OCF Device Specification

VERSION 2.0.1 | February 11, 2019

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1 Scope

ISO/IEC 30118-5 is an Application Profile specification.

The Device definitions use Resource definitions from the ISO/IEC 30118-4:2018.

This document is built on top of ISO/IEC 30118-1:2018. ISO/IEC 30118-1:2018 specifies the core architecture, interfaces protocols and services to enable the implementation of profiles for IoT usages and ecosystems. ISO/IEC 30118-1:2018 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 devices) and more capable devices (smart devices).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 30118-1:2018 Information technology -- Open Connectivity Foundation (OCF) Specification -- Part 1: Core specification
https://www.iso.org/standard/53238.html
Latest version available at: https://openconnectivity.org/specs/OCF_Core_Specification.pdf

ISO/IEC 30118-2:2018 Information technology -- Open Connectivity Foundation (OCF) Specification -- Part 2: Security specification
https://www.iso.org/standard/74239.html
Latest version available at: https://openconnectivity.org/specs/OCF_Security_Specification.pdf

ISO/IEC 30118-4:2018 Information technology -- Open Connectivity Foundation (OCF) Specification -- Part 4: Resource type specification
https://www.iso.org/standard/74241.html
Latest version available at:
https://openconnectivity.org/specs/OCF_Resource_Type_Specification.pdf

OpenAPI specification, fka *Swagger RESTful API Documentation Specification*, Version 2.0
https://github.com/OAI/OpenAPI-Specification/blob/master/versions/2.0.md

IETF RFC 4566, SDP: Session Description Protocol, July 2006
https://tools.ietf.org/html/rfc4566

Draft Report: A Basic Classification System for Energy-Using Products--Universal Device Classification, December 2013
https://eta-intranet.lbl.gov/sites/default/files/lbnl-classification-v1.pdf

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

– ISO Online browsing platform: available at https://www.iso.org/obp

– IEC Electropedia: available at http://www.electropedia.org/

3.1.1
Actuator
resource with support of the UPDATE operation.

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3.1.2
Bridge Device
a Device that is capable of representing other devices that exist on the network.

3.1.3
OCF Device
a Device that is conformant to the normative requirements contained in this document.

3.1.4
Sensor
resource without support of the UPDATE operation.

3.1.5
Healthcare Device
a Device that is conformant to the normative requirements contained in Annex C of this document.

3.2 Abbreviated terms

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

3.2.4
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.

3.2.5
UDC
Universal Device Classification
An enumeration of device types published as A Basic Classification System for Energy-Using Products--Universal Device Classification

4 Document conventions and organization

4.1 Conventions

In this document 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.

4.2 Notation

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

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Required (or shall or mandatory).

These basic features shall be implemented. The phrases “shall not”, and “PROHIBITED” indicate behaviour that is prohibited, i.e. that if performed means the implementation is not in compliance.

Recommended (or should).

These features add functionality supported by a Device and should be implemented. Recommended features take advantage of the capabilities a Device, 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 a Device, 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 document, they should not be implemented except for backward compatibility. The occurrence of a deprecated feature during operation of an implementation compliant with the current document 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 document.

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

Words that are emphasized are printed in *italic*.

4.3 Data types

See ISO/IEC 30118-1:2018.

4.4 Document structure

This document describes specific requirements governing the indication of Device Types on Devices and the requirements that are associated with specific Device Types themselves. The document makes use of functionality defined in the ISO/IEC 30118-1:2018 and ISO/IEC 30118-4:2018.

Annex A specifies the Device Types that shall be used by an OCF Device.

Annex B specifies the profiles that that shall be used by an OCF Device that is part of the Smart Home vertical.

Annex C specifies the profiles that shall be used by an OCF Device that is part of the Healthcare vertical.

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Annex D specifies the profiles that shall be used by an OCF Device that is part of the Industrial vertical.

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

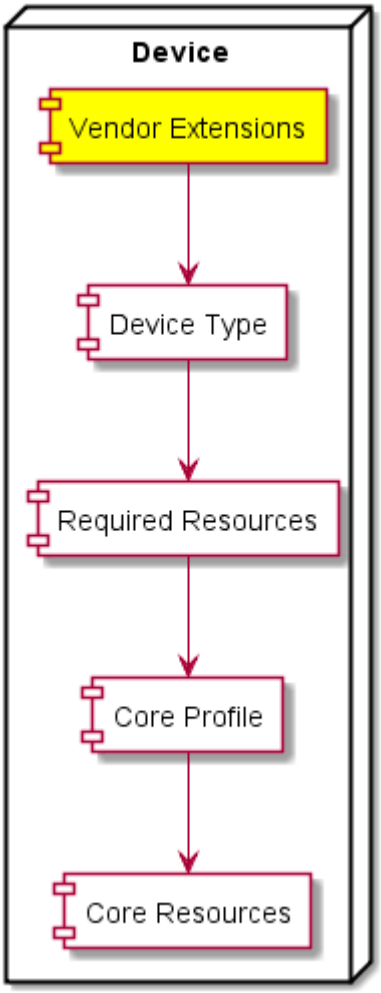

Figure 1 – Device building blocks

5 Operational scenarios

5.1 Document version

All Devices conformant to this document shall add the string “ocf.sh.1.3.0” to the dmv Property in oic.wk.d. This Property is for legacy Device support only and will no longer be revised in alignment with document versions.

6 Core resource model

6.1 Introduction

The Core Resource model is described in ISO/IEC 30118-1:2018.

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6.2 Device type

The Device Types of all devices 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 defined Device names and types are in Table A.2, Annex B and Annex C detail the minimal Resource(s) that a Device shall implement for a specific Device Type where required by a vertical. A Device may expose additional OCF and 3rd party defined Resources other than those indicated in these Annexes.

ISO/IEC 30118-1:2018 defines a Device Resource with a URI of “/oic/d”. A Device shall include in the “Resource type” Property of “/oic/d” the Device Type (or Device Types) from Table A.2 of the physical device hosting the Server; the inclusion of the Device Type shall be done using one of the methods provided by clause 11.3.4 of ISO/IEC 30118-1:2018 (i.e. add to the array of values).

Therefore a Device may be discovered by adding a query for the “rt” of the Device Type itself (e.g. “?rt=oic.d.fan”) to the multicast Endpoint discovery method (see 8.1).

6.3 Profile of ISO/IEC 30118-1:2018

This clause describes the profiling of the Core Resources and transport mechanisms and functions that are defined in ISO/IEC 30118-1:2018.

The required ISO/IEC 30118-1:2018 Resources are also required for a profile implementation.

In addition to the required Resources the optional ISO/IEC 30118-1:2018 Resources in Table 1 shall be required.

Table 1 – Required resources for devices

Resource (“rt”)	Required in Profile
Intentionally left blank	Intentionally left blank

For each of the Resources listed in Table 1, Table 2 details the Properties within those Resources that shall be required.

Table 2 – Required properties in resource

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

A Device shall support CoAP based endpoint discovery as defined in clause 10.3 of ISO/IEC 30118-1:2018.

The messaging protocol for a Device shall be CoAP (see ISO/IEC 30118-1:2018).

A Device shall support a network layer as defined in clause 9 of ISO/IEC 30118-1:2018 including any necessary defined bridging functions that ensure inter-operability with IPv6.

7 Modelling of multiple logical devices

7.1 Introduction

A physical Device may be modelled as a single Platform and Device, a single Platform with multiple Devices, multiple separately discoverable discrete Platforms and Devices, or as a single Platform and Device where the Device is represented as a composition of other Devices.

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For example, a door that includes the functionality of a contact sensor, a lock and a camera may be modeled as a single-Platform, a multi-Platform, or a Composite Device. Each of these three options will be detailed in clauses 7.2, 7.3, and 7.4.

7.2 Single platform model

The physical Device exposes one or more logical Devices that are independently discoverable (i.e. they separately respond to multicast discovery request messages as defined in clause 11.3 of ISO/IEC 30118-1:2018). Given the door example there could be a single discovery response with an instance of “/oic/d” that exposes a single Device Type (such as “oic.d.door”) or multiple discovery responses, each response having a single Device Type in the “rt” of “/oic/d” that represents the logical Device. The common denominator being that for all discovered logical Devices the Properties of “/oic/p” have the same values.

7.3 Multi-platform model

Just like the single-Platform model, one or more logical Devices that make up a physical Device respond independently to multicast discovery request messages and expose their own Resources. Like the single-platform model, each logical Device exposes a single Device Type in the "rt" value of "/oic/d". The difference from the single-platform model is that each logical Device does not have the same values for the Properties of "oic/p".

7.4 Composite device model

When modelling a Server as a Composite Device there shall be a single Platform which represents the Composite Device. The Resource Type Property Value of “/oic/d” exposed should contain all of the Device Types of the Devices that compose the Composite Device. For each Device that is part of the Composite Device when using this approach there shall exist a Collection that represents one of the distinct Devices in the composition. Further each Collection shall have a Resource Type that at a minimum includes the Device Type that the Collection represents (e.g. [”oic.d.door”]).

Figure 2 illustrates the response to a discovery request using the baseline Interface on “/oic/res” for a Composite Device modeled as described in this clause. Figure 3 illustrates the response to a unicast RETRIEVE request using the baseline Interface to the Collection that represents the door Device.

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```
[
 {
  "rt": ["oic.wk.res"],
  "if": ["oic.if.baseline", "oic.if.ll" ],
  "links":
   [
    {
     "anchor": "ocf://dc70373c-1e8d-4fb3-962e-017eaa863989",
     "href": "/oic/d",
     "rt":   ["oic.wk.d","oic.d.door","oic.d.sensor","oic.d.lock","oic.d.camera"],
     "if":   ["oic.if.r","oic.if.baseline"],
     "p":    {"bm": 3},
     "eps": [{"ep": "coap://[fe80::b1d6]:1111"}]
    },
    {
     "anchor": "ocf://dc70373c-1e8d-4fb3-962e-017eaa863989",
     "href": "/mydevice/mydoor",
     "rt":   ["oic.d.door"],
     "if":   ["oic.if.ll","oic.if.baseline","oic.if.r"],
     "p":    {"bm": 3},
     "eps": [{"ep": "coaps://[fe80::b1d6]:1111"}]
    },
    {
     "anchor": "ocf://dc70373c-1e8d-4fb3-962e-017eaa863989",
     "href": "/mydevice/mysensor",
     "rt":   ["oic.d.sensor"],
     "if":   ["oic.if.ll","oic.if.baseline","oic.if.r"],
     "p":    {"bm": 3},
     "eps": [{"ep": "coaps://[fe80::b1d6]:1111"}]
    },
    {
     "anchor": "ocf://dc70373c-1e8d-4fb3-962e-017eaa863989",
     "href": "/mydevice/mylock",
     "rt":   ["oic.d.lock"],
     "if":   ["oic.if.ll","oic.if.baseline","oic.if.r"],
     "p":    {"bm": 3},
     "eps": [{"ep": "coaps://[fe80::b1d6]:1111"}]
    },
    {
     "anchor": "ocf://dc70373c-1e8d-4fb3-962e-017eaa863989",
     "href": "/mydevice/mycamera",
     "rt":   ["oic.d.camera"],
     "if":   ["oic.if.ll","oic.if.baseline","oic.if.r"],
     "p":    {"bm": 3},
     "eps": [{"ep": "coaps://[fe80::b1d6]:1111"}]
    }
   ]
 }
]
```

322 **Figure 2 – Example composite device model**

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```
{
"rt": ["oic.d.door"],
"if": ["oic.if.ll","oic.if.r","oic.if.baseline"],
  "id": "unique_example_id",
  "di":   "dc70373c-1e8d-4fb3-962e-017eaa863989",
  "icv":  "ocf.1.3.0",
  "dmv":  "ocf.res.1.3.0, ocf.sh.1.3.0",
  "piid": "6F0AAC04-2BB0-468D-B57C-16570A26AE48",
  "links": [
   {
     "href": "/mydoor/openlevel",
     "rt":   ["oic.r.openlevel"],
     "if":   ["oic.if.a", "oic.if.baseline"],
      "p": {"bm": 2},
     "eps": [
       {"ep": "coaps://[fe80::b1d6]:1122"}
     ]
   }
  ]
}
```

Figure 3 – RETRIEVE response to example door from composite device model

8 Discovery

8.1 Endpoint discovery

Clients may discover Servers by using the mechanisms defined by ISO/IEC 30118-1:2018 clause 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.

Devices may be discovered by Device Type or implemented Resource Type. This difference is conveyed by the population of any “rt” query parameter included as part of discovery (see clause 11.3 of ISO/IEC 30118-1:2018).

The values that may be used for discovering a specific Device Type are listed in Table A.2. The values that may be used to discover a specific Resource Type are listed in clause 6 of ISO/IEC 30118-4:2018.

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.

8.2 Resource discovery

Clause intentionally left blank

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9 Security

A Device shall implement the mandated Security Virtual Resources specified in the ISO/IEC 30118-2:2018. Additionally, all exposed ISO/IEC 30118-4:2018 defined Resources shall be accessible via at least one secure Endpoint (i.e. use of a “coaps” or “coaps+tcp” scheme locator within the “eps” Parameter exposed by /oic/res; see ISO/IEC 30118-1:2018 clause 10.2.4). A Device shall not expose ISO/IEC 30118-4:2018 defined Resources using unsecured Endpoints (i.e. “coap” or “coap+tcp” scheme locator in the “eps” Parameter).

With the exception of those Resources related to Discovery that are explicitly identified by the ISO/IEC 30118-1:2018 as not requiring secured access (see ISO/IEC 30118-1:2018 clause 11.3.4), all other Resources defined in ISO/IEC 30118-1:2018 implemented in the Smart Home Device shall be accessible via at least one secure Endpoint (i.e. use of a “coaps” or “coaps+tcp” scheme locator within the “eps” Parameter exposed by /oic/res). Similarly, any Resources defined in ISO/IEC 30118-1:2018 that do not require unsecured access that are not listed in /oic/res shall also be accessible via “coaps” or “coaps+tcp”.

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Annex A
(normative)

Device categories and device types

A.1 Device categories

Devices are grouped into Device Categories based on the Universal Device Classification (UDC) (see A Basic Classification System for Energy-Using Products--Universal Device Classification), all Device Categories are listed in Table A.1.

Table A.1 – List of device categories

Device Category Name	Description
Space Conditioning	Heating and cooling systems
Lighting	
Appliance	Also known as “white goods”; covers major appliances only.
Electronics	Personal electronics
Miscellaneous	Small appliances, other
Infrastructure	Physical building and infrastructure
Transportation	Vehicles, fixed devices that provide movement (e.g. Escalators)
Fitness	Includes lifestyle
Medical	
Personal Health	
Other	

A.2 Device types

The complete Universal Device Classification with Device Types per Device Category is provided in Table A.2. Note that not all Devices within the UDC classification have equivalent OCF defined Device Types. All defined Device Types are of the form “oic.d.<thing>” where <thing> is a single alphanumeric string (lower case [a..z],[0..9] only) no more than 24 characters in length giving a total maximum length of the Device Type of 32 characters. Where an abbreviated form of the Device Type is required (applicable only to population of a Wi-Fi beacon IE) then the “oic.d.” portion of the Device Type may be omitted.

Table A.2 does not specify the mandatory resources that are implemented by an instance of such a Device Type; the set of applicable mandatory Resources is dependent on the application domain. In this document the following domains are specified: Smart Home, Healthcare. The ‘Reference’ column in the table references vertical specific annexes where the Device Type is further refined (e.g. mandatory Resources).

Table A.2 – Per category list of device types

Device Category Name	UDC Device Name	Device Name	Device Type (Normative)	Reference
Space Conditioning	Unitary System	Air Conditioner	oic.d.airconditioner	B.1
	Boiler	Water Heater	oic.d.waterheater	B.1
	Furnace	Furnace	oic.d.furnace	

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	Pump	Pump	oic.d.pump	
	Fan	Fan	oic.d.fan	B.1
	Condensing Unit	Condensing Unit	oic.d.condensingunit	
	Condenser	Condenser	oic.d.condenser	
	Humidifier	Humidifier	oic.d.humidifier	B.1
	Dehumidifier	Dehumidifier	oic.d.dehumidifier	B.1
	HVAC – Control	Thermostat	oic.d.thermostat	B.1
	HVAC - Other	HVAC	oic.d.hvac	
		Air Purifier	oic.d.airpurifier	B.1
		Air Quality Monitor	oic.d.airqualitymonitor	B.1
Lighting	Lighting - Controls	Lighting Controls	oic.d.lightingcontrol	
	Lighting - Other	Light	oic.d.light	B.1
Appliance	Clothes Dryer	Dryer (Laundry)	oic.d.dryer	B.1
	Clothes Washer	Washer (Laundry)	oic.d.washer	B.1
		Clothes Washer Dryer	oic.d.washerdryer	B.1
	Dishwasher	Dishwasher	oic.d.dishwasher	B.1
	Freezer	Freezer	oic.d.freezer	B.1
	Ice Machine	Ice Machine	oic.d.icemachine	
	Oven	Oven	oic.d.oven	B.1
	Range	Range	oic.d.range	
	Refrigerator	Refrigerator	oic.d.refrigerator	B.1
	Water Heater	Water Heater	oic.d.waterheater	B.1
	Appliance - Other	Cooker Hood	oic.d.cookerhood	B.1
		Cooktop	oic.d.cooktop	B.1
		Steam Closet	oic.d.steamcloset	B.1
Electronics	Audio System	Audio System	oic.d.audiosystem	
	A/V Player	AV Player	oic.d.avplayer	
	Camera	Camera	oic.d.camera	B.1
	Computer – Desktop	Desktop PC	oic.d.desktoppc	
	Computer - Notebook	Notebook PC	oic.d.notebookpc	
	Computer - Server	Server	oic.d.server	
	Computer – Other	Computer	oic.d.pc	

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	Data Storage	Data Storage Unit	oic.d.datastorageunit	
	Display	Display	oic.d.display	
	Electronics - Portable	Portable Electronics	oic.d.portableelectronics	
	Game Console	Game Console	oic.d.gameconsole	
	Imaging Equipment	3D Printer	oic.d.3dprinter	B.1
		Printer	oic.d.printer	B.1
		Printer Multi-Function	oic.d.multifunctionprinter	B.1
		Scanner	oic.d.scanner	B.1
	Musical Instrument	Musical Instrument	oic.d.musicalinstrument	
	Networking Equipment	Networking Equipment	oic.d.networking	
	Phone Handset	Handset	oic.d.handset	
	Receiver	Receiver	oic.d.receiver	B.1
	Set Top Box	Set Top Box	oic.d.stb	B.1
	Telephony	Telephony	oic.d.telephonydevice	
	Television	Television	oic.d.tv	B.1
	A/V - Other	Active Speaker	oic.d.speaker	
	Electronics – Other	Electronics	oic.d.smallelectrical	
Miscellaneous	Air Compressors	Air Compressor	oic.d.aircompressor	
	Bathroom Device	Bathroom General	oic.d.bathroomdevice	
	Battery Charger	Battery Charger	oic.d.batterycharger	
	Business Equipment	Business Equipment	oic.d.businessequipment	
	Cleaning Equipment	Robot Cleaner	oic.d.robotcleaner	B.1
	Cooking – Portable	Portable Stove	oic.d.portablestove	
	Exercise Machine	Exercise Machine	oic.d.exercisemachine	
	HVAC – Portable	Portable HVAC	oic.d.hvacportable	
	Industrial	Optical augmented RFID Reader	oic.d.orfid	D.1
	Kitchen	Coffee Machine	oic.d.coffeemachine	B.1
		Food Probe	oic.d.foodprobe	B.1
		Grinder	oic.d.grinder	B.1

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		Kettle	oic.d.kettle	B.1
	Lighting – Decorative	Decorative Lighting	oic.d.lighdecorative	
	Lighting – Emergency	Emergency Lighting	oic.d.lightemergency	
	Microwave Oven	Microwave Oven	oic.d.microwave	B.1
	Vending Machine	Vending Machine	oic.d.vendingmachine	
	Water Dispenser	Water Dispenser	oic.d.waterdispenser	
		Battery	oic.d.battery	B.1
Infrastructure	Breakers	Water Valve	oic.d.watervalve	B.1
	Doors/Windows	Blind	oic.d.blind	B.1
		Door	oic.d.door	B.1
		Garage Door	oic.d.garagedoor	B.1
		Smart Lock	oic.d.smartlock	B.1
		Window	oic.d.window	B.1
	Fireplace	Fireplace	oic.d.fireplace	
	Pump	Pump	oic.d.pump	
	Power - Portable	Energy Generator	oic.d.energygenerator	B.1
		Smart Plug	oic.d.smartplug	B.1
	Power - Fixed	Switch	oic.d.switch	B.1
	Security	Security Panel	oic.d.securitypanel	B.1
	Sensors	Generic Sensor	oic.d.sensor	B.1
	Meter	Electric Meter	oic.d.electricmeter	B.1
Transportation	Transport - Other	Electric Vehicle Charger	oic.d.electricvehiclecharger	B.1
Fitness		Fitness Device	oic.d.fitnessdevice	
		Blood Pressure Monitor	oic.d.bloodpressuremonitor	C.4
		Body Thermometer	oic.d.bodythermometer	C.4
Medical		Medical Device	oic.d.medicaldevice	
		Blood Pressure Monitor	oic.d.bloodpressuremonitor	C.4
		Glucose Meter	oic.d.glucosemeter	C.4
		Body Scale	oic.d.bodyscale	C.4
		Body Thermometer	oic.d.bodythermometer	C.4

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Personal Health		Personal Health Device	oic.d.personalhealthdevice	
		Blood Pressure Monitor	oic.d.bloodpressuremonitor	C.4
		Glucose Meter	oic.d.glucosemeter	C.4
		Body Scale	oic.d.bodyscale	C.4
		Body Thermometer	oic.d.bodythermometer	C.4
Other	Other		oic.d.unknown	

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Annex B
(normative)

Smart home device types

B.1 Smart home required resources per device type

Device Types may mandate that specific Resources be implemented. The required Resource per Device Type where mandated is listed in Table B.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 B.1, some 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 B.1 – Alphabetical list of device types ("rt"), including required resources for smart home

Device Name (informative)	Device Type ("rt") (Normative)	Required Resource name	Required Resource Type
3D Printer	oic.d.3dprinter	Binary Switch	oic.r.switch.binary
		3D Printer	oic.r.printer.3d
		Operational State	oic.r.operational.state
		Temperature	oic.r.temperature
		Print Queue	oic.r.printer.queue
Active Speaker	oic.d.speaker	Binary Switch	oic.r.switch.binary
		Audio Controls	oic.r.audio
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
Air Quality Monitor	oic.d.airqualitymonitor	Air Quality Collection	oic.r.airqualitycollection
Battery	oic.d.battery	Battery	oic.r.battery
Blind	oic.d.blind	Open Level	oic.r.openlevel
Camera	oic.d.camera	Media	oic.r.media
Clothes Washer Dryer	oic.d.washerdryer	Binary Switch	oic.r.switch.binary
		Operational State	oic.r.operational.state
Coffee Machine	oic.d.coffeemachine	Binary Switch	oic.r.switch.binary
		Operational State	oic.r.operational.state
Cooker Hood	oic.d.cookerhood	Airflow Control	oic.r.airflowcontrol
		Binary Switch	oic.r.switch.binary
		Mode	oic.r.mode
Cooktop	oic.d.cooktop	Heating Zone Collection	oic.r.heatingzonecollection

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Dehumidifier	oic.d.dehumidifier	Binary Switch	oic.r.switch.binary
		Humidity	oic.r.humidity
Dishwasher	oic.d.dishwasher	Binary Switch	oic.r.switch.binary
		Mode	oic.r.mode
Door	oic.d.door	Open Level	oic.r.openlevel
Dryer (Laundry)	oic.d.dryer	Binary switch	oic.r.switch.binary
		Mode	oic.r.mode
Electric Vehicle Charger	oic.d.electricvehiclecharger	Binary Switch	oic.r.switch.binary
		Operational State	oic.r.operational.state
		Battery	oic.r.battery
		Vehicle Connector	oic.r.vehicleconnector
Electric Meter	oic.d.electricmeter	Energy Consumption	oic.r.energy.consumption
Energy Generator	oic.d.energygenerator	Energy Generation	oic.r.energy.generation
Fan	oic.d.fan	Binary Switch	oic.r.switch.binary
Food Probe	oic.d.foodprobe	Temperature (Sensor)	oic.r.temperature
Freezer	oic.d.freezer	Temperature(2)(1 Sensor and 1 Actuator)	oic.r.temperature
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.
Grinder	oic.d.grinder	Operational State	oic.r.operational.state
		Grinder Settings	oic.r.grinder
Humidifier	oic.d.humidifier	Binary Switch	oic.r.switch.binary
Kettle	oic.d.kettle	Binary Switch	oic.r.switch.binary
Light	oic.d.light	Binary Switch	oic.r.switch.binary
Oven	oic.d.oven	Binary Switch	oic.r.switch.binary
		Temperature (2) (1 Sensor and 1 Actuator)	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)[a]	oic.r.operational.state
		Automatic Document Feeder	oic.r.automaticdocumentfeeder[b]
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

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Refrigerator	oic.d.refrigerator	Temperature (2) (1 Sensor and 1 Actuator)	oic.r.temperature
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
Set Top Box	oic.d.stb	Binary Switch	oic.r.switch.binary
Smart Lock	oic.d.smartlock	Lock Status	oic.r.lock.status
Smart Plug	oic.d.smartplug	Binary Switch	oic.r.switch.binary
Steam Closet	oic.d.steamcloset	Binary Switch	oic.r.switch.binary
		Mode	oic.r.mode
		Operational State	oic.r.operational.state
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) (1 Sensor and 1 Actuator)	oic.r.temperature
Washer (Laundry)	oic.d.washer	Binary Switch	oic.r.switch.binary
		Operational State	oic.r.operational.state
Water Heater	oic.d.waterheater	Binary Switch	oic.r.switch.binary
		Temperature(2) (1 Sensor and 1 Actuator)	oic.r.temperature
Water Valve	oic.d.watervalve	Open Level	oic.r.openlevel
Window	oic.d.window	Open Level	oic.r.openlevel

[a] 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).

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

B.2 Standardized enumeration values

B.2.1 Introduction

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

– Generic list of supported values

– Mandated list of supported values when applied to a specific Device

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B.2.2 Alphabetical list of standardized enumeration types

This clause lists the standardized enumeration types that are used in the oic.r.mode, oic.r.operational.state, and oic.r.consumable 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
- boiling
  - unit is in boiling state or mode
- brewing
  - unit is in brewing state or 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
- disabled
  - unit’s current operational mode is disabled
- enabled
  - unit’s current operational mode is enabled
- filterMaterial
  - filter material that is used by a device
- grinding
  - unit is in grinding state or mode
- idle

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    - new jobs can start processing without waiting
- ink
    - generic ink cartridge for a device
- inkBlack
    - black ink cartridge for a device
- inkCyan
    - cyan ink cartridge for a device
- inkMagenta
    - magenta ink cartridge for a device
- inkTricolour
    - tricolour ink cartridge for a device
- inkYellow
    - yellow ink cartridge for a device
- keepwarm
    - unit is in keep warm state or mode
- notsupported
    - ability to set a specific operational mode by a client is not supported
- 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
- toner
    - generic toner cartridge for a device
- tonerBlack
    - black toner cartridge for a device

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- tonerCyan
  - cyan toner cartridge for a device
- tonerMagenta
  - magenta toner cartridge for a device
- tonerYellow
  - yellow toner cartridge for a device
- wash
  - unit is in wash mode
- wrinklePrevent
  - unit is in winkle prevent mode

B.2.3 Standardized list of supported values for mode resource type (oic.r.mode)

Table B.2 lists the enumeration values that apply to both the supportedModes and modes Properties within the Mode Resource Type.

Table B.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 document 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 B.1 provides an illustrative example of a possible set of modes and the transitions between them for a Dryer Device Type (oic.d.dryer).

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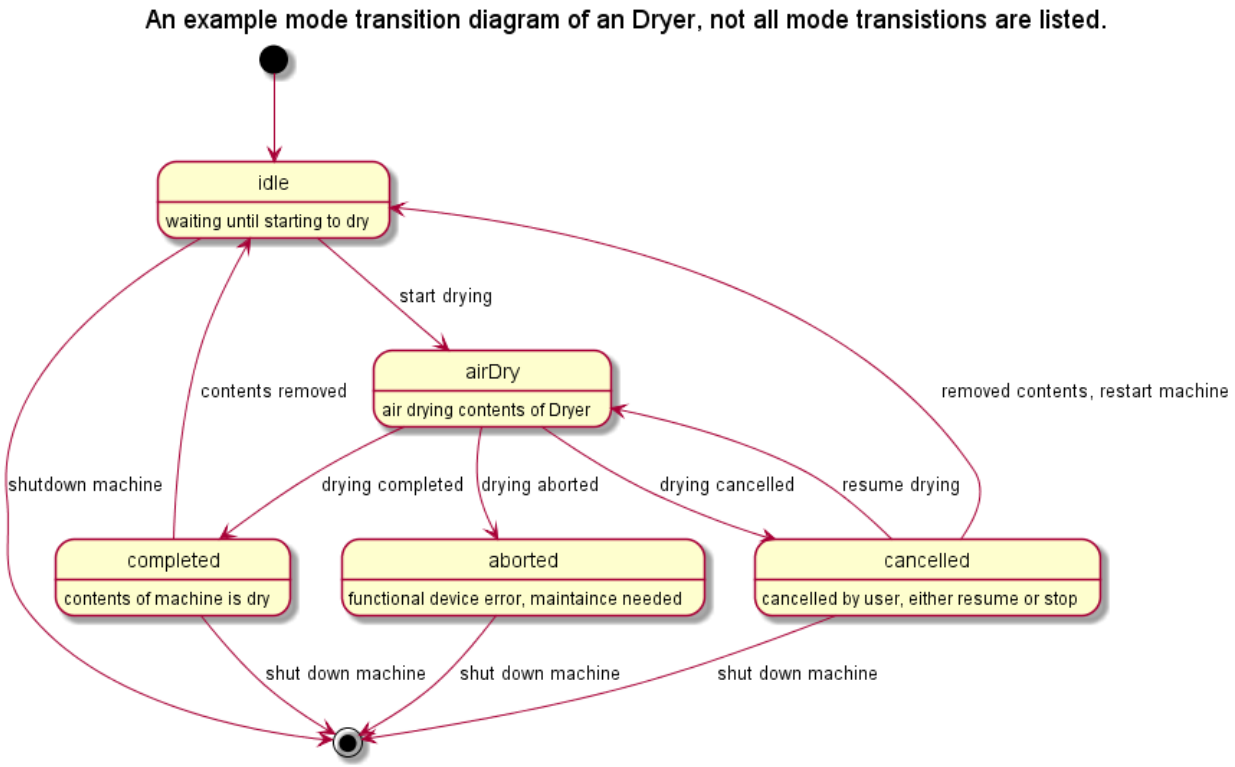

Figure B.1 – Example of mode transitions of a dryer

B.2.4 Standardized list of supported values for operational state resource type (oic.r.operational.state)

Table B.3 lists the enumeration values that apply to the jobStates and machineStates Properties within the operational state Resource Type.

Table B.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

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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 document 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 B.2 provides an illustrative example of a possible set of job states and the transitions between them for a Printer Device Type (oic.d.printer).

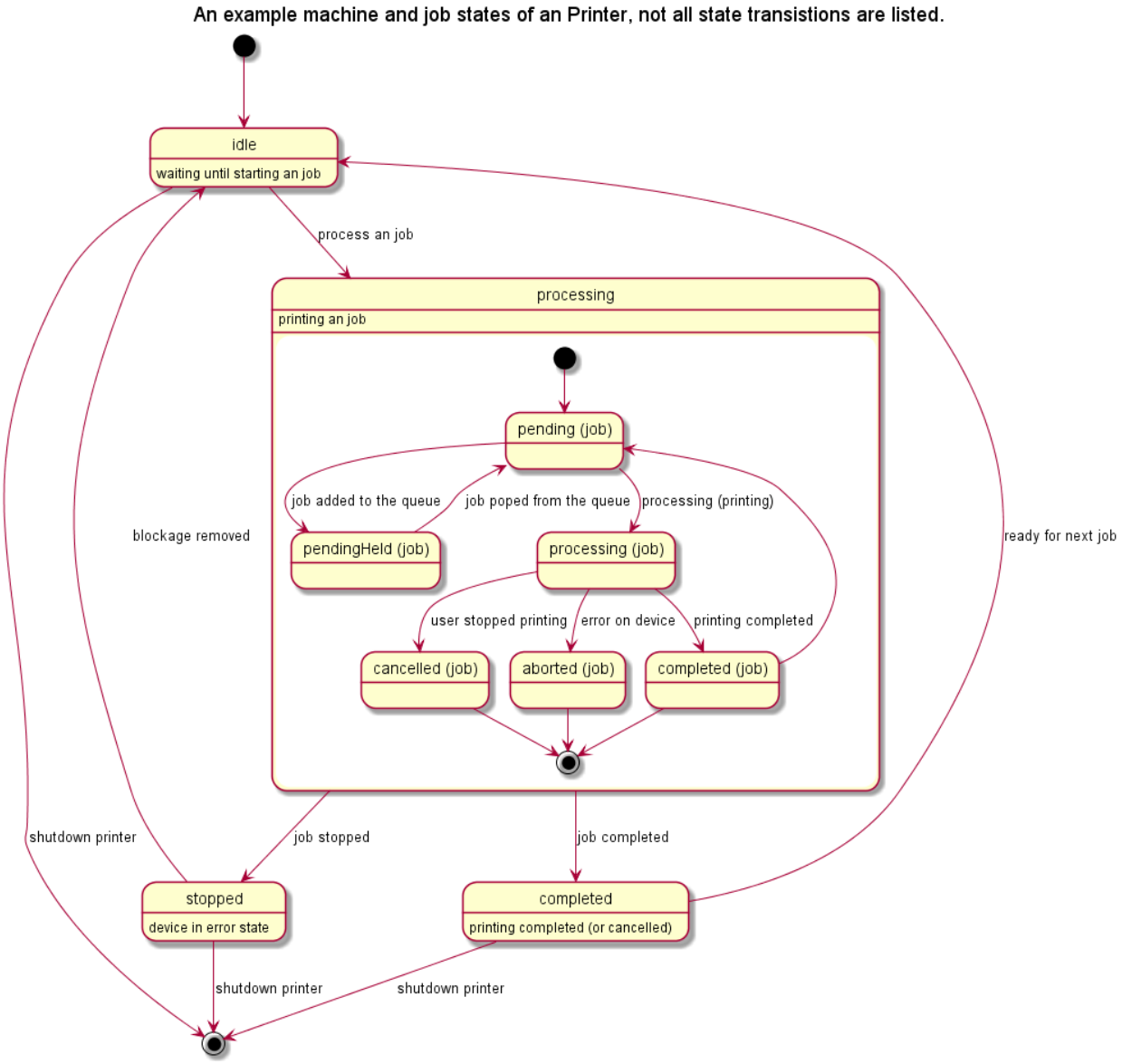

Figure B.2 – Example of job state transitions of a printer

B.2.5 Standardized list of supported values for consumable and consumable collection resource types (oic.r.consumable, oic.r.consumablecollection)

Table B.4 lists the enumeration values that may be populated in both the supportedconsumables (in oic.r.consumablecollection) and typeofconsumable (in oic.r.consumable) Properties within the Consumable and Consumable Collection Resource Types. The typeofconsumable Property shall only be populated with a value exposed within the supportedconsumables Property in a specific instance of the Consumable Collection Resource Type.

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This constitutes the known set of possible values for these Properties in the Consumable and Consumable Collection Resources. A vendor may extend this set by providing vendor defined enumerations following the convention defined in ISO/IEC 30118-4:2018.

Table B.4 – List of defined enumeration values for oic.r.consumable, oic.r.consumablecollection

Friendly Name (informative)	Enumeration Value (Normative)	Description (Informative)
Toner Cartridge	toner	Generic toner cartridge.
Black Toner Cartridge	tonerBlack	Black toner cartridge
Cyan Toner Cartridge	tonerCyan	Cyan toner cartridge
Magenta Toner Cartridge	tonerMagenta	Magenta toner cartridge
Yellow Toner Cartridge	tonerYellow	Yellow toner cartridge
Filter Material	filterMaterial	Any replaceable or reusable filter material; such as water filters, air filters, dust filters etc.
Ink Cartridge	ink	Generic ink cartridge
Black Ink Cartridge	inkBlack	Black ink cartridge
Cyan Ink Cartridge	inkCyan	Cyan ink cartridge
Magenta Ink Cartridge	inkMagenta	Magenta ink cartridge
Yellow Ink Cartridge	inkYellow	Yellow ink cartridge
Tricolour Ink Cartridge	inkTricolour	Tri-colour ink cartridge; typically Cyan plus Magenta plus Yellow.

B.3 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 B.5.

Table B.5 – 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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B.4 Additional requirements per device type

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Annex C
(normative)

Healthcare device types

C.1 Scope

This Annex defines Device Types for use in the healthcare and fitness vertical, and describes general use cases to which OCF Healthcare Devices apply, along with common functional requirements.

Although some common requirements are defined in this document, implementation is responsible for checking appropriate security, safety, environmental, and health practices, and applicable regulatory requirements from national health authorities.

C.2 Introduction to OCF healthcare devices

This Annex references and inherits data models defined in the ISO/IEC 30118-4:2018, to define OCF Healthcare Device Types in clause C.4.

C.3 Operational scenarios

Personal fitness and/or medical data are read by a monitoring Device (OCF Client role) from Healthcare Devices (OCF Server role), and the monitoring Device triggers appropriate actions based on the data collected. Many of the target usages are for personal health or fitness, although clinical use cases can be realized with similar modelling.

As shown in Figure C.1, data from various fitness and healthcare devices can be gathered on a smart phone for monitoring and can be transmitted to the healthcare services through a gateway or through the smartphone. The protocol to be used for transmission is defined in ISO/IEC 30118-1:2018. Collected personal fitness and/or medical data are used for condition monitoring or medical research, receiving advice from a trainer/doctor, or triggering an emergency notification.

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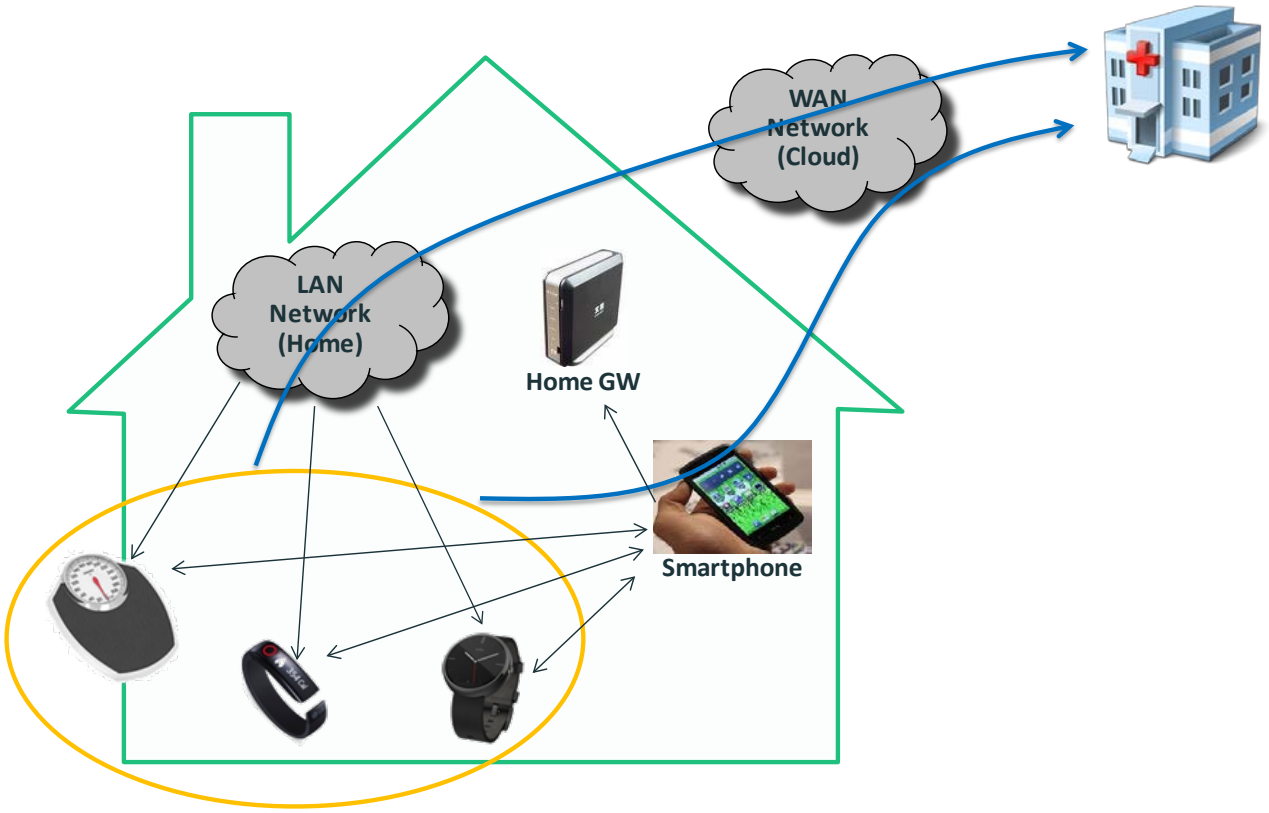

562
563

564 **Figure C.1 – Schematic diagram of healthcare usages**

565 ## C.4 Standardized device types

566 ### C.4.1 Introduction

567 OCF Healthcare Device Types specify Devices in the healthcare and fitness domains of the OCF
568 ecosystem. The Device Type exposed by the "rt" value of /oic/d of all Healthcare Devices shall
569 have a Resource Type value (“rt”) prefixed with “oic.d.” The Healthcare Device Types are listed in
570 Table C.1.

571 **Table C.1 – Alphabetical list of healthcare device types**

Clause	Device Name	Device Type (rt)
C.3.1	Blood Pressure Monitor	oic.d.bloodpressuremonitor
C.3.2	Glucose Meter	oic.d.glucosemeter
C.3.3	Body Scale	oic.d.bodyscale
C.3.4	Body Thermometer	oic.d.bodythermometer

572 The remainder of this Annex defines Resource Types for each Device Type, but for full definitions
573 of Resource Types, see ISO/IEC 30118-4:2018.

574 Each Device Type defines a minimal set of Resource Types that are implemented by that Device
575 Type as required Resource Types. A Healthcare Device may expose additional OCF-defined
576 optional Resource Types. It should be noted that all Resource Types are commonly available for
577 all Device Types, but if a Device Type aims to implement optional Resource Types related to
578 healthcare, it shall expose such Resource Types using the definitions provided in this annex.

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When a Resource Type is listed as Mandatory (M) in this Annex, the Device shall:

– expose that Atomic Measurement Resource Type in /oic/res

– expose that Resource Type as a Link in the Atomic Measurement

The mandatory Resource Types for an Atomic Measurement shall be listed in the "rts-m" Property Value.

When a Resource Type is listed as Optional (O) in this Annex, the Device uses that Resource Type as a Link in the Atomic Measurement if the Device makes that feature available via OCF. For example, if a blood pressure monitor (i.e. oic.d.bloodpressuremonitor) measures pulse rate and chooses to expose that feature over OCF, it exposes the oic.r.pulserate Resource Type as a Link in the blood pressure monitor Atomic Measurement (oic.r. bloodpressuremonitor-am). The allowed Resource Types for an instance of an Atomic Measurement (which includes both the M and O Resource Types that are implemented) shall be listed in the "rts" Property Value.

Some Resource Types are commonly used for all Healthcare Device Types; these are provided in Table C.2. Users may want to associate timestamps to the measurements when they access their healthcare information (in RFC3339 date and time format, oic.r.time.stamp). A Healthcare Device may be used by different users, so identifying a specific user with an ID may be appropriate (oic.r.userid). These Resource Types are exposed as Conditionally Required Resource Types of an Atomic Measurement (as defined per clause 7.8.4 of ISO/IEC 30118-1:2018**.**) of a specific Healthcare Device. The "rt" value of Resource Types that use Atomic Measurements are suffixed by -am (Atomic Measurements). When present in an Atomic Measurement, oic.r.time.stamp and oic.r.userid indicate the time when a sample of data is measured by a certain user.

Table C.2 – Commonly used resource types of healthcare device types

Resource Type Name	Resource Type Value	Requirement (M, S, O, CA, CR)
Observed Time	oic.r.time.stamp	O
User ID	oic.r.userid	O

It should also be noted that Resource-level and Property-level requirements can be different. All OCF Resource Types are specified using OpenAPI 2.0 and the Properties which are defined in a specific schema can either be mandatory or optional. In other words, even if a Resource Type is mandatory for a Device Type, some of its Properties may not be mandatory.

C.4.2 Blood pressure monitor

C.4.2.1 Introduction

A blood pressure monitor measures blood pressure [i.e., systolic, diastolic, and mean arterial pressure (MAP)]. Blood pressure is most frequently measured using the units of millimetres of mercury (mmHg). Blood pressure is often denoted as 120/80 mmHg, which means systolic blood pressure of 120 and diastolic blood pressure of 80.

Table C.3 describes the Device Type for a blood pressure monitor. Table C.4 describes the Atomic Measurement that is present in all instances of a blood pressure monitor.

Table C.3 – Healthcare device type of blood pressure monitor

Device Type (rt)	Resource Type Name	Resource Type Value	Requirement level
oic.d. bloodpressuremonitor	Blood pressure monitor Atomic Measurement	oic.r.bloodpressuremonitor-am	M

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614 **Table C.4 – Atomic measurement of blood pressure monitor**

Atomic Measurement Resource Type Value	Resource Type Name	Resource Type Value	Requirement level
oic.r. bloodpressuremonitor-am	Blood pressure	oic.r.blood.pressure	M
	Pulse rate	oic.r.pulserate	O

615

616 ### C.4.2.2 Required resource types

617 A blood pressure monitor shall expose oic.r.blood.pressure to report the blood pressure (systolic
618 and diastolic) and optionally MAP.

619 ### C.4.2.3 OCF-defined optional resource types

620 A blood pressure monitor measures pulse rate using the oic.r.pulserate Resource Type.

621 See Table C.2 for additional commonly used Resource Types that could be used here.

622 ## C.4.3 Glucose meter

623 ### C.4.3.1 Introduction

624 A glucose meter measures the concentration of glucose in the blood. Glucose, or blood sugar, is
625 the human body's primary source of energy. The blood glucose level is a key parameter that
626 diabetics measure multiple times per day.

627 Table C.5 describes the Device Type for a glucose meter. Table C.6 describes the Atomic
628 Measurement that is present in all instances of a glucose meter.

629 **Table C.5 – Healthcare device type of glucose meter**

Device Type (rt)	Resource Type Name	Resource Type Value	Requirement level
oic.d.glucosemeter	Glucose meter Atomic Measurement	oic.r.glucosemeter-am	M

630 **Table C.6 – Atomic measurement of glucose meter**

Atomic Measurement Resource Type Value	Resource Type Name	Resource Type Value	Requirement level
oic.r.glucosemeter-am	Glucose	oic.r.glucose	M
	Context Carbohydrates	oic.r.glucose.carb	O
	Context Exercise	oic.r.glucose.exercise	O
	Hemoglobin Bound to Glucose A1c Form (HbA1c)	oic.r.glucose.hba1c	O
	Context Health	oic.r.glucose.health	O
	Context Meal	oic.r.glucose.meal	O
	Context Medication	oic.r.glucose.medication	O
	Context Sample Location	oic.r.glucose.samplelocation	O
	Context Tester	oic.r.glucose.tester	O

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632 ### C.4.3.2 Required resource types

633 A glucose meter shall expose oic.r.glucose to report the blood glucose level in mg/dL or mmol/L.

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C.4.3.3 OCF-defined optional resource types

A glucose meter measures context carbohydrates, then it shall expose the context carbohydrates using oic.r.glucose.carb Resource Type.

A glucose meter measures context exercise using the oic.r.glucose.exercise Resource Type.

A glucose meter measures Hemoglobin Bound to Glucose A1c Form (HbA1c) using the oic.r.glucose.hba1c Resource Type.

A glucose meter measures context health using the oic.r.glucose.health Resource Type.

A glucose meter measures context meal using the oic.r.glucose.meal Resource Type.

A glucose meter measures context medication using the oic.r.glucose.medication Resource Type.

A glucose meter measures context sample location using the oic.r.glucose.samplelocation Resource Type.

A glucose meter measures context tester using the oic.r.glucose.tester Resource Type.

See Table C.2 for additional commonly used Resource Types that could be used here.

C.4.4 Body scale

C.4.4.1 Introduction

A body scale measures the weight. The weight is most frequently measured using the units of kilograms (kg) or pounds (lb).

Table C.7 describes the Device Type for a body scale. Table C.8 describes the Atomic Measurement that is present in all instances of a body scale.

Table C.7 – Healthcare device type of body scale

Device Type (rt)	Resource Type Name	Resource Type Value	Requirement level
oic.d.bodyscale	Body scale Atomic Measurement	oic.r.bodyscale-am	M

Table C.8 – Atomic measurement type of body scale

Atomic Measurement Resource Type Value	Resource Type Name	Resource Type Value	Requirement level
oic.r.bodyscale-am	Weight	oic.r.weight	M
	Body Mass Index (BMI)	oic.r.bmi	O
	Height	oic.r.height	O
	Body Fat	oic.r.body.fat	O
	Body Water	oic.r.body.water	O
	Body Soft Lean Mass	oic.r.body.slm	O
	Body Fat Free Mass	oic.r.body.ffm	O

C.4.4.2 Required resource types

A body scale shall expose oic.r.weight to report the body weight of a person.

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C.4.4.3 OCF-defined optional resource types

A body scale measures height using the oic.r.height Resource Type. Especially, a body scale measures the height if BMI is also reported because the height is used when a body scale measures BMI.

A body scale measures Body Mass Index (BMI) using the oic.r.bmi Resource Type.

A body scale measures body fat using the oic.r.body.fat Resource Type.

A body scale measures body water using the oic.r.body.water Resource Type.

A body scale measures body soft lean mass using the oic.r.body.slm Resource Type.

A body scale measures body fat free mass using the oic.r.body.ffm Resource Type.

See Table C.2 for additional commonly used Resource Types that could be used here.

C.4.5 Body thermometer

C.4.5.1 Introduction

A body thermometer measures the temperature at some point. In general, the body thermometer is placed at the measurement site for sufficient time for the measuring probe to reach the same temperature as the body site, and when stable, a direct digital reading of the probe temperature is taken.

Table C.9 describes the Device Type for a body thermometer. Table C.10 describes the Atomic Measurement that is present in all instances of a body thermometer.

Table C.9 – Healthcare device type of body thermometer

Device Type (rt)	Resource Type Name	Resource Type Value	Requirement level
oic.d.bodythermometer	Body thermometer Atomic Measurement	oic.r.bodythermometer-am	M

Table C.10 – Atomic measurement type of body thermometer

Atomic Measurement Resource Type Value	Resource Type Name	Resource Type Value	Requirement level
oic.r.bodythermometer-am	Temperature	oic.r.temperature	M
	Body Location for temperature	oic.r.body.location.temperature	O

C.4.5.2 Required resource types

A body thermometer shall expose oic.r.body.temperature to report the temperature level and the unit of a measured temperature is reported either in C, F or K.

C.4.5.3 OCF-defined optional resource types

A body thermometer measures temperature site using the oic.r.body.location.temperature Resource Type.

See Table C.2 for additional commonly used Resource Types that could be used here.

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Annex D
(normative)

Industrial device types

D.1 Operational scenarios

The Optical RFID Tag and Optical RFID Station Resource Types describe the attributes associated with an optical augmented RFID system of a smart factory environment for integrating the observation and the actuation in production lines of plants.

Commercial observation is the real-time monitoring to collect broad series of data from each product on the production line and machineries from the plant floor. This collected big data can be sent to OCF cloud and/or manufacturer's internal OCF network where it is analysed and used to estimate overall production flow, productivity and identify failure parts.

Commercial actuation is the real-time interaction to take actions on system failures such as defected product's isolation, possibly sending the product into a repair line, alarming, such as production line status, display panels and hazard issues such as fire and flood of the Commercial environment by sending actuation requests to actuators directly and/or to client(s).

Optical augmented RFID reader and tag assist in production line control utilizing the OCF ecosystem for smart factory environment. The optical augmented RFID reader is represented by the RFID Station Resource Type, the tag by the RFID Tag Resource Type.

In the RFID Tag Resource Type the tagid is an integer showing the currently read optical augmented RFID tag's identity information.

In the RFID Station Resource Type the process represents the stage of the product in the product line which has an optical RFID tag on its body. Event is represented by a Boolean value set to "True" or "False" alarming the issue when additional action is requested for the tagged product. actionrequest represents necessary actions like the isolation of the product, to send the product back to another specific line to modify or fix an issue.

Figure D.1 shows a normal, non-error case process flow in the smart factory. Blue arrow lines are where OCF communication exists. ORFID tag ID is only readable to maintain consistent identity.

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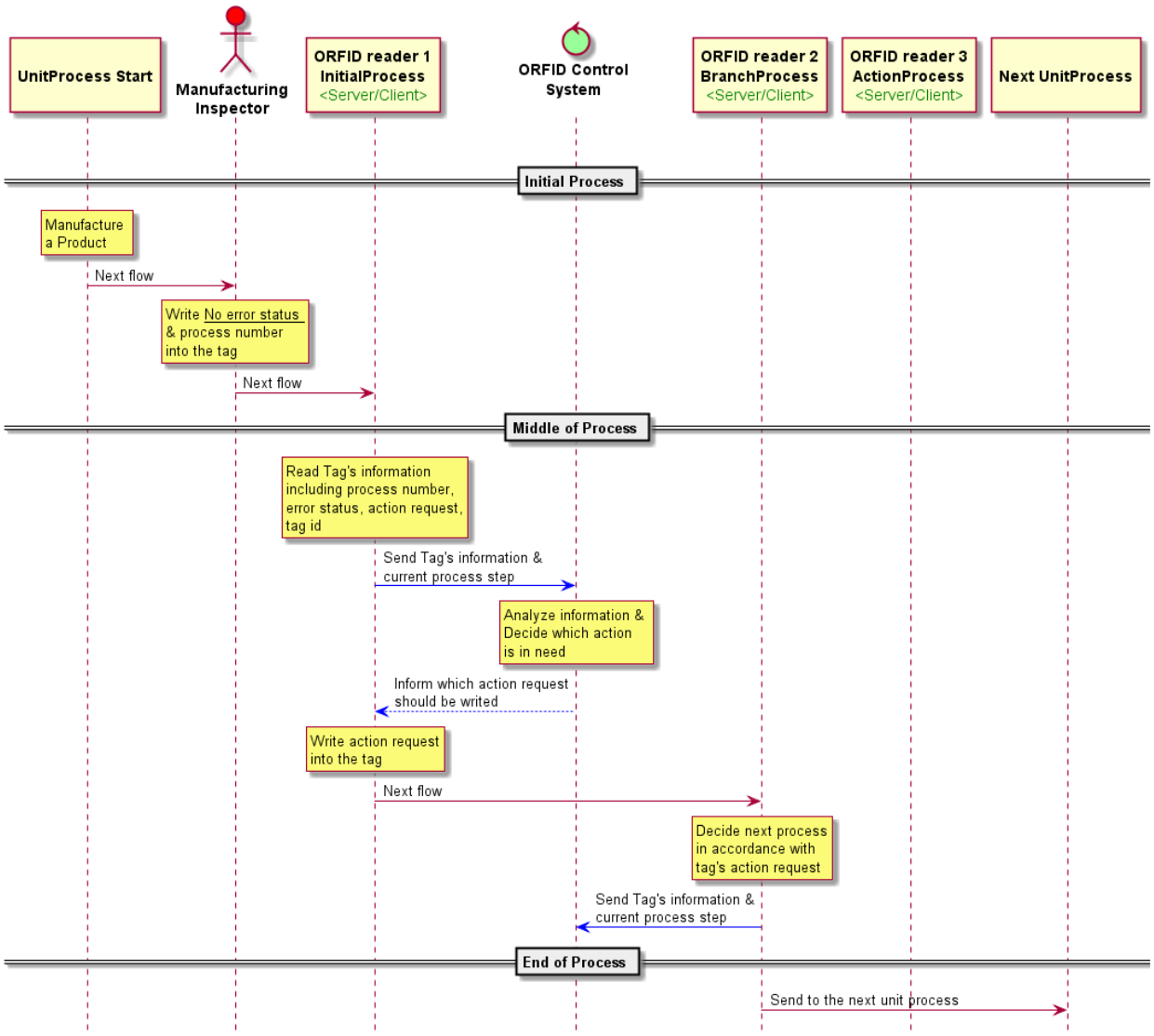

713

714 **Figure D.1 – Normal process scheme of optical augmented RFID in smart factory**
715 **environment**

716 Figure D.2 shows product error control scheme in the smart factory. Blue arrow lines are where
717 OCF communication exists. ORFID tag ID is only readable to maintain consistent identity.

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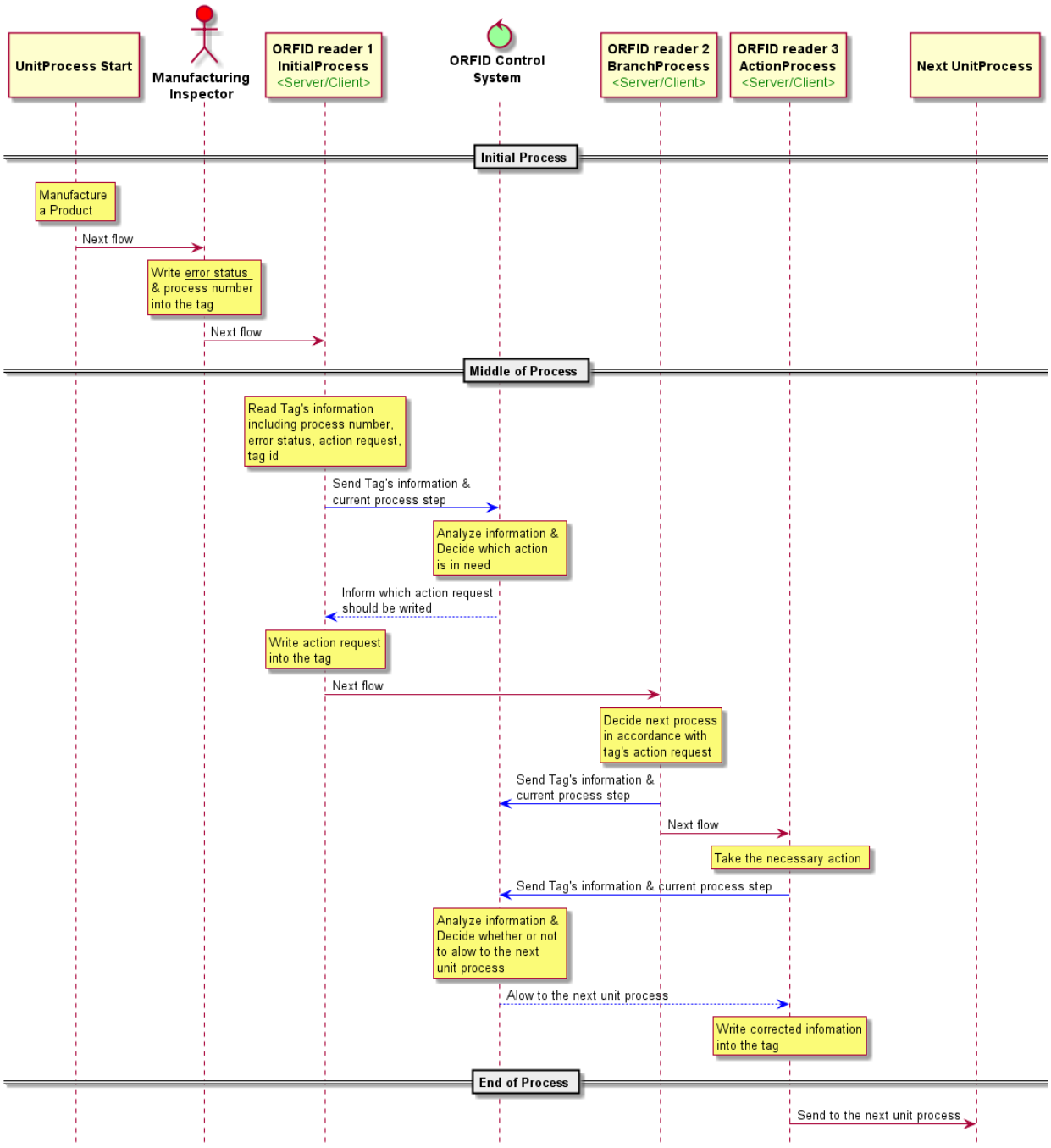

Figure D.2 – Abnormal process scheme of optical augmented RFID in smart factory environment

Manufacturing Inspector writes "error status" and "process number" into the tag after manufacturing a product. ORFID reader1 reads Tag's information and sends the information including current process step to ORFID Control System. Then ORFID reader1 waits until ORFID Control System replies. When ORFID reader1 receives "action request" from ORFID Control System. ORFID reader1 writes "action request" into the tag.

ORFID reader2 located at the BranchProcess line decides next flow in accordance with tag's "action request" information then it sends Tag's information and current process step to ORFID Control System, and sends the product to the right flow.

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If the product has an error, the product gets necessary action at ActionProcess line. Then ORFID reader3 sends repaired product's information. Then ORFID reader3 waits until ORFID Control System replies. When ORFID reader3 receives instruction from ORFID Control System for the next flow, ORFID reader3 sends the product according to instruction.

D.2 Industrial required resources per device type

Device Types may mandate that specific Resources be implemented. The required Resource per Device Type where mandated by the Industrial vertical is listed in Table B.1.

Table D.1 – Alphabetical list of device types (“rt”), including required resources for Industrial

Device Name (informative)	Device Type (“rt”) (Normative)	Required Resource name	Required Resource Type
Optical augmented RFID Reader	oic.d.orfid	Optical RFID Tag	oic.r.orfid.tag
		Optical RFID Station	oic.r.orfid.station

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