OIIE Scenario 31 – Pull Historical Operational Data and State Events from CONTROL to O&M

The ORM (Operational Risk Management system) needs to be able to request historical measurements, alarms, and events from a CONTROL historian system when performing CBM diagnosis/prognosis to determine the entire state of process or equipment. The retrieved historical information may be maintained by the ORM for a short period in support of its analytics. Commonly, the CONTROL system is provided by an OPC UA server; however, the historian may also be accessible directly rather than through the OPC UA environment. The ORM is used as a typical example of an O&M system(s) that make use of such historical data. This scenario encompasses access to the historian in a variety of configurations, using both OPC UA and/or MIMOSA CCOM.

Actors

CONTROL System	The CONTROL system historian responds to queries regarding operating data, alarms, and events related to selected “tags” (measurement locations, assets, devices/transducers, functional locations, etc.)
Operational Risk Management System	The ORM system queries the CONTROL system regarding historical operating data, alarms, and events for selected “tags” (measurement locations, assets, devices/transducers, functional locations, etc.)

Data Content

Historical measurement data with timestamp and data quality, with associated events and alarms.

The query for historical measurement, event, or alarm data sent from the ORM to the CONTROL system Historian may be based on any relevant contextual entities, such as:

- Physical/virtual measurement location(s) of interest at which measurements were taken
- Functional location(s) of interest
- Serialized asset(s) of interest
- Device(s)/transducer(s) of interest that took the measurement
- Measurement source(s)/data collector(s) of interest from which the measurement data was published

The data sent from the CONTROL System Historian to the ORM System comprises historical measurement data including:

- The measurement/data value
- The timestamp at which the value was acquired
- The data quality

- Any associated events
- Any associated alarms

Additionally, contextual data may be provided in the response, which may comprise any of the following:

- The physical/virtual measurement location at which the measurement was taken
- The functional location
- The serialized asset
- The device/transducer that took the measurement
- The measurement source/data collector from which the measurement data was published
- Any Agent(s) and/or AgentRole(s) associated with an event/alarm (e.g., person who acknowledged an alarm)

MIMOSA CCOM Reference Types

For the purposes of reference data management, the following MIMOSA CCOM types may be referenced:

- AgentRoleType
- AgentType
- AssetType
- CalculationType
- DataQualityType
- EventType
- HighlightType (for alarm visualization)
- MeasurementLocationType
- MeasurementSourceType
- PostScalingType
- RegionType (for alarming)
- SegmentType
- SeverityLevelType (for alarm regions)
- TransducerAxisDirectionType
- TransducerType
- UOMQuantity/UnitOfMeasurement

OPC UA Reference Types

For the purposes of reference data management and mapping, the following OPC UA types may be referenced:

- AggregateFunctionType – OPC UA Parts 5, 8, & 13
- BaseVariableType – OPC UA Parts 5 & 8
- EUInformation – OPC UA Part 5 & 8
- BaseEventType (where the type is not one of the more specific types listed below) – OPC UA Part 5
- LimitAlarmType – OPC UA Part 9
- DiscreteAlarmType – OPC UA Part 9
- DiscrepancyAlarmType – OPC UA Part 9
- RoleType – OPC UA Part 5

- Status Codes, Result Codes, etc., specific to Historical Access – OPC UA Part 11

NOTE Due to the diversity of OPC UA information models, subtypes of the above will need to be mapped to common reference data on a per information model basis.

NOTE The Transformation Rules section below describes only an abstract mapping between OPC UA and MIMOSA CCOM: a more detailed mapping may be realized by the OPC UA / MIMOSA CCOM companion specification.

System Interoperability Events

This scenario the requires the sending/receipt of the following Events:

- Pull Historical Measurement Data
- Pull Historical Alarm and State Event Data

Data Formats

The data sent/received by the CONTROL system historian and sent/received by the O&M system(s) must conform to one of the following:

- MIMOSA CCOM BODs (XML or JSON, preferring the latter); or
- OIIE BODs for OPC UA content in OPC UA XML or OPC UA JSON format according to OPC UA Part 6 Mappings 1.04 specification as described in the IEC 62541-6:2020 standard. Depending on the type of data the content will comprise:
    - Historical query parameters and returned historical data must comply with OPC UA Part 11 – Historical Data Access 1.04 as described in the IEC 62541-11:2020 standard

Infrastructural Components

ISBM

The communication between all systems occurs via the ISBM using request-response services via the REST interface.

Implementation Requirements

The O&M system must implement a REST client for ISBM Consumer Request and Channel Management (GetChannel operation only) Services. The O&M system may implement the ISBM Notify Listener Service for message notification.

The CONTROL system (or historian) must implement a REST client for the ISBM Provider Request and Channel Management (GetChannel operation only) Services. The CONTROL system (or historian) must respond to all requests. The CONTROL system (or historian) may implement the ISBM Notify Listener Service for message notification.

Suggested Channel/Topic Configuration

A channel should be created for measurement data requests and should conform to the following format:

```
/Enterprise/Enterprise Subdivision/.../ISO18435:D1.1/Request
```

For example:

```
/Demo Enterprise/Refinery A/Area A/Light Ends Area/ISO18435:D1.1/Request
```

As outlined in the document ISBM Guidelines, topics should match the message content. Correspondingly, the following topic format should be used:

```
OIIE:S31:V1.2/StandardSchemaName{:Version}
```

For example:

```
OIIE:S31:V1.2/OPCUA-XML:GetHistoricalDataAccess:V1.04
OIIE:S31:V1.2/OPCUA-JSON:GetHistoricalAlarmsAndConditions:V1.04
OIIE:S31:V1.2/CCOM-XML:GetMeasurements:V1.0
OIIE:S31:V1.2/CCOM-JSON:GetMeasurements:V1.0
OIIE:S31:V1.2/CCOM-JSON:GetActualEvents:V1.0
OIIE:S31:V1.2/CCOM-JSON:GetTriggeredRegions:V1.0
```

SDAIR

The Scenario may require the use of an SDAIR in the following capacities:

- Registry of contextual data including any or all of the following: functional location tags, serialized assets, measurement locations, measurement device/transducer tags, and measurement sources/data collectors

CIR

The CIR is used to keep track of the object mappings between all systems for contextual data.

Additionally, the CIR is used to keep track of measurement, event, and alarm object mappings for ***historized*** measurement, event, and alarms data. Multiple queries of measurement, event, and alarm data must result in entities with the same unique identifiers to prevent consumers from receiving duplicate information.

NOTE Non-historized data may not require tracking of the mappings as it will not be possible to query the CONTROL system (or historian) for the non-historized data later. Refer Scenario 29 for the publishing of measurement, event, and alarm data including non-historized data.

Suggested Categories Configuration

The following CIR categories are suggested:

OPC UA Categories	MIMOSA CCOM Categories
Equipment	Segment
Device	Asset
Variable	Measurement Location
Variable Data Change Events	Measurement
Event Types	Event Type
Discrete Alarm Event	Actual Event
Limit Alarm Event	Measurement Location Triggered Region
Discrepancy Alarm Event	Measurement Location Triggered Region
User Identities/Clients	Agent / Agent Role
Role Type	Agent Role Type

In general, the identifiers of the OPC UA Nodes will be the NodeID, and the identifiers of OPC UA Events will be the EventID field.

Transform Engine

A transform engine *MAY* be used in this Scenario to convert the measurement, event, and alarm data from OPC UA format from the CONTROL system historian to MIMOSA CCOM format for the receiving O&M systems. A bidirectional mapping from OPC UA to MIMOSA CCOM is required for this Scenario to support both the query and response. Identifier transformation is only required if the OPC UA NodeIds and EventIDs do not conform to MIMOSA CCOM UUIDs.

NOTE The bidirectional transformation need only focus on the subset of data required for each direction. That is, the query transformation is predominantly focused on identifier transformation (e.g., measurement location, functional location, serialized assets, event type, etc.) and time ranges, while the transformation for returned data requires mappings to CCOM event entities and links to their context.

NOTE It is also possible for the OPC UA / MIMOSA CCOM Adapter to implement the transformation rules directly rather than utilize a distinct Transform Engine.

Transformation Rules

The following is a general set of rules describing the required transformation of OPC UA data to MIMOSA CCOM.

- The CONTROL system and/or individual OPC UA servers will be identified with InfoSource objects.
- OPC UA Variables of interest become MeasurementLocations.
    - If the origin of the Variable/MeasurementLocation is the CONTROL system, a UUID will need to be generated and the NodeID of the Variable will become placed in the IDInInfoSource field (with an InfoSource corresponding to the CONTROL system or OPC UA server).
    - Otherwise, the mapping to the MeasurementLocation from the Engineering Data or Asset Data will need to be retrieved.
    - Depending on the parent of the Variable, the MeasurementLocation may be for an Asset or a Segment.
- Variable Data Change Events become Measurements with the EventID placed in the IDInInfoSource field and a new UUID generated for the Measurement object.
- Alarm Types, i.e., subtypes of LimitAlarmType, DiscreteAlarmType, and DiscrepancyAlarmType, should map to EventTypes defined by common reference data.
- The limit configuration variables of LimitEventTypes (e.g, HighLimit, LowLimit, etc.) become Region and RegionType configurations of the parent MeasurementLocation.
- Discrete Alarm Events become ActualEvents with the EventID placed in the IDInInfoSource field and a new UUID generated for the ActualEvent object.
- Limit Alarm Events and Discrepancy Alarm Events become MeasurementLocationTriggeredRegions, with the EventID placed in the IDInInfoSource field and a new UUID generated for the MeasurementLocationTriggeredRegion event.
- EUInformation maps to UnitOfMeasure and UOMQuantity objects

NOTE More detailed transformation rules may be available in an OPC UA / MIMOSA CCOM Companion Specification.

The inverse of this mapping is required when determining which nodes to query. That is:

- The target server of the query may be identified by the InfoSource if a specific OPC UA server is used
- A query filtered by MeasurementLocation becomes a query to the specific Variable node

- A query filtered by functional location (Segment) becomes a query to all historized child Variables or Events of the mapped node
- A query filtered by serialized asset (Asset) becomes a query to all historized child Variables or Events of the mapped node
- A query filtered by EventType will further restrict the prior to those Events matching the mapped EventType
- A query will usually operate only on the SourceTimestamp; however, it is possible that queries may use additional timestamps that map to the ServerTimestamp

OIIE Adapter for OPC UA

An independent OIIE adapter may be used as a gateway between the OPC UA environment of the CONTROL system and the ISBM. Such an adapter may directly implement the transformation rules described for the Transform Engine or call on the services of the Transform Engine.

Communication between the independent OIIE adapter and the CONTROL system occurs via OPC UA Part 4 Services, while communication between the OIIE adapter and the O&M system(s) occurs via the ISBM using request-response services via the REST interface.

Implementation Requirements

The independent OIIE adapter must implement an OPC UA Part 4 Services compliant client, specifically the HistoryRead service required by OPC UA Part 11 Historical Access and any other services required to find nodes for contextual data necessary for translating a query, and subscribe to the appropriate OPC UA servers available from the CONTROL system historian.

The independent OIIE adapter OPC UA client may be read-only.

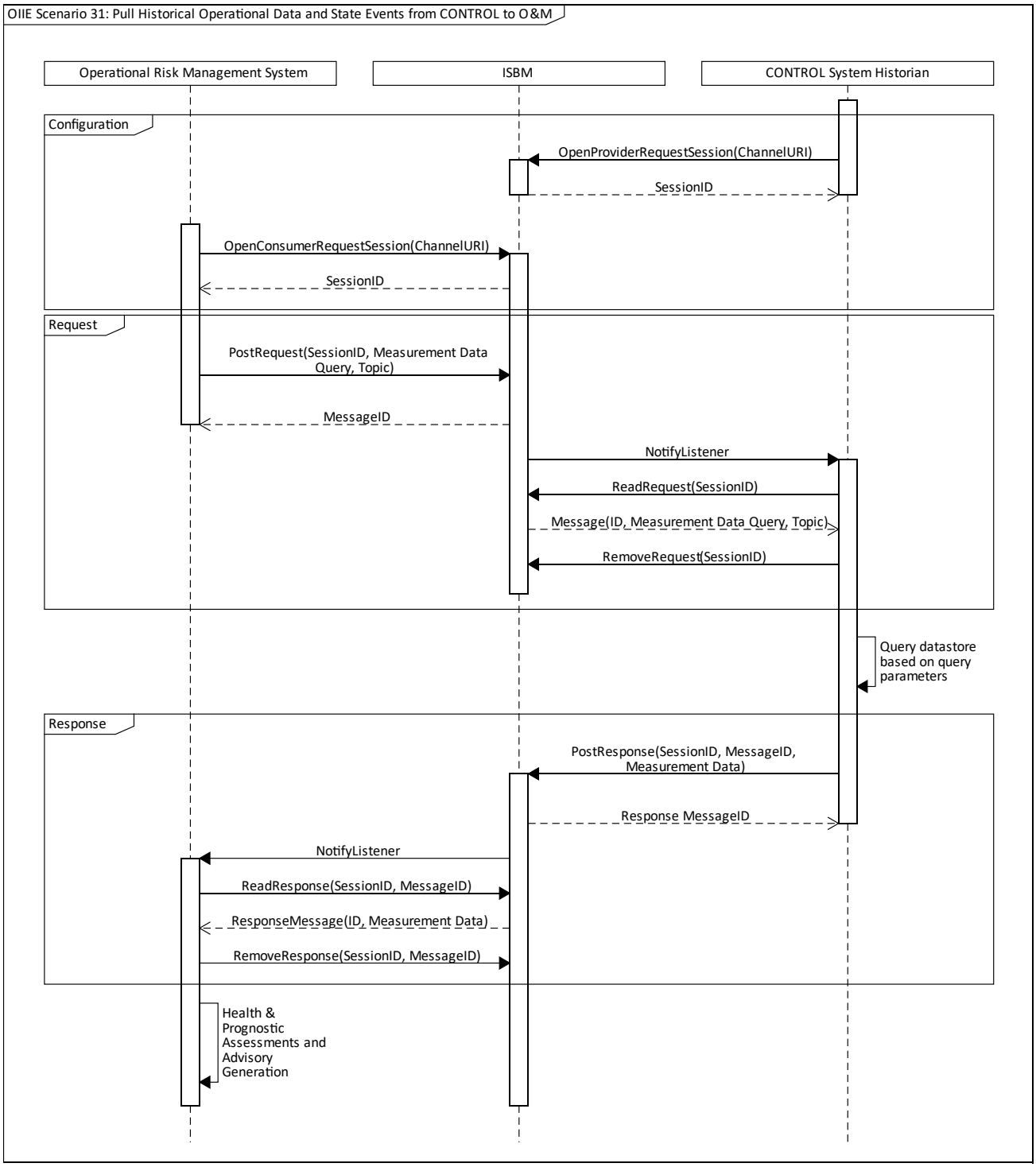
The independent OIIE adapter must implement a REST client for the ISBM Provider Request and Channel Management (GetChannel operation only) Services. It may implement the ISBM Notify Listener Service for message notification.

The independent OIIE adapter will translate requests received from the ISBM interface into queries for historical data in OPC UA and then translate the response back onto the ISBM in compliance with the Data Format requirements described above.

Event Sequence

The following diagram represents a simplified set of exemplar interactions between the systems required to achieve this Scenario. The system actors are assumed to have OIIE/ISBM adaptors implemented as required, with services according to the ISBM Implementation Requirements described above. For simplicity, it is assumed that each system/adaptor implements the optional Notify Listener service.

The example illustrates the CONTROL System Historian directly participating in the OIIE interactions using MIMOSA CCOM BODs; in which case the mapping of the query and response data is handled internally (possibly using the CIR for identifier mappings) and may not utilize the OPC UA transformation described above depending on whether the Historian is backed by a proprietary database. Other configurations are supported by this Scenario, for example, an external OIIE adapter that acts as an OPC UA client to query the OPC UA environment and using a Transform Engine to perform the transformation from OPC UA to MIMOSA CCOM and vice versa.



Version Applicability/Alignment

Scenarios describe general data requirements and, hence, they are aligned to specific versions of CCOM and/or other MIMOSA standards. For example, older versions of CCOM may not include the data elements required by newer Scenarios, while older Scenarios may become obsolete or have their data requirements change over time.

This Scenario is applicable to the following versions of CCOM:

- CCOM 3.x (part of OSA-EAI 3.x)
- CCOM 4.x

NOTE Use of 'x' in the version number indicates a variable version. For example, "4.x" indicates applicability to all versions of CCOM with the MAJOR version '4', regardless of MINOR and PATCH versions.

This Scenario is applicable to the following OPC UA Parts and versions (and their normative references):

- OPC UA Part 4 – Services v1.04 (IEC 62541-4:2020)
- OPC UA Part 6 – Mappings v1.04 (IEC 62541-6:2020)
- OPC UA Part 11 – Historical Access v1.04 (IEC 62541-11:2020)

Document Versioning

Version	Date	Major Changes
1.2	2020-12-11	Updated to use OpenO&M template Added detail to the OPC UA aspects and its general mapping to CCOM.
1.1	2019-02-16	Updated to revised Use Case Architecture. Expanded definition of the scenario to encompass OPC UA and CCOM data.
1.0	2019-02-09	Imported from old draft use case documentation.