802.11 Station Bridges

Three solutions to the problem of 802.11 stations that are also bridges

Rev. 1

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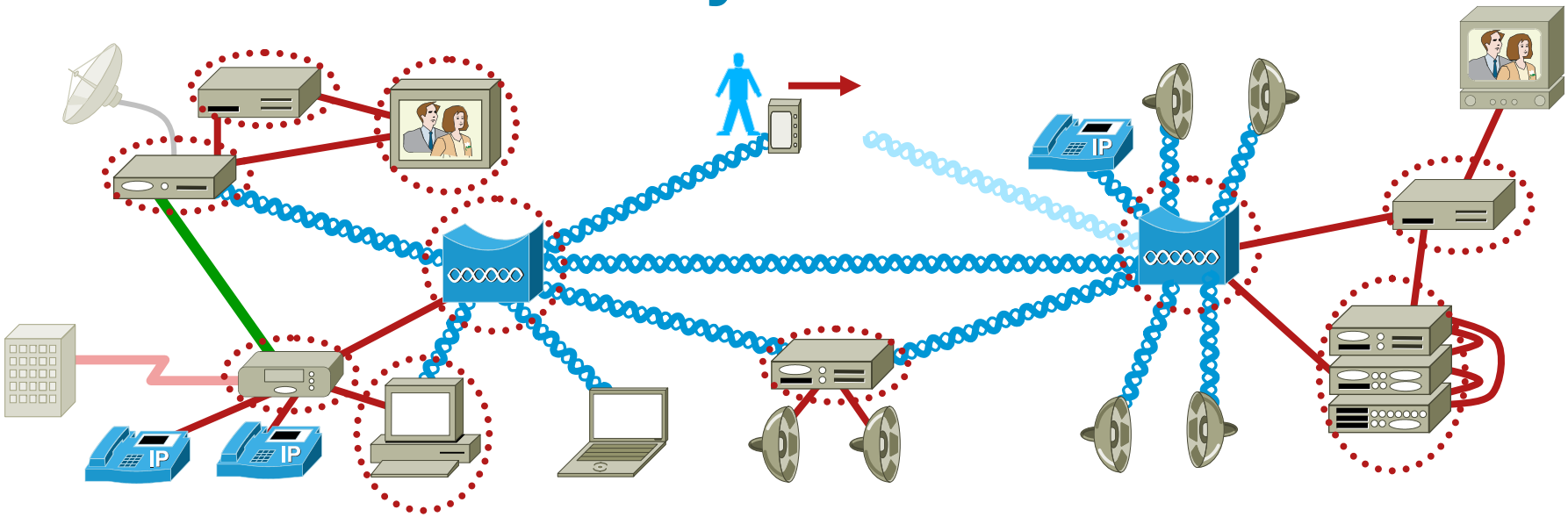
References

- This presentation is available at: http://www.ieee802.org/1/files/public/docs2008/avb-nfinn-802-11-bridging-0108-v1.pdf
- For a more complete description of the 802.11 station bridge problem, see: http://www.ieee802.org/1/files/public/docs2007/avb-nfinn-wireless-bridges-0707-v2.pdf

Executive summary



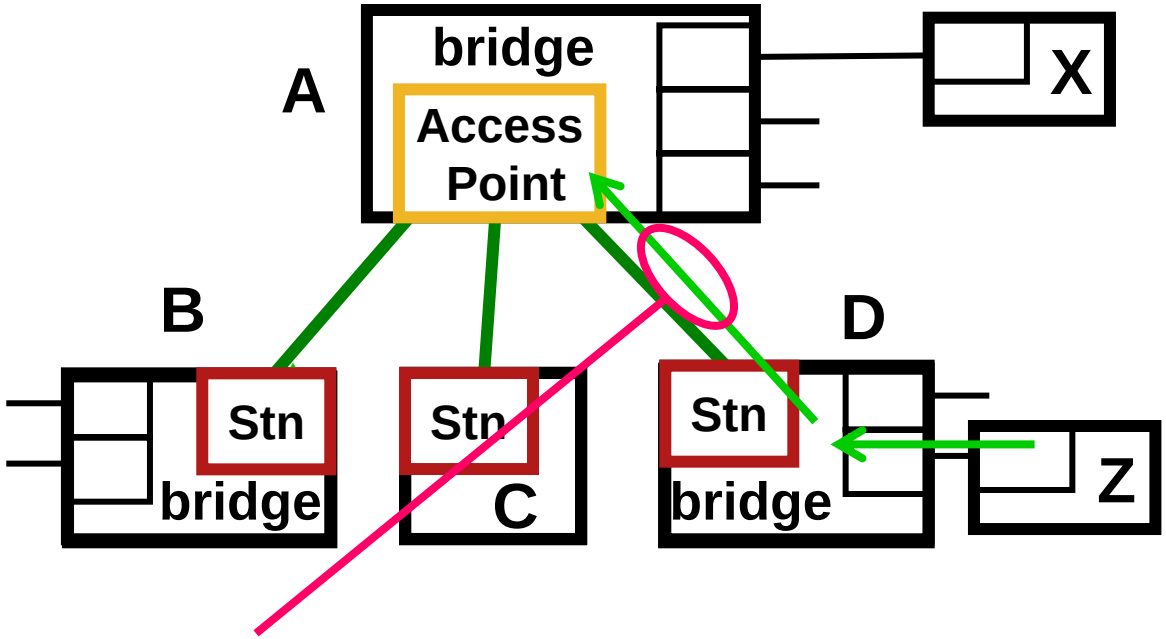
- In a home or small studio, there may be many Ethernet-like links: 802.3, 802.11, MoCA, Ether/DSL, etc.
- To ensure connectivity, every device with multiple links must be an 802.1 bridge, whether M/RSTP or 802.1aq.
- The IEEE 802 standards do not support an 802.11 wireless station that is also a bridge.

The core of the problem

- IEEE Std. 802 leaves it up to a particular 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.
- IEEE 802.11 wireless media reflect frames back to the source.
- There are (at least) three potential solutions to this problem.

Solution 1: Four address format

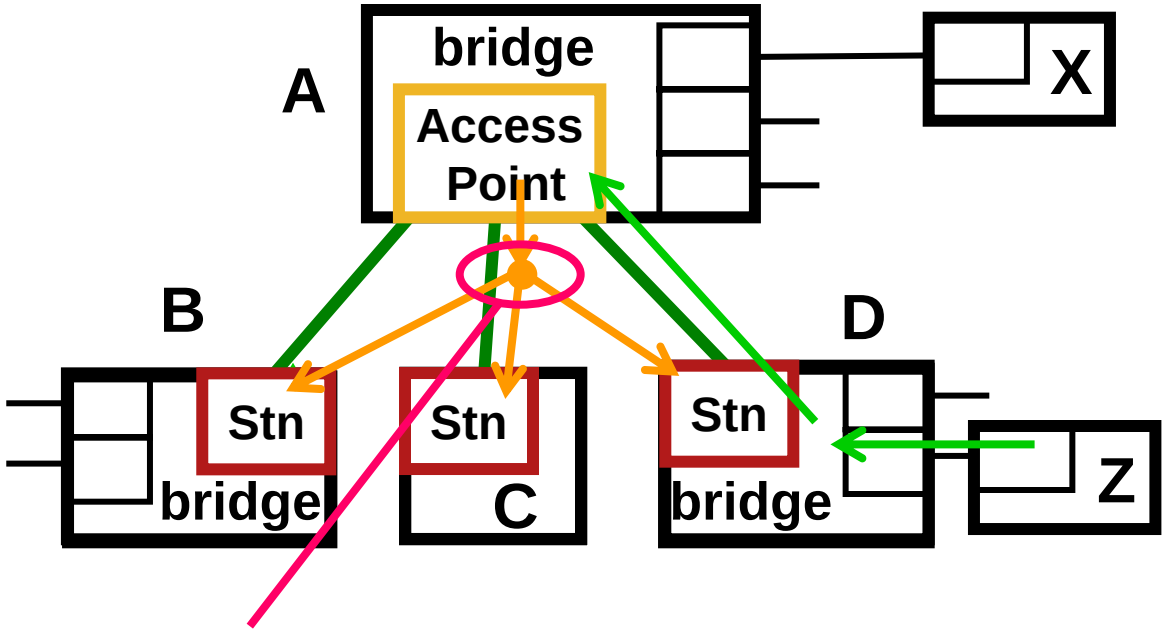
Four address format



- In the UP direction, use the 802.11 four-address format:

Receiver Address:	A, the access point
Transmitter Address:	D, the transmitting station
Destination Address:	Original Ethernet destination
Source Address:	Z, the Ethernet source

Four address format



- In the DOWN direction, use the four-address format:

Receiver Address:	Multicast address indicating, “not D”
Transmitter Address:	A, the access point
Destination Address:	Original Ethernet destination
Source Address:	Z, the Ethernet source.

Special multicast address: “Not XYZ”

- We need a Receiver Address in the DOWN (reflected) frame such that the station that transmitted the frame to the access point, in this case Bridge D, will discard the reflected frame, and all other stations will accept it.
- Using D’s MAC address (the Transmitter Address from the UP frame) would accomplish this, but that would be a perversion of the meaning of the Receiver Address – “everybody except this unicast address should receive the frame”.
- Instead, we can use a fixed range of multicast MAC addresses, taken from an 802.1 or 802.11 OUI, and place the Association Identifier of a station in the low-order bits of the address.

Special multicast address: “Not XYZ”

- Each station subscribes to (accepts) all of these multicast addresses except the one with its own AID, thus accomplishing the suppression of own-multicasts.
- This is perfectly normal behavior for dealing with multicast addresses, and is compatible with the spirit of the definitions of the four addresses.
- For broadcasts or multicasts coming from the bridge / access point, rather than being reflected from a station’s transmission, the Receiver Address can be either:

  A special AID value, indicating the access point.

  The broadcast address.

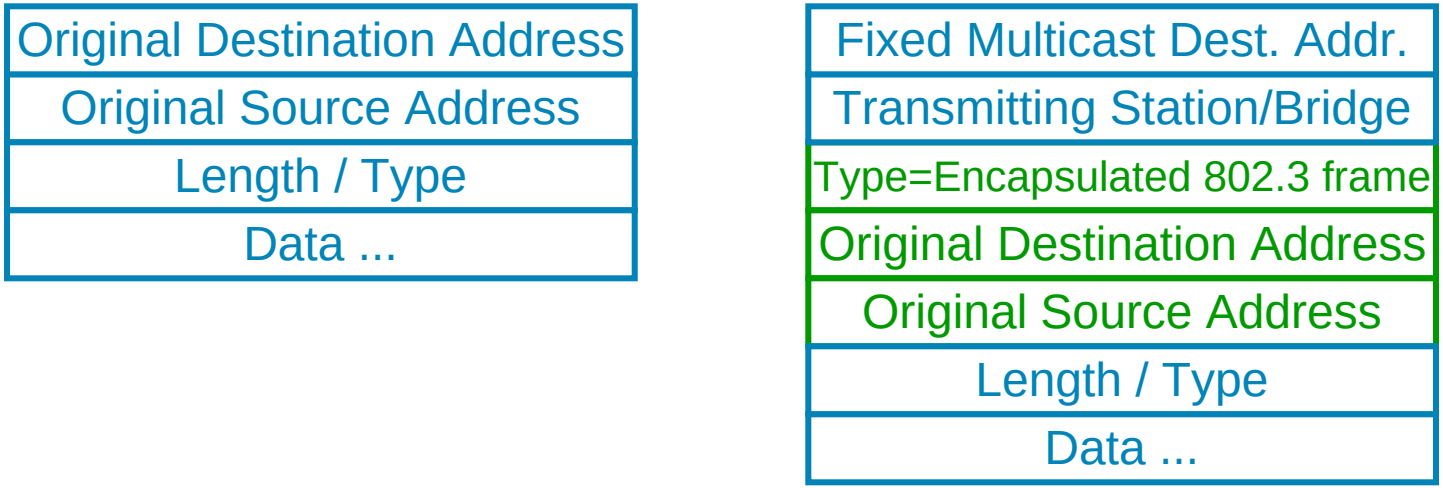
- This solution applies to 802.1aq, as well as 802.1Q.

Compatibility with old 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.

Solution 2: Encapsulated 802.3 EtherType

Encapsulated 802.3 EtherType



Original **Encapsulated**

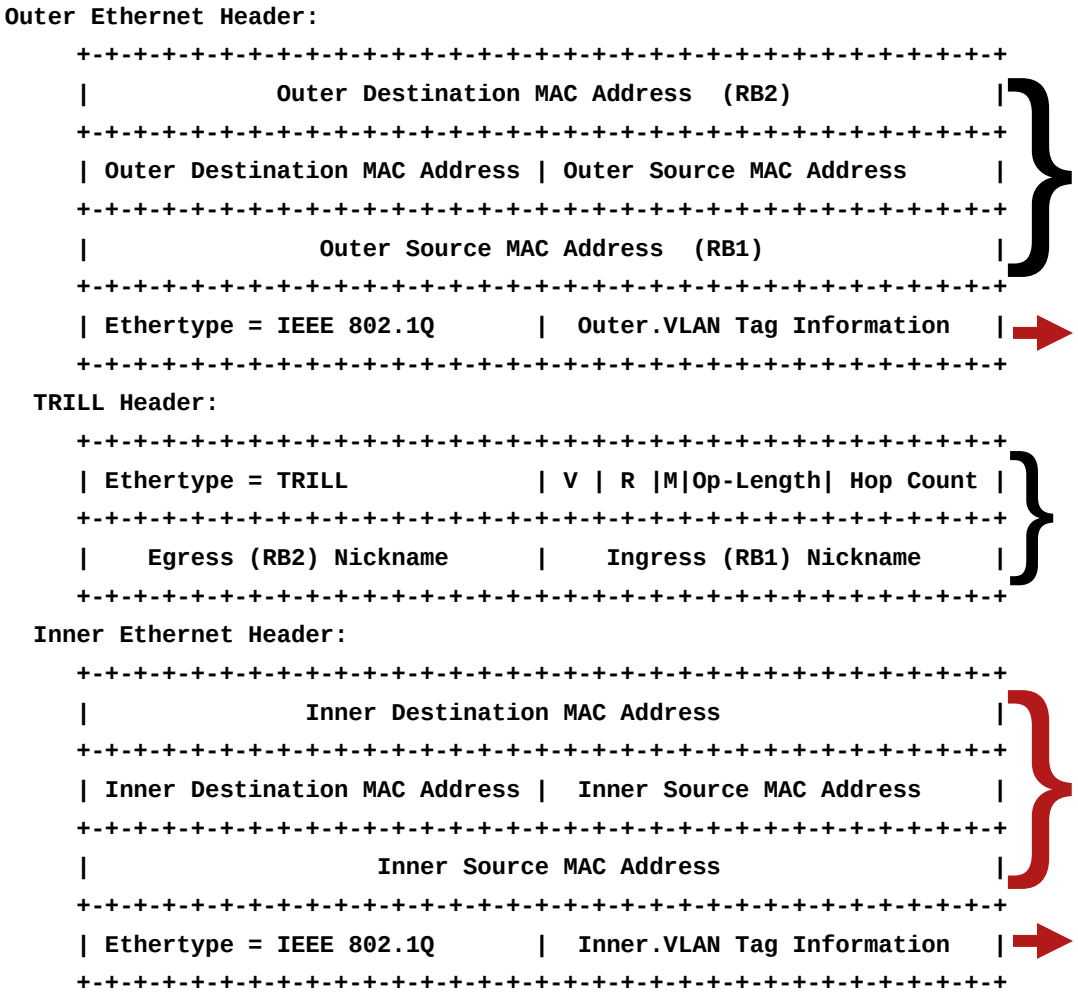
- Extra transmitter/receiver address not shown.
- We define a new EtherType, meaning “An 802.3 frame follows.”
- The extra addresses allow reflection suppression.

Encapsulated 802.3 EtherType

- The access point still has to change, as for the 4-address solution. (These encapsulated frames cannot be passed on to the wired network behind the access point.)
- All of the encapsulated vs. unencapsulated rules apply exactly as for 3-address or 4-address rules for the 4-address solution.
- This solution would be available for other reflective media, should any become common.
- This solution is a valid alternative, if there are large numbers of stations that would cause the 4-address solution to fail.
- This solution applies to 802.1aq, as well as 802.1Q.

Solution 3: TRILL'

Current IETF TRILL frame format



OK

This is needed only for one purpose, labeling IS-IS packets. That layer interconnection indicates something is wrong.

OK

Should be considered part of the TRILL header, not separate

The TRILL layer cannot assume that this will always follow TRILL.

Source: draft-ietf-trill-rbridge-protocol-06.txt

Improved TRILL' frame format

Next hop MAC DA
Last hop MAC SA
Eth = Encapsulated 802.3 frame
Final MAC DA
Final MAC SA
Eth = TRILL'
VRM,OpL,TTL, Pri,DE,VLAN ID
Egress RBID
Ingress RBID
Length/Ethertype
Payload …

Next hop MAC DA
Last hop MAC SA
Eth = TRILL'
VRM,OpL,TTL, Pri,DE,VLAN ID
Egress RBID
Ingress RBID
Final MAC DA
Final MAC SA
Length/Ethertype
Payload …

- Extra transmitter/receiver address not shown.
- If TRILL migrated to either of these two formats, the “next hop” address would solve the reflection problem.

Encapsulated 802.3 EtherType

- The access point still has to change, as for the 4-address and encapsulation solutions. (The access point must understand the TRILL format.)
- All of the encapsulated vs. unencapsulated rules apply exactly as for 3-address or 4-address rules for the 4-address solution, or encapsulated or unencapsulated rules for the encapsulation solution.
- This solution would be available for other reflective media, should any become common.
- This solution is a valid alternative, if there are large numbers of stations that would cause the 4-address solution to fail.

Summary

Summary

- In all three solutions, the access point has to change; the stations and bridges cannot do it alone.
- In all three solutions, a mixture of new station bridges and old stations that don't know the new technique requires broadcasts to be sent twice.
- Either the 4-address or Encapsulation solutions are quickly available; it is not yet clear whether TRILL will soon be suitable, e.g.,

  What is the relationship between TRILL and 802.1 bridging?

  Between TRILL and other AVB protocols?
- Ranked by frame size penalty, least to greatest:

  4-address (with STP or with 802.1aq)

  Encapsulation (with STP or with 802.1aq)

  TRILL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