

Combining Synchronous Ethernet and IEEE-1588™ for use in Telecom

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AGENDA

- **Background**
- **The Basic Problem**
- **Definition of Synchronous Ethernet**
- **Combining Synchronous Ethernet with 1588**
- **Summary**

IEEE-1588™ is trademark of its respective owner

Background

- **Next Generation Networks (NGN) are migrating to a packet-based network**
- **Service providers worldwide are faced with major challenges:**
 - Increasing service revenue
 - Lowering network costs and
 - Delivering QoS (quality of service)
- **Service providers are moving from voice services to networked services and solutions**
 - TDM transport continues to represent significant revenue for carriers
 - TDM must be supported in this new model

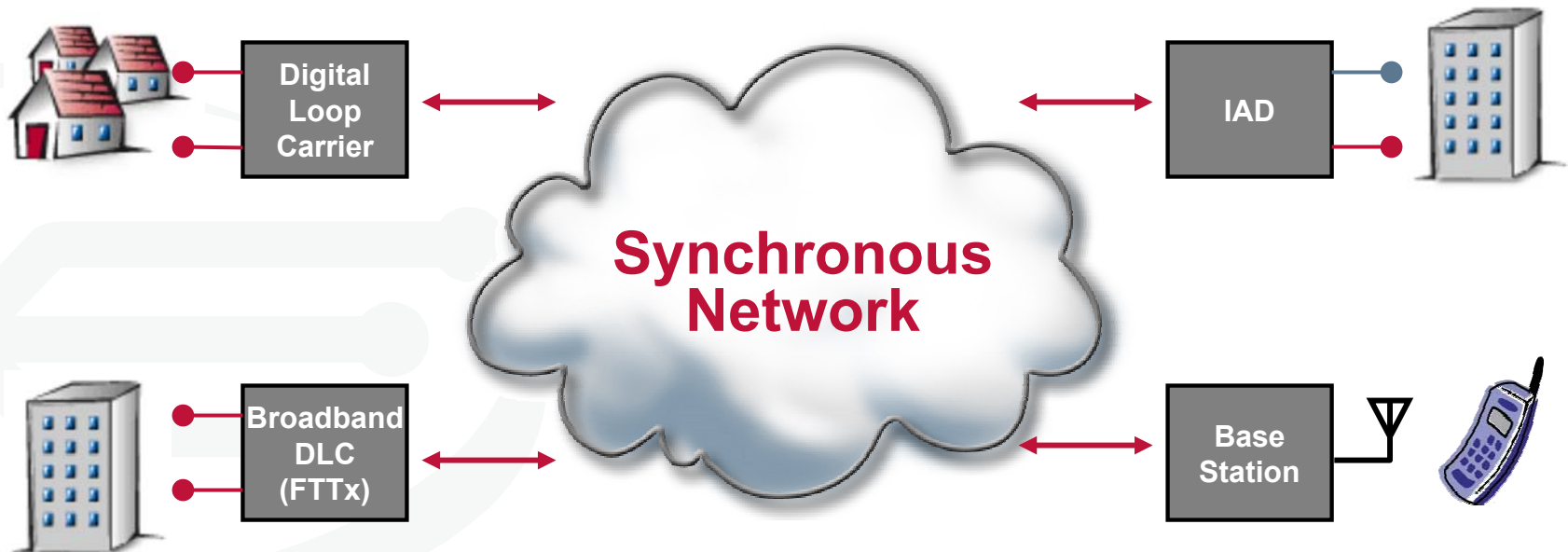
Background cont'd

- **There are applications that still require synchronization in a PSN (packet switched network)**
 - **Cellular base station**

Synchronization allows smooth call hand-off between base stations, it minimizes dropped calls, it reduces customer churn
 - **Legacy services: E1, fax, modem**
 - **Increases bandwidth utilization**
 - **Improves QoS**
- **Synchronization is essential for wireless and wireline carriers to move to NGN**

Synchronous Networks

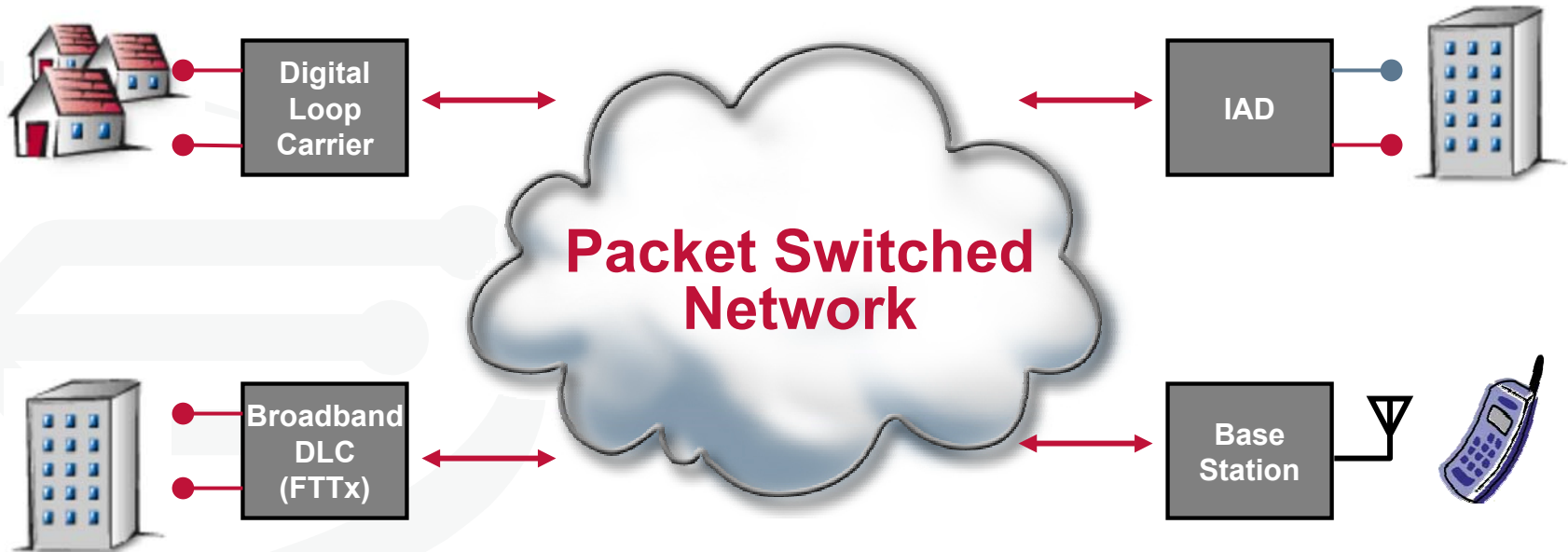
- No problem with synchronous network...
- Current synchronization distribution in circuit switched networks
 - T1/DS1 or E1
 - Sonet or SDH



Packet Switched Networks

The Basic Problem

- In the PSN the synchronization chain is broken...
- But... there is still a need for synchronization to support time-sensitive services over PSN

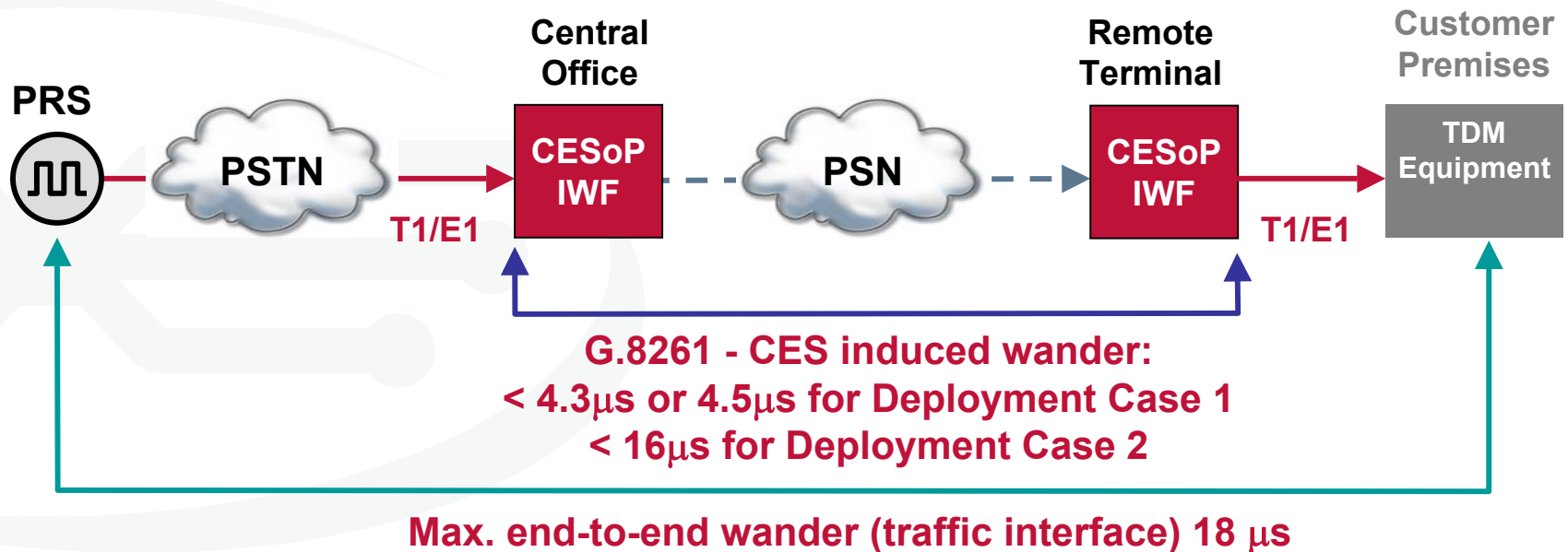


ITU-T Recommendation G.8261

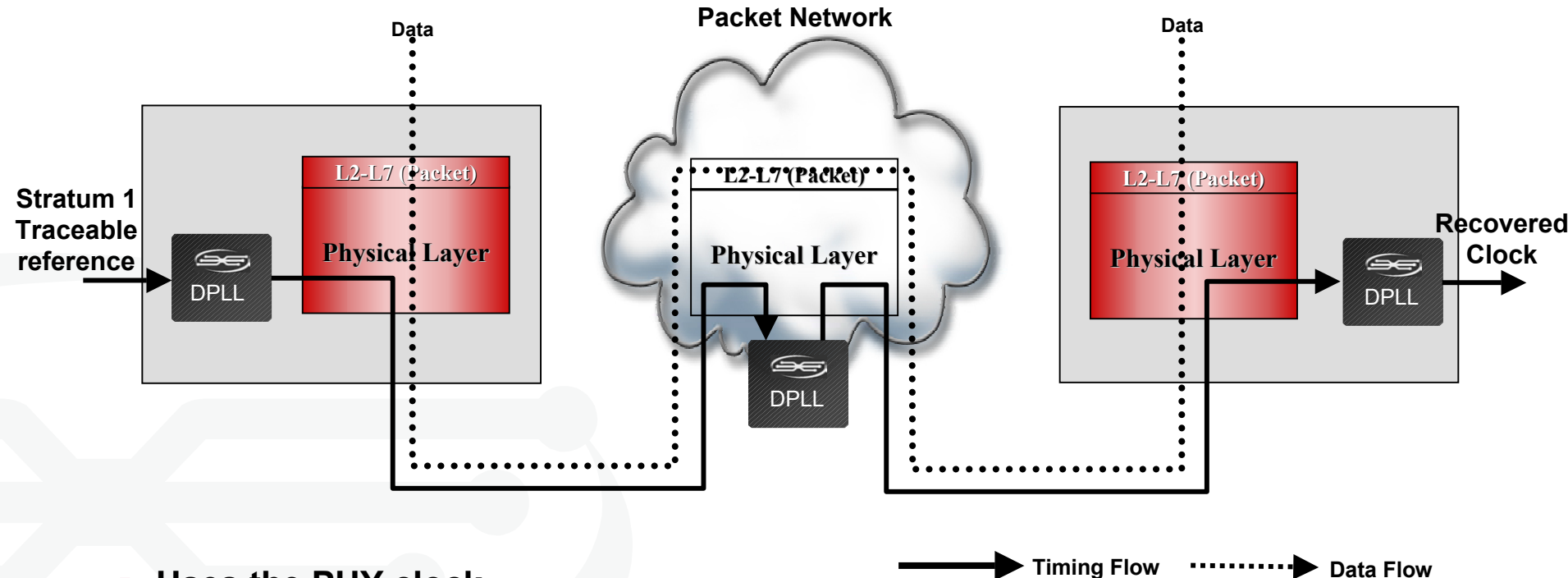
- Recommendation published in May 2006
- Defines timing and synchronization elements of packet networks
- Specifies the minimum equipment tolerance to jitter and wander at the boundary of the packet networks at TDM interfaces
- Outlines the minimum requirements for the synchronization function of network elements
- Two methods for clocking distribution
 - Plesiochronous and network synchronous methods
Synchronous Ethernet
 - Packet based methods
IEEE-1588 is an example of this method, but ITU does not refer to it
- Four clocking methods
 - Network - synchronous operation
 - Differential methods
 - Adaptive methods
 - Reference clock available at the TDM end systems

Standards for Synchronization

- E1 standards (2.048 Mbps)
- Traffic interface (G.823, Table 2)
 - 18 μ s over 1000s
- T1 standards (1.544 Mbps)
- Traffic interface (G.824, Table 2)
 - 18 μ s over 24 hours



Synchronous Ethernet Concept



- Uses the PHY clock
 - Generates the clock signal from “bit stream”
 - Similar to traditional SONET/SDH/PDH PLLs
- Each node in the Packet Network recovers the clock
- Performance is independent of network loading

G.8261 – Synchronous Ethernet

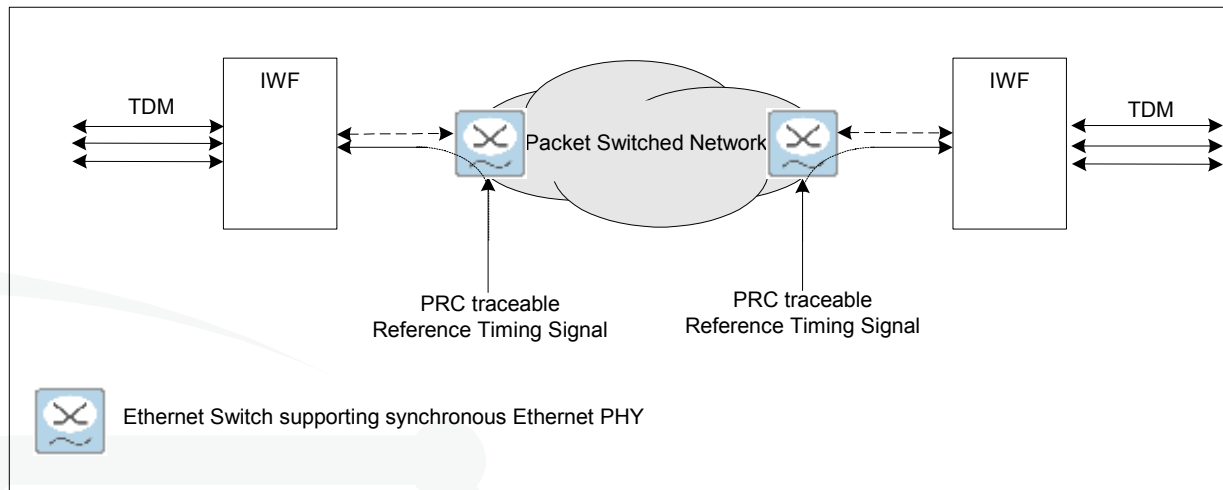


Figure 4/G.8261 - Timing to Ethernet IWF provided over Ethernet PHY

- A reference timing signal traceable to a PRC is injected into the Ethernet switch using an external clock port

G.8261 – Synchronous Ethernet cont'd

- **Synchronous Ethernet clocking distribution can be considered an extension of the current synchronization distribution network**
- **It does not impact any existing IEEE 802.3 specifications such as frequency tolerance, but refers to the new additional network element clock functionality**
- **Uses the OAMPDUs (protocol data units) to pass SSM (synchronization status message)**
- **ITU is working on a new recommendation G.paclock**
 - **Outlines requirements such as clock bandwidth, frequency accuracy, holdover and noise generation**
 - **Proposal is to model Synchronous Ethernet as an SDH equipment slave clock (as defined in recommendation G.813)**

G.8261 – Architecture for Synchronous Ethernet

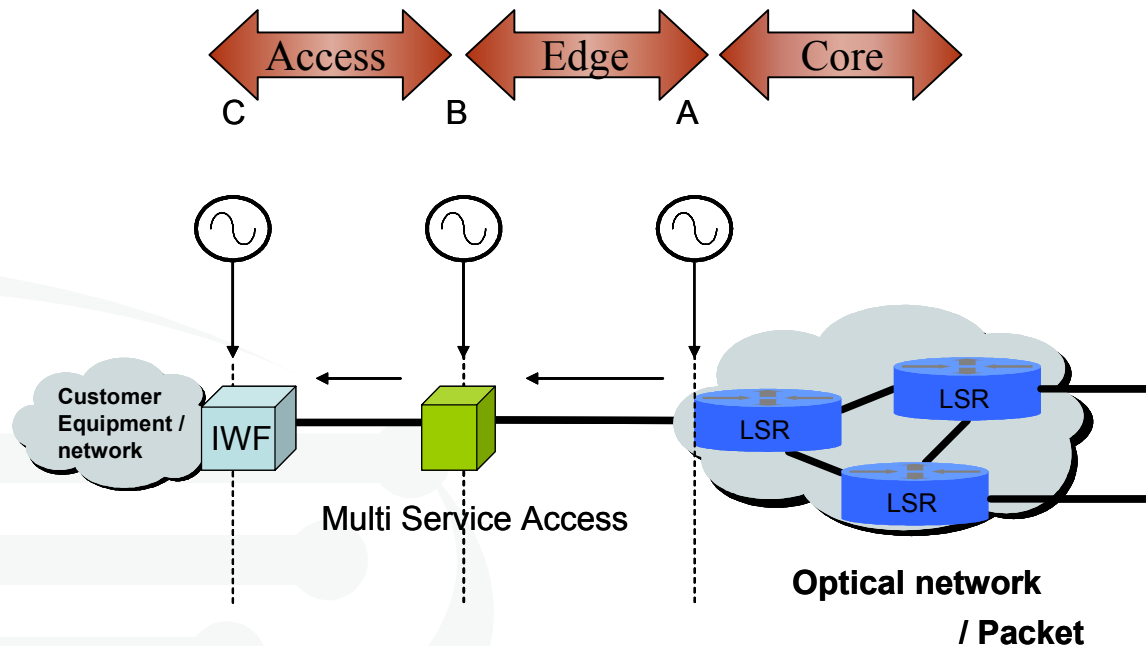
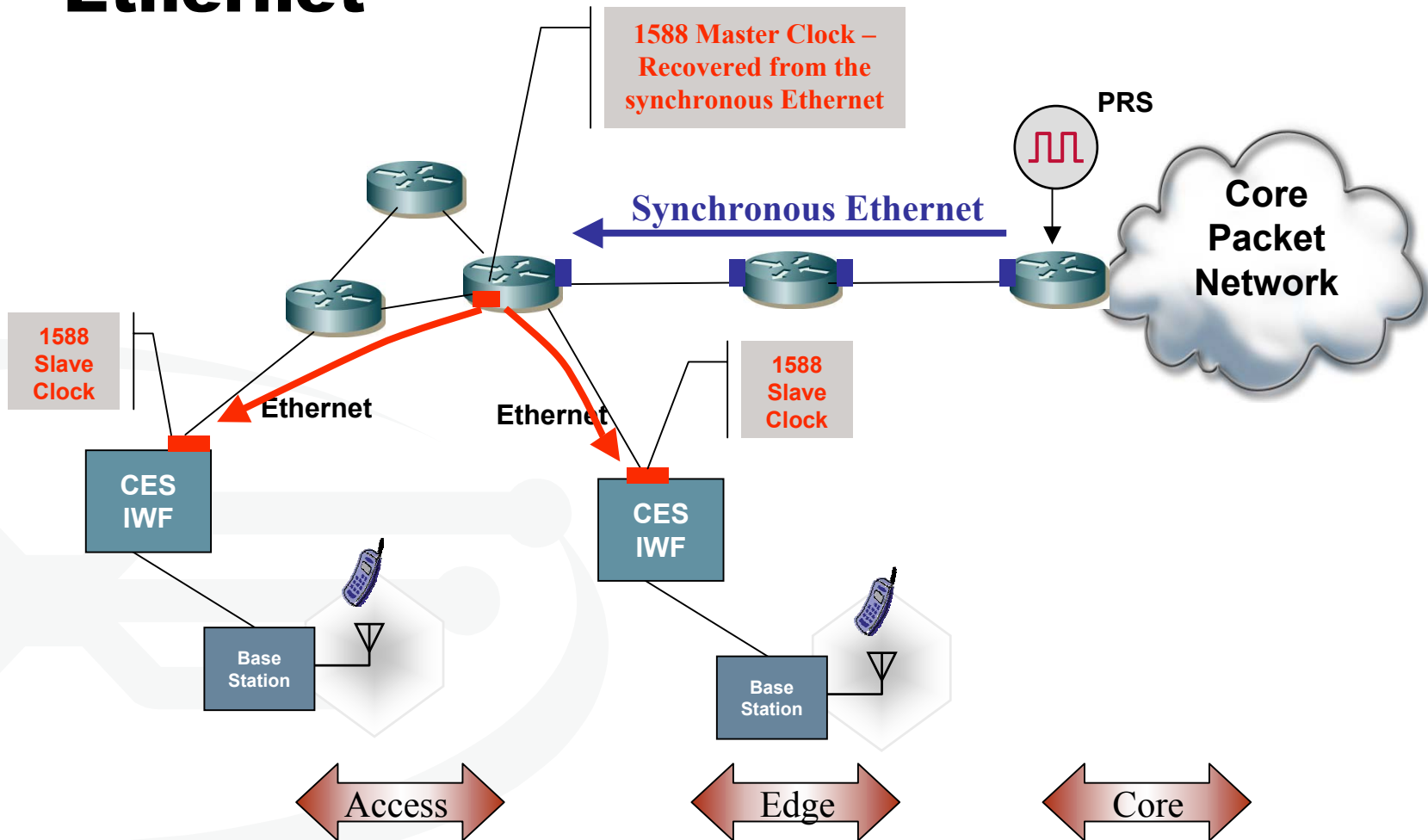


Figure A.1/G.8261 – Reference Clock Location

Example of IEEE-1588 and Synchronous Ethernet



IEEE-1588 and Synchronous Ethernet

- **IEEE-1588**
 - Independent of the physical layer
 - Can distribute time of the day and frequency
 - Can be affected by impairments of the telecom network such as packet delay variation
- **Synchronous Ethernet**
 - Uses the physical layer of Ethernet
 - Can only distribute frequency, it can not distribute time of the day
 - It is not affected by impairments introduced by the higher levels of the network
- Applications like billing and SLA (service level agreements) can benefit from a network that is aware of the time of the day
- Some networks are very noisy and there is a need to have carrier class synchronization
- In these conditions Synchronous Ethernet can be used to deliver frequency and IEEE-1588 can be used to deliver time of the day

Summary

- **Work done at ITU-T is complementary to the work done at IEEE-1588 standards committees**
- **There are new technologies being proposed at ITU that will complement the use of IEEE-1588**
 - Synchronous Ethernet
- **There is a lot of interest in IEEE1588 in the Telecom Industry**
- **The work in IEEE-1588 to support Telecom is going well**
 - Committee is reviewing version 2 draft that includes key features for telecom

Thank you!

