

---

# Point to Multipoint (P2MP) 802 Architecture Compliance Issues

- John Pickens, COM21
- Dolors Sala, Broadcom
- John Limb, Broadcom
- Ajay Gummalla, Broadcom
- Hiroshi Suzuki, Cisco

# Outline

---

- Summarize IEEE 802 architecture requirements
- Characterize point to multipoint media (P2MP)
- Describe solutions for 802 compliant MAC/PHY design
- Discuss layering options for the solutions
- Solicit feedback from 802.1

Assumption: that all 802, 802 MAC, and 802.1D architectural requirements are relevant.



# Review of IEEE 802 MAC Architecture

- “The MAC sublayer performs the functions necessary to provide packet-based, connectionless-mode data transfer between stations ... for LANs that support it.”
- “...an IEEE 802 LAN or MAN ... provides sufficient capabilities to support the MAC service ... between two or more MSAPs. This requires the ability to convey LLC data from one MSAP to  $n$  other MSAPS, where  $n$  can be any number from 1 to all of the other MSAPs on the network.”
  - Note: the interpretation of “one to  $n$ ” is “as required by the addressing mode.” I.E. the MAC layer is responsible for all peer-to-peer forwarding within a single access domain.
- Source: IEEE 802 LAN/MAN Architecture



# Point to Multipoint – P2MP

---

- Definition – P2MP

- Any media with a root station that can broadcast on a single frequency/wavelength through a trunk and branch structure to leaf stations, and with
- leaf stations that can unicast on a single common frequency/wavelength through a branch and trunk structure to the root station, but in which
- the leaf nodes can not communicate peer to peer.



# P2MP Media Examples

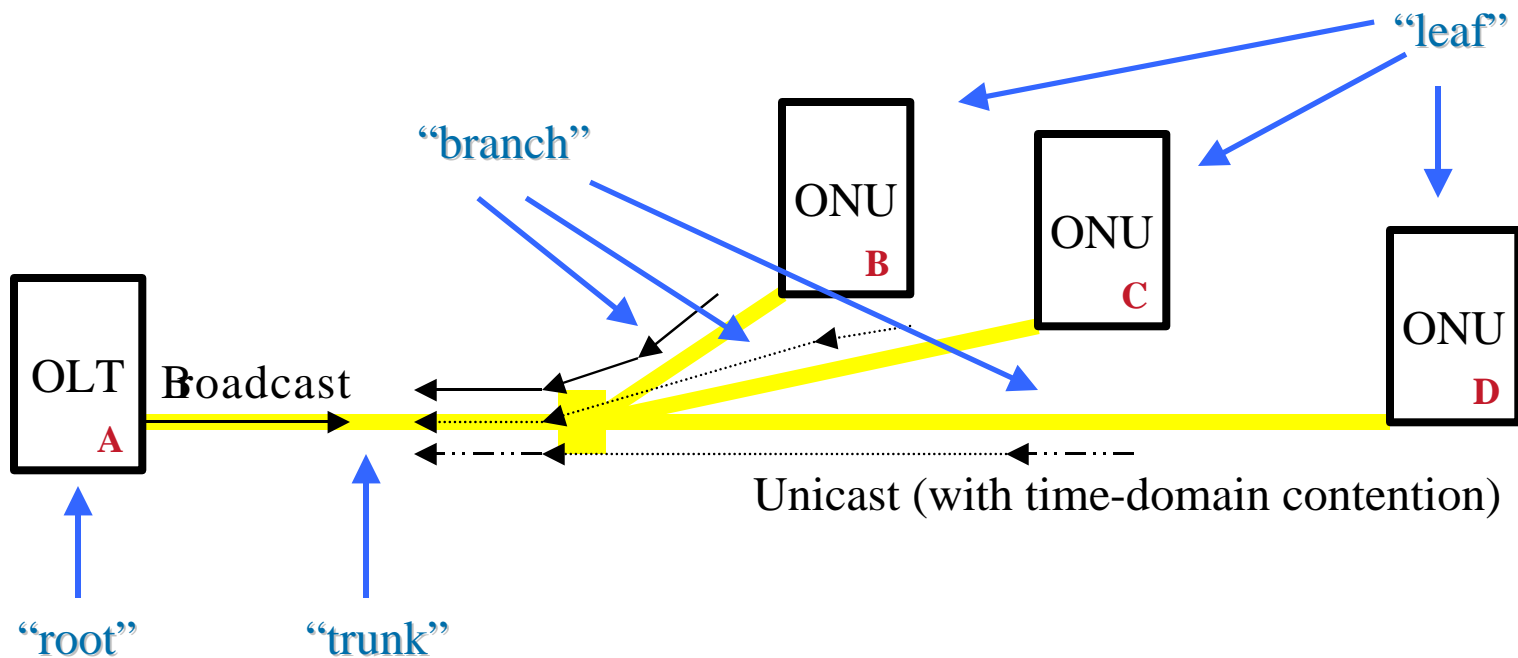
---

- Fiber P2MP
  - fiber, passive splitter, shared lambdas, MAN
- HFC Cable (8 Q. 4)
  - coax, passive splitters, shared frequencies, MAN
- 10BaseB
  - coax, passive splitters, shared frequencies, LAN
- 802.16 Wireless
  - passive RF, shared frequencies, MAN



# 802.3ah EPON – MAN P2MP

*MAN is a special P2MP category with long-reach (vis-à-vis latency) from “root” to “leaf” in which it is deemed undesirable to repeat all “upstream” traffic to “downstream”.*



## P2MP Observations

---

- Raw P2MP is NOT pure shared media
- Raw P2MP is NOT pure point to point media
- Raw P2MP is therefore not conformant to 802.1 architecture requirements
- Raw P2MP can, with augmentations, be transformed into 802.1 conformant shared or point-to-point LAN/MAN models
- *Note: “Raw” means “the physical layer without PHY or MAC augmentations”*

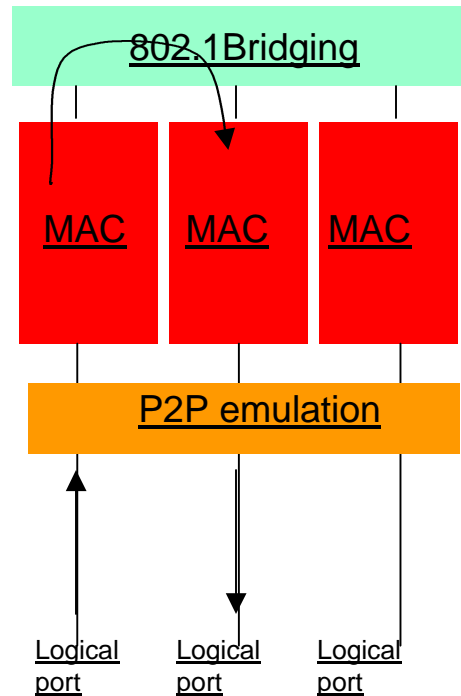


# Augmentations which deliver 802.1 view of MAC: P2P or Shared Media

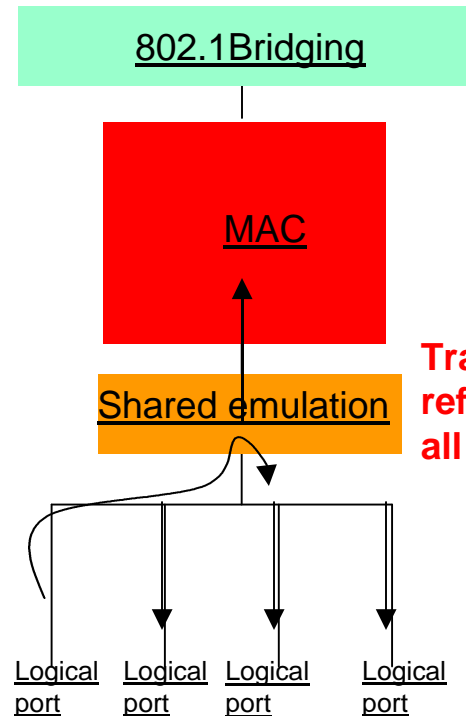
Forwarding among ONUs only at higher layer

Transmit and demux frames to each MAC corresponding Logical PHY ID

Transmit own Logical PHY ID, receive only matching ID



**P2P Emulation**



Transmit OLT PHY ID, reflect and receive all frames

Everybody sees all frames except own

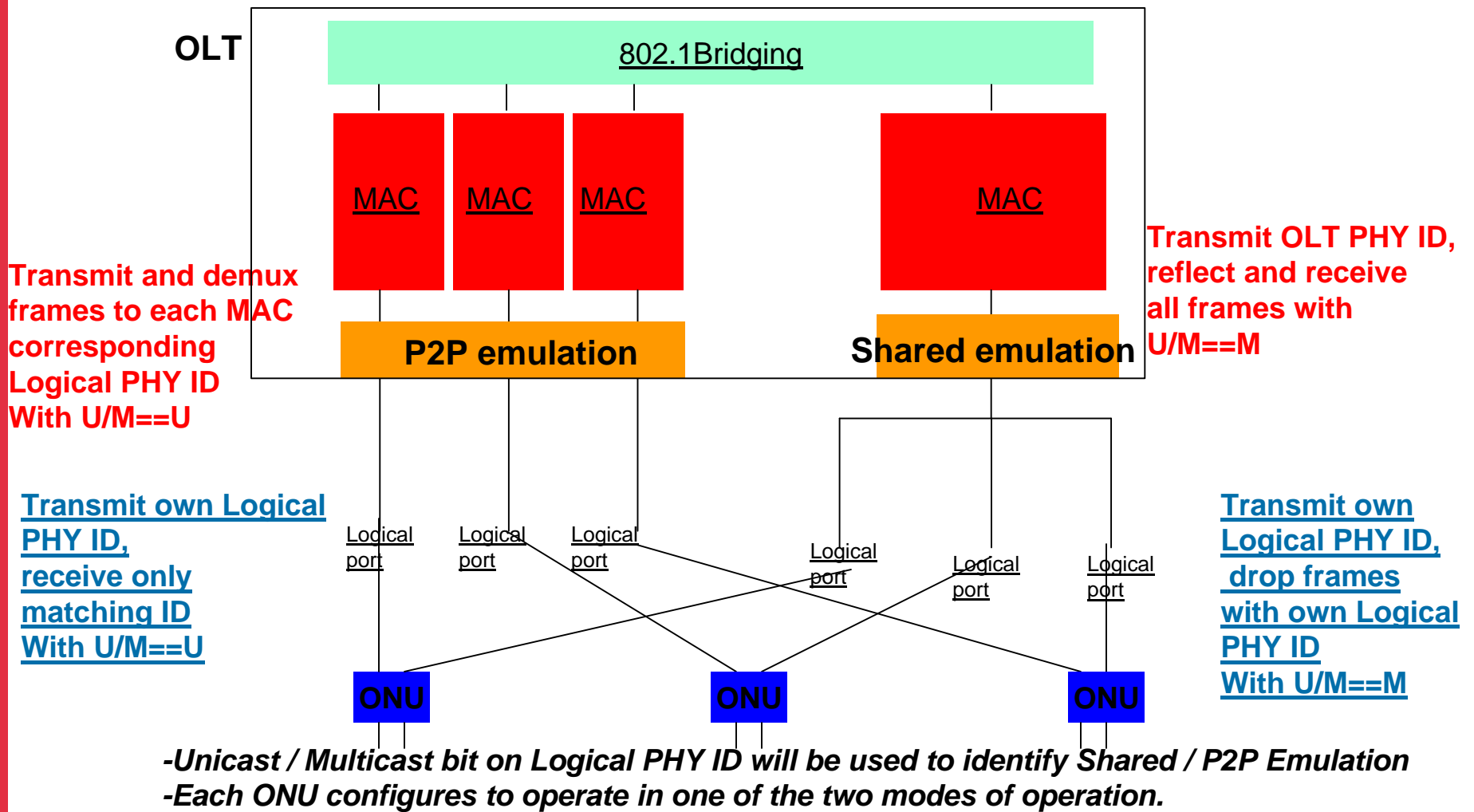
Transmit own Logical PHY ID, drop frames with own Logical PHY ID

**Shared Media Emulation**





# Augmentations can be combined to create per-leaf choice of P2P or Shared Media Mode



# Comments on these augmentations

- For a given P2MP type these initial augmentations can be sufficient.
- P2P augmentation
  - emulates point-to-point
  - but sacrifices broadcast mode
- Shared Media augmentation
  - promiscuously reflects all upstream traffic to downstream
  - but sacrifices link efficiency – up to 50% if all traffic is off-net
- But both are conformant to 802.1 architecture, and, for a given P2MP media, may satisfy all necessary requirements



# Deeper Issues

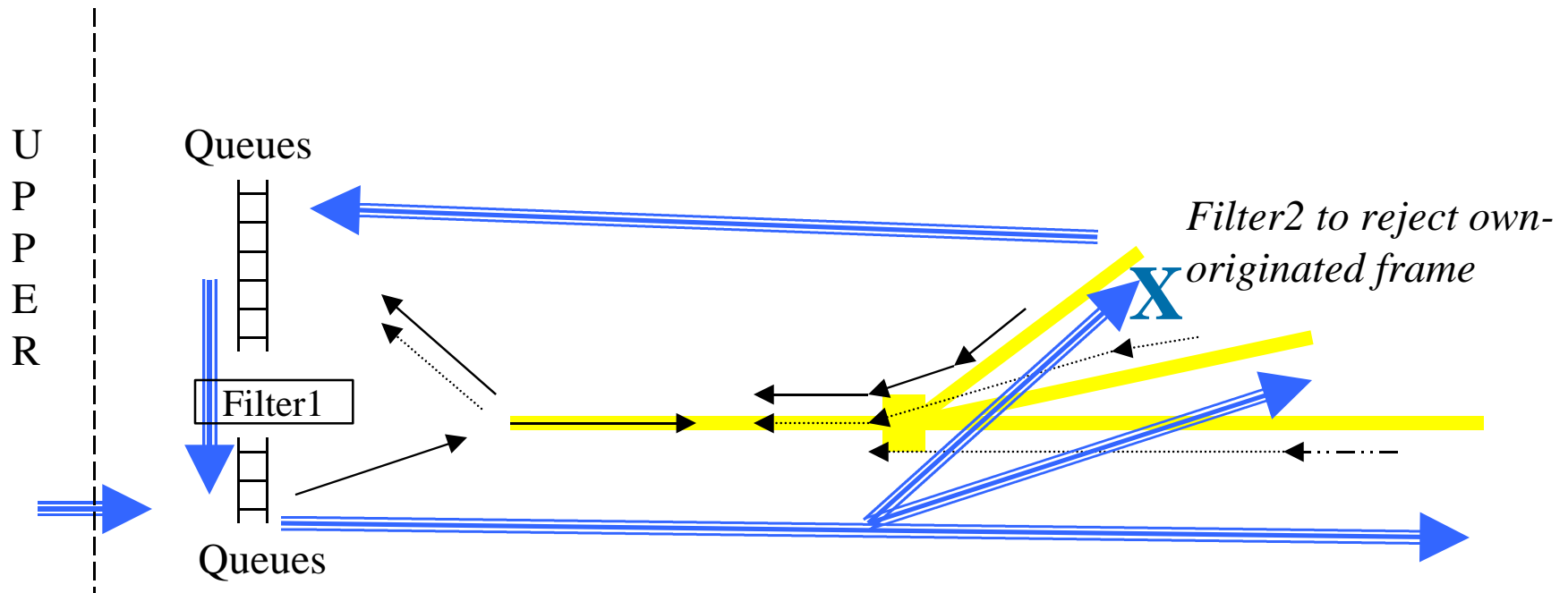
---

- Perhaps with these augmentations and their requirements implications (link efficiency and/or no broadcast) we can stop here...
- But what if we want increased link efficiency (double) and unicast-to-leaf and broadcast-to-leafs services concurrently?
  - Call this the “Max Requirements” model

Disclaimer: Fiber, Coax, and Wireless P2MP may have differing requirements with respect to efficiency, unicast service, and broadcast service.



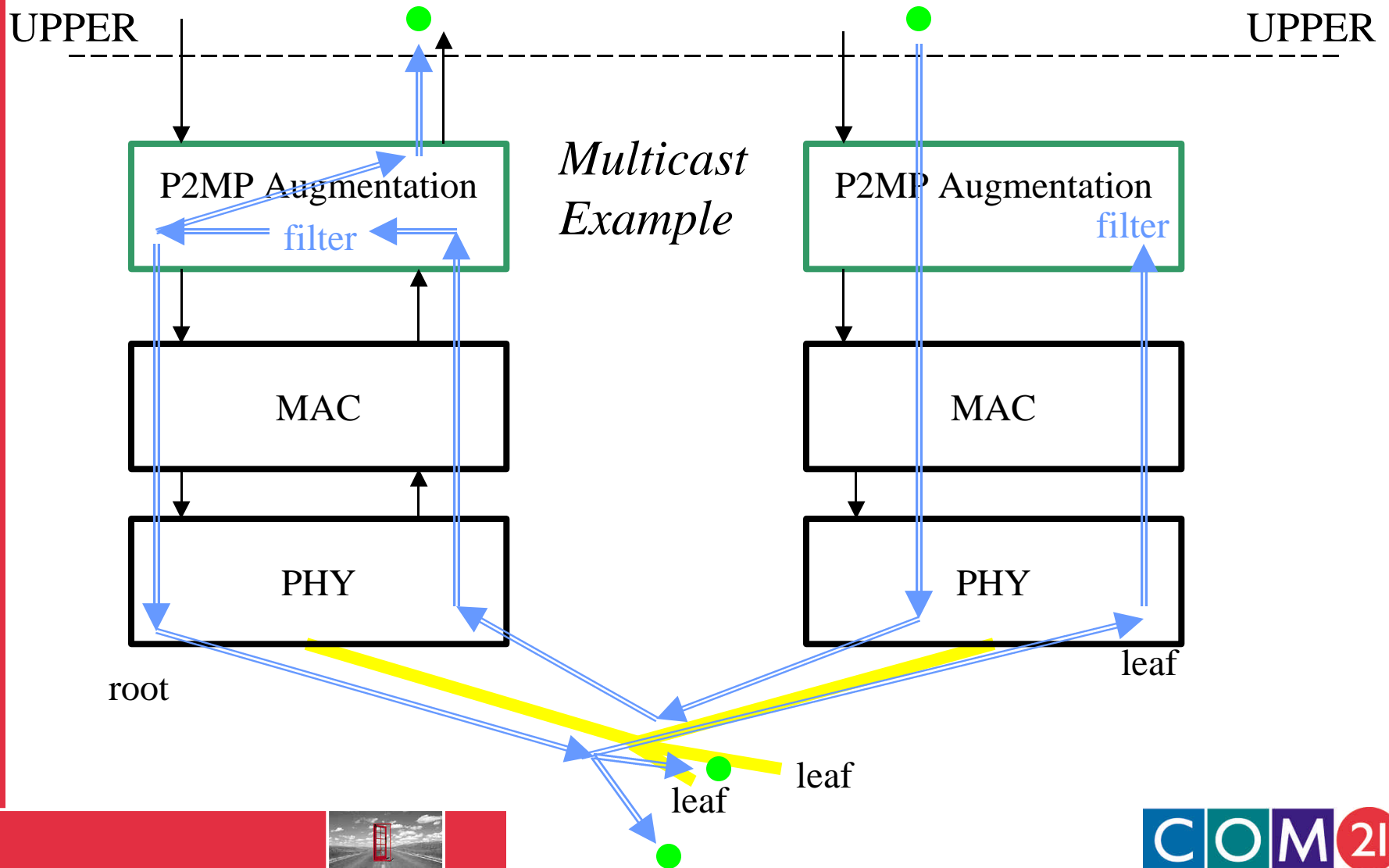
# “Max Requirements” Augmentation



- No specific layering model (PHY, MAC, above MAC) implied
- No specific filtering mechanism implied (MAC Address, PHYID)
- Root has choice of using unicast or multicast PHY service (if options exist)
- Filter1 assures that only necessary subset of upstream traffic is reflected downstream
- *Because of learning function and forwarding rules this seems “bridge-like”*



# One Possible Layering



# Possible Filtering Parameters

- (a) PHY ID
- (b) Unicast, Multicast, Broadcast address filtering
- (c) VLAN tag and classification filtering
- (a) and (b)
- (b) and (c)
- (a) and (b) and (c)

Note: degree of filtering is proportional to the degree of link efficiency desired. Simplest level (@root) is “if PHY ID (or equivalent) is valid, forward the frame to all leafs via broadcast service”

Note: possible (b) and (c) filtering rules detailed in following slides.



# General Layering Observations

- Previous examples have not suggested specific layering
- Depending upon mechanism provided, augmentation layering could be in PHY, in existing MAC, in new MAC sub-layer (like link aggregation), or in 802.1
- For future work of extension of 802.1 sublayer service interface (if undertaken), two interesting MAC service interface models (viewed from root perspective) are worth considering
  - (a) the “partial shared media” model
  - (b) the “PTP plus PTMP model”



# Layering: partial shared media model

- Broken leaf-to-leaf forwarding
- Identical port/sublayer model as today
- Identical M\_UNITDATA abstract interface as today
- Root augmentation layer completes the forwarding model
  - Promiscuous or selective-filtering
- Sample selective-filtering rules (if selective-filtering enabled) - root forwards frame received from leaf back downstream when
  - DA is known and is in leaf and VLAN attached to LAN/MAN, or
  - DA is multicast and multicast group member(s) is(are) present and VLAN members is (are) present in the attached LAN/MAN, or
  - DA is broadcast and VLAN is present in LAN/MAN, or
  - DA is unknown and VLAN is present in LAN/MAN





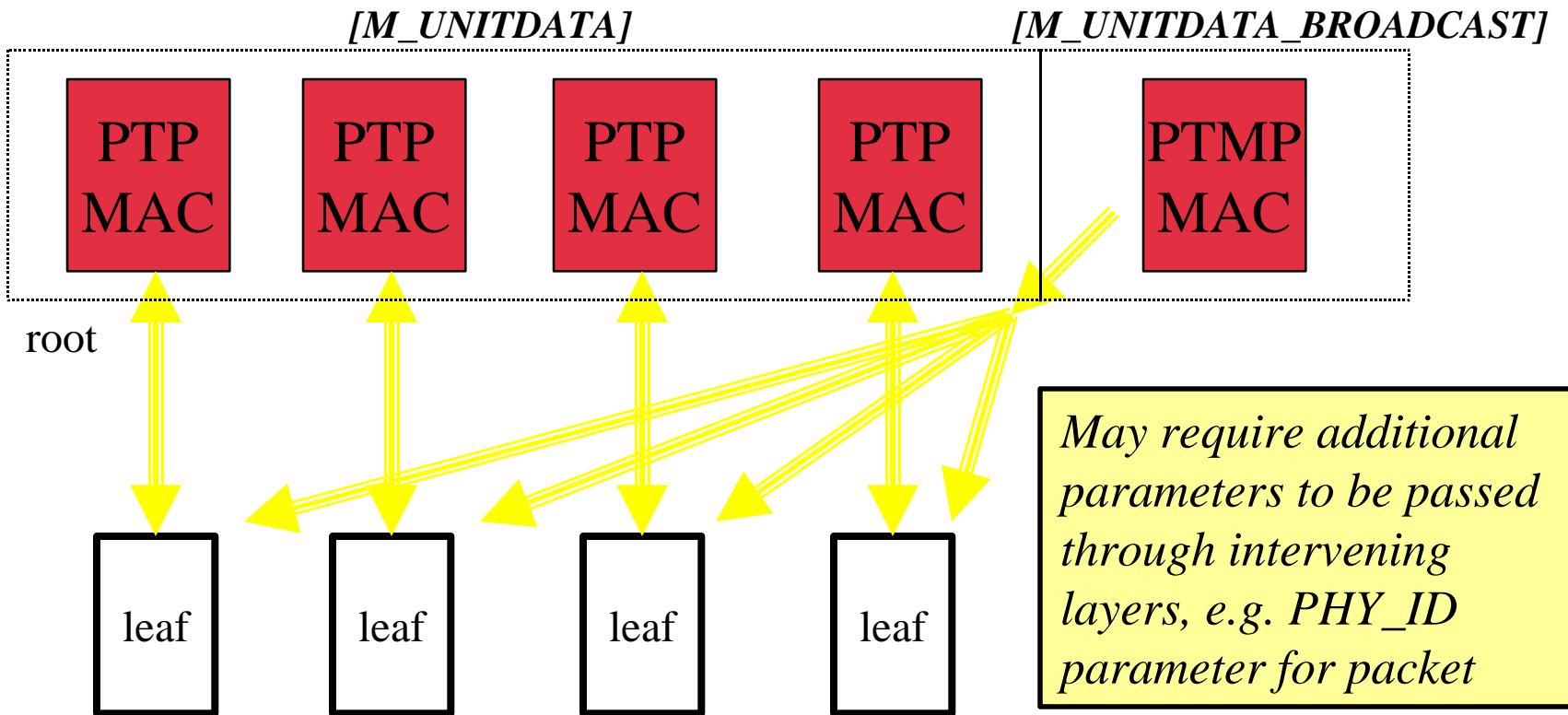
# Layering: PTP plus PTMP model

- New model - LAN/MAN port model expands to sub-ports
- Each sub-port corresponds to a root-to-leaf association
- M\_UNITDATA for unicast-service transmission/reception to/from single sub-port
- M\_UNITDATA\_BROADCAST for broadcast-service transmission to all sub-ports
- Each leaf can be reached by both M\_UNITDATA and M\_UNITDATA\_BROADCAST
- The mechanisms whereby the root augmentation layer decides between broadcast service and unicast service are undefined.

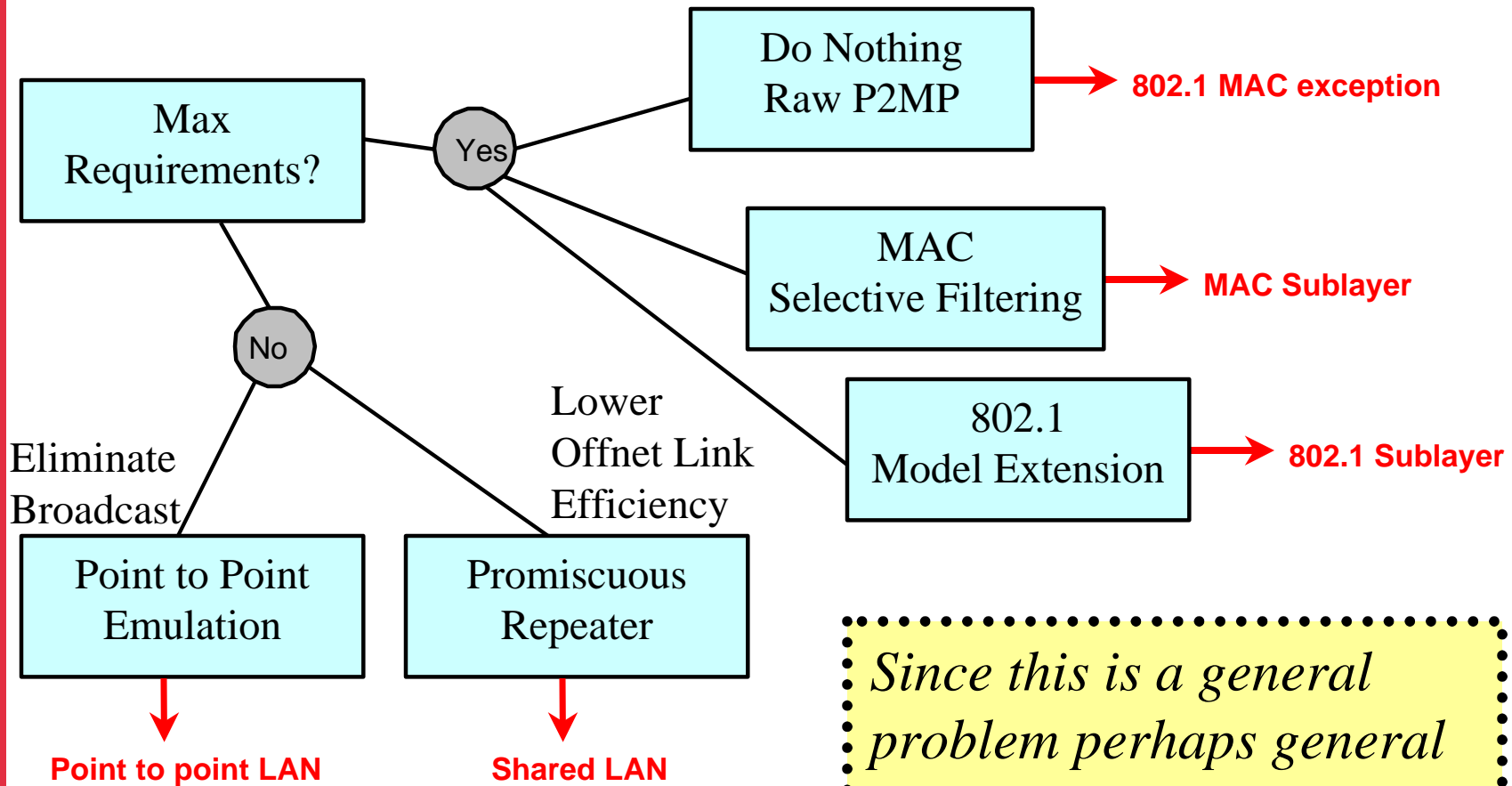


# PTP plus PTMP model

Unspecified augmentation layer – 802.1 or 802.x



# Wrapup: P2MP Design Decision Tree



*Since this is a general problem perhaps general 802.1/802.x solutions are worth considering*

