

Paris, 16-18 October 2018



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## Online & remote interoperability testing for IoT

Presented by Federico SISMONDI and César VIHO

# Agenda

- Why the F-Interop project?
- Online remote interoperability testing requirements
- F-Interop platform architecture and components
- Current status of F-Interop platform
- Remote interoperability testing in practice with F-Interop
- F-Interop achievements and next steps

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## F-Interop: the context, the needs from SDOs and SMEs

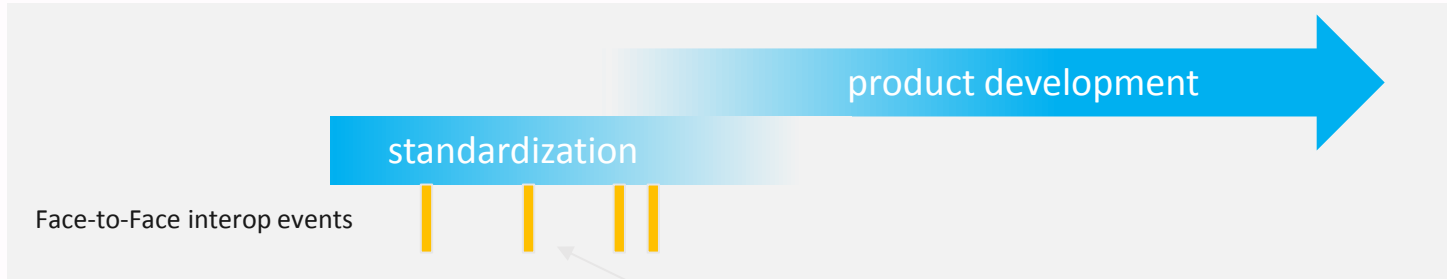
## Interoperability testing

“The purpose of interoperability testing is to prove that end-to-end functionality between (at least) two communicating systems is as required by the standard(s) on which those systems are based.”

<https://portal.etsi.org/Services/CentreforTestingInteroperability/ETSIApproach/InteroperabilityTesting.aspx>

## State of the Art: Face-to-Face Events

Similar requirements  
 from all SDOs:



Goals of these events:

- Make better standards
- Reduced time-to-market
- Increase adoption

Example: ETSI plugtests

- 6TiSCH: Jul'15, Feb'16, Jul'16
- oneM2M: Sep'15, May'16, Nov'16
- CoAP: Mar'12, Nov'12, Nov'13, Mar'14





Joint 6TiSCH/6lo Agenda (JULY 2016)			
Time	Friday 15	Saturday 16	Sunday 17
08:30		Room Opening	Room Opening
09:00 11:00		TEST SESSION #3	TEST SESSION #7
11:00 13:00	SET-UP	TEST SESSION #4	TEST SESSION #8
13:00 14:00	LUNCH 12:30 to 13:30 WELCOME 13:30 to 14:00	LUNCH	LUNCH
14:00 16:00	TEST SESSION #1	TEST SESSION #5	TEAR-DOWN 14:00 to 15:00
16:00 18:00	TEST SESSION #2	TEST SESSION #6	
18:00 19:00	WRAP UP	WRAP UP	



**Few and far apart**

- *Once or twice a year*

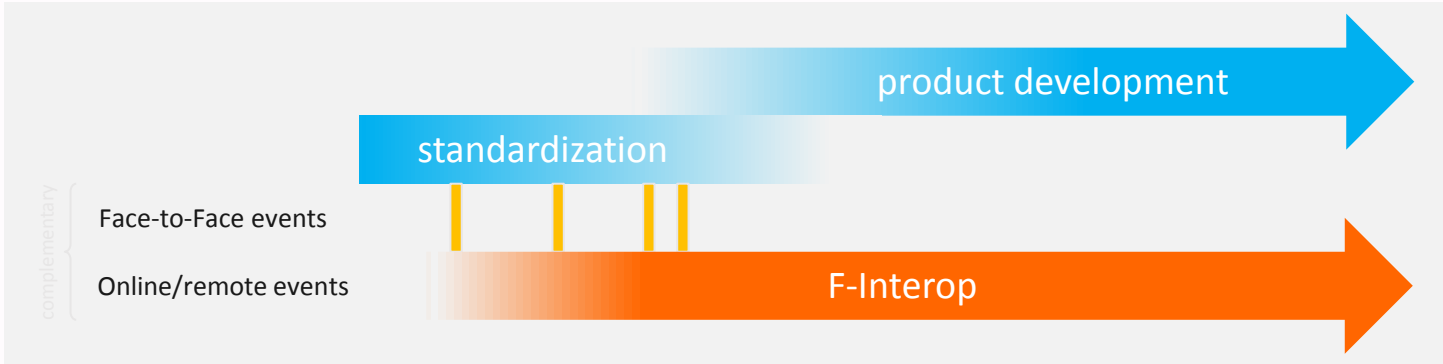
**Short**

- *2-5 days typical*

**Face-to-face**

- *Cost of traveling*

*In practice, attended by large companies working on standardization ☹️*

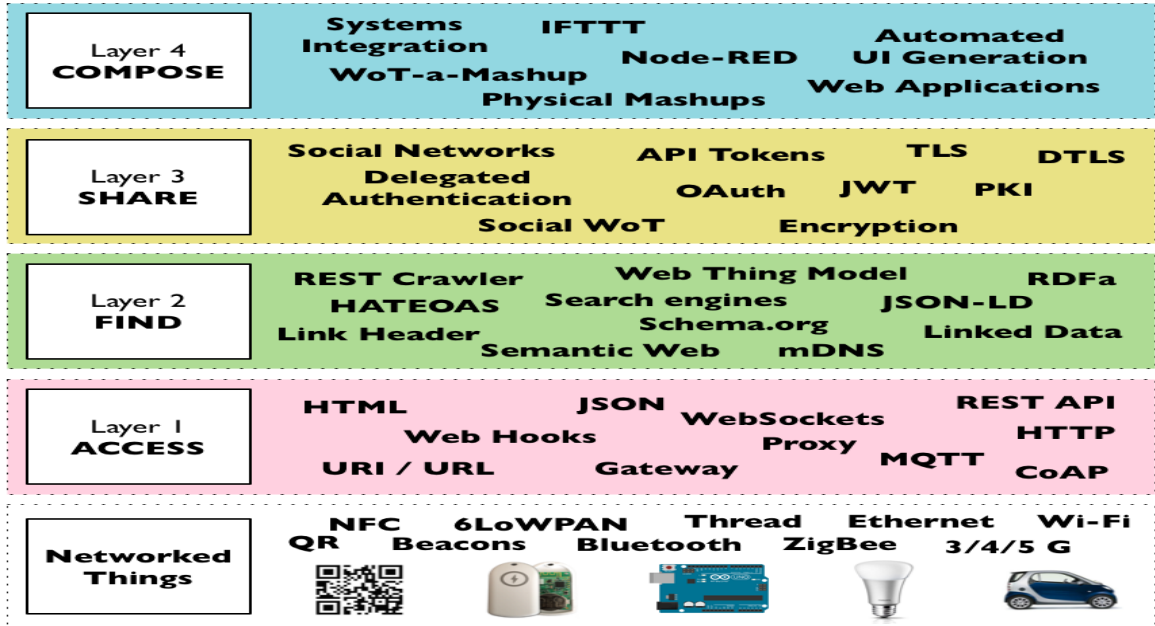


**Online**

**Remote**

*Inclusive of SMEs, more standards-based products on the market, faster 😊*

# IoT standards and technologies evolve fast



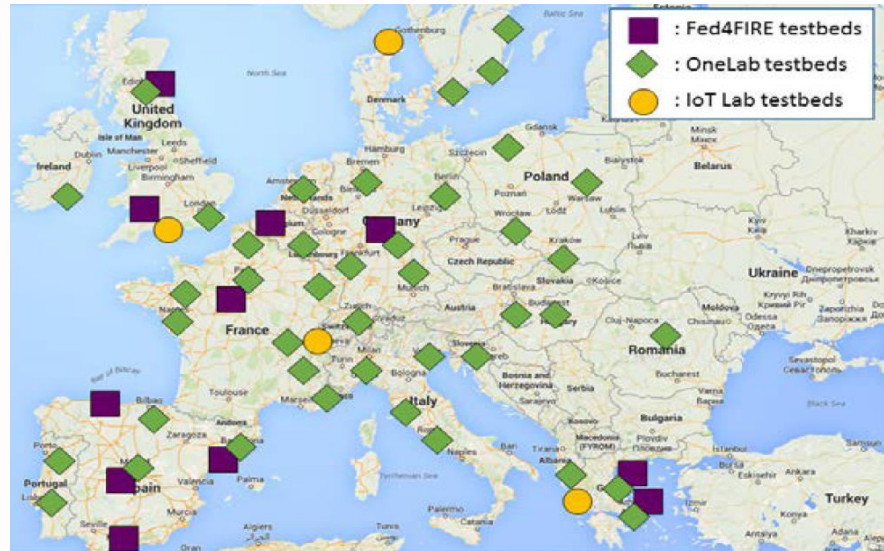
Source: Building the Web of Things: book.webofthings.io  
Creative Commons Attribution 4.0



## Leveraging from European 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))



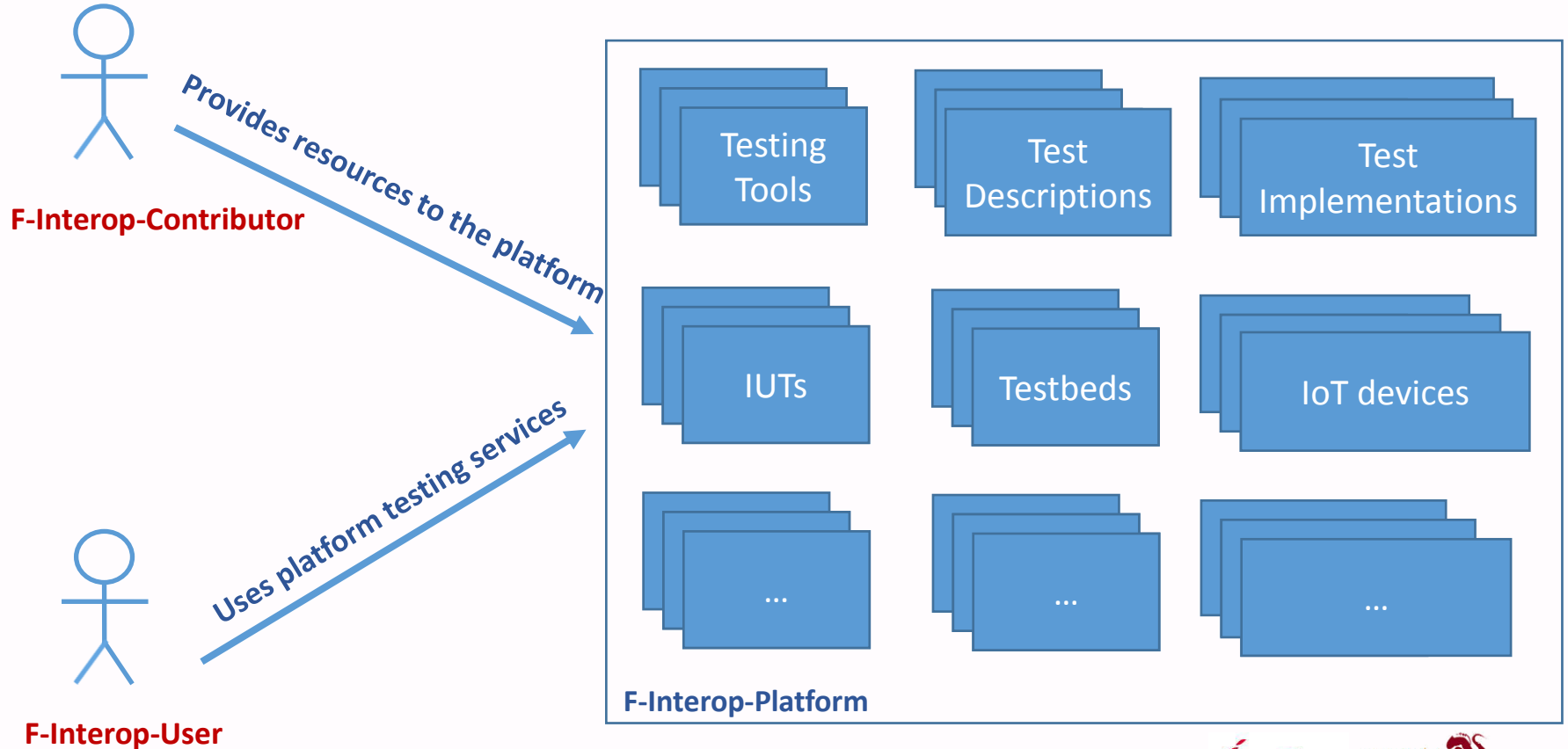
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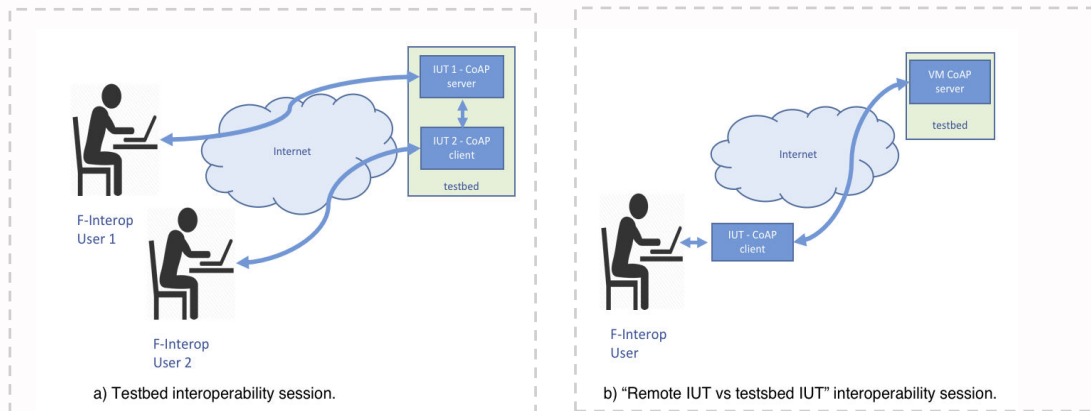
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## F-Interop: remote interop testing requirements

# F-Interop actors and components



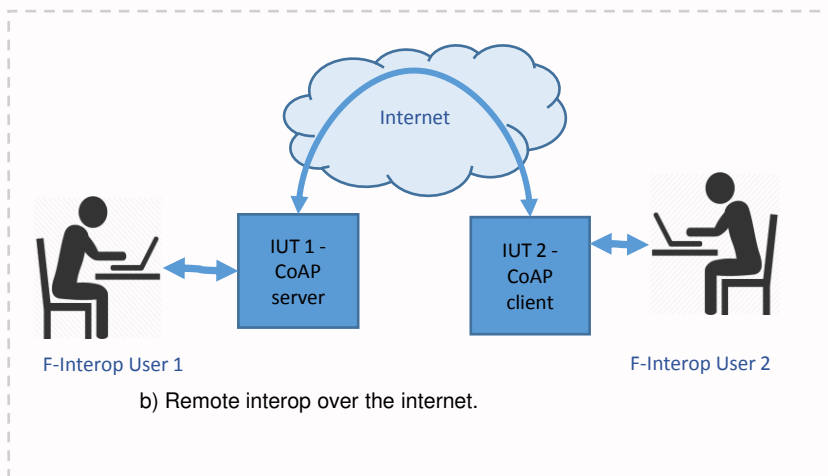
# Gathering requirements



ETSI  
Plugtests  
tests  
specification



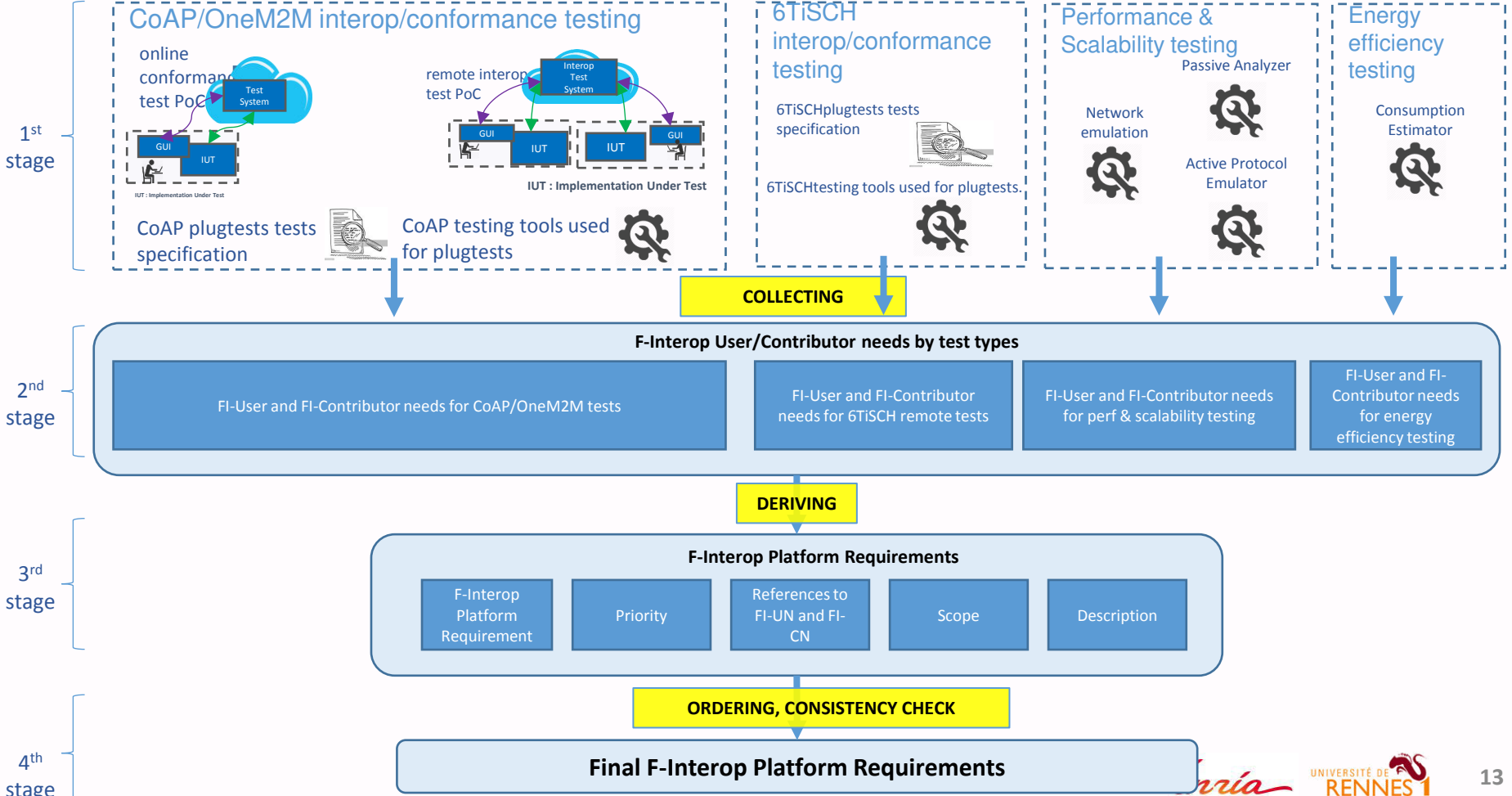
Interoperability  
tests  
best practices  
documents



Testing tools  
used  
during  
plugtests



# Methodology for deriving F-Interop-Platform requirements



# Platform requirements

F-Interop-Platform requirements				
Req. Id	Field/Step	Requirement Scope	Requirement description	Reference FI-UN/FI-CN
FI-PR.05	FI-Session.1	Test suites discovery and selection.	<p>FI-Platform MAY provide networking compatibility and reachability tests adapted to the protocol testing solution and the location model chosen.</p> <p>FI-Platform MAY provide tools for overcoming most common compatibility and reachability problems –e.g. port forwarding via <u>ssh</u> tunneling for UDP-based test suites must be provided if FI-User is running his/her IUT behind a firewall that is filtering UDP traffic-</p>	FI-UN.18, FI-UN.19
FI-PR.06	FI-Session.1	Test suit discovery and selection	FI-Platform SHOULD allow active and passive traffic analysis i.e. the use of Agents and probes installed in the IUT(s).	
FI-PR.07	FI-Session.1	Test suit discovery and selection	FI-Platform SHOULD support different tools to gather network traffic and statistics in real-time.	
FI-PR.08	FI-Session.1	Test suites discovery and selection	FI-Platform MUST provide the user with timeline control to allow the user to set scalability parameters for points in time relative to the beginning of test when using active protocol emulators for scalability tests.	FI-UN.22, FI-UN.23, FI-UN.24

For complete list see <https://www.f-interop.eu/index.php/documents/public-deliverables>



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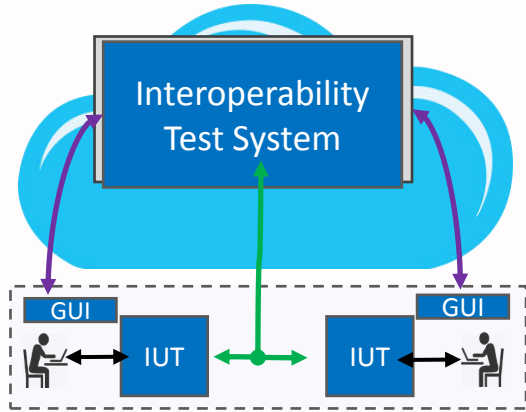


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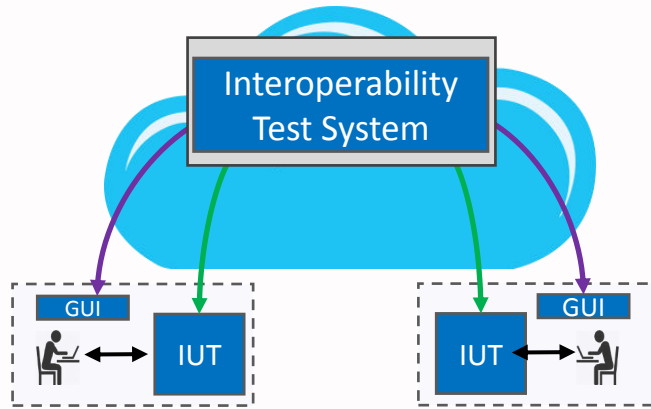
# F-Interop: Location Models and Architecture

# Location models

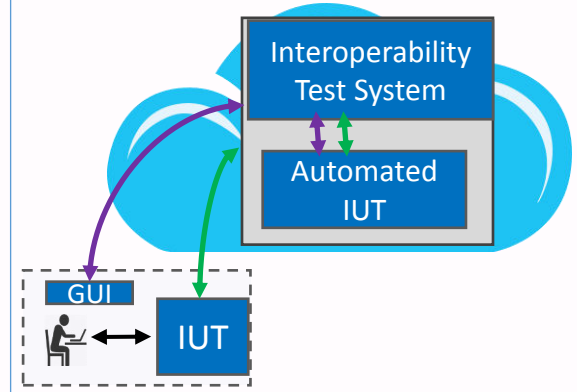
Both IUT and users in same location



Remote user-to-user



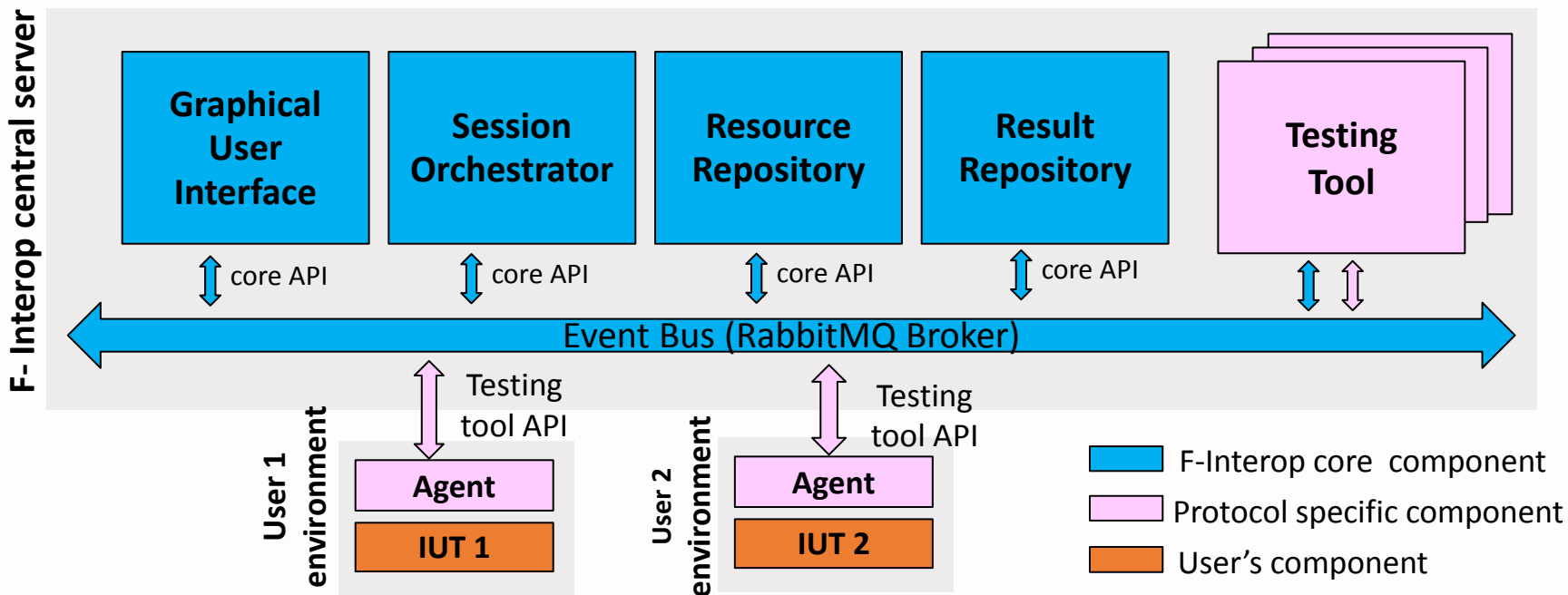
Remote single-user testing against automated IUT (hosted by F-Interop)



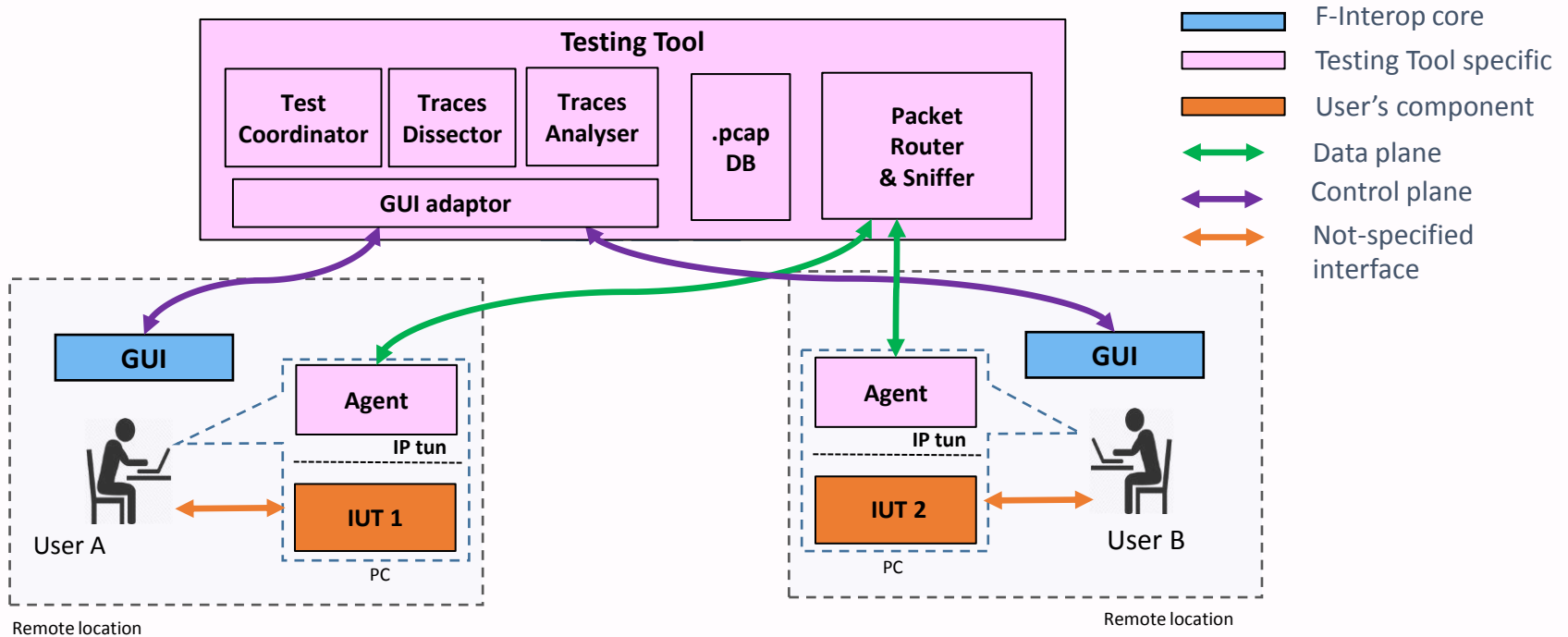
- Data plane
- Control plane
- Unspecified interface

3

# Platform architecture overview



# Testing Tool architecture overview



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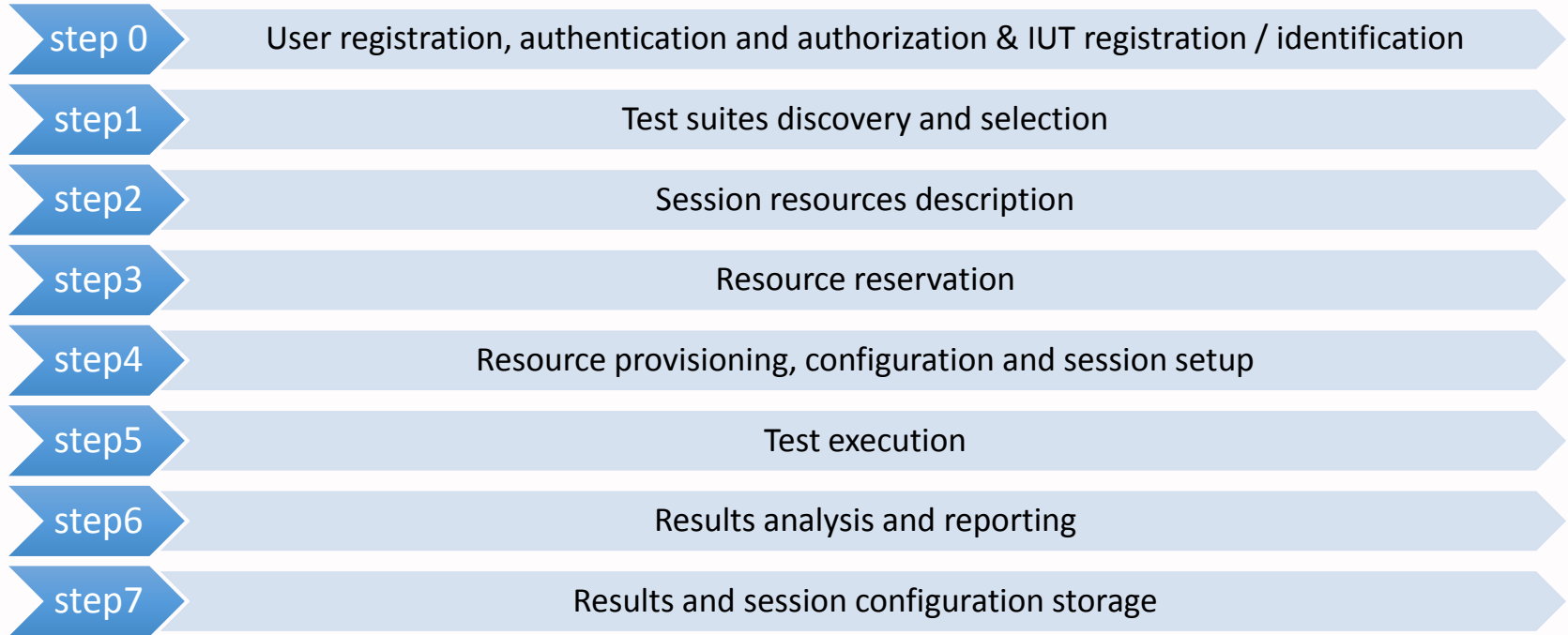


Organizer:



## A F-Interop session

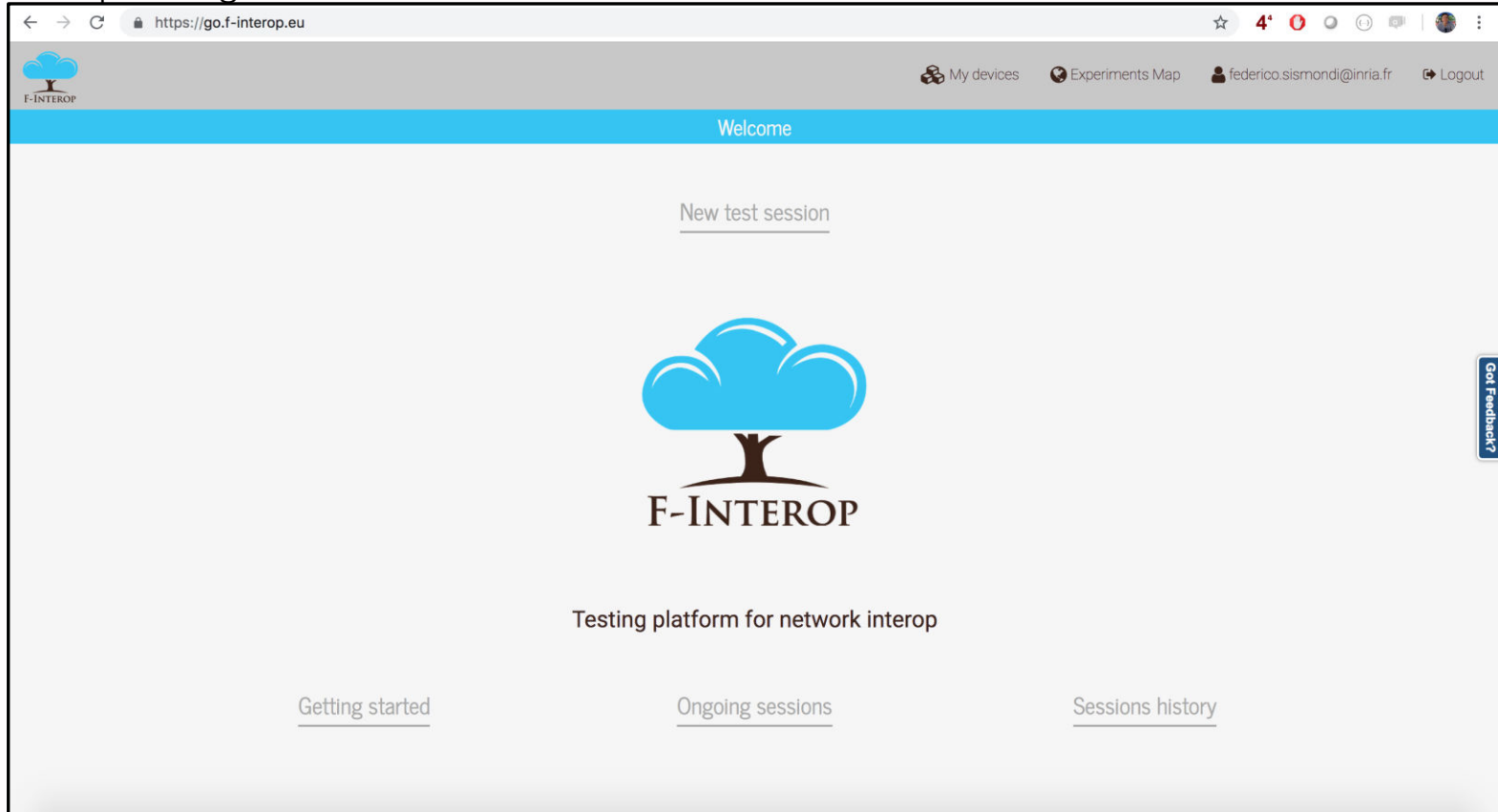
## F-Interop session: Only 8 steps to get your IoT device tested





# The F-Interop platform

go.f-interop.eu – go! check it out!



# The F-Interop session – step 0

User registration, authentication and authorization

Browser address bar: <https://go.f-interop.eu/settings>

Navigation: My devices, Experiments Map, federico.sismondi@inria.fr, Logout

Profile: FEDERICO SISMONDI/

- Profile
- SSH Keys
- Password

Profile picture: FS

Form fields:

- First Name: Federico
- Last Name: Sismondi
- Email: federico.sismondi@inria.fr
- Authority: Authority
- Your Url: Your Url
- Biography: Biography

Update Profile

Vertical button: Get Feedback?

# The F-Interop session – step 1

Test suites discovery and selection

Test suite — Configuration — Start

Select your test suite

Filter by type

Conformance  Interoperability  Performance  Privacy

<input type="checkbox"/> 6TISCH Testing Tool	public	▼
<input type="checkbox"/> 6LoWPAN test suite (single user)	public	▼
<input type="checkbox"/> 6LoWPAN test suite (user to user)	public	▼
<input checked="" type="checkbox"/> CoAP test suite (single user)	public	▼
<input type="checkbox"/> CoAP test suite (user to user)	public	▼
<input type="checkbox"/> CoMI test suite (single user)	public	▼
<input type="checkbox"/> CoMI test suite (user to user)	public	▼

>

# The F-Interop session – step 2

## Test Suite Setup

Testing tool version (optional)

testingtool.version

Test cases selection (optional, all testcases are executed by default)

testsuite.testcases

Automated-IUT selection

Californium CoAP Server

Californium CoAP Server

August Cellars CoAP Server

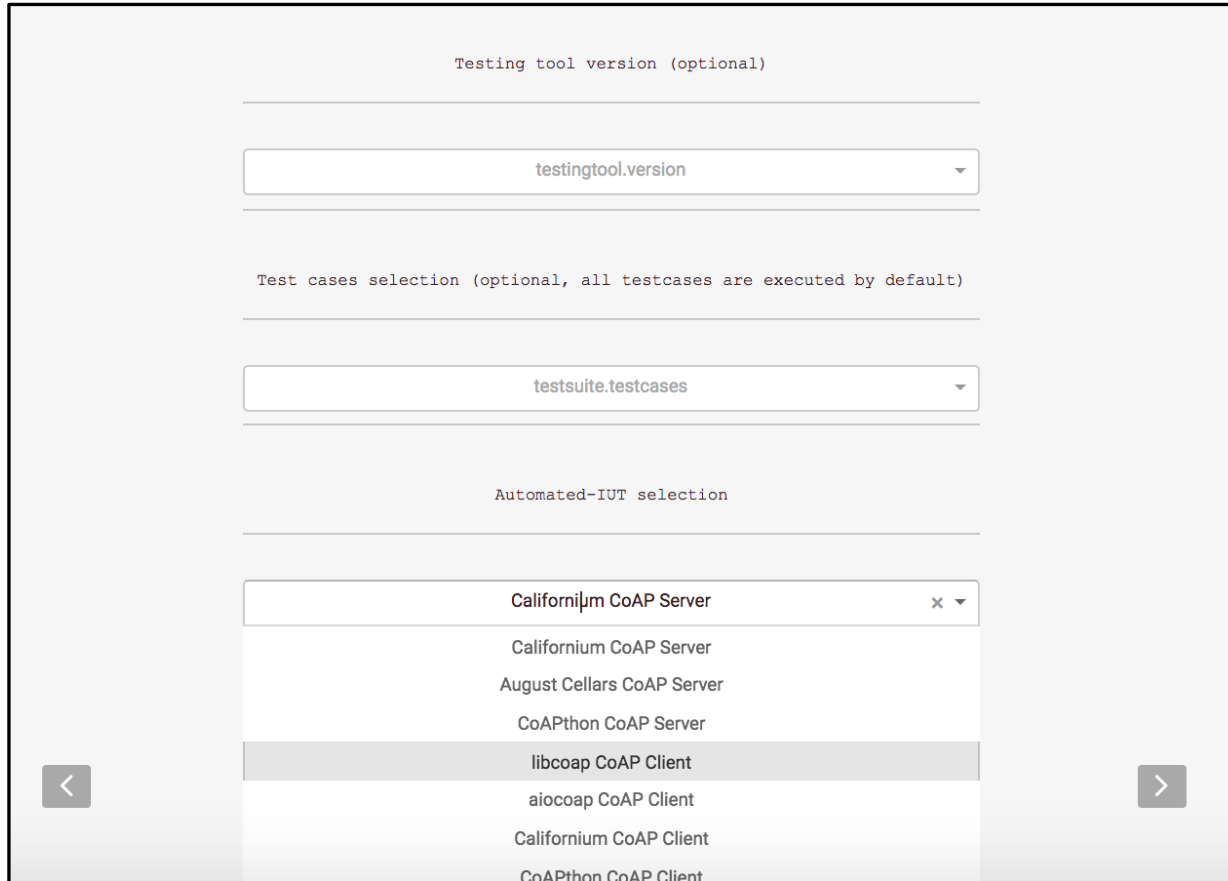
CoAPthon CoAP Server

libcoap CoAP Client

aiocoap CoAP Client

Californium CoAP Client

CoAPthon CoAP Client



# The F-Interop session – step 3 and step4

Resource reservation and resource provisioning

New Session

Test suite — Configuration — Start

```
2018-09-19T09:47:57.272000+00:00 - info - Session created locally
2018-09-19T09:47:57.404422+00:00 - info - Deploying session
2018-09-19T09:47:57.447891+00:00 - info - Created user at Session Orchestrator
2018-09-19T09:47:57.557542+00:00 - info - Created session at Session Orchestrator
2018-09-19T09:47:57.557589+00:00 - info - Session deployed
```

<

✓ session started

# F-Interop session - Step 5

## Test execution (1/3)

https://go.f-interop.eu/sessions/97e2fb49-60bd-4a04-9897-12c05c1329c4

My devices Experiments Map federico.sismondini@inria.fr Logout

### Session

Timeline: session\_setup, agents\_info

Pending action: Confirm to continue [confirm]

Session controls: Started, Reset, Terminate, Info, i Info, websocket, Logs

### Messages

**How does my implementation will reach other implementations?**

For running the tests both implementations need to be reachable, for this we will set up a IP tunnel (ipv6 only) between both implementations under test (IUT). The software component for setting this up is called the agent, it plays a role similar to a VPN client. The following doc will describe how to install and launch the agent. This component will create a tun interface in your PC which allows you to communicate with other implementations, the solution goes more or less like this:

```
graph TD
    subgraph PC_user_1 [PC user 1]
        A1[Agent tun mode]
        C1[IPv6-based communicating piece of software e.g. coap client]
        A1 --- C1
    end
    subgraph PC_user_2 [PC user 2]
        A2[Agent tun mode]
        C2[IPv6-based communicating piece of software e.g. coap sever]
        A2 --- C2
    end
    subgraph Packet_Router [Packet Router]
        R1[r_key_1 & r_key_3]
        R2[r_key_4 & r_key_2]
    end
    A1 --- T1[tun interface] --- R1
    A2 --- T2[tun interface] --- R2
    R1 --- R2
```

AMQP Event Bus

```
r_key_1=fromAgent.agent_1_name.ip.tun.packet.raw
r_key_2=toAgent.agent_1_name.ip.tun.packet.raw
r_key_3=fromAgent.agent_2_name.ip.tun.packet.raw
r_key_4=toAgent.agent_2_name.ip.tun.packet.raw
```

More about the agent component:  
[link to agent README](http://gitlab.f-interop.eu/f-interop-contributors/agent/blob/master/README.md) (http://gitlab.f-interop.eu/f-interop-contributors/agent/blob/master/README.md)



# F-Interop session - Step 5

## Test execution (2/3)

Timeline

- session\_setup
- agents\_info
- agents\_connect
- agents\_test
- packets
- testsuite
- testcase TD\_COAP\_CORE\_01

Pending action

Do you want to start the TEST CASE <TD\_COAP\_CORE\_01>?

tc\_start

tc\_skip

Session

Started

Reset

Terminate

Info

Info

websocket

Logs

Messages

Next test case to be executed

```
-----
| Test Case ID      | TD_COAP_CORE_01
|-----|-----
| Test Case URL     | http://doc.f-interop.eu/tests/TD_COAP_CORE_01
|-----|-----
| Test Case Objective | Perform GET transaction(COAP mode)
|-----|-----
| Configuration ID  | COAP_CFG_01
|-----|-----
| Configuration URL | http://doc.f-interop.eu/tests/CoAP_CFG_01
|-----|-----
| Test Case pre-conditions | - Server offers the resource /test with resource content is not empty that
|                          | handles GET with an arbitrary payload
|-----|-----
| Nodes             | - coap_client
|                  | - coap_server
|-----|-----
| coap_server       | - CoAP servers running service at [hbhbb:2]5683
|                  | - CoAP servers are requested to offer the following resources
|                  |   - /test
|                  |   - Default test resource
|                  |   - Should not exceed 64bytes
|                  |   - /seg1/seg2/seg3
|                  |   - Long path resource
|                  |   - Should not exceed 64bytes
|                  |   - /query
|                  |   - Resource accepting query parameters
|                  |   - Should not exceed 64bytes
|                  |   - /separate
|                  |   - Resource which cannot be served immediately and which cannot be acknowledged
|                  | in a piggy-backed way
|-----|-----
```

# F-Interop session - Step 5

Test execution (3/3)

The screenshot shows the F-INTEROP web interface. At the top, there is a navigation bar with the F-INTEROP logo, user information (federico.sismondi@inria.fr), and a Logout button. Below the navigation bar is a 'Session' header. The main area is divided into three sections: 'Timeline', 'Pending action', and 'Session'. The 'Timeline' section on the left lists various steps: session\_setup, agents\_info, agents\_connect, agents\_test, packets, testsuite, testcase TD\_COAP\_CORE\_01, packets TD\_COAP\_CORE\_01 (highlighted in blue), testcase TD\_COAP\_CORE\_02, packets TD\_COAP\_CORE\_02, and testsuite\_report. The 'Pending action' section in the center displays 'No messages'. The 'Session' section on the right contains control buttons: Started (green), Reset (orange), Terminate (red), Info (black), websocket (green), and Log (black). Below these buttons, the 'Messages' section shows a data packet from 'coap\_client' with hex and ASCII representations. A detailed dissection of the packet is shown below, identifying it as an IPv6 UDP packet with source address bbbb::1 and destination address bbbb::2.

Timeline

- session\_setup
- agents\_info
- agents\_connect
- agents\_test
- packets
- testsuite
- testcase TD\_COAP\_CORE\_01
- packets TD\_COAP\_CORE\_01
- testcase TD\_COAP\_CORE\_02
- packets TD\_COAP\_CORE\_02
- testsuite\_report

Pending action

No messages

Session

Started

Reset

Terminate

Info

websocket

Log

Messages

```
data packet: coap_client -> TESTING TOOL
interface:tun0
60 0e a9 34 00 19 11 40      bb bb 00 00 00 00 00
00 00 00 00 00 00 00 00      01 bb bb 00 00 00 00
00 00 00 00 00 00 00 00      00 02 b6 55 16 33 00
19 13 da 48 01 73 6a 32      61 65 62 64 65 62 62
b4 74 65 73 74
```

Frame:

```
-----
| frame timestamp | 2018-09-19 07:52:39
| frame error     | None
-----
| Dissection      | ###[ IPv6 ]###
| |               | Version=      6
| |               | TrafficClass= 0x00
| |               | FlowLabel=    0xea934
| |               | PayloadLength= 25
| |               | NextHeader=   17 (User Datagram)
| |               | HopLimit=     64
| |               | SourceAddress= bbbb::1
| |               | DestinationAddress= bbbb::2
| |               | Payload=
| |               | ###[ UDP ]###
| |               | SourcePort=   46677
| |               | DestinationPort= 5683
| |               | Length=       25
| |               | Checksum=     0x13da
| |
```

# F-Interop session - Step 6

Analysis of traces, verdicts and reporting (1/2)

The screenshot shows the F-Interop web interface. At the top, there is a navigation bar with the URL `https://go.f-interop.eu/sessions/97e2fb49-60bd-4a04-9897-12c05c1329c4`. Below the navigation bar, the interface is divided into several sections:

- Timeline:** A vertical list of session events including `session_setup`, `agents_info`, `agents_connect`, `agents_test`, `packets`, `testsuite`, `testcase TD_COAP_CORE_01` (highlighted in blue), `packets TD_COAP_CORE_01`, and `testcase TD_COAP_CORE_02`.
- Pending action:** A dialog box asking "Would you like to run again the test case?" with a `restart_testcase` button.
- Session:** A control panel with buttons for `Started`, `Reset`, and `Terminate`. Below these are sections for `Info` (with an `Info` button), `websocket` (with a green heart icon), and `Logs` (with a right arrow icon).
- Messages:** A large text area displaying a verdict report for the test case `TD_COAP_CORE_01`.

The verdict report in the Messages section contains the following information:

```
Verdict on TEST CASE: TD_COAP_CORE_01
-----
| Verdict      | inconclusive |
| Verdict info | premature end of conversation |
| Test case ID | TD_COAP_CORE_01 |
| Test Purpose | Perform GET transaction (CON mode) |
| Test case URL | http://doc.f-interop.eu/tests/TD_COAP_CORE_01 |
-----

Analysis Tool Checks:
-----
| <Frame 3: [bbbb:1 -> bbbb:2] CoAP [CON 29546] GET /test> Match: CoAP(type=0, code=1) |
-----

Step results:
-----
| Step ID      | Partial      | Verdict      | Description |
| TD_COAP_CORE_01_step_02 | | - | - CHECK step: postponed |
| TD_COAP_CORE_01_step_03 | | - | - CHECK step: postponed |
-----
```

# F-Interop session - Step 6

## Analysis of traces, verdicts and reporting (2/2)

**Timeline**

- session\_setup
- agents\_info
- agents\_connect
- agents\_test
- packets
- testsuite
- testcase TD\_COAP\_CORE\_01
- packets TD\_COAP\_CORE\_01
- testcase TD\_COAP\_CORE\_02
- packets TD\_COAP\_CORE\_02
- testsuite\_report

**Pending action**

No messages

**Session**

Started  
Reset  
Terminate  
Info  
websocket  
Logs

**Messages**

**Test suite report**

Testcase ID	Verdict	Description
TD_COAP_CORE_01	inconclusive	premature end of conversation
TD_COAP_CORE_02	inconclusive	Expected CoAP(code=66, mid=0x736e, tok=b"649e0d") from the server but premature end of conversation
TD_COAP_CORE_03	None	Testcase TD_COAP_CORE_03 was skipped.
TD_COAP_CORE_04	None	Testcase TD_COAP_CORE_04 was skipped.
TD_COAP_CORE_05	None	Testcase TD_COAP_CORE_05 was skipped.
TD_COAP_CORE_06	None	Testcase TD_COAP_CORE_06 was skipped.
TD_COAP_CORE_07	None	Testcase TD_COAP_CORE_07 was skipped.
TD_COAP_CORE_08	None	Testcase TD_COAP_CORE_08 was skipped.
TD_COAP_CORE_09	None	Testcase TD_COAP_CORE_09 was skipped.
TD_COAP_CORE_10	None	Testcase TD_COAP_CORE_10 was skipped.
TD_COAP_CORE_11	None	Testcase TD_COAP_CORE_11 was skipped.
TD_COAP_CORE_12	None	Testcase TD_COAP_CORE_12 was skipped.
TD_COAP_CORE_13	None	Testcase TD_COAP_CORE_13 was skipped.
TD_COAP_CORE_14	None	Testcase TD_COAP_CORE_14 was skipped.

# F-Interop session - Step 7

Session results and configuration storage

Sessions

4fb09e12-0451-4f7f-aa07-5e63c745d23a ↓Result

<b>id:</b>	4fb09e12-0451-4f7f-aa07-5e63c745d23a
<b>status:</b>	terminated
<b>event:</b>	092bb585-aca6-486c-8661-6f89f0104682
<b>password:</b>	EZZPM2RV
<b>start_date:</b>	29/08/2018 16:19
<b>testSuiteType:</b>	interoperability
<b>amqp_url:</b>	amqp://7B0WK0VB:EZZPM2RV@mq.dev.f-interop.eu:443/4fb09e12-0451-4f7f-aa07-5e63c745d23a
<b>login:</b>	7B0WK0VB
<b>users:</b>	federico_sismondiojxu, myslice
<b>end_date:</b>	
<b>testSuite:</b>	http://orchestrator.dev.f-interop.eu:8181/tests/f-interop/interoperability-coap-single-user
<b>slice_id:</b>	urn:publicid:IDN+finterop:project1+slice+testing

55a63a9d-98dd-4973-9101-c18fafb9c730 ↓Result

<b>id:</b>	55a63a9d-98dd-4973-9101-c18fafb9c730
<b>status:</b>	terminated
<b>password:</b>	DF34VT04
<b>start_date:</b>	29/08/2018 11:58
<b>testSuiteType:</b>	interoperability
<b>amqp_url:</b>	amqp://OR5X7Z5P:DF34VT04@mq.dev.f-interop.eu:443/55a63a9d-98dd-4973-9101-c18fafb9c730
<b>login:</b>	OR5X7Z5P
<b>users:</b>	federico_sismondiojxu, myslice

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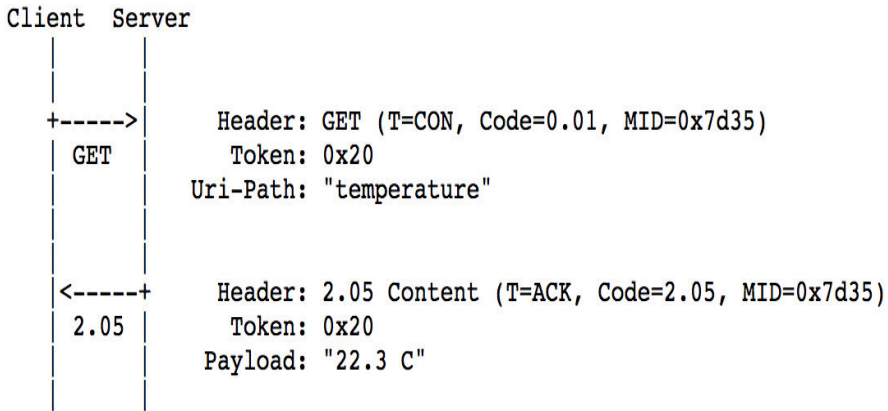
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# F-Interop: interoperability testing in practice

# CoAP protocol use case

- What's CoAP?
  - IETF standard for the IoT, with a web approach
  - client-server communications
  - ~ HTTP for IoT but enabling asynchronous transactions
- Testing CoAP interoperability, what do we need?
  - Two implementations, a client and a server
  - Test specification
  - Test Setup
  - Demo using F-Interop (video)

## CoAP defines request-response exchange pattern



Sources:

<https://tools.ietf.org/html/rfc7252#page-104>

<https://tools.ietf.org/html/rfc7641#page-24>

## Also enables SUSSCRIPTION to states

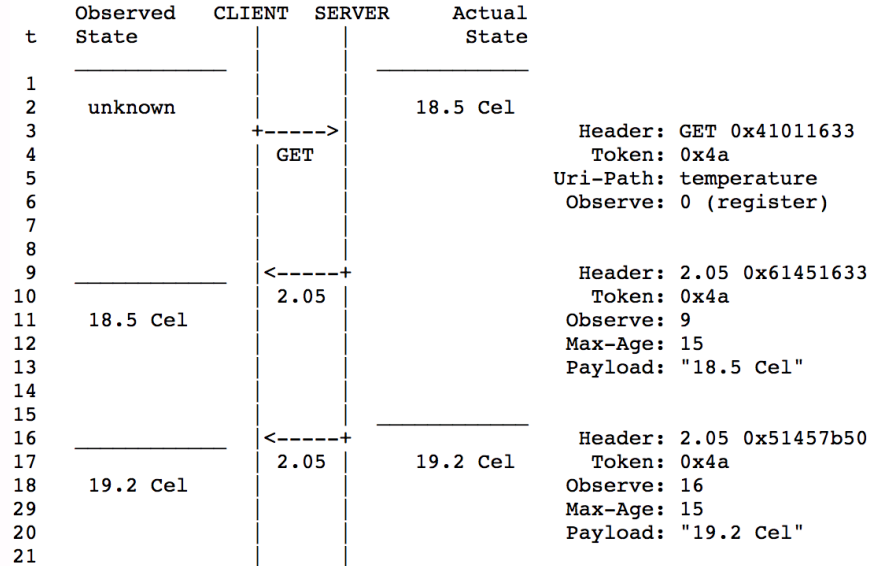
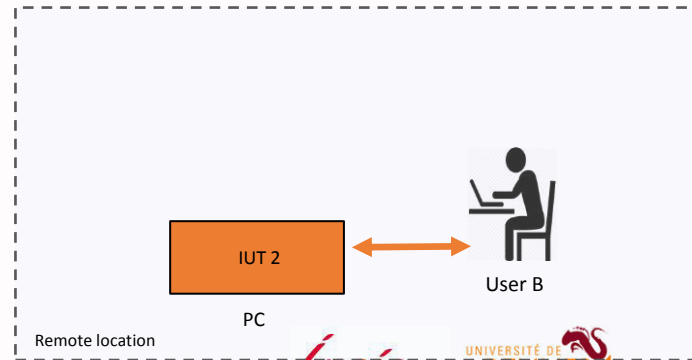
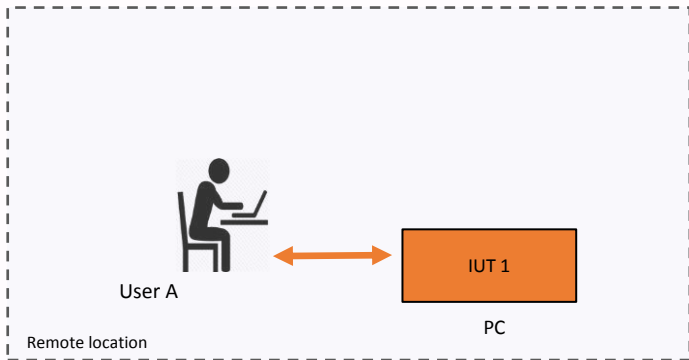
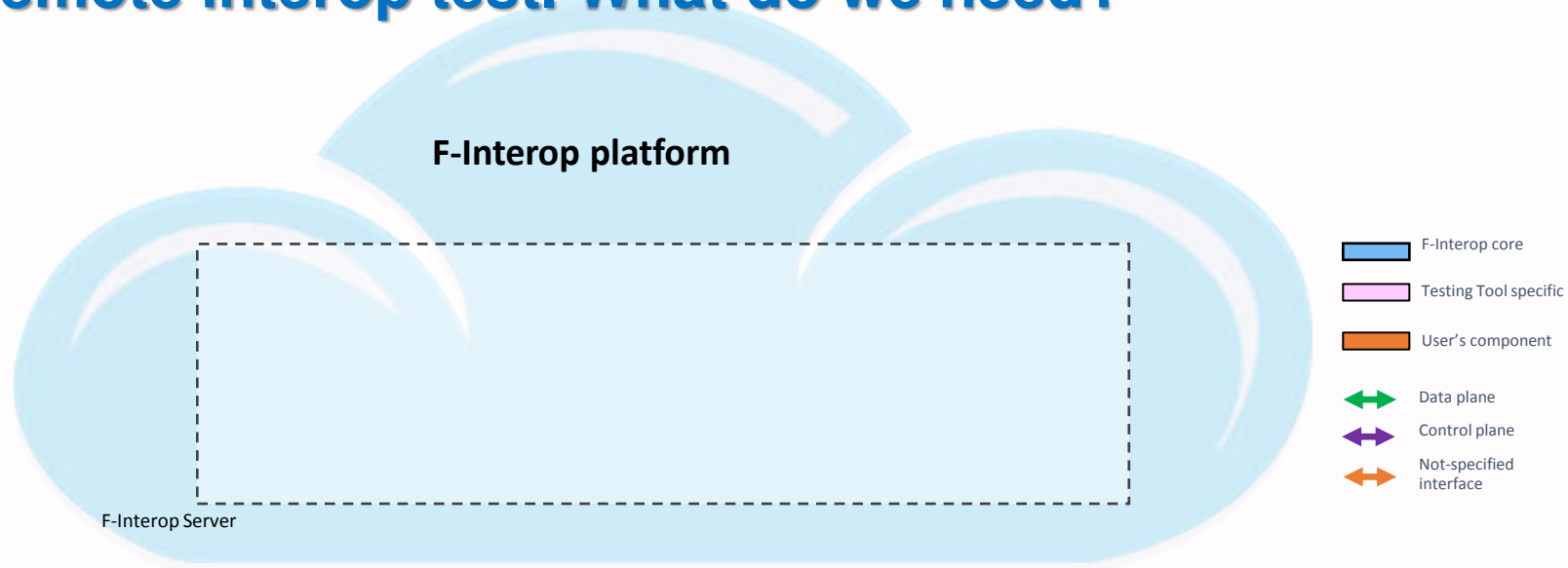


Figure 3: A Client Registers and Receives One Notification of the Current State and One of a New State upon a State Change



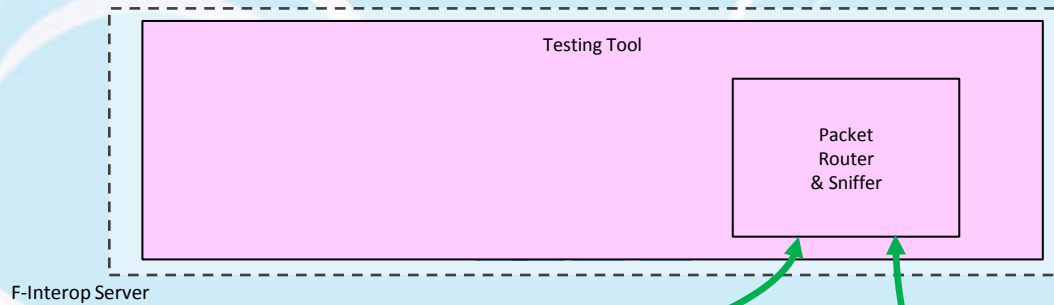
# CoAP remote interop test. What do we need?









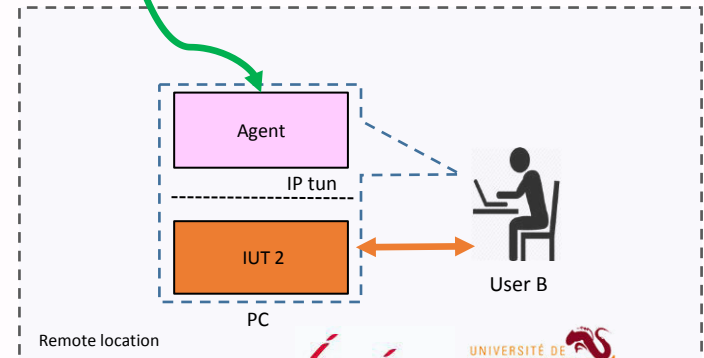
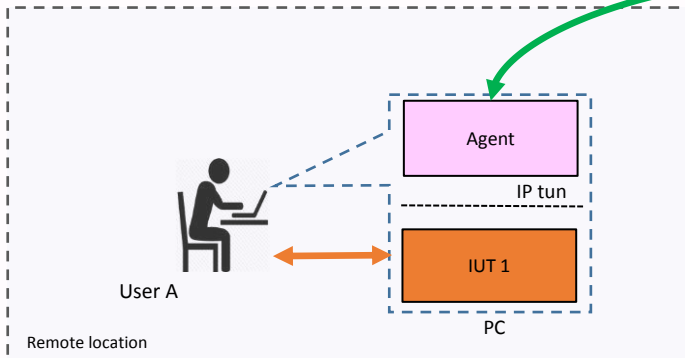
# CoAP remote interop test.

Tunneling  
Packet sniffing

## F-Interop platform



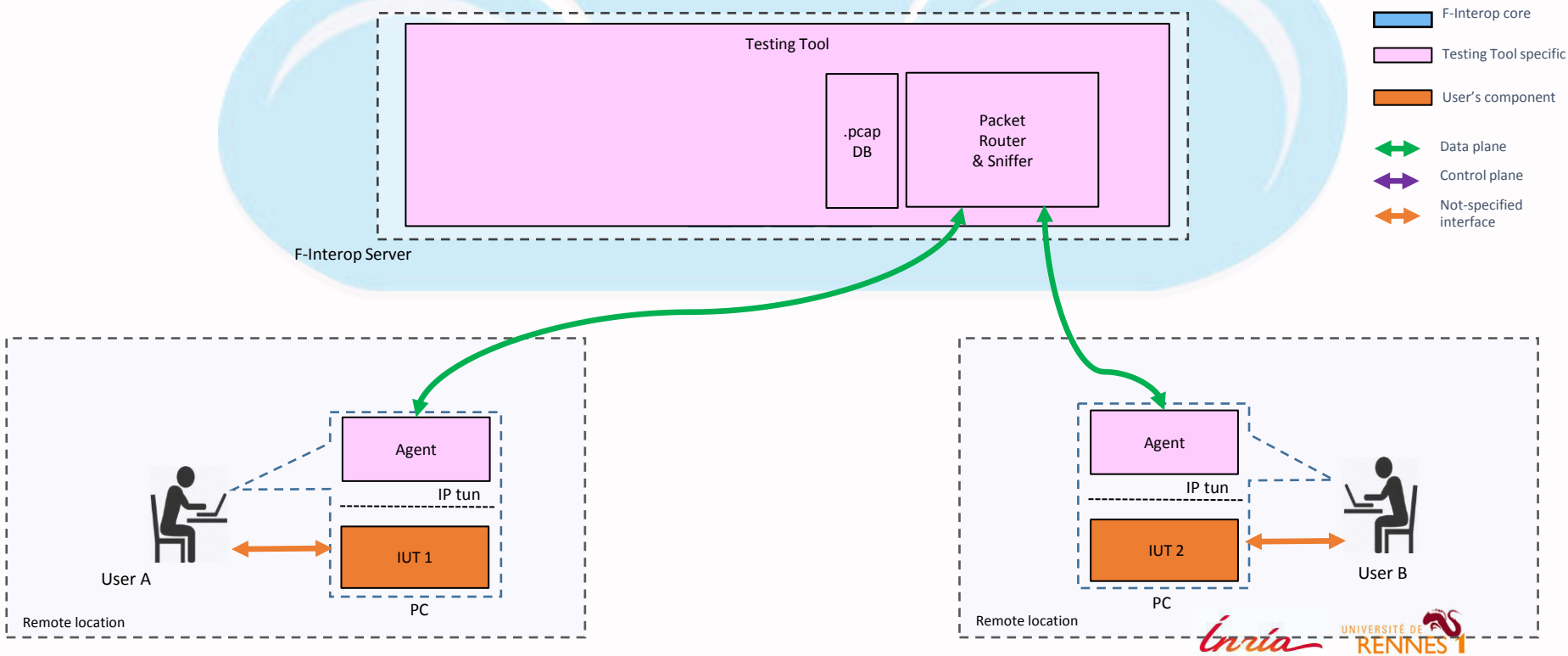
-  F-Interop core
-  Testing Tool specific
-  User's component
-  Data plane
-  Control plane
-  Not-specified interface



# CoAP remote interop test.

Tunneling  
Packet sniffing  
Network traces logging

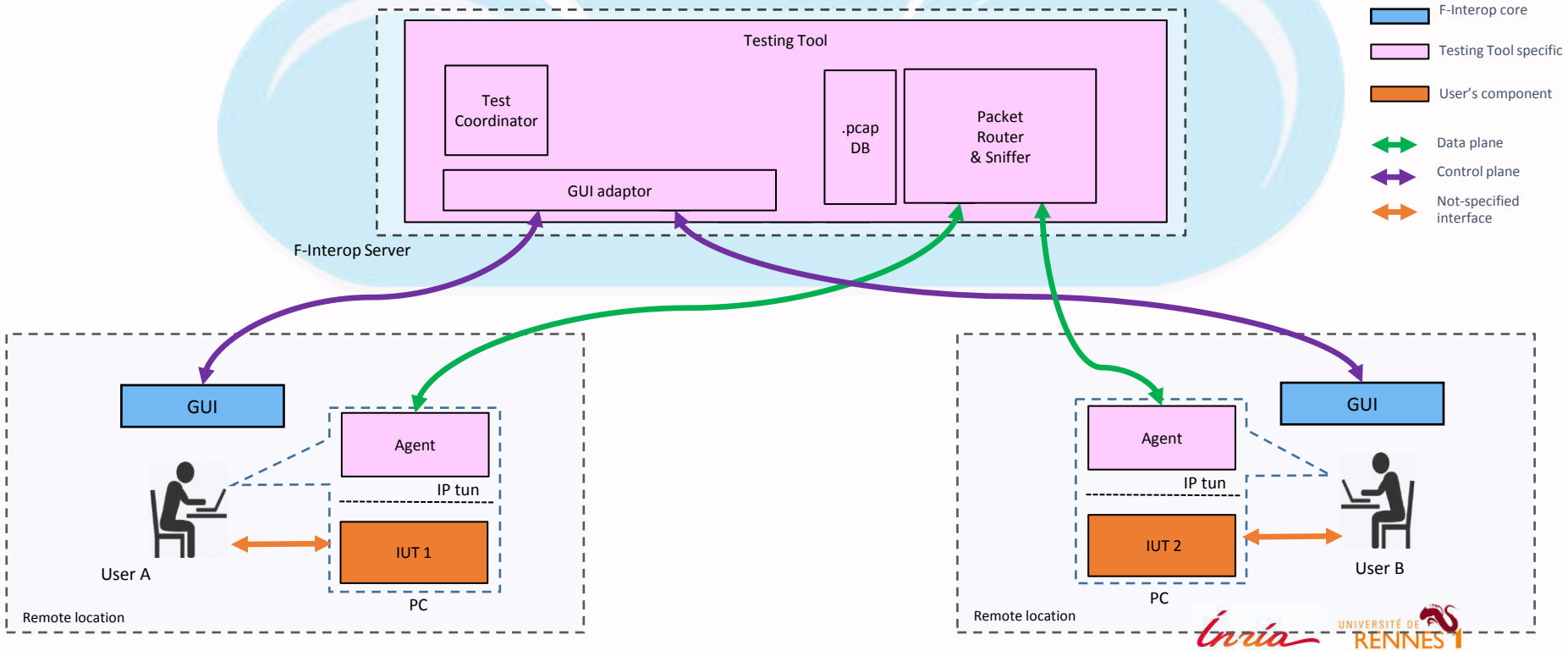
## F-Interop platform



# CoAP remote interop test.

Tunneling  
Packet sniffing  
Network traces logging  
Test coordination

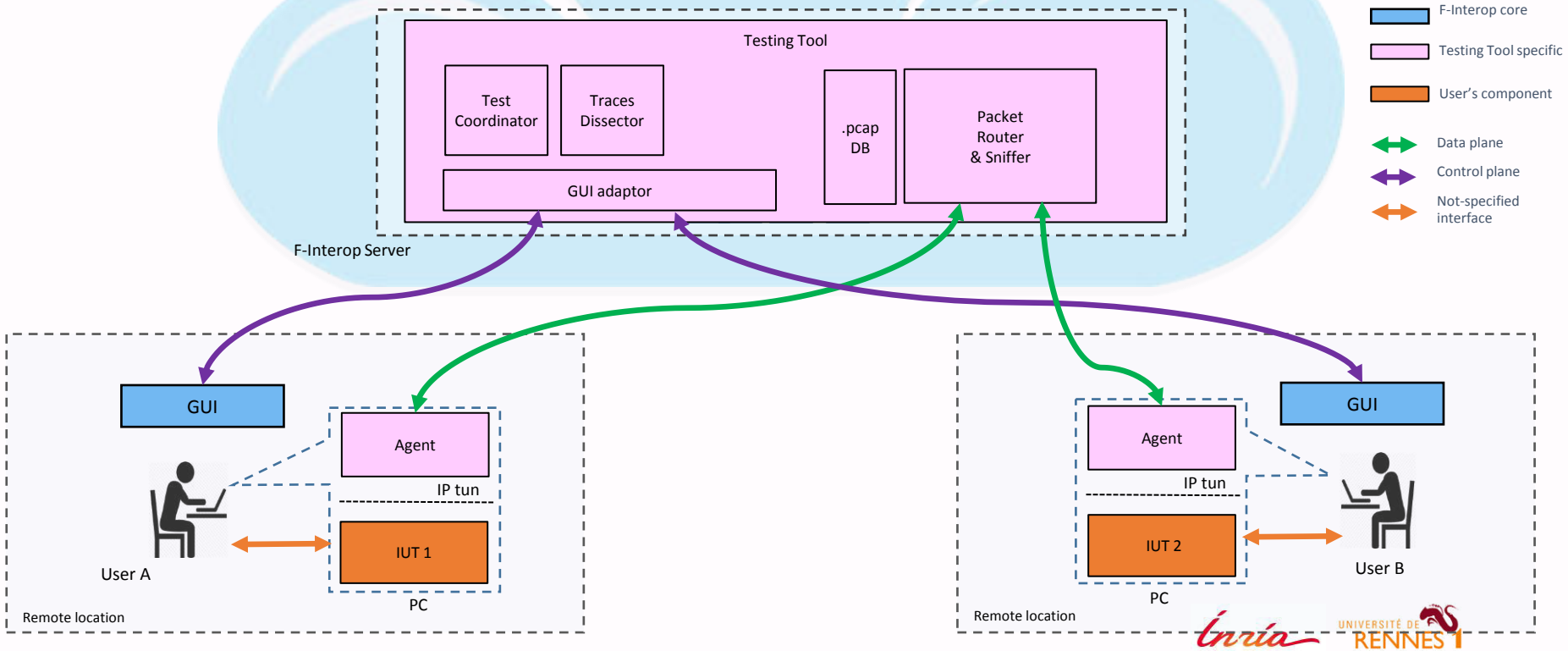
## F-Interop platform



# CoAP remote interop test.

Tunneling  
Packet sniffing  
Network traces logging  
Test coordination  
Network traces dissection

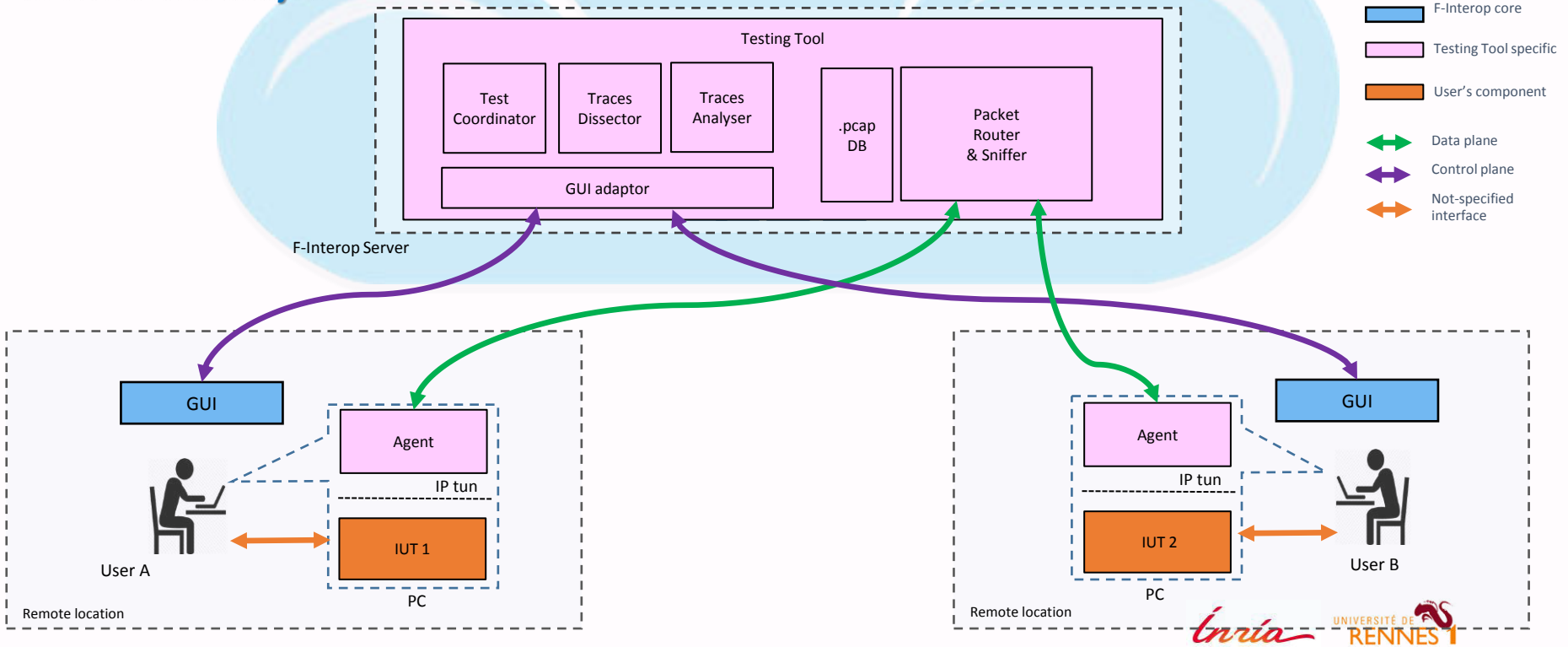
## F-Interop platform



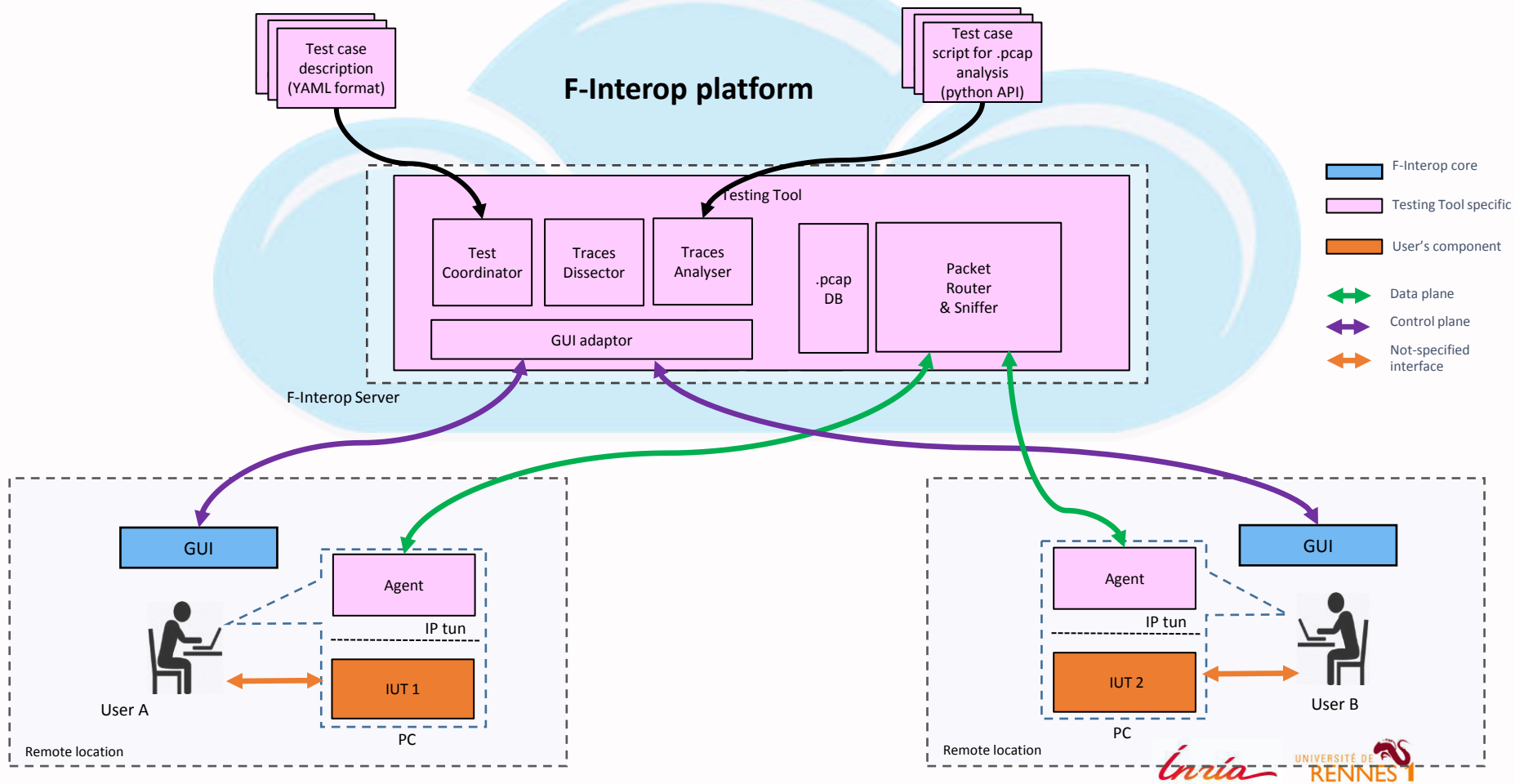
# CoAP remote interop test.

- Tunneling
- Packet sniffing
- Network traces logging
- Test coordination
- Network traces dissection
- Network traces analysis

## F-Interop platform



# How do we add new tests?



# Under the Hood: What's a test?

## 1. Test description in human and machine language

```
--- !testcase
testcase_id: TD_COAP_CORE_01_v01
uri : http://f-interop.paris.inria.fr/tests/TD_COAP_CORE_01_v01
configuration: CoAP_configuration_BASIC
objective: Perform GET transaction(CON mode)
pre_conditions: Server offers the resource /test with resource content is not empty that handles GET with an arbitrary payload
references: '[COAP] 5.8.1, 1.2, 2.1, 2.2, 3.1'
sequence:
- step_id: 'TD_COAP_CORE_01_v01_step_01'
  type: stimuli
  iut : coap_client
  description:
  - Client is requested to send a GET request with
  - Type = 0(CON)
  - Code = 1(GET)
- step_id: TD_COAP_CORE_01_v01_step_02
  type: check
  description:
  - The request sent by the client contains
  - Type=0 and Code=1
  - Client-generated Message ID(\u2794 CMID)
  - Client-generated Token(\u2794 CTOK)
  - Uri-Path option "test"
- step_id: TD_COAP_CORE_01_v01_step_03
  type: check
  description:
  - Server sends response containing
  - Code = 2.05(Content)
  - Message ID = CMID, Token = CTOK
  - Content-format option
  - Non-empty Payload
- step_id: TD_COAP_CORE_01_v01_step_04
  type: verify
  iut: coap_client
  description:
  - Client displays the received information
```

STIMULI either executed manually by USER  
Or by a automated IUT

CHECK executed automatically by Analyzer on the exchanged traces  
(automatically issue verdicts!)

VERIFY executed manually by user! (User sends verify response using GUI)



# Under the Hood: What's a test?

## 2. Test analysis scripts for CHECK for conformance and interoperability errors

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

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

class TD_COAP_CORE_01 (CoAPTestcase):

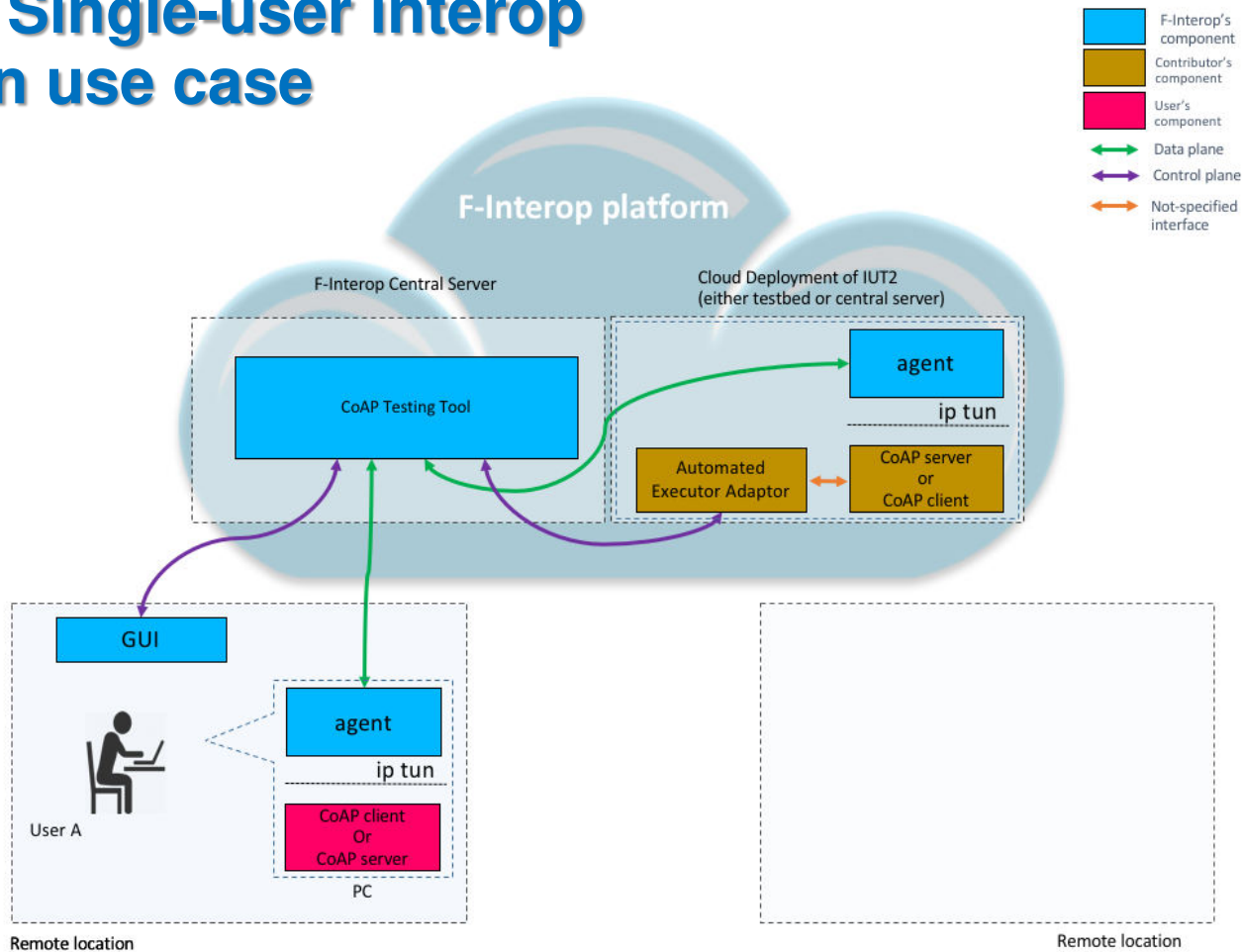
    def run (self):

        # 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")
```

# Demo: Single-user interop session use case





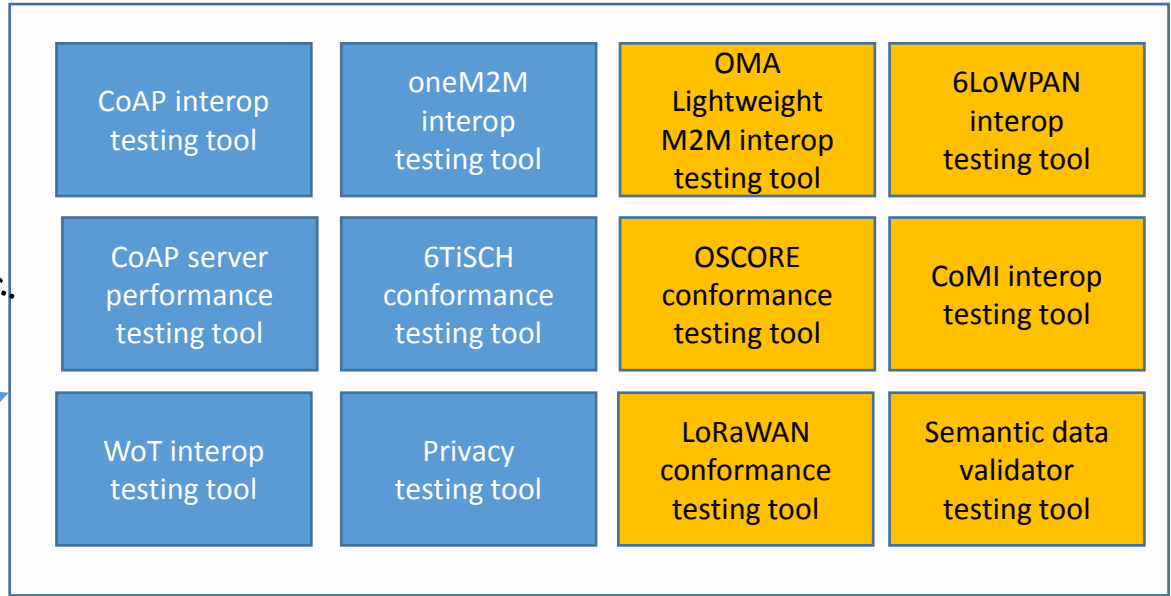
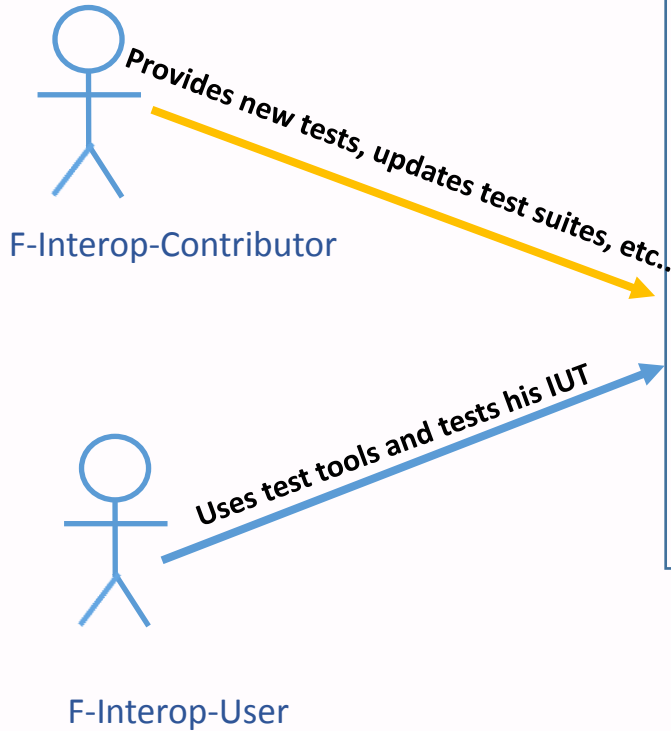
( 10 mins approx.)

Paris, 16-18 October 2018



Organizer:  TESTING  
SOLUTIONS  
& SERVICES

## F-Interop: current status



F-Interop-Platform

- Developed by F-Interop
- Developed by F-Interop contributor

## F-Interop's face-to-face and remote interoperability test events:

- 14-15 July 2017: ETSI #1 F-Interop 6TiSCH Interoperability Event, Prague (CZ), Inria-UR1
- 26-27 June 2018: ETSI #2 F-Interop 6TiSCH Interoperability Event, Paris : Inria –UR1
- October 2018: F-Interop CoAP Interoperability Event, Full remote, To be organized by Kereval & Inria-UR1



Paris, 16-18 October 2018



Organizer:  TESTING  
SOLUTIONS  
& SERVICES

# F-Interop: Achievements and next steps



## Achievements and next step

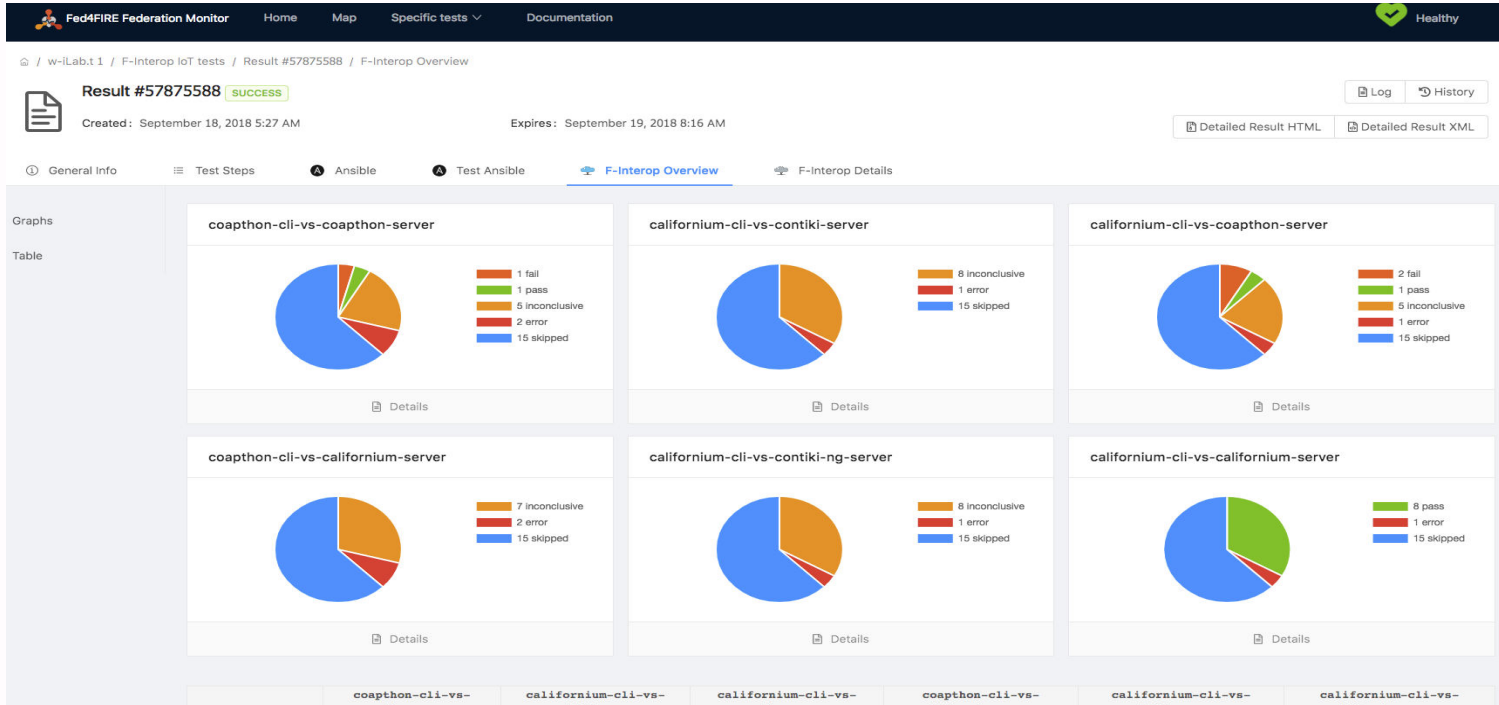
- F-Interop project is officially ending in November 2018
- **F-Interop platform answers to the predefined needs**
  - Platform enables full remote & online interop test execution
  - Tests IoT implementations from companies' premises
  - Feedbacks to standardization process
  - Shortens time-to-market for IoT implementations
- **Future of the F-Interop platform**
  - Remote online ETSI's plugtests events?
  - labelling/certification for IoT protocols?
  - Continuous interoperability testing! Already in the pipes!



# Continuous interoperability testing

- Not a just idea, we have running code!!
- Check out <https://fedmon.fed4fire.eu/> -> F-Interop IoT tests

# Continuous interoperability testing



# Continuous interoperability testing

## Test californium-cli-vs-contiki-server

TD\_COAP\_CORE\_01 inconclusive

**Description:** premature end of conversation

**Partial verdicts:**  
TD\_COAP\_CORE\_01\_step\_02 skipped  
CHECK step: postponed

TD\_COAP\_CORE\_01\_step\_03 skipped  
CHECK step: postponed

TD\_COAP\_CORE\_01\_step\_04 pass  
VERIFY step: User informed that the information was displayed correctly on his/her IUT

tat\_check\_1 pass  
<Frame 3: [bbbb::1 -> bbbb::2] CoAP [CON 19410] GET /test>  
Match: CoAP(type=0, code=1)

tat\_check\_2 inconclusive  
premature end of conversation

TD\_COAP\_CORE\_02 inconclusive

**Description:** Expected CoAP(code=66, mid=0x9abf, tok=b'Y\x04\xe6\x10\xb8\x90\xe9\x15') from the server but premature end of conversation

**Partial verdicts:**  
TD\_COAP\_CORE\_02\_step\_02 skipped  
CHECK step: postponed

TD\_COAP\_CORE\_02\_step\_03 skipped  
CHECK step: postponed

TD\_COAP\_CORE\_02\_step\_04 pass  
VERIFY step: User informed that the information was displayed correctly on his/her IUT

tat\_check\_1 pass  
<Frame 4: [bbbb::1 -> bbbb::2] CoAP [CON 39615] DELETE /test>  
Match: CoAP(type=0, code=4)

tat\_check\_2 inconclusive  
premature end of conversation

tat\_check\_3 inconclusive  
Expected CoAP(code=66, mid=0x9abf, tok=b'Y\x04\xe6\x10\xb8\x90\xe9\x15') from the server but premature end of conversation

TD\_COAP\_CORE\_03 inconclusive

**Description:** Expected CoAP(code=Any(65,68), mid=0x908b, tok=b'\xed\x1cM\xaf\xd5a\xca') from the server but premature end of conversation

**Partial verdicts:**  
TD\_COAP\_CORE\_03\_step\_02 skipped  
CHECK step: postponed

TD\_COAP\_CORE\_03\_step\_03 pass  
VERIFY step: User informed that the information was displayed correctly on his/her IUT

TD\_COAP\_CORE\_03\_step\_04 skipped  
CHECK step: postponed

TD\_COAP\_CORE\_03\_step\_05 pass  
VERIFY step: User informed that the information was displayed correctly on his/her IUT

tat\_check\_1 pass  
<Frame 4: [bbbb::1 -> bbbb::2] CoAP [CON 37003] PUT /test>  
Match: CoAP(type=0, code=3)

tat\_check\_2 pass  
<Frame 4: [bbbb::1 -> bbbb::2] CoAP [CON 37003] PUT /test>  
Match: CoAP(opt=Opt(CoAPOptionContentFormat()))

tat\_check\_3 inconclusive  
premature end of conversation

tat\_check\_4 inconclusive  
Expected CoAP(code=Any(65,68), mid=0x908b, tok=b'\xed\x1cM\xaf\xd5a\xca') from the server but premature end of conversation

# Thank you



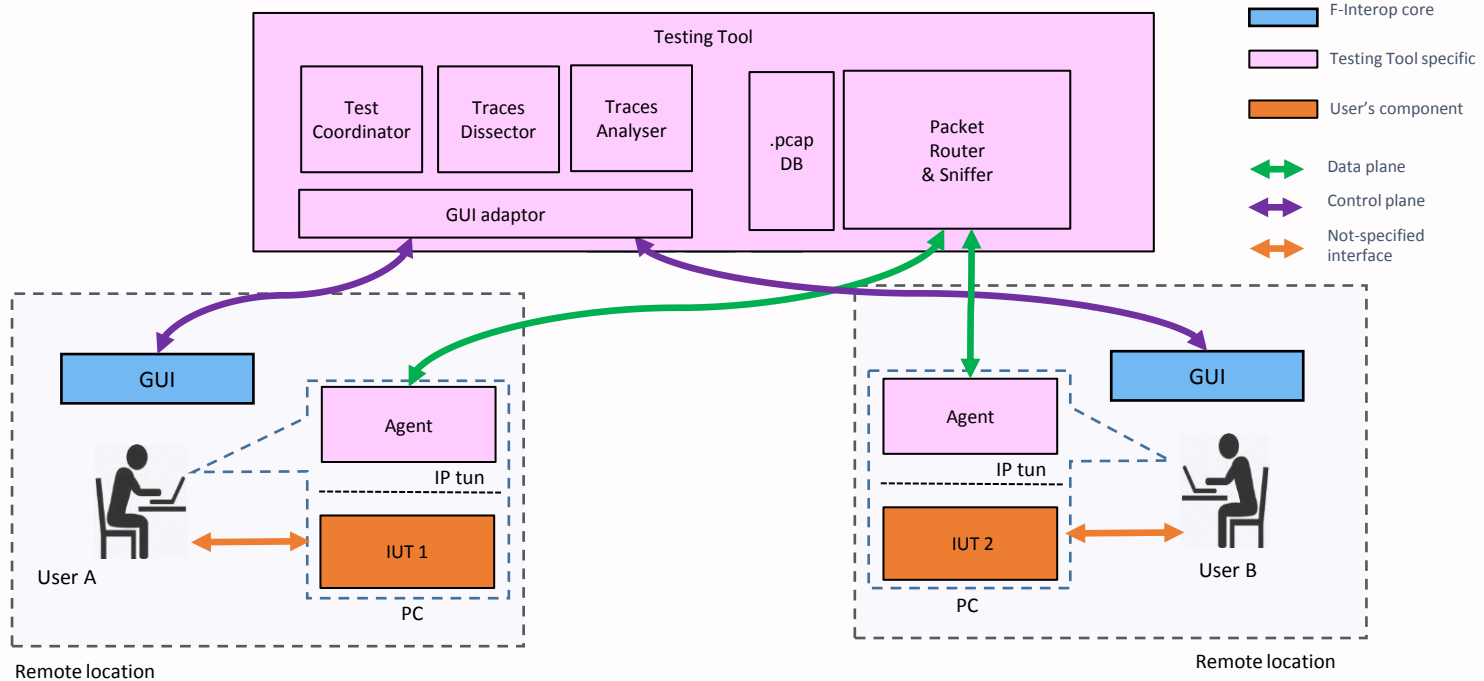
Contacts:

[federico.sismondi@irisa.fr](mailto:federico.sismondi@irisa.fr) ; [cesar.viho@irisa.fr](mailto:cesar.viho@irisa.fr)

# F-Interop's interoperability testing tools

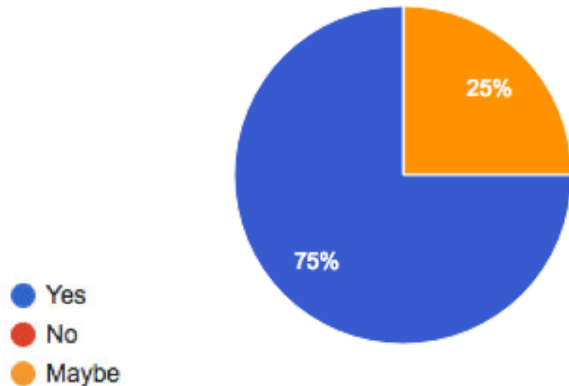
- “The purpose of interoperability testing is to prove that end-to-end functionality between (at least) two communicating systems is as required by the standard(s) on which those systems are based.” (ETSI)
- testing tools create an environment which will help the user(s) executing **online and remote standard-based interoperability tests**
- communication “tunneling” between IUTs (a VPN-like setup)
  - controlled environment
  - bypass UDP-blocking firewalls and other middle boxes
- coordinating the interop test
  - dispatches commands to users (through GUI) based on test descriptions
  - e.g. 'user1: CoAP Client is requested to send a GET request with...'
- sniffing the traffic
  - generate PCAP files records
  - Users can download PCAP files at the end of test session.
- dissecting the messages
  - include wireshark-like view of the exchanges between implementations
  - help users find problems in the messages exchanged by the implementations
- analyzing the traffic exchanged
  - automatically issue PASS/FAIL/INCONCLUSIVE verdicts based on the test description

# Testing Tool architecture overview:



# DEMAND: Survey Results – Remote vs. Face-2-face

Do you think your organization will participate more in testing services when provided remotely?



REMOTE / ONLINE TESTING	
+	-
Cost effective	Privacy & Confidentiality
Flexibility on location/ no need to travel	Reliability & Quality of testing
Flexibility on time, availability	Security
Faster, repeatability	No meeting with community, no exchange of knowledge
Faster standards development	Complexity: remote interconnection
Easier organization	Instructions
	No clear verdict from platform?