Three's response to Ofcom call for input on future demand for mobile broadband spectrum and consideration of potential candidate bands. WRC 15 Agenda item 1.1.

Non-Confidential

Date: 29th April 2013

1. Three's answers to Ofcom questions.

Question 1: How much do you expect UK mobile data demand to change in the period 2015-2030? Please provide evidence for the trend and, where possible, please indicate how demand might vary across the device categories listed in paragraph 4.7. How should we account for factors (including pricing) that would constrain demand?

We agree with the accepted view that there will be significant underlying increase in demand for mobile data in the next 2 decades.

Three has in the past used similar sources to Ofcom when trying to predict long term future demand and agree that (with careful interpretation) the data sets being considered in respect of market level data consumption are appropriate.

As Ofcom will know MNOs generally design networks on the basis of a peak hour throughput (Gbps), which is a more useful consideration (from our perspective) than the total consumption of data over a given period (e.g. per month).

In this respect Three estimates that (for budget purposes) our 2013 peak hour network throughput is expected to be [] and that this will increase exponentially. The table below summarises our expectations based on internal and external sources:

Table 1: Increases in Three's network peak hour throughput.

Period	Factor Increase	Gbps Increase
2013 – 2018		
2018 – 2023		
2023 – 2028		
2028 – 2032		
2013 – 2032 (total increase)		

Source: Three

Moreover we are observing a trend which suggests these estimates may be conservative. Specifically that in 2013, were it not for our demand management strategies, throughput looks to exceed our original prediction by [ ]%.

When extrapolated over the same period this trend suggests that Three's data traffic could grow by a significantly higher factor than shown above.

We actively look to facilitate easy consumption of data by our customers through generous propositions and network investment. We acknowledge that our data usage increases (on a per customer basis on the mobile network) may be greater than other operators in the short term.

However we believe that the market is developing such that all operators will have to adapt (and price) for customers who have an underlying expectation that they will be able to access data services without being overly concerned about restrictive allowances or high costs regardless of what system they are using[1].

Therefore it's not unreasonable to suggest that our estimates could be extrapolated for the overall market (relative to customer base) to provide a useful indication of the data requirements for the MNOs macro site networks.

We nevertheless note that if available capacity on mobile data networks becomes constrained by difficulty in acquiring affordable new sites or affordable new spectrum, then this will inevitably have an impact on customer experience (i.e. expected speeds and congestion in busy locations) and/or customer pricing.

Device Categories

We can provide informed opinion as to the sub-split of traffic distribution within the "personal mobile devices" category in Para 4.7.

[1] I.e. MBB on macro site mobile networks, Wi-Fi or Small Cells.

Question 2: What evidence do you think is relevant to assessing the extent of consumer benefits associated with meeting the increase in demand for mobile data?

Hardware trends

It would seem sensible to consider the evidence showing the significant increase in consumer preference towards devices manufactured to facilitate access to mobile data services (smart phones & tablets), when compared to devices that tend to access data on fixed networks (i.e. laptops).

Not only are the consumer benefits associated with the manufacture and sale of such devices contingent on there being an infrastructure to enable their use; this trend indicates that delivery of the variety of data services[2] will be in large part reliant on there being sufficient capacity in mobile networks to facilitate access to them.

It would seem reasonable to suggest that a significant proportion of the consumer benefit estimated for these services could also be attributed to meeting the capacity needed to use them in the way that customers clearly prefer.

We note that Ofcom estimates at least half of the traffic generated by these data services will need (want) to be accessed via devices using mobile networks[3]. Furthermore insights from other markets where LTE is more established suggests that the percentage of traffic offloaded in relative terms decreases as customers become more reliant on mobile networks for access to data services[4].

Tablets vs. Notebook sales

Research suggests that sales of tablets will far exceed laptop sales in the next 5 years. Sources indicate that by 2017 tablets will represent almost 75% of the total shipments[5]. Assuming this trend continues, and that in most developed nations people who currently own a notebook will acquire a tablet, it seems likely that we will find ourselves in a world where consumers want to access all data service types ubiquitously.

[2] For example – Social Media, E-commerce, Streaming / content delivery, software upgrades, messaging and web browsing
[3] http://stakeholders.ofcom.org.uk/binaries/consultations/cfi-mobile-bb/summary/cfi-mobile-bb.pdf (Fig. A5.2)
[4] See our answer to question 3 below.
[5] http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/130107_tablet_pc_market_forecast_to_surpass_notebooks_in_2013.asp

Growth in smart phone sales

Ofcom's own research[6] confirms that the vast majority of mobile phones sold now are smart phones. Coupled with the evidence showing the reduction in volume of calls and the ever increasing demand for data services it shows that general consumer use of these devices will be ever more capacity hungry (as demonstrated in our own network).

Again as argued above, consumers want to use these devices to access data services anytime anywhere, they will rely on mobile networks to do so at least half the time, and therefore MNOs (and the capacity they require) are important enablers of the variety of consumer benefits attributable to the wider digital world.

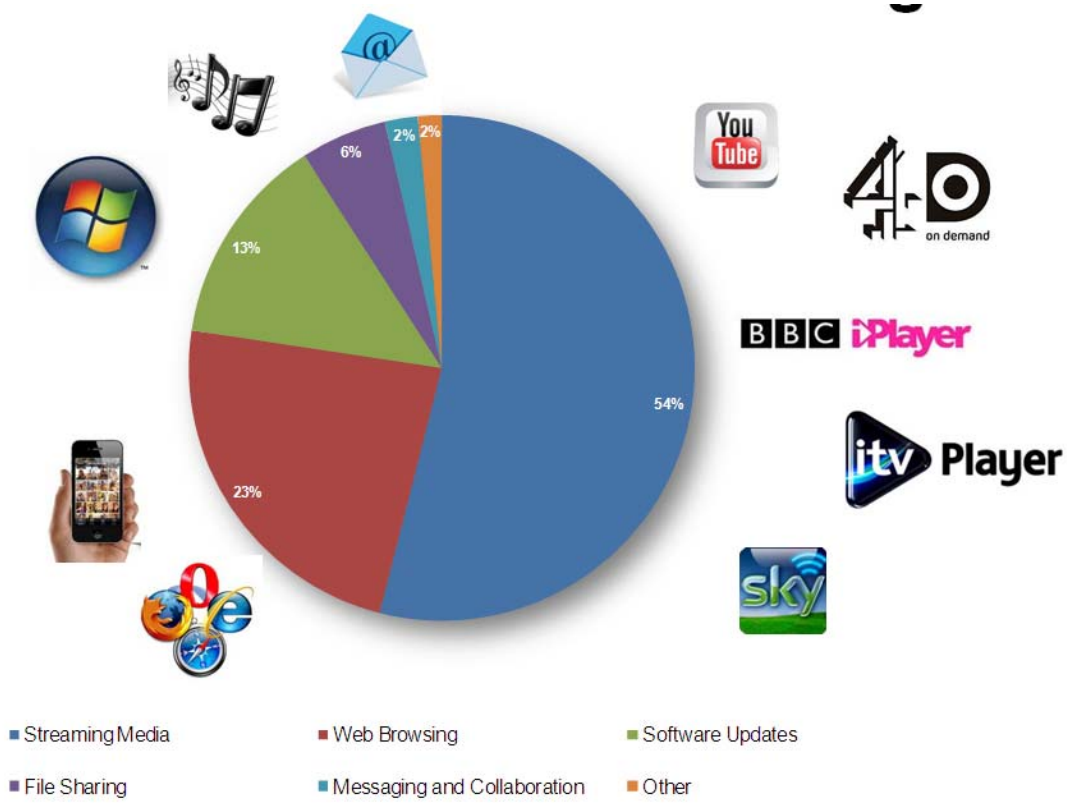
Relative Capacity Use by Service.

Ofcom could also consider analysing the capacity demands for different types of data service and factoring this relativity into any estimate of the consumer benefits derived from releasing additional spectrum.

Three carefully monitors the data usage by service type on our network. The chart below shows the distribution:

[6] Ofcom CMR 2012

Figure 1: Data usage by service type on Three's network.



Source: Three.

In the example above the majority of our network capacity (54%) is consumed by streaming services. It therefore follows that Ofcom could estimate the relative consumer benefit of such services, attribute a proportion of it to meeting demand for additional spectrum whilst taking into account that around half the capacity needed for MBB will be used by streaming services.

This also raises an interesting question which should be subject of further review as part of the wider debate about finding & funding sufficient capacity to meet demand:

***Three's question**: Streaming services are and will be heavy users of limited capacity, should regulators be seeking ways to ensure that the practical and financial burdens of releasing spectrum and building infrastructure to support access to these services are more proportionally shared between beneficiaries rather than being exclusively the problem of governments and MNOs?*

Comparisons using Fixed Broadband & LTE Tariffs

The fixed broadband market is more developed than MBB and it may be helpful to use information derived from this sector to help estimate consumer value.

In our response to Ofcom's Second Consultation on the Award of 800MHz and 2.6GHz Three provided evidence showing the relative prices that customers were willing to pay for super fast broadband when compared to a standard service[7]. This premium would seem to have some correlation to the question of consumer value associated with providing high speed MBB (compared to a slower service) and therefore releasing the capacity needed to enable it.

The same logic dictates that careful analysis of price differentiation between LTE and 3G / 2G services in mature markets further contributes to this data set.

Question 3: What proportion of mobile data traffic do you expect to be carried over (a) Wi-Fi and similar systems in licence-exempt spectrum and (b) mobile networks in licensed spectrum? How do you expect this to change over the period 2015-2030 and how do you expect total data demand for Wi-Fi and similar systems in licence-exempt spectrum to change over the same period? How might this vary by location, environment etc.?

Three has a smaller proportion of traffic offloaded to Wi-Fi than other UK mobile networks, we estimate currently [✂] due to our more generous data tariffs. The chart below shows offload assumptions collated by an external source:

[7] http://stakeholders.ofcom.org.uk/binaries/consultations/award-800mhz/responses/Three.pdf Annex E

Figure 2: Analysis of traffic offload from mobile networks.

Source: Mobidia

We have observed that in countries where the LTE market is mature the relative percentage of traffic offloaded actually reduces. It may be that this trend is also observed in the UK and Europe in the years to come. The table below provides some useful insight:

Table 2: WiFi data usage comparisons 3G vs. 4G networks.

Country	WiFi data usage as a % of total (3G handset)	WiFi data usage as a % of total (LTE handset)
South Korea	71	52
Japan	60	50
USA	61	59

Source: Three.

This trend suggests it may be possible that data offload onto Wi-Fi (unlicensed spectrum) may decrease to around 40% in relative terms during the period in question. The absolute amounts of traffic will of course continue increasing on both systems.

Question 4: What factors will act to change the spectral efficiency of mobile technologies in the future? What spectral efficiency values are appropriate for consideration in our study for the period 2015-2030?

Three believes it is prudent to assume that technology factors will deliver comparatively smaller increases in capacity during the period in question[8]. Technology is fast reaching the physical limits of spectral efficiency[9].

In general terms we believe that known technological developments will increase available capacity by 1.5 times during the next 10 years. It could be argued that advances yet to be proven or created may increase this to a multiple of 2.

Specifically we believe that a 5MHz LTE carrier will have a realistic cell throughput of circa 5.75Mbps.

We caution that whilst estimates of spectral efficiency may be theoretically achievable the practical implementation of systems to leverage them has to be considered. (For example 4x4 MIMO whilst theoretically possible is currently difficult to implement on real world networks).

Question 5: What service bit rate values are appropriate for consideration in our study for the period 2015-2030? What evidence do you have of changing needs for service bit rates?

[8] When compared to the last 10 years and factors such as greater spectrum availability.
[9] Shannon-Hartley Theorem

Question 6: What proportion of traffic do you consider should be assumed to be carried on each cell types for the period 2015-2030? How will this vary with service environment i.e. between home, office, public areas, rural, suburban and urban? What evidence do you have of the factors affecting the uptake of small cells in licensed spectrum in the future?

In general terms we believe that future capacity (in the UK) could be realistically increased by around a multiple of 1.5 through the construction of additional macro sites. As and when small cell solutions are factored in we believe this may increase to a multiple of around 4.

The chart provided in answer to question (3) provides further insight on the current distribution. We are still formulating firm views on how traffic will be distributed by cell type in the medium to long term on our network.

Question 7: Given the current mix of services on cellular networks what is the ratio of downlink to uplink capacity currently dimensioned for and how would you expect this to change over time by 2015, 2020, 2025 and 2030? How do you expect the ratio of downlink to uplink demand to vary for the service categories given in Table A5.4 of Annex 5, and what factors might affect this? How does this ratio of downlink to uplink capacity change (if at all) with network radio access technology and offload to licence-exempt systems?

Question 8: What are your views about the pros and cons of the frequency ranges in Table A6.1 in Annex 6 for mobile broadband and for existing applications using this spectrum? Do you have views on other bands that are not in Table A6.1?

We strongly agree that the ITU should study 1452MHz – 1492MHz on the basis that wider adoption of this band may encourage the development of a more comprehensive (and competitive) device and equipment eco-system to support the UK's decision to make this available for MBB on a technology neutral basis.

We also agree that the ITU should study bands in the 1300 – 1400MHz range and 1427 – 1527MHz on the basis that portions of these bands (1375-1400 paired with 1427 – 1452MHz) have been identified by DCMS as being earmarked for study in the UK with a view to releasing it as part of the wider strategy to make 500MHz of spectrum available for mobile broadband[10].

Our reading of Table A6.1 suggests that the ITU is proposing not to study the 3400 – 3600MHz band which we find surprising given its near-future availability in the EU (including the UK) for MBB. We assume Ofcom has considered whether it may be desirable to push for study in this band.

Question 9: Are there any other bands that are not in Table A6.1 for which you think we should be considering their pros and cons for mobile broadband and for existing applications using this spectrum?

No – but we assume that Ofcom are ensuring that where appropriate any bands identified for current or future study by DCMS will be reviewed against the proposals to the ITU.

Question 10: What are your views on bands which should be a priority for consideration for mobile broadband?

As a general principal Three considers that whilst it may be intuitively tempting to make a large range of bands available for mobile broadband the well understood issues of fragmentation must always be considered.

[10] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/77429/Spectrum_Release.pdf (Para 7.21).

In the global context considered by the ITU we agree that studying a broad range of frequencies for IMT/Mobile is sensible because it may provide more flexibility to country level regulators when seeking to make spectrum available.

However our preference for the UK is that Ofcom's efforts are primarily focused on ensuring the prompt release of spectrum bands that are already, or have the greatest potential to be, supported by cost effective eco-systems[11].

Capacity (particularly in low frequency) will become a problem for some operators in the relatively near future and therefore it is the next 5-10 years which occupies the mind of the MNOs. It is here that we hope Ofcom will ensure sufficient time and resource is allocated.

[11] For example already identified bands such as 700MHz, 2.3GHz, 3.4-3.6GHz, S-Band, L-Band.