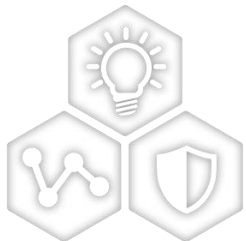


Industry Update on the IEEE P1952™ Standard



A Leading Provider of Smart, Connected and Secure Embedded Control Solutions



SMART | CONNECTED | SECURE

Greg Wolff

May 2026

Agenda

- **History**
- **Overview of IEEE P1952™ Project**
- **Resilience levels**
- **How industries are adopting P1952**

Definition of Resilience

Presidential Directive – Critical Infrastructure and Resilience

The term "resilience" means the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents.

Presidential Policy Directive -- Critical Infrastructure Security and Resilience/PPD-21 – February 12, 2013

<https://obamawhitehouse.archives.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil>

Executive Order 13905 – Responsible Use of PNT

 U.S. Department of Transportation

ABOUT DOT ▾ PRIORITIES ▾ CONNECT ▾ 



[Home](#) \ [PNT & Spectrum MGT](#)

Positioning, Navigation and Timing (PNT) & Spectrum Management

Responsibilities

Contacts

External Links

Policy Areas >

Public Notices and Events

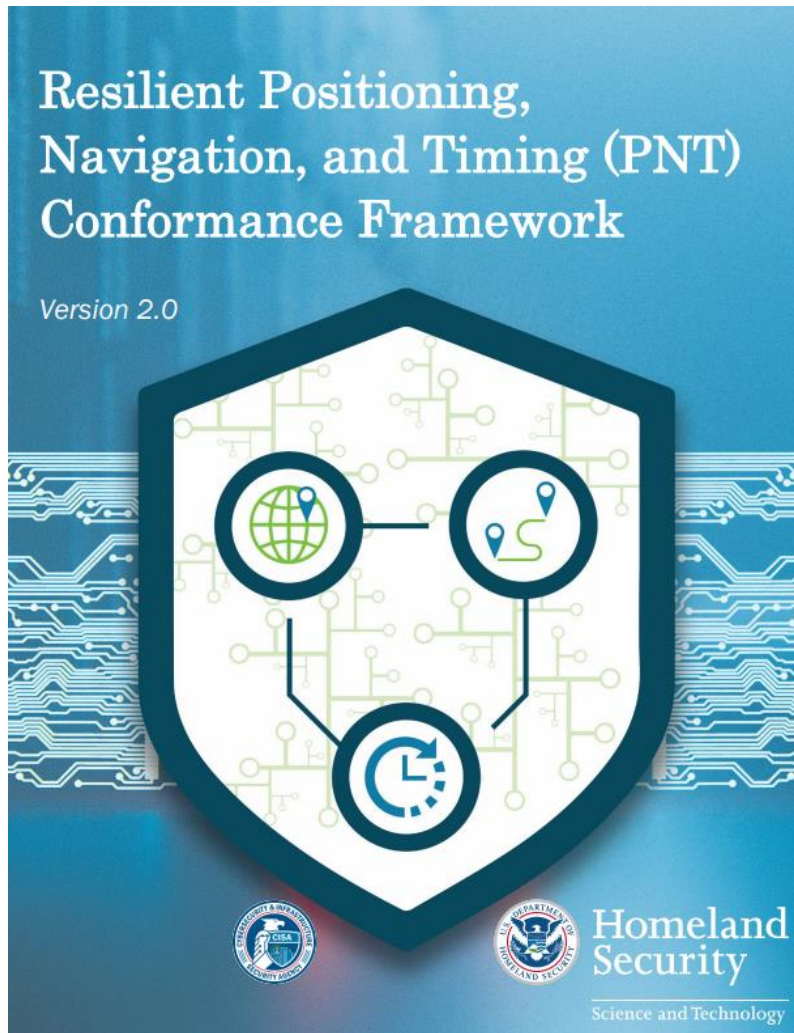
Executive Order on Strengthening National Resilience through Responsible Use of Positioning, Navigation, and Timing Services

Document

 [Executive Order on Strengthening National Resilience through Responsible Use of Positioning.pdf](#)

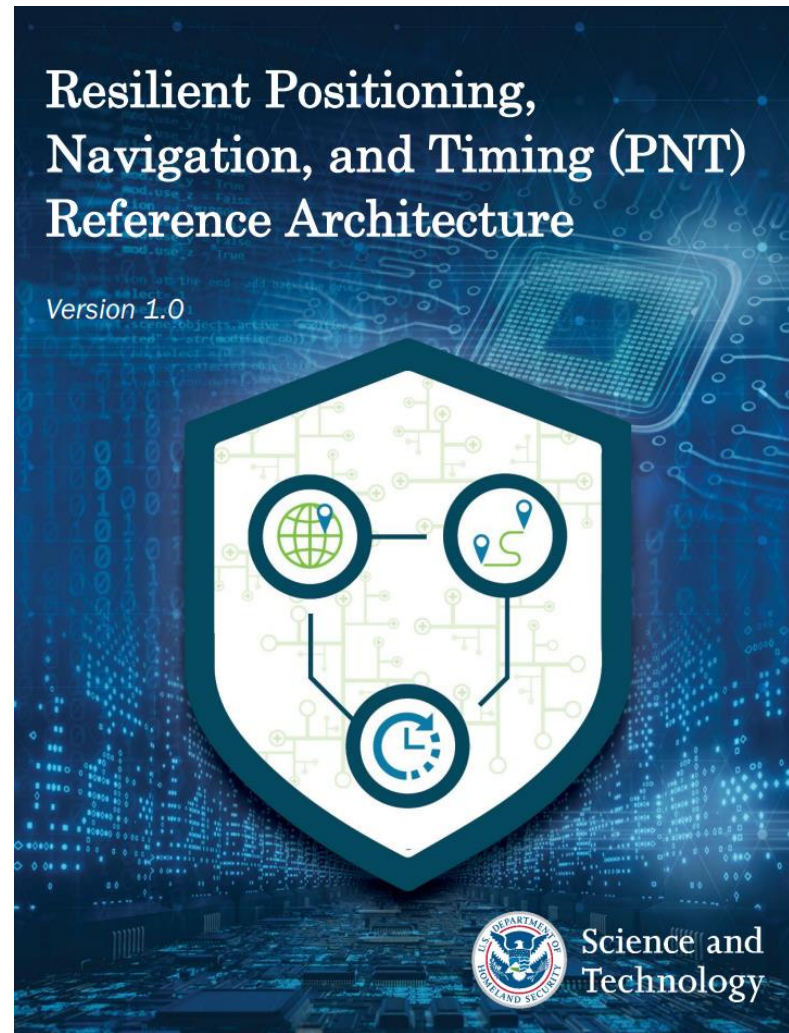
Executive Order on Strengthening National Resilience through Responsible Use of Positioning, Navigation, and Timing Services - On February 12, 2020, President Donald J. Trump signed an Executive Order (EO) establishing the first comprehensive national policy promoting the responsible use of positioning, navigation, and timing (PNT) services by the Federal Government and critical infrastructure owners and operators to strengthen critical infrastructure resilience. With this EO, the Trump Administration is strengthening American resilience by identifying and promoting approaches to manage the risks to critical transportation systems and supporting commercial infrastructure from the disruption and manipulation of PNT services.

Standards Focusing on PNT Resilience



<https://www.dhs.gov/publication/st-resilient-pnt-conformance-framework>

Initial release December 16, 2020



<https://www.dhs.gov/science-and-technology/publication/resilient-pnt-reference-architecture>

Released June 9, 2022

IEEE SA
STANDARDS
ASSOCIATION

P1952





Title: Standard for Resilient Positioning, Navigation and Timing (PNT) User Equipment

Scope: This standard specifies technical requirements and expected behaviors for resilient Positioning, Navigation, and Timing (PNT) User Equipment (UE). The scope is limited to the reception, ingestion, processing, handling, and output of PNT data, information, and signals. The scope does not include standards relating to the characteristics of PNT sources. Based on technical requirements, the standard defines different levels of resilience to enable users to select a level that is appropriate based on their risk tolerance, budget, and application criticality. This standard applies to UE that outputs PNT solutions, including PNT systems of systems, integrated PNT receivers, and PNT source components (such as Global Navigation Satellite System (GNSS) chipsets).

WG Officers

Chair
Shelby Savage,
ssavage@mitre.org

Vice Chair
Steve Guendert,
steve.guendert@ibm.com

Secretary
Patricia (Patty) Larkoski,
plarkoski@mitre.org

Program Manager
Tom Thompson,
thomas.thompson@ieee.org

<https://sagroups.ieee.org/p1952/>

Started May 21, 2021

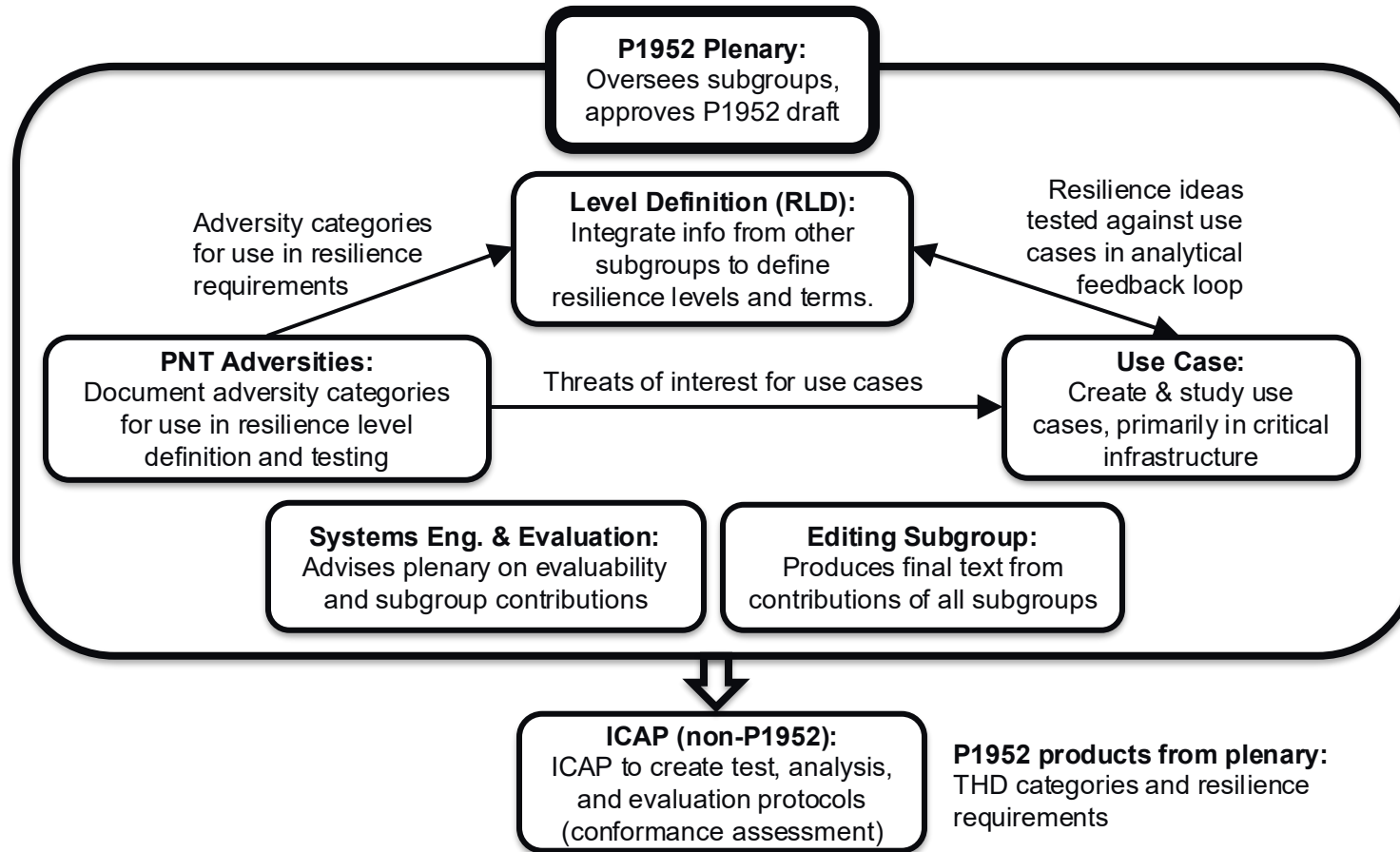


IEEE P1952™ project



- **Resilient Positioning, Navigation and Timing User Equipment Working Group**
- **Project to create an IEEE standard**
 - Standard for Resilient Positioning, Navigation and Timing User Equipment
- **In Scope**
 - Requirements on behaviors of PNT User Equipment
 - Defines levels of resilience for PNT UE
- **Out of scope**
 - Requirements on PNT source systems (e.g., GPS constellation)
 - UE design or technologies to achieve resilience levels

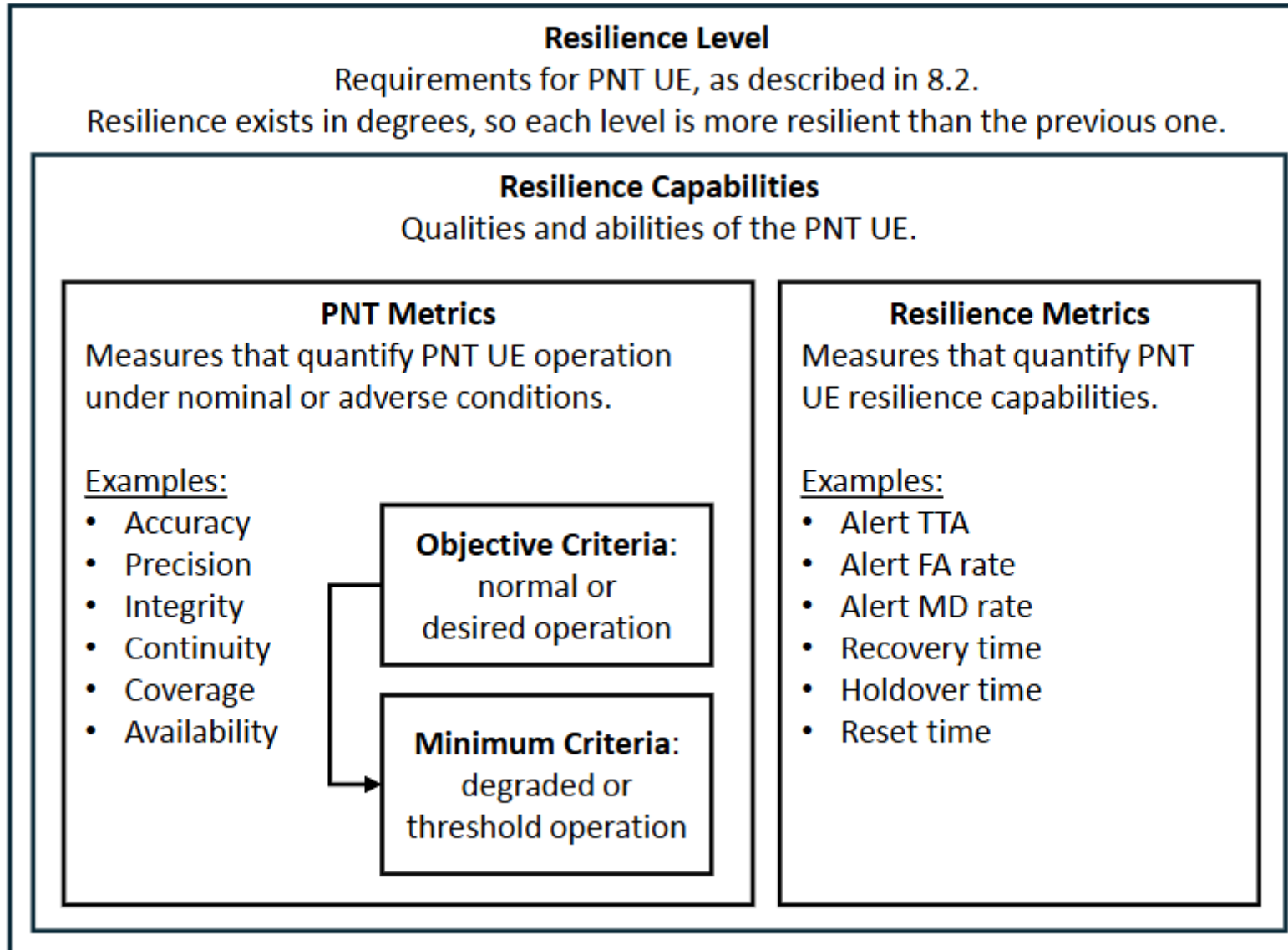
Division of Labor Within P1952



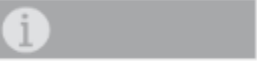
P1952 Adversity Categories

- P1952 Resilience is focused on resilience to PNT adversities
- Out of scope:
 - General reliability
 - Design flaws that do not affect PNT performances
 - Power disruptions
- PNT adversities are: natural, unintentional or malicious disturbances of the PNT input signals
- Adversity examples for timing systems:
 - GNSS jamming/interference
 - GNSS spoofing
 - GNSS ionospheric delay variation
 - GNSS system errors
 - PTP Asymmetry
 - PTP Rogue T-GMs
 - PTP message manipulation
 - PTP delay attacks
 - Loss of SyncE

What is a Resilience Level?



Overview of Resilience Levels

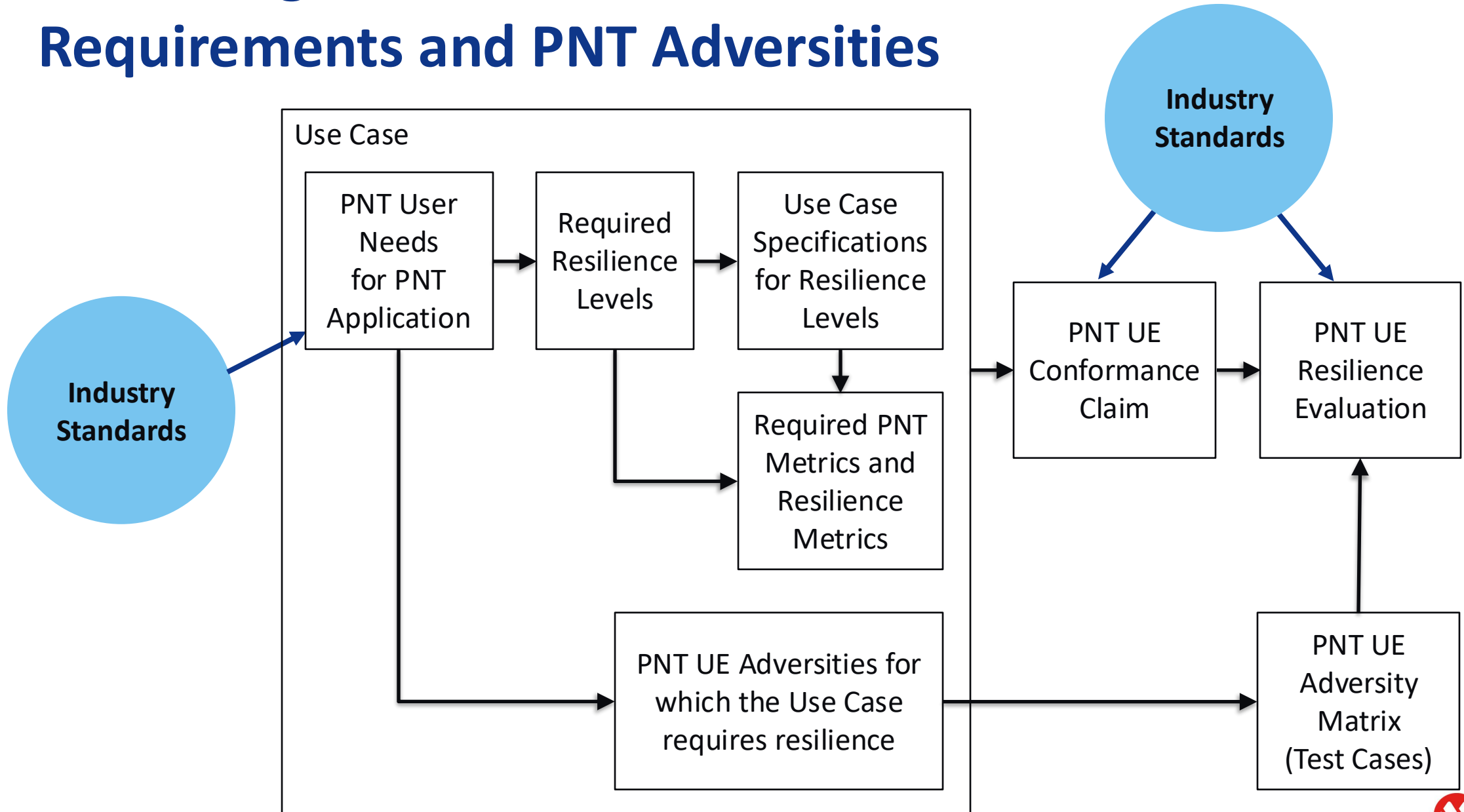
Resilience Level Name	Resilience Capabilities Timeline			Required Resilience Capabilities*
	Baseline	During adversity	After adversity	
Level 1 Detect and Alert				Detect and alert
Level 2 Recover			 	Detect and alert Recover
Level 3 Resist		 	 	Detect and alert Resist** (holdover) Recover
Level 4 Withstand		 	 	Detect and alert Withstand, resist Recover
Level 5 Verify	 	  	  	Verify Detect and alert Withstand, resist Recover

Key		Objective criteria PNT metrics met		Alert
		Minimal criteria PNT metrics met		Report
		Continuous PNT solution or source verification		

* All levels have a hard reset capability.

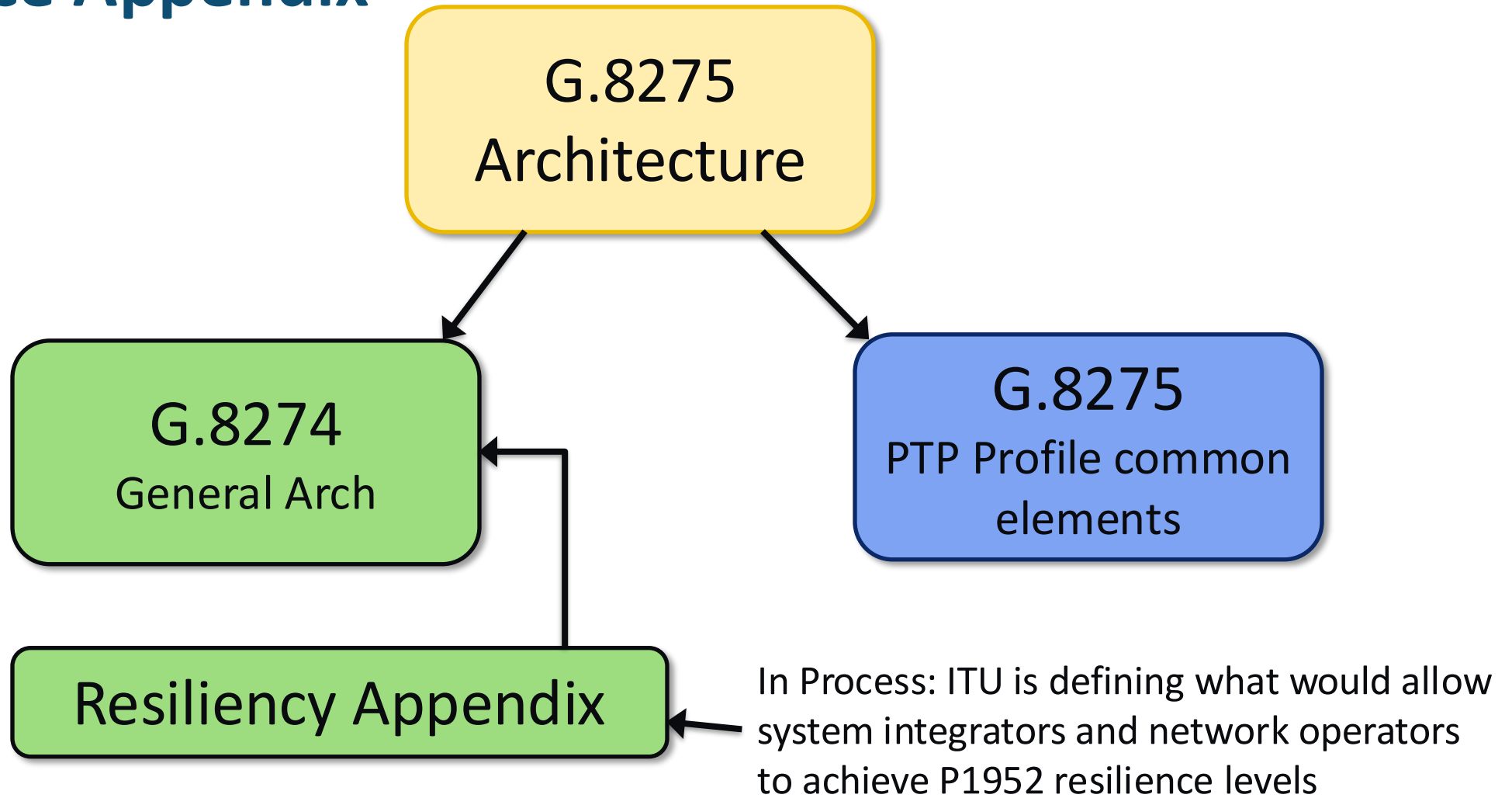
** When resisting, the PNT metrics can degrade, either as a step down or as gradual fading.

Evaluating PNT UE Resilience Levels with Use Case Requirements and PNT Adversities



International Telecommunications Union (ITU-T)

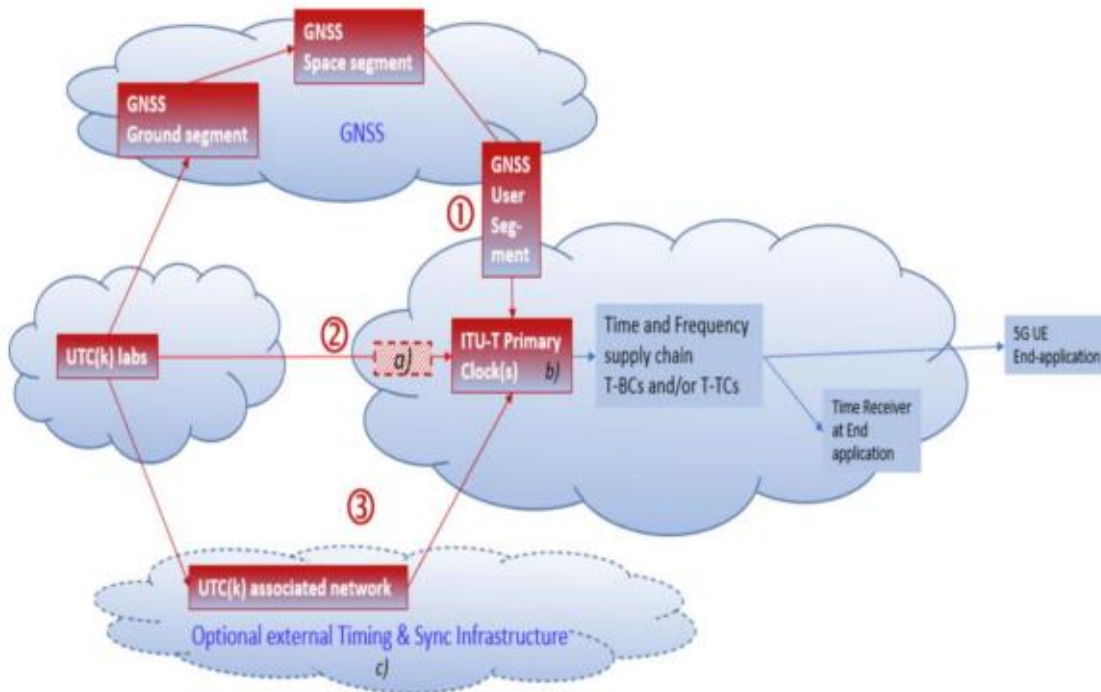
Resilience Appendix



ITU-T Defined Primary Clocks

Primary Source		Implementation variant number	Additional sources (external primary clocks)						
			None	external Frequency		external Phase/time			
				PRC via high-accuracy time transfer	PRC via SyncE	Phase/time via high-accuracy time transfer	via PTP-FTS profile	via PTP-APTS profile	UTC(k)
1	PRTC (G.8272)	1	x						
		2			x				
		3					x		
2	ePRTC (G.8272.1)	4	x						
		5			x				
		6							x
3	cnPRTC (G.8272.2)	7	x						
		8							x

Primary clocks and resilience levels



IEEE P1952 Resilience Level			Proposal	threat duration time	PRTC			ePRTC			cnPRTC	
					PRTC	PRTC with SyncE	PRTC with APTS	ePRTC	ePRTC with SyncE	ePRTC with UTC(k)	cnPRTC	cnPRTC with UTC(k)
1	Detect	The ability to detect an adversity that might impact performance and generate an alert.	With the available on-board resources of the specific primary clock variants, resilience level 1 should be met without restrictions.		x	x	x	x	x	x	x	x
	Alert											
2	Recover	The ability to automatically recover and operate normally after an adversity.	With the available on-board resources of the specific primary clock variants, resilience level 2 should be met without restrictions.		x	x	x	x	x	x	x	x
3	Resist	The ability to operate during an adversity, perhaps with reduced performance, but still within specifications, for a specified length of time.	It is proposed to consider the maximal length of time for fulfillment of resilience level 3.	<< 1 day	x	x	x	x	x	x	x	x
				1 - 40 days	-	based on SyncE	based on PTS	x	x	x	x	x
				> 40 days	-			-	based on PRC via SyncE	x	(x)	x
4	With-stand	Withstand: The ability to operate during an adversity, perhaps with reduced performance, but still within specifications, indefinitely.	A indefinitely withstand can be guaranteed with usage of external UTC(k) only.		-	-	-	-	-	-	-	x
5	Verify	The ability to determine that information from a PNT source is accurate.	A indefinitely withstand can be guaranteed with usage of external UTC(k) only.		-	-	-	-	-	-	-	x

Summary of the IEEE P1952™ Project



P1952 specifies what is needed to achieve resilience in PNT user equipment



Defines Resilience Levels for PNT User Equipment

Resilience exists in degrees, so each level is more resilient than the previous one
Resilience levels are based on the Qualities and the Abilities of the UE



Industry standards can drive use cases for P1952 resilience levels

For example, ITU clock standards (PRTC, ePRTC, cnPRTC) are being mapped to the P1952 resilience levels

Thank you

Greg Wolff
greg.wolff@microchip.com