Comparative connectivity metrics for Europe, South Korea and the United States

A report for **Telekom Austria Group**

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About Plum

Plum Consulting offer strategy, policy and regulatory advice in the telecoms, media and online sectors; and on radio spectrum as a key sector input. We draw on economics, our knowledge of the sector and our clients understanding and perspective to shape and respond to convergence.

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Table of Contents

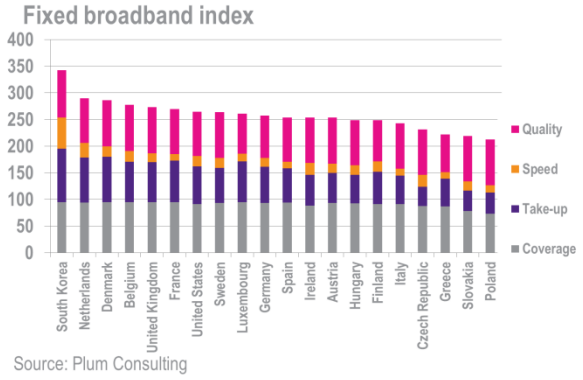
Executive Summary

Convergence affects how we connect to the internet and what we do when connected; therefore the metrics we use to measure internet connectivity must reflect convergence. However many existing metrics are out of date and fail to capture the impact of changing technologies. These issues are discussed in more detail in an accompanying paper, “Connectivity metrics for a converged era”. In this report we have compiled four indices to try and better measure the converging world. These indices are by no means conclusive and we hope that they can be improved over time as better data becomes available.

Each index is composed of four metrics scored out of 100, so the maximum score of each index is 400. The four indices and the individual metrics are:

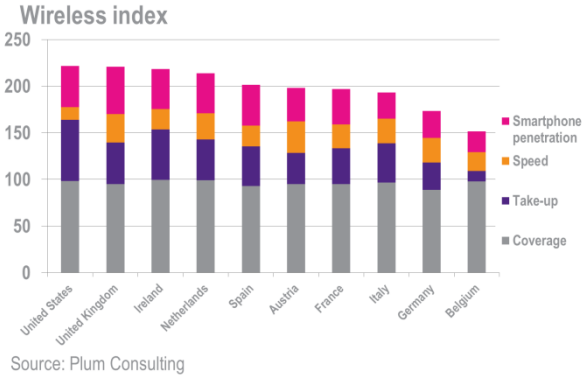
- Fixed connectivity index − fixed coverage, fixed take-up, fixed speed and fixed quality.
- Wireless connectivity index − 3G coverage, wireless take-up, wireless connection speed and Wi-Fi hotspot use or smartphone penetration (poor data availability limits sample size for Wi-Fi use in particular)
- Internet use index − regular internet use, frequent internet use, time online and e-commerce.
- Forward looking index − spectrum availability, LTE availability, FTTx coverage and FTTx take-up.

Figure 1



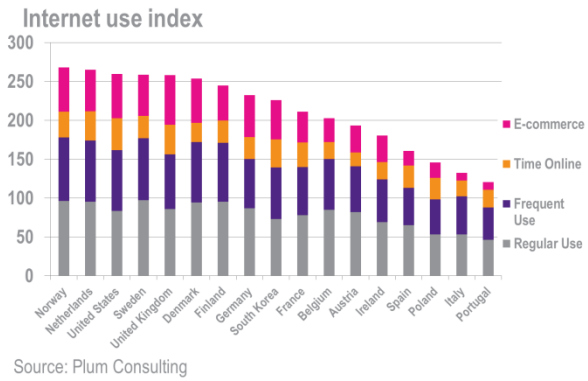
Source: Plum Consulting

Figure 2



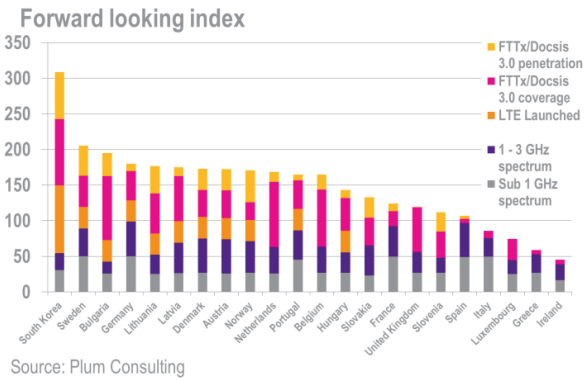
Source: Plum Consulting

Figure 3



Source: Plum Consulting

Figure 4



Source: Plum Consulting

Figure 1 shows the fixed broadband index. South Korea leads Europe with nearly universal take-up and high speeds (though not use – see Figure 3). Fixed take-up (measured on a household basis)

varies widely across Europe and a number of countries have less than 50% take-up. The lowest scores are in fixed speed, which is measured as a percentage of 30 Mbps, the target of the Digital Agenda for Europe.

The results of the wireless connectivity index are shown in Figure 2. The set of countries included is much smaller due to limited data for a number of countries. The results suggest that although Europe is performing relatively well in terms of fixed broadband, it still has a way to go on mobile connectivity. We note that the wireless landscape is undergoing a rapid transformation with rising smart device adoption, changes in spectrum availability and on-going LTE deployment. Wireless coverage is variable, whereas fixed coverage is nearly universal in most countries included in the sample.

Figure 3 shows the internet use index results. Internet use varies widely across the measured countries as all four metrics show significant variation. For example the percentage of people who have made an online purchase is over 60% in the UK, but less than 5% in Bulgaria.

Time spent online also varies; however compared to the number of TV viewing hours it is very low. Measuring this metric will become increasingly difficult due to increasing smartphone and tablet use (where applications may run in the background and internet use may involve frequent short-duration sessions) as will making the comparison with TV as IPTV and OTT viewing grow in popularity. Despite Korea performing so well in the fixed index, it is middle of the range in the use index suggesting a good fixed infrastructure is not sufficient to promote use.

The forward looking index is shown in Figure 4. Again South Korea leads Europe but relatively low spectrum availability may act as a constraint in South Korea unless additional spectrum is made available. Around half of the sample countries have launched LTE and there is wide variation in spectrum availability. Although FTTx/DOCSIS 3.0 coverage is high in a number of countries, the take-up of super-fast broadband services has been limited in most countries.

These metrics and indices aim to provide a better measure of the converging internet and the connected world. However there are still a number of areas where existing metrics could be improved and new metrics developed. Our work has highlighted that good metrics should be:

- Transparent in terms of their definition and data sources which should be publicly available.
- Ideally technology neutral or frequently updated to reflect the changing mix of technology.
- Based on actual measures rather than indirect proxies.
- Adjusted over time to reflect the value consumers place on different outputs.

1 Introduction

Convergence will drive changes in the data we collect and how it is collected; this is discussed in more detail in the accompanying report. In this report we have compiled four indices and 17 metrics which aim to address some of the problems with current data sources. All of the data we have used is currently available and publicly sourced. Therefore in some instances the metrics we have used are not our preferred choice. Hopefully over time more metrics will be collected and this will allow improvements to the metrics and indices we identify here. The four indices are:

- The fixed connectivity index aims to capture the coverage, take-up and use of fixed line broadband services. It is composed of four indicators: fixed coverage, fixed take-up, fixed speed and fixed quality.
- The wireless connectivity index aims is similar to the fixed index, it aims to capture coverage, take-up and speed of wireless networks. We identify five metrics to be included in the index: 3G coverage, wireless take-up, wireless connection speed, Wi-Fi hotspot use and smartphone penetration. We then present two versions of the index, one including Wi-Fi hotspot use and one including smartphone penetration.
- The internet use index aims to capture how intensively and frequently individuals use the internet, this can include both fixed and mobile access. The indicators included are: regular internet use, frequent internet use, time online and e-commerce.
- The forward looking index looks at measures that are likely to impact fixed and mobile connectivity and internet use in the future as well as today. The index is composed of four indicators: spectrum availability, LTE availability, FTTx availability and FTTx take-up.

Each metric is scored out of 100 and given a unitary weighting in the index so the maximum score of each index is 400. This is designed to avoid creating a bias by choice of weightings. Although the decision on how the metric is converted to a score of 100 will impact the resulting weight, this is unavoidable.

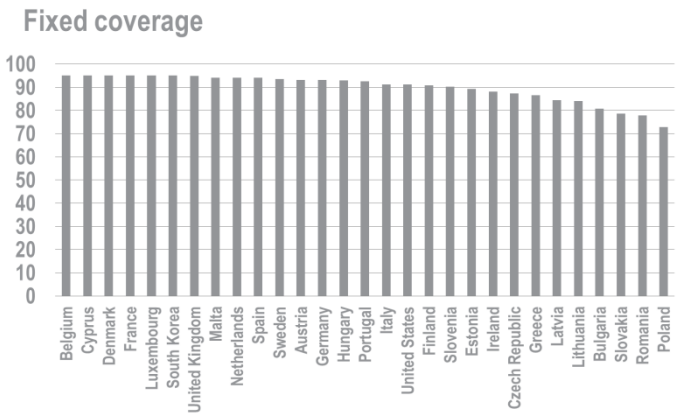
Data has been collected for the EU-27 and where possible Norway. We have also collected data for the United States and South Korea as international benchmarks. It should be noted that much of the South Korean and United States data is from alternative data sources and therefore may not be perfectly comparable.

We have chosen to present the most recent version of the data. For the majority of metrics this is 2011, however some metrics are available from 2012 and some are only available up to 2010. For each indicator data is presented for all those countries for which data was available. For the “index graphic” countries were only included if data was available for all four of the indicators. Therefore the number of countries shown will be lower than for the individual indicators.

In the next sections we provide a brief overview of all the indicators and why they were included. A full list of data sources and definitions is available in the Appendix A.

2 Fixed broadband connectivity index

Figure 2-1: Population served by either DSL or cable modem



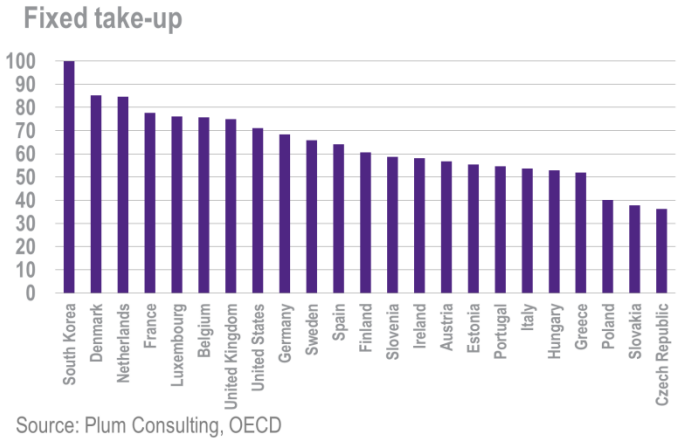
Source: Plum Consulting, Digital Agenda Scoreboard

2.1 Fixed coverage

The fixed coverage indicator is measured as the percentage of the rural population living in areas served by either a DSL or cable modem. We have used rural rather than total coverage to capture a greater variance across countries. In theory if a customer lives in an area served by DSL or cable modem they should be able to receive speeds of at least 2 Mbps. However due to technical issues such as line length this is often not the case. To account for this we have multiplied the percentage by 95 (rather than 100) to arrive at the indicator score.

The majority of countries score above 90 as fixed broadband is nearly universal. However three countries; Slovakia, Romania and Poland score below 80 and therefore a significant proportion of the population is unable to receive broadband speeds above 2 Mbps.

Figure 2-2: Fixed subscriptions per 100 households



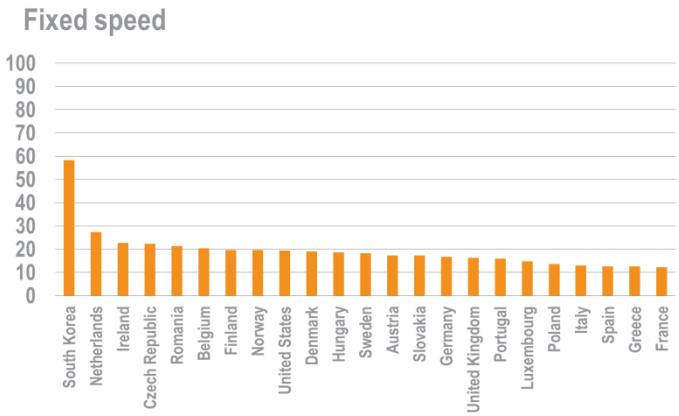
Source: Plum Consulting, OECD

2.2 Fixed take-up

Fixed take-up is measured as the number of fixed broadband subscriptions per household. This figure may be a slight overestimate as the number of fixed broadband subscriptions includes business subscriptions (this is also the case measured on a per individual basis).

South Korea leads Europe on fixed take-up with an estimated 100% of households having a broadband line (as mentioned this is likely an overestimate). A number of European countries have household take-up above 70%; however there are three countries, Poland, Slovakia and Czech Republic, with take-up at or below 40%.

Figure 2-3: Fixed average connection speed as a percentage of 30 Mbps



Source: Plum Consulting, Akamai

2.3 Fixed speed

The fixed speed indicator is based on average connection speed as measured by Akamai. This is taken as a percentage of 30 Mbps to give a score out of 100. The 30 Mbps base was chosen so that countries could be compared against the digital agenda target of universal availability of 30 Mbps by 2020.

The results show that South Korea is ahead of Europe with average speeds of 17.5 Mbps. There are no European countries with an average connection speed above 10 Mbps and eight countries have an average speed below 5 Mbps including the UK, France, Italy and Spain – well short of the Digital Agenda targets.

Figure 2-4: Fixed VoIP call quality

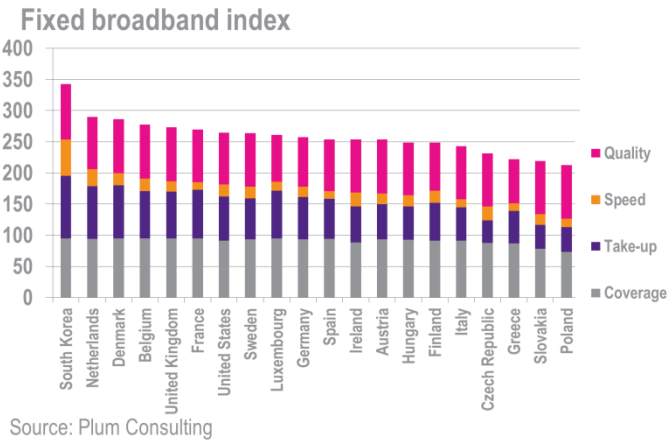
Source: Plum Consulting, Ookla Net Index

2.4 Fixed quality

The quality indicator tries to capture the quality of a fixed broadband connection. It is based on data from the Ookla Net Index and test results from Pingtest.net. The indicator is a measure of VoIP call quality, which is affected by packet loss, ping and jitter. A score above 80 indicates good voice quality with few problems, while a score below 50 would have serious call problems.

The majority of countries have a score of between 80 and 90. However four countries, Germany, Finland, Luxembourg and Greece, score below 80 and therefore the average user may suffer from problems when using VoIP.

Figure 2-5: Fixed broadband connectivity index



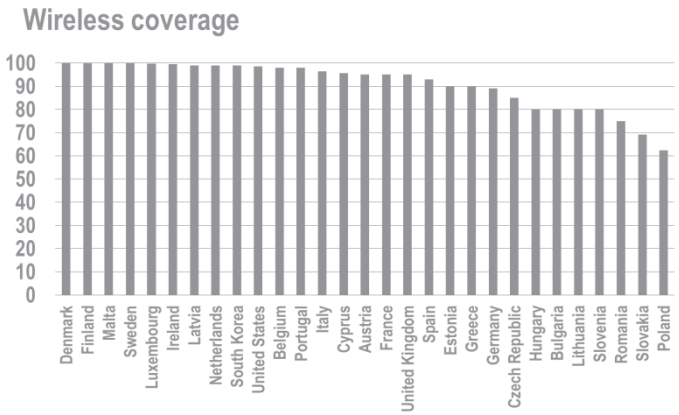
Source: Plum Consulting

2.5 Fixed connectivity index

The fixed index has a total score out of 400. South Korea comes out top with a total score of 342. The majority of European countries score between 250 and 300, the main area of weakness is connection speed where countries are still a long way off the ambitious 2020 targets. Greece, Slovakia and Poland have a total score of less than 225 and show weakness across all of the indicators.

3 Wireless data connectivity index

Figure 3-1: Wireless data coverage



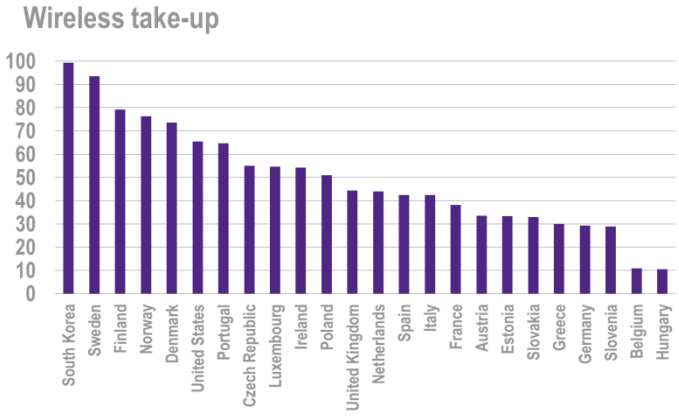
Source: Plum Consulting, Digital Agenda Scoreboard

3.1 Wireless data coverage

Wireless coverage is measured as the percentage of the population covered by a 3G signal (LTE coverage is expected to be less than 3G coverage for some time). This estimate is based on the signal outside a person's place of residence; signal inside the home may not register. It is also measured as the signal on all available networks which means coverage of an individual network may be much lower. Therefore the consumer perception of coverage can often be much lower than reported coverage. New consumer sourced data such as OpenSignalMaps may soon provide alternative data points.

A number of countries have reported 3G coverage of over 95%.However two countries; Slovakia and Poland, have 3G coverage below 70%.

Figure 3-2: Wireless subscriptions per 100 individuals



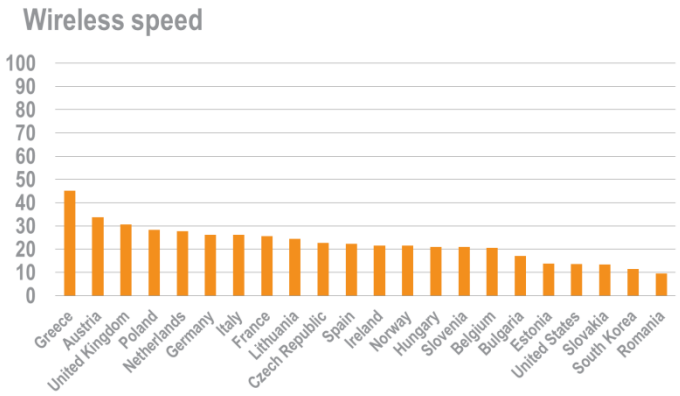
Source: Plum Consulting, OECD

3.2 Wireless data take-up

Wireless take-up is measured as the number of wireless broadband subscriptions per 100 inhabitants. This measure includes mobile subscriptions that have been used to make an internet data connection in the past three months, dedicated mobile data subscriptions, fixed wireless and satellite subscriptions.

Both South Korea and Sweden have mobile take-up above 90 (although a number of individuals will have multiple subscriptions so this does not translate into universal mobile take-up). There is a large variation in take-up with Belgium and Hungary having take-up of just 11% and 10% respectively.

Figure 3-3: Wireless average connection speed as a proportion of 10 Mbps



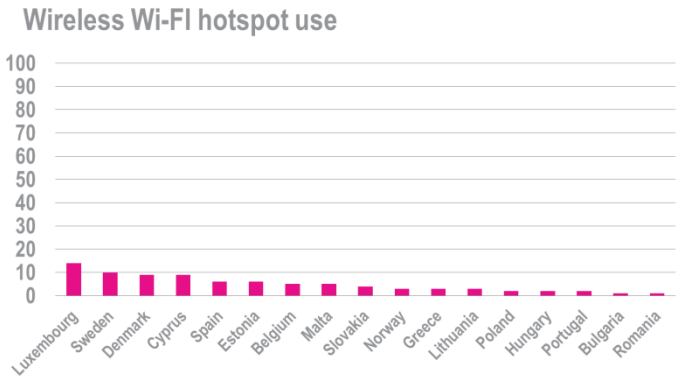
Source: Plum Consulting, Akamai

3.3 Wireless speed

Wireless speed data is from Akamai, and is the average connection speed. To give an indicator score out of 100 the average connection speed is taken as a percentage of 10 Mbps. 10 Mbps was chosen as a suitable benchmark because this is seen as suitable target for LTE (in the near future). Akamai's mobile data measure is on an operator level; therefore to arrive at country averages a simple arithmetic average of the operators connections speed in a given country is taken. This methodology is not precise and ideally a weighted average would be taken but Akamai operator data is anonymised.

Six countries, including South Korea, have speeds below 2 Mbps. The South Korea result may be a spurious result because this data is from 2011 Q1 (compared to 2011 Q4 for the rest of the sample) as Akamai have chosen not to include it in more recent versions of the report. Data on mobile speeds is very limited at the moment with Akamai providing the only comprehensive source.

Figure 3-4: Percentage of people who have used Wi-Fi hotspots in the last three months



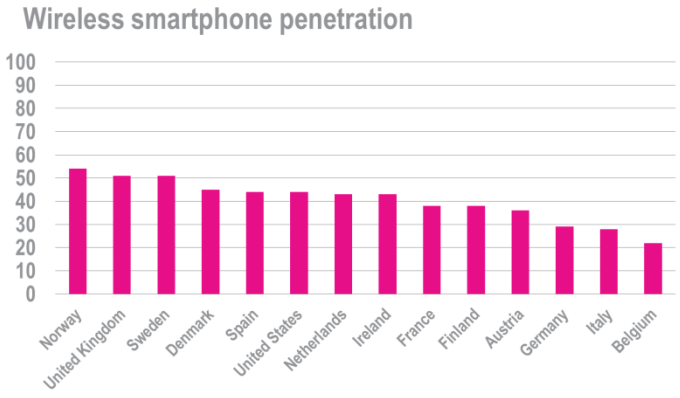
Source: Plum Consulting, Eurostat

3.4 Wi-Fi hotspot use

This indicator is measured as the percentage of individuals who have accessed the internet in a hotspot (at hotels, airports, public places etc.) in the last three months. We choose this indicator to try and capture both frequency of use of Wi-Fi hotspots and availability as this will impact on how often individuals use them.

The data shows that use of Wi-Fi hotspots is still limited. Luxembourg and Sweden are the only countries in which 10 % or more of the population have used a hotspot in the last three months.

Figure 3-5: Wireless smartphone penetration



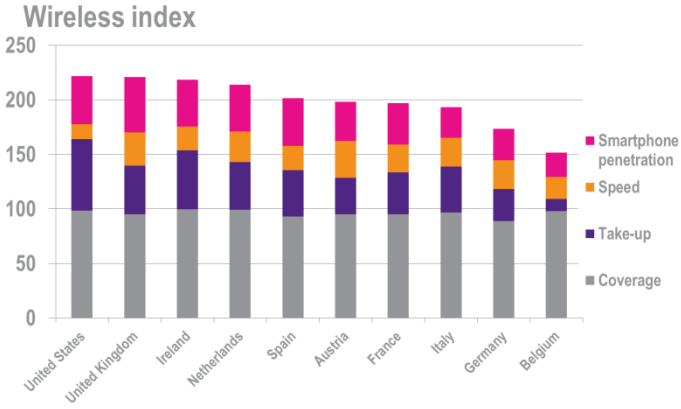
Source: Plum Consulting, Our Mobile Planet

3.5 Smartphone penetration

Wireless smartphone penetration is measured as the percentage of the total population who have a smartphone. This data was collected from a survey. Obviously this measure will be correlated with the take-up indicator. However it is still a useful indicator given the different data source and that the take-up category includes a wider range of connections/devices.

The data shows that three countries, Norway, the UK and Sweden, have smartphone penetration greater than 50%. Only one country, Belgium, has smartphone penetration below 25%. We note that the smartphone indicator gives a higher figure for some countries than the take-up indicator, even though the take-up indicator should include smartphones. The main reason for this is the smartphone data is from 2012 whereas the take-up date is from 2011, smartphone penetration has been on the rise in the last year. A second possible reason is that some smartphone users may not use their phone to access the internet and therefore are not included in the take-up matric.

Figure 3-6: Wireless index with smartphone penetration



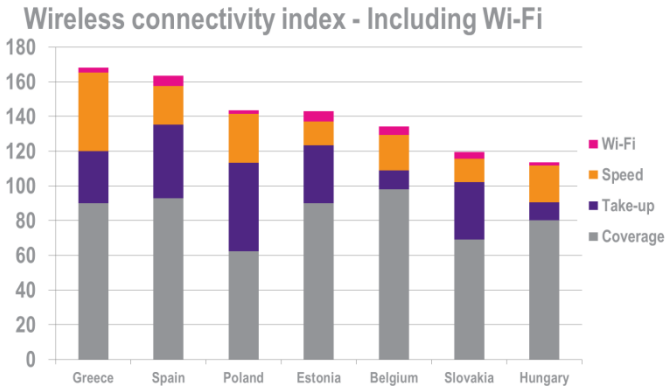
Source: Plum Consulting

3.6 Wireless connectivity index

We have considered two versions of the wireless index with different choice of the fourth indicator; either smartphone penetration or Wi-Fi use. This was done because of limited availability of data for these two indicators. Therefore the wireless index is only available for a small number of countries.

Figure 3-6 shows the wireless index including smartphone penetration; here the US is the leader, but only by a small margin. Belgium has the lowest score, primarily a result of low take-up and smartphone penetration.

Figure 3-7: Wireless index with Wi-Fi use

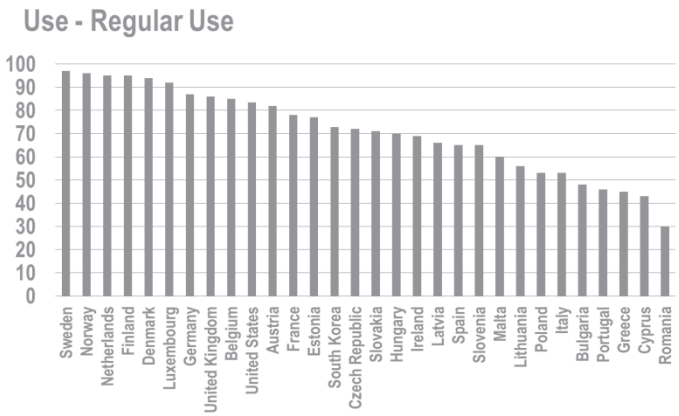


Source: Plum Consulting

Figure 3-7 shows the wireless index including Wi-Fi use for which complete data was only available for seven countries. Overall scores are low with all countries receiving less than 175 (out of 400), due to low take-up, speed and Wi-Fi use.

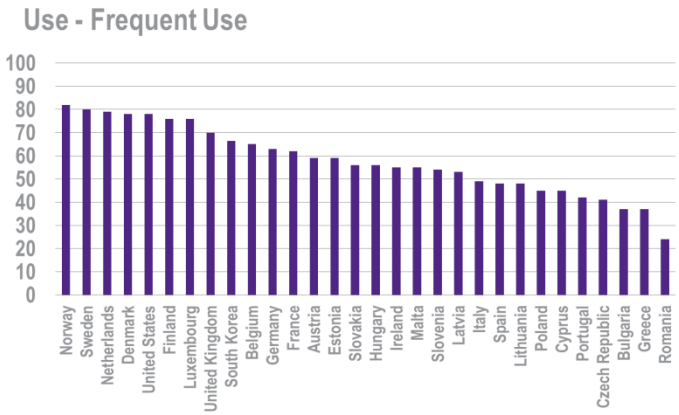
4 Internet use index

Figure 4-1: Percentage of 45 – 54 year olds who have accessed the internet in the last three months



Source: Plum Consulting, Eurostat

Figure 4-2: Percentage of individuals who use the internet on a daily basis



Source: Plum Consulting, Eurostat

4.1 Regular internet use

The regular use indicator as measured as the percentage of 45 – 54 year olds who have accessed the internet in the last three months. The 45 – 54 age category was chosen because it gives a good range of data across countries, unlike broader or younger age categories which are often close to 100 with little variation.

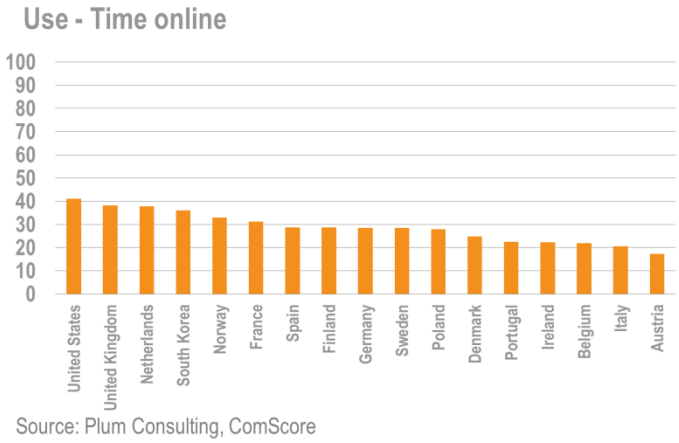
The results show that six countries have a regular use score of over 90, these countries are primarily Scandinavian countries. However five countries have a score of less than 50 and only 30% of 45 – 54 year olds in Romania have used the internet in the last three months.

4.2 Frequent internet use

The frequent use indicator aims to capture the percentage of people who use the internet on a frequent basis. It is measured as a percentage of the total population who use the internet on a daily basis.

Two countries, Norway and Sweden, score 80 or above. However there are 10 countries in which less than 50% of individuals use the internet on a daily basis, with Romania again having the lowest score.

Figure 4-3: Average number of hours online per month



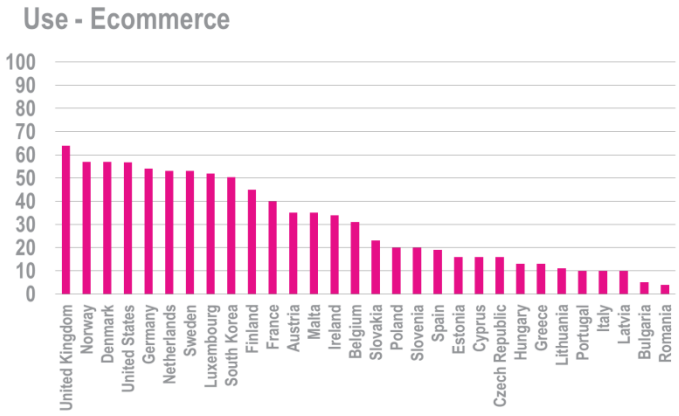
Source: Plum Consulting, ComScore

4.3 Time online

Time online is measured as the average number of hours an individual spends online each month at home and at work excluding mobile phones and tablets.

Individuals in the United States spend the longest time online, with a monthly average of 41 hours. Individuals in Austria are the only ones to spend less than 20 hours online a month.

Figure 4-4: Percentage of individuals who have made an online purchase in the last three months



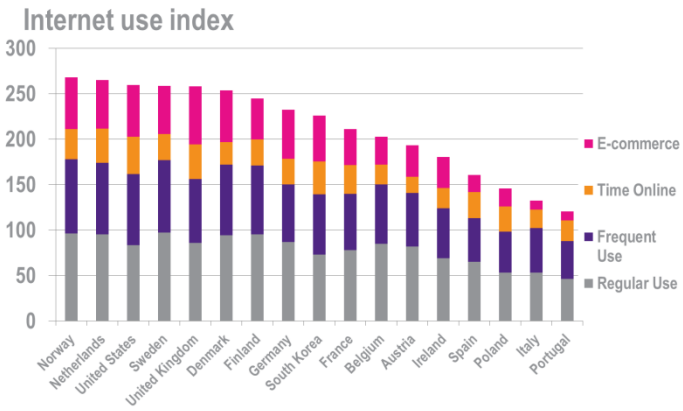
Source: Plum Consulting, Eurostat

4.4 E-commerce

The e-commerce indicator is measured as the percentage of individuals who have made an online purchase in the last three months.

In a number of countries over 50% of individuals have made an online purchase in the last three months, the proportion is highest in the UK at 64%. However there are five countries which score 10 or less, in Romania just 4% of individuals have made an online purchase in the last three months.

Figure 4-5: Use Index



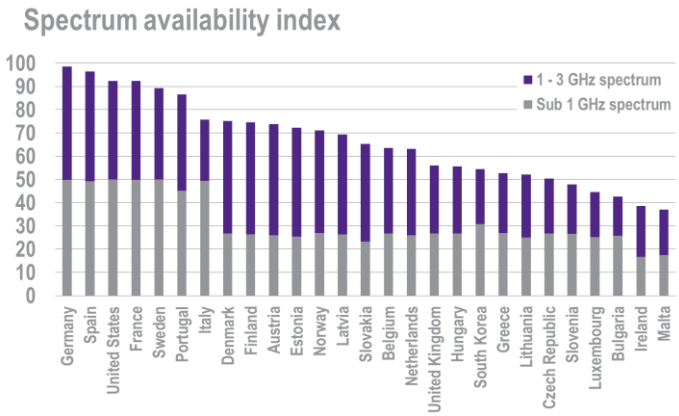
Source: Plum Consulting

4.5 Internet use index

The use index has a maximum score of 400 and six countries score over 250. We note that South Korea, despite universal fixed broadband take-up and high speed connectivity, does not score highly in terms of internet use. The two main areas in which the top six countries lose points on are e-commerce and time online. Three countries, Poland, Italy and Portugal, score below 150. We note that a number of very low scoring countries, for example Romania, were not included in the index because data on time online was not available.

5 Forward looking index

Figure 5-1: Spectrum availability index



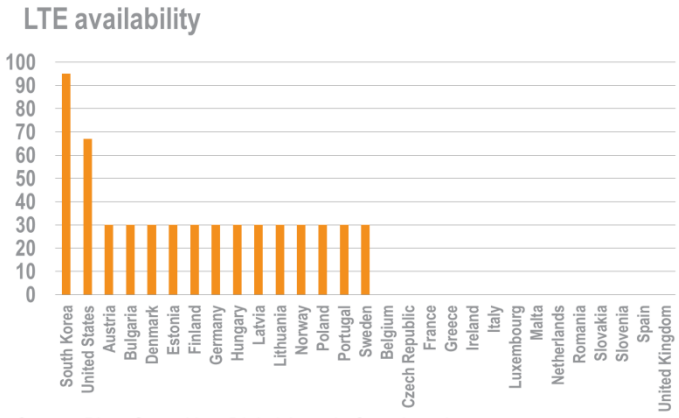
Source: Plum Consulting, ECO

5.1 Mobile spectrum availability

The mobile spectrum availability index was created by Plum to measure the spectrum available for use by mobile operators. The index is split into two: spectrum available below 1 GHz (which offers coverage at least cost and has offers in-building penetration), and spectrum available between 1 and 3 GHz (which offers capacity). Each section has a maximum score of 50. The score out of 50 is based on the amount of spectrum licensed for mobile use as a percentage of the total spectrum harmonised for IMT services in Europe, divided by two.

Those countries that have auctioned both the 800 MHz band and 2.6 GHz band have the most spectrum available. Six countries have auctioned less than 50% of the IMT harmonised spectrum to mobile use.

Figure 5-2: LTE availability



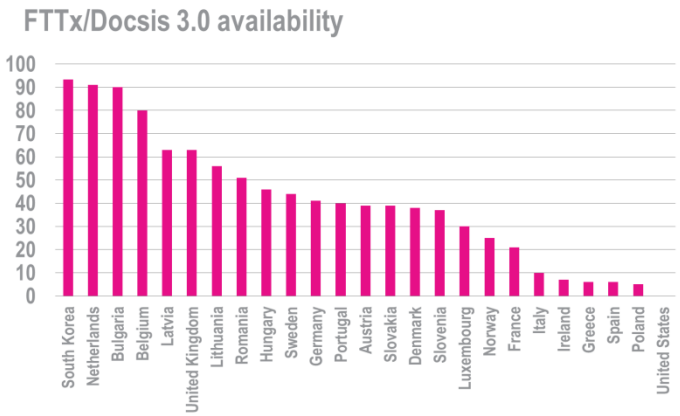
Source: Plum Consulting, Digital Agenda Scoreboard

5.2 LTE availability

This indicator aims to capture the current availability of LTE. Ideally this would measure LTE population coverage but this data was only available for South Korea and the United States. Those European countries that have commercially launched LTE were given a score of 30; otherwise they received a score of zero. Thirty was chosen as a benchmark because in Europe most LTE deployments are in their early phases and therefore this may be an overestimate for some countries.

The United States and South Korea have good LTE coverage. Europe is split into two, those who have commercially launched LTE and those who have not.

Figure 5-3: Population coverage of FTTx and DOCSIS 3.0 services



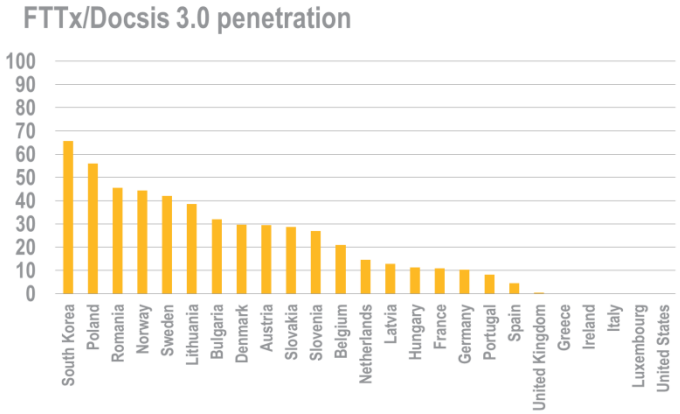
Source: Plum Consulting, iDate

5.3 FTTx/DOCSIS 3.0 coverage

This indicator aims to capture the current coverage of super-fast broadband. It is measure as the population coverage of FTTx (includes FTTH, FTTB and FTTC) and DOCSIS 3.0 services. This data is from the end of 2010 so coverage will have increased in many countries.

Both South Korea and the Netherlands have over 90% coverage of super-fast broadband services although the technology deployed is FTTH in South Korea compared to primarily DOCSIS 3.0 in the Netherlands. A number of European countries have very limited coverage including Spain and Italy.

Figure 5-4: Penetration of FTTx and DOCSIS 3.0 services in covered areas



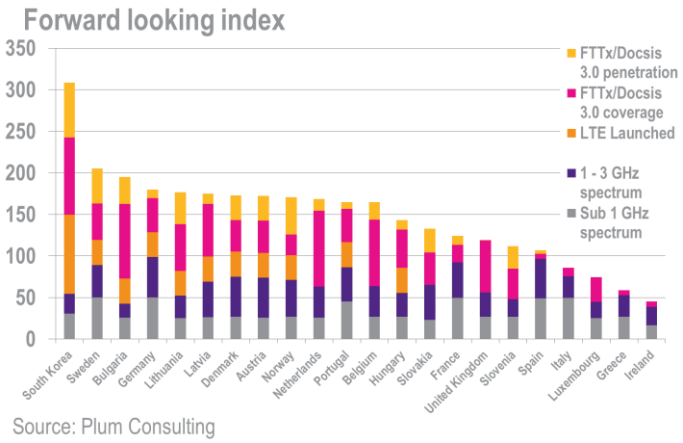
Source: Plum Consulting, IDATE

5.4 FTTx/DOCSIS 3.0 penetration

This indicator is measured as the penetration of FTTx and DOCSIS 3.0 services in areas where FTTx and DOCSIS 3.0 are available. Again data is from the end of 2010 so penetration will have increased significantly in many countries.

The results show that demand for superfast broadband services has been limited so far, penetration is only above 50% in South Korea and Poland. In the majority of European countries penetration is below 30% in covered areas.

Figure 5-5: Forward looking index



Source: Plum Consulting

5.5 Forward looking index

Figure 5-5 shows the forward looking index. South Korea leads by a large margin despite having relatively low availability of mobile spectrum. European countries show a range of scores and a number of countries have released very little spectrum alongside low level of FTTx/DOCSIS 3.0 deployment.

6 Conclusion

This report has presented four indices and a number of indicators aiming to capture the impact of convergence on internet connectivity. Changes to the existing measures are needed as they do not adequately capture the realities of the changing world and often act as poor proxies. However that is not to say that the metrics we present here are the definitive list, rather they should be viewed as a step in the right direction. We hope that as more data is collected and discussion encourages progress many of these metrics will be improved or replaced.

Our work bought us face to face with many of the problems that existing metrics suffer from. Therefore we propose a number of recommendations that all future metrics should abide by, namely that they should be:

- Transparent in terms of their definition and data sources which should be publicly available.
- Technology neutral or frequently updated to reflect the changing mix of technology.
- Based on actual measures rather than indirect proxies.
- Adjusted over time to reflect the value consumers place on different outputs.

Appendix A: Data sources

Table A-1: European data sources

Metric	Source	Definition and conversion to metric out of 100 (x100 unless otherwise stated)
Fixed broadband coverage	European Digital Agenda Scoreboard (2010)[1]	% of rural population living in rural areas served by either DSL or cable modem networks x 95 (to reflect technological issues which reduce the availability and speed for customers)
Fixed broadband take-up	OECD Broadband Portal (June 2011)[2]	Fixed (wired) broadband subscriptions per 100 inhabitants (includes DSL, Cable and Fibre/LAN) x "Number of individuals per household"
Fixed broadband speed	Akamai State of the Internet report (Q4 2011)[3]	Average connection speed. % of 30 Mbps.
Fixed quality	Ookla Net Index (May 2012)[4]	The rolling mean R Factor over the past 30 days where the mean distance between the client and the server is less than 300 miles. The R Factor is used to quantitatively express the subjective quality of VoIP traffic.
3G coverage	European Digital Agenda Scoreboard (2010)	% of total population living in areas covered by 3G (third generation mobile networks)
Wireless take-up	OECD Broadband Portal (June 2011)	Terrestrial mobile wireless broadband subscriptions per 100 inhabitants (includes satellite, terrestrial fixed wireless, standard mobile broadband subscriptions and dedicated mobile data subscriptions)
Wireless speed	Akamai State of the Internet report (Q4 2011)	Average connection speed. Averaged across all mobile operators for which data is available. % of 10 Mbps.
Wi-Fi hotspot use	Eurostat (2011)[5]	Percentage of individuals who accessed internet in a hotspot (at hotels, airports, public places etc) in the last 3 months (I_IHOT)

[1] http://ec.europa.eu/information_society/digital-agenda/scoreboard/index_en.htm

[2] http://www.oecd.org/document/54/0,3746,en_2649_34225_38690102_1_1_1_1,00.html

[3] http://www.akamai.com/stateoftheinternet/

[4] http://www.netindex.com/quality/

[5] http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/themes

Metric	Source	Definition and conversion to metric out of 100 (x100 unless otherwise stated)
Smartphone penetration	Our Mobile Planet (2012)[6]	Smartphone penetration – percentage of the total population
Regular use	Eurostat (2011)	Percentage of 45 – 54 year olds who have used the internet in the last 3 months (I_IU3)
Frequent use	Eurostat (2011)	Percentage of individuals who access the internet on a daily basis (I_IDAY)
Hours online	Comscore (2011) – "It's a social world – Top 10 need-to-knows about social networking and where it's heading"[7]	"Average time spent on social networks" divided by "Share of time spent on social networking". Data is collected from a global survey and excludes mobile use
E-commerce	Eurostat (2011)	Percentage of individuals who have made an online purchase in the last 3 months (I_BUY3)
Spectrum index	ECO Report 03 (2012) – The licensing of 'Mobile Bands' in CEPT [8]	Amount of spectrum, in MHz, licensed for mobile use in the following bands; • 790-862 MHz (60 MHz) • 880-915 MHz / 925-960 MHz (70 MHz) • 1710-1785 MHz / 1805-1880 MHz (150 MHz) • 1900-1980 MHz / 2010-2025 MHz / 2110-2170 MHz (155 MHz) • 2500-2690 MHz (190 MHz) Spectrum below 1 GHz is taken as a percentage of the possible maximum (130 MHz) and divided by 2. Spectrum between 1 and 3 GHz is taken as a percentage of the possible maximum (495 MHz) and divided by 2.
LTE availability	LTE maps (2012)[9]	Ideally this metric would measure LTE coverage however this data is only available for South Korea and the US (see below). For European countries; those countries that have commercially launched mobile LTE are given a score or 30, other countries are given a score of zero. x 100 (for South Korea and the US)

[6] http://www.ourmobileplanet.com/en/

[7] http://www.comscore.com/Press_Events/Presentations_Whitepapers/2011/it_is_a_social_world_top_10_need-to-knows_about_social_networking

[8] http://cept.org/eco/deliverables/eco-reports

[9] http://ltemaps.org/

Metric	Source	Definition and conversion to metric out of 100 (x100 unless otherwise stated)
FTTx/DOCSIS 3.0 coverage	IDATE (data as of 31 December 2010) – Broadband coverage in Europe 2011 survey	Percentage of the population covered by FTTx services (includes FTTH/B, FTTC/VDSL and DOCSIS 3.0)
FTTx/DOCSIS 3.0 penetration	IDATE (Data as of 31 December 2010) – Broadband coverage in Europe 2011 survey	FTTx subscribers per 100 inhabitants divided by percentage of the population covered. x "Number of individuals per household"

When possible we have used the same data source for South Korea and the United States. However for some of the metrics these two countries were not included in the sample, therefore we have used other data sources. The collection method and data definitions are not always a perfect match with the European sources and therefore data will not be perfectly comparable. However we have tried to find sources as closely aligned as possible. The table below shows those metrics for which South Korea and United States data was not available and the alternative sources used.

Table A-2: South Korea data sources

Metric	Source	Definition
Fixed broadband coverage	OECD Broadband Portal (2009)	DSL coverage
3G coverage	OECD Broadband Portal (2009)	3G population coverage
Wi-Fi hotspot use	Not available	-
Regular use	KISA ISIS – 2011 survey on the internet usage[10]	Internet usage rate – average of the 40s and 50s age categories
Frequent use	KISA ISIS – 2011 survey on the internet usage	"Percentage of internet users who the internet at least once a day" x "percentage of people who use the internet"

[10] http://isis.kisa.or.kr/eng/board/?pageId=040100

Metric	Source	Definition
E-commerce	KISA ISIS – 2011 survey on the internet usage	"Percentage of internet users who have purchased goods and services over the internet in the last 12 months" x "percentage of people who use the internet"
Spectrum index	APT Report (2011) on information of mobile operators' frequencies, technologies and license durations in Asia pacific countries[11] and personal communication	Spectrum licensed for mobile use. Same conversion as European spectrum data.
LTE availability	Network World (2012)[12]	LTE population coverage
FTTx/DOCSIS 3.0 coverage	OECD (2010) – "Fibre access – network developments in the OECD area"[13]	Homes passed by FTTH/B divided by number of households. This may be a slight underestimate as it does not include FTTC or DOCSIS 3.0 but given the high level of FTTH/B coverage this will have a limited impact.
FTTx/DOCSIS 3.0 penetration	2010 South Korea Internet White Paper[14]	"Number of urban subscribers on 50 – 100 Mbps broadband services" x "number of internet subscribers" x "urban population as a percentage of total" divided by "number of households"

Table A-3: United States data sources

Metric	Source	Definition
Fixed broadband coverage	Connecting America: The National Broadband Plan (2009)[15]	Percentage of the population living in areas with no wireline provider
3G coverage	FCC Fifteenth Report (2011)[16]	Total US population covered by wireless broadband services by one or more service providers. Includes 3G and 4G but 4G is expected to be minimal and overlap.

[11] http://www.apt.int/sites/default/files/APT-AWF-REP-15_APT_Report_on_Mobile_Band_Usage.doc

[12] http://www.networkworld.com/news/2012/022912-sk-telecom-bolsters-coverage-with-256824.html

[13] http://www.oecd-ilibrary.org/science-and-technology/fibre-access_5kg9sqzz9mlx-en

[14] http://isis.nida.or.kr/eng/ebook/ebook.html

[15] http://www.broadband.gov/plan/

[16] http://transition.fcc.gov/Daily_Releases/Daily_Business/2011/db0630/FCC-11-103A1.pdf

Metric	Source	Definition
Wi-Fi hotspot use	Not available	-
Regular use	Pew Internet (2012)[17]	Percentage of individuals who use the internet. Average of the 30-49 and 50-64 age categories.
Frequent use	Pew Internet (2010)	Percentage of the population who used the internet yesterday
E-commerce	Pew Internet (2012)	"Percentage of internet users who buy a product online" x "Percentage of people who use the internet"
Spectrum index	FCC Fifteenth Mobile Wireless Competition Report[18]	Spectrum usable for mobile wireless services (includes Cellular, SMR, Broadband PCS, AWS-1, 700 MHz, 2.5 GHz, 1.4 and 1.6 GHz and 1910-15/1990-95 MHz bands)
LTE availability	Verizon Wireless (2012)[19]	LTE population coverage
FTTx/DOCSIS 3.0 coverage	Only FTTx available – therefore not included	-
FTTx/DOCSIS 3.0 penetration	Only FTTx available – therefore not included	-

[17] http://www.pewinternet.org/

[18] http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-11-103A1.pdf

[19] http://news.verizonwireless.com/LTE/Overview.html