SIEMENS

IEEE 802.1ASbt for Industrial Networks

Further Discussion on Domain and Redundancy

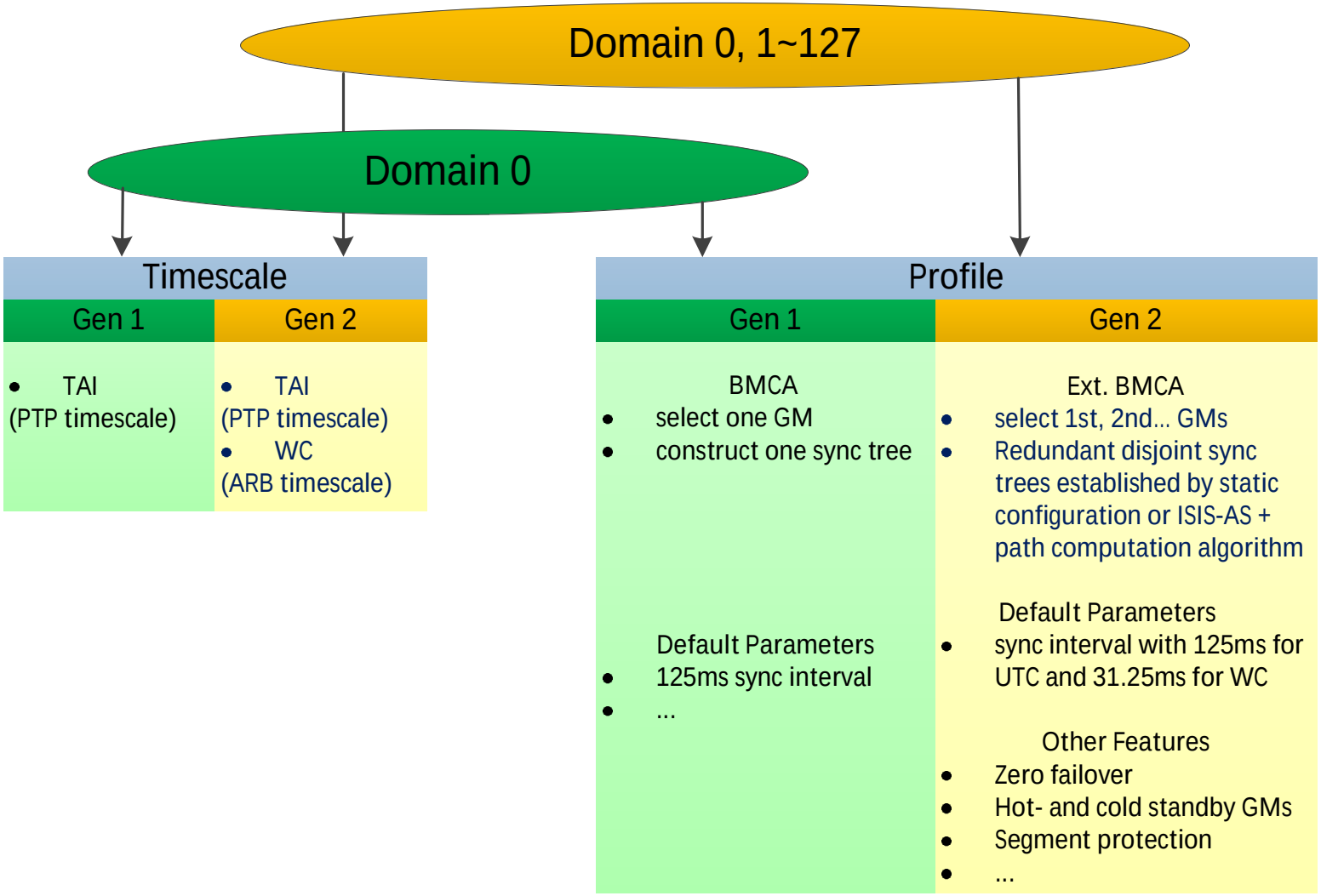
IEEE 802.1 Interim Meeting - May 2014, Norfolk
Feng Chen, Siemens AG
Franz-Josef Goetz, Siemens AG

SIEMENS

Contents

1. Recap: What is “Domains” for?
2. Recap: Proposals for Redundant Synchronization in ASbt
3. Issues of Using “Domains” for Redundancy
4. Requirements of Using “Calculated” Redundant Sync Paths
5. Extended BMCA for Redundant GMs

1. Recap:
What is “Domains” for?



2. Recap: Proposals for Redundant Synchronization in ASbt

SIEMENS

GM redundancy

- primary GM (GM_P) and redundant GM (GM_R)
- redundant GM operates in either cold- or hot-stand-by mode
- GM_P and redundant GM_R are to be synchronized (not yet discussed)
- need to extend BMCA to support selection of 1st, 2nd (or 3rd …) GMs

Sync path redundancy

- (maximally) disjoint redundant sync trees
  - receiving redundant sync msgs at each slave
- Redundant sync trees are established by
  - static configuration, or
  - "ISIS-AS" + path computation algorithm
- each sync tree is assigned with a unique *TreeID*
  - which could be located, e.g. in the *DomainID* field of sync msgs

www.ieee802.org/1/files/public/docs2013/asbt-goetz-HighAvailableSync-0319-v02.pdf

SIEMENS

3. Issues of Using “Domains” for Redundancy

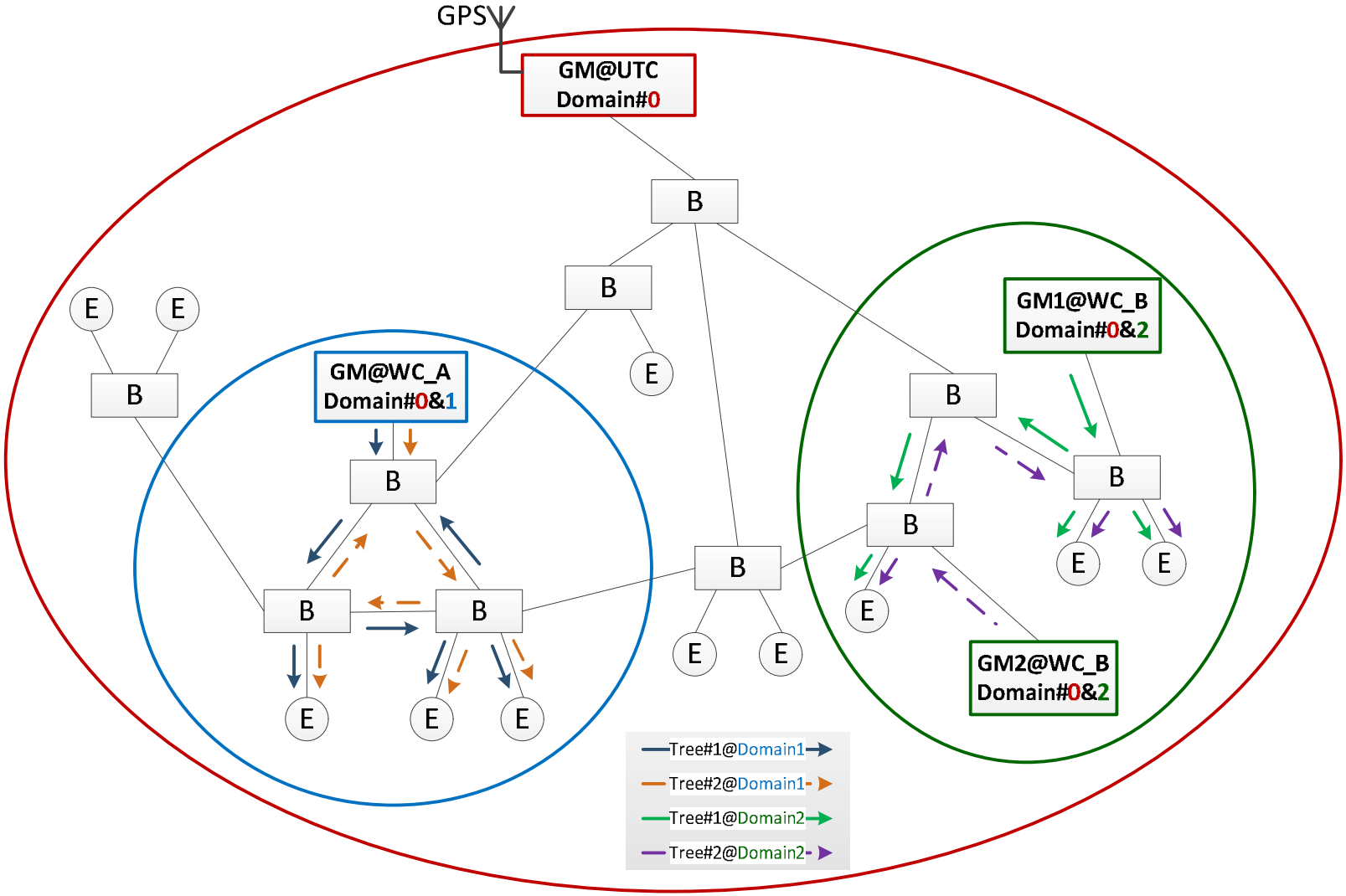
- Options of PTP redundancy were discussed at the April IEEE 1588 Plenary Meeting at CERN

Alternatives for Multiple Masters

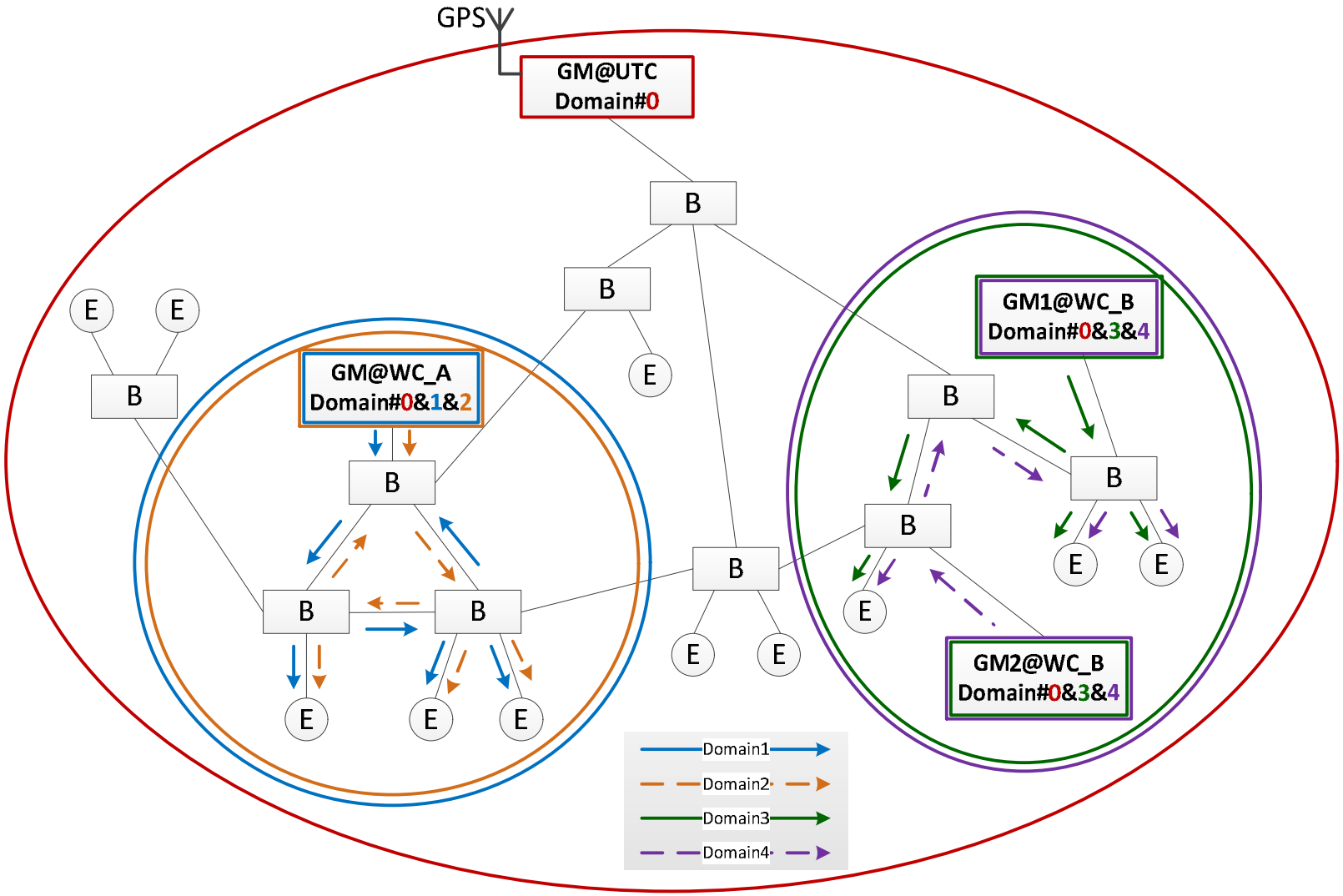
- Change PTP to allow multiple clocks to send Sync and Announce messages even though they are not the Best Master
  - Consistent with Unicast PTP
  - Not consistent with 2008 version
- Alternate Master Flag
  - Some testing at ISPCS
  - Unclear how to support multiple spanning trees
- Multiple Domains for Multiple Masters
  - May help support multiple spanning trees
  - Two different purposes for domains must be explained in standard

√

An Example of not Using “Domains” for Redundancy



An Example of Using “Domains” for Redundancy



SIEMENS

Concerns about Using “Domains” for Redundancy

- “Domains” has been used for timescales and profiles
- Domain is supposed to be independent, but redundancy needs interactions e.g. between redundant masters and paths

If using “Domains” also for redundancy

- **need an extra layer to handle inter-domain interactions for redundancy**

- **complex management**
  - e.g. for one control network supporting both UTC and WC, with both GM and path redundancy for WC, we might need to allocate and thus manage **5** domains on each time-aware system

- **high implementation cost**
  - 5 domain require 5 PTP instances
    - meaning that 5 sets of PTP parameters, 5 PDelay measurements for each port, …

4. Requirements of Using “Calculated” Redundant Sync Paths in ASbt

SIEMENS

Distributing (redundant) sync msgs along calculated paths leads to relatively small jitter in synchronized time on each time-aware system, in comparison to other methods like sync flooding

- this is already used in Gen 1
- in Gen 2, this forms a good base for an end-station to combine multiple sync flows (from redundant sync paths or/and redundant GMs) in a certain way for achieving higher accuracy and reduced jitter.

Using calculated redundant sync paths enables diagnostic capabilities

- for performing jitter monitoring on each of multiple sync paths
- for detecting from which path sync failure occurs, e.g. link-down
- diagnostic information could be used to
  - dynamically adjust sync strategy at end-stations
  - perform sync path switching in case of link-failure, e.g. segment protection

5. Extended BMCA for ASbt

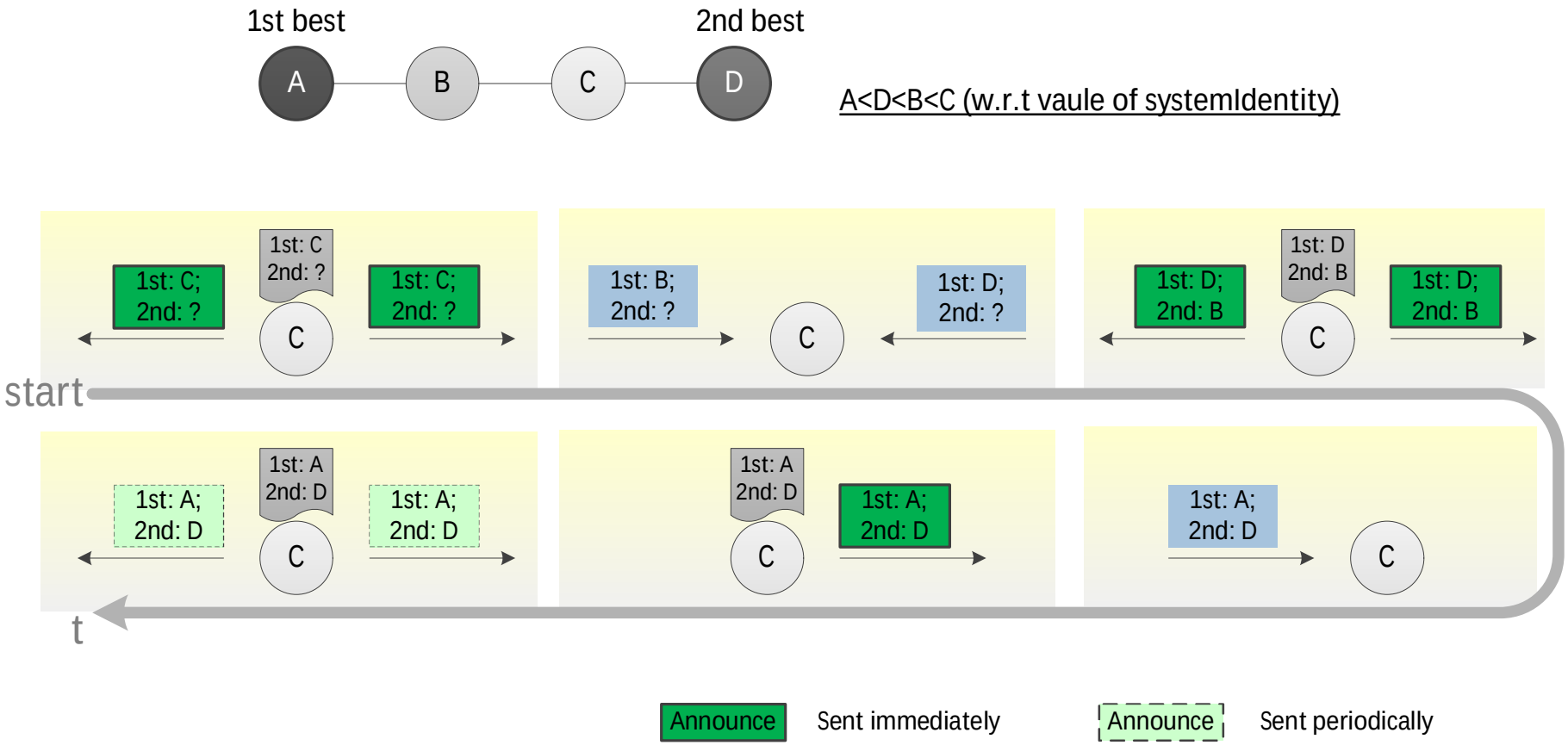
BMCA in AS Gen 1

- Choose GM (one per domain)
- Establish Sync tree (one per domain)
  - Via transmission (in Announce msgs), comparison and maintenance of several *Spanning Tree Priority Vectors*
  - Port role selection algorithm is specified
- Announce msgs transmitted only on master ports

ext. BMCA in ASbt

- Choose 1st, 2nd, (or 3rd …) best masters for each domain
- Not to be used to establish sync trees, thus port role selection is not executed
  - redundant sync trees (of disjoint paths) will be
    - Manual configuration
    - ISIS-AS
- Announce msgs transmitted on all ports
  - time-aware systems connected must be in the same domain
- Changes in *Spanning Tree Priority Vectors*
  - Only *rootSystemIdentity* is significant, but need to have multiple instances like *1stRootSystemIdentity, 2ndRootSystemIdentity …*

An Example of Selecting Two GMs with ext. BMCA



We might only need to compare the *rootSystemIdentity* values (Extended for 1st, 2nd or more) conveyed in a received Announce Message (i.e. *messagePriorityVector*), with the ones maintained locally (i.e. *gmPriorityVector*).