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#### **Energy Profiling of Fog-based Indoor Positioning Systems**

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# Outline

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- > 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

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Premise:

"I want to offload the resource intense computation"

# The main idea



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Why?:

>The resources of mobile devices are limited

Consequences:

>The produced data transfer and it's delays

# What's fog?

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# What's fog? It's a local cloud

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#### 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





### How to apply the fog?



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# **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**

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- > 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"



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



# **Upload Bugreport**

Both .txt and .zip bug reports are accepted.



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#### Network Information:

	Search: Copy
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)



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App Selection		System Stats History Stats App Stats		
Sort apps by				Garry
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WIFI (Uid: 1010)	c 🔻	Application	WIFI	
Tables		Version Code		
System State		UID	1010	
		CPU user time	3s 25ms	
<ul> <li>✓ History Stats</li> <li>Summary 0, 05:25-07:56, Apr 25</li> </ul>		CPU system time	12s 885ms	
		Device estimated power use due to CPU usage	0.00%	
Device State Summary		Network Information:		
DataConnectionSummary			Search:	Copy
ConnectivitySummary				
Der App Strac Summan		Full wifi lock time		
PerAppSyncSummary		Wifi scan count 8		
WakeupReasonSummary		Wifi scan time 14s 892.50ms		
FirstWakelockAfterSuspend ForegroundProcessSummary		Wifi idle time 0s		
		Wifi transfer time 3s 933ms total (3s 249ms receiving, 684ms transmitting)		

# Time schedule



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#### 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
- Set familiar with the provided code
- Learn about the different data transfer options
- > Check out omnet++



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#### Any Suggestions or Questions?