EDGEFOG
NODE ELECTION AND ASSIGNMENT TO INCREASE LOCAL PROCESSING

Prepared By: Mohammad Shbiri, Akram Zaben, Amjad Arbasi

Supervisor: Dr. Othman Othman

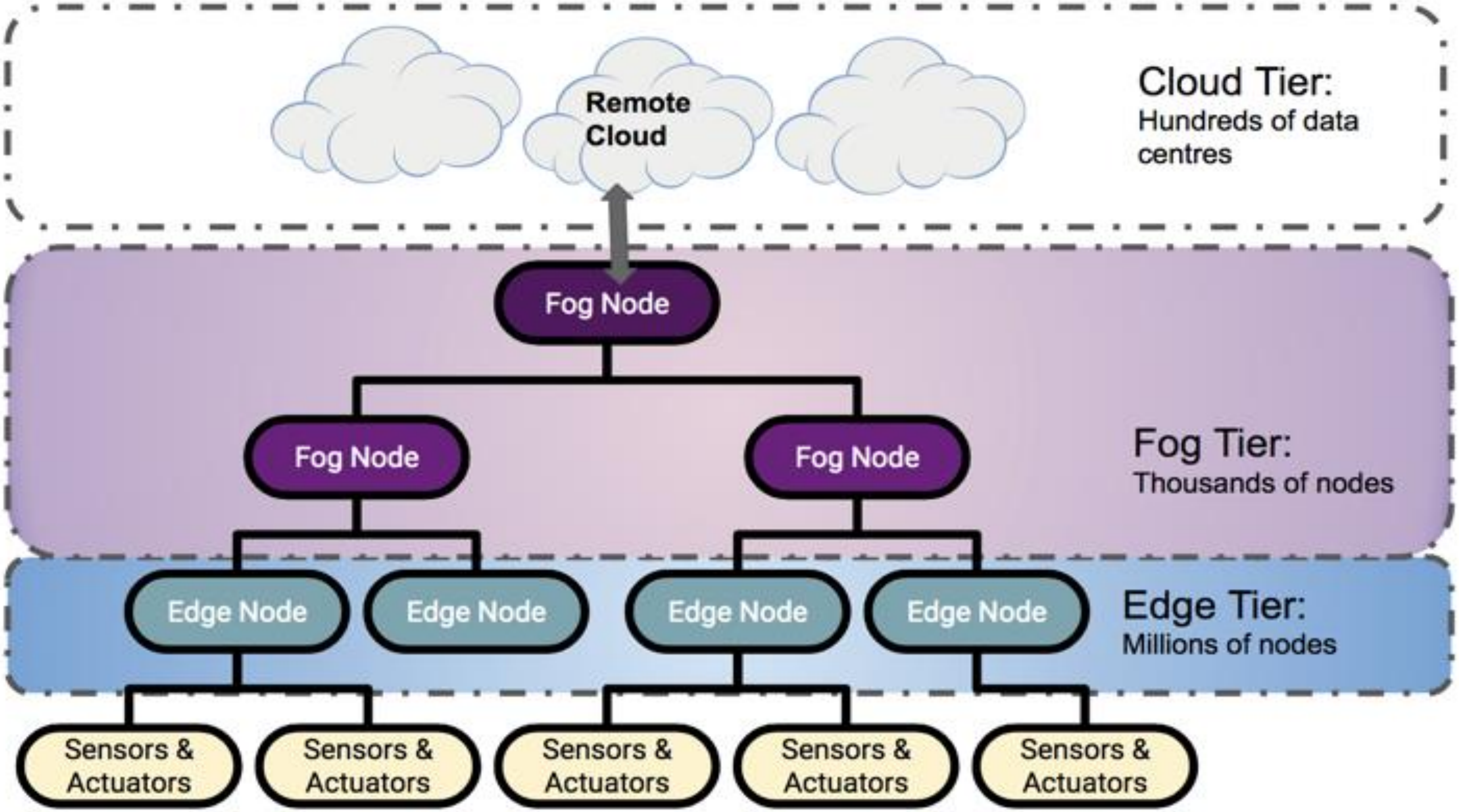
Outline

- Introduction
- Motivation
- Orchestrator
- System Architecture
- Algorithm and Design
- Simulation

Introduction

What is fog?

- Cloud models are not adequate
- Fog computing solves the limitations in cloud-based infrastructures.
- can be deployed anywhere in the network
- 3-tier architecture



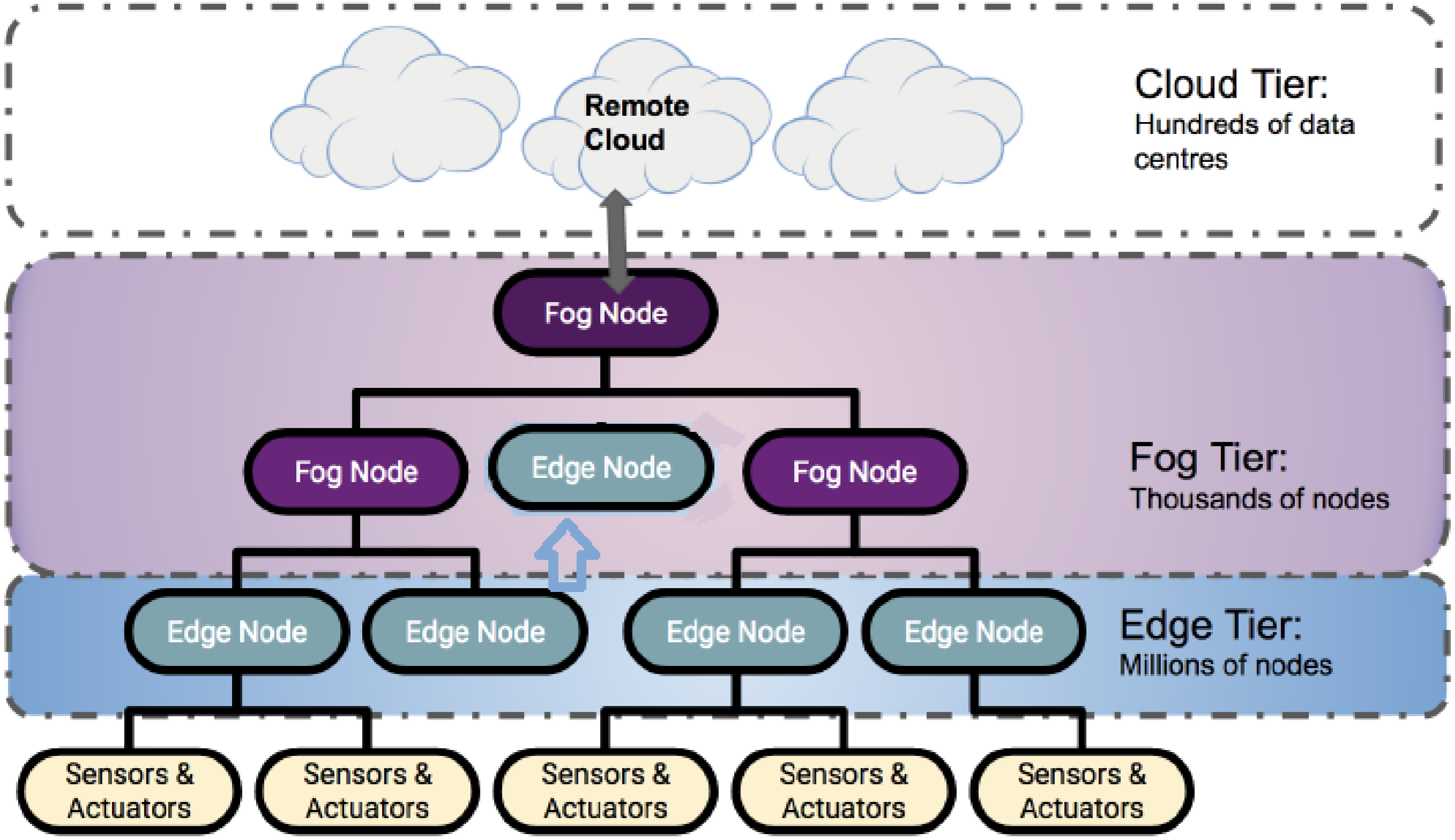
Remote Cloud
Cloud Tier:
Hundreds of data centres
Fog Node
Fog Node
Fog Node
Fog Tier:
Thousands of nodes
Edge Node
Edge Node
Edge Node
Edge Node
Edge Tier:
Millions of nodes
Sensors & Actuators
Sensors & Actuators
Sensors & Actuators
Sensors & Actuators
Sensors & Actuators

Benefits of the fog

- Low latency
- Loss of connection is nearly impossible
- Optimizing cost.
- Improved Security
- Power-efficiency

Fog computing vs EdgeFog computing

	Fog-Computing	EdgeFog-Computing
Latency	Low Latency	Lower Latency
Cost-Benefits analysis	With a small number of fog nodes can be overwhelmed with hundreds of IoT sensors, e.g. an engine fitted with 5,000 sensors can generate up to 10 GB of data per second.	Increases number of fog nodes distributing the load as shown in figure 2
Availability	Adequate availability	Increased Availability as the number of fog devices increased
CPU Utilization	60% fog, 20% cloud	25% fog, 10% cloud



Remote Cloud
Cloud Tier:
Hundreds of data centres
Fog Node
Fog Node
Edge Node
Fog Node
Fog Tier:
Thousands of nodes
Edge Node
Edge Node
Edge Node
Edge Node
Edge Tier:
Millions of nodes
Sensors & Actuators
Sensors & Actuators
Sensors & Actuators
Sensors & Actuators
Sensors & Actuators

The main contributions of our project

- Fog computing environment consisting of multiple tiers
- Algorithm to decide which edge node is capable of performing fog node tasks
- Conducting performance analysis with various simulations

Orchestrator

- What is the fog Orchestrator
- Responsibilities of the orchestrator

Orchestrator responsibilities

- Scheduling
- Discovery
- Security
- Monitoring

System Architecture

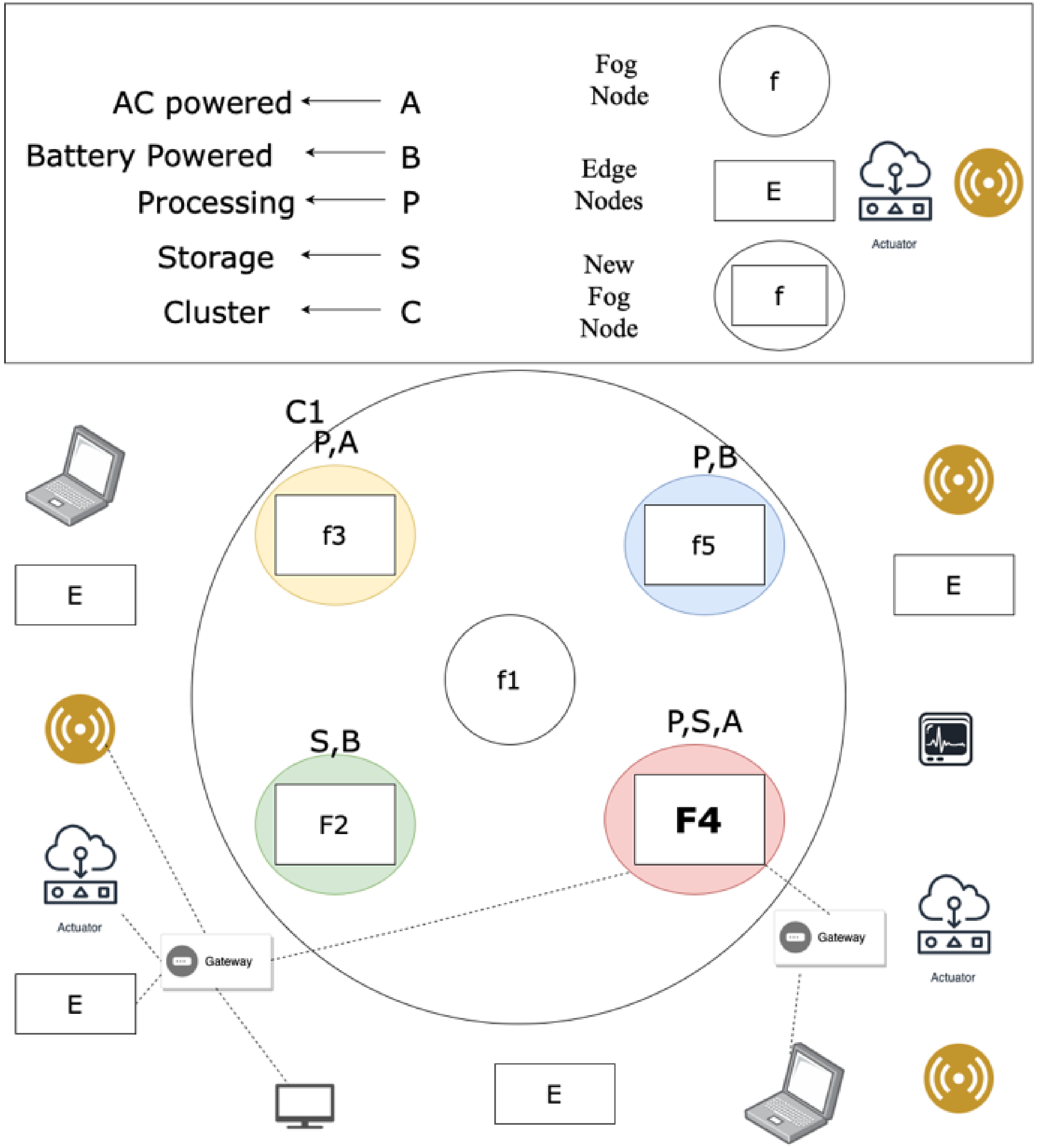
- To have a better understanding of the context; consider the following scenario
- The problem with cloud only scenario.
- Our project main objective is to increase the number of fog nodes by utilizing edge devices like tablets, TVs, receivers, laptops/PCs into fog nodes

Detailed Scenario

- First, we have multiple subnets; each considered an Area. The protocol is running on an existing fog node. and in every desired Area there would be a fog cluster that consists of fog orchestrator and many fog nodes.
- Information Query
- Information Response
- Inform Orchestrator
- Orchestrator Advertisement
- Information Advertisement

Message Types

Message Type	Size (bytes)	Description
IQ	12	Edge nodes capabilities request
IR	30	Edge nodes send their performance metrics to the initial fog node
IOR	20	Informing the best fog, that it became an orchestrator and a list of fog nodes
OA	12	Inform all nodes of the orchestrator
IA	30	Keep-alive and status monitoring



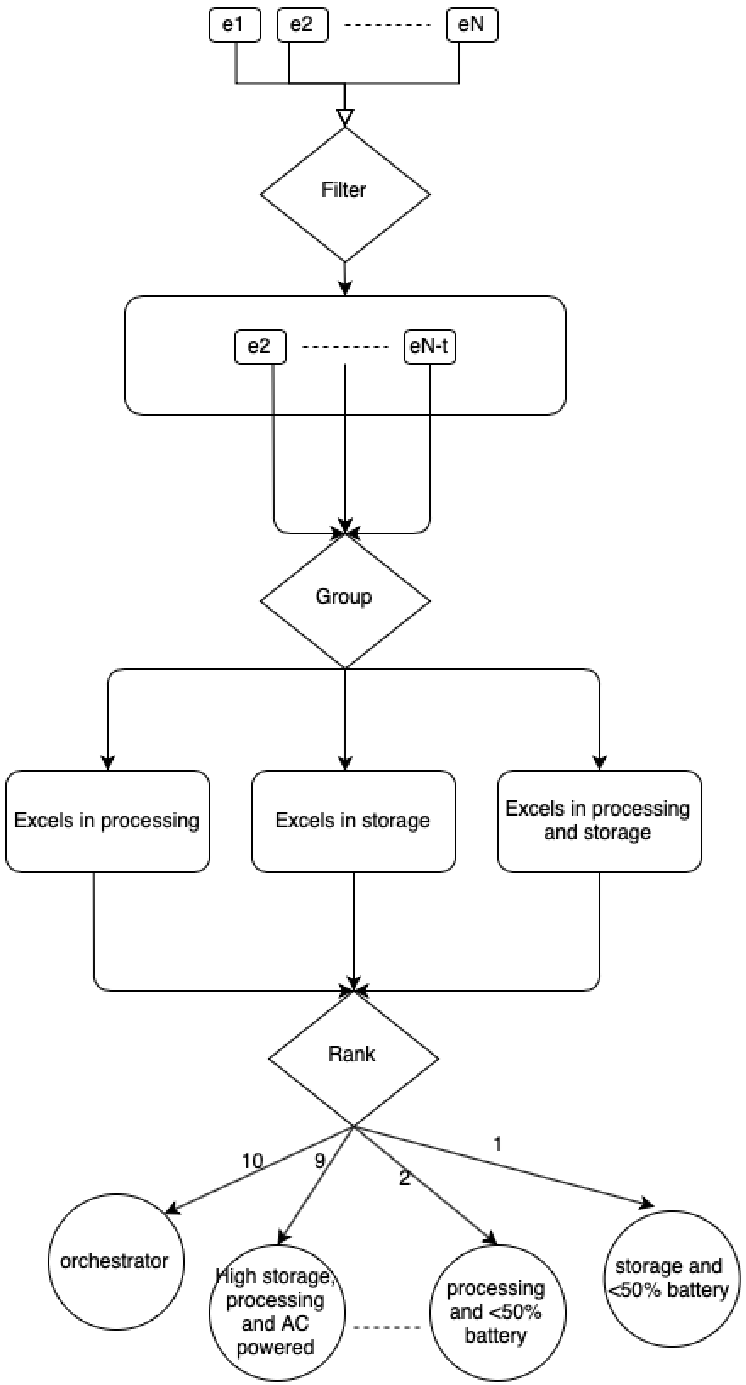
AC powered A
Battery Powered B
Processing P
Storage S
Cluster C
Fog Node
f
Edge Nodes
E
Actuator
New Fog Node
f
C1
P,A
f3
P,B
f5
f1
S,B
F2
P,S,A
F4
E
E
E
E
Actuator
Actuator
Gateway
Gateway

Fog orchestrator will place that service on

- The orchestrator itself
- The fog node responsible for the requested service type.
- neighboring cluster
- Cloud (Healthcare example)

Selection algorithm consists of 3 stages

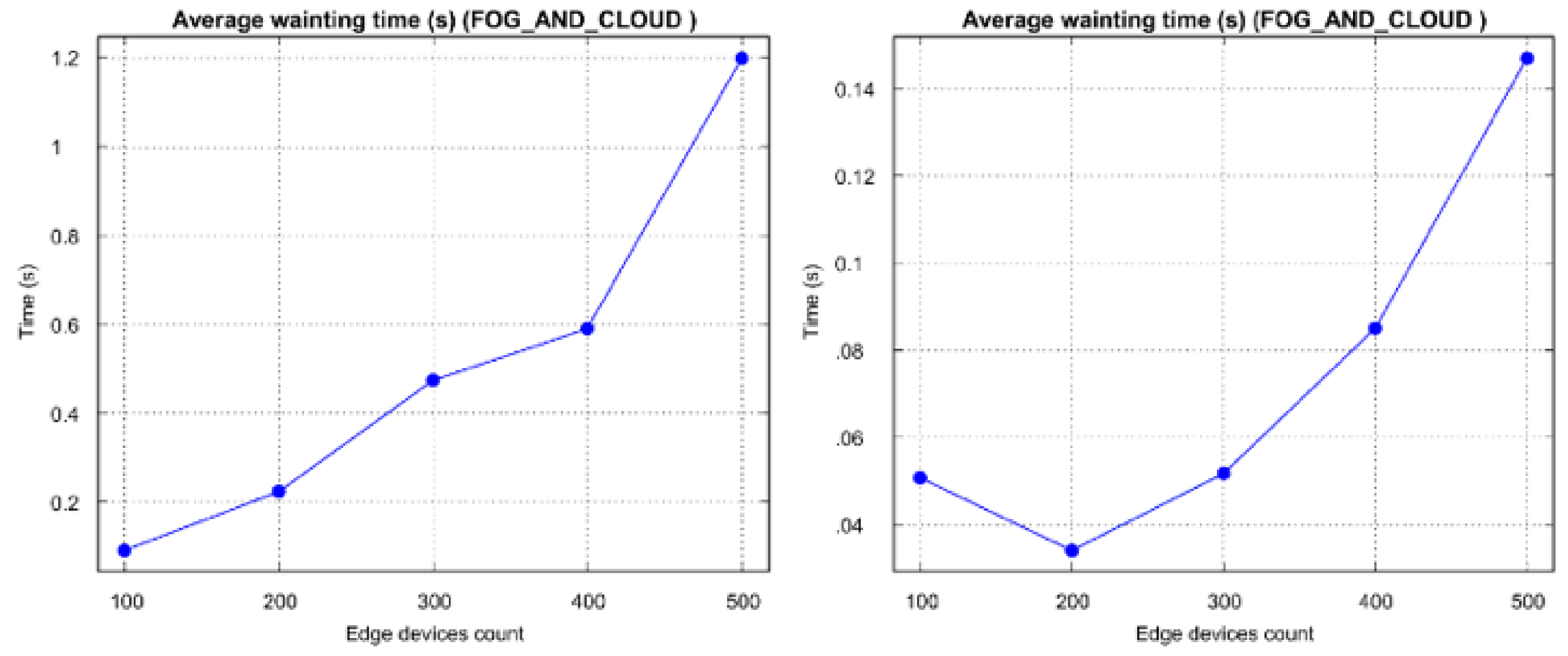
- Filtration
- Grouping
- Ranking


e1
e2
eN
Filter
e2
eN-t
Group
Excels in processing
Excels in storage
Excels in processing and storage
Rank
10
9
2
1
orchestrator
High storage, processing and AC powered
processing and <50% battery
storage and <50% battery

Fault Tolerance

- Faults in fog environments
- In addition to the above, catering to IoT edge nodes would face increased loss of connectivity
- Fog Orchestrator failure
- Fog node failure

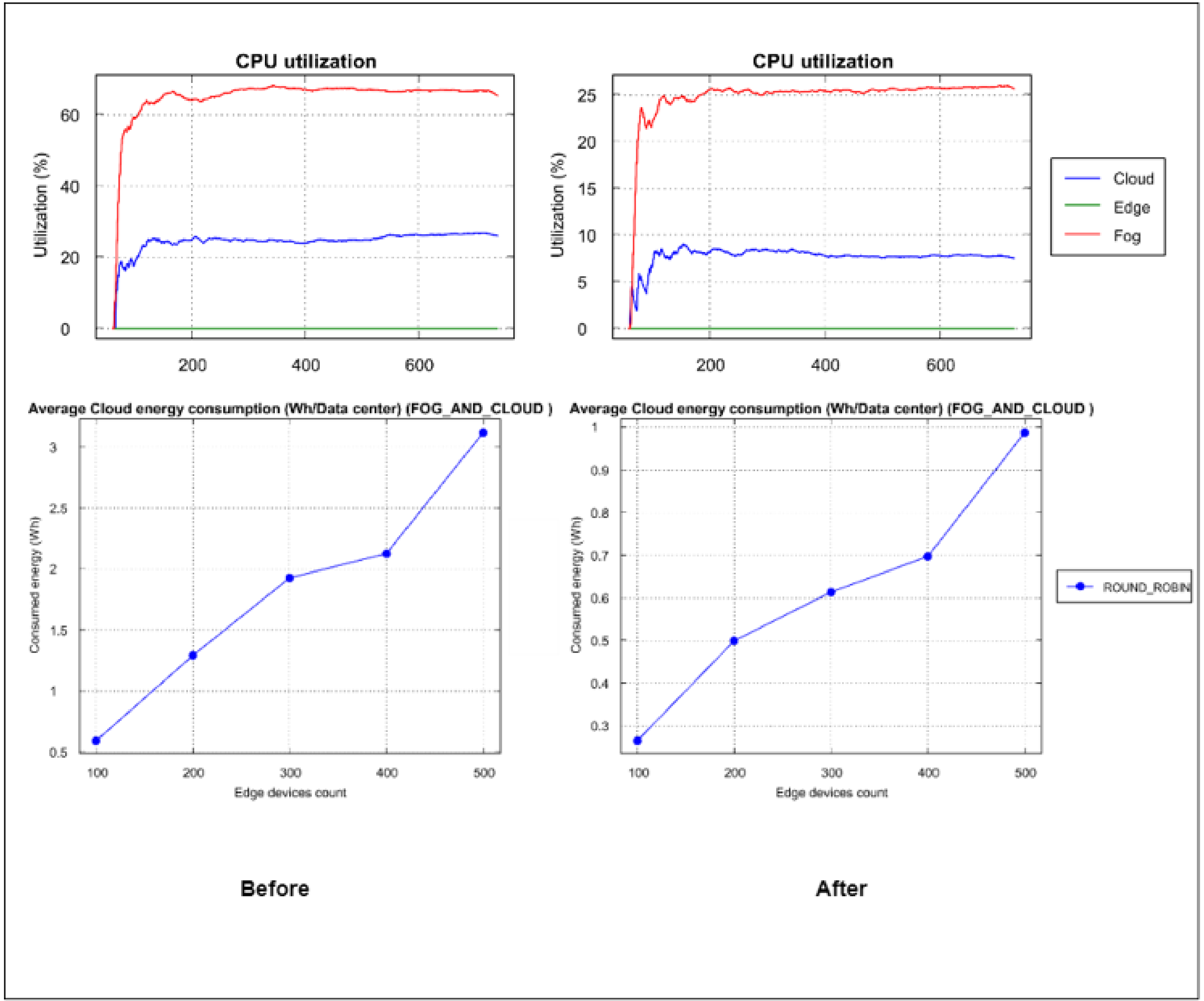
Simulation



Before

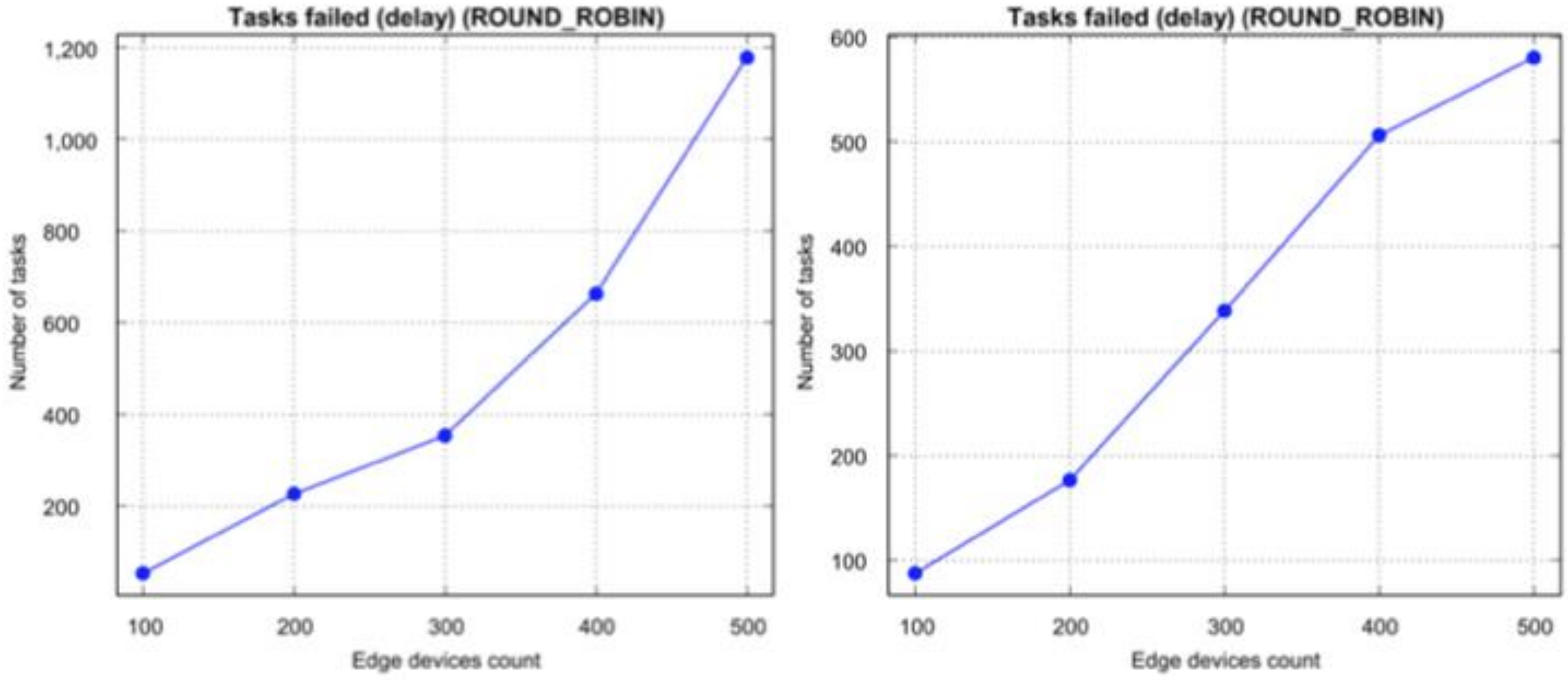
After

Simulation



CPU utilization
Utilization (%)
60
40
20
0
200
400
600
CPU utilization
Utilization (%)
25
20
15
10
5
0
200
400
600
Cloud
Edge
Fog
Average Cloud energy consumption (Wh/Data center) (FOG_AND_CLOUD)
Consumed energy (Wh)
3
2.5
2
1.5
1
0.5
100
200
300
400
500
Edge devices count
Average Cloud energy consumption (Wh/Data center) (FOG_AND_CLOUD)
Consumed energy (Wh)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
100
200
300
400
500
Edge devices count
ROUND_ROBIN
Before
After

Simulation



Before

Before

Thank You

Overhead estimation

- The scenario consists of 1 fog node and 100 edge nodes.
- • L1 overhead - preamble, IPG: 8+12 = 20 bytes
- • L2 overhead - Ethernet header, FCS = 18 bytes
- • L3 overhead - EdgeFog header = 104 bytes
- The L3 maximum packet size of 1500 results in a total L1 data
- size of 1500+18+20 = 1538 bytes and a maximum L3 payload size
- of 1500-104 = 1396 bytes.
- • Overhead: (104+20+18)/1538 *100% = 9.23%
- • Efficiency: 1396/1538 *100% = 90.76%