# 802.11 Station Bridges

## A way to standardize 802.11 non-AP stations that are bridge ports

**Rev. 3**

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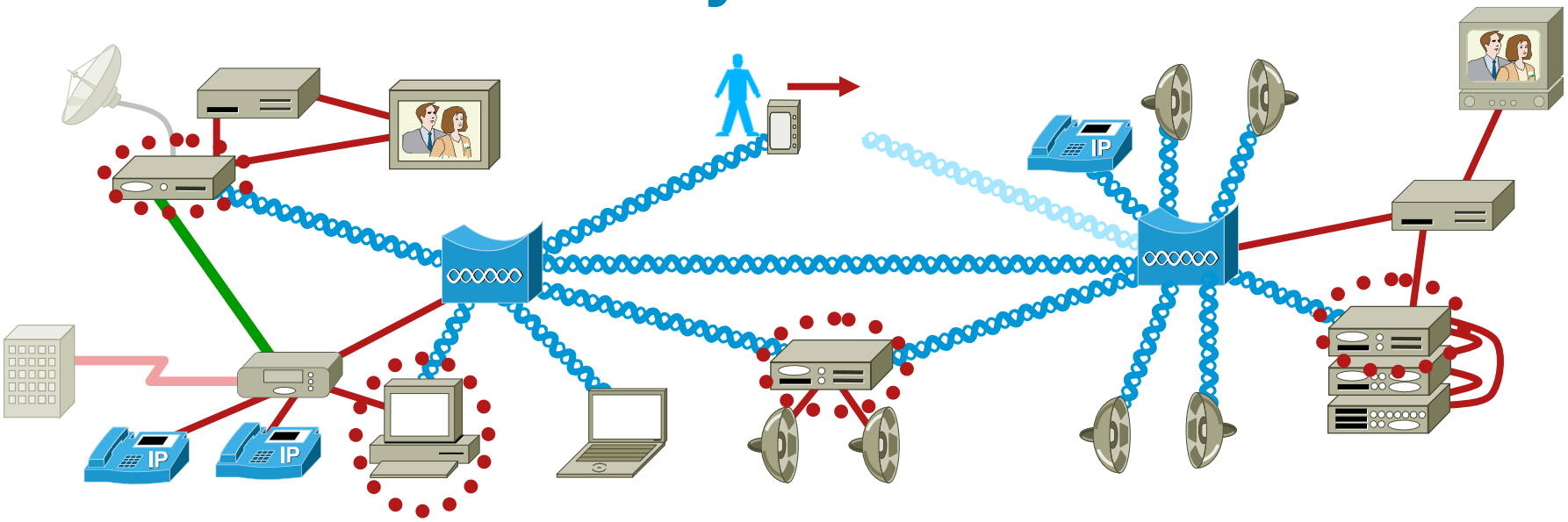
# References

- This presentation is available at: http://www.ieee802.org/1/files/public/docs2008/avb-nfinn-802-11-bridging-0308-v3.pdf
- For a more complete description of the station bridge problem and possible solutions, see: http://www.ieee802.org/1/files/public/docs2007/avb-nfinn-wireless-bridges-0707-v2.pdf
  or:
  http://www.ieee802.org/1/files/public/docs2008/avb-nfinn-802-11-bridging-0308-v2.pdf

# Executive summary

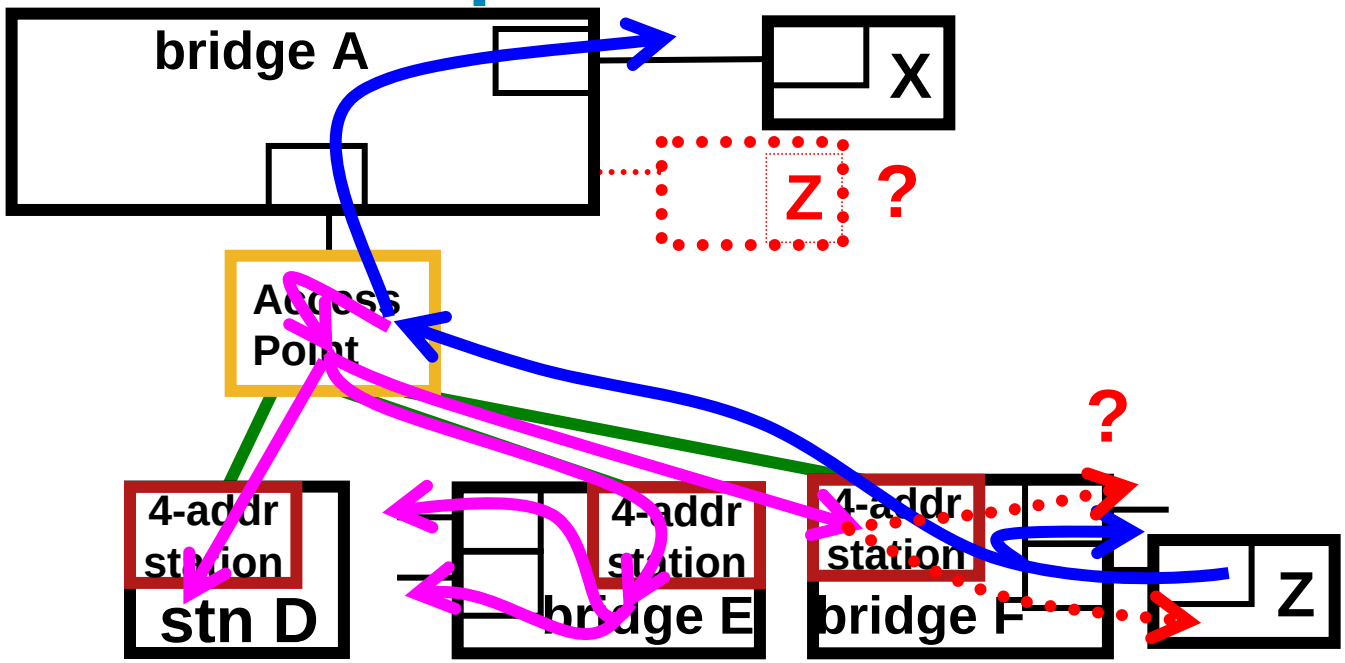



- In a home or small studio, there may be many Ethernet-like links: 802.3, 802.11, MoCA, Ether/DSL, etc.
- Loop-free connectivity is assured if every device with multiple links is an 802.1 bridge (M/RSTP or 802.1aq).
- IEEE 802 standards do not support a "station bridge": an 802.1 bridge with a non-AP station as one of its ports.

# What do we mean by, "A station bridge is not supported"?

- IEEE Std. 802 leaves it up to each medium whether frames transmitted on that medium are reflected back and received at the source.
- IEEE Std. 802.1D and 802.1Q make it clear that a bridge does not work on any medium that reflects frames back to the source.
- An IEEE 802.11 wireless access point reflects frames (with a time delay!) back to the source non-AP station.
- On this reflecting medium, a station bridge cannot distinguish between frames it should discard as reflections, and frames from which it should learn.

# Demonstration of the problem




- Bridge F relays a **broadcast frame** from Station Z.
- The Access Point **relays that broadcast** back to the wireless medium.
- Bridge F **can't decide** whether to learn that Z has moved and distribute the frame, or to suppress the reflection.

# ASSUMPTIONS

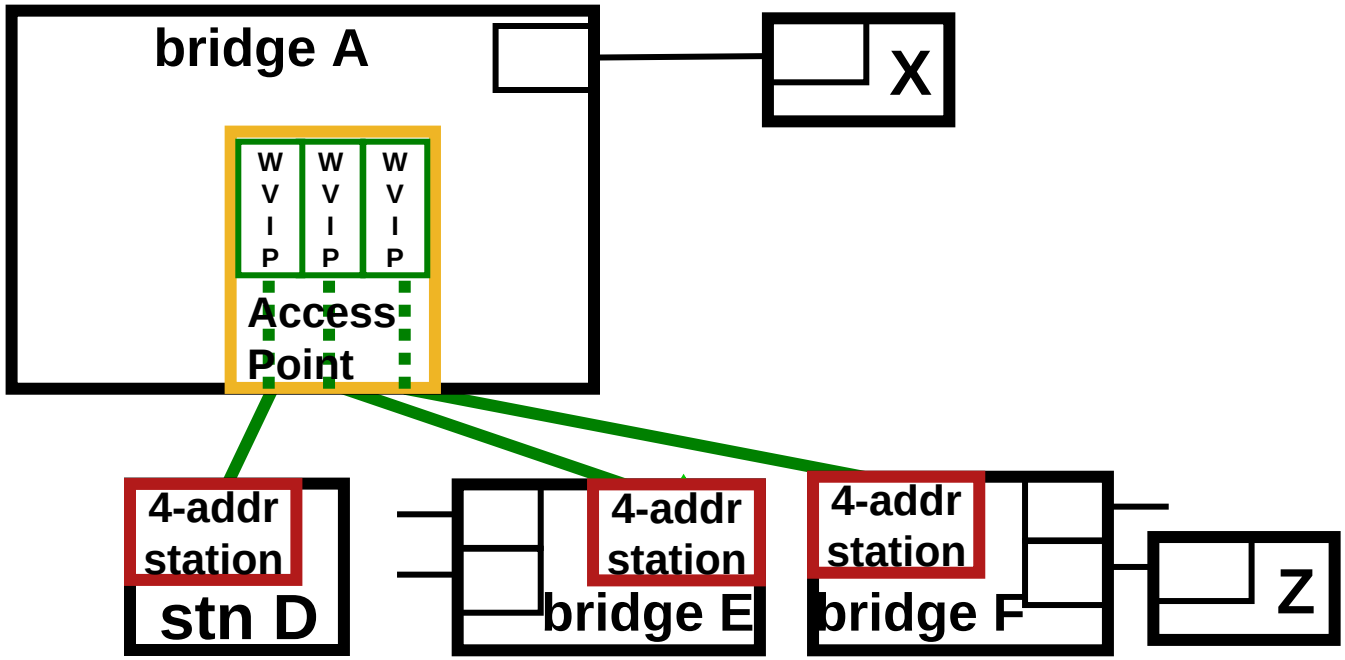
- To solve that problem, and to handle unknown unicasts, MVRP, GVRP, and new protocols now in progress, the Access Point cannot be at “arm’s length” from the bridge.

  The Access Point is a bridge.

  The bridge and the access point are integrated more closely than having a wire (whether virtual or real) connecting them.

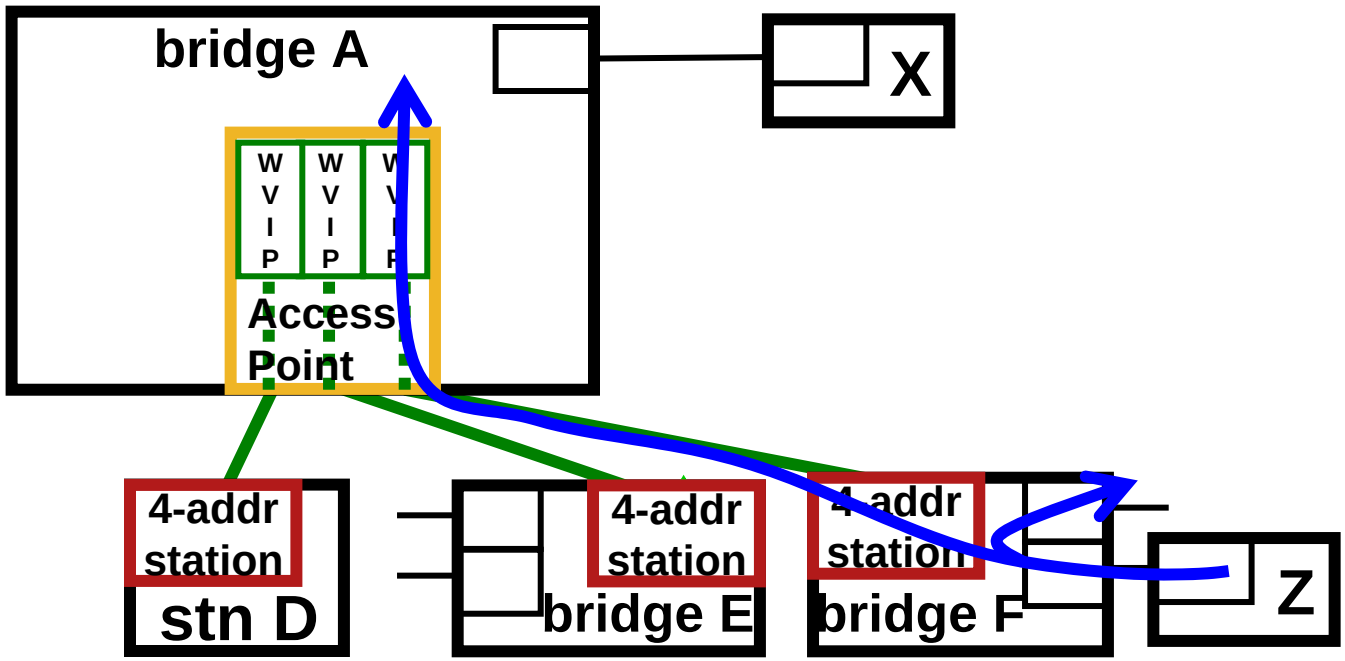
- Each non-AP station associated with the Access Point, whether a bridge or not, looks like a separate port on the bridge.
- The Access Point continues to manage the peculiar aspects of the wireless media.
- The AP can optimize sending so that multiple copies of one frame on multiple “ports” can be sent only once.

# An example: an unknown unicast



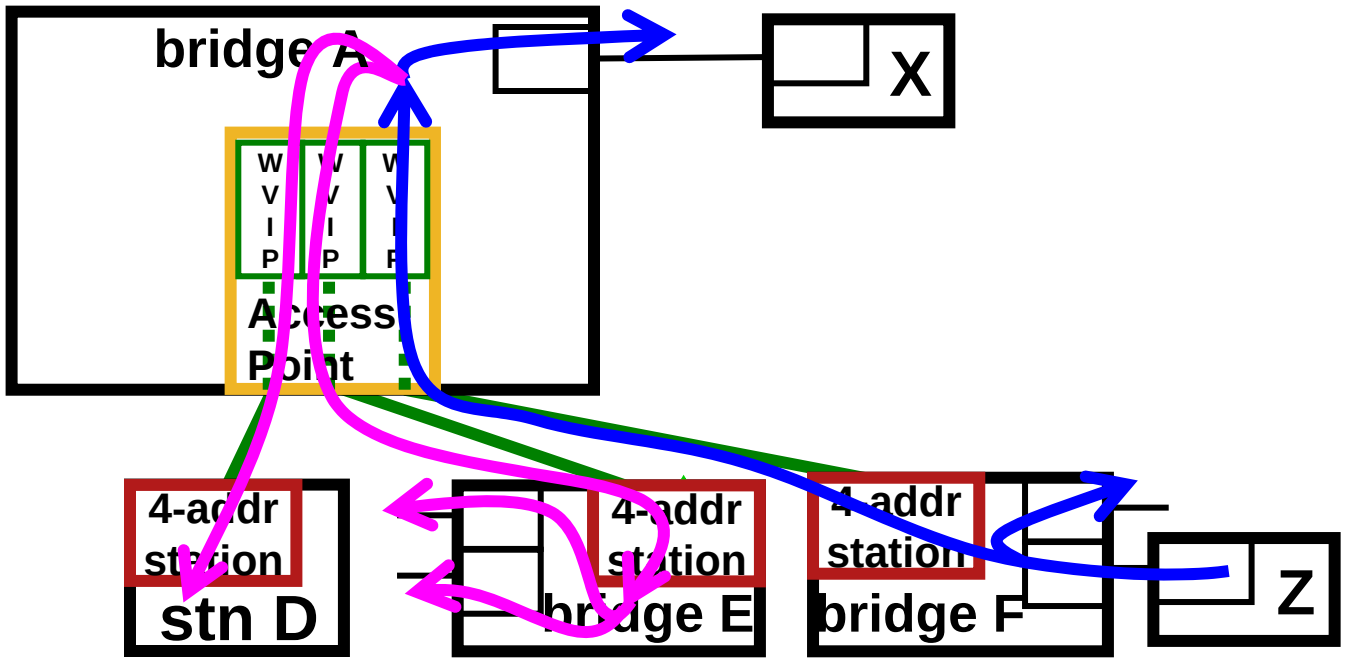

- The transmission of a **unicast frame** with an address that is **unknown** to the bridges in the network (at least, to Bridge A) is a clear example of the **remaining problem**.
- Broadcasts and unicasts would be handled in exactly the same way.

# An example: an unknown unicast



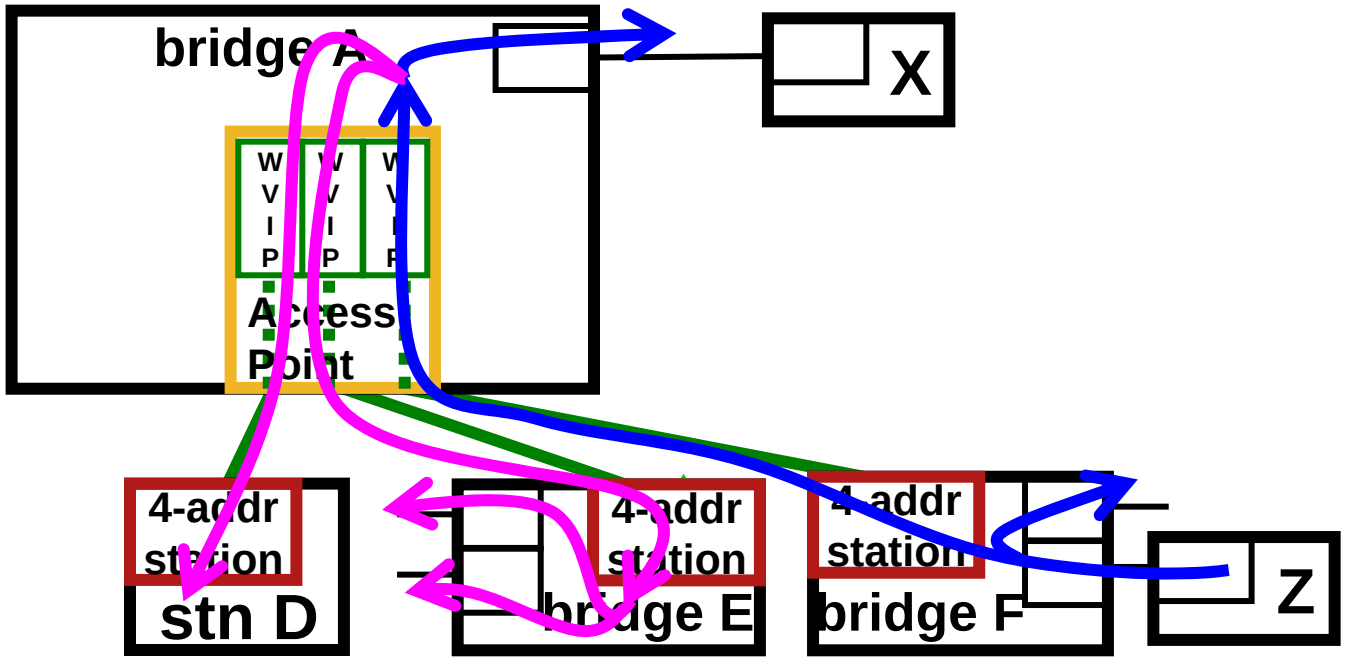

- Suppose Bridge F relays an **unknown unicast frame** from Station Z to "W" via Bridge A (and to its other ports).

# An example: an unknown unicast



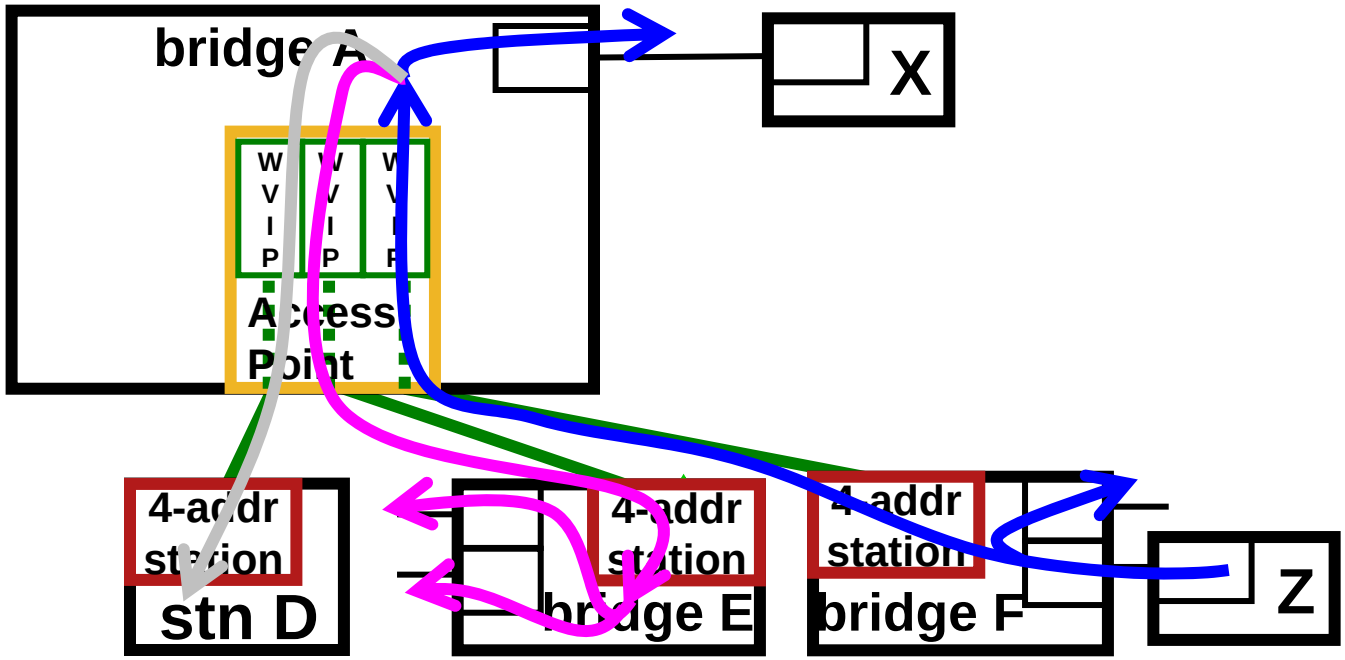

- Suppose Bridge F relays an unknown unicast frame from Station Z to “W” via Bridge A (and to its other ports).
- Bridge A, of course, relays that unknown unicast to its other ports, **not including** the port to Bridge F.

# An example: an unknown unicast




- Suppose Bridge F relays an unknown unicast frame from Station Z to “W” via Bridge A (and to its other ports).
- Bridge A, of course, relays that unknown unicast to its other ports, not including the port to Bridge F.
- **How does the AP send it to D and E, but not to F?**

# Method 1 to transmit an unknown unicast




- Send a **unicast** with the 802.11 four-address format.

  Receiver Address: **Station E**

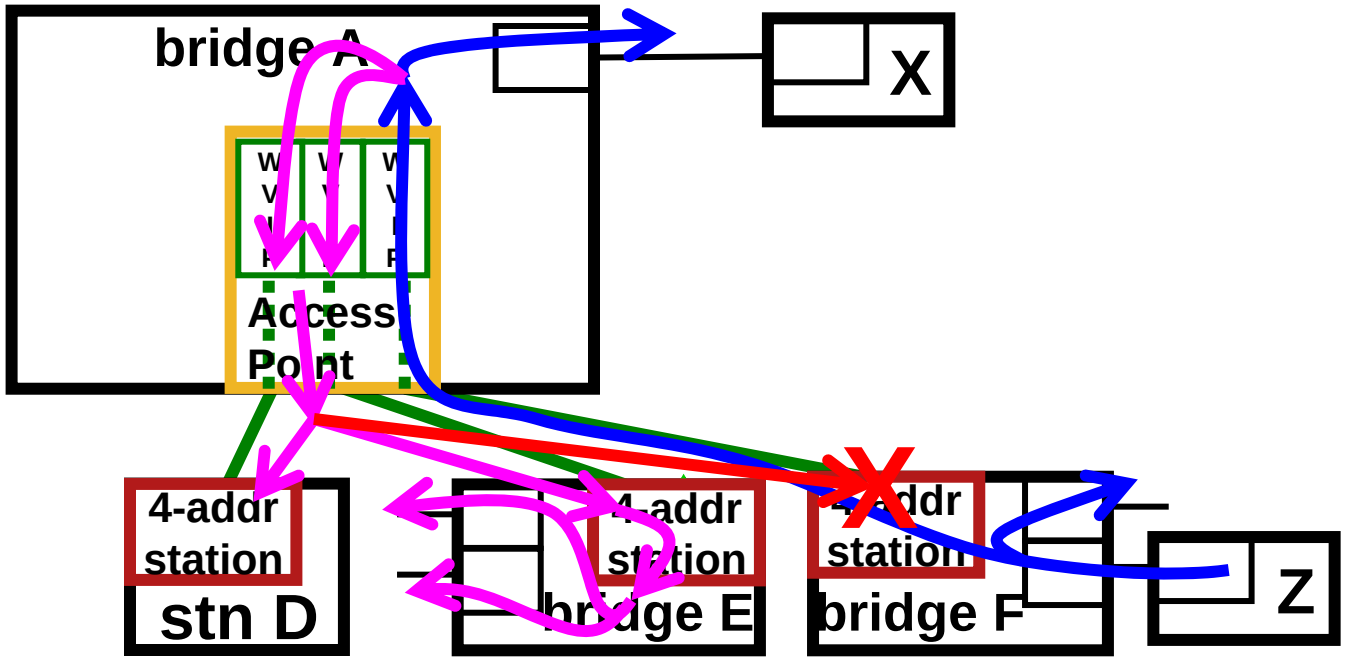
  Transmitter Address: A, the access point

  Destination Address: Original Ethernet destination, W

  Source Address: Z, the Ethernet source.

  (AP and bridge both know D doesn't need the frame; D's not a bridge.)

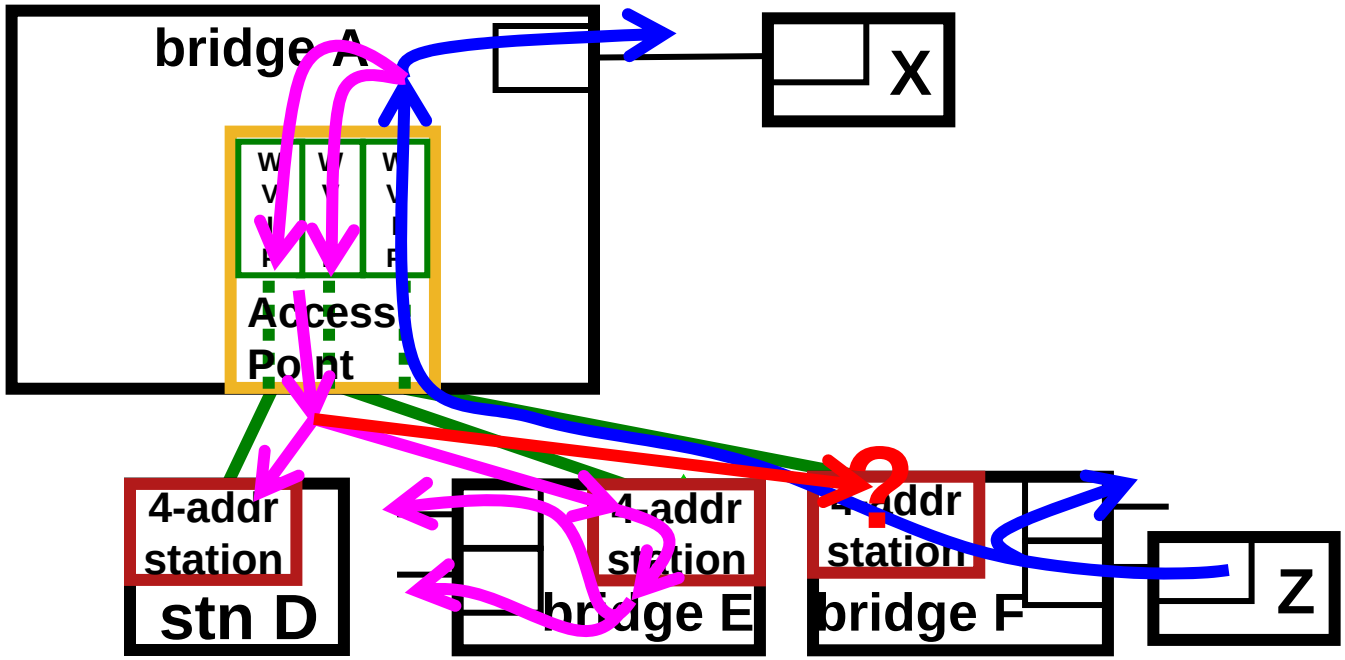
# Method 2 to transmit an unknown unicast




- Send **one multicast** with the 802.11 four-address format.

| | |
|---|---|
| Receiver Address: | **Not station F** |
| Transmitter Address: | A, the access point |
| Destination Address: | Original Ethernet destination, W |
| Source Address: | Z, the Ethernet source. |

# Why not the 3-address format?

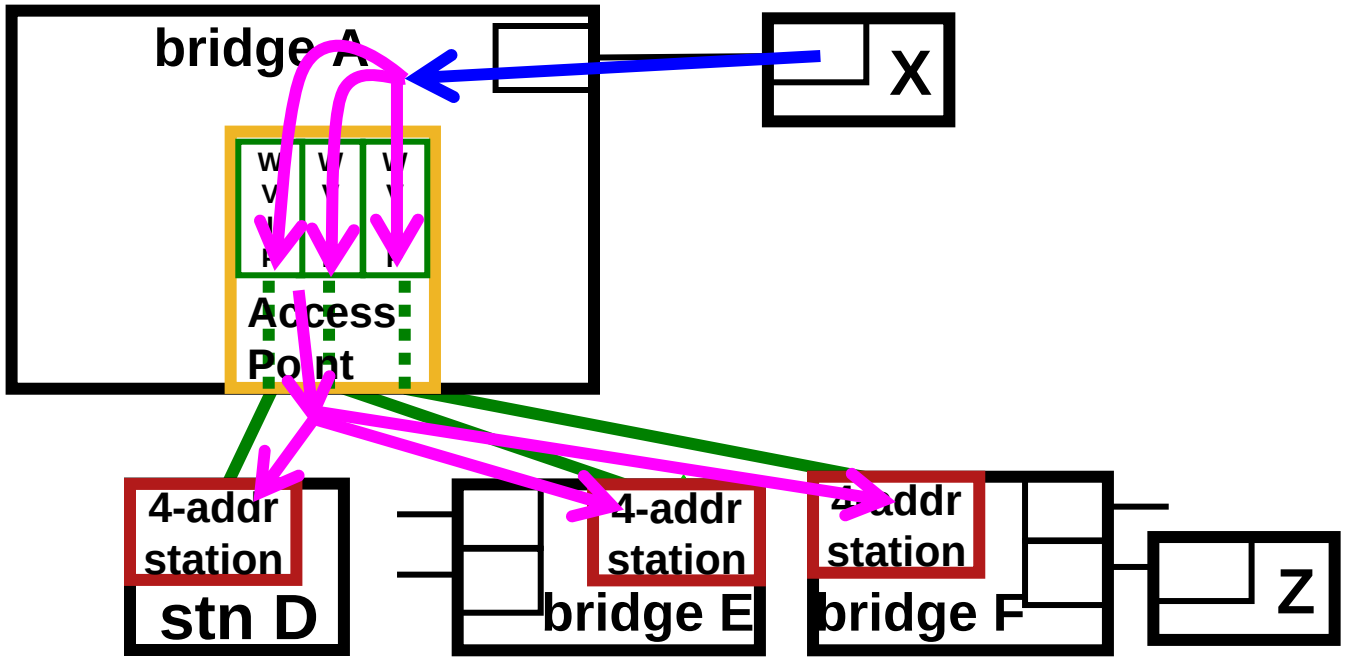



- There are four addresses: Source Z, Destination W, Transmitter A, and a Receiver address, either **D**, **E**, or perhaps, "**all except F**".
- We cannot let the receiver address == the destination address, because then Bridge F does not know whether to **discard** the frame or **learn** from it that Z has moved.

# Sending to “Not Station F”

- We need a Receiver Address in the reflected frame such that the station that transmitted the frame to the access point (Bridge F) will discard it, and the others accept it.
- Using F’s MAC address (Transmitter Address from the original frame) would accomplish this, but that would be a perversion of the meaning of the Receiver Address – “everybody except this address should receive it”.
- So, we use a fixed range of multicast addresses, taken from an 802.1 or 802.11 OUI, and place the Association Identifier of Station F in the low-order bits of the address.
- Every station “**subscribes**” to all multicast addresses in this range **except** the one with its own Association ID.

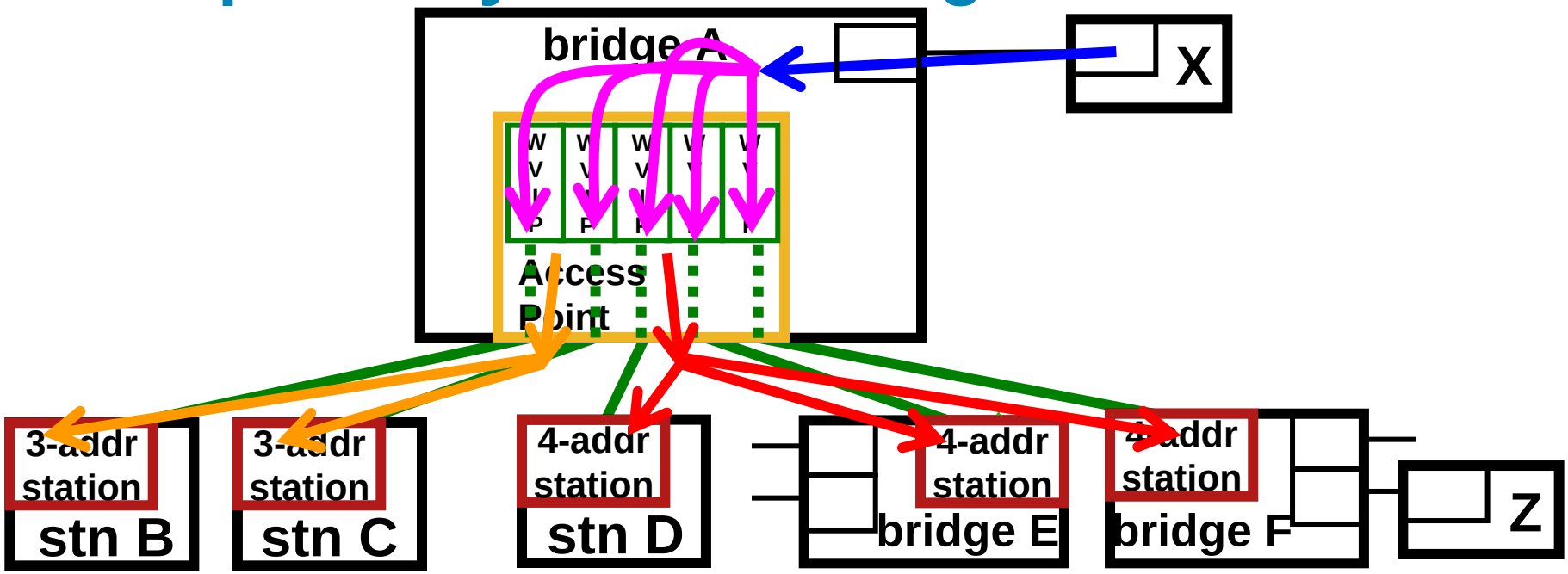
# An unknown unicast from station X to W




- Send **one multicast** with the 802.11 four-address format.

| | |
|---|---|
| Receiver Address: | **Broadcast** |
| Transmitter Address: | A, the access point |
| Destination Address: | Original Ethernet destination, W |
| Source Address: | X, the Ethernet source. |

# Compatibility with existing 3-addr Stations




- Unknown unicasts never need to be sent to non-bridge stations, whether 3- or 4-address.
- Broadcasts and multicasts have to be **sent twice**, once to **three-address stations**, once to **4-address stations** (and station bridges).
- The Bridge doesn't know this – the Access Point takes care of it.

# Compatibility with existing 3-addr Stations

- The access point must be 4-address capable.
- All data frames transmitted or received by Station Bridges are in 4-address format.
- 4-address-capable Stations operate either in 3-address or in 4-address mode, but not both, and the access point knows which.
- Station Bridges and 4-address-mode Stations ignore 3-address frames.
- Old 3-address-only Stations (hopefully) ignore 4-address frames.
- If a frame, e.g. a broadcast, needs to be sent to both 4-address and 3-address Stations, then the access point must send two copies, one in each format.

# Standards work needed

- The 4-address solution can be standardized by 802.1:

  Describe the use of the 4-address format in 802.1D subclause 6.5.4 “Support by IEEE Std 802.11 (Wireless LANs)”.

  Change to 802.1Q clause 13 to signal the case when the AP’s end of a wireless link is blocked.

  To 6.5.4 or 13, add 3-address vs. 4-address station recognition, and the decision for 4-capable stations of which mode to use.

- Some changes to 802.11 standards would be helpful, but not vital, to achieve interoperability:

  The descriptions of the 4 addresses’ meanings are unchanged.

  But, the standard bridge filtering database now decides **where** to send the frames, and the AP decides **how** to get them there (3- vs. 4-address format, unicast vs. multicast).