Bring Raw Data to Life: Leveraging Grafana for Advanced ns-O-RAN Data Analysis and Monitoring

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Introduction

Context: Unlike other disciplines in Information Technology, the study of telecommunications networks finds great relevance and utility in the proper visualization and analysis of data.

Object: We have created an extensible framework for collecting data generated by network traffic, with customized ns-3 scenarios for data collection, Grafana control dashboards and InfluxDB time series database (TSDB) for high-performance data collection.

Workflow

The software used represents cutting-edge technologies in their respective fields of application. The steps of the framework are the following:

- Docker containers are created and orchestrated with Docker Compose in order to run the E2 simulator and NS-3 framework.

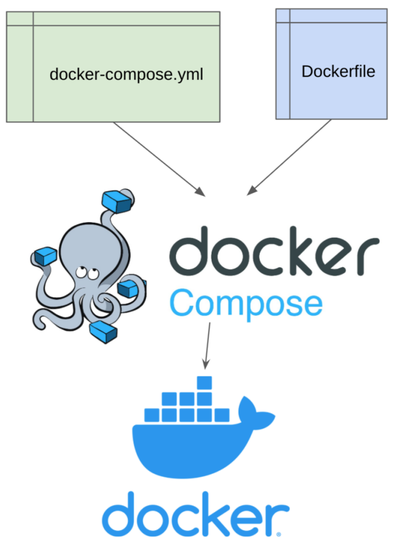

Figure 1: Technologies Stack Diagram

- CSV Data are generated from NS-3 simulations
- StatsD collect simulation data from CSV files, aggregates and send it to the Influx database thanks to Telegraf and Starlark
- InfluxDB (TSDB) is used for real-time data storage and analysis, organizing data with retention policies and automating storage using continuous queries.
- Grafana then retrieves the data from InfluxDB, creating visual infographics and monitoring panels.

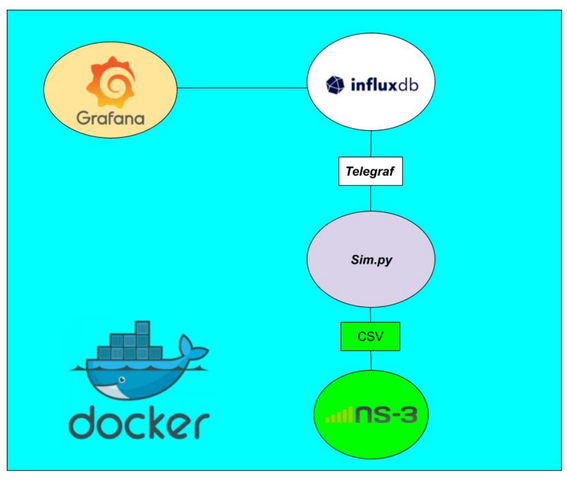

Figure 2: Technologies Stack Diagram

Application

5G simulation: Using a 5G scenario in ns-3, data are visualized through our custom framework. The chosen scenario involves up to 12 users connecting to numbered 5G cells. The simulation generates CSV files, categorized into Control Plane, User Plane and Distributed Unit information.

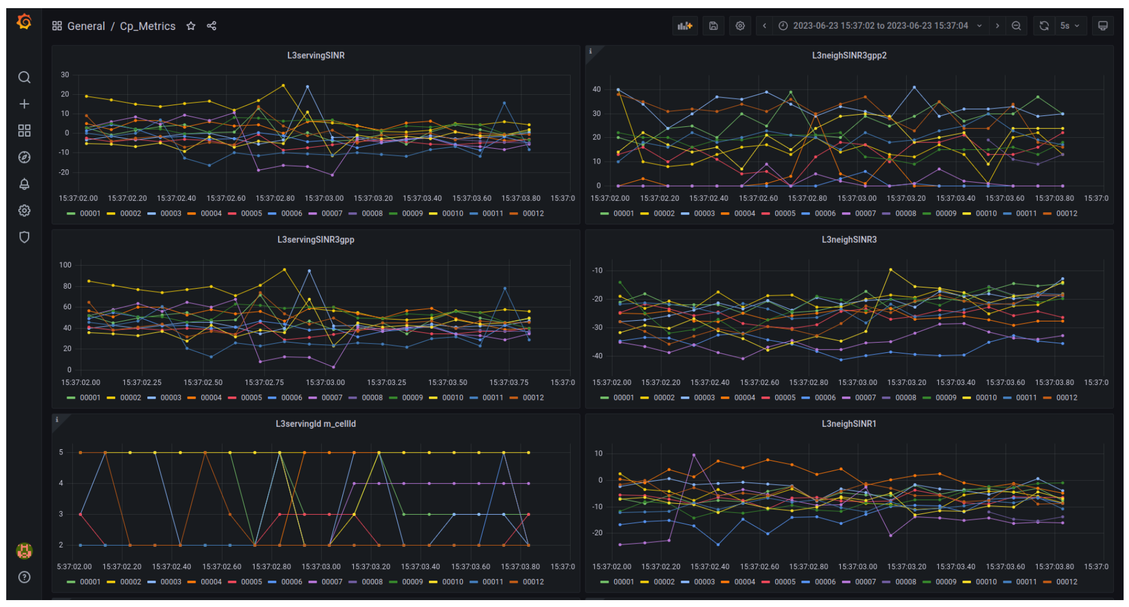

Figure 3: Control Plane metrics

Customization and Real-Time Monitoring: Grafana dashboards are highly customizable, allowing data to be displayed in various ways. For example, it is possible to filter the plots to display metrics specific to a subset of User Equipment (UEs).

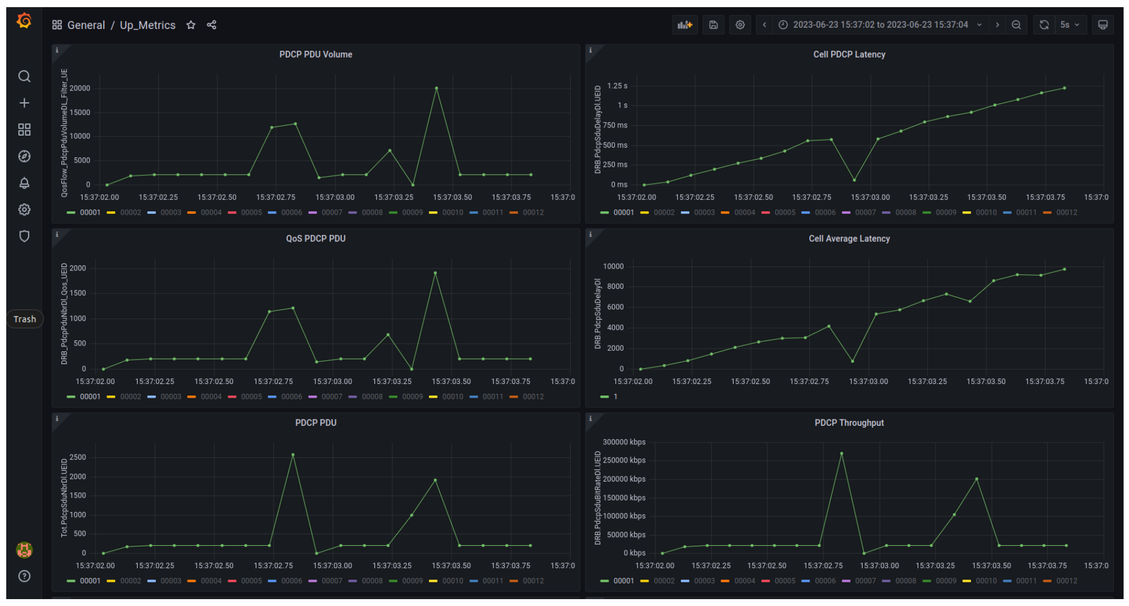

Figure 4: User Plane metrics for a UE 1 of the simulation

We can also display aggregated metrics from CP, UP and DU, monitoring the simulation in real-time

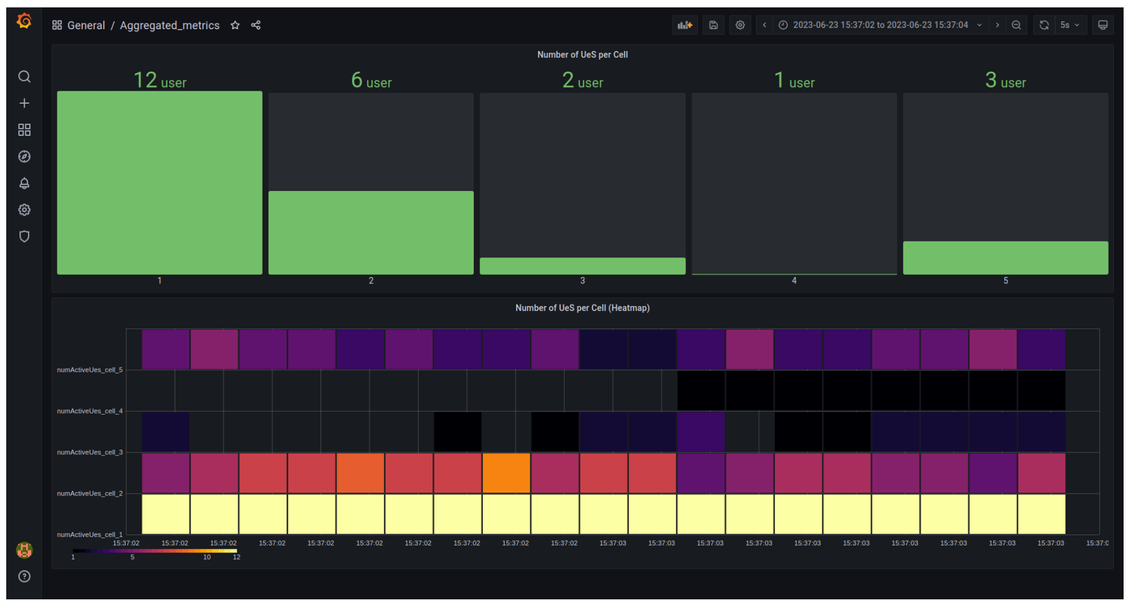

Figure 5: An histogram showing the cells workload and the corresponding heatmap

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