Thing Plug

ThingPlug 활용 실습
MQTT on Arduino

이상민/이호상/성지웅 Manager

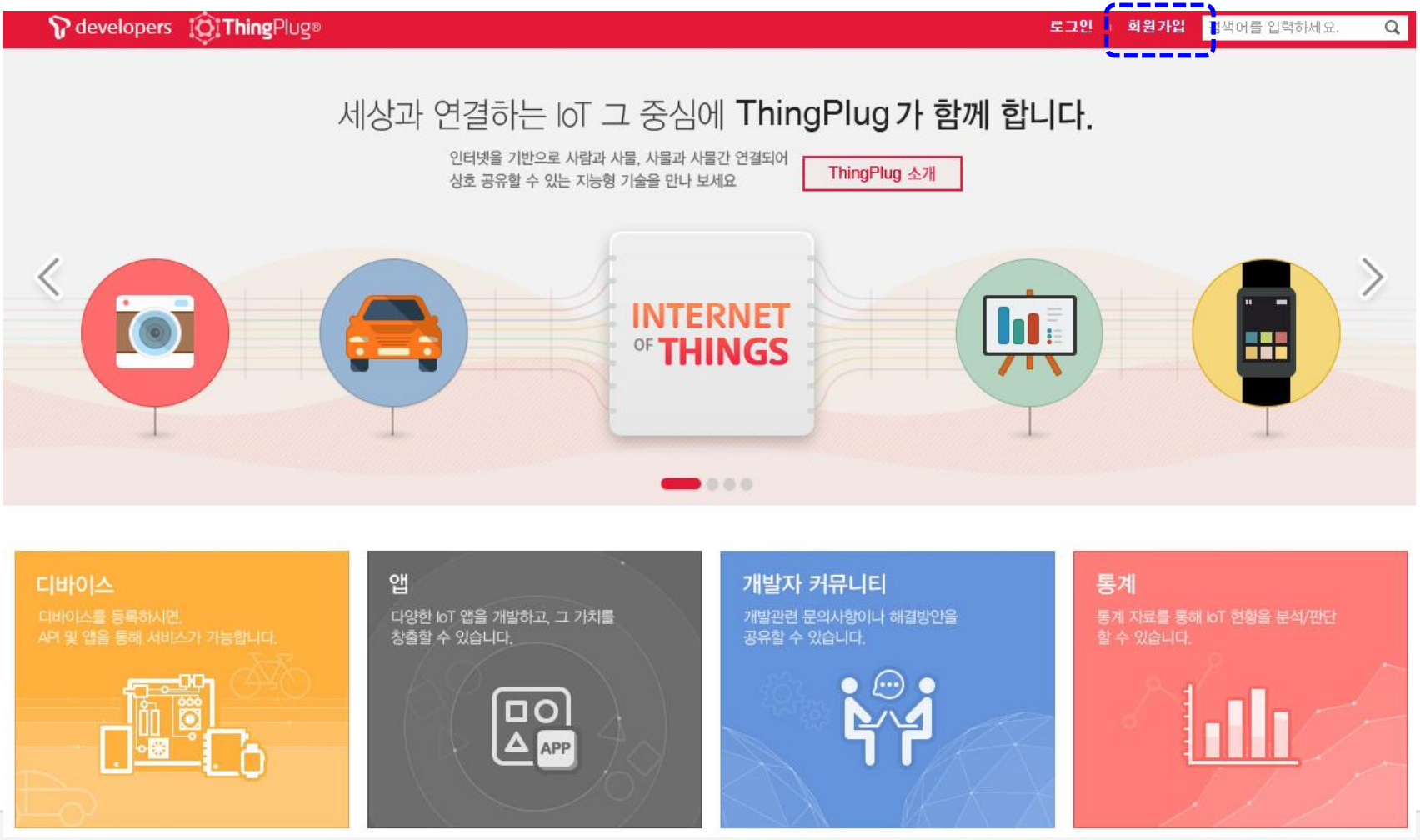
SK텔레콤 | 플랫폼기술원 | IoT Tech Lab.

SK telecom

Syllabus

1. ThingPlug 소개
2. ThingPlug – Device API
3. ThingPlug – Application API
4. Demo & 실습

- 회원가입: https://thingplug.sktiot.com



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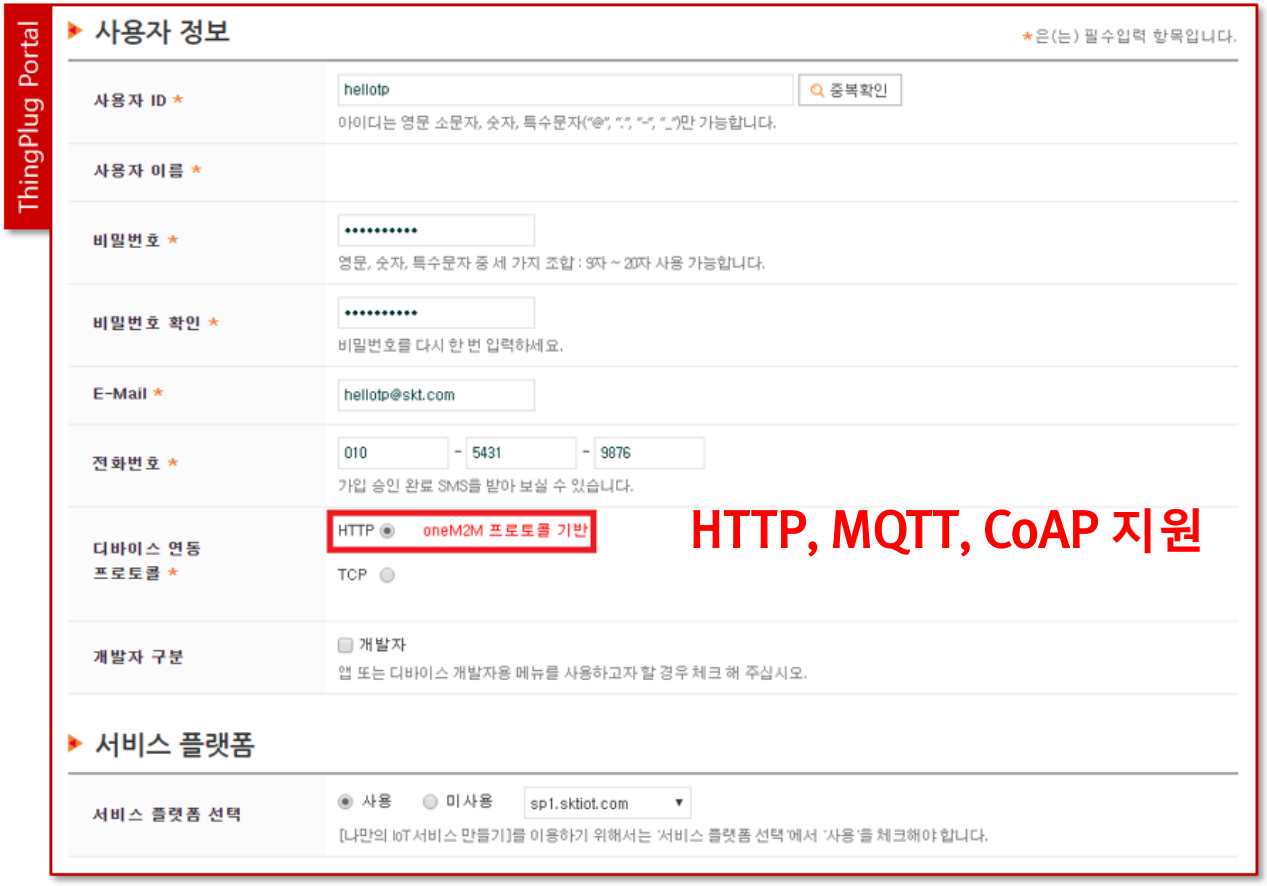
- 디바이스 연동 프로토콜: HTTP 선택 (oneM2M 국제표준 기반규격)



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- 디바이스 ID: **nodeID (0.2.481.1.101.01087654321)** 휴대폰 전화번호, MAC주소 등 고유번호
- 사용자 인증키: **uKey (시스템 생성)**
- 디바이스 인증키: **dKey (시스템 생성)**

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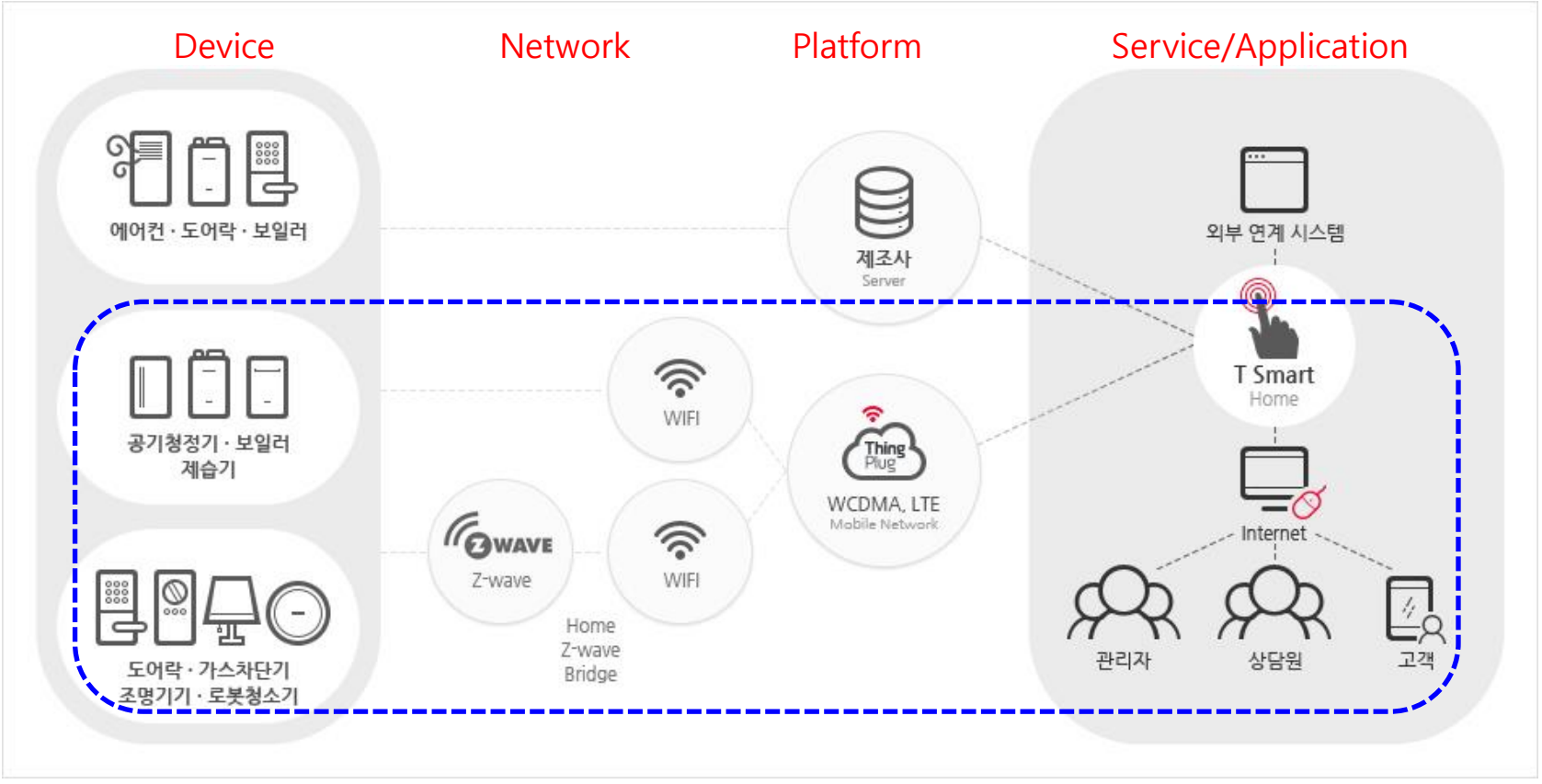
- **IoT 서비스 구조: 스마트홈 사례**



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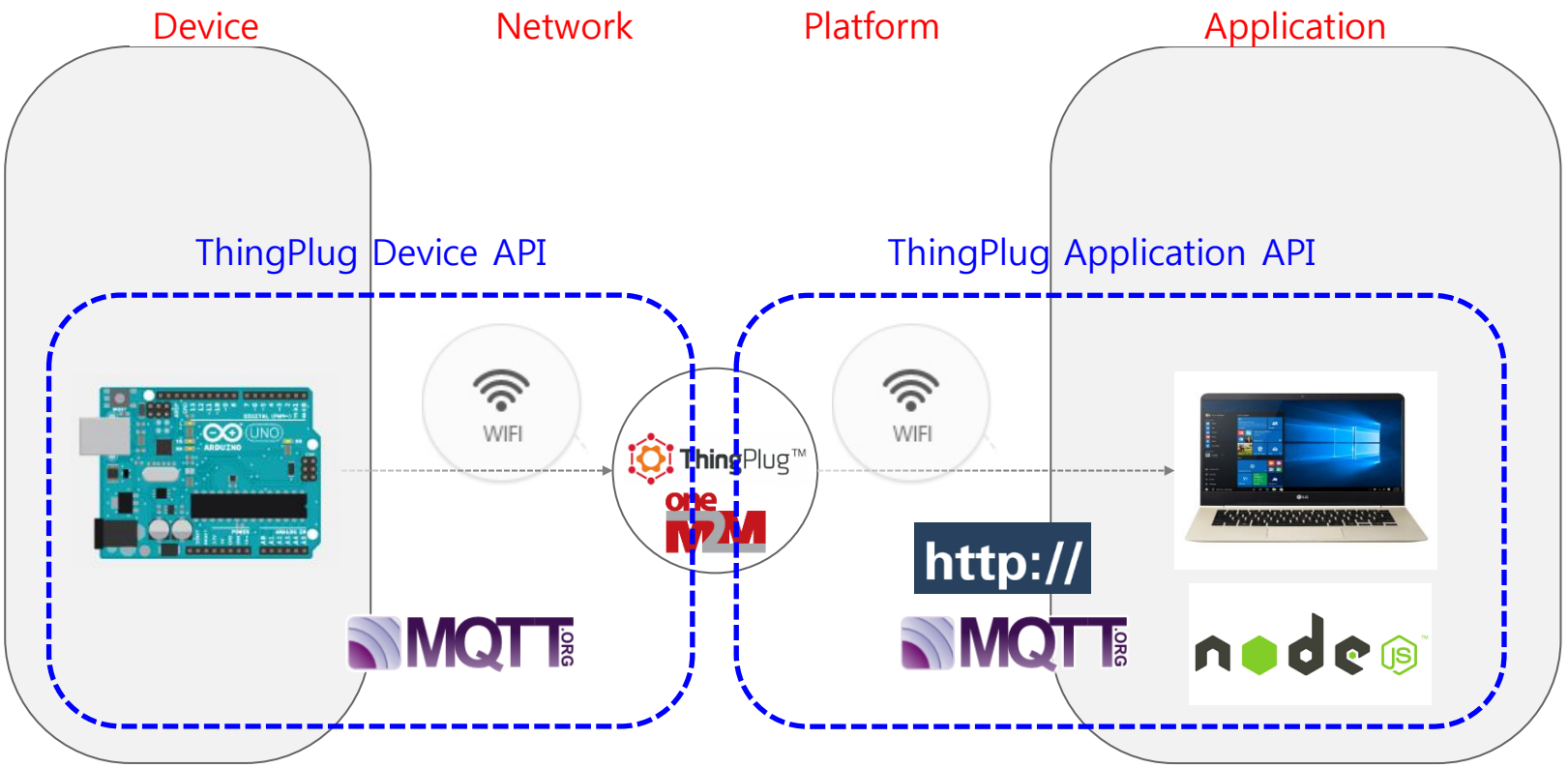
- **IoT 서비스 구조: 실습 구조**



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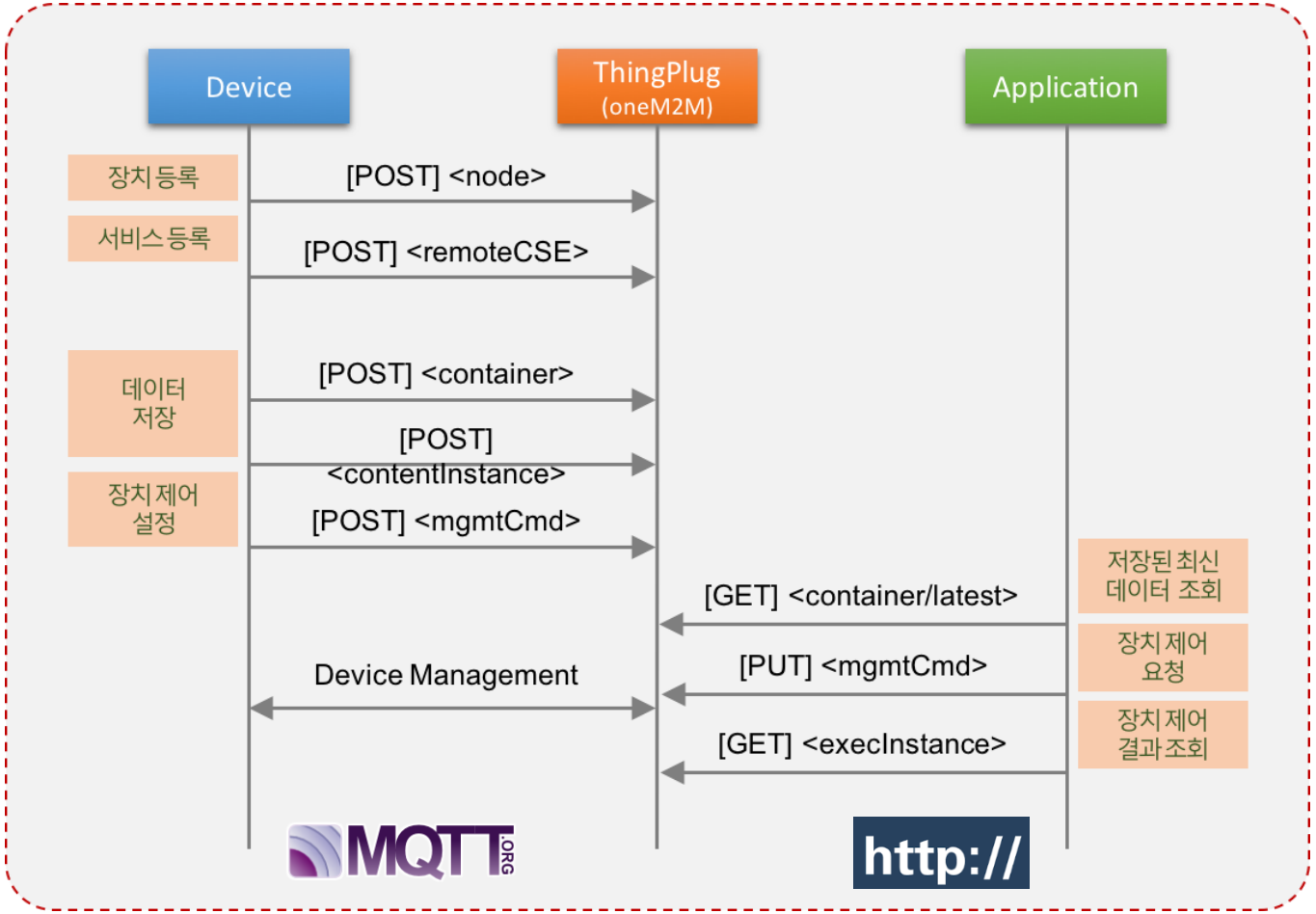
- **oneM2M Protocol: http://onem2m.org/technical/published-documents**



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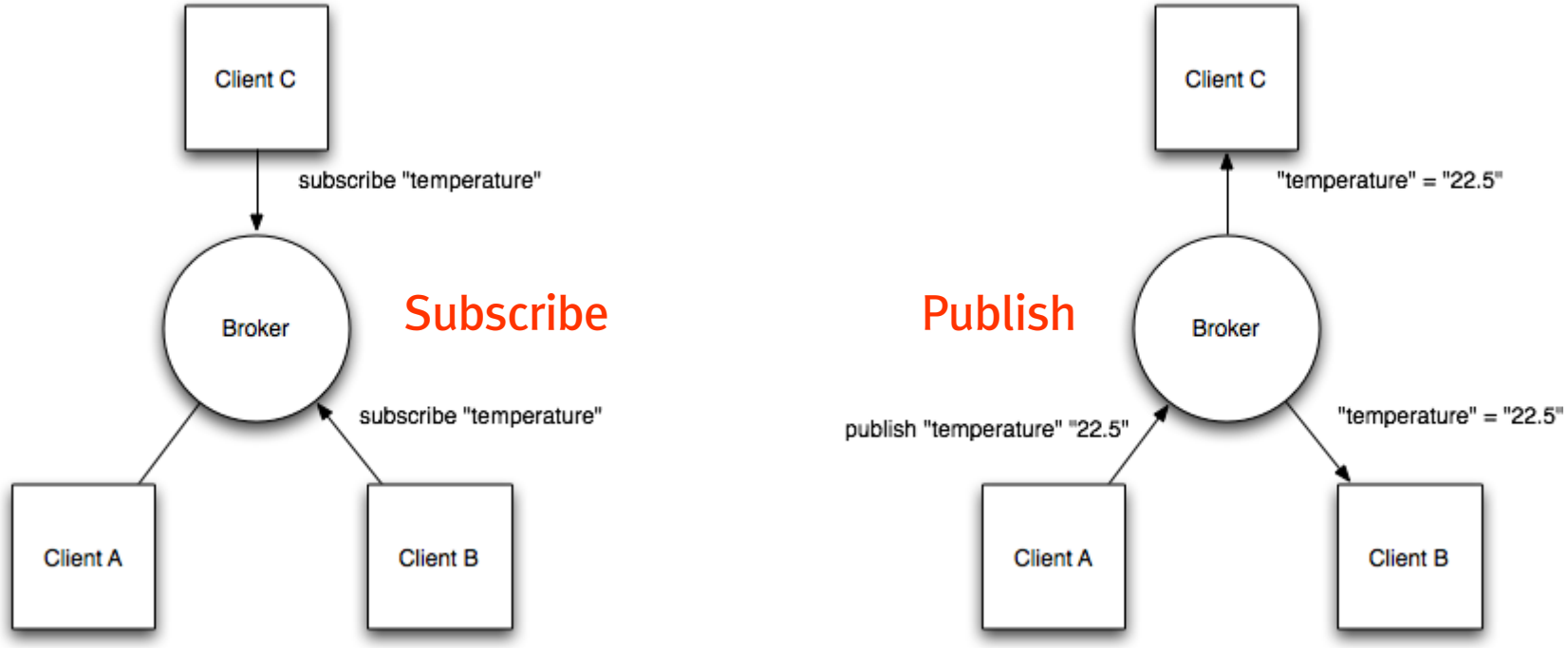
MQTT

- **MQTT** (MQ Telemetry Transport) is an ISO standard (ISO/IEC PRF 20922) **publish–subscribe based "light weight" messaging protocol** for use on top of the TCP/IP protocol (from Wikipedia)

- MQTT의 개념



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- **MQTT client 설치**

1. MQTTLens: chrome extension
   https://chrome.google.com/webstore/detail/mqttlens/hemojaaeigabkbcookmlgmdigohjobjm

2. MQTT.fx: Java application
   http://mqttfx.jfx4ee.org/

3. MQTT client for Arduino
   https://github.com/knolleary/pubsubclient

Subscribe

Publish

ThingPlug™ oneM2M

Hostname : onem2m.sktiot.com
Port : 1883
Keep-alive: 120 sec

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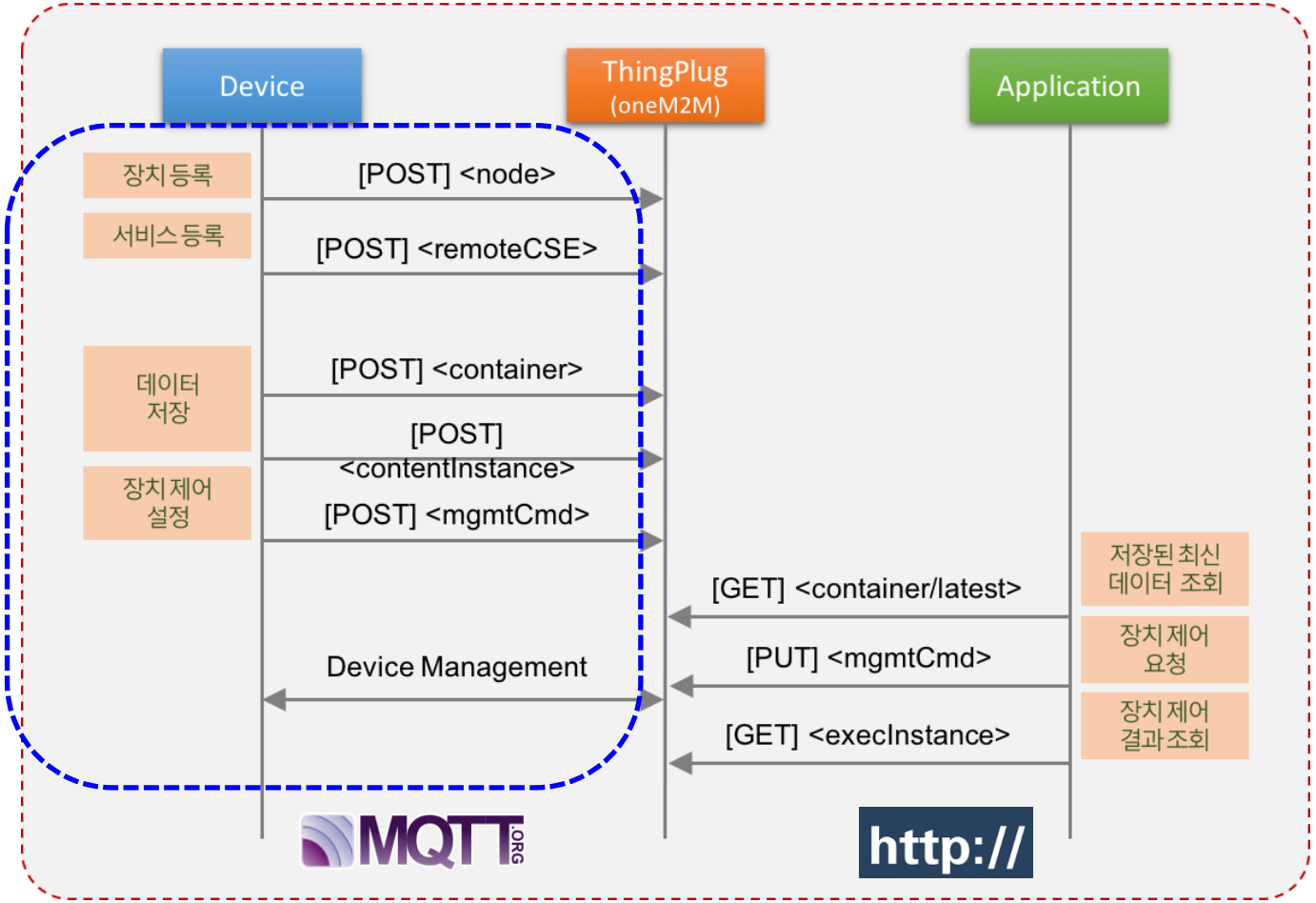
ThingPlug – Device API

- Service Scenario



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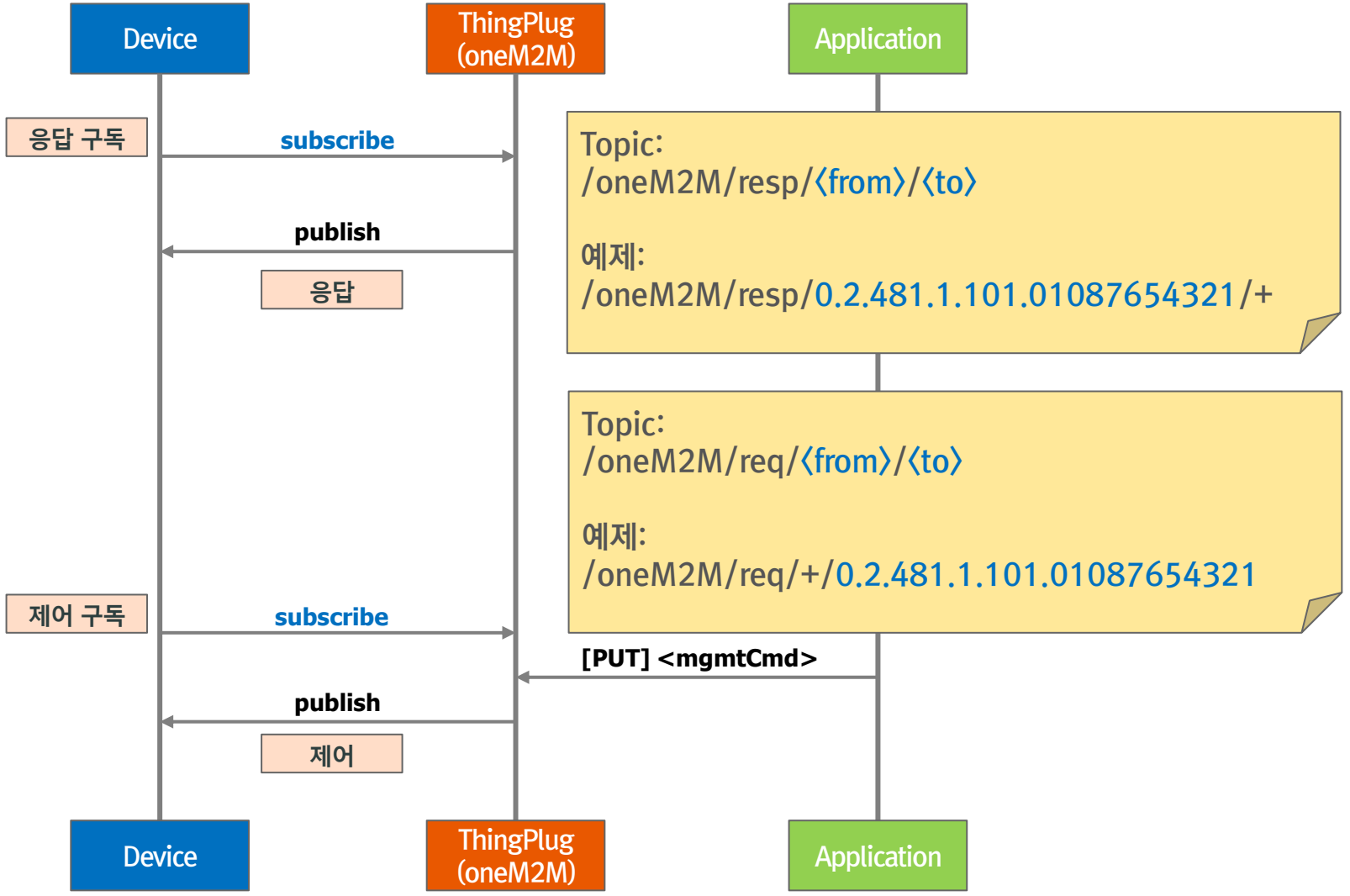
ThingPlug – Device API

- MQTT



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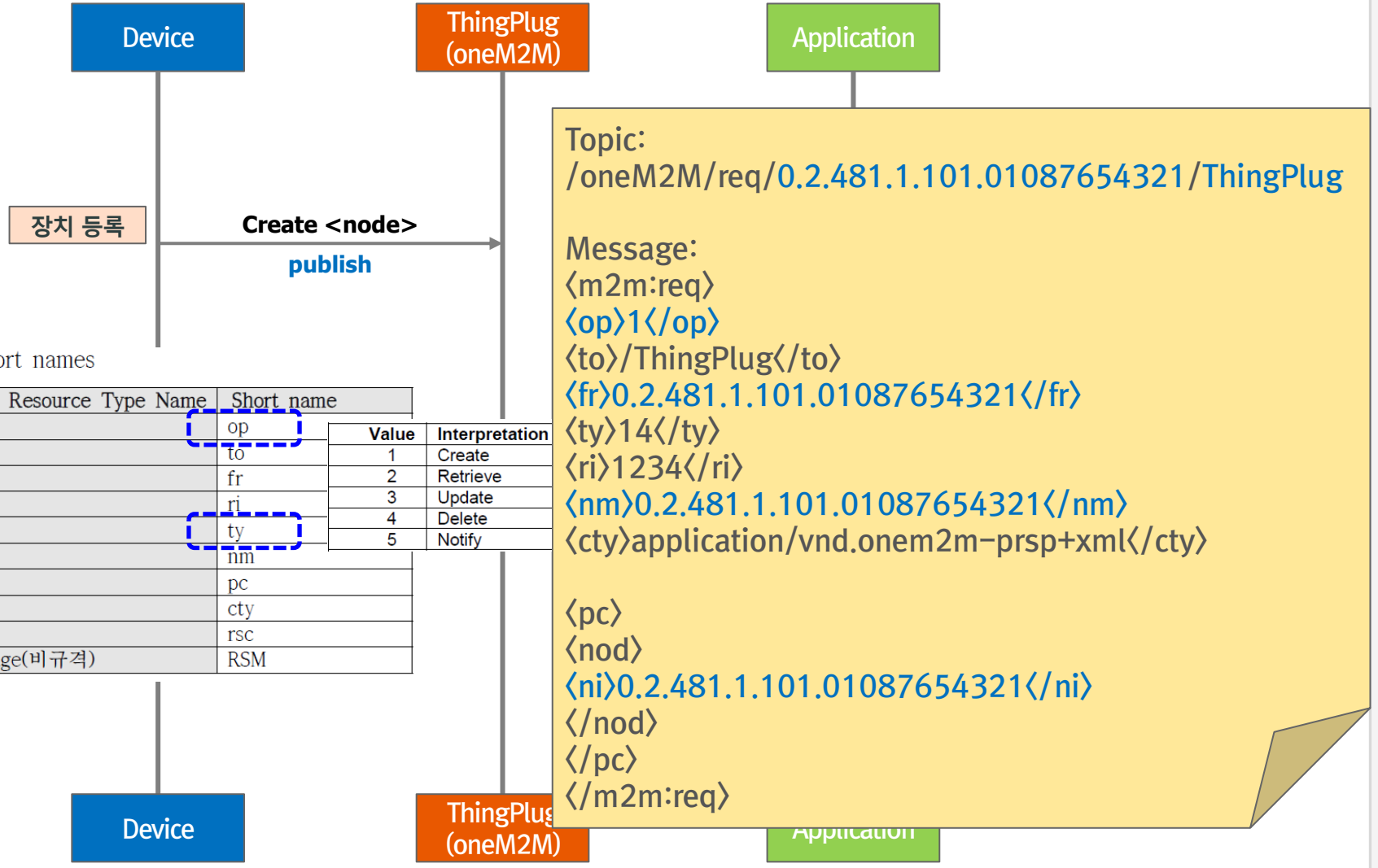
ThingPlug – Device API

- MQTT



- 리소스 attribute short names

Resource Type Name	Short name
Operation	op
To	to
From	fr
Request Identifier	ri
Resource Type	ty
Resource Name	nm
Content	pc
Content-Type	cty
Response Status Code	rsc
Response Status Message(비규격)	RSM

Value	Interpretation
1	Create
2	Retrieve
3	Update
4	Delete
5	Notify

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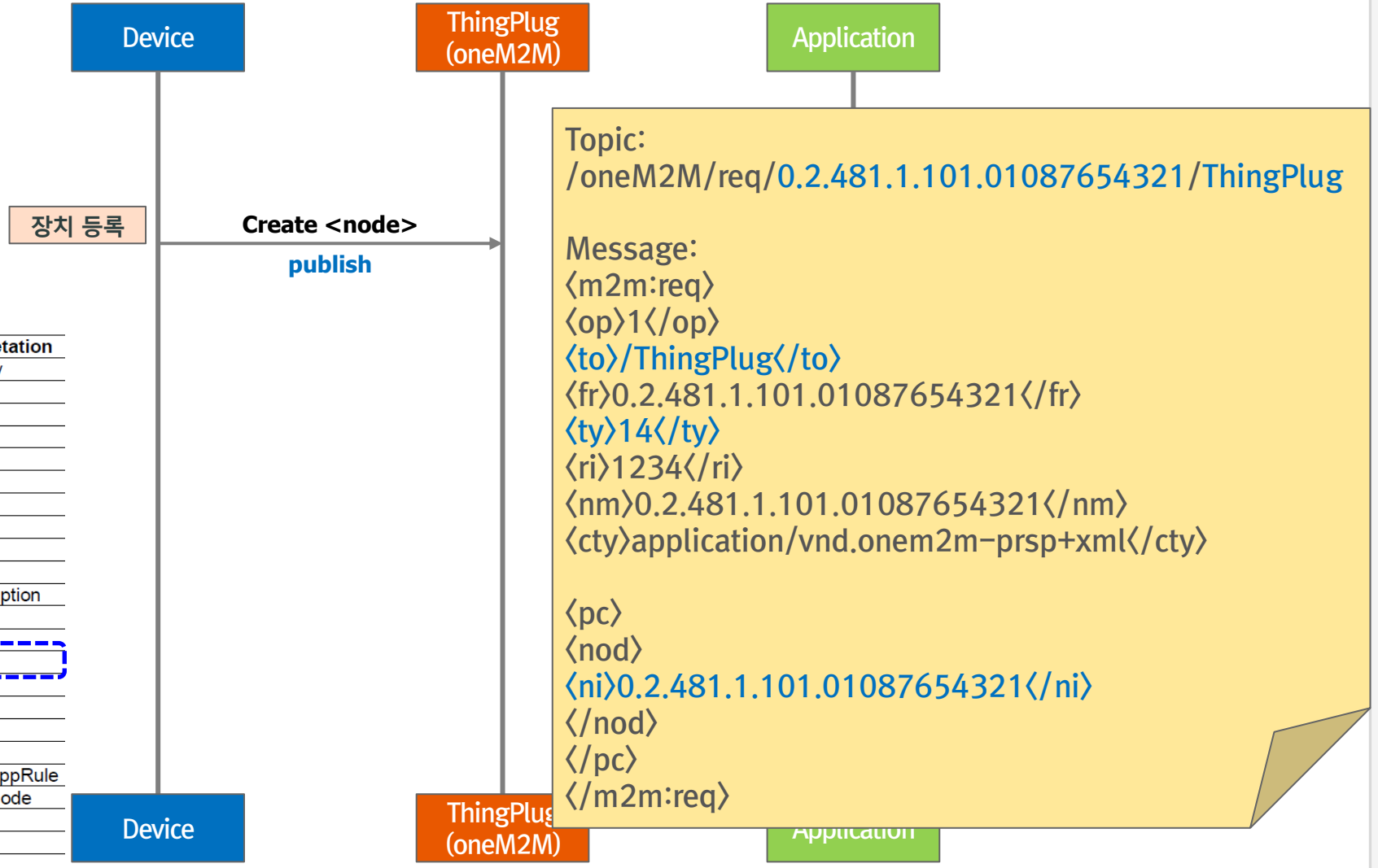
ThingPlug – Device API

- MQTT



Value	Interpretation
1	accessControlPolicy
2	AE
3	container
4	contentInstance
5	CSEBase
6	delivery
7	eventConfig
8	execInstance
9	group
10	locationPolicy
11	m2mServiceSubscription
12	mgmtCmd
13	mgmtObj
14	node
15	pollingChannel
16	remoteCSE
17	request
18	schedule
19	serviceSubscribedAppRule
20	serviceSubscribedNode
21	statsCollect
22	statsConfig
23	subscription

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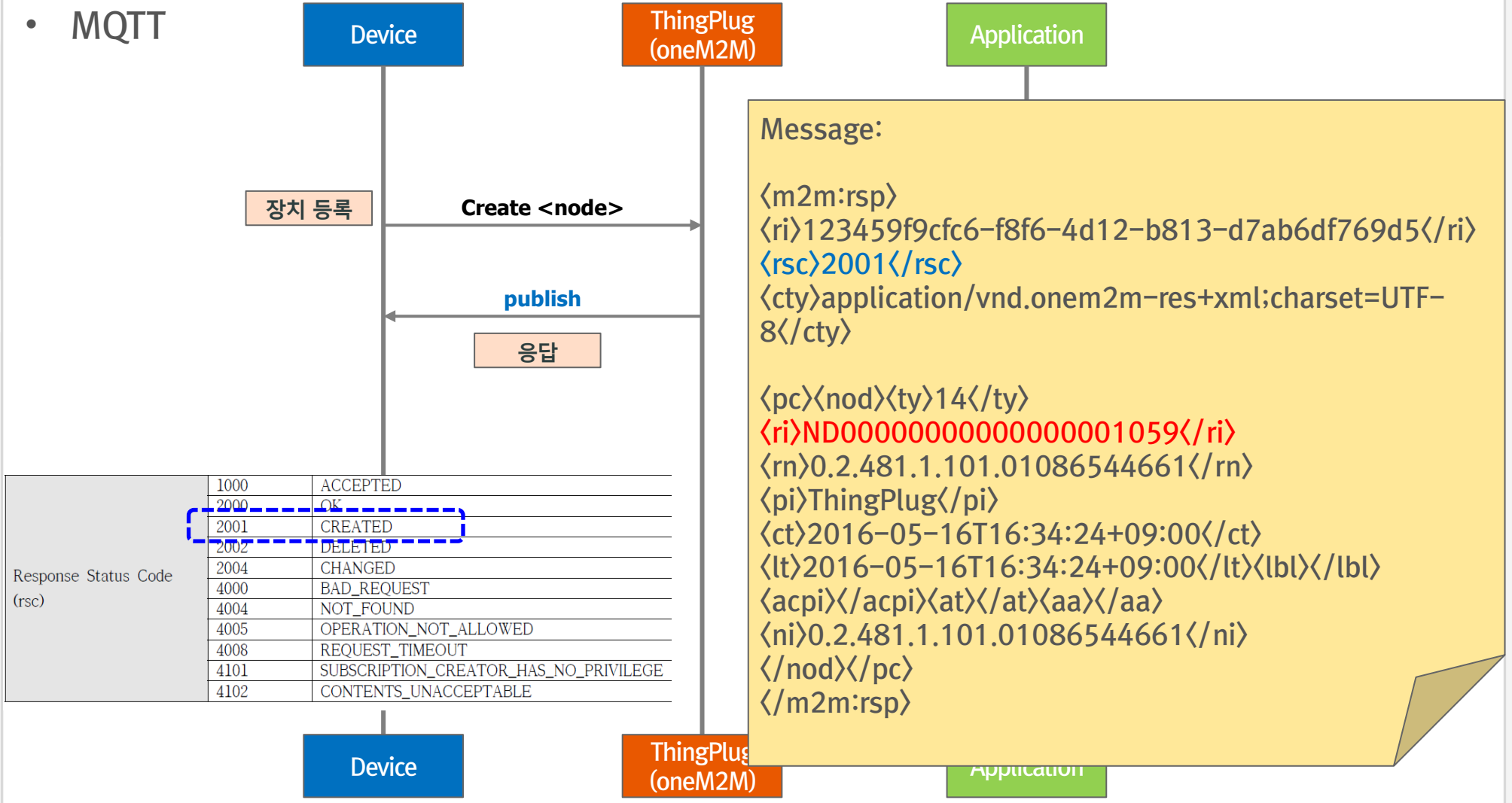
ThingPlug – Device API

- MQTT



Response Status Code (rsc)	1000	ACCEPTED
	2000	OK
	2001	CREATED
	2002	DELETED
	2004	CHANGED
	4000	BAD_REQUEST
	4004	NOT_FOUND
	4005	OPERATION_NOT_ALLOWED
	4008	REQUEST_TIMEOUT
	4101	SUBSCRIPTION_CREATOR_HAS_NO_PRIVILEGE
	4102	CONTENTS_UNACCEPTABLE

Message:

```
<m2m:rsp>
<ri>123459f9cfc6-f8f6-4d12-b813-d7ab6df769d5</ri>
<rsc>2001</rsc>
<cty>application/vnd.onem2m-res+xml;charset=UTF-8</cty>

<pc><nod><ty>14</ty>
<ri>ND000000000000000001059</ri>
<rn>0.2.481.1.101.01086544661</rn>
<pi>ThingPlug</pi>
<ct>2016-05-16T16:34:24+09:00</ct>
<lt>2016-05-16T16:34:24+09:00</lt><lbl></lbl>
<acpi></acpi><at></at><aa></aa>
<ni>0.2.481.1.101.01086544661</ni>
</nod></pc>
</m2m:rsp>
```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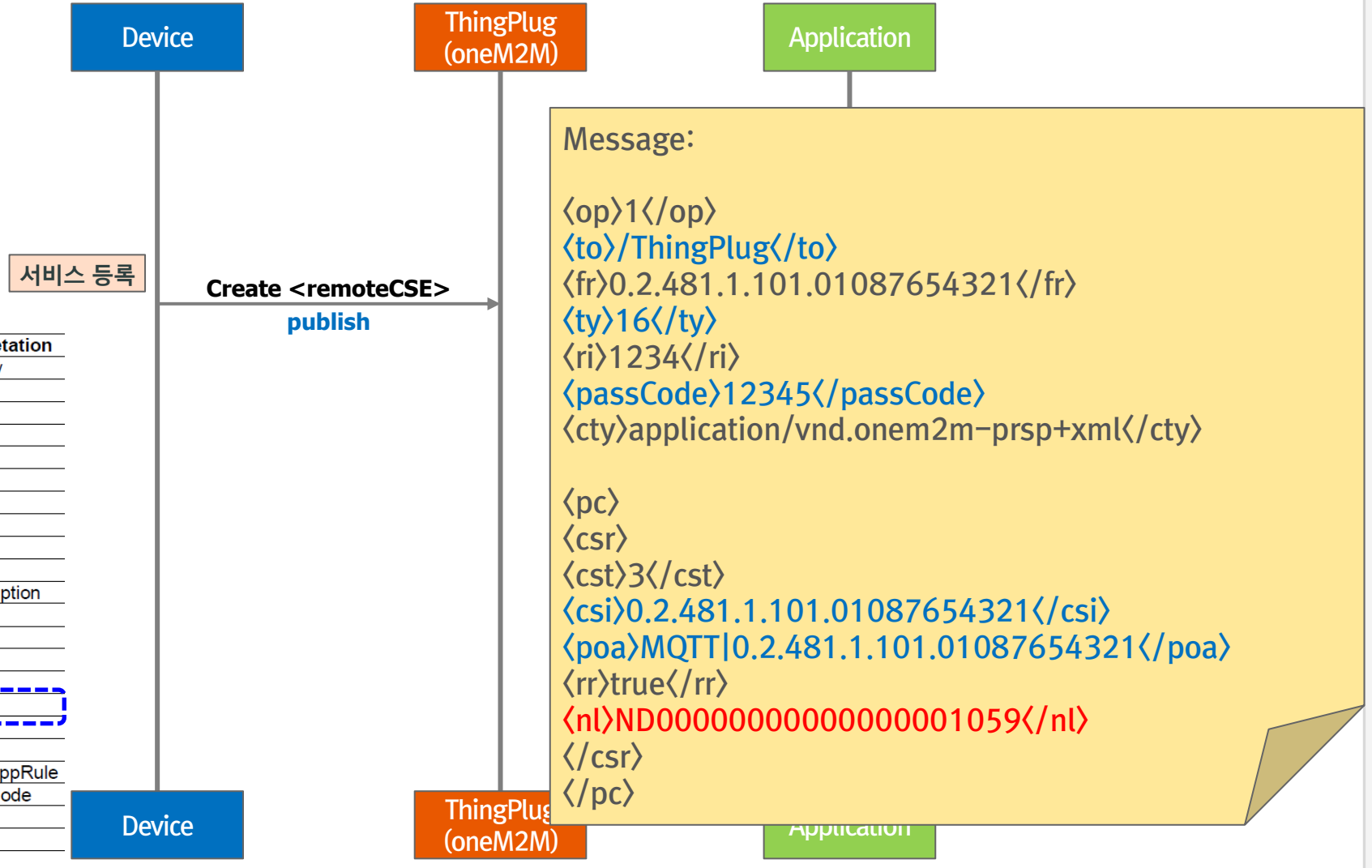
ThingPlug – Device API

- MQTT



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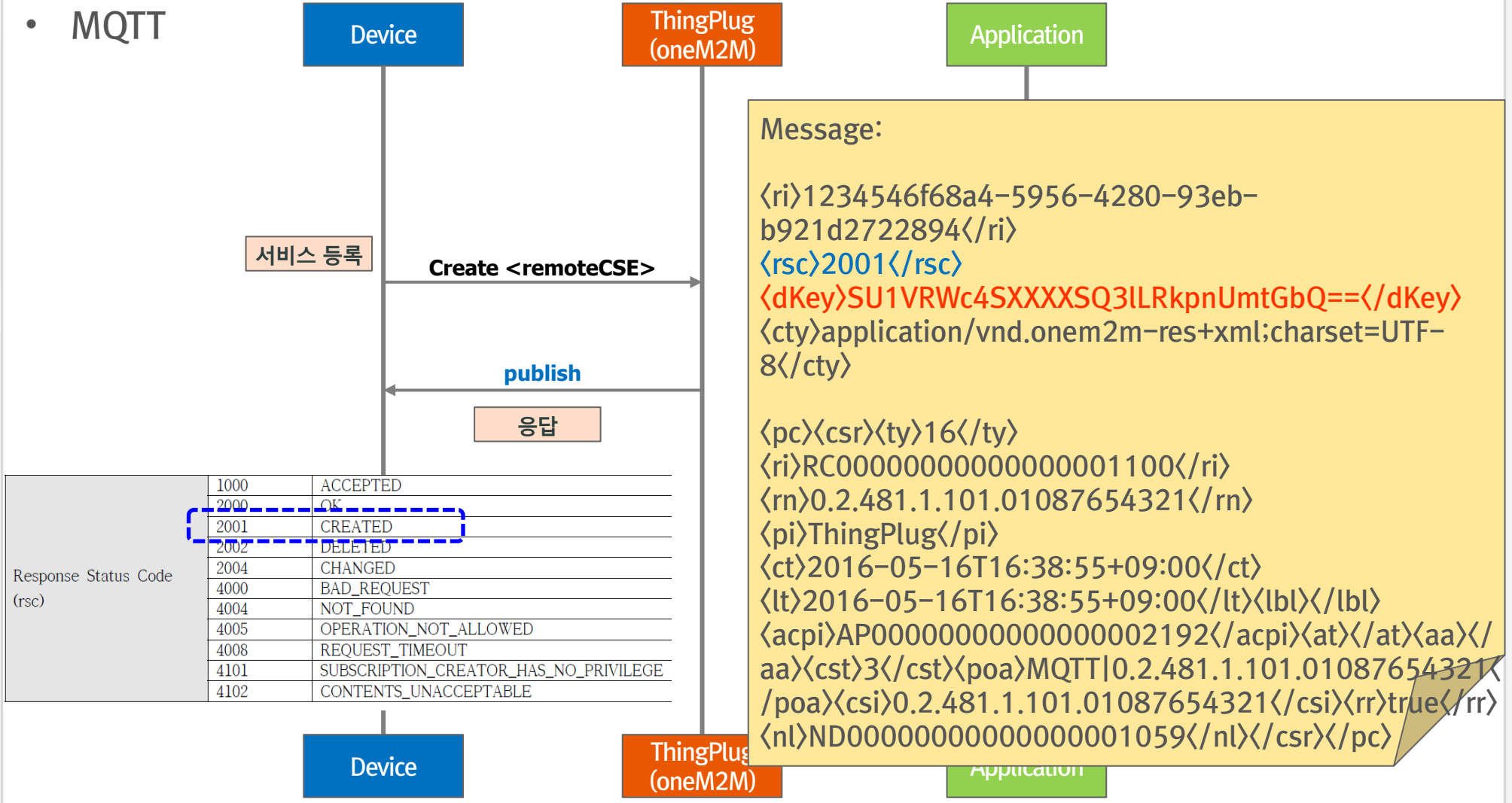
ThingPlug – Device API

- MQTT



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	2004	CHANGED
	4000	BAD_REQUEST
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	4005	OPERATION_NOT_ALLOWED
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	4101	SUBSCRIPTION_CREATOR_HAS_NO_PRIVILEGE
	4102	CONTENTS_UNACCEPTABLE

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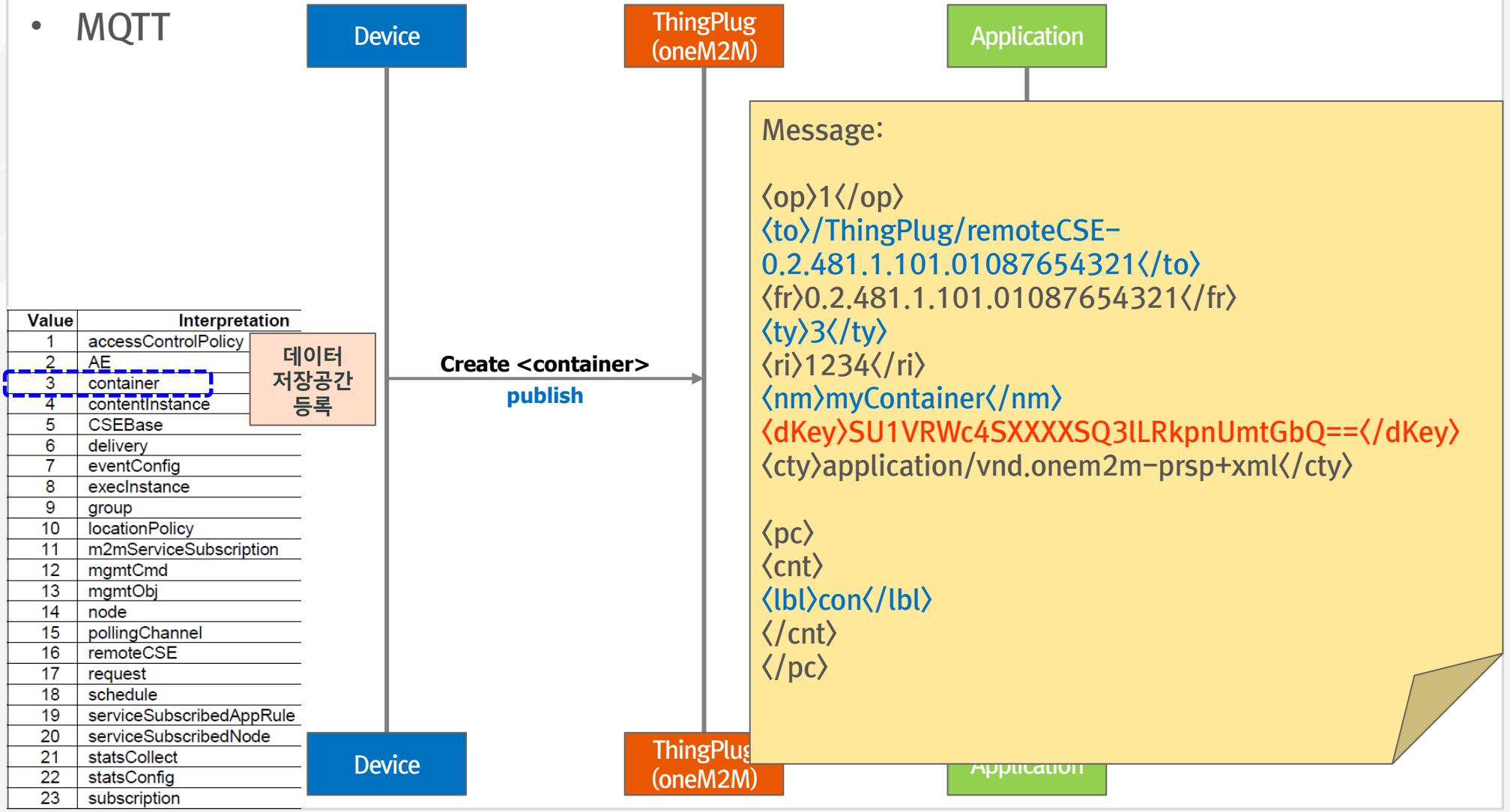
ThingPlug – Device API

- MQTT



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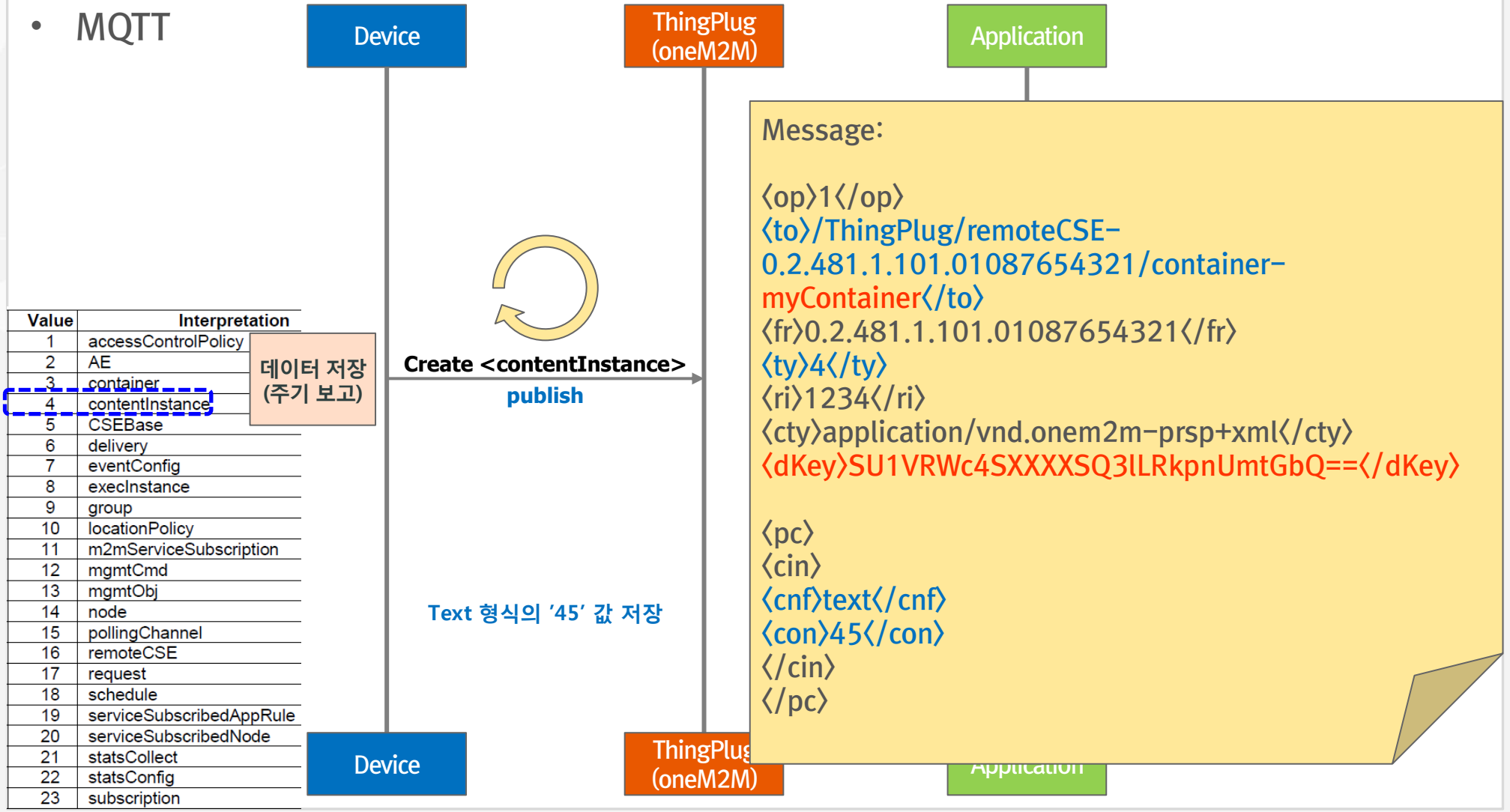
ThingPlug – Device API

- MQTT



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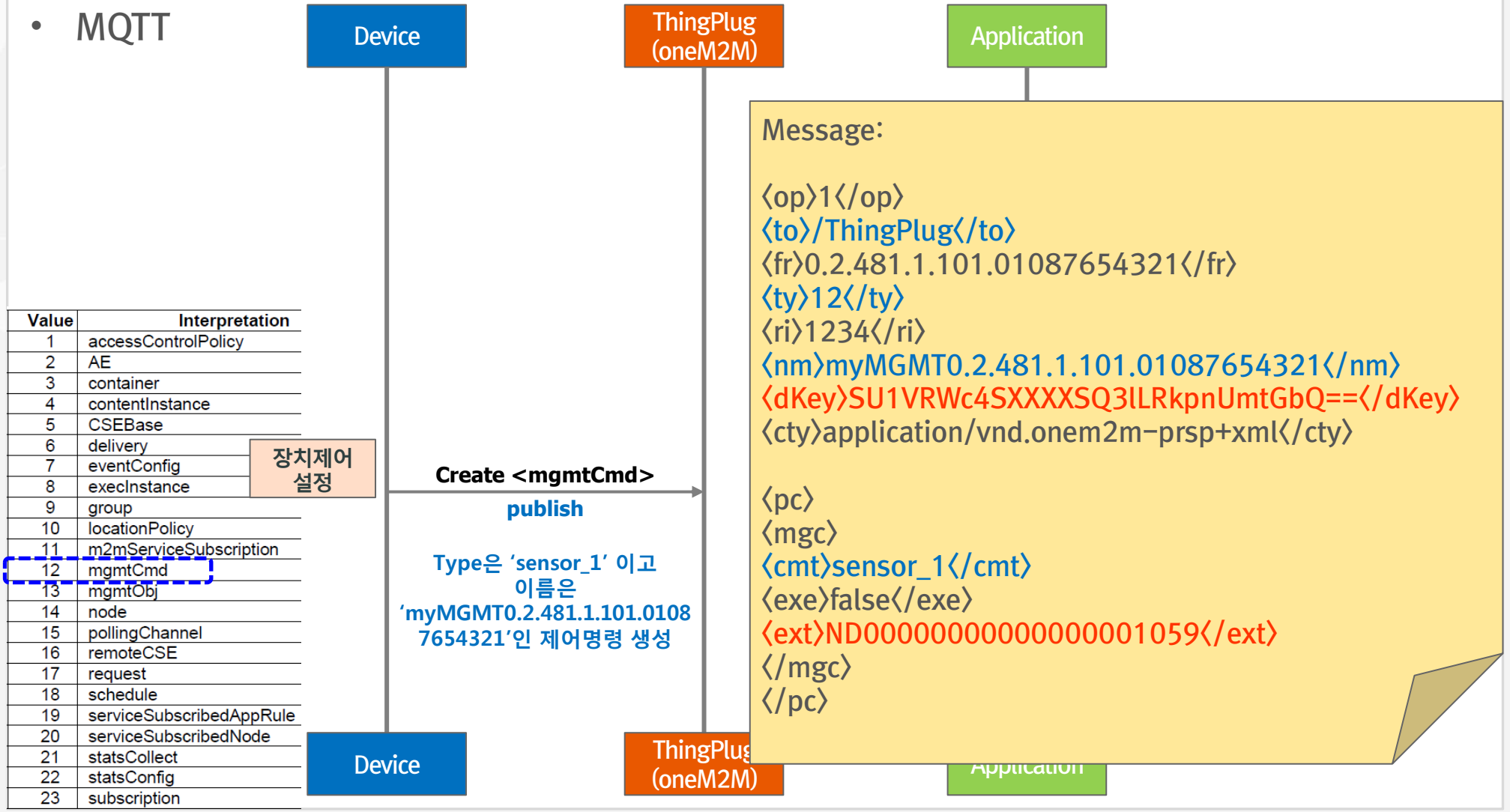
ThingPlug – Device API

- MQTT



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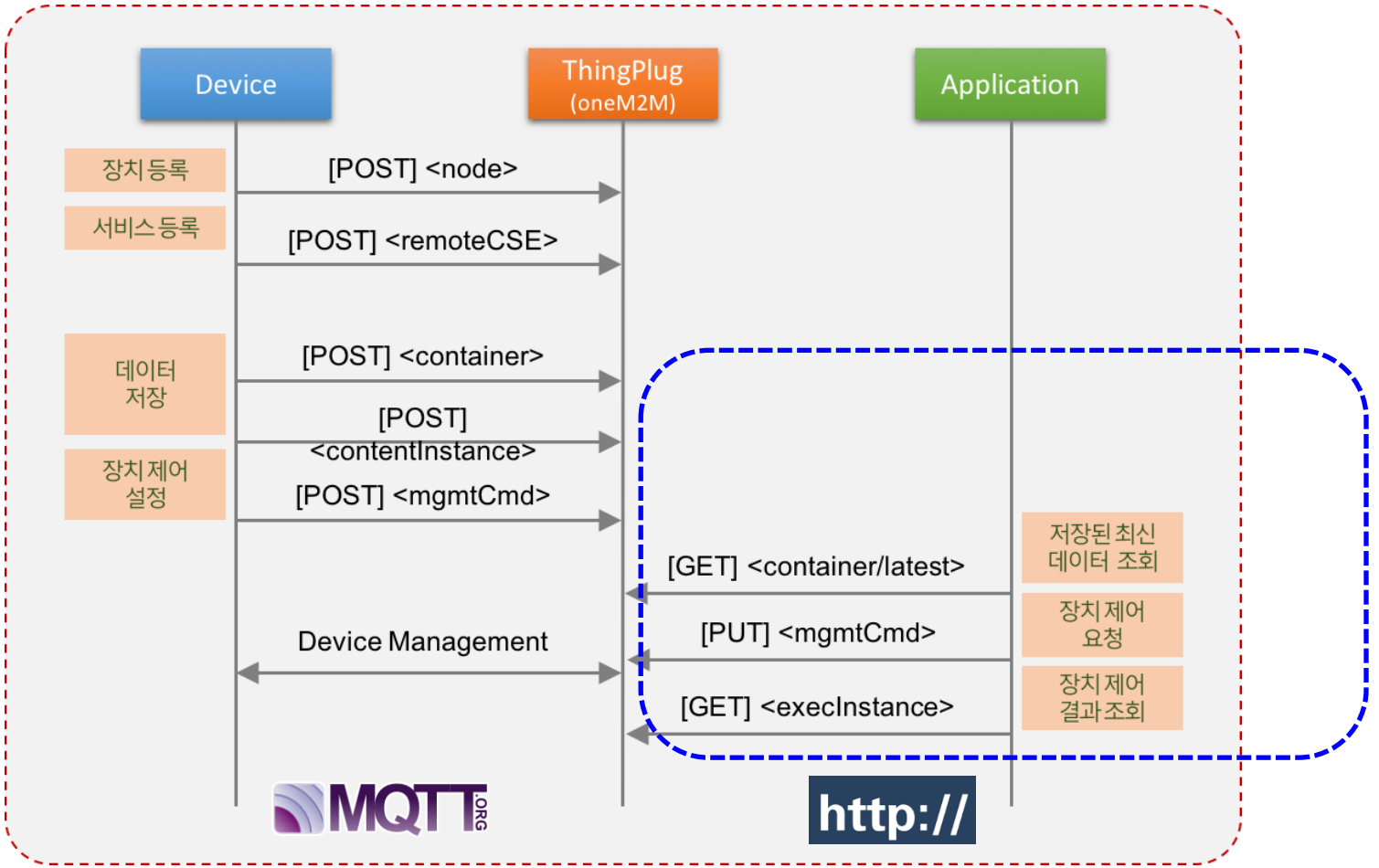
ThingPlug – Application API

- Service Scenario



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ThingPlug – Application API

- **Node.js 설치 https://nodejs.org**

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- **Node.js 설치 확인**

```
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\SKTelecom>node --version
v4.4.4

C:\Users\SKTelecom>
```


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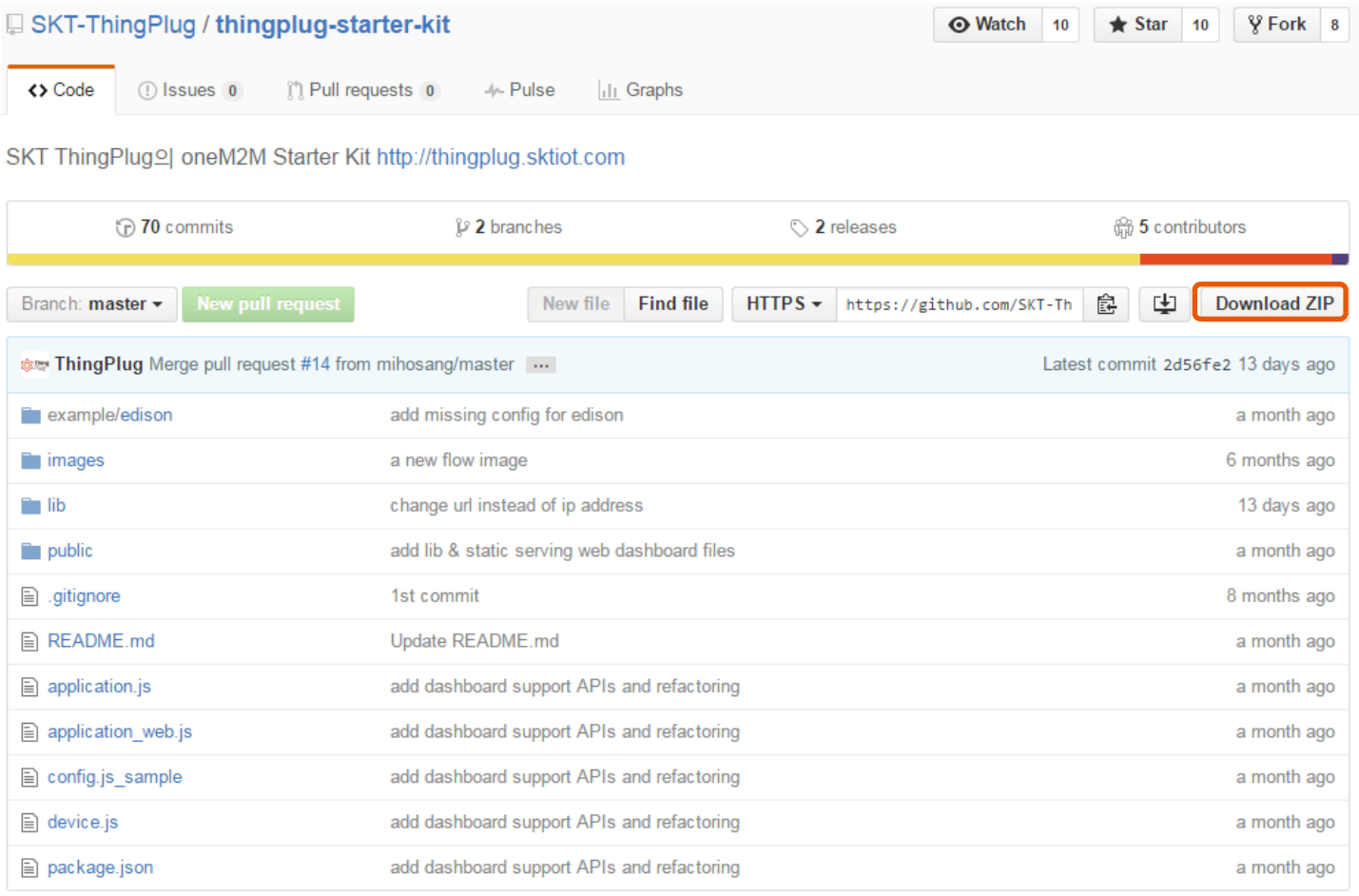
ThingPlug – Application API

- **oneM2M Starter Kit 다운로드**
- **https://github.com/SKT-ThingPlug/thingplug-starter-kit**



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ThingPlug – Application API

- ThingPlug 홈페이지로 이동 ➔ https://thingplug.sktiot.com/
- 로그인 ➔ 마이페이지 ➔ 마이 IoT 중 '사용자 인증키' == uKey
- Starter Kit 의 config.js_sample 을 config.js 로 Rename
- config.js 의 항목 중 uKey를 ThingPlug 홈페이지 값으로 변경
- config.js 의 항목 중 nodeID 맨 뒷자리를 핸드폰 번호로 변경 (중복 방지)

```
module.exports = {
 uKey : 'USER_KEY_FROM_SANDBOX.SKIOT.COM',
 nodeID : '0.2.481.1.101.01000000000', // Device ID  (핸드폰 번호 사용 권장)
 passCode : '000101',
  appID : 'myApplication', //Application ID
 containerName:'myContainer', // starter kit에서 생성하고 사용할 container 이름
 mgmtCmdPrefix : 'myMGMT', // starter kit에서 생성하고 사용할 제어 접두사
 cmdType : 'sensor_1' // starter kit에서 사용할 제어 타입 (임의지정)
};
```


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ThingPlug – Application API

실행 방법

- npm install : **의존성 모듈 설치** (**최초 1회**)
- node application.js : **최신 주기보고 데이터 조회 및** device**에 제어명령 전송**

```
C:\Users\SKTelecom> node application.js
content : 45
resouceId : CI00000000000032409251
생성일 : 2016-05-16T16:32:08+09:00
resourceId : EI00000000000000050401
execStatus : 2
```


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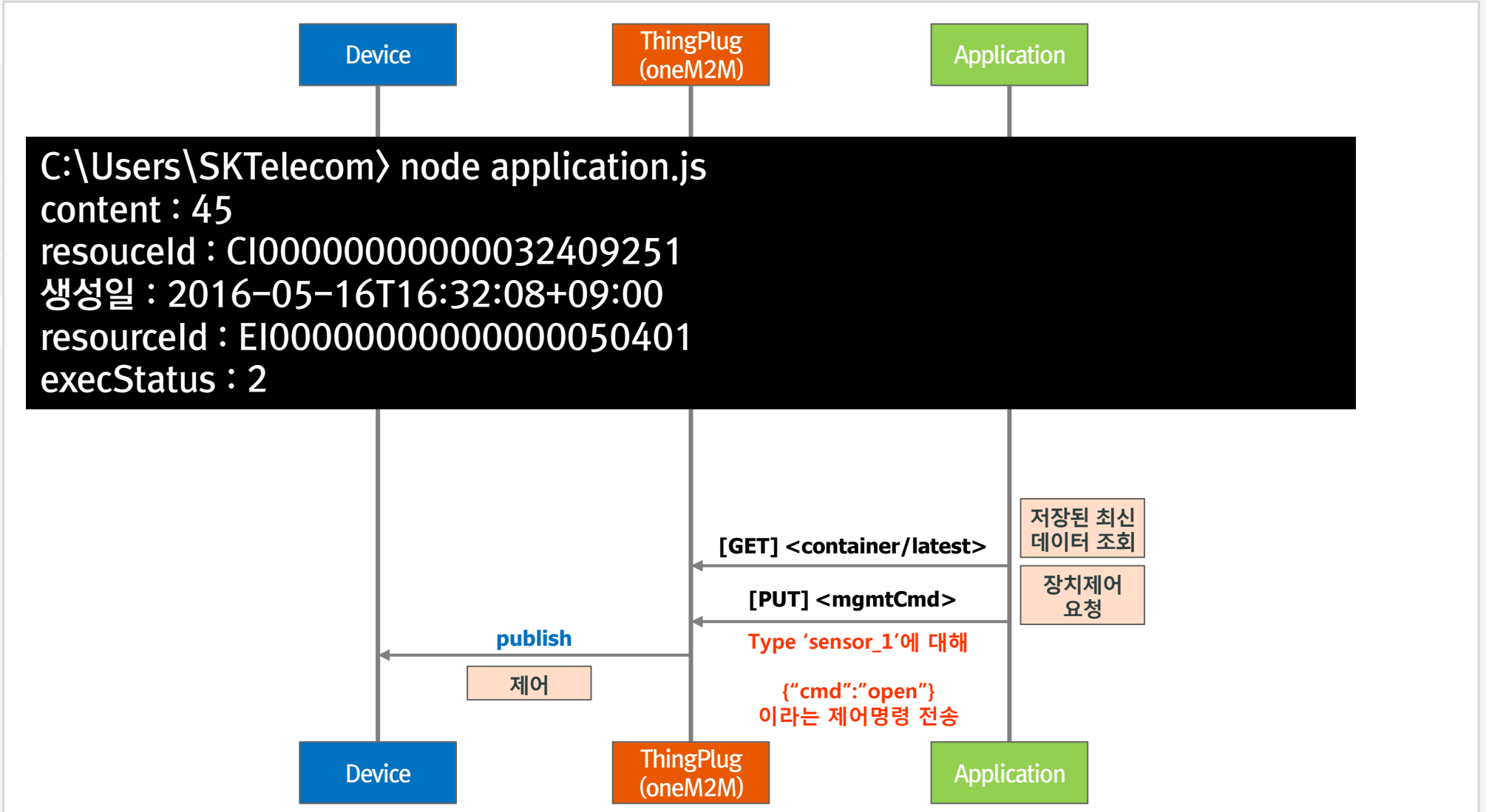
ThingPlug – Application API



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ThingPlug – Device API

- MQTT

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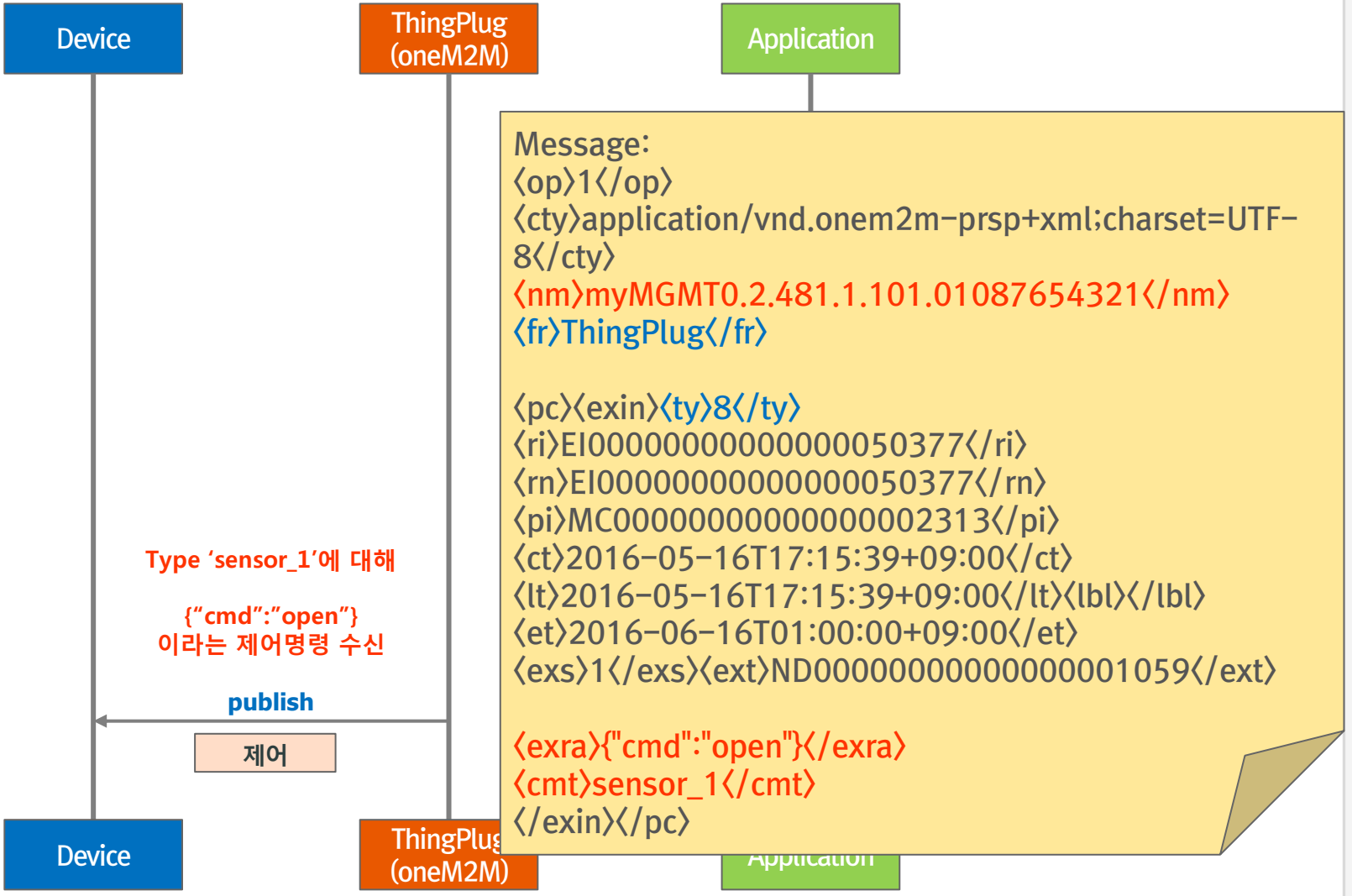

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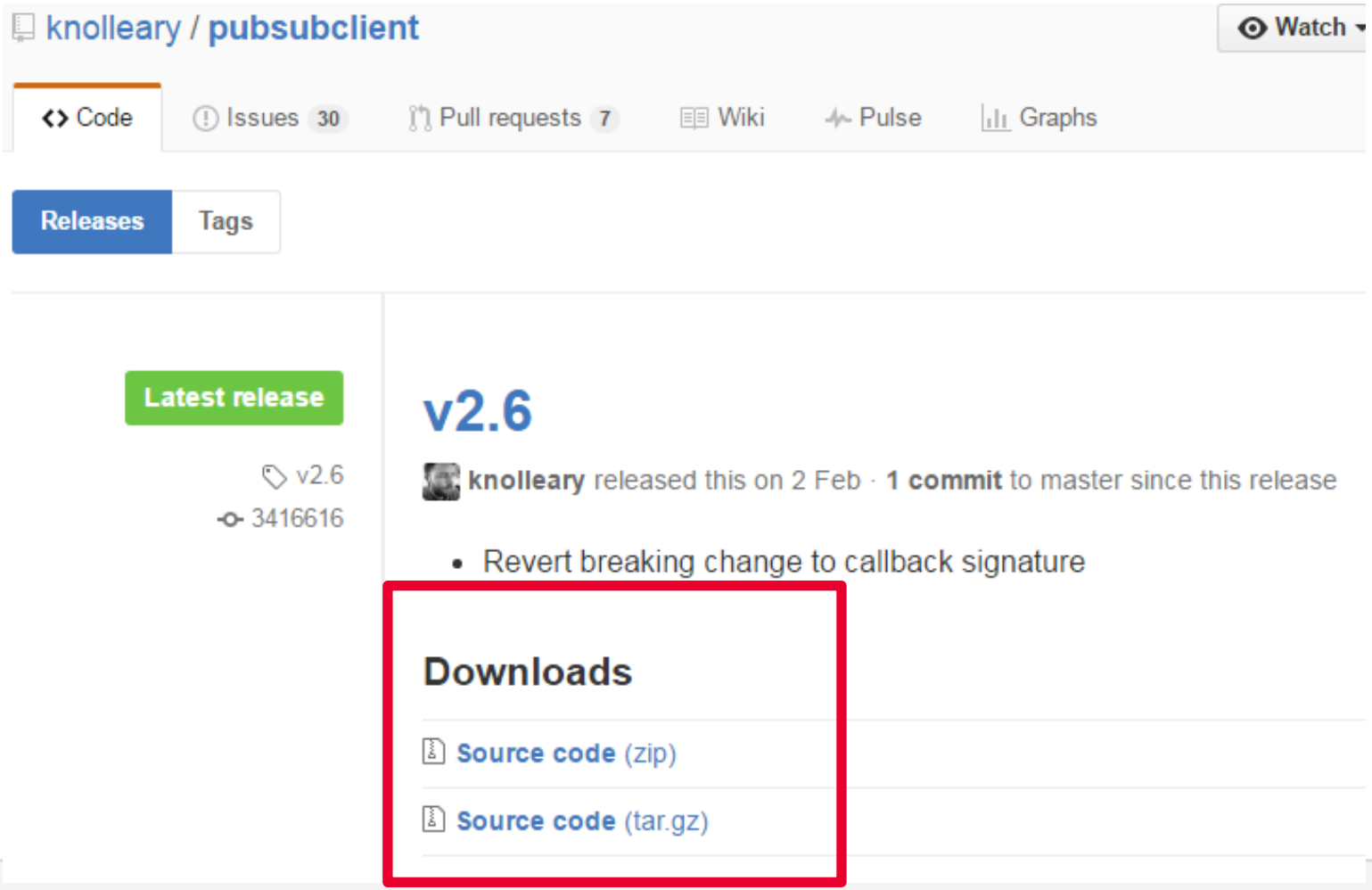
PubSubClient 설치

http://pubsubclient.knolleary.net/index.html
https://github.com/knolleary/pubsubclient/releases/latest



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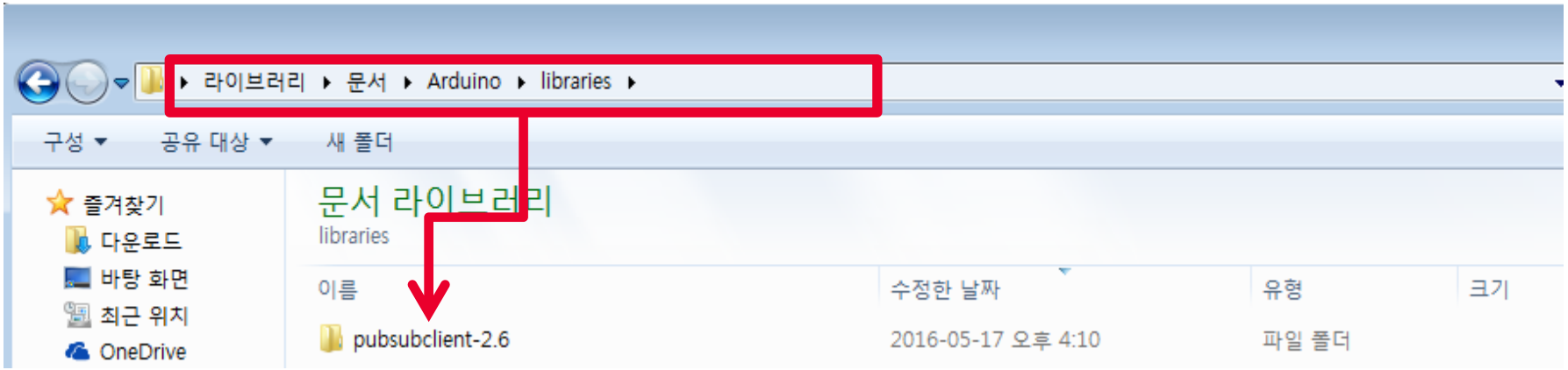
PubSubClient 설치 – 압축해제



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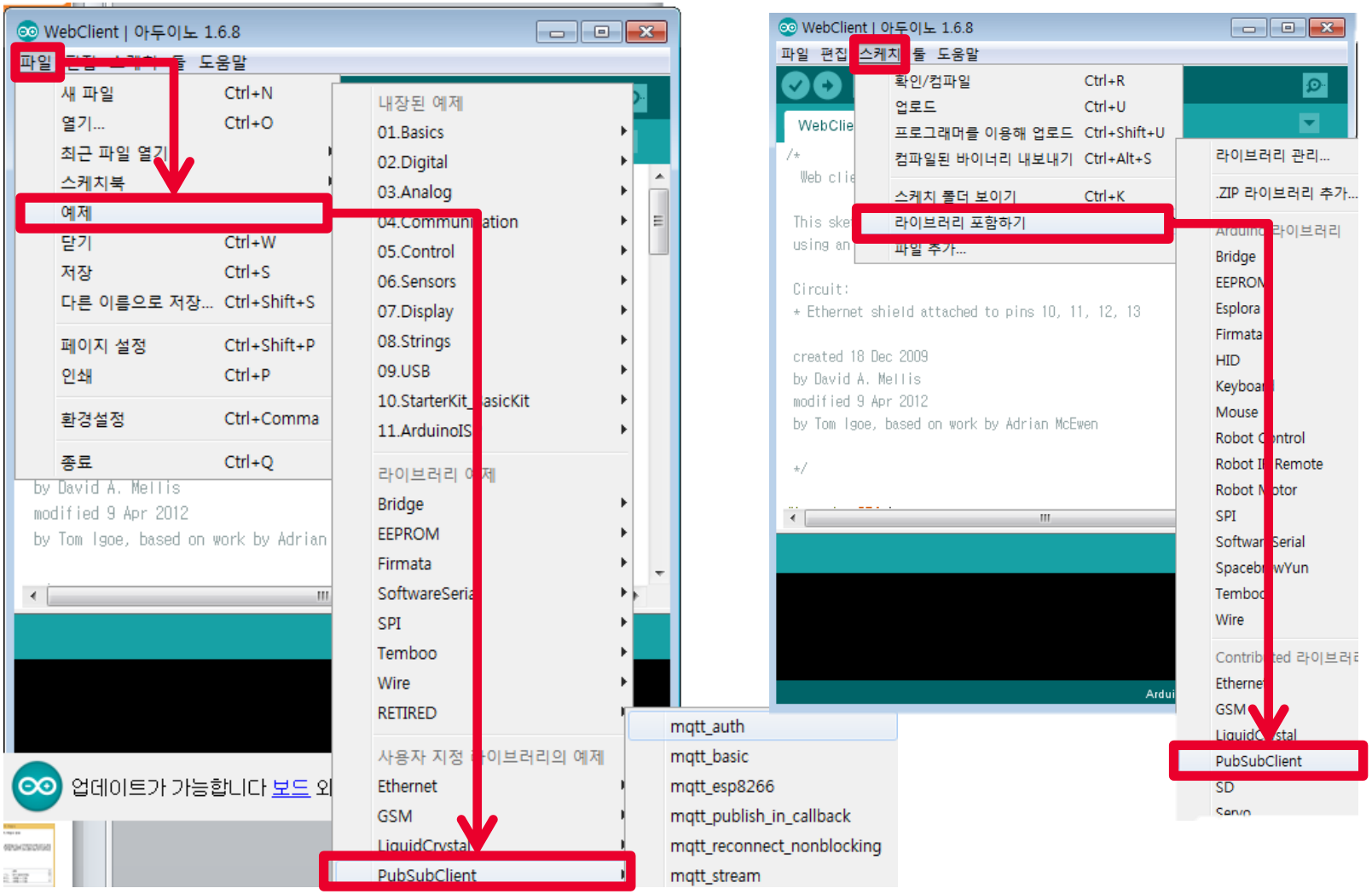
설치과정 – 아두이노 적용



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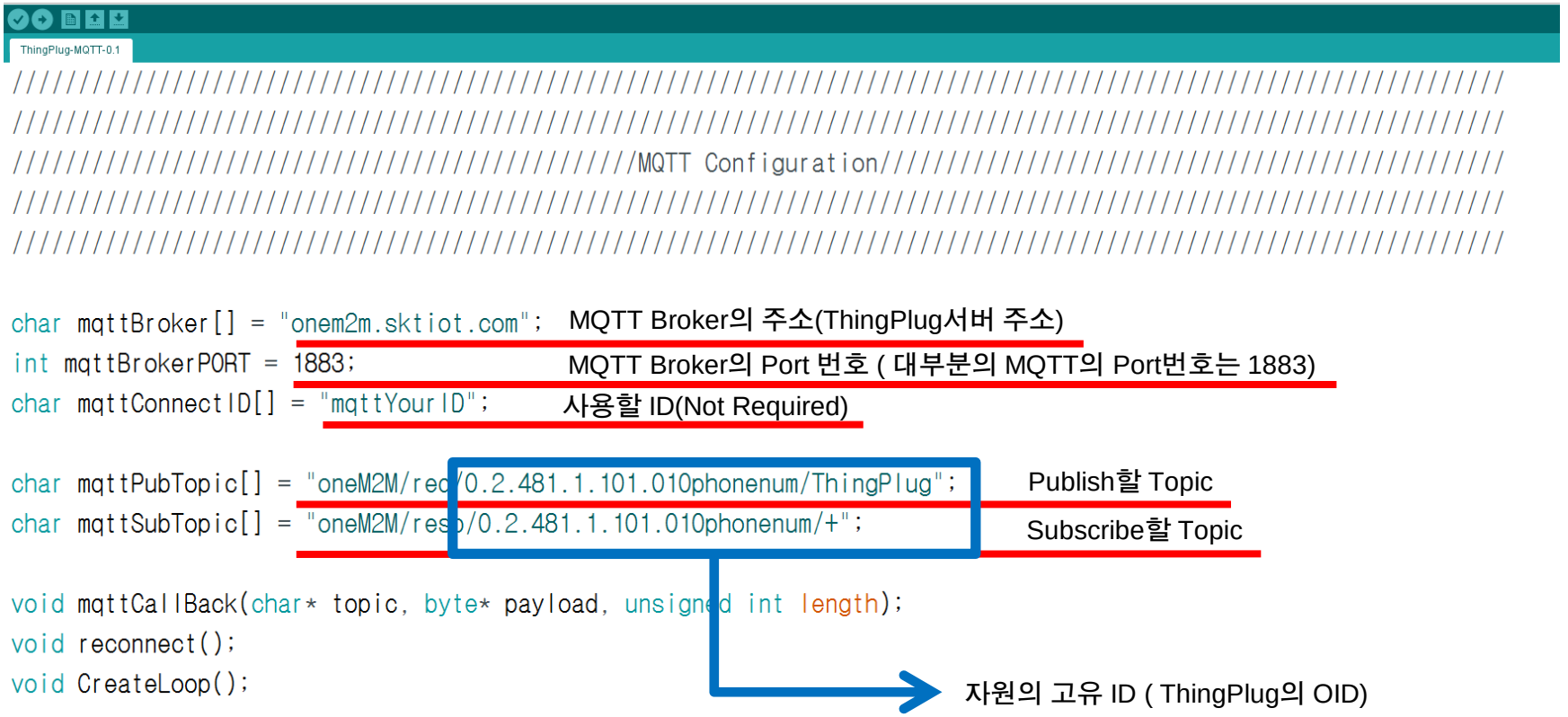
샘플코드 – ThingPlug.ino

ThingPlug-MQTT-0.1 | 아두이노 1.6.8

파일 편집 스케치 툴 도움말



```
ThingPlug-MQTT-0.1
////////////////////////////////////////////////////////////////////////////////////////////////////
////////////////////////////////////////////////////////////////////////////////////////////////////
//////////////////////////////////////////////MQTT Configuration/////////////////////////////////////
////////////////////////////////////////////////////////////////////////////////////////////////////
////////////////////////////////////////////////////////////////////////////////////////////////////

char mqttBroker[] = "onem2m.sktiot.com";
int mqttBrokerPORT = 1883;
char mqttConnectID[] = "mqttYourID";

char mqttPubTopic[] = "oneM2M/req/0.2.481.1.101.010phonenum/ThingPlug";
char mqttSubTopic[] = "oneM2M/resp/0.2.481.1.101.010phonenum/+";

void mqttCallBack(char* topic, byte* payload, unsigned int length);
void reconnect();
void CreateLoop();

PubSubClient mqttClient(mqttBroker, mqttBrokerPORT, mqttCallBack, ethClient);
```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샘플코드 – ThingPlug.ino

ThingPlug-MQTT-0.1 | 아두이노 1.6.8

파일 편집 스케치 툴 도움말

```
////////////////////////////////////MQTT PAYLOAD for ThingPlug Connect////////////////////////////////////
////////////////////////////////////////////////////////////////////////////////////////////////////////
////////////////////////////////////////////////////////////////////////////////////////////////////////
const unsigned char mqttPubCreateNode[] PR                    .onem2m.org/xml/protocolsW" xmlns:xsi=W"http://www.w3.org/2001/XMLSchema-instanceW" xsi:schemaLoca
//*<ri>ND00000000000000001032</ri> 값 parsing 필요 -> remoteCSE Create할 때, <nl>값으로 설정필요
//* <fr><ni>의 0.2.481.1.101.010phonenum 값 사용자 정의 필요(ThingPlug OID)

const unsigned cha mqttPubCreateRemoteCSE[]                   rotocolsW" xmlns:xsi=W"http://www.w3.org/2001/XMLSchema-instanceW" xsi:schem
//* <passCode>12345</passCode> 값 사용자 정의 필요
//* <fr><csi><poa>의 0.2.481.1.101.010phonenum 값 사용자 정의 필요(ThingPlug OID)
//* Node Create후 response의 <ri>ND00000000000000001032</ri> 값을 <nl>값으로 설정필요
//* <dKey>64bit based decoding value</dKey> 값 parsing 필요 -> 하위 Create들 실행시 필요

const unsigned cha mqttPubCreateContainer[]                   rotocolsW" xmlns:xsi=W"http://www.w3.org/2001/XMLSchema-instanceW" xsi:schem
//* <nm>myContainer</nm> 값 사용자 정의 필요
//* <fr><ni>의 0.2.481.1.101.010phonenum 값 사용자 정의 필요(ThingPlug OID)
//* RemoteCSE Create후 response의 <dKey>64bit based decoding value</dKey> 값 설정필요

const unsigned cha mqttPubCreateMgmtCmd[]                     " xmlns:xsi=W"http://www.w3.org/2001/XMLSchema-instanceW" xsi:schemaL
//* <nm>myMGMT0.2.481.1.101.010phonenum</nm> 값 사용자 정의 필요
//* <cmt>sensor_1</cmt>  값 사용자 정의 필요
//* Node Create후 response의 <ri>ND00000000000000001032</ri> 값을 <ext>값으로 설정필요
//* RemoteCSE Create후 response의 <dKey>64bit based decoding value</dKey> 값 설정필요

const unsigned cha mqttPubCreateContentInstance[]             xmlns:xsi=W"http://www.w3.org/2001/XMLSchema-instanceW" xsi
//* <to>/ThingPlug/remoteCSE-0.2.481.1.101.010phonenum/container-myContainer</to> 의 container 이름 값 설정필요
//* <cnf>text</cnf>, <con>45</con> 값들 사용자 정의 필요
//* RemoteCSE Create후 response의 <dKey>64bit based decoding value</dKey> 값 설정필요

void mqttCallBack(char* topic, byte* payload, unsigned int length);
```

Device 등록 요청

Device의 필수 정보 제공

데이터 저장공간 생성 요청

Device가 받아들일 제어 명령어 설정

센서값을 서버의 Container에 기록

받은 명령 처리

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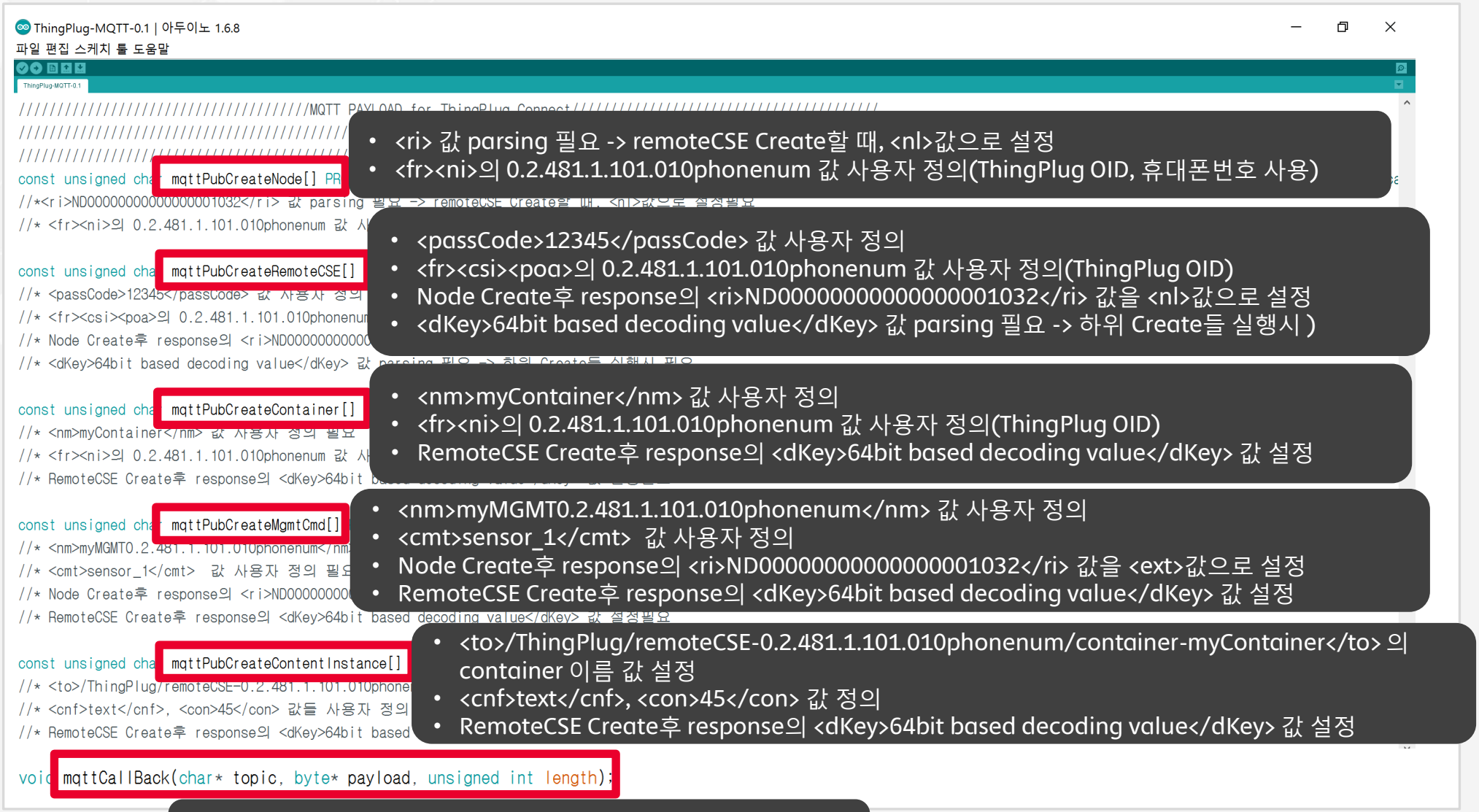
샘플코드 – ThingPlug.ino



- <ri> 값 parsing 필요 -> remoteCSE Create할 때, <nl>값으로 설정
- <fr><ni>의 0.2.481.1.101.010phonenum 값 사용자 정의(ThingPlug OID, 휴대폰번호 사용)

- <passCode>12345</passCode> 값 사용자 정의
- <fr><csi><poa>의 0.2.481.1.101.010phonenum 값 사용자 정의(ThingPlug OID)
- Node Create후 response의 <ri>ND00000000000000001032</ri> 값을 <nl>값으로 설정
- <dKey>64bit based decoding value</dKey> 값 parsing 필요 -> 하위 Create들 실행시)

- <nm>myContainer</nm> 값 사용자 정의
- <fr><ni>의 0.2.481.1.101.010phonenum 값 사용자 정의(ThingPlug OID)
- RemoteCSE Create후 response의 <dKey>64bit based decoding value</dKey> 값 설정

- <nm>myMGMT0.2.481.1.101.010phonenum</nm> 값 사용자 정의
- <cmt>sensor_1</cmt> 값 사용자 정의
- Node Create후 response의 <ri>ND00000000000000001032</ri> 값을 <ext>값으로 설정
- RemoteCSE Create후 response의 <dKey>64bit based decoding value</dKey> 값 설정

- <to>/ThingPlug/remoteCSE-0.2.481.1.101.010phonenum/container-myContainer</to> 의 container 이름 값 설정
- <cnf>text</cnf>, <con>45</con> 값 정의
- RemoteCSE Create후 response의 <dKey>64bit based decoding value</dKey> 값 설정

- Application이 Device를 제어할 명령어를 받는 callback 함수
- <exra>{"cmd":"____"}</exra> 에서 {"cmd":"____"} 파싱

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샘플코드 – 버퍼크기수정 /Documents/Arduino/libraries/pubsubclient-2.6/src/PubSubClient.h

```
/*
 PubSubClient.h - A simple client for MQTT.
  Nick O'Leary
  http://knolleary.net
*/

#ifndef PubSubClient_h
#define PubSubClient_h

#include <Arduino.h>
#include "IPAddress.h"
#include "Client.h"
#include "Stream.h"

#define MQTT_VERSION_3_1      3
#define MQTT_VERSION_3_1_1    4

// MQTT_VERSION : Pick the version
//#define MQTT_VERSION MQTT_VERSION_3_1
#ifndef MQTT_VERSION
#define MQTT_VERSION MQTT_VERSION_3_1_1
#endif

// MQTT_MAX_PACKET_SIZE : Maximum packet size
#define MQTT_MAX_PACKET_SIZE 700
#endif

// MQTT_KEEPALIVE : keepAlive interval in Seconds
#ifndef MQTT_KEEPALIVE
#define MQTT_KEEPALIVE 60
#endif

// MQTT_SOCKET_TIMEOUT: socket timeout interval in Seconds
#ifndef MQTT_SOCKET_TIMEOUT
#define MQTT_SOCKET_TIMEOUT 30
#endif

// MQTT_MAX_TRANSFER_SIZE : limit how much data is passed to the network client
//  in each write call. Needed for the Arduino Wifi Shield. Leave undefined to
//  pass the entire MQTT packet in each write call.
//#define MQTT_MAX_TRANSFER_SIZE 80

// Possible values for client.state()
#define MQTT_CONNECTION_TIMEOUT     -4
#define MQTT_CONNECTION_LOST        -3
#define MQTT_CONNECT_FAILED         -2
#define MQTT_DISCONNECTED           -1
```

Packet Size 수정

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샘플코드 – 실행결과

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References

- **ThingPlug**
  1. ThingPlug 개발자 포털: https://thingplug.sktiot.com
  2. ThingPlug github: https://github.com/SKT-ThingPlug/thingplug-starter-kit
- **oneM2M**
  1. oneM2M 표준: http://onem2m.org/technical/published-documents
  2. oneM2M TS-0004: "Service Layer Core Protocol Specification"
  3. oneM2M TS-0010: "MQTT Protocol Binding"

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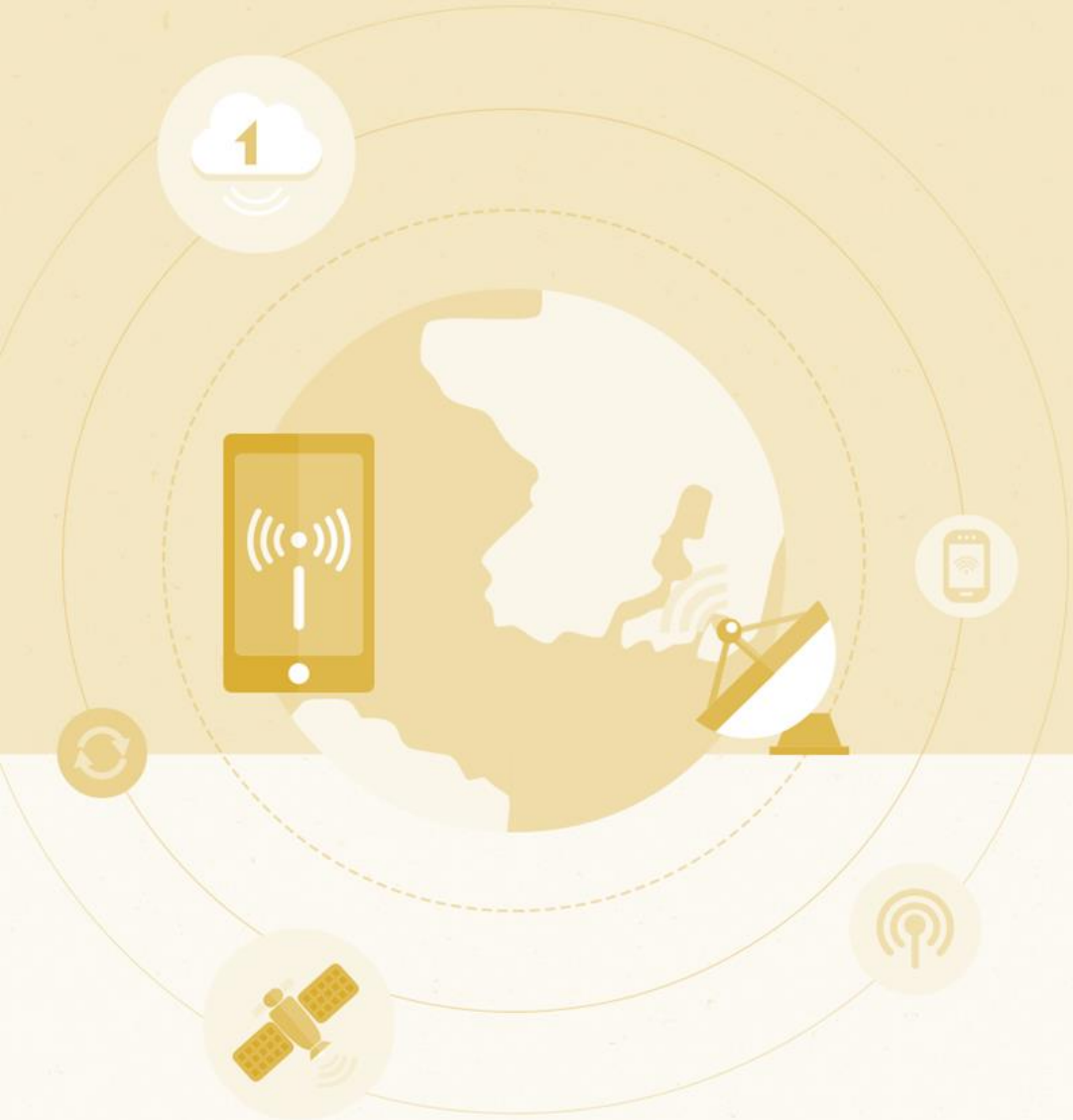

감사합니다.