

# ELEC-E7120 Wireless Systems

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**“A Comparative Analysis of  
4G Networks Provided by  
Three Different Operators  
and Wi-Fi Networks in Five  
Distinct Locations”**

**11.10.2023**



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# Introduction:

- 4G in Different Operators VS Wi-Fi:

In today's digitally connected world, network performance is crucial. This presentation explores the key differences between 4G networks offered by three operators, DNA, Telia, and Elisa, and Wi-Fi networks.

We will delve into the unique aspects of 4G networks, including frequency bands, signal strengths, data rates, and latency, as provided by these operators.

We'll also examine Wi-Fi networks, which are widely accessible, and discuss how they compare to 4G in terms of performance.



## Introduction:

- Measurement Tools:
- CellMapper
- Opensignal
- Wi-Fi Analyzer





# Our approach

The methodology for analyzing and visualizing the coverage of 4G and Wi-Fi networks

- Conduct measurements in few locations around the campus
- Organize data in an Excel sheet (Dataset)
- Analyse the dataset using Python and some its libraries
- Visualize dataset for comparison of the network coverages using Python and some its libraries

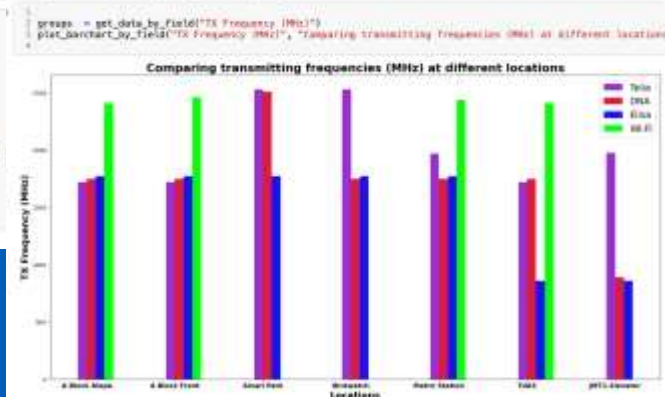
	Location	Download Speed	Upload Speed	Latency (ms)	Operator	Standard	Received Signal Strength (dBm)	RX Frequency (MHz)	TX Frequency (MHz)
0	A Block Alpa	70.89	8.44	17.0	Ora	LTE	-89.0	1887.5	1770.0
1	A Block Alpa	80.58	22.70	70.0	Telia	LTE	-91.0	1875.0	1750.0
2	A Block Alpa	50.43	59.80	341.0	Ora	LTE	-88.0	1844.8	1749.8
3	A Block Alpa	92.40	105.00	4.0	Wii	Wi-Fi	-93.0	2417.0	2410.0
4	A Block Front	158.02	17.80	38.0	Ora	LTE	-88.0	1887.5	1770.0
5	A Block Front	158.02	36.00	26.0	Ora	LTE	-87.0	1844.8	1749.8
6	A Block Front	98.02	32.80	21.0	Telia	LTE	-87.0	1875.0	1750.0
7	A Block Front	120.02	127.00	12.0	Wii	Wi-Fi	-87.0	2460.0	2460.0
8	Alvari Park	120.02	9.20	24.0	Ora	LTE-A	-87.0	1887.5	1770.0
9	Alvari Park	120.02	50.70	22.0	Telia	LTE	-87.0	1875.0	1750.0
10	Alvari Park	85.02	45.80	85.0	Ora	LTE	-85.0	1887.5	1770.0
11	Alvari Park	Not	Not	Not	Wii	Wi-Fi	Not	Not	Not
12	Birdwatch	14.80	17.80	78.0	Ora	LTE	-88.0	1887.5	1770.0
13	Birdwatch	151.02	9.20	18.0	Telia	LTE	-87.0	1875.0	1750.0
14	Birdwatch	24.02	30.00	30.0	Ora	LTE	-87.0	1887.5	1770.0
15	Birdwatch	Not	Not	Not	Wii	Wi-Fi	Not	Not	Not
16	Metro Station	120.02	9.80	10.0	Ora	LTE	-87.0	1887.5	1770.0
17	Metro Station	35.02	13.30	80.0	Ora	LTE	-89.0	1887.5	1770.0
18	Metro Station	100.02	14.10	19.0	Telia	LTE	-87.0	1875.0	1750.0
19	Metro Station	77.02	88.30	Not	Wii	Wi-Fi	Not	Not	Not
20	TUAS	98.12	0.20	16.0	Ora	LTE	-87.0	1887.5	1770.0
21	TUAS	81.22	87.80	30.0	Ora	LTE	-87.0	1887.5	1770.0
22	TUAS	60.42	32.70	70.0	Telia	LTE	-87.0	1875.0	1750.0
23	TUAS	0.02	1.20	90.0	Wii	Wi-Fi	-79.0	2460.0	2460.0
24	gfi's Elevator	1.20	0.20	30.0	Ora	HSPA+	-100.0	1887.5	1770.0
25	gfi's Elevator	0.20	1.21	74.0	Ora	HSPA+	-100.0	1887.5	1770.0
26	gfi's Elevator	4.20	0.20	80.0	Ora	HSPA+	-100.0	1887.5	1770.0
27	gfi's Elevator	Not	Not	Not	Wii	Wi-Fi	Not	Not	Not

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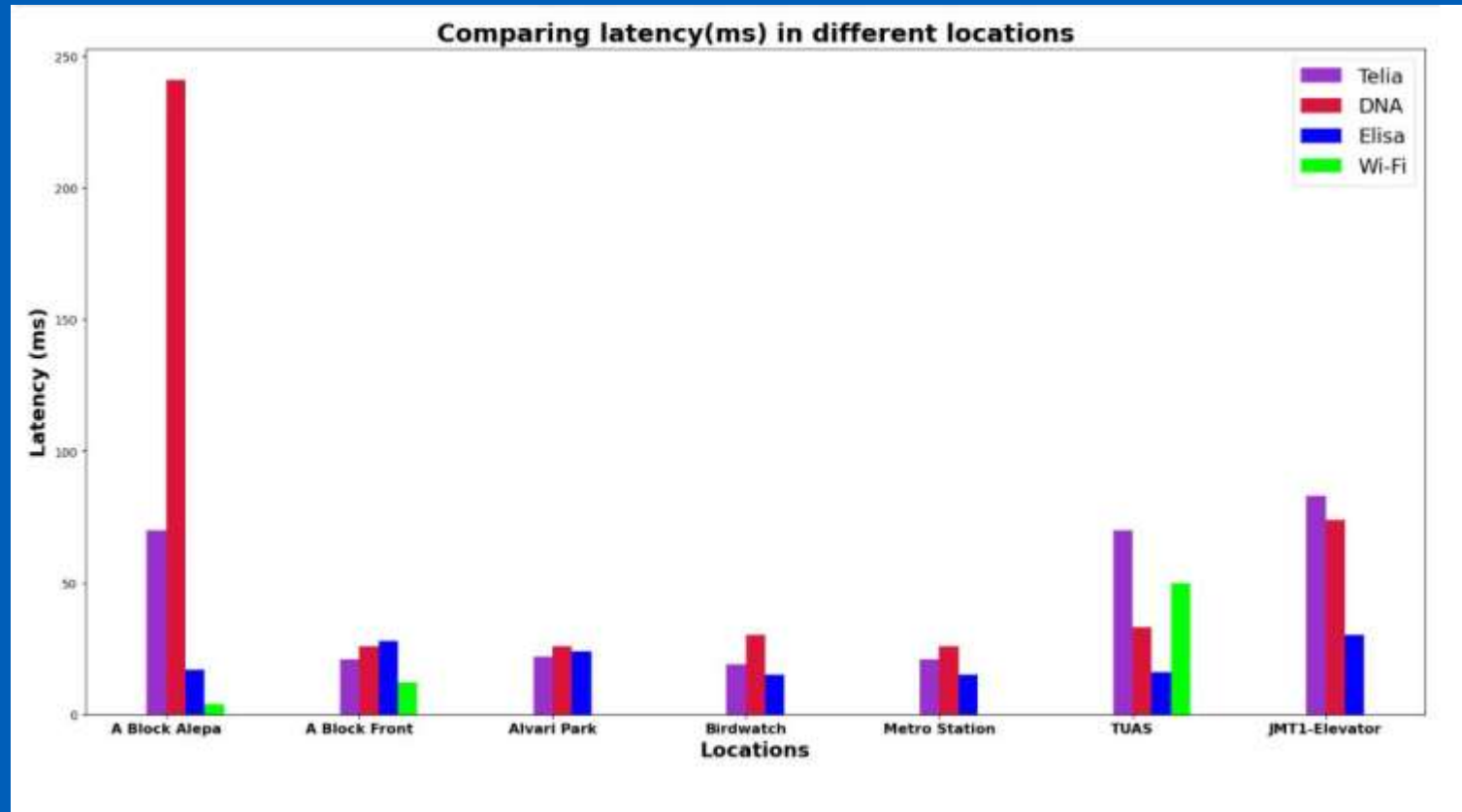
1 def get_data_by_field(field):
2     locations = df["Location"].unique()
3     df_bylocation = df.groupby("Location")
4
5     telia = []
6     ora = []
7     elisa = []
8     wifi = []
9
10    for _ in locations:
11        temp_df = df_bylocation.get_group(_)
12        telia.append(float(temp_df.loc[temp_df["Operator"] == "Telia"])[field])
13        ora.append(float(temp_df.loc[temp_df["Operator"] == "Ora"])[field])
14        elisa.append(float(temp_df.loc[temp_df["Operator"] == "Elisa"])[field])
15        wifi.append(float(temp_df.loc[temp_df["Operator"] == "Wii"])[field])
16    return telia, ora, elisa, wifi
17
18 def plot_bar chart_by_field(field, title, group):
19     i = 0
20     width = 0.1
21     telia, ora, elisa, wifi = groups
22
23     Telia = plt.bar(i+0.5*width, telia, width, color='darkorchid')
24     Ora = plt.bar(i+1.5*width, ora, width, color='darkorchid')
25     Elisa = plt.bar(i+2.5*width, elisa, width, color='blue')
26     Wifi = plt.bar(i+3.5*width, wifi, width, color='lime')
27
28     bars = ['A Block Alpa', 'A Block Front', 'Alvari Park', 'Birdwatch', 'Metro Station', 'TUAS',
29             'gfi's Elevator']
30     plt.xlabel('Locations', fontweight='bold', fontsize=17)
31     plt.ylabel(field, fontweight='bold', fontsize=17)
32     plt.title(title, fontweight='bold', fontsize=17)
33     plt.xticks(i, bars, fontweight='bold', fontsize=12)
34     plt.legend([Telia, Ora, Elisa, Wifi], ['Telia', 'Ora', 'Elisa', 'Wi-Fi'], fontsize=17)

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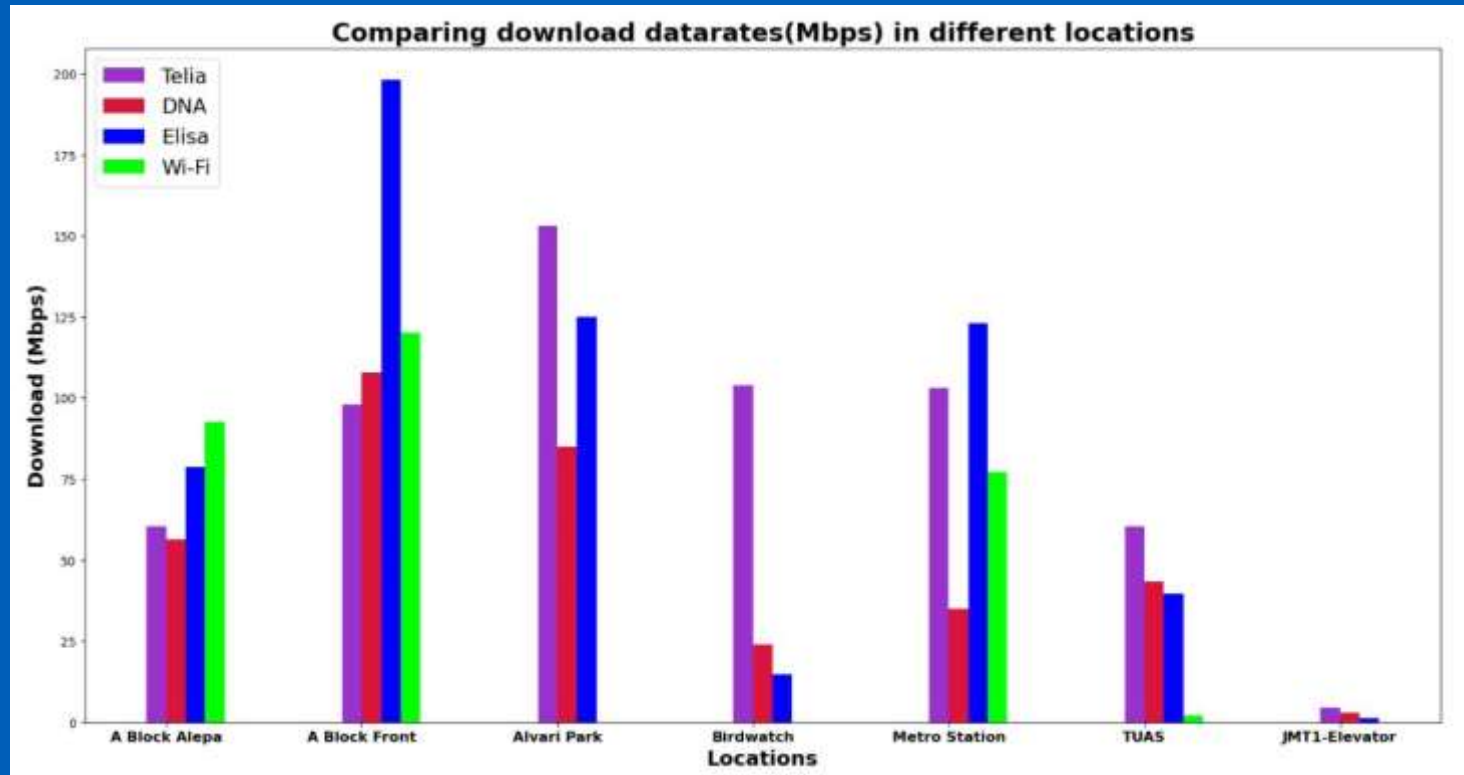
Compare transmitting frequencies (MHz) at different locations



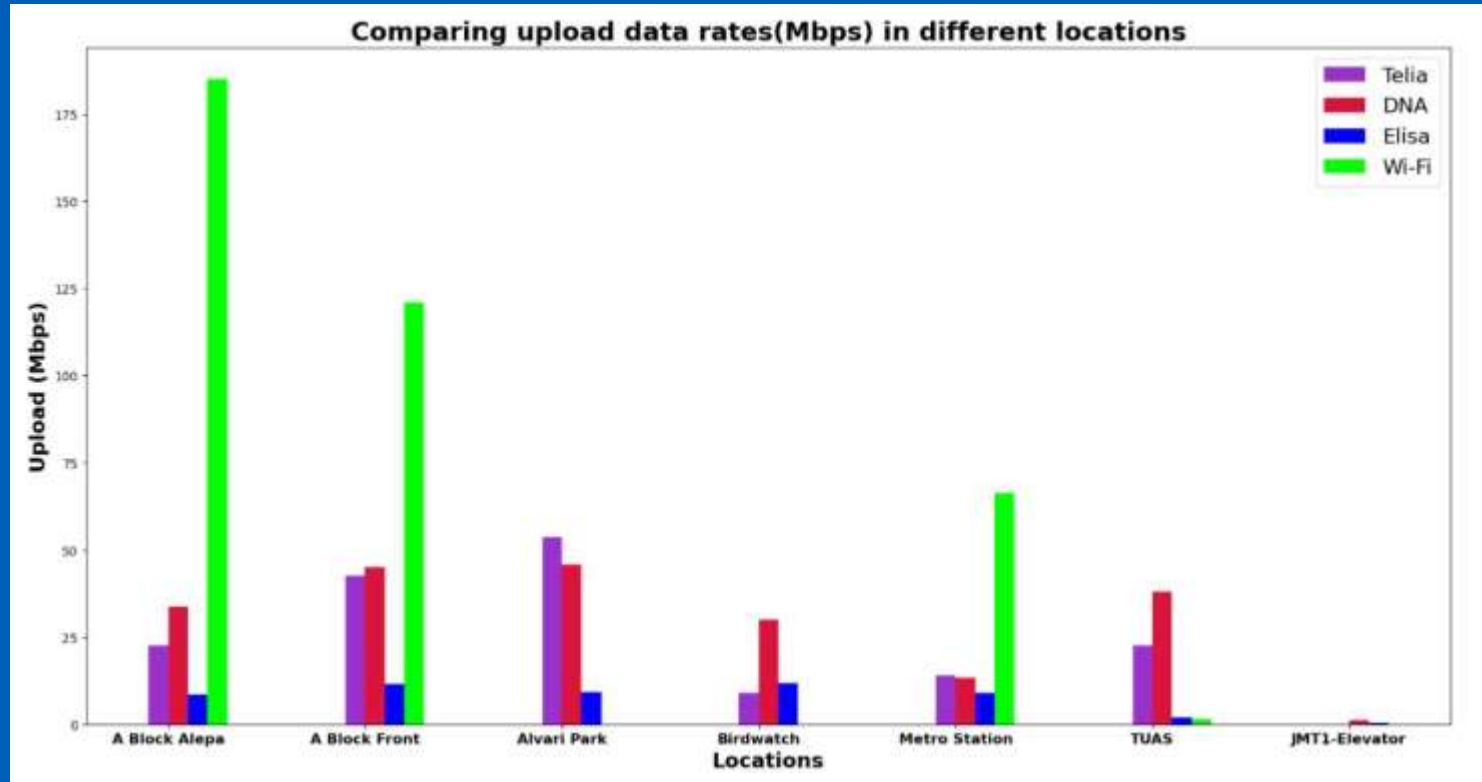
# Latency



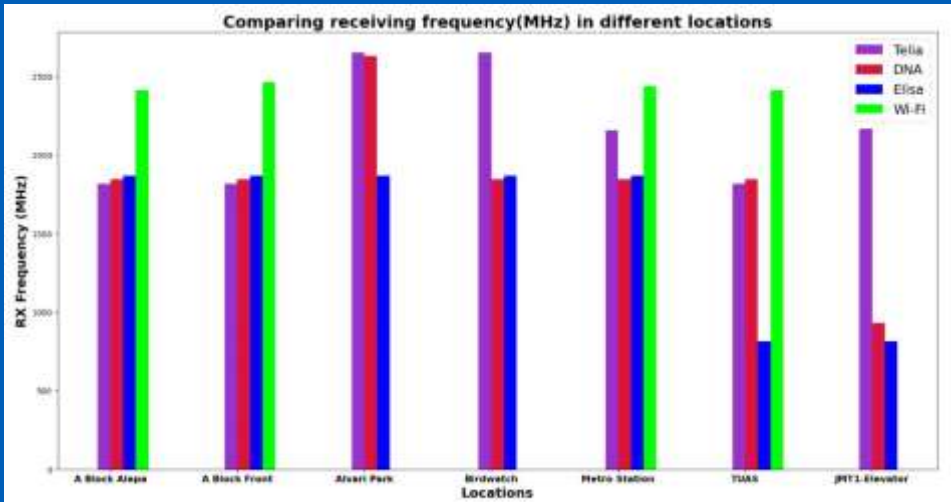
# Download Data Rates



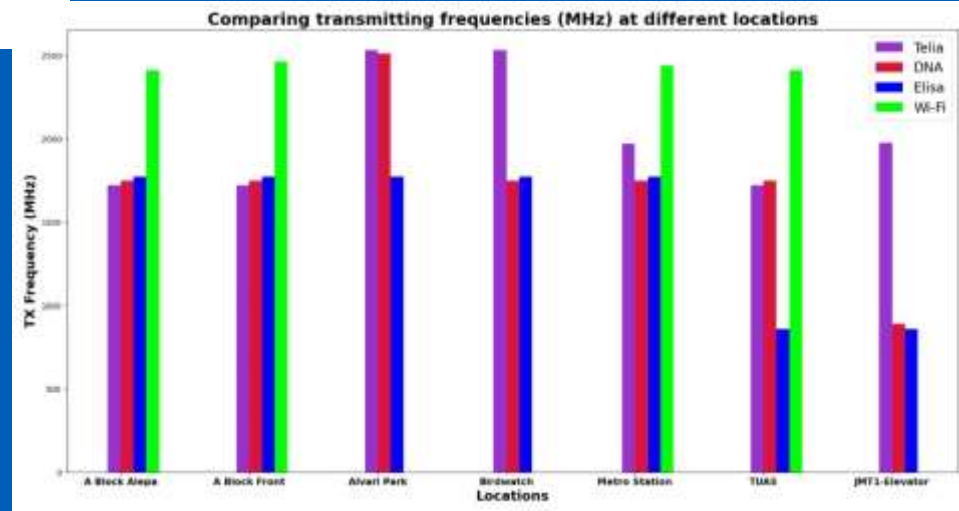
# Upload Data Rates



# Frequency Bands

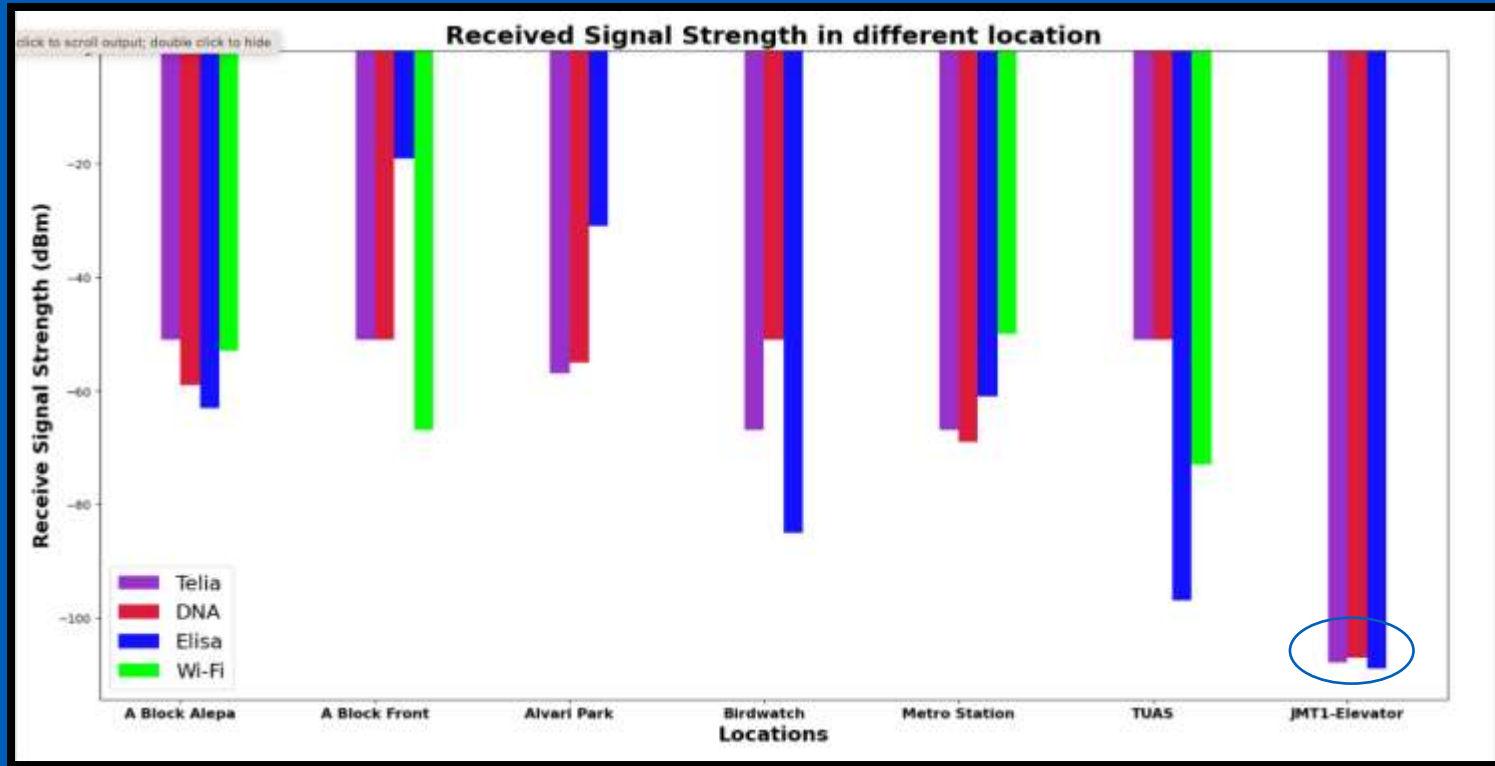


- Cellular:
  - B3 (1800 MHz) is mostly used
  - JMT-1 connections were 3G
- Wi-Fi: Eduroam, "only" 2.4 GHz
  - Few measurements used 5 GHz instead of 2.4 GHz
  - 2.4 GHz is congested

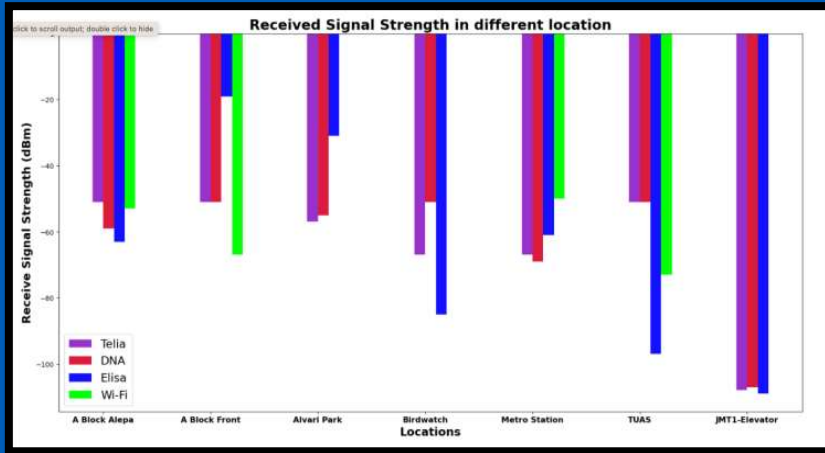




# Signal Strength



# Signal Strength



With the exception of Alvari Park and A Block, Elisa has always displayed stronger signal strength, particularly at the TUAS Building.

Additionally, there is a strong connection between DNA and Telia.

However, Wifi has had some issues and often disappears.

# Conclusion

## Analysis

- Elisa has improved signal strength and download speed and minimal latency.
- Though not always available, wi-fi has the fastest upload speeds.
- DNA and Telia are displaying average records.

## Significance

- Coverage Assessment
- Performance Optimization
- Comparing Network Performance

