WiFiMon Overview

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Online Event

March 21, 2024

WiFiMon GÉANT Service

- **Open-source** tools for Wi-Fi performance monitoring
- Measurements relying on:
  - ***Crowdsourcing* (*software probes*):** Reports of Wi-Fi performance as experienced by end users
  - ***Hardware probes*:** Reports from devices placed at fixed locations
- Richer analysis options (e.g. throughput per Access Point - AP) for IEEE 802.1X networks (**eduroam**) by incorporating data from RADIUS & DHCP logs

Contributions:

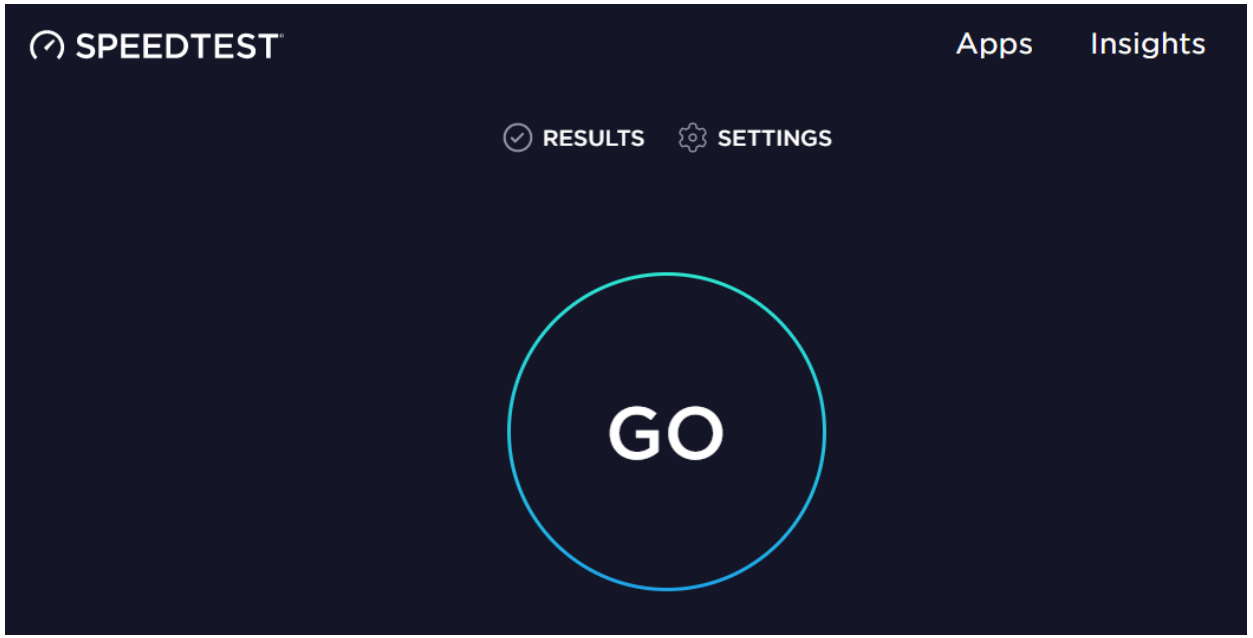
- Measurements independent of specific Access Point (AP) vendors
- Detection of Wi-Fi throughput degradation

  → Admins may enhance performance, e.g. by installing more APs
- Smart distributed control and configuration of hardware probes

WiFiMon vs Related Monitoring Tools

- Monitoring from the end-user perspective (***end-user experience***)
- No requirements for app installation or end-user intervention
- Flexible control and configuration of hardware probes in a distributed manner

Example: WiFiMon vs Ookla Speedtest

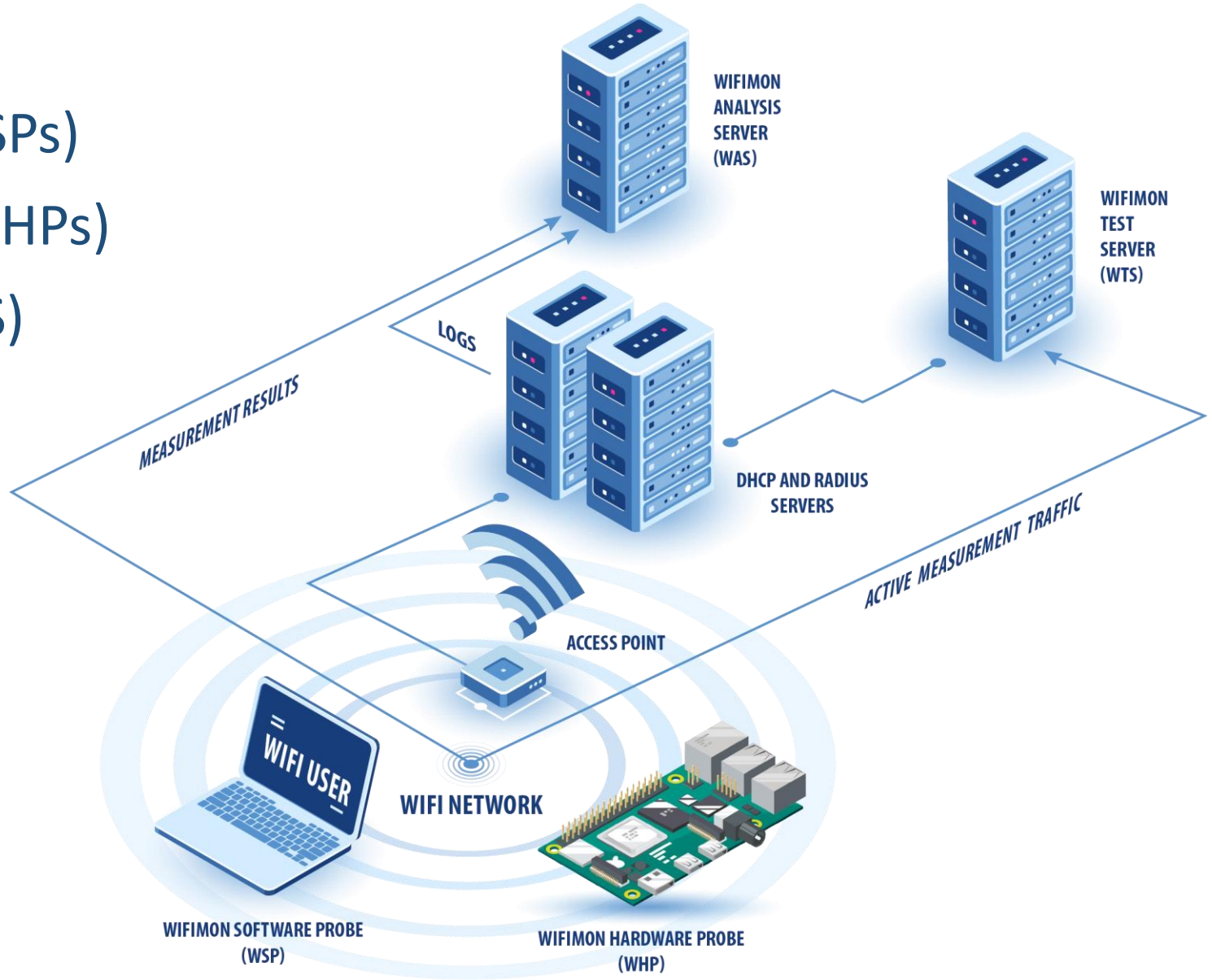


	WiFiMon	Ookla Speedtest
Measurements are triggered:	Automatically by visiting a site	By pressing “GO”
Results collected by:	Wi-Fi administrator	End users

WiFiMon Operation

WiFiMon Components:

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



WiFiMon Test Server (WTS)

Purpose: 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 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 Capabilities: Recent Pilot at Yerevan, Armenia

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Pilot Details

The 3rd WiFiMon pilot

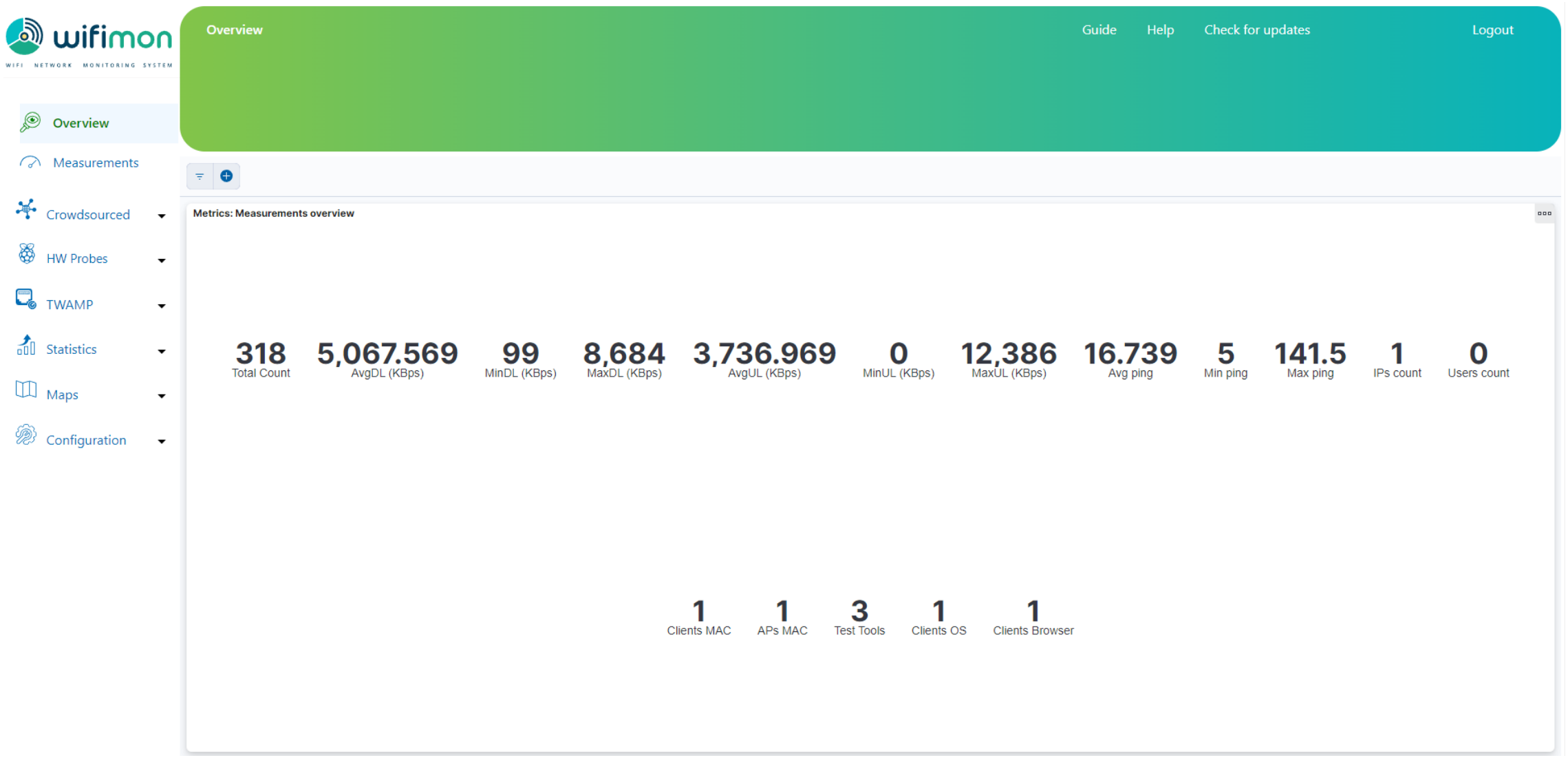
- Monitoring **eduroam** at the Institute for Informatics and Automation Problems (IIAP) - National Academy of Sciences of Armenia
- Pilot duration: **September 21st – October 4th 2023**
- Monitoring about 50-100 people (researchers, professors, engineers, students)
- Measurements from 1 WHP (Raspberry Pi 4 Model B)
- WAS/WTS installed in a single VM with 4 vCPU's, 8 GB RAM (WiFiMon v2.1.0)

Pilot Goals:

→ Experiment with newly introduced WiFiMon features

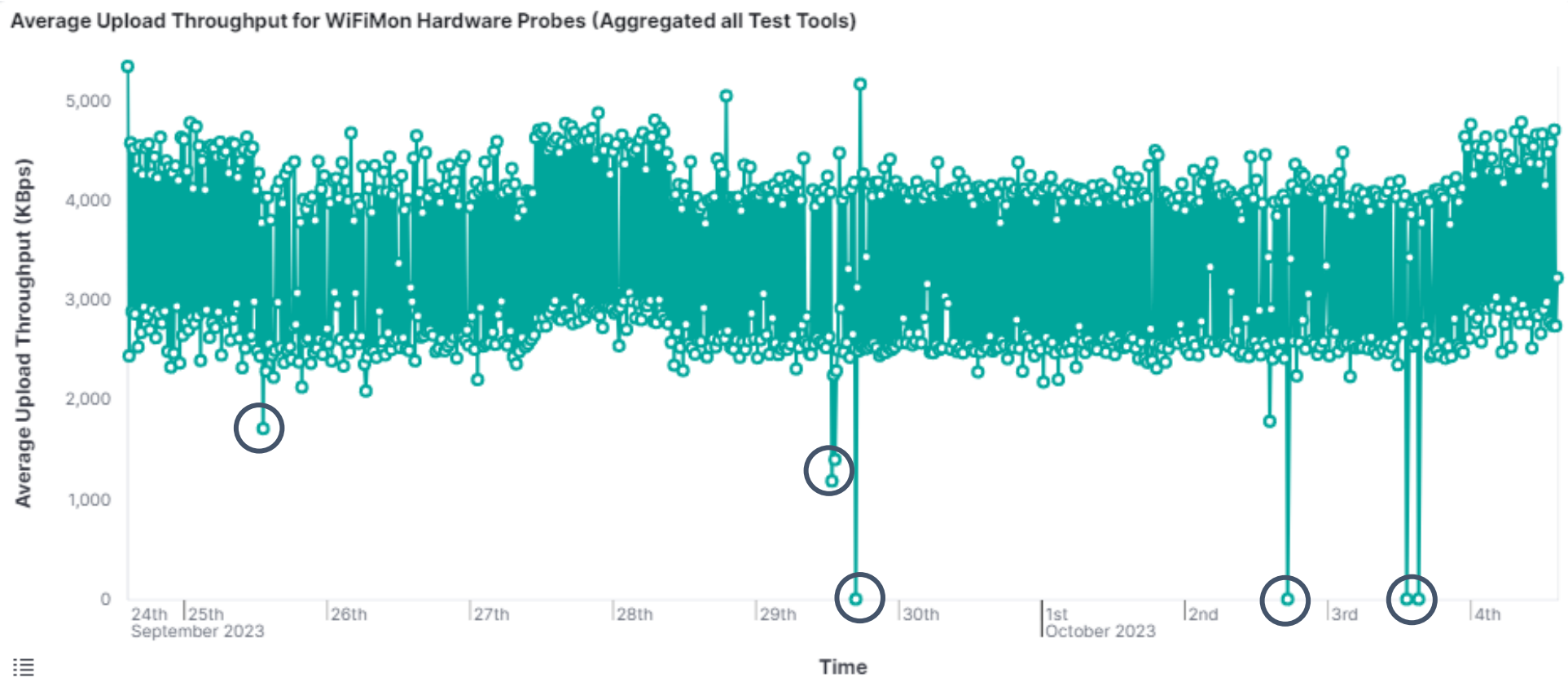
→ Help IIAP Wi-Fi administrators identify interesting points that require further inspection

Overview of WiFiMon Measurements



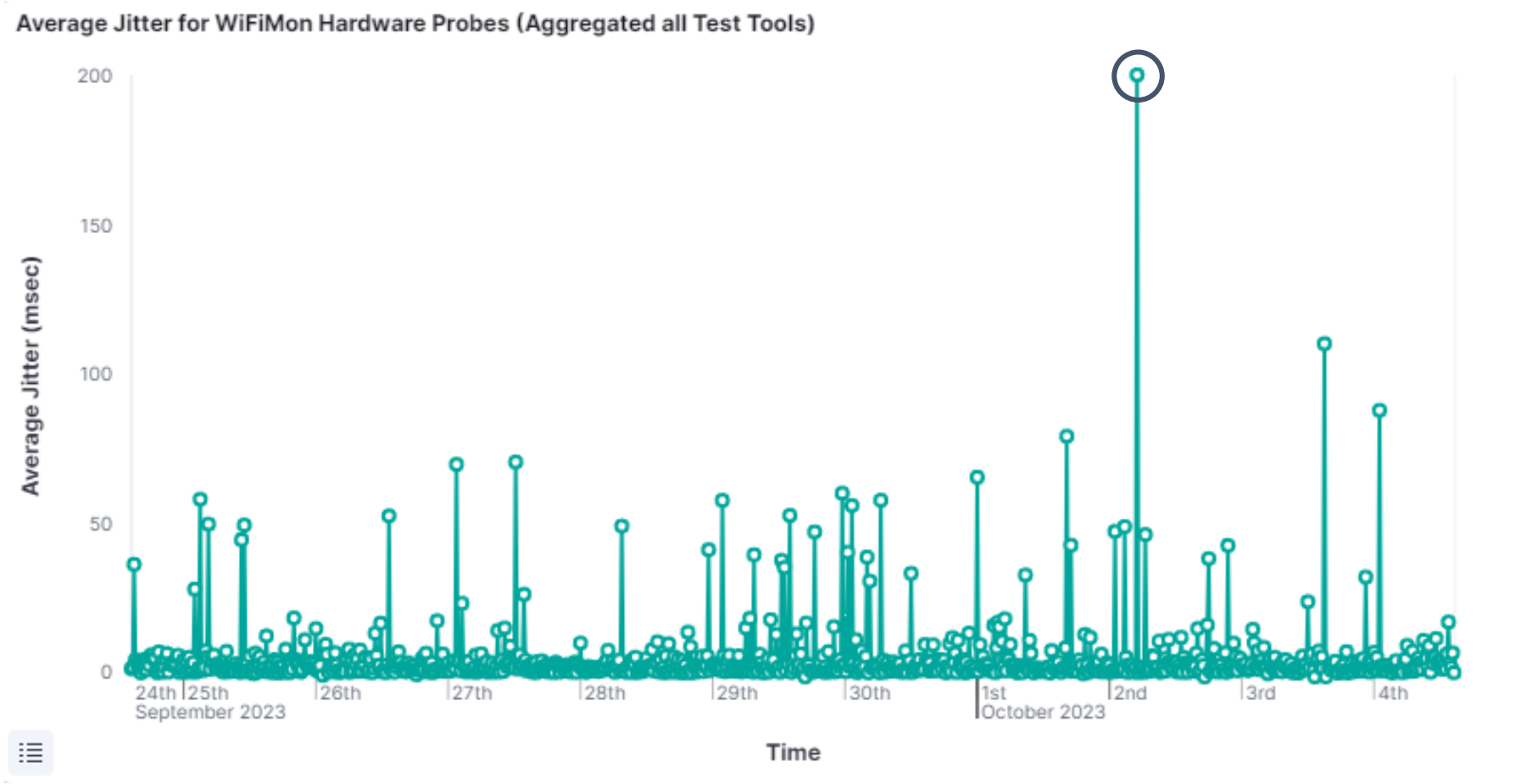
The ***Overview*** tab summarizes received measurements on a daily basis

Average Upload Throughput Measurements



- The results of all test-tools (Boomerang and LibreSpeed) are aggregated
- Significant drops (blue circles) are visible in the chart

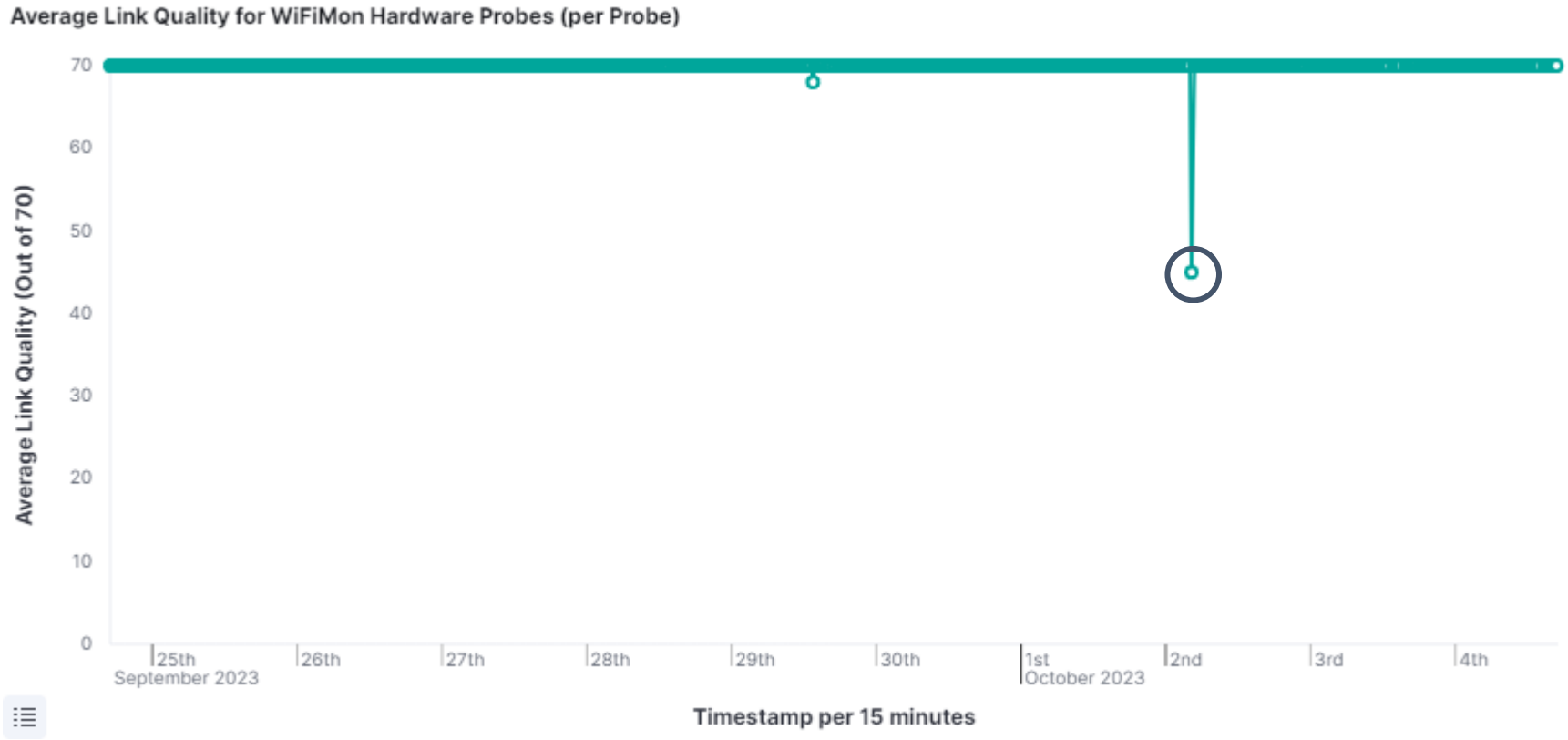
Average Jitter during the last 10 days:



Increased jitter (blue circle) is reported on October 2nd

Average Link Quality

Average link quality reported from the probe wireless NIC:

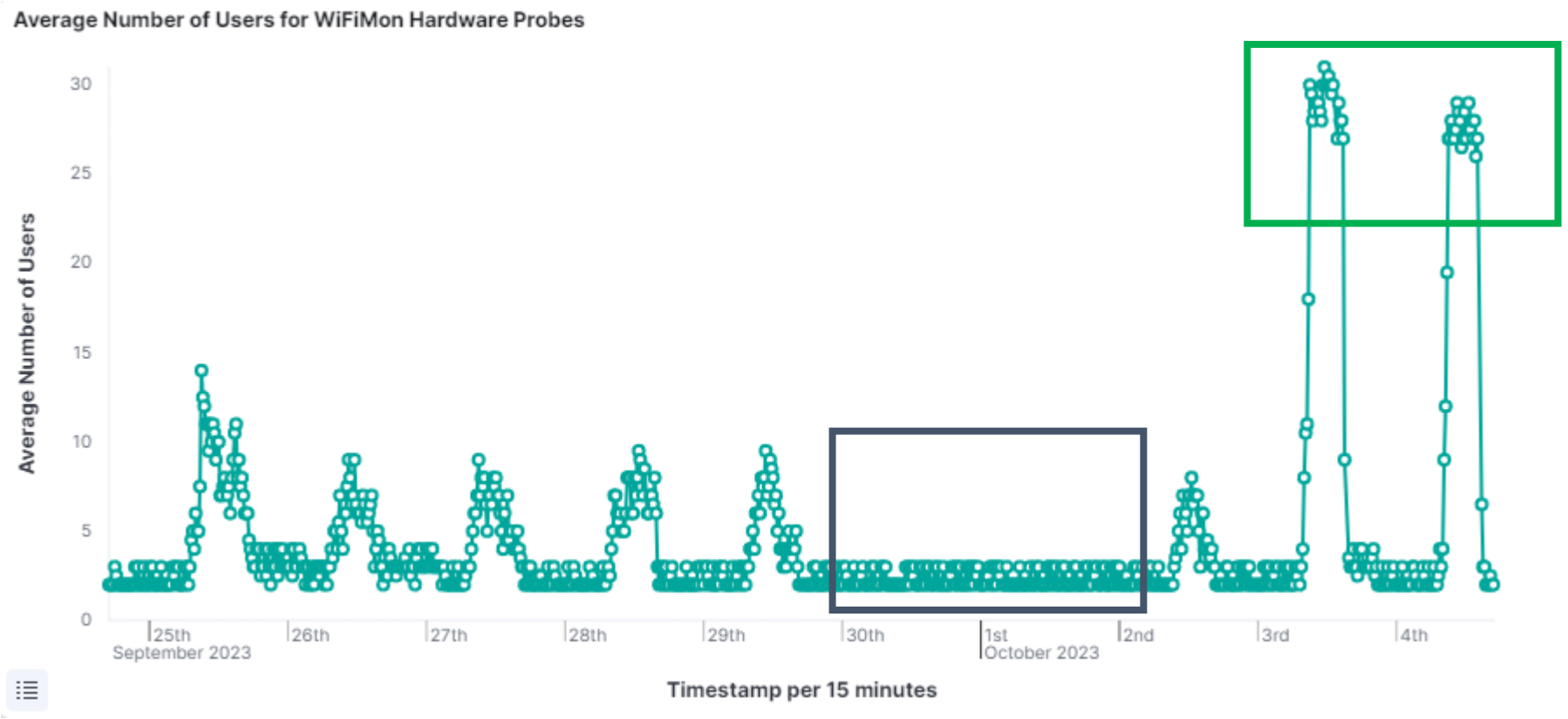


→ Link quality (WLAN NIC) does not capture the performance drops reported by the active monitoring tools (Boomerang and LibreSpeed)

→ A major drop on October 2nd matches the jitter increase (previous slide)

Average Number of Users

Average number of Wi-Fi users reported by the arp-scan Linux utility:



→ Almost no users during the weekend (**blue rectangle**)
→ Higher number of users on October 3rd and 4th (**green rectangle**) when a conference took place at IIAP

Installation

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WiFiMon Installation

- **Ansible playbook** for **WAS/WTS** automated installation
- Duration: **15 - 20 minutes**

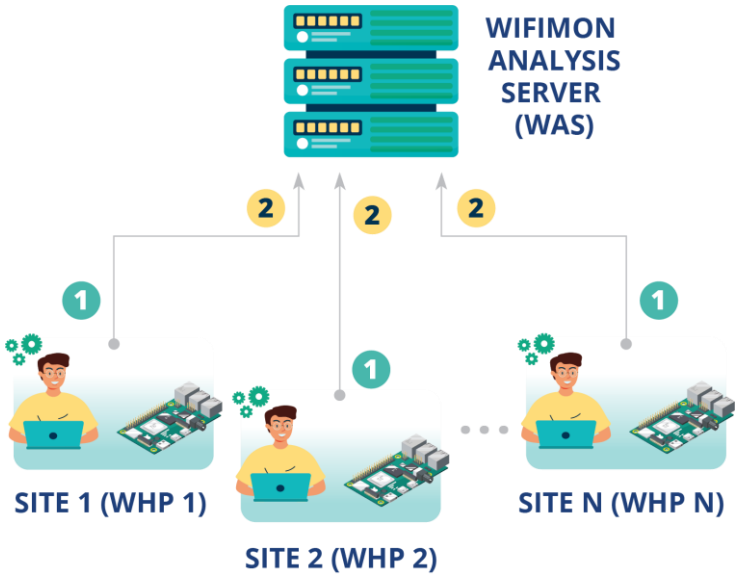
WHP Configuration & Control

WHP Configuration & Control

Old approach

Limitations reported by WiFiMon users:

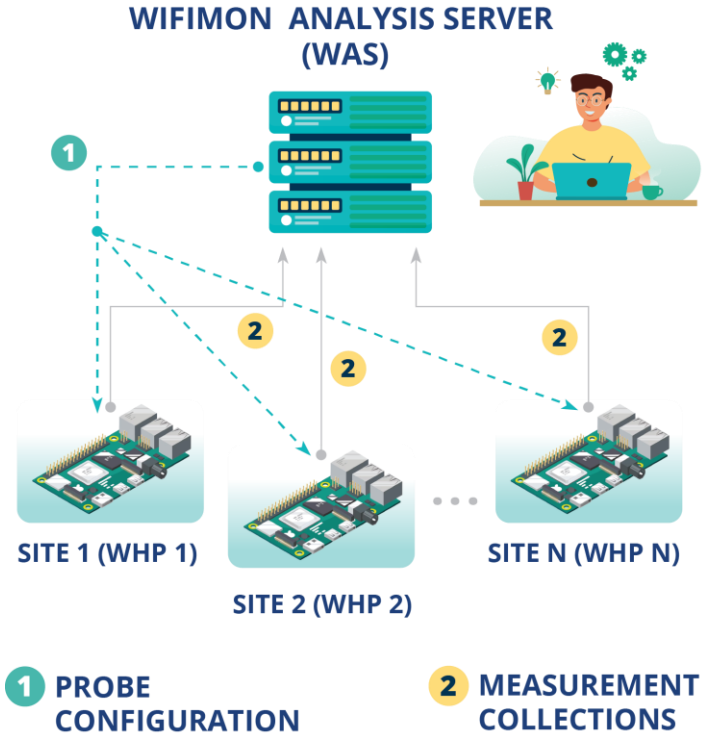
- WHP configuration proved time-consuming (especially for **NAT networks**)
- Manually editing configuration files proved hard and error-prone



Novel approach introduced!

→ Remote & user-friendly configuration of WHPs from a central point (WAS)

→ Flexibility to control WHPs behind NAT networks



Remote WHP 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

Based on Salt

WAS → Salt Master

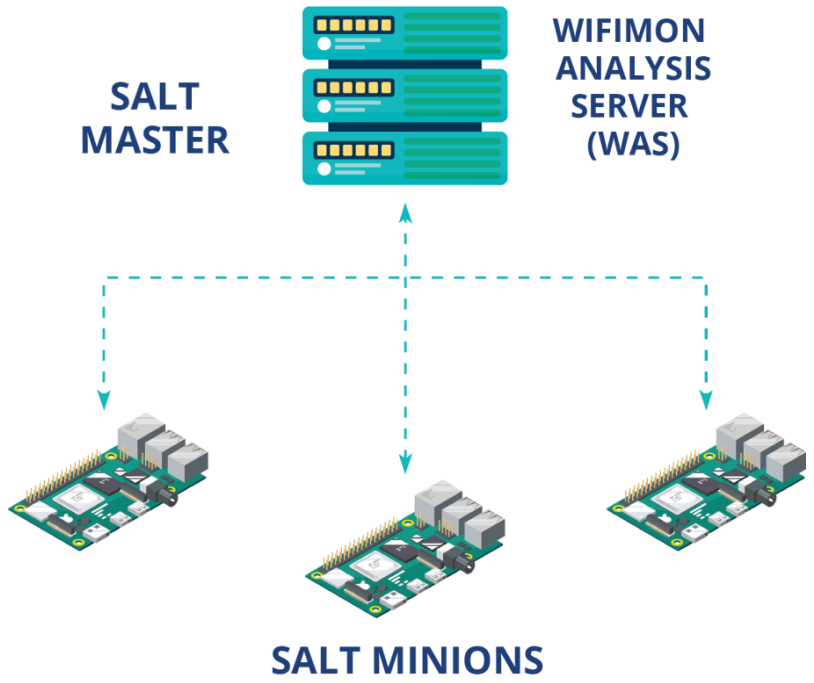
WHPs → Salt Minions

2

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

3

Configuration files generated from Jinja2 **templates** transferred from the WAS to WHPs



Basic Steps Towards Anomaly Detection

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WiFiMon Anomaly Detection Feature

Older WiFiMon versions:

→ WiFiMon administrators are expected to **manually** inspect measurements

→ No mechanisms to automatically detect important throughput deviations

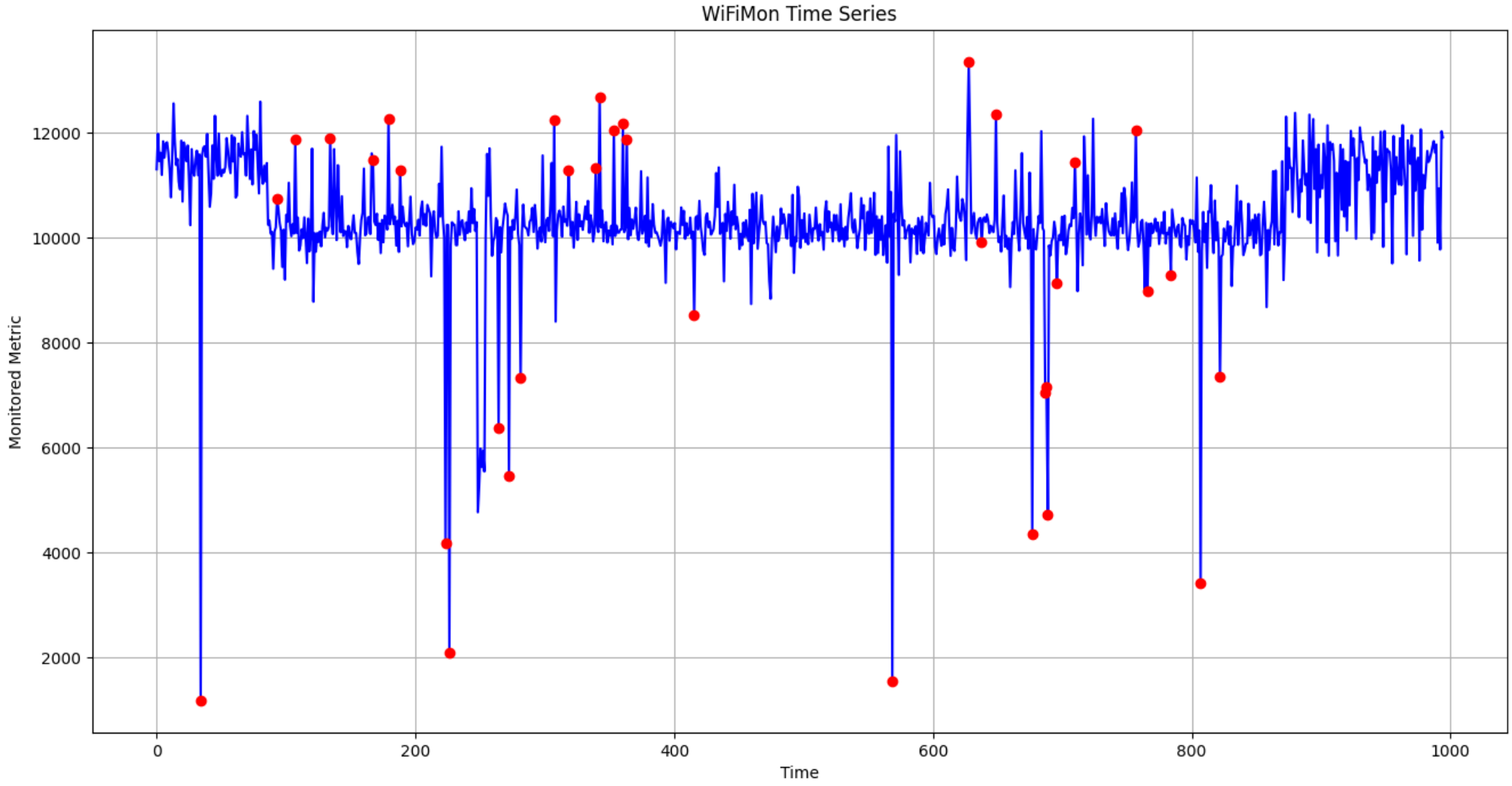
WiFiMon v2.2.0 (current version) introduces mechanisms for automated time series analysis

→Anomalies are detected using the **Hampel** method, which assesses deviations from a median value evaluated for specific time windows

→WiFiMon UI has been enriched to support the new feature

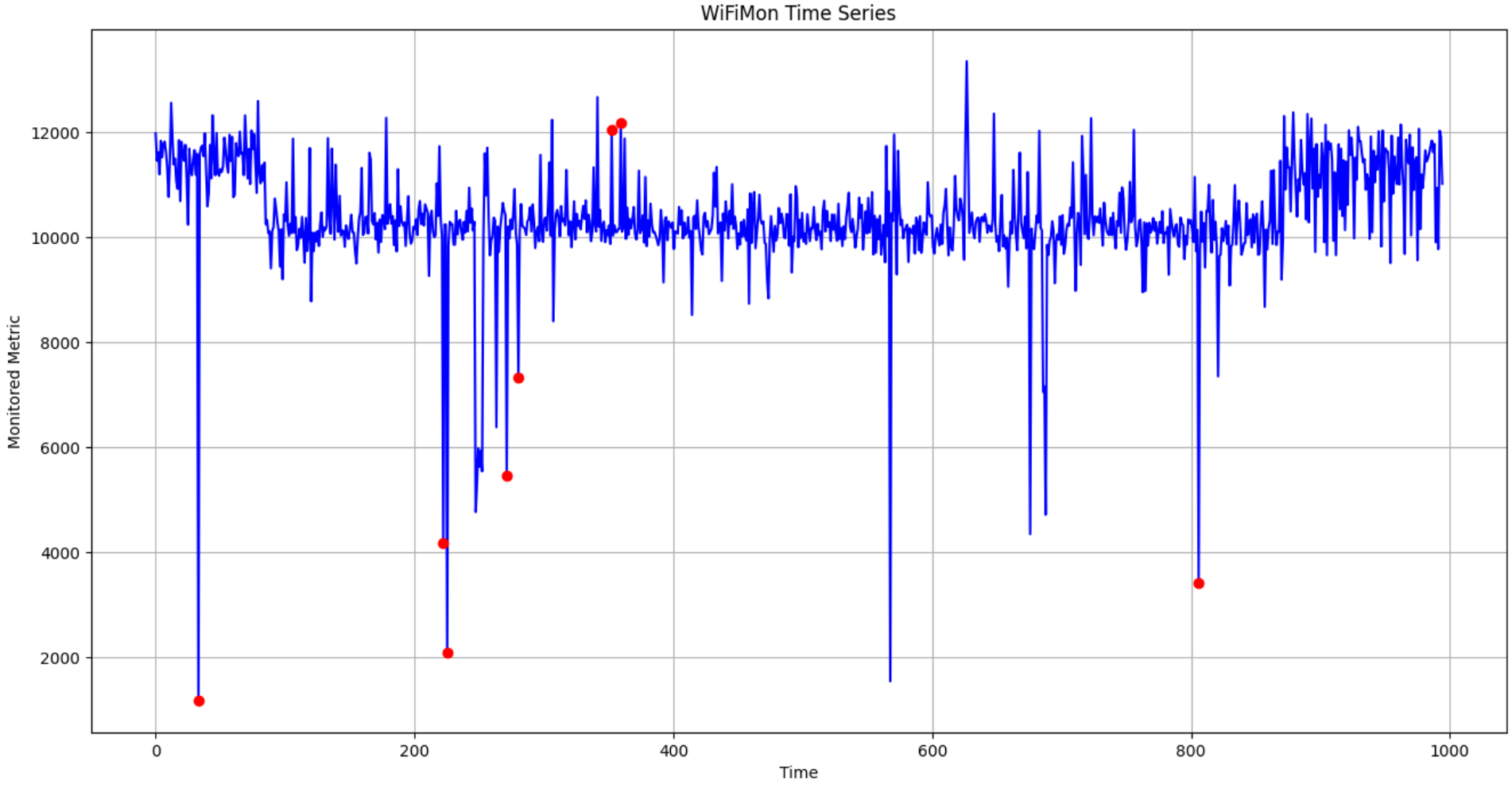
→Still **under improvement**

Results for ASNET-AM Pilot (1/2)



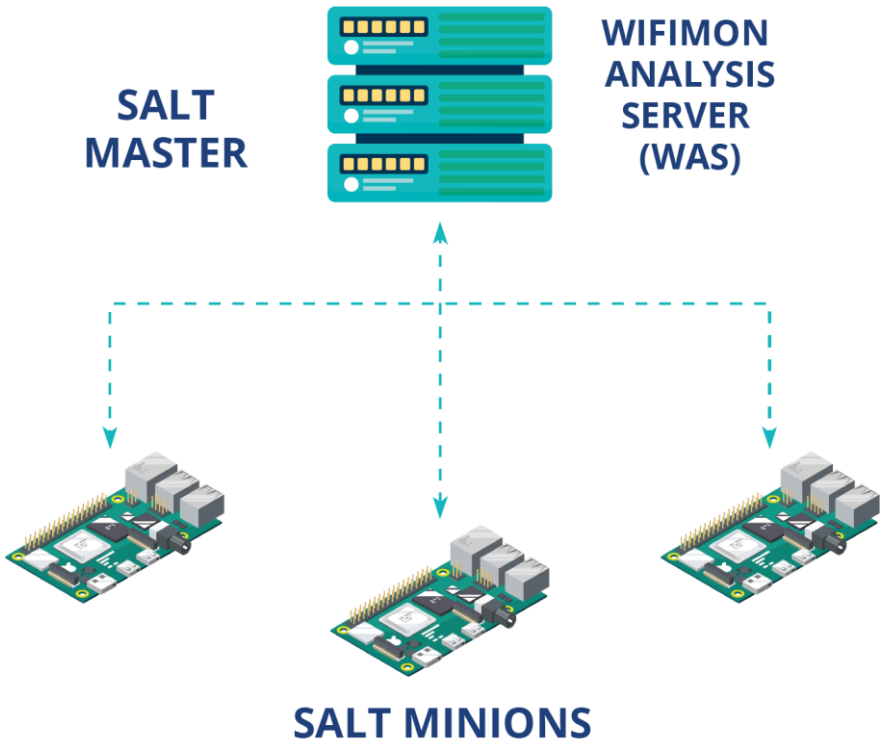
Red dots indicate points that should be further inspected

Results for ASNET-AM Pilot (2/2)



Stricter Hampel method parameters may return less red dots, i.e. anomaly indications that are more serious

WiFiMon Looking Glass



Based on Salt

1. **Locate active WHP's with Salt "*test.ping*" utility**

2. **Execute Linux command from a selected WHP:**
   - *Ping*
   - *Traceroute*
   - *Dig*
   - *Ifconfig*
   - *Routing table*

Thank You

Homepage: https://wiki.geant.org/display/WIF

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

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Co-funded by
the European Union