SAND2015-4473R

Use Case Realization Report
UCR-03.02.08 Compares Events

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1 Use Case Description

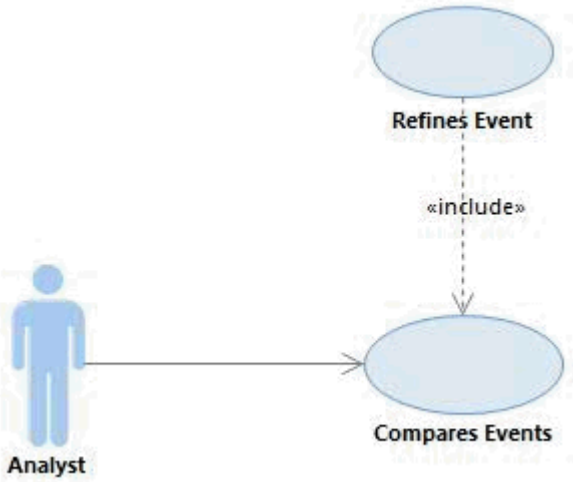
This architecturally significant use case describes how the Analyst compares events to determine how similar events were constructed. The Analyst compares waveforms from comparison events by visually inspecting an overlay of the waveforms to determine if the events are from a similar source. The Analyst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

This use case is architecturally significant due to the introduction of the capability to compare events within an operational context.

2 Architecture Description

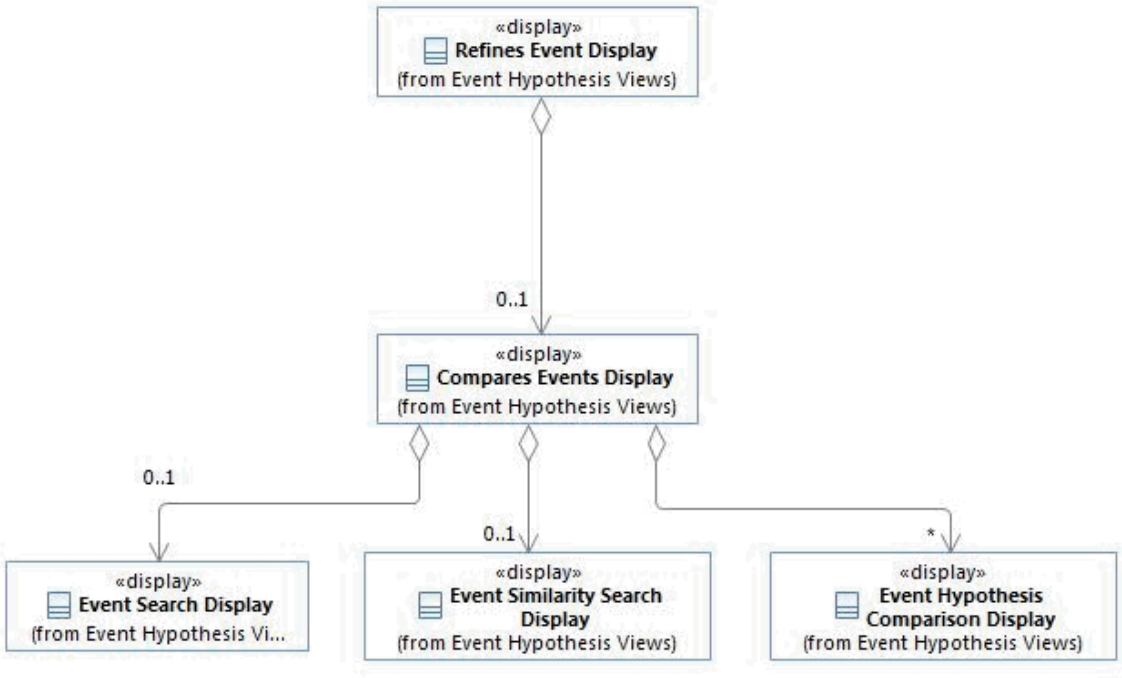
The Analyst opens the Compares Events Display from the Refines Events Display to compare the Event under refinement to other Events. The Analyst selects to search for Events using the Event Search Display and Event Similarity Search Display. The Analyst uses these Displays to select and populate a list of Events in the Compares Events Display to compare against. The Analyst compares multiple Event Hypotheses against the Event under refinement using the Event Hypothesis Comparison Display.

3 Use Case Diagram



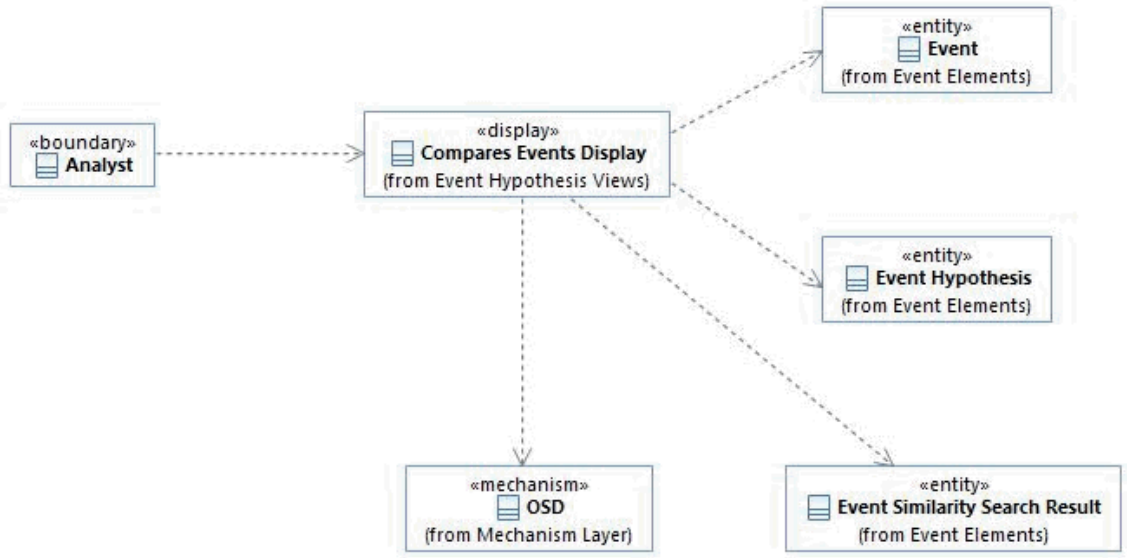
4 Class Diagrams

4.1 Classes - Displays



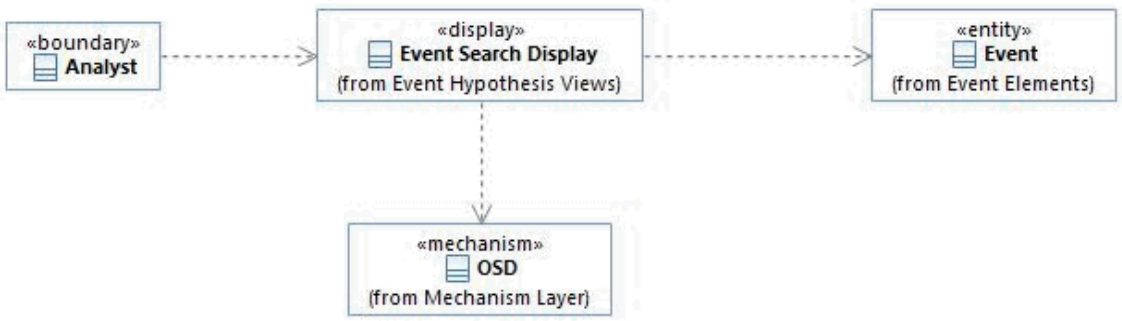
This diagram shows the display classes for selecting, viewing, and comparing Events and Event Hypotheses. The Analyst selects to compare Events from the Refines Events Display. The Analyst uses the Compares Events Display to initiate event searches and event comparisons. The Analyst uses the Event Search Display and the Event Similarity Search Display to find and select Events for comparison. The Analyst uses the Event Hypothesis Comparison Display to compare multiple Event Hypotheses.

4.2 Classes - Compares Events Display



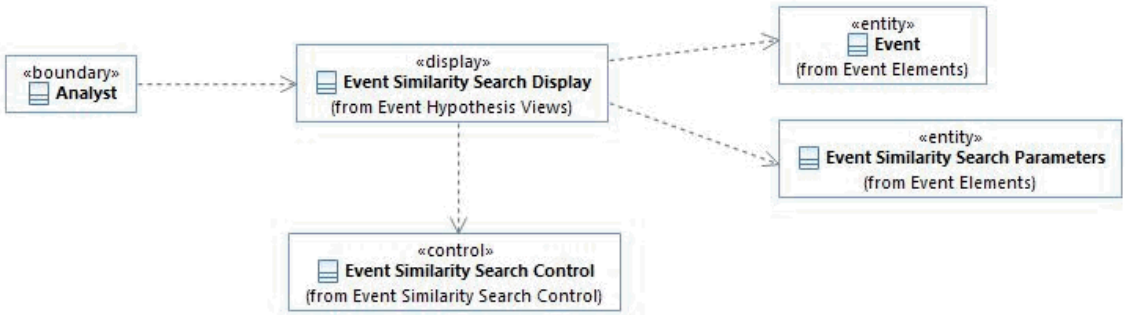
This diagram shows the Compares Events Display and its related classes. The Compares Events Display will populate a list of Events from a retrieved list of Event Similarity Search Results associated to the Event under refinement. The Analyst will use the Compares Events Display to search for Events to further populate this list, and to select Event Hypotheses to compare to the Event under refinement.

4.3 Classes - Event Search Display



This diagram shows the Event Search Display. The Analyst uses the Event Search Display to find and select Events from the OSD by providing parameters for the OSD to query and compare Events against. An example of these parameters might be Events in a given area of the world for a given start and end time.

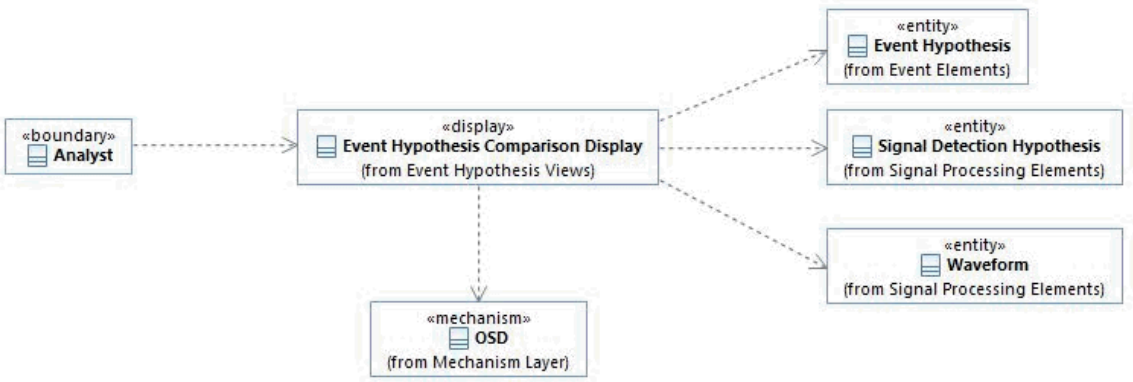
4.4 Classes - Event Similarity Search Display



This diagram shows the Event Similarity Search Display and its related classes. The Analyst uses the Event Similarity Search Display to find and select similar Events using the Event Similarity Search Control. The Event Similarity Search Control uses waveform correlation to find similar Events to the Event under

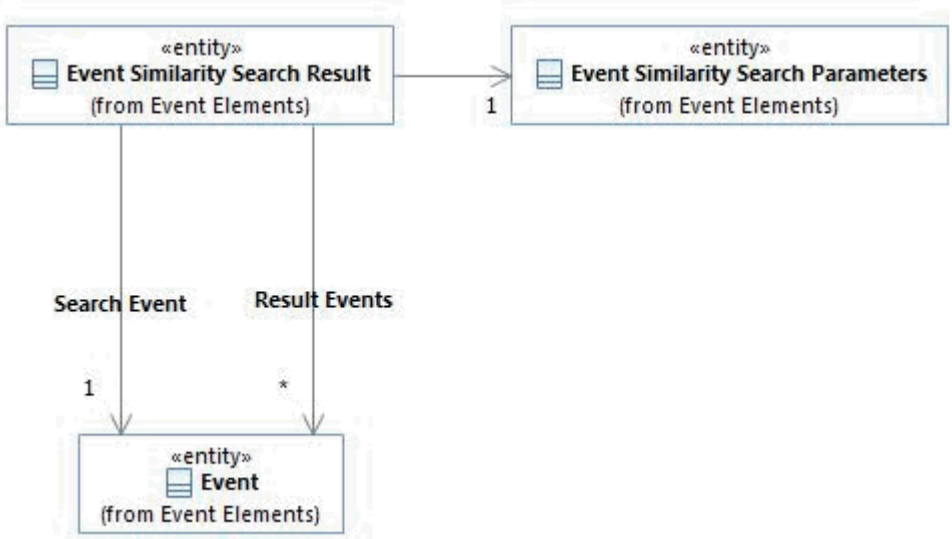
refinement. The Event Similarity Search Display will visualize the correlated Events using a dendrogram created by agglomerative hierarchical clustering, where the Analyst selects the clustering distance algorithm and any associated parameters or weights. The final resultant Events are determined by a distance threshold selected by the Analyst.

4.5 Classes - Event Hypothesis Comparison Display



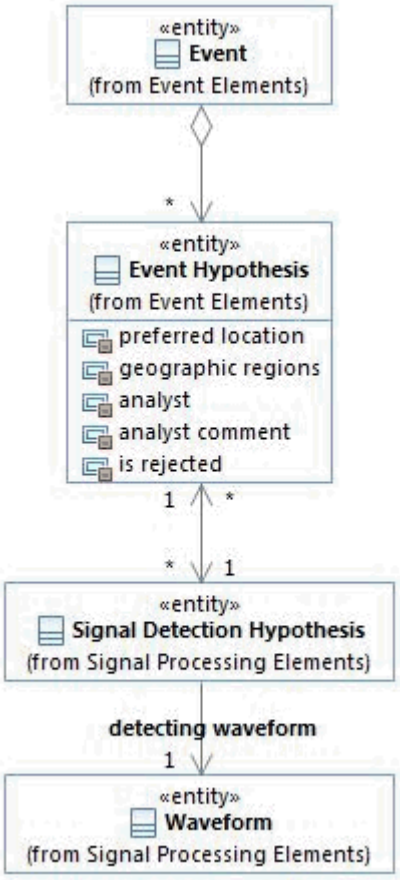
This diagram shows the Event Hypothesis Comparison Display. The Analyst uses the Event Hypothesis Comparison Display to compare and overlay waveforms and signal detections from a primary Event Hypothesis against those from a set of other Event Hypotheses.

4.6 Classes - Event Similarity Search Result



This diagram shows the Event Similarity Search Result and its related classes. The Event Similarity Search Result contains a set of event similarity search parameters, the primary Event searched against, and a list of result Events that met the criteria of the search parameters. The Compares Events Display will retrieve Event Similarity Search Results in order to pre-populate the Compares Events Display with a list of known similar Events to compare against.

4.7 Classes - Event



This diagram shows Event and related classes used by the Event Hypothesis Comparison Display for comparison. While other related values from an Event Hypothesis are immediately accessible for comparison, Signal Detection Hypotheses and Waveforms must be retrieved from the OSD during initialization of the Event Hypothesis Comparison Display.

5 Class Descriptions

<<boundary>> Analyst
Represents the Analyst actor.

<<display>> Refines Event Display
Display that provides the Analyst with the ability to refine an event. Each saved refinement of the event results in a new Event Hypothesis.

<<entity>> Event
Represents information about an Event. Keeps track of all the Event Hypotheses for the event, which hypothesis is the preferred one for each processing stage, the active analysts for the event (i.e. whether the event is under "active review"), whether the event is "complete" for each processing stage, and other event-related information.

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

<<entity>> Event Similarity Search Parameters
Represents the set of parameters used by the Event Similarity Search Control to search for similar Events. These parameters include the type of search performed, and all parameters necessary for that search to operate.

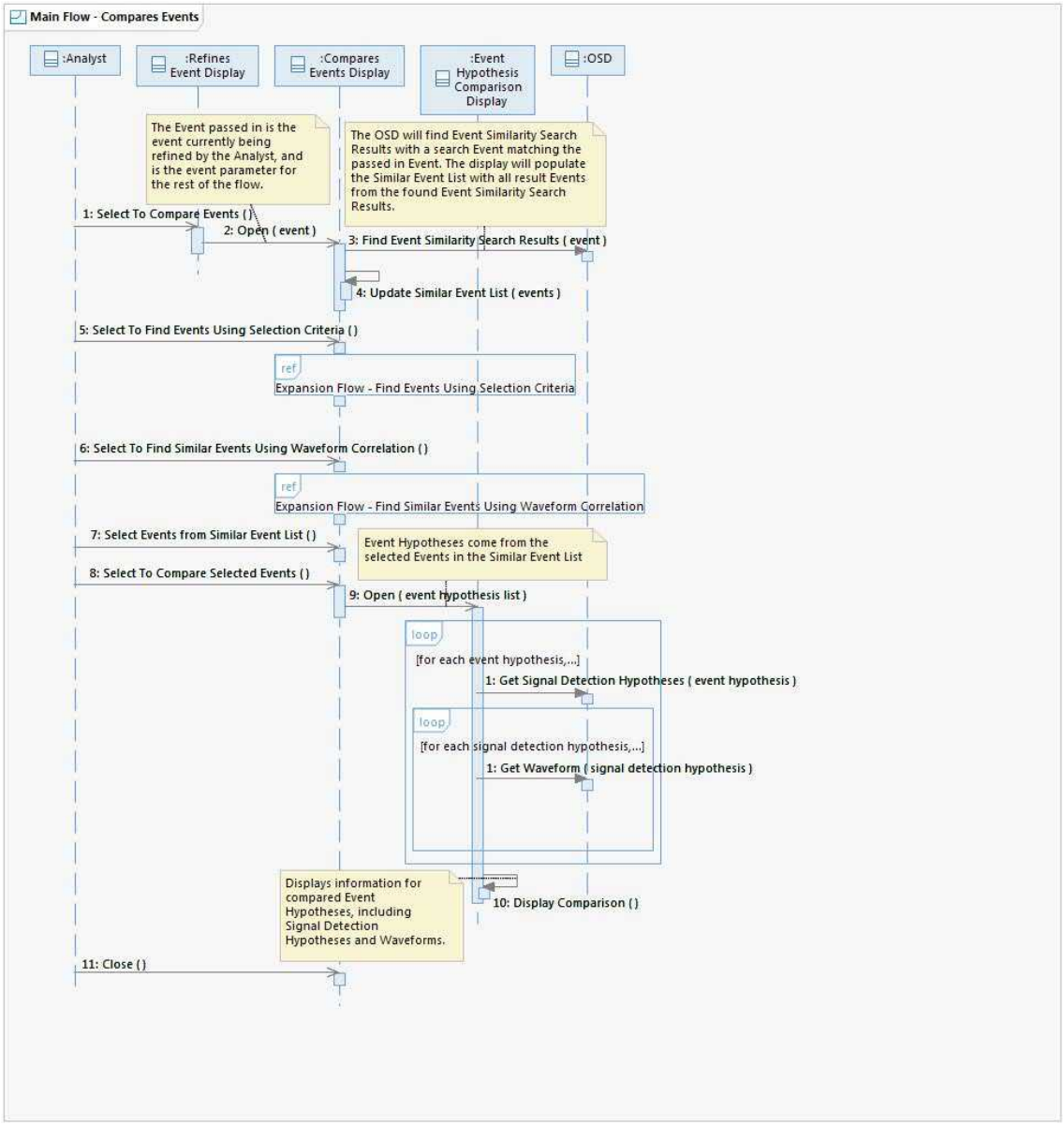
<<entity>> Event Similarity Search Result
Entity that describes a search for Events similar to a provided Event. Stores the Event searched against, the parameters used to search against the Event, and the resulting Events meeting the search criteria described by the parameters.

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

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

6 Sequence Diagrams

6.1 Main Flow - Compares Events

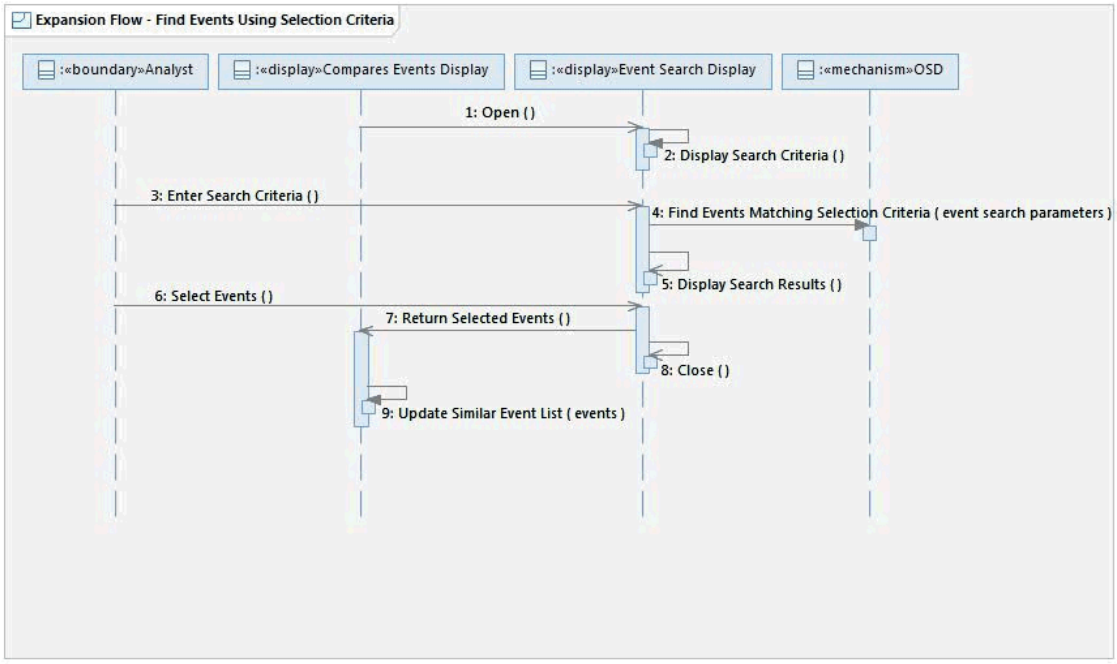


This flow shows how the Analyst interacts with the Compares Events Display. The Analyst will search for and select Events to display and compare with the Event under refinement.

6.1.1 Operation Descriptions

None

6.2 Expansion Flow - Find Events Using Selection Criteria

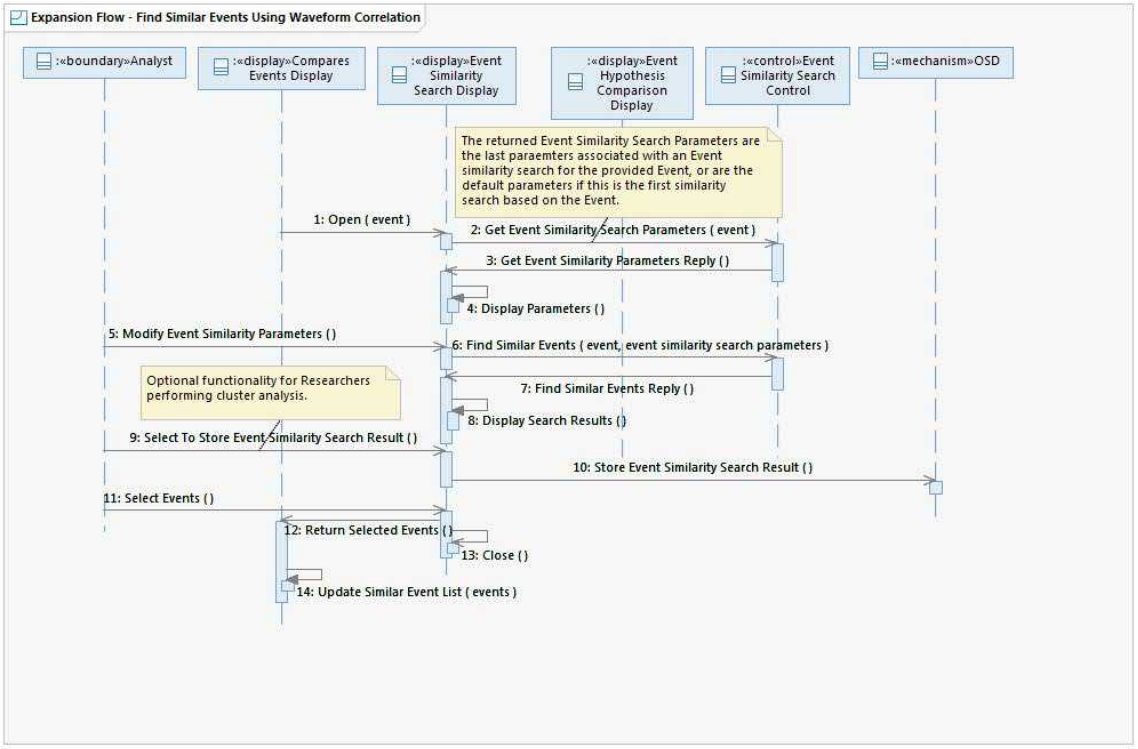


This flow shows how the Analyst interacts with the Event Search Display. The Analyst searches for and selects Events using specified selection criteria, and populates the Compares Events Display with the selected Events.

6.2.1 Operation Descriptions

None

6.3 Expansion Flow - Find Similar Events Using Waveform Correlation



This flow shows how the Analyst interacts with the Event Similarity Search Display. The Analyst searches for and selects Events using waveform correlation, and populates the Compares Events Display with the selected Events.

6.3.1 Operation Descriptions

None

7 State Machine Diagrams

None

8 SSD Mappings

The following SSDs are mapped to this use case:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

S-2111: [*Threshold*] The System shall provide the System User the capability to compare two event bulletins for signal detection characteristics of two event hypotheses.

S-2112: [*Threshold*] The System shall provide the System User the capability to compare two event bulletins for the characteristics of two event hypotheses.

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

9 Notes

The Analyst has the capability to map signal detections and their phase assignments from one channel to another in the Event Hypothesis Comparison Display.

10 Open Issues

None

11 Change History

1. E3 Iteration Review (03/31/15) - Fully Described
    a. Initial version
2. E3 Iteration Review (04/09/15) - Fully Described
    a. Changes made per previous review.
3. E3 Iteration Review(04/27/15) - Reviewed
    a. Moved sequences involving finding events into expansion flows to free up space.
    b. Added option for Analyst to store an Event Similarity Search Result from the Event Similarity Search Display.
    c. Added note specifying the Analyst's ability to map signal detections in the Event Hypothesis Comparison Display.