802.1AS : Redundant Paths

Rodney Greenstreet

Rodney Cummings

National Instruments

Introduction

- 802.1AS is specific
  - State machines, interfaces, variables, …
  - Presumably we want to keep it this way
    - Interoperability is clear
- Challenge with redundancy: Few specifics
  - Requirements are clear, but we need to move forward
- This presentation: Specific proposal for redundant paths
  - Not redundant GM

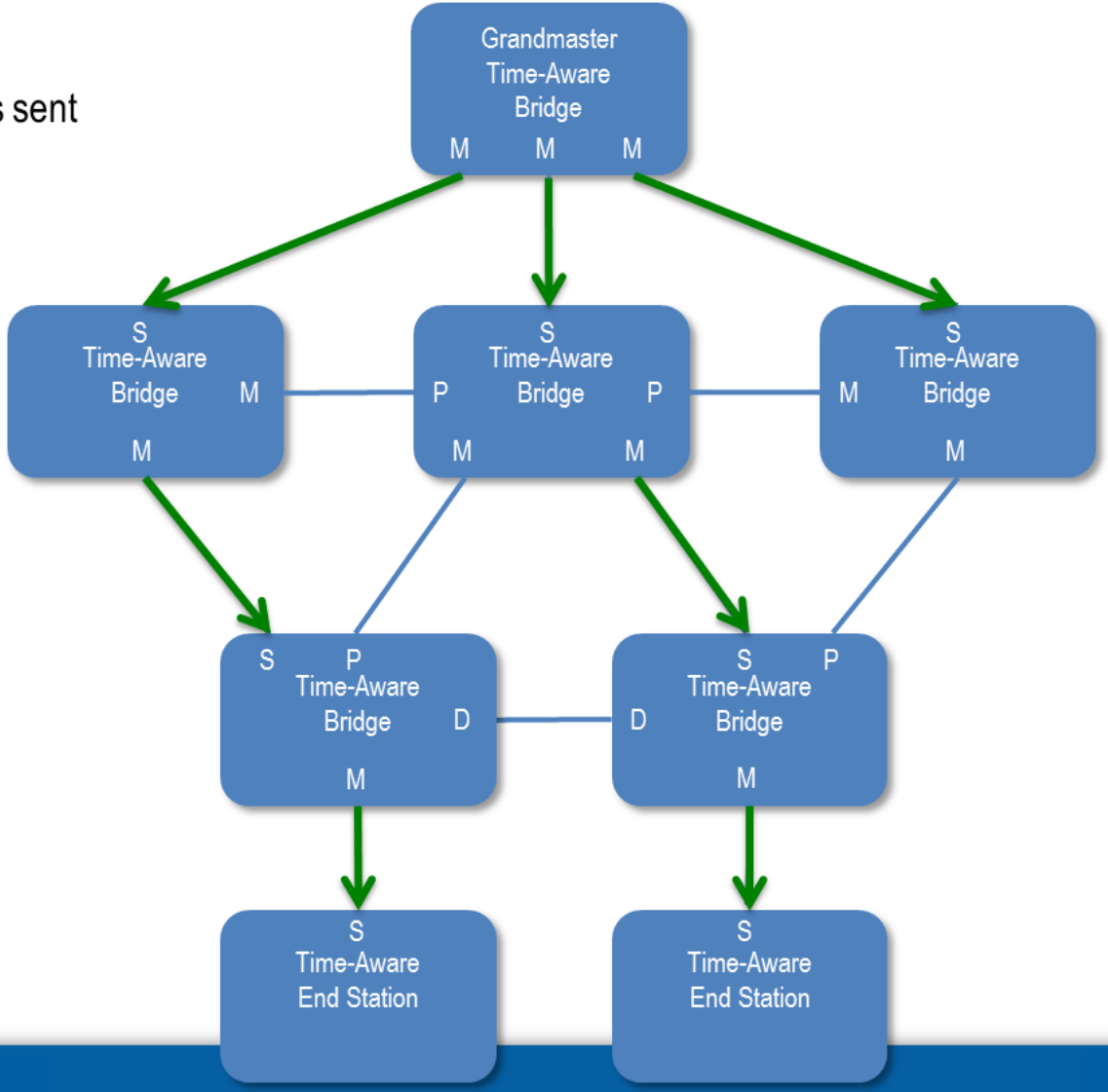
Review of 802.1AS-2011

Relevant Aspects of 802.1AS

- Synchronization spanning tree algorithm (part of BMCA)
  - Finds all acyclic paths from GM to slaves (including bridges)
  - Not same as forwarding spanning tree (e.g. RSTP)
  - Initially selects shortest path from GM
- Sync Interval (10.6.2.3)
  - Mean time between time-sync event messages
  - Default is 125 ms
  - Modifiable through TLV and management
- Sync Receipt Timeout (10.6.3.1)
  - Number of missed sync intervals until re-evaluate port roles (BMCA)
  - Default is 3 sync intervals (375 ms)
  - Modifiable through management

Example Using 802.1AS Figure 10-10

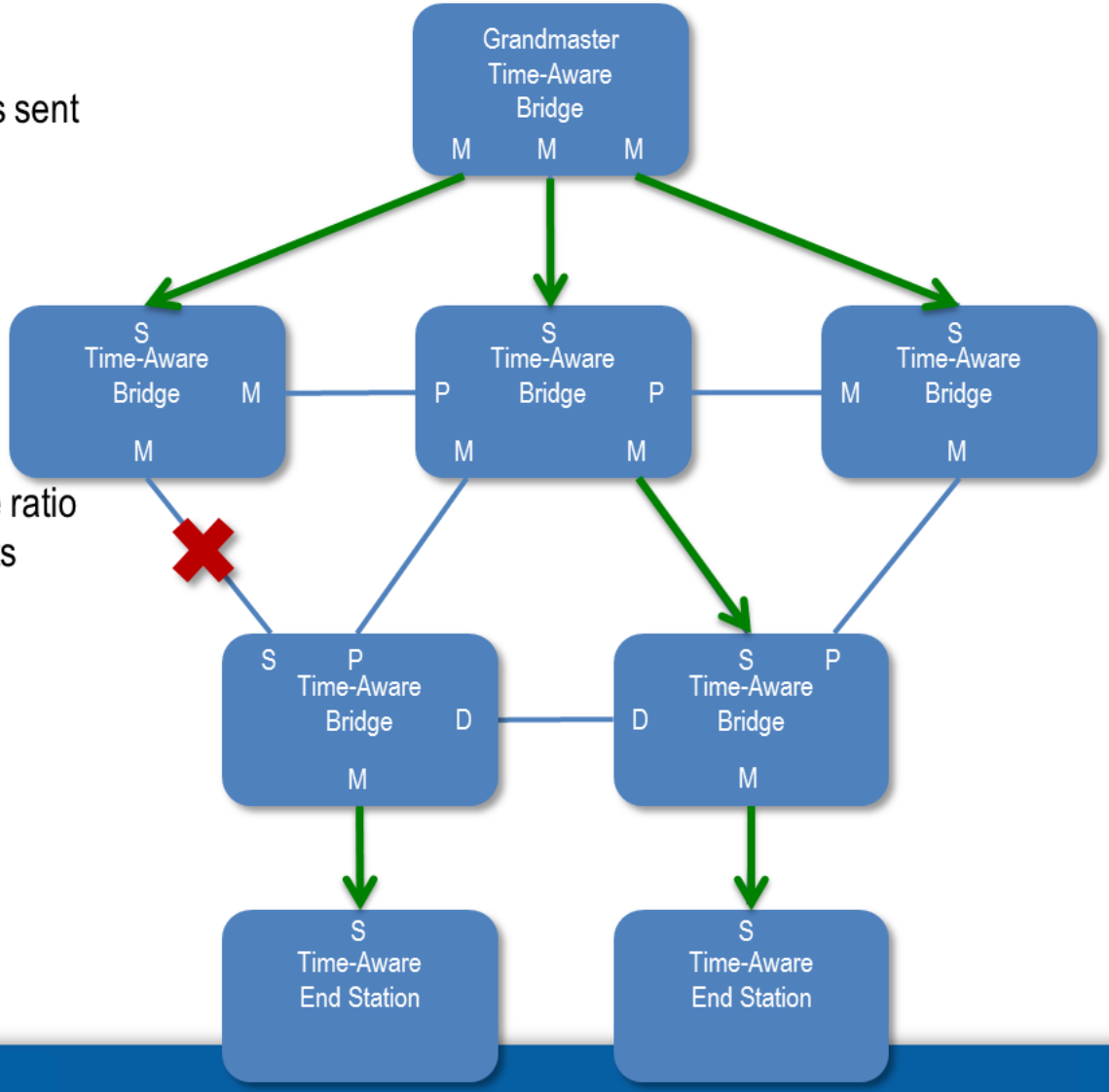
Sync messages sent every 125 ms



Example Using 802.1AS Figure 10-10

Sync messages sent every 125 ms

Break occurs; Pdelay and rate ratio on Passive ports



Example Using 802.1AS Figure 10-10

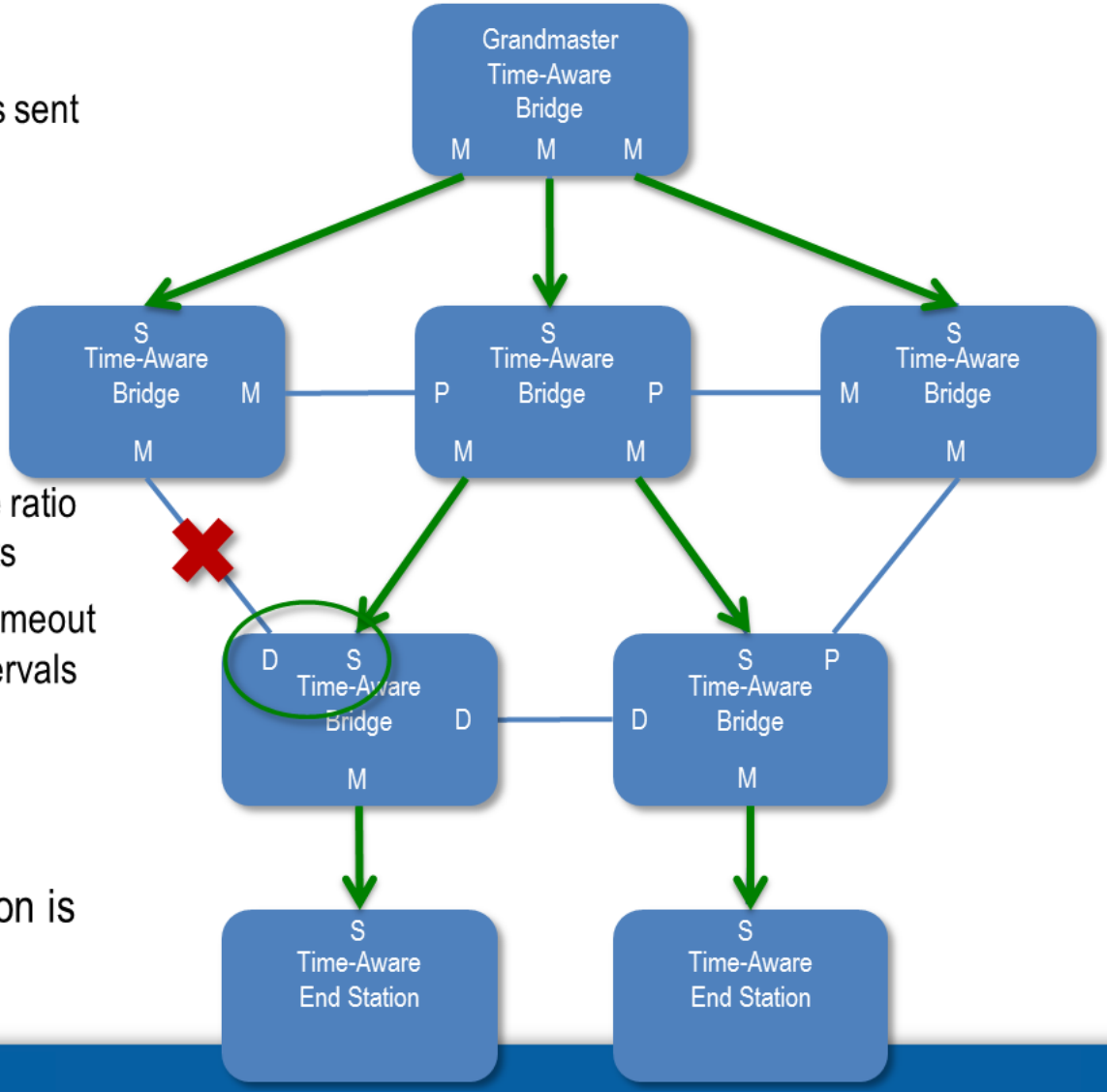
Sync messages sent every 125 ms

Break occurs; Pdelay and rate ratio on Passive ports

Sync Receipt Timeout after 3 sync intervals (375 ms)

Port roles are re-evaluated

Synchronization is restored



802.1AS-2011 BMCA

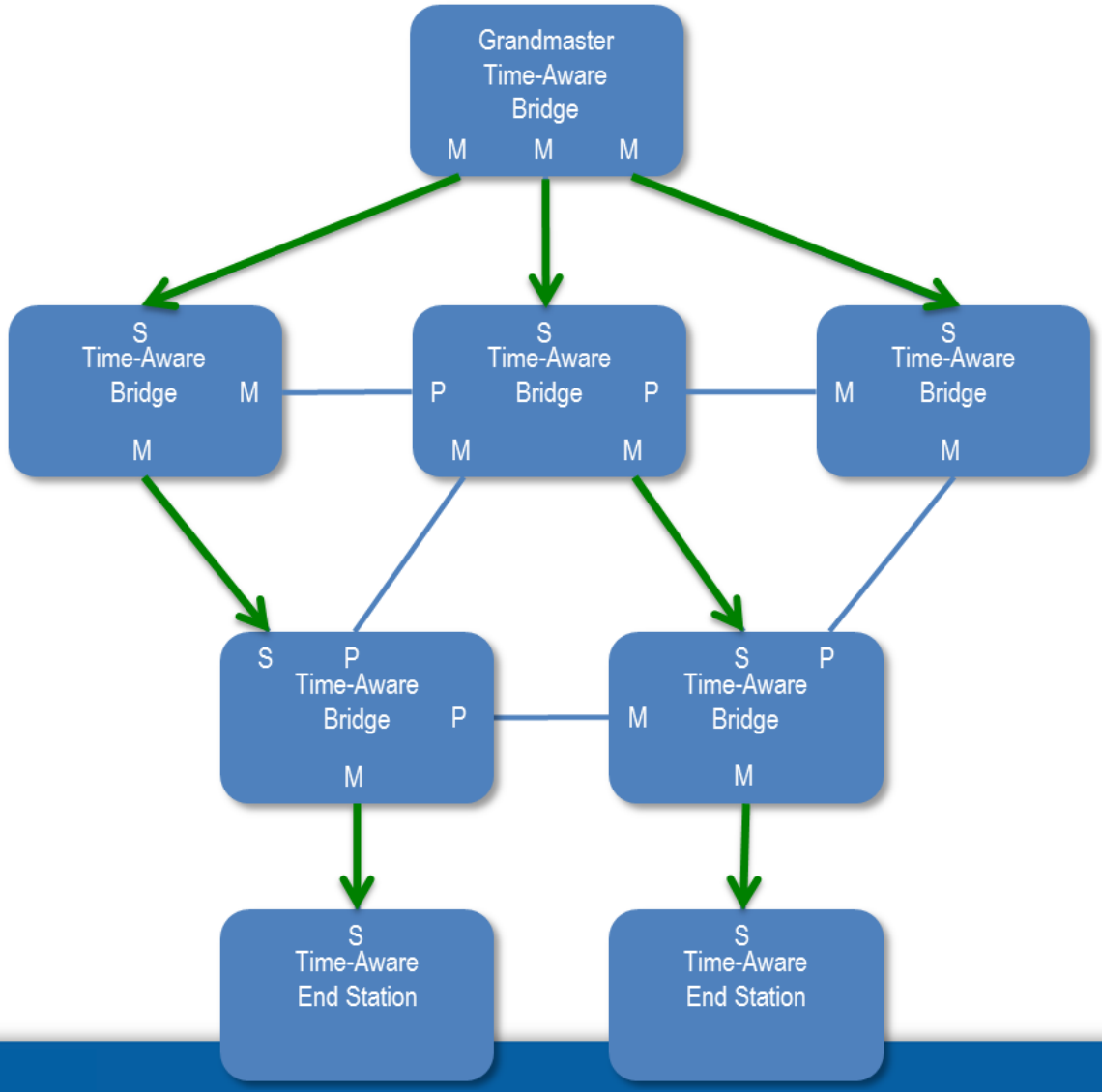
- Uses the following attributes
  1. System Identity: Selects the GM (10.3.2)
     - Priority 1, Clock Class, Clock Accuracy, Offset Scaled Log Variance, Priority 2, Clock Identity
  2. Steps Removed: Selects among multiple paths (10.3.3)
  3. Source Port Identity: Tie-breaker
     - Clock Identity and Port Number of transmitting neighbor
  4. Receiving Port Number: Tie-breaker
- Priorities can be changed with management
  - Provides explicit control of GM selection
- No explicit control of path selection

Proposal for 802.1AS Rev

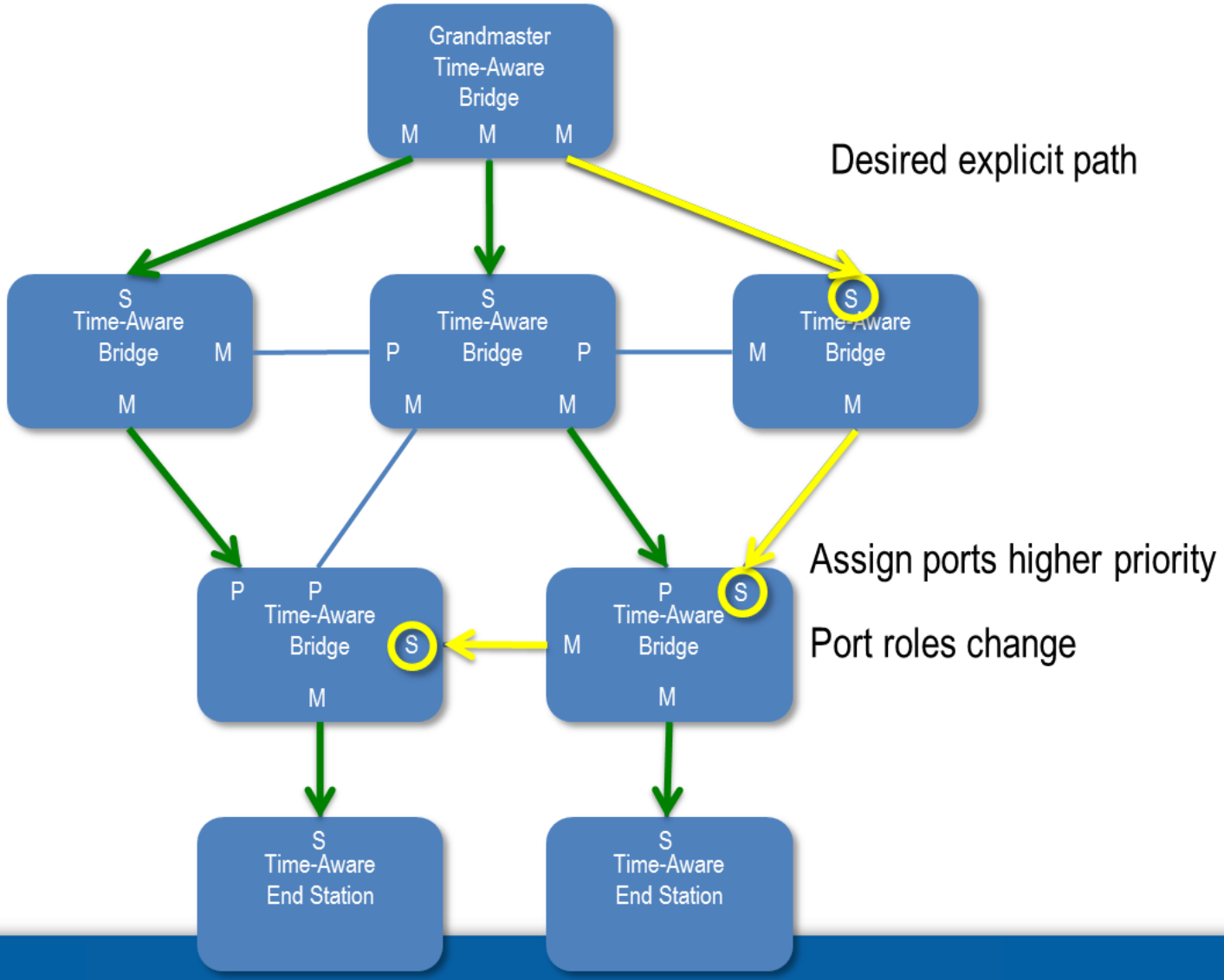
Proposal: Explicit Path Control

- New management variable: Port Priority
  - Analogous to Priority 1 of System Identity
  - Evaluate prior to Steps Removed
  - Default is “None” for backward compatibility
- Any control-plane protocol can set this variable
  - E.g. 802.1Qca could specify how its TLVs translate to setting this variable

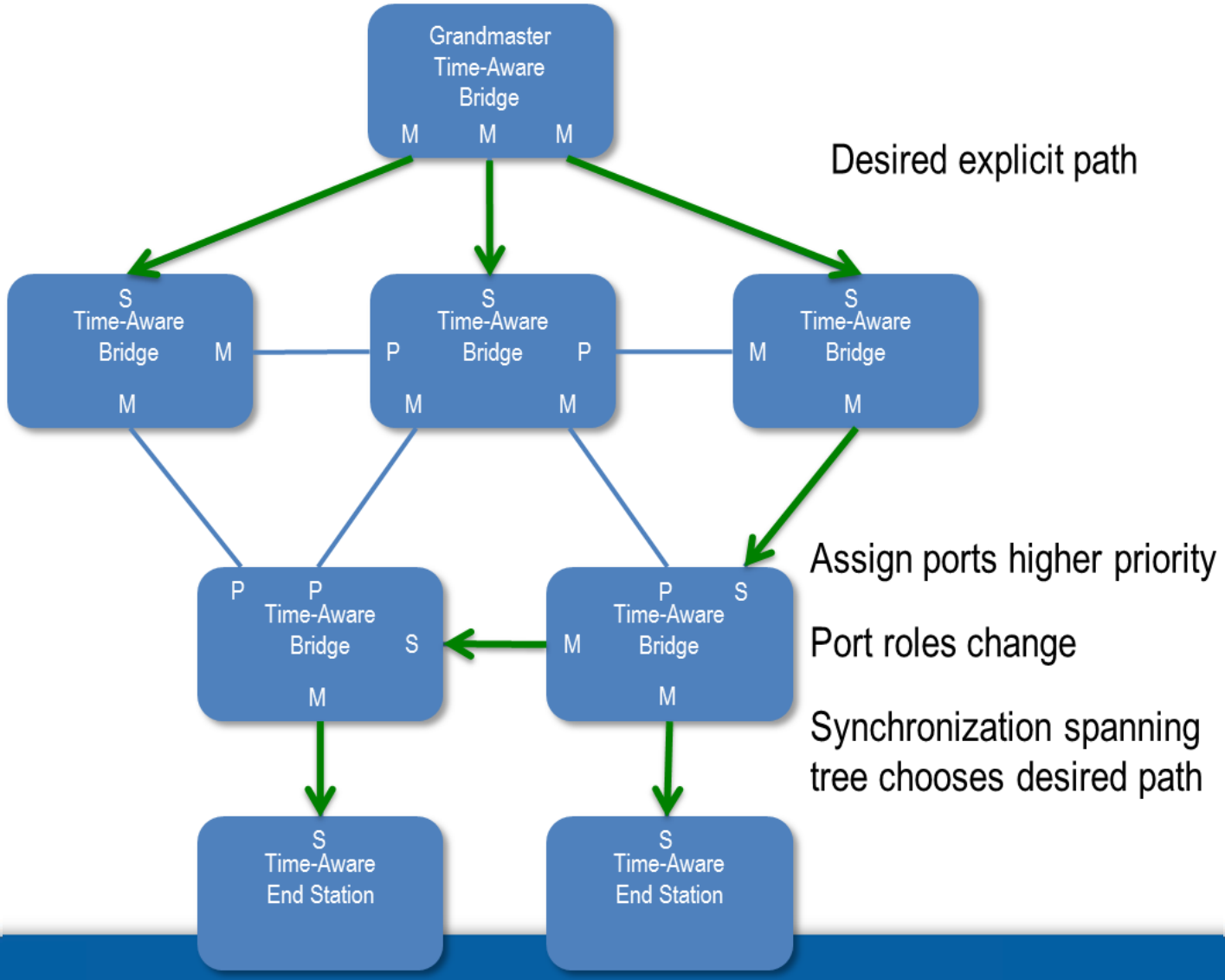
Example of Explicit Paths



Example of Explicit Paths



Example of Explicit Paths



Identifying Redundant Paths

- Tree ID proposal from slide 7 of
  - http://www.ieee802.org/1/files/public/docs2014/as-chen-goetz-industrial-requriements-for-working-clock-sync-0714-v01.pdf

  - Would require coordination with 1588 on bit usage
- This ID does not exist in 802.1AS-2011
  - Redundant paths use same domain ID
  - Redundant paths are distinguished by port number

Proposal: Do Not Add Tree ID

- Claim: This ID is not needed at all
- Needed for 802.1Qca?
  - No: 802.1Qca does not refer to bits in the frame's payload
- Needed to establish explicit paths?
  - No: All paths established; Adding Port Priority to manage
- Needed for diagnostics (detect faults)?
  - No: Preferable for the bridge to diagnose the faulted port
  - Same rationale for avoiding tree ID in 802.1CB
- Needed to combine (e.g. average) all paths?
  - No: TSN doesn't have a specific proposal to combine

Proposal: Drift Damping

- Each industry / application-layer can mandate defaults for sync interval & timeout
  - For path redundancy, set sync timeout to meet requirements
    - E.g. Protocol XYZ can use default interval of 31.25ms, timeout of 4
- What if I cannot sync and/or timeout that fast?
  - We can borrow a concept from FlexRay's redundant clocks
- New management variable: Drift Damping
  - Limit to change in PTP time applied each sync reception
    - Phase not frequency, since rate ratio is always measured
  - Goal: If sync timeout is large, avoid a jump in time
  - Default is 0 (no damping)

Summary of Proposal

- 802.1AS-2011 already finds all paths
- 802.1AS-2011 already supports path redundancy
  - Each industry can meet its requirements
- Add features in 802.1AS Rev
  - Port priority for explicit paths
  - Drift damping to avoid jumps
- No need for tree ID

- Details to be determined, but let's move forward

Thank You