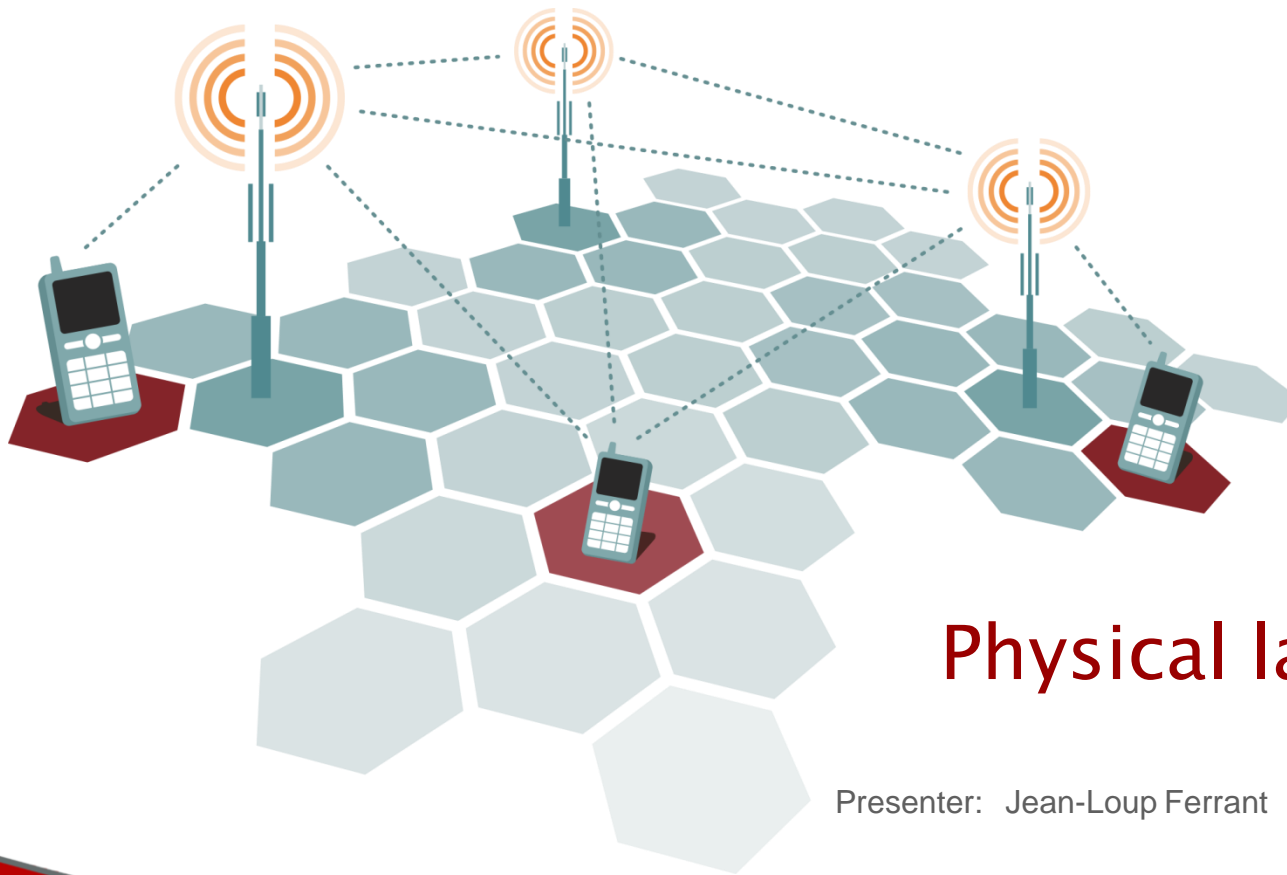




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Physical layer– SyncE

Presenter: Jean-Loup Ferrant Sponsored by Calnex Solutions



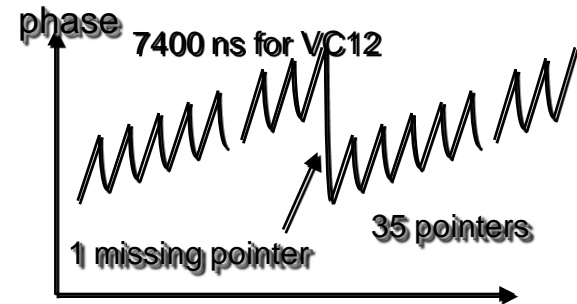
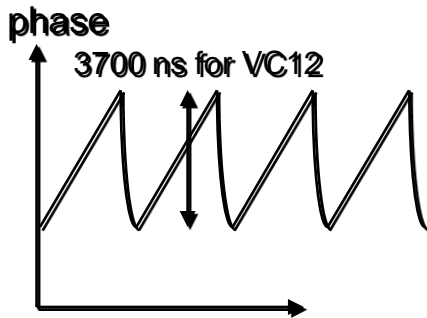
Physical layer

- It is possible to use the physical layer of a signal to transport a frequency reference.
- This has been used at the beginning of digital networks with 2 Mbit/s lines carrying a 2048 kHz reference.
- But when the 2 Mbit/s was multiplexed into a higher PDH rate such as 34 or 140 Mbit/s, the 2 Mbit/s is not anymore transported by the physical layer
 - it passes through buffers that are not timing transparent
 - But the PDH hierarchy was designed so that the timing remain acceptable



Physical layer vs SDH mapping

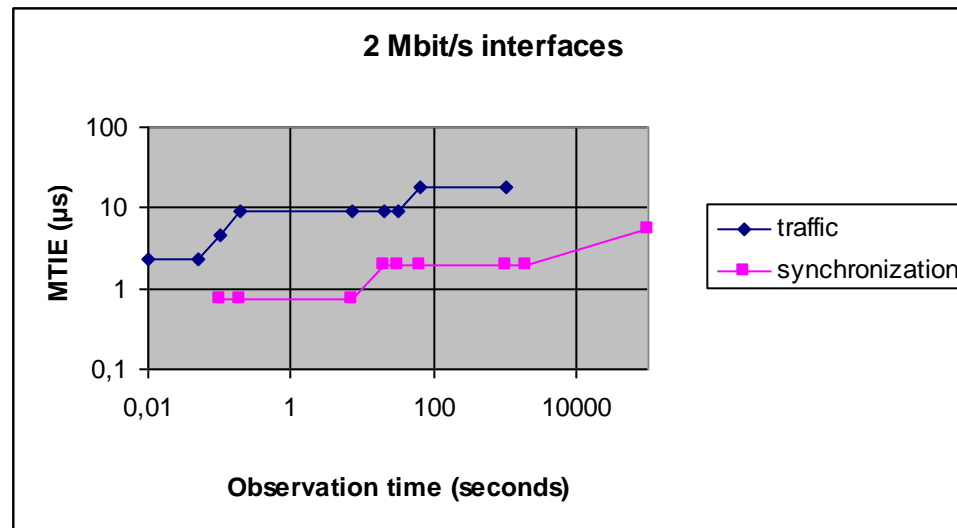
- In SDH, the mapping of a 2 Mbit/s could result in a severe corruption of timing due to VC12 pointers





Performance of the physical layer

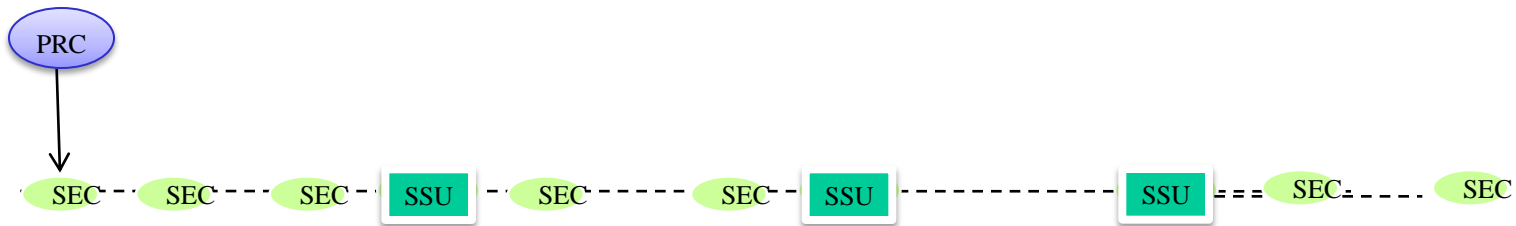
- When transported via a physical layer, the 2 Mbit/s can meet the template of a synchronization interface
- When it is mapped into a VC12, the output quality only meets the traffic interface template





SDH, « the physical layer »

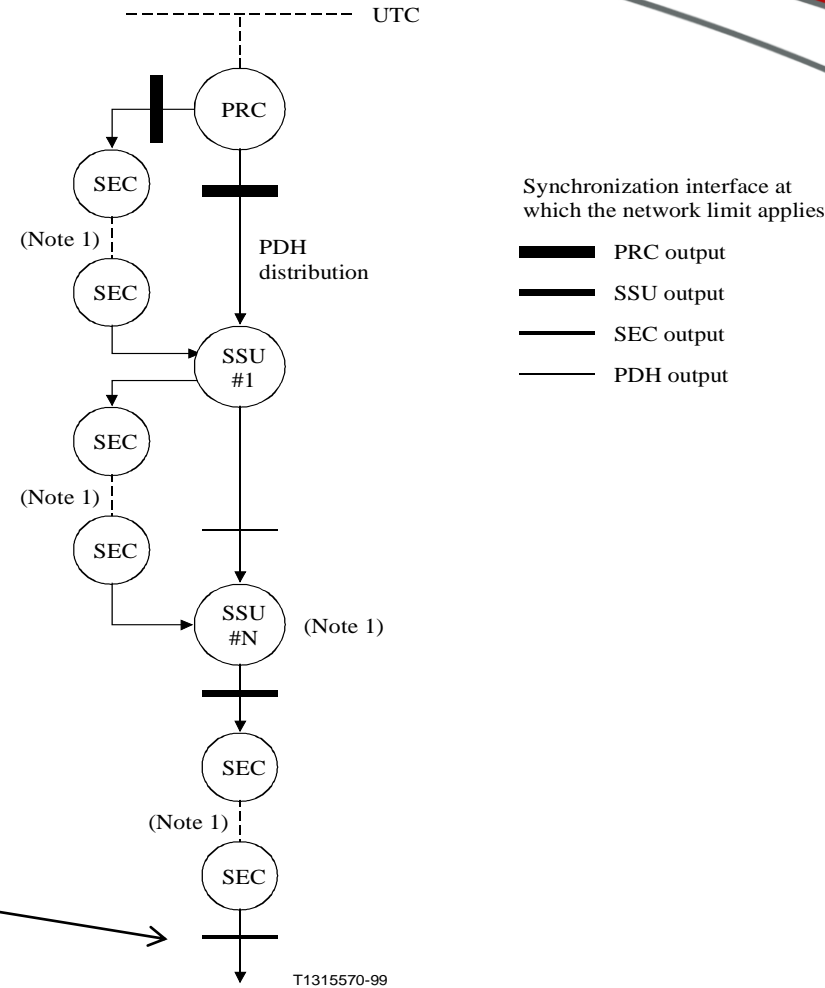
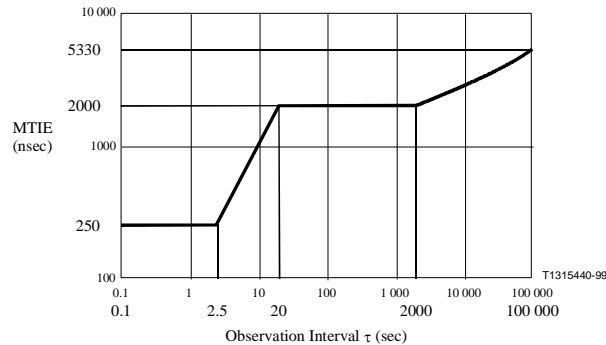
- The synchronization reference chain of SDH (G.803) specifies the maximum size of a SDH network able to transport a frequency reference over the SDH physical layer over 10 SSUs, 60 SECs and thousands of kms.
 - 2 MHz or 2 Mbit/s between PRC and SEC
 - Reference frequency carried by $n \times 155.52$ Mbit/s STM-n signal
 - The output timing meets the synchronization interface template





Clock hierarchy

- A clock hierarchy has been defined
 - PRC, SSU, SEC, (regenerator)
- The SSM has been defined for traceability
- The specification of this hierarchy required almost a decade



NOTE 1 – The maximum numbers of SSU and SEC clocks in these chains is defined in ITU-T Recommendation G.803.

NOTE 2 – PRC function is defined in ITU-T Recommendation G.811.

NOTE 3 – SSU function is defined in ITU-T Recommendation G.812 (Type 1)

NOTE 4 – SEC function is defined in ITU-T Recommendation G.813 (Option 1)



Other types of physical layer

- Ethernet
 - 10 G WAN bit to bit identical to STM-64
 - Non synchronous, each switch generates the output Eth signals with its own free running oscillator
- OTN
 - Another non synchronous hierachy with a free running oscillator per NE



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Synchronous Ethernet

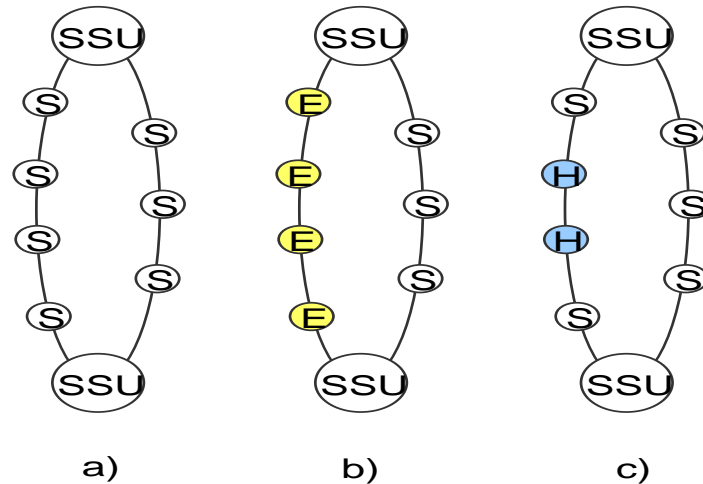
- It has been proposed in September 2004 to use the physical layer to transport a frequency reference in order to
 - Provide G.811 traceability to applications
 - Provide a timing quality independent of traffic payload
- It was decided to align SyncE on SDH
- to avoid defining a new synchronous hierarchy
- To allow mix of SDH and SyncE NEs in the G.803 reference chain
- In February 2008, the 3 recommendations defining Synchronous Ethernet were consented by ITU SG15
 - G.8261 for architecture and network limits
 - G.8262 for the definition of the clock
 - G.8264 for the definition of the SSM



Architecture of Synchronous ethernet

- In order to provide interworking between SyncE and SDH
 - A chain of 20 SDH NEs must be replaceable by 20 SyncE NEs
 - A chain of 20 NEs can mix SDH and SYNC E NEs
 - An NE can be equipped with both SDH and SyncE ports

- S:SDH
- E:Eth
- H:hybrid





SyncE requirements

- The SyncE NE
 - must have a clock compatible with SDH/SONET
 - Recovers timing from a synchronous Ethernet signal, with an SSM
 - Must be able to recover the data from an Ethernet signal
 - Must be able to provide traceability via SSM



SyncE clock: G.8262

- Compliance with SDH implies that SyncE clocks are based on G.813
 - Jitter is related with clock recovery
 - It is a port function, to recover clock and data
 - Wander is related with noise accumulation on a chain of clocks.
 - It is a clock function
 - Frequency pull-in –range
 - Must be 100 ppm on the port so that data of legacy Eth can be processed
 - Must be 4.6 ppm at clock input to comply with SDH clocks

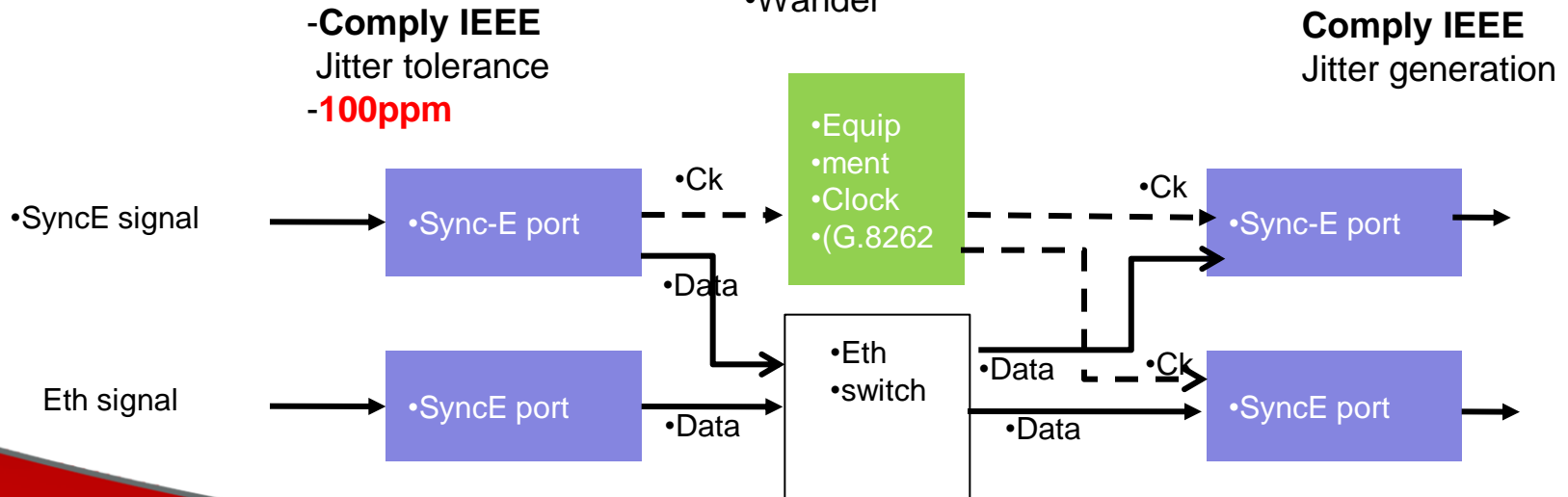


Compliance with IEEE and SDH

- SyncE ports must recover synchronous and non synchronous Eth signals
- SyncE signals are characterized by a SSM

- **Comply with G.813**

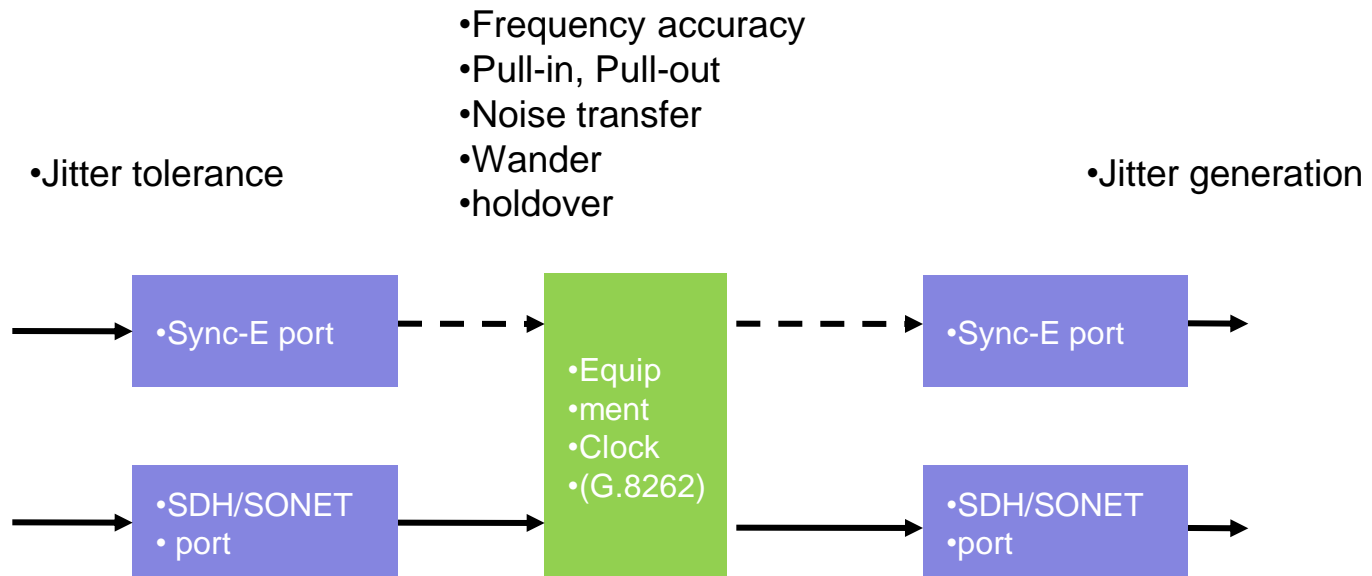
- Frequency accuracy
- Pull-in, Pull-out, **4.6ppm**
- Noise transfer
- holdover
- Wander





Hybrid network

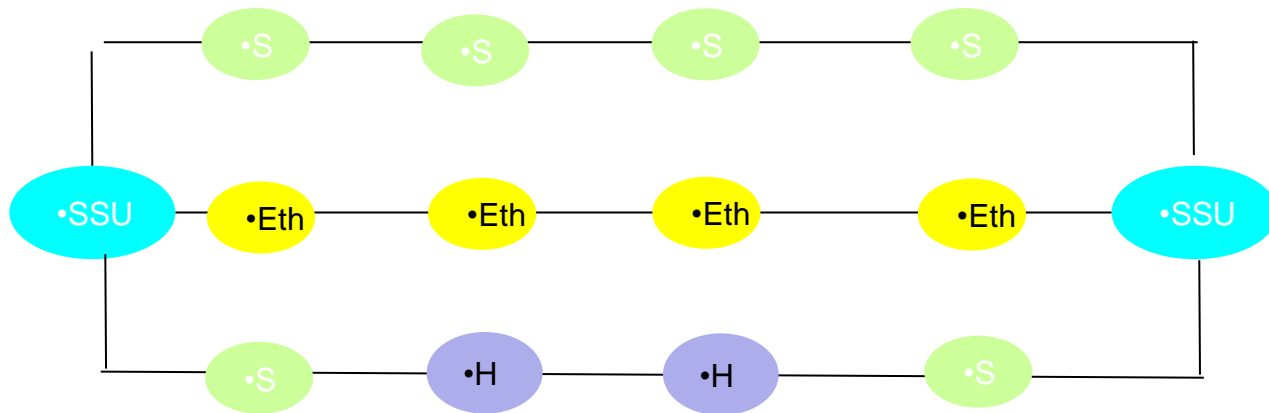
- Has both SyncE and SDH ports





Need for a SSM in SyncE equipments

- SSM is needed on all kinds of chains, SDH, SyncE and hybrid
 - to provide automatic protection of a chain of NE
 - To avoid timing loops





SSM in SyncE

- Synchronous Ethernet must meet all SSM delays of SDH
 - since these values depend on network limits and G.813
 - Since the timing performance are required to be similar to SDH
- Transport of SSM messages has been defined by a cooperation between IEEE and ITU SG15
 - IEEE proposed to use an Organization Specific slow Protocol as defined in G.802.3ay
- ITU-T Q13/15 has defined a new SSM protocol
 - that requires less than 10 messages per second per OAM application
 - that does not require large calculation time from the equipment
 - that meets the G.781 timing requirements



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SSM transport

- The SSM is transported in the ESMC Ethernet Synchronization Messaging Channel
- Two types of messages are transmitted
 - An event message sent immediately in case of SSM change
 - A heartbeat message
 - Sent at a rate of about 1 Hz
 - No message for 5 seconds means ESMC failure
- Quality Level data is mapped into a TLV format
- Future information might be mapped according TLV format



Conclusion

- Synchronous Ethernet provides the same quality transport of timing as SDH.
- Synchronous Ethernet does not provide transport of time, although it has been agreed that the use of ESMC might allow it.



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Calnex Paragon Sync

