SIG-PMV Meeting

Wireless Crowdsourced Performance Monitoring and Verification

WiFi Performance Measurement Using End-User Mobile Device Feedback

Team GN4-2-SA3T5 WiFiMon
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Outline

- **Introduction on WiFi network Performance Monitoring and Verification**
- **WiFiMon Architecture in a Nutshell**
- **Walk-through**
- **Expertise**
  - Dublin City University campus measurements
- **Conclusions**
- **Future work**

Introduction - Problem statement

Measuring and verifying the performance of a WiFi network is challenging

No (single) tool available, covering all aspects of performance monitoring and verification

No (single) tool available, determining how end-users experience on WiFi at a given place on the network, at a given time

At present, information for wireless networks can be reported in three ways:

Mobile End-User Device – Apps

Wireless Access Points (WAP) / WiFi-Controller

Network Management Systems (NMS)

➔These sources allow "only" determining the wireless network is overall OK (e.g. up/down)←

HW probes collect performance measurement but are installed at fixed locations

Introduction - Our approach

We asked:

"Is it possible to gather data from multiple sources, including browser-based measurements in addition to traditional monitoring, and extract meaningful information on the performance of a WiFi from that data?"

Under Conditions:

We do not replace traditional hardware-probe based performance measurements

We provide supplement "non-invasive" performance measurements from the end users' devices

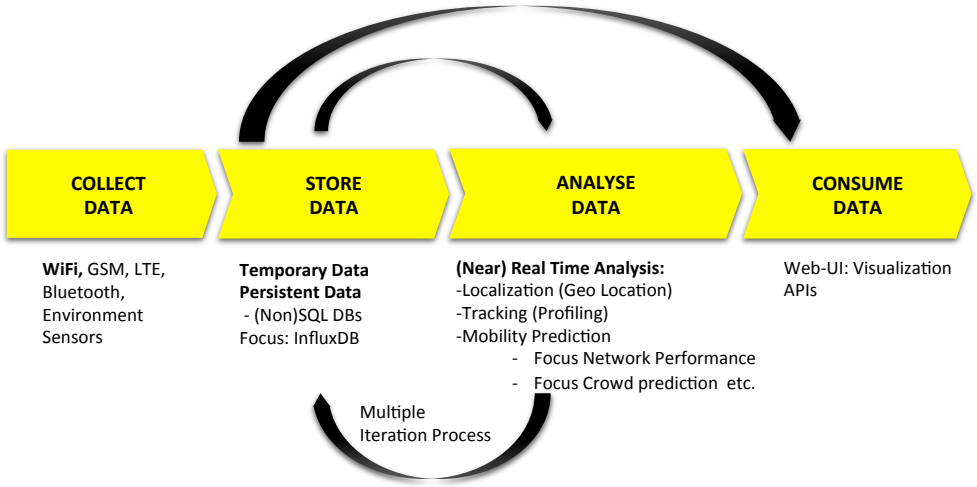
Including

A Hybrid solution that combines

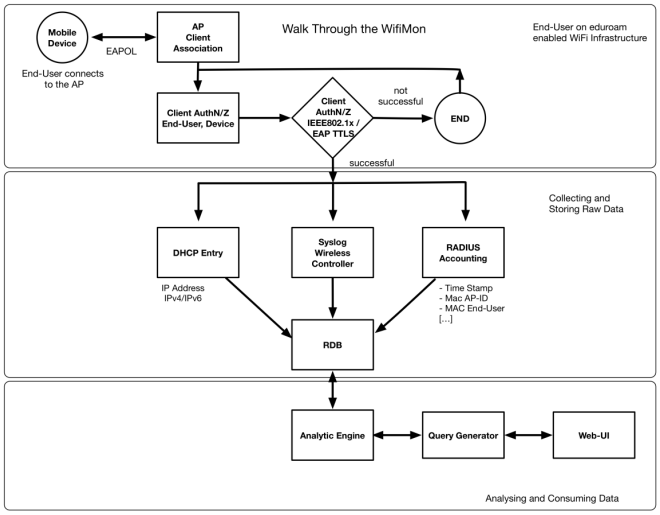
Static infrastructure performance information (HW probes objective measurements)

Dynamic performance behavior, thanks to the end-users (mobile clients)

Basics – Methodology (cont)



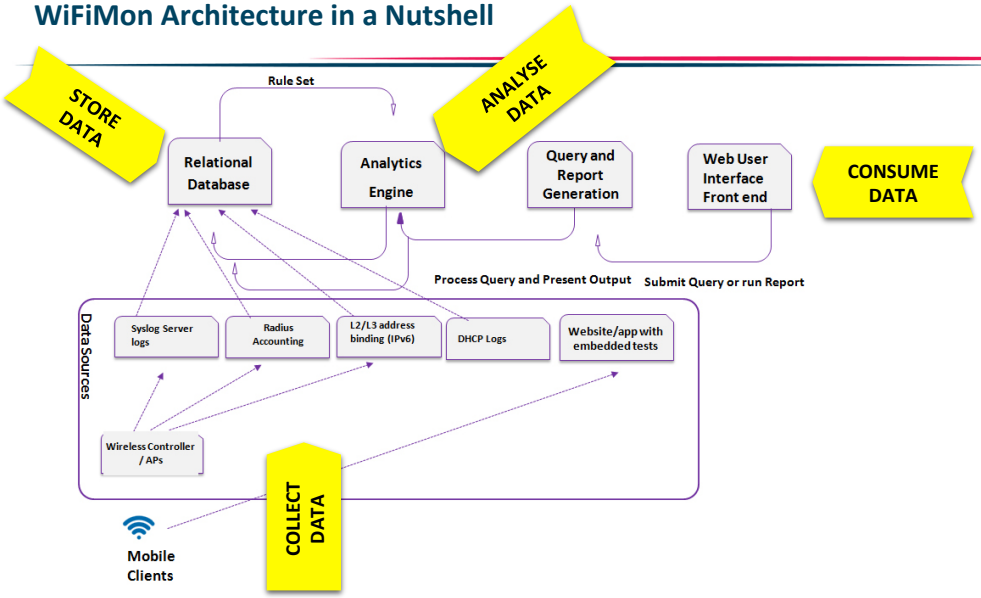
Basics - Walk-through



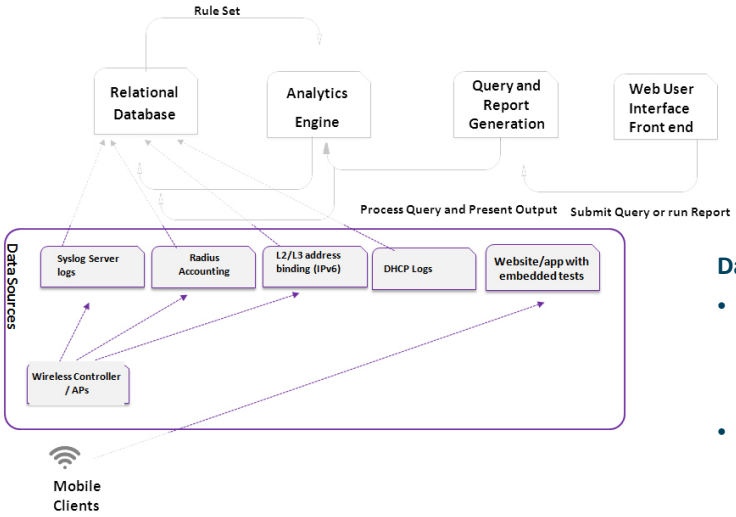
The end user is required to visit a web page with JavaScript installed

- Initiates a series of download and upload file requests (NetTest)
- Measurements are populated to RDB where it is parsed along with the data from the RADIUS and DHCP logs
- Correlation of access point identifier (location) with the mobile device and its performance on the wireless network

WiFiMon Architecture in a Nutshell



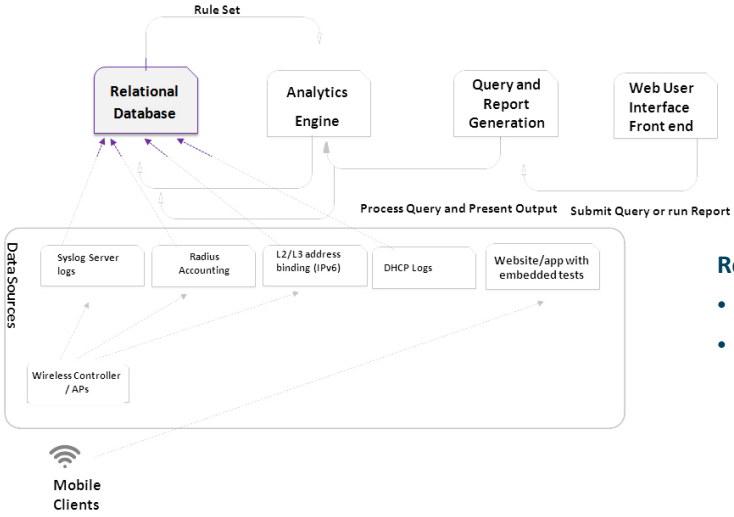
WiFiMon Architecture in a Nutshell (cont I)



Data Source

- Generates information through websites with embedded JavaScript code to run measurement tests (NetTest) without user intervention
- Exports raw data from data source collectors (Radius, DHCP logs, etc)

WiFiMon Architecture in a Nutshell (cont II)



STORE DATA

Relational Database (RDB)

- Automatically collects the raw data
- Technologies
  - PostgreSQL for the relational database,
  - InfluxDB for a time-series database used for visualization

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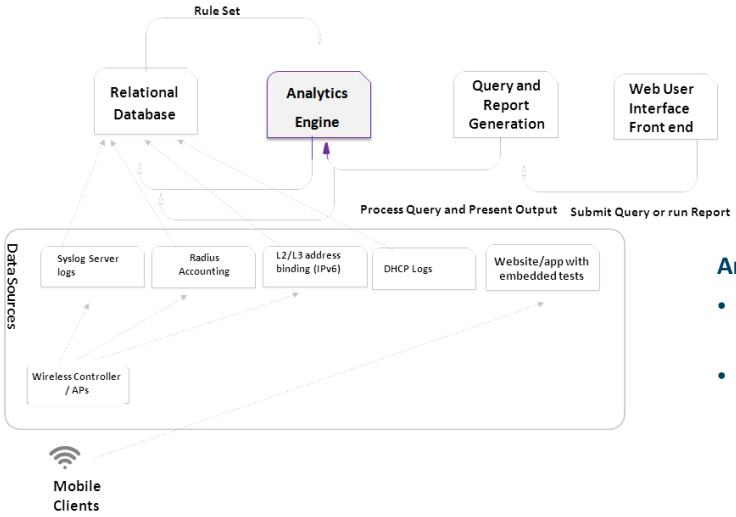
WiFiMon Architecture in a Nutshell (cont III)



ANALYSE DATA

Analytic Engine (AE)

- Sorts the raw data collected, analyze it, and provide visualizations
- In the current approach Grafana is used to create the measurement and monitoring dashboards

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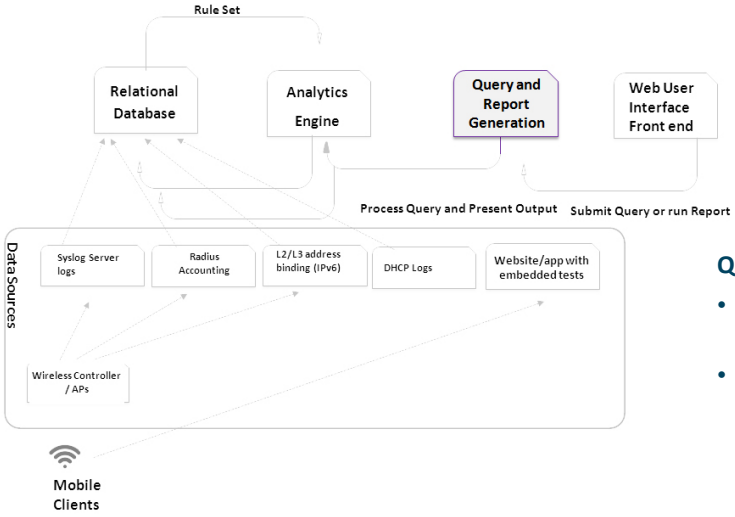
WiFiMon Architecture in a Nutshell (cont IV)



CONSUME DATA

Query and Report Generation (QaRG)

- Searches for usable information from RDB and AE
- Posts this information in the form of reports or visualization options to the Web-user Interface

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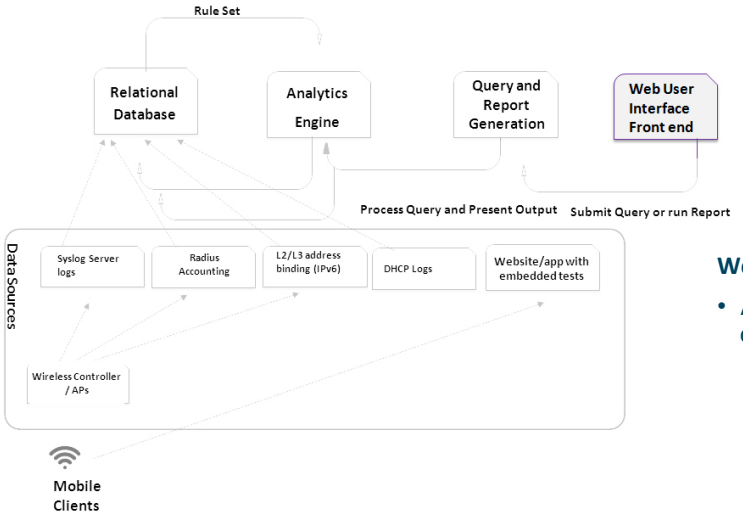
WiFiMon Architecture in a Nutshell (cont V)



CONSUME DATA

Web User Interface (Web-UI)

- Allows real-time visualization options
  - Data collected in a specific time period
  - Measurements for user-related parameters (i.e. operating system, browser used)
  - Min-max-mean measurements

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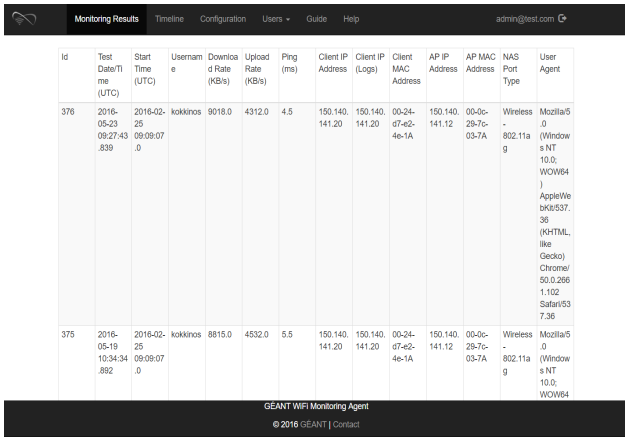
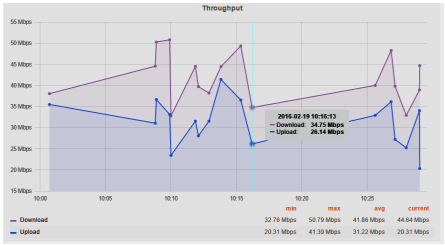
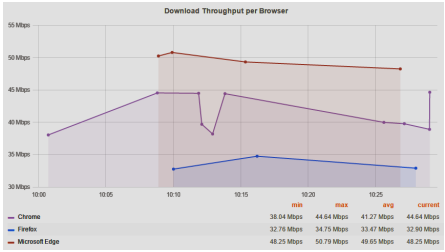
WiFiMon Architecture in a Nutshell - Web-UI

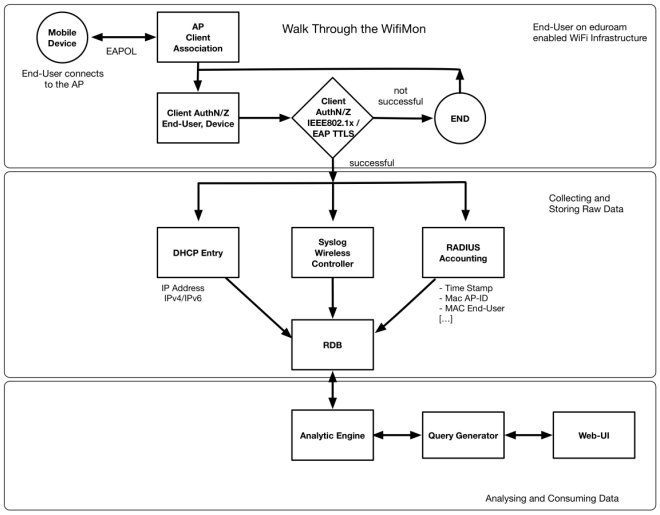


Id	Test Date/Time (UTC)	Start Time (UTC)	Username	Download Rate (KB/s)	Upload Rate (KB/s)	Ping (ms)	Client IP Address	Client IP (Logs)	Client MAC Address	AP IP Address	AP MAC Address	NAS Port Type	User Agent
376	2016-05-23 09:27:43.839	2016-02-25 09:09:07.0	kokkinos	9018.0	4312.0	4.5	150.140.141.20	150.140.141.20	00-24-d7-e2-4e-1A	150.140.141.12	00-0c-29-7c-03-7A	Wireless-802.11ag	Mozilla/5.0 (Windows NT 10.0; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/50.0.2661.102 Safari/537.36
375	2016-05-19 10:34:34.892	2016-02-25 09:09:07.0	kokkinos	8815.0	4532.0	5.5	150.140.141.20	150.140.141.20	00-24-d7-e2-4e-1A	150.140.141.12	00-0c-29-7c-03-7A	Wireless-802.11ag	Mozilla/5.0 (Windows NT 10.0; WOW64





Basics - Walk-through (Log files)



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How we manage it – Measurements and Correlations

Establish NetTest Server

To enable measurements:

- Define sample images hosted in an Apache2 sever

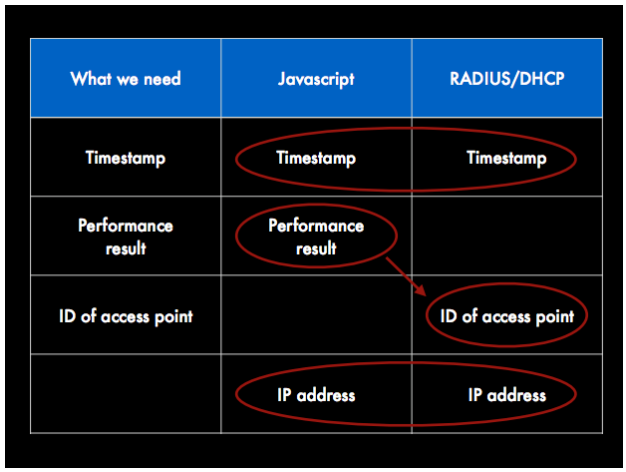
User-Related Information

NetTest calculates:

- BW: The duration of the download throughput between Client and Web server hosting the sample image
- Latency: A similar process for the RTTs

Correlation:

- Performance Results (User-related information) BW, Latency with the WAP that the measurement was taken from
- Radius Accounting (authN/Z logs)



Expertise - Dublin City University campus

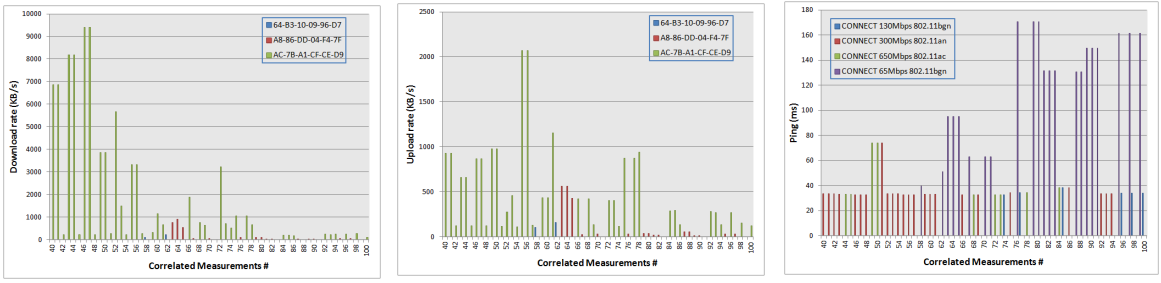
Dublin City University (DCU)

- Includes 800 wireless access points, across multiple campuses
- Uses FreeRADIUS with a DHCP server for authentication
- WiFi authentication is performed through the eduroam configured service

Procedure

- While roaming, a number of clients visited a webpage that allowed NetTest measurements
- When NetTest was executed a query was triggered in order to automatically populate the measurement results to the RDB
- Measurements where then correlated with the FreeRADIUS and DHCP logs
- 154 performance tests were recorded

Expertise - Results



Download (16 KB/s to 9300 KB/s), upload rates (16 KB/s to 2070 KB/s) and RTT (31.5 ms and 170.5 ms) show great variation

- Different wireless technology during measurements (e.g. 650Mbps 802.11ac, 130Mbps 802.11bgn)
  - e.g. majority of the high RTT values when connected to a low speed WAP, i.e. “65Mbit/s IEEE 802.11bgn”
- Varied user’s distance from the AP
- Measurements are relative to the server location that hosts the NetTest files (Athens, Greece)

Conclusions and future work

The expertise gained so far revealed that it is possible to:

- Measure specific parameters of a wireless network through JavaScript
- Correlate these measured raw data from various log files
- Monitor and validate the performance of WiFi as experienced by end-users

Future steps:

- Verification of JavaScript measurements accuracy (comparison with HW monitoring probes)
- Mobile app development to allow measurements (expand browser-based measurements)
- Explore privacy issues so as to be in accordance with campus policies
  - Inform the end-user through pop-ups, approve performance tests
  - Links or pop-ups that explain the process of data collection.
  - If tests are performed without user intervention, ensure that sensitivedata will be analysed with caution.

Thank you
Any Questions?

Contact us

GN4-2 SA3T5 WiFiMon email list: gn4-2-sa3-t5wifimon@lists.geant.org
WiFiMon-End-User list: wifimon-users@list.geant.org

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Links for live demo

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WiFiMon Web UI

- https://vm11-gn3-sa2t5.vm.grnet.gr:8441/login

Website for measurements

- https://vm3-gn3-sa2t5.vm.grnet.gr/measurement.html

Find public IP

- http://www.whatismypublicip.com/