

# Test and Evaluation System For Multi-Protocol Sampled Value Protection Schemes

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**802.3<sup>TM</sup>**

**IEC  
61850-9-2**

**1588<sup>TM</sup>**

**IEC  
61850-8-1**



# Presentation overview

- Transmission smart-grid
- Project information
- Process connections
- Test bed equipment
- Time synchronisation
- Preliminary results
- Summary

# The “Transmission Smart Grid”

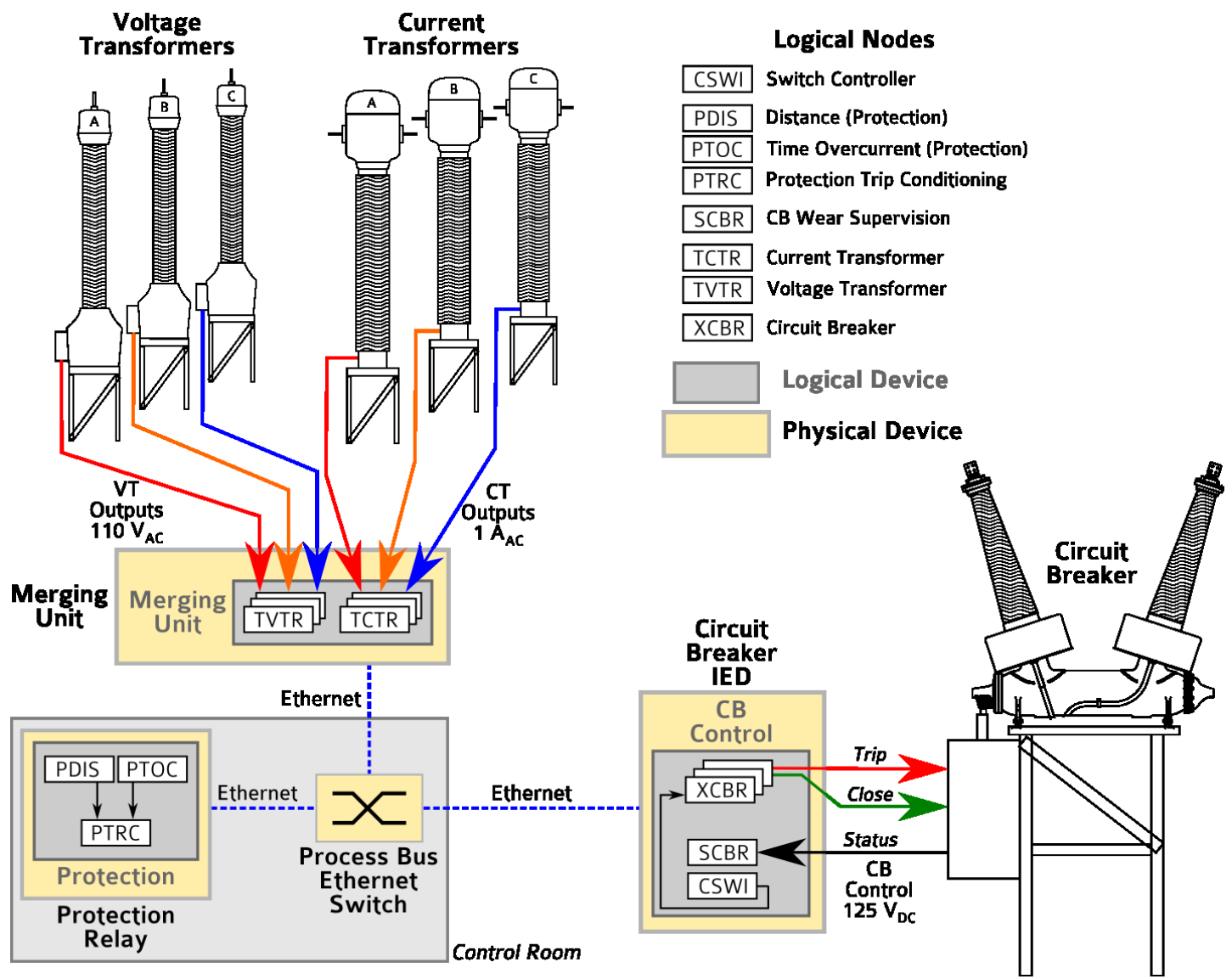
- IEC and NIST have released Smart Grid ‘roadmaps’.
  - ‘Foundation’ standards are recommended.
  - Cooperation between the organisations.
- Characteristics
  - Digitisation
  - Autonomy
  - Coordination
  - Self healing
- Benefits
  - Reliability
  - Flexibility
  - New Technology



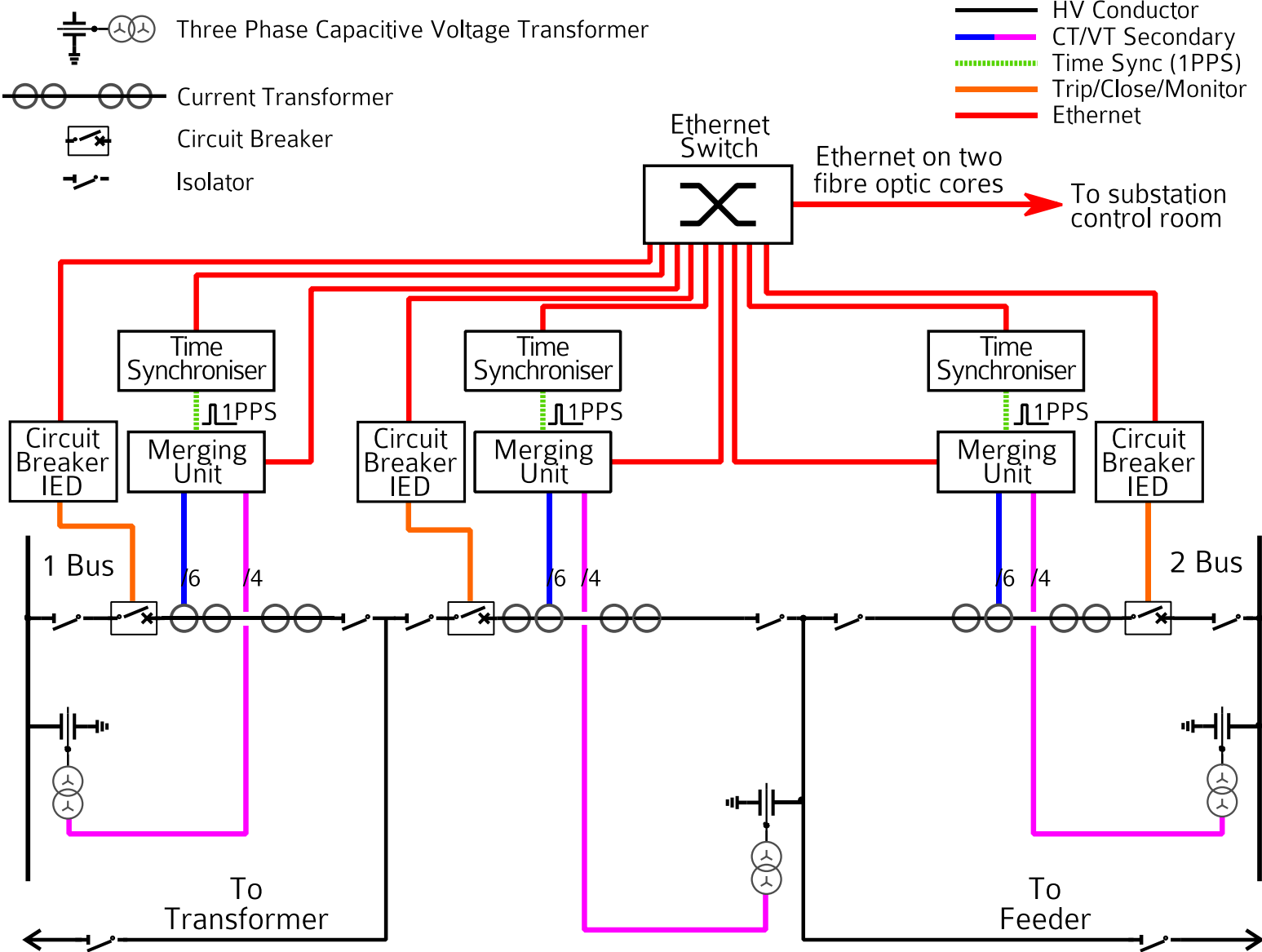
# Project information

- Process bus and NCITs not new technology.
- Seeking to discover:
  - Technical limitations and utilities' concerns
  - Interaction of protocols
- A test & evaluation framework used to assess this.
- Aim is to provide tangible information on performance.
  - Provide utilities confidence to adopt the technology.

# Process bus distributed protection

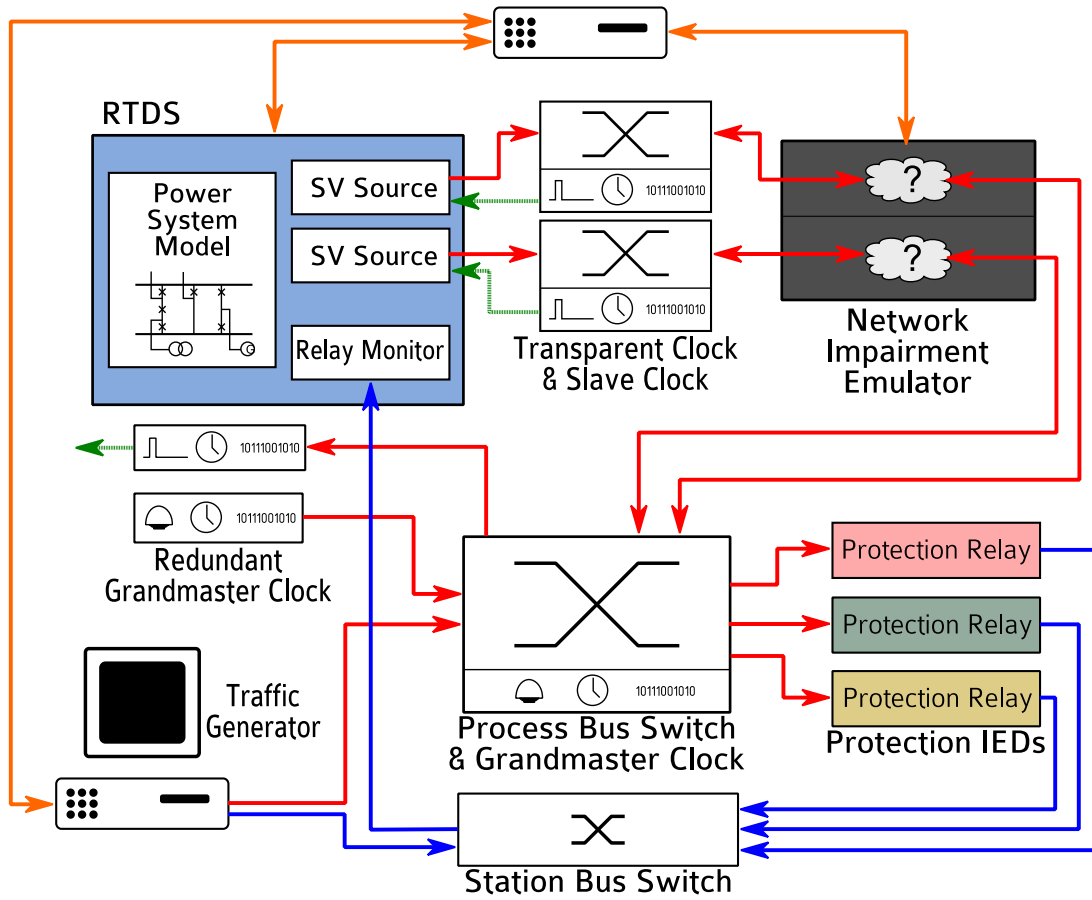


# SV process bus connections

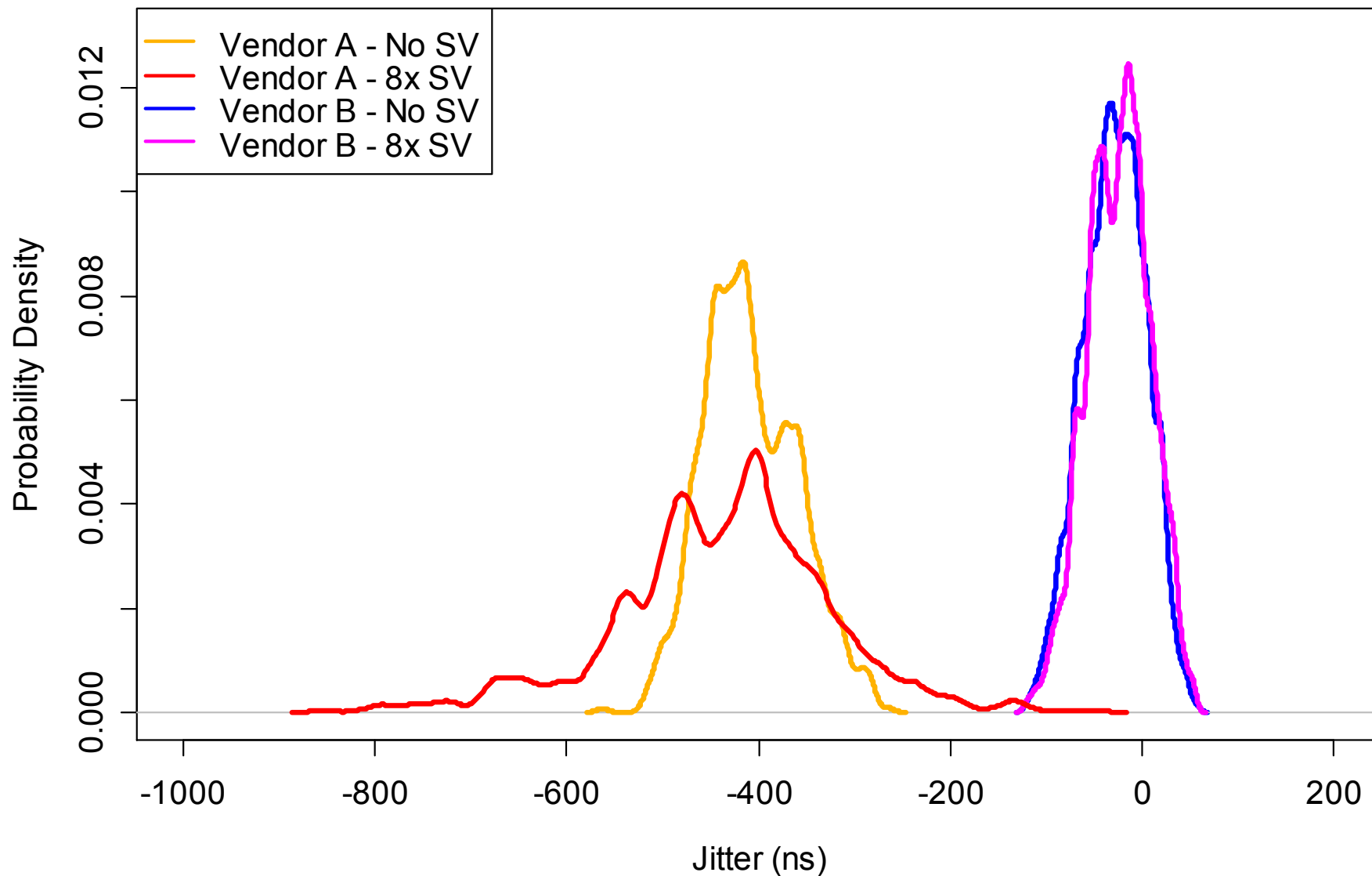


# Test and evaluation system

- IEC 61850-9-2 & IEEE Std 1588
- IEC 61850-8-1
- Test Control (TCP/IP)
- 1PPS Time Sync



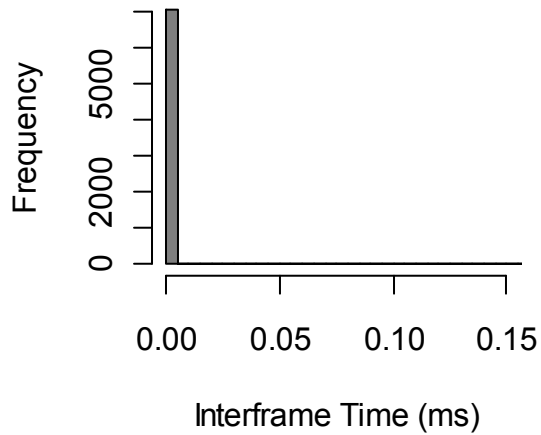
# Effect of SV traffic on PTP performance



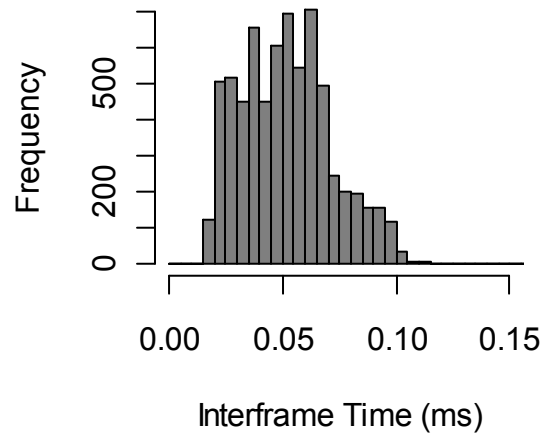


# Frame delay measurement

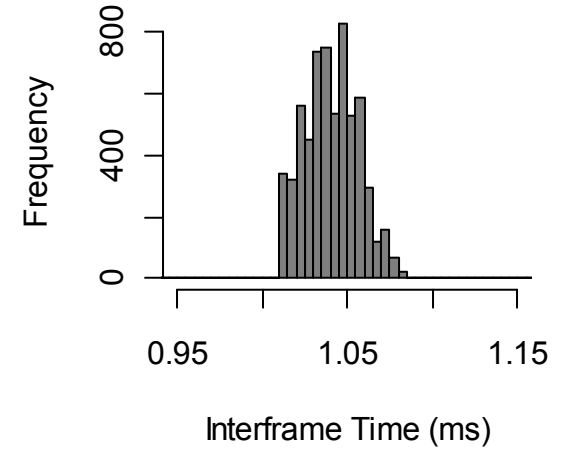
**Same Switch**



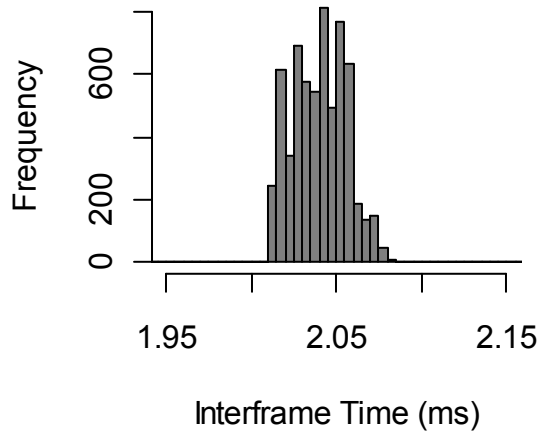
**Wire Mode**



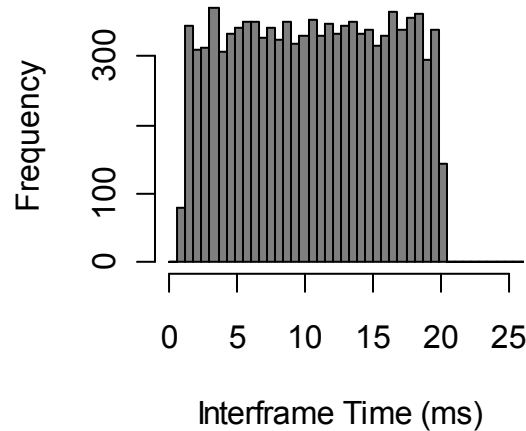
**Fixed Delay  
1 ms**



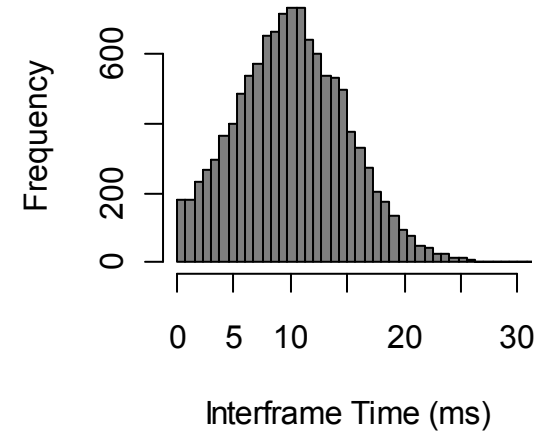
**Fixed Delay  
2 ms**



**Uniform Distribution  
1-20 ms**



**Normal Distribution  
mean = 10 ms, var = 5 ms**



# Summary

- Test bed will evaluate SV **system** performance.
- SV, GOOSE and PTP impact each other.
- ‘Scale model’ testing evaluates the unknown factors.
- PTP is a viable means of synchronising merging units.
- IEEE Std 1588 and the IEC 61850 series facilitate the implementation of the transmission smart grid.

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