Architecture for Time and Phase ITU-T G.8275

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Editor – G.8275

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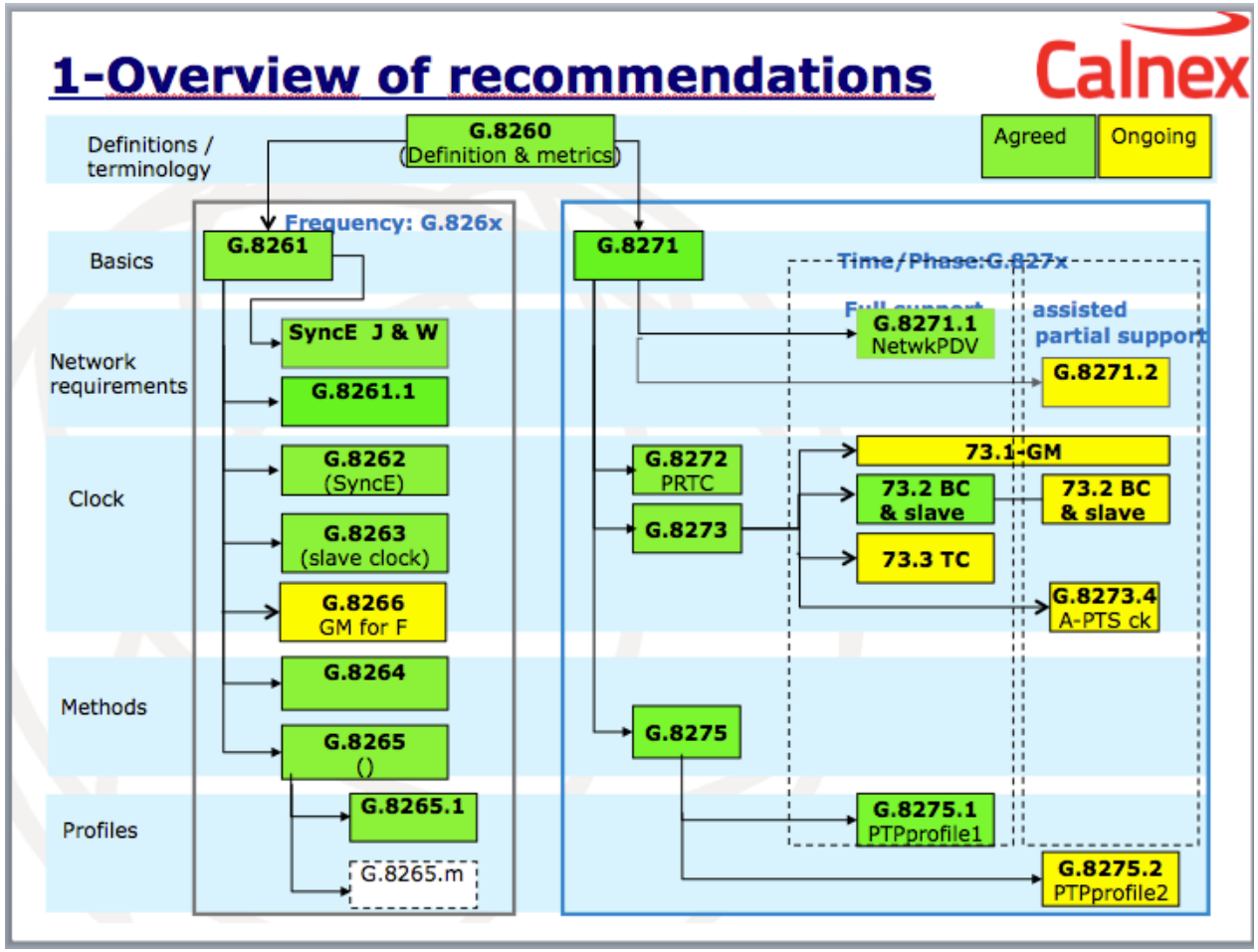
Overview

- Architecture Recommendations relative to Q13/15
- Rationale for development of arch. Rec's
- Details of G.8275
  - General architecture
  - Packet master protection
  - Packet slave protection
  - PRTC configurations
  - Partial support
- Future areas of work

Relationships to other Rec's



Slide courtesy of J-L Ferrant

Architecture Recs: current versions

- 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 (10/2010)
  - G.8265/Y.1365 (2010) Amd. 1 (04/2011)
  - G.8265/Y.1365 (2010) Amd. 2 (10/2012)
- G.8275: Architecture and requirements for packet-based time and phase delivery
  - Consented July 12, 2013
  - Published November 2013

Why define architecture?

- Architecture recommendations provide high level guidance to the development of other recommendations
- Act to coordinate other functions where necessary
  - Interface aspects,
  - Clock aspects,
  - Recommendations from other questions
  - Coordination similar functions over different technologies
- Time/phase distribution is new a well defined architecture is needed to ensure that development of functionality can be well coordinated

Examples of ITU-T architectures

- G.803: architecture of SDH
- G.872: architecture of OTN
- G.8010: Architecture of Ethernet…
- G.8121: MPLS

- Note formal architectures are based on a fixed set of principles defined in separate recommendations

Relationship to "Profiles"

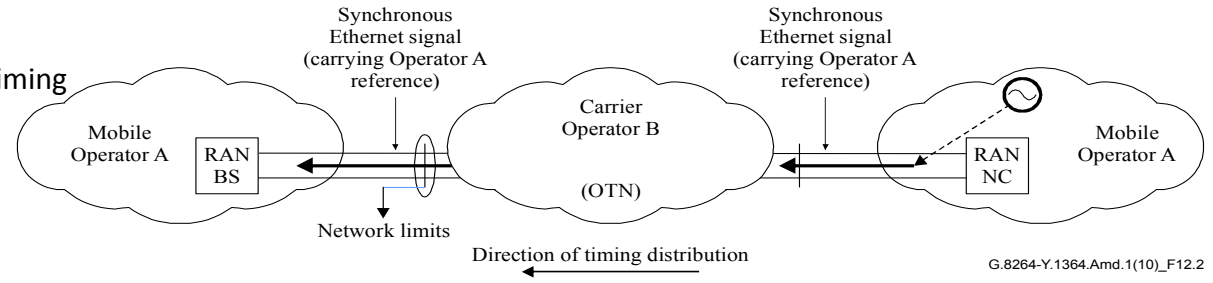
- Telecom timing distribution can occur over different technologies and with different mechanisms
  - SONET/SDH, Circuit Emulation, NTP, PTP
  - High level requirements can be the same (e.g. transfer frequency)
  - Individual technology architecture documents are aligned with respect to requirements
  - Adhering to the architecture results in coordinated deployment
    - Example: SDH/SONET and Sync Ethernet are compatible
- IEEE-1588 profile mechanism to address different applications
  - Telecom is more than one application (e.g. frequency, phase/time) and may have existing technologies to consider
- The "Application" is defined by the architecture
  - Specific packet functionality (e.g. packet slave clocks) can be described within the architecture to ensure fit with other technologies
- The profile and the architecture must be considered together
  - "In order to claim compliance with the telecom profile the requirements in this annex (e.g. the G.8265.1 profile) and in the main body of [G.8265.1] must be met.
  - The architecture (G.8265) is a normative reference in the Telecom profile

Why architecture?

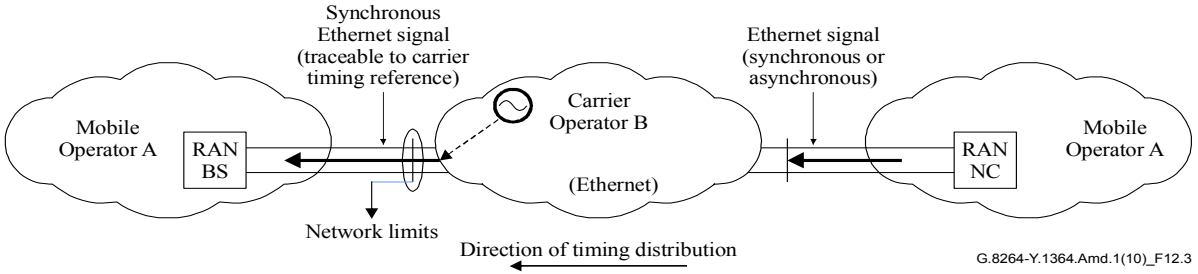
- Specific examples of why architecuture is important follow
- Example 1: multiple options to provide "service"
  - Example using frequency distribution for different technologies and different ownership models
- Example 2: architecture details to aid the development of standards outside of Q13/15
  - Coordination with Ethernet equipment specifications

Architecture: Provides flexibility (Frequency distribution example)

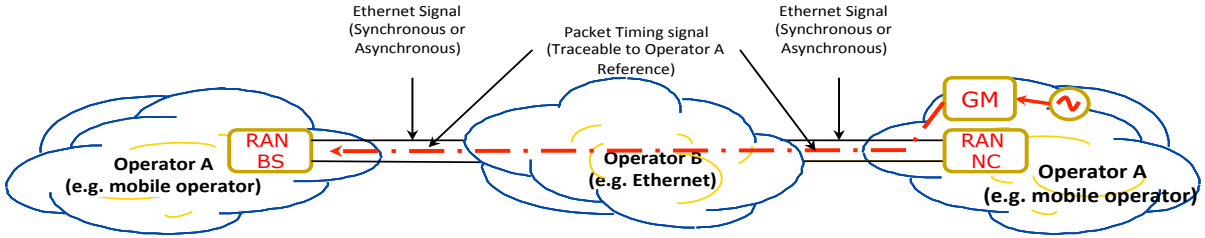
Physical layer:
Service owner provides timing



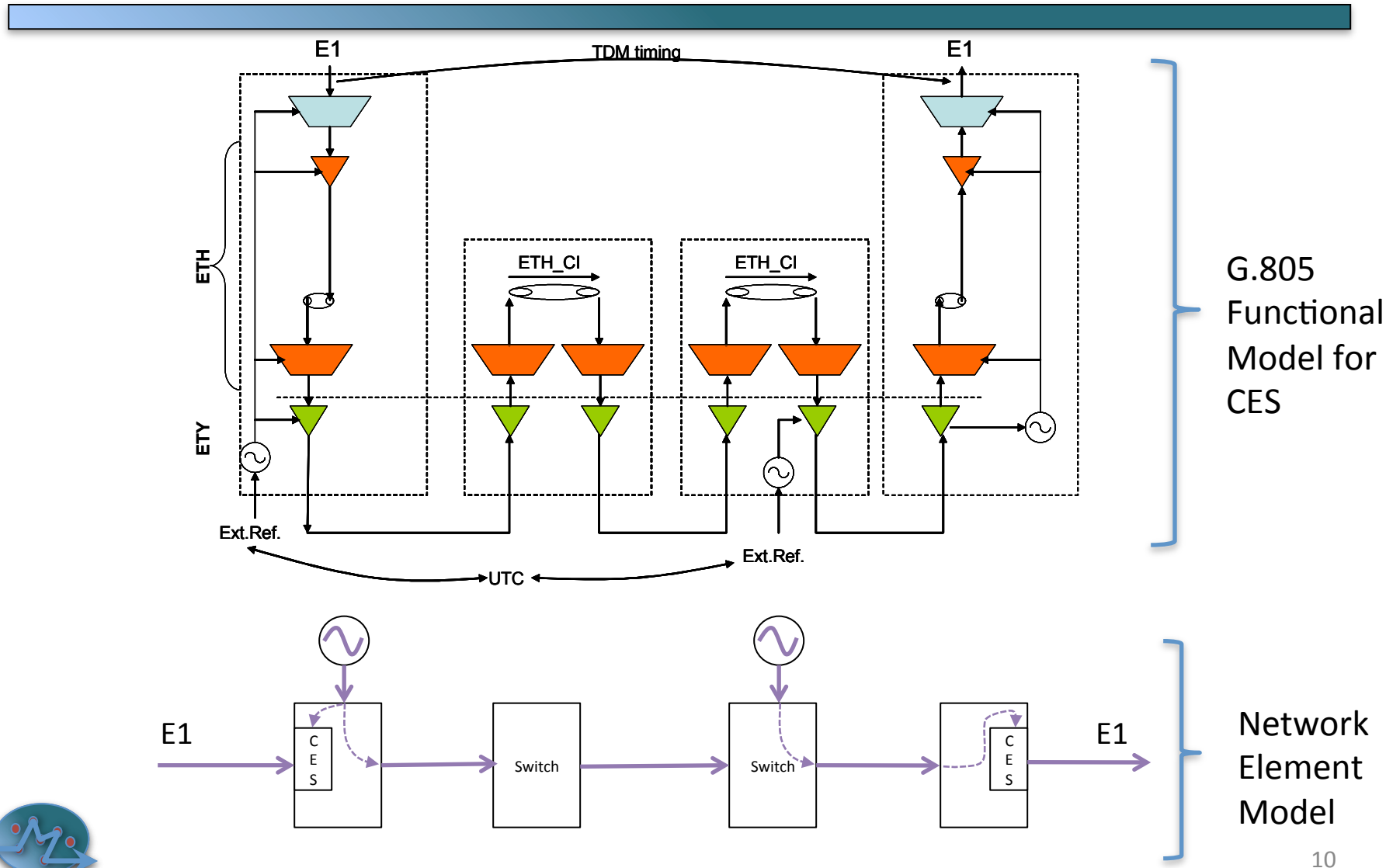
Physical layer:
Intermediate carrier provides timing



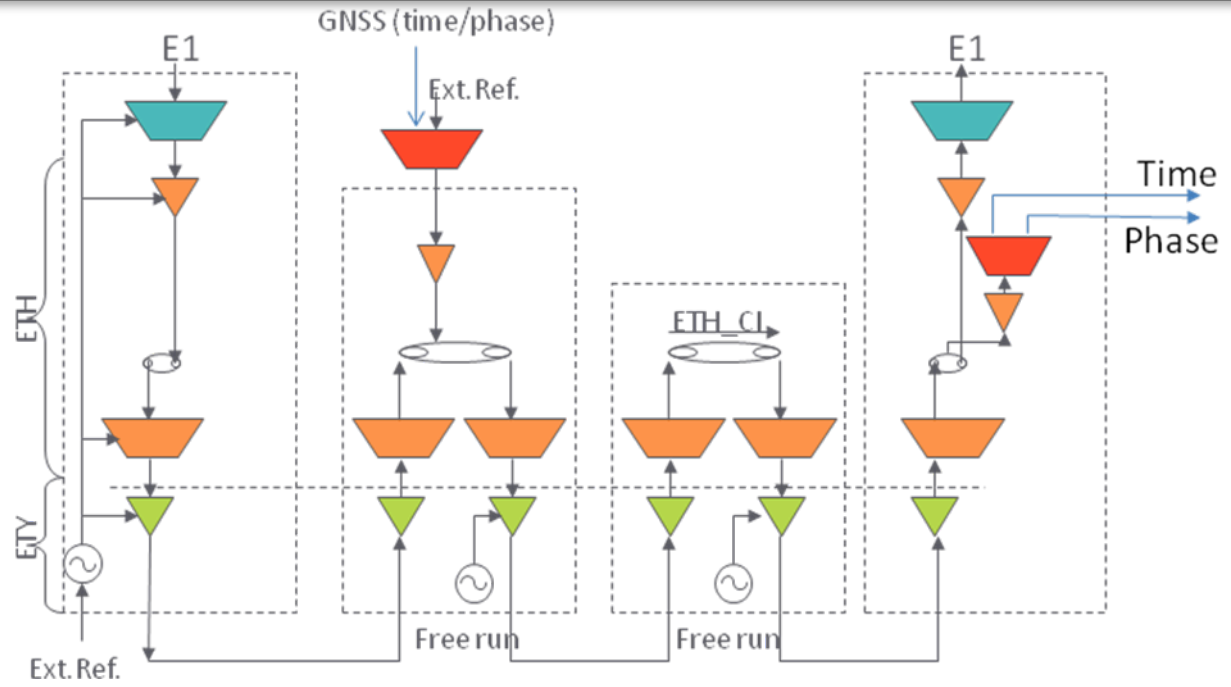
Packet layer:
Service owner provides timing



What does the architecture look like?

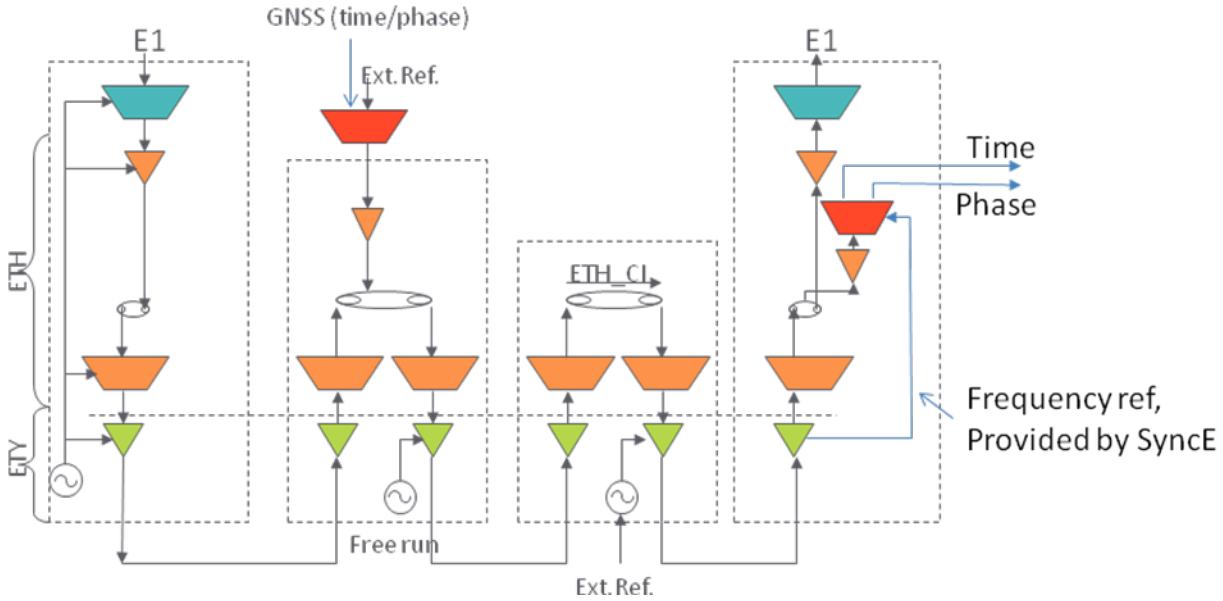


Extension for Packet timing



- Specific functions needed for Time distribution can be added to the basic model
  - Network may remain unchanged

Going further: Frequency assist

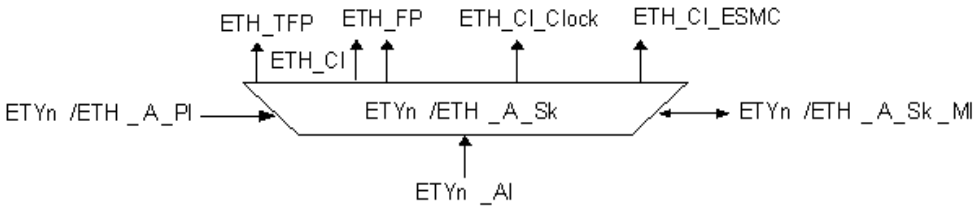


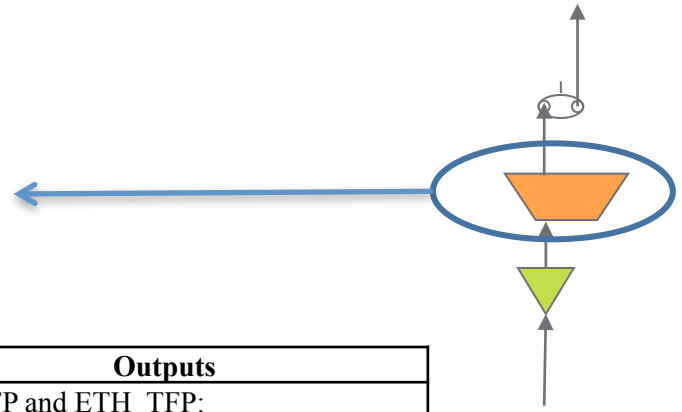
- Physical layer synchronization model is that of SDH/SyncE.
  - Boundary clock function starts to appear

Details of functions

- Individual functions may be specified in different recommendations
- May include other aspects related to basic transport, in addition to synchronization
- Some blocks may contain significant detail
  - Sync functions in G.781
  - Clocks in G.8262 (e.g. EEC)
  - Transport functions in G.8021 (Ethernet)

Ethernet detail example

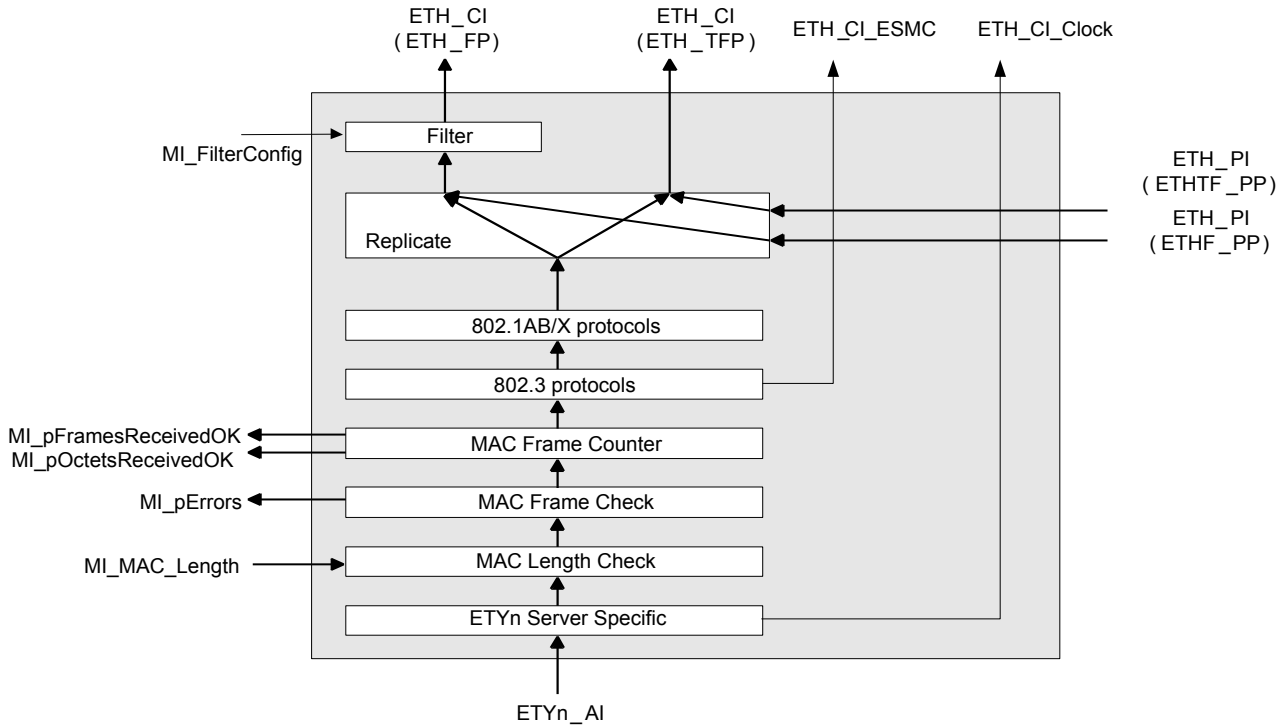




Inputs	Outputs
ETYn_AP: ETYn_AI_Data ETYn_AI_Clock ETYn_AI_TSF ETYn_AI_TSFrdi ETYn_AI_TSFfdi ETH_PP: ETH_PI_Data ETYn/ETH_A_Sk_MP: ETYn/ETH_A_Sk_MI_FilterConfig ETYn/ ETH_A_Sk_MI_MAC_Length Holdover control MI	ETH_FP and ETH_TFP: ETH_CI_Data ETH_CI_Clock ETH_CI_SSF ETH_CI_SSFrdi ETH_CI_SSFfdi ETH_FP: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

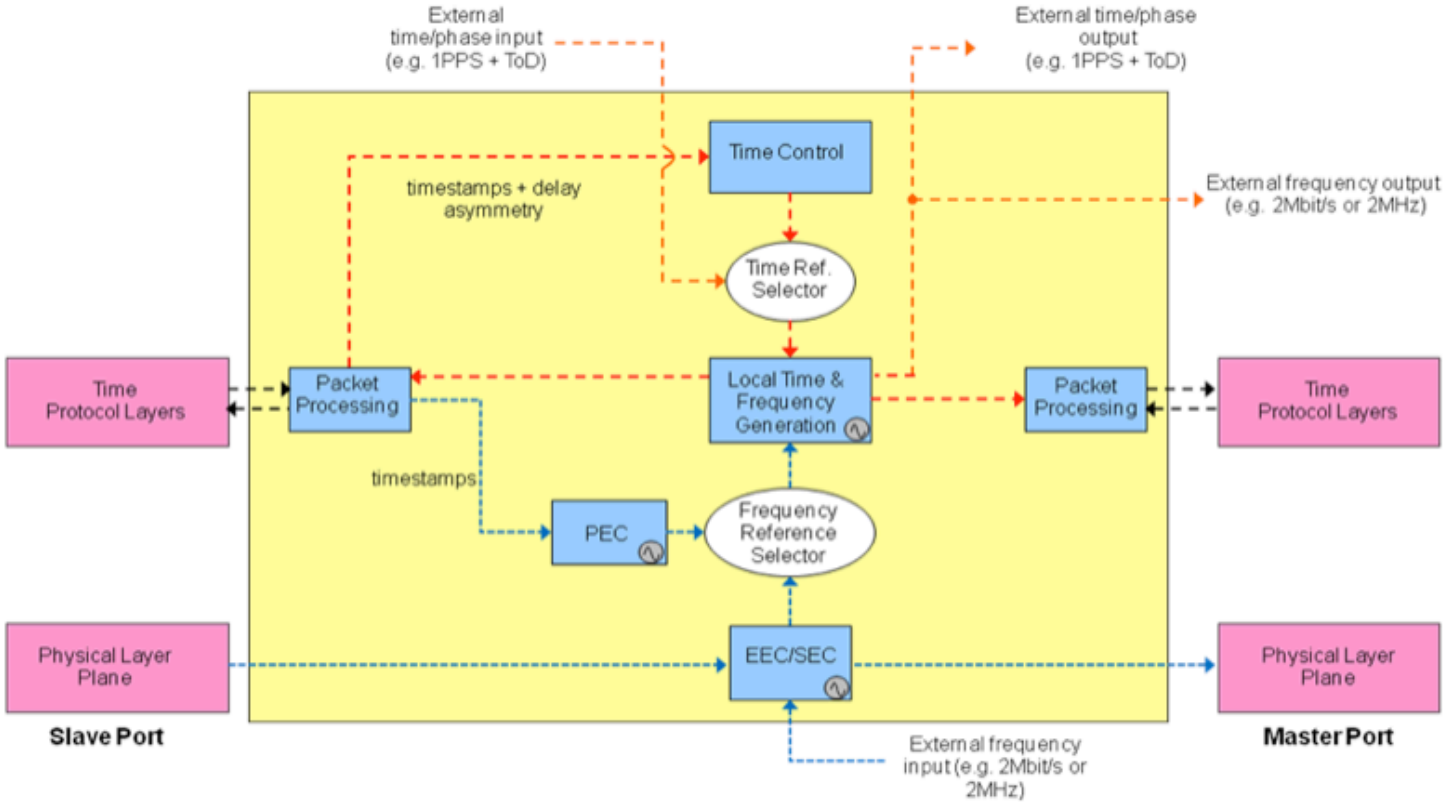
From Ethernet equipment specification: G.8021

More detail can be illustrated

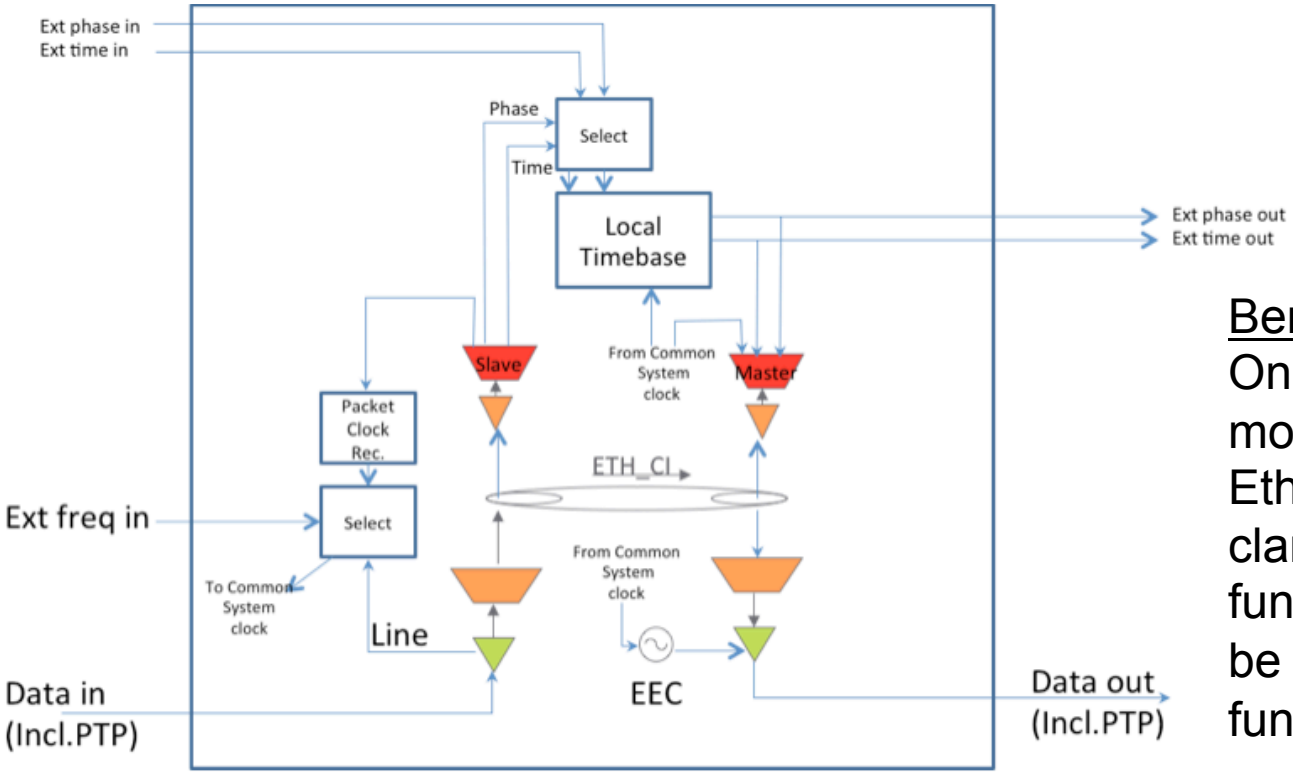


- Description of functional block will specify as much detail as necessary to define implementation requirements
  - Note: references IEEE802

BC block diagram



Possible functional Model of BC



Benefit of functional model:
One can compare the model with existing Ethernet switch models to clarify the additional functionality that needs to be added to support the BC function.

G.8275 details

- First version consented in July 2013
  - Comments addressed October 2013
  - Published in November 2013.
- Aspects covered
  - High level requirements
  - General topology for time/phase distribution
  - High level protection concepts
    - Packet master protection
    - Packet slave protection
  - PRTC configurations
  - Initial functional models for time/phase
  - Partial timing support (currently non-normative in first version)

Time/phase requirements

- Packet-based mechanisms for time and phase distribution must meet the following requirements:

  1) Mechanisms must be specified to allow interoperability between the various phase/time clocks defined in this architecture.

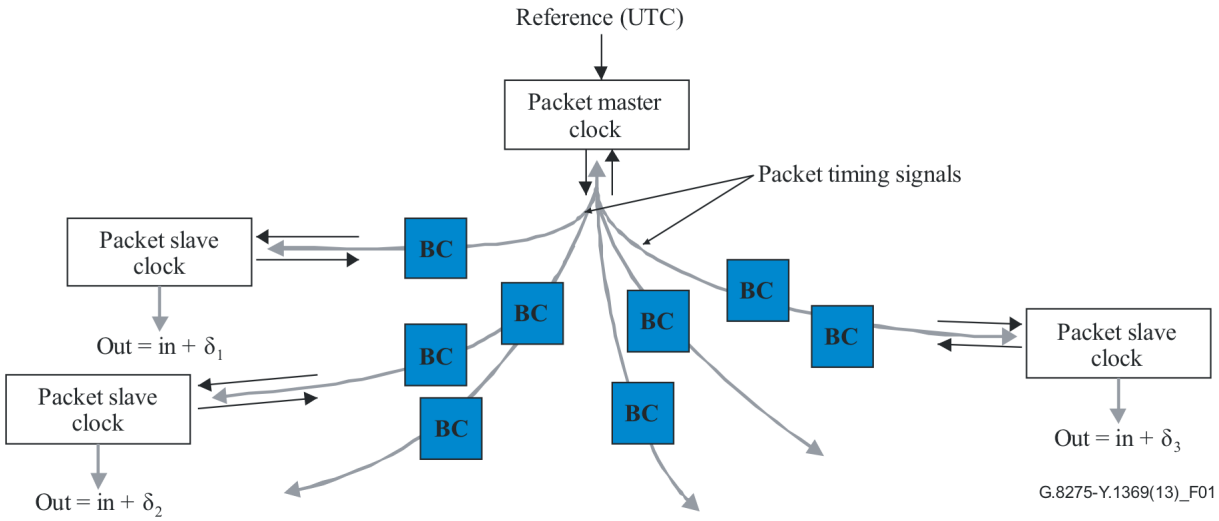
  2) Mechanisms must permit consistent operation over managed wide area telecom networks.

  3) Packet-based mechanisms must allow the synchronization network to be designed and configured in a fixed arrangement.

  4) Protection schemes used by packet-based systems must be based on standard telecom operational practice and allow telecom time slave clocks (T-TSC) the ability to take phase and time from multiple geographically separate telecom grand master (T-GM) clocks.

  5) Phase/time reference source selection based on received phase/time traceability and local priority should be permitted. Automatic establishment of the phase/time synchronization network topology may also be possible.

Time/phase distribution

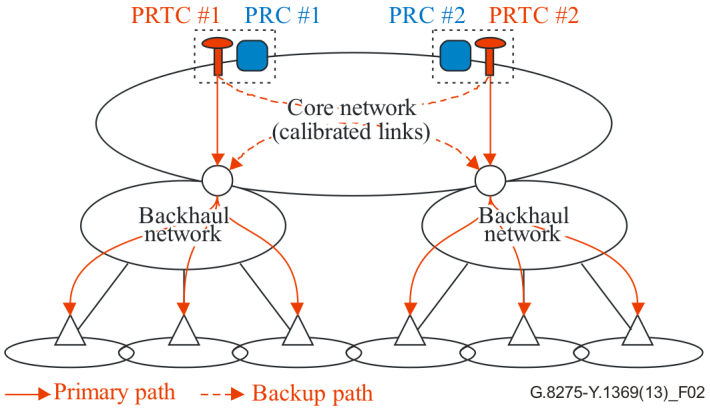


- High level distribution based on G.8265
  - Intermediate network elements are “PTP aware”
  - Restricted to boundary clocks in first version

High level protection

- Protection methods are needed for
  - Master protection
    - Provides guidance on deployment
    - Four scenario's considered
  - Slave protection
    - Provides guidance on mechanisms (e.g. how BMCA may work)
    - Three scenario's considered

Packet master protection



NOTE – T-GM are connected to the PRTC in this architecture

Scenario 1 (Case A)

Four scenarios considered

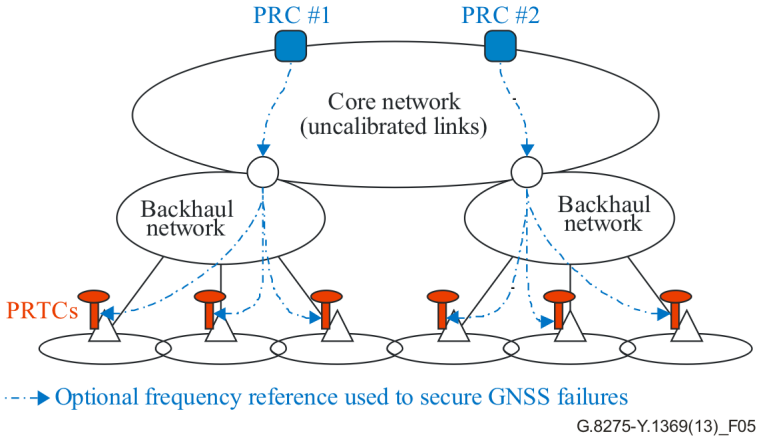
-Each case the PTC moves towards the edge of the network

-may place different requirements on PTRC

Note: Scenarios 2 and 3 are not shown

2: Separates PRTC and PRC

3: Moves PRTC to head of backhaul (refer to G.8275 Figures 3 and 4)



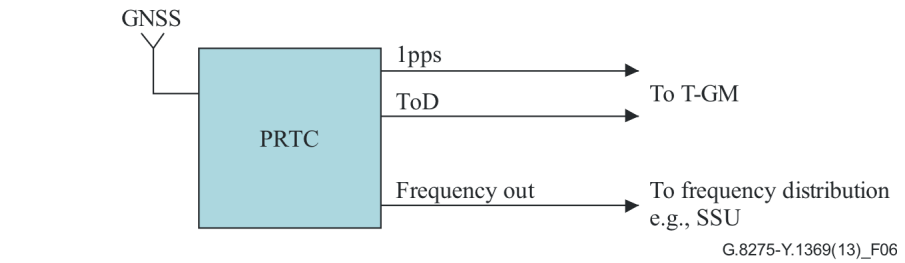
NOTE – There is normally no T-GM connected to the PRTC in this architecture

Scenario 4 (Case D)

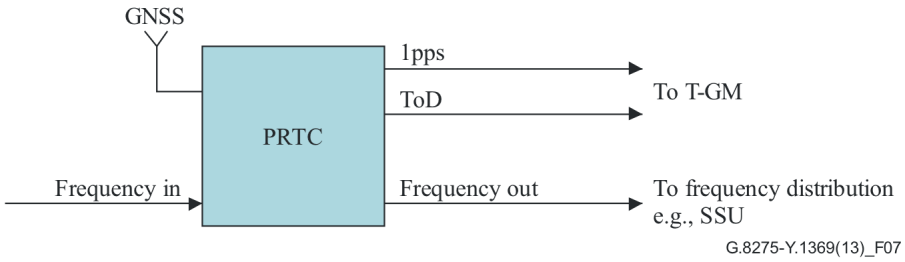
PRTC configurations

- Protection methods do not require the same PTRC configurations
- The architecture provides guidance for development of equipment specifications

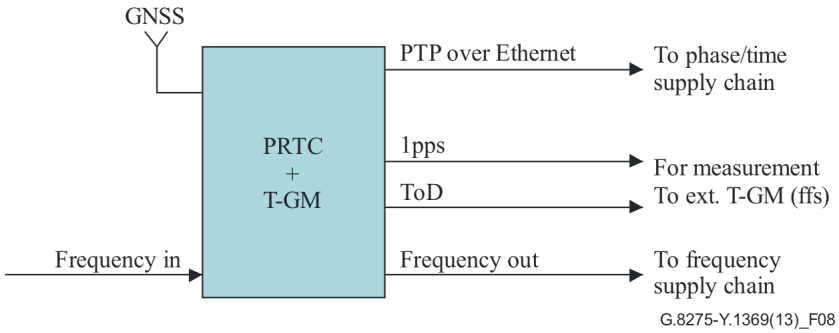
PRTC configurations



PRTC (no physical reference)
-Frequency/phase/time all provided by single GNSS input
-Applies only to first scenario



PRTC with capability of input frequency reference for holdover
-Frequency/phase/time all provided by single GNSS input
-Can be used in all scenarios



PRTC functionality integrated with Telecom Grand Master
-PTP over Ethernet interface can also provide physical layer frequency synchronization

Packet slave protection

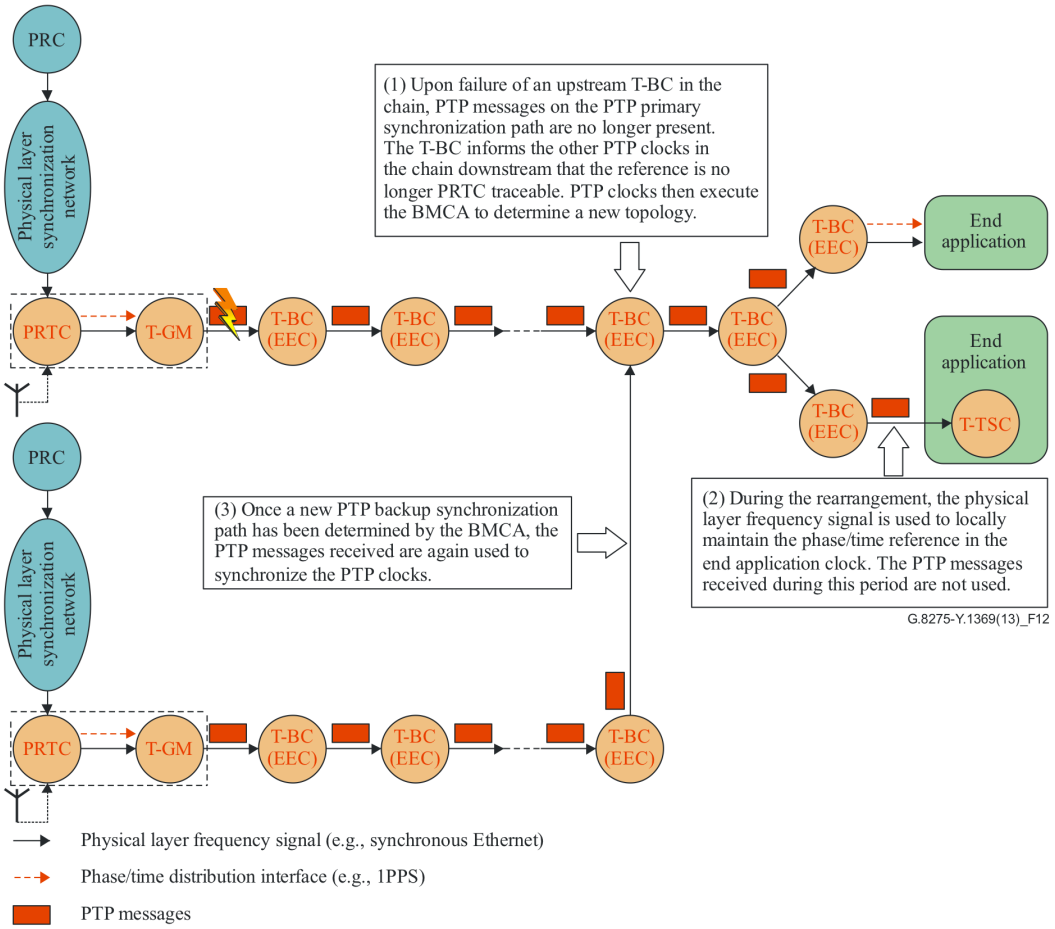
- Describes how redundant timing paths can be provided to the slave
- Three general cases:

  1: phase/time protection using physical layer frequency support

  2: Switching to a redundant reference with physical layer support (for frequency)

  3: switching to a redundant reference without physical layer support

Packet slave protection example



Packet slave protection

-Specific example is scenario 2: protection with support provided by physical layer frequency (holdover).

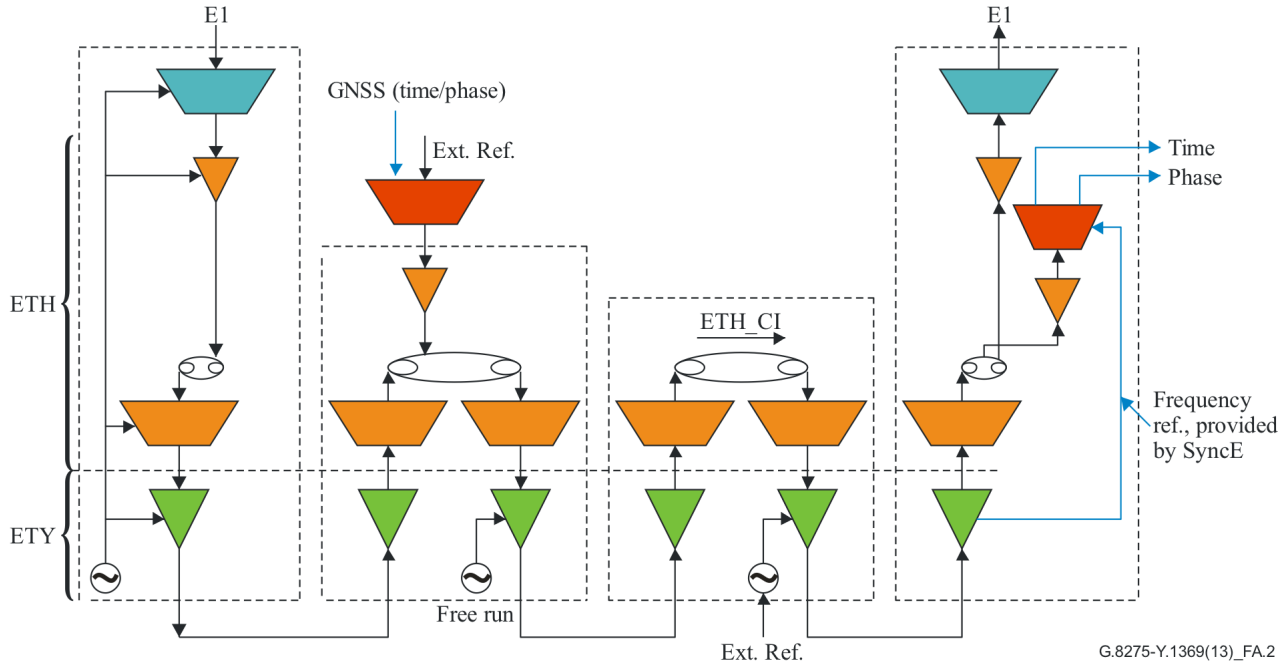
-Scenario 3 is similar (refer to G.8275)

-two types of end application are show, there the end application includes the end clock, or when the end application is driven by a stand-alone clock.

Time/phase functional models

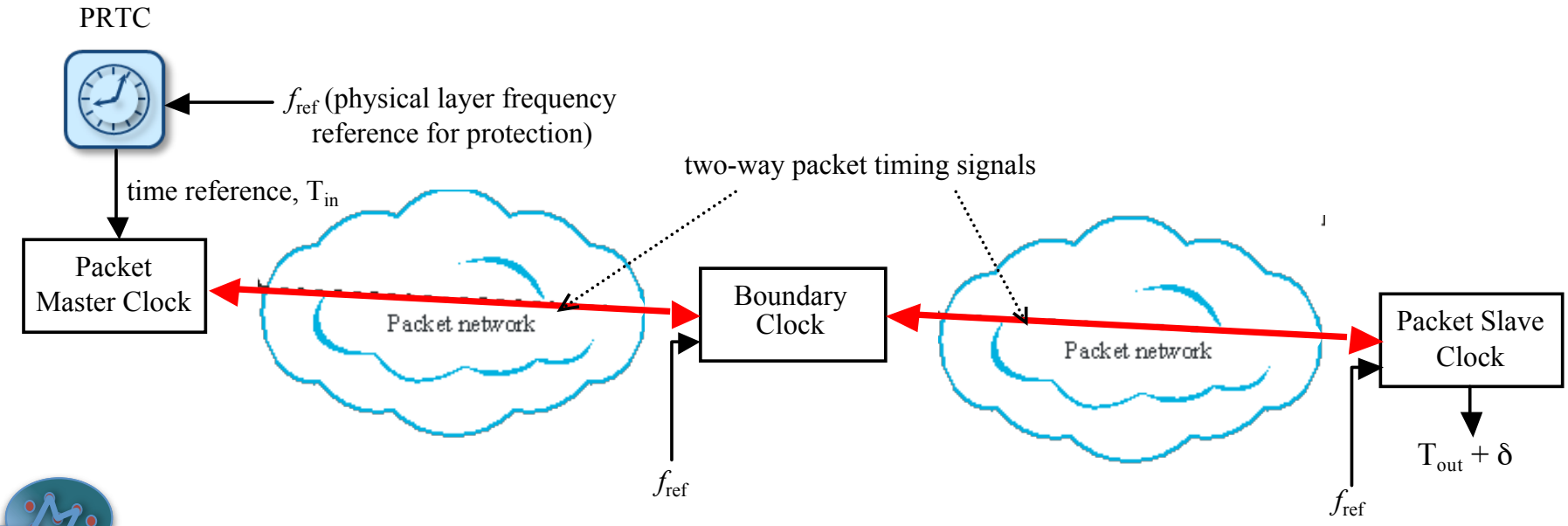
- Extensions of G.8264 models to describe time/ phase with support from physical layer (SyncE) have been included as Annex.
- Provides guidance to other questions in developing appropriate equipment specifications
- Models are similar to what was described on earlier slides

Functional model showing Time reference distribution



Partial timing support

- Evolution from G.8265 (Frequency) to provide time/phase
- Currently non-normative in G.8275
- Not all network elements are BC
- Architecture begins to define functional requirements



Areas of further work

- First version approved 2013
- Areas for further work will be captured in amendments
- Further work expected
  - Partial support
  - Enhancements to architecture
  - PTP over OTN proposed some aspects should be noted in the architecture to define expected applications