# OSS-7
## AN OPEN SOURCE DASH7 STACK

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# DASH7 ALLIANCE PROTOCOL

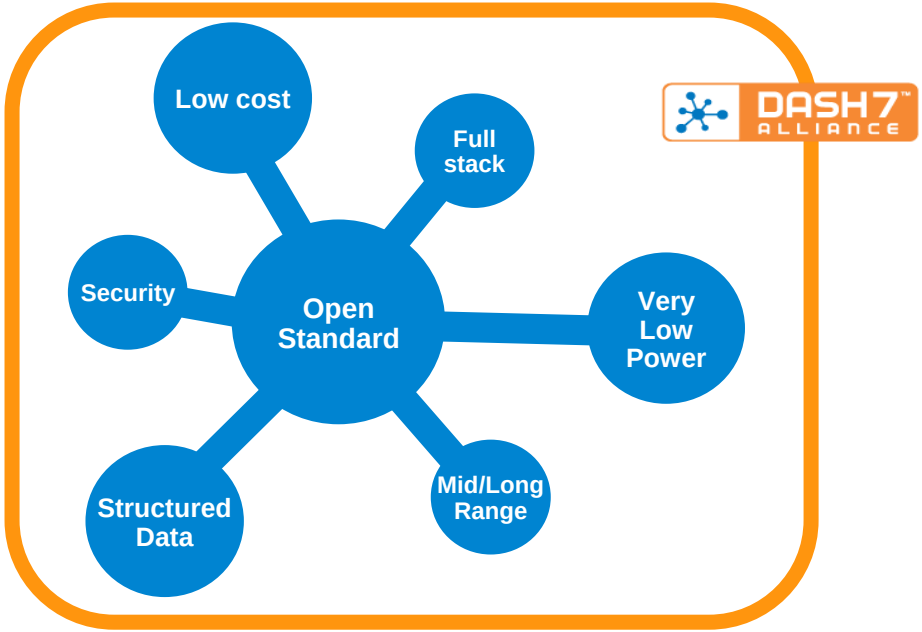
## WHEN ACTIVE RFID MEETS IOT

- Open standard
- Wireless Sensor and Actuator Network Protocol
- Originates from ISO 18000-7 (“dash7”) active RFID std
- Extended to support IoT functionalities
- All subGHz bands
- Star or tree topology (no mesh)
- V1.1 of spec published in Q1 2017
- Research group active member in alliance and driving opensource implementation

# DASH7 ALLIANCE PROTOCOL

## KEY ASPECTS

- Asynchronous
- Low power
- Full stack
- Everything is a file
  - Config
  - Sensor Data

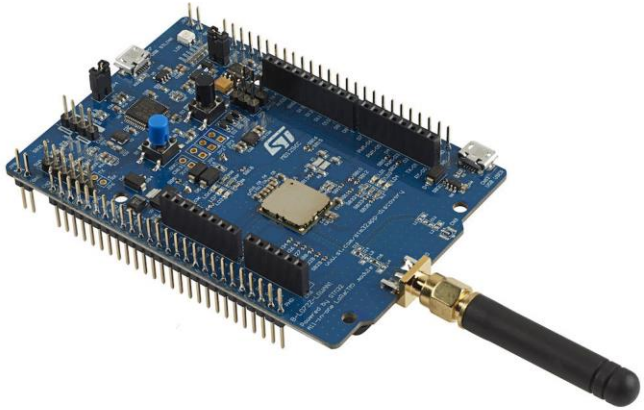


# APPLICATION LAYER PROGRAMMING INTERFACE

- ALP commands (request/response)
- Generic API to manage the filesystem
  - Not specific to D7AP
- Operations
  - Read file
  - Write file
  - Execute file
  - ...

# GATEWAY NODE

## SERIAL D7 MODEM



- STMicroelectronics devkit
- Laptop with pyd7a
- ALP over serial

# DEMO

- Browse local FS using modem-webgui
- Execute local ALP command using modem-webgui

# SENSOR NODES

## STMICROELECTRONICS DEVKIT + SENSOR SHIELD

# SENSOR APPLICATION

## ONLY MEASURE AND WRITE TO FILE

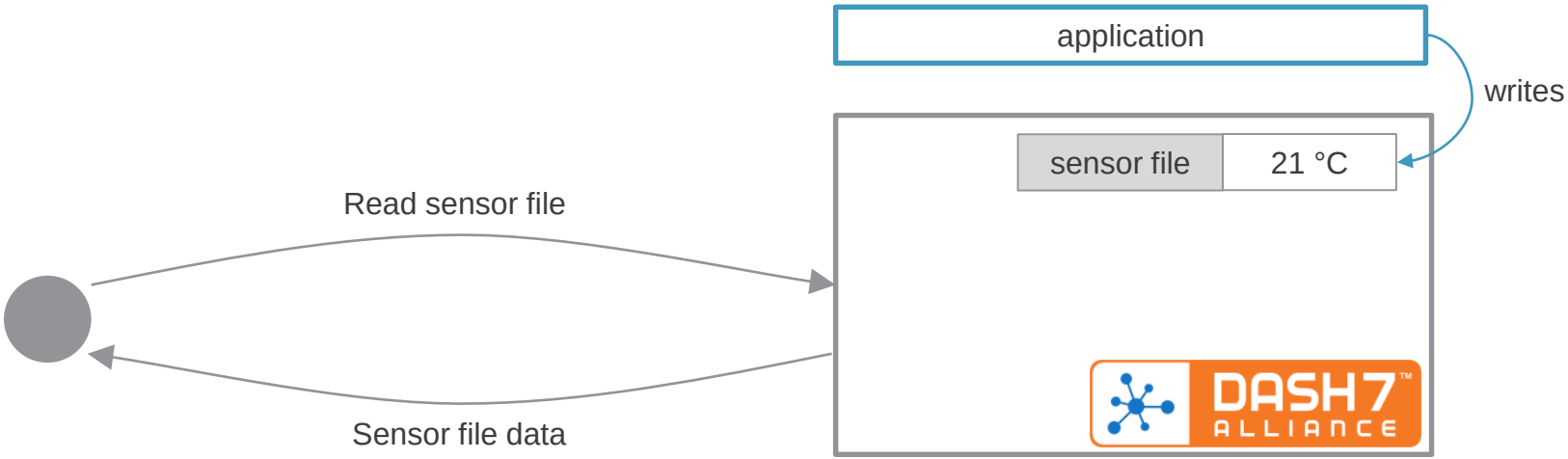
```
void execute_sensor_measurement()
{
  int16_t temperature = 0; // in decicelsius.
  HTS221_Get_Temperature(hts221_handle, &temperature);

  fs_write_file(SENSOR_FILE_ID, 0, (uint8_t*)&temperature, SENSOR_FILE_SIZE);

  timer_post_task_delay(&execute_sensor_measurement, SENSOR_INTERVAL_SEC);
}
```

# DEMO

- Query remote nodes sensor files using modem-webgui

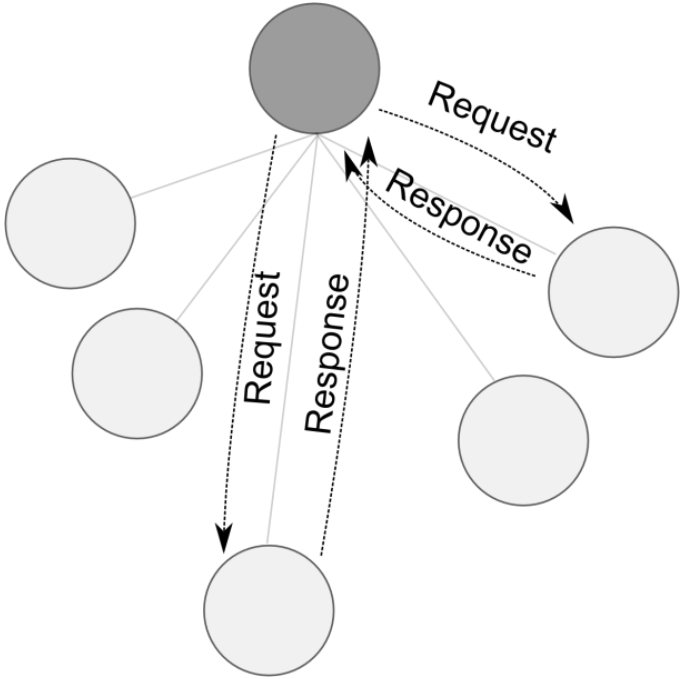
# SENSOR APPLICATION

## PULL



# COMMUNICATION SCHEMES

## PULL



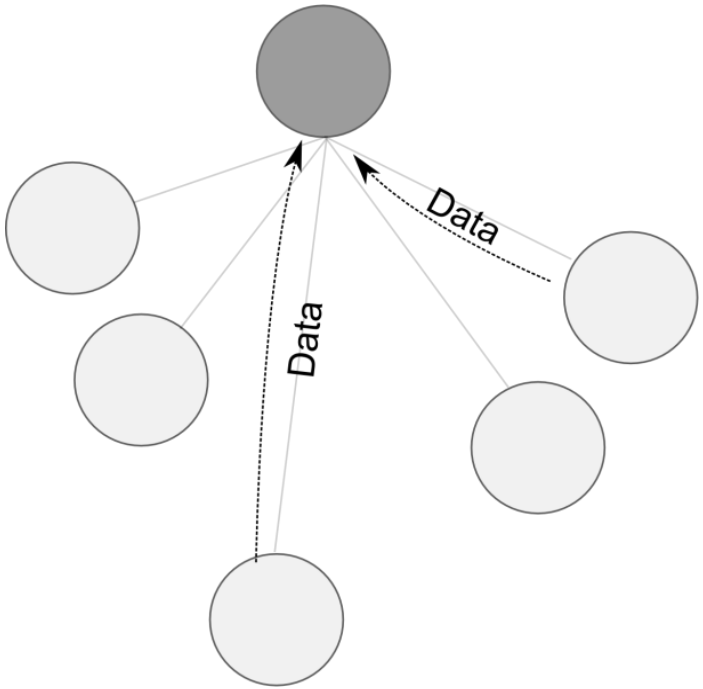

- Request the data only when needed
- Interrogate multiple responders at once
- Ad-hoc synchronization
- Tradeoff latency versus energy consumption

# AD-HOC SYNCHRONIZATION

## OR LOW-POWER LISTENING

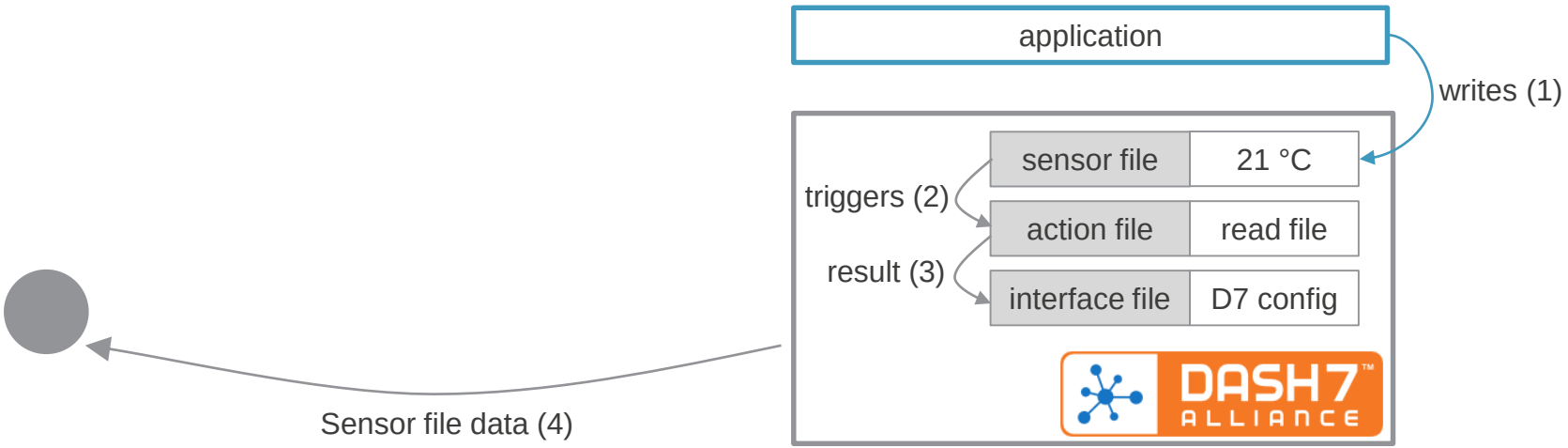
# COMMUNICATION SCHEMES
## PUSH

- Tag talk first
  - Periodic data
  - Sensor triggered
- Unsolicited response
  - To a question never asked explicitely by requester
- D7A Action Protocol



# D7A ACTION PROTOCOL

## USE FILE TRIGGERS FOR FLEXIBLE PUSH COMMUNICATION



# DEMO

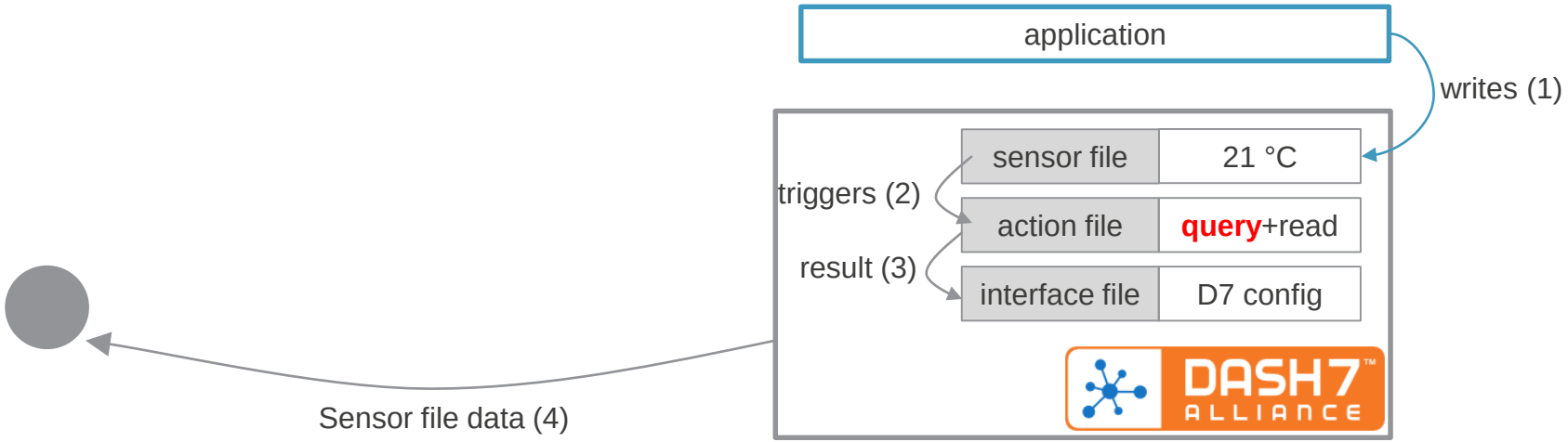
- Demo enable D7ActP on the remote nodes using pyd7a
  - Action is same as in pulling sensor file example (read file)
- Show incoming sensor values on thingsboard dashboard

# ALP QUERY OPERATION

- Compare file data <> data in query or another file
  - Arithmetic (==, !=, <, >, ...)
  - String search
- Result determines further execution of command
- Sophisticated addressing
  - “All nodes with temperature > 25 degrees: return content of file x”

# D7A ACTION PROTOCOL

## USE FILE TRIGGERS FOR FLEXIBLE PUSH COMMUNICATION



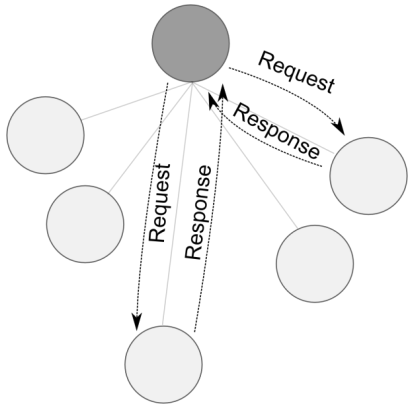
# DEMO

- Add query condition to D7ActP action (temp > x) on the remote nodes
- Show no new incoming values, until we increase temp on 1 node > x
- Show we can still query the other nodes with temp < x

# COMMUNICATION SCHEMES

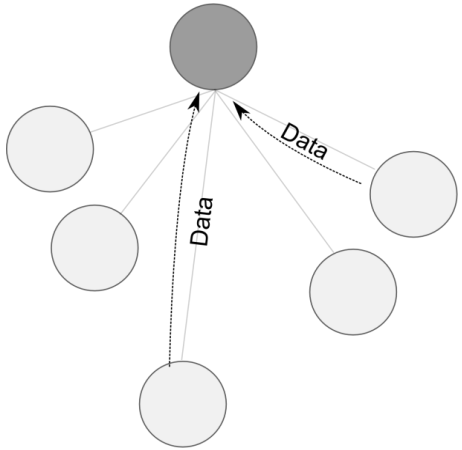
## Pull

To obtain tag sensor data
To set actuator data



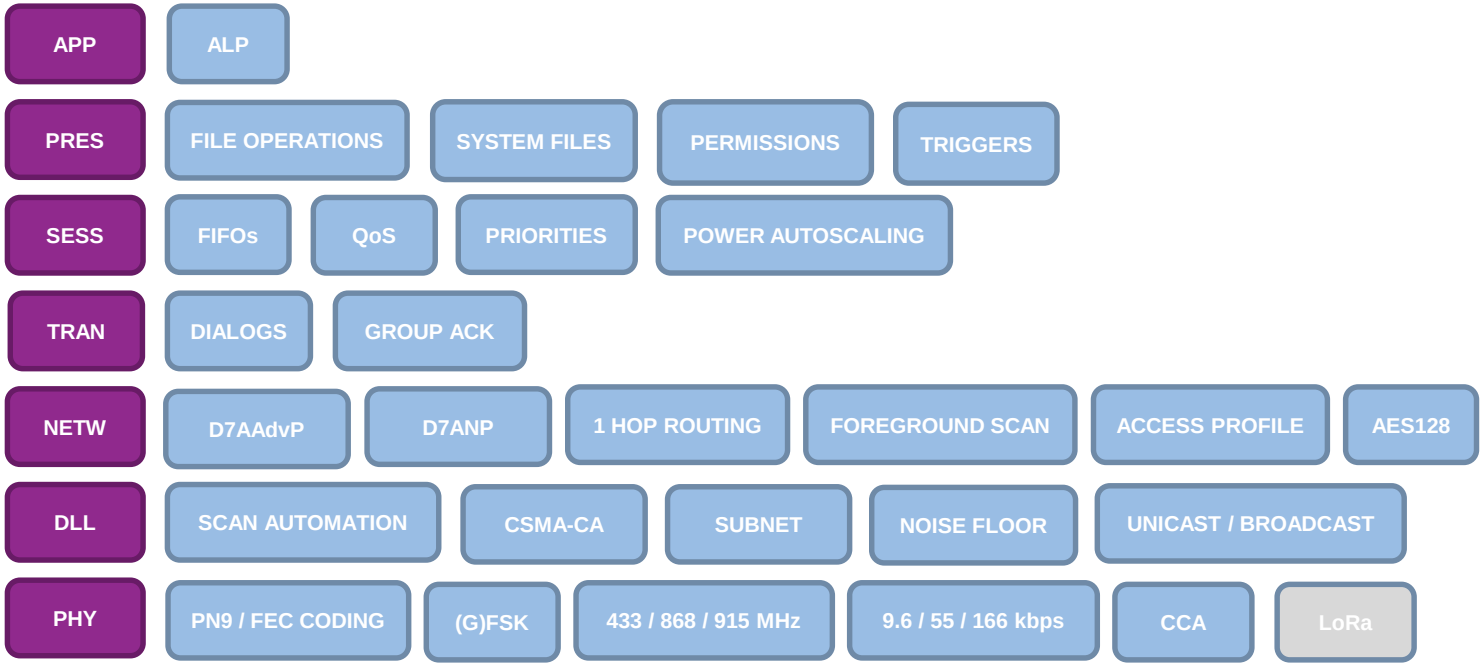

## Push

For alarms and periodic data




Combinations possible. Other options: dormant sessions, push with frequency agility

# FULL STACK SPECIFICATION



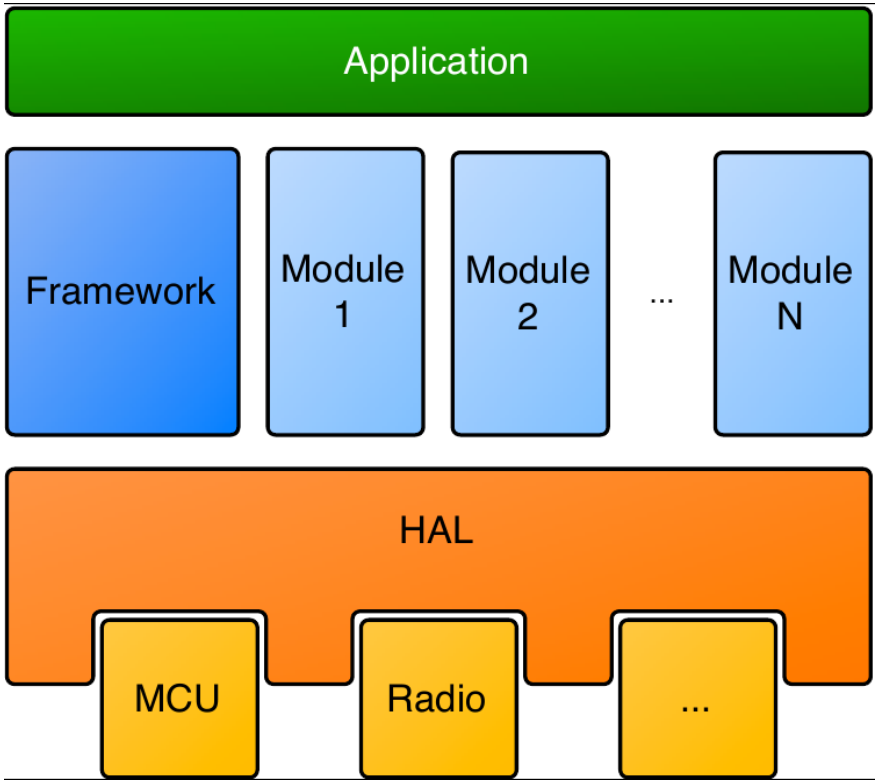
# OSS-7

## AN OPEN SOURCE D7AP IMPLEMENTATION

- Reference implementation for spec
- Generate interest in D7AP
- Support multiple hardware platforms
- Firmware + tools
- Apache License v2.0
  - Allows commercial products

# OSS-7
## SIMPLE AND FLEXIBLE FRAMEWORK

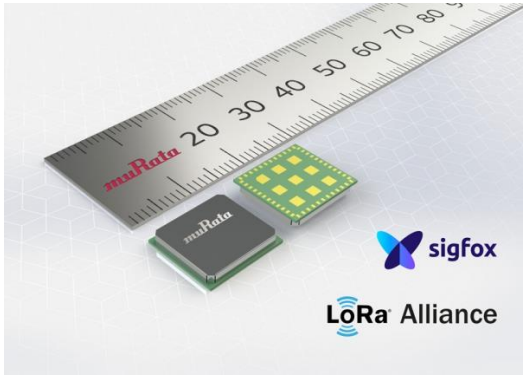
- HAL
- Drivers for peripherals and radio
- Platform: combination of drivers + wiring on board
- Low power cooperative scheduling
- Module
  - D7AP
  - LoRaWAN

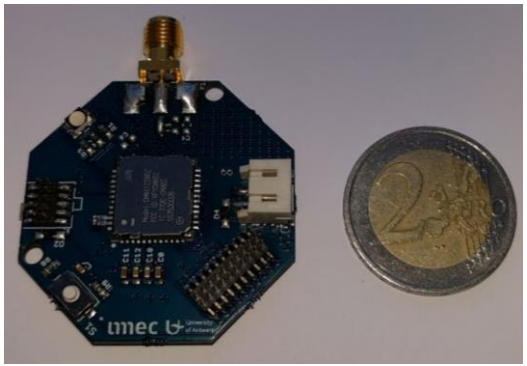


# MURATA LPWA MODULE

## EASY INTEGRATION OF D7 MODEM

- App MCU + modem
  - Serial connection (ALP)
  - App does not interfer with stack timings
  - Modem separately certified
- Murata Type ABZ
  - stm32l0 + semtech sx1276
  - Minimal external components



# RELATED TOOLS

- pyd7a
  - Parser / generator for ALP / frames
  - Modem API
  - Examples + tools
  - webgui
- oss7-thingsboard-gateway
  - Integrate modem with ThingsBoard IoT platform
  - Digital twin
  - Up and downlink
  - Parse sensor data (plugins)
- oss7-testsuite
  - Integration tests on physical modems
  - driven by pyd7a + pytest
  - Jenkins CI

# OSS-7
## NEXT STEPS

- Feature completeness
- Move to D7AP v1.2 (under discussion)
- Over the air update
- C modem library
- Enable porting to other OSs
  - RIOT OS

# JOIN US!

- @ossdash7
- https://github.com/MOSAIC-LoPoW/dash7-ap-open-source-stack
- http://groups.google.com/group/dash7-ap-oss
- http://www.dash7-alliance.org/

QUESTIONS?