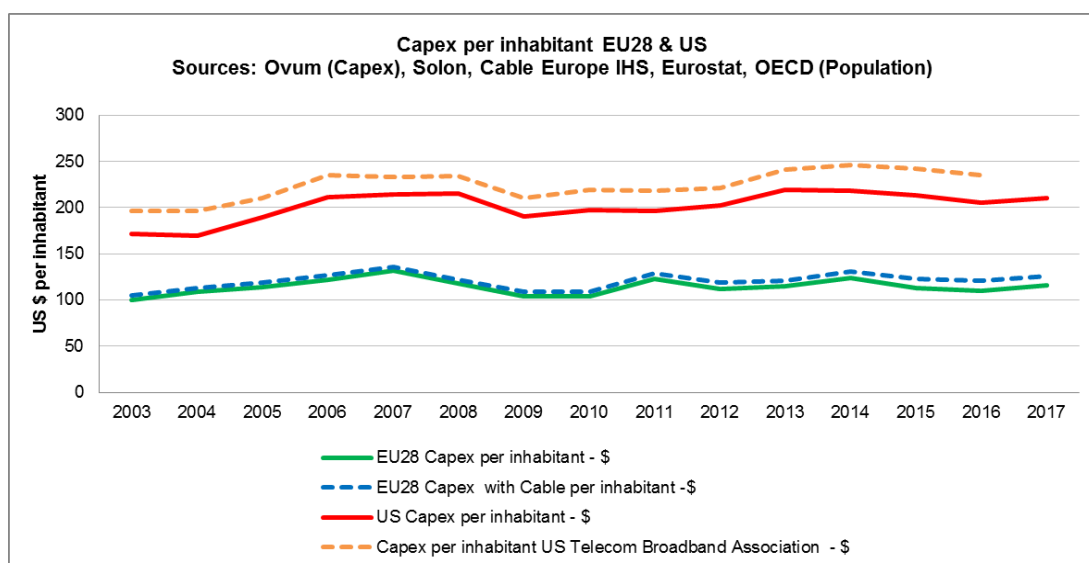


Investments in telecommunications services higher in the United States than in the European Union: a robust and enduring gap

Main findings

The aim of this paper is to draw an EU-US comparison in terms of level and intensity of investment by the sector of telecommunication services over 2003-2017.

- *There is a persistent investment intensity gap in favour of the US, which increased during 2003-2013 and tended to stabilize in the most recent period (2013-2017). Investment intensity in the US was 1.8 the level of the EU in 2010 and 1.6 in 2017¹.*
- *The United-States remain leaders in both investment levels and intensity measured by investment per inhabitant: investment in the EU is in the range of 120 / 127 USD per inhabitant in the most recent years, and of 200 / 211 USD per inhabitant in the US.*
- *After a notable increase, (+3.6% over 2009-2013), the investment intensity in the US declined (-2.2% over 2013-2016), before increasing again in 2017.*
- *While the debate leading to the adoption of the Open Internet Order by the FCC cannot be directly linked to the decrease in the investment intensity of US network operators, its influence on their investment plans cannot be dismissed.*



¹ Measures of investment in intensity are based on Capital Expenditures (CAPEX) of private operators.

Contents

Introduction	3
1 .EU and US CAPEX in telecommunications services can be derived from the industry sources	4
1.1. The US telecommunications CAPEX: analysis from industry sources	4
1.2. The EU telecommunications CAPEX: analysis from industry sources	5
<i>Inclusion of cable companies in the European CAPEX statistics</i>	<i>5</i>
2.Capex per inhabitant have stayed constantly larger in the US than in the EU since 2003	7
2.1. EU & US CAPEX per inhabitant in telecommunications services from the industry sources.....	7
2.2. Comparison of telecom services CAPEX per inhabitant in the EU28 and the US.....	8
<i>Conclusion on a comparison based on aggregate CAPEX by continent</i>	<i>10</i>
Conclusion.....	11
1. Methodological elements	12
1.1. The sector perimeter: broadcasting and audio-visual content diffusion	12
1.2. The wholesale market: the access to legacy infrastructure.....	12
2. Investments of the US telecommunications services from the national accounts.....	12

Introduction

Investment is the main driver of productivity and economic growth. Investments of the digital industries, and notably of telecommunications, incorporate the technological progress that is displayed in other industries of the economy which adopt digital assets and services. Telecommunications assets are not just regular intermediate consumption good amongst others for industries and services, as they induce structural process changes when adopted.

Investment of telecommunication industries supports the deployment of infrastructures and services on which the whole digital ecosystem is built. The investment dynamics of the telecommunications are crucial to the development of the digital ecosystem, hence to the efficiency and competitiveness of adopting industries. The intensity of telecommunications investment in a given area is a relevant indicator of the expected technological evolutions of the whole digital ecosystem, especially when investments are measured at a country level or at a continental scale.

This note proposes: (1) An analysis of investment based on sources from telecommunications industry, that measure investment by capital expenditures (CAPEX) from the telecommunications and cable operators; (2) Drawing a comparison of investment intensity ratios between the European Union and the United States. The Appendix discusses the limitations that can potentially affect the indicators of investment, and presents the US investments measured by the Gross Fixed Capital Formation of the telecommunications services sector, on the basis of the US national accounts.

1. EU and US CAPEX in telecommunications services can be derived from the industry sources

This section analyses the US and EU levels of investment in telecommunications services on the basis of industry sources. The investment is measured by the level of capital expenditures (CAPEX) of network operators. The available sources allow analysing the US and EU CAPEX from 2003 to 2017.

The sources from the telecommunications industry provide private operators' CAPEX ("Capital Expenditures" or fixed capital expenditures) aggregated by country and by regions or continents. The CAPEX of private operators include expenditures in tangible assets (equipment, materials and machinery) and intangible assets (software, patents, brand or databases). Fixed capital expenditures of government agencies are only partly taken into account, when they are included in companies' financial accounts as part of a Public-Private-Partnership (PPP). These sources do not include the acquisition of licenses for the use of frequencies. The main sources are from OVUM (2017)². CAPEX not reported to Ovum in US\$ are calculated using average quarterly exchange rates.

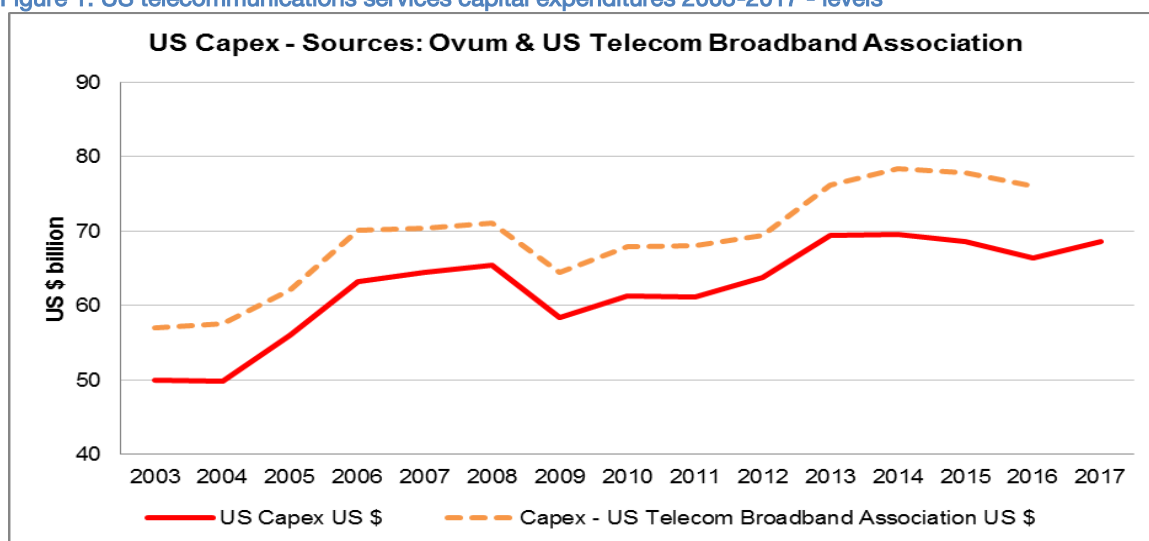
1.1. The US telecommunications CAPEX: analysis from industry sources

The available data for capital expenditures of the United States telecommunications operators and cable operators do not raise particular measurement issues. All cable operators are indeed included in the calculations of CAPEX, and there is no uncertainty related to the geographical perimeter. However, we have to consider the possible inclusion of investment in original content production by cable operators in the measured expenditures in private fixed assets. The evolution of US aggregate capital expenditures in telecommunications services (from telecommunications operators & cable operators) from reliable industry sources are reported in table 1, over the period 2003-2017, and in Figure 1, which shows the trend of Capex levels from both sources.

Table 1: US telecommunications services capital expenditures 2003-2017 - levels

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
US - Capex Ovum billions \$	50	50	56	63	64	65	58	61	61	64	69	70	69	66	69
US - Capex US Broadband Association billions \$	57	58	62	70	70	71	65	68	68	69	76	78	78	76	

Figure 1: US telecommunications services capital expenditures 2003-2017 - levels



Sources: Ovum, US Telecom and Broadband association

² The main files for data sources from OVUM are extracted from: "Communication Service Provider Revenue and Capex Tracker: Q42017", published in April 2018.

The investments from the US network operators - telecommunications operators and cable operators have increased at a 2.3% annual average rate over 2003-2017. After the 2009 low and during 2009-2013, US Capex exhibit a stronger increasing trend (4.4% a year), however since 2013 the US CAPEX dynamic has weakened (-0.3% a year between 2013 and 2017). The CAPEX data from OVUM are smaller than the CAPEX data provided by the US Telecom - Broadband Association (which is established from the Associations' internal sources) however they follow similar patterns and trends as well. These data sources take into account all the cable operators and include all non-financial fixed assets. The CAPEX levels measured by OVUM and by the US Telecom-Broadband Association include tangible assets ("*property, plant and equipment*") and intangible assets (including capitalized software and capitalized interest during construction³). Both OVUM and the US Telecom-Broadband Association sources exclude satellite providers, telecommunications resellers, and electric utilities (the local infrastructure providers issued from the 1996 Telecom Act). This information confirms that the measure of aggregate fixed capital investment of US operators is not subject to any bias that could raise significant inaccuracy issues, except for the possible inclusion of investment in original content. Both industry sources evidence a decline in the levels of CAPEX in the recent period: from USD 70 to USD 66 billion over 2014-2016 according to data from OVUM and from USD 78 to USD 76 billion over 2014-2016 according to the US Telecom-Broadband Association IHS).

1.2. The EU telecommunications CAPEX: analysis from industry sources

Unlike in the United States, the measurement of CAPEX levels and Capex per inhabitant for the European telecommunications industry is affected by a potential⁶ error concerning the coverage of cable operators in the European footprint. A base-case path for CAPEX per inhabitant is defined on statistical data from OVUM, and an upper bound is built on the basis of this base-case line, which is then expressed in terms of CAPEX per inhabitant. The base-case CAPEX trajectory for the European Union (the green curve in Figure 3), which is drawn from the OVUM data for CAPEX of the European Union (EU28), is subject to a bias relating to an incomplete inclusion of European cable operators. This bias can be addressed because economic information for the CAPEX from cable operators which might have been omitted in the Ovum base-case CAPEX series are available from the European cable industry sources, Cable-Europe HIS and Solon survey.

Inclusion of cable companies in the European CAPEX statistics

A potential measurement approximation stems from cable operators' coverage, about which OVUM sources files are unclear⁴. We consider that the CAPEX series for the EU-28 are biased downwards due to incomplete cable coverage. We propose to estimate what would be the EU-28 CAPEX aggregate if all cable operators were included in the original OVUM sample: we assume that the base-case CAPEX do not include any cable operators, and then we calculate the maximum gap (*the maximum error that we would commit if OVUM had not taken into account any cable operator in the original sample*). We find that if OVUM had not included any cable operators in its sample for EU-28 aggregate CAPEX calculation, it would have underestimated EU-28 CAPEX by \$4.3billion in 2013

³ <http://www.ustelecom.org/broadband-industry-stats/investment/historical-broadband-provider-capex/methodology>. Data from US Telecom are as follows: «We analysed capital expenditure data for wireline telecommunications, wireless telecommunications, and cable broadband providers in order to approximate industry aggregates. Other providers, such as satellite providers, telecommunications resellers, and electric utilities are excluded. The majority of telecommunications data were taken from company financial statements, taking into account business segment reporting, mergers, and spin-offs. Our analysis is subject to the reporting practices of individual companies. Capital expenditures may include investment in property, plant, and equipment, capitalized software, capitalized interest during construction, corporate, directory, and other capital expenditures, and intra-company eliminations. We made reasonable efforts to eliminate double-counting, non-U.S. investment, and non-capital spending. We made estimates for non-reporting companies». Other sources are considered: «United States Census Annual Capital Expenditures Survey», «Yankee Group Global Capex Forecast 2010», «Skyline Marketing Capex Report 2010», «Cellular Telecommunications & Internet Association (CTIA)», «New Paradigm Resources Group», «Association for Local Telecommunications Services (ALTS)».

⁴ In one source file, OVUM indicates that it does only include cable operators that are large enough (those that are "of significant size") in the regions other than North America, while in the other source file it indicates that cable operators are only included for North America.

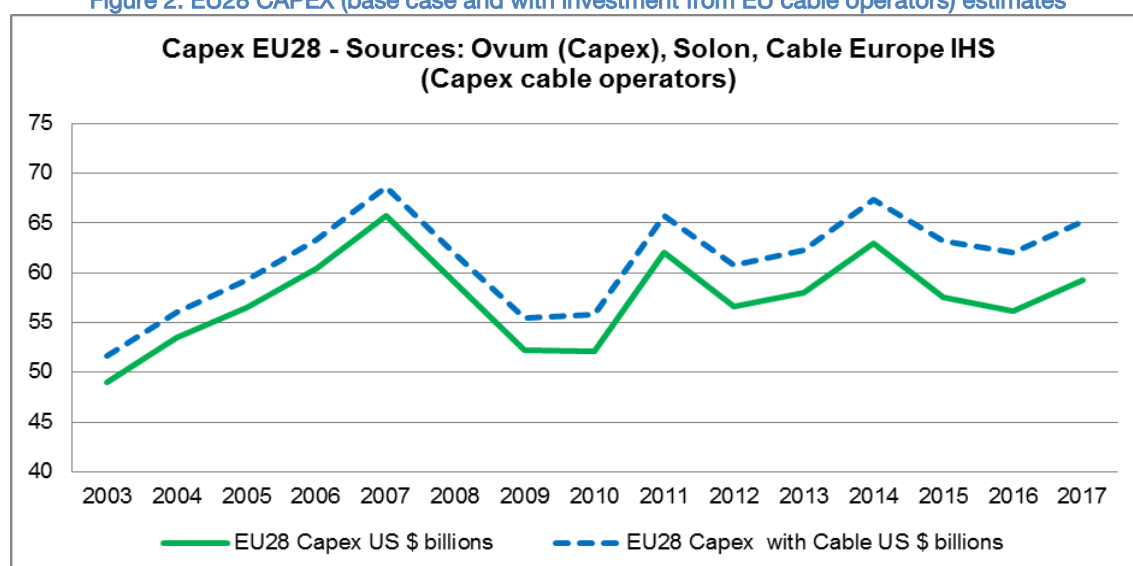
and \$5.9 billion in 2017, as shown in the Table 1, which reports the estimate of the upper Capex curve based on estimations of revenues and capital expenditures from the European cable operators. The upper curve is derived from an estimation of European cable operators' capital expenditures based on their annual revenues and the CAPEX on revenues ratio, provided by industry sources Cable Europe IHS and Solon survey. The upper curve is simply the sum of the cable operators' CAPEX per inhabitant and of the base-case CAPEX per inhabitant. This upper bound is represented by the dashed blue line in the Figure 2, where the green curve represents the base-case CAPEX.

Table 2: EU28 Cable industry revenues and CAPEX in levels and per inhabitant estimates

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
European Cable Revenue IHS € billions	12,0	12,8	13,8	14,7	15,8	16,8	18,0	19,7	20,7	21,8	22,7	23,6	25,0	26,0	26,8
European Cable Capex IHS - Solon € billions	3,0	3,2	3,4	3,7	3,9	4,2	4,5	4,9	5,2	5,5	5,7	5,9	6,3	6,5	6,7
European Cable Revenue IHS \$ billions	10,6	10,3	11,1	11,7	11,5	11,5	12,9	14,9	14,9	17,0	17,1	17,7	22,5	23,5	23,7
European Cable Capex IHS - Solon \$ billions	2,7	2,6	2,8	2,9	2,9	2,9	3,2	3,7	3,7	4,2	4,3	4,4	5,6	5,9	5,9
European Capex base-case - \$ billions	49,0	53,5	56,5	60,4	65,8	59,1	52,3	52,1	62,0	56,6	58,0	62,9	57,5	56,2	59,2
European Capex with cable - \$ billions	51,6	56,1	59,2	63,4	68,6	62,0	55,5	55,8	65,8	60,8	62,3	67,4	63,2	62,1	65,2

Sources: Cable-Europe IHS, Solon Survey, OVUM

Figure 2: EU28 CAPEX (base case and with investment from EU cable operators) estimates



To derive our EU-28 CAPEX estimates, we use the revenues of European cable operators from the most recent report from Cable Europe & IHS "European Broadband Cable 2017". By applying the capital intensity ratios (CAPEX/Revenue) from the Solon survey of European cable communications⁵ to the estimated European cable Revenues, we obtain the estimated CAPEX of European cable operators in the retail Broadband market (€5.7 Billion and €6.7 Billion in 2013 and 2017). Our calculation consists in multiplying the CAPEX/Revenue ratios (25% on average) to the Revenues of European cable operators provided by the Solon survey in order to obtain the evolution of their capital expenditures on the retail Broadband market. After the 2009 macroeconomic downturn, the European CAPEX has been increasing at 8% annual rate until 2017 (3.3% a year between 2003 and 2009), and has followed a sustained increasing trend after 2013 (8.6% from 2013 to 2017). In addition, the ETNO 2017 annual report indicates that the capital expenditures (in tangible fixed assets) of the European telecommunications operators have been increasing at a 2.6% annual average rate from 2010 to 2016, (from €40.5 to €47.5 Billion), on the basis of IDATE information⁶.

⁵ Capital intensity ratios for European cable operators are provided by Cable Europe and are around 23% over the period.

⁶The 2017 ETNO annual report with IDATE estimates of European operators' capital expenditures in tangible fixed assets: [https://etno.eu/datas/publications/annual-reports/ETNO%20Annual%20Economic%20Report%202017%20\(final%20version%20web\).pdf](https://etno.eu/datas/publications/annual-reports/ETNO%20Annual%20Economic%20Report%202017%20(final%20version%20web).pdf)

2. Capex in telecommunications per inhabitant have stayed constantly larger in the US than in the EU since 2003

This section analyses the US and EU intensity of investment in telecommunications services on the basis of industry sources and draws a comparison between both areas. Intensity of investment refers to the capital expenditures (CAPEX) of network operators to population ratio. The available sources allow analysing the US and EU CAPEX from 2003 to 2017.

2.1. EU & US CAPEX per inhabitant in telecommunications services from the industry sources

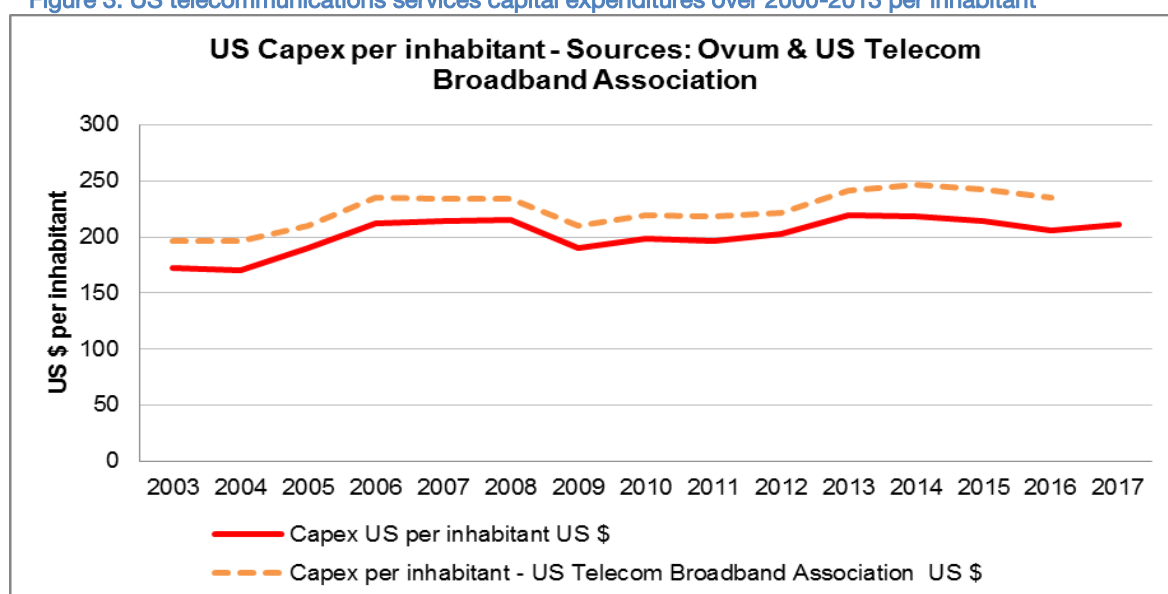
This section provides information on investment intensity of network operators, based on industry sources, for the European Union and the United States. The investment intensity of the telecommunications services sector is defined by the ratio of telecommunications and cable operators CAPEX to the population. For both the European Union and the United States, capital expenditures are obtained from Ovum and US Telecom Broadband Association, and the total national population is obtained from the OECD population tables. The evolutions of the CAPEX per inhabitant ratios of the United States according to both industry sources (OVUM and US Telecom-Broadband Association) appear consistent, as evidenced in Table 3 and Figure 3.

Table 3: US telecommunications services capital expenditures per inhabitant 2003-2017

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
US - Capex per inhabitant Ovum billions \$	172	170	190	212	214	215	190	198	196	203	219	218	214	205	211
US - Capex per inhab. Broadband Association billions \$	196	196	210	235	234	234	210	220	218	221	241	246	243	235	

Source: OVUM & US Broadband Association

Figure 3: US telecommunications services capital expenditures over 2000-2013 per inhabitant



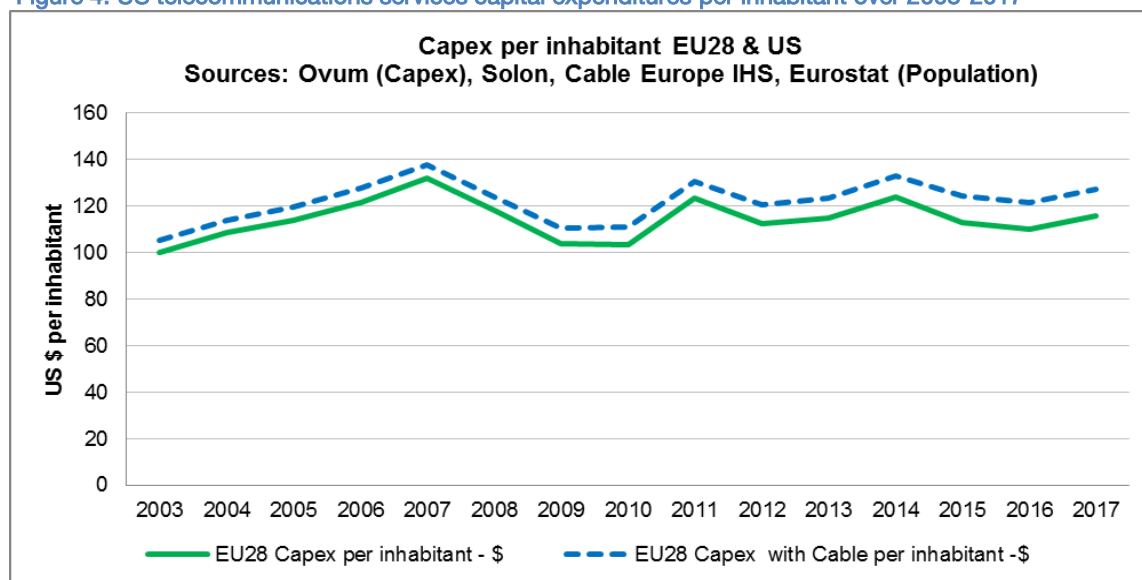
For the European Union, capital expenditures intensity ratios are derived from the calculus of the upper trajectory that includes the capital expenditures from the European cable operators which might have been omitted in the Ovum estimates. The levels of capital expenditures (CAPEX) derived from Cable-Europe IHS and Solon survey are divided by the population of the European Union to obtain the European CAPEX intensity ratios for both the base-case and the upper trajectory that includes cable operators' capital expenditures in the European footprint. The Table 4 and the Figure 4 show the CAPEX intensity ratios of the European Union for both cases.

Table 4: US telecommunications services capital expenditures per inhabitant 2003-2017

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
European Cable Capex per inhabitant IHS - Solon \$	5,4	5,2	5,6	5,9	5,8	5,7	6,4	7,4	7,4	8,4	8,5	8,7	11,1	11,5	11,6
European Capex per inhabitant base case - Ovum \$	100	109	114	122	132	118	104	104	123	112	115	124	113	110	116
European Cable Capex per inhabitant (with cable) \$	105	114	120	128	138	124	110	111	131	121	123	133	124	122	127

Source: OVUM, Cable-Europe HIS, Solon survey, & OECD

Figure 4: US telecommunications services capital expenditures per inhabitant over 2003-2017



2.2. Comparison of telecom services CAPEX per inhabitant in the EU28 and the US

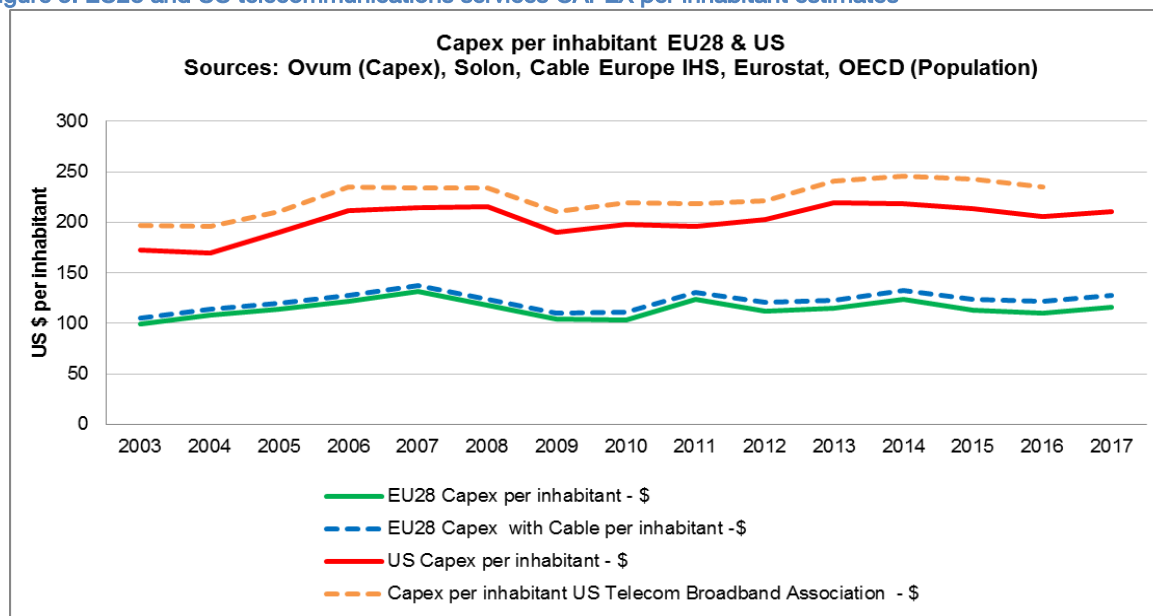
The comparison of EU28 and US CAPEX per inhabitant ratios clearly shows that there is a significant gap in terms of investment intensity between both regions. The US CAPEX per inhabitant have increased by 1.5% at an average annual rate over the whole period (2003-2017), while the base-case CAPEX per inhabitant have only increased by average annual rate of 1.1% in the EU28 (by 1.4% if including cable). The gap between the European Union and the United States has continued to increase after the 2009 macroeconomic downturn, from which the United States have recovered more rapidly and more significantly than the EU28, which CAPEX per inhabitant have been increasing slowly. The US CAPEX per inhabitant ratio has indeed increased steadily over 2009-2013 (at a 3.6% average annual rate), whereas the EU28 CAPEX per inhabitant ratio has declined sharply over 2007-2010, at a 7% average annual rate. For both regions, the CAPEX per inhabitant has been decreasing in the recent period, at a 2.2% rate in the United States between 2013 and 2016, and at a 0.5% rate in the European Union over 2013-2016, before an increase in both regions after 2016. The gap between the United States and the European Union terms of CAPEX per inhabitant has been increasing over the period 2003-2009 at a 3% average annual rate, and only at a 1.2% rate between 2009 and 2017. The gap has increased more rapidly between 2003 and 2013 (3.8% a year), and has decreased notably between 2013 and 2017 (-2.4% a year). Between 2014 and 2017, the gap has been increasing at only 0.3% a year. This indicates that the gap between both areas has tended to stabilize after 2013 at a lower value than before, notably during the decade 2003-2013. The recent trends do not evidence any convergence between the capital expenditure intensities of both regions, and the US remain above the European Union. From the calculation of investment trends over the period 2003-2017, it appears that the United States exhibit stronger growth than the EU28 over 2003-2013. The table 5 and Figure 5 show the evolution of capital expenditures per inhabitant in the European Union and in the United States, including the upper curves for both the United States (on the basis of the data retrieved from the US Telecom-Broadband Association) and the European Union (on the basis of the data retrieved from the Cable-Europe HIS and Solon survey publications).

Table 5: EU28 and US telecommunications services CAPEX per inhabitant estimates

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
EU28 Capex per inhabitant \$	100	109	114	122	132	118	104	104	123	112	115	124	113	110	116
EU28 Capex (with Cable) per inhabitant \$	105	114	120	128	138	124	110	111	131	121	123	133	124	122	127
US Capex per inhabitant - (Ovum) \$	172	170	190	212	214	215	190	198	196	203	219	218	214	205	211
US Capex per inhabitant - US Telecom Broadband Association \$	196	196	210	235	234	234	210	220	218	221	241	246	243	235	

Sources: OVUM, Cable-Europe IS, Solon Survey, OECD, Eurostat

Figure 5: EU28 and US telecommunications services CAPEX per inhabitant estimates



In order to compare the evolution of CAPEX intensity in both areas, it is useful to represent the ratios starting at a same base year. The table 8 and Figure 8 show the evolution of capital expenditures per inhabitant in both areas (index with base 2003). Over the period 2003-2017, the EU28 and US Capex increased at a comparable pace (1.3% and 1.5% a year), while after the 2009 downturn and until 2017, the European investments have maintained a stronger momentum (1.8% a year against 1.3% for the US). The CAPEX per inhabitant have slowed down for both regions after 2013, at a 1% average annual rate for the European Union over 2013-2017 and a declining trend for the United States (-1%) for the same period. Both industry sources evidence a decline in CAPEX per inhabitant in the recent period: from USD 219 to USD 205 per inhabitant between 2013 and 2016 (-2.2% a year) according to OVUM and from USD 241 to USD 235 per inhabitant between 2013 and 2016 (-0.8% a year) according to the US Telecom-Broadband Association IHS. It is possible that the public debate and the process which resulted in the adoption of Open Internet Order by the FCC in February 2015 might have led network operators to restrict their investments⁷. The adoption of strong neutrality rules by the FCC cannot be directly linked to the decrease in the investment intensity of US network operators. However it might have influence their investment plans.

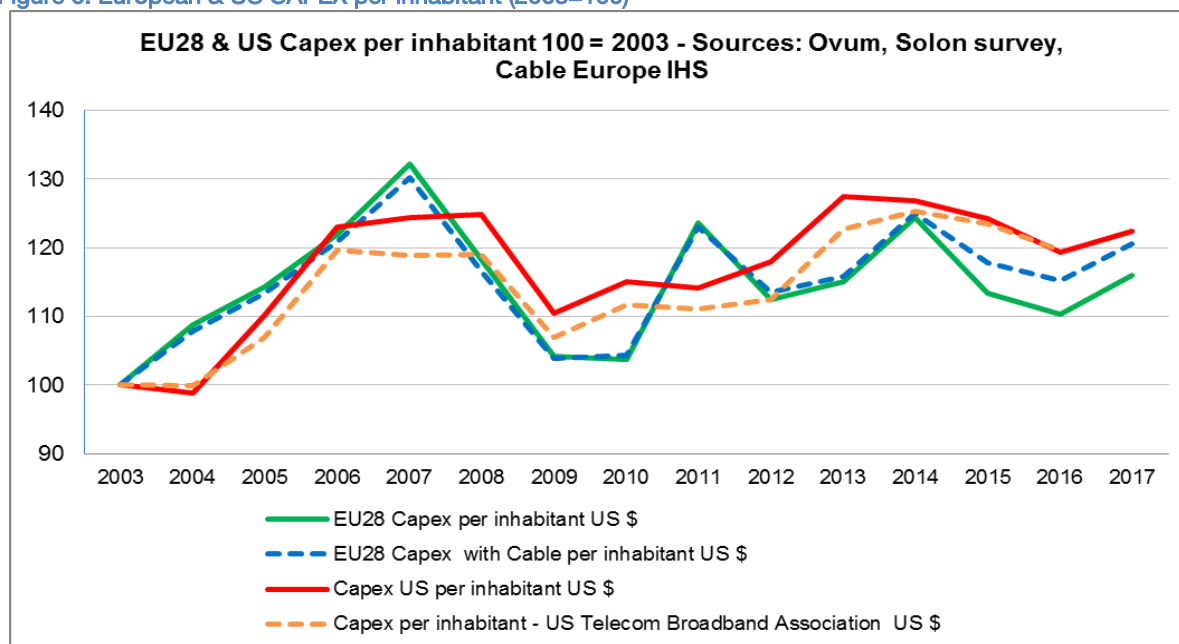
Table 6: European & US CAPEX per inhabitant (2003=100)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
EU28 Capex per inhabitant US \$	100	109	114	122	132	118	104	104	124	112	115	124	113	110	116
EU28 Capex with Cable per inhabitant US \$	100	108	114	121	131	118	105	105	124	115	117	126	118	116	121
Capex US per inhabitant US \$	100	99	110	123	124	125	110	115	114	118	127	127	124	119	122
Capex per inhabitant - US Telecom Broadband Association US \$	100	100	107	120	119	119	107	112	111	112	123	125	123	120	

Sources: OVUM, Cable-Europe IHS, Solon, OECD, Eurostat

⁷ https://transition.fcc.gov/Daily_Releases/Daily_Business/2015/db0312/FCC-15-24A1.pdf

Figure 6: European & US CAPEX per inhabitant (2003=100)



Conclusion on a comparison based on aggregate CAPEX by continent

There is a persistent investment gap between the European Union and the United States. This gap has however stabilized at a lower level over the most recent period. The small differences in both trends for EU28 CAPEX per inhabitant indicate that the measurement approximations are unlikely to affect significantly the assessment of the gap between the EU28 and the US CAPEX per inhabitant ratios (as well as CAPEX levels) trends for the telecommunications services. The United-States are above the European Union in terms of CAPEX per inhabitant (and in terms of CAPEX levels as well) throughout the 2003-2017 period and the gap, as shown by the calculation of CAPEX per inhabitant trends for the base year 2003, has recently been slightly reduced in 2016 and 2017. The US CAPEX per inhabitant ratio was 1.78 the EU28 ratio in 2010 and 1.65 in 2017. With an average of 1.66, the US CAPEX per inhabitant to EU28 CAPEX per inhabitant ratio does not evidence any convergence between both areas.

Conclusion

The United States are well above the European Union over the period 2003-2017, despite a lower gap in the recent period (2013-2017). Our estimates are consistent with other reports. IDATE (2014) confirms that the investment gap between the European Union and the US has been increasing between 2012 and 2014⁸. Layton (2014) estimates investment per inhabitant (Capital Expenditures from private telecom and cable operators, including Satellite) for the EU28 and the US over 2003-2013, and finds that the divergence between the two areas has been increasing since 2009. In 2009, 2013 and 2017, the US CAPEX was nearly twice the EU28 level. Moreover, a study from Mazars (2015) shows that investment in the US (a panel of top 4 operators accounting for 95% of US mobile investments) has risen by 39% over 2006-2013 while it has decreased by 5% in the European Union (a panel of 7 European operators with more than 100 million subscribers). More recently, the ETNO 2017 annual report has shown that the capital expenditures (in tangible fixed assets) of the European telecommunications operators have been increasing at a 2.6% annual average rate from 2010 to 2016, (from €40.5 to €47.5 Billion), on the basis of IDATE information⁹.

An in-depth analysis of quantitative sources would be required to fully understand the causes and the impact of the investment gap between the two sides of the Atlantic on fixed and mobile service availability and adoption. In particular, it might be the case that the process leading to the adoption of strong neutrality rules by the FCC in early 2015 could have led the US network operators to delay or postpone their planned investments, thus explaining partly the decrease in their investment intensity.

⁸ https://www.etno.eu/datas/publications/economic-reports/ETNO_Annual_Economic_Report_2014_FINAL_21012015.pdf

⁹The 2017 ETNO annual report with IDATE estimates of European operators' capital expenditures in tangible fixed assets: [https://etno.eu/datas/publications/annual-reports/ETNO%20Annual%20Economic%20Report%202017%20\(final%20version%20web\).pdf](https://etno.eu/datas/publications/annual-reports/ETNO%20Annual%20Economic%20Report%202017%20(final%20version%20web).pdf)

Appendix

This Appendix entails a discussion on the limitations affecting data sources for investment and an analysis of investment of the US telecommunications services based on the US national accounts.

1. Methodological elements

The first section of the Appendix section briefly discusses the indicators of investment in the telecommunications services from telecommunications and cable operators and how to handle their potential limitations.

1.1. The sector perimeter: broadcasting and audio-visual content diffusion

The telecommunications sector covers mobile services and fixed telecom services as well. On the mobile services side, there might be a minor ambiguity due to the possible inclusion of satellite services, that are sometimes (not systematically) included in investment statistics of telecommunications services. On the fixed telecommunication side, the major potential discrepancy is related to uncertainties about the inclusion of cable services providers in the perimeter of telecommunications services. The weight of cable industry in terms of revenues and investment levels is though so important that the potential gap would be immediately noticeable. A problematic perimeter bias relates to the integration of broadcasting activities in the field of telecommunications services: the integration of comprehensive programs for TV channels in bunches of programs or channels and their distribution are included in national investment data, in conformity with the international accounting nomenclature for the industry of telecommunications services. The production of original TV program or audio-visual content are not taken into account in telecommunications services in national investment data, as they are reported in the section J60 "Programming and Broadcasting activities" of the National Accounts system. However, this differentiation between the two broadcasting activities can hardly be made on the basis of industry statistics, as companies do not provide the split in their reports on capital expenditures. At this stage, we cannot therefore formally exclude the possibility that investments of telecommunications operators and cable operators in the creation or production of audio-visual content are part of the reported investment in statistics provided by industrial analysts. This amount can be significant in the US, as cable operators are taking an active part of content production.

1.2. The wholesale market: the access to legacy infrastructure

In the telecommunications sectors of the European Union's member States, the introduction of competition has led the incumbents to provide access to their access network on a wholesale ex-ante regulated price. As a result, alternative operators are granted access to the legacy network to provide their services, even if no new access infrastructures are deployed when these investments are made. A part of this spending (corresponding amongst other to activation fees or non-recurring fees) is activated by alternative operators, and as a result, a share of total capital expenditures reported by usual sources does not involve actual deployments of physical infrastructure. As both National Accounts and industry sources perform aggregation of companies' investments, the more open networks there are, the more "artificial" investment (investment that does not lead to access infrastructure deployment) is accounted for in the statistics. However, it is not possible to assess the wholesale costs that are included in the capital expenditures of the alternative operators.

2. Investments of the US telecommunications services from the national accounts

This second section of the appendix section analyses the US investments from institutional sources (US Bureau of Economic Analysis and the OECD). Eurostat has cancelled most of the information that was available in 2015, which does not allow building an estimate for a trend in the investment of the telecommunications services in the European Union.

The US telecommunications services' investment can be analysed on the basis of the US National Accounts. The National Accounts systems use Gross Fixed Capital Formation (GFCF) as a measure of gross investment. It refers to the accumulation of non-residential fixed assets that are being used in a production process for duration of at least one year. The GFCF includes fixed tangible assets (equipment, machinery, buildings) and some fixed intangible assets (software, literary & artistic originals, and intellectual property rights). The expenditures on Research & Development (R&D) have been included in the Gross Fixed Capital Formation since 2014, (they were previously recorded in the Gross Domestic Expenditure on R&D (GERD)). The GFCF does not include training costs, advertising and promotion expenditures, relocation and reorganization expenditures, and do not include investments in financial assets and land, and foreign direct investment as well. Spectrum acquisition cost is considered as a non-produced asset and is therefore not taken into account in GFCF.

The US annual National Accounts (from the Bureau of Economic Analysis-BEA¹⁰), of the telecommunications services branch of industry corresponds to the "*Broadcasting and Telecommunications*" industry. Its investment is measured by the GFCF that is presented as the sum of gross tangible investments (equipment, materials and machines) and gross intangible investments ("*Intellectual property rights products*", including software and television programs). Over 2000-2011, US investment of telecommunications services measured by the US BEA is equivalent to US investment measured by the OECD for the "D61-JB" branch in the STAN database for structural analysis. The OECD data have not been actualised since 2011. The OECD classification for telecommunications services includes integrated comprehensive programs for TV channels¹¹ in bunches of programs or channels and their distribution, and does not include the production of radio and television programs¹² (that are accounted for in the "J60" section of the international National Account system)¹³. The GFCF of telecom services in the US exhibits similar trends than the CAPEX of telecoms and cable operators, with a 2.9% average annual growth rate over 2003-2016. The investment intensity (the GFCF per inhabitant) is computed using OECD data for population). The table presents both investments in fixed tangible assets and in fixed intangible assets as reported by the US Bureau of Economic Analysis-BEA. The evolution of investments by the US sector of telecommunications services according to National Accounts are reported in Table 1 and Figure 1. Both National Account sources appear to be consistent up to 2011.

Table 1: Gross Fixed Capital Formation of the US telecommunications services

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
US GFCF Tangible assets (Equipment) - billions \$	94	79	48	44	48	49	60	66	62	53	59	58	59	59	58	60	60
US GFCF Intangible assets (PPI) - billions \$	36	35	29	28	29	32	34	35	35	35	35	37	41	40	45	46	49
US GFCF (Equipment & PPI) - billions \$	130	114	77	72	77	82	94	101	98	88	94	95	99	99	103	106	109
US GFCF (Equipment & PPI except TV programs) - billions \$	117	100	62	55	60	62	74	81	78	68	74	74	76	75	76	79	81
US GFCF OECD STAN Rev. 4 - billions \$	142	125	81	70	74	79	94	104	103	88	89	90					

Sources: US Bureau of Economic Analysis-BEA

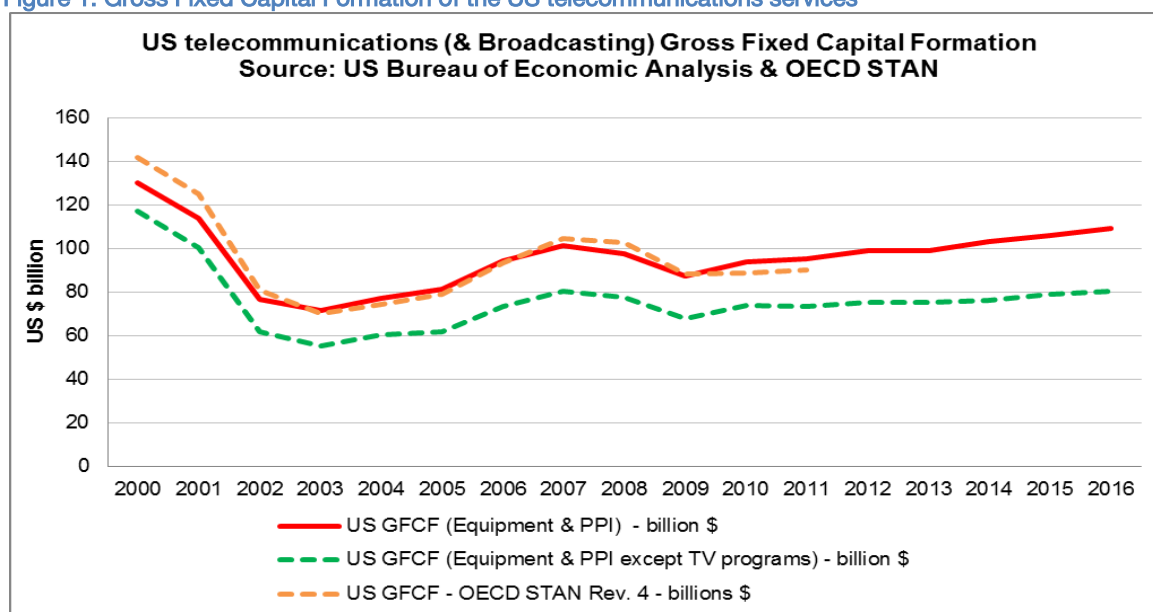
¹⁰ See the US Bureau of Economic Analysis data index: http://www.bea.gov/iTable/index_FA.cfm

¹¹ The TV channels programs are produced in the division J60: "Programming and Diffusion" of the National Account system.

¹² Radio and Television Programs are also produced in the J60 of the National Account System.

¹³ The account system defined by the United Nations indicates for division J61: "This division includes the activities of providing telecommunications and related service activities, i.e. transmitting voice, data, text, sound and video. The transmission facilities that carry out these activities may be based on a single technology or a combination of technologies. The commonality of activities classified in this division is the transmission of content, without being involved in its creation. The breakdown in this division is based on the type of infrastructure operated. In the case of transmission of television signals this may include the bundling of complete programming channels (produced in division 60) in to programme packages for distribution". <http://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=27&Lg=1&Co=61>

Figure 1: Gross Fixed Capital Formation of the US telecommunications services



The BEA has revised its National Accounts System in 2013 to include TV programs as intangible assets¹⁴. The intangible assets include three separate sections: Software acquisitions, exploitation of TV programs- "*Long-lived television programs*", and all other intangible assets, which are included in the "All-other non-manufacturing category". In the US, cable operators ("cable networks") are participating in the creation of original TV program "*Long-lived television programs*" that can be broadcasted several times during a long period. Since the GFCF time series by OECD and US BEA are similar, it is unlikely that US BEA includes the creation of TV programs in intangible fixed assets. It does only include the diffusion of these programs (in conformity with the international nomenclature for the industry of telecommunications services). Nevertheless, we cannot formally exclude that investments from large cable operators in the creation or production of audio-visual contents are accounted for in the US BEA National accounts (and OECD as well).

¹⁴ <https://www.bea.gov/papers/pdf/Television%20Programs%20as%20a%20Capital%20Asset.pdf>