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IDC RE-ENGINEERING REPORT

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IDC Re-Engineering Phase 2 Iteration E3 Use Case Realizations

Version 1.2

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Abstract

This document contains 4 use case realizations generated from the model contained in Rational Software Architect. These use case realizations are the current versions of the realizations originally delivered in Elaboration Iteration 3.

REVISIONS

Version	Date	Author/Team	Revision Description	Authorized by
1.0	There is no version 1.0 of this document.			
1.1	11/01/2016	SNL IDC Re-Engineering Team	Initial Release for E3	M. Harris
1.2	12/16/2016	SNL IDC Re-Engineering Team	Release for the end of the Elaboration Phase	M. Harris

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IDC Use Case Realization Report

UCR-01.01 System Receives Station Data

Use Case Description

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

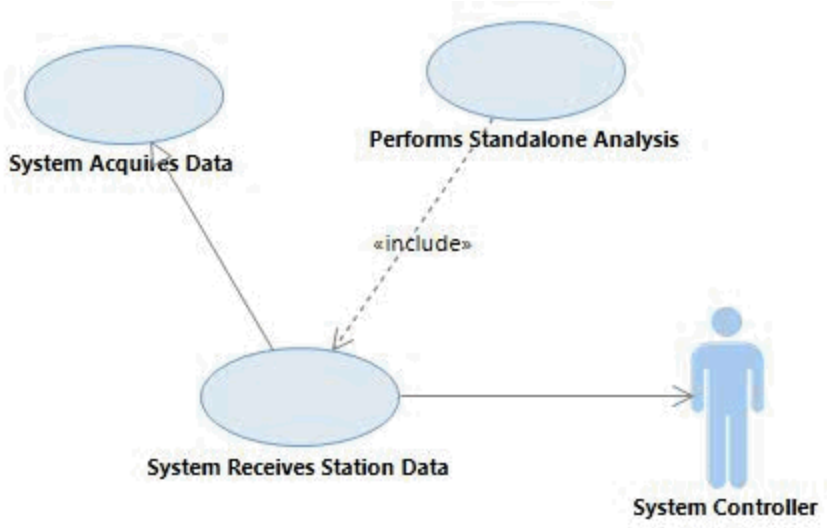
This use case is architecturally significant because it describes acquiring data from multiple sources in various formats and protocols and distributing the data to processing components within timeliness requirements.

Architecture Description

The Station Data Receiver Control acquires station data from seismic, hydroacoustic, and infrasound stations on the Data Acquisition Partition. The Station Data Receiver Control receives the data, converts the data to the System format (if necessary), creates Raw Station Data Frame objects, and stores them in the OSD. Station Data Acquisition Control subscribes for OSD callbacks related to stored Raw Station Data Frames to perform further processing. The Station Data Acquisition Control authenticates the frame objects based on digital signatures, accumulates Raw Station Data Frame objects over time for each station into Waveforms, and stores the Waveforms in the OSD.

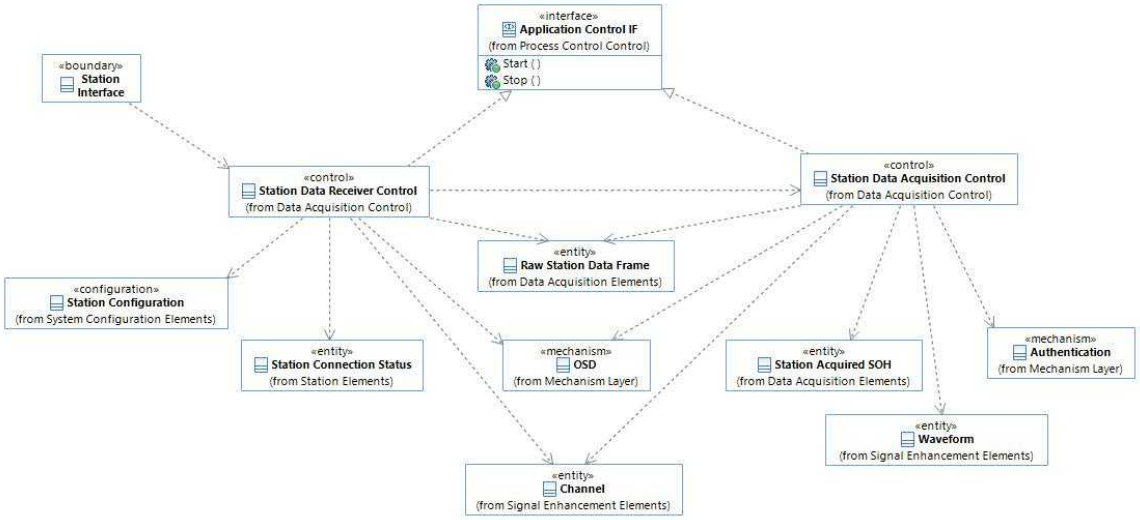
Each Data Acquisition Partition may transfer data to other Data Acquisition Partitions. On the sending Data Acquisition Partition, an instance of the Transfer Control class periodically transfers Raw Station Data Frames to the receiving Data Acquisition Partition along with a Transfer Invoice containing a log of transferred frames. A separate instance of Transfer Control on the Data Acquisition Partition periodically checks for transferred frames, audits received frames against the Transfer Invoice, and stores the frames to the OSD which triggers OSD callbacks to Station Data Acquisition Control to process and store the data. Storage of Waveforms in the OSD triggers callbacks on the Processing Sequence Control mechanism (which runs in the Data Processing Partition) to process the data (see "System Detects Event" UCR). In the case where frames are missing, the Transfer Control notifies the System Controller. The System Controller uses the Request Transfer Display on the sending Data Acquisition Partition to transfer the missing frames to the receiving Data Acquisition Partition.

Use Case Diagram



Class Diagrams

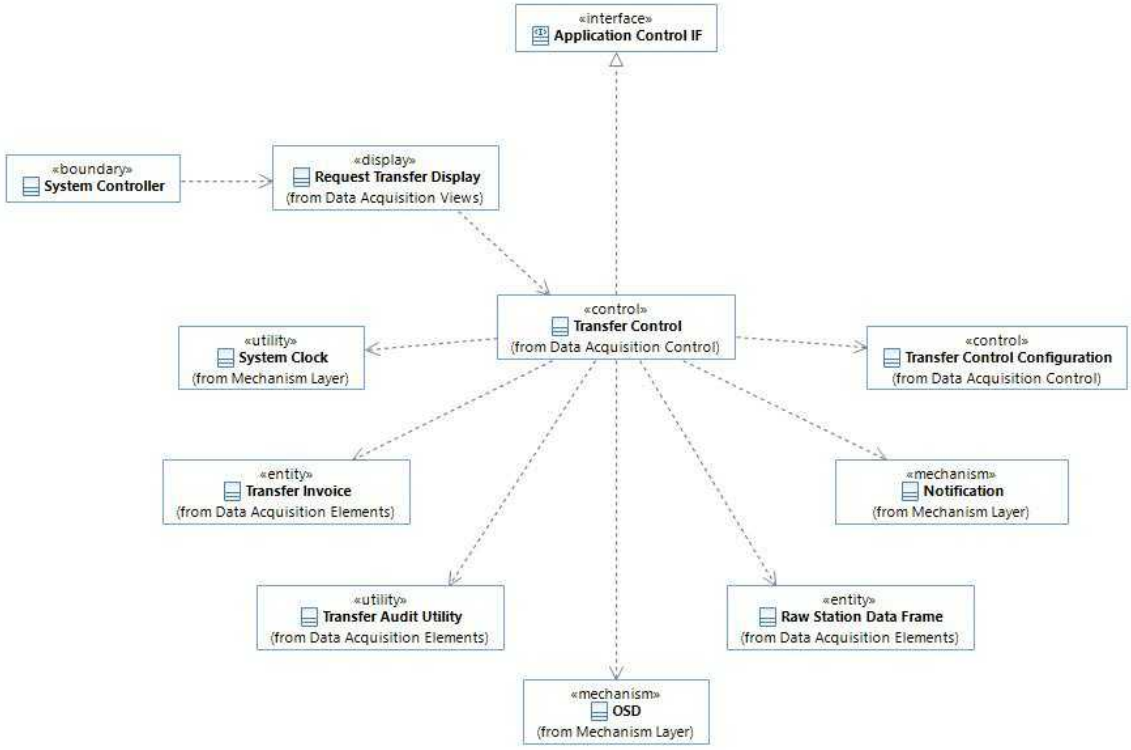
Classes - Data Reception and Acquisition



This class diagram depicts the control classes involved in reception and acquisition of station data from a Station Interface. Station Data Receiver Control receives the station data from the Station Interface, creates Raw Station Data Frames, and passes them to Station Data Acquisition Control for further processing. Station Data Acquisition Control authenticates the frames and accumulates them into Waveforms, and stores them the OSD. Note that the Station Data Receiver Control class only runs on the Data Acquisition Partition. There can be multiple Data Acquisition Partitions within a Subsystem and individual stations connect to only one of the instances, depending on the particular station. The Station Data Acquisition Control class also only runs on the Data Acquisition Partition. Raw Station Data Frames can be transferred between Data Acquisition Partitions, in which case Station Data Acquisition Control performs the same processing occurs on the Raw Station Data Frames in each partition (see "Classes -

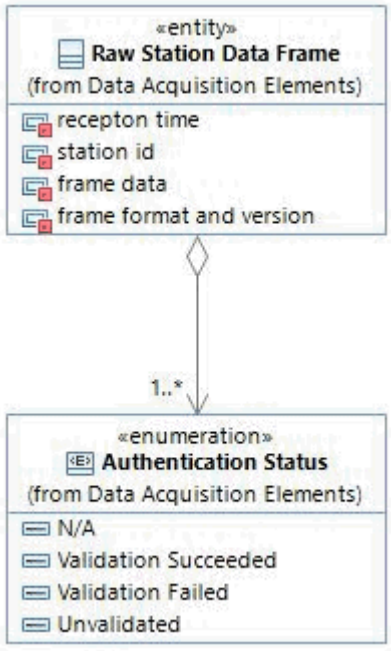
Data Transfer" for details).

Classes - Data Transfer



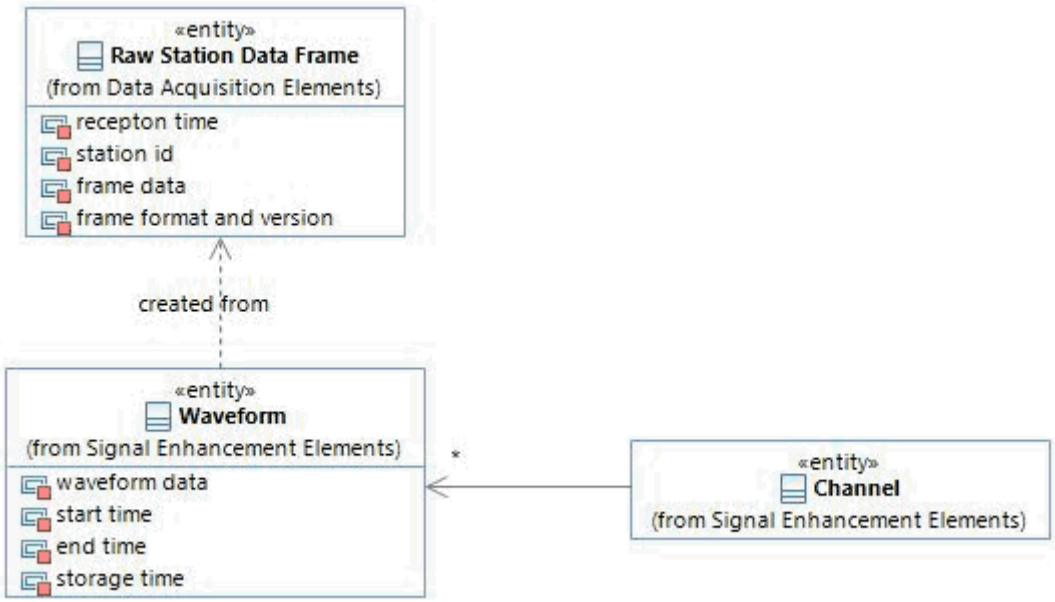
This diagram depicts the classes involved in transfer of data frames between two Data Acquisition Partitions. The Transfer Control class runs in both partitions. On the sending Data Acquisition Partition, the Transfer Control class periodically transfers Raw Station Data Frames to the receiving Data Acquisition Partition and maintains a Transfer Invoice to keep track of the frames it transferred. In addition, it also transfers the Transfer Invoice itself. On the receiving Data Acquisition Partition, the Transfer Control responds to System Clock callbacks to periodically audit the transfers via the Transfer Audit Utility to determine if all frames were transferred. When Transfer Audit Utility finds missing frames Transfer Control either automatically requests retransmission of the missing frames or sends a notification to the System Controller of the missing frames. Transfer Control stores frames that were successfully received in the OSD, triggering a callback to the Station Data Acquisition Control instance on the receiving Data Acquisition Partition for further processing. In the case where the System Controller is notified of missing frames on the receiving Data Acquisition Partition, the System Controller uses the Request Transfer Display on the sending Data Acquisition Partition to manually initiate a retransfer of missing frames.

Classes - Raw Station Data Frame



This diagram depicts the Raw Station Data Frame class and related classes. Frame data within the Raw Station Data Frame is stored in the System format. To facilitate possible migration to future formats, each Raw Station Data Frame keeps track of its format and version. Each frame may optionally have a digital signature. The System attempts to validate signed frames. Frames without digital signatures have Authentication Status of "N/A".

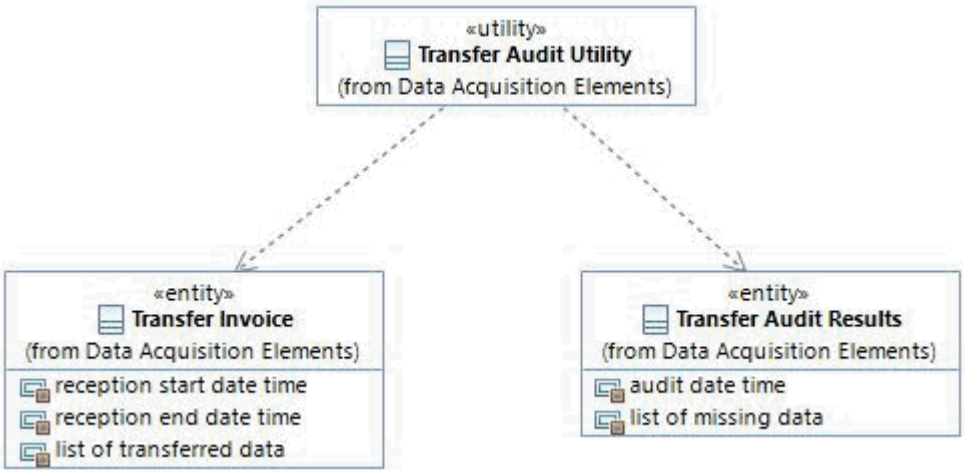
Classes - Waveform



This diagram depicts details of the Waveform class. Station Data Acquisition Control converts

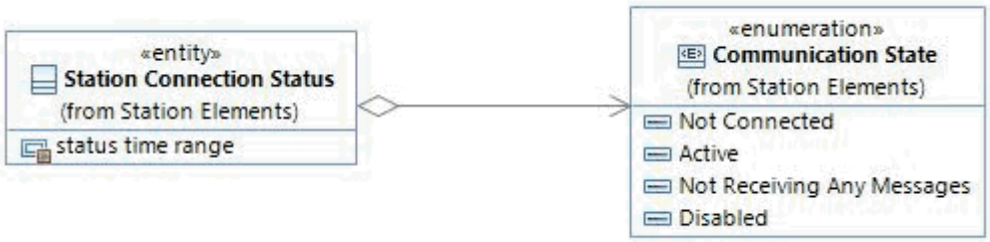
Raw Station Data Frames into Waveform objects for automatic and interactive processing.

Classes - Transfer Audit Utility



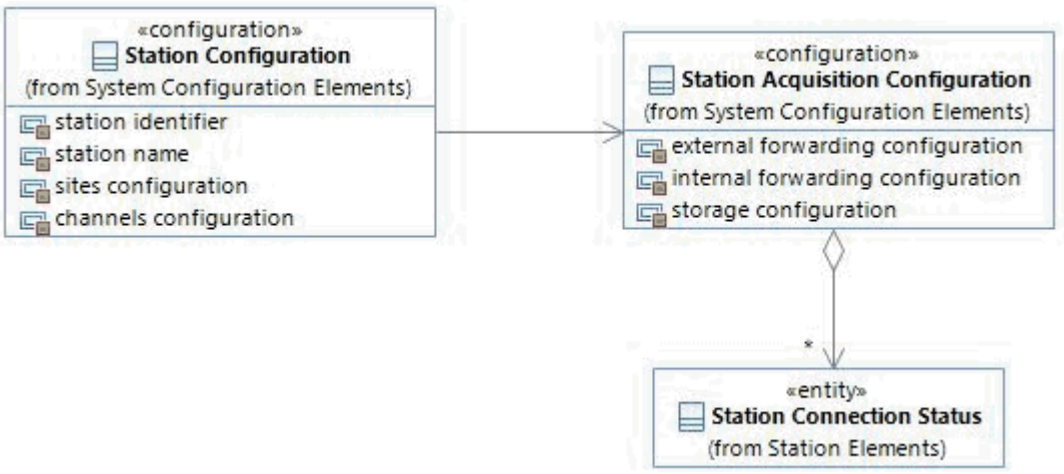
This class diagram depicts the Transfer Audit Utility class and related classes. The Transfer Audit Utility is used by the Transfer Control instance on the receiving Data Acquisition Partition to read the Transfer Invoice and produce the Transfer Audit Results.

Classes - Station Connection Status



This diagram shows the Station Connection Status class, which is maintained by Station Receiver Control for each station connection.

Classes - Station Configuration



This diagram shows the Station Configuration class and related classes. Station Configuration information is configured by the System Controller (see "Controls Data Acquisition" and "Configures Station Usage" UCRs).

Class Descriptions

<<boundary>> Station Interface
Represents the interface to a station (i.e. the Station actor).

<<boundary>> System Controller
Represents the System Controller actor.

<<configuration>> Station Acquisition Configuration
Represents configuration for how waveforms acquired from a Station are stored and forwarded within the System.

<<configuration>> Station Configuration
Represents the configurable aspects of a Station such as its name, location, the sites at the station, the channels from the sites, site instrumentation, instrument calibration, etc.

<<control>> Station Data Acquisition Control
Responsible for authenticating Raw Station Data Frames and accumulating them as Waveforms.

<<control>> Station Data Receiver Control
Responsible for acquiring the Raw Station Data Frames from the external network of stations (seismic, hydroacoustic and infrasound) and parsing the received data to create Raw Station Data Frame objects.

<<control>> Transfer Control
Responsible for transfer of data (e.g. Raw Station Data Frames, meteorological data, bulletins, etc.) between Data Acquisition Partitions. A separate instance runs on both partitions to

coordinate the transfer.

<<control>> Transfer Control Configuration
Contains configuration for the Transfer Control class, such as how often to transfer data between Data Acquisition Partitions and what data to transfer. Different types of data have different configurations.

<<display>> Request Transfer Display
Display that provides the System Controller with the capability to transfer missing data (e.g. Raw Station Data Frames, meteorological data, bulletins, etc.) between Data Acquisition Partitions.

<<entity>> Channel
A Channel represents a source of Waveforms. A Channel can either be a Raw Channel, representing data from a station, or a Derived Channel, representing data after an enhancement has been applied to it.

<<entity>> Raw Station Data Frame
A data frame comprised of the typical amount of data sent by a station in a single message (e.g. this might be 10 seconds of seismic or hydroacoustic data, or 30 seconds of infrasound data). Each frame includes data from one or more of the station's sensors and each sensor's data is called a subframe. Includes Authentication Status for the entire frame and for each subframe. The reception time field may include multiple values tracking the times when the frame was received on different Data Acquisition Partitions.

<<entity>> Station Acquired SOH
Represents the state-of-health for a single Station. Includes state-of-health information acquired from the Station (including whether the station has GPS locked) and digital signature authentication status.

<<entity>> Station Connection Status
Represents the status of the Station Data Receiver Control's connection to a Station for a specified time range.

<<entity>> Transfer Audit Results
Includes the list of data (e.g. Raw Station Data Frames, System Format Meteorological Data, etc.) that was not successfully transferred between Data Acquisition Partitions.

<<entity>> Transfer Invoice
A list of transferred data (e.g. Raw Station Data Frames, System Format Meteorological Data) between Data Acquisition Partitions, and information about previous transfers.

<<entity>> Waveform
A Waveform represents a time-series of data from a Channel.

<<enumeration>> Authentication Status
Enumeration representing the status of digital signature authentication for a Raw Station Data

Frame, as follows:

N/A - original acquired format does not support digital signatures
Validation Succeeded - digital signature was successfully validated
Validation Failed - digital signature failed validation
Unvalidated - digital signature has not been validated yet, or private/public key is missing or expired.

<<enumeration>> Communication State
Enumeration representing the possible states for Station Connection Status.

<<interface>> Application Control IF
Defines the interface implemented by all <<control>> classes in the system that are controlled by System Control.

<<mechanism>> Authentication
Represents the mechanism to authenticate digital signatures using Public Key Infrastructure (PKI) private/public keys.

<<mechanism>> Notification
Represents the mechanism to distribute messages to user(s). The mechanism filters which messages it delivers to each user and delivers messages to users at predefined frequencies. See "Views Messages" UCR for details on how users configure these preferences.

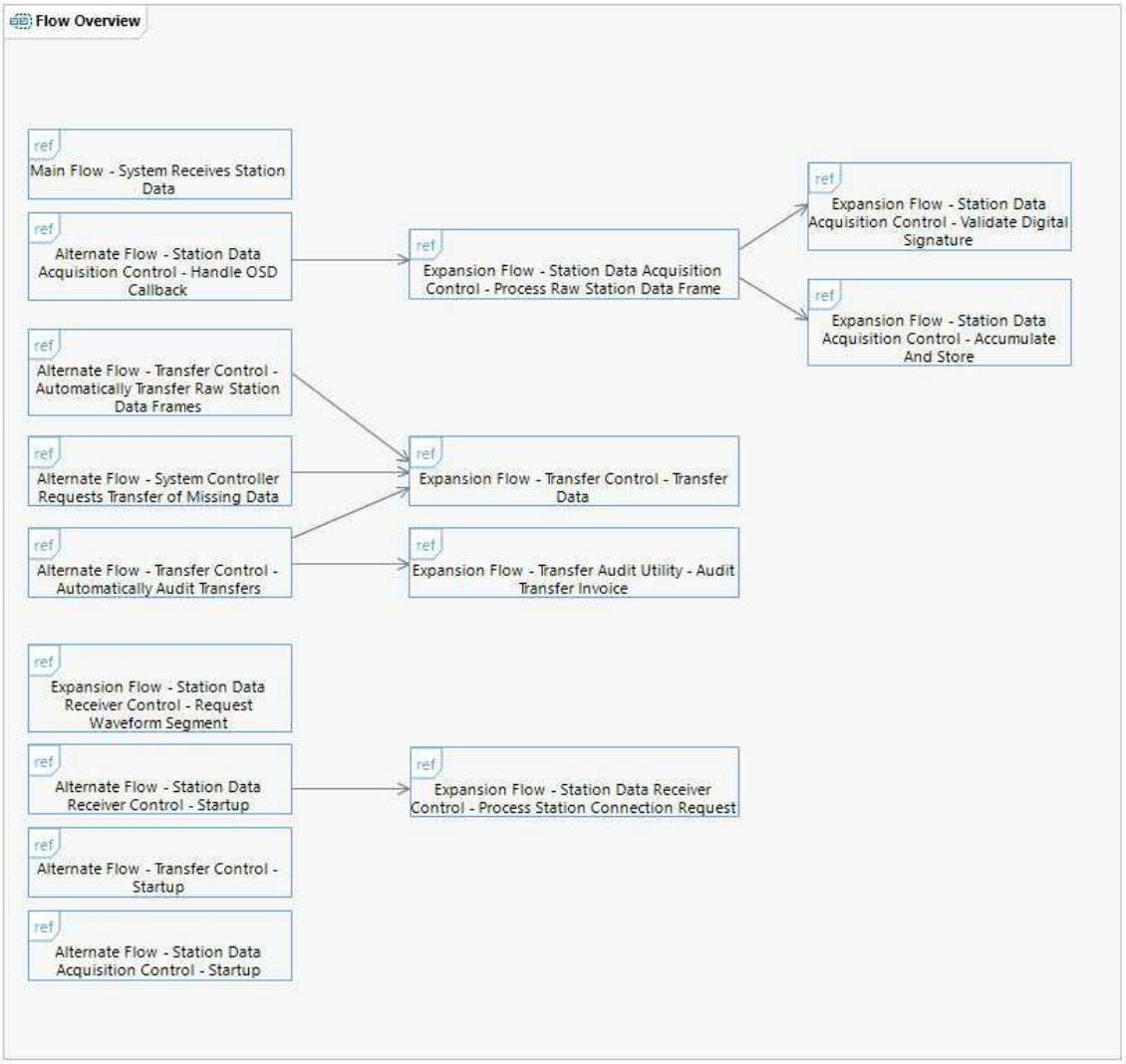
<<mechanism>> OSD
Represents the Object Storage and Distribution mechanism for storing and distributing data objects internally within the system.

<<utility>> System Clock
Represents the mechanism to schedule, reschedule, and cancel callbacks.

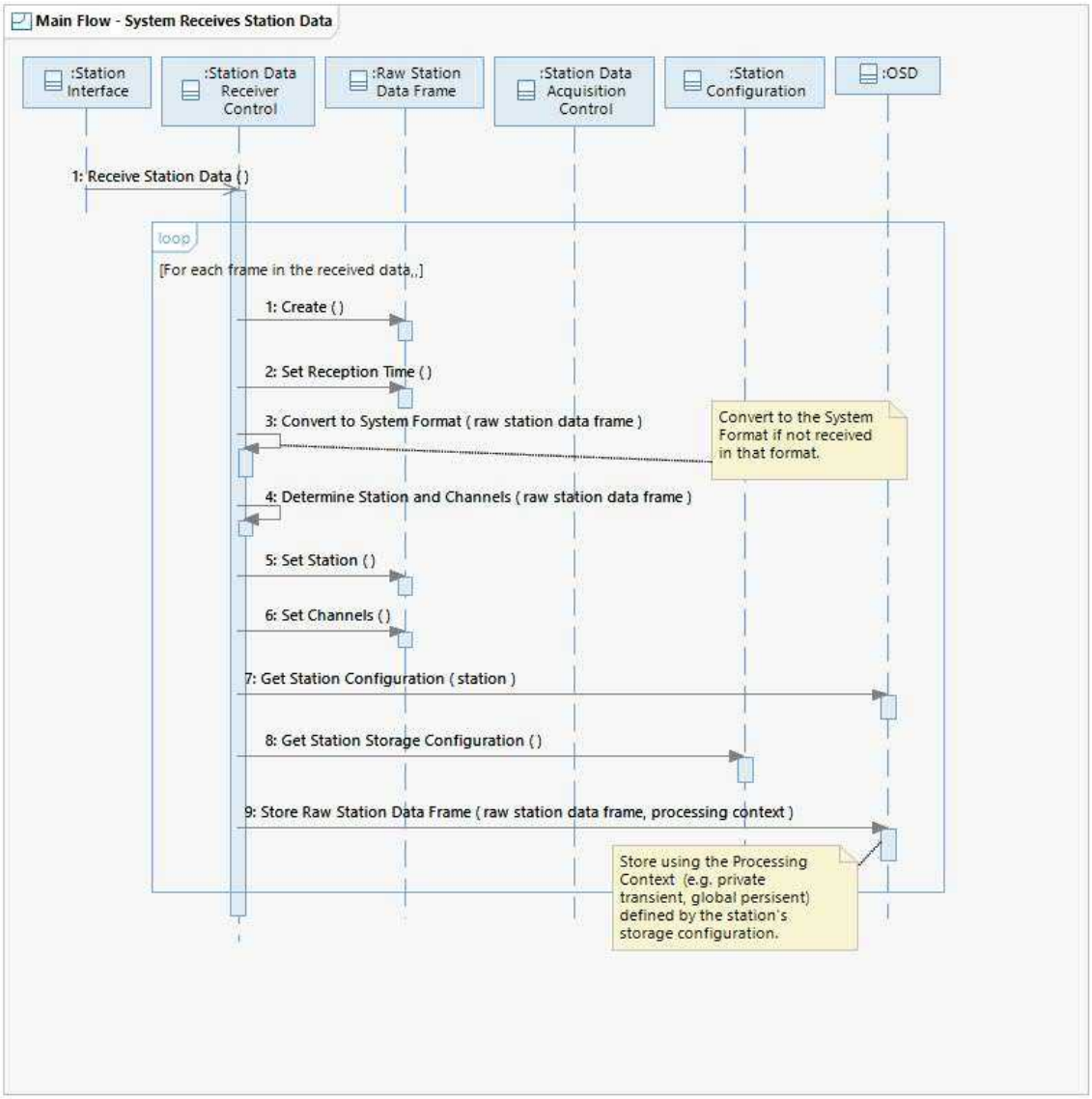
<<utility>> Transfer Audit Utility
Performs audits of transferred data frames and generates audit results.

Sequence Diagrams

Flow Overview



Main Flow - System Receives Station Data

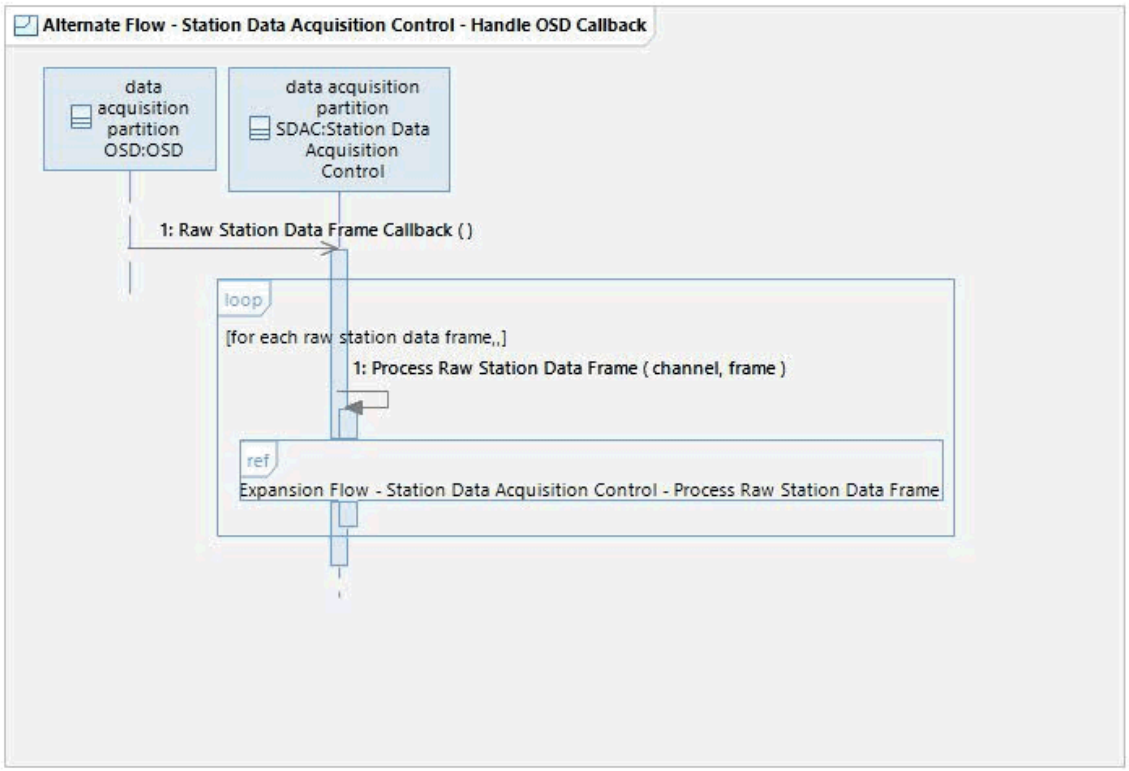


This flow shows Station Data Receiver Control receiving and formatting data frames from seismic, hydroacoustic, and infrasound stations.

Operation Descriptions

None

Alternate Flow - Station Data Acquisition Control - Handle OSD Callback

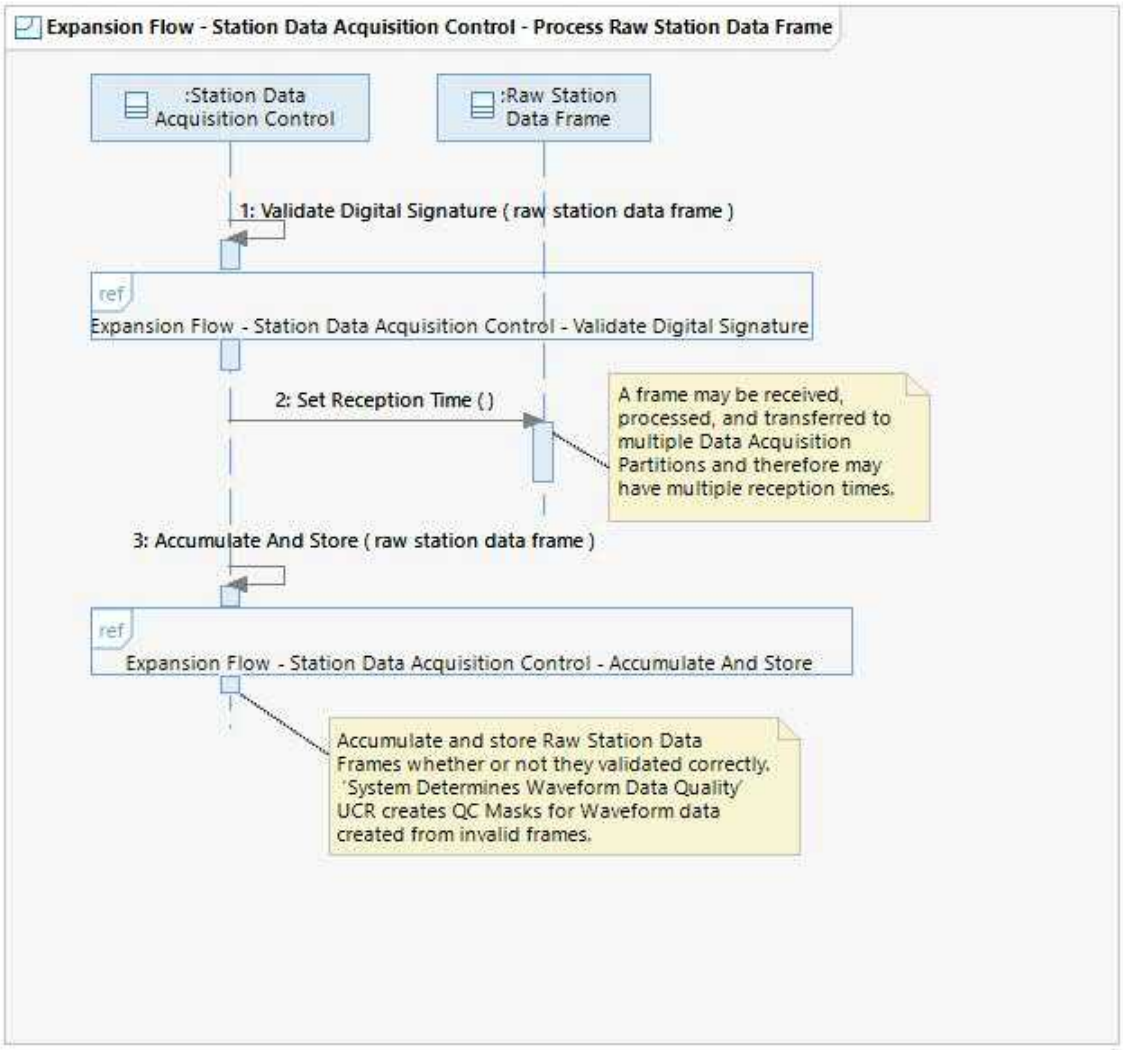


This flow depicts how the Station Data Acquisition Control handles a callback from the OSD to process raw station data frames that have been stored.

Operation Descriptions

None

Expansion Flow - Station Data Acquisition Control - Process Raw Station Data Frame

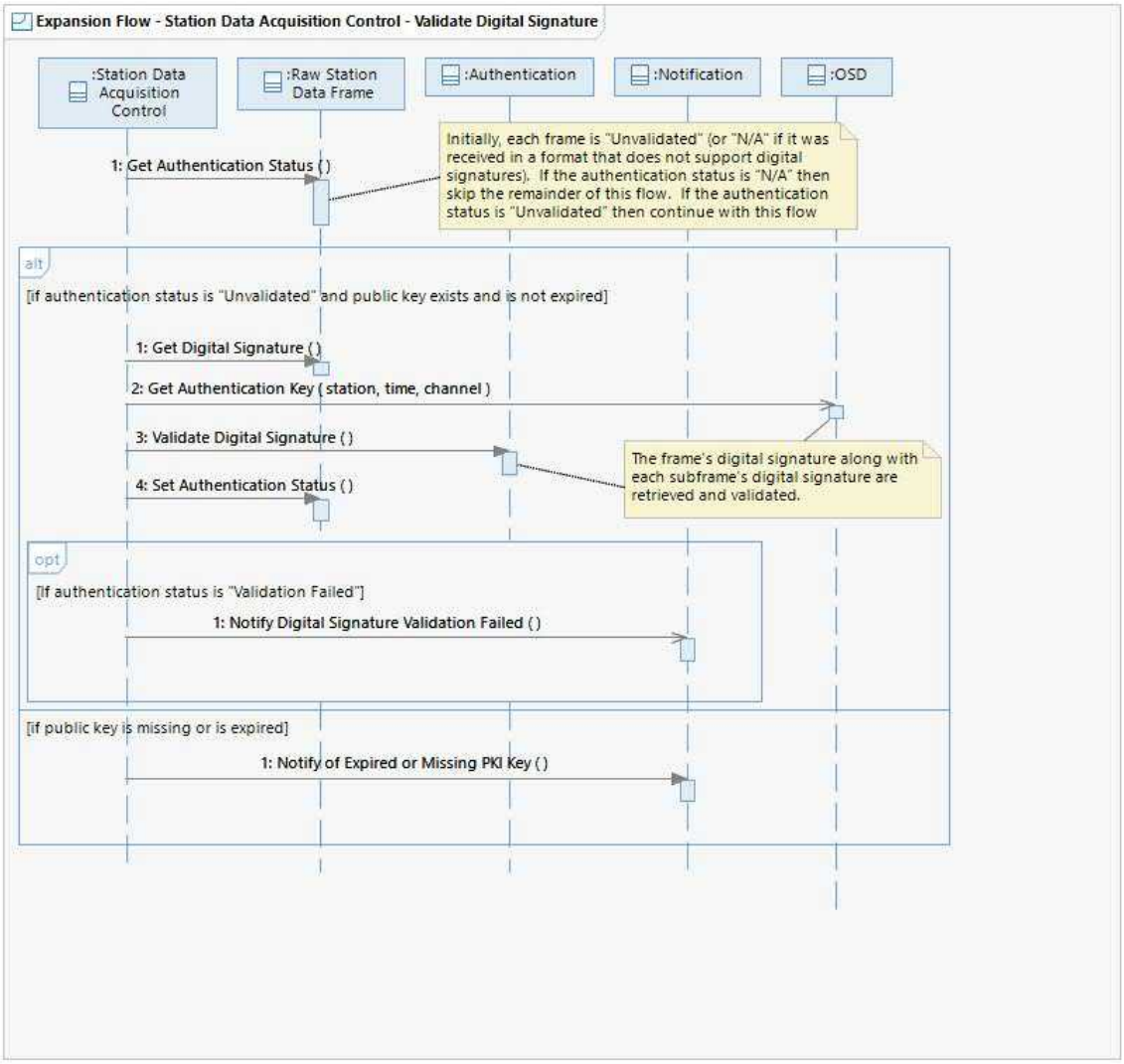


This flow describes how the Station Data Acquisition Control processes station data.

Operation Descriptions

None

Expansion Flow - Station Data Acquisition Control - Validate Digital Signature



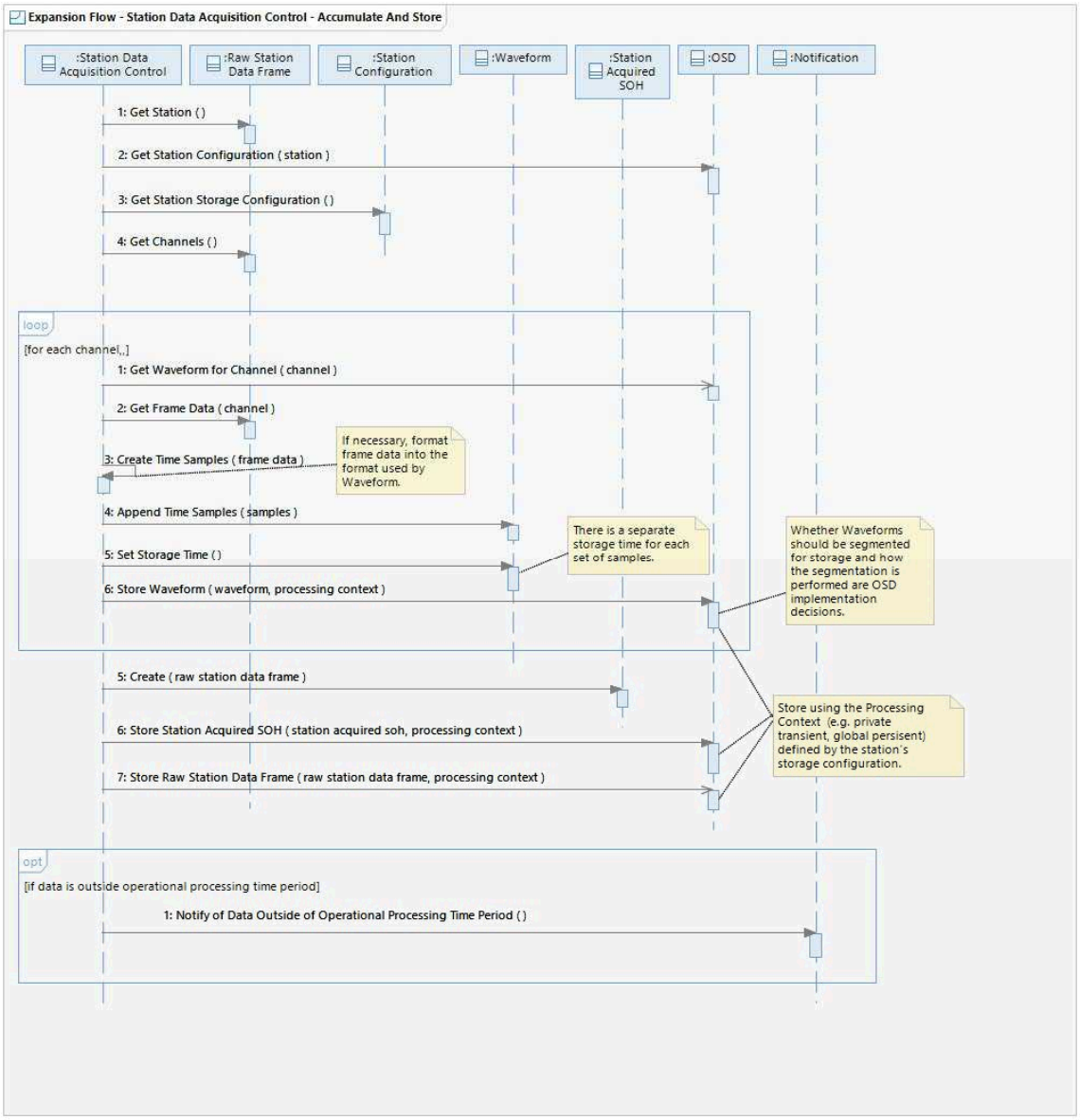
This flow describes how Station Data Acquisition Control authenticates a Raw Station Data Frame and any included subframes using their digital signatures. Note that frames may be received in formats that do not support digital signatures, in which case the Authentication Status is "N/A". In addition, authentication may not be possible if public/private keys have expired. In that case the Authentication Status is left as "Unvalidated". Unvalidated frames are still made available for processing by the System. The System Maintainer may manually validate frames later on (see 'Views Security Status' UCR).

Note that this flow is invoked in response to an OSD callback indicating a Raw Station Data Frame has been stored (see “Expansion Flow - Station Data Acquisition Control - Process Raw Station Data Frame”) and therefore may be invoked in multiple Data Acquisition Partitions. If a Raw Station Data Frame is validated on one partition before it is transferred to another partition, the frame will not be revalidated on the second partition because its authentication status will no longer be “Unvalidated”.

Operation Descriptions

None

Expansion Flow - Station Data Acquisition Control - Accumulate And Store



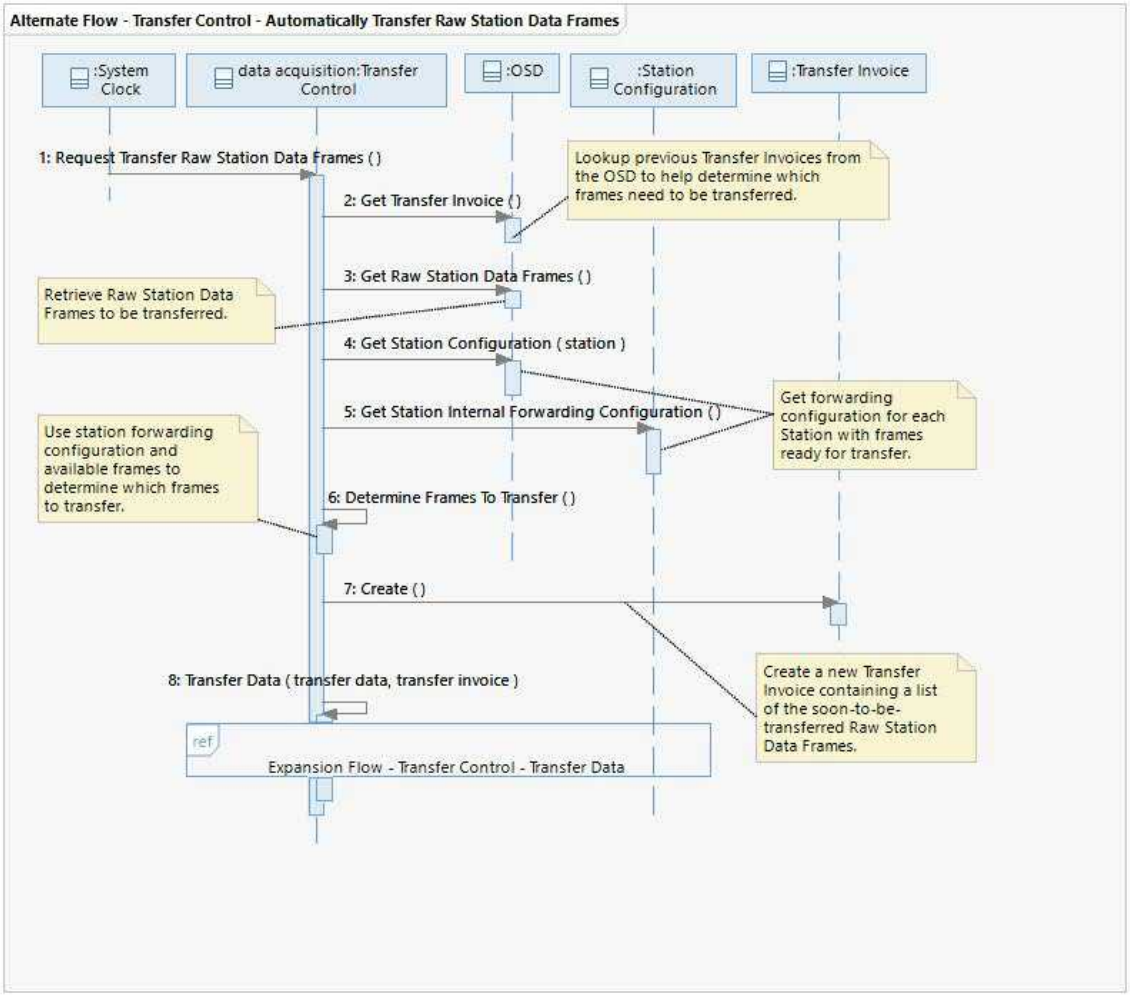
This flow describes how the Station Data Acquisition Control accumulates Raw Station Data Frames into Waveforms. Station Data Acquisition Control accumulates Raw Station Data Frames in Waveform objects (one Waveform for each channel in the Raw Station Data Frame) and stores the Waveforms in the OSD for use in automatic and interactive processing. Station Data Acquisition Control also parses Station SOH from the Raw Station Data Frame and stores the Station SOH object in the OSD.

Operation Descriptions

Operation: OSD::Store Waveform()

Store the given Waveform with the given lifespan (persistent vs. transient) and visibility (private vs. global) as specified by the given Processing Context and notify relevant subscribers via callbacks.

Alternate Flow - Transfer Control - Automatically Transfer Raw Station Data Frames

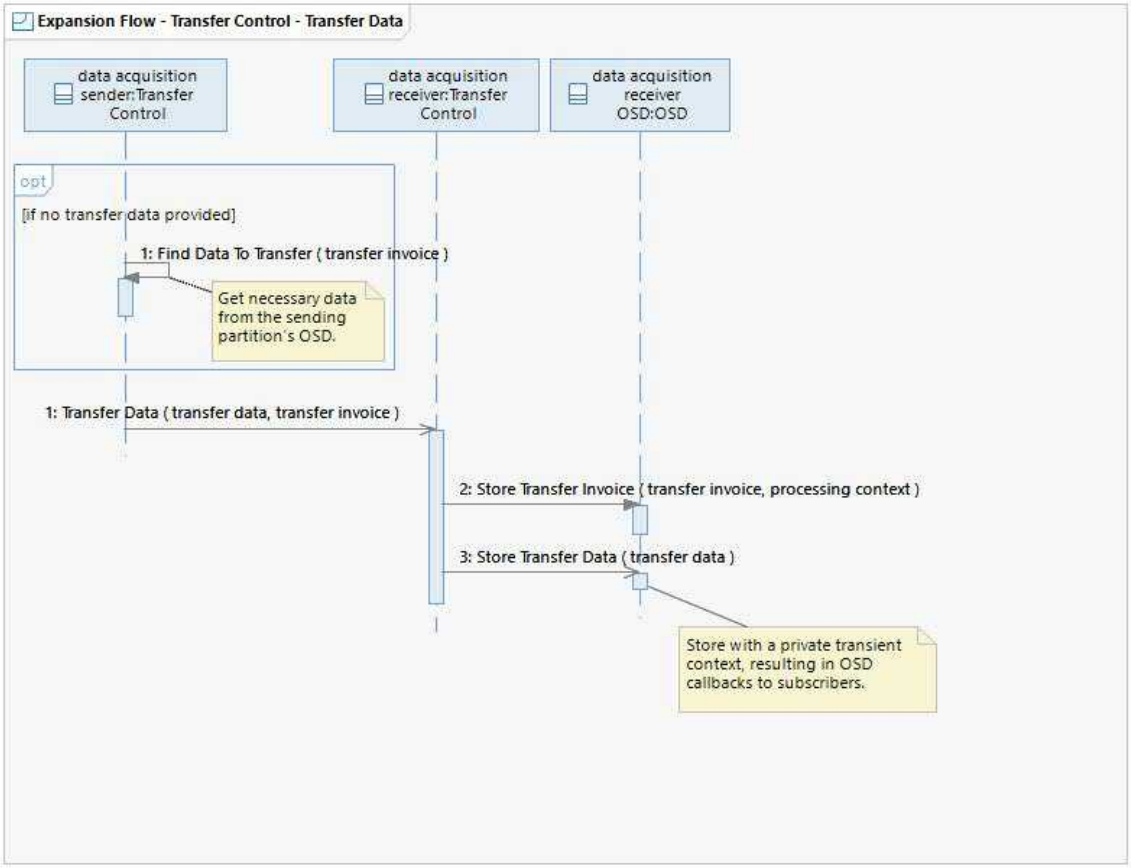


This flow is only performed on the sending Data Acquisition Partition. The Transfer Control class periodically transfers Raw Station Data Frames from the sending Data Acquisition Partition to the receiving Data Acquisition Partition.

Operation Descriptions

None

Expansion Flow - Transfer Control - Transfer Data



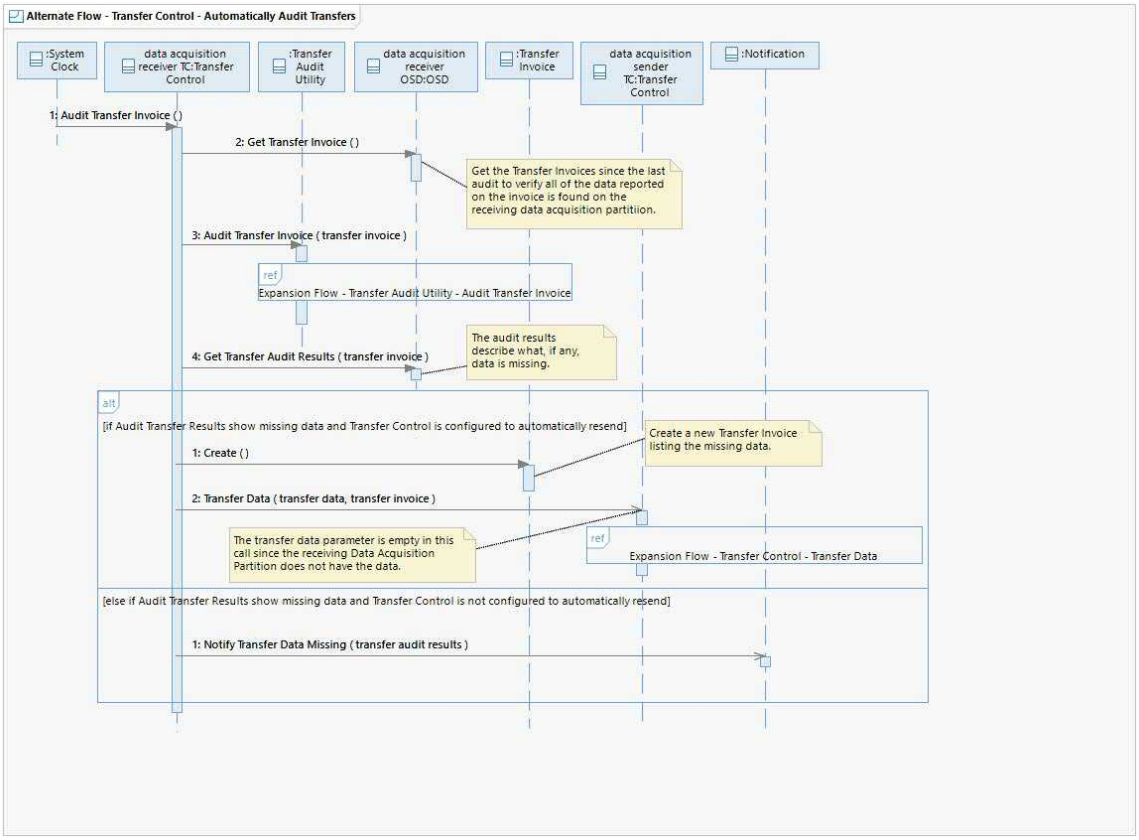
This flow describes how Transfer Control on the sending Data Acquisition Partition transfers data and the Transfer Invoice to the receiving Data Acquisition Partition for further processing. If necessary, Transfer Control on the sending Data Acquisition Partition uses the Transfer Invoice to find the data to transfer. Transfer Control on the receiving Data Acquisition Partition stores the transferred data to the OSD, which causes the OSD to send callbacks to subscribers (e.g. Station Data Acquisition Control, etc.).

Operation Descriptions

Operation: OSD::Store Transfer Data()

The COI stores the data in the format received from the stations for the purpose of later replay.

Alternate Flow - Transfer Control - Automatically Audit Transfers

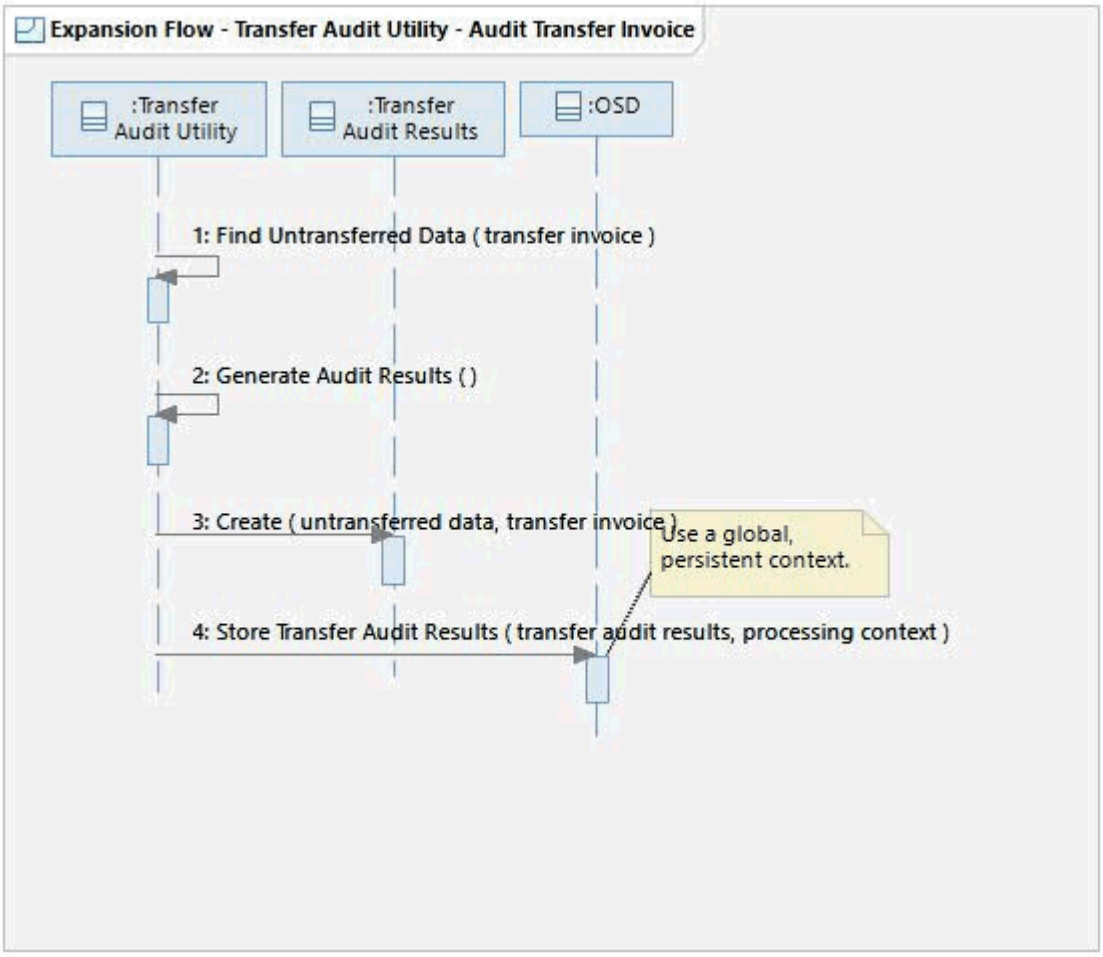


This flow is performed only on the receiving Data Acquisition Partition. The Transfer Control instance on the receiving Data Acquisition Partition periodically audits data frames transferred from the sending Data Acquisition Partition against the Transfer Invoice to verify the data was successfully transferred to the receiving Data Acquisition Partition and stored in the OSD.

Operation Descriptions

None

Expansion Flow - Transfer Audit Utility - Audit Transfer Invoice

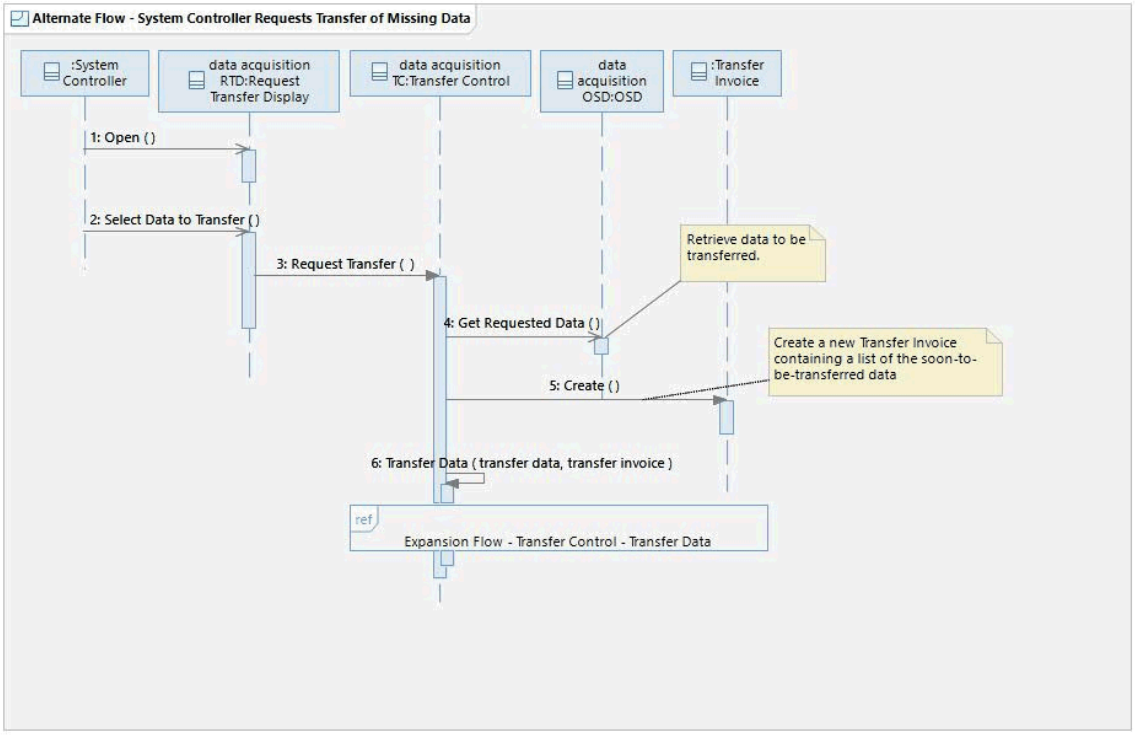


This flow is performed only on the receiving Data Acquisition Partition. The Transfer Audit Utility checks the OSD to determine if the data listed in the Transfer Invoice (e.g. Raw Station Data Frames, System Format Meteorological Data, bulletins, etc.) exists in the OSD, and creates and stores the Transfer Audit Results in the OSD.

Operation Descriptions

Operation: Transfer Audit Utility::Find Untransferred Data()
Queries the OSD to determine if the data listed in the Transfer Invoice (e.g. Raw Station Data Frames, System Format Meteorological Data, bulletins, etc.) exist in the OSD.

Alternate Flow - System Controller Requests Transfer of Missing Data

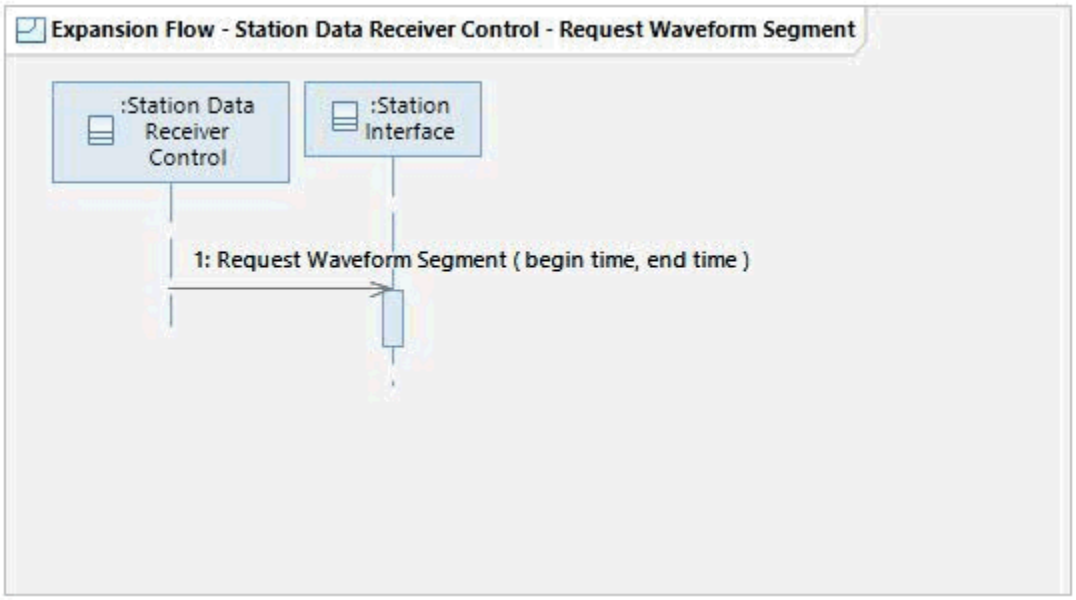


This flow is performed only on the sending Data Acquisition Partition. The System Controller uses the Request Transfer Display to request transfer of missing data from the sending Data Acquisition Partition to the receiving Data Acquisition Partition.

Operation Descriptions

None

Expansion Flow - Station Data Receiver Control - Request Waveform Segment

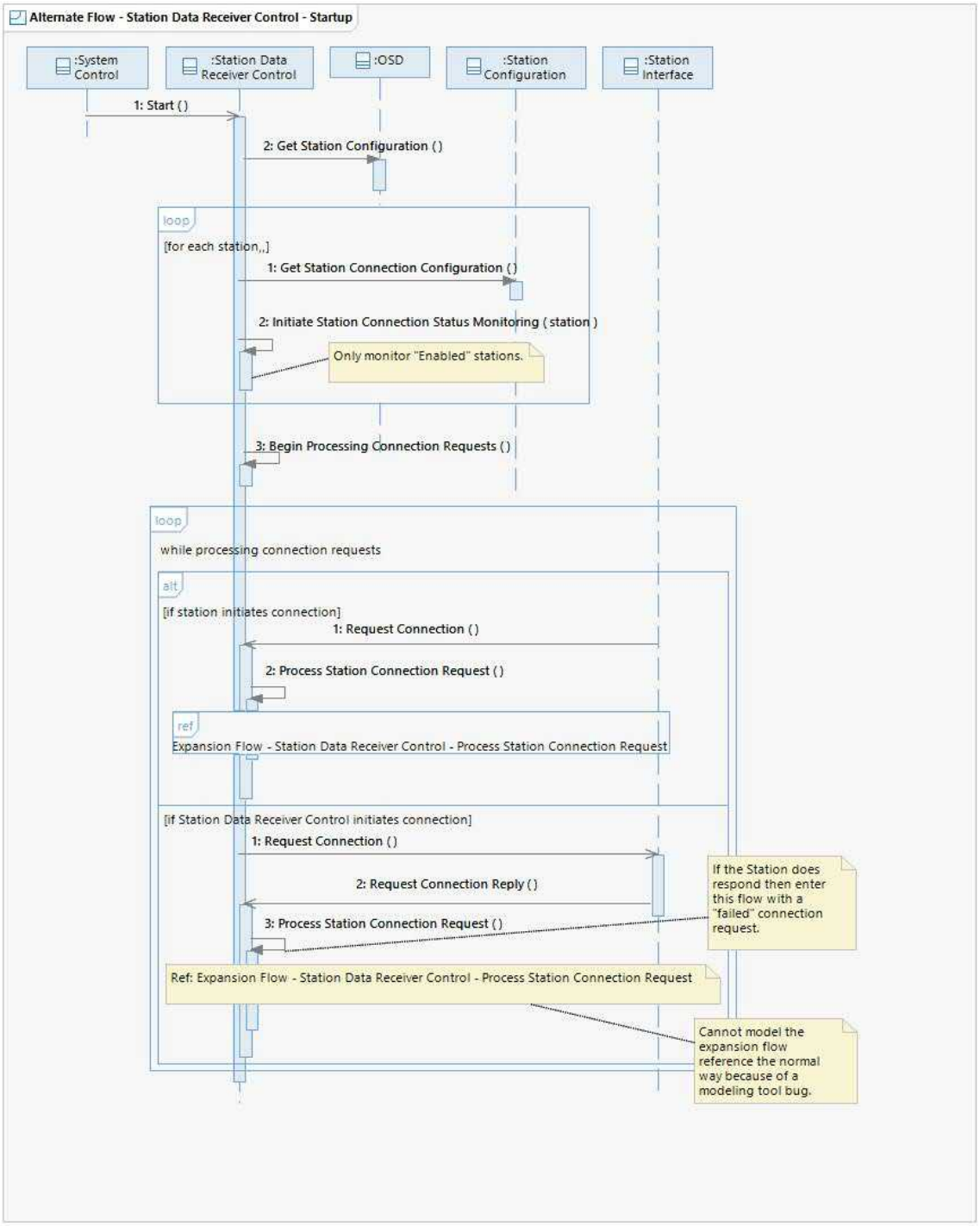


This flow shows Station Data Receiver Control requesting a waveform segment from a station. The station asynchronously provides the requested segment to Station Data Receiver Control (see "Main Flow – System Receives Station Data").

Operation Descriptions

None

Alternate Flow - Station Data Receiver Control - Startup

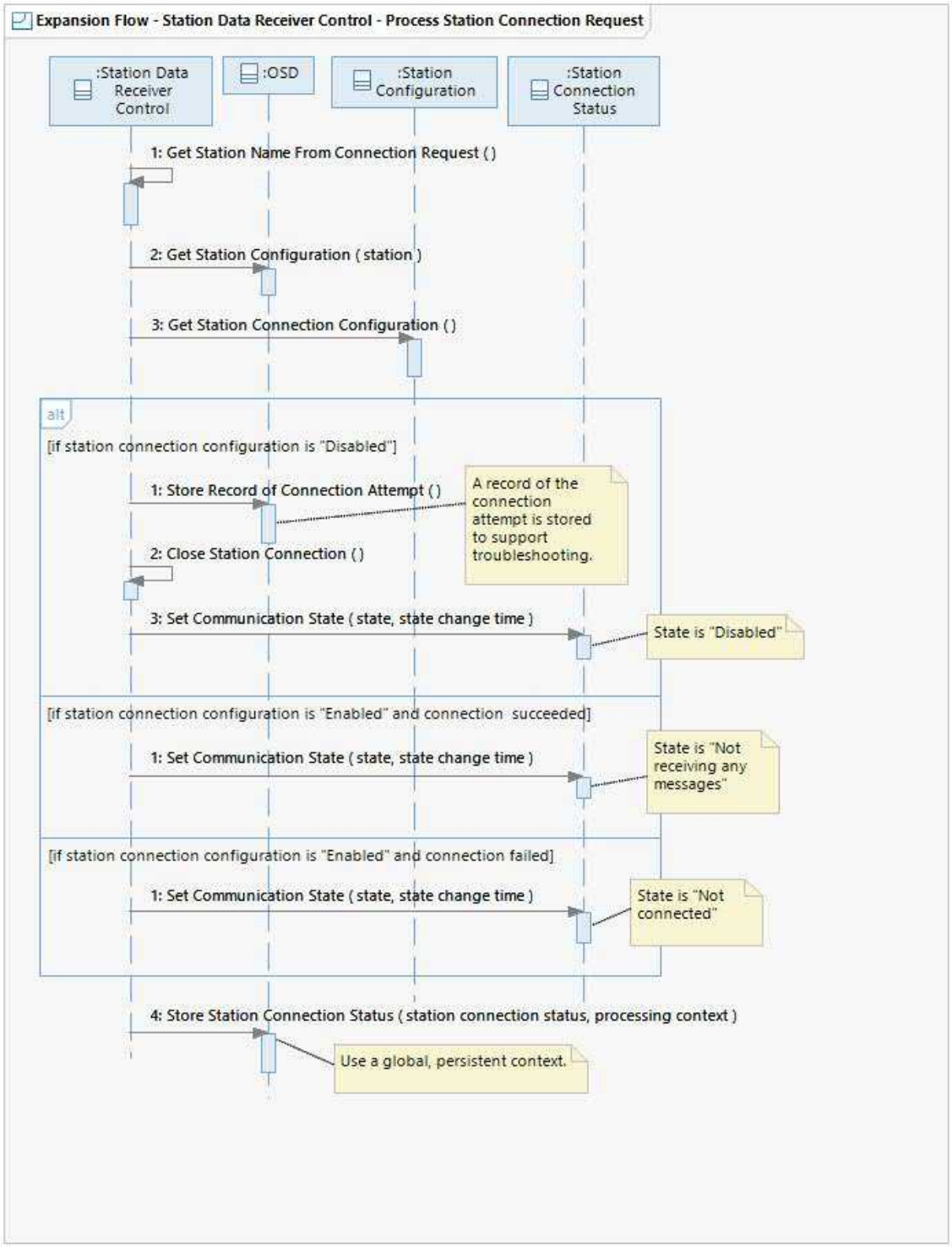


This flow describes how the Station Data Receiver Control initializes at startup. Station Data Receiver Control opens, listens for incoming station connection requests, and processes requested station connections. Station Data Receiver Control also monitors the connection status of enabled stations (see 'States - Station Connection Status - Communication State' for the possible connection states).

Operation Descriptions

None

Expansion Flow - Station Data Receiver Control - Process Station Connection Request



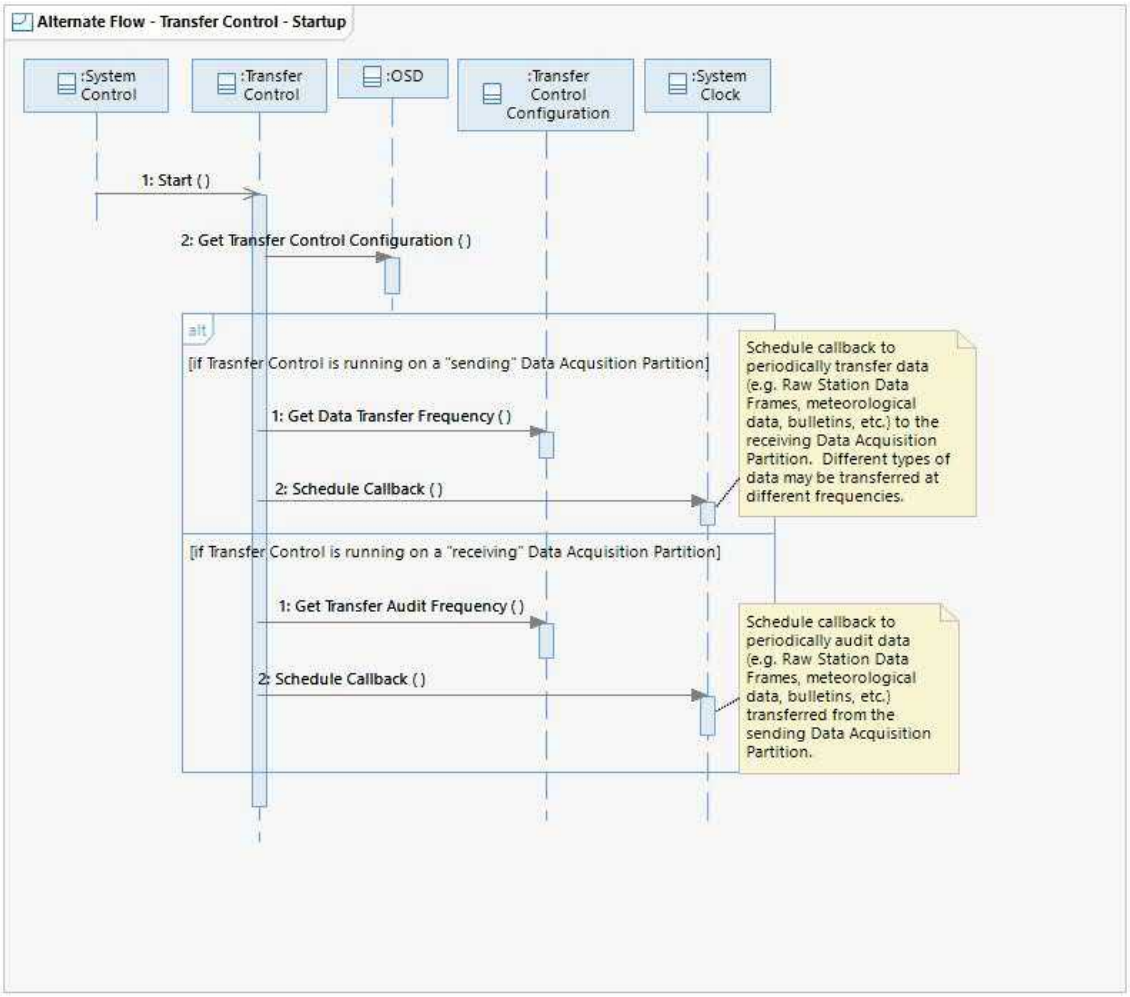
This flow describes how the Station Data Receiver Control processes a station connection

request. The Station Data Receiver Control looks at Station Configuration to determine if the station is currently enabled. Station Connection Configuration is set by the System Controller (see 'Configures Station Usage' UCR). If the station is disabled, Station Data Receiver Control refuses the connection and records the connection attempt (e.g., station id, station's IP address, number of connection attempts within a time period). Station Data Receiver Control also records the connection attempt if the connection fails.

Operation Descriptions

None

Alternate Flow - Transfer Control - Startup

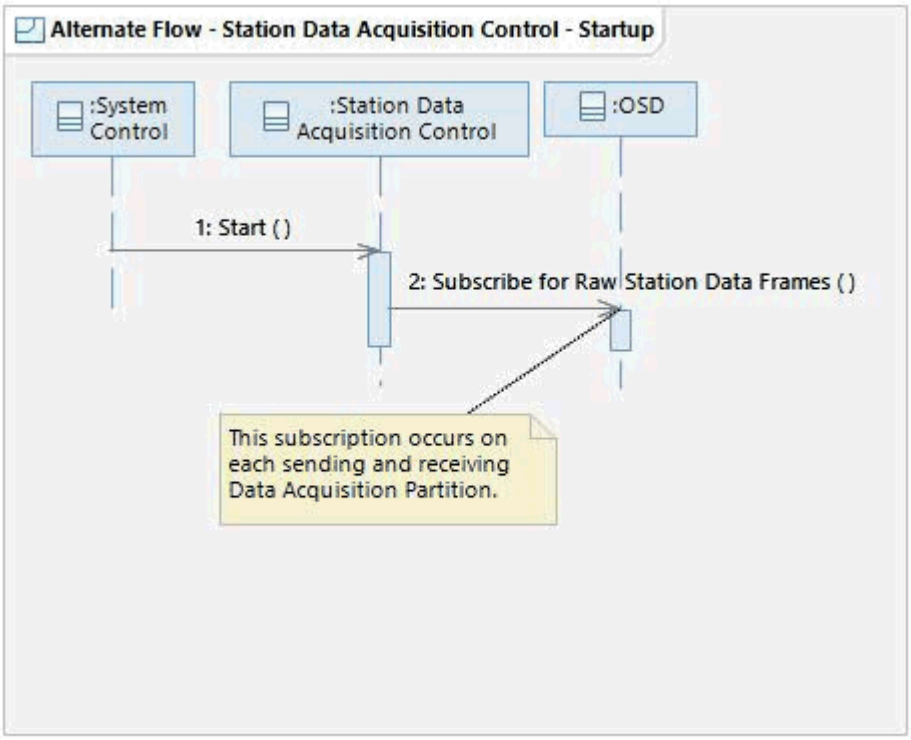


This flow describes how the Transfer Control class initializes at startup. The Transfer Control class runs on the sending and receiving Data Acquisition Partitions.

Operation Descriptions

None

Alternate Flow - Station Data Acquisition Control - Startup



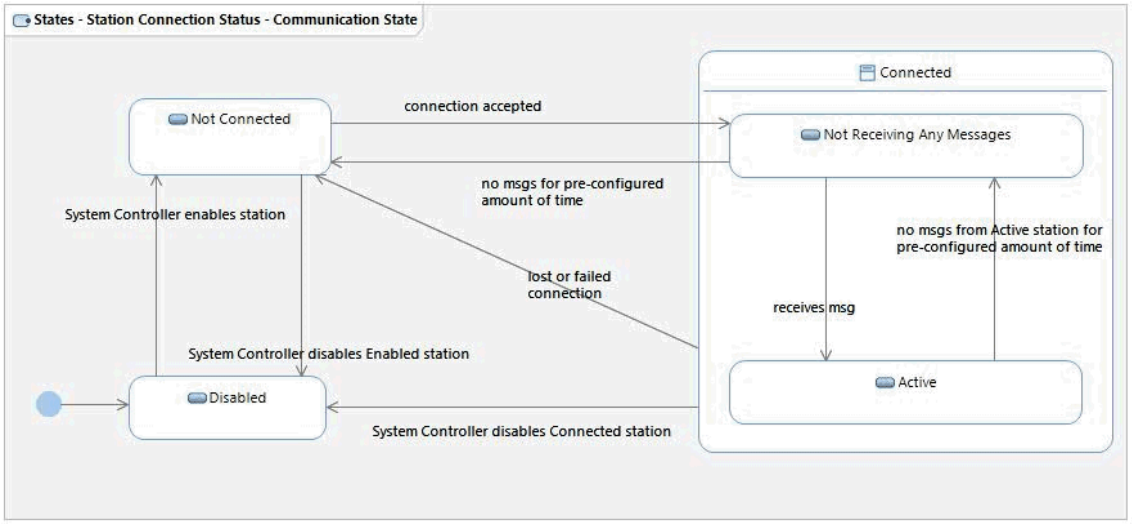
This flow illustrates how the Station Data Acquisition Control subscribes for OSD callbacks on startup, which allows it to respond to and process Raw Station Data Frames when they are stored in the OSD. This flow occurs on each Data Acquisition Partition.

Operation Descriptions

None

State Machine Diagrams

States - Station Connection Status - Communication State



This diagram shows the state transitions for the states defined in the "Communication State" enumeration. These states are maintained by Station Data Receiver Control for individual stations. The System Maintainer configures the timeouts for the state transitions which occur when no messages have been received for a pre-configured amount of time.

State Descriptions

State: Not Connected
The station is currently not connected and is not expected to be connected.

State: Disabled
The station is disabled. Attempts to connect with the station will be blocked.

State: Connected::Active
The station is connected and the server has received data within a pre-configured amount of time.

State: Connected::Not Receiving Any Messages
The station is connected but hasn't received data for a pre-configured amount of time.

SSD Mappings

General:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

IDC Specific:

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

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

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

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

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

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

Notes

General:
1. The initial System format for Raw Station Data Frames is CD1.1.

2. Waveform objects can be replayed into the system (see "Replays Test Data Set" UCR).

3. Stations can be connected to OPS, ALT, or both.

4. This UCR shows Station Data Acquisition Control first storing the acquired Raw Station Data Frame in the Main Flow and then storing it again in "Expansion Flow – Station Data Acquisition Control - Accumulate and Store" after the control class validates the frame data. This is done because each frame's authentication status is stored with the frame.

5. This UCR addresses real time station data acquisition that provides inputs to pipeline processing. Other station data acquisition, such as importing a tape containing data from a new station, is addressed in 'Imports Data' UCR. The Analyst may interactively process this data (see 'Analyzes Events' UCR) and the Researcher may also access and process this data (see 'Performs Research' UCR).

6. Acquired Station SOH and acquired waveform data is stored and available on the sending Data Acquisition Partition and the receiving Data Acquisition Partition.

7. Station Data Acquisition Control determines whether to store acquired waveform data on each Data Acquisition Partition based on the Station Configuration set by the System Controller (see 'Controls Data Acquisition' UCR). This allows the System Controller to configure storage based on available hardware resources (e.g. the Standalone Subsystem may have limited disk space).

8. See 'System Determines Waveform Data Quality' UCR for details on how the System creates Waveform QC Masks using Acquired Station SOH.

9. The PKI certificate authority and key management system is external to the System. System components requiring access to public keys retrieve them from the key management system. As a design decision, the Standalone Subsystem may need to use self-signed certificates if it does not have reliable access to the key management system.

IDC Specific:
None.

IDC Use Case Realization Report

UCR-02.12 System Predicts Signal Features

Use Case Description

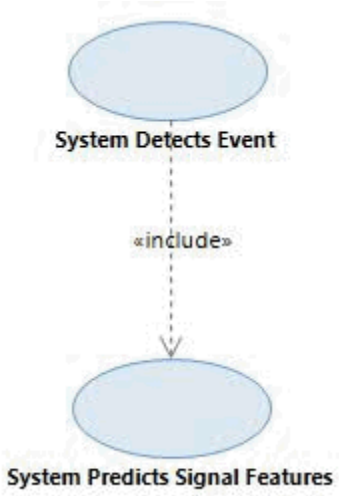
This architecturally significant use case describes how the System predicts signal features in order to accomplish key monitoring tasks. Signal features include phase identification, probability of detection, arrival time, azimuth, slowness, amplitude, and spectral content. The System references both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

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

Architecture Description

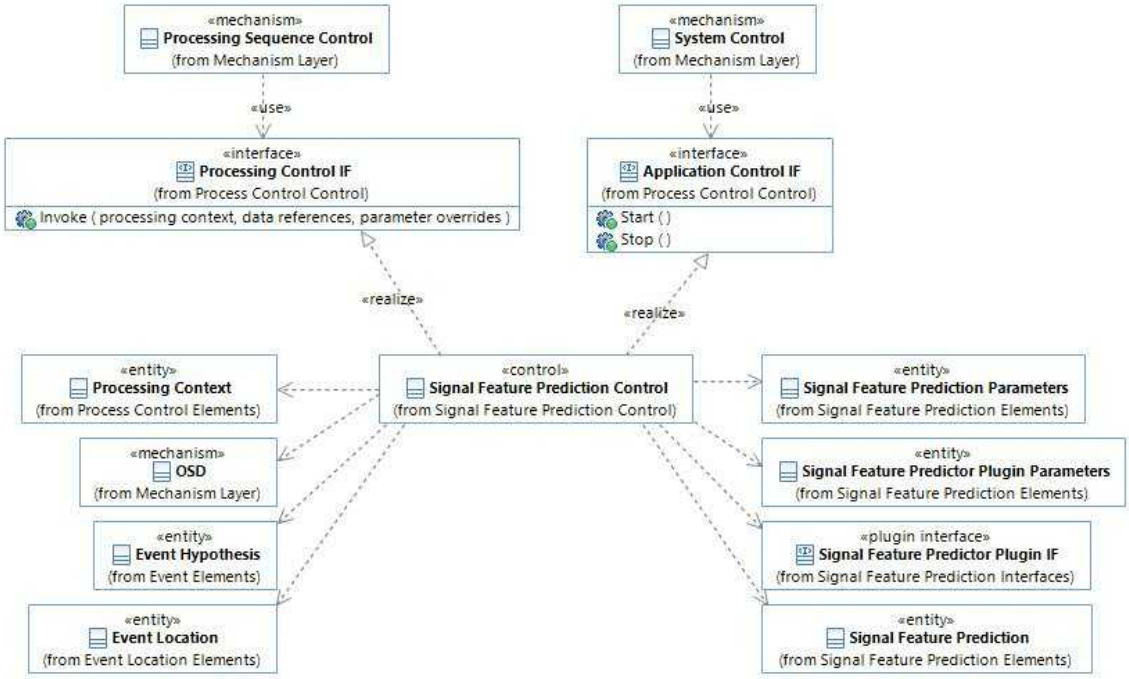
The Signal Feature Prediction Control class is responsible for controlling signal feature prediction computations. Signal Feature Prediction Control may be invoked by Processing Sequence Control as part of executing a step in a Processing Sequence (see "System Detects Event" UCR). Signal Feature Prediction Control uses a Signal Feature Predictor Plugin to perform the signal feature prediction calculations. Multiple Signal Feature Predictor plugins exist in the system, each realizing a common plugin interface. The specific Signal Feature Predictor plugin used varies dynamically at runtime based on the Signal Feature Prediction Parameters. When invoked from Processing Sequence Control, Signal Feature Prediction Control builds up the Signal Feature Predictor Plugin Parameters, selects and invokes the appropriate Signal Feature Predictor Plugin, updates the appropriate Event Location with the signal feature prediction, and stores the Event Hypothesis via the OSD mechanism.

Use Case Diagram



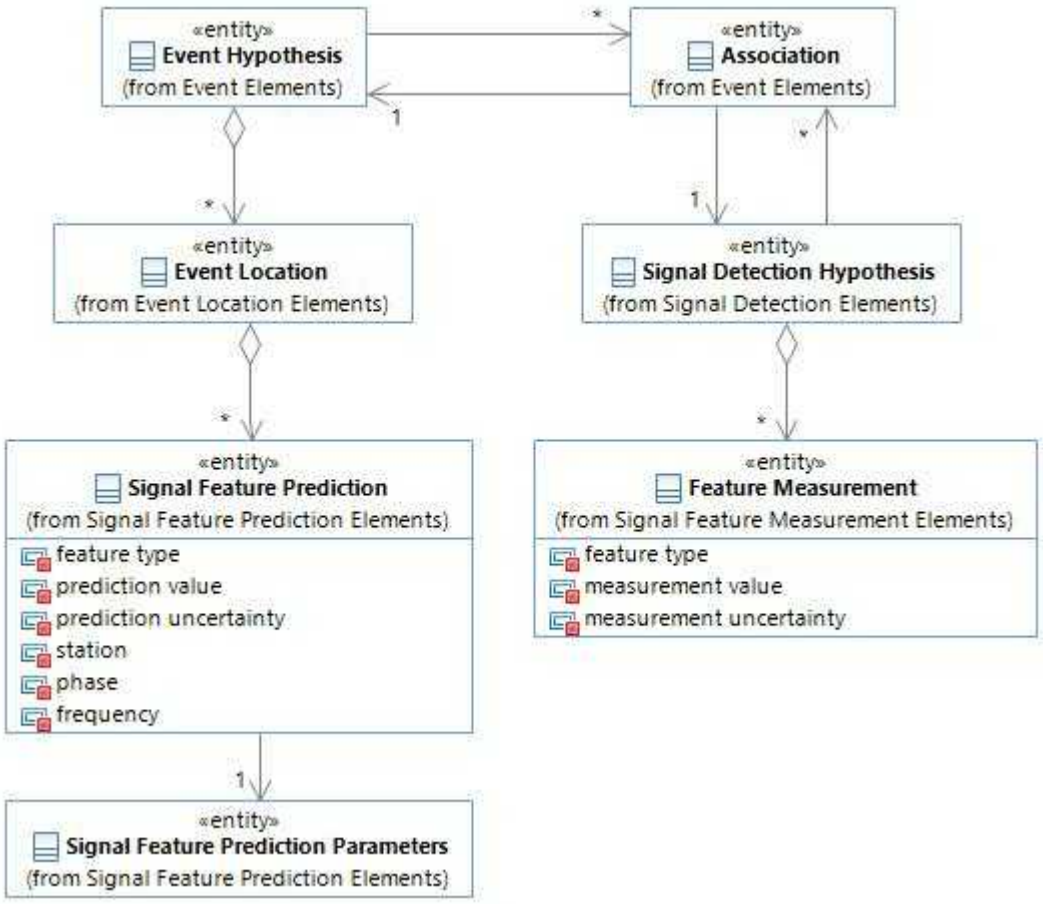
Class Diagrams

Classes - Signal Feature Prediction Control



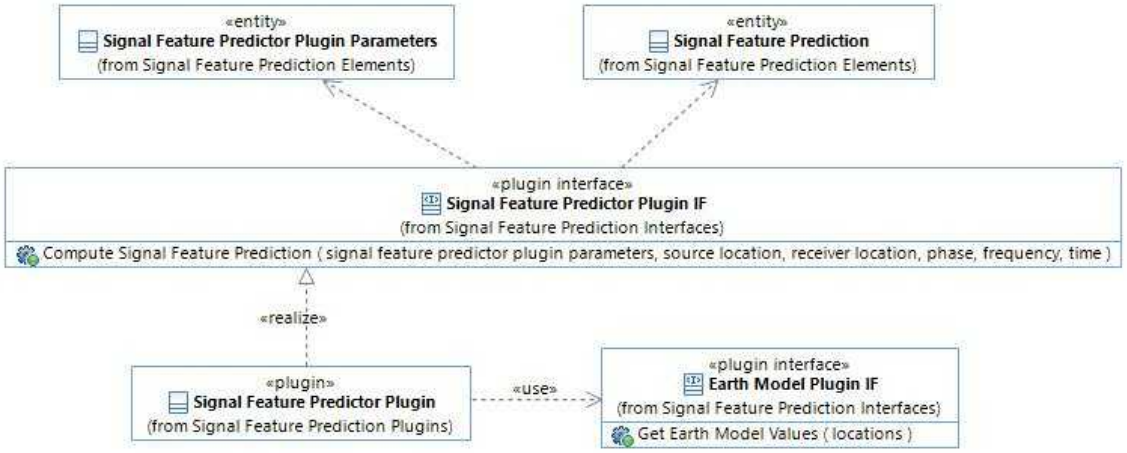
This diagram shows the Signal Feature Predictor Control class and related classes. The Control class invokes a Signal Feature Predictor Plugin via the plugin interface to compute Signal Feature Predictions. The prediction is based on a particular Event Location and a particular station location. The Control class associates the prediction to the Event Location and stores the predictions in the OSD.

Classes - Signal Feature Prediction



This diagram shows how the Signal Feature Prediction and Signal Feature Prediction Parameters classes relate to the Event Hypothesis class via the Event Location class. Tracing associations backwards from Signal Feature Prediction to Feature Measurement show the relationship between corresponding prediction and a measurement values. Using this type of a relationship or a more direct relationship between these classes is an implementation detail.

Classes - Signal Feature Predictor Plugin



This diagram shows the Signal Feature Predictor Plugin IF, which is a common interface to all Signal Feature Predictor plugins. A Signal Feature Predictor Plugin may access plugins implementing the Earth Model Plugin IF.

Class Descriptions

<<control>> Signal Feature Prediction Control
Responsible for controlling the signal feature prediction computations. Retrieves necessary data, invokes the appropriate Signal Feature Predictor Plugin to compute the desired signal feature prediction, and stores the result.

<<entity>> Association
Represents an association between a Signal Detection Hypothesis and an Event Hypothesis.

<<entity>> Event Hypothesis
Represents geophysical information about an Event as determined by an Analyst or through pipeline processing. There can be multiple Event Hypotheses for the same Event (e.g. different associated Signal Detection Hypotheses, different location solutions).

<<entity>> Event Location
Represents a computed location for an event.

<<entity>> Feature Measurement
Represents the value and uncertainty of a measured feature of a signal detection.

<<entity>> Processing Context
Represents the context in which data is being stored and/or processed. This includes the Processing Stage (either automatic or interactive) and Interval performing the processing session (e.g. processed by Analyst vs. processed by System). For Analyst processing, may identify the Analyst work session. For System processing, may identify the Processing Sequence and/or Processing Step being executed (including a way to identify a particular Processing Sequence and Processing Step among the many possible instantiations), the visibility for the results

(private vs. global), and the lifespan of the data (transient vs. persistent). This information is needed by the Processing Sequence Control to manage the execution of Processing Sequences, which may execute in the context of an Analyst refining an Event or in the context of the system initiating automatic processing. It is also needed by the Object Storage and Distribution (OSD) mechanism to determine how to store and distribute the data.

<<entity>> Signal Detection Hypothesis
Represents geophysical information about a Signal Detection as determined by an Analyst or through pipeline processing. There can be multiple Signal Detection Hypotheses for the same Signal Detection (e.g. different onset times, different phase labels).

<<entity>> Signal Feature Prediction
Represents a predicted signal feature (e.g., travel time, azimuth, slowness, amplitude, probability of detection) and the associated uncertainties.

<<entity>> Signal Feature Predictor Plugin Parameters
Represents the parameters used by an invocation of a Signal Feature Predictor Plugin. This includes parameters that apply to all Signal Feature Predictor Plugins and may also include plugin specific parameters.

<<interface>> Application Control IF
Defines the interface implemented by all <<control>> classes in the system that are controlled by System Control.

<<interface>> Processing Control IF
Defines the interface implemented by all <<control>> classes in the system that are controlled by the Processing Sequence Control <<mechanism>>. <<control>> classes realize this common interface to support configurable processing sequence definition and execution. Processing Sequence Control uses the Invoke() operation declared in Processing Control IF to call <<control>> classes while executing processing sequences. When called in this way the <<control>> classes operate on the provided data (e.g. event hypotheses, signal detections, etc.) using either default parameters configured by the System Maintainer and loaded by the <<control>> class on startup or override parameters provided to the Invoke() operation.

<<mechanism>> OSD
Represents the Object Storage and Distribution mechanism for storing and distributing data objects internally within the system.

<<mechanism>> Processing Sequence Control
Mechanism for executing and controlling processing sequences configured by the System Maintainer.

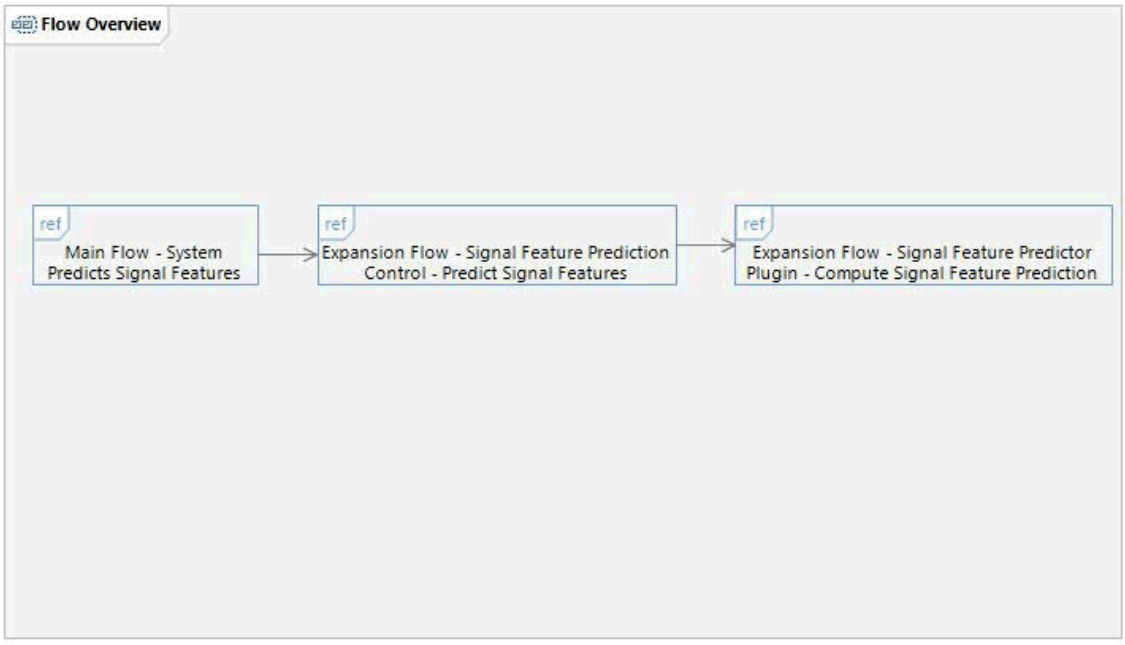
<<plugin interface>> Earth Model Plugin IF
Standard interface for all Earth Model plugins. All Earth Model plugins in the system realize this interface.

<<plugin interface>> Signal Feature Predictor Plugin IF
Standard interface for all Signal Feature Predictor plugins. All Signal Feature Predictor plugins in the system realize this interface. Plugins that implement Signal Feature Predictor IF may predict different types of signal features, such as travel time, azimuth, slowness, amplitude, and probability of detection.

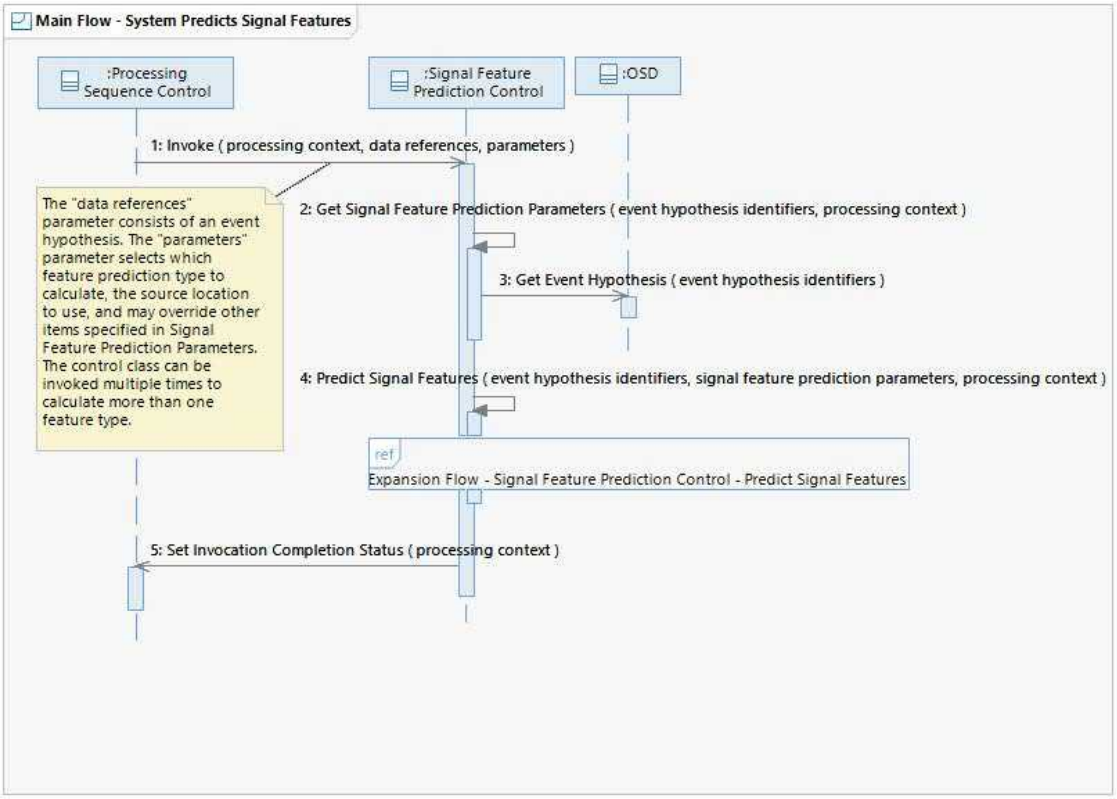
<<plugin>> Signal Feature Predictor Plugin
Abstract class that represents any/all of the Signal Feature Predictors that may be plugged in to the system behind the Signal Feature Predictor IF plugin interface. Signal Feature Predictors are responsible for calculating signal feature predictions.

Sequence Diagrams

Flow Overview



Main Flow - System Predicts Signal Features



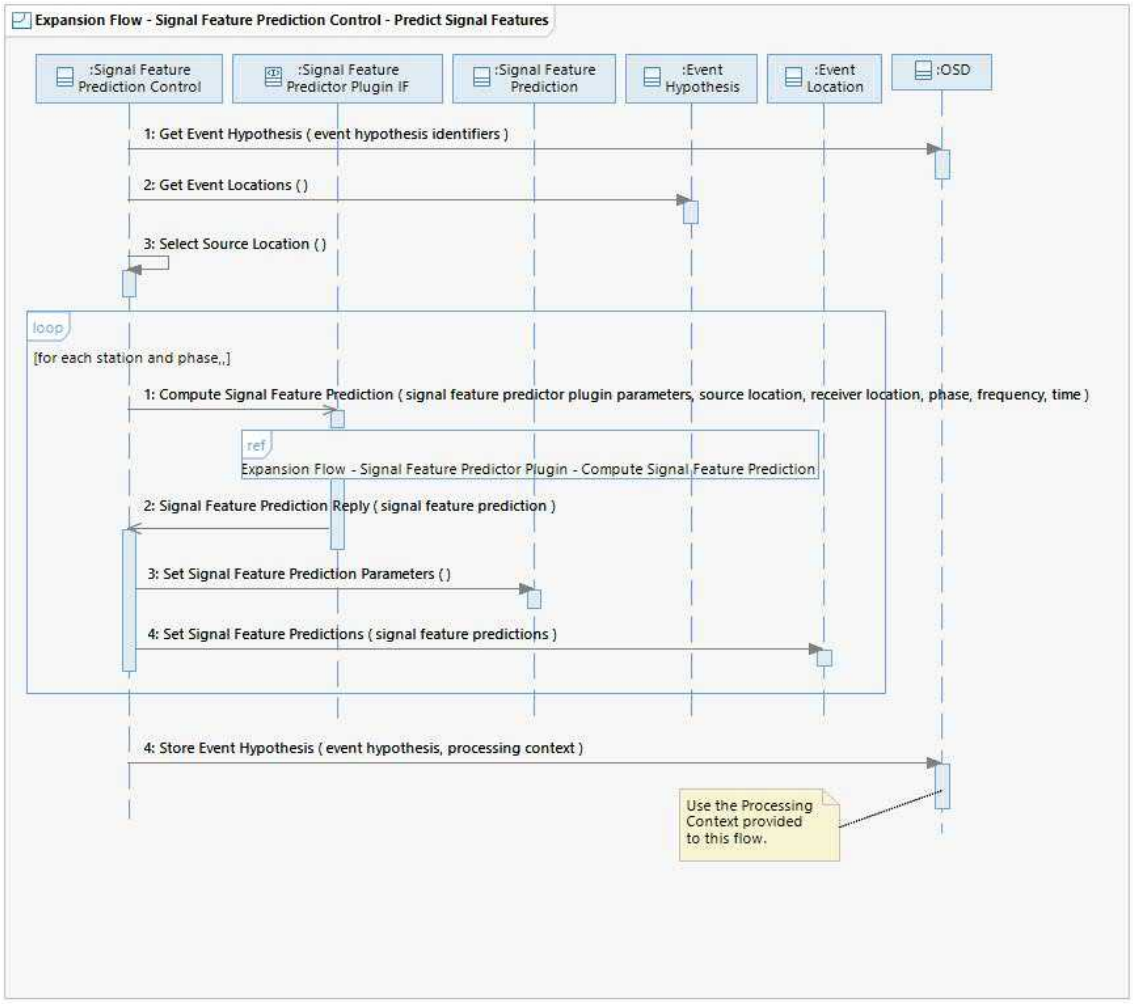
This flow shows how the system predicts signal features. The flow is stimulated by the Processing Sequence Control mechanism as part of executing an automatic processing sequence. The precise triggering conditions for such sequences are configured by the System Maintainer (see "Defines Processing Sequence" UCR). For more information about the Processing Sequence Control mechanism see "System Detects Event" UCR.

Signal Feature Predictor Plugin IF implementations may predict different types of signal features such as travel time, azimuth, slowness, amplitude, and probability of detection.

Operation Descriptions

None

Expansion Flow - Signal Feature Prediction Control - Predict Signal Features

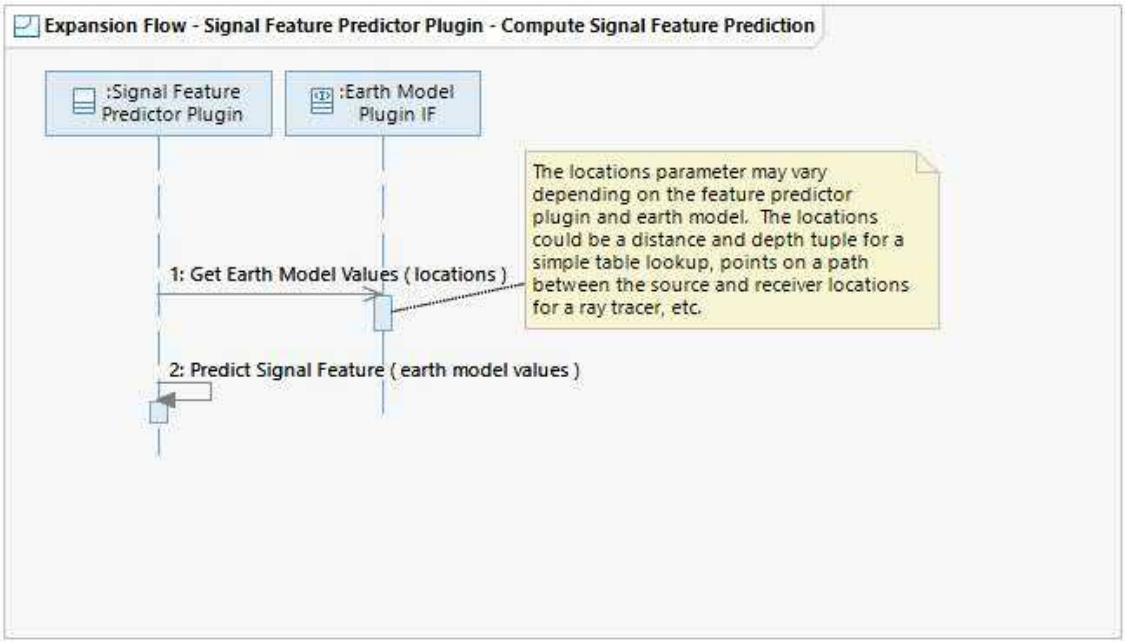


This flow shows Signal Feature Prediction Control predicting signal features using the Signal Feature Predictor Plugin IF. Signal Feature Predictor Plugin IF implementations may predict different types of signal features such as travel time, azimuth, slowness, amplitude, and probability of detection.

Operation Descriptions

Operation: OSD::Store Event Hypothesis()
Store the given Event Hypothesis with the given lifespan (persistent vs. transient) and visibility (private vs. global) as specified by the given Processing Context and notify relevant subscribers via callbacks.

Expansion Flow - Signal Feature Predictor Plugin - Compute Signal Feature Prediction



This flow notionally shows how a particular Signal Feature Predictor plugin might compute Signal Feature Predictions. The flow shown here may not apply to all Signal Feature Predictor Plugins. In this example, the Signal Feature Predictor uses an Earth Model Plugin to obtain model values needed for the prediction. The Signal Feature Predictor Plugin selects the specific Earth Model Plugin to use based on parameters in the Signal Feature Predictor Plugin Parameters class. The specific Earth Model Plugin and Signal Feature Predictor Plugin must be compatible with one another (e.g. in terms of dimensionality, levels of precision, prediction algorithm, etc.) The System only allows combinations that make sense, as configured by the System Maintainer.

Operation Descriptions

None

State Machine Diagrams

None

SSD Mappings

General:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

and depth/elevation.

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

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

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

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

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

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

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

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

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

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

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

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

S-1801: [*Extensibility*] The System shall compute predicted travel-times using a three-

dimensional phase-specific basemodel.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

S-1829: [*Threshold*] The System shall compute predicted amplitude attenuation uncertainties

from phase and frequency dependent one-dimensional basemodels.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Notes

General:
1. Signal Feature Predictor Plugin may apply corrections to Signal Feature Predictions or a correction model could be implemented as an Earth Model Plugin.

IDC Specific:
None.

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IDC Use Case Realization Report

UCR-05.02 Views System Results

Use Case Description

This architecturally significant use case describes how an Authorized External User views current and past reports through the System web servers. An Authorized External User views event reports, event bulletins, station state-of-health (SOH) and event web pages originating from the System. An Authorized External User views event reports and event bulletins from third parties.

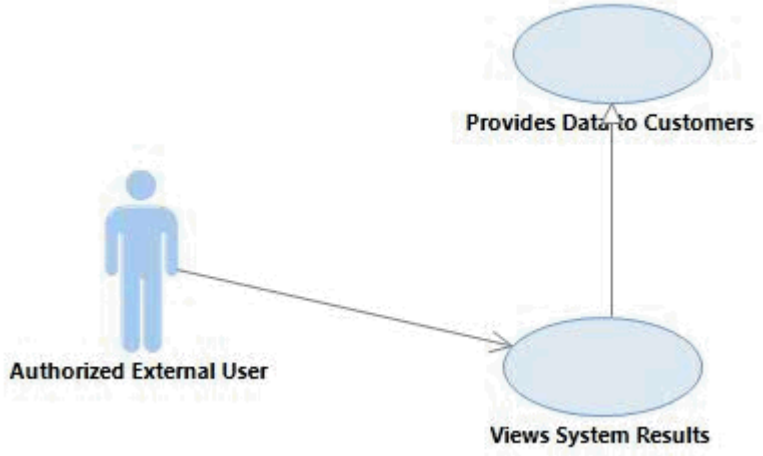
This use case is architecturally significant because it provides an interactive method for large number of external customers to access a high volume and diverse set of System results in a timely manner.

Architecture Description

The Authorized External User views system results via the Views System Results Display, which displays information in both tabular and GIS forms. System results include event information (Released Events and Event Bulletins), Station information (both static configuration and state-of-health), Waveforms, and other types of reports. Views System Results Display obtains data from the External System Results Control class, which in turn obtains data from an external instance of the OSD (so as not to interfere with internal system processing). External System Results Control filters returned results based on the configured permissions for the user.

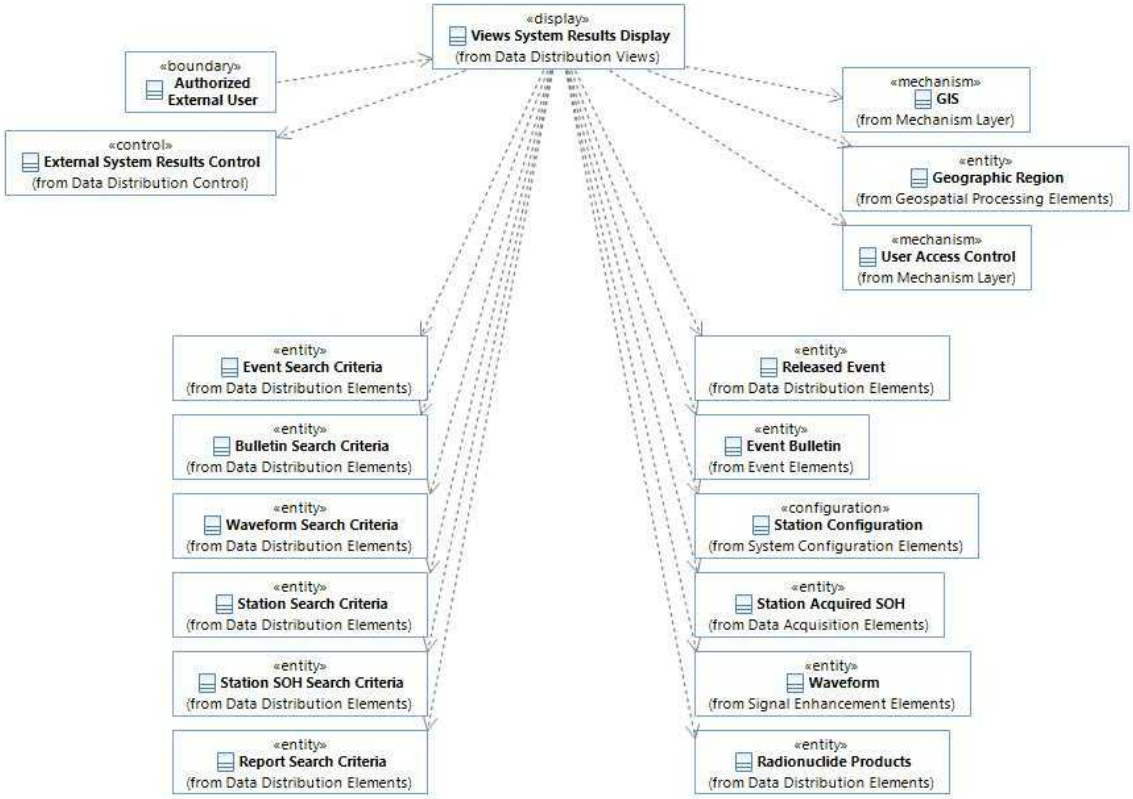
When first opened, Views System Results Display validates the user's access with the User Access Control mechanism before obtaining initial Event and Station information from External System Results Control using default search criteria. The Authorized External User may select overrides for these criteria to view different results.

Use Case Diagram



Class Diagrams

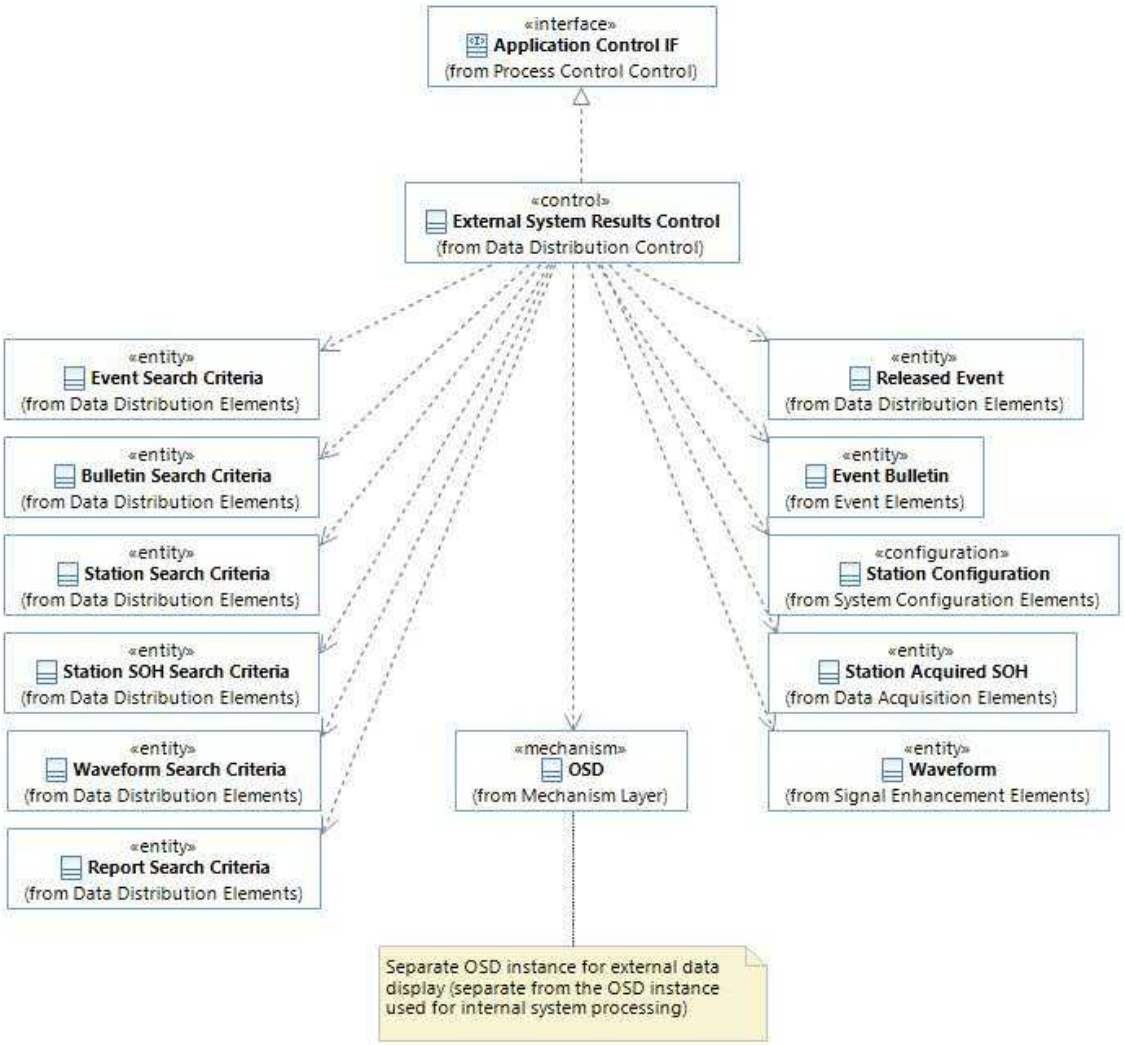
Classes - Views System Results Display



This diagram shows the Views System Results Display class and related classes. The display requests results from External System Results Control using the various "search criteria" classes and displays the results in both tabular and GIS form. The display uses the GIS mechanism to display the results on a map. The display uses the User Access Control mechanism to validate

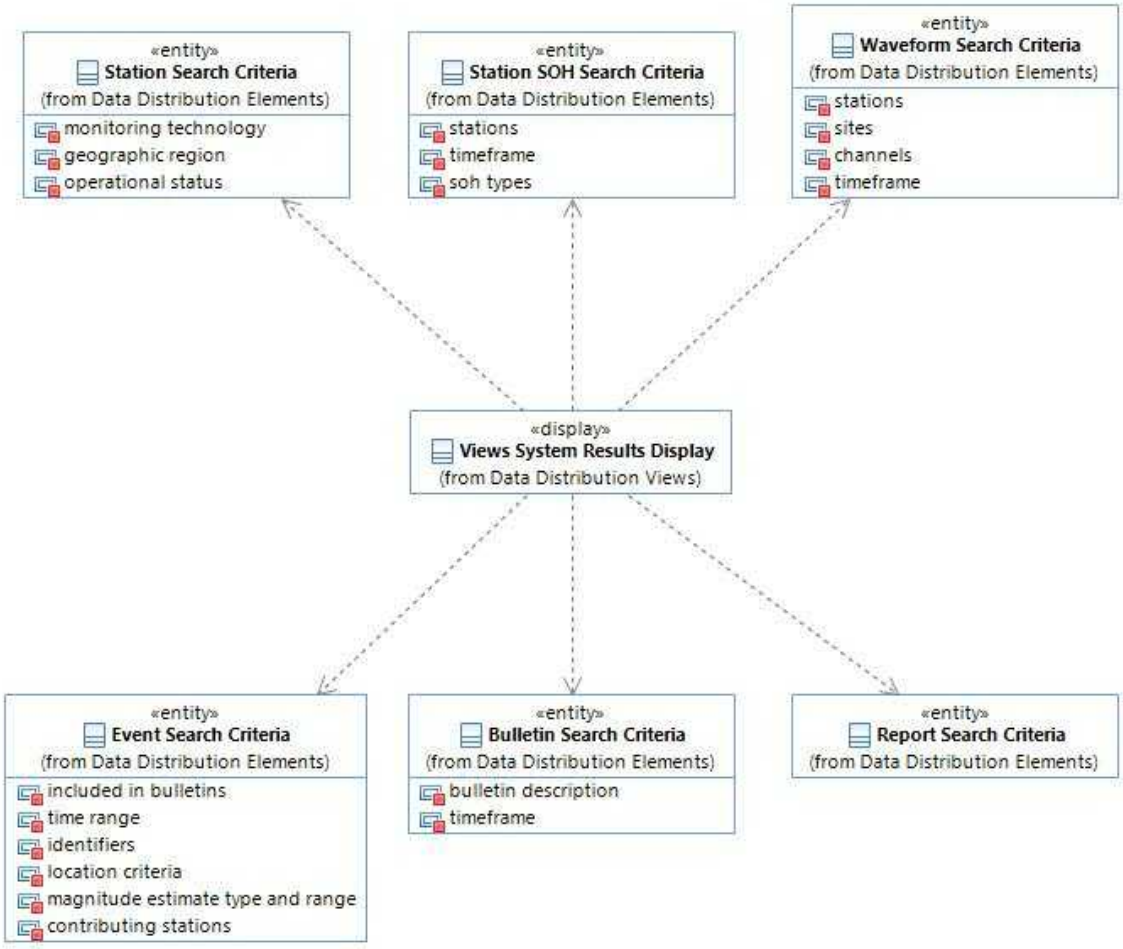
the user's credentials before providing the user access to search from and view the System results.

Classes - External System Results Control



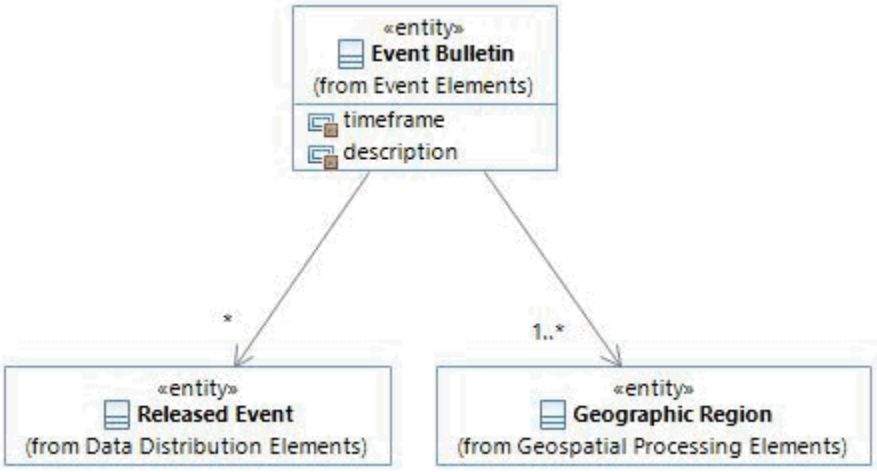
This diagram shows the External System Results Control class and related classes. The control class queries the OSD for in response to requests and search criteria provided by the Views System Results Display.

Classes - Search Criteria



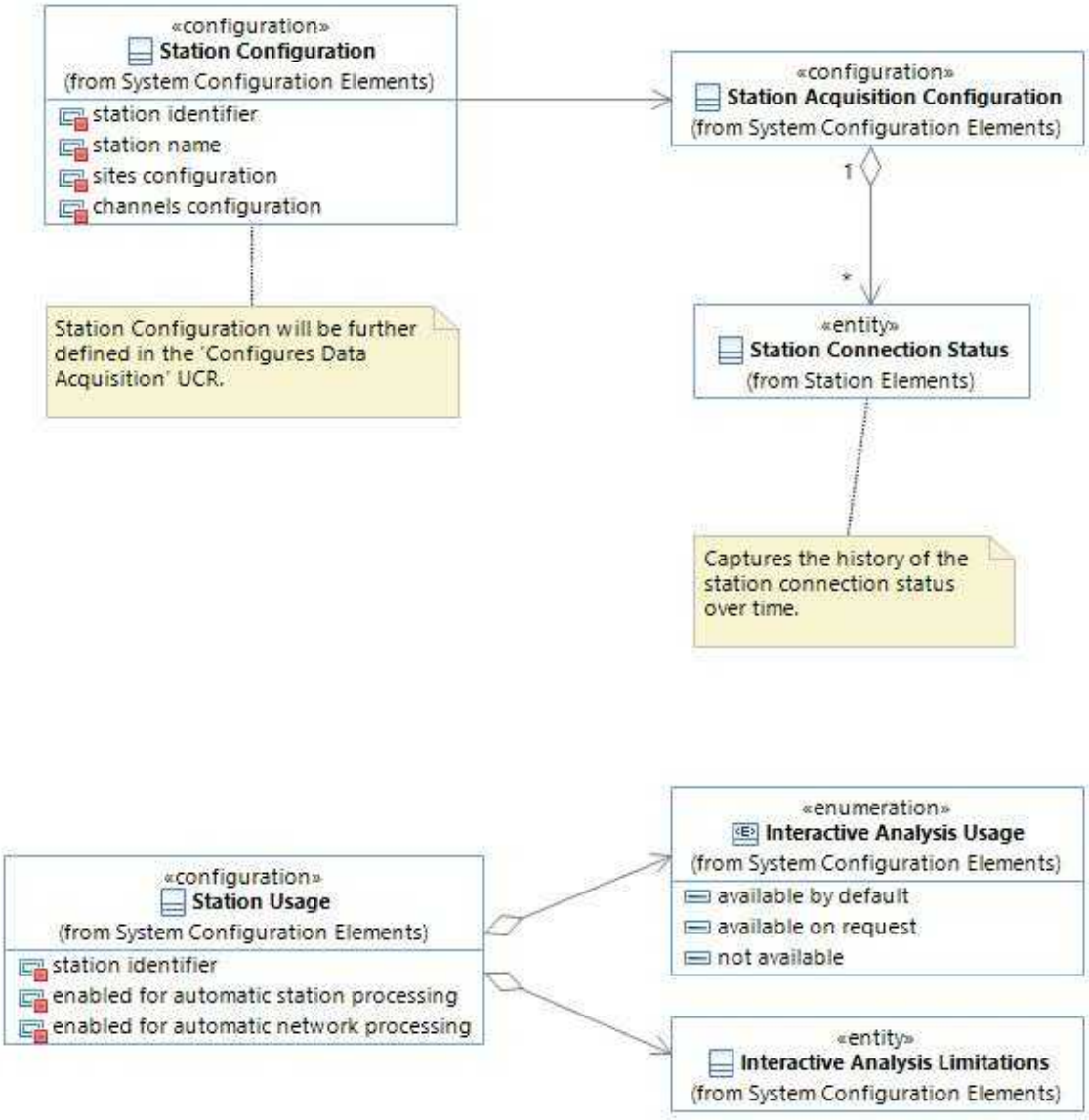
This diagram shows the various search criteria classes and details of those classes selected by the Authorized External User on the Views System Results Display. Though not shown on this diagram, the display class provides the criteria to the External System Results Control class which searches the OSD for classes matching the criteria, filters them based on user permissions, and returns them to the display for presentation to the Authorized External User.

Classes - Event Bulletin



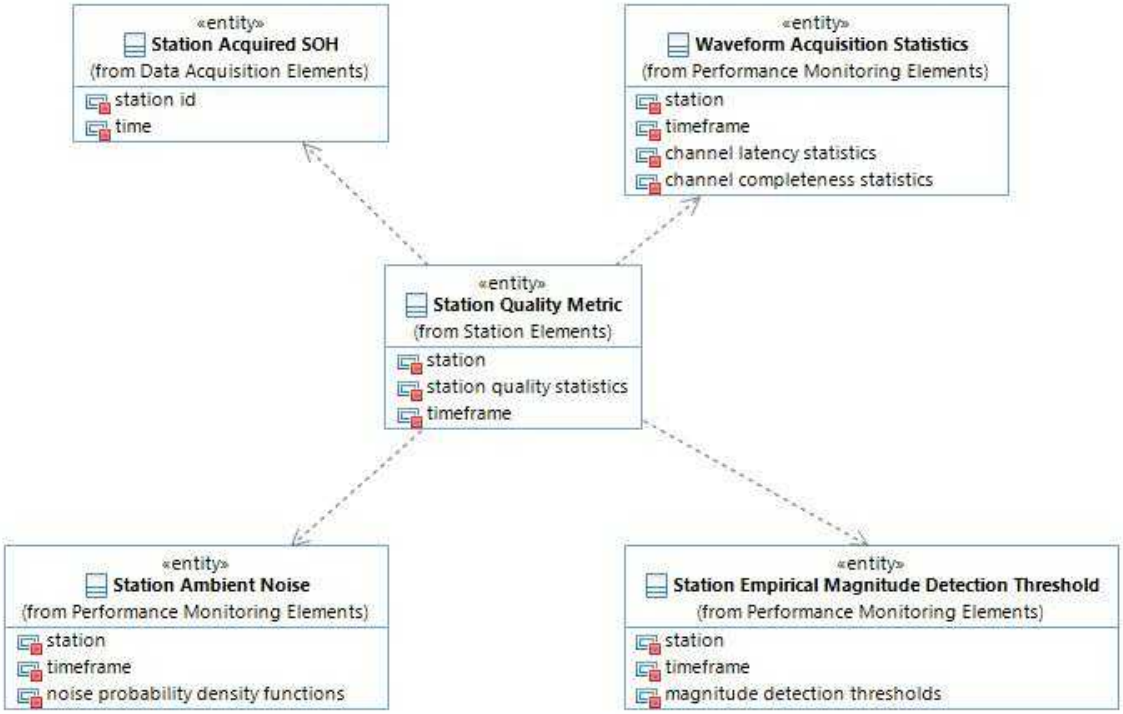
This diagram shows the Event Bulletin class, the Released Event class, and related classes. An Event Bulletin is a list of Released Events which occurred in a particular Geographic Region during a particular timeframe. A Released Event is any Event that is available for release external to the System.

Classes - Station Configuration



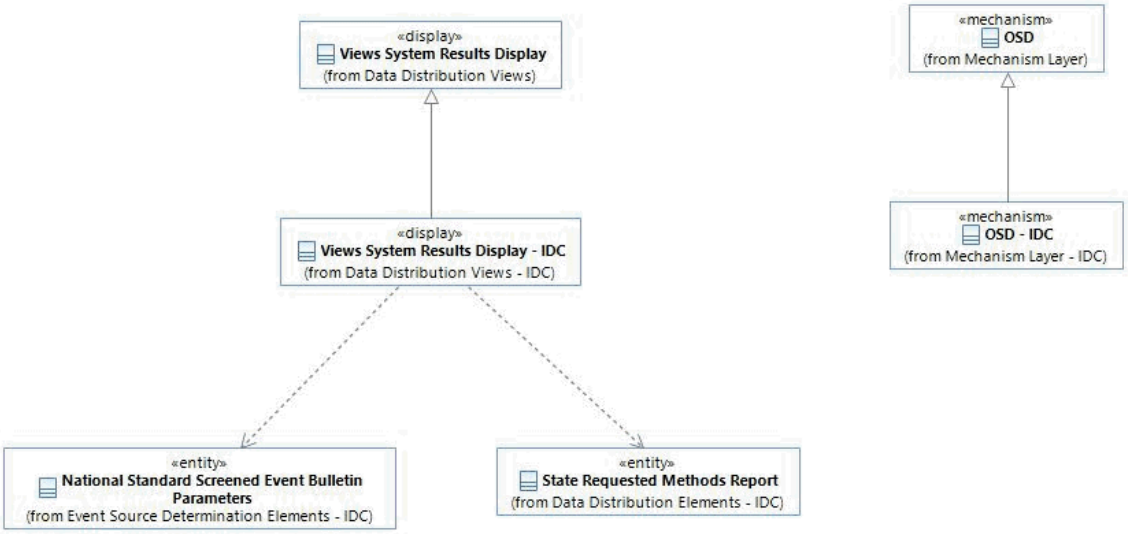
This diagram shows the Station Configuration class and related classes describing the Station's connections to the System and operational usage.

Classes - Station State-of-Health



This diagram shows the classes representing Station state-of-health (SOH) including the SOH information acquired from Stations, acquisition statistics, ambient noise, empirical magnitude detection thresholds, and quality metrics.

IDC Classes - External Results and Search Parameters



This diagram shows IDC specific classes related to providing System results to the Authorized External User via the Views System Results Display. The IDC specific Views System Results Display provides the Authorized External User the capability to search for and view Automated Warning/Notification Parameters and IDC only products such as the State Requested Methods

Report. The IDC specific OSD stores and provides access to the IDC only products.

Class Descriptions

<<configuration>> Station Acquisition Configuration
Represents configuration for how waveforms acquired from a Station are stored and forwarded within the System.

<<configuration>> Station Configuration
Represents the configurable aspects of a Station such as its name, location, the sites at the station, the channels from the sites, site instrumentation, instrument calibration, etc.

<<control>> External System Results Control
Responsible for managing external data provided to customers.

<<display>> Views System Results Display
Responsible for displaying system results to Authorized External Users.

<<display>> Views System Results Display - IDC
A specialization of the Views System Results Display class containing operations unique to the IDC.

<<entity>> Bulletin Search Criteria
Represents the criteria used to search the OSD for an Event Bulletin. Includes the bulletin description (e.g., the monitoring organization producing the bulletin; the type of bulletin such as Reviewed Event Bulletin (REB), Screened Event Bulletin (SEB), etc.) and the event timeframes.

<<entity>> Event Bulletin
Contains metadata describing a collection of Released Events (e.g., timeframe when the Events occurred, Geographic Regions where the Events occurred, a description of bulletin's type (including the monitoring organization and a name (e.g., LEB, REB, UEB) assigned to the bulletin) and the collection of Released Events satisfying those criteria.

<<entity>> Event Search Criteria
Represents criteria used to search the OSD for matching events. The criteria include: bulletin, Event time, Event identifier, Event location (e.g. by location range, by Geographic Region), Event magnitude estimate range, and Stations with Signal Detections associated to the Event.

<<entity>> Geographic Region
Represents a region on the Earth (e.g. a Flinn-Engdahl seismic or geographic region). Consists of a boundary (either an arbitrary polygon or a predefined shape such as a rectangle, ellipse, etc.), a description, and the timeframes during which the region is/was active.

<<entity>> Interactive Analysis Limitations
Represents any System Maintainer configured limitations on a Station's usage during interactive processing (e.g., availability for interactive signal detections, availability for Fk spectra calculations, etc.).

<<entity>> National Standard Screened Event Bulletin Parameters
Represents parameters used by Event Screening Control to calculate a National Standard Screened Event Bulletin. The Authorized External User selects parameters controlling calculation of the individual event screening criteria and calculation of the overall screening category from the metrics.

<<entity>> Radionuclide Products
Represents the radionuclide products the System provides to the Authorized External User.

<<entity>> Released Event
An Event which meets external release criteria and is available for release to Authorized External Users and/or External Data Centers. This is separate from the Event class since Released Event is provided to external users and may include different information or different data representations than the Event class used during analysis.

<<entity>> Report Search Criteria
Represents the criteria used to search the OSD for reports (e.g. radionuclide products, event reports, State Requested Methods Reports, etc.). Search criteria include the report type, report date/time, and other criteria specific to the desired report (e.g. Geographic Region, Station, etc.).

<<entity>> State Requested Methods Report
Entity representing a report of analysis undertaken by a Fusion and Review Officer per request from a member-state, possibly using extra data and/or software provided by the member-state.

<<entity>> Station Acquired SOH
Represents the state-of-health for a single Station. Includes state-of-health information acquired from the Station (including whether the station has GPS locked) and digital signature authentication status.

<<entity>> Station Ambient Noise
Contains the ambient noise statistics over a defined time range for each Channel from a Station.

<<entity>> Station Connection Status
Represents the status of the Station Data Receiver Control's connection to a Station for a specified time range.

<<entity>> Station Empirical Magnitude Detection Threshold
Represents empirical Station magnitude detection thresholds for particular timeframes, geographic regions, and type of magnitude estimate.

<<entity>> Station Quality Metric
Represents a Station's quality for a particular time. Separate station quality metrics can be computed for a Station with each metric based on different selections of the Station's raw and derived waveforms (e.g. Station Quality Metric could be computed using Waveforms from a Station's raw Channels and a separate quality metric could be computed for a beam created from

the Station's waveforms).

<<entity>> Station SOH Search Criteria
Represents the criteria used to search the OSD for Station state-of-health (SOH) information. Includes the Stations, a timeframe, and the types of SOH (e.g. SOH acquired from the Stations, waveform acquisition statistics, ambient noise, etc.) to retrieve.

<<entity>> Station Search Criteria
Represents the criteria used to search the OSD for Station configuration information (location, instrumentation, site information, channel information, etc.). Includes the monitoring technology (e.g., seismic, hydroacoustic, infrasound, radionuclide), station locations, and station operational status (operational, installed, under construction, etc.) to retrieve.

<<entity>> Waveform
A Waveform represents a time-series of data from a Channel.

<<entity>> Waveform Acquisition Statistics
Contains the waveform acquisition statistics over a particular timeframe for each Channel in a Station.

<<entity>> Waveform Search Criteria
Represents the criteria used to search the OSD for Waveforms (e.g., Stations, Sites, Channel, timeframe).

<<interface>> Application Control IF
Defines the interface implemented by all <<control>> classes in the system that are controlled by System Control.

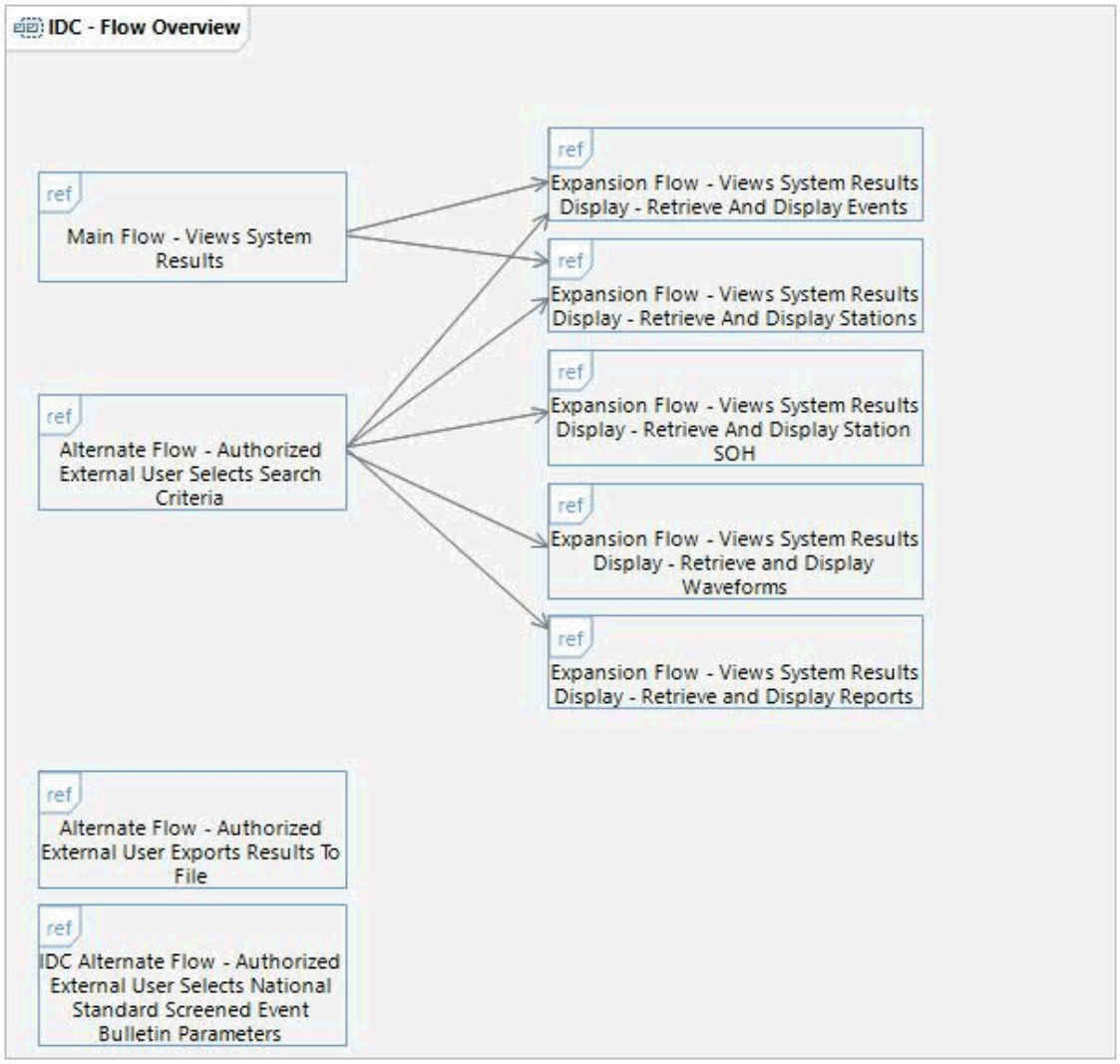
<<mechanism>> OSD
Represents the Object Storage and Distribution mechanism for storing and distributing data objects internally within the system.

<<mechanism>> OSD - IDC
A specialization of the OSD mechanism containing operations unique to the IDC.

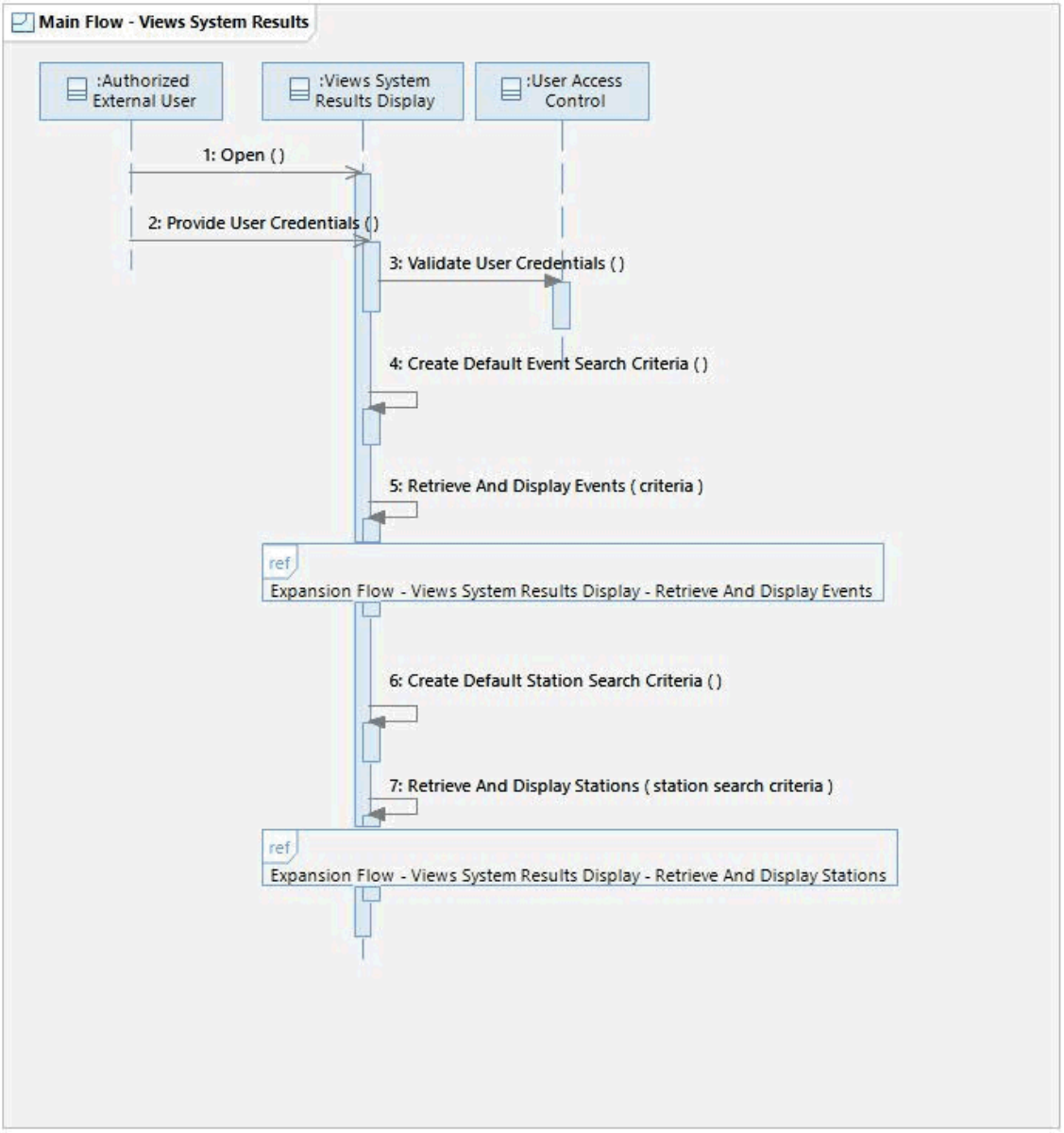
<<mechanism>> User Access Control
Validates user credentials for both System Users and Authorized External Users to help ensure the System only provides users access to approved information, displays, etc.

Sequence Diagrams

IDC - Flow Overview



Main Flow - Views System Results

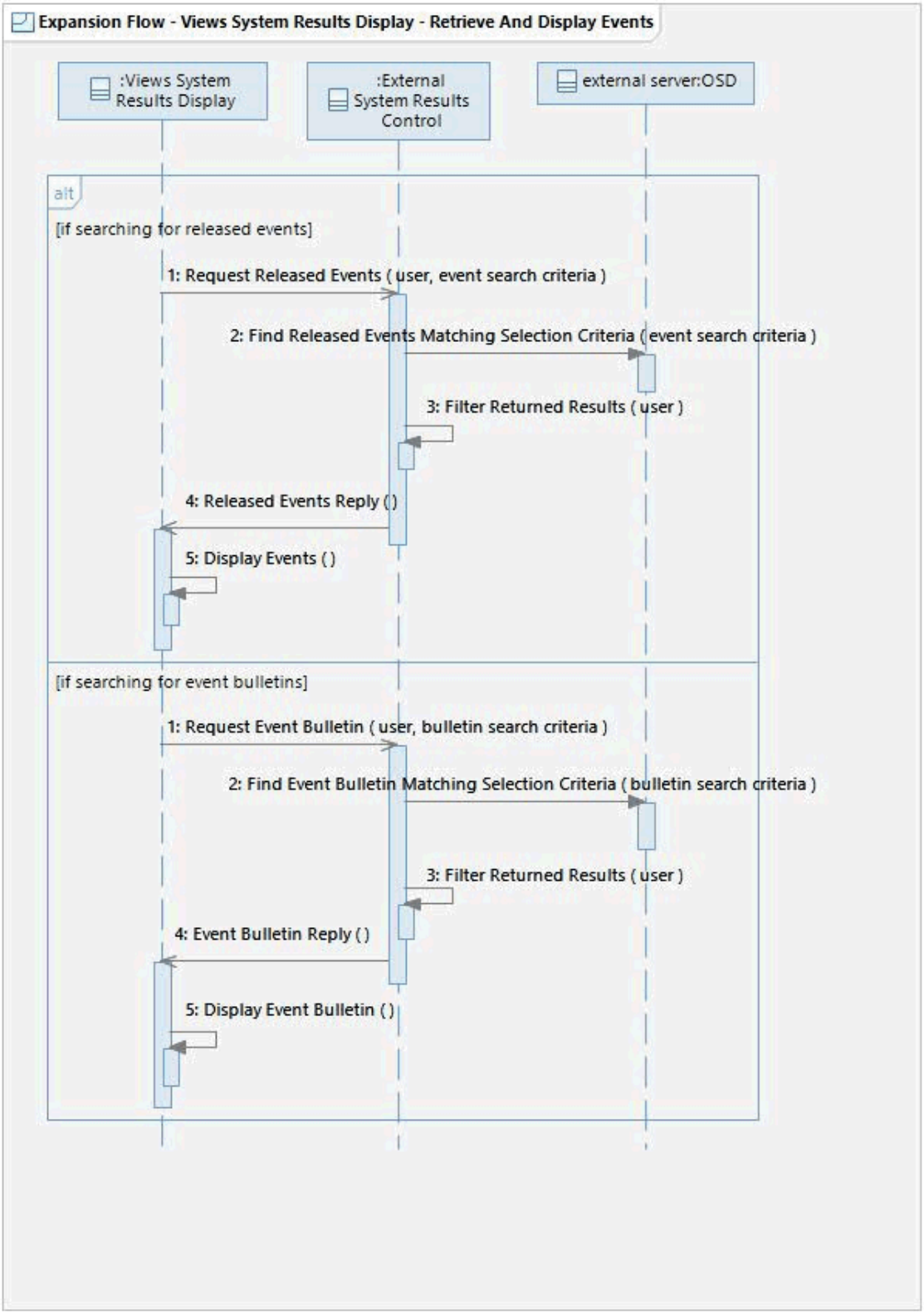


The flow shows the Authorized External User opening the Views System Results Display. The display uses the User Access Control mechanism to validate the user's credentials. The display performs default queries for Events and Stations and displays the results.

Operation Descriptions

None

Expansion Flow - Views System Results Display - Retrieve And Display Events



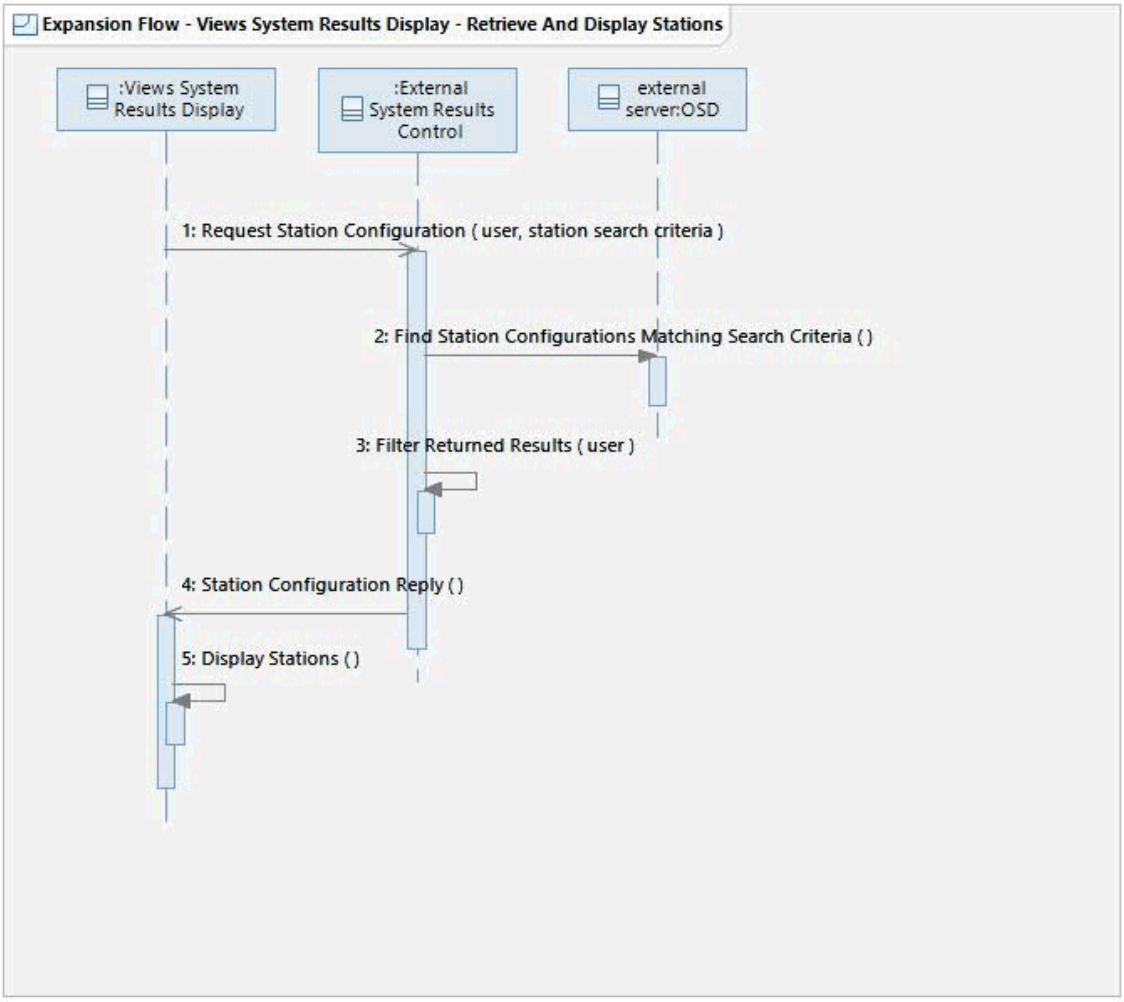
This flow shows how the Views System Results Display uses the External System Results

Control to request Released Events and Event Bulletins for display to the Authorized External User.

Operation Descriptions

None

Expansion Flow - Views System Results Display - Retrieve And Display Stations

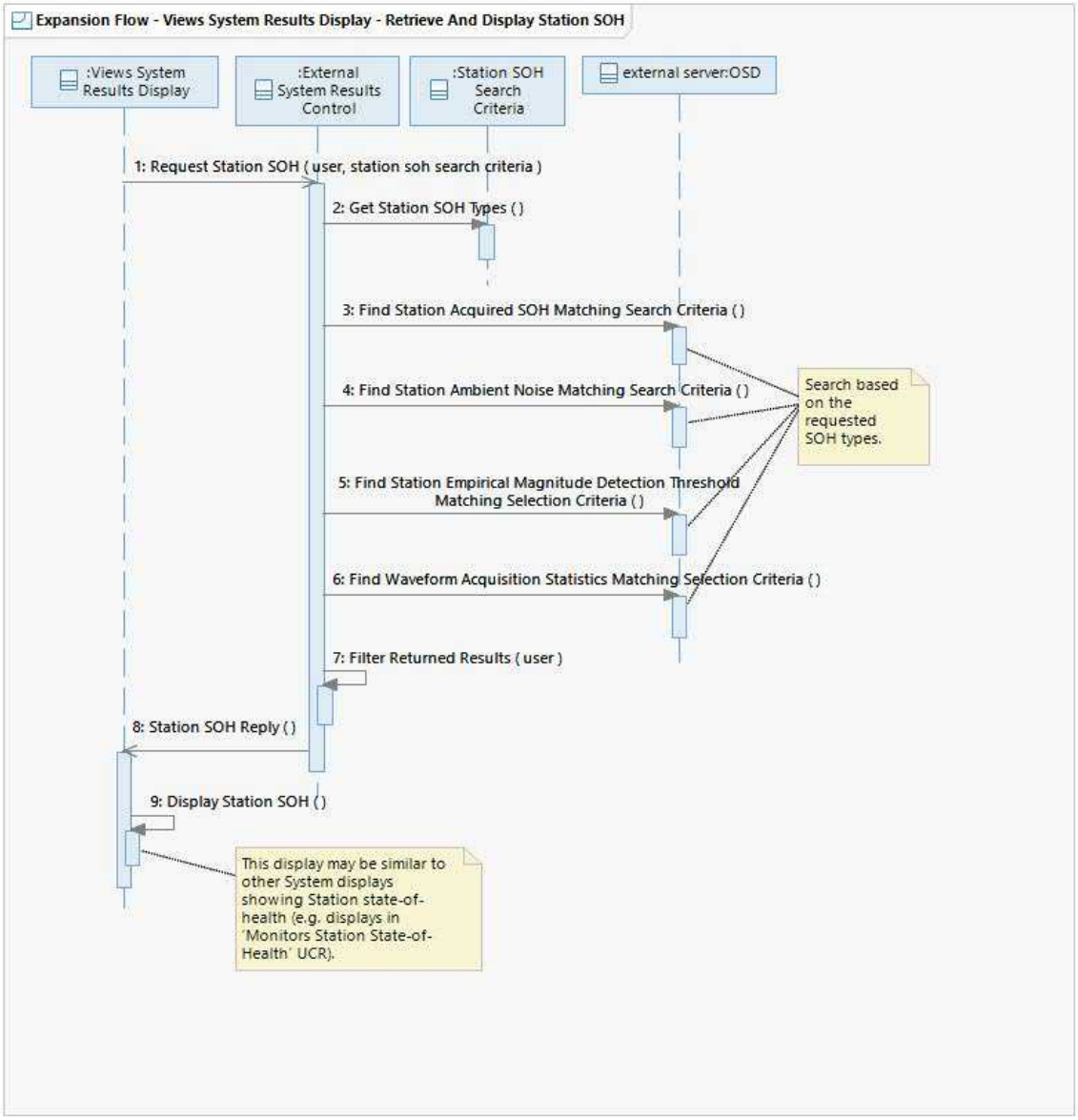


This flow shows how the Views System Results Display uses the External System Results Control to request Station configuration (location, instrumentation, site information, channel information, etc.) for display to the Authorized External User.

Operation Descriptions

None

Expansion Flow - Views System Results Display - Retrieve And Display Station SOH

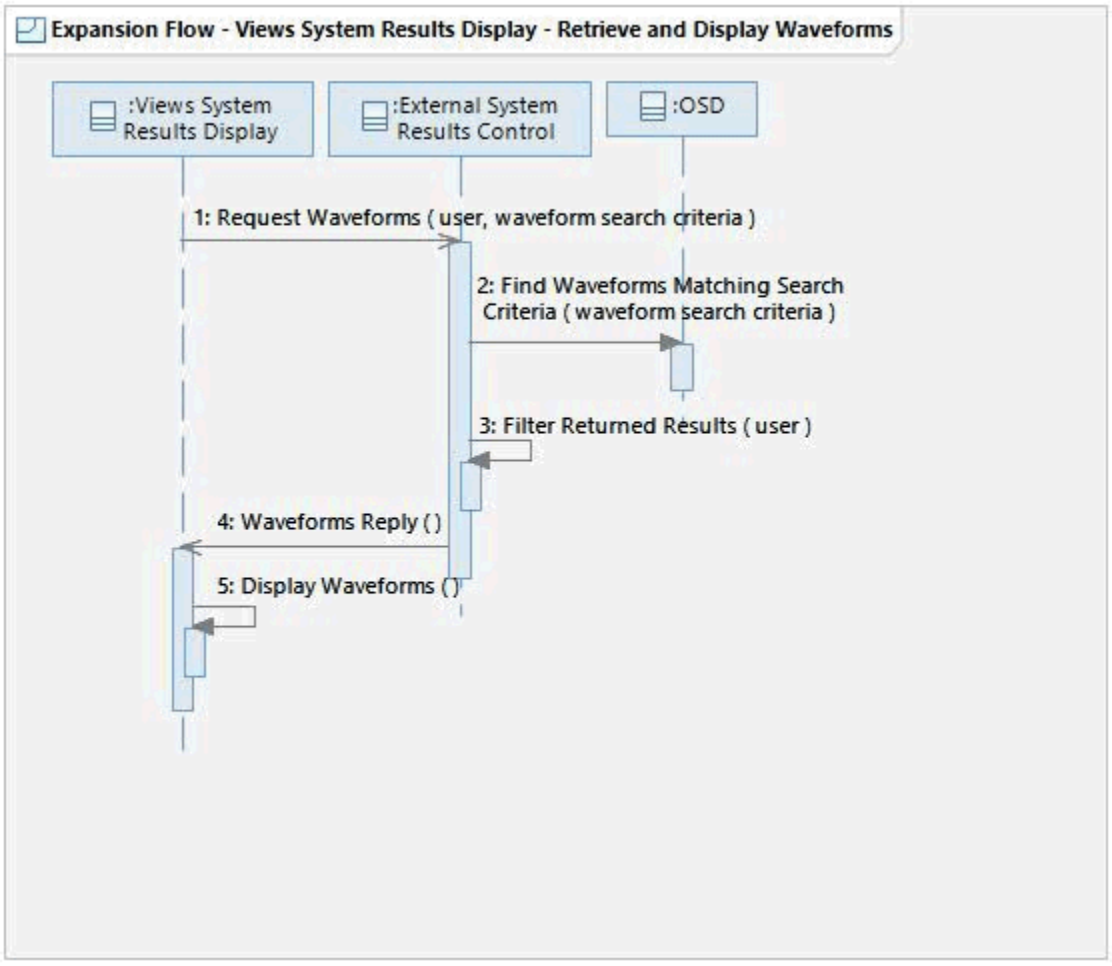


This flow shows how the Views System Results Display uses the External System Results Control to request various types of Station SOH for display to the Authorized External User.

Operation Descriptions

None

Expansion Flow - Views System Results Display - Retrieve and Display Waveforms

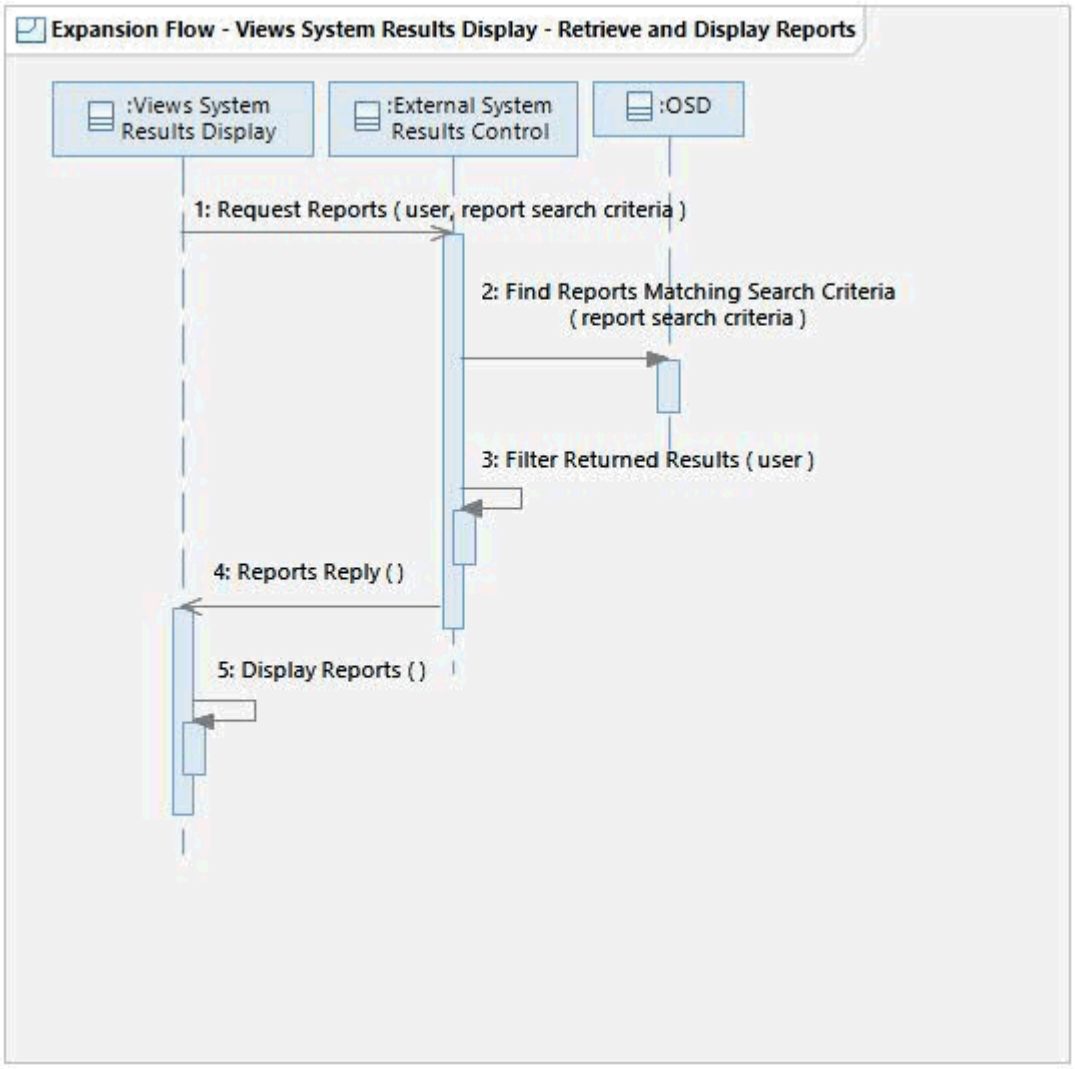


This flow shows how the Views System Results Display uses the External System Results Control to request Waveforms for display to the Authorized External User.

Operation Descriptions

None

Expansion Flow - Views System Results Display - Retrieve and Display Reports

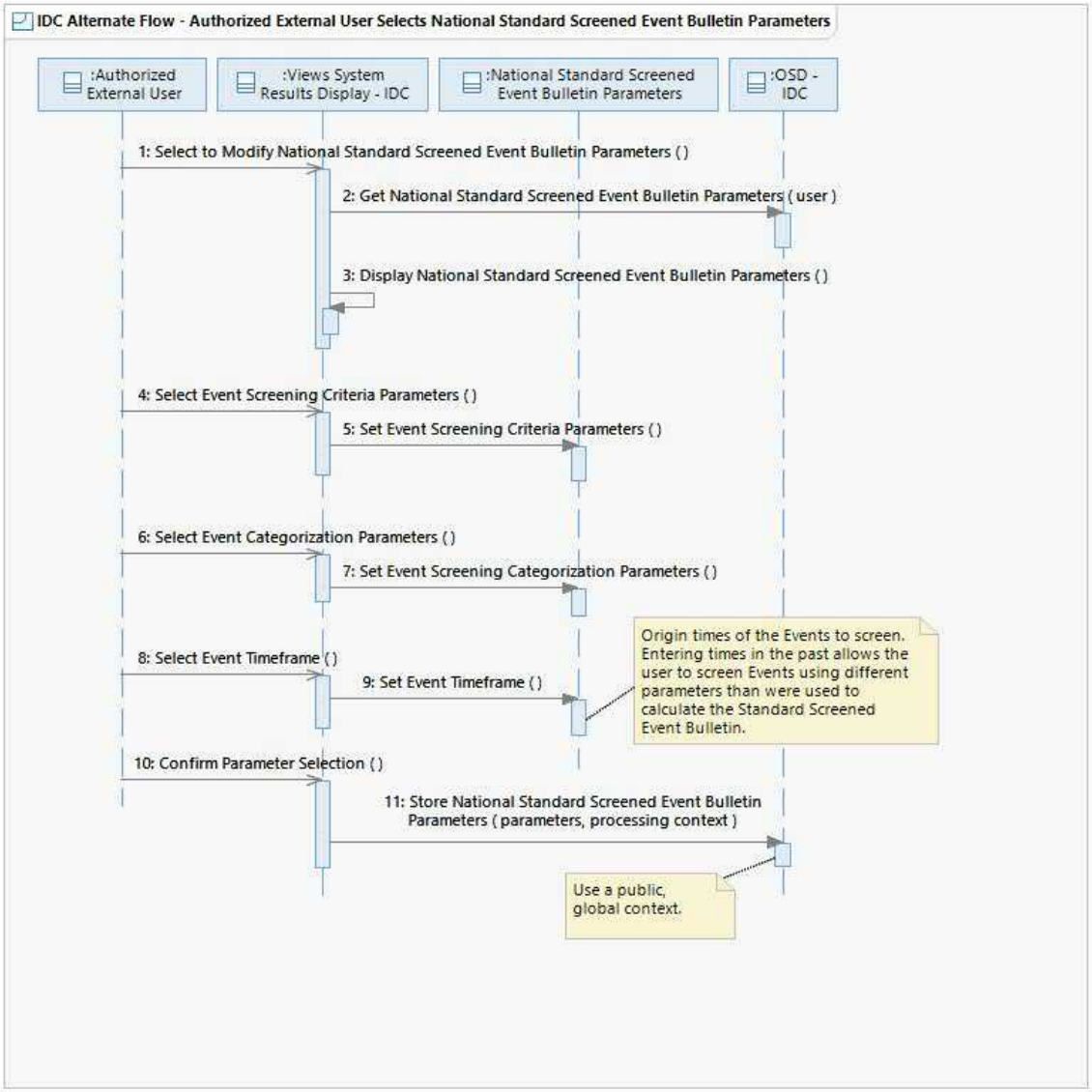


This flow shows how the Views System Results Display uses the External System Results Control to request Reports for display to the Authorized External User.

Operation Descriptions

None

IDC Alternate Flow - Authorized External User Selects National Standard Screened Event Bulletin Parameters

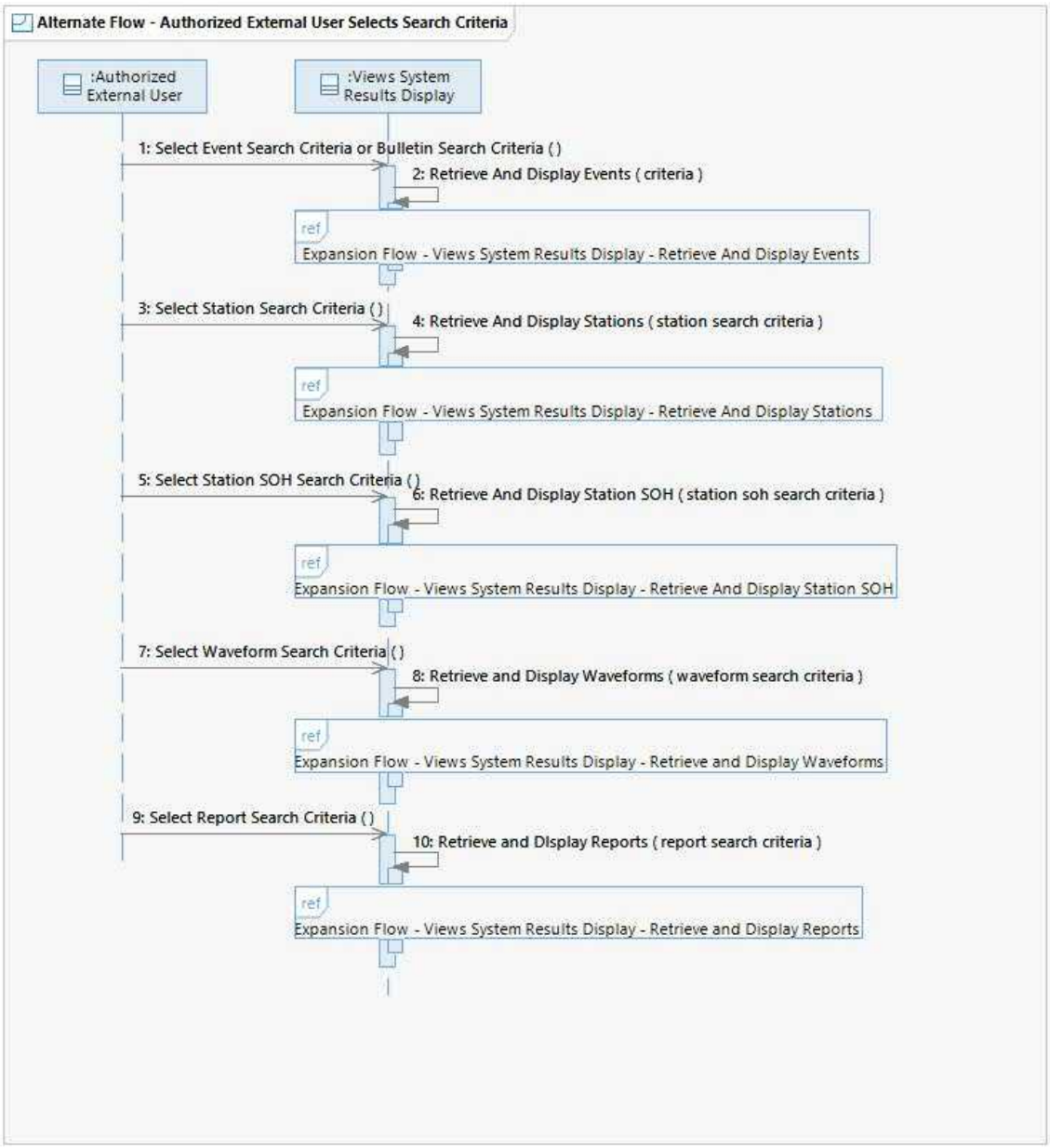


This flow shows the Authorized External User entering the National Standard Screened Event Bulletin Parameters. Event Screening Control (see 'System Screens Events' UCR) uses these parameters to calculate the National Standard Screened Event Bulletin. The Authorized External User may subscribe to regularly receive National Standard Screened Event Bulletins (see 'Requests System Data' UCR). When the Authorized External User selects to screen events which already exist in the System (i.e. selects an Event Timeframe that at least partially occurs in the past), the System automatically screens the events and sends the results to the Authorized External User. An OSD callback occurring on storage of the National Standard Screened Event Bulletin Parameters initiates the screening calculation. The System provides the results to the Authorized External User in the same way it provides other Event Bulletins (see 'Requests System Data' UCR).

Operation Descriptions

None

Alternate Flow - Authorized External User Selects Search Criteria

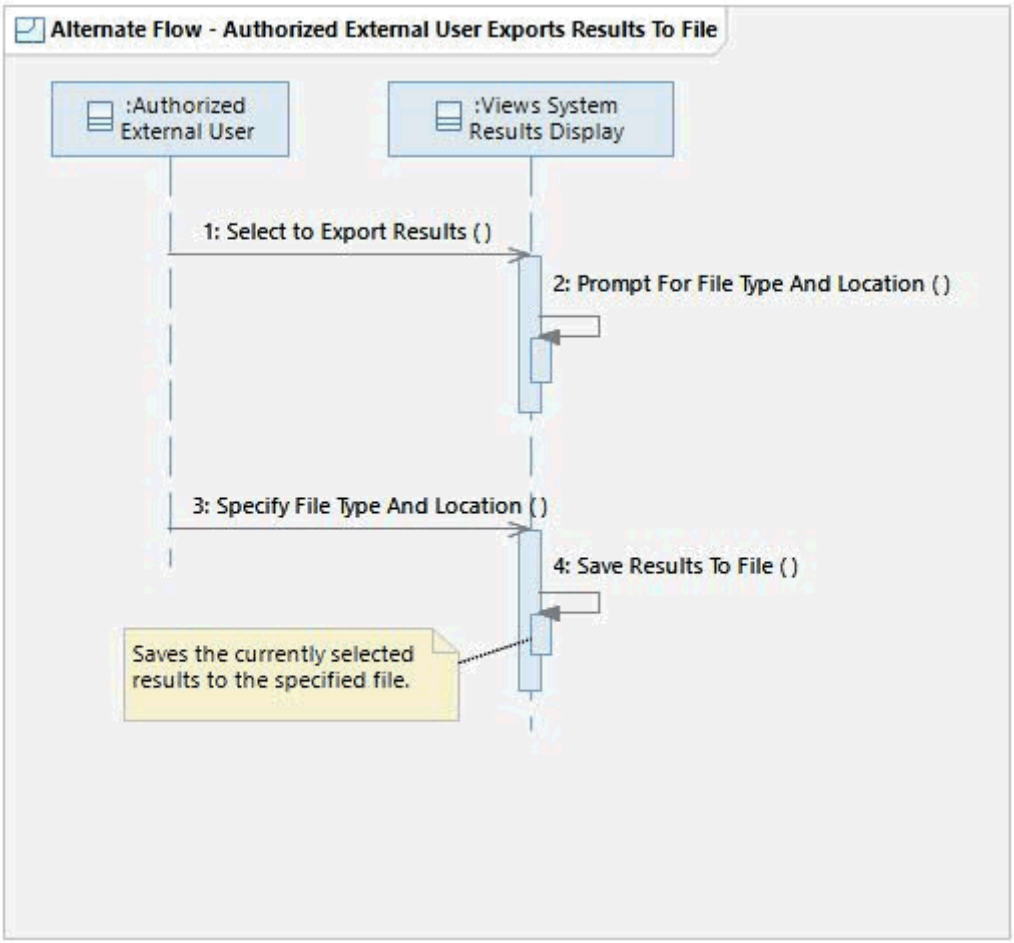


This flow shows how the Authorized External User can tailor the information displayed by Views System Results Display by selecting the search criteria External System Results Control uses to query the OSD. The Authorized External User may also subscribe to regularly receive updated System results matching the search criteria entered in this flow (e.g. subscribe based on station, event location, event azimuth from station, SNR, etc.). See 'Requests System Data' UCR for details.

Operation Descriptions

None

Alternate Flow - Authorized External User Exports Results To File



This alternate flow shows how the Authorized External User can export results to a specified file. The display is responsible for exporting the data to the file.

Operation Descriptions

None

State Machine Diagrams

None

SSD Mappings

General:

S-1229: [*Threshold*] The System shall provide the Authorized External User the capability to

view station data acquisition statistics via a web site.

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

S-2006: [*Threshold*] The System shall provide the Authorized External User the capability to access reports based on their roles and privileges.

S-2007: [*Threshold*] The System shall provide the Authorized External User the capability to access reports via a web server.

S-2008: [*Threshold*] The System shall provide the Authorized External User the capability to view station SOH via a web server.

S-2011: [*Threshold*] The System shall provide the Authorized External User the capability to export reports.

S-2012: [*Threshold*] The System shall provide the Authorized External User the capability to access third-party reports.

S-2016: [*Threshold*] The System shall provide the Authorized External User the capability to create an event bulletin from the set of released events.

S-2017: [*Threshold*] The System shall provide the Authorized External User the capability to create event bulletins based on any combination of geographic region, time interval, depth, magnitude interval, source type, stations, latitude, and longitude.

S-2020: [*Threshold*] The System shall provide the Authorized External User the capability to view a list of events created in any processing stage (automated or interactive).

S-5710: [*Threshold*] The System shall provide an extensible architecture for the distribution of new data and reports.

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

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

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

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

S-5964: [*Threshold*] The System shall provide the Authorized External User the capability to

view the authentication status of waveform data.

S-5965: [*Threshold*] The System shall provide the Authorized External User the capability to view the station instrumentation, station deployment, and station configuration parameter values.

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

S-5988: [*Threshold*] The System shall provide the Authorized External User to view station data on an interactive map.

S-5989: [*Threshold*] The System shall provide the Authorized External User the capability to view geographic data on an interactive map.

S-5990: [*Threshold*] The System shall provide the Authorized External User the capability to view active geographic region boundaries on an interactive map.

S-5992: [*Threshold*] The System shall provide the Authorized External User the capability to view on an interactive map whether an event hypothesis location is within active geographic regions.

S-5993: [*Threshold*] The System shall provide the Authorized External User the capability to simultaneously view event hypothesis locations and active geographic region boundaries on an interactive map.

S-5994: [*Threshold*] The System shall provide the Authorized External User the capability to simultaneously view event hypothesis locations and inactive geographic region boundaries on an interactive map.

S-5996: [*Threshold*] The System shall provide the Authorized External User the capability to specify the time associated with whether an event hypothesis location or event hypothesis location uncertainty is within an active geographic region.

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

S-6002: [*Threshold*] The System shall provide the Authorized External User the capability to view geographic data on a two-dimensional projection and on a three-dimensional virtual globe.

S-6428: [*Threshold*] The System shall provide the System User the capability to access the System as an Authorized External User.

S-6429: [*Threshold*] The System shall provide the Authorized External User the capability to view third-party event bulletins.

S-6430: [*Threshold*] The System shall provide the Authorized External User the capability to

select geographical data on any interactive map (such as events and stations) and export them to a standardized format (e.g. KML/KMZ).

S-6431: [*Threshold*] The System shall export geographic data in KML/KMZ format.

S-6433: [*Threshold*] The System shall provide the Authorized External User the capability to view an event from any processing stage that has been approved for release.

S-6434: [*Threshold*] The System shall provide the Authorized External User the capability to view station calibration results.

S-6455: [*Threshold*] The System shall provide the Authorized External User the capability to view station magnitude detection thresholds computed for a geographic region.

S-6456: [*Threshold*] The System shall provide the Authorized External User the capability to access third-party event bulletins in the same way they access event bulletins produced by the System.

IDC Specific:

S-5686: [*Threshold*] The System shall provide the System User the capability to access the System using their CTBTO "single sign on" credentials.

S-5687: [*Threshold*] The System shall provide user identification and authentication through the CTBTO "single sign on".

S-6543: [*Threshold*] The System shall provide the Authorized External User the capability to select the screening criteria parameters the System uses to calculate a National Standard Screened Event Bulletin.

S-6544: [*Threshold*] The System shall provide the Authorized External User the capability to select parameters controlling which screening criteria numerical metric scores the System combines when calculating overall screening categories for a National Standard Screened Event Bulletin.

Notes

General:
1. Many of the Station quality classes will be further elaborated by other UCRs (e.g., UCR "System Monitors Mission Performance" computes Station Ambient Noise, UCR "System Monitors Mission Performance" computes Station Empirical Magnitude Detection Thresholds, UCR "Monitors Station State-of-Health" computes Waveform Acquisition Statistics, etc.)

IDC Specific:
1. Open issue: Need to find out more details about what is represented by the Radionuclide

Products class and then update the class description (CR-3060).

2. The Authorized External User accesses Radionuclide Products, the results of Expert Technical Analysis (i.e. State Request Methods Reports), and data fusion products using the Report Search Criteria in “Alternate Flow – Authorized External User Selects Search Criteria”.

3. System Users accessing Views System Results Display provide their credentials to the CTBTO’s “single sign on” system. Authorized External Users provide their credentials to an alternate validation system. Details of this system are deferred to the detailed design.

4. Whether an Event meets external release criteria depends on the bulletin including the Event. Some bulletins only include Events meeting a series of consistency checks (see ‘Assesses Event Consistency’ UCR)

IDC Use Case Realization Report

UCR-08.02 Controls the System

Use Case Description

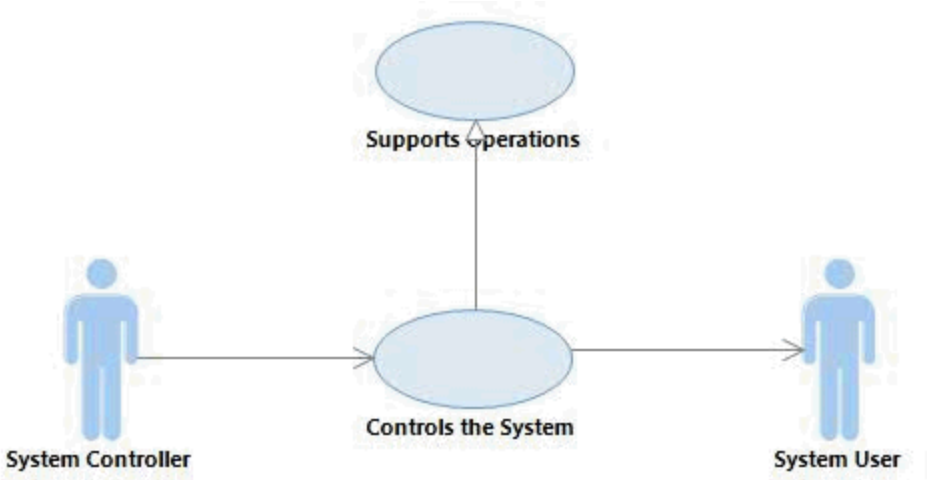
This architecturally significant use case describes how the System Controller starts and stops the System, and switches pipeline processing from the Primary to the Backup. When the System Controller starts the System, the System data processing starts and automatically accepts connections for acquiring 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.

Architecture Description

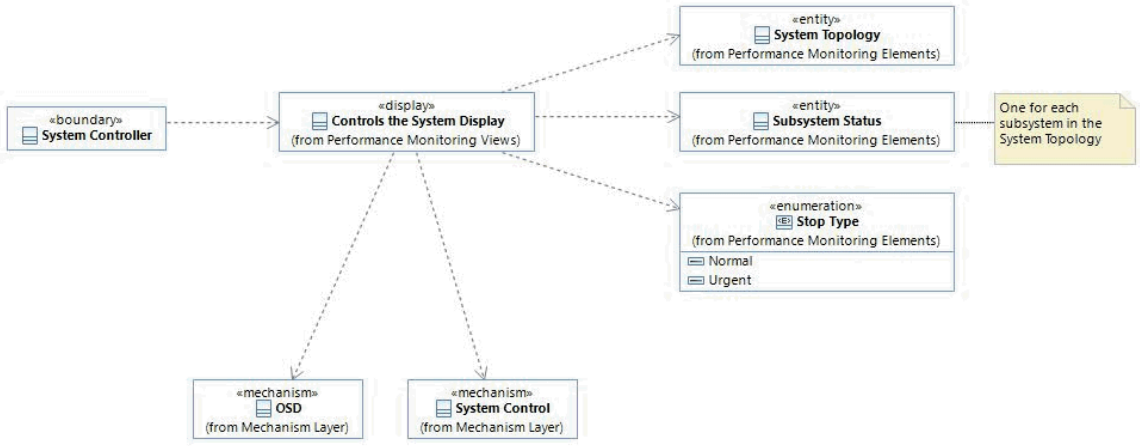
The System Controller controls the system via the "Controls the System Display". The display shows the System Topology, which defines the subsystems that fulfill the Primary and Backup roles, and the Subsystem Status of each subsystem in the topology. Using the display, the System Controller may start/stop either subsystem in the topology, transfer pipeline processing from Primary to Backup subsystem, start/stop individual processes on either subsystem, and shutdown workstations. To carry out these actions, the display uses the System Control mechanism. A separate instance of System Control runs on each subsystem in the topology.

Use Case Diagram



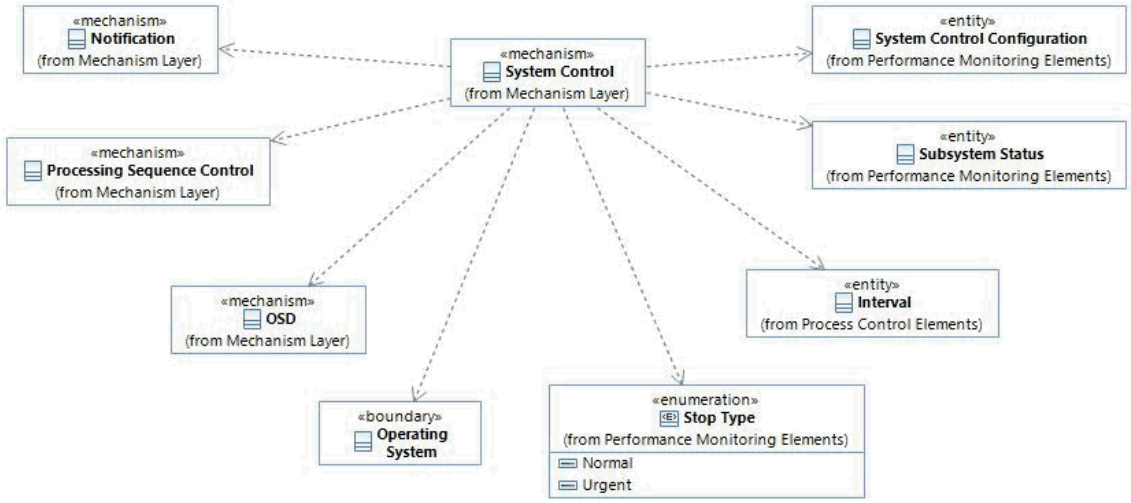
Class Diagrams

Classes - Controls the System Display



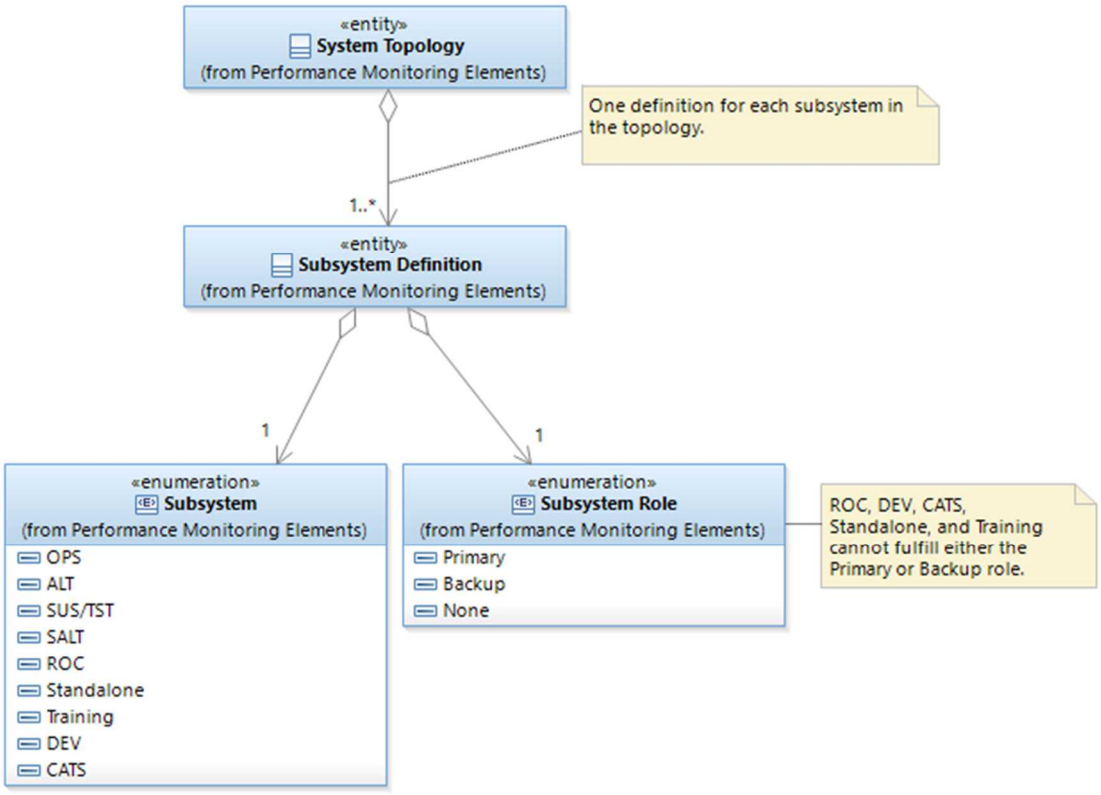
This diagram shows the "Controls the System Display" and related classes. The display is used by the System Controller to control the system and displays System Topology (obtained via OSD subscription) and Subsystem Status (obtained via System Control).

Classes - System Control



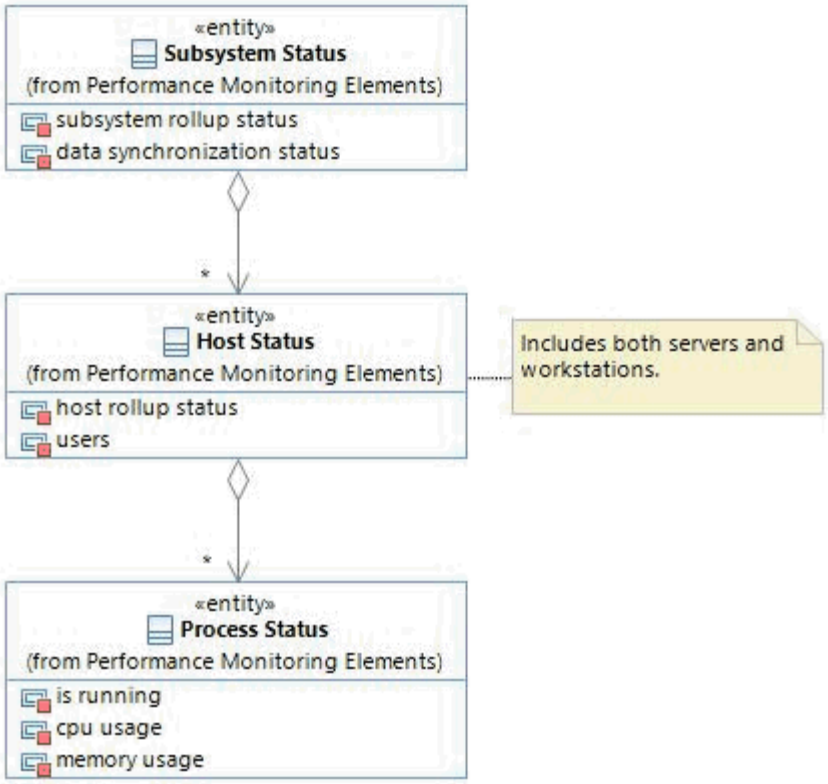
This diagram shows the System Control mechanism, which is responsible for starting and stopping primary and backup subsystems and individual processes. Separate instances of System Control run in each subsystem. System Control uses the Notification mechanism to notify users that subsystems are starting or stopping, uses the Processing Sequence Control mechanism to disable further automatic processing when stopping a subsystem, uses the OSD mechanism to subscribe for Intervals to determine when automatic processing has completed, and interacts with the Operating System to start/stop processes. System Control collects and distributes Subsystem Status to other System Control instances in the System Topology and uses the System Control Configuration to determine the list of processes that execute within a subsystem during different subsystem modes.

Classes - System Topology



This diagram shows the System Topology class and related classes. System Topology defines a group of related subsystems and the Primary/Backup mission roles currently designated for the subsystems.

Classes - Subsystem Status



This class shows the Subsystem Status class and related classes. Subsystem Status is determined by System Control.

Class Descriptions

<<boundary>> System Controller
Represents the System Controller actor.

<<entity>> Interval
Class for tracking the status of interactive or automatic processing on a specific timeframe of data. Specialized intervals exist for Processing Stage, Processing Activity, and Processing Sequence.

<<entity>> System Topology
Represents a collection of subsystems and each subsystem's current mission processing role.

<<mechanism>> Notification
Represents the mechanism to distribute messages to user(s). The mechanism filters which messages it delivers to each user and delivers messages to users at predefined frequencies. See "Views Messages" UCR for details on how users configure these preferences.

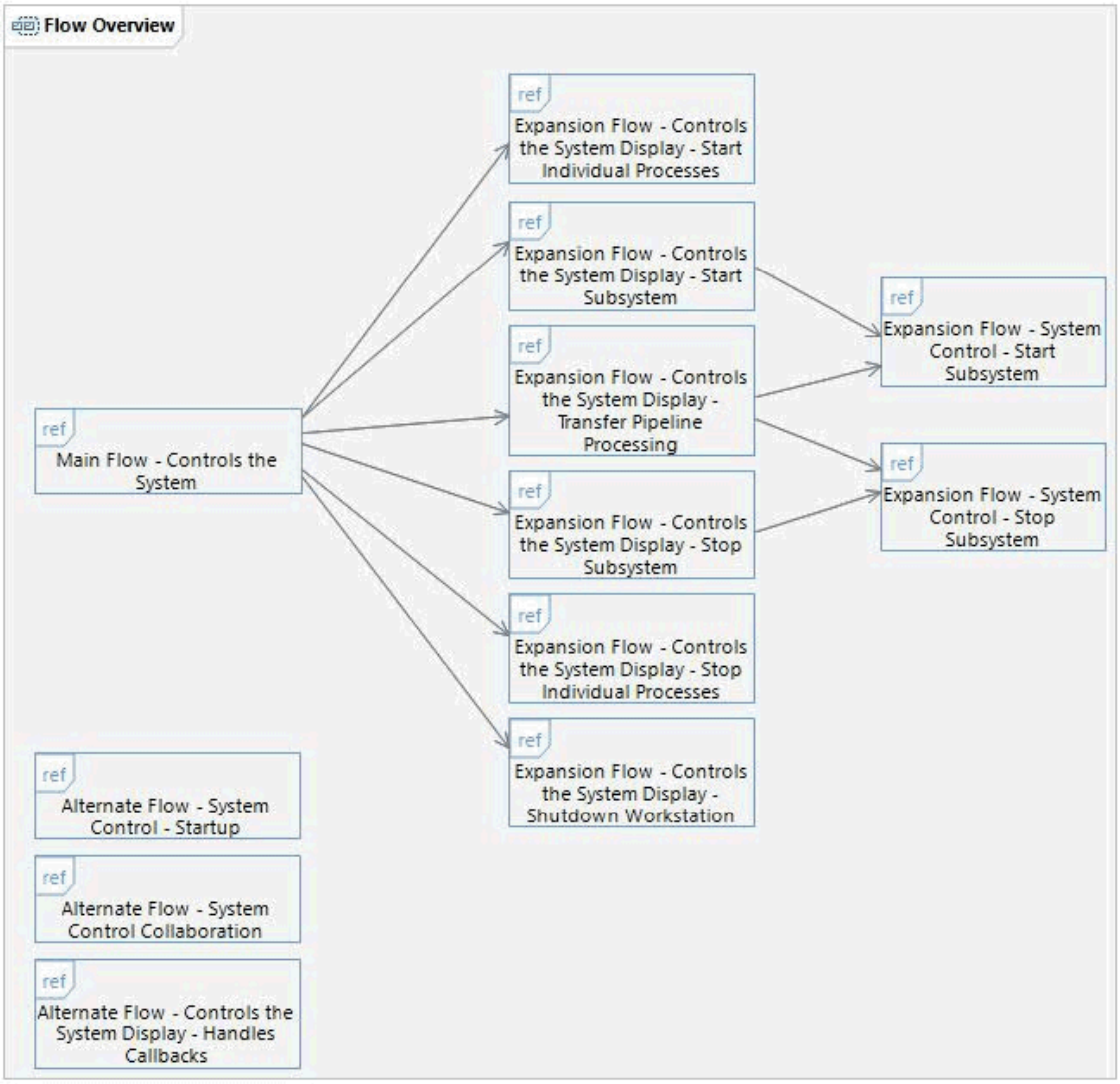
<<mechanism>> OSD
Represents the Object Storage and Distribution mechanism for storing and distributing data

objects internally within the system.

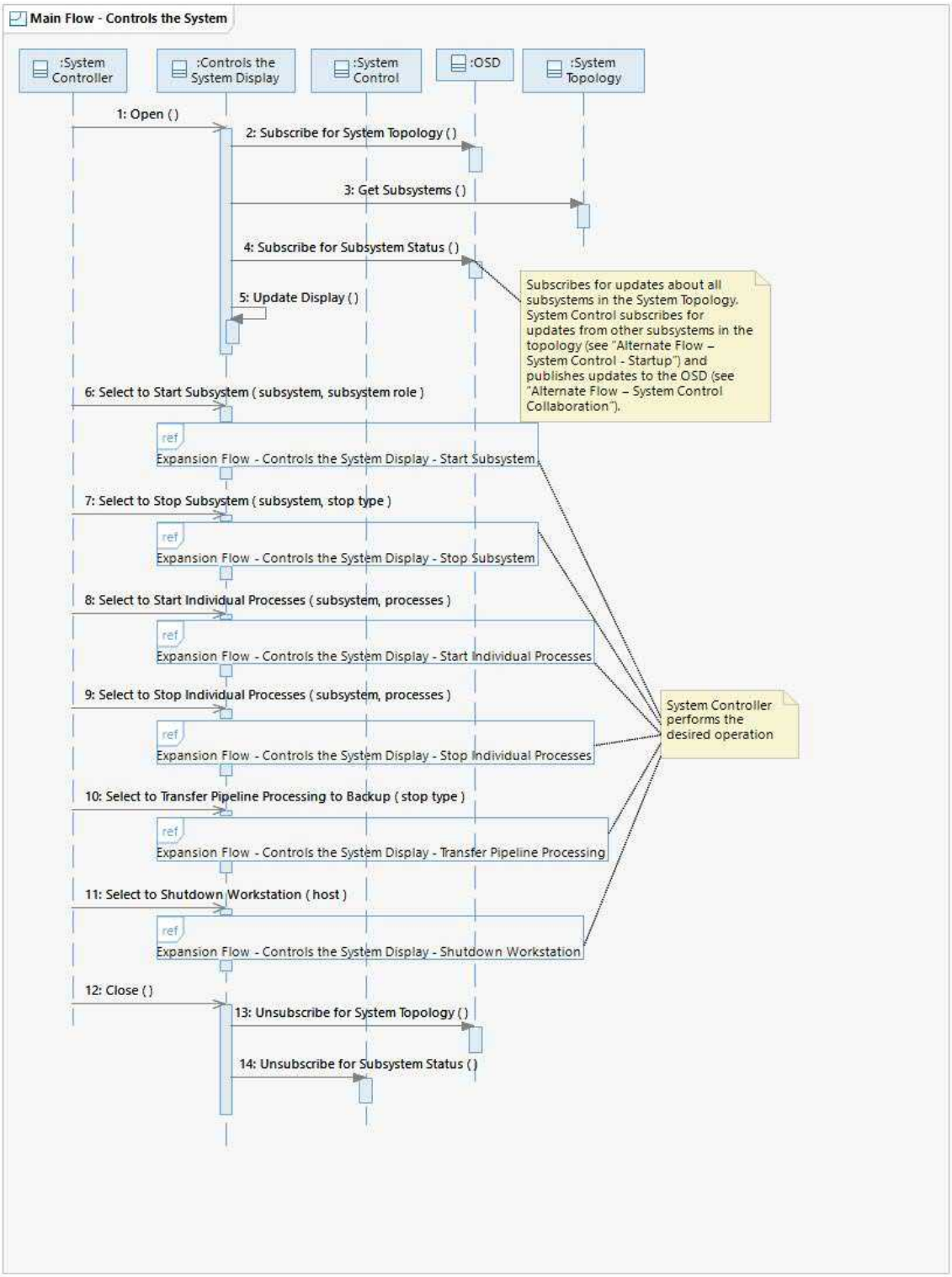
<<mechanism>> Processing Sequence Control
Mechanism for executing and controlling processing sequences configured by the System Maintainer.

Sequence Diagrams

Flow Overview



Main Flow - Controls the System

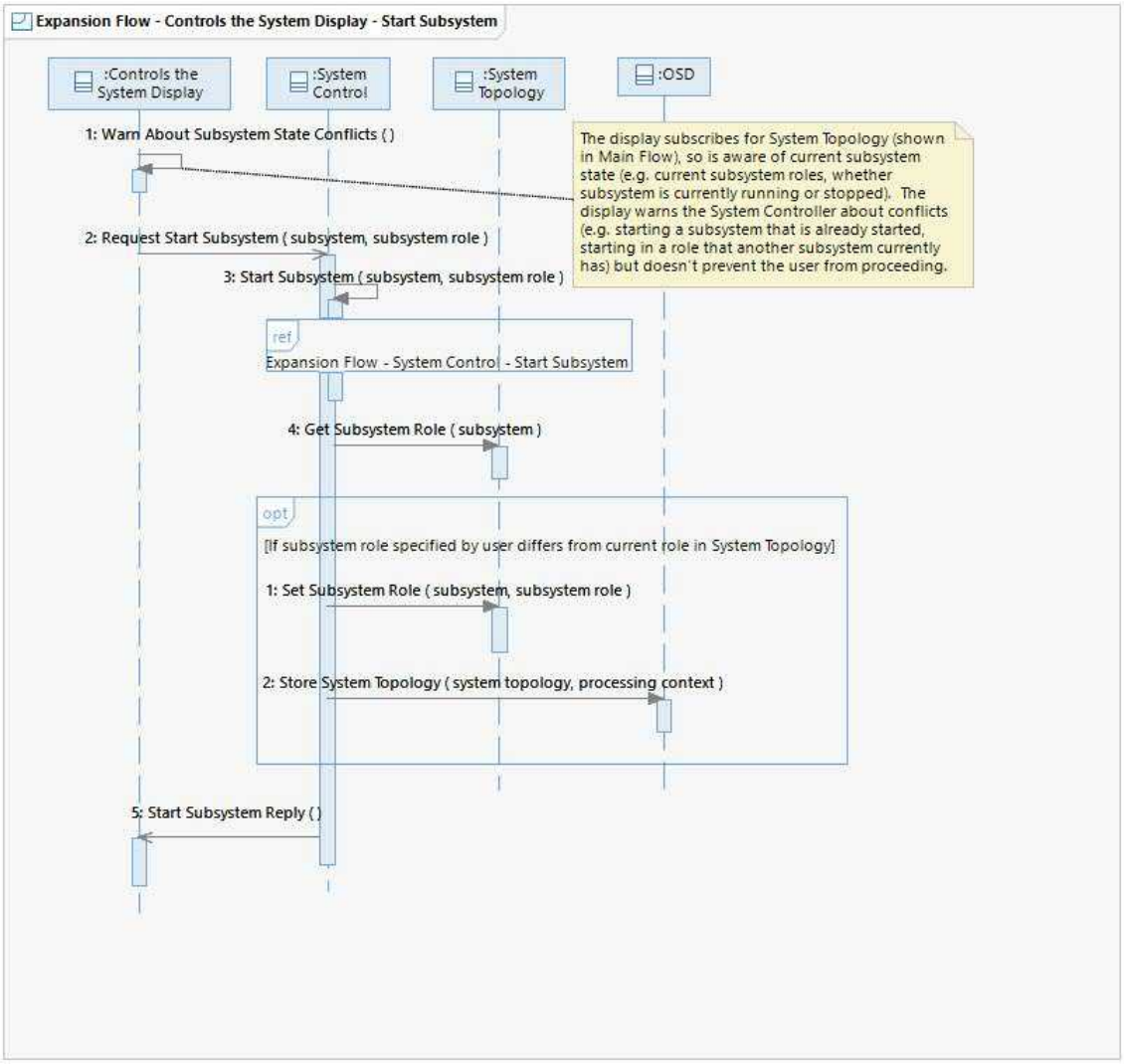


This diagram depicts the main flow. The System Controller controls the system via the "Controls the System Display". The display provides the ability to view the status of and control all subsystems in the System Topology.

Operation Descriptions

None

Expansion Flow - Controls the System Display - Start Subsystem

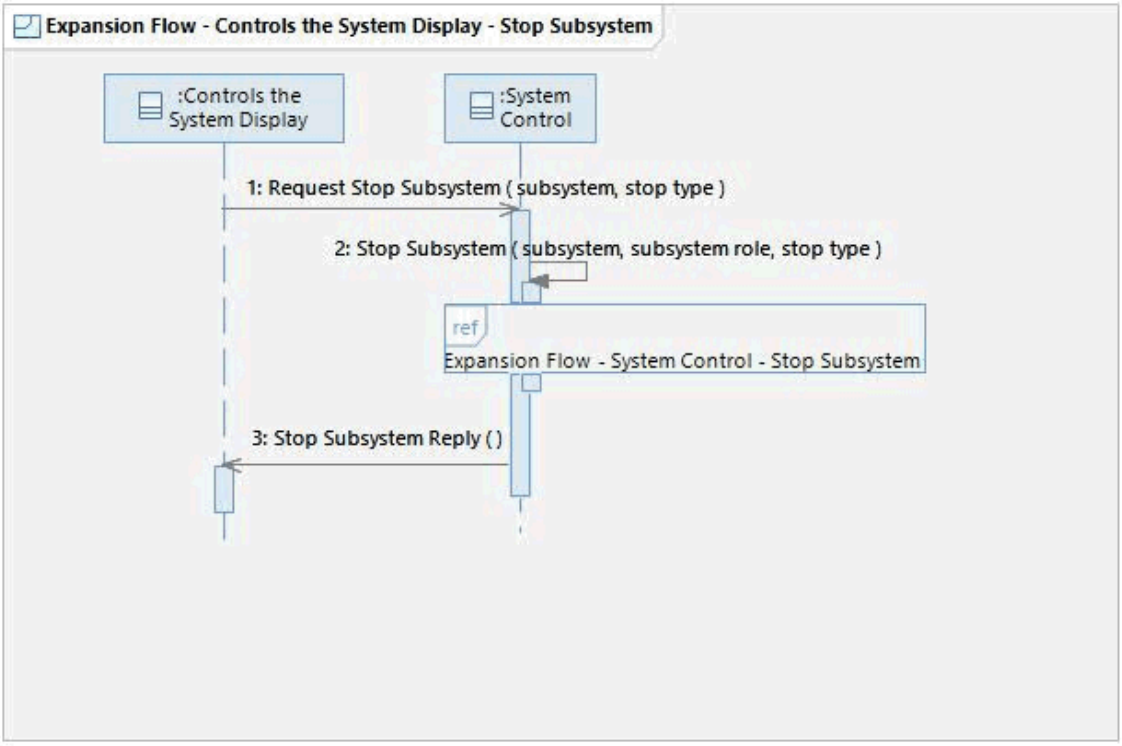


This flow shows how the Controls the System Display starts a subsystem. This flow receives the subsystem to start and the role for the subsystem to start up as (Primary, Backup, or None). The System Controller selects these values in the invoking flow. The display warns the System Controller and updates the System Topology if the specified role differs from the current System Topology.

Operation Descriptions

None

Expansion Flow - Controls the System Display - Stop Subsystem

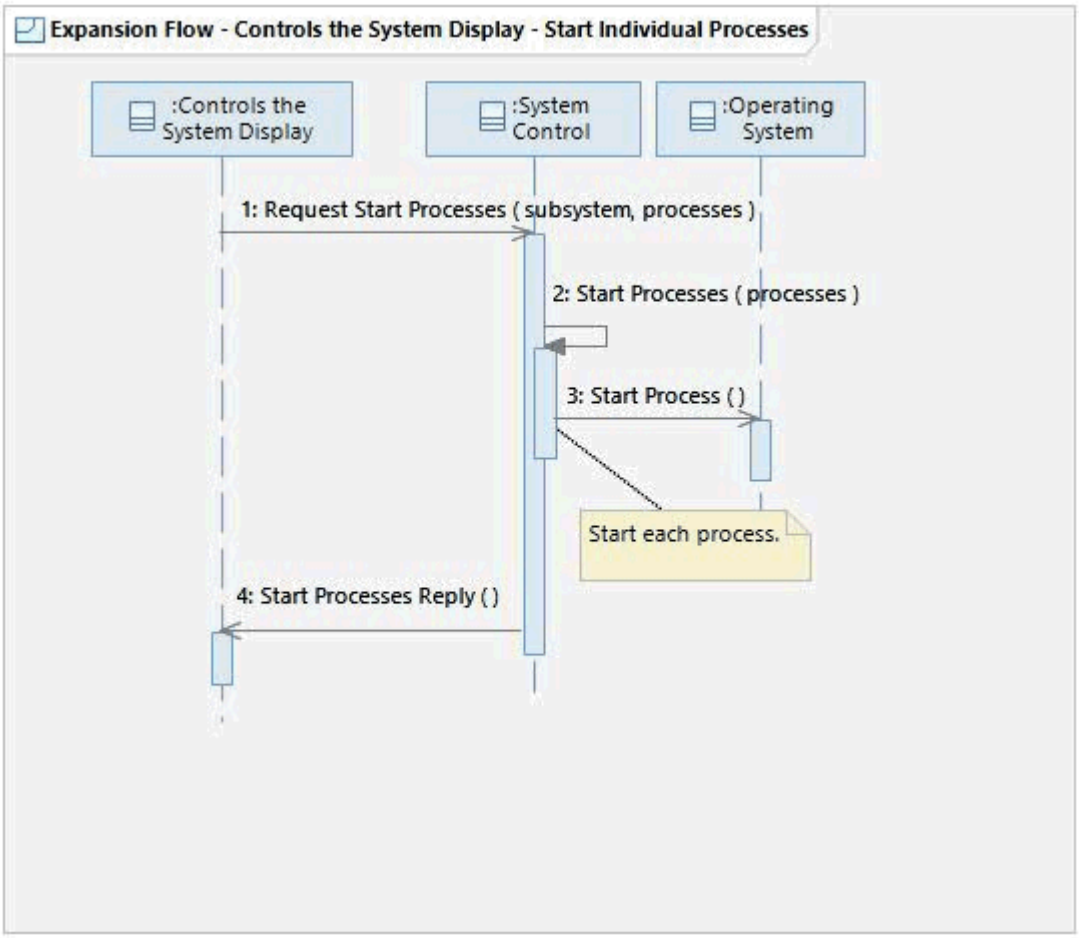


This flow shows how the Controls the System Display stops a subsystem. This flow receives the subsystem to stop and the stop type (Normal or Urgent). The System Controller selects these values in the invoking flow. The display requests the System Control mechanism to stop the subsystem. Note that stopping a subsystem does not affect the subsystem's role in the System Topology (Primary, Backup, or None).

Operation Descriptions

None

Expansion Flow - Controls the System Display - Start Individual Processes

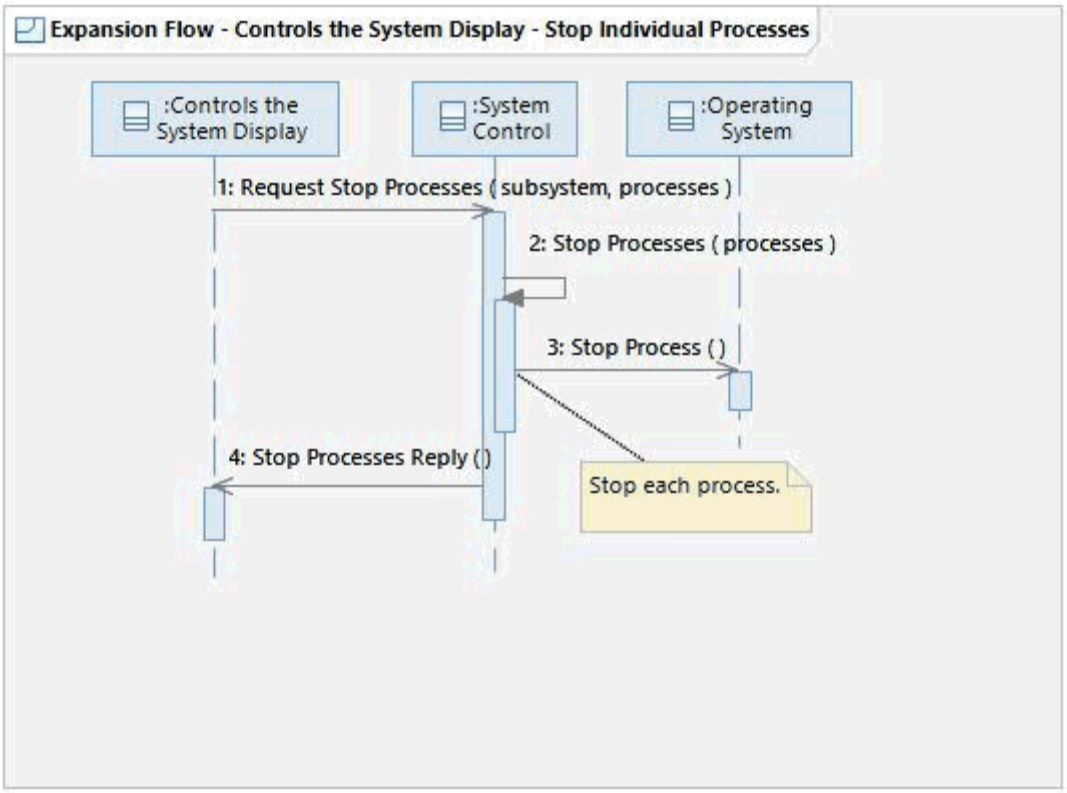


This flow shows how the Controls the System Display starts individual processes. This flow receives the processes to start and the Subsystem where the process should run. The System Controller selects these values in the invoking flow. This flow supports the case where a process that is expected to be running has crashed and needs to be restarted.

Operation Descriptions

None

Expansion Flow - Controls the System Display - Stop Individual Processes

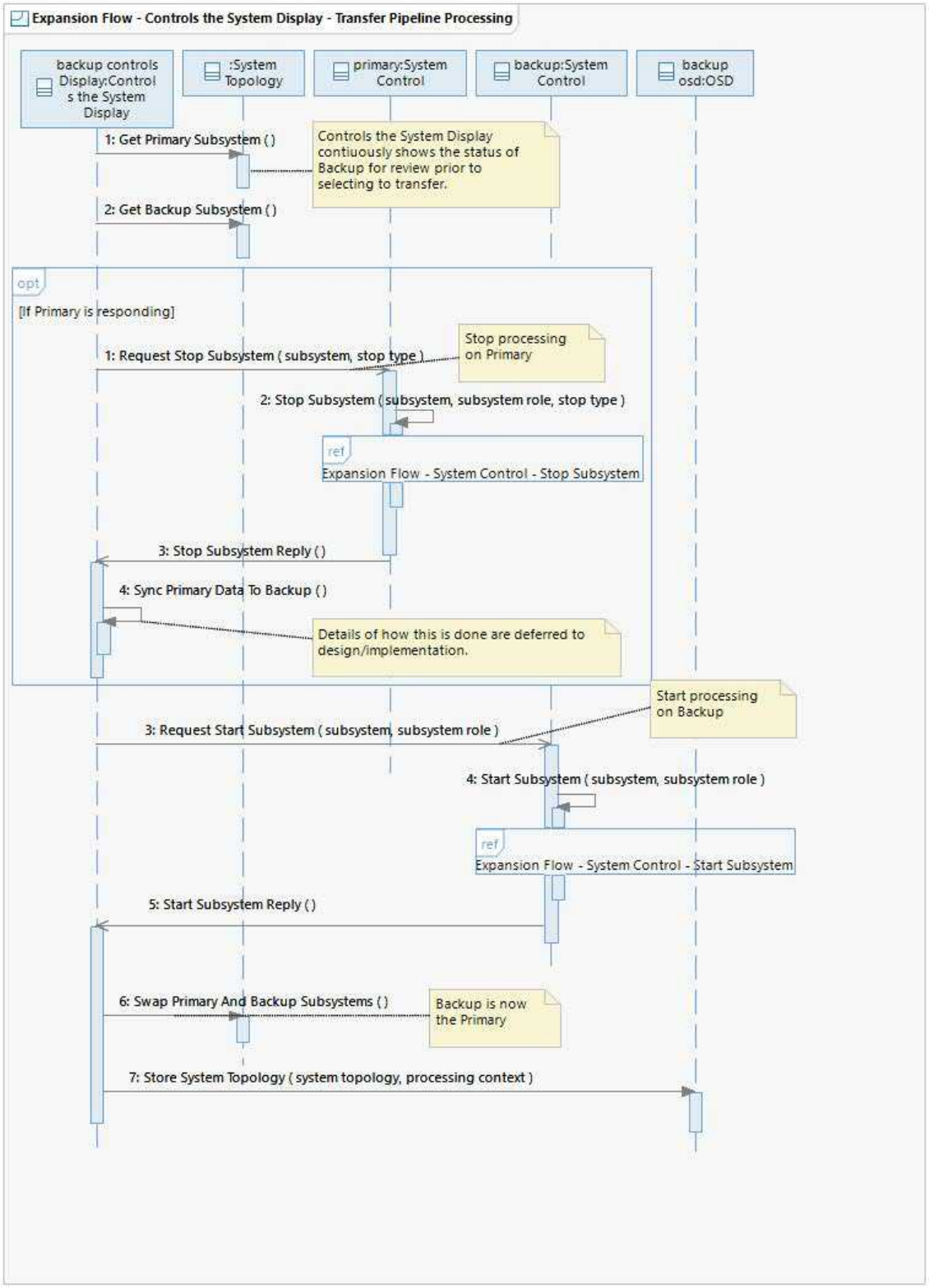


This flow shows how the Controls the System Display stops individual processes. This flow receives the process to stop and the Subsystem where the process is running. The System Controller selects these values in the invoking flow. This flow supports the case where a process is running but not functioning properly (e.g. non-responsive) and needs to be restarted.

Operation Descriptions

None

Expansion Flow - Controls the System Display - Transfer Pipeline Processing



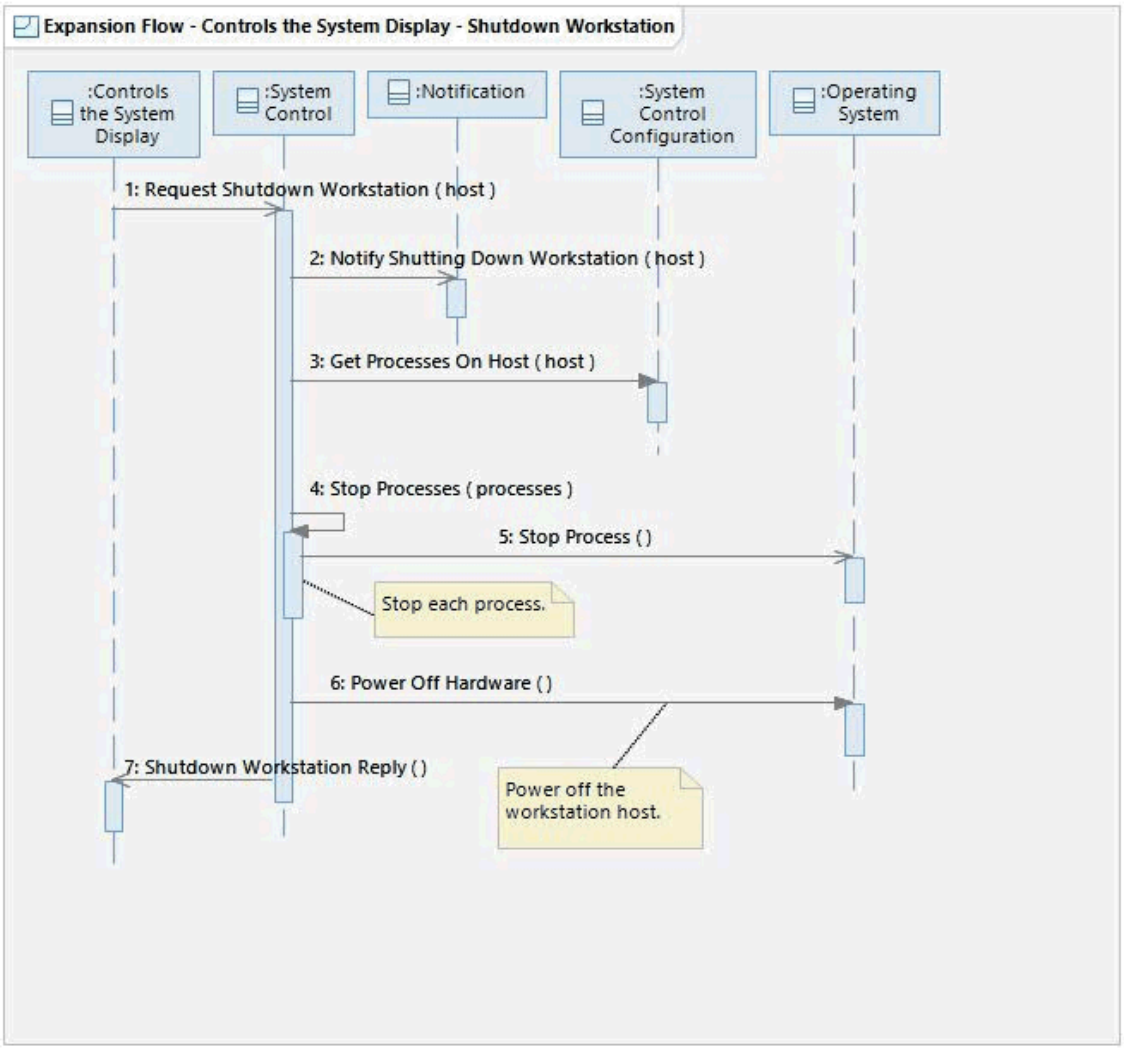
This flow shows how the Controls the System Display transfers pipeline processing from the

primary to the backup. This flow receives the stop type (Normal or Urgent) to use on the Primary. The System Controller selected this value in the invoking flow. The display coordinates the transfer, and uses System Control to start/stop processes on the primary and backup. At the conclusion this flow the backup becomes the primary (and vice-versa).

Operation Descriptions

None

Expansion Flow - Controls the System Display - Shutdown Workstation

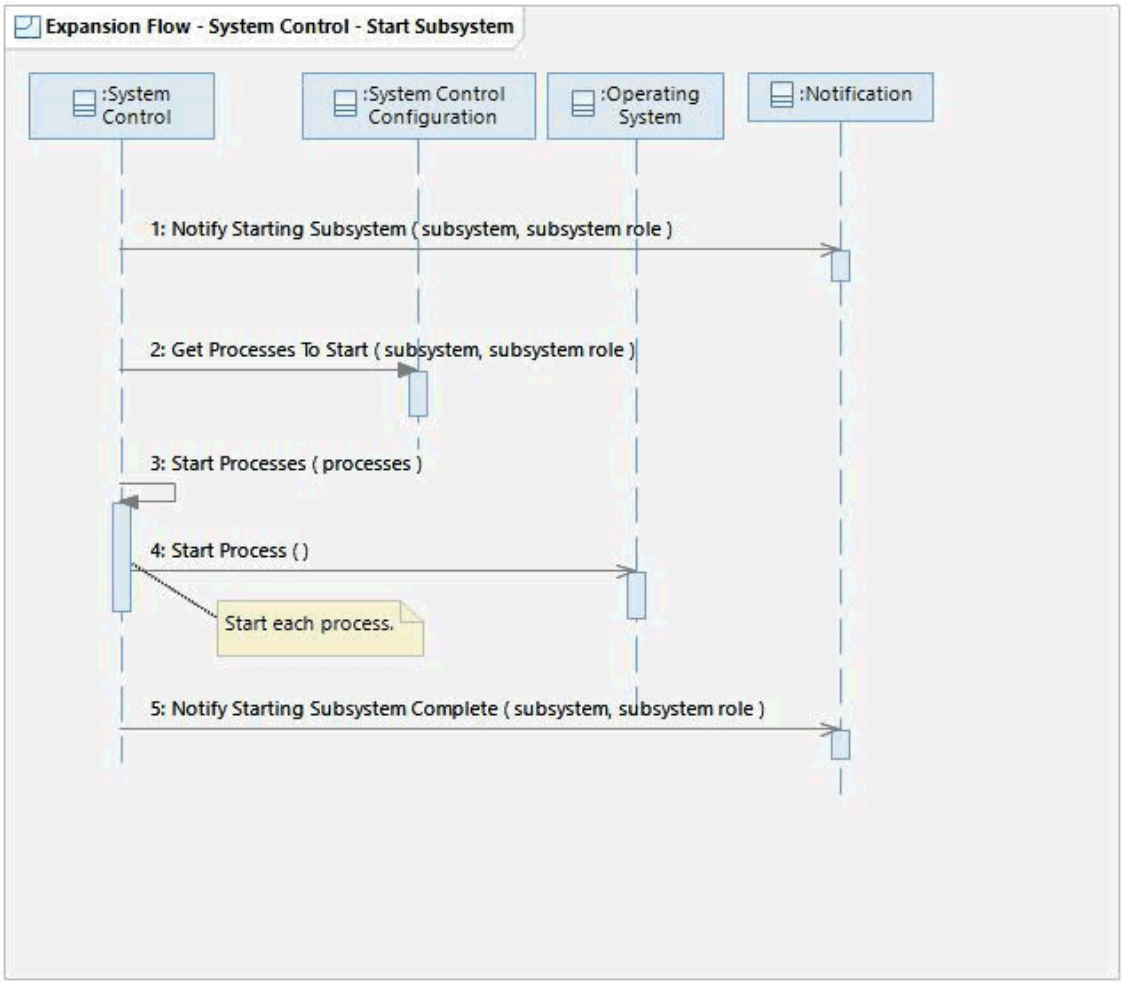


This flow shows how the Controls the System Display shuts down a workstation. This flow receives the workstation shutdown, which the System Controller selected in the invoking flow. System Control stops all the processes on the workstation and powers it off.

Operation Descriptions

None

Expansion Flow - System Control - Start Subsystem

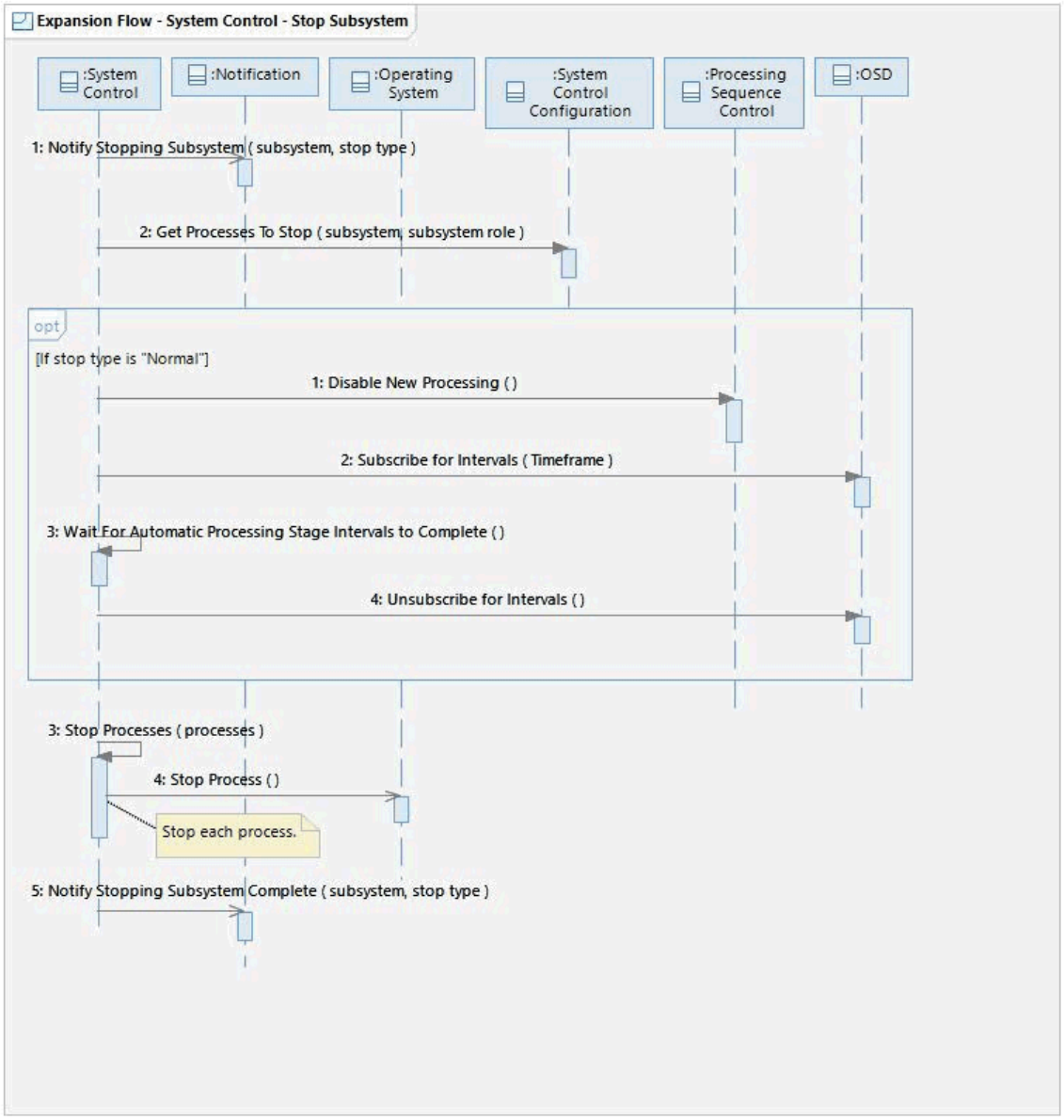


This flow shows how the System Control mechanism starts a subsystem. The subsystem and its current subsystem role (Primary, Backup, or None) are inputs to this flow.

Operation Descriptions

None

Expansion Flow - System Control - Stop Subsystem



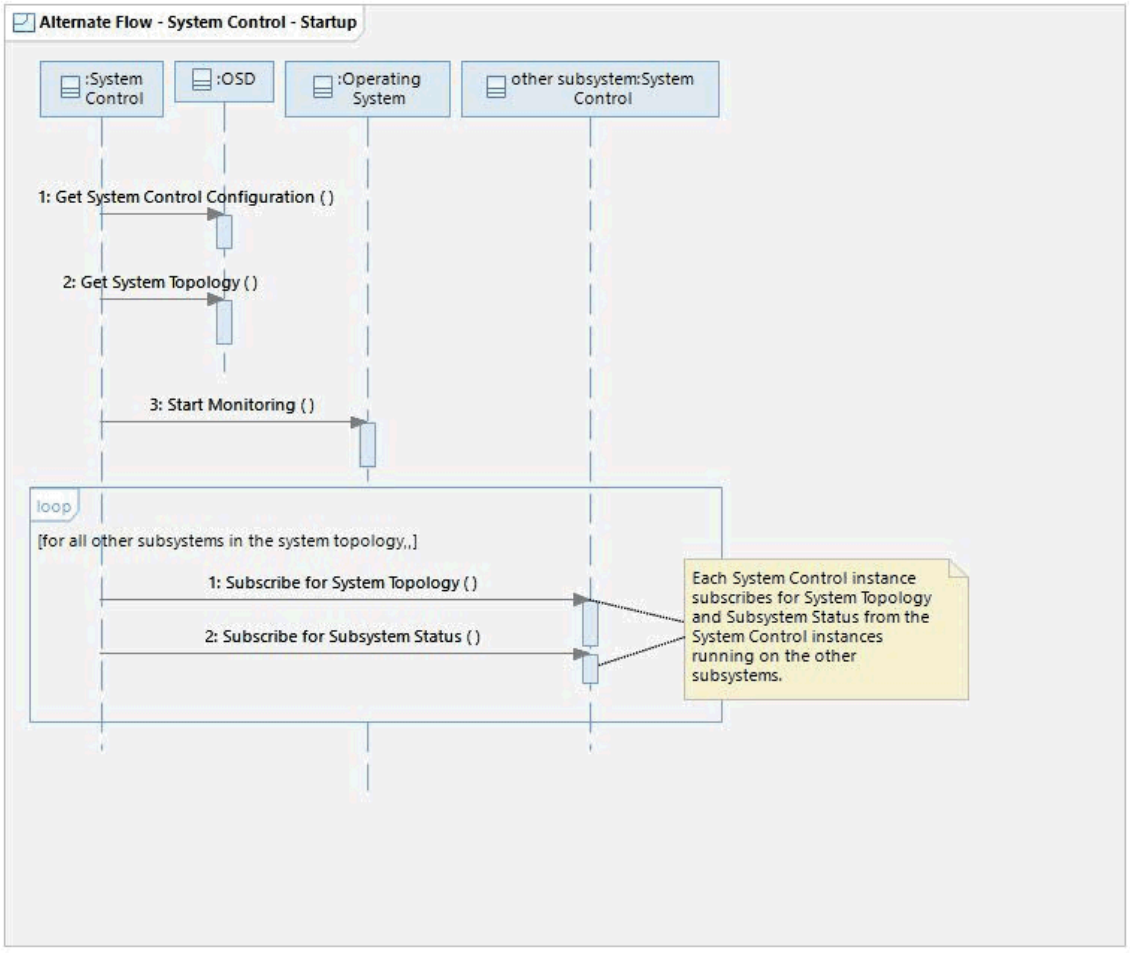
This flow shows how the System Control mechanism stops a subsystem. The subsystem, current subsystem role (Primary, Backup, None), and stop type (Normal or Urgent) are inputs to this flow.

Operation Descriptions

Operation: OSD::Subscribe for Intervals()

Subscribe for changes to Interval objects that overlap with the given timeframe. Interval objects track the active analysts and completion status of intervals corresponding to processing stages and processing activities within processing stages. Callbacks are invoked on subscribers any time the set of active analysts or completion status for an Interval changes.

Alternate Flow - System Control - Startup

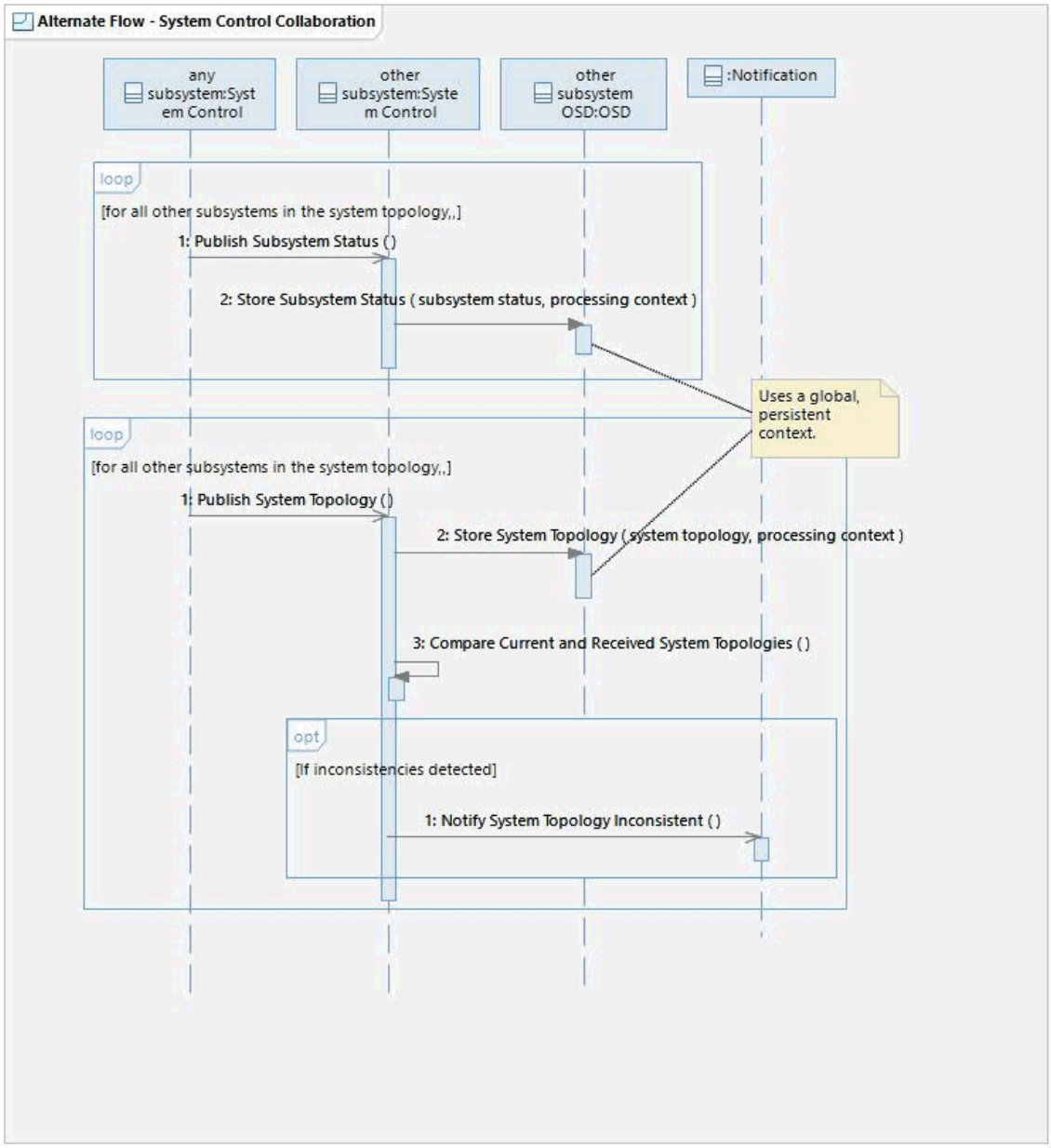


This flow shows actions performed by System Control when it first starts up. Each System Control instance in the topology subscribes for Subsystem Status and System Topology from the other instances.

Operation Descriptions

None

Alternate Flow - System Control Collaboration

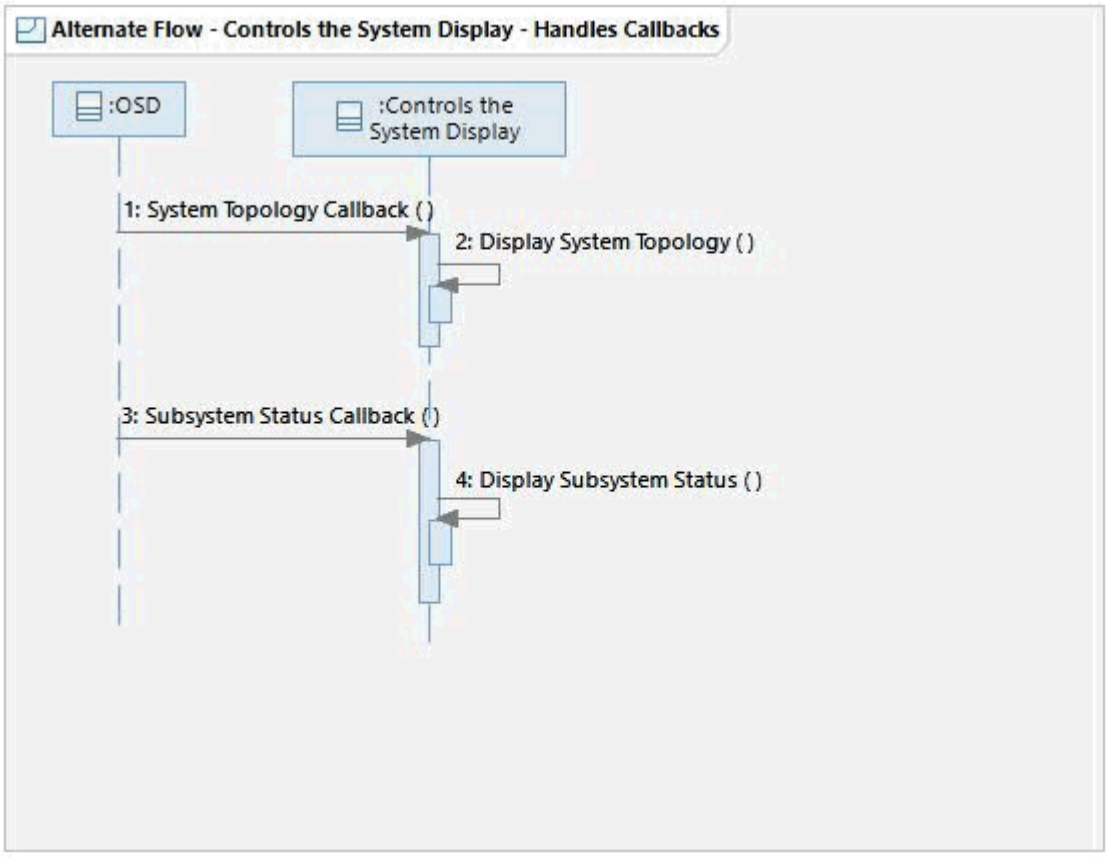


This flow shows how each subsystem in a system topology shares its Subsystem Status and System Topology with the other subsystems in the system topology. Each instance publishes its own Subsystem Status and System Topology and subscribes for the Subsystem Status and System Topology from the other subsystems. The System Controller is notified of inconsistencies between subsystems (e.g. if subsystems have different notions of the current System Topology).

Operation Descriptions

None

Alternate Flow - Controls the System Display - Handles Callbacks



This flow shows how the "Controls the System Display" handles callbacks. The display subscribes with the OSD for System Topology and displays it any time it changes. The System Topology indicates subsystem roles (Primary vs. Backup), which can change if the System Controller transfers pipeline processing between subsystems or starts a subsystem up in a new role. The display also subscribes with the OSD for Subsystem Status and dynamically displays it any time it changes. Subsystem Status indicates whether a subsystem is started or stopped as well as detailed information for individual hosts and processes. System Control subscribes for Subsystem Status and System Topology updates from all subsystems in the topology. When it receives callbacks from the other subsystems (see "Alternate Flow – System Control Collaboration") System Control stores the updated information in the OSD, triggering callbacks to Controls the System Display. System Control also publishes local system topology and subsystem status updates to the OSD which trigger callbacks to Controls the System Display.

Operation Descriptions

None

State Machine Diagrams

None

SSD Mappings

General:

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

S-2250: [*Threshold*] The System shall provide the System Controller the capability to remotely operate the Primary from the Backup.

S-2251: [*Threshold*] The System shall provide the System Controller the capability to remotely operate the Backup from the Primary.

S-2288: [*Threshold*] The System shall provide the System Controller the capability to perform a planned shutdown of the System.

S-2289: [*Threshold*] The System shall provide the System Controller the capability to perform a startup of the System.

S-2290: [*Threshold*] The System shall complete a planned shutdown within 30 minutes of its initiation.

S-2291: [*Threshold*] The System shall provide the System User the capability to shutdown individual analyst workstations without affecting the operation of other analyst workstations.

S-2292: [*Threshold*] The System shall provide the System User the capability to startup individual analyst workstations without affecting the operation of other analyst workstations.

S-2293: [*Threshold*] The System shall provide the System Controller the capability to perform an urgent shutdown of the System.

S-2294: [*Threshold*] The System shall complete an urgent shutdown within 15 minutes of its initiation.

S-2295: [*Threshold*] The System shall provide the System Controller the capability to start processes.

S-2296: [*Threshold*] The System shall provide the System Controller the capability to stop processes.

S-2297: [*Threshold*] The System shall provide the System Controller the capability to initiate and terminate system processing.

S-2567: [*Threshold*] The System shall be operational within one hour of a hardware restart.

S-2568: [*Threshold*] The System shall be operational within 30 minutes of a software restart.

S-5885: [*Threshold*] The System shall complete a planned switch between the Primary and Backup with no loss of data or data consistency.

S-5887: [*Threshold*] The System shall provide the System Controller the capability to initiate a switch between the Primary and Backup.

IDC Specific:

S-5886: [*Threshold*] The System shall provide station data to external users in no more than one (1) hour following an unplanned switch between the Primary and Backup.

S-5888: [*Threshold*] The System shall initiate the automatic processing of waveform data in no more than six (6) hours from the start of an unplanned switch between the Primary and Backup.

S-5889: [*Threshold*] The System shall provide the Analyst the capability to perform interactive reviews of processing results in no more than six (6) hours from the start of an unplanned switch between the Primary and Backup.

S-5890: [*Threshold*] The System shall provide the System Controller the capability to disseminate data and products in no more than six (6) hours from the start of an unplanned switch between the Primary and Backup.

Notes

General:
1. The system is composed of multiple System Topologies (e.g. OPS/ALT/ROC, SUS/SALT). The System Controller performs this use case separately for each System Topology.

2. The subsystems within a topology may have varying abilities to view and control the status of other subsystems in the topology. For example, a System Controller on the DEV subsystem may be able to monitor the status of the OPS subsystem but not control it whereas the System Controller on OPS does not see the status of DEV or control or control DEV.

3. The System Topology is displayed to the System Controller to provide awareness of which subsystems within the System Topology are currently fulfilling the Primary and Backup roles. Nominally, only one of the subsystems should be fulfilling a given role at any given point in time, however the System does not enforce that rule. In cases where the System cannot definitively determine the roles (e.g. due to loss of connectivity between subsystems) or the roles become inconsistent (e.g. multiple subsystems in the topology think they are the Primary), the System Controller is responsible for bringing the topology back into a consistent state (e.g. by stopping one of the subsystems and starting it in the correct role, etc.)

4. Each subsystem in a System Topology has a separate OSD and the OSD data is synchronized

within the topology. See "System Synchronizes Acquired Station Data" UCR and "System Synchronizes Processing Results" UCR for more details of how this is accomplished.

5. User workstations are associated with a System Topology, not individual subsystems. Users may configure display software running on workstations to interact with any subsystem in the topology.

6. Users may subscribe for notifications from any of the subsystems in a System Topology (see "Views Messages" UCR).

7. Processes related to the OSD mechanism, Notification mechanism, System Control mechanism and the Controls the System Display itself are controlled outside the scope of this use case (e.g. via OS boot scripts, etc.) since they are needed in order to support controlling the system.

IDC Specific:
1. The IDC consists of the following Subsystems: OPS, ALT, Training, Standalone, DEV, SUS/TST, CATS.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