1. **Scope as stated in the Standard:**

   This standard specifies a common profile for use of IEEE 1588-2008 Precision Time Protocol (PTP) in power system protection, control, automation and data communication applications utilizing an Ethernet communications architecture.

   The profile specifies a well-defined subset of IEEE 1588-2008 mechanisms and settings aimed at enabling device interoperability, robust response to network failures, and deterministic control of delivered time quality. It specifies the preferred physical layer (Ethernet), higher level protocol used for PTP message exchange and the PTP protocol configuration parameters. Special attention is given to ensuring consistent and reliable time distribution within substations, between substations, and across wide geographic areas.

2. **Purpose as stated in the Standard:**

   The purpose of this standard is to facilitate adoption of IEEE Std 1588-2008 for power system applications requiring high precision time synchronization. It specifies a common subset of PTP parameters and options to provide global time availability, device interoperability and failure management. This set of PTP parameters and options allows IEEE 1588-2008 based time synchronization to be used in mission critical power system protection, control, automation and data communication applications.

3. **Are the scope and purpose aligned with the actual standard?**

   Yes

4. **SGAC team summary of purpose and scope**

   SGAC concurs with the summary and scope of the standard. It specifies a common profile for use of Precision Time Protocol (PTP) in power system protection, control, automation and data communication applications and can be leveraged by any power system applications that require high precision time synchronization.

5. **What Conceptual Model Domains are affected:**

   Markets | X
6. What Levels in the ISO 7 Layer Model affected: [NOTE Add GWAC Stack as analytic tool – use either]


   Some impact may exist at the session (timing) and application layers (specific delay or timing in presentation or synchronization of data)

<table>
<thead>
<tr>
<th>Layer</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td>X</td>
</tr>
<tr>
<td>Presentation</td>
<td></td>
</tr>
<tr>
<td>Session</td>
<td>X</td>
</tr>
<tr>
<td>Transport</td>
<td></td>
</tr>
<tr>
<td>Network</td>
<td></td>
</tr>
<tr>
<td>Data Link</td>
<td>X</td>
</tr>
<tr>
<td>Physical</td>
<td>X</td>
</tr>
</tbody>
</table>

7. If the standard addresses multiple layers... Why? Is there effective separation of layers (in the ISO or GWAC stack)? Is there a plan to migrate to single layer standard?

   No it does not.

8. How would technology based on the standard be used in applications in the future? Adapted to today’s applications?

   This standard will be used to deploy new technology and new applications such as synchrophasor and their integration with enterprise applications. Legacy applications will need to be integrated to support this new standard.

9. Is there a migration path from current use in the area of the standard to this standard?

   The migration path needs to be defined.

10. Does this standard affect any other PAP (if yes, list)?

    Not specifically but PAP12 is related.

11. Has this cross PAP affect been discussed by the SGAC evaluation team?

    No
12. What action items resulted from team discussions?

Open item discussions need to be addressed.

<table>
<thead>
<tr>
<th>Action Item</th>
<th>Assigned to</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>Support of Legacy Systems: Integration of the legacy PMU with High Speed PTP protocol</strong></td>
<td>R Farquharson</td>
<td>Complete</td>
</tr>
<tr>
<td>Legacy PMUs that do not support IEEE 1588-2008 PTP protocol will need to receive the time data by another means that is supported by the devices such as GPS / IRIG-B.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. <strong>Architectural issues related to provisioning and maintenance of PMUs, PDCs and Synchrophasors using PTP protocol. How are they or will be addressed?</strong></td>
<td>R Farquharson</td>
<td>Complete</td>
</tr>
<tr>
<td>For PMUs and PDCs that are using PTP, typical Ethernet communications architecture consists of a reference clock, bridges and end devices. Bridges with boundary clock functionality may also be used at interconnection points between different PTP domains or PTP profiles.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. <strong>Performance:</strong></td>
<td>R Farquharson</td>
<td>Complete</td>
</tr>
<tr>
<td>a. <strong>How is the performance of PTP measured?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NIST is currently developing test methods to characterize and analyze the performance of 1588 in meeting Smart Grid requirements. With respect to performance, accuracy of the distributed time synchronization, reliability in maintaining accuracy under various fault/stress scenarios, security and interoperability are being examined, beginning with the 1588 power profile, IEEE C37.238. NIST has developed a software-based 1588 performance testing dashboard and is working on making the software open-source so that it is publicly available for testing 1588 networks.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. <strong>The impact of security (firewalls, authentication, authorization etc) on the speed and frequency of data collected and performance.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The use of security techniques is an important consideration; and, based on the application may be desirable or mandated. This standard is a subset power profile of IEEE 1588-2008 and as such security extensions and network engineering methods for hardening the PTP-based time distribution system against malicious attacks are not covered, and are outside of scope. If security techniques are used, they should not impair the ability of devices to achieve performance, specified in this standard. Future improvements in IEEE 1588 security mechanism are anticipated and will be considered in a revision of this standard.

4. **CIM compliance:**
   
   a. **Will PTP be harmonized with IEC 61968, IEC 61970?**

   At this time IEEE 1588 is not harmonized with CIM. However it is certainly possible to harmonize CIM with time synchronization protocols such as IEEE 1588 (and C37.238) does fall within the scope of the CIM and IEC 61968, IEC 61970.

5. **Testing Tools:**
   
   a. **What type of tools are available for testing?**

   NIST has developed a software-based 1588 performance testing dashboard and is working on making the software open-source so that it is publicly available for testing 1588 networks. The dashboard provides a single interface for performance test deployment, configuration capabilities as can be executed via the 1588 management node, and both real-time and offline data analysis. Performance tests for distributed timing accuracy, convergence, and very basic security and interoperability are under development. The test suites can be run automatically (for example over a weekend) without manual intervention, allowing more tests and longer test runs to be performed for more reliable data. It can also...
automatically generate statistics and graphs. Work is being done to create a 1588 Power Systems Profile test suite, with more test methods will need to be implemented.

6. Security
   a. Give that synchrophasor require much higher degree of security, Is this compliant with NERC CIP expectations -- or rather what is currently defined by NERC CIP?

   At this time NERC CIP does not state specific requirements for synchrophasor data. However the UtiliSec ASAP-SG Work Group is developing a Security Profile for WAMS (Wide Area Monitoring Systems) to address synchrophasor data.

   b. How will the security architecture impact communication between these PMU, PDC etc.

   PMU and PDC communications and the impact of security architecture is outside of the scope of IEEE C37.238

   c. What is the level of integration with IEC 62351

   As noted above, the UtiliSec ASAP-SG Work Group are developing a Security Profile for WAMS (Wide Area Monitoring Systems) to specifically address synchrophasor data. This profile is also being reviewed by IEC TC 57 – WG 15 with the intention of harmonization between the profile and IEC 62351.

R Farquharson | Complete

7. Time Quality
   a. Quality of time may impact system architecture?

   Assuming the time quality requirement is known at the time of designing the system architecture, then yes this
could impact the architecture in including the network design and the types and specifications of the devices.

(Add rows as needed)

13. If there are use cases related to the standard, are the use cases and the standard aligned? Are these current/past use cases? Are they white box/black box? Are there future use cases or requirements?

No

The limits to the time precision in this standard have no impact on current plans from an accuracy standpoint, but may have an impact in the future.

This accurate a time standard may cause a need for a staggering (fuzz-ing) use case in the future to support soft start and soft stop for equipment on the system to prevent sudden changes in demand.

14. If there are use cases, are they candidates for the Conceptual Architecture – Requirements Document? If not present, what new requirements may need to be added?

Some can be candidates for Conceptual Architecture Requirements Document.

15. Is the terminology reasonably understandable by the intended audience? Is the terminology consistent through the document? Are standard dictionary(ies) referenced normatively?

Terminology is understandable but some of the broader context or application of it does not exist.

16. If UML class or other diagrams are useful for understanding the standard, are they available or used in the standard?

No. Diagrams do not exist in the document, but may be useful in a future version.

17. Does the standard include transitional artifacts? If so, are the transitional artifacts necessary to support legacy applications? Can they ever go away?

No. There are no transitional artifacts in the document, some transitional guideline may be required to move to this standard, a separate document may need to be created.
18. Are there things in the standard that have no obvious purpose in the use of the standard? Why do we think they’re there? Are those things supporting evolution of application architectures?

No the standard is fairly technical and supports the intent.

19. This standard is: A

A. A new standard that is being created by a new working group
B. A new standard that is being created by an established working group
C. A standard that was in draft form, but not finalized yet
D. A standard that was released but does not have a testing and conformance plan
E. A standard that is released, has a testing and conformance plan, but is undergoing a major revision
F. A standard that is mature, has testing and conformance and no major revisions are pending

20. Does this Standard limit options for innovation in the future? How? If yes, what limits are placed on innovation?

No

21. Other Comments:

1. We would like to suggest that a comment should be added that IEEE 1588 and hence PC37.238 is not for wireless links especially those with CSMA MAC layers.

2. Based upon the intent of this standard, it does not provide guidance in synchronization of time between various NIST domains.

22. Summary position (added by RF):

1. The SGAC has confirmed full acceptance of the standard.