Geophysical Monitoring System (GMS) for IDC Re-engineering

Sandia National Laboratories

GMS Geophysical Monitoring System

PRESENTED BY

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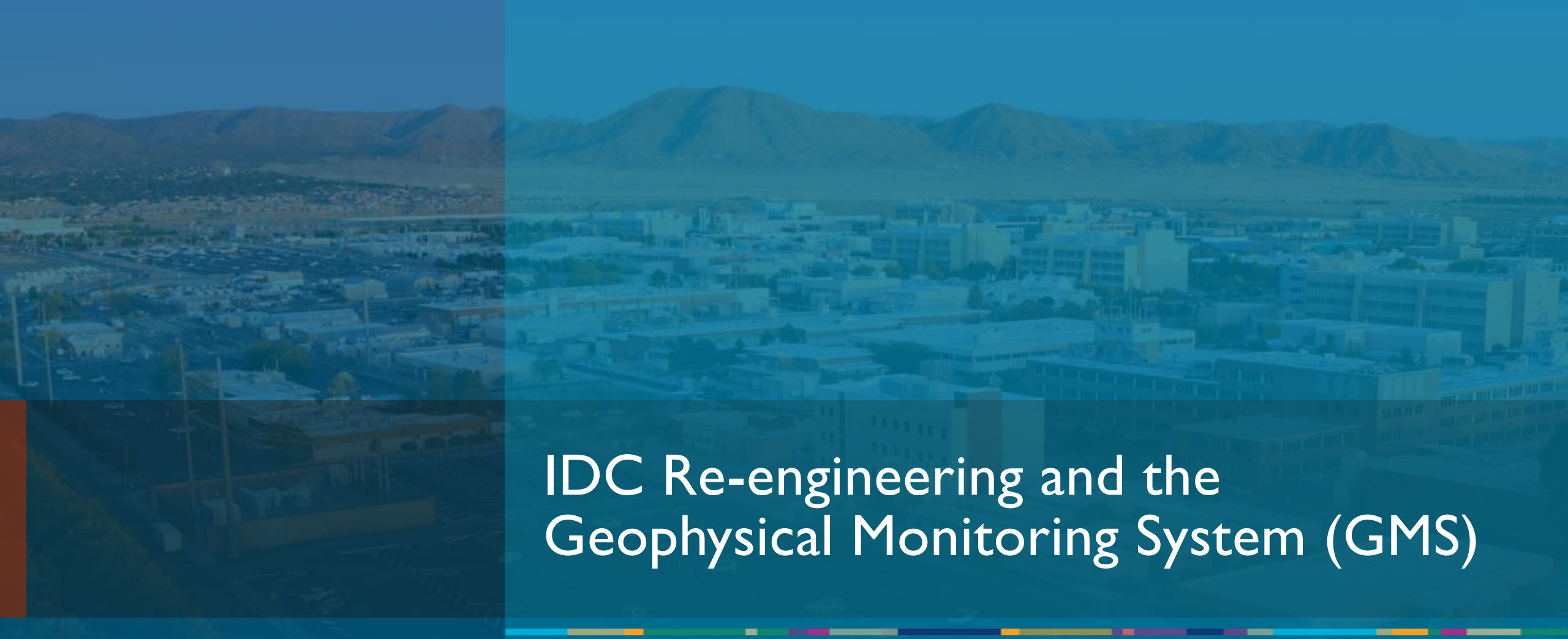
Topics

IDC Re-engineering and the Geophysical Monitoring System (GMS)

Analyst Workspace Examples

GMS 2019 Release



IDC Re-engineering and the Geophysical Monitoring System (GMS)

Phases of IDC Re-engineering

Re-engineering Phase 1 (RP1)

- Enhance or replace major components of the system

Re-engineering Phase 2 (RP2)

- Design a unified architecture for all seismic, hydroacoustic, and infrasound (SHI) software
- Included support from Sandia National Laboratories to help document IDC requirements, specifications, use cases, and storyboards

Re-engineering Phase 3 (RP3)

- Development and deployment of components based on the architecture designed in RP2
- Leveraging US Contribution-in-Kind of common components from system development for US NDC Modernization
- Substantial effort at IDC to integrate, test, and develop IDC-unique components – much opportunity for contributions by the community

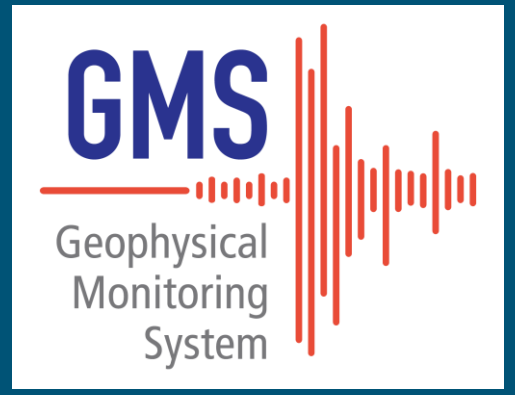
The Geophysical Monitoring System (GMS)

Sandia National Laboratories is developing a new waveform processing system for the US National Data Center (US NDC)

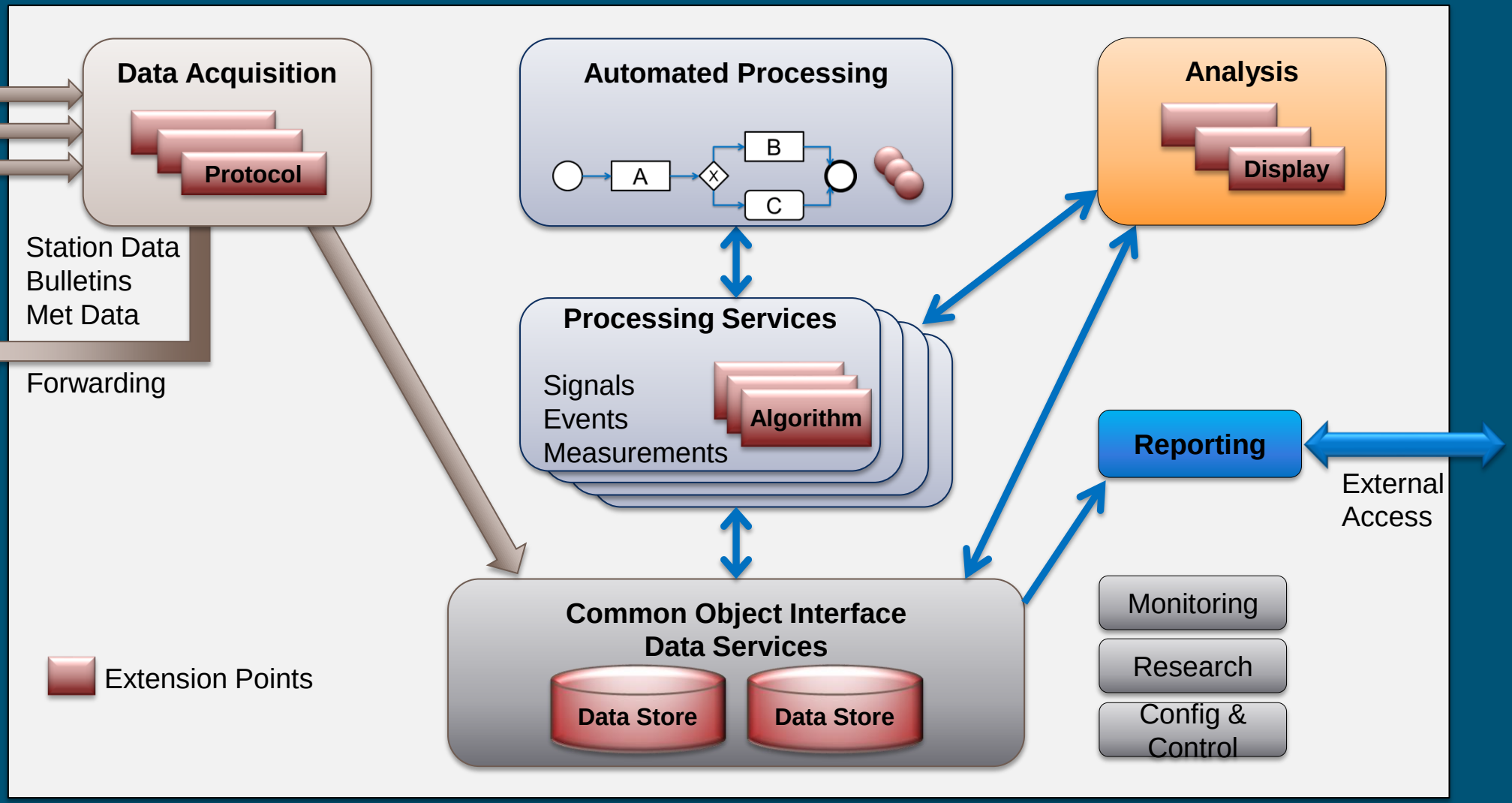
This is the **Geophysical Monitoring System (GMS)**

GMS Vision: Build a new system to meet US NDC mission requirements that improves **maintainability, extensibility, testability,** etc.

GMS executes data QC, station processing, association, event building, and bulletin generation for SHI data.



Addressing all parts of the Waveform Processing System



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)

United States Support for IDC Re-engineering Development

The IDC and US NDC have *substantial overlap* in processing system requirements and needs

To help meet the needs of the IDC, the US is contributing the Geophysical Monitoring Software (GMS) developed for US NDC Modernization

Software delivery is an Open Source Project

- Includes common components from USNDC Modernization
- Generic runnable system (not configured specifically for IDC)
- Limited SNL support for IDC testing and evaluation

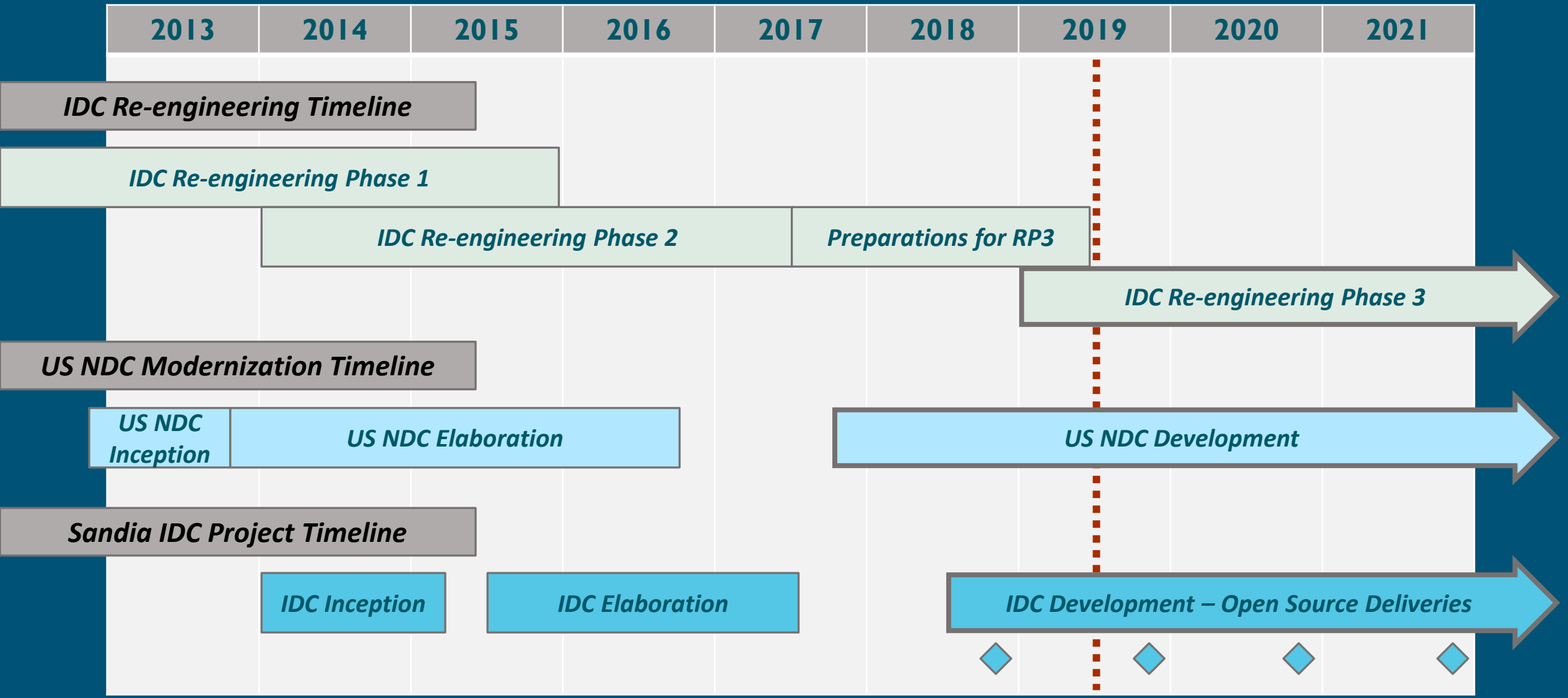
Dec 2018 – First GMS Open Source Release

- Program Increment 3 software release– very limited functionality, not buildable externally
- Released for review only

2019 – Working toward Next Release

- Generic buildable, runnable system

IDC Re-engineering Timeline

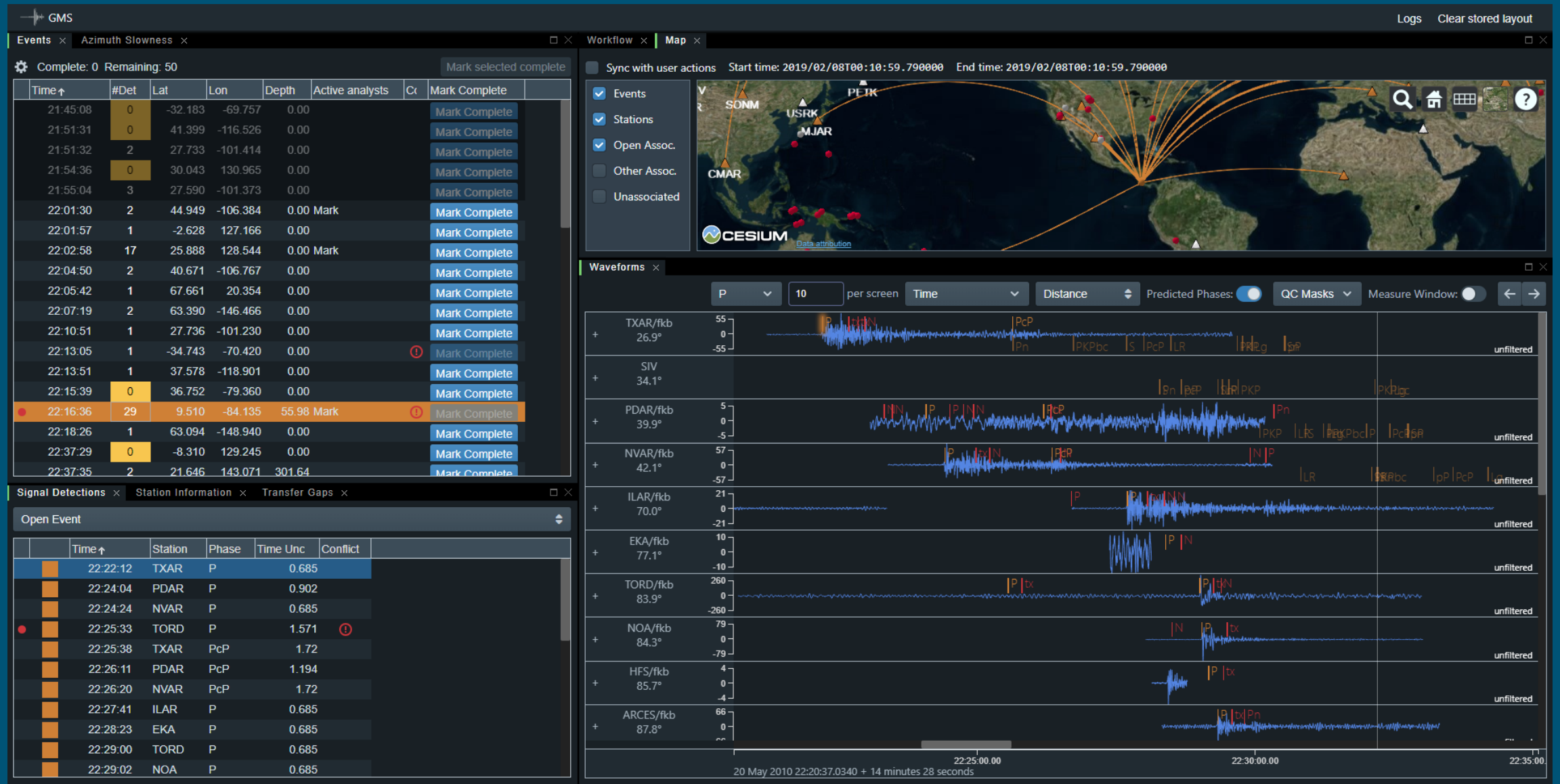


Analyst Workspace Examples

The Analyst Workspace

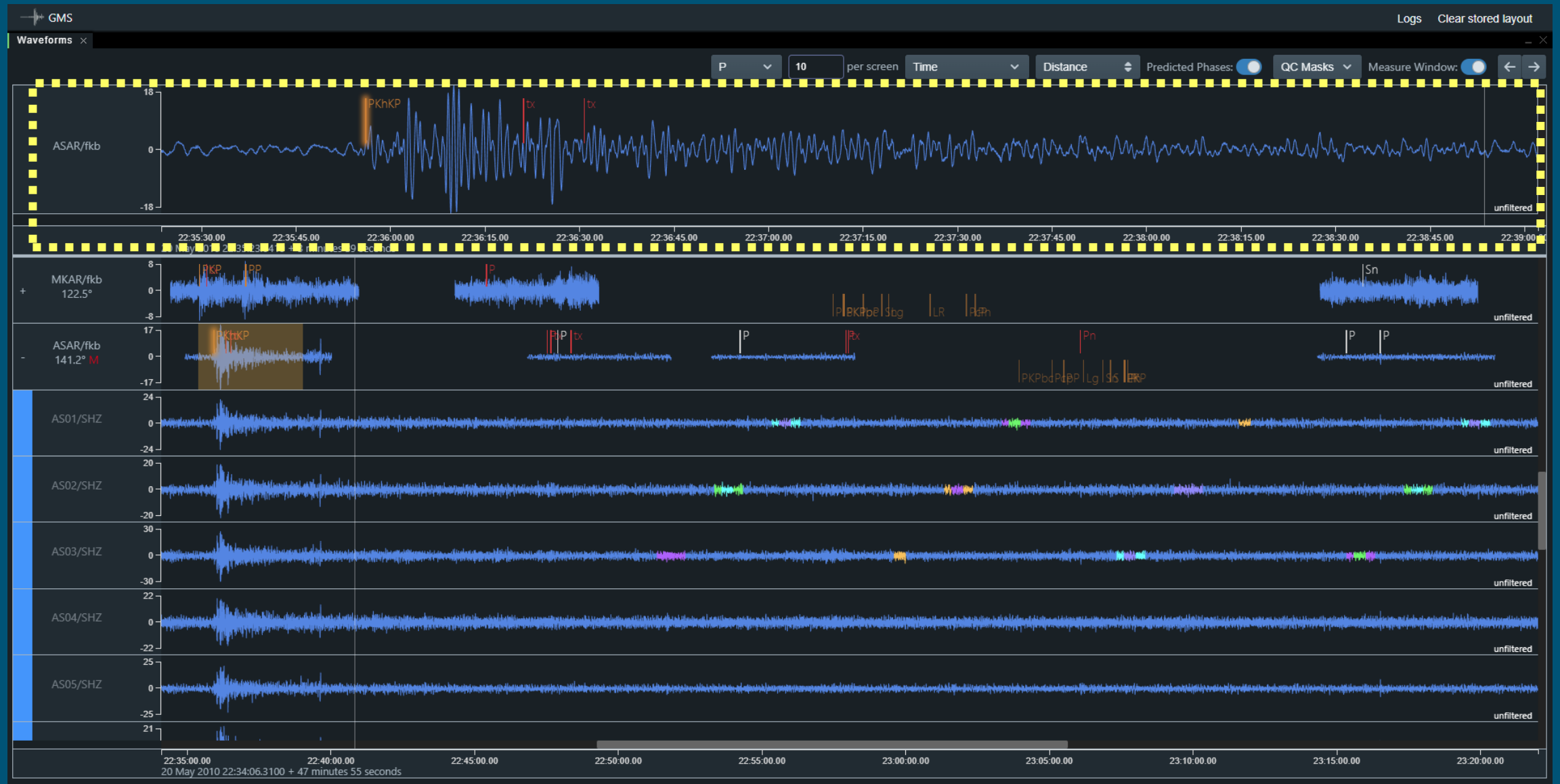
- Manages the displays used for Waveform and Event Analysis as a system
  - Workflow
  - Map
  - Waveform Display
  - Signal Detection List
  - Event List
  - Azimuth/Slowness (FK)
  - Amplitude Measurement
  - Location
  - Magnitude
- Developed using web technologies
  - Common UI features – multi-paned, tabbed panels
  - Supports both browser and desktop app deployments
- Workspace layout is user-customizable
- Data is synchronized across all workspace displays

Analyst Workspace Displays

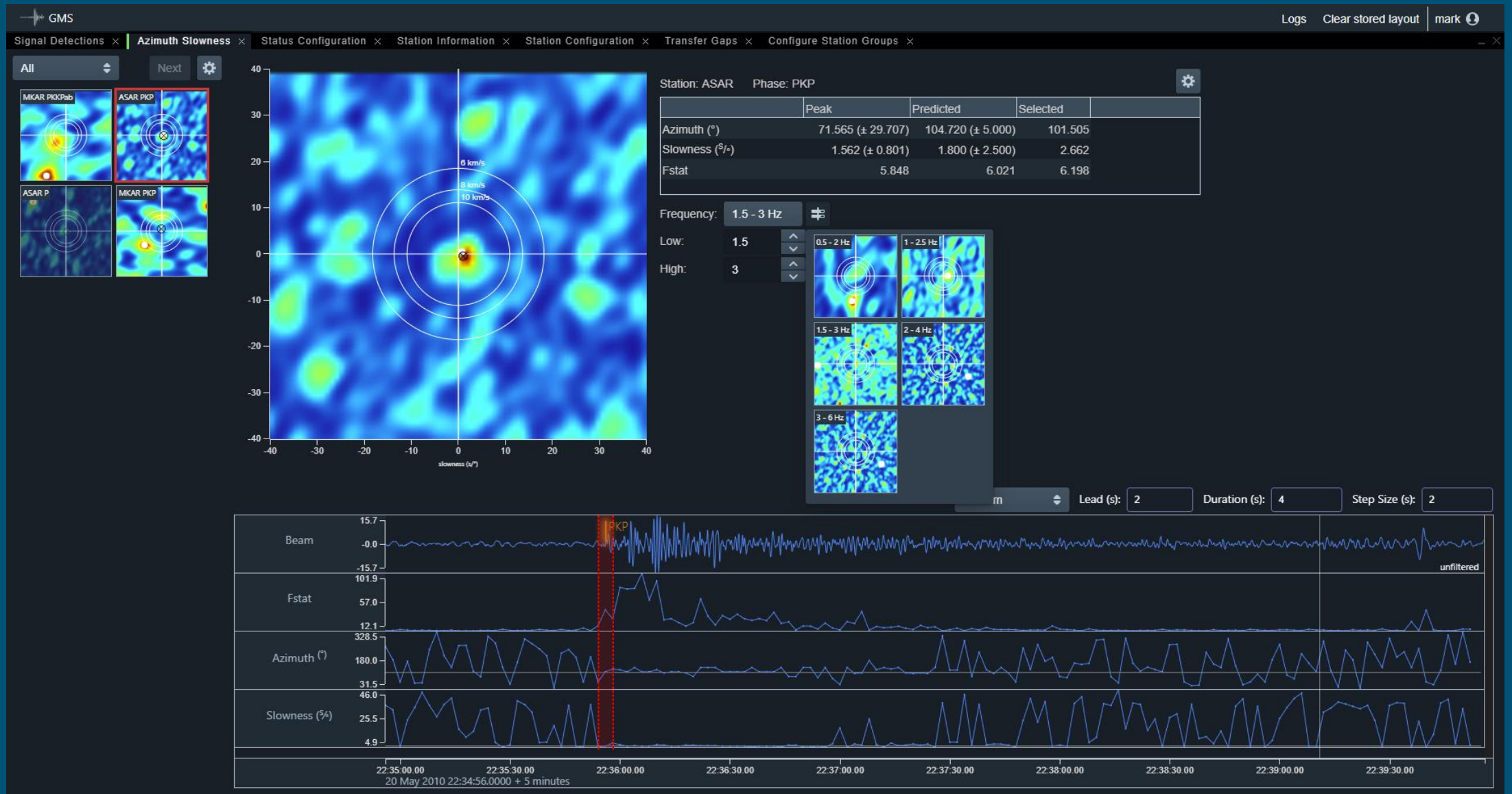


Analyst Workspace – Customizable Layout

Waveform Display with new Measurement Window



Azimuth/Slowness (FK) Display



Provenance: Viewing Signal Detection and QC Mask History

GMS 2019 Release

Capabilities 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
- Data Acquisition Configuration Display
- Station SOH Display

Operations

- COI Data Service

Processing

- Processing Sequence Execution - initial station processing
- Processing Sequence Configuration Display
- Waveform QC
- Linear Filtering (FIR)
- Beamforming
- Power Detector (STA/LTA)
- Onset Time Refinement (AIC)
- FK Spectra
- FK Measurements – az, slow, fstat
- Feature Prediction – 1D time, az, slow, mag correction
- Event Building – preliminary events
- 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
- Event Magnitude

2019 Release Plans

GMS Development is planned through 2023
- US plans an Open Source release each year

GMS 2019 Release (PI 7 code completed in May)
- 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

Release Content
- Software, Build files, Instructions, Design Documentation

GMS development is less than 1/3 complete
– most operational aspects of the system are still immature
- Configuration
- Control
- Monitoring
- Performance
- Only simple versions of algorithms
- No multi-analyst support