



# Review OC4 experiments “ANGEL”

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LYSiS**

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FED4FIRE+ FEC6

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# ANGEL Experiment Description

## CONCEPT AND OBJECTIVES

- ❑ Assess the effectiveness of using on top of an SDN domain, a 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

# ANGEL Experiment Description

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## BACKGROUND AND MOTIVATION

- INFOLYSiS is an innovative SME company, established in Athens, Greece, specialising on the design and development of chatbots apps over messaging platforms such as Viber and Messenger
- The motivation for this experiment is the observation that INFOLYSiS has made during the deployment of chatbot apps for controlling smart home devices in the Greek market, about the plethora of the different IoT devices, operating under different IoT protocols and producing heterogeneous data, along with the lack of a software-based IoT gateway for offering integration and auto-detection for ensuring interoperability between different types of objects and physical IoT technologies

# ANGEL Experiment Description

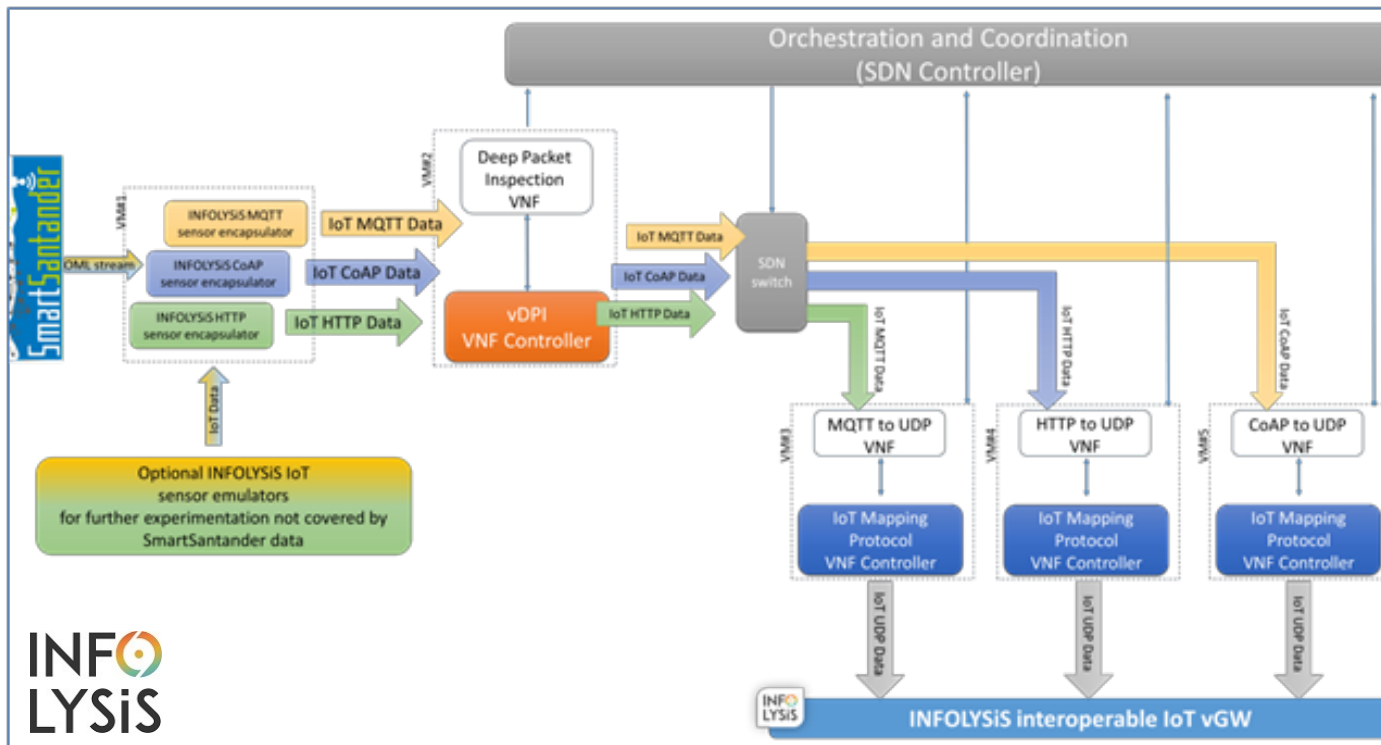


## EXPERIMENT SET-UP 1/2

- The traffic retrieved by SmartSantander Data Repository is encapsulated either in MQTT, CoAP or HTTP protocols.
- These IoT protocol flows are passed through the INFOLYSiS vDPI
- Based on the classification of the flows to the different protocols, the appropriate SDN rules are applied
- Each mapping VNF maps each IoT-protocol specific data flow to a generic data protocol flow
- The interoperable IoT data are saved in the IoT GW.

# ANGEL Experiment Description

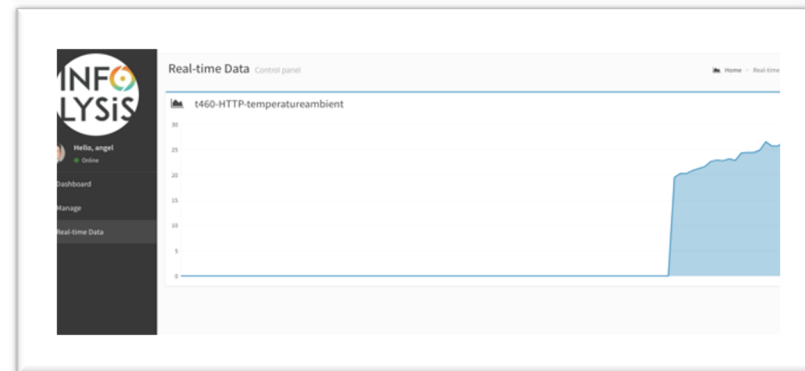
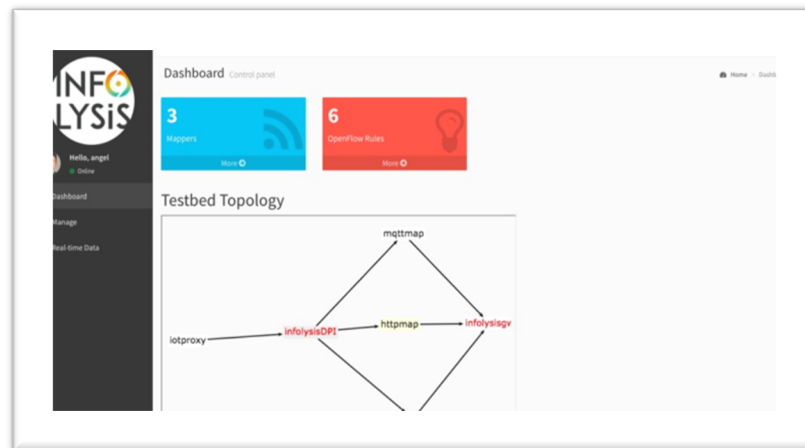
## EXPERIMENT SET-UP 2/2



# ANGEL Results

## MEASUREMENTS 1/2

```
| CoAP (port 5777) IoT Data discovered and redirected to CoAPMap  
| HTTP (port 80) IoT Data discovered and redirected to HTTPMap  
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| HTTP (port 80) IoT Data discovered and redirected to HTTPMap  
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| CoAP (port 5777) IoT Data discovered and redirected to CoAPMap  
| MQTT (port 1883) IoT Data discovered and redirected to MQTTMap  
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| HTTP (port 80) IoT Data discovered and redirected to HTTPMap  
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| HTTP (port 80) IoT Data discovered and redirected to HTTPMap
```



# ANGEL Results

## MEASUREMENTS 2/2

```
Interface      RX Rate      RX #      TX Rate      TX #
*MapMarch (source: local)
lo              0.00B         0          0.00B         0
eth0           177.00B       3          673.00B       0
eth1           330.00B       3          278.00B       2
eth2            0.00B         0          0.00B         0
eth1.3142      255.00B       3          278.00B       2
eth2.3142       0.00B         0          0.00B         0

K1B
2.38 .....*.....
1.98 .....*.....
1.59 .....*.....
1.19 .....*.....
0.79 .....*..... [-0.03%]
0.40 .....*..... [-0.03%]
1 5 10 15 20 25 30 35 40 45 50 55 60 s

K1B
2.71 .....*.....
2.26 .....*.....
1.81 .....*.....
1.36 .....*.....
0.90 .....*.....
```

```
# Interface      RX Rate      RX #      TX Rate      TX #
#MapMarch (source: local)
# lo              0.00B         0          0.00B         0
# 1 eth0          157.00B       3          570.00B       1
# 2 eth1          137.00B       2          123.00B       2
# 1 eth2            0.00B         0          0.00B         0
# 2 eth1.3142     137.00B       2          123.00B       2
# 3 eth2.3142     0.00B         0          0.00B         0

B
582.00 .....*.....
485.00 .....*.....
388.00 .....*.....
291.00 .....*.....
194.00 .....*.....
97.00 .....*..... [-0.02%]
1 5 10 15 20 25 30 35 40 45 50 55 60 s

B
368.00 .....*.....
308.00 .....*.....
248.00 .....*.....
188.00 .....*.....
128.00 .....*.....
68.00 .....*..... [-0.02%]
1 5 10 15 20 25 30 35 40 45 50 55 60 s
```

```
# Interface      RX Rate      RX #      TX Rate      TX #
*MapMarch (source: local)
lo              221.00B       3          221.00B       3
eth0           136.00B       3          594.00B       1
eth1           758.00B      11          872.00B      12
eth2            0.00B         0          0.00B         0
eth1.3142      758.00B      11          872.00B      12
eth2.3142       0.00B         0          0.00B         0

K1B
2.21 .....*.....
1.84 .....*.....
1.47 .....*.....
1.10 .....*.....
0.74 .....*.....
0.37 .....*..... [-0.02%]
1 5 10 15 20 25 30 35 40 45 50 55 60 s

K1B
1.98 .....*.....
1.65 .....*.....
1.32 .....*.....
0.99 .....*.....
0.66 .....*.....
0.33 .....*..... [-0.02%]
1 5 10 15 20 25 30 35 40 45 50 55 60 s
```

# ANGEL Results

## LESSONS LEARNED

### 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)



# ANGEL - Business Impact



## IMPACT ON INFOLYSiS - VALUE PERCEIVED

- ANGEL experiment gave the chance to INFOLYSiS to evaluate the efficient operation of IoT vGW and to develop a vDPI – VNF
- INFOLYSiS gained valuable knowledge that allows it to further improve the operational efficiency and commercialization capacity of the tested SDN/NFV-based network self-organisation controller
- Using the Fed4FIRE+ infrastructure, INFOLYSiS could quickly perform tests without having to set up from scratch the test environment/infrastructure and generate its own IoT test data, minimizing the time and cost involved

# ANGEL - Business Impact



## IMPACT ON INFOLYSIS - VALUE PERCEIVED

- ANGEL experiment results added both direct and indirect value to INFOLYSIS by further developing, testing and verifying the proposed SDN based IoT Interoperability service and vDPI – VNF
- INFOLYSIS will integrate its unique experience in chatbot apps development over messaging platforms (such as Viber and Messenger) with the novelty and interoperability offered by the INFOLYSIS IoT vGW solution for the seamless and more efficient control of Smart Home solutions and IoT implementations

# ANGEL - Business Impact



## IMPACT ON INFOLYSIS - VALUE PERCEIVED

- ANGEL experiment results will further assist INFOLYSIS to accurately adapt its pricing models and strategy for better addressing its services to the smart homes and smart cities market
- The results and the value gained by the ANGEL experiment may also be exploited internally for documentation purposes (e.g. documentation of all KPIs and metric results acting as an internal guideline/roadmap)

# ANGEL - Business Impact



## IMPACT ON INFOLYSIS - FUNDING

- Fed4FIRE+ OC4 funding facilitated the successful execution and completion of analysis, design, development and experimentation phases of ANGEL
- Received funding was sufficient to perform successfully and timely the ANGEL experiment
- Without Fed4FIRE+ OC4 testbeds and funding, INFOLYSIS would NOT be able to permanently fund internally ANGEL activities and have timely access to the necessary infrastructure and resources

# ANGEL - Feedback

## USED RESOURCES AND TOOLS

### Resources

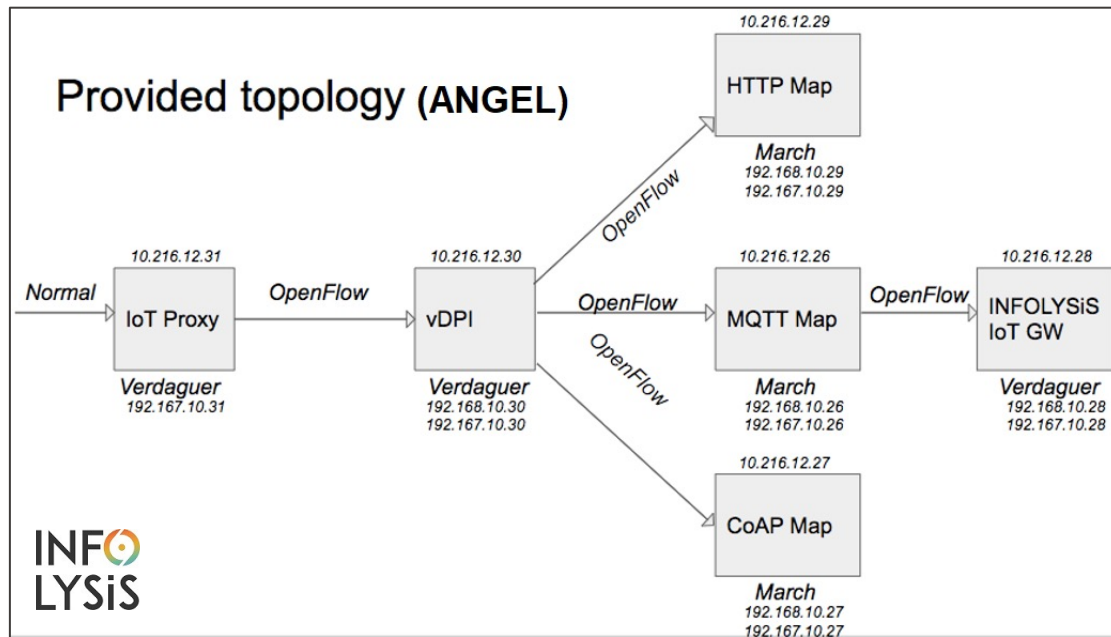
- SmartSantander (UC)
- i2CAT OFELIA island

### Tools

- Fed4FIRE+ portal
- JFed
- SmartSantander API

# ANGEL - Feedback

## USED RESOURCES AND TOOLS



In Total, **6 Virtual Machines** from **2 servers** were used and they were connected with OpenFlow switches

# ANGEL - Feedback



## ADDED VALUE OF FED4FIRE

- 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

# ANGEL - Feedback



## ADDED VALUE OF FED4FIRE

- INFOLYSIS team is fully satisfied by the Fed4FIRE+ team support that was offered to us
- The experiment process and assistance to us was very clear and well coordinated
- INFOLYSIS team was well guided through every step of the process and assisted to transform ANGEL proposal into a successful experiment





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