WiMax Network Modeling with OpNet

Authors: Bălăceanu Neluș-Constantin

Crăciun Dragoș-Ștefan

2022-2023

The basic scenario

It consists of 4 BS (Base Stations), 4 SS (Subscriber Stations), 1 Gateway Router and the Server. The network will test the VOIP application and Handover performance

Crearea unui nou proiect

Once we enter the OpNet program, creating a new project is done as follows:

File -> New -> Project (choose the name of the project and the name of the scenario) as in the figure below:

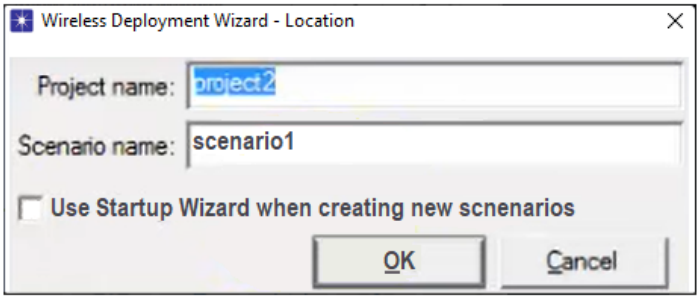

Fig.1 Creating a new project

After choosing the name, from the Topology -> Deploy Wireless Network -> Continue menu. This will open a new window, which can also be seen in the examples below.

Network Creation (leave default)

Location (leave default) -> here you can choose the coordinates (latitude and longitude)

Technology -> choose WiMax technology

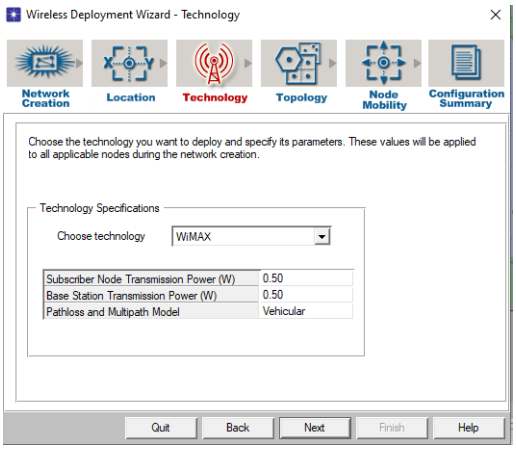

Fig.2 Technology

Topology -> choose cell type (Hexagonal), cell number (4) and cell radius of 1 km. Nodes remain "Random", to randomly scatter in the cell. Grid or Circular could also be chosen, but that would have meant that nodes would have to spread according to some rule in the cell. Also here the number of stations per cell is chosen.

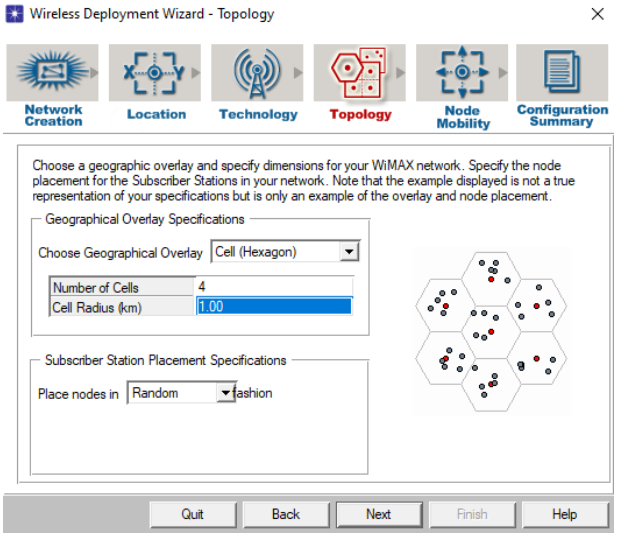

Fig.3 Topology

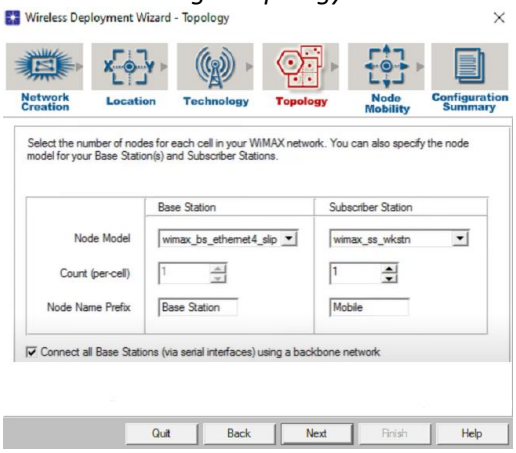

Fig.4 Topology - count (per cell)

Node Mobility -> delete the trajectory information already set in the related table and continue to Configuration Summary.

Configuration Summary -> Here we show all the settings made, to be checked, and press Finish.

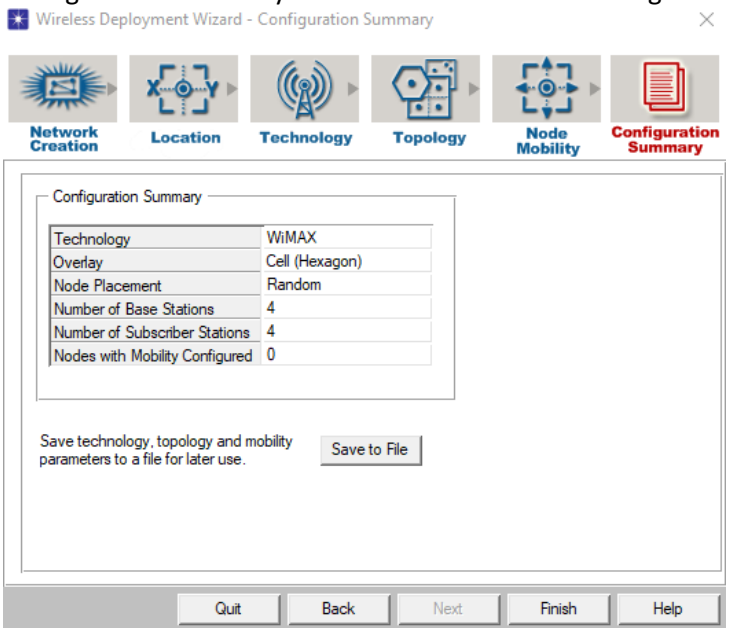

Fig.5 Configuration Summary

Next, the cell system will look exactly like the figure below:

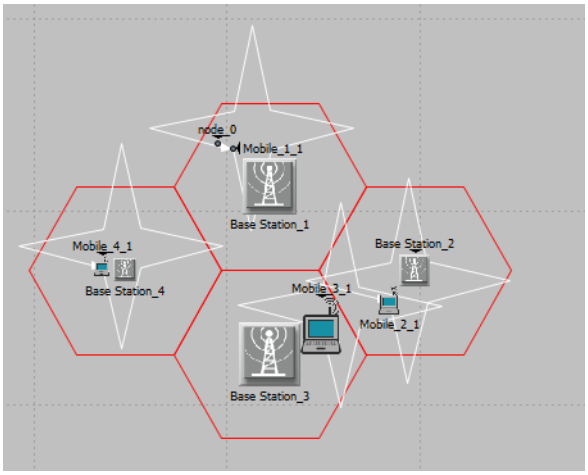

Fig.6 Cell system

From the "Object Palette Tree" menu choose: WiMax -> Application Config + Profile Config and drag and drop them into the project as in figure 7.

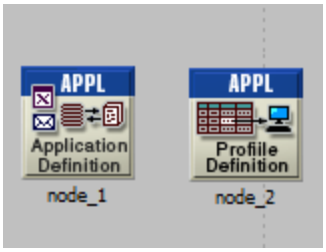

Fig.7 Application Definition + Profile Definition

Application Config

Right click on Application Definition -> Edit Attributes and change the following:

- Number of Rows = 1
- Name = voice_app
- Description -> Voice = PCM Quality Speech

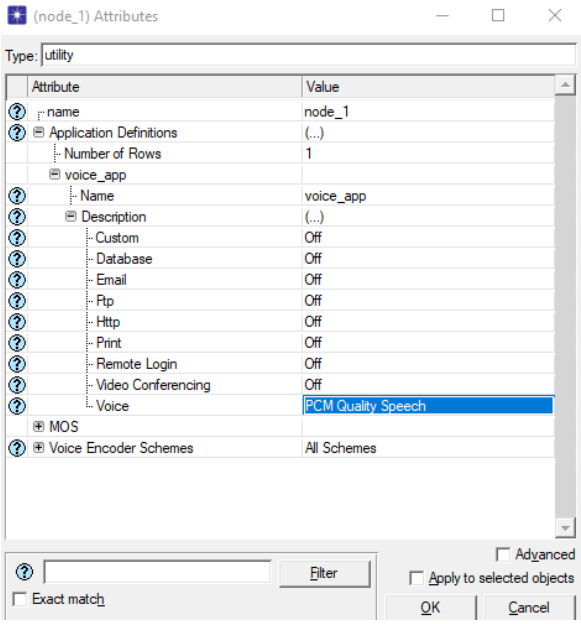

Fig.8 Application Definition

Profile Config

Right click on Profile Definition -> Edit Attributes and change the following:

- Number of Rows = 1
- Profile Name = voice_pro
- Applications -> Number of Rows = 1

- Applications -> Name = voice_app

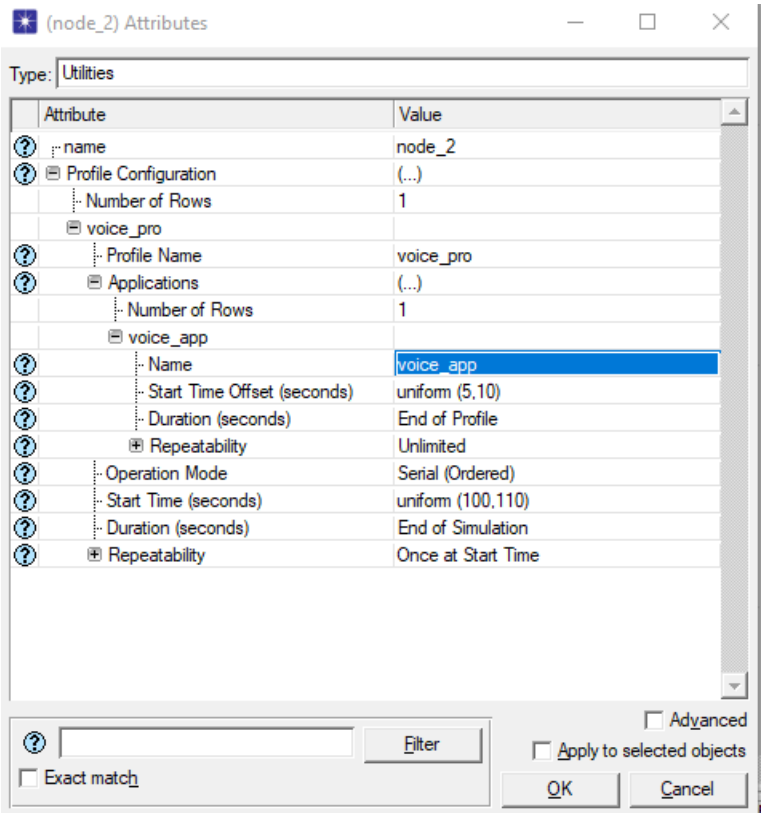

Fig.9 Profile Definition

WiMax Config

From the "View" menu you get the WiMax configurator as follows:

View -> Show Network Browser -> WiMax_config (double click) - the configurator will appear on the map, which is copied and inserted into our project as in figure 10.

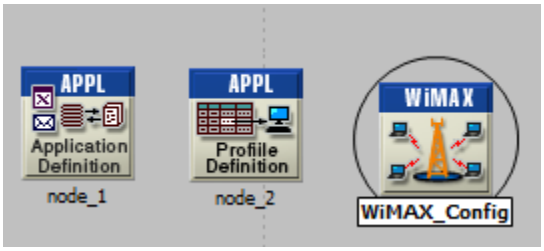

Fig.10 WiMax_config

Right click on WiMax_config -> Edit Attributes and from here change the following:

- MAC Service Class Def. -> Row -> Maximum Sustained Traffic Rate = 384 Kbps
- MAC Service Class Def. -> Row -> Maximum Reserved Traffic Rate = 384 Kbps

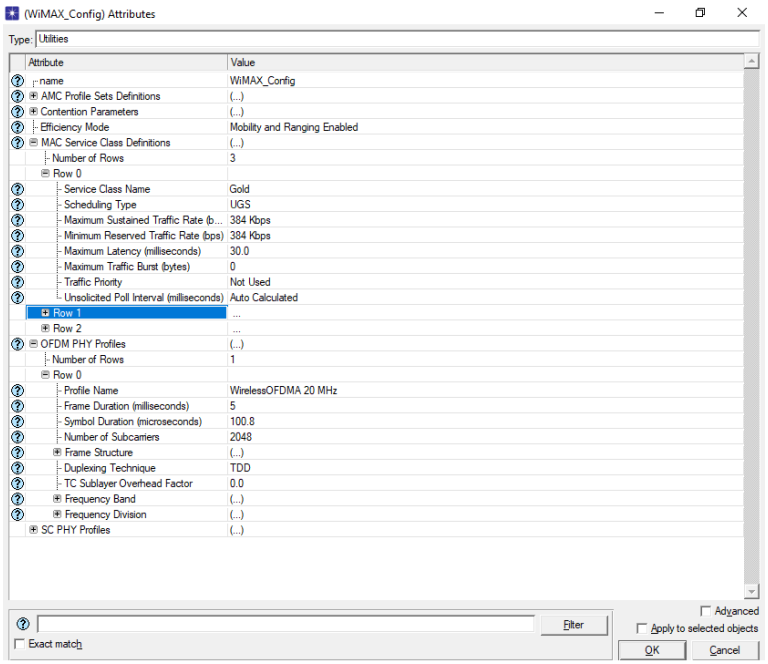

Fig.11 WiMax_config

Subscriber Station Config

Right click on one of the 4 SS (Subscriber Station) and select the option "Select Similar Nodes" to find all similar nodes. Then from the "Edit Attributes" option change the following:

Subscriber Station 4

- Check "Apply to selected objects"

- Application: Supported Profiles -> Edit = a second window will open where you select Rows = 1 (bottom left in figure 12), and in the table will appear to select the name of the profile. Click and select "voice_pro".

- Application: Supported Services - do exactly the same as "Supported Profiles", only in the second window select the profile name = "voice_app".

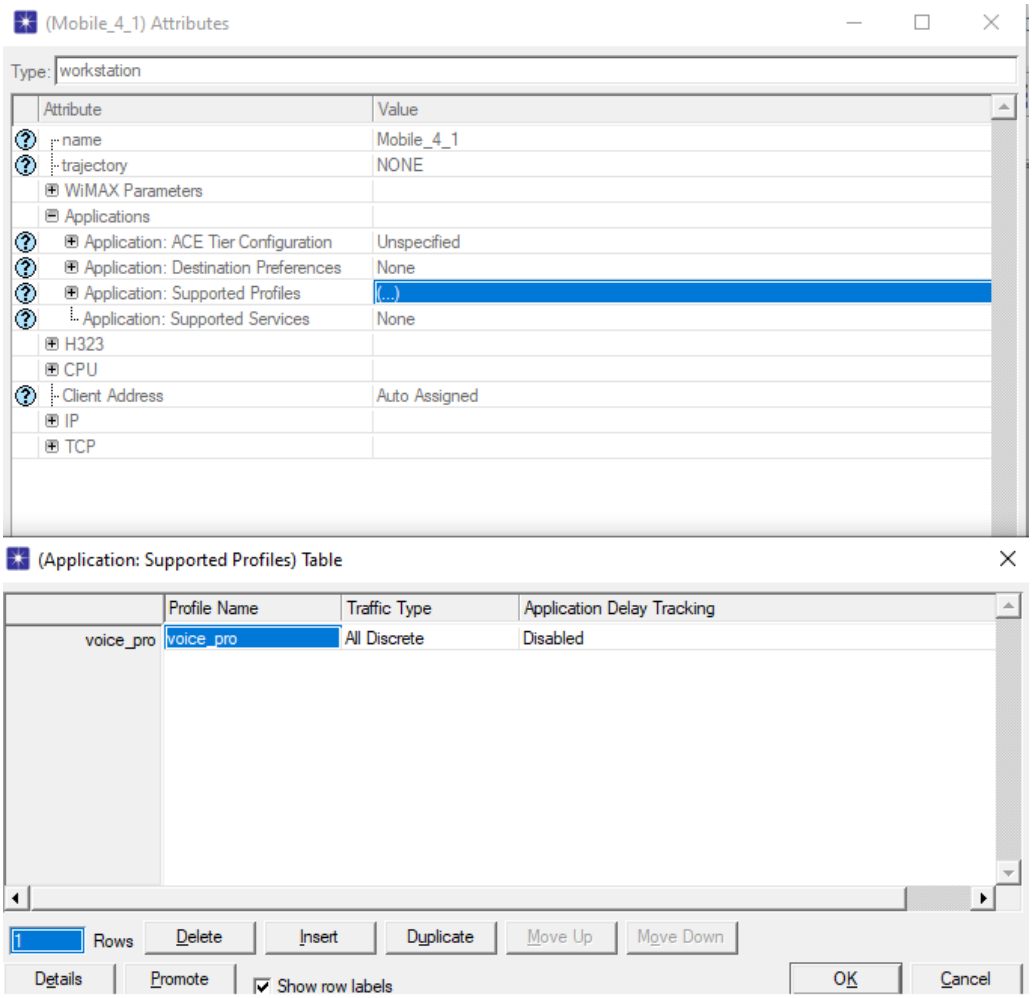

Fig.12 Subscriber Station 4 Config

Subscriber Station 1

- Check “Apply to selected objects”
- Trajectory = wimax_example_amc_0

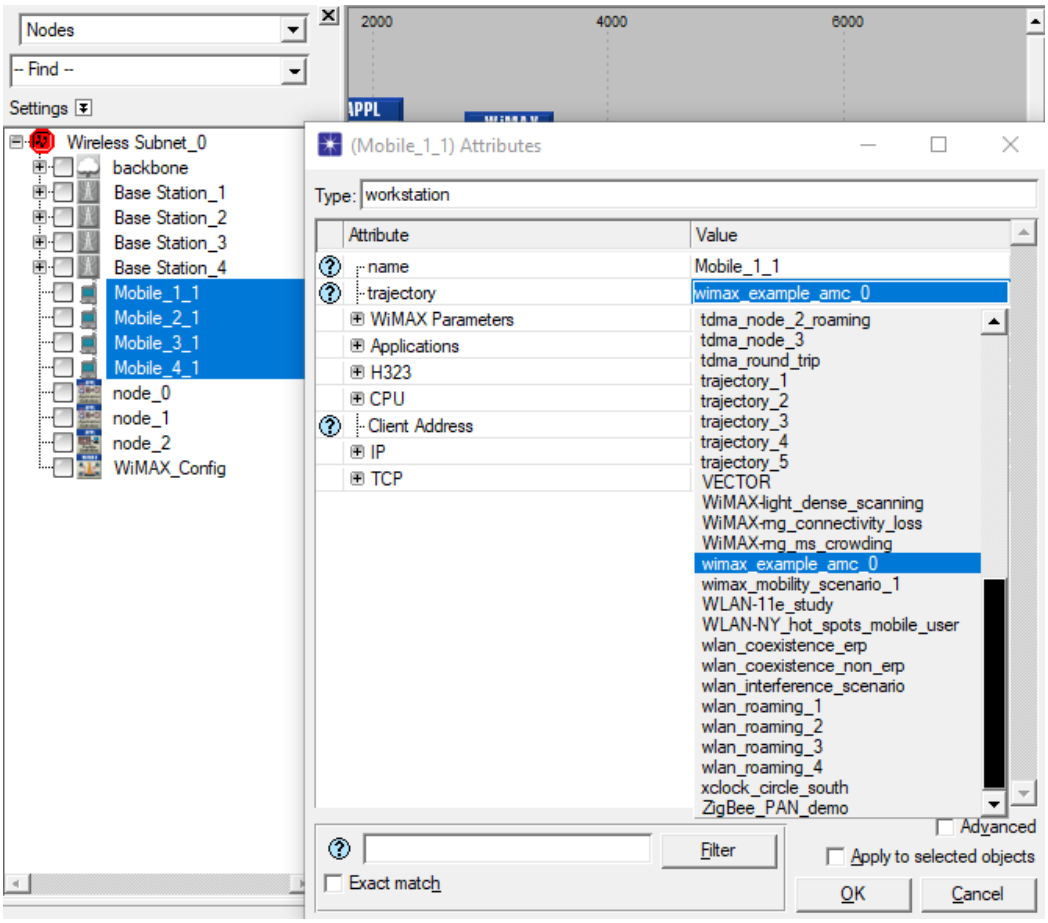

Fig.13 Subscriber Station 1 Config

Subscriber Station 2

- WiMax Parameters -> Classifier Definitions -> Number of rows = 1
- Match Values = Interactive Voice (6)

- Service Class Name = Gold
- Downlink Service Flows -> Number of rows = 1
- Service Class Name = Gold
- Uplink Service Flows -> Number of rows = 1
- Service Class Name = Gold
- Multipath Channel Model = ITU Pedestrian A

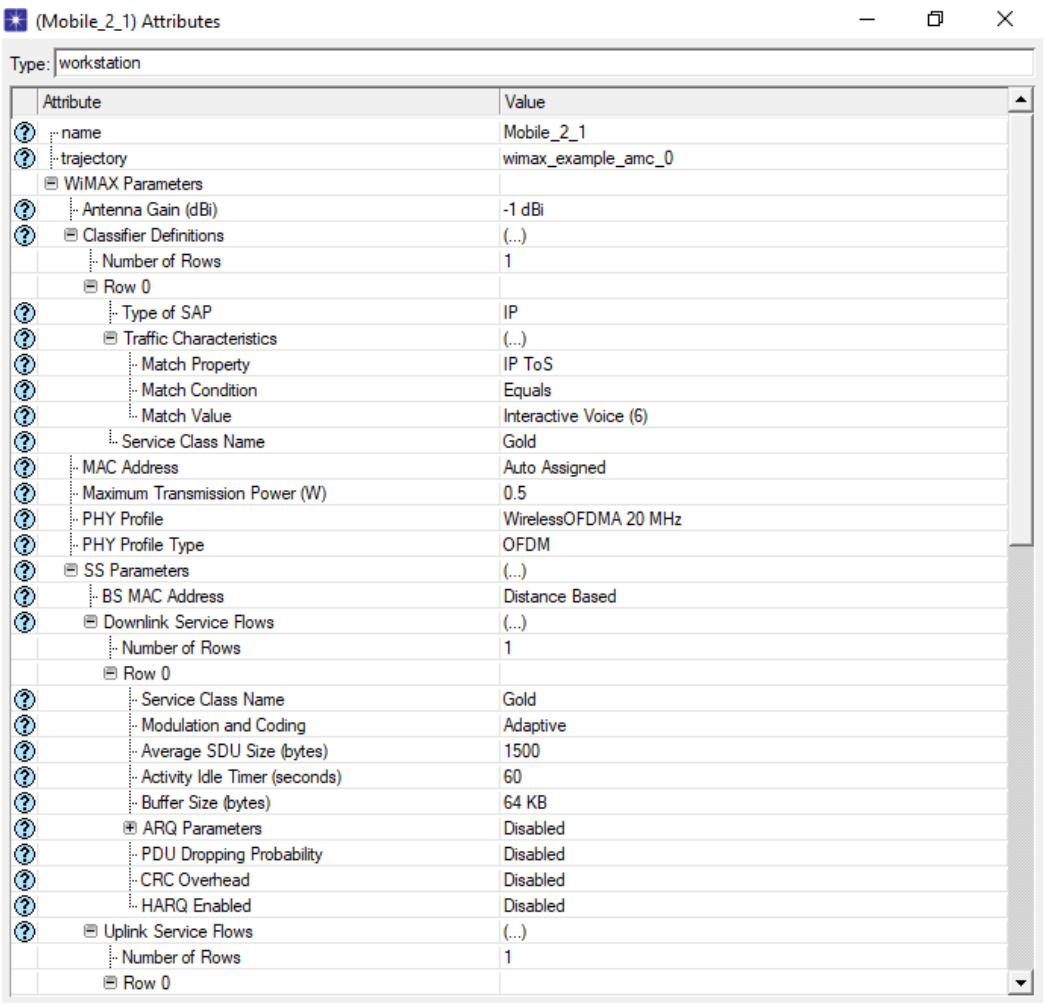

Fig.14 Subscriber Station 2 Config

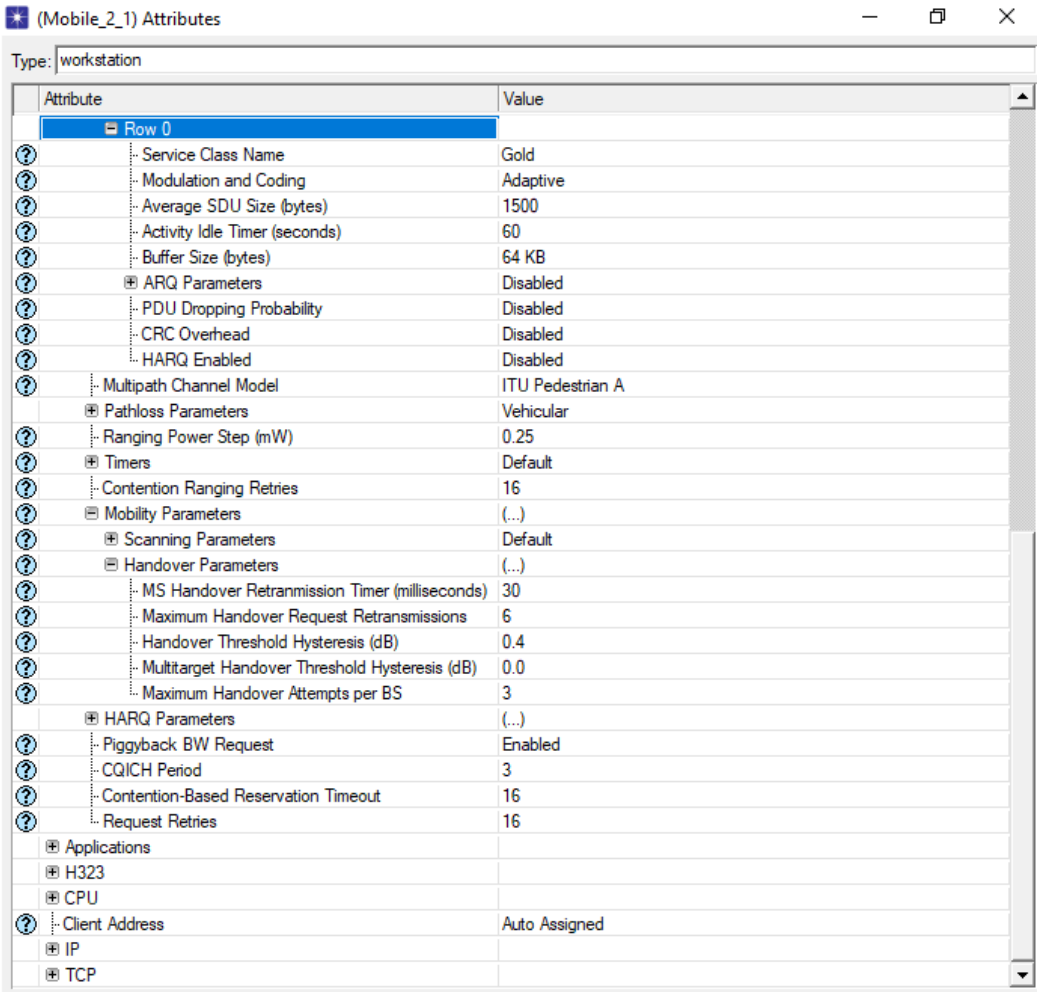

Fig.14_1 Subscriber Station 2 Config

Base Station Config

Right click on one of the 4 BS (Base Station) and select the option "Select Similar Nodes" to find all similar nodes. Then from the "Edit Attributes" option change the following:

- Classifier Definitions -> Number of rows = 1
- Match Value = Interactive Voice (6)
- Service Class Name = Gold

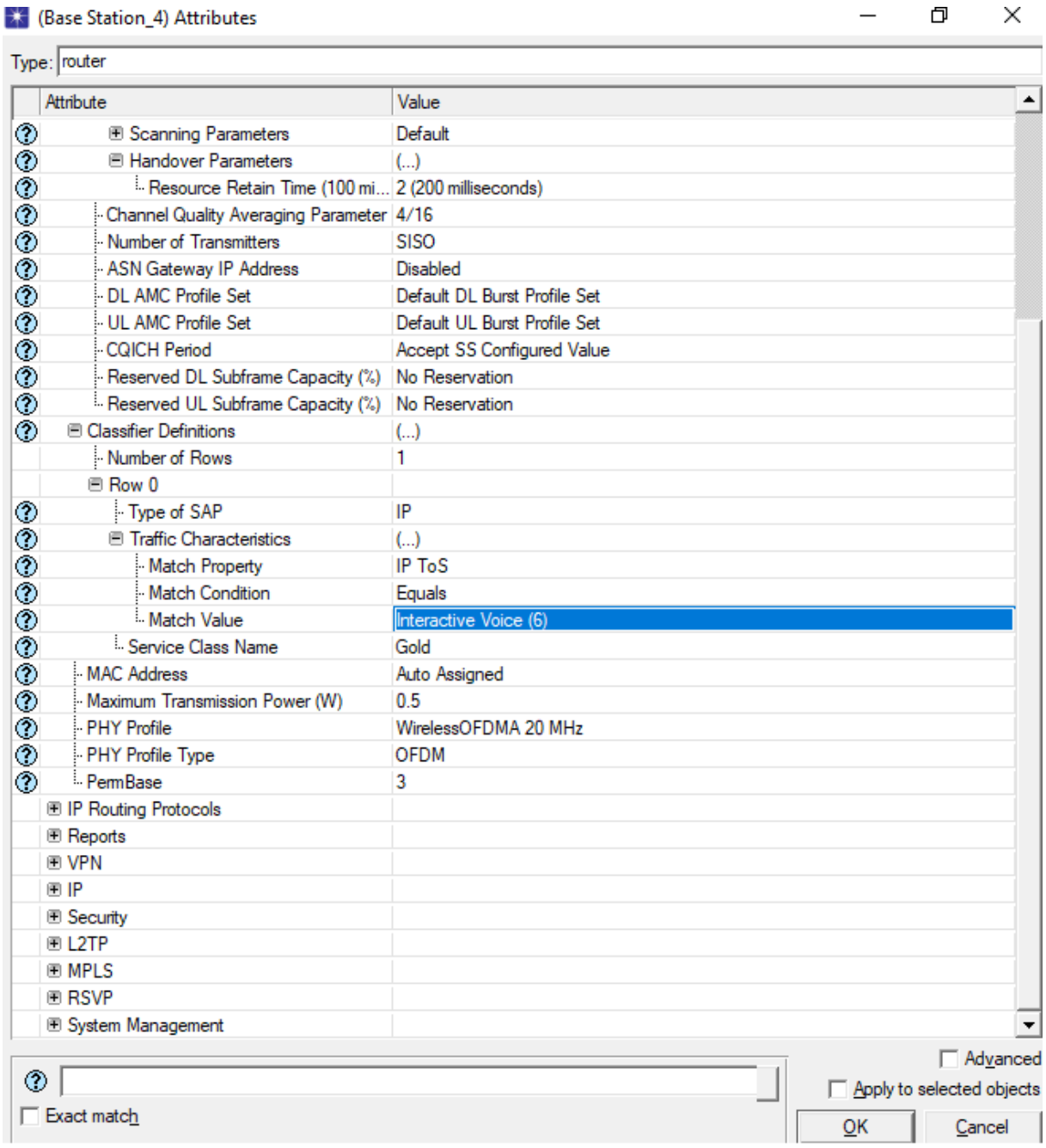

Fig.15 Base Station Config

From the Run menu, clicking will open a window with the run configuration parameters. Here you select the duration of 30 minutes and click on Run.

Run Config

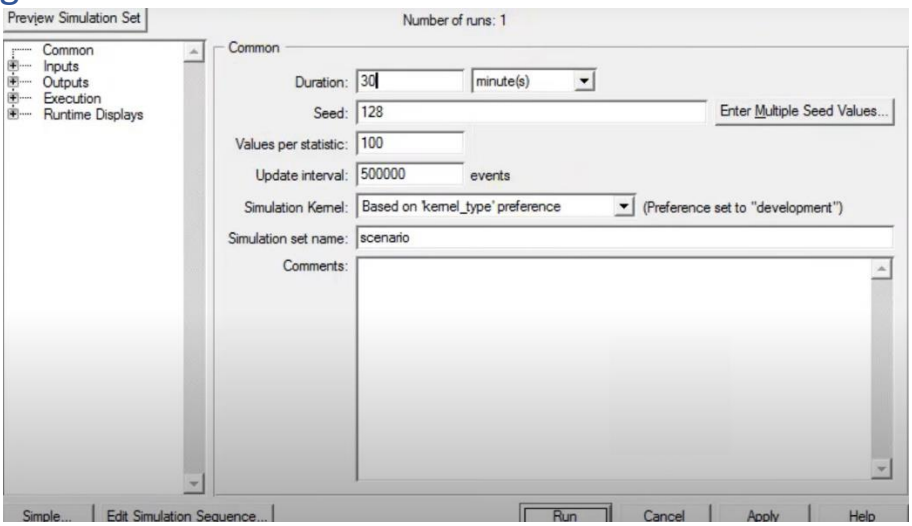

Fig.16 Run Config

Simulation

Once the simulation has loaded, press "Close".

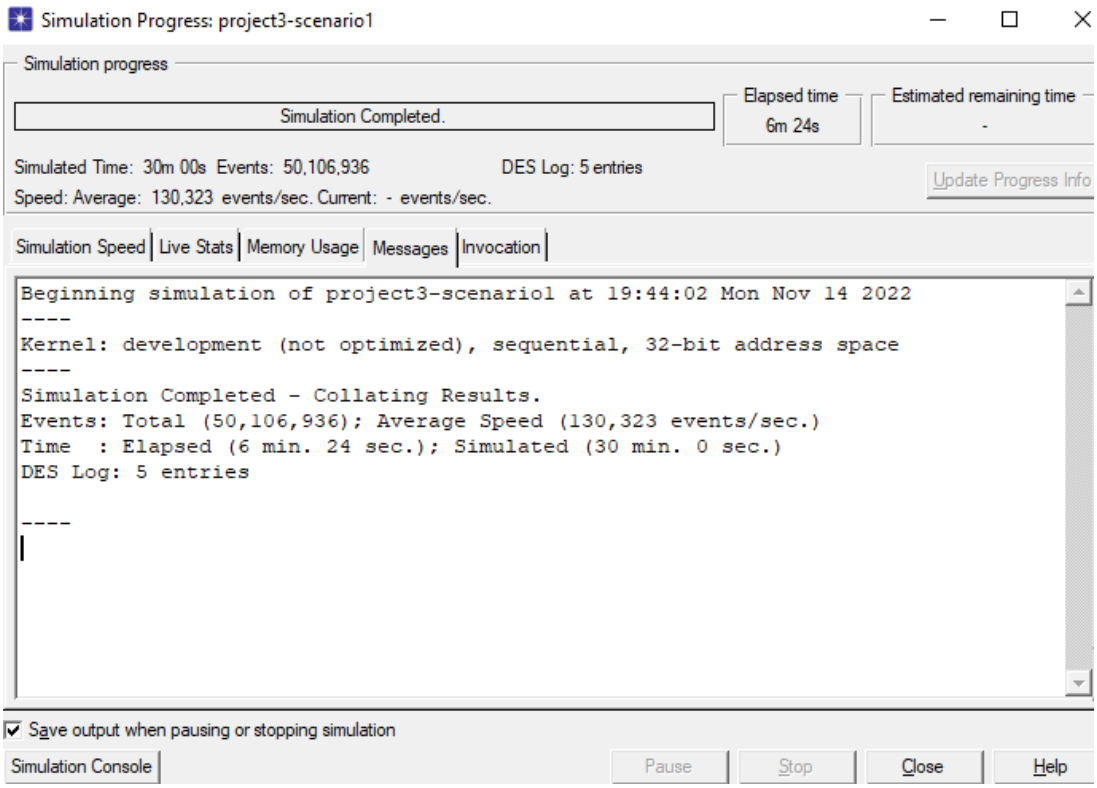

Fig.17 Simulation

Next, to see the results, right-click and select the "View Results" option. A window will open and in the top left under "Results for:" we select "Current Scenario".

At the bottom left will appear the two options "Voice" and "WiMax".

Results for Voice

Jitter (sec) + MOS value

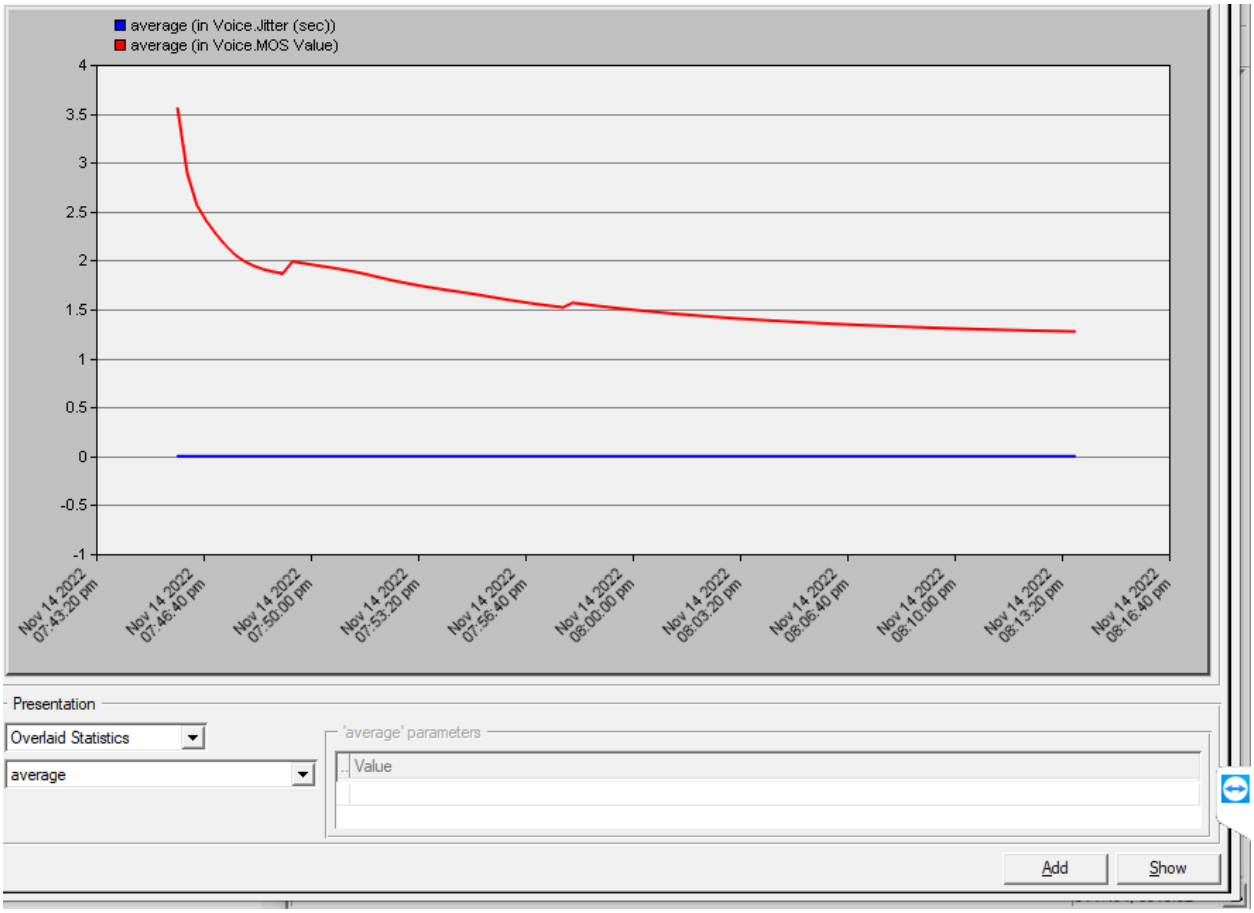

Fig.18 Jitter + MOS value

Packet Delay Variation + Packet End-to-End Delay (sec)

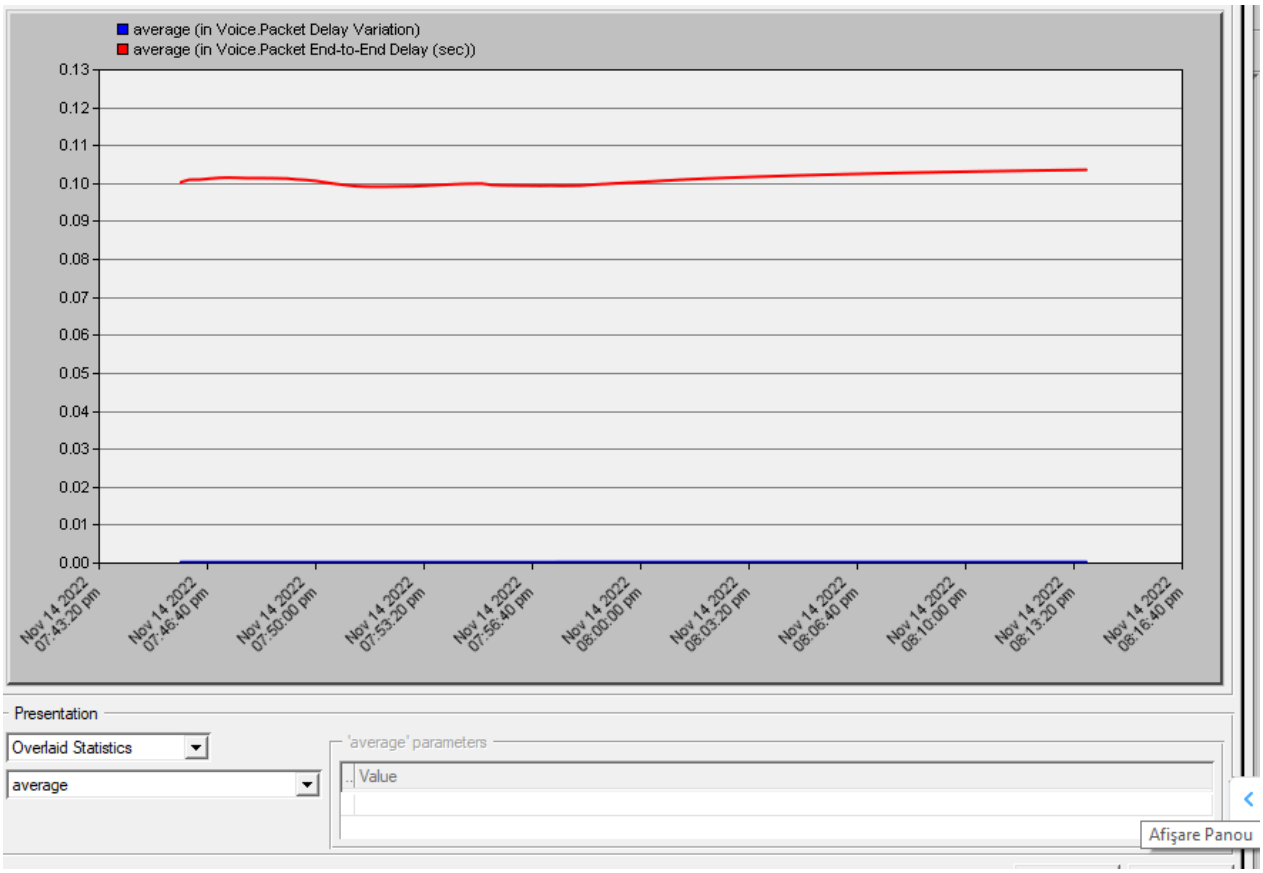

Fig.19 Packet Delay Variation + Packet End-to-End Delay (sec)

Traffic Received (bytes/sec) + Traffic Received (packets/sec)

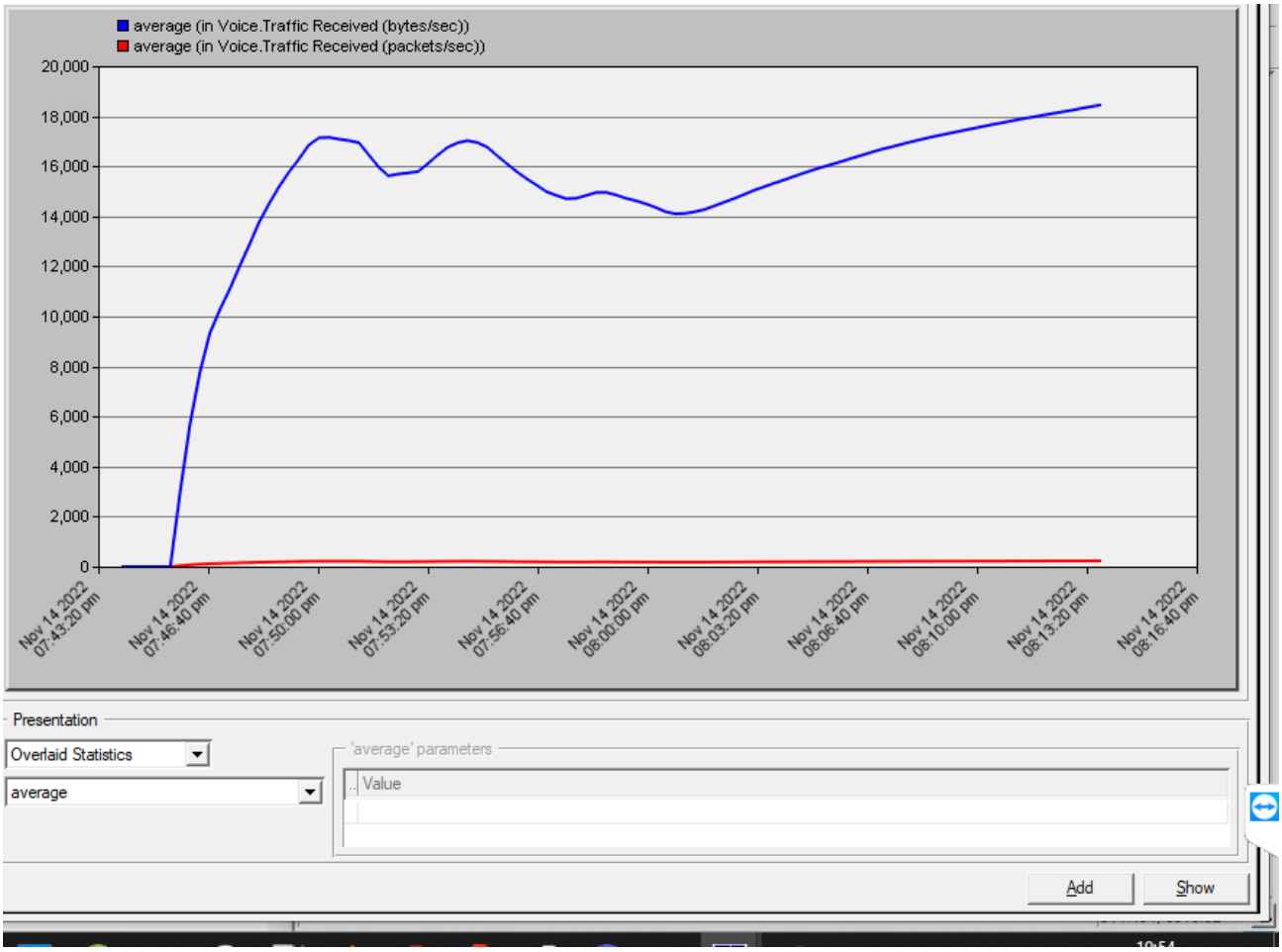

Fig.20 Traffic Received (bytes/sec) + Traffic Received (packets/sec)

Traffic Send (bytes/sec) + Traffic Send (packets/sec)

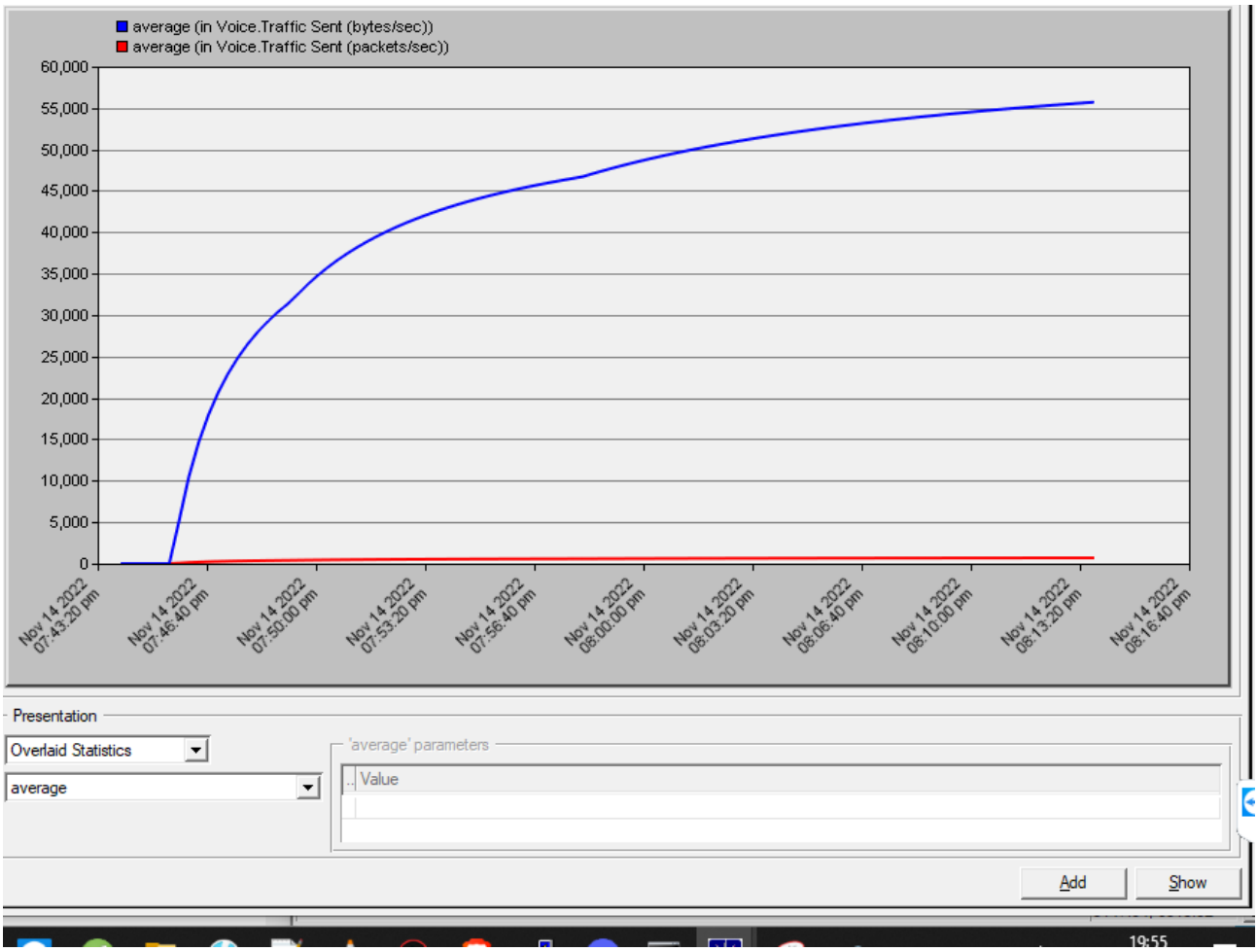

Fig.21 Traffic Send (bytes/sec) + Traffic Send (packets/sec)

Results for WiMax

Delay (sec) + Load (bits/sec)

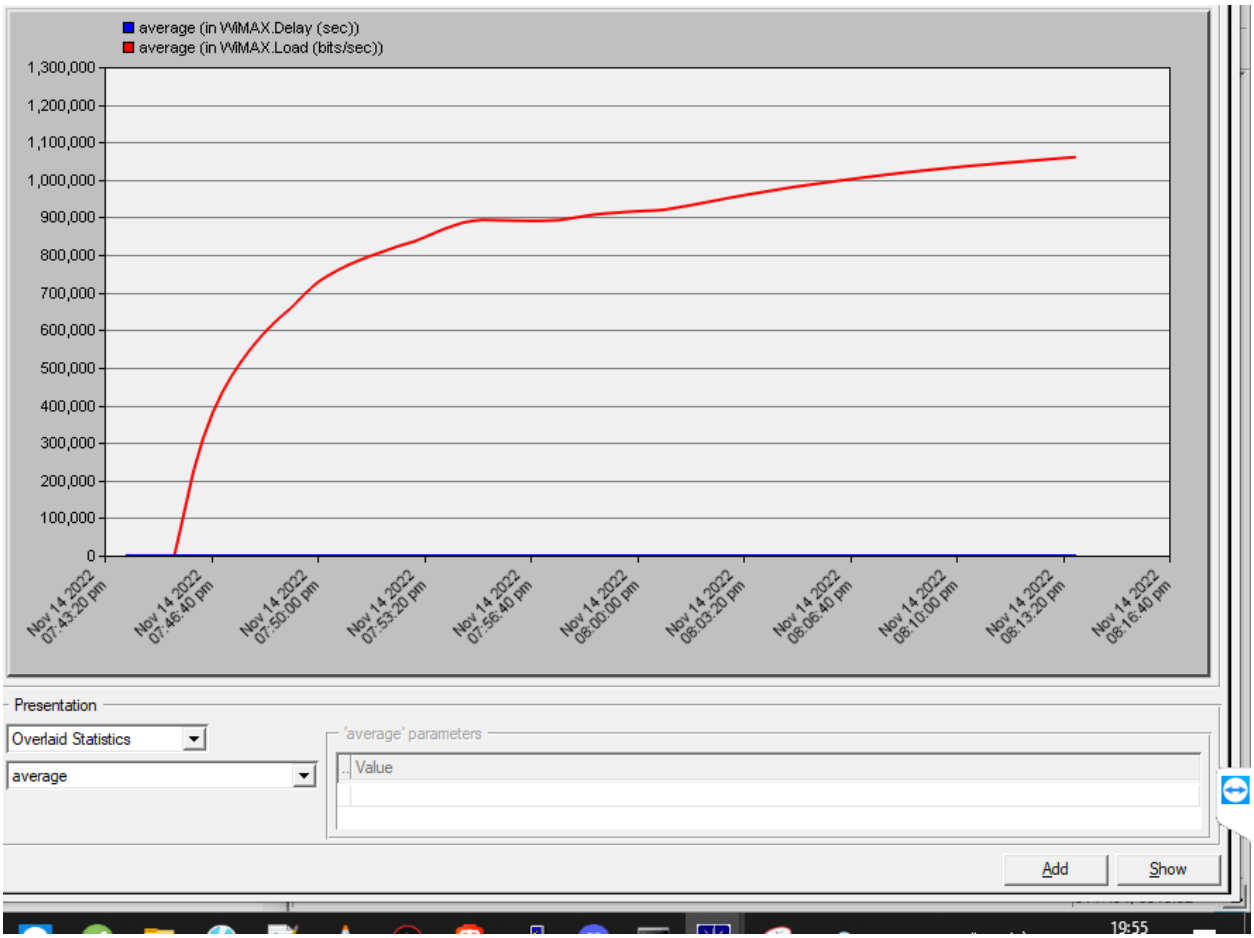

Fig.22 Delay + Load (bits/sec)

Load (packets/sec) + Throughput (bits/sec)

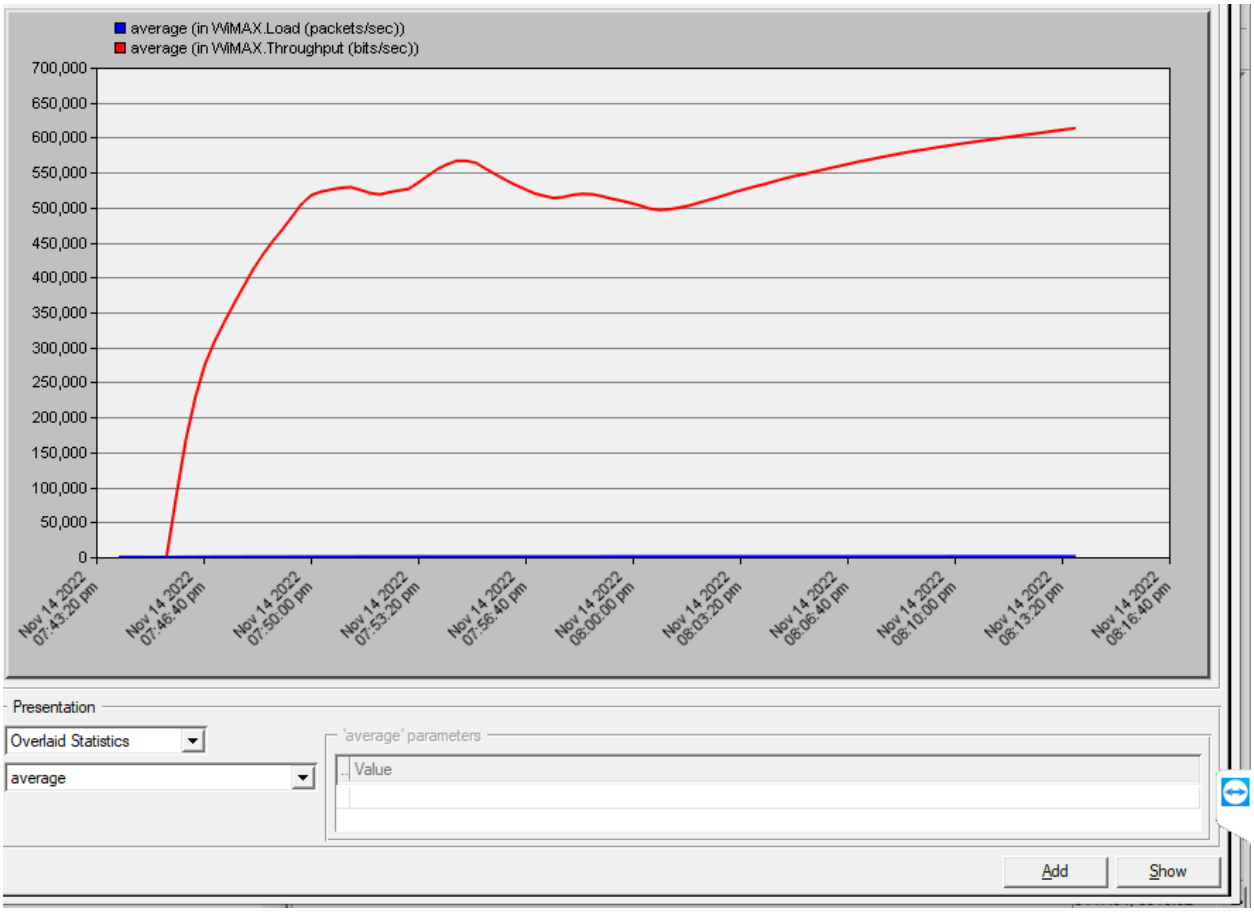

Fig.23 Load (packets/sec) + Throughput (bits/sec)

Throughput (packets/sec)

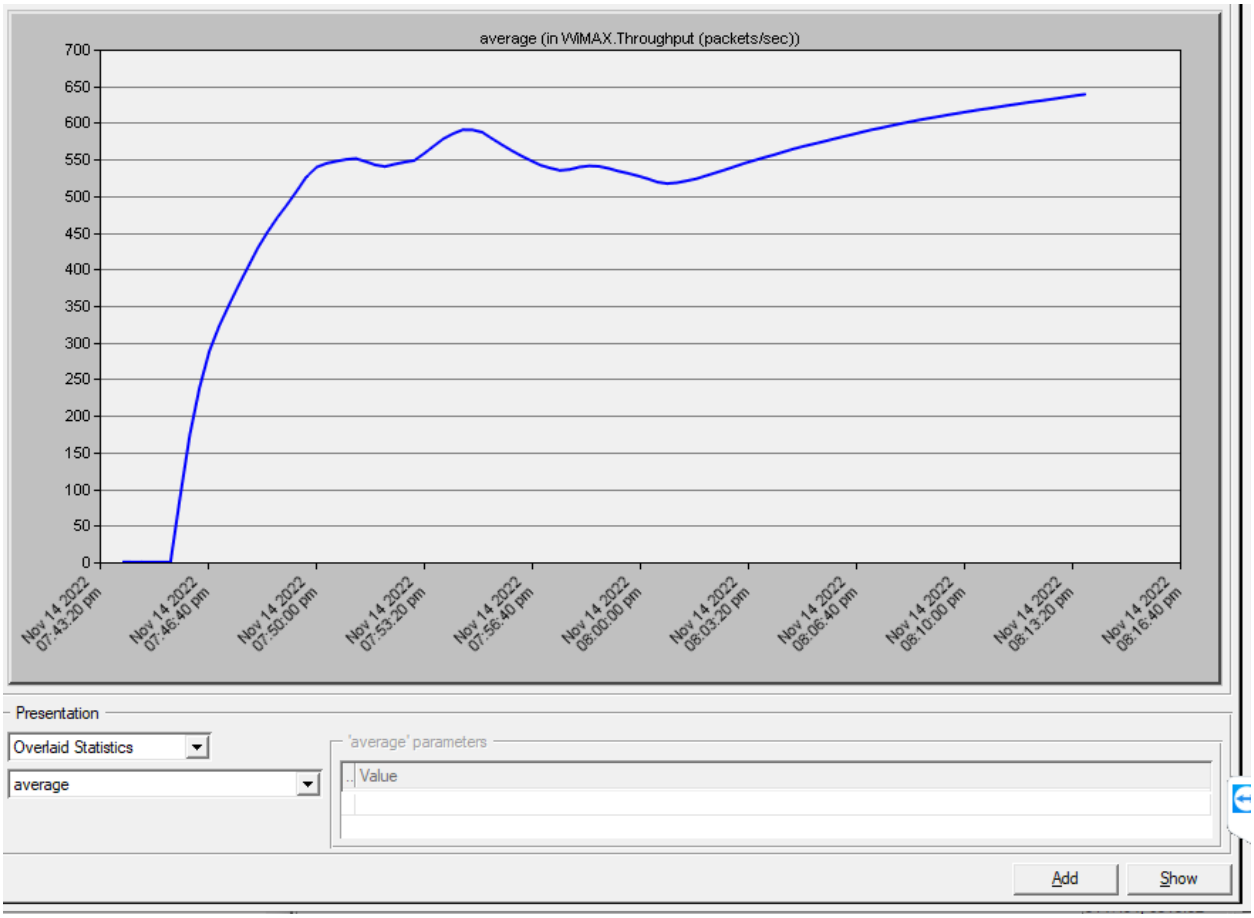

Fig.24 Throughput (packets/sec)