

# Overview of OPC Alarms and Events

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EXELE Information Systems  
(585) 385-9740  
Web: <http://www.exele.com>  
Support: [support@exele.com](mailto:support@exele.com)  
Sales: [sales@exele.com](mailto:sales@exele.com)

# Table of Contents

<b>Overview of OPC A&amp;E .....</b>	<b>3</b>
OPC A&E Overview and Terminology .....	4
Sample Facility - Bakery .....	4
Event Type and Category.....	5
Event Area and Source .....	6
Event Severity .....	6
Browsing the OPC A&E Server .....	7
OPC A&E Event Fields .....	7
Type.....	7
Category .....	7
Area .....	7
Source .....	7
Severity .....	8
Event time .....	8
Message .....	8
Active time (event type = condition).....	8
Condition name (event type = condition) .....	8
Subcondition name (event type = condition) .....	8
Quality (event type = condition).....	8
Changed (event type = condition) .....	8
New State (event type = condition).....	10
Acknowledge required (event type = condition) .....	10
OPC A&E Subscriptions.....	11
Active .....	11
Buffer time.....	11
Maximum size.....	11
Keep-alive time.....	11
Filter .....	11
Filter Mask .....	12
Detecting alarm/condition active .....	13
<b>Filter Masks .....</b>	<b>14</b>

## Overview of OPC A&E

OPC A&E is a standard that allows alarm and event generators to report the details of their events to clients. An OPC A&E client (TopView Events) can subscribe to the events without knowledge of the specifics of the underlying alarm generator.

Each OPC A&E event contains details such as:

- The type of event
- The area and source of the event
- Severity
- Event message

Example OPC A&E Servers include:

- Emerson DeltaV ([more](#))
- Iconics ([more](#))
- Kepware ([more](#))
- GE Proficy iFix ([more](#))
- Honeywell Experion ([more](#))
- Yokogawa Exaopc ([more](#))

See [www.opcfoundation.org](http://www.opcfoundation.org) for more information on OPC A&E.

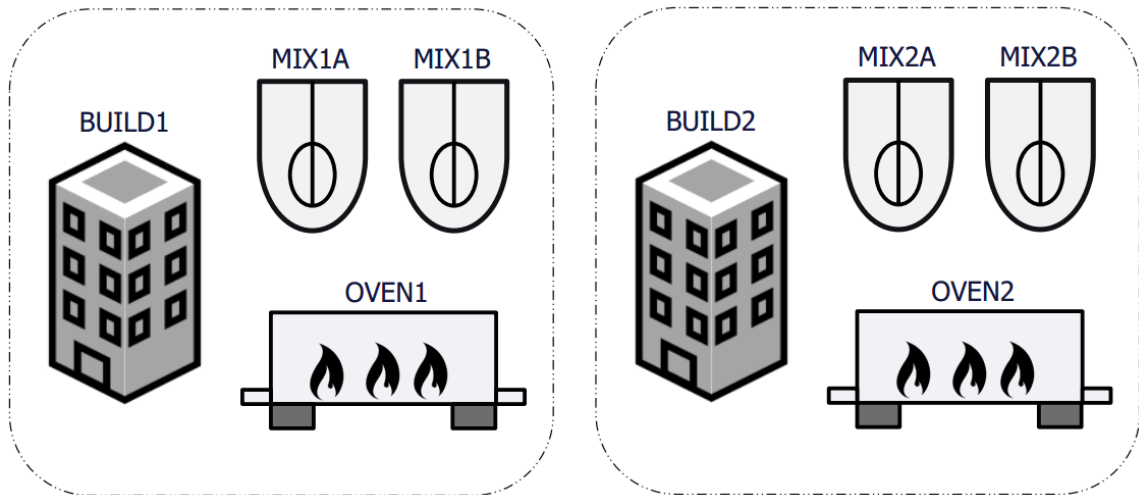
## **OPC A&E Overview and Terminology**

To receive OPC A&E events, a client must create a subscription with the OPC A&E Server. Each subscription defines details of the desired events (subscription filter) and settings that define the some details of event delivery.

Each OPC A&E event contains basic information such as what happened (*high level alarm*) and when (*at 10am this morning*) as well as additional details such as the type of event (*rate-of-change alarm*), where it happened (*processing area 9*) and who generated the event (*tank 9A*). Each OPC A&E Server vendor can use these fields to provide meaningful event information to clients.

### **Sample Facility - Bakery**

To help explain OPC A&E we will use the following sample facility:



A Bakery facility has 2 buildings, BUILD1 and BUILD2. Each Building contains 2 mixers and 1 oven.

- BUILD1
  - MIX1A and MIX1B
  - OVEN1
- BUILD2
  - MIX2A and MIX2B
  - OVEN2

The mixers have alarms for low/high mixing speed ( $\text{rpm} < \text{low limit}$  OR  $\text{rpm} > \text{high limit}$ ).

The ovens have alarms for low/high temperature ( $\text{temperature} < \text{low limit}$  OR  $\text{temperature} > \text{high limit}$ ) and rate-of-change alarms ( $\text{temperature change more than 1 degree up}$  OR  $\text{down within a specified period of time}$ )

## Event Type and Category

OPC A&E defines 3 event types: Simple, Tracking, and **Condition**. Alarms fall under the Condition event type. Each event type can contain categories of alarms.

- TYPE = Simple, Tracking, or Condition
  - Category 1
  - Category 2

If the event type is Condition, each category can define a list of possible conditions

- TYPE = Condition
  - Category 1
    - Condition 1
    - Condition 2
  - Category 2
    - Condition 3

### Bakery Example (see **Sample Facility - Bakery**)

- Event type = Condition
  - Category = Level
    - Condition = HI
    - Condition = LO
  - Category = Rate of Change
    - Condition = ROC UP
    - Condition = ROC DOWN

## Event Area and Source

Each OPC A&E event contains a source name. Each source exists within an area.

- Area 1
  - Source 1
  - Source 2
- Area 2
  - Source 3
  - Source 4

### Bakery example (see **Sample Facility - Bakery**)

The Areas are our buildings, and the Sources are the mixers and ovens

- Area = BUILD1
  - Source = MIX1A
  - Source = MIX1B
  - Source = OVEN1
- Area = BUILD2
  - Source = MIX2A
  - Source = MIX2B
  - Source = OVEN2

## Event Severity

Each OPC A&E event contains a severity value from 1-1000

### Bakery Example (see **Sample Facility - Bakery**)

- Mixer low/high alarms (speed): severity = 500
- Oven low/high alarms (temperature): severity = 500
- Oven rate-of-change alarms (temperature): severity = 800

## Browsing the OPC A&E Server

The OPC A&E Specification provides a mechanism for a client to query the OPC A&E Server for some supported field values.

If implemented by the Server, a client can query the following information

- Event Type
  - Categories
    - Conditions
- Areas
  - Sources

The ability to query this information can assist with the definition of a subscription filter. See **Filter** for more information on the subscription filter.

## OPC A&E Event Fields

The OPC A&E standard defines the available event fields. Some fields are available for all event types while other fields are specific to one event type. The vendor can also supply a set of vendor attributes to provide information beyond the standard list of event fields.

When describing the event fields, we may use example information from our **Sample Facility - Bakery**.

Note: The following list of OPC A&E event fields does not include a few fields used internally by OPC A&E clients.

### Type

- Condition: associated with the detection of some condition that generally requires some sort of response by the user or operator. Alarms are condition events.
- Tracking: typically involve an action taken (example: machine stopped)
- Simple: all other events

### Category

Categories are groupings of events supported by an OPC A&E Server. Each category contains a name (string) and an ID (integer).

All 3 event types support categories but each category can include events of only one type.

Each source may generate events for multiple event categories. Category names must be unique within the OPC A&E Server.

Bakery: Level (low/high) and Rate-of-change are categories

### Area

An area is a grouping of equipment. The available areas are defined by the OPC A&E Server.

Bakery: BUILD1 and BUILD2 are our Areas.

### Source

A reference to the object that generated the event. A source could be a process tag, a device, or a subsystem. Available sources are defined in the OPC A&E Server.

Bakery: MIX1A, MIX1B, OVEN1, MIX2A, MIX2B, and OVEN2 are our Sources

### **Severity**

The urgency of the event. This may be a value in the range of 1 – 1000. Low severities are meant for informational alarms, and high severities indicate critical issues.

Bakery: we will define severity levels of 500 to Level alarms and 800 to rate-of-change alarms

### **Event time**

The time that the event occurred.

### **Message**

Message text that describes the event.

### **Active time (event type = condition)**

Time that the condition became active (for single-state conditions), or the time of the transition into the current sub-condition (for multi-state conditions).

### **Condition name (event type = condition)**

A condition is a named state. An alarm is a special case of a condition, one which is deemed to be abnormal and requiring special attention.

Bakery: HI, LO, ROC UP, and ROC DOWN are conditions.

### **Subcondition name (event type = condition)**

Conditions may be single state, or multi-state. A multi-state condition is one whose state encompasses multiple "ranges" or sub-states which are of interest. For example, a "Level Alarm" condition may have multiple sub-states including HI and HIHI. Each sub-state is represented by a Subcondition. Subconditions must be mutually exclusive.

If a condition is single state, it has one subcondition whose value is equal to the condition.

Bakery: HI, LO, ROC UP, and ROC DOWN are conditions. We did not define subconditions therefore the event condition and subcondition will contain the same value.

### **Quality (event type = condition)**

Indicates the quality of the underlying data items upon which this condition is based. The three basic quality values are Good, Bad, and Uncertain.

As an example, a "HI" condition event may be generated by a measurement value with an uncertain quality. The event quality would also be uncertain.

### **Changed (event type = condition)**

Indicates which properties of the condition have changed to have caused the OPC A&E Server to send the event.

The changed properties can include:

- Active state
- Acknowledged state
- Enable state
- Quality



- Severity
- Subcondition
- Message
- Vendor attribute

**New State (event type = condition)**

Indicates the event properties of the condition which are currently set.

The new state can include:

- Active
- Acknowledged
- Enabled

Note: New state does not indicate that an item has changed. It indicates that the item is currently set.

As an example, a condition/alarm may occur and then later be acknowledged while the alarm is still active. Two events arrive: one for the alarm active and one for the acknowledge. In both events the New State value of Active is set because the alarm is active. In the second event the New State value of Acknowledged is also set.

See **Detecting alarm/condition active** for information on detecting new alarm events.

**Acknowledge required (event type = condition)**

An indicator as to whether or not an acknowledgement is required.

## **OPC A&E Subscriptions**

An OPC A&E client can configure one or more subscriptions. Each subscription defines:

- The OPC A&E Server
- Details of the desired events (subscription filter)
- Settings that define the details of event delivery

An OPC A&E client does not ask for new events from the subscription. An OPC A&E subscription creates callbacks to the client - as new events occur the client's method for processing is called with the new events (the "callback").

The subscription properties allow the client to control some details of event delivery. A few of these settings are requests that can be overridden by the OPC A&E Server.

### **Active**

Indicates if the subscription should receive events or not

### **Buffer time**

The minimum time between sending of events to the client

### **Maximum size**

The maximum number of events that will be sent to the client in one callback

### **Keep-alive time**

Requests the OPC A&E Server to send heartbeat events if no real events have been sent. This allows a client to know that the subscription is healthy even if real events are not occurring.

### **Filter**

The subscription can specify a filter based on five event field values.

See **OPC A&E Event Fields** for more information on each event fields.

- Event type: one or more event types (simple, tracking, condition)
- Severity: a range of allowed severity levels specified as "low severity" through "high severity". Severity is a value from 1-1000.
- Category: one or more event categories
- Area: one or more areas or area masks (wildcards)
- Source: one or more sources or source masks (wildcards)

\* It may be possible to query the OPC A&E Server for a list of categories, conditions, areas, and sources. See **Browsing the OPC A&E Server**.

If multiple fields are specified in the filter they are logically AND'd together.

Example: filter "EventType=Condition", "Area=BUILD1" includes events with event type = Condition AND area = BUILD1

If the same field is specified multiple times in the filter they are logically OR'd together.

Example filter "Area=BUILD1", "Area=BUILD2" includes events with event type = BUILD1 or BUILD2.

**Filter Mask**

Area and Source subscription filters can include a mask to allow a range of values. The mask can include wildcard characters (\*, ?, ...) to match multiple values. See Filter Masks for more information on mask syntax and rules.

## **Detecting alarm/condition active**

Once a subscription and subscription filter have been configured, an OPC A&E client can start receiving events. After specifying a subscription filter that only returns alarm/condition events, events may arrive due to:

- A Condition going active
- A Condition changing subconditions (e.g. HI to HIHI)
- A Condition being Acknowledged
- A Condition going inactive

In OPC A&E clients such as TopView, the user may only be interested in events where a condition becomes active (change into alarm from inactive state) or a subcondition has changed (e.g. alarm remains active and subcondition changes from HI to HIHI).

TopView for OPCA&E allows the user to perform additional filtering of incoming events based on all relevant fields of an OPC A&E event. This additional filter, configured as part of the Events Tag filter, allows the user to detect alarm/condition events.

The following configuration of the Events Tag filter should detect alarm/condition events.

\* You should view the events of your OPC A&E subscription to verify the States and Changed fields of the desired events.

- Configure the OPC A&E subscription filter  
event type = condition  
(and optionally severity, category, area, and source)
- Once events are received, check for the following event fields by configuring the Events Tag event filter:
  - Event type: Condition (should be true due to the subscription filter)
  - New state: Active (the state of the condition is currently active)
  - Changed:
    - Subcondition (a subcondition just changed)  
In most OPC A&E Servers the subcondition will change for new alarms (Active state just changed) and subcondition changes (e.g. HI to HIHI)
    - Active (the active state just changed)  
This setting is optional and can be used if you are only interested in new alarms and not subcondition changes. In most OPC A&E Servers the Active state will change when a new alarm occurs.

## Filter Masks

Filter masks are supported in the OPC A&E subscription filter.

Characters in mask string:

- ? Any single character.
- \* Zero or more characters.
- # Any single digit (0-9).
- [charlist] Any single character in charlist.
- [!charlist] Any single character not in charlist.

A group of one or more characters (charlist) enclosed in brackets ([ ]) can be used to match any single character and can include almost any character code, including digits.

Note: To match the special characters left bracket ([), question mark (?), number sign (#), and asterisk (\*), enclose them in brackets. The right bracket (]) can't be used within a group to match itself, but it can be used outside a group as an individual character.

By using a hyphen (-) to separate the upper and lower bounds of the range, charlist can specify a range of characters. For example, [A-Z] results in a match if the corresponding character position in string contains any uppercase letters in the range A-Z. Multiple ranges are included within the brackets without delimiters.

Other important rules for pattern matching include the following:

- An exclamation point (!) at the beginning of charlist means that a match is made if any character except the characters in charlist is found in the string. When used outside brackets, the exclamation point matches itself.
- A hyphen (-) can appear either at the beginning (after an exclamation point if one is used) or at the end of charlist to match itself. In any other location, the hyphen is used to identify a range of characters.
- When a range of characters is specified, they must appear in ascending sort order (from lowest to highest). [A-Z] is a valid pattern, but [Z-A] is not.
- The character sequence [] is considered a zero-length string ("")