# The New Timing Standard for Packet Networks, G.8261 (*G.pactiming*)

Prague, November - 2006

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# Presentation Outline

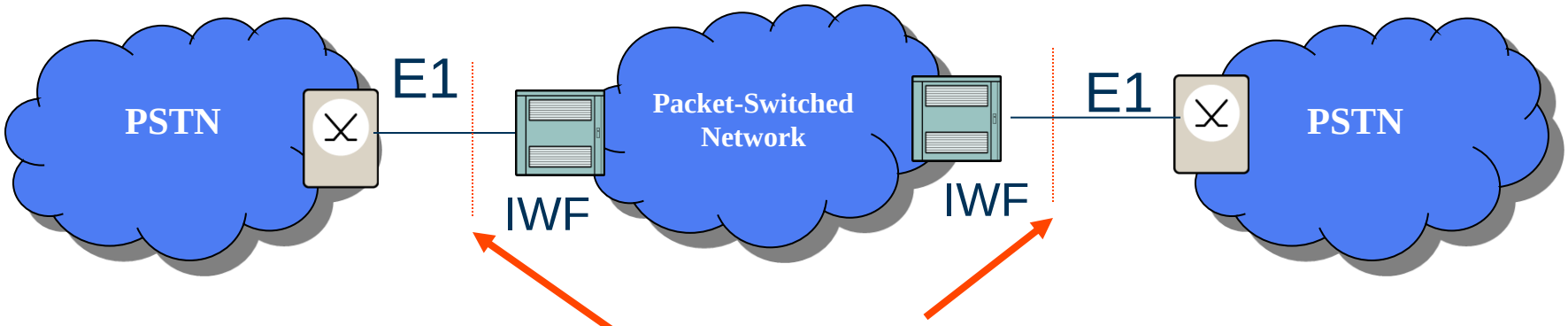
- The need for a new ITU-T Recommendation
- ITU-T G.8261, the “2006” version
- Next step: enhanced G.8261 and the new ITU-T Recommendations (G.paclock, G.pacmod)

# Next Generation Networks Requirements ?

Requirements are often derived from the needs of the “Old” Generation Networks

# Packet technology in the Next Generation Networks

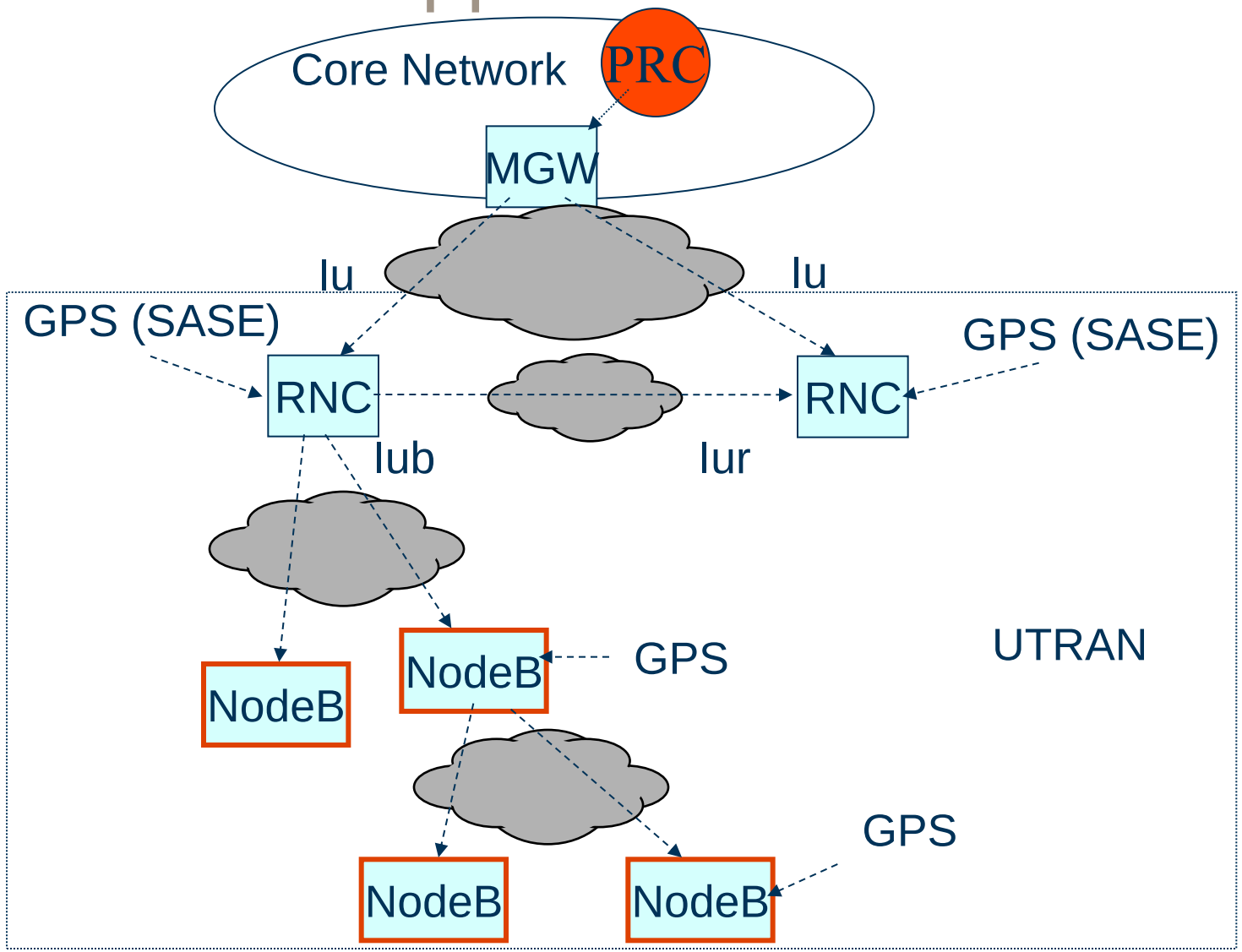
- Next Generation Network (NGN, ITU-T Y.2001, Y.2011) : transport technologies (packet based) are independent of the services to be carried.
- This means :
  - Real Time Services carried over packet network.
  - Transport of TDM over Packet switched networks (CES)




CES Circuit Emulated Services
IWF InterWorking Function

- Network interface requirements
- Recovery of the service timing

# Synchronisation Distribution in the UTRAN: 50 ppb on the radio interface




Synch paths

Traditionally on E1 / T1 or STM-1

How to distribute sync over Ethernet ?

# What about sync requirements in the standards?

- Synchronization requirements in existing standards (e.g. ITU-T G.803, G.811, G.823, G.824) are addressing a “best in class” synchronization network (frequency accuracy = $10^{-11}$, limited jitter and wander)
- How can these standards be applied?
  Are they always needed (e.g. end applications as RBSs)?
- Alternative methods may be required to distribute sync in a packet network environment (e.g. adaptive methods)
- Packet networks will degrade the synchronization: how can a network operator  be confident that the network will correctly operate also in these scenarios

# ITU-T G.8261 ?

- The “Synchronous Ethernet” specification ?
- A competitor to IEEE 1588 (sync via packets) ?
- The recommendation for the CES (Circuit Emulated Services) ?

# ITU-T G.8261: The Scope

*This ITU-T Recommendation defines synchronization aspects in packet networks.*

*It specifies the maximum network limits of jitter and wander that shall not be exceeded.*

*…*

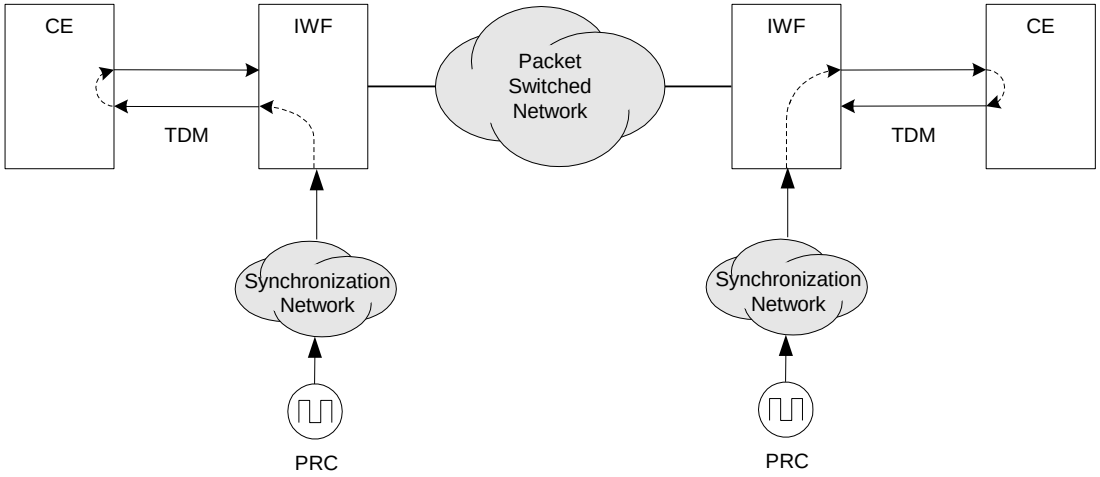
*In particular it focuses on the transport of synchronization information of TDM signals over packet networks.*

*…*

*The packet networks that are in the scope of this recommendation are currently limited to the following scenarios: Ethernet*

*…*

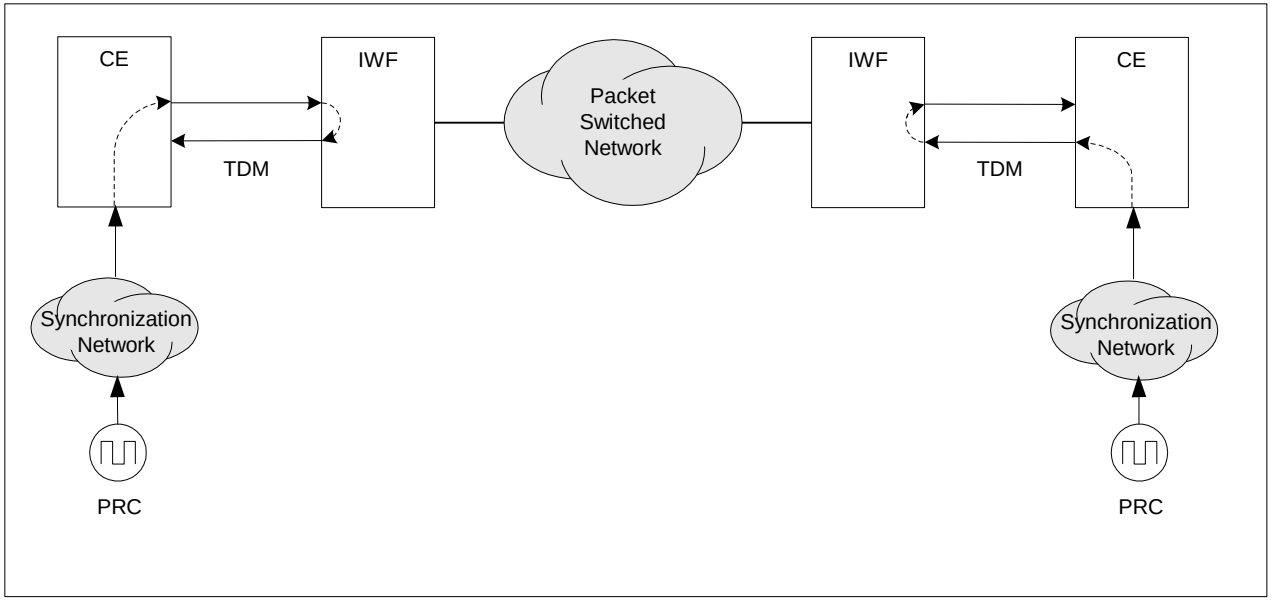
# TDM Timing Recovery options (1)



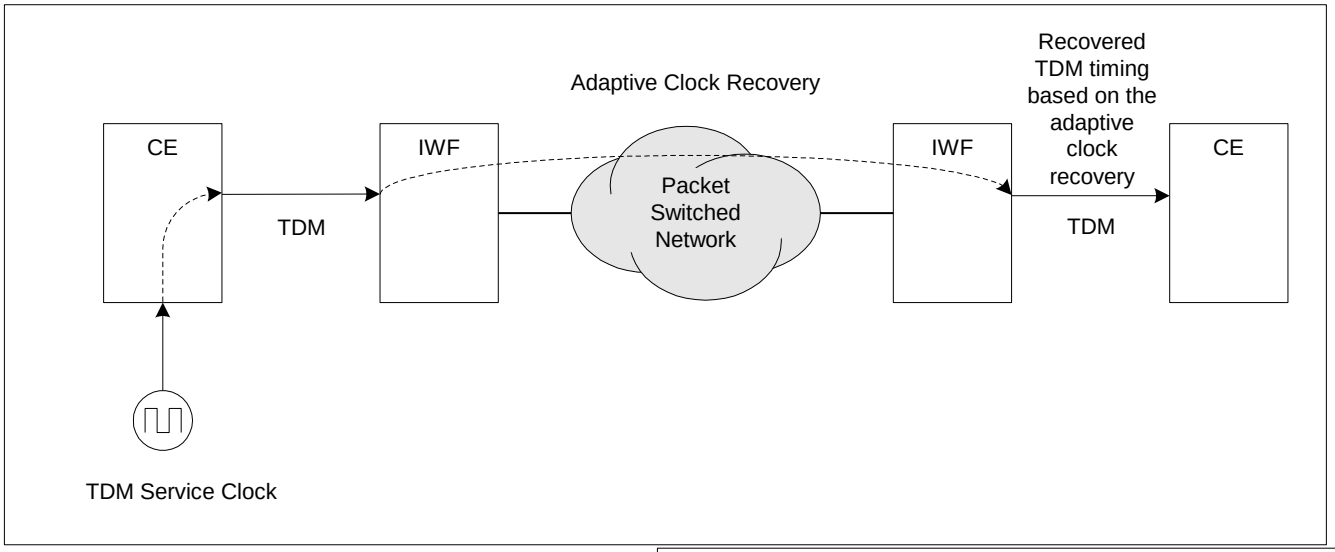

**Network Synchronous Operation**

The two PRCs may also originate from the same source.

**PRC signal available at the TDM end systems**

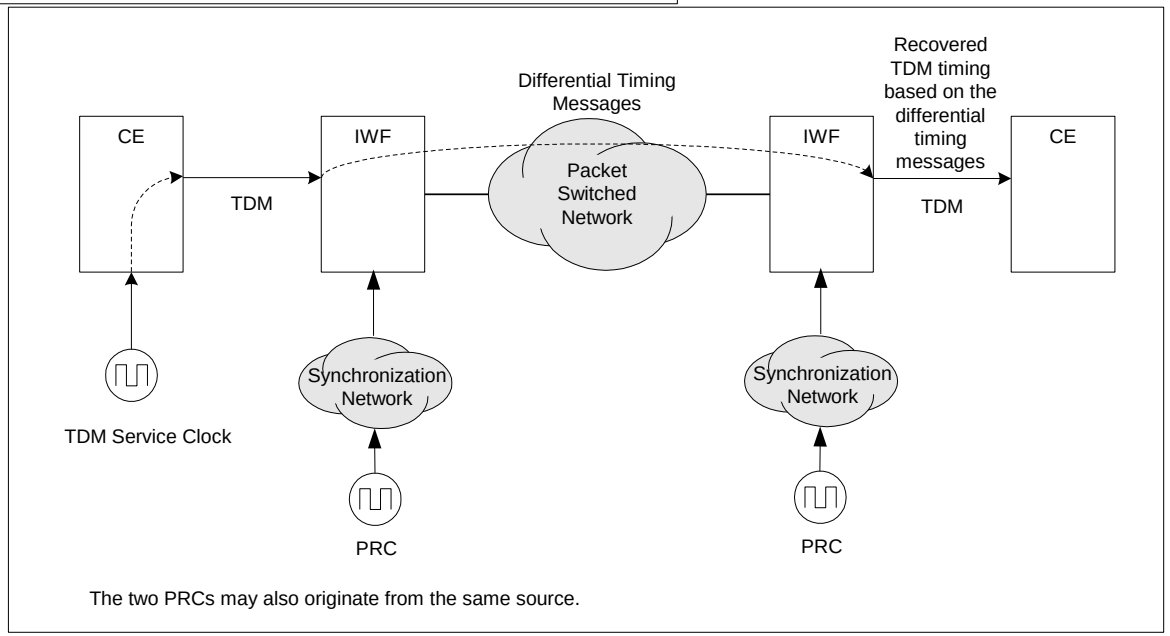


# TDM Timing Recovery options (2)

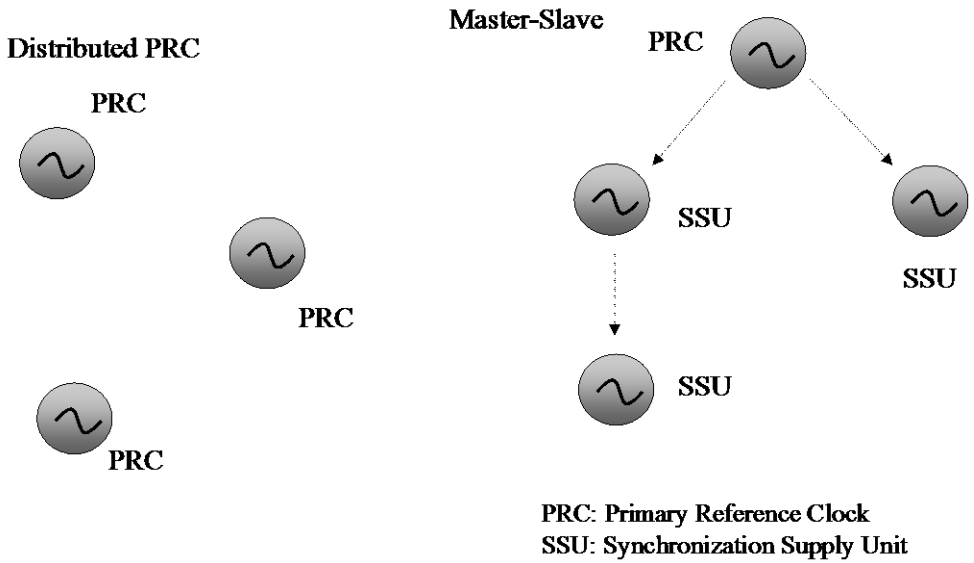



## Adaptive Methods

## Differential Methods

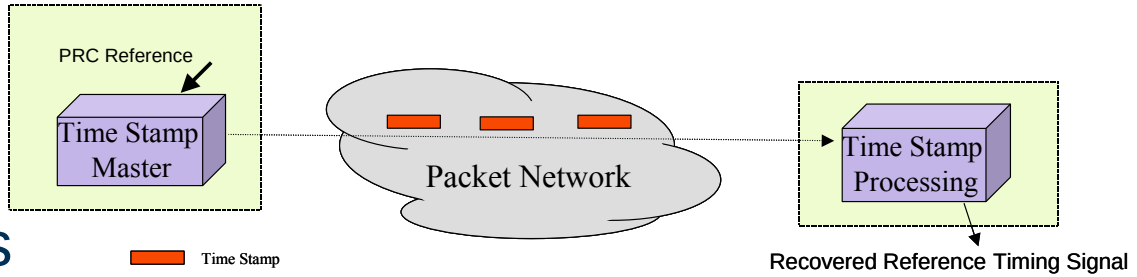


# Timing reference signal distribution options




The “traditional” solutions:
Distributed PRCs (e.g. GPS) or sync via synchronous physical layer (e.g. SDH)

The “new” solutions:
via dedicated sync packets



# Time Stamps, NTP and PTP

- Protocols to deliver Time Stamps over packet networks: NTP (RFC 1305) and PTP (IEEE1588)


- IEEE1588 standard is under development, targeting accurate time/phase distribution (proper network design is needed)

- NTP is an established protocol, traditionally used to distribute time. RFC 1305 provides descriptions of the algorithms to recover the “time” at the client side

- The long-term accuracy ($10^{-11}$) available at the NTP Time Servers can be used to distribute a frequency reference as well (e.g. towards RBS); proper filtering algorithm is needed on the client side

# (CES) Network Limits

Extract from the ITU-T G.823 ..

"… specifies relevant parameters and their limiting values that are able to satisfactorily control the amount of jitter and wander present at Network Node Interfaces (NNI) of Plesiochronous Digital Hierarchy (PDH) and synchronization networks .

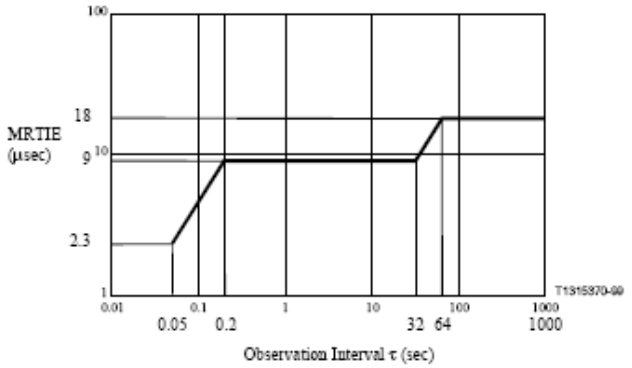
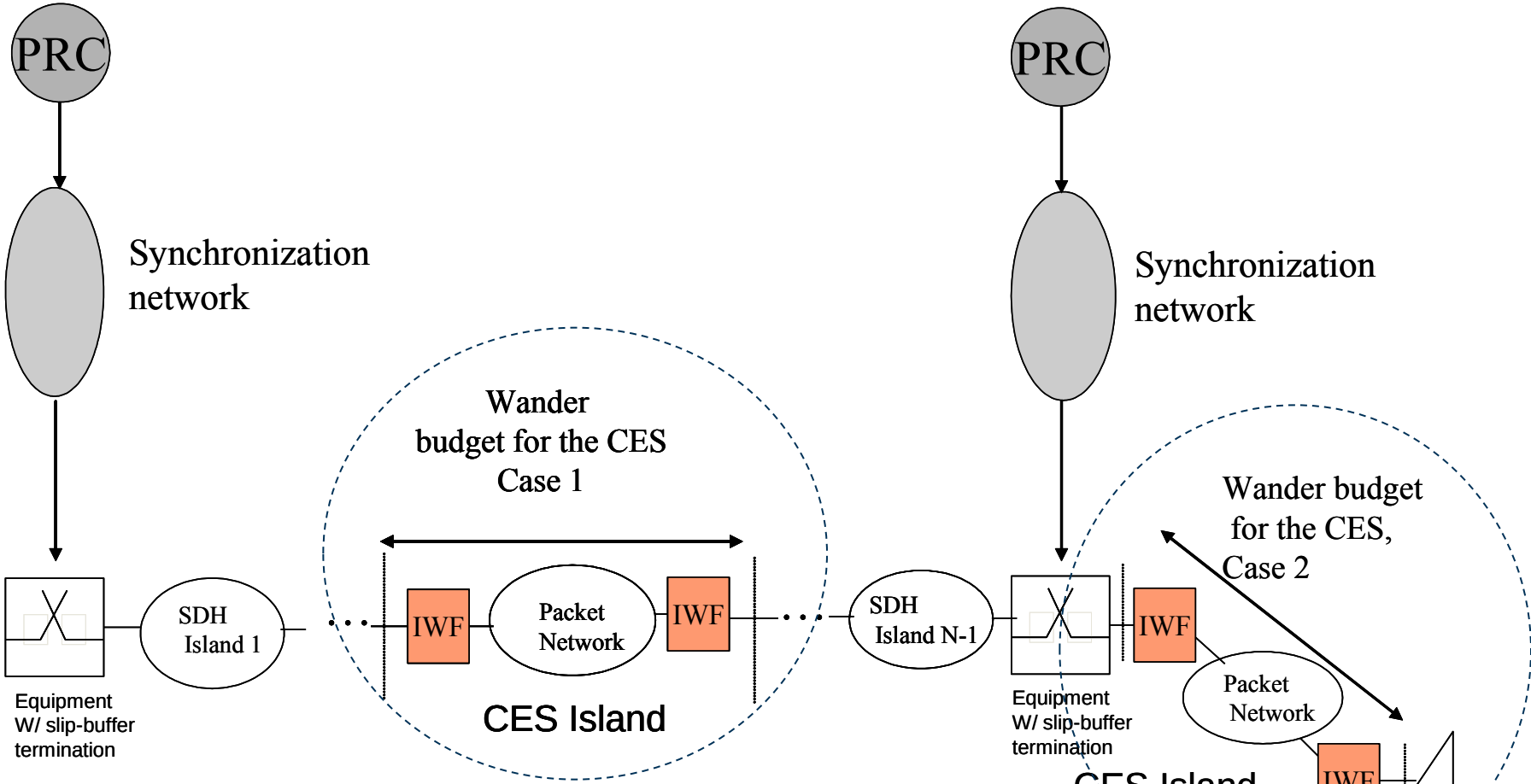



Figure 1/G.823 – 2048 kbit/s interface output wander limit

**The jitter and wander requirements specified in this ITU-T Recommendation are applicable to the interfaces irrespective of the underlying transport mechanism** (PDH, SDH or ATM networks, for example)."

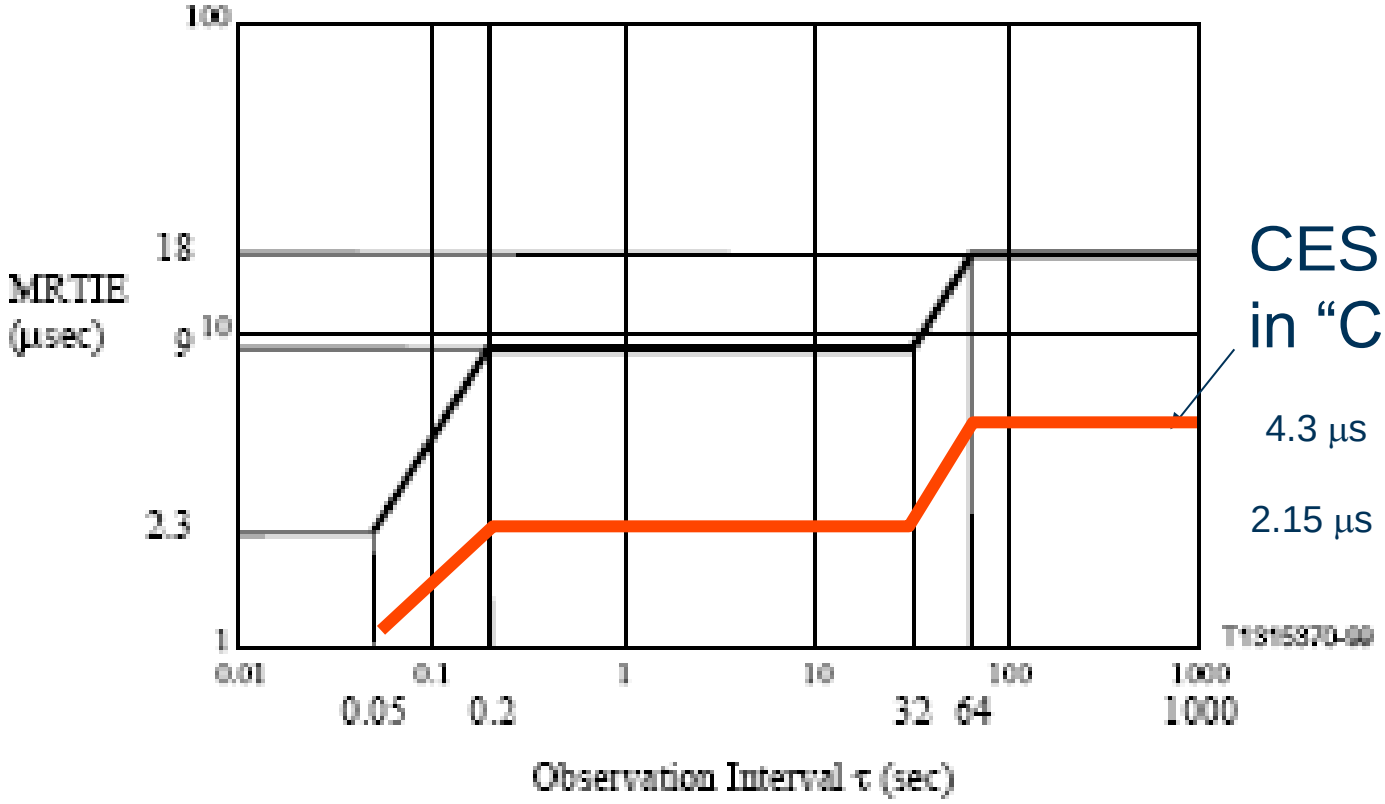
# Network Limits: CES is only part of a wider transport network




N = 4 for networks based on 2048 kbit/s hierarchy
N = 8 for networks based on 1544 kbit/s hierarchy

## Connecting end equipment

# Network Limits in Case 1 (2048 kbit/s)



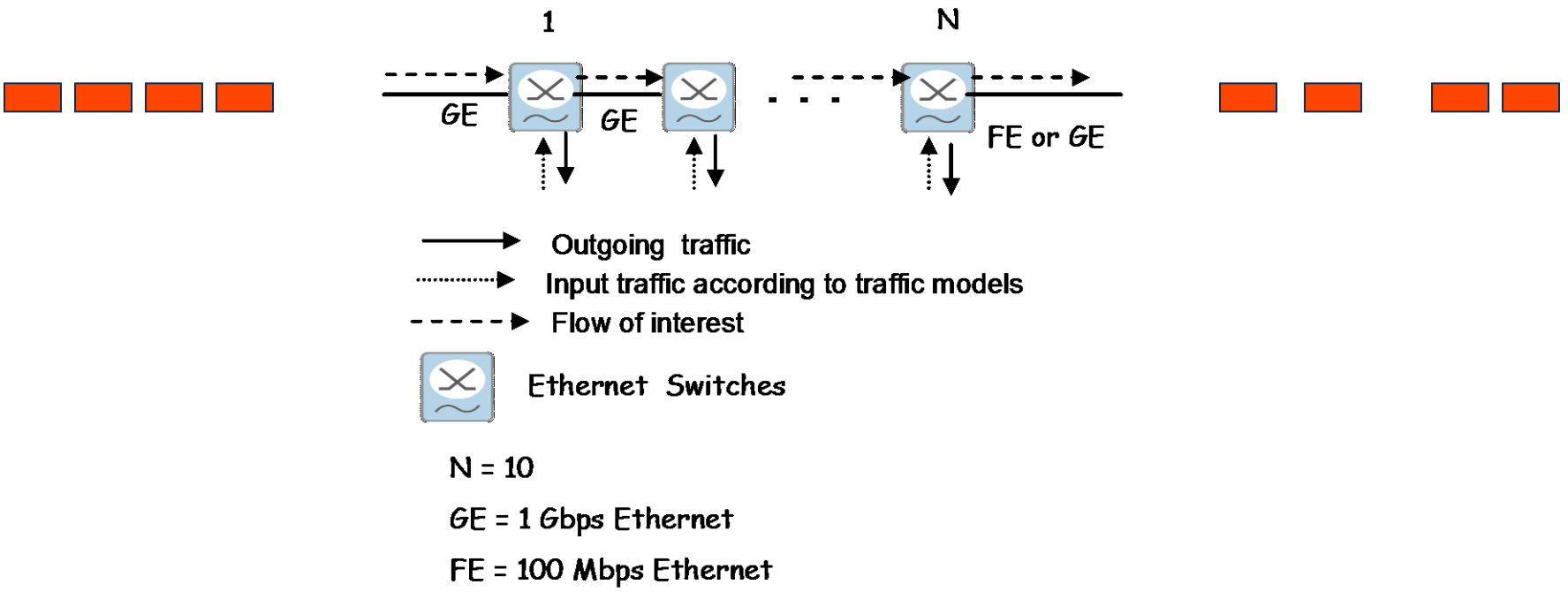

CES island budget in "Case 1" < G.823

4.3 µs

2.15 µs

**Figure 1/G.823 – 2048 kbit/s interface output wander limit**

# Network and Traffic Models



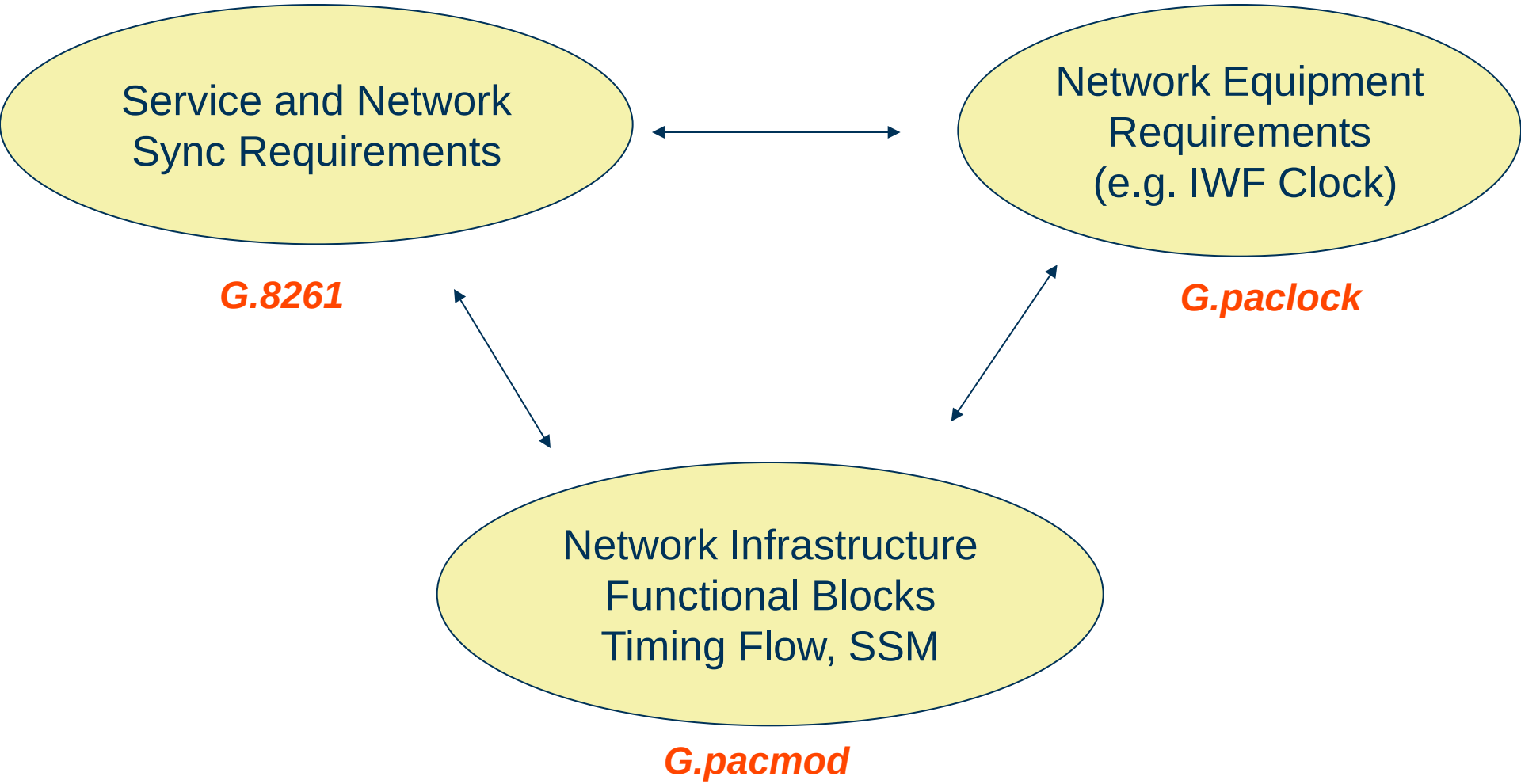

The “reference packet” is a packet with fixed length (e.g. 90 to 256 bytes) sent at typical packet rates, from 1 packets /s to 1000 packets/s)

# The G.8261 challenges

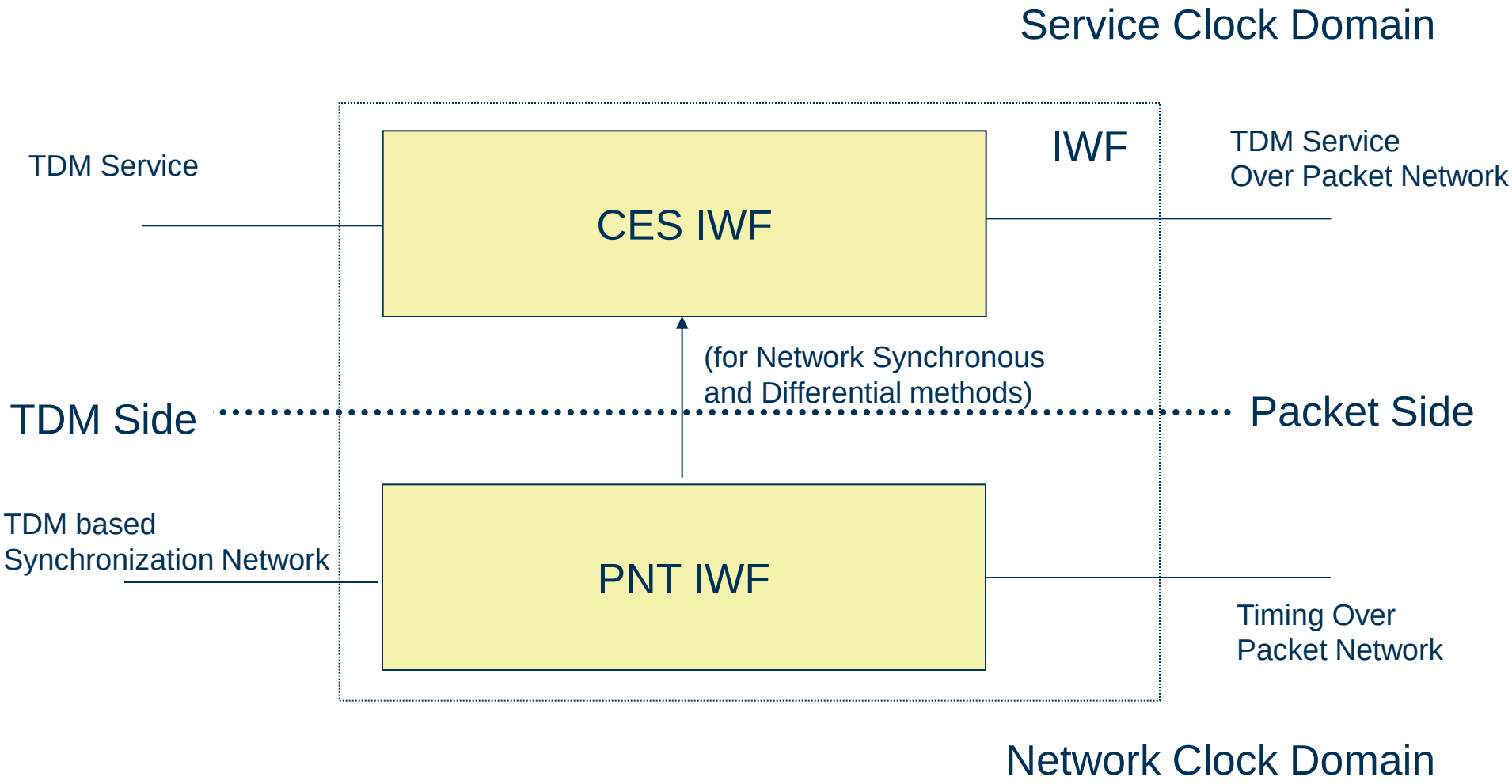
- How can a packet network be modelled: what are the typical network architectures, typical traffic characteristics (load, CBR vs VBR, etc.)
- How to “measure” if a specific packet network is suitable to carry synchronization (e.g. via adaptive methods)
- What shall be the max allowed wander generated in a CES* island
- Synchronous Ethernet PHY
- Two different aspects:
  - How to recover the timing of TDM services
  - How to distribute sync in packet network
- …

**segment of a network, based on packet switched technologies that emulates either the characteristics of a circuit switched network or of a PDH/SDH transport network, in order to carry TDM services (e.g., E1)*

# The new recommendations



# IWF Partitioning




PNT: Packet Network Timing
CES: Circuit emulation services

# Conclusions

- Synchronization is of vital importance to the deployment of Next Generation Networks: G.8261 is the first ITU-T recommendation for sync in packet networks
- The G.8261 provides the basic guidelines on how the synchronization can be distributed and how the TDM timing can be recovered over packet networks
- Some of the sync methodologies (e.g. adaptive methods), may not be suitable in any scenario (but this is also true for SDH networks…)
- G.8261 released this year is an important achievement but there is still a lot of work to be done: it will become the basis for the development of three further recommendations (enhanced G.8261-G.paclock-G.pacmod)
- G.8261 and IEEE1588 are not competing: IEEE 1588 as well as NTP can be valid methods supporting the G.8261

# THANK YOU

QUESTIONS ?