Architecture for the transfer of timing

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Outline and Intent

Architecture for the transfer of timing:

- Background
  - What is it/Why is it important
- NGN synchronization
  - Evolution of the current synchronization network
- ITU-T Recommendations under development
  - Overview and relationship with other recommendations under development within Q13
  - Some key points of G.8264, G.8265 and G.8275.

Intent:

- Provide background to understand the development of architecture in standards and how it relates to equipment and network design

Architecture: what is it

Architecture*:

- 1. the art or practice of designing and constructing buildings: *schools of architecture and design*
  - the style in which a building is designed and constructed, especially with regard to a specific period, place, or culture: *Georgian architecture*
- 2. the complex or carefully designed structure of something: *the chemical architecture of the human brain*
  - the conceptual structure and logical organization of a computer or computer-based system.

Applying the above to the architecture for the transfer of time:

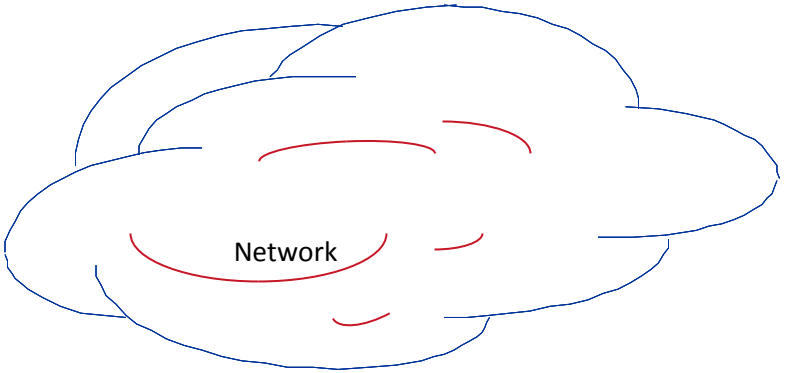
- The structure and organization of components necessary for the transfer of timing (frequency, phase and time)

* Oxford: http://oxforddictionaries.com/definition/english/architecture?q=architecture

Why specify/study?

Telecom networks:

- Interconnection of devices to allow the transport of information in a geographically disperse environment
- Telecom network complexity has increased
  - Voice>switched voice > digital voice > data
  - Connections > connectionless
- Complexity is often hidden. (is it a “cloud” or is it “fog”?)



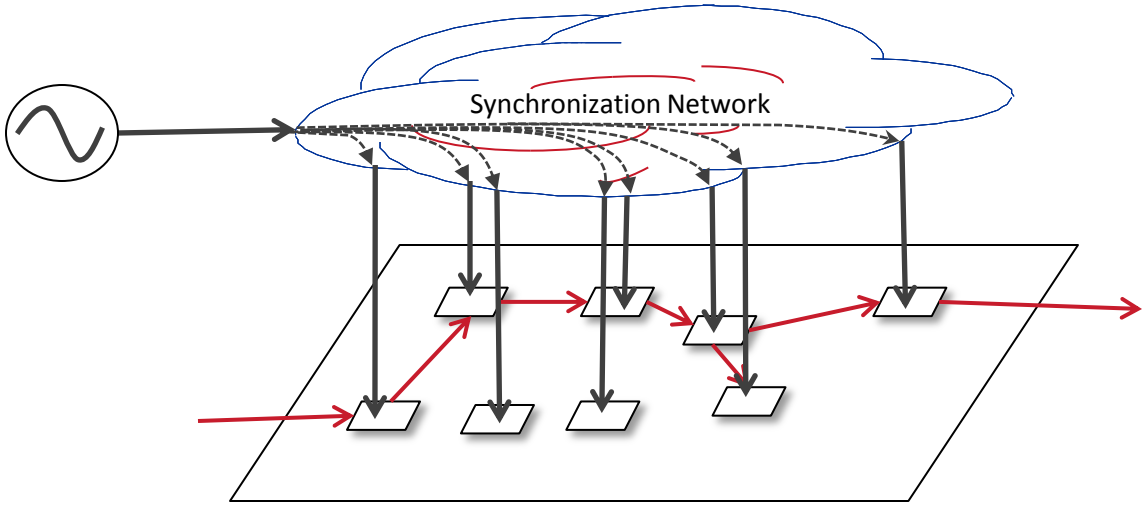
Synchronization network architecture

Synchronization is needed to support some services

- PDH voice, SDH transport, Wireless base-station timing

Synchronization "network" is needed to transfer the appropriate supporting information:

- Frequency (historically)
- Phase/time



Why specify?

The synchronization network is distributed

- Network is composed of various clocks
  - PRC/PRS, SSU SEC
- Impairments accumulate: Network planning required
  - Limit and optimize distribution of a clock chain
  - Hierarchical distribution to control performance
- High level concepts need to be described (“the architecture”)
  - Provide guidance on deployment
  - Provide guidance on specification of Individual components and functionality
- Example ITU-T recommendations for legacy synchronization network
  - Architecture: G.803
  - Clocks: G.811, G.812, G.813
  - Detail: G.781

NGN synchronization architecture

Synchronization requirements have been changing

- Focus is away from needs of the service to needs of the infrastructure
- New technologies and services are being defined
- Multi-carrier topologies

Existing synchronization network needs to evolve

- The current synchronization network is not disposable

New technologies are being developed

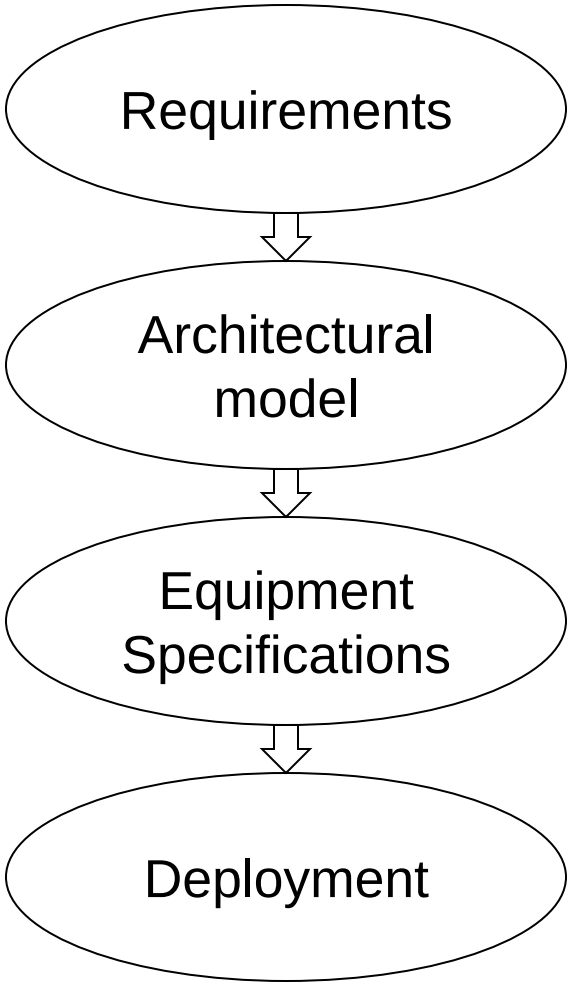
- Synchronous Ethernet
- Circuit Emulation
- IEEE1588

How to fit the pieces together?

Architecture development

Process

- List/validate requirements
  - What is intended
- Develop a high level picture
- Refine to add detail
- Validate requirements again
  - Can it be done?
  - What restrictions
- Start to specify the individual components

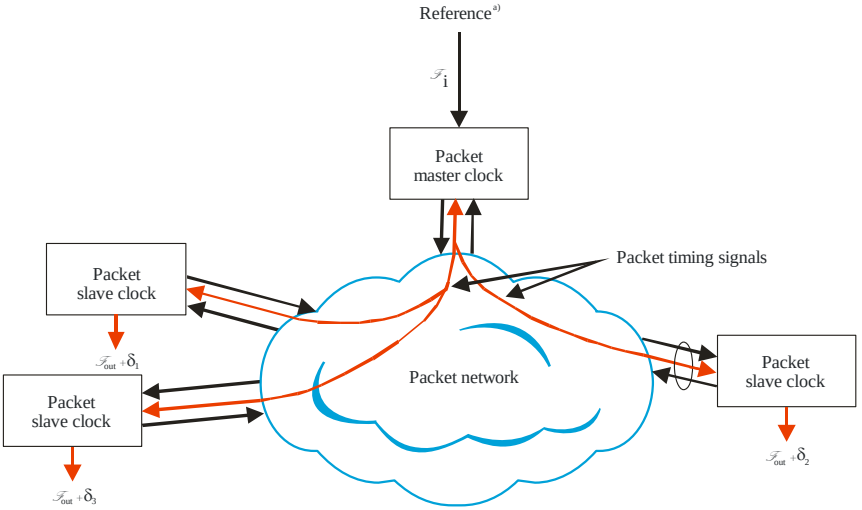


What does the architecture look like?

Specification of "architecture" needs to be precise yet flexible

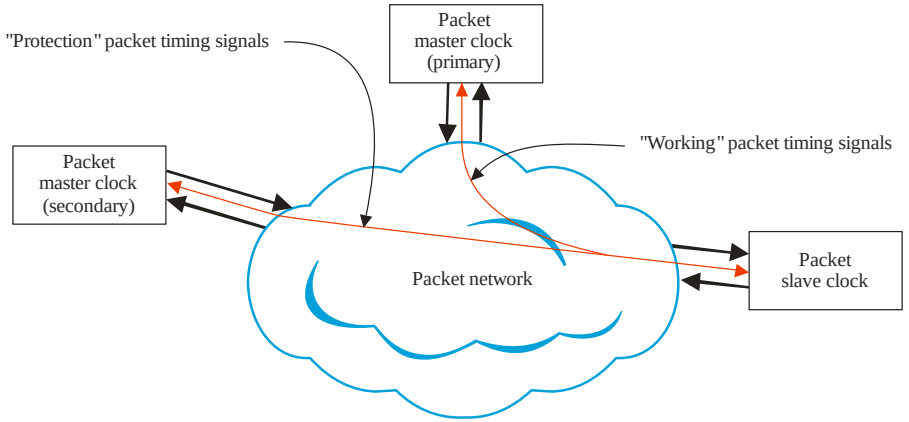
- Often a very simple diagram
  - prone to interpretation (but the intended interpretation?)
- Network can be created based on the collection of functions
  - Develop functional blocks
  - A network element may implement multiple functions
- Formal modeling techniques are used to aid specification process
  - OSI Reference model
  - ITU G.80x modeling
  - Allows definition of information and interfaces
  - Maps the high level architecture to the equipment

Architecture starting points can be simple



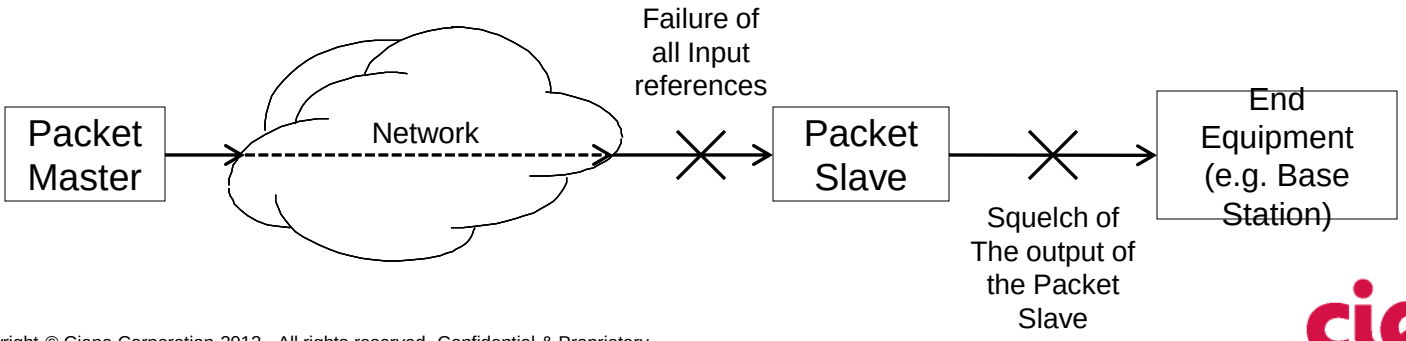
a) The reference may be from a PRC directly, from a GNSS or via a synchronization network

G.8265/Y.1365(10)_F01

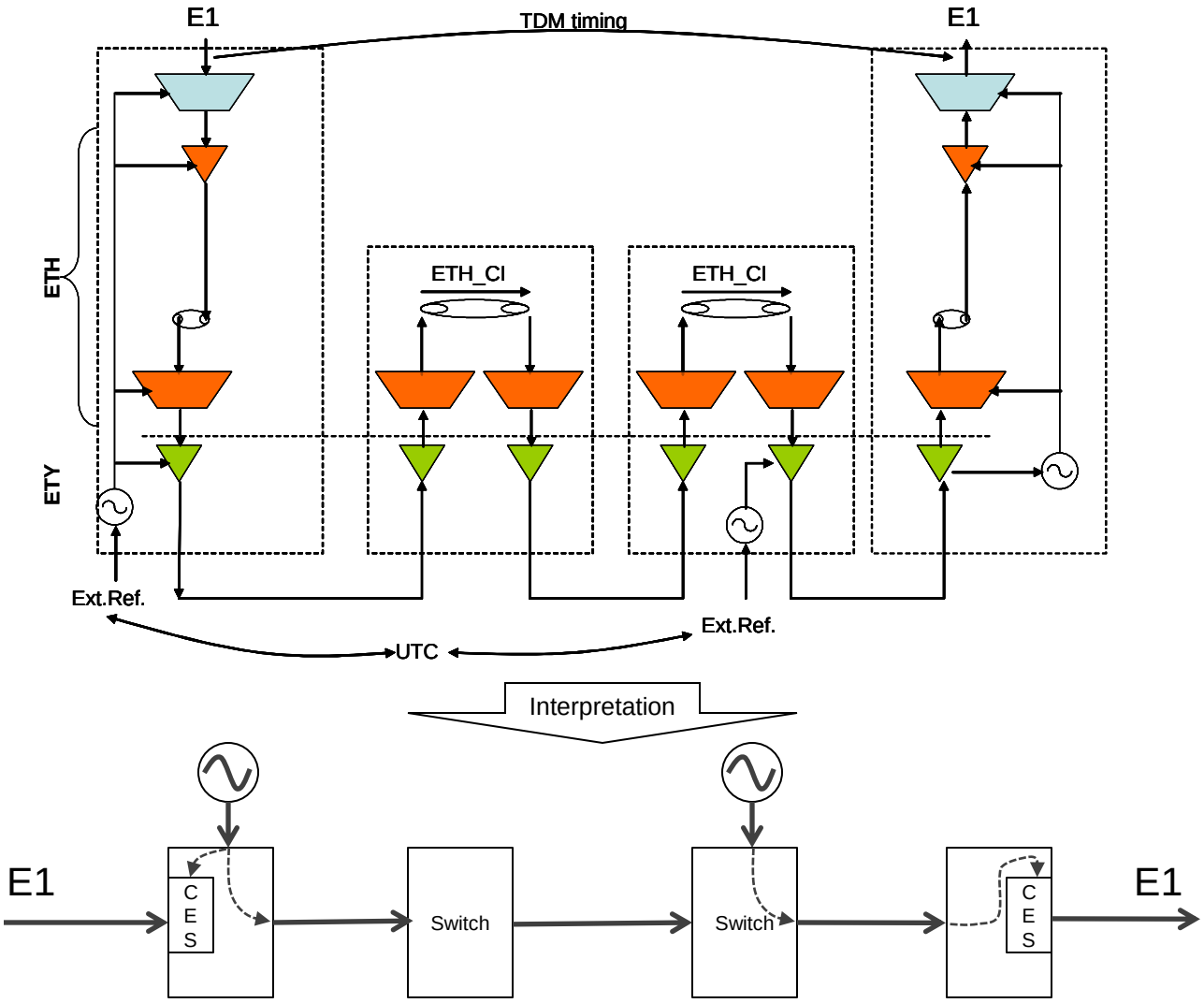


NOTE – For clarity, the network reference signals to masters are not shown.

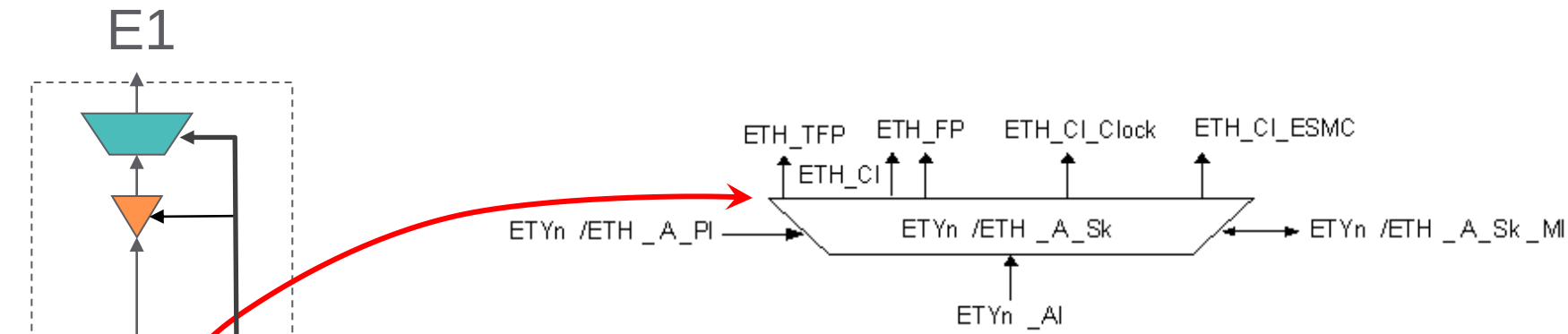
G.8265/Y.1365(10)_F02



Formal architecture adds more details (from G.8264)



Functional block will describe interfaces/outputs

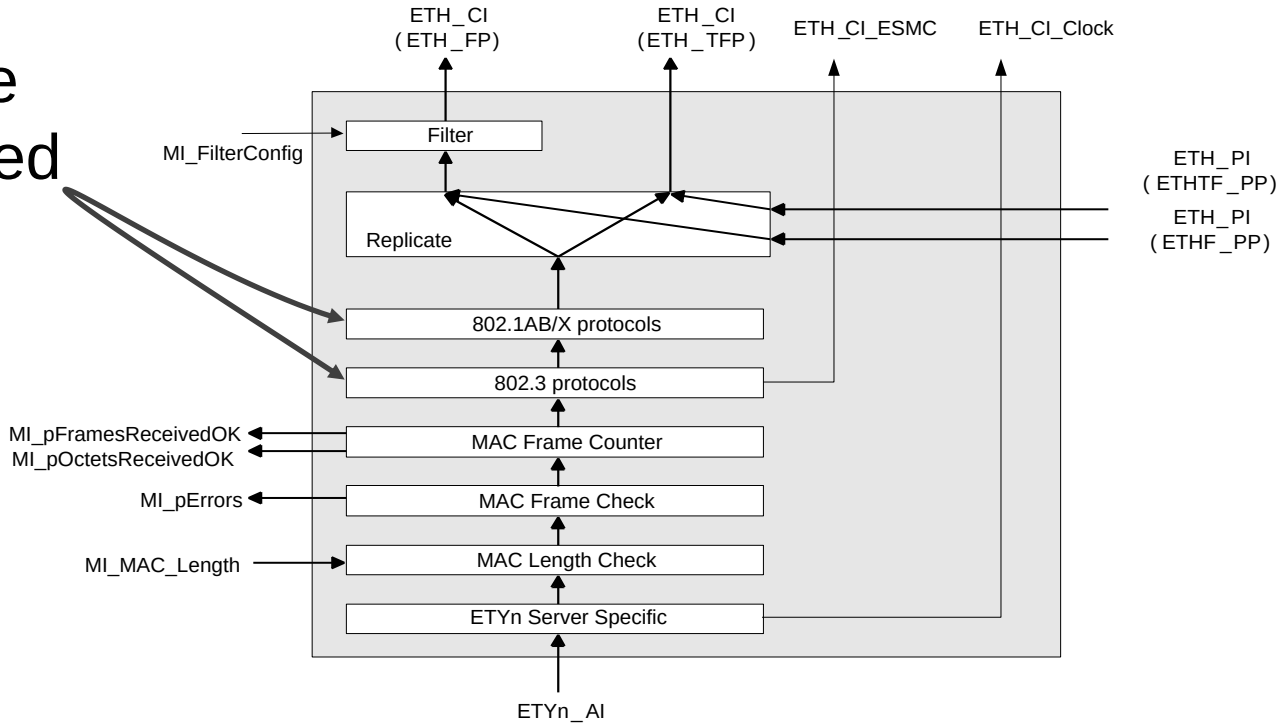


Inputs	Outputs
ETYn_AP: ETYn_AI_Data ETYn_AI_Clock ETYn_AI_TSF ETYn_AI_TSFrdi ETYn_AI_TSFfdi ETH_PP: ETH_PI_Data ETYn/ETH_A_Sk_MP: ETYn/ETH_A_Sk_MI_FilterConfig ETYn/ETH_A_Sk_MI_MAC_Length Holdover control MI	ETH_FP and ETH_TFP: ETH_CI_Data ETH_CI_Clock ETH_CI_SSF ETH_CI_SSFrdi ETH_CI_SSFfdi ETH_FP: ETH_CI_ESMC ETYn/ETH_A_Sk_MP: ETYn/ETH_A_Sk_MI_pErrors ETYn/ETH_A_Sk_MI_pFramesReceivedOK ETYn/ETH_A_Sk_MI_pOctetsReceivedOK

And additional detail can be specified

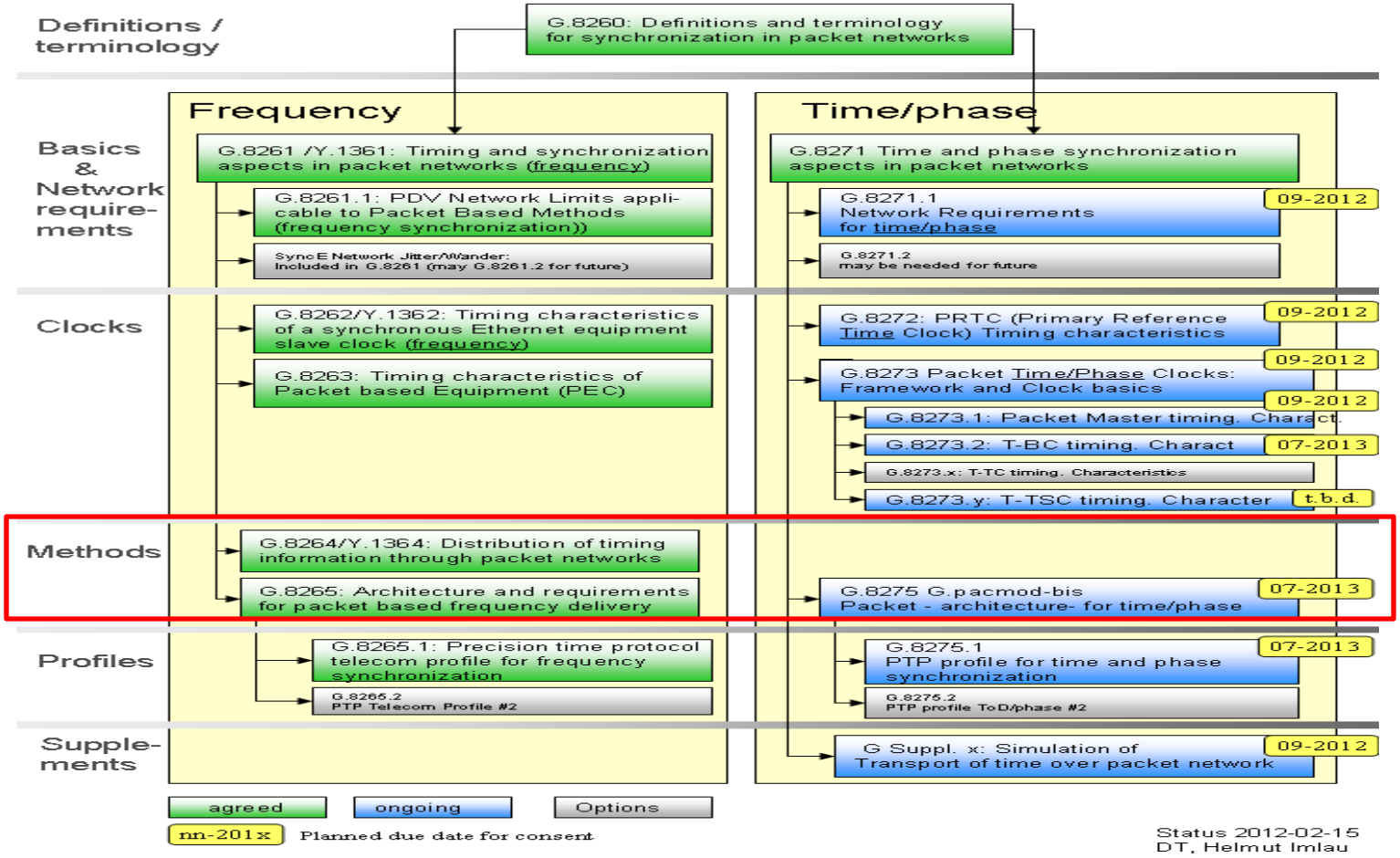
Detail may reference functionality described by other standards

Note: IEEE802 uses OSI model to describe specification



Appropriate detail added to define an interoperable system

Architecture: Relationship to other ITU Recommendations



NGN sync recommendations on Architecture

G.8264/Y.1364: Distribution of timing information through packet networks

- G.8264/Y.1364 (10/2008)
- G.8264/Y.1364 (2008) Amd. 1 (09/2010)
- G.8264/Y.1364 (2008) Cor. 1 (11/2009)
- G.8264/Y.1364 (2008) Amd. 2 (02/2012)
- G.8264/Y.1364 (2008) Cor. 2 (02/2012)

G.8265/Y.1365 : Architecture and requirements for packet-based frequency delivery

- **G.8265/Y.1365 (10/10)**

G.8275: Architecture and requirements for packet-based time and phase delivery

- Under development

G.8264: Distribution of timing information through packet networks

Main aspects:

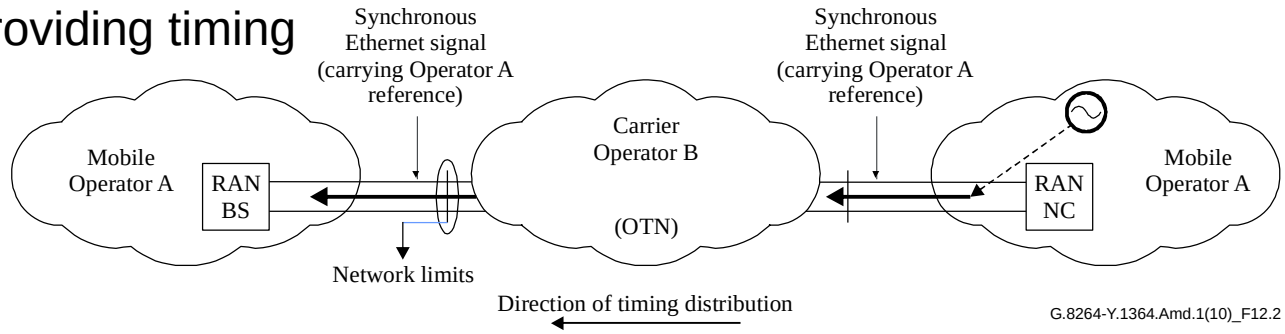
- NGN sync concepts
  - Evolution of network to packet based network and use of CES to support PDH services
  - Describes Sync Ethernet concepts in coordination with G.8261 and G.8262
- Synchronous Ethernet Sync status message channel
  - ESMC
  - Based on IEEE802.3 slow protocol, using Organization Specific Slow Protocol (OSSP)
  - Defines PDU format
- Sync Selection based on SSM QL
- Use of Synchronous Ethernet in Multi-operator context
- Supporting functional models

G.8264: Multi-carrier operation

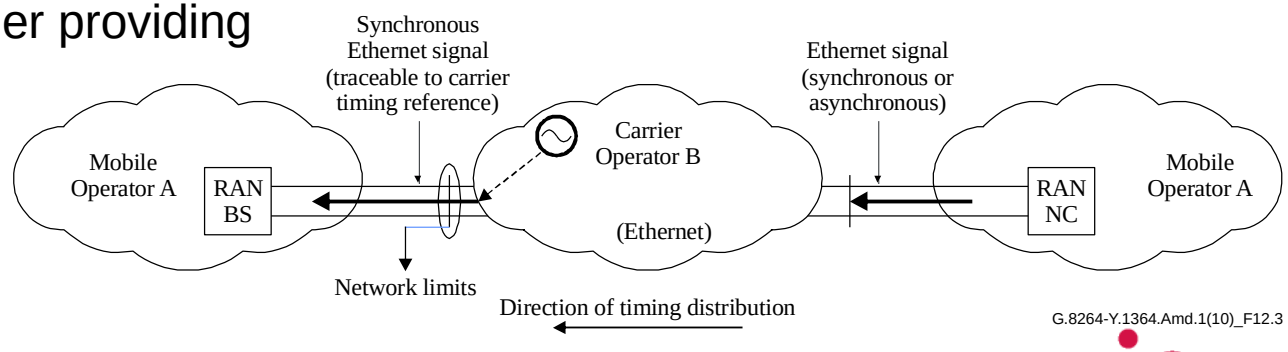
While not a specific work item, the directions taken reflect the increased view by carriers that timing will become a service

- Distribution of sync moving to the edge
- Multi-carrier situations now part of standards

Service owner providing timing



Intermediate carrier providing timing



G.8265: Architecture and requirements for packet-based frequency delivery

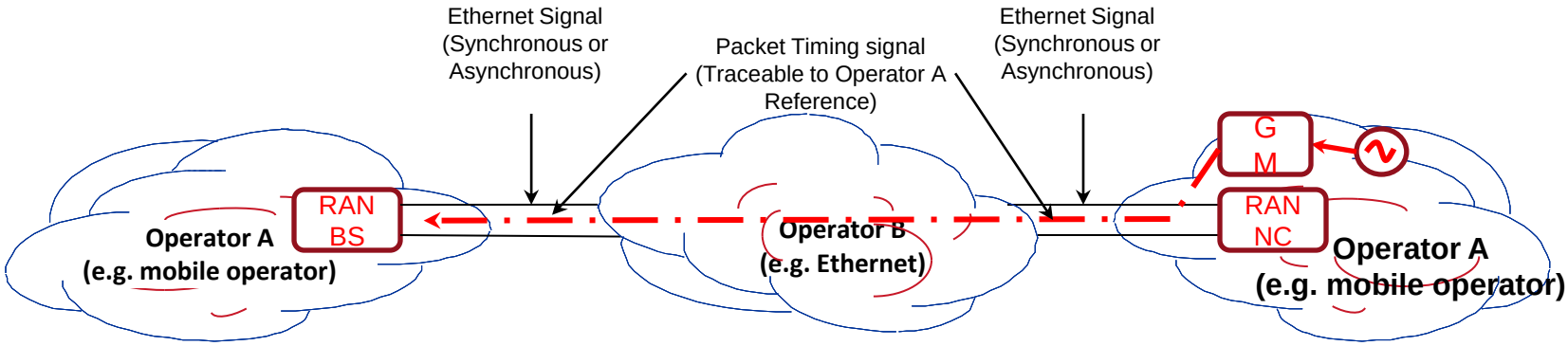
Next step in synchronization distribution is based on packet techniques such as PTP.

G.8265 established basic requirements for frequency distribution

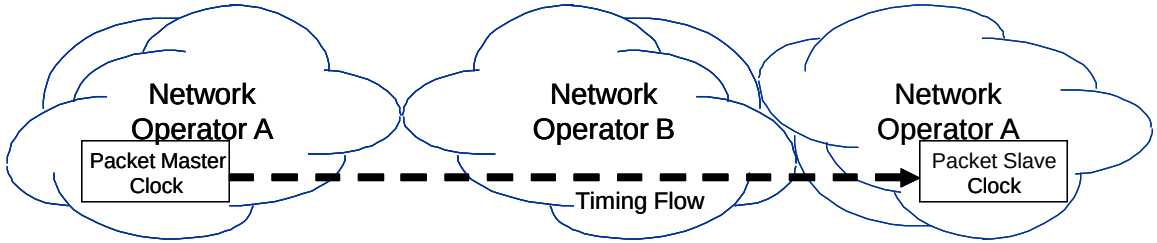
- Necessary in order to define operation of a packet system within overall synchronization distribution network.
- Although not mandated, a network could have mixed technology
  - SDH
  - Sync Ethernet
  - Packet
- Frequency only
  - Applicable to both NTP and PTP
- Addresses protection aspects
  - IEEE1588 Profile development based on architecture
  - Telecom slave clock defined

G.8265 multi-carrier support now with packets

Extension of timing as a service reflected in PTP work (redraw of G.8264 example)



Version in G.8265:

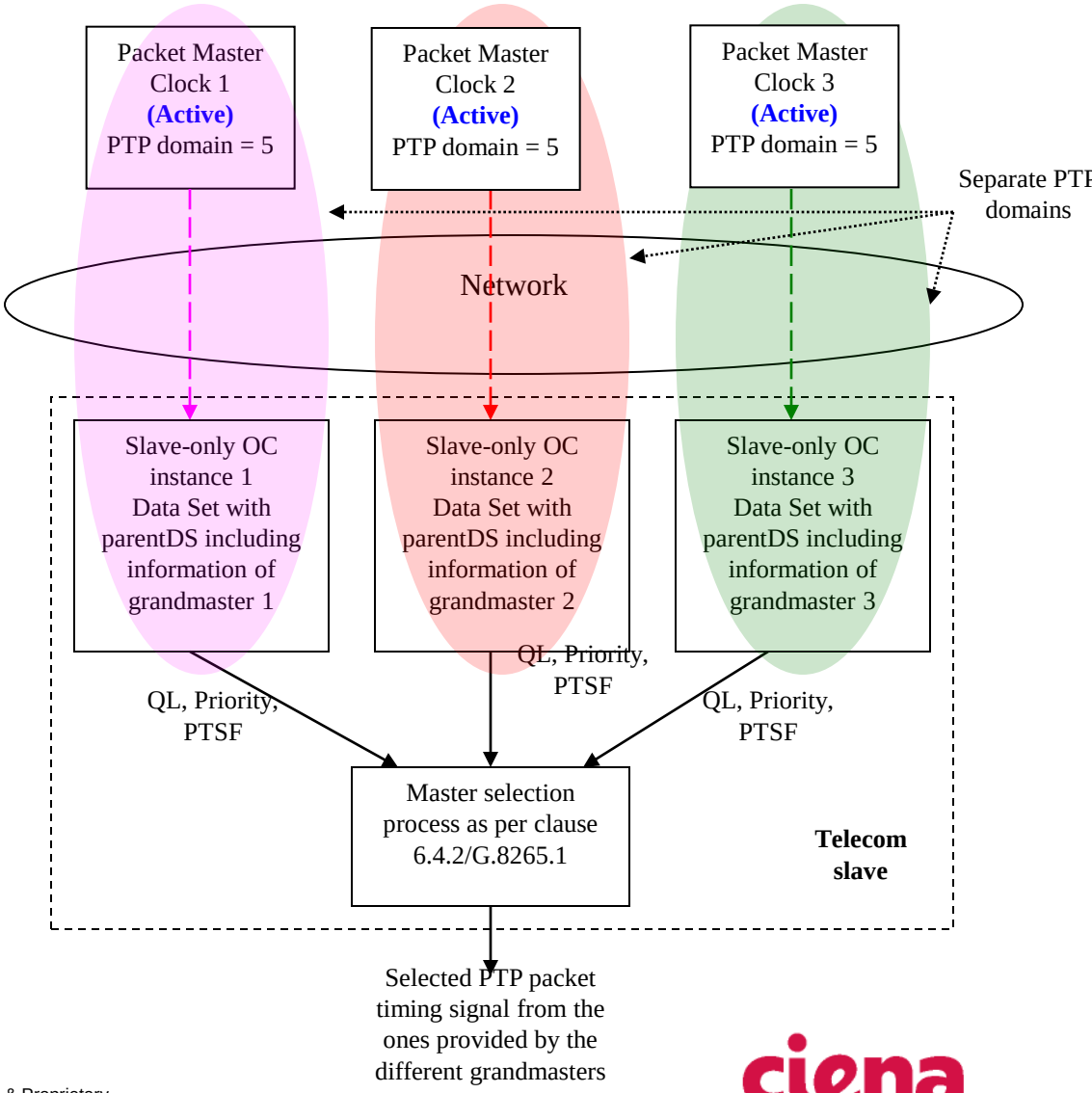


Architecture impacts: Supporting Telecom requirements

Telecom requirements

- Not directly supported in IEEE1588
- "telecom Slave" construct used to support telecom requirements in G.8265.
- Covers Frequency
  - Similar may be required for time/phase

Architecture drives some aspects of equipment specification



G.8275: Architecture and requirements for packet-based frequency delivery

Recommendation under development (planned completion in 2013)

Focus on network based on time/phase distribution using IEEE1588

- Time/phase requirements are a substantially different paradigm

Architectural aspects

- How do the multiple types of network clocks interact
  - Boundary and Transparent clocks
  - Slave clocks
  - Grand Master clocks
  - Packet Reference Time Clock (PRTC)
- Protection aspects
  - Best Master clock
  - Fit with BMCA with telecom practices (e.g. automatic vs provisioned)
- Syntonization provided by Synchronous Ethernet
- Information aspects (information across time interface)

Summary/conclusions

Network architecture:

- Describes how a collection of functions enables a service
  - A specific distribution of functions defines the network
- Synchronization architecture defines the functions necessary to distribute synchronization (frequency, phase, time) in a network
- Description of the architecture in a formal manor allows the development of standards by multiple groups with maximum interoperability

Synchronization architecture standards in ITU-T

- Clarify and state requirements from the network level
- Defines protection aspects necessary to be implemented in individual equipment (impacts operations)
- Are developed to allow migration of network
- Are developed in coordination with other performance related standards
- Provides network scope for other equipment standards
- Provides guidance to other SDOs developing related standards

Thank you