Greybus for IOT

Alexandre Bailon ELCE Berlin 2016

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Project ARA

What is Project ARA ?

The goal of project ARA was:

- to create a modular smartphone

Features

- Interchangeable modules
- Modules can be added or removed at runtime
- There can be many types of modules:
  - Screen
  - Camera
  - Speaker
  - E-ink
  - ...

Greybus

An RPC protocol to manage and control modules.

Greybus

Features

- hotplug / hot unplug
- Modules discovery
- Class and protocols to talk to modules

Main classes

- Camera
- Audio
- HID
- I2C
- SPI
- GPIO
- SDIO
- PWM
- UART

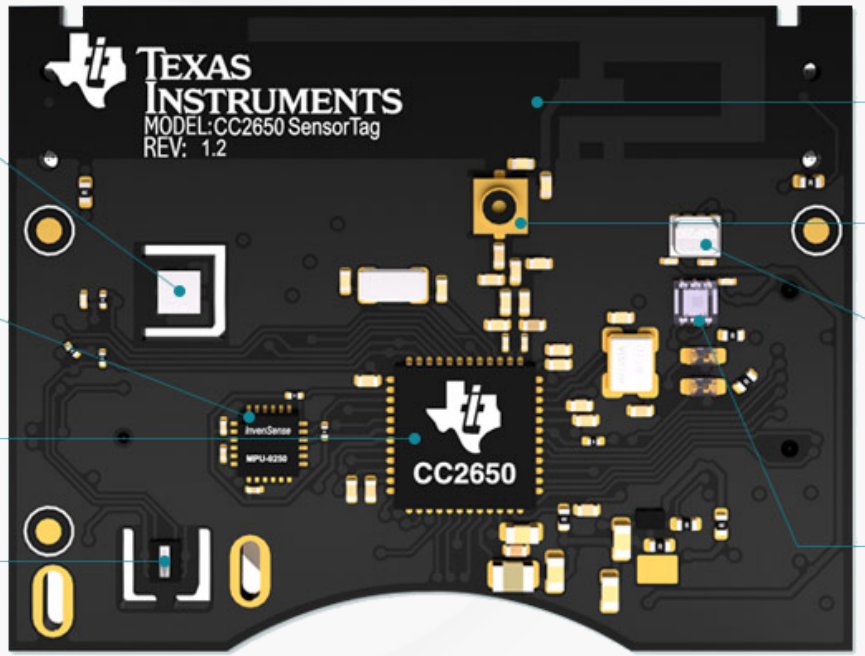
Greybus for IOT

Why Greybus may be useful for IOT ?

- Free
- Highly documented
- Will be merged to mainline kernel soon (currently in linux-next)
- Keep the intelligence in the host
- It just works!

Greybus for IOT

CC26xx SensorTag



IR Thermopile Temperature Sensor
TMP007
Texas Instruments

9-axis Motion Sensor
MPU-9250
Invensense

Multi-Standard Wireless MCU
CC2650
Texas Instruments

Digital Humidity Sensor
HDC1000
Texas Instruments

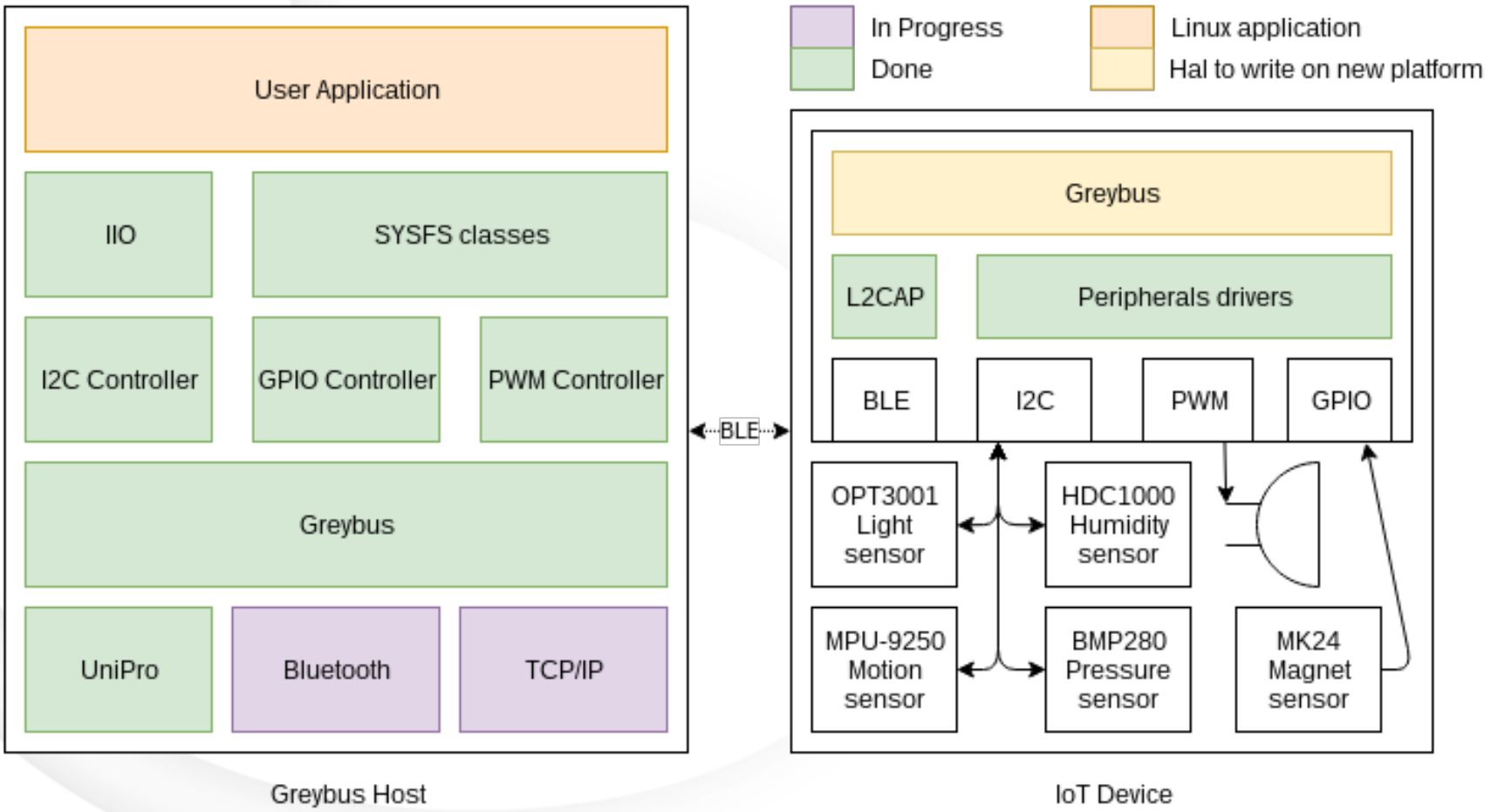
PCB antenna
High-performance Inverted-F PCB Antenna

uSMA RF connector

Altimeter/Pressure Sensor
BMP280
Bosch Sensortec

Ambient Light Sensor
OPT3001
Texas Instruments

Greybus for IOT



Greybus: An application layer of UniPro

What is UniPro ?

UniPro is an interface to interconnect integrated circuits in mobile phone. It implements layer 1 to 4 of the OSI model.

UniPro applications layer

- UFS: Universal Flash Storage
- CSI-3: Camera Serial Interface
- DSI-2: Display Serial Interface
- Greybus

Greybus: An application layer of UniPro

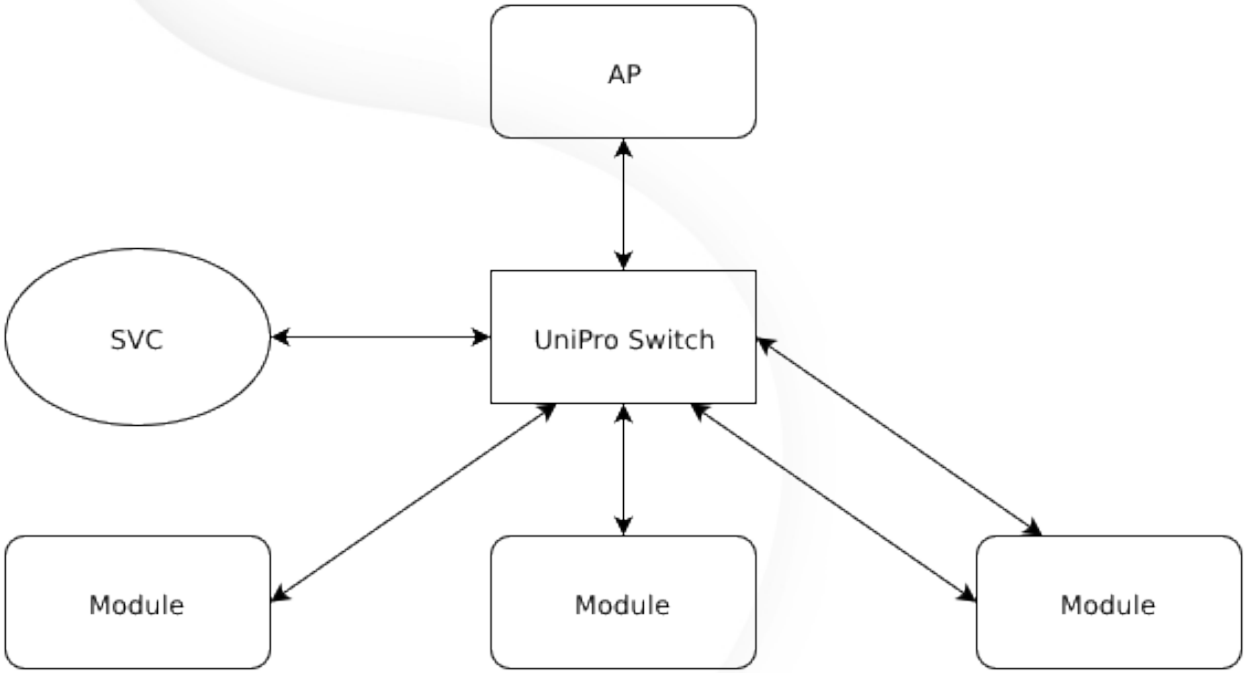
UniPro features

- High speed physical interface
- High bandwidth
- Low power

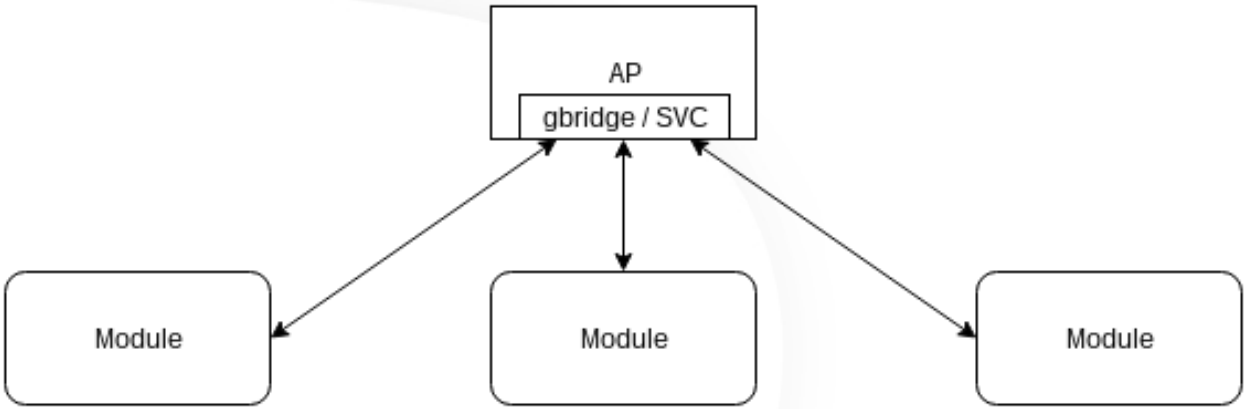
But

- Doesn't support hotplug / hot unplug
- Just a network

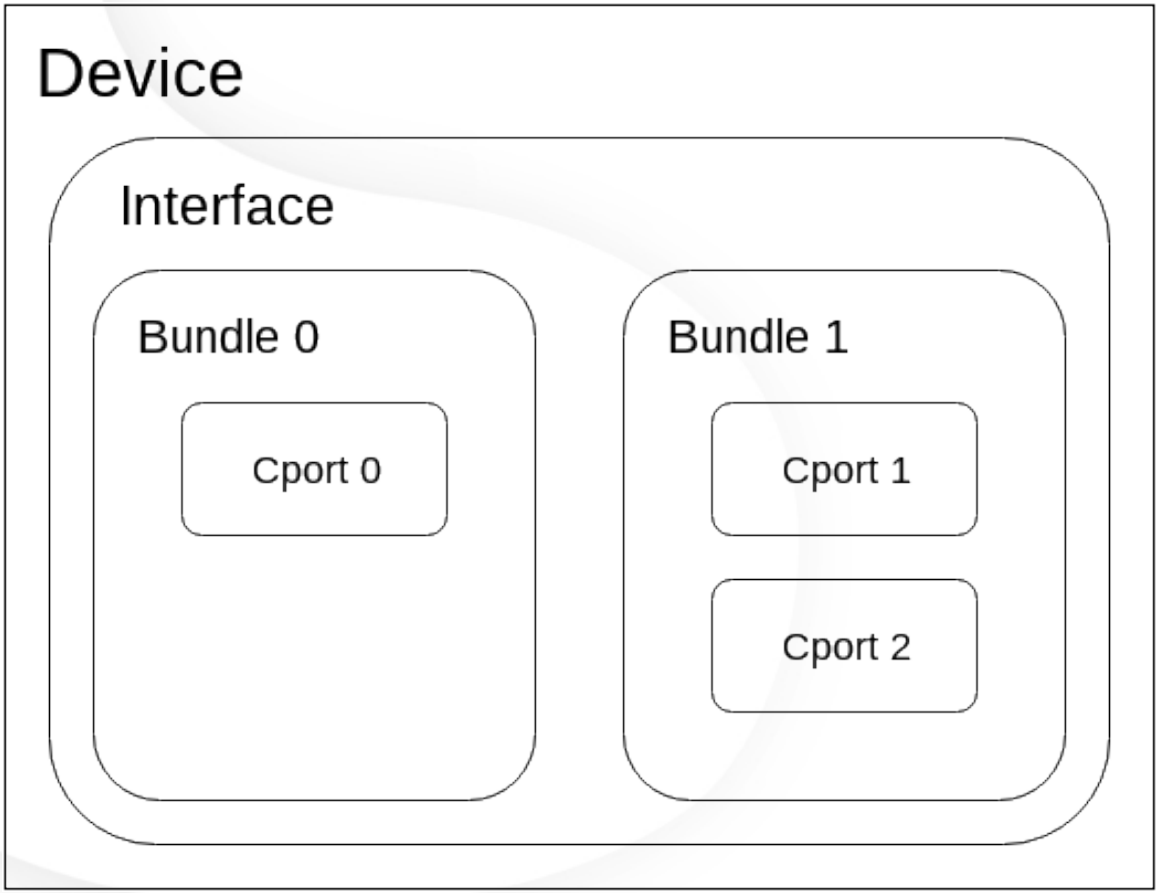
Greybus / UniPro topology



Greybus / IOT topology



Greybus



Greybus sysfs

sysfs layout

- /sys/bus/greybus/devices/
  - 1-1: module
  - 1-1.1: interface
  - 1-1.1.1: bundle 1
  - 1-1.1.ctrl: control bundle

Greybus manifest

```
[manifest-header]
version-major = 0
version-minor = 1

[interface-descriptor]
vendor-string-id = 1
product-string-id = 2

[string-descriptor 1]
string = BayLibre

[string-descriptor 2]
string = Simple GPIO Interface

[cport-descriptor 1]
bundle = 1
protocol = 0x02

[bundle-descriptor 1]
class = 2
```

Greybus GPIO sample

- /sys/class/gpio
  - export
  - gpiochip506
  - unexport
- cat /sys/class/gpio/gpiochip506/label
  - greybus_gpio
- cat /sys/class/gpio/gpiochip506/ngpio
  - 6
- echo 506 >/sys/class/gpio/export
- echo out >/sys/class/gpio/gpio506/direction
- echo 1 >/sys/class/gpio/gpio506/value

Firmware sample

```
uint8_t gb_gpio_direction_out(struct gb_operation *operation)
{
    struct gb_gpio_direction_out_request *request =
        gb_operation_get_request_payload(operation);

    gpio_direction_out(request->which, request->value);
    return GB_OP_SUCCESS;
}

uint8_t gb_gpio_set_value(struct gb_operation *operation)
{
    struct gb_gpio_set_value_request *request =
        gb_operation_get_request_payload(operation);

    gpio_set_value(request->which, request->value);
    return GB_OP_SUCCESS;
}
```

Limitations

Performances

- Quite variable
- Some protocols only execute one RPC at time
- A high round trip latency will break down performances

Power Management

- Incomplete
- Remote wake up is missing
- Protocol overhead

Limitations

Security

- No security (except the one provided by transport medium)
- Not safe to use for some usages

Other

- Need Greybus module on the host
- Only work on local network

Source code

Requirements

- A Beagle Bone Black to run gbsim
- A computer to run Greybus and gbridge

Sources

- git clone https://github.com/anobli/gbridge.git -b ELCE
- git clone https://github.com/anobli/greybus.git -b ELCE
- git clone https://github.com/anobli/gbsim.git -b ELCE

Next steps

- Update gbridge and gbsim to work with the latest version of Greybus
- Port Greybus to an OS for MCU.

Contribute

- Greybus was driven by Google to develop a module phone
- Now, we are free to do what ever we want

Thank you