

**OCF 1.3 Should device A be able to DELETE device B's published Links in an RD? –
CR2003**

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11 Functional interactions

<Existing Spec Text>

11.3 Resource discovery

<Existing Spec Text>

11.3.6 Resource directory (RD) based discovery

11.3.6.1 Introduction

11.3.6.1.1 Indirect discovery for lookup of the Resources

Direct discovery is the mechanism used currently to find Resources in the network. When needed, Resources are queried at a particular Device directly or a multicast packet is sent to all Devices. Each queried Device responds directly with its Resources to the discovering Device. Resources available locally are registered on the same Device.

In some situations, one of the other mechanisms described in section 11.3.2.3, called indirect discovery, may be required. Indirect discovery is when a 3rd party Device, other than the discovering Device and the discovered Device, assists with the discovery process. The 3rd party Device, called Resource Directory (RD), only provides information on Resources on behalf of another Device but does not host Resources on part of that Device.

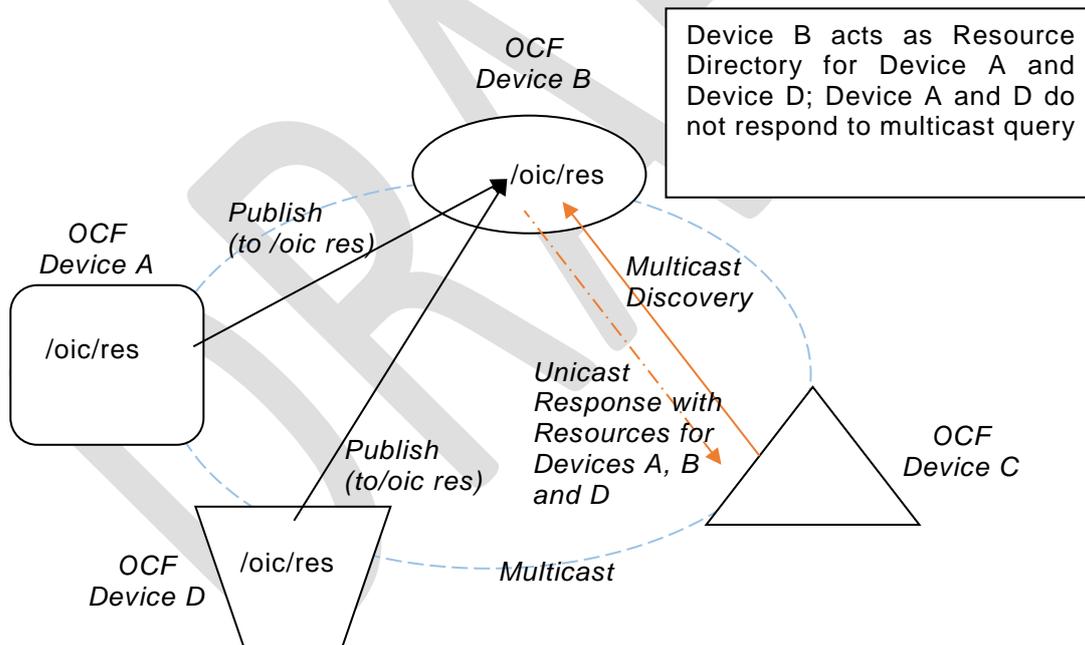


Figure 16. Indirect discovery of Resources by via an RD

In Figure 16, Device B acts as Resource Directory for Device A and Device D. Device A and Device D publish their Resource information to Device B. Device C may query Device B to acquire the Resource information of Device A and Device D. Device A and Device D may not respond to a multicast query when Device B, as a Resource Directory, responds to the query on their behalf.

Indirect discovery is useful for a constrained Device that needs to sleep to manage power and cannot process every discovery request, or when Devices may not be on the same network and requires optimization for discovery. Once Resources are discovered using indirect discovery, i.e., RD query,

then the access to the Resource is done by a request sent directly to the Device that hosts that Resource.

11.3.6.1.2 Resource directory

A Resource Directory (RD) is a Device that assists with indirect discovery. A Device which acts as an RD will be involved in the following operations.

- **RD discovery** – the procedure with which publishing Devices discover an RD and acquire the criteria to select from among multiple detected RDs.
- **Resource publish** – the procedures with which Devices publish their Resource information, i.e. Links. Future revision of this specification will allow modifying RD entries with UPDATE and DELETE operations. Any UPDATE or DELETE operations performed on an RD in this specification should be either silently ignored or generate an error.
- **Resource exposure** – the feature with which RDs expose the Links hosted by the 3rd party Devices via their own "/oic/res".

For the above, RDs make use of Resource Type "oic.wk.rd" defined in Table 22 and Table 23. A Device that supports the capability to host indirect discovery shall expose an instance of "oic.wk.rd" in its "/oic/res" to announce that it serves as an RD. The discoverable instance of "oic.wk.rd" shall allow only secure connections (e.g. endpoint with a scheme of "coaps" or "coaps+tcp"). A publishing Device may send a RETRIEVE request to "/oic/rd" to acquire the selection criteria among multiple RDs. Then it may send an UPDATE request to "/oic/rd" with its Links in the payload to publish the Links in "/oic/res" of the RD. A publishing Device is responsible to ensure an RD has the correct published Links to expose via its "/oic/res".

Table 22. "oic.wk.rd" Resource Type definition

Pre-defined URI	Resource Type Title	Resource Type ID ("rt" value)	Interfaces	Description	Related Functional Interaction
"/oic/rd"	Resource Directory	"oic.wk.rd"	"oic.if.baseline"	The discoverable Resource Type through which an RD 1) facilitates its discovery and provides the criteria to select an RD and 2) allows Devices to publish their Links in "/oic/res" of the RD.	Discovery

Table 23. "oic.wk.rd" Properties

Property title	Property name	Value type	Value rule	Unit	Access mode	Mandatory	Description
Selector	sel	Integer			R	yes	Provides the criteria for RD selection. An integer representing a value calculated by the RD. The value is in the range of 0 to 100. The lower the value, the more preferable the RD is.

An RD may be queried at its "/oic/res" Resource to find Resources hosted on other Devices. These Devices can be sleepy nodes or any other device that cannot or may not respond to discovery requests. A publishing Device may publish all or a partial list of Resources they host to an RD. The RD then responds to queries for Resource discovery on behalf of the publishing Device (for example: when a Device may go to sleep). For general Resource discovery, the RD behaves like any other Server in responding to requests to "/oic/res".

The remainder of section 11.3.6 is divided into three two parts. The first part covers "RD Discovery" (section 11.3.6.2), i.e., discovering and selecting of an RD. The second part covers "Resource publish" (section 11.3.6.3), i.e., publishing of Resources. The third part covers "Resource exposure" (section 11.3.6.4) where the RD replies to queries from Devices looking to discover Resources.

11.3.6.2 RD discovery

11.3.6.2.1 Discovering an RD

An RD shall support RD discovery.

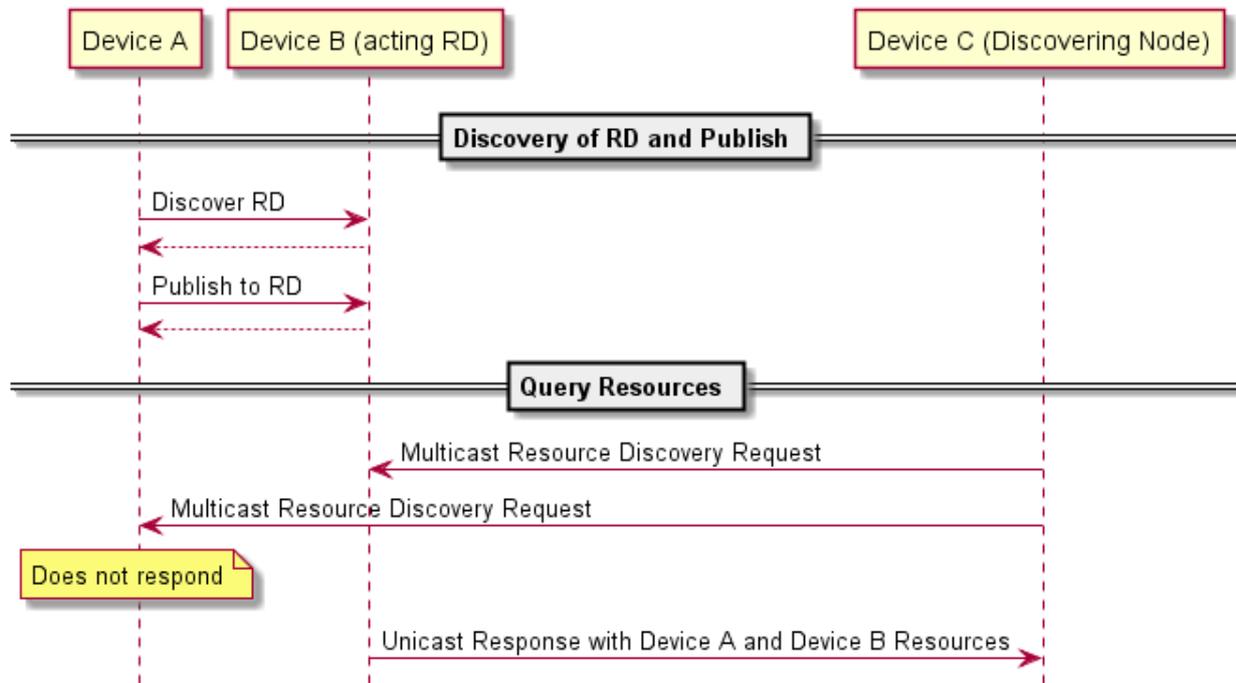


Figure 17. RD discovery and RD supported query of Resources support

As shown in Figure 17, a Device that wishes to publish its Resources first discovers an RD and then publishes the desired Resource information. Once a set of Resources have been published to an RD then the publishing Device should not respond to multicast Resource discovery queries for those published Resources when the RD is on the same multicast domain. In that case, only the RD should respond to multicast Resource discovery requests on the Resource published to it.

It is allowed for more than one Device to act as an RD. The reason to have multiple RD support is to make networks scalable, handle network failures and prevent centralized Device failure bottlenecks. This does not preclude a scenario where a use case or deployment environment may require a single Device in the environment to be deployed as the only RD (e.g. gateway model).

Discovering an RD may result in responses from more than one RD. If more than one RD responds, the discovering Device may select on of them based on the weighting parameter(s) provided in the response from the RD.

A Client that performs Resource discovery uses an RD just like it uses any other Server for discovery. It may send a unicast request to the RD when it needs only the Resources published on the RD or do a multicast query when it does not require or have explicit knowledge of an RD.

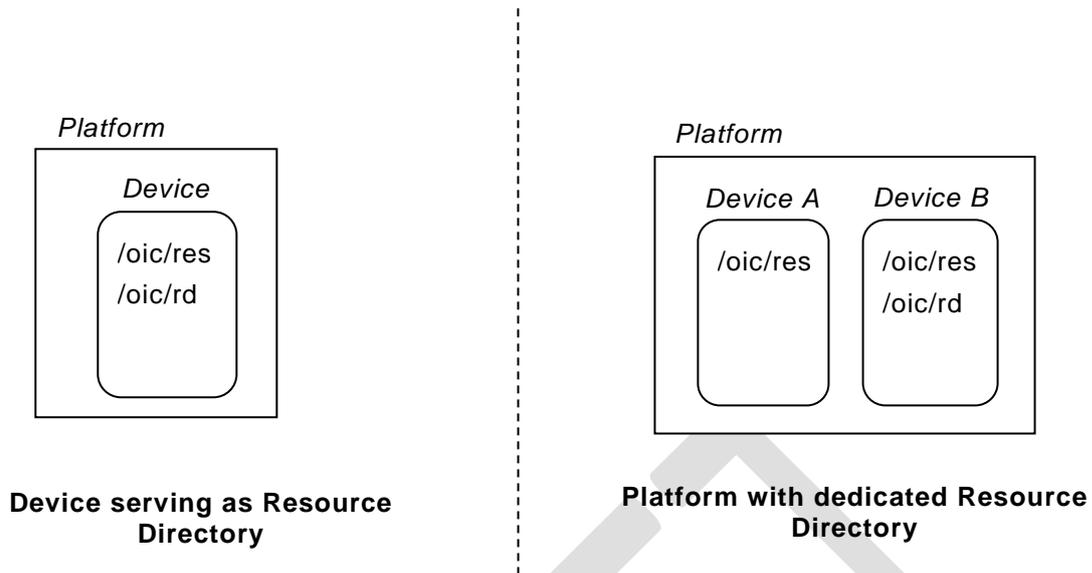


Figure 18. Resource Direction Deployment Scenarios

RDs may also be discovered in the following ways:

- Pre-configuration: Devices wishing to publish Resource information may be configured a priori with the information (e.g. IP address, port, transport etc.) of a specific RD. This pre-configuration may be done at onboarding or may be updated on the Device using an out-of-band method. This pre-configuration may be done by the manufacturer.
- Query-oriented: A publishing Device wanting to discover resource directories using query-oriented discovery may issue a multicast Resource discovery request for "/oic/res?rt=oic.wk.rd". Only and all Devices that can be an RD shall respond to this query. The "/oic/rd" response shall include information about the RD i.e., the presence of "oic.wk.rd" Link (as defined by the Resource Type) and a subsequent query to "/oic/rd" would produce weighting parameters to allow the discovering Device to select between RDs (see details in RD selection section 11.3.6.2.2). The "oic.wk.rd" resource shall be instantiated on the Devices acting as RDs. The "oic.wk.rd" schema is as defined in D.13.

11.3.6.2.2 RD selection process

The Device that wants to use an RD will find zero or more RDs on the network. There may not be an RD within the network. When discovering RDs, the Device needs to select an RD of all RDs found on the network. The Device may send a RETRIEVE request to "/oic/rd" of a specific RD, the RD shall respond with the representation of "/oic/rd/" containing selection criteria as defined by the "sel" Property. The lower the "sel" Property value is, the more preferable the responding RD is. The creation of the "sel" value is vendor defined.

For example an "/oic/rd" response may return the following.

```
{
  "rt": ["oic.wk.rd"],
  "if": ["oic.if.baseline"],
  "sel": 50
}
```

The selection based on the "sel" Property value will ensure that a Device can judge if the found RD is suitable for its needs.

The following situations may occur during the selection of an RD:

- 1) A single or multiple RDs are present in the network
- 2) No RD is present in the network
- 3) an additional RD arrives on the network

In the first scenario, the RDs are already present. If a single RD is detected then that RD may be used. When multiple RDs are detected the Device may use the "sel" Property value to select the RD.

In the second scenario, the publishing Device may continue looking for an RD until one is found or give up using an RD altogether.

In the third scenario, the Device has already published its resources to an existing RD, then discovers a new RD on the network. After judging the "sel" Property value, the Device may choose to move to the new RD. The Device should delete its Resource information from the currently used RD and publish the information to the new RD.

11.3.6.3 Resource publish

11.3.6.3.1 Overview

An RD shall provide the facility to allow Devices to publish their Resource information to a RD.

11.3.6.3.2 Publish resources

11.3.6.3.2.1 Overview

After the selection process of an RD, a device may push its Resource information to the selected RD, i.e., publish the Links in its "/oic/res" to the "/oic/res" of the RD.

The publishing Device may decide to publish all Resources or just a few of the Resources on the RD. The publishing Device should only publish Resources that are otherwise published to its own "/oic/res"; a publishing Device should not publish non-discoverable Resources or Resources hosted by some other Device. A publishing Device shall respond to discovery requests on its "/oic/res" resource unless all its discoverable Resources have been published in an RD.

11.3.6.3.2.2 Publish: Push Resource information

Resource information may be published using an UPDATE request sent to "/oic/rd".

A Device which hosts a Resource may publish the Resource information, i.e. the Link targeting the Resource, to an RD by sending an UPDATE request with the Link in the payload. The published Link shall be exposed through the "/oic/res" of the RD.

When a Device first publishes a Link or Links, it shall send an UPDATE request to the "/oic/rd" Resource of the RD including the following key-value pairs in the payload:

- **di** –its value shall be the Device ID of the publishing Device, i.e. the "di" value of "/oci/d".
- **links** –its value shall be the array of Links to be published. Links may omit the "ins" parameter in which case the RD will assign a value for each Link. The supplied "ins" parameter by the Client is allowed to be overruled by the RD, e.g. an RD can ignore the supplied "ins" value.
- **ttl** –its value indicates how long (in seconds) the publishing Device requests the RD to keep this published Link.

Take notice that the payload shall carry the appropriate Content-Format of "application/vnd.ocf+cbor":

```
{
  "di": "e61c3e6b-9c54-4b81-8ce5-f9039c1d04d9",
  "links": [
    {
      "anchor": "ocf://e61c3e6b-9c54-4b81-8ce5-f9039c1d04d9",
      "href": "/myLightSwitch",
      "rt": ["oic.r.switch.binary"],
      "if": ["oic.if.a", "oic.if.baseline"],
      "p": {"bm": 3},
      "eps": [
        {"ep": "coaps://[fe80::b1d6]:1111", "pri": 2},
        {"ep": "coaps://[fe80::b1d6]:1122"},
        {"ep": "coaps+tcp://[2001:db8:a::123]:2222", "pri": 3}
      ]
    },
    {
      "anchor": "ocf://e61c3e6b-9c54-4b81-8ce5-f9039c1d04d9",
      "href": "/myLightBrightness",
      "rt": ["oic.r.brightness"],
      "if": ["oic.if.a", "oic.if.baseline"],
      "p": {"bm": 3},
      "eps": [
        {"ep": "coaps://[[2001:db8:a::123]:2222"}
      ]
    }
  ],
  "ttl": 600
}
```

When an RD receives this initial UPDATE request, it determines whether to grant the request or not. Upon granting the request, the RD shall send back an UPDATE response to the publishing Device. The response shall include a payload with the same information as the original UPDATE request with the following possible differences:

- For each Link, an "ins" Parameter shall be included in the response. The RD shall assign a unique "ins" value identifying the Link among all the Links it advertises. If the publishing Device included an "ins" value in the UPDATE request, the RD may use it as long as it doesn't match any existing "ins" value in the published Links.
- The "ttl" Property Value shall be assigned by the RD and it shall be included in the response. The RD should use the value included in the UPDATE request but may assign a value that is lower if it is not able to honour the requested "ttl" value. After this time elapses, the RD shall remove the Links. To keep a Link alive the publishing Device may update the "ttl" using the UPDATE schema.

The RD shall add the new Links to its "/oic/res" and expose them to a valid discovery query, i.e. RETRIEVE request:

```
{
  "di": "e61c3e6b-9c54-4b81-8ce5-f9039c1d04d9",
  "links": [
    {
      "anchor": "ocf://e61c3e6b-9c54-4b81-8ce5-f9039c1d04d9",
      "href": "/myLightSwitch",
      "rt": ["oic.r.switch.binary"],
      "if": ["oic.if.a", "oic.if.baseline"],
      "p": {"bm": 3},
      "eps": [
        {"ep": "coaps://[fe80::b1d6]:1111", "pri": 2},
        {"ep": "coaps://[fe80::b1d6]:1122"},
        {"ep": "coaps+tcp://[2001:db8:a::123]:2222", "pri": 3}
      ],
      "ins": 11235
    },
    {
      "anchor": "ocf://e61c3e6b-9c54-4b81-8ce5-f9039c1d04d9",
      "href": "/myLightBrightness",
      "rt": ["oic.r.brightness"],
      "if": ["oic.if.a", "oic.if.baseline"],
      "p": {"bm": 3},
      "eps": [
        {"ep": "coaps://[[2001:db8:a::123]:2222"}
      ],
      "ins": 112358
    }
  ],
  "ttl": 600
}
```

Once a publishing Device has published Resources to an RD, it may choose not respond to the multicast discovery queries for the same Resources against its own "/oic/res", especially when on the same multicast domain as the RD. After publishing Resources, primarily it is the RDs responsibility to reply to the queries for the published Resources.

There is another possibility that the RD and the publishing Device both respond to the multicast query from the discovering Device. This will create a duplication of the information but is an alternative that may be used for non-robust networks. It is not a recommended option but for industrial scenarios,

this is one of the possibilities. Either way, discovering Clients need to always be prepared to process duplicate information in responses to multicast discovery request. The `"/oic/rd"` schema is as defined in D.13 to specify publishing to the `"/oic/rd"` Resource.

11.3.6.4 Resource exposure

11.3.6.4.1 `"/oic/res"` and retrieving of the Resources

The `"/oic/res"` based discovery process remains the same as that in the absence of an RD. Resources may be discovered by retrieving the `"/oic/res"` Resource by sending a multicast or unicast request. In the case of a multicast discovery request, an RD shall include in its response any published Resources on behalf of the Device that hosts the Resources. Clients should be prepared to process duplicate Resource information from more than one RD responding with the same information or from an RD and the hosting Device (publishing the Resource information) both responding to the request. Interaction with Resources discovered using the RD is done using the same mechanism and methods as with Resources discovered by retrieving the `"/oic/res"` Resource of the Device hosting the Resources (e.g., connect to the hosting Device and perform CRUDN operations on the Resource).

Resource Directories provide different `"/oic/res"` responses according to the requesting Clients, which indicate their preference with content format. OCF 1.0 Clients request with a "Content Format of `application/vnd.ocf+cbor`" in the Accept Option, whereas the Content-Format `application/cbor` in the Accept Option indicates OIC 1.1 Clients. For OIC 1.1 Clients, the `"/oic/res"` response includes Links conforming to OIC 1.1 specification, which OIC 1.1 Clients can understand. In this case the Resources hosted by the same Device shall be grouped together within a single JSON Object with `"di"` indicating the hosting Device. For a 3rd party Resource, i.e., a Resource which doesn't belong to the responding RD, its `"href"` value shall be a fully qualified transfer protocol URI with an IP address and port number as its authority component (e.g., `coaps://[2001:db8:b::c2e5]:22222/myLightSwitch`).

For example, an RD might return the following to an OIC 1.1 Clients:

```
[
  {
    "di": "88b7c7f0-4b51-4e0a-9faa-cfb439fd7f49",
    "links": [
      {
        "href": "/oic/res",
        "rel": "self",
        "rt": ["oic.wk.res"],
        "if": ["oic.if.ll", "oic.if.baseline"],
        "p": {"bm": 3, "sec": false}
      },
      {
        "href": "/oic/d",
        "rt": ["oic.wk.d", "oic.d.fan"],
        "if": ["oic.if.r", "oic.if.baseline"],
        "p": {"bm": 3, "sec": false}
      },
      {
        "href": "/oic/p",
        "rt": ["oic.wk.p"],
        "if": ["oic.if.r", "oic.if.baseline"],
        "p": {"bm": 3, "sec": true, "port": 33333}
      },
      {
        "href": "/myFanIntrospection",
        "rt": ["oic.wk.introspection"],
        "if": ["oic.if.r", "oic.if.baseline"],
        "p": {"bm": 3, "sec": true, "port": 33333}
      },
      {
        "href": "/oic/rd",
```



```
"rt": ["oic.wk.rd"],
"if": ["oic.if.baseline"],
"p": {"bm": 3, "sec": true, "port": 33333}
},
{
  "href": "/myFanSwitch",
  "rt": ["oic.r.switch.binary"],
  "if": ["oic.if.a", "oic.if.baseline"],
  "p": {"bm": 3, "sec": true, "port": 33333}
},
{
  "href": "/oic/sec/doxm",
  "rt": ["oic.r.doxm"],
  "if": ["oic.if.baseline"],
  "p": {"bm": 1, "sec": false}
},
{
  "href": "/oic/sec/pstat",
  "rt": ["oic.r.pstat"],
  "if": ["oic.if.baseline"],
  "p": {"bm": 1, "sec": true, "port": 33333}
},
{
  "href": "/oic/sec/cred",
  "rt": ["oic.r.cred"],
  "if": ["oic.if.baseline"],
  "p": {"bm": 1, "sec": true, "port": 33333}
},
{
  "href": "/oic/sec/acl2",
  "rt": ["oic.r.acl2"],
  "if": ["oic.if.baseline"],
  "p": {"bm": 1, "sec": true, "port": 33333}
}
]
},
{
  "di": "dc70373c-1e8d-4fb3-962e-017eaa863989",
  "links": [
    {
      "href": "coap://[2001:db8:b::c2e5]:66666/oic/d",
      "rt": ["oic.wk.d", "oic.d.light", "oic.d.virtual"],
      "if": ["oic.if.r", "oic.if.baseline"],
      "p": {"bm": 3, "sec": false}
    },
    {
      "href": "coaps://[2001:db8:b::c2e5]:22222/oic/p",
      "rt": ["oic.wk.p"],
      "if": ["oic.if.r", "oic.if.baseline"],
      "p": {"bm": 3, "sec": true, "port": 22222}
    },
    {
      "href": "coaps://[2001:db8:b::c2e5]:22222/myLightSwitch",
      "rt": ["oic.r.switch.binary"],
      "if": ["oic.if.a", "oic.if.baseline"],
      "p": {"bm": 3, "sec": true, "port": 22222}
    },
    {
      "href": "coaps://[2001:db8:b::c2e5]:22222/myLightBrightness",
      "rt": ["oic.r.brightness"],
      "if": ["oic.if.a", "oic.if.baseline"],
      "p": {"bm": 3, "sec": true, "port": 22222}
    }
  ]
}
```

```

    ]
  }
]

```

For OCF 1.0 Clients, the "/oic/res" response includes the OCF 1.0 Links with the "anchor" Parameter containing an OCF URI. The "/oic/res" response has a single array of Links to conform to IETF RFC 6690. Each Link shall contain the "anchor" Parameter of the value OCF URI where the authority component of <deviceId> indicates the Device hosting the target Resource.

For example, an RD may return the following to an OCF 1.0 Client.

```

[
  {
    "anchor": "ocf://88b7c7f0-4b51-4e0a-9faa-cfb439fd7f49",
    "href": "/oic/res",
    "rel": "self",
    "rt": ["oic.wk.res"],
    "if": ["oic.if.ll", "oic.if.baseline"],
    "p": {"bm": 3},
    "eps": [{"ep": "coap://[2001:db8:a::b1d4]:7777"},
            {"ep": "coaps://[2001:db8:a::b1d4]:33333"}]
  },
  {
    "anchor": "ocf://88b7c7f0-4b51-4e0a-9faa-cfb439fd7f49",
    "href": "/oic/d",
    "rt": ["oic.wk.d", "oic.d.fan"],
    "if": ["oic.if.r", "oic.if.baseline"],
    "p": {"bm": 3},
    "eps": [{"ep": "coap://[2001:db8:a::b1d4]:7777"},
            {"ep": "coaps://[2001:db8:a::b1d4]:33333"}]
  },
  {
    "anchor": "ocf://88b7c7f0-4b51-4e0a-9faa-cfb439fd7f49",
    "href": "/oic/p",
    "rt": ["oic.wk.p"],
    "if": ["oic.if.r", "oic.if.baseline"],
    "p": {"bm": 3},
    "eps": [{"ep": "coaps://[2001:db8:a::b1d4]:33333"}]
  },
  {
    "anchor": "ocf://88b7c7f0-4b51-4e0a-9faa-cfb439fd7f49",
    "href": "/myFanIntrospection",
    "rt": ["oic.wk.introspection"],
    "if": ["oic.if.r", "oic.if.baseline"],
    "p": {"bm": 3},
    "eps": [{"ep": "coaps://[2001:db8:a::b1d4]:33333"}]
  },
  {
    "anchor": "ocf://88b7c7f0-4b51-4e0a-9faa-cfb439fd7f49",
    "href": "/oic/rd",
    "rt": ["oic.wk.rd"],
    "if": ["oic.if.baseline"],
    "p": {"bm": 3},
    "eps": [{"ep": "coaps://[2001:db8:a::b1d4]:33333"}]
  },
  {
    "anchor": "ocf://88b7c7f0-4b51-4e0a-9faa-cfb439fd7f49",
    "href": "/myFanSwitch",
    "rt": ["oic.r.switch.binary"],
    "if": ["oic.if.a", "oic.if.baseline"],
    "p": {"bm": 3},
  }
]

```

```
"eps": [{"ep": "coaps://[2001:db8:a::b1d4]:33333"}]
},
{
  "anchor": "ocf://88b7c7f0-4b51-4e0a-9faa-cfb439fd7f49",
  "href": "/oic/sec/doxm",
  "rt": ["oic.r.doxm"],
  "if": ["oic.if.baseline"],
  "p": {"bm": 1},
  "eps": [{"ep": "coap://[2001:db8:a::b1d4]:77777"},
          {"ep": "coaps://[2001:db8:a::b1d4]:33333"}]
},
{
  "anchor": "ocf://88b7c7f0-4b51-4e0a-9faa-cfb439fd7f49",
  "href": "/oic/sec/pstat",
  "rt": ["oic.r.pstat"],
  "if": ["oic.if.baseline"],
  "p": {"bm": 1},
  "eps": [{"ep": "coaps://[2001:db8:a::b1d4]:33333"}]
},
{
  "anchor": "ocf://88b7c7f0-4b51-4e0a-9faa-cfb439fd7f49",
  "href": "/oic/sec/cred",
  "rt": ["oic.r.cred"],
  "if": ["oic.if.baseline"],
  "p": {"bm": 1},
  "eps": [{"ep": "coaps://[2001:db8:a::b1d4]:33333"}]
},
{
  "anchor": "ocf://88b7c7f0-4b51-4e0a-9faa-cfb439fd7f49",
  "href": "/oic/sec/acl2",
  "rt": ["oic.r.acl2"],
  "if": ["oic.if.baseline"],
  "p": {"bm": 1},
  "eps": [{"ep": "coaps://[2001:db8:a::b1d4]:33333"}]
},
{
  "anchor": "ocf://dc70373c-1e8d-4fb3-962e-017eaa863989",
  "href": "/oic/d",
  "rt": ["oic.wk.d", "oic.d.light"],
  "if": ["oic.if.r", "oic.if.baseline"],
  "p": {"bm": 3},
  "eps": [{"ep": "coap://[2001:db8:b::c2e5]:66666"},
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DRAFT