IDC RE-ENGINEERING REPORT
SAND2017-XXXX R
Unlimited Release
January, 2017

IDC Re-Engineering Phase 2 Iteration E1 Use Cases
Version 1.1

J. Mark Harris, Dorthe Carr, Jamie Coram

Sandia National Laboratories

IDC Re-Engineering Phase 2 Iteration E1 Use Cases
Version 1.1

J. Mark Harris, Dorthe Carr, Jamie Coram
Next Generation Monitoring Systems
Sandia National Laboratories
P.O. Box 5800
Albuquerque, New Mexico 87185-MS0401

Abstract

This document contains 21 use cases generated from the model contained in Rational Software Architect.

REVISIONS

Version	Date	Author/Team	Revision Description	Authorized by
1.0	12/17/2015	SNL IDC Re-Engineering Team	Initial Release for E1	M. Harris
1.1	1/3/2017	SNL IDC Re-Engineering Team	Updated version redelivered in E3	M. Harris

TABLE OF CONTENTS

Use Case Hierarchy

The IDC Use Case Hierarchy is shown here. The use cases highlighted in yellow are the use cases that appear in this document.

1   System Acquires Data

1.1   System Receives Station Data
1.2   System Receives Bulletin Data
1.3   System Automatically Distributes Data
1.4   System Acquires Meteorological Data
1.5   System Synchronizes Acquired Station Data
1.6   System Synchronizes Processing Results

2   System Detects Event

2.1   System Determines Waveform Data Quality
2.2   System Enhances Signals
2.3   System Detects Events using Waveform Correlation
2.4   System Detects Signals
2.5   System Measures Signal Features
2.6   System Builds Events using Signal Detections
2.7   System Resolves Event Conflicts
2.8   System Refines Event Location
2.9   System Refines Event Magnitude
2.10   System Evaluates Moment Tensor
2.11   System Finds Similar Events
2.12   System Predicts Signal Features

3   Analyzes Events

3.1   Selects Data for Analysis
3.2   Refines Event
3.2.1   Determines Waveform Data Quality
3.2.2   Enhances Signals
3.2.3   Detects Signals
3.2.4   Measures Signal Features
3.2.5   Refines Event Location
3.2.6   Refines Event Magnitude
3.2.7   Evaluates Moment Tensor
3.2.8   Compares Events
3.3   Scans Waveforms and Unassociated Detections
3.4   Builds Event
3.5   Marks Processing Stage Complete

4   NA

5   Provides Data to Customers

5.1   Requests System Data

UC-01.01 System Receives Station Data

USE CASE DIAGRAM
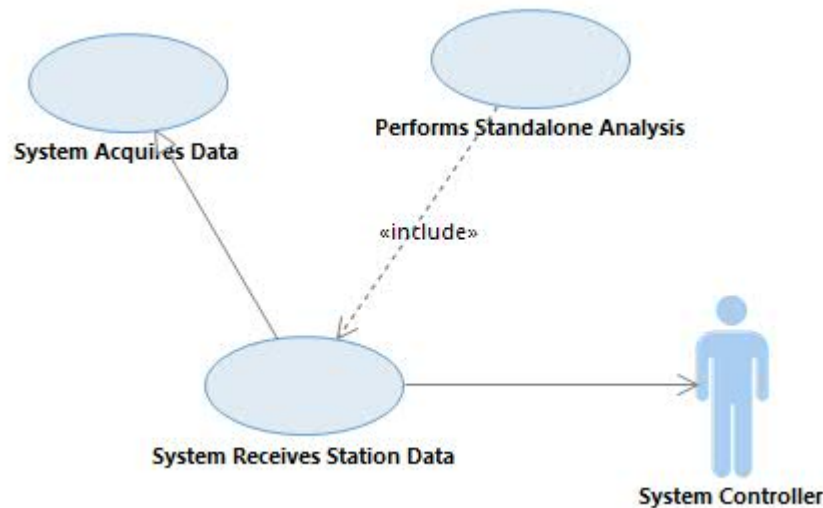
BRIEF DESCRIPTION

This architecturally significant use case describes how the System acquires continuous station data or requests data and puts them into the correct formats for automatic and interactive processing. Stations send seismic, hydroacoustic and infrasound data to the System in a variety of formats. The System converts the data into the internal format and authenticates the data. The System parses the data into waveform data, station data, and state-of-health (SOH) data and puts them in the data storage format. The Data Acquisition Partition forwards the data to other Data Acquisition Partitions in the System or stores the data for access by the Data Processing Partition during automatic and interactive processing. The System Controller can request retransmission of data between Data Acquisition Partitions.

This use case is architecturally significant because it describes acquiring data from multiple sources in various formats and protocols and distributing the data to processing components within timeliness requirements.

ACTOR DESCRIPTIONS

System Controller - The System Controller actor is a System User who monitors and controls the System and external data connections.

PRECONDITIONS

1. The System is configured to receive station data (see 'Controls Data Acquisition' UC and 'Configures Station Usage' UC) on the Data Acquisition Partition on either the Primary or Backup systems.

POSTCONDITIONS

1. Data is available for pipeline processing and analysis on the Data Processing Partition.

ACTIVITY DIAGRAMS

Main Flow
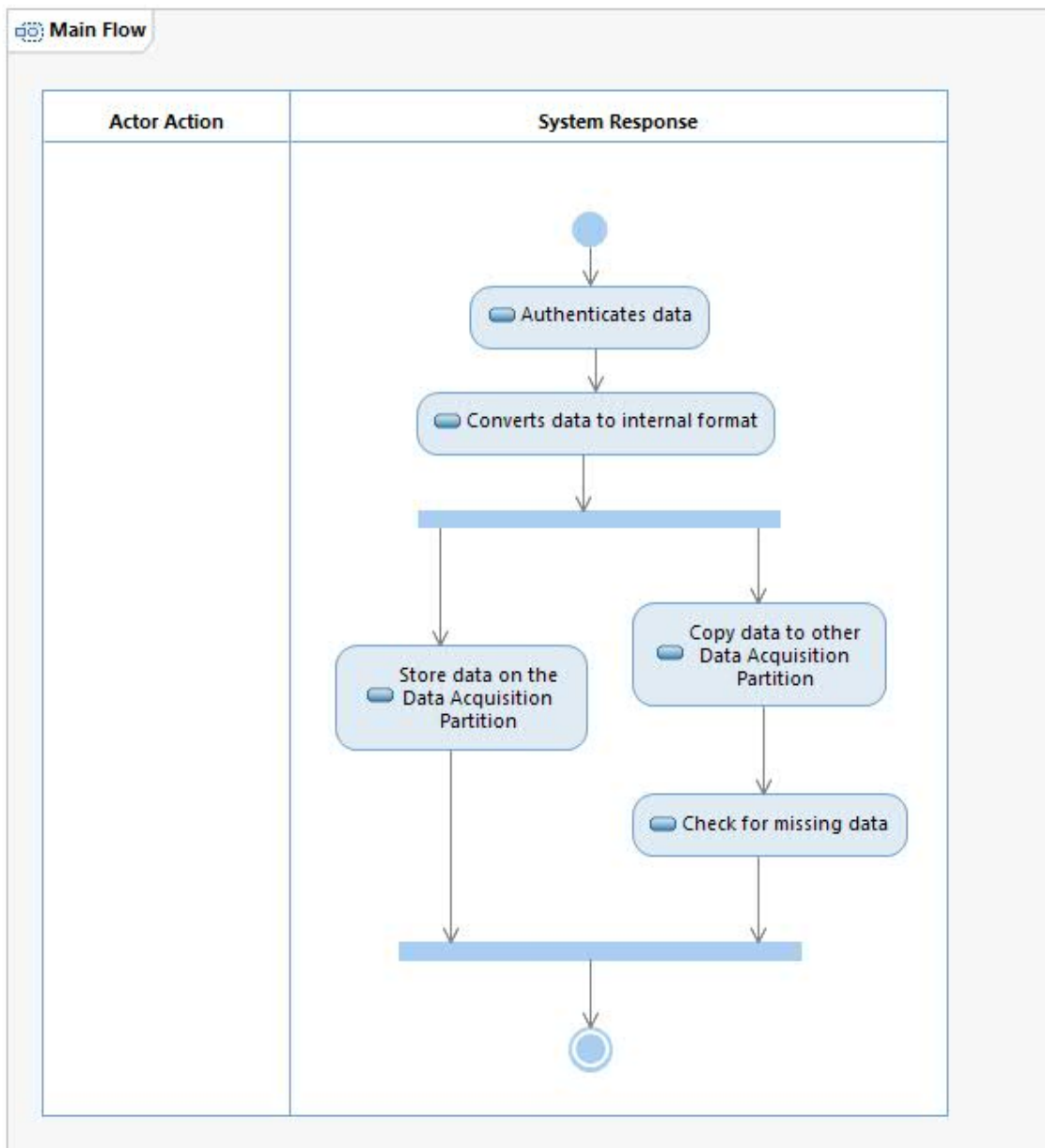
Action Descriptions

Action: "Authenticates data"
For data in the CD-1.1 format, the System verifies the signatures included in the data frames using keys available from the PKI and stores the authentication status for each data frame.

Action: "Converts data to internal format"
The System converts all data to the internal format. The internal formatted data may be used to create a data set that can be replayed (see 'Creates Test Data Set for Replay', 'Replays Test Data Set' and 'Replays Analyst Actions' UCs).

Action: "Copy data to other Data Acquisition Partition"
The System copies the internal formatted data on other Data Acquisition Partitions on the System and stores it for access and processing by the Data Processing Partition.

Action: "Store data on the Data Acquisition Partition"
The System stores the data in the internal format on the Data Acquisition Partition for access and processing by the Data Processing Partition.

Alternate Flows
1. Action "Copy data to other Data Acquisition Partition". If data fail to transfer from the sending Data Acquisition Partition to the receiving Data Acquisition Partition then the System either notifies the System Controller of the missing data or automatically requests retransmission of the missing data.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1184: [*Threshold*] The System shall provide the System Controller the capability to request that waveform data be re-transmitted between partitions

S-1191: [*Objective / Priority 1*] The System shall store all raw waveform data.

S-1192: [*Threshold*] The System shall store signed waveform data in a format supporting retrospective authentication.

S-1199: [*Threshold*] The System shall authenticate the digital signature using PKI credentials upon receipt of signed station waveform data.

S-1204: [*Threshold*] The System shall allow for PKI credential changes without interrupting operations if made prior to key expiration.

S-1205: [*Threshold*] The System shall mark acquired waveform data as unauthenticated when the data cannot be authenticated.

S-1234: [*Threshold*] The System shall accept waveform data in the CD1.1 format.

S-1235: [*Threshold*] The System shall accept waveform data in the CD1.0 format.

S-1236: [*Threshold*] The System shall accept station information, waveform data, and processing results in the CSS3.0 format.

S-1237: [*Objective / Priority 1*] The System shall accept station information and waveform data in the SEED format.

S-1238: [*Objective / Priority 1*] The System shall accept waveform data in the mini-SEED format.

S-1239: [*Objective / Priority 1*] The System shall accept waveform data in the Antelope format.

S-1240: [*Extensibility*] The System shall accept waveform data in new formats.

S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface Guidelines.

S-2064: [*Threshold*] The System shall identify data lost during transfer between partitions.

S-2067: [*Threshold*] The System shall confirm 100% of data transfer integrity prior to deleting data from source storage.

S-2134: [*Threshold*] The System shall store raw waveform data availabilities for specific points in the processing history.

S-2135: [*Threshold*] The System shall store latency measurements for waveform data intervals.

S-2223: [*Threshold*] The System shall store all data and derived processing results to persistent storage as soon as the data and/or derived processing results are available.

S-5625: [*Threshold*] The System shall store all data that are available for external release on the Data Acquisition Partition.

S-6542: [*Threshold*] The System shall automatically forward acquired waveform data between partitions.

IDC Specific:
S-5577: [*IDC only, Threshold*] The System shall acquire continuous waveform data from hydroacoustic, infrasound, and primary seismic stations of the IMS Network.

S-5578: [*IDC only, Threshold*] The System shall request waveform data segments from auxiliary seismic stations of the IMS network.

S-5580: [*IDC only, Threshold*] The System shall provide data buffering allowing acceptance of waveform data arriving a minimum of 10 days after its recording at a station.

S-5607: [*IDC only, Threshold*] The System shall acquire waveform data from auxiliary seismic stations of the IMS Network.

S-5609: [*IDC only, Objective / Priority 1*] The System shall acquire continuous waveform data from hydroacoustic, infrasound, and primary seismic stations of the IMS Network.

S-5785: [*IDC only, Threshold*] The System shall complete transfer of waveform data from the Data Acquisition Partition to the Data Processing Partition within 5 minutes of receipt of the data.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

CD-1.0 Format and Protocols - A standard used for transmitting continuous waveform data from stations of the International Monitoring System (see IMS [International Monitoring System]) to the International Data Center (see IDC [International Data Center]) and for transmitting these data from the IDC to National Data Centers (NDCs). CD-1.0 uses a TCP/IP program-to-program socket communication to send binary formatted waveform data (frames). The CD-1.0 standard has been superseded by the CD-1.1 standard (see CD-1.1 Format and Protocols). The format and protocols are described in the document "Formats and Protocols for Continuous Data CD-1.0" from the CTBTO.

CD-1.1 Format and Protocols - A standard used for transmitting continuous waveform and state-of-health (see Station State-of-Health [SOH]) data from stations of the International Monitoring System (see IMS [International Monitoring System]) to the International Data Center (see IDC [International Data Center]) and for transmitting these data from the IDC to National Data Centers (NDCs). This protocol is designed to support multicasting of continuous data, which entails more complex data flow topologies. The format and protocols are described in the document "Formats and Protocols for Continuous Data CD-1.1" from the CTBTO.

Data Acquisition Partition - The portion of the System where data are acquired and re-distributed.

Data Authentication - The corroboration that data have not been altered in an unauthorized manner by using such mechanisms as digital signatures, PKI (public key infrastructure), etc.

Data Processing Partition - The portion of the System where data are processed, analyzed, and evaluated, and where data processing products are distributed and archived.

Data Provider - See data source.

Data Source - A source of waveform and/or event data for the System. Data sources can be stations or external data centers.

IDC (International Data Center) - The International Data Center (IDC) is the data processing component of the monitoring system associated with the proposed Comprehensive Nuclear Test Ban Treaty (CTBT). The IDC processes the data from a global sensor network known as the International Monitoring System (IMS) (see IMS [International Monitoring System]). The National Data Centers (NDCs) receive IMS station data and bulletins from the IDC.

14

IMS (International Monitoring System) - The International Monitoring System (IMS) is a world-wide network of seismic, hydroacoustic, infrasound, and radionuclide stations deployed as part of the CTBT verification regime.

Mini-SEED Format - A format used to identify SEED data records without any control header information, also known as Data Only SEED. The Mini-SEED format is described in Appendix G of the "SEED Reference Manual," from the Incorporated Research Institutions for Seismology (IRIS), found at fdsn.org/seed_manual/SEEDManual_V2.4.pdf.

PKI (Public Key Infrastructure) - Infrastructure used for the secure exchange of information.

PKI Credentials - Digital keys used for authenticating messages exchanged between systems.

Pipeline Processing - The sequence of real-time automatic data processing by the System, which begins after acquisition of raw waveform data, and results in a set of event hypotheses with associated signal detections.

Site - See station.

Station - An installation where monitoring sensors are installed. Multiple sensors can be installed at the same station (see channel). An array is a group of stations, but is sometimes referred to as a station.

Station Data - Data sent to the System by contributing stations. This includes both the ground-motion data (see waveform) as well as state-of-health (SOH) station data (see Station State-Of-Health [SOH]).

Waveform - A generic term for either a raw waveform (see waveform, raw) or a derived waveform (see waveform, derived).

Waveform, Raw - Output from a raw channel (see channel, raw) during a particular time interval.

IDC Specific:
None.

NOTES

General:
1. The System accepts and stores data from stations, regardless of how old the data are.

2. There can be multiple Data Acquisition Partitions depending on Subsystem Configuration. Each Data Acquisition Partition may store data and may forward data to other Data Acquisition Partitions.

3. The System can be configured to disable the storage of station data on the Data Acquisition Partition on a per station basis (see UC Controls Data Acquisition). The System checks the state of this configuration parameter before storing data in this use case.

IDC Specific:
1. Data from auxiliary stations is sent to the Data Processing Partition as requested.

2. If data fail to transfer from the sending Data Acquisition Partition to the receiving Data Acquisition Partition then the data are automatically retransmitted.

OPEN ISSUES

None.

UC-01.04 System Acquires Meteorological Data

USE CASE DIAGRAM
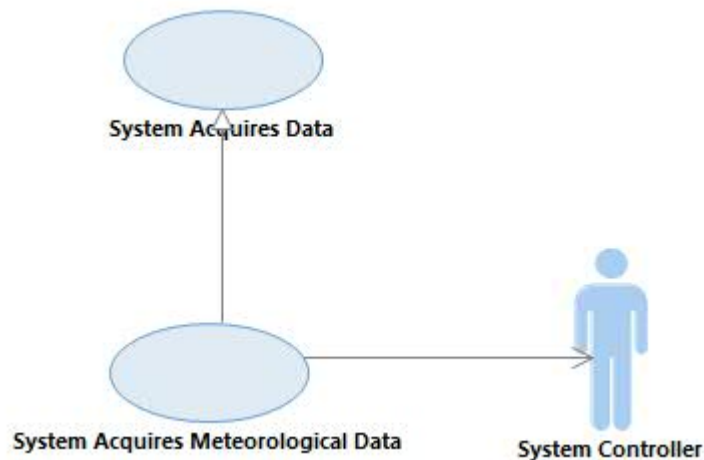
BRIEF DESCRIPTION

This architecturally significant use case describes how the System acquires meteorological data to build atmospheric models used in automatic and interactive processing of infrasound data. The System requests the latest available high-resolution global meteorological data from external data centers and puts them into the correct formats for generation of infrasound propagation models. The System forwards the meteorological data to other Data Acquisition Partitions in the System or stores the data for access and processing by the Data Processing Partition. The System builds a new atmospheric model based on the meteorological data.

This use case is architecturally significant because it describes acquiring meteorological data from various sources and creating dynamic atmospheric transmission models to support the prediction of infrasonic signal detections.

ACTOR DESCRIPTIONS

System Controller - The System Controller actor is a System User who monitors and controls the System and external data connections.

PRECONDITIONS

1. Meteorological data are available to create a current atmospheric model.

POSTCONDITIONS

1. A new atmospheric model is available on the Data Processing Partition.

ACTIVITY DIAGRAMS

Main Flow
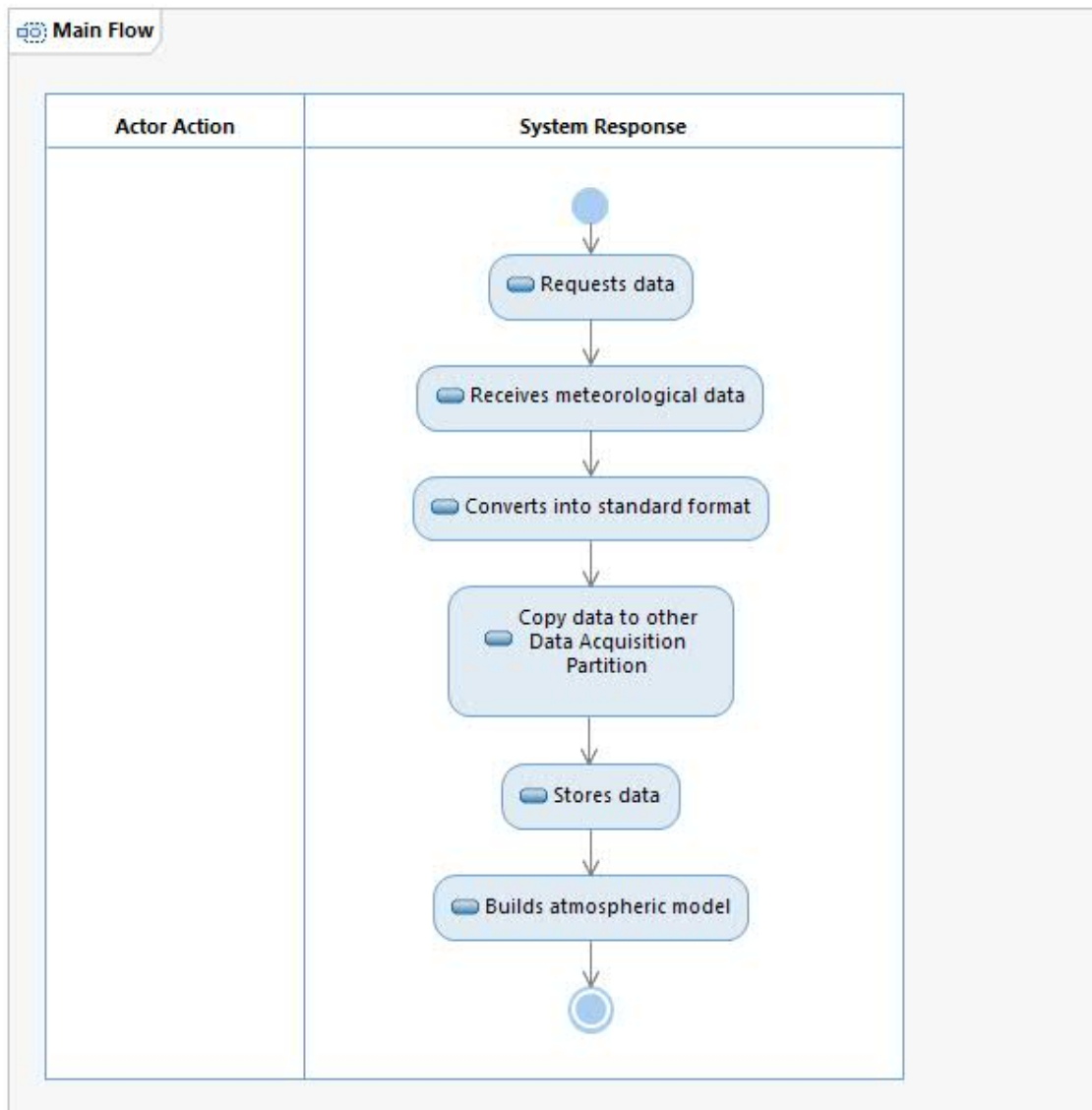
Action Descriptions
Action: "Requests data"
The System requests meteorological data from external data centers.

Action: "Receives meteorological data"
The System receives meteorological data on the Data Acquisition Partition from an external data center. The data includes the time interval for which the data are valid.

Action: "Converts into standard format"

If required, the System converts the data into the system format for meteorological data. This includes merging data from various sources/models and converting data in pressure coordinate format into altitude coordinate format.

Action: "Copy data to other Data Acquisition Partition"
The System copies the meteorological data from the Data Acquisition Partition to other Data Acquisition Partitions on the System. The System verifies that the meteorological data were copied.

Action: "Stores data"
The System stores the data in the System standard meteorological data format on the receiving Data Acquisition Partition for access and processing by the Data Processing Partition.

Action: "Builds atmospheric model"
The System uses the meteorological data corresponding to a specified time interval to build an atmospheric model for that time interval. Once the model has been built, the System stores the model and it is synchronized with the Backup (see UC: System Synchronizes Processing Results).

Alternate Flows
1. Action "Copy data to other Data Acquisition Partition" - If the meteorological data does not get copied from the sending Data Acquisition Partition to the receiving Data Acquisition Partition, the System either notifies the System Controller of the missing data or automatically requests retransmission of the missing data.

2. Action "Builds Atmospheric Model" -- If the atmospheric model fails to be built, the System notifies the System Controller.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-5623: [*Threshold*] The system shall request global meteorological data (3D wind, temperature and uncertainties) from specified sources spanning the altitude range of 0 km (sea level) to 140 km above sea level.

S-5624: [*Threshold*] The system shall convert global meteorological data received in pressure coordinate format into altitude coordinate format.

S-5652: [*Extensibility*] The System shall compute corrections to wind velocity predictions based on a model for atmospheric gravity waves.

S-5653: [*Extensibility*] The System shall compute corrections to atmospheric temperature predictions based on a model for atmospheric gravity waves.

S-5654: [*Threshold*] The system shall compute an infrasound propagation model using gravity wave corrected wind velocity and atmospheric temperature predictions.

S-5656: [*Objective / Priority 1*] The system shall compute an infrasound propagation model that incorporates high resolution meteorological data.

S-5714: [*Threshold*] The System shall store global meteorological data.

S-5717: [*Extensibility*] The System shall store gravity wave corrections to temperature predictions.

S-5759: [*Objective / Priority 1*] The System shall request global meteorological data from specified sources within 10 minutes of its availability.

IDC Specific:
None.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Atmospheric Model - A model of the atmosphere that can be used to predict the location-specific atmospheric properties that are needed to model infrasound signal propagation. An atmospheric model can either be static or dynamic.

Data Acquisition Partition - The portion of the System where data are acquired and re-distributed.

Data Processing Partition - The portion of the System where data are processed, analyzed, and evaluated, and where data processing products are distributed and archived.

Meteorological Data - The set of location-specific predicted atmospheric properties that result from numerical modeling of the atmosphere at a weather forecasting agency. The primary use of meteorological data is weather forecasting, but for infrasound monitoring, meteorological data are used to build infrasound-specific dynamic atmospheric models for modeling signal propagation.

IDC Specific:
None.

NOTES

General:
1. This use case runs on the Data Acquisition Partitions of both the Primary and Backup.

2. The System Maintainer configures meteorological data sources and request schedules as described in 'Configures Station Usage' UC.

3. Meteorological data are received on the Data Acquisition Partitions for both the Primary and the Backup. The acquired meteorological data are synchronized between the Primary and the Backup.

4. The atmospheric models built on the Data Processing Partition using the acquired meteorological data are synchronized between the Primary and Backup by invoking 'System Synchronizes Processing Results' UC.

5. The atmospheric model is formed by merging meteorological data from various external numerical weather prediction models sources and climatology (HWM and MSIS) atmospheric models/formats.

6. The acquired meteorological data is not stored on the System, but the System may re-request the data if it is needed at a later time.

IDC Specific:
1. Meteorological data are acquired from various data centers (e.g., World Meteorological Organization (WMO) and European Centre for Medium-Range Weather Forecasts (ECMWF)) in their native formats then transformed into the system format for meteorological data for processing and distribution. This system format will be defined by the IDC. The IDC distributes the meteorological data to NDCs in system format.

2. If data fail to transfer from the sending Data Acquisition Partition to the receiving Data Acquisition Partition then the data are automatically retransmitted.

OPEN ISSUES

None.

UC-02 System Detects Event

USE CASE DIAGRAM
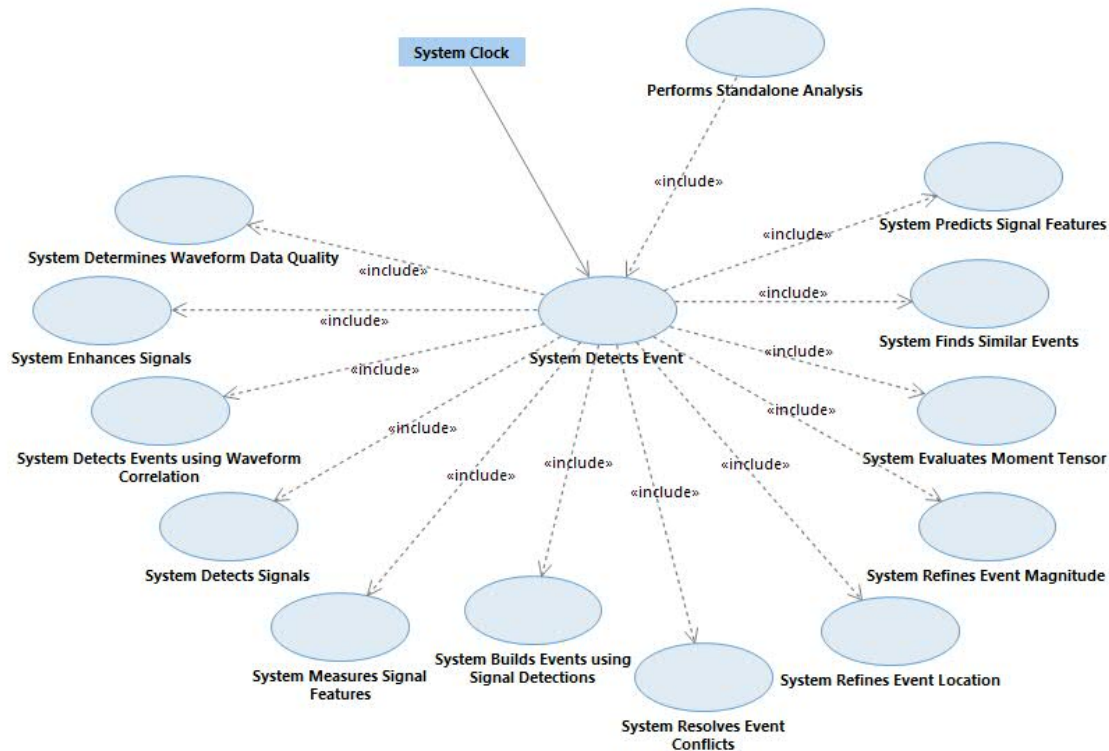
BRIEF DESCRIPTION

This use case describes how the System pipeline processes the raw seismic, hydroacoustic, and infrasound waveform data from a time interval to form event hypotheses. The System first checks the quality of arriving waveform data and creates data quality control masks for waveform sections containing data that is unsuitable for processing (see 'System Determines Waveform Data Quality' UC). The System then processes waveforms to enhance signal content while reducing noise (see 'System Enhances Signals' UC).

The System detects signals (see 'System Detects Signals' UC), measures features on the signal detections (see 'System Measures Signal Features' UC), and then uses the signal detections and feature measurements to build both single station and network event hypotheses (see 'System Builds Events using Signal Detections' UC). The System uses channel based waveform correlation techniques to form single-station or network event hypotheses (see 'System Detects Events using Waveform Correlation' UC). The System measures signal features for the event hypotheses on waveform channels across the network (see 'System Measures Signal Features' UC). The System predicts signal detections and their features for events (see 'System Predicts

Signal Features' UC). The System uses similarity parameters to search for historic events similar to the new event hypothesis (see 'System Finds Similar Events' UC).

After forming event hypotheses, the System resolves conflicting event hypotheses (see 'System Resolves Event Conflicts' UC) and then refines each event hypothesis' location (see 'System Refines Event Location' UC) and magnitude (see 'System Refines Event Magnitude' UC). The System evaluates the moment tensor for an event (see 'System Evaluates Moment Tensor' UC).

The System pipeline follows a sequence configured by the System Maintainer when pipeline processing raw waveform data to form event hypotheses (see 'Configures Processing Sequence' UC).

ACTOR DESCRIPTIONS

System Clock - The System Clock is an internal clock that provides the system with the ability to periodically execute activities.

PRECONDITIONS

None.

POSTCONDITIONS

1. Zero or more Event Hypotheses are created or updated, based on processing data.

ACTIVITY DIAGRAMS

Main Flow - Notional Example
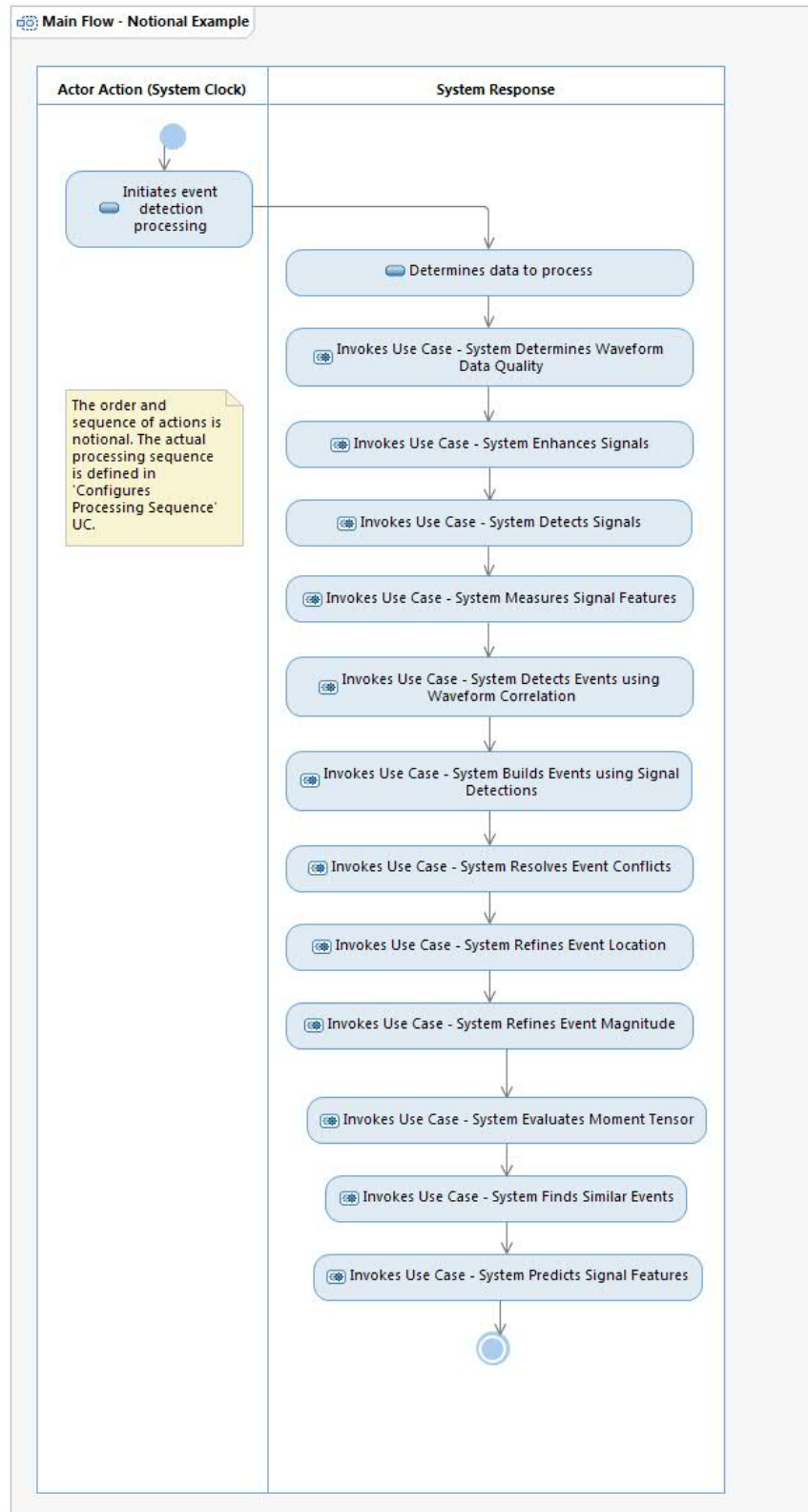
Action Descriptions
Action: "Initiates event detection processing"
The System Clock periodically initiates this use case to perform automatic processing.

Action: "Determines data to process"
The System determines what data to process. The type of data to be processed varies by the function being performed (see subsequent steps in this flow for details). The amount (i.e., time interval) of data processed in this flow may vary by function, station and/or processing stage and may be configured by the System Maintainer on a per-function, per-station, per-stage basis (see 'Configures Processing Components' UC). In general, the System keeps track of data that has already been processed and only selects data for processing that are new or modified since the last time this flow was performed. Note that the System may select data that was created or updated by the System in a previous invocation of this flow. The System does not autonomously update data under active review. In general, the System will not automatically overwrite data created by the Analyst. In addition, when selecting data to process the System generally prioritizes real-time data over late-arriving data.

Action: "Invokes Use Case - System Determines Waveform Data Quality"
The System invokes the 'System Determines Waveform Data Quality' UC to check the quality of waveforms and create data quality control masks for sections containing data that is unsuitable for processing. The System stores the created masks and associated metadata for use during subsequent automatic and interactive processing.

Action: "Invokes Use Case - System Enhances Signals"
The System invokes the 'System Enhances Signals' UC on raw channels in order to enhance signals prior to detection. The enhancements applied in this step may vary according to the type of station as follows:

1. Single vertical component - Performs filtering.
2. Three-component - Performs filtering and rotation.
3. Array of single vertical component elements - Performs filtering and beaming.
4. Array of three-component elements - Performs filtering, rotation and beaming.

The specific functions performed and their order can be configured by the System Maintainer (see 'Configures Processing Component' UC).
The System stores the resulting derived channels & associated metadata for use during subsequent automatic and interactive processing (Note: derived channels that do not have any signal detections are only stored if the System Maintainer has configured the System to do so).

Action: "Invokes Use Case - System Detects Signals"
The System invokes the 'System Detects Signals' UC on the raw or derived channels to detect signals within the channels. The System stores the resulting detections and associated metadata (such as type of detector) for use during subsequent automatic and interactive processing.

Action: "Invokes Use Case - System Measures Signal Features"

The System invokes the 'System Measures Signal Features' UC to measure signal detection features and assign preliminary phase labels on each signal detection, and to group signal detections on a station-by-station basis. The measured features include general time and frequency domain features, plus additional features based on the type of station. The System stores the following (along with related metadata) for use during subsequent automatic and interactive processing:

1. Computed signal detection feature measurements including preliminary phase labels for each signal detection
2. Station-by-station groupings of signal detections corresponding to distinct events

Action: "Invokes Use Case - System Detects Events using Waveform Correlation"
The System invokes the 'System Builds Events using Waveform Correlation' UC to form single-station and network event hypotheses using waveform correlation. The System stores any new event hypotheses created by the use case for subsequent use by automatic or interactive processing.

Action: "Invokes Use Case - System Builds Events using Signal Detections"
The System invokes the 'System Builds Events using Signal Detections' UC to build and update event hypotheses using signal detections and their feature measurements. The System stores the following for subsequent use by automatic or interactive processing:

1. New or updated event hypotheses, including phase labels and feature measurement defining states, station quality metrics and event hypothesis quality metrics.

Action: "Invokes Use Case - System Resolves Event Conflicts"
The System invokes the 'System Resolves Event Conflicts' UC to resolve conflicts between events built based on signal detection vs. events built based on waveform correlation. The System resolves the conflicts by modifying (including in some cases rejecting) existing event hypothesis. The System stores the modified event hypotheses for subsequent use by automatic or interactive processing.

Action: "Invokes Use Case - System Refines Event Location"
The System invokes the 'System Refines Event Location' UC to compute event locations for new or modified event hypotheses. The System stores the following for use by subsequent automatic or interactive processing:

1. The computed location
2. The parameters that were used to configure the computation
3. The location uncertainty bounds
4. The modeling uncertainties
5. The defining/non-defining state of signal detection feature measurements used to calculate the location

Action: "Invokes Use Case - System Refines Event Magnitude"

The System invokes the 'System Refines Event Magnitude' UC to estimate event magnitudes for new or modified event hypotheses. The specific magnitude types computed in this step can be configured by the System Maintainer (see 'Configures Processing Component' UC). The System stores the following for use by subsequent automatic or interactive processing:

1. The computed magnitudes
2. The parameters that were used to configure the computation
3. The defining/non-defining state of signal detection feature measurements used to calculate the magnitude

Alternate Flows
1. All System Actions - The sequence of actions shown above is only a notional example of a processing pipeline. The sequence of actions can be configured by the System Maintainer (see 'Defines Processing Sequence' UC) and may therefore differ from the flow shown above. In addition, the sequence may be tailored for specific stations. The flow above is a notional example that reflects the general flow in the current System.

2. Any System Action - If the System encounters data that an Analyst is working on then this flow ends for that data, but continues for other data. The System interrupts automatic processing of data when an Analyst selects the data for analysis (see 'Selects Data for Analysis' UC).

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1296: [*Threshold*] The System shall store the processing time period(s) during which each Waveform QC Mask was applied to the underlying waveform data.

S-1297: [*Threshold*] The System shall store the Waveform QC Masks applied to the waveform data used for each waveform processing operation.

S-1298: [*Threshold*] The System shall store the channel masked by each Waveform QC Mask.

S-1299: [*Threshold*] The System shall store the identity of the user or processing stage creating each Waveform QC Mask.

S-1300: [*Threshold*] The System shall store the identity of the user or processing stage modifying each Waveform QC Mask.

S-1301: [*Threshold*] The System shall store the identity of the user or processing stage removing each Waveform QC Mask.

S-1302: [*Threshold*] The System shall store the time of each Waveform QC Mask creation.

S-1303: [*Threshold*] The System shall store the time of each Waveform QC Mask removal.

S-1304: [*Threshold*] The System shall store the time of each Waveform QC Mask modification.

S-1305: [*Threshold*] The System shall store the type of error being masked for each automatically created Waveform QC Mask.

S-1386: [*Threshold*] The System shall store the beam definition parameters for all beams.

S-1387: [*Threshold*] The System shall store continuous beams for virtual event hypotheses for predefined locations.

S-1393: [*Threshold*] The System shall store all derived channels related to one or more signal detections.

S-1394: [*Threshold*] The System shall store derived waveform data with no related signal detections for the Operational Processing Time Period.

S-1405: [*Threshold*] The System shall create an origin beam steered to an event hypothesis' hypocenter and a seismic array station's predicted first P arrival time whenever a seismic array station lacks a first P signal detection association.

S-1421: [*Threshold*] The System shall store all signal detections.

S-1438: [*Threshold*] The System shall store time domain measurements.

S-1450: [*Threshold*] The System shall store polarization feature measurements.

S-1465: [*Threshold*] The System shall store frequency domain waveform measurements.

S-1486: [*Threshold*] The System shall store fk spectra measurements.

S-1549: [*Threshold*] The System shall perform late network signal association during the operational processing time period.

S-1556: [*Threshold*] The System shall store all event hypotheses formed by the System.

S-1557: [*Threshold*] The System shall store all signal detection associations for each event hypothesis stored by the System.

S-1576: [*Threshold*] The System shall store the station quality metrics for all stations for each event hypothesis.

S-1580: [*Threshold*] The System shall recompute the event hypothesis quality metric for an event hypothesis when any of the event hypothesis quality statistics used to calculate the event hypothesis quality metric are updated.

S-1588: [*Threshold*] The System shall store the event quality metric for each event hypothesis.

S-1599: [*Threshold*] The System shall compute a new event hypothesis relocation when an automatic process modifies any event hypothesis relocation parameter contributing to that event hypothesis' location.

S-1618: [*Threshold*] The System shall store up to 300 unique event hypotheses for each event.

S-1619: [*Threshold*] The System shall store the confidence level of each computed event hypothesis location uncertainty bound.

S-1620: [*Threshold*] The System shall store the type (i.e., confidence, coverage, or k-weighted with the associated weights) of each location uncertainty bound.

S-1621: [*Threshold*] The System shall store modeling uncertainties for model based predictions of signal detection measurements.

S-1622: [*Threshold*] The System shall store uncertainties for observed signal detection measurements.

S-1623: [*Threshold*] The System shall store the sum squared weighted residual for each event hypothesis location.

S-1624: [*Threshold*] The System shall store the defining/non-defining state for each signal detection measurement associated to a stored event hypothesis.

S-1625: [*Threshold*] The System shall store a preferred event hypothesis for each event for each processing stage.

S-1626: [*Threshold*] The System shall store the processing stage during which each event hypothesis location was created.

S-1627: [*Threshold*] The System shall store the processing stage during which an event hypothesis is modified.

S-1628: [*Threshold*] The System shall store the processing stage that rejected an event.

S-1663: [*Threshold*] The System shall store uncertainties for all event hypothesis magnitude estimates.

S-1664: [*Threshold*] The System shall store each single station magnitude estimate for each event hypothesis.

S-1665: [*Threshold*] The System shall store each network magnitude estimate for each event hypothesis.

S-1666: [*Threshold*] The System shall store the defining/non-defining state for each station magnitude associated to a stored event hypothesis.

S-1816: [*Threshold*] The System shall store the earth model and version used to compute an earth model prediction.

S-1817: [*Threshold*] The System shall store the corrections applied to earth model predictions.

S-1818: [*Threshold*] The System shall store the correction surface used to correct an earth model prediction.

S-1819: [*Threshold*] The System shall store the predicted slowness computed from a basemodel.

S-1820: [*Threshold*] The System shall store the uncertainties of a predicted slowness computed using a basemodel.

S-1821: [*Threshold*] The System shall store the predicted azimuths computed using a phase-specific basemodel.

S-1822: [*Threshold*] The System shall store the uncertainties of predicted azimuths computed using a basemodel.

S-1823: [*Threshold*] The System shall store the predicted travel-times computed from a basemodel.

S-1824: [*Threshold*] The System shall store the uncertainties of predicted travel-times computed using a basemodel.

S-1842: [*Threshold*] The System shall store predicted amplitude attenuation.

S-1843: [*Threshold*] The System shall store predicted amplitude attenuation uncertainties.

S-1860: [*Threshold*] The System shall process waveform data within a configurable processing time interval when a configurable percentage of data is available.

S-1861: [*Threshold*] The System shall process all available alphanumeric data within a configurable processing time interval.

S-1862: [*Threshold*] The System shall run a previously configured group of operations whenever the triggering event for that group of operations occurs.

S-1872: [*Threshold*] The System shall provide the Analyst the capability to interrupt automated event hypothesis processing to analyze data if configured.

S-1967: [*Threshold*] The System shall store results from all stages of data processing.

S-2042: [*Threshold*] The System shall store automatic and interactive processing parameters in the database.

S-2043: [*Threshold*] The System shall store automatic and interactive processing results.

S-2044: [*Threshold*] The System shall store the relation of processing results to processing parameters in the database.

S-2166: [*Threshold*] The System shall automatically process late-arriving waveform data within one (1) minute of receipt by the Data Processing Partition.

S-2171: [*Threshold*] The System shall prioritize the processing of real time data over the processing of late arriving data.

S-2172: [*Threshold*] The System shall automatically initiate data processing within 5 minutes of data acquisition on the Data Processing Partition.

S-2173: [*Threshold*] The System shall automatically execute processing of waveform data (i.e., data acquisition, data processing, and data storage).

S-2175: [*Threshold*] The System shall process up to 2000 seismic event hypotheses per day without disruption of the Data Processing Partition.

S-2177: [*Threshold*] The System shall produce an automated event bulletin in near real-time during normal conditions without disrupting operations.

S-2178: [*Threshold*] The System shall produce an automated event bulletin in near real-time during swarm conditions without disrupting operations.

S-2223: [*Threshold*] The System shall store all data and derived processing results to persistent storage as soon as the data and/or derived processing results are available.

S-2417: [*Threshold*] The System shall store hydroacoustic signal detection groups

S-5610: [*Threshold*] The Data Processing Partition shall access and process all waveform data stored on the system.

S-5715: [*Threshold*] The System shall store wind velocity (including uncertainty) computed from meteorological models.

S-5716: [*Threshold*] The System shall store temperature (including uncertainty) computed from meteorological models.

S-5717: [*Extensibility*] The System shall store gravity wave corrections to temperature predictions.

S-5720: [*Threshold*] The System shall store spectrograms.

S-5722: [*Threshold*] The System shall store power spectral density.

S-6469: [*Threshold*] The System shall store detection feature maps.

S-6521: [*Threshold*] The System shall store seed events.

S-6522: [*Threshold*] The System shall store seed event quality.

IDC Specific:
S-5795: [*IDC only, Threshold*] The System shall compute Event Consistency checks when an event hypothesis is saved.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Active Review - The state of a set of data indicating an Analyst is reviewing the data. The set of data in Active Review is defined by either an event being refined and its associated signal detections and waveforms, or the time interval of visible waveforms and signal detections being scanned. The System prevents changes by automated processing to data in Active Review. Analysts are notified of relevant data in Active Review by other analysts.

Analysis Time Interval - The time interval bounding the data reviewed by an analyst. Those data include waveforms, event hypotheses and their associated signal detections, and unassociated signal detections.

Automatic Processing - Data processing that is performed by the system without analyst interaction. This type of processing is initiated by a configurable trigger such as availability of data or the completion of a previous processing step. Includes station processing, network processing, post-analysis processing, post-evaluation processing, and late data processing.

Event - The estimate by the System or Analyst of the occurrence of some transient source of energy within the Earth's body, oceans, or atmosphere that can be detected by seismic, hydroacoustic, and/or infrasonic sensors. For the same event, many different event hypotheses may be created at different processing stages. One of these event hypotheses must be designated as preferred.

Event Hypothesis - A proposed solution for an Event. Each event consists of a sequence of event hypotheses that describe an evolution to a final best model of the event. Each event hypothesis is composed of a set of associated signal detections and has one or more event hypothesis location solutions, one of which must be designated as preferred.

Event Set - The set of one or more event hypotheses that an analyst selects for analysis.

Late-Arriving Waveform - Waveform data acquired by the System after pipeline processing has been initiated.

Operational Processing Time Period - The time during which analysts may refine and save events without special procedures (currently 45 days).

Pipeline Processing - The sequence of real-time automatic data processing by the System, which begins after acquisition of raw waveform data, and results in a set of event hypotheses with associated signal detections.

Processing Sequence - An ordered grouping of processing steps or other nested processing sequences connected by logic elements that specify sequencing, branching, concurrency, and entry and exit criteria. Processing sequences may specify control parameters such as data buffering and data source, and must adhere to an interface standard for invocation, status return, data access, logging, messaging, etc.

IDC Specific:
None.

NOTES

General:
1. This use case automatically and continuously processes new data as they become available. Sources of new data include:

   a. A time interval of waveform data acquired from Stations (see 'System Acquires Data' UC), including late-arriving data.

   b. A time interval/event set marked by an Analyst as complete (see 'Marks Processing Stage Complete' UC).

2. This use case does not process ingested waveform data that are older than the Operational Processing Time Period.

3. The Processing Sequence that defines the pipeline depicted in this use case may differ across Subsystems. For example, the Processing Sequence for the OPS pipeline may differ from the Processing Sequence for a Standalone subsystem, SUS/TST, DEV, etc. Processing Sequences are defined by the System Maintainer (see 'Defines Processing Sequence' UC).

4. Use cases invoked by this use case are responsible for computing quality metrics.

IDC Specific:
1. There may be cases where the IDC wishes to prioritize processing late-arriving data over real-time data. One such case may be late-arriving data that are received immediately before a bulletin is due to be issued.

2. The System will assess event consistency when an event is saved (see ' System Assesses Event Consistency' UC).

3. The Data Processing Partition shall request auxiliary seismic waveform data from the Data Acquisition Partition.

OPEN ISSUES

None.

UC-02.03 System Detects Events Using Waveform Correlation

USE CASE DIAGRAM
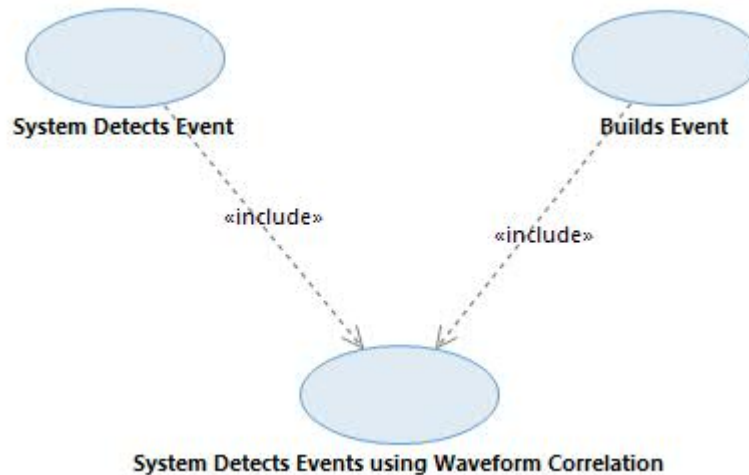
BRIEF DESCRIPTION

This architecturally significant use case describes how the System detects both single station and network event hypotheses using waveform correlation. The System forms an event hypothesis corresponding to a historical event when the waveform data from one or more channels has high correlation with the same channels' waveform data from the historical event. The System uses the historic event's associated signal detections to create and associate signal detections to the new event hypothesis.

This use case is architecturally significant because waveform correlation requires high levels of processing and memory resources for evaluating large sets of historic data for relevance to real-time events.

ACTOR DESCRIPTIONS

None.

PRECONDITIONS

1. One or more waveforms recorded by channels with associated waveform correlation reference waveforms are available for processing.

POSTCONDITIONS

1. The System detected zero or more new event hypotheses.

2. The System created zero or more new signal detections associated to the new event hypotheses.

3. The System created zero or more new associations of existing signal detections to the new event hypotheses.

ACTIVITY DIAGRAMS

Main Flow
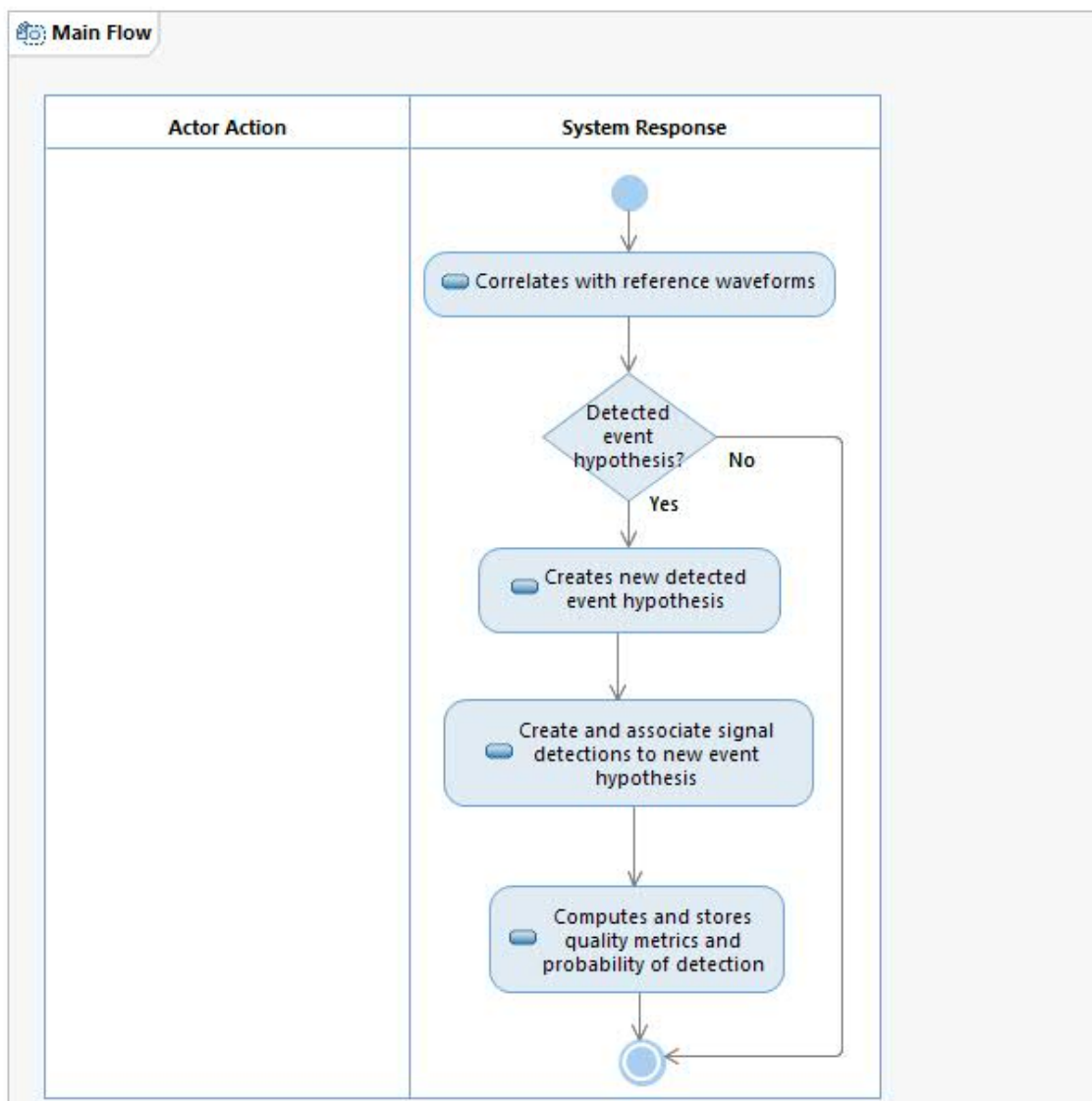
Action Descriptions

Action: "Correlates with reference waveforms"

The System correlates waveforms currently being processed with waveforms from the same channel containing reference event hypotheses. Some reference waveforms are preselected prior to running waveform correlation event detectors. Reference waveforms of this type can be waveform templates previously selected as representative waveforms for a family of events, waveforms created by combining two or more waveforms (e.g., waveforms created through a

clustering or data dimensionality reduction process, like those used for subspace detectors), or waveforms from selected historic event hypothesis (e.g., waveforms from important events). Other reference waveforms are dynamically selected at runtime by searching for event hypotheses within a preconfigured distance of a presumed event location and using the waveforms associated with those event hypotheses as the waveform correlation reference waveforms.

The reference waveforms, cross correlation coefficient thresholds, and search criteria used to find dynamic reference waveforms are configured by the System Maintainer (see 'Configures Processing Components' UC).

Decision: "Detected event hypothesis?"
The System checks if the cross correlation coefficients exceed the thresholds required to detect a new event hypothesis. For single channel waveform correlation, a waveform from a single channel must have a cross correlation coefficient with a reference waveform exceeding a threshold. For multi-channel waveform correlation, waveforms from two or more channels must each have cross correlation coefficients with their reference waveforms exceeding a threshold. The System Maintainer configures the cross correlation coefficient thresholds, or combinations of thresholds, required for the System to detect a new event hypothesis (see 'Configures Processing Components' UC).

Action: "Creates new detected event hypothesis"
The System creates a new detected event hypothesis with the same location solutions as the reference event hypothesis. The detected event hypothesis is associated to the reference event hypothesis.

Action: "Create and associate signal detections to new event hypothesis"
The System uses the signal detections from the reference event to create and associate signal detections to the new event hypothesis. The System also sets signal detection feature measurements and uncertainties for the created signal detection hypotheses. If existing signal detections on the current waveforms match the waveform correlation detections, those signal detections will be associated to the new event hypothesis rather than creating new signal detections.

Action: "Computes and stores quality metrics and probability of detection"
The System computes and stores a station processing metric, station probability of detection, and event quality metric for each location solution of the new event hypothesis. Station calculations are configured for raw and derived channels.

Alternate Flows
1. Action "Creates new detected event hypothesis" - The System may find the waveform has cross correlation coefficients exceeding the threshold for the reference waveforms from two or more reference events. In this case, the System determines which reference waveform the waveform matches best (e.g., by comparing the cross correlation coefficients, time-bandwidth products, instrument response, and calibrations, etc.) and only creates a detected event hypothesis corresponding to the reference event for the best match. The minimum time allowed

between two detected event hypotheses is configured by the System Maintainer (see 'Configures Processing Components' UC).

The System can only modify an Analyst reviewed event hypothesis when the change in quality metric exceeds the configured threshold for the most recent Analyst stage that either created or reviewed the event hypothesis.

2. Action "Create and associate signal detections to new event hypothesis" - The System may skip the association actions.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1273: [*Threshold*] The System shall select to process waveform data containing a QC Mask based on configured parameters.

S-1401: [*Threshold*] The System shall detect signals of interest in waveform data by correlating the waveform with waveforms from historic event hypotheses.

S-1517: [*Objective / Priority 2*] The System shall recreate previously rejected event hypotheses as a result of the Analyst invoking automated processing algorithms only when the event quality metric for the automatic event hypothesis improves more than a configured threshold.

S-1556: [*Threshold*] The System shall store all event hypotheses formed by the System.

S-1557: [*Threshold*] The System shall store all signal detection associations for each event hypothesis stored by the System.

S-1560: [*Threshold*] The System shall associate signal detections to event hypotheses found with waveform correlation event processing by mapping signal detections on all network sensors to compatible signal detections on the historic waveforms.

S-1561: [*Threshold*] The System shall assign phase identifications to signal detections associated to event hypotheses found via waveform correlation to the same phases as the matching historic event hypotheses.

S-1564: [*Threshold*] The System shall calculate signal detection feature measurement uncertainties for signal detections found using waveform correlation using the cross correlation coefficient.

S-1579: [*Threshold*] The System shall compute an event hypothesis quality metric using the event hypothesis quality statistics for each event hypothesis formed on the System.

S-1588: [*Threshold*] The System shall store the event quality metric for each event hypothesis.

S-2043: [*Threshold*] The System shall store automatic and interactive processing results.

S-2223: [*Threshold*] The System shall store all data and derived processing results to persistent storage as soon as the data and/or derived processing results are available.

S-5949: [*Threshold*] The System shall detect events in a waveform by correlating the waveform with waveforms from historic event hypotheses.

IDC Specific:
None.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Channel - A generic term for either a raw channel (see channel, raw) or a derived channel (see channel, derived). A time interval of data from a channel is a waveform.

Correlation Coefficient - A measure of similarity between two waveforms. The absolute value of the correlation coefficient ranges from 0 (no similarity) to 1 (a perfect match). Formally, the correlation coefficient for two entities is the covariance divided by the square root of the product of the variances. For waveforms, this is the cross-correlation of the two waveforms, divided by the square root of the product of the auto-correlations.

Event Hypothesis - A proposed solution for an Event. Each event consists of a sequence of event hypotheses that describe an evolution to a final best model of the event. Each event hypothesis is composed of a set of associated signal detections and has one or more event hypothesis location solutions, one of which must be designated as preferred.

Reference Event - An event recognized by an analyst as containing unique or important characteristics that may help in the analysis of future events that are related. For example, a nuclear test could be designated as a reference event for any subsequently detected nearby events thought to be tests.

Signal Detection - A specific interval on a waveform marking the arrival of a signal of interest. Other portions of the waveform are noise.

Waveform Correlation Event Processing - A technique used to find events by matching current waveforms to waveforms of known historical events. Waveform similarity is determined using the correlation coefficient. When a match is found, there is high probability that a new event has occurred, which is of the same source type and near the same location (see event location) as the historical event.

IDC Specific:
None.

NOTES

General:

1. Waveform cross correlation operations have the potential to consume large amounts of processor time and system memory. The consumption increases with the number of reference waveforms and with the number of acquired channels pipeline processed using waveform correlation. This use case is architecturally significant because the System must account for the resource consumption of storing, accessing, and processing large amount of historical event information and waveforms when detecting events using waveform correlation. In general, the required resources will increase as the number of acquired channels increases and as the number of reference waveforms increases.

2. Reference event hypotheses and reference waveforms in this use case are not the same as the Reference Event Database described in the SRD. The Reference Event Database has been replaced by the concept of Event Catalogs.

3. The System uses correlation thresholds and historical event sets configured by the System Maintainer (see 'Configures Processing Components' UC).

4. The System does not correlate waveforms containing configurable types of waveform QC masks. Reference waveforms used for waveform correlation and waveforms being processed for event detections by this UC must not have active QC masks of the types configured to prevent processing. The System Maintainer configures which types of QC masks prevent the masked waveforms from being processed (see 'Configures Processing Components' UC).

5. This UC does not imply the System must create synthetic waveforms generated by waveform propagation through an earth model to use with waveform correlation. This UC only requires the System to use the reference waveforms configured by the System Maintainer. Selecting the reference waveforms is an activity performed by the Researcher (see 'Develops New Models and Algorithms' UC).

6. Although this Use Case does not store data, this Use Case maps to storage specifications because it creates data that are stored in other Use Cases. See 'System Detects Event' UC and 'Refines Event' UC.

IDC Specific:
None.

OPEN ISSUES

None.

UC-02.06 System Builds Events Using Signal Detections

USE CASE DIAGRAM
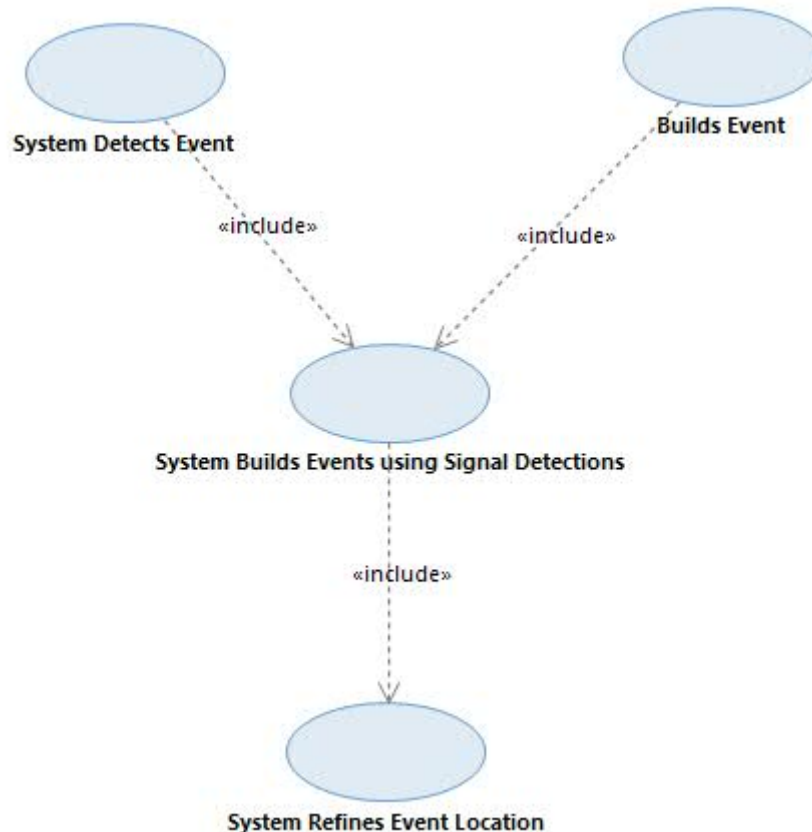
BRIEF DESCRIPTION

This architecturally significant use case describes how the System uses signal detections and features measured from those signal detections to build single station event hypotheses, build network event hypotheses, and associate previously unassociated signal detections to existing event hypotheses.

To build an event hypothesis, the System associates signal detections from one or more seismic, hydroacoustic, or infrasound stations. The System builds event hypotheses meeting predefined event formation criteria and associates previously unassociated signal detections to existing event hypotheses using signal detections, feature measurements based on those signal detections (see 'System Measures Signal Features' UC), and single station signal detection groups. The System references empirical knowledge from past events and geophysical models when forming

event hypotheses and when associating previously unassociated signal detections to existing event hypotheses. The System makes signal detection phase assignments using information available when considering signal detections in the context of event hypotheses. The System validates event hypotheses and phase assignments using empirical and geophysical model based parameters. The System computes quality metrics for all event hypotheses.

The System Maintainer configures the phase assignment parameters, signal detection association parameters, and event hypothesis quality metric parameters (see 'Configures Processing Components' UC). The Analyst has the option to select values for these parameters during interactive review (see 'Builds Event' UC).

This use case may initiate reprocessing of earlier analysis steps such as signal enhancement (see 'System Enhances Signals' UC), signal detection (see 'System Detects Signals' UC) and signal feature measurement (see 'System Measures Signal Features' UC) if an iterative, feedback-based processing sequence is implemented.

This use case is architecturally significant because it involves complex algorithms for automatically building and modifying events.

ACTOR DESCRIPTIONS

None.

PRECONDITIONS

1. One or more unassociated signal detections are available for processing.

2. Zero or more existing event hypotheses are available for processing.

3. Station quality metrics, station probabilities of detection, and event hypothesis quality metrics have been computed for all event hypotheses provided to this use case.

4. Zero or more single station signal detection groups are available for processing.

POSTCONDITIONS

1. The System built or modified zero or more event hypotheses. The System also assigned phase labels and feature measurement defining states to all signal detections associated to event hypotheses by this use case. The System computed station quality metrics, station probability of detection, and event hypothesis quality metrics for each built or modified event hypothesis.

ACTIVITY DIAGRAMS

Main Flow

Main Flow

Actor Action	System Response
	● (start)
	Associates additional signal detections
	Builds new event hypotheses
	Assigns phase labels
	Assigns signal detection defining states
	Defining state or phase label changed? — No / Yes
	Invokes Use Case - System Refines Event Location
	Calculates station probability of detection and quality metric
	Calculates event hypothesis quality metrics
	Rejects invalid event hypotheses
	◉ (end)

Action Descriptions
Action: "Associates additional signal detections"
The System associates unassociated signal detections to the existing set of event hypotheses. The System associates each signal detection to at most one event hypothesis. If a signal detection has the potential to associate with multiple event hypotheses, the System associates it to the event hypothesis it associates with best. The System uses signal detection template matching to associate additional signal detections to event hypotheses. The System associates signal detections found using any signal detection method (e.g., waveform correlation, power detection, etc. see 'System Detects Signals' UC) to event hypotheses built or detected using any technique (i.e., previously built by signal detection association by this use case or detected by waveform correlation (see 'System Detects Events using Waveform Correlation' UC)). The System shall exclude detected microbarom signals, preventing them from being associated to an event hypothesis.

The System associates unassociated signal detections to event hypotheses using the signal detection feature measurements and waveform data (including availabilities and qualities) on which the signal detections occur. The System uses prior knowledge based on historic signal detection probabilities and an earth prediction model (or models) for calculating expected observations of the presumed event hypotheses. The earth prediction models are based on either empirical knowledge from past events or geophysical model based parameters. The System also uses signal detection feature measurement residuals computed from the earth prediction models and other path dependent information (e.g., hydroacoustic blockage, atmospheric wind conditions). The System rejects associations of signal detections to event hypotheses that no longer meet the association criteria.

The System Maintainer configures the parameters used to associate signal detections to event hypotheses (see 'Configures Processing Components' UC). The Analyst has the option to select values for these parameters (see 'Builds Event' UC).

Action: "Builds new event hypotheses"
The System builds event hypotheses meeting the predefined event hypothesis formation criteria. The System uses single station event hypothesis formation criteria for building event hypotheses from a single station's signal detections and uses network event hypothesis formation criteria for building event hypotheses from combinations of seismic, hydroacoustic, and/or infrasound station signal detections. The System uses signal detection templates to build new event hypotheses from signal detections matching templates created from previously built event hypotheses. The System associates each signal detection to at most one event hypothesis. If a signal detection has the potential to associate with multiple event hypotheses, the System associates it to the event hypothesis it associates with best. The System builds event hypotheses using single station signal detection groups, unassociated signal detections, associated signal detections (including Analyst reviewed signal detections) with the potential to associate to the same event hypotheses as the unassociated signal detections, the signal detections' feature measurements, and waveform data (including availabilities and qualities) on which the signal detections occur. The System also uses prior knowledge based on historic signal detection probabilities and an earth prediction model (or models) for calculating expected observations of the presumed event hypotheses. The earth prediction models are based on either empirical

knowledge from past events or geophysical model based parameters. The System also uses signal detection feature measurement residuals computed from the earth prediction models and other path dependent information (e.g., hydroacoustic blockage, atmospheric wind conditions).

The System Maintainer configures the default event hypothesis formation criteria. These criteria are configurable based on the geographic region where the event hypothesis is located and, for single station event hypotheses, the station detecting the event hypothesis (see 'Configures Processing Components' UC). The Analyst has the option to select values for these parameters (see 'Builds Event' UC). The System allows multiple different event formation criteria to be in effect at any given time and will form an event hypothesis whenever any of the criteria are satisfied.

Action: "Assigns phase labels"
The System finalizes phase label assignments for all signal detections associated to event hypotheses during this subflow. The System assigns phase labels using the signal detection feature measurements (see 'System Measures Signal Features' UC) for signal detections associated to event hypotheses during this subflow and expected observations of the event hypotheses based on empirical knowledge from past events and geophysical model based parameters. For event hypotheses detected using waveform correlation with reference event hypotheses, the System assigns phase labels to associated signal detections according to the phase labels of the matching signal detections associated to the reference event hypotheses. The System Maintainer configures the default phase assignment criteria (see 'Configures Processing Components' UC). The Analyst has the option to select values for these parameters (see 'Builds Event' UC).

Action: "Assigns signal detection defining states"
The System sets the event hypothesis location, and magnitude defining states for all signal detections in the event hypotheses built or modified by this flow. The System makes all feature measurements non-defining for new signal detections associated to event hypotheses that were previously reviewed by an Analyst. For event hypotheses detected using waveform correlation with reference event hypotheses, the System makes location defining only those signal detections that match location defining signal detections associated to the reference event hypotheses. When this use case is invoked by an Analyst (see 'Builds Event' UC), the System assigns the default defining states to signal detections associated to newly built event hypotheses while all signal detections the System automatically associates to existing event hypotheses are set to non-defining. The System Maintainer configures the criteria used to determine default defining states (see 'Configures Processing Components' UC).

Decision: "Defining state or phase label changed?"
The System checks if the previous Actions "Assigns phase labels" or "Assigns signal detection defining states" changed any signal detection defining states or phase labels. Each event hypothesis with associations to those signal detections changed in these actions follows the "Yes" branch of this decision where the System iteratively refines the event hypothesis' locations, phase labels, and defining states. The other event hypotheses follow the "No" branch to skip the iteration.

Action: "Calculates station probability of detection and quality metric"
The System computes each station's probability of detection for each location solution of the event hypotheses. The System computes station quality metrics for configured raw and derived channels based on the location solutions of the event hypotheses. The System computes station probability of detection from the station quality metrics and the source to receiver path. The System computes station quality metrics by combining the station's network signal detection association parameters, station type (array vs. non-array), and whether or not the station was operational during the time period it would have observed the event. This allows the System to evaluate the significance of both detecting and non-detecting stations. The System Maintainer configures the station probability of detection and quality metric parameters (see 'Configures Processing Components' UC).

Action: "Calculates event hypothesis quality metrics"
The System calculates the event hypothesis quality metric for each location solution of each event hypothesis built or modified by this flow. Event hypothesis quality metrics are based on station quality metrics and the signal detection association parameters. The System Maintainer configures event hypothesis quality metric parameters and the event hypothesis quality statistic parameters (see 'Configures Processing Components' UC).

Action: "Rejects invalid event hypotheses"
The System rejects invalid event hypotheses by unassociating all signal detections from the invalid event hypotheses and removing them from further processing. The System uses two methods to find invalid event hypotheses built or modified by this use case. First, the System rejects any event hypotheses that do not meet the predefined event hypothesis formation criteria. Second, the System rejects any System built (i.e., not built by an Analyst) event hypotheses that do not have event hypothesis quality metrics exceeding a previously configured threshold.

The System Maintainer configures the event hypothesis formation criteria and event hypothesis quality metric thresholds the System uses to find invalid event hypothesis (see 'Configures Processing Components' UC).

Alternate Flows
1. Initial Action - If an Analyst is actively reviewing any of the unassociated signal detections the System would use in this use case, those signal detections are disregarded from the remainder of this use case, and this use case continues.

2. Action "Associates additional signal detections" - The System will not reassociate a signal detection to an event if an Analyst has previously unassociated that signal detection from that event. The System marks as requiring Analyst review any event previously reviewed by an Analyst that had one or more signal detections associated to it or unassociated from it by this use case. All events not previously reviewed by an Analyst require Analyst review.

3. Action "Builds new event hypotheses" - this use case may be invoked only to associate signal detections to existing event hypotheses without building new event hypotheses, in which case the action is skipped, and this use case continues.

4. Action "Builds new event hypotheses" - The System may find that a signal detection associated to an Analyst reviewed event hypothesis is more likely associated with a newly built event hypothesis. When this occurs, the System builds two versions of the new event hypothesis. One version contains the previously reviewed signal detection and the other does not. When this use case reaches Action "Rejects event hypotheses", the System compares the event hypothesis quality metrics for the two versions of the event hypothesis. If the version containing the signal detection would not otherwise be rejected and has an event hypothesis quality metric more than a configurable threshold over the version not containing the signal detection, then the System a) rejects the version of the event hypothesis not containing the signal detection, b) unassociates the signal detection from the Analyst reviewed event hypothesis, c) recomputes the station quality metric that was invalidated by unassociating the signal detection from the Analyst reviewed event hypothesis, d) recomputes the event hypothesis quality metric for the Analyst reviewed event hypothesis, and e) processes the version of the event hypothesis containing the signal detection the same as any other event hypothesis built in this use case. Otherwise, the System a) rejects the version of the new event hypothesis containing the signal detection, b) does not modify the Analyst reviewed event hypothesis, and c) processes the version of the event hypothesis not containing the signal detection the same as any other event hypothesis built in this use case.

The System Maintainer configures the minimum change in quality metric required for the System to modify an Analyst reviewed event hypothesis based on Analyst stage (see 'Configures Processing Components' UC). The System can only modify an Analyst reviewed event hypothesis when the change in quality metric exceeds the configured threshold for the most recent Analyst stage that either created or reviewed the event hypothesis.

5. Action "Builds new event hypothesis" - Other sources of events (e.g. 3rd party bulletins, waveform correlation results, etc.) are reviewed and can be used to create new candidate events. The event quality for these candidate events is weighted based on the source. Once the candidate event has been created, the System may associate signal detections to them using the action 'Associates additional signal detections'

6. Action "Assigns Phase Labels" - If no event hypotheses were built or modified by this use case then this use case ends.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1504: [*Threshold*] The System shall use the seismic, hydroacoustic, and infrasound network signal association parameters to form event hypotheses from any combination of seismic, hydroacoustic, and infrasound signal detections meeting the signal association event hypothesis formation criteria.

S-1505: [*Threshold*] The System shall use empirical values of the network signal association parameters during event hypothesis formation.

S-1506: [*Threshold*] The System shall use historic probability of signal detection during event hypothesis formation.

S-1507: [*Threshold*] The System shall use seismic network signal association parameters to assign phases to seismic signal detections.

S-1508: [*Threshold*] The System shall use hydroacoustic network signal association parameters to assign H phases to hydroacoustic signal detections at hydrophone stations.

S-1509: [*Threshold*] The System shall use hydroacoustic network signal association parameters to assign T phases to hydroacoustic signal detections from T-phase stations.

S-1510: [*Threshold*] The System shall use infrasound network signal association parameters to assign phases to infrasound signal detections.

S-1511: [*Threshold*] The System shall support concurrent signal association event hypothesis formation criteria.

S-1513: [*Threshold*] The System shall associate unassociated signal detections created by any signal detection algorithm to event hypotheses formed by any event formation algorithm.

S-1514: [*Threshold*] The System shall compute the station probability of detecting an event hypothesis during event formation.

S-1515: [*Threshold*] The System shall use variable resolution representations of the Earth for signal association parameter predictions during signal association to account for the varying ability to resolve signals originating in different areas.

S-1516: [*Objective / Priority 2*] The System shall create new event hypotheses which modify existing user-reviewed event hypotheses only when the event quality metric for the automatic event hypothesis improves more than a configured threshold.

S-1517: [*Objective / Priority 2*] The System shall recreate previously rejected event hypotheses as a result of the Analyst invoking automated processing algorithms only when the event quality metric for the automatic event hypothesis improves more than a configured threshold.

S-1518: [*Threshold*] The System shall use the configured earth model(s) during signal detection association.

S-1540: [*Threshold*] The System shall perform late network signal association using the seismic, hydroacoustic, and infrasound network signal association parameters to form event hypotheses from any combination of seismic, hydroacoustic, and infrasound signal detections meeting the signal association event hypothesis formation criteria.

S-1541: [*Threshold*] The System shall perform late network signal association for a time interval when one or more signal detections for that time interval become available that were not

available during prior network signal association or late network signal associations for that time interval.

S-1542: [*Threshold*] The System shall not automatically perform network signal association affecting signal detections that the Analyst is actively reviewing.

S-1543: [*Threshold*] The System shall set signal detections to non-defining for event hypothesis location calculations when the System automatically associates them to Analyst reviewed event hypotheses.

S-1544: [*Threshold*] The System shall set station magnitudes to non-defining for event hypothesis magnitude calculations when the System automatically associates them to Analyst reviewed event hypotheses.

S-1547: [*Threshold*] The System shall recreate an event hypothesis during late association that was rejected in user review only when the event quality metric for the automatic event hypothesis improves more than a configured threshold or when the new event hypothesis definition differs from the original event hypothesis more than a configurable threshold.

S-1548: [*Threshold*] The System shall not automatically reassociate a signal detection to an event hypothesis if an Analyst has previously unassociated that signal detection from the event hypothesis.

S-1549: [*Threshold*] The System shall perform late network signal association during the operational processing time period.

S-1554: [*Threshold*] The System shall set to non-defining newly associated signal detections when the Analyst invokes automated processing algorithms to associate signal detections to existing event hypotheses.

S-1556: [*Threshold*] The System shall store all event hypotheses formed by the System.

S-1557: [*Threshold*] The System shall store all signal detection associations for each event hypothesis stored by the System.

S-1560: [*Threshold*] The System shall associate signal detections to event hypotheses found with waveform correlation event processing by mapping signal detections on all network sensors to compatible signal detections on the historic waveforms.

S-1561: [*Threshold*] The System shall assign phase identifications to signal detections associated to event hypotheses found via waveform correlation to the same phases as the matching historic event hypotheses.

S-1572: [*Threshold*] The System shall compute the station quality metric for all events.

S-1576: [*Threshold*] The System shall store the station quality metrics for all stations for each event hypothesis.

S-1579: [*Threshold*] The System shall compute an event hypothesis quality metric using the event hypothesis quality statistics for each event hypothesis formed on the System.

S-1580: [*Threshold*] The System shall recompute the event hypothesis quality metric for an event hypothesis when any of the event hypothesis quality statistics used to calculate the event hypothesis quality metric are updated.

S-1581: [*Threshold*] The System shall not automatically form event hypotheses with event hypothesis quality metrics below the event hypothesis quality metric threshold.

S-1582: [*Threshold*] The System shall not screen any Analyst created event hypotheses by their event hypothesis quality metrics.

S-1588: [*Threshold*] The System shall store the event quality metric for each event hypothesis.

S-1597: [*Threshold*] The System shall compute new event hypothesis relocations when an automatic process associates a new location defining signal detection to that event hypothesis.

S-1598: [*Threshold*] The System shall compute new event hypothesis relocations when an automatic process unassociates a location defining signal detection from that event hypothesis.

S-2036: [*Threshold*] The System shall use configured default defining/non-defining state settings and precedence rules to determine the initial defining/non-defining state for each parameter.

S-2043: [*Threshold*] The System shall store automatic and interactive processing results.

S-2223: [*Threshold*] The System shall store all data and derived processing results to persistent storage as soon as the data and/or derived processing results are available.

S-2342: [*Threshold*] The System shall mark as requiring Analyst review any event previously reviewed by an Analyst that has its signal detection associations subsequently modified by the System.

S-3026: [*Threshold*] The System shall build new events using signal detection templates.

S-5596: [*Threshold*] The System shall use station-to-event distance when associating signal detections to events.

S-5597: [*Threshold*] The System shall use event magnitude when associating signal detections to events.

S-5598: [*Threshold*] The System shall use waveform data quality when associating signal detections to events.

S-5599: [*Threshold*] The System shall use station noise level when associating signal detections to events.

S-5600: [*Threshold*] The System shall use event location to assign phase identifications to signal detections based on predicted phase ID matching.

S-5601: [*Threshold*] The System shall use event location to assign phase identifications to signal detections based on available empirical phase ID matching.

S-5641: [*Objective / Priority 1*] The System shall identify microbarom signals.

S-5642: [*Objective / Priority 1*] The System shall prevent association of microbarom signals to events.

S-5968: [*Threshold*] The System shall associate signal detections to existing events using signal detection templates.

S-6513: [*Threshold*] The System shall build new events using seed events from third-party event bulletins.

S-6519: [*Threshold*] The System shall compute seed event quality for each seed event based on the source providing the seed event.

S-6521: [*Threshold*] The System shall store seed events.

S-6522: [*Threshold*] The System shall store seed event quality.

IDC Specific:
None.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Active Review - The state of a set of data indicating an Analyst is reviewing the data. The set of data in Active Review is defined by either an event being refined and its associated signal detections and waveforms, or the time interval of visible waveforms and signal detections being scanned. The System prevents changes by automated processing to data in Active Review. Analysts are notified of relevant data in Active Review by other analysts.

Association - See signal association.

Defining/Non-Defining - Any observation that contributes to the determination of an event attribute is considered to be "defining" for that attribute. The detection of an event, the location

of an event (see event location), the magnitude of an event (see event magnitude, network), and the source type assigned to an event are all determined by specific types of defining observations (travel time, azimuth, slowness, amplitude) from one or more phases recorded by one or more stations. If an observation is linked to an event (associated), but does not contribute to the calculation of an event attribute, then it is considered to be non-defining for that attribute.

Event - The estimate by the System or Analyst of the occurrence of some transient source of energy within the Earth's body, oceans, or atmosphere that can be detected by seismic, hydroacoustic, and/or infrasonic sensors. For the same event, many different event hypotheses may be created at different processing stages. One of these event hypotheses must be designated as preferred.

Event Hypothesis - A proposed solution for an Event. Each event consists of a sequence of event hypotheses that describe an evolution to a final best model of the event. Each event hypothesis is composed of a set of associated signal detections and has one or more event hypothesis location solutions, one of which must be designated as preferred.

Event Location - The combination of an event's spatial location (see event hypocenter), temporal location, spatial location uncertainty, and temporal location uncertainty.

Event Quality Metric - A quality metric computed as a number in the closed interval [0.0, 1.0] (low to high) for each event hypothesis formed on the System. This metric indicates the quality of the event hypothesis as a function of the event hypothesis's associated signal detections and related measurements, location solution, station state-of-health, and network state-of-health information. The System computes a new event quality metric whenever any parameter used for calculating the metric is updated and stored.

Late Signal Association - A network signal association process triggered when a signal detection is made on a waveform after normal network signal association has occurred. Late signal association includes associating the new signal detections to previously formed event hypotheses as well as using them to form new event hypotheses.

Phase - An indication of the path and type of a signal originating from an event traveling through the body of the Earth, the oceans, or the atmosphere. For example, the seismic P phase refers to a compressional wave refracting within the mantle of the Earth, while the seismic ScS phase refers to a shear wave reflecting off the outer core boundary.

Rejected Event Hypothesis - An event hypothesis determined to be invalid by either the System or an Analyst. The history of rejected event hypotheses, including signal detection associations, are available on the System, and rejected event hypotheses can be reopened by Analysts. All signal detections are unassociated from an event hypothesis when it is rejected, making those signal detections available to form other event hypotheses.

Seed Event - Event information (e.g., event location, event magnitude, detecting stations) provided to a signal association algorithm as a hint about an event hypothesis the algorithm should attempt to build.

Signal Association - The process of linking (associating) a set of signal detections from a network of stations to an event hypothesis, either existing or new. Association is based on consistency of observed and predicted signal detection feature measurements (e.g., arrival time, azimuth, slowness). Signal association can be done automatically by the system (see pipeline processing), or manually by an analyst.

Signal Detection - A specific interval on a waveform marking the arrival of a signal of interest. Other portions of the waveform are noise.

Signal Detection Feature Measurement - A measurement of a signal detection feature, including measurement uncertainty.

Signal Detection Feature Prediction - A prediction of a signal detection feature, including prediction uncertainty.

Signal Detection Template - The set of signal detections associated with an event. The relative timing of the signal detections is indicative of the location of the event. Shifting the timing of a signal detection template, and matching it with signal detections on current waveforms, can help determine whether a similar event has occurred, and aid in identifying and associating signal detections to existing events. These templates can be particularly helpful for building events in an aftershock or swarm sequence.

IDC Specific:
None.

NOTES

General:
1. This use case covers both normal and late signal detection association processing.

2. Although this Use Case does not store data, this Use Case maps to storage specifications because it creates data that are stored in other Use Cases. See 'System Detects Event' UC and 'Refines Event' UC.

3. The System sets default defining states based on rules previously configured by the System Maintainer (see 'Configures Processing Components' UC).

4. When calculating the station probability of detection, the fact that there are non-detecting stations could be feedback to the System to look for detections on those stations.

5. For standalone systems it may not be possible to have all events reviewed by an Analyst.

IDC Specific:
None.

OPEN ISSUES

None.

UC-02.08 System Refines Event Location

USE CASE DIAGRAM
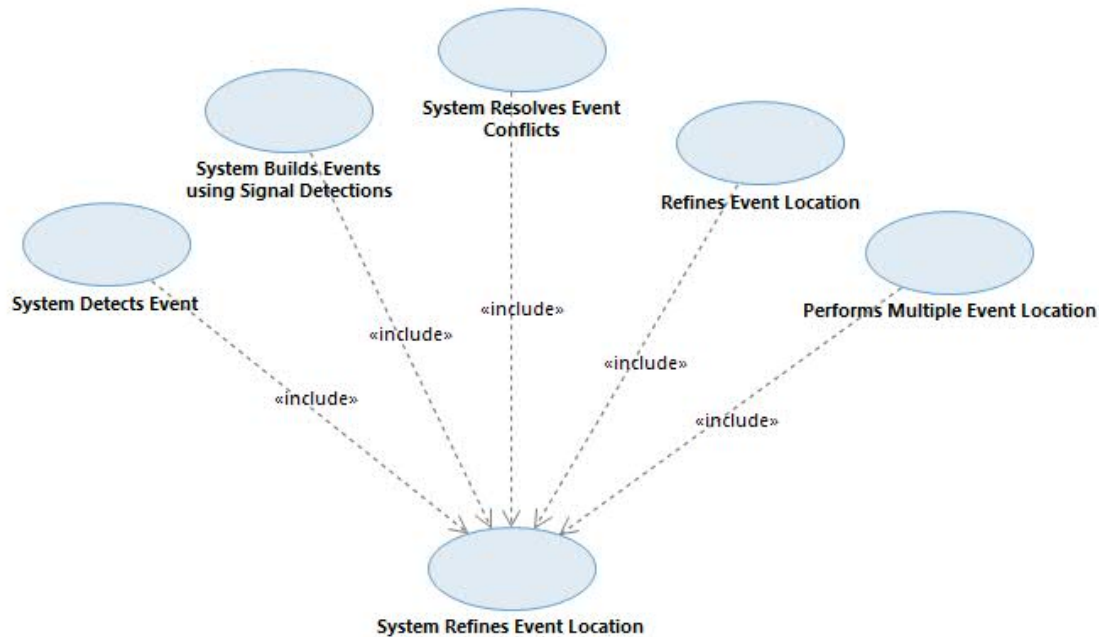
BRIEF DESCRIPTION

This use case describes how the System refines event hypothesis location solutions using single event or multiple event algorithms. Event locations can be absolute or relative. The System locates events by finding the event location minimizing the difference between signal detection feature measurements and signal detection feature predictions (see 'System Measures Signal Features' UC). The System references both empirical knowledge from past events and geophysical models to form the signal detection feature predictions (see 'System Predicts Signal Features' UC). The System also computes an uncertainty bound for each event hypothesis location solution describing a region bounding the event hypothesis' hypocenter and origin time at a particular confidence level. The System creates a variety of location solutions for each event hypothesis. These location solutions vary from one another in either the input parameters the System uses or in the location solution components the System restrains to fixed values (e.g., depth) during event location calculations. The System computes location solutions using input parameters configured by the System Maintainer (see 'Configures Processing Components' UC). The Analyst has the option to override input parameters originally configured by the System Maintainer (see 'Refines Event Location' UC).

ACTOR DESCRIPTIONS

None.

PRECONDITIONS

1. At least one event hypothesis is available for location refinement.

POSTCONDITIONS

1. This use case relocates one or more event hypotheses.

ACTIVITY DIAGRAMS

Main Flow
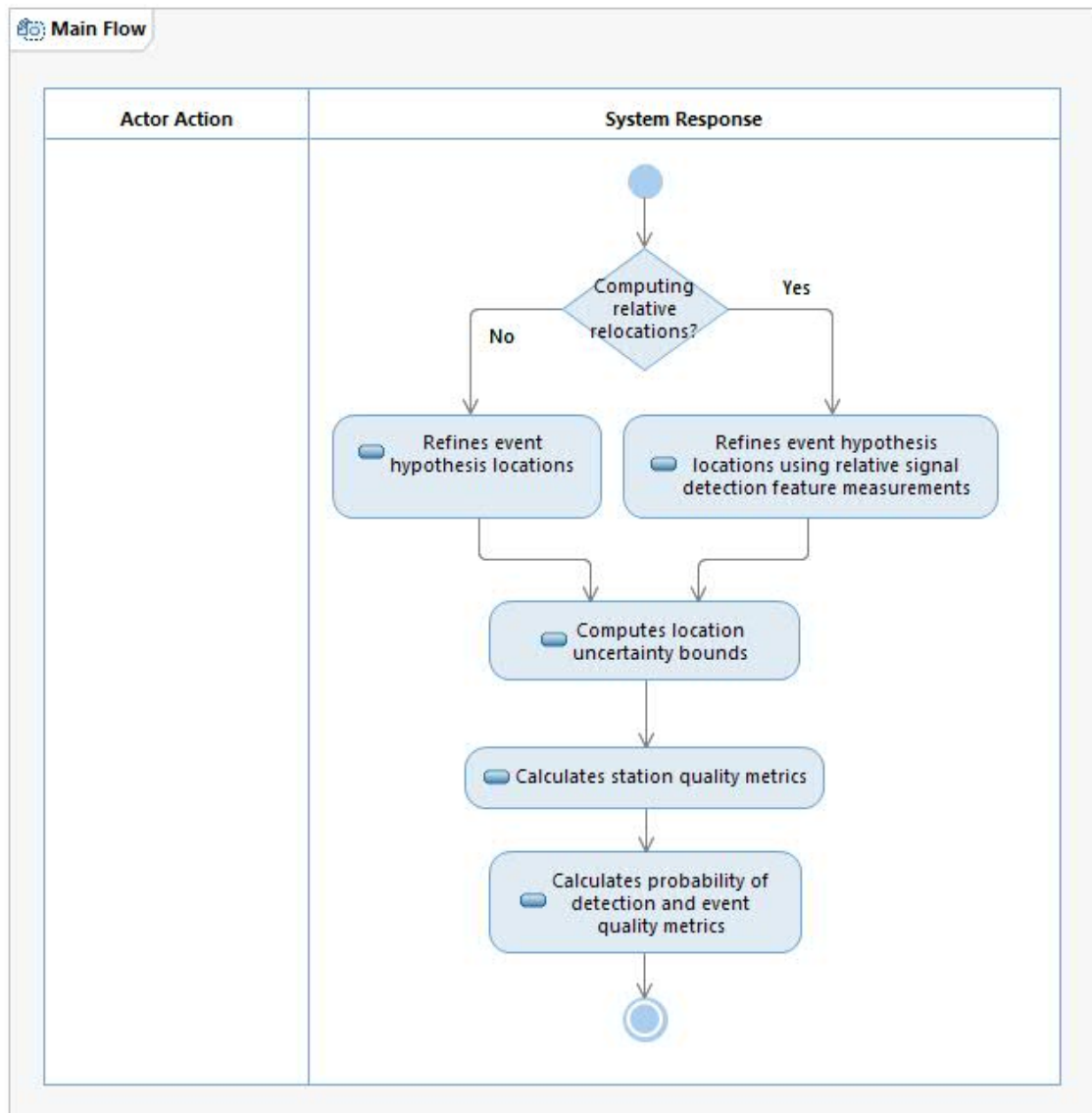
Action Descriptions
Initial Action
This use case begins when the System needs to refine the location solutions for one or more
event hypotheses.

Event location refinement processing uses these parameters:
a. One or more event hypotheses.
b. An event location refinement algorithm (including relative relocation algorithms, i.e., master event relocation or multiple event relocation).
c. Signal detections, including signal detection feature measurements, associated to the event hypotheses. All associated signal detections are used as the locator may toggle any individual signal detection feature measurement (except those specifically configured as always non-defining) between location defining and non-defining.
d. Types of event location solutions (e.g., unrestrained, restrained to a particular depth) to compute. For restrained event hypothesis location solutions this also includes values for the restrained parameters. Parameters that can be restrained are: latitude, longitude, depth, and time.
e. Uncertainty bounds to compute. Each uncertainty bound is specified by a type (coverage, confidence, or k-weighted bound with associated weight), scaling factor, and confidence level.
f. A signal prediction model: an earth model, empirical data, or both, providing signal detection feature predictions for signal detections associated to the event hypotheses.

The System Maintainer configures default values for event location refinement processing parameters (see 'Configures Processing Components' UC). The Analyst has the option to override these parameters (see 'Refines Event Location' UC).

Decision: "Computing relative relocations?"
The System checks the type of event hypothesis relocation to perform. The System refines all event hypotheses using the same type of relocation. When performing relative relocation the System relocates relative to one another the entire set of event hypotheses input to this use case.

Action: "Refines event hypothesis locations"
The System refines each event hypothesis' location independent of the other event hypotheses. While refining event hypothesis locations, the System computes signal detection feature predictions for the following signal features: arrival time, back azimuth, and horizontal slowness (see 'System Predicts Signal Features' UC). The System has the option to modify the location defining/non-defining state of signal detection feature measurements while refining event hypothesis locations.

Action: "Refines event hypothesis locations using relative signal detection feature measurements"
The System simultaneously refines the locations of each event hypothesis in the group using the differences in signal detection feature measurement values (e.g., travel time, back azimuth, horizontal slowness) between the event hypotheses. The System computes feature measurement differences either algorithmically (e.g., it may compute travel time differences using waveform cross correlation time offsets) or by directly computing the difference between feature measurements. The System may use signal detection feature measurements and predictions (similar to how it uses these values during non-relative relocation) instead of feature measurement differences for some of the feature measurements. The System has the option to modify the location defining/non-defining state of signal detection feature measurements while refining event hypothesis locations.

Action: "Computes location uncertainty bounds"
The System uses signal detection feature measurement uncertainties and signal detection feature prediction uncertainties to compute each requested location uncertainty bound for each refined event location.

Action: "Calculates station quality metrics"
The System computes the station quality metric for configured raw and derived channels. The System computes station quality metrics by combining the station's network signal detection association parameters, station type (array vs. non-array), and whether or not the station was operational during the time period it would have observed the event. The System computes the quality metrics for each location solution of each event hypothesis. The System Maintainer configures the station quality metric parameters (see 'Configures Processing Components' UC).

Action: "Calculates probability of detection and event quality metrics"
The System computes the probability of detection and event quality metric for each location solution of each event hypothesis.

Alternate Flows
1. Action "Refines event hypothesis locations using relative signal detection feature measurements" - this use case may be invoked to only update the locations for one of the input event hypotheses (e.g., as occurs for master event relocation), in which case the System does not update the location solutions for the other event hypotheses during this use case, and this use case continues.

2. Action 'Refines event hypothesis locations' and 'Refines event hypothesis location using relative signal detection feature measurements' - The System may not be able to refine an event hypothesis' location (e.g., an iterative refinement algorithm does not converge on a solution), in which case this use case performs no further actions for that event hypothesis, and this use case continues.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1563: [*Threshold*] The System shall locate event hypotheses found using waveform correlation processing using the same location algorithms as events found using other types of event processing.

S-1572: [*Threshold*] The System shall compute the station quality metric for all events.

S-1576: [*Threshold*] The System shall store the station quality metrics for all stations for each event hypothesis.

S-1580: [*Threshold*] The System shall recompute the event hypothesis quality metric for an event hypothesis when any of the event hypothesis quality statistics used to calculate the event hypothesis quality metric are updated.

S-1588: [*Threshold*] The System shall store the event quality metric for each event hypothesis.

S-1592: [*Threshold*] The System shall compute event hypothesis relocations using seismic, hydroacoustic, and infrasound signal detection feature measurements.

S-1593: [*Threshold*] The System shall compute event hypothesis relocations using the signal detection feature measurements from a single station.

S-1594: [*Threshold*] The System shall compute event hypothesis relocations using the signal detection feature measurements from multiple stations.

S-1595: [*Threshold*] The System shall compute event hypothesis relocation uncertainty bounds.

S-1596: [*Threshold*] The System shall compute the uncertainty coverage ellipse for each event hypothesis relocation.

S-1600: [*Threshold*] The System shall set the defining/non-defining state for signal detection measurements during event hypothesis relocation processing.

S-1619: [*Threshold*] The System shall store the confidence level of each computed event hypothesis location uncertainty bound.

S-1620: [*Threshold*] The System shall store the type (i.e., confidence, coverage, or k-weighted with the associated weights) of each location uncertainty bound.

S-1623: [*Threshold*] The System shall store the sum squared weighted residual for each event hypothesis location.

S-1624: [*Threshold*] The System shall store the defining/non-defining state for each signal detection measurement associated to a stored event hypothesis.

S-1631: [*Threshold*] The System shall compute event hypothesis relocations using teleseismic and regional seismic signal detections.

S-1640: [*Threshold*] The System shall perform master event relocation using travel time differences.

S-1653: [*Threshold*] The System shall compute new event hypothesis magnitude estimates when a new event hypothesis location is computed.

S-2036: [*Threshold*] The System shall use configured default defining/non-defining state settings and precedence rules to determine the initial defining/non-defining state for each parameter.

S-2043: [*Threshold*] The System shall store automatic and interactive processing results.

S-2223: [*Threshold*] The System shall store all data and derived processing results to persistent storage as soon as the data and/or derived processing results are available.

S-6290: [*Threshold*] The System shall perform multiple event relocation using differences in signal detection feature measurements.

IDC Specific:
None.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Earth Model - A representation of one or more physical properties of the Earth, generally used for calculating a predicted value for an observation measured at a station for a particular event (e.g., travel time, azimuth, and slowness). Earth models are used to predict observables for seismic, infrasonic, or hydroacoustic signals.

Earth Model, 1D - An Earth model in which the physical properties represented vary only with one dimension. Generally, this dimension is depth for seismic and hydroacoustic models, and elevation for infrasonic models. 1D depth/altitude varying models are effective, because gradients of physical properties are generally much stronger in the vertical direction, due to gravitational effects on the solid Earth, oceans, and atmosphere.

Earth Model, 2D - An Earth model in which the physical properties represented vary with two dimensions. Generally, these dimensions are latitude and longitude. There are not many examples of physical properties that vary only with latitude and longitude and not with depth, so 2D models are less common than 1D or 3D models. Examples of types of 2D models are surface wave group velocities (for predicting dispersion) and body or surface wave attenuation (for predicting amplitude).

Earth Model, 3D - An Earth model in which the physical properties represented vary with three dimensions. Generally, these dimensions are latitude, longitude, and depth. 3D Earth models represent the highest level of fidelity of static (non-time varying) Earth models.

Event Hypothesis - A proposed solution for an Event. Each event consists of a sequence of event hypotheses that describe an evolution to a final best model of the event. Each event hypothesis is composed of a set of associated signal detections and has one or more event hypothesis location solutions, one of which must be designated as preferred.

Event Hypothesis Location Solution - An estimate of an event location (latitude, longitude, depth, origin time) that is tied to a particular event hypothesis. Each location solution is based on a set of defining signal detection feature measurements (e.g., time, azimuth, slowness).

Event Location - The combination of an event's spatial location (see event hypocenter), temporal location, spatial location uncertainty, and temporal location uncertainty.

Master Event Relocation - A method of relative event relocation where the new location is determined relative to an event with a known, fixed location (the master event). The location of the new event is determined by minimizing the travel time differences between the signal detections of the new event and the master event. Assuming the two events are in fact close to each other, this relative location can be determined with significantly greater precision than a standard relocation. However, the location accuracy depends completely on the location accuracy of the master event.

Multiple Event Relative Relocation - The process of simultaneously estimating the relative locations of a set of event hypotheses in a localized source region by using precise relative values of observations (usually travel times). Relative event locations calculated in this manner are more accurate than locations produced by relocating each event hypothesis independently.

Origin - See event hypothesis location solution.

Signal Detection - A specific interval on a waveform marking the arrival of a signal of interest. Other portions of the waveform are noise.

Signal Detection Feature - A feature associated with a signal detection (e.g., arrival time, back azimuth, horizontal slowness, amplitude, frequency content).

Signal Detection Feature Measurement - A measurement of a signal detection feature, including measurement uncertainty.

Signal Detection Feature Prediction - A prediction of a signal detection feature, including prediction uncertainty.

IDC Specific:
None.

NOTES

General:
1. The System does not use relative relocation algorithms (master event relocation or multiple event relocation) during automatic processing. The System makes the algorithms accessible for use in interactive processing (see 'Refines Event Location' UC and 'Performs Multiple Event Location' UC).

2. The System estimates magnitude for an event hypothesis after relocating the event hypothesis. The System Maintainer configures processing sequences to estimate event hypothesis magnitude after event hypothesis relocation (see 'Defines Processing Sequence' UC).

3. Although this Use Case does not store data, this Use Case maps to storage specifications because it creates data that are stored in other Use Cases. See 'System Detects Event' UC and 'Refines Event' UC.

4. The System sets default location defining states based on rules previously configured by the System Maintainer (see 'Configures Processing Components' UC).

IDC Specific:
None.

OPEN ISSUES

None.

UC-02.12 System Predicts Signal Features

USE CASE DIAGRAM
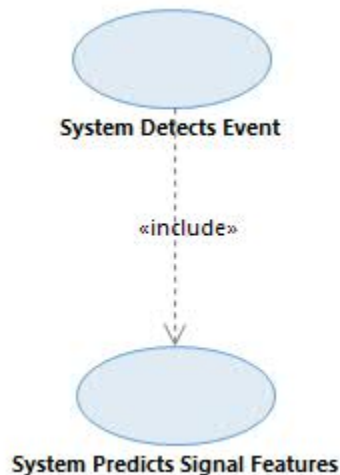
BRIEF DESCRIPTION

This architecturally significant use case describes how the System predicts signal features in order to accomplish key monitoring tasks. Signal features include phase identification, probability of detection, arrival time, azimuth, slowness, amplitude, and spectral content. The System references both empirical knowledge from past events and geophysical models, including time-varying geophysical models, to predict the signal features. The System applies empirical corrections to predictions. The System provides uncertainties for predictions as appropriate. The System uses default signal prediction parameters configured by the System Maintainer (see 'Configures Processing components' UC) or selected by the Analyst (see 'Refines Event' UC).

This use case is architecturally significant because it involves use of large and complex earth models for calculation of signal propagation through the earth, including time-varying models of the atmosphere and ocean.

ACTOR DESCRIPTIONS

None.

PRECONDITIONS

1. An event hypothesis location is available in the System.

POSTCONDITIONS

None.

ACTIVITY DIAGRAMS

Main Flow

Actor Action	System Response
	Performs one or more of the following actions as specified by the invoking use case
	Predict probability of signal detections and phase identification
	Predict signal detection arrival time
	Predict signal detection azimuth
	Predict signal detection slowness
	Predict signal detection amplitude for specified frequencies
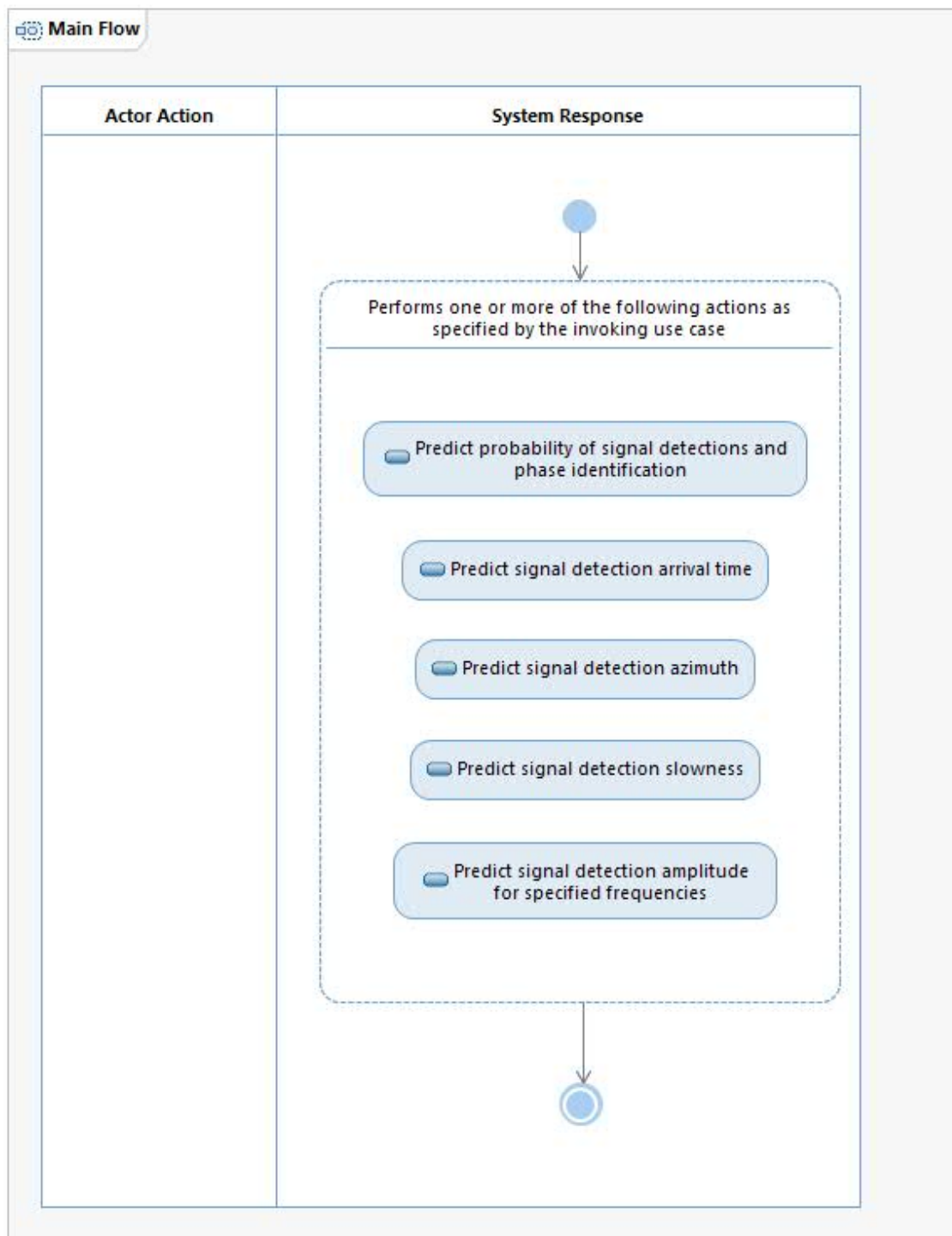
Action Descriptions
Action: "Predict probability of signal detections and phase identification"

The System predicts the probability of a signal detection and the phase identification for a specific event location and station location. The System predicts signal detections using empirical knowledge from past events, geophysical models or both.

Action: *"Predict signal detection arrival time"*
The System predicts the arrival time for a signal detection based on a specific event location and station location. The System predicts arrival times using empirical knowledge from past events, geophysical models or both.

Action: *"Predict signal detection azimuth"*
The System predicts the azimuth for a signal detection based on a specific event location and station location. The System predicts azimuths using empirical knowledge from past events, geophysical models or both.

Action: *"Predict signal detection slowness"*
The System predicts the slowness for a signal detection based on a specific event location and station location. The System predicts slowness using empirical knowledge from past events, geophysical models or both.

Action: *"Predict signal detection amplitude for specified frequencies"*
The System predicts the amplitude at specified frequencies for a signal detection based on a specific event location and size, and station location frequency/period. The System predicts amplitudes at the specified frequencies using empirical knowledge from past events, geophysical models or both.

Alternate Flows
None.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1601: [*Threshold*] The System shall compute modeling uncertainties for model based predictions of signal detection measurements.

S-1776: [*Threshold*] The System shall use correction surfaces to compute corrections to earth model predictions.

S-1777: [*Threshold*] The System shall apply earth model prediction corrections to earth model predictions computed from basemodels.

S-1778: [*Threshold*] The System shall apply empirical Master Event Corrections by station and phase to earth model predictions and prediction uncertainties.

S-1779: [*Threshold*] The System shall compute predicted slowness using a one-dimensional phase-specific basemodel.

S-1780: [*Threshold*] The System shall compute phase-specific slowness predictions using a velocity model where the velocity of the Earth varies as a function of depth/elevation but not latitude or longitude.

S-1781: [*Threshold*] The System shall compute the uncertainties of predicted slowness computed using a one-dimensional phase-specific basemodel.

S-1782: [*Threshold*] The System shall compute the uncertainty of phase-specific slowness predictions using a velocity model where the velocity of the Earth varies as a function of depth/elevation but not latitude or longitude.

S-1783: [*Objective / Priority 1*] The System shall compute predicted slowness using a three-dimensional phase-specific basemodel.

S-1784: [*Objective / Priority 1*] The System shall compute phase-specific slowness predictions using a velocity model where the velocity of the Earth varies as a function of latitude, longitude, and depth/elevation.

S-1785: [*Objective / Priority 1*] The System shall compute the uncertainties of predicted slowness computed using a three-dimensional phase-specific basemodel.

S-1786: [*Objective / Priority 1*] The System shall compute the uncertainty of phase-specific slowness predictions using a velocity model where the velocity of the Earth varies as a function of latitude, longitude, and depth/elevation.

S-1787: [*Objective / Priority 1*] The System shall compute predicted azimuths using a three-dimensional phase-specific basemodel.

S-1788: [*Objective / Priority 1*] The System shall compute phase-specific azimuth predictions using a velocity model where the velocity of the Earth varies as a function of latitude, longitude, and depth/elevation.

S-1789: [*Objective / Priority 1*] The System shall compute the uncertainties of predicted azimuths computed using a three-dimensional phase-specific basemodel.

S-1790: [*Objective / Priority 1*] The System shall compute uncertainty of phase-specific azimuth predictions using a velocity model where the velocity of the Earth varies as a function of latitude, longitude, and depth/elevation.

S-1791: [*Threshold*] The System shall compute predicted travel-times using a one-dimensional phase-specific basemodel.

S-1792: [*Threshold*] The System shall compute phase-specific travel-time predictions using a velocity model where the velocity of the Earth varies as a function of depth/elevation but not latitude or longitude.

S-1793: [*Threshold*] The System shall compute the uncertainties of predicted travel-times computed using a one-dimensional phase-specific basemodel.

S-1794: [*Threshold*] The System shall compute the uncertainty of phase-specific travel-time predictions using a velocity model where the velocity of the Earth varies as a function of depth but not latitude or longitude.

S-1795: [*Threshold*] The System shall compute predicted travel-times using a two-dimensional phase-specific basemodel.

S-1796: [*Threshold*] The System shall compute phase-specific travel-time predictions using a velocity model where the velocity of the Earth varies as a function of latitude and longitude but not depth/elevation.

S-1797: [*Threshold*] The System shall compute predicted travel time of Rayleigh waves and Love waves using frequency-specific group and phase velocity models where the group/phase velocity varies as a function of latitude and longitude but not depth.

S-1798: [*Threshold*] The System shall compute the uncertainties of predicted travel-times computed using a two-dimensional phase-specific basemodel.

S-1799: [*Threshold*] The System shall compute phase-specific uncertainty of predicted travel-time using a velocity model where the velocity of the Earth varies as a function of latitude and longitude but not depth/elevation.

S-1800: [*Threshold*] The System shall compute uncertainty of predicted travel time of Rayleigh waves and Love waves using frequency-specific group and phase velocity models where the group/phase velocity varies as a function of latitude and longitude but not depth.

S-1801: [*Extensibility*] The System shall compute predicted travel-times using a three-dimensional phase-specific basemodel.

S-1802: [*Objective / Priority 1*] The System shall compute phase-specific travel-time predictions using a velocity model where the velocity of the Earth varies as a function of latitude, longitude, and depth/elevation.

S-1803: [*Extensibility*] The System shall compute the uncertainties of predicted travel-times computed using a three-dimensional phase-specific basemodel.

S-1804: [*Extensibility*] The System shall compute phase-specific uncertainty of predicted travel-time using a velocity model where the velocity of the Earth varies as a function of latitude, longitude, and depth/elevation.

S-1816: [*Threshold*] The System shall store the earth model and version used to compute an earth model prediction.

S-1817: [*Threshold*] The System shall store the corrections applied to earth model predictions.

S-1818: [*Threshold*] The System shall store the correction surface used to correct an earth model prediction.

S-1819: [*Threshold*] The System shall store the predicted slowness computed from a basemodel.

S-1820: [*Threshold*] The System shall store the uncertainties of a predicted slowness computed using a basemodel.

S-1821: [*Threshold*] The System shall store the predicted azimuths computed using a phase-specific basemodel.

S-1822: [*Threshold*] The System shall store the uncertainties of predicted azimuths computed using a basemodel.

S-1823: [*Threshold*] The System shall store the predicted travel-times computed from a basemodel.

S-1824: [*Threshold*] The System shall store the uncertainties of predicted travel-times computed using a basemodel.

S-1827: [*Threshold*] The System shall compute predicted amplitude attenuation from phase and frequency dependent one-dimensional basemodels.

S-1828: [*Threshold*] The System shall compute amplitude correction factors using Q models where Q in the Earth varies as a function of phase, frequency and depth, but not latitude or longitude.

S-1829: [*Threshold*] The System shall compute predicted amplitude attenuation uncertainties from phase and frequency dependent one-dimensional basemodels.

S-1830: [*Threshold*] The System shall compute the uncertainty of amplitude correction factors computed using Q models where Q in the Earth varies as a function of phase, frequency and depth, but not latitude or longitude.

S-1837: [*Extensibility*] The System shall compute predicted amplitude attenuation from frequency dependent three-dimensional basemodels.

S-1838: [*Threshold*] The System shall compute amplitude correction factors using Q models where Q in the Earth varies as a function of phase, frequency, latitude, longitude and depth.

S-1839: [*Extensibility*] The System shall compute predicted amplitude attenuation uncertainties from frequency dependent three-dimensional basemodels.

S-1840: [*Extensibility*] The System shall compute the uncertainty of amplitude correction factors computed using Q models where Q in the Earth varies as a function of phase, frequency, latitude, longitude and depth.

S-1842: [*Threshold*] The System shall store predicted amplitude attenuation.

S-1843: [*Threshold*] The System shall store predicted amplitude attenuation uncertainties.

S-1846: [*Extensibility*] The System shall compute time dependent predicted amplitude attenuation for infrasonic signals.

S-1847: [*Extensibility*] The System shall compute time dependent predicted amplitude attenuation uncertainties for infrasonic signals.

S-1848: [*Extensibility*] The System shall compute time dependent predicted amplitude attenuation for hydroacoustic signals.

S-1849: [*Extensibility*] The System shall compute time dependent predicted amplitude attenuation uncertainties for hydroacoustic signals.

S-1851: [*Threshold*] The System shall incorporate monthly variations in hydroacoustic blockage.

S-1852: [*Objective / Priority 1*] The System shall incorporate monthly variations in travel time for hydroacoustic data.

S-1853: [*Objective / Priority 1*] The System shall use a meteorological model for computing travel times in infrasound data.

S-1856: [*Objective / Priority 2*] The System shall model Lamb waves when computing travel times in infrasound data.

S-2043: [*Threshold*] The System shall store automatic and interactive processing results.

S-2223: [*Threshold*] The System shall store all data and derived processing results to persistent storage as soon as the data and/or derived processing results are available.

S-3041: [*Threshold*] The System shall compute predicted signal amplitude decay from geometric spreading as a function of phase and distance from the source.

S-3042: [*Threshold*] The System shall compute uncertainty of predicted signal amplitude decay from geometric spreading as a function of phase and distance from the source.

S-3043: [*Threshold*] The System shall compute predicted signal amplitude decay from geometric spreading as a function of phase, frequency, and propagation path from the source.

S-3044: [*Threshold*] The System shall compute uncertainty of predicted signal amplitude decay from geometric spreading as a function of phase, frequency, and propagation path from the source.

S-3045: [*Threshold*] The System shall correct signal amplitudes for decay from geometric spreading when applying amplitude attenuation corrections.

S-5615: [*Threshold*] The System shall compute wind velocity predictions using meteorological models that vary as a function of latitude, longitude, altitude, and time.

S-5652: [*Extensibility*] The System shall compute corrections to wind velocity predictions based on a model for atmospheric gravity waves.

S-5653: [*Extensibility*] The System shall compute corrections to atmospheric temperature predictions based on a model for atmospheric gravity waves.

S-5654: [*Threshold*] The system shall compute an infrasound propagation model using gravity wave corrected wind velocity and atmospheric temperature predictions.

S-5655: [*Objective / Priority 1*] The system shall compute infrasound travel-time, trace velocity, and attenuation using an infrasound propagation model and thermospheric, tropospheric, stratospheric, and direct phases.

S-5656: [*Objective / Priority 1*] The system shall compute an infrasound propagation model that incorporates high resolution meteorological data.

S-5657: [*Objective / Priority 1*] The system shall compute uncertainties of infrasound travel-time, trace velocity, and attenuation using an infrasound propagation model and thermospheric, tropospheric, stratospheric, and direct phases.

S-5715: [*Threshold*] The System shall store wind velocity (including uncertainty) computed from meteorological models.

S-5716: [*Threshold*] The System shall store temperature (including uncertainty) computed from meteorological models.

S-5717: [*Extensibility*] The System shall store gravity wave corrections to temperature predictions.

S-5828: [*Objective / Priority 1*] The System shall use a daily and hourly varying meteorological model for computing travel times in infrasound data.

S-5830: [*Threshold*] The System shall use a meteorological model for computing azimuths in infrasound data.

S-6541: [*Threshold*] The System shall compute the probability of a station detecting a signal from an event.

IDC Specific:
None.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Amplitude Correction Factor - A phase- and frequency-specific multiplicative factor, which represents the decrease in the amplitude of a wavefront due to attenuation as it travels from source to receiver. Amplitude correction factors are applied in conjunction with corrections due to geometric spreading.

Attenuation - The decrease in amplitude of a signal due to loss of energy as the signal propagates away from its source. Attenuation consists of two components: intrinsic attenuation, which is the phenomenon in which kinetic energy is converted to heat by anelastic processes or internal friction, and scattering attenuation, which is caused by energy reflecting off of small scale material heterogeneities. In addition to attenuation, geometric spreading also acts to modify the amplitude of seismic signals.

Azimuth - The angle in degrees measured clockwise from geographic North of a signal arriving at a station. Azimuth and slowness completely describe the vector direction of arrival for a signal at a station.

Earth Model - A representation of one or more physical properties of the Earth, generally used for calculating a predicted value for an observation measured at a station for a particular event (e.g., travel time, azimuth, and slowness). Earth models are used to predict observables for seismic, infrasonic, or hydroacoustic signals.

Earth Model, 1D - An Earth model in which the physical properties represented vary only with one dimension. Generally, this dimension is depth for seismic and hydroacoustic models, and elevation for infrasonic models. 1D depth/altitude varying models are effective, because gradients of physical properties are generally much stronger in the vertical direction, due to gravitational effects on the solid Earth, oceans, and atmosphere.

Earth Model, 2D - An Earth model in which the physical properties represented vary with two dimensions. Generally, these dimensions are latitude and longitude. There are not many examples of physical properties that vary only with latitude and longitude and not with depth, so 2D models are less common than 1D or 3D models. Examples of types of 2D models are surface wave group velocities (for predicting dispersion) and body or surface wave attenuation (for predicting amplitude).

Earth Model, 3D - An Earth model in which the physical properties represented vary with three dimensions. Generally, these dimensions are latitude, longitude, and depth. 3D Earth models represent the highest level of fidelity of static (non-time varying) Earth models.

Empirically Derived Corrections - Corrections that are applied to predictions (e.g., seismic travel time) calculated using basemodels to improve fidelity of the predictions. Empirically derived corrections are based on measurements from ground-truth events and are developed specifically for a particular basemodel. Empirically derived corrections are only used by entities that have a need for accuracy beyond what can be provided by an Earth model.

Geometric Spreading - The decrease in signal amplitude as a wavefront expands away from its source that accounts for the increasing wavefront size.

Q (Quality Factor) - A parameter used to characterize intrinsic attenuation for signals propagating through a particular type of material. Q is inversely proportional to intrinsic attenuation. Strictly speaking, while Q does not include scattering attenuation, tomographic Q models generally include the effects of both scattering and intrinsic attenuation.

Signal Detection - A specific interval on a waveform marking the arrival of a signal of interest. Other portions of the waveform are noise.

Signal Detection Feature - A feature associated with a signal detection (e.g., arrival time, back azimuth, horizontal slowness, amplitude, frequency content).

Slowness - A measure of the inverse apparent velocity of a wave moving across the surface of the Earth at a station. The inverse of slowness is the apparent velocity of such a wave. Slowness is often used in phase identification and is sometimes used for determining event location.

Trace Velocity - The apparent horizontal velocity of a wave moving across a set of sensors (e.g., a seismic or infrasonic array).

IDC Specific:
None.

NOTES

General:
1. Although this Use Case does not store data, this Use Case maps to storage specifications because it creates data that are stored in other Use Cases. See 'System Detects Event' UC and 'Refines Event' UC.

2. The gravity model is expected to be included as part of the meteorological model.

IDC Specific:
None.

OPEN ISSUES

None.

IDC Use Case Report
UC-03.02 Refines Event

USE CASE DIAGRAM
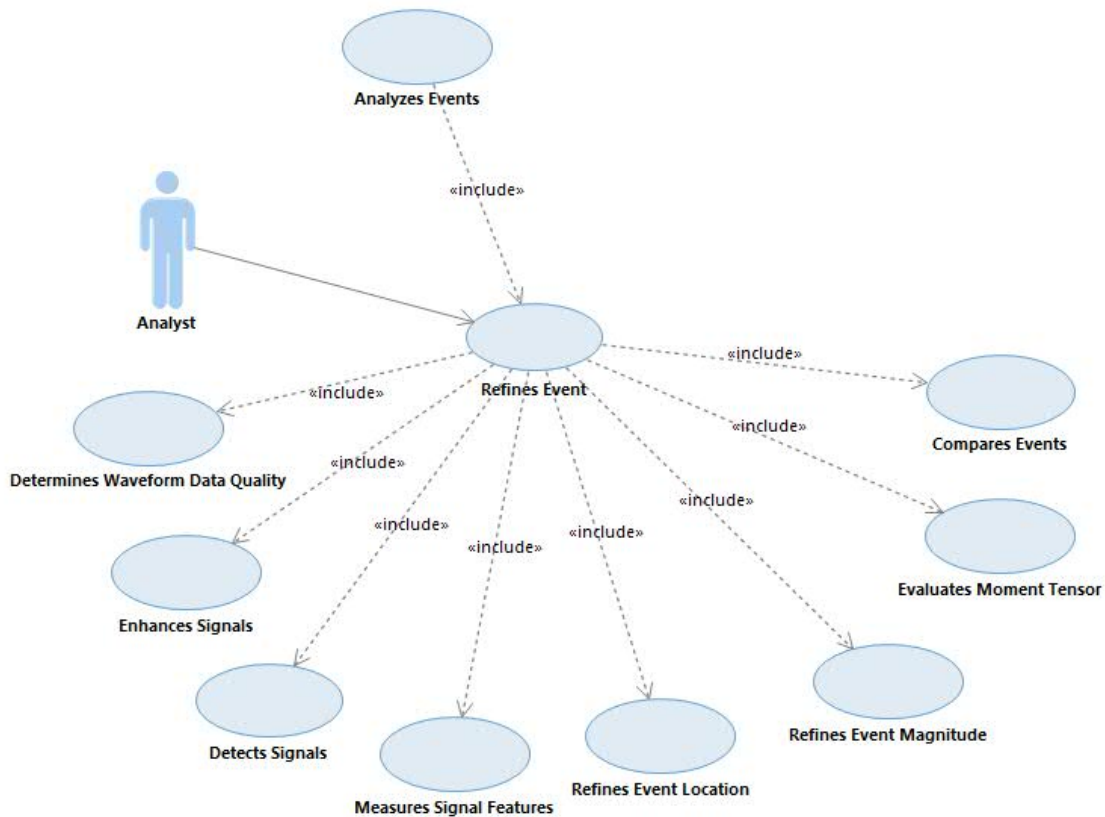
BRIEF DESCRIPTION

This architecturally significant use case describes how the Analyst refines an event hypothesis. The Analyst checks waveform quality (see 'Determines Waveform Data Quality' UC). For waveforms of sufficient quality, the Analyst enhances signals and suppresses noise on waveforms for relevant stations (see 'Enhances Signals' UC), adds and associates missing detections, and modifies or unassociates detections already associated with the event hypothesis (see 'Detects Signals' UC). The Analyst rejects event hypotheses that are invalid. For valid event hypotheses, the Analyst measures signal features associated with the detections (see 'Measures Signal Features' UC) and evaluates the moment tensor ('Evaluates Moment Tensor' UC). The Analyst uses these signal features to refine the location (see 'Refines Event Location' UC) and magnitude (see 'Refines Event Magnitude' UC) of the event hypothesis. The Analyst compares events to determine how similar events were constructed (see 'Compares Events' UC). The Analyst repeats these steps until satisfied with the results.

This use case is architecturally significant because it encompasses interaction between a large number of capabilities available to Analysis, including synchronized interaction among those capabilities, the Analyst ability to initiate automatic processing algorithms with overridden System parameters, and capture and display of provenance for Analyst actions.

ACTOR DESCRIPTIONS

Analyst - The Analyst is a System User who analyzes events. This actor includes all the traditional analysis roles. Any Analyst can access all System event analysis capabilities from a use case perspective. Individual analyst capabilities may be further specified by operations procedures.
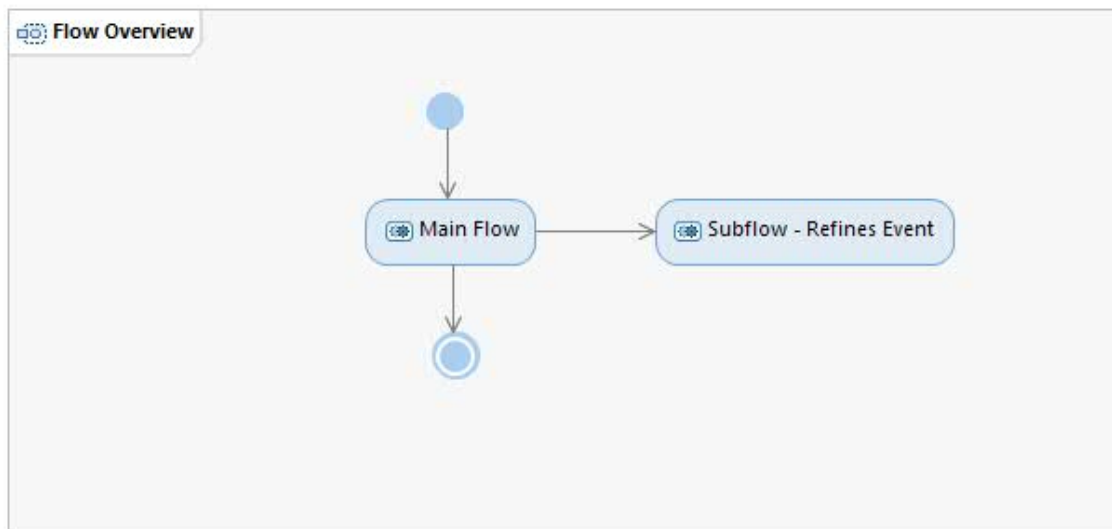
PRECONDITIONS

1. Analyst has selected an event, event set, or analysis time interval (see 'Selects Data for Analysis' UC).
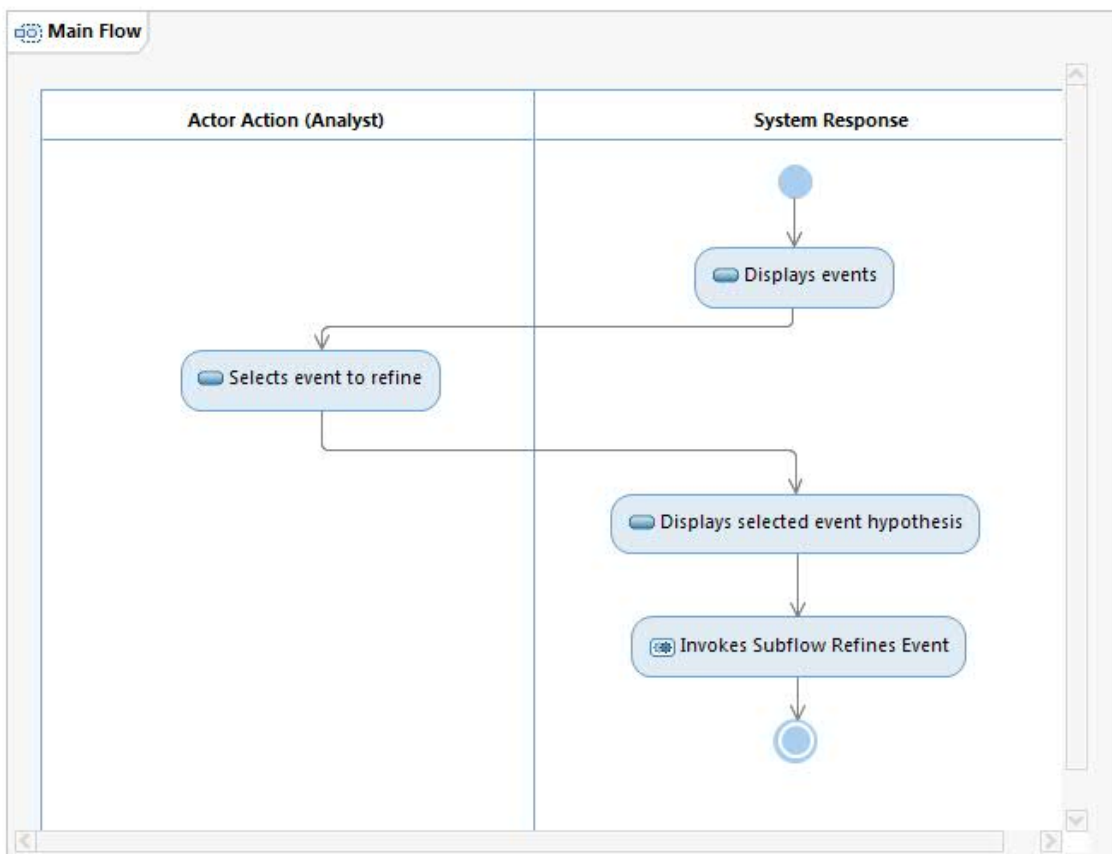
POSTCONDITIONS

1. Zero or more events have been updated in the System.

ACTIVITY DIAGRAMS

Flow Overview

Main Flow

Action Descriptions
Action: "Displays events"

The System displays either the events in the event set or analysis time interval selected by the Analyst (see 'Selects Data for Analysis' UC). One or more event hypotheses comprise a single event.

Action: "Selects event to refine"
The Analyst selects the event containing the event hypothesis to be refined.

Action: "Displays selected event hypothesis"
When an event hypothesis is selected for refinement, a new working version of that event hypothesis is created. The System displays the preferred event hypothesis for the selected event which includes waveforms associated with that event hypothesis, their related QC masks including mask types, predicted signal detections (including type of prediction: model or empirical), associated signal detections and their features, location (including location on a map), and magnitude. The System also displays additional information if available, including related events.

The System Maintainer configures which stations' waveform data are displayed in an analysis session by configuring whether or not the data are available to interactive processing, automated station processing, and/or automated network processing (see 'Configures Station Usage' UC). There are multiple levels of configuration available for data available to interactive processing:
- Default for interactive analysis: These are the default stations that are available for interactive analysis.
- Available for analysis: These are the stations that are available for interactive analysis in an "on-demand" mode.
- Limited analysis capability: These are the stations that are not configured for all levels of analysis (e.g., they might be available for viewing and adding signal detections but not configured for things like fk displays, coda mag calculations).

The data for stations that are configured as "Default for interactive analysis" are automatically displayed for the event hypothesis, including the station quality metrics for those stations. During interactive processing for this event hypothesis, the Analyst may load data from additional stations beyond those that are the default for interactive analysis (i.e., stations that are configured as "Available for analysis" or "Limited analysis capability"). Those stations' data will always be loaded with this event in the future.

Alternate Flows
1. Any Actor Action - The Analyst may choose to cancel, in which case this use case ends, and returns to the 'Analyzes Events' UC.

2. Action 'Displays selected event hypothesis' - The Analyst may open previous versions of the event hypothesis for the selected event if they do not wish to view the preferred event hypothesis (see 'Views Event History' UC).

3. Action 'Displays selected event hypothesis' - This action is an alternate entry point for this use case. When an Analyst builds a new event (see 'Builds New Event' UC) from unassociated detections, they enter this use case from this action.

Subflow - Refines Event

Subflow - Refines Event

Actor Action (Analyst)	System Response
Selects one of the following actions	Indicates event is being refined
a) Determines waveform data quality	Performs selected action
b) Enhances signals / suppresses noise	a) Invokes Use Case - Determines Waveform Data Quality
c) Adds/associates missing detections, modify or unassociate detections	b) Invokes Use Case - Enhances Signals
d) Measures signal features	c) Invokes Use Case - Detects Signals
e) Refines event hypothesis location	d) Invokes Use Case - Measures Signal Features
f) Refines event hypothesis magnitude	e) Invokes Use Case - Refines Event Location
g) Evaluates moment tensor	f) Invokes Use Case - Refines Event Magnitude
h) Compares events	g) Invokes Use Case - Evaluates Moment Tensor
i) Saves event hypothesis	h) Invokes Use Case - Compares Events
j) Adds a comment to the event hypothesis	i) Saves event hypothesis
k) Marks the event hypothesis as the preferred event hypothesis for this stage	j) Adds a comment to the event hypothesis
l) Rejects event	k) Marks the event hypothesis as the preferred event hypothesis for this stage
m) Adds event to an event catalog	l) Rejects event
n) Saves signal detection template for this event	m) Adds event to an event catalog
o) Creates a copy of this event	n) Saves signal detection template for this event
p) Views additional waveforms	o) Creates a copy of this event
	p) Displays additional waveforms
	Displays updates to event hypothesis

Done refining?
No / Yes

Action Descriptions
Action: "Indicates event is being refined"

The System prevents automatic processing while the event is being refined. The System will notify the Analyst if incoming data are relevant to the current event. The System will notify the Analyst if another Analyst wishes to modify the event currently being modified.

Action: "Selects one of the following actions"
When an event hypothesis is selected for refinement, a new working version of that event hypothesis is created.

Action: "i) Saves event hypothesis"
The System saves the current event hypothesis and all related information (associated signal detections and their feature measurements, location solutions, magnitude estimates). When the Analyst saves the event hypothesis, the System notifies the Analyst of any values that are no longer valid but automatically computes missing or invalid quantities that don't require Analyst input.

If saving an event would cause a conflict with another event, the System indicates that there is a conflict.

Action: "j) Adds a comment to the event hypothesis"
The System associates the Analyst's comment with this event hypothesis.

Action: "k) Marks the event hypothesis as the preferred event hypothesis for this stage"
The System marks the event hypothesis as the preferred event hypothesis for this event.

Action: "l) Rejects event"
The System designates the event as rejected to remove it from further automatic processing and to prevent the System from automatically creating a similar event in the future. The System preserves the rejected event's history, which includes event hypotheses and signal detection associations. The System makes the signal detections associated to the event's event hypotheses available for association to other event hypotheses. The rejected event can be reopened by an Analyst at a later time.

Action: "m) Adds event to an event catalog"
The System adds the event to an event catalog. This event will now be available as part of the event catalog.

Action: "n) Saves signal detection template for this event"
The System creates a signal detection template for this event. This signal detection template will be available to the Analyst.

Action: "o) Creates a copy of this event"
The System creates a copy of the current event and adds it to the list of events to be refined. Conflicts will exist between the event being refined and this newly created event since initially all signal detections will be shared. Once the Analyst has finished refining both the current event and the event that was created as a copy of the current event, no conflicts should exist.

Action: "p) Displays additional waveforms"
The System provides the Analyst with a way to read in and display data for more stations beyond the default set configured for interactive processing.

Action: "Displays updates to event hypothesis"
The System displays any changes made to the event hypothesis to the Analyst. This could include updating displays to indicate that certain values are no longer valid.

Alternate Flows
1. Any Actor Action except "Save event hypothesis" - The Analyst may undo/redo previous actions.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1157: [*Objective / Priority 2*] The System shall provide the Analyst the capability to view newly acquired waveform data within 1 minute of acquisition.

S-1296: [*Threshold*] The System shall store the processing time period(s) during which each Waveform QC Mask was applied to the underlying waveform data.

S-1297: [*Threshold*] The System shall store the Waveform QC Masks applied to the waveform data used for each waveform processing operation.

S-1298: [*Threshold*] The System shall store the channel masked by each Waveform QC Mask.

S-1299: [*Threshold*] The System shall store the identity of the user or processing stage creating each Waveform QC Mask.

S-1300: [*Threshold*] The System shall store the identity of the user or processing stage modifying each Waveform QC Mask.

S-1301: [*Threshold*] The System shall store the identity of the user or processing stage removing each Waveform QC Mask.

S-1302: [*Threshold*] The System shall store the time of each Waveform QC Mask creation.

S-1303: [*Threshold*] The System shall store the time of each Waveform QC Mask removal.

S-1304: [*Threshold*] The System shall store the time of each Waveform QC Mask modification.

S-1306: [*Threshold*] The System shall store the Analyst's rationale for creating a Waveform QC Mask.

S-1307: [*Threshold*] The System shall store the Analyst's rationale for modifying a Waveform QC Mask.

S-1308: [*Threshold*] The System shall store the Analyst's rationale for removing a Waveform QC Mask.

S-1386: [*Threshold*] The System shall store the beam definition parameters for all beams.

S-1393: [*Threshold*] The System shall store all derived channels related to one or more signal detections.

S-1394: [*Threshold*] The System shall store derived waveform data with no related signal detections for the Operational Processing Time Period.

S-1421: [*Threshold*] The System shall store all signal detections.

S-1438: [*Threshold*] The System shall store time domain measurements.

S-1450: [*Threshold*] The System shall store polarization feature measurements.

S-1465: [*Threshold*] The System shall store frequency domain waveform measurements.

S-1486: [*Threshold*] The System shall store fk spectra measurements.

S-1532: [*Threshold*] The System shall provide the Analyst the capability to reject an event hypothesis.

S-1574: [*Threshold*] The System shall provide the System User the capability to view station quality metrics.

S-1576: [*Threshold*] The System shall store the station quality metrics for all stations for each event hypothesis.

S-1580: [*Threshold*] The System shall recompute the event hypothesis quality metric for an event hypothesis when any of the event hypothesis quality statistics used to calculate the event hypothesis quality metric are updated.

S-1586: [*Threshold*] The System shall provide the Analyst the capability to view event hypothesis quality metrics.

S-1588: [*Threshold*] The System shall store the event quality metric for each event hypothesis.

S-1616: [*Threshold*] The System shall provide the Analyst the capability to designate the preferred event hypothesis for each event.

S-1618: [*Threshold*] The System shall store up to 300 unique event hypotheses for each event.

S-1619: [*Threshold*] The System shall store the confidence level of each computed event hypothesis location uncertainty bound.

S-1620: [*Threshold*] The System shall store the type (i.e., confidence, coverage, or k-weighted with the associated weights) of each location uncertainty bound.

S-1621: [*Threshold*] The System shall store modeling uncertainties for model based predictions of signal detection measurements.

S-1622: [*Threshold*] The System shall store uncertainties for observed signal detection measurements.

S-1623: [*Threshold*] The System shall store the sum squared weighted residual for each event hypothesis location.

S-1624: [*Threshold*] The System shall store the defining/non-defining state for each signal detection measurement associated to a stored event hypothesis.

S-1625: [*Threshold*] The System shall store a preferred event hypothesis for each event for each processing stage.

S-1626: [*Threshold*] The System shall store the processing stage during which each event hypothesis location was created.

S-1627: [*Threshold*] The System shall store the processing stage during which an event hypothesis is modified.

S-1628: [*Threshold*] The System shall store the processing stage that rejected an event.

S-1644: [*Threshold*] The System shall provide the Analyst the capability to manually align waveforms.

S-1645: [*Threshold*] The System shall provide the Analyst the capability to align waveforms based on travel time differences.

S-1646: [*Threshold*] The System shall provide the Analyst the capability to align waveforms based on optimal lag calculated by waveform cross correlation.

S-1663: [*Threshold*] The System shall store uncertainties for all event hypothesis magnitude estimates.

S-1664: [*Threshold*] The System shall store each single station magnitude estimate for each event hypothesis.

S-1665: [*Threshold*] The System shall store each network magnitude estimate for each event hypothesis.

S-1666: [*Threshold*] The System shall store the defining/non-defining state for each station magnitude associated to a stored event hypothesis.

S-1711: [*Objective / Priority 1*] The System shall store the type of ground motion used by moment tensor calculations.

S-1712: [*Objective / Priority 1*] The System shall store the filter applied to observed and synthetic waveforms when computing moment tensor solutions.

S-1713: [*Objective / Priority 1*] The System shall store the Green functions used to compute a moment tensor solution.

S-1714: [*Objective / Priority 1*] The System shall store the Earth models used to compute a moment tensor solution.

S-1715: [*Objective / Priority 1*] The System shall store the elements of moment tensor solutions.

S-1716: [*Objective / Priority 1*] The System shall store the percentage of deviatoric moment tensor solutions belonging to the double couple components.

S-1717: [*Objective / Priority 1*] The System shall store the double couple fault plane solution computed from a moment tensor solution.

S-1718: [*Objective / Priority 1*] The System shall store the scalar seismic moment computed from a moment tensor solution.

S-1719: [*Objective / Priority 1*] The System shall store the station specific goodness of fit between theoretical and observed waveforms for moment tensor solutions.

S-1735: [*Objective / Priority 1*] The System shall store the ε value computed for moment tensor solutions.

S-1736: [*Objective / Priority 1*] The System shall store the k value computed for moment tensor solutions.

S-1737: [*Objective / Priority 1*] The System shall store the uncertainty bounds on ε and k computed for moment tensor solutions.

S-1738: [*Objective / Priority 1*] The System shall store the confidence level of uncertainty bounds on ε and k computed for moment tensor solutions.

S-1816: [*Threshold*] The System shall store the earth model and version used to compute an earth model prediction.

S-1817: [*Threshold*] The System shall store the corrections applied to earth model predictions.

S-1818: [*Threshold*] The System shall store the correction surface used to correct an earth model prediction.

S-1819: [*Threshold*] The System shall store the predicted slowness computed from a basemodel.

S-1820: [*Threshold*] The System shall store the uncertainties of a predicted slowness computed using a basemodel.

S-1821: [*Threshold*] The System shall store the predicted azimuths computed using a phase-specific basemodel.

S-1822: [*Threshold*] The System shall store the uncertainties of predicted azimuths computed using a basemodel.

S-1823: [*Threshold*] The System shall store the predicted travel-times computed from a basemodel.

S-1824: [*Threshold*] The System shall store the uncertainties of predicted travel-times computed using a basemodel.

S-1842: [*Threshold*] The System shall store predicted amplitude attenuation.

S-1843: [*Threshold*] The System shall store predicted amplitude attenuation uncertainties.

S-1876: [*Threshold*] The System shall notify Analysts working in a common processing stage if they are concurrently modifying event hypotheses for an event.

S-1877: [*Threshold*] The System shall notify Analysts working in a common processing stage if they are concurrently modifying signal detections in the same analysis time interval.

S-1878: [*Threshold*] The System shall provide the Analyst the capability to access and view all waveform data stored on the System.

S-1885: [*Threshold*] The System shall display 24 hours of continuous waveform data before the waveform displays flatline.

S-1915: [*Threshold*] The System shall provide the Analyst the capability to process data without altering another Analyst's existing solution.

S-1917: [*Threshold*] The System shall provide the Analyst the capability to add or remove an event from an event catalog.

S-1920: [*Threshold*] The System shall provide the Analyst the capability to view any saved event hypothesis.

S-1921: [*Threshold*] The System shall provide the Analyst the capability to enter comments for an event hypothesis.

S-1922: [*Threshold*] The System shall provide the Analyst the capability to view comments for an event hypothesis.

S-1927: [*Threshold*] The System shall provide the Analyst the capability to select signal detections as processing input based on a time interval for an entire network during an analysis session.

S-1928: [*Threshold*] The System shall provide the Analyst the capability to select signal detections as processing input based on a time interval for a selected subset of stations during an analysis session.

S-1929: [*Threshold*] The System shall provide the Analyst the capability to individually select signal detections as processing input during an analysis session.

S-1930: [*Threshold*] The System shall provide the Analyst the capability to store new event hypotheses created during interactive processing.

S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface Guidelines.

S-1967: [*Threshold*] The System shall store results from all stages of data processing.

S-1985: [*Threshold*] The System shall provide the System User the capability to view event hypothesis data on an interactive map.

S-1996: [*Threshold*] The System shall provide the System User the capability to access geospatial data.

S-2042: [*Threshold*] The System shall store automatic and interactive processing parameters in the database.

S-2043: [*Threshold*] The System shall store automatic and interactive processing results.

S-2044: [*Threshold*] The System shall store the relation of processing results to processing parameters in the database.

S-2164: [*Threshold*] The System shall access requested waveform data within one (1) minute of receipt by the Data Processing Partition.

S-2167: [*Threshold*] The System shall write a 6 hour or less time block of 40Hz waveform data within the Operational Processing Time Period with a maximum 5 second latency. (Goal: 1 second.)

S-2168: [*Threshold*] The System shall read a 6 hour or less time block of 40Hz waveform data outside the Operational Processing Time Period with a maximum 10 second latency. (Goal: 2 seconds.)

S-2169: [*Threshold*] The System shall read a 6 hour or less time block of 40Hz waveform data within the Operational Processing Time Period with a maximum 5 second latency. (Goal: 1 second.)

S-2170: [*Threshold*] The System shall write a 6 hour or less time block of 40Hz waveform data outside the Operational Processing Time Period with a maximum 10 second latency. (Goal: 2 seconds.)

S-2223: [*Threshold*] The System shall store all data and derived processing results to persistent storage as soon as the data and/or derived processing results are available.

S-2417: [*Threshold*] The System shall store hydroacoustic signal detection groups

S-2603: [*Threshold*] The System shall provide the System User the capability to access requested waveform data.

S-2604: [*Threshold*] The System shall provide the Analyst the capability to access late-arriving waveform data within one (1) minute of receipt by the Data Processing Partition.

S-3025: [*Threshold*] The System shall provide the Analyst the capability to create a signal detection template from an existing event.

S-5708: [*Threshold*] The System shall read a 6 hour or less time block of processing results within the Operational Processing Time Period with a maximum 5 second latency. (Goal: 1 second.)

S-5709: [*Threshold*] The System shall write a 6 hour or less time block of processing results within the Operational Processing Time Period with a maximum 5 second latency. (Goal: 1 second.)

S-5712: [*Threshold*] The System shall read a 6 hour or less time block of processing results outside the Operational Processing Time Period with a maximum 10 second latency. (Goal: 2 seconds.)

S-5713: [*Threshold*] The System shall write a 6 hour or less time block of processing results from outside the Operational Processing Time Period with a maximum 10 second latency. (Goal: 2 seconds.)

S-5715: [*Threshold*] The System shall store wind velocity (including uncertainty) computed from meteorological models.

S-5716: [*Threshold*] The System shall store temperature (including uncertainty) computed from meteorological models.

S-5717: [*Extensibility*] The System shall store gravity wave corrections to temperature predictions.

S-5720: [*Threshold*] The System shall store spectrograms.

S-5722: [*Threshold*] The System shall store power spectral density.

S-6469: [*Threshold*] The System shall store detection feature maps.

IDC Specific:
S-5612: [*IDC only, Threshold*] The System shall provide the Analyst the capability to request auxiliary seismic waveform data from the Data Acquisition Partition.

S-5795: [*IDC only, Threshold*] The System shall compute Event Consistency checks when an event hypothesis is saved.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Analysis Time Interval - The time interval bounding the data reviewed by an analyst. Those data include waveforms, event hypotheses and their associated signal detections, and unassociated signal detections.

Event - The estimate by the System or Analyst of the occurrence of some transient source of energy within the Earth's body, oceans, or atmosphere that can be detected by seismic, hydroacoustic, and/or infrasonic sensors. For the same event, many different event hypotheses may be created at different processing stages. One of these event hypotheses must be designated as preferred.

Event Catalog - A named collection of events.

Event Hypothesis - A proposed solution for an Event. Each event consists of a sequence of event hypotheses that describe an evolution to a final best model of the event. Each event hypothesis is composed of a set of associated signal detections and has one or more event hypothesis location solutions, one of which must be designated as preferred.

Event Set - The set of one or more event hypotheses that an analyst selects for analysis.

Signal Detection Template - The set of signal detections associated with an event. The relative timing of the signal detections is indicative of the location of the event. Shifting the timing of a signal detection template, and matching it with signal detections on current waveforms, can help determine whether a similar event has occurred, and aid in identifying and associating signal detections to existing events. These templates can be particularly helpful for building events in an aftershock or swarm sequence.

IDC Specific:
None.

NOTES

General:
1. If new data becomes available that are relevant to the event being analyzed, the Analyst will be notified and provided with the option to load in this data.

2. Most of the items mentioned in storage specs mapped to this use case are created in the children to the 'System Detects Events' UC.

3. Use cases invoked by this use case are responsible for computing quality metrics.

IDC Specific:
1. The Analyst can request seismic waveform data from auxiliary stations from the Data Acquisition Partition.

2. The System will assess event consistency when an event is saved (see ' System Assesses Event Consistency' UC).
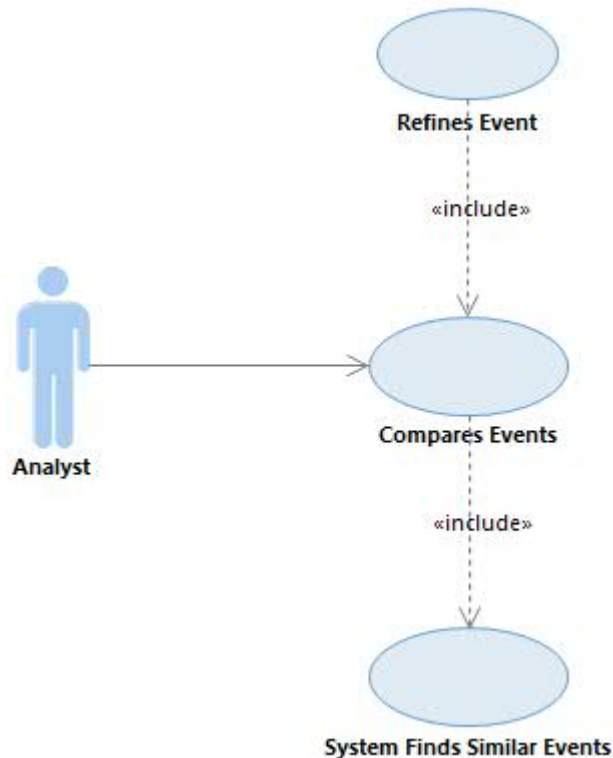
OPEN ISSUES

None.

UC-03.02.08 Compares Events

USE CASE DIAGRAM

BRIEF DESCRIPTION

This architecturally significant use case describes how the Analyst compares events to determine how similar events were constructed. The Analyst compares waveforms from comparison events by visually inspecting an overlay of the waveforms to determine if the events are from a similar source. The Analyst searches for comparison events or creates agglomerative hierarchical clusters of waveforms from events (see 'System Finds Similar Events' UC) and determines that the events are from a similar source if the correlation coefficient is above a selected threshold.

This use case is architecturally significant because it provides a capability to view and compare the analysis and provenance of multiple events.

ACTOR DESCRIPTIONS

Analyst - The Analyst is a System User who analyzes events. This actor includes all the traditional analysis roles. Any Analyst can access all System event analysis capabilities from a use case perspective. Individual analyst capabilities may be further specified by operations procedures.
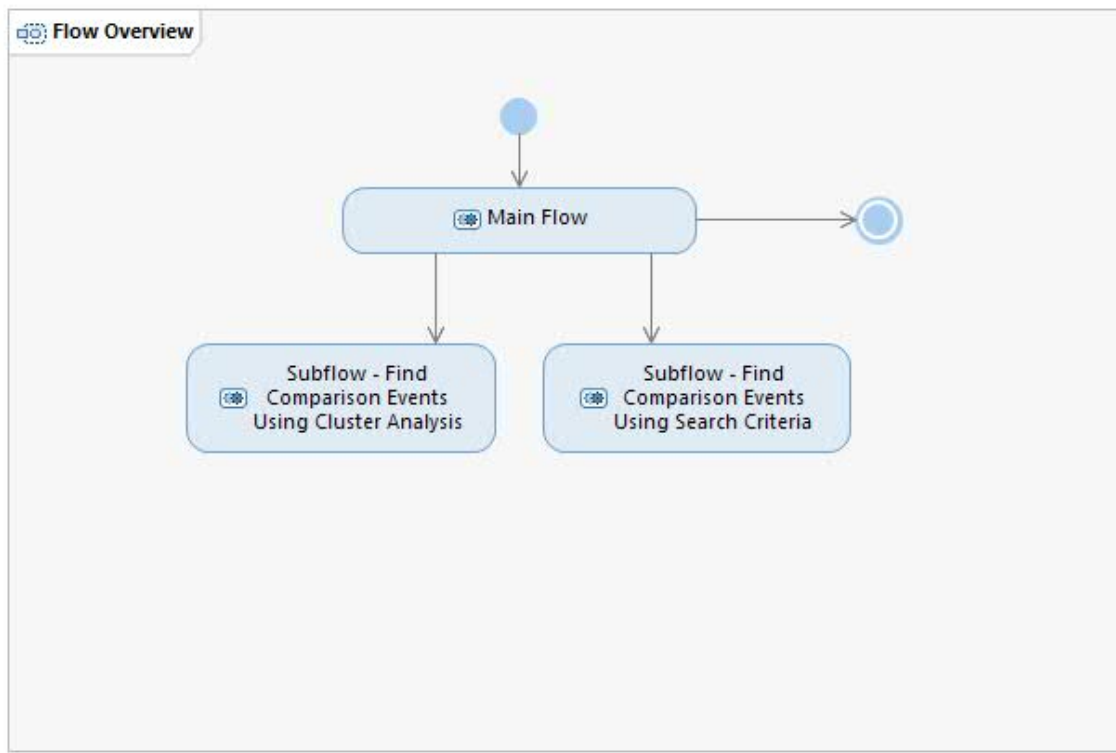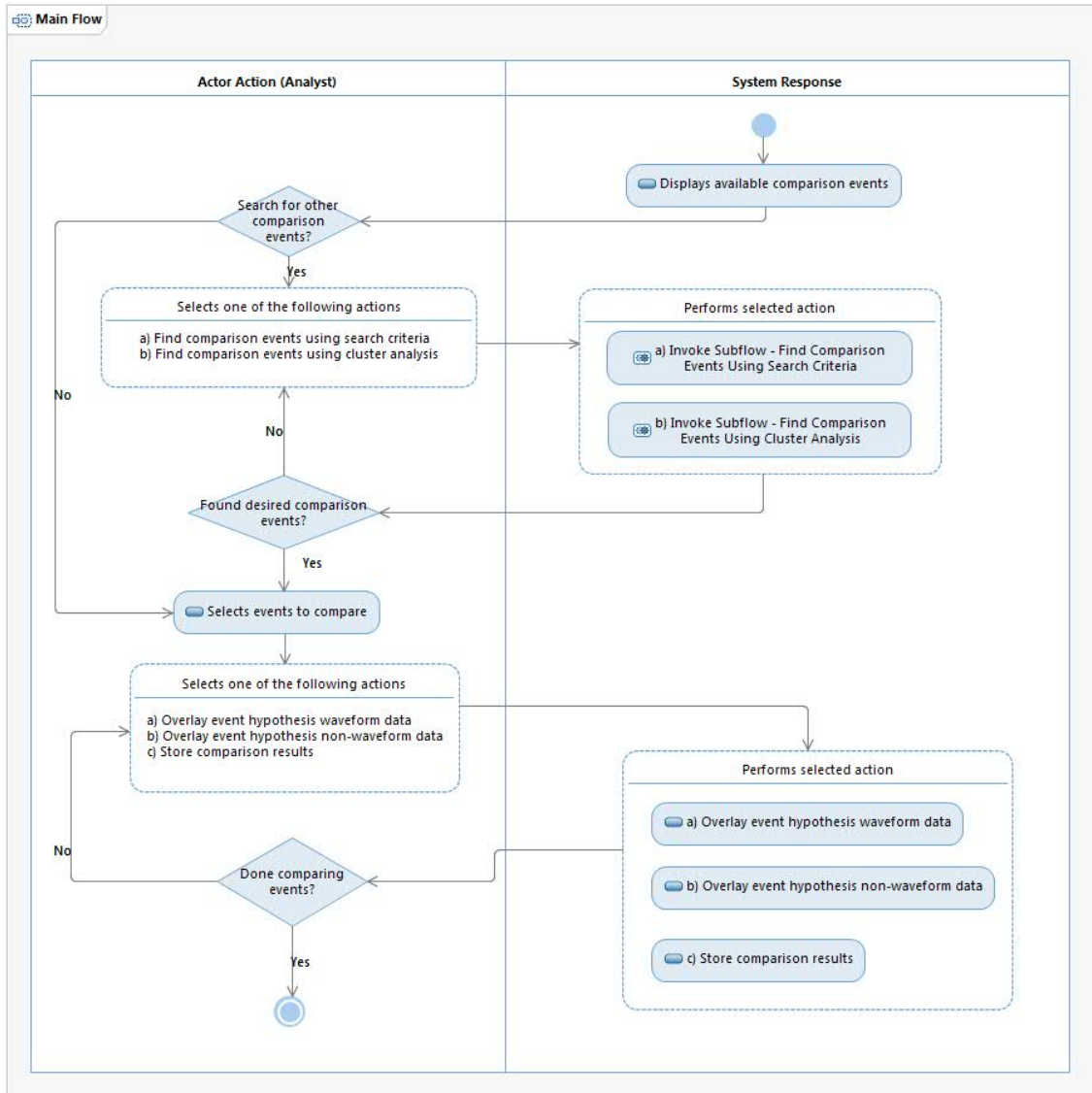
PRECONDITIONS

None.

POSTCONDITIONS

1. The System may store comparison results associated to the event being refined.

ACTIVITY DIAGRAMS

Flow Overview

Main Flow

Main Flow

Actor Action (Analyst)	System Response

Displays available comparison events

Search for other comparison events?
Yes / No

Selects one of the following actions
a) Find comparison events using search criteria
b) Find comparison events using cluster analysis

Performs selected action
a) Invoke Subflow - Find Comparison Events Using Search Criteria
b) Invoke Subflow - Find Comparison Events Using Cluster Analysis

Found desired comparison events?
No / Yes

Selects events to compare

Selects one of the following actions
a) Overlay event hypothesis waveform data
b) Overlay event hypothesis non-waveform data
c) Store comparison results

Performs selected action
a) Overlay event hypothesis waveform data
b) Overlay event hypothesis non-waveform data
c) Store comparison results

Done comparing events?
No / Yes

Action Descriptions

Initial Action

This use case begins when the Analyst selects to compare the event currently being analyzed to other events.

Action: "Displays available comparison events"

The System displays comparison events available for the current event. Comparison events are events that are similar to the event being analyzed. If the event was built using waveform correlation, the System displays the events that drove event creation. If the event was built using signal detections, the System displays past events that are similar to the event (e.g., events within a lat/lon box centered on the event within a given magnitude range) or similar events added to an event catalog.

Action: "Performs selected action"

The number of comparison events is limited by the data available to be searched. (For example, if this use case is being run on the standalone system, the number of comparison events available is limited by the data available on the standalone system.)

Action: "a) Invoke Subflow - Find Comparison Events Using Search Criteria"
The System searches for events that might be similar enough to compare to the current event.

Action: "b) Invoke Subflow - Find Comparison Events Using Cluster Analysis"
The System creates clusters of events in order to determine which events might be similar enough to compare to the current event.

Action: "a) Overlay event hypothesis waveform data"
The System overlays selected waveforms (including pre-processing information and signal enhancement operations for those waveforms) and waveform features (e.g., signal detections) for the event hypothesis.

Action: "b) Overlay event hypothesis non-waveform data"
The System overlays non-waveform data for the selected event hypothesis.

Action: "c) Store comparison results"
The System stores the comparison results for later use (event history, including in a report, etc.)
Comparison results include:
- Events that are similar to each other
- Correlation coefficients for those similar events
- Information regarding how events were built in the past (e.g., stations used, signal detections, filters)

Alternate Flows
1. Any Actor Action - The Analyst may choose to cancel, in which case this use case ends, and returns to the 'Refines Event' UC.

Subflow - Find Comparison Events Using Search Criteria
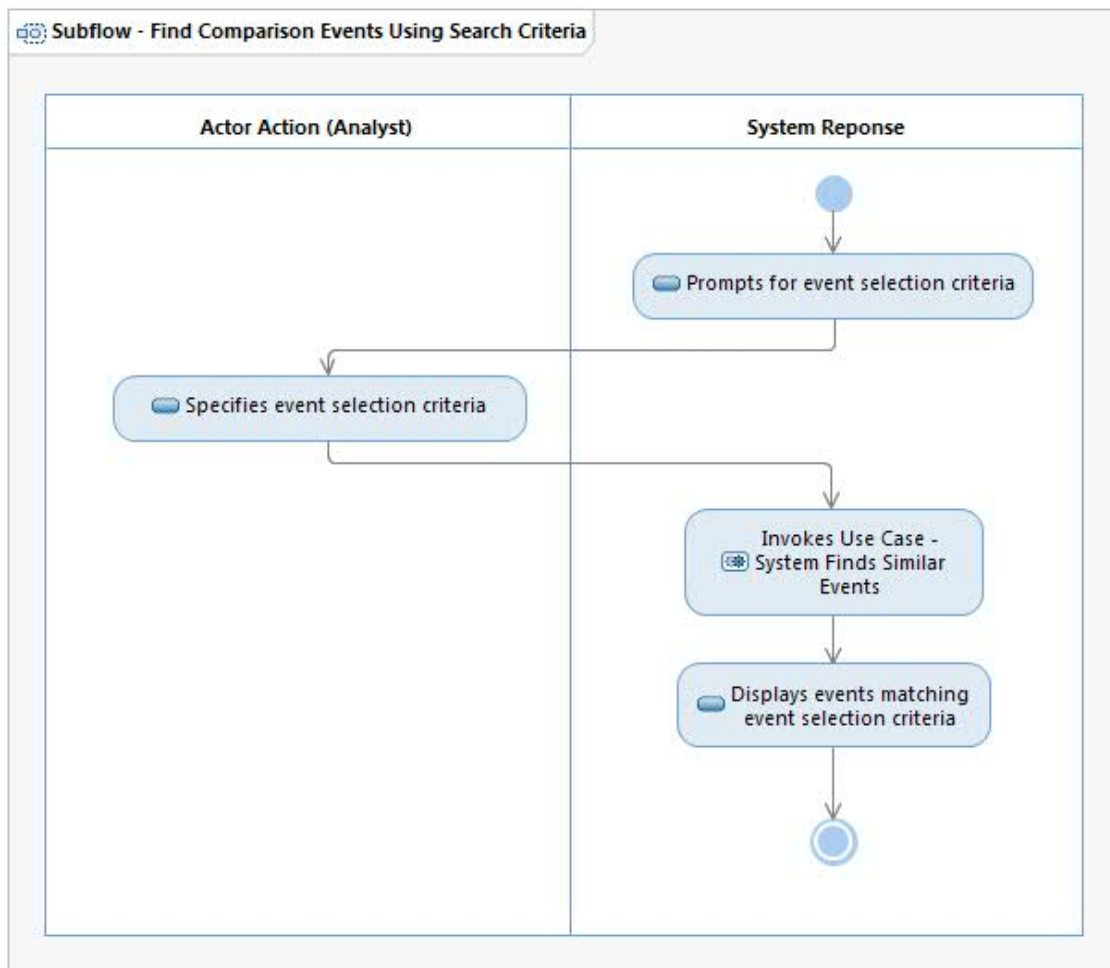
Action Descriptions
Action: "Specifies event selection criteria"
This search criteria could include:
- Unique event identifier(s) (perhaps from cluster analysis results)
- Past events selected from a map
- Past events selected from events added to an event catalog
- Other event selection criteria (e.g., magnitude range, date/time)
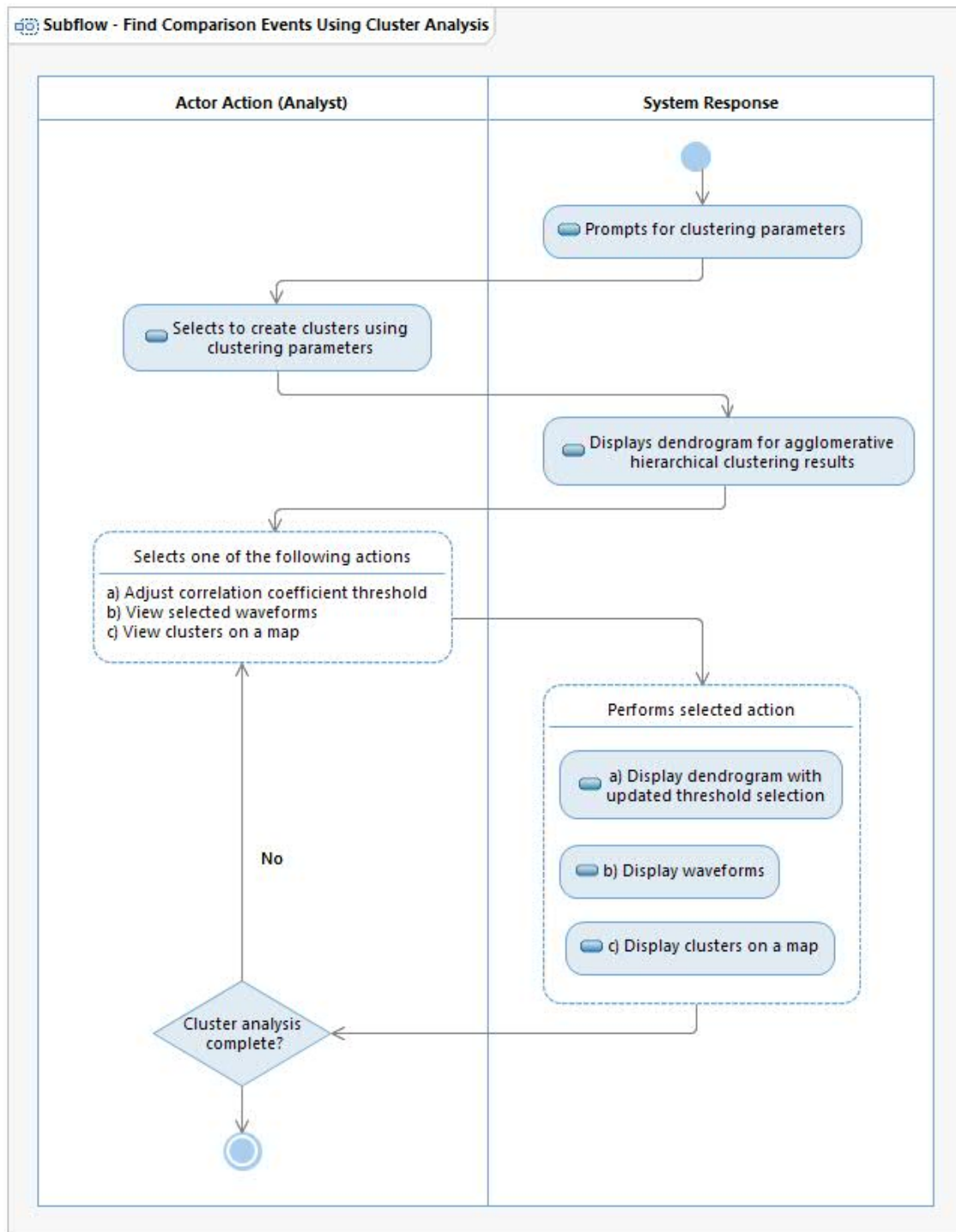- Predefined set of events

Action: "Displays events matching event selection criteria"
The System displays the event data requested by the Analyst.

Alternate Flows
None.

Subflow - Find Comparison Events Using Cluster Analysis

Action Descriptions
Action: "Selects to create clusters using clustering parameters"
Clustering parameters include:
- Waveform data to cluster (including selection of source of events used to define waveforms)
- Waveform processing options

- Correlation Options (e.g., channels to use, how to merge results)
- Clustering Options (e.g., weights, clustering distance algorithms)

Action: "Displays dendrogram for agglomerative hierarchical clustering results"
The System displays a dendrogram for waveform clusters. Each waveform cluster contains waveforms with a correlation coefficient (a similarity measure) at or above a user-specified threshold.

Action: "a) Display dendrogram with updated threshold selection"
The System updates the dendrogram display to reflect adjustments to threshold.

Action: "b) Display waveforms"
The System displays waveforms grouped such that they correspond to how waveforms are displayed in the dendrogram either by ordering or color coding or some other visual grouping technique.

Action: "c) Display clusters on a map"
The System displays the representative location for each cluster on a map.

Alternate Flows
None.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1643: [*Threshold*] The System shall provide the Analyst the capability to map signal detections and their phase assignments from one channel to another channel.

S-1644: [*Threshold*] The System shall provide the Analyst the capability to manually align waveforms.

S-1645: [*Threshold*] The System shall provide the Analyst the capability to align waveforms based on travel time differences.

S-1646: [*Threshold*] The System shall provide the Analyst the capability to align waveforms based on optimal lag calculated by waveform cross correlation.

S-1889: [*Objective / Priority 1*] The System shall provide the Analyst the capability to overlay waveforms with other waveforms.

S-1916: [*Threshold*] The System shall provide the Analyst the capability to select and retrieve an event and associated waveform data from an event catalog.

S-1918: [*Threshold*] The System shall provide the Analyst the capability to view a list of events from an event catalog.

S-1934: [*Threshold*] The System shall create agglomerative hierarchical clusters of sets of waveforms based on the maximum cross correlation coefficient of each pair of waveforms in the set.

S-1935: [*Threshold*] The System shall use the agglomerative hierarchical clustering distance algorithms while agglomerative hierarchical clustering.

S-1936: [*Threshold*] The System shall automatically choose a correlation threshold value to determine clusters when forming a dendrogram.

S-1938: [*Threshold*] The System shall provide the Analyst the capability to view the results of correlation analysis in a dendrogram.

S-1939: [*Threshold*] The System shall provide the Analyst the capability to select the weights used by the general weighted distance clustering algorithm.

S-1940: [*Threshold*] The System shall provide the Analyst the capability to select the agglomerative hierarchical clustering distance algorithm to use in agglomerative hierarchical clustering.

S-1941: [*Threshold*] The System shall provide the Analyst the capability to select the set of waveforms to use in agglomerative hierarchical clustering.

S-1942: [*Threshold*] The System shall provide the Analyst the capability to select the threshold value used in hierarchical clustering.

S-1943: [*Threshold*] The System shall provide the Analyst the capability to select the agglomerative hierarchical clustering threshold selection algorithm to use in agglomerative hierarchical clustering.

S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface Guidelines.

S-2040: [*Threshold*] The System shall provide the System User the capability to retrieve stored processing results from computations.

S-2043: [*Threshold*] The System shall store automatic and interactive processing results.

S-2223: [*Threshold*] The System shall store all data and derived processing results to persistent storage as soon as the data and/or derived processing results are available.

S-2358: [*Threshold*] The System shall provide the Analyst the capability to select the dynamic waveform correlation search parameters the System uses to find previously analyzed event hypotheses occurring at locations near an event hypothesis.

S-5621: [*Threshold*] The System shall by default invoke the same algorithms during interactive processing as those used in automated processing.

IDC Specific:
None.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Agglomerative Hierarchical Clustering - A method to find clusters of similar individuals within a population. The population is the set of waveforms recorded at a single station for a set of events and the measure of similarity is correlation coefficient. Agglomerative hierarchical clustering iteratively clusters waveforms into a single tree-like structure called a dendrogram. For more information on the agglomerative hierarchical clustering algorithm, see the book Cluster Analysis, by Everitt et al.

Correlation Coefficient - A measure of similarity between two waveforms. The absolute value of the correlation coefficient ranges from 0 (no similarity) to 1 (a perfect match). Formally, the correlation coefficient for two entities is the covariance divided by the square root of the product of the variances. For waveforms, this is the cross-correlation of the two waveforms, divided by the square root of the product of the auto-correlations.

Reference Event - An event recognized by an analyst as containing unique or important characteristics that may help in the analysis of future events that are related. For example, a nuclear test could be designated as a reference event for any subsequently detected nearby events thought to be tests.

IDC Specific:
None.

NOTES

General:
1. Comparing bulletins is covered in the 'Analyzes Mission Performance' UC.
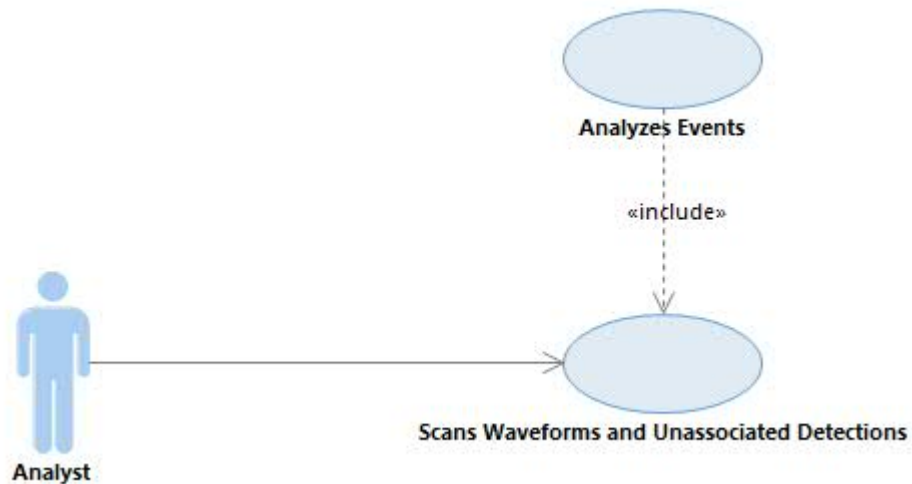
IDC Specific:
None.

OPEN ISSUES

None.

IDC Use Case Report
UC-03.03 Scans Waveforms and Unassociated Detections

USE CASE DIAGRAM

BRIEF DESCRIPTION

This architecturally significant use case describes how the Analyst scans waveforms and detection feature maps to find signal detections missed by prior processing. The Analyst scans unassociated signal detections to find signal detections that should be associated to existing event hypotheses (see 'Detects Signals' UC) and to build new events (see 'Builds Event' UC). The Analyst saves unassociated signal detections.

This use case is architecturally significant because it requires a platform for the Analyst to efficiently review large amounts of sensor data in order to evaluate, correct, and improve signal detection and event formation.

ACTOR DESCRIPTIONS

Analyst - The Analyst is a System User who analyzes events. This actor includes all the traditional analysis roles. Any Analyst can access all System event analysis capabilities from a use case perspective. Individual analyst capabilities may be further specified by operations procedures.
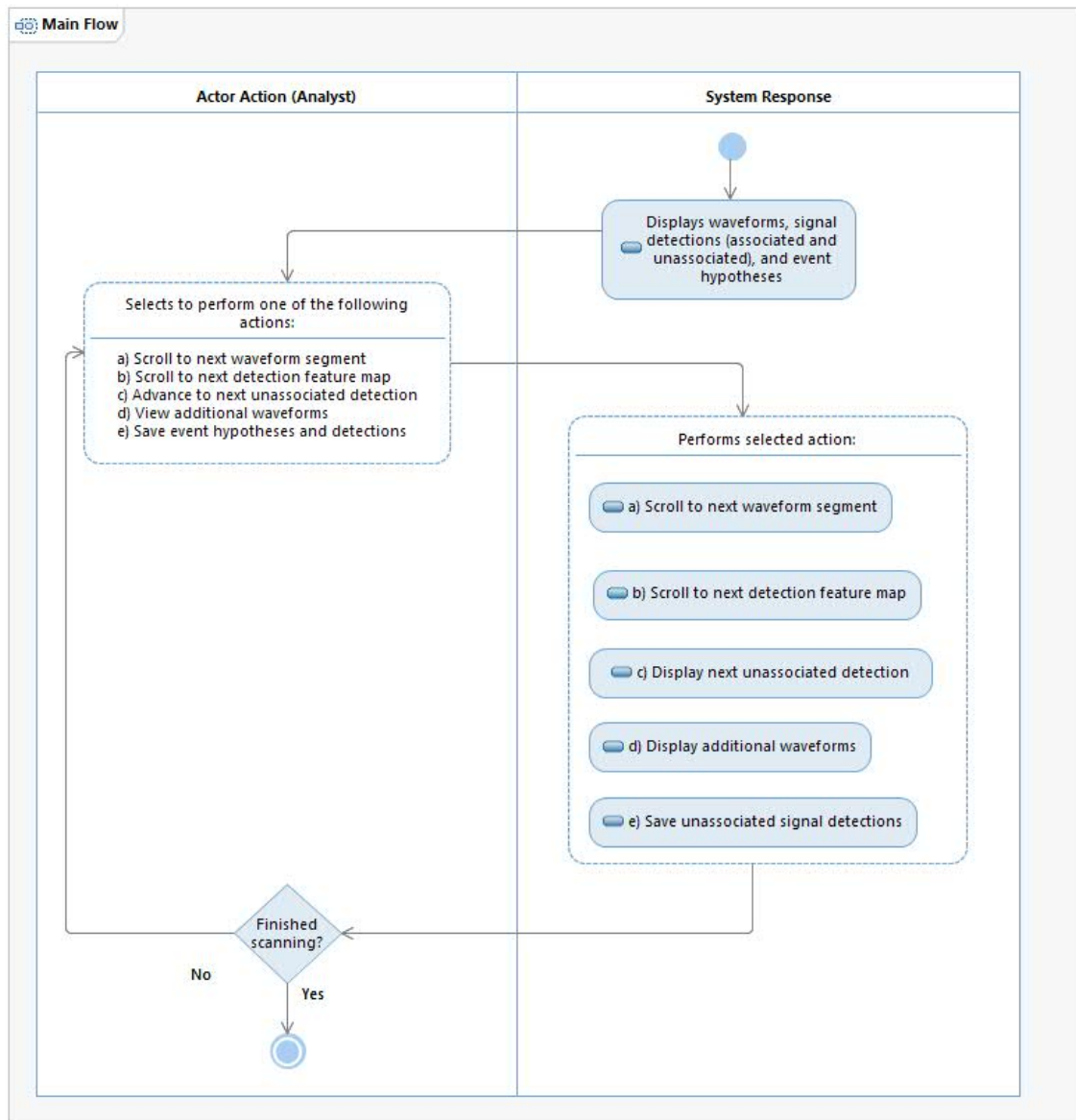
PRECONDITIONS

1. The Analyst has invoked the "Selects Data for Analysis" UC to select an Analysis Time Interval.

POSTCONDITIONS

None.

ACTIVITY DIAGRAMS

Main Flow

Action Descriptions

Action: "Displays waveforms, signal detections (associated and unassociated), and event hypotheses"

The System displays waveforms configured by the System Maintainer as default for interactive analysis (see 'Configures Station Usage' UC), signal detections, and event hypotheses occurring in the selected time interval. Waveforms in the display might be limited based on the loaded Analysis Time Interval or the type of scan the Analyst is performing (e.g., limited by a

geographic region). If the Analyst is scanning unassociated signal detection the System displays the first unassociated signal detection.

Action: "a) Scroll to next waveform segment"
The System scrolls to the next time segment and displays the waveforms, signal detections, and event hypotheses in that time segment. The System updates the processing stage workflow status to indicate the Analyst is actively reviewing the waveforms and signal detections in the visible time segment.

Action: "c) Display next unassociated detection"
The System advances the selected unassociated signal detection to the next unassociated signal detection.

Action: "d) Display additional waveforms"
When the Analyst selects to view additional waveforms the System displays which station's waveform data can be loaded into the scan and whether the data are configured as "available for analysis" or with "limited analysis capability". The System displays any waveforms selected by the Analyst. The System Maintainer configures waveform data from each station as either default for interactive analysis, available for interactive analysis, or available for limited analysis (see 'Configures Station Usage' UC).

Action: "e) Save unassociated signal detections"
The System saves new versions of any signal detections or event hypotheses the Analyst has modified since the most recent save. If any of the saved signal detections are made on waveforms that have not been saved the System also saves those waveforms. The System saves the event hypotheses, signal detections, and waveforms without overwriting or modifying values previously written by other Analysts or by pipeline processing. The System notifies the Analyst of any invalid values (e.g., a magnitude estimate that has not been updated since the event hypothesis was relocated), and automatically computes any missing or invalid quantities that don't require Analyst input. The System updates the processing stage workflow status to display the new event hypotheses created by the Analyst while performing the scanning activity. The System indicates the Analyst is reviewing the new event hypotheses.

Decision: "Finished scanning?"
When the Analyst has finished the scanning activity the System updates the processing stage workflow status to indicate the Analyst is no longer actively reviewing the waveforms and signal detections in the time interval. Additionally, the System updates the workflow display to reflect the change in analysis status (i.e., new, rejected, or modified) for any event hypotheses the Analyst created or modified in this UC.

Alternate Flows
1. Any Actor Action - The Analyst may choose to cancel, in which case the time interval is made available (if previously reserved) and this use case ends, and returns to the 'Analyzes Events' UC.

2. Any Actor Action - The Analyst may undo previous actions.

3. Action "Displays waveforms, signal detections (associated and unassociated), and event hypotheses" – The System may acquire waveform data while the Analyst is scanning waveforms and unassociated detections. The System notifies the Analyst if the acquired waveform data overlaps the time interval being scanned and provides the Analyst the capability to load and scan this data.

4. Action "Displays waveforms, signal detections (associated and unassociated), and event hypotheses" – Another Analyst may create a signal detection while the Analyst is scanning waveforms and unassociated detections. The System notifies the Analyst if the signal detection occurs in the time interval being scanned and provides the Analyst the capability to load and scan this data.

5. Action "Save unassociated signal detections" – The Analyst may choose to save derived waveforms that do not contain any signal detections. The System will not delete these saved waveforms after the operational processing time period. After the System saves the Analyst's selected waveform this use case continues.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1157: [*Objective / Priority 2*] The System shall provide the Analyst the capability to view newly acquired waveform data within 1 minute of acquisition.

S-1373: [*Threshold*] The System shall provide the Analyst the capability to view continuous beams for virtual event hypotheses for predefined geographic regions.

S-1393: [*Threshold*] The System shall store all derived channels related to one or more signal detections.

S-1877: [*Threshold*] The System shall notify Analysts working in a common processing stage if they are concurrently modifying signal detections in the same analysis time interval.

S-1878: [*Threshold*] The System shall provide the Analyst the capability to access and view all waveform data stored on the System.

S-1885: [*Threshold*] The System shall display 24 hours of continuous waveform data before the waveform displays flatline.

S-1888: [*Threshold*] The System shall provide the Analyst the capability to analyze continuous waveform data from within a selected time block.

S-1915: [*Threshold*] The System shall provide the Analyst the capability to process data without altering another Analyst's existing solution.

S-1929: [*Threshold*] The System shall provide the Analyst the capability to individually select signal detections as processing input during an analysis session.

S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface Guidelines.

S-2043: [*Threshold*] The System shall store automatic and interactive processing results.

S-2164: [*Threshold*] The System shall access requested waveform data within one (1) minute of receipt by the Data Processing Partition.

S-2167: [*Threshold*] The System shall write a 6 hour or less time block of 40Hz waveform data within the Operational Processing Time Period with a maximum 5 second latency. (Goal: 1 second.)

S-2168: [*Threshold*] The System shall read a 6 hour or less time block of 40Hz waveform data outside the Operational Processing Time Period with a maximum 10 second latency. (Goal: 2 seconds.)

S-2169: [*Threshold*] The System shall read a 6 hour or less time block of 40Hz waveform data within the Operational Processing Time Period with a maximum 5 second latency. (Goal: 1 second.)

S-2170: [*Threshold*] The System shall write a 6 hour or less time block of 40Hz waveform data outside the Operational Processing Time Period with a maximum 10 second latency. (Goal: 2 seconds.)

S-2223: [*Threshold*] The System shall store all data and derived processing results to persistent storage as soon as the data and/or derived processing results are available.

S-2420: [*Threshold*] The System shall provide the Analyst the capability to store selected derived waveforms.

S-2603: [*Threshold*] The System shall provide the System User the capability to access requested waveform data.

S-2604: [*Threshold*] The System shall provide the Analyst the capability to access late-arriving waveform data within one (1) minute of receipt by the Data Processing Partition.

S-5708: [*Threshold*] The System shall read a 6 hour or less time block of processing results within the Operational Processing Time Period with a maximum 5 second latency. (Goal: 1 second.)

S-5709: [*Threshold*] The System shall write a 6 hour or less time block of processing results within the Operational Processing Time Period with a maximum 5 second latency. (Goal: 1 second.)

S-5712: [*Threshold*] The System shall read a 6 hour or less time block of processing results outside the Operational Processing Time Period with a maximum 10 second latency. (Goal: 2 seconds.)

S-5713: [*Threshold*] The System shall write a 6 hour or less time block of processing results from outside the Operational Processing Time Period with a maximum 10 second latency. (Goal: 2 seconds.)

S-6437: [*Threshold*] The System shall provide the Analyst the capability to time align detection feature maps based on signal detections.

S-6438: [*Threshold*] The System shall provide the Analyst the capability to time align detection feature maps with waveforms.

S-6439: [*Threshold*] The System shall provide the Analyst the capability to select signal detections on a detection feature map.

IDC Specific:
S-5612: [*IDC only, Threshold*] The System shall provide the Analyst the capability to request auxiliary seismic waveform data from the Data Acquisition Partition.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Analysis Time Interval - The time interval bounding the data reviewed by an analyst. Those data include waveforms, event hypotheses and their associated signal detections, and unassociated signal detections.

Detection Feature Map - A matrix of values for a particular feature as measured at a particular station over time. The matrix contains a feature vector calculated for each point in time based on the processing of one or more waveforms from the station. The feature vector is a set of values indexed by secondary independent variables, for example, frequency. Detection feature maps are used to detect and identify signals. A spectrogram is an example of a detection feature map where the feature is signal amplitude and the index is frequency. Array coherence is another example where the feature is coherence (or another feature gated by a coherence threshold) and the index is frequency.

Event Hypothesis - A proposed solution for an Event. Each event consists of a sequence of event hypotheses that describe an evolution to a final best model of the event. Each event hypothesis is composed of a set of associated signal detections and has one or more event hypothesis location solutions, one of which must be designated as preferred.

Geographic Region - An area on the surface of the Earth defined by either a polygon in geographic coordinates or an ellipse. Geographic Regions are used to visualize information on a map, for geospatial analysis, and in configuration of processing operations. Examples of geographic regions are Flinn-Engdahl seismic and geographical regions, but may be any arbitrary closed polygon or ellipse useful in the system. An "active geographic region" is a region definition that is valid in the system at a particular time. Regions may be created, changed, or made inactive.

Missed Event - An event that was known to have occurred but that was not detected by the System (automatic processing and/or analyst review). Adjustments can be made to the system to reduce the number of missed events, but usually only with a corresponding increase in the number of false events built by the system.

Signal Detection - A specific interval on a waveform marking the arrival of a signal of interest. Other portions of the waveform are noise.

Virtual Event Hypothesis - A trial event hypothesis created for analyzing waveform and alphanumeric data in an attempt to discover evidence supporting the existence of an actual event.

Waveform - A generic term for either a raw waveform (see waveform, raw) or a derived waveform (see waveform, derived).

IDC Specific:
None.

NOTES

General:
1. The System tracks which signal detections occur in the time interval the Analyst is scanning and does not use those signal detections for signal detection association within the automatic pipeline until the Analyst has completed the scan.

2. While scanning the Analyst can create new signal detections (see 'Detects Signals' UC), build new events (see 'Builds Events' UC), and enhance signals (see 'Enhances Signals' UC).

IDC Specific:
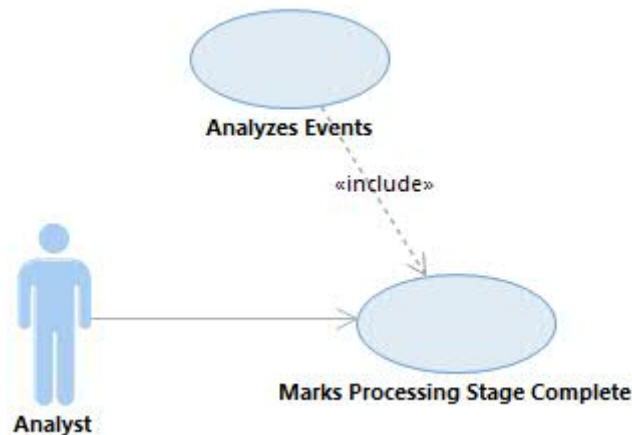1. The Analyst can request seismic waveform data from auxiliary stations from the Data Acquisition Partition.

OPEN ISSUES

None.

UC-03.05 Marks Processing Stage Complete

USE CASE DIAGRAM

BRIEF DESCRIPTION

This architecturally significant use case describes how the Analyst marks a processing stage complete upon completing analysis of an Event Set or an Analysis Time Interval. The Analyst marks an Event Set or Analysis Time Interval complete to allow the Event Set or Analysis Time Interval to proceed to the next processing stage.

This use case is architecturally significant because it describes how the Analysts complete their defined analysis activities in the context of a processing stage in order to transition control to the next processing stage.

ACTOR DESCRIPTIONS

Analyst - The Analyst is a System User who analyzes events. This actor includes all the traditional analysis roles. Any Analyst can access all System event analysis capabilities from a use case perspective. Individual analyst capabilities may be further specified by operations procedures.
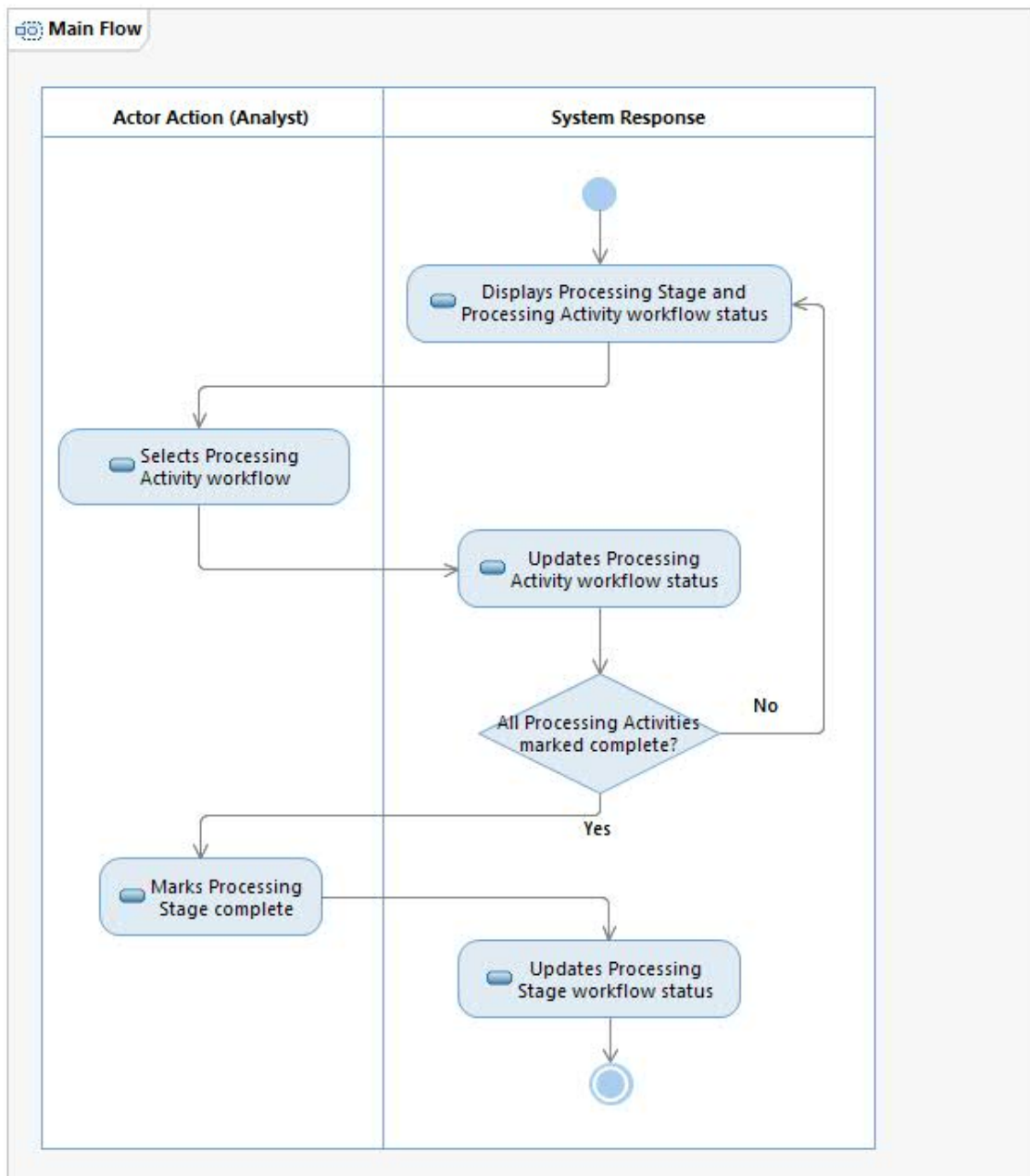
PRECONDITIONS

None.

POSTCONDITIONS

1. An event set or analysis time interval is marked complete for the Analyst's current processing stage.

ACTIVITY DIAGRAMS

Main Flow

Action Descriptions

Action: "Displays Processing Stage and Processing Activity workflow status"
The System displays the current Processing Stage workflow status and the Processing Activity workflow status. The Processing Stage and Processing Activity workflow statuses reflect Analyst activity.

Action: "Updates Processing Activity workflow status"

The System updates the Processing Activity workflow status with the status selected by the Analyst. The Analyst changing the Processing Activity status may trigger automatic processing sequences preconfigured by the System Maintainer (see 'Defines Processing Sequence' UC).

Decision: "All Processing Activities marked complete?"
The Analyst can mark a Processing Stage complete if all event review processing activities are Complete and all time interval review activities are either Not Complete or Complete.

Action: "Marks Processing Stage complete"
The Analyst marks the Processing Stage complete. If not all Processing Activities in the Processing Stage are complete, the Analyst confirms that not all Processing Activities in the Processing Stage will be completed.

Action: "Updates Processing Stage workflow status"
The System updates the Processing Stage workflow status with the status selected by the Analyst. The Analyst marking the Processing Stage complete may trigger automatic processing sequences preconfigured by the System Maintainer (see 'Defines Processing Sequence' UC).

Alternate Flows
1. Any Analyst Action – the Analyst may choose to cancel, in which case the System reverts any Processing Stage or Processing Activity workflow status changes made by the Analyst to their prior state and this use case ends, and flow returns to 'Analyzes Events' UC.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1859: [*Threshold*] The System shall set the processing stage workflow status of a processing time interval to reflect analysis activity.

S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface Guidelines.

S-2588: [*Threshold*] The System shall set the processing stage workflow status of events to reflect analysis activity.

S-2589: [*Threshold*] The System shall provide the Analyst the capability to set the processing stage workflow status of a processing time interval.

S-2590: [*Threshold*] The System shall provide the Analyst the capability to set the processing stage workflow status of an event.

IDC Specific:
None.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Analysis Time Interval - The time interval bounding the data reviewed by an analyst. Those data include waveforms, event hypotheses and their associated signal detections, and unassociated signal detections.

Event Set - The set of one or more event hypotheses that an analyst selects for analysis.

Processing Stage - A named group of data processing and analysis functions, used to track status of increments of work performed on time intervals and events through the System. The flow of data through the System, from data acquisition, through automated processing and multiple reviews, to reporting of an event, is defined as a series of processing stages (e.g., Pipeline, traditional analysis roles). A processing stage may define automatic sequences (see processing sequences), interactive-only activities, or interactive and automatic sequences. A stage description includes a list of functions that are performed, entry criteria (time, event, or data availability triggers), and exit criteria (completion of processing, recognition of an important event, or declaration by an Analyst).

IDC Specific:
None.

NOTES

General:
1. The System Maintainer configures the criteria for Processing Stage completion (see 'Defines Processing Sequence' UC).

IDC Specific:
1. Before marking the processing stage complete, the Lead Analyst and the IDC reviews the list of events including the determination by the System of which events meet the event formation criteria to be migrated to the next IDC bulletin.
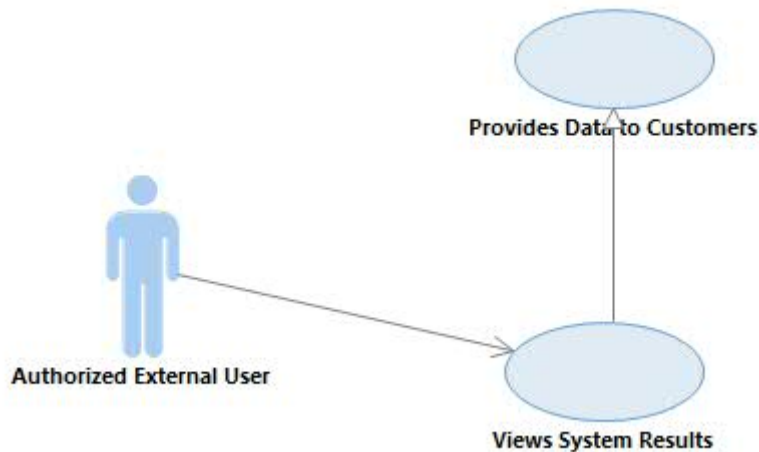
OPEN ISSUES

None.

UC-05.02 Views System Results

USE CASE DIAGRAM

BRIEF DESCRIPTION

This architecturally significant use case describes how an Authorized External User views current and past reports through the System web servers. An Authorized External User views event reports, event bulletins, station state-of-health (SOH) and event web pages originating from the System. An Authorized External User views event reports and event bulletins from third parties.

This use case is architecturally significant because it provides an interactive method for large number of external customers to access a high volume and diverse set of System results in a timely manner.

ACTOR DESCRIPTIONS

Authorized External User - The Authorized External User actor is an external user who has limited access to request and receive System data, view System results, or provide data for import into the System.
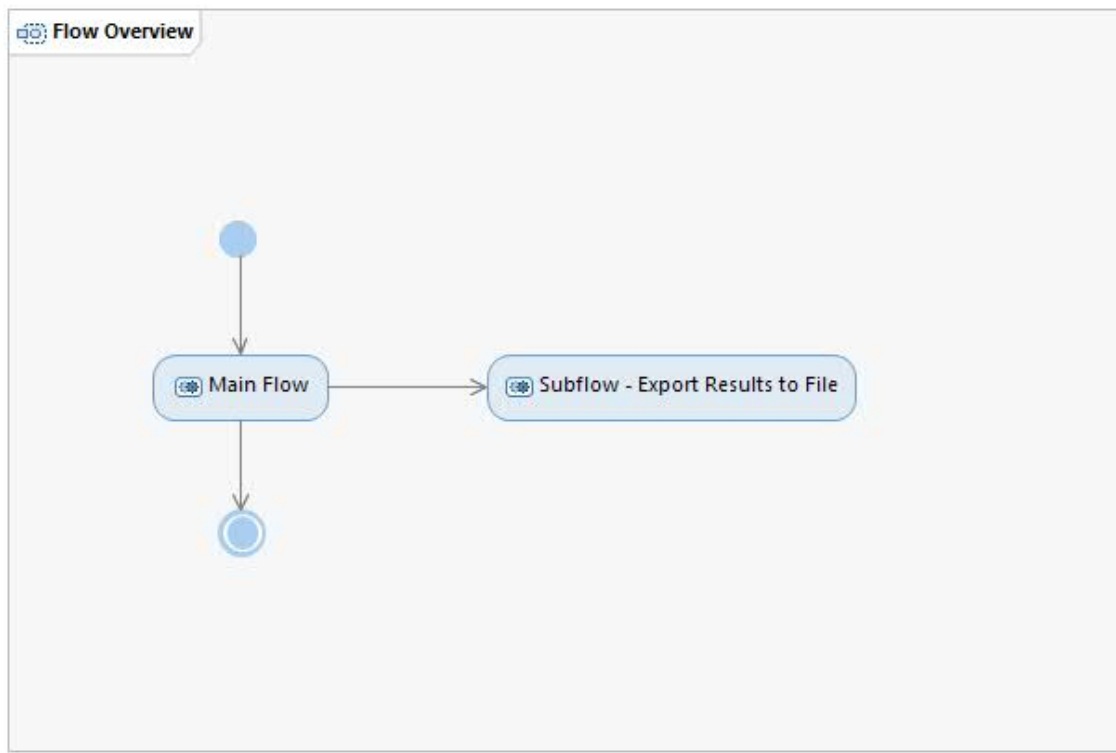
PRECONDITIONS

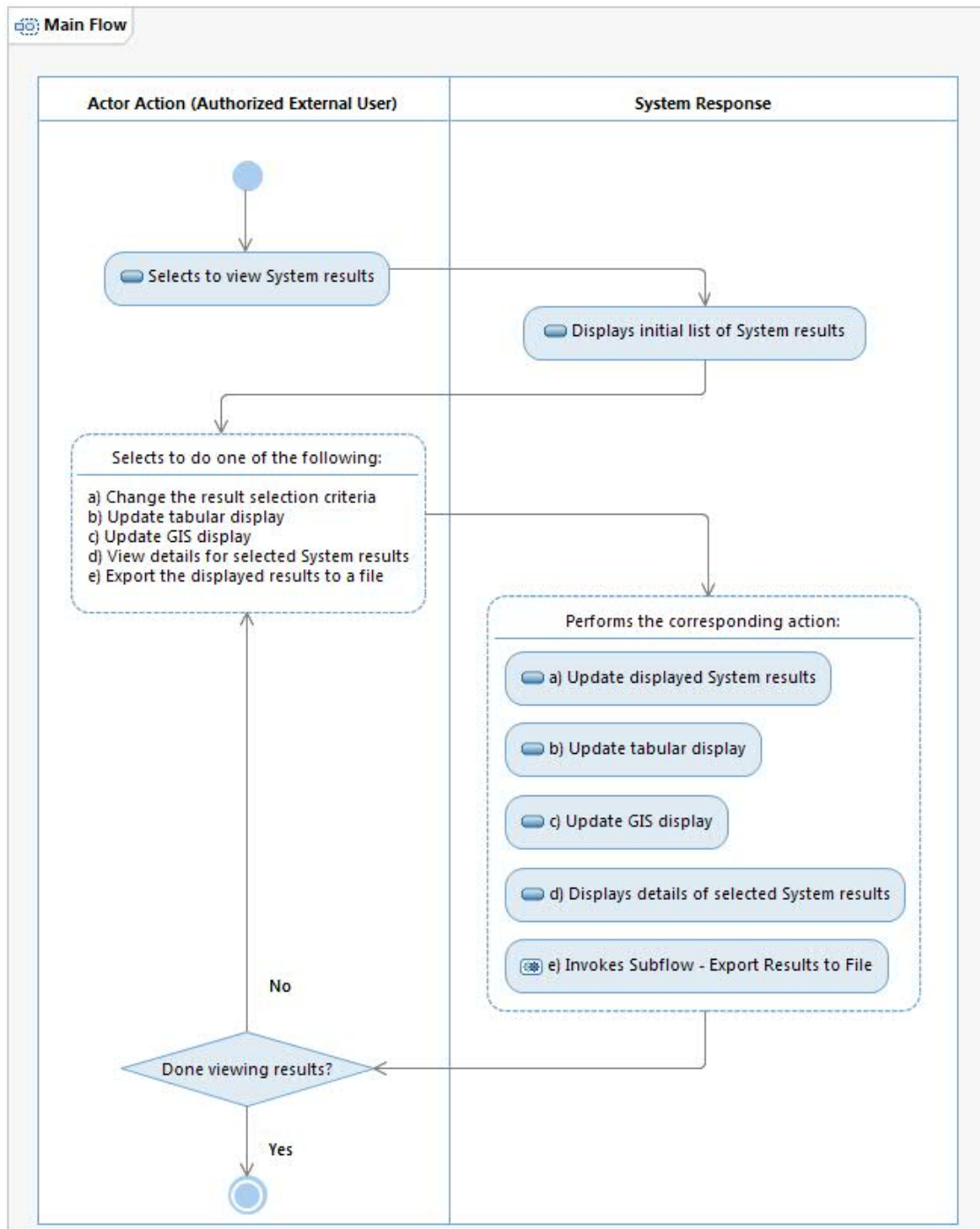1. The Authorized External User has been granted access to the System web servers

POSTCONDITIONS

None.

ACTIVITY DIAGRAMS

Flow Overview

Main Flow

Action Descriptions

Action: "Selects to view System results"

The Authorized External User logs into the System website and selects to view System results.

Action: "Displays initial list of System results"

The System displays an initial list of System results and displays them in tabular form, and on the GIS. System results include events, signal detections, station deployments, station state-of-health, station ambient noise statistics, station calibration results, waveform authentication status,

112

etc. The System determines which results to initially display based on the Authorized External User's roles/privileges. The System Maintainer configures roles and privileges (see 'Configures System Permissions' UC).

Action: "Selects to do one of the following:"
a) Change the result selection criteria:
   - The Authorized External User selects criteria such as geographic region, time interval, event parameters (e.g., depth interval, magnitude interval, etc.) source type, processing stage, or result type, etc.

b) Update tabular display:
   - The Authorized External User updates table aspects such as sort fields, sort direction, etc.

c) Update GIS display:
   - The Authorized External User zooms, pans, shows/hides various map elements, etc.

d) View details for selected System results:
   - The Authorized External User selects to view additional information about a particular result.

e) Export the displayed results to a file:
   - The Authorized External User selects to export the results (i.e., event list, reports, GIS display, tabular display, station state-of-health, etc.) to a file on the file system.

Action: "a) Update displayed System results"
The System repopulates the tabular and GIS displays with events that meet the new selection criteria.

Action: "b) Update tabular display"
The System updates the tabular display (e.g., new sort field or new sort direction).

Action: "c) Update GIS display"
The System updates the GIS display.

Action: "d) Displays details of selected System results"
The System displays details for the selected results. For example, if the result is an event the System displays information such as location, magnitude, and the stations detecting the event; if the result is a report the System displays the full report; if the result is ambient noise statistics the System displays the statistics and a spectrum plot; if the results is station state-of-health the System displays waveform acquisition latencies, waveform completeness, station noise levels, etc.

Alternate Flows
1. Any Actor Action - The Authorized External User may cancel, in which case this use case ends.

Subflow - Export Results to File
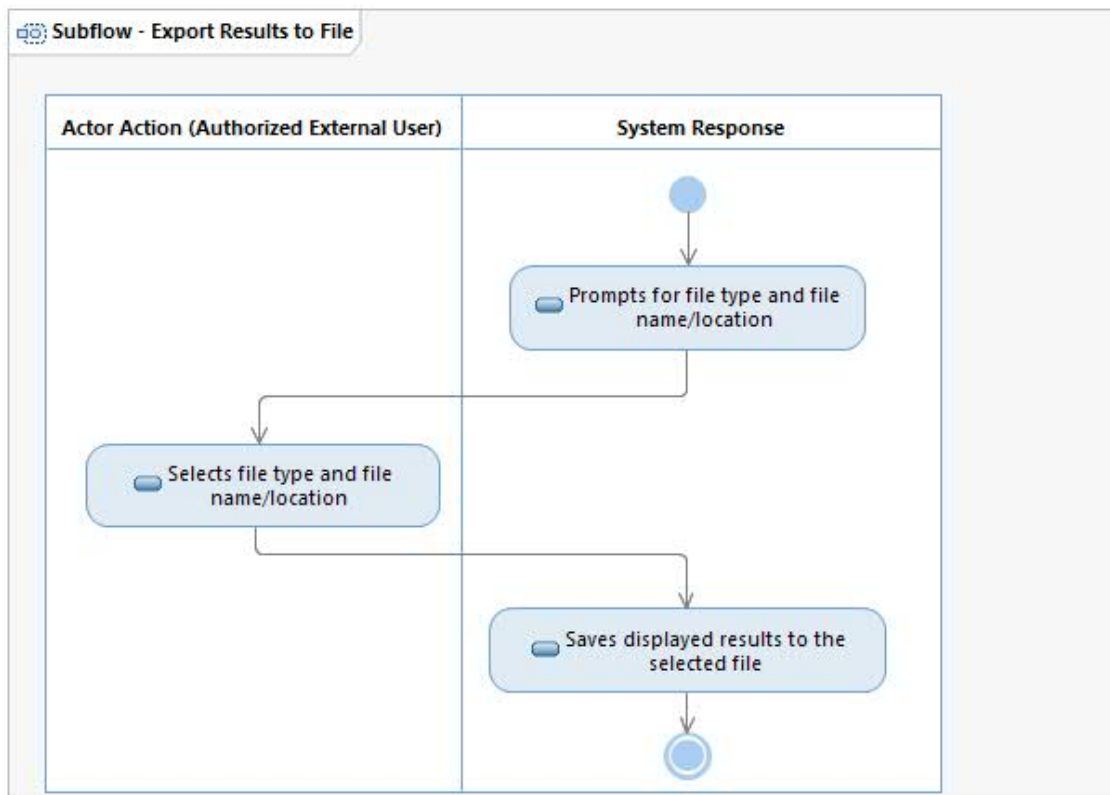
Action Descriptions
Action: "Selects file type and file name/location"
The Authorized External User selects a location on their local file system to save the file. The Authorized External User selects a file type appropriate for the exported data (e.g., CSV, KML, PDF)

Alternate Flows
1. Any Actor Action - The Authorized External User may cancel, in which case the file is not written and the subflow ends, and returns to the Main Flow.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1229: [*Threshold*] The System shall provide the Authorized External User the capability to view station data acquisition statistics via a web site.

S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface Guidelines.

S-2006: [*Threshold*] The System shall provide the Authorized External User the capability to access reports based on their roles and privileges.

S-2007: [*Threshold*] The System shall provide the Authorized External User the capability to access reports via a web server.

S-2008: [*Threshold*] The System shall provide the Authorized External User the capability to view station SOH via a web server.

S-2011: [*Threshold*] The System shall provide the Authorized External User the capability to export reports.

S-2012: [*Threshold*] The System shall provide the Authorized External User the capability to access third-party reports.

S-2016: [*Threshold*] The System shall provide the Authorized External User the capability to create an event bulletin from the set of released events.

S-2017: [*Threshold*] The System shall provide the Authorized External User the capability to create event bulletins based on any combination of geographic region, time interval, depth, magnitude interval, source type, stations, latitude, and longitude.

S-2020: [*Threshold*] The System shall provide the Authorized External User the capability to view a list of events created in any processing stage (automated or interactive).

S-5710: [*Threshold*] The System shall provide an extensible architecture for the distribution of new data and reports.

S-5892: [*Threshold*] The System shall provide the Authorized External User the capability to view reports.

S-5894: [*Threshold*] The System shall provide the Authorized External User the capability to access reports via a GIS.

S-5962: [*Threshold*] The System shall provide the Authorized External User the capability to access reports via tabular format.

S-5963: [*Threshold*] The System shall provide the Authorized External User the capability to view station ambient noise probability density functions.

S-5964: [*Threshold*] The System shall provide the Authorized External User the capability to view the authentication status of waveform data.

S-5965: [*Threshold*] The System shall provide the Authorized External User the capability to view the station instrumentation, station deployment, and station configuration parameter values.

S-5986: [*Threshold*] The System shall provide the Authorized External User the capability to view event hypothesis data on an interactive map.

S-5988: [*Threshold*] The System shall provide the Authorized External User to view station data on an interactive map.

S-5989: [*Threshold*] The System shall provide the Authorized External User the capability to view geographic data on an interactive map.

S-5990: [*Threshold*] The System shall provide the Authorized External User the capability to view active geographic region boundaries on an interactive map.

S-5992: [*Threshold*] The System shall provide the Authorized External User the capability to view on an interactive map whether an event hypothesis location is within active geographic regions.

S-5993: [*Threshold*] The System shall provide the Authorized External User the capability to simultaneously view event hypothesis locations and active geographic region boundaries on an interactive map.

S-5994: [*Threshold*] The System shall provide the Authorized External User the capability to simultaneously view event hypothesis locations and inactive geographic region boundaries on an interactive map.

S-5996: [*Threshold*] The System shall provide the Authorized External User the capability to specify the time associated with whether an event hypothesis location or event hypothesis location uncertainty is within an active geographic region.

S-6000: [*Threshold*] The System shall provide the Authorized External User the capability to access geospatial data.

S-6002: [*Threshold*] The System shall provide the Authorized External User the capability to view geographic data on a two-dimensional projection and on a three-dimensional virtual globe.

S-6428: [*Threshold*] The System shall provide the System User the capability to access the System as an Authorized External User.

S-6429: [*Threshold*] The System shall provide the Authorized External User the capability to view third-party event bulletins.

S-6430: [*Threshold*] The System shall provide the Authorized External User the capability to select geographical data on any interactive map (such as events and stations) and export them to a standardized format (e.g. KML/KMZ).

S-6431: [*Threshold*] The System shall export geographic data in KML/KMZ format.

S-6433: [*Threshold*] The System shall provide the Authorized External User the capability to view an event from any processing stage that has been approved for release.

S-6434: [*Threshold*] The System shall provide the Authorized External User the capability to view station calibration results.

S-6455: [*Threshold*] The System shall provide the Authorized External User the capability to view station magnitude detection thresholds computed for a geographic region.

S-6456: [*Threshold*] The System shall provide the Authorized External User the capability to access third-party event bulletins in the same way they access event bulletins produced by the System.

IDC Specific:
S-5686: [*IDC only, Threshold*] The System shall provide the System User the capability to access the System using their CTBTO "single sign on" credentials.

S-5687: [*IDC only, Threshold*] The System shall provide user identification and authentication through the CTBTO "single sign on".

S-6543: [*IDC only, Threshold*] The System shall provide the Authorized External User the capability to select the screening criteria parameters the System uses to calculate a National Standard Screened Event Bulletin.

S-6544: [*IDC only, Threshold*] The System shall provide the Authorized External User the capability to select parameters controlling which screening criteria numerical metric scores the System combines when calculating overall screening categories for a National Standard Screened Event Bulletin.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Event Bulletin - A list of event hypothesis location solutions, with or without the associated signal detections. The primary product of most seismic monitoring agencies (e.g., IDC, National Earthquake Information Center [NEIC]) is an event bulletin. Event bulletins can be constrained by region, by time, by magnitude, etc.

Geographic Information System (GIS) - A software application designed to capture, store, manipulate, analyze, manage, and present geospatial data.

Geographic Region - An area on the surface of the Earth defined by either a polygon in geographic coordinates or an ellipse. Geographic Regions are used to visualize information on a map, for geospatial analysis, and in configuration of processing operations. Examples of geographic regions are Flinn-Engdahl seismic and geographical regions, but may be any arbitrary closed polygon or ellipse useful in the system. An "active geographic region" is a

region definition that is valid in the system at a particular time. Regions may be created, changed, or made inactive.

Station State-Of-Health (SOH) - An assessment of how well a station is functioning for a specified time interval. Station SOH is based on station SOH data, which may include any type of data that can be time indexed, and that can be used to determine the capability of a station to meet mission requirements (e.g., status of sensor channels, site temperature, power status, security status).

IDC Specific:
None.

NOTES

General:
1. Although the actor for this use case is listed as the Authorized External User, this use case can also be performed by any System User.

2. 'Views System Results' UC and 'Requests System Data' UC both address Authorized External Users requesting data from the System. 'Requests System Data' is primarily focused on data acquired by the System while 'Views System Results' UC focuses on processing results. These functions are in two separate UCs because of the different customer perceptions of the purpose of the UCs even though they share mappings to many specifications. The implementation of these functions should consider use of common software.

IDC Specific:
1. The Authorized External User can select to view various bulletins (e.g., SEL1, SEL2, SEL3, REB, National Screened Event Bulletins, custom bulletins based on processing previously specified by the Authorized External User, etc.) in action "Change event selection criteria".

2. In Main Flow Action "Displays initial list of System Results" the System results also include radionuclide products, data fusion products, and Expert Technical Analysis reports.

3. In Main Flow action "Selects to do one of the following", an additional option is available for the Authorized External User to select user-specified processing of data and products to create a custom screened bulletin (i.e., National Standard Screened Event Bulletin). The user-specific processing relies only on the event screening software components already used by the System to create the Standard Screened Event Bulletin.
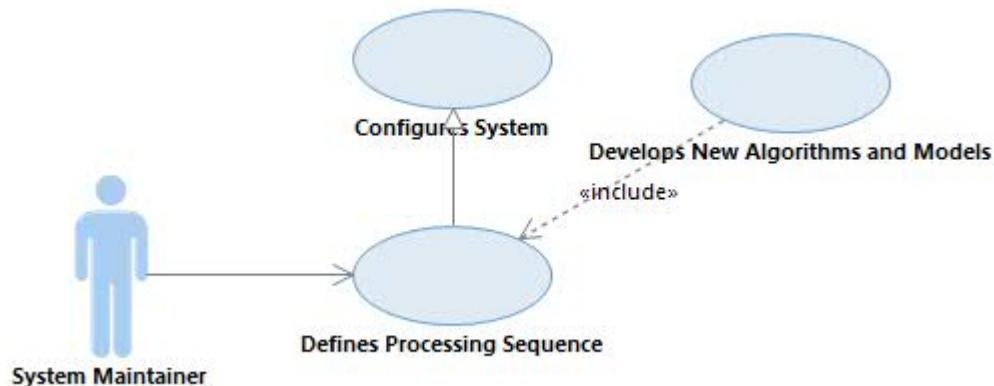
4. Single sign on capabilities (S-5686, S-5687) only apply to System Users accessing the web portal and will be met using OS level login capabilities. External users who do not have CTBTO "single sign on" will not be able to use the single sign on capability to access the web portal.

OPEN ISSUES

None.

UC-06.03 Defines Processing Sequence

USE CASE DIAGRAM

BRIEF DESCRIPTION

This architecturally significant use case describes how the System Maintainer defines Processing Configurations, which include Processing Stages, Processing Sequences, and Analyst Activities. At the highest level, a Processing Stage is associated with a Processing Sequence. The System Maintainer defines a Processing Sequence to be executed, which includes other Processing Sequences and/or Processing Steps. The System Maintainer defines Analyst Activities which are associated with Processing Stages. Once the System verifies that the configuration is valid, the System Maintainer saves all changes made to the Processing Sequence. The configuration changes do not take effect until they are installed as a software update (see 'Installs Software Update' UC).

This use case is architecturally significant because it drives the system architecture to support flexible and extensible definition of processing and analysis control flow.

ACTOR DESCRIPTIONS

System Maintainer - The System Maintainer actor is a System User who installs, tests, and configures the System.
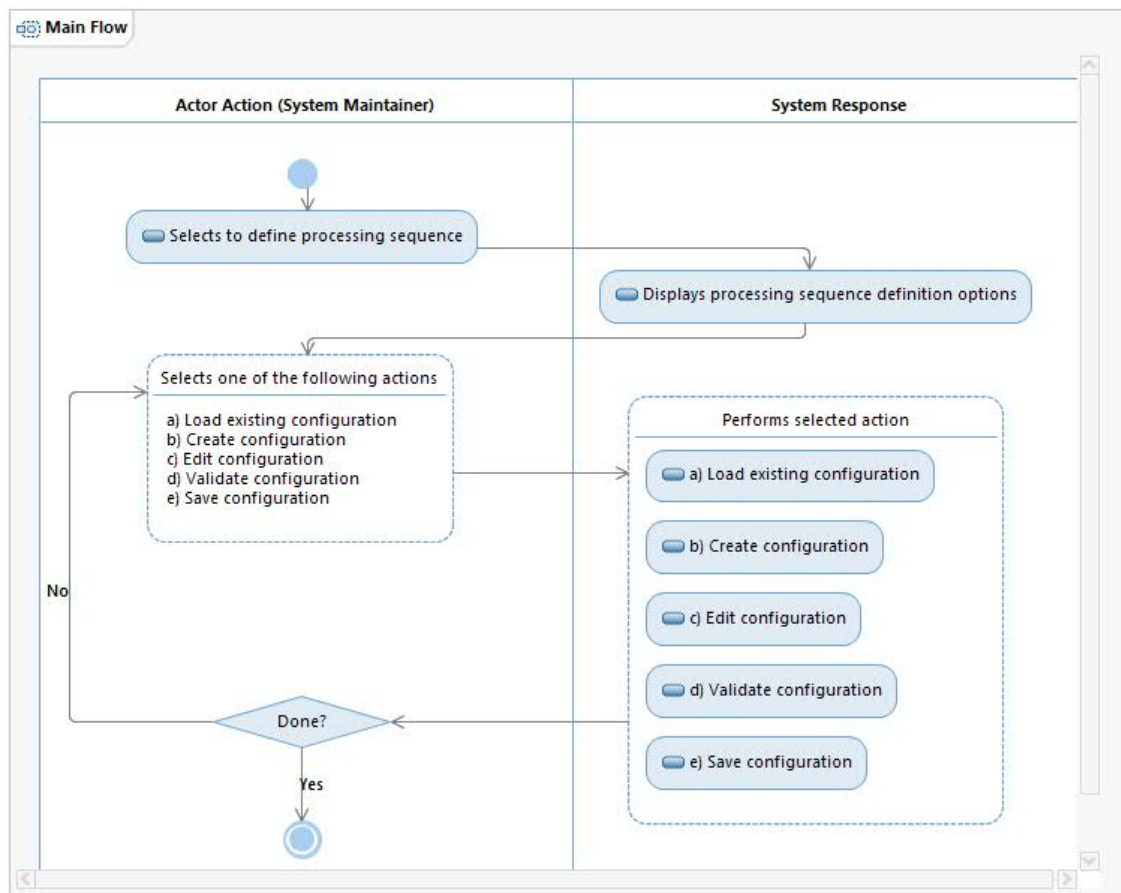
PRECONDITIONS

None.

POSTCONDITIONS

1. The processing sequence configuration is available to be installed as a software update on the Operational, Alternate, or Training Subsystems or upon restarting the pipeline on the Development, Testing, or Standalone Subsystems.

ACTIVITY DIAGRAMS

Main Flow

Action Descriptions

Action: "a) Load existing configuration"
The System loads and displays an existing configuration to the System Maintainer.

Action: "b) Create configuration"
The System creates and displays a new, empty configuration to the System Maintainer.

Action: "c) Edit configuration"
The System provides the System Maintainer an interface for editing the processing sequence configuration. This includes creating and updating the elements contained within processing sequences (other nested processing sequences and/or processing steps), defining the flow between those elements (including sequencing, branching, concurrency), specifying control

parameters including timing information for when a processing sequence should execute. A processing stage is associated with a top-level sequence.

Action: "d) Validate configuration"
The System verifies that the processing sequence configuration is valid, including checking that the inputs and outputs between connecting elements are of the same type. Processing sequences must adhere to an interface standard for invocation, status return, data access, logging, messaging, etc.

Action: "e) Save configuration"
The System saves the processing sequence configuration, including the user that saved the changes, in a format that can be managed by a configuration management system. The System indicates which elements of the processing sequence are invalid.

Alternate Flows
1. Any Actor Action - The System Maintainer may choose to cancel, in which case this use case ends.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1411: [*Threshold*] The System shall provide the System Maintainer the capability to configure signal processing operations to apply prior to signal detection.

S-1412: [*Threshold*] The System shall provide the System Maintainer the capability to configure signal processing operations to apply prior to signal detection by geographic region.

S-1413: [*Threshold*] The System shall provide the System Maintainer the capability to configure signal processing operations to apply prior to signal detection by station.

S-1653: [*Threshold*] The System shall compute new event hypothesis magnitude estimates when a new event hypothesis location is computed.

S-1865: [*Threshold*] The System shall provide the System Maintainer the capability to configure the processing time interval and percentage of data available for waveform data processing.

S-1866: [*Threshold*] The System shall provide the System Maintainer the capability to configure the processing time interval for event hypothesis data processing.

S-1867: [*Threshold*] The System shall provide the System Maintainer the capability to configure the initiation of automatic processing based on time intervals.

S-1868: [*Threshold*] The System shall provide the System Maintainer the capability to configure the initiation of automatic processing based on data availability.

S-1869: [*Threshold*] The System shall provide the System Maintainer the capability to configure the initiation of automatic processing based on processing stage completion.

S-1870: [*Threshold*] The System shall provide the System Maintainer the capability to configure groups of operations to run whenever a triggering event specified by the System Maintainer occurs.

S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface Guidelines.

S-2159: [*Threshold*] The System shall provide the Researcher the capability to store time-series signals generated by each transformation applied during system signal processing for evaluation by third-party tools.

S-2173: [*Threshold*] The System shall automatically execute processing of waveform data (i.e., data acquisition, data processing, and data storage).

S-5557: [*Threshold*] The System shall provide the System Maintainer the capability to configure whether the Analyst can interrupt automated event hypothesis processing.

S-5736: [*Threshold*] The System shall maintain a history of the system configurations.

IDC Specific:
None.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Processing Sequence - An ordered grouping of processing steps or other nested processing sequences connected by logic elements that specify sequencing, branching, concurrency, and entry and exit criteria. Processing sequences may specify control parameters such as data buffering and data source, and must adhere to an interface standard for invocation, status return, data access, logging, messaging, etc.

Processing Stage - A named group of data processing and analysis functions, used to track status of increments of work performed on time intervals and events through the System. The flow of data through the System, from data acquisition, through automated processing and multiple reviews, to reporting of an event, is defined as a series of processing stages (e.g., Pipeline, traditional analysis roles). A processing stage may define automatic sequences (see processing sequences), interactive-only activities, or interactive and automatic sequences. A stage description includes a list of functions that are performed, entry criteria (time, event, or data availability triggers), and exit criteria (completion of processing, recognition of an important event, or declaration by an Analyst).

Processing Step - A basic processing action with defined inputs and outputs. Processing steps may specify control parameters such as data buffering and data source, and must adhere to an interface standard for invocation, status return, data access, logging, messaging, etc.

IDC Specific:
None.

NOTES

General:
1. Because this use case is not run on the operational system, there is minimal validation of user actions. Once a processing sequence is defined, it will be deployed to DEV in order to test that configuration (see 'Installs Software Update' UC). This is when some of the invalid configuration issues might be discovered.
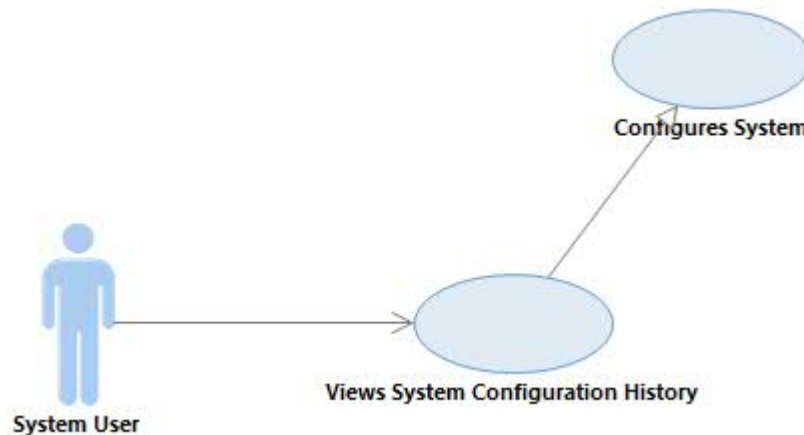

IDC Specific:
None.

OPEN ISSUES

None.

UC-06.06 Views System Configuration History

USE CASE DIAGRAM

BRIEF DESCRIPTION

This architecturally significant use case describes how the System User views the system configuration change history. The System stores each configuration change and can present a list of configuration changes or a trend display of configuration values over time. The System User can also view the system configuration at a selected time. The configuration history contains information on the user who modified the configuration and when the configuration changed.

This use case is architecturally significant because it defines a new feature of the System to store and view the system configuration at any point in time to support analysis of the impact of configuration changes.

ACTOR DESCRIPTIONS

System User - The System User actor is any internal user who accesses the System.
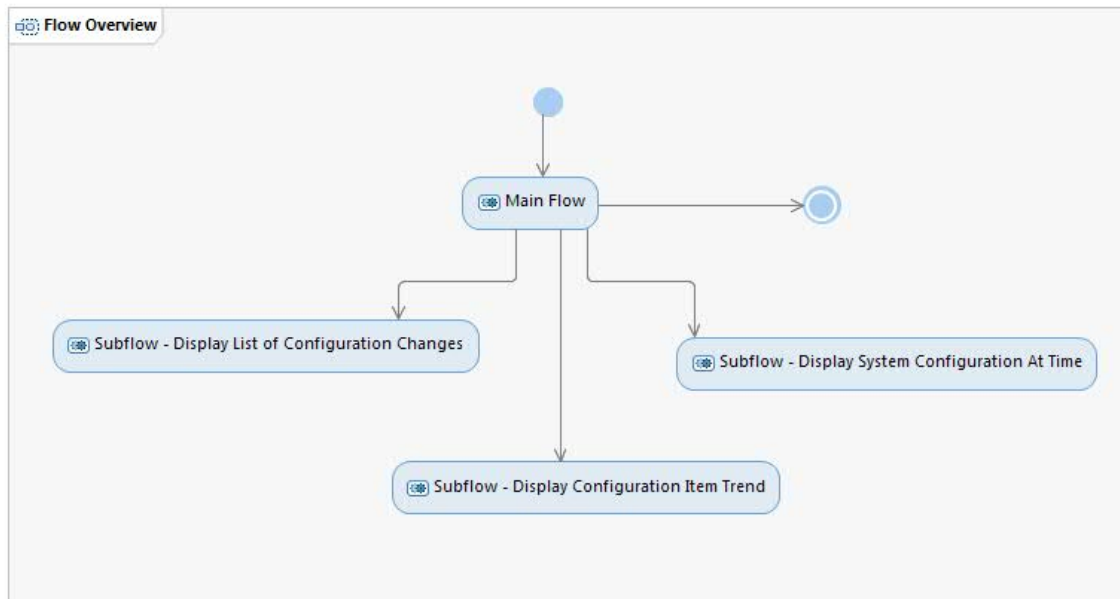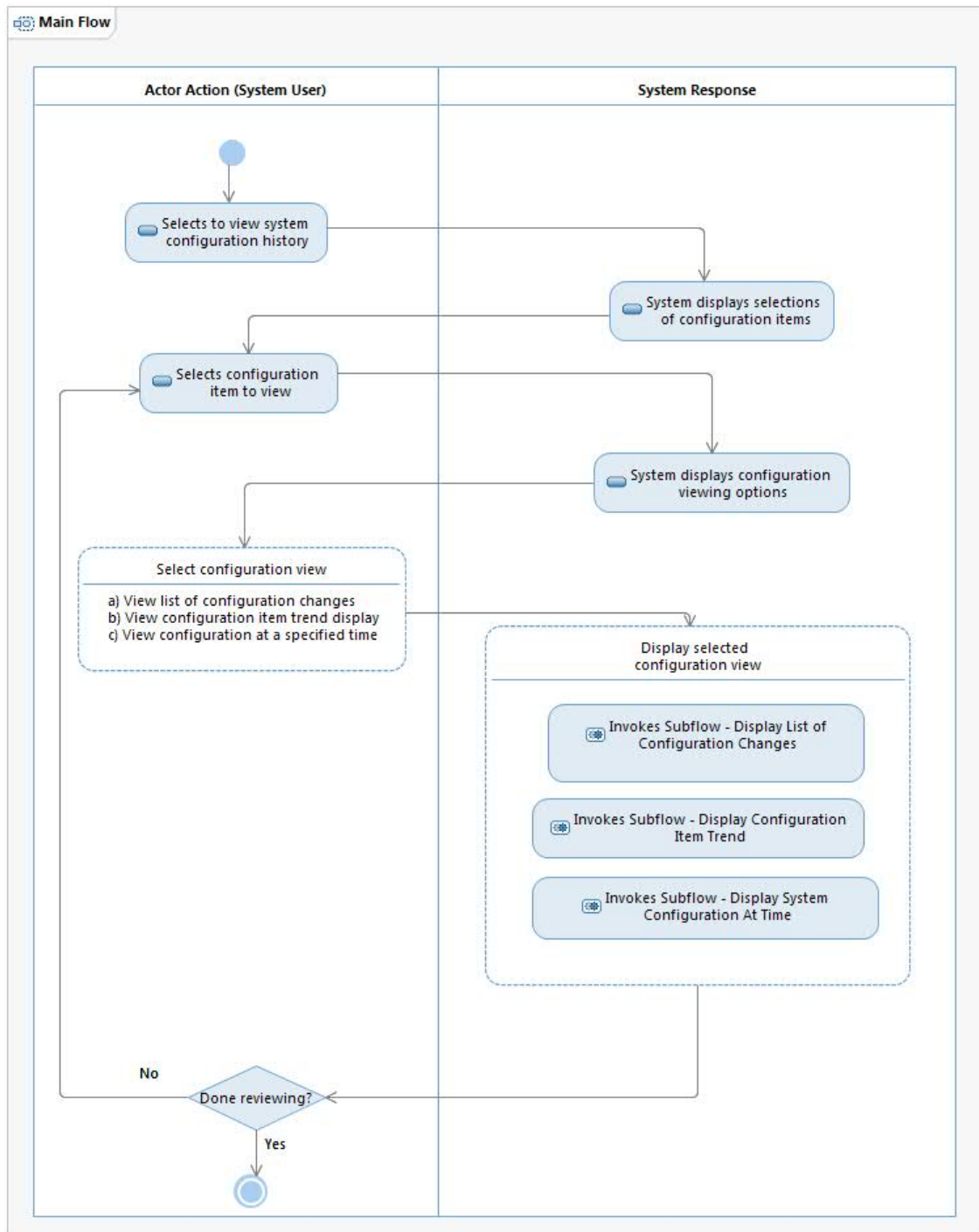
PRECONDITIONS

None.

POSTCONDITIONS

None.

ACTIVITY DIAGRAMS
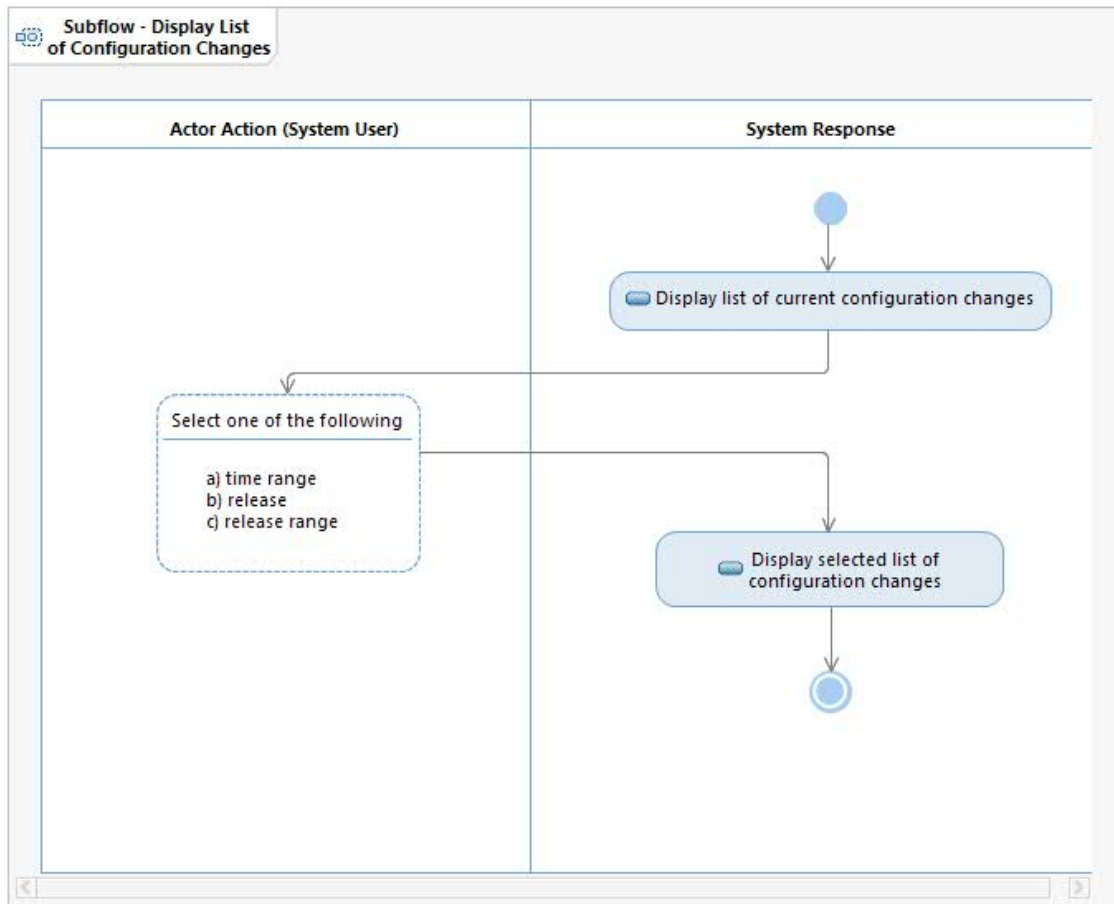
Flow Overview

Main Flow

Action Descriptions

None.

Alternate Flows

1. Any Actor Action - The System User may choose to cancel, in which case this use case ends.

# Subflow - Display List of Configuration Changes

Action Descriptions

Action: "Display list of current configuration changes"
Display a list of the most recent configuration changes for the selected configuration item.

Alternate Flows

1. Any Actor Action - The System User may choose to cancel, in which case this flow ends, and returns to the Main Flow.

# Subflow - Display Configuration Item Trend
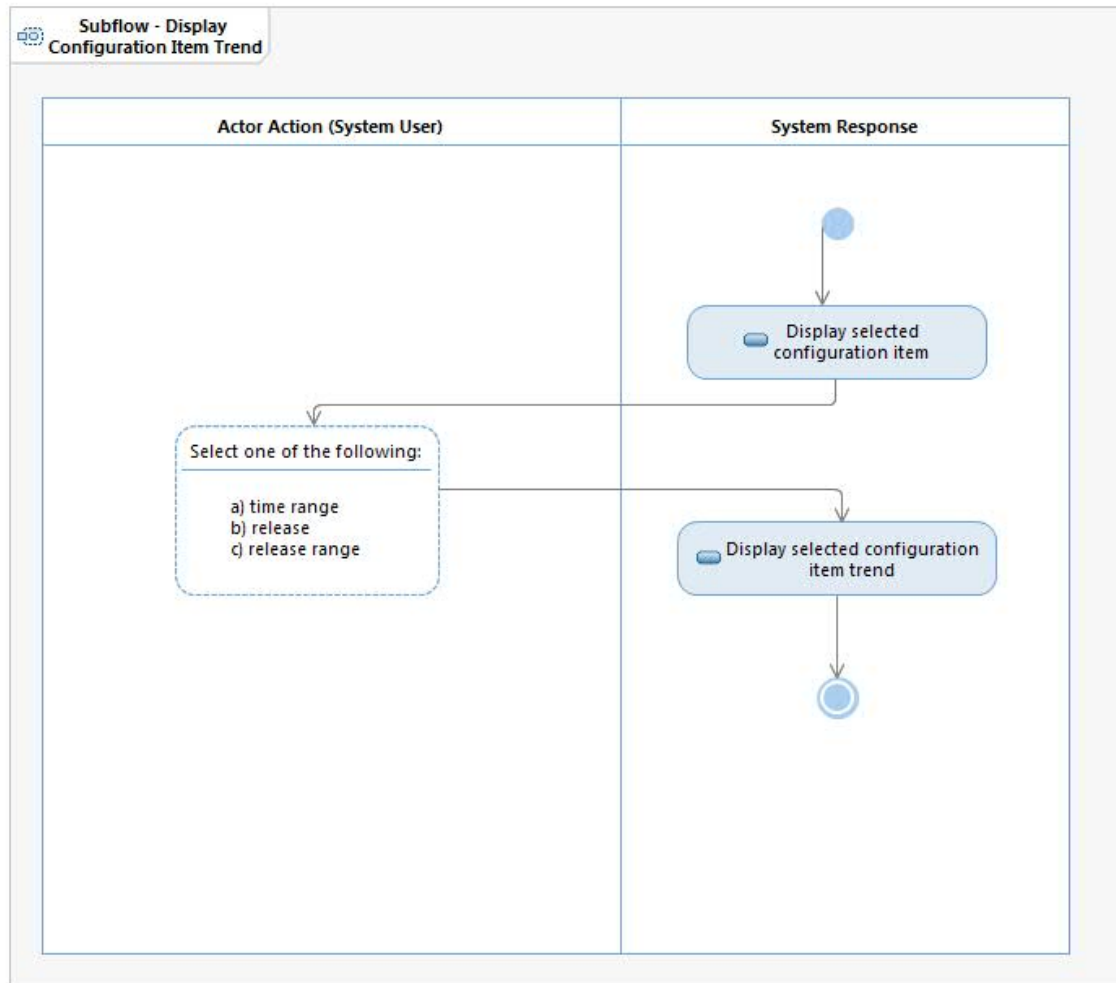
Action Descriptions

Action: "Display selected configuration item trend"
The trend display will vary based on the configuration items selected. Data values are plotted on a graph against time. Binary values or configuration files are displayed in a list showing the times when the configuration item changed.

Alternate Flows

1. Any Actor Action - The System User may choose to cancel, in which case this flow ends, and returns to the Main Flow.

Subflow - Display System Configuration At Time
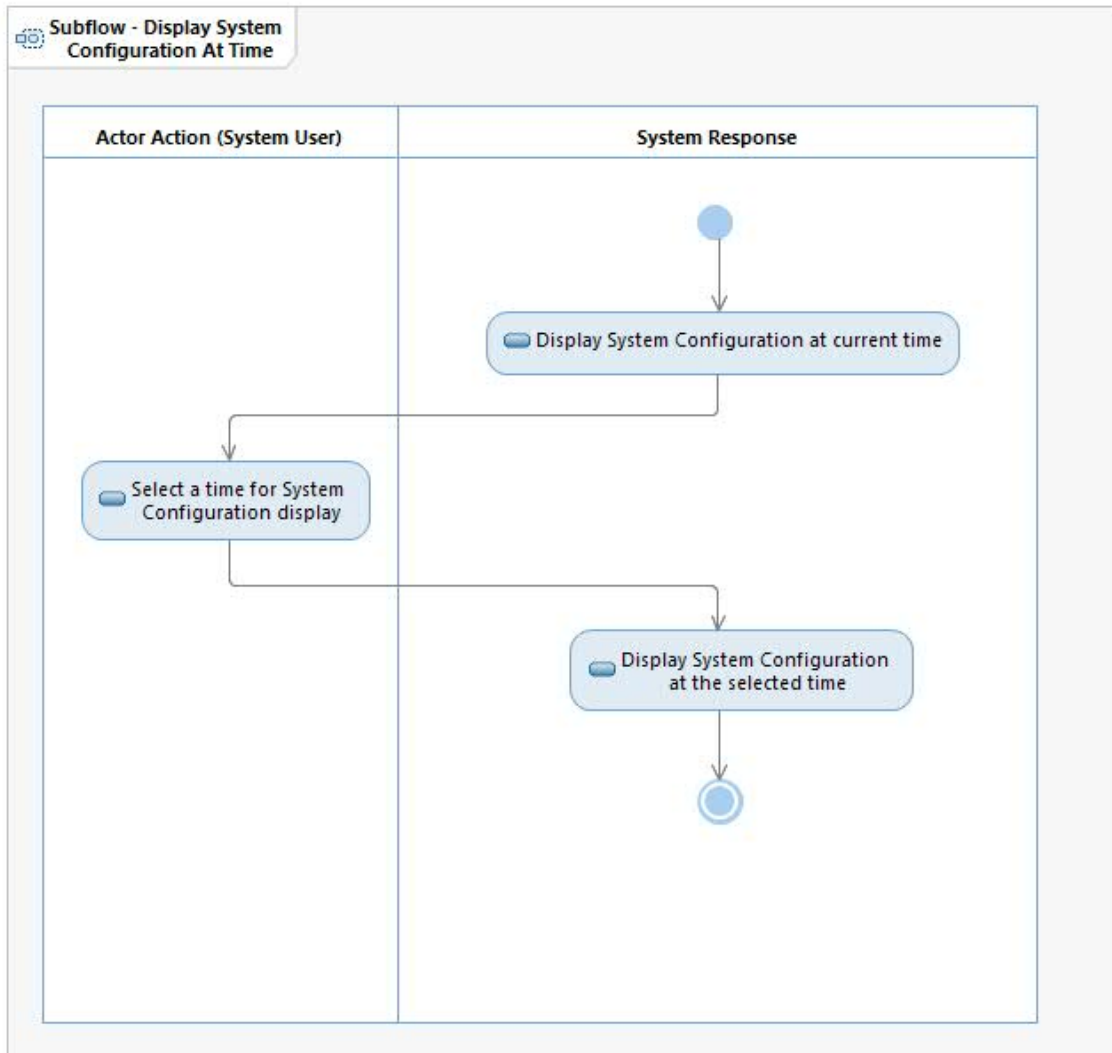
Action Descriptions

None.

Alternate Flows

1. Any Actor Action - The System User may choose to cancel, in which case this flow ends, and returns to the Main Flow.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1133: [*Threshold*] The System shall provide the System Maintainer the capability to configure new stations.

S-1134: [*Threshold*] The System shall provide the System Maintainer the capability to configure the station instrumentation parameter and sensor deployment.

S-1135: [*Threshold*] The System shall provide the System Maintainer the capability to configure processing of data from a new station in processing stages without disrupting ongoing processing operations.

S-1136: [*Threshold*] The System shall provide the System Maintainer the capability to configure whether acquisition and storage is enabled or disabled for new station data.

S-1137: [*Threshold*] The System shall provide the System Maintainer the capability to configure whether selection for interactive processing is enabled or disabled for new station data.

S-1138: [*Threshold*] The System shall provide the System Maintainer the capability to configure whether station processing is enabled or disabled for new station data.

S-1139: [*Threshold*] The System shall provide the System Maintainer the capability to configure whether network processing is enabled or disabled for new station data.

S-1140: [*Threshold*] The System shall provide the System Maintainer the capability to configure which stations are no longer processed.

S-1141: [*Threshold*] The System shall provide the System Maintainer the capability to configure whether ongoing processing or acquisition operations of data from a station or instrument is enabled or disabled in processing stages without disrupting ongoing processing operations.

S-1143: [*Threshold*] The System shall provide the System User the capability to view the station instrumentation, station deployment, and station configuration parameter values.

S-1275: [*Threshold*] The System shall provide the System Maintainer the capability to configure the minimum change in amplitude with respect to time that is automatically recognized as an amplitude spike.

S-1276: [*Threshold*] The System shall provide the System Maintainer the capability to configure the minimum number of equal, consecutive amplitude values required for automatic recognition of a repeated amplitude value data error.

S-1278: [*Threshold*] The System shall provide the System Maintainer the capability to configure the maximum percent of data samples in a waveform section allowed to contain data errors.

S-1280: [*Threshold*] The System shall provide the System Maintainer the capability to configure the execution order of Waveform QC Mask application on a per sensor basis.

S-1281: [*Threshold*] The System shall provide the System Maintainer the capability to configure the maximum time length in the future for user created Waveform QC Masks.

S-1282: [*Threshold*] The System shall provide the System Maintainer the capability to authorize a System User to create Waveform QC masks extending into the future.

S-1329: [*Threshold*] The System shall provide the System Maintainer the capability to configure waveform filters by geographic region.

S-1391: [*Threshold*] The System shall provide the System Maintainer the capability to configure which derived waveforms with no related signal detections are stored during automated processing.

S-1408: [*Threshold*] The System shall provide the System Maintainer the capability to configure signal detection parameters per channel.

S-1409: [*Threshold*] The System shall provide the System Maintainer the capability to configure channel detection criteria by time of year.

S-1410: [*Threshold*] The System shall provide the System Maintainer the capability to configure channel detection criteria by time of day.

S-1411: [*Threshold*] The System shall provide the System Maintainer the capability to configure signal processing operations to apply prior to signal detection.

S-1412: [*Threshold*] The System shall provide the System Maintainer the capability to configure signal processing operations to apply prior to signal detection by geographic region.

S-1413: [*Threshold*] The System shall provide the System Maintainer the capability to configure signal processing operations to apply prior to signal detection by station.

S-1429: [*Threshold*] The System shall provide the System Maintainer the capability to configure time domain measurement configuration parameters per channel.

S-1430: [*Threshold*] The System shall provide the System Maintainer the capability to configure time domain measurement configuration parameters by geographic region.

S-1443: [*Threshold*] The System shall provide the System Maintainer the capability to configure polarization feature measurement parameters per channel.

S-1457: [*Threshold*] The System shall provide the System Maintainer the capability to configure frequency domain waveform measurement parameters per channel.

S-1458: [*Threshold*] The System shall provide the System Maintainer the capability to configure frequency domain waveform measurement parameters by geographic region.

S-1473: [*Threshold*] The System shall provide the System Maintainer the capability to configure fk spectra measurement parameters per channel.

S-1474: [*Threshold*] The System shall provide the System Maintainer the capability to configure fk spectra measurement parameters by phase type.

S-1475: [*Threshold*] The System shall provide the System Maintainer the capability to configure if array station waveform data is automatically normalized prior to fk spectra calculations.

S-1476: [*Threshold*] The System shall provide the System Maintainer the capability to configure fk space-based filters.

S-1493: [*Threshold*] The System shall provide the System Maintainer the capability to configure the seismic signal detection grouping criteria.

S-1494: [*Threshold*] The System shall provide the System Maintainer the capability to configure the seismic signal detection phase assignment parameters.

S-1495: [*Threshold*] The System shall provide the System Maintainer the capability to configure seismic signal detection grouping criteria by geographic region.

S-1496: [*Threshold*] The System shall provide the System Maintainer the capability to configure seismic signal detection grouping criteria by station.

S-1497: [*Threshold*] The System shall provide the System Maintainer the capability to configure seismic signal detection phase assignment parameters by station.

S-1498: [*Threshold*] The System shall provide the System Maintainer the capability to configure seismic signal detection phase assignment parameters by geographic region.

S-1520: [*Threshold*] The System shall provide the System Maintainer the capability to configure the signal association event hypothesis formation criteria.

S-1521: [*Threshold*] The System shall provide the System Maintainer the capability to configure the network signal association parameters by station.

S-1522: [*Threshold*] The System shall provide the System Maintainer the capability to configure the network signal association parameters by geographic region.

S-1524: [*Threshold*] The System shall provide the System Maintainer the capability to configure the signal association event hypothesis formation criteria by geographic region.

S-1525: [*Threshold*] The System shall provide the System Maintainer the capability to configure the signal association event hypothesis formation criteria for single station event hypotheses by station.

S-1526: [*Threshold*] The System shall provide the System Maintainer the capability to configure the event hypothesis merge criteria by geographic region.

S-1527: [*Threshold*] The System shall provide the System Maintainer the capability to configure the event quality metric improvement threshold for modifying user-reviewed event hypotheses.

S-1551: [*Threshold*] The System shall provide the System Maintainer the capability to configure by geographic region the parameters used by late network signal association to prevent the formation of event hypotheses previously rejected during Analyst review.

S-1584: [*Threshold*] The System shall provide the System Maintainer the capability to configure the event hypothesis quality metric threshold by geographic region.

S-1603: [*Threshold*] The System shall provide the System Maintainer the capability to configure the criteria used during event hypothesis relocation processing to set the defining/non-defining state for signal detection measurements for event hypothesis relocation by geographic region.

S-1604: [*Threshold*] The System shall provide the System Maintainer the capability to configure the criteria used during event hypothesis relocation processing to set the defining/non-defining state for signal detection measurements for event hypothesis relocation by channel.

S-1633: [*Threshold*] The System shall provide the System Maintainer the capability to configure which types of event hypothesis locations (e.g. restrained event hypothesis locations, unrestrained event hypothesis locations, types of n-locations) to automatically compute for each event hypothesis.

S-1634: [*Threshold*] The System shall provide the System Maintainer the capability to configure which types of event hypothesis locations to automatically compute by geographic region.

S-1655: [*Threshold*] The System shall provide the System Maintainer the capability to configure the types of event hypothesis magnitude estimates to compute for newly computed event hypothesis locations by geographic region.

S-1656: [*Threshold*] The System shall provide the System Maintainer the capability to configure event hypothesis magnitude estimate calculation parameters by channel.

S-1657: [*Threshold*] The System shall provide the System Maintainer the capability to configure event hypothesis magnitude estimate calculation parameters by geographic region.

S-1701: [*Objective / Priority 1*] The System shall provide the System Maintainer the capability to configure the criteria used to determine if a moment tensor solution is automatically computed for an event hypothesis by geographic region.

S-1702: [*Objective / Priority 1*] The System shall provide the System Maintainer the capability to configure the type of ground motion (displacement or velocity) to use for moment tensor calculations by station.

S-1703: [*Objective / Priority 1*] The System shall provide the System Maintainer the capability to configure which stations that have detected an event hypothesis are used in automatically initiated moment tensor calculations by geographic region.

S-1704: [*Objective / Priority 1*] The System shall provide the System Maintainer the capability to configure the filter applied to observed and synthetic waveforms when computing moment tensor solutions.

S-1806: [*Threshold*] The System shall provide the System Maintainer the capability to configure the default earth models used for earth model predictions per observation type.

S-1807: [*Threshold*] The System shall provide the System Maintainer the capability to configure the default earth models used for earth model predictions per station, phase, frequency and channel.

S-1808: [*Threshold*] The System shall provide the System Maintainer the capability to configure station, phase, and frequency dependent correction surfaces for earth model prediction corrections.

S-1809: [*Threshold*] The System shall provide the System Maintainer the capability to configure earth model parameters.

S-1865: [*Threshold*] The System shall provide the System Maintainer the capability to configure the processing time interval and percentage of data available for waveform data processing.

S-1866: [*Threshold*] The System shall provide the System Maintainer the capability to configure the processing time interval for event hypothesis data processing.

S-1867: [*Threshold*] The System shall provide the System Maintainer the capability to configure the initiation of automatic processing based on time intervals.

S-1868: [*Threshold*] The System shall provide the System Maintainer the capability to configure the initiation of automatic processing based on data availability.

S-1869: [*Threshold*] The System shall provide the System Maintainer the capability to configure the initiation of automatic processing based on processing stage completion.

S-1870: [*Threshold*] The System shall provide the System Maintainer the capability to configure groups of operations to run whenever a triggering event specified by the System Maintainer occurs.

S-1880: [*Threshold*] The System shall provide the System Maintainer the capability to configure automated event warning/notification targets as geographic regions defining areas of interest.

S-1913: [*Threshold*] The System shall provide the System Maintainer the capability to configure when multiple Analysts are allowed to concurrently process data based on processing stage.

S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface Guidelines.

S-1949: [*Threshold*] The System shall provide the System Maintainer the capability to configure the triggering event activities recorded in the Operations Log.

S-1954: [*Threshold*] The System shall provide the System Maintainer the capability to configure which System Users are authorized to view the Operations Log.

S-1955: [*Threshold*] The System shall provide the System Maintainer the capability to configure the criteria for failures, warnings and notifications.

S-1957: [*Objective / Priority 1*] The System shall provide the Analyst the capability to enable and disable automatic display synchronization for each display.

S-1961: [*Threshold*] The System shall provide the System User audible and visual cues denoting failures, warnings, and notifications.

S-1981: [*Threshold*] The System shall provide the System Maintainer the capability to configure a geographic region.

S-1983: [*Threshold*] The System shall provide the System Maintainer the capability to configure an active time range of a geographic region.

S-2038: [*Threshold*] The System shall provide the System Maintainer the capability to configure the default defining/non-defining state by geographic region, time of year, network, station, channel, phase, parameter type, and processing function.

S-2083: [*Threshold*] The System shall provide the System Maintainer the capability to configure the parameters the System uses to calculate station ambient noise probability density functions.

S-2185: [*Threshold*] The System shall provide the System Maintainer the capability to configure which user accounts are available (i.e. add and delete user accounts).

S-2206: [*Threshold*] The System shall provide the System Maintainer the capability to configure which user accounts are locked or unlocked.

S-2207: [*Threshold*] The System shall provide the System Maintainer the capability to configure temporary user passwords.

S-2261: [*Threshold*] The System shall provide the System Maintainer the capability to configure the waveform and processing results data to send to the SUS/TST Subsystem.

S-2348: [*Threshold*] The System shall provide the System Maintainer the capability to configure subspace waveform correlators.

S-2349: [*Threshold*] The System shall provide the System Maintainer the capability to configure single channel waveform correlators.

S-2350: [*Threshold*] The System shall provide the System Maintainer the capability to configure multi-component waveform correlators.

S-2351: [*Threshold*] The System shall provide the System Maintainer the capability to configure array station waveform correlators.

S-2352: [*Threshold*] The System shall provide the System Maintainer the capability to configure the dynamic waveform correlation search parameters the System uses to find previously analyzed event hypotheses occurring at locations near an event hypothesis.

S-2353: [*Threshold*] The System shall provide the System Maintainer the capability to configure the dynamic waveform correlation search parameters by geographic region.

S-2412: [*Threshold*] The System shall provide the System Maintainer the capability to configure hydroacoustic signal detection grouping criteria by geographic region.

S-2413: [*Threshold*] The System shall provide the System Maintainer the capability to configure hydroacoustic signal detection grouping criteria by station.

S-2418: [*Threshold*] The System shall provide the System Maintainer the capability to configure waveform filters by channel.

S-2422: [*Threshold*] The System shall provide the System Maintainer the capability to configure 3-component seismic waveform rotations by station.

S-2424: [*Threshold*] The System shall provide the System Maintainer the capability to configure array station beams by station.

S-5557: [*Threshold*] The System shall provide the System Maintainer the capability to configure whether the Analyst can interrupt automated event hypothesis processing.

S-5620: [*Threshold*] The System shall provide the System Maintainer the capability to configure the event hypothesis quality metric threshold.

S-5627: [*Threshold*] The System shall provide the System Maintainer the capability to configure the hydroacoustic signal detection phase assignment parameters.

S-5628: [*Threshold*] The System shall provide the System Maintainer the capability to configure hydroacoustic signal detection phase assignment parameters by station.

S-5629: [*Threshold*] The System shall provide the System Maintainer the capability to configure hydroacoustic signal detection phase assignment parameters by geographic region.

S-5635: [*Threshold*] The System shall provide the System Maintainer the capability to configure infrasonic phase grouping criteria.

S-5636: [*Threshold*] The System shall provide the System Maintainer the capability to configure infrasonic phase grouping criteria by station

S-5639: [*Threshold*] The System shall provide the System Maintainer the capability to configure the infrasound signal detection phase assignment parameters.

S-5640: [*Threshold*] The System shall provide the System Maintainer the capability to configure infrasound signal detection phase assignment parameters by station.

S-5643: [*Objective / Priority 1*] The System shall provide the System Maintainer the capability to configure the microbarom identification parameters.

S-5695: [*Threshold*] The System shall provide the System Maintainer the capability to configure access control for System Users by roles and privileges.

S-5696: [*Threshold*] The System shall provide the System Maintainer the capability to configure the access control for Authorized External Users by roles and privileges.

S-5719: [*Threshold*] The System shall provide the System Maintainer the capability to configure the parameters used to calculate spectrograms per channel.

S-5721: [*Threshold*] The System shall provide the System Maintainer the capability to configure the parameters used to calculate power spectral density for any channel.

S-5789: [*Threshold*] The System shall provide the System Maintainer the capability to configure for which phases and stations to automatically create origin beams.

S-5936: [*Threshold*] The System shall provide the System Maintainer the capability to configure on a channel basis whether waveform data with a specific type of QC mask is processed.

S-6195: [*Threshold*] The System shall provide the System Maintainer the capability to configure the dispersion models to be used for phase match filtering.

S-6202: [*Threshold*] The system shall provide the System Maintainer the capability to configure a set of pre-defined filters for Analyst application to waveforms.

S-6470: [*Threshold*] The System shall provide the System Maintainer the capability to configure detection feature map calculations per station.

S-6482: [*Threshold*] The System shall provide the System Maintainer the capability to configure how often the System computes station quality metrics.

S-6483: [*Threshold*] The System shall provide the System Maintainer the capability to configure for which raw channels and derived channels the System computes the station quality metric.

S-6520: [*Threshold*] The System shall provide the System Maintainer the capability to configure how the System uses seed events to build new events.

S-6524: [*Threshold*] The System shall provide the System Maintainer the capability to configure how the System creates seed events from event bulletins.

IDC Specific:
S-5595: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure Waveform QC Mask processing parameters on a per station basis.

S-5606: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure seismic stations as either primary or auxiliary.

S-5734: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure the event parameters that can be automatically corrected by the System.

S-5743: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure which screening criterion to calculate for each event.

S-5746: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure which individual screening criteria numerical metric scores are combined to calculate an overall screening category.

S-5833: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure the minimum number of event location defining primary stations as part of the event consistency calculation.

S-5834: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure a threshold value of the sum of weights for location defining signal detections as part of the event consistency calculation.

S-5835: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure an expected list of phases at each station as a function of event location and magnitude as part of the event consistency calculation.

S-5836: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure an expected set of observing stations as a function of event location and magnitude as part of the event consistency calculation.

S-5837: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure the station magnitude consistency with network magnitude range.

S-5838: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure allowed values for time, azimuth, slowness defining settings per associated signal detection as part of the event consistency calculation.

S-5839: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure the threshold value for time, azimuth, and slowness residuals for location defining associated signal detections as part of the event consistency calculation.

S-5842: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure the threshold number of location defining signal detections for deep events as part of the event consistency calculation.

S-5845: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure a threshold values of the difference between ML and mb magnitudes as part of the event consistency calculation.

S-5848: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure what geographic regions are known to have deep seismicity as part of the event consistency calculation.

S-5850: [*IDC only, Threshold*] The System shall provide the System Maintainer the capability to configure the threshold value for time, azimuth, and slowness residuals for location non-defining associated signal detections as part of the event consistency calculation.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

System Configuration - The complete set of parameters that define the operation of the System software for one subsystem (OPS, ALT, DEV, SUS). Examples include sensor thresholds, filters (see filter, waveform), the particular version of an earth model in use, and processing sequences. Each instance of a system configuration is saved so the state of all parameters at any time can be recalled.

IDC Specific:
None.

NOTES

General:
1. Several items on the System can be configured. The UCs listed below describe how various items are configured:

- Configures Station Usage UC
- Configures Processing Components UC

- Defines Processing Sequence UC
- Controls Data Acquisition UC
- Configures System Permissions UC
- Configures Analysis Interfaces UC
- Views Messages UC

2. The System User can only see the configuration of the subsystem where the UC is being run. There is no capability to compare configurations between subsystems with this UC. However, the System User may export configurations from multiple subsystems (see 'Exports Data' UC) and compare them using offline tools.
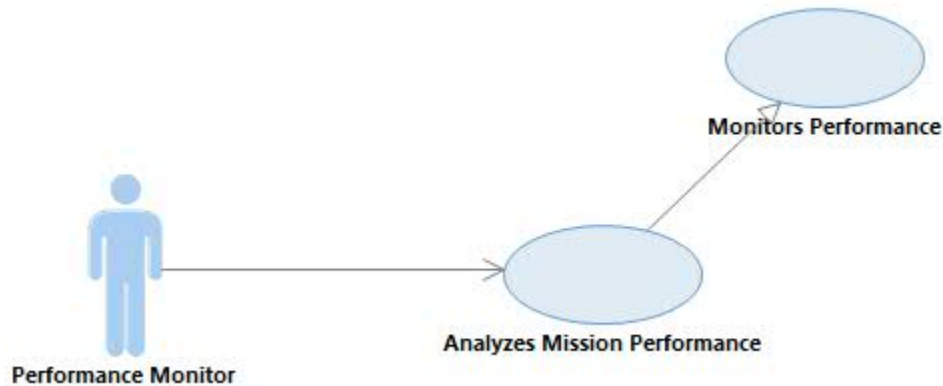

IDC Specific:
None.

OPEN ISSUES

None.

UC-07.01 Analyzes Mission Performance

USE CASE DIAGRAM

BRIEF DESCRIPTION

This architecturally significant use case describes how the Performance Monitor views metrics to verify the correct overall mission processing performance of the System. The trends highlighted by these metrics build confidence in the Performance Monitor that the station processing of signal detections and the network processing and association of these signals into events has been performing correctly over time. The Performance Monitor can drill down into the trended metric data to further investigate potential problems and gather information that informs corrective actions (addressed under the 'Configures System' use cases). The Performance Monitor may also view the usage of the individual Analyst Tools to assess their relative utility and need.

This use case is architecturally significant because it describes the display and analysis of a rich set of metrics to assess System mission performance and tune the System.

ACTOR DESCRIPTIONS

Performance Monitor - The Performance Monitor actor is a System User who monitors performance of the System.
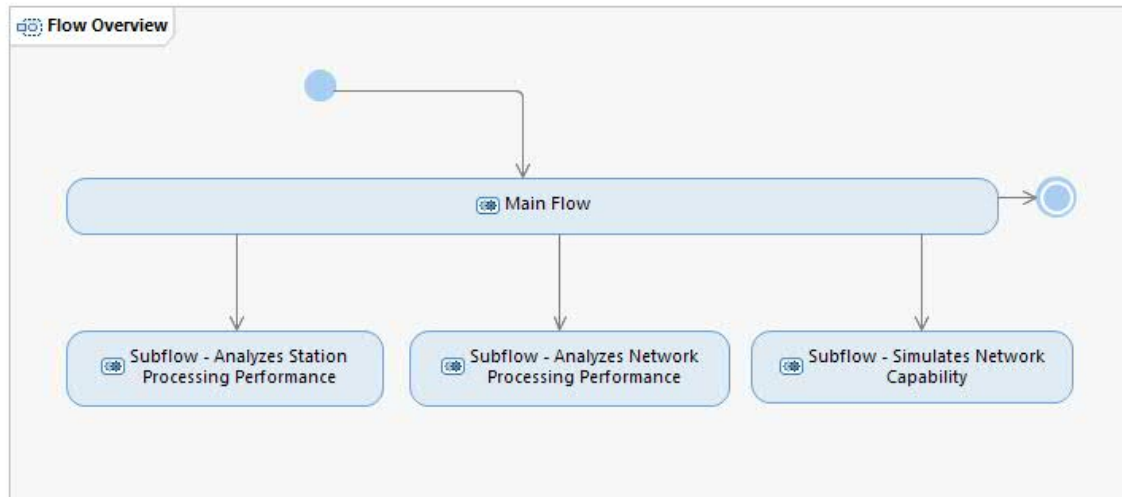
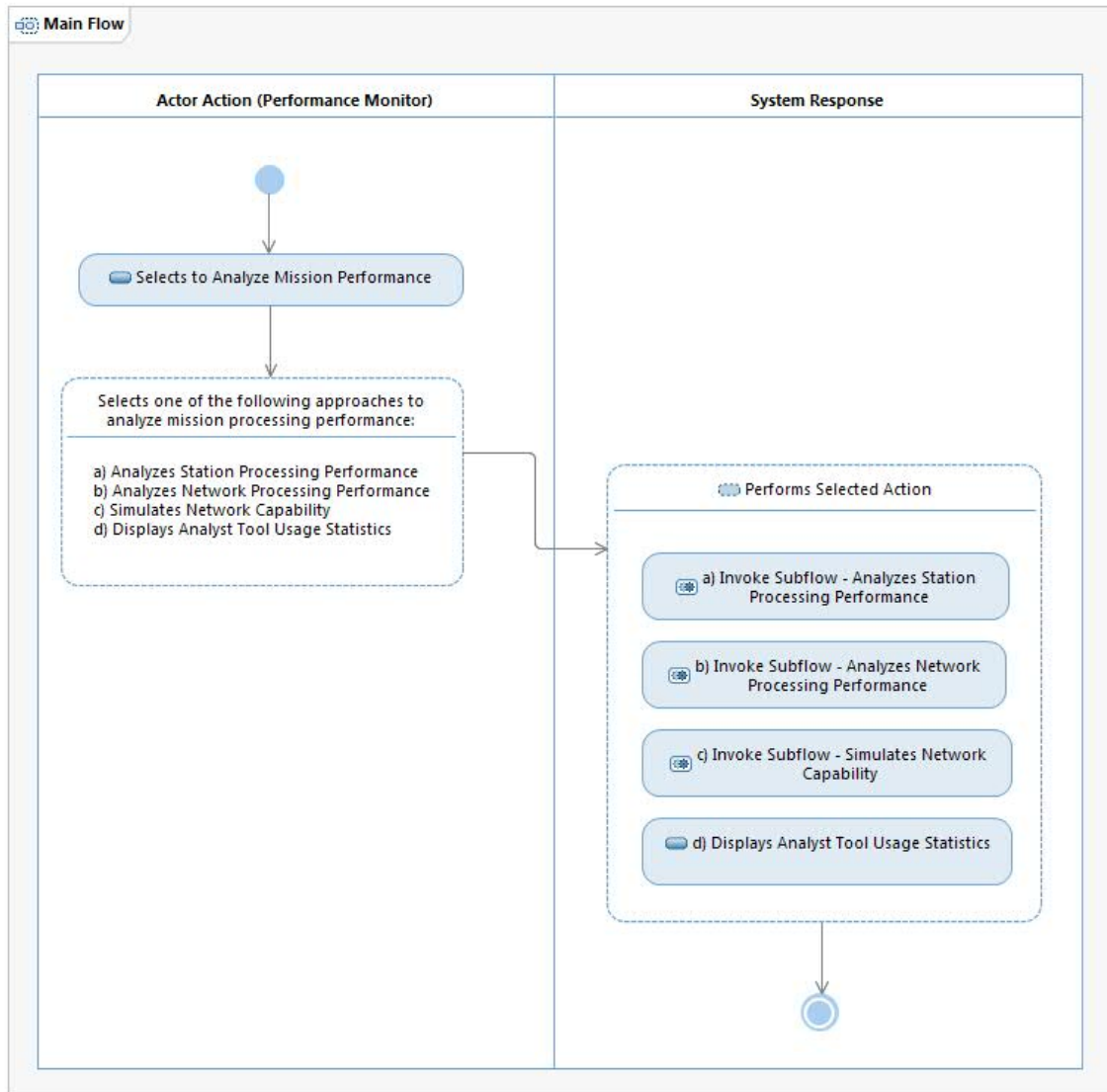## PRECONDITIONS

None.

POSTCONDITIONS

None.

ACTIVITY DIAGRAMS

Flow Overview

Main Flow

Main Flow

| Actor Action (Performance Monitor) | System Response |

Selects to Analyze Mission Performance

Selects one of the following approaches to analyze mission processing performance:

a) Analyzes Station Processing Performance
b) Analyzes Network Processing Performance
c) Simulates Network Capability
d) Displays Analyst Tool Usage Statistics

Performs Selected Action

a) Invoke Subflow - Analyzes Station Processing Performance

b) Invoke Subflow - Analyzes Network Processing Performance

c) Invoke Subflow - Simulates Network Capability

d) Displays Analyst Tool Usage Statistics

Action Descriptions

Action: "Selects one of the following approaches to analyze mission processing performance:"

a) Analyzes Station Processing Performance
b) Analyzes Network Processing Performance
c) Simulates Network Capability
d) Displays Analyst Tool Usage Statistics

Action: "Performs Selected Action"

There are four aspects to analyzing mission performance, three of which are captured by separate subflows.

a) The Performance Monitor verifies the Station Processing is correctly processing the raw waveform data from each station and is appropriately detecting signals.

143

b) The Performance Monitor verifies the Network Processing is correctly deriving events by associating related signal detections from the network of seismic stations and producing events of acceptable quality.
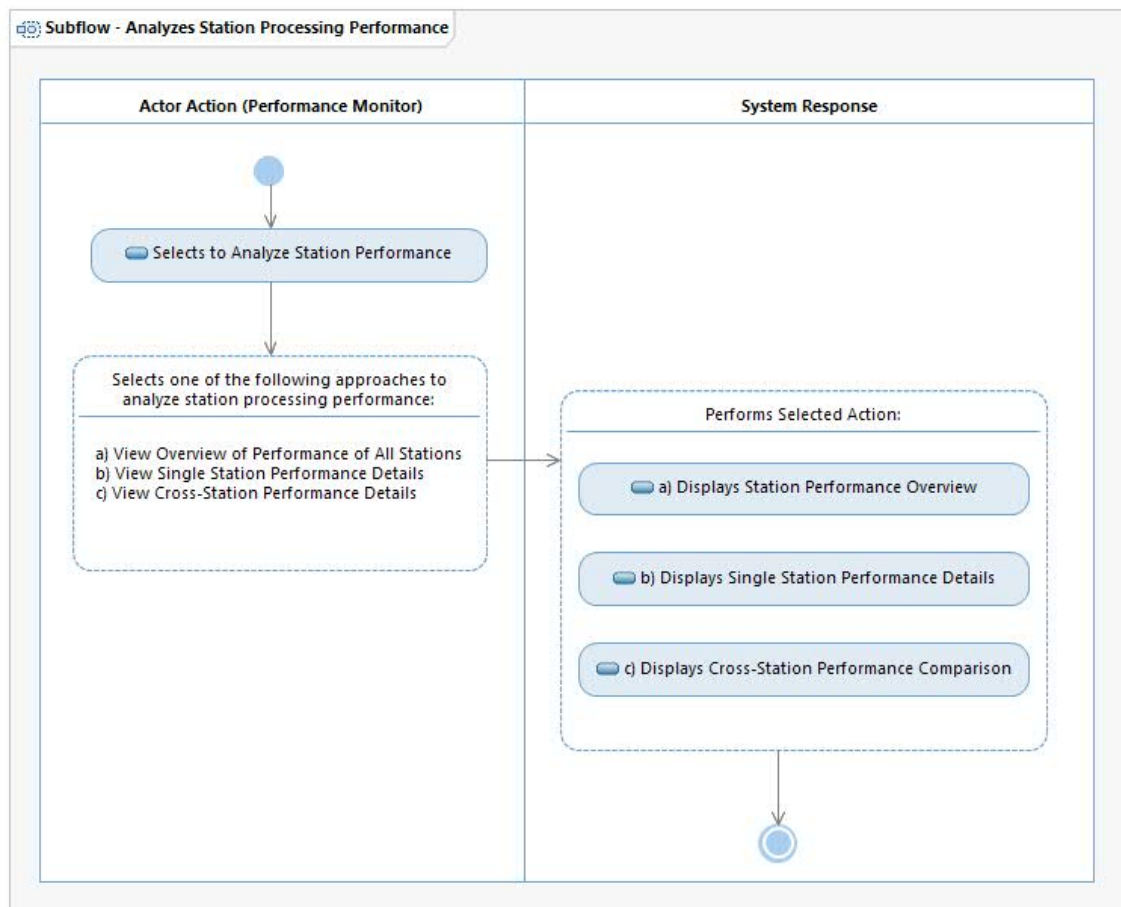
c) The Performance Monitor analyzes the network capability via a simulation to determine the minimum detectable magnitude for various configurations. While technically this is related to analysis of the Network Processing, it is sufficiently complicated to warrant its own separate subflow.

d) The Performance Monitor displays Analyst Tool Usage Statistics to assess their relative utility and need.

Alternate Flows
1. Any actor action - The Performance Monitor may choose to cancel the request to analyze mission performance, in which case this use case ends.

Subflow - Analyzes Station Processing Performance

Action Descriptions
Action: "Selects to Analyze Station Performance"
The Performance Monitor selects to monitor the availability and quality of the raw waveform data from each station and to verify the Station Processing is appropriately detecting signals from the waveform data.

Action: "Selects one of the following approaches to analyze station processing performance:"
a) View Overview of Performance of All Stations
The Performance Monitor selects to monitor the availability and quality of the raw waveform data and to verify the Station Processing is appropriately detecting signals from the waveform data for all stations.

b) View Single Station Performance Details
The Performance Monitor selects to view all available Station Processing performance metrics from a single station.

c) View Cross-Station Performance Details
The Performance Monitor selects to view a single Station Processing performance metric and how it compares across a selection of stations.

Action: "a) Displays Station Performance Overview"
The System displays an overview of performance metric plots from all stations. The System updates the plots as new data are available.

Available metric plots include:
  - Waveform Latency/Completeness vs. Time
  - Waveform Amplitude vs. Time
  - Power Spectral Density
  - Station Magnitude Relative to Network
  - Station Quality vs. Time
  - Number of Detections over Time

Action: "b) Displays Single Station Performance Details"
The System displays a Single Station Performance display showing all metric plots available for a single station. The System updates the plots as new data are available.

Action: "c) Displays Cross-Station Performance Comparison"
The System displays a Cross Station Performance Comparison display showing single metric plots from a selection of available stations. The System updates the plots as new data are available.

Alternate Flows
1. Any actor action - The Performance Monitor may choose to stop analyzing station processing performance, in which case this subflow ends and returns to the main flow.

Subflow - Analyzes Network Processing Performance
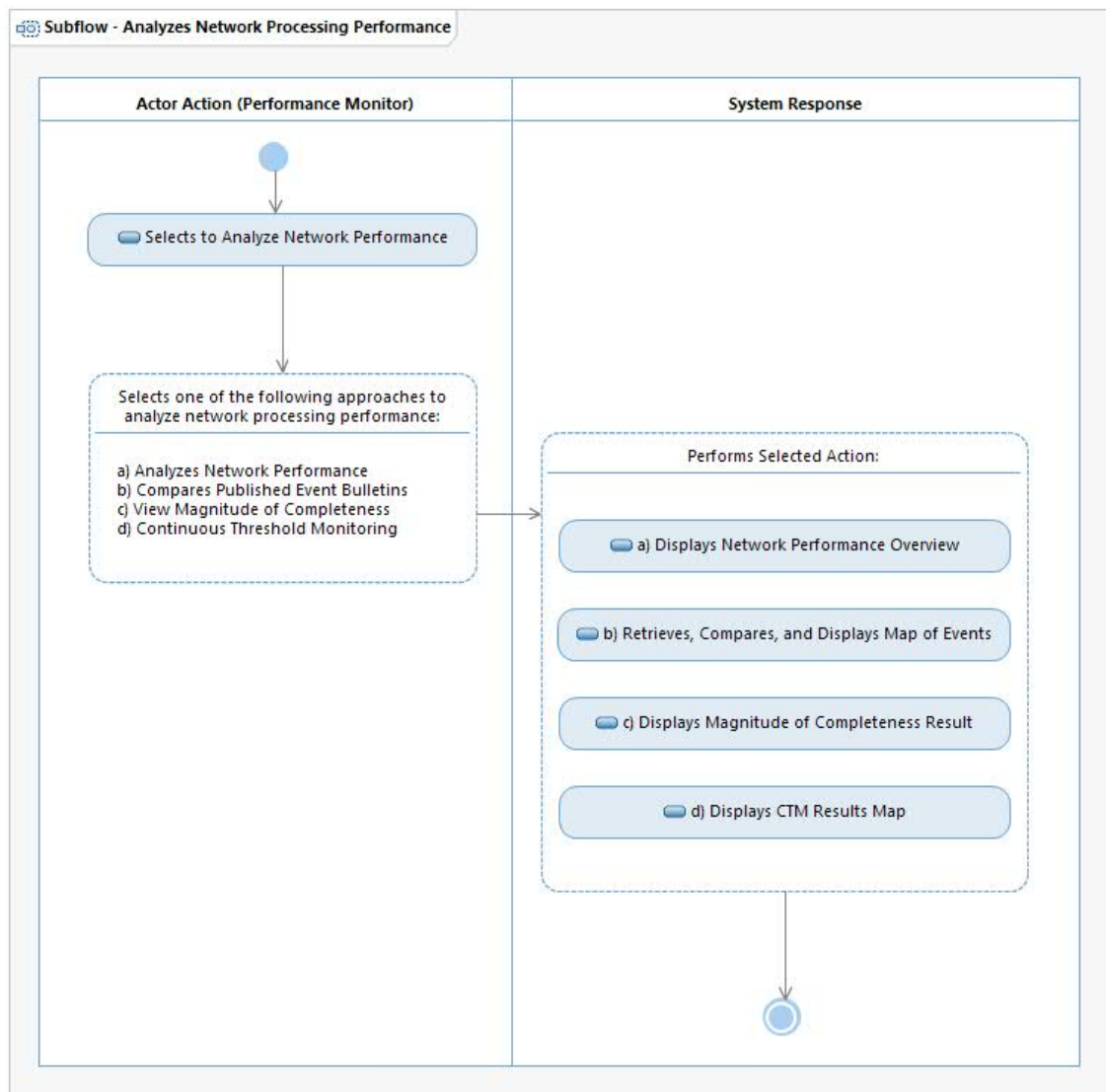
Action Descriptions

Action: "Selects one of the following approaches to analyze network processing performance:"

a) Analyzes Network Performance

The Performance Monitor selects to see an at-a-glance dashboard showing network processing performance metrics.

b) Compares Published Event Bulletins

The Performance Monitor selects event bulletins by geographic region, and by time period - current vs. historic. The Performance Monitor may also select event bulletins to compare with such as by analyst or by event bulletin source.

c) View Magnitude of Completeness

The Performance Monitor selects to view magnitude of completeness. The Performance Monitor selects station(s), time period (current vs. historic information), and geographic region in order to view network magnitude detection thresholds.

d) Continuous Threshold Monitoring
The Performance Monitor selects to compare the performance of one network over time. The Performance Monitor selects station(s), time period (current vs. historic information), and sets a spatial and temporal resolution of the desired Continuous Threshold Monitoring calculation.

Action: "a) Displays Network Performance Overview"
The System displays an overview of network performance metric plots. The System updates the plots as new data are available.

Available metric plots include:
  - Number of events from each stage vs. Time
  - Raw magnitude variances between processing stages
  - Magnitude residuals between processing stages
  - Location changes between processing stages

Action: "b) Retrieves, Compares, and Displays Map of Events"
The System compares the selected event bulletins, characterizes their differences such as event location, depth, and associations and performs statistical comparisons. The event bulletin locations are displayed on a map for comparison. Bulletins seen by only one system or the other are highlighted, while bulletins seen by both systems can be compared. For historical event bulletins, the System displays System Configuration information exhibiting when configuration changes occurred and installations performed.

Action: "c) Displays Magnitude of Completeness Result"
The System retrieves and displays the network magnitude detection threshold statistics based on empirical estimates from detected events and continuous thresholds monitoring results. For historical network magnitude detection threshold statistics, the System displays System Configuration information exhibiting when configuration changes occurred and installations performed.
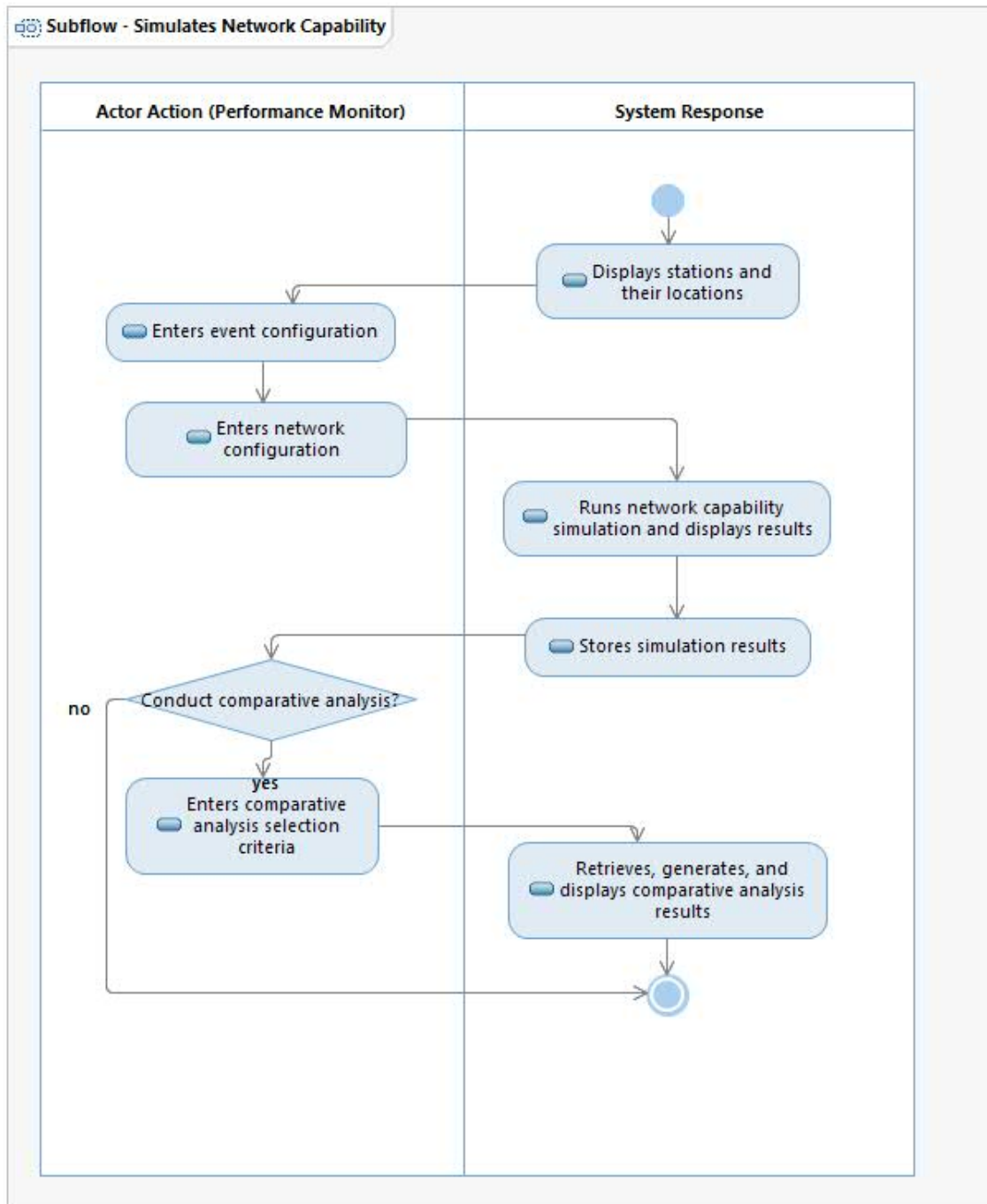
Action: "d) Displays CTM Results Map"
The System displays a map showing the computed minimum detectable magnitudes.

Alternate Flows
1. Any actor action - The Performance Monitor may choose to stop analyzing network processing performance, in which case this subflow ends and returns to the main flow.

Subflow - Simulates Network Capability

Subflow - Simulates Network Capability

| Actor Action (Performance Monitor) | System Response |

Displays stations and their locations

Enters event configuration

Enters network configuration

Runs network capability simulation and displays results

Stores simulation results

Conduct comparative analysis?

no

yes

Enters comparative analysis selection criteria

Retrieves, generates, and displays comparative analysis results

Action Descriptions
Action: "Displays stations and their locations"
The System displays a global view of all stations and their locations.

Action: "Enters event configuration"
The Performance Monitor specifies the event time, magnitude, type, and location to simulate the probability of event detection and event detection thresholds.

148

Action: "Enters network configuration"
The Performance Monitor enters network configuration for existing and notional stations, which stations are part of the simulation, signal detectors they use, location, noise levels, path decay, station uptime, and blockage information.

Action: "Runs network capability simulation and displays results"
The System runs the network capability simulation and displays event detection capability or predicted event location uncertainty.

Action: "Enters comparative analysis selection criteria"
The Performance Monitor selects to compare the current simulation results against previous simulations or empirical network detection threshold statistics.

Action: "Retrieves, generates, and displays comparative analysis results"
The System generates and displays comparative analysis for the entered analysis criteria both in tabular and graphical format.

Alternate Flows
1. Action "Enters event configuration" - The Performance Monitor may cancel the entering of event parameters, in which case flow returns to this flow's "Displays stations and their locations."

2. Action "Enters network configuration" - The Performance Monitor may cancel the entering of network configuration, in which case flow returns to this flow's "Displays stations and their locations."

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1150: [*Threshold*] The System shall provide the System User the capability to view the data completeness states of raw channels on the OPS Subsystem Data Acquisition Partition.

S-1151: [*Threshold*] The System shall provide the System User the capability to view the data completeness states of raw channels on the OPS Subsystem Data Processing Partition.

S-1152: [*Threshold*] The System shall provide the System User the capability to view the data completeness states of raw channels on the ALT Subsystem Data Acquisition Partition.

S-1153: [*Threshold*] The System shall provide the System User the capability to view the data completeness states of raw channels on the ALT Subsystem Data Processing Partition.

S-1154: [*Threshold*] The System shall provide the System User the capability to view the real-time data acquisition status of raw channels.

S-1155: [*Threshold*] The System shall provide the System User the capability to view the real-time mission capability state of each station.

S-1189: [*Objective / Priority 1*] The System shall provide the System User the capability to view acquired station State-of-Health data.

S-1285: [*Threshold*] The System shall provide the Analyst the capability to view the Waveform QC Masks that were active at a user specified date and time.

S-1292: [*Threshold*] The System shall provide the System User the capability to compare Waveform QC Masks generated by each processing stage for selected points in the processing history.

S-1293: [*Threshold*] The System shall provide the System User the capability to compare Waveform QC Masks generated by each Subsystem for selected points in the processing history.

S-1574: [*Threshold*] The System shall provide the System User the capability to view station quality metrics.

S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface Guidelines.

S-2019: [*Threshold*] The System shall provide the System User the capability to access third-party event bulletins in the same way they access event bulletins produced by the System.

S-2084: [*Threshold*] The System shall provide the Performance Monitor the capability to select thresholds for station processing statistics.

S-2085: [*Threshold*] The System shall provide the Performance Monitor the capability to select the time interval used for computing station processing statistics.

S-2086: [*Threshold*] The System shall provide the Performance Monitor the capability to select the computation of station processing statistics based on geographic region.

S-2087: [*Threshold*] The System shall provide the Performance Monitor the capability to select the geographic regions the System uses to compute empirical station magnitude detection thresholds.

S-2088: [*Threshold*] The System shall provide the Performance Monitor the capability to select by geographic region the distance range the System uses to compute the station magnitude detection thresholds for aseismic regions.

S-2089: [*Threshold*] The System shall provide the Performance Monitor the capability to select the temporal range used to compute the station magnitude detection threshold for a specific geographic region

S-2091: [*Threshold*] The System shall provide the System User the capability to view real-time estimates of event detection probability at a specified magnitude based on empirical and model based parameters.

S-2092: [*Threshold*] The System shall provide the System User the capability to view real-time estimates of event location uncertainty based on empirical and model based parameters.

S-2094: [*Threshold*] The System shall provide the Performance Monitor the capability to select the models to be used for network capability simulation.

S-2095: [*Threshold*] The System shall provide the Performance Monitor the capability to select the parameters to be used for network capability simulation.

S-2096: [*Threshold*] The System shall provide the Performance Monitor the capability to select the network configuration to be used for network capability simulation.

S-2098: [*Threshold*] The System shall provide the System User the capability to compare current station ambient noise probability density functions with the station's ambient noise probability density functions from other (up to 5) selectable time periods concurrently.

S-2105: [*Threshold*] The System shall provide the Performance Monitor the capability to view tables of station processing statistics.

S-2106: [*Threshold*] The System shall provide the System User the capability to graphically view station processing statistics.

S-2107: [*Threshold*] The System shall provide the Performance Monitor the capability to simultaneously view station processing statistics, the processing parameters used to compute those statistics, and the dates and times of changes to those processing parameters.

S-2109: [*Threshold*] The System shall provide the Performance Monitor the capability to compare a current station statistic with other (up to 5) selectable time periods concurrently.

S-2110: [*Threshold*] The System shall provide the System User the capability to view station magnitude detection thresholds computed for a geographic region.

S-2111: [*Threshold*] The System shall provide the System User the capability to compare two event bulletins for signal detection characteristics of two event hypotheses.

S-2112: [*Threshold*] The System shall provide the System User the capability to compare two event bulletins for the characteristics of two event hypotheses.

S-2113: [*Threshold*] The System shall provide the System User the capability to perform statistical comparisons between two event bulletins.

S-2114: [*Threshold*] The System shall provide the System User the capability to view event hypothesis statistics for a user specified geographic region for a specified time period.

S-2146: [*Objective / Priority 1*] The System shall provide the System User the capability to view Analyst Application usage statistics.

S-5723: [*Threshold*] The System shall provide the System User the capability to compare current station spectrograms with the station's spectrograms from other (up to 5) selectable time periods concurrently.

S-5724: [*Threshold*] The System shall provide the System User the capability to compare current station power spectral density with the station's power spectral density from other (up to 5) selectable time periods concurrently.

S-6432: [*Threshold*] The System shall provide the System User the capability to view a list of events containing the events created in any processing stage (automatic or interactive) that forms events.

IDC Specific:
None.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Event Bulletin - A list of event hypothesis location solutions, with or without the associated signal detections. The primary product of most seismic monitoring agencies (e.g., IDC, National Earthquake Information Center [NEIC]) is an event bulletin. Event bulletins can be constrained by region, by time, by magnitude, etc.

Event Hypothesis - A proposed solution for an Event. Each event consists of a sequence of event hypotheses that describe an evolution to a final best model of the event. Each event hypothesis is composed of a set of associated signal detections and has one or more event hypothesis location solutions, one of which must be designated as preferred.

Event Magnitude, Network - An estimate of the size of a seismic event determined by combining the set of available station event magnitudes (see event magnitude, station). Separate network event magnitudes can be calculated for each available station magnitude type (e.g., mb, Ms).

Event Magnitude, Station - An estimate of the size of a seismic event determined by processing the waveform data recorded by one station. Separate station event magnitudes can be calculated for different magnitude types (e.g., mb, Ms).

Monitoring Mission Performance - A measure of how well the System is performing the monitoring mission. This is based on the System's metrics and statistics supporting sensor state-of-health, geophysical network capability, algorithmic performance, and detected event statistics.

Network - A group of stations used for monitoring. For example, the IMS network is the group of stations used by the IDC to monitor the CTBT. Spacing between stations in a network is much larger than in an array, and array processing techniques are generally not applied across a network.

Network Magnitude Detection Threshold - The geographically varying magnitude below which events monitored by a specified network can no longer be detected with a specified level of confidence (generally 90% or 95%). This threshold can either be determined empirically (if a sufficient number of events spanning a range of sizes have occurred in a region) or by modeling.

Station Magnitude Detection Threshold - The geographically-varying event magnitude below which a station is not expected to detect events. This can be empirically estimated as the magnitude at which a station's signal detections no longer follow the Gutenberg & Richter frequency-magnitude relationship, predicting that for every decrease in size of 1 magnitude unit, the number of events detected should increase by a factor of 10. The highest magnitude at which a station's detected events deviate from this prediction indicates the threshold below which the station does not detect events presumed to have occurred.

System Configuration - The complete set of parameters that define the operation of the System software for one subsystem (OPS, ALT, DEV, SUS). Examples include sensor thresholds, filters (see filter, waveform), the particular version of an earth model in use, and processing sequences. Each instance of a system configuration is saved so the state of all parameters at any time can be recalled.

IDC Specific:
None.

NOTES

General:
1. The Performance Monitor can generate reports for any of the analysis done in this use case.

2. The Performance Monitor may view and analyze meteorological data when it has been acquired as a raw channel from stations.

IDC Specific:
1. For a description of station SOH items of interest for the IDC, see the description of the CDqual tool in the CD Tools Software User Guide, QCTOOL Software Design Description, and QCTOOL Software User Tutorial.

2. Examples of the metrics collected on the current IDC system are listed in the International Data Centre (IDC) Monthly Performance Report.
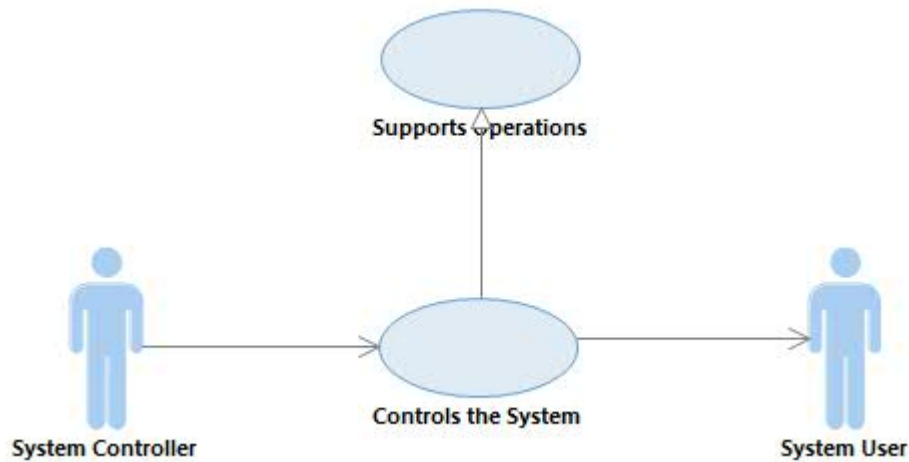
OPEN ISSUES

None.

UC-08.02 Controls the System

USE CASE DIAGRAM

BRIEF DESCRIPTION

This architecturally significant use case describes how the System Controller starts and stops the System, and switches pipeline processing from the Primary to the Backup. When the System Controller starts the System, the System data processing starts and automatically accepts connections for acquiring data. The Primary synchronizes processing results with the Backup (see 'Synchronizes Processing Results' UC). When the System Controller stops the System, the System data processing stops and automatically disconnects all incoming data connections and outgoing data connections. When the System Controller switches pipeline processing to the Backup, the Backup becomes the Primary.

This use case is architecturally significant due to the System's timeliness requirements to start and stop the System and to transfer mission assignment from the Primary to the Backup.

ACTOR DESCRIPTIONS

System Controller - The System Controller actor is a System User who monitors and controls the System and external data connections.

System User - The System User actor is any internal user who accesses the System.

PRECONDITIONS

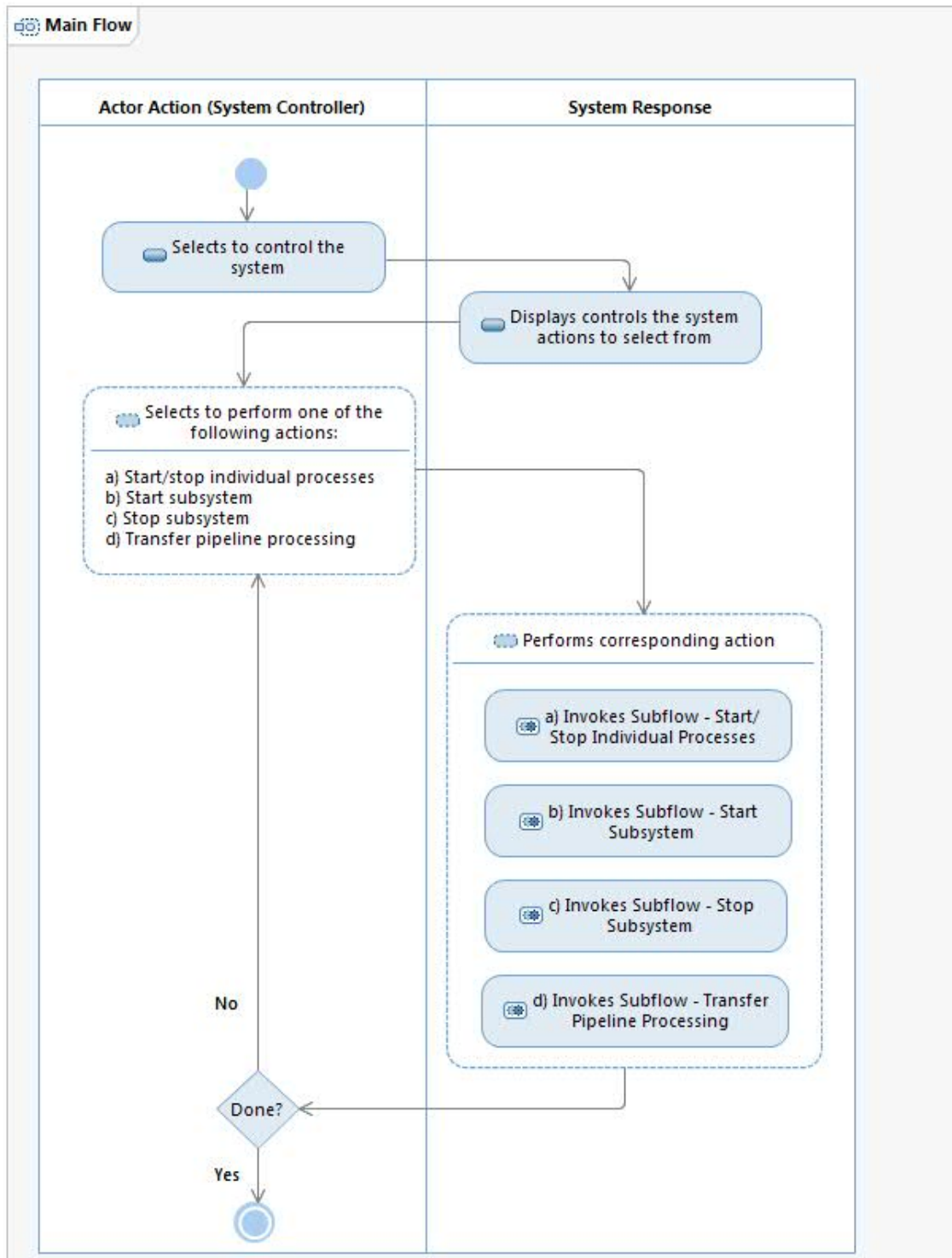1. The subsystem hardware is assumed to be turned on.

POSTCONDITIONS

None.

ACTIVITY DIAGRAMS

Flow Overview

Main Flow

Main Flow

Actor Action (System Controller)	System Response

Selects to control the system

Displays controls the system actions to select from

Selects to perform one of the following actions:

a) Start/stop individual processes
b) Start subsystem
c) Stop subsystem
d) Transfer pipeline processing

Performs corresponding action

a) Invokes Subflow - Start/Stop Individual Processes

b) Invokes Subflow - Start Subsystem

c) Invokes Subflow - Stop Subsystem

d) Invokes Subflow - Transfer Pipeline Processing

No

Done?

Yes

Action Descriptions
None.
Alternate Flows
1. Action "Selects to perform one of the following actions" - The System Controller may cancel, in which case this use case ends.

158

Subflow - Start/Stop Individual Processes
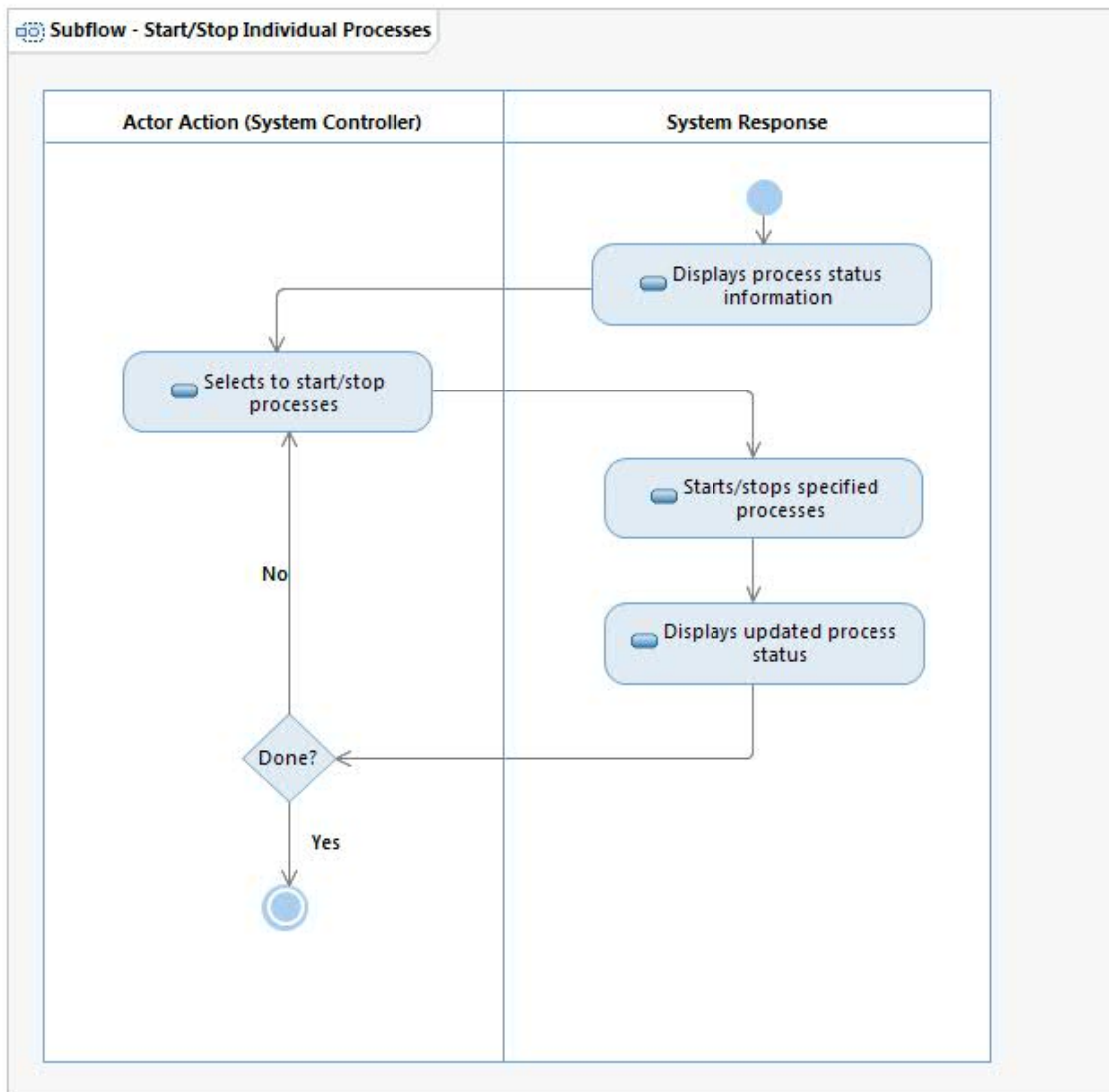
Action Descriptions

Action: "Displays process status information"

The System displays status of system processes, grouped by computing node and workstation. The displayed status includes process state (e.g., running/not running), memory usage, CPU usage, etc.

Action: "Selects to start/stop processes"

The System Controller selects to start or stop specific processes. For cases where the System runs multiple instances of a given process, the System Controller can specify whether to start/stop all instances or only specific instances.

Action: "Starts/stops specified processes"

The System starts or stops all of the processes specified by the System Controller.

Action: "Displays updated process status"

159

The System displays the new status of the processes that were started or stopped.

Alternate Flows
1. Action "Selects to start/stop processes" - The System Controller may cancel, in which case this subflow ends, and returns to the Main Flow.

2. Action "Start/stops specified process" - If any processes fail to start or cleanly terminate, the System logs the failures and notifies the System Controller.

Subflow - Start Subsystem
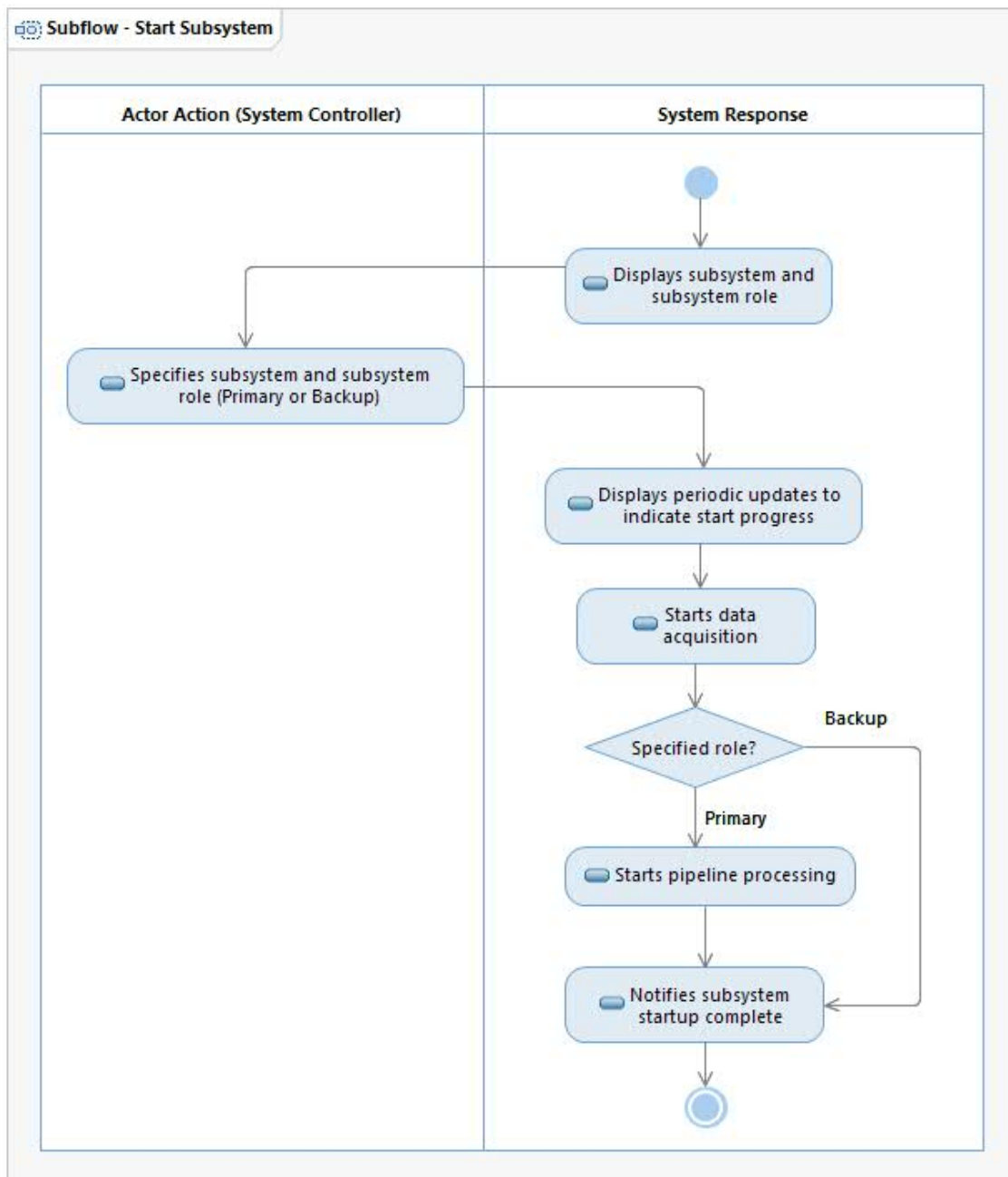
Action Descriptions
Action: "Specifies subsystem and subsystem role (Primary or Backup)"
The System Controller specifies the subsystem to start and the role to start it in (Primary or Backup).

Action: "Displays periodic updates to indicate start progress"
The System periodically displays progress updates to the System Controller.

Action: "Starts data acquisition"

The System starts all data acquisition processes for the subsystem.

Decision: "Specified role?"
The System checks which role the System Controller specified to start the subsystem.

Action: "Starts pipeline processing"
The System starts all pipeline processes for the subsystem.

Action: "Notifies subsystem startup complete"
The System notifies the System Controller the subsystem startup is complete.

Alternate Flows
1. Action "Specifies subsystem and subsystem role (Primary or Backup)" - The System Controller may cancel, in which case this flow ends, and returns to the Main Flow.

2. Action "Starts data acquisition" – The System Controller may set the station data transmission destination to the OPS Subsystem or ALT Subsystem as appropriate for each station (see 'Controls Data Acquisition' UC).

3. Actions "Starts data acquisition" and "Starts pipeline processing" - If any processes cannot be started the System logs the failures and notifies the System Controller.

Subflow - Stop Subsystem
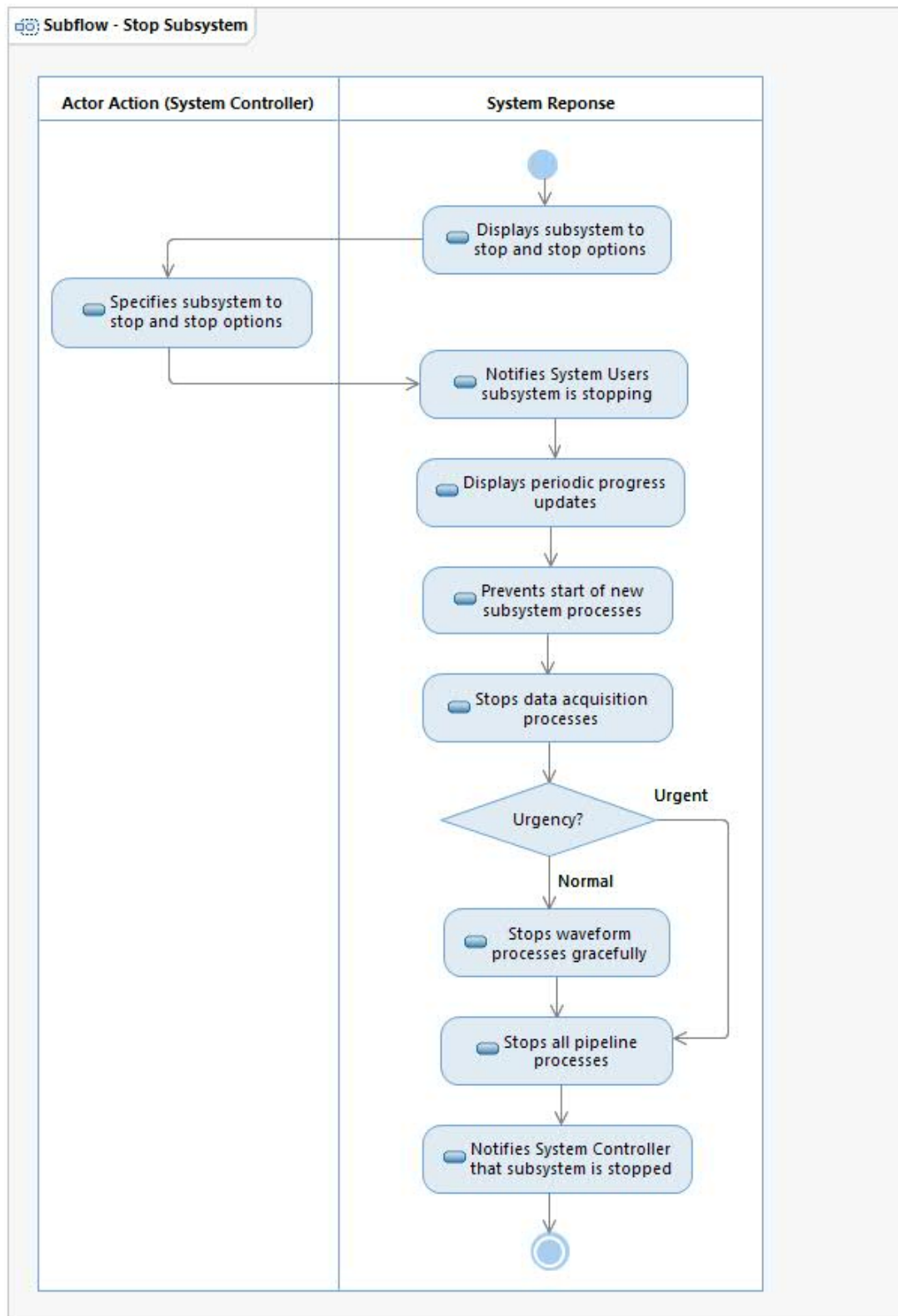
Action Descriptions

Action: "Specifies subsystem to stop and stop options"
The System Controller specifies subsystem to stop and the following option:

1. Urgency of stop (Normal or Urgent). A Normal stop guarantees waveform processing results are stored. An Urgent stop is faster but does not provide the same guarantee, which means the System will need to repeat that waveform processing when the subsystem is restarted.

Action: "Notifies System Users subsystem is stopping"
The System notifies System Users that the subsystem is stopping and gives logged on users an allotted amount of time to log off.

Action: "Displays periodic progress updates"
The System displays periodic progress updates regarding the subsystem stop to the System Controller.

Action: "Prevents start of new subsystem processes"
The System prevents the start of new automatic processing within the subsystem.

Decision: "Urgency?"
The System checks to see what urgency the System Controller specified (Normal or Urgent).

Action: "Stops waveform processes gracefully"
The System waits for all in progress waveform processing to complete to ensure subsequent processing can pick up where it left off when the subsystem is started again.

Action: "Stops all pipeline processes"
The System stops all processes in the automatic pipeline for the subsystem.

Action: "Notifies System Controller that subsystem is stopped"
The System notifies the System Controller that the subsystem is stopped.

Alternate Flows
1. Action "Specifies subsystem to stop and stop options" - The System Controller may cancel, in which case this flow ends, and returns to the Main flow.

2. Action "Stops waveform processes gracefully" - If the waveform processes have not completed gracefully after a certain time period, the System stops the waveform processes forcibly, logs the failure, and notifies the System Controller.

3. Actions "Stops all pipeline processes" and "Stops data acquisition processes" - If a process fails to stop, the System logs the failure and notifies the System Controller.

Subflow - Transfer Pipeline Processing
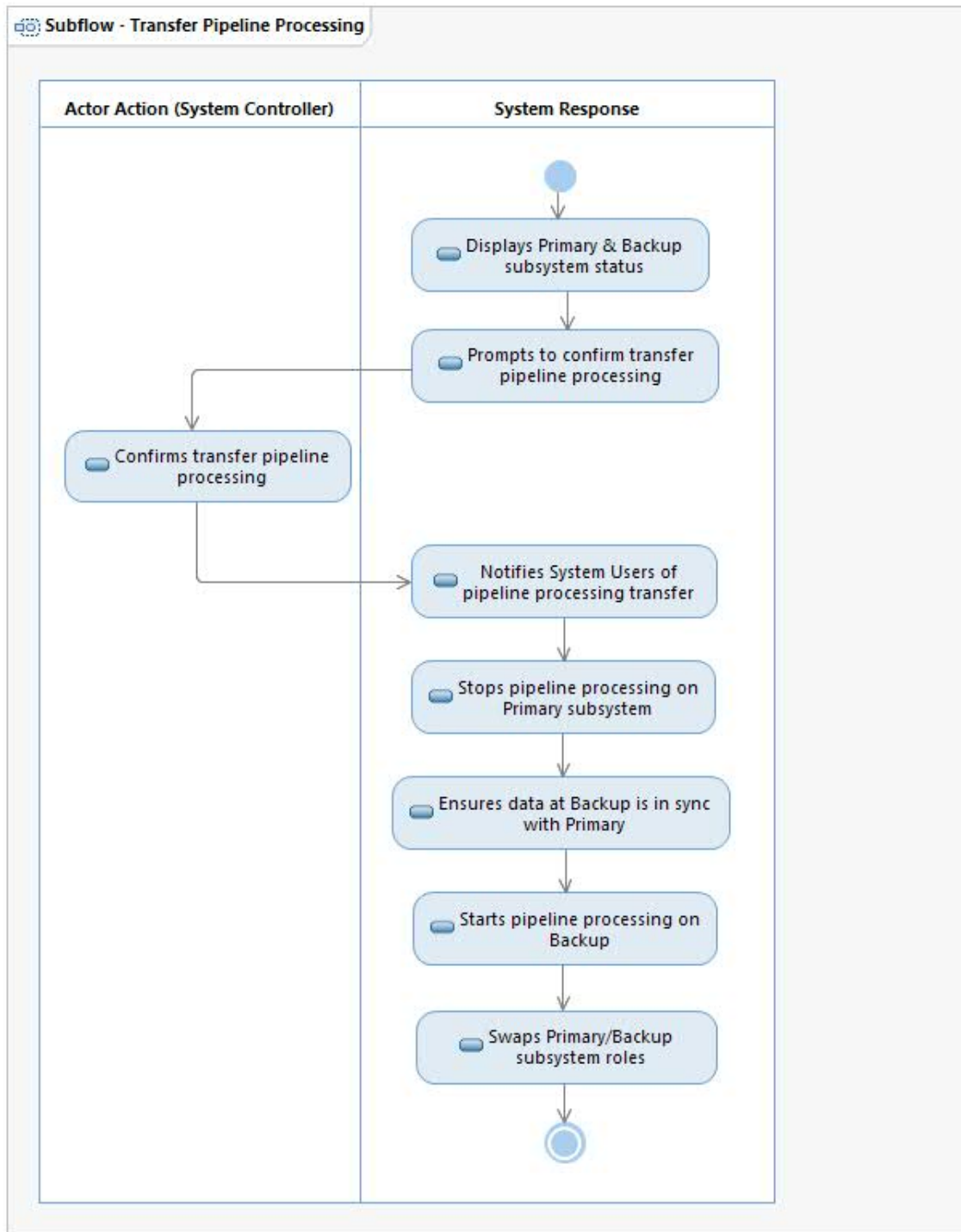
Action Descriptions

Action: "Displays Primary & Backup subsystem status"
The System displays the status of the current Primary and Backup subsystems and indicates whether the current Backup subsystem able to become the new Primary.

Action: "Prompts to confirm transfer pipeline processing"

The System prompts the System Controller to confirm that they wish to transfer pipeline processing from the current Primary to the Backup.

Action: "Notifies System Users of pipeline processing transfer"
The System notifies System Users of the pipeline processing transfer.

Action: "Ensures data at Backup is in sync with Primary"
The System ensures that all of the data at the Primary subsystem are also on the Backup subsystem.

Action: "Swaps Primary/Backup subsystem roles"
The System swaps the roles for the Primary and Backup subsystems (i.e., the subsystem currently designated as Primary becomes designated as Backup and vice-versa).

Alternate Flows
1. Action "Confirms transfer pipeline processing" - The System Controller may cancel, in which case his subflow ends, and returns to the Main Flow.

2. Action "Stops pipeline processing on Primary subsystem" - If any pipeline processes fail to stop cleanly, the System logs the failure, notifies the System Controller and continues.

3. Action "Starts pipeline processing on backup" - If any pipeline process fails to start, the System logs the failure, notifies the System Controller and provides the System Controller the option to continue with the transfer to the Backup or restart processing on the Primary.

4. Action "Starts pipeline processing on backup" - If the primary system is inaccessible or has failed, the UC begins at this action and the Backup is set to be Primary.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface Guidelines.

S-2250: [*Threshold*] The System shall provide the System Controller the capability to remotely operate the Primary from the Backup.

S-2251: [*Threshold*] The System shall provide the System Controller the capability to remotely operate the Backup from the Primary.

S-2288: [*Threshold*] The System shall provide the System Controller the capability to perform a planned shutdown of the System.

S-2289: [*Threshold*] The System shall provide the System Controller the capability to perform a startup of the System.

S-2290: [*Threshold*] The System shall complete a planned shutdown within 30 minutes of its initiation.

S-2291: [*Threshold*] The System shall provide the System User the capability to shutdown individual analyst workstations without affecting the operation of other analyst workstations.

S-2292: [*Threshold*] The System shall provide the System User the capability to startup individual analyst workstations without affecting the operation of other analyst workstations.

S-2293: [*Threshold*] The System shall provide the System Controller the capability to perform an urgent shutdown of the System.

S-2294: [*Threshold*] The System shall complete an urgent shutdown within 15 minutes of its initiation.

S-2295: [*Threshold*] The System shall provide the System Controller the capability to start processes.

S-2296: [*Threshold*] The System shall provide the System Controller the capability to stop processes.

S-2297: [*Threshold*] The System shall provide the System Controller the capability to initiate and terminate system processing.

S-2567: [*Threshold*] The System shall be operational within one hour of a hardware restart.

S-2568: [*Threshold*] The System shall be operational within 30 minutes of a software restart.

S-5885: [*Threshold*] The System shall complete a planned switch between the Primary and Backup with no loss of data or data consistency.

S-5887: [*Threshold*] The System shall provide the System Controller the capability to initiate a switch between the Primary and Backup.

IDC Specific:
S-5886: [*IDC only, Threshold*] The System shall provide station data to external users in no more than one (1) hour following an unplanned switch between the Primary and Backup.

S-5888: [*IDC only, Threshold*] The System shall initiate the automatic processing of waveform data in no more than six (6) hours from the start of an unplanned switch between the Primary and Backup.

S-5889: [*IDC only, Threshold*] The System shall provide the Analyst the capability to perform interactive reviews of processing results in no more than six (6) hours from the start of an unplanned switch between the Primary and Backup.

S-5890: [*IDC only, Threshold*] The System shall provide the System Controller the capability to disseminate data and products in no more than six (6) hours from the start of an unplanned switch between the Primary and Backup.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Backup - The Subsystem acting as the backup location for the System. The pipeline and analyst processing do not actively run on the Backup. May be either OPS Subsystem or ALT Subsystem. The Primary always synchronizes data to the Backup. During a pipeline transfer, the Primary and Backup roles switch.

Operational Subsystem (OPS) - The portion of the System residing at the principal location that supports the operational mission. This subsystem can serve as Primary or Backup. To insure there is no impact on mission capability, development and testing are supported with separate subsystems (DEV and SUS).

Pipeline Processing - The sequence of real-time automatic data processing by the System, which begins after acquisition of raw waveform data, and results in a set of event hypotheses with associated signal detections.

Pipeline Processing Transfer - The process of transferring the execution of System operations from the Primary to the Backup.

Primary - The system role defining the location of the active pipeline and analyst processing; may be either OPS or ALT. The Primary is always syncing data to the Backup. During a pipeline transfer, the Primary and Backup roles switch.

Waveform Processing - Any operation on waveform data involving signal detection (see signal detection algorithms), polarization measurements (see polarization features), time domain measurements, frequency domain measurements, beamforming, magnitude measurements (see magnitude estimation), filtering (see filter, waveform), waveform correlation (see waveform correlation event processing), and ambient noise calculations.

IDC Specific:
None.

NOTES

General:
1. The concepts of 'transfer pipeline processing', 'Primary', and 'Backup' do not apply to Training and Standalone Subsystems. These concepts apply only to transfers between OPS/ALT and transfers between SUS/SALT.

2. The System does not allow the System Controller to start a process or subsystem that is already started, or stop a process or subsystem that is already stopped.

3. This use case describes how the System Controller controls the system and its system state transitions. By no means does this use case provide an exhaustive list of system states and rules governing when the system can and cannot transition from one state to another. System states and their rules are details described in the associated use case realization.

4. Following transfer of pipeline processing, the Backup transitions to an idle state with nominal processes running.

IDC Specific:
None.

OPEN ISSUES

None.

UC-08.05 Views Event History

USE CASE DIAGRAM
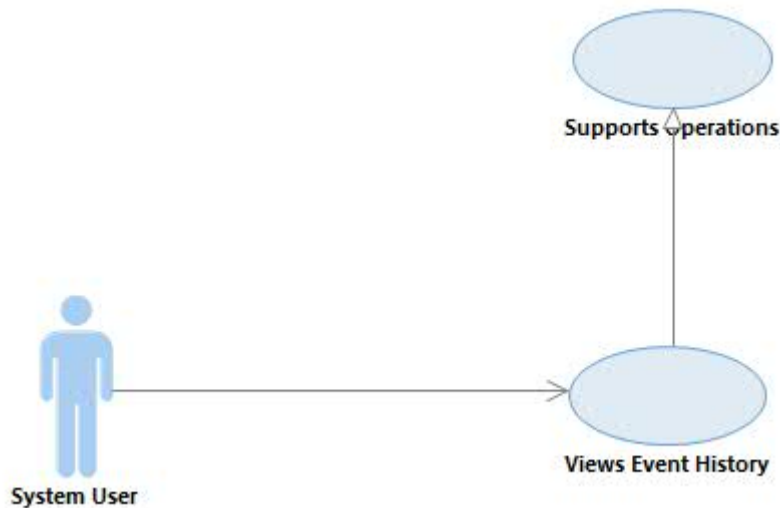
BRIEF DESCRIPTION

This architecturally significant use case describes how the System User observes the change history of a given event. The change history is a series of one or more saved event hypotheses. System Users view all the event hypotheses and the set of location solutions for each hypothesis. The System User views the relationship between event hypotheses including the preferred hypothesis for each processing stage. The event change history persists across work sessions for subsequent review.

This use case is architecturally significant because it describes viewing and comparing multiple versions of an event to review the history of how an event was formed and what data were available at each stage of event formation.

ACTOR DESCRIPTIONS

System User - The System User actor is any internal user who accesses the System.

PRECONDITIONS

None.

POSTCONDITIONS

None.

ACTIVITY DIAGRAMS

Main Flow
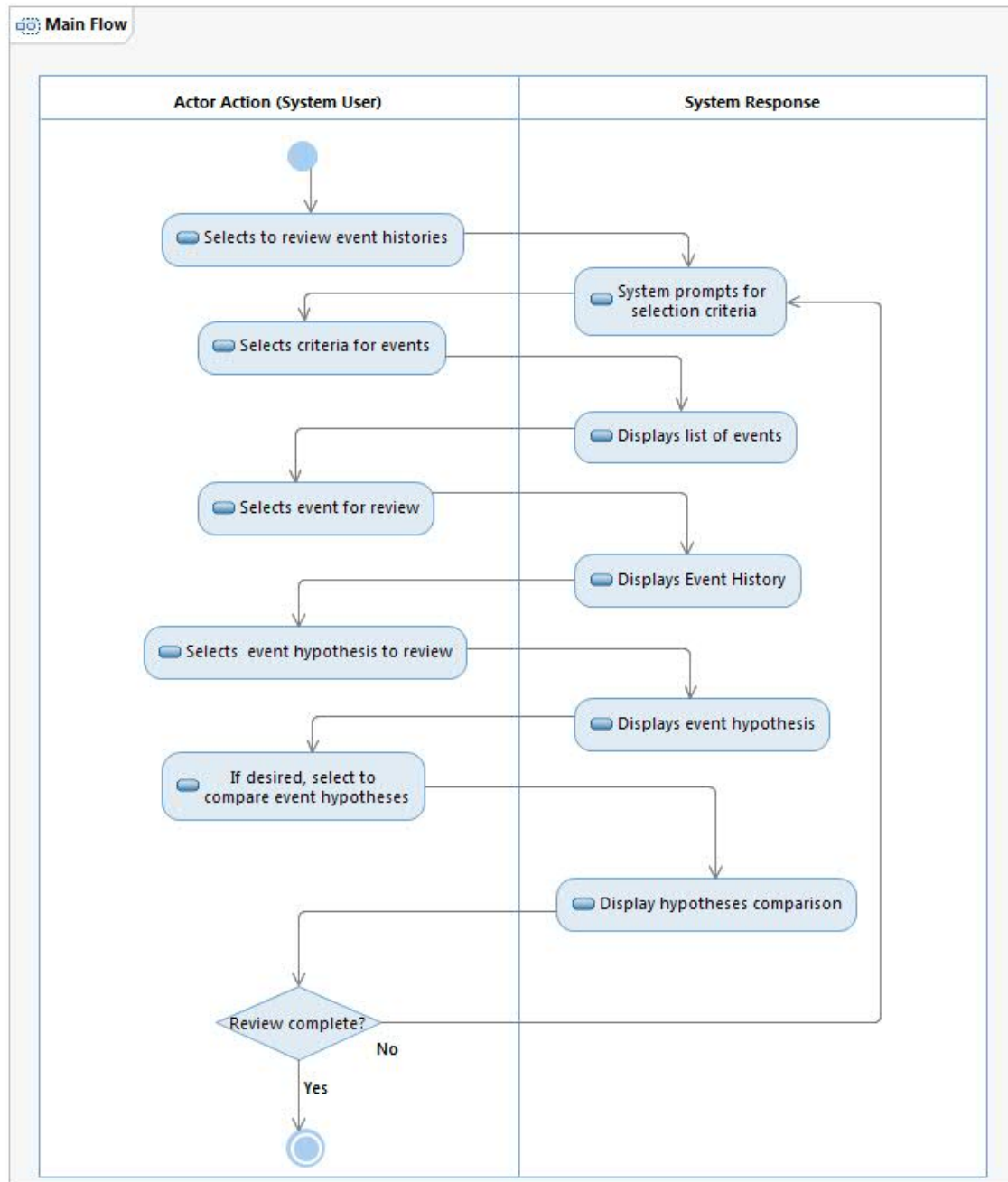
Action Descriptions

Action: "Displays Event History"

The System displays the selected event and the hierarchy of event hypotheses saved for the event. The display indicates the preferred event hypotheses for the event.

Action: "Display hypotheses comparison"

Show comparison of event hypotheses including, for example, signal detections for each hypothesis, filters, data availability at hypothesis creation time, and locations.

Alternate Flows
1. Any Actor Action - The System User may choose to cancel, in which case this use case ends.

2. Action "Displays Event History" – The System User can invoke this use case from any System event list to see the history of a selected event.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1292: [*Threshold*] The System shall provide the System User the capability to compare Waveform QC Masks generated by each processing stage for selected points in the processing history.

S-1926: [*Threshold*] The System shall provide the System User the capability to view the complete history of an event.

S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface Guidelines.

S-1985: [*Threshold*] The System shall provide the System User the capability to view event hypothesis data on an interactive map.

S-1996: [*Threshold*] The System shall provide the System User the capability to access geospatial data.

S-1999: [*Threshold*] The System shall provide the System User the capability to view tabular listings of the results of spatial processing of geospatial data.

S-2040: [*Threshold*] The System shall provide the System User the capability to retrieve stored processing results from computations.

IDC Specific:
None.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Event - The estimate by the System or Analyst of the occurrence of some transient source of energy within the Earth's body, oceans, or atmosphere that can be detected by seismic, hydroacoustic, and/or infrasonic sensors. For the same event, many different event hypotheses

may be created at different processing stages. One of these event hypotheses must be designated as preferred.

Event Change History - A complete record of the evolution of the event hypotheses corresponding to a single event, from the initial detection of the event, through the final version approved for release.

Event Hypothesis - A proposed solution for an Event. Each event consists of a sequence of event hypotheses that describe an evolution to a final best model of the event. Each event hypothesis is composed of a set of associated signal detections and has one or more event hypothesis location solutions, one of which must be designated as preferred.

IDC Specific:
None.

NOTES

General:
1. Action: Displays hypotheses comparison - "Ghosting" of signal detections provides a method to compare signal detections. Data should be viewable in tables, on maps, and in data trees showing relationships.

2. Action: Displays event hypothesis, Action: Displays hypotheses comparison - Displays include a comparison of locations solutions, both within an event hypothesis and between event hypotheses.

3. Displays to compare data between two event hypotheses will be covered by the 'Views Event History' UIS. The displays addressing more specific display content will be developed for 'Refines Event' UIS. 'Views Event History' will reuse the event, event hypothesis, waveform, and map displays developed for 'Refines Event'. Therefore, 'Views Event History' UC does not address the display specifications.

4. As a UI convenience, the user should have a shortcut to be able to select an event hypothesis in Views Event History and then select to open the hypothesis for review.

5. While viewing an event history an Analyst can provide feedback via the 'Provides Analyst Feedback' UC.

6. The ability to view the released event history is provided to the Authorized External User in 'Views System Results' UC.
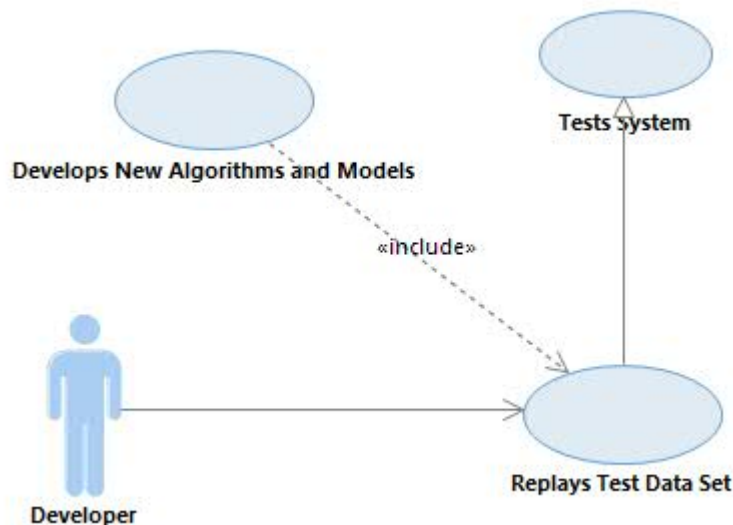

IDC Specific:
None.

OPEN ISSUES

None.

UC-09.03 Replays Test Data Set

USE CASE DIAGRAM

BRIEF DESCRIPTION

This architecturally significant use case describes how the Developer replays a waveform Test Data Set into the System processing pipeline. The Developer selects a previously created waveform test data set (see 'Creates Test Data Set for Replay' UC) and initiates the data set replay. The System plays back the waveform Test Data Set using the captured data acquisition time sequence information, substituting the waveform Test Data Set for the actual real time waveform data. The Developer can terminate the playing waveform Test Data Set manually or allow it to self-terminate after it completes its duration time.

This use case is architecturally significant because it describes a testing capability to duplicate system configuration and to inject captured raw data into the System to support testing of error fixes or newly developed capability under known conditions.

ACTOR DESCRIPTIONS

Developer - The Developer actor is a System User who develops and tests System components.

PRECONDITIONS

1. This UC is to be used on the Development and Sustainment Subsystems only.
2. At least one Test Data Set must exist - see "Creates Test Data Set for Replay" UC.
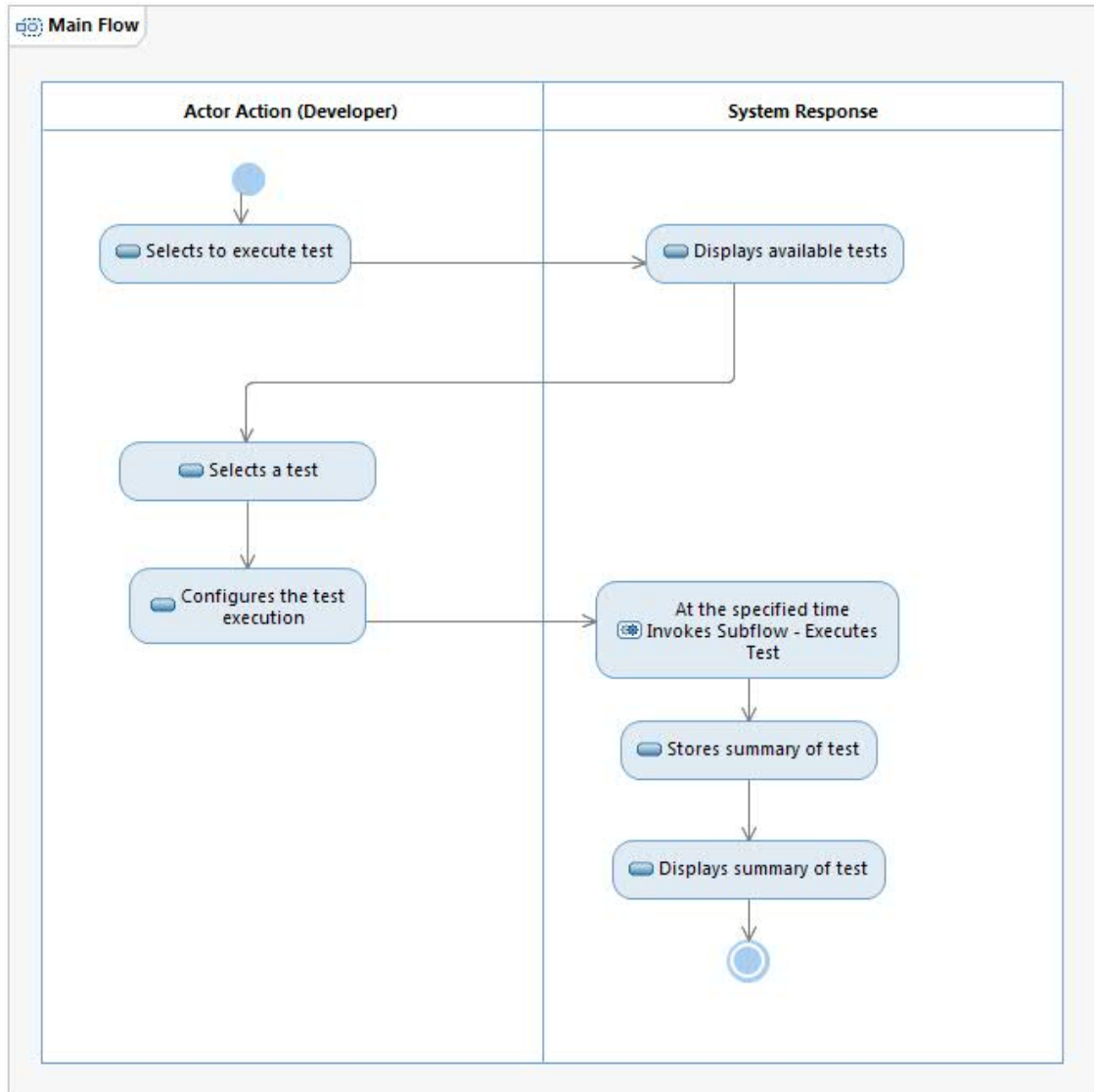
POSTCONDITIONS

1. Test results and exit status are available.
2. The System that has just supported the test run has been restored to its pre-test configuration settings.

ACTIVITY DIAGRAMS

Flow Overview
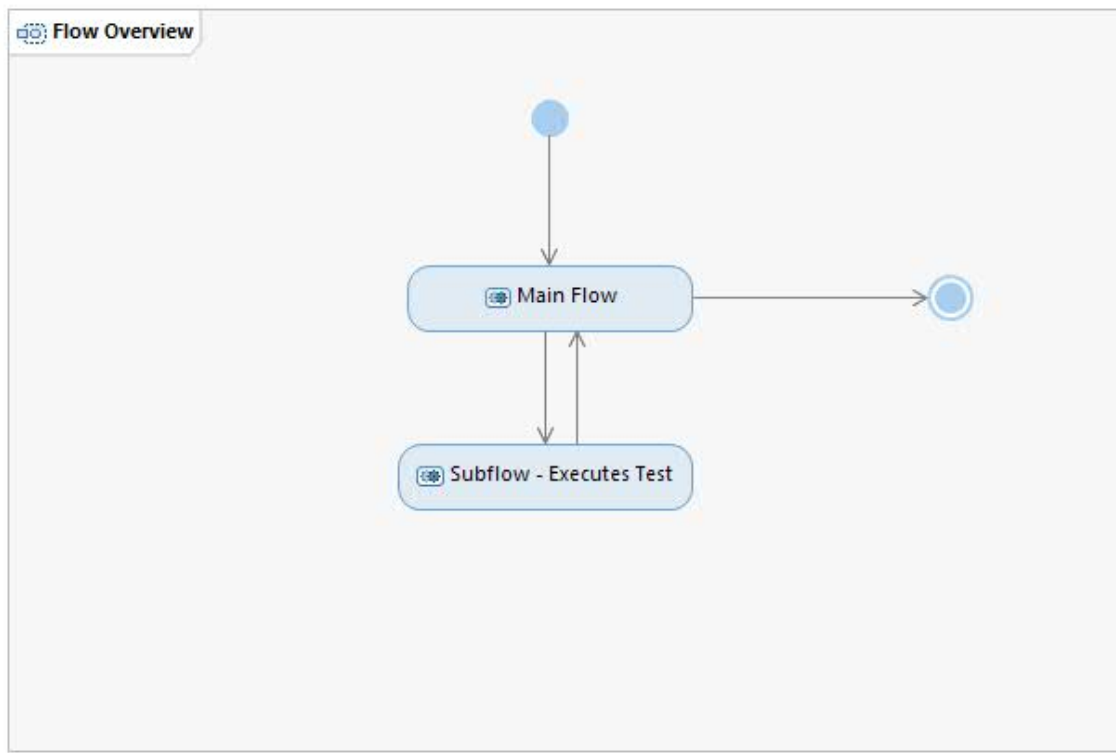
Main Flow

Action Descriptions

Action: "Selects to execute test"
The Developer will select from a list of available tests.

Action: "Displays available tests"
The System presents a list of previously defined tests. If a different test is needed, see 'Creates Test Data Set for Replay' UC.

Action: "Configures the test execution"
The Developer specifies a time for the test to start (now or a future time) and specifies whether the test will be interactive or in an unattended batch mode. The Developer may also specify any necessary changes to the system configuration if they are planning to execute tests containing Test Data Sets that do not contain system configuration criteria, or if the Developer wishes to override a system configuration setting contained within a Test Data Set.

177

Action: "At the specified time Invokes Subflow - Executes Test"
If the time for the test execution was set to be in the future, the System waits until the specified time and then invokes the Subflow "Executes Test". If no future time for the test was set, the Subflow will begin immediately.

Action: "Stores summary of test"
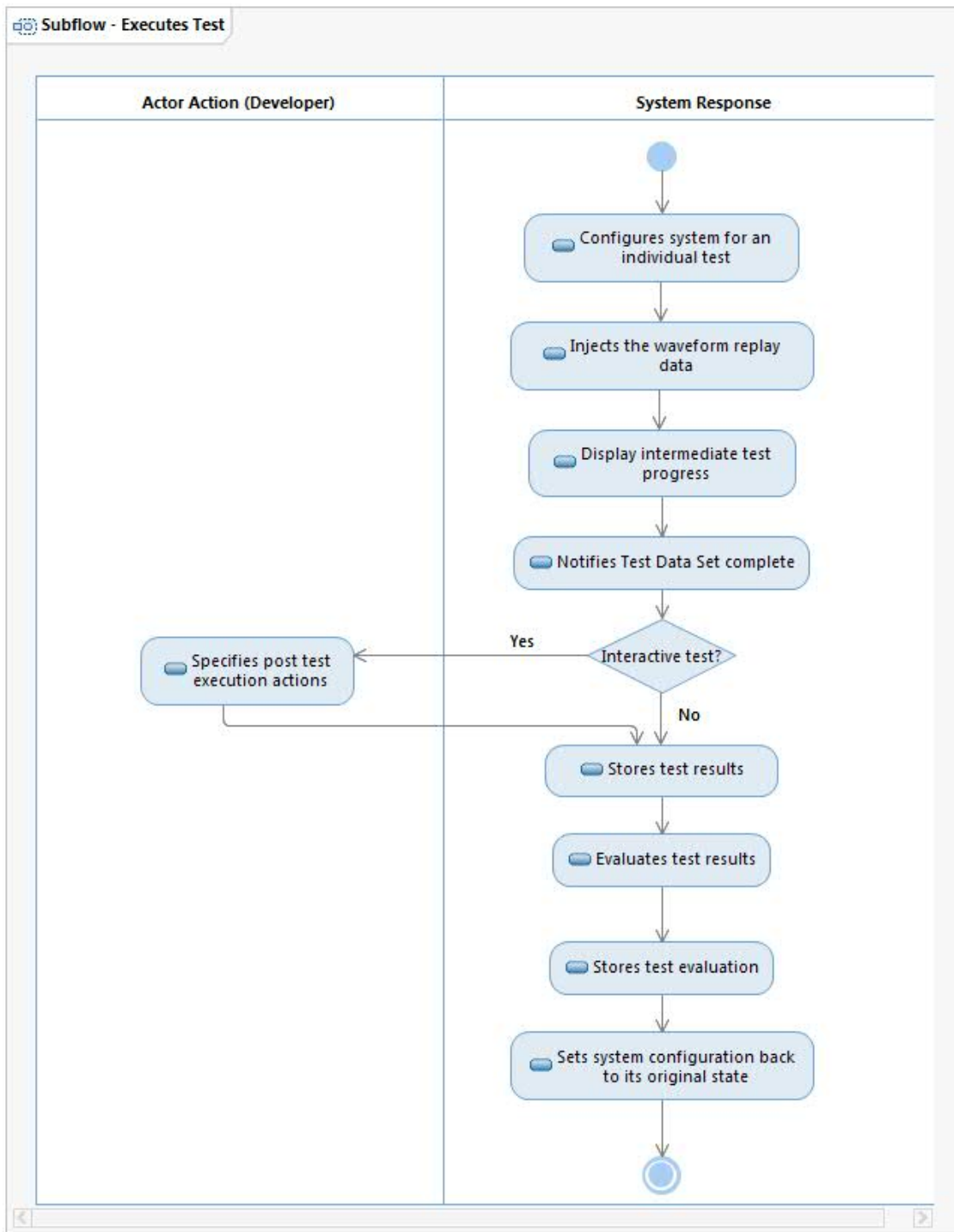The test execution summary will be versioned and stored with the test results.

Action: "Displays summary of test"
The test execution exit summary will be indicated to the Developer.

Alternate Flows
1. Any Actor Action - the Developer may cancel, in which case this use case ends.

Subflow - Executes the test

Action Descriptions

Action: "Configures system for an individual test"
Configure the System for the test. The System's configuration settings are set (if the Test Data Set has a system configuration and the Developer has not overridden it) to appropriate values for the execution of the Test Data Set - these values are obtained from the Test Data Set definition

(see 'Creates Test Data Set for Replay' UC). See the Notes for a representative list of system configuration settings required for test setup.

Action: *"Injects the waveform replay data"*
Using information stored within the Test Data Set, the System injects a specific pre-existing waveform data (real or synthetic) to support the Test Data Set test run. The replay of pre-existing captured real data will be time synchronized to match the frame order that the data was captured in. Once initiated, the waveform data injection will continue until the data stream reaches the end of the waveform replay data or until a preset end time defined within the Test Data Set is reached.

Action: *"Display intermediate test progress"*
Display a continually updated test completion progress indicator.

Action: *"Notifies Test Data Set complete"*
Once the time sequence replay data has completed execution (the test is finished), the System notifies the Developer that the Test Data Set has competed.

Action: *"Specifies post test execution actions"*
In this interactive case, the Developer specifies whether to execute the subsequent steps or skip to the end of this flow without saving the test results.

Action: *"Stores test results"*
The Test Data Set test results and exit status are stored (versioned).

Action: *"Evaluates test results"*
Invoke test result evaluation methods to determine correctness of the test results. These methods (comparison capabilities) and the metrics and artifacts they are evaluating are defined within the Test Data Set - see 'Creates Test Data Set for Replay' UC. For Test Data Sets that contain expected results, a set of test result values will be defined to capture the completion status after each test run – these results values will comprise a larger set of potential results (one such example would be a DIFF results state meaning the test ran and generated different results than the set of expected results defined within the Test Data Set) states than simple PASS or FAIL values.

Alternate Flows
1. Any Action - the Developer may abort the test run, in which case the System restores the pre-test system configuration, and this use case ends.
2. Actor Action "Specifies post test execution actions" - the Developer can decide to make a change to the system configuration here and can also decide to skip the next four steps to move directly to the end of this flow.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:

S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface Guidelines.

S-2214: [*Threshold*] The Development Subsystem shall replay waveform data using the data's original acquisition sequencing and latencies.

S-2215: [*Threshold*] The System shall provide the Developer the capability to synchronize injection of waveform replay data stemming from multiple data sources.

S-5728: [*Threshold*] The Development Subsystem shall provide the Developer the capability to select the waveform data for replay.

S-5729: [*Extensibility*] The Development Subsystem shall replay waveform data faster than real time.

S-5730: [*Extensibility*] The Development Subsystem shall provide the Developer the capability to select the waveform data replay data rate.

IDC Specific:
S-5807: [*IDC only, Threshold*] The CATS subsystem shall provide the Developer the capability to access, modify, create, compile, run, and test software (source code and configuration files).

S-5808: [*IDC only, Threshold*] The CATS subsystem shall test software without affecting the OPS Subsystem.

S-5809: [*IDC only, Threshold*] The CATS subsystem shall test software on a regular basis at user defined time intervals.

S-5810: [*IDC only, Threshold*] The CATS subsystem shall provide the Developer the capability to request the CATS subsystem to test software at user defined time intervals.

S-5814: [*IDC only, Threshold*] The CATS subsystem shall provide the Developer the capability to perform semi-automatic testing of stations prior to release for operational use.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Test Data Set - A group of artifacts that comprise the required components to define a single test. This group contains a test name, a list of the station(s) associated with the waveform data to be used for replay, the replay start and stop time for the waveform data, and the System state start time (the state start time is prior to the replay start time), to allow the System to establish a System state baseline enabling consistent replay test runs. Optionally, this group contains a set of

expected test results (this set can include expected number of signal detections, events, etc. to be constructed during the replay test), or a set of Analyst actions.

IDC Specific:
None.

NOTES

General:
1. This use case does not support the replaying of Bulletin data from External Data Centers.

2. Categories of configuration settings relevant to replaying a Test Data Set including the following list. These configuration items are captured as part of the Test Data Set.
    a.   QC Configuration
    b.   Signal Detection Configuration
    c.   Signal Processing Configuration
    d.   Signal Association Configuration
    e.   Event Formation Configuration
    f.   Automatic Processing Configuration
    g.   System Performance Configuration
    h.   Station Processing Configuration
    i.   Event Location Configuration
    j.   Test Specific Configuration
    i.   Apparent System time (to enable the ability to run the System as if the time were not the present time)
    ii.   Database view (to allow for different test specific views for test results storage)

3. Any database snapshots or external file information that is required to support waveform data playback and alphanumeric data access are included within the Test Data Set as created by the Developer (see "Creates Test Data Set for Replay" UC).

IDC Specific:
1. The System supports automated, recurring testing using the CATS Subsystem. The CATS Subsystem performs software regression testing at user defined time intervals or as triggered by software development activities. The CATS Subsystem supports the testing and assessment of stations prior to their operational use.
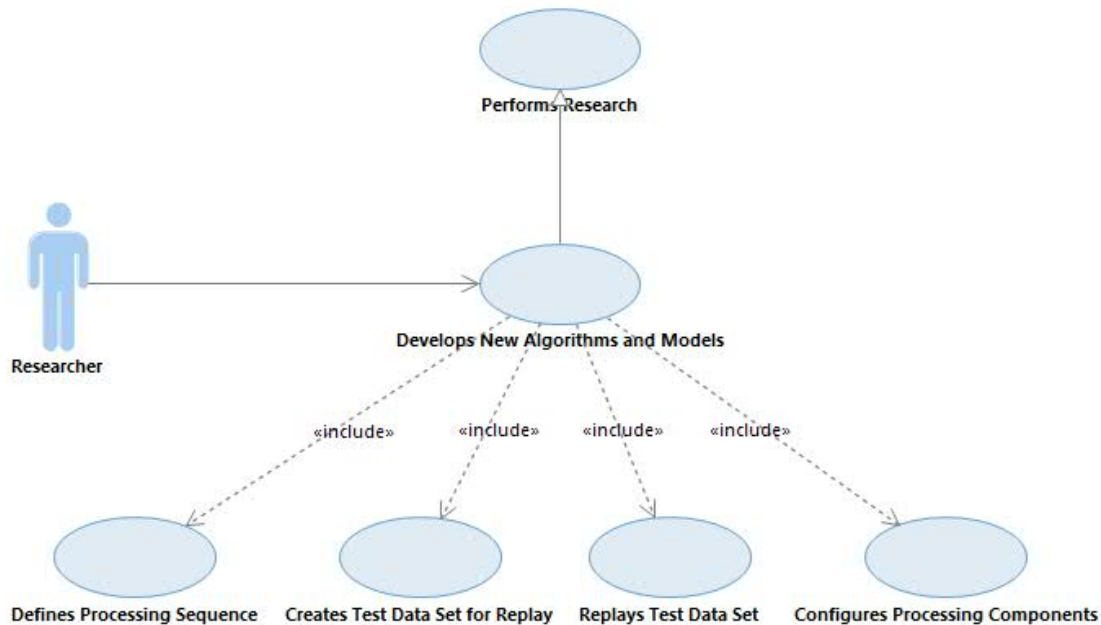
OPEN ISSUES

None.

IDC Use Case Report
UC-11.02 Develops New Algorithms and Models

USE CASE DIAGRAM

BRIEF DESCRIPTION

This architecturally significant use case describes how the Researcher develops and tests new algorithms and models for potential improvement of the System. The Researcher retrieves the data needed for developing and testing new algorithms and models. The Researcher compares the output from these tests to the System output. The Researcher recommends updates to the System.

This use case is architecturally significant because it drives the system architecture to provide interfaces to the System data and processing components accessible to Researchers through command line interfaces and a Common Object Interface (COI).

ACTOR DESCRIPTIONS

Researcher - The Researcher actor is an Analyst who performs research to optimize performance of the System, to provide more detailed information about events of interest, and to develop new algorithms.
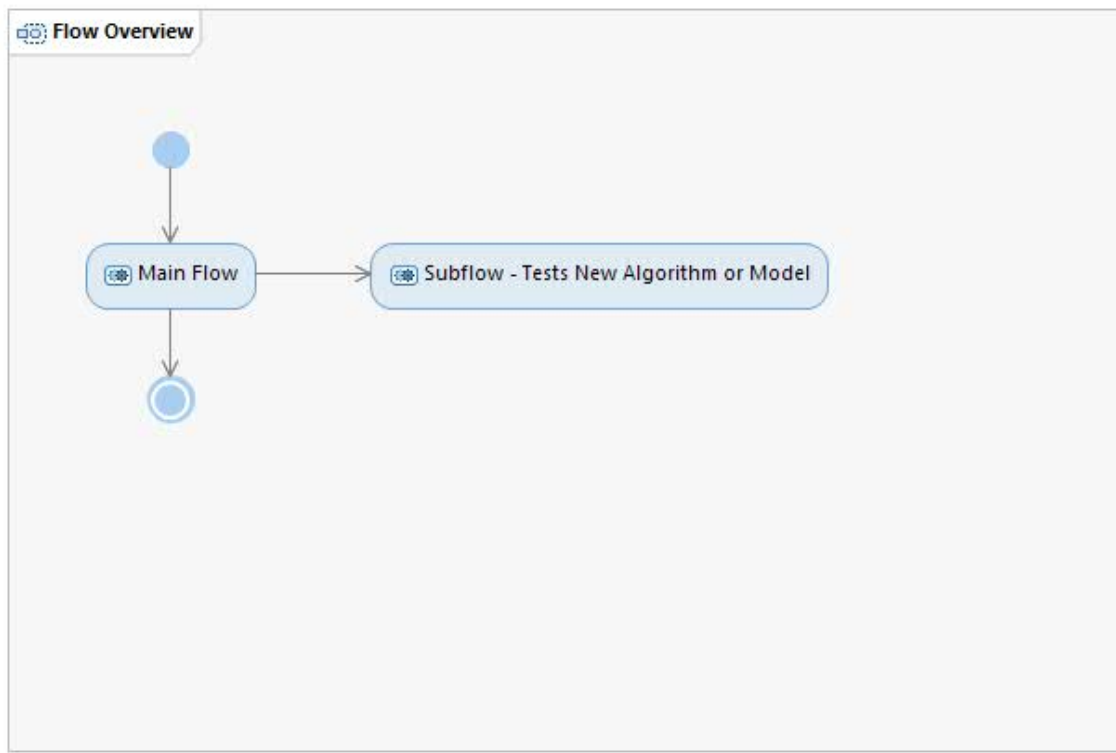
PRECONDITIONS

1. This use case runs on either the Development Subsystem or a Standalone Subsystem.
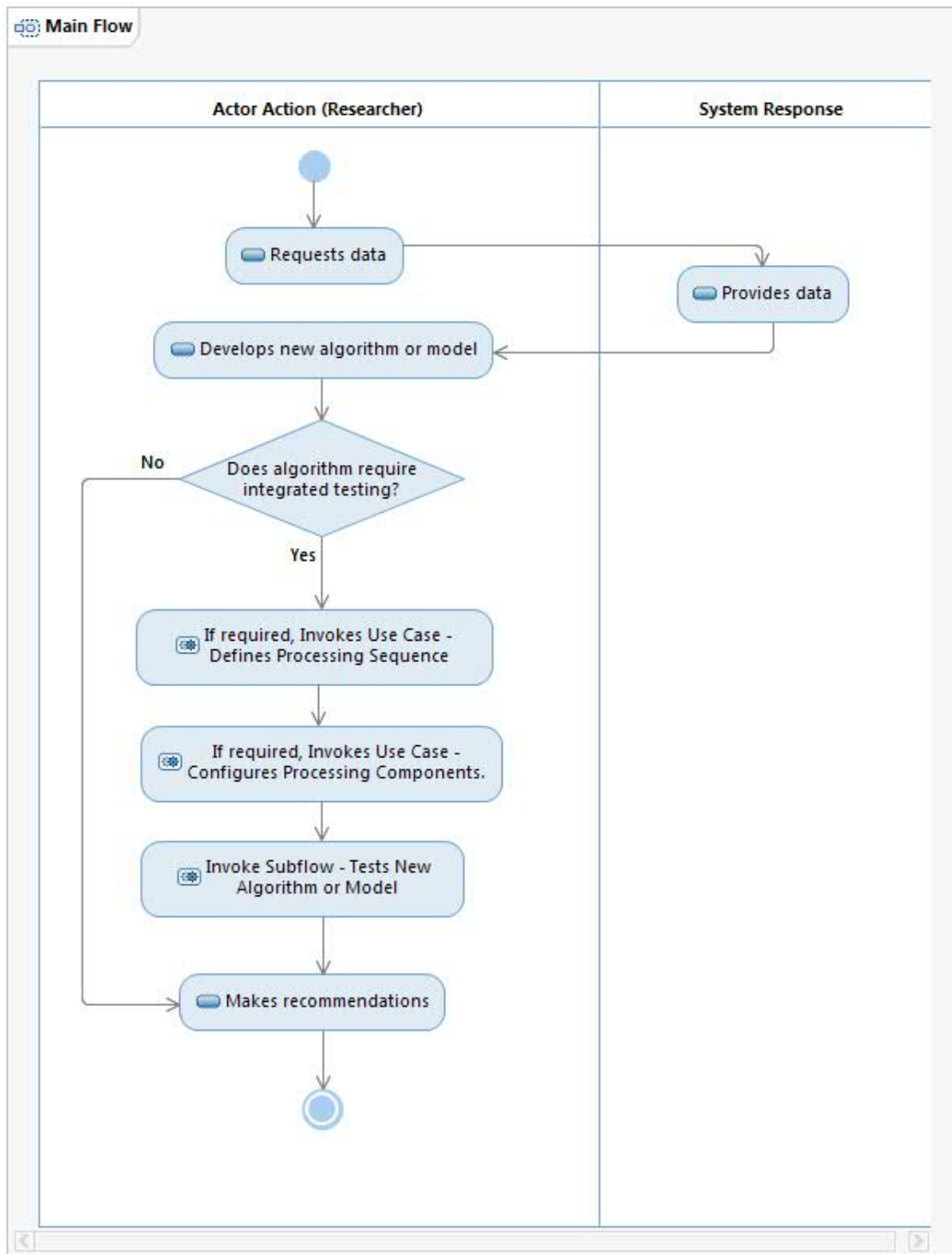
POSTCONDITIONS

1. The Researcher has collected information and made recommendations for changes to System operations.

ACTIVITY DIAGRAMS

Flow Overview

Main Flow

Action Descriptions

Action: "Requests data"

The Researcher uses the COI to request System data. The requested data can be any data stored on the System:

1. Acquired alphanumeric data

2. Acquired waveforms
3. System configuration parameters
4. System processing results

Action: "Develops new algorithm or model"
The Researcher uses the requested data and resources available outside of the System to develop new algorithms or models for the System to use during pipeline processing or interactive processing. The Researcher also creates and runs unit tests for the new algorithm software.
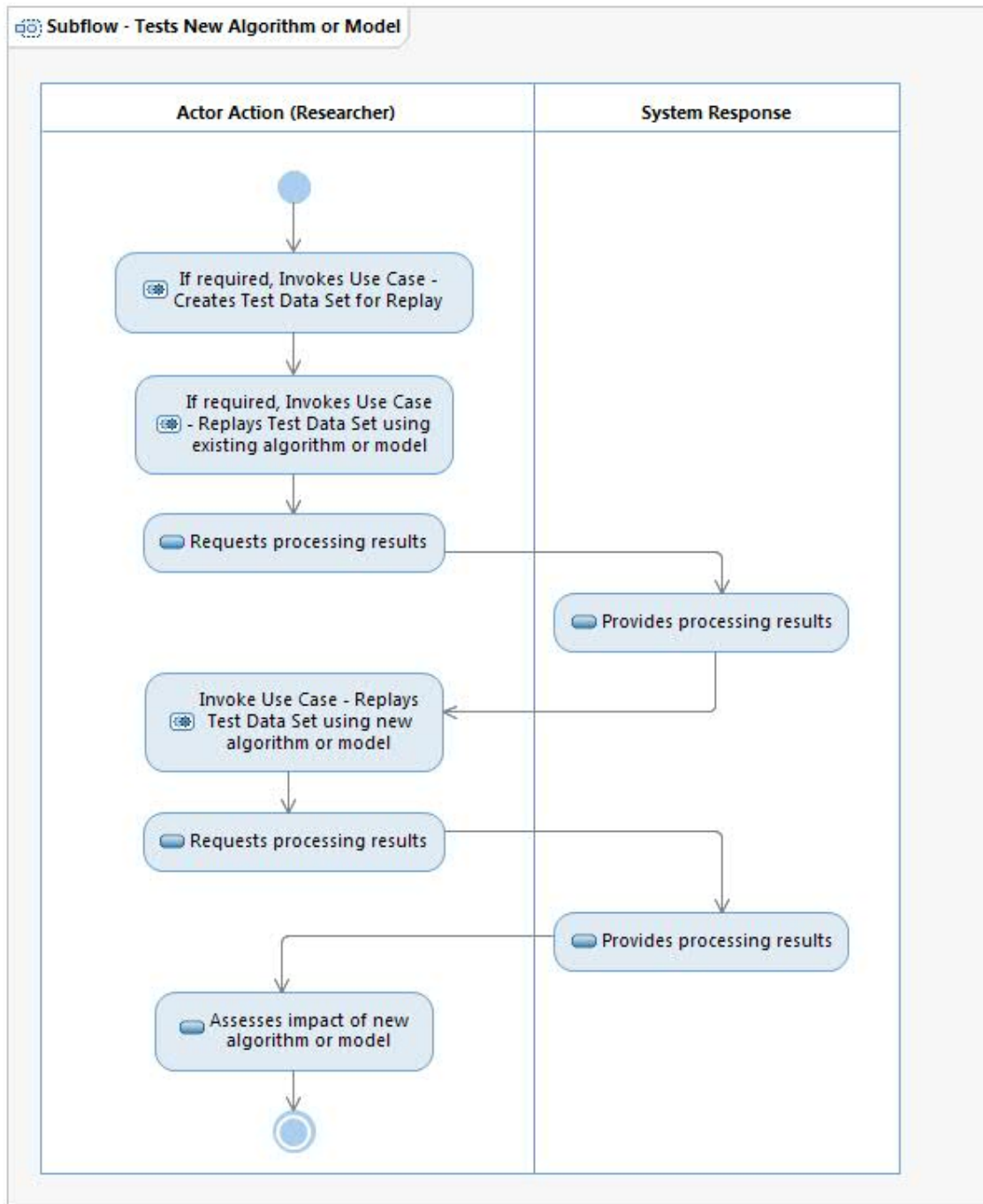
Action: "Makes recommendations"
The Researcher uses results from testing the new algorithm or model to recommend System updates.

Alternate Flows
1. Actions "Requests data" - The Researcher may choose to cancel, in which case this use case ends.

Subflow - Tests New Algorithm or Model

Action Descriptions

Action: "If required, Invokes Use Case - Creates Test Data Set for Replay"
The Researcher creates a test data set for evaluating the new or updated algorithm or model.

Action: "If required, Invokes Use Case - Replays Test Data Set using existing algorithm or model"

The Researcher replays the test data set using a System configuration that accesses algorithms or models providing baseline comparison results for the new algorithm or model.

Action: "Invoke Use Case - Replays Test Data Set using new algorithm or model"
The Researcher replays the test data using a System configuration that accesses the new algorithm or model.

Action: "Assesses impact of new algorithm or model"
The Researcher assesses the impact of the new algorithm or model by comparing the processing results between replaying the test data set with the existing model or algorithm and replaying the test data set with the new model or algorithm. The Researcher has the option to use both System tools and external tools to make this assessment.

Alternate Flows
1. Action "If required, Invoke Use Case: Creates Test Data Set for Replay" – If invoking this use case does not result in a new test data set being created (e.g., the Researcher cancels or the Researcher specifies invalid test data set creation criteria), then this subflow ends, and returns to Main Flow.

2. Action "If required, Invoke Use Case: Replays Test Data Set using existing algorithm or model" - If invoking this use case does not create processing results (e.g., the Researcher cancels, the System cannot replay the Researcher's selected test data set with the processing component configuration), then this subflow ends, and returns to Main Flow.

3. Action "Invoke Use Case: Replays Test Data Set using new algorithm or model" - If invoking this use case does not create processing results (e.g., the Researcher cancels, the System cannot replay the Researcher's selected test data set with the processing component configuration), then this subflow ends, and returns to Main Flow.

4. Any Actor Action - The Researcher may choose to cancel, in which case this subflow ends, and returns to the Main Flow.

5. Actions to "Invoke Use Case – Replays Test Data Set" – The Researcher may choose to test the new algorithm or model by executing individual processing components rather than replaying acquired waveform data into a processing sequence, in which case the Researcher invokes 'Performs Software Component Testing' UC or uses the command line interface to access the processing components outside of a processing sequence. When using the command line interface to invoke processing components the Researcher also has the option to select configuration parameter values for those processing components. Whether the Researcher is using these functions to gather processing results from the existing algorithm or model or using these functions to test the new algorithm or model, flow continues at the subsequent Action "Requests processing results".

SSD MAPPINGS

The following SSDs are mapped to this use case:

189

General:
S-1331: [*Threshold*] The System shall provide the Researcher the capability to decimate waveforms.

S-1332: [*Threshold*] The System shall provide the Researcher the capability to interpolate waveforms.

S-1333: [*Threshold*] The System shall provide the Researcher the capability to resample waveforms.

S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface Guidelines.

S-1950: [*Threshold*] The System shall provide the Researcher the capability to initiate system software applications without dependency on an automated processing pipeline.

S-1951: [*Threshold*] The System shall provide the Researcher the capability to use the command line interface.

S-1952: [*Threshold*] The System shall provide a command line interface to initiate each application using specific configuration parameters.

S-2030: [*Objective / Priority 1*] The System shall provide the Researcher the capability to access data through a common object interface.

S-2040: [*Threshold*] The System shall provide the System User the capability to retrieve stored processing results from computations.

S-2264: [*Threshold*] The Development Subsystem shall provide the Developer the capability to access, modify, create, compile, run, and test source code and configuration files.

S-2266: [*Threshold*] The Development Subsystem shall provide the Developer the capability to access, modify, run, and test existing and new processes in an operational-like mode.

IDC Specific:
S-2031: [*IDC only, Threshold*] The System shall provide the Researcher the capability to access the database through a read-only ANSI/ISO standard SQL interface.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:
None.

IDC Specific:

None.

NOTES

General:

1. As developing new algorithms and models consumes significant amounts of time, this use case does not imply the Researcher's activities occur within a single session on the Development Subsystem or Standalone Subsystem. The flows only show explicit Researcher interactions with a Subsystem during the course of algorithm and model development.

2. The System provides command line interfaces to the waveform processing capabilities accessible only to the Researcher (e.g., interpolating, decimating, and resampling waveforms).

IDC Specific:

1. In Main Flow Researcher action "Requests Data", the Researcher may also use an ANSI/ISO standard SQL interface to request System data in addition to the COI.
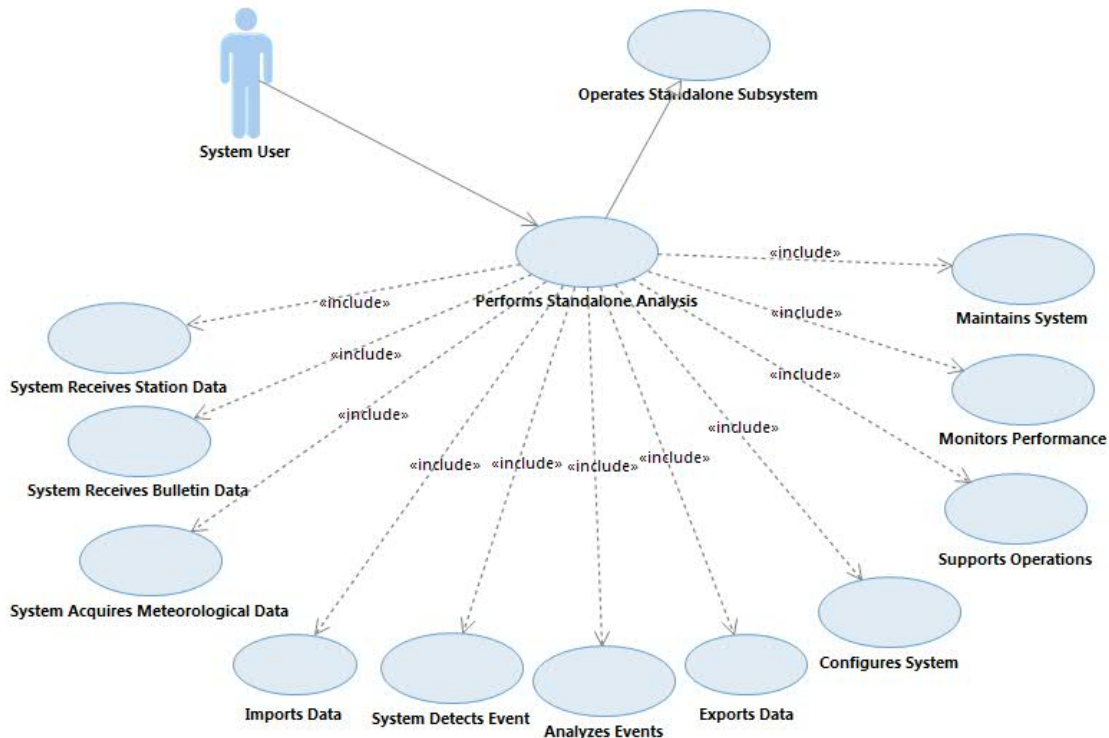
OPEN ISSUES

None.

UC-13.02 Performs Standalone Analysis

USE CASE DIAGRAM

BRIEF DESCRIPTION

This architecturally significant use case describes how the System User performs analysis using the Standalone Subsystem. The Standalone Subsystem acquires station data, external bulletin data, and meteorological data (see 'System Receives Station Data' UC, 'System Receives Bulletin Data' UC and 'System Acquires Meteorological Data' UC) or the System User imports data (see 'Imports Data' UC). The Standalone Subsystem detects events (see 'System Detects Events' UC). The System User analyzes events (see 'Analyzes Events' UC) using analysis components that are available on the Standalone Subsystem and exports the processing results (see 'Exports Data' UC). The System User configures, operates, monitors, and maintains the Standalone Subsystem as needed (see 'Configures System' UC, 'Supports Operations' UC, 'Monitors Performance' UC, and 'Maintains System' UC).

This use case is architecturally significant because it drives the System architecture to support configurable software distributions at various scales of data processing, computing hardware, and personnel to support third-party organizations performing similar monitoring functions.

ACTOR DESCRIPTIONS

System User - The System User actor is any internal user who accesses the System.
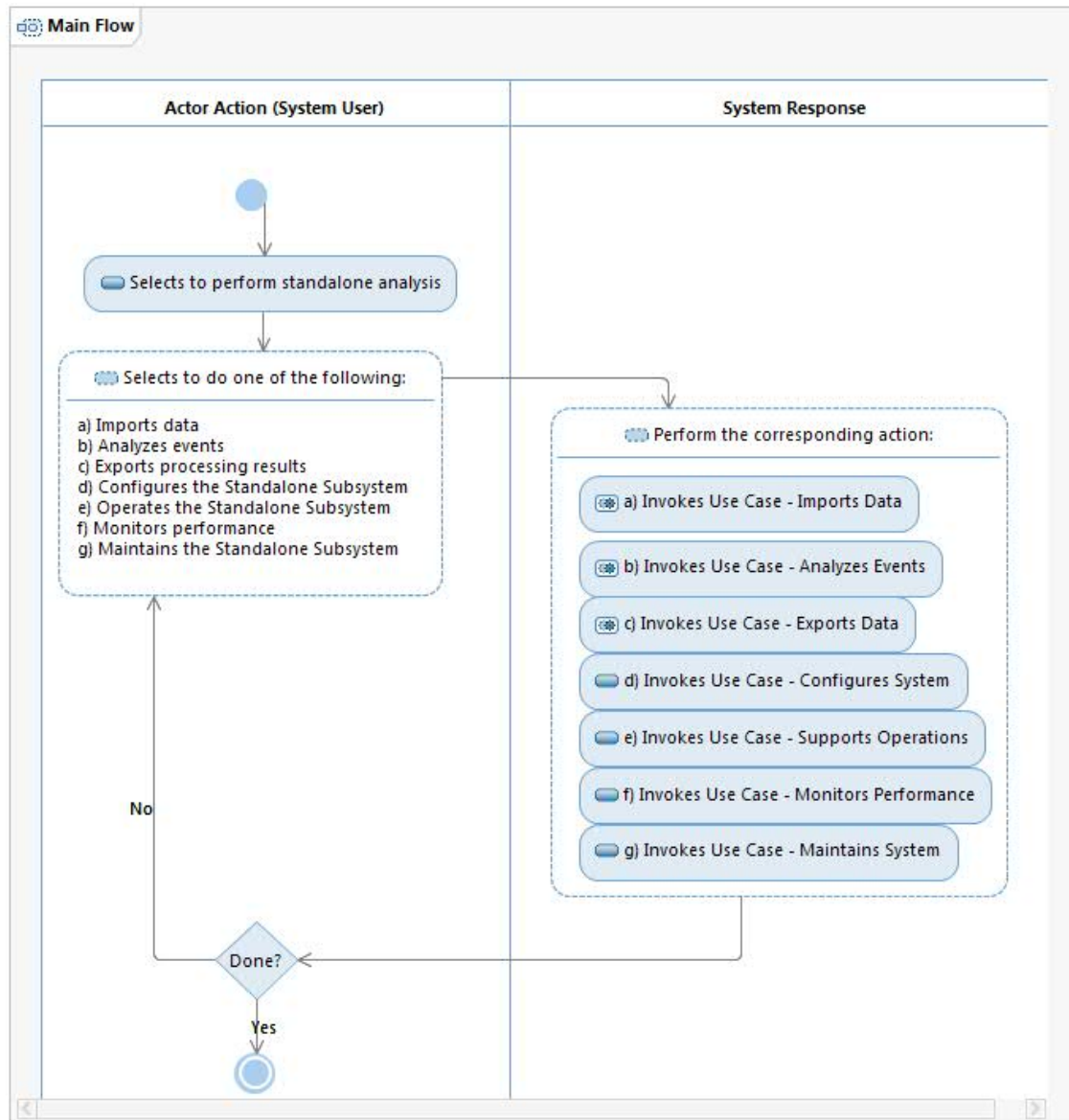
PRECONDITIONS

1. The System User has access to a Standalone Subsystem (see 'Accesses the System' UC).

POSTCONDITIONS

None.

ACTIVITY DIAGRAMS
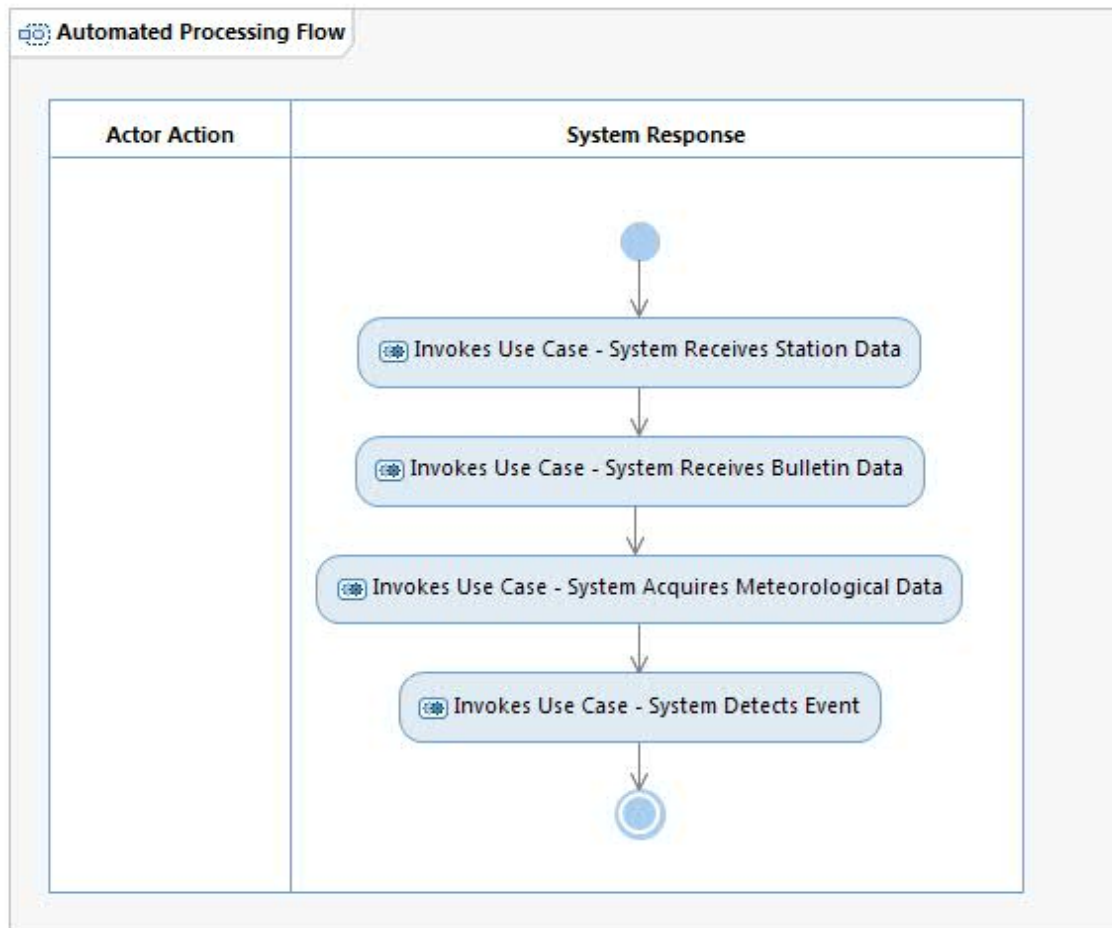
Main Flow

Action Descriptions
None.
Alternate Flows
None.

Automated Processing Flow

Action Descriptions
Initial Action
The Standalone Subsystem may be configured to perform automated processing. This flow
shows a notional automated processing configuration that includes station, bulletin data, and
meteorological data acquisition and pipeline processing.

Alternate Flows
None.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface
Guidelines.

S-2269: [*Threshold*] The Standalone Subsystem shall be scalable to operate on a field laptop.

S-2270: [*Threshold*] The Standalone Subsystem shall be scalable to operate on a reduced data center hardware installation.

S-2271: [*Threshold*] The Standalone Subsystem shall operate on low-cost computing infrastructure including the database management system.

S-2272: [*Threshold*] The System shall provide components that can be distributed and run on the Standalone Subsystems.

IDC Specific:
None.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Data Acquisition Partition - The portion of the System where data are acquired and re-distributed.

Data Processing Partition - The portion of the System where data are processed, analyzed, and evaluated, and where data processing products are distributed and archived.

Standalone Subsystem - A distribution of the System containing a selected set of system components used for standalone analysis and site surveys. The Standalone Subsystem may receive data from the operational subsystem but does not provide system results to the operational subsystem.

IDC Specific:
None.

NOTES

General:
1. Standalone analysis captures any waveform or event analysis performed on a Standalone Subsystem. Nominally all processing features of the System are available on a Standalone Subsystem, but each standalone distribution may be packaged to include features as needed (for examples of features that may be included see 'Defines Processing Sequence' UC).

2. Typically a Standalone Subsystem operates at a smaller scale of data acquisition, data processing, computing hardware, and personnel than other subsystems. Potentially the Standalone Subsystem will be deployed to different computing components (e.g., hardware, network, database).

3. For this use case all actor roles are generalized to System User.

4. Each Standalone Subsystem will be deployed to only one partition. Multiple redundant installations are not supported (e.g., Primary and Backup configurations).

IDC Specific:
1. The Standalone Subsystem will be developed so as to be 1) affordable and 2) not restricted from use by any signatory.
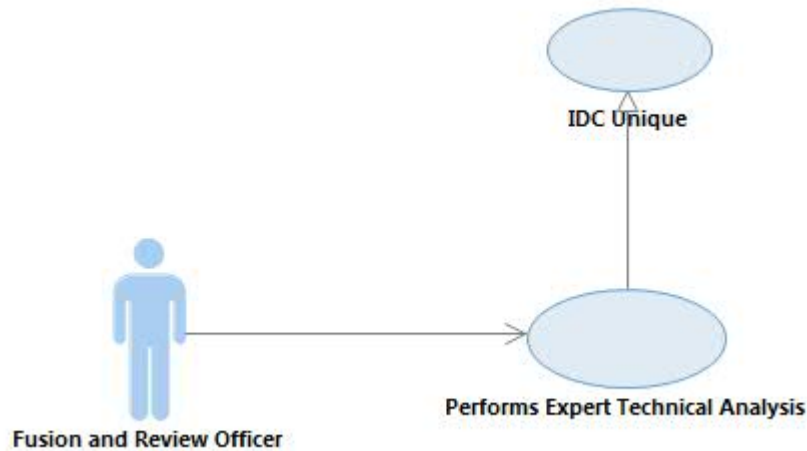
OPEN ISSUES

None.

UC-14.04 Performs Expert Technical Analysis

USE CASE DIAGRAM

BRIEF DESCRIPTION

This architecturally significant use case describes how the Fusion and Review Officer conducts an expert technical analysis upon request from a member state. A member state may request either more detailed analysis of a specific event using IMS data and software, or specific analysis using member state specified data and/or software. Both types of analysis may include but are not limited to geographic location, time, depth, magnitude, waveforms, the signal detection list, a map, phase and depth refinement, and focal mechanism.

If the request is for an Updated Event Bulletin (UEB), the Fusion and Review uses existing System tools and IMS data to improve an event solution or add measurements (see 'Analyzes Event' UC), storing the results in the UEB.

If the request is for a State Requested Methods Report (SRMR), the Fusion and Review Officer retrieves System data as needed for the analysis, performs analysis outside the System using the specified data and software (see 'Analyzes Research Event' UC), and creates an SRMR containing the results of this analysis.

The Fusion and Review Officer makes the UEB, SRMR, and member-state provided data and software available to all member states (see 'Views System Results' UC).

This use case is architecturally significant due to the inclusion of data and software provided by member states.

ACTOR DESCRIPTIONS

Fusion and Review Officer - The Fusion and Review Officer actor is an Analyst who performs expert technical analysis.
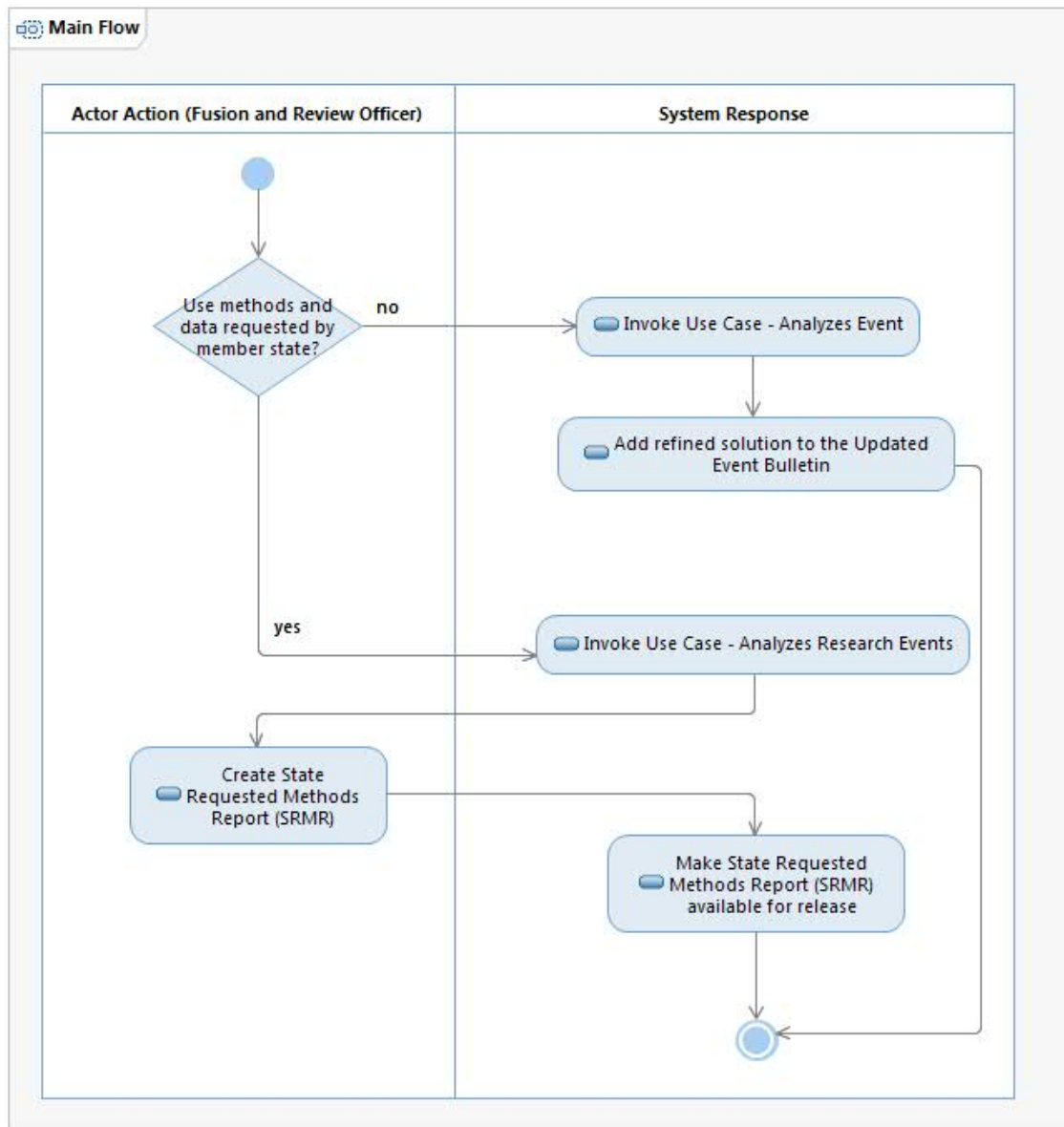
PRECONDITIONS

1. All necessary data and software provided by a member state to be used in the Expert Technical Analysis is available for use by the Fusion and Review Officer.

POSTCONDITIONS

None.

ACTIVITY DIAGRAMS

Main Flow

Action Descriptions
Decision: "Use methods and data requested by member state?"
The Fusion and Review officer can be requested to a) do a more detailed analysis of the IMS data using System tools to refine an event or b) use methods and data provided by a member state to analyze the event.

Action: "Add refined solution to the Updated Event Bulletin"
The more detailed analysis of the event provides an updated event solution that is added to the Updated Event Bulletin.

Action: "Create State Requested Methods Report (SRMR)"

The Fusion and Review Officer prepares the State Requested Methods Report (SRMR) after re-analyzing the event with the additional data, new algorithms and/or additional software. The SRMR provides detailed information about a particular event and can include text, tables, figures, and maps.

Alternate Flows
1. Any Actor Action - The Fusion and Review Officer may choose to cancel, in which case this use case ends.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1947: [*Threshold*] The System shall implement user interfaces according to the User Interface Guidelines.

IDC Specific:
S-5763: [*IDC only, Extensibility*] The System shall apply user-specified processing to existing data and products to create custom reports.

S-5764: [*IDC only, Extensibility*] The System shall provide the Authorized External User the capability to select user-specified processing of data and products to create custom reports.

S-6457: [*IDC only, Threshold*] The System shall provide the Fusion and Review Officer the capability to create an event report.

S-6458: [*IDC only, Threshold*] The System shall provide the Fusion and Review Officer the capability to create a State Requested Methods Report.

S-6459: [*IDC only, Threshold*] The System shall provide the Fusion and Review Officer the capability to save an event to the Updated Event Bulletin.

S-6460: [*IDC only, Threshold*] The System shall provide the Fusion and Review Officer the capability to distribute a State Requested Methods Report.

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:
None.

IDC Specific:
None.

NOTES

General:

None.

IDC Specific:

1. The Updated Event Bulletin and State Requested Methods Report (SRMR) are processing results that are available for access by an Authorized External User (see 'Views System Results' UC and 'Requests System Data' UC).

OPEN ISSUES

None.

Sandia National Laboratories