ZCL over IP (dotdot) – Basics

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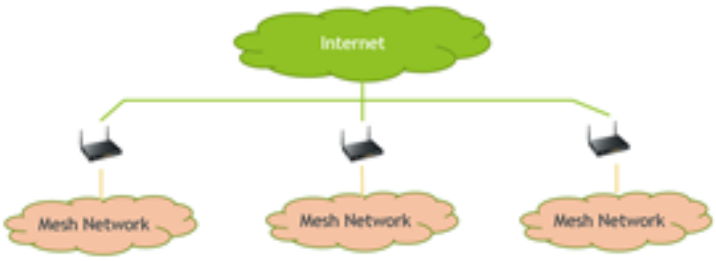
What is dotdot?

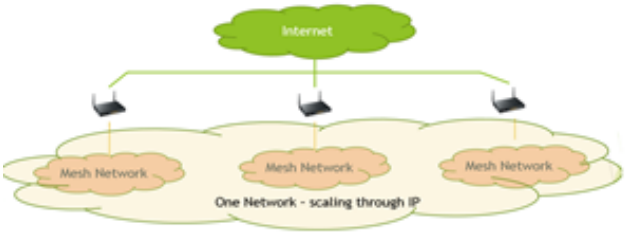
“Dotdot is the universal language of the Internet of Things, making it possible for smart objects to work together on any network” (https://www.speakdotdot.com).
In other words, is a generalization of the application layer functionality developed by ZigBee Alliance, including parts of the ZigBee Cluster Library and ZigBee PRO functionality.

IP vs non-IP wireless mesh architecture

Non-IP mesh architecture. Individual mesh networks. Mesh design scaled by duplication (e.g short Address); Complex network management for each Gateway



IP mesh architecture. Simplified network management. Synchronized operations across subnets. Shared gateway connections to a plant network. One network scaling through IP.



Concepts. ZigBee to ZCL over IP

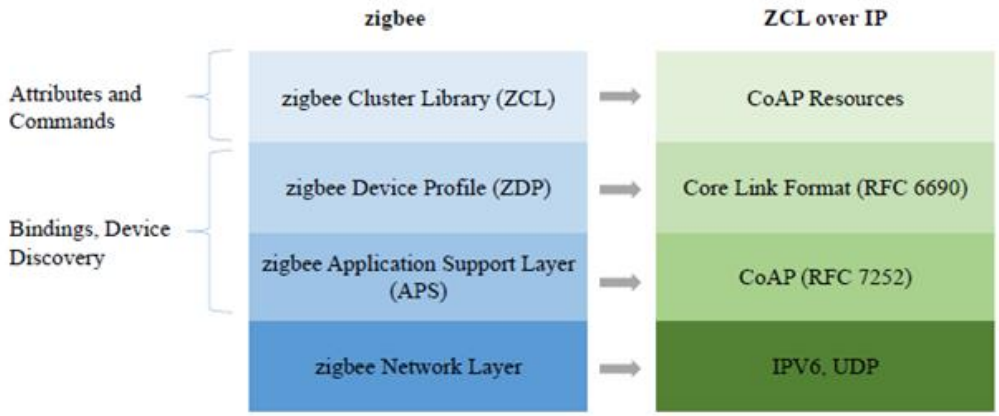
Node ->Endpoints -> Clusters -> attributes and commands:

- A node contains an 802.15.4 radio and is defined by one or more application endpoints;
- A device, in ZCL terms, resides to an endpoint (e.g. OnOffLight, DimmableLight); This includes a list of input and output clusters;
- Each cluster is a collection of commands and attributes used to act and store a specific state of a device. In programming terms, a cluster is an object (e.g – DimmableLight device contains Level Control Cluster);
- Attributes are the state of the cluster, or the data;

Addressing methods:

- Direct addressing, binding and group (multicast) methods;
- Unique Identifier is introduced because the IPv6 address can change any time;

ZigBee to ZCL over IP mapping:



Application layer security (ZCL over IP)

- Unique Identifier. This is associated to a certificate provided by manufacturer.
- All devices must support handling of operational certificates;
- DTLS based on pre-shared key raw public key or certificates;

ZCL Commands and CoAP

- The concept of transactions: request, followed by response. In ZCL over IP each transaction consists in a request, CoAP method (GET/PUT/POST/DELETE) and a corresponding CoAP response (e.g 2.05 Content, 4.05 Method not Allowed, 2.04 Changed).
- ZCL over IP resource table:

Resource	Methods	URI
Resource discovery	GET	/zcl
Endpoints	GET	/e
Attributes	GET, PUT, POST	/a
Commands	GET, POST	/c
Bindings	GET, PUT, POST, DELETE	/b
Report Configuration	GET, PUT, POST, DELETE	/r
Report Notification	POST	/n
Group Notification	POST	/g
EZ-Mode Commissioning	GET, POST	/m

- ZCL commands and CoAP options
  - Read Attributes = CoAP GET -> /a/<attributeID>;
  - Write Attributes = CoAP PUT/POST -> /a/<attributeId>;
  - Discover Attributes = CoAP GET /a;
  - Configure Reporting instance = CoAP PUT/POST/DELETE -> /r/<reportId>
  - Configure Reporting collection = CoAP PUT/POST/DELETE -> /r
  - Read configure reporting = CoAP GET -> /r/<reportId>
  - Report attributes = CoAP POST -> /n
- Examples of commands:

- ZDP discovery commands (e.g, discover endpoints implementing the client side of the onoff cluster - Id = 0x006 -):
    Request - multicast query:
        GET COAP:///[FF03::FD]/.well-known/core?rt=urn:zcl:c:6.c
    Reply – CoAP reponse code 2.05 Content:
        2.05 Content (Content format: application/link format (40))
        <coap: //[fd01:3ead:0001::dece:0001]/zcl/e/1/c6>;rt-urn:zcl:c:6.c;ze=urn:z:cl:d.103.1
- Read attribute (e.g OnOff attribute, Id = 0x000, cluster Id = 0x0006, Endpoint = 0x08)
    Request – CoAP GET
        GET COAP:///[fd01:3ead:0001::dece:00002]/zcl/e/8/s6/a/0
    Reply – CoAP reponse code 2.05 Content:
        2.05 Content with a CBOR map payload {0:0} (indicating that the OnOff attribute is currently in the Off state);
- Cluster Commands (e.g: On command, cluster Id = 0x0006, endpoint id = 0x08, command Id = 0x01):
    Request – CoAP POST
        POST COAP:///[fd01:3ead:0001::dece:00002]/zcl/e/8/s6/c/1
    Reply – CoAP reponse code 2.04 Changed:
        2.04 Changed with no payload (indicating a Default response with status Success)
- Wireshark capture (configure reporting command):