Status of ITU Q13/15 sync standards and relationship with IEEE 1588

ITSF-2014

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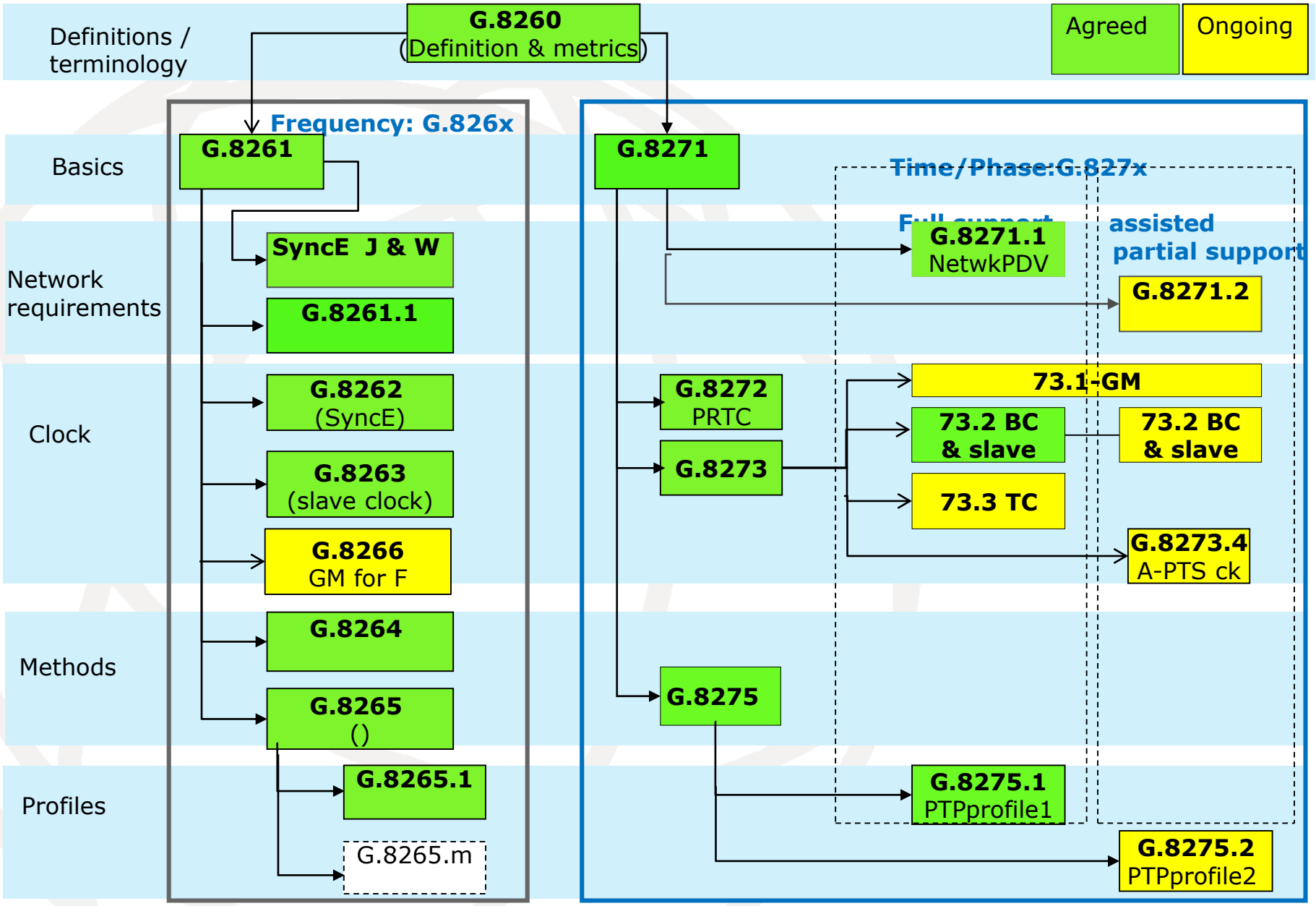
International Telecommunication Union

ITU –T Q13 Summary

- I-Synchronization over packet networks
  - Transport of frequency
    - Mainly a maintenance activity
  - Transport of phase and time
    - 2 profiles defined
      - Full support from the network- G.8275.1
      - Partial timing support
        - Assisted- G.8275.2 (ongoing)
        - Non assisted (to be developped)
- II-Synchronization over OTN
  - New requirement to transport F, Ø and T
- III-ITU and IEEE1588 evolution

1-Overview of recommendations



I-2 transport of frequency

- Consented recs in April 2014
  - G.8260 Amd2
    - Time error definitions Improvement
      - Dynamic time error and maximum absolute time error
  - G.8261.1Amd1
    - Added a subsection recognizing that many networks (HRM1) do not create more than 75 µs of PDV
  - G.8263 Amd2
    - Text for AppendixI on Packet Delay Variation noise tolerance testing

I-3 transport of frequency

- Consented recs in April 2014
- G.8264
  - A new revision has been consented.
- G.8265.1
  - A new revision taking advantage of the work on G.8275.1 to improve the text.
- New work item
  - G.8266
    - T-GM for frequency

I-4 transport of phase and time

- Consented recs in April 2014
  - G.8271.1 Amd1 (see S. Ruffini's presentation)
  - G.8273.2 T-BC(see S Rodrigues's presentation)
  - G.8275.1 (see S. Jobert's presentation)
- New work item
  - G.8273.4
    - Specification of a clock for A-PTS

I-5 G.8273.2 T. Boundary Clock

- Main characteristics of G.8273.2
  - T-BC and T-TSC (time slave clock)are specified in G.8273.2
  - 2 classes of clocks are defined for both T-TBC and T-TSC

Table 2 – T-BC Permissible Range of Constant Phase/Time Error

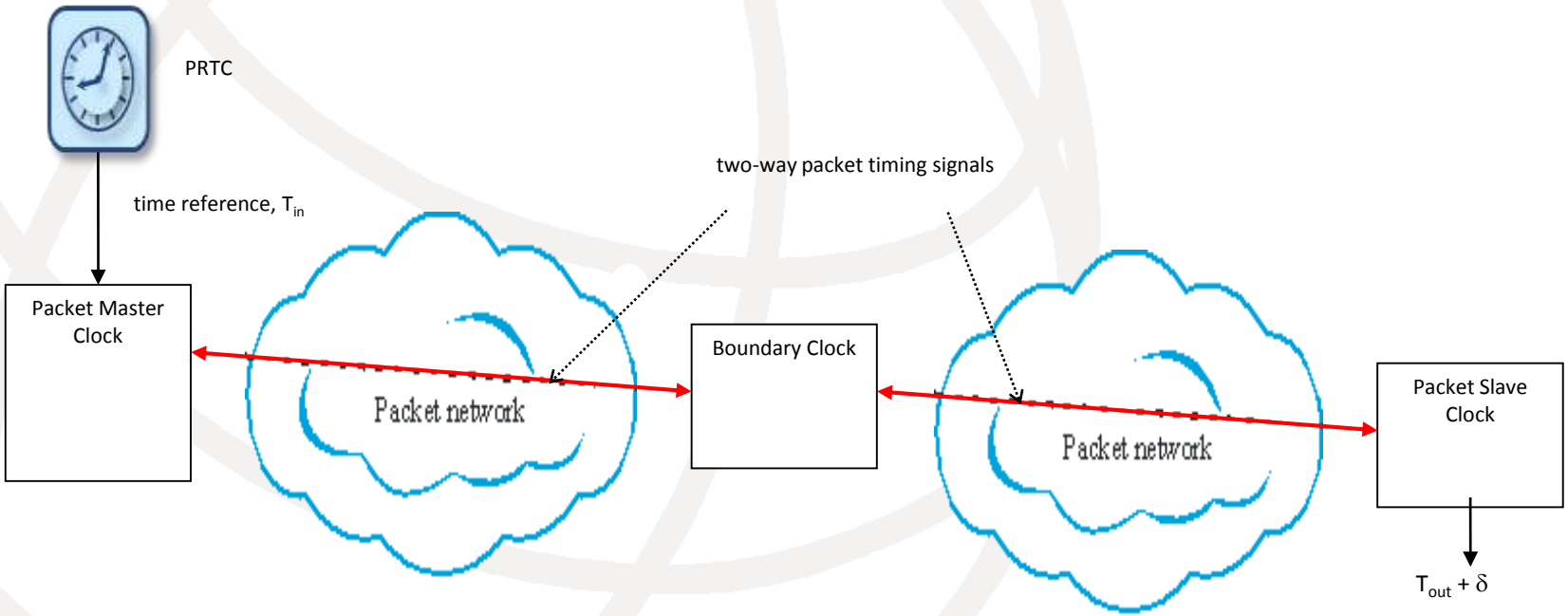
T-BC Class	Permissible Range of Constant Phase/Time Error – cTE(ns)
A	±50
B	±20

I-6 Time profiles

- First profile
  - **Full timing support** from the network
    - It means that all NEs process the PTP messages
    - PTP messages mapped in Ethernet (G.8275.1)
  - Completed with
    - G.8272 (PRTC)
    - G.8273.2 (BC and slave clock)
  - Will be upgraded with
    - Stand alone T-GM G.8273.1
    - Transparent clocks G.8273.3

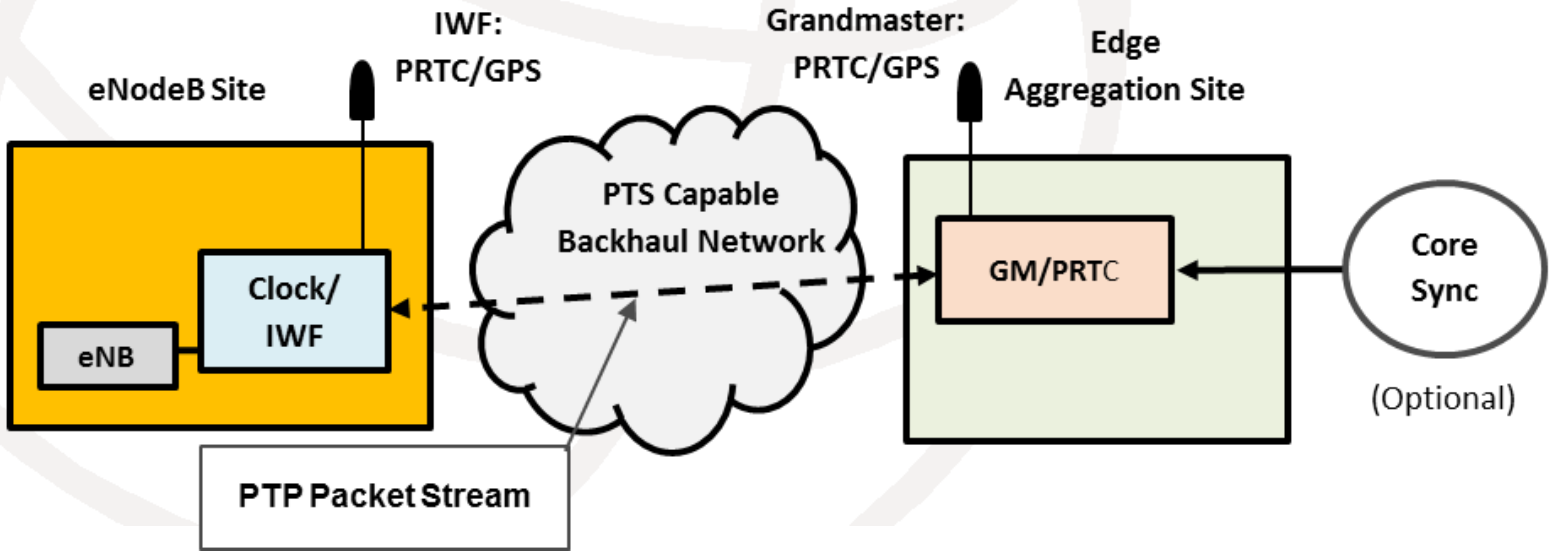
I-7 Second time profile

- Partial Timing Support profile (PTS)
  - **Work item created in July 2013**
  - **General architectural view (G.8275)**
    - **PTP unaware networks separated by T-BCs**
    - **PTP messages mapped in IP**



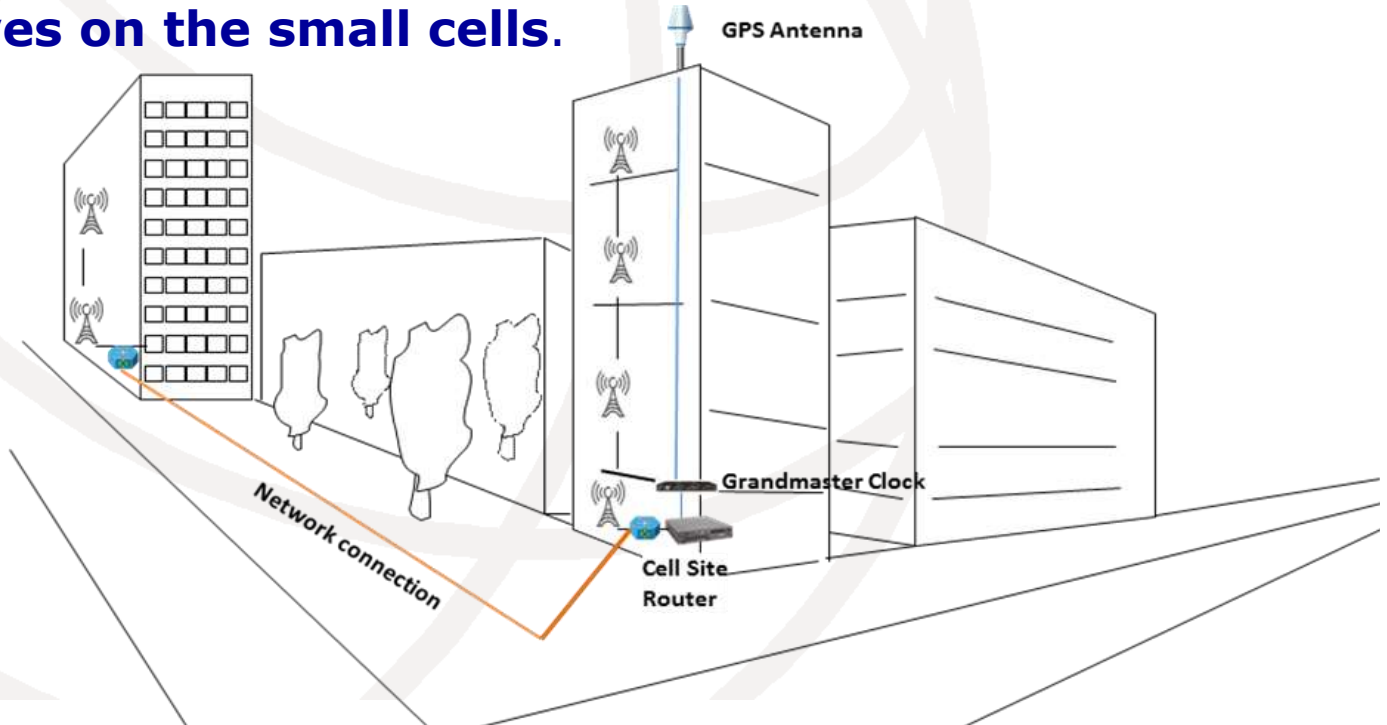
I-8 Assisted PTS profile (A-PTS)

- New ideas brought in October 2013
  - eNode B be synchronized with GPS receivers in priority
  - PTP will be used only as a backup in case of GPS failure
  - Operators request A-PTS for end 2014
    - Seems difficult to achieve on time



I.9 PTS profile- « nonA-PTS »

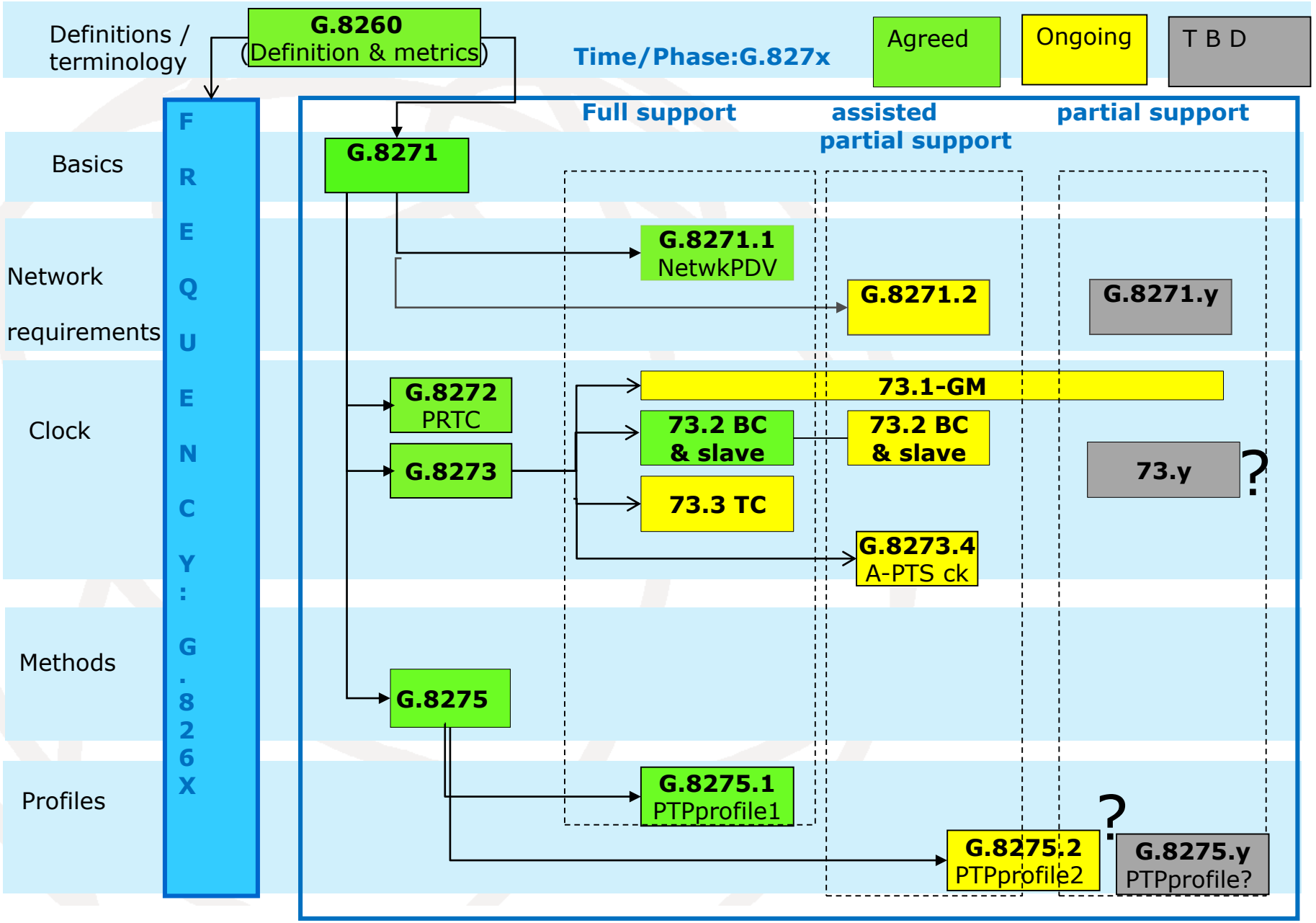
- New architecture agreed in September 2014
  - **simple PTP over IP based distributed deployment model**
  - **a grandmaster is deployed inside a building to provide frequency and time synchronization to the small cells within the building or to nearby buildings.**
  - **Only a <u>few</u> PTP-unaware nodes between the local GM and the slaves on the small cells.**



I-10 Partial Timing Support profile

- New recommendations required
  - G.8275
    - Add the « 1588unaware » equipments in the network architectures for A-PTS & « nonA »-PTS
  - G.8271.2(A-PTS), G.8271.x(PTS)?
    - Define the network limits and HRMs
  - G.8273.2
    - Define a new Boundary Clock if needed
  - G.8273.4(A-PTS), G.8273.y(PTS)?
    - Defines new clocks if needed
  - G.8275.2, G.8275.x??
    - both A-PTS & PTS based on IP

I-11-Future of recommendations?



II-1 Synchronization over OTN

- Optical Transport Network
  - First Definition in 2001
    - Not part of the synchronization network
    - Asynchronous network equipments
    - Transport of frequency reference via SDH tribs
  - SyncE in 2011
    - New mapping defined to transport tributary SyncE over OTN in timing transparency way

II-2 Synchronization over OTN

- New requirement
  - Transport of timing without SDH or SyncE
- Solution under discussion
  - Transport of frequency over the OTN physical layer as in SDH, so called **SyncO**
    - Q11 work
  - Transport of freq. & time via 1588 over OTN
    - Option3 (first priority):through OSC
      - OSC not std
      - Q13 might address performance aspects based on an HRM defined with Q11
    - Option1: through client signal
    - Option2 (last priority): through ODU/OTU

III-1 IEEE work on 1588

- Working Group to revise IEEE 1588 was formed
- Project Authorization Request (PAR) was approved in June 2013
- Several items in the Scope of the PAR
  - Correct known technical and editorial errors
  - Precision and accuracy improvements
  - SNMP-compliant MIB
  - Security
  - Clarification of layering, interfaces, and protocol of the standard
  - **Backwards compatibility with version 2**

III-2 IEEE work on 1588

- Five sub committees have been created to focus on several aspects of the technical work
  - Architecture
  - High Accuracy
  - Upkeep
  - Management
  - Security

III-3 IEEE 1588 Architecture

- Charter
  - "It needs to clarify the layering, interfaces, and protocol of the standard, including the behavior of systems that deploy different protocol options"
- Needs clarification in IEEE 1588
  - Guidelines on the interaction of different profiles
  - Support of multiple profiles on the same network
  - Revise the description of the IEEE 1588 architecture and layering of the protocol (e.g. media dependent versus media independent interface)
  - Reduce duplication between SDOs
  - Mixed mode multicast (sync/Announce) and unicast (delay_req/delay_resp)
  - SC is working on a proposal describing constraints on alternate BMCAs

III-4 IEEE 1588 High Accuracy

- Charter
  - "The protocol enhances support for synchronization to better than 1 nanosecond"
- Proposal includes the option to use Synchronous Ethernet for frequency synchronization at the physical layer
- Add clause(s) and/or informative annex to clearly describe the steps when a PTP link is being established for high accuracy
- Example on how to use the mechanism to achieve high accuracy
- The requirements document has been finalized

III-5 IEEE 1588 UPKEEP

- Charter
  - "Incorporate official IEEE interpretations and other known errors or needed clarifications into 1588-2008 in order to provide a clean version as a basis for modifications of the current P1588 working group.
  - Once this is done serve as a 'quality control' function for any modifications proposed by other committees to ensure freedom from inconsistencies and backward compatibility issues."
- Working on proposals to correct known technical and editorial errors
- Several items dealt at the IEEE 1588 Interpretations Committee have been addressed
  - A proposal to clarify Transparent Clock Source Address has been accepted
  - Working on text to add clarity throughout the standard
    - Ex. ClockIdentity, Announce Receipt Timeout, Unicast

III-6 IEEE 1588 management

- Charter
  - "The management SC will consider the management of IEEE 1588 clocks, e.g. MIB, related management protocols (SNMP and native management protocol), and OAM mechanisms."
- The proposal is to create a single IEEE 1588 MIB
- IEEE C37.238 (Power profile) and IEEE 802.1AS have defined their own MIB
- They are also looking for a mechanism to allow in-service monitoring of synchronization quality

III-7 IEEE 1588 security

- Charter
  - "To specify a security capability for PTP. This capability is expected to be optional"
- The requirements document is based on the IETF document "draft-ietf-tictoc-security-requirements"
- Potential technologies that could be use as basis
  - MACSec – link (MAC) based
  - IPSEC
  - Adapt/change/improve Annex K, or deprecate it?

III-8 ITU-T and IEEE 1588 evolution

- All new Q13 recommendations will refer to IEEE 1588-2008, until a revision is published by IEEE, as ITU-T can only refer to approved standards
- But Q13 follows the work done in IEEE,
  - Liaison rapporteur, liaisons
  - Many Q13 participants in 1588 groups
- **Q13 already communicated to 1588 the importance of backward compatibility in telecoms**
  - This was stated by operators in Q13

Where to get the recommendations?

http://www.itu.int/ITU-T/recommendations/index.aspx?ser=G

Calnex

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www.calnexsol.com

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Calnex Paragon Sync

Backup slides

List of main ITU-T recommendations related to synchronization

(updated November 2014)

Recommendations for TDM hierarchies

- **G.803 (03/2000),** ***Architecture of transport networks based on the synchronous digital hierarchy (SDH)***
  - **G.803Amd1(06/2005)**
- **G.810 (08/1996),** ***Definitions and terminology for synchronization networks***
  - ***G.810 Corr1(10/2001)***
- **G.811 (09/1997),** ***Timing requirements of primary reference clocks***
- **G.812 (06/2004),** ***Timing requirements of slave clocks suitable for use as node clocks in synchronization networks***
- **G.813 (03/2003),** ***Timing requirements of SDH equipment slave clocks (SEC)***
  - **G.813 Corr1(06/2005)**
- **G.822 (11/1988),** ***Controlled slip rate objectives on an international digital Connection***
- ***G.823 (03/2000), The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy***
- ***G.824 (03/2000), The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy***
- ***G.825 (03/2000), The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)***
  - ***G.825 Amd1 (05/2008)***
- ***G.781 (09/2008), Synchronization layer functions***

Recommendations for timing over packet networks

- *G.8260 rev(02/2012), Definitions and terminology for synchronization in packet networks*
  - *G.8260 Amd1 (8/2013), Amd2 (5/2014)*

Recommendations for Synchronous Ethernet

- *G.781 (09/2008), Synchronization layer functions*
- *G.8261 rev(08/2013), Timing and Synchronization aspects in Packet Networks*
- *G.8262 (07/2010), Timing characteristics of synchronous Ethernet Equipment slave clock*
  - *G.8262 Amd1 (02/2012), Amd2 (10/2012)*
- *G.8263 (02/2012), Timing characteristics of packet-based equipment clocks*
  - *G.8263 Amd1 (08/2013), Amd2 (05/2014)*
- *G.8264 rev(05/2014), Distribution of timing information through packet networks*

Recommendations for the telecom profile for time and phase

- ***G.8271 (02/2012), Time and phase synchronization aspects of packet networks***
  - ***G.8271 Amd1 (08/2013)***
- ***G.8271.1(08/2013), Network Limits for Time Synchronization in Packet Networks***
  - ***G.8271.1 Amd1 (5/2014)***
- ***G.8272 (10/2012), Timing characteristics of primary reference time clocks***
  - ***G.8272 Amd1 (8/2013)***
- ***G.8273 (08/2013), Framework of phase and time clocks***
  - ***G.8273 Corr1 (5/2014)***
- ***G.8273.2 (05/2014) Timing characteristics of telecom boundary clocks and telecom time slave clocks***
- ***G.8275 (11/2013), Architecture and requirements for packet-based time and phase distribution***
- ***G.8275.1 (07/2014), Precision time protocol telecom profile for phase/time synchronization with full timing support from the network***

Recommendations for OTN

- ***G.8251 (09/2010), The control of jitter and wander within the optical transport network (OTN)***
  - ***G.8251 Amd1 (04/2011),Amd2 (02/2012), Amd3 (10/2012)***
  - ***G.8251 Corr1 (02/2012)***

Recommendations for the telecom profile for frequency only

- ***G.8261 rev(08/2013), Timing and Synchronization aspects in Packet Networks***
- ***G.8261.1 (02/2012), Packet Delay Variation Network Limits applicable to Packet Based Methods (Frequency Synchronization)***
  - ***G.8261.1 Amd1 (5/2014)***
- ***G.8263 (02/2012), Timing characterisctics of packet based equipment clocks***
  - ***G.8263 Amd1 (8/2013), Amd2 (5/2014)***
- ***G.8265 (10/2010), Architecture and requirements for packet based frequency delivery***
- ***G.8265.1 rev(07/2014), Precision time protocol telecom profile for frequency synchronization***

Future recommendations (provisional titles)

- ***G.8266 Stand alone T-GM for frequency***
- ***G.8273.1 Telecom Grand Master***
- ***G.8273.3 Telecom transparent clock***
- ***G.8273.4 A-PTS clock***
- ***G.8275.2 Telecom profile for the transport of time/phase with partial timing support from the network***

Recommendation on Jitter and wander tests equipments

- ***O.171 (04/1997), Timing jitter and wander measuring equipment for digital systems which are based on the plesiochronous digital hierarchy (PDH)***
- ***O.172 (04/2005) , Jitter and wander measuring equipment for digital systems which are based on the synchronous digital hierarchy (SDH)***
- ***O.173 (02/2012), Jitter measuring equipment for digital systems which are based on the Optical Transport Network***
- ***O.174 (11/2009), Jitter and wander measuring equipment for digital system based on synchronous Ethernet network***