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For Automotive

meta-ocf-automotive tutorial

Automotive Linux Summit

#LFALS, Tokyo, Japan <2017-05-31>

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こんにちは from Philippe Coval

SAMSUNG
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- Software engineer for Samsung Research
  - Open Source Group, EU team (@UK + DE + *FR* + CZ...)
- Commit into IoTivity, Tizen
  - Plus automotive related projects: Yocto, GENIVI, AGL
- Interest: Usages, OS/hardware support, build, community
- Ask me online for help:
  - https://wiki.tizen.org/wiki/User:Pcoval

Agenda

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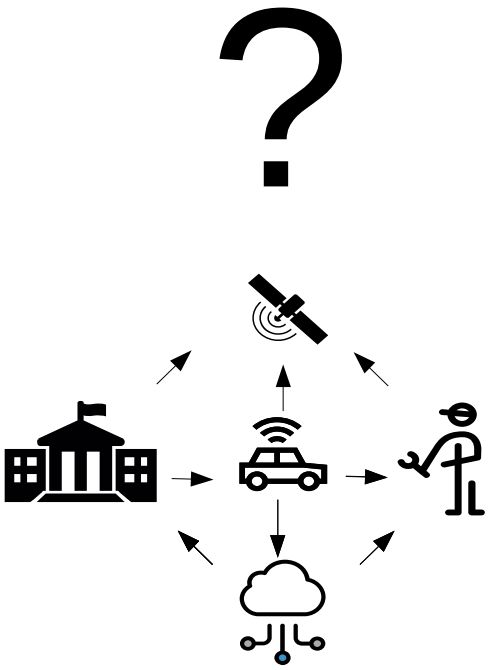
- IoT interoperability
  - Open Connectivity Foundation + IoTivity
- OCF Automotive working group
  - Demos
- Learning IoTivity by examples
- Convergence of automotive data models



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"Without **trust** there's no cooperation.
And without **cooperation**
there's no **progress**.
History stops."
~ *Rick Yancey, The Last Star*

Motivations for Interoperability in IoT

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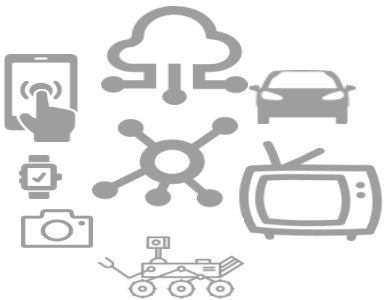
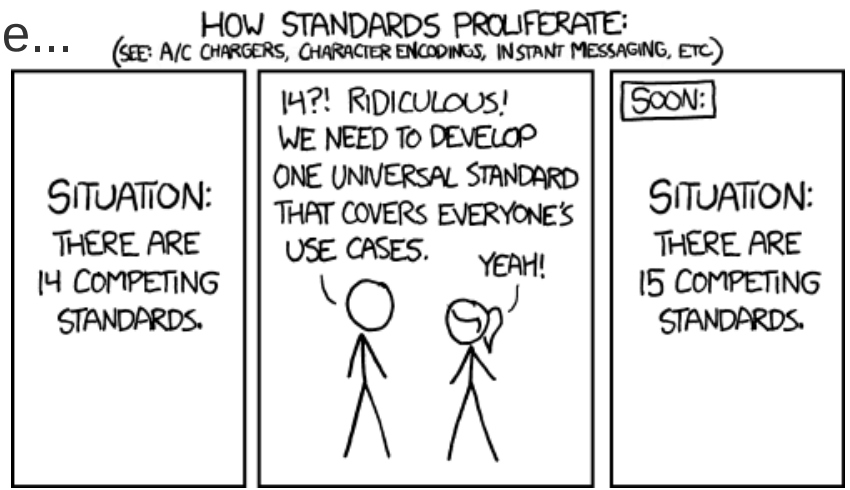


- To break **silos** between:
  - Personal devices: Mobile, Wearable...
  - Shared devices: SmartHome, Cars (IVI, many OS)
  - Infrastructure: Buildings, Cities (traffic, pedestrians...)
  - Online services and probably more to come...
- A **common** open standard is welcome !
  - To provide abstracted features:
    - Connectivity, Security, Portability, Modularity
    - Protocol, Opensource stack, Community



Open connectivity foundation's missions

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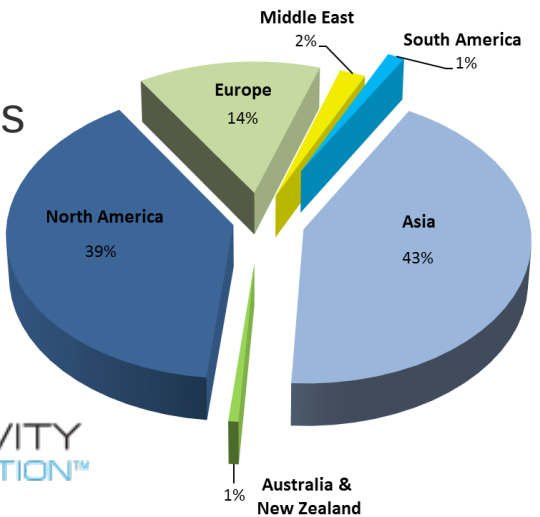
- Provide software linking the Internet Of Things
  - Focus on interoperability and seamless connectivity between devices
- Write **specification**, establish a protocol (formerly named OIC)
  - Rely on existing standards (IETF: CoAP, Cbor..)
- Sponsor Reference **implementation**: IoTivity
  - OpenSource (Apache 2.0 license) use existing FLOSS libs
    - Hosted by Linux Foundation (like kernel, Tizen etc)
  - Rule: No unimplemented features in specification
- **Certify** products for over 300 members (join us!)



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Common technology for multiple profiles

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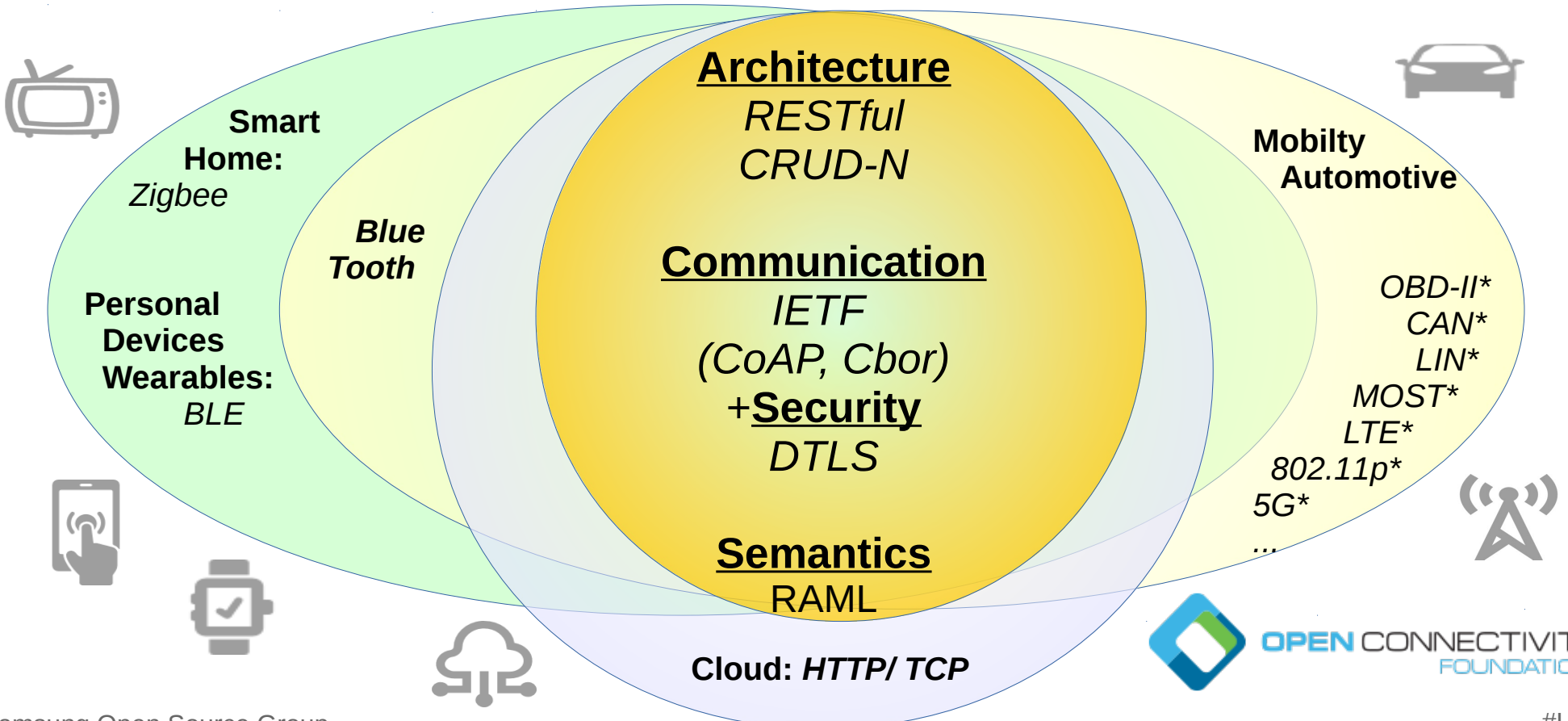

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IoTivity Framework for connecting devices

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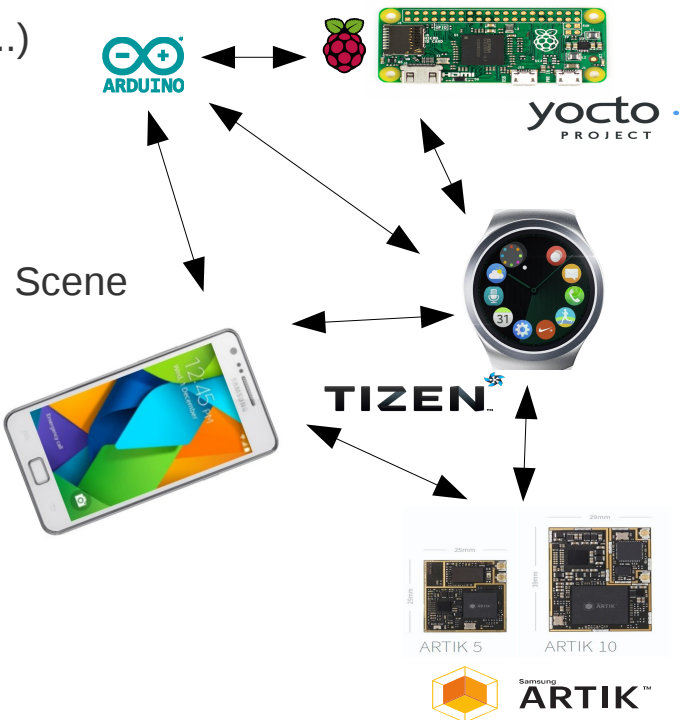
- Core cross platform libraries
  - **C API**: **resource** layer + connectivity abstraction (IP, BT, BLE...)
    - Link to libcoap, tinycbor (code footprint ~128-KiB), + mbedtls
  - **C++ API:** C++11 bindings to build extra services
- + High level **services** (Mostly C++)
  - Data/Device Management: Container, Hosting, Encapsulation, Scene
  - Simulator (Eclipse based), http proxy
- + Plugins: Transport, Cloud Interface, Bridging
- Related projects
  - IoTivity-Node: Javascript bindings
  - IoTivity-contrainted: For thin devices (micro-controllers)



Security matters for IoT

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- Link layer provides **secure channel** (using DTLS) to connectivity abstraction (CA)
- Devices need to be owned (once or xfer) and **provisioned** using onboarding tool:
  - Establish ownership in user's network
- Secure Resource Manager (SRM):
  - Secure platform's resources
    - Device provisioning, Credentials, Access control list, Persistence
  - Policy engine: Request filtering: Grant, deny resource requests
    - Per policy, requester ID, ACL, device status...
  - Is an OIC resource (“/oic/sec/cred”)
- Hardware hardening: use encryption and secure contexts, RNG, IO etc
- Details: https://www.slideshare.net/SamsungOSG/iot-meets-security

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"Any sufficiently
advanced technology
is indistinguishable
from **magic**."
~ *Arthur C. Clarke*

OCF Automotive profile's mission

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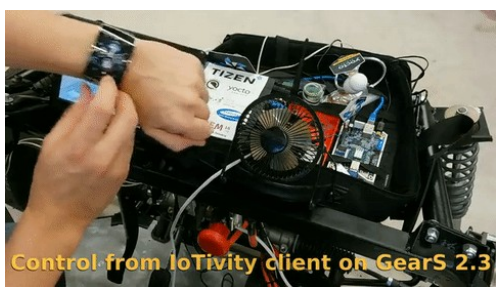
- Provide OCF technology for connected cars, by proposing
  - A common definition of vehicle resources
  - A common way to interact with those (inside or outside vehicle)
  - Based on or bridging to existing standards
- **Cooperative** effort of existing FLOSS Automotive projects
  - Tizen, GENIVI, AGL, W3C, RVI ...



SmartHome to Automotive #CES2017

https://youtu.be/3d0uZE6lHvo

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CES

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IoTivity

GENIVI

TIZEN™

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"The secret of getting ahead
is getting **started**."
~ Mark Twain

Supported Automotive OS

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- Download OS image shipping IoTivity: Tizen, GDP, AGL?
  - Or install package from repository (RPM)
- Use “meta-oic” layer on OE/Yocto based distributions:
  - **GENIVI** (Specification first): integrated
  - **AGL/Automotive Grade Linux** (Code first): optional
  - Tizen Yocto project to build Common + IVI
- Rebuild package from sources for most GNU/Linux systems
  - https://wiki.iotivity.org/build

Build Yocto's Poky with IoTivity

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- Adding “meta-oic” layer to poky reference distribution

```
git clone http://git.yoctoproject.org/git/poky
cd poky && source ./oe-init-build-env
git clone http://git.yoctoproject.org/git/meta-oic
```

- Append to environment files previously generated:
  - **“poky/conf/bblayers.conf”** (Layer path file)

```
RELATIVE_DIR := \
"${@os.path.abspath(os.path.dirname(d.getVar('FILE', True))+'/../..')}"
BBLAYERS += "${RELATIVE_DIR}/meta-oic"
```

  - **“poky/conf/local.conf”** (Project configuration file)

```
CORE_IMAGE_EXTRA_INSTALL += " packagegroup-iotivity "
```

- Rebuild poky image using: `bitbake core-image-minimal`

Check using samples apps

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- Shared libs plus various **validation examples** are shipped :
  - find /opt/iotivity*
- Ie: playback smart light example scenario on loopback
  - Open 2 sessions (hint: use GNU screen) for client and server:

```
cd /opt/iotivity/examples/resource/cpp/ && ./simpleserver
cd /opt/iotivity/examples/resource/cpp/ && ./simpleclient
```

- More: https://wiki.iotivity.org/examples

Build AGL with IoTivity

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- Use **repo** tool to pull sublayers (including meta-ioc):

```
repo init -u https://gerrit.automotivelinux.org/gerrit/AGL/AGL-repo
repo sync
```

- Use custom configuration script to select features (agl-full, agl-iotivity...):

```
MACHINE=qemux86-64
source ./meta-agl/scripts/aglsetup.sh -m $MACHINE \
                                      agl-all-features agl-iotivity
```

- Use regular yocto tools:

```
bitbake iotivity agl-demo-platform

ROOTFS=$PWD/tmp/deploy/images/$MACHINE/agl-demo-platform-$MACHINE.ext4 \

runqemu $MACHINE; ssh ; find /opt/iotivity* # as part of OS
```

Build GENIVI with IoTivity

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- Download distribution sources using **git**:

```
git clone https://github.com/GENIVI/genivi-dev-platform
```

- Setup using GDP custom configuration script

```
MACHINE=qemux86-64 # or minnowboard, raspberrypi2 etc
source ./init.sh ${MACHINE}
```

- Use regular yocto tools:

```
bitbake iotivity genivi-dev-platform
ROOTFS=$PWD/tmp/deploy/images/${MACHINE}/*-${MACHINE}.ext4 \
runqemu ${MACHINE} ; ssh root@${target_ip} # Or use xvncviewer
find /opt/iotivity* # As part of OS
```

TIZEN ❤ IoTivity

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- Tizen is an **Operating System** based on FLOSS
  - Shipped into **consumer electronic** products
- Tizen:{3,4} part of platform (ARM/x86 32/64 .rpm)
- Tizen:2 can ship shared lib into native app (.tpk)
  - Tizen:2.4:Mobile: Samsung Z{1,2,3}
  - Tizen:2.3:Wearable: Samsung GearS{2,3}
- Tizen:3:Yocto same as poky (1.7 dizzy)

Timeline

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- 2014-12-31: **meta-oic** 0.9.1 Initiated by Kishen Maloor (Intel) , (with demo for edison)
- 2016-01-31: FOSDEM: Presented how to use meta-oic on Tizen Yocto (Tizen fan)
- 2016-09-14: meta-oic 1.1.1 Philippe Coval (Samsung) new contribitor
- 2016-04-27: GENIVI AMM : Presented demos (fan+map+wearables on 1.1.1), +RVI
- 2016-05-08: meta-oic 1.1.1 integrated in GENIVI
- 2016-05-27: AGLF2F meeting, meta-ocf-automotive Introduced
- 2016-09-21: meta-oic 1.1.1 integrated in AGL
- 2016-12-20: meta-oic 1.2.0 integrated in GENIVI and AGL
- 2017-01-05: CES, GENIVI+Smarthome+Wearables demos (contact Sanjeev BA)
- 2017-02-04: FOSDEM: Presented “streetlight+cloud” usecase on AGL 3.0
- 2017-02-15: GENIVI announced partnership with **Open Connectivity Foundation**
- 2017-03-20: meta-oic 1.2.1+ : Phil C keeps maintaining it

FOSDEM

Embedded Linux Conference

OpenIoTSummit

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CES

GENIVI

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"Talk is cheap.
Show me **the code**."
~ Linus Torvalds

What is “meta-ocf-automotive”

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- Playground for OCF and Automotive **R&D experiments**
- Connecting Automotive platforms (AGL, GENIVI, Tizen)
  - Hardware: RPi {0,1,2,3}, ARTIK10, Intel, Renesas, Qualcomm…
  - to other products: SmartHome, Mobile, Wearable
- “Real world” integration/validation tests (QA)
- **Tutorial of demo codes** to learn about IoTivity, Yocto, AGL, GDP, Tizen...

```
git clone http://git.s-osg.org/meta-ocf-automotive
```

- More: https://wiki.iotivity.org/automotive

Prepare your environment

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- Build IoTivity from sources for your OS: https://wiki.iotivity.org/os
  - Hint: build system package to use standard paths (/usr/include)
    - Or ask me for packages for Debian, Fedora, Arch (unsupported)
- Tizen: Install OS on supported hardware and setup GBS tool

```
git clone https://git.tizen.org/cgit/platform/upstream/iotivity
cd iotivity && gbs build -P tizen_unified_armv7l -A armv7l
```

- Yocto (AGL, GDP): meta-oic + meta-ocf-automotive layers to pull iotivity-example
- Note: **Security** can be disabled at build time (for prototyping on 1.3-rel)
  - https://wiki.iotivity.org/security

iotivity-example tutorial

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- OCF application developers might not develop in upstream source tree
  - SCons build system is complex (even for sample apps)
- A **standalone project** is better to get inspiration from or derivate
  - minimalist, can be used as base skeleton (fork it at will, SDK?)
- Download a **collection** of standalone subprojects:
  - `git clone http://git.s-osg.org/iotivity-example/ ; make`
- Each ”feature” subproject is a git module (pulling a branch based on other)
  - Nice history to understand each steps of development
  - For many OSes or build system (Currently, GNUmake, Linux, Tizen, More welcome)

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"**Simplicity**
is the ultimate sophistication."
~ Leonardo da Vinci

Base example: Resource discovery

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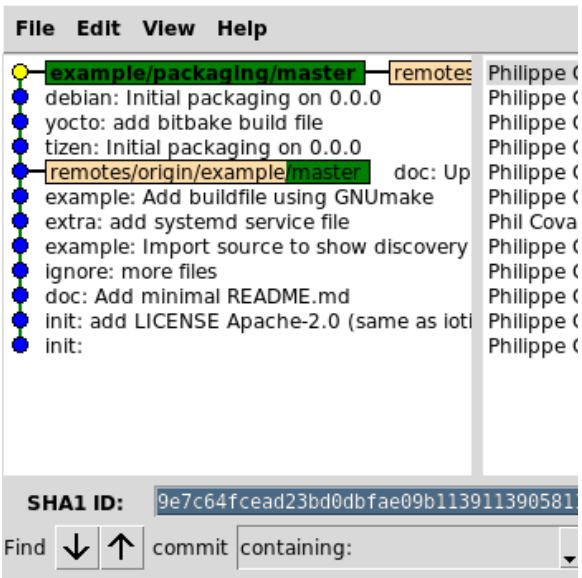
- branch=example/master (src/example/master/README.md)
  - Server **register** a “dummy” resource identified as “/ExampleResURI”
  - Client **discover** and list all resources' endpoints served in local network
  - GNUmake is used to build it
  - Systemd service provided to start it once installed
- branch=example/packaging is based on previous one
  - Bitbake recipe
  - RPM spec file for Tizen
  - More packaging files: Debian/Ubuntu etc



Resource discovery example flow

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IoTivity Server

IP Network

IoTivity Client(s)


```
main {
IoTServer::init() { ModeType::Server }
IoTServer::createResource()
  { OCPlatform::registerResource(... uri ...) }
  // loop on OCProcess() is called internally
}
```

```
main {
IoTClient::init() { ModeType::Client }

IoTClient::start()
{ OCPlatform::findResource(onFindCallback) }
  IoTClient::onFind(resource)
                    { print(resource->uri) }
```

```
$ ./bin/server -v
(...)
log: { IoTServer::createResource(...)
log: Successfully created\
     org.example.r.example resource
log: } OCStackResult
(...)
```

```
$ ./bin/client -v
(...)
log: { void IoTClient::onFind(...)
log: Resource: uri: /oic/d
(...)
log: Resource: uri: /ExampleResURI
coap://[fe80::baca:3aff:fe9b:b934%25eth0]:47508
```

Geolocation example: Observation

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- Branch “geolocation/master” is based on “example/packaging” and adapted :
  - Resource's URL is changed to “**/GeolocationResURI**”
  - **Resource type** changed to “**oic.r.geolocation”** (from OCF/Onelot)
  - Simulated GPS that update position continuously

- ./bin/server: is updating current position and **notifying** it

```
m_Representation.setValue(); OCPlatform::notifyAllObservers(…);
```

- ./bin/observer: is **observing** changes in `IoTObserver::onObserve`

```
geolocation: 48.1043, -1.6715
```

- ./bin/client : can also get value using GET: `m_OCResource->get`

Derivate to Tizen app

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- Port to tizen **native app**: support SDK build files, app manifest files
  - + GUI using EFL's Elementary map widget (from SDK sample)
  - Branch: “geolocation/tizen/mobile/2.4/master”
- Need to rebuild IoTivity’s **shared lib** (to be packaged) using helper:

  ./tizen.mk ; ls lib/*.so

  ./tizen.mk run # deploy tpk on device (ie TM1)
- More details: https://wiki.iotivity.org/tizen

Binary switch example: Boolean resource

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- **Actuator**, client change value (on/off) of server's resource
  - iotivity-example's “switch/master” branch
    - based on “example/packaging” and adapted
- Usage:


```
./bin/server -v
log: { OCEntityHandlerResult
IoTServer::handleEntity(...)
log: { OCStackResult IoTServer::handlePost(...)
log: { void Platform::setValue(bool)
1
log: } void Platform::setValue(bool)
log: { void IoTServer::postResourceRepresentation()
(...)
```

```
./bin/client
menu:
0) Set value off
1) Set value on
(...)
1
```

Binary switch example: Resource update

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IoTivity Server

IP Network

IoTivity Client(s)


```
OCPlatform::Configure(...);
OCPlatform::registerResource( …);
```

```
handleEntity(OCResourceRequest) {
  switch entityHandlerRequest->method
  {
    case 'POST:
      // update actuator state
      ...

  OCPlatform::sendResponse(response);
  }
}
```

```
OCPlatform::Configure(...);
OCPlatform::findResource(...);
  onFind(... resource ...)
```

```
OCResource::post(rep,
callback);
  onPost(...)
```

- Client controls actuator:
  - Set resource's value
- Server is handling request
  - and responding

More examples

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- **GPIO** switch to control relay attached to raspberrypi, minnowboard, ARTIK10
- **CSDK** version of binary switch
  - Arduino port (1.2-rel)
- Secured example
  - IoTivity 1.3 will have security enabled by default,

ARDUINO

- MRAA: same as GPIO switch but using generic I/O Communication library
- Constrained example: (WIP) targeting MCUs (smaller than CSDK)

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Constantly **talking**
isn't necessarily **communicating**
~ Charlie Kaufman

OCF Resource Model

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URI:
+ common properties: Policy Interface...

Resource Type:
+ attribute(s)

```
/example/BinarySwitchResURI
{
  “p” : Discoverable & Observable & Secured,
  “if” : ["oic.if.a","oic.if.baseline"],
  “rt” : [“oic.r.switch.binary”],
    “value” : true
  ...
}
```

- Well knows resources URI (/oic/*):
  - “res” discovery, “p” for platform , “d”: device (role: C/S), “sec/*” : security

Data models can be:

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- **Described**
  - For RESTful operations (CRUD)
  - RAML+JSON, Swagger Schemas
- Reviewed and validated
  - OCF check consistency and versions
- **Shared**
  - http://OneIotA.org repository & tools
- Note:
  - IoTivity works with private models too

- `oic.r.switch.binary.json`
  - http://www.oneiota.org/revisions/1580
- `/* … */ "definitions": {`

```
"oic.r.switch.binary": {
  "properties": {
    "value": {
      "type": "boolean",
      "description":
        "Status of the switch"
} } } /* … */
```

Aligning semantic: W3C, OCF, OMA...

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- **W3C**: Automotive Working Group:
  - Vehicle Signal Specification (VSS): YAML & Json
- Many specific signals on ~100 interfaces (Chassis, OBD, Cabin, ADAS, Media...)
  - Could be dispatched over generic OCF models:
    - Switch, Speed, Distance, Movement, Audio, TimePeriod, Weight
- Example of aligned concepts:
  - oic.r.sensor.geolocation : { latitude, longitude, altitude }
    - W3C: Signal.Cabin.Infotainment.Navigation.DestinatonSet.Longitude
    - Longitude of destination, Integer double [-180..+180]
  - oic.r.switch.binary: for lights, door, brake, belt...
- Details: http://tinyurl.com/omaocf2017

OCF-VSS Translator
https://youtu.be/jKt_fPnqggo

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Want more ?

Smart City's Street lights use case

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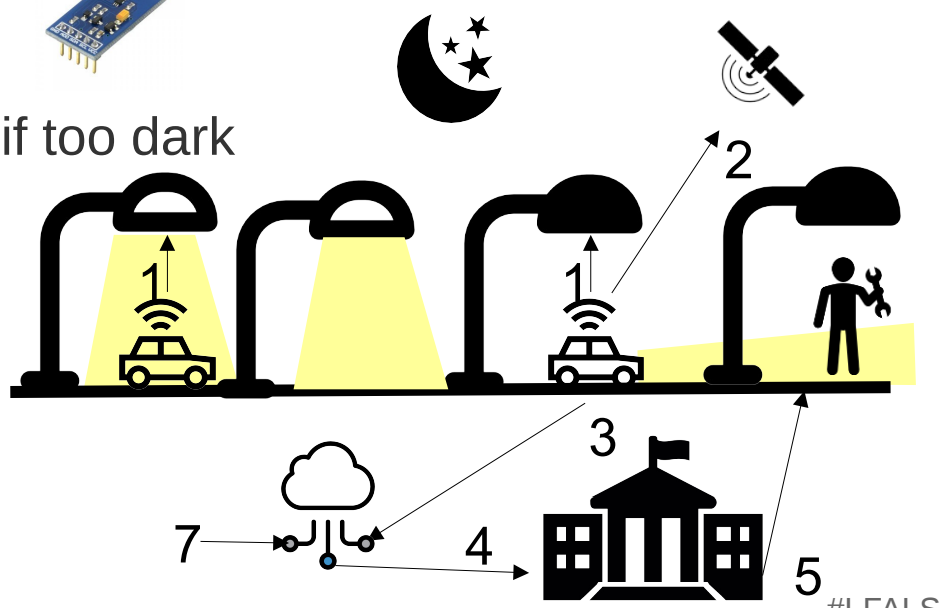
- Iotivity-example (Branch "sandbox/pcoval/on/master/demo")
  - Various examples combined in demo using nodejs
- Defective Street lights notification service:
  - Sensor reads luminance
  - Micro controller **switch** car's light on if too dark
  - **geolocation** updated continuously
  - Gateway sends message to cloud



From sensor to ARTIKCloud #FOSDEM2017

https://youtu.be/3L6_DbMLJ1k

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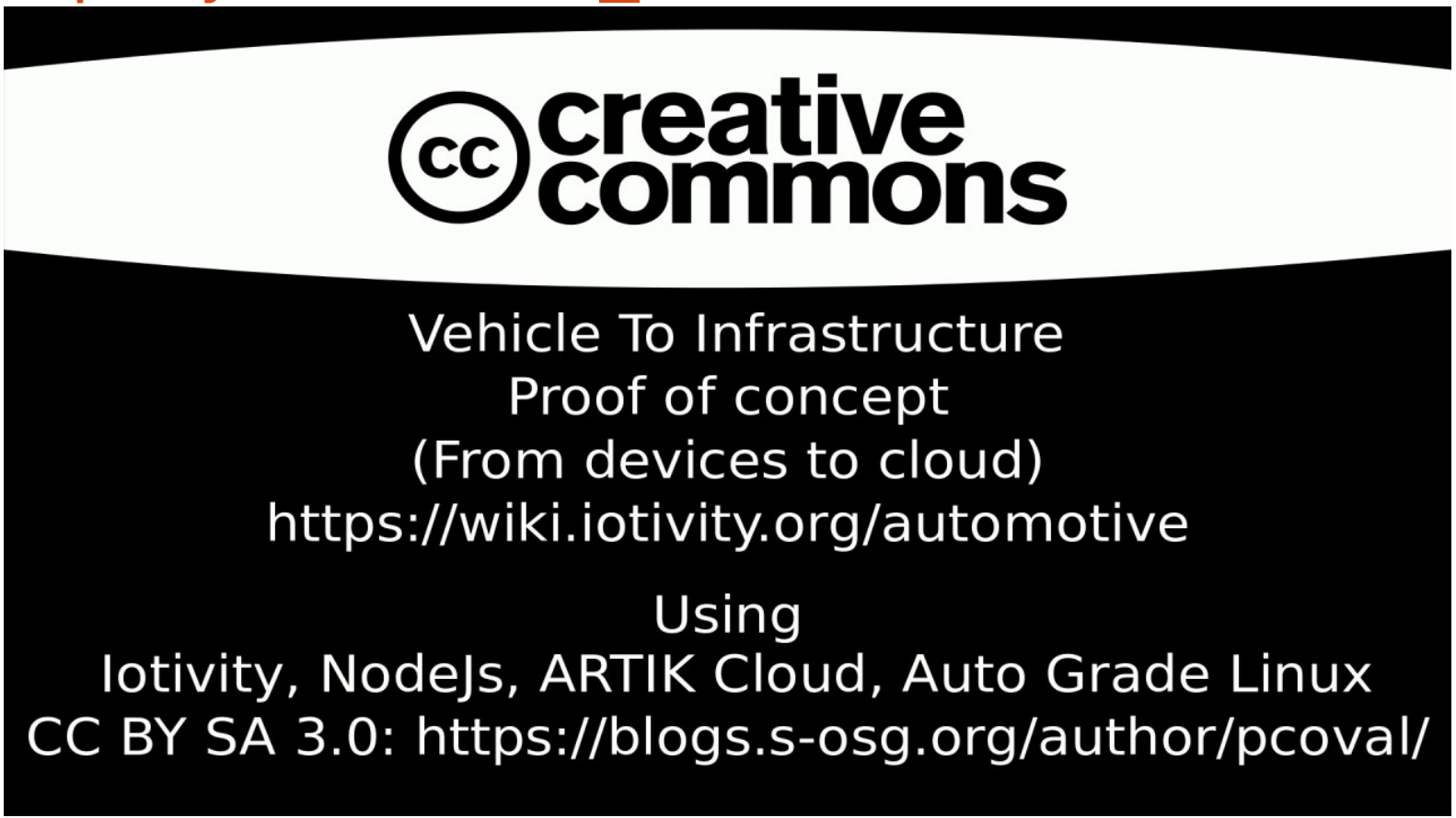

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A Vehicle to Infrastructure notification service

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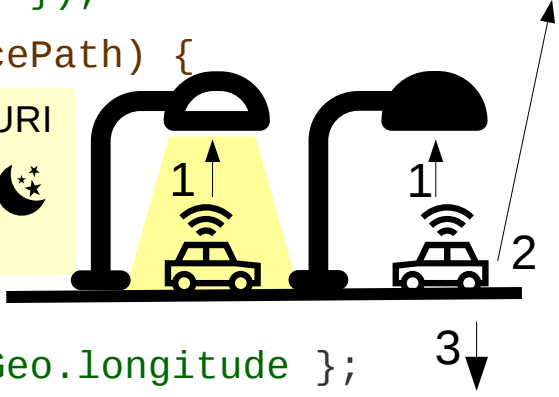
```
client.on("resourcefound", function(resource) {
  if ("/GeolocationResURI" === resource.resourcePath) {
    resource.on("update",
      function(resource) { gGeo = resource.properties; });
  } else if ("/IlluminanceResURI" === resource.resourcePath) {
    resource.on("update", handle);
}};
function handle(illuminance) {
  if (illuminance < gThreshold ) {
    var data= { illuminance: illuminance,
                latitude: gGeo.latitude, longitude: gGeo.longitude };
    sender.send(data); // { ARTIK's client.post(url...); }
} }
```

/GeoLocationResURI
{
  latitude: 52.165,
  longitude: -2.21,
}

/IlluminanceResURI
{
  illuminance: 42
}



https://api.artik.cloud/
{
  illuminance: 42,
  latitude: 52.165,
  longitude: -2.21
}

Samsung ARTIK™ Cloud

Summary

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- OCF establishes a **standard** for interconnecting things

  - Several profiles: SmartHome, Automotive, Health...
  - Common technology: Resource model & RESTful architecture
  - Definitions must be shared to ensure interoperability
- **Open Source** project IoTivity

  - implements it in C, C++, Java and Javascript
  - Ready to be used on Automotive Oses and beyond
  - Try using examples. Feedback welcome !

References

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- Entry points:
  - http://wiki.iotivity.org/automotive
  - https://openconnectivity.org/industries/automotive
  - https://blogs.s-osg.org/tag/automotive/
  - http://git.s-osg.org/iotivity-example
  - http://git.s-osg.org/meta-ocf-automotive/
- Going further:
  - https://openconnectivity.org/resources/iotivity
  - https://openconnectivity.org/resources/oneiota-data-model-tool
  - https://news.samsung.com/global/samsung-contributes-to-open-iot-showcase-at-ces-2017
- Keep in touch online:
  - https://wiki.iotivity.org/community (Wiki, Mailing list, IRC, Events ...)
  - https://wiki.tizen.org/wiki/Meeting
  - https://www.meetup.com/OCF-France/ (Local events worldwide, Soon in Tokyo)
  - https://blogs.s-osg.org/author/pcoval/

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Q&A or Extras ?

IoTivity on GENIVI demo platform: https://youtu.be/DJKYauaOmsc

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GENIVI®

IoTivity on Automotive Grade Linux (AGL)

https://youtu.be/w_c0wxJfBsw

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IoTivity

AUTOMOTIVE GRADE LINUX

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Thank you
ありがとう
Merci !

Resources: flaticons CC

Visit OpenConnectivity #LFALS booth !

Contact:
https://wiki.tizen.org/wiki/User:Pcoval