



Intel® Internet of Things (IoT) Developer Kit

Cloud Analytics User Guide

14 February 2014

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1.0 Introduction

Intel operates a server cloud for users of the Intel® IoT Developer Kit. Each project account has its own space. This guide provides information on how to access and use this cloud to collect and read the data and use cloud analytics functions with the data.

For information on how to set up and provision the IoT Developer Kit's components, see the Intel® IoT Developer Kit Getting Started Guide that accompanied those components and this guide.

1.1. Revision History

Date	Revision	Description
February 2014	-001	

1.2. Overview of Cloud Analytics Technologies

For background information, we provide this overview of the technologies used in the Cloud Analytics solution that you will be working with through your IoT Developer Kit.

Data collection and processing (technologies: Akka/Kafka)

- Data transformation and load
- Real-time message collection, parsing and storage
- RESTful APIs to support registration and un-registration of devices

Data visualization and reports (technologies: Phoenix, HBase*)

- Online streaming monitoring charts
- Multiple measures and devices display
- Aggregation of data for effective data presentation

Self-service rule engine (technology: Spark*)

- Experts rules
- Intuitive UI for rules self-creation with rich statistical capabilities
- Multi-expression (AND/OR) ability to allow identification of complex events
- Advanced reset condition capability to minimize alerting volume

Advanced analytics (technology: Spark)

- Innovative change detection to detect when a process change occurs
- Support various incoming distributions as well as periodicity

APIs and interfaces

- Rich set of RESTful APIs between UI and back end
- Secure and authenticated APIs

1.3. Glossary - Terms, Acronyms and Abbreviations

Term	Definition
Akka	Open source toolkit and runtime simplifying the construction of concurrent and distributed applications
Gateway	A device capable of sending sensor data to the broker over the network
HBase	Open source, non-relational, distributed database modeled after Google's BigTable* and written in Java
Kafka	Distributed publish-subscribe messaging system



Phoenix	Open source SQL query engine for Apache HBase enables querying and managing HBase tables using SQL
Spark	Fast and general engine for large-scale data processing

2.0 Accessing and Using Cloud Functionality

2.1. Download and install IoT agent

Intel operates a server cloud for users of the IoT Developer Kit. Each project account has its own space. If you have not downloaded the IoT agent yet, please perform the following:

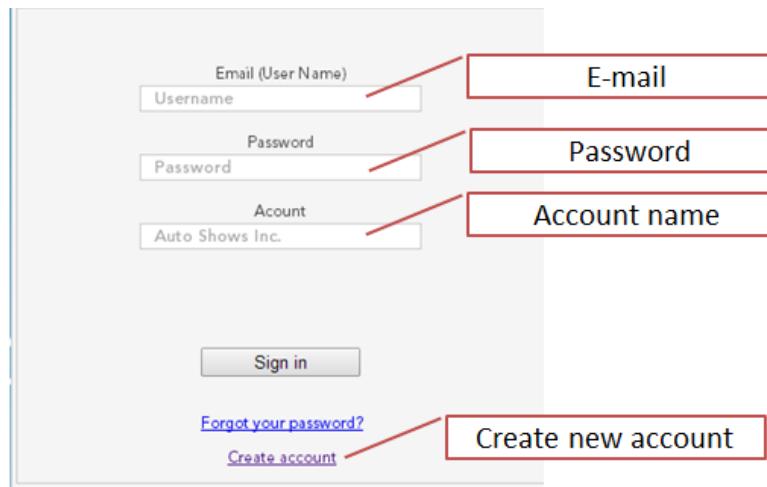
1. Go to: https://github.com/enableiot/iotkit-agent/archive/master.zip .	2014-02-12T03:45:54.236Z - info: IoT Kit Cloud Agent: 84-3A-4B-45-2D-A8
2. Download and unzip this file.	2014-02-12T03:45:54.905Z - info: Cloud client created
3. Execute setup script: <code>cd iotkit-agent./setup-agent.sh</code>	2014-02-12T03:45:54.914Z - debug: Reg doc: <...>
4. Allow approximately 10 minutes for setup.	2014-02-12T03:45:54.923Z - info: Starting listeners...
5. Type "node agent" at prompt.	2014-02-12T03:45:55.295Z - info: REST listener started on port: 9090
6. Note "IoT Kit Cloud Agent" string at top and copy in a safe place. (See bold text on right.)	2014-02-12T03:45:55.314Z - info: TCP listener started on port: 7070
7. Reboot board.	2014-02-12T03:45:55.325Z - info: MQTT listener started on port: 1883
8. Board should reboot with time automatically set and agent started.	2014-02-12T03:45:55.330Z - info: UDP listener started on port: 41234
9. To perform a check, open a console to the board and type "data" to check date/time.	
10. Type "ps" to make sure node.js process is running the agent.	

2.2. Login and Account creation

To **log in** to the system a user with an account must enter three mandatory fields:

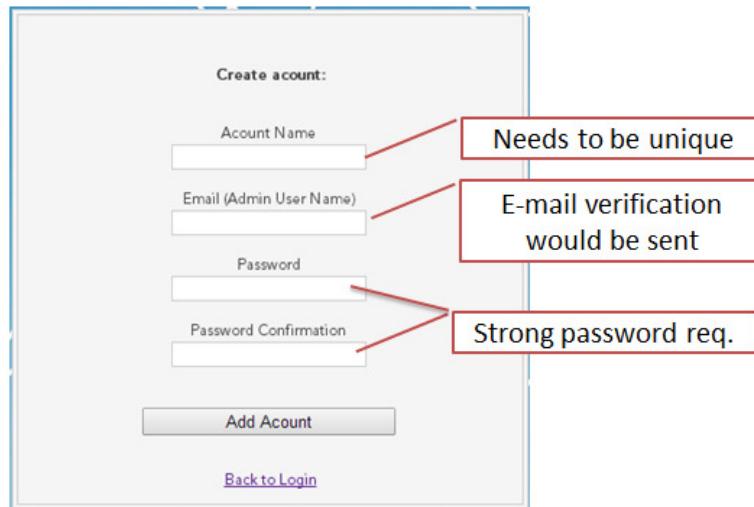
- Email
- Password
- Account name

To **create an account**, skip these fields and, instead, click the "create account" link near the bottom of the window.



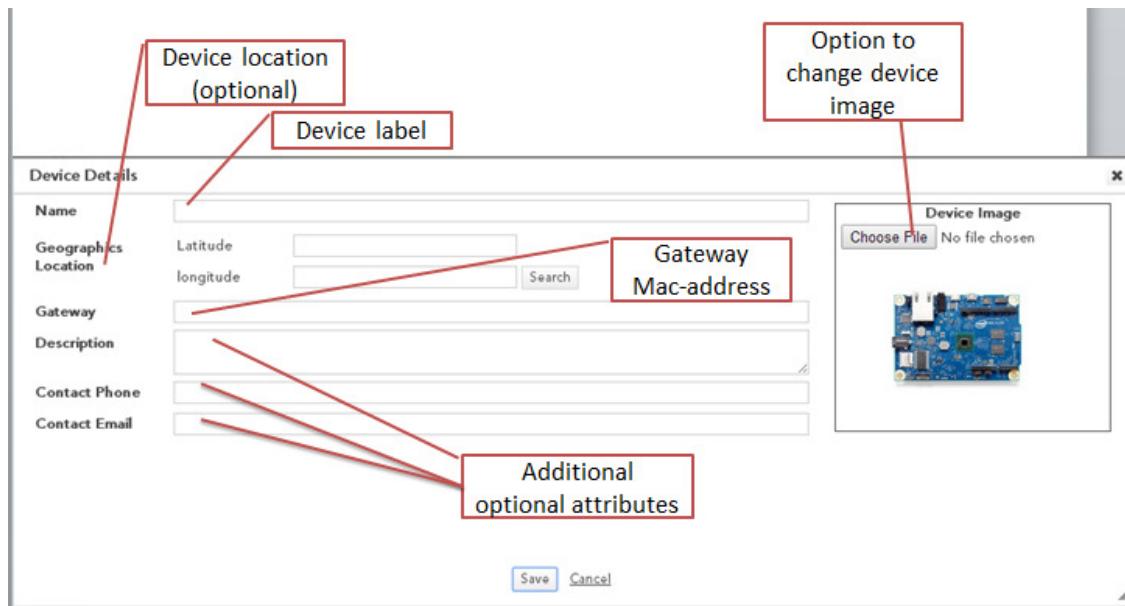
Account creation gives the user who creates the account Admin privileges. The applicant must provide:

- A globally unique account name
- Valid email address (email verification is required to enable the account)
- Strong password (greater than 6 characters with at least 1 digit and at least 1 special character)



2.3. Adding a device

To add a device to the cloud, select the “Devices” tab and click the “Add device” button. Once pressed, the following pop-up will appear.



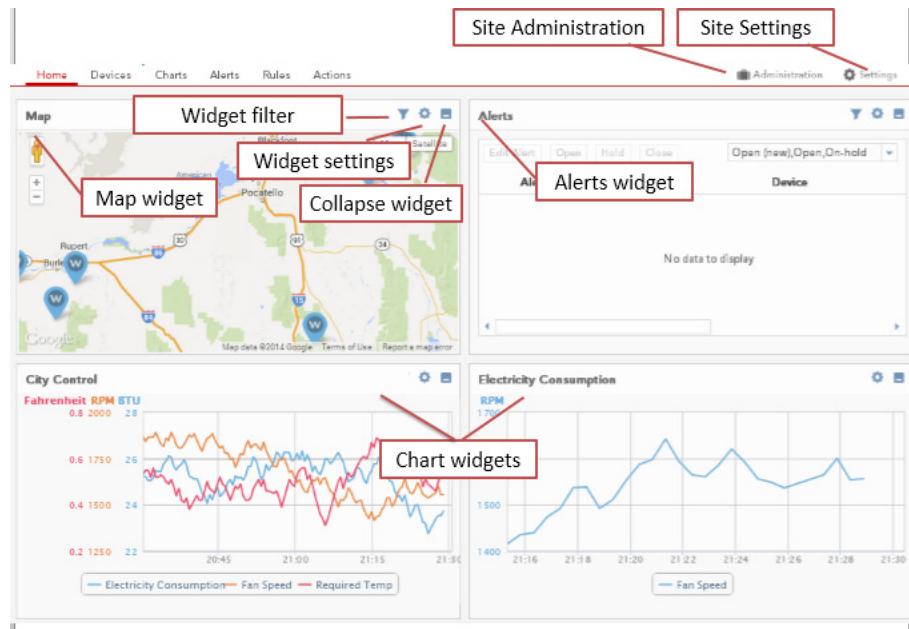
Fields are:

- **Gateway** (mandatory) – usually device Mac-Address
- **Name** (mandatory) – your choice
- **Additional optional attributes** – location (latitude/longitude), device picture, description, contact phone, contact email, etc.

1. In "Device Details" window, enter "Device Name."
2. Enter in "Gateway" field the string you saved from earlier step.
3. Press "Save." Your device is now listed in "Devices".
4. Perform a board reboot (button near USB connectors) to connect device to cloud. (Note: A soft reboot will cause OS to hang.)

2.4. Dashboard

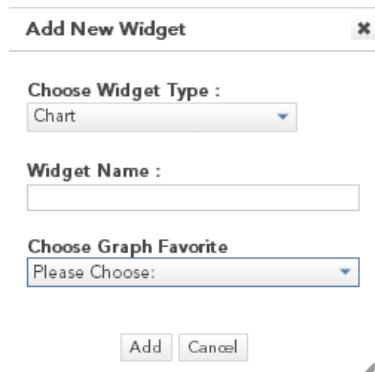
The site home page is a configurable dashboard of widgets. All widgets are resizable and can be ordered by drag and drop.



A user can build and configure the dashboard with the following widgets:

- **Map** – displays all account devices and alerts. Implemented using Google map including zoom capabilities.
- Widget filter – tree filter used to filter map's devices and alerts
- Settings menu options – removes widget from dashboard
- **Alerts Grid** – see section 2.7 Alerts Grid of this document.
- Widget filter – tree filter used to filter displayed device alerts
- Settings menu options – provides ability to (a) select columns; (b) remove widget from dashboard
- **Chart** – displays a pre-defined chart that was created in the chart module and saved in favorites.
- **Settings menu options.**

A user can select to add one or more of above widgets to his dashboard. Add widgets using Site Settings:

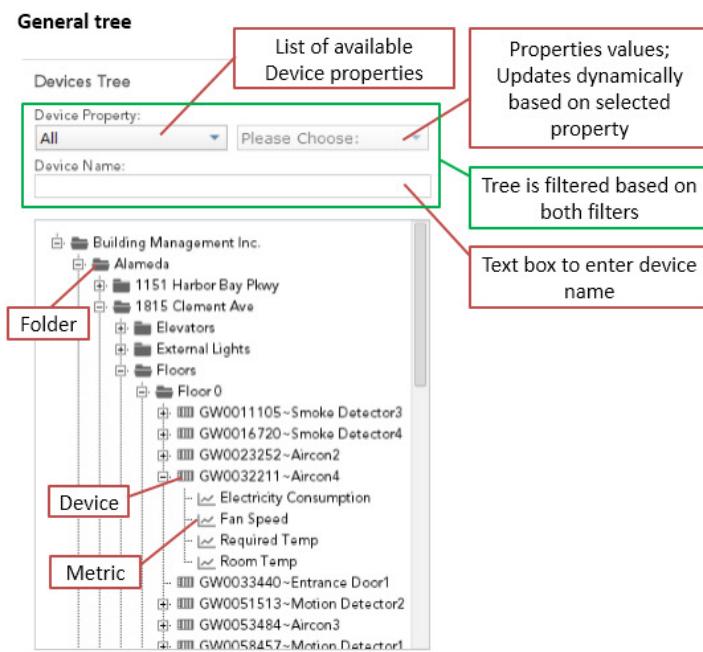


The figure shows a 'Add New Widget' dialog box. It has a title bar 'Add New Widget' with a close button. Below it is a 'Choose Widget Type :' dropdown set to 'Chart'. There is a 'Widget Name :' input field. Below that is a 'Choose Graph Favorite' dropdown set to 'Please Choose'. At the bottom are 'Add' and 'Cancel' buttons.

Widget customization choices include:

- **Widget Type** – map, chart or alert
- **Widget Name** – name that will be displayed as widget title
- **Graph Favorite** – list of available charts that were pre-created and saved by one of the account users (displayed only if a chart widget was selected)

2.5. Tree

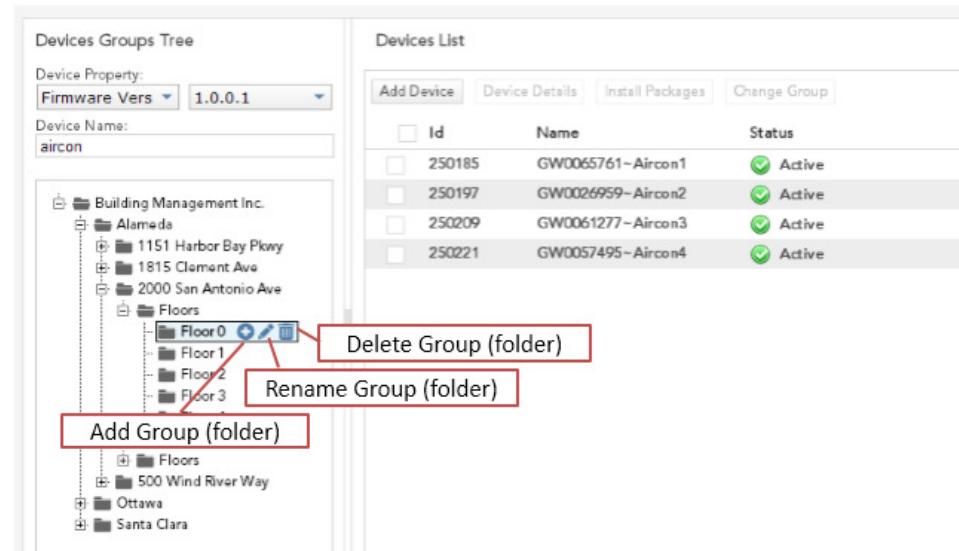


There are a number of different trees to use for filtering devices, rules, alerts, and more. In general, all trees work similarly.

- **Tree filters** – the tree should diminish dynamically following each filter change to display only devices that have the selected property and contain the text entered in the name text box (also known as the “like” operator).
- **Device name filter** – the tree includes a search by name option. When a user searches in the tree, the tree diminishes online based on the search. The results will show all devices with a name that contains similar terms to the string typed by the user.

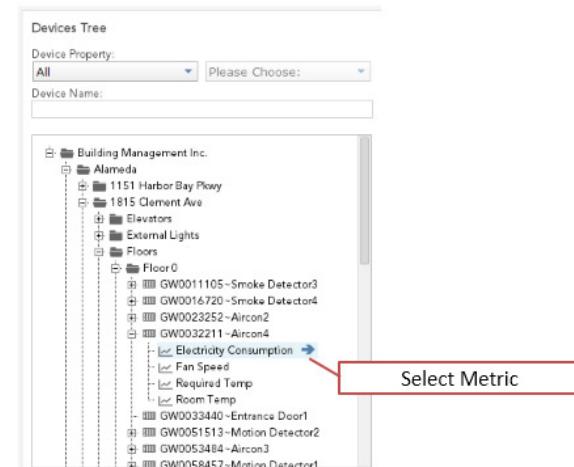
The following are some sample tree screenshots from the different application modules. We note specific functionalities for each.

Devices tree



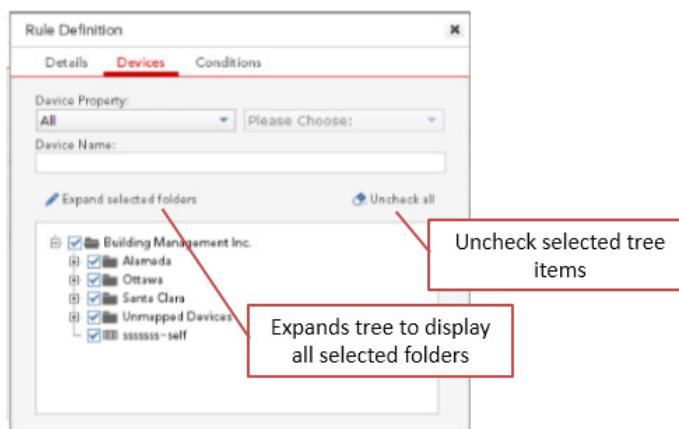
The Devices Groups Tree is a user-defined logical object that holds devices and/or folders. Deleting a group will re-assign all its devices to "Unmapped Devices."

Chart tree



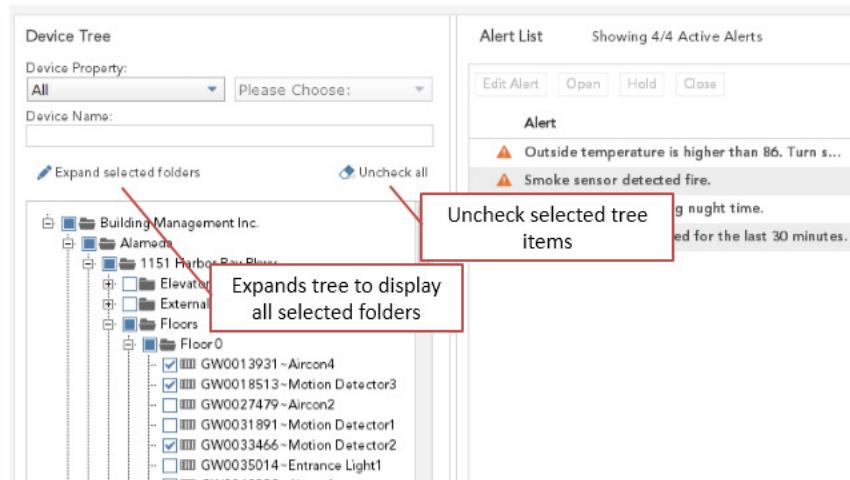
The Chart Tree has a "Select Metric" function that enables a metric to be selected for the graph by: (a) clicking the arrow icon, dragging and dropping it into the chart area; or (b) double clicking it.

New/Edit Rule tree



The New/Edit Rule tree is used to filter grids data (Alerts Grid, Devices list). User can check/uncheck tree folders and/or devices to filter and show data only associated with selected devices.

Alerts tree



The Alerts tree's functionality makes it easy to expand the tree to display selected folders and to de-select all selected items.

2.6. Chart

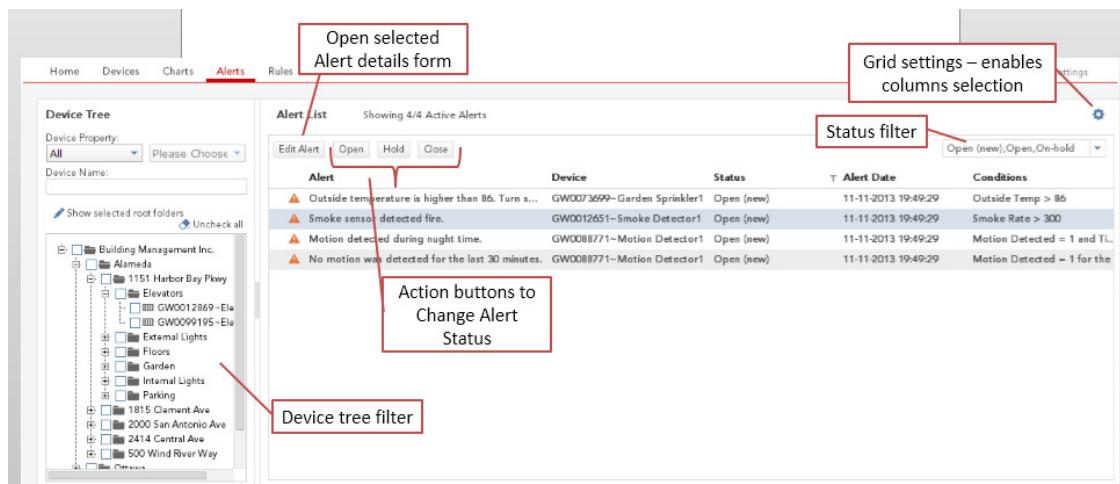


A chart can display multiple metrics from different devices on a time scale with various Y scales. A user can perform the following actions:

1. Add metrics to chart using drag and drop or the arrow button (→).
2. Remove metrics using the bottom legend.
3. Scroll over the graph to see a metric's values at a particular time.
4. Send the chart via email as an Excel* document with the raw data that was sent from HBase (potentially aggregated data).

Chart streaming (every 5 seconds) is available only for chart of "last 15 minutes" and "last hour." Chart aggregation is done to 800 points and is based on splitting the data into equal-time sections and aggregating all points within that time to a single point. Streaming is elaborated in the [interface requirement document](#). Charts support favorites functionality, allowing a user to save a chart's timeframe and displayed metrics. Each point then has the average value and the minimum timestamp of all point within that section.

2.7. Alerts Grid



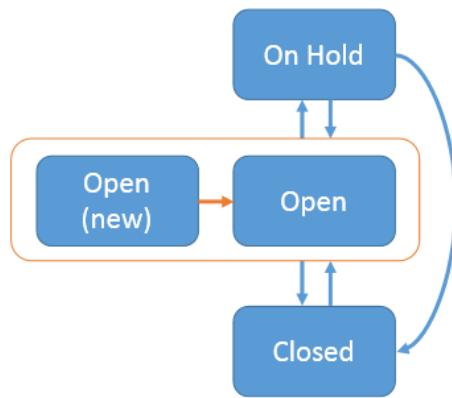
Columns that are displayed by default are **bolded**. The following information is available:

- **Severity icon** – indicates high/medium/low severity according to a rule.
- **Alert** – provides a description of the event.
- **Device** – indicates the device which generated the alert.

- **Status** – provides current status of the alert.
- **Alert Date** – gives the date and time the alert occurred.
- **Conditions** – specifies the parameters in natural language that will trigger an alert and determine its severity (high, medium or low).
- Owner
- Last update date

A user can use the tools on the Alerts Grid to perform the following actions:

- **Grid selection** – select rows with mouse click and select multiple rows using Ctrl/Shift keys.
- **Tree filtering** – filter to show only alerts that were generated by checked devices.
- **Alert status** – change the status of selected alert(s); actions are available based on alert lifecycle shown below.



- Status changes automatically when a user opens alert's details
- Status changes upon button click on Alerts grid OR Alert details

2.8. Alert Details Form

When a user selects the Edit Alert tab on the Alerts Grid screen, the Alert Details Form appears with three tabs:

- Details
- Alert Log
- Alert Graph

Alert: 6 , Device: GW0012651~Smoke Detector1

Details Alert Log Alert Graph

Smoke sensor detected fire. (Alert Id: 6)	Rule name & Alert ID
Alert Date 11-11-2013 19:49:29	Rule priority
Priority ▲ Medium	
Device GW0012651~Smoke Detector1	Link to device details form
Alert Status Open	Status dropdown
Alert Owner admin	Owner dropdown
Alert Values	
Condition Smoke Rate > 300	Value 300
Comments	
At 3 minutes ago user admin wrote: Sam is on his way to the building	
Add Comment	

Save Cancel

There are several key tools on the Alert Details Form:

- **Status dropdown** – displays the current status and enables user to change it by selecting a different value.
- **Owner dropdown** – displays the current owner and enables user to change the owner by selecting a different name from the current list of account users.
- **Condition Grid** – lists all rule conditions and their value when the alert was generated.

An Alert Log tab (below) enables a user to review alert events/actions.

Alert: 6 , Device: GW0012651~Smoke Detector1

Details Alert Log Alert Graph

When	Action Done	Changed By
15 minutes ago	Status was changed: Open (new) <img src="images/...	admin
11-11-2013 19:49:29	Alert was created with status: Open (new)	admin

The Alert Graph tab displays a chart of the alert's metrics with a range of plus and minus one hour within the alert.

2.9. Rule Grid

Status action buttons – changes status of selected rule/s

Status filter

Open New Rule form

Clone selected rule

Open selected rule for Editing

Rules List

Add Rule	Edit Rule	Clone Rule	Activate	Archive	Disable		
271 Turn off sprinkler	Clone selected rule	Description	Owner	Priority	Status	Conditions	Last Update Date
272 Turn off elevators in case of fire		id watering the yard when outside temper...	admin	Medium	Active	Outside Temp > 86	11-11-2013 19:48:00
273 Detect motion during night time		in case the heat sensors in the building sense ...	admin	Medium	Active	Smoke Rate > 300	11-11-2013 19:48:00
274 Turn off lights in case of motion		Motion was detected during office closure ho...	admin	Medium	Active	Motion Detected = 1 and Time B...	11-11-2013 19:48:00
275 Turn off A/C if required temp is not met		Turn the light off in case no motion was detected...	admin	Medium	Active	Motion Detected = 1 for the last ...	11-11-2013 19:48:00
		The A/C required temp was set for an unauth...	admin	Low	Active	Required Temp > 80	11-11-2013 19:48:00



In the Rule Grid, a user can select a row with a mouse click and select multiple rows using Ctrl/Shift keys. The default setting for the status filter is to display all rules except those that are archived.

Rule Status Settings:

- Draft – when creating a new rule, a user can select to save it as Draft. A draft rule will not be tracked by the Rule Engine for exceptions.
- Active – the rule is tracked by Rule Engine.
- Archive - the rule is not tracked by Rule Engine.
- OnHold - the rule is not tracked by Rule Engine.

Table: Grid Controls

Control	Row Applicability	Rule Status Applicability
Add	Single	All
Edit	Single	All
Clone	Single	All
Activate	Single & Multiple	Draft, On Hold, Archive
Archive	Single & Multiple	Draft, On Hold, Active
Disable	Single & Multiple	Draft, Active, Archive

Other tools:

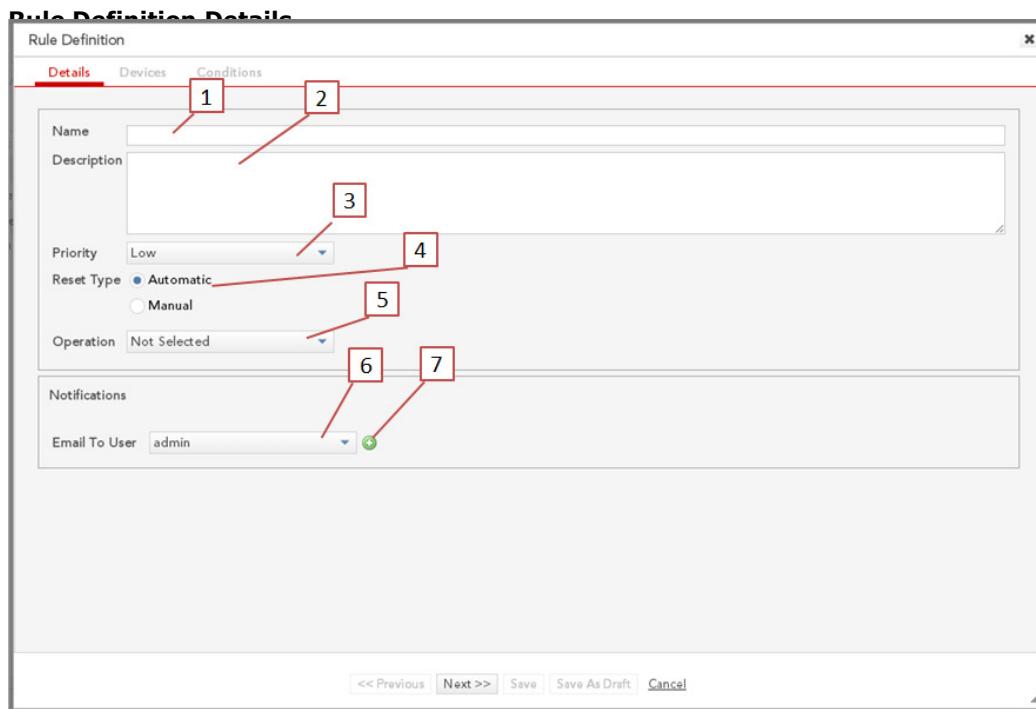
- Clone Rule – opens “Add New Rule” form filled in with all the cloned rule’s parameters.
- Conditions – provides natural language text for each rule’s conditions.

2.10. New/Edit Rule

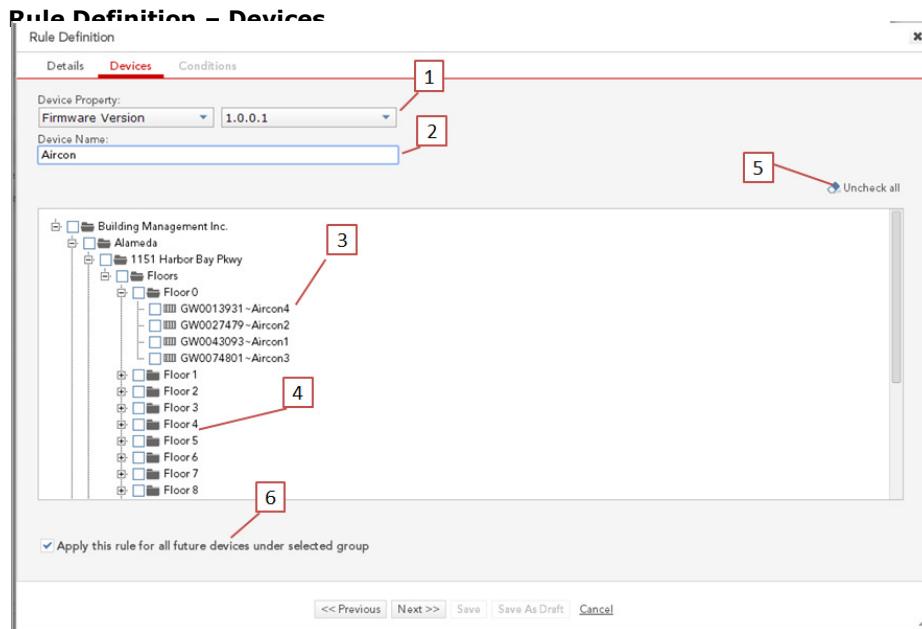
Creation of a rule definition consists of a 3-step wizard:

1. Details – enables input of general rule details (name, priority, notifications, and more).
2. Devices – allows specification of the device population for which this rule will apply.
3. Conditions – enables input of the parameters for a rule.

For each wizard step, there are mandatory fields and optional fields. A user will be prompted for a missing mandatory field when trying to progress from one tab to the other.



1. Rule name
2. Rule description
3. Rule priority – enables representation of alert priority by icon
4. Reset Type
 - Automatic – alert is reset once the condition for an alert is not matched anymore
 - Manual – no additional alerts for this rule and device combination are raised until the alert is closed
5. Operation – specifies the action which would be triggered on an alert, such as an action triggered on the alerted device
6. Email notification – enables selection of the various users defined for the account to receive an email concerning an alert
7. Option to add additional emails for notification

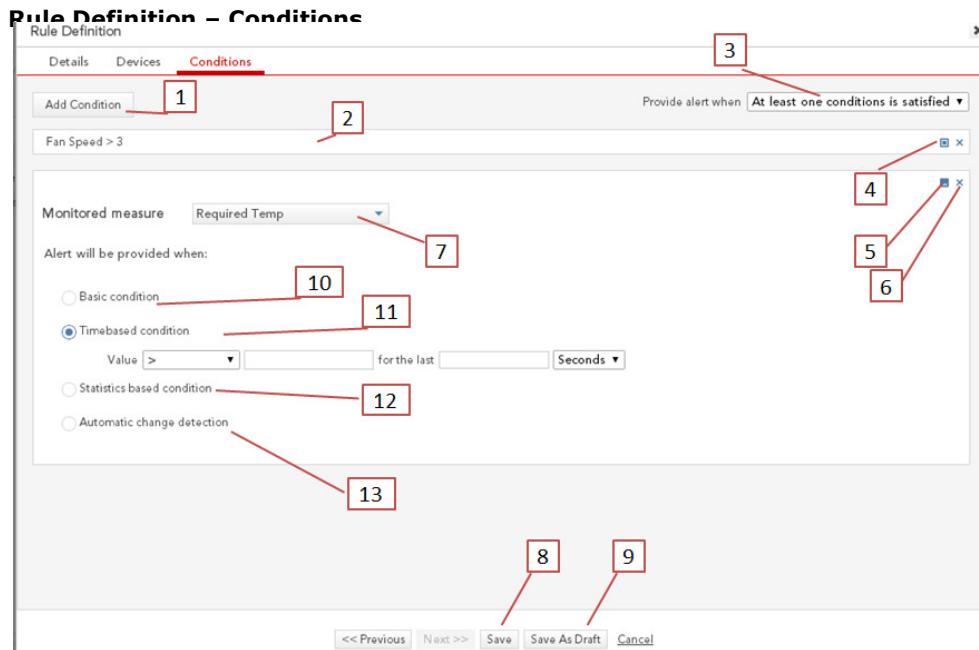


Each rule must have at least one device or folder in its population. A rule population is defined by 3 fields/selections:

1. Device property
2. Device name
3. Tree

Other functionalities to note:

4. Selecting an entire folder in the tree enables all devices in that folder to be monitored by the rule being created.
5. All folders in a tree can be de-selected at once with the “uncheck all” command.
6. The checkbox below the tree enables application of the rule to future devices in the selected folder(s).



The following functionalities are available to the user:

1. Add Condition – use to add a new condition (no limit exists to the number of conditions)
2. Natural language explanation of the condition being created
3. Relation among all conditions – can be either AND or OR
4. Enlarge condition
5. Minimize condition
6. Delete condition
7. Drop-down menu for specifying all possible metrics for the device population selected in previous wizard step
8. Save – saves selections for the rule and starts monitoring from this point forward
9. Save As Draft – saves selections, but the rule remains inactive and does not trigger alerts
10. Basic condition (example: value X >10)
 - Possible values:
 - String – equal, not equal
 - Non-string - <, >, >=, <=, equal, not equal, between, not between
11. Time-based condition (example: value X >10 for 3 minutes)
 - String
 - Possible values – equal, not equal
 - Additional info – can contain multiple values with relation OR between them
 - Non-string
 - Possible values <, >, >=, <=, equal, not equal, between, not between
12. Statistical-based condition (example: value X > avg + 2stdev)
 - Only relevant for numeric metrics
 - Possible values <, >, <=, >=, between, not between
 - Additional parameters/advanced settings
 - Control limits 2, 3
 - Time back to calculate baseline
 - Minimal instances to calculate baseline
13. Automatic change detection
 - Monitors single metric for deviation from historical performance
 - Sensitivity levels (low, medium, high) defined in CD design document
 - Can contain one condition only and cannot be used with additional conditions



3.0 Install IoT Kit Arduino Library and Samples

You can download samples from <http://github.com/enableiot/iotkit-samples/blob/master/arduino/IoTkit.zip>.

1. From Arduino IDE, select: Sketch ->Import Library ->Add Library
2. Browse to IoTkit.zip file.
3. Press "Open" button.
4. After installation finishes, you should see under "File ->Examples" the IoTkit listed.

4.0 Start Working with Cloud

You are now ready to write Arduino scripts to send data to the cloud. Write the scripts on your computer and then download them to the board and run. After a few minutes, check <http://www.enableiot.com> to view the data.