MOBILE DATA TRAFFIC FORECAST IN IRELAND

27 April 2018

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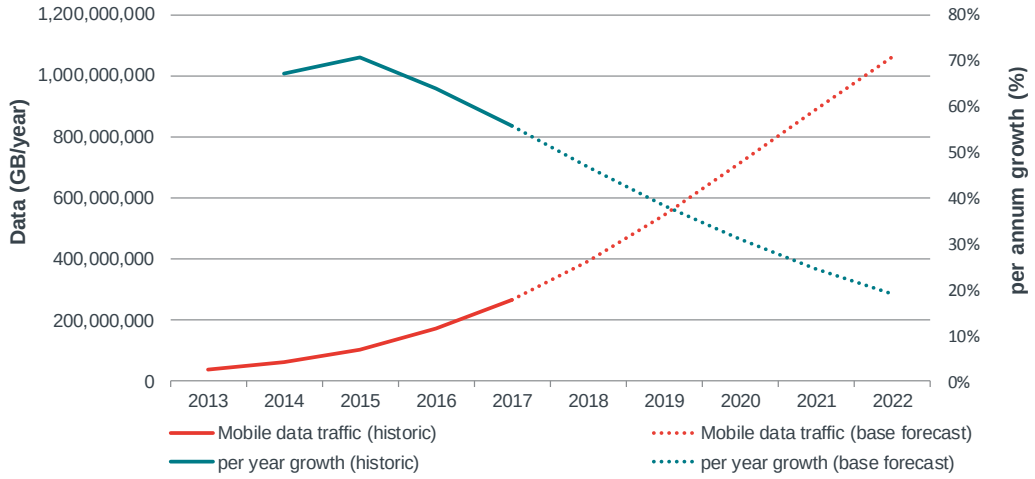
SUMMARY OF FORECASTS

This report prepared for the Commission for Communications Regulation ("ComReg") provides forecasts of mobile data traffic in Ireland for every year between 2018 and 2022. This report supports ComReg in implementing Action 33 of the Report of the Mobile Phone and Broadband Taskforce (the 'Taskforce')[1].

The forecasts of mobile data[2] traffic[3] take the 2017 usage figures as the baseline and then projects forward changes in demand for mobile data. To derive these projections, we have developed a model which disaggregates current usage by device type (smartphone, 2G phone, Mobile Broadband (MBB), and Machine to Machine (M2M)). Based on recent usage trends in Ireland, the model then projects the total number of devices and the total mobile data use per device.

Based on this analysis, the demand for mobile data in Ireland is to forecast to grow at an average[4] of 32% per year up to 2022, though the rate of growth will slow during the forecast period, as indicated by the blue line in Figure 1 below. Total annual mobile data traffic[5] will increase from 268 million GB/year in 2017 to 1,059 million GB/year in 2022, as indicated by the red line in Figure 1.

Figure 1 Base forecast of total mobile data traffic



Source: Frontier

Low and high scenarios are also presented which forecast data traffic of 694 million GB/year and 1,613 million GB/year respectively in 2022.

This increase in the demand for mobile data is driven by a number of factors.

1 See: http://www.dccae.gov.ie/en-ie/communications/publications/Documents/66/Taskforce%20Report.pdf

2 Mobile data refers to data downloaded from a connection that is not fixed to any one location. For the avoidance of doubt, it does not include any data downloaded by a mobile device using a fixed connection regardless of whether that connection is fixed or wireless (i.e. FWA).

3 Mobile data traffic refers to the volume of data traffic used by consumers over mobile networks and includes downloading files from online sources, streaming, online games, email, and other data traffic generated by various kinds of mobile applications and services.

4 Based on a Compound Average Growth Rate over the five year period.

5 Excluding roaming data.

On the demand side, the growing use of mobile devices to consume audio-visual content is increasing the demand for data. Linked to this, the rapid growth of social networks (such as WhatsApp, Snapchat, Facebook Messenger, iMessage, Viber Twitter, Facebook etc.) as platforms to share video (including third party content as well as user generated content) has significantly increased the demand for mobile data.

On the supply side, the expansion of 3G (UMTS 900), increased coverage of 4G networks, the growth in sophisticated devices entering the market and the declining cost of data plans driven by retail competition (including “all you can eat” plans), have changed consumption patterns. However, whilst these factors drive growth, the increasing use of Wi-Fi off-load (i.e. using mobile devices on fixed networks via Wi-Fi), will offset some of this growth. Over the period of this forecast, increasing investments in residential fixed networks and the availability of public Wi-Fi “hotspots” will increase the proportion of data off-loaded. 5G technology is unlikely to have a significant impact on mobile traffic demand over the forecast period, as the date of its introduction and the nature of its use is currently uncertain.

Finally, rates of growth are likely to slow over the forecast period. This arises mainly as the extent to which migration to 4G fuels growth begins to slow and the number of 4G subscriptions reaches market saturation. Further, increased availability of fixed connections (e.g. in more rural areas) will increase the extent to which Wi-Fi offloading becomes a viable option for these consumers.

1 INTRODUCTION

This report, prepared for the Commission for Communications Regulation ("ComReg"), provides forecasts of mobile data traffic in Ireland.

We set out below:

- the background and objectives to the report; and
- an overview of the approach used to derive this forecast.

1.1 Background and objectives

This report supports ComReg in implementing Action 33 of the Mobile Phone and Broadband Taskforce (the 'Taskforce')[6]. This Taskforce was set up by the Government when it entered office in 2016 to identify tangible actions that could be taken to improve the quality of broadband and mobile voice services being provided to citizens across Ireland.

The Taskforce requested ComReg to produce an economic report setting out a five-year forecast of mobile data traffic in Ireland. We understand this forecast will help enable better network planning by operators and assist stakeholders to keep pace with consumer demand for services.

A number of factors affect mobile data traffic and these can be split into demand and supply side factors. Demand side factors include: population growth; the use of different mobile applications by consumers and businesses, such as video streaming and audio, web browsing, social networking and gaming; and the growth in M2M (Machine to Machine) traffic. Supply side factors include the evolution of mobile devices used by consumers, the degree of Wi-Fi offload and the impact of iterative developments of mobile technology (from 3G to 4G, and in the longer term to 5G[7]).

1.2 Summary of the forecasting methodology

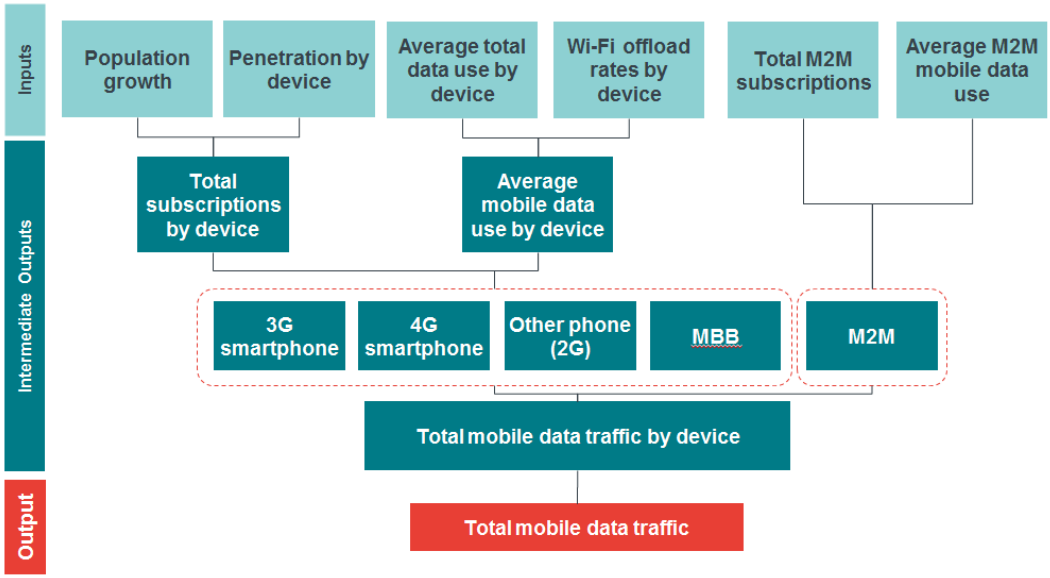
The forecasts of mobile data demand take the 2017 usage figures as the baseline and then project forward changes in demand for mobile data. To derive these projections, we have developed a model which disaggregates current usage by device type (smartphone, 2G phone, Mobile Broadband (MBB), and Machine to Machine (M2M)). Based on recent usage trends in Ireland, the model then projects the total number of devices and the total mobile data use per device.

A high level schematic of the model structure is set out below in Figure 2.

[6] See: http://www.dccae.gov.ie/en-ie/communications/publications/Documents/66/Taskforce%20Report.pdf

[7] See Section 3.3, Frontier does not consider the impact of 5G to be relevant in the forecast period.

Figure 2 Overview of model structure



Source: Frontier

As noted in Figure 2, the model forecasts a number of intermediate outputs of penetration and data demand per device. These relate to consumer devices (such as smartphones, 2G phones and MBB subscriptions) as well as M2M subscriptions used by businesses.

The projection of consumer device subscriptions (3G/4G smartphones, 2G phones and MBB) partly reflect population growth in Ireland, adjusted for recent trends in device penetration. M2M subscriptions from businesses are expected to continue to increase at a rapid rate as the number of devices connected to the Internet of Things (IoT) increases. However, M2M subscriptions are not assumed to relate to population growth (since they are not consumer devices).

The model projects data use per device for the different types of devices (3G, 4G smartphones, 2G phones, MBB and M2M). Data usage per smartphone has grown significantly in recent years, driven by a number of factors. These are explored in Section 3.2. However, in summary, on the demand side the increasing use of mobile devices to consume audio-visual content has increased the demand for data[8]. The rapid growth of social networks[9] as platforms to share video (including third party content as well as user generated content) has significantly increased the demand for mobile data.

On the supply side, the increased coverage of 4G networks, the rise in sophisticated devices entering the market and the declining cost of data plans driven by retail competition (including 'all you can eat' and 'zero rating' plans), has changed consumption patterns. However, whilst these factors drive growth, the increasing use of Wi-Fi off-load (i.e. using mobile devices on fixed networks via Wi-

[8] We note, when planning network capacity, mobile network operators will have regard to the capacity at "busy hour" (i.e. the hour when the demand for mobile data is highest). Therefore they will consider whether increases in peak usage will differ from increases in total usage referred to in this report.

[9] Social networks are applications which are used to communicate to other users of the platform. They can include Over The Top messaging applications (such as WhatsApp, Snapchat, Facebook Messenger, iMessage etc.); or social networks (such as Twitter, Facebook, or Instagram etc.)

Fi) will offset some of this growth. Over the period of this forecast, increasing investments in residential fixed networks and the availability of public Wi-Fi "hotspots" will increase the proportion of data off-loaded.

Our forecasts are based on assumptions about consumers' future use of mobile devices in Ireland. There are inherent uncertainties in forecasting usage in this fast moving and dynamic market. These uncertainties are, to a degree, reflected in the "high" and "low" forecasts. However, while every attempt has been made to support the forecasts with relevant evidence (i.e. various mobile consumer surveys, historical usage, and experience in related projects) uncertainties remain and caution should be exercised in interpreting the results.

1.3 Structure of this report

The structure of the remainder of this report is as follows.

- Section 2 discusses the profile of data usage in Ireland up to 2017.
- Section 3 presents the results of the base forecast, and discusses the factors that are driving the increases in demand for mobile data.
- Section 4 conducts scenario analysis and presents the low and high scenario forecasts.
- ANNEX A describes in detail the approach used to calculate the forecasts.

2 PROFILE OF DATA USAGE IN IRELAND

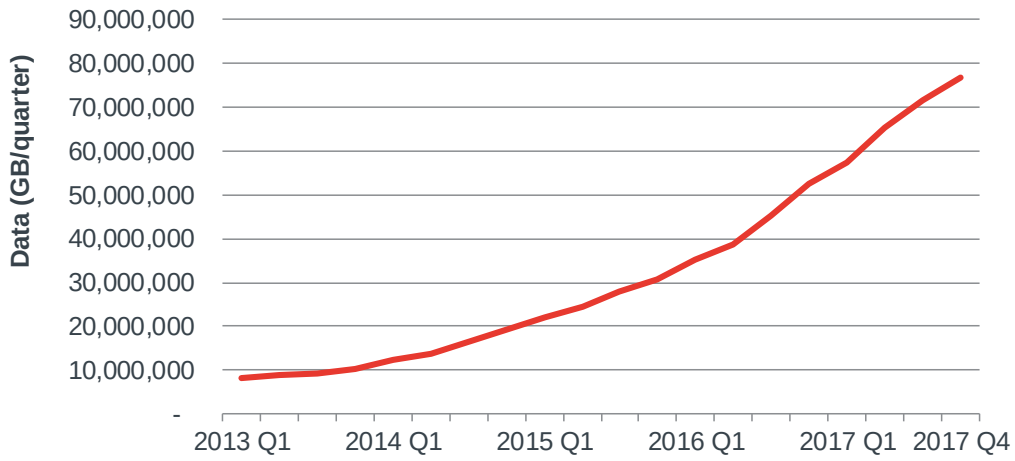
Ireland has seen a significant increase in demand for mobile data in recent years. However, underlying the growth in overall mobile data traffic there are a number of trends which are specific to each type of mobile device.

This section sets out the key trends in mobile data consumption in Ireland in aggregate and for each type of mobile device.

2.1 Mobile data traffic growth

Total mobile traffic has grown by over 9-fold since the beginning of 2013 (when 3G was expanded across the country using UMTS 900 and 4G was launched in Ireland). Figure 3 sets out the quarterly total mobile data traffic in the period 2013 to 2017. As set out therein, total mobile data traffic was 77m GB in 2017 Q4 (up from 8m GB in 2013 Q1) and expanded at a rate of 60% per year on average over the period.

Figure 3 Total mobile data traffic (GB/quarter)



Source: ComReg Doc 17/108

2.2 Use of devices in Ireland

There are a number of different types of device that use mobile data networks.

- Smartphones (capable of 3G and 4G[10]). Modern smartphones are devices used for a range of activities in addition to voice communications, for example, video communications, camera and video recorder, music and video player, web browser, or navigation tool. All these activities can require upload and download of mobile data.

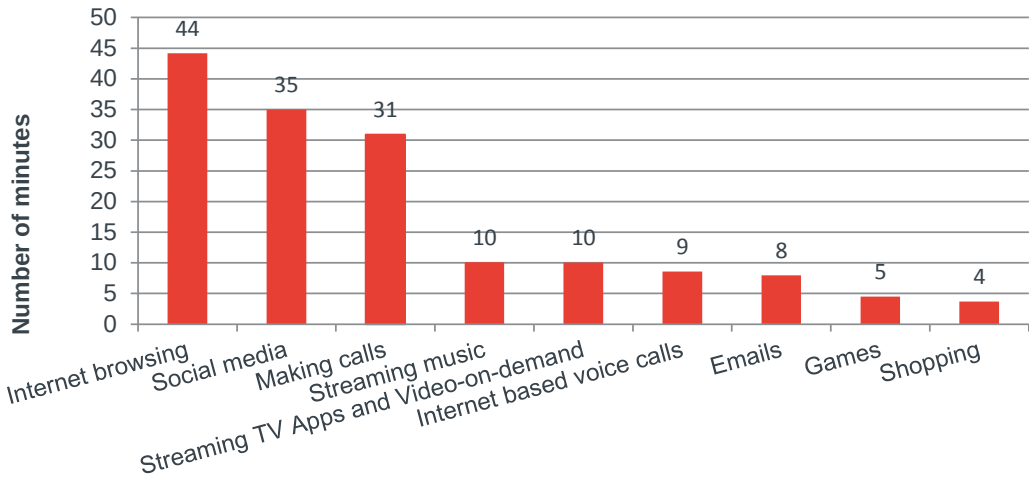
[10] The definitions of a 3G subscription, or use of a 3G data network, depend on the device, and whether the device connects to the 3G and/or 4G network during the relevant quarterly reporting period. If a device connects to a 4G network at any point during the quarter, then it is counted as a 4G subscription. All data consumed by that subscriber during the quarter is counted as 4G data (even if it drops down to a 3G network on occasion, or even if it only connects to the 4G network once). However, if a 4G enabled device does not connect to a 4G network during the quarter (say the customer is based in an area without 4G coverage for the entire quarter) then the subscription and data usage is counted as 3G.

- 2G phones which provide limited mobile data functionality (calls and texts) and are not classified as smartphone since they do not enable users to download applications and customise their device.
- Dedicated mobile broadband (MBB) subscriptions are data subscriptions which provide access to the internet but do not include a voice subscription (used for "dongles" or datacards to provide connectivity for laptops or tablets). Typically, users with dedicated MBB subscriptions have had much higher demand for data than a typical smartphone as these devices are often used to substitute for the absence of a fixed connection.
- M2M, which provides connectivity to devices but does not support access to the internet or voice access. Typically, an M2M subscription has very low data demand. However, it is expected that the volume of M2M subscriptions will increase rapidly.

Smartphones are used for increasingly sophisticated activities

Smartphones are increasingly used for activities that require high demand for bandwidth such as consumption of audio visual content. Figure 4 sets out the activities that smartphone users engage in each day on their device. Smartphones in Ireland are used more for web browsing (44 minutes per day) and social media (35 minutes per day) than making calls (31 minutes per day). Other activities that place a high burden on mobile data networks include streaming TV (10 minutes per day) and gaming (5 minutes per day).

Figure 4 Average number of minutes spent using mobile data per day by smartphone users



Source: ComReg Doc 17/100a (B&A Mobile consumer experience survey)

Note: Base for all activities except "Making calls": All have smartphone
Base for "Making calls": All have mobile phone

The different activities have different impacts on mobile data demand.

- Whilst internet browsing is the most frequently used activity, it only uses about 10 MB per hour[11].

[11] https://www.bonkers.ie/guides/broadband-phone-tv/how-much-mobile-phone-data-do-i-need/

- Watching video tends to be the most data intensive activity. Different resolutions of video use varying amounts of data; Vodafone estimates that watching sport for an hour uses 500 MB, but that watching HD video uses 1 GB per hour[12]. The data requirement to access social media will depend on the degree to which users access video content.
- Streaming an hour of music uses only 69 MB per hour.
- Sending and receiving emails (say 20 per hour) would use 2MB per hour (assuming 0.1 MB per email, though downloading attachments or pictures will increase data demand).
- VoIP will consume different amounts of data depending on the type of codec used for the service and the parameters of the VoIP service[13]. However, 45 MB per hour is a reasonable estimate[14].
- Gaming will consume varying amounts of data depending on the nature of the game. Some games may not require a network connection, other games may use relatively low amounts of data (say 10 MB per hour). Whereas multi-player online games may require higher data such as 40-50 MB per hour.

Demographic patterns of data consumption

An aging population might have an effect on mobile data traffic. A ComReg survey found that of consumers who own a mobile phone, younger consumers are more likely to own a smartphone than their elders[15] (see Figure 5). In addition to being more likely to own a smartphone, younger consumers are also more likely to use 4G data services.

Figure 5 Smartphone ownership and data use across age demographics

Age demographic	% of mobile users that own a smartphone	% of mobile users that use 3G data	% of mobile users that use 4G data
16-24	98%	66%	59%
25-34	93%	70%	52%
35-49	90%	60%	46%
50-64	75%	40%	32%
65+	49%	28%	16%

Source: ComReg Doc 17/100a (B&A Mobile consumer experience survey)

IAB Ireland[16] found that 34% of 16-24 year olds use a smartphone to view video on demand, whilst only 8% of those aged 45 and above do[17]. This suggests that younger consumers are also likely to use a higher amount of data than their elders.

12 https://n.vodafone.ie/support/data.html

13 Such as the size of voice packets, the intervals at which they are sent.

14 See for example: https://www.lifewire.com/megabytes-for-one-minute-conversations-3426705

15 ComReg Doc 17/100a

16 IAB Ireland is the trade association for digital advertising.

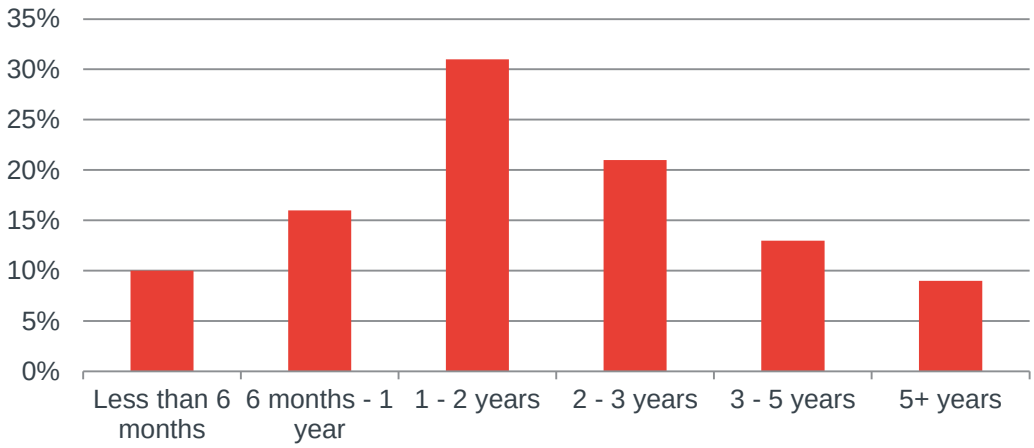
17 IAB Ireland Video on Demand 2016 report: https://www.iabeurope.eu/wp-content/uploads/2016/07/Nielsen-IAB-IRE-VOD-2016-FINAL-including-appendix.pdf

Age of mobile handset

Typically, users might upgrade their handset every 2 years; Figure 6 shows that the median age of Ireland's consumers' phones is 1-2 years and the weighted average is about 2.1 years[18]. However, about 40% of users will probably upgrade their handset more infrequently.

Advances in device technology mean that each iteration of handset will be more sophisticated with higher screen resolution and faster processing power and will be 3G and 4G enabled. As users update their handsets to more sophisticated versions, their demand for mobile data will increase (for the reasons discussed more fully in Section 3.2). Figure 6 sets out the age of handsets as at May-June 2017.

Figure 6 Age of current mobile phone



Source: ComReg Doc 17/100a (B&A Mobile consumer experience survey)
Note: Base: All have mobile

This means that the cohort of users with older handsets will generally have relatively lower demand for mobile data. But over time, as the stock of older handsets are replaced, then this cohort of users may experience an increase in demand for mobile data as they migrate to more advanced handsets if they use the handset's advanced features and 3G/4G capabilities.

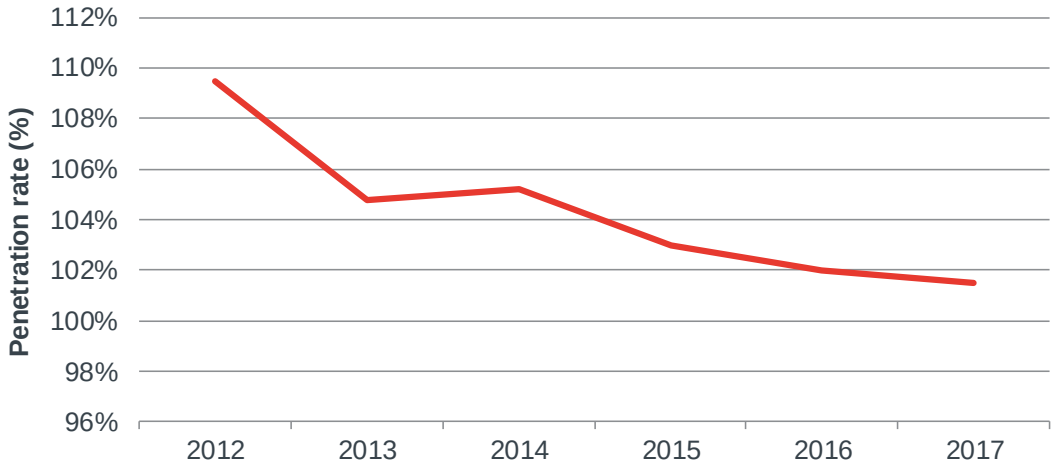
2.3 Total device penetration

2.3.1 Mobile phones (2G, 3G and 4G)

Mobile phone penetration in Ireland appears to be "mature". In fact, total mobile phone penetration has been declining slightly in recent years, falling from 110% in 2012 to 102% in 2017. This means that the number of individuals owning more than one subscription is declining (for example fewer individuals have a distinct subscription for both personal and business use). Therefore, the growth in mobile data demand observed since 2012 has not been as a result of increasing total mobile penetration.

[18] Source: ComReg (B&A Mobile consumer experience survey). Assumes that the average in the "less than 6 months" category is 3 months and the average of the "5+ years" category is 6 years.

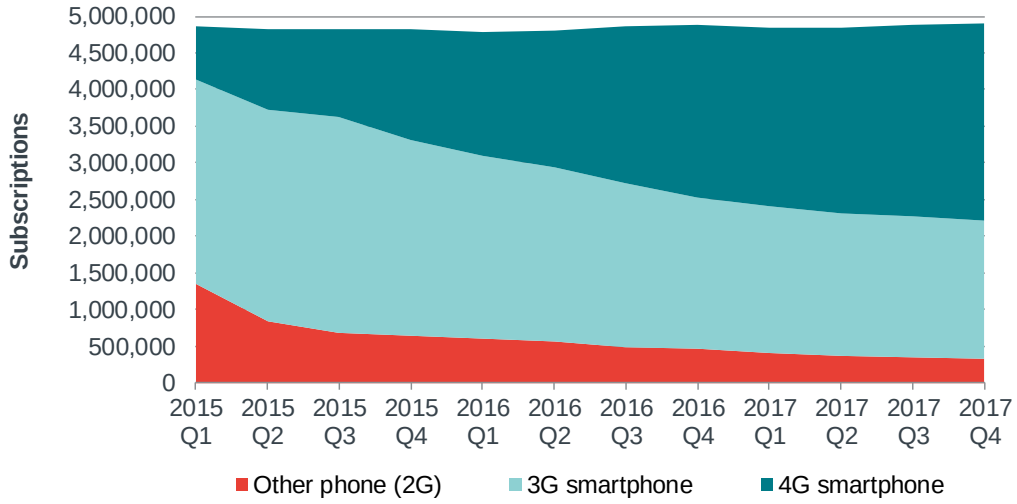
Figure 7 Total mobile phone penetration



Source: ComReg Doc 17/108

However, as can be seen in Figure 8, the proportion of 4G devices is increasing as users upgrade their 2G and 3G devices for more modern 4G compatible devices[19]. Indeed, the number of 4G smartphone subscriptions overtook 3G smartphone subscriptions in Q4 2016 and now accounts for 59% of mobile subscriptions. However, there remains a significant proportion of 2G phones.

Figure 8 Migration to 3G then 4G smartphones



Source: ComReg Doc 17/108

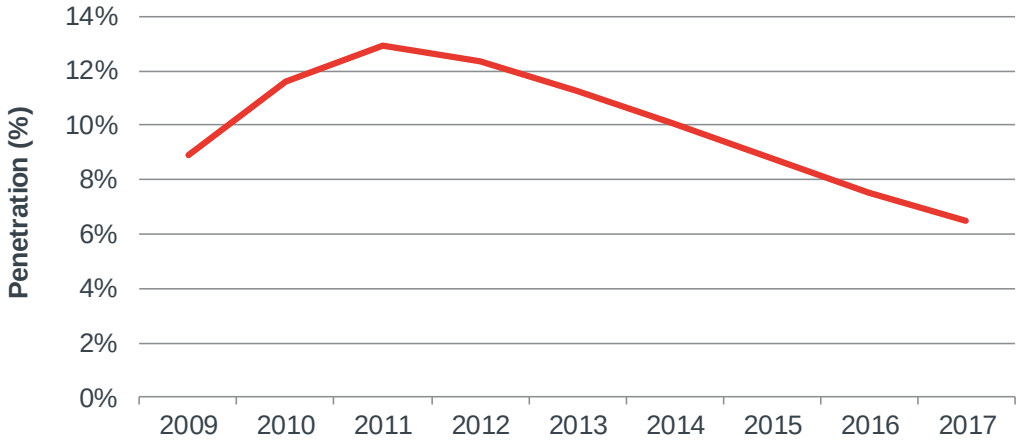
2.3.2 MBB

MBB penetration grew until 2011 and has since been in decline, as shown in Figure 9. This is likely to be for three main reasons. First, there is increased availability of fixed connections that can offer higher speeds and increased reliability in more rural areas. For example, since 2011, fixed broadband connections increased by

[19] As noted in Section 2.2, however, it is not possible to perfectly identify 4G handsets and data use.

over 300,000 from a penetration rate of 23% to 29%[20]. Second, smartphone handsets are now more powerful and sophisticated and can be used for some of the functions that were historically more suited to larger dedicated MBB devices. Third, smartphone devices and subscriptions support "tethering", where a smartphone subscription can be used to provide connectivity (often wirelessly) to other portable devices, thus reducing the need for specific MBB devices.

Figure 9 MBB penetration

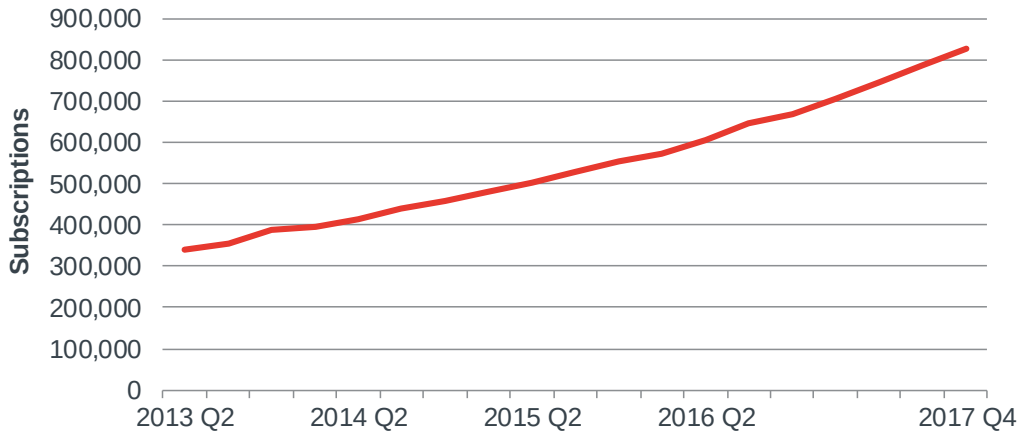


Source: ComReg Doc 17/108

2.3.3 M2M

M2M penetration has grown consistently as businesses increasingly adopt M2M technology for uses within Ireland. M2M is used in a variety of sectors for specific commercial uses. These could be logistic tracking, vehicle monitoring, and healthcare monitoring.

Figure 10 M2M subscriptions



Source: ComReg Doc 17/108

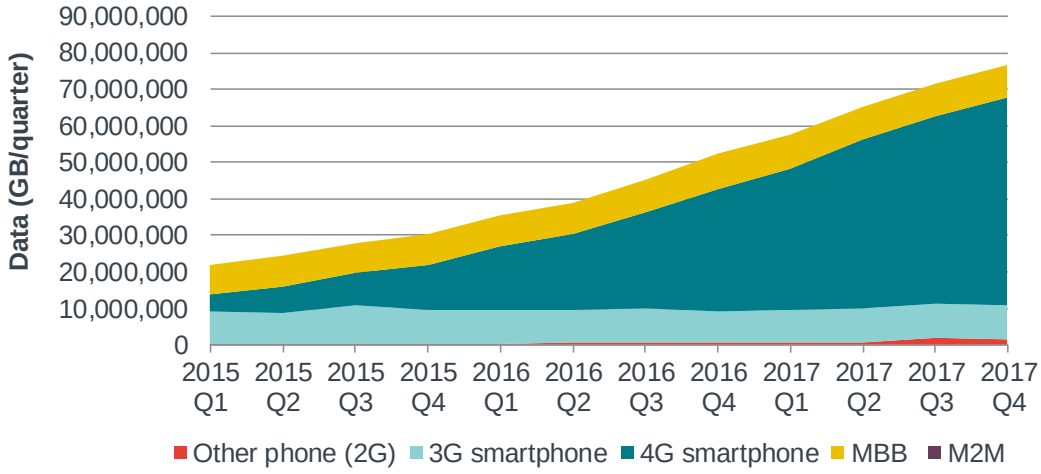
[20] ComReg quarterly data.

2.4 Data consumption by device

As can be seen from Figure 11, smartphones are, by far, the category of devices that contribute the most to mobile data demand. 4G smartphones now account for 74% of data traffic, whilst 3G smartphones account for only 12% of traffic[21].

While demand from 4G traffic has grown, demand from 3G smartphones has been relatively flat (with increasing data per device offset by declining number of subscriptions). MBB mobile traffic has been relatively flat, with increasing data per device offset by a declining number of subscriptions. MBB data as a share of total mobile traffic decreased from 37% in 2015 Q1 to 12% in 2017 Q4, highlighting the relative decline in traffic originating from MBB. 2G phone subscriptions[22] and M2M subscriptions respectively account for only 1% and 0.02% of data traffic.

Figure 11 Mobile data consumption (GB per quarter)



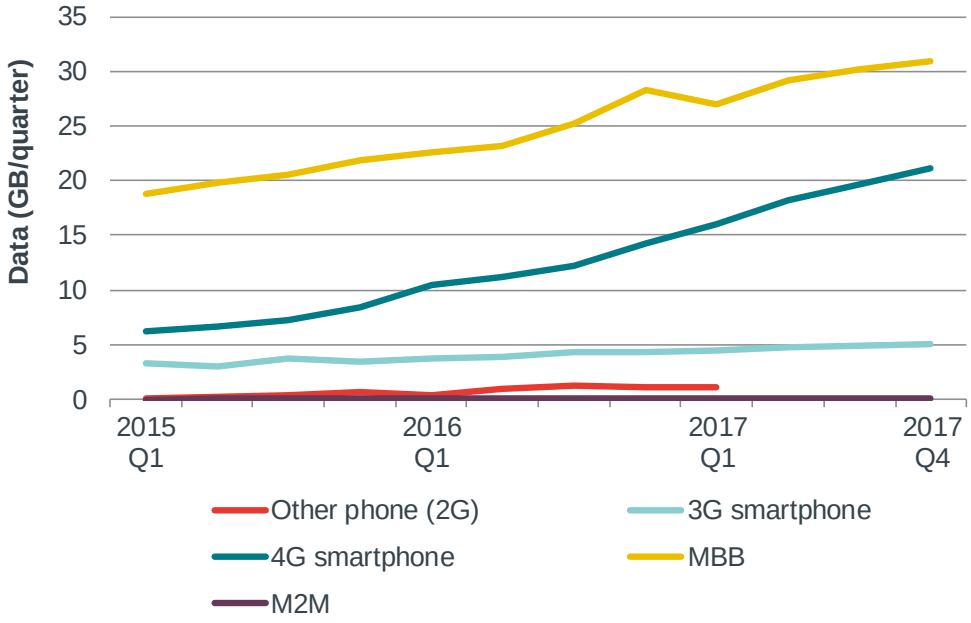
Source: ComReg 17/108

The mobile data per device is shown in Figure 12. 4G smartphone data has increased at a rate of 56% per year since 2015 Q1 whereas 3G smartphone data has been steady over the period. The data use per MBB device is higher at 31 GB per quarter, however it is increasing at a slower rate than 4G smartphones (20% increase per year). The contribution of M2M devices is small at 0.02 GB per device per quarter.

[21] Note that traffic generated by a 4G device may be carried on a 3G network if 4G capacity is constrained at the time.

[22] 2017 Q1.

Figure 12 Mobile data use per device (GB per quarter)



Source: *ComReg*

Notes: *Other phone (2G) data is not included after 2017 Q1, as the way it was measured was changed (to include roaming data).*

3 BASE FORECAST

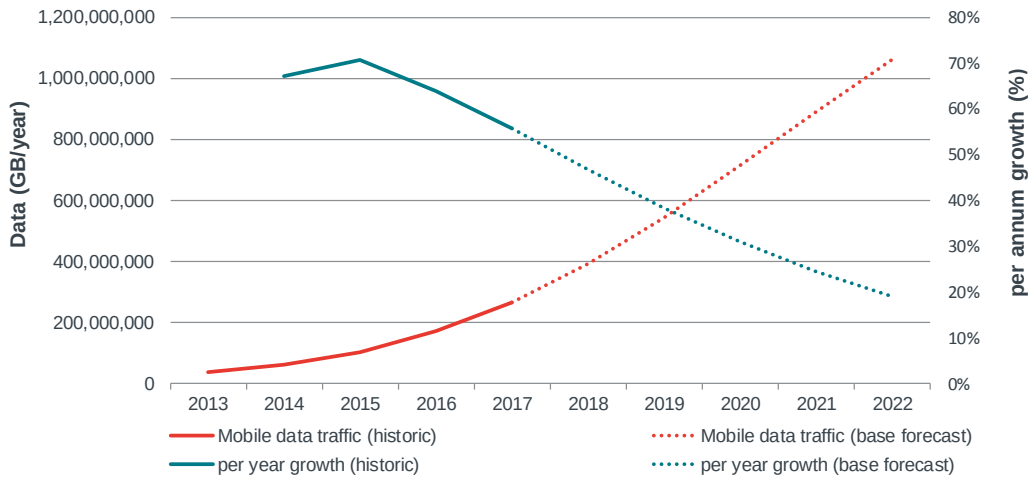
This section presents the base demand forecasts for mobile data traffic in Ireland between 2018 and 2022. It comments on the main drivers affecting mobile data traffic growth in Ireland. The forecasts for the low and high scenario are presented in Section 4.

- Section 3.1 presents the base forecast.
- Section 3.2 discusses the main factors driving growth of data demand.
- Section 3.3 discusses other factors that could impact demand but which are considered to have less impact within the forecast horizon.

3.1 Results

The forecast growth for mobile data in Ireland is set out in Figure 13. As set out in that chart, mobile data is forecast to grow at an average of 32% per year[23] up to 2022 (i.e. gradually slowing from the current rate of growth of 56% per year) with growth rates higher in the earlier years of the forecast period.

Figure 13 Base forecast of total mobile data traffic



Source: Frontier

We set out below the forecast growth in data demand for each of:

- smartphone;
- 2G phones;
- MBB subscriptions; and,
- M2M subscriptions.

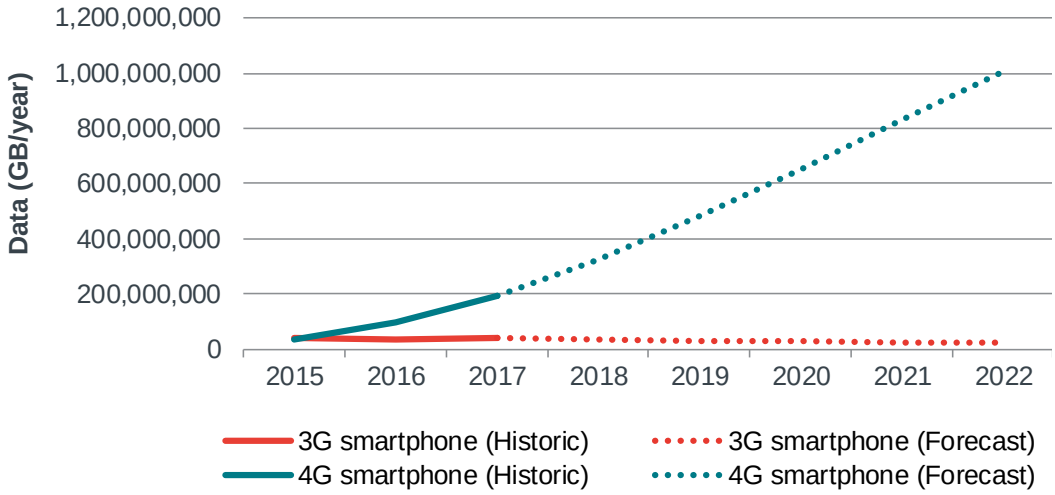
[23] Five year CAGR.

3.1.1 Smartphone

The increase in overall data traffic is driven primarily by the increase in smartphone traffic.

There are a number of factors which are likely to mean that recent growth in smartphone traffic will continue, though at a slower rate than previously observed (as discussed in section 3.2 below). We project that users will continue to migrate to 4G handsets (which generate significantly more traffic than 3G handsets). As such, the contribution of 3G traffic will decline in relative and absolute terms.

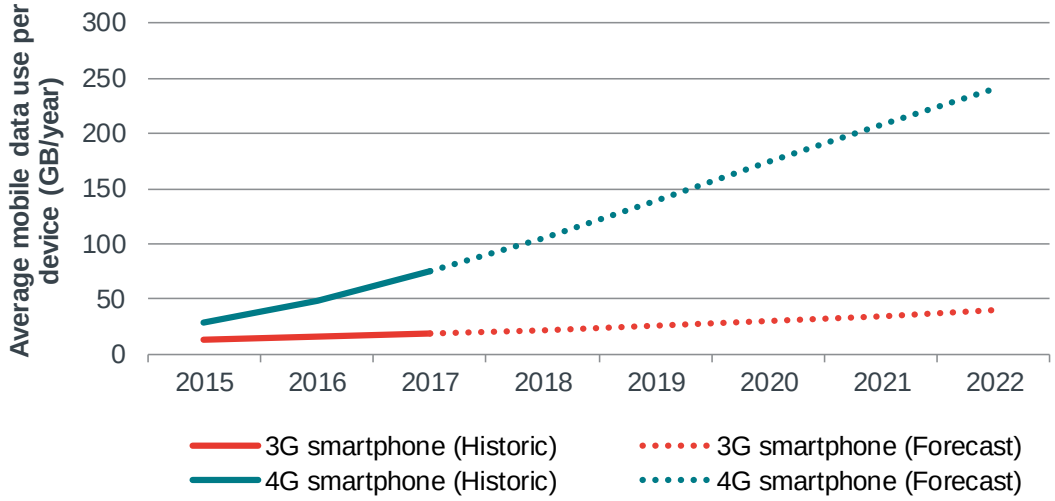
Figure 14 Base forecast of smartphone (3G & 4G) data traffic



Source: Frontier

The total volume of data per smartphone is also projected to increase (for the reasons set out below in Section 3.2) but again at a declining rate. Data use per 3G device is expected to continue to increase but at a much slower rate than for 4G devices. This is because the technical limitations of 3G devices (namely that they are likely to have lower resolution and smaller screens) will limit their use as devices for consuming high bandwidth content.

Figure 15 Base forecast of average mobile data use per smartphone (3G & 4G)



Source: Frontier

3.1.2 2G phones

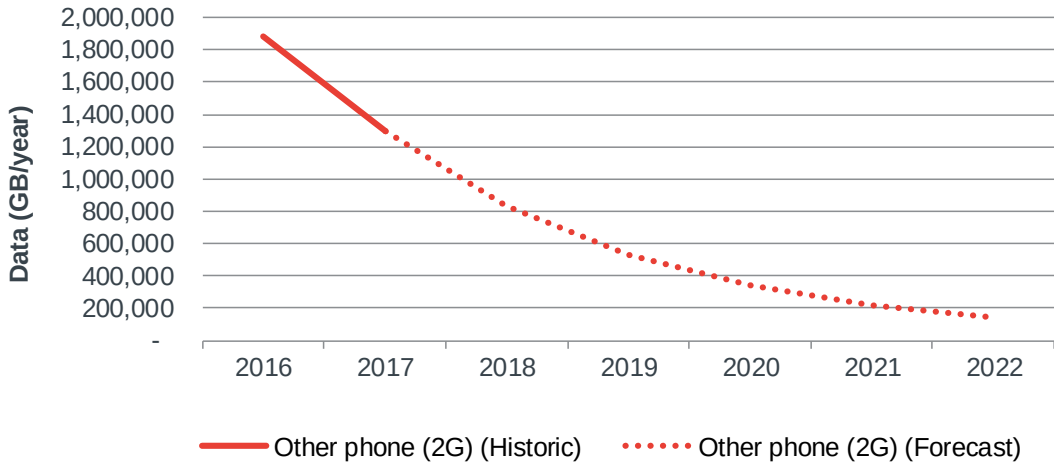
Similarly, the forecast suggests that the volume of traffic generated by 2G services will decline as users migrate to more sophisticated handsets. The data use per 2G phone is expected to remain constant at 2017 levels (0.9GB per quarter – compared with 19 GB per quarter for 4G smartphones in 2017). This is because these are likely to be legacy devices with limited mobile data functionality. Therefore we would not expect consumption patterns to radically change in the forecast period.

The decline in the total volume of forecast traffic is driven by the reduction in the number of 2G phones.

While the model forecasts 2G phones subscriptions to fall to just under 40,000 by 2022, this refers to 2G phones only. Operators may continue to use 2G networks (or introduce LP-WANs[24]) to provide for M2M communications which are increasing substantially over the period.

[24] Low Power Wide Area Networks

Figure 16 Base forecast of 2G phone data traffic



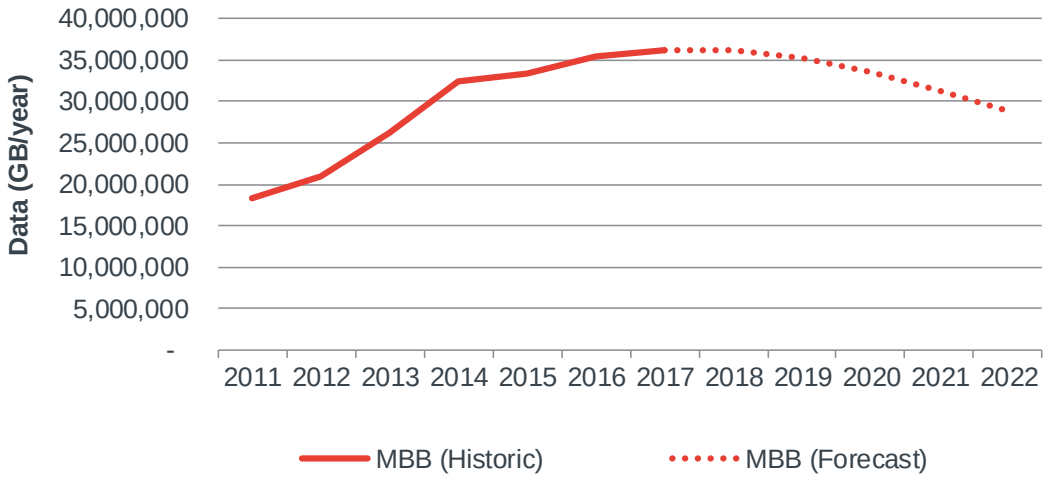
Source: Frontier

3.1.3 MBB

The forecast also suggests that the volume of MBB traffic will gradually decline as the increase in data traffic per device is more than offset by a decline in the number of MBB subscriptions. The MBB penetration rate peaked in 2011, and has been falling since. The model forecasts that from 2017 MBB penetration will continue to fall at a constant rate equal to the average annual rate of decline that was observed between 2011 and 2017.

This is shown in the charts below.

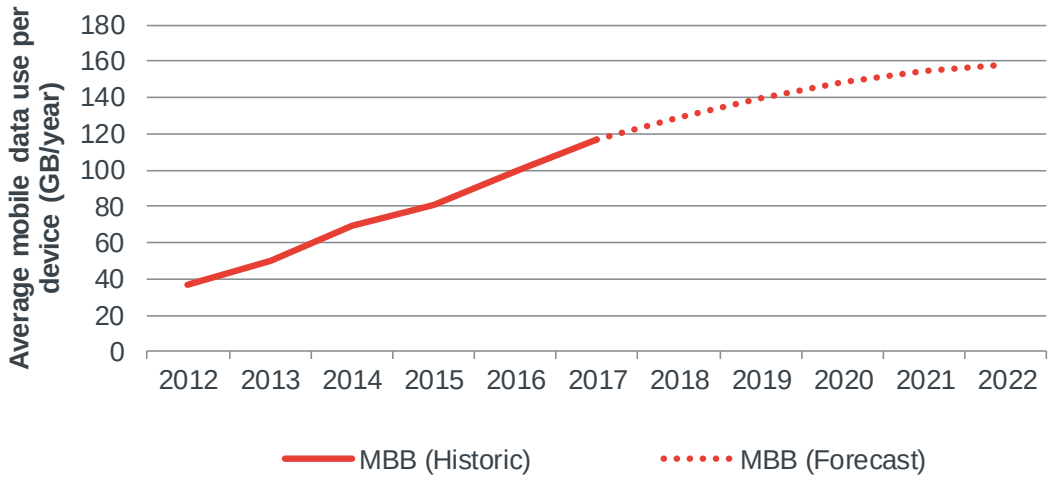
Figure 17 Base forecast of MBB data traffic



Source: Frontier

The traffic per MBB device is projected to increase, though at a lower rate than 4G smartphones (Figure 18). This reflects the fact that there is not expected to be the same degree of innovation in how MBB devices are used when compared with smartphones over the forecast period.

Figure 18 Base forecast of average mobile data use per MBB device

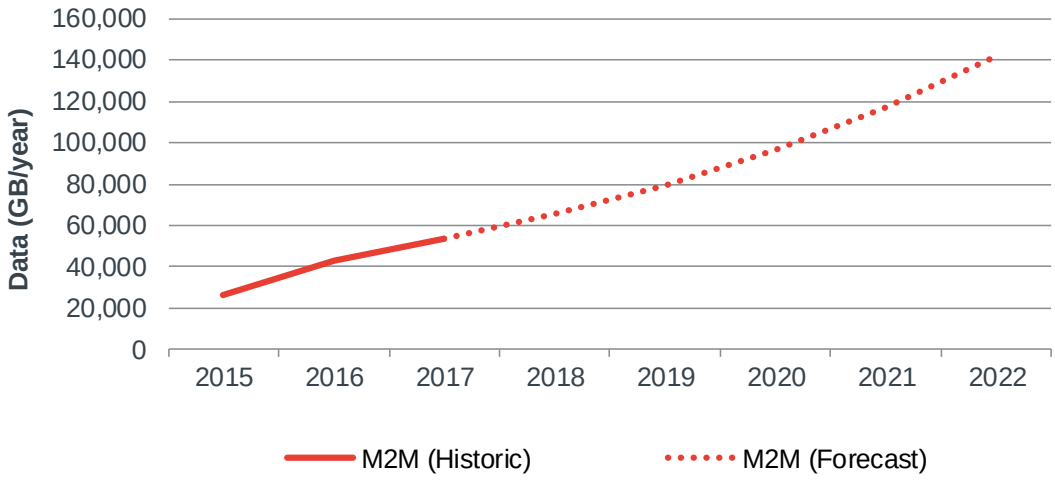


Source: Frontier

3.1.4 M2M traffic

Consistent with recent trends, the forecast suggests that the volume of M2M traffic will grow, on average, at a rate of 21% per year . However, the contribution of M2M towards total mobile data traffic is small (and declining – given the growth in smartphone traffic). It is projected to contribute only 0.01% of data traffic demand by 2022. The wider adoption of M2M devices is expected to increase the volume of subscriptions, however, the data generated by each subscription is expected to remain low particularly as low powered, smaller M2M devices are expected to drive growth. That is, mobile data use per M2M subscription is expected to remain constant at 2017 levels (0.02GB per quarter) in the base forecast.

Figure 19 Base forecast of M2M data traffic



Source: Frontier

3.2 Factors driving growth

There are a number of factors that are driving demand for mobile data in Ireland. These include trends in consumer demand such as:

- viewing audio visual content; and
- consumption of increasingly "rich" content on web browsing.

On the supply side, there are a number of trends influencing data consumption. These include:

- improvement in network capability and coverage;
- the adoption of "unlimited" data tariffs;
- increasing use of Wi-Fi offload;
- improvements in device technology; and
- availability of additional spectrum and carrier aggregation.

These are discussed below in the context of the Irish market.

3.2.1 Demand side factors

In addition to the factors set out above (such as the gradual upgrade of handsets resulting in an increasing proportion of 4G devices), there are a number of specific demand side factors which will drive mobile data growth.

Changing trends in video consumption

A key driver of the rapid growth of mobile data use per device is the growing consumption of video on mobile devices. In Ireland in 2017, 64% of people used smartphones to watch video on demand, with this having grown from 49% in 2015[25]. As noted above (Figure 4) every smartphone user in Ireland spends on average 10 minutes per day streaming video content.

One of the reasons why mobile video consumption has increased is the rising popularity of social media. Ireland's average smartphone user now spends approximately 35 minutes a day using mobile data to access social media on their smartphones[26], and social media is becoming an increasingly common way to view video.

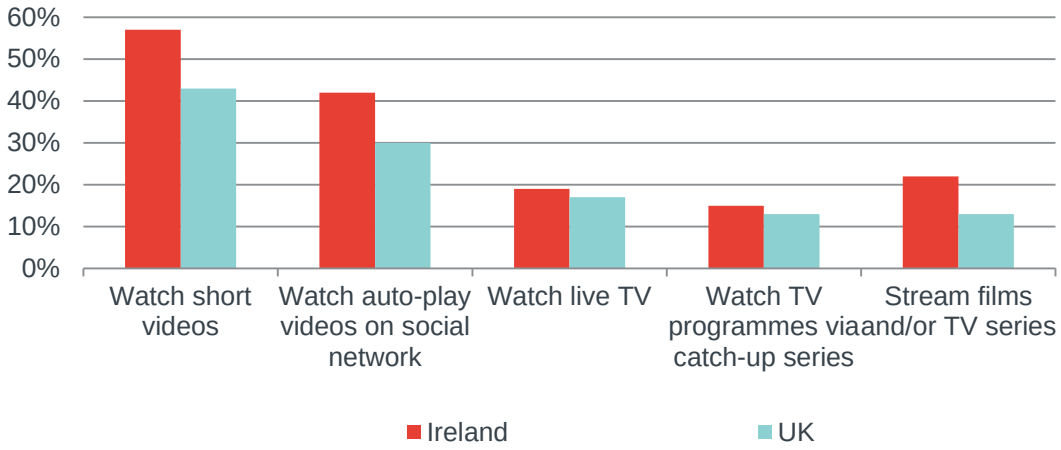
About 42% of Ireland's smartphone users watch short videos that start playing automatically when using social media.[27] Indeed, it is noteworthy that online consumption of video from streaming services or social media is higher in Ireland than a comparator country such as the UK (see Figure 20).

[25] IAB Ireland Video on Demand 2016 report: https://www.iabeurope.eu/wp-content/uploads/2016/07/Nielsen-IAB-IRE-VOD-2016-FINAL-including-appendix.pdf

[26] ComReg Mobile consumer experience survey 2017 (ComReg Doc 17/100a, slide 38)

[27] Certain devices restrict updates until a Wi-Fi connection is available, therefore such impacts will vary across consumers.

Figure 20 Percentage of people who watch videos on their smartphones (%, Ireland vs. UK, 2016)



Source: *Deloitte Ireland Mobile Consumer Survey (2016): https://www2.deloitte.com/ie/en/pages/technology-media-and-telecommunications/articles/Mobile-Consumer-Survey-2016.html*

Note: *Base: Smartphone owners*

Linked to the rising use of social media, smartphone users are now creating and uploading more of their own content. About 16% of Ireland's smartphone users say that they upload or share videos using either social networking or instant messaging apps on their phones every single day[28].

If the use of social media and consumer content creation on mobile devices continue to grow in popularity, then it is also likely that consumers will watch more video using mobile data, which would increase the average mobile data use per device. We project that the increasing penetration of more sophisticated 4G devices will mean that video content, whether streamed directly from content providers or accessed via social media platforms, will drive demand for mobile data.

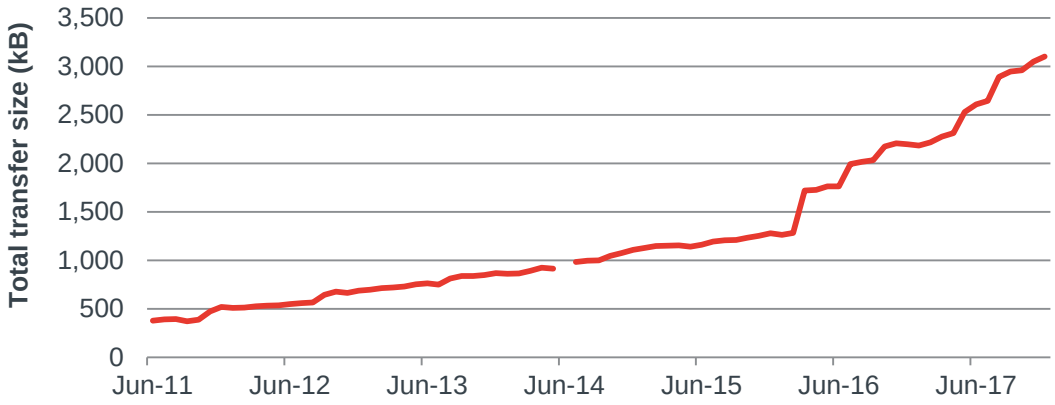
Changing content on mobile web pages

Another important driver of demand for mobile data is the growing sophistication of mobile web pages. The data required to download a typical webpage increases over time. The increase in data is driven by richer content on web sites such as embedded video, higher resolution images, and embedded video advertising. Figure 21 shows the average data used per mobile webpage has increased five-fold over the past six years. We expect that web pages will increasingly incorporate "rich" content which will increase demand for data.

As noted above (Figure 4) smartphone users spend 44 minutes each day browsing the internet. Therefore the growing sophistication of web pages means this activity increases mobile data demand.

[28] Deloitte Ireland Mobile Consumer Survey (2016): https://www2.deloitte.com/ie/en/pages/technology-media-and-telecommunications/articles/Mobile-Consumer-Survey-2016.html

Figure 21 Total transfer size of the average mobile webpage



Source: http archive: http://mobile.httparchive.org/trends.php?s=All&minlabel=Jun+1+2011&maxlabel=Nov+15+2017#bytesTotal&reqTotal

Notes: This source analyses the top 10,000 global URLs from a mobile device to assess the average amount of data transferred to a mobile device in order to access a single mobile website page. There is a break in the data in June 2014 as data was unavailable.

3.2.2 Supply side factors

There are a number of supply side factors that affect demand for mobile data: the coverage and use of 4G networks; the increasing availability of spectrum to support higher capacity networks; changing tariffs; and Wi-Fi offload.

4G coverage and increases in network speed

The roll out of UMTS 900 and LTE 4G services has likely been one of the main drivers of the rapid growth of mobile data use per device. In Ireland, 3G networks (using the UMTS 900) increased availability of mobile broadband to large areas of the population previously unserved. The rollout of 4G networks enabled maximum speeds of up 225 Mbps[29]. Field work conducted by ComReg revealed that on average *actual* download speeds were 2-3 times faster on LTE compared to 3G when stationary, and 5-6 times faster when mobile[30]. Furthermore, future LTE releases include significant features and improvements providing customers with compliant handsets access to higher connection speeds. In turn, faster speeds encourage consumers to spend more time browsing or watching video using mobile data. Frontier notes below that similar benefits will likely arise after the assignment of additional spectrum, including the 700 MHz band, and carrier aggregation (as set out below).

eir was the first to launch 4G in Ireland on 25 September 2013, with the goal of reaching 43% of the population by the end of 2013. Since then coverage has grown, with both eir and Three Ireland[31] claiming to have 96% population coverage and Vodafone claim to have 90% population coverage in every county[32] (though

[29] Three network. See: http://www.three.ie/explore/4g/

[30] Results were based on drive tests conducted in winter 2016. See ComReg 17/25. Results compare the average download speeds obtained for each operator on LTE and 3G networks.

[31] Vodafone claim to have 90% population coverage in every county.

[32] https://n.vodafone.ie/network.html

geographic coverage would be much lower). This increased population coverage is likely to have significantly contributed to the increases in mobile data usage per device in recent years. However, as 4G population coverage has become closer to 100%, there is no longer room for population coverage to grow as before. This may moderate the growth in mobile data demand. Though mobile operators may increase geographic coverage or invest in capacity constrained urban areas which may increase speeds.

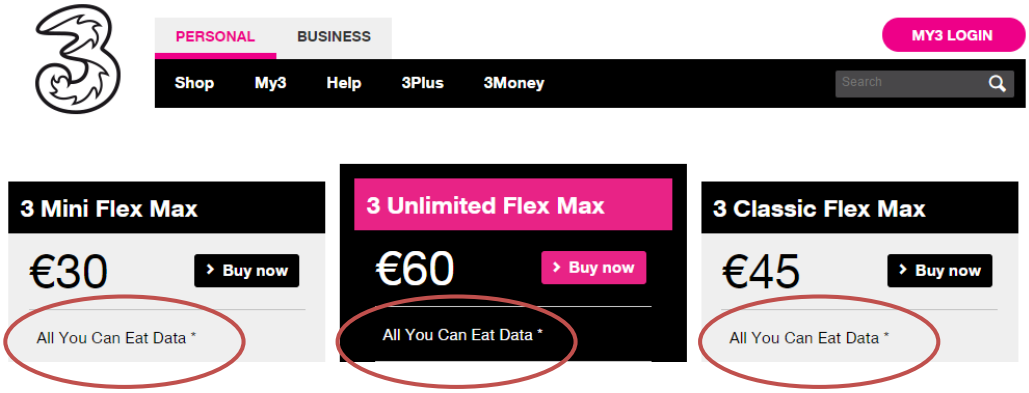
Increased availability of spectrum

Increased availability of spectrum will enable operators to deploy techniques to offer much faster mobile data speeds (via techniques such as 3-band carrier aggregation or MIMO networks). Faster, higher quality networks with more capacity in urban areas will increase demand for mobile data. ComReg plans to progress its award proposals, which may include the 700 MHz, 1.4 GHz, 2.1 GHz, 2.3 GHz and 2.6 GHz bands within the timeframe of the spectrum management strategy.[33] This availability of additional spectrum should also enable 3-band carrier aggregation a key technology which will reduce the cost of high speed connectivity. As noted above, faster speeds encourage consumers to spend more time browsing or watching video using mobile data. However, these impacts are dependent on the upgrade of sites after the assignment of spectrum therefore the impact of additional spectrum is only likely to begin to take effect towards the end of the forecast period.

Changing tariffs

Increasingly, mobile operators are offering tariffs which support (and indeed encourage), high mobile data consumption. For example, Three Ireland, which accounts for over 30% of the market, offers "all you can eat" tariffs on all its "bill pay" tariffs. At this stage Vodafone and Meteor have not adopted this approach, however, their bundles do offer large data usage packages.

Figure 22 Examples of "all you can eat" (unlimited use) tariffs



Source: http://www.three.ie/eshop/phone-plans/bill-pay/

[33] https://www.comreg.ie/media/2016/03/Radio-Spectrum-Management-Strategy-2016-2018.pdf

Wi-Fi offload

One factor which could moderate the growth of mobile data is the prominence of Wi-Fi offloading.

Consumers currently use fixed networks (Wi-Fi) to access data on their mobile devices to complement access via their mobile networks. This may be to avoid out-of-bundle charges or to access a better quality connection. We forecast that users will increasingly use their mobile devices via Wi-Fi from fixed networks. This implies that demand will moderate as users substitute some consumption to fixed networks. Increasing take-up of ultrafast broadband networks might increase use of Wi-Fi networks. Conversely upgrades in mobile networks might reduce use of Wi-Fi networks. The “low” and “high” scenarios reflect this uncertainty.

Changing trends in device (screen resolution / processing power)

Another important driver of mobile data traffic growth is the trend of increasing screen size, screen resolution, processing power and camera resolution in handsets, as mobile phones have developed from communication tools to a converged multimedia device. Figure 23 shows how all of these specifications have improved since 2007. The increased screen size and pixel density mean that smartphones load webpages or stream videos at a higher resolution, and require more data.

While top of the range handsets may be taken by only a minority of consumers, the features on “high end” devices over time become more common place. As users adopt more sophisticated devices, their use of mobile networks may increase and they will be more likely to use mobile devices to access video and other high bandwidth applications.

Figure 23 Evolution of smartphone specifications

	iPhone	iPhone 4	iPhone 6	iPhone 7 Plus	iPhone X
Year of release	2007	2010	2013	2015	2017
Display	3.5"	3.5"	4.7	5.5	5.8
Pixel density	163 ppi	326 ppi	326 ppi	401 ppi	458 ppi
CPU	Single core 412 MHz	1.0 GHz Cortex-A8	Apple A8 (1.4 GHz)	Apple A10 Fusion (2.34 GHz)	Apple A11 Bionic (2.39 GHz)
Camera Resolution	2 megapixels	5 megapixels	8 megapixels	12 megapixels	12 megapixels Dual

Source: http://socialcompare.com/en/comparison/apple-iphone-product-line-comparison

However the growth of screen sizes and resolutions may plateau. Mobile phones are designed to be conveniently portable, and so there is a limit that the size of the screen can practically reach. Additionally, there is no clear incentive to improve screen resolutions beyond the level at which differences are not perceptible to the human eye. If screen sizes and resolutions stop growing, this could reduce the growth of average data use per device.

3.3 Other factors that may affect demand for mobile data

There are a number of other factors that could affect mobile data traffic, and these are considered qualitatively below. However, the forecast model assumes that none of the below factors will have a significant impact on mobile data traffic in Ireland within the forecast horizon of 2018 – 2022.

3.3.1 Video compression capabilities

It is possible that, over time, changing trends in video compression capabilities will reduce demand for mobile data. Typically, new compression technologies and standards are introduced and adopted every decade or so (from MPEG 2, to MPEG4, and more recently the adoption of the H.265 standard). Each version, when adopted, lowers the data required for a given resolution of video. However, these are long term trends which are unlikely to materially affect outputs within the forecast period, and past improvements in compression are already factored into

the baseline. Therefore we do not make a specific adjustment for compression efficiency improvements in the model.

3.3.2 Trends in gaming such as Virtual Reality / Augmented Reality (VR/AR))

Changing trends in gaming (such as VR and AR) affect the demand for mobile data. If VR and AR are widely adopted, then this could create a much greater demand for mobile data. For example, some VR services will require substantially more data to stream VR content compared to standard video content[34].

However, while increased use of VR and AR might be a trend in the long run, it is unlikely that widespread adoption would be achieved over the forecast period. Therefore, we do not specifically consider that changes in use of mobile devices for gaming purposes will drive demand.

3.3.3 Take up of 5G devices

The use of 5G devices could lead to a significant increase in mobile data demand (in a way that 4G devices led to a step change in demand for data). However the date of its introduction, the nature of its use for mobile[35] and the availability of handsets for 5G over the forecast period is currently uncertain. Therefore, 5G is unlikely to have a significant impact on mobile data demand over the forecast period and are not considered as part of these forecasts. Any future updates to this forecast should consider any updated information on the availability of 5G services (properly defined) in Ireland.

3.3.4 Demographic change

In addition to the population growth forecasts that are used directly in the model, it is possible that the changing demographic composition of the Irish population could affect demand for data.

Figure 24 CSO Ireland population forecasts

Age demographic	Share of population		Trend
	2016	2021	
0-14	22.3%	21.6%	↓
15-24	11.4%	12.4%	↑
25-44	28.9%	25.6%	↓
45-64	24.1%	25.3%	↑
65+	13.3%	15.0%	↑

Source: CSO

[34] VR requires much higher data than standard video as it is necessary to download video which is beyond the user's current field of view, so when the user turns their head, the image changes immediately accordingly.

[35] For the avoidance of doubt, the forecasts in this report refer to mobile data usage and do not include data traffic from a fixed location e.g. fixed line or fixed wireless.

The proportion of Ireland's population that is expected to be aged over 45 will increase from 37.4% to 40.3%, with a corresponding decline in the proportion aged under 45.

As noted in Section 2.2 there are demographic related differences patterns of data consumption. Therefore, if smartphone penetration rates and data usage remain constant across the different age demographics throughout time, then it would be expected that an aging population would lead to a decrease in the percentage penetration of smartphone subscriptions and average data usage.

However, it is unlikely that smartphone penetration rates and data usage within given age demographics will remain constant across time. Instead, new cohorts of older demographics will have higher penetration and use of smartphones than existing cohorts.

Therefore, given that the demographic changes are relatively small, and that older demographics are likely to increase their mobile data use, we do not make a specific adjustment for this in the forecast.

4 SCENARIO ANALYSIS

Recognising the uncertainty in making forecasts for mobile data, we have presented a plausible high and low scenarios by varying the assumptions on penetration and mobile data use per device.

Inevitably, forecasts are based on assumptions about future use of mobile networks. However, the uncertainties in making forecasts mean that the low cannot be relied on as the minimum, and the high as the maximum as unknown factors may influence the outturns.

4.1 Key results

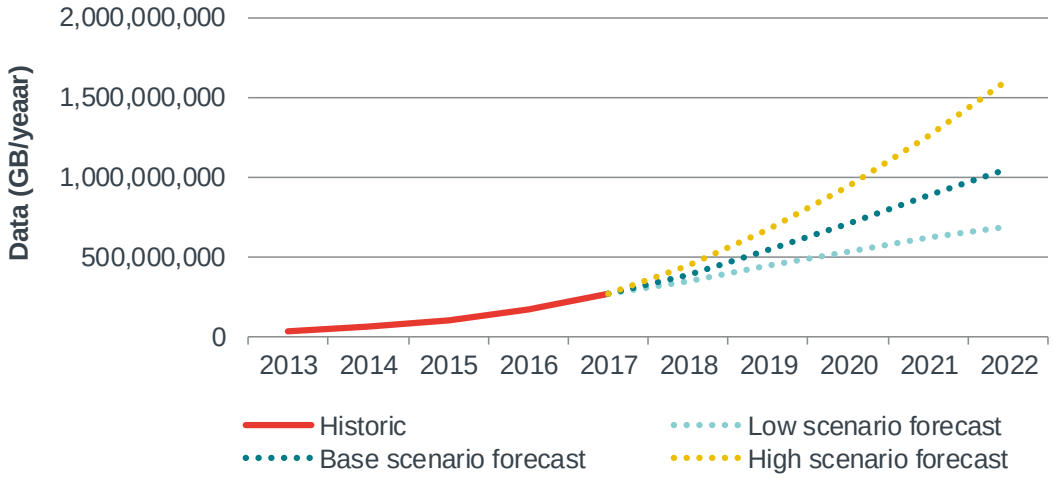
In the baseline scenario we assume that the demand and supply factors described in Section 3.2 continue to drive growth. The base case assumes the following.

- On the demand side:
  - users will continue the increasing trend for consuming audio-visual content on mobile devices;
  - increasing penetration of high end smartphones will drive demand for higher definition content; and
  - web browsing places increasing demand for data as the average data content per page continues to increase.
- On the supply side:
  - while population coverage will not significantly increase (given the high levels of coverage claimed by the operators), geographic coverage of 4G may increase and mobile operators may continue to invest in capacity in urban areas with high demand;
  - increasing capacity in mobile networks will be supported by planned releases of spectrum which will enable operators to aggregate carriers across a number of different spectrum bands to offer very high speeds; and
  - larger tariff bundles (including “all you can eat” data bundles) will induce consumers to use their mobile services more frequently, and for higher bandwidth applications (such as streaming video).
  - However, some of the forecast growth factors will be offset by increasing use of Wi-Fi offload (using mobile equipment on home and public Wi-Fi networks.

In the lower / high case we assume that in combination lower / high growth in the parameters result in lower / high mobile data demand.

Figure 25 and Figure 26 presents the forecasts for the base, high and low scenarios.

Figure 25 Scenario forecasts of total mobile data traffic[36]



Source: Frontier

Figure 26 Scenario forecasts of total mobile data traffic (m GB/year)[37]

	2017	2018	2019	2020	2021	2022
Low Scenario	268	353	447	540	624	694
Growth (%)		32%	27%	21%	16%	11%
Base Scenario	268	393	544	713	888	1,059
Growth (%)		47%	38%	31%	25%	19%
High Scenario	268	447	675	947	1,262	1,613
Growth (%)		67%	51%	40%	33%	28%

Source: Frontier

Across all three scenarios assume that mobile data traffic will continue to grow but at a decreasing rate.

4.2 Scenario Assumptions

Figure 27 explains the scenarios' differing assumptions used to forecast the base, high and low case. While we have not specifically modelled demand for data in a bottom up way, the low and high scenarios are consistent with the following assumptions.

[36] Excluding roaming data.

[37] Excluding roaming data.

Figure 27 Summary of scenario assumptions

Input	Scenario	Assumption	Rationale
Population growth	Base	Grows at about 0.8% per year.	Consistent with CSO's forecast.
	Low	No change from base.	
	High	No change from base.	
Smartphone penetration	Base	Grows at a declining rate (1.1% per year to 0%)	Growth rate declines at average per year speed of 2015-2017, as smartphone penetration plateaus.
	Low	Remains at 2017 level of 93.9%	Smartphone penetration may have already plateaued.
	High	Grows at about 1.1% per year.	Growth rate maintained at projected 2018 level
Share of smartphones that are 3G	Base	Falls at about 22% per year.	Rate of decline constant at average per year growth rate of 2015-2017.
	Low	Falls at about 11% per year.	Rate of decline half of observed 2015-2017 rate
	High	Falls at about 45% per year.	Rate of decline double of observed 2015-2017 rate
Other phone (2G) penetration	Base	Falls at about 36% per year.	Rate of decline constant at average per year rate of 2015-2017.
	Low	No change from base.	
	High	No change from base.	
MBB penetration	Base	Falls at about 11% per year.	Rate of decline constant at average rate of 2011-2017.
	Low	Falls at about 22% per year.	Rate of decline half of observed 2011-2017 rate
	High	Falls at about 5% per year.	Rate of decline double of observed 2011-2017 rate
M2M subscriptions	Base	Grows at about 21% per year.	Growth rate constant at average per year growth rate of 2013-2017.
	Low	Grows at about 16% per year.	Growth rate constant at 5% per year lower than the base case.
	High	Grows at about 26% per year.	Growth rate constant at 5% per year higher than the base case.
Wi-Fi offload rate	Base	Grows at about 1 percentage point per year.	Consistent with industry forecast of rate adjusted for the Irish context.
	Low	Grows at about 1.5 percentage points per year.	50% faster change in the Wi-Fi offload rate than base case
	High	Grows at about 0.5 percentage points per year.	50% slower change in the Wi-Fi offload rate than base case
Average total data use per 3G smartphone (pre-WiFi offload)	Base	Grows at about 20% per year.	Growth rate constant at average per year growth rate of 2015-2017. 3G coverage has not significantly changed since 2015 and is not expected to change. Therefore stable moderate growth (20% per year) is expected to continue.
	Low	Grows at about 15% per year.	5% lower growth rate than the base case.

	High	Grows at about 25% per year.	5% higher growth rate than the base case.
Average total data use per 4G smartphone (pre-WiFi offload)	Base	Grows at a declining rate (45% per year to 20% per year)	Growth rate declines until 2022 when it reaches the constant 3G smartphone growth rate (about 20%). The rapid increases in 2015-2017 were likely driven by expanding 4G coverage, which cannot continue to expand as before (population coverage is not expected to materially change).
	Low	Slower growth than base (42% per year to 14% per year)	Growth declines faster than expected in the base case.
	High	Faster growth than base (47% per year to 27% per year)	Growth declines more slowly than expected in the base case.
Average total data use per MBB (pre-WiFi offload)	Base	Grows at a declining rate (15% per year to 6% per year)	Growth rate declines for the same reason as for data per 4G smartphone (population coverage is not expected to materially change).
	Low	Slower growth than base (14% per year to 5% per year)	Growth declines faster than expected in the base case.
	High	Faster growth than base (15% per year to 9% per year)	Growth declines more slowly than expected in the base case.
Average mobile data use per M2M (post-WiFi offload)	Base	Remains at 2017 level.	We assume recent growth in data use per device does not continue as smaller, cheaper, lighter and less powerful IoT devices become more commonplace.
	Low	Fall at about 5% per year.	The impact of M2M devices becoming smaller and cheaper may outweigh the impact of increasing M2M data per M2M device observed in recent years.
	High	Grows at about 26% per year.	Growth rate constant at average per year growth rate observed 2014-2017 as M2M becomes more sophisticated.
Average mobile data use per other phone (2G) (post-WiFi offload)	Base	Remains at 2016 level.	Insufficient evidence that it would either increase or decrease.
	Low	No change from base.	
	High	No change from base.	

Source: *Frontier*

Notes: *Where annual growth rates change, these are shown as the growth rate in 2018 compared with the growth rate in 2022. For example "Grows at a declining rate (14% per year to 6% per year)" implies that growth declines gradually from 14% per year in 2018 to 6% per year in 2022)*

The low case makes the following assumptions.

- On the demand side:
  - the trend for consuming audio-visual content on mobile devices will slow, potentially if interest in social networks starts to wane;
  - late adopters of high end smartphones have lower demand for video content as late adopters tend to be those who are less technologically engaged; and
  - the data required to download web pages does not increase at the same rate as recent trends.
- On the supply side:
  - the growth in data demand which resulted from 4G coverage increases slows as population coverage is close to 100%; and
  - operators withdraw larger tariff bundles (including “all you can eat” data bundles).
  - Consumers increasingly use Wi-Fi offload (using mobile equipment on home and public Wi-Fi networks.

The high case makes the following assumptions.

- On the demand side:
  - users will continue the trend for consuming audio-visual content on mobile devices though rates of increase are slower than recent trends they are higher than the base case;
  - increasing penetration of high end smartphones will drive demand for higher definition content, in particular as penetration of 4G increases; and
  - web browsing drives increasing demand for data as the average data content per page continues to increase.
- On the supply side:
  - increases in urban capacity (supported by spectrum releases) and in coverage continue to drive demand for mobile data as users substitute from fixed to mobile data to use data services;
  - all operators adopt “all you can eat” data bundles; and
  - increases in mobile capacity reduce the rate of increase in use of Wi-Fi networks.

ANNEX A DETAILED MODEL METHODOLOGY

A.1 Introduction and model overview

The model uses mobile data in 2017 as the base year and projects forward demand. The model reports mobile data in each calendar year between 2018 and 2022. It makes separate forecasts for different types of mobile devices: 4G and 3G smartphones, 2G phones (assumed not to be smartphones), MBB subscriptions, and M2M subscriptions.

Forecasts are based on projections of number of subscriptions, and the average data use per devices.

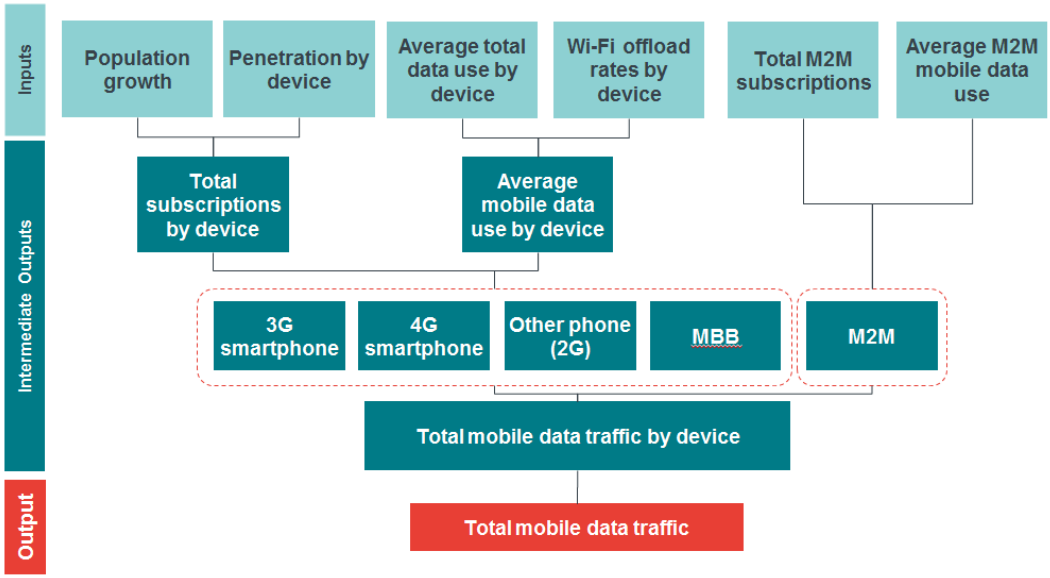
The model assumes that the number of smartphones (3G & 4G), 2G phones and MBB subscriptions is directly dependent on the size of the population, as these devices are primarily used by consumers. Therefore, the model forecasts their respective penetration rates and applying the penetration forecasts to population forecasts.

M2M devices used by businesses on a national basis in Ireland are assumed to increase based on recent trends (independent of population growth).

The total mobile traffic for different devices depends on forecasts of mobile data per device, and assumptions on the degree of traffic offloaded to fixed networks via Wi-Fi.

Mobile data use per device is forecast for each type of mobile device. The model assumes that 3G smartphones, 4G smartphones and MBB devices experience the same Wi-Fi offload rate in any given year. The model also assumes that the Wi-Fi offload rate for 2G phones is zero for every year.

Figure 28 Overview of model structure



Source: Frontier

The model projects mobile data demand using annualised data. This is because some input assumptions (such as population forecasts) are only available on an annualised basis, and as it reduces the effect of short term volatility in quarterly data.

A.2 Inputs and forecasts

Section A.2 explains, for each input in turn, how the central scenario forecasts are made and then additionally how the low and high scenario assumptions differ.

A.2.1 Population

CSO provides historic data on Ireland's population as well as forecasts for the future population (made in 2013).

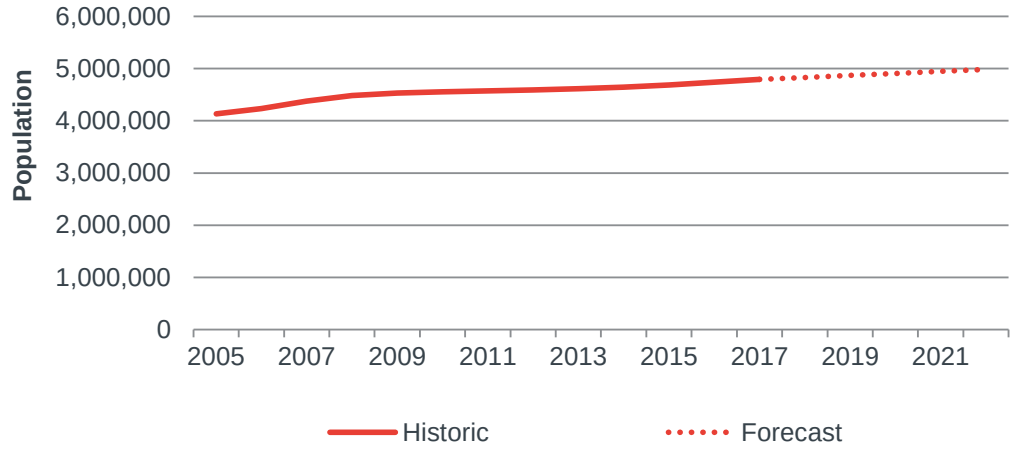
Figure 29 CSO population forecasts

	2016 CSO Forecast	2021 CSO Forecast	Annual CAGR 2016 - 2021
Total Population	4,686,790	4,876,368	0.8%

Source: CSO

The model assumes that between 2017 and 2022, Ireland's population will grow at the annual compound average growth rate (CAGR) predicted by the CSO's 2016 and 2021 forecasts (see Figure 29).

Figure 30 Total population forecast



Source: CSO, Frontier

All three scenarios use the same population forecast.

A.2.2 Penetration by device (smartphones, other phones and MBB)

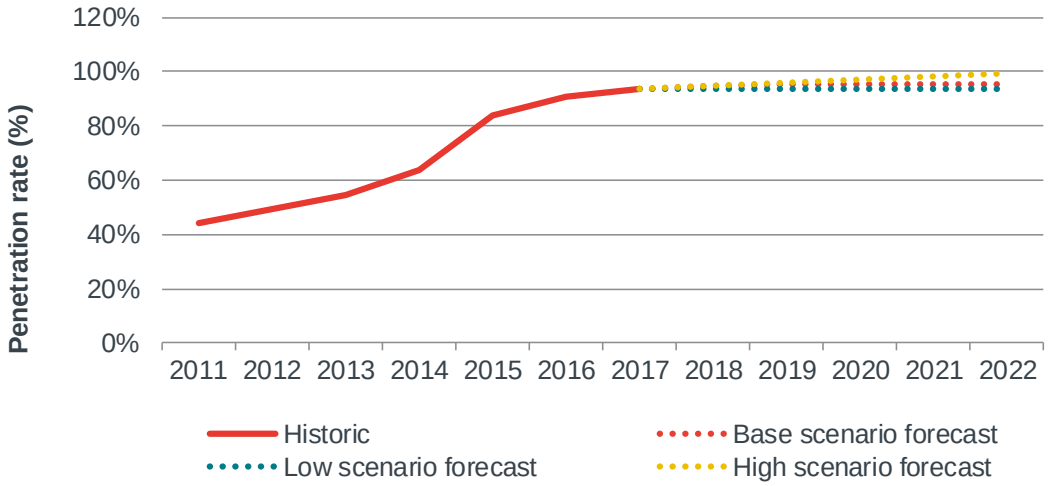
The ComReg quarterly report data provides historic quarterly data that can be used to calculate the historic annual penetration rates for smartphones, other phones and MBB.

Smartphone

Since 2011, smartphone penetration has been increasing in the shape of an S-curve. Smartphone penetration increased at a growing rate, until 2015, when penetration growth began to slow. This means that the smartphone market may be maturing and approaching saturation levels, and so the model assumes that smartphone penetration rates will plateau.

Therefore, the model forecasts that smartphone penetration will continue to grow at a declining rate for every year of the forecast period. The result of this is that the smartphone penetration rate is forecast to plateau at about 95% by 2022.

Figure 31 Smartphone penetration scenario forecasts



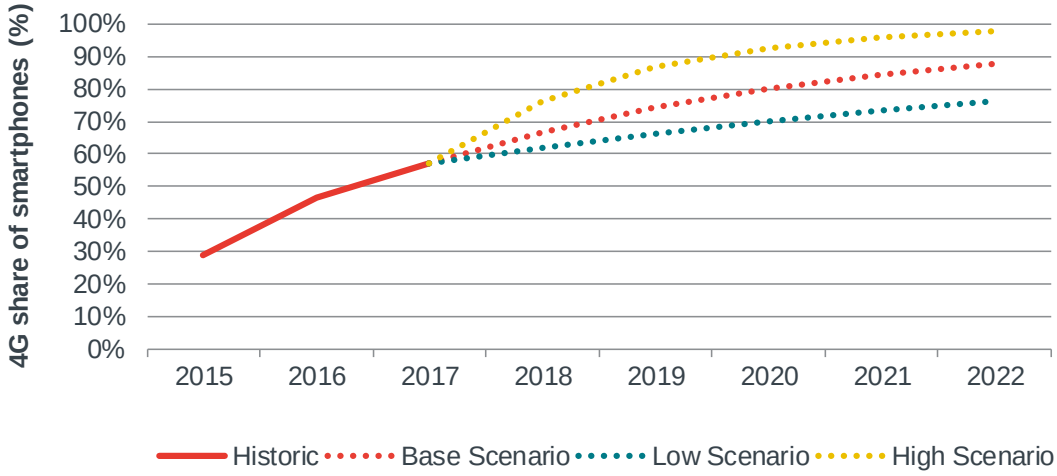
Source: ComReg, Frontier.

The model disaggregates the forecast for the number of smartphone subscriptions into forecasts for 3G smartphones and 4G smartphones.

Historic ComReg data shows that 43% of smartphones were 3G in 2017. The model assumes that the share of smartphones that are 3G will fall at a rate equal to the average annual growth rate observed between 2015 and 2017 (about -22%).

This means that by 2022, about 88% of smartphones are forecast to be 4G smartphones.

Figure 32 Split of smartphones between 3G & 4G scenario forecasts



Source: Comreg, Frontier

Low

The low scenario assumes that the smartphone penetration rate will not increase beyond its 2017 level.

The low scenario also assumes that the share of smartphones that are 3G will fall at half the average annual rate it did between 2015 and 2017.

High

The high scenario assumes that the smartphone penetration rate will grow at a rate of about 1.1% for every year of the forecast.

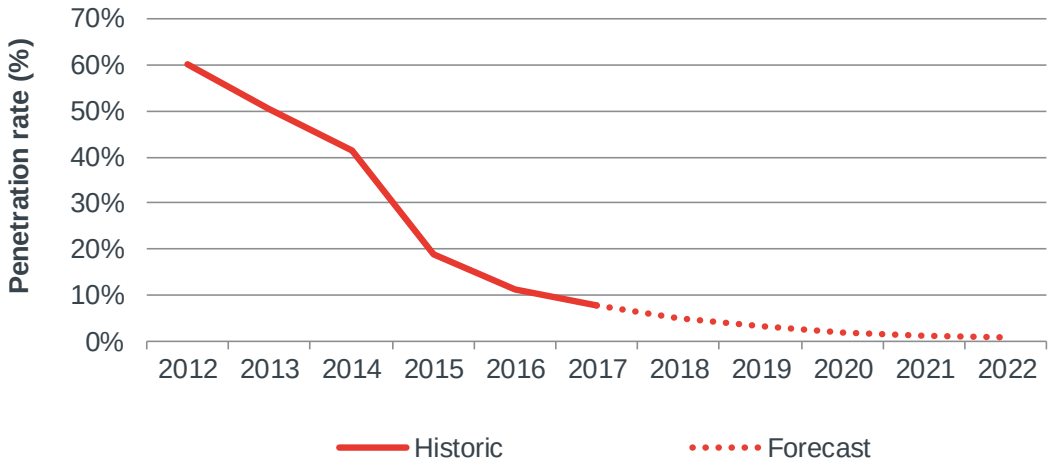
The high scenario also assumes that the share of smartphones that are 3G will fall at twice the average annual rate it did between 2015 and 2017.

2G phones

Since 2011, the change in the penetration rate of 2G phones has mirrored the change in the smartphone penetration rate, as consumers switched from 2G phones to smartphones.

The model forecasts the 2G phone penetration to continue to fall at a rate equal to the average annual rate observed between 2015 and 2017. The result of this is that the 2G phone penetration rate is forecast to have fallen to 0.8% by 2022.

Figure 33 2G phone penetration forecast



Source: ComReg, Frontier

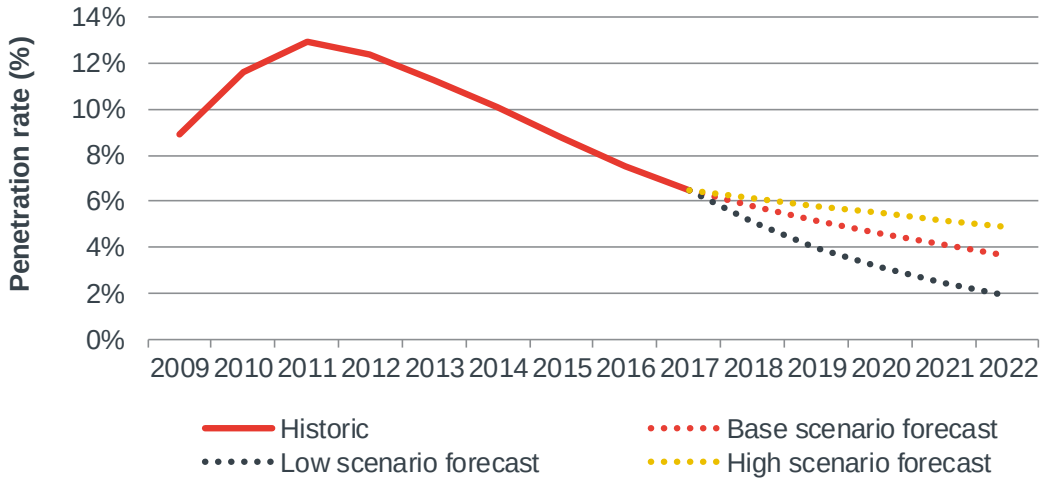
All three scenarios use the same 2G phone penetration forecast.

MBB

The MBB penetration rate peaked in 2011, and has been falling since.

The model forecasts that from 2017 MBB penetration will continue to fall at a constant rate equal to the average annual rate of decline that was observed between 2011 and 2017.

Figure 34 MBB penetration scenario forecasts



Source: ComReg, Frontier

Low

The low scenario assumes that the MBB penetration rate falls at twice the speed of the base scenario.

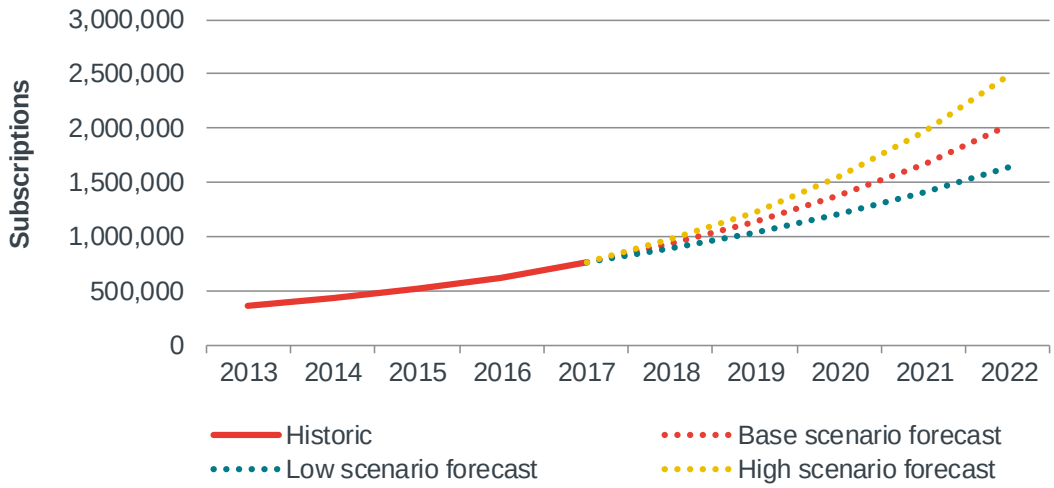
High

The high scenario assumes that the MBB penetration rate falls at half the speed of the base scenario.

A.2.3 Number of M2M subscriptions

Since 2013, the number of M2M subscriptions has grown by just over 21% every year on average (CAGR). Therefore, the model forecasts that over the next five years the number of M2M subscriptions will continue to grow at a rate equal to the average annual growth rate observed between 2013 and 2017 (about 21%).

Figure 35 M2M subscriptions scenario forecasts



Source: ComReg, Frontier

Low

The low scenario assumes that the number of M2M subscriptions will grow at a rate that is five percentage points lower than in the base scenario (so about 16%).

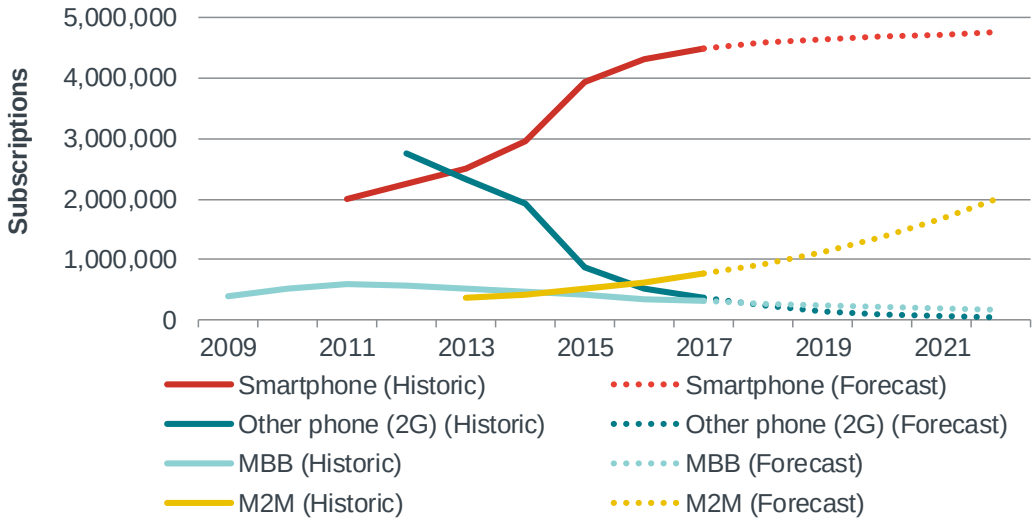
High

The low scenario assumes that the number of M2M subscriptions will grow at a rate that is five percentage points high than in the base scenario (so about 26%).

A.2.4 Number of subscriptions for all devices (smartphone, MBB, M2M and other phone

The forecasts for the total number of subscriptions for smartphones, 2G phone and MBB devices are calculated by multiplying the forecasts for the respective device's penetration rate by the forecast for the population.

Figure 36 Historic and forecasted total number of subscriptions for each device



Source: ComReg, CSO, Frontier

A.2.5 Average mobile data use per device (smartphone, MBB, M2M and other phone)

The ComReg quarterly report data provides historic quarterly data that can be used to calculate the historic annual average mobile data use per device for smartphones, MBB, M2M and 2G phones. Our forecasts set out below are on a per user basis which are then aggregated in line with the model methodology to forecast total mobile data usage in Ireland.

Average mobile data use per device for 3G smartphones, 4G smartphones and MBB, the model accounts for trends in Wi-Fi offload. As discussed in Section A.2.6, the propensity to use Wi-Fi offload is forecast to increase.

4G smartphone

Base

The average annual growth rate between 2015 and 2017 for the average mobile data use per 4G smartphone was about 61%, meaning that it grew faster than for 3G smartphones.

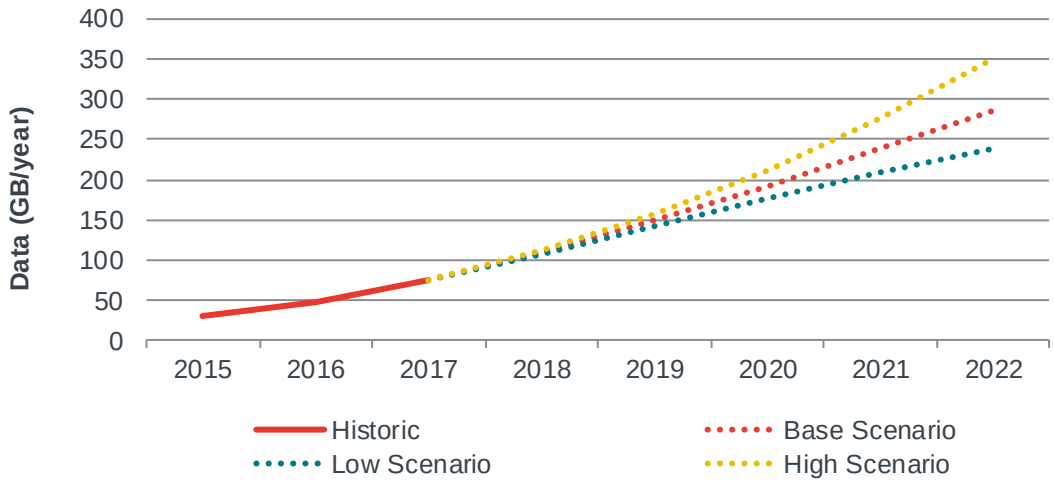
However, there are reasons to suggest that the average mobile data use per 4G smartphone would not continue to grow at such a high rate as observed between 2015 and 2017 as explained in Section 3 of the report (as 4G population coverage is already close to 100% and further evolution of device features (such as screen resolution) may begin to slow compared to recent trends).

The model assumes that the average mobile data per 4G smartphone, (before accounting for changing Wi-Fi offload rates), will grow at a declining rate from 2017 to 2022. Specifically, it is forecast to grow from about 75 GB/year in 2017 to about 286 GB/year in 2022.

This means that whilst the average mobile data per 4G smartphone will continue to grow faster than the average mobile data per 3G smartphone; by 2022 the growth rate in average mobile data per device for both 3G & 4G smartphones will be approximately the same at about 20%.

However, again, in the calculation of the total mobile data traffic forecast, the model does account for increasing trends in Wi-Fi offload rates in the smartphone and MBB forecasts. The forecast for the Wi-Fi offload rate is presented in Section A.2.6.

Figure 37 Average mobile data per 4G smartphone scenario forecasts (before Wi-Fi offload) (GB/year)



Source: ComReg, Frontier

Low

The low scenario assumes that the average mobile use per 4G smartphone, before accounting for Wi-Fi offload trends, will grow at a slower pace than in the base scenario. Specifically, the low scenario forecasts it to grow from about 75 GB/year in 2017 to about 239 GB/year in 2022.

High

The high scenario assumes that the average mobile use per 4G smartphone, before accounting for Wi-Fi offload trends, will grow at a faster pace than in the base scenario. Specifically, the high scenario forecasts it to grow from about 75 GB/year in 2017 to about 350 GB/year in 2022.

3G smartphone

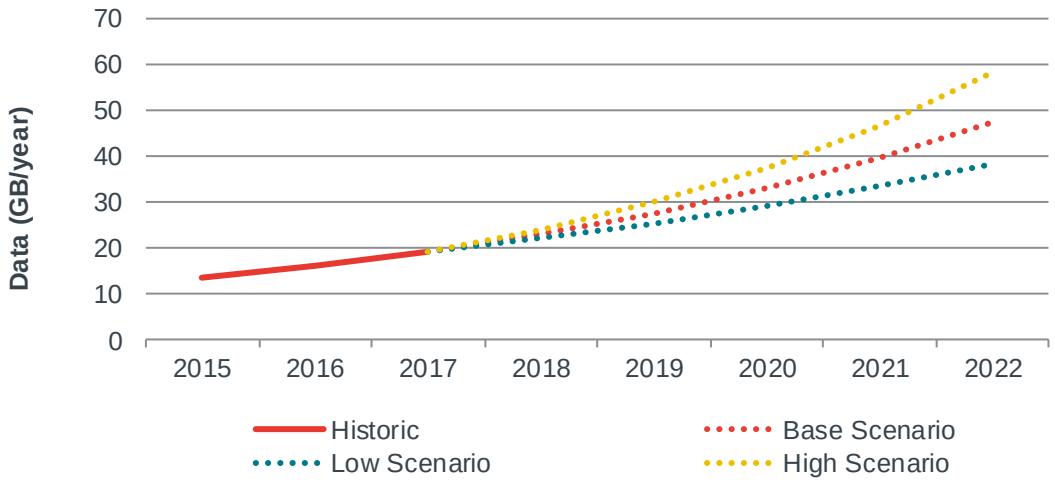
Base

The ComReg data shows that in 2016 and 2017 the growth rate of the average mobile data use per 3G smartphone was about 20% per year.

Before accounting for Wi-Fi offload trends, the model assumes that the average mobile data use per 3G smartphone will continue to grow at about 20% per year from 2017 to 2022. This is because the coverage of 3G networks has not significantly changed over the recent past and hence the change in traffic per device will be likely to be driven by changes in consumption patterns such as increased video consumption, higher data requirements of web browsing. By contrast some of the trends which has driven recent growth in 4G networks (coverage expansion and evolution of devices) may begin to slow.

However, in the calculation of the total mobile data traffic forecast, the model does account for increasing trends in Wi-Fi offload rates in the smartphone and MBB forecasts. The forecast for the Wi-Fi offload rate is presented in Section A.2.6.

Figure 38 Average mobile data per 3G smartphone scenario forecasts (before Wi-Fi offload) (GB/year)



Source: ComReg, Frontier

Low

The low scenario assumes that the average mobile use per 3G smartphone will grow at about before 15% per year (5% per year lower than the base), before accounting for Wi-Fi offload trends.

High

The high scenario assumes that the average mobile use per 3G smartphone will grow at about before 25 % per year (5% per year higher than the base), before accounting for Wi-Fi offload trends.

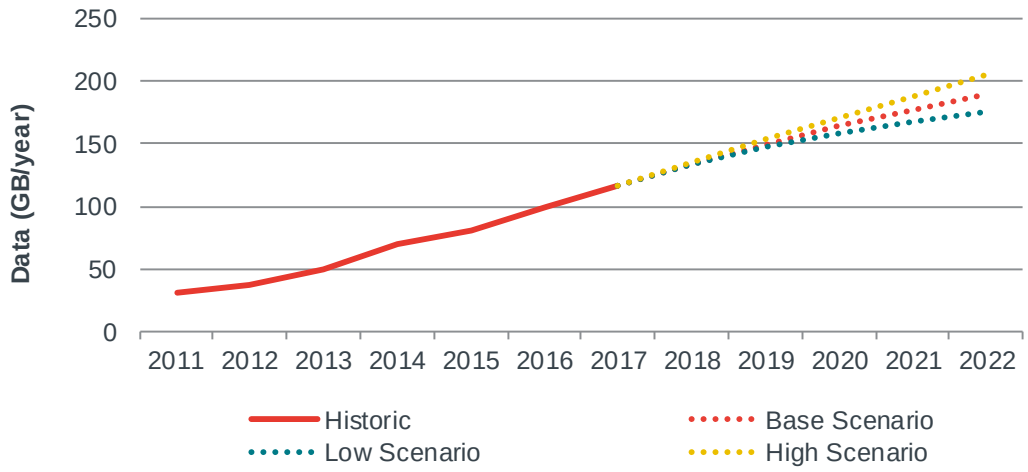
MBB

The average mobile data use per MBB device has been growing consistently over the last six years, with an average annual growth rate of about 26% per year.

The model assumes that the average mobile data per MBB device, before accounting for Wi-Fi offload rates, will grow at a declining rate from 2017 to 2022 (for the same reason as for 4G smartphones as explained above). Specifically, it is forecast to grow from about 117 GB/year in 2017 to about 189 GB/year in 2022.

However, again, in the calculation of the total mobile data traffic forecast, the model does account for increasing trends in Wi-Fi offload rates in the smartphone and MBB forecasts. The forecast for the Wi-Fi offload rate is presented in Section A.2.6.

Figure 39 Average mobile data per MBB device scenario forecasts (before Wi-Fi offload) (GB/year)



Source: ComReg, Frontier

Low

The low scenario assumes that the average mobile use per MBB device, before accounting for Wi-Fi offload trends, will grow at a slower pace than in the base scenario. Specifically, the low scenario forecasts it to grow from about 117 GB/year in 2017 to about 176 GB/year in 2022.

High

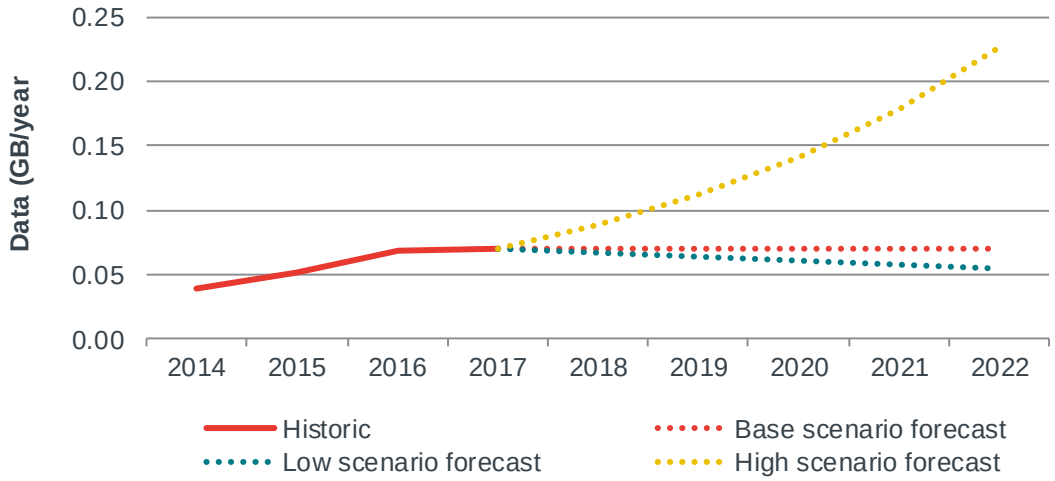
The high scenario assumes that the average mobile use per MBB device, before accounting for Wi-Fi offload trends, will grow at a faster pace than in the base scenario. Specifically, the high scenario forecasts it to grow from about 117 GB/year in 2017 to about 204 GB/year in 2022.

M2M

Since 2014 (when the data begins), the average mobile data per M2M device has risen slightly, with some volatility.

The model forecasts that the average mobile data use per M2M device will remain stable at its 2017 amount.

Figure 40 Average mobile data per M2M device scenario forecasts (GB/year)



Source: ComReg, Frontier

Low

The low scenario assumes that the average mobile data per M2M device will fall by 5% per year. This may be the case if smaller, lower powered, cheaper devices with lower data requirements become more popular.

High

The high scenario assumes that the average mobile data per M2M device will grow by the average annual growth rate observed between 2014 and 2017 (about 26%).

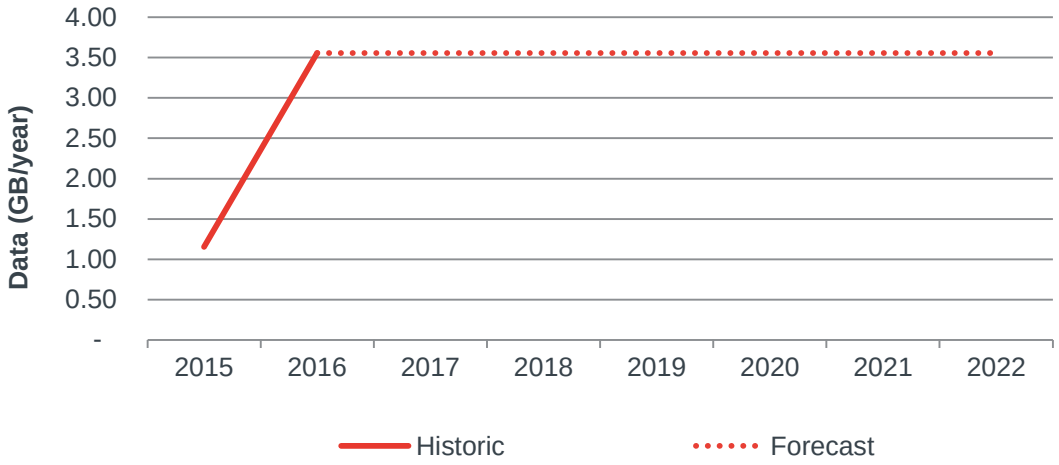
2G phones

The average mobile data use per 2G phone increased between 2015 and 2016, but the available data is restricted to just these two years, which provides very little evidence for future growth patterns.

Furthermore, there is a limit to the capability that non-3G/4G phones have to use mobile data.

Therefore, the model assumes that the average mobile data use per 2G phone will stay at the same level that it was in 2016 for the whole of the forecast period.

Figure 41 Average mobile data per 2G phone (GB/year)



Source: ComReg, Frontier

Both the low and high scenario assume that the average mobile data use per 2G phone will be the same as in the base scenario. The forecasts are not sensitive to assumptions on average mobile data per 2G phone.

A.2.6 Wi-Fi offload

The forecasts for average mobile data use per 3G smartphone, per 4G smartphone and per MBB device take into account trends in Wi-Fi offload rates. The model assumes that the same Wi-Fi offload rate applies to all of 3G smartphones, 4G smartphone and MBB devices in any given year.

The assumptions are based on industry forecasts, (provided by Cisco) adjusted for the Irish context. Cisco provides forecasts for smartphone Wi-Fi offload rates for 2016 and 2021 in both the UK and the 'Rest of Western Europe' (which includes Ireland, Denmark Iceland, the Netherlands and Norway)[38]. Cisco estimates that Wi-Fi offload rates are higher in the UK than in the 'Rest of Western Europe' (in 2016), and then forecasts that the rates will increase in both places.

Figure 42 Cisco forecasts of smartphone Wi-Fi offload rates

Smartphone Wi-Fi offload rate	2016	2021	Average annual linear increase
Rest of Western Europe	51.4%	56.8%	1.1%
UK	66.2%	71.2%	1.0%

Source: Cisco

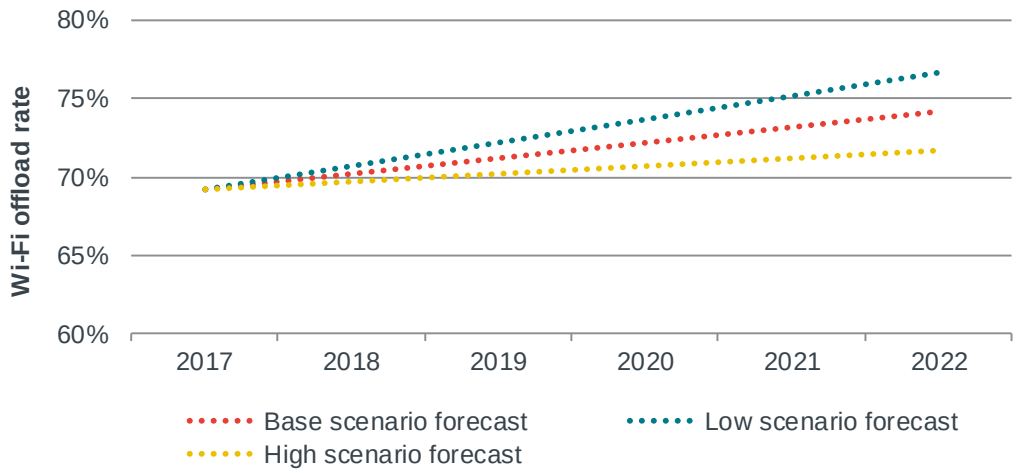
Wi-Fi offload rate is adjusted to reflect higher use of Wi-Fi offload in Ireland than the comparator country of the UK. 67% of Ireland's smartphone users report that they use fixed data more often than mobile data on smartphones, whilst for the UK the estimated figure is only 60%[39]. This suggests that Wi-Fi offload rates are likely to be higher in Ireland than they are in the UK.

[38] https://www.cisco.com/c/m/en_us/solutions/service-provider/vni-forecast-highlights.html#

[39] Deloitte Ireland Mobile Consumer Survey (2016): https://www2.deloitte.com/ie/en/pages/technology-media-and-telecommunications/articles/Mobile-Consumer-Survey-2016.html

Therefore, the model assumes that the Ireland Wi-Fi offload rates is 2 percentage points higher than the Cisco UK forecast in 2017 (69.2% for Ireland), and that the Ireland Wi-Fi offload rate will then increase at the same annual linear amount as the Cisco UK forecast (approximately one percentage point increase per year).

Figure 43 Forecasted Wi-Fi offload rates (%)



Source: Frontier

Low

The low scenario assumes that the Wi-Fi offload rate will grow at about 1.5 percentage points per year from 2017, which is 1.5 times the annual change of the base scenario.

High

The low scenario assumes that the Wi-Fi offload rate will grow at about 0.5 percentage points per year from 2017, which is half the annual change of the base scenario.

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