Modifications to 802.11 are limited to:
  1. [ToDS=Set , FromDS=Set] mode behavior redefined at ingress AP and ingress STA
  2. New 802.11 action frame for bridging address learning (STAs advertise their discovered bridged MAC address to the AP, to populate and update the bridging table)
  3. MSDU received from STA are broadcasted with the same Sequence Number as the received MSDU to allow the originating STA to filter out the multicast MSDU
  4. Additional Parameters to MLME-DLS primitives

AP Bridging


BSS
Bridging Table
DA
RA
MAC_1
MAC_2
MAC_5
MAC_4
SA
[MAC_1]
STA
[MAC_2]
AP
[MAC_3]
STA
[MAC_4]
DA
[MAC_5]
Action Frame
MAC Address Learning
(MAC_1 : MAC_2)
Action Frame
MAC Address Learning
(MAC_5 : MAC_4)
MSDU
DA = MAC_5
SA = MAC_1
FromDS = 1
ToDS = 1
DA = MAC_5
SA = MAC_1
TA = MAC_2
RA = MAC_3
FromDS = 1
ToDS = 1
DA = MAC_5
SA = MAC_1
TA = MAC_3
RA = MAC_4
DA = MAC_5
SA = MAC_1

Addition to the 802.11 Standard

- New Element in Beacon and Probe Response
  - AP indicates it BSS Bridging Capability in a new BSS Bridging Element in Beacon and Probe Response
    - AP BSS bridging Capability is controlled by a dot11BSSBridgingCapabilityEnabled parameter
- New Action Frame
  - STAs discover the Unicast and Multicast addresses they bridge and advertise them to the AP thru a periodic Bridged Address Advertisement action frame
    - Action value = Bridged Address
    - Destination MAC address
    - STA MAC address bridging the Destination MAC address

New [To DS = Set, From DS = Set] Handling

- STA MSDU received by the AP:
  - AP performs a lookup to the AP Bridging table with the Destination Address (DA) to retrieve the MAC address of the STA bridging the DA and use it as the Receiver Address (RA) of the forwarded MSDU
- AP MSDU received by the STA:
  - If the DA is a Broadcast/Multicast Address, the STA checks if the MSDU Sequence Number matches any of the Sequence Numbers of the latest Multicast MSDUs sent by this STA.
    - In case of match, the STA discards the receive frame.
    - Otherwise the STA extracts the (DA,SA) and uses them as the (DA,SA) of the MSDU bridged by the STA

DLS Mode Bridging

- For Direct Link Setup mode, a new MLME-BDLS request primitive could be specified with the DA MAC address replacing the STA MAC address as parameter:

  MLME-BDLS.request (
  PeerDAMACAddress,
  DLSTimeoutValue,
  DLSResponseTimeout)

- The associated confirm primitive returns the STA MAC address bridging the DA MAC address :

  MLME-BDLS.confirm (
  PeerDAMACAddress,
  PeerSTAMACAddress,
  ResultCode,
  CapabilityInformation,
  DLSTimeoutValue,
  SupportedRates)

MSDU Broadcast

- MSDU with unknown or Multicast DA addresses are broadcasted by the AP
  - AP broadcasts the MSDUs received from STAs with the same Sequence Number (as the received MSDU) to allow the originating STA to filter out the multicast MSDU

Thank You