OIC SMART HOME DEVICE SPECIFICATION V1.1.0

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1 Scope

The OIC Smart Home Device specification is an 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 core architecture, interfaces protocols and services to enable the implementation of 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 1.1.

OIC Resource Type Specification, *Open Interconnect Consortium Resource Type Specification*, Version 1.1.

OIC Security Specification, *Open Interconnect Consortium Security Capabilities*, Version 1.1

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.
https://github.com/raml-org/raml-spec/blob/master/raml-0.8.md

IETF RFC 4566, SDP: Session Description Protocol, July 2006 https://www.ietf.org/rfc/rfc4566.txt

3 Terms, definitions symbols and abbreviations

3.1 Terms and definitions

3.1.1
Actuator
Resource with support of the UPDATE operation.

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

3.1.3
Smart Home Device(s)
A Device(s) that is(are) conformant to the normative requirements contained in this specification.

3.1.4
Sensor
Resource without support of the UPDATE operation.

3.2 Symbols and abbreviations

3.2.1

CRUDN

Create Retrieve Update Delete Notify

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

3.2.2

CSV

Comma Separated Value

Comma Separated Value is a construction to have more fields in 1 string separated by commas. If a value itself 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.

3.2.6

SDP

Session Description Protocol

SDP describes multimedia sessions for the purposes of session announcement, session invitation, and other forms of multimedia session initiation. It is fully defined in IETF RFC 4566

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 a Device for usage in the Smart Home vertical. This document describes a 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 Devices. The following functionality is used:

- Required Core Resources.
- Required transports.

Note that other mandatory functions in the OIC Core Specification 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 Resource Types specified in the OIC Resource Type Specification.

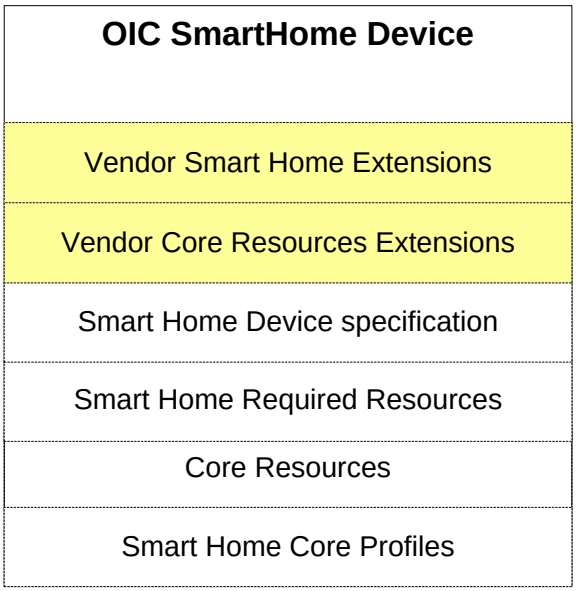

Figure 1 Smart Home device building blocks.

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

5 Operational Scenarios

5.1 Specification Version

Devices conformant to this specification version shall add the string “sh.1.1.0” to the OIC Core Specification defined dmv Property in oic.wk.d.

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 defined by this Specification shall have a Resource Type name (“rt”) prefixed with “oic.d.”

Examples of 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 a 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 URI of "/oic/d". A Smart Home Device shall include in the Resource Type ID of "/oic/d" the device type from Table 10-1; the inclusion of the device type shall be done using one of the methods provided by Section 11.3.4 of the OIC Core Specification (i.e. add to the array of values). An instance of "/oic/d" with its Resource Type name modified in this manner shall expose all mandatory Properties for "/oic/d" defined in the OIC Core Specification.

Therefore a Smart Home Device may be discovered by adding a query for the "rt" of the Device Type itself (e.g. oic.d.fan) to the OIC Core Specification defined multicast endpoint discovery method (see also Section 7.1).

A Smart Home Device may additionally define a Resource with a vendor defined URI that is discoverable within "/oic/res" with a Resource Type ID from Table 10-1. In this instance the Resource shall have the Resource Properties and be subject to the same semantics as oic.wk.d as defined by the OIC Core Specification. In the case where the Resource tagged in this manner additionally follows the Collection semantics defined in the OIC Core Specification then the Resources that are part of that Collection shall at a minimum include the Resources defined for the Resource Type ID in Table 10-1.

6.3 Profile of OIC Core Specification

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 Specification Resources are also required for a Smart Home profile implementation.

In addition to the required Resources the optional OIC Core Specification Resources in Table 6-1 shall be required for a Smart Home Profile.

Table 6-1 Required Resources for Smart Home Devices

Resource ("rt")	Required in Profile
Intentionally left blank	Intentionally left blank

For each of the Resources listed in Table 6-1 Required Resources for Smart Home Devices, Table 6-2 Required Properties in Resource details the Properties within those Resources that shall be required for a Smart Home Profile.

Table 6-2 Required Properties in Resource

Resource ("rt")	Property name	Required in Profile
Intentionally left blank	Intentionally left blank	Intentionally left blank

A Smart Home Device shall support CoAP based endpoint discovery as defined in Section 10.2 of the OIC Core Specification.

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

A 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.

7 Discovery

7.1 Endpoint Discovery

Clients may discover Servers by using the mechanisms defined by the OIC Core Specification Section 10. A Client may populate an “rt” query parameter with the Device Types that the Client wants to discover, or if no “rt” query parameter is provided then the search is for all available Device Types irrespective.

Smart Home Devices may be discovered by Device Type or implemented Resource Type. This difference is conveyed by the wanted “rt” argument of the OIC Core Specification discovery method (see section 11.3 of the OIC Core Specification).

The values that may be used for discovering a specific Device Type are listed in Table 10-1 . The values that may be used to discover a specific Resource Type are listed in the OIC Resource Type Specification in section 6.

The discovery process provides the base URI of the Device that is acting as a Server to the Client. The structure of the detected Device can then be retrieved by Resource Discovery.

7.2 Resource Discovery

Section intentionally left blank

8 Smart Home Bridge Device

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

A Smart Home Bridge Device is a device that represents one or more other devices as 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 a Device and a bridged device is how the device is encapsulated in a Smart Home Bridge Device.

A Smart Home Bridge Device shall be indicated on the network with a Device Type of “oic.d.bridge”. This provides to a client an explicit indication that the discovered Device is performing a bridging function. This is useful for a number of reasons; 1) when establishing a home network the Client can determine that the bridge is reachable and functional when no bridged devices are present, 2) allows for specific actions to be performed on the bridge taking into account the known functionality a bridge supports, 3) should the bridged devices be subject to a progressive reveal it enables user indications to be provided showing that sequence of discovery, 4) allows for explicit discovery of all devices that are serving a bridging function which benefits trouble shooting and maintenance actions on behalf of a user. When such a device is discovered the exposed Resources on the Smart Home Bridge Device describe other devices. For example as shown in Figure 2 Schematic overview of a Smart Home Bridge Device bridging non-OIC devices. Note that there is no requirement to enable a 1:1 mapping from the bridged device to the OIC representation, how the bridged device is represented within OIC is entirely up to the implementation.

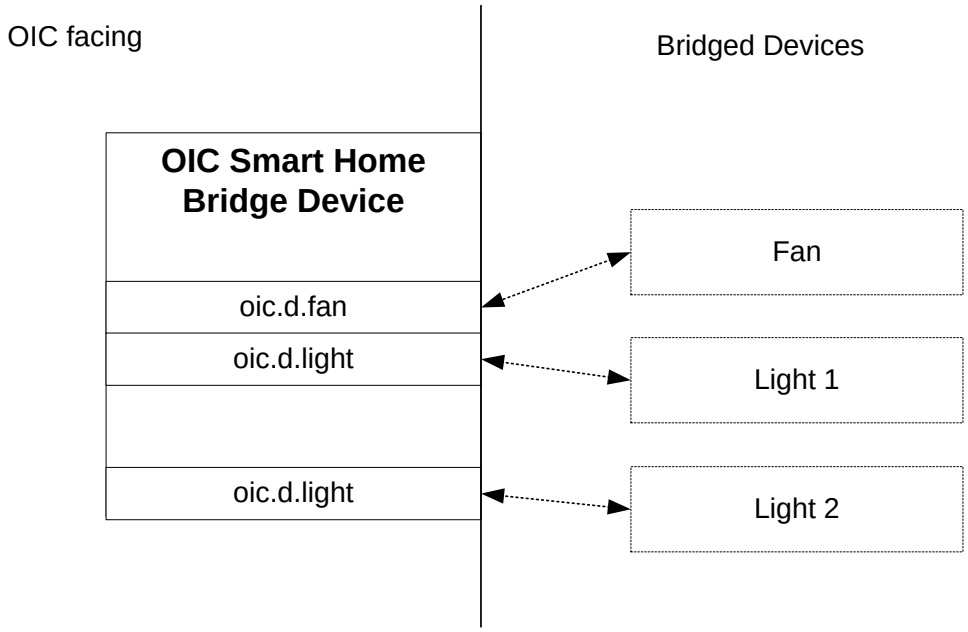

Figure 2 Schematic overview of a Smart Home Bridge Device bridging non-OIC devices

It is expected that the Smart Home Bridge Device creates a set of devices during the start-up of the 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 a Smart Home Bridge Device changes its set of exposed devices it shall notify any subscribed Clients.

A 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 discoverable via "/oic/res" of the Smart Home Bridge Device. The Resources of bridged devices shall either be directly included as Links in "/oic/res" of the Smart Home Bridge Device or as Links within a Collection (see Section 6.2 for application of a Device Type to a Collection Resource) that is itself directly included in "/oic/res".

The response to a RETRIEVE on "/oic/res" shall only include the devices that match the RETRIEVE request.

The resource reference determined from each Link exposed by "/oic/res" on the Smart Home Bridge shall be unique. The Smart Home Bridge shall meet the requirements defined in the OIC Core Specification for population of the Properties and Link parameters in "/oic/res".

The relationship between the Smart Home Bridge and the devices exposed therein is indicated via the population of the "rel" element within the Link in "/oic/res". The value "contains bridged" should be used when the bridged device is not part of the Smart Home Bridge device. Conversely, when the bridge and embedded bridged devices share a common physical platform, the value "contains" should be used.

Figure 3 Requesting different device types within a Smart Home Bridge provides one possible instantiation of a Smart Home Bridge. Note the use of the Device Type for a Smart Home Bridge and the Device Type of the exposed devices that are modelled leveraging the Collection semantics defined by the OIC Core Specification. This is for illustrative purposes only.

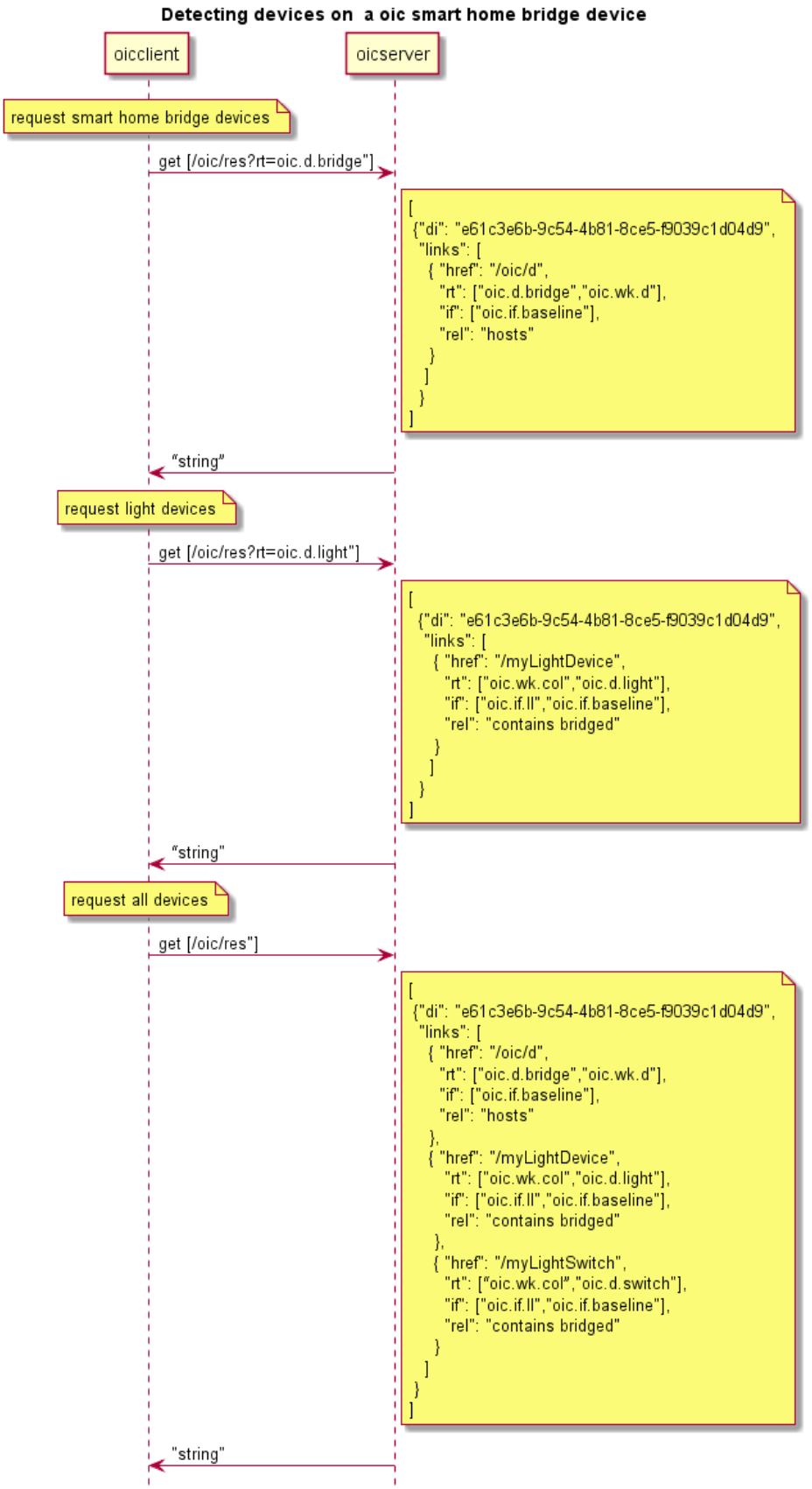

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Figure 3 Requesting different device types within a Smart Home Bridge

9 Security

A Smart Home Device shall implement the mandated security Resources specified in OIC Security Specification. Additionally a Smart Home Device shall secure all links used to access Resources using DTLS.

10 Device Types

10.1 Standardized device types

Device Types can mandate that specific Resources be implemented. The required Resource per Device Type is listed in Table 10-1. Additionally, specific Resources that use enumeration values to indicate supported states or modes may mandate usage of standardized enumeration values. The mandated allowed values are indicated for each applicable Resource Type, the Property of interest on that Resource Type and to which device type it applies.

Per table 10-1, some Smart Home Device types support two instances of the same Resource Type. When this is the case, the Resources shall support different CRUDN actions, e.g. one Resource acts as a Sensor (CRUDN action write not supported) and the other Resource acts as an Actuator (CRUDN actions read and write supported at a minimum) unless otherwise specified.

Table 10-1 Alphabetical list of device types ("rt"), including required Resources.

Device Name (informative)	Device Type ("rt") (Normative)	Required Resource name	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
		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	Any Resource Type that supports and exposes in "/oic/res" the oic.if.s interface.	oic.r. <x> Where this equates to any Resource Type that supports the oic.if.s Interface.
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)[1]	oic.r.operational.state
		Automatic Document Feeder	oic.r.automaticdocumentfeeder[2]
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	Temperature (2)	oic.r.temperature

[1] 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).

[2] 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 Lock	oic.d.smartlock	Lock Status	oic.r.lock.status
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
		Operational State	oic.r.operational.state
Water Valve	oic.d.watervalve	Open Level	oic.r.openlevel

10.2 Standardized enumeration values

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

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

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 Type (oic.r.mode)

The following enumeration values apply to both the supportedModes and modes Properties within the Mode Resource Type. The 'Required enumeration value' for each device type lists the minimum set of values that are populated in supportedModes.

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
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 a Client point of view.

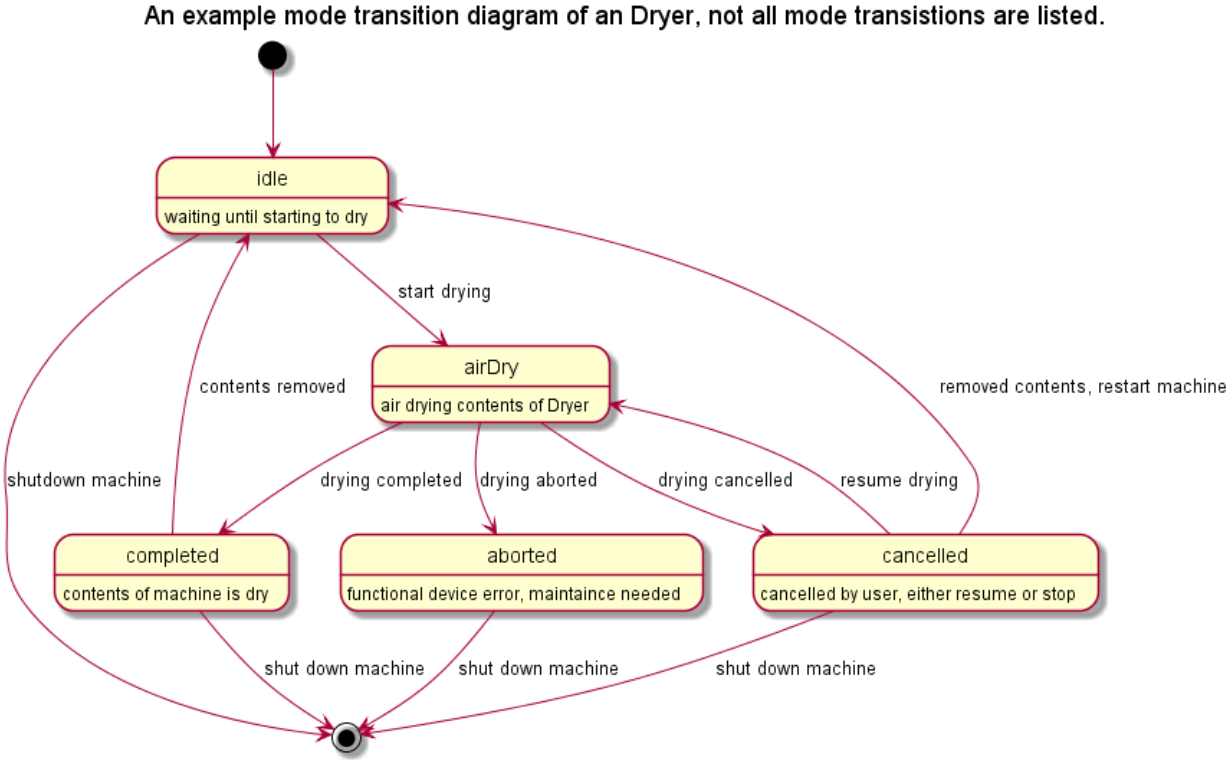

Figure 4 Example of mode transitions of a Dryer.

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

The following enumeration values apply to the jobStates and machineStates Properties within the operational state Resource Type.

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

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

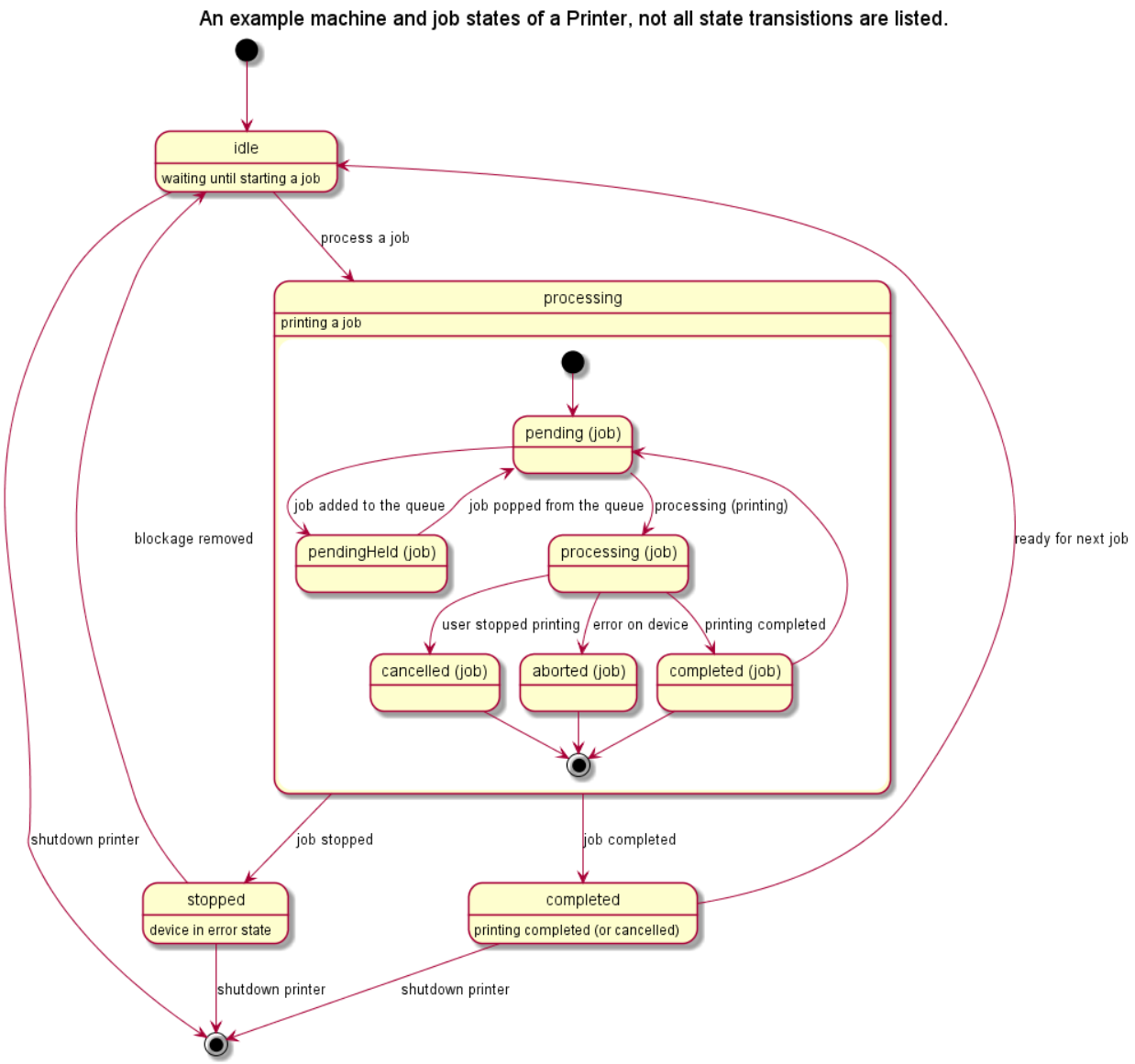

Figure 5 Example of mode transitions of a Printer.

10.6 Camera Media Format (oic.r.media)

The supported camera media formats can be discovered by looking at the SDP (see IETF RFC 4566) list of the media Resource Type. 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)

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