CSN & 802.11 BSS Bridging

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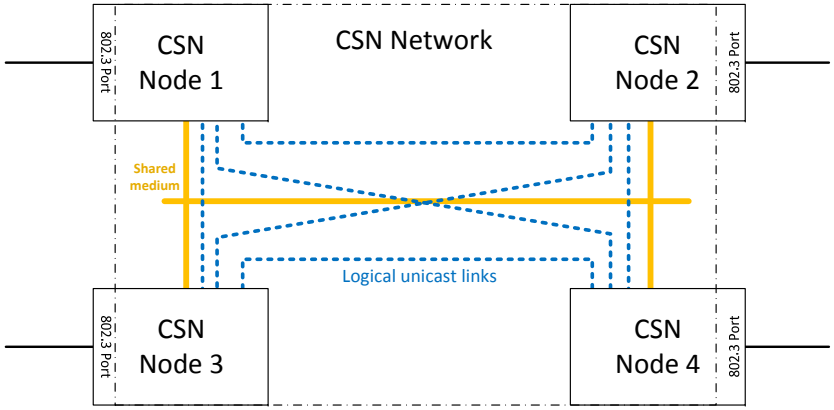
IEEE 802.1 / 802.11 Bridging Study Group, Oct 2012

bz-phkl-11-bbs-bridging-1012-v1

The issue

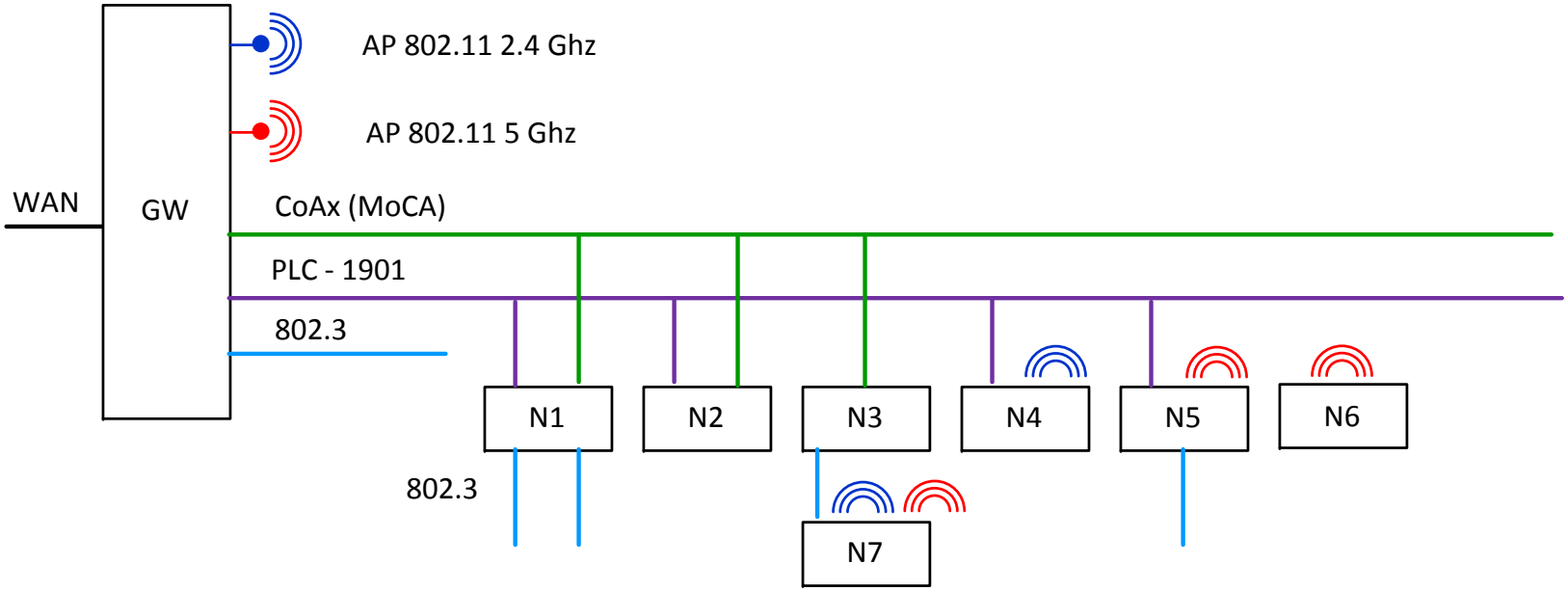
- 802.11 non-AP STA devices are end devices that do **not** bridge to external networks. This:
  - limit the topology of 802.11 BSS to “stub networks”
  - do not allow a (STA-)AP-STA wireless link to be used as a connecting path (backbone) between other networks
- Partial solutions exist to overcome 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)

Coordinated Shared Network (CSN)

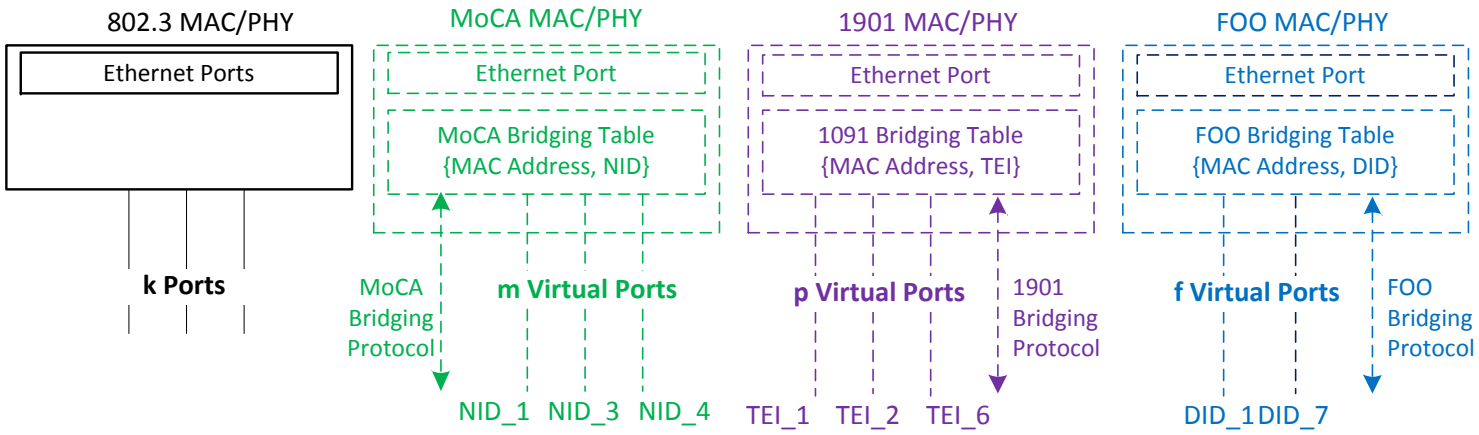


- Contention-free, time-division multiplexed-access, network of devices sharing a common medium and supporting reserved bandwidth based on priority or flow (QoS).
  - one of the nodes of the CSN acts as the network coordinator, granting transmission opportunities to the other nodes of the network.
- Physically a shared medium, in that a CSN node has a single physical port connected to the half-duplex medium,
  but logically a fully-connected one-hop mesh network, in that every node can transmit frames to every other node over the shared medium.
- Supports two types of transmission:
  - unicast transmission for point-to-point (node-to-node)
  - transmission and multicast/broadcast transmission for point-to-multipoint (node-to-other/all-nodes) transmission.

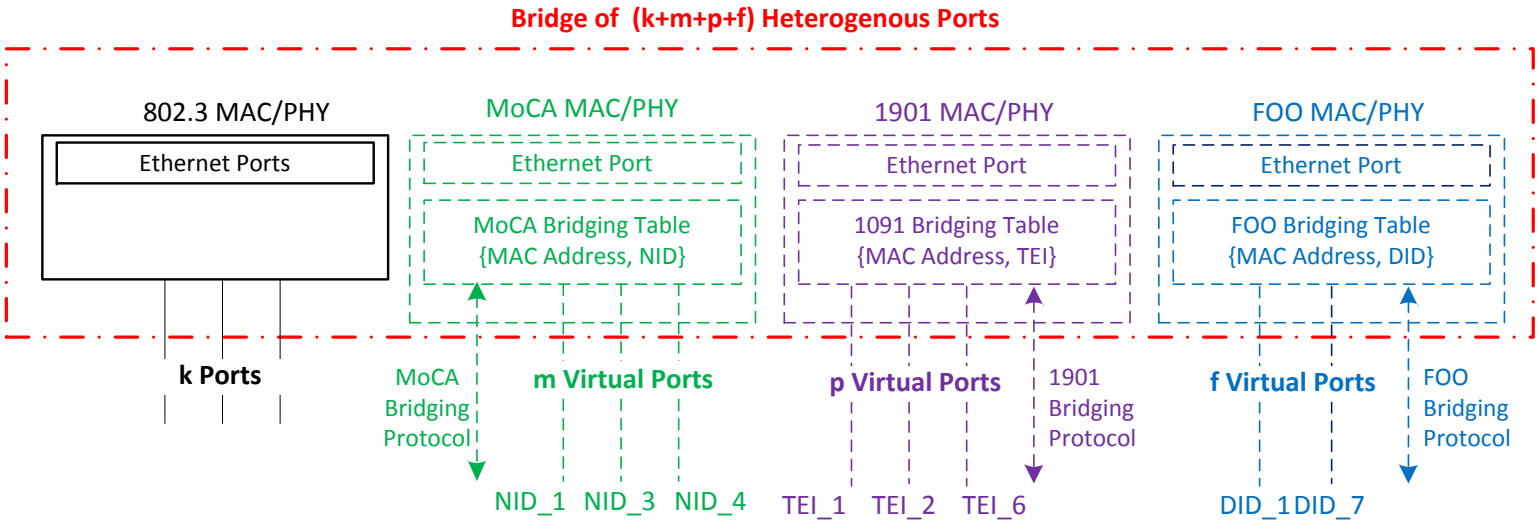
(GW Centric) Heterogeneous Home Network



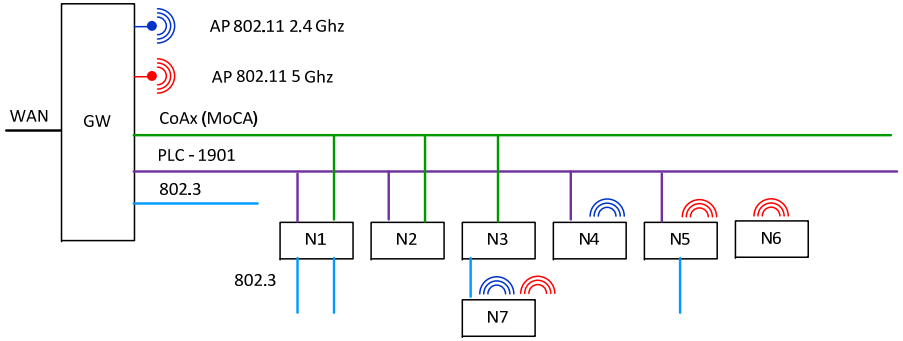
Heterogeneous Network Bridge Model

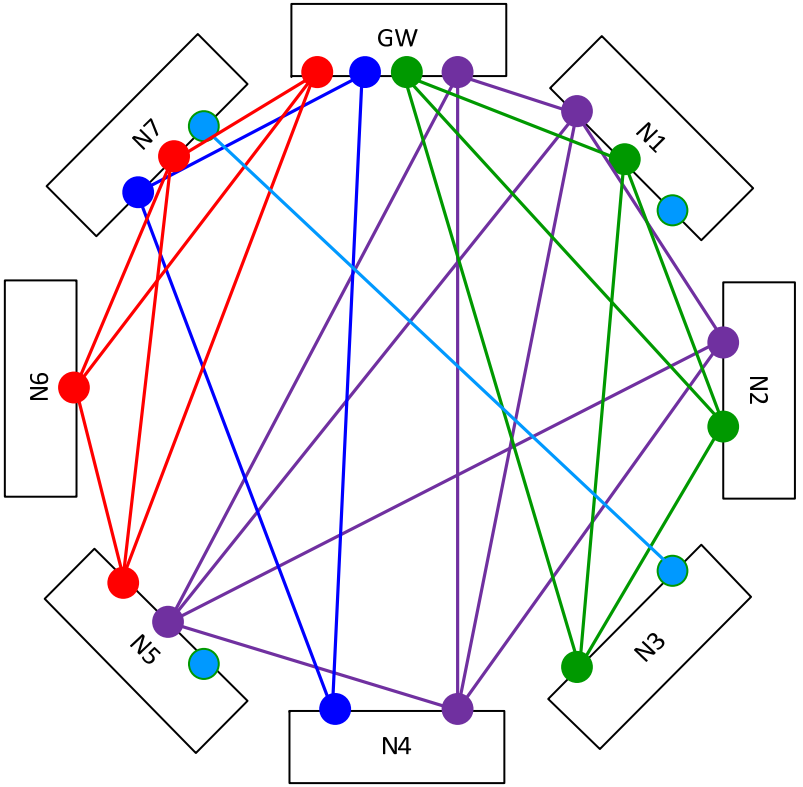


Heterogeneous Network Bridge Model - 1



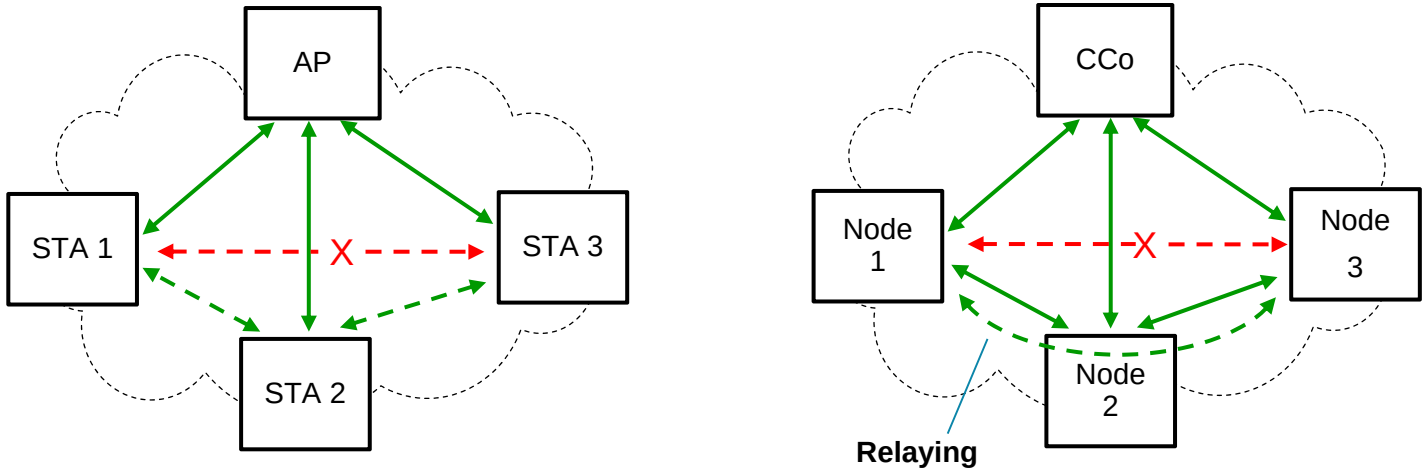
GW Centric Home Network – P2P Model





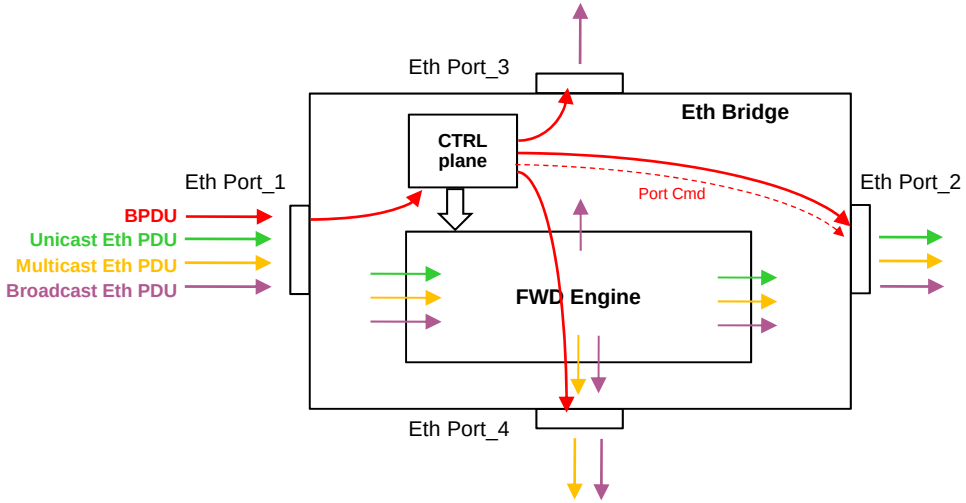
Hidden Nodes…

- On **both** 802.11 and 1901 networks, nodes could be hidden to other nodes…
- …but both 802.11 AP and 1901 CCo see all nodes

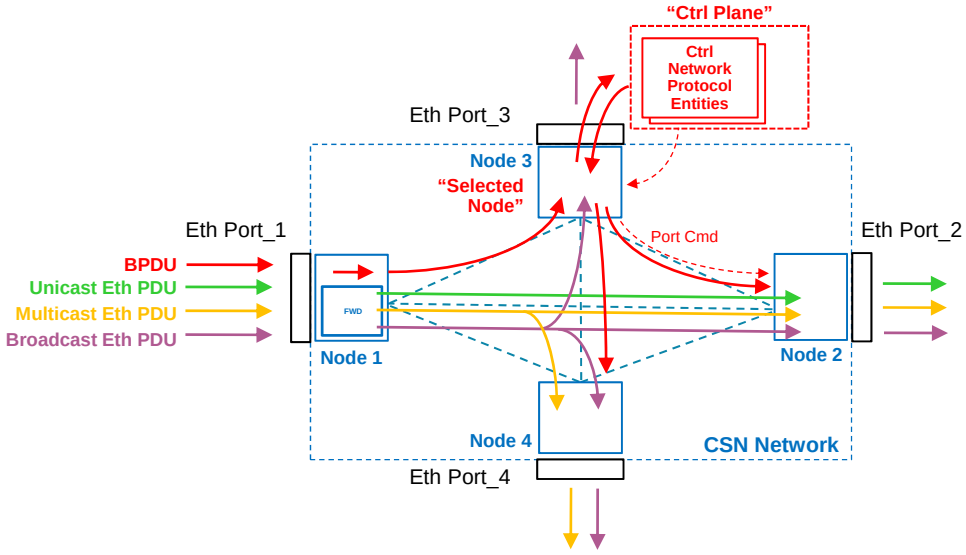


CSNs behave as L2 Bridges…

L2 Bridge



CSN Network

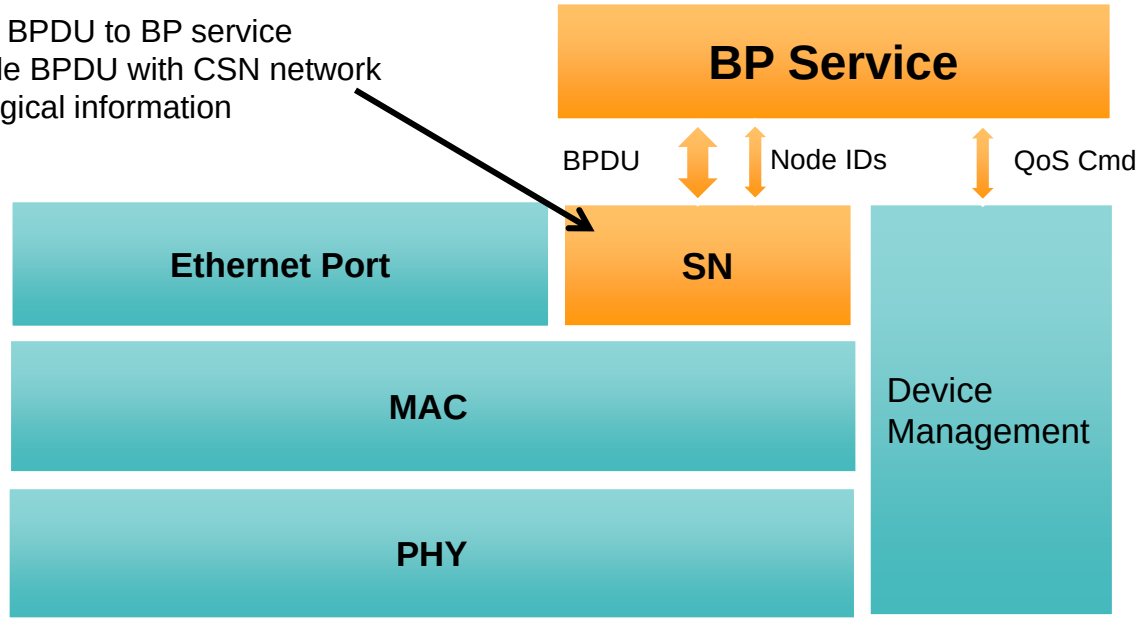


CSN as Distributed Bridge - Pros

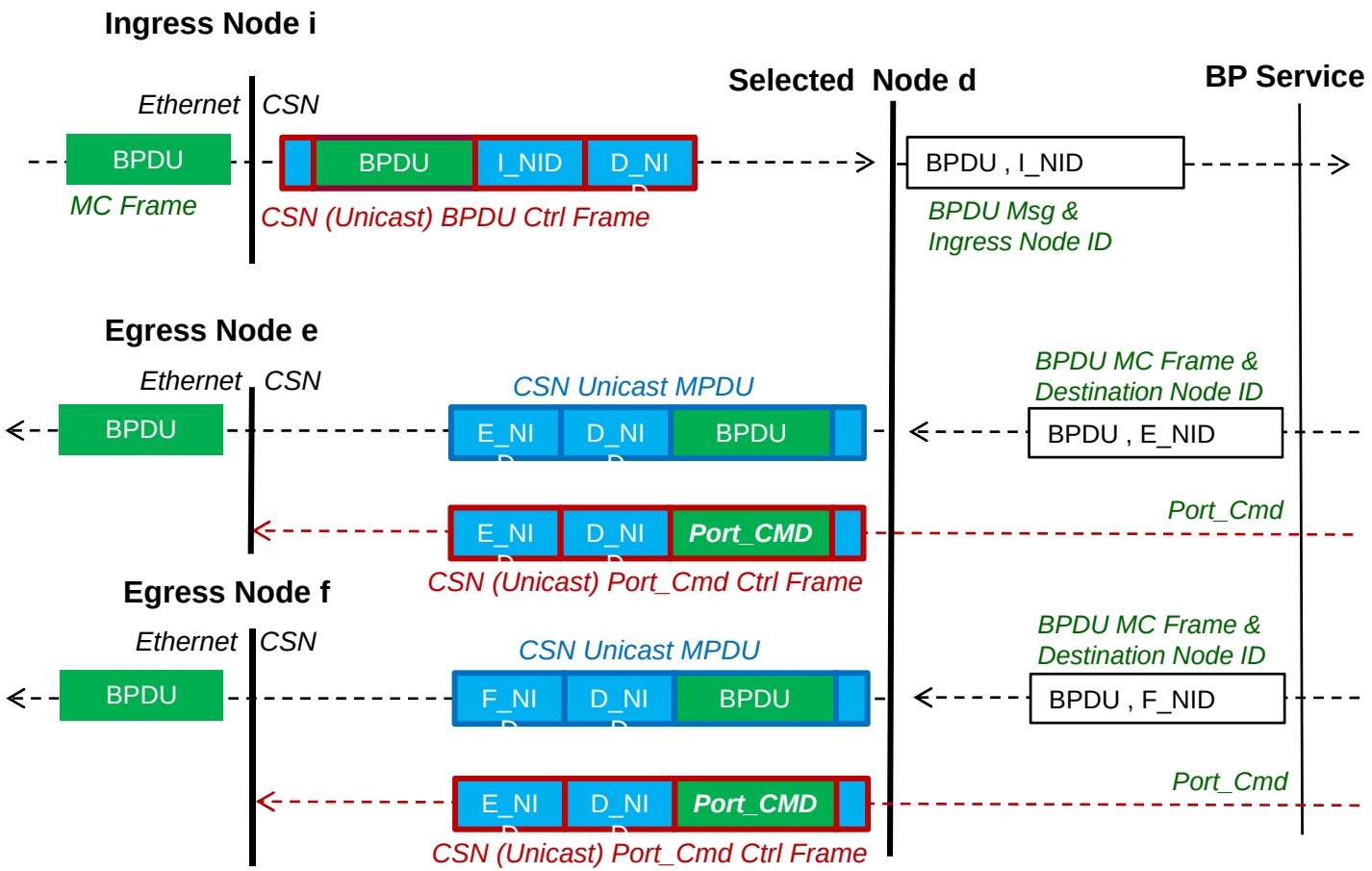
- Scalable:
  - Single bridge per CSN regardless # of nodes
    vs P2P mesh where each node is a bridge
- Optimized for “heavy”/”light” nodes
  - *(single ctrl plane node + n-1 “dumb” ports rather than n bridges)*
- No duplication of resources
  - 1 single Ctrl plane entity per CSN
- Reuse of standard L2 Ctrl protocol entities
  - requires only a simple adaptation layer
    (cf “White Paper: Control Plane Implementation on Coordinated Shared Networks (CSN)”
    http://www.ieee802.org/1/files/public/docs2011/avb-phkl-wp-csn-ctrl-plane-1111-v01.pdf)
- Support ranking
  - without modification of the underlying network protocol
- Network agnostic interface to underlying network
  - simple interface
  - CSN bridging method is kept “internal” *(including “node relaying” when applicable)*
- *This model is already used by MSRP for CSN and 802.11 BBS (IEEE 802.1Q-2011, Annex C)*

Selected Node Architecture

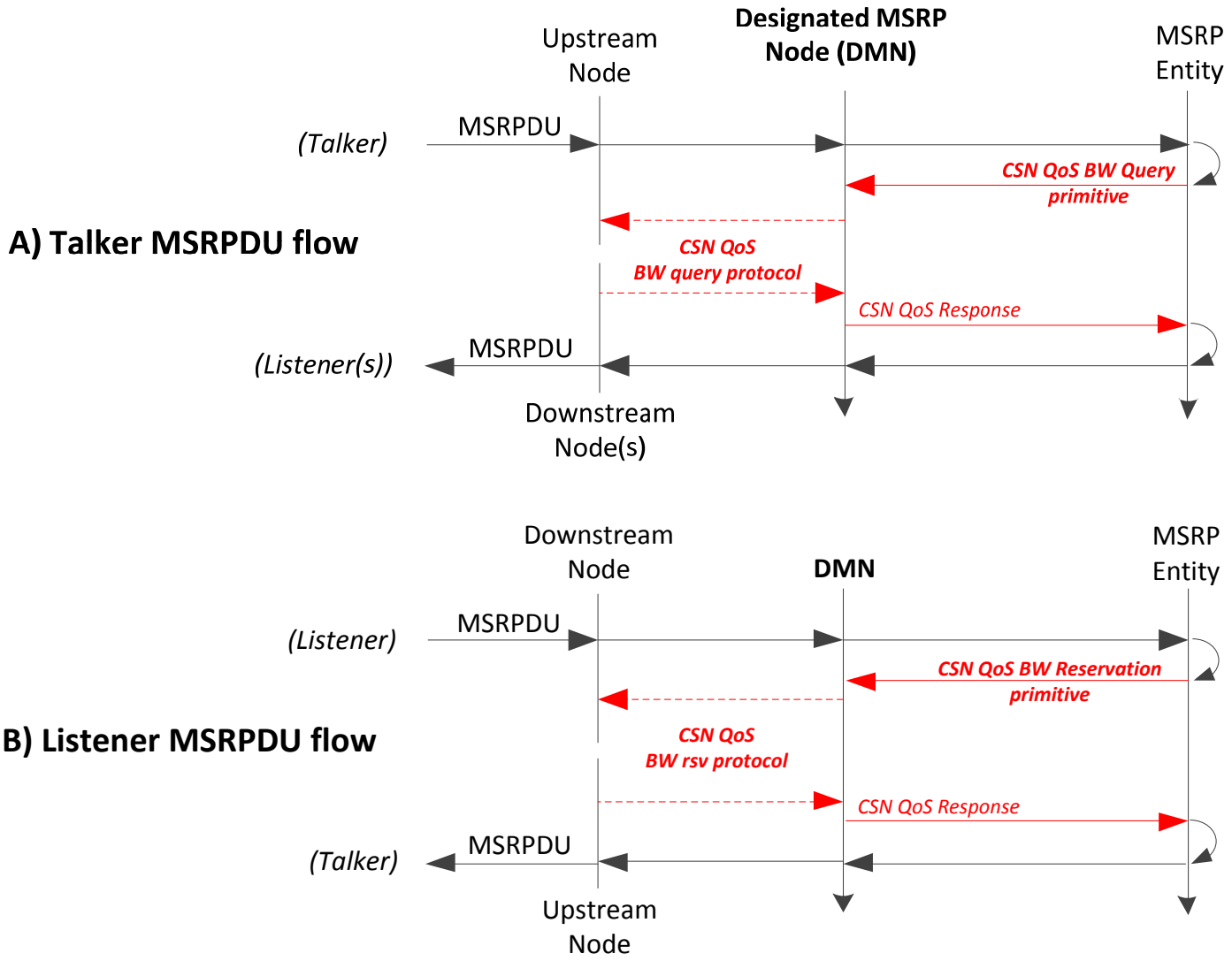
- Route BPDU to BP service
- Provide BPDU with CSN network topological information



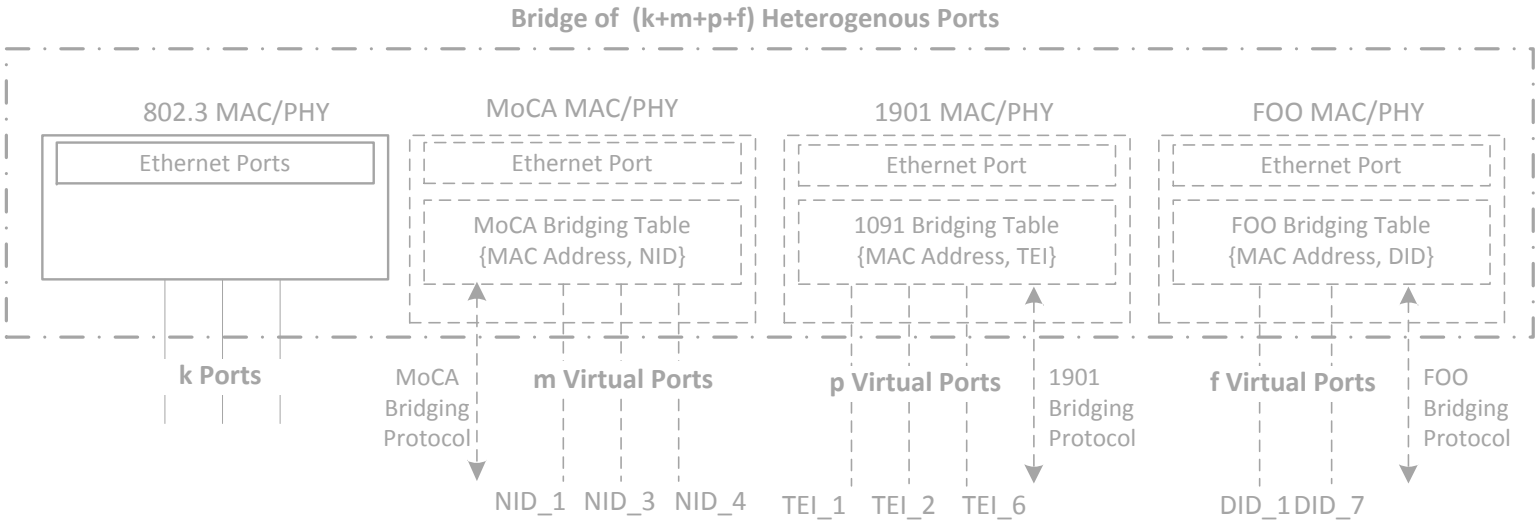
BPDU Propagation over CSN

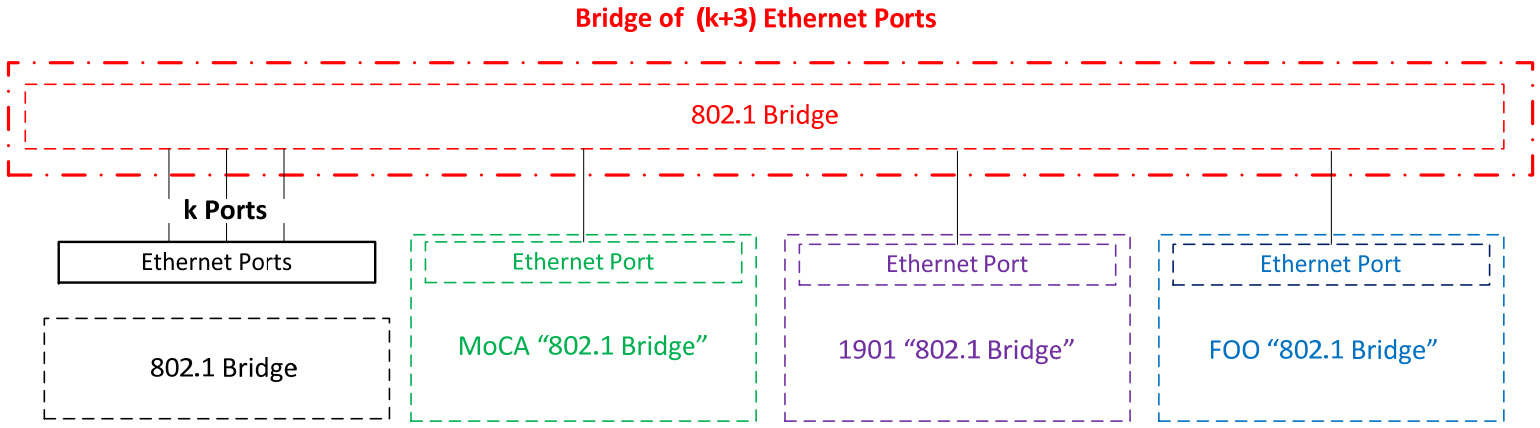


MSRP Example

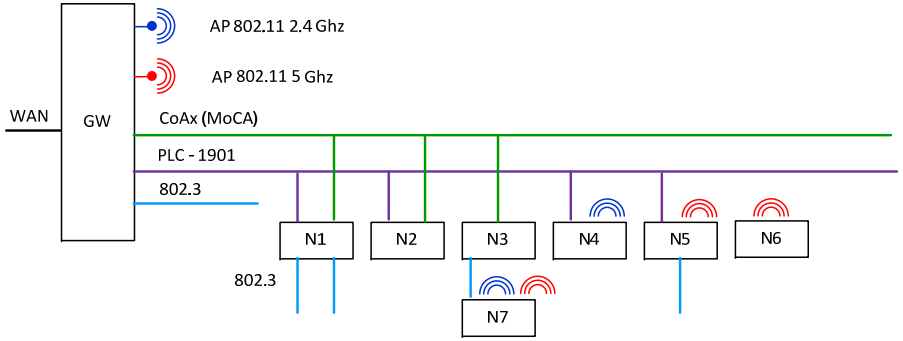


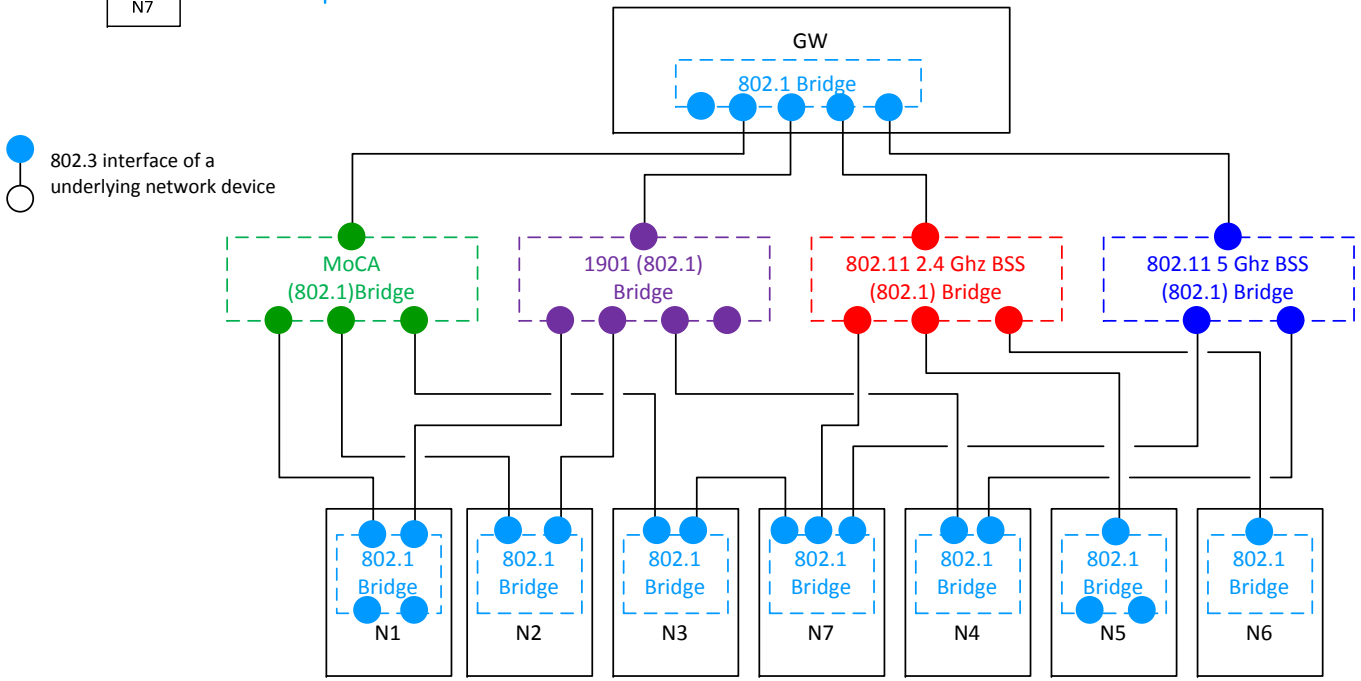
Heterogeneous Network Bridge Model - 2





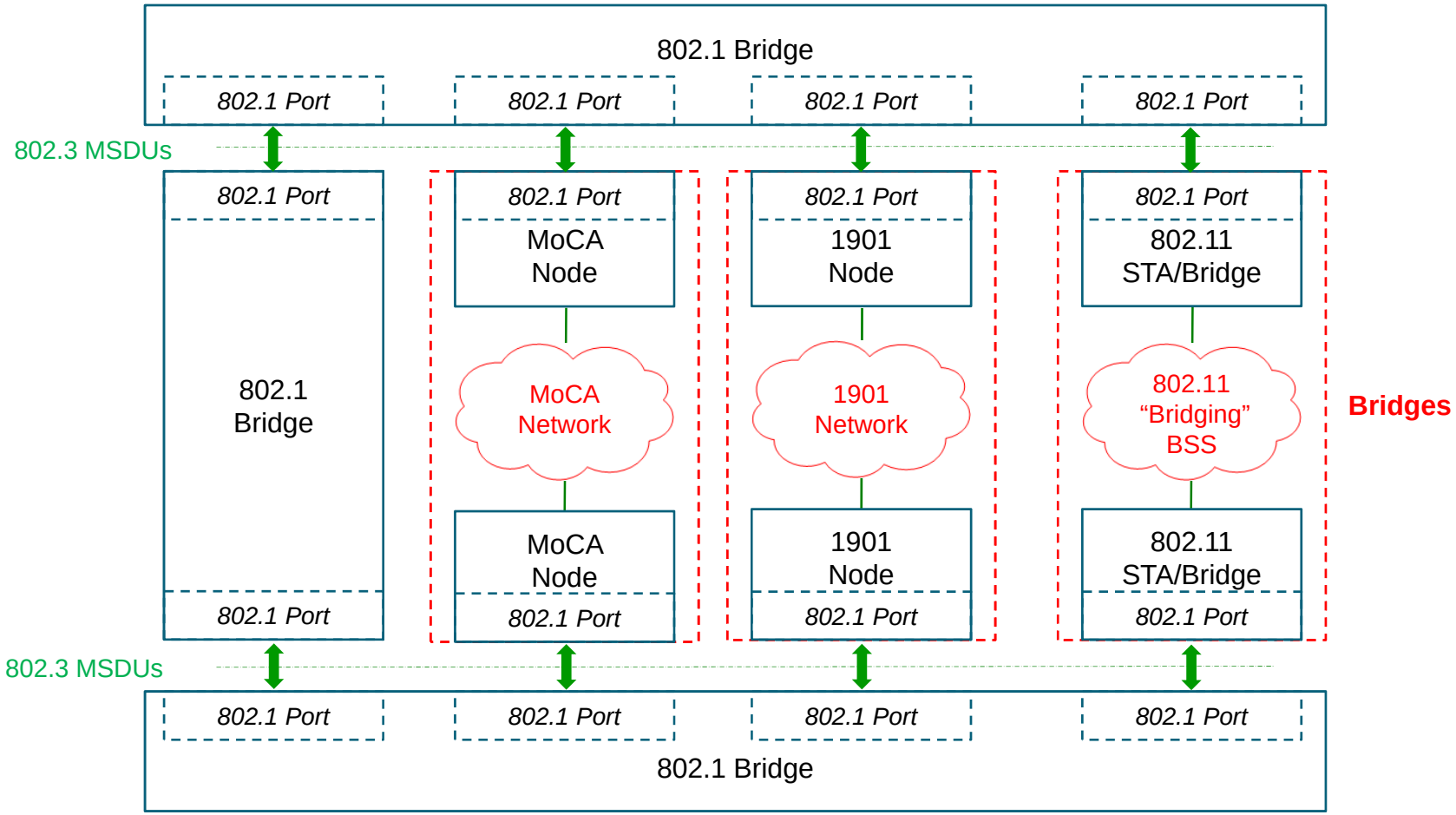
GW Centric Home Network – Bridge Model





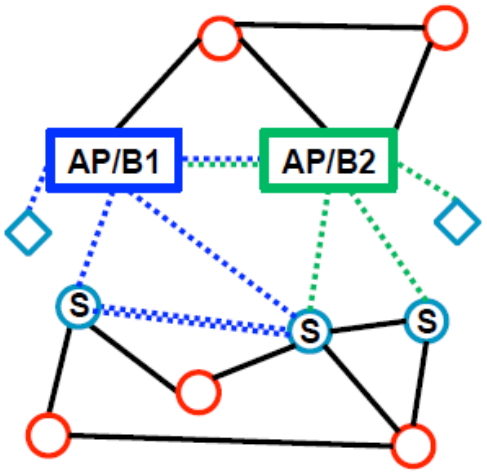
Heterogeneous Networks are Bridged LANs

- 802.11 BSS handled as other CSN networks



Reminder – Model #1: P2P Link Model

Set of point-to-point links

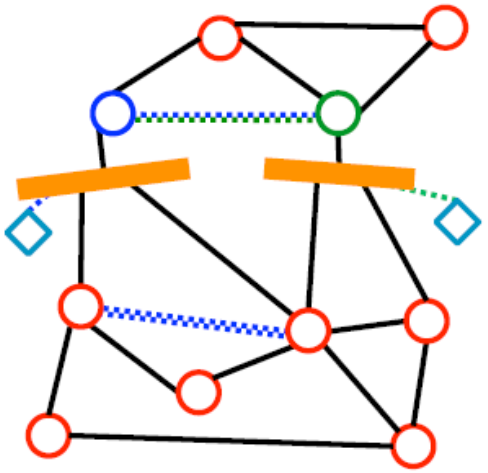


- The Access Points and their co-resident bridging functions become integrated AP bridges (AP/Bs).
- Devices with non-AP station capability(ies) and wired connections become "non-AP station bridges" (S).
- Of course, not all stations are bridges. (The diamonds are non-bridge non-AP stations.)

Source - Norm Finn's presentation www.ieee802.org/1/files/public/docs2012/new-nfinn-11-medium-choice-0812-v02.pdf

Reminder – Model #2 : Emulated LAN Model

802.11 LAN emulation

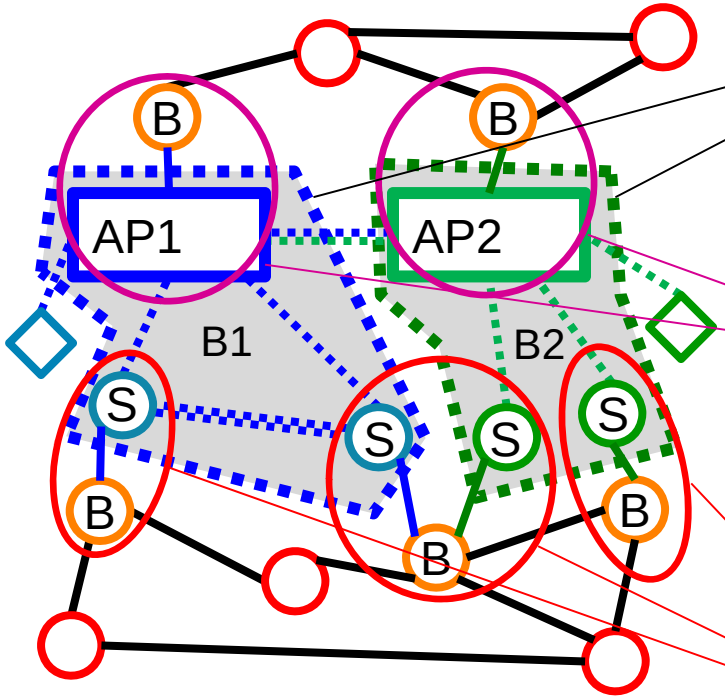


- Each AP and its stations emulate a shared medium LAN (fat yellow coax), as seen by the wired bridges.
- Each AP uses its bridge knowledge to optimize forwarding through the 802.11 medium, rather than broadcasting every frame.
- Direct AP-AP links have to be modeled separately from "coax". Station-station links can be separate (shown) or part of emulated LAN.

New-nfinn-11-medium-choice-0812-v02.ppt For IEEE 802.1/802.11 bridging study groups, Aug. 2012 5

Source - Norm Finn's presentation www.ieee802.org/1/files/public/docs2012/new-nfinn-11-medium-choice-0812-v02.pdf

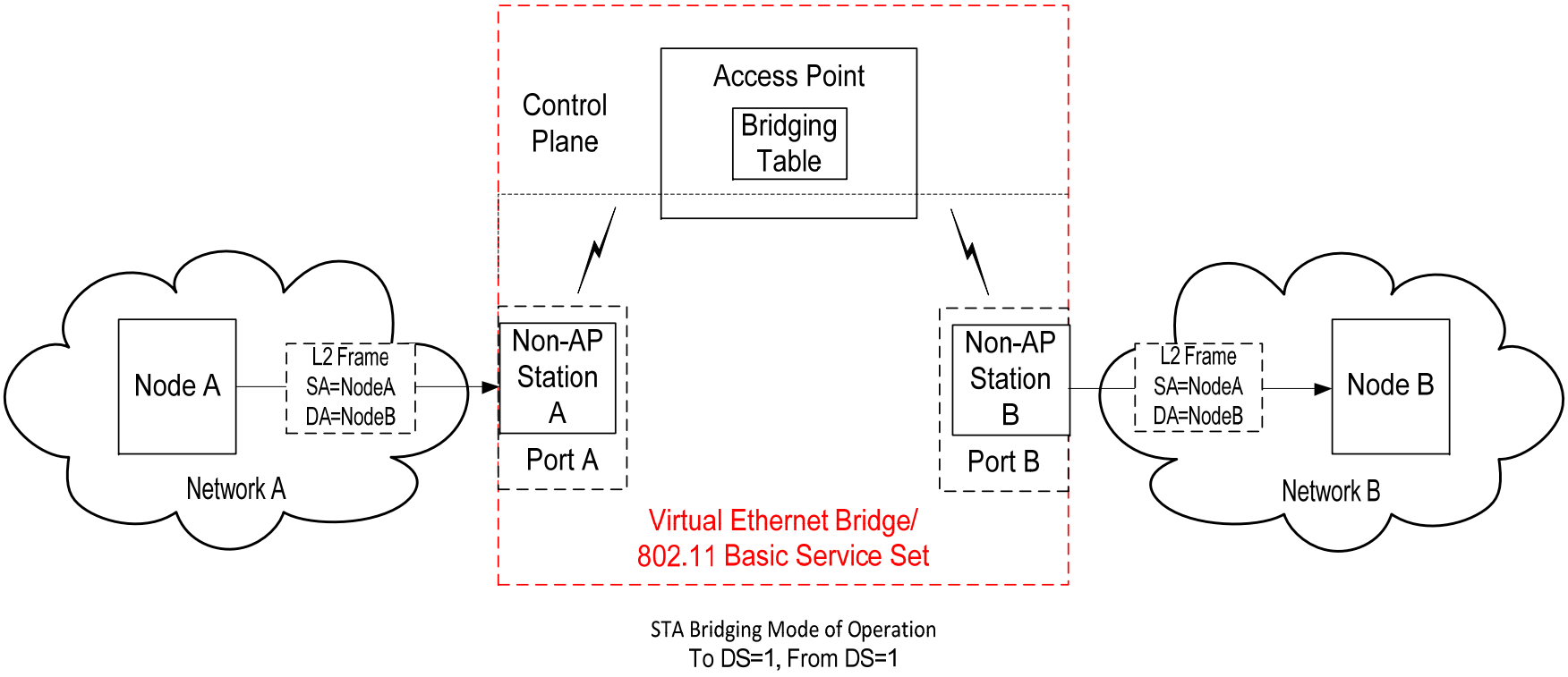
Proposal - Model #3 : Emulated Bridge Model



- Each BSS (Access Point and its non-AP stations) emulate a single, separated bridge [B1] [B2].
- An AP with wired connections is logically separated into an BBS bridge port (AP) and a wired bridge (B).
- Each non-AP station/bridge is logically separated into an BSS bridge port and a (virtual) wired bridge (B) (with wires to each component).

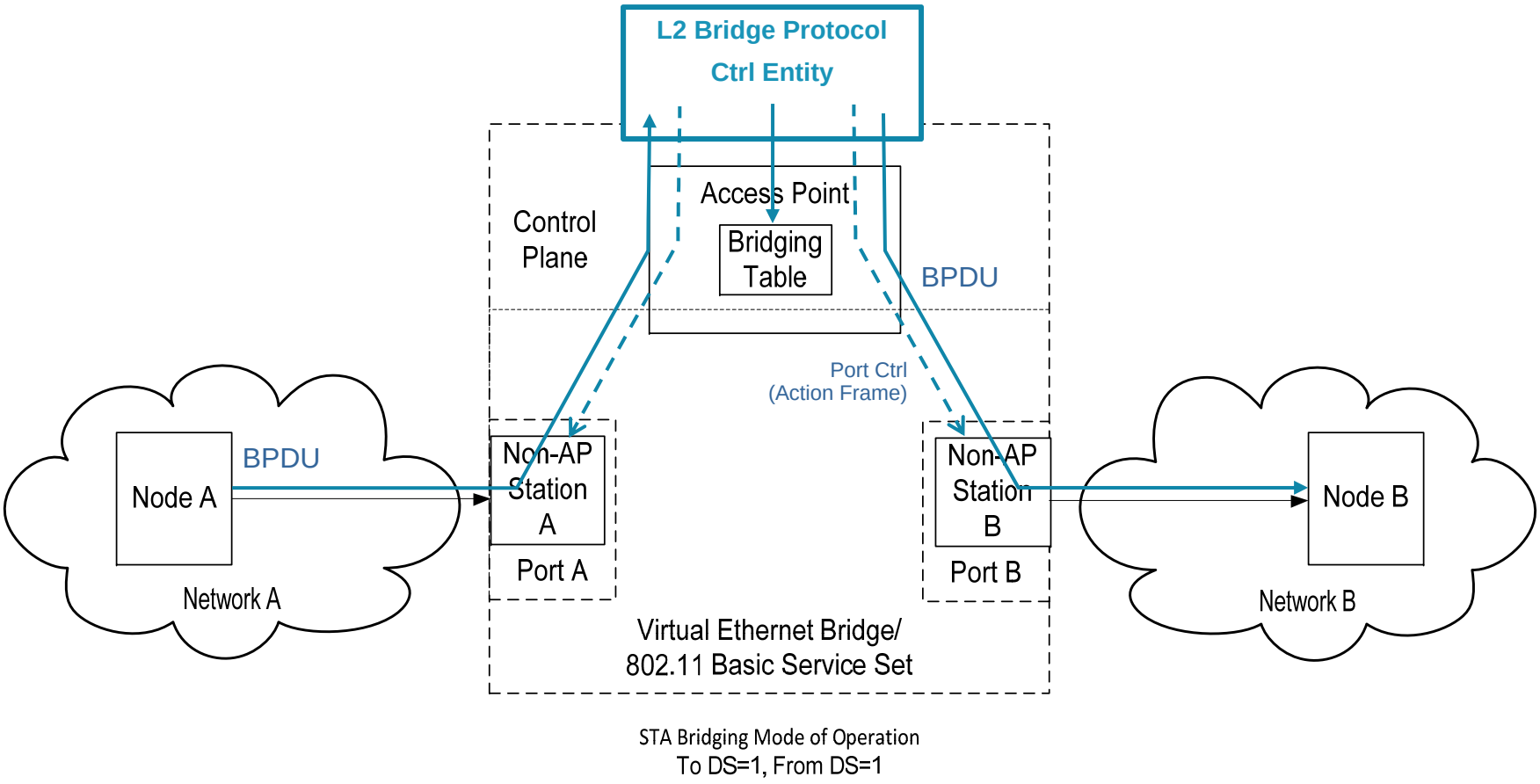
Based on slide, courtesy of Norm Finn

BSS Bridging Model

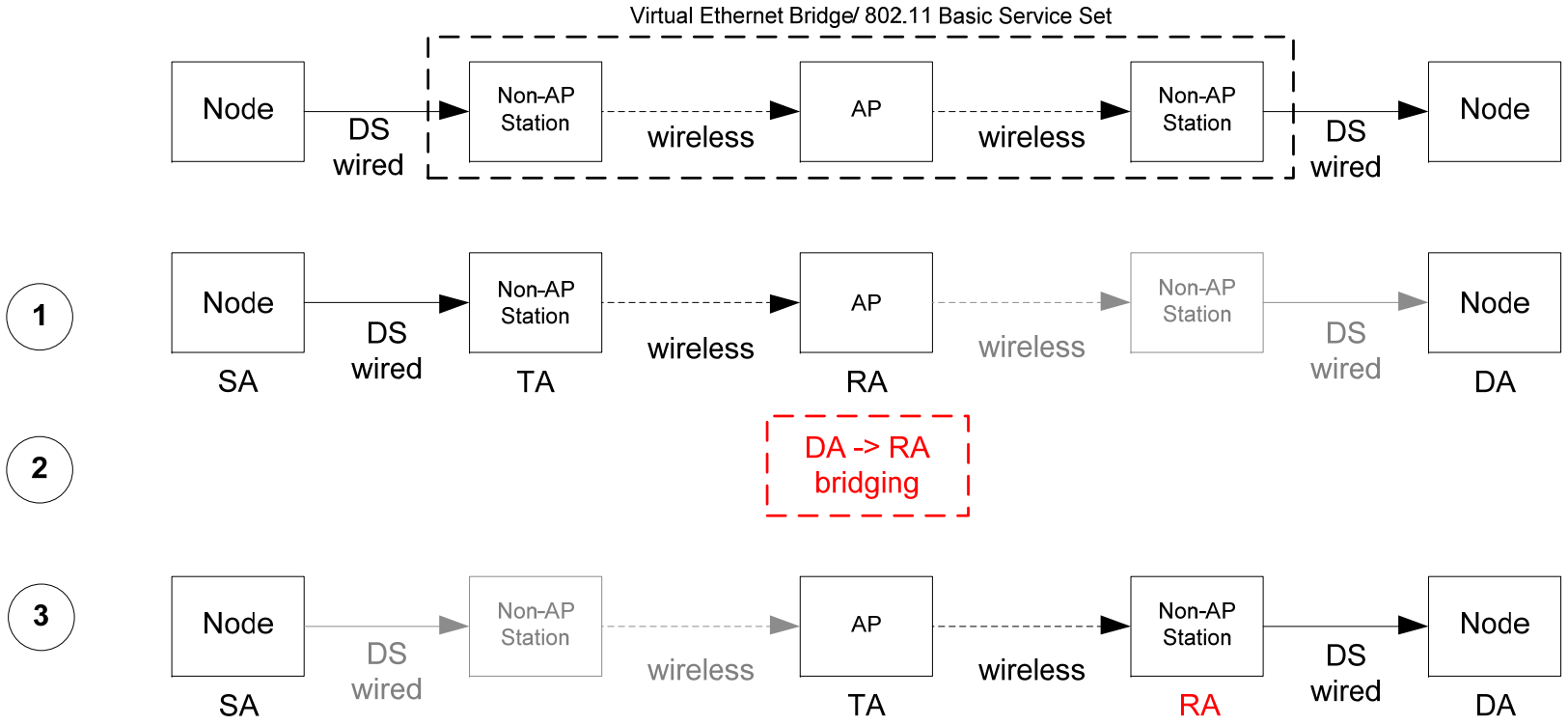


STA Bridging Mode of Operation
To DS=1, From DS=1

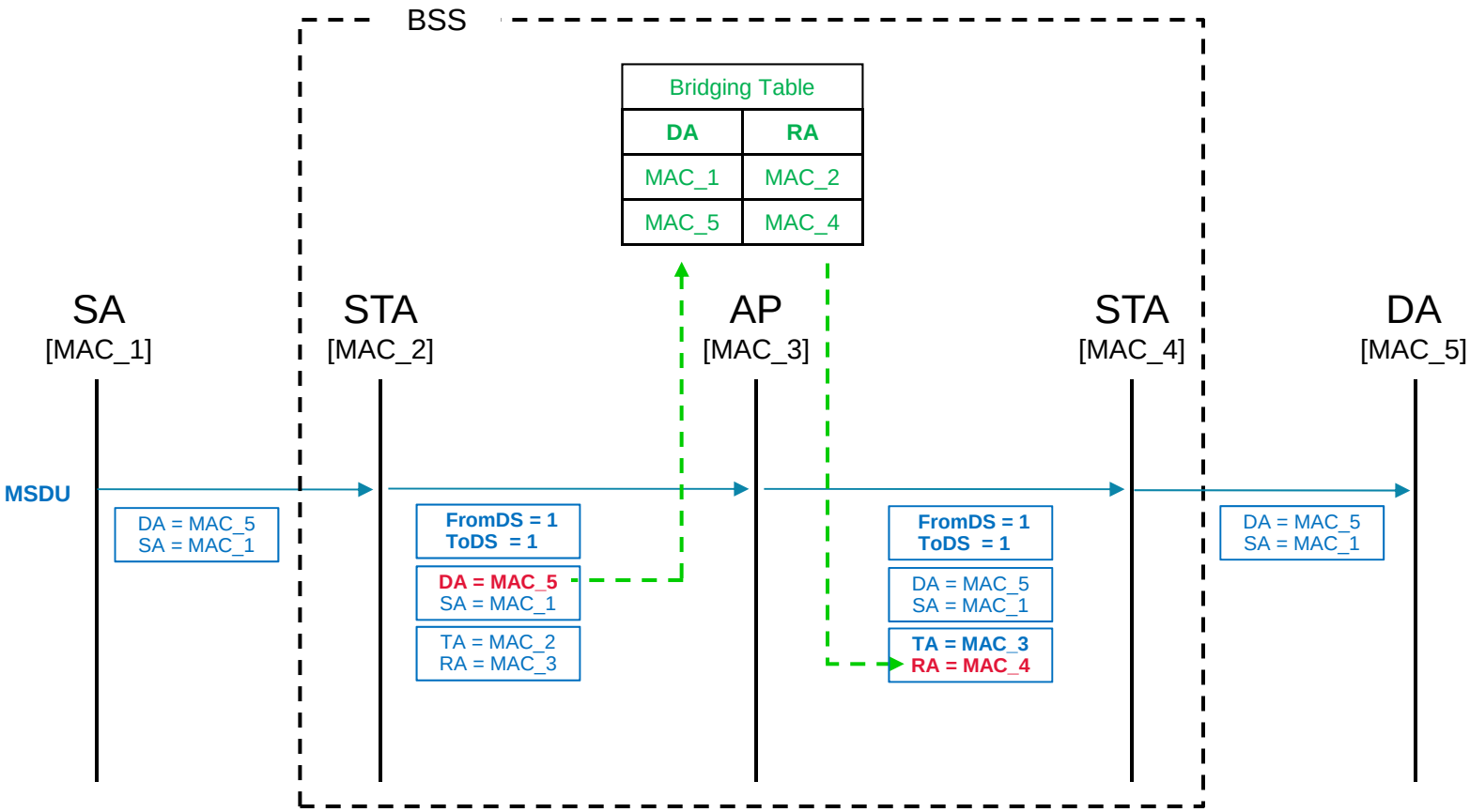
BSS Bridging Model (Single Ctrl Plane)



New AP Bridging Traffic Type



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]
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

BSS Bridging

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

- Modifications to 802.11 are limited to:
  1. [ToDS=Set , FromDS=Set] mode behavior redefined at ingress AP and ingress non-AP Stations
  2. Broadcast "Echo Cancellation" Method <TBD>
     Could be:
     - *APs broadcast MSDUs without modifying the Sequence Number & non-Stations filter out broadcasted MSDUs they originated on SN matches*
     - *Non-Stations filter out broadcasted MSDUs they originated on TID matches*
  3. Additional Parameters to MLME-DLS primitives

Addition to the 802.11 Standard

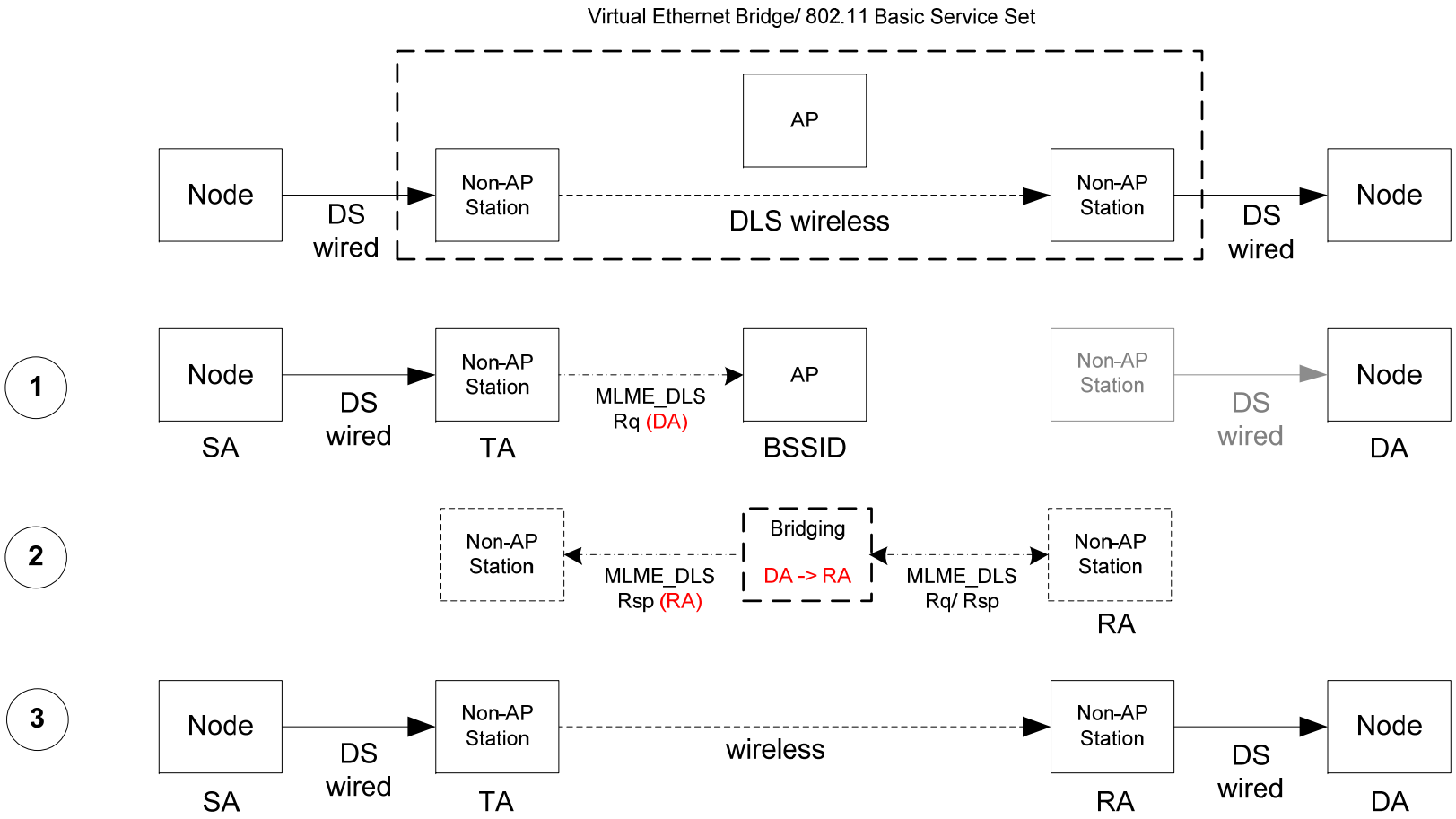
- New Element in Beacon and Probe Response
  - AP indicates it BSS Bridging Capability in a new BSS Bridging Element in Beacon and Probe Response
  - AP BSS bridging Capability is controlled by a dot11BSSBridgingCapabilityEnabled parameter
- New Action Frames <TBD>
  - AP control to non-Station ports (i.e. block port…)

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

- Non-AP Station originated MSDU received by AP:
  - AP performs a lookup to the AP Bridging table with the Destination Address (DA) to retrieve the MAC address of the non-AP Station bridging the DA and use it as the Receiver Address (RA) of the forwarded MSDU
  - MSDU with unknown or Multicast DA addresses are broadcasted by the AP

- AP originated MSDU received by non-AP Station:
  - If the DA is a Broadcast/Multicast Address, the non-AP Station checks the MSDU Sequence Number or TDI (to match any of the SNs (or TIDs) of the latest Multicast MSDUs by this non-AP Station:
    - If match, the non-AP Station discards the receive frame
    - Otherwise the non-AP Station extracts the (DA,SA) and uses them as the (DA,SA) of the MSDU bridged by the non-AP Station

New DLS Bridging Traffic Type



DLS Mode Bridging

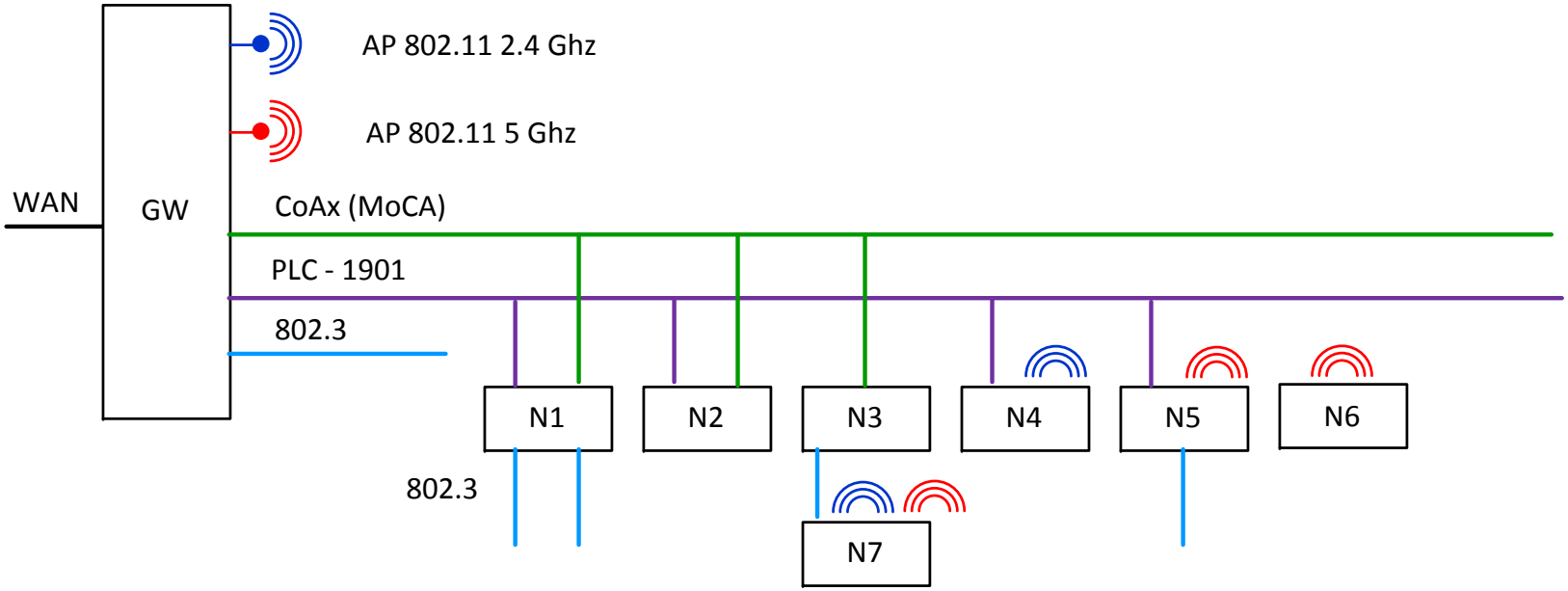
- For Direct Link Setup mode, a new MLME-BDLS request primitive could be specified with the DA MAC address replacing the non-AP Station MAC address as parameter:

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

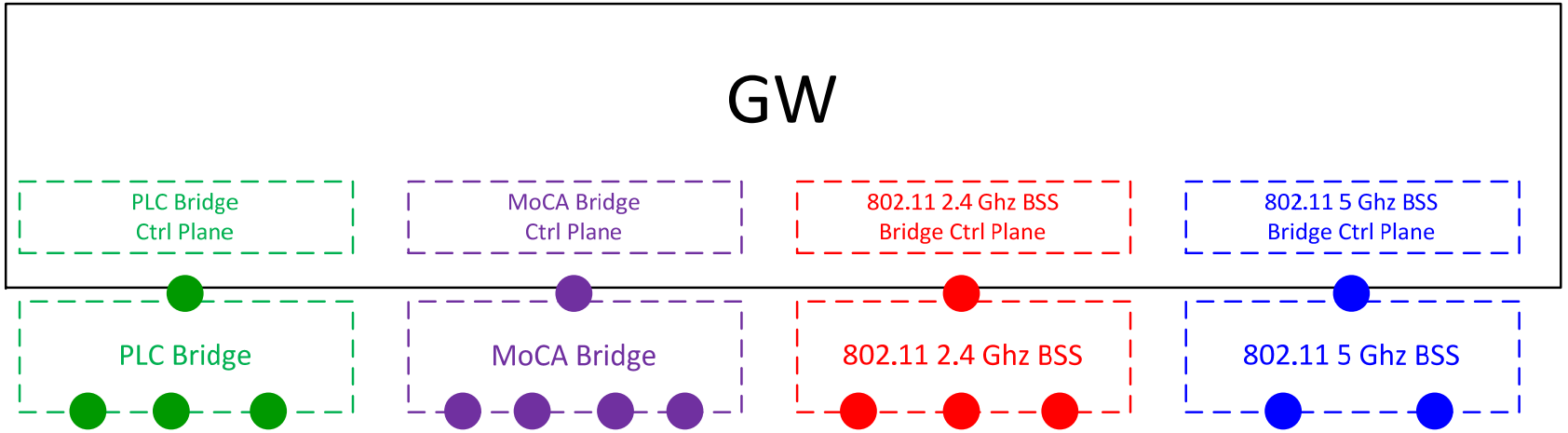
- The associated confirm primitive returns the non-AP Station MAC address bridging the DA MAC address :

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

GW Centric Heterogeneous Home Network



GW Centric Data Planes

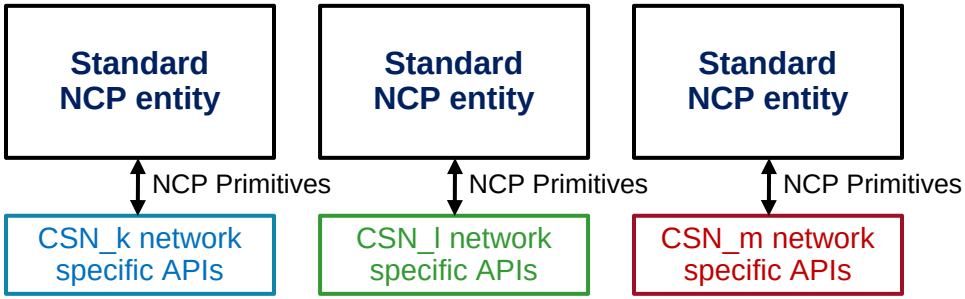


- GW is the Designated Node for each CSN:

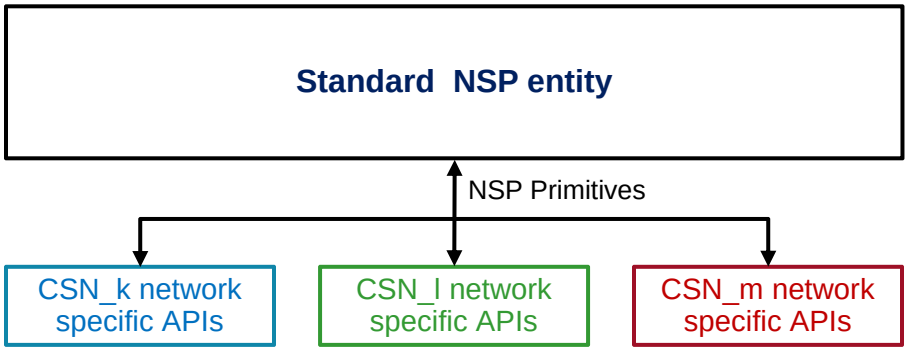
  CSN Bridge Data Planes are co-hosted on the GW

GW Centric Data Plane

- For Network **Control** Protocols (such RSTP)
  each CSN bridge runs its owns control plane
  same 802.1 standard protocol entity instantiated per CSN bridge

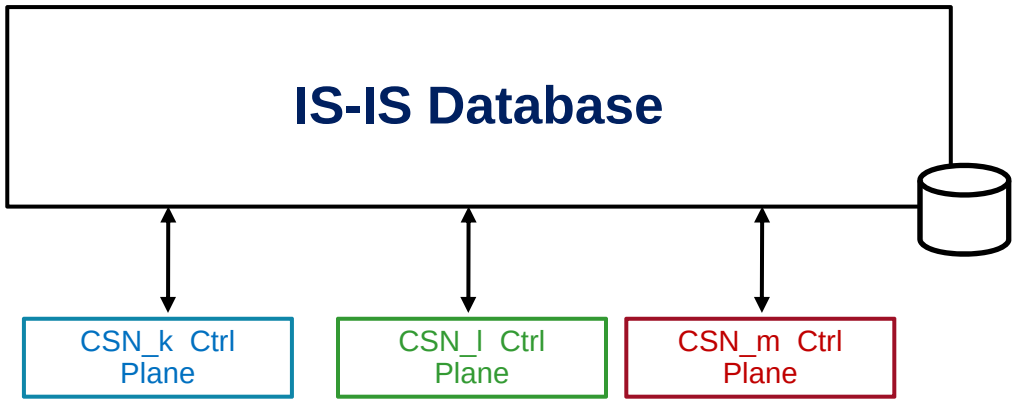


- For Network **Service** Protocols (such MSRP)
  - a single control plane for all the CSNs
  - NSP primitives mapped to each CSN specific APIs



GW Centric Data Plane

- Optimized case for IS-IS:
  - Single IS-IS Database
  - Immediate topology change “propagation”
    - Immediate coherency
    - No traffic overhead between bridges
    - Optimized resource



Thank You

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