



GÉANT WiFiMon for Wi-Fi Network Monitoring

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Network Performance and Monitoring Workshop

Virtual Event

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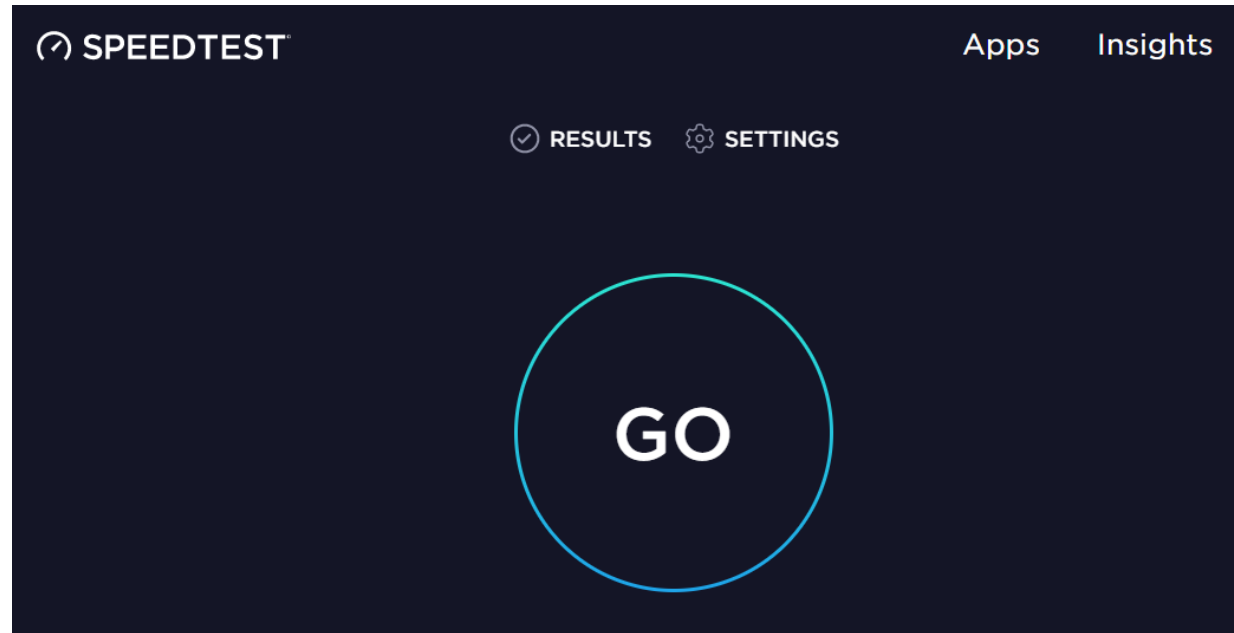
- **Open-source** tools for Wi-Fi performance monitoring
- Measurements relying on:
 - **Crowdsourcing (software probes)**: Reports of Wi-Fi performance as experienced by end users
 - **Hardware probes**: Reports from devices placed at fixed locations
- Richer analysis options (e.g. throughput per Access 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

- 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

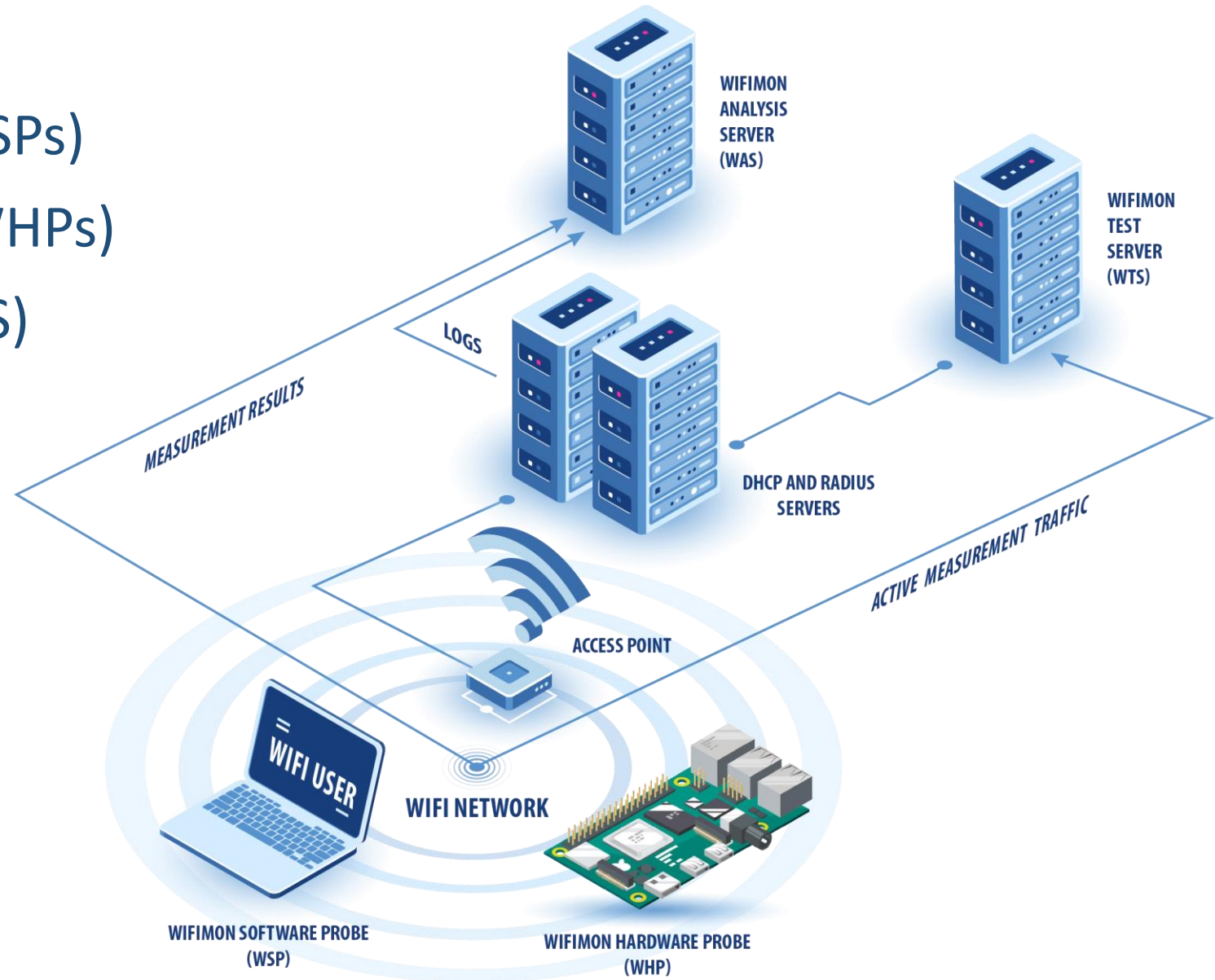




	<i>WiFiMon</i>	<i>Ookla Speedtest</i>
Measurements are triggered:	Automatically by visiting a site	By pressing "GO"
Results collected by:	Wi-Fi administrator	End users

WiFiMon Components:

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



LibreSpeed

WTS Placement: Close to the monitored networks

(RTT between end devices and WTS included in results)

→ *If impossible:* WiFiMon captures **relative** performance changes

- 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

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

Guide Help Check for updates Logout

Overview

Measurements

Crowdsourced

HW Probes

TWAMP

Statistics

Maps

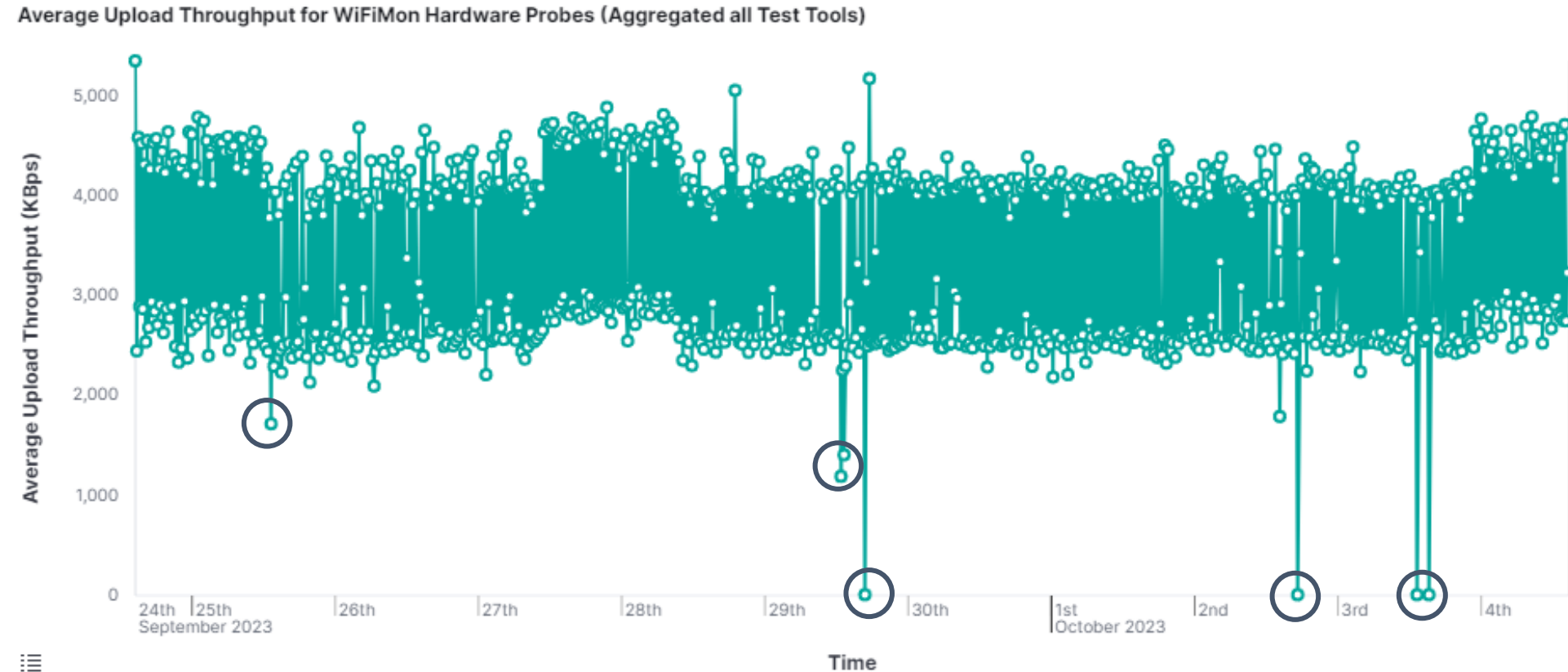
Configuration

Metrics: Measurements overview

318 Total Count	5,067.569 AvgDL (KBps)	99 MinDL (KBps)	8,684 MaxDL (KBps)	3,736.969 AvgUL (KBps)	0 MinUL (KBps)	12,386 MaxUL (KBps)	16.739 Avg ping	5 Min ping	141.5 Max ping	1 IPs count	0 Users count
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1 Clients MAC	1 APs MAC	3 Test Tools	1 Clients OS	1 Clients Browser
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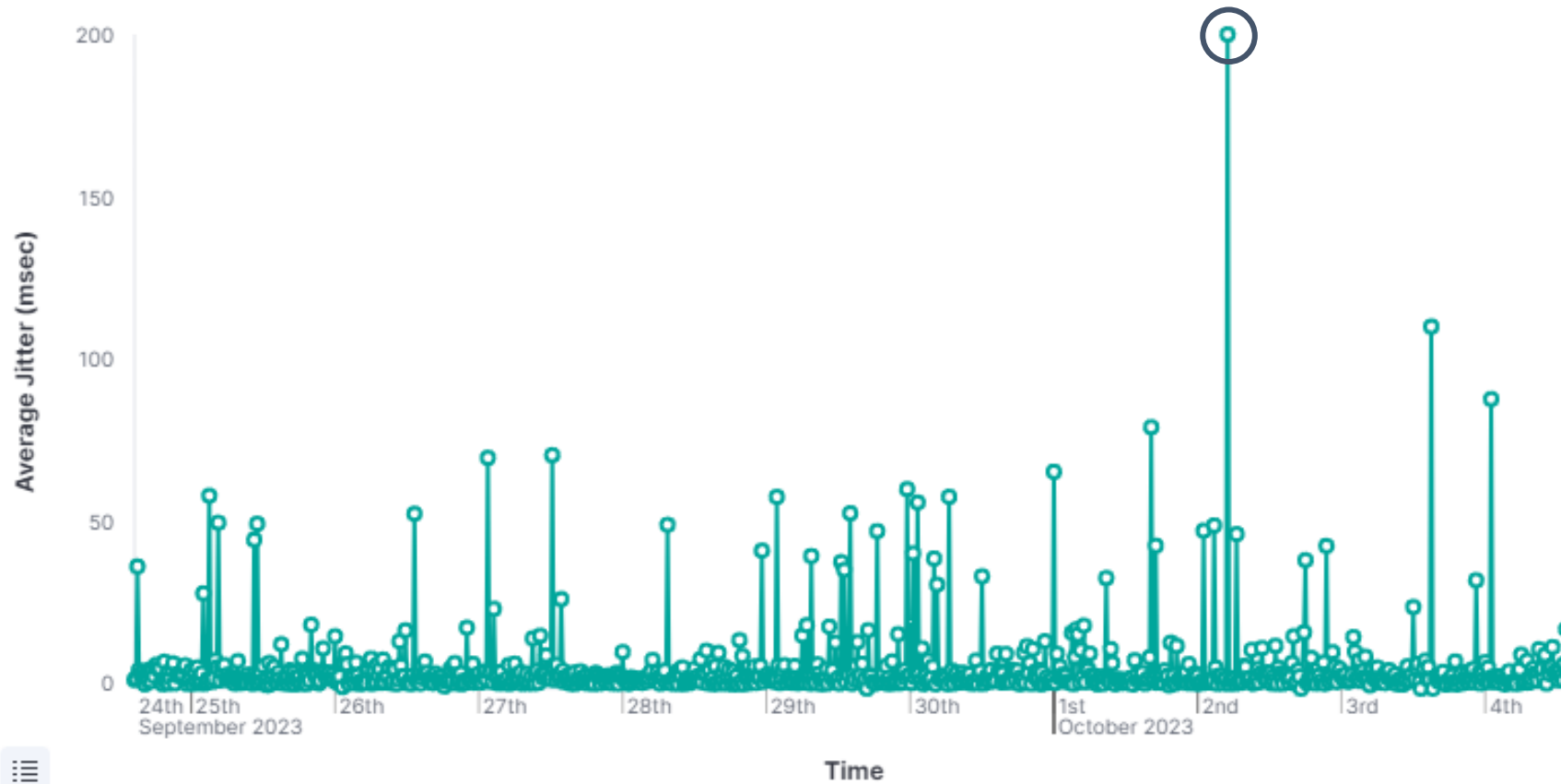
The **Overview** tab summarizes received measurements on a daily basis



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

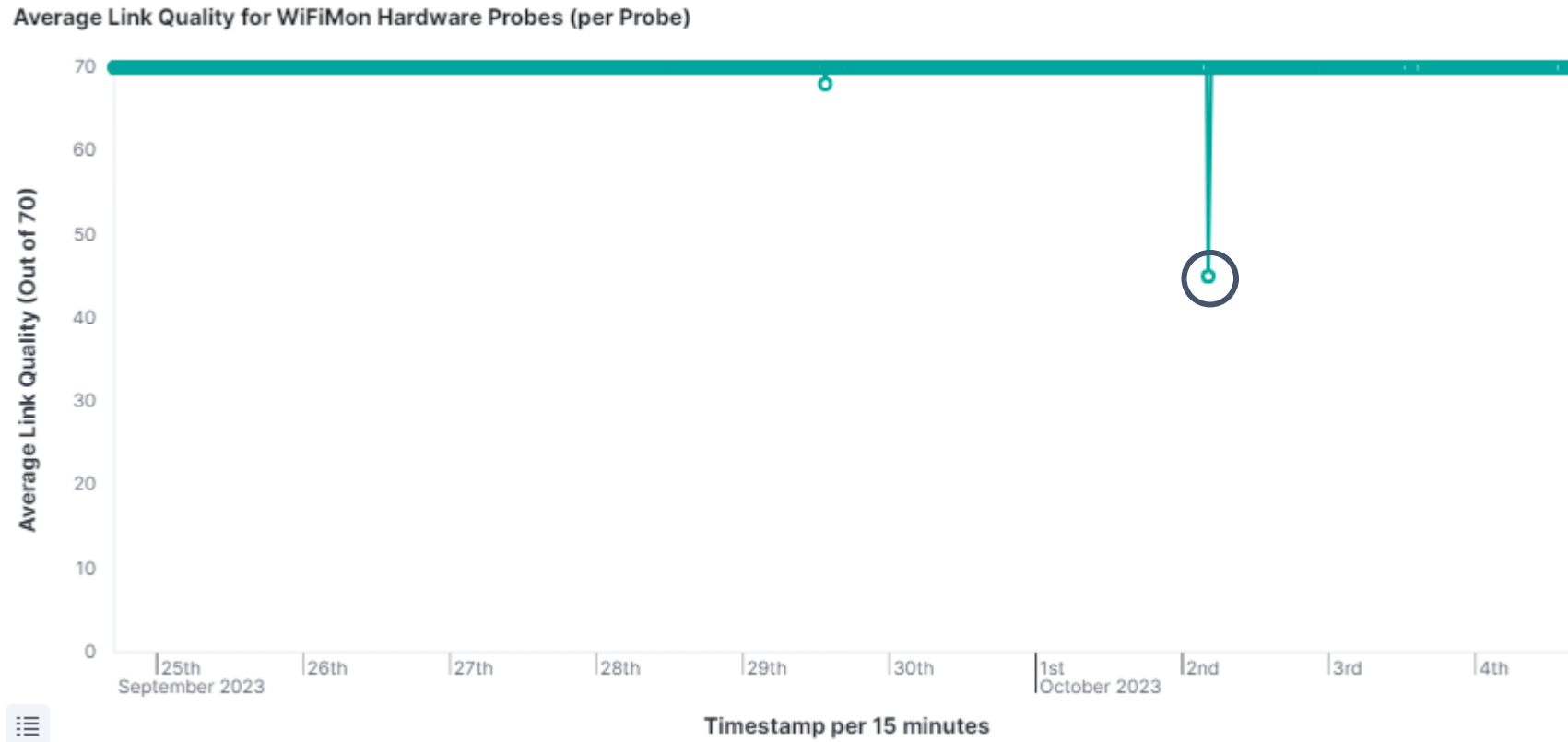
Average Jitter during the last 10 days:

Average Jitter for WiFiMon Hardware Probes (Aggregated all Test Tools)



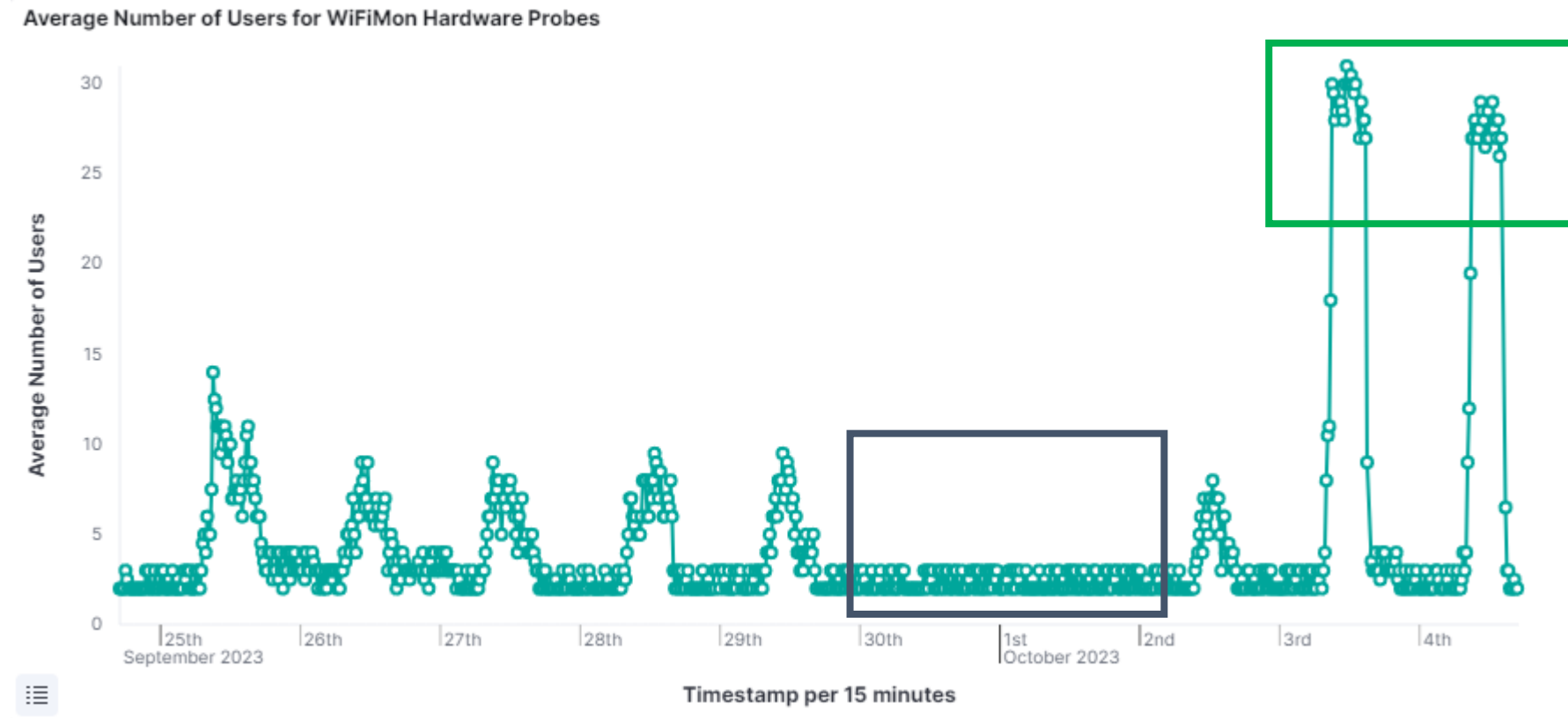
Increased jitter (blue circle) is reported on October 2nd

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 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

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

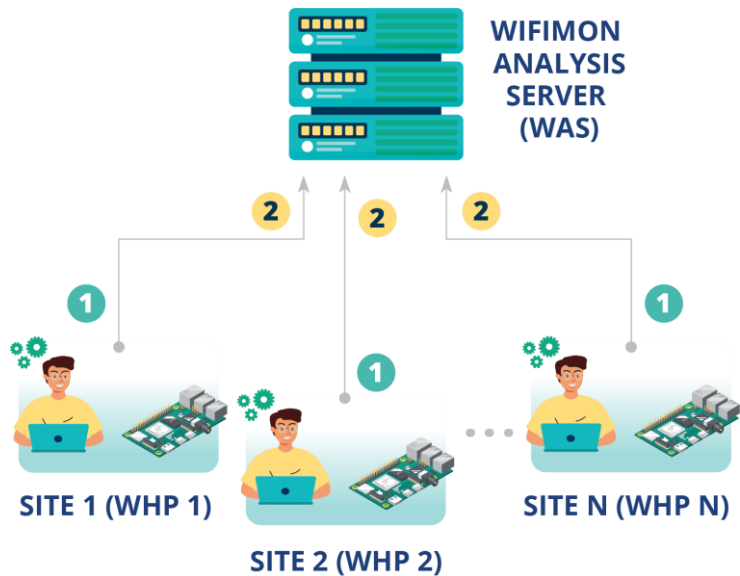


WHP Configuration & Control

Old approach

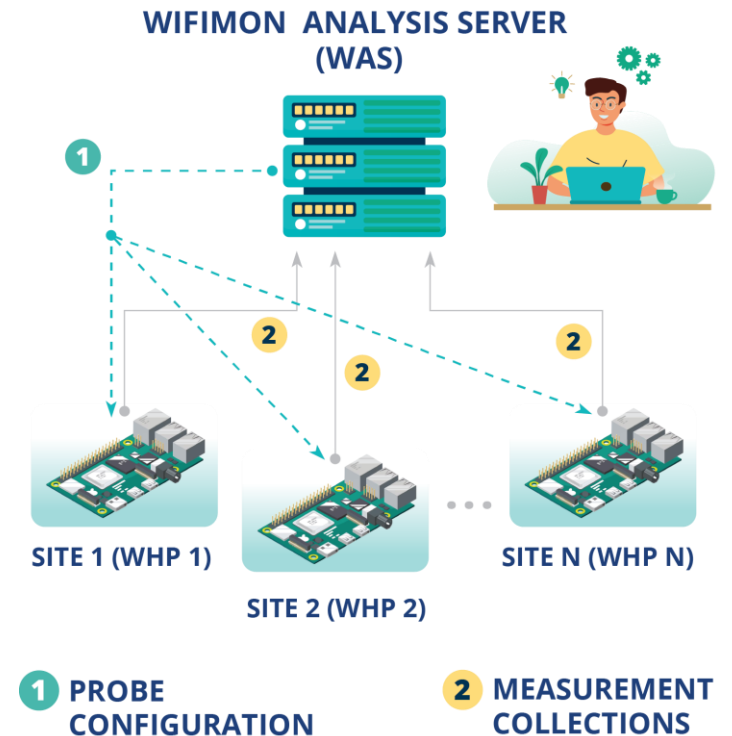
Limitations reported by WiFiMon users:

- 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



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

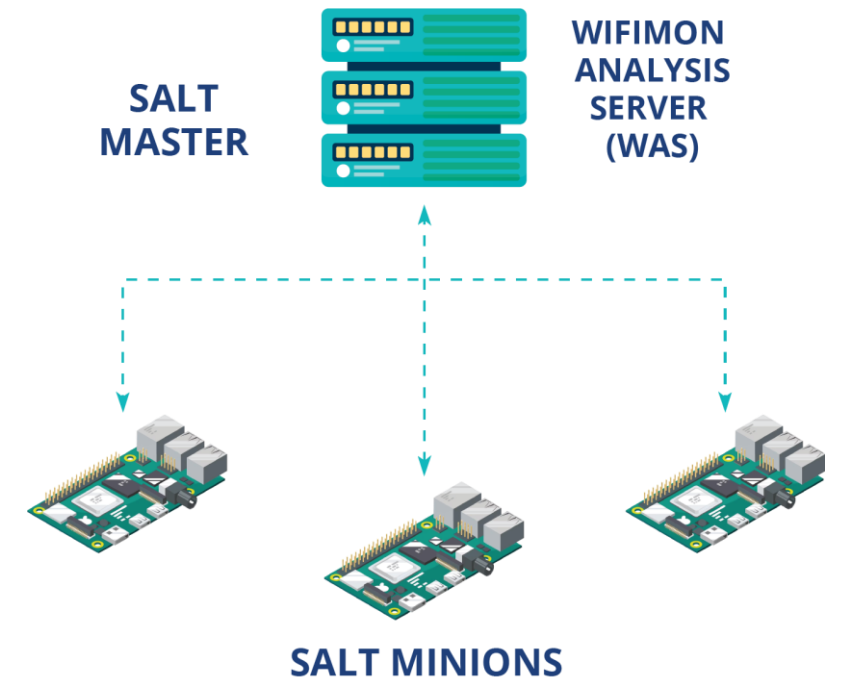
3

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

Based on Salt

WAS → Salt Master

WHPs → Salt Minions





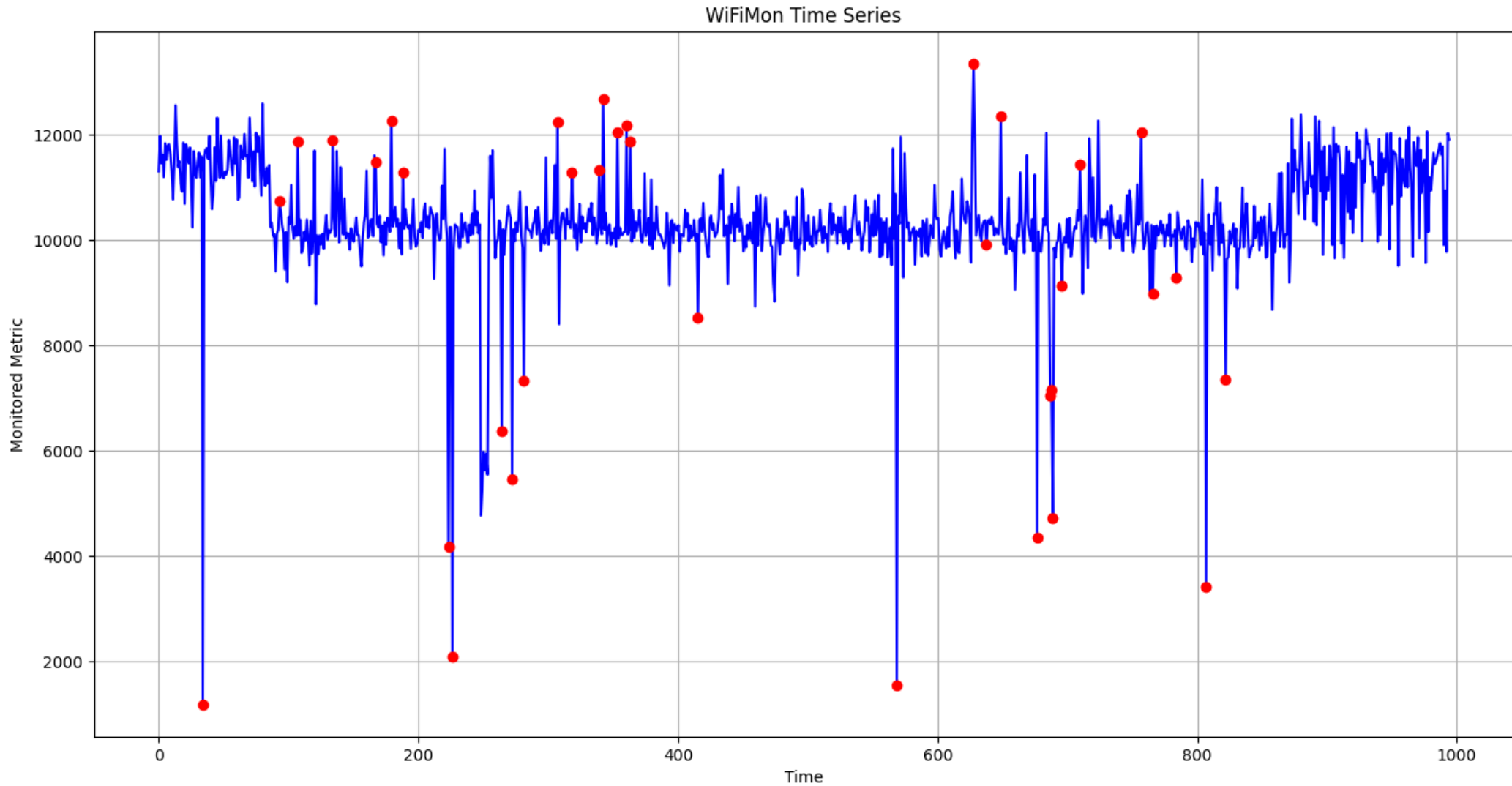
Basic Steps Towards Anomaly Detection

Older WiFiMon versions:

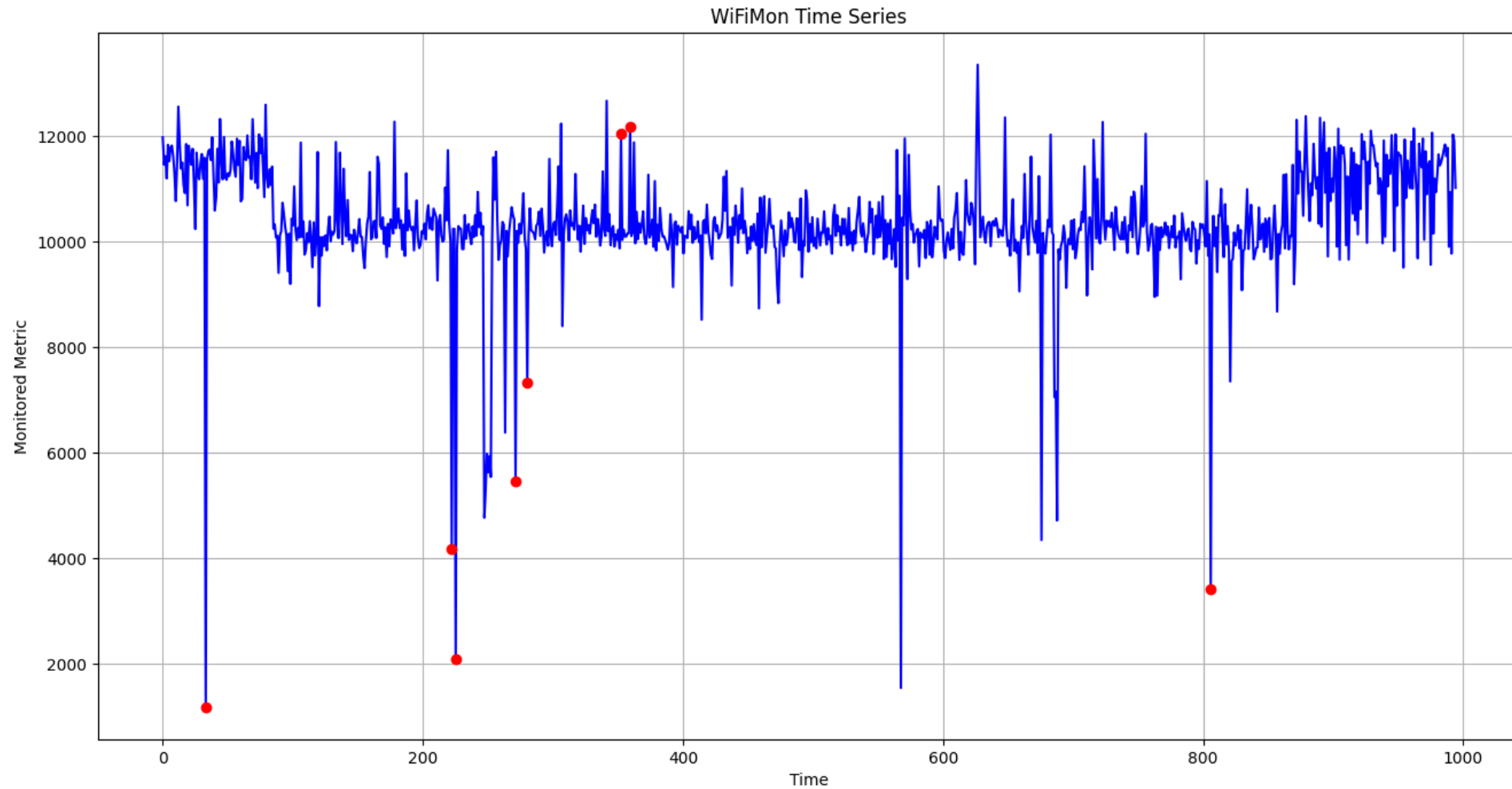
- WiFiMon administrators are expected to **manually** inspect measurements
- No mechanisms to automatically detect important throughput deviations

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**



Red dots indicate points that should be further inspected



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



Thank You

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

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

www.geant.org



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