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Radio Access Network Traffic Forecast Analysis for Mobile Network Operators in Anticipation of 5G

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Radio Access Network Traffic Forecast Analysis for Mobile Network Operators in Anticipation of 5G

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1. Introduction

The Mobile Data Traffic Forecast analyses historic data traffic, together with drivers of future growth, to provide traffic projections for wireless telecom services based on a given technology. The forecast is based on a transparent set of inputs, assumptions, and methodology. This approach enables operators to challenge the methodology and assumptions and modify the inputs if they disagree with the baseline assumptions.

The analysis provides various outputs which can be used independently or as an input to the *Network Evolution Forecast* analysis. They may also be used as a baseline for Network Improvement Assistant based analysis as well as for any additional advisory services.

The key highlights of the analysis output are:

- 5 year forecast of mobile data traffic growth
- Total network traffic as well as data traffic per connection
- Data traffic per radio technology
- Fixed Wireless Access scenario modelling
- Benchmarking analysis of total traffic, traffic per subscriber, ARPU and affordability of data
- Phases of data growth analysis

The analysis provides key tangible benefits for operators, including:

- Network capacity planning
- Long range budget forecasting
- Data pricing

2. Methodology & Calculations

2.1 Summary

The forecast provides a view of how 3G, 4G, and 5G data traffic volumes will evolve over a 5-year period, reflecting the growth of 4G adoption together with operator strategies related to content and data monetisation. Combined with the mobile connections forecast, it provides a view of total network data traffic along with traffic per connection, split explicitly for each radio access technology.

Data Collection inputs:

1. Current number of mobile connections as reported by Operator
2. Mobile connection forecast from GSMA with adjustments to reflect competitive impact not considered by the GSMA methodology
3. Historic data traffic volumes as reported by Operators, or if unavailable then Supplier assumptions based on regulator and/or competitor reported data

Data Analysis is based on:

1. Data traffic forecast for 5-year period: total, per connection, growth rate, for 3G/4G/5G/combined
2. Difference in data usage between 3G,4G, 5G over time
3. Mobile connection forecast for 5-year period
4. Impact of content evolution, e.g. adoption of higher bandwidth video

2.2 Methodology

2.2.1 Assumptions

- a) Mobile connections capable of data services on a technology will use more data than connections on an older technology. Multipliers based on observed data are used to calculate the difference in traffic between 2G/3G/4G/5G.
- b) Mobile traffic data calculations are based on mobile and FWA connections excluding M2M / IoT connections and traffic
- c) The traffic shown is the total generated for a connection capable of operating at that technology level, i.e. a 5G connection may include 2G/3G/4G traffic, a 4G connection include 2G/3G traffic

2.2.2 Levers

The data traffic forecast is based on 3 levers.

1. SIMs supporting more advanced technology use more data

Calculating the increase in data consumption due to subscribers moving from one technology to another. i.e. a 4G connection is expected to use more data than a 3G connection, so if we see a shift in connections from 3G to 4G then we expect to see a corresponding increase in data traffic.

This calculation is based off the previous year's data traffic figure.

2. Market Maturity

This calculates the increase in data traffic related to the maturity of the market. As markets mature subscribers find more uses for their mobile devices and consume more content. The level of 4G and 5G penetration is used as the indicator of market maturity and regression analysis is used to calculate the level of increased data traffic.

This calculation is based off the previous year's data traffic figure plus the increase associated with Technology Evolution.

3. Content Evolution

This calculates the increase in data traffic related to future content evolution. Even in a market with static radio access technology penetration data consumption will increase as new content becomes available to consumers. For instance, future drivers include 4K/8K video, AR/VR, game streaming services.

This calculation is based off the combination of the previous year's data traffic figure, the increase associated with Technology Evolution and the increase due to market maturity

2.2.2.1 Lever 1: SIMs supporting more advanced technology use more data

If a subscriber moves from a 2G connection to a 3G connection, we expect them to use more data. If they move to a 4G connection, we would expect their data usage to be still higher. The first lever in the methodology takes the mobile connection forecast from GSMA and calculates an increase in data usage for each upgraded connection. The amount of extra data is based on data points gathered from multiple operators, referred to as multipliers.

Figure 1 shows the difference in data usage between an LTE handset and a non-LTE handset – this is an example of a **multiplier**. Such data points are used to calculate the increase in data usage as a subscriber migrates from one radio access technology to another. For example, if an average 4G connection uses 3GB and the average 3G connection uses 1GB then the 4G multiplier is 3.0 (3 divided by 1), and for each connection migrating from 3G to 4G we'd expect an extra 2GB of usage.

The right-hand side of the figure is an example of how the mix of mobile connections have changed for an operator. In this example the total number of mobile connections have decreased but the operator has migrated a significant number of connections from 2G to 3G/4G. In this situation we would expect the overall data traffic to grow, despite the fall in total connections. If the operator has a good data monetisation strategy then we'd also expect ARPU and revenue to grow as well, with the increased revenue from the 3G and 4G connections more than offsetting the lost 2G connections.

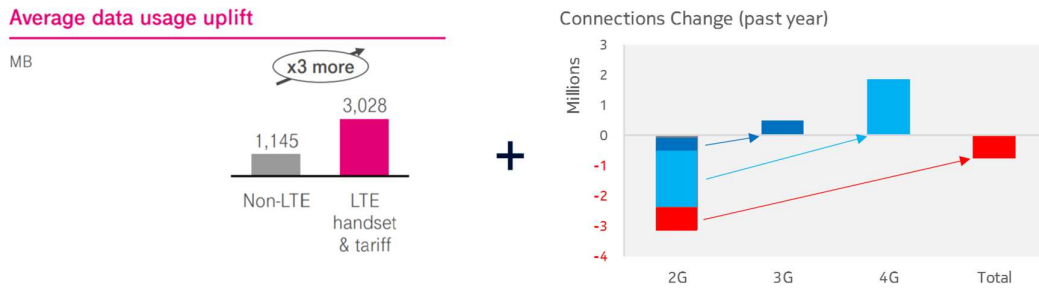


Figure 1: Example of mobile connection change used to calculate increase in data traffic

Figure 2 shows a summary of the inputs and calculation used for lever 1.

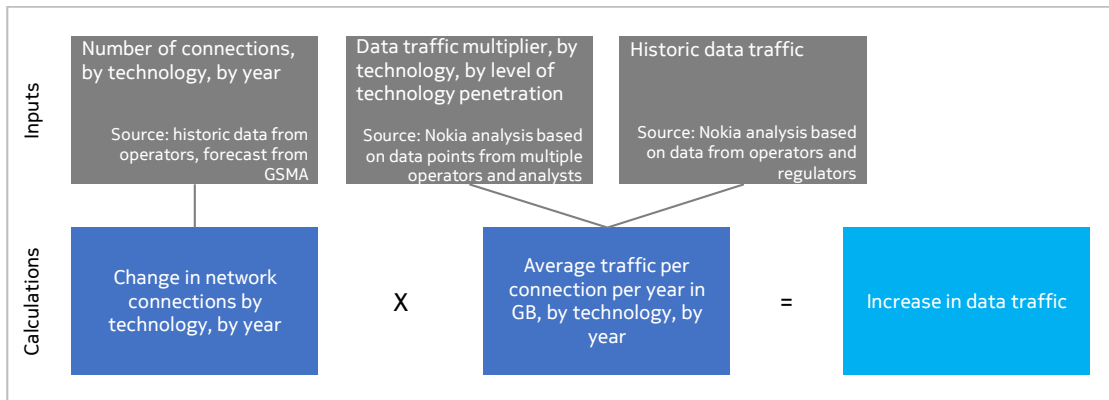


Figure 2: Calculation of increased data traffic due to mobile connection changes

This first lever considers levels of data usage at the current level of market maturity. However, as 4G and 5G penetration increases, so too does the average usage per connection. This is addressed with the second lever.

2.2.2.2 Lever 2: Data Traffic Increases as Markets Mature

As markets mature, subscribers' usage increases, driven by their own behaviour, operator initiatives and through the influence of OTT providers. Contributing factors include [1]:

- Time spent on mobile
- Number of apps downloaded and updating
- Time spent on mobile network versus Wi-Fi
- Number of OTT offerings
- OTT country specific content
- Operator bundled content
- Operator data pricing

There is a strong correlation between the maturity of a market, in terms of 4G penetration, and the amount of data used per mobile connection, as shown in is Figure 3. Regression analysis is used to calculate the additional data traffic expected based on the difference for the current and future levels of market maturity.

Data per connection against 4G+5G penetration

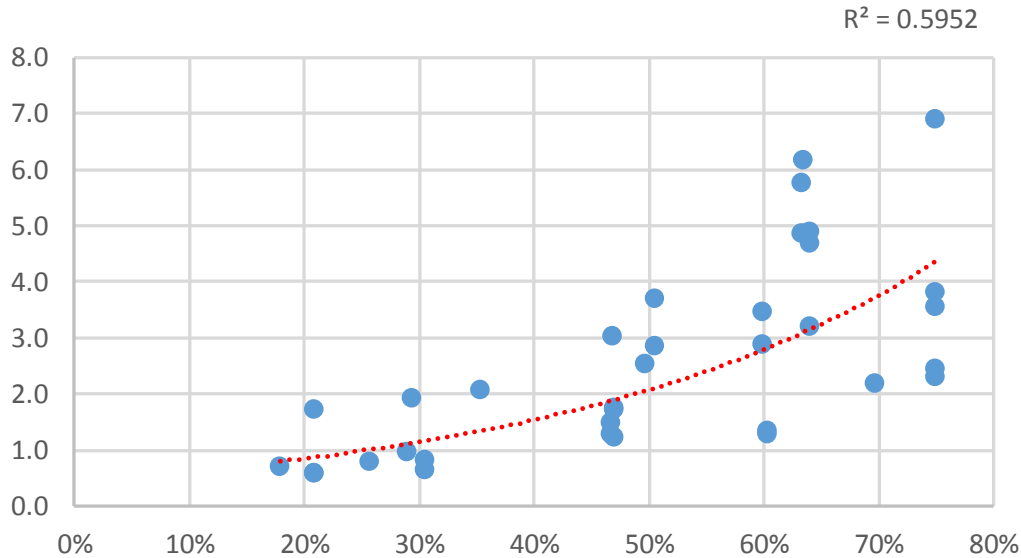


Figure 3: Regression analysis to calculate increased data traffic associated with an increase in market maturity

Figure 4 shows a summary of the inputs and calculation used for level 2.

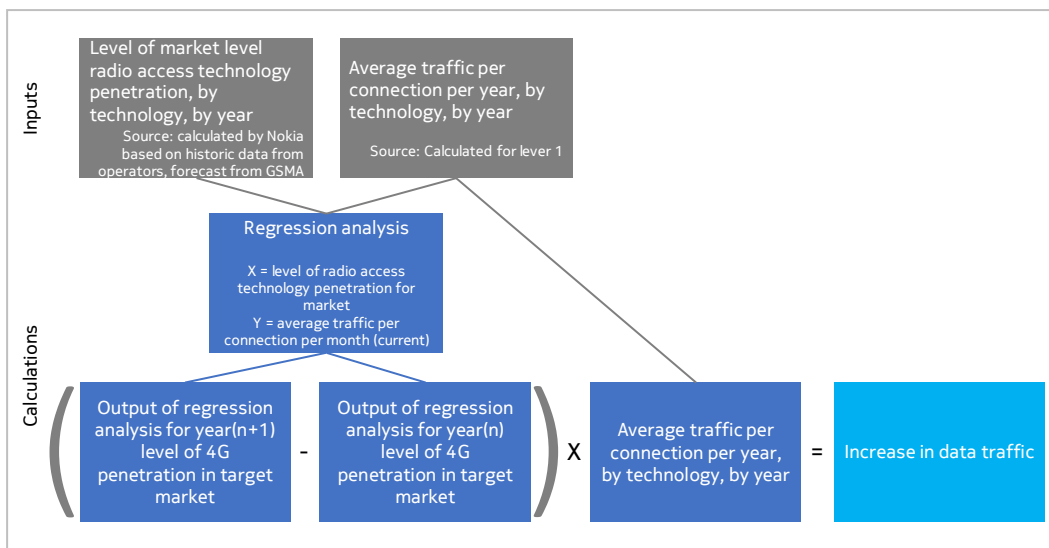


Figure 4: Calculation of increased data traffic due to the change in market maturity

2.2.2.3 Level 3: Content Evolution

Even if there is no change in the number and type of mobile connections, we still expect data traffic consumption to increase. This is due to the increased adoption of existing content as well as the introduction of new content. For example, as subscribers upgrade to devices with higher resolution screens they also begin to consume more video content at a higher resolution. Video is responsible for the majority of today’s mobile data traffic and leading OTT providers are already increasing the quantity of 4K and even 8K content. This will result in significant future growth, even in an otherwise static market. In addition to video, there is expected to be a substantial increase in data traffic due to the rise of cloud gaming platforms, particularly with the introduction of 5G which offers a better gaming experience due to its lower latency [2]. Figure 5 provides some example of content evolution and the levels of bandwidth they require.

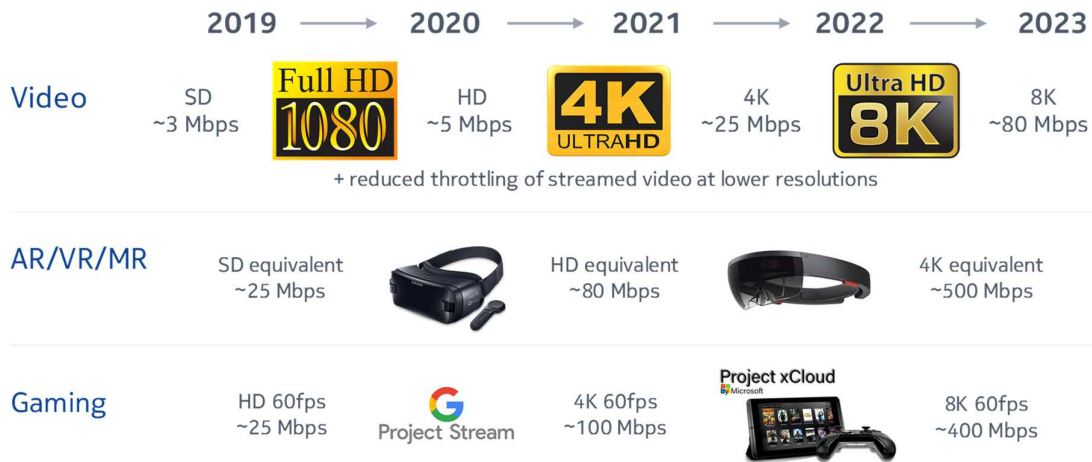


Figure 5: Examples of evolving content driving higher data traffic

The data traffic increase due to content evolution is calculated by taking the previous year’s data traffic together with the increases from levers 1 and 2, then multiplying this by a content evolution factor, see Figure 6. The content evolution factor is based on an assessment of when new content is expected to enter the market, the rate of adoption and the bandwidth requirements compared to the format it is replacing. A standard set of content evolution factors are used for most markets, but country specific factors are applied for some markets where a significantly different evolution is expected. The content evolution factors are subject to continued review as forecasts for new and existing content change.

Figure 6 shows a summary of the inputs and calculation used for level 3.

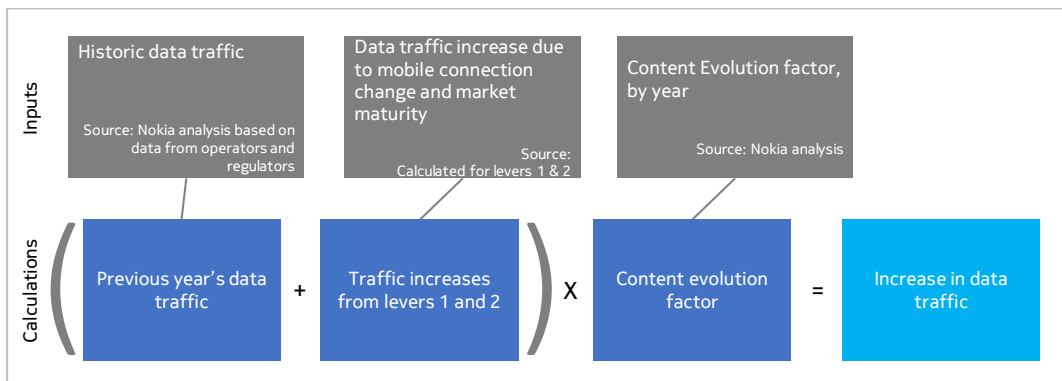


Figure 6: Calculation of increased data traffic due to content evolution

2.2.2.4 Fixed Wireless Access (FWA)

FWA penetration has a significant impact on data traffic but there is limited data availability so has not been included as a lever in the analysis. However, provided that the level of penetration does not significantly change then the forecast should still be valid. If we know that there is a plan by the operator to drive up FWA adoption, as many are considering with 5G, then the analysis provides a scenario planner to model the impact of different levels of penetration and data usage.

3. Output and Visualizations

The analysis provides various outputs related to traffic projections and forecasting, as described in the following charts.

3.1.1 Data for Supply and Demand Model

The first chart is a summary of the forecast in tabular form. This is primarily to be used as input for the supply and demand model but can also be useful for viewing a summary of all the data.

Input for Supply and Demand Model						
	2018	2019	2020	2021	2022	2023
mobile connections (m)	24.2	25.0	25.1	25.2	25.3	25.4
2G	5.5	4.9	3.5	2.3	1.2	0.1
3G	3.3	3.0	2.8	2.4	1.9	1.5
4G	15.5	17.2	18.5	17.7	16.1	15.5
5G	-	-	0.4	2.8	6.0	8.2
connection growth rate	1%	3%	0%	0%	0%	0%
Data volume per connection per month (GB)	3.5	4.4	5.9	9.0	15.5	24.8
2G	-	-	-	-	-	-
3G	1.5	1.7	2.0	2.6	3.8	5.3
4G	5.2	6.2	7.6	9.7	13.1	16.8
5G	-	-	9.1	17.5	28.8	43.8
Data growth rate per connection per month	104%	31%	34%	52%	73%	60%
Traffic distribution per technology						
2G	0%	0%	0%	0%	0%	0%
3G	6%	5%	4%	3%	2%	1%
4G	94%	95%	94%	76%	54%	42%
5G	0%	0%	2%	21%	44%	57%
Data volume per year (PB), Total	1,018	1,336	1,790	2,720	4,704	7,548
Data volume per year (PB), 2G	-	-	-	-	-	-
Data volume per year (PB), 3G	60	61	66	72	88	95
Data volume per year (PB), 4G	958	1,275	1,682	2,067	2,534	3,133
Data volume per year (PB), 5G	-	-	41	580	2,083	4,320

Figure 7: summary output in tabular form

3.1.2 Assumption summary

These elaborate the inputs and assumptions if Operator want to understand the basis of the forecast [3].

General notes and assumptions

- This clarifies what is and is not included in the data traffic forecast: existing fixed wireless access (FWA) connections are included, but IoT connections are not
- Data traffic per technology is the total generated for a connection capable of operating at that technology level, i.e. a 5G connection may include 2G/3G/4G traffic, a 4G connection include 2G/3G traffic

Data

- Historic mobile connections and forecast shows the number of mobile connections, historic and forecast, together with the source of the data
- Historic mobile data traffic with details of the data source – note that the source is automatically updated based on the selected operator
- Multiplier table: this shows the traffic multipliers used in the forecast calculations for each technology and level of penetration. 2G multipliers are usually set to zero, meaning 2G traffic

is not taken into consideration, and 3G is used as the base for the other technologies and is always 1. Using the example in Figure 8, if an operator has 40% 4G connections, 35% 3G and 25% 2G: the 4G multiplier is 2.6, the 3G multiplier is 1, and the 2G multiplier is zero. Section 2.2.2.1 has a further description of multipliers.

3.1.3 Mobile Data Traffic Forecast

This session covers the different aspects of the data traffic forecast. The Mobile Connections view, Figure 8, shows the historic and forecast connections for the selected operator, split by technology. It is a useful visualisation to discuss the current situation. For example, re-farming of spectrum as 2G and 3G decline, speed of 5G take-up based on level of 4G penetration and comparison with historic take-up of 4G.

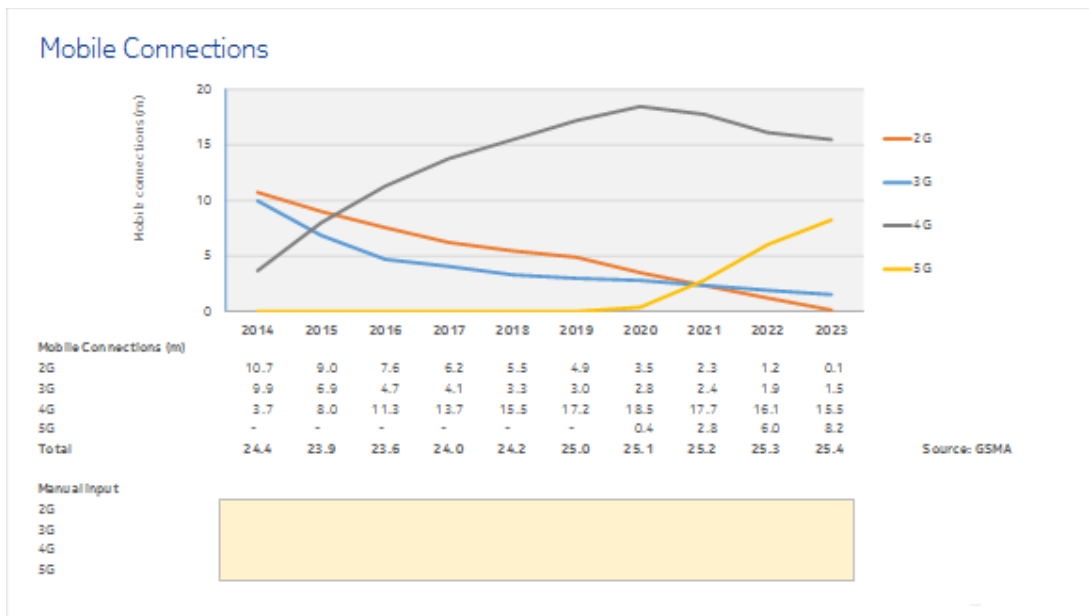


Figure 8: Visualization of mobile connection forecast from GSMA

The data traffic forecast view, Figure 9, provides the first look at the data traffic forecast. The column chart on the left shows the total mobile data traffic, historic and forecast, together with a line showing the total number of mobile connections.

The table on the right shows the compound annual growth rates (CAGR) for key KPIs. Often the 2014-18 figures are very high, reflecting the period when many markets launched 4G and the 2014 level of traffic was very low. The 2018-2023 figure can be compared to a consensus among analysts for worldwide data growth of ~40% per annum up to 2023. Note that the 2018-23 growth rate for 4G may become negative for markets with aggressive 5G launches. Finally, the table at the bottom shows the connections and data traffic in tabular form.

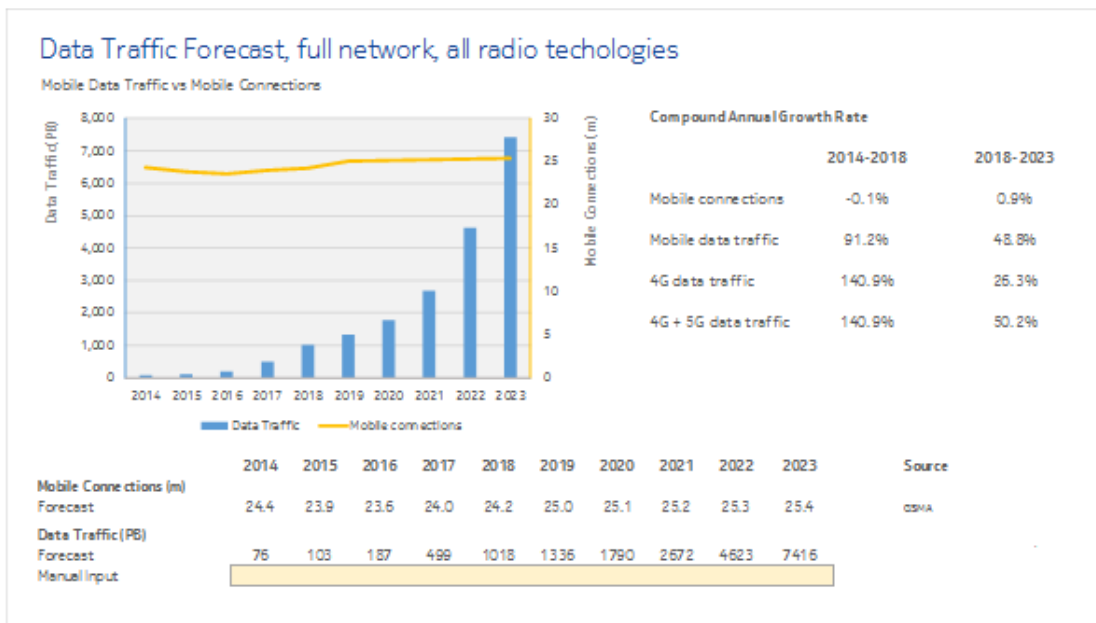


Figure 9: Data traffic forecast and number of mobile connections, with compound annual growth rate calculations

Figure 10 shows another aspect of data traffic forecast, this time split by technology. The stacked column chart on the left depicts the growth over time, whereas the chart on the right shows how the technology share of mobile data traffic is changing over time.

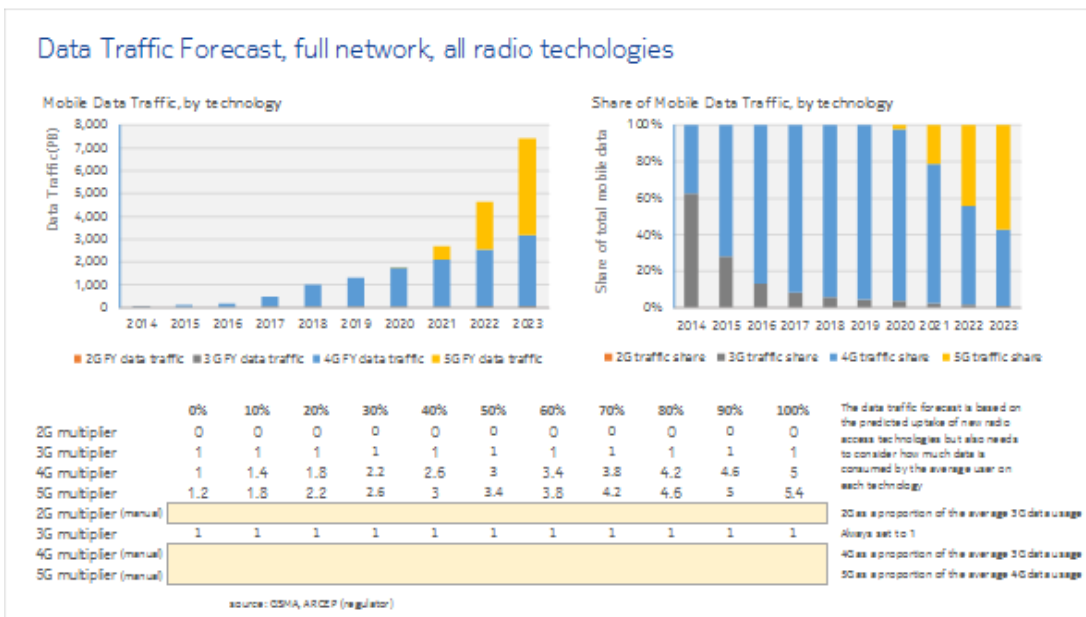


Figure 10: data traffic forecast, split by technology

Figure 11 provides an alternative version of the slide without the table and manual override, suitable for PowerPoint presentation.

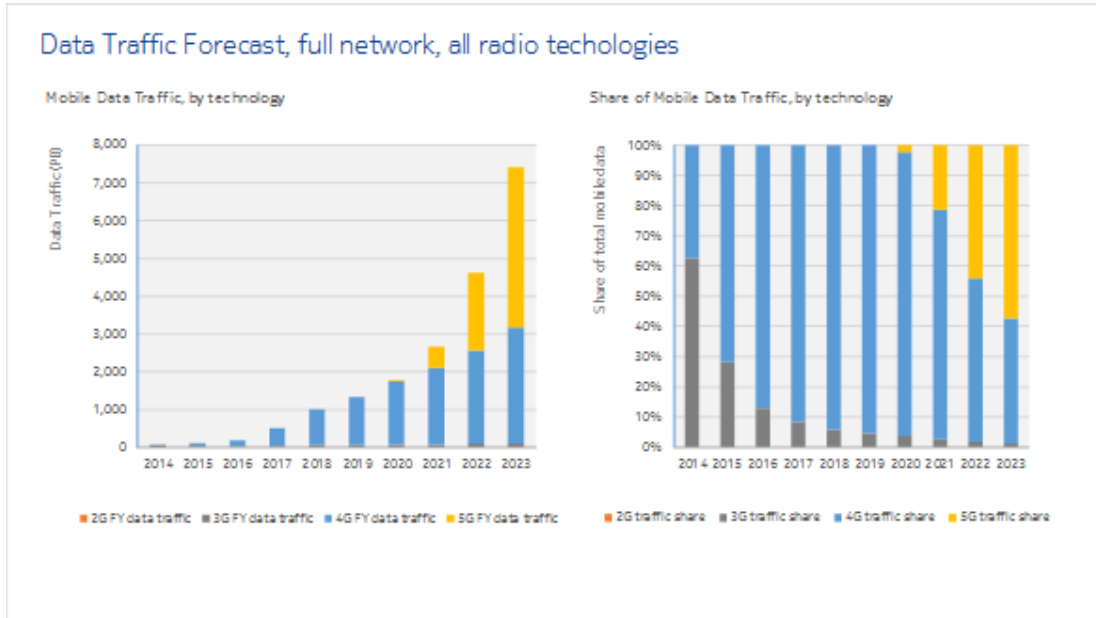


Figure 11: Data traffic forecast, split by technology

The Data Usage per Connection view, Figure 12, shows how the level of usage is forecast to evolve for each type of connection. It is important to understand that this is the average usage per connection, not total traffic. Note that 3G will be declining in many markets, but the average usage per 3G user may still be increasing and this doesn't mean that the total 3G traffic is increasing.

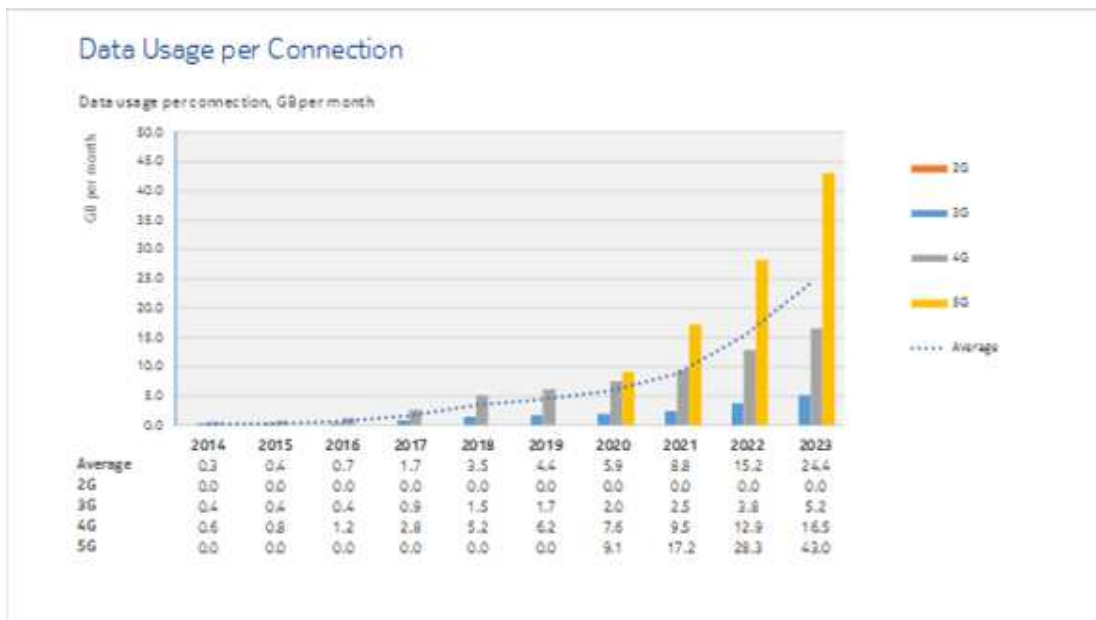


Figure 12: Data usage per mobile connection, per month, split by technology

Figure 13 provides a 5G only view, providing a summary of the 5G data from included in previous views.

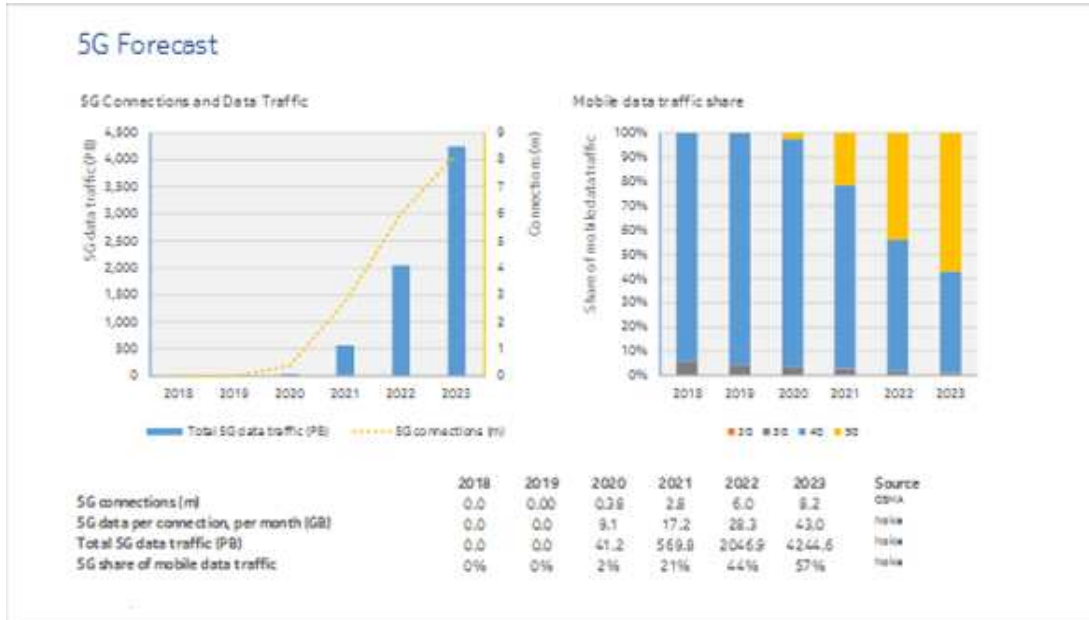


Figure 13: Summary of all 5G data

3.1.4 Fixed Wireless Access (FWA) Scenario Modeler

This aim of this part of the analysis is to provide a high-level analysis of the impact of new or increased Fixed Wireless Access connections on the operator’s network. It makes use of the data from the traffic forecast combined with user inputs for FWA penetration, the FWA traffic multiplier (how many times more data an FWA connection uses compared to the average mobile connection) and the expected ARPU per FWA connection. The chart shows the existing mobile data traffic forecast in blue, with the additional data associated with FWA in yellow. A projection of FWA related revenue is shown in the table below the chart in Figure 14.

The user provides the assumptions in the yellow boxes. Note that 4G FWA typically uses 3 to 6 times as much data as a mobile connection and this is dependent on several factors, how much data is bundled with the service. For 5G FWA the multiplier is expected to be much higher.

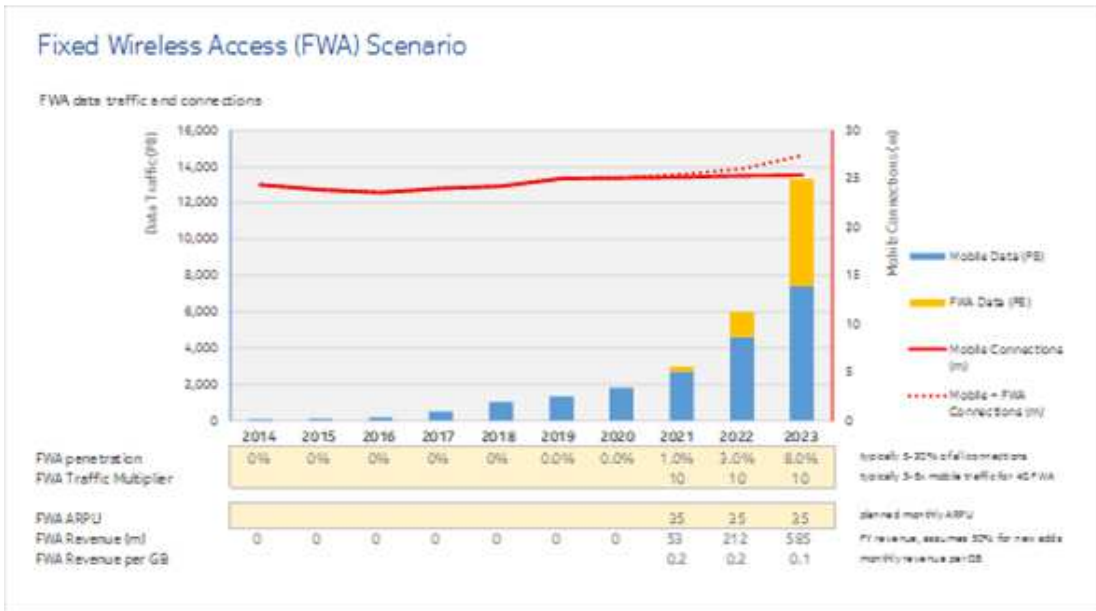


Figure 14: FWA scenario modeler with manual inputs for FWA assumptions

3.1.5 Benchmarks

There are four benchmark analysis to help position the operator in terms of data traffic and ARPU versus their competitors and other markets.

Figure 15: shows the total mobile data traffic for the selected operators. This is a good introductory slide but gives less insight than the other benchmarks. It gives context to the market and competitive positioning – the most relevant comparison is with other operators in the same country, comparing the load on their networks. ISO standard two-letter country codes are used to help identify the operators.

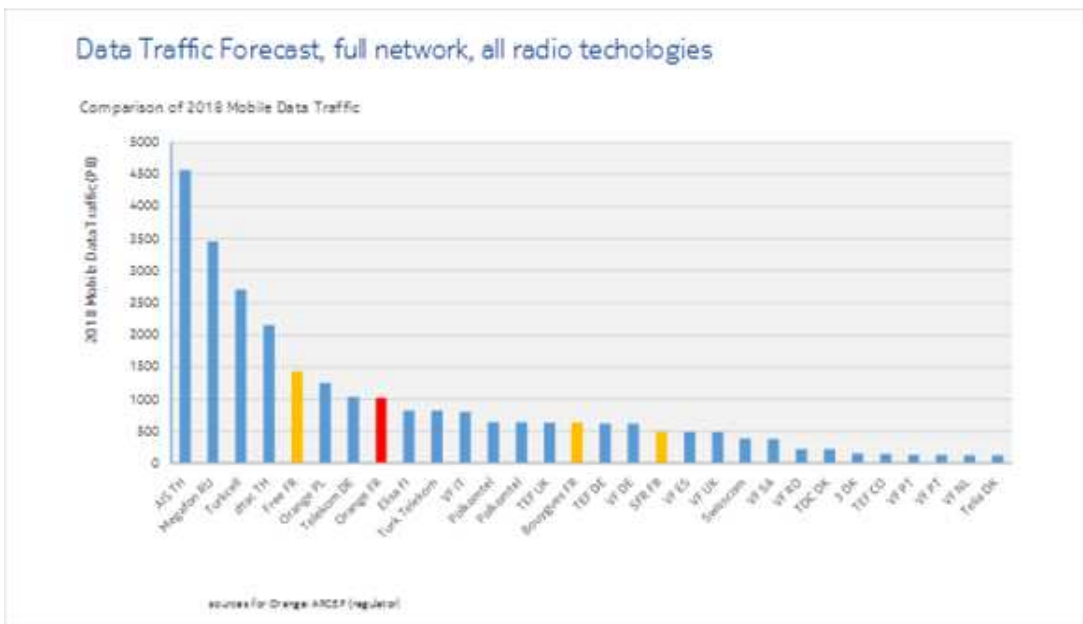


Figure 15: Total mobile data traffic benchmark

Figure 16 provides a better comparison, looking at the average monthly data traffic per connection. Here the data from other markets becomes more relevant. For instance, Elisa shows that subscribers will use much more data if the conditions are right - so the opportunity for data driven revenue growth is very real for the other markets.

In this example for Orange France we see that not only is it serving less than 50% of the average data used by a Free Mobile subscriber, but also significantly less than a Bouygues subscriber. Orange France has the best performing network, but the benchmark suggests that there may be greater pressure on it to expand capacity in its network if it wants to maintain its current performance advantage.

Data Traffic Forecast, monthly data traffic per connection

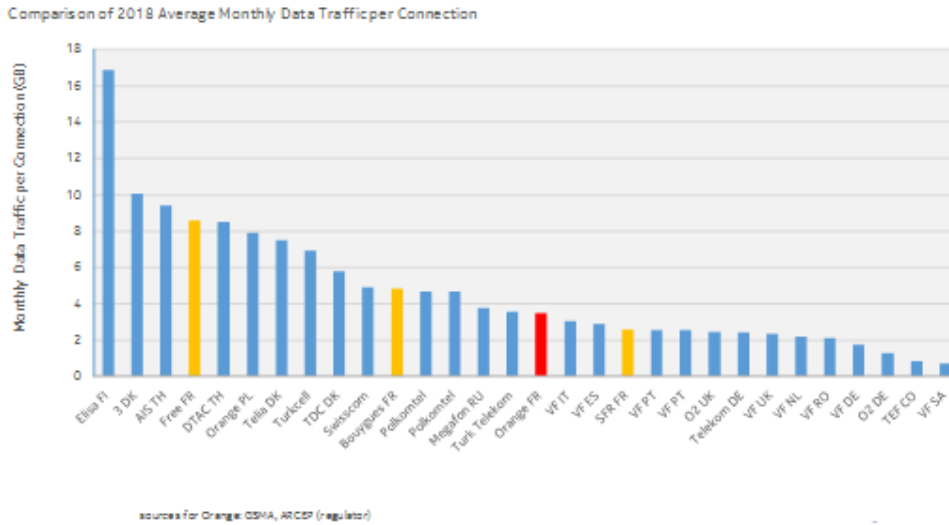


Figure 16: Data traffic per connection benchmark

Figure 17 looks at the Average Revenue Per User (ARPU) per GB, i.e. if we ignore voice and SMS, how much ARPU is generated for each GB of data on the network. In this example we see a huge range across the French operators, reflecting their differing strategies, subscriber mixes, and level of network investment. Free Mobile is offering the cheapest data, central to its strategy, whilst SFR is one of the most expensive, reflecting its low level of 4G adoption and high reliance on its 2G and 3G subscribers.

Note that ARPU does not equate to tariff. A subscriber may buy a tariff with a 20GB data allowance but only use 1GB.

ARPU per GB

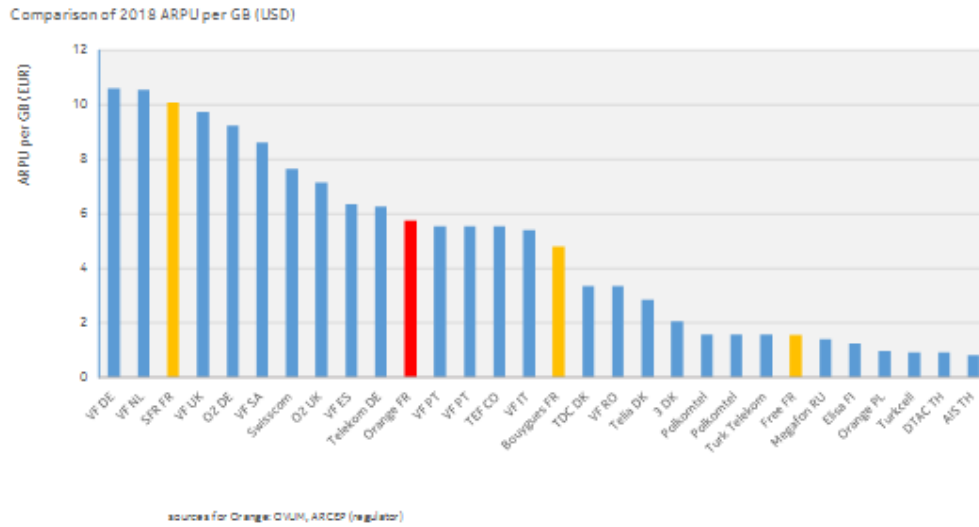


Figure 17: ARPU per GB in EUR, positioned versus other markets

Whilst the comparison between the French operators is useful, the other markets can be misleading as the benchmark doesn't consider the differences in income levels between markets. For instance, Switzerland has one of the highest costs per GB, but also has a very high Gross National Income (GNI) per Capita.

Figure 18 addresses this by including GNI per capita in the benchmark. The y-axis, 'affordability', shows the percentage of monthly income spent for each GB of data used. This provides a fairer comparison of how much revenue per GB the operators are achieving compared to other operators. The trend is that data continues to become cheaper and the chart gives a guide to the level of revenue per GB they will need to achieve in the future as their market matures. This is measuring data used not the data allowance a subscriber has paid for.

Affordability of Data

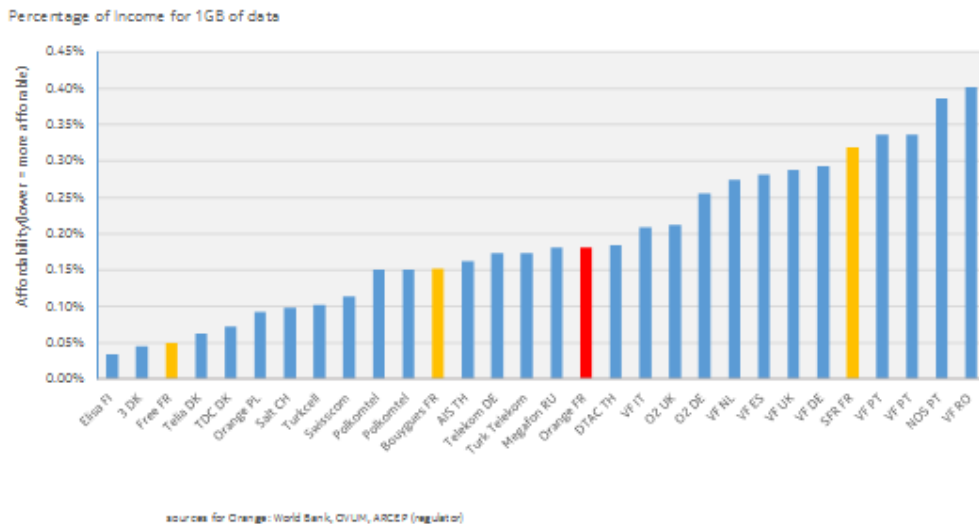


Figure 18: Affordability of data

3.1.6 Phases of Data Growth

This analysis uses the strong correlation between data usage per connection and affordability of data to position operators in one of four phases of data growth. This can be used to gauge how successful they are in the execution of their current strategy and give direction in terms of the market pressure on their data pricing as data usage grows over the 5-year period of analysis. Note that the years in red show the forecast position of the selected operator.

Phases of data growth

Data traffic versus affordability (based on 2018 data)



source: for Orange-World Bank, OVUM, ARCEP (regulator)

Figure 19: Phases of data growth

4. Conclusion

Radio Access Network Traffic Forecast poses one of the key vectors in analysing Mobile Network Operators' demand and traffic projection. This approach attracts technology-based prediction for wireless telecom services to analyses investments plan in 4G networks evolution towards 5G. However, due to the dynamic patterns in data usage in different markets, predicting an accurate forecast is controversial practice. This study analysed traffic and budgetary planning. The work provided key tangible benefits for operators, including network evolution planning and long-range budget forecasting. Further, this paper enhances non-tangible business imperatives needed to build an increased level of engagement between operators and service providers. Finally, it yields a deeper insight into Mobile Network Operator' s future and projects a credible demand planning forecast based on it.

5. References

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6. Appendix A: Data Collection

6.1.1.1 Mobile Connections

Data for mobile connections are sourced from GSMA Intelligence [4]. Note that his report excludes IoT connections – this is important as the nature of IoT traffic is very different to mobile and Fixed Wireless Access (FWA) connections.

6.1.1.2 Historic Data Traffic

Data is collected and estimated using a variety of sources and consolidated into a single spreadsheet table comprising a list of operators and data traffic by year from 2012 to 2025. There are three types of data source.

6.1.1.2.1 Operator data

Where available, mobile data traffic is collected from operator financial reports. This is always the preferred source.

6.1.1.2.2 Data points

When full data is unavailable from the operator there is often the opportunity to collect data points from operator reporting or other sources such as the country regulator or third-party analysis.

Once available data points have been collected the remaining data fields are estimated.

6.1.1.2.3 Comparator

When no other data is available then the closest matching competitor with available data is selected as a comparator. Data traffic usage is calculated based on the relative mix of 2G/3G/4G/5G connections, as reported by GSMA.

6.1.1.3 Difference in usage between radio access technologies

One part of the traffic forecasting calculation is based on how the technology mix for the operator is expected to change. For instance, if a subscriber switches from 3G to 4G we expect them to use more data. As the adoption of a technology increases the observed behaviour is that the traffic usage will further increase. There are many reasons for this, such as subscribers taking time to realise the potential of a faster connection and operators investing more in content as their 4G/5G subscriber base grows.

Figure 20 shows the current assumptions for the multipliers used to calculate the relative traffic per technology for different levels of that technology.

Data usage across 2G/3G/4G/5G		0%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%	
radio access technology penetration																							
2G multiplier	average traffic per sub compared to 3G	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3G multiplier	always 1	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
4G multiplier	average traffic per sub compared to 3G	1	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.0
5G multiplier	average traffic per sub compared to 4G	1.2	1.5	1.8	2.0	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5	5.2	5.4	5.4

Figure 20: Traffic multipliers

The multiplier values will be revised every 6 months based on the availability of any new data points.

Note that traffic for 2G is assumed as zero. This is a valid assumption for most markets due to the extremely low proportion of data, but can be manually adjusted in the analysis for less mature markets if required

3G is used as the base for the 2G and 4G multipliers, whilst the 5G multiplier is based on the 4G traffic.

Example:

3G data per subscriber per month (GB) = 2

4G penetration is 50%

Therefore, 4G data subscriber per month (GB) = 2 x (50% 4G multiplier) = 2 x 3 = 6

5G penetration is 5%

Therefore, 5G data subscriber per month (GB) = 1.5 x (5% 5G multiplier) = 6 x 1.5 = 9

This approach also assumes that as penetration of a technology decreases, so too will the average usage per subscriber. This is an observed behaviour and is because of the heaviest data users tending to upgrade first.

7. Appendix B: Detailed Calculations

The data traffic forecast calculations are split into four parts.

1. Derive KPIs for Forecasting, taking the data inputs and calculating KPI values required for the forecasting
2. Technology Evolution, calculating the increase in data consumption due to subscribers moving from one technology to another. i.e. a 4G connection is expected to use more data than a 3G connection, so if we see a shift in connections from 3G to 4G then we expect to see a corresponding increase in data traffic. This calculation is based off the previous year's data traffic figure.
3. Market Maturity, this calculates the increase in data traffic related to the maturity of the market. As markets mature subscribers find more uses for their mobile devices and consume more content. The level of 4G and 5G penetration is used as the indicator of market maturity and regression analysis is used to calculate the level of increased data traffic. This calculation is based off the previous year's data traffic figure + the increase associated with Technology Evolution.
4. Content Evolution, this calculates the increase in data traffic related to future content evolution. Even in a market with static radio access technology penetration data consumption will increase as new content becomes available to consumers. For instance, future drivers include 4K/8K video, AR/VR, game streaming services. This calculation is based off the combination of the previous year's data traffic figure, the increase associated with Technology Evolution and the increase due to market maturity

7.1.1.1 Derive KPIs for forecasting

The first step is to use the input data to derive values for KPIs required for the forecasting calculations.

Inputs:

1. Total number of connections, by year (a)
2. Number of connections, by technology, by year (b)
3. Traffic multipliers, by technology, by level of penetration (c)
4. Historic total data traffic from previous year (d)

Step 1: calculate the level of radio access technology penetration by technology, by year (e)

$$e = b/a$$

Step 2: calculate the traffic multiplier by technology, by year (f)

$$f = c(e)$$

Note: c is a table and e is the input for the index function

Step 3: calculate the traffic multiplier multiplied by the level of radio access penetration, by technology, by year (g)

$$g = f * e$$

Step 4: calculate the traffic share by technology, by year (h)

$$h = \frac{g(\text{required technology})}{g(\text{sum of all technologies})}$$

Step 5: calculate the data traffic by technology, by year (i)

$$i = d * h$$

Step 6: calculate the average traffic per connection per month in GB, by technology, by year (j)

$$j = l / b$$

7.1.1.2 Technology Evolution

The next step is to calculate the first part of the forecast – the impact from the change in radio access technology penetration.

Inputs:

1. Number of connections, by technology, by year (b)
2. Traffic multipliers, by technology, by level of penetration (c)
3. Average traffic per connection per month in GB, by technology, by year (j)

Step 1: calculate the increase in data in GB related to technology evolution, by technology, by year (k,l)

For 2G/3G/4G

$$k = (b(\text{current year}) - b(\text{previous year})) * j * 12$$

For 5G (need to calculate based off 4G average data traffic per connection as 5G value will be zero at launch, so use 4G value * 5G multiple)

$$l = (b(\text{current year}) - b(\text{previous year})) * j(\text{4G value}) * c * 12$$

Step 2: sum the results for each technology (m)

$$m = \text{Sum}(l) + m$$

7.1.1.3 Market Maturity

The next step is to calculate the increase in data traffic related to market maturity.

Inputs:

1. Traffic multipliers, by technology, by level of penetration (c)
2. Historic total data traffic from previous year (d)
3. Level of radio access technology penetration by technology, by year (e)

Step 1: Regression analysis to calculate coefficient for penetration level (n) and intercept (o)

Set X range to e (current year)

Set Y range to j (current year)

Figure 21 shows an example of the regression analysis output. In this example n = 4.28 and o = 0.30

Regression Statistics	
Multiple R	0.42
R Square	0.18
Adjusted R Square	0.14
Standard Error	1.47
Observations	25.00

ANOVA					
	df	SS	MS	F	Significance F
Regression	1.00	10.85	10.85	5.04	0.03
Residual	23.00	49.51	2.15		
Total	24.00	60.35			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.30	0.93	0.33	0.75	1.62	2.23	1.62	2.23
Current 4G penetration	4.28	1.90	2.25	0.03	0.34	8.22	0.34	8.22

Figure 21: Example output from regression analysis

Step 2: Calculate the percentage increase in data traffic due to market maturity (p) as:

$$p = \frac{((\text{current level of maturity} \times \text{4G penetration level coefficient}) + \text{intercept}) - ((\text{previous level of maturity} \times \text{4G penetration level coefficient}) + \text{intercept})}{((\text{current level of maturity} \times \text{4G penetration level coefficient}) + \text{intercept})}$$

$$p = \frac{((e^{(4G \text{ current year})} + (e^{(5G \text{ current year})} \times c_{(5G \text{ current year})}) \times n) + o) - ((e^{(4G \text{ previous year})} + (e^{(5G \text{ previous year})} \times c_{(5G \text{ previous year})}) \times n) + o)}{((e^{(4G \text{ current year})} + (e^{(5G \text{ current year})} \times c_{(5G \text{ current year})}) \times n) + o)}$$

Step 3: Calculate the total data traffic including the impact of technology evolution and market maturity (q)

$$q = (d + m) \times (1 + p)$$

7.1.1.4 Content Evolution

The final step is to calculate and add the impact of content evolution. The multiplier for content evolution is the result of a separate piece of analysis and is simply applied to the traffic forecast calculated in the previous steps.

Inputs:

1. Total data traffic including the impact of technology evolution and market maturity (q)
2. Content Evolution multiplier (r)

Step 1: calculate the total data traffic forecast including the impact of technology evolution, market maturity and content evolution (s)

$$s = q \times (1 + r)$$