SAND2019-1692PE

IDC Re-engineering - Geophysical Monitoring System (GMS) Overview

PRESENTED BY

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US NDC – IDC Bilateral Meeting

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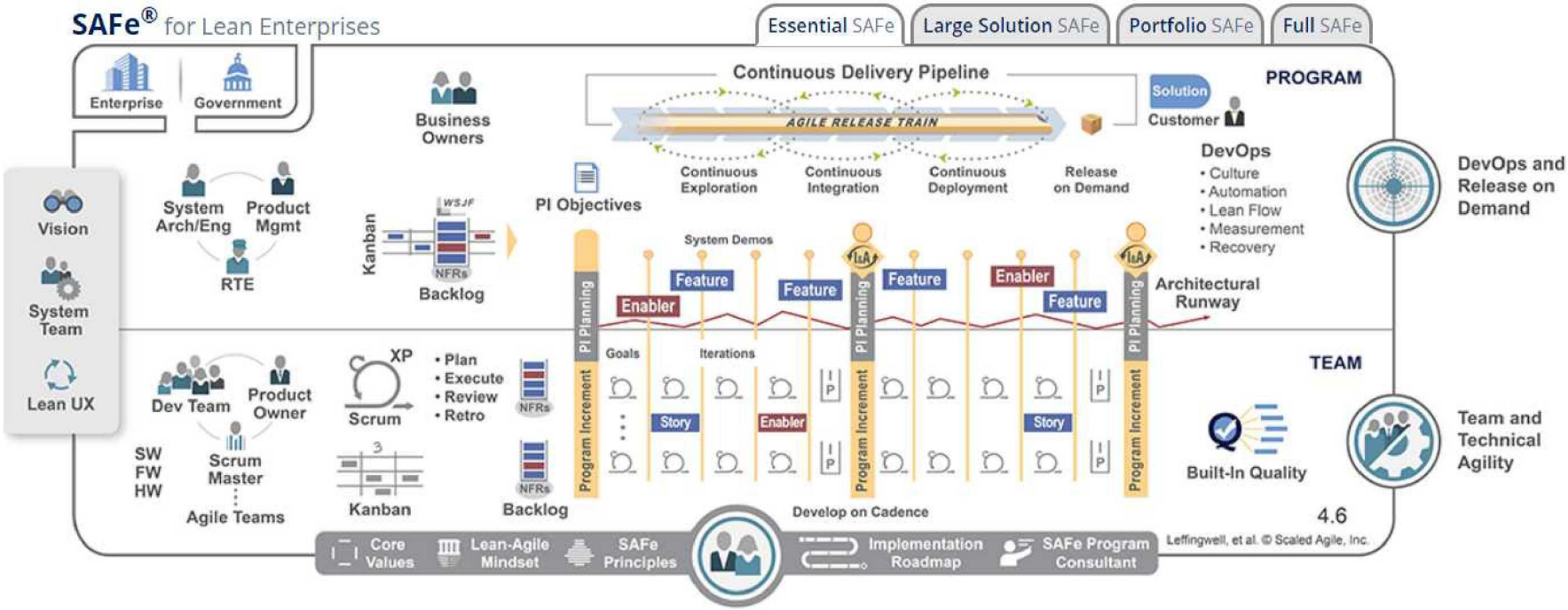
SAND2019-XXXX PE

Topics

- US NDC Modernization Status
- Sandia IDC Re-engineering Project
- GMS 2018 Release
- GMS 2019 Release

US NDC Modernization Status

Using the Scaled Agile Framework



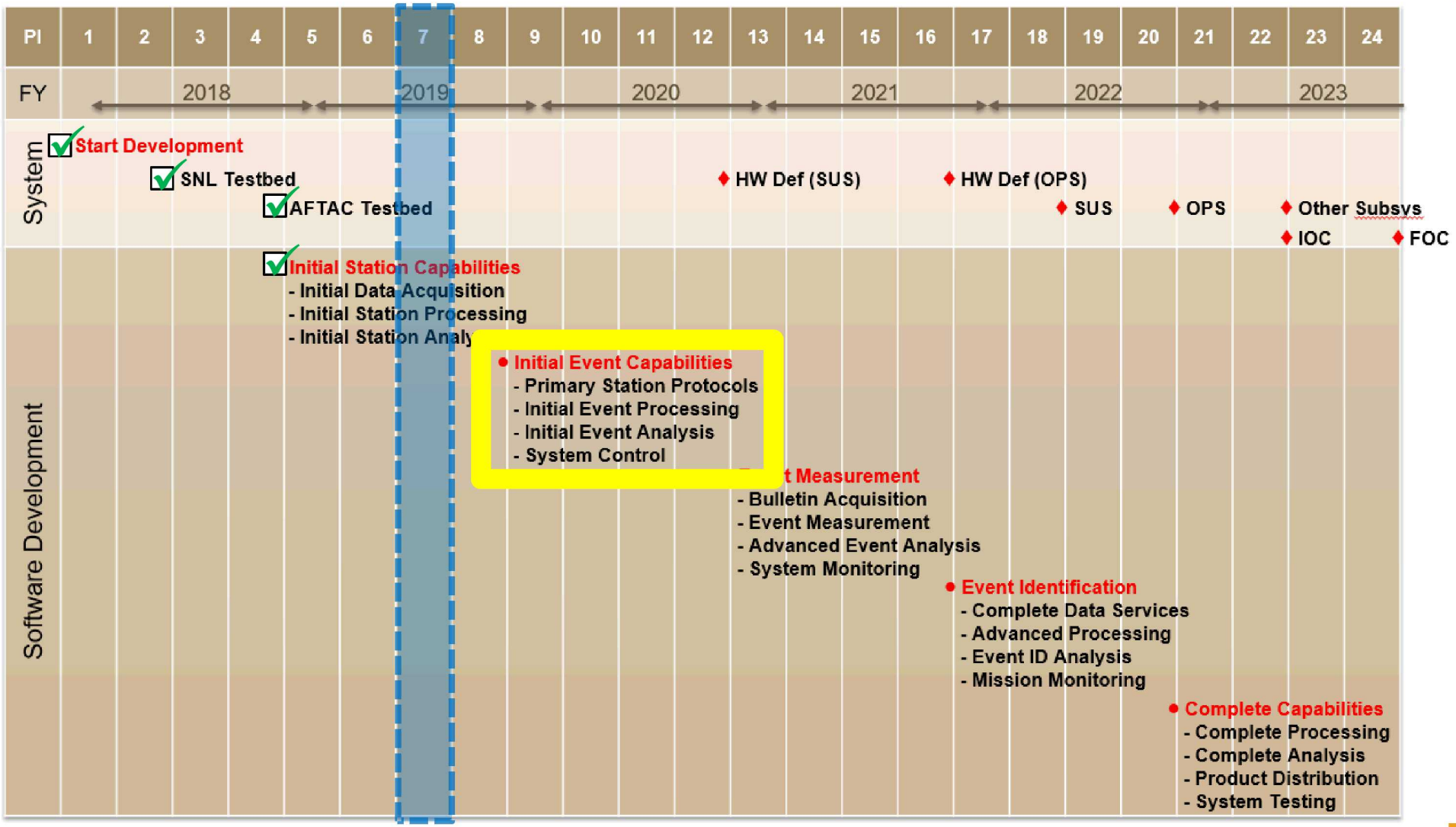
SAFe

- Program Increments (12 weeks)
- Guided by Solution Intent
  - Requirements, Use Cases, Storyboards, Qualities, Architecture
- SNL and AFTAC collaboration on engineering and development
- Testbeds at SNL and AFTAC – updated each PI

Teams

- Four Development Teams
  - Data Acquisition
  - Station Processing
  - Network Processing
  - Analysis
- System Team
- System Engineering Team
- Architecture Team
- Subject Matter Experts (SME) Team

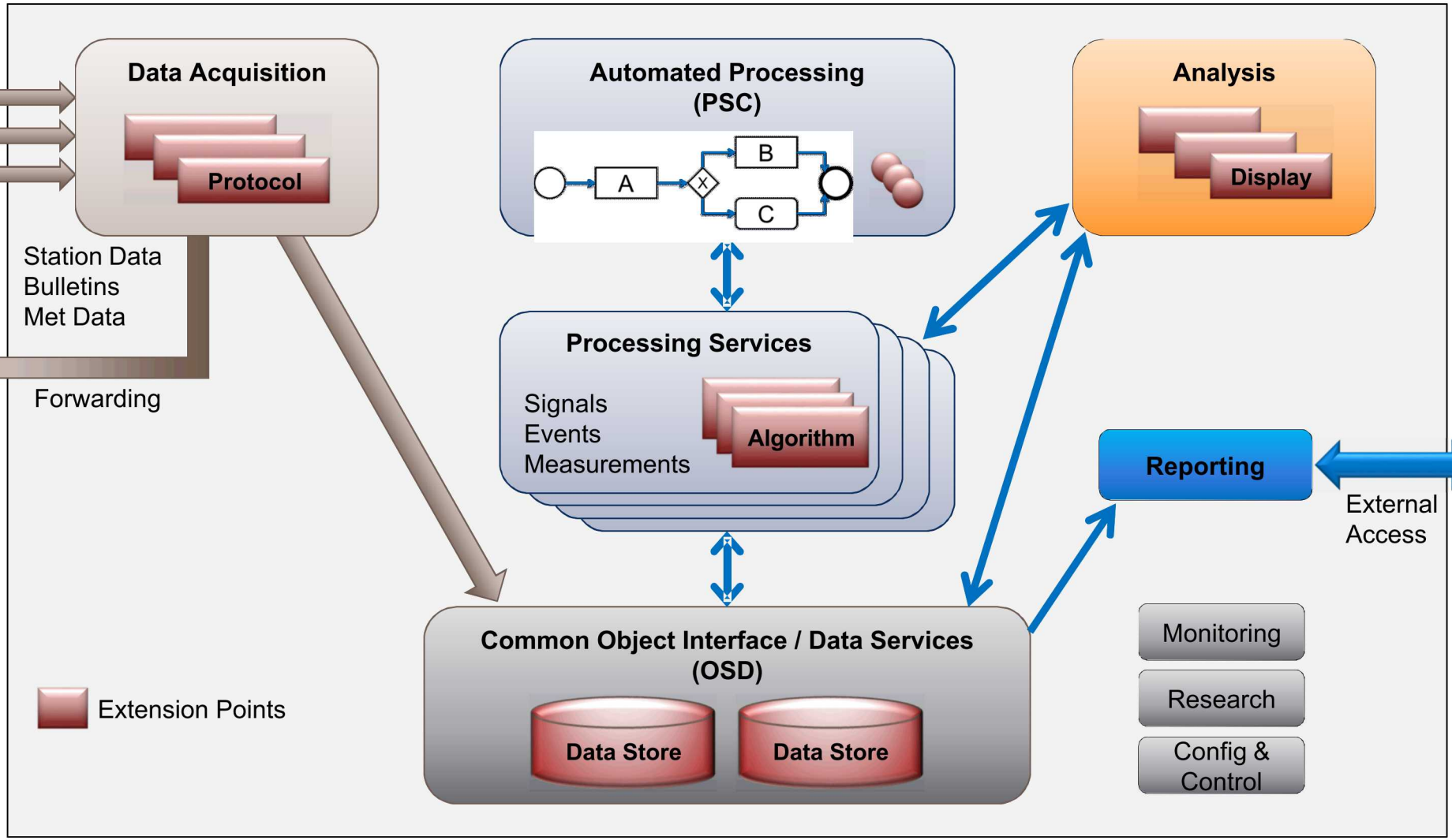
Working Toward Year-Two Milestone



Architecting for System Qualities

- **Extensibility** (add/replace processing components, displays, data storage, other mechanisms)
- **Maintainability** (SE, models, standards, collaboration with maintainers)
- **Scalability** (redundant 24/7 data centers → down to laptop)
- **Usability** (consistent, modern UI)
- **History** (capture and use provenance of results)
- **Configurability** (all parameters accessible for tuning)
- **Flexibility** (easily change data processing and analyst workflow)
- **Platform Independence** (use open, extensible technologies)
- **Longevity** (plan for 20-year life)
- **Growth** (expecting exponential growth of data, new processing techniques)
- **Testability** (data replay and analyst action replay at system level)
- **Security** (must meet standards)

GMS High Level Architecture

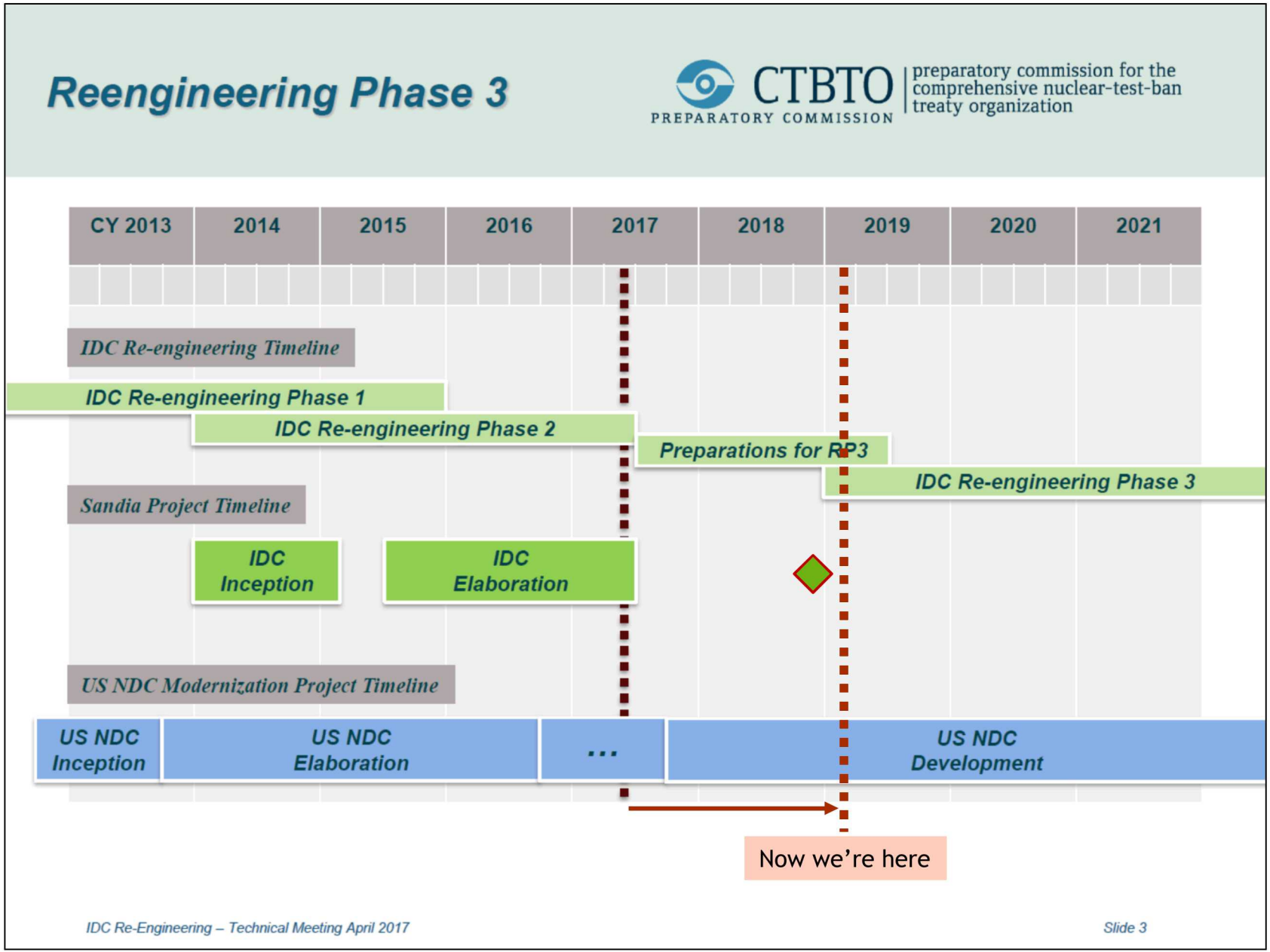


Sandia IDC Re-engineering Project

IDC Re-engineering

- Re-engineering Phase 1 (RP1) – enhance/replace major components of the system
- Re-engineering Phase 2 (RP2) – design a unified architecture for all seismic, hydroacoustic, and infrasound (SHI) software
  - completed in April 2017
  - Included SNL project to define IDC requirements, specifications, use cases, and storyboards
  - Several Technical Meetings were held with Member States (~annually)
- Re-engineering Phase 3 (RP3) – development and deployment of components based on the architecture designed in RP2
  - IDC Established Two Options for RP3
  - Option A: if US NDC Modernization contribution – work with new architecture
  - Option B: if no US contribution – evolve current system
  - Plan included preparation phase to allow US NDC Modernization to progress
- IDC decision based on US support / open source release

IDC Plan for Preparing for RP3 (from 2017)



US Support for IDC Re-engineering

- US stakeholders desire to support IDC RP3 in an effective and affordable manner, leveraging the USNDC Modernization GMS development
- In 2017 SNL proposed four levels of service
- US has funded "Managed Open Source Project"
  - Includes common components of GMS from USNDC Modernization
  - SNL manages open source project
    - Bug reports, remote contributions
    - Supports coordination to maintain commonality
  - Generic runnable system (not configured specifically for IDC)
  - Limited SNL support for IDC testing and evaluation

- First GMS Open Source Release in 2018
  - PI 3 software release – very limited functionality, not buildable externally
  - Posted December 2018
  - https://github.com/SNL-IDC/SNL-GMS-Common/

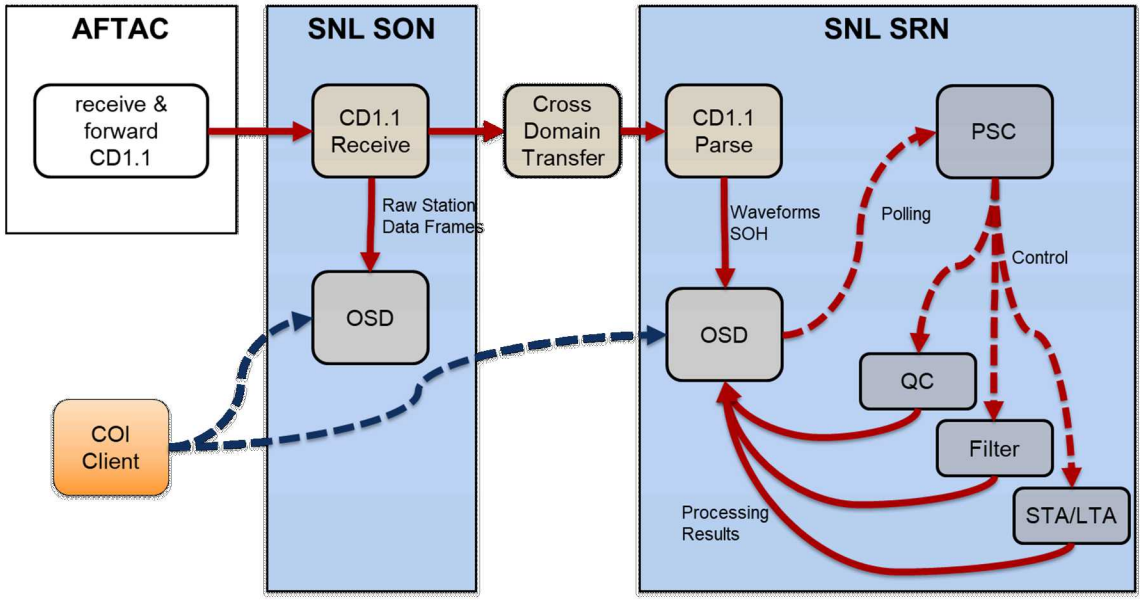
GMS 2018 Release

2018 Release (PI 3) Capabilities

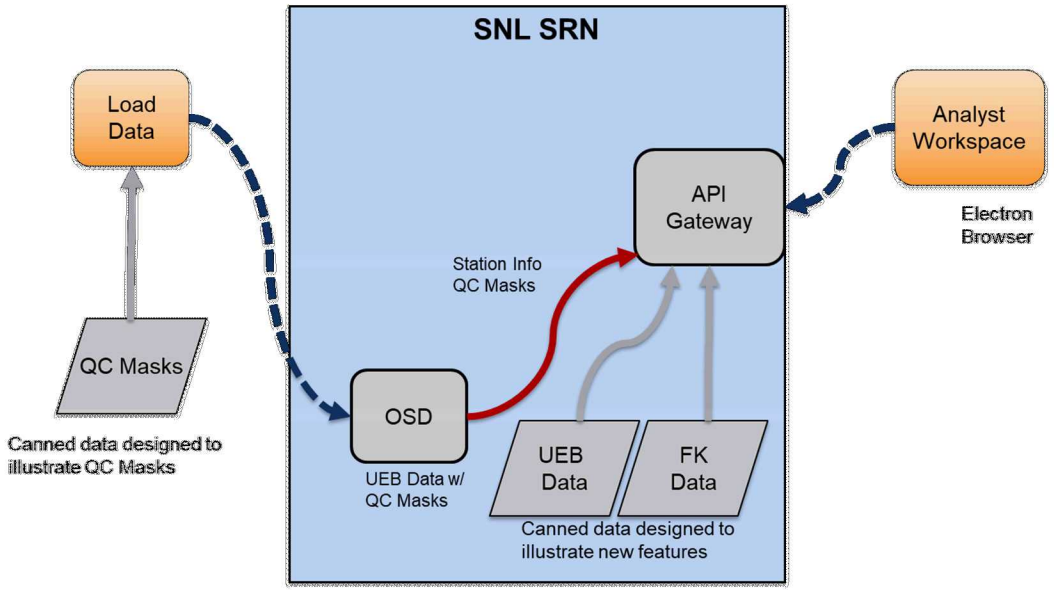
- **Most features are an initial minimal implementation**
- **Acquisition**
  - Station Data Acquisition (CD-1.1)
  - Station Data Acquisition (CSS3.0)
  - Cross Partition Data Transfer
- **Processing**
  - Processing Sequence Execution - initial station and network processing
  - Waveform QC - SOH and simple data quality problems
  - Linear Filtering - FIR filters
  - Power Detector (STA/LTA) - standard algorithm
- **Analysis**
  - Data Selection Display
  - Waveform Display
  - Event List Display
  - Signal Detection List Display
  - Map Display
  - Waveform Data Quality Analysis
  - Signal Detection Analysis
  - FK Analysis
- **Operations**
  - COI Data Service – station info, waveforms, processing results

PI 3 Demonstration System (SNL Testbed)

Data Acquisition and Processing



Analysis



PI 3 Release Limitations

- This initial release of the GMS common source code is provided for evaluation of design and is not for operational use
  - Receiving data from a small number of stations (<10)
  - Only processing one station
  - Analysis tools are limited to one user
- The PI 3 release is not buildable or runnable
  - PI 3 code repository structure was causing significant build issues
    - GMS transitioned to mono-repo in PI 4
  - Substantial information security issues were found in the PI 3 release that had to be removed
    - Build tool configuration, deployment files, test data
    - GMS is refactoring to separate code and configuration
  - PI 3 required OpenShift platform for deployment and test
    - Complex and expensive
    - GMS is moving to simpler Docker deployment environment
- Future versions will support testing in an operational environment

GMS 2019 Release

2019 Release (PI 7) Plans

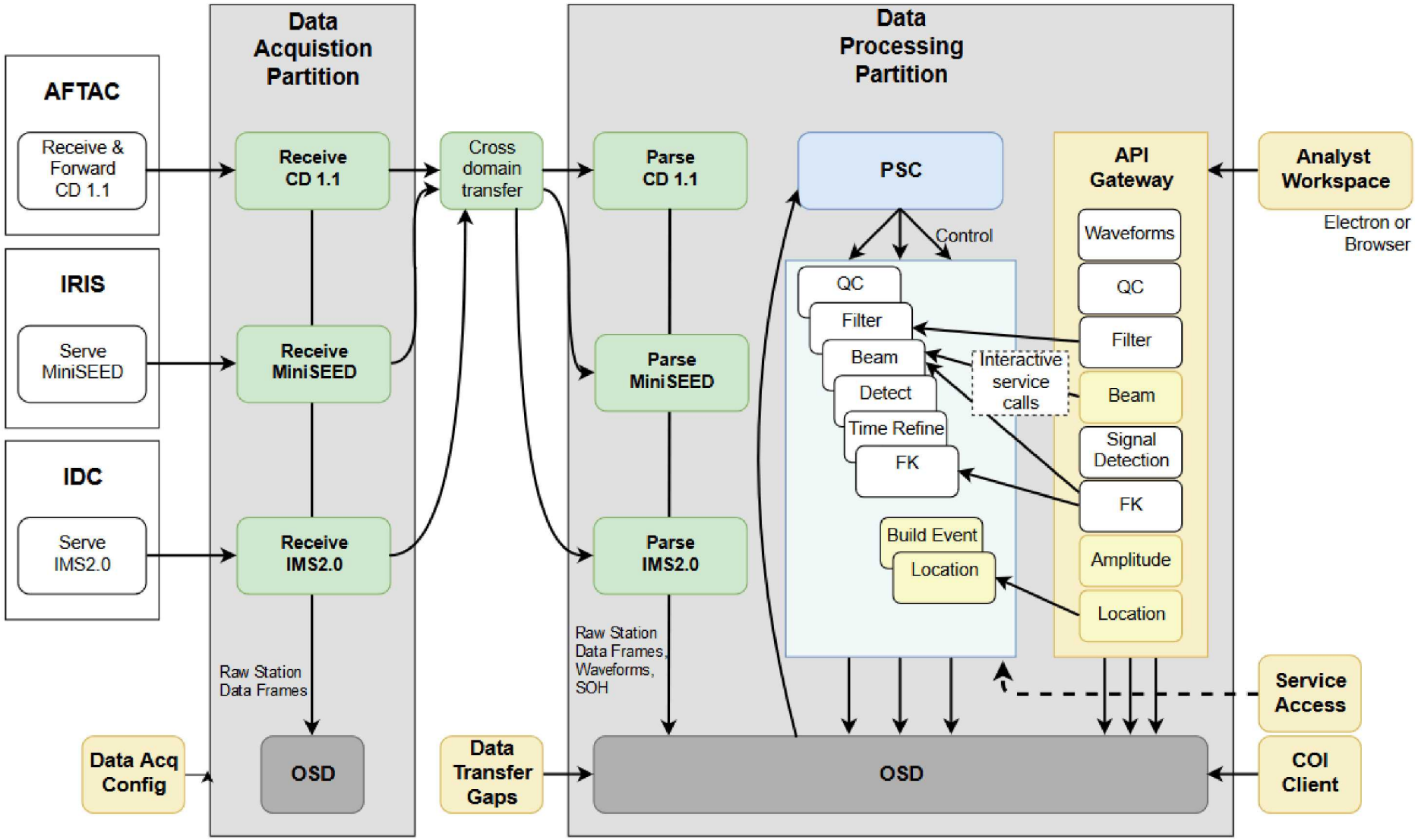
- Target is PI 7 Release (code complete in May 2019)
  - Posted as soon as review and approval complete
- Common Components Configured as a “Generic Runnable System”
- Buildable from released source code
- Runnable in a virtual testbed environment
- Using Docker compose or Docker Swarm

- Many operational aspects of the system will still be immature
  - Configuration
  - Control
  - Monitoring
  - Simple versions of algorithms
  - Performance
  - Limited multi-user support

Capabilities Expected in PI 7 Release

- **Acquisition**
  - Station Data Acquisition (CD-1.1)
  - Station Data Acquisition (CSS 3.0)
  - Station Data Acquisition (MiniSEED)
  - Station Data Acquisition (IMS 2.0)
  - Cross Partition Data Transfer
  - Data Acquisition Status Display (Gaps in Transfer)
  - Data Acquisition Configuration Display
- **Processing**
  - Processing Sequence Execution - initial station and network processing
  - Processing Sequence Configuration Display
  - Waveform QC - SOH and simple data quality problems
  - Linear Filtering - FIR filters
  - Beamforming
  - Power Detector (STA/LTA) - standard algorithm
  - Onset Time Refinement (AIC)
  - FK Spectra
  - FK Measurements – azimuth, slowness, fstat
  - Feature Prediction – 1D time, azimuth, slowness, magnitude correction
  - Event Building
  - Event Location
- **Analysis**
  - Data Selection Display
  - Waveform Display
  - Event List Display
  - Signal Detection List Display
  - Map Display
  - Waveform Data Quality Analysis
  - Waveform Filtering
  - Signal Detection Analysis
  - FK Analysis
  - Event Building – manual association
  - Event Location
- **Operations**
  - COI Data Service

PI 7 System


AFTAC
Receive & Forward CD 1.1
IRIS
Serve MiniSEED
IDC
Serve IMS2.0
Data Acquistion Partition
Receive CD 1.1
Receive MiniSEED
Receive IMS2.0
Raw Station Data Frames
Data Acq Config
OSD
Cross domain transfer
Data Transfer Gaps
Data Processing Partition
Parse CD 1.1
Parse MiniSEED
Parse IMS2.0
Raw Station Data Frames, Waveforms, SOH
PSC
Control
QC
Filter
Beam
Detect
Time Refine
FK
Build Event
Location
Interactive service calls
API Gateway
Waveforms
QC
Filter
Beam
Signal Detection
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Electron or Browser
Service Access
COI Client

END