Wi-Fi Network Monitoring with GÉANT WiFiMon

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Introduction
WiFiMon GÉANT Service

- Monitoring Wi-Fi performance as experienced by end users
- Combination of crowdsourced & hardware probe measurements
- IEEE 802.1X networks (eduroam): Data from RADIUS & DHCP logs for richer analysis, e.g. per Access Point (AP)

Contribution:
- Detection of Wi-Fi throughput degradation
- Determination of underperforming areas within a Wi-Fi network
  → Admins may enhance performance, e.g. by installing more APs
WiFiMon vs Related Monitoring Tools

- Monitoring from the end-user perspective (*end-user experience*)
- No requirements for app installation or end-user intervention
- Centralized view of Wi-Fi performance available to the administrator
Example: WiFiMon vs Ookla Speedtest

<table>
<thead>
<tr>
<th></th>
<th>WiFiMon</th>
<th>Ookla Speedtest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurements are triggered:</td>
<td>Automatically by visiting a site</td>
<td>By pressing “GO”</td>
</tr>
<tr>
<td>Results collected by:</td>
<td>Wi-Fi administrator</td>
<td>End users</td>
</tr>
</tbody>
</table>
WiFiMon Operation

WiFiMon Components:

- WiFiMon Software Probes (WSPs)
- WiFiMon Hardware Probes (WHPs)
- WiFiMon Analysis Server (WAS)
- WiFiMon Test Server (WTS)
Components
WiFiMon Test Server (WTS)

**Purpose:** Holds code and test data for performance measurements
- Based on *JavaScript (JS)* technology
- *HTML* script tags pointing to test tools added to frequently visited sites

2 available test tools:

- Akamai Boomerang
- LibreSpeed Speedtest

**WTS Placement:** Close to the monitored networks
*(RTT between end devices and WTS included in results)*

→ **If impossible:** *WiFiMon* captures relative performance changes
WiFiMon Software Probes (WSPs)

End-user devices

• Crowdsourced measurements triggered against the WTS when users visit a WiFiMon-enabled site

• No requirement for additional software within user devices

• Repetitive measurements regulated via a cookie value
WiFiMon Hardware Probes (WHPs)

- Wi-Fi performance measurements from fixed points within the network
- Baseline throughput that complements crowdsourced measurements
- Performance measurements similar to WSP ones
- Additional data about monitored and nearby ESSIDs
- TWAMP Measurements, System data (CPU, memory, etc)

Triggering measurements based on crontabs

Tested for Raspberry Pi v3 and v4
WiFiMon User Interface (1)

Results per WHP

Aggregated Results
WiFiMon User Interface (2)

Dashboards available for:
- Average values
- Median values
- Maximum values
- Minimum values
- 95th Percentile values

That may be:
- Uncorrelated
- Correlated with the available APs

Depicting estimations of:
- Download throughput
- Upload throughput
- HTTP ping Round Trip Time (RTT)

Sources:
- Crowdsourced measurements
- Hardware Probe measurements
Correlation with RADIUS/DHCP Logs

Logs are:
- Extracted from RADIUS/DHCP servers using Filebeat
- Processed and transformed by Logstash in WAS
- Stored in Elasticsearch of WAS

Correlation options:
- With end-user IP address (only RADIUS logs)
- With end-user MAC address (both RADIUS & DHCP logs)

**Personally Identifiable Information:** IP/MAC addresses secured in transit using TLS-encrypted channels and stored hashed in WAS (X-Pack)
Installation
Installation Options

• Institutions install all components on their premises
  - Ansible playbook for WAS/WTS automated installation
  - All data stay within the institution premises

• NMaaS (simpler option for testing/trying WiFiMon)
  - Another GÉANT Service
  - WiFiMon WAS instance deployed on NMaaS
  - WTS installation still required by institutions
    (should be close to the monitored network)

Manual WAS installation: Abandoned by WiFiMon
WiFiMon Evolution
WiFiMon Evolution

2015
WiFiMon is born

2015
First presentation at TNC15, Porto

2019-2020
WiFiMon pilots in TNC19 and GÉANT Symposium 2020

2020
WiFiMon declared official GÉANT service

2023
Probe control made easy

2022
Eduroam support Additional Data Sources

2021
Automating server components

2020
Cloudifying WiFiMon
**WHP Configuration & Control**

**Old approach**
Administrator feedback demonstrated **limitations**:
- In **NAT networks**
- In **public networks**
- Administrators edit config directly

**Novel approach required!!!**
- Remote & user-friendly configuration of **WHPs** from a central point (**WAS**)
- Flexibility to control **WHPs** behind **NAT networks**
Configuration Made easy

Administrators (re)configure WHPs from the WiFiMon UI

Provided data:
- Device ID
- FQDNs/IP addresses of WiFiMon components
- Location information

Configuration files are generated based on Jinja2 templates
Remote Configuration Made Possible

1. Salt establishes application layer communication:
   - WHPs remotely configured from the WAS
   - Reconfiguration easier for WHPs behind NAT
   - Public IP addresses not required
     → IP space is conserved

2. Salt includes a ZeroMQ message broker:
   Parallel configuration regardless of the WHP number

3. Configuration files generated from templates transferred from the WAS to WHPs

Based on Salt
WAS ➔ Salt Master
WHPs ➔ Salt Minions
Homepage: https://wiki.geant.org/display/WIF

WiFiMon mailing list: wifimon-ops@lists.geant.org

Thank you

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