OIC SMART HOME DEVICE SPECIFICATION V1.0.0

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1 Scope

The OIC Smart Home Device specification is an OIC Application Profile specification.

The Smart Home Device specification specifies the Smart Home devices. The Smart Home Device definitions use Resource definitions from the OIC Resource Type Specification

The Smart Home Device Specification is built on top of the Core Specification. The Core Specification specifies the OIC core architecture, interfaces protocols and services to enable the implementation of OIC profiles for IoT usages and ecosystems. The Core specification also defines the main architectural components of network connectivity, discovery, data transmission, device & service management and ID & security. The core architecture is scalable to support simple devices (constrained device) and more capable devices (smart device).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

OIC Core Specification, *Open Interconnect Consortium Core Specification*, Version 1.0.

OIC Resource Type Specification, *Open Interconnect Consortium Resource Type Specification*, Version 1.0.

OIC Security Specification, *Open Interconnect Consortium Security Capabilities*, Version 1.0

IETF RFC 7049, *Concise Binary Object Representation (CBOR)*, October 2013
http://www.ietf.org/rfc/rfc7049.txt

IETF RFC 7159, *The JavaScript Object Notation (JSON) Data Interchange Format*, March 2014
http://www/ietf.org/rfc/rfc7159.txt

RAML, *Restful API modelling language,* Version 0.8.
http://raml.org/spec.html.

3 Terms, definitions symbols and abbreviations

3.1 Terms and definitions

3.1.1
Actuator
OIC Resource with support of the update operation.

3.1.2
OIC Smart Home Bridge Device
An OIC Smart Home Device that is capable of representing other devices that exist on the network.

3.1.3
OIC Smart Home Device
An OIC Device that is conformant to the normative requirements contained in this specification.

3.1.4
Sensor
OIC Resource without support of the update operation.

3.2 Symbols and abbreviations

3.2.1

CRUDN

Create Read Update Delete Notify

This is an acronym indicating which operations are possible on the resource.

3.2.2

CSV

Comma Separated Value List

Comma Separated Value List is a construction to have more fields in 1 string separated by commas. If a value contains a comma then the comma can be escaped by adding "\" in front of the comma

3.2.3

OIC

Open Interconnect Consortium

The organization that created these specifications

3.2.4

RAML

RESTful API Modelling Language

RAML is a simple and succinct way of describing practically-**RESTful APIs**. See **RAML.**

3.2.5

REST

Representational State Transfer

REST is an architecture style for designing networked applications and relies on a stateless, client-server, cacheable communications protocol.

3.3 Conventions

In this specification a number of terms, conditions, mechanisms, sequences, parameters, events, states, or similar terms are printed with the first letter of each word in uppercase and the rest lowercase (e.g., Network Architecture). Any lowercase uses of these words have the normal technical English meaning.

4 Document conventions and organization

This document lists all the Devices used in the Smart Home Domain. The devices are specified by which mandatory and optional Resources are used.

For the purposes of this document, the terms and definitions given in OIC Core Specification and OIC Resource Type Specification apply.

4.1 Notation

In this document, features are described as required, recommended, allowed or DEPRECATED as follows:

Required (or shall or mandatory).

> These basic features shall be implemented to comply with OIC Core Architecture. The phrases "shall not", and "PROHIBITED" indicate behavior that is prohibited, i.e. that if performed means the implementation is not in compliance.

Recommended (or should).

These features add functionality supported by OIC Core Architecture and should be implemented. Recommended features take advantage of the capabilities OIC Core Architecture, usually without imposing major increase of complexity. Notice that for compliance testing, if a recommended feature is implemented, it shall meet the specified requirements to be in compliance with these guidelines. Some recommended features could become requirements in the future. The phrase “should not” indicates behavior that is permitted but not recommended.

Allowed (or allowed).

These features are neither required nor recommended by OIC Core Architecture, but if the feature is implemented, it shall meet the specified requirements to be in compliance with these guidelines.

Conditionally allowed (CA)

The definition or behaviour depends on a condition. If the specified condition is met, then the definition or behaviour is allowed, otherwise it is not allowed.

Conditionally required (CR)

The definition or behaviour depends on a condition. If the specified condition is met, then the definition or behaviour is required. Otherwise the definition or behaviour is allowed as default unless specifically defined as not allowed.

DEPRECATED

Although these features are still described in this specification, they should not be implemented except for backward compatibility. The occurrence of a deprecated feature during operation of an implementation compliant with the current specification has no effect on the implementation’s operation and does not produce any error conditions. Backward compatibility may require that a feature is implemented and functions as specified but it shall never be used by implementations compliant with this specification.

Strings that are to be taken literally are enclosed in “double quotes”.

Words that are emphasized are printed in *italic*.

4.2 Data types

See OIC Core Specification.

4.3 Document structure

The Smart Home Device specification defines an OIC Device for usage in the Smart Home vertical. This document describes an OIC Device and makes use of functionality defined in the OIC Core Specification and OIC Resource Type Specification.

The OIC Core Specification provides building blocks to define OIC Devices. The following Core functionality is used:

- Required OIC Core Resources.
- Required transports.

Note that other mandatory functions in the Core might be needed to create an OIC compliant device, but are not mentioned in this document.

The Smart Home Device profile consists of using RAML as a specification language and using JSON Schemas as payload definitions for all CRUDN actions. The mapping of the CRUDN actions is specified in the CORE.

Other building blocks used in this document are the OIC Resources specified in the OIC Resource Type Specification.

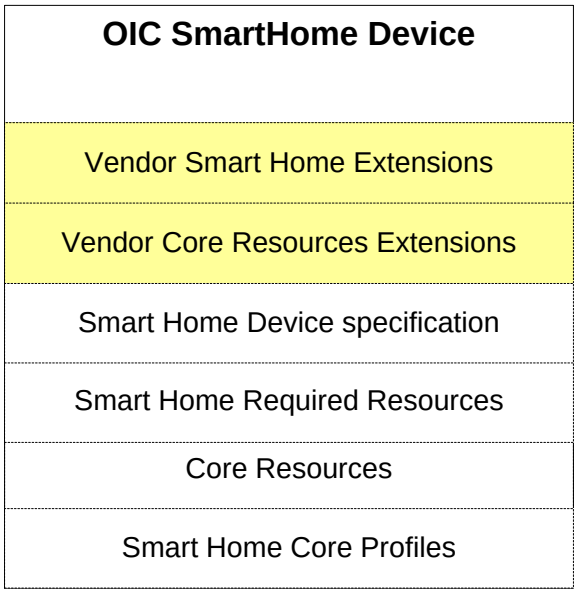


Figure 1 Smart Home device building blocks.

This document describes which constructs are used for an OIC Smart Home Device and which resources are mandated to be implemented for each OIC Smart Home Device. A typical OIC Smart Home Device consisting of data elements defined in the referenced specification documents is depicted in Figure 1.

5 Operational Scenarios

Section intentionally left blank.

6 Core Resource model

6.1 Introduction

The Core resource model is described in the OIC Core Specification.

6.2 Device Type

The device types of all Smart Home devices shall have a resource type name (rt) prefixed with "oic.d."

Examples of OIC Device types are:

- oic.d.fan
- oic.d.thermostat

The full list of Smart Home defined Device names and types are in Table 10-1. This table also includes the list of minimal resource(s) that an OIC Device shall implement for that device type. A device may expose additional OIC and Vendor defined Resources than indicated in this Table.

The OIC Core Specification defines a Device resource with a well-known URI of /oic/d. The base resource type name for this resource shall be overridden by an OIC Smart Home Device with the

device type of the device hosting the OIC Server. An instance of /oic/d with its resource type name overridden in this manner shall expose all mandatory properties for /oic/d defined in the OIC Core Specification.

This then results in the OIC Smart Home Device being exposed in /oic/res as a link to /oic/d with an ‘rt’ that designates the Device Type as defined in this specification,

Therefore an OIC Smart Home Device can be discovered by adding a query for the ‘rt’ of the device itself (e.g. oic.d.fan) to the Core defined multicast Endpoint Discovery method (see also Section 7.1).

6.3 Profile of OIC Core

This section describes the profiling of the Core Resources and transport mechanisms and functions that are defined in the OIC Core Specification.

The required OIC Core Resources are also required for an OIC Smart Home profile implementation.

In addition to the OIC required Core Resources the optional OIC Core Resources in Table 6-1 are required for an OIC Smart Home Profile.

Table 6-1 Required Resources for OIC Smart Home Devices.

Resource (rt)	Required in Profile

Table 6-2 Required properties in Resource

Resource (rt)	Property name	Required in Profile
		…

An OIC Smart Home Device shall support CoAP based Endpoint Discovery as defined in Section 10.2 of the OIC Core Specification.

The messaging protocol for an OIC Smart Home Device shall be CoAP (see OIC Core Specification).

An OIC Smart Home Device shall support a network layer as defined in Section 9 of the OIC Core Specification including any necessary defined bridging functions that ensure inter-operability with IPv6.

6.4 Vendor specified Resource Types

This section describes how a vendor can add vendor defined Resource Types.

A vendor can specify additional (non-OIC Resources) within an OIC Device. The vendor defined OIC Resource Type shall still implement the core and smart home specified mandatory properties in the resource instance. The vendor shall use the following syntax for rt:

x.<ICANNName).<resource identification>

where in the ICANNName the “.” (dots) are replaced with “-” (dash)

Examples:

x.samsung-com.galaxyphone.accelerator

x.cisco-com.ciscorouterport

x.hp-com.printerhead

7 Discovery

7.1 Endpoint Discovery

OIC Clients can discover OIC Devices by issuing network search commands. The commands are issued with the rt Query values of the devices that the OIC Client wants to discover, or if no rt Query value is provided then the search is for all available devices irrespective of device type.

The discovery mechanism is set up in such way that the OIC Smart Home Devices can be found by device type or implemented resource type. This difference is conveyed by the wanted *rt* argument of the Core Search method (see section 11.2 of OIC Core Specification).

The values that can be used for discovering a specific device type are listed in Table 10-1 . The values that can be used to discover a specific resource (service) type are listed in the OIC Resource Type Specification in section 6.]

The discovery process provides the root URL of the OIC Device to the OIC Client. The structure of the detected OIC Device can then be retrieved by Resource Discovery.

7.2 Resource Discovery

Section intentionally left blank

8 OIC Smart Home Bridge Device

This section describes the functionality of an OIC Smart Home Bridge Device; such a device is illustrated in Figure 2 Schematic overview of an OIC Smart Home Bridge Device bridging proprietary devices

An OIC smart home bridging device is a device that represents one or more other devices as OIC Smart Home Devices on the network. The represented devices themselves are out of the scope of this document. The bridging is implementation and vendor specific. The only difference between an OIC Device and a bridged device is how the device is encapsulated in an OIC Smart Home Bridge Device.

An OIC Smart Home Bridge Device shall be indicated on the network with an “rt” of “oic.d.bridge”. When such a device is discovered the exposed resources on the OIC Smart Home Bridge Device describe other OIC Devices.

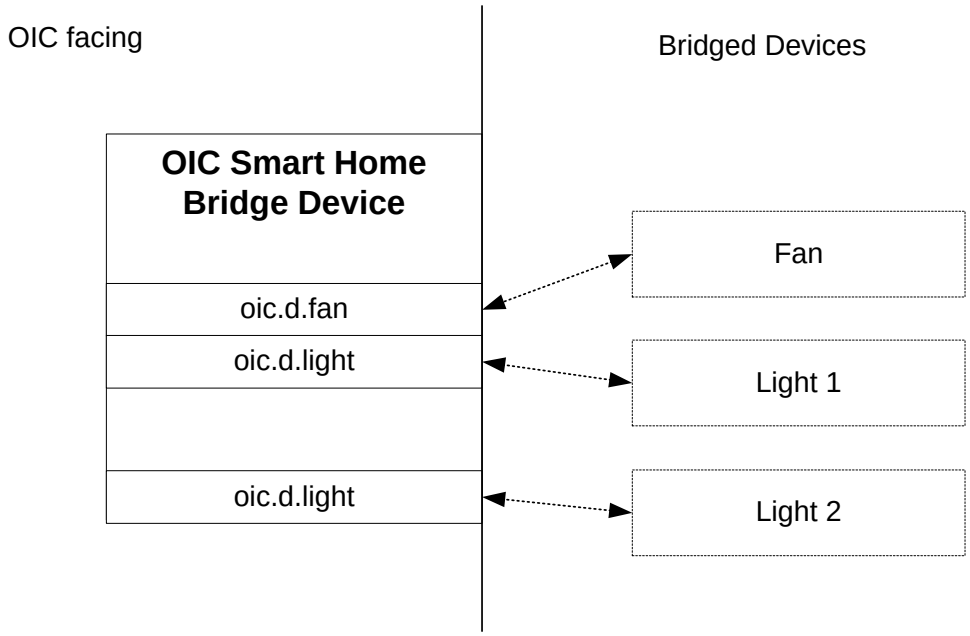
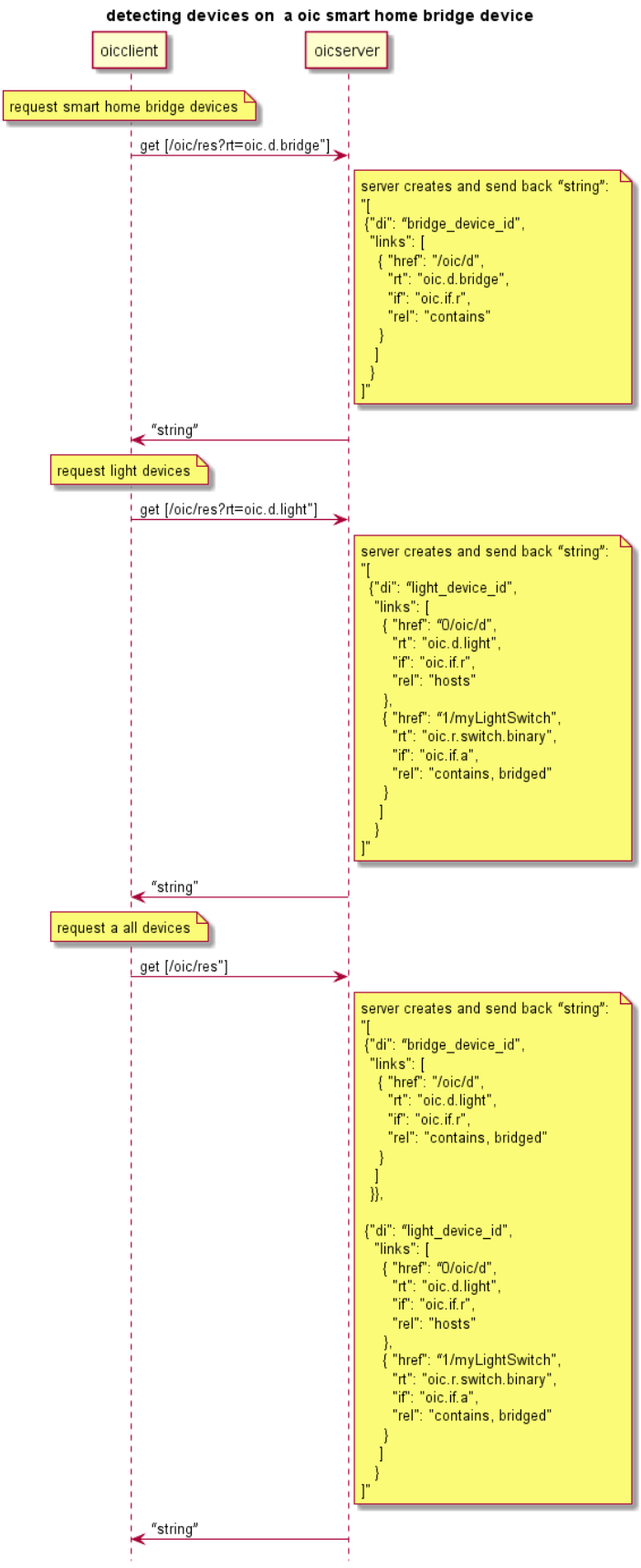


Figure 2 Schematic overview of an OIC Smart Home Bridge Device bridging proprietary devices

It is expected that the OIC Smart Home Bridge Device creates a set of devices during the start-up of the OIC Smart Home Bridge Device. The exposed set of devices can change as bridged devices are added or removed from the bridge. The adding and removing of bridged devices is implementation dependent. When an OIC Smart Home Bridge Device changes its set of exposed devices it shall notify any subscribed clients.

An OIC Smart Home Bridge Device shall respond to network discovery commands on behalf of the exposed bridged devices. All bridged devices with all their resources shall be listed in /oic/res. The response to a RETRIEVE on /oic/res shall only include the devices that match the RETRIEVE request.

The bridged devices shall populate the ‘rel’ element within the link in /oic/res with “contains bridged” when the bridged device is not part of the OIC Smart Home Bridge device. The additional “bridged” relationship must be used when the bridged device is connected to the OIC Smart Home Bridge device by means of an external physical connection. Conversely, when the bridge and embedded bridged devices share a common physical platform, the ‘rel’ element is populated with “contains”.



306 **Figure 3 Call Sequences of requesting different devices in a smart home bridge including**
307 **responses**

308 # 9 Security

309 An OIC Smart Home Device shall implement the mandated security resources specified in OIC
310 Core Specification. Additionally an OIC Smart Home device shall secure all links used to access
311 resources using DTLS.

312 # 10 Device Types

313 ## 10.1 Standardized device types

314 Standardized device types can mandate that specific resources be implemented. The required
315 resource per device type is listed in Table 10-1. Additionally, specific resources that use
316 enumeration values to indicate supported states or modes can mandate usage of standardized
317 enumeration values. The mandated allowed values are indicated for each applicable resource
318 type, the property of interest on that resource type and to which device type it applies.

319 Some OIC Devices shall support 2 resources of the same type. When this is the case the
320 Resources shall be different in support of CRUDN actions. E.g. one Resource shall act as a
321 sensor (CRUDN action write shall not be supported) and the other Resource shall act as an
322 actuator (CRUDN actions supported: at a minimum, read and write).

323 **Table 10-1 Alphabetical list of device types (rt), including required resources.**

324

Device Name (informative)	Device Type (rt) (Normative)	Required Resource name[1]	Required resource type
Air Conditioner	oic.d.airConditioner	Binary switch	oic.r.switch.binary
		Temperature	oic.r.temperature
Air Purifier	oic.d.airPurifier	Binary switch	oic.r.switch.binary
Blind	oic.d.blind	Open Level	oic.r.openLevel
Camera	oic.d.camera	media	oic.r.media
Dishwasher	oic.d.dishwasher	Binary switch	oic.r.switch.binary
		mode	oic.r.mode
Door	oic.d.door	Open Level	oic.r.openLevel
Dryer	oic.d.dryer	Binary switch	oic.r.switch.binary

[1] Note that the functionality associated with, or visibility of, an instance of a BinarySwitch resource exposed by a Device may be restricted depending upon local (per country or legislative region) regulatory requirements (e.g. in some jurisdictions the ability to remotely power on a connected device is restricted).

		mode	oic.r.mode
Fan	oic.d.fan	Binary switch	oic.r.switch.binary
Garage Door	oic.d.garageDoor	Door	oic.r.door
Generic Sensor	oic.d.sensor	At least one of oic.r.sensor.<x>	oic.r.sensor.<x>
Light	oic.d.light	Binary switch	oic.r.switch.binary
Oven	oic.d.oven	Binary switch	oic.r.switch.binary
		Temperature (2)	oic.r.temperature
Printer	oic.d.printer	Binary switch	oic.r.switch.binary
		Operational State	oic.r.operational.state
Printer Multi-Function	oic.d.multifunctionPrinter	Binary switch	oic.r.switch.binary
		Operational State (2)[2]	oic.r.operational.state
		Automatic Document Feeder	oic.r.automaticDocumentFeeder[3]
Receiver	oic.d.receiver	Binary switch	oic.r.switch.binary
		Audio Controls	oic.r.audio
		Media Source List (2)	oic.r.media.input, oic.r.media.output
Refrigerator	oic.d.refrigerator	Binary switch	oic.r.switch.binary
		Refrigeration	oic.r.refrigeration
		Temperature (2)	oic.r.temperature

[2] A Multi-Function Printer shall expose two instances of an Operational State resource; each in discrete collections, one for the Printer specific operational state information and one for the Scanner specific operational state information. The friendly name for the collections should indicate the device modality (printer or scanner).

[3] A Multi-Function Printer shall only expose an Automatic Document Feeder resource if the device has the Automatic Document Feeder capability.

Robot Cleaner	oic.d.robotCleaner	Binary switch	oic.r.switch.binary
		Mode	oic.r.mode
Scanner	oic.d.scanner	Binary switch	oic.r.switch.binary
		Operational State	oic.r.operational.state
		Automatic Document Feeder	oic.r.automaticDocumentFeeder
Security Panel	oic.d.securityPanel	Mode	oic.r.mode
Smart Plug	oic.d.smartPlug	Binary switch	oic.r.switch.binary
Switch	oic.d.switch	Binary switch	oic.r.switch.binary
Television	oic.d.tv	Binary switch	oic.r.switch.binary
		Audio Controls	oic.r.audio
		Media Source List	oic.r.media.input
Thermostat	oic.d.thermostat	Temperature (2)	oic.r.temperature
Washer	oic.d.washer	Binary switch	oic.r.switch.binary
		Mode	oic.r.mode
Water Valve	oic.d.waterValve	Open Level	oic.r.openLevel

10.2 Standardized enumeration values

Some resources have a list of supported enumeration values. The supported enumeration values can differ when applied in different devices. In this section the affected resources are described by:

- Generic list of supported values
- Mandated list of supported values when applied to a specific device

Also a device vendor is allowed to extend the generic list of supported enumeration values. A vendor specific value is defined as:

X_<ICANNName)_<enum value>

where in the ICANNName the “.” (dots) are replaced with “-” (dash)

Examples:

x.samsung-com.washer.superfluffyspin

x.cisco-com.firmwareupdate

x.hp-com.fastscan

10.3 Alphabetical list of standardized enumeration types

This section lists the standardized enumeration types that are used in the oic.r.mode and oic.r.operational.state resources.

- aborted
  - An internal device, communication or security error
- active
  - Unit is active
- airDry
  - unit is air drying
- armedAway
  - unit is armed for away
- armedInstant
  - unit is armed instantly
- armedMaximum
  - unit is armed at maximum level
- armedNightStay
  - unit is armed in night stay
- armedStay
  - unit is armed in stay mode
- cancelled
  - the job was cancelled either by the remote client or by the user
- completed
  - job finished successfully
- down
  - unit is unavailable
- dry

- unit is dry mode

- idle
  - new jobs can start processing without waiting
- pause
  - unit is paused (by user)
- pending
  - job initiated, engine is preparing
- pendingHeld
  - job is not a candidate for processing for any number of reasons, will return to pending state if reasons are solved.
- preWash
  - unit is pre wash mode
- processing
  - processing the job
- rinse
  - unit is rinse mode
- stopped
  - error condition occurred
- spin
  - unit is in spin mode
- testing
  - calibrating, preparing the unit
- wash
  - unit is in wash mode
- wrinklePrevent
  - unit is in winkle prevent mode

10.4 Standardized list of supported values for Mode resource (oic.r.mode)

The following enumeration values apply to both the supportedModes and Modes properties within the Mode resource.

394 **Table 10-2 list of required oic.r.mode supported values per device type (rt)**

Device Name (informative)	Device Type (rt) (Normative)	Required enumeration value
Dishwasher	oic.d.dishwasher	wash
		airDry
		preWash
		completed
		aborted
		idle
Dryer	oic.d.dryer	airDry
		completed
		aborted
		idle
Robot Cleaner	oic.d.robotCleaner	active
		idle
		completed
		aborted
Washer	oic.d.washer	wash
		rinse
		spin
		idle
		aborted
		cancelled

		completed
Security Panel	oic.d.securityPanel	active
		armedAway
		armedInstant
		armedMaximum
		armedNightStay
		armedStay

The modes can be viewed upon as mode changes of the device. However this specification does not impose any relationship between the different modes of a device. Hence all mode changes are expected to occur from an OIC Client point of view.

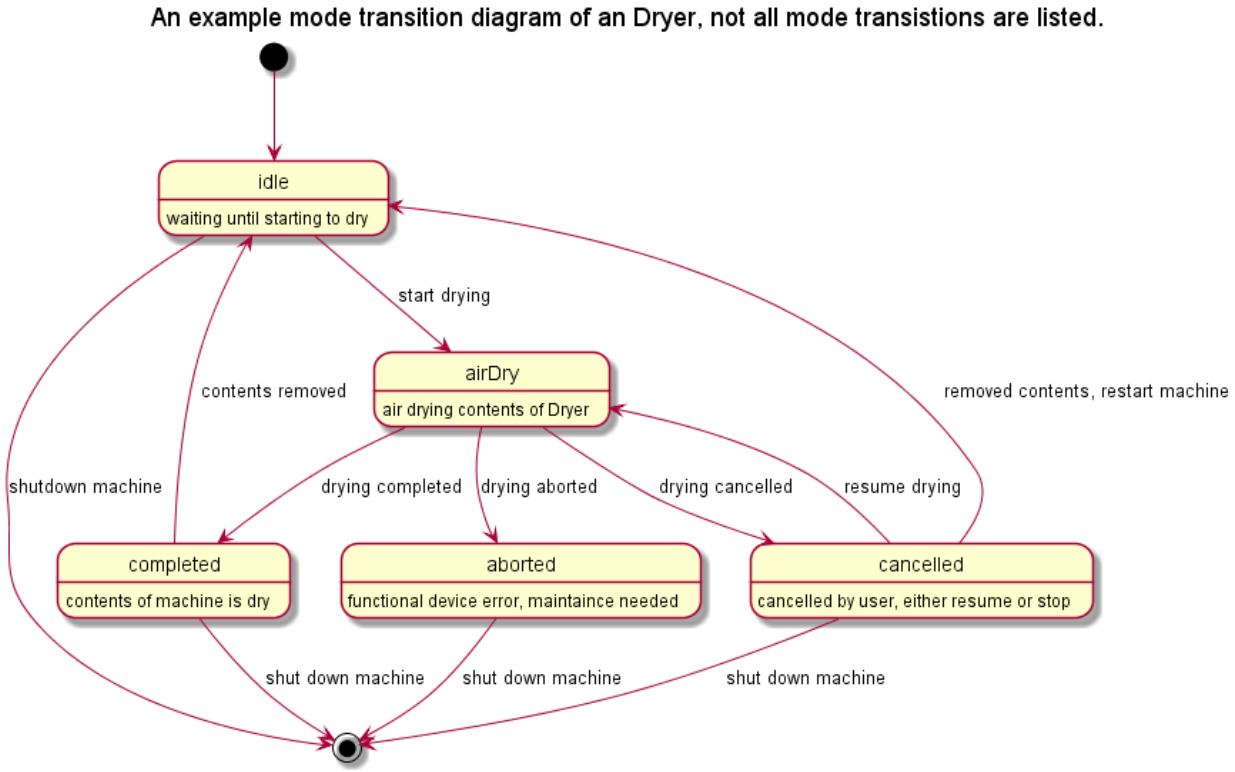


Figure 4 Example of mode transitions of a Dryer.

10.5 Standardized list of supported values for Operational State resource (oic.r.operational.state)

The following enumeration values apply to the jobStates and machineStates properties within the Operational State resource.

406 **Table 10-3 list of required oic.r.operational.state supported values per device type (rt)**

Device Name (informative)	Device Type (rt) (Normative)	Required enumeration value machineStates	Required enumeration value jobStates
Printer	oic.d.printer	idle	pending
		processing	pendingHeld
		stopped	processing
			cancelled
			aborted
			completed
Printer Multi-Function	oic.d.multifunctionPrinter	See printer	See printer
		See scanner	See scanner
scanner	oic.d.scanner	idle	cancelled
		processing	aborted
		testing	completed
		stopped	pending
		down	processing

407 The operational state can be viewed as state changes of the device that includes separate
408 handling of jobs within the overall machine state. However this specification does not impose any
409 relationship between the different machine or job states of a device. Hence all machine states
410 and or jobstate changes are expected to occur from an OIC Client point of view.

411

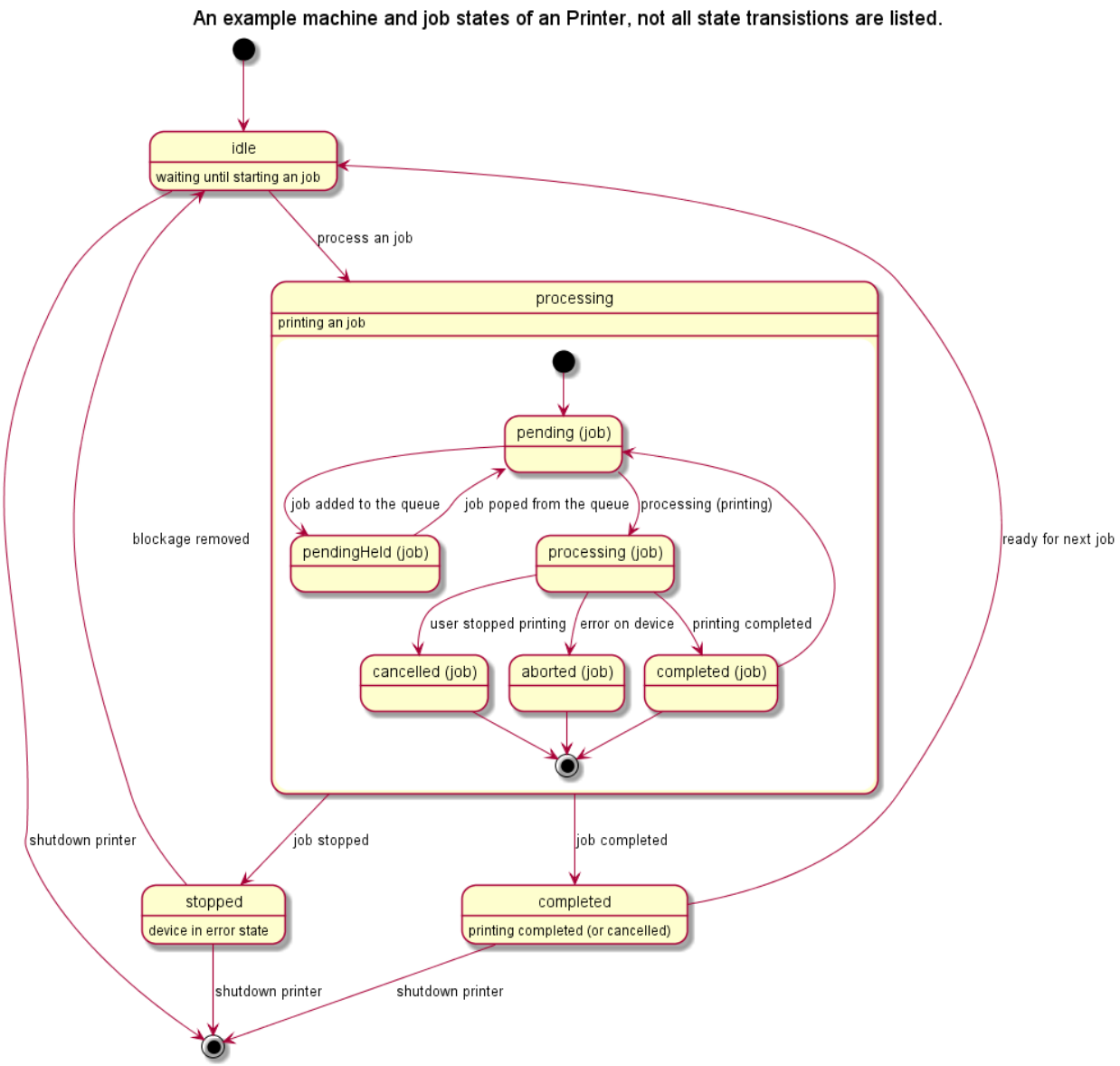


Figure 5 Example of mode transitions of a Printer.

10.6 Camera Media Format (oic.r.media)

The supported camera media formats can be discovered by looking at the SDP list of the media resource. The recommended list of supported media formats are listed in Table 10-4.

Table 10-4 Recommended media profiles.

Mediatype	codec	Content container format	transport	Additional information
Audio	AAC		RTP	
Video	H.264		RTP	Recommended minimal resolution 1920x1080 (width, height)

Video	H.264/AAC	MPEG-2 TS	RTP	Recommended minimal resolution 1920x1080 (width, height)
Still image	JPEG	JPEG	RTP	Recommended minimal resolution 1920x1080 (width, height)

419

