



Picking a model for 802.11/802.1 bridging

Point-to-point links, emulated LAN, or emulated bridge?

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Version 3

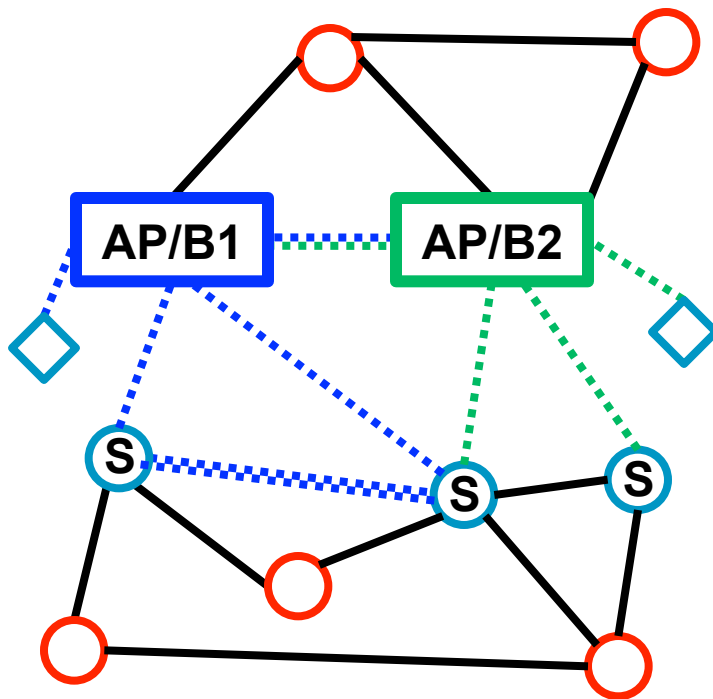
Introduction

- This presentation is available at:
<http://www.ieee802.org/1/files/public/docs2012/new-nfinn-11-medium-choice-0812-v03.pdf>
- This presentation differs from earlier versions of the same title in that **the similarities and differences of the models are highlighted.**

Three different models

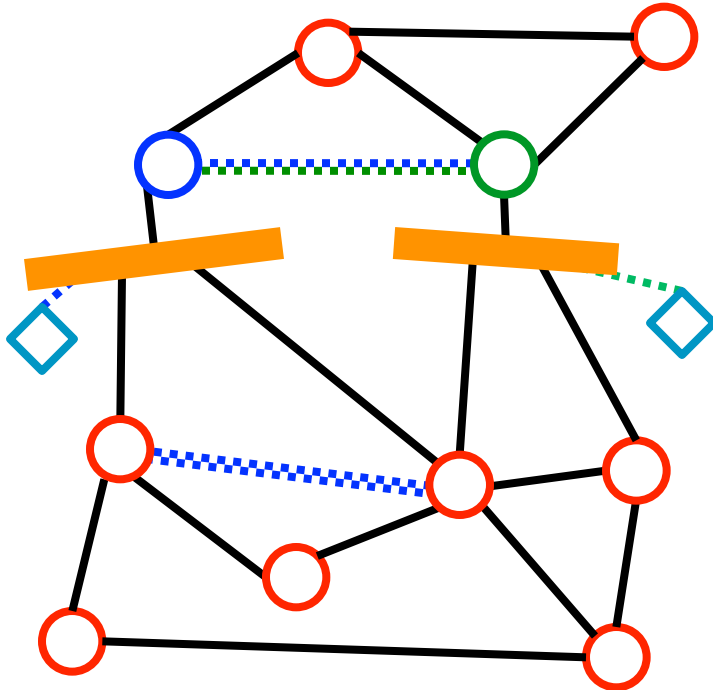
1. An 802.11 AP and its non-AP stations export to the rest of the network, and utilize themselves, a view of the 802.11 medium as a **set of point-to-point links** such that every non-AP station has a link to the AP. There may also be links between APs or between some pairs of non-AP stations.
2. The 802.11 AP and its non-AP stations appear to the logical bridge functions that may reside in some or all of the AP and its associated non-AP stations to be a single **emulated LAN**, rather similar to the original 802.3 “fat yellow coax”.
3. The 802.11 AP and its non-AP stations appear to be a single **emulated bridge** to the rest of the network.

Set of point-to-point links



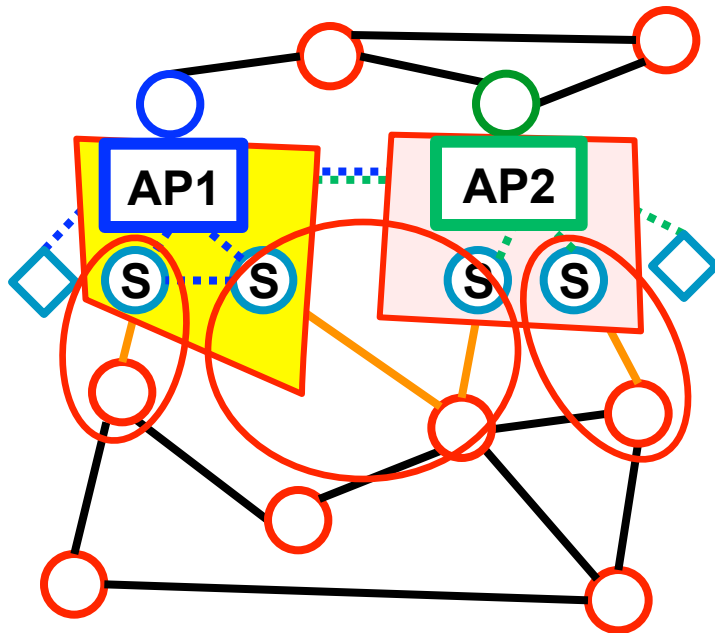
- The Access Points and their co-resident bridging functions become integrated AP bridges (AP/Bs).
- Devices with non-AP station capability(ies) and wired connections become “non-AP station bridges” (S).
- Of course, not all stations are bridges. (The diamonds are non-bridge non-AP stations.)

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.

Emulated Bridge



- Each Access Point and its non-AP stations emulate a single, separate bridge.
- An AP with multiple wired connections is logically separated into an AP and a wired bridge.
- Each station/bridge must be broken up with separate stations and a virtual wired bridge, with virtual wires to each component.

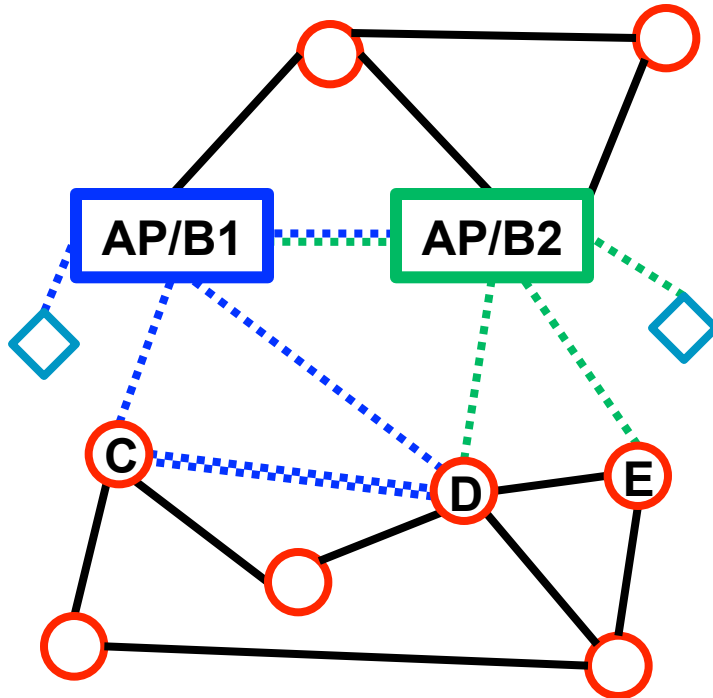
How different are these models?

How different are these models, really?

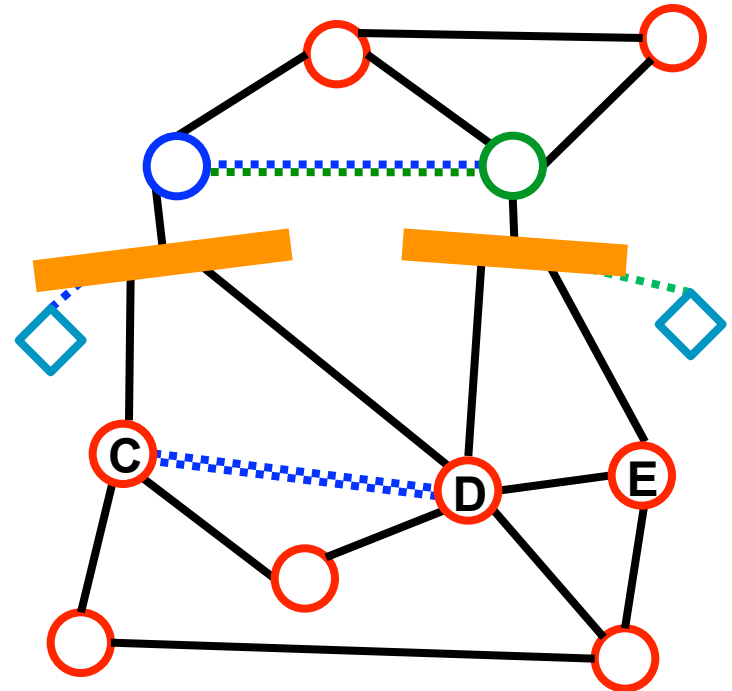
- None of these models have been proposed by fools; they all will work.
- Because they all work, and because they all have the same data plane in reality, it is easy to morph one model into the other to highlight the real differences.

Point-to-point vs. emulated LAN (IS-IS)

point-to-point model



emulated LAN model

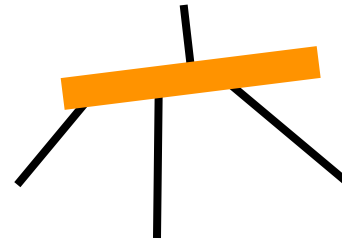


- Let us assume that we are using IS-IS.
- (Above, station-station link is separated from the LAN.)

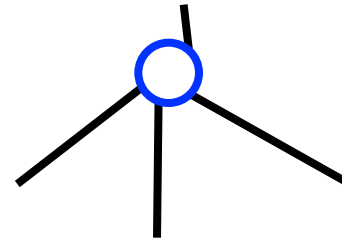
Emulated LAN emulation by IS-IS

- As pointed out in the Study Group Webex conversations, IS-IS emulates a shared medium by creating a pseudo-node with point-to-point links to each member of the shared medium.

- That is, a shared medium:

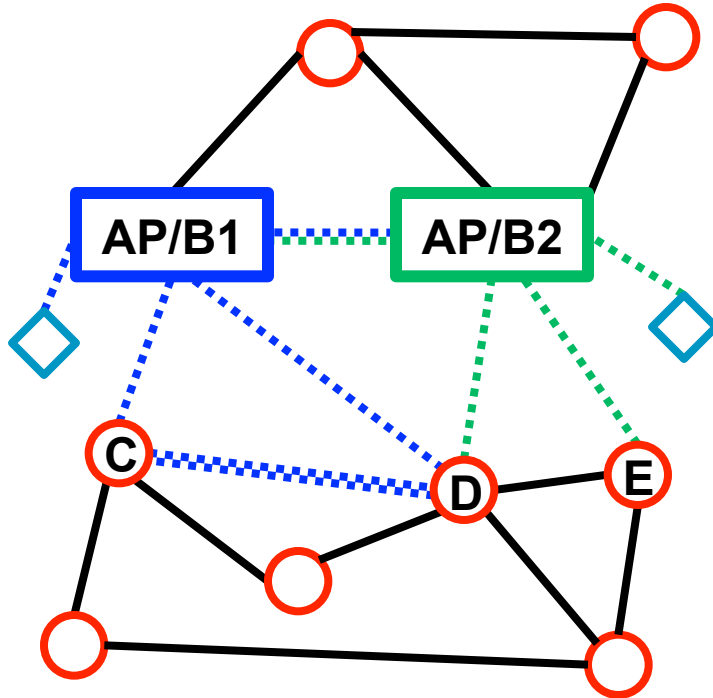


- Is emulated by IS-IS as:

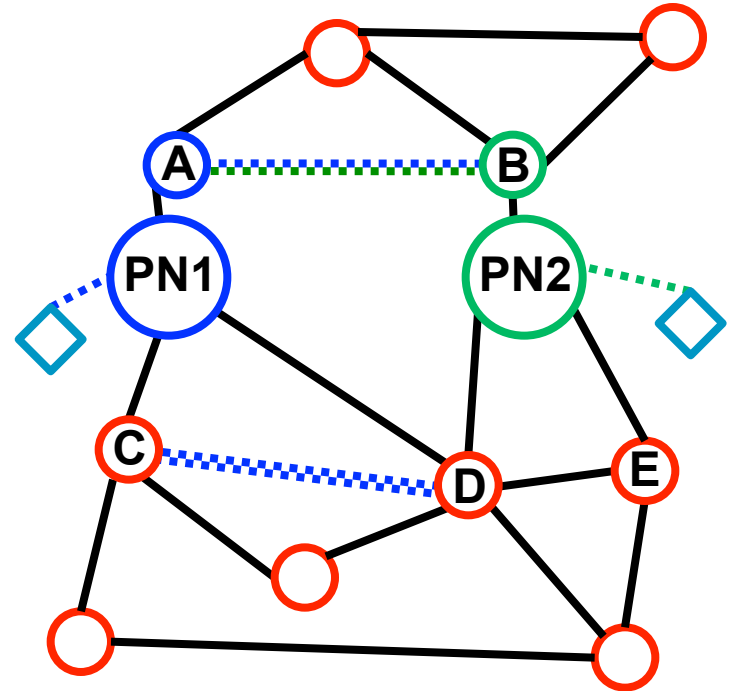


Point-to-point vs. emulated LAN (IS-IS)

point-to-point model



IS-IS view of emulated LAN model



- With IS-IS, bridges **A**, **C**, and **D** cooperate to emulate **PN1**, and **B**, **D**, and **E**, emulate **PN2** to the rest of the network.

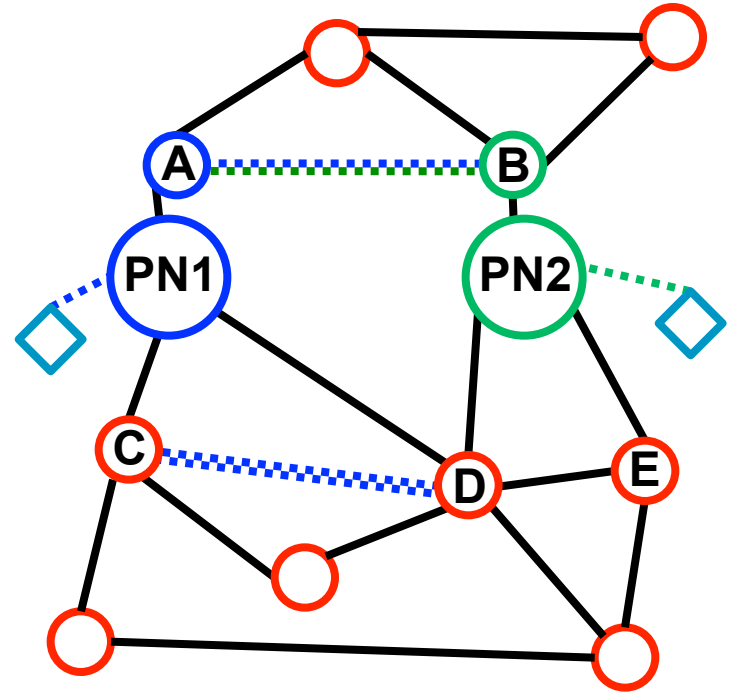
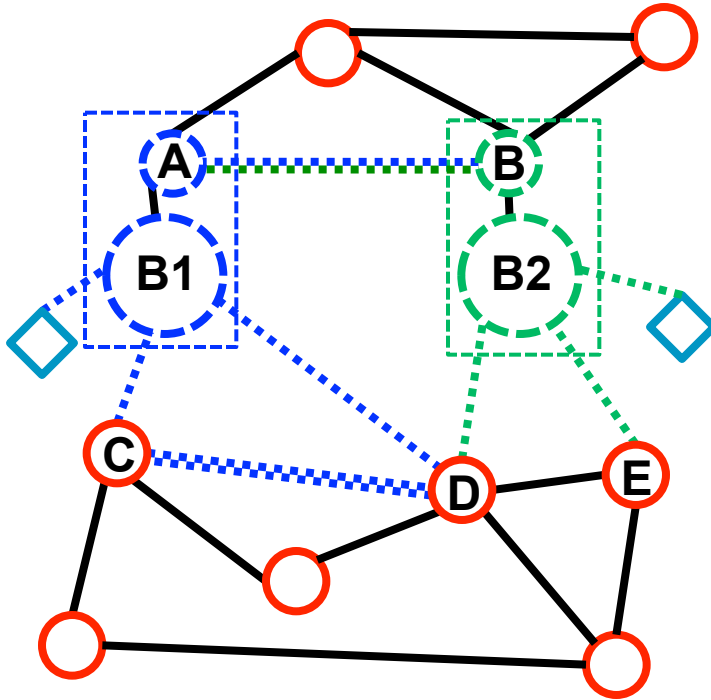
Bridge + Access Point or APBridge

- Much has been made in earlier slides between:
 - The 802.11 architecture, which separates the bridge function from the AP function (an AP has only one wired connection); and
 - The point-to-point model, which combines the bridge and AP functions into a single bridge/AP function.
- But, **in the context of IS-IS running over the point-to-point model**, this difference is hidden from an observer outside the box containing the bridge and the AP. Whatever the implementation, the box can be represented to the outside world **either way**, as one function or two.

Point-to-point vs. emulated LAN (IS-IS)

alternate IS-IS view of point-to-point model

IS-IS view of emulated LAN model

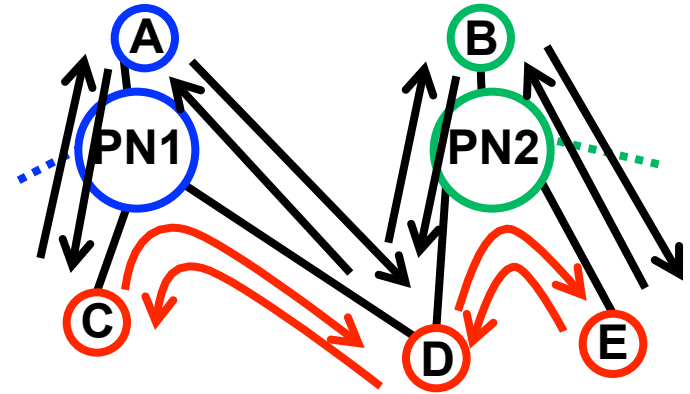
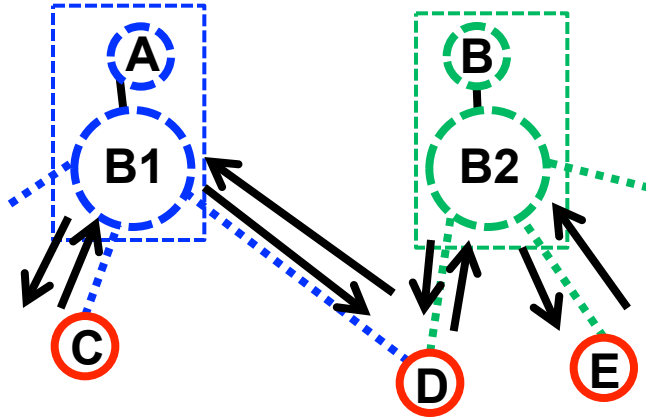


- It is a local choice whether, in the **IS-IS + point-to-point** model, one represents a bridge+AP box to the rest of the network as **two** separate bridges, or **one**.

The real differences to IS-IS

alternate IS-IS view of point-to-point model

IS-IS view of emulated LAN model

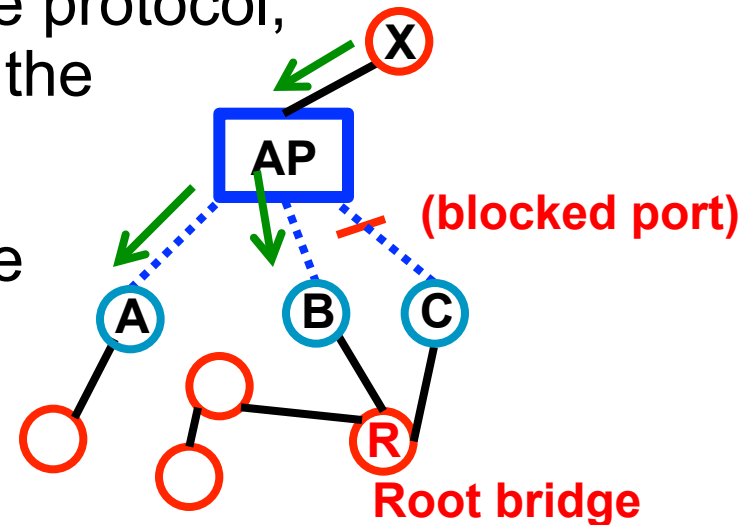


1. The point-to-point model sends $2(n-1)$ packets per update cycle for IS-IS over each medium. The emulated LAN model sends $n(n-1)$ packets.
2. Point-to-point works well with all .1 protocols. Emulated LAN has 6-second convergence timeout, prevents the AP from performing VLAN, multicast, and I-SID pruning, and SRP must be modified.

Issues peculiar to point-to-point model

Issue: Multicast distribution

- Each device below is a bridge, wireless connections are treated as point-to-point links, and a broadcast frame is sent by bridge **X**.
- Suppose bridge **R** is the spanning tree root, so that one of the AP's "ports" is blocked.
- In the standard spanning tree protocol, bridge **C** does not know that the AP's link to it is blocked.
- How does the AP forward the broadcast to **A** and **B** but not to **C**?



Multicast distribution

- One solution would be to extend/modify MSTP and/or Shortest Path Bridging to provide a handshake to tell bridge **C** that the AP end of the link is blocked.
- Another solution is to send multiple unicasts to the bridges, at least until the handshake (if any) is done.
- Another solution would be to provision a set multicast Receive Addresses, in frames sent by the AP, to specify sets of bridge / stations. (In this case, “**A** and **B** but not **C**”.)
 - This latter idea has its own problems – either we must limit an AP to at most 24 bridge/stations (the number of bits available following the OUI in a MAC address), or define a protocol for distributing a mapping of vectors of stations to 24-bit IDs.

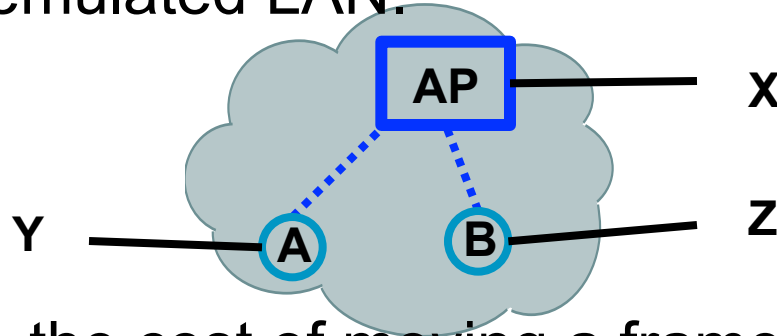
Multicast distribution

- Any of the above solutions have another consequence to bridges: In order to be efficient, 802.1Q needs to have the concept of a special port that provides multicast services to some number of individual ports.
- This same concept is required to support 802.1 EPON and MoCA media.
- This has been investigated by a number of 802.1 people over the years, and is believed to not be difficult for 802.11.

Issues peculiar to LAN emulation model

Issue: Hidden costs

- There are issues with the actual vs. the apparent cost to cross the emulated LAN.



- For example, the cost of moving a frame between X and Y is typically half the cost of moving a frame between Y and Z.
- This cost difference can be important when dealing with video streams, and cannot be factored into forwarding decisions if the links are part of an emulated LAN, to which bridging protocols give a single cost.

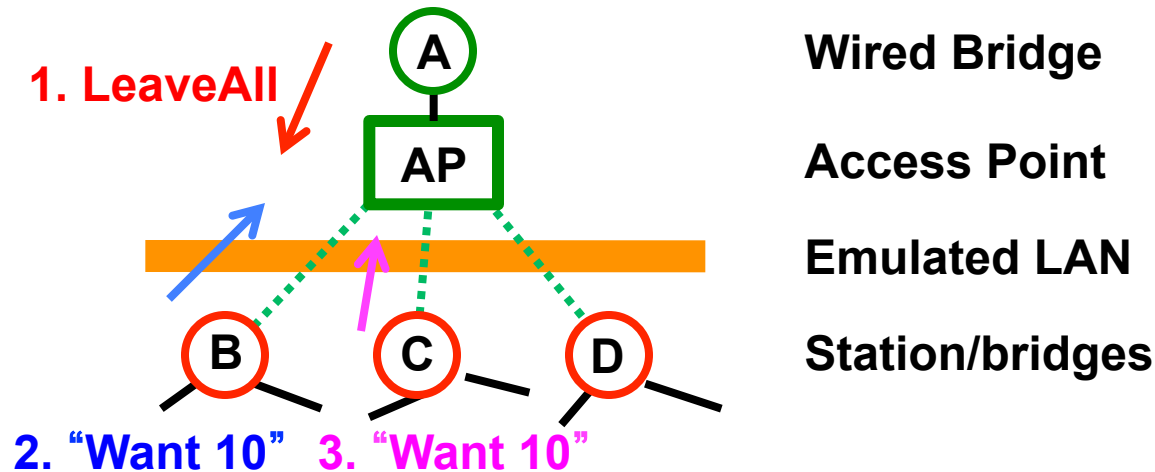
Issue: Protocols over emulated LANs 1

- On point-to-point links, MSTP performs a handshake with its neighbor, blocking a port briefly, in order to ensure against temporary forwarding loops. With this handshake, MSTP can converge in **milliseconds** after a topology change.
- There is no reliable handshake defined for a shared medium; instead, MSTP blocks a default timeout of **6 seconds**.
- This is one reason Shortest Path Bridging protocol (SPB) does not now support shared media. SPB uses a handshake to prevent forwarding loops that works very much like the MSTP handshake – it would have to time out on shared media.

Issue: Protocols over emulated LANs 2

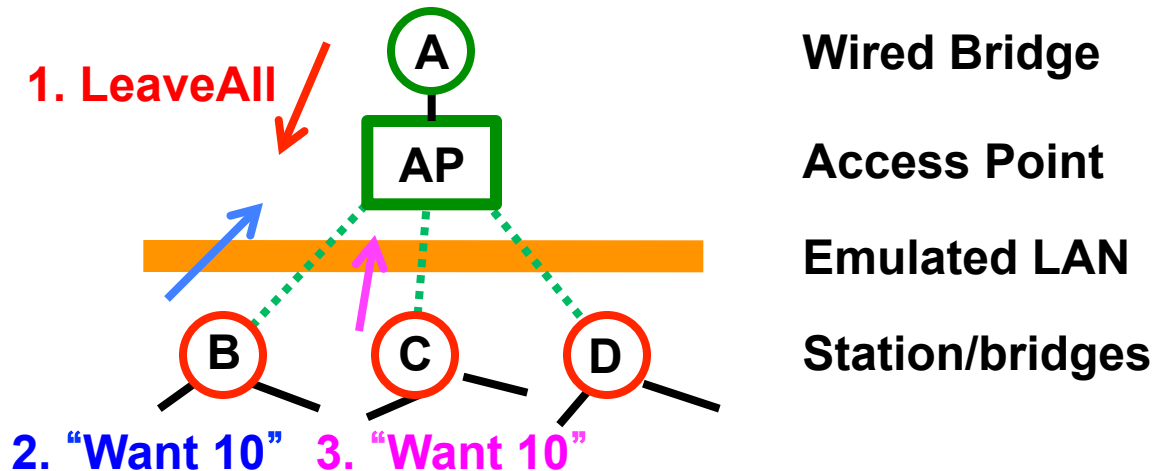
- The **good news**: 802.1Q MRP (Multiple Registration Protocol, on which **MVRP**, **MMRP**, **MIRP**, and **SRP** are based) and IETF **IGMP** are very clever, in that they work on shared media with a minimum of transmitted frames.
- The **bad news**: **All such protocols require active assistance** by the LAN emulators in order to work on an emulated LAN unless the devices emulating the LAN take special steps.

Issue: Protocols over emulated LANs 2



- Four bridges, A-D, attached to an 802.11 emulated LAN.
- All frames are broadcast to all bridges.
- Bridge A sends MVRP **"LeaveAll"** = "Reset & resend soon."
- All bridges (including A) start a short random timer.
- Bridge B times out first, & multicasts, **"I want VLAN 10"**.
- Bridge C times out, & multicasts, **"I want VLAN 10"**.

Issue: Protocols over emulated LANs 2

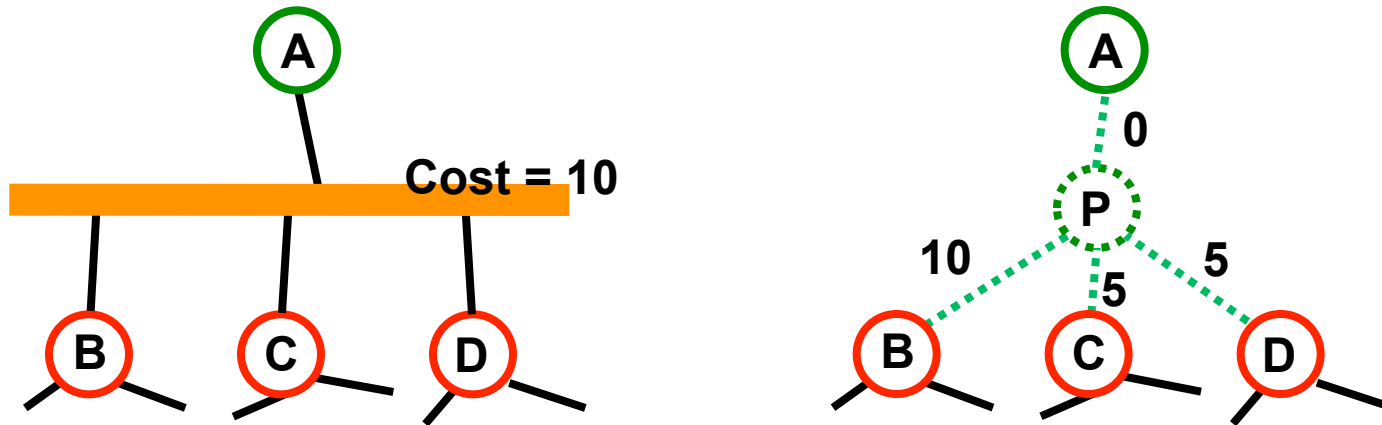


- Even if bridges A and D also need VLAN 10, **they say nothing**, because they see the others' transmissions, and thus know that everyone on the shared medium has seen the announcement (this stops unneeded chatter), so A and D will receive any VLAN 10 frames on the medium.
- The AP does not know whether A and D need VLAN 10, so it must send VLAN 10 to all four bridges, whether they need it or not! **Pruning doesn't work; bandwidth is wasted.**

Possible solutions for LAN emulation issues

Hidden costs

- Shortest Path Bridging (SPB) is based on IS-IS.
- IS-IS can handle a shared medium by replacing the shared medium in its calculations with a pseudo-node with a point-to-point link to each port on the medium.



- This improves the “hidden costs” issue for SRP, but not for MSTP (which has no pseudo-node), and does not help the protocols over emulated LANs problem.

Protocols over emulated LANs

- In order to emulate a shared medium, while still providing the optimizations expected of a bridge (which are particularly to 802.11, because of limited bandwidth), the 802.11 stations must treat all of these protocols specially: MSTP BPDUs, MVRP, MMRP, MIRP, SRP, IGMP, and SPB loop handshakes.
- One obvious fix is to treat the shared medium as a set of point-to-point links for these protocols.
- One must then ask, if we handle these protocols as if they were done with bridges connected via point-to-point links, and if the data movement takes place over these same point-to-point links, then in what sense is this really different from the point-to-point model?