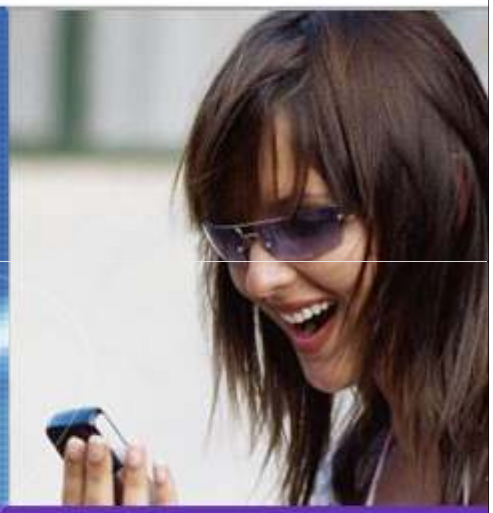
Synchronization standards in ITU-T



Jean-Loup Ferrant

November 4th, 2008

ITU-T SG15 Q13 (Q13 of Study Group 15 of ITU-T)

Q13 is responsible for:

- Network synchronization and time distribution performance

Question raised to Q13 for the 2004-2008 study period

- What network synchronization characteristics should be recommended for services carried over packet based networks?

1-Overview of available and future recommendations

2-Q13 worked on the following items

- **2.1-CES- TDM over PSN**
- **2.2-Synchronous Ethernet - Frequency over Ethernet PHY layer**
- **2.3-Use of time protocols over PSN for frequency distribution**
- **2.4-Characterization of PSN- metrics**

3-Q13 will continue for time and frequency distribution

1-Status of standards in ITU

	TDM	SyncE	CES
Definitions	G.810		
Architecture	G.803	G.8261	G.8261
Performance	G.823/4/5	G.8261	G.8261
Functional model	G.781/783	G.8264* G.781	G.8261
Clock specification	G.811/2/3	G.8262	G.8263
Test equipment	O.171/172		

***AAP closed October 28, Version focussing on SyncE**

1-Standards in progress in ITU-T

	SyncE	Packet based methods	
		Frequency	Frequency+time
Definitions	G.810	Extension of G.810?	
Architecture	G.8261	G.8261	G.pactiming-bis
Performance	G.8261	G.8261	G.pactiming-bis
Functional model	G.8264* G.781	G.8264	G.pacmod-bis
Clock specification	G.8262	G.8263	G.8263?
Test equipment	Under analysis in Q5/4		

Item under study

2.1-CES

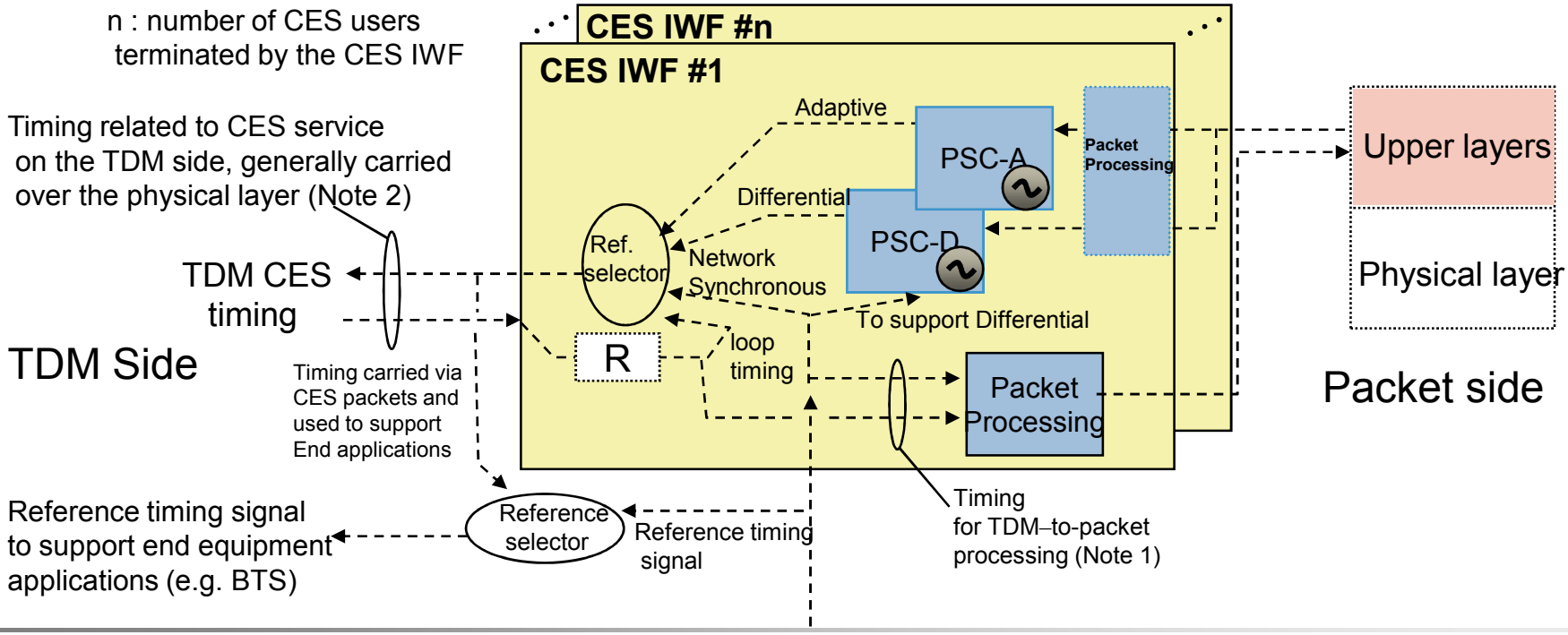
Different methods: adaptive, differential, network synchronous

Deployment cases and associated wander budget

Modelization

PSC Packet-based Service Clock to be defined in G.8263

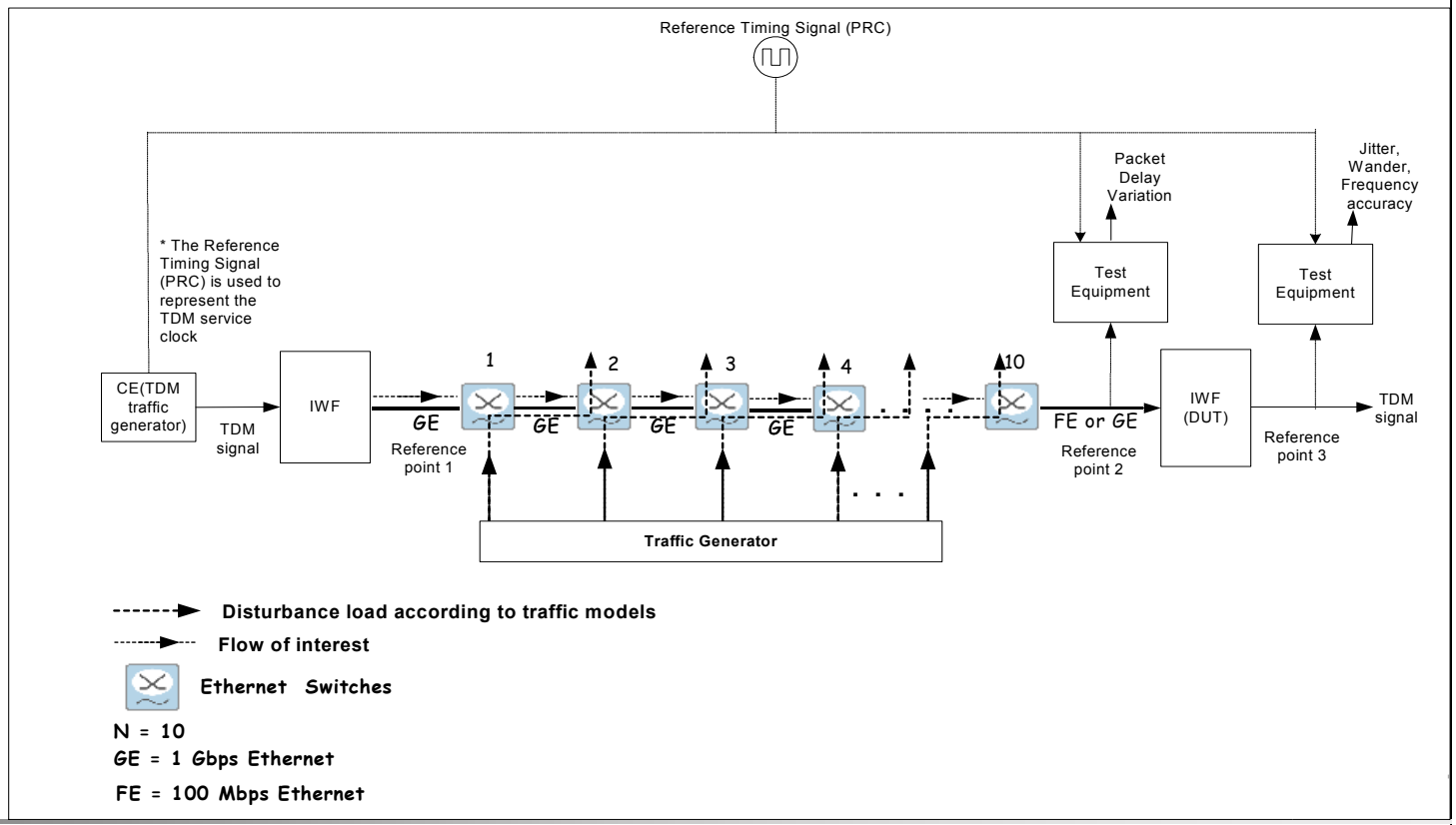
- A-adaptive, D differential



2.1-CES-Characterization

Benchmark PDV effect –Appendix VI test cases

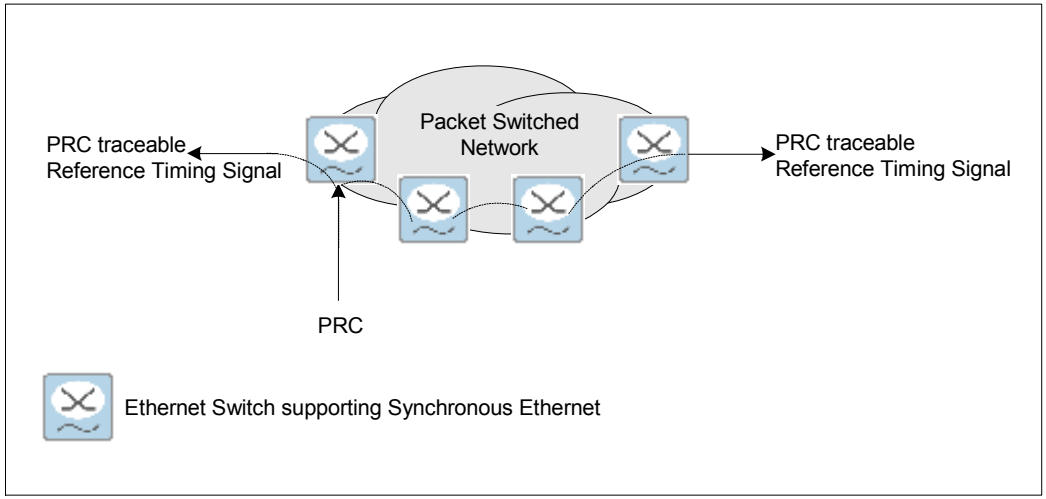
- Static payload
- Sudden large and persistent payload changes
- slow payload changes
- Beating effect
- Congestion
- etc



2.2-Synchronous Ethernet (1)

Principle

- Transport a reference frequency in the Eth Physical Layer, not impacted by PDV
- Reuse SDH principles to allow Synchronous Ethernet to interwork with SDH synchronization network
- Ensure interworking with « legacy » Ethernet equipments
- For Eth interfaces where a clock can be continuously recovered from the Eth data



2.2- Synchronous Ethernet (2)

G.8261

- Architecture annex A
- EEC clock (synchronous Ethernet Equipment Clock)
- Network limits, copied from SDH
- Measurements issues appendix X

G.8262

- This is a « replica » of G.813 option1 for EEC option1 and G.812 type IV for EEC option2
- 2 options, ETSI for compliance with G.813 opt.1 and US for compliance with G.812 typeIV
- Same clock parameters as for G.813

  Frequency accuracy,noise generation , transfer and tolerance,Transients and holdover
- Full compatibility with the G.803 SDH reference chain
- Mix of SEC and EEC can be done in the G.803 SDH reference chain
- Specifies Synchronous Ethernet , STM-N and PDH as interfaces for EEC

2.2- Synchronous Ethernet (3)

G.8264

Frequency transfer using Synchronous Ethernet (section 10)

- General information
- Operation modes: synchronous and non-synchronous

SSM for Synchronous Ethernet (section 11)

- Definition of the ESMC: Ethernet Synchronization Messaging Channel

  SSM for Ethernet implements a channel using 802.3 Organization Specific Slow Protocol

  Event messages and heartbeat defined to meet performance requirement for reference switching in G.781

  ESMC PDU format allowing a data field from25 to 1490 bytes

  Quality Level data is mapped into a TLV format

  Future information might be mapped according TLV format

2.2- Synchronous Ethernet (4)

G.781 (Q9/15)

- Fig 17/G.781 Synchronization layer atomic function has been updated
- ETH/SD functions has been added
- ETY/LC function has been added

G.8021 (Q9/15)

To be aligned with the revision of G.781: expected in December 2008

2.2- Synchronous Ethernet (5) – G.781 update

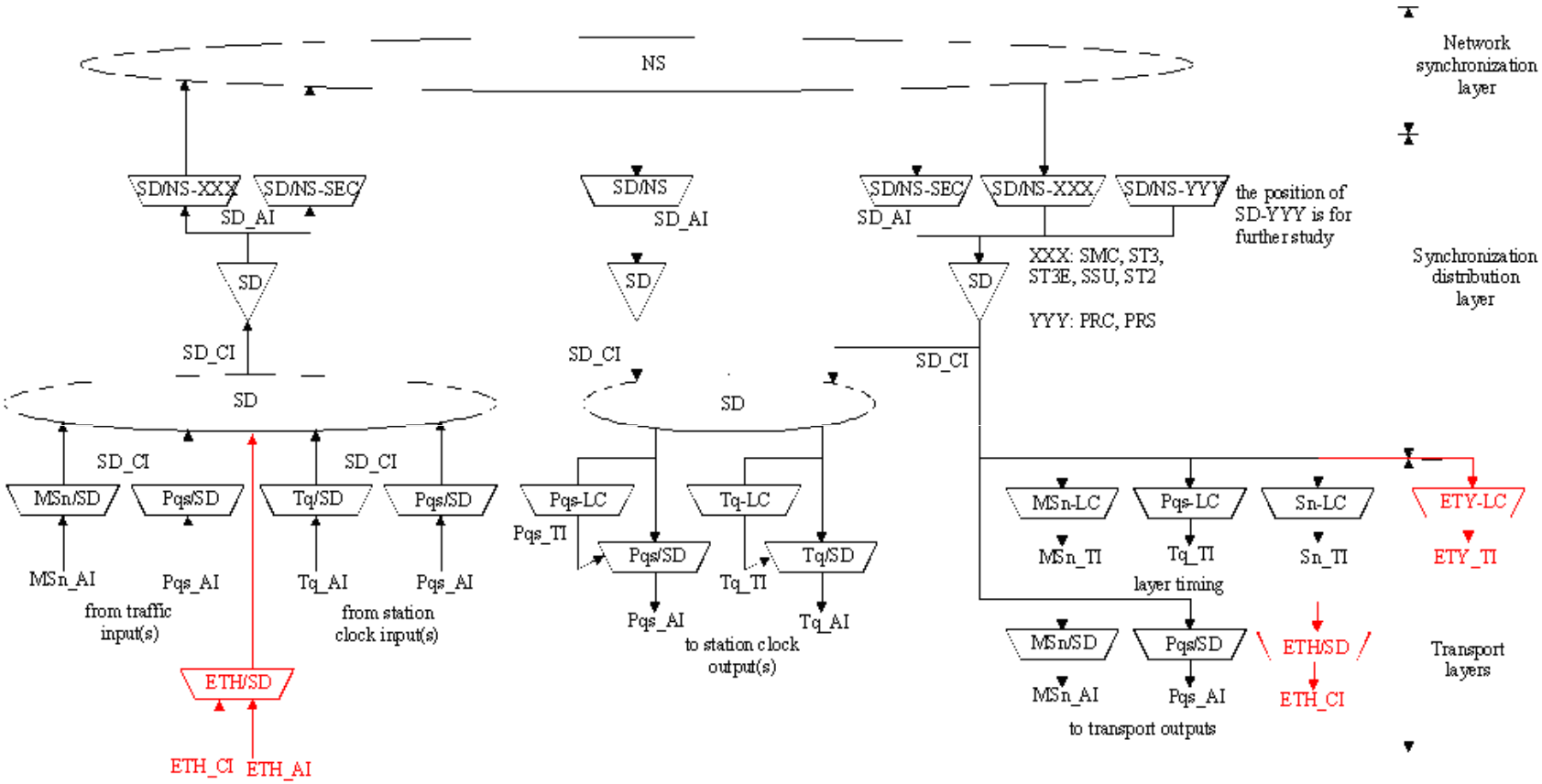


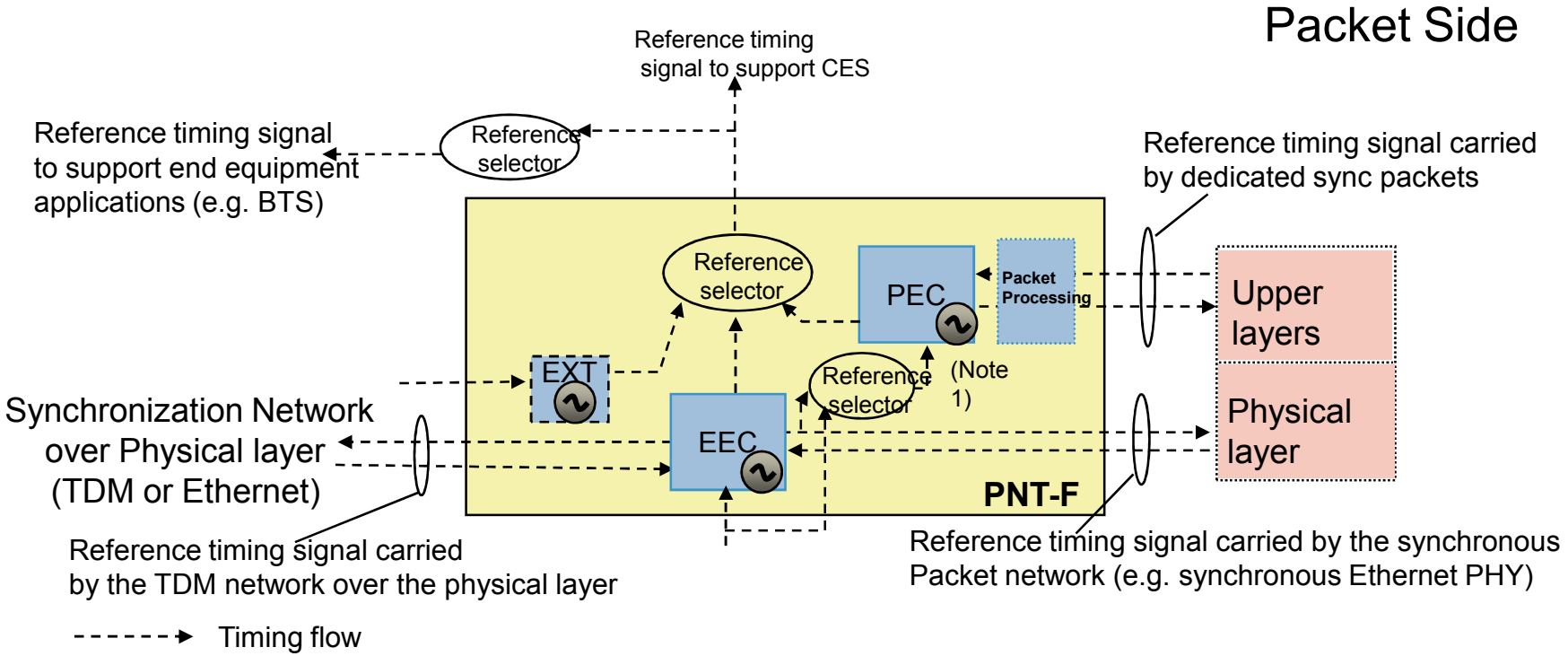
Figure 17/G.781 – Synchronization Distribution and Network Synchronization layer atomic functions

2.3- Transport of frequency through PSN – PEC (Packet-based Equipment Clock)

PEC recovers the timing transported by a time protocol through PSN

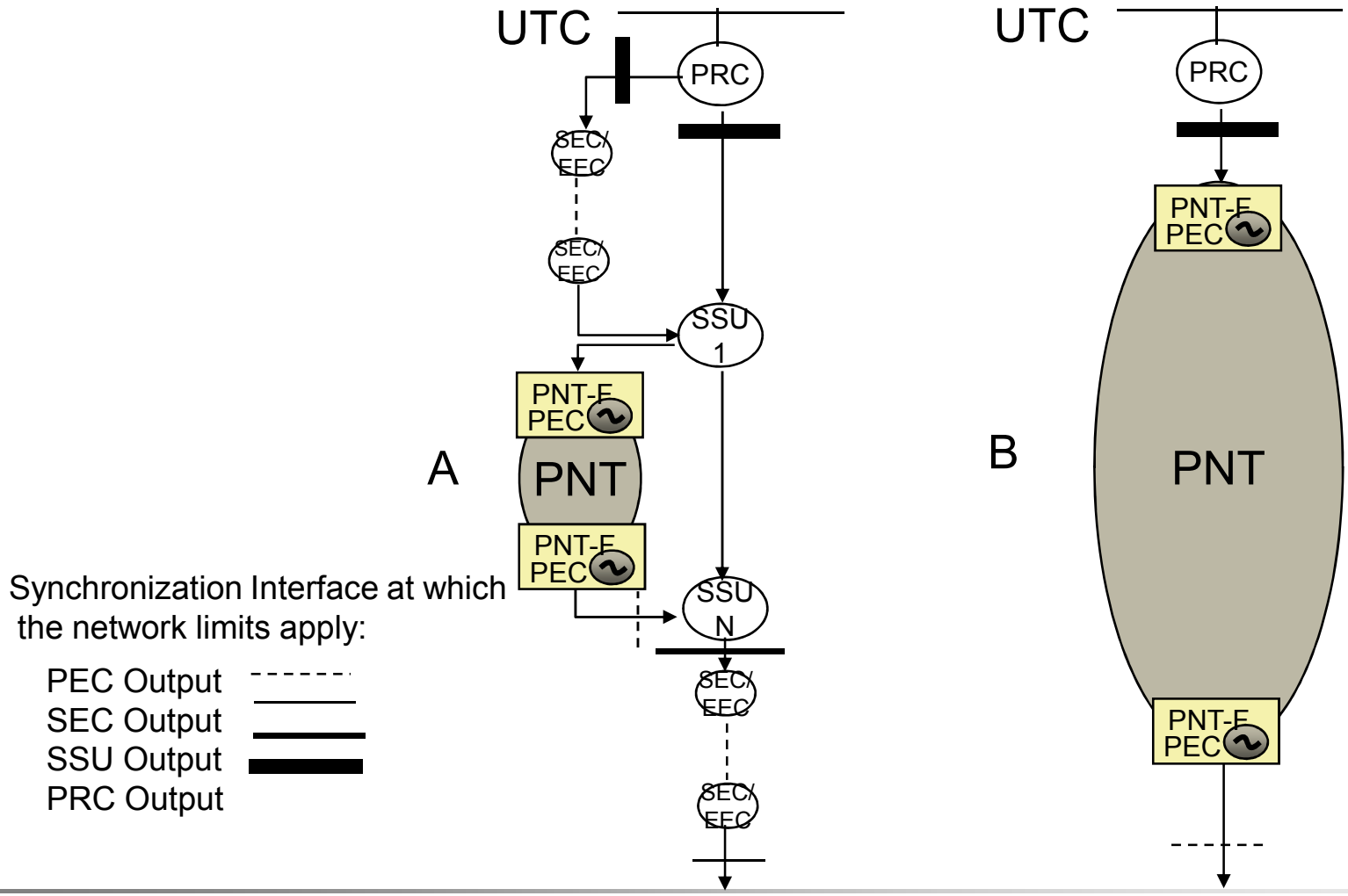
E.g. it may recover a frequency from a 1588 message flow

It will be specified in G.8263



2.3- Transport of frequency through PSN - Network limits

Network limits defined similarly to the G.803 sync reference chain



2.3- Transport of frequency through PSN – 1588V2 telecom profile

Q13 agreed to define a **first** telecom profile for the transport of frequency only in an end–to-end case, where intermediate nodes do not process 1588V2 messages.

The profile will address independantly protocol and performances

The choices to be done in December 2008 to complete the protocol are:

- Unicast vs multicast
  - unicast already agreed for delay request and delay response messages
- One way vs two way mode
- One step vs two step clocks: need for a follow up message
- Best Master Clock algorithm

Architectural aspect of time protocol will be studied

NTP is also under consideration in Q13 for frequency delivery

2.4- Transport of frequency through PSN - metrics

Metrics characterize the effect of PDV on packets

Min TDEV

- Similar to TDEV, but the mean of the sample window is replaced by the minimum of the sample window
- Useful when a set of packets present a PDV close to a minimum delay
- Need to be used in addition to other metric, such as TDEV
- Other TDEV based metrics are under study

xxTIE

- based on TIE is still under definition

2.5- Work for the next study period 2008-2012

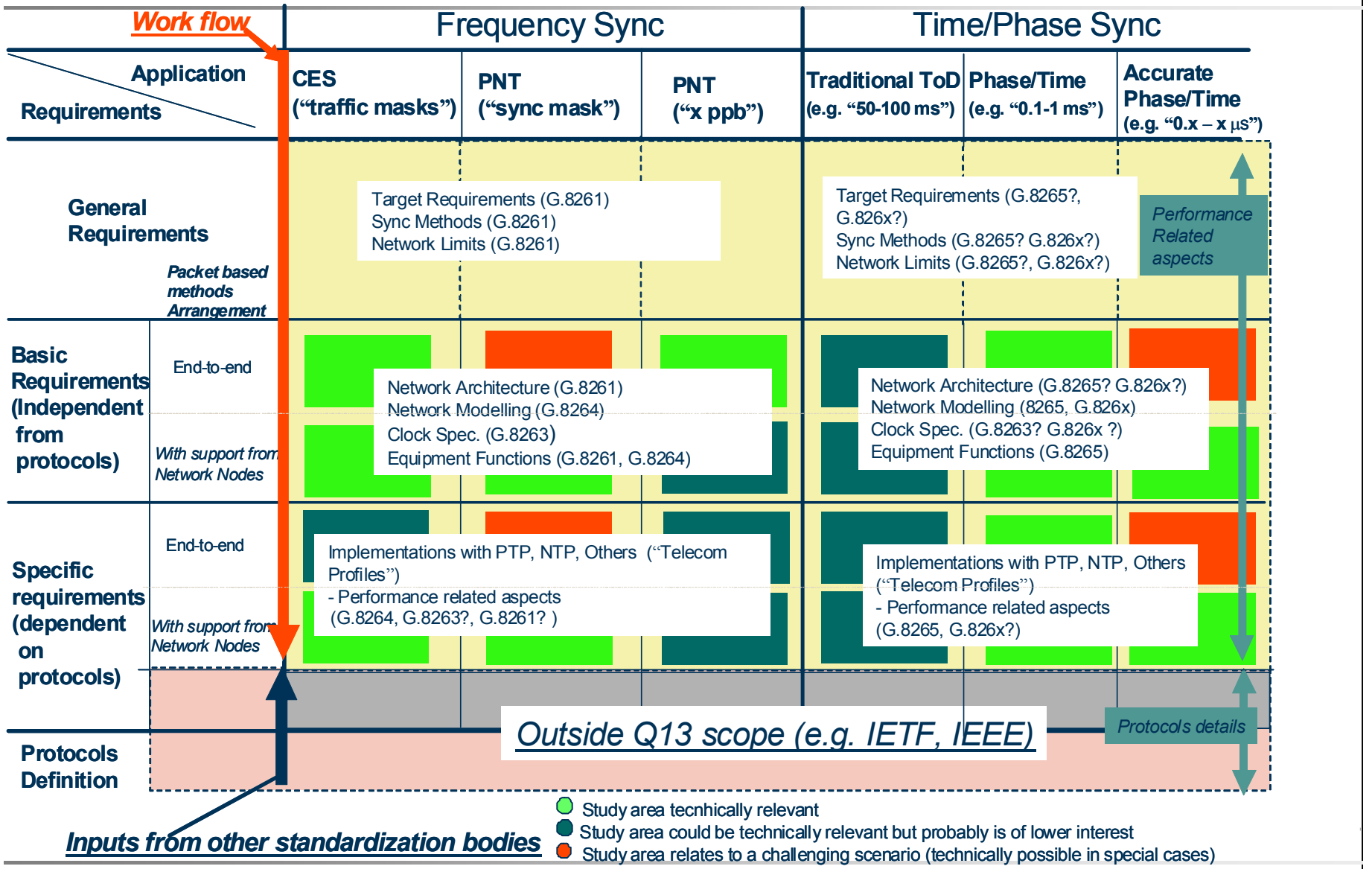
Transport of time through packet networks

- Ensure cooperation with IETF tictoc group
- Architectural aspects of
- Based on IEEE 1588V2 ,definition of profiles for the transport of time and frequency
- NTP has also been mentioned as a candidate protocol
- Several classes of performances will be specified

- SSM will be extended with new TLV
- Metric definition will continue

2.5- General work flow of Q13

(Presented in May 2008 by the G.8261 editor, Stefano Ruffini- Ericsson)



Alcatel·Lucent

Thank you

This logo is inserted when a figure is copied from an ITU-T recommendation

List of ITU-T main recommendations related to synchronization

G.803 (2000), ***Architecture of transport networks based on the synchronous digital hierarchy (SDH)***

G.810 (1996), ***Definitions and terminology for synchronization networks***

G.811 (1997), ***Timing requirements of primary reference clocks***

G.812 (2004), ***Timing requirements of slave clocks suitable for use as node clocks in synchronization networks***

G.813 (2003), ***Timing requirements of SDH equipment slave clocks (SEC)***

G.822 (1988), ***Controlled slip rate objectives on an international digital connection***

G.823 (2000), The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy

G.824 (2000), The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy

G.825 (2000), The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)

G.781 (1999), Synchronization layer functions

G.826G.8261 (2008), Timing and Synchronization aspects in Packet Networks

G.8262 (2007), Timing characteristics of synchronous Ethernet Equipment slave clock (EEC)

G.8264 (2008), Distribution of timing through packet networks