SNS COLLEGE OF ENGINEERING

An Autonomous Institution

Coimbatore-107

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

19IT503-INTERNET OF THINGS

UNIT-3 EVOLVING IoT STANDARDS & PROTOCOLS

Topic:3 – CoAP

Constrained Application Protocol (CoAP)

- Background
- Messaging Model
- Request/Response Model
- Intermediaries and Caching

Constrained Application Protocol (CoAP) Background

- CoAP is a simple application layer protocol targeted to simple electronic devices (e.g., IoT/M2M things) to allow them to communicate interactively over the Internet.
  - CoAP is designed for low power sensors (wireless sensor network [WSN] nodes and actuators.
- CoAP can be seen as a specialized web transfer protocol for use with constrained networks and nodes for M2M applications.
- CoAP operates with HTTP (hypertext transfer protocol) for basic support with the web

Constrained Application Protocol (CoAP) Background

- CoAP protocol are as follows:
  - (i) minimal complexity for the mapping with HTTP;
  - (ii) low header overhead and low parsing complexity;
  - (iii) support for the discovery of resources;
  - (iv) simple resource subscription process;
  - (v) simple caching based on max-age.

Constrained Application Protocol (CoAP) Background

- CoAP makes use of two message types, requests and responses, using a simple binary base header format.
  - Any bytes after the headers in the packet are considered the message body if any.
  - The length of the message body is implied by the datagram length.

Constrained Application Protocol (CoAP) Background

- The constrained nodes for which CoAP is targeted often have 8-bit microcontrollers with small amounts of ROM and RAM, while networks such as 6LoWPAN (IPv6 OVER LOWPOWER WPAN)
- CoAP provides a method/response interaction model between application end-points, supports built-in resource discovery, and includes key web concepts such as URIs (uniform resource identifiers) and content-types.
- CoAP easily translates to HTTP for integration with the web.

Constrained Application Protocol (CoAP) Background

- The use of Web Services (WS) on the Internet has become ubiquitous in most applications; it depends on the fundamental representational state transfer (REST) architecture of the web.

Constrained Application Protocol (CoAP) Background

- CoAP has the following main features:
  - Constrained web protocol fulfilling M2M requirements;
  - UDP (User datagram protocol) binding with optional reliability supporting unicast and multicast requests;
  - Asynchronous message exchanges;
  - Low header overhead and parsing complexity;
  - URI and content-type support;
  - Simple proxy and caching capabilities;
  - A stateless HTTP mapping, allowing proxies to be built providing access to CoAP resources via HTTP in a uniform way or for HTTP simple interfaces to be realized alternatively over CoAP
  - Security binding to datagram transport layer security (DTLS).

Constrained Application Protocol (CoAP) Background

- M2M interactions typically result in a CoAP implementation acting in both client and server roles (called an end-point).
- A CoAP request is equivalent to that of HTTP and is sent by a client to request an action (using a method code) on a resource (identified by a URI) on a server.
- The server then sends a response with a response code; this response may include a resource representation.
- Unlike HTTP, CoAP deals with these interchanges asynchronously over a datagram-oriented transport such as UDP. This is done logically using a layer of messages that supports optional reliability (with exponential back-off).
- CoAP defines four types of messages:
  - confirmable (CON), non-confirmable (NON), acknowledgement, reset;
- Method codes and response codes included in some of these messages make them carry requests or responses.
- The basic exchanges of the four types of messages are transparent to the request/response interactions.

Constrained Application Protocol (CoAP) Background

- CoAP logically as
  - using a two-layer approach,
  - a CoAP messaging layer used to deal with UDP (User Datagram Protocol)
  - the asynchronous nature of the interactions,
  - the request/response interactions using method and response codes

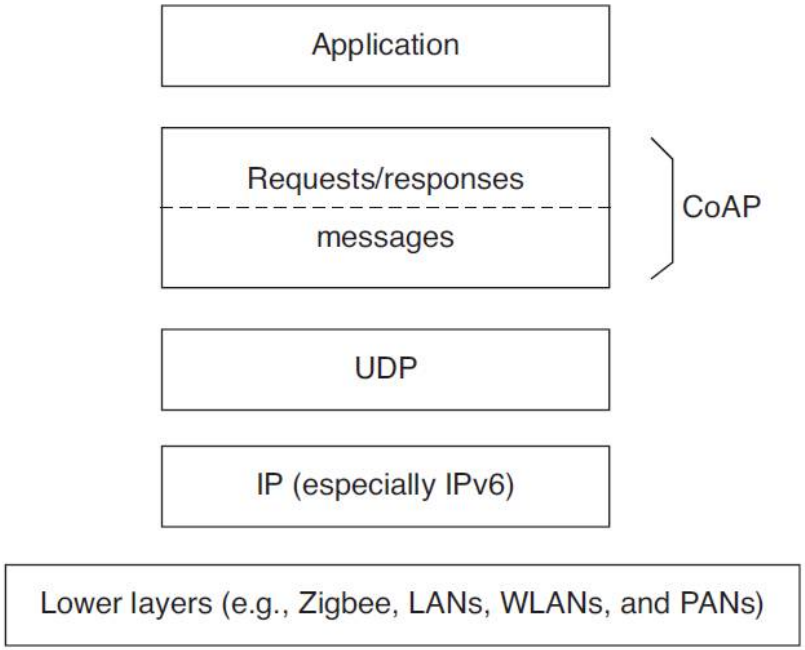


FIGURE 5.2 Abstract layering of CoAP.

Constrained Application Protocol (CoAP) Background

- CoAP is, however, a single protocol, with messaging and request/response just features of the CoAP header.
- Figure depicts the overall protocol stack that is being considered in the CoAP context.

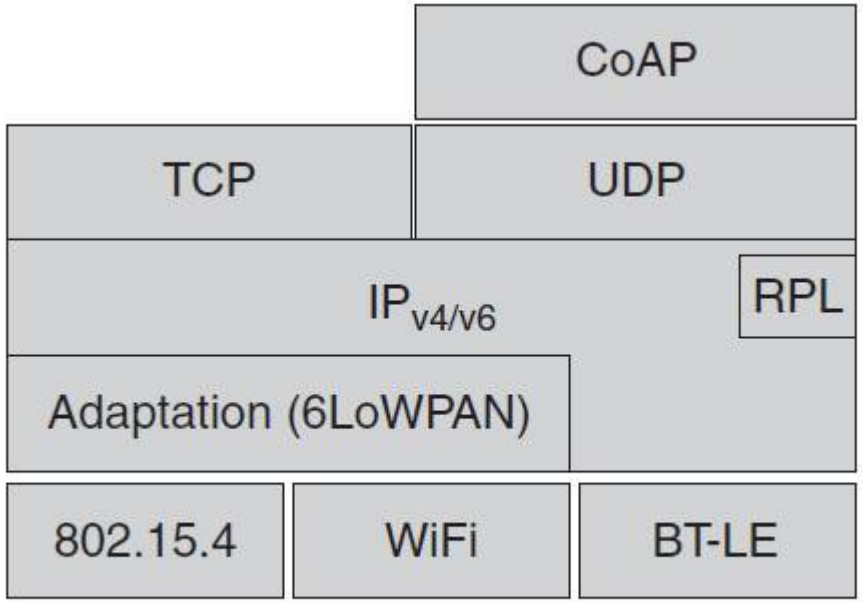


FIGURE 5.3 Overall protocol stack in CoAP's environment.

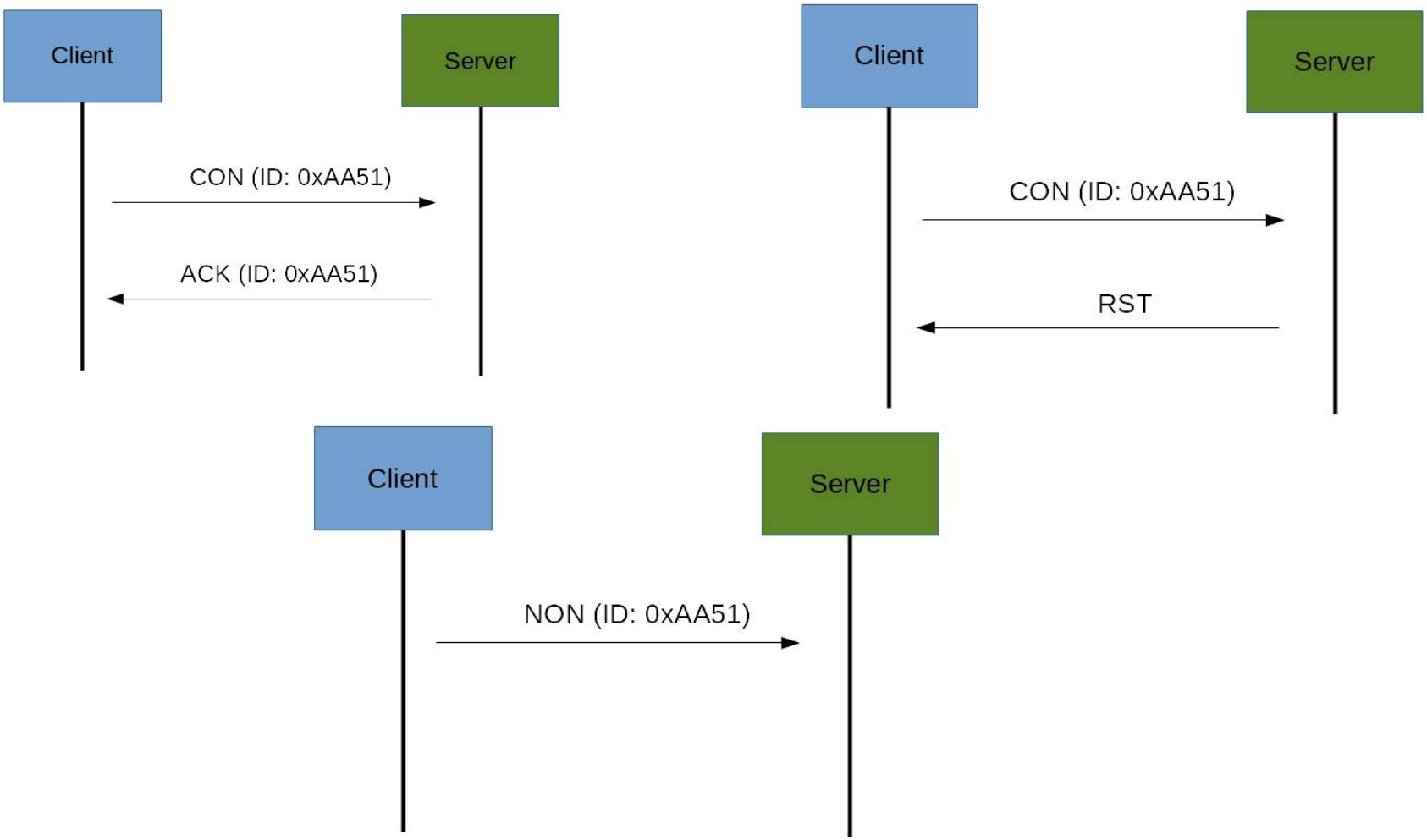
Constrained Application Protocol (CoAP)
Messaging Model

- The CoAP messaging model is based on the exchange of messages over UDP between end-points.
  - It uses a short fixed-length binary header (4 bytes) that may be followed by compact binary options and a payload.
  - This message format is shared by requests and responses.
  - Each CoAP message contains a message ID used to detect duplicates and for optional reliability.

Constrained Application Protocol (CoAP) Messaging Model

- Reliability is provided by marking a message as CON.
- A CON message is retransmitted using a default timeout and exponential back-off between retransmissions, until the recipient sends an acknowledgement message (ACK) with the same message ID from the corresponding end-point.
- When a recipient is not able to process a CON message, it replies with a reset message (RST) instead of an ACK.
- A message that does not require reliable delivery, for example, each single measurement out of a stream of sensor data, can be sent as a NONmessage.
  - These are not acknowledged, but still have a message ID for duplicate detection.
  - When a recipient is not able to process a NON message, it may reply with an RST.
- Since CoAP is based on UDP, it also supports the use of multicast IP destination addresses, enabling multicast CoAP requests.

CON and NON


Client
Server
CON (ID: 0xAA51)
ACK (ID: 0xAA51)
Client
Server
CON (ID: 0xAA51)
RST
Client
Server
NON (ID: 0xAA51)

Constrained Application Protocol (CoAP)
Request/Response Model

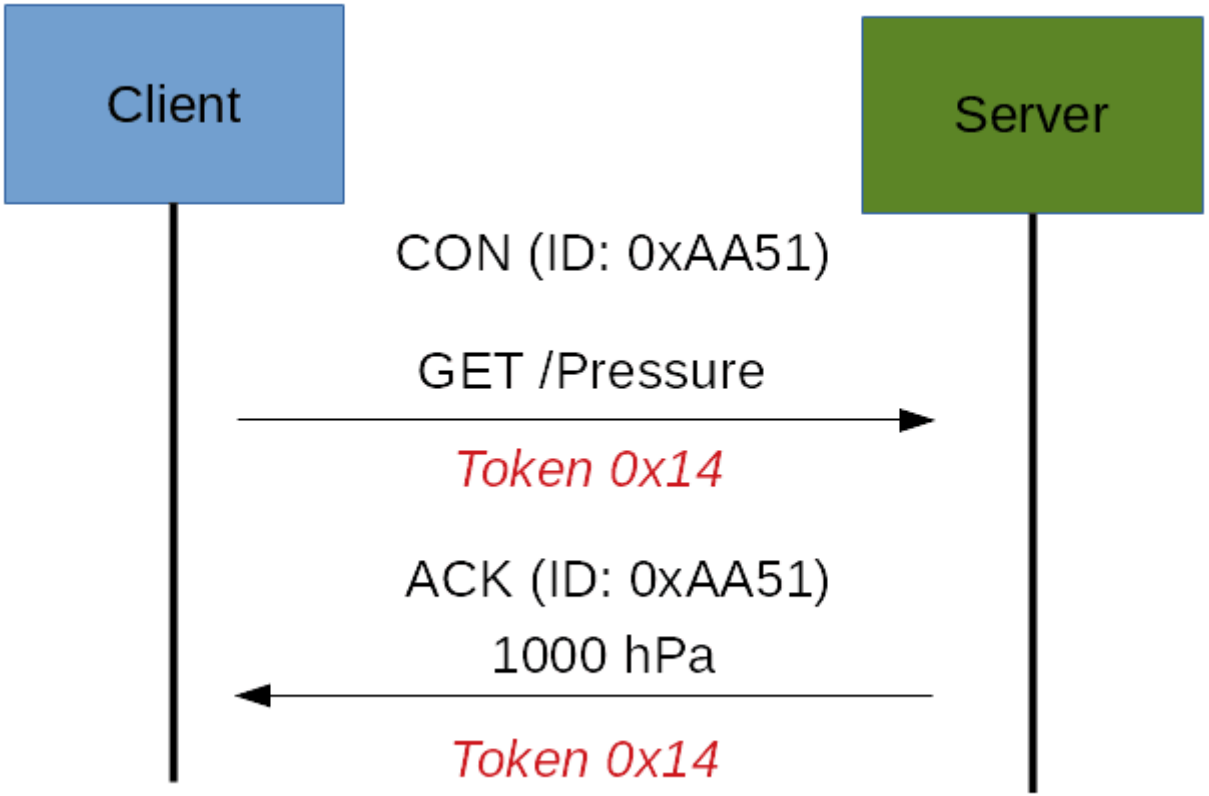
- CoAP messages, which include either a method code or response code, respectively.
- Optional (or default) request and response information, such as the URI (uniform resource identifier) and payload content-type, are carried as CoAP options.
- A token option is used to match responses to requests independent of the underlying messages.

Constrained Application Protocol (CoAP)

Request/Response Model

- A request is carried in a CON (confirmable) or NON (non-confirmable) message, and if immediately available, the response to a request carried in a CON message is carried in the resulting ACK message. This is called a **piggy-backed response**.
- If the server is not able to respond immediately to a request carried in a CON message, it simply responds with an empty ACK message so that the client can stop retransmitting the request.
- When the response is ready, the server sends it in a new CON message (which then in turn needs to be acknowledged by the client). **This is called a separate response.**
- Likewise, if a request is sent in a NON message, then the response is usually sent using a new NON message, although the server may send a CON message.
- CoAP makes use of GET, PUT, POST, and DELETE methods in a similar manner to HTTP.

Request/Response Model



Constrained Application Protocol (CoAP)

Intermediaries and Caching

- The protocol supports the caching of responses in order to efficiently fulfill requests.
- Simple caching is enabled using freshness and validity information carried with CoAP responses.
- A cache could be located in an end-point or an intermediary.

Constrained Application Protocol (CoAP)

Intermediaries and Caching

- Proxying is useful in constrained networks for several reasons, including
  - (i) network traffic limiting,
  - (ii) to improve performance,
  - (iii) to access resources of sleeping devices,
  - (iv) for security reasons.
- The proxying of requests on behalf of another CoAP end-point is supported in the protocol.
- The URI of the resource to request is included in the request, while the destination IP address is set to the proxy.

THANK YOU