Internet Society
Pulse

MIRA – a platform to measure Internet resilience in real-time

Amreesh Phokeer
phokeer@isoc.org

Motivation

The Straits Times

Why am I not getting the broadband speeds I paid for?

SINGAPORE - Singapore is gearing up to equip more households with 10Gbps broadband networks, providing $100 million worth of grants to help...

5 Aug 2024

Security.org

ISP Throttling: How Do You Know If You're Being Throttled?

One way you can tell if your ISP is throttling your speeds is by using a VPN. In many cases, ISPs throttle you based on your IP address.

3 Oct 2021

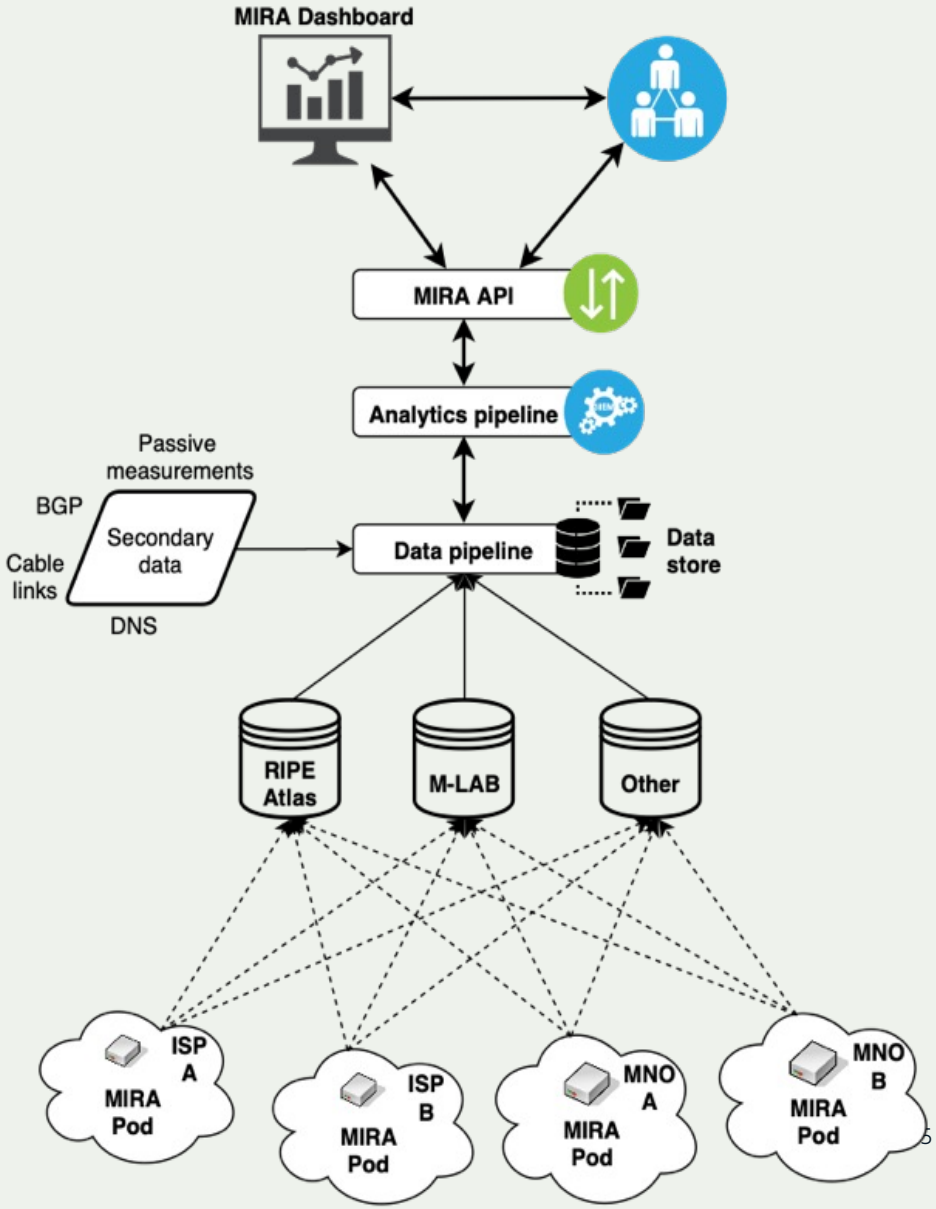
Real-time measurements

Why we need real time measurements?

- Real time measurements help show an accurate picture of the Internet experience on the ground
- Using an active measurement platform allows for real time measurements to be conducted.
- Such measurements can be done on a small network or over a large geographical area.
- As part of the initial phase of the Internet Resilience project, the Internet Society developed a proof-of-concept active measurement infrastructure consisting of measurement devices (pods), OpenBalena management server and client, and Data aggregation server.
- More of a blueprint that others can replicate

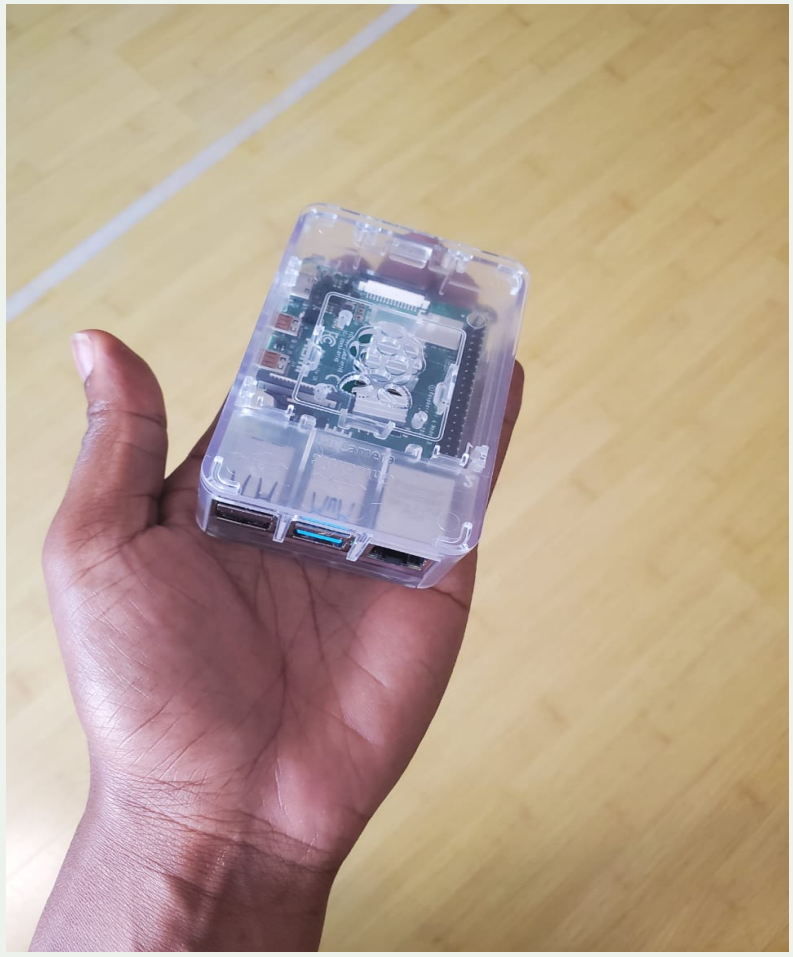
Prototype active measurements infrastructure

- Use of Raspberry Pis as hosts to run the RIPE Atlas & M-Lab clients for real time measurements (MIRA Pods)
  - NDT7: Speed and latency
  - RIPE Atlas: Traceroute, ping, DNS, SSL, etc
- Devices send data to a local server for storage and visualization (M-Lab).
- Documentation of this project available allowing for the management and deployment of a distributed measurement network to city wide or national scale

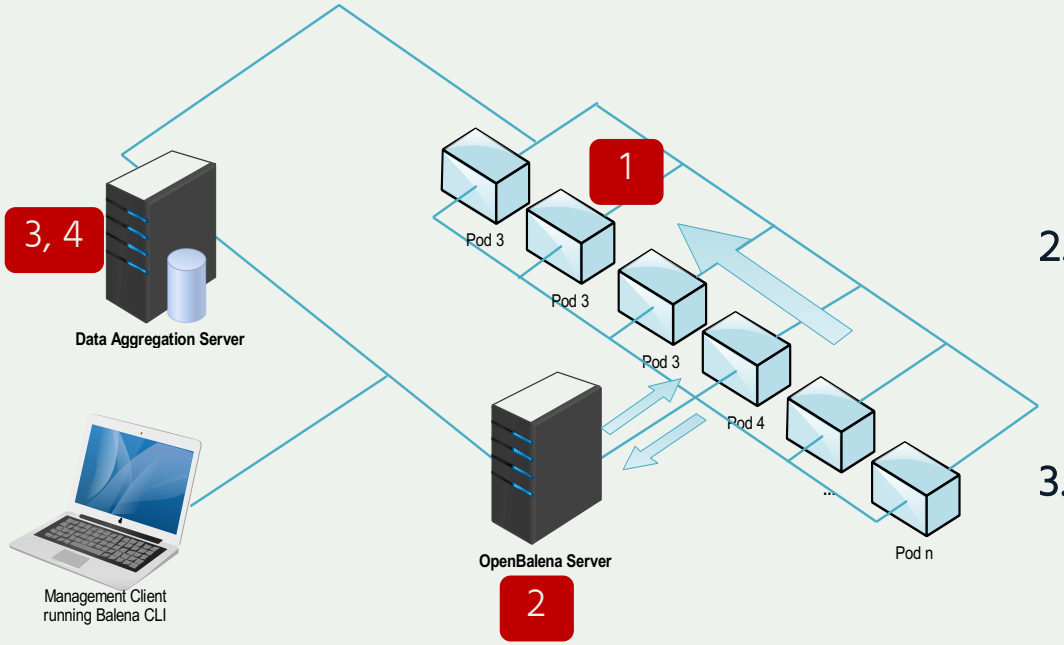


Measurement infrastructure in the project

- RIPE Atlas & M-Lab clients/servers were used in 10 countries
- Raspberry PIs used as hosts to run the RIPE Atlas & M-Lab clients on Balena OS
- Measurements carried out every 6 hours (NDT7 -> Target servers)
- Measurement servers setup to increase measurement targets in Africa



Components of the active measurements



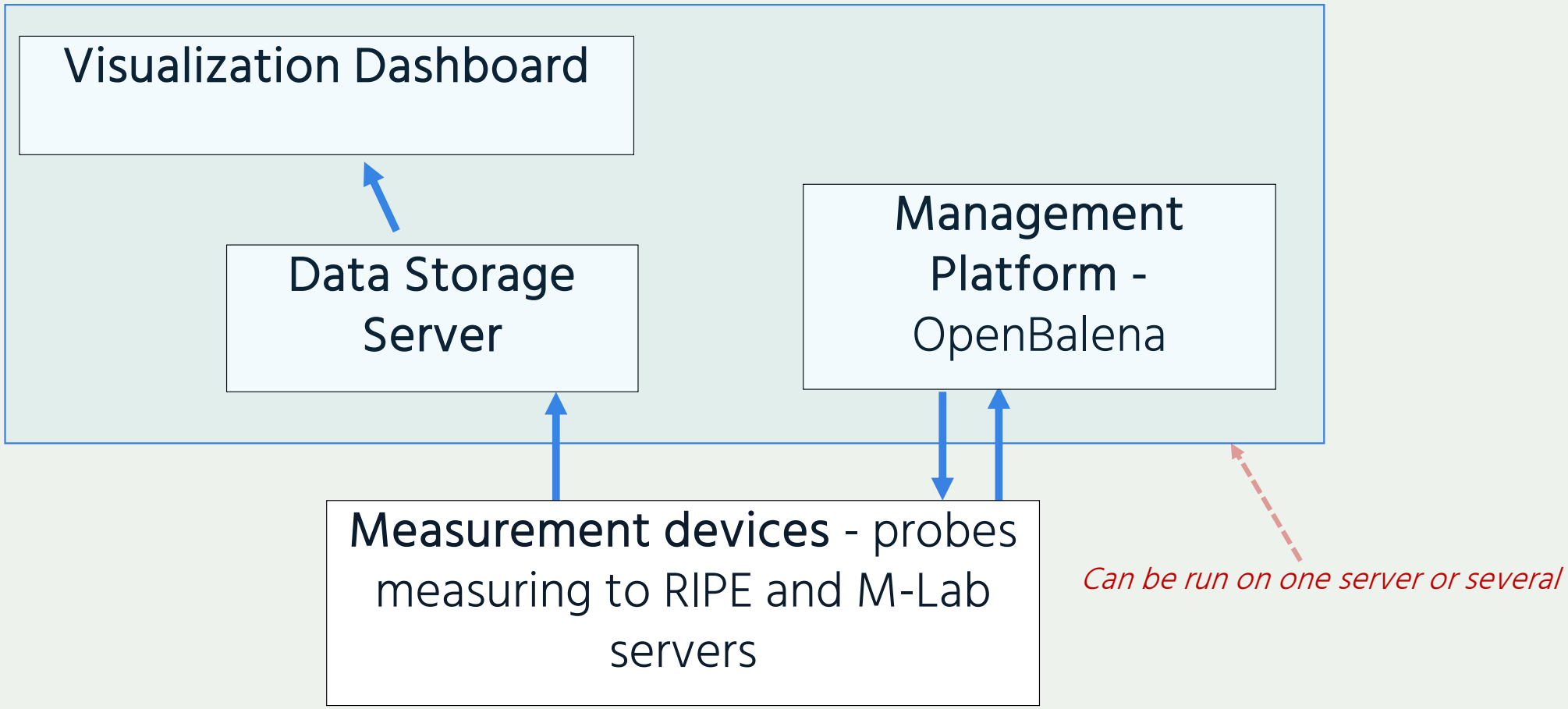
1. **Measurement devices (pods)**: These are low power and lightweight measurement devices deployed in various parts of the network to carry out the actual measurements

2. **Management Platform**: The platform allows management of pods remotely over the Internet.

3. **Data Aggregation Server:** As measurements are carried out, data is received from pods and stored in a data collection server for processing.

4. **Visualization Dashboard:** To visualize the data being collected and extract meaningful information,

Overview of the design of the process



Features of OpenBalena Management Platform

1. Device Management: View device status, update software, monitor performance, and troubleshoot issues remotely.

2. Application Deployment: (OTA) over the air updates using OpenBalena. This makes it easy to distribute and update software on a large number of devices.

3. Security: It supports secure communication between devices and the central management server.

4. Customization: Customize OpenBalena to suit your specific IoT project requirements. Eg: defining device types, configuring network settings, etc

5. Cost-Efficiency: As an open-source solution, OpenBalena can help reduce the costs associated with managing IoT devices compared to proprietary alternatives such as BalenaCloud

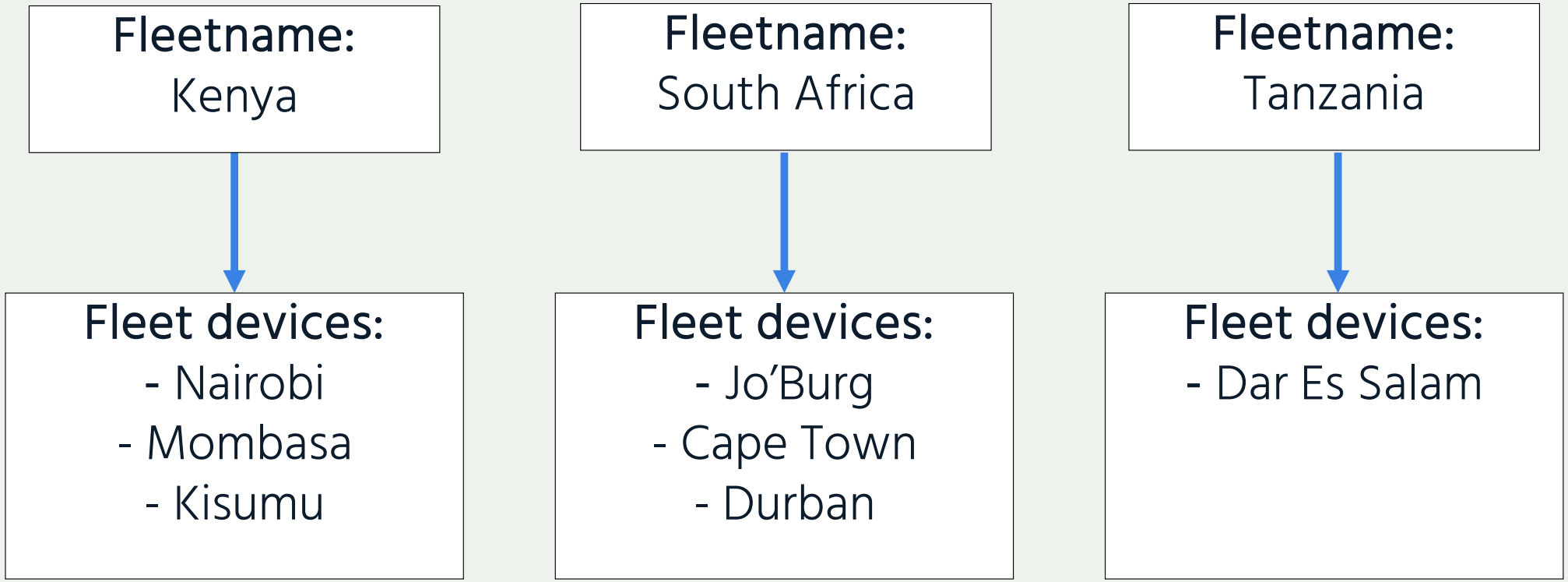
Server Setup

1. OpenBalena server – any Linux distro (used Debian/Ubuntu)
2. Storage server – any Linux/Unix distro that can run SSH (used Debian/Ubuntu)
3. Visualization server – any Linux distro (used Debian/Ubuntu)

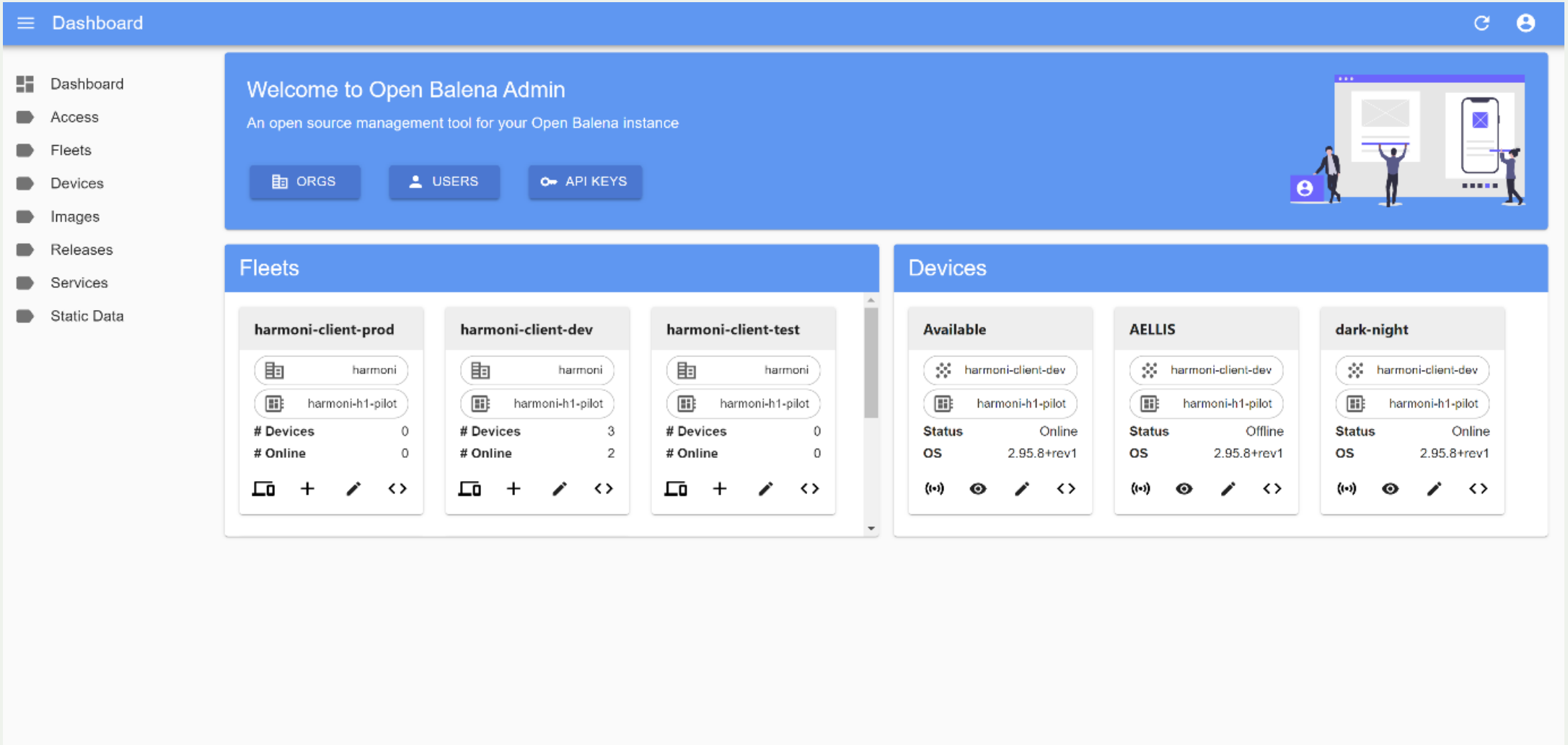
RPi Setup

1. Create installable image on a PC for each fleet
2. Copy image to the RPI's removable SSD disk
3. Boot the RPi
4. RPi is then visible on the OpenBalena dashboard

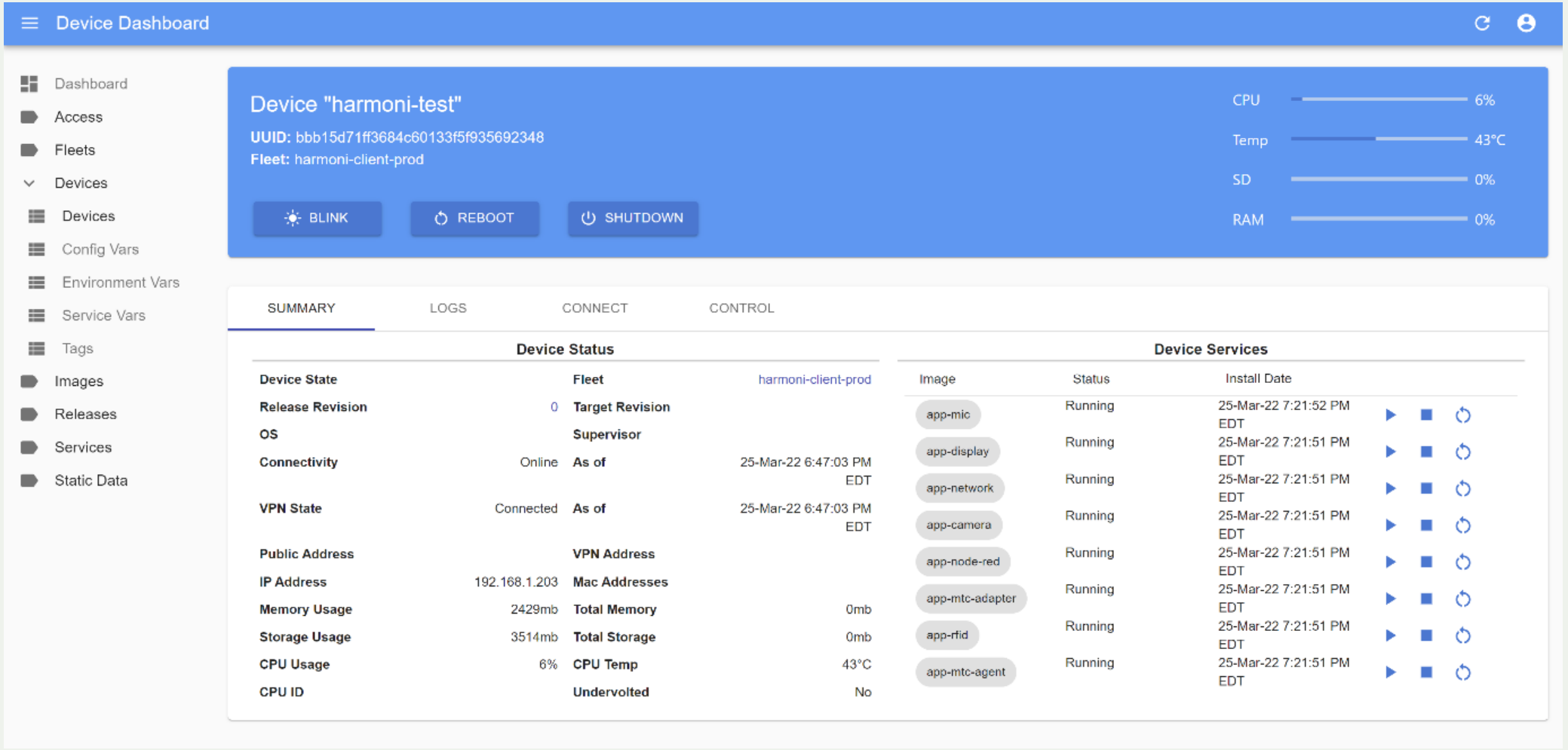
Fleet Design



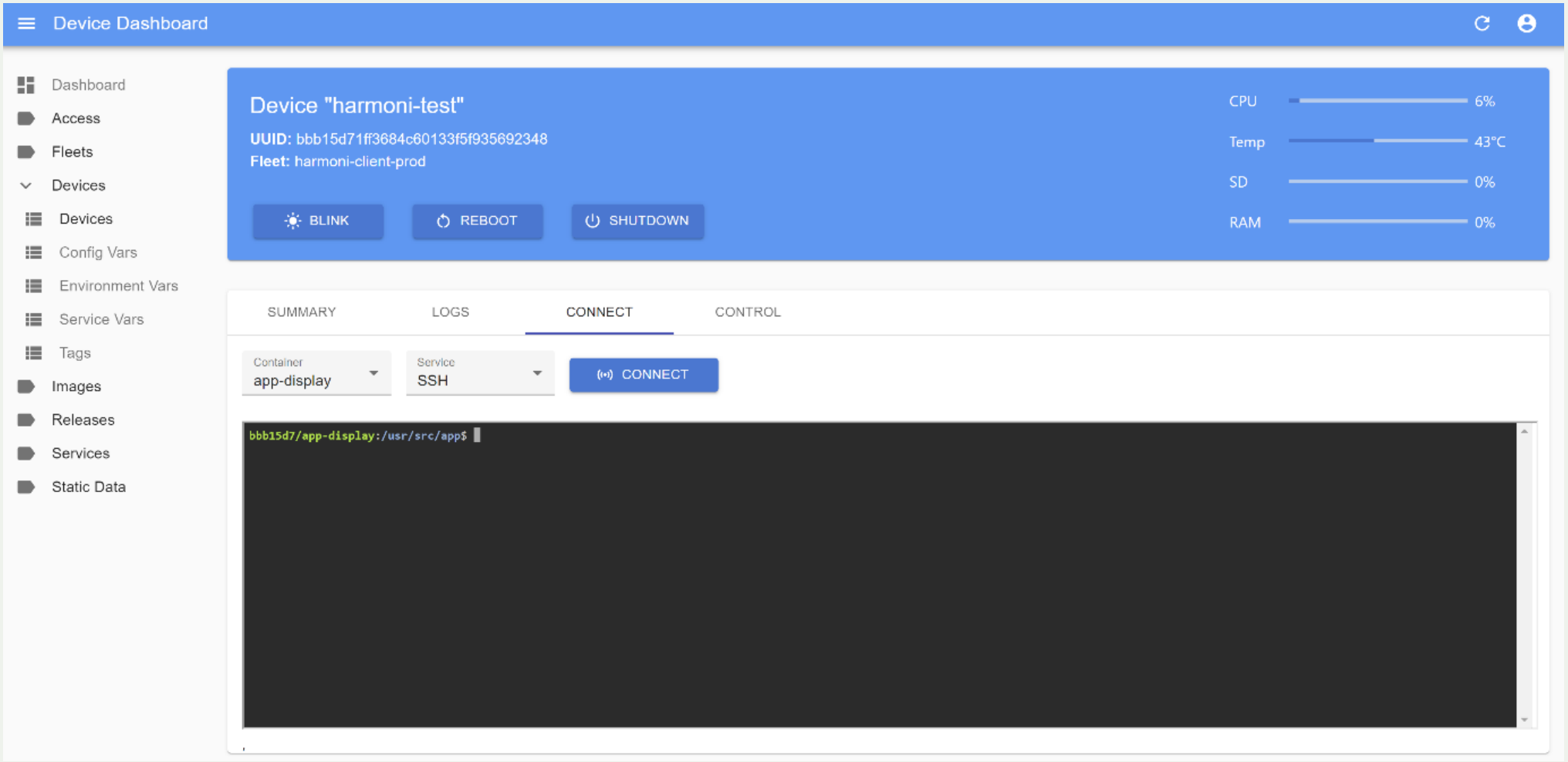
OpenBalena Frontend



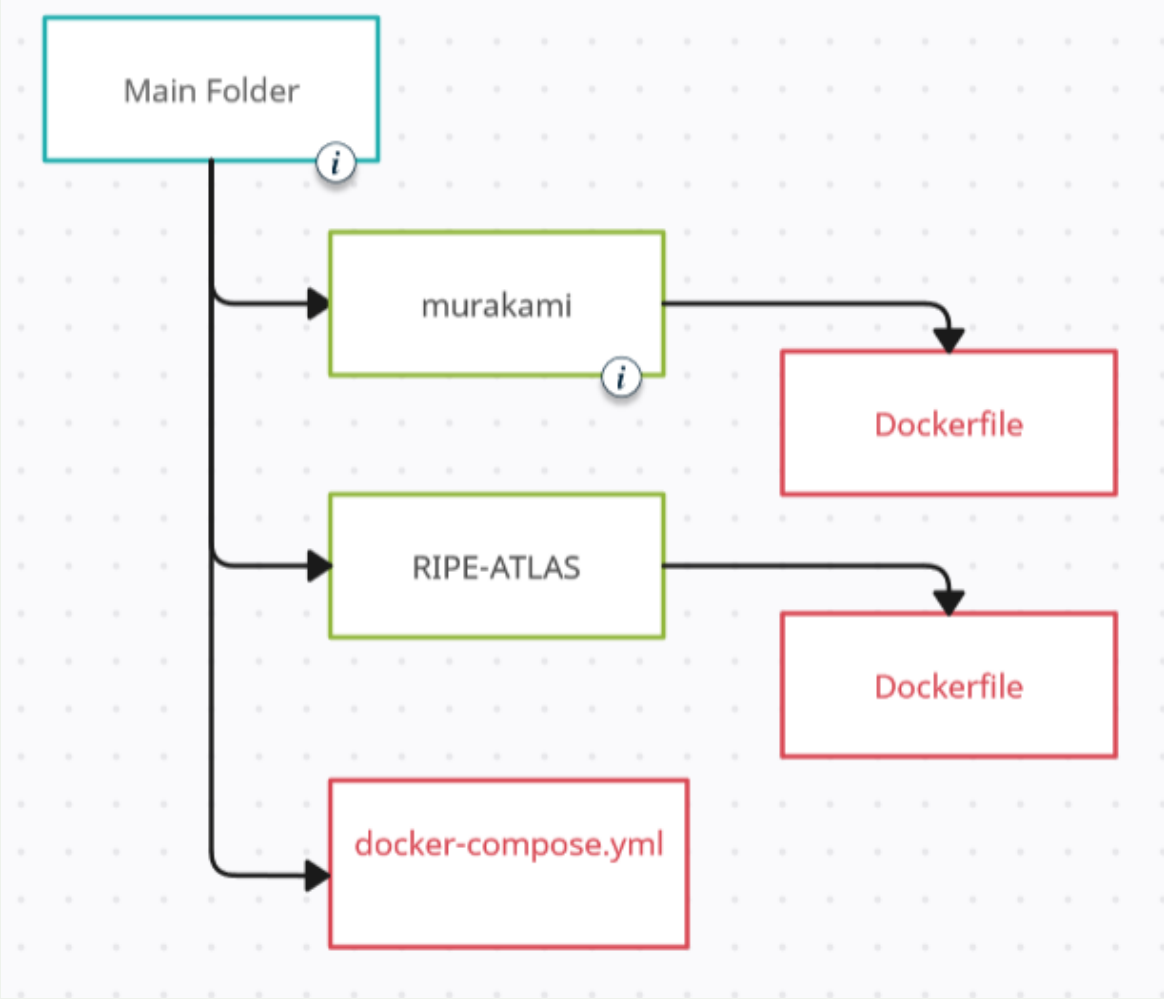
Device management on OpenBalena



Accessing a device on OpenBalena



Internal storage design on RPi device



- Consists of docker containers of the Murakami client and the RIPE atlas software client
- Other software can be run as docker clients
- Device is configured to be sent to an SSH server for Murakami or to a Google Cloud Storage (GCS) instance

Sample output JSON File


```
{
  "TestName": "ndt7",
  "TestStartTime": "2021-05-27T03:37:11.637526",
  "TestEndTime": "2021-05-27T03:37:33.857756",
  "MurakamiLocation": "BF-OUA",
  "MurakamiConnectionType": "ONATEL-Fibre",
  "MurakamiNetworkType": "15Mbps",
  "MurakamiDeviceID": "df20f76726f7ee88db5e007756f00f59",
  "ServerName": "ndt-mlab1-los02.mlab-oti.measurement-lab.org",
  "ServerIP": "102.88.1.139",
  "ClientIP": "196.[redacted],
  "DownloadUUID": "ndt-6mrgq_1619897333_00000000000D33BA",
  "DownloadValue": 44.28560905250475,
  "DownloadUnit": "Mbit/s",
  "DownloadError": null,
  "UploadValue": 31.392730603544052,
  "UploadUnit": "Mbit/s",
  "UploadError": null,
  "DownloadRetransValue": 0.0024454155278487515,
  "DownloadRetransUnit": "%",
  "MinRTTValue": 219.432,
  "MinRTTUnit": "ms"
}
```


- All tests were using NDT7
- NDT7 uses well known ports which are normally not blocked by firewalls (port 443 and port 80)

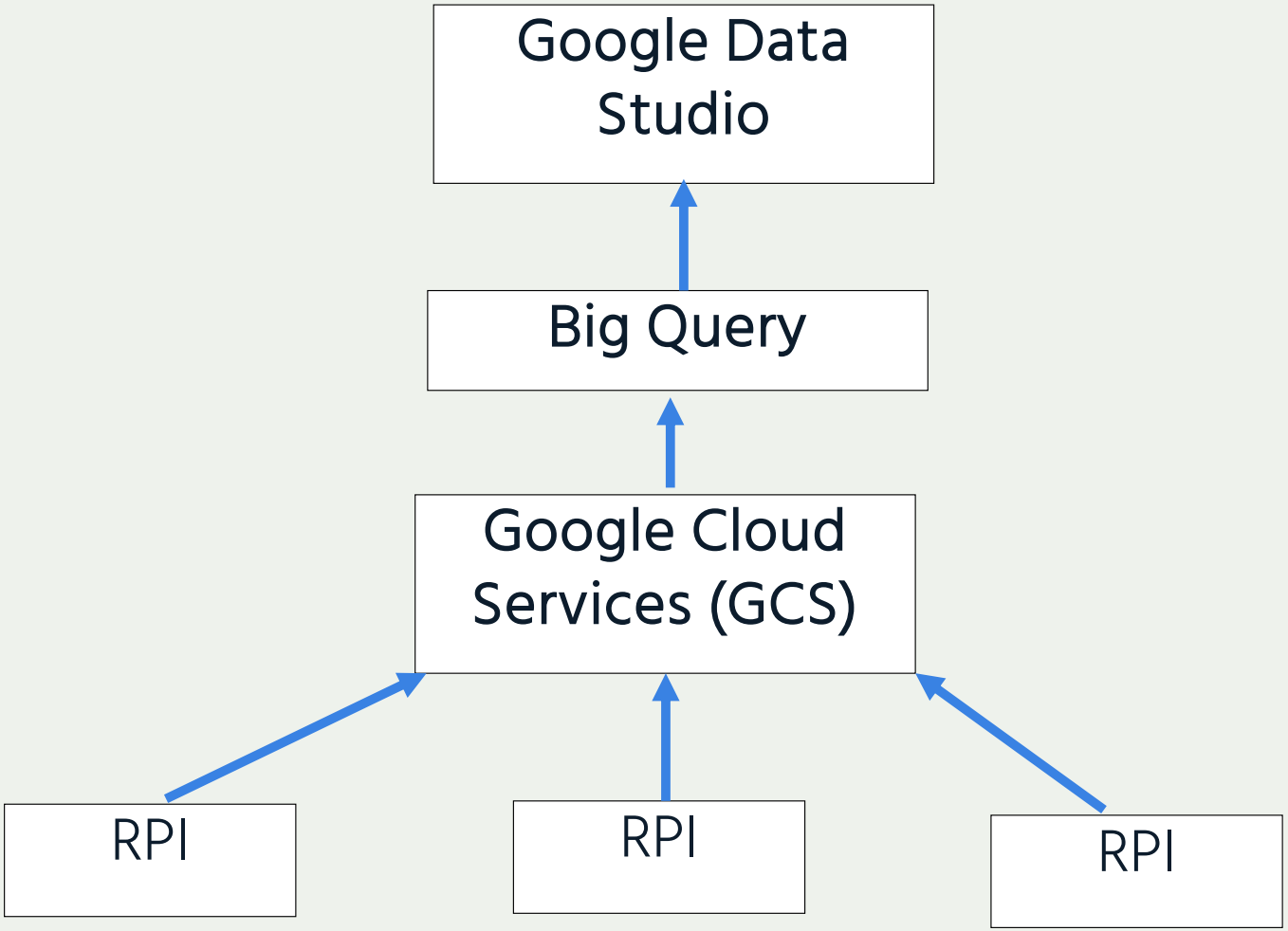
Data Visualization

Countries measured during the PoC

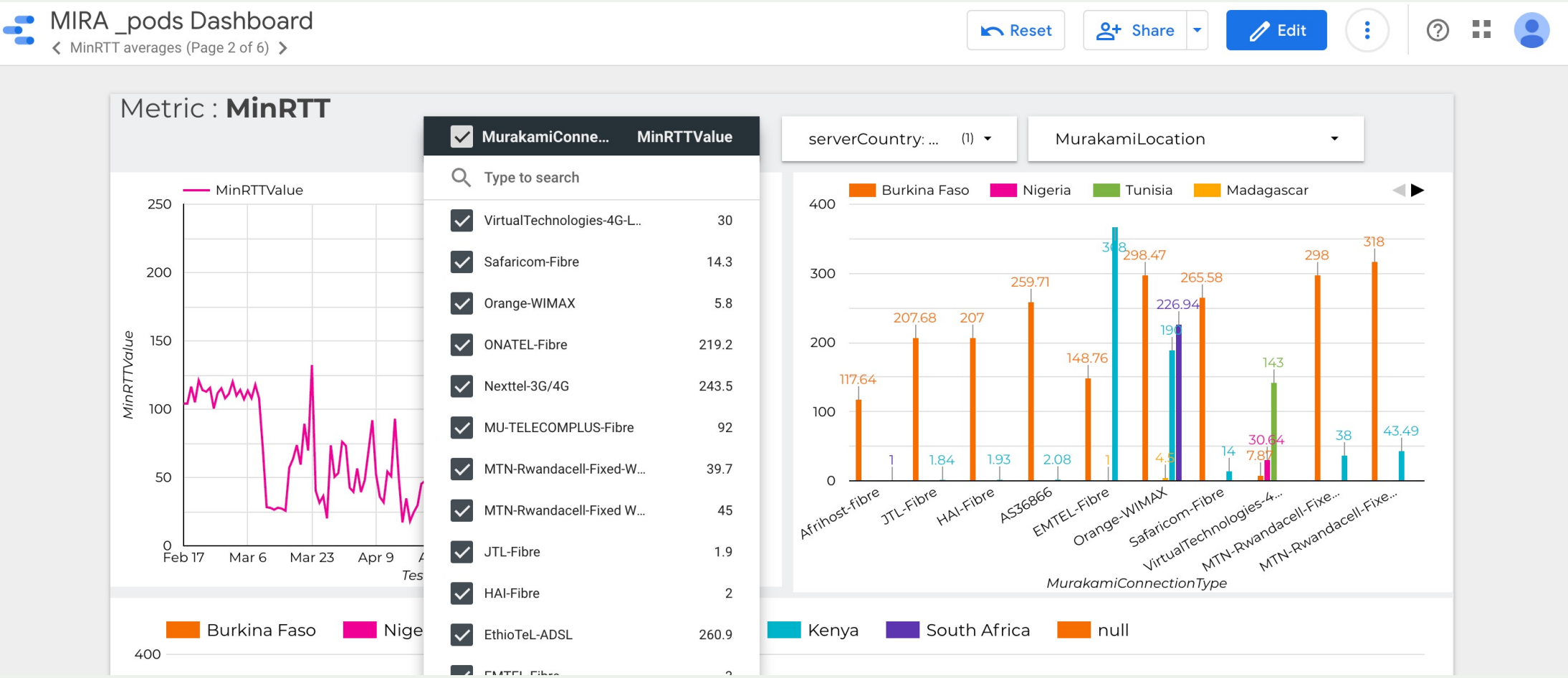
Country	Active MIRA Pods	ISPs being measured
Benin	✅ (2 probes)	JENY, ISOCEL
Burkina Faso	✅ (5 probes)	RISINA, ONATEL, Orange, VTS, IP Plus
Cameroon	✅ (2 probes)	CAMTEL
Ethiopia	✅ (1 probe)	EthioTel
Kenya	✅ (3 probes)	JTL, Safaricom, Liquid (HAI)
Madagascar	✅ (3 probes)	Orange, Telma, Blueline
Mauritius	✅ (2 probes)	Emtel, TelecomPLUS
South Africa	✅ (2 probes)	Afrihost Ltd
Zimbabwe	✅ (2 probes)	TBC
Rwanda	✅ (2 probes)	MTN

- We also added measurement servers in Burkina Faso and Mauritius
- Measurements could be run across Africa facilitating comparison of inter country links

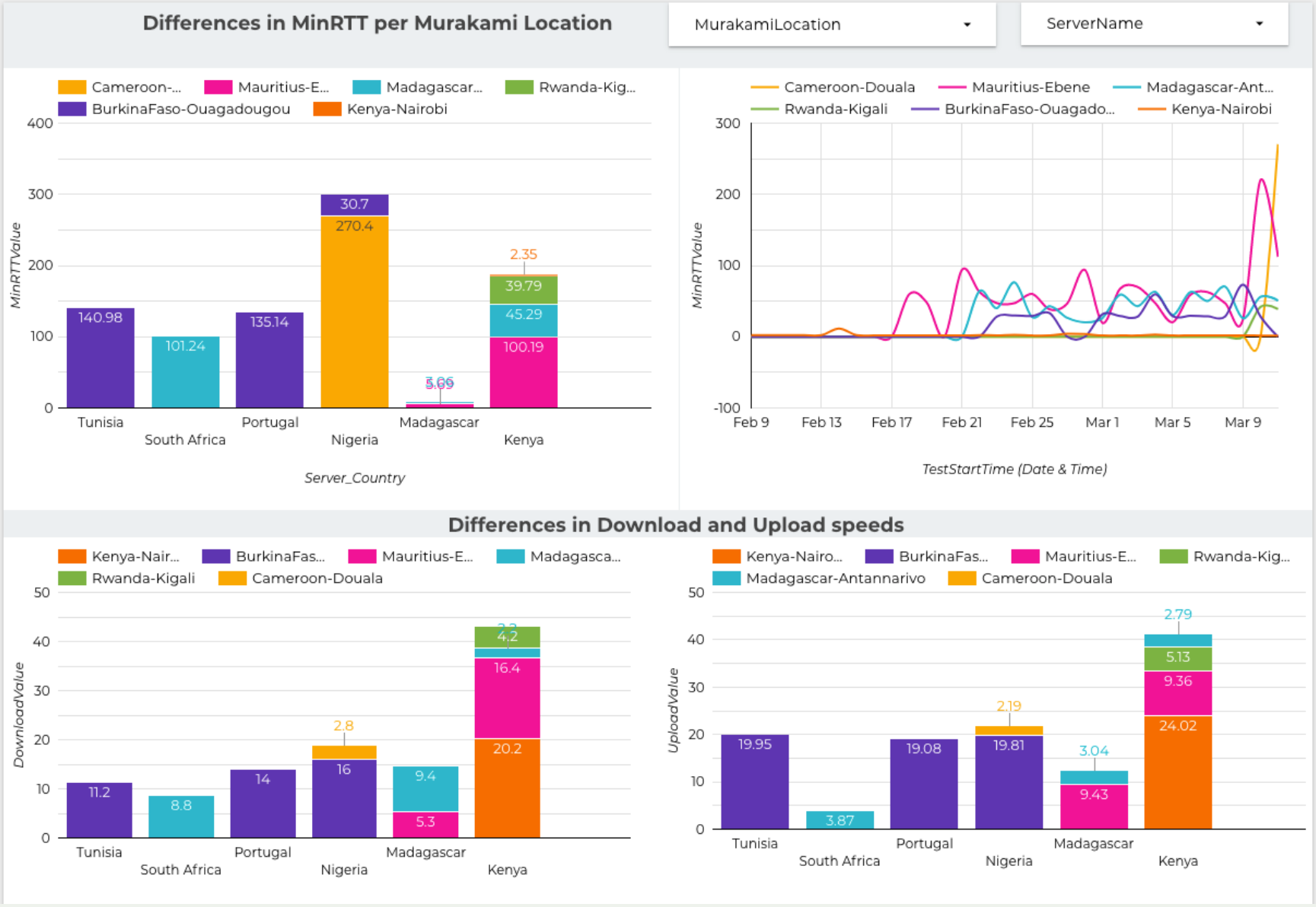
Visualization Pipeline when using GCS



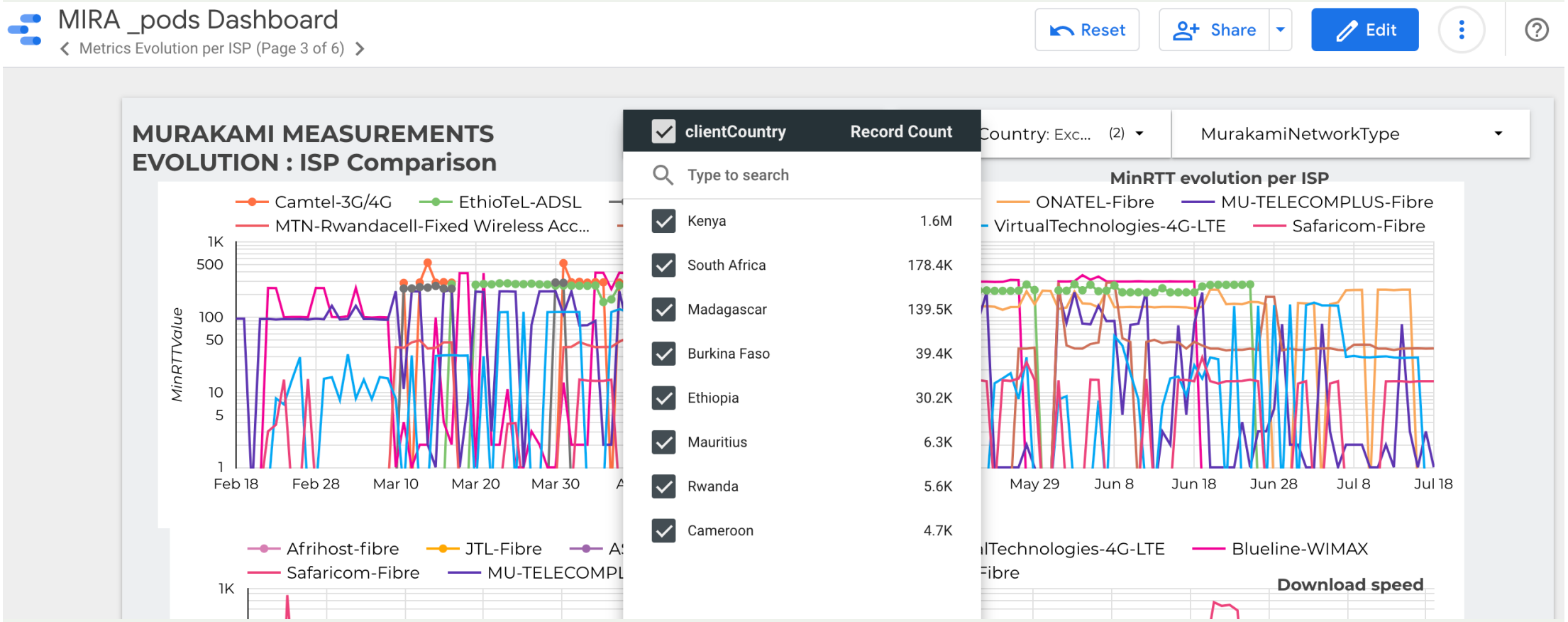
Google Data Studio Visualization Dashboard



Google Visualization Dashboard



Google Data Studio Visualization Dashboard



Lessons learned

Insights – lessons learned from the project

- Covering an entire continent with devices is challenging and requires partnerships with organizations with similar interests.
- A private measurement platform is simple to design. Scaling requires planning for staff time to monitor devices, report downtimes, schedule updates, etc
- Free software solutions exist and work well. Improvements can be made to these open-source tools.
- More measurement targets are needed in Africa as well as measurement clients to increase vantage points.

Internet Society
Pulse

Thank You

Amreesh Phokeer
phokeer@isoc.org