Power Matters

Microsemi

Trends in Time & Phase Synchronization

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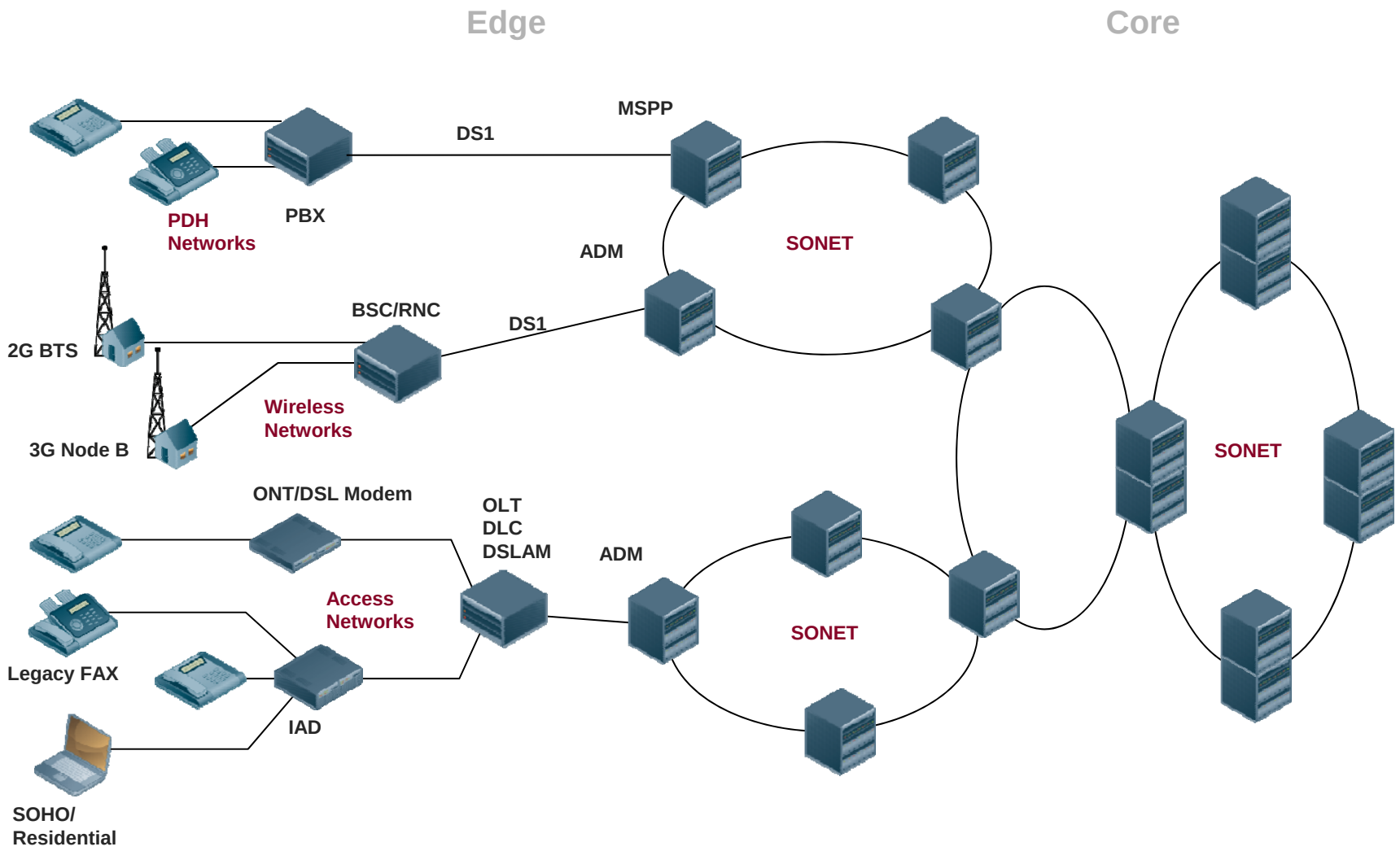
Introduction

- Drivers for synchronization in the network
- Migration from Traditional networks for voice to Packet networks for multimedia applications
- The evolving Core & Edge networks
- The evolving synchronization requirements

Drivers for Synchronization in the Network

The Circuit Switched Network



From Voice to Applications

- Video is the major contributor to internet traffic

[1]

Over 800M unique visitors per month
Over 4Bn videos viewed per day

2Bn hours viewed in Q4CY11
Over 20M subscribers world wide

[2]


[3]

845M monthly active users by end CY11

Search engine accounts for 7% of Internet traffic
Internet Traffic is growing 40% annually
245 terabytes per second by 2015

[4]

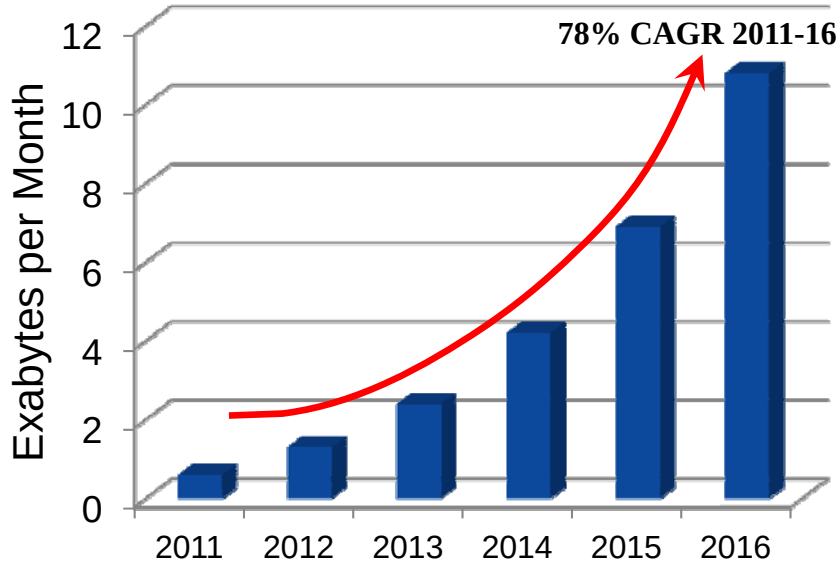
- Emergence of Cloud Computing will accelerate traffic further

1 - YouTube web statistics 2 – Netflix web statistics
3 – Facebook web statistics 4 - Fifth annual Cisco VNI Forecast (2010-15)

Applications go Mobile

- 5.5Bn mobile subscribers, 78% of the world population
  - Tablets to reach 63M units by 2011, expected to reach 129M by the end of 2012[1]
- YouTube[2]
  - Over 600M mobile videos viewed per day
  - Mobile traffic tripled in 2011
- Facebook 425M monthly active mobile users by end CY11[3]

Global mobile data traffic to increase 18x from 2011 to 2016[4]



1 - IHS iSuppli, March 2012
2 – YouTube web statistics
3 – Facebook web statistics
4 – Cisco VNI Global Mobile data report

Core Network Transition

Solving the Traffic load Problem

SONET - Falling Short

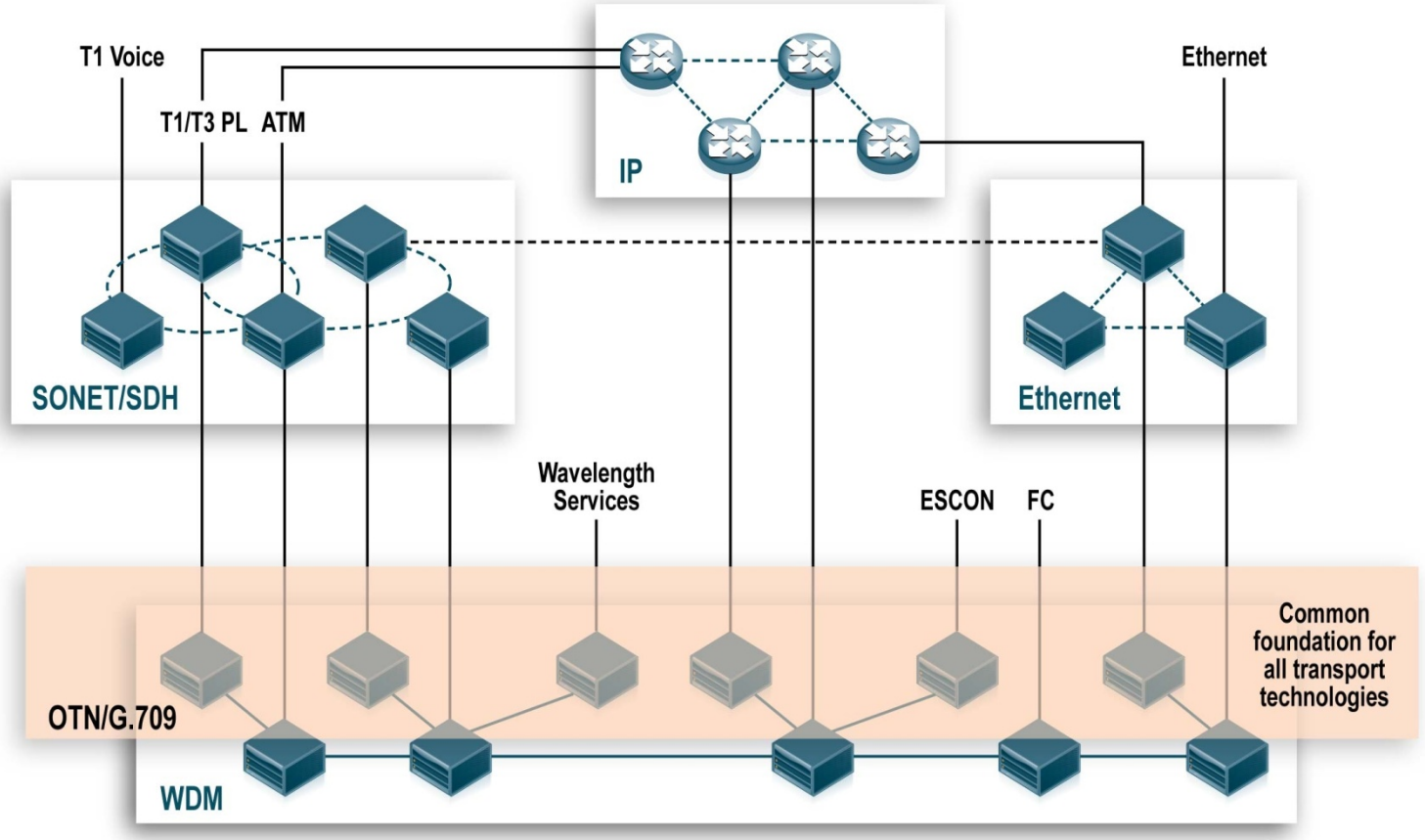
- Specifically designed for the high speed transmission of a single application, Voice
- Specifically designed for frequency traceability
  - GPS or Cesium Sources
- Network applications have brought new demands on the network core
  - Massive amounts of asynchronous data traffic
  - Time Alignment
- SONET is struggling to keep up with the increasing bandwidth demands
  - 40G may be a bridge too far for SONET

The Emergence of OTN

- OTN provides flexibility and scalability for both data traffic and synchronization
- Even though OTN itself does not require synchronization, SONET, synchronous Ethernet and other transport signals can have their own timing carried transparently end-to-end
- Asynchronous packet networks do not require synchronization, these also can be carried by OTN

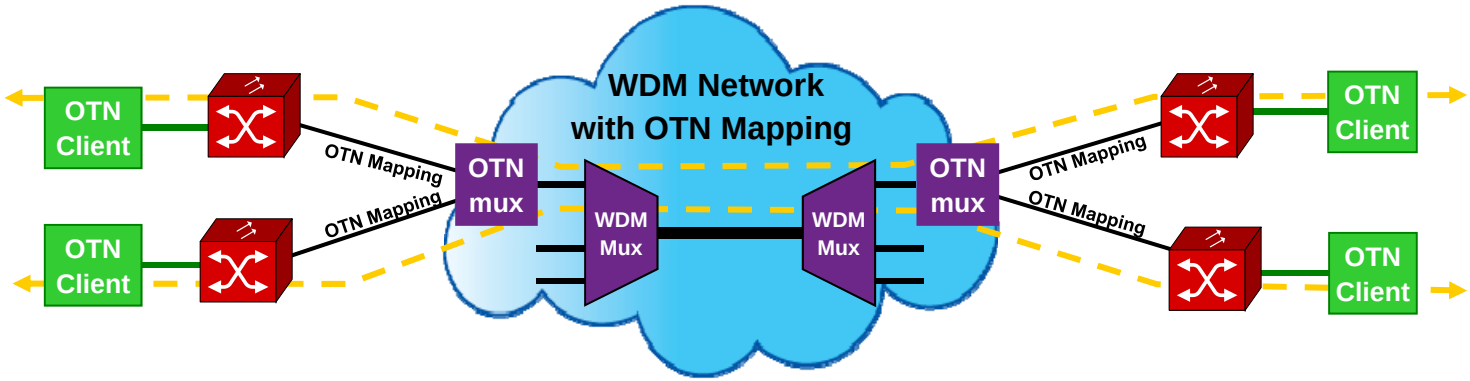
Optical Transport Network

- OTN can meet the traffic mix demands
- OTN makes WDM manageable and provides a common foundation
- OTN enables efficient bandwidth utilization at 40G and above

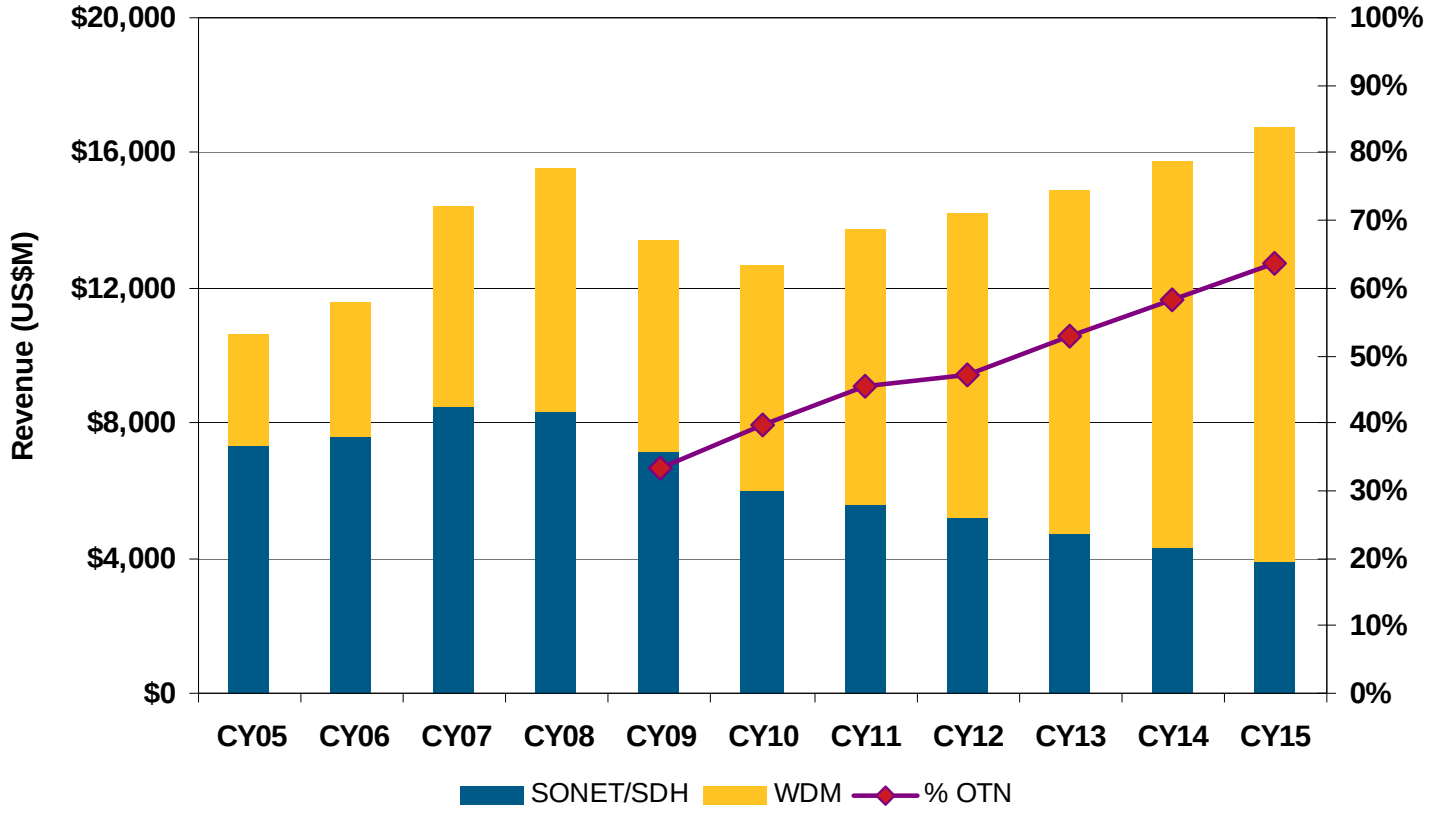


OTN Timing Transparency

- OTN physical layer is asynchronous and therefore does not require the sophisticated timing distribution associated with TDM hierarchy
- OTN includes per-service timing adjustments to carry Client timing preserved through network
- OTN's transparency enables carrying any service
- Timing transparency is important for offering wholesale services for third-party providers



Market Rapidly Transitioning to OTN



- OTN spending will be about 65% of total optical spend by 2015
  - Overall optical market growth +6% CAGR (2010 to 2015)
  - OTN market growth +16% CAGR (2010 to 2015)

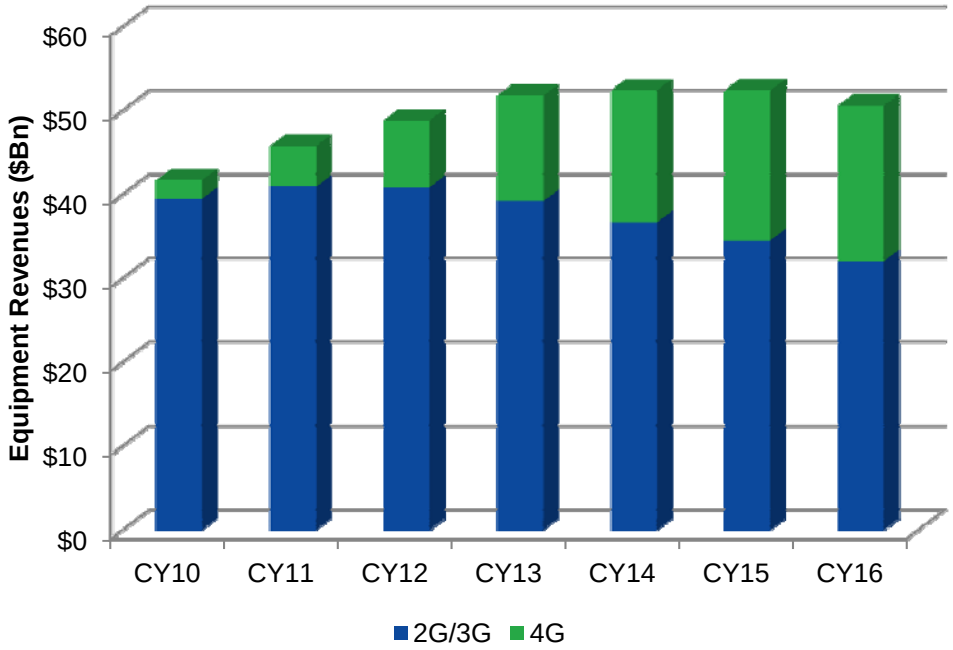
Source: Infonetics 2012 OTN Hardware Report

Edge Network Transition

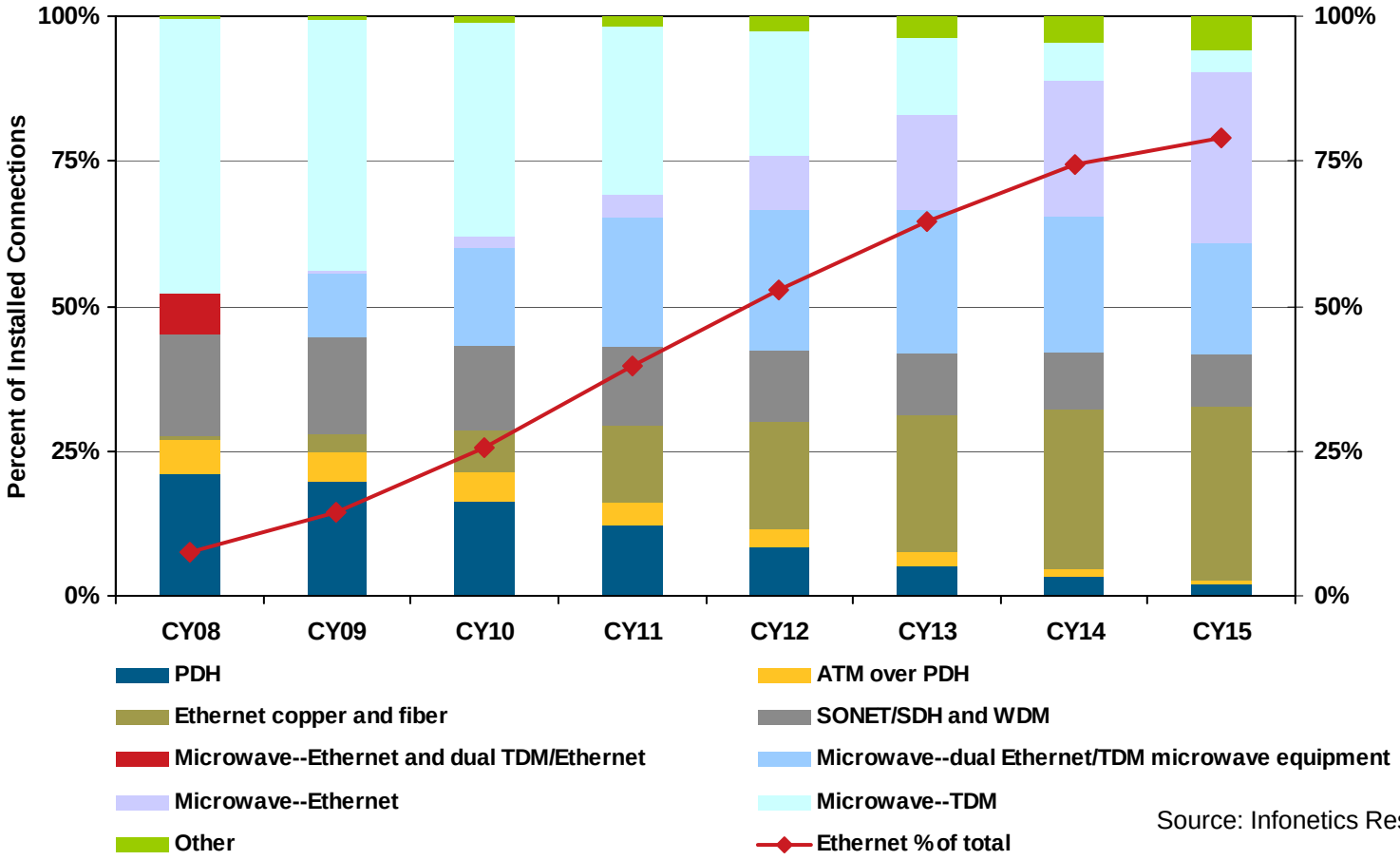
Solving the Bandwidth and Synchronization Problem

Servicing the Application Demands

- To meet the data demands of existing and new applications, we have a number of years of infrastructure build-out still to come
  - Less than 80% of the population is covered with 2G
  - Less than 30% of the population is covered with 3G
- 4G investment to kick in during CY12 to CY16



Ensuring the User Experience

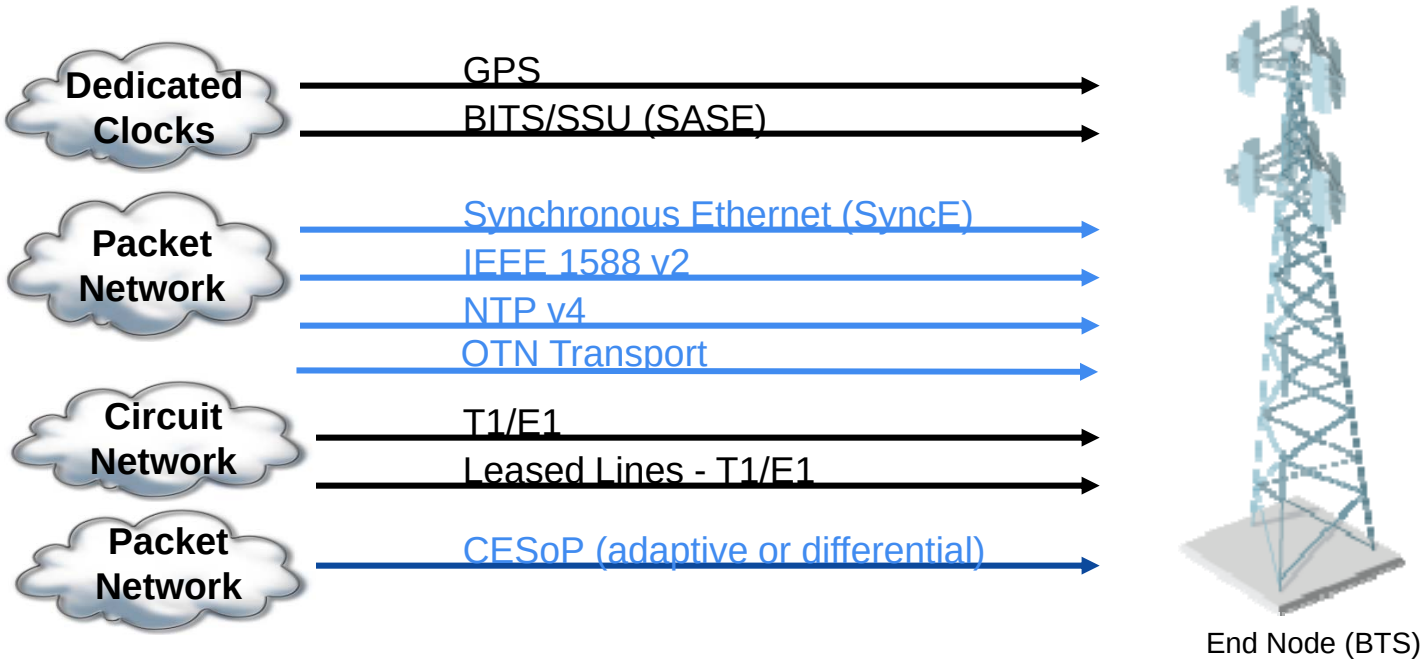


Source: Infonetics Research

- Ethernet installed cell site backhaul connections continue to increase as a portion of total connections from 26% in 2010, to 79% by 2015

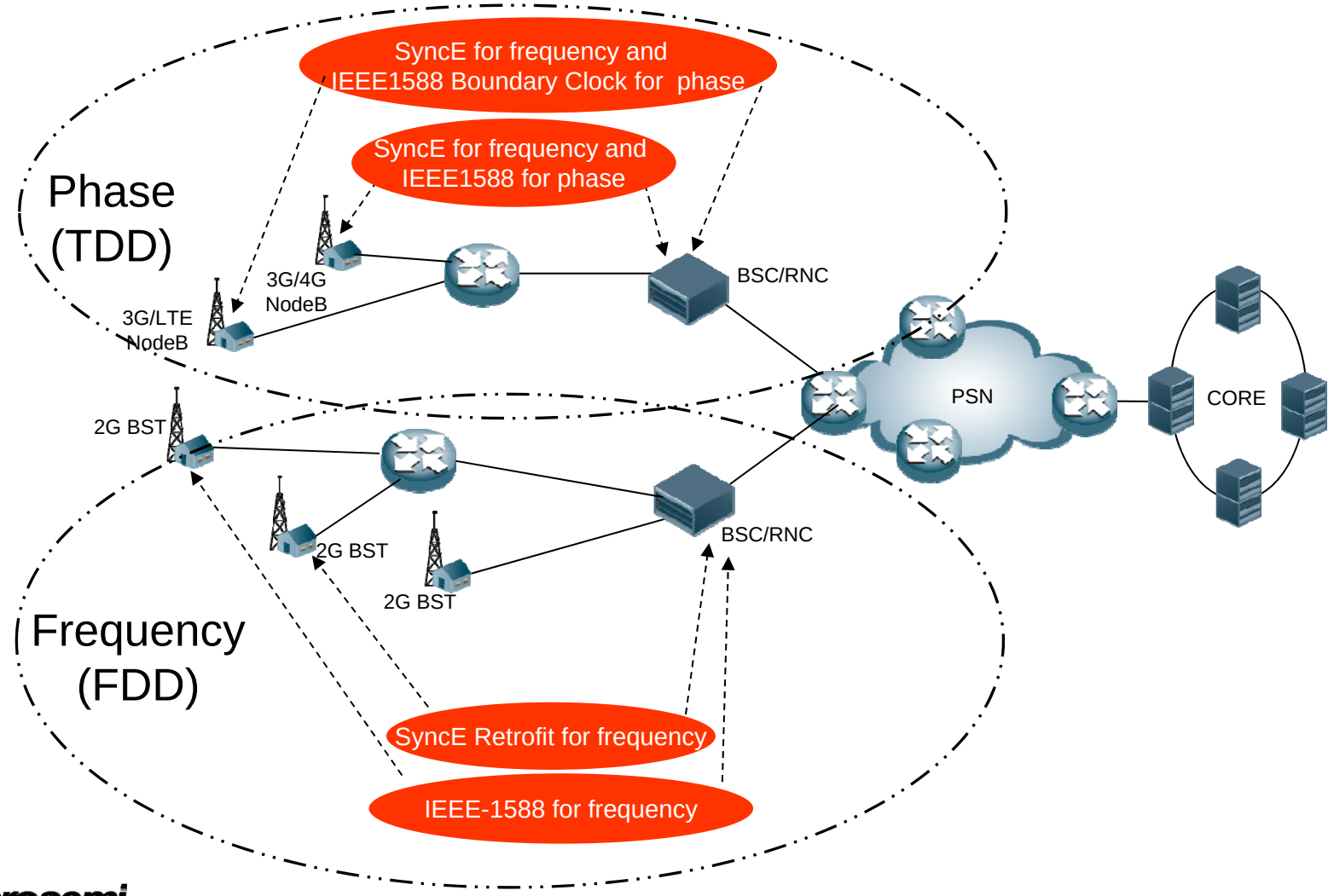
Synchronization for Mobile Networks

- FDD applications for 2G & 3G
  - Frequency accuracy from 15ppb to 50ppb
- TDD applications for 3G & 4G
  - Frequency & Phase alignment to better than +/-1us



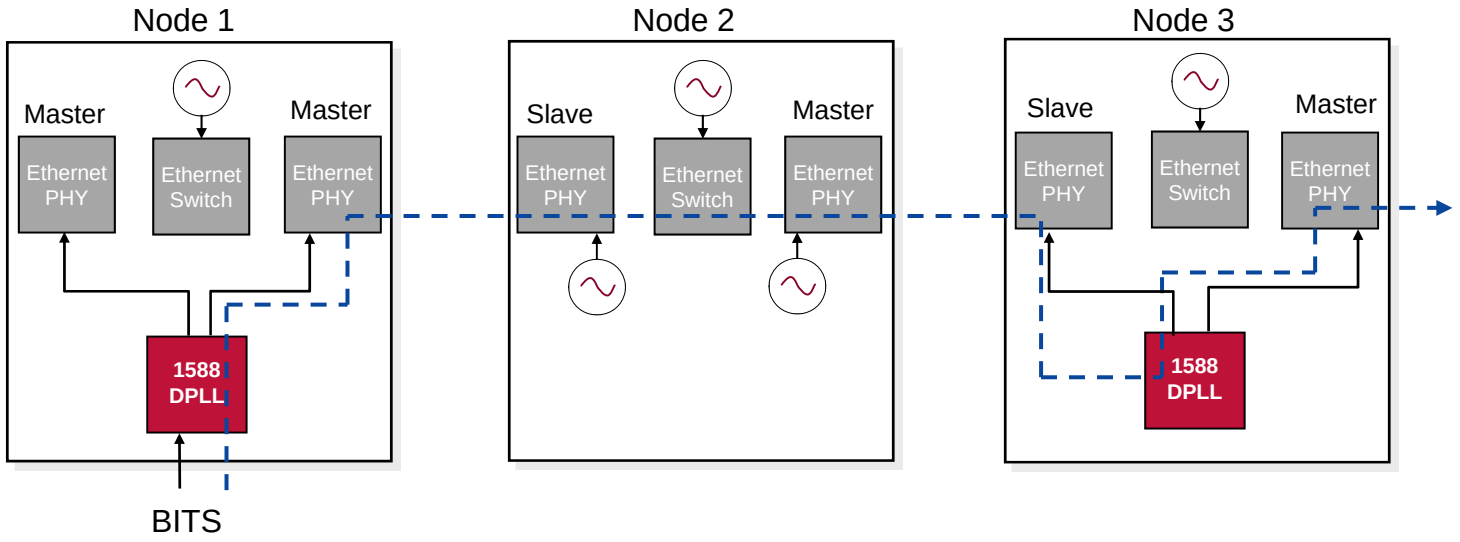
Use Of Protocol & Physical Layer Synchronization

Is it time to get synchronization from the **“Cloud”** not the **“Sky”**?

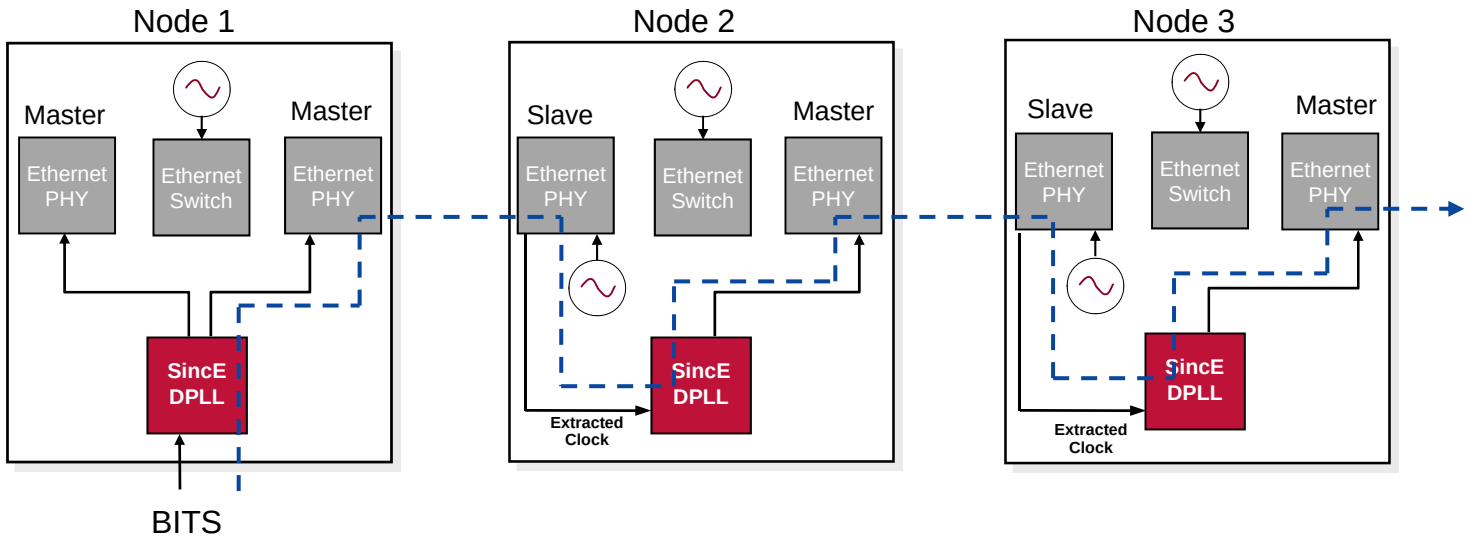


Timing Distribution Protocol & Physical

Protocol Layer ***(IEEE 1588)***

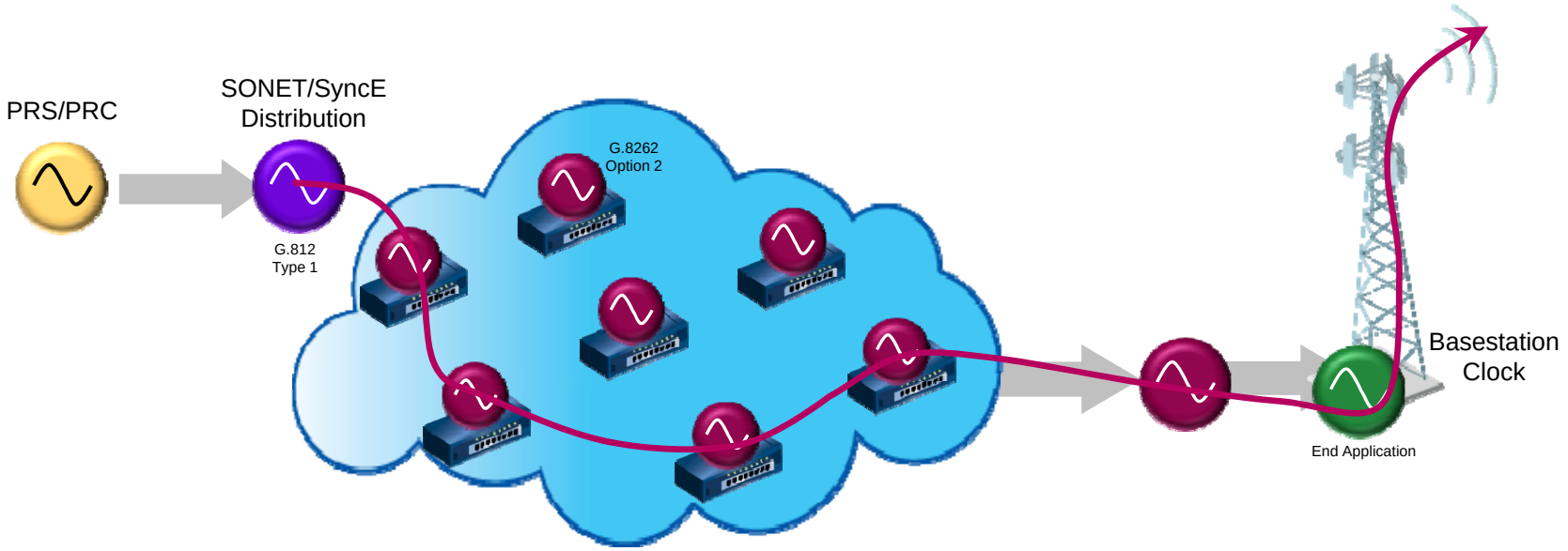


Physical Layer ***(SyncE)***



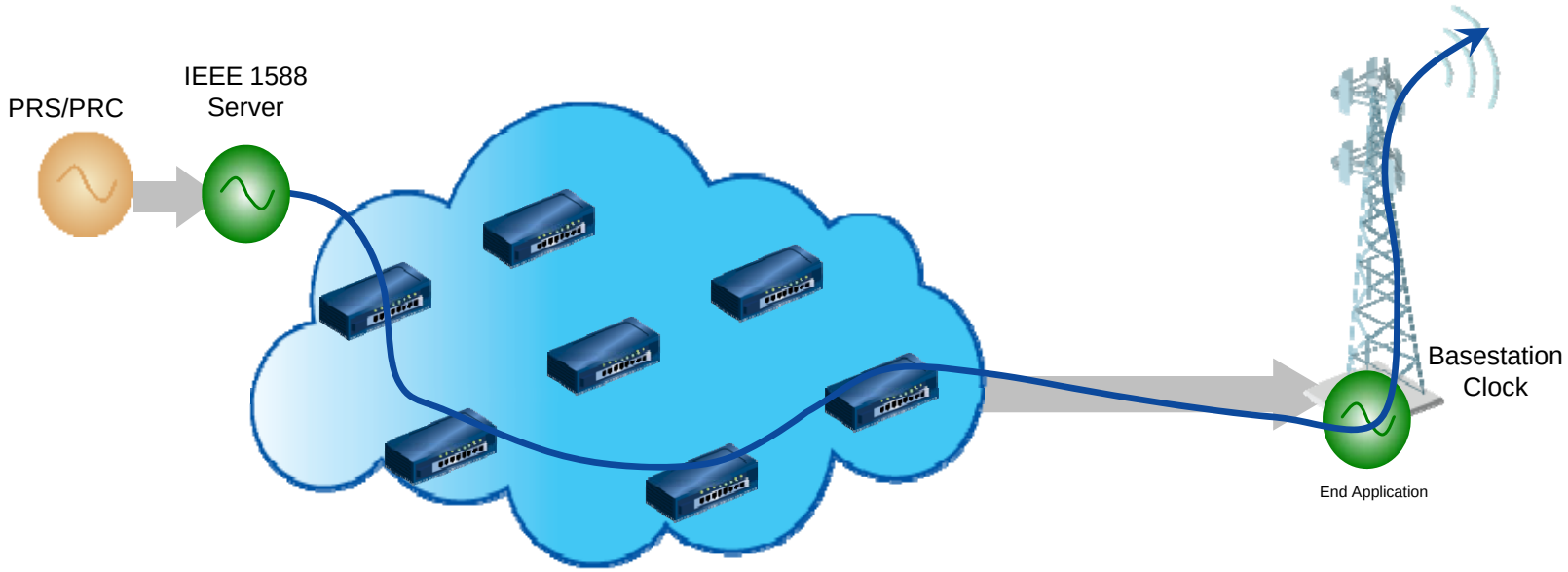
SyncE for FDD

- The clocks are designed to control jitter and wander in the network
- Uses SONET synchronization concepts for packet networks
- Use the Ethernet bit timings to transport physical layer frequency synchronization between Ethernet switches
- Already widely used by equipment vendors



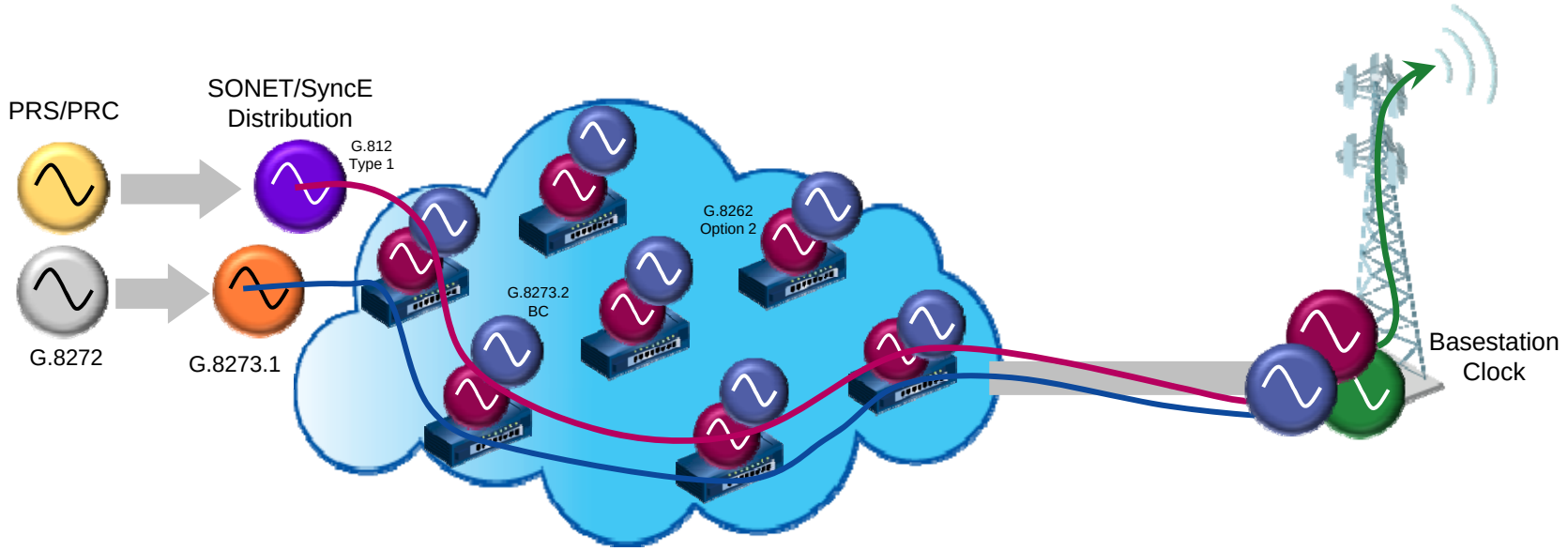
IEEE1588 for FDD

- Telecom Profile for Frequency
  - A PSN may be inserted between the server and client, that is not aware of protocol layer synchronization packets (e.g. IEEE 1588-2008)
  - Suitable for frequency (MTIE, TDEV, FFO) transfer



SyncE-IEEE1588 for TDD

- Aware Networks
  - Targeted for TDD basestation applications
  - Uses Boundary Clock + SyncE
- Telecom Profile for Phase
  - The PSN has ‘on-path support’ where each switch / router is aware of protocol layer synchronization packets (e.g. Boundary Clock)
  - Support frequency (MTIE, TDEV, FFO) & phase/time (PPS, ToD) transfer



Summary

- "Applications" drive the shape & structure of the network
  - Data is king, Voice is just another Application
- "Wireless Networks" drive the need for Synchronization
  - Frequency & Phase
- Protocol & Physical layer Synchronization

Questions for the Conference

- Can synchronization be sold as a service with pricing based on features and accuracy?
- Can Cloud and Sky synchronization live in harmony?
  - Can we ever live without GPS?