

ANGEL An Agile IoT Interoperability Platform



GOALS

Making IoT data interoperable, homogeneous, ready for exploitation!

- Assess the effectiveness of using on top of an SDN domain, a Deep Packet Inspection (vDPI) function combined with virtual functions that map IoT protocols to UDP in order to provide an agile platform for IoT interoperability
- Design and develop an SDN-app that provides an agile logic in the automatic provision of IoT interoperability on top of IoT nodes/sensors, based on the automatic sensing of the IoT protocols by the vDPI and mapping of each IoT data flow to UDP data protocol
- Abstract, via the INFOLYSiS interoperable IoT vGW, the IoT sensors' control plane by exploiting the deployed and instantiated mapping VNFs on top of the OFELIA/i2cat island for achieving IoT interoperability

CHALLENGES

- The IoT interoperability challenge within the framework of 5G using SDN/NFV technologies
- Dealing efficiently and cost-effectively with a mix of IoT streams such as MQTT, CoAP or HTTP IoT protocol data, which a typical IoT GateWay (GW) cannot handle
- Achieving smooth integration of the IoT devices and their services into one networked system under a single data protocol
- Lack of an agile infrastructure, leading to a simpler configuration of the network, which is suitable for IoT interoperability goals
- Ensure operational efficiency and no data loss via the use of SDN/NFV and vDPI technologies for offering IoT Interoperable data

DEMO SETUP





ANGEL experiment successfully met and documented the following results:

- □ Automatic sensing by the vDPI of CoAP, MQTT, HTTP IoT protocols
- □ Success rate >95% in the SDN-based traffic steering to mapping VNFs
- □ Mapping of each IoT data flow to UDP data protocol with zero packet loss
- Successful self-organization of the ANGEL platform for the 4 different protocol combinations (CoAP-MQTT, CoAP-HTTP, MQTT-HTTP, CoAP-MQTT-HTTP)
- Design and development of an SDN-app suitable for providing an automatic way of IoT interoperability for 3 different data protocols
- Provision of SDN-app capable of adapting on the fly, once new IoT data flows have been detected with a delay <2 sec</p>
- Successful service chaining of each mapping function and the vDPI of the ANGEL platform for the 4 different protocol combinations.

MORE RESULTS

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Fig. 1: vDPI detection of CoAP, MQTT & HTTP

#	Interface	RX Rate	RX	#	TX Rate	ТХ	#
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1	eth0	177.00B		3	673.00B		0
2	eth1	330.00B		3	278.00B		2
3	eth2	0.00B		0	0.00B		0
4	eth1.3142	255.00B		3	278.00B		2
5	eth2.3142	0.00B		0	0.00B		0
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Fig. 4: HTTP mapping

*]	Received	UDP	data:	t586:0:COAP:illuminance
*]	Received	UDP	data:	f3155:46:HTTP:temperatureambient
*]	Received	UDP	data:	f3070:200:HTTP:temperatureambient
*]	Received	UDP	data:	f3001:17.9:HTTP:temperatureambient
*]	Received	UDP	data:	f3042:20.5:HTTP:temperatureambient
*]	Received	UDP	data:	f3041:200:HTTP:temperatureambient
*]	Received	UDP	data:	f3155:13:MQTT:relativehumidity
*]	Received	UDP	data:	f3042:51:MQTT:relativehumidity
*]	Received	UDP	data:	f3001:39:MQTT:relativehumidity
*]	Received	UDP	data:	f3041:200:MQTT:relativehumidity
*]	Received	UDP	data:	f3070:200:MQTT:relativehumidity
*]	Received	UDP	data:	f3022:20:HTTP:temperatureambient
*]	Received	UDP	data:	f3006:17.7:HTTP:temperatureambient
*]	Received	UDP	data:	f3011:19:HTTP:temperatureambient
*]	Received	UDP	data:	t3248:0:HTTP:rainfall
*]	Received	UDP	data:	f3011:56:MQTT:relativehumidity
*]	Received	UDP	data:	t3248:-39.7:HTTP:temperatureambient
*]	Received	UDP	data:	f3006:58:MQTT:relativehumidity
*]	Received	UDP	data:	f3022:50:MQTT:relativehumidity
*]	Received	UDP	data:	t3248:0:COAP:windspeed
*]	Received	UDP	data:	t358:20.06:HTTP:temperatureambient
*]	Received	UDP	data:	t358:0:COAP:illuminance
*]	Received	UDP	data:	f3077:19.1:HTTP:temperatureambient
*]	Received	UDP	data:	t3248:1008.18:MQTT:atmosphericpressure
*]	Received	UDP	data:	t3248:-2.08:MQTT:relativehumidity
*]	Received	UDP	data:	t373:17.22:HTTP:temperatureambient

Fig. 2: Interoperable UDP-based IoT data

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e	th1	. 314	12						13	7.0	ØB					2	2		12	3.0	ØB					2
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Fig. 5: CoAP mapping



Fig. 3: INFOLYSiS Dashboard: Real-time experimental VNFs topology

**	Interface	RX Rate	RX #	TX Rate	TX #
QTT	MapMarch (source: l	ocal)			
0	lo	221.00B	3	221.00B	3
1	eth0	136.00B	3	594.00B	1
2	eth1	758.00B	11	872.00B	12
3	eth2	0.00B	0	0.00B	0
4	eth1.3142	758.00B	11	872.00B	12
5	eth2.3142	0.00B	0	0.00B	0
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Fig. 6: MQTT mapping

CONCLUSIONS

FEEDBACK TO Fed4FIRE+

- ANGEL experiment highlighted the opportunity of IoT interoperability provision by the forthcoming 5G networks
- □ Researched IoT interoperability through the agility provided by SDN, NFV and DPI,
- Demonstrated the intelligence to analyze and handle heterogeneous IoT data flows in real-time
- Combined the agility of vDPI function with the flexibility of mapping protocol functions - VNFs (i.e. CoAP, MQTT, HTTP to generic UDP data traffic)
- Complete and operational OpenFlow/Cloud testbed for experimenters
- Diversity of available resources based on each experimenter's requirements
- Out-of-the-box interoperability of different testbeds
- Easy setup and execution of the experiments
- Concise and comprehensive documentation
- □ High responsiveness of the Fed4FIRE+ team to any problem or issue raised