

# White Rabbit standardization in IEEE 1588 (PTP)

Maciej Lipinski

White Rabbit Workshop

2016-03-14

Amsterdam

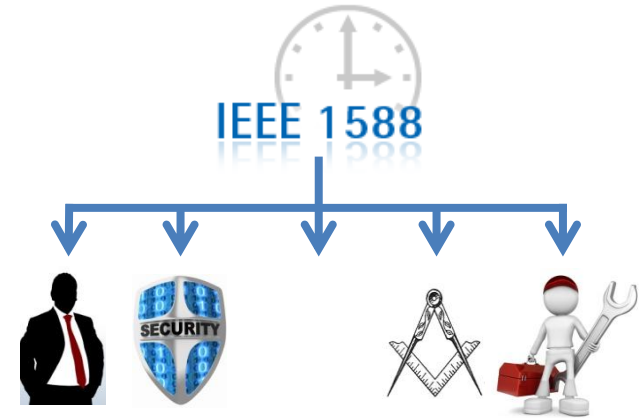
# IEEE 1588 standard revision



- Enforced by standard life-cycle
- Performed by **P1588 Working Group** with over 200 members

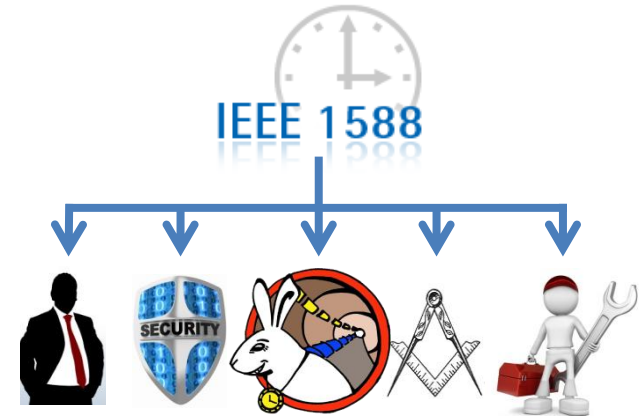
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- High Accuracy sub-committee dedicated to White Rabbit

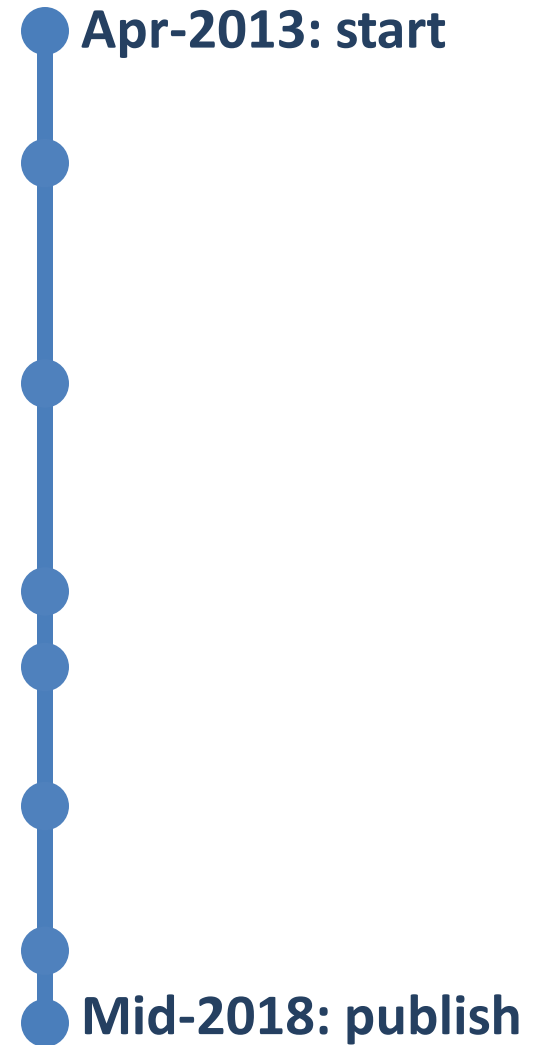


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# High Accuracy process



# High Accuracy process

## Project Authorisation Request (PAR)

IEEE Standard for a Precision Clock  
Synchronization Protocol for  
Networked Measurement and Control  
Systems

The protocol enhances  
support for synchronization to  
better than 1 nanosecond.

### 1. Overview

#### 1.1 Scope

This standard defines a protocol enabling precise synchronization of clocks in measurement and control systems implemented with technologies such as network communication, local computing, and distributed objects. The protocol is applicable to systems communicating by local area networks supporting multicast messaging including, but not limited to, Ethernet. The protocol enables heterogeneous systems that include clocks of various inherent precision, resolution, and stability to synchronize to a grandmaster clock. The protocol supports system-wide synchronization accuracy in the sub-microsecond range with minimal network and local clock computing resources. The default behavior of the protocol allows simple systems to be installed and operated without requiring the administrative attention of users. The standard includes mappings to User Datagram Protocol (UDP)/Internet Protocol (IP), DeviceNet, and a layer-2 Ethernet implementation. It includes formal mechanisms for message extensions, higher sampling rates, correction for asymmetry, a clock type to reduce error accumulation in large topologies, and specifications on how to incorporate the resulting additional data into the synchronization protocol. The standard permits synchronization accuracies better than 1 ns. The protocol has features to address applications where redundancy and security are a requirement. The standard defines conformance and management capability. There is provision to support unicast as well as multicast messaging. The standard includes an annex on recommended practices. Annexes defining communication-medium-specific implementation details for additional network implementations are expected to be provided in future versions of this standard.

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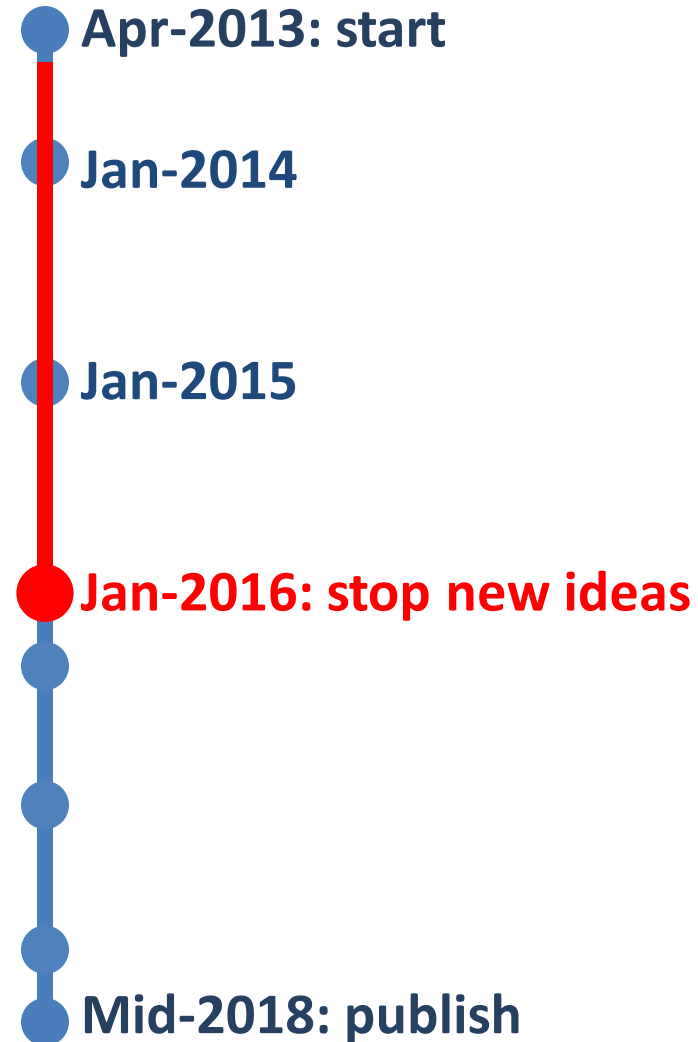
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● Apr-2013: start



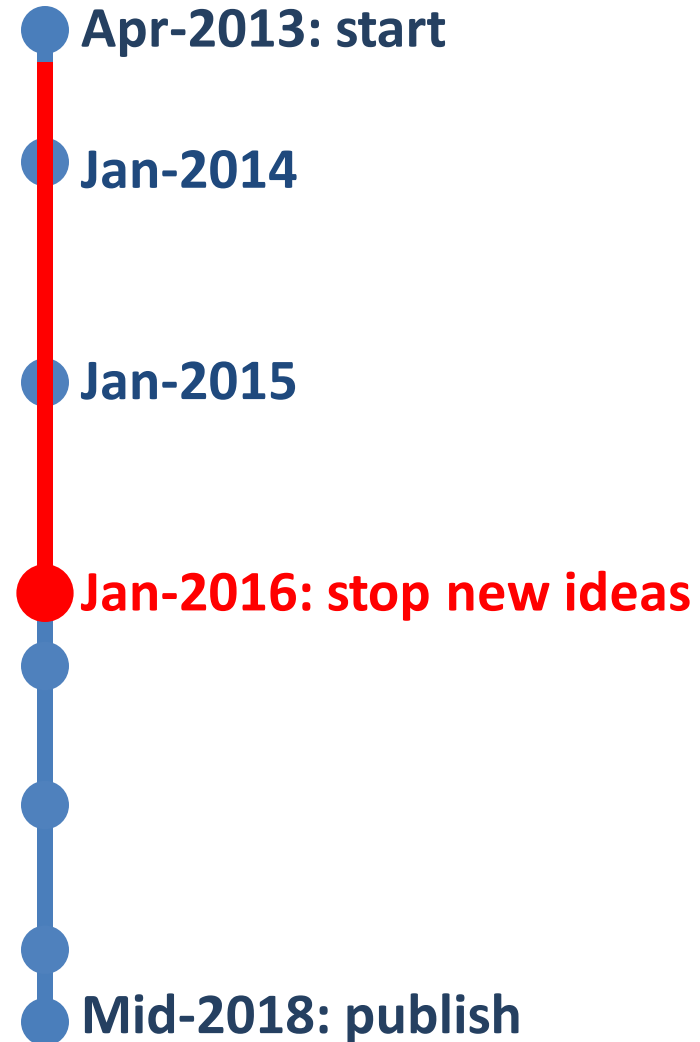
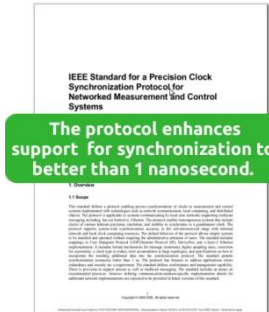
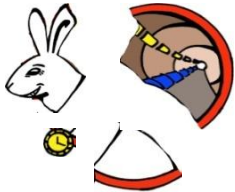
● Mid-2018: publish

# High Accuracy process

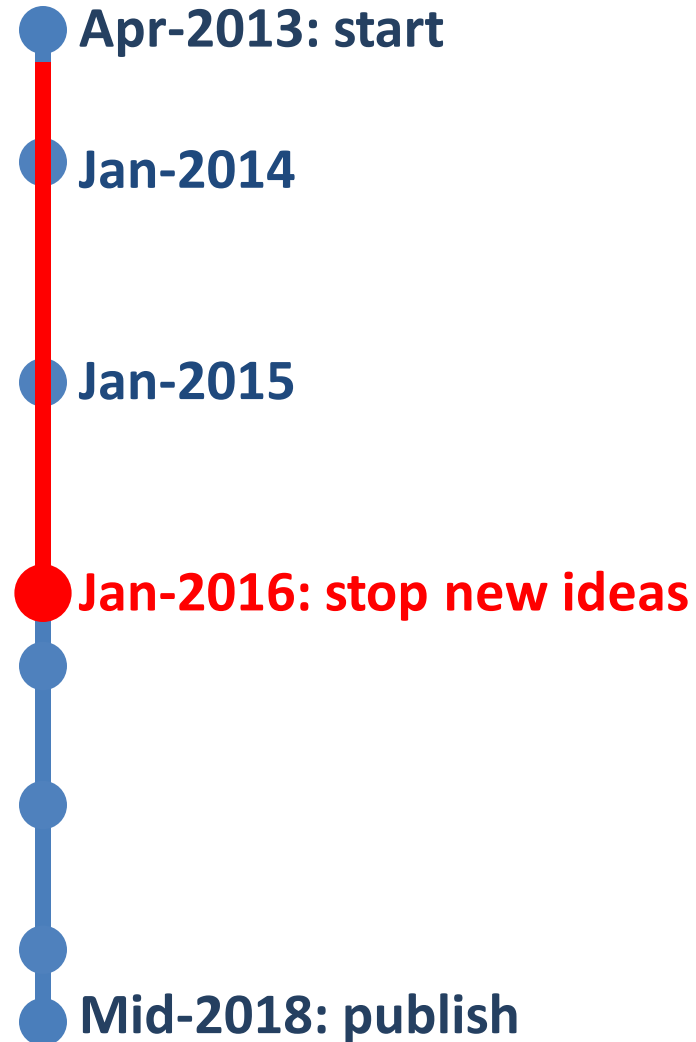
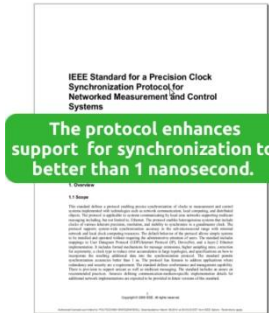
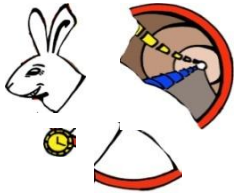




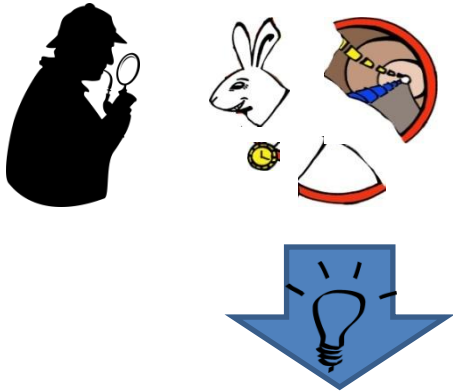
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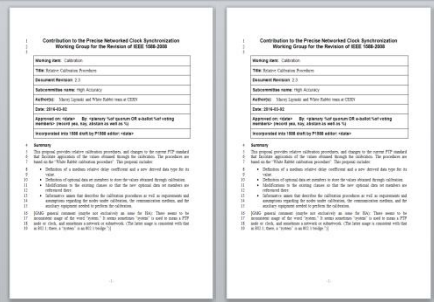
● Jan-2014

● Jan-2015

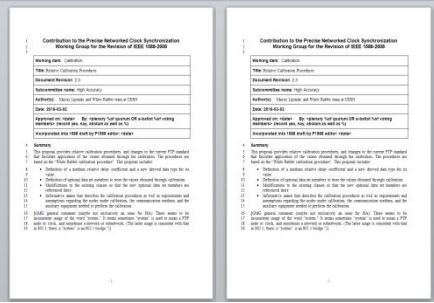
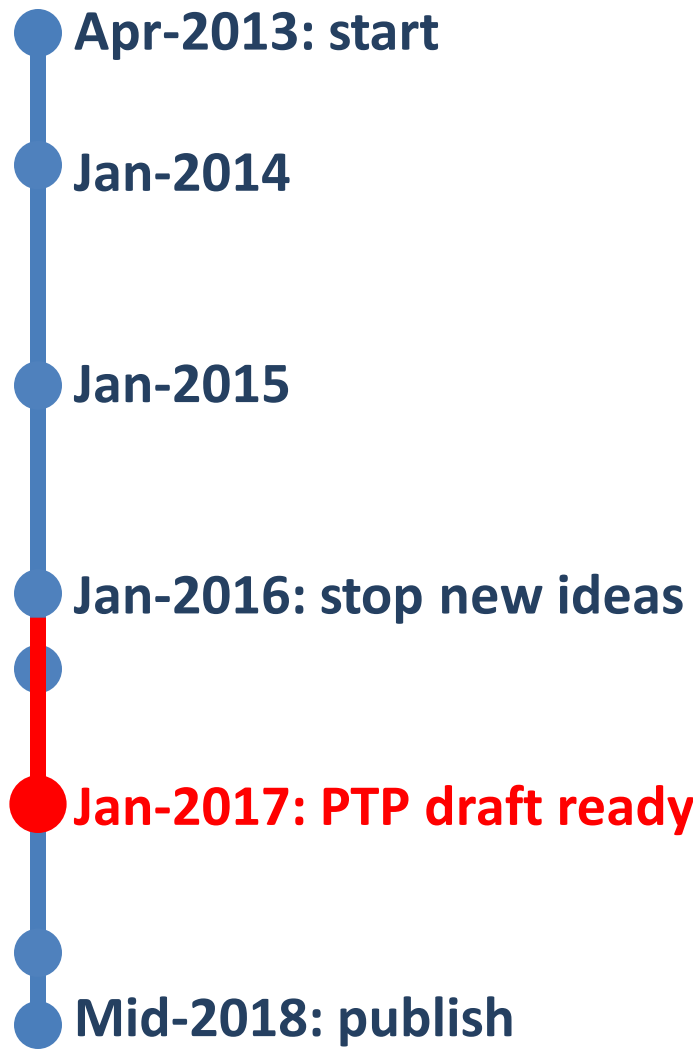
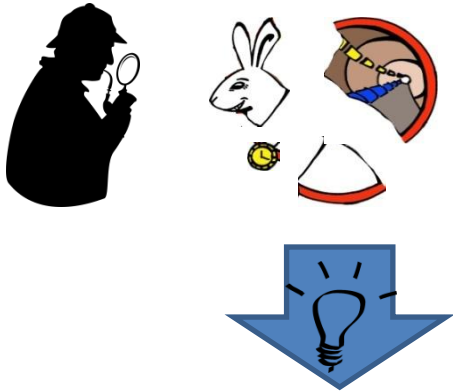
● Jan-2016: stop new ideas

● Mid-2018: publish

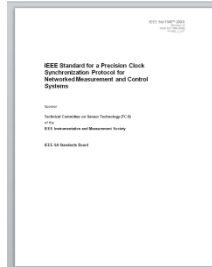
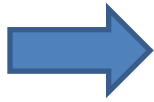
Drafts of proposals



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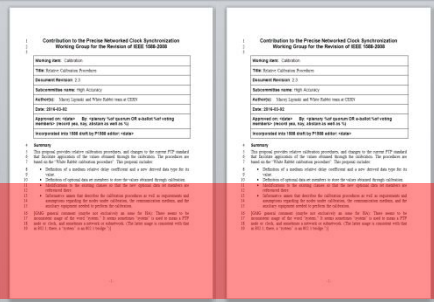
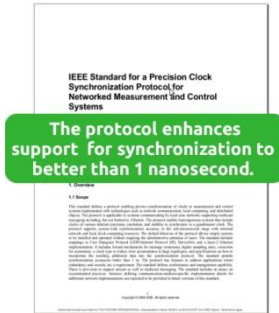
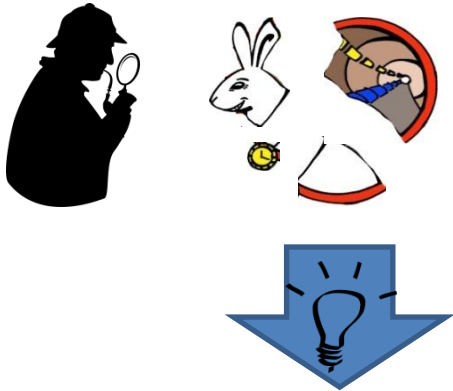


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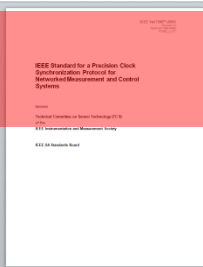
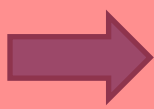


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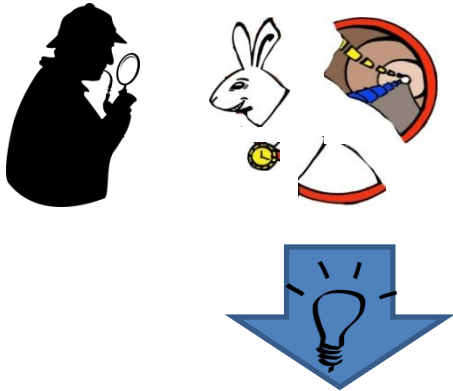


Drafts of proposals



Draft of revised IEEE1588 **now**

# High Accuracy process



Apr-2013: start

Jan-2014

Jan-2015

Jan-2016: stop new ideas

WR Workshop Amsterdam

Jan-2017: PTP draft ready

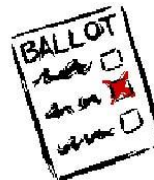
Jan- 2018: finish ballot

Mid-2018: publish

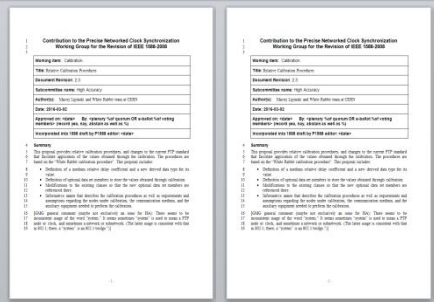
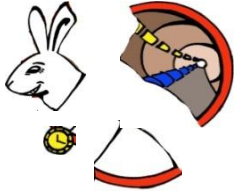
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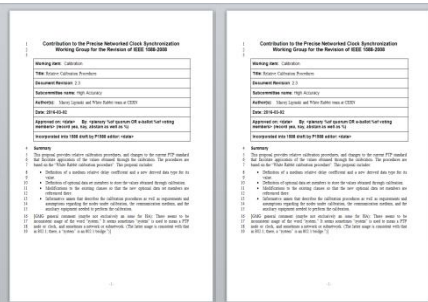
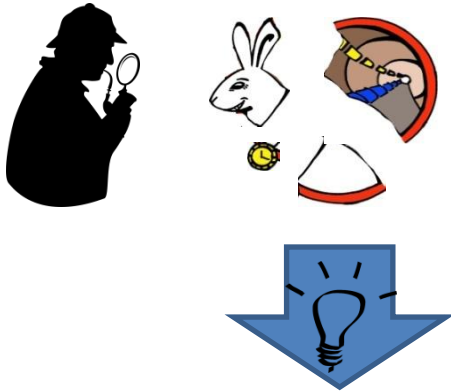


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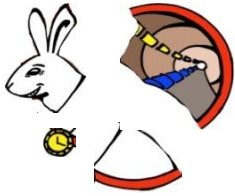
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  - Definitions
  - Sub-ns range for grandmaster's clockAccuracy attribute

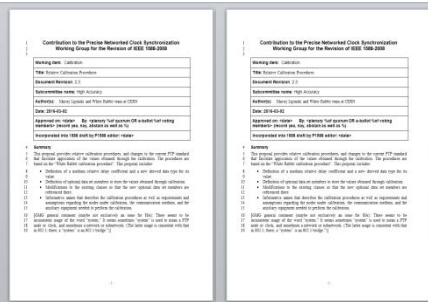




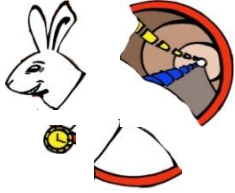
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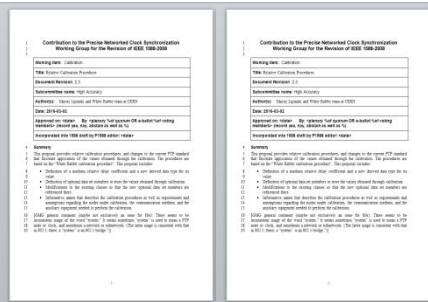
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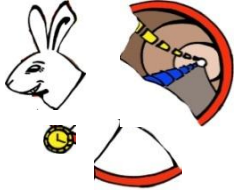
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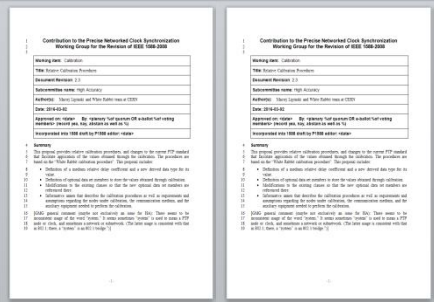
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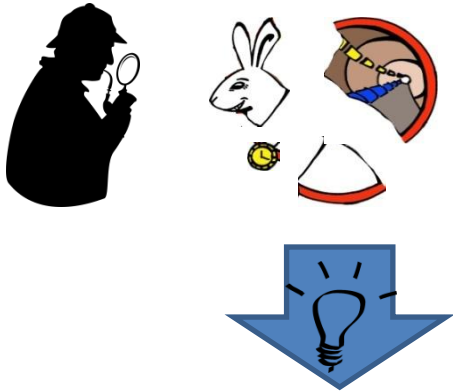
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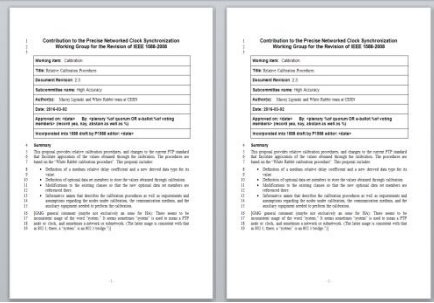
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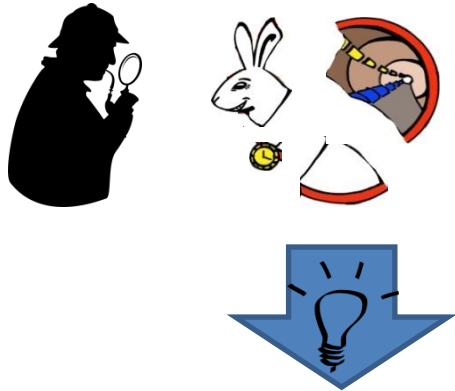
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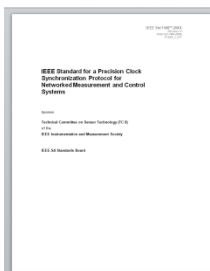
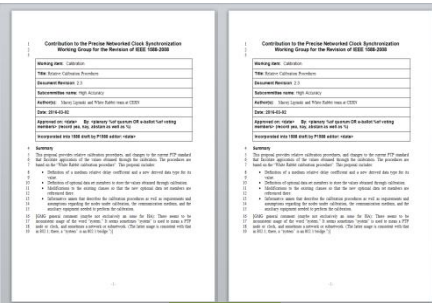
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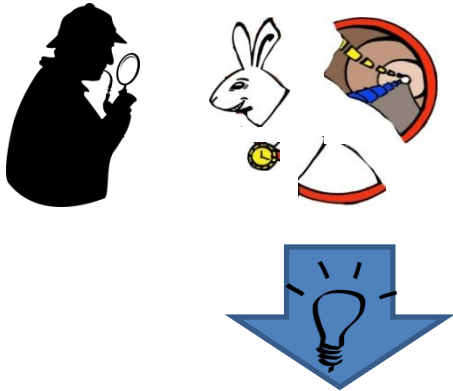


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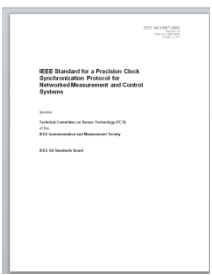
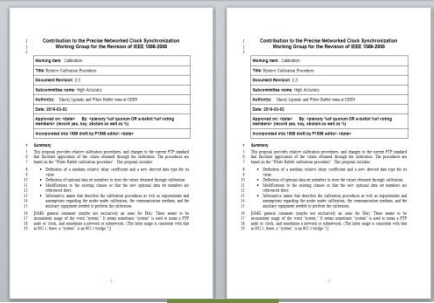


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# Drafts of proposals



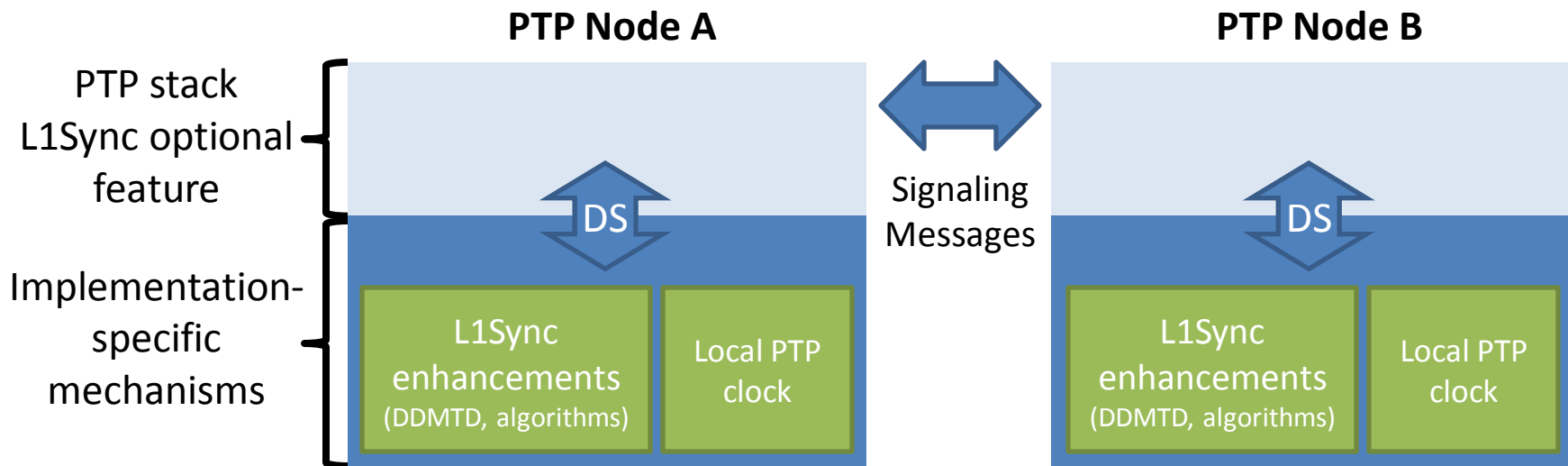
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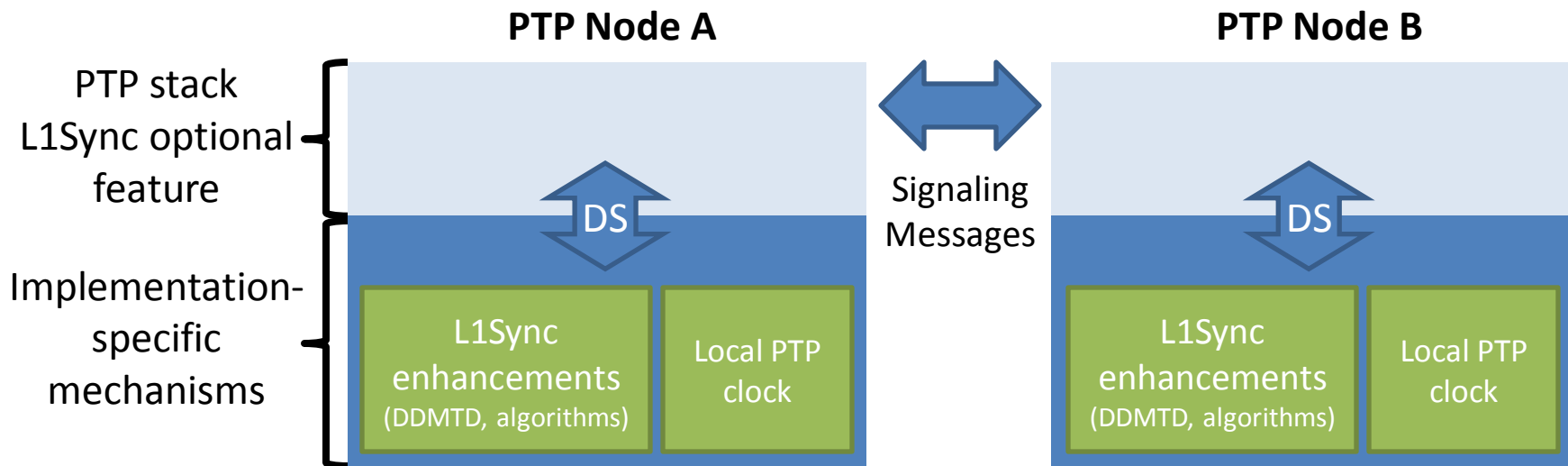
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- Network communication using **Signaling Messages**:
- Local communication using **PTP data sets (DS)**:



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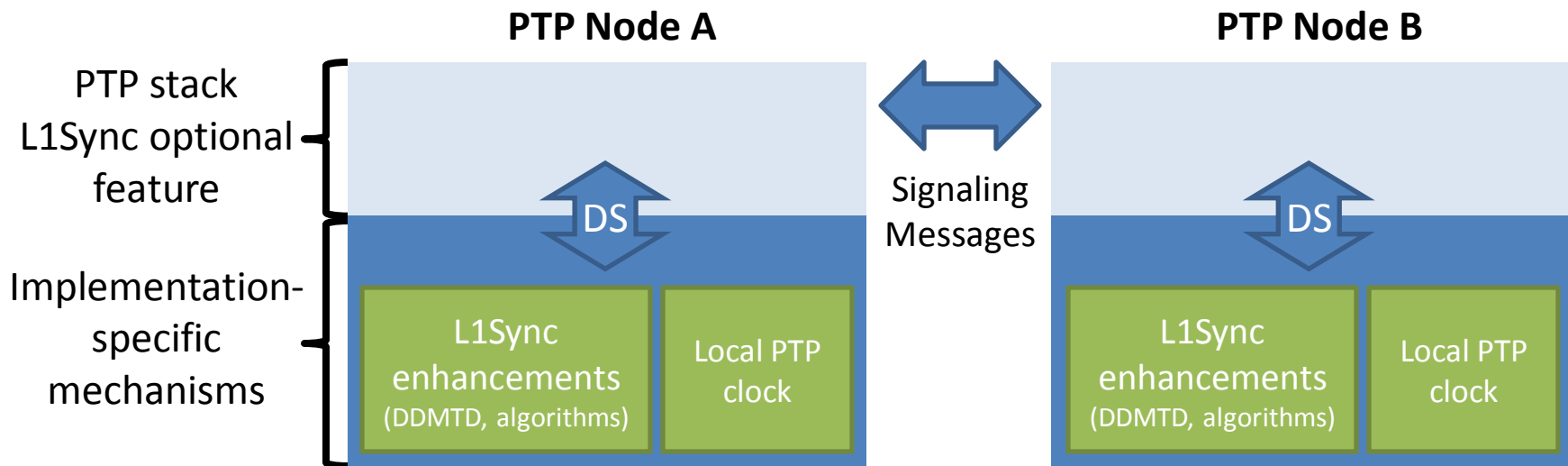
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- Local communication using **PTP data sets (DS)**:





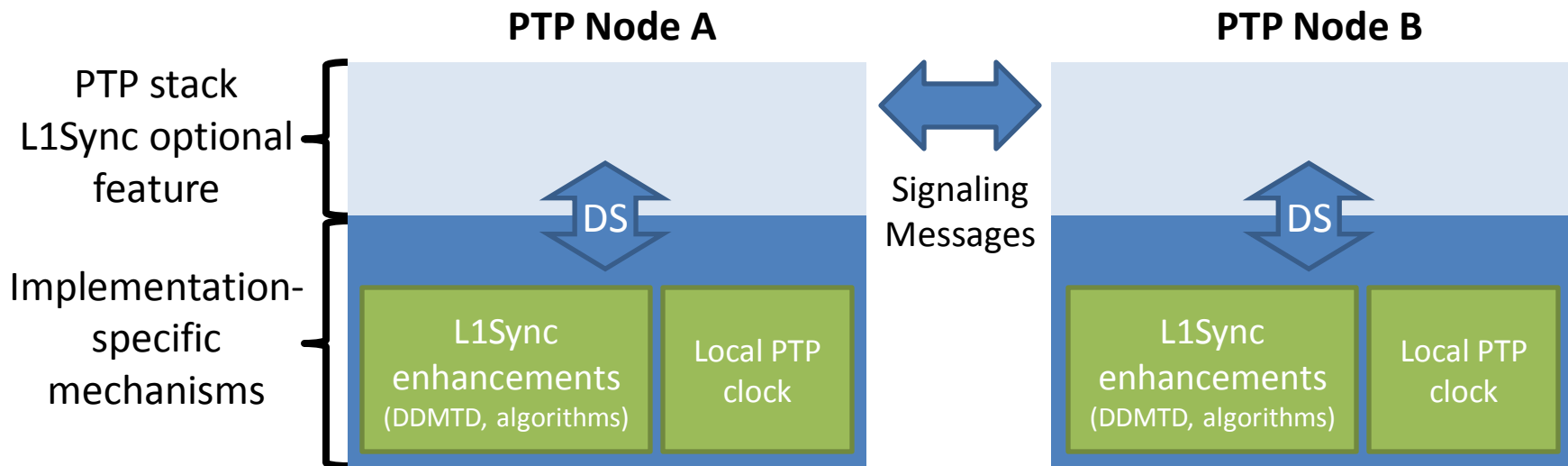
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# L1-based synchronization enhancements

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  - Ensure direct connection
  - Ensure identical configuration
  - Ensure appropriate state
- Local communication using **PTP data sets (DS)**:
  - Communicate configuration
  - Communicate current state
- For sub-ns implementation of High Accuracy (White Rabbit), it ensures
  - Ensure locked state of slave's PLL
  - Ensure loopback of frequency for DDMTD



# Calibration

- Data Sets
  - ingressLatency, egressLatency, delayAsymmetry, delayCoefficient ( $\alpha$ )
  - store configuration
  - allow configuration through management

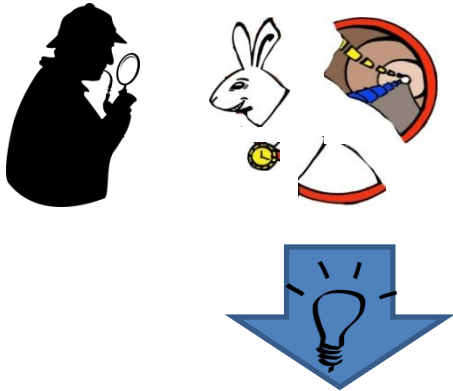
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  - store configuration
  - allow configuration through management
- Calculation of delayAsymmetry from delayCoefficient ( $\alpha$ )
- Informative annex with Calibration procedures
  - Theoretical Background
  - Assumptions and requirements
  - Two-way medium delay calibration
  - Calibrator pre-calibration
  - PTP node calibration
  - Calibrator recovery-calibration
  - Calibration of relative delay coefficient for media with interrelated one-way delays

# Drafts of proposals



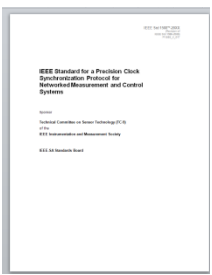
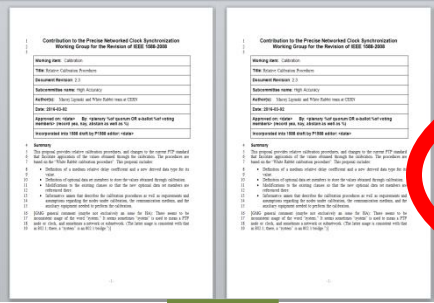
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## Other Optional Features

- Port configuration from an external interface
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## High Accuracy Default Req Resp Profile

- **Description of Sub-ns implementation**

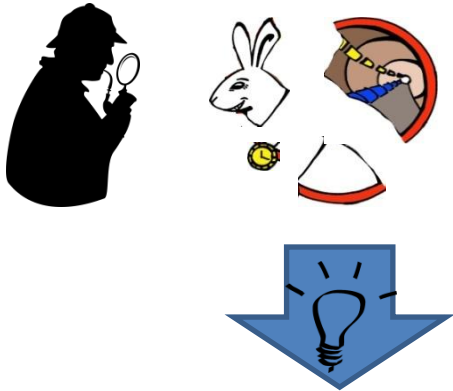


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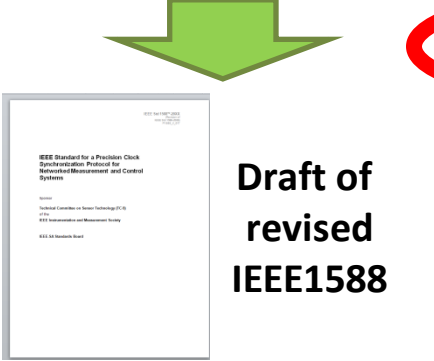
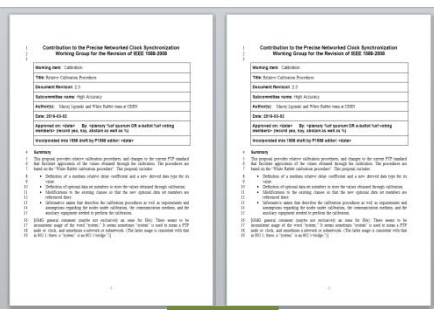
# Other Optional Features

- Port configuration from external interface
  - Disable Best Master Clock Algorithm
  - Use management to configure port states: master/slave
- **masterOnly mode**
  - Use Best Master Clock Algorithm
  - Disallow some ports from being Slave

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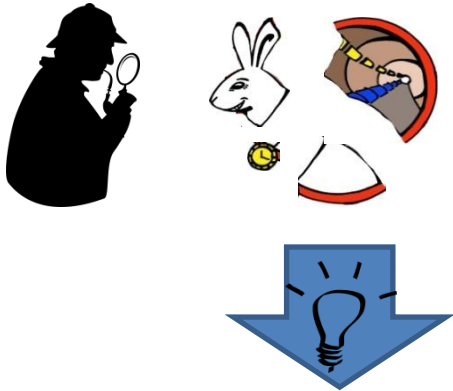
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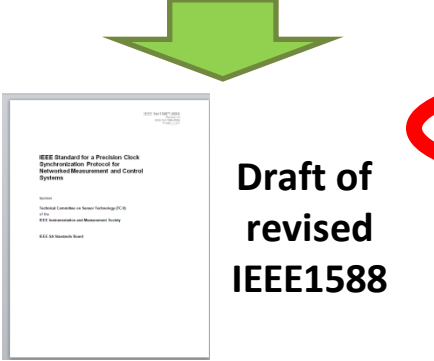
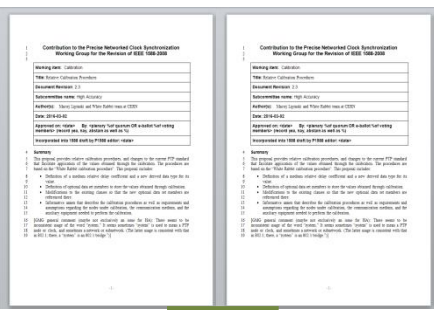
# High Accuracy Default Req-Resp Profile

- Extends Delay Req-Resp Default PTP Profile
- Mandates support of optional features required by High Accuracy
- Defines default and allowed values for the optional features
- Mandates interoperability with Delay Req-Resp Default Profile
- Defines High Accuracy Clock Model
  - Syntonization through Layer-1
  - Synchronization through PTP

# Drafts of proposals

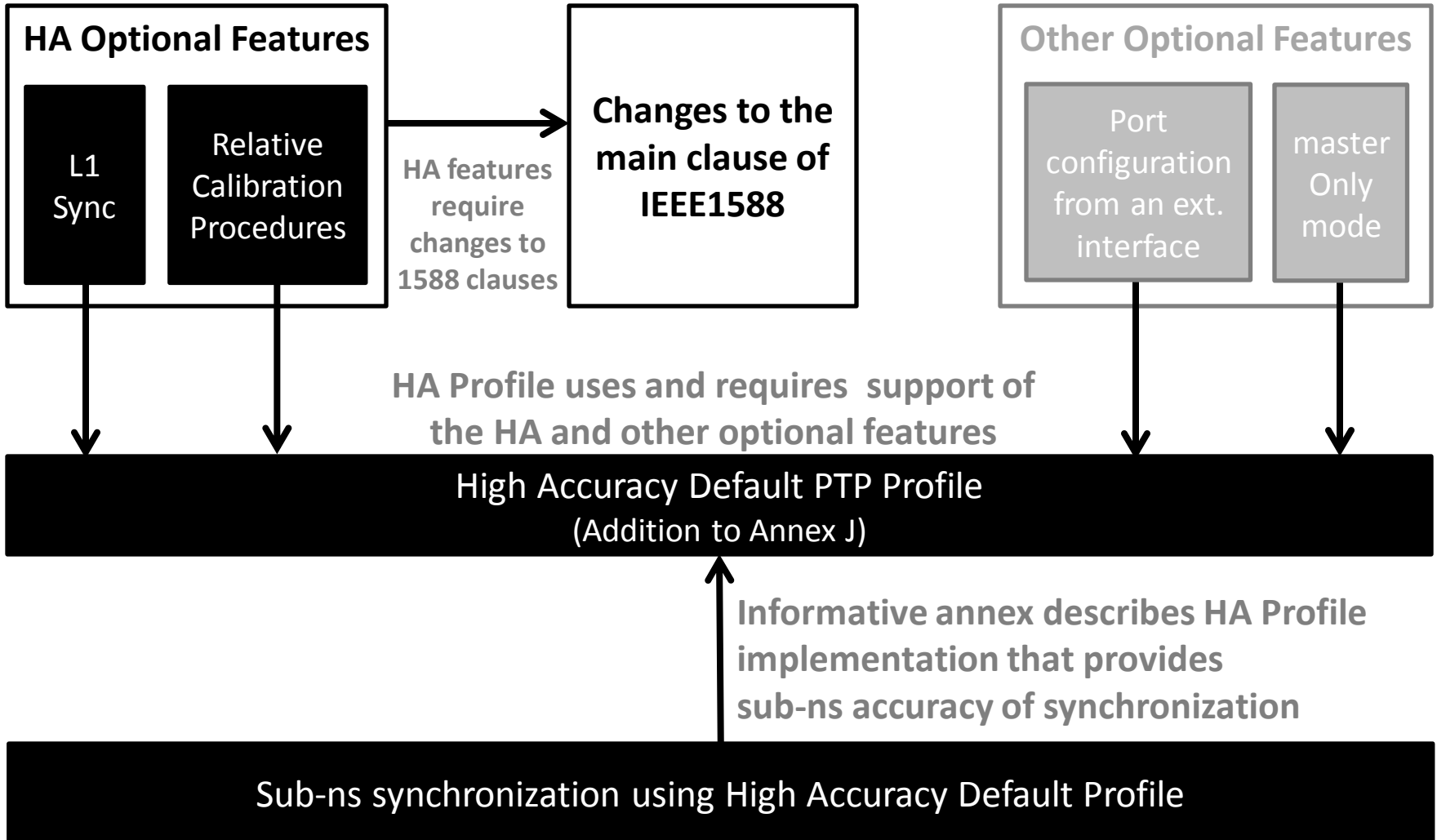


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# High Accuracy Package



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