INTERNET2 TECHNOLOGY EVALUATION CENTER

The Status of NG9-1-1 Certification and Cybersecurity

March 18, 2025

Meet the Panelists

Michael E Fox

Executive Director
Texas A&M University System
ITEC

Brandon Abley

Chief Technology Officer
NENA: The 9-1-1 Association

Logan Freeman

Sr. Network Research Engineer
Texas A&M University System
ITEC

A.J. Renold

Sr. Associate Director
Texas A&M University System
ITEC

Next Generation 9-1-1 Interoperability Testing Framework

The Next Generation 911 (NG911) Interoperability Testing Framework, a project funded by the Department of Homeland Security, aims to revolutionize emergency response by transitioning from traditional voice-only systems to a comprehensive, multimedia-capable network. This initiative, led by experts from various agencies and organizations, focuses on ensuring seamless communication and data transfer across 911 call centers and first responders. By integrating advanced technologies and adhering to rigorous standards, the program seeks to enhance the efficiency, reliability, and interoperability of emergency services nationwide.

TEXAS A&M

TEXAS A&M UNIVERSITY.
Internet2 Technology
Evaluation Center

UNIVERSITY OF
ILLINOIS
URBANA-CHAMPAIGN

CIRI | CRITICAL INFRASTRUCTURE
RESILIENCE INSTITUTE

What is NG9-1-1?

Brandon Abley, Chief Technology Officer

NENA: The 9-1-1 Association

What is NG9-1-1?

- NG9-1-1 is built around SIP and IP (like modern VoIP services/LTE)

- Provides standardized interfaces from emergency call and message services

- Processes all types of calls: voice, text, data, and multimedia information

- Acquires and integrates additional call data useful to call routing and handling

- Delivers calls, messages, and data to the appropriate entity based on the location of the caller and other policies

- Supports data, video, and other communications needs

- Interoperates with services and networks used by first responders

Key Technical Standards for NG9-1-1

NENA i3

- NG9-1-1 Core services standard
- Developed by NENA
- Basis for International Work (e.g., Europe and Canada)

IETF

- Internet standards: core set of global standards for networks
- Much of i3 is built off of IETF specifications

NENA New & Upcoming Standards (some)

- i3 Version 3

- NG-PSAP

- NG-SEC v2

- EIDO (Emergency Incident Data Object)

- EIDO Conveyance

- EIDO Management

- 3D GIS Requirements

- Updates to GIS Data Model

- 9-1-1 Call Processing Standard

- PKI Certificate Policy and Validation Policy

- CLDXF version 2 and Canada CLDXF

- Social Media Emergency Requests for Service

- Acute/Traumatic and Chronic Stress Management Standard

- NENA Suicide/Crisis Line Interoperability Standard

I3 Standard for Next-Generation 9-1-1

- "i3" refers to the NG9-1-1 system architecture defined by NENA, which standardizes the structure and design of Functional Elements making up the set of software services, databases, network elements and interfaces needed to process multi-media emergency calls and data for NG9-1-1.

- i3 is the core services standard for NG9-1-1, and is the most important standard overall in the entire standards family

- But, i3 is not all of NG9-1-1, and increasingly, the NG9-1-1 expands into other important documents (NG-PSAP, EIDO, EIDO Conveyance, etc)

- i3 is currently in version 3e-2021; work on version 4 is ongoing

- Following are some of the new features in i3 version 3

NENA i3 Standard for Next Generation 9-1-1

Abstract: This Standard provides the detailed functional and interface specifications for a post-transition IP (Internet Protocol)-based multimedia telecommunications system, including the Core Services and legacy gateways necessary to support delivery of emergency calls via an IP-based Emergency Services IP network.

NENA i3 Standard for Next Generation 9-1-1

NENA-STA-010.3a-2021
DSC Approval: 05/18/2021
PRC Approval: 07/09/2021
NENA Executive Board Approval: 07/12/2021
ANSI Board of Standards Review Approved: 10/07/2021
Next Scheduled Review Date: 07/12/2024

Prepared by:
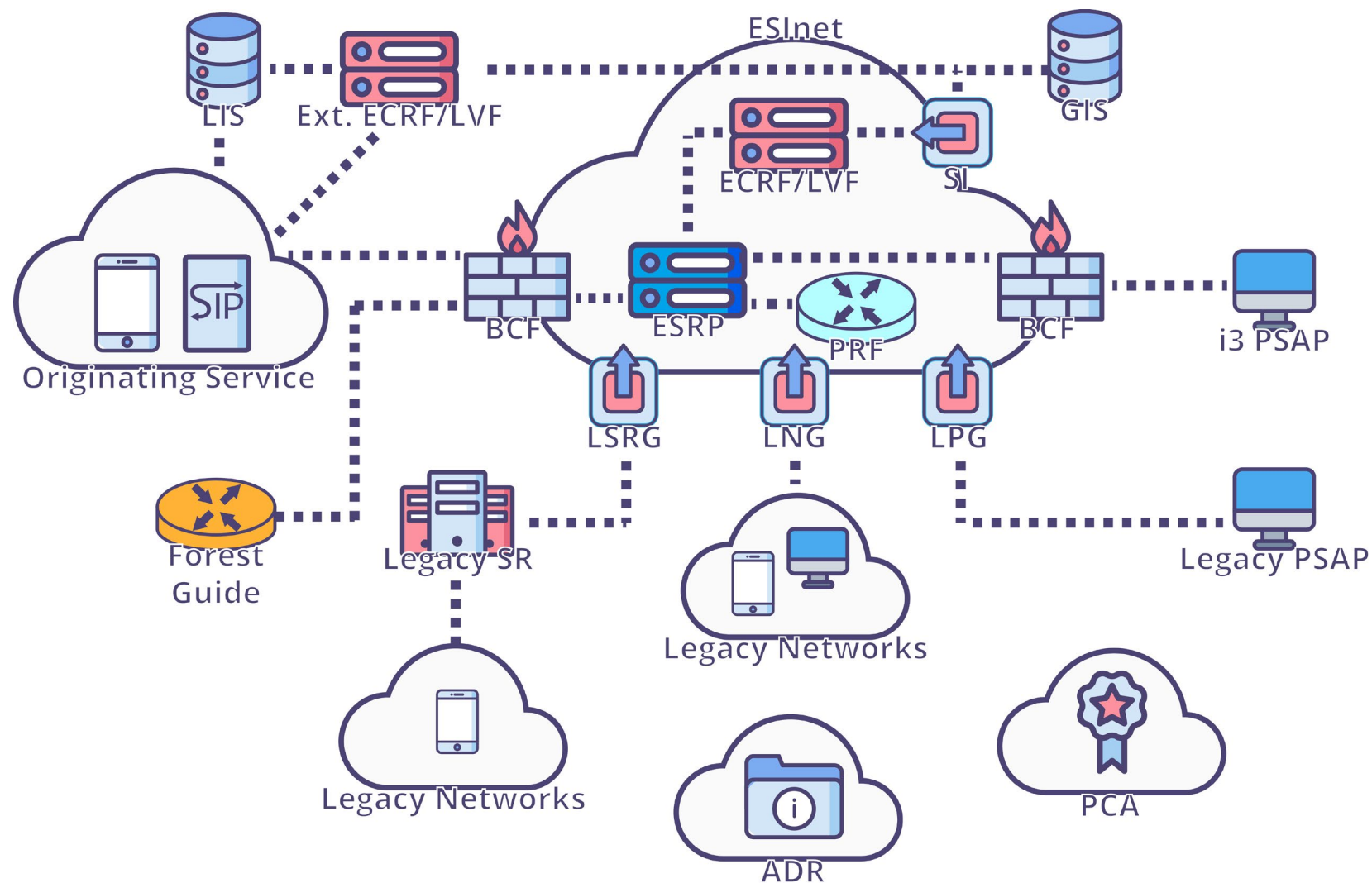National Emergency Number Association (NENA) 911 Core Services Committee, i3 Architecture Working Group

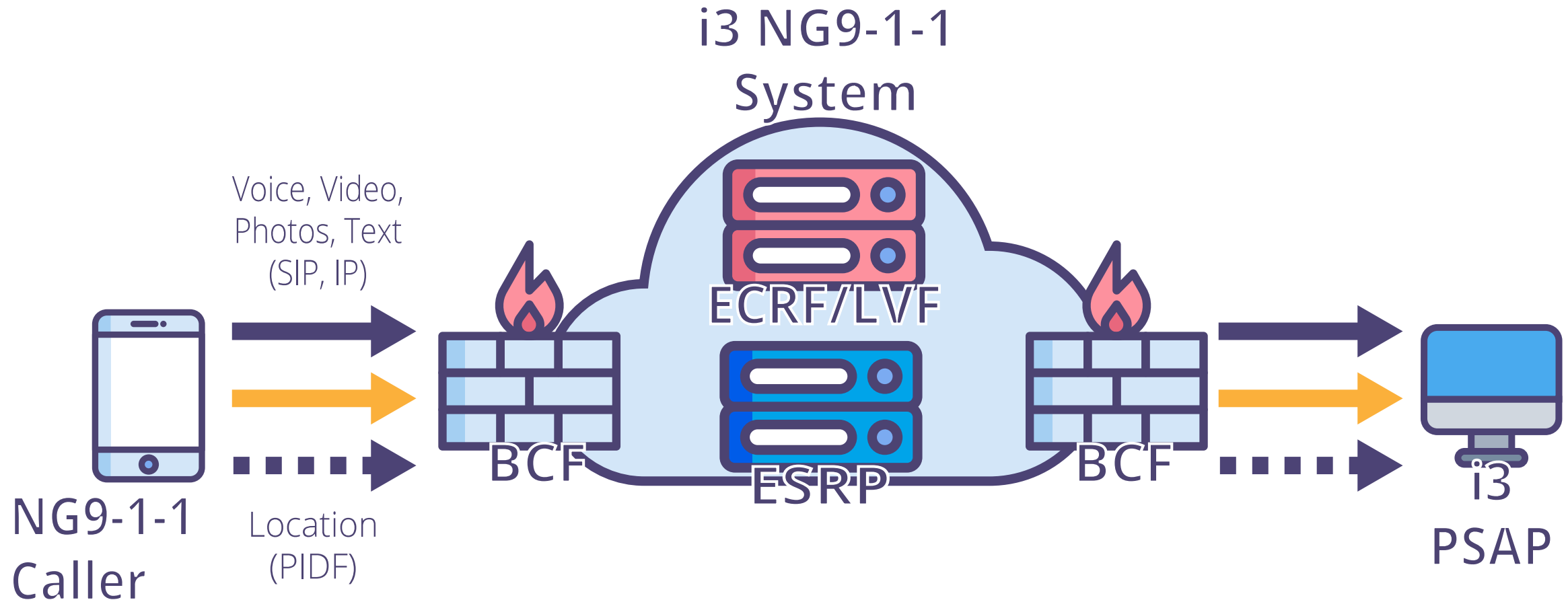Published by NENA
Printed in USA

© Copyright 2011-2021 National Emergency Number Association, Inc.

NG9-1-1 (simplified)

- All-IP and SIP
- Uses same signaling and protocols as LTE
- Routing elements use your actual location
- Legacy gateways for transitional elements
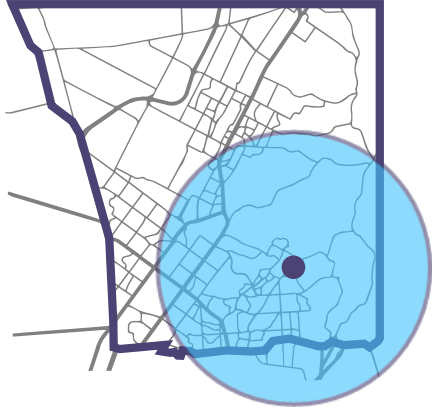- Interoperability between localities, states and nations

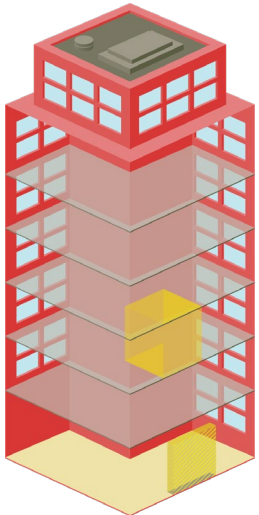# NG9-1-1: Multimedia (IP and SIP) vs E9-1-1

i3 NG9-1-1 System

Voice, Video, Photos, Text (SIP, IP)

NG9-1-1 Caller

Location (PIDF)

BCF

ECRF/LVF

ESRP

BCF

i3 PSAP

i3 NG9-1-1 is designed to handle rich multimedia and location natively as part of the system.

LoST and PIDF-LO

Geometry

X=38.80587   CNF=90%
Y=-77.059400   UNC=20m
Z= 20m   Z-UNC= 2.4m`

Civic Address

1700 Diagonal Rd
Alexandria, VA 22314

- Internet Standard, IETF 6848
- Location in NG9-1-1 is expressed in this format
- Can be expressed with geometry (a point)
- Uses WGS-84 reference ellipsoid (standard coordinate system)
- Though PIDF-LO supports many shapes, with caller location, we generally expect a point, circle or ellipsoid
- Shapes convey location +uncertainty
- Can be expressed as a civic address (dispatchable location)
- Included in signaling information in the SIP header

A call is a call

- NG9-1-1 includes a variety of novel call types

- Regardless of call type, a call is a call

- The same features, including geospatial or policy-based routing are generally available for all kinds of calls

- The service can be configured to set up any kind of special call for any kind of special destination

- Just because transitional NG9-1-1 doesn't support all of these features, it is still a worthwhile investment to improve 9-1-1 service today
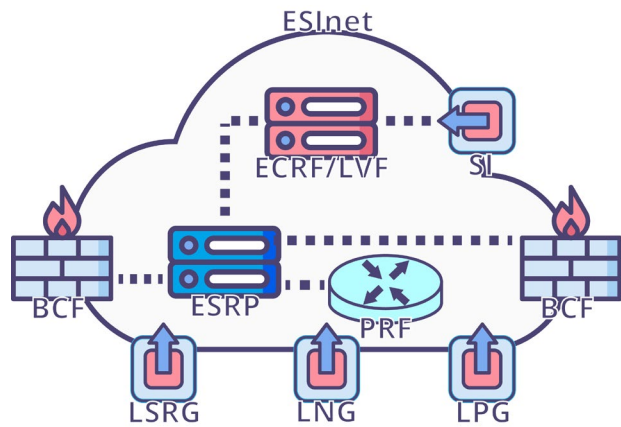
A look at call types in NG9-1-1
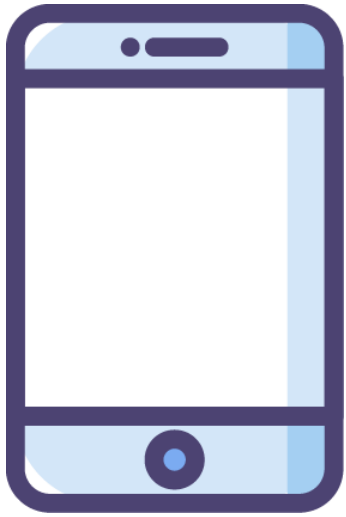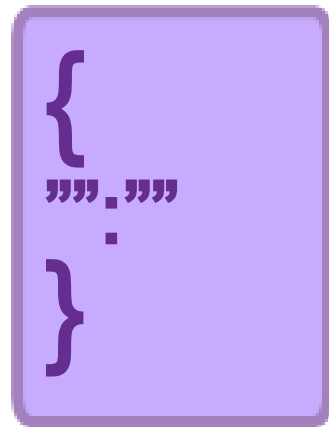
SIP call

Non-interactive Call
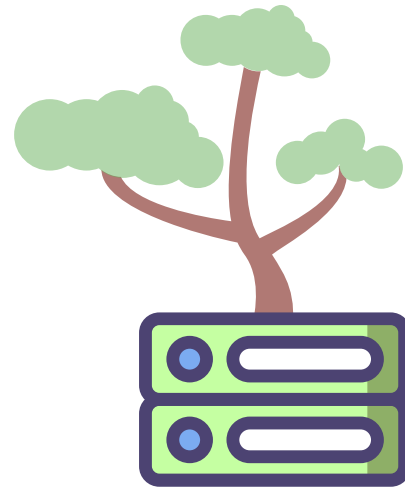
AACN

Interoperability in NG9-1-1

- NG9-1-1 systems are built by many 9-1-1 authorities on many schedules

- We'll highlight some key features in NG9-1-1 that provide for interoperability

Standardization of Interfaces

EIDO

Forest Guide

PKI ("PCA") and Identity

Questions?

Brandon Abley
Chief Technology Officer

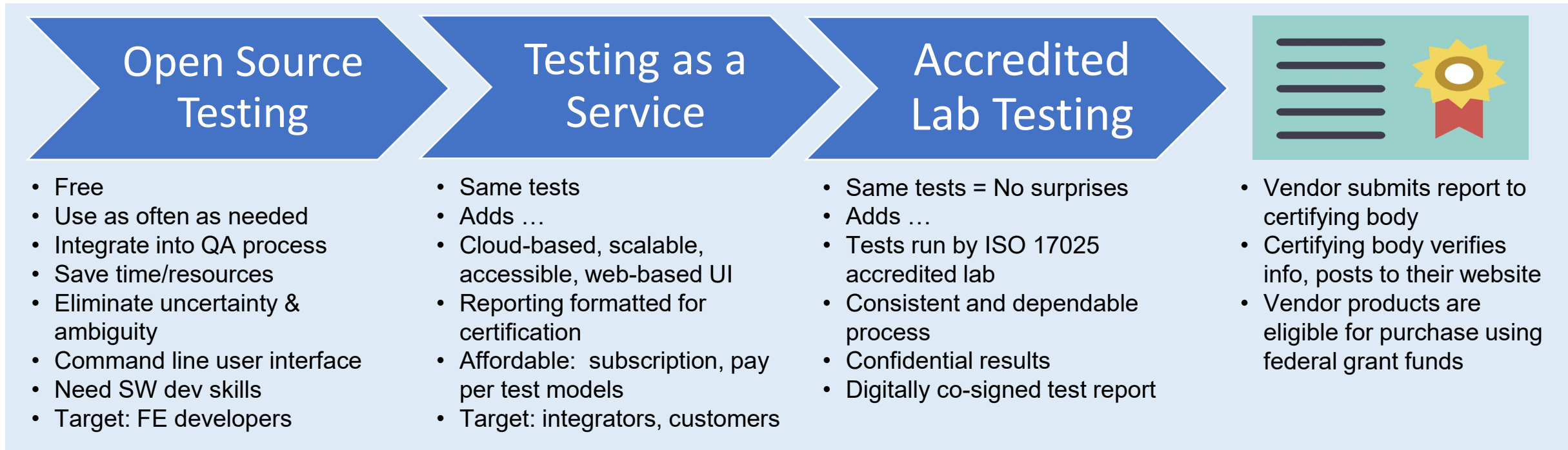🐦 **@911NENA911**
f **/911NENA911**

DHS NG9-1-1 Conformance and Interoperability Testing Program

The Need

- In 2019, DHS, Department of Transportation (DoT) and Department of Defense (DoD) identified the need to develop a testing and certification program to ensure that NG-911 solutions developed will are interoperable and conformal to standards

- DHS S&T and DoT co-funded first phases of research to identify and approach and framework for the program In 2020, DHS S&T kicked off the NG-911 Certification Program

- Strong industry engagement/User community: NENA, NASNA, iCERT, multiple vendors, local and state agencies

- Multiple Federal stakeholders: DHS S&T, DHS CISA, DoT 911 Office, DoD

NG9-1-1 Testing Program: Phase 1

Main objective: Engage with stakeholders, recommend program structure

Open Source Testing	Testing as a Service	Accredited Lab Testing	
• Free	• Same tests	• Same tests = No surprises	• Vendor submits report to certifying body
• Use as often as needed	• Adds …	• Adds …	• Certifying body verifies info, posts to their website
• Integrate into QA process	• Cloud-based, scalable, accessible, web-based UI	• Tests run by ISO 17025 accredited lab	• Vendor products are eligible for purchase using federal grant funds
• Save time/resources	• Reporting formatted for certification	• Consistent and dependable process	
• Eliminate uncertainty & ambiguity	• Affordable: subscription, pay per test models	• Confidential results	
• Command line user interface	• Target: integrators, customers	• Digitally co-signed test report	
• Need SW dev skills			
• Target: FE developers			

NG9-1-1 Testing Program: Phase 2 (2A & 2B)

Main tasks: Build testbed; define end-to-end scenarios, create certification report format, document costs, produce outreach video
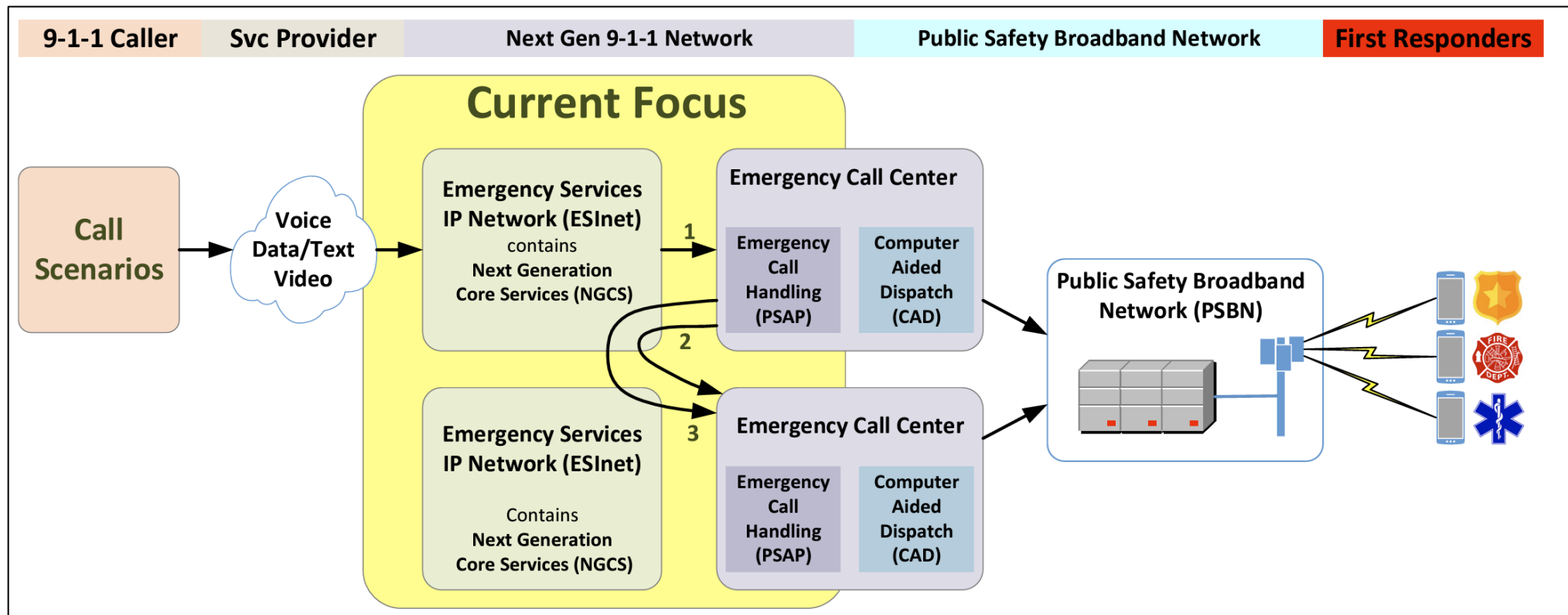
NG9-1-1 Testing System

Logan Freeman, Sr. Network Research Engineer

Texas A&M University, ITEC

NG9-1-1 Testing System: Key Characteristics

- Conformance + Interoperability + End-to-End testing
- Free open-source code on public repository
- Testing as a Service (TaaS) platform; uses the same testing source code
- Processes: validation, versioning, …
- Key design criteria: low cost for both test system and test labs

Conformance Test Scope
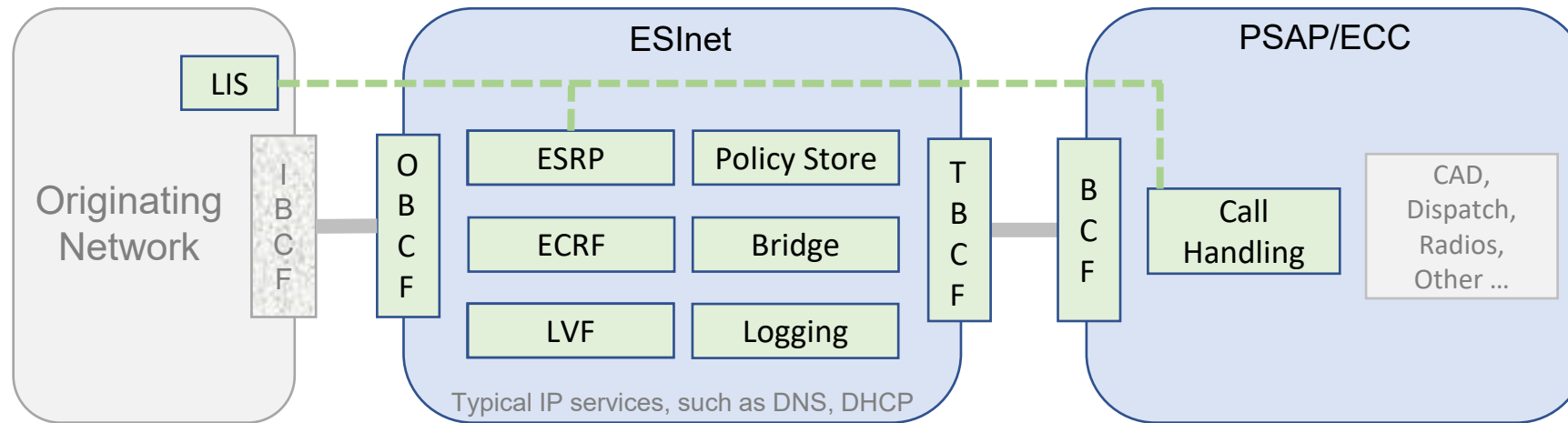
LIS = Location Information Server
ESInet = Emergency Services IP Network
BCF = Border Control Function
ESRP = Emergency Services Routing Proxy
ECRF = Emergency Call Routing Function
LVF = Location Validation Function
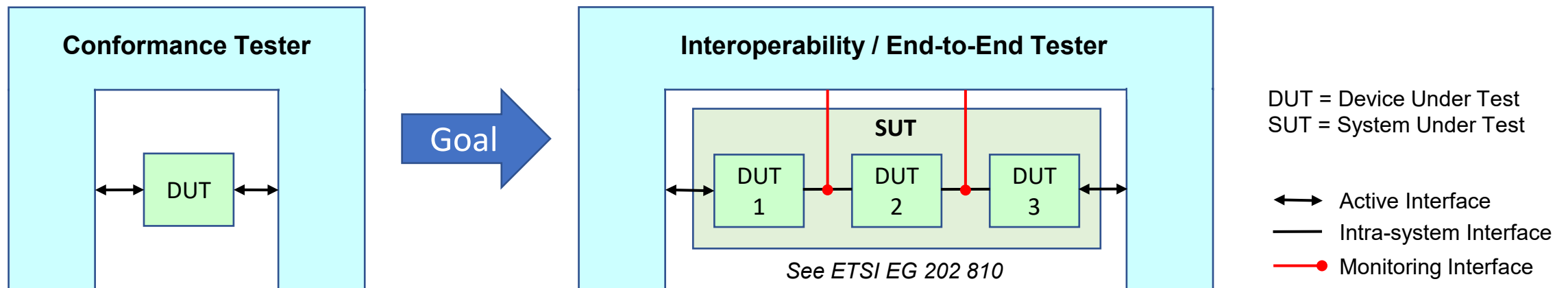PSAP = Public Safety Answering Point

In Scope for current TAMU project
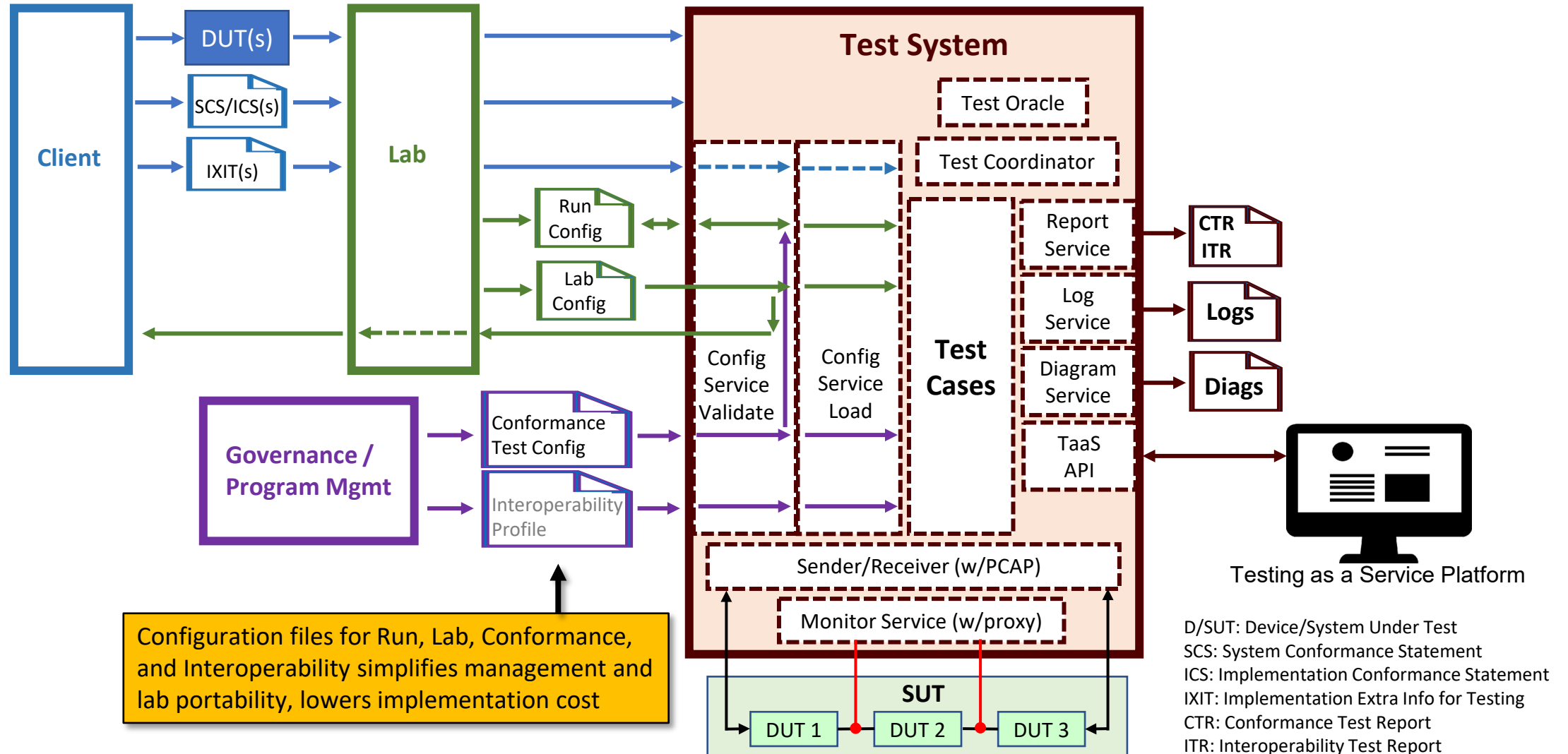
Out of Scope (for current TAMU project)

Out of Scope (for current TAMU project); In Scope (Interoperability Task Force/Technical Committee)

Conformance *AND* E2E Interoperability Testing

- Automated conformance testing is well understood

- But end-to-end interoperability is the ultimate goal

- Manual interoperability & E2E testing is time consuming and expensive
  - Just one of the end-to-end test scenarios has over 30 variations, each with over 350 steps!

- ETSI EG 202 810 provides a model for automated interoperability test
  - Our objective: make it cost-effective and flexible (configurable) for developers and ISO labs

Conformance Tester

DUT

Goal

Interoperability / End-to-End Tester

SUT

DUT 1 — DUT 2 — DUT 3

See ETSI EG 202 810

DUT = Device Under Test
SUT = System Under Test

↔ Active Interface
— Intra-system Interface
— Monitoring Interface

High-Level Test System Workflow, Architecture

Testing as a Service Platform

Configuration files for Run, Lab, Conformance, and Interoperability simplifies management and lab portability, lowers implementation cost

D/SUT: Device/System Under Test
SCS: System Conformance Statement
ICS: Implementation Conformance Statement
IXIT: Implementation Extra Info for Testing
CTR: Conformance Test Report
ITR: Interoperability Test Report

Who Can Test?

- Anyone!

- ***Vendors, developers*** can access and use the open-source test suite for <u>free</u>
  - Should reduce QA costs since vendors don't need to develop and validate the tests themselves

- ***Customers, integrators*** will likely prefer the TaaS platform
  - Same code; simple web-based interface
  - Should reduce integration costs by confirming interoperability

- ***Authorized test facilities*** can generate reports for the certification

Cybersecurity

Assessments and Recommendations

# Risk Assessments

- ## Functional Elements
  - FEs as part of the test lab; involves risk scenarios based on NG9-1-1 objectives and FE functionality.
  - Focus: system, network, and application security
  - Share practical recommendations for risk reduction

- ## ITEC Testbed
  - The NG9-1-1 testbed itself, including tools and services
  - External interfaces, including remote access and cloud
  - Isolation of the NG9-1-1 testbed from other projects currently operating at ITEC

- ## Open-source Test Engine
  - The test engine itself, including application and software supply chain security
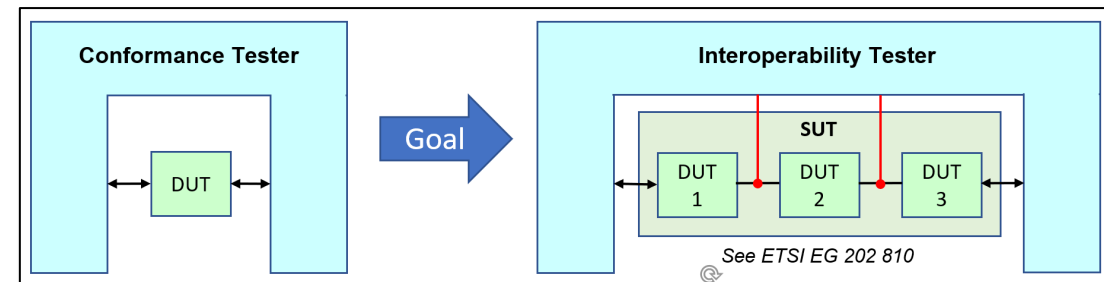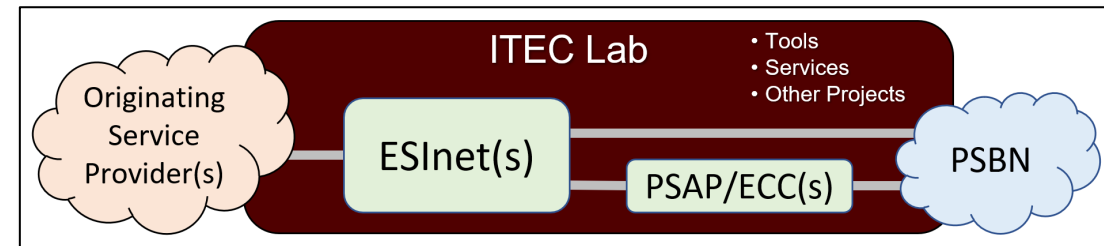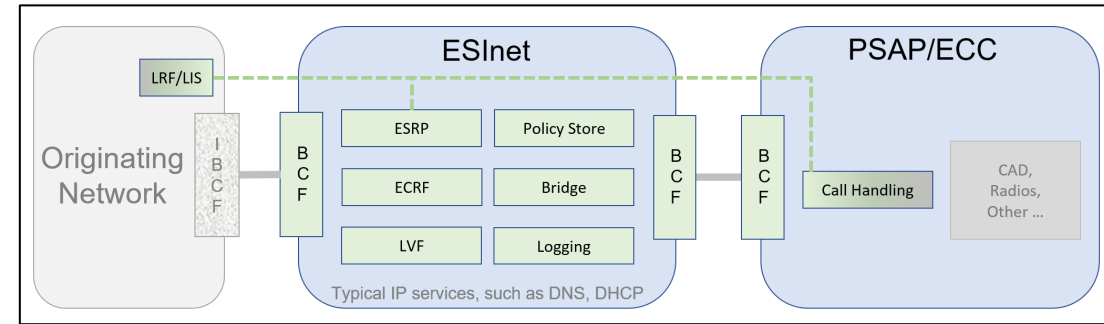
Recommendations

- EC3 (Emergency Communications Cybersecurity Center)
  - Uses existing test lab components to configure a simple Proof of Concept EC3
  - Develop example scenarios and examine EC3 abilities to collect/enrich/analyze/share data, integrate third party security solutions such as IDS, etc.
  - Develop practical recommendations on establishing an EC3 test bed with foundational capabilities

- NG9-1-1 to PSBN Interconnection
  - Uses existing 4G/5G systems at ITEC and PSBN connections to assess cybersecurity implications of NENA-STA-031.1-2021
    - "NENA Standard for Interconnecting Emergency Services IP Networks and Public Safety Broadband Networks"
  - Develop recommendations based on findings for interconnectivity.
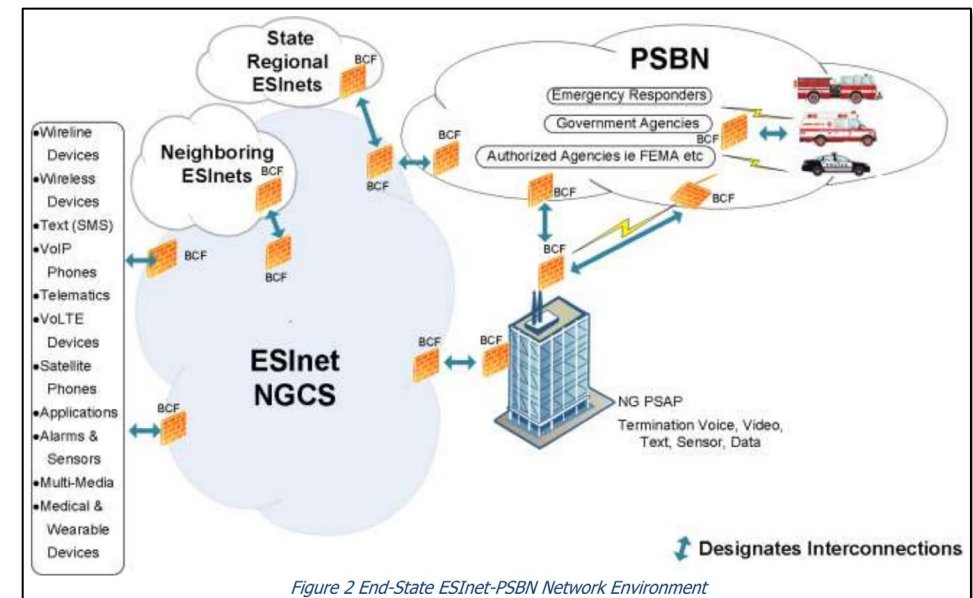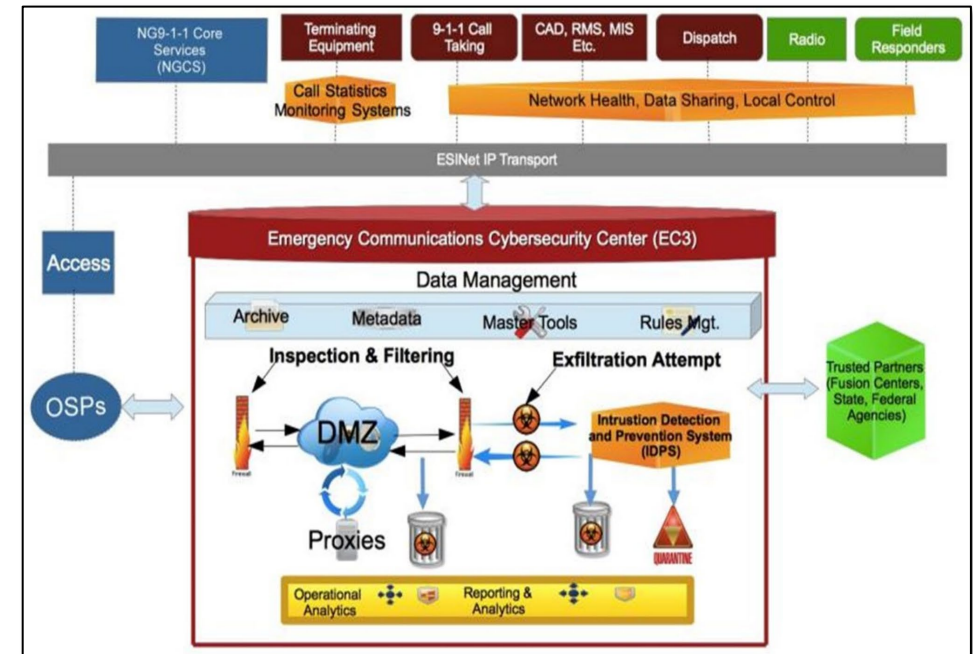

Figure 2 End-State ESInet-PSBN Network Environment

ISO Lab

A.J. Renold, Sr. Associate Director

Texas A&M University System, ITEC

Why ISO Accreditation?

ISO/IEC 17025
General requirements for the competence of testing and calibration laboratories

- Requirement:
  - Trusted, repeatable, reliable, neutral, confidential, verifiable
- Standard: ISO/IEC 17025 (www.iso.org)
  - International reference for testing and calibration laboratories
  - Verifies competent operations and valid results
  - Facilitates cooperation between laboratories and other bodies
- Certifying body will maintain list of authorized labs that:
  - Have demonstrated competency in NG9-1-1
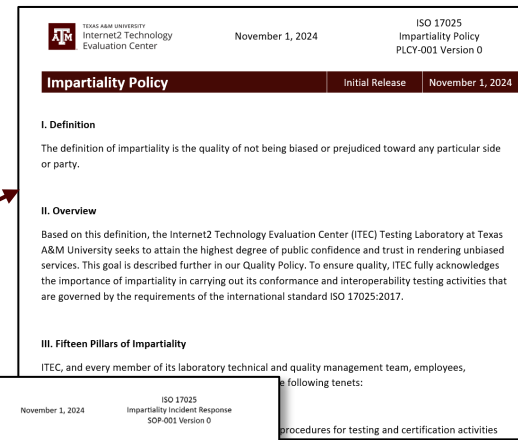 - Are ISO/IEC 17025 accredited for NG9-1-1 testing

ISO Documentation
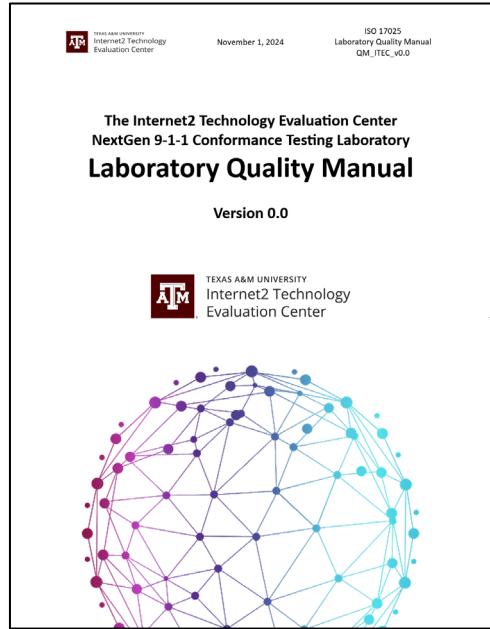
Quality Manual
- Primary guide; 50 pgs
- ISO 17025-aligned sections
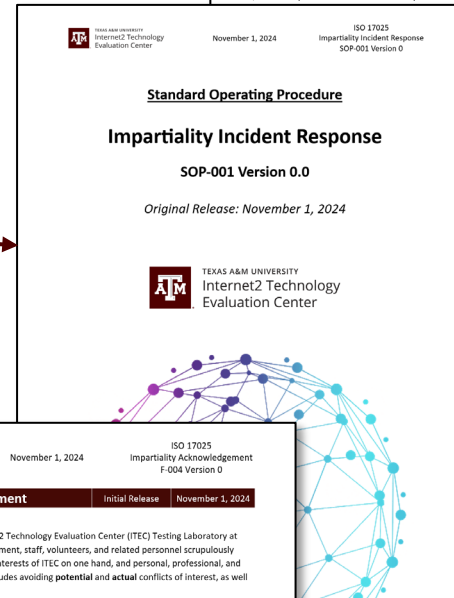- Guides use of policies, SOPs, other docs

37 Other Documents
15 Forms
7 Records/Logs
15 Miscellaneous
(checklists, job descriptions, …)

3 Policies
- Impartiality
- Confidentiality
- Quality

19 Standard Operating Procedures
1. Impartiality Incident Response
2. Document Control and Management
3. Corrective and Preventive Actions
4. Training for Laboratory Personnel
5. Laboratory Complaint Handling
6. Purchase and Receipt of Supplies and Services
7. Control of Non-conforming Tests
8. Review of Requests, Quotes, and Contracts
9. Identification and Control of Lab Records
10. Handling of Test Items
11. Maintenance of Lab Equipment
12. Quality System Suitability Testing
13. Accreditation Symbol Control
14. Laboratory Audits
15. Laboratory Management Reviews
16. Managing Confidentiality
17. Personnel Life Cycle
18. Monitoring Validity
19. How to Perform Tests
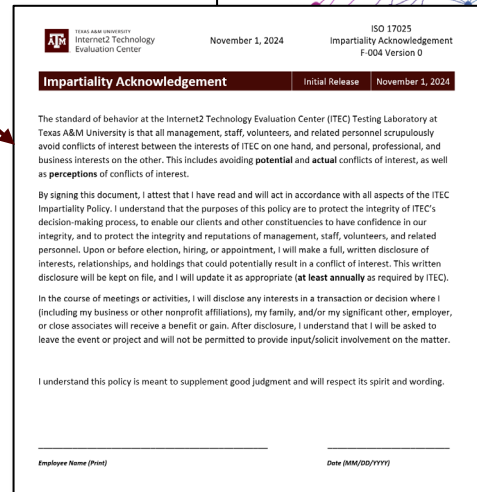
ISO Training

Employee Training: ISO 17025

General requirements for the competence of testing and calibration laboratories

Training Topics

- Lesson 1 – Introduction to ISO 17025
- Lesson 2 – Scope
- Lesson 3 – Terms and Definitions
- Lesson 4 – General Requirements
- Lesson 5 – Structural Requirements
- Lesson 6 – Resource Requirements*
- Lesson 7 – Process Requirements*
- Lesson 8 – Management System Requirements*

INTERNET2 TECHNOLOGY EVALUATION CENTER

Financial Model

Test System Costs

- Identify requirements
  - MUST/MUST, SHOULD/SHOULD NOT, …
  - From NENA i3 (NENA-STA-010)
- Define tests
  - Plain English description
- Write test cases
  - Python and other open-source tools
- Validate test cases
  - Confirm correctness
- Test system architecture
  - Configuration, send/receive, monitor, logging, reporting, …
- Sustaining
  - New tests as standard evolves
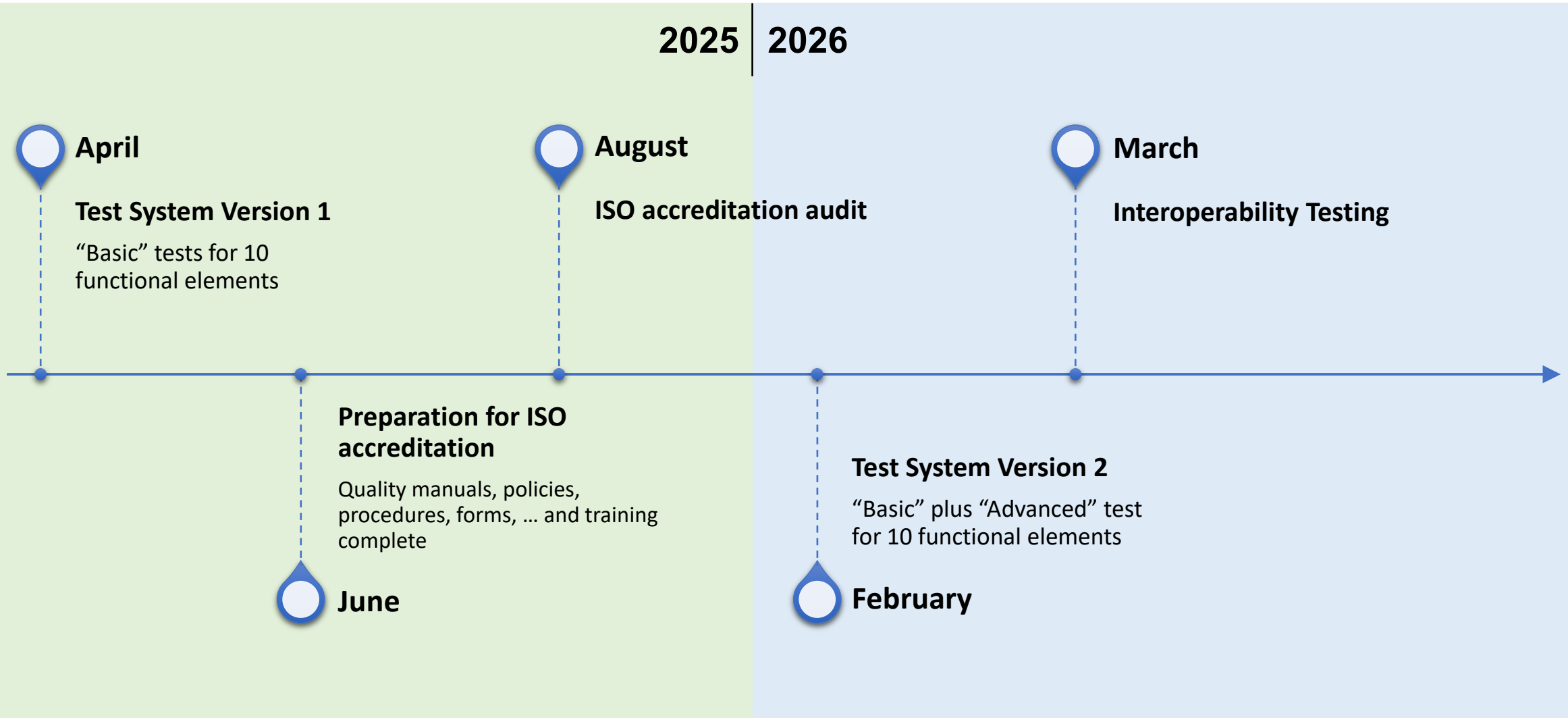
ISO Lab Accreditation Lab Costs

- ISO 17025 research
- Define policies and procedures
- Documentation
  - Quality manual, policies, procedures, forms, logs, etc.
- Training
- Business/administrative
- Security
- Lab Hardware/software
- ISO audits by 3rd party

NG9-1-1 Interoperability

Vendors, Standards Bodies, Public Safety, and Defence

They all agree!

Sounds Great! When?

2025 | **2026**

April

Test System Version 1

"Basic" tests for 10 functional elements

Preparation for ISO accreditation

Quality manuals, policies, procedures, forms, … and training complete

June

August

ISO accreditation audit

March

Interoperability Testing

Test System Version 2

"Basic" plus "Advanced" test for 10 functional elements

February

Questions?

THE TEXAS A&M UNIVERSITY SYSTEM
INTERNET2 TECHNOLOGY EVALUATION CENTER

https://itec.tamu.edu

info@itec.tamu.edu