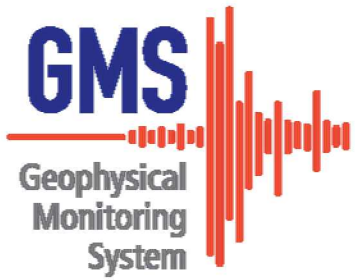
SAND2019-14470PE

IDC Re-engineering - Geophysical Monitoring System (GMS) 2019 Update



PRESENTED BY

J. Mark Harris

US DOD – CTBTO PTS Bilateral Meeting
5-6 December 2019

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SAND2019-XXXX PE

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

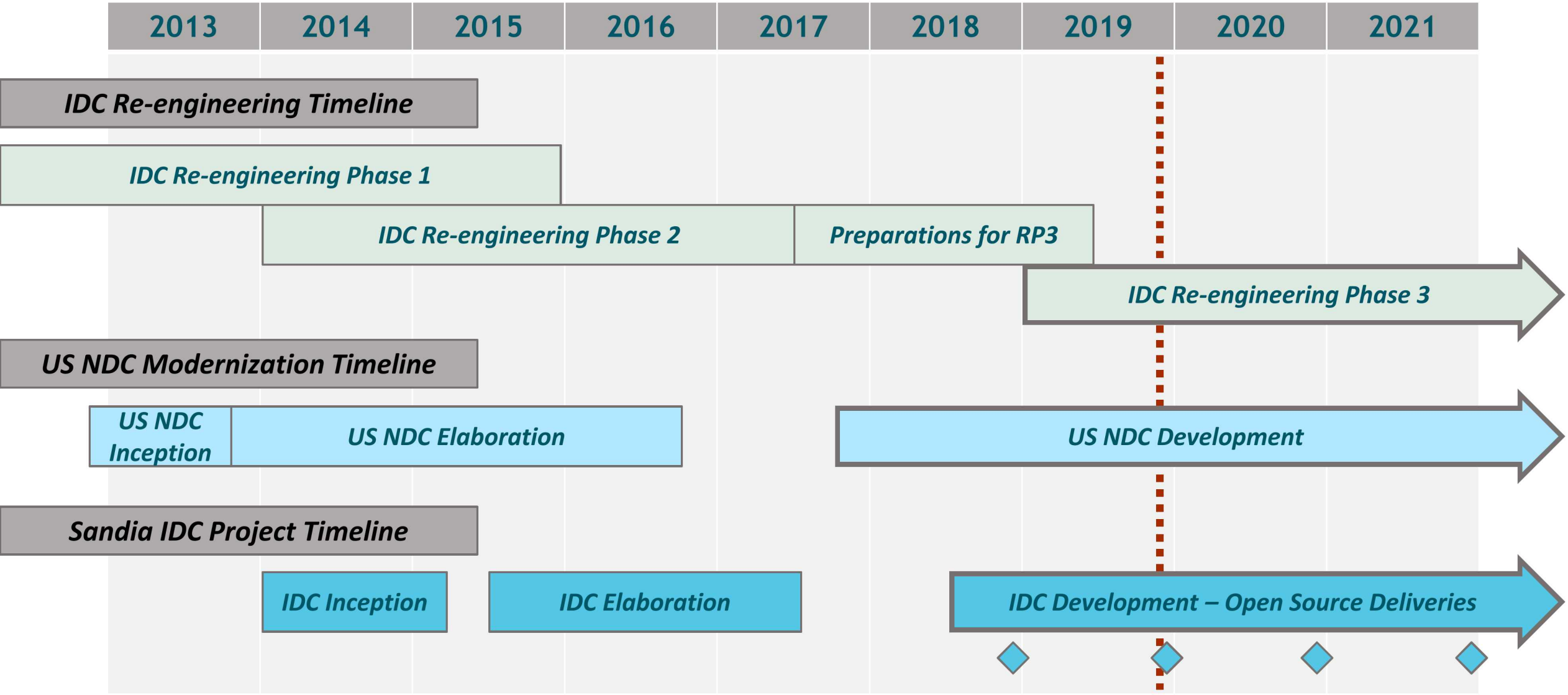
Dec 2018 – First GMS Open Source Release

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

Dec 2019 – Second Release

- Generic buildable, runnable system

IDC Re-engineering Timeline



2019 Release

GMS 2019 Release (PI 7 code completed in May)

- 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

2019 Activities

May – Completed GMS PI 7 software and began release effort

- Code clean-up, release approval, configuration for Generic Runnable System, testing

June – Provided GMS status at SnT 2019

July – Presented GMS architecture and demonstrated GMS software at the Technical Meeting on SHI Software Engineering

August – Provided IDC with Preliminary Build Guide for GMS to help prepare for the release

October – SNL completed review of software; AFTAC approval for release

December – USG approval for release; post to GitHub

2020 Activities

March 2020 – SNL hosting US NDC – IDC Bilateral Meeting

Scope of 2019 Release

The "Generic Runnable System" is a configuration of the GMS “common” software that may be deployed to and operated in a SNL- and AFTAC-free "generic" environment.

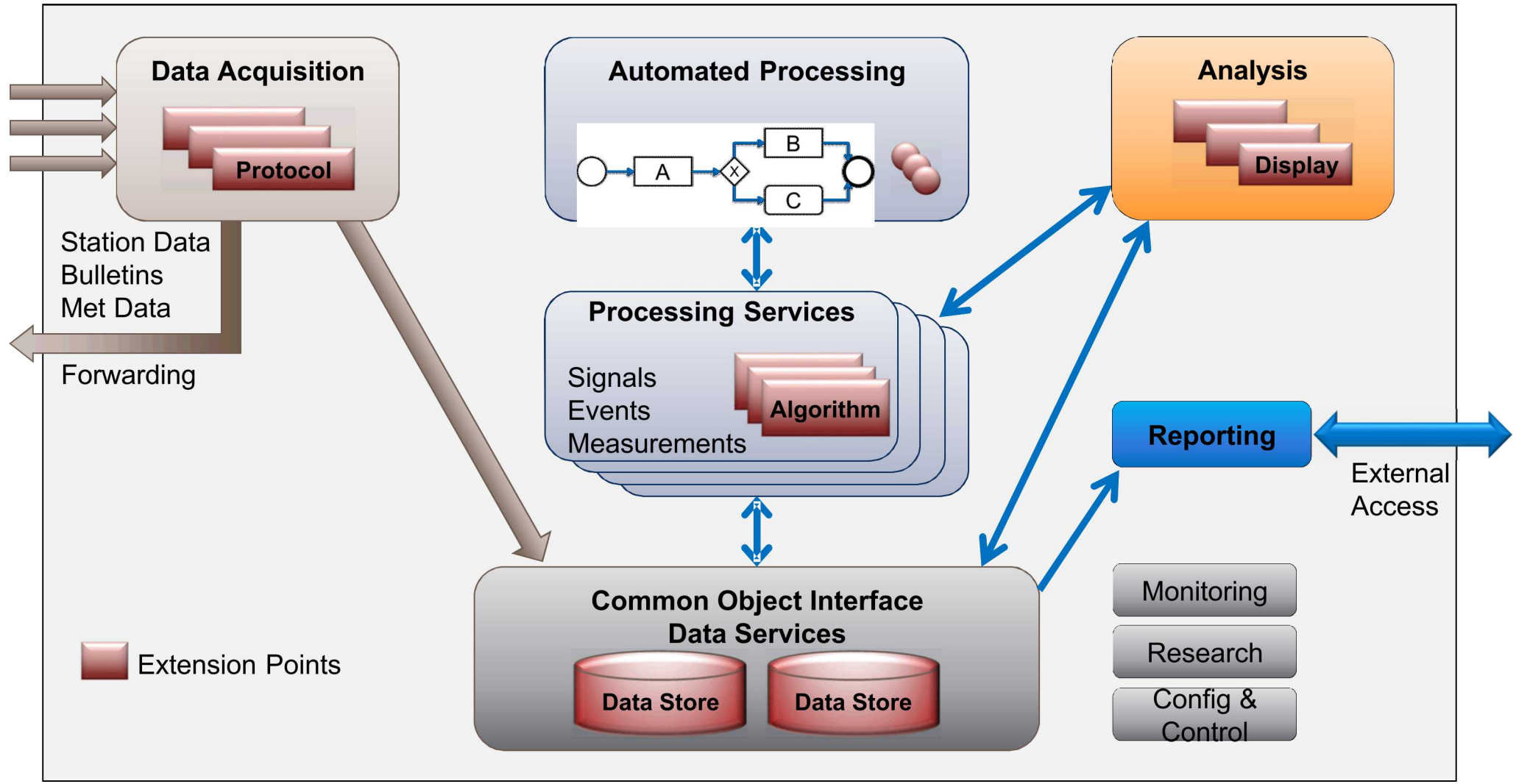
Given a single large Linux server/VM, an internet connection, and the released GMS code and documentation, a "generic" developer must be able to complete the following tasks by following straightforward documentation and procedures contained within the release:

1. Build the system from source code.
   - The result of this step should be a number of Docker images loaded into the Docker daemon on the Linux server/VM.
2. Run the system.
   - The result of this step should be a number of Docker containers (data acquisition, station processing, OSD repositories, interactive analysis UI, Traefik, etc) running in Docker Swarm on the Linux server/VM.
3. Configure the running system to accept live data.
   - This includes loading station reference data, loading the proper templates into NiFi, adjusting settings in the data acquisition components to receive CD 1.1, SeedLink, and/or IMS 2.0 data in the "generic" context, etc.

Release Elements of the GMS Common Generic Runnable System (GRS)

Item	Release Element	Description
1	Bill of Materials (BOM)	All items needed by the Generic Runnable System to build and run (software and hardware specifications)
2	Build Instructions	Detailed instructions for how to compile and build the Generic Runnable System
3	Source Code	The open-source release of the GMS Common source code that can be compiled and run as a Generic Runnable System
4	Run Instructions	Detailed instructions for how to run the Generic Runnable System
5	Configuration Instructions	Detailed instructions for how to further configure of the Generic Runnable System

Early Development is Addressing all parts of the Waveform Processing System



Capabilities in 2019 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
- Station SOH Display

Processing

- Processing Sequence Execution - initial station 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 – preliminary events
- Event Location

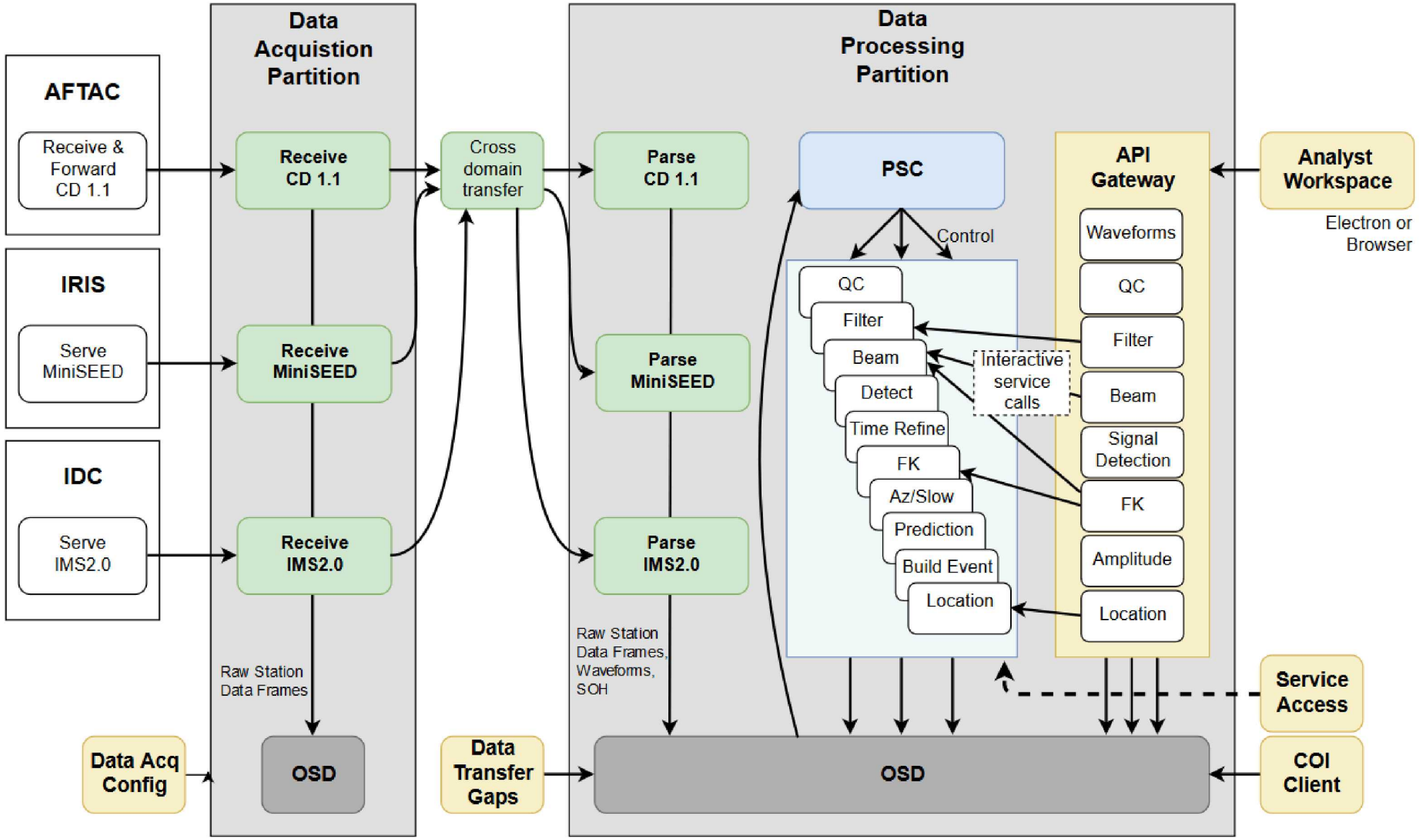
Analysis

- 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

Operations

- COI Data Service

PI 7 System

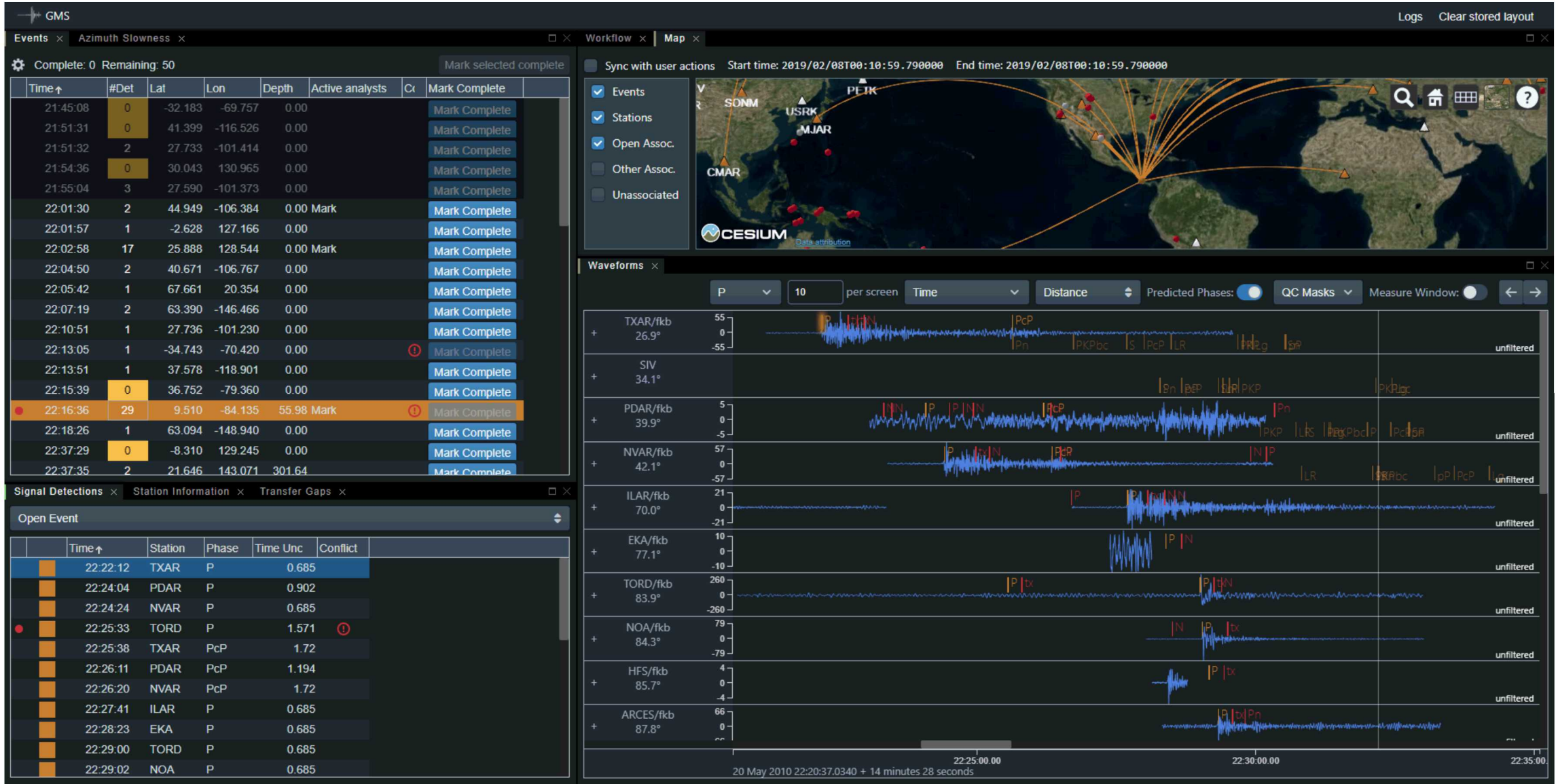

Data Acquistion Partition
Data Processing Partition
AFTAC
Receive & Forward CD 1.1
IRIS
Serve MiniSEED
IDC
Serve IMS2.0
Receive CD 1.1
Receive MiniSEED
Receive IMS2.0
Cross domain transfer
Parse CD 1.1
Parse MiniSEED
Parse IMS2.0
PSC
Control
QC
Filter
Beam
Detect
Time Refine
FK
Az/Slow
Prediction
Build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

Analyst Workspace Examples

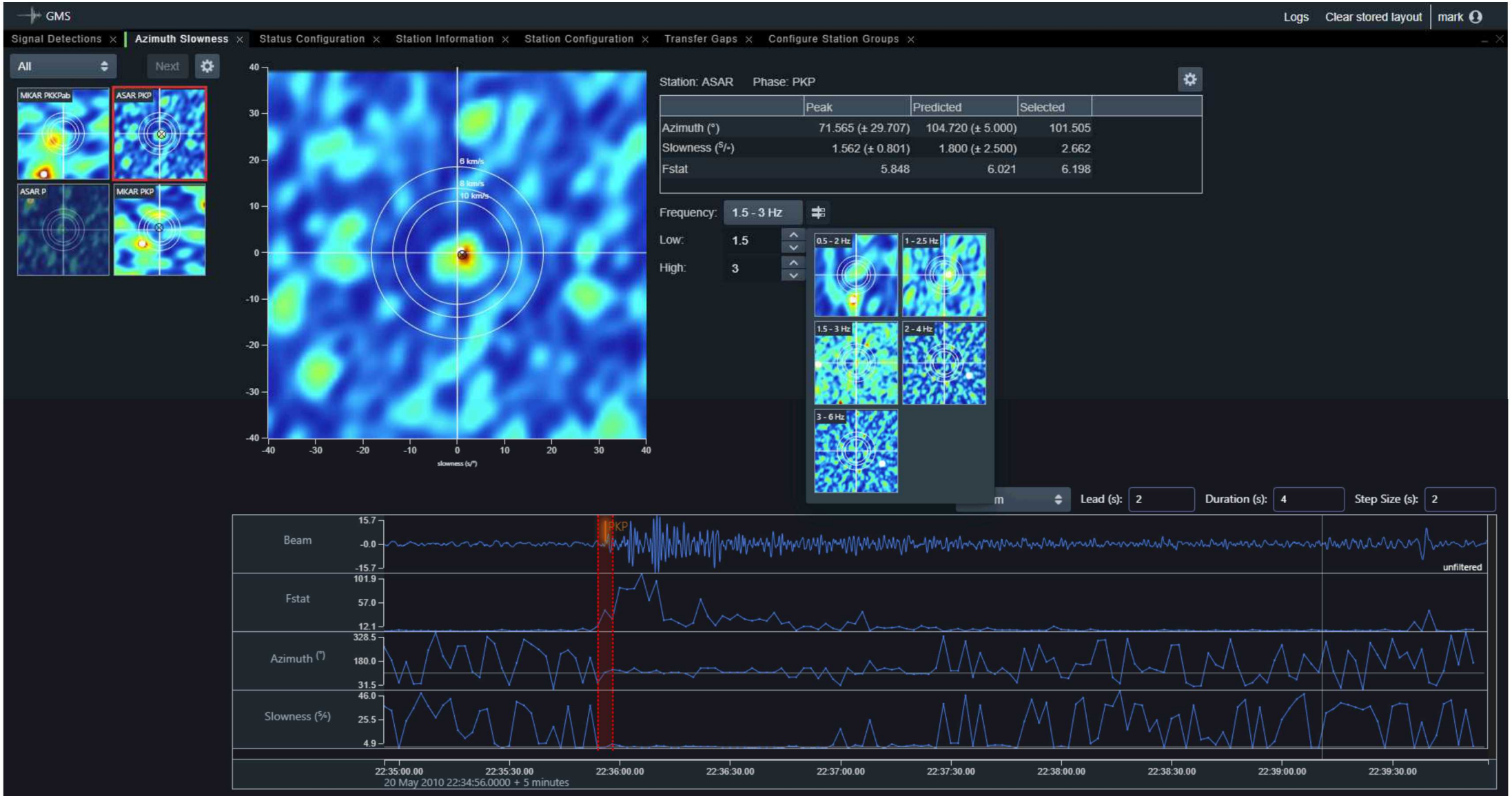
The Analyst Workspace

- 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



Azimuth/Slowness (FK) Display



Provenance: Viewing Signal Detection and QC Mask History

END