# Avoiding Frame Duplication and Misordering in 802.17

David James (dvj@alum.mit.edu)
Anoop Ghanwani (anoop@lanterncom.com)

# Introduction

- 802.1D has stringent requirements on frame duplication and reordering
- In the absence of enhanced bridging, all frames with destination MAC addresses that are not ring-local are flooded
- This presentation describes a solution for avoiding frame duplication even when flooding bridged frames

# Functional Requirements

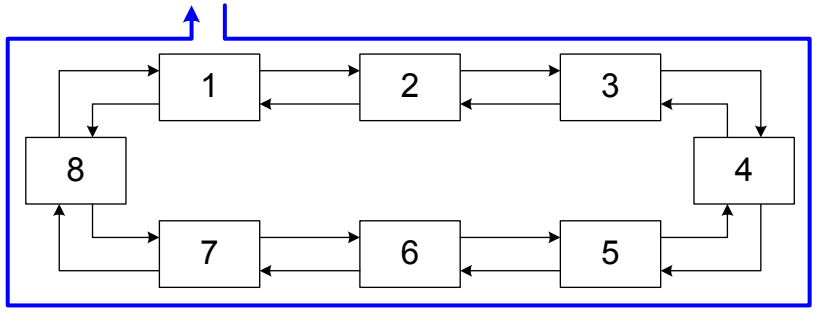
- There are many ways to flood frames
  - The MAC should be able to change flooding direction/method and still maintain packet order
- A node should be able to source packets without knowing that topology maps on all nodes on the ring are in sync
  - However, the packets may only get delivered only when the topology maps are in sync
  - The “topology map” refers to the picture of the ring that the node sees when combining information from both topology and protection protocols
- Must support bridged and non-bridged traffic on the same ring
  - MAC DA and SA may not be local to the ring

# Flooding Alternatives

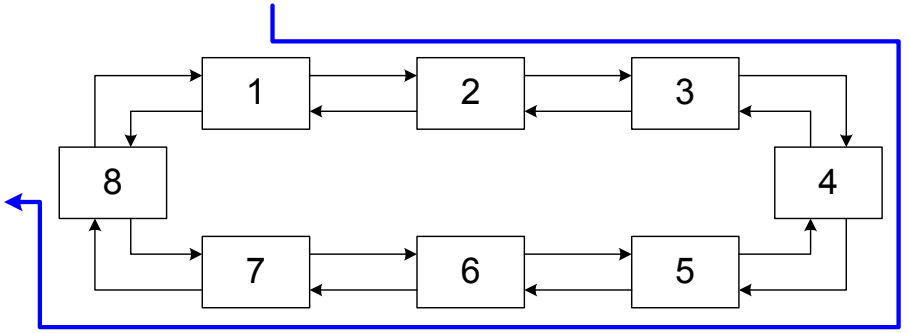
| Method | Description |
|---|---|
| Unidirectional1 | Unidirectional flood with destination set to the source. |
| Unidirectional2 | Unidirectional flood with destination set to the node upstream of the source. |
| Bidirectional1 | Flood in both directions with destination as the same station; specify only one of the copies for delivery to the destination. |
| Bidirectional2 | Flood in both directions; in each direction the destination specified is a different node. |

# Flooding Alternatives

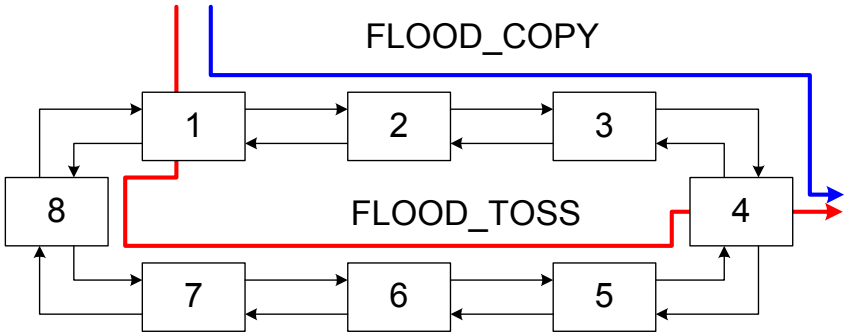
Unidirectional1



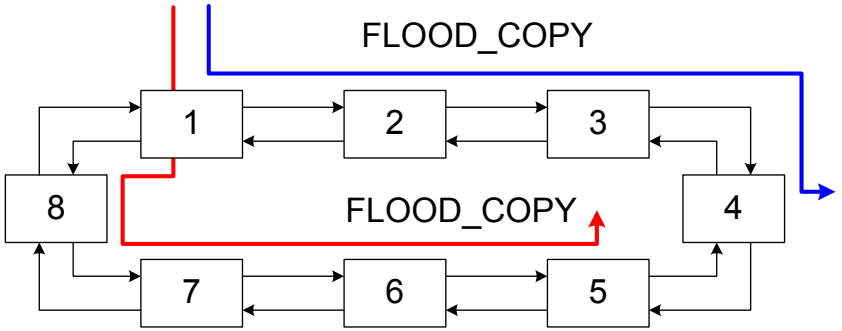

Unidirectional2




Bidirectional2




Bidirectional1



# Some Challenging Scenarios

- Bidirectional flooding in use due to a failure and ring heals
- A node sources a multicast frame and dies and the ring uses wrapping
- With bridged packets is there is no way (currently) to identify the ring-local source and destination of the packet
  - Using the TTL for limiting the scope of such frames is insufficient

# Basic Elements of the Proposal to Avoid Frame Duplication

- Use of ring-local source and destination identifiers
  - The DSID is always set for flooded frames to a station ID that will strip it
- Use of a bit in the header to indicate FLOOD_TOSS or FLOOD_COPY
- A special procedure for marking and validating wrapped frames

# Why Use Station IDs?

- Explicitly identifying the source and destination on the ring helps with bridging
- The MAC DA and SA always refer to end stations
- Without station IDs, it is not possible to strip bridged frames based on source / destination address
  - Also increases potential of frame duplication during failure scenarios
- Stations IDs can either be
  - 48-bit MAC addresses (requires a CAM in the transit path)
  - 8-bits or fewer depending on max. number of stations supported (How to ensure uniqueness?)

# Assignment of 7-bit Station IDs

- 7-bits supports a maximum of 128 stations on the ring
- Manual configuration is one possibility
- Topology discovery can be enhanced to provide these in an automated fashion
  - Details are provided in a written contribution

# Frame Sourcing Rules

- frame.timeToLive = 255
- frame.Wrapped = 0
- frame.SSID = MSID (source identifier)
- Setting of frame.Type and frame.DSID as follows:
  - Local or global unicast

    frame.type = DIRECT_DATA, frame.DSID = MSID
  - Unidirectional1 flooding

    frame.type = FLOOD_TOSS, frame.DSID = MSID
  - Bidirectional1 flooding, Direction A

    frame.type = FLOOD_COPY, frame.DSID = HSID (SID of the midpoint station)
  - Bidirectional1 flooding, Direction B

    frame.type = FLOOD_TOSS, frame.DSID = HSID
  - Similarly, the fields can be set for Unidirectional2 and Bidirectional2 flooding methods

# Additional Processing for Wrapped Frames

- At the first wrap point, discard if
  frame.wrapped != 0
- When returning through the source, set frame.wrapped = 1, and frame.timeToLive = 255
- At the second wrap point
  - Discard if frame.wrapped == 0 or
    frame.timeToLive <= 128
  - Otherwise, set frame.timeToLive = 383 – frame.timeToLive (The frame now has a TTL of 128+the distance to the source)

# Node Processing Rules

- TTL is always assumed to be set to 255
- Address deletion—Both of the following must be satisfied
  - frame.srcMacAddr != frame.srcMacAddr
  - frame.srcMacAddr == database.myMacAddr
- Identifier deletion—Both of the following must be satisfied
  - frame.SSID != frame.DSID
  - frame.SSID == database.MSID
- Duplicate squash for unwrapped ring—frame.wrapped == 0 and Any of the following is satisfied
  - sHops[frame.SSID] != 256 – frame.timeToLive
  - sHops[frame.DSID] == NULL (Destination disappeared)
  - sHops[frame.DSID] > sHops[frame.SSID] (destination appears to have been passed)
- Duplicate squash for wrapped ring (to be done only by nodes supporting wrapping)—frame.wrapped == 1 and any of the following is satisfied
  - database.c == 0 (ring is unwrapped)
  - dHops[frame.DSID] == NULL (Destination disappeared)
  - dHops[frame.DSID] < dHops[frame.SSID] (destination appears to have been passed)
  - dHops[frame.SSID] != frame.timeToLive – 128
- If frame is not deleted, frame is copied based on the frame.Type
  - FLOOD_COPY is copied to the client
  - FLOOD_TOSS is copied to the client, unless frame.DSID == MSID
- If frame.DSID == MSID frame is stripped
- The TTL is decremented and the frame is forwarded

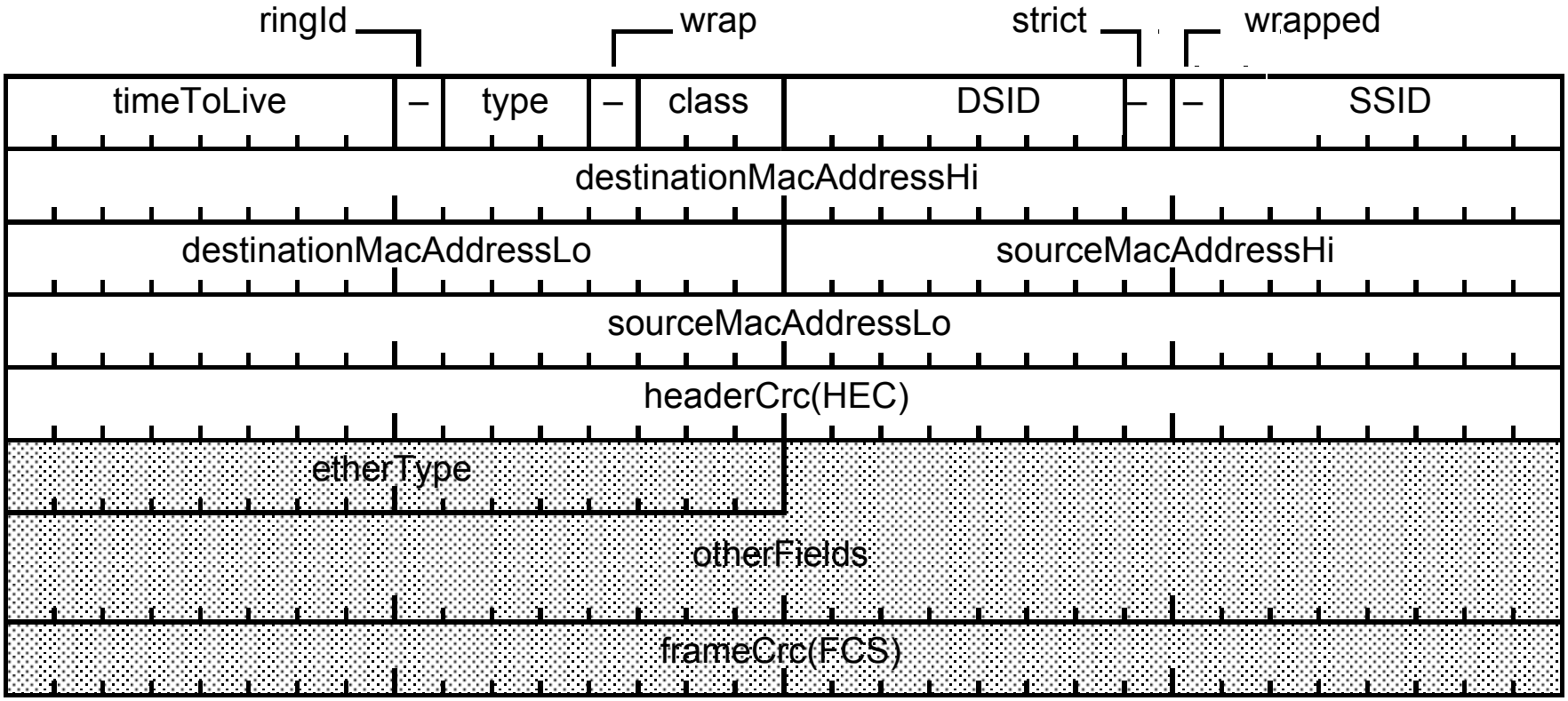
# Avoiding Frame Misordering

- Requires a ring purge whenever the flooding mechanism changes, e.g. unidirectional to bidirectional, etc.

- This can be achieved by having each node do the following when it sees a protection status message indicating a change
  - Empty its transit buffers
  - Source no new traffic for a RTT

- For non-protection related changes to the flooding method, a node must be silent for 1 RTT

# Proposed Frame Format



# Summary

- This presentation outlined some of the problems related to duplication and misordering in 802.17 networks
- A robust method for ensuring no duplication was presented
- A method for purging the ring to ensure no misordering is required