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IDC Use Cases
Working Draft for IDC Discussions

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Abstract

This document contains 10 use cases generated from the model contained in Rational Software Architect.

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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	**Reports Event of Interest**
5	**Provides Data to Customers**
5.1	Requests System Data

5.2 Approves Events for External Release
5.3 Views System Results
6 Configures System
6.1 Controls Data Acquisition
6.2 Configures Station Usage
6.3 Defines Processing Sequence
6.4 Configures Data Acquisition
6.5 Configures Processing Components
6.6 Configures System Messages
6.7 Views System Configuration History
6.8 Configures Analysis Interfaces
6.9 Configures System Permissions
7 Monitors Performance
7.1 Analyzes Mission Performance
7.2 Monitors System Performance
7.3 Monitors Station State-of-Health
7.4 System Monitors Mission Performance
7.5 Monitors Mission Processing
8 Supports Operations
8.1 Accesses the System
8.2 Controls the System
8.3 Exports Data
8.4 Imports Data
8.5 Views Event History
8.6 Maintains Operations Log
8.7 Provides Analyst Feedback
8.8 Views Analyst Feedback
8.9 Views Analyst Performance Metrics
8.10 Views Security Status
8.11 Views Messages
9 Tests System
9.1 Performs Software Component Testing
9.2 Creates Test Data Set
9.3 Replays Test Data Set
9.4 Replays Analyst Actions
10 Maintains System
10.1 Performs System Backups
10.2 Performs System Restores
10.3 Installs Software Update
10.4 System Monitors Security
11 Performs Research
11.1 Analyzes Special Events

11.2 Develops New Algorithms and Models
11.3 Determines Optimal Processing Component Configuration
11.4 Performs Multiple Event Location

12 Performs Training

12.1 Configures Data for Training Subsystem
12.2 Trains Analysts

13 Operates Standalone Subsystem

13.1 Conducts Site Survey
13.2 Performs Standalone Analysis

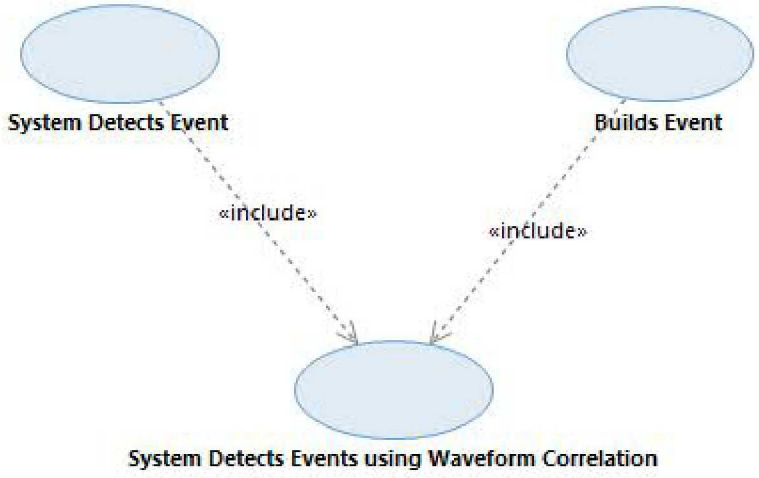
14 IDC Unique

14.2 System Assesses Event Consistency
14.3 Assesses Event Consistency
14.4 System Screens Event
14.5 Controls Monitoring Stations

IDC Use Case Report

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 due to large amounts of waveform data being processed and the impact on waveform data storage and management.

ACTOR DESCRIPTIONS

None

PRECONDITIONS

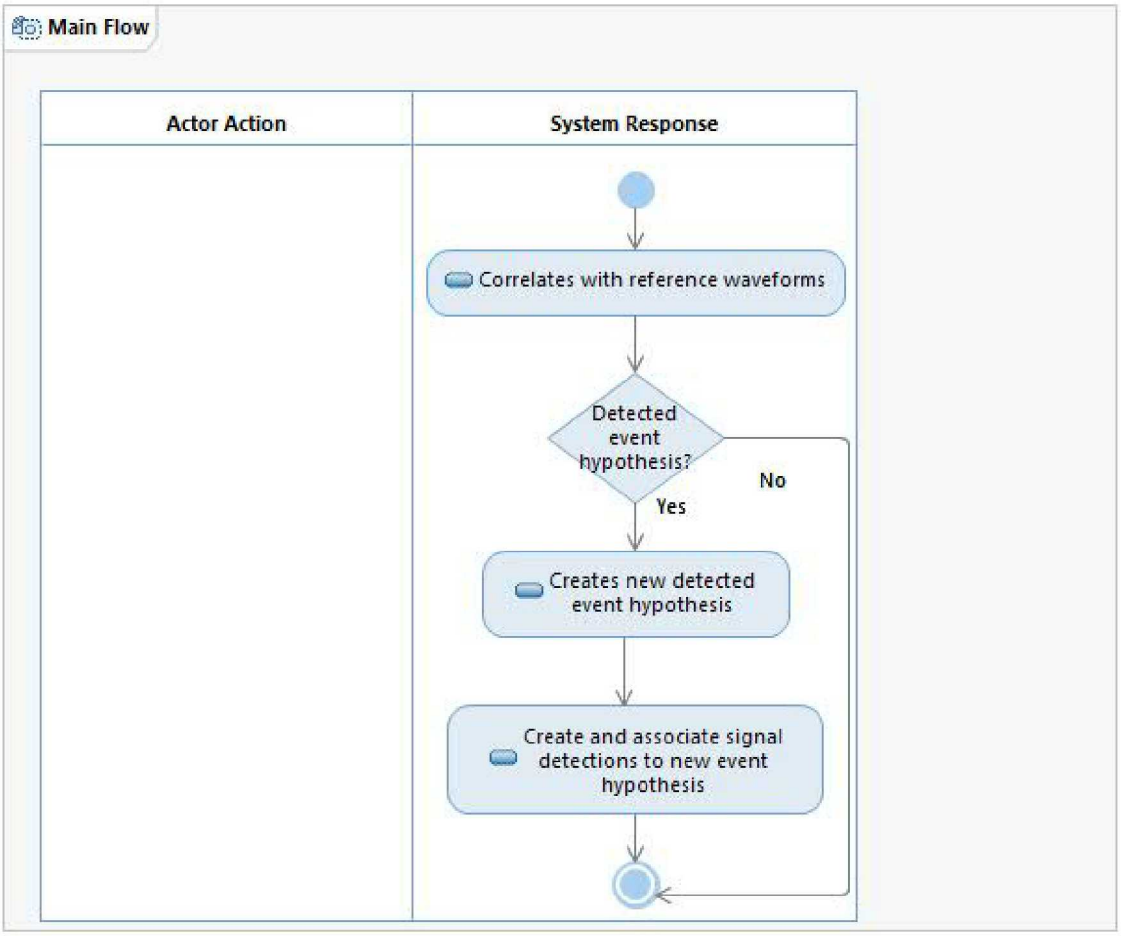
1. One or more waveforms recorded by channels with associated waveform correlation reference waveforms are available for processing.

POSTCONDITIONS

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

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.

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).

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 not use waveform sections containing configured Waveform QC Masks during waveform processing.

S-1401: [*Threshold*] The System shall detect signals of interest in waveform data by correlating the waveform with waveforms from historic 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-5949: [*null*] 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 set of signal detections and calculated event parameters that are associated with an event. An event hypothesis has one or more event hypothesis location solutions, one of which must be designated as preferred.

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 that 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.

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 is stored in other Use Cases. See 'System Detects Event' UC and 'Refines Event' UC.

IDC Specific:

None.

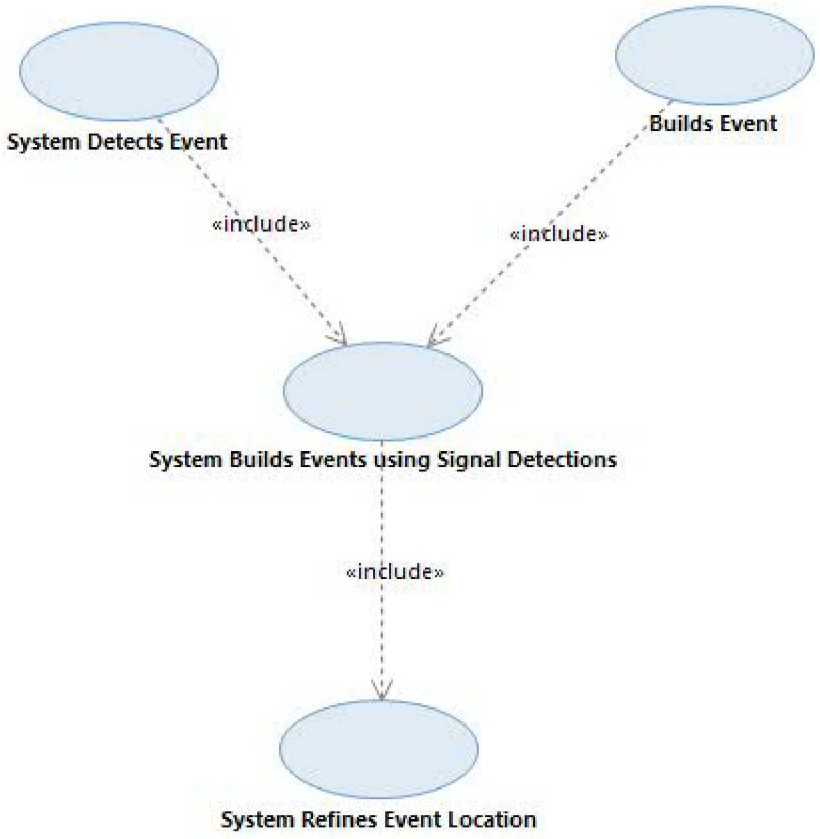
OPEN ISSUES

None.

IDC Use Case Report

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 is architecturally significant due to the potential of integrating new algorithms to build 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.

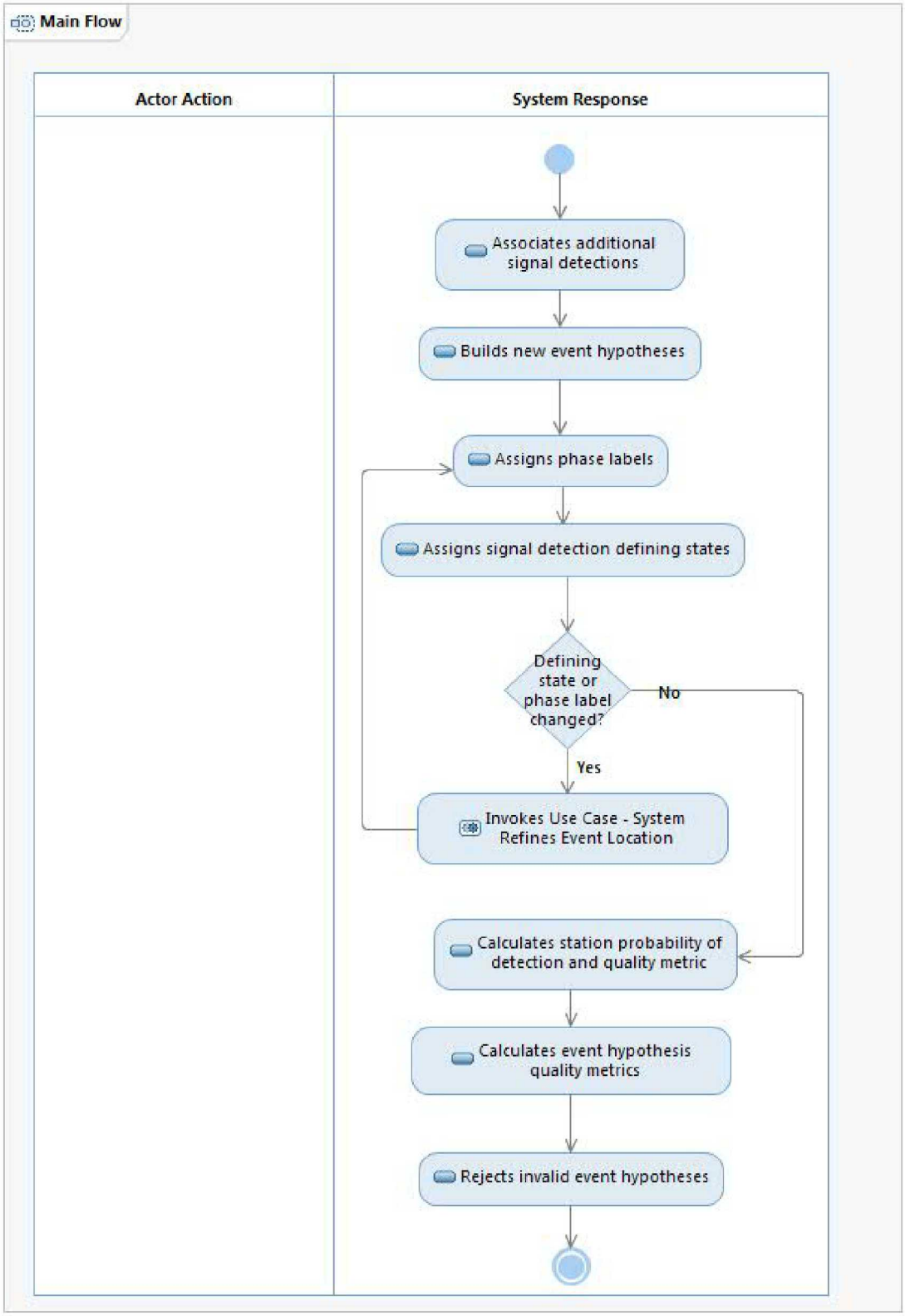
4. Zero or more single station signal detection groups are available for processing.

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



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 associates signal detections to event hypotheses detected using waveform correlation by finding and associating signal detections matching those signal detections associated to the reference event hypotheses. 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)). In cases where several possible signal detections can be associated to an event hypothesis detected using waveform correlation, the System prioritizes associating signal detections found using waveform correlation to signals detected using other methods.

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 will not reassociate a signal detection to an event hypothesis if an Analyst has previously unassociated that signal detection from that event hypothesis. The System marks as requiring Analyst review any event hypothesis 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.

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 event hypothesis. 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 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 "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).

3. 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.

4. 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-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-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-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 stations for each event hypothesis.

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-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-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-1779: [*Extensibility*] 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 but not latitude or longitude.

S-1781: [*Extensibility*] 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 but not latitude or longitude.

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

S-1784: [*Threshold*] 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.

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

S-1786: [*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 latitude, longitude, and depth.

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

S-1788: [*Threshold*] 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.

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

S-1790: [*Threshold*] 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.

S-1791: [*Extensibility*] 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 but not latitude or longitude.

S-1793: [*Extensibility*] 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: [*Extensibility*] 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.

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: [*Extensibility*] 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.

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.

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.

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: [*Extensibility*] 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: [*Extensibility*] 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-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: [*Objective / Priority 1*] 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 seasonal climatological model for computing travel times in infrasound data.

S-1855: [*Objective / Priority 1*] The System shall model thermospheric phases when computing infrasonic travel times.

S-1856: [*Objective / Priority 1*] The System shall model Lamb waves when computing travel times in infrasound data.

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-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-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-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-5652: [*Objective / Priority 1*] The System shall compute corrections to wind velocity predictions based on a model for atmospheric gravity waves.

S-5653: [*Objective / Priority 1*] The System shall compute corrections to atmospheric temperature predictions based on a model for atmospheric gravity waves.

S-5654: [*Objective / Priority 1*] The system shall compute an infrasound propagation model using gravity wave corrected wind velocity and atmospheric temperature predictions.

S-5655: [*Threshold*] The system shall compute infrasound travel-time, slowness, and attenuation using an infrasound propagation model.

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

S-5657: [*Threshold*] The system shall compute uncertainties of infrasound travel-time, slowness, and attenuation using an infrasound propagation model.

S-5772: [*Objective / Priority 1*] The System shall model tropospheric phases when computing infrasonic travel times.

S-5773: [*Objective / Priority 1*] The System shall model stratospheric phases when computing infrasonic travel times.

S-5774: [*Objective / Priority 1*] The System shall model direct phases when computing infrasonic travel times.

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

IDC Specific:
None

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

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 occurrence of some 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 set of signal detections and calculated event parameters that are associated with an event. An event hypothesis 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' 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.

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 a reference event. The relative timing of the signal detections is indicative of the location of the reference event. By shifting the timing of a signal detection template and matching it with signal detections on current waveforms, it 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 is 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

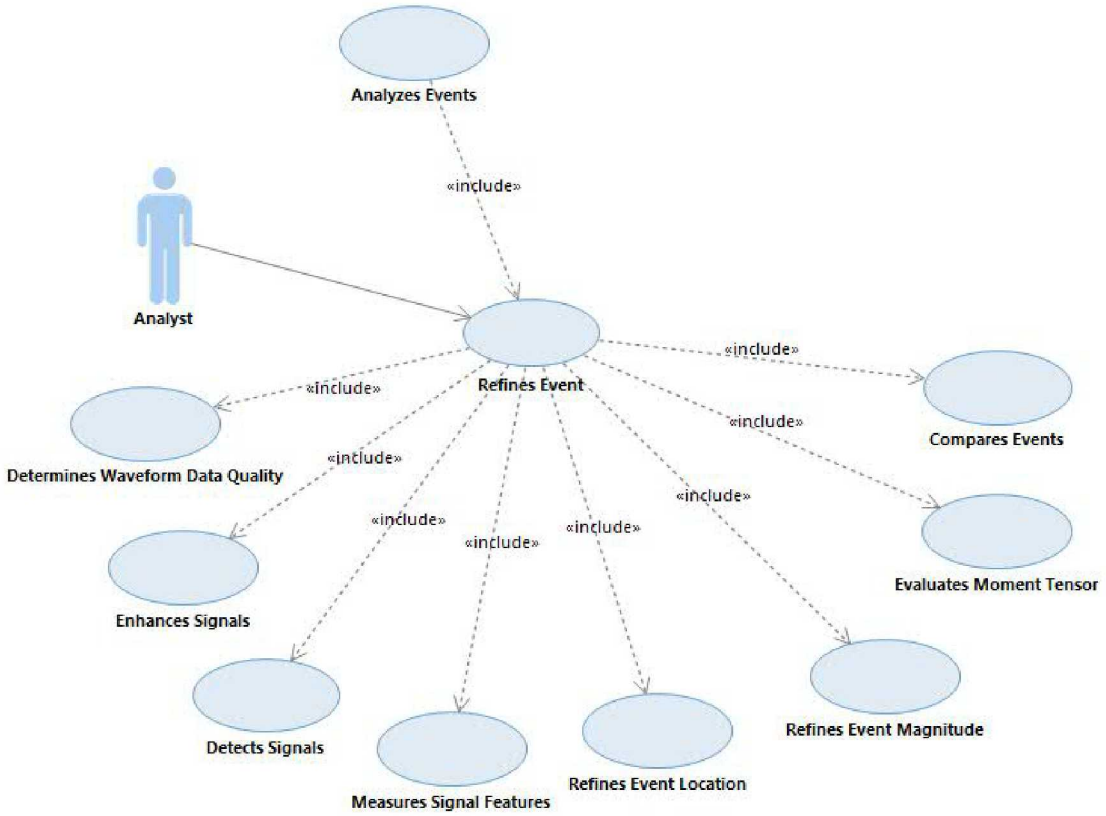
OPEN ISSUES

1. There is an alternate flow on the Main Flow to support S-1542. Under which scenarios does an Analyst have a signal detection under "active review"? Is it limited to the cases listed in UC 'Selects Data for Analysis'? If so, "active review" might be further limited if, for example, not all signal detections in a time interval opened for scanning are under "active review".

IDC Use Case Report

UC-03.02 Refines Event

1 USE CASE DIAGRAM



2 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. Analysts may provide feedback for previous Analysts during any of these steps (see 'Provides Analyst Feedback' UC).

This use case is architecturally significant because it captures the interplay between all of the Analyst activities.

3 ACTOR DESCRIPTIONS

Analyst - The Analyst actor is a System User who analyzes events. This actor includes the traditional event analysis roles, including for example, AL1, AL2, Operations Manager, Evaluator, Duty Officer, External Release Authority, and Researcher. Any Analyst can access all System event analysis capabilities but use may be limited by operational role.

4 PRECONDITIONS

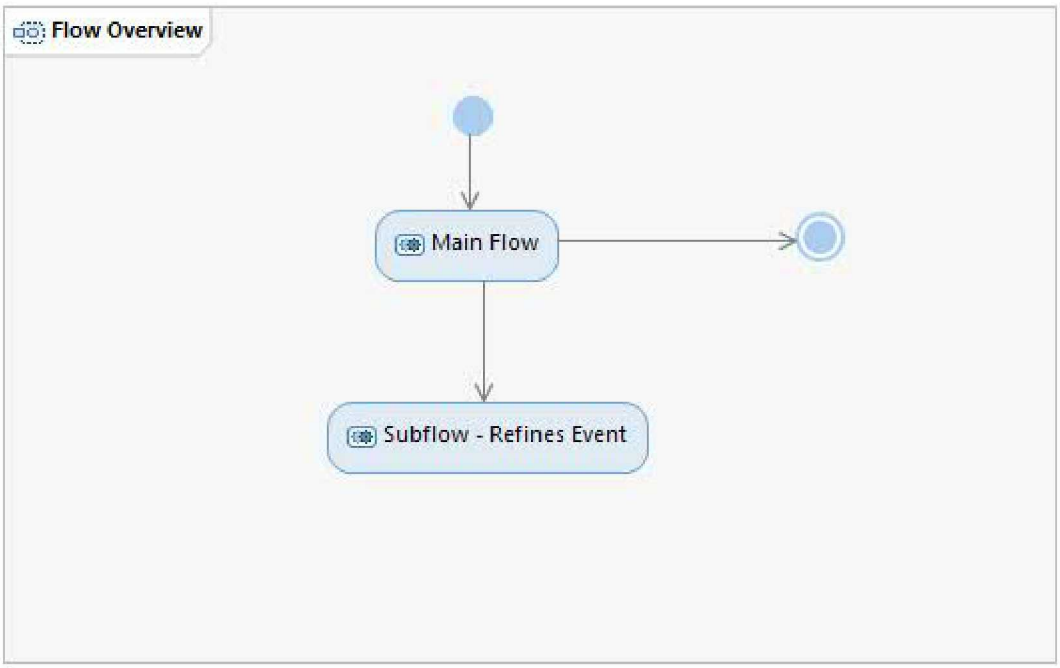
1. Analyst has selected an event, event set, or analysis time interval (see 'Selects Data for Analysis' UC).

5 POSTCONDITIONS

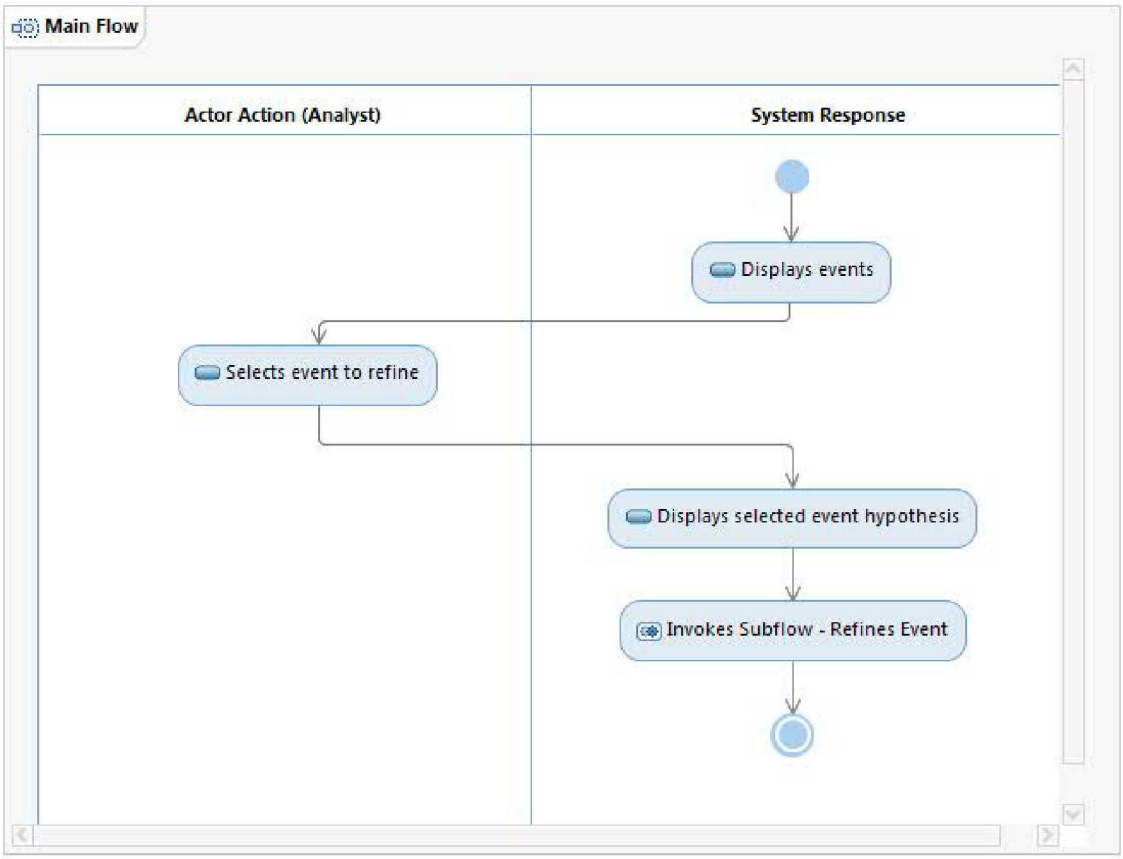
None

6 ACTIVITY DIAGRAMS

6.1 Flow Overview



6.2 Main Flow



6.2.1 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"
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 Maintainer configures which stations' waveform data are displayed in an analysis session by configuring whether or not the data is 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 picks but not configured for things like fk displays, coda mag calculations, etc.)

The data for stations that are configured as “Default for interactive analysis” is 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.

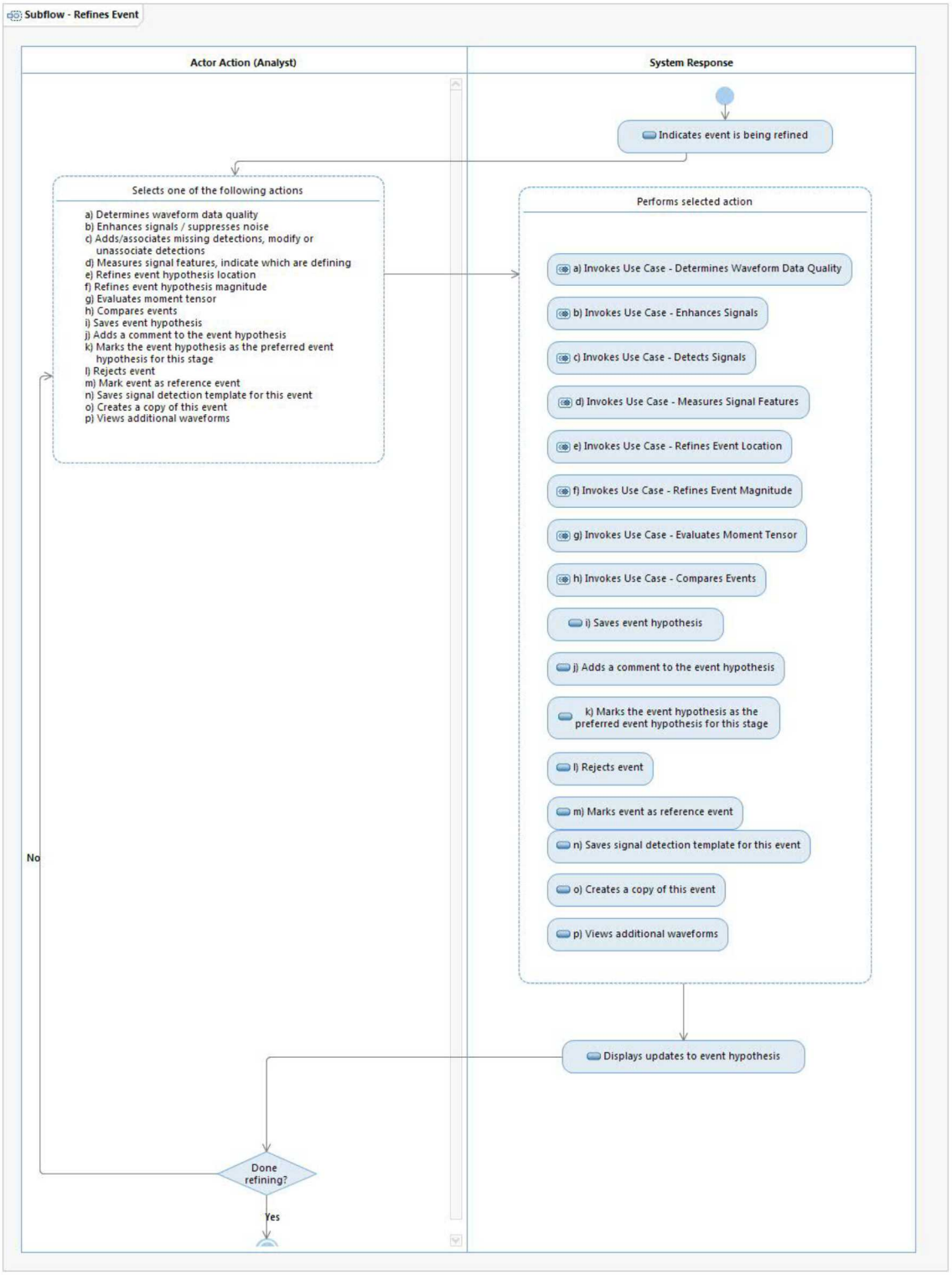
6.2.2 Alternate Flows

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.

6.3 Subflow - Refines Event



6.3.1 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 is 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 (e.g. a magnitude that has not been updated since the event hypothesis was relocated, a filter that was applied that is invalid with the current event location) and 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 and does not allow the Analyst to save the event.

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) Marks event as reference event"
The system marks the event as a reference event. This event will now be available in the list of reference events.

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) Views 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.

6.3.2 Alternate Flows

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

7 SSD MAPPINGS

The following SSDs are mapped to this use case:

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

S-1284: [*Threshold*] The System shall provide the Analyst the capability to view Waveform QC Masks.

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-1372: [*Threshold*] The System shall provide the Analyst the capability to view continuous beams.

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

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-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-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: [*Threshold*] The System shall store the type of ground motion used by moment tensor calculations.

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

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

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

S-1715: [*Threshold*] The System shall store the elements of moment tensor solutions.

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

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

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

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

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

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

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

S-1738: [*Threshold*] 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-1888: [*Threshold*] The System shall provide the Analyst the capability to analyze continuous waveform data from within a selected time block.

S-1892: [*Threshold*] The System shall provide the Analyst the capability to iteratively undo/redo back to the last saved state of an event.

S-1893: [*Threshold*] The System shall provide the Analyst the capability to sort channels based on distance from event.

S-1894: [*Threshold*] The System shall provide the Analyst the capability to sort channels based on station name.

S-1895: [*Threshold*] The System shall provide the Analyst the capability to sort channels based on station probability of detection for an event.

S-1896: [*Threshold*] The System shall provide the Analyst the capability to show all channels for a beam.

S-1897: [*Threshold*] The System shall provide the Analyst the capability to show all channels for an array.

S-1898: [*Threshold*] The System shall provide the Analyst the capability to show all channels for a 3-component station.

S-1899: [*Threshold*] The System shall provide the Analyst the capability to zoom the time axis of the waveform display.

S-1900: [*Threshold*] The System shall provide the Analyst the capability to scale the amplitude of individual displayed waveforms.

S-1901: [*Threshold*] The System shall provide the Analyst the capability to view a group of waveforms with their amplitudes scaled relative to the amplitudes of the other waveforms in the group.

S-1902: [*Threshold*] The System shall provide the Analyst the capability to adjust the height of an individual waveform display.

S-1903: [*Threshold*] The System shall provide the Analyst the capability to scroll waveform data along the time axis.

S-1904: [*Threshold*] The System shall provide the Analyst the capability to scroll the channels shown on the waveform display.

S-1905: [*Threshold*] The System shall provide the Analyst the capability to select the number of channels that are simultaneously visible on the waveform display.

S-1906: [*Threshold*] The System shall provide the Analyst the capability to time align waveforms based on observed signal detections for a user selected phase.

S-1907: [*Threshold*] The System shall provide the Analyst the capability to time align waveforms based on real time.

S-1908: [*Threshold*] The System shall provide the Analyst the capability to align waveforms based on theoretical signal detections for a user selected phase.

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 mark an event as a reference event.

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-1946: [*Threshold*] The System shall synchronize the System User's displays based on user actions.

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

S-1959: [*Threshold*] The System shall provide the System User the capability to view on-line help.

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-1986: [*Threshold*] The System shall provide the System User the capability to view associated and unassociated signal detections on an interactive map.

S-1987: [*Threshold*] The System shall provide the System User the capability to view station data on an interactive map.

S-1988: [*Threshold*] The System shall provide the System User the capability to view geographic data on an interactive map.

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

S-1997: [*Threshold*] The System shall provide the Analyst the capability to save geospatial data.

S-1998: [*Threshold*] The System shall provide the System User the capability to determine the spatial relationships of geospatial data.

S-1999: [*null*] The System shall provide the System User the capability to view tabular listings of the results of spatial processing of geospatial data.

S-2000: [*null*] The System shall provide the System User the capability to view graphical images of the results of spatial processing of 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 in the database for use by subsequent processing.

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-2166: [*Threshold*] The System shall automatically process late-arriving 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 from 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 non-volatile memory / persistent storage as soon as the data and/or derived processing results are available.

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

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

S-2588: [*Threshold*] The System shall set the processing stage workflow status of events to reflect analysis activity.

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

IDC Specific:
None

8 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. That data includes waveforms, event hypotheses and their associated signal detections, and unassociated signal detections.

Event - The occurrence of some 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 set of signal detections and calculated event parameters that are associated with an event. An event hypothesis 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 a reference event. The relative timing of the signal detections is indicative of the location of the reference event. By shifting the timing of a signal detection template and matching it with signal detections on current waveforms, it 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

9 NOTES

General:
1. The system provides all of the functionality described in this use case to all Analysts without restriction. However, certain Analyst roles (e.g. Lead Analyst, Associate Analyst, Release Authority and Researcher) may typically only utilize certain subsets of this functionality, as shown below:

Determines Waveform Data Quality
Enhances Signals
Detects Signals
Measures Signal Features
Refines Event Location
Refines Event Magnitude
Determines Potential Event of Interest Other actors such as Researchers may typically perform any or all of the above, plus the following:
Compares Events: The system does not enforce any limitation on the activities The Lead Analyst and the Associate Analyst can perform.

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

3. Marking an event as a reference event is likely only done by a Researcher; however, it is available through this use case to all Analysts.

4. The Duty Officer marking an event as reported is a special case of marking an event as a reference event.

5. User Interface Design Requirements exist in many of the SSDs mapped to this use case. These will be covered by storyboards and/or detailed user interface design requirements. Some examples (not a comprehensive list) of these types of SSDs are: SSD-196 (RRC-ID 1340), SSD-324 (RRC-ID 1284), SSD-520 (RRC-ID 1372), SSD-759 (RRC-ID 1927), SSD-1594 (RRC-ID 1644), SSD-1595 (RRC-ID 1645), SSD-1608 (RRC-ID 1987), SSD-1916 (RRC-ID 1893), SSD-1917 (RRC-ID 1894), SSD-1918 (RRC-ID 1896), SSD-1919 (RRC-ID 1897), SSD-1920 (RRC-ID 1898), SSD-1921 (RRC-ID 1899), SSD-1922 (RRC-ID 1900), SSD-1923 (RRC-ID 1902), SSD-1924 (RRC-ID 1903), SSD-1925 (RRC-ID 1904), SSD-1926 (RRC-ID 1906), SSD-1927 (RRC-ID 1908), and SSD-2009 (RRC-ID 1959).

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

IDC Specific:
None

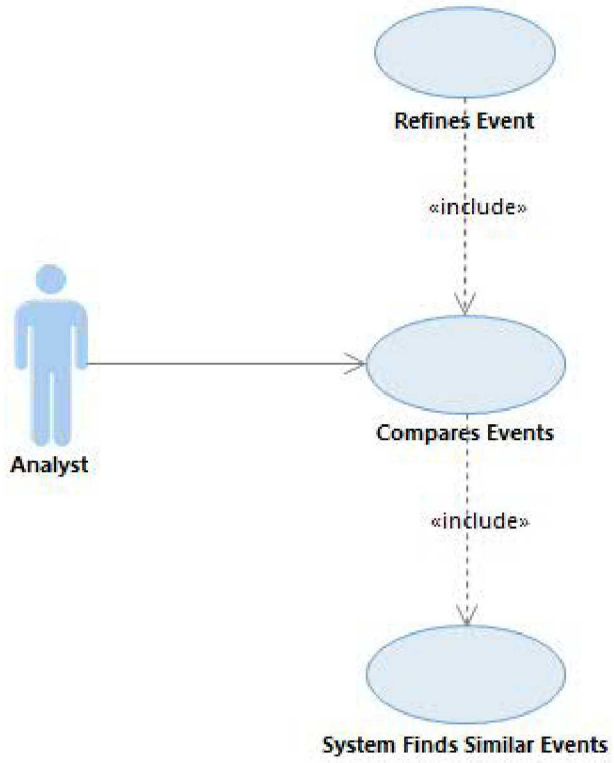
10 OPEN ISSUES

None.

IDC Use Case Report

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 due to the introduction of the capability to compare events within an operational context.

ACTOR DESCRIPTIONS

Analyst - The Analyst actor is a System User who analyzes events. This actor includes the traditional event analysis roles, including for example, AL1, AL2, Operations Manager, Evaluator, Duty Officer, External Release Authority, and Researcher. Any Analyst can access all System event analysis capabilities but use may be limited by operational role.

PRECONDITIONS

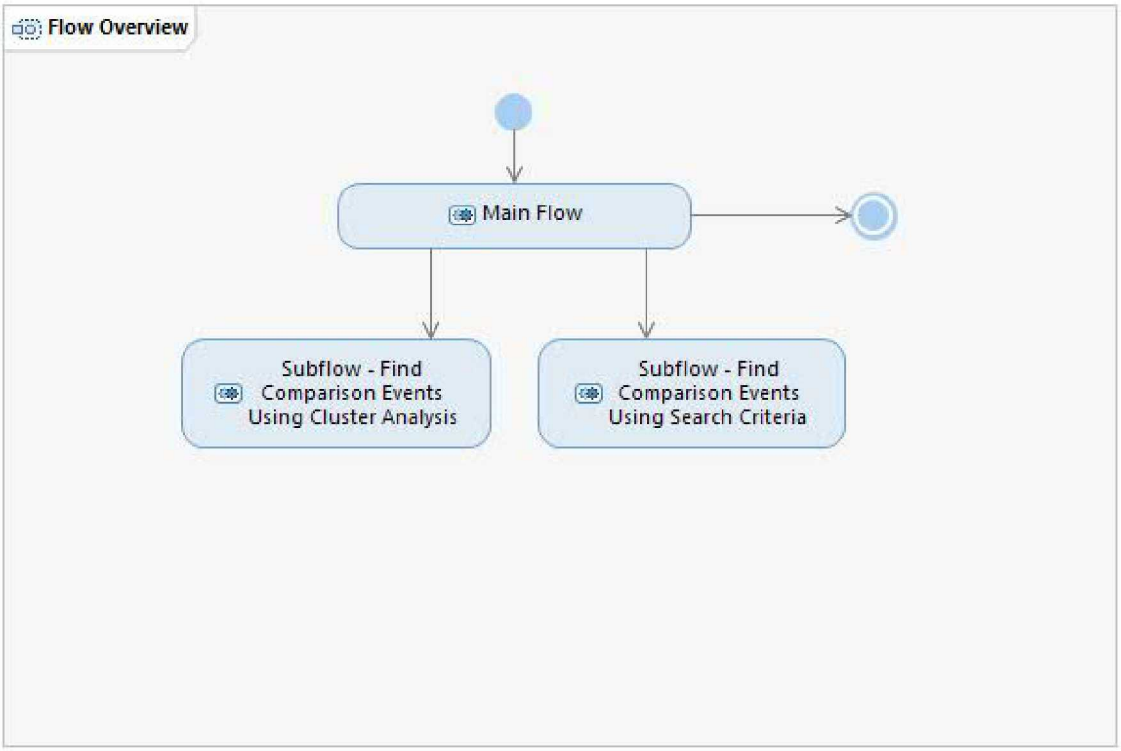
None

POSTCONDITIONS

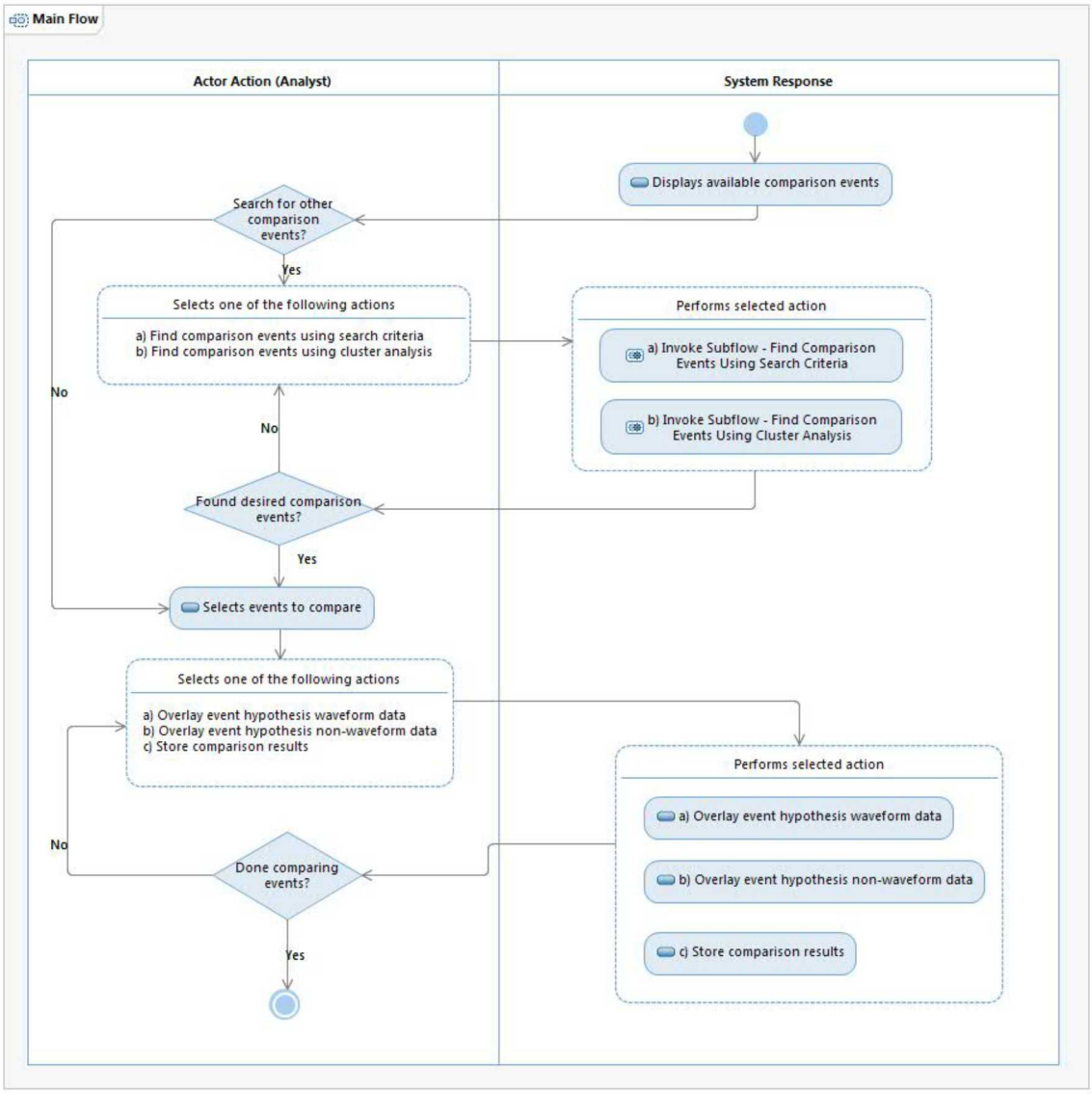
None

ACTIVITY DIAGRAMS

Flow Overview



Main Flow



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 reference events.

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.

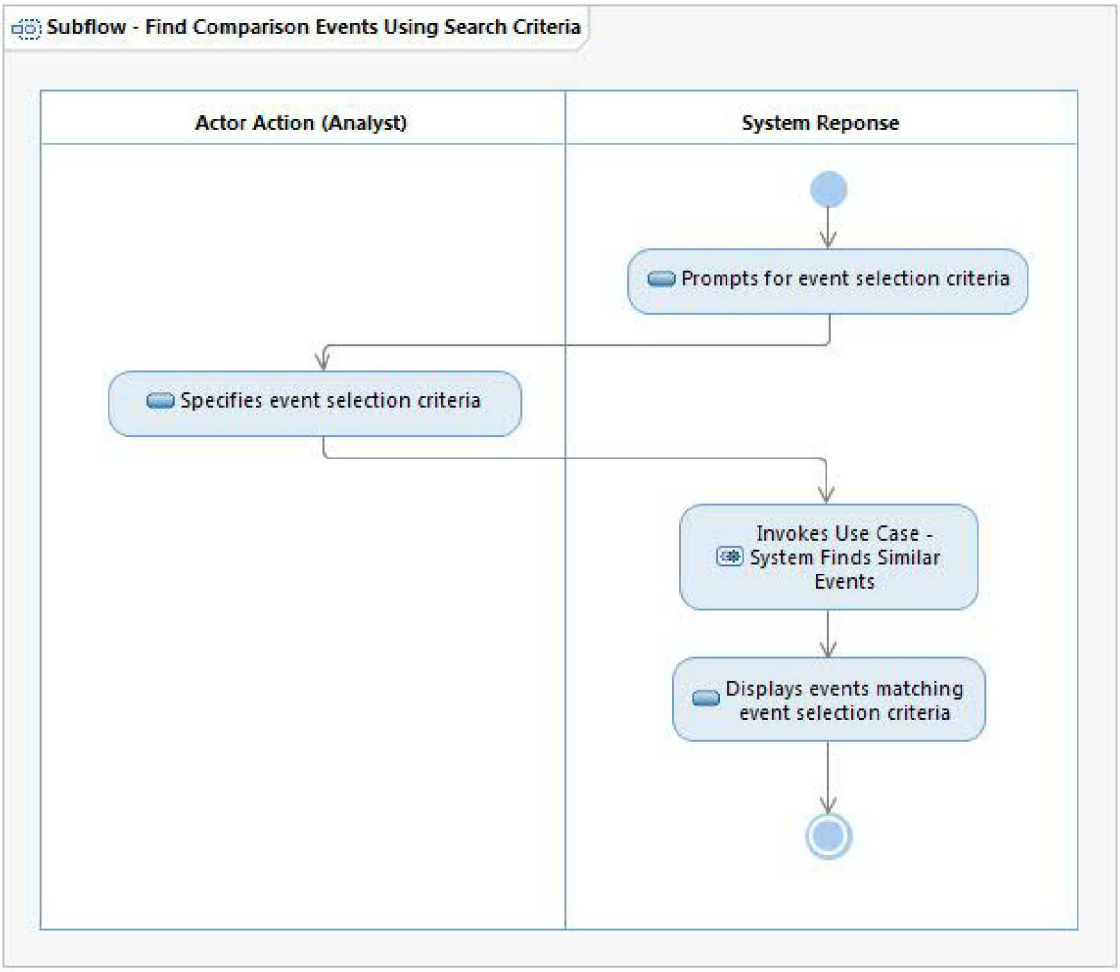
Action: "a) Overlay event hypothesis waveform data"
The system overlays selected waveforms (including pre-processing information and signal enhancement operations for those waveforms) and waveform features (e.g. signal detections) for the event hypothesis.

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 the reference event database
- Other event selection criteria (e.g. magnitude range, date/time, etc.)
- Predefined set of reference events

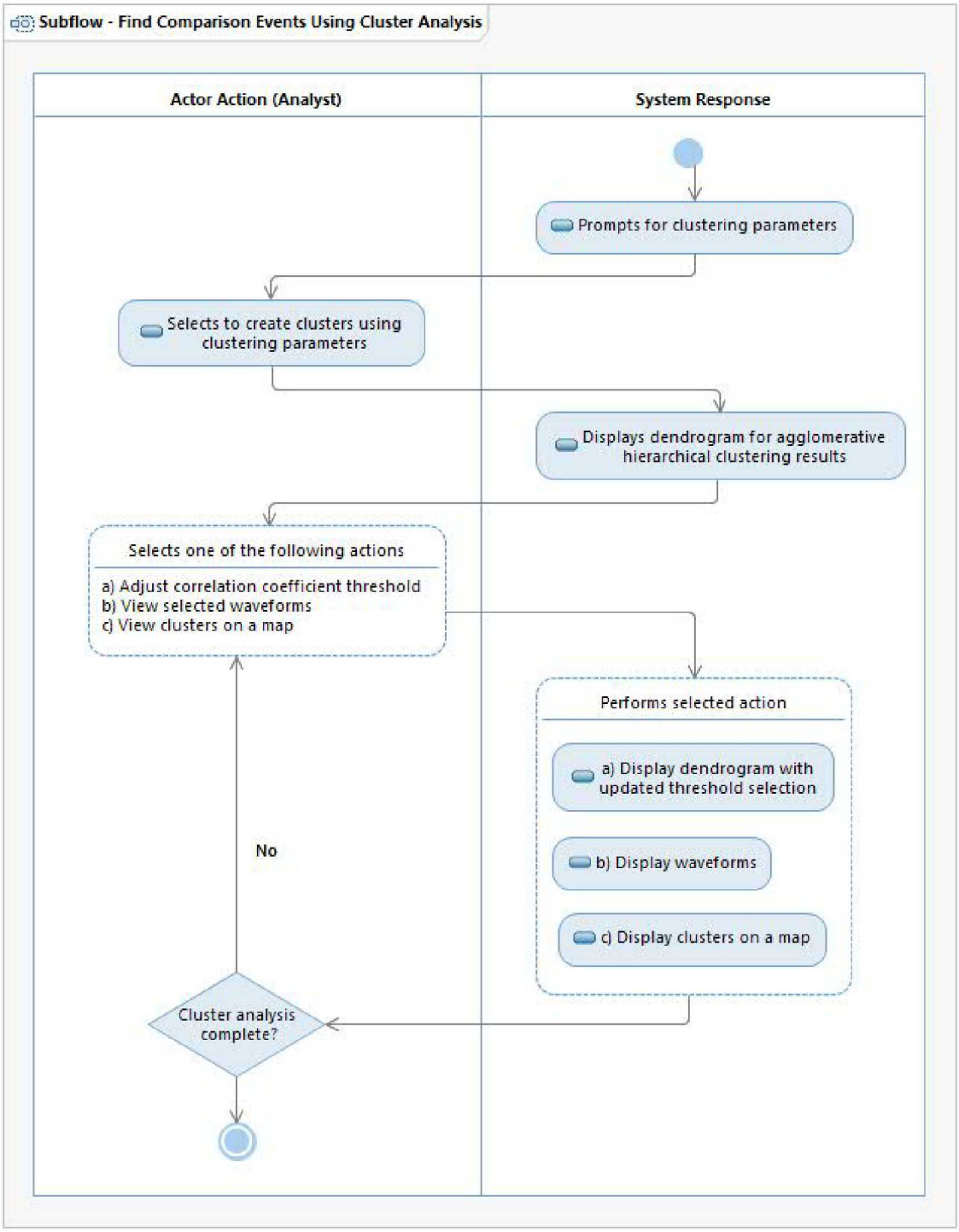
Action: "Displays events matching event selection criteria"

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
- 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: [*Threshold*] 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 a reference event hypothesis and associated waveform data.

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

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-1946: [*Threshold*] The System shall synchronize the System User's displays based on user actions.

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

S-1959: [*Threshold*] The System shall provide the System User the capability to view on-line help.

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

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-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.

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.

2. User Interface Design Requirements exist in many of the SSDs mapped to this use case. These will be covered by storyboards and/or detailed user interface design requirements. Some examples (not a comprehensive list) of these types of SSDs are: SSD-1594 (RRC-ID 1644), SSD-1595 (RRC-ID 1645), and SSD-2106 (RRC-ID 1646).

IDC Specific:
None

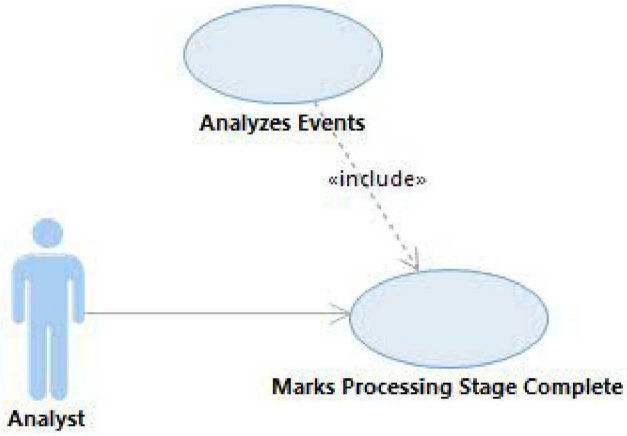
OPEN ISSUES

1. The Main Flow refers to event hypothesis non-waveform data. This refers to all data that comprise an event hypothesis. However, the subset of this data that is applicable to this use case is yet to be defined.

IDC Use Case Report

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 due to expected changes to the analysis process (including operational concept changes).

ACTOR DESCRIPTIONS

Analyst - The Analyst actor is a System User who analyzes events. This actor includes the traditional event analysis roles, including for example, AL1, AL2, Operations Manager, Evaluator, Duty Officer, External Release Authority, and Researcher. Any Analyst can access all System event analysis capabilities but use may be limited by operational role.

PRECONDITIONS

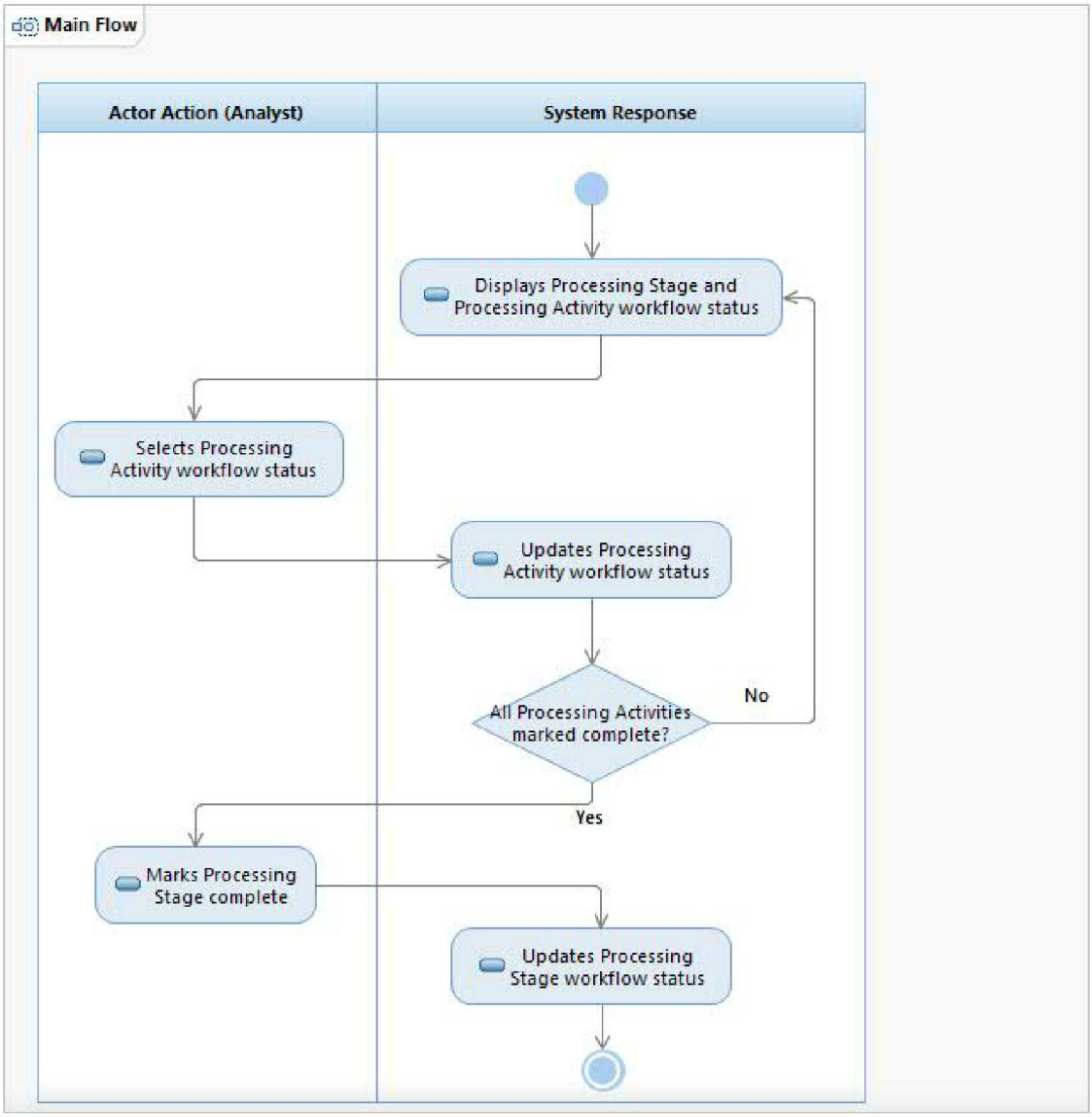
None.

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 Analyst's current Processing Stage workflow status as well as the Processing Activity workflow status for each event review and time interval review Processing Activity within that Processing Stage. The Processing Stage and Processing Activity workflow statuses reflect Analyst activity.

Action: "Selects Processing Activity workflow status"

The Analyst selects the Processing Stage or Processing Activity workflow status.

For event review processing activities the status can be Not Started, In Progress, or Complete.

For time interval review processing activities the status can be Not Started, In Progress, Not Complete, or Complete. When data needs to progress to the next Processing Stage even though not all time interval review Processing Activities within the Processing Stage are Complete (e.g. data for a station could not be scanned since the station was down), the Analyst marks the time interval review Processing Activity as "Not Complete" and enters a comment indicating the reason the activity could not be completed.

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
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-1946: [*Threshold*] The System shall synchronize the System User's displays based on user actions.

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

S-1959: [*Threshold*] The System shall provide the System User the capability to view on-line help.

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. That data includes 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, Analyst 1, etc.). 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:
None.

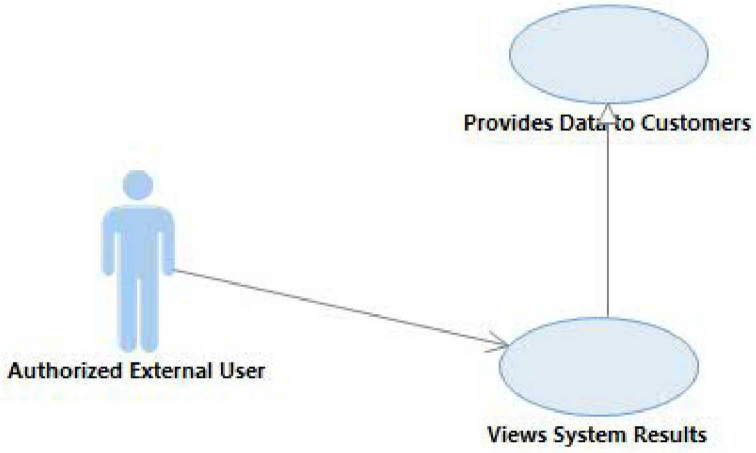
OPEN ISSUES

None.

IDC Use Case Report

UC-05.03 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 interface for Authorized External Users.

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

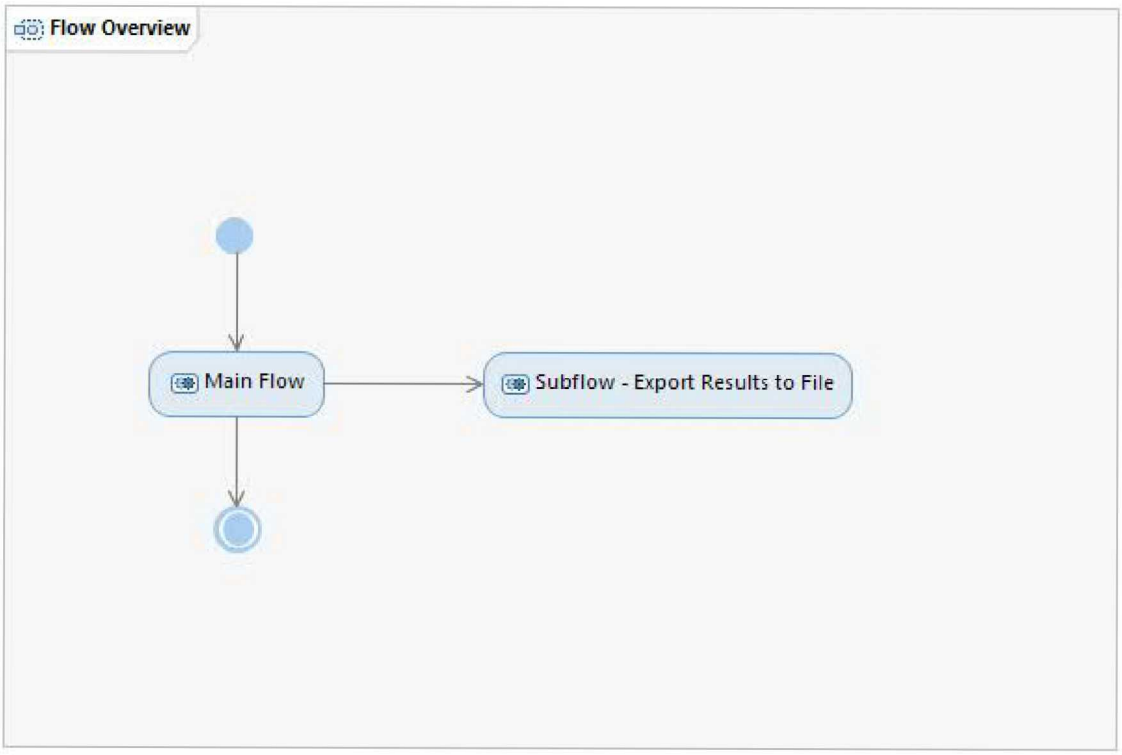
None.

POSTCONDITIONS

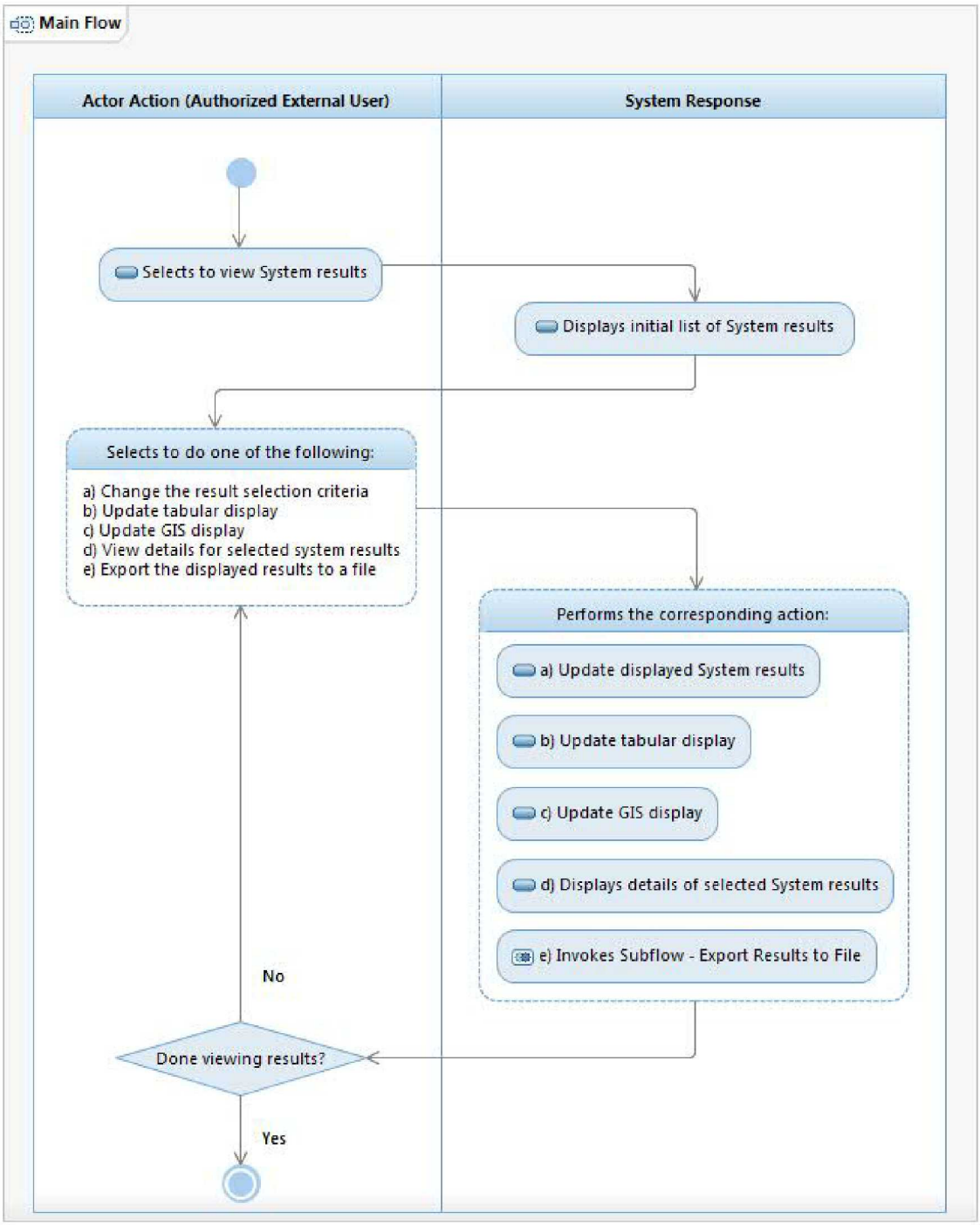
None

ACTIVITY DIAGRAMS

Flow Overview



Main Flow



Action Descriptions

Action: "Selects to view System results"

The Authorized External User selects to view System results on the System website.

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,

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.

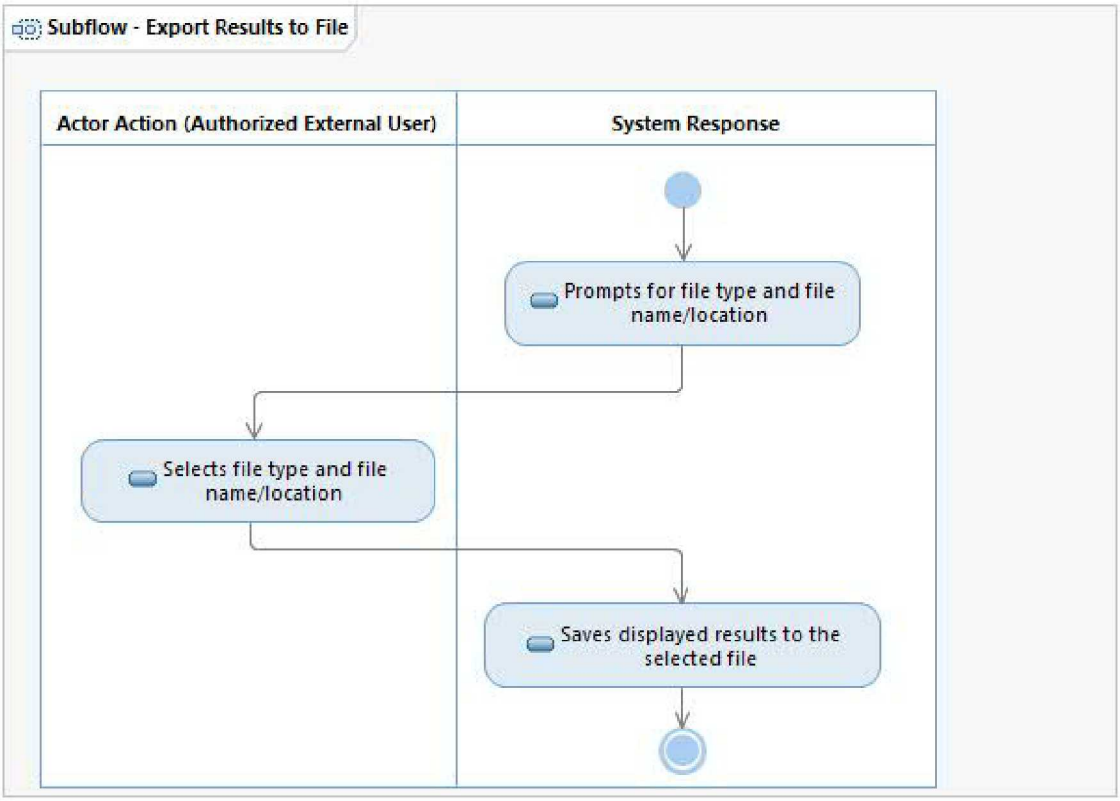
Action: "b) Update tabular display"
The System updates the tabular display (e.g. new sort field or new sort direction).

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, etc.

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-1974: [*Threshold*] The System shall generate graphical images of the results of spatial processing of geospatial data.

S-1975: [*Threshold*] The System shall generate tabular listings of the results of spatial processing of geospatial data, e.g. event hypothesis data selected by spatial processing with geographic information.

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-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-5700: [*null*] The System shall provide the Authorized External User the capability to request reports via a secure website.

S-5892: [*null*] The System shall provide the Authorized External User the capability to view reports.

S-5894: [*null*] The System shall provide the Authorized External User the capability to access reports via a GIS.

S-5962: [*null*] The System shall provide the Authorized External User the capability to access reports via tabular format.

S-5963: [*null*] The System shall provide the Authorized External User the capability to view station ambient noise probability density functions.

S-5964: [*null*] 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, deployment, and configuration parameter values for detection and feature extraction functions.

S-5986: [*Threshold*] The System shall provide the Authorized External User the capability to view event hypothesis data on an interactive map.

S-5987: [*Threshold*] The System shall provide the Authorized External User the capability to view associated and unassociated signal detections 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-5991: [*Threshold*] The System shall provide the Authorized External User the capability to view inactive 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-5995: [*Threshold*] The System shall provide the Authorized External User the capability to view on an interactive map whether an event hypothesis location uncertainty bound intersects an active geographic region for a user specified time.

S-5996: [*null*] 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-5998: [*Threshold*] The System shall provide the Authorized External User the capability to view on an interactive map whether an event hypothesis location is within an active geographic region for a user specified time.

S-5999: [*Threshold*] The System shall provide the Authorized External User the capability to search via GIS for the percentage of an event hypothesis uncertainty ellipse that is within an active geographic region.

S-6000: [*Threshold*] The System shall provide the Authorized External User the capability to access geospatial data.

S-6001: [*Threshold*] The System shall provide the Authorized External User the capability to determine the spatial relationships of geospatial data.

S-6002: [*null*] 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-6003: [*null*] The System shall provide the Authorized External User the capability to view tabular listings of the results of spatial processing of geospatial data.

S-6004: [*null*] The System shall provide the Authorized External User the capability to view graphical images of the results of spatial processing of geospatial data.

S-NEW1: The System shall provide the System User the capability to access the System as an Authorized External User.

S-NEW2: The System shall provide the Authorized External User the capability to view third-party event bulletins.

S-NEW3: 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-NEW4: The System shall export geographic data in KML/KMZ format.

S-NEW5: 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-2017-UPDATED: [*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-UPDATED: [*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-5674-UPDATED: [*Threshold*] The System shall provide the Authorized External User the capability to view station calibration results.

IDC Specific:
S-5668: [*IDC only, null*] The System shall convert event bulletins to the QuakeML format

S-5705: [*IDC only, null*] The System shall provide the Authorized External User the capability to request station configuration data in the SeisComP3XML format.

S-5751: [*IDC only, null*] The System shall provide the Authorized External User the capability to request waveform data for an event.

S-5792: [*IDC only, null*] The System shall provide the Authorized External User the capability to modify previously configured automated event warning/notification targets.

S-5840: [*IDC only, null*] The System shall provide the Authorized External User the capability to request event bulletins in QuakeML format.

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, 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.

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, etc.

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. This use case also provides the Authorized External User with displays used to select parameters controlling automated event warnings and notifications.

3. In Main Flow Action “Displays initial list of System Results” the System results also include radionuclide reports, radionuclide bulletins, atmospheric transport modeling results (e.g. source receptor sensitivity), and Expert Technical Analysis reports.

OPEN ISSUES

1. Write and map specs related to radionuclide results (CR-1846).

2. Write and map specs related to expert technical analysis results (CR-1941).

3. Determine if it is appropriate for the specs about “requesting” data (e.g. S-5700, S-5751, S-5840, S-5705) to be mapped to this UC (CR-1942).

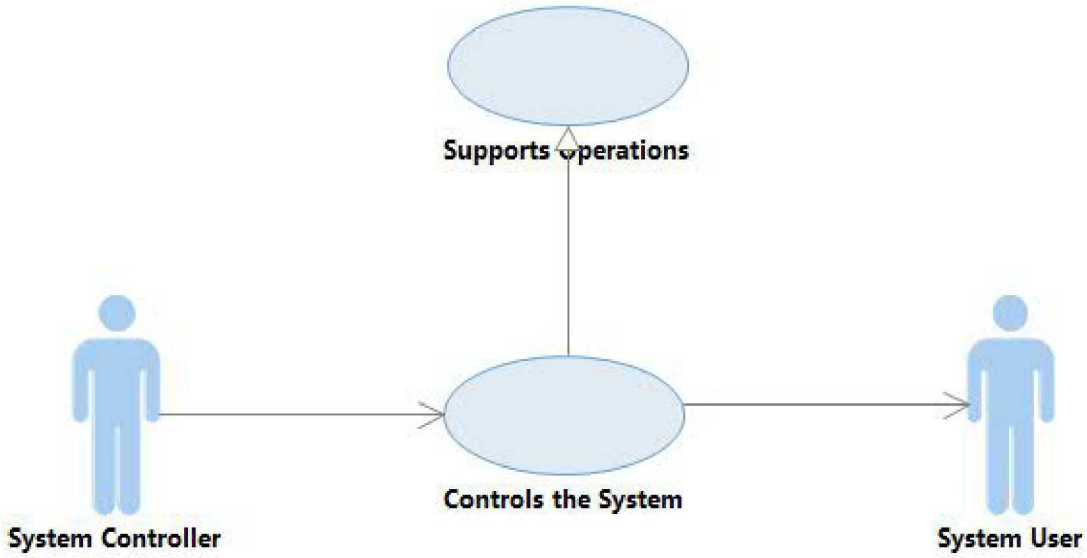
4. Map new specs for specific system results accessible to the Authorized External User (CR-1951).

5. Determine the level of provenance and configuration information available to the Authorized External User in ‘Views System Results’ UC (CR-1952)

IDC Use Case Report

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

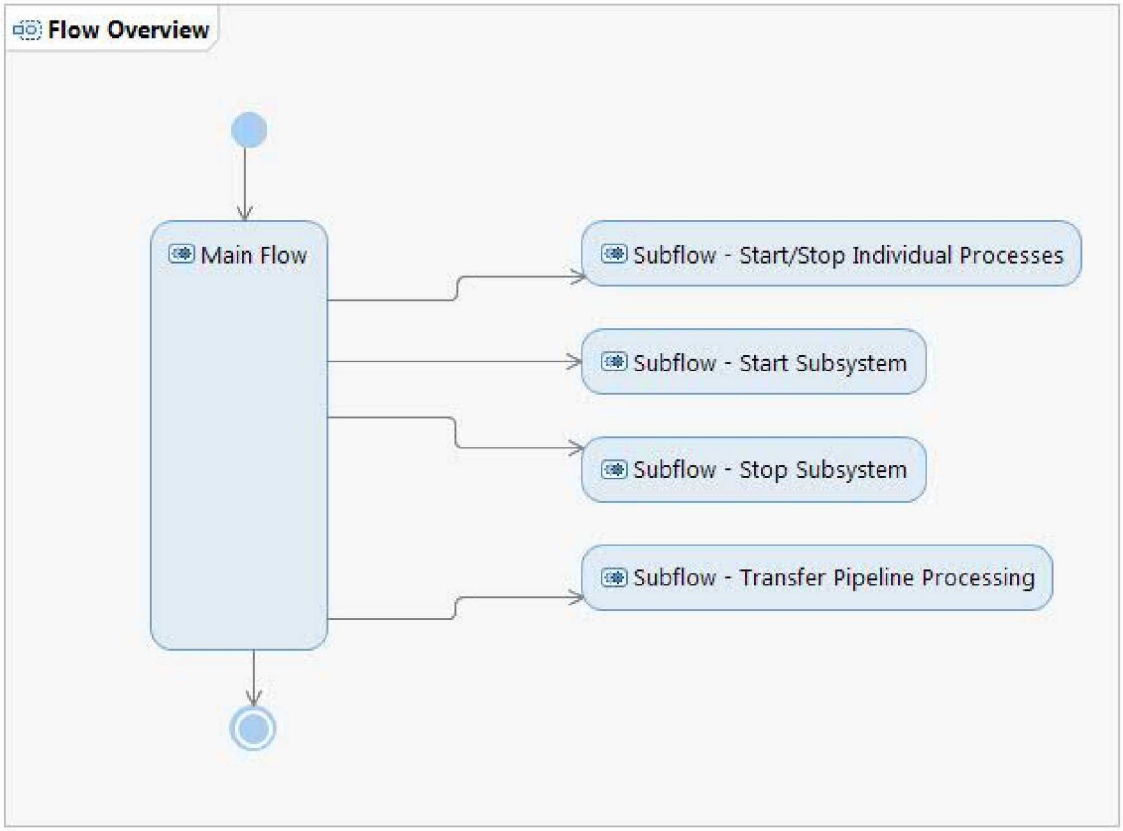
1. The subsystem hardware is assumed to be turned on.

POSTCONDITIONS

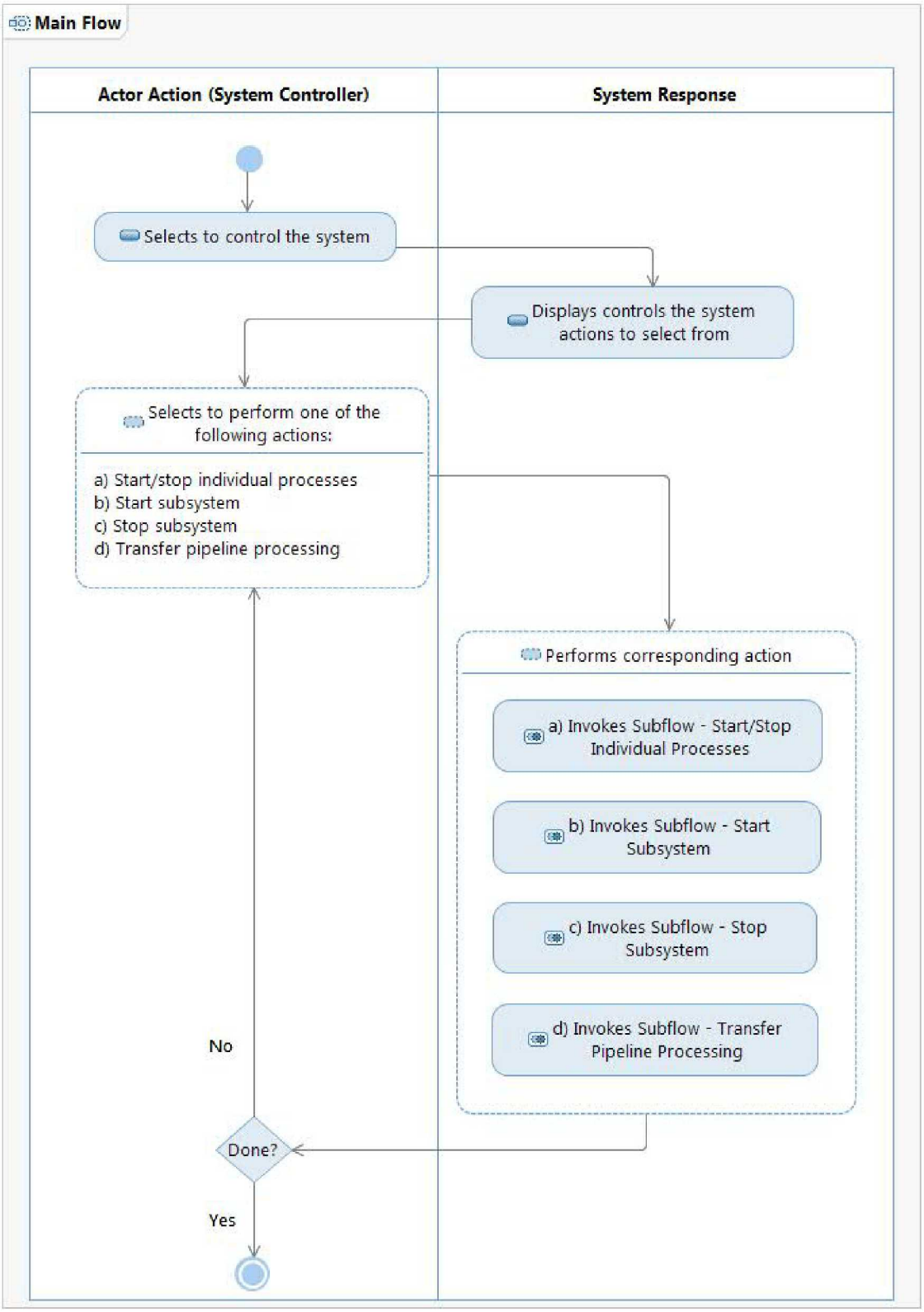
None

ACTIVITY DIAGRAMS

Flow Overview



Main Flow



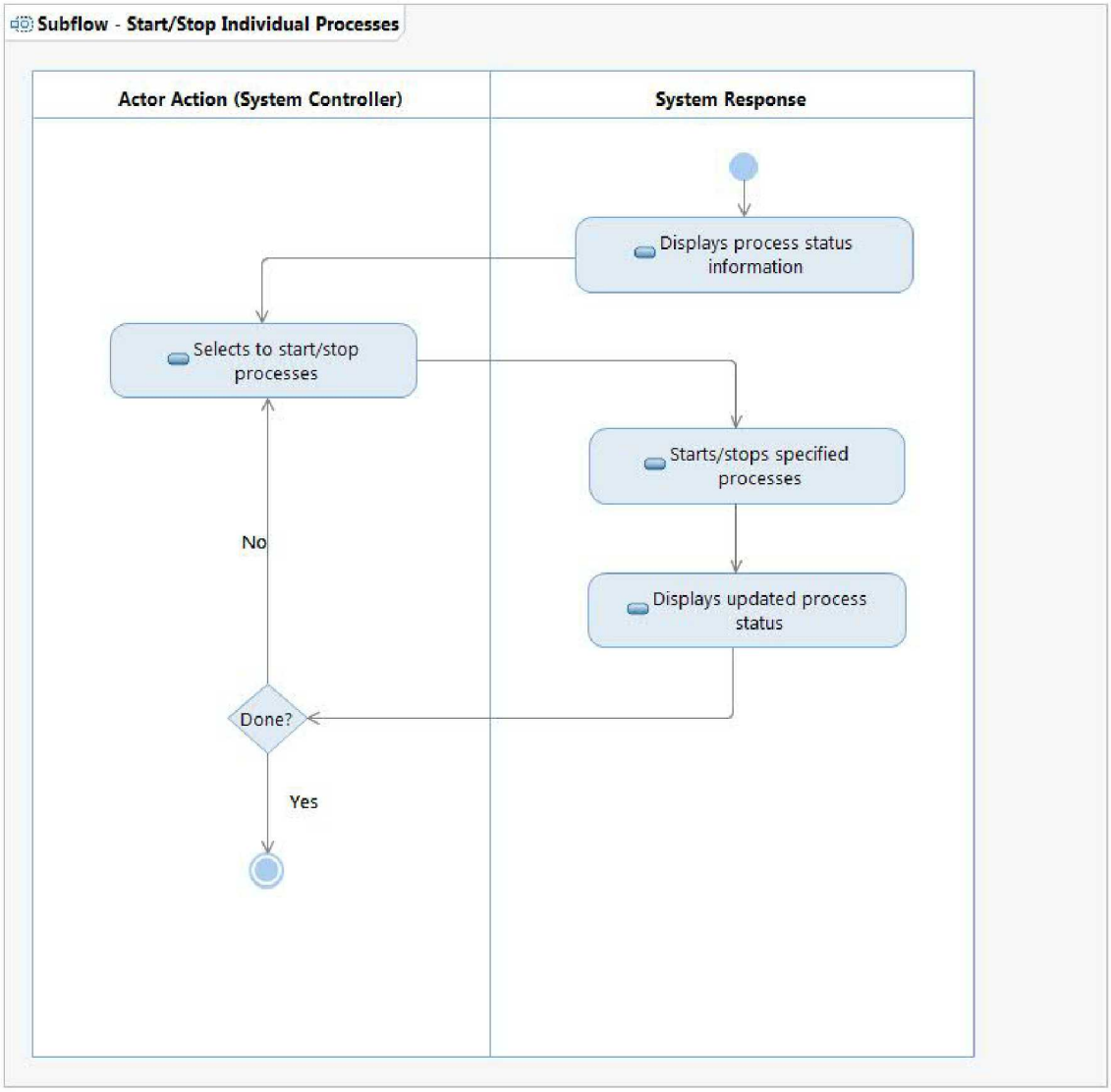
Action Descriptions

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.

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"

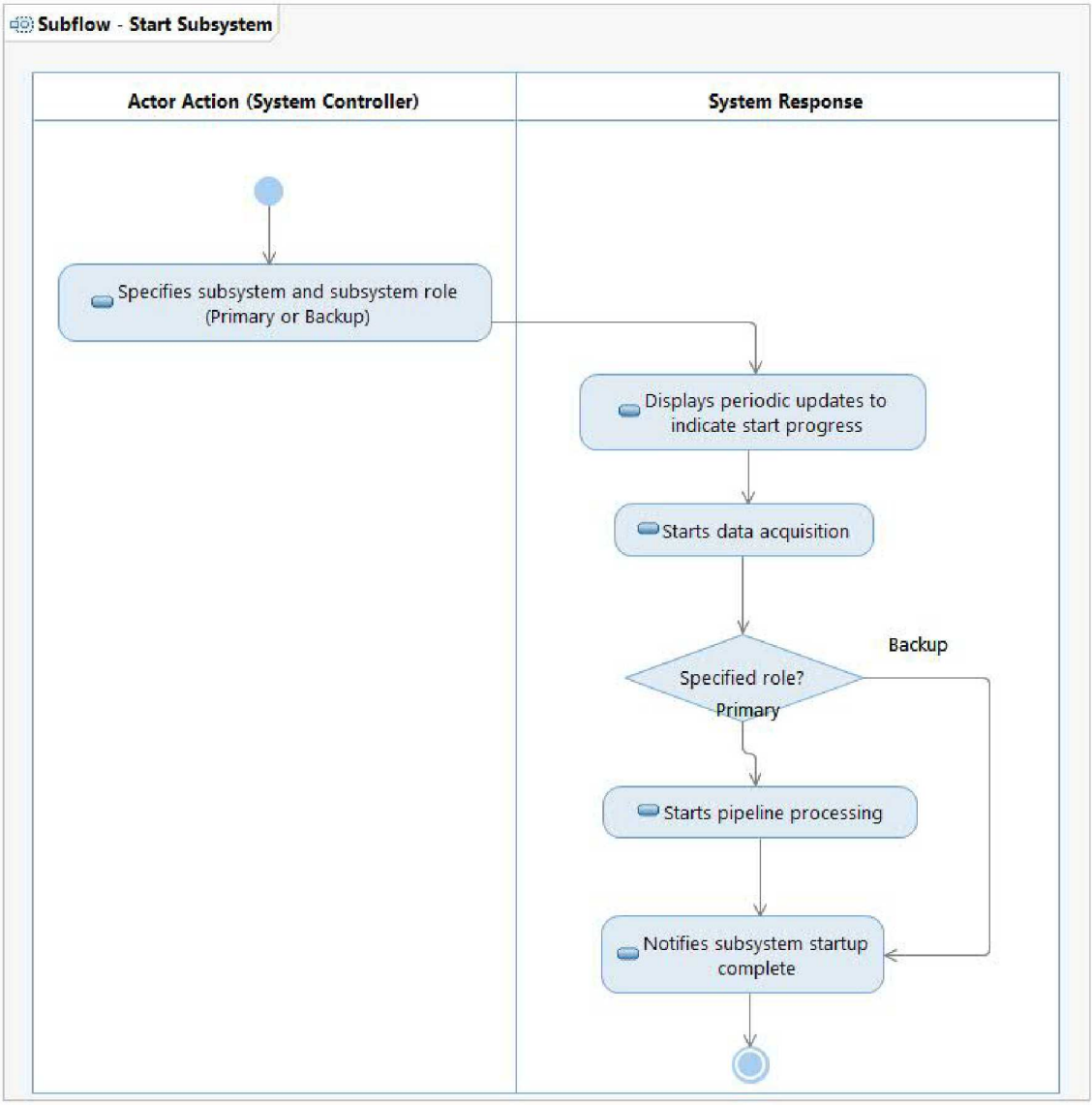
The system starts or stops all of the processes specified by the System Controller.

Action: "Displays updated process status"
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.

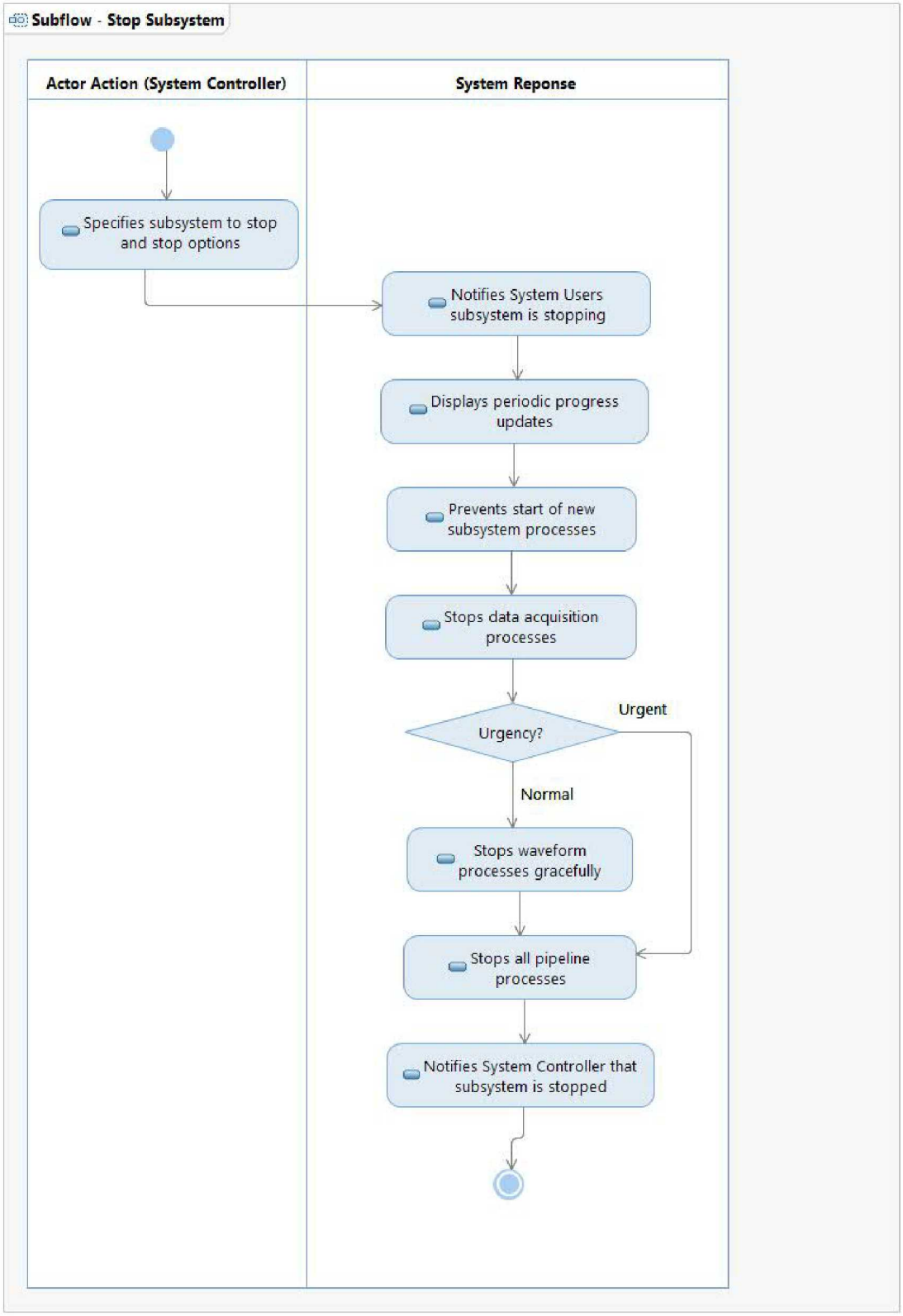
Action: "Notifies subsystem startup complete"
The system notifies the System Controller the subsystem startup is complete.

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. Actions "Start 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.

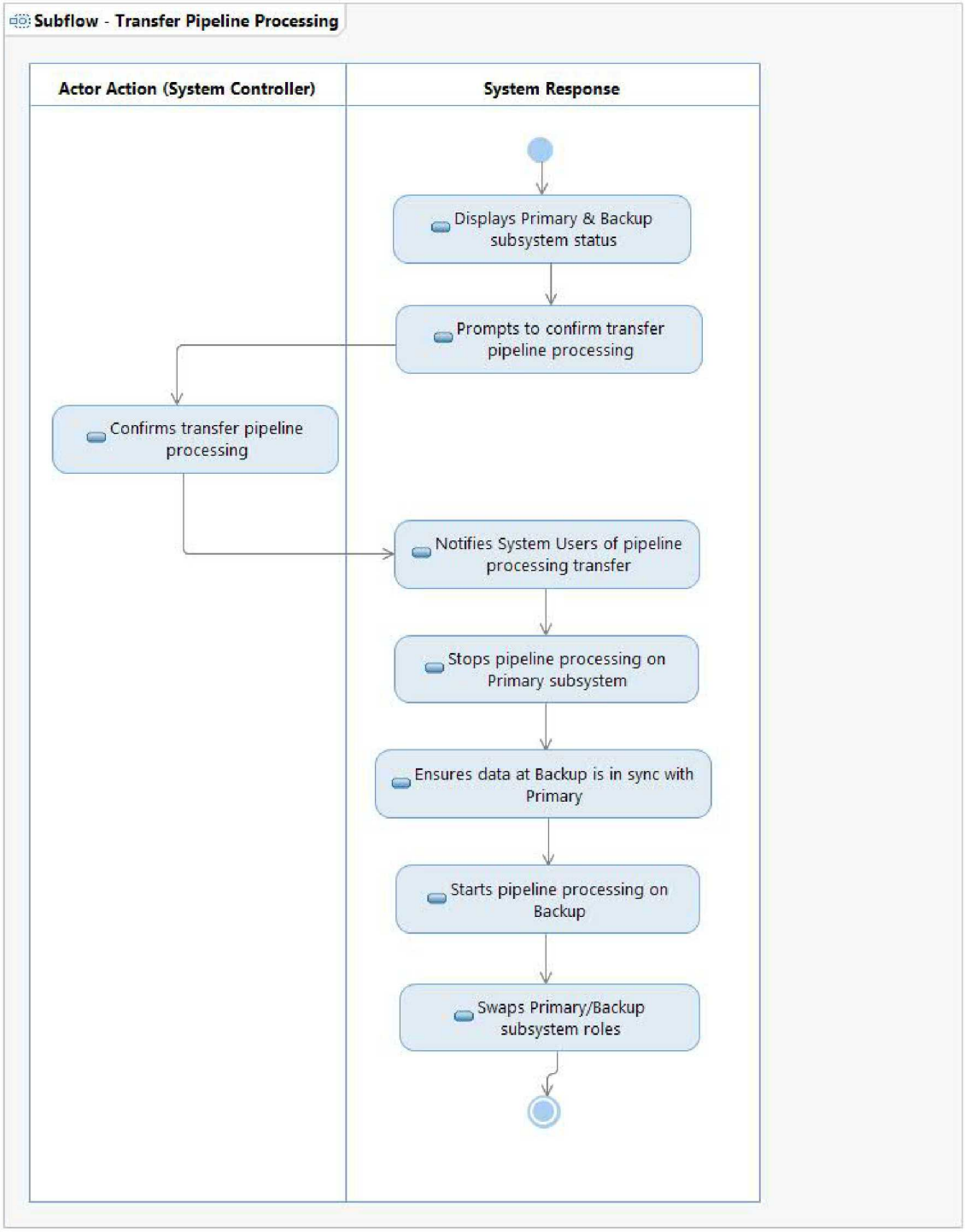
Action: "Notifies System Controller that subsystem is stopped"
The system notifies the System Controller that the subsystem is stopped.

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 is 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 continues. If the primary system is inaccessible or has failed, the UC begins at this action.

SSD MAPPINGS

The following SSDs are mapped to this use case:

General:
S-1946: [*Threshold*] The System shall synchronize the System User's displays based on user actions.

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

S-1959: [*Threshold*] The System shall provide the System User the capability to view on-line help.

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.

IDC Specific:
None

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.

Mission Transfer - The process of transferring the execution of System operations from the Primary to the Backup.

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

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.

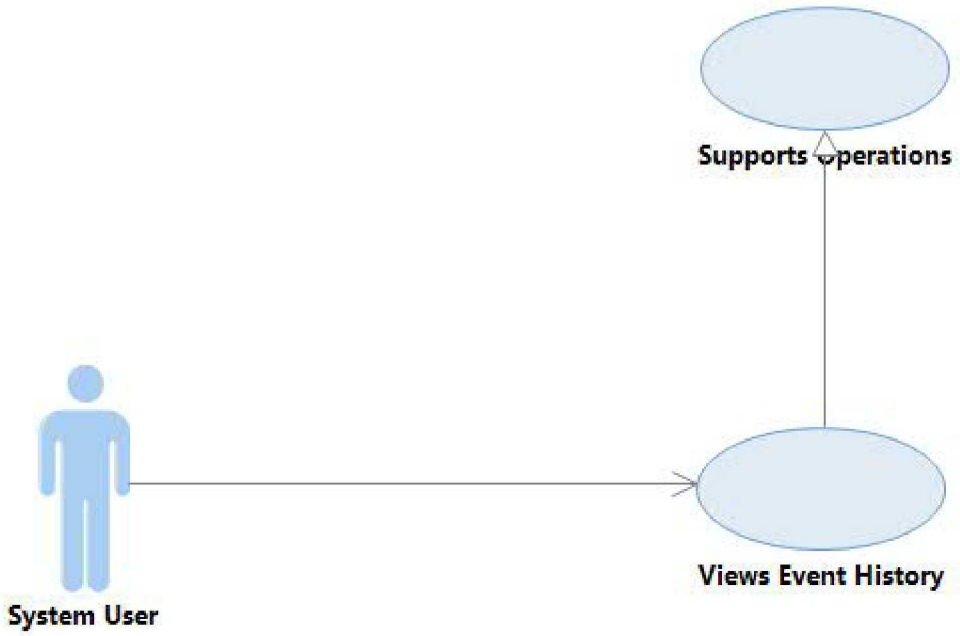
OPEN ISSUES

None

IDC Use Case Report

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 covers review of stored versions of event hypotheses.

ACTOR DESCRIPTIONS

System User - The System User actor is any internal user who accesses the System.

PRECONDITIONS

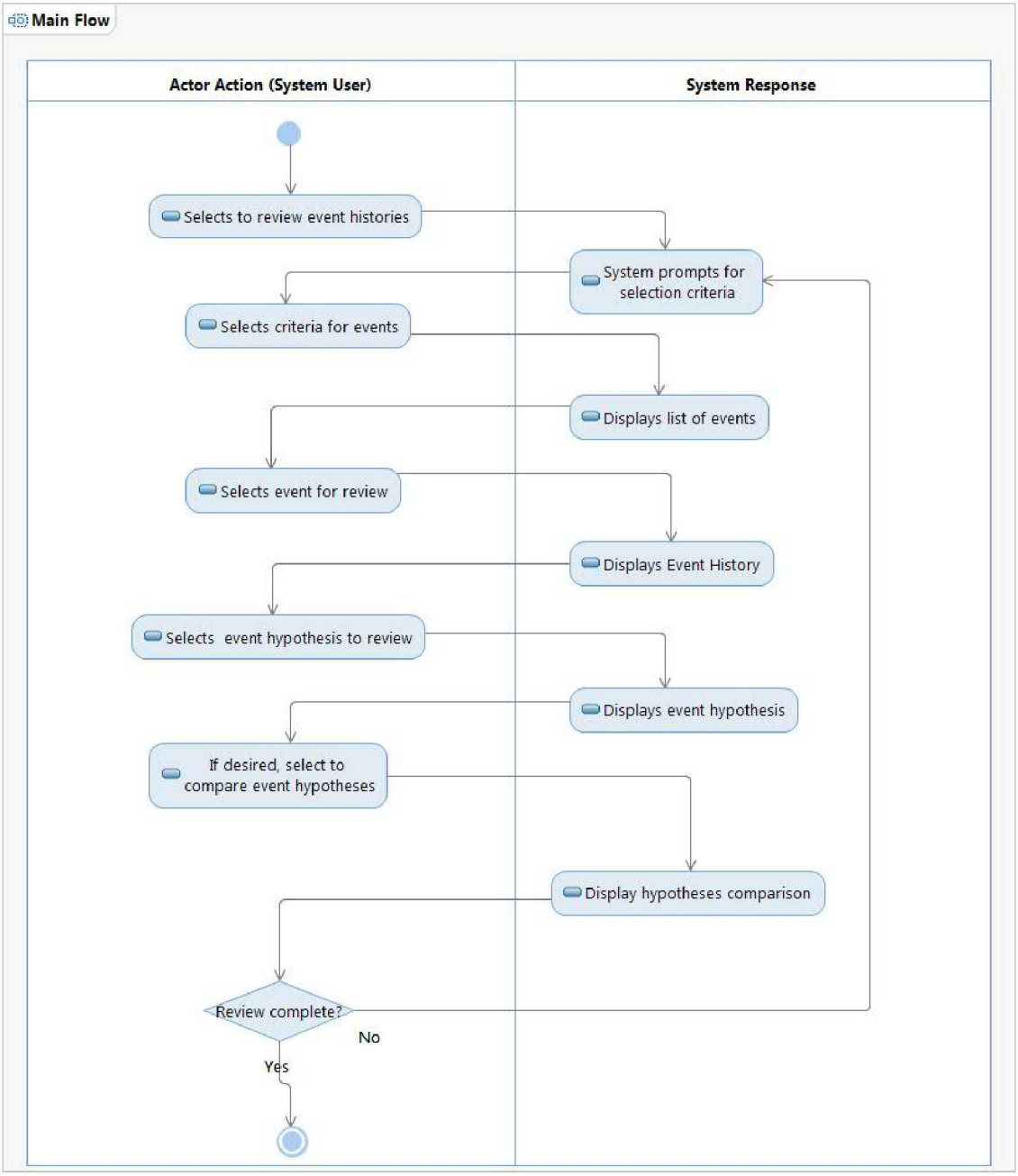
None

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.

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

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

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

S-1926: [*Threshold*] The System shall provide the System User the capability to view the complete history of an event.

S-1946: [*Threshold*] The System shall synchronize the System User's displays based on user actions.

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

S-1959: [*Threshold*] The System shall provide the System User the capability to view on-line help.

S-1974: [*Threshold*] The System shall generate graphical images of the results of spatial processing of geospatial data.

S-1975: [*Threshold*] The System shall generate tabular listings of the results of spatial processing of geospatial data, e.g. event hypothesis data selected by spatial processing with geographic information.

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

S-1986: [*Threshold*] The System shall provide the System User the capability to view associated and unassociated signal detections on an interactive map.

S-1987: [*Threshold*] The System shall provide the System User the capability to view station data on an interactive map.

S-1988: [*Threshold*] The System shall provide the System User the capability to view geographic data on an interactive map.

S-1989: [*Threshold*] The System shall provide the System User the capability to view active geographic region boundaries on an interactive map.

S-1990: [*Threshold*] The System shall provide the System User the capability to simultaneously view event hypothesis locations and active geographic region boundaries on an interactive map.

S-1991: [*Threshold*] The System shall provide the System User the capability to view on an interactive map whether an event hypothesis location is within active geographic regions.

S-1993: [*Threshold*] The System shall provide the System User the capability to view on an interactive map whether an event hypothesis location uncertainty bound intersects an active geographic region for a user specified time.

S-1995: [*Threshold*] The System shall provide the System User the capability to search via GIS for the percentage of an event hypothesis uncertainty ellipse that is within an active geographic region.

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

S-1997: [*Threshold*] The System shall provide the Analyst the capability to save geospatial data.

S-1998: [*Threshold*] The System shall provide the System User the capability to determine the spatial relationships of geospatial data.

S-1999: [*null*] The System shall provide the System User the capability to view tabular listings of the results of spatial processing of geospatial data.

S-2000: [*null*] The System shall provide the System User the capability to view graphical images 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.

S-2597: [*null*] The System shall provide the System 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-5603: [*Threshold*] The System shall provide the System User the capability to view inactive geographic region boundaries on an interactive map.

S-5604: [*Threshold*] The System shall provide the System User the capability to simultaneously view event hypothesis locations and inactive geographic region boundaries on an interactive map.

S-5997: [*Threshold*] The System shall provide the System User the capability to view on an interactive map whether an event hypothesis location is within an active geographic region for a user specified time.

IDC Specific:
None

GLOSSARY REFERENCES

The following glossary terms are referenced by this use case:

General:

Event - The occurrence of some 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 set of signal detections and calculated event parameters that are associated with an event. An event hypothesis 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. This use case can be invoked from any event list to see the history of a selected event, and it can also be invoked independently where the user will first need to select an event.

6. While viewing an event history an Analyst can provide feedback via the 'Provides Analyst Feedback' UC.

7. The ability to view the released event history is provided to the Authorized External User in ‘Views System Results’ UC.

IDC Specific:
None

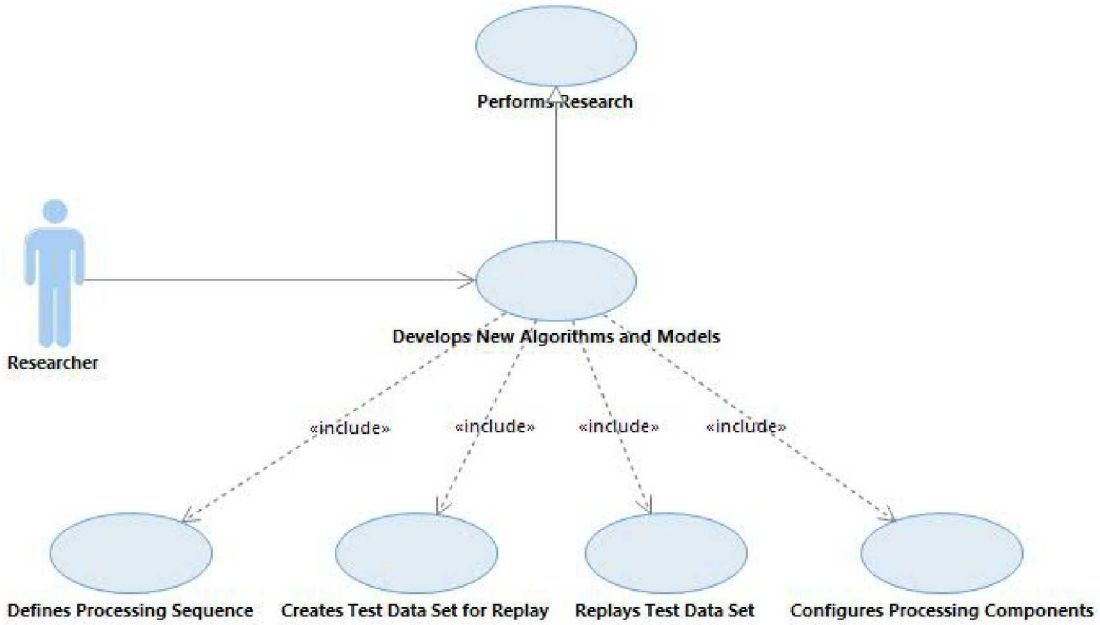
OPEN ISSUES

None

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 as the Researcher requires access to System data and algorithm implementations used in pipeline processing and interactive processing 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

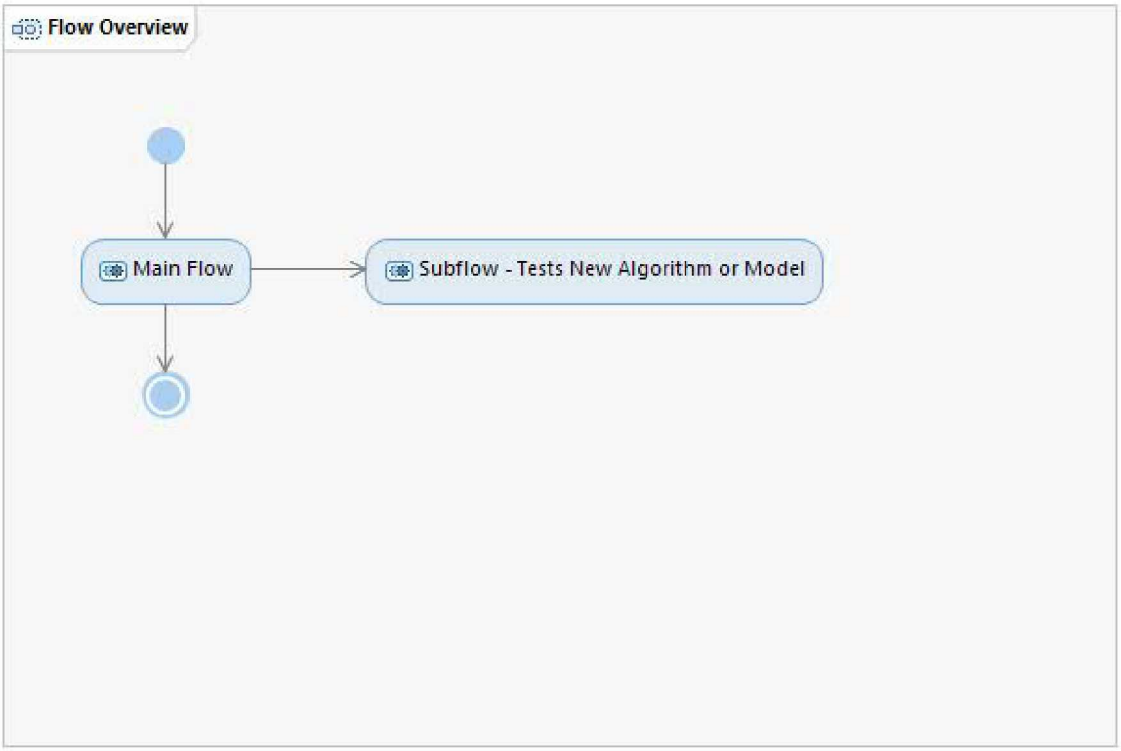
1. This use case runs on either the Development Subsystem or a Standalone Subsystem.

POSTCONDITIONS

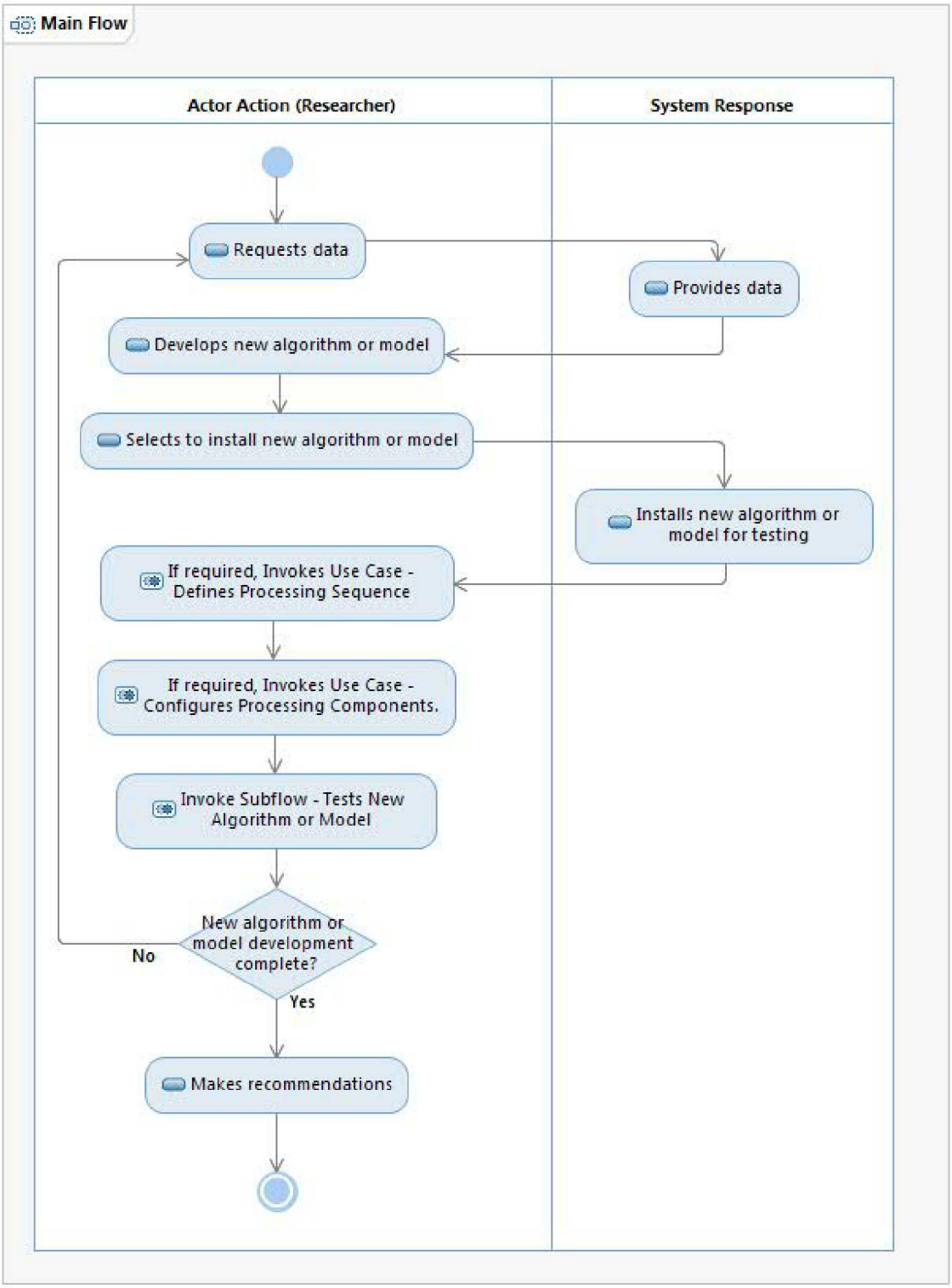
1. The Researcher has collected information and made recommendations for changes to System operations.

ACTIVITY DIAGRAMS

Flow Overview



Main Flow



Action Descriptions

Action: "Requests data"

The Researcher uses the COI or an ANSI/ISO standard SQL interface 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.

Action: "Selects to install new algorithm or model"
The Researcher selects to install the new algorithm or model.

Action: "Installs new algorithm or model for testing"
The Development Subsystem or Standalone Subsystem makes the new algorithm or model available for testing

Action: "If required, Invokes Use Case - Defines Processing Sequence"
If necessary, the Researcher invokes 'Defines Processing Sequence' UC to define a processing sequence using the new algorithm or model.

Action: "If required, Invokes Use Case - Configures Processing Components."
If necessary, the Researcher invokes 'Configures Processing Components' UC to configure the new algorithm or model.

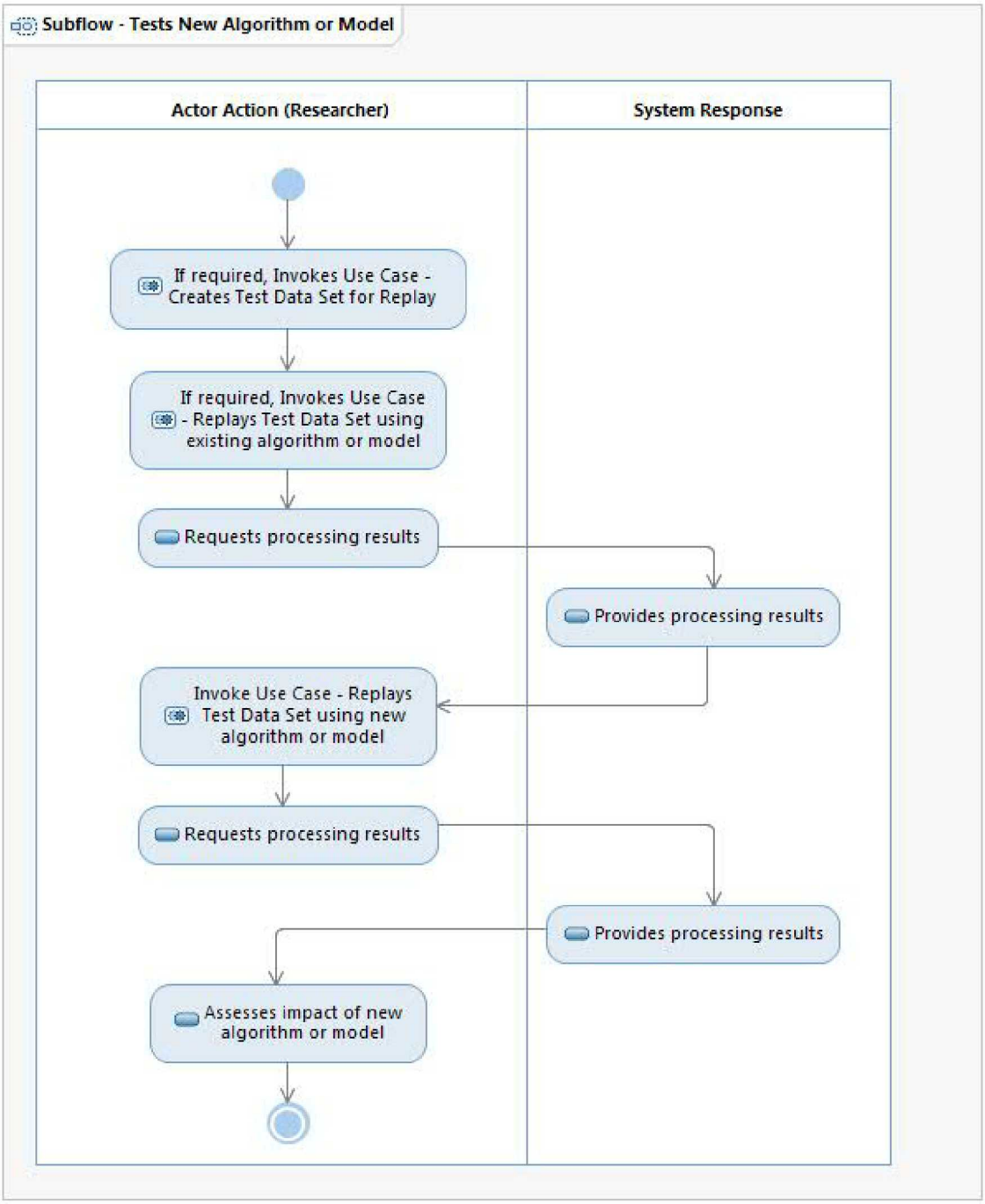
Action: "Makes recommendations"
The Researcher uses results from testing the new algorithm or model to recommend System updates.

Alternate Flows
1. Action "Selects to install new algorithm or model" - The Researcher may choose another method of testing the new algorithm or model, in which case flow proceeds to Action "Makes recommendations".

2. Action "Installs new algorithm or model" - If the new algorithm or model cannot be installed then flow returns to Action "Develops new algorithm or model".

3. Actions "Requests data" and "Selects to install new algorithm or model"- 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:

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-1946: [*Threshold*] The System shall synchronize the System User's displays based on user actions.

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-1959: [*Threshold*] The System shall provide the System User the capability to view on-line help.

S-2030: [*Threshold*] The System shall provide the Researcher the capability to access data through a common object interface.

S-2031: [*Threshold*] The System shall provide the Researcher the capability to access the database through an ANSI/ISO standard SQL 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:
None

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:
None.

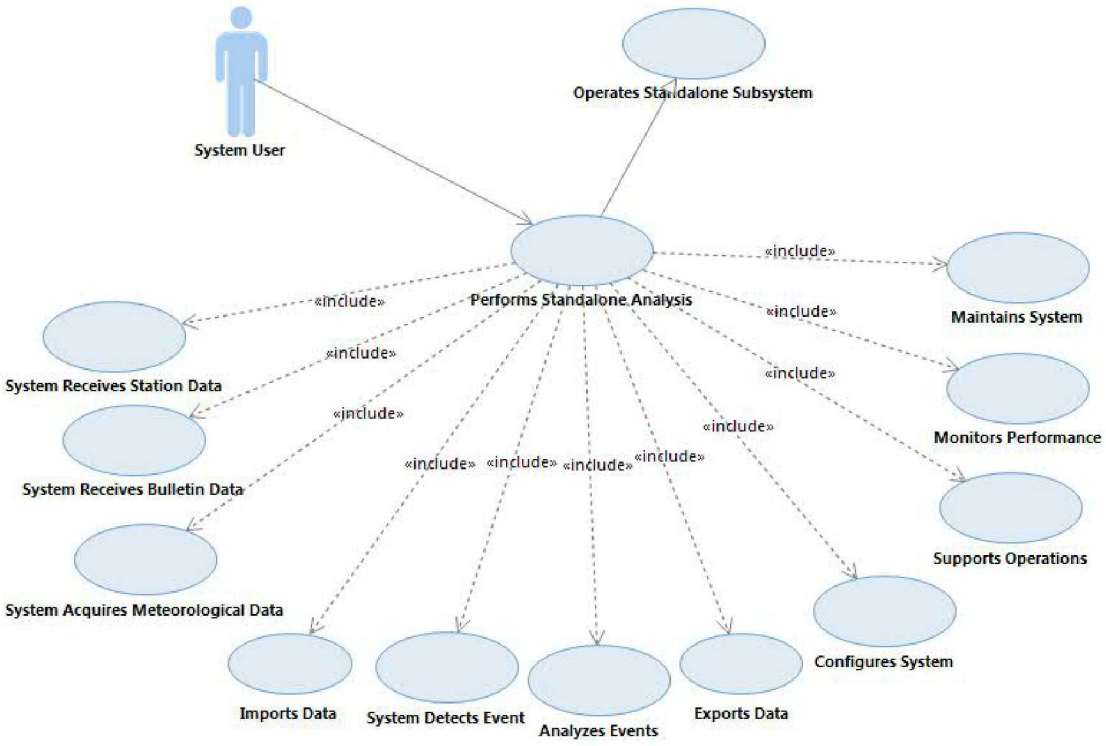
OPEN ISSUES

None.

IDC Use Case Report

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 since it requires the System architecture to support configurable software distributions at various scales of data processing, computing hardware, and personnel.

ACTOR DESCRIPTIONS

System User - The System User actor is any internal user who accesses the System.

PRECONDITIONS

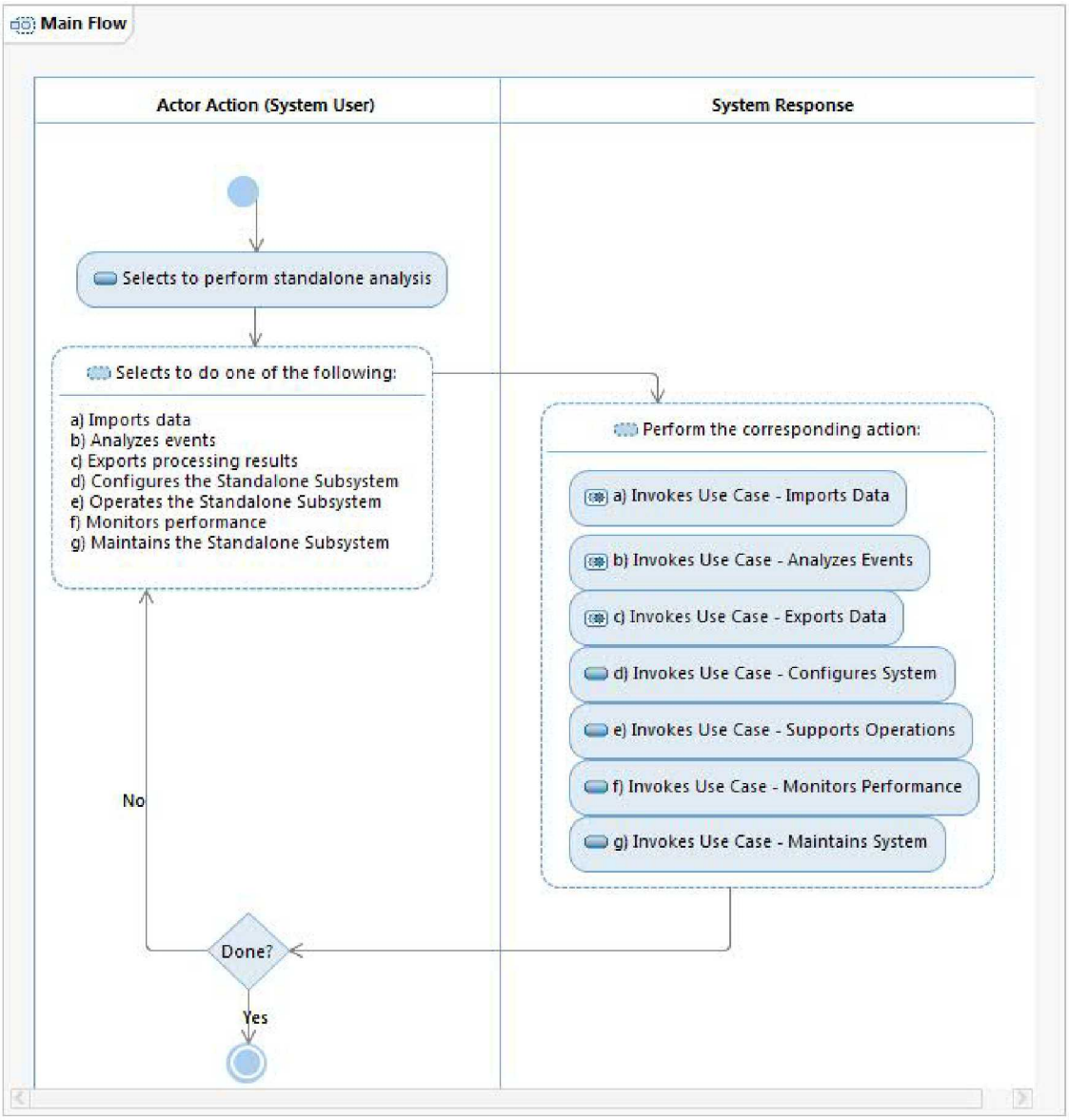
1. The System User has access to a Standalone Subsystem (see 'Accesses the System' UC).

POSTCONDITIONS

None

ACTIVITY DIAGRAMS

Main Flow



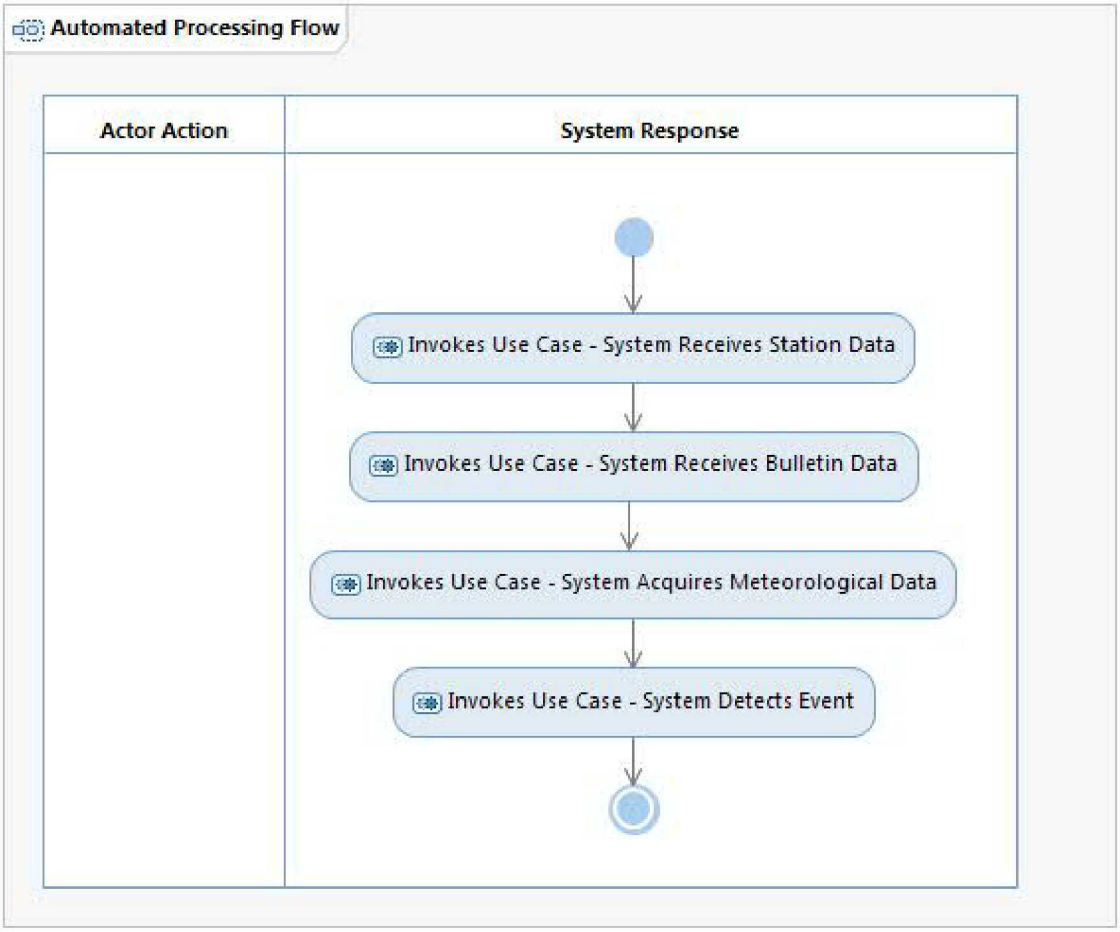
Action Descriptions

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-1946: [*Threshold*] The System shall synchronize the System User's displays based on user actions.

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

S-1959: [*Threshold*] The System shall provide the System User the capability to view on-line help.

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:

Standalone Subsystem - A distribution of the System containing a selected set of system components, not connected to other subsystems, used for standalone analysis and site surveys.

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 security partition. Multiple redundant installations are not supported (e.g., Primary and Backup configurations).

IDC Specific:
None

OPEN ISSUES

None