Working Together to Connect the World by 2020

Reinforcing Connectivity Initiatives for Universal and Affordable Access

A discussion paper to Partners working to Connect the World

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The views expressed in this paper are those of the author and do not necessarily reflect the opinions of ITU or its Membership

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Introduction

ICT technologies present unprecedented opportunities for advancing inclusive growth. Nevertheless, there are still large gaps in connectivity mainly due to the lack of effective policies, corresponding tools and investment. Filling these gaps can help achieve the full potential of these technologies and bring us closer to our overall goal of an inclusive digital society accessible by all. A growing number of governments, international organizations and ICT stakeholders are presenting and advocating initiatives, strategies and programs in relation to connecting the next 1.5 billion people. Such initiatives include: the **UN Broadband Commission for Sustainable Development**; the **World Economic Forum's Future of the Internet**; the outcomes of the **World Summit on the Information Society (WSIS)**; the **U.S. Department of State "Global Connect" initiative**; **Connect the World** from **ONE.org**; the **Alliance for the Affordable Internet** and **Internet.org**; **ITU**'s efforts to connect the world through the **Connect 2020 Agenda**; the GSMA's **Network 2020** initiative; the **World Bank Group's "Broadband for all" initiative**; the **Digital Impact Alliance (DIAL)** from the **UN Foundation** and **UNESCO's** programs on **inclusive education**.

Against this background, the UN Broadband Commission is hosting a Special Session in Davos on 21 January 2016 to facilitate alignment and collaboration among these established initiatives and foster joint investments and promote partnership, as well as help to contribute to maximizing synergies among various efforts to extend the benefits of connectivity worldwide. This discussion paper presents an overview of existing research with the aim of kickstarting a discussion to determine the investments needed to connect the world. Interested partners are invited to bring their expertise and data to join this effort going forward.

This note presents three statements together with supporting evidence and underlying assumptions to initiate the discussion by highlighting some high-level facts in relation to: (1) the impact that broadband may have on the economy generally, (2) the aggregate investment required to connect the next 1.5 billion individuals currently not using the Internet, and (3) the impact that a progressive enabling and regulatory environment has on broadband penetration.

Statement 1: The impact that broadband may have on the economy generally

Based on a significant body of research[1] on the economic impact of broadband, it is generally accepted that broadband has a beneficial impact on economic growth. Moreover, some research suggests that broadband speed matters.

The impact of broadband includes (1) direct effects through large-scale infrastructure investments that lead to increased economic activity in the investment area (e.g. immediate increase in employment[2] and purchase of raw material), (2) indirect- or long-term effects that spur innovation and productivity through e.g. improved broadband speeds, and (3) induced effects such as spill-over into other economic sectors by enabling access to entertainment, education, healthcare, banking services, e-commerce and other.[3] The benefits of faster broadband include economic effects such as increased innovation and productivity, social effects such as better access to services and improved healthcare and environmental effects such as more efficient energy consumption.

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1 See Annex 1 for a list of broadband impact studies.

2 Two employment effects can be distinguished (1) an immediate positive and short-term effect, which stems from infrastructure installation and conrresponding construction jobs, and (2) a long-term negative capital-labour substitution effect, which stems from an adoption of more efficient business processes and subsequent job substitution and thereby direct job losses.

3 See for example Ericsson, Arthur D. Little, Chalmers University of Technology (2013) "Socioeconomic Effects of Broadband Speed".

More than 200 studies have been conducted in the area of broadband impact. These range from

- **macro- and microeconomic studies** that examine the impact of broadband access and broadband speed[4] on GDP, productivity, employment, firm efficiency, and other socioeconomic variables and use econometric models, input/output tables and consumer surplus calculations[5];
- to **broadband investment requirement studies** involving cost-modelling, geographic, demographic and economic data mapping;
- as well as **global connectivity studies** that examine demand-side variables such as content, relevance and affordability.

Studies of the impact of broadband on the economy have generated a number of elasticity estimates for a 10% increase in broadband penetration. These estimates refer to different geographic regions and country clusters. The range proposed by these studies for the impact on GDP of a 10% increase in broadband penetration is 0.25%- 1.38%. For broadband speed, it has been found that a doubling of broadband speeds for an economy can add 0.3% to GDP growth.[6] These different elasticities are set out in Table 1 below. It should be noted that results indicate that the impact on GDP from an increase in penetration and also speed is higher for lower-income countries, as compared with higher income countries. However, results also show that a critical mass of penetration is needed to achieve these positive effects.[7]

Table 1: Elasticities with regards to the impact of broadband penetration and speed on the economy (GDP growth)

Country	Author	Data	Effect
Increase in Broadband penetration			
USA	Crandall et al (2007) – Brookings Institution	48 States of US for the period 2003-2005	No statistically significant results
	Thompson and Gar- bacz (2008) – Ohio University	46 US States during the period 2001-2005	A 10% increase in broad- band pene- tration is associated with a 3.6% in- crease in efficiency
OECD	Czernich et al. (2009) – University of Munich	25 OECD countries between 1996 and 2007	An increase in broadband penetra- tion of 10% raises per-capita GDP growth by 0.9-1.5 per- centage points
	Koutroumpis (2009) – European Investment Bank	2002-2007 for 22 OECD countries	An increase in broad- band penetra- tion of 10% yields 0.25% increase in GDP growth

4 Studies prior to 2010 mainly focus on broadband access, whereas as of 2010, the focus of studies shifts to the impact of broadband speed rather than just access.

5 For an introductory overview, please see ITU Broadband Series (2012) "Impact of Broadband on the Economy" and see also European Commission (2013) "Study on the socio-economic impact of bandwidth" SMART20100033, by Analysys Mason.

6 Bohlin et al (2014), EIB Institute, "The economic impact of broadband speed: Comparing between higher and lower income countries".

7 See Qiang et al (2009), "Economic Impact of Broadband".

Country	Author	Data	Effect
High Income Economies	Qiang et al. (2009) – World Bank	1980-2002 for 66 high income countries	10 % increase in broadband penetration yielded an additional 1.21% in GDP growth
Low & Middle income economies	Qiang et al. (2009) – World Bank	1980-2002 for the remaining 120 countries (low and middle income)	10 % increase in broadband penetration yielded an additional 1.38% in GDP growth
Latin American and Caribbean Countries	Antonio García Zaballos, Rubén López-Rivas (2012)	Time series pool cross section, with data from 26 Latin American and Caribbean countries, analyzed year over year from 2003 to 2009 (wealth model)	10 percent increase in broadband penetration brought about an average increase of 3.19% in per capita GDP
Increase in broadband speeds			
33 OECD countries	Bohlin, Rohman (2012)	33 OECD countries during the period 2008-2010 from OECD database Ookla for broadband speed data	Doubling broadband speed increases GDP growth by 0.3%, depending on the size of the coefficient of broadband speed and on existing economic growth of each country
High-and low income economies	EIB, Bohlin, Rohman (2014)	Lower and higher income OECD countries 2008-2012, World Bank, OECD, Ookla, the Heritage Foundation	An increase in broadband speed leading to an increase in GDP; however, these exact numbers of the coefficients should be interpreted with caution The causality of high speed broadband and economic outputs in all the models shows that the results are robust and that broadband speed does matter

Source: Author, adapted from ITU Broadband Series (2012) "Impact of Broadband on the Economy".

Based on the discussion set out above, we can make the following aggregate statement:

> STATEMENT 1: A 10% increase in broadband penetration is likely to have a positive impact, and could raise economic growth by between 0.25%- 1.4%. If broadband speed is doubled, GDP may increase, potentially by up to 0.3%.

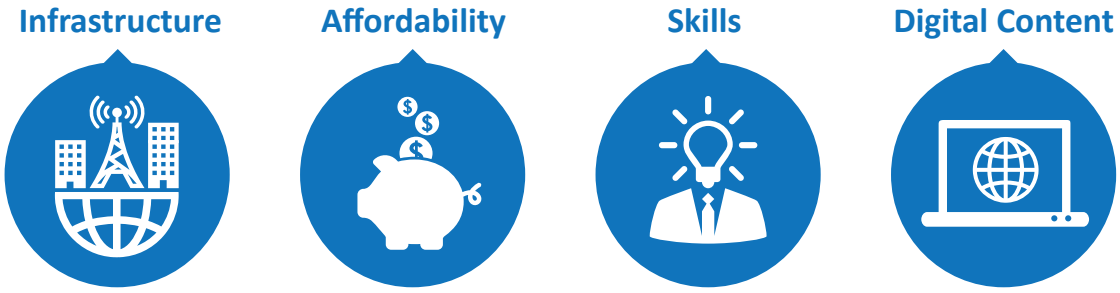
Statement 2: The aggregate investment required to connect the next 1.5 billion people

Given the well-researched beneficial impact of broadband on the economy and society at large and the associated development goals and connectivity targets set by the international community, it is helpful to know roughly how much in terms of investment is required to achieve the connection of

the next 1.5 billion individuals currently not using the Internet to develop a better understanding of the magnitude of the task at hand.

In order to undertake this exercise, we need to firstly understand the following question: Why are people not connected? Existing research[8] has identified four key reasons of why people are not connected, which are lack of infrastructure (the lack of sufficient physical infrastructure to allow meaningful access), the lack of affordability (the cost of Internet access is still too high for the majority of the unconnected), lack of skills (Internet unawareness, absence of e-literacy / digital skills), and lack of digital content (no relevant content / language).

Figure 1: Key focus areas for connecting individuals not using the Internet



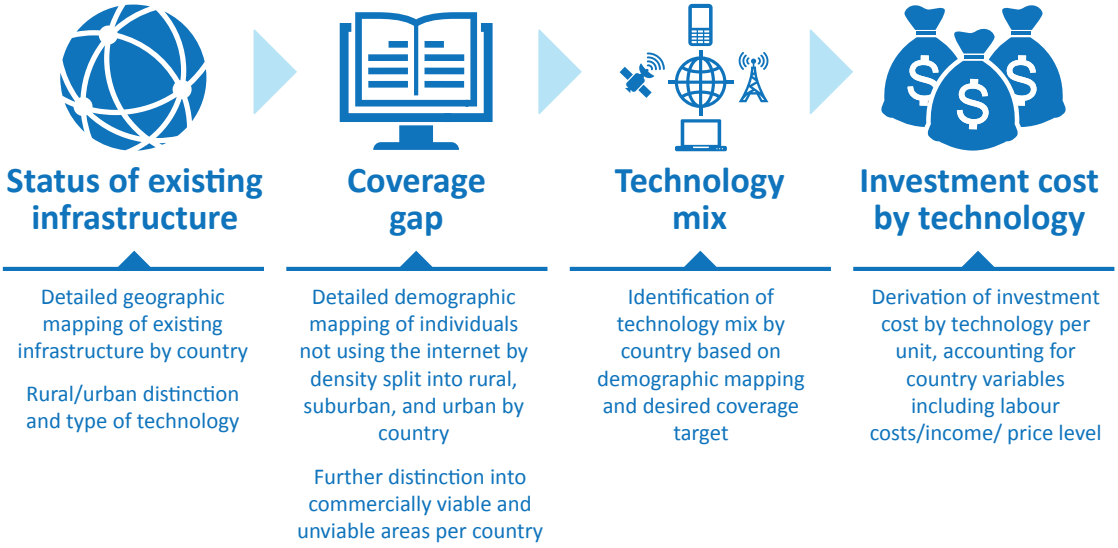
Source: Author

Given that without infrastructure there won't be any Internet at all, this discussion paper focuses on **infrastructure investment** and conjures up a **rough and high-level estimate** of infrastructure investment required to connect the next 1.5 billion individuals currently not using the Internet. This discussion paper is not an in-depth exercise that relies on a sophisticated model, but overviews existing research and presents an initial high-level investment quantification with the aim of kickstarting a discussion and providing the impetus to determine investment needs going forward. We would be willing to work with different partners to bring different insights and expertise to the table to inform a future more in-depths analysis.

There are a number of approaches to estimating investment costs required. The cost basis may differ depending on the types of technologies deployed in any given geographic area. Costs can thus be based on different denominators, including: number of subscribers, homes passed, households, catchment areas / isochrones and other. While for example an estimate for mobile or satellite technology investment would be more meaningful on a per subscriber basis or based on a catchment area per base station/satellite, calculating fiber connectivity investment needs may be more meaningful on a homes passed or per household basis. It should be noted that a number of different technologies are likely used in any given geographic area to provide connectivity. Thus, a combination of different cost bases may have to be used. Figure 2 below shows a theoretical framework to determine total infrastructure investment needs for different technology mixes.

[8] See for example "State of Connectivity: 2014 – A Report on Global Internet Access" by Internet.org http://newsroom.fb.com/news/2015/02/the-state-of-global-connectivity/, or Internet Society "Global Internet Report" 2014 and 2015 https://www.internetsociety.org/sites/default/files/Global_Internet_Report_2014.pdf , http://www.internetsociety.org/globalinternetreport/

Figure 2: Theoretical framework to determine total infrastructure investment needs



Source: author

There is a significant body of research, particularly in the European Union and the US, but also at national and regional level in connection with National Broadband Plans, of investment requirements to achieve different levels of broadband access based on different technology mixes and desired coverage levels.[9] Most of the variables as set out in Figure 2 have been examined in parts and different regional or national contexts given the mostly national and at the widest regional nature of broadband plans and policies. Moreover, there has also been work performed in relation to the degree of public intervention to foster certain connectivity targets.[10] The key findings of investment needs of a sample of studies are summarized in Table 2 below:

Table 2: Key findings of investment needs

Country / Region	Technology and coverage target	Investment Required	Author / Type of Study
Europe, 2013	100% NGA by 2020 (>= 30 Mbps)	€ 82 billion (€52 billion rural (14%), €22 billion semi-rural and €8 billion urban) € 2,000 per HH rural, € 150 per HH urban	Point Topic
Europe	NGA, Digital Agenda	€ 180-€ 270 billion	European Commission
Europe, 2012	FTTH, Digital Agenda Target 2	€ 202 billion	FTTH Council

9 See Point Topic 2013 "Europe's superfast broadband investment needs" at http://point-topic.com/wp-content/uploads/2013/05/Point-Topic-Europes-superfast-broadband-investment-needs-20130520-1.2.pdf, or Koutroumpis 2013 for the European Parliament http://www.europarl.europa.eu/stoa/webdav/site/cms/shared/2_events/workshops/2013/20130926/Pantelis%20Koutroumpis.pdf, or WIK's 2012 "Ausbau und Finanzierung von Breitbandhochleistungsnetzen", http://www.bmwi.de/BMWi/Redaktion/PDF/Publikationen/Studien/studien-ausbau-und-finanzierung-von-breitbandhochleistungsnetzen,property=pdf,bereich=bmwi2012,sprache=de,rwb=true.pdf , Broadband Commission's Broadband Report 2014 at http://www.broadbandcommission.org/documents/reports/bb-annualreport2014.pdf

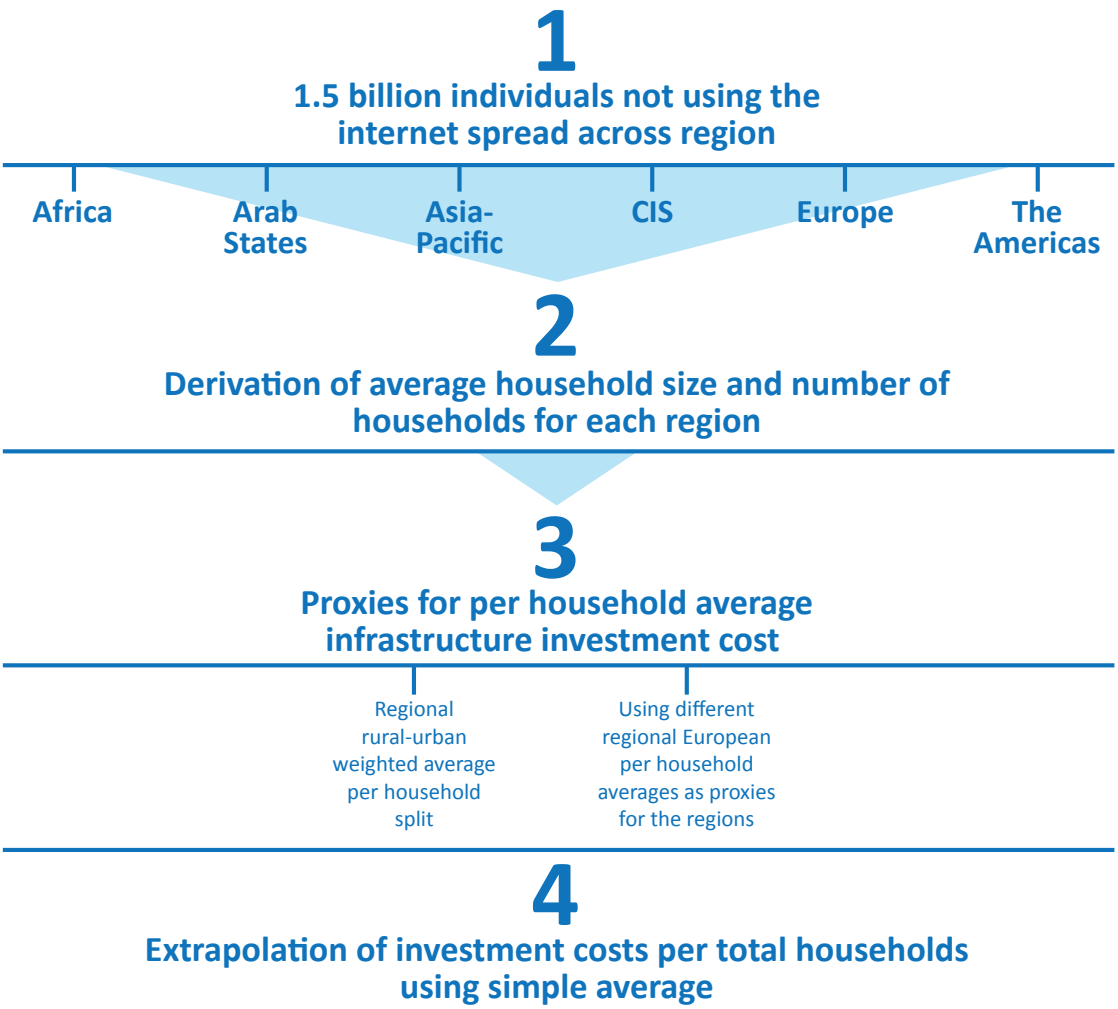
10 See for example a study by Analysys Mason for the European Commission "Study on the socioeconomic impact of bandwidth" at https://ec.europa.eu/digital-agenda/en/news/study-socio-economic-impact-bandwidth-smart-20100033

Country / Region	Technology and coverage target	Investment Required	Author / Type of Study
Europe	Digital Agenda Target 2, excluding WiMAX and Satellite	€ 73-221 billion (or € 517-707 per HH)	Koutroumpis for EIB
MENA, 2014	FTTC and LTE at 10 Mbps 100%, 30 Mbps 50%- backbone, backhaul and international connectivity	US$ 28-35 billion	World Bank
Latin America and Caribbean	NGN	US$ 355 billion	AHCIET
Africa, 2007		US$ 57 billion	GSMA
24 African countries 2008-2015	Universal Voice and broadband services	US$ 5.8 billion for voice coverage US$ 6 billion for broadband coverage US$ 1.8 billion for intercontinental connectivity (Sub-Saharan countries) US$ 229-515 million for intraregional connectivity (Sub-Saharan countries)	World Bank "Costing the Needs for Investment in ICT Infrastructure in Africa"
UK, 2010	Wireless and Satellite	Scenario A GBP500 / home Scenario B GBP2800 / home Scenario C GBP5800 / home	Analysys Mason
Europe, 2012	Satellite	€250-€350 million per satellite (1 satellite connecting 1 million subscribers)	European Commission, Eutelsat, SES Broadband Services, Skylogic

Source: Author

Given the cross-regional scope of the exercise at hand, the initial methodology used is highly simplified based on 1.5 billion individuals currently not using the Internet, identified pro-rata based on current total population and their proportional regional spread. The simplified initial methodology is shown in Figure 3 below.

Figure 3: Initial methodology



Source: Author

Following the initial methodology as set out in Figure 3 above, Table 3 shows the number of individuals not using the Internet and and their regional spread, number of households contained within each region and the corresponding investment costs per total households by region:

Table 3: Spread of 1.5 billion individuals, households by region and investment costs per total households (in millions)

Region	Individuals not using the Internet (millions)	Number of households per region (millions)	Investment costs per total households (millions)
Africa	267.59	53.00	62207.04
Arab States	86.87	17.40	14122.80
Asia & Pacific	932.20	288.81	313689.07
CIS	41.14	15.64	14336.81
Europe	50.90	21.16	17877.10
The Americas	121.30	34.42	25658.45
Total	1500.00	430.43	447891.26

Source: Author

Based on Table 3, the following statement can be populated:

STATEMENT 2: If we invest US$ 450 billion globally, we can connect the next 1.5 billion people

For a detailed description of the initial methodology and data used, please refer to Annex I.

Statement 3: the impact that a progressive regulatory environment on average has on broadband penetration

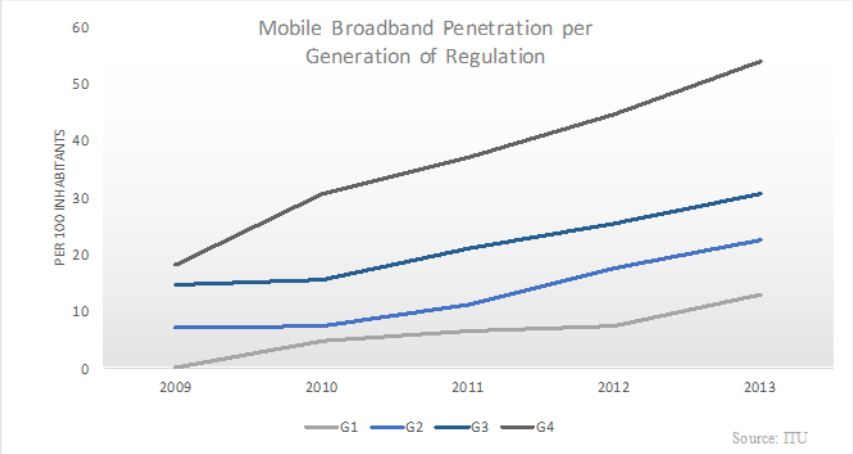
There are a number of factors that drive the uptake of ICTs. One factor that has been identified as key in this process is the regulatory environment. The right regulatory environment can ensure that consumers can use the full palette of new opportunities and services brought about by the greater choice of devices, online services and applications, by creating the right framework for consumer protection, investment and innovation. Regulators around the world have endorsed a set of best practice guidelines[11] to protect consumer interests while also ensuring a level-playing field for traditional and new market players by fostering a light-touch regulatory approach.

There has been significant qualitative and quantitative research into the impact that the regulatory environment has on variables such as fixed and mobile broadband uptake.[12] The relationship is illustrated in Figure 4 below for mobile broadband.

[11] See: GSR 14 Best Practice Guidelines on consumer protection in a digital world- http://www.itu.int/en/ITU-D/Conferences/GSR/Documents/GSR14_BPG_final_en.pdf

[12] The Regulatory and Markets Environment Division of ITU / BDT has been studying the impact using ITU Regulatory Tracker.

Figure 4: Better regulation is associated with faster growth in mobile broadband - Evolution of mobile broadband penetration, by generation of regulation, 2009-2013



The magnitude of the impact depends on the progress a country makes in relation to its regulatory environment.[13] This magnitude has been quantified by ITU for both fixed and mobile-cellular broadband penetration using a panel regression model.[14] The model shows that a 10% increase in a country's regulatory score is associated with a 7.7% increase on average in fixed-broadband penetration and a 2.3% increase on average in mobile-cellular penetration.[15] Moreover, joint research by ITU, the Broadband Commission and Cisco in 2013 has found that the introduction or adoption of a broadband plan is associated with 2.5% higher fixed broadband penetration, and 7.4% higher mobile broadband penetration on average.[16] [17] Based on the above, we can make the following general statement:

STATEMENT 3: A more advanced regulatory environment is on average associated with a higher mobile and fixed broadband penetration.

[13] ITU Regulatory Tracker categorizes the regulatory environment into four main clusters, including: (1) Regulatory authority, (2) Regulatory mandate, (3) Regulatory regime, and (4) Competition framework. Each cluster comprises a set of different indicators and corresponding maximum scores that can be achieved per indicator and cluster, depending on the type of regulatory tool/measure/enabler/policy in place and associated progress. Based on these scores, countries fall into different regulatory generations, of which there are four. For example, a country that has a Tracker score of >= 85 points falls into the most advanced category of fourth-generation. For a detailed description of the ITU Regulatory Tracker, please visit https://www.itu.int/en/ITU-D/Regulatory-Market/tracker/Pages/default.aspx

[14] A **regression model** is a statistical measure that attempts to determine the strength of the relationship between one dependent variable (usually denoted by Y) and a series of other changing variables (known as independent variables). **Panel data** refers to multi-dimensional data frequently involving measurements over time. Panel data contain observations of multiple phenomena obtained over multiple time periods for the same firms or individuals. For further elaboration on the model used, see Annex 2 of Chapter 1 of "Trends in Telecommunication Reform 2015", ITU 2015.

[15] For a detailed presentation of the model, please refer to Chapter 1, pp. 13-19 in Trends in Telecommunications Reform 2015: Getting ready for the digital economy, 15th edition of Trends in Telecommunication Reform https://www.itu.int/pub/D-PREF-TTR/en and http://www.itu.int/en/publications/Documents/Trends2015-short-version_pass-e374681.pdf

[16] For the impact of National Broadband Plans on broadband penetration, see ITU, Broadband Commission and Cisco.2013. Planning for Progress: Why National Broadband Plans Matter, 2013 http://www.broadbandcommission.org/publications/Pages/planning-for-progress.aspx

[17] The analysis was conducted using panel regressions of up to 165 countries based on data for a ten-year period from 2001-2011. For a detailed description of the models' outputs and variables used and assumptions made, please refer to pp. 39-41 of Planning for Progress: Why National Broadband Plans Matter, 2013.

Annex I

This annex sets out the initial methodology and data used to derive the second statement.

Initial methodology and data sources for Statement II

The initial methodology used to derive Statement II is highly simplified and is based on 1.5 billion individuals not using the Internet and their proportional regional spread.

In a first step, the **total individuals not using the Internet** have been calculated, using the inverse of "Percentage of Individuals using the Internet" based on total population as provided by ITU statistics, which can be found at https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx . The regional proportions of the individuals not using the Internet were applied across a population of 1.5 billion, which generated the regional split of the individuals not using the Internet. The regions are ITU regions available at https://www.itu.int/en/ITU-D/Statistics/Pages/definitions/regions.aspx .

In a second step, the **average household size**[18] per region was derived by constructing simple averages from a subset of countries for each ITU region. The average household size was subsequently used to derive the number of households not using the Internet per region. The total number of households not using the Internet serves as the basis to calculate the investment cost per total households.

In a third step, **regional rural and urban population percentages** by country were used from United Nations, Department of Economic and Social Affairs, Population Division (2014) to introduce a degree of regional variation.

In a fourth step, the **investment estimates** were prepared, using as the basis European household estimates sourced from two different sources as described below. This generated a higher and a lower total per household estimate. These were subsequently averaged, given that the second lower set of estimates from Koutroumpis exclude WiMAX and Satellite technologies, which are likely technologies for providing coverage in uneconomical areas across e.g. Africa, the Arab States and the Americas.

- The first estimates for rural and urban investment requirements were sourced from **Point Topic**[19], who derived an estimate per household of €150 for urban areas and an estimate of €2000 per household for rural areas. These estimates were generated for Europe and are based on fulfilling the Digital Agenda Targets of 100% NGA access by 2020. The significant difference between urban and rural is explained in that rural areas are often uneconomical and require completely new infrastructure roll-out (coverage), whereas urban areas mainly require investment into further capacity rather than coverage.
- The second estimates were sourced from **Koutroumpis**[20], who generated 5 different per household estimates for each of the key European regions (Baltics, Eastern Europe, Southern Europe, Western Europe, and the Nordics), based on labour costs and demographics. These estimates refer to all three Digital Agenda Targets for a subset of technologies, **excluding WiMAX and Satellite**.

In a fifth step, the **Point Topic estimates** were used as a **rural-urban weighted average per region** using average regional rural-urban population statistics.

In a sixth step, the **Koutroumpis rural-urban average estimates** were used as proxies for the different regions, using the lowest estimate of **€517**per household for Africa, the Arab States and Asia-Pacific, the Eastern European estimate of **€665** per household for the CIS region, the Southern European

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18 This has been sourced from http://www.nakono.com/tekcarta/databank/full/16/

19 See Point Topic 2013 "Europe's superfast broadband investment needs" at http://point-topic.com/wp-content/uploads/2013/05/Point-Topic-Europes-superfast-broadband-investment-needs-20130520-1.2.pdf

20 Koutroumpis 2013 for the European Parliament http://www.europarl.europa.eu/stoa/webdav/site/cms/shared/2_events/workshops/2013/20130926/Pantelis%20Koutroumpis.pdf

estimate of **€613** per household for The Americas region and a **weighted average** of the 5 different estimates of **€635**[21] per household for Europe.

In a seventh step, a **simple average** was calculated of the two estimates derived to arrive at the **final investment cost per total households**.

Key variables

Table I.1 shows the 1.5 billion individuals not using the Internet by region:

Table I.1: 1.5 billion individuals not using the Internet by region

Region (Note)	Total unconnected (millions)	Percent of unconnected by region	Distribution of 1.5 billion unconnected by region (millions)	Number of Households per region (millions)
Africa	738.58	17.84%	267.59	53.00
Arab States	239.77	5.79%	86.87	17.40
Asia & Pacific	2'572.98	62.15%	932.20	288.81
CIS	113.55	2.74%	41.14	15.64
Europe	140.50	3.39%	50.90	21.16
The Americas	334.81	8.09%	121.30	34.42
Total	4'140.18	100.00%	1500.00	430.43

NOTE – ITU Regions, see https://www.itu.int/en/ITU-D/Statistics/Pages/definitions/regions.aspx

Source: ITU Statistics, https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx

Table I.2 shows average household size by region

Table I.2: Average household size used

Region	Average Household Size
Africa	5.05
Arab States	4.99
Asia & Pacific	3.23
CIS	2.63
Europe	2.41
The Americas	3.52

Source: Author, sourced from http://www.nakono.com/tekcarta/databank/full/16/

The percentage split for rural and urban population by region is shown in Table I.3 as follows:

[21] The following percentages were applied to generate the weigted European average: Baltic States 1%, Nordics 5%, Western Europe 53%, Eastern Europe 18%, Southern Europe 23%.

Table I.3: Percentage split of urban and rural population by region

Region	Rural population	Urban population
Africa	60%	40%
Arab States	30%	70%
Asia & Pacific	52%	48%
CIS	31%	69%
Europe	26%	74%
The Americas	20%	80%

Source: Author, based on rural-urban population statistics from United Nations, Department of Economic and Social Affairs, Population Division (2014) and ITU regions.

Table I.4 shows the investment cost estimates used.

Table I.4: Investment estimates used

Source	Description
Point Topic 2013	€ 2,000 per household rural, € 150 per household urban to provide 100% NGA coverage at >= 30Mbps
Koutroumpis 2013	Baltics € 517.7 per household, Eastern Europe € 665.9 per household, Southern Europe € 613.4 per household, Western Europe € 630.4 per household, Nordics € 707.8, fulfilling all Digital Agenda Targets for residential broadband access only, based on a subset of technologies excluding WiMAX and Satellite, covering rural, suburban and urban areas

Source: Author, Point Topic and Koutroumpis

Key variables used

The key variables that are used to derive total investment cost are set out below:

- Individuals not using the Internet by region
- Number of 1.5 billion individuals not using the internet by region
- Average number of households per region
- Average household size by region
- Average rural and urban population statistics by region
- Average per household cost of infrastructure investment for Europe as proxies for different regions
- Rural-urban weighted average per household cost of investment

Key assumptions made

The assumptions are crude and high level. The following should be noted:

- The inverse of Individuals using the Internet based on total population in 2015 is used to derive individuals not using the Internet. Using this definition will overestimate the number of people not using the Internet, as it is based on total population including children and the elderly.
- Regional distribution of the next 1.5 billion individuals not using the Internet are derived from the regional spread of the individuals not using the Internet based on total population.

- The regional average size of households is a simple average of per country average size of households.
- The rural and urban population proportions per country are averaged across the regions; there is no distinction into semi-rural areas.
- The only regional differentiations that are filtered into the cost estimates are made using (1) estimates for different intra-European regions as proxies, which are differentiated by demography and labour costs[22], and (2) using the regional averages of rural-urban population statistics[23].
- The technology mix is the same for all regions based on the European proxies used that are based on the 3 European Commission Digital Agenda Targets (see Table I.6 for a description)[24].
- Through the use of Point Topic and Koutroumpis estimates, the exercise is constrained by the assumptions that determine those estimates. Thus, the derived investment estimates will be higher for regions with lower income and price levels and possibly lower for regions with higher income / price levels.
- The calculation does not include a time horizon, but only reflects how much investment is roughly required to connect the next 1.5 billion of individuals not using the Internet.

[22] Koutroumpis 2013 for the European Parliament http://www.europarl.europa.eu/stoa/webdav/site/cms/shared/2_events/workshops/2013/20130926/Pantelis%20Koutroumpis.pdf

[23] Source: United Nations, Department of Economic and Social Affairs, Population Division (2014). World Urbanization Prospects: The 2014.

[24] Koutroumpis 2013 for the European Parliament http://www.europarl.europa.eu/stoa/webdav/site/cms/shared/2_events/workshops/2013/20130926/Pantelis%20Koutroumpis.pdf and See Point Topic 2013 "Europe's superfast broadband investment needs" at http://point-topic.com/wp-content/uploads/2013/05/Point-Topic-Europes-superfast-broadband-investment-needs-20130520-1.2.pdf

Main output variables

Table I.5: Output Table in US$[25]

Region	Individuals not using the Internet (millions)	Number of households per region (millions)	Total investment costs 1* (millions)	Total investment costs 2** (millions)	Total investment costs 3*** (millions)
Africa	267.59	53.00	88063.72	36350.36	62207.04
Arab States	86.87	17.40	16313.07	11932.53	14122.80
Asia & Pacific	932.20	288.81	429304.70	198073.44	313689.07
CIS	41.14	15.64	14857.58	13816.04	14336.81
Europe	50.90	21.16	17916.06	17838.12	17877.10
The Americas	121.30	34.42	23315.49	28001.41	25658.45
Total	1500.00	53.00	589770.62	306011.91	447891.26

Source: Author

*This estimate is a weighted rural-urban average **per region** using average regional rural-urban population statistics based on Point Topic.

**This estimate uses different European regional estimates from Koutroumpis as proxies for the different regions.

***This estimate is the simple average of investment cost estimates 1 and 2.

Table I.6 provides a description of the European Commission's Digital Agenda Broadband Targets by broadband category, access speed and enabling technologies. The table is added to provide insight into the technology mix, that the estimates from Koutroumpis and Point Topic are based on.

[25] Converted from € based on the 10-year average exchange rate of US$1.32 for the period 2006-2015.

Table I.6: European Commission's Digital Agenda Broadband Targets

Digital Agenda Broadband Targets	Broadband category	Access Speed	Enabling Technologies
Target I: Basic Broadband for all by 2013	Basic Broadband	150 kbps – 30 Mbps	Copper (ADSL2, VDSL1, SDSLS), Cable (EuroDOCSIS 1.1/2), Mobile (EDGE, 3G, HSPA), Wireless (WiMax), Satellite
Target II: High or very High access speed for all by 2020 (>=30 Mbps)	High Speed Very High Speed	30 Mbps – 50 Mbps 50 Mbps – 100 Mbps	Copper (VDSL2), Mobile (HSPA+, LTE) FTTH (GPON, PtP), Mobile (LTE advanced)
Target III: 50% or more of EU households subscribe to Internet access above 100 Mbps by 2020	Ultra High Speed	100 Mbps – 1 Gbps	FTTH (NGA1, NGA2, PtP), Cable (EuroDOCSIS 3)

Source: Koutroumpis

Annex II

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