

Energy Profiling of Fog-based Indoor Positioning Systems

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Outline

- > The main idea
- > What's fog?
- > The current situation
- > How to apply the fog?
 - The implementation idea
- > Energy Consumption
 - Theoretical and experimental approach
 - Battery Historian
- > Time schedule

The main idea

Premise:

> “I want to offload the resource intense computation”

The main idea

Why?:

>The resources of mobile devices are limited

Consequences:

>The produced data transfer and it's delays

What's fog?



What's fog? It's a local cloud

Figure 2. Fog Data Services Coordinate the Movement of Data from Fog to Cloud

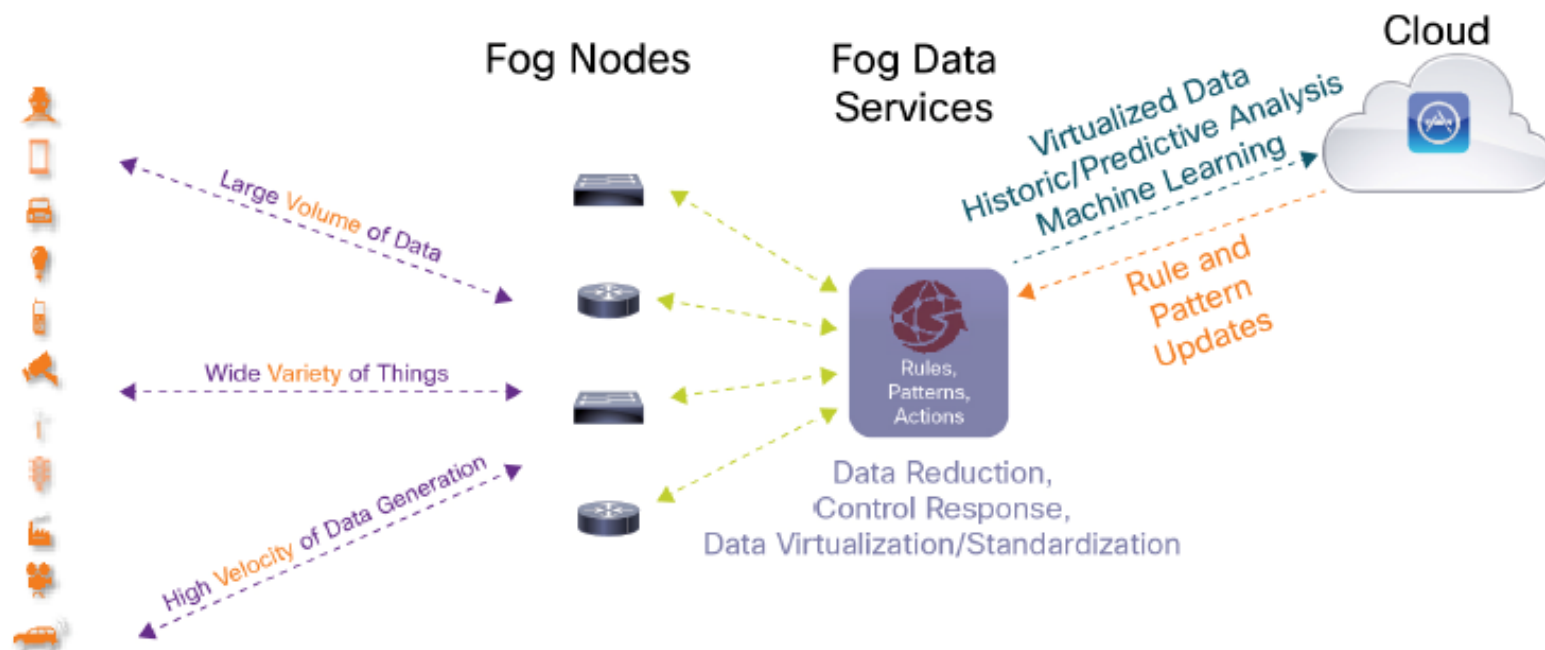


Figure: „Cisco Fog Computing Solutions: Unleash the Power of the Internet of Things“ from www.cisco.com

What's fog? It's a local cloud

> „Unleash the Power of the IoT“

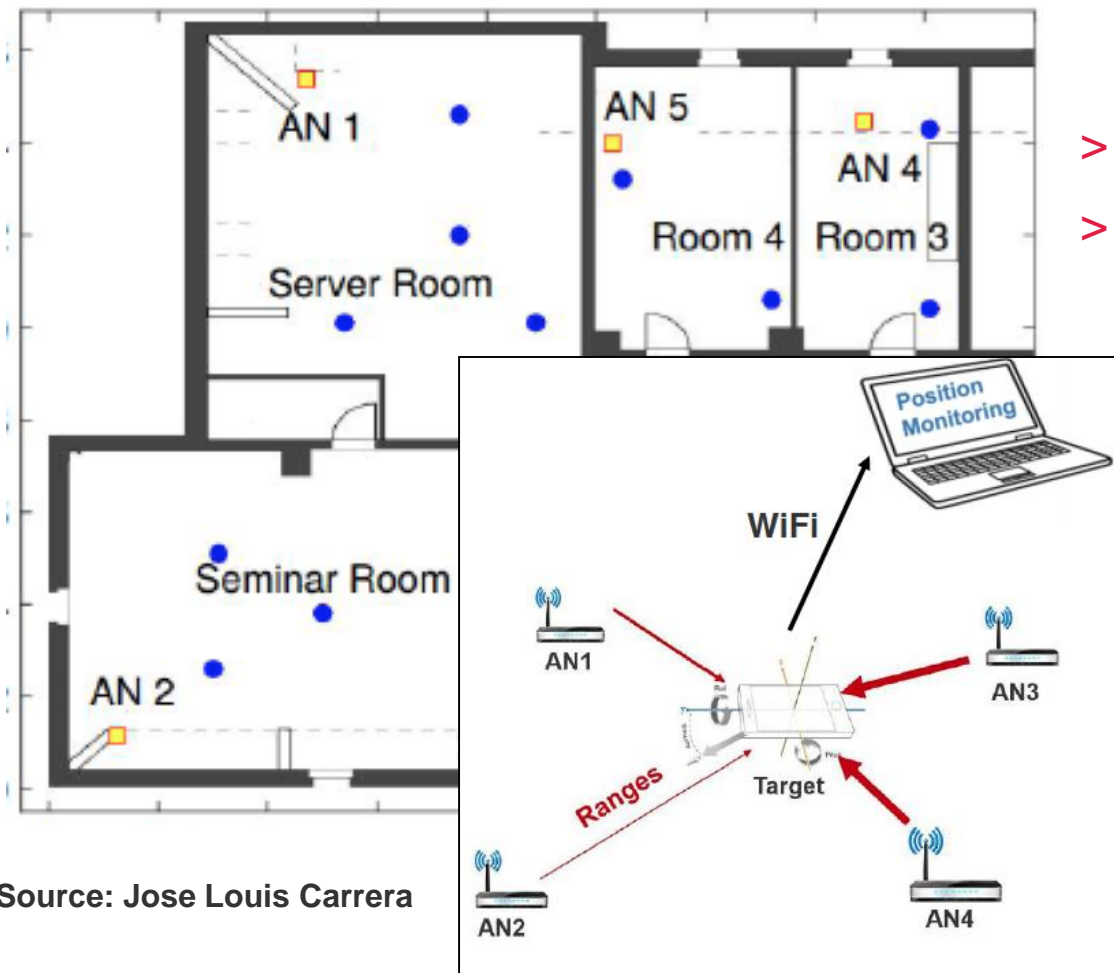
Advantages:

- > Network connectivity
- > Security
- > Fog applications
- > Data Analytics

- > Use cases
 - Traffic lights
 - Rails



The current situation

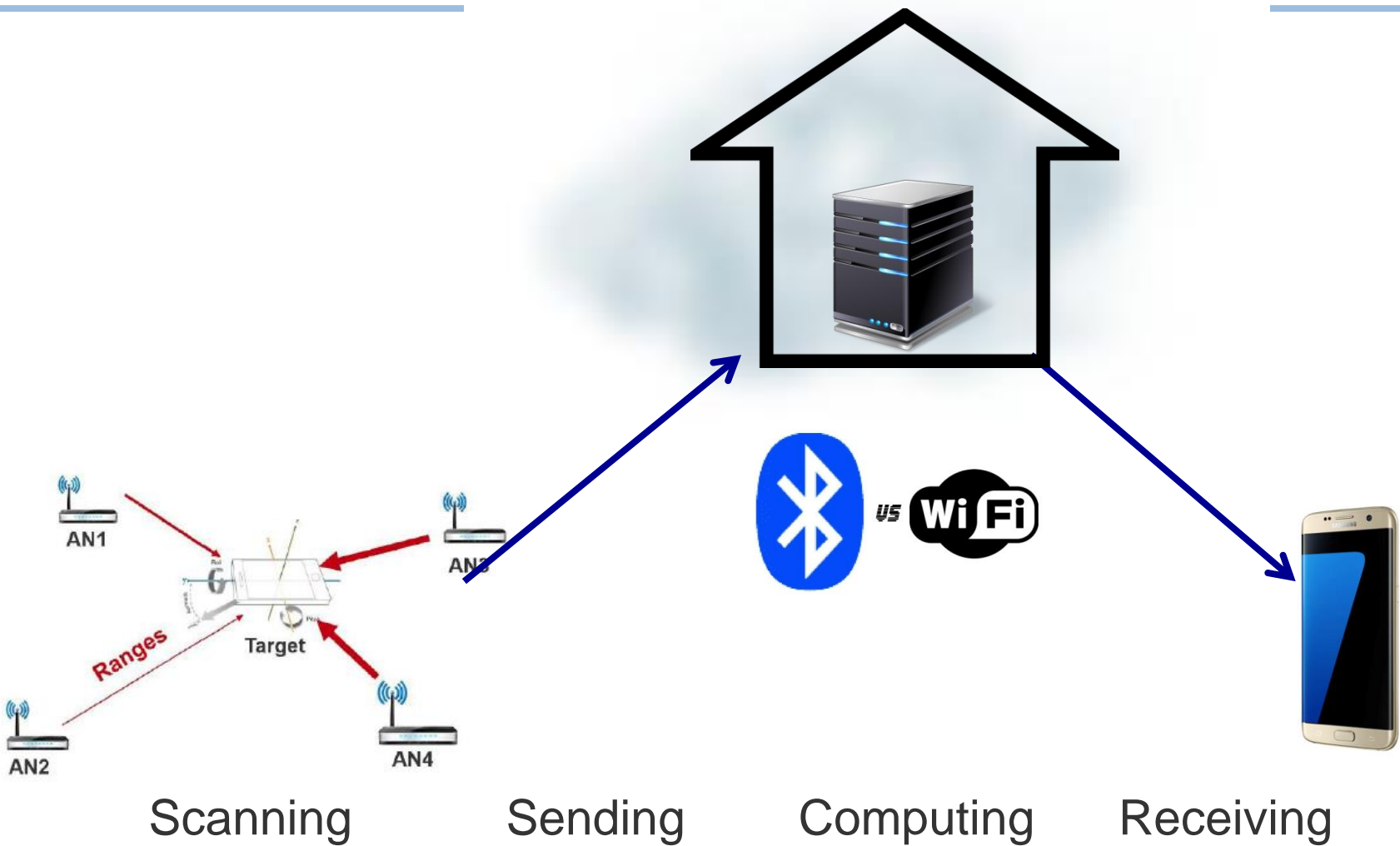


- > Scanning & Computing
- > Upload @ Checkpoints

- Requires:
- CPU
 - Energy
 - Real Time Data

Source: Jose Luis Carrera

How to apply the fog?



The Implementation

The Goals

- > Particle filter on a fog server
- > Interfaces needed

The Approach:

- > Iterative with vertical prototyping
 - App sending a string
 - App sending and returning the signal strength
 - Creating all the interfaces
 - Implementing a first particle filter (fed with mocked data)

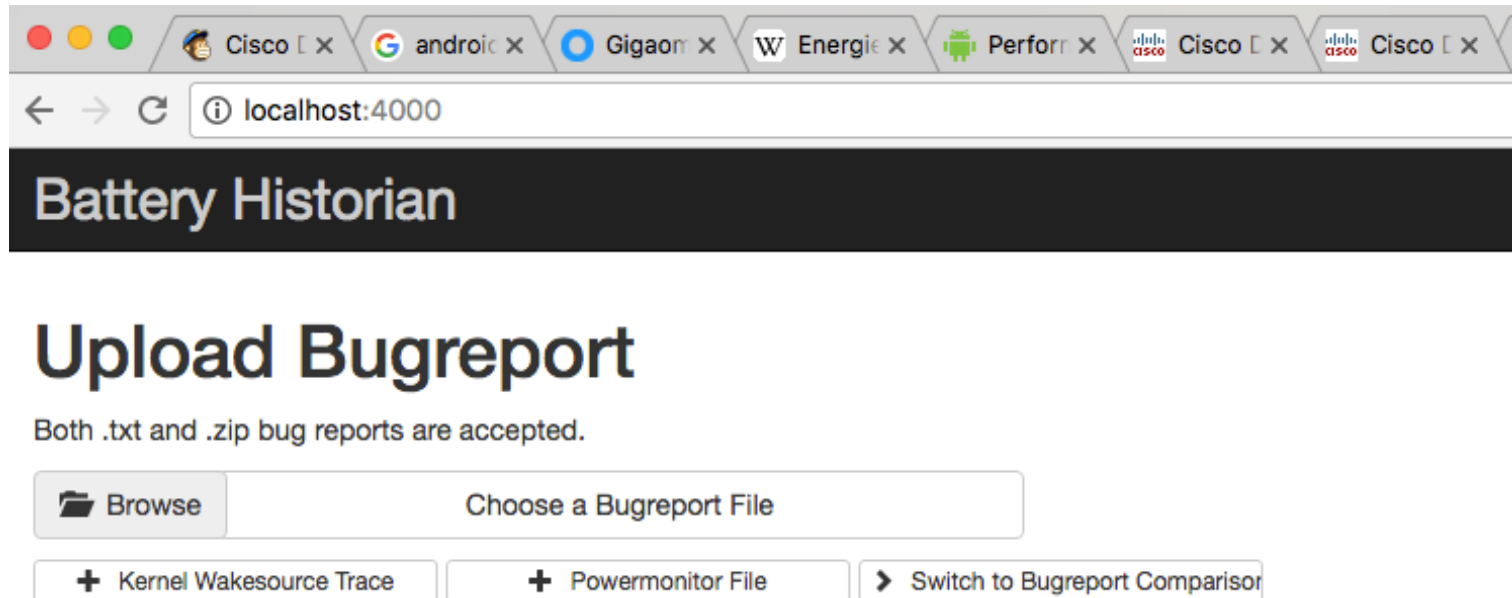
Energy Consumption – Local vs. Fog

- > Theoretical approach from omnet++:
 - Check energy consumption model of different wireless techniques

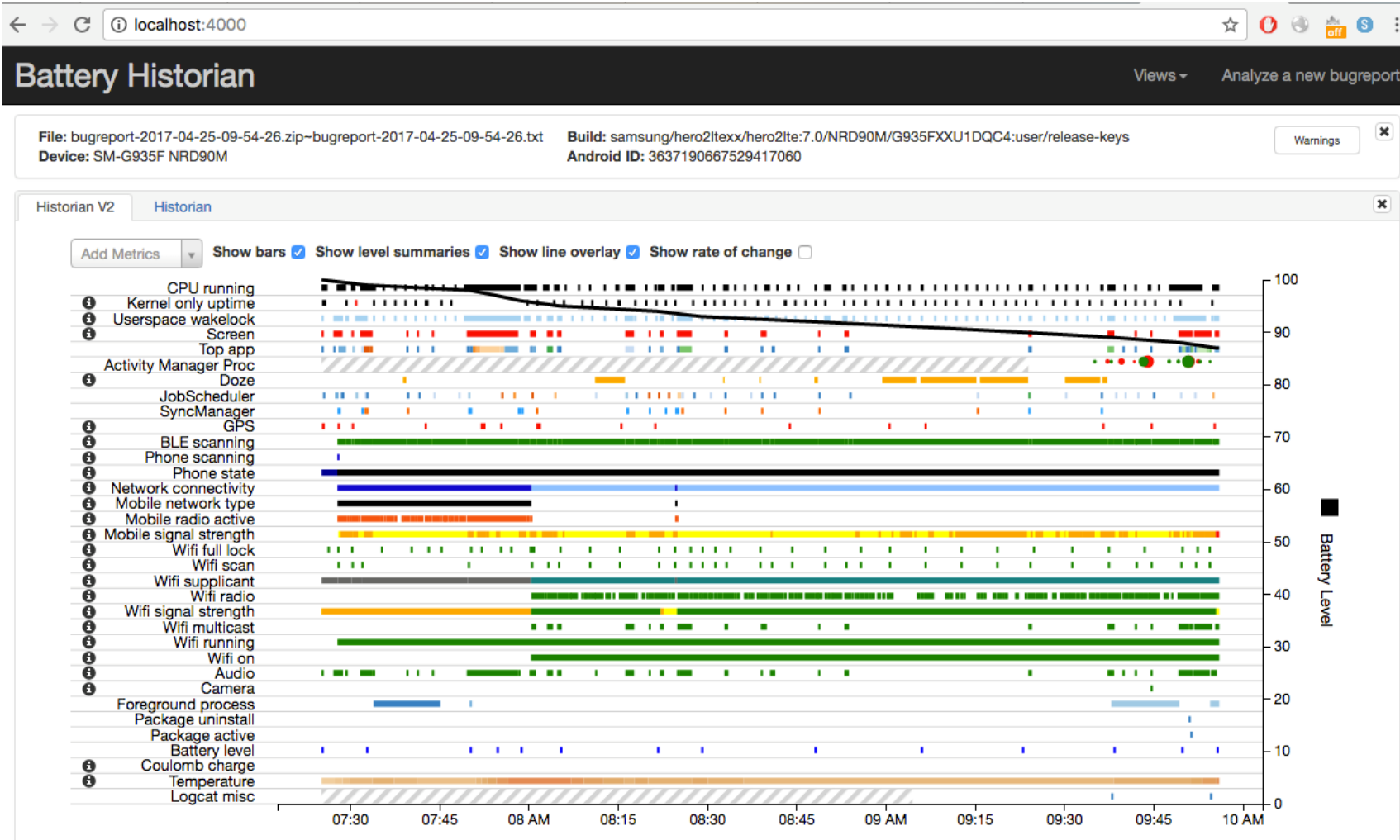
- > Experimental approach:
 - creating scenarios
 - profiling different types of phones
 - use more particle for the filter
(trade-off between delay & accuracy)
 - check fix and variable indicators using “Battery Historian”

Battery Historian

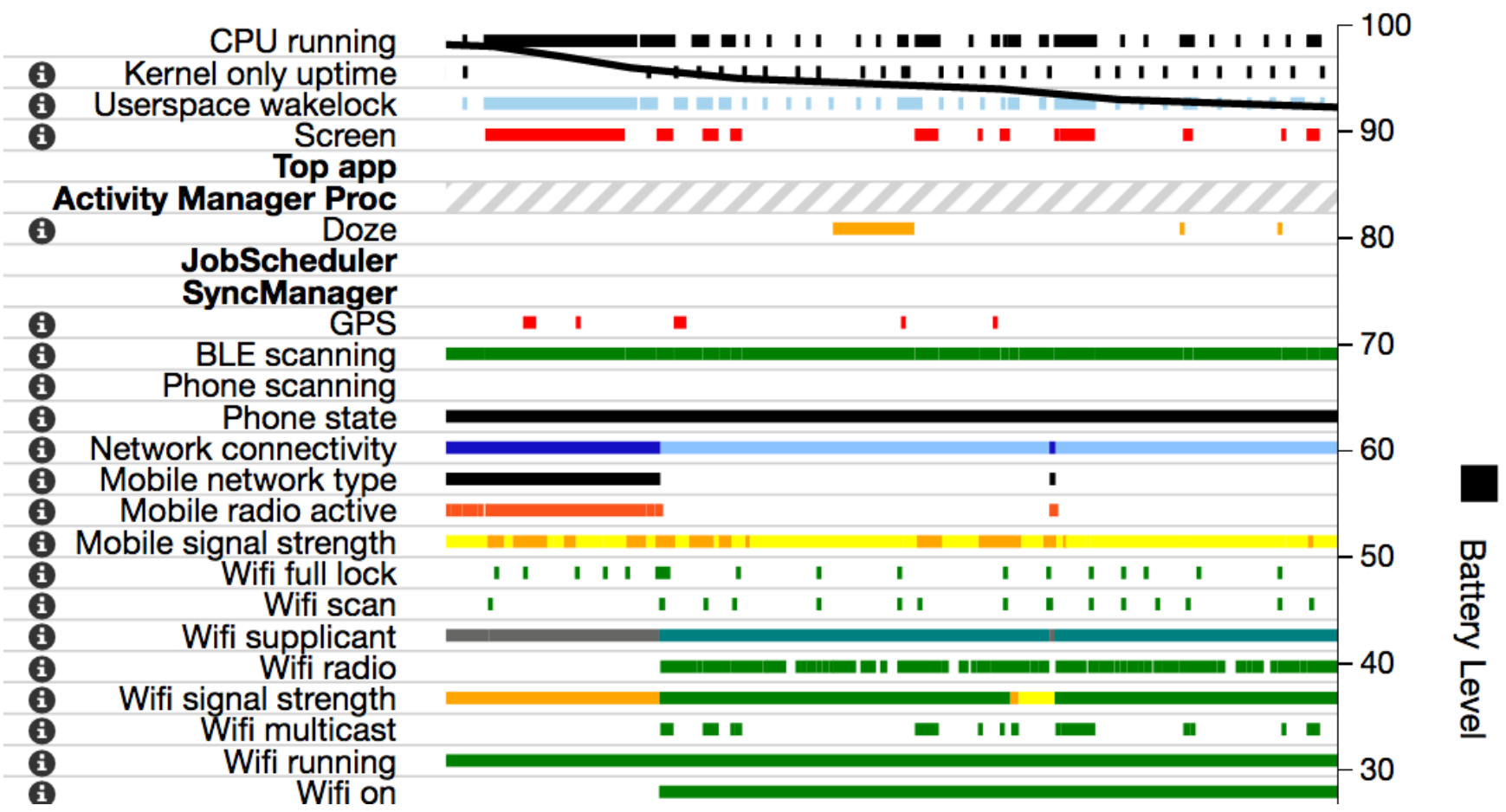
- > Phone with Android 7.0 Nougat
- > Create a Bugreport
- > Run the google Battery Historian in a Docker Container



Battery Historian



Battery Historian



Battery Historian

- Network Information:

Search:

Mobile data transferred	0.56 KB total (0.00 bytes received, 0.56 KB transmitted)
Wifi data transferred	104.54 KB total (18.34 KB received, 86.20 KB transmitted)
Mobile packets transferred	8 total (0 received, 8 transmitted)
Wifi packets transferred	501 total (219 received, 282 transmitted)
Mobile active time	804.75ms
Mobile active count	2
Full wifi lock time	2s 691ms
Wifi scan count	1
Wifi scan time	2s 511ms
Wifi idle time	16s 474ms
Wifi transfer time	1s 83ms total (1s 25ms receiving, 58ms transmitting)

Battery Historian

App Selection

Sort apps by

Name

WIFI (Uid: 1010)

Tables

- System Stats
- History Stats
 - Summary 0, 05:25-07:56, Apr 25
 - Device State Summary
 - DataConnectionSummary
 - ConnectivitySummary
 - PerAppSyncSummary
 - WakeupReasonSummary
 - FirstWakelockAfterSuspend
 - ForegroundProcessSummary

System Stats History Stats App Stats

Copy

Application	WIFI
Version Code	
UID	1010
CPU user time	3s 25ms
CPU system time	12s 885ms
Device estimated power use due to CPU usage	0.00%

Network Information:

Search: Copy

Full wifi lock time	
Wifi scan count	8
Wifi scan time	14s 892.50ms
Wifi idle time	0s
Wifi transfer time	3s 933ms total (3s 249ms receiving, 684ms transmitting)

Time schedule

Till now:

- > Study the provided papers
- > Got familiar with the functionality of particle filters, Android Studio and its different Tools
- > Made some thoughts about energy consumption
- > Running environment

Next steps:

- > Start implementing a client-server application
- > Get familiar with the provided code
- > Learn about the different data transfer options
- > Check out omnet++

Thanks a lot for your attention!

Any Suggestions or Questions?