

PLATFORM FOR ONLINE INTEROPERABILITY AND PERFORMANCE TEST



## F-Interop platform

### Remote Conformance & Interop Testing

**OMA Device Management (DM) and Interoperability (IOP) Working Group**

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## Goals

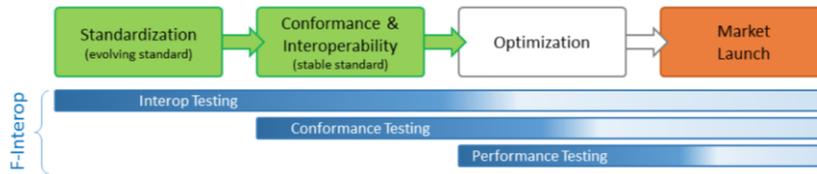


1. Describe the F-Interop platform
2. Is this useful for the OMA community?
3. How can the OMA community contribute?
4. Introduce the F-Interop open call

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## Why remote conformance & interop?



### ➤ SDOs

- save time and resources
- running code early
- accelerate standardization process

### ➤ SMEs and companies

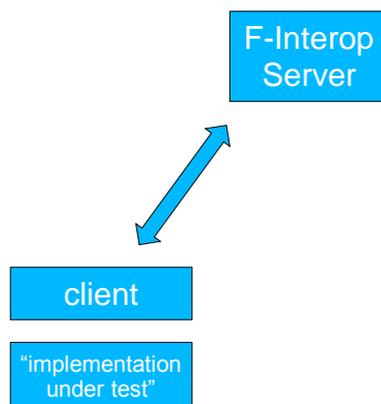
- interop tests without needing to travel
- lower development cost
- faster development of standards-based products

→ more standards-based products

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## Core Idea

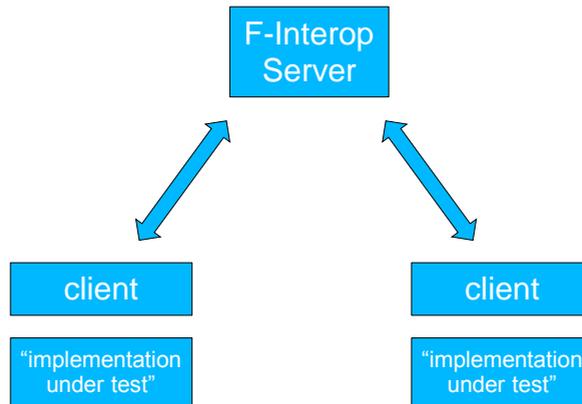


Conformance Testing

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## Core Idea

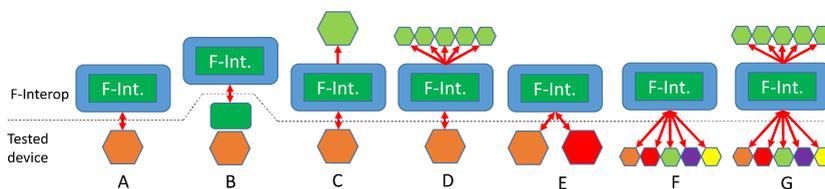


Interop Testing

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## Different Configurations



- A. Tested Device  $\leftrightarrow$  F-Interop test server
- B. Deported test with downloaded resource
- C. Remote interop with 2 participants
- D. Interop against testbed
- E. Local interop
- F. Remote interop with N participants
- G. Remote interop with N participants and testbeds

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## F-Interop H2020 Project



- [www.f-interop.eu](http://www.f-interop.eu)
- 1 November 2015 – 31 October 2018
- *develop and provide online interoperability and performance test tools to support emerging technologies from research to standardization and market launch*
- 9 partners



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## Testbeds



32 testbeds, 4755 nodes

- **Fed4FIRE**  
([www.fed4fire.eu/testbeds](http://www.fed4fire.eu/testbeds))
  - 24 testbeds
  - ~1000 nodes
- **OneLab**  
([onelab.eu](http://onelab.eu))
  - Includes 6 IoT-lab deployments (including 2728 IoT nodes)
- **IoT lab**  
([www.iotlab.eu](http://www.iotlab.eu))



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## Targeted Standards



- Initially standards of the IoT realm
- We take, as a starting point, the ETSI plugtests specifications and build an architecture that allows those to be done remotely (CoAP, 6TiSCH, 6LoWPAN)
- **Contributions/extensions are expected by design**

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## Example CoAP Test



- From ETSI plugtest CoAP#4, IETF89 (London)

Interoperability Test Description		
<b>Identifier:</b>	TD_COAP_CORE_01	
<b>Objective:</b>	Perform GET transaction (CON mode)	
<b>Configuration:</b>	CoAP_CFG_BASIC	
<b>References:</b>	[COAP] 5.8.1, 1.2, 2.1, 2.2, 3.1	
<b>Pre-test conditions:</b>	Server offers the resource /test with resource content is not empty that handles GET with an arbitrary payload	
<b>Test Sequence:</b>	Step	Type
	1	Stimulus
	2	Check
	3	Check
	4	Verify

Client is requested to send a GET request with:

- Type = 0 (CON)
- Code = 1 (GET)

The request sent by the client contains:

- Type=0 and Code=1
- Client-generated Message ID (→ CMID)
- Client-generated Token (→ CTOK)
- Uri-Path option "/test"

Server sends response containing:

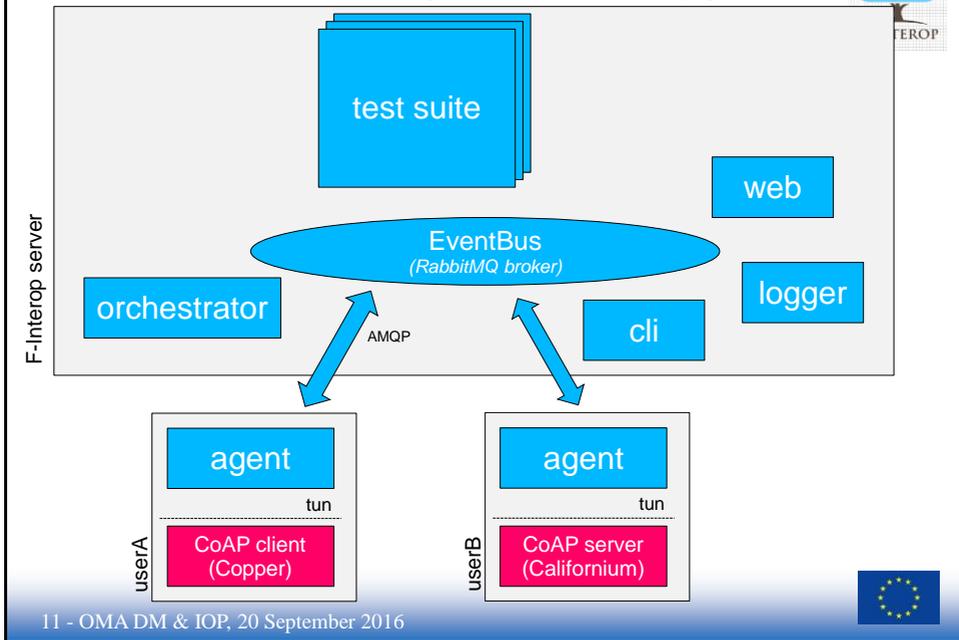
- Code = 2 05 (Content)
- Message ID = CMID, Token = CTOK
- Content-format option
- Non-empty Payload

Client displays the received information

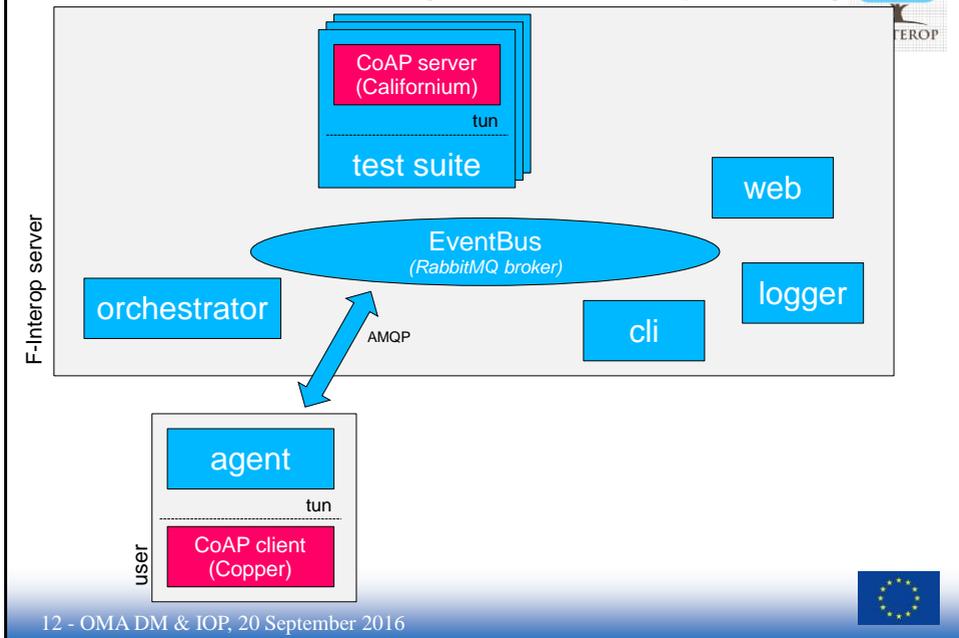
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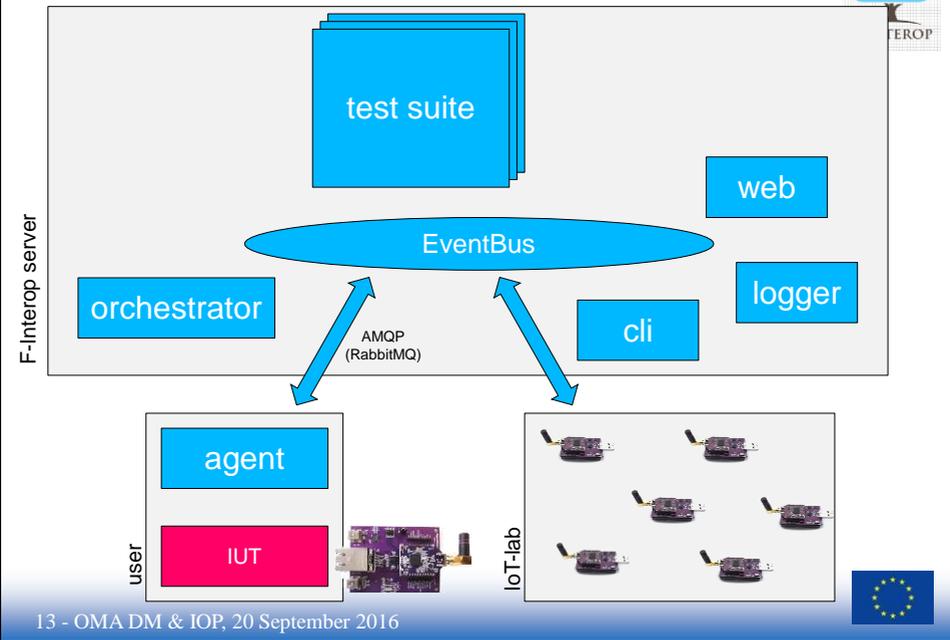
## Base Architecture (CoAP interop)



## Base Architecture (CoAP interop demo)



# Advanced Architecture (testbed example)



# CoAP demo



## Download the Agent



The screenshot shows a web browser window with the URL `f-interop.paris.inria.fr`. The page content includes:

- F-interop**: A platform for interoperability testing.
- Home**: A navigation menu.
- Download the agent**: A link highlighted with a red circle.
- IETF 96 demo**: A section with the following content:
  - Goals**
    - Testing CoAP GET [link to the test description](#)
    - Tests coming from: Test Descriptions for ETSI plugtest CoAP#4. [IETF89](#)
    - Testing an already existing implementation (copper/coap).
  - Set up**
    - Download the agent (Will be released later on after documentation)
    - <http://f-interop.paris.inria.fr/static/agent/agent.py>
    - Connect to the session *bonjour* with username/password and we play the role of a *client*

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## Connect to the F-Interop Server



```
# sieben @ sieben-lincs in ~/Dropbox/workspace/f-interop_ietf on git:develop x [14:29:58] C:1
$ sudo python -m finterop.agent.agent connect --user bonjour --session bonjour --name client
Password: █
```

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# Select and Start the Test Case



**Test cases**

**Test case references**

- TD\_COAP\_CORE\_01  
Perform GET transaction (CON mode)
- TD\_COAP\_CORE\_02  
Perform DELETE transaction (CON mode)
- TD\_COAP\_CORE\_03  
Perform PUT transaction (CON mode)

**Console**

Start Test Case

28 test cases loaded

CoAP server URL:  
coap://[bbb::2]/test

**No Frame Selected**

No Frame

No frame selected for the moment

**Frame list**

No test case selected for the moment

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# Send CoAP Packets



**[bbb::2]:5683 (RTT: 115ms)**

## 2.05 Content

**[bbb::2]:5683**

- well-known
  - core
  - large
  - large-create
  - large-post
  - large-separate
  - large-update
  - link1
  - link2
  - link3
  - location-query

Value	Option
T... Acknowledgment	Content-F... 0
C... 2.05 Content	Max-Age ...
... 63915	
T... empty	

**Payload (38)**

Incoming Rendered Outgoing

Type: 0 (CON)  
Code: 1 (GET)  
MID: 63915

**Debug Control** **Reset**

Token  
use hex (0x..) or string

**Request Options**

Accept

**Content-Format**

Block1 (Req.) Block2 (Res.) A

block no. x block no. x

Size1 Size2

total size x total size x

Observe  
use integer

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# Finish Test Case



Finterop client - Google Chrome

https://rawgit.com/... Finterop\_IETFBe... Finterop

Finterop client

Finterop.paris.inria.fr/session/bonjour/coap

F-INTEROP Inria

### Test cases

**Test case references**

- TD\_COAP\_CORE\_01**  
Perform GET transaction (CON mode)
- TD\_COAP\_CORE\_02  
Perform DELETE transaction (CON mode)
- TD\_COAP\_CORE\_03  
Perform PUT transaction (CON mode)

### Console

**Finish Test Case**

28 test cases loaded

CoAP server URL:  
coap://[bbbb::2]/test

No Frame Selected

No Frame

No frame selected for the moment

Frame list

No test case selected for the moment

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Verdict!

F-INTEROP Inria

### Test cases

- TD\_COAP\_CORE\_01 pass  
Perform GET transaction (CON mode)
- TD\_COAP\_CORE\_02 pass  
Perform DELETE transaction (CON mode)
- TD\_COAP\_CORE\_03 pass  
Perform PUT transaction (CON mode)
- TD\_COAP\_CORE\_04 pass  
Perform POST transaction (CON mode)
- TD\_COAP\_CORE\_05 inconc  
Perform GET transaction (NON mode)
- TD\_COAP\_CORE\_06 pass  
Perform DELETE transaction (NON mode)
- TD\_COAP\_CORE\_07 fail  
Perform PUT transaction (NON mode)
- TD\_COAP\_CORE\_08** start  
Perform POST transaction (NON mode)
- TD\_COAP\_CORE\_09  
Perform GET transaction with separate response (CON mode, no piggyback)
- TD\_COAP\_CORE\_10  
Perform GET transaction containing non-empty Token (CON mode)
- TD\_COAP\_CORE\_11  
Perform GET transaction containing non-empty Token with a separate response (CON mode)
- TD\_COAP\_CORE\_12  
Perform GET transaction using empty Token (CON mode)
- TD\_COAP\_CORE\_13  
Perform GET transaction containing several URI-Path options (CON mode)
- TD\_COAP\_CORE\_14

### Console

Start Test Case

**TD\_COAP\_CORE\_07**  
Gave the verdict fail  
Review frames: 4, 5  
**More informations**  
127.0.0.1 | CoAP [NON 13185] PUT /test/ [ pass ] match: CoAP(type=1, code=3) [ fail ] mismatch:  
CoAP(opt=Opt(CoAPOptionContentFormat()), pi=Not(b-?)) CoAP(opt: CoAPOptMismatch got: expected: CoAPOptionContentFormat) 127.0.0.1 | CoAP [NON 59896] 2.04 Changed > [ pass ] match: CoAP(type=1, code=Any(65,68), tok=b-?bxdx)

Test case TD\_COAP\_CORE\_07 started, press the Finish button when completed

**TD\_COAP\_CORE\_06**  
Gave the verdict pass  
Review frames: 2  
**More informations**

**TD\_COAP\_CORE\_05**  
Gave the verdict inconc  
Review frames: 1, 2  
**More informations**

**TD\_COAP\_CORE\_04**  
Gave the verdict pass  
Review frames: 2  
**More informations**

### Analyse TC - TD\_COAP\_CORE\_07

**Frame n°4**

CoAP

Version: 1  
Type: 1  
TokenLength: 2  
Code: 3  
MessageID: 0x3361  
Token: b?bxdx  
Options:  
CoAPOptionURIPath:  
Delta: 11  
Length: 4  
Value: test  
Payload: b?8

UDP

IPv4

NullLoopback

Frame list

1. [127.0.0.1 -> 127.0.0.1] UDP 50845 -> 50845
2. [127.0.0.1 -> 127.0.0.1] UDP 49374 -> 5684
3. [127.0.0.1 -> 127.0.0.1] Internet Control Message
4. [127.0.0.1 -> 127.0.0.1] CoAP [NON 13185] PUT /test
5. [127.0.0.1 -> 127.0.0.1] CoAP [NON 59896] 2.04 Changed

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# Under the Hood: What's a test?



```
#!/usr/bin/env python3

from ttproto.ts_coap.common import CoAPTestcase
from ttproto.ts_coap.templates import *

class TD_COAP_CORE_01 (CoAPTestcase):

    def run (self):

        # match stimuli
        self.match_coap ("client", CoAP (type="con", code="get",
                                         opt = self.uri ("/test")))
        CMID = self.frame.coap["mid"]
        CTOK = self.frame.coap["tok"]

        # match step 2
        self.next()
        if self.match_coap ("server", CoAP (
            code = 2.05,
            mid = CMID,
            tok = CTOK,
            pl = Not(b""),
        )):

            # match step 3
            self.match_coap ("server", CoAP (
                opt = Opt (CoAPOptionContentFormat()),
            ), "fail")
```

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# Under the Hood: Interface Docs



The screenshot shows the F-INTEROP API documentation website. The left sidebar contains a search bar and a navigation menu with the following items: Introduction, Event Bus (MOM layer), Components description, Messaging pattern types used in, Examples, Application Layer Messages, Orchestration, Test Coordinator, Stiller, Test Analyser (TAT), Protocol Desactor, Agent, Packet Generator, Result repository, Graphical interface and other..., and Other common event. The main content area is titled 'Examples' and 'Application Layer Messages'. It includes a diagram showing 'component 1' and 'component 2' connected via a 'level bus'. Below the diagram, there is a section for 'Application Layer Messages' with a 'Message Header' table. The table has columns for 'Field', 'Type', and 'Description'. The '.\_type' field is described as 'string basically it describes what the message is about'. A 'Json Example Python' window is open on the right, showing a JSON object for a service start event.

doc.f-interop.eu

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## Next Milestones



- July 2016
  - minimal CoAP interop testing (done) -> see demo
- November 2016
  - Functional platform available
  - CoAP CORE interop tests available
- March 2017
  - 6TiSCH support, update at IETF98
- July 2017
  - Use at 6TiSCH/6lo plugtests
  - minimal CoAP interop testing

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## Thoughts about using F-Interop for testing OMA L2M2M



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# Using F-Interop for OMA LWM2M?



## Goal:

- Automating SCR?
- Is there an interoperability TD?

## Thoughts:

- Application-level protocol greatly simplifies testing
  - No tight timing requirements
  - Remote testing ideal
  - CoAP supporting tools (e.g. Wireshark, [TLV support](#))
- 4 clear interfaces (bootstrap, registration, management, data)
- Reference LWM2M client and/or server?
- Using F-Interop as “cloud version” of existing test suite possible

OMA TS LightweightM2M\_V1\_0\_20160407\_C Page 88 (1/2)

**Appendix B. Static Conformance Requirements (Normative)**  
 The notation used in this appendix is specified in [SCRBS13].

**B.1 SCR for LWM2M Client**

**B.1.1 Bootstrap Interface**

Item	Prerequisites	Reference	Requirement
LWM2M-BOOT-001-C-M	Support of at least one Bootstrap table	Section 5.1	
LWM2M-BOOT-002-C-D	Support of Factory Bootstrap table	Section 5.2.1.1	
LWM2M-BOOT-003-C-D	Support of Bootstrap Data Structures	Section 5.2.2.2	LWM2M-BOOT-01X-C-D
LWM2M-BOOT-004-C-D	Support of Client Initiated Bootstrap	Appendix F	
LWM2M-BOOT-005-C-D	Support of Server Initiated Bootstrap	Section 5.2.3	
LWM2M-BOOT-006-C-M	Support of LWM2M Server Bootstrap Information	Section 5.2.4	
LWM2M-BOOT-007-C-D	Support of LWM2M Bootstrap Server Bootstrap Information	Section 5.2.1	
LWM2M-BOOT-008-C-M	Support of receiving Bootstrap Information transferred	Section 5.2.1	
LWM2M-BOOT-009-C-M	Support of Bootstrap Success	Section 5.2.3	
LWM2M-BOOT-010-C-M	Support of Bootstrap Failure	Section 5.2.4	
LWM2M-BOOT-011-C-D	Support of Bootstrap Basic Bootstrap table, Server Change	Section 5.2.2.2	LWM2M-BOOT-01X-C-D AND LWM2M-SEC-001-C-D
LWM2M-BOOT-012-C-D	Feature B Process bootstrap data Basic Bootstrap	Section 5.2.2.2	
LWM2M-BOOT-013-C-D	Check for Bootstrap Data Change in Bootstrap	Section 5.2.2.2	

**B.1.2 Client Registration**

Item	Prerequisites	Reference	Requirement
LWM2M-CR-001-C-M	Support of "Register" operation	Section 5.3.1	
LWM2M-CR-002-C-M	Support of Endpoint Client Change operation	Section 5.3.1	
LWM2M-CR-003-C-M	Support of Lifetime operation	Section 5.3.1	
LWM2M-CR-004-C-D	Support of LWM2M Lifetime parameter	Section 5.3.1	

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# Open Call



## Open Call Categories



- **New testing tools** to extend capabilities of F-Interop
- **New test descriptions** to test conformance and interoperability of other standards
- **SME F-Interop assessment reports:** SME device Interop tests to test F-Interop platform
- **Plugtest Events:** Third parties selected to conduct 3 remote online plugtest events

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## Supported Activities & Budget

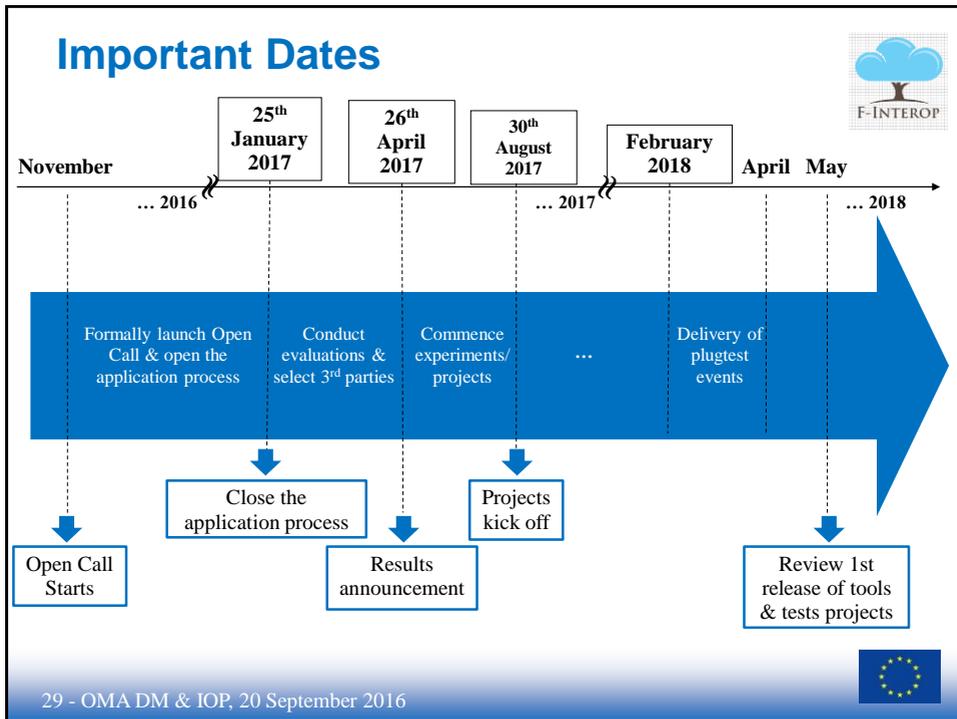


610k for 19 projects

List of Categories	Grants	Award
New F-Interop tools extensions	3	100 000
New interop test descriptions	3	60 000
SME devices F-Interop tests and report	10	10 000
Plugtest Events	3	10 000

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## How to apply?

- Template for the proposal
- Guide for Applicants
- Standard Industrial Experiment Contract
- Open Call Terms and Conditions
- **Submission Portal**

**<http://www.f-interop.eu/index.php/open-call>**

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## Thomas Watteyne



Thomas Watteyne (<http://www.thomaswatteyne.com/>, [@thomaswatteyne](https://twitter.com/thomaswatteyne)) is an insatiable enthusiast of low-power wireless mesh technologies. He is a researcher at Inria in Paris, in the new EVA research team, where he designs, models and builds networking solutions based on a variety of Internet-of-Things (IoT) standards. He is Senior Networking Design Engineer at Linear Technology, in the Dust Networks product group, the undisputed leader in supplying low power wireless mesh networks for demanding industrial process automation applications. Since 2013, he co-chairs the IETF 6TiSCH working group, which standardizes how to use IEEE802.15.4e TSCH in IPv6-enabled mesh networks, and recently joined the IETF Internet-of-Things Directorate. Prior to that, Thomas was a postdoctoral research lead in Prof. Kristofer Pister's team at the University of California, Berkeley. He founded and co-leads Berkeley's OpenWSN project, an open-source initiative to promote the use of fully standards-based protocol stacks for the IoT. Between 2005 and 2008, he was a research engineer at France Telecom, Orange Labs. He holds a PhD in Computer Science (2008), an MSc in Networking (2005) and an MEng in Telecommunications (2005) from INSA Lyon, France. He is Senior member of IEEE. He is fluent in 4 languages.

