

Update on the evolution of IEEE 1588

Doug Arnold
Meinberg USA
ISPCS October 2022

Agenda

1. IEEE 1588
2. Organization and process
3. Projects
4. Inclusive terminology
5. Security
6. Messaging terminology
7. Management
8. For further information or to participate

IEEE 1588 Working Group

- Sponsored by:
 - IEEE Instrumentation and Measurement Society (IMS)
 - Technical Committee 9: Sensors Technology (TC -09)
 - Chair: Kang Lee
- Official Name
 - IM/ST PNCS working group
 - Precision Network Clock Synchronization
 - Not used outside of the IEEE Standards Association

IEEE SA

**STANDARDS
ASSOCIATION**



IEEE 1588 History

- Invented by John Eidson at Hewlett Packard Laboratories in the 1990s
 - Looking for a replacement for the HP-IB trigger bus for test equipment with network ports
 - Chaired IEEE 1588 WG until 2020
- IEEE 1588-2002
 - Defined PTP v1
 - Designed mostly to meet the needs of Industrial Automation
- IEEE 1588-2008
 - Defined PTP v2
 - Not backwards compatible with PTPv1
 - Allows profiles to support many industries
- IEEE 1588-2019
 - Defined PTPv2.1
 - Backward compatible with PTPv2



IEEE Working Group

- Officers
 - IEEE Society Sponsor: Kang Lee, NIST
 - Chair: Doug Arnold, Meinberg
 - Vice Chair: Rodney Cummings, National Instruments
 - Secretary: Silvana Rodrigues, Huawei
 - Editor: John MacKay, Progeny Systems
- Sub-groups (sub-committees)
 - **New Features** (Chairs: Maciej Lipinski, CERN and Stefano Ruffini, Calnex)
 - **Security** (Chair: Karen O'Donoghue, Internet Society)
 - **Management** (Chair: Rodney Cummings)
 - **Maintenance** (Chair: Doug Arnold)
 - **Outreach** (Chair: Terry Jones, Oak Ridge National Laboratory)

Revising an IEEE Standard

- Corrigenda
 - Collection of minor editorial corrections to current edition
- Amendment
 - Collection of editorial and technical changes to current edition
 - Usually on a focused topic
- Revision
 - Only method used by the IEEE 1588 working group so far
 - New edition replaces old
 - Incorporates any existing corrigenda and amendments
 - Called “roll-up revision” if only change is bringing in existing corrigenda and amendments
- Current 1588 working group approach:
 - Amendments + roll-up revisions
 - For greater agility

IEEE SA Amendments Process

Process highlights

1. Submit a project authorization request (PAR) to IEEE standards association and get it approved
2. Working group creates a draft amendment and votes to send it to the IEEE standards association
3. IEEE SA ballot: people comment on draft and vote, must get 75% yes votes and resolve all comments
4. Recommended by IEEE RevCom, and approved by IEEE Standards Board
5. Working group leaders work with IEEE editors on final formatting and editorial changes
6. Amendment is published and available for download
 - If you buy the standard, you get any published amendments and corrigenda

Agenda

1. IEEE 1588
2. Organization and process
3. Projects
4. Inclusive terminology
5. Security
6. Messaging terminology
7. Management
8. For further information or to participate

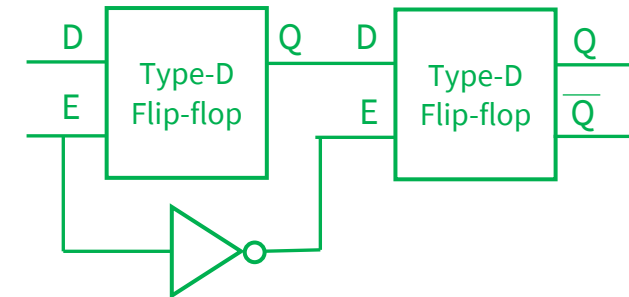
Approved IEEE 1588 Projects (PARs)

Project	Topic	Sub-group	Status
P1588a	Informative annexes on BMCA and alternate BMCAs	New features	SA ballot 1 Comment resolution
P1588b	Mapping for Optical Transport Networks (OTN)	New features	Published
P1588c	Clarification of terminology	Maintenance	Prep for SA ballot 1
P1588d	GDOI key management	Security	PAR change submitted for title change
P1588e	SNMP MIB and YANG data model for PTP	Management	WG ballot 3
P1588f	Asymmetry corrections	New features	drafting
P1588g	Alternative to Master and slave	Maintenance	Schedule for RevCom review

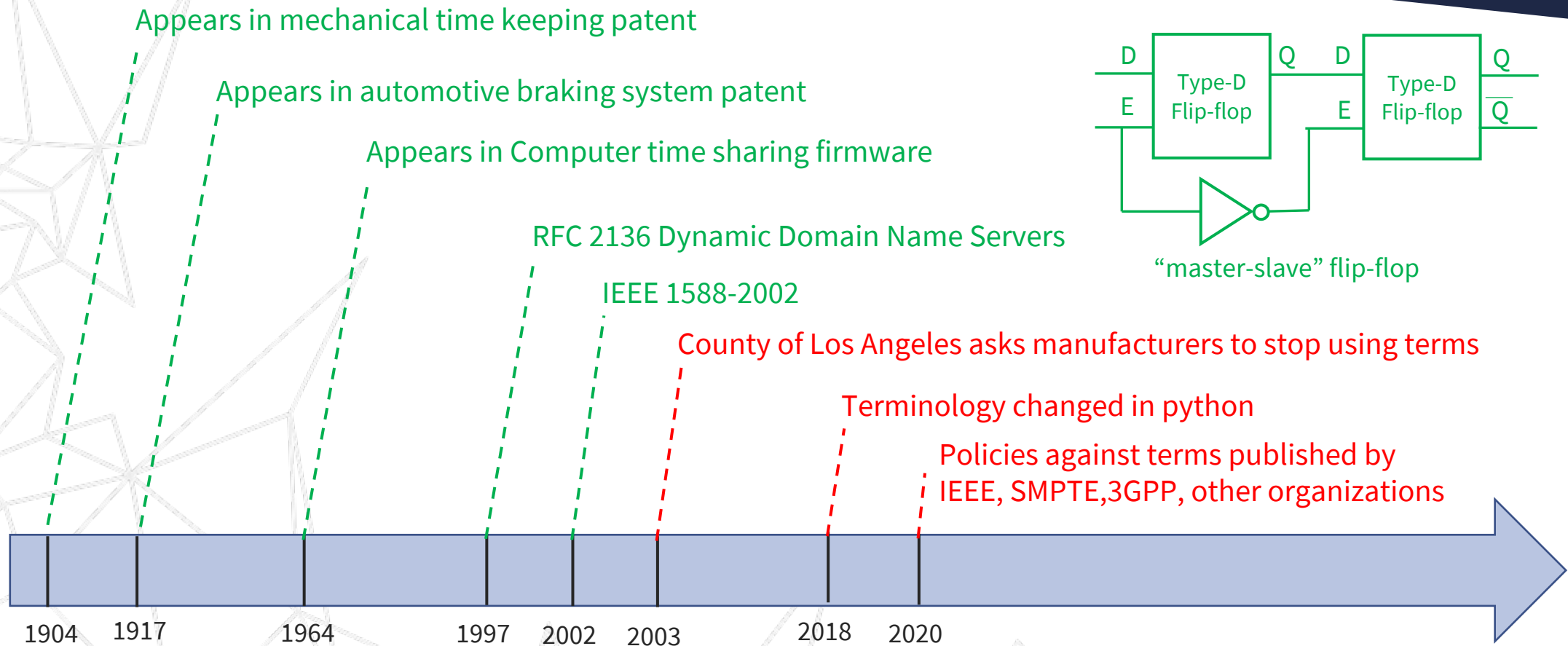
Agenda

1. IEEE 1588
2. Organization and process
3. Projects
4. Inclusive terminology
5. Security
6. Messaging terminology
7. Management
8. For further information or to participate

Master-slave Terminology in Technology



“master-slave” flip-flop



Eglash found ~ 20,000 patents using master/slave terminology (1976 - 2006)

“Broken Metaphor: The Master-Slave Analogy in Technical Literature,”
Ron Eglash (University of Michigan) Technology and Culture, April 2007

P1588g Outcome and Status

- Alternative terms selected
 - master -> timeTransmitter
 - slave -> timeReceiver
 - Grandmaster unchanged (not included in PAR)
- On the schedule for review by RevCom in December
- IEEE 802.1AS amendment will be based on P1588g alternative terminology. However, they will actually make the change in their standard.

Why Not Actually Change the Terms in 1588?

- Change not supported by a majority of working group members
 - Some WG members support the project only or mainly to discourage profiles and products from all using different new terms, causing confusion
- Concerns:
 - Cost of changing product management interfaces, manuals and marketing literature
 - Confusion of PTP user community after three editions of 1588 and numerous profiles used master-slave
 - Amount of work needed to change standard (498 pages, hundreds of tables and figures)
 - 1496 instances of slave or master (not counting grandmaster) in standard
 - “This is a political issue and outside of the scope of a technical working group.”
 - “This is an American issue of no relevance to other countries.”
- No issue has led to more debate than this one since I have been involved with 1588.
 - That is, since the start of the first revision of 1588 starting in 2005.

Why Not a New Term for Grandmaster?

- Master has two meanings
 1. Related to command and control
 2. Related to expertise at a skill or subject matter
- The use of master to describe a role in the institution of slavery is based on meaning 1
- Grandmaster is based on meaning 2
 - For example, grandmaster of chess or martial arts
- Less commonly grandmaster is used as a title in an organizational hierarchy
 - For example, the Free Masons, Knights Templar
- Neither of these uses of grandmaster are related to the institution of slavery

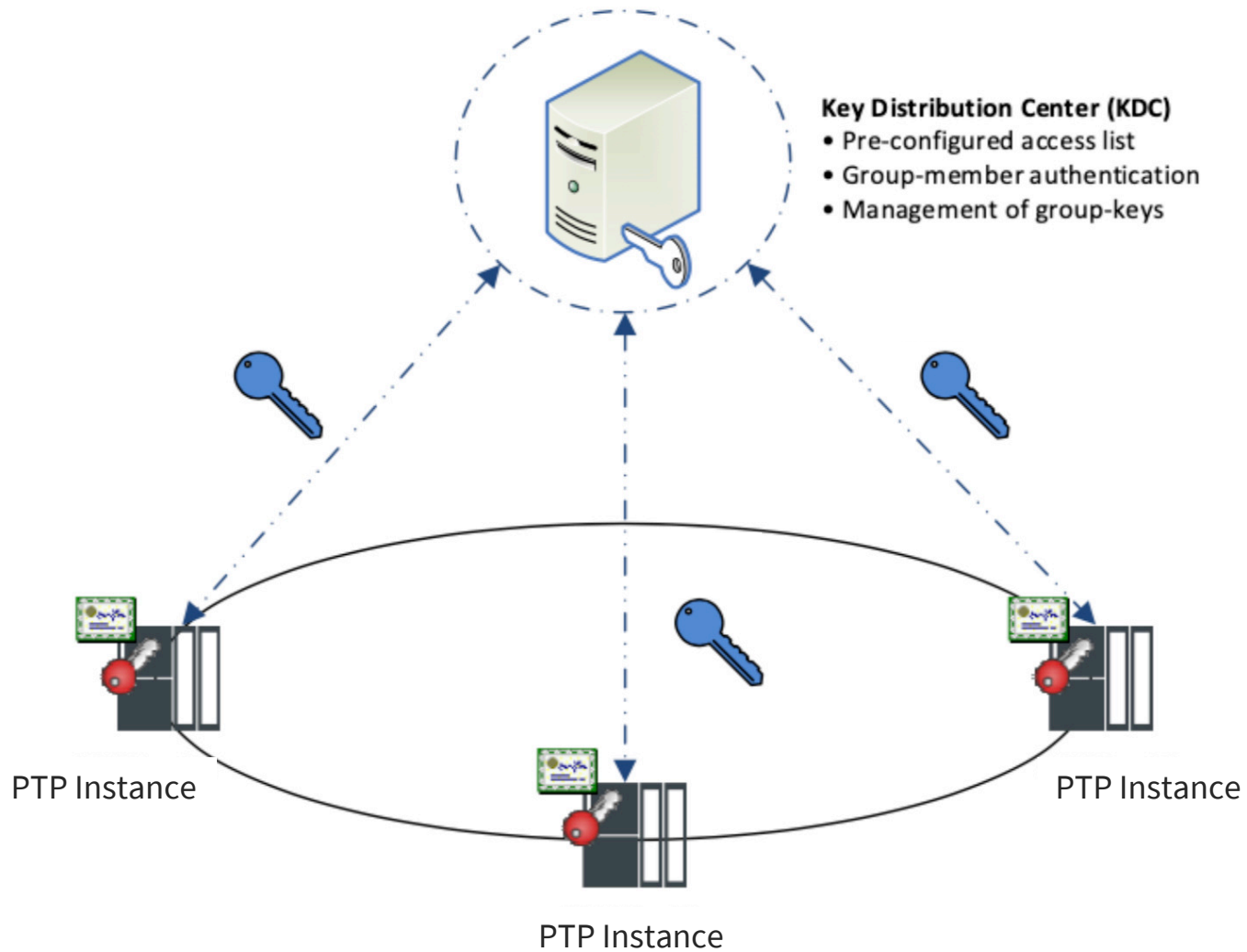
Agenda

1. IEEE 1588
2. Organization and process
3. Projects
4. Inclusive terminology
5. **Security**
6. Messaging terminology
7. Management
8. For further information or to participate

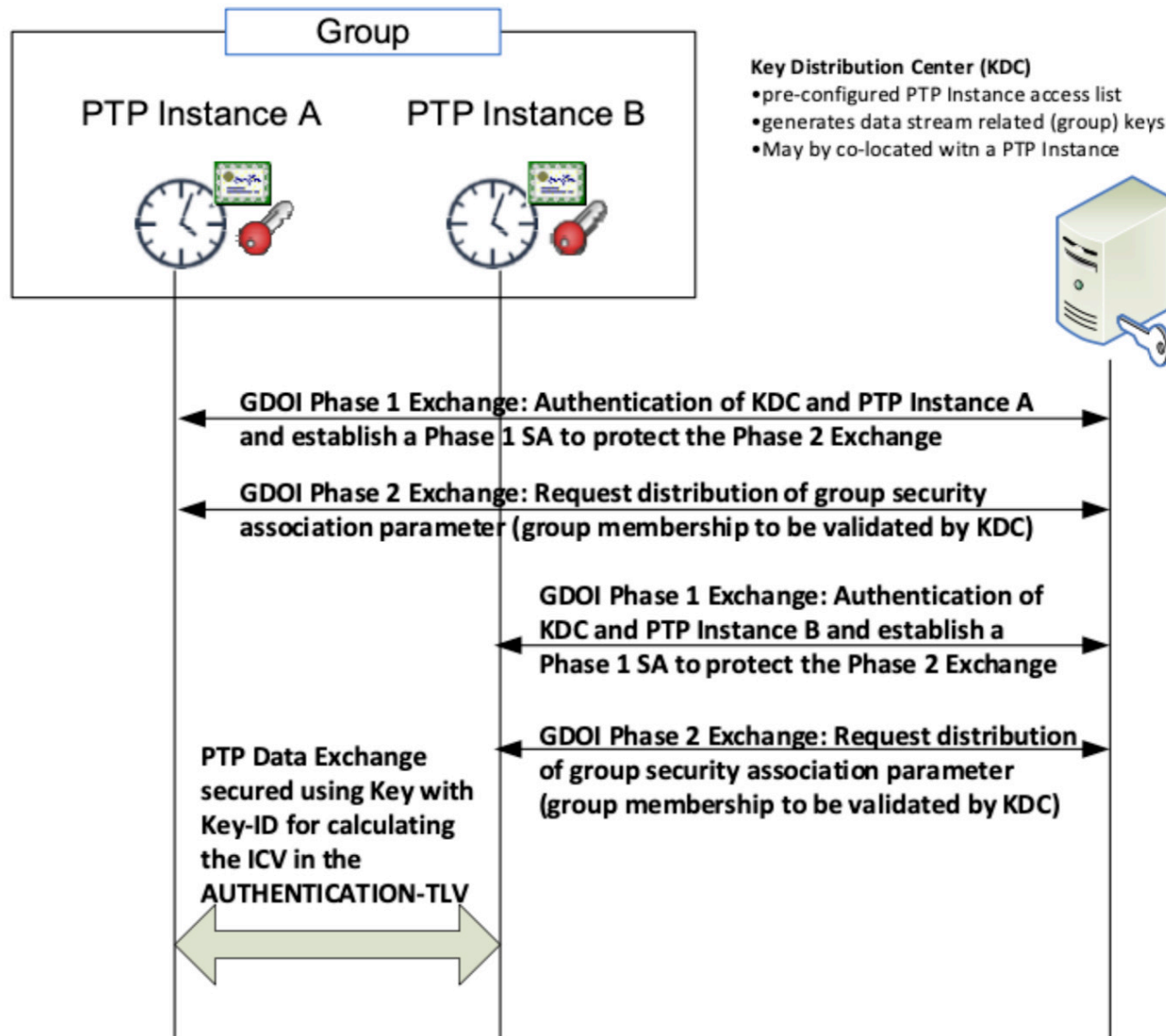
Key Management for Security

- IEEE 1588-2019 defined AUTHENTICATION TLV
 - Can be used to determine if a PTP Message has been altered in the PTP communication path
 - 1588-2019 did not specify a detailed mechanism for automated key distribution and renewal
- P1588d addresses key management
 - Originally intended to present several key management mechanisms
 - Only GDOI Key management was sufficiently developed to be included
- GDOI key management
 - Group key scheme: PTP instances in a configured group periodically get common Symmetric key
 - PTP instances may get authenticated when joining group or getting new key
 - PTP instances may authenticate key distribution center (key server)
 - Underlying technology is based on IPsec

Key Distribution Center



GDOI for PTP



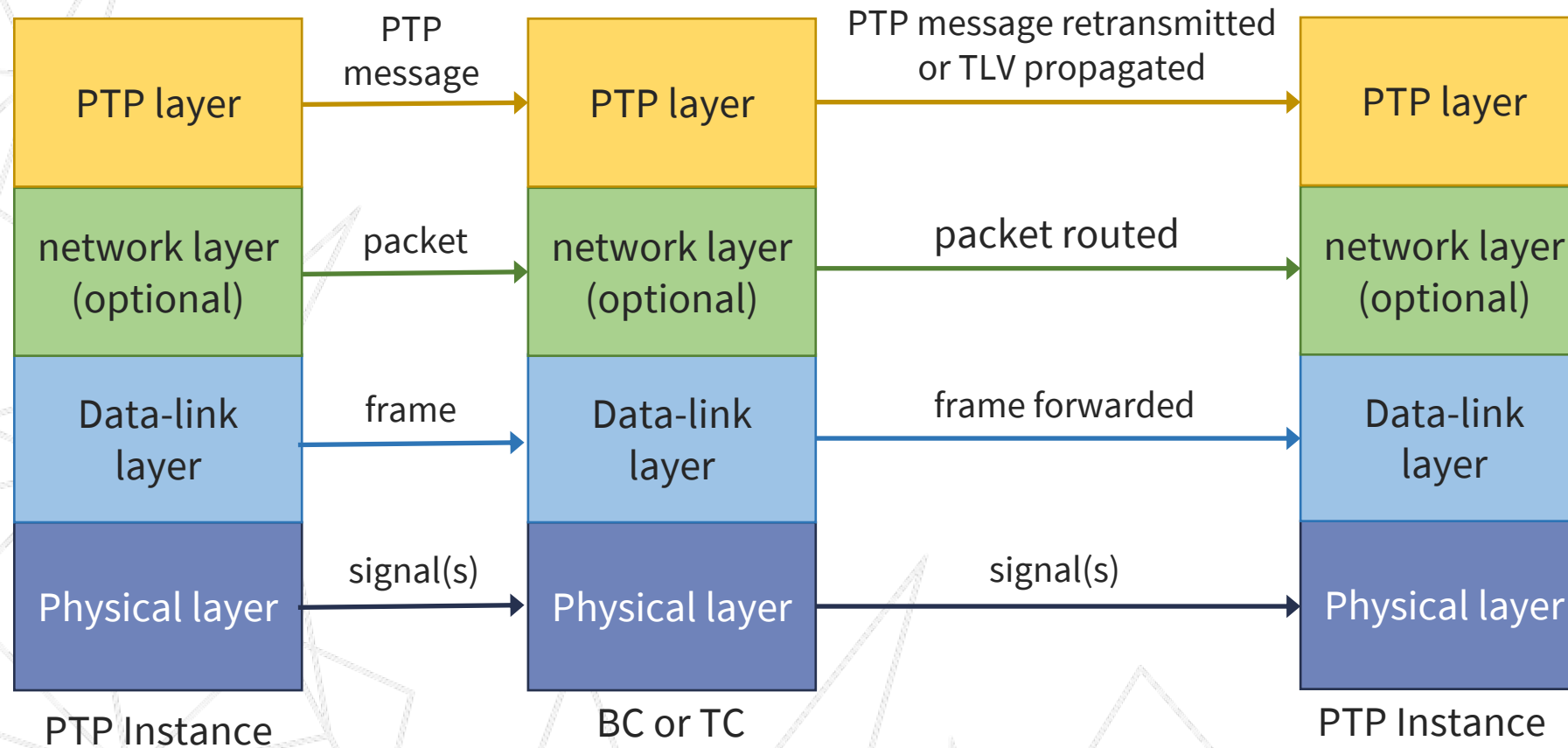
Agenda

1. IEEE 1588
2. Organization and process
3. Projects
4. Inclusive terminology
5. Security
- 6. Messaging terminology**
7. Management
8. For further information or to participate

IEEE Maintenance Process

1. WG members add items to the Maintenance Items Database
 - description of issue
 - submitted resolution
2. Maintenance Subgroup reviews items
 - Accept proposed resolution
 - Edit proposed resolution
 - reject item (reason must be documented)
3. Proposed resolution assigned to most appropriate amendment process

P1588c Clarification of terminology



P1588c Clarification of Terminology

- Retransmission vs transmission of new PTP message
 - A PTP message can be retransmitted at the PTP layer by BC or TC
 - Retransmission generally means that it is the same message as one received by the BC or TC
 - Retransmitted message can have some fields altered
 - Retain source port identity of original PTP Port
- TLV propagation
 - Some TLVs are terminated at BC or TC, others are propagated in retransmitted messages, or attached to new transmitted messages of the same type
 - Whether TLVs propagate or not depends on feature TLVs support
 - Only TLVs attached to Announce messages might be propagated by BC or TC that do not support that TLV (depending on TLV number)
- Many small corrections and clarifications from Maintenance Item Database

Agenda

1. IEEE 1588
2. Organization and process
3. Projects
4. Inclusive terminology
5. Security
6. Messaging terminology
7. Management
8. For further information or to participate

P1588e Standard MIB and YANG for PTP

- IEEE 1588 has never previously specified an SNMP MIB or YANG data model for PTP capable device management
- MIB and YANG designed to take advantage of features, and live within limitations, of their respective technologies
 - As opposed to auto generating one from the other
- Challenge: PTP Profiles
 - Option 1 – make a copy and edit it
 - Option 2 – turn off unused features, and add new ones to “stubs” in sturctures based on profile
- Challenge: Multiple instances – instance number at top level of structure
- Project status: Third working group ballot

For more information

- Public website on IEEE 1588: <https://sagroups.ieee.org/1588/>
 - Information on 1588 standards development
 - Tutorial information on PTP
- How to get involved: <https://sagroups.ieee.org/1588/how-to-join-p1588/>
- Thank you for your attention

