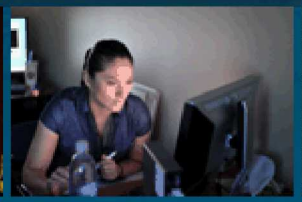
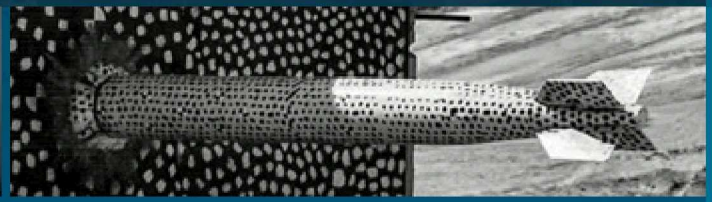
SAND2019-1693PE

Geophysical Monitoring System (GMS)
Conceptual Data Model Overview and Status Update





PRESENTED BY

Chris Young

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Outline

- Data Model Motivation and Process
- Overview of Conceptual Data Model Document
- Station Reference Information
- Data Acquisition Configuration
- Processing Configuration
- Processing Results

DATA MODEL MOTIVATION AND PROCESS

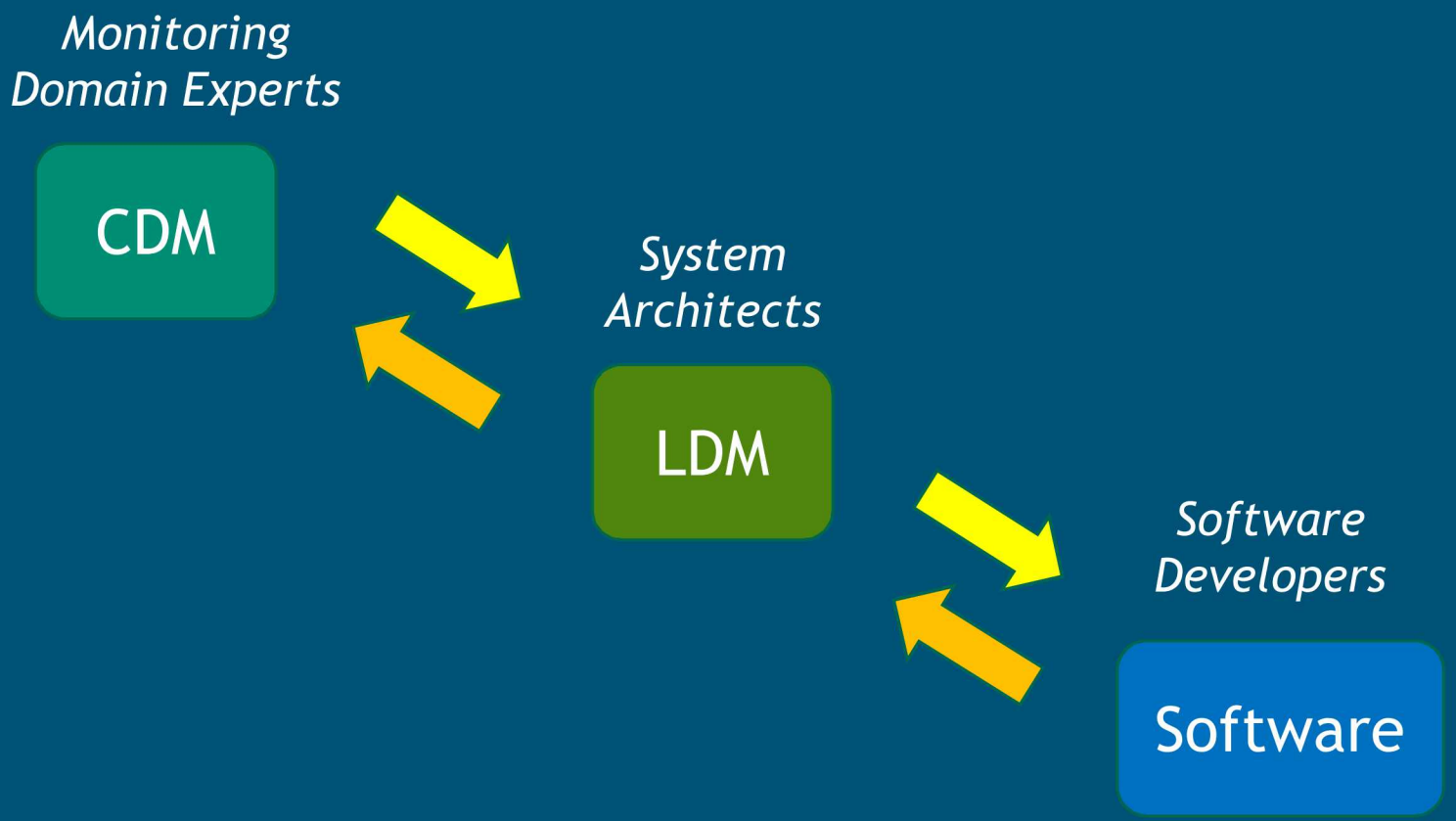
Why A Data Model?

- The GMS is fundamentally about ingesting and transforming data.
- Data must be passed around within the System and to and from Users that interface with the System.
- Types of data must be specified, but given the huge variety of types of related data that are involved, more is needed: a *model* must be established.
- The model not only defines types of data, but also the relationships between them.

Why A Conceptual Data Model?

- For software developers, there must be a logical version of the data model that shows how the various types of data are actually represented within the System, but for most System users, the logical model does not provide the right level of detail.
- The conceptual data model captures the key aspects of the data model without going into the level of detail that is needed for the System software developers.
- The conceptual data model provides the right level of detail for System users to understand what types of data are handled by the System.
- In many cases, portions of the conceptual data model were developed first by nuke monitoring domain experts to make sure the data types and relationships were correct, and then the System architects developed the logical model.

Data Model Design Flow



- Sometimes CDM proves problematic to implement in software.
- Minor discrepancies may not warrant updating CDM to reflect implementation decision.
- When changes are more significant, we update CDM to be consistent with implementation.

CONCEPTUAL DATA MODEL DOCUMENT OVERVIEW

Conceptual Data Model Document (CDMD)

Current version is 2.5 (November, 2018)

- Updated Station Reference classes.
- Added numerous sections to Channel Processing Configuration (parameters for all algorithms that have been implemented and some that soon will be).
- Fleshed out data provenance for FK Power Spectra
- Reworked QC Masking (QC Segments and Processing Masks)
- Updated Feature Measurement classes
- Updated Feature Prediction classes

Note: the Data Model will continue to expand and change throughout system development

Purpose and Objectives

Purpose

- Provide conceptual data model to guide the development of a new SHI data processing system for the US NDC and IDC.
- Identify important objects and relationships
- To be used by domain experts and software engineers

Scope

- Addresses data acquisition, processing, analysis, distribution

Objectives

- Define data model used by all software – “Common Object Interface”
- Does not necessarily replace data transport or persistence
- Enable Data Provenance

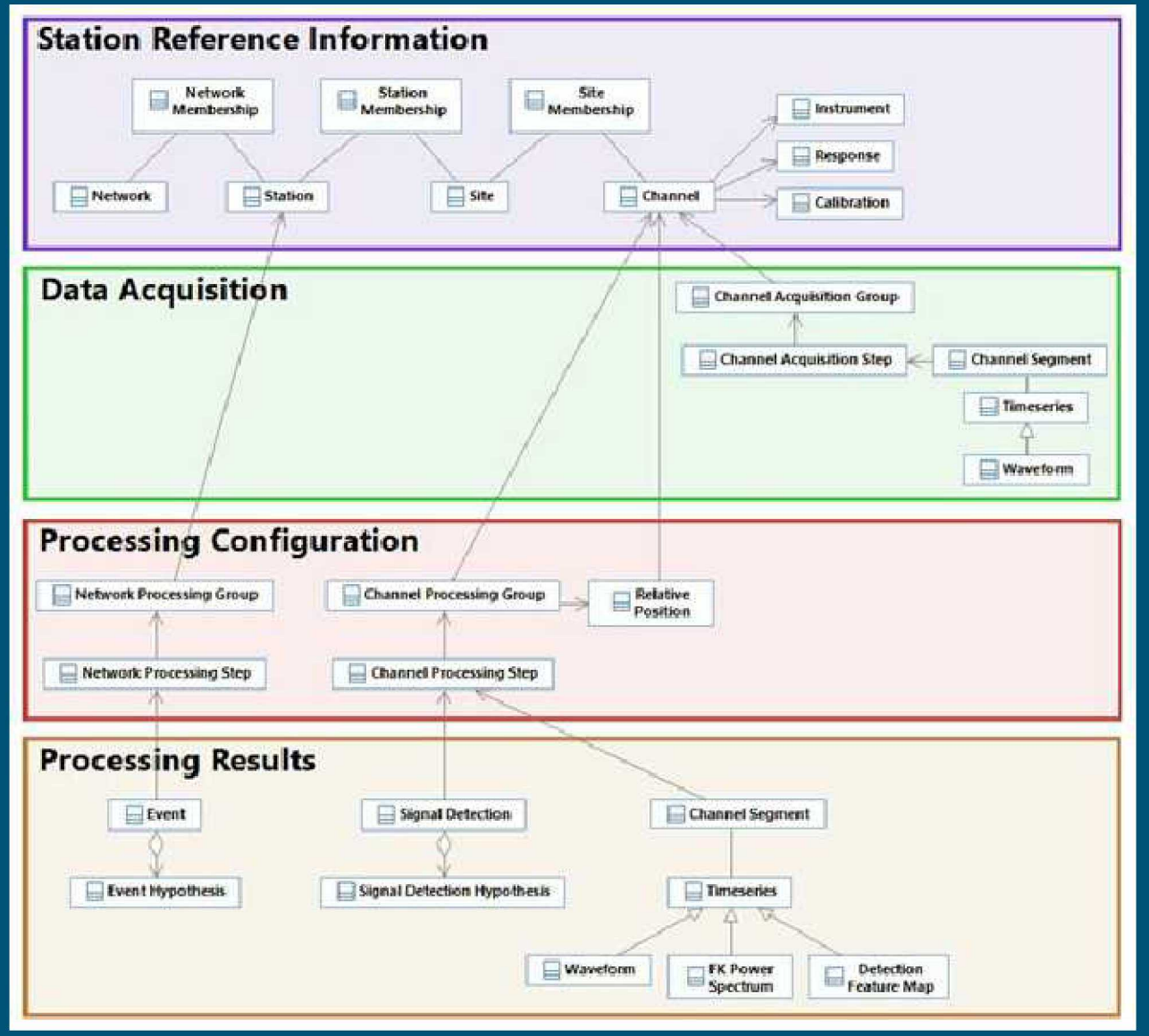
Provenance

Provenance - *information about how processing results were computed and evolved over time.*

This model addresses provenance in three ways:

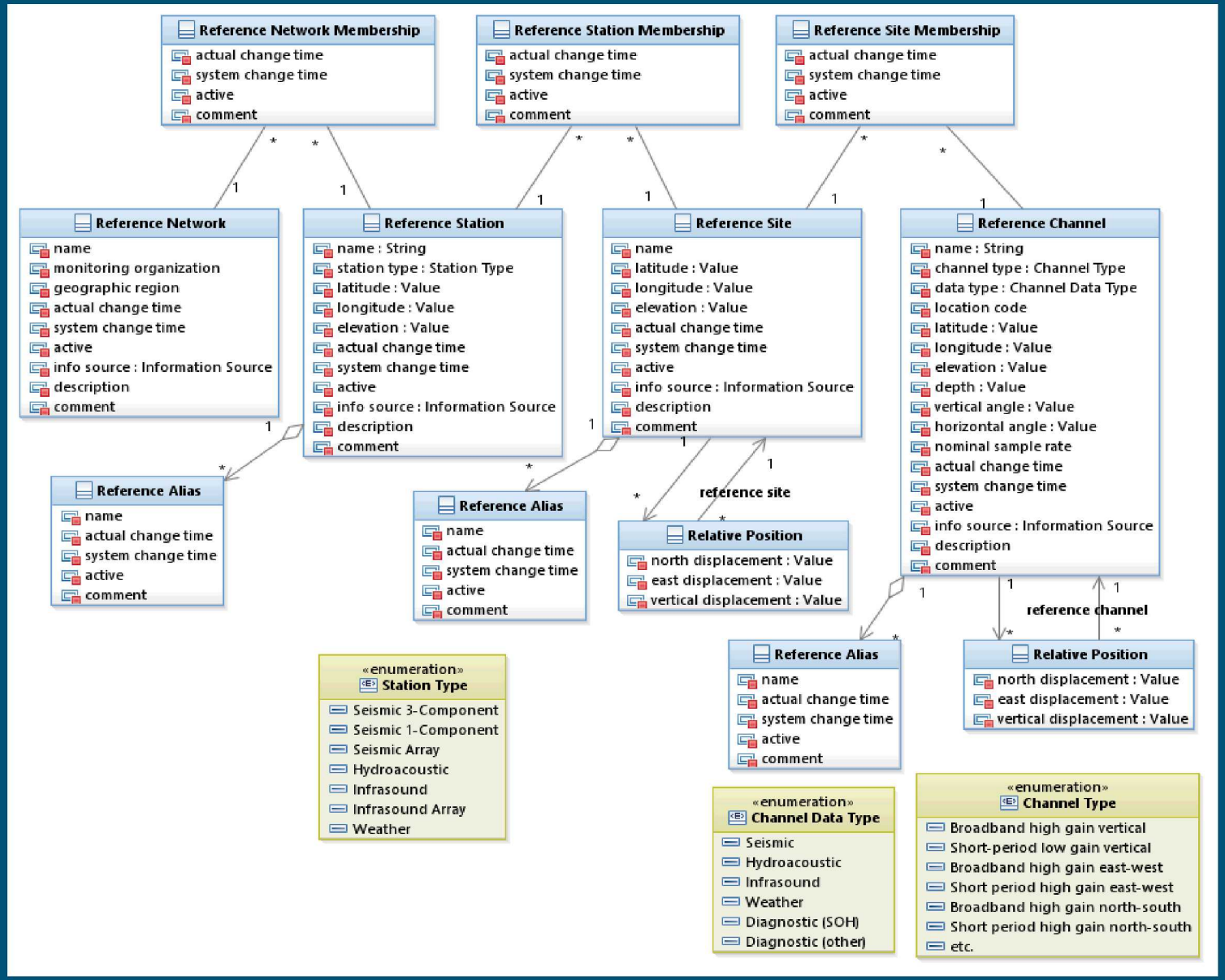
1. Versioning of primary data objects such as data channels, signal detections, and events to capture the history of changes to those objects in the System.
2. Defining and capturing processing configuration and parameters and associating those values to a processing result.
3. Capturing creation information (creation source and time) on all objects to allow connection to general System configuration and other information.

Organization of the Data Model

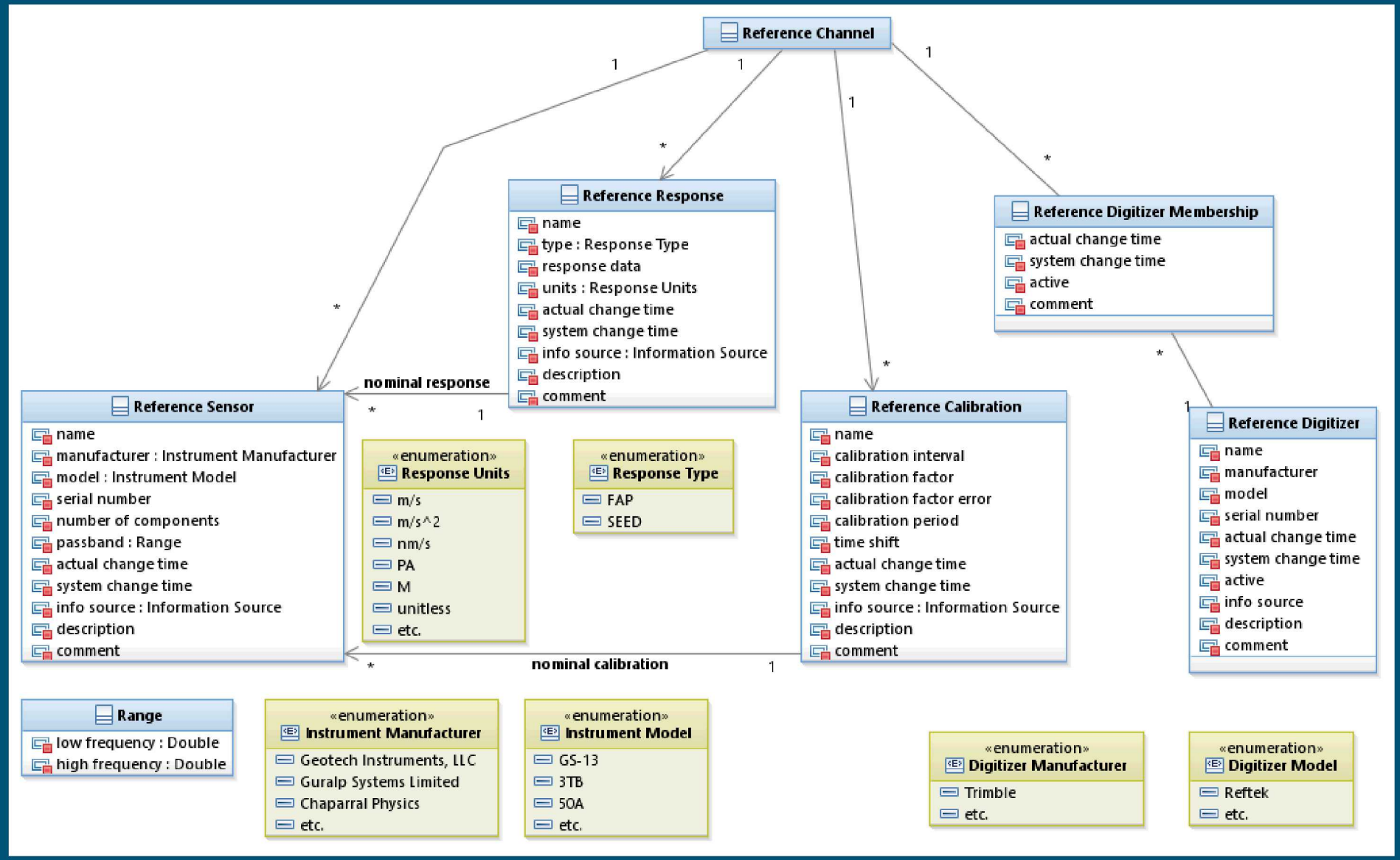


STATION REFERENCE INFORMATION

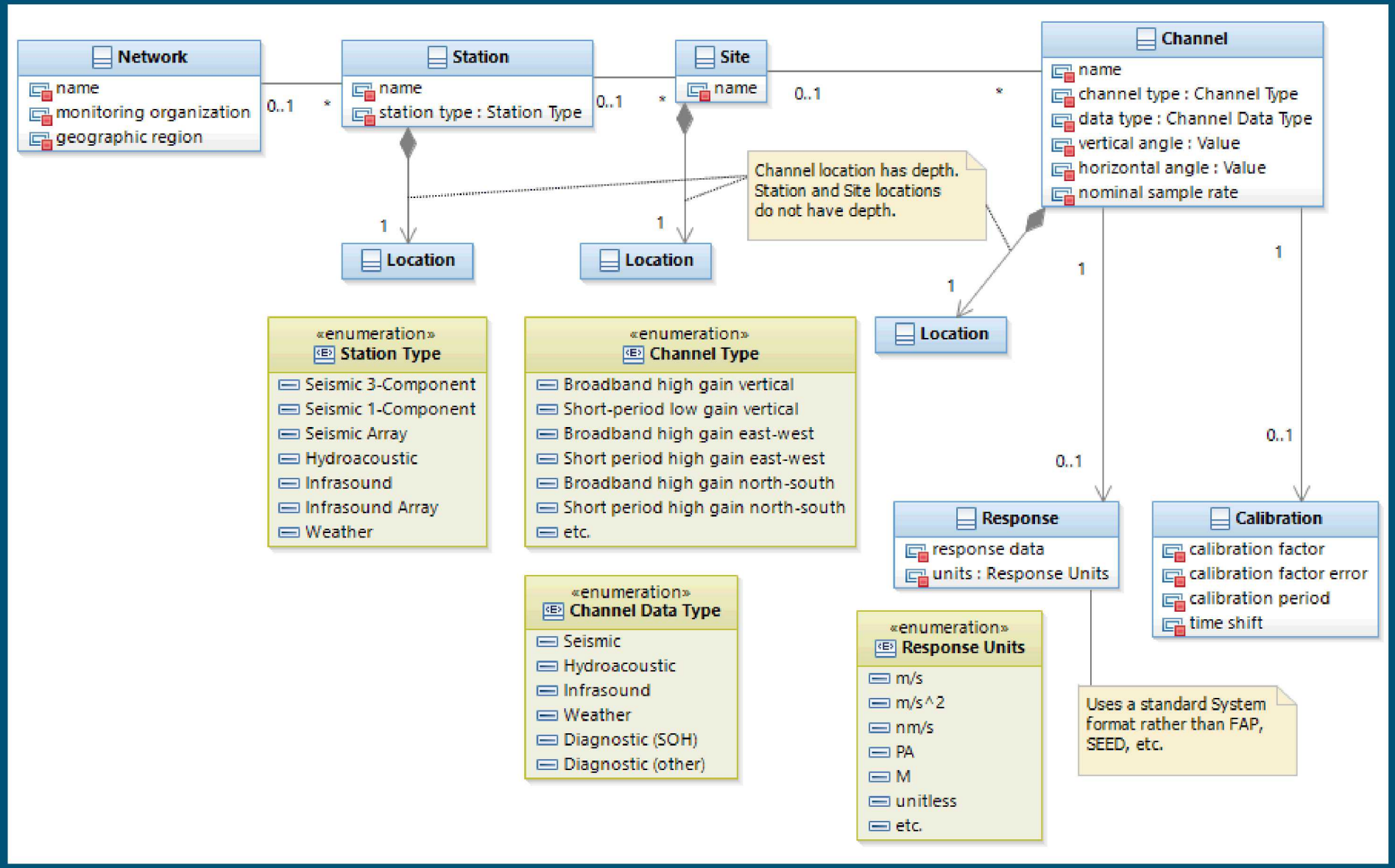
Network, Station, Site, Channel



Instrument Response

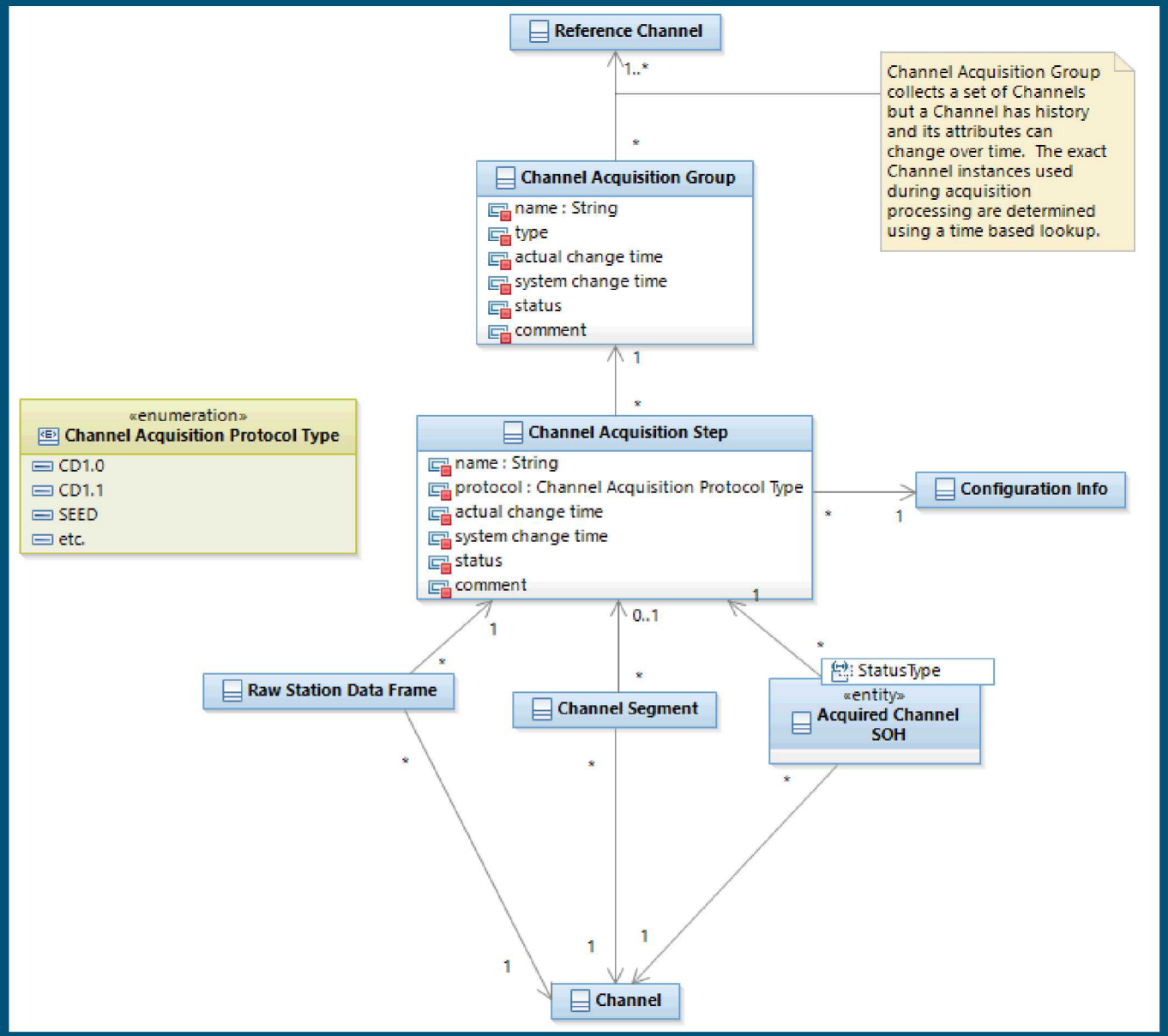


Network, Station, Site, Channel (Processing)

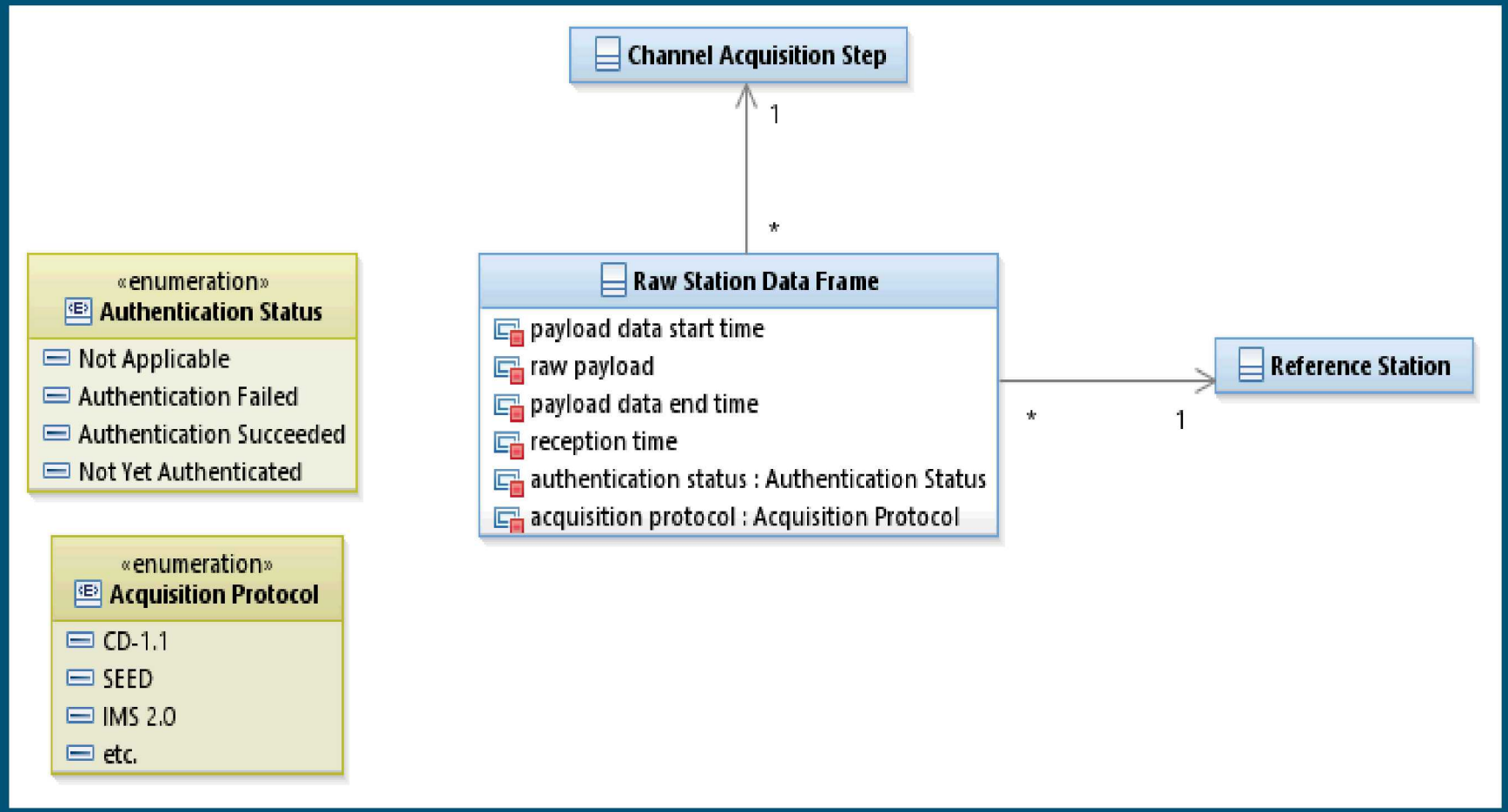


DATA ACQUISITION CONFIGURATION

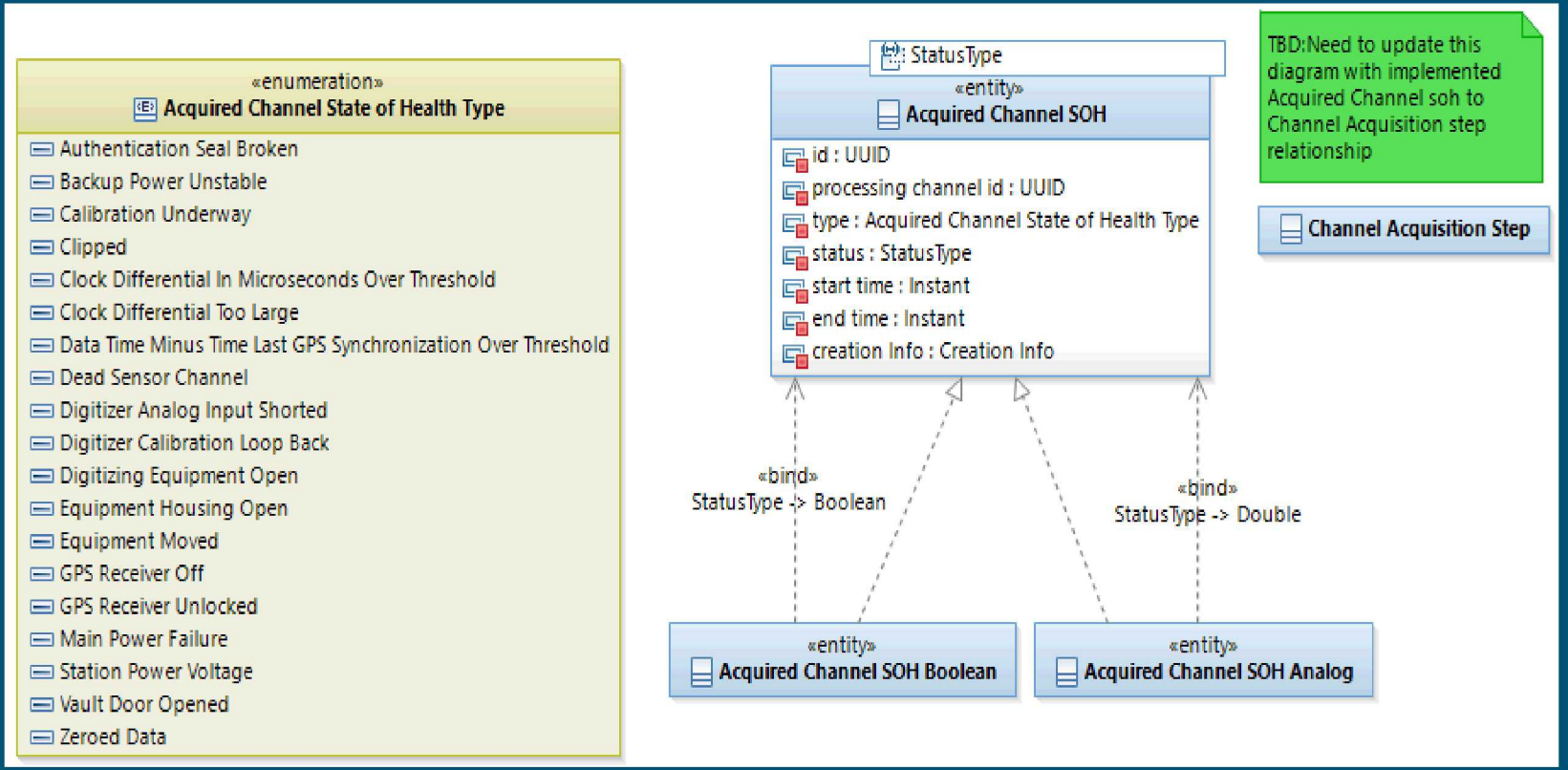
Data Acquisition Configuration



Raw Station Data Frames

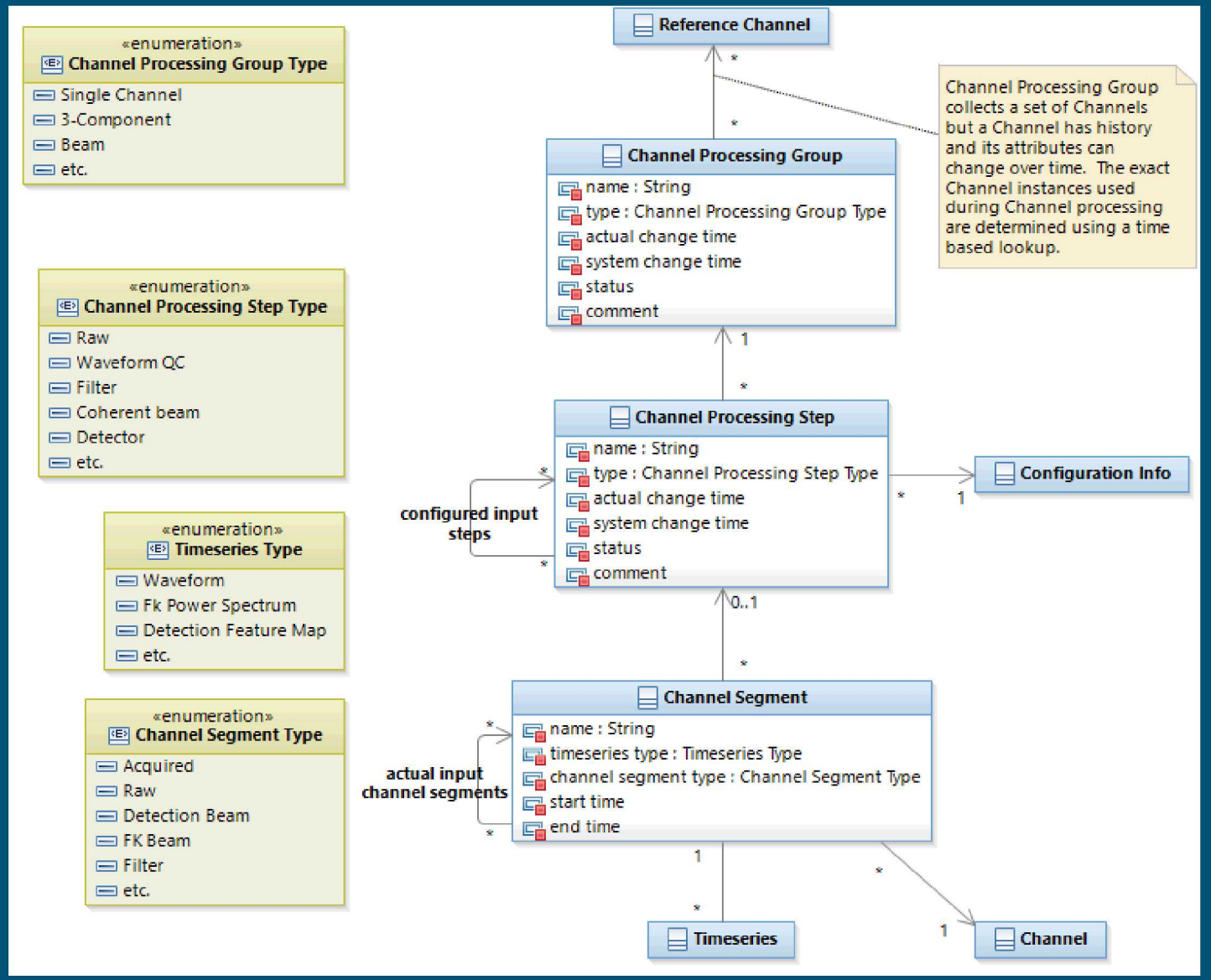


Acquired Channel State of Health



PROCESSING CONFIGURATION
CHANNEL PROCESSING

Channel Processing Sequence Configuration

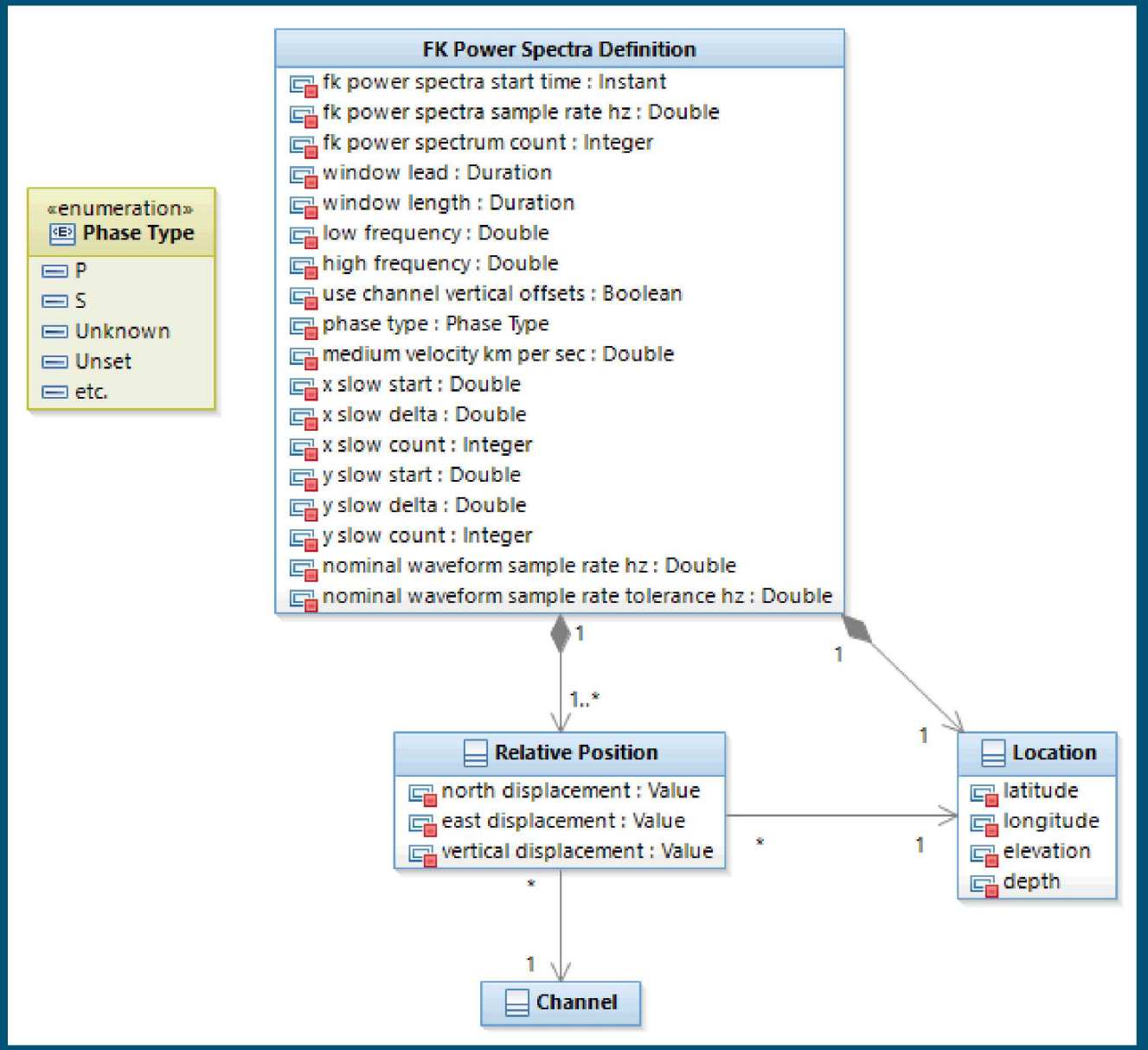


Channel Processing Step Configuration: overview

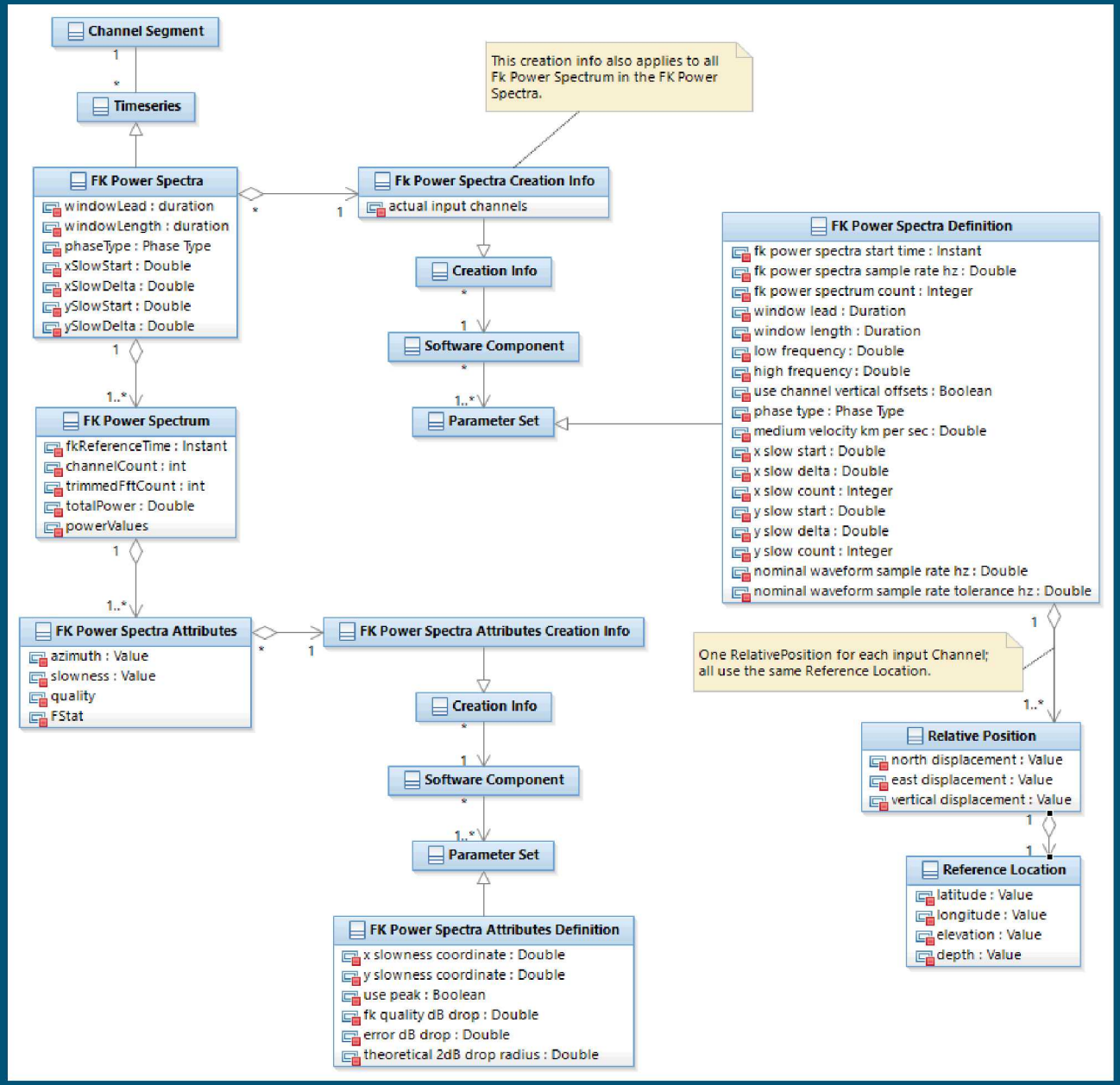
The CDMD currently includes configuration info for:

- QC Segment identification (i.e. QC masking)
- Filtering
- Beamforming
- STA/LTA Signal Detection
- AIC Onset Time Refinement
- Amplitude Measurement
- FK Power Spectra
- FK Power Spectrum Feature Measurement (Peak Azimuth & Slowness)

Channel Processing Step Configuration: FK Power Spectra

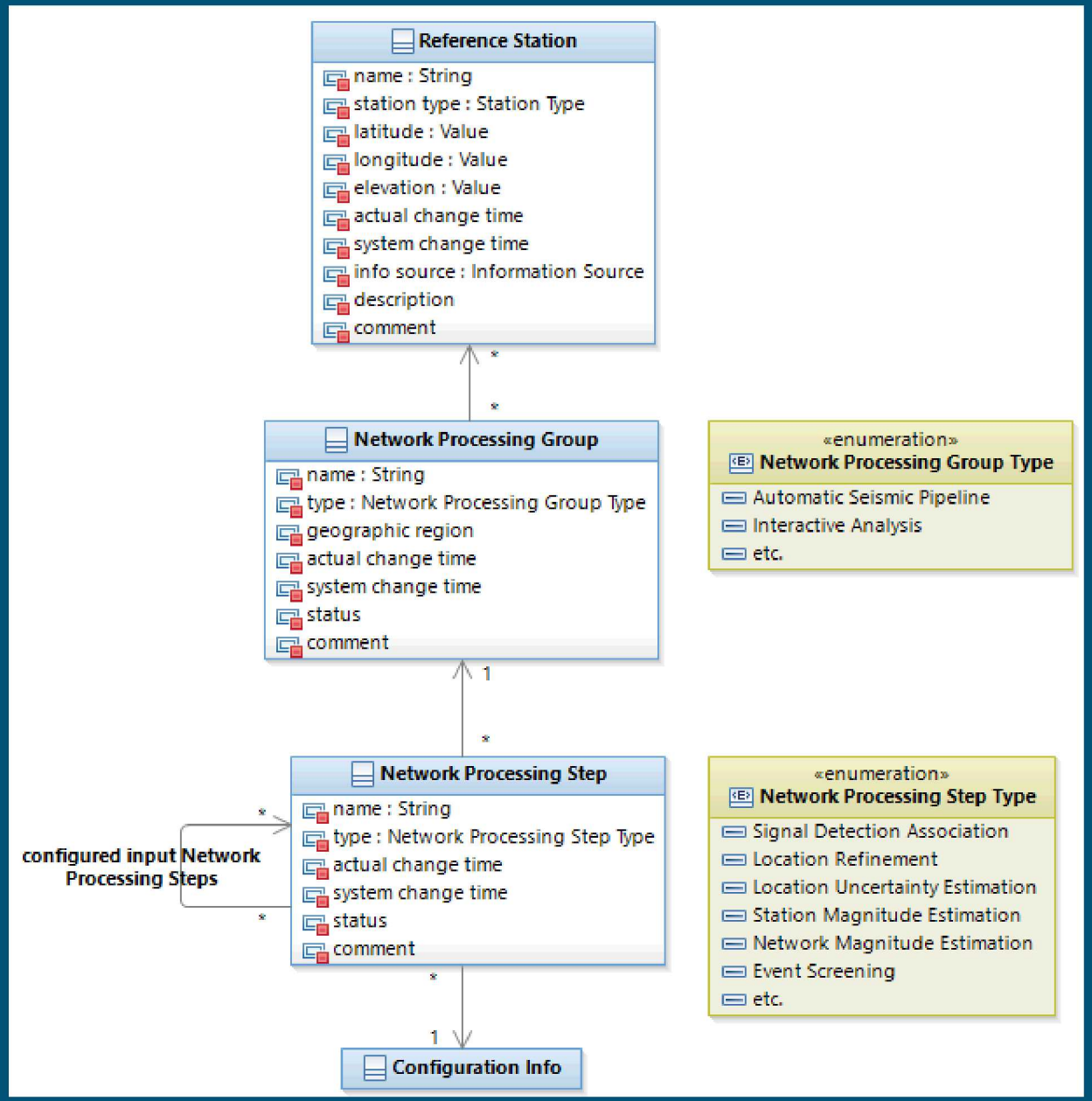


Channel Processing Step Configuration: FK Power Spectra (Provenance)



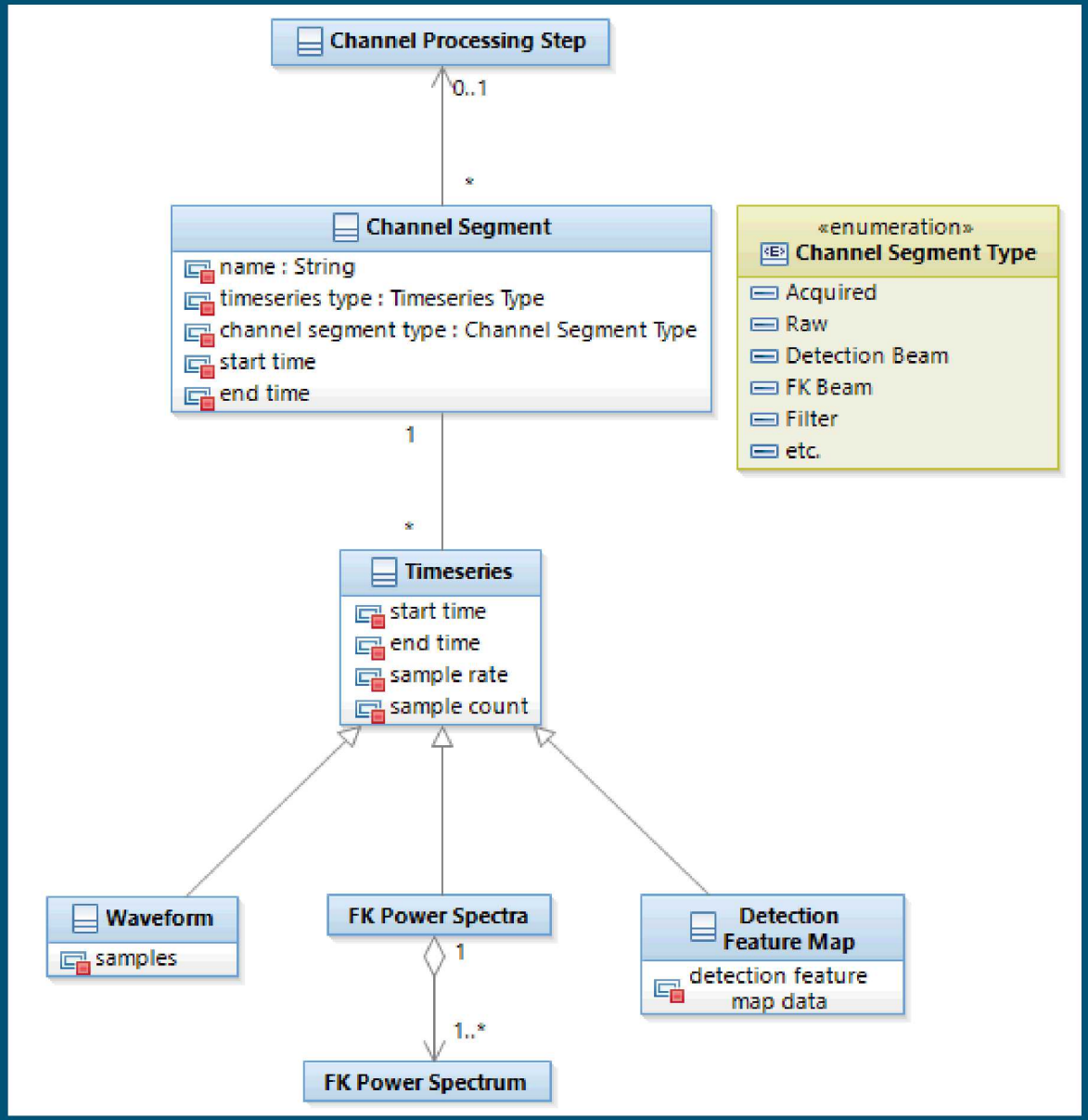
PROCESSING CONFIGURATION
NETWORK PROCESSING

Network Processing

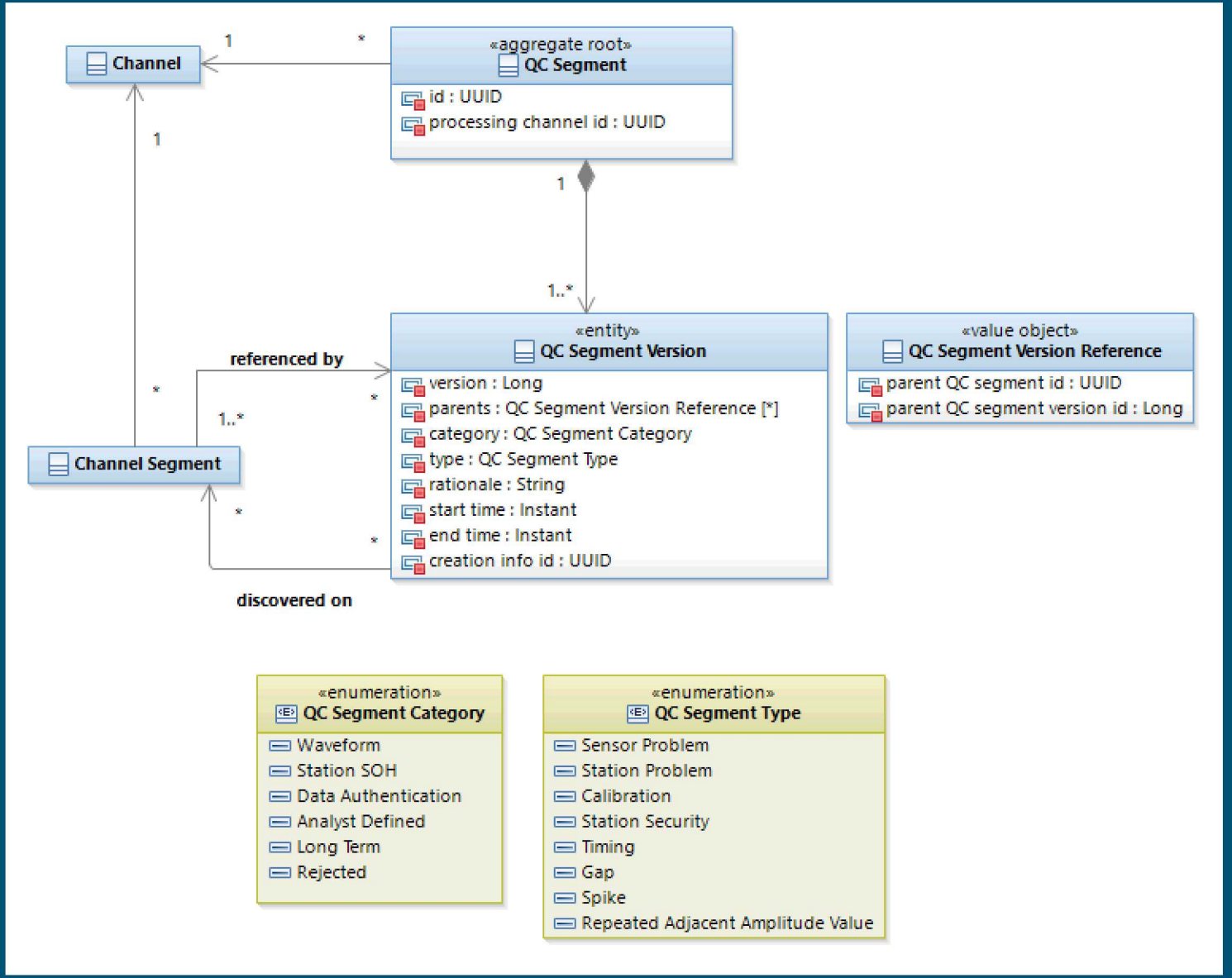


PROCESSING RESULTS

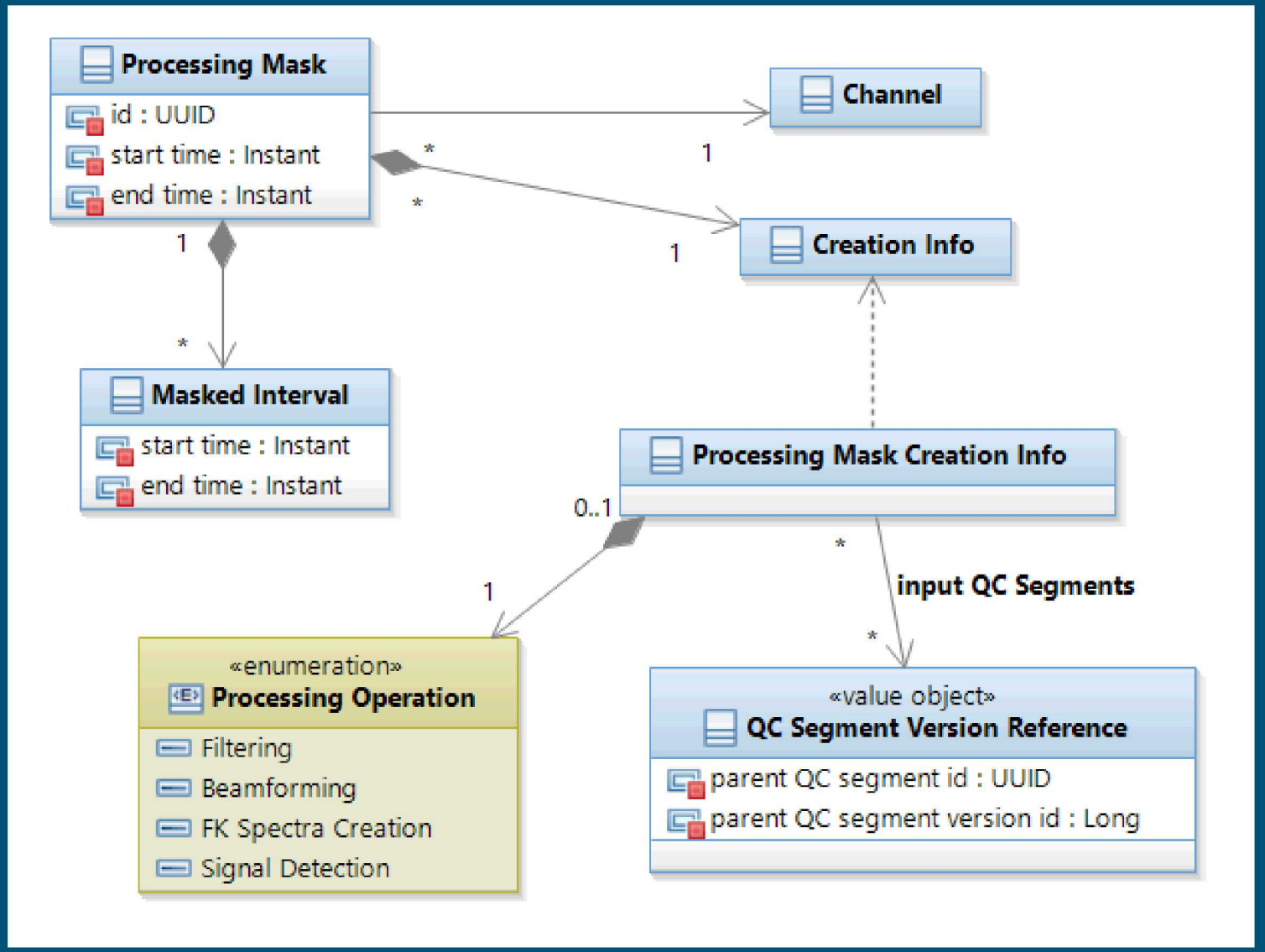
Channel Segment



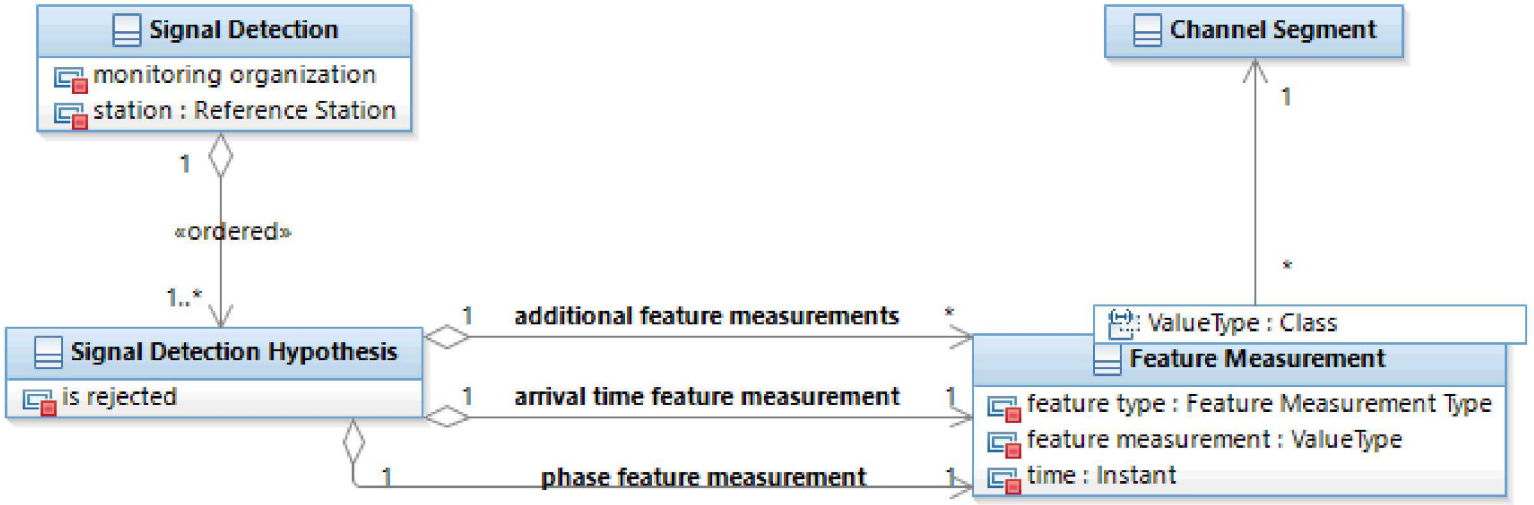
Waveform QC Segment



Waveform Processing Mask



Signal Detection & Feature Measurement



Classes used for Feature Measurement ValueType

Numeric Measurement Value
- referenceTime : Instant
- measurementValue : Value

Instant Value
- measurementValue : Value

Enumerated Measurement Value
- enumeratedValue : Phase Type
- confidence : Double

Amplitude Measurement Value
- startTime : Instant
- amplitude : Value
- period : Duration

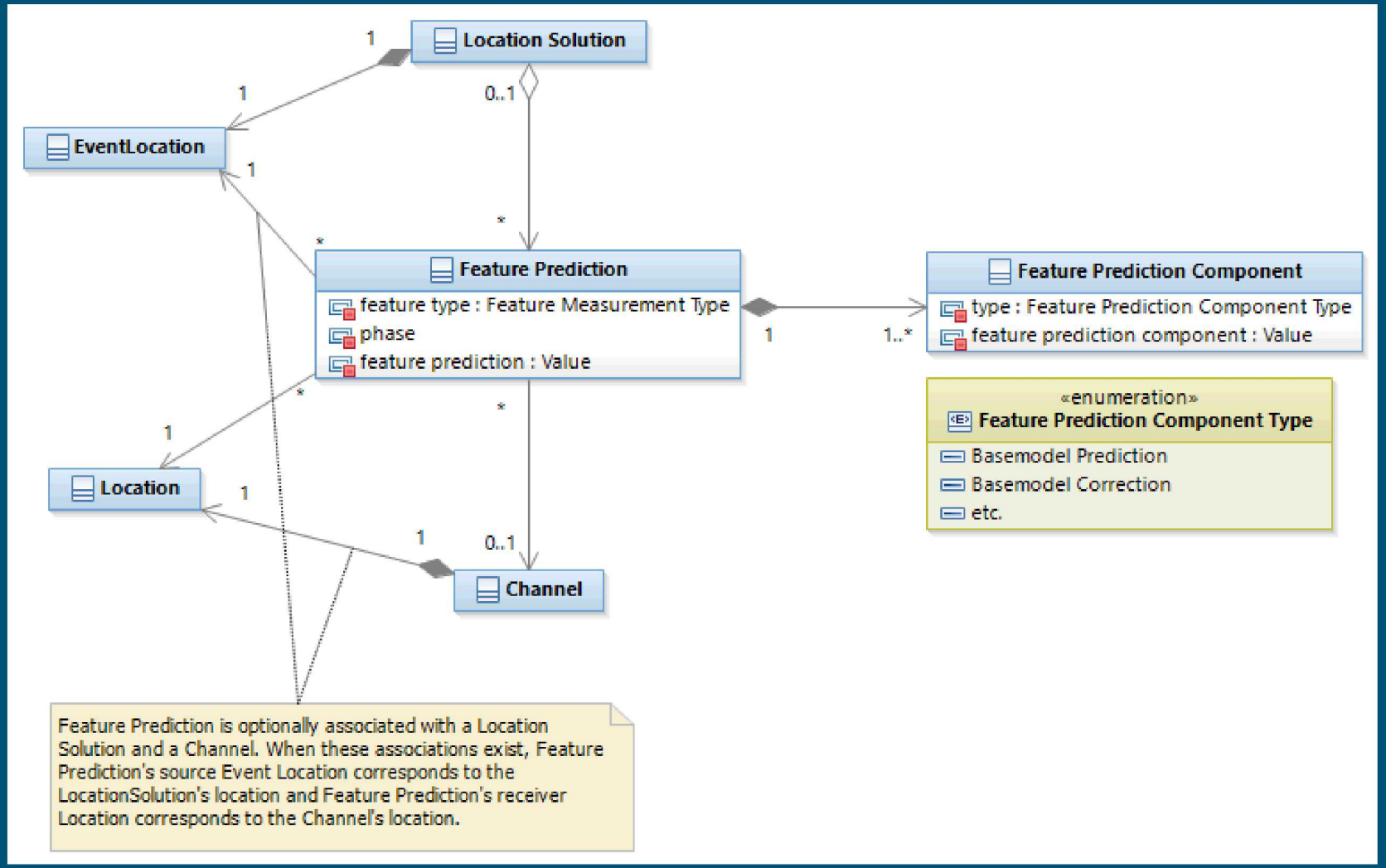
Duration Measurement Value
- startTime : Instant Value
- durationValue : Value

«enumeration» **Phase Type**
- P
- S
- etc.

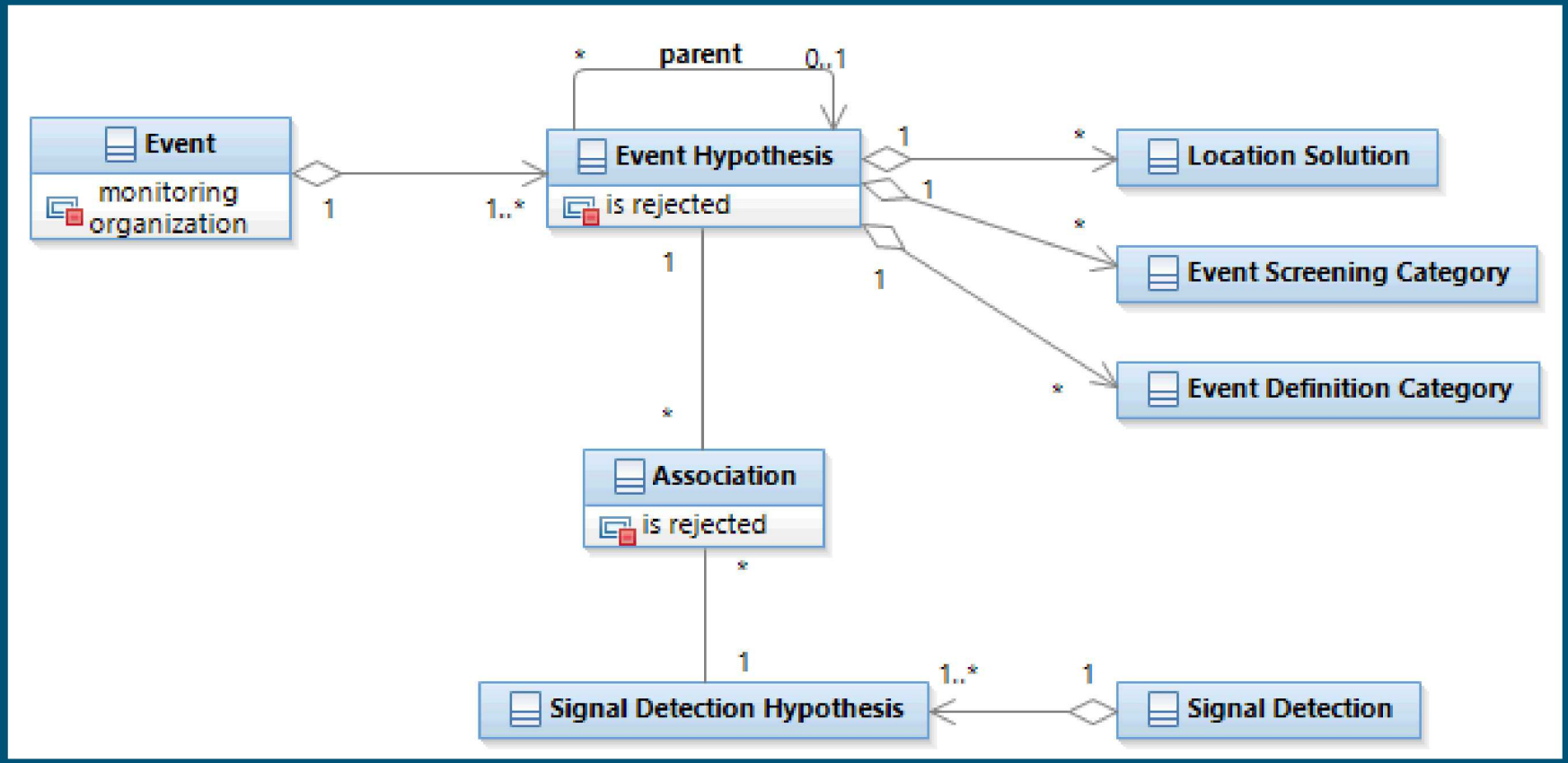
«enumeration» **First Motion Type**
- compression
- dilitation
- indeterminate

«enumeration» **Feature Measurement Type**
- Arrival Time
- Phase
- Azimuth
- Slowness
- Emergence Angle
- Rectilinearity
- First Motion
- SNR
- Amplitude: A5/2
- etc.

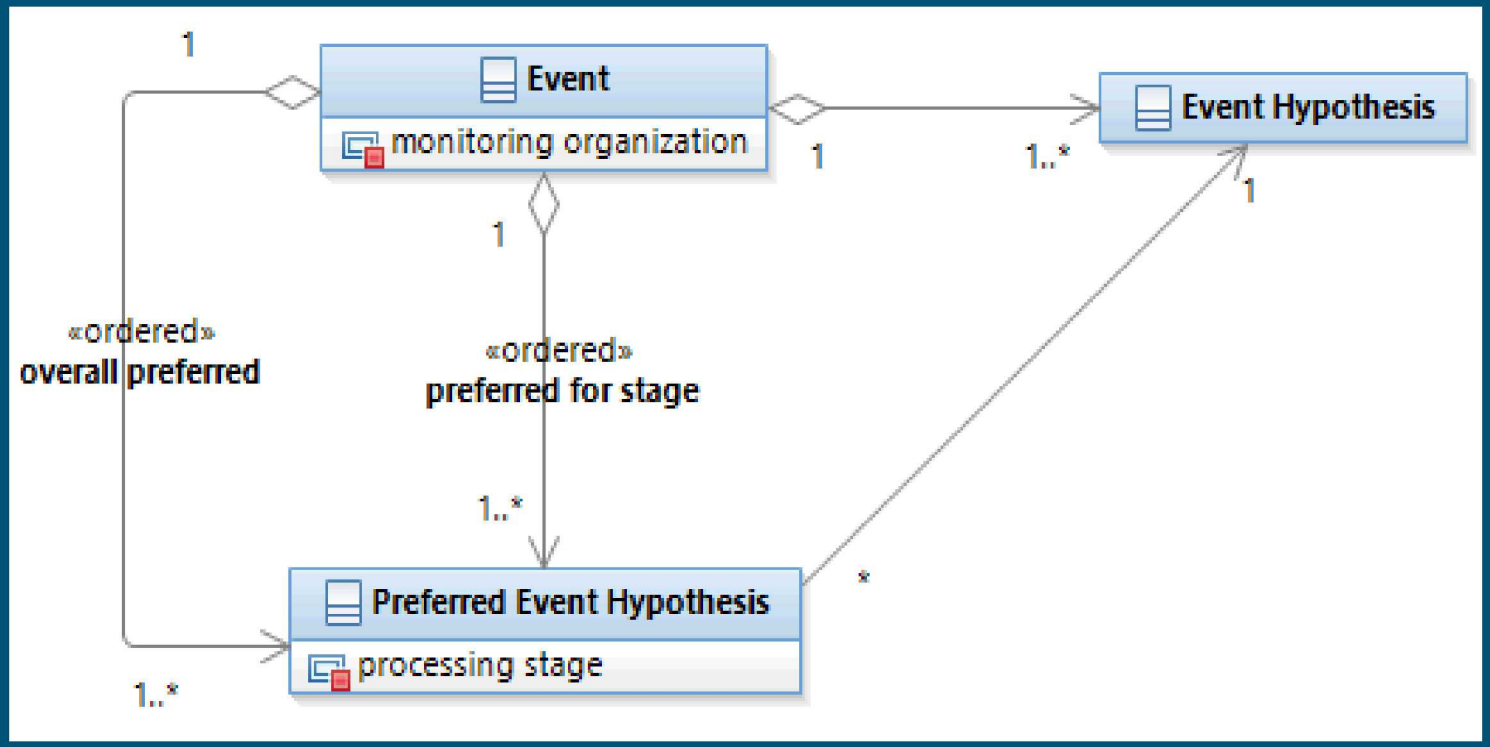
Feature Prediction



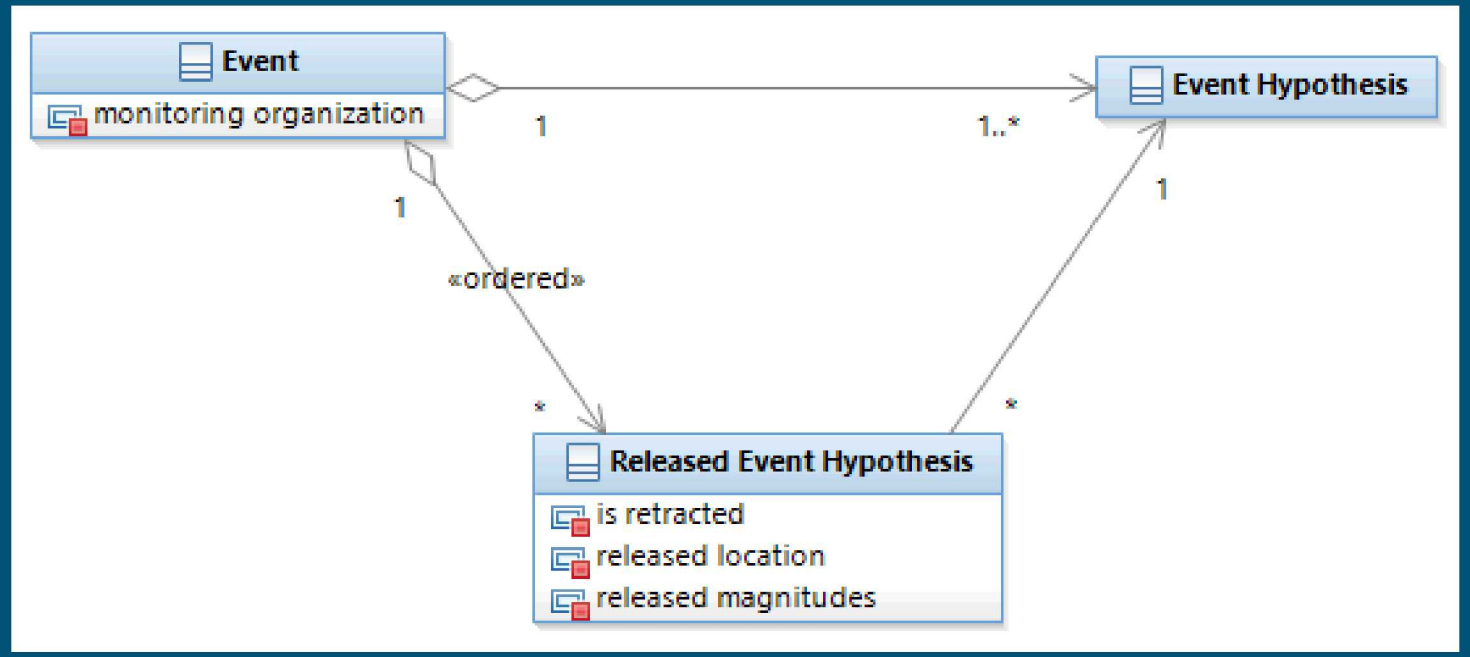
Event


parent
*
0..1
Event
monitoring
organization
1
1..*
Event Hypothesis
is rejected
1
*
Location Solution
1
*
Event Screening Category
1
*
Event Definition Category
1
*
Association
is rejected
*
1
1..*
1
Signal Detection Hypothesis
Signal Detection

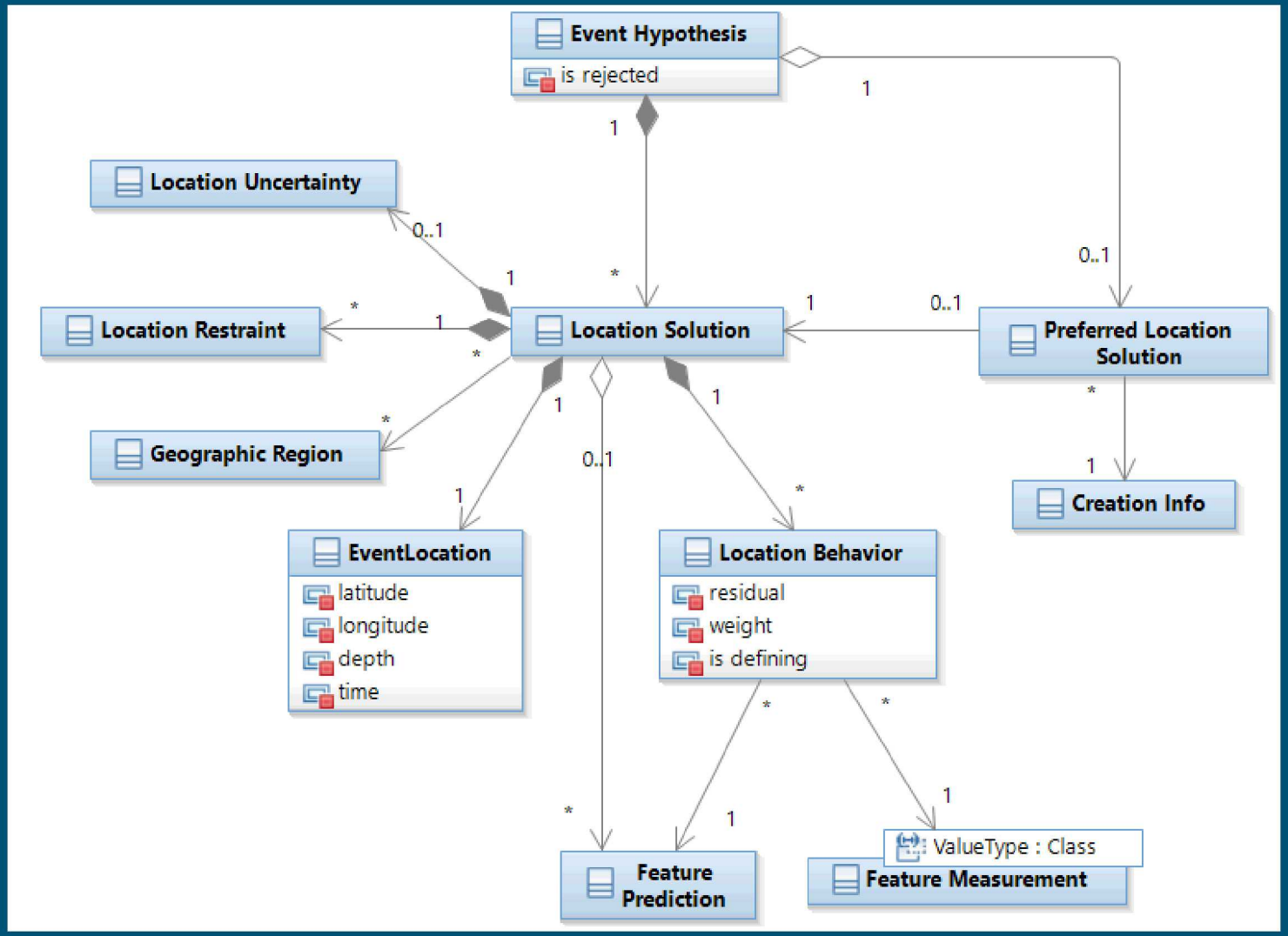
Preferred Event Hypotheses



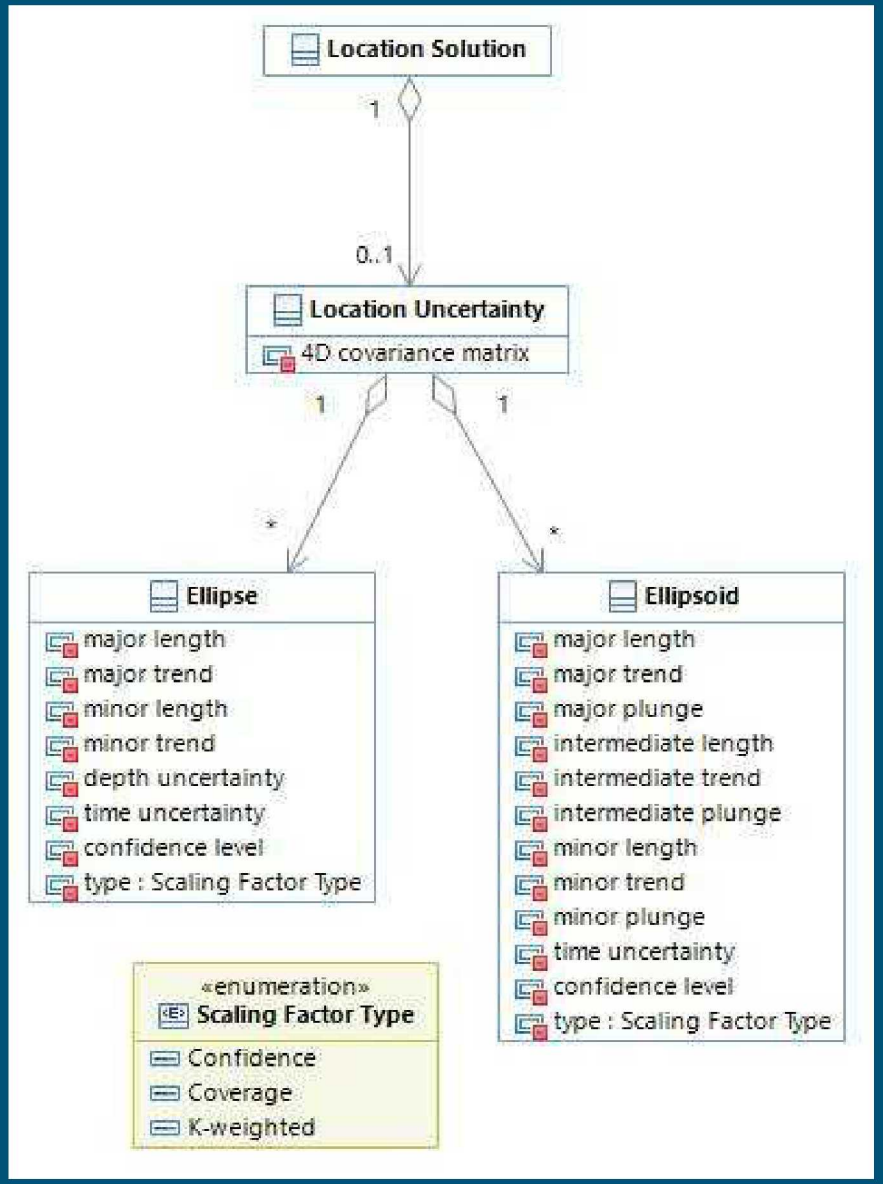
Released Event Hypotheses



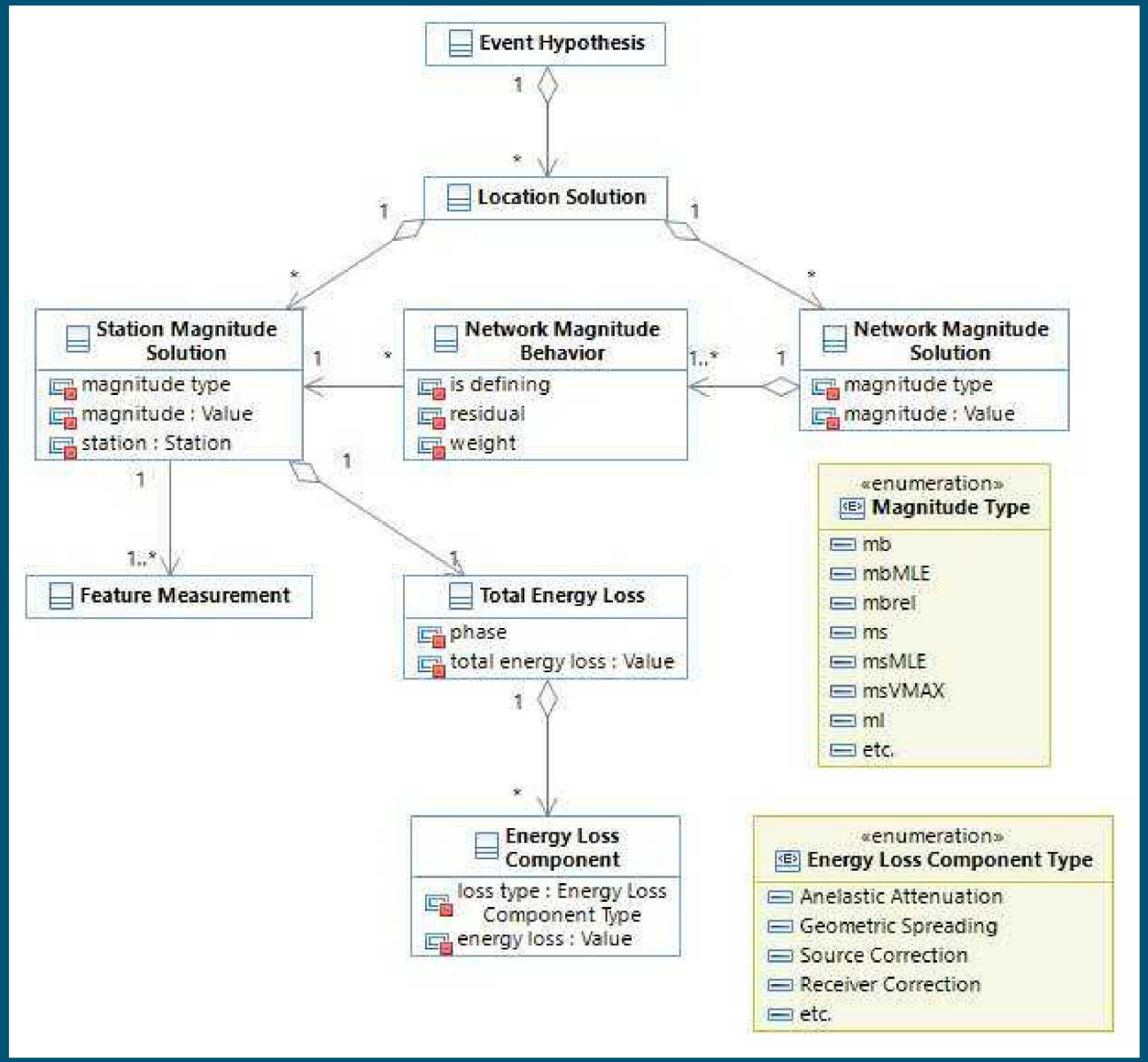
Location Solution



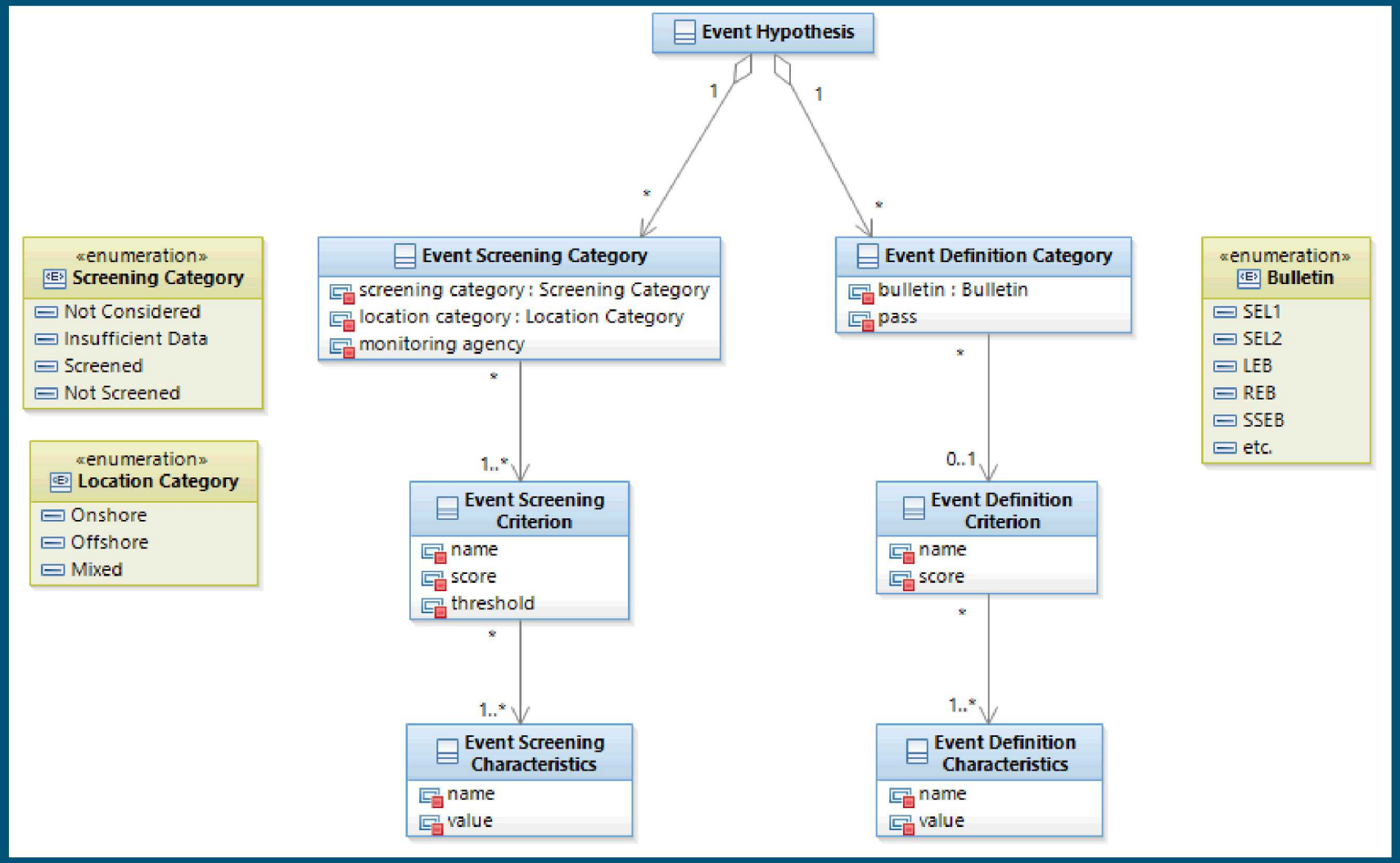
Location Uncertainty



Magnitude Solution



Event Screening



Questions?