ETHERNET TIME & SYNC

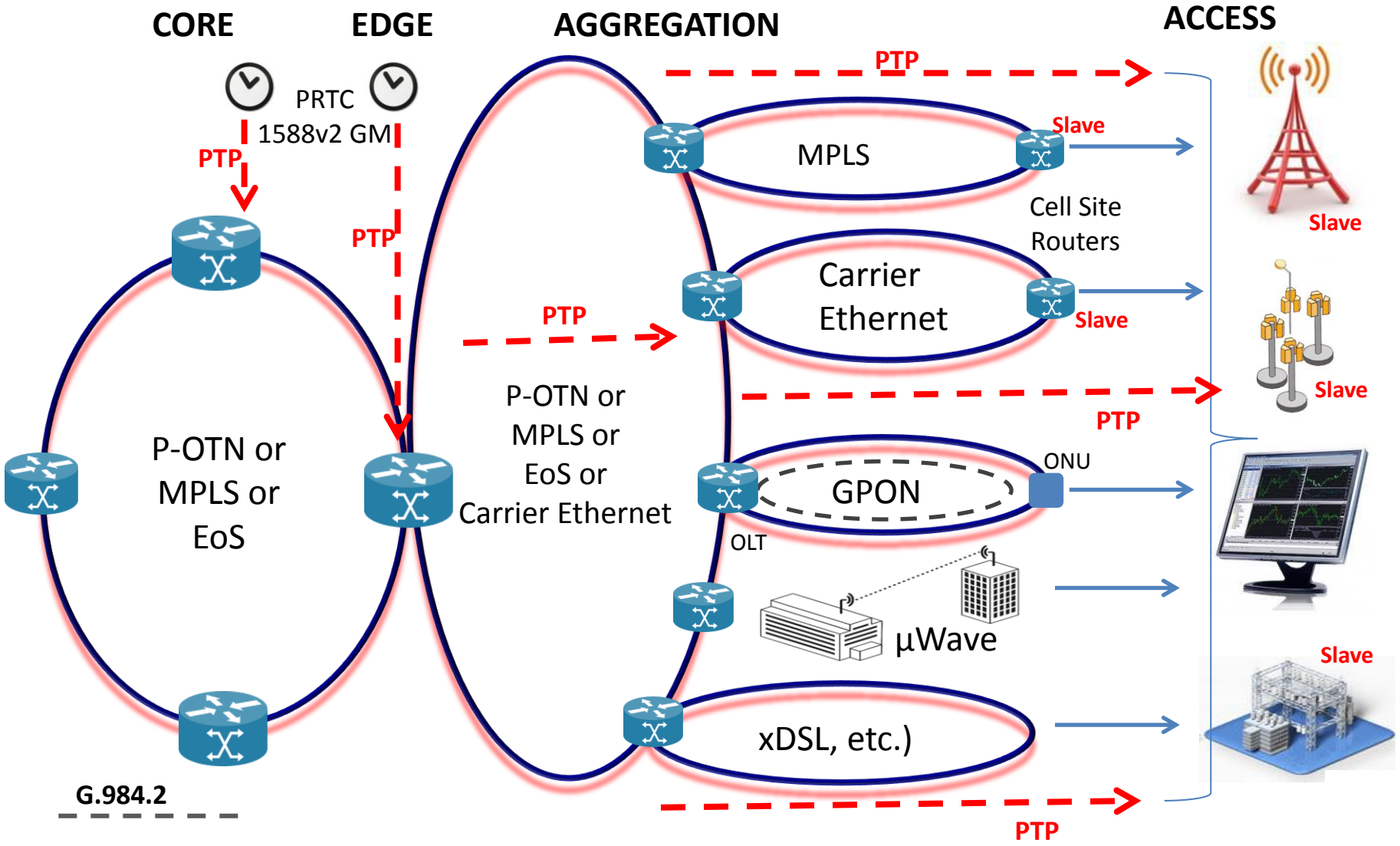
In Telecoms, Finance, Power, Broadcast, ...

WSTS San Jose, April 2013

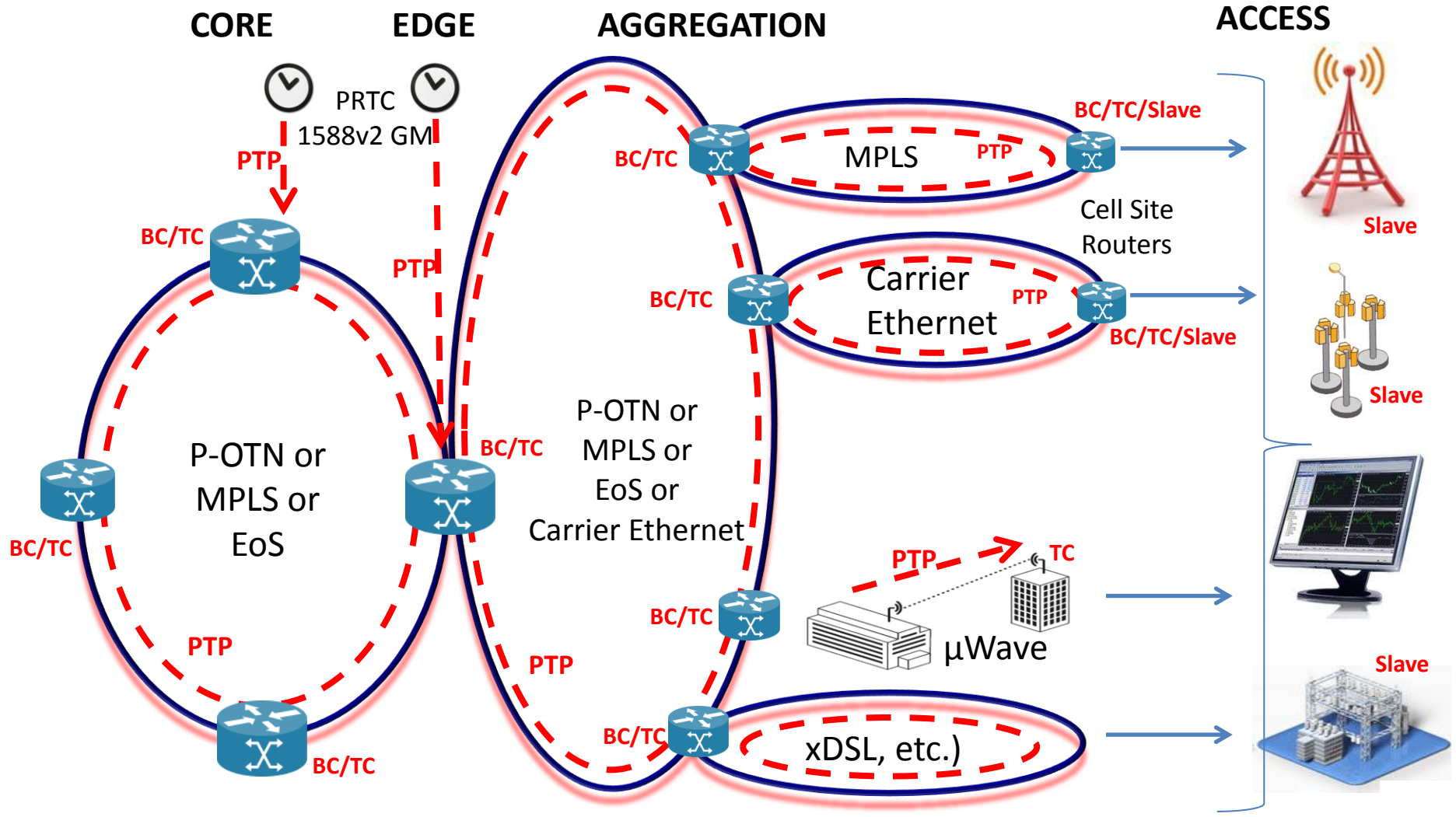
Telecoms

Specifically Mobile Backhaul

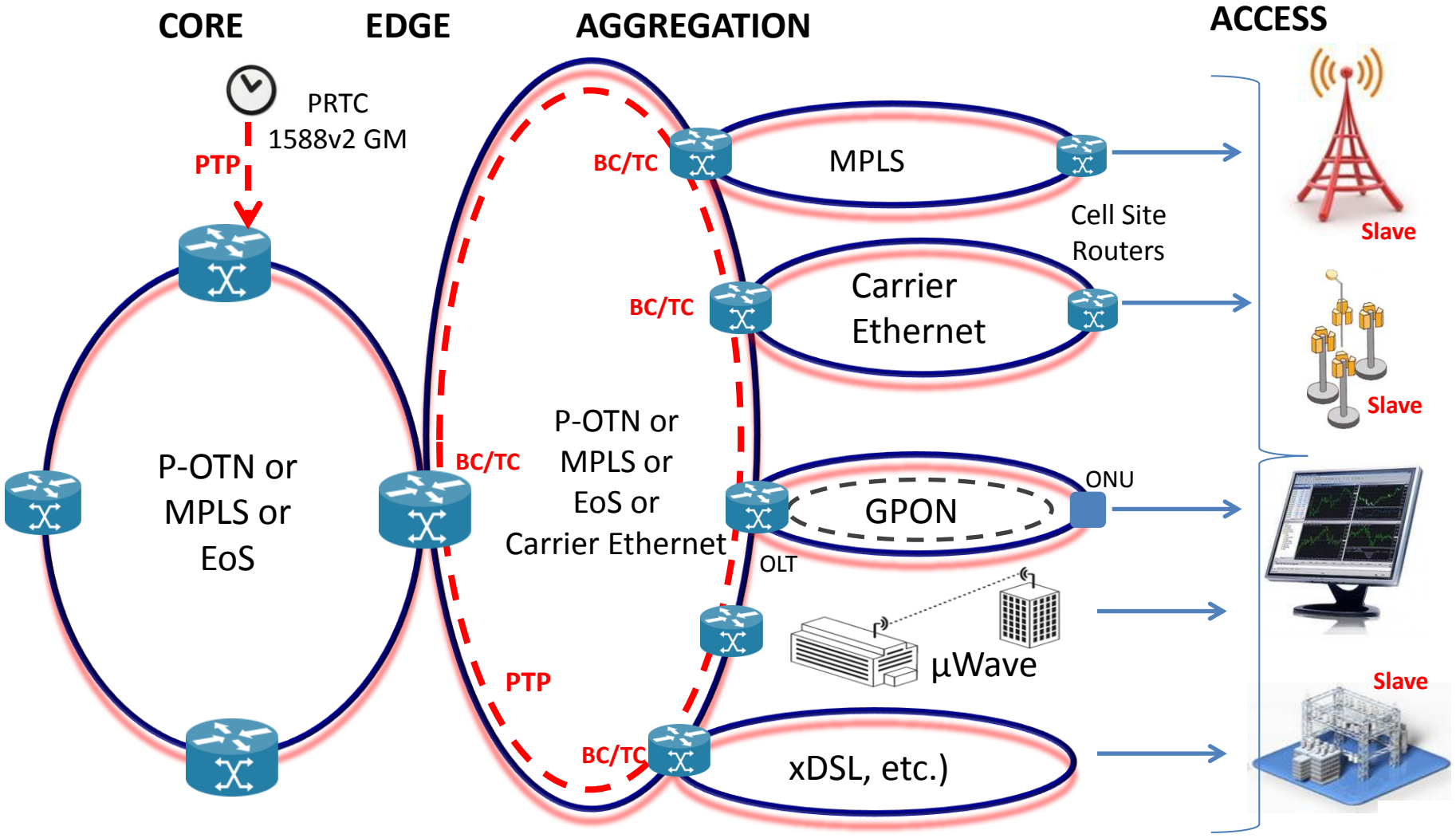
G.8265.1 - 1588v2 for Frequency



G.8275.1 - 1588v2 for Phase/Time



G.8275.2 - 1588v2 for Phase/Time



Note: This is just a **sample** representation of Partial On-Path Support

Power

Smart Grid – One term, many meanings

Calnex

Consumer Requirements for Electrical Power are changing:

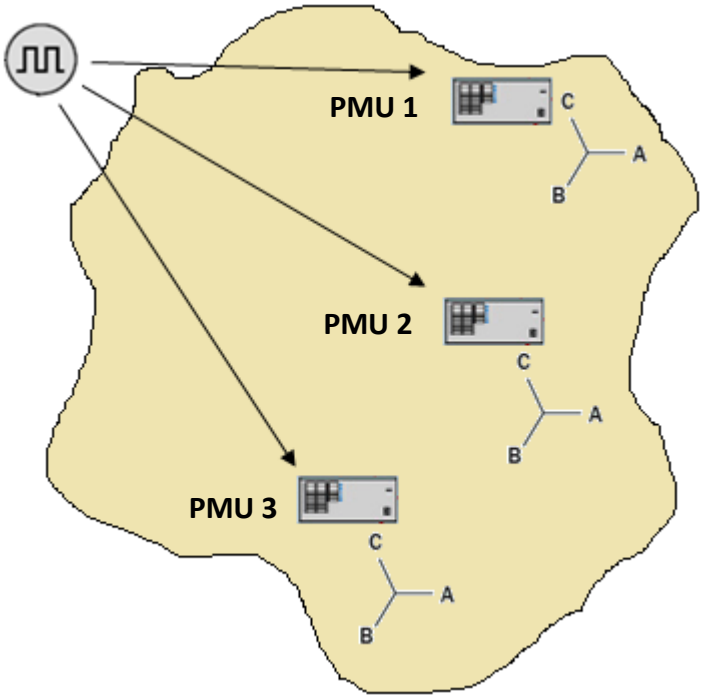
- Often drawn from decentralised locations.
- Must be responsive to real-time need.
- High demand for low cost, extremely reliable power.

To provide responsive, reliable, low-cost power, existing power grids must evolve.

In general, 'Smart Grid' refers to any improvement/change in Technology, Distribution or Transmission for Power.

Synchrophasors need 1µs accuracy

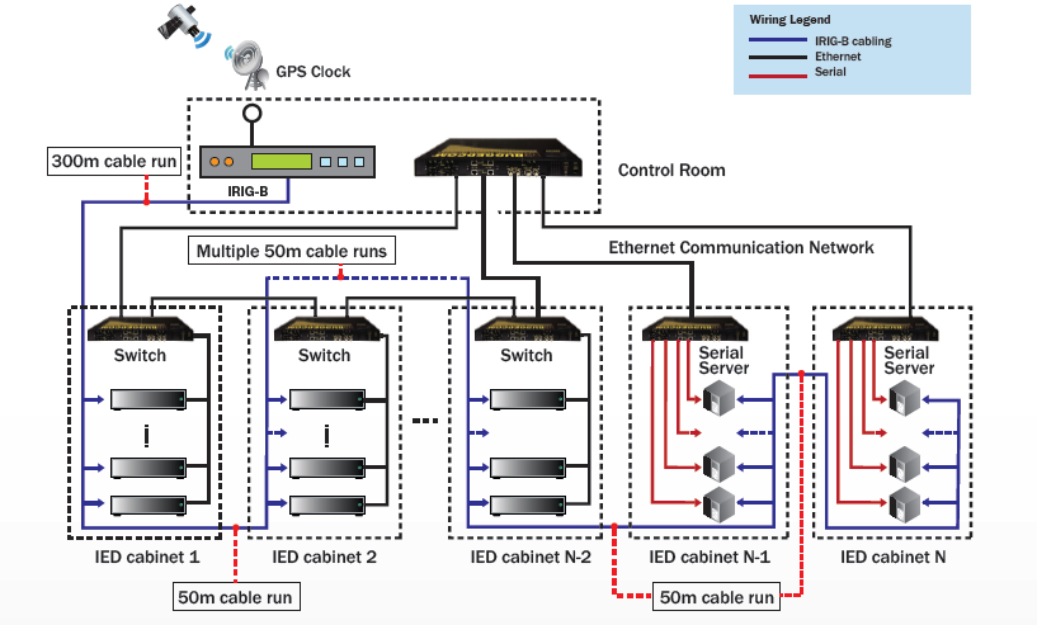
- Phasor Measurement Units (PMUs) need to provide Phasor information with total vector accuracy up to 1 degree at 60Hz **= 47µs** (IEEE C 37.118.1)
- Time accuracy is a factor for these measurements.
- Meeting vector accuracy needs PMU synchronisation up to 1µs.
- This must be to absolute time.



- The aim is to have accurately timestamped information at each site – This is then collated e.g. regionally
- Ultimately, Synchrophasors are intended to be the information providers for system control.

Substation Communications

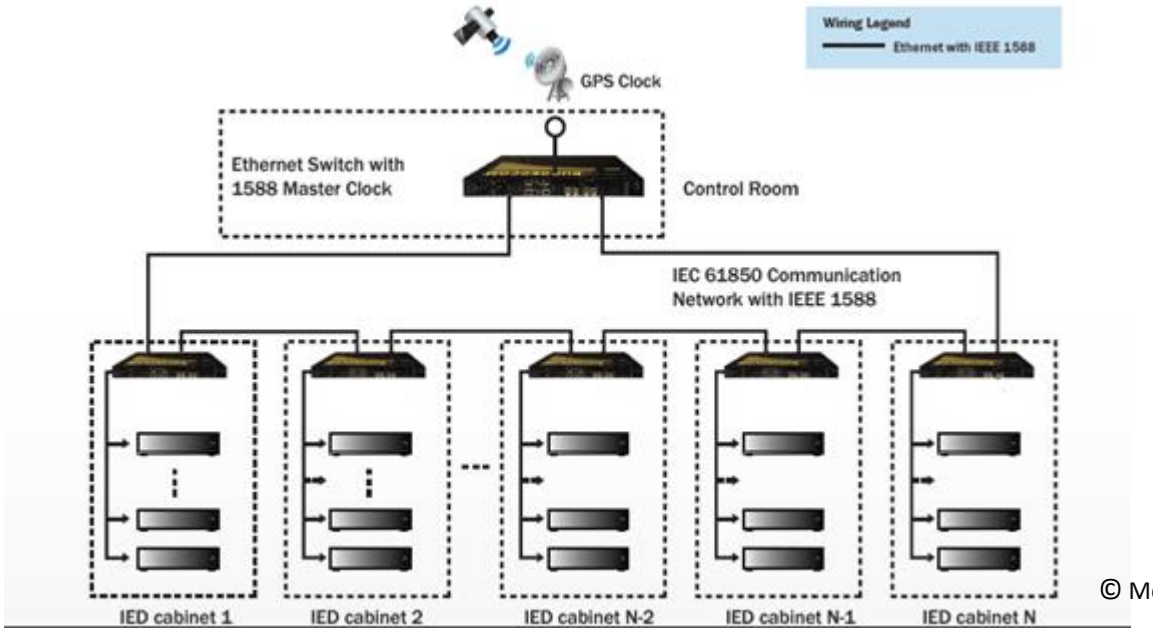
- Timing must also be distributed accurately **within** substations:
  - Sequence of Event Timing, Process Bus (IEC 61850)
- IEDs, e.g. Instrument Transformers can require <u>up to 1µs accuracy</u>
- Synchronisation can be delivered to devices by dedicated lines (IRIG-B, 1pps, Serial)



This incurs cost for both cabling and equipment

1588v2 for Substation Communications

- Synchronisation requirements can be met with 1588v2
- No need for dedicated lines (IRIG-B, 1pps, Serial)
- Scales well
- Expected to be included in future editions of the IEC 61850 standard



Finance

The need for Sync in Financial Networks

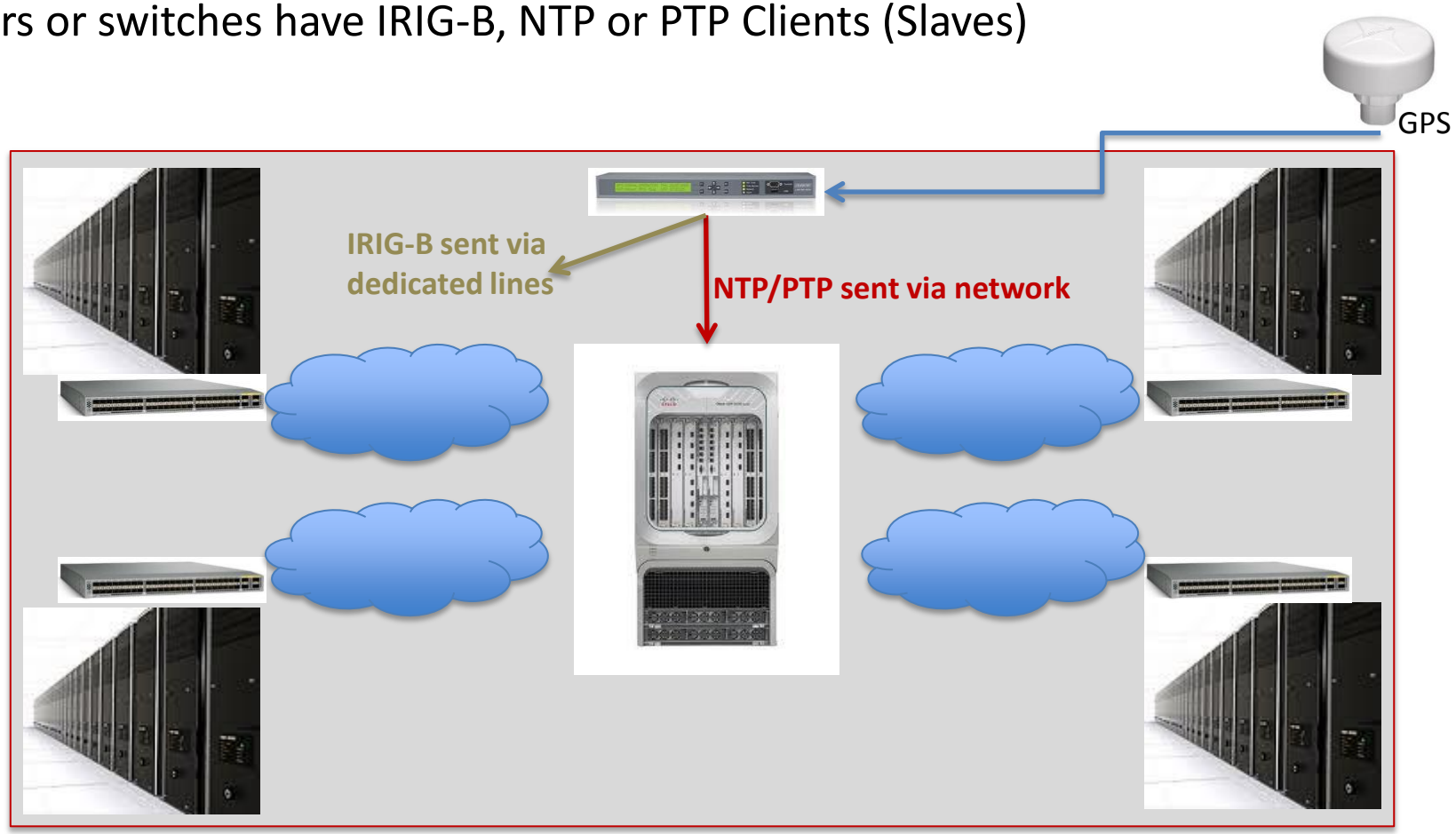
Calnex

- High-Frequency Trading (HFT) requires accurate timestamping of trades for:
  - Accurate records of transactions during playback regression to improve trading algorithms
  - Reporting and regulatory purposes, disputes, etc.
- GPS has primarily been used for this but faces issues:
  - Coverage and signal loss is a significant and expensive issue
  - Security - a US$20 device can jam GPS signals
- 1588v2 PTP is getting a lot of interest
  - Time can be delivered via the Ethernet network
  - However accuracy needs to be verified during trials and monitored in-service

Sync in the trading floor

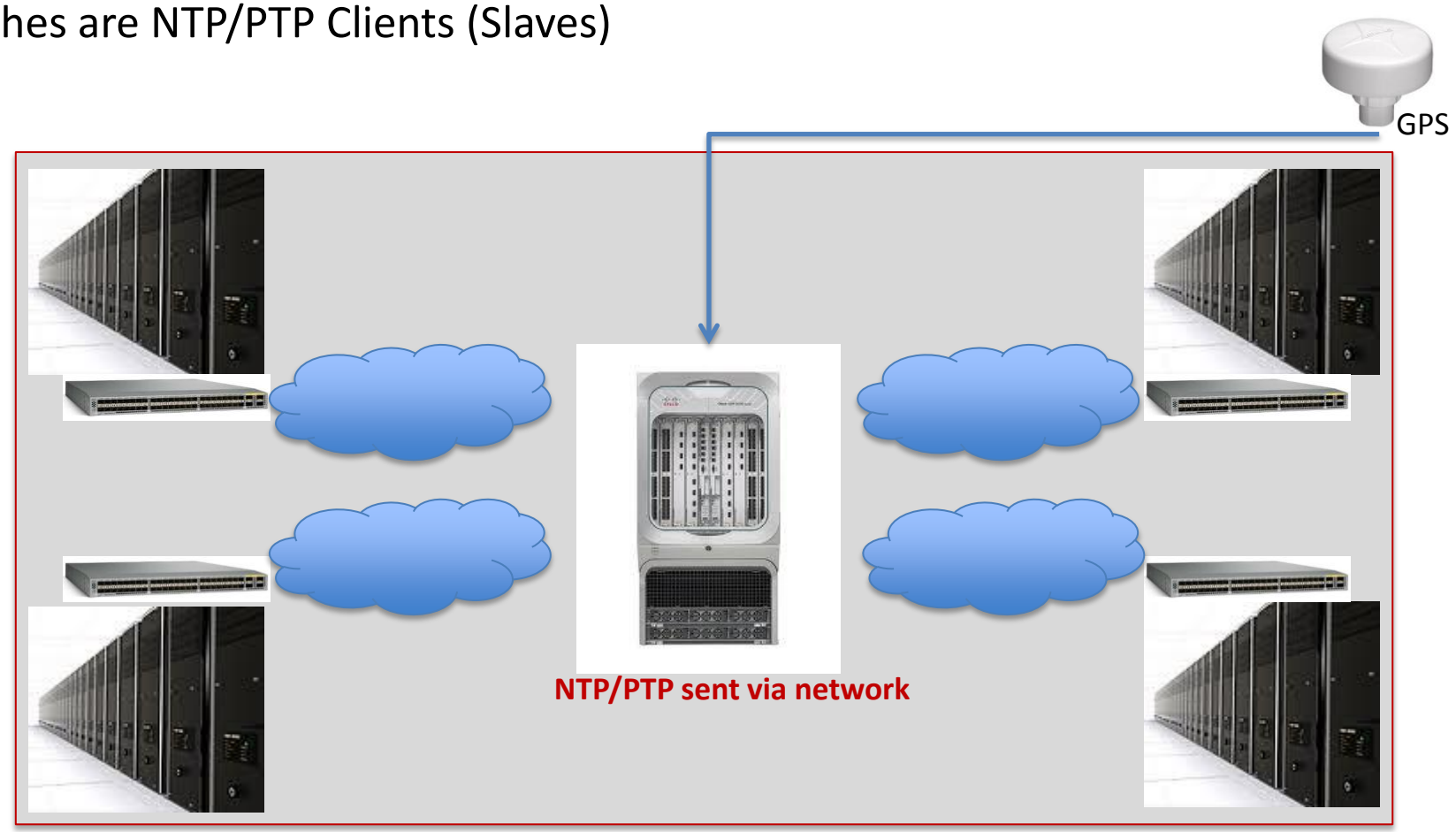
Calnex

Scenario 1 – all servers co-located in the Trading Exchange or Data Warehouse
GPS-locked Time-master, feed to servers via IRIG-B, NTP or 1588v2 PTP
Servers or switches have IRIG-B, NTP or PTP Clients (Slaves)



Sync in the trading floor

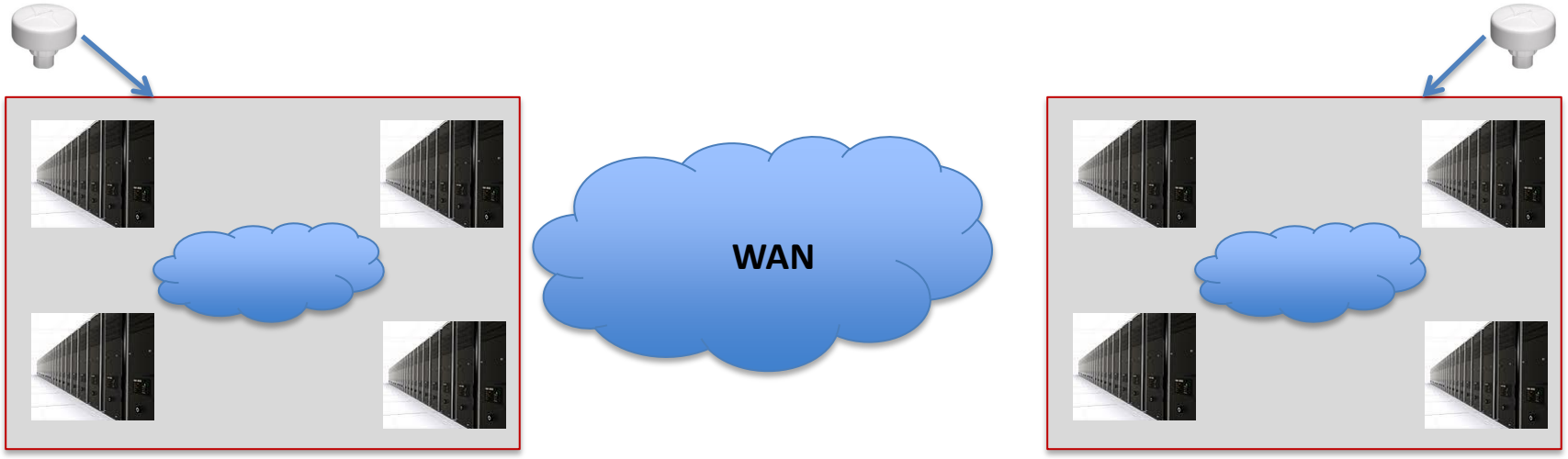
Scenario 2 – all servers co-located in the Trading Exchange or Data Warehouse
GPS-locked Router is 1588v2 PTP Master
Switches are NTP/PTP Clients (Slaves)



Sync in the trading floor

Calnex

Scenario 3 –servers located in multiple locations
GPS at every location, either Scenario 1 or Scenario 2 at each location
Switches are NTP/PTP Clients (Slaves)



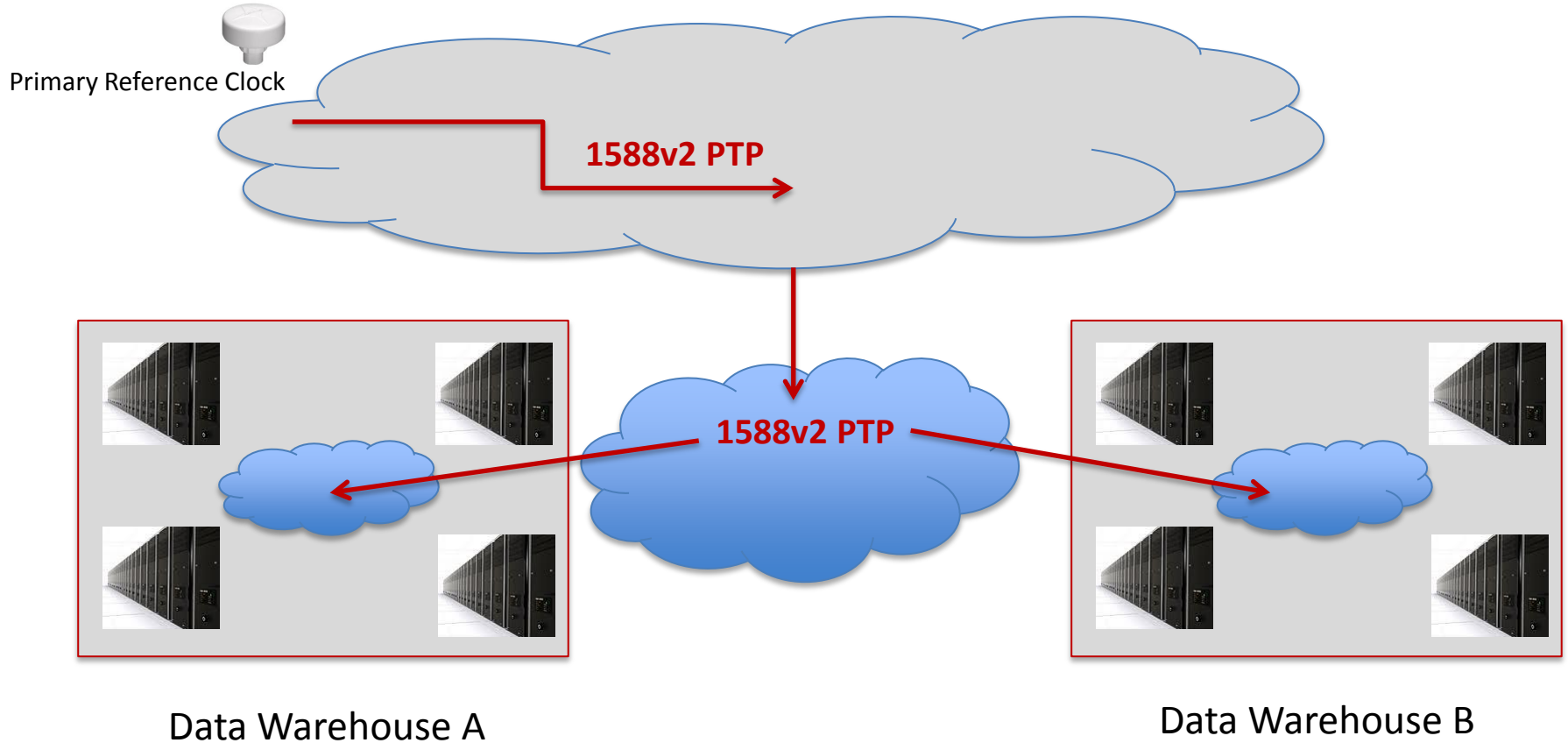
Data Warehouse A

Data Warehouse B

Sync in the trading floor

Calnex

Scenario 4 –servers located in multiple locations
1588v2 PTP (Timing Service) from Telco Carrier



The Requirement and The Options

Requirement

- Conventional wisdom is:
  - The applications need 1ms, so the hardware needs **1µs**

Options

- GPS and IRIG-B
  - IRIG-B is old technology (limited support) and needs a costly dedicated link
  - Used in older installs
- GPS and NTP
  - Not accurate enough - deliver 1ms rather than 1µs
  - Used when 1ms is sufficient
- GPS and 1588v2 PTP (or PTP-only)
  - Loading changes cause PDV and Asymmetry, which cause inaccuracy
  - Ongoing trials and investigations

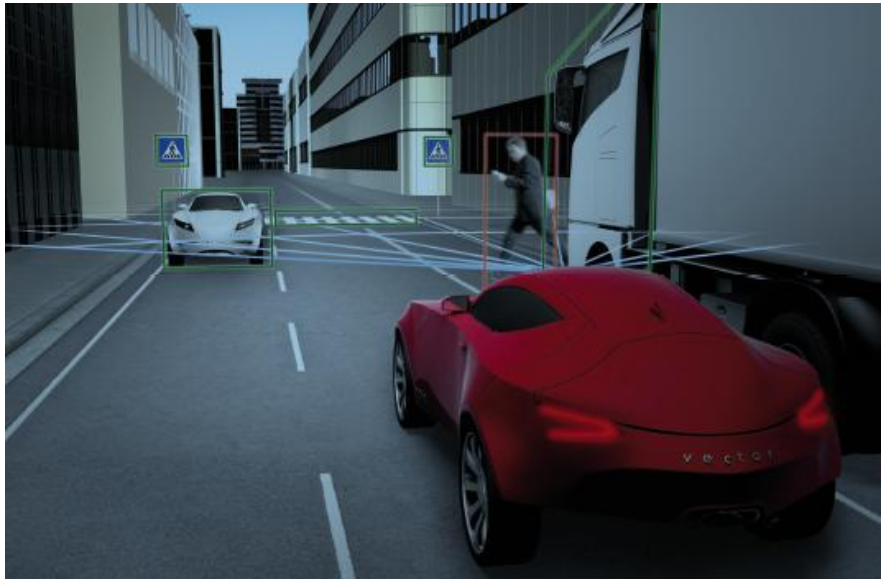
IEEE 802.1AS, Broadcast, etc.

IEEE 802.1AS

Calnex

- The standard for transport of precise timing and sync in Bridged LANs, e.g. Audio/Video Bridging (AVB) networks
- Seeing adoption in other areas – for example Data Center Bridging
- Other Audio/Video apps that need sync...*next slide*

In-Car 1588v2

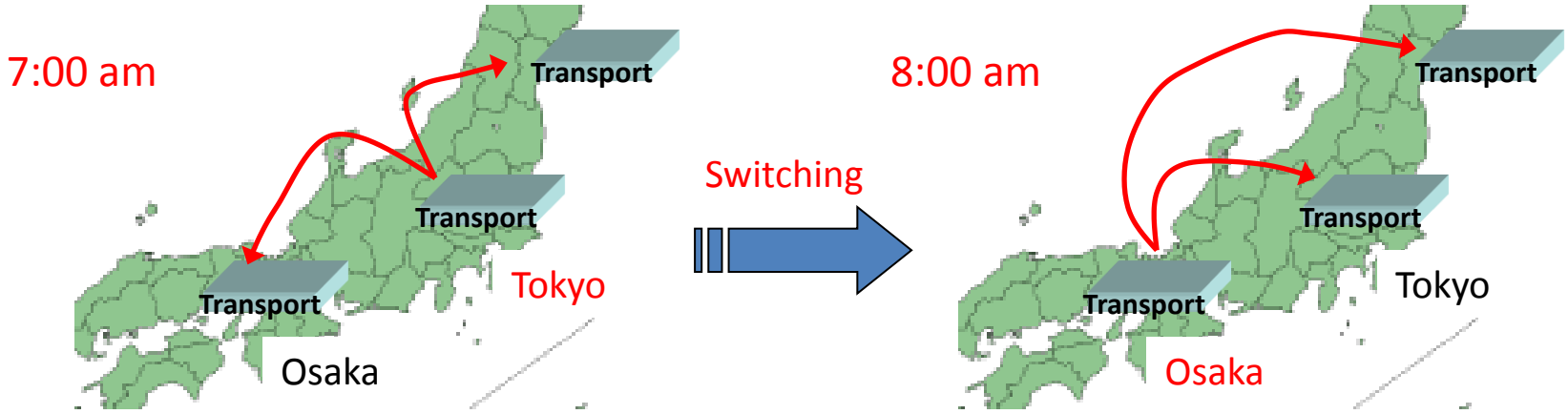


© Vector

- CAN, LIN, MOST, FlexRay are bus technologies for In-Car comms
- See www.autosar.org/ - **AUT**omotive **O**pen **S**ystem **Ar**chitecture
- Intend to use Ethernet and 802.1AS, for 802.1AS probably a subset as only 1 Master (BMCA not needed), static networks, etc.
- Applications include Brake by Wire, Camera Drive Assistance, etc.
- In the future – Car2x – Vehicle-Infrastructure comms – could get exciting!

Broadcast Sync

- Between broadcast stations:
  - E.g. – 7am feed from Tokyo, 8am feed from Osaka



- Within broadcast centres or OB vans
  - See next presentation from Cisco!

THANK YOU

See you at dinner tomorrow!