

ESTIMATING OTT TRAFFIC-RELATED COSTS ON EUROPEAN TELECOMMUNICATIONS NETWORKS

A report for Deutsche Telekom, Orange, Telefonica and Vodafone

31 MARCH 2022

CONTENTS

Executive summary	3
1 Introduction and context	4
2 Approach	4
2.1 Data collection	5
2.2 Approach to cost estimation	5
3 Results	8
4 Interpreting our results	8
Annex A - Approach for fixed networks	10
Annex B - Approach for mobile networks	12

EXECUTIVE SUMMARY

Data traffic on telecom networks continues to grow at an exponential rate, largely driven by an increase in the usage and quality of internet services delivered ‘over-the-top’ (OTT) to end users. Telecommunications operators have invested to ensure that their networks can support this exponential growth in traffic. While the resulting market is ‘two sided’, telecoms operators have effectively only been able to recover network costs from end users.

There is a policy debate on whether the current structure of prices is optimal given the ‘two-sided’ nature of the internet market. In this context, Frontier Economics has been asked by Deutsche Telekom, Orange, Telefonica and Vodafone to estimate the costs that are associated with the ‘traffic sensitive’ elements of fixed and mobile telecom networks across Europe that can be attributed to OTT traffic.

Given this objective and the scope of the project, we have chosen to use a ‘top-down’ approach to cost estimation, relying on information that was readily available, either from the operators or in the public domain. We then adopted a relatively straightforward approach to calculating total costs that can be attributed to OTT traffic across Europe and we present a range of the estimated costs in the Table below.

TABLE 1 ESTIMATED TOTAL COSTS ATTRIBUTABLE TO OTT TRAFFIC FOR FIXED AND MOBILE

	FIXED	MOBILE
Weighted average cost per subscriber	€40 - €47	€43 - €46
Annualised OTT costs across Europe	€8 billion - €10 billion	€28 billion - €30 billion

The ‘total costs’ above include some costs which network operators incur to deliver traffic but which do not vary as the level of traffic increases. We recognise that it may be useful to understand the scale of total OTT costs that vary with traffic (i.e. incremental costs). We have therefore applied some high level assumptions to the total traffic related costs above in order to estimate the incremental element.

TABLE 2 ESTIMATED INCREMENTAL COSTS ATTRIBUTABLE TO OTT TRAFFIC FOR FIXED AND MOBILE

	FIXED	MOBILE
Weighted average cost per subscriber	€11 - €29	€20 - €33
Annualised OTT costs across Europe	€2 billion - €6 billion	€13 billion - €22 billion

As can be seen in the tables above, there is a wide range for incremental costs, compared to total costs. This reflects the inherent difficulty in estimating the degree to which the actually incurred costs would vary if (hypothetically) network traffic differed from the current level of traffic. This is particularly relevant in markets undergoing rapid demand and technology transformation. Instead, the high-level incremental cost estimates can act as an indication of the likely magnitude of the costs.

It is also important to note that the results above show the *average* ‘traffic sensitive’ costs attributable to OTT traffic for fixed and mobile networks across Europe – this means that the costs for any individual operator and jurisdiction could be significantly higher or lower than this average.

In addition, we have based our estimates on the actual reported cost base for a sample of operators, rather than a hypothetical ‘optimal’ cost base determined based on a ‘bottom-up’ exercise. This also has implications for our results. For example, the use of accounting depreciation and book value in our approach may not reflect ‘economic’ costs due to differences over time in input costs, demand or investment lifecycle effects.

1 INTRODUCTION AND CONTEXT

Data traffic on telecom networks continues to grow at an exponential rate, driven by an increase in the usage of internet services (such as video streaming and gaming)¹ delivered ‘over-the-top’ (OTT) to end users by internet platforms and the development of more data intensive OTT applications (such as 4K video streaming).² Telecommunications operators have therefore had to ensure that their networks can support this exponential growth in traffic between end users and internet platforms.

At the same time, telecoms operators have effectively only been able to set charges to recover network costs from end users, rather than from OTT/content providers.³ In part this reflects historic charging approaches which were developed in a world where traffic was dominated by symmetric voice traffic between end users. This approach was maintained after the introduction of broadband services, with internet data traffic becoming highly asymmetrical, as an overlay on top of the existing voice services.⁴

There is a policy debate on whether the current structure of prices is optimal given the ‘two-sided’ nature of the internet market and the need for continued investment in networks to meet growing demand.

In this context, Frontier Economics has been asked by Deutsche Telekom, Orange, Telefonica and Vodafone (“the operators”) to estimate the costs that are associated with the ‘traffic sensitive’ elements of fixed and mobile telecom networks across Europe that can be attributed to OTT traffic.

2 APPROACH

The objective of the exercise is to estimate the relevant ‘traffic sensitive’ network costs of European telecoms networks, which are the costs of network components that are primarily dimensioned according to the level of traffic carried.⁵ There are two broad approaches to do network cost estimation:

- ‘Top-down’ approaches which use financial information from operators to estimate costs based on actual and historic expenditure; and

¹ This is also caused by the increase in the deployment and take-up of higher bandwidth telecom services (fibre and 5G).

² It should be noted that these OTT applications are provided separately from the retail providers of the network services and underlying network operators.

³ This is reflected by the regulatory framework where traffic costs are assumed to be fully recovered from end-users.

⁴ In addition, telecom operators are also constrained by net neutrality rules which effectively limit the ability to charge OTT providers for the carriage of traffic.

⁵ This will include costs which are variable with respect to traffic, but also some costs which are required to deliver any traffic but which do not vary with the level of traffic carried.

- 'Bottom-up' approaches which attempt to estimate costs for a hypothetical network or networks required to meet a certain level of demand based on a combination of engineering rules and information on the costs of the individual components of the network.

While 'bottom-up' approaches can provide more flexibility in determining costs based on a range of scenarios (such as estimating the incremental cost of traffic), 'bottom-up' approaches will require a significant amount of detailed information and assumptions on demand and engineering rules to dimension networks and on the expenditure required to build, operate and maintain networks. Therefore, given the scope and size of our project, we have chosen to use a 'top-down' approach that relies on information that was readily available, either from the operators or in the public domain, to produce our estimates. We have been further constrained by the need to collect information on a comparable basis across operators, which means that the cost information is based on operators' statutory financial information.

To ensure compliance with, *inter alia*, applicable competition laws, we have employed strict information barriers to ensure that potentially sensitive data has not been shared between the operators.

In this section, we first discuss our overall approach on data collection. We then provide a high level overview of our methodology (a detailed explanation of our methodology is covered in Annex A for fixed and Annex B for mobile). Finally, we provide a brief discussion on how best to interpret our results.

2.1 DATA COLLECTION

We have based our analysis on the information provided by the operators in response to our data requests. These were made using standard pro forma covering:

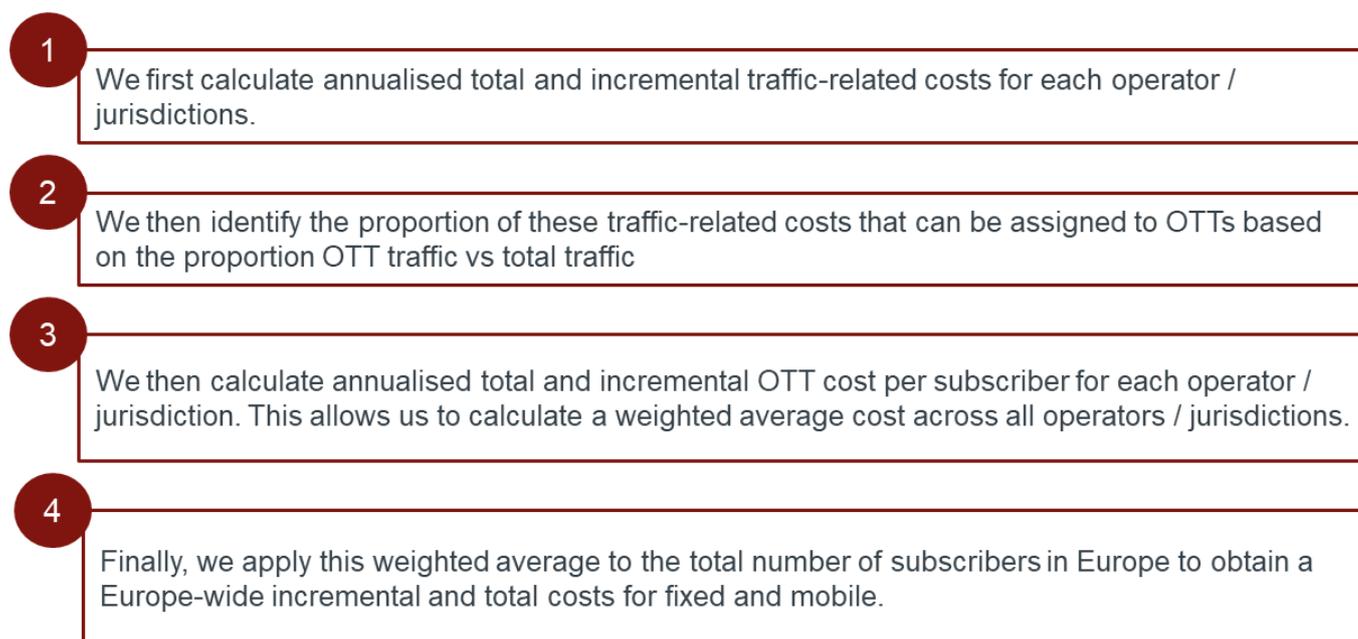
- demand (i.e. subscribers and broadband traffic);
- network structure, including the parts of the network used by different types of broadband traffic; and
- financial information on costs (i.e. depreciation, net book value and operating costs) for different parts of the network.

Information was requested separately for fixed and mobile networks and for a subset of the European countries in which each of the telecom groups had operations (as driven by data availability).

2.2 APPROACH TO COST ESTIMATION

We have adopted a simple approach to calculating total and incremental costs attributable to OTT across Europe (EU27 + UK). The approach is discussed in more detail below and is also highlighted in the Figure below:

FIGURE 1 OUR OVERALL APPROACH



STEP 1: CALCULATION OF TRAFFIC-RELATED COSTS

We first identify the relevant costs for the fixed and mobile networks. We restrict our analysis to ‘traffic sensitive’ network costs. This means that we exclude ‘subscriber sensitive’ network costs (i.e. costs of network elements that are primarily dimensioned based on the number of subscribers rather than the level of traffic) and non-network costs (e.g. customer acquisition and service related costs).

The extent of ‘traffic sensitive’ costs will vary based on whether the network is fixed or mobile⁶:

- **‘Traffic sensitive’ costs within fixed networks**

For fixed networks, the access network components closest to the end user generally tend to be dimensioned according to the number of customers served or potentially served, while aggregation and core components higher up the network hierarchy tend to be dimensioned according to traffic load. While the precise dividing line between ‘subscriber’ and ‘traffic sensitive’ network components is dependent on network topology, we have adopted the existing regulatory cost accounting convention in which costs within the access network (i.e. costs relating to any access equipment up to the first switching layer) are considered ‘subscriber sensitive’ and recovered from per user charges. We therefore focus on the aggregation and core components of fixed networks.

- **‘Traffic sensitive’ costs within mobile networks**

Unlike fixed networks, mobile access networks do not have ‘subscriber sensitive’ elements as the components used, including infrastructure, active equipment and spectrum, tend in part to be a function of traffic. The costs of any ‘subscriber sensitive’ network elements are immaterial (e.g.

⁶ Given that we use accounting information from the operators, we rely on the operators to provide us with their split between ‘traffic sensitive’ and ‘subscriber sensitive’ costs. For example, for fixed networks, we rely on the operators to separate out the costs between the access network sections and other network sections.

costs relating to location registers). We therefore include costs across the entire network (the radio access network, aggregation and core network) as these are all ‘traffic sensitive’ network components.

We calculate the total annualised costs in relation to the ‘traffic sensitive’ components of the fixed network (i.e. costs within the edge, aggregation and core network sections) and mobile networks (i.e. costs in relation to actives, passives, backhaul, core and spectrum) as follows:

- **Fixed networks:** We sum up the depreciation, operating costs (OPEX) and return on capital employed (ROCE⁷) for each network section.
- **Mobile networks:** We sum up depreciation, OPEX and ROCE across the entire mobile network, and then add the annualised costs of spectrum.⁸

For incremental traffic related costs, we apply high-level assumptions to each asset category (e.g. ducts and cable) for fixed and each network section (e.g. active and passives) for mobile to calculate the scale of costs that vary with traffic that is carried. These assumptions were based on publicly available information as well as information submitted by the operators.⁹

STEP 2: ALLOCATION OF COSTS TOWARDS OTT TRAFFIC

While the majority of traffic on telecoms networks is now OTT traffic, a material proportion of traffic is generated within networks, e.g. peer to peer traffic or wholesale traffic carried for other operators. To reflect this we only allocate a proportion of total costs to OTT traffic.

For each network, we use busy hour bandwidth¹⁰ to calculate the proportion of OTT traffic at each level of the network, i.e. separately for the aggregation and core network sections. This proportion is then applied to total and incremental costs for the network level calculated above in order to calculate a share of the costs attributed to OTT services.

STEP 3: CALCULATION OF AVERAGE OTT TRAFFIC COST PER SUBSCRIBER

For mobile networks and fixed networks separately we calculate a weighted average cost per retail subscriber¹¹ for the sample of operators and jurisdictions.¹² This is done for both total and incremental OTT related costs.

⁷ This is equal the net book value (NBV) multiplied by the WACC from each operator and jurisdiction

⁸ We calculate annualised spectrum costs by calculating the sum of annual fees and the annuity value of the one-time amount paid.

⁹ We recognise that a bottom-up exercise could in theory produce improved incremental cost estimates but this fell outside the scope of our work.

¹⁰ We use traffic in cases where information on busy hour bandwidth is not available.

¹¹ Note that mobile excludes any Mobile to Mobile (M2M) connections.

¹² Given the high level nature of the model, our results will not be fully reflective of the geographic conditions that operators may face within any particular country.

STEP 4: CALCULATION OF EUROPE WIDE COSTS

Finally, we apply this average to the total number of subscribers in Europe (EU27 + UK) in order to obtain a Europe wide costs for fixed and mobile. Given the relatively small sample of operators and jurisdictions in our data¹³, we present a maximum and minimum range of the likely costs for fixed and mobile – this range is based on various sensitivities including adjusting the proportion of incremental costs, the total number of subscribers across Europe and the weights that are applied to each operator and jurisdiction during the weighted average calculations.

3 RESULTS

The Table below shows our results for fixed and mobile based on the methodology outlined above:

TABLE 3 ESTIMATED TOTAL COSTS ATTRIBUTABLE TO OTT TRAFFIC FOR FIXED AND MOBILE

	FIXED	MOBILE
Weighted average cost per subscriber	€40 - €47	€43 - €46
Annualised OTT costs across Europe	€8 billion - €10 billion	€28 billion - €30 billion

TABLE 4 ESTIMATED INCREMENTAL COSTS ATTRIBUTABLE TO OTT TRAFFIC FOR FIXED AND MOBILE

	FIXED	MOBILE
Weighted average cost per subscriber	€11 - €29	€20 - €33
Annualised OTT costs across Europe	€2 billion - €6 billion	€13 billion - €22 billion

4 INTERPRETING OUR RESULTS

The results above show the total and incremental ‘traffic sensitive’ costs for the fixed and mobile networks across Europe¹⁴. The results for individual operators may differ significantly from these average levels reflecting differences in the operating environment in the country, the level of demand in the country and the operating model adopted.

Additionally, there is a wider range to the incremental costs compared to total costs. This reflects the inherent difficulty in identify the degree to which costs are incremental or fixed with respect to traffic, and each operator’s view on the share of incremental costs can vary significantly.

Furthermore, as mentioned above, given the size and timescale of this project, we have adopted a simple approach to providing indicative costs on the level of OTT traffic sensitive costs across Europe. In

¹³ The operators and jurisdictions in our sample accounts for c.24% of total fixed subscribers and c.22% of total mobile subscribers across Europe.

¹⁴ These estimates are illustrative of the relevant costs and cannot be construed as indicative of a hypothetical amount of recovery by Telcos from OTTs.

particular we have based our estimates on the reported cost base for a sample of operators, rather than a hypothetical cost base determined based on a 'bottom-up' exercise.

This has implications for our results:

- To the degree that the sample of operators we have received information from might not be representative, the results may not reflect average costs across Europe;
- The model relies on data provided by the operators and this means that our results will reflect any internal assumptions at the data gathering stage (e.g. the fixed results will reflect any differences due to the method that the operators have used to attribute costs between access and other network sections);
- The incremental cost calculations rely on some high level assumptions that are applied uniformly across all operators and jurisdictions. This means that the results will not be able to reflect any specific differences in the relevant proportion of fixed and incremental costs across operators and jurisdictions;
- The use of statutory depreciation and book value in our approach to estimated annual costs may not reflect optimal 'economic' depreciation due to differences over time in input costs, demand or investment lifecycle effects; and
- If the current cost data already reflects sub-optimal investment as a result of the charging structure, our estimates will also reflect this.

ANNEX A - APPROACH FOR FIXED NETWORKS

We used a 3 step process to calculate costs for the fixed network: (i) identification of relevant traffic-related costs, (ii) allocation of costs to OTT traffic specifically; and (iii) calculation of costs across Europe. This is discussed in more detail below.

A.1 - STEP 1: IDENTIFICATION OF TRAFFIC-RELATED COSTS

We first examine the network topology for each operator and jurisdiction, and calculate the annualised costs for each network section (edge, aggregation and core). These annualised costs corresponded to the sum of annual depreciation, return on capital employed (WACC¹⁵ multiplied by Mean Capital Employed) and operating costs (OPEX), see Figure below.

FIGURE 2 CALCULATION OF TOTAL COSTS



We then calculate the incremental costs for each network section. For this, we use a range of assumptions from the operators and from public sources.¹⁶ We applied these assumptions to the total traffic related costs within each network asset category (e.g. cable and ducts), see Figure below, and then summed up the costs within each network section.

FIGURE 3 CALCULATION OF INCREMENTAL COSTS



A.2 - STEP 2: ALLOCATION OF COSTS TO OTT

We allocate total and incremental costs in Step 1 to OTT services, at each level of the network, by:

- First, using the routing factors that were submitted by the operators to determine what type of traffic is routed through each network section; and

¹⁵We use market level WACCs. Given that we only have market level WACC for Orange France (see <https://etno.eu/downloads/reports/beyond%20the%20wacc%20january%202022.pdf>), we scaled up the regulated WACCs for all operators based on the proportional difference between the regulated and market level WACC for Orange's operations in France.

¹⁶ For example, cost volume relationships (CVRs) estimated by BT for the purposes of deriving 'top down' LRIC estimates.

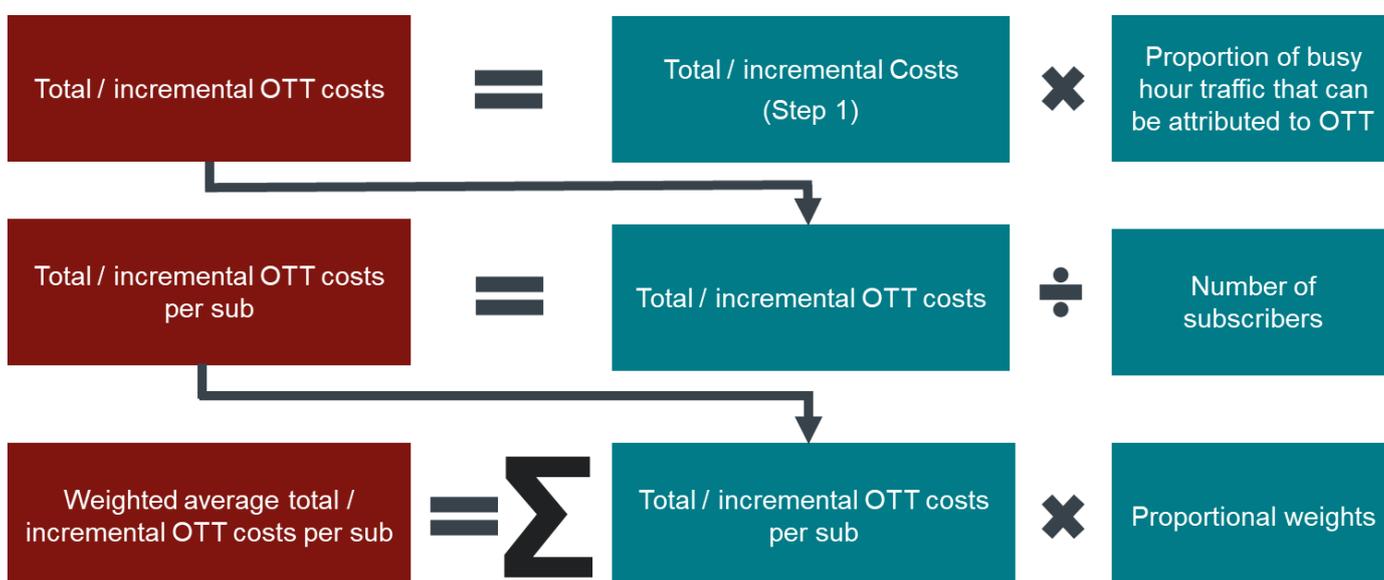
- Then, using the proportion of busy hour bandwidth that can be attributed to OTT versus other traffic that is routed over that network section (e.g. other retail and WCA traffic).

We consider busy hour bandwidth to be the correct metric for determining costs as operators will dimension their network to satisfy peak usage rather than average usage.

This gives us the annualised total and incremental OTT costs for each operator/jurisdiction combination.

After this, we use the subscriber data to calculate an average OTT cost per subscriber for each operator and jurisdiction and then use various weights to calculate a weighted average OTT cost per subscriber across all operators and jurisdictions.

FIGURE 4 CALCULATION OF COSTS ATTRIBUTABLE TO OTT



A.3 - STEP 3: CALCULATION OF COSTS ACROSS EUROPE

We use the weighted average costs across all operators in Step 2 and apply this to the total number of broadband subscribers across Europe. This then produces our estimate on the total and incremental costs that can be attributed to OTT in Europe.

FIGURE 5 CALCULATION OF COSTS ACROSS EUROPE



Given the relatively small sample of operators and jurisdictions within our data, we calculated a range for the annualised fixed OTT costs across Europe. This range reflects the maximum and minimum value of total costs based on the following sensitivities:

- **Choice of weights:** we apply various weights to each operator and jurisdiction including subscribers, ARPU, GDP per capita in PPP terms and hourly labour costs¹⁷.
- **Choice of subscribers across Europe:** we use two separate sources on subscribers (Telegeography and Analysys Mason) to calculate total costs across Europe

ANNEX B - APPROACH FOR MOBILE NETWORKS

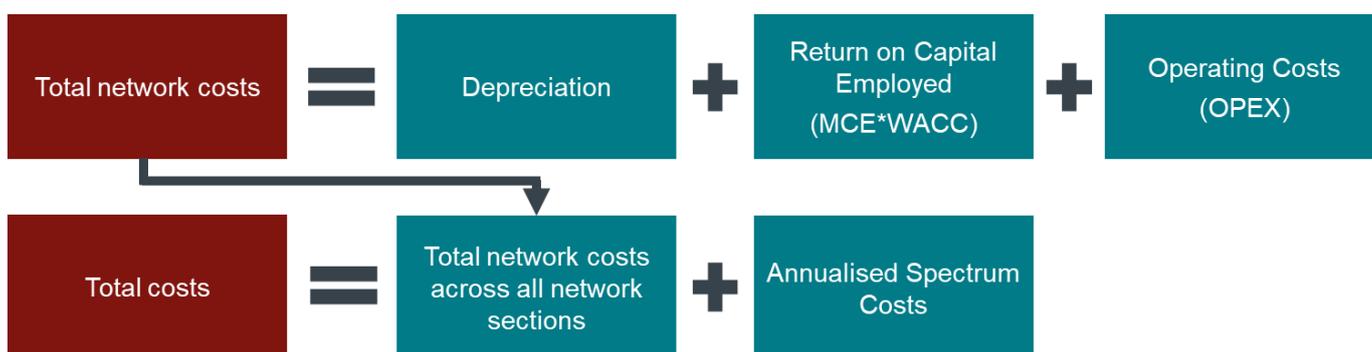
For the mobile model, we have similarly used a 3 step process to calculate costs: (i) identification of relevant costs, (ii) allocation of costs to OTT; and (iii) calculation of costs across Europe.

B.1 - STEP 1: IDENTIFICATION OF COSTS

We first calculate the annualised total network costs for each network section (actives, passives, backhaul and core) – these annualised costs corresponds to the sum of annual depreciation, return on capital employed (WACC¹⁸ multiplied by Mean Capital Employed) and operating costs (OPEX).

We then calculate total costs by summing up the total costs across all network sections and adding on the annualised spectrum costs (this is the sum of annual fees plus the annuity value of the one-off fees), see figure below.

FIGURE 6 CALCULATION OF TOTAL COSTS



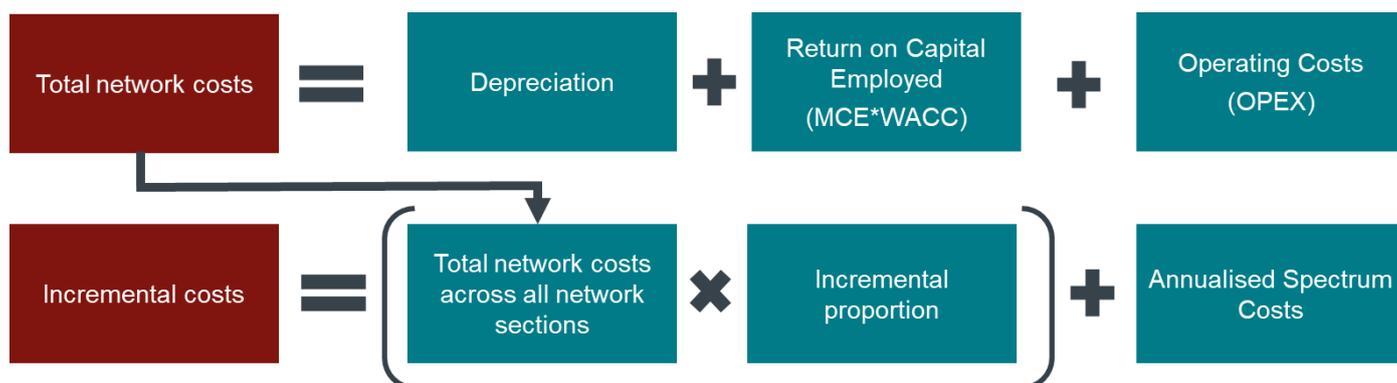
For incremental costs, given the inherent difficulties in estimating the proportion of costs that is incremental (this is reflected by the differences in how operators classified incremental costs), we used a range between 33% and 66% of total costs within each network section. This range roughly reflects the information provided by the operators and information from public sources such as public LRIC models.

We then calculated total incremental costs by summing up the incremental costs across all network sections and adding on the annualised spectrum costs, see below.

¹⁷ We use a variety of different weights in order to ensure that our range for the weighted average costs is able to better reflect the differences in economic and competitive conditions across the different jurisdictions in our sample.

¹⁸ Similar to the fixed methodology, we use the market level WACCs for each operator.

FIGURE 7 CALCULATION OF INCREMENTAL COSTS

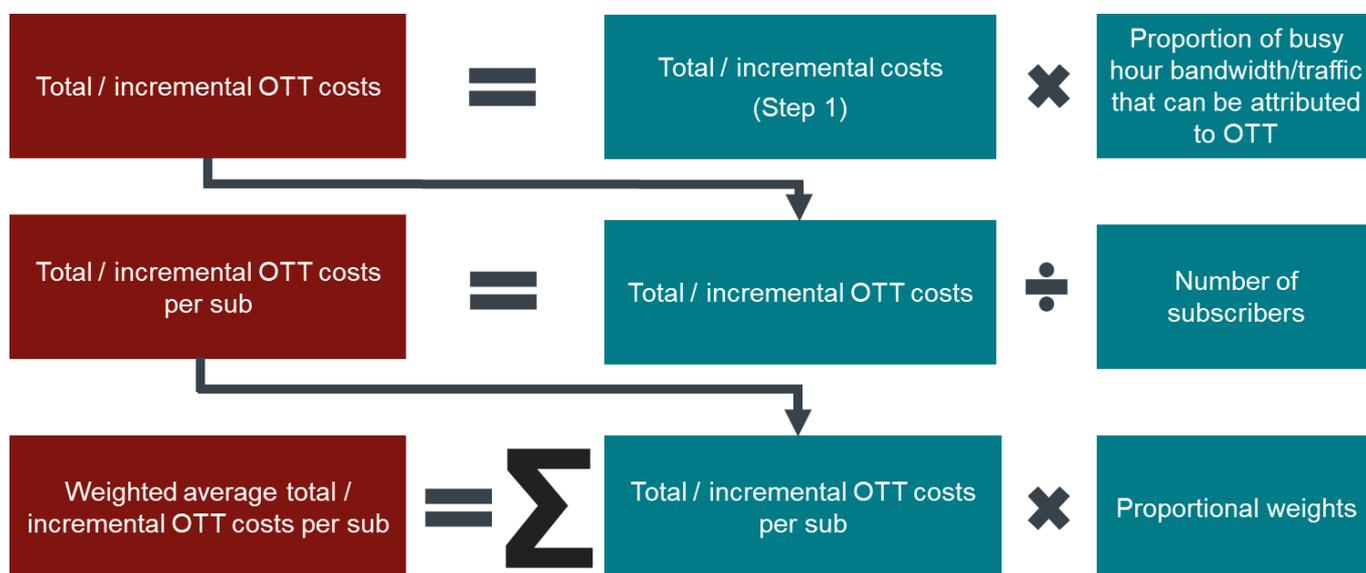


B.2 - STEP 2: ALLOCATION OF COSTS TO OTT

We allocate total and incremental costs in Step 1 to OTT services using the proportion of busy hour bandwidth or traffic¹⁹ that can be attributed to OTT versus other uses (e.g. other retail, MVNO, national roaming and international roaming).

We use the subscriber data in order to calculate an average OTT cost per subscriber for each operator and jurisdiction and then use various weights to calculate a weighted average OTT cost per subscriber across all operators and jurisdictions.

FIGURE 8 CALCULATION OF COSTS ATTRIBUTABLE TO OTT



B.3 - STEP 3: CALCULATION OF COSTS ACROSS EUROPE

¹⁹ We use traffic in cases where information on busy hour bandwidth is not available

We use the weighted average costs across all operators in Step 2 and apply this to the total number of mobile subscribers across Europe. This then produces our estimate on the total and incremental costs that can be attributed to OTT in Europe.

FIGURE 9 CALCULATION OF COSTS ACROSS EUROPE



Given the relatively small sample of operators and jurisdictions within our data, we calculated a range for the annualised mobile OTT costs across Europe. This range reflects the maximum and minimum value of total costs based on the following sensitivities:

- **Choice of weights:** we apply various weights to each operator and jurisdiction including subscribers, ARPU, GDP per capita in PPP terms, hourly labour costs and proportion of users that have a smartphone.
- **Choice of subscribers across Europe:** we use two separate sources on subscribers (Telegeography and Analysys Mason) to calculate total costs across Europe

Frontier Economics Ltd is a member of the Frontier Economics network, which consists of two separate companies based in Europe (Frontier Economics Ltd) and Australia (Frontier Economics Pty Ltd). Both companies are independently owned, and legal commitments entered into by one company do not impose any obligations on the other company in the network. All views expressed in this document are the views of Frontier Economics Ltd.