



Telecom Notice of Consultation CRTC 2020-131

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Call for comments – Review of the approach to rate setting for wholesale telecommunications services

Deadline for submission of interventions: 23 July 2020

[\[Submit an intervention or view related documents\]](#)

The Commission invites interested persons to identify issues associated with the approach to rate setting for wholesale telecommunications services, with the intent to establish a more transparent and efficient rate-setting process while ensuring that rates for regulated wholesale services remain just and reasonable.

Background

1. Wholesale telecommunications services (hereafter referred to as wholesale services) are the services that telecommunications companies provide to each other, and are integral to the overall development of the Canadian communications system.
2. The provision of wholesale services primarily supports competition in various retail service markets by enabling competitors to access certain telecommunications facilities and network components from incumbent carriers, such as incumbent local exchange carriers (ILECs) and cable companies, so that competitors can extend their networks where necessary to provide their own services to consumers.
3. The Commission sets wholesale service rates to facilitate competition between providers and to promote innovative services and affordable prices for Canadians, while also ensuring that rates are just and reasonable.

Essentiality Test

4. In Telecom Decision 2008-17, the Commission established a series of conditions to be used to determine if a wholesale service is considered an essential service and should therefore be mandated (the Essentiality Test). The components of the Essentiality Test are as follows:

- a. The facility¹ is required as an input by competitors to provide telecommunications services in a relevant downstream market² (the input component);
 - b. The facility is controlled by a firm³ that possesses upstream market power such that denying (or withdrawing) access to the facility would likely result in a substantial lessening or prevention of competition in the relevant downstream market (the competition component); and
 - c. It is neither practical nor feasible for competitors to duplicate the functionality of the facility (the duplicability component).
5. However, in practice, essentiality has been only one of the factors that the Commission has considered in deciding whether to mandate the provision of wholesale services. Wholesale services serve other purposes, such as ensuring the efficient interconnection of competing networks, ensuring public safety through the provision of emergency services, and optimizing the use of support structures such as poles and conduits.
 6. When the Commission has decided to mandate the provision of a wholesale service, companies are typically⁴ asked to file proposed tariff rates, supported by associated cost studies. These cost studies are generally conducted using the Phase II costing framework.

Phase II

7. In Telecom Decision 79-16, the Commission concluded the second phase of an inquiry into costing and accounting procedures with respect to the costing of new services. That decision provided new service costing guidance to the ILECs by providing a basic costing framework and specific directives to assist in the implementation of this new costing framework.
8. The incremental costing methodology used to determine the appropriate rates for regulated retail telecommunications services offered by the ILECs was subsequently adopted for wholesale services to encourage facilities-based competition, and is known as Phase II. The Phase II concepts have undergone several modifications

¹ A reference to a facility or service may be taken as a reference to a facility, function, or service (or all three), as appropriate in the context.

² Generally, the downstream market represents the market for retail services that rely on underlying telecommunications facilities as an essential input. In contrast, the upstream market represents the market for the underlying telecommunications facilities themselves.

³ In this context, “firm” includes a group of firms exercising collective market power.

⁴ In certain instances, companies have been permitted to employ other means to develop tariff rates. For example, companies have been permitted to proxy tariff rates off existing tariffed rates for similar or identical services provided by other companies.

since their adoption, but the original methodological framework has remained largely intact.⁵

9. When the Phase II framework was established, the Commission's statutory role in setting rates for telecommunications services was set out in the *Railway Act*.⁶ Section 340 required all tolls to be just and reasonable and to be charged equally to all persons at the same rate when conditions were substantially similar, without undue preference or unjust discrimination. It also gave the Commission jurisdiction to enforce these provisions.
10. With the enactment of the *Telecommunications Act* (the Act) in 1993, Parliament explicitly empowered the Commission, when determining whether a rate is "just and reasonable", to employ "any method or technique that it considers appropriate, whether based on a carrier's return on its rate base or otherwise,"⁷ and further required⁸ the Commission to exercise its powers (including with respect to the setting of rates) with a view to implementing the policy objectives laid out by Parliament in section 7 of the Act and in accordance with policy directions issued by the Governor in Council or technical standards issued by the Minister of Industry.
11. As the Supreme Court confirmed in 2009,⁹ the combined changes to the Commission's rate-making power and the statutory context within which it operates provide the Commission with the discretion to consider a broad range of approaches in deciding what constitutes a just and reasonable rate under the Act. Section 7 of the Act and the policy directions issued by the Governor in Council in 2006¹⁰ and 2019¹¹ under section 8 of the Act (Policy Directions) lay out a broad range of interests and objectives the Commission is required to take into account in setting those rates.
12. In Telecom Regulatory Policy 2015-326, the Commission examined various alternative approaches to wholesale rate setting, ultimately finding that no party

⁵ In order to promote consistency in the application of Phase II concepts, and in an attempt to improve efficiency in wholesale rate setting, the Commission has introduced several key decisions, such as Telecom Regulatory Policy 2012-592, which provided clarity on required public disclosure of information pertaining to wholesale costing study submissions, and Telecom Decision 2008-14, which set out (i) the appropriate expense inclusions and the associated approaches and methodologies to estimate causal expenses for inclusion in regulatory economic studies, and (ii) the follow-up processes with respect to the filing requirements of the ILECs' regulatory economic studies manuals.

⁶ RSC 1985 c. R-3

⁷ *Telecommunications Act*, SC 1993, c. 38, s. 27(5)

⁸ *Telecommunications Act*, SC 1993, c. 38, s. 47

⁹ *Bell Canada v. Bell Aliant Regional Communications*, 2009 SCC 40

¹⁰ *Order Issuing a Direction to the CRTC on Implementing the Canadian Telecommunications Policy Objectives*, SOR/2006-355, 14 December 2006

¹¹ *Order Issuing a Direction to the CRTC on Implementing the Canadian Telecommunications Policy Objectives to Promote Competition, Affordability, Consumer Interests and Innovation*, SOR/2019-227, 17 June 2019

provided compelling evidence for any alternative costing approach that justified a deviation from the Phase II costing methodology.

13. Since Telecom Regulatory Policy 2015-326, however, interventions have been received on the record of various wholesale service rate-setting proceedings in which the Phase II methodology has been challenged or companies have proposed adjustments to its principles.
14. Wholesale rate setting can have a significant impact on the telecommunications market, and the establishment of wholesale services and associated rates is an important aspect of establishing and maintaining a competitive Canadian telecommunications environment. Rates that are not just and reasonable can have the following impacts: ¹²
 - Setting rates too low creates a disincentive for incumbents to invest in their network, while simultaneously deterring wholesale customers from making further network investments, as the tariffed rates are much lower than the cost to build;
 - Setting rates too high creates an environment in which wholesale customers cannot effectively compete due to inflated prices, yielding an imbalance in favour of the incumbents.
15. Given the importance of ensuring that rates are just and reasonable and established in an efficient manner, the Commission is initiating this proceeding to review the issues identified below.
16. In the appendix to this notice, the Commission is also providing a report prepared by Commission staff on the wholesale rate-setting methodology used by several international regulators: Australia, the European Union, France, Germany, the United Kingdom, and the United States. Parties should note that the report reflects the Commission's current understanding of the approach to wholesale rate setting in those jurisdictions, but is provided solely for the purpose of assisting parties and is subject to comment during this proceeding.

Call for comments

17. The Commission invites submissions on the issues identified below. In their interventions, parties should provide supporting rationale and all evidence on which they rely to formulate their position. Parties should structure their submissions according to the topics and questions identified in this notice.

¹² For additional detail, see *Delivering Choice: A Study of Competition in Canada's Broadband Industry*, 7 August 2019, Competition Bureau Canada, at page 48.

What is the appropriate methodology for the setting of wholesale service rates?

18. The Commission invites comments on each of the five rate-setting approaches proposed below and encourages parties to provide arguments for and/or against each approach. The Commission also requests that parties identify their preferred approach, with detailed supporting rationale and the potential benefits, drawbacks, and risks of adopting their preferred wholesale rate-setting methodology, including how each identified methodology would (i) impact the efficiency and transparency of the wholesale rate-setting process and (ii) be consistent with the context established by sections 27 and 47 of the Act, the section 7 policy objectives, and the Policy Directions.
19. If parties have additional approaches they would like the Commission to consider that are not included in the five approaches outlined below, they are invited to propose the additional approaches and identify all potential benefits and drawbacks. The five approaches identified by the Commission are as follows:
 - (i) Continued use of Phase II for regulated wholesale services;
 - (ii) Adoption of a “retail-minus” rate-setting approach, whereby regulated wholesale service rates would be determined based on the current retail rates for similar services, less a predetermined percentage;
 - (iii) Adoption of a “most efficient operator” model approach, whereby all companies using similar network technology in similar geographic markets would participate, along with other impacted parties, in the development of a single model predicated on the most efficient network design. This model would then be used to develop regulated wholesale service costs for all companies deploying similar technology, taking into consideration company-specific input assumptions;
 - (iv) Adoption of accounting-based costing to create wholesale service rates. Company-specific costs, derived from accounting-based or activity-based costing systems¹³ within each company, would be used to create service rates, with an appropriate markup. The costs of activities or assets would be included based only on what is applicable given the service studied. Companies would be expected to update their rates on an annual basis using the latest accounting information available, and results could be subject to scheduled audits as appropriate; and
 - (v) Adoption of commercially negotiated rates between wholesale customers (individually or in a group) and wholesale service providers. Regulated service rates would be established based on mutually agreed-upon rates between service providers, with the Commission available to mediate any disputes.

¹³ An activity-based costing system is a costing methodology that maps costs within a company to activities performed by the company according to each activity’s consumption of resources. These activity costs can then also be mapped to individual products or services within respective markets.

Should the same rate-setting methodology be used for all wholesale services?

20. While it is generally more efficient to employ the same rate-setting methodology for all regulated wholesale services, it is understood that not all regulated wholesale services operate in the same competitive environment.
21. The Commission invites parties to comment on the possibility that market or service conditions could impact the application of the wholesale rate-setting methodology. Parties are further invited to comment on factors that could be included in an analysis of an appropriate wholesale rate-setting methodology, such as market conditions or market competition, as well as on the appropriateness of employing different wholesale rate-setting methodologies for interim versus final rates. All proposals and supporting arguments should be accompanied by detailed supporting rationale, including how each proposed methodology would impact the efficiency and transparency of the wholesale rate-setting process.

Should the same wholesale rate-setting methodology be employed by all companies providing wholesale regulated services?

22. Many companies that are required to file wholesale rates do so on an infrequent basis, sometimes having to file wholesale service rates for a single service only. In these cases, considering that the filing of a cost study and the acquisition and maintenance of Phase II costing knowledge could be challenging, the Commission has approved alternative methodologies, such as using the retail-minus approach, or using rates for a similar or identical approved wholesale service, calculated using Phase II methodology, as a proxy rate. This proxy approach has typically been employed for smaller service providers.
23. The Commission invites parties to comment on the continuation of this process on a case-by-case basis; the adoption of a single, consistently applied wholesale rate-setting methodology to be employed by all companies for all studies; or some other method. Parties are invited to identify the benefits and drawbacks of each approach, as applicable.

Based on the option selected, should the Commission assist companies in acquiring and maintaining knowledge of wholesale rate-setting methodology and of the Commission's expectations in the wholesale rate-setting process? If so, how should the Commission assist companies in this regard?

24. The costing knowledge required in order to participate in the wholesale rate-setting process can be considerable. For many in the industry, the burden of having to acquire and maintain such knowledge can often act as a barrier to active participation in the process.
25. Understanding that there are several possible approaches to wholesale rate setting, the Commission invites parties to comment on whether, regardless of the methodology employed in wholesale rate setting for regulated services, the Commission should assist companies in acquiring and maintaining knowledge of (i)

the methodology and (ii) the Commission's expectations in the wholesale rate-setting process.

26. The Commission invites parties to comment on approaches that could be used to assist companies in acquiring and maintaining knowledge of wholesale rate-setting methodology. Parties are invited to identify the benefits and drawbacks of each approach, as applicable.

How would technological changes be addressed in the wholesale rate-setting process?

27. Regardless of the wholesale rate-setting approach adopted, technological changes and the impacts of new deployed technology and services are likely to pose an ongoing challenge. The Commission invites parties to comment on how they would propose to address complex wholesale rate-setting issues specific to a given wholesale rate-setting proceeding when those issues could lead to a deviation from the accepted wholesale rate-setting approach. For example, should those issues be addressed prior to the wholesale rate-setting proceeding?

If there were to be a change in the wholesale rate-setting approach for regulated wholesale services, how would such a transition occur?

28. Any modification to the wholesale rate-setting methodology has the potential to change established wholesale service rates upon the filing of new or updated submissions. This in turn has the potential to create uncertainty in the affected markets.
29. The Commission invites parties to comment on how the Commission would (i) implement any suggested changes to the wholesale rate-setting approach in terms of a proposed timeline to roll out the proposed methodology, and (ii) implement the rate-setting methodology for existing wholesale services.

Are there methods that could be employed to create a more efficient wholesale rate-setting process?

30. In previous proceedings, the Commission and impacted parties have expressed concern regarding the extended time requirements and delays in the wholesale rate-setting process.
31. The Commission invites parties to comment on how they would improve the efficiency of the wholesale rate-setting process, and to identify the benefits and drawbacks of each provided suggestion.

Procedure

32. The *Canadian Radio-television and Telecommunications Commission Rules of Practice and Procedure* (the Rules of Procedure) apply to this proceeding. The Rules of Procedure set out, among other things, the rules for the content, format, filing, and

service of interventions, answers, replies, and requests for information; the procedure for filing confidential information and requesting its disclosure; and the conduct of public hearings. Accordingly, the procedure set out below must be read in conjunction with the Rules of Procedure and related documents, which can be found on the Commission's website at www.crtc.gc.ca, under "[Statutes and regulations](#)". The guidelines set out in Broadcasting and Telecom Information Bulletin 2010-959 provide information to help interested persons and parties understand the Rules of Procedure so that they can more effectively participate in Commission proceedings.

33. Interested persons who wish to become parties to this proceeding must file an intervention with the Commission regarding the above-noted issues by **23 July 2020**. The intervention must be filed in accordance with section 26 of the Rules of Procedure.
34. Parties are permitted to coordinate, organize, and file, in a single submission, interventions by other interested persons who share their position. Information on how to file this type of submission, known as a joint supporting intervention, as well as a [template](#) for the accompanying cover letter to be filed by parties, can be found in Telecom Information Bulletin 2011-693.
35. All documents required to be served on parties to the proceeding must be served using the contact information contained in the interventions.
36. All parties may file replies to interventions with the Commission by **24 August 2020**.
37. The Commission encourages interested persons and parties to monitor the record of this proceeding, available on the Commission's website at www.crtc.gc.ca, for additional information that they may find useful when preparing their submissions.
38. Submissions longer than five pages should include a summary. Each paragraph of all submissions should be numbered, and the line *****End of document***** should follow the last paragraph. This will help the Commission verify that the document has not been damaged during electronic transmission.
39. Pursuant to Broadcasting and Telecom Information Bulletin 2015-242, the Commission expects incorporated entities and associations, and encourages all Canadians, to file submissions for Commission proceedings in accessible formats (for example, text-based file formats that enable text to be enlarged or modified, or read by screen readers). To provide assistance in this regard, the Commission has posted on its website [guidelines](#) for preparing documents in accessible formats.
40. Submissions must be filed by sending them to the Secretary General of the Commission using **only one** of the following means:

by completing the
[\[Intervention form\]](#)

or

by mail to
CRTC, Ottawa, Ontario K1A 0N2

or

by fax to
819-994-0218

41. Parties who send documents electronically must ensure that they will be able to prove, upon Commission request, that filing, or where required, service of a particular document was completed. Accordingly, parties must keep proof of the sending and receipt of each document for 180 days after the date on which the document is filed or served. The Commission advises parties who file or serve documents by electronic means to exercise caution when using email for the service of documents, as it may be difficult to establish that service has occurred.
42. In accordance with the Rules of Procedure, a document must be received by the Commission and all relevant parties by 5 p.m. Vancouver time (8 p.m. Ottawa time) on the date it is due. Parties are responsible for ensuring the timely delivery of their submissions and will not be notified if their submissions are received after the deadline. Late submissions, including those due to postal delays, will not be considered by the Commission and will not be made part of the public record.
43. The Commission will not formally acknowledge submissions. It will, however, fully consider all submissions, which will form part of the public record of the proceeding, provided that the procedure for filing set out above has been followed.
44. The Commission expects to publish a decision on the issues raised in this notice within four months of the close of record.

Important notice

45. All information that parties provide as part of this public process, except information designated confidential, whether sent by postal mail, fax, email, or through the Commission's website at www.crtc.gc.ca, becomes part of a publicly accessible file and will be posted on the Commission's website. This includes all personal information, such as full names, email addresses, postal/street addresses, and telephone and fax numbers.
46. The personal information that parties provide will be used and may be disclosed for the purpose for which the information was obtained or compiled by the Commission, or for a use consistent with that purpose.
47. Documents received electronically or otherwise will be posted on the Commission's website in their entirety exactly as received, including any personal information

contained therein, in the official language and format in which they are received. Documents not received electronically will be available in PDF format.

48. The information that parties provide to the Commission as part of this public process is entered into an unsearchable database dedicated to this specific public process. This database is accessible only from the web page of this particular public process. As a result, a general search of the Commission's website with the help of either its search engine or a third-party search engine will not provide access to the information that was provided as part of this public process.

Availability of documents

49. Electronic versions of the interventions and other documents referred to in this notice are available on the Commission's website at www.crtc.gc.ca by using the public record number provided at the beginning of this notice or by visiting the "Consultations and hearings – Have your say!" section, then selecting "our applications and processes that are open for comment". Documents can then be accessed by clicking on the links in the "Subject" and "Related Documents" columns associated with this particular notice.

50. Documents are also available at the following address, upon request, during normal business hours.

Les Terrasses de la Chaudière
Central Building
1 Promenade du Portage
Gatineau, Quebec
J8X 4B1
Tel.: 819-997-2429
Fax: 819-994-0218

Toll-free telephone: 1-877-249-2782
Toll-free TTY: 1-877-909-2782

Secretary General

Related documents

- *Review of wholesale wireline services and associated policies*, Telecom Regulatory Policy CRTC 2015-326, 22 July 2015
- *Filing submissions for Commission proceedings in accessible formats*, Broadcasting and Telecom Information Bulletin CRTC 2015-242, 8 June 2015
- *Confidentiality of information used to establish wholesale service rates*, Telecom Regulatory Policy CRTC 2012-592, 26 October 2012

- *Filing of joint supporting interventions*, Telecom Information Bulletin CRTC 2011-693, 8 November 2011
- *Guidelines on the CRTC Rules of Practice and Procedure*, Broadcasting and Telecom Information Bulletin CRTC 2010-959, 23 December 2010
- *Revised regulatory framework for wholesale services and definition of essential service*, Telecom Decision CRTC 2008-17, 3 March 2008
- *Review of certain Phase II costing issues*, Telecom Decision CRTC 2008-14, 21 February 2008
- *Inquiry into Telecommunications Carriers' Costing and Accounting Procedures Phase II: Information Requirements for New Service Tariff Filings*, Telecom Decision CRTC 79-16, 28 August 1979

Appendix to Telecom Notice of Consultation CRTC 2020-131

Wholesale rate-setting methodology used by international regulators

Background

Given that mandated wholesale services are integral to ensuring a competitive telecommunications services market, and as outlined in the Background section of this notice, Phase II is now used primarily by the Commission for mandated wholesale services and select retail services.¹⁴ As a result of the increased complexity of both networks and industry players in recent years, achieving just and reasonable rates for mandated wholesale services has continued to be a challenge, both in Canada and abroad.

In 2012, the CRTC commissioned independent consulting firm Wall Communications Inc.¹⁵ to conduct a study of wholesale costing approaches used in a sample of jurisdictions facing similar challenges (the Wall report). The study was driven by the CRTC's investigation into whether there was an appetite to deviate from Phase II within the Canadian telecommunications environment. As part of this exercise, the CRTC sought to increase its understanding of best practices adopted in other jurisdictions, including whether there are different approaches for traditional services versus newer services and technologies. Countries included in the Wall report were Australia, France, Germany, Sweden, the United Kingdom (U.K.), and the United States (U.S.), and the review also examined the regulatory framework for electronic communications networks and services in the European Union.

Overall, the Wall report found that most of the countries surveyed followed either a cost-oriented or a cost-based approach to setting rates for copper unbundled local loops (ULLs), though regulators used varied terminologies for similar services. For valuation of local loop assets, most countries relied on current cost accounting (CCA) valuation, with some (e.g. Australia and the U.K.) relying on hybrid historical cost accounting (HCA)/CCA approaches.

In terms of costing methodology, the report found that the countries were evenly split between top-down, fully allocated cost (FAC) methodologies (e.g. Australia, the U.K., and France) and long-run incremental cost (LRIC) approaches (e.g. Germany, Sweden, and the U.S.). Only Australia and the U.K. applied annual price controls or caps to ULL rates. The Wall report concluded that Canada's Phase II approach for ULLs is a forward-looking LRIC methodology based on estimates (over a multi-year period) of prospective future cost streams associated with the service in question. In other words, it was comparable to the LRIC approaches followed in many countries, including three of the six surveyed in the report: Germany, Sweden, and the U.S.

¹⁴ While Phase II is the standard costing methodology that has been employed since Telecom Decision 79-16, other methodologies have been used on a case-by-case basis. Examples are the net book value costing approach for copper facilities in Bell Canada's unbundled loop rates (Telecom Decision 2011-24) and the causally attributable costs method used for support structures (Telecom Decision 95-13).

¹⁵ [Wall Communications Inc.](#) is an economics consulting firm specializing in telecommunications, broadcasting, and copyright and intellectual property research, among other fields.

One key finding of the Wall report was that all countries surveyed shared the goal of facilitating and promoting the deployment of next-generation facilities to the greatest and fastest degree possible. As a result, a concern shared by all regulators was the potential impact of wholesale copper access pricing on incentives to deploy fibre access facilities. In 2012, at the time of writing the Wall report, regulators in most of the surveyed countries did not regulate the price of fibre access facilities. In one of the earliest cases, in May 2010, the Swedish Post and Telecom Authority (PTS) decided on price regulation on fibre access, whereby the operator with significant market power should apply LRIC methodology in its wholesale fibre access pricing.¹⁶ PTS set wholesale fibre access prices in May 2011. While access to fibre was mandated in the U.K. and Germany, the report found at that time that the fibre access prices had not been set and no costing methodologies had been adopted for unbundled fibre access.¹⁷

The purpose of the information set out below is to ascertain whether there have been changes in wholesale costing methodologies in six¹⁸ of the jurisdictions discussed in the Wall report in recent years. Any major shifts and the impact those shifts may have had on wholesale service rates could offer insight for the notice of consultation regarding the CRTC's wholesale rate-setting approach.

I. Australia

Executive summary

Australia's national telecommunications regulatory authority is the Australian Competition and Consumer Commission (ACCC). The government plays a considerable ownership role in the country's broadband project, the national broadband network (NBN), in part via the government-owned wholesale-only corporation NBN Co Limited (NBN Co). Australia's leading telecommunications service provider, offering a range of communications services, is Telstra Corporation Limited (Telstra). Telstra is the incumbent owner of the copper and hybrid fibre coaxial (HFC) fixed-line network infrastructure, which is being migrated to the wholesale-only NBN Co. NBN Co rolls out, owns, and maintains the NBN, while Telstra remains a retail service provider in respect of services on the NBN. Telstra does not own the NBN; rather it resells the services to its customers, much like the other retail service providers in Australia. [1] Telstra has been structurally separating by progressively migrating its retail services from its fixed-line networks onto the NBN managed by NBN Co. Once complete (full separation is scheduled for January 2020), Telstra will no longer control the fixed-line telecommunications network that competitors use to service Australian customers.¹⁹ Telstra will still be able to use

¹⁶ PTS dnr: 07-11757/23

¹⁷ Though Australia and Sweden had mandated fibre access subject to cost regulation, the regulators had yet to set final price ceilings at the time of writing the report.

¹⁸ At the time of publishing this notice, Commission staff had not received confirmation from the Swedish telecommunications regulator of the accuracy of the Sweden section of the appendix. As a result, that section of the appendix was removed.

¹⁹ In 2011, Telstra and NBN Co negotiated a complex long-term contract (the Telstra Definitive Agreement) for the provision of a significant portion of the required infrastructure to NBN Co. The agreement provided the foundation on which the NBN could be built by leveraging Telstra's existing network assets and infrastructure.

*the lines taken over by NBN Co, but on the same open market basis as any other business that sells phone and Internet services to end users.*²⁰

Australia's approach to the regulation of wholesale telecommunications services can be summarized as follows:

- *Declared (regulated) wholesale services:*
 - *These include unconditioned local loop services (ULLS), line sharing services (LSS), wholesale line rental (WLR), local carriage services (LCS), and wholesale asymmetric digital subscriber line (ADSL), which have traditionally been supplied by Telstra, mainly on its copper public switched telephone network (PSTN) and digital subscriber line (DSL) networks.*
- *Wholesale costing methodology:*
 - *Telstra uses the building block methodology (BBM) approach.*
 - *NBN Co also uses a BBM-based methodology – the long-term revenue constraint methodology (LTRCM).*
 - *In 2015, the ACCC instituted a uniform 9.4 per cent decrease in the prices of all seven declared line services supplied by Telstra in order to promote efficiency and competition during the transition to the NBN. In reaching its decision, the ACCC balanced the benefits of relative price stability with the potential short-term efficiency losses from prices diverging from their underlying costs. [2]*
- *Cost allocation: the fully allocated costs (FAC) model is used for fixed-line services.*
- *Mobile access services:*
 - *Mobile terminating access services (MTAS) use a cost-based approach – the total service long-run incremental cost plus (TSLRIC+) approach.*
 - *The ACCC has relied on a number of methodologies to implement that approach through the years.*
- *Domestic transmission capacity service:*

²⁰ The ACCC also has a regulatory role in relation to wholesale access and pricing of other non-NBN high-speed fixed-line services, known as the Superfast Broadband Access Service (SBAS) and the Local Bitstream Access Service (LBAS). These networks largely supply high-speed Internet services in new housing estates and large apartment buildings. A number of these networks predate the NBN and provide similar services to those supplied by the NBN. For most of these networks, the ACCC set fall-back prices for 25 Mbps access and an aggregation service equal to NBN Co's prices for these services at the time of the decision. For further information about the ACCC's approach to the pricing of SBAS and LBAS services, refer to [this document](#).

- *The ACCC relies on a domestic benchmarking approach.*

Regulatory environment and market composition

Market trends

According to the Australian Competition and Consumer Commission's (ACCC) 2017-18 Communications Market Report (CMR) [3], Australia's national broadband network (NBN) deployment and activations surpassed 8.1 million premises in 2018. The rollout had a particularly important impact in regional areas, which account for the majority of active NBN services at 55 per cent, followed by metropolitan areas at 35 per cent, and outer metropolitan areas at nine per cent.²¹ In 2017-18, consumers experienced an improvement in speeds on the NBN, namely through an increase in the take-up of higher-speed services: the number of 50 megabits per second (Mbps) services increased from four to 35 per cent of all NBN services.

At a national level, there are four main NBN wholesale access seekers: Telstra Corporation Limited (Telstra); TPG Telecom Limited; Singtel Optus Pty Limited, doing business as Optus; and Vocus Group Limited. Telstra maintains the largest national market share, with around 50 per cent of NBN services nationwide, followed by TPG Group with 22 per cent, Optus with 14 per cent, and Vocus Group at 9 per cent. By access technology, Telstra has around 50 per cent of NBN fixed-line services, which include fibre to the building (FTTB), fibre to the curb (FTTC), fibre to the node (FTTN), fibre to the premises (FTTP), and hybrid fibre coaxial (HFC). At 55 per cent, Telstra also has the largest number of fixed wireless services. NBN Co Limited (NBN Co) sells wholesale services in a range of speed tiers, including 12/1 Mbps (i.e. speeds of 12 Mbps download and 10 Mbps upload), 25/5 Mbps, 50/20 Mbps, and 100/40 Mbps. The 50 Mbps speed tier accounts for around 60 per cent of NBN Co's services. [3]

Mobile virtual network operators (MVNOs) provide competition to three main mobile network operators (MNOs) and the service sections of the market that the MNOs do not cater to. MNOs and MVNOs rely on individual commercial agreements for wholesale access. Australia saw a growth of three percentage points of MVNOs' market share over the two years leading up to the publication of the CMR, with MVNOs comprising 13 per cent of the market. Mobile coverage in regional Australia is a significant area of focus, with continued investments being made to address mobile black spots. Consequently, the ACCC indicated that it is considering a series of regulatory and policy measures to assist in improving coverage. [3]

The ACCC

In Australia, the government plays a significant ownership role in the NBN, including through the government-owned, wholesale-only corporation, NBN Co, which is tasked with the design, build, and operation of the network. The ACCC is responsible for economic regulation of the communications sector, including communications and the NBN. [4]²² The ACCC is an independent Commonwealth statutory authority whose role is to enforce, among other

²¹ Figures are rounded

²² ACCC also regulates a number of other industries, namely national infrastructure services where there is limited competition, such as bulk water, energy, rail and aviation

legislation, Australia's *Competition and Consumer Act 2010* to promote competition and fair trading and to regulate national infrastructure. [5] The ACCC's involvement in the telecommunications sector encompasses a number of key areas, including work to improve competition and access functions across the country through assessing and enforcing terms of access to the NBN, assessing and enforcing Australia's incumbent local exchange carrier's (Telstra's) structural separation undertaking,²³ setting wholesale prices, monitoring and reporting on prices and competition, and investigating claims of anti-competitive conduct in the telecommunications sector.

Telstra

Telstra is Australia's largest telecommunications provider, offering a range of communications services in all telecommunications markets. [6] As a result of competition concerns around Telstra's incentive to favour its own retail business over other service providers that access its network, [7] in 2010 the Australian government introduced legislation that created a framework for reforming the telecommunications industry through structurally separating Telstra by the progressive migration of its fixed-line access services to the wholesale-only NBN. [8] The government established NBN Co to construct, own, and operate the NBN fixed-line network. In 2012, the government accepted Telstra's structural separation undertaking, which entailed the progressive ceasing of the supply of fixed-line voice and broadband services over its copper and HFC networks and commencing to supply those services over the NBN network. [9] This means that Telstra is still able to use the lines taken over by NBN Co, but on the same open market basis as any other business that sells phone and Internet services to end users. [10]²⁴ Completion of Telstra's structural separation was originally planned for July 2018. However, due to delays in the completion of the NBN, the designated day for completion of the NBN rollout was changed to 30 June 2020. [10] In the meantime, Telstra's wholesale division has continued to sell broadband services (and comparable services to its retail customers) during the transition period. [11] Aside from selling phone and Internet services using the NBN, Telstra's wholesale division – Telstra Wholesale – offers a number of other wholesale broadband and voice services (via ADSL and cable), data and Internet Protocol services, and mobile services, although, as noted above, the plan for the NBN is ultimately to replace existing cable and ADSL services almost everywhere in Australia. [12] On 1 November 2019, the ACCC announced that it has decided to maintain existing price and non-price terms until 30 June 2024 for seven declared (regulated) fixed-line wholesale services supplied by Telstra, in order to provide real price reductions and certainty for the industry in relation to voice and broadband services that are still being provided through Telstra's copper network and other legacy infrastructure. While the NBN is due to be completed in June 2020, actual customer migration is expected to be mostly done by 2022. Of note, a separate inquiry is ongoing with regard to NBN Co's wholesale pricing and basic speed retail plans for basic speed broadband access services. [13]

²³ In late 2010, new legislation reformed the communications industry by introducing a framework for the structural separation of Telstra and migration of its fixed-line access services to the National Broadband Network (NBN)

²⁴ The company will continue to own the lines inside the NBN wireless and satellite areas as well as the lines it provides to some customers, such as some large government agencies and businesses.

NBN and NBN Co

Australia's NBN was launched in 2009 as part of the government's effort to connect all Australian households with a fibre connection. The government established NBN Co with a mandate to supply wholesale-only high-speed broadband access services. In 2013, the ACCC accepted NBN Co's special access undertaking (SAU), which set out the terms and conditions under which NBN Co was to make its facilities access service available to access seekers. [14] However, due to a change in government since the launch of the NBN, an alternative and less costly NBN model was adopted, which was to rely on a multi-technology mix instead of delivering high-speed fibre as originally planned. This means that NBN Co provides access to its network via a number of fixed-line connections to the premises, including FTTP, fibre to the building (FTTB), HFC, fibre to the curb (FTTC), and fibre to the node (FTTN). For the FTTN, FTTB, and FTTC networks, broadband is delivered from nodes, basements, and curbs to the premises using existing copper cables. HFC is a legacy technology comprised of existing cables throughout Australia that were traditionally used to deliver pay TV services. [15]

NBN Co provides a wholesale (last mile) access service. It does this through the NBN Ethernet Product, which is a Layer 2 virtual connection that carries traffic between a user network interface (UNI) to serve premises and a point of interconnection (POI), and which enables an NBN wholesale customer or its downstream service provider to supply a carriage or content service to a premises. The NBN Ethernet Product is supplied by means of the FTTP, FTTB, FTTN, FTTC, HFC, and wireless or satellite network. There are four product components that an NBN wholesale customer must acquire: network-network interface (NNI), a connectivity virtual circuit (CVC), an access virtual circuit (AVC), and a UNI. [16]

In order for retail service providers to supply services through the NBN, they must acquire AVCs at a specified speed tier and traffic class for each customer premises, and need at least one AVC for each. AVCs are available for four types of traffic classes:

- Traffic Class 1 (TC-1) – highest priority, dedicated capacity traffic class, suitable for voice
- Traffic Class 2 (TC-2) – business grade, used for delivering high-speed symmetrical Internet
- Traffic Class 3 (TC-3) – gives priority to transactional data such as business applications running on a wide area network (WAN)
- Traffic Class 4 (TC-4) – standard “best efforts” class used for delivering residential and small business broadband services. [16]

Services in each traffic class are available at different speed tiers defined by their upstream and downstream Layer 2 peak information rate (PIR).

Retail service providers using the NBN must also buy CVC capacity from NBN Co to carry aggregated customer traffic to the points at which their networks interconnect with the NBN. Providers can decide how much capacity to acquire for specific geographic regions or connectivity serving areas. The amount of CVC required determines the aggregate bandwidth

available on the NBN to send and receive data in a particular area. CVC is also acquired based on traffic class. [16]

NBN Co also provides fixed wireless and satellite connections for premises in regional and remote areas. [17]

NBN Co's customer base includes both small and large wholesale customers (retail service providers). The largest retail service providers acquire wholesale NBN services directly from NBN Co at all POIs and combine them with other communication services (e.g. transmission, interconnection, and Internet services) to supply retail NBN broadband services to end users.²⁵ Smaller retail service providers generally cannot connect to all POIs or may find it too costly, and instead acquire NBN aggregation services from a larger service provider. The larger provider supplies an aggregation service combining wholesale NBN services with other wholesale products in a bundled product through wholesale aggregation agreements, which are commercial agreements that are not subject to ACCC regulation. [18] Other retail service providers adopt a hybrid approach and directly acquire wholesale NBN services from NBN Co at some NBN POIs, but also acquire NBN aggregation service from other wholesale service providers at other POIs because, for instance, they do not have the scale to connect to them directly. [18]

Findings of the Wall report [19]

Under Australia's *Competition and Consumer Act*, the ACCC has the authority to issue access determinations (or declarations) and set wholesale service price ceilings and non-price terms of service for declared (or regulated) services. In 2011, the ACCC issued a final access determination covering six types of service: unconditioned local loop service (ULLS), wholesale line rental (WLR), public switched telephone network fixed originating and terminating access (FOAS and FTAS), and local carriage service (LCS).

In 1997, the ACCC determined that wholesale prices should generally be based on a hybrid costing approach. It argued that wholesale prices should be based on total service long-run incremental costs, which include a contribution to, or markup for, the recovery of common costs, referred to as TSLRIC+. The methodology would apply only to declared services that were well developed and necessary for competition in dependent markets, and in instances where the forces of competition worked poorly in constraining prices to efficient levels. The ACCC also decided to apply a retail minus retail costs (RMRC) approach for wholesale access pricing for some declared services, such as WLR and LCS. The RMRC approach is a top-down methodology that takes the retail price for a declared service and deducts the avoidable costs of retailing the service to end users to calculate an access price.

Following a review of its wholesale service pricing approaches, the ACCC issued a draft report of its findings in September of 2010, in which it argued against the continued use of the

²⁵ Five Australian retail service providers have publicly stated that they acquire NBN wholesale services at all 121 NBN POIs. However, there are at least nine NBN wholesale access seekers at each of the 121 POIs (the five noted above, which are at all the POIs, plus a number of other wholesale access seekers that obtain services from a number of POIs but not all POIs).

forward-looking TSLRIC+ approach²⁶ in favour of a building block model (BBM) approach. BBM allows for calculation of the revenue required to cover the access provider's efficient costs, including a commercial return on investments. Unlike TSLRIC+, under the BBM, asset values are locked in using an initial regulatory asset base (RAB) as the basis for setting prices. [19] The ACCC considered the BBM pricing approach as a means to meet the objective of ensuring that the access provider is adequately compensated for its costs over time. This is also consistent with the regulatory principle that a regulated business should expect to receive sufficient revenue to allow it to cover all expected prudent expenditure necessary to maintain a given level of service at each period into the future.

The Wall report also noted Australia's adoption of a structural separation approach where fibre-based wholesale services would fall under the purview of NBN Co, although its costing methodology was under review at the time.

Australia's approach to wholesale rate-setting methodology since 2012

In terms of pricing methodology, the ACCC has continued to use the BBM approach for the legacy declared fixed-line services supplied by Telstra. Subsequently, it also approved a BBM-based methodology called the long-term revenue constraint methodology (LTRCM) to determine prices for services provided by NBN Co. In Australia, the BBM and its variations are commonly used for regulating utilities.²⁷ [20]

Telstra

The BBM pricing methodology was implemented through the fixed-line services model (FLSM), which calculated prices in three steps: determining annual revenue requirements for each asset class, allocating costs to declared services, and determining prices from allocated costs. The FLSM calculates the aggregate revenue requirement according to the following formula:

$$RR_t = E(OPEX_t) + (RAB_{t-1} * WACC) + E(DEP_t) + E(TAX)_t [21],$$

where:

RR_t = the aggregate revenue requirement for the year

$E(OPEX_t)$ = the forecast operating expenditures for the year

RAB_{t-1} = the RAB at the beginning of the year, which equals the closing value of the RAB for the previous year

WACC = the regulatory weighted average cost of capital, which is multiplied by the RAB to calculate the required return on capital for the year

²⁶ For more information, refer to the Wall report and the ACCC Access Pricing Principles for Fixed Line Services Review [Draft Report](#), 2010

²⁷ For instance, the Australian Energy Regulator relies on the BBM to regulate wholesale electricity rates ([link](#))

$E(\text{DEP}_t)$ = the forecast depreciation expense for the period, which represents the return of capital for the year

$E(\text{TAX}_t)$ = the tax liabilities forecast to be incurred during the year

In 2015, the ACCC added wholesale ADSL service to the list of declared services, for a total of seven regulated services: ULLS, LSS, WLR, LCS, and wholesale ADSL. These are mainly supplied by Telstra on its copper public switched telephone network (PSTN) and digital subscriber line (DSL) networks. [2]

As indicated in the Wall report, the BBM pricing approach is designed to encourage economically efficient use of, and investment in, the infrastructure that supplies services to consumers. It does this by estimating prices that are based on efficiently incurred costs and enabling the access provider to recover those efficiently incurred costs, including a commercial return on the provider's investment. The fixed principles provision locks in an initial value for the RAB and specifies how certain pricing inputs within the BBM pricing methodology are to be determined. Since their establishment in 2011, the ACCC has decided to keep the fixed principles unchanged. [2] The FLSM was developed in 2011 and amended for the 2013 final access determinations to include assets used to supply the wholesale ADSL service. Since its initial adoption of the BBM approach, the ACCC has reviewed its position on a number of related issues, namely with regard to determining the inputs within the BBM pricing methodology and looking at other pricing issues that were not considered in the 2011 final access determinations.

In 2015, the ACCC held an inquiry as part of an overall review of fixed-line services, to determine the terms and conditions, including price, for these services. In the decision, the key issues that determined the set prices for the declared fixed-line services included (i) setting of regulated charges through a uniform price change; (ii) a revised cost allocation framework used to determine the regulated revenue to be covered; (iii) the appropriate level of operating and capital expenditure to be recovered (including updates to the inputs, as per NBN Co's updated rollout plan²⁸); and (iv) treatment of costs that arise as a result of the NBN. The ACCC also considered NBN Co's release of a revised rollout schedule, the reduction in Telstra's cost of capital since the 2011 charges, and the low level of inflation in 2015. [2]

Uniform price change

The ACCC's key final decision was for a uniform 9.4 per cent reduction in the prices of all seven declared line services offered by Telstra. This decision was in part based on the unique circumstances of the rollout of the NBN and the impact it had on Telstra's fixed-line assets. These include the arrangements that Telstra entered into with NBN Co as part of the NBN rollout, the sale and leasing of certain assets of its fixed-line network to NBN Co, and changes in the NBN plan and timing. The ACCC noted that there were no regulatory precedents for addressing these challenges, nor for the changes to the NBN arrangements that directly affected the ACCC's pricing decision and that had occurred since the ACCC began looking into final access determinations. In particular, there was a significant delay to the ACCC's inquiry,

²⁸ Set out in NBN Co's 2016 corporate plan

caused by the need for Telstra to update its demand and expenditure forecasts following the change to the multi-technology mix architecture for the NBN.

The decision to implement a uniform price reduction also reflects the ACCC's estimation of the prudent and efficient costs that should be recovered by Telstra. It also reflects the ACCC's view that access seekers should not incur higher charges as a result of costs associated with the arrangements between Telstra and NBN Co, which include expenditures related to the provision of services to the NBN Co by Telstra and the costs related to asset redundancy and under-utilization resulting from the migration of services from Telstra to NBN Co. The ACCC considered that, since users of the fixed-line network were not the cause of the aforementioned asset redundancy and under-utilization, costs should not to be allocated to them, particularly since Telstra has been provided with the opportunity to be compensated for those costs. [2] The ACCC set prices that were based on the costs of providing services on Telstra's fixed-line networks during the transition to the NBN and would ultimately provide certainty for all parties. The ACCC also decided not to make any changes to the geographic price structures for the declared ULLS, wholesale ADSL, or FOAS and FTAS. [2] The goal of the ACCC's decision to implement a uniform price reduction was to reduce industry disruption in the supply of different fixed-line services in the transition to the NBN. The ACCC considered this to be essential in helping to promote continued competition in the markets for carriage services. [2]

The final access determinations of primary prices following the 2015 decision (which were set to expire in June 2019) were as follows [22]:

Type of service	Unit	Final decision charges
<i>ULLS Bands 1 to 3</i>	\$ per line per month	14.68
<i>ULLS Band 4</i>	\$ per line per month	43.65
<i>WLR</i>	\$ per line per month	20.69
<i>LSS</i>	\$ per line per month	1.63
<i>LCS</i>	¢ per call	8.06
<i>FOAS & FTAS</i>	¢ per minute	0.86
<i>Wholesale ADSL Zone 1</i>	¢ per port per month	22.14
<i>Wholesale ADSL Zones 2/3</i>	\$ per port per month	26.87
<i>Wholesale AGVC/VLAN (capacity component of the wholesale ADSL service)</i>	\$ per Mbps per month	29.27

As per the ACCC's recent decision on the inquiry into final access determinations for fixed-line services, published in November 2019 [23], these prices will be extended until June 2024.

Revised cost allocation framework: fully allocated costs

Prior to the ACCC's development of the BBM approach, the majority of cost allocation factors for the 2011 final access determinations were based on a TSLRIC+ model. [2] The ACCC has since adopted a cost allocation framework that fully allocates the costs of the fixed-line

network, due to a rise in substitution from fixed-line to mobile services by end users, which in turn has led to the under-utilization of fixed-line assets. The result was an increase in unit cost for Telstra that the company could not recoup elsewhere. Therefore, the revised cost allocation framework would allow the allocation of some of the costs to access seekers and promote competition and efficient use of, and investment in, infrastructure. [2]

Changes to forecasting of operating and capital expenditures

The Wall report indicated that, at the time of the NBN rollout, its impact on Telstra's forecast expenditures and demand for the declared fixed services would be limited during the regulatory period covered by its decision (mid-2014). However, in 2015 the ACCC decided to exclude NBN-related expenditures from expenditure forecasts, given that they were considered incremental to the NBN and therefore future users of the NBN network, not current users of Telstra's fixed-line services, should bear the costs of NBN-related expenditures. [2]

Impacts of the NBN

As part of the move for the NBN to replace Telstra's fixed-line network to provide fixed-line telecommunications services in Australia, Telstra has had to begin migrating its customer base to the NBN, while selling and leasing certain infrastructure to NBN Co (and receiving payments for doing so). The ACCC predicted that this would lead to a loss of economies of scale of Telstra's fixed-line networks until it is fully decommissioned. As a result, the ACCC has decided to use the regulatory values approach to account for the Telstra-NBN arrangements. This involves treating assets sold to NBN Co as asset disposals and removing them from the RAB at their regulatory value. [2]

In order to reflect this decision in the FLSM, the ACCC made the following changes:

- Assets sold to NBN Co and made redundant by NBN migration are treated as asset disposals in the roll forward of the RAB;
- Telstra's approach to reflecting NBN Co's use of fixed-line assets in its cost allocation framework is maintained; and
- Adjustments are made to allocation factors for assets that are under-utilized as a result of NBN migration.

2019 inquiry into final access determinations for fixed-line services

The most recent inquiry on fixed-line services [23] concluded on 1 November 2019 and maintains the prices and non-price conditions for final access determinations²⁹ for all seven declared fixed-line services that are, at present, mainly supplied by Telstra on its copper networks, on the same terms of access as the existing services, to apply until the end of June 2024. The decision states that the ACCC considers this duration to be sufficient to ensure pricing stability and regulatory certainty, which in turn enable the declared services to support industry investment and planning in the remaining period to the completion of the NBN rollout. [22].

The ACCC's reasoning for the continuation of existing prices in nominal terms for these services is that it will promote the long-term interests of end users by providing price stability to access seekers in the remaining period of the completion of the NBN rollout as customers migrate to the NBN. Maintaining existing prices will also reduce the regulatory burden on the industry compared to a full reconsideration of fixed-line prices applicable during this relatively short period. The existing final access determinations contain a set of fixed principles that relate only to price terms and conditions and give form to the BBM pricing methodology used for declared fixed-line services. These existing fixed principles will expire on 30 June 2021, partway through the term of the new final access determinations.

The ACCC decision was to not apply the fixed principles for their remaining life. The ACCC also decided to not make new fixed principles for the balance of the term of the new final access determinations (FADs).

NBN Co

In 2013, NBN Co submitted a SAU that sets out the commitments relating to NBN Co's pricing as a wholesale-only service provider over the long run.³⁰ NBN Co's proposed costing approach is based on the LTRCM for determining prices for services (or "NBN Offers") provided by NBN Co. The LTRCM is based on the BBM, but it also incorporates an initial cost recovery account (ICRA). The ACCC ultimately accepted NBN Co's proposal on the grounds that the terms and conditions that set out the LTRCM are reasonable and in the long-term interest of end users.

NBN Co chose the LTRCM approach because it provides the company with the opportunity to recover its prudent and efficient costs of supply over the term of the SAU, including an appropriate commercial return. [20] The key elements of LTRCM are the annual building block revenue requirement (ABBRR), which is the revenue NBN Co must earn to recover its costs (including on previous capital investments); the RAB roll-forward equation, which determines how the value of capital investments made by NBN Co will change over time; and the ICRA, which facilitates the capitalization and deferred recovery of initial revenue shortfalls. In NBN

²⁹ Once a service is declared, the ACCC can make regulated terms of access through a final access determination, which specifies how an access provider is to comply with any or all of the standard access obligations.

³⁰ The undertaking is set to expire in 2040; Module 1 of the undertaking, which includes NBN Co's set charges, expires in 2023.

Co's case, the expected low initial take-up of NBN services combined with price controls was predicted to result in insufficient revenues to enable NBN Co to meet its annual revenue requirement. These shortfalls would then be included in the ICRA, to be recovered in later years. [20]

The LTRCM assumes that all cash flows – capital and operating expenditure and revenue – are incurred approximately at the end of each financial year and held constant throughout the term of the SAU. This form of timing consistency is assumed to achieve a net present value of zero for NBN Co's expected future cash flows over the term of the SAU. The ACCC determined that the consistent end-of-year timing assumptions are transparent and easy to administer and will allow the company to recover its prudent and efficient costs, but no more. [20]

Of note is that NBN Co's SAU allowed for the way in which building block components are calculated to change over time. In Module 1 (ending in June 2023),³¹ they will be determined annually *ex post* by the ACCC based on the methodologies set out in its SAU, and the cost of capital would be calculated by adding a fixed-risk premium to the risk-free rate. In Module 2 (operational from June 2023 to the end of the undertaking in 2040), building block components will be determined periodically *ex ante*, based on forecasts and approved by the ACCC, and the cost of capital will be determined periodically *ex ante* in replacement module applications approved or rejected by the ACCC. [20] Unlike Module 1, the LTRCM provisions contained in Module 2 do not specify detailed methodologies for determining the ABBRR, the RAB, or the ICRA, but instead set out the high-level principles that will apply to the determination of these values, with detailed methodologies to be specified in additional replacement modules of three to five years' duration. [20]

NBN Co's SAU also sets out price ceilings (or initial maximum regulated prices) for new and previously zero-priced NBN offers and other charges. The ACCC permits maximum regulated prices to change over time through a number of processes, including the Consumer Price Index less 1.5 per cent price control, a price review arrangement (which can be initiated by either NBN Co or the ACCC), tax change events (through a process for changing maximum regulated prices in response to a tax change event), or changes to zero-priced NBN offers and other charges. [20] In its final decision accepting NBN Co's SAU, the ACCC noted that by placing restrictions on how prices change over time, NBN Co has incentives to price services in a manner that encourages take-up and increases revenue, because it has to increase demand for existing services or introduce new services in order to increase its revenue. Further, these restrictions on how prices change over time also creates incentives for efficient investment in networks, given that NBN Co cannot set prices above the price control to recover costs. [20]

As set out in NBN Co's SAU, access seekers incur a charge for each AVC purchased (with the price being dependent on speed), as well as a charge for the amount of CVC purchased to service these AVCs. For instance, the charge for 12/1 Mbps AVC is \$24 per month, and CVC is charged at \$17.50. However, between 2016 and 2018, NBN Co introduced a series of discounting methods, starting with a discount where the higher level of provisioning of CVC

³¹ NBN Co has proposed two modules or time periods for the duration of the undertaking: Module 1 has been in operation since the commencement of the undertaking and will end in June 2023, while Module 2 is to operate from the expiry of Module 1 to the end of the undertaking in 2040.

per AVC was offered at a reduced price. Subsequently, the company introduced another discount, whereby each retail service provider customer was able to pay a CVC price that depended on its own average level of provisioning per AVC. NBN Co also introduced a type of discount called Focus on 50 (Fo50), allowing retail service providers to purchase around 50 per cent more CVC per AVC without paying more than they were paying under dimension-based discount³² by retail provider (DBDR) prices. Subsequently, NBN Co offered a monthly discount of \$7 on the 50 Mbps AVC to make it the same price as the 25 Mbps AVC of \$27 per month. This resulted in a continued increase in CVC per AVC purchased by retail service providers and a rise in take-up of 50 Mbps services, which improved the performance of end-user NBN services in Australia in 2018. [16] Near the end of 2018, bundled discounts introduced by NBN Co had fully replaced the Fo50 discounts. In order to take advantage of them, retail service providers must operate separate CVCs for specific services and unbundled services for each customer service area. CVC prices for unbundled services have reverted to the DBDR discount prices, due to expire in 2020. The evolution of the above-mentioned discount-based pricing approaches gave rise to concerns about rising costs for basic wholesale access prices, and consequently to higher prices and reduced availability of retail plans for basic broadband services. [16]

Following an extensive consultation with retail service providers and industry groups, in November 2019 NBN Co issued the results of its Wholesale Pricing Review 2019 [24]. Based on feedback received, NBN Co decided to implement the following changes to its wholesale pricing model:

- Modify the bundle discount on the wholesale 12 Mbps service by reducing the additional charges applied for monthly peak CVC usage across entry-level bundle services.
- Reduce the charge for the wholesale 25 Mbps bundle discount for both fixed-line and fixed wireless services.³³
- Increase CVC inclusions and make certain bundle discounts more affordable for retail service providers, to address the high end-user demand for video streaming and gaming.
 - This included introducing an overhead allowance on certain AVC speeds.³⁴
- Update the fixed-line 50 Mbps and wireless bundle discounts (by increasing CVC inclusions) to accommodate retail service providers who are seeing growth in usage of data-intensive applications.³⁵

³² The dimension-based discount is an initiative introduced by NBN Co for its wholesale CVC, whereby the cost per unit decreases as providers increase their CVC purchases. It is designed to encourage providers to purchase higher-quality services.

³³ A customer will be able to order a wholesale 25 Mbps bundle discount at a charge of \$37 per month rather than \$45 per month, and 1.25 Mbps rather than 2 Mbps of included CVC.

³⁴ Where NBN Co configures existing AVC shaper to increase the achievable Layer 2-peak downstream speed where network capacity permits, in turn assisting retail service providers to supply higher layer 3-peak downstream speeds to customers.

- Develop new AVC product tiers for wholesale 100 Mbps, 250 Mbps, and up to 1 Gbps speeds, and adopt lower wholesale prices for each tier.³⁶
- Keep in place the detailed conditions requiring retail service providers to ensure they are purchasing enough CVC capacity to meet the usage demands of their customers, while making several adjustments starting in spring of 2020:
 - adopting a new aggregate calculation method to determine the amount of CVC overage retail service providers incur;
 - increasing the overage waiver threshold from 300 Mbps to 1.5 Gbps; and
 - simplifying the CVC utilization conditions and breach consequences.
- Standardize various AVC activation charges, such as service transfers and reactivation fees in 2020; in the interim, NBN Co will temporarily discount service transfer fees.³⁷
- Make changes to the discount review process, including a commitment for NBN Co to (i) conduct a review of discounts and CVC inclusions on an annual basis, and (ii) publish the roadmap of charges for bundle discounts and CVC inclusions extending to two years, adding visibility each year with respect to upcoming changes in the next year of the pricing schedule.

Mobile access services

As mentioned above, the ACCC regulates declared services, which are those for which a service provider must supply to other parties in accordance with the standard access obligations. Aside from fixed-line services, mobile terminating access services (MTAS) are considered declared services. An MTAS is a wholesale service provided by an MNO to fixed-line operators and other MNOs to connect (or “terminate”) calls on its mobile network. In Australia, the commercial arrangements between network providers are based on the “calling party pays” or “termination” model. [25] Ultimately, the ACCC regulates the MTAS to ensure that calls can be made between consumers on all mobile networks and between consumers on mobile networks and fixed-line networks.

The ACCC regulates MTASs to prevent MNOs from setting unreasonable terms, including setting high prices, for access to terminating voice calls on their network. Since the calling party pays model means that the receiving party does not consider the charge for terminating a call

³⁵ From May 2020, the CVC inclusion in the fixed-line wholesale 50 Mbps and wireless bundle discounts will be increased from 2 Mbps to 2.25 Mbps per AVC, while keeping the effective charge unchanged at \$45 per month. This provides \$2 of additional value of CVC capacity at no additional cost to retail service providers. From May 2021, the CVC inclusion will be increased to 2.5 Mbps per AVC, while keeping the effective charge unchanged at \$45 per month.

³⁶ Tier 1 (100/20 Mbps) bundle discount starting with 3.75 Mbps of included CVC capacity, to be increased to 4.25 Mbps in May 2021, at an effective charge of \$58 per month; Tier 2 (250/25 Mbps) bundle discount starting with 4.75 Mbps of included CVC capacity, to be increased to 5.25 Mbps in May 2021, at an effective charge of \$68 per month; and Tier 3 (up to 1000/502 Mbps) bundle discount starting with 5.75 Mbps of included CVC capacity, to be increased to 6.25 Mbps in May 2021 at an effective charge of \$80 per month.

³⁷ The interim service transfer fees will be discounted from \$22.50 to \$5.00, effective from 29 November 2019 to 30 November 2020.

when choosing their mobile service provider, and there is currently no effective substitute to the downstream services for which MTAS is an essential input, the terminating network has the ability to exercise market power, distort competition, and, ultimately, charge inefficiently high prices. [25]

The ACCC has taken a cost-based approach to setting prices for the MTAS, due to the notion that it promotes competition and allocative efficiency in the downstream markets in which the service is an essential input. [25] Since 2004, the ACCC used the TSLRIC+ model to set regulated prices for the MTAS, though it has relied on a number of methodologies to implement it through the years [25] as follows:

- 2004: the ACCC adopted the gradual adjustment path to determine a target MTAS rate, whereby the target rate would be reached over a period of four years;
- 2007 (and again in 2009): the ACCC set indicative prices for the MTAS based on the output from a custom Wik-Consult³⁸ cost model, which estimated the cost of a hypothetical efficient MNO providing the MTAS on a 2G network, based on the TSLRIC+ pricing principles;
- 2011: the ACCC set price terms for the MTAS in an final access determination; the ACCC assessed the efficient cost of providing the MTAS based on the estimates from the Wik-Consult model, industry developments, and international estimates of the efficient cost of providing the MTAS;
- 2015: the 2015 final access determination used an international benchmarking approach to estimate the costs of voice termination services (i.e. TSLRIC+ outputs from various cost models of other jurisdictions). At this time, SMS termination was added to the list of declared services, with the cost of termination charges estimated based on the proportion of the cost for voice termination and the cost of specific infrastructure required to carry SMS traffic. ACCC pricing decisions for the MTAS since 2004 are set out below [25]:

Time period	Voice (cents/min)	SMS (cents/SMS)
1 July – 1 December 2004	21	N/A
1 January – 31 December 2005	18	N/A
1 January – 31 December 2006	15	N/A
1 January – 30 June 2007	12	N/A
1 July 2007 – 31 December 2011	9	N/A
1 January – 31 December 2012	6	N/A
1 January – 31 December 2013	4.8	N/A
1 January – 30 December 2015	3.6	N/A
Since 1 January 2016	1.7	0.03*

*Expiry extended until a new determination is made

³⁸ Wik-Consult is a third-party consultant that was hired by the ACCC to develop the model.

- 2019: the ACCC decided not to extend the declaration of SMS termination, because over-the-top messaging services are now considered to be effective substitutes for SMS services for which SMS termination is required to be supplied, and extending the declaration of SMS termination is not necessary to promote the long-term interests of end users. [26] The ACCC has also decided to extend the effective period of the existing determinations (set to expire in June 2019) until a new determination is made. [26]

The ACCC is currently engaged in a public inquiry for a review of its domestic MTAS final access determinations, including optimal pricing methodologies going forward. On 4 December 2019, the ACCC extended the decision making period for the proceeding for a period of six months, to June 2020, in order to undertake further work to develop and implement the pricing methodology for the MTAS, including further consultation on the pricing methodology. A position and consultation paper was published on 18 December 2019, which details the pricing methodology being developed by the ACCC. [27]

Domestic transmission capacity services

The domestic transmission capacity service (DTCS) is another declared service that is regulated by the ACCC.

The DTCS is a generic transmission service that provides an essential input for the supply of almost all other downstream retail and wholesale telecommunications services, including fixed-line, mobile, and NBN services. Declaration of the DTCS limits the potential for carriers to exercise market power by preventing or hindering access, and thereby allows entities seeking access to third-party infrastructure to acquire services on reasonable terms.

Only specific types of transmission service are classified as DTCSs. As set out in its service description, a DTCS is a service that carries large volumes of voice and data communications from one point to another point via symmetric network interfaces on a permanent and uncontended basis. The DTCS does not include communications

- from one customer transmission point directly to another customer transmission point,
- from one access seeker network location directly to another access seeker network location, or
- among certain transmission routes that have been deregulated, including specified inter-capital, regional, and metropolitan routes.

Over time, the ACCC has progressively removed regulation in areas that have been found to be competitive, while maintaining it in areas where there is no effective competition or where access to transmission services is limited.

Prior to 2012, there was no regulated price for the DTCS, and no agreed methodology for setting prices. In the 2012 DTCS FAD, the ACCC adopted a domestic benchmarking model to price the DTCS. It used observed pricing information on transmission routes that were deemed to have effective competition, to determine transmission prices on uncompetitive routes.

In this manner, the pricing approach sought to limit the capacity for monopoly profits to be earned on those uncompetitive routes, and to reflect the cost efficiencies generated on competitive routes.

In the 2016 DTCS FAD, the ACCC refined its benchmarking approach based on industry feedback and commercial contract data supplied by transmission providers. In particular, it specified a regression model, with key determinants being those factors that had the strongest statistical relationship with price, namely

- capacity (Mbps) – the data rate of the connection, measured in Mbps;
- distance (km) – the radial distance between the A-end exchange service area (ESA) and the B-end ESA; and
- route type – whether the route is inter-capital, metropolitan, regional, or tail-end, based on the DTCS service description.

A dummy variable was also used to account for a structural break in the pricing of services less than 2.5 Mbps and less than 5 km.

The model allowed the ACCC to set regulated prices for DTCS services up to 1 Gbps, with higher-capacity services determined by commercial negotiation.

The ACCC is currently reviewing its pricing approach as part of the 2019-20 DTCS FAD inquiry.

Glossary of terms/definitions

ABBRR: Annual building block revenue requirement

Represents the amount of revenue that NBN Co would be required to earn in order to recover its costs, including a return on and of its previous capital investments in a particular year. ([Source](#))

ADSL/ADSL2+: symmetric digital subscriber line

Uses copper phone line to deliver Internet while allowing for the delivery of home phone service. ([Source](#))

AVC: Access virtual circuit

Usually comprises the first component of the wholesale cost, and is assigned to each subscriber in order to identify their traffic on the NBN. Access seekers (retail service providers) generally purchase one AVC per subscriber. ([Source](#))

BBM: Building block model

A costing methodology commonly used in Australia based on a calculation of the revenue required to cover the access provider's efficient costs, including a commercial return on investments.

CVC: Connectivity virtual circuit

A bandwidth pipe, where the size is determined by its cost. The larger the CVC, the better the service to subscribers within the area. Access seekers (retail service providers) purchase CVCs for each connectivity serving area they cover. ([Source](#))

DBDR: Dimension-based discount by retail service provider

A discount introduced by NBN Co in 2017 on unbundled services. ([Source](#))

DSL: Digital subscriber line

DSLAM: Digital subscriber line access multiplexer – A piece of equipment, operated by a telephone company, that allows customers to receive high-speed data access services over existing copper telephone lines. The DSLAM is located at the central office or other location designated by the telephone company and delivers high-speed data transmission by separating voice-frequency signals from high-speed data traffic. The DSLAM controls and routes high-speed data traffic between the subscriber's end-user equipment (router, modem, or network interface card) and the service provider's network. ([Source](#))

Ex ante: Refers to future events, such as the potential returns of a particular security, or the returns of a company. Means “before the event” in Latin. ([Source](#))

Ex post: Refers to actual returns, and is customarily used to forecast the probability of incurring a loss on an investment on any given day. Means “after the fact” in Latin. ([Source](#))

FAD: Final access determination**FLSM:** Fixed-line services model

Designed by the ACCC to facilitate the application of a building block approach to set prices for declared fixed access services. The model allocates capital charges, operating costs, and overheads to services, and uses these to calculate prices for declared wholesale services. ([Source](#))

FOAS: Fixed originating access services (public switched telephone network originating access service)

FTAS: Fixed terminating access service (public switched telephone network terminating access service)

FTTB: Fibre to the building

Used when NBN connects an apartment block or similar type of building to the NBN access network by running a fibre optic line to the fibre node or cabinet in the building's communications room, relying on the building's existing technology to connect to individual apartments. The third-party provider manages the set-up and provides the modem. ([Source](#))

FTTC: Fibre to the curb

A newer access technology as part of NBN's broadband access rollout, used in circumstances where fibre is extended close to the premises, connecting to a small distribution point unit generally located inside a pit on the street. From this point, the existing copper network connects to the fibre to form the final connection. In some cases, end users are able to self-install the necessary NBN connection box, though they must purchase a plan from a third-party provider. ([Source](#))

FTTN: Fibre to the node

Used where the existing copper phone and Internet network from a nearby fibre node (e.g. a street cabinet) is used to make the final part of the connection to the NBN access network. Street cabinets allow the NBN access network signal to travel over a fibre optic line from the exchange to the cabinet, and to connect with the existing copper network to reach the premises. ([Source](#))

FTTP: Fibre to the premises

Used in circumstances where a fibre optic line is run from the nearest available fibre node directly to the premises. Management of installations including delivery of service to end users is managed by a phone or Internet provider that purchases the wholesale service from NBN. ([Source](#))

HFC: Hybrid fibre coaxial

A technology employing both optical fibre cable and coaxial cable in different portions of the network to carry broadband content (video, data, voice). NBN relies on an HFC connection in circumstances where the existing cable network can be used to make the final part of the NBN network connection; i.e. an HFC line runs from the nearest available fibre node to the premises. The installation of the specialized access network device is managed by a third-party provider. ([Source](#))

ICRA: Initial cost recovery account**Layer 2 virtual connection:**

A circuit based on a point-to-point connection that transports traffic by means of a tunneling technology on the service provider network. A Layer 2 circuit creates a virtual connection to direct traffic between two customer edge routers across a service provider network. ([Source](#))

LCS: Local carriage service

A declared service that enables access seekers to resell local calls to end users without having to invest in their own network and switching equipment. The LCS is purchased in conjunction with the WLR service. ([Source](#))

LRIC: Long-run incremental cost

LSS: Line sharing service

A declared service that enables access seekers to share the use of the copper line connecting consumers to the telephone exchange, enabling them to provide fixed Internet services using their own equipment. ([Source](#))

LTRCM: Long-term revenue constraint methodology

Wholesale costing methodology used by NBN Co. It determines NBN Co's allowed annual regulated revenue and the value of its regulatory asset base, and accumulates the initial unrecovered costs that NBN Co may recover during the term of the SAU. The LTRCM process allows NBN Co to recover only its prudent and efficient costs, including an appropriate return on investment. In this way, it provides NBN Co incentives to incur only efficient expenditure. ([Source](#))

MNO: Mobile network operator**MVNO:** Mobile virtual network operator**MRP:** Maximum regulated price**MTAS:** Mobile terminating access service**NBN:** National broadband network

A wholesale-only, open access telecommunications data network project to provide broadband access to nearly all of Australia's population at 100 Mbps. It was designed to replace the existing copper cable telephony network using a multi-technology mix consisting of FTTB, FTTC, FTTN, FTTP, HFC, fixed wireless and satellite.

NBN Co: A wholly government-owned entity established in 2009 to design, build, and operate Australia's wholesale broadband access network (NBN).

NNI: Network-to-network interface**PIR:** Peak information rate

The maximum speed you can expect on an uncongested network. Actual speed will be affected by a variety of factors. [28]

POI: Point of interconnection

The connection point that allows retail service providers and wholesale service providers to connect to the access network [29]

PSTN: Public switched telephone network

In Canada, the network of local and long-distance switching centres that are interconnected through transmission facilities and provide circuit-switched connections that can access and be accessed by telephone subscribers through the local loop.

RAB: Regulatory asset base – The net value of the organization’s regulated assets [30]

SAU: Special access undertaking

Statement given to the ACCC by an NBN corporation (such as NBN Co) under section 152BEBB of the *Competition and Consumer Act 2010 (CCA)*. ([Source](#))

Structural separation: A company’s retail business, which deals directly with customers, as distinct from its network business, which operates infrastructure. ([Source](#))

TSLRIC+: Total service long-run incremental cost plus an allocation of indirect overhead costs. [31]

ULLS: Unconditioned local loop service

The declared ULLS allows access seekers to use the copper line connecting end users to the local telephone exchange, allowing them to provide both fixed Internet (broadband) and voice services using their own DSLAM and other exchange equipment. ([Source](#))

UNI: User network interface

An interface located at a physically defined end user’s premises, where the access provider’s designated superfast telecommunications network is present to an end user. [32]

WAN: Wide area network

A network that provides communications services to a geographic area larger than that served by a local area network or a metropolitan area network.

WBA: Wholesale broadband agreement

Sets out price and non-price terms in relation to the supply of NBN Co’s services, and the processes for providing NBN Co’s customers with operational and technical information in relation to these services. ([Source](#))

WLR: Wholesale line rental

The declared WLR allows access seekers, for a monthly per-user charge, to purchase a line rental service, which includes access to the copper line and associated services (including a dial tone and telephone number) supplied using Telstra’s equipment. ([Source](#))

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II. European Union

Executive summary

The telecommunications sector in the European Union (EU) is broadly regulated by the regulatory framework for electronic communications, which is designed to address technological progress and market requirements within the EU. Most recently, the EU adopted the European Electronic Communications Code (EECC), which aims to apply uniform rules throughout Europe, encourage competitive pricing, and protect consumers. The Body of European Regulators for Electronic Communications (BEREC) assists national regulatory authorities (NRAs) of EU member states in the implementation of the telecommunications rules, gives advice on request and on its own initiative to European institutions, and complements the regulatory tasks performed at the national level by the NRAs.

The EU’s regulatory framework for wholesale telecommunications services can be summarized as follows:

- *Wholesale voice call termination:*
 - *The evaluation of efficient costs must be based on current cost values, and the cost methodology to calculate efficient costs must be based on a bottom-up modelling approach using long-run incremental traffic-related costs of providing the wholesale service (i.e. bottom-up long-run incremental cost [BU-LRIC]).*
- *Access to specific network elements and facilities (including unbundled local loops [ULLs] and sub-loops, and active or virtual network elements and services): NRAs may impose their own obligations on undertakings.*
- *Wholesale access to copper and next-generation technology: NRAs should adopt a bottom-up long-run incremental costs plus (BU-LRIC+) methodology.*
- *Civil engineering assets: NRAs can set access price controls, where appropriate. Any such controls should include pricing arrangements that depend on volumes or length of contract in accordance with EU law, and should have no discriminatory effect.*
- *Next-generation broadband services: pricing flexibility*
 - *NRAs have the ability to decide whether to maintain or not to impose regulated wholesale access prices on next-generation networks if sufficient competition exists.*
 - *Where there are undertakings with significant market power (SMP), pricing flexibility should be accompanied by additional safeguards to protect competition and end-user interests.*
 - *Co-investment agreements (i.e. co-ownership of network assets) is encouraged to promote long-term risk sharing.*
- *Mobile roaming: completely eliminated*
 - *Maximum average price of 3.2 cents per minute of voice calls, until June 2022*
 - *Maximum average price of 1 cent per text message (SMS), until June 2022*
 - *Gradual reduction of maximum average charges for regulated data roaming services*

Regulatory environment and market composition

The European Union (EU) is an economic and political union of 28 countries whose key institutional bodies include the European Council, the European Parliament, and the European Commission. The European Commission promotes the interests of the EU as a whole by proposing and enforcing legislation as well as by implementing policies and the EU budget. [1]

Member states' own regulatory bodies are referred to as national regulatory authorities (NRAs). Telecommunications markets in the EU have evolved over the years, gradually moving away from national public monopolies within member states to full liberalization.

The telecommunications sector is broadly regulated by the current regulatory framework for electronic communications, [2] adopted in 2002 and updated in 2009, which has since been supplemented by a number of additional legislative instruments. The current framework is made up of a number of directives and regulations, including the Access Directive,³⁹ the Universal Service Directive, the Regulation on Body of European Regulators for Electronic Communications (BEREC), and the Regulation on roaming on public mobile communications networks. [3] The framework is designed in consideration of technological progress and market requirements within the EU. More recently, the EU adopted the European Electronic Communications Code (EECC), which aims to apply uniform rules throughout Europe, encourage competitive pricing, and protect consumers. The EECC entered into force in December 2018 and will need to be transposed into national law within member states by December 2020. [4]

In 2009, the European Parliament established BEREC,⁴⁰ supported by the BEREC Office, headquartered in Riga, Latvia, to assist NRAs in the implementation of the telecommunications rules, give advice on request and on its own initiative to the European institutions, and complement the regulatory tasks performed at the national level by the NRAs. [5] BEREC also issues its own guidelines to ensure consistent implementation of the Regulatory framework for electronic communications by NRAs. BEREC's strategic objectives include promoting competition and investment, promoting the internal (EU) market, and empowering and protecting end users. BEREC commenced its activities in 2010 and became fully functional in 2011. [6]

A note on the EU's legal instruments

In the EU, primary legislation generally refers to treaties that are negotiated at intergovernmental conferences and ratified by each member state. They set out rules and procedures for EU decision making. Institutions involved in the process are the European Council and Council of the European Union, European Parliament, and the European Commission.

Secondary legislation includes three binding legal instruments:

- **Regulations** have general application, are binding in their entirety, and are applicable in all member states.
- **Directives** are binding with regard to the result to be achieved, and upon each member state to which they are addressed, but leave the NRAs the choice of form and method.
- **Decisions** are not binding in their entirety, but instead specify those to whom they are addressed, and are binding only upon them.

and two non-binding legal instruments:

³⁹ The Access Directive sets out specific directions for NRAs to impose obligations on operators to provide access to specific network elements, including ULLs, interconnection facilities, co-location, and open access to technical interfaces, protocols and other technologies that are required for interoperability of services or virtual network services.

⁴⁰ BEREC was created by a 2009 regulation that was replaced in 2018.

- **Recommendations** call upon the party to whom they are addressed to behave in a particular way without placing it under any legal obligation.
- **Opinions** are issued by the EU institutions and give assessments of situations or developments in the EU or in the individual member states. They may also prepare the way for subsequent, legally binding acts, or be a prerequisite for the institution of proceedings before the Court of Justice of the European Union. [19]

The telecommunications regulatory framework sets up an *ex-ante* access regulation by identifying competitive bottlenecks in telecommunications markets in the EU and imposing remedies to address them. This approach has historically been effective in establishing competitive telecommunications markets within the EU, resulting in increased choice, affordable prices, and high-quality innovative services. Member states' NRAs can implement their own access regulations, but they must do so in close cooperation with the European Commission, and must conduct national and EU-wide consultations on draft regulatory measures they intend to take prior to the adoption of the measures. [3] While the framework has resulted in benefits for end consumers, the liberalization of telecommunications markets has been largely felt only at the national level, and has not resulted in a true single market. [3] In 2015, the Commission adopted a "digital single market for Europe" initiative, which sets out the European Commission's priorities in the field of the digital economy and highlighted the creation of a single market for content and telecommunications services. The legislative proposals are currently being considered by the European Parliament and the Council. [3]

The EU regulatory framework imposes relatively strict access obligations on incumbent operators compared to other jurisdictions, such as the U.S., and covers both legacy and fibre infrastructures. [7] In terms of traditional copper telephone networks, regulation has been based on the "ladder of investment" concept whereby new entrants enter the markets gradually so that each step requires a certain level of investment in their own infrastructure. This has enabled access seekers to increase their capabilities to offer better service at the retail level. [3] The new EECC is focused on the rollout of very high-capacity fixed networks. It effectively strengthened the role of NRAs – giving them the flexibility to implement the rules as appropriate – and reinforced competition safeguards as part of the new co-investment model, which encourages agreements between operators based on risk- and cost-sharing, and increased use of existing infrastructure such as towers and wiring.

With regard to mobile broadband service markets, there are, on average, three or four mobile network operators (MNOs) in each EU member state, which has generally remained constant over the years. The EU has also established detailed legislation on significant market power (SMP) that applies to markets for wholesale voice call termination on individual mobile networks largely run by structural monopolies. In Europe, the increase in demand for better mobile networks has given rise to a number of operators engaging in various forms of network sharing, where two or more MNOs agree to share network infrastructure with a view to reducing the cost of deployment or operation of the network. This type of sharing can apply to either passive or "non-intelligent" aspects of the radio access network (RAN), such as sites, masts, and antennas, or to active "intelligent" elements of the RAN, such as base stations, controllers, and in some cases, radio spectrum.

The Commission also allows for state intervention in cases where there is a need to provide support for telecommunications companies to ensure broadband is delivered to all EU citizens, particularly those that live in rural and remote regions. State aid is governed through a set of

rules and guidelines to ensure support is justified and does not result in harm of commercial broadband providers. [3]

Findings of the Wall report [8]

The Wall report found that the European Commission set a common obligation of cost orientation for wholesale services as set out in its 2002 Access Directive, but that it did not adopt any single recommended costing approach, with the exception of call termination. In this instance, the European Commission issued a recommendation in 2009⁴¹ stating that evaluation of efficient costs should be based on current cost and the use of a bottom-up long-run incremental cost (BU-LRIC) modelling approach. The recommendation also stated that the results of this approach may be compared with those of a top-down model, which uses audited data with a view to verifying and improving the robustness of the results. Further, the cost model should be based on efficient technologies available in the time frame considered by the model, that the increment should be defined as the wholesale voice call termination service provided to third parties, and that depreciation should be relied on wherever feasible.

In terms of transition to next-generation networks, the Wall report noted the European Commission's goal of ensuring consistency of regulatory approaches taken by NRAs through its 2010 recommendation on next-generation access. In instances where an operator was found to have SMP,⁴² the European Commission deemed it appropriate to mandate access to a number of services, including civil engineering infrastructure (e.g. passive infrastructure such as buildings, towers, poles, masts, and manholes), unbundled access to fibre-to-the-home (FTTH) or fibre-to-the-building connections, unbundled access to nodes or cabinets, and wholesale broadband access. Prices should be cost-oriented and must be based on guidelines that NRAs use for pricing next-generation access. This included a recommendation for NRAs to consider whether duplication of the relevant next-generation access infrastructure is economically feasible and efficient, and, where it is not, to use different cost bases for the calculation of cost-oriented prices for replicable and non-replicable assets, or at least adjust the parameters underpinning their cost methodologies in the latter case. In cases where next-generation access investments' profitability depends on uncertain factors such as assumptions of significantly higher average revenues per user or increased market shares, NRAs should assess whether the cost of capital reflects the higher risk of investment relative to investment into current networks based on copper.

For pricing of access to fibre in the case of FTTH (an unbundled fibre loop, which refers to an access network method that delivers the highest possible connection speed by using optical fibre that runs directly into the home, building, or office [9]), the European Commission recommended that NRAs include a higher risk premium to reflect any additional and quantifiable investment risk incurred by the SMP operator. In addition, pricing flexibility could be provided via long-term commitment rates or volume discounts. As part of its non-

⁴¹ Recommendation on the regulatory treatment of fixed and mobile termination rates

⁴² NRAs may withdraw or amend conditions imposed on operators should a market analysis indicate that they do not have SMP (see Article 6.3 of the Access Directive). [20]

discrimination principle, the European Commission also recommended that the price charged to the SMP's downstream arm should be the same as the price charged to third parties.

For pricing access to the copper sub-loop (the EU defines a local sub-loop as a partial local loop connecting the network termination point at the subscriber's premises to a concentration point or a specified intermediate access point in the fixed public telephone network [10]) in the case of fibre to the node, it was recommended that NRAs impose a cost-based access to all items required for sub-loop unbundling (including backhaul and ancillary remedies) and set access prices at levels no higher than the cost incurred by an efficient operator⁴³ (i.e. efficient costs, which should be evaluated using bottom-up modelling or benchmarks where available). In addition, the European Commission recommended that NRAs not consider the risk profile to be different from that of existing copper infrastructure.

The recommendation on next-generation access also covered access to civil engineering (namely ducts), where it noted that the principle of cost orientation should also be applied. It was recommended that individual NRAs regulate access prices to such infrastructure consistently, using the same methodology used for pricing access to the unbundled local copper loop (ULL). They should also ensure that access prices reflect the costs borne by the SMP operator, and that they capture the proper value of the infrastructure concerned. Actual infrastructure lives should be taken into account, and the risk profile should not be considered to be different from that of copper infrastructure, except where the SMP operator had to incur specific civil engineering costs to deploy the network.

The EU's approach to wholesale rate-setting methodology since 2012

While there have been several legislative and policy developments within the EU's communications sector over the past decade, the scope of its regulatory involvement in the wholesale pricing of telecommunications services does not appear to have shifted dramatically. A notable change was the adoption in 2018 of the EECC, as well as a revised remit for BEREC, focusing on BEREC's increased role in assisting in the rollout of high-capacity networks and ensuring smooth and consistent application of regulatory measures within the EU.

In 2013, the Commission issued a recommendation on costing methodologies aimed at promoting competition and enhancing broadband investment. [11] One of the key drivers of the recommendation was the continued presence of inconsistencies among member states in terms of regulatory obligations and application of price controls. The Commission recommended that, for wholesale access to copper and next-generation technology, NRAs should adopt a bottom-up long-run incremental costs-plus (BU-LRIC+) methodology. This methodology includes a bottom-up modelling approach using long-run incremental cost (LRIC) as the cost model with the addition of a markup for the recovery of common costs. [11] NRAs were recommended to value all assets constituting the regulatory asset base (RAB) of the modelled network on the basis of replacement costs, except for reusable legacy civil engineering assets. For these, NRAs should rely on an indexation method, whereby the RAB is set at the regulatory accounting value

⁴³ Evaluation is based on current cost values. The cost methodology to calculate efficient costs shall be based on a bottom-up modelling approach using long-run incremental traffic-related costs of providing the wholesale voice call termination service to third parties. See Article 73 of the [EECC directive](#) for more information.

net of the accumulated depreciation at the time of calculation, indexed by an appropriate price index, such as the retail price index. When applying the method of asset valuation, NRAs should lock in the RAB corresponding to the reusable legacy civil engineering assets and then roll it forward from one regulatory period to the next. The lifetime of civil engineering assets should be set at a duration corresponding to the expected period of time during which the asset is useful and to the demand profile (normally not less than 40 years in the case of ducts). NRAs can consider various approaches to modelling the hypothetical efficient next-generation network, depending on the access technology and network topology that best fit national circumstances. [11]

The new EECC

Since 2017, the EU has been engaged in telecommunications reform to prepare for high-speed connectivity and next-generation technologies such as 5G. In 2018, the EU adopted the new, legally binding EECC,⁴⁴ which includes many of the same principles regarding wholesale voice termination rates that were set out in previous recommendations. There is also a new requirement for the European Commission to adopt a delegated act setting out uniform maximum voice termination rates for all of the EU. The EECC also includes rules for wholesale-only operators with SMP.

The EECC reaffirms that equivalence of inputs (EoI)⁴⁵ is the surest way of achieving effective protection from discrimination. It also recognizes that providing regulated wholesale inputs on an EoI basis is likely to trigger higher compliance costs, and asserts that those costs should be measured against the benefits of (i) more vigorous competition downstream, and (ii) the relevance of non-discrimination guarantees in circumstances where the SMP operator is not subject to direct price controls. NRAs must take caution to assess whether provision of wholesale inputs on an EoI basis would create disproportionate effects on the operators. [12]

For access to specific network elements and facilities, the new EECC rules are generally in line with past recommendations; namely, NRAs may impose obligations on undertakings to allow access to their network elements, including ULLs and sub-loops, and active or virtual network elements and services. [12] NRAs may consequently also impose obligations relating to cost recovery and price control. This can include obligations for cost orientation of prices and obligations concerning cost accounting systems, where the lack of effective competition has been demonstrated. To determine whether price control obligations would be appropriate, the EECC obliges NRAs to take into account the need to promote competition and long-term end-user interests related to the deployment and take-up of next-generation networks. Undertakings must also be allowed a reasonable rate of return on adequate capital employed, taking into account any risks to a new investment network project. The EECC also states that NRAs must ensure that any cost-recovery mechanism or pricing methodology mandated within the member

⁴⁴ This also included a revised remit for BEREC, as mentioned above. [22]

⁴⁵ EoI refers to the provision of services and information to internal and third-party access seekers on the same terms and conditions, including price and quality of service levels, within the same time scales using the same systems and processes, and with the same degree of reliability and performance. It may apply to the access products and associated and ancillary services necessary for providing wholesale inputs to internal and third-party access seekers.

state serves to promote investment of new networks and contributes to sustainable competition. In this regard, NRAs may look to prices in comparable competitive markets. [12]

In terms of civil engineering assets, the EECC allows NRAs to set access price controls, where appropriate. Any such controls should include pricing arrangements that depend on volumes or length of contract in accordance with EU law, and should have no discriminatory effect. Access conditions should respect the need to preserve effective competition in services to consumers and businesses. [12]

Given the uncertainty regarding demand for next-generation broadband services, the EECC allows operators investing in new or upgraded networks a certain degree of pricing flexibility in order to promote efficient investment and innovation. The NRAs have the ability to decide whether to maintain or to not impose regulated wholesale access prices on next-generation networks if sufficient competition exists. However, in markets where there are undertakings with SMP, pricing flexibility should be accompanied by additional safeguards to protect competition and end-user interests. [12] The EECC also highlights the benefits of co-investment agreements, which allow for co-ownership of network assets, or long-term risk sharing through co-financing or purchase agreements. [12]

With regard to wholesale voice call termination, for which the European Commission had set out pricing principles in the past (as summarized in the Wall report), the EECC concluded that there are no substitutes at the wholesale level to constrain the setting of charges for termination in a given network in both fixed and mobile markets. In light of the ability and incentives of terminating operators to raise prices substantially above cost, cost orientation is considered to be the most appropriate intervention to address the concern over the medium term. The EECC sets out specific parameters and criteria for the determination of wholesale voice termination rates as follows:

- The evaluation of efficient costs must be based on current cost values, and the cost methodology to calculate efficient costs must be based on a bottom-up modelling approach using long-run incremental traffic-related costs of providing the wholesale service (i.e. BU-LRIC).
- The incremental costs must be calculated by taking into consideration only those costs directly attributable to the wholesale service in question.
- Only traffic-related costs that would be incremental to a wholesale voice termination service being provided must be allocated to the relevant termination increment.
- Costs related to additional network capacity are to be included only to the extent that they are driven by the need to increase capacity for the purpose of carrying additional wholesale voice termination traffic.
- Radio spectrum fees must be excluded from the mobile voice termination increment.
- Only wholesale commercial costs that are directly related to the provision of the wholesale voice termination service can be included.

- All fixed operators, regardless of their size, must be considered to provide voice termination services at the same unit costs as the efficient operator.⁴⁶
- For MNOs, the minimum efficient scale must be set at a market share not below 20 per cent.
- The relevant approach for asset depreciation must be economic depreciation (i.e. the decline in market value of the asset versus the historic cost of the asset over the periods which it is to be used). [13]
- The technology choice of the modelled networks must be forward-looking, based on an Internet Protocol core network, and take into account the technologies likely to be used over the period of validity of the maximum rate. In the case of fixed networks, calls must be considered to be exclusively packet switched. [12]

The EECC requires the European Commission to adopt a delegated act setting out a single maximum voice termination rate for mobile services and a single maximum voice termination rate for fixed services that would apply EU-wide, taking into account the views of BEREC. [12] In July 2019, the European Commission launched a public consultation on the scope and application of the future EU harmonized rules on voice call termination services, which in turn will identify the scope of the proposed *Delegated Act*, to be adopted by the end of 2020. [14]

The EECC also includes a provision on wholesale-only undertakings deemed to have SMP, whereby it enables the NRAs to impose on such undertakings any obligations related to fair and reasonable pricing, so long it is justified on the basis of a market analysis. [12]

Wholesale mobile market: Roaming within the EU

In recent years, the EU has taken steps to eliminate mobile roaming charges, beginning with a cap on prices for the whole of the EU. The rates were then gradually reduced and roaming charges were completely eliminated by 2017. Today, EU residents pay the same price for calls, text (SMS) messages, and mobile data as they do at home, wherever they are travelling within the EU. Before the application of this rule, the European Parliament and Council requested that the wholesale roaming market (i.e. the prices operators charge each other when their customers use other networks when roaming in the EU) also be appropriately reformed. [15] In 2016, a political agreement was reached that allows providers to charge a roaming rate in exceptional circumstances where a roaming provider is not able to recover its overall actual costs (for example, in instances where consumers exceed their contract limits when roaming). The provider must apply for authorization to apply such a charge. The roaming charges must not be higher than the wholesale roaming caps, which are set as follows: [16] [17]

⁴⁶ See [Article 73](#) of the [EECC directive](#) for more information on efficient operators.

Maximum average price of 3.2 cents per minute of voice calls (until June 2022)

- The maximum average price must be calculated by dividing the total wholesale roaming revenue received by the total number of wholesale roaming minutes actually used for the provision of wholesale roaming calls, aggregated on a per-second basis, adjusted to take into account the possibility for the operator of the visited network to apply an initial minimum charging period not exceeding 30 seconds.

Maximum average price of 1 cent per SMS message (until June 2022)

- The maximum average price must be calculated by dividing the total wholesale revenue received by the visited network operator or home network operator for the origination and transmission of regulated roaming SMS messages within the EU by the total number of such messages originated and transmitted on behalf of the roaming provider or home network operator within that period. The visited network operator may not levy any charge or a roaming customer's roaming provider or home network operator, separate from the above-mentioned charge, for the termination of a regulated roaming SMS message sent to a roaming customer while roaming on its visited network.

Gradual reduction of maximum average charges for regulated data roaming services

- A step-by-step reduction over five years for data caps:
 - Decreasing from €7.70 per GB (as of 15 June 2017) to €6 per GB (as of 1 January 2018),
 - €4.50 per GB (as of 1 January 2019),
 - €3.50 per GB (as of 1 January 2020),
 - €3.00 per GB (as of 1 January 2021), and
 - €2.50 per GB (as of 1 January 2022).
- The charges must apply between any pair of operators and be calculated over a 12-month period, or a shorter period that may remain before June 2022. The calculations must be done by dividing total wholesale revenue received by the visited network or home network operator for the provision of regulated data roaming services in the relevant period by the total number of megabytes of data actually consumed through the provision of those services within that period, aggregated on a per-kilobyte basis on behalf of the relevant roaming provider or home network operator within that period.

A subsequent regulation [18] clarified that the costs incurred in order to provide regulated retail roaming services should be determined by reference to the effective wholesale roaming charges applied to the outbound roaming traffic of the roaming provider in excess of its inbound roaming traffic, as well as by reference to reasonable provision for joint and common costs.

Revenues from regulated retail roaming services should be determined by reference to revenues at domestic price levels attributable to the consumption of regulated retail roaming services, whether on a unit-price basis or as a proportion of a flat fee, reflecting the respective actual and projected proportions of regulated retail roaming services consumption by customers within the EU and domestic consumption.

The regulation also stipulates that it is important to consider the consumption of regulated retail roaming services and domestic consumption by the roaming provider's customers; the level of competition, prices, and revenues in the domestic market; and any observable risk that roaming at domestic retail prices would appreciably affect the evolution of such prices [18].

The regulation further stipulates that the NRAs must monitor and supervise compliance with rules within their territories, including monitoring of developments in wholesale and retail charges in voice and data communications. One of BEREC's role in this regulatory framework is to regularly collect data from NRAs on developments in both retail and wholesale charges for regulated voice, SMS, and data roaming services, on wholesale roaming agreements not subject to the price caps. BEREC must report its findings to the European Commission twice a year. [16]

Glossary of terms/definitions

BEREC: Body of European Regulators for Electronic Communications

BU-LRIC: Bottom-up long-run incremental cost

BU-LRIC+: Bottom-up long-run incremental costs-plus

EECC: European Electronic Communications Code

EoI: Equivalence of inputs

Refers to the provision of same product/service to all customers on the same terms and conditions.

Ex ante: Refers to future events, such as the potential returns of a particular security, or the returns of a company. ([Source](#))

FTTH: Fibre to the home

An access network method that delivers the highest possible speed of Internet connection by using optical fibre that runs directly into the home, building, or office. [9]

LRIC: Long-run incremental cost

MNO: Mobile network operator

NRA: National regulatory authority

RAB: Regulatory asset base

SMP: Significant market power

Sub-loop: A partial local loop connecting the network termination point at the subscriber's premises to a concentration point or a specified intermediate access point in the fixed public telephone network.

ULL: Unbundled local loop

A regulatory access requirement whereby an incumbent network provider is required to lease elements of the network (e.g. copper) to competitors, to enable the competitors to provide a service in competition to the incumbent. The physical wire connection between customer and company is often referred to as the "local loop" and was historically owned by the incumbent local exchange carrier. [10]

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III. France

Executive summary

The Autorité de régulation des communications électroniques, des postes et de la distribution de la presse (ARCEP) is the main state entity (independent administrative authority) responsible for regulating the electronic communications industry in France. Orange S.A. (Orange) is the largest fixed and wireless electronic communications provider; it is the incumbent and the firm with significant market power (SMP), and it runs its (vertically integrated) wholesale division under the name Orange Wholesale France.

In addition to ARCEP, the other regulatory bodies that have a stake in the sector and share jurisdiction with ARCEP include

- *the government;*
- *the Agence nationale des fréquences, a government body that represents France in international meetings relating to the global allocation of frequencies;*
- *the Autorité de la concurrence (Competition Authority);*
- *the Conseil supérieur de l’audiovisuel, which deals with regulations concerning audio-visual communications;*
- *the Agence nationale de la sécurité des systèmes d’information, which is responsible for improvements to network security; and*
- *the Commission nationale de l’informatique et des libertés, responsible for the protection of users’ data privacy.*

As a firm with SMP, Orange is required by the regulatory authority, among other things, to provide rental access to its unbundled local loops using wholesale rates that are established by means of a price cap. These rates are established by ARCEP using a long-run incremental cost methodology. French companies are also subject to mandated access to a variety of other wholesale services, detailed further in this document and in the table summarizing France’s costing approach. In addition, France has introduced so-called “symmetrical” regulation under the European framework. As such, French law provides that all operators of fibre-to-the-home (FTTH) networks must provide access to their networks according to reasonable and non-discriminatory conditions, in accordance with ARCEP decisions. This regulation provides for tariff obligations. Similar to other regulators, ARCEP has stated nationwide connectivity and competition goals of its wholesale costing regime, aiming to ensure that private sector electronic communications growth is encouraged and able to proliferate in the public interest. In 2015, ARCEP undertook a strategic review of its regulatory functions and mandate.

In the fixed line market, digital subscriber line connection remains the dominant national technology. However, FTTH connections have increased, partly as a result of strong investments in infrastructure from French telecommunications companies and local authorities, generally with financial support from the government. As of 31 December 2018, more than 13.6 million private residences and commercial premises were linked to an FTTH network, representing an increase of 3.2 million (31 per cent) since 2017.

France is subject to the European telecommunications regulations adopted by the Council of the European Union (EU) and the European Parliament, with direct application in the case of EU regulations and as implemented by national legislation in the case of directives. Among others, this is the case for the directive that established the European Electronic Communications Code, which followed the creation of the digital single market (DSM) in Europe, driven by the European Commission. The key objectives of the DSM are to improve online access for businesses and consumers throughout Europe and to create a favourable environment and a level playing field for innovative services and advanced digital networks. (France has two years to introduce this text into national law). In this context, ARCEP collaborates with the Body of European Regulators for Electronic Communications, which aims in particular to clarify this European framework through guidelines and to facilitate the sharing of best practices among regulators.

Summary of France's costing approach (source: Ovum) [1]

Wholesale fixed regulation

Service		Required to offer	Cost methodology
<i>Voice interconnection</i>	<i>Public switched telephone network origination and termination</i>	<i>Yes</i>	<i>Pure bottom-up long-run incremental cost (BU-LRIC)</i>
<i>Wholesale access</i>	<i>Wholesale line rental</i>	<i>Yes</i>	<i>Cost-based</i>
	<i>Carrier selection and preselection</i>	<i>No</i>	-
	<i>Leased lines</i>	<i>Yes</i>	<i>Cost-based</i>
<i>Wholesale broadband services</i>	<i>Bitstream⁴⁷</i>	<i>Yes</i>	<i>Coûts courant économiques and BU-LRIC+</i>
	<i>Local loop unbundling (LLU)</i>	<i>Yes</i>	<i>Coûts courant économiques and BU-LRIC+</i>
	<i>Sub-loop unbundling (SLU)</i>	<i>Yes</i>	<i>Coûts courant économiques and BU-LRIC+</i>
	<i>Fibre bitstream</i>	<i>No</i>	-
	<i>Fibre unbundling⁴⁸</i>	<i>No</i>	-
	<i>Physical infrastructure access (PIA)</i>	<i>Yes</i>	<i>Coûts courant économiques and BU-LRIC+</i>
	<i>Dark fibre</i>	<i>Yes</i>	<i>Coûts courant économiques and BU-LRIC+</i>

Wholesale mobile regulation

Service	Required to offer	Cost methodology
<i>Mobile call termination</i>	<i>Yes</i>	<i>Pure BU-LRIC</i>
<i>SMS termination</i>	<i>No</i>	-
<i>National roaming</i>	<i>No</i>	-

⁴⁷ The cost orientation applies in certain areas only

⁴⁸ There is no fibre unbundling, but there is passive fibre access at a reasonable price.

<i>MVNO access</i>	<i>No</i>	-
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Regulatory environment and market composition

In France, ARCEP is the national regulator responsible for electronic communications, postal services, and media. Its predecessor, the Telecommunications Regulatory Authority (ART), was initially created in 1997 to increase competition within the French electronic communications sector by encouraging the emergence of alternatives to the incumbent, France Telecom, which was later renamed Orange. [2] [3] For the purposes of this report, France Telecom will be referred to throughout as Orange.

In 2005, the postal sector was added to ART's responsibilities, and its name was changed to ARCEP. ARCEP's powers were extended to media distribution in October 2019. Since ART's inception, electronic communications have evolved significantly. With the now near-ubiquitous use of next-generation networks (NGNs), including the deployment of traditional copper, optical fibre, 2G, 3G, and 4G networks, as well as broadband, the French government takes the view that a national governing authority such as ARCEP is central to the development of these technologies. ARCEP has the status of an independent administrative authority and is at arm's length from the government. ARCEP is managed directly by a seven-member executive board: the President of France appoints the chair and two other members; the President of the National Assembly appoints two members, and the President of the Senate appoints two members for a six-year, irrevocable, non-renewable term. [3]

The collective goal of ARCEP's mandate is to ensure (i) that private sector electronic communications sector growth is reconciled with the public interest, which in France's case is to achieve nationwide connectivity, and (ii) that there is fair and effective competition between operators for the benefit of end users. [3] As a result of the new and emerging communications technologies, ARCEP found it necessary to undertake a strategic review of its regulatory functions and mandate: in 2015 it began a comprehensive review, including a review of its internal staff and procedures, incorporating the opinions and suggestions of outside stakeholders. As a result of that review, it was able to draw a roadmap of its future activities and further develop its objectives and mission statement. [3]

Currently, Orange has the largest market share in France and is the incumbent telecommunications operator. The French mobile market is centred on the following major industry operators: [4]

- Orange
- SFR-Numéricable (renamed SFR in 2018)
- Bouygues Telecom
- Free

Orange was declared to have significant market power (SMP) in the wholesale fixed high-speed/very high-speed broadband markets, and in 2006, accounting separation between its wholesale and retail businesses was imposed by ARCEP. This was reaffirmed through several

other obligations (such as cost accounting obligation, the account separation obligation for the access and interconnection markets, and the obligation to keep accounts on retail market activities and services). [5] Presently, Orange conducts business related to its wholesale activities through a separate division, Orange Wholesale France, with a separate CEO, albeit under the same corporate umbrella as its other divisions (this wholesale division reports to the same board of directors that governs the parent company). [6]

In addition to the laws and directive presented above, while ARCEP is the main regulatory body for electronic communications in France, there are other bodies that also have a stake in the sector and share jurisdiction with ARCEP. These agencies include the *Agence nationale des fréquences* (ANFR), which is the administrative body that represents France in international meetings relating to the global allocation of frequencies, the *Autorité de la concurrence* (Competition Authority), and the *Conseil supérieur de l'audiovisuel* (CSA), which deals with regulation concerning audio-visual communications. In addition, under the authority of the Minister of the Economy and Finance, the Directorate General for Enterprises drafts and implements public policies, particularly those related to electronic communications.

France is a highly connected country. In 2018, 84 per cent of the population had a home phone line, though this number continues to decline. Additionally, 94 per cent of the French population owned a mobile phone and three quarters of the population owned a smartphone. Furthermore, a mobile connection reaching the speed of 4G was available to 60 per cent of the population. Also, 86 per cent of the population had a fixed Internet connection at home (70 per cent connected through asymmetric digital subscriber line (ADSL), 21 per cent through cable or fibre, and 6 per cent through another means). Eleven per cent had a connection slower than 8 megabits per second (Mbps), 18 per cent had a connection between 8 and 30 Mbps, and 25 per cent had access to speeds greater than 30 Mbps. A further 8 per cent had access to speeds above 100 Mbps. [7]

Digital subscriber line (DSL) connection remains the dominant national technology, but fibre-to-the-home (FTTH) connections have increased, partly as a result of strong investments in infrastructure from local governments and French electronic communications companies. From 2014 to 2015, FTTH connections increased by 52.6 per cent. [7]

The French government inaugurated a strategic plan entitled “Plan France Très Haut Débit” in 2013 in order to invest in high-speed Internet; the objective is to ensure a 100 per cent national penetration rate of speeds attaining at least 8 Mbps by 2020, and a 100 per cent penetration rate of speeds of at least 30 Mbps by 2022. To reach this goal, this plan also notably detailed the need for both government and the private sector to invest in electronic communications infrastructure and the construction of fibre networks nationwide; the government has committed to 3.3 billion euros of state funding. [8]

Legislative/regulatory environment

France is subject to electronic communications regulations under the legislative framework adopted by the European Parliament and by the Council of the European Union (EU). In this context, ARCEP collaborates with the Body of European Regulators for Electronic Communications (BEREC), including by clarifying the European framework via guidelines and facilitating the sharing of best practices among regulators. The relevant legislation regulating wholesale services within the EU is the European Electronic Communications Code (the Code).

[9] This document lays out a host of consumer and business protections with the end objective of creating a single digital market among EU member states. In addition to these protections, the Code lays out regulations pertaining to infrastructure competition, enacts rules for co-investment (while making current regulations more predictable), promotes risk sharing in the deployment of very high-capacity networks (including specific rules for wholesale-only operators with SMP), and ensures equality of treatment of all players in the electronic communications services sector, whether traditional or web-based, by clarifying the definition of electronic communications services. [9]⁴⁹ France and ARCEP are responsible for applying European regulations such as those on Open Internet or international roaming.

Key national pieces of legislation and regulation enacted by the French government and its parliament governing the national telecommunications industry are as follows:

Postal Services and Electronic Communications Code [8]

Fundamental service provisions for the electronic communications sector can be found within this code, which was first established in the 1950s but undergoes periodic updates. The provisions relevant to wholesale costing are the following:

- Quality and availability of network and service
- Confidentiality and neutrality relating to communication
- Universal service
- Interconnection
- Non-discrimination or equality of treatment of foreign operators
- Interoperability of services
- Obligations enabling ARCEP to control operators
- User information (consumers and professionals)

Telecommunications Act

Passed in 1996, this act built on and subsequently amended article 32 of the Postal Services and Electronic Communications Code and set the framework for a competitive French telecommunications market. This act also established the ART (which evolved into ARCEP) and increased the purview of the ministerial advisory body known as the Public Service Commission for Posts and Telecommunications. [10]

Digital Republic Act

Passed in 2016, this act establishes new regulations for electronic data, online commerce, and access to the Internet, among other aspects of the online economy. It deals mainly with online data privacy, but remains a major piece of legislation governing electronic communications in France.

⁴⁹ For more detailed information on the EU approach to wholesale costing, see the section on the EU in this appendix

Findings of the Wall report [11]

At the outset, the national regulator relied on a long-run incremental costs (LRIC) approach to setting rates for local loops. In 2005, it conducted a review of alternative costing methodologies. A decision was subsequently issued that outlined a revised costing approach for local loop unbundling (LLU) services.

In early 2005, the regulator found that Orange possessed significant market power (SMP) in unbundled copper loops and sub-loops and imposed an obligation on Orange to continue to make these wholesale services available to alternative operators.

In follow-up to these decisions, Orange was mandated to provide (i) direct access to the local loop via unbundling (including shared access and full unbundling), and (ii) wholesale bitstream service provided at either the regional or departmental level (delivered in Ethernet, Internet Protocol [IP], or asynchronous transfer mode [ATM]⁵⁰) on a shared or “naked” ADSL access basis).

The wholesale pricing principles and objectives ultimately adopted by ARCEP included adherence to the principle of non-discrimination between the internal prices paid by Orange and alternative operators, the encouragement of efficient investment by Orange and alternative operators, and the promotion of competition.

When revisiting the costing methodology for local loops in 2005, ARCEP chose to adopt a CCA-based approach with economic depreciation.

The costing approach adopted by ARCEP for LLU can be considered a top-down FAC approach, in which costs are developed using accounting rather than modelled data. In 2011, ARCEP expanded the LLU obligation on Orange to include wholesale access to copper sub-loops. This required Orange to offer LLU operators collocation and fibre backhaul solutions for their equipment installed in the new supply points in the sub-loop, and at prices that provide enough of an incentive to allow alternative carriers to deliver unbundled access from such locations.

In December 2011, ARCEP issued a report on the incumbent’s copper local loop costs and how the transition from copper to fibre would affect those costs. This was in response to the increasing deployment of fibre networks in the country. The belief was that copper would fall into disuse in favour of NGN (partially as a result of the migration of customers from one to the other), also noting that in lower-density areas this might take an extended amount of time to occur, leaving copper as the single wire local loop infrastructure.

In 2011, ARCEP completed a market review of the wholesale broadband access market, which covers Orange’s wholesale bitstream services. Similar to LLUs, a forward-looking CCA/FAC approach is also utilized to govern Orange’s wholesale broadband access service prices.

⁵⁰ Technique for multiplexing data flows in the form of packets

In 2011, ARCEP reviewed the markets for fixed telephony. During this review, ARCEP upheld existing obligations relating to the provision of wholesale access to fixed call origination and termination services and imposed a symmetrical pricing scheme on operators (ARCEP set call termination rates on the basis of the estimated LRIC of a generic efficient [pure NGN] operator). Additionally, ARCEP forbade Orange from charging excessive prices for call origination services.

In 2011, ARCEP also completed its review of the wholesale market, requiring Orange to provide competing operators with access to its infrastructure. This enabled operators to deploy their own fibre local loop networks on a cost-oriented basis (using the FAC costing approach that was used to set LLU prices).

France's approach to wholesale rate-setting methodology since 2012

Although the European Commission recommends (EU Recommendation 2013/466/UE) the bottom-up, long-run incremental costs plus (BU-LRIC+) approach as an ideal costing methodology for regulating wholesale access services within the EU, member states can modify this approach to best suit country-specific needs. This methodology portrays the incremental capital (including sunk) and operating costs borne by a hypothetically efficient operator in providing all access services, and adds a markup for strict recovery of common costs. [12] According to the EU, cable, fibre, and mobile networks are currently competing against copper networks; as a result, SMP operators have begun to replace copper networks with next-generation access (NGA) to address this competitive threat. The BU-LRIC+ methodology calculates the current costs of deploying a modern, efficient NGA network. [12]

To further explain and expand on this subject, the European Commission in recommendation 2010/572/UE (which France conforms with) explained that when investments in assets that cannot easily be reproduced (e.g. civil engineering infrastructure) do not relate to the deployment of NGA networks, the risk should not be considered as different from that of the existing copper infrastructure. [53]

For several years, the convergence of fixed and mobile networks has been a trend in the French markets, illustrated by the progressive disappearance of purely mobile network operators. Corresponding with the adoption of IP technology in fixed and mobile core networks and the deployment of optical fibre, networks have become converged data networks. In response to this development, ARCEP required Orange to provide access to unbundling and its civil engineering for the connection of mobile sites (as part of the *ex-ante* regulation of the local access market), and to provide access to its links for the collection of mobile sites connected by the local copper loop. [53]

With the goal of providing alternative operators more predictability on the evolution of the rates of passive (unbundling) and enabled (bitstream) access to the local copper loop, which constitute a significant portion of the costs, ARCEP made a determination (on 16 February 2016) regarding a tariff framework for access to local copper wired loop for the years 2016 and 2017, which set ceilings for the main tariffs of the unbundling offer. The maximum monthly recurring rate for total unbundling was set at 9.10 euros for 2016 and 9.45 euros for 2017, and the monthly recurring rate for access activated without single-channel dial-up service was set at

12.63 euros for 2016 and 12.93 for 2017. For the 2017-2020 cycle, as per Decisions Nos. 2017-1347 and 2017-1348, the Authority chose to maintain this framework. [36]

In December 2017, ARCEP decided to set a tariff framework for access to the local copper loop from 2018 to 2020 (unbundling and bitstream access component). The rates are maximum 9.31 euros for total unbundling (from 1 January 2018), 9.41 euros per month (from 1 January 2019), and 9.51 euros per month (from 1 January 2020). ARCEP has developed a bottom-up model for the costs of the local shared optical loop. Its goal is to build on the costs of this bottom-up model to incorporate the costs of future reference infrastructure (the local optical loop). The bottom-up model developed by the Authority provides a stable cost reference, guaranteeing a measure of predictability. [36] The rates set by ARCEP (in both cases) take into account the transition from copper networks to very high-speed networks.

As in other jurisdictions, wholesale infrastructure in France is provided to alternative operators by network owners. [13] ARCEP has mandated that Orange provide access to the copper local loop and sub-loop and to its civil engineering infrastructure, while also providing access seekers with a set of wholesale offers covering backhaul, co-location, and unbundling services under non-discriminatory terms and conditions. [13] Cost-oriented pricing is used to regulate rates charged by a firm with SMP, in particular for access to local copper loops and sub-loops, civil engineering infrastructure used for fibre local loops, and ancillary services. [13]

France has chosen to base interconnection rates on costs, and has chosen the LRIC method as the method of interconnection costing. This costing methodology was implemented by ARCEP to meet the regulator's stated objectives of maintaining and safeguarding a competitive yet innovative telecommunications industry. [14] [15]

As detailed in the Wall report, until the year 2000, historical cost accounting (HCA) was applied to Orange's local loop. From the year 2000 to 2005, ARCEP's approach was modified to costing local loop using an LRIC approach based on a top-down and a bottom-up model. In 2005, ARCEP reviewed its valuation model, implementing a CCA approach utilizing tilted annuity depreciation to help stabilize the means of access, specifically copper wire and unbundled local loops (ULLs). It was determined that costs (i.e. operating, output, and equipment) were expected to change over time. [16] [17] In addition, a pure LRIC model is used for local loop in France, as well as for termination rates. [18]

Interconnection can be informal, taking the form of anti-competitive behaviour, or it can be a formal arrangement. [19] ARCEP engages in various information-gathering activities, such as surveys, consultations, and research, in order to determine the competitive landscape, particularly with respect to its market analyses. If intervention is deemed to be required, ARCEP can intervene in the case of unfair practices. If a dispute arises between the various players involved, ARCEP can impose conditions of its own in an objective, transparent, non-discriminatory, and proportionate manner in the case of access and interconnection, and can also be called upon to settle such disputes between telecommunications players. [20] [21] Decision No. 2012-0366 (introduced in 2012 but last amended in 2014) allowed ARCEP to gather information on interconnection from industry, including technical and pricing terms. [22]

In June 2010, the "programme national très haut débit" was introduced as a precursor to the "France Très Haut Débit" plan of 2013, intended to aid in the deployment of high-speed fibre optic broadband for national use. [19] This plan, as articulated by the government, was also

meant to guide the actions of local authorities, setting out a method for the objective and consistent development of tariff levels available to commercial operators. [24]

Directive 2014/61/EU provided for interconnection and infrastructure sharing (including broadband) by opening up various firms' infrastructure to alternative operators. Prior to its issue, only firms with SMP status were obliged by ARCEP to provide access. If requests are denied, ARCEP can ask the subject firm for a justification, or intervene to arbitrate the dispute. [26] [27]

In October 2015, ARCEP released a tariff model for access to high-speed fibre networks outside of densely populated areas. This project was undertaken because many stakeholders expressed the need for greater clarity regarding wholesale rate setting in less densely populated areas. This model is centred on cash flow, based on a multi-year comparison of all costs and revenues associated with the construction and operation of the various segments of the network on the wholesale market. This approach is therefore based on a prospective vision of these costs and revenues. [28]

Given the price unpredictability, ARCEP imposed price caps for the years 2018-20 (previously, rates had been set on an annual basis) for local and sub-loop unbundling and for central access provided at a fixed location for mass-market products in order to increase the certainty of prices. [28] ARCEP also proposed to set the tariffs for full unbundling and bitstream using the top-down methodology that is currently in use and the newly developed bottom-up cost model (BU-LRIC+), based on the costs of deploying a shared FTTH network. [28] In addition, ARCEP proposed to set price caps for the copper full unbundling monthly fee, and to maintain price caps on partial unbundling and DSL access.

ARCEP sets different rates for the leasing out of local loops, or telecommunications wires, cables, fibre, etc. France divides these rates into two categories: full LLU and partial LLU. Full unbundling is when an operator leases its full connection (e.g. copper, twisted pair) to another operator, allowing it to operate a full range of services using the incumbent's infrastructure. Partial unbundling, by contrast, does not permit an operator that is leasing infrastructure to offer a full suite of services. [29] [30] These rates are based on a combination of the CCA with the economic depreciation model, and the LRIC model. [31] [32]

In Decisions Nos. 2017-1347 and 2017-1348 concerning wholesale broadband and high-speed broadband services through copper, fibre, and coaxial cable networks (the market for wholesale local access provided at a fixed location and wholesale central access provided at a fixed location), Orange was again defined in ARCEP's analysis as an operator with SMP. As a result, ARCEP stipulated that Orange must (i) provide bitstream access over its copper network; (ii) provide access on a non-discriminatory basis; (iii) implement accounting separation (ensuring that the prices paid for wholesale inputs by other operators and the price paid by the operator with SMP are the same); and (iv) for those areas where Orange is the only wholesale supplier of DSL, provide cost orientation and transparency. [33] [34]

Orange has invested in and maintained approximately 2 million arterial roads of underground or over ground civil engineering, 15,000 points of presence (POPs) (subscriber connection nodes (SCNs) for copper local loops and optical connection nodes for optical local loops), and an

optical backbone linking nearly all points of presence. [35] In order to facilitate infrastructure sharing, Orange can, and does, create new SCNs (increased bandwidth subscriber connection nodes), allowing increased throughput on connected copper lines. [35]

Future developments

Looking forward, France has committed to creating regulations and strategic plans premised on four main objectives: [37]

- To promote clear and concise regulation promoting innovation and investment;
- To promote collaborative regulation, partnering with domestic partners (public and private) as well as international ones;
- To promote relevant and useful regulation; and
- To promote efficient regulation, simplifying administrative requirements and red tape.

FTTH and fibre-to-the-premises networks continue to be deployed by operators within France. Regarding network deployments, the country has been divided into two distinct geographical regions by ARCEP to facilitate this rollout by various players, namely “zones très denses” and “zones moins denses” (i.e. rural and less densely populated areas). [38]

ARCEP issued a decision in 2015 (Decision No. 2015-0776) on the technical and operational requirements involved in sharing FTTH networks between building operators and commercial operators, i.e. network operators helping to build the infrastructure for the high-speed fibre optic network. According to ARCEP, shared optical loop deployment has seen an increase in recent years. Furthermore, ARCEP is aiming to develop a standardized information sharing system between operators for this purpose, to limit long-term price increases for FTTH services.

5G technology and Internet-of-Things devices are being researched, developed, and deployed in France. For example, Orange has been and is preparing for this digital transformation by investing 17 billion euros in upgrading its network infrastructure (between 2015 and 2018), in order to make it suitable for NGN technologies to increase network capacity, such as long-range or li-fi technology – a connection technology that uses lights – in addition to networks that consume less energy. [39] [40]

IP, an international standard towards which countries with legacy phone networks are migrating, has seen increasing popularity in France. In France, the goal is to transition the public telephone network to a completely IP-based model by 2023. In order to mitigate the issues with those who do not have IP-enabled devices, telecommunications companies such as Orange are offering devices that adapt IP network jacks to fit legacy devices. [41]

On 15 July 2019, ARCEP commenced a public consultation pertaining to the terms and conditions for allocating 5G frequencies; the government plans to set the financial conditions, then launch the frequency allocation procedure. [42] Following this consultation, ARCEP sent the government its final proposal on 21 November 2019. Large-scale trials of 5G networks and technology are currently ongoing. In order to support 5G implementation, the European

Commission released a proposal entitled “5G for Europe: an action plan” on 14 September 2016. This was meant to provide the blueprint for prime member states for 5G network deployment by 2020, coordinate the allocations, and the availability, of spectrum, promote 5G deployment, and facilitate an industry venture fund. [43]

ARCEP is committed to facilitating the spread of 5G networks within France. Based on regulations safeguarding the Open Internet (2015) adopted by the European Parliament and the Council of the EU through the prioritization of net neutrality principles, and acceptance of guidelines for national regulators on the enforcement of the European Open Internet regulation (published in 2016 by BEREC), France has taken a positive step towards the coexistence of 5G networks and net neutrality. The government has the objective of attaining 5G deployment for consumer use by 2020, and by 2025, to have all major urban areas covered by 5G as well as transportation routes. [44] [45] [46]

The program ‘Plan Très Haut Débit’ runs until 2022 and aims to connect all of France using high-speed broadband. This plan will largely fund local infrastructure plans and NGA, and will be subject to the same type of access regulations as other wholesale infrastructure.

Glossary of terms/definitions

ADSL: Asymmetric digital subscriber line

Allows a lot of information to be sent very quickly using phone lines.

ANFR: *Agence Nationale des Fréquences*

The administrative body representing France relating to the global allocation of frequencies

ARCEP: *Autorité de Régulation des Communications Électroniques et des Postes*

The French regulatory body responsible for electronic communications, the post, and print media

ART: *Autorité de Régulation des Télécommunications* (Telecommunications Regulatory Authority)

The name of the previous regulator in France, which was responsible for the electronic communications sector from 1997-2005

ATM: Asynchronous transfer mode

A network whereby end stations attach to the network using dedicated full duplex connections

BEREC: Body of European Regulators for Electronic Communications

A body of the European Commission that ensures a consistent application of the EU regulatory framework for telecommunications

BU: Bottom up

Bitstream: Binary bits of information (1s and 0s) that can be transferred from one device to another. Bitstreams are used in PC, networking, and audio applications

CCA: Current cost accounting

A valuation of method where assets and goods used in production are valued at their actual or estimated current market prices at the time the production takes place (sometimes described as replacement cost accounting), rather than using the historic cost (i.e. the price at which the assets were originally purchased).

CDN: Internet content delivery network

Networks that relay large amounts of traffic to several Internet service providers (ISPs), in various geographical locations

CSA: *Conseil Supérieur de l'Audiovisuel*

The French regulator dealing with audio-visual communications.

EC: European Commission

FAC: Fully allocated cost

Costs associated with a service, including the cost of employees' salaries and benefits, space, equipment, materials, and other costs necessary to perform the service.

FTTH: Fibre to the home

FTTx: Fibre to the building/curb/home/node/premises

Fibre delivered to any number of distribution points

HCA: Historical cost accounting

Measure of value used in which the value of an asset on the balance sheet is recorded at its original cost when acquired, even if it has increased in value over time. HCA prevents overstating an asset's value when asset appreciation may be the result of volatile market conditions.

IP: Internet Protocol

A protocol that provides packet delivery for the Internet

Li-Fi: Light fidelity

A technology that transmits data through light-emitting diodes (LEDs), therefore using the optical spectrum.

LLU: Local loop unbundling

A regulatory access requirement whereby an incumbent network provider is required to lease elements of the network (e.g. copper) to competitors, to enable the competitors to provide a service in competition to the incumbent. The physical wire connection between customer and company is often referred to as the “local loop” and was historically owned by the incumbent local exchange carrier.

LME: Loi de modernisation de l'économie

LRIC/LRIC+/LRAIC: Long-run incremental cost

A forward-looking cost that a company is able to predict and plan for over the long term. These types of costs generally refer to changes associated with making a product, such as the cost of inputs or raw materials.

Net neutrality: The concept that all traffic on the Internet should be given equal treatment by Internet providers with little to no manipulation, interference, prioritization, discrimination or preference given [47]

NGA: Next-generation access network

New or upgraded infrastructure that will allow substantial improvements in broadband speeds and quality of service

On-net CDN: CDN located directly in an ISP's network

SMP: Significant market power

SLU: Sub-loop unbundling

Provides access to a partial local loop. It connects the network termination point at your customer's premises to a concentration point or a specified intermediate access point in the local network.

TD: Top down

Throttling: The slowing down of transfer rates of data traffic by delaying certain data packets at certain points in the network

VDSL: Very high-speed digital subscriber line

WACC: Weighted average cost of capital

The average rate a company expects to pay to finance its assets

XDSL: Digital subscriber line technologies in general, including ADSL, HDSL, SDSL and VDSL

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IV. Germany

Executive summary

The Bundesnetzagentur (BNetzA) is the main federal agency responsible for regulating the telecom market in Germany. Deutsche Telekom AG (DT) is the largest telecommunications provider, with 44 per cent of national telecom revenue in 2018. [1] DT is judged to have significant market power (SMP) and is the main provider of wholesale services in Germany. Its various wholesale activities are performed by a subsidiary, Deutsche Telekom Global Carrier, which provides wholesale services not only in Germany, but also internationally. [2]

As a firm with SMP, DT is required by the regulatory authority, BNetzA, to provide rental access to its unbundled local loops (ULL) using established wholesale rates. These rates are established using a long-run incremental cost plus (LRIC+) methodology according to the standard of the costs of an efficient operator. Rates for ULL leasing are determined when DT applies to the national regulator; BNetzA applies mandated rates after taking into account technical considerations and market conditions. [3] [4] German companies are also subject to

mandated access to a variety of other wholesale services, detailed further in this document and in the table summarizing Germany's costing approach.

This approach has remained largely unchanged since the Wall report. The regulator (BNetzA) has periodically reviewed its costing methodology, most recently in the 2018 application for ULL rates by DT, which are valid through to September of 2020.

Similar to other regulators, the stated goals of BNetzA's wholesale costing regime are to strike a balance between

- *encouraging investment in a gigabit fibre optical network as part of their Digital 2025 strategy;*
- *encouraging competition by ensuring that telecommunications providers who make use of wholesale services are able to achieve and maintain sustainable profit margins; and*
- *ensuring that all German consumers have access to high-quality, affordable broadband Internet, regardless of geographic location within the country.*

In 2017, the national regulator initiated a consultation in order to build a framework for the rollout of fibre to the home and fibre to the building. This process examined regulatory possibilities, including various forms of regulation. The results of this consultation have yet to be released. [5]

As a member of the European Union (EU), Germany typically takes into account the guidelines from the Body of European Regulators for Electronic Communication (BEREC), but it is up to each national regulatory association to implement laws and regulations surrounding the telecommunications market. As such, another goal of the wholesale costing regime and telecommunications regulation in general is that of a digital single market (DSM), whose objectives are to ensure that Europe is a world leader in the digital economy, such as by enabling everyone in the EU to have access to the best possible Internet connection and thereby to participate fully in the digital economy. [5]

Summary of Germany's costing approach (source: Ovum) [6]

Wholesale fixed regulation

Service		Required to offer	Cost methodology
<i>Voice interconnection</i>	<i>Public switched telephone network (PSTN) origination</i>	<i>Yes</i>	<i>LRAIC+</i>
	<i>PSTN termination</i>	<i>Yes</i>	<i>Pure BU-LRIC</i>
<i>Wholesale access</i>	<i>Wholesale line rental</i>	<i>No – offered by DT on a voluntary basis</i>	<i>Retail minus</i>
	<i>Carrier selection and preselection</i>	<i>Yes</i>	<i>LRAIC+</i>
	<i>Leased lines</i>	<i>Yes</i>	<i>Consistent with the costs of an efficient provision of service</i>

<i>Wholesale broadband services</i>	<i>Bitstream</i>	<i>Yes</i>	<i>Ex-post price control</i>
	<i>Local loop unbundling (LLU)</i>	<i>Yes</i>	<i>LRIC+</i>
	<i>Sub-loop unbundling (SLU)</i>	<i>Yes</i>	<i>LRIC+</i>
	<i>Fibre bitstream</i>	<i>Yes</i>	<i>Ex-post price control</i>
	<i>Fibre unbundling</i>	<i>Yes</i>	<i>Ex-post price control</i>
	<i>Physical infrastructure access</i>	<i>Yes</i>	<i>LRIC+</i>
	<i>Dark fibre</i>	<i>Yes</i>	<i>LRIC+</i>

Wholesale mobile regulation

Service	Required to offer	Cost methodology
<i>Mobile call termination</i>	<i>Yes</i>	<i>Based on the costs of an efficient operator</i>
<i>SMS termination</i>	<i>No</i>	<i>n/a</i>
<i>National roaming</i>	<i>No</i>	<i>n/a</i>
<i>MVNO access</i>	<i>No</i>	<i>n/a</i>

Regulatory environment and market composition

The main regulator of telecommunications in Germany is the Bundesnetzagentur (BNetzA). It was created as an arms-length independent agency under the Federal Ministry for Economic Affairs and Energy (BMWi) and was renamed in 2005. [8] It was preceded by the Regulatory Authority for Telecoms and Posts. BNetzA is governed by a president and two vice-presidents. The regulating agency has the authority to make binding decisions in the areas of electricity, gas, telecoms, the postal sector, and railway infrastructure (added to the agency’s portfolio in 2006). [8] The priorities of the agency fall into five broad categories, namely (i) competition in both urban and rural areas, (ii) German citizens’ access to basic telecommunications at fair prices, iii) the promotion and use of telecommunications services in public institutions, iv) the efficient use of frequencies, and v) public safety in telecommunications. [8] The main legislation governing this sector of the German economy is the German Telecommunications Act (TKG), which was passed in 1996 and has since undergone various updates. Broadly speaking, the TKG cohesively incorporates various European Commission (EC) directives issued between the enactment of the first Telecommunications Act in 1996, the second in 2004, and the third in 2012. [9] [10]

The Bundeskartellamt (national competition authority) is also under the umbrella of the BMWi and has a role to play in telecommunications, its principal objective being to safeguard against restraints of competition. The authority was established in 1957 and has the dual function of maintaining competition in all sectors and implementing EC competition law.

Generally, BNetzA finalizes its market analysis first, then imposes regulatory remedies on firms with significant market power (SMP).⁵¹

Deutsche Telekom (DT) is the main incumbent in Germany and has SMP in all relevant wholesale markets. [6] It provides wholesale services in Germany, while its international wholesale activities are performed by its subsidiary, Deutsche Telekom Global Carrier. [2]

Total revenue in the telecommunications market (retail and wholesale combined) totalled €57.4bn in 2018. Of this total, DT accounted for 44 per cent. Within the telecommunications market, mobile revenue (retail and wholesale) accounted for €26.54bn of revenue in 2018 vs. €26.45bn in 2017 (a rise of 34 per cent), and has seen consistent growth. Revenue from hybrid fibre-coax (HFC) networks continues to increase (6 per cent year over year), totalling €5.8bn (wholesale revenue accounted for just below 2 per cent). [1]

Competitive investment in the telecommunications market (defined as all companies excluding DT) increased to 51 per cent in 2018, up from 49 per cent in 2017. In 2018, there were 25 million broadband connections in Germany, with the majority based on DSL technologies. All other technologies accounted for approximately 9.2 million connections (8 million HFC connections and approximately 1.1 million fibre-to-the-building (FTTB) or fibre-to-the-home (FTTH) connections. Fixed-network broadband connections accounted for 34.2 million connections, and connections with speeds of minimum 100 megabits per second (Mbps) rose to 6.8 million (a 39 per cent increase compared to 2017). While the trend favours the adoption of higher speeds by broadband users, 4.1 million customers continued to use speeds of under 10 Mbps. [1]

Germany is subject to telecommunications regulation mandated by the EC. As a member of the European Union (EU), Germany must transpose the telecommunications directives issued by the EU into national law. The guiding document with regard to wholesale services within the EU will be the European Electronic Communications Code (the Code), which is currently being transposed into German national law through amendments to the TKG. [11]

The TKG 2012, which transposes the 2009 EU Framework for Electronic Communications Networks and Services, is currently the basis of telecommunications regulation in Germany. This document lays out a host of consumer and business protections, with the ultimate objective of creating a digital single market among EU states. In addition to these protections, the Code lays out regulations pertaining to infrastructure competition, enacts rules for co-investment, promotes risk sharing in the deployment of very high-capacity networks – including specific rules for wholesale-only operators with significant market power – and ensures equality of treatment of all players in the telecommunications services sector, whether traditional or web-based, by clarifying the definition of electronic communication services. [11]⁵²

⁵¹ National regulatory authorities designate market power as an entity having the ability to influence market conditions, i.e. an uncontrolled room for manoeuvre, which is deemed to be the case when the market share is equal to or exceeds 40 per cent (the SMP Guidelines were updated in 2018, cf. European Commission Communication C(2018)2374) (European Commission 2002).

⁵² For more detailed information on the EU approach to wholesale costing, see the section on the EU in this appendix

In 2007, BNetzA released a research essay on margin squeeze with the goal of helping stakeholders and the public understand what constitutes margin squeeze and therefore the different considerations that encompass the national regulatory agency's rate-setting methodology. The position paper was intended to promote understanding and a common basis for a conversation between industry and the general public. Margin squeeze (abuse of the market) is when the "margin between the price that the SMP operator charges for access and the retail price is not enough to enable an efficient undertaking to achieve a reasonable return on capital." [12]

In May 2009, BNetzA released a report on the consistency of its regulation and on its rate-setting approach. Again, the goal was to promote an understanding of governmental priorities in the area of telecommunications for both industry and the public. The report helped to lay the common groundwork for understanding the approach set out by BNetzA, and explained

- the principles governing consistent rate regulation,
- that rates must be configured so that providers operating on different levels of the value chain are able to operate efficiently (promoting investment and fair competition),
- that the retail and wholesale levels must be taken into account,
- that the stage of market development must be taken into account,
- that margin squeeze needs to be prevented,
- that the costs of efficient service need to mimic the price that can be charged in a competitive environment,
- that rate regulation should allow for the evolution of the industry and provide for conditions of the future, and
- that investment and fair competition must be safeguarded. [13]

The German industry also uses weighted average cost of capital (WACC) to help determine its wholesale rates. The rates used from 2010-2018 are detailed below. [13]

Ref. date	Smoothed WACC fixed network	Smoothed WACC mobile network
30.06.2010	7,11	7,88
30.09.2012	6,77	7,15
30.09.2013	6,58	6,84
30.06.2014	6,20	6,38
30.06.2015	5,90	6,02
30.06.2016	5,63	5,72
30.06.2017	5,20	5,26
30.06.2018	4,87	4,91

The unbundled local loop (ULL) is the so-called “last mile” of the fixed network and represents most of the physical component of a network’s infrastructure (although all network components are available to be leased by the incumbent for use by other operators). An ULL is a copper line that connects the cable distributors to the consumer. The last-mile connections are owned by DT, which is obliged by the national regulator to make them available for rental by other operators. As the incumbent firm with SMP, this stipulation applies exclusively to DT (which currently leases 9.5 million local loops). Consequently, DT is also responsible for ULL maintenance and upkeep. Rates for ULL leasing are determined once DT applies to the national regulator with proposed rates; BNetzA can then rule on their admissibility (they are either accepted, rejected, or mandated to be modified). [9]

Interconnection in Germany is mandated by the national regulator, which can impose obligations on operators if certain market dynamics, including service discrimination, are viewed as unfair or anti-competitive. If two operators cannot agree on the interconnection rates on their own, they have the option of appealing to the national regulator, which can then order interconnection at a price that it determines to be fair for all parties involved. [15]

As the incumbent in the German telecommunications market, DT’s broadband services (asymmetric digital subscriber line, or ADSL; very high-speed digital subscriber line, or VDSL; and fibre to the premises, or FTTP) are, or will be, subject to access regulation. ADSL and VDSL have been subject to such regulation since 2006. In a May 2019 draft market analysis, BNetzA included FTTH in the market as before, and designated DT as the SMP operator. BNetzA is currently in the process of imposing remedies, including for FTTH lines, where DT has an obligation to provide access to fibre loops but the price is regulated only *ex post* (see below). In 2016, BNetzA issued an amended proposal to allow DT to upgrade its infrastructure to allow for the use of vectoring technology. Vectoring technology theoretically allows for an increase in broadband speeds, but must be applied to bundled loops due to technological specificities. The EC appealed the original proposal by BNetzA, mainly on the grounds that competition, and therefore access, by alternative operators would be restricted. BNetzA’s modified proposal was accepted, albeit with a warning from the EC that the national regulator should be wary of limitations to competition that could arise. [16]

BNetzA published a document entitled “Key Elements”, based on discussions with stakeholders that initially started in 2005. Through its next-generation access (NGA) forum (a group of all relevant stakeholders assembled by the government to help advise on pertinent network issues), the regulator drafted the document to create an understanding of framework conditions for the interconnection of Internet Protocol (IP)-based networks and to identify trends in interconnection. The final report, entitled “Framework Conditions for the Interconnection of IP-based Networks”, was published in December 2006. Key Elements was published as a culmination of stakeholder input and the NGA Forum’s own analysis. [17] [18]

In 2011, through its NGA Forum, BNetzA further identified interoperability as a priority area for the government, labeling it as integral to the successful deployment of expanded broadband networks and NGA. [19] The forum additionally released and adopted further documents pertaining to interoperability, entitled “Technical and operational aspects of access to optical fibre networks and other NGA networks” and “Specifications of a Layer 2 Bitstream Access Product”. The former explored what could be achieved through NGA expansion, as well as the

links between network segments, possible network access points, and wholesale products. Additionally, the passive infrastructure and Ethernet requirements were explored and suggested. [20] The latter document, “Specifications of a Layer 2 Bitstream Access Product”, explored technical and operational interfaces, the key business processes necessary for integration, and the requirements of the necessary technical interfaces. [20]

BNetzA commissioned an issues paper in order to solicit feedback from industry and various stakeholders in 2017, the most recent regulatory development regarding fibre rollout in Germany. In that paper, the regulatory authority sought to initiate a conversation on investment costs, competition, and the degree of regulatory freedom that should be provided for in FTTH and FTTB regulation. [21]

In February 2009, the government published the first of its broadband strategies in order to incentivize the rollout of broadband across the country. The plan had two main objectives: [22]

- Nationwide broadband-capable access should be available by the end of 2010
- With respect to NGA networks, 75 per cent of households should have broadband access with transmission rates of at least 50 Mbps by 2014

Findings of the Wall report [23]

In a first for both Germany and the EC, BNetzA mandated in 1997 that DT, as the incumbent firm with SMP, allow operators within the German wholesale telecommunications market access to its fully unbundled local loop. Furthermore, access to the local network is required to be cost oriented and authorized by the regulator. In addition to stipulated access to fully unbundled local loops, access to sub-loops, broadband (bitstream), street cabinets, ducts, FTTH facilities (not cost oriented and regulated on an *ex-post* basis), and/or dark fibre is also mandated.

In 1997, it was decided that a bottom-up (BU) long-run incremental cost (LRIC) costing approach would be used for setting wholesale rates. The model was formulated by Wik-Consult, an external consultancy group, by request of the national regulator. In 2000, this model was further revised and refined, and it was updated again in 2011 in order to take into consideration FTTx and IP technology (used for local loop unbundling [LLU], broadband access, and interconnection services). The model establishes cost through use of the elements in an efficiently designed network; the network is broken down into its various components based on many characteristics, notably function, switching, and transmission.

The 2011 BU-LRIC costing approach is based primarily on copper technology, which was in wider use at the time the costing method was developed. Other aspects of the model include a forward-looking costing approach, based on current costs, which is designed to model the costs that would be incurred by an efficient operator (LLU and interconnection rates). Regarding network access services, two main assumptions are made: (i) that the individual services correspond directly to network elements, or (ii) that costs can be arrived at by adding the costs of the different elements used. This approach is termed element-based charging.

A certain degree of access is mandated by BNetzA to civil engineering infrastructure, although this applies mainly to access to ducts and, notably in the case of sub-loop unbundling, to access between the main distribution frame and the street cabinet. The wholesale costing methodology used in the case of duct access is BU-LRIC in conjunction with a current cost accounting (CCA) asset valuation.

Germany's approach to wholesale rate setting since 2012

In terms of the actual cost model that Germany and in turn BNetzA uses with regard to its wholesale infrastructure, there have not been any changes since the Wall report was published in 2012. BNetzA continues to use a BU analytical cost model, incorporating an element-based approach in establishing the LRICs of the network infrastructure (an LRIC-approach). [24] At the time of writing this report, there were no plans to change that approach in the near future.

In 2018, the German government updated its strategic plan; it is currently aiding in the deployment of high-capacity gigabit-capable telecommunications infrastructure, as evidenced by its Digitale Strategie 2025 (Digital Strategy 2025) program and in the issue paper developed by the German Federal Ministry of Transport and Digital Infrastructure, entitled “Zukunftsoffensive Gigabit-Deutschland” (Future Initiative Gigabit Germany). As regards wholesale infrastructure, the government has outlined its plan to subsidize the expansion of FTTx networks with the objective of outfitting the entire nation with gigabit-capable networks by 2025. The initial focus of this plan is regions where high-speed access is still unavailable, as well as other high-priority areas, such as industrial zones, schools, and hospitals. In conjunction with providing regulatory incentives to increase private sector investment, this is the government's plan to ensure a connected Germany. [24] [21] [1]

As of 2016, DT has been strong in investing in and deploying VDSL services, [25] and in the same vein, operators delivering fibre and utility companies are cooperating vis-à-vis infrastructure investment for broadband. [26]

On 25 September 2018, one-off charges for access to DT's local loops, valid to September 2020, were approved by the regulator with respect to provisioning and cancellation charges for the 18 types of local loops, as well as to charges for a number of additional services. [27] The EC, officially commenting on this decision by the German regulatory body, implored BNetzA to reassess its use of the exponential smoothing adjustment in its WACC calculations. [27] The final outcome was pending at the time of writing this report.

On 8 March 2018, BNetzA approved the charges for Layer 2 bitstream access provided by DT (EC docket DE/2018/2055). The EC subsequently conveyed its concerns regarding BNetzA's use of the less strict cost standard of an abuse test,⁵³ and its 15 per cent markup (Erheblichkeitszuschlag) on LRIC+ costs. The use of exponential smoothing⁵⁴ was also mentioned as an area of concern. At the time of writing, this issue was still pending.

⁵³ For a thorough understanding of what constitutes abuse and of associated remedies, see Klotz and Fehrenbach (2003) [28]

⁵⁴ See the following link for a detailed explanation of the exponential smoothing concept: [Link](#)

In EC docket DE/2018/2133 (2018), BNetzA decided on remedies to be applied to wholesale high-quality access provided at a fixed location. The EC again criticized the regulatory authority for the length of time it had taken to impose remedies after the market analysis was performed, the market analysis for this wholesale segment having been performed in 2016. The EC urged BNetzA to detail its price control measures as soon as possible. [27]

The fixed-network termination rates (FTRs) expired at the end of 2018 and were based on comparative market analysis instead of pure LRICs. On 28 June 2019, BNetzA approved FTRs for all operators – both DT and alternative operators – that are valid until December 2020. [29]

In July 2019, BNetzA confirmed that it was raising rates for ULLs, including line leasing and cable duct leasing, taking into account DT's position that the cost of building last-mile networks has increased. This was taken as justification for raising rates, which were set until 30 June 2022. [29]

Future developments

With respect to the wholesale costing approach, there is no current plan to deviate from the LRIC methodology that has been in use since 1997. BNetzA continues to refine and update its costing model as new challenges and technologies present themselves, but there has been no indication from the regulator that there will be a fundamental shift in methodology at any point in the foreseeable future.

Net neutrality is set to be an issue for Germany in the future, with both the EC and the national regulatory authority issuing decisions and recommendations on the matter (European Union Regulation (EU) 2015/2120 safeguards the principles of equality of access, services, and data). Further, the key themes in BNetzA's annual report for 2018-19 are safeguarding open Internet access, transparency measures, supervision and enforcement, and penalties. [30]

In October 2019, DT announced plans to begin operating 5G-capable networks in Germany by the year 2020. With the help of its 5G-enabled networks, BNetzA aims to connect 99 per cent of its population to a high-speed broadband network (at minimum speeds of 50 Mbps) by 2025. DT and the other main mobile operators, as well as a newcomer to Germany, participated in the BNetzA spectrum auction for 5G frequencies in June 2019. This spectrum was subsequently assigned by the regulator in September 2019, and will aid in the German strategy to deploy 5G-enabled networks. [31] [32] In addition, DT specifically has plans to modernize its existing mobile network infrastructure, having recently signed a partnership with equipment manufacturer Ericsson AB. [32]

The promotion of broadband deployment is coupled with the government's encouragement of investment in the area. Digital Strategy 2025, published by the Federal Ministry for Economic Affairs and Energy, demonstrates Germany's commitment to modernizing and updating its digital services and infrastructure; it is meant to act as a roadmap for the future of broadband in Germany. The main priorities for Germany are to [33]

- a. encourage the development of a gigabit optical fibre network in Germany by 2025, one of its priorities being to ensure the connection of rural areas to this national network, prioritizing capacity, availability, and latency;

- b. launch a start-up era by assisting start-ups and encouraging cooperation between young and established companies;
- c. create a regulatory framework for increased investment and innovation, with the objective of providing room for the development of enterprising investments, product innovation, and new data-based services;
- d. create a technical digital single market (DSM);
- e. create a regulatory DSM;
- f. encourage smart networks in key commercial infrastructure areas of the economy (with “smart networks” standing for comprehensive and systematic use of the possibilities for digitization in major infrastructure areas, such as energy, transportation, health, education, and public administration);
- g. strengthen data security and develop informational autonomy;
- h. enable new business models for SMEs, the skilled craft sector, and services;
- i. utilize Industry 4.0 to modernize Germany as a production location;
- j. create excellence in digital technology research, development, and innovation;
- k. introduce digital education to all phases of life; and
- l. create a digital agency as a modern centre of excellence.

Glossary of terms/definitions

ADSL: Asymmetric digital subscriber line

Allows a lot of information to be sent very quickly using phone lines.

ATM: Asynchronous transfer mode

A network whereby end stations attach to the network using dedicated full duplex connections.

BEREC: Body of European Regulators for Electronic Communications

A body of the European Commission that ensures a consistent application of the EU regulatory framework for telecommunications.

BU: Bottom up

Bitstream: Binary bits of information (1s and 0s) that can be transferred from one device to another. Bitstreams are used in PC, networking, and audio applications.

CCA: Current cost accounting

A valuation method whereby assets and goods used in production are valued at their actual or estimated current market prices at the time the production takes place (sometimes described as replacement cost accounting) rather than using the historic cost (i.e. the price at which the assets were originally purchased).

DSL: Digital subscriber line

DSM: Digital single market

EC: European Commission

FAC: Fully allocated cost

Costs associated with a service, including the cost of employees' salaries and benefits, space, equipment, materials, and other costs necessary to perform the service.

FTTB: Fibre to the building

FTTH: Fibre to the home

FTTP: Fibre to the premises

FTTx: Fibre to the X

Fibre delivered to any number of distribution points

HCA: Historical cost accounting

A valuation method whereby the value of an asset on the balance sheet is recorded at its original cost when acquired, even if it has increased in value over time. HCA prevents the overstating of an asset's value when asset appreciation may be the result of volatile market conditions.

HFC: Hybrid fibre-coax

A network that combines fibre optic cables and devices with coaxial cables and RF-based devices.

IP: Internet Protocol

A protocol that provides packet delivery for the Internet.

LLU: Local loop unbundling

A regulatory access requirement whereby an incumbent network provider is required to lease elements of the network (e.g. copper) to competitors, to enable competitors to provide a service in competition with the incumbent. The physical wire connection

between customer and company is often referred to as the local loop and was historically owned by the incumbent local exchange carrier.

LRIC/LRIC+/LRAIC: Long-run incremental cost

A forward-looking cost that a company is able to predict and plan for over the long term. These types of costs generally refer to changes associated with making a product, such as the cost of inputs or raw materials.

MVNO: Mobile virtual network operator

A mobile wireless service provider that relies on some or all the components of a wireless carrier's network.

Net neutrality: The concept that all traffic on the Internet should be given equal treatment by Internet providers, with little to no manipulation, interference, prioritization, discrimination, or preference [39].

NGA: Next-generation access network

New or upgraded infrastructure that will allow substantial improvements in broadband speeds and quality of service.

P2P: Point to point

A point-to-point connection refers to a communications connection between two nodes or endpoints.

SMP: Significant market power

SLU: Sub-loop unbundling

Provides access to a partial local loop. It connects the network termination point at the customer's premises to a concentration point or a specified intermediate access point in the local network.

VDSL: Very high-speed digital subscriber line

WACC: Weighted average cost of capital

The average rate a company expects to pay to finance its assets.

XDSL: Digital subscriber line technologies in general, including ADSL, HDSL, SDSL, and VDSL.

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V. United Kingdom

Executive summary

The Office of Communications (Ofcom) regulates the telecommunications industry in the United Kingdom (U.K.). Openreach, a wholly owned subsidiary of British Telecom (BT), provides wholesale services over the local access network by connecting users to the national broadband and telephone network (the last mile). Ofcom sets charge controls for these wholesale services, specifically those that deliver broadband and voice services to end consumers at lower bandwidths, due to BT’s significant market power in this area. Openreach has deployed fibre between local exchanges and street cabinets (a fibre-to-the-cabinet [FTTC] network), though copper is still largely used between street cabinets and customers’ premises. Ofcom has identified the lack of incentives to invest in new broadband networks, including full-fibre networks, as one of the key challenges facing the U.K. telecommunications industry.

Ofcom currently uses an “anchor pricing” approach for wholesale services, whereby it regulates the price of a lower bandwidth (or anchor) service at cost, while allowing flexibility in rate setting for higher bandwidths. Ofcom defines lower bandwidths as speeds of up to 40 megabits per second (Mbps). This approach achieves the goal of offsetting the benefits of pricing flexibility for higher bandwidth services and protects consumers from the risk of high retail prices for lower bandwidth services. Ofcom’s service-based approach to setting charge controls is as follows:

- *Legacy/copper-based access (metallic path facility [MPF] or local loop unbundling (LLU) services over a national efficient ongoing copper network):*
 - *Ofcom uses the long-run incremental cost (LRIC) top-down model, where the markup is set on an equi-proportionate markup basis when allocating costs between service groups – in this case, services using MPF and Generic Ethernet Access (GEA) services.*
 - *LRIC is a forward-looking, gradual cost that a company is able to predict and plan for over the long term.*
- *FTTC-based access (GEA or fibre access services using FTTC overlay) delivering speeds of 40 Mbps download / 10 Mbps upload:*
 - *Ofcom uses the LRIC bottom-up model, where FTTC costs are modelled using very-high-bit-rate digital subscriber line (VDSL) technology as an ongoing overlay to an existing copper network (i.e. an MPF).*
- *For total aggregate costs across the total wholesale market, excluding legacy/copper-based access and FTTC-based access:*
 - *Ofcom applies the current cost accounting (CCA) and fully allocated cost (FAC) model.*
 - *CCA is a valuation method where assets and goods used in production are valued at their actual or estimated current market prices at the time of production.*
 - *FACs are costs associated with a service, including the cost of employees’ salaries and benefits, space, equipment, materials, etc.*
 - *This approach ensures transparency and ensures that costs are not missed or double-counted.*
- *Fibre-based virtual local access network delivering speeds over 40 Mbps:*
 - *Ofcom does not set price controls, but allows for pricing flexibility to help support incentives to invest in fibre network build.*

The new price controls came into effect in April 2018, and will run until the end of March 2021. Ofcom indicated that future reviews will be conducted to reflect the state of the evolving industry.

Regulatory environment and market composition

In the U.K., the Office of Communications (Ofcom) is the regulatory authority responsible for the telecommunications sector. Its regulatory responsibility extends to broadband, home phone, and mobile services; television and radio; universal postal service; airway management; and consumer protection. Ofcom was established under the Office of Communications Act 2002 and operates under a number of Acts of Parliament. [2]

The U.K.'s dominant incumbent telecommunications carrier is British Telecom (BT).⁵⁵ According to Ofcom's most recent market data, [3] BT's share of the U.K.'s fixed broadband connections (which amount to 26.7 million) is between 70 and 80 per cent. The U.K.'s main phone and broadband network is managed by BT's functionally separate organization called Openreach, which was founded in 2006. [4] [5] Openreach provides services over the local access network, installing and maintaining the fibre and copper communications networks that connect end users throughout the U.K. In other words, Openreach connects homes and businesses in the U.K. to the national broadband and telephone network (the last mile) through local exchanges. Regional interconnections beyond the local exchanges are managed by BT's Wholesale division. [6]

Openreach's customer base is made up of communications service providers that access its network to deliver services to homes and businesses, including home broadband, television, telephone, and high-speed data connections. Communications service providers access the network on equivalent terms, meaning they have access to the same products, prices, and levels of service. [7] Openreach also provides network access and engineering services for copper, fibre, Ethernet and optical, and infrastructure solutions.

In 2016, as part of its Digital Communications Review, Ofcom announced plans to overhaul Openreach's governance and strengthen its independence from BT. In March 2017, BT and Ofcom reached an agreement on a long-term regulatory settlement that made Openreach a distinct, legally separate company within BT Group (i.e. a wholly owned subsidiary [8]), called Openreach Limited. Under the agreement, Openreach gained more control of its strategy, investments, and plans within a strategic framework defined by BT. [7] Openreach has full control of the assets, including the physical access network, and makes decisions on their build and maintenance, while BT retains a title of ownership on these assets. [9]

Today, Ofcom continues to regulate wholesale charges for local loop unbundling (LLU), and in respect of virtual unbundled local access (VULA) services, has recently decided to set a charge control for Openreach's Generic Ethernet Access (GEA) 40/10 service (i.e. with speeds of 40 megabits per second [Mbps] download and 10 Mbps upload), which is used to provide broadband services over Openreach's fibre connections. [10]

⁵⁵ BT Group plc is the listed holding company for the BT group of companies. British Telecommunications plc is a wholly-owned subsidiary of BT Group plc and encompasses all businesses and assets of the BT Group. BT Group plc is listed on the London Stock Exchange.

Findings of the Wall report [11]

As indicated in the Wall report, Ofcom’s approach to rate setting has continued to evolve over the last 20 years. In 2005, Ofcom moved from using an LRIC approach for setting rates for unbundled local loops to a hybrid HCA/CCA FAC approach. This approach aimed to take into consideration BT’s pre-1997 copper access network assets in a manner that did not over-recover the costs of those assets. Regulatory asset value (RAV) was established to represent the remaining value of the pre-1997 copper access network assets. RAV gradually disappears over time as the older assets are replaced with newer ones. Assets that were developed post-1997 continued to be valued on a CCA FAC basis throughout their lives. In 2009, Ofcom made a similar decision for call origination and termination services, while the LRIC pricing approach remained for support structures.

In terms of setting price ceilings for wholesale services, such as wholesale line rental, LLU, and wholesale fixed call origination and termination services, Ofcom has typically applied a multi-year price cap that adjusts to the price ceiling annually according to an established retail price index (RPI)-X formula (i.e. inflation less a productivity offset that may be negative or positive).

Wall report – Summary of Ofcom’s costing methodologies

Service	Asset cost base	Costing methodology
<i>LLU</i>	Hybrid HCA/CCA RAV model	FAC model (top down)
<i>Interconnection (originating and terminating access)</i>	CCA (next-generation network- based)	FAC model (top down)
<i>Support structure services (cost orientation)</i>	CCA	LRIC (risk adjusted)

For next-generation services, the Wall report indicated that Ofcom did not regulate prices for services such as VULA; in other words, services that provide access to the fibre network through a virtual connection. Rather, Ofcom allowed flexibility to price these services according to emerging trends in the market demand and supply.

The U.K.’s approach to wholesale rate-setting methodology since 2012

In the U.K., broadband services continue to be marketed in terms of download speeds. For instance, standard broadband service offers download speeds of up to 30 Mbps and is provided using copper wires to connect homes to Openreach’s local exchange.⁵⁶ Openreach has deployed fibre between local exchanges and street cabinets to make a fibre-to-the-cabinet (FTTC)⁵⁷ [12]

⁵⁶ Though BT owns the title to the capital assets (i.e. broadband networks), for sake of simplicity this document will refer to Openreach, which installs and manages the local area network and provides wholesale access to other companies.

⁵⁷ In the U.K., “FTTC” refers to fibre optic cables that run from the telephone exchange to street cabinets before using standard copper telephone wires to connect to homes. In the U.K., most fibre connections are FTTC.

network, with copper still used between the street cabinet and the customers' premises. In a small number of instances, Openreach has deployed full-fibre connections, referred to as fibre to the premises (FTTP). Broadband with download speeds above 30 Mbps is referred to by Ofcom as "superfast" broadband service. While this type of service can be delivered by either FTTC or FTTP, it is largely delivered in the U.K. using FTTC services and a copper access service for connecting the premises (i.e. the last mile). [13] A recent review of the U.K.'s wholesale local access market examining the state of the industry (including wholesale rate setting, competition, and network investment) found that the so-called "superfast" broadband services (defined as those offering download speeds from 30 Mbps to 300 Mbps) are available to over 90 per cent of U.K. premises. Where available, 50 per cent of broadband lines were at superfast speeds by 2017, with a forecast of above 70 per cent by 2020-21. However, while the U.K. performs well internationally with regard to availability and take-up of superfast broadband, it lags behind other countries in full-fibre broadband (full-fibre networks can deliver speeds in excess of 1 gigabit per second [Gbps]), with only 10 per cent of premises able to benefit from these types of connections. [13] [15]

The review also found that BT (including its subsidiary, Openreach) continues to have significant market power in the U.K.,⁵⁸ which has given rise to reduced incentives to invest in new networks by both BT and its competitors. While there has been steady progress in the proliferation of broadband speeds of 30 Mbps or more in the U.K., as well as increased adoption of cloud-based services, there continues to be a need for greater investment to build next-generation broadband networks. This, in Ofcom's view, is best achieved through competition among different networks, as well a strategic shift to encourage large-scale investment in full-fibre networks and to discourage competitors' reliance on Openreach's (largely copper-based) technologies. As a result, the key measures Ofcom has taken to promote investment and competition are as follows:

- **Improving access to Openreach's ducts and poles to make it easier and cheaper for competitors to build their own fibre networks.** In other words, opening up the access to Openreach's ducts and poles to enable rival operators to lay new fibre networks, given that the largest part of the cost of deploying a network is the construction cost of physical infrastructure. Using pre-existing ducts and poles would allow for quicker deployment of new networks, and an estimated 50 per cent reduction in up-front costs of building.
- **Continuing pricing flexibility for Openreach's wholesale services with higher speeds (above 40 Mbps), while introducing a control on its prices for speeds below that threshold.** Pricing of Openreach's wholesale services plays an important role in investment incentives, both for Openreach and its competitors, because the majority of retail service providers that compete with BT currently purchase wholesale services from Openreach. These retail providers are expected to invest in their own networks only if it is more attractive than buying wholesale services from Openreach. Likewise, Openreach's incentives

⁵⁸ National regulatory authorities (NRAs) have the power to designate undertakings as having significant market power when they possess 25 per cent market share, with the possibility to deviate from this threshold taking into account the undertaking's ability to influence the market. [24]

to invest in new networks will be influenced by the return achieved on investment (i.e. the prices it can charge for services delivered over the network). To address this concern, Ofcom decided to implement an anchor pricing approach, discussed in greater detail below.

- **Maintaining access and pricing controls on BT’s copper network.** The objective of this measure is to protect consumers during the transition to greater network competition.
- **Improving quality of service.** Setting higher standards of quality on BT’s copper network to protect consumers in the transition to greater network competition. [13]

Price controls

Openreach’s wholesale copper access services have been subject to price controls for some time, while the company had flexibility in how it sets prices for its FTTC services. In its recent consultations, Ofcom found that pricing flexibility for FTTC services, combined with imposing a cost-based control on lower-speed copper services, has proved successful in acting as incentives to invest in FTTC and contributed to the take-up of broadband services in the U.K. Ofcom found that Openreach has been able to make a reasonable return on its initial risky investment in FTTC, even taking into account the at-cost charge control on lower-speed services (up to 40 Mbps). Similarly, Ofcom decided to set an anchor pricing approach whereby charges would be based on the costs of providing metallic path facility (MPF) services over a national efficient ongoing copper network, as well as on GEA services using FTTC overlay. [14] Ofcom allows continued flexibility in how Openreach sets prices on VULA services of higher (and lower) bandwidths.⁵⁹ In this case, anchor pricing – regulating the price of a lower bandwidth (or anchor) at cost – achieves the goal of offsetting the benefits of pricing flexibility for higher bandwidth services and protects consumers from the risk of high retail prices for lower bandwidth services. [13] This approach recognizes that the focus of investment is now on full-fibre networks, and there is the prospect of competitive investment, which was not the case in FTTC. The charge control on VULA 40/10 Mbps services was a consumer price index (CPI)-X control, with X set to align charges to forecast efficient costs of an ongoing FTTC network by the penultimate year of the charge control period (i.e. cost-based charge control). Ofcom argues that this form of price cap regulation provides incentive for the regulated entity to make efficiency gains over and above those forecast as part of the control. If Openreach is able to deliver the required services at a lower cost than has been forecast, it can keep the profits resulting from these savings, resulting in incentives to outperform the control.

In conjunction with the new decision, Ofcom decided it is no longer necessary to subject BT to the detailed VULA margin condition imposed in 2014, which obliged the company to provide a sufficient margin between retail and wholesale prices and to report on compliance bi-annually.

The new price control came into effect in April 2018, and will run until the end of March 2021. Wholesale charge controls were reduced from previous levels in two time increments so that

⁵⁹ Openreach will continue to have flexibility in setting wholesale prices for full-fibre services where the charge-controlled FTTC services are also available. In the limited cases where Openreach has deployed full-fibre networks but offers no other (lower speed) broadband service, anchor pricing approach will apply. [13]

they align with Ofcom's forecast of efficient cost in 2019/20 and 2020/21. The charge controls were set as follows: ⁶⁰

Ofcom wholesale charge controls – Charge control nominal annual charge estimates⁶¹ (£)

Service	Annual charge before 23 March 2018	2018-19	2019-20 (Step 1)	2020-21 (Step 2)
<i>MPF</i>	84.38	85.74	85.36	85.36
<i>GEA 40/10</i>	88.80	69.59	61.12	59.91
<i>Combined rental charge (MPF plus GEA 40/10)</i>	173.18	155.33	146.48	145.27

To prevent Openreach from stifling new investment by rivals as network competition emerges, the company will not be allowed to make geographically targeted reductions to wholesale rental charges in areas where competitors are starting to build new networks. Given that it takes time to deploy new networks, Ofcom recognized that the shift to network competition may take some time. [13] Ofcom also indicated that, over time, it can be expected that the constraint imposed by the cost-based, up-to-40-Mbps VULA services on the faster VULA services will weaken, and that charge controls beyond those currently in place for copper access and up-to-40-Mbps VULA services will not be extended as a matter of course. In fact, Ofcom argued that a shift away from price regulation of VULA can be expected with increased investment by competing providers, and that different regulation may need to be considered for different geographic areas.

The review noted the need to adopt a geographically differentiated approach to price regulation in the future: in places with effective competitive pressure, Ofcom would be expected to deregulate; conversely, in areas where competition does not emerge, wholesale prices would be controlled for higher-speed services to address the risk of high prices. In its July 2018 Strategic Policy Position, Ofcom decided to vary its approach depending on the intensity of network competition in different areas, allowing for widespread availability of full fibre across the U.K. Where competing networks exist or are likely to emerge, it is expected that there will be scope for greater deregulation. [15] Ofcom predicts that there will be three different geographic areas:

- competitive: locations where there are at least three competing fixed networks;
- potentially competitive: locations where competition between fixed networks could emerge; and
- non-competitive: parts of the country where the deployment cost is prohibitively high for new entrants, relative to demand for services. [15]

⁶⁰ These figures were modified in a subsequent explanatory note. [25]

⁶¹ The actual price will depend on the consumer price index minus the “x” applied.

In terms of copper access regulation, Ofcom's key objective was to protect consumers who use fixed services delivered via the Openreach network. Ofcom defines two types of LLU: MPF, as mentioned above, and shared metallic path facility (SMPF). With MPF, a telecommunications service provider can offer a retail bundle composed of the exchange line (including voice services over the same line) and broadband, while with SMPF, it provider can supply only a retail broadband service (with another provider supplying voice service). Given the increase in importance of MPF and the expectation that demand for SMPF will decline significantly, Ofcom decided the following: [13]

- Openreach must continue to offer LLU to competitors, on which Ofcom will continue to impose a cost-based charge control on the main LLU and the supporting services used by competitors (see above table); and
- specific network access obligation and charge control on shared LLU (SMPF) would be removed. BT would still have to provide network access to shared LLU upon receiving reasonable requests, would have to do so at fair and reasonable charges, and would be subject to a no undue discrimination obligation. [13]

Approach to setting charge controls

As indicated above, Ofcom used CCA FAC, or other similar approaches such as LRIC+, when setting charge controls in the past. In its 2018 wholesale local access market review [16], Ofcom recognized the similarities between CCA FAC and LRIC+, noting that both standards use accounting rules and assumptions for the recovery of common costs for different services and reflect forward-looking costs rather than the actual prices at the time assets are purchased.

Per the findings of the Wall report, Ofcom moved away from using an LRIC approach for setting rates for ULLs in 2005 (and again in 2009 for call origination and termination services). In its 2018 review [16], Ofcom decided to continue to apply the CCA FAC as the basis for forecasting the efficient total aggregate cost across the portfolio of services offered by Openreach within the wholesale line access market, while using LRIC+ as the cost standard for MPF and GEA services. [16] In the former scenario, Ofcom felt that CCA FAC data continued to provide the best source of cost data across all services in the market, which is of importance when allocating common costs. Using the CCA FAC also ensures that costs are not missed or double-counted, and that they could be audited in a transparent way. [16] However, Ofcom noted that the CCA FAC standard is not optimal for determining relative charges. For some services, setting prices at LRIC without a markup may be more appropriate, because in those instances the efficiency or competition advantages of LRIC outweigh the practical benefits of FAC. Ofcom is able to calculate the LRIC of GEA services using FTTC from its bottom-up model, where FTTC costs are modelled using very high bit rate digital subscriber line technology as an ongoing overlay to an existing copper network. To obtain LRIC estimates for services using the copper network (MPF), Ofcom relied on the top-down LRIC model. Ofcom set the markup (the "+" in LRIC+) on an equi-proportionate-markup (EPMU) basis when allocating costs between service groups – in this case, between services using MPF and GEA services. [16]

In order for the cost estimates to better reflect the economic cost of providing MPF and GEA services, Ofcom made three significant adjustments to the top-down cost data provided by BT:

- the ongoing network adjustments,
- taking account of the value of copper sales, and
- operating expenditure (opex) adjustments for the level of faults on Openreach's network. [16]

Ofcom also made adjustments to the actual historical cost data provided by Openreach to ensure that it reflects expected future costs of the network.

Physical infrastructure access (PIA)⁶²

Following the 2018 review [17], Ofcom issued a decision to impose a specific network access obligation on Openreach, requiring it to provide access to its physical infrastructures, as follows:

- **Access to ducts and poles:** Openreach must allow other telecommunications service providers access to deploy their own networks in its ducts and poles. This also obligates Openreach to make adjustments to existing infrastructure, so that it is ready for use (i.e. to make repairs and relieve congestion) where necessary.
- **Flexibility:** Ofcom has also relaxed its PIA usage restriction to allow mixed usage (broadband and non-broadband services), provided that the primary purpose of the deployment is delivery of broadband services.
- **Level playing field:** Openreach became subject to a “no undue discrimination” condition, requiring strict equivalence for all processes/sub-products that contribute to supply and consumption of duct access.
- **Access to digital maps:** telecommunications service providers must have access to digital maps with Openreach's duct and pole networks, as well as information on spare capacity.
- **Efficiency:** Openreach must publish and order stating how all operational processes will work, along with relevant terms and conditions including service level agreements and guarantees.
- **Pricing:** Ofcom set a cap on PIA rental charges, resulting in significant reductions compared to those set previously. Costs associated with making the existing infrastructure ready for use will be recovered from all users of the infrastructure, up to a limit of £4,750/km, with other ancillary charges required to be cost-based. Ofcom also placed a number of financial reporting requirements on BT for effective monitoring.

In July 2018, Ofcom published a Strategic Policy Position on regulatory certainty to support investment in full-fibre broadband [15], in which it highlighted its strategy to secure full-fibre investment by promoting network-based competition through, among other efforts, introducing proposals that seek to provide unrestricted access to Openreach's ducts and poles nationwide. In a subsequent consultation document [20], Ofcom reiterated its proposal to allow rival

⁶² For more information on Ofcom's key decisions on access to BT's network of poles and underground ducts, refer to *Wholesale Local Access Market Review: Statement – Volume 3*, Ofcom, 28 March 2018 [17]

companies to have greater access to Openreach’s ducts and poles in order to lay their own fibre networks, indicating that this access can cut the up-front cost of building networks by around half. [20]

Wireless access services

Ofcom’s review examined wireless services from the perspective of the definition of a wholesale product market and the extent to which they served as substitutes to retail services. Ofcom concluded [13] that the market for wholesale local access comprises, at the moment, only services supplied over copper/fibre and cable connections. The review found that wireless-based services were highly differentiated; i.e. they did not act as a constraint on a hypothetical monopolist of a local access over copper/fibre or cable connections. The review recognized that, with the advent of new wireless technologies, this may change, and that some wireless technologies could begin to be used as a substitute to a cable, copper, or fibre connection, which may require appropriate reviews in the future.

In the U.K., mobile virtual network operators (MVNOs) offer retail mobile wireless services to end consumers without owning all the mobile service infrastructure themselves. In 2017, there were 104 active MVNOs in the U.K. – including Tesco Mobile, Virgin Mobile, Asda Mobile, and GiffGaff [19] – serving 13.5 million customers. [18] The U.K.’s four established mobile network operators that provide access to MVNOs are EE, Vodafone, Telefonica, and H3G. Ofcom has not imposed access obligations on mobile network operators that supply wholesale access to MVNOs on a commercial basis because it had found that there was sufficient competition in the market. [20] While Ofcom regulates wholesale services offered by a mobile wireless service provider to connect a call to a consumer on its network (also referred to as mobile call termination), [10] research conducted for this report suggests that there is currently no regulatory regime for mobile wireless service costing in the U.K.

Future developments

In the summer of 2019, Ofcom launched a consultation on the approach to modelling the costs of a fibre network in order to understand the costs and investment needed to upgrade the U.K.’s broadband infrastructure in support of providing competing “ultrafast” broadband services (with speeds greater than or equal to 300 Mbps). [21] [22] The consultation closed on 9 August 2019.

In its initial consultation document, Ofcom outlined its proposed approach to modelling the costs of services provided over a fibre network. This includes

- using a bottom-up modelling approach to estimate the costs of building an efficient fibre network,
- a proposed design of the modelled fibre network, and
- proposals regarding the design of the cost model. [22]

Ofcom considered both the bottom-up approach (estimating how much network equipment is needed for a forecast level of volumes or traffic, followed by a calculation of the total cost of this network equipment using evidence of the capital and operating costs of each piece of equipment) and a top-down approach (using total network cost data and allocating these costs to

services based on service usage factors, without relying on assumptions of how the network is constructed; modelled costs are instead calculated using cost-volume elasticities reflecting assumptions about the way the cost of high-level network components change as traffic rises or falls).

Ultimately, Ofcom proposed a bottom-up approach to modelling a fibre network, since it is considered to provide better flexibility to assess the costs across different geographic regions and for different scales of deployment. Bottom-up cost modelling for fibre networks would be calibrated based on information from telecommunications service providers' business plans, as well as information on actual network rollout, as appropriate. [22]

Ofcom's report, "Final proposals in relation to defining markets, assessing significant market power, and setting regulatory remedies", was published in January 2020. The document reiterates and expands on Ofcom's proposal for addressing BT's market power in the provision of physical telecommunications infrastructure by applying different approaches to regulating Openreach's residential broadband products in different parts of the U.K., providing support for Openreach in retiring its old copper, allowing greater access for rival companies to Openreach's ducts and poles, regulating leased lines (high-speed data connections used by large organizations) in a similar way to residential broadband regulation, and maintaining quality of service safeguards. [20] The proposal will be open for consultation until April 2020, following which Ofcom will publish a statement of decisions before the new regulation takes effect in April 2021.

Glossary of terms/definitions

ADSL: Asymmetric digital subscriber line

Technology that delivers broadband using the standard copper telephone line. ADSL 2+ refers to a type of broadband service usually advertised as offering speeds of up to 17 megabits per second or without any reference to connection speed. ([Source](#))

CCA: Current cost accounting

A valuation method where assets and goods used in production are valued at their actual or estimated current market prices at the time the production takes place (sometimes described as replacement cost accounting), rather than using the historic cost (i.e. the price at which the assets were originally purchased). ([Source](#))

Charge control: prices that are regulated by Ofcom across a number of different segments covering telecom, broadcasting and postal services markets. ([Source](#))

CPI: Consumer price index

FAC: Fully allocated cost

Costs associated with a service, including the cost of employees' salaries and benefits, space, equipment, materials, and other costs necessary to perform the service. ([Source](#))

FTTC: Fibre to the cabinet/curb

FTTP: Fibre to the premises

GEA: Generic Ethernet Access

BT's wholesale product providing telecommunications service providers with access to its fibre networks to supply higher-speed broadband services ([Source](#))

HCA: Historical cost accounting

Measure of value used in accounting in which the value of an asset on the balance sheet is recorded at its original cost when acquired, even if it has increased in value over time. Historical cost accounting prevents overstating an asset's value when asset appreciation may be the result of volatile market conditions. ([Source](#))

IP: Internet Protocol

A standard describing software that keeps track of the Internet address for different nodes, routes outgoing messages, and recognizes incoming messages.

LLU: Local loop unbundling (ULL: Unbundled local loops)

A regulatory access requirement whereby an incumbent network provider is required to lease elements of the network (e.g. copper) to competitors, to enable the competitors to provide a service in competition to the incumbent. The physical wire connection between customer and company is often referred to as the "local loop" and was historically owned by the incumbent local exchange carrier. ([Source](#))

In the case of the U.K., LLU enables providers to deliver standard broadband over BT's copper network. The two variants of LLU are metallic path facility (MPF) and shared metallic path facility (SMPF). In the U.K., telecommunications service providers use BT's LLU service to serve around ten million customers, while VULA is used by BT's competitors to supply around four million customers. ([Source](#))

LRIC: Long-run incremental cost

A forward-looking cost that a company is able to predict and plan for over the long term. These types of costs generally refer to changes associated with making a product, such as the cost of inputs or raw materials. ([Source](#))

MPF: Metallic path facility (Local loop unbundling)

Enables both voice and broadband services. MPF provides a two-wire metallic transmission path between the network terminating equipment at a customer's premises and a main distribution or jumper frame at the exchange. ([Source](#))

MVNO: Mobile virtual network operator

Ofcom: Office of Communications

PIA: Physical infrastructure access

RAV: Regulatory asset value

RPI: Retail price index

SMP: Significant market power

SMPF: Shared metallic path facility (a.k.a. local loop unbundling)

Functions like an MPF, but enables a provider to offer broadband services over the copper network to end customers while another communications provider supplies voice services on the same line. ([Source](#))

VULA: Virtual unbundled local access

Provides access to BT's fibre through a virtual connection. There are two variants: Generic Ethernet Access–Fibre to the cabinet/curb (GEA-FTTC), and Generic Ethernet Access–Fibre to the premises (GEA-FTTP), each of which is available in a range of bandwidths, with the price of the service increasing with the bandwidth offered.

In the U.K., telecommunications service providers use BT's local loop unbundling (LLU) service to serve around ten million customers, while VULA is used by BT's competitors to supply around four million customers. ([Source](#))

WLR: Wholesale line rental

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VI. United States

Executive summary

The Federal Communications Commission (FCC) is the main national regulatory authority of the communications sector in the U.S. The key piece of legislation governing the U.S. telecommunications industry is the 1996 Telecommunications Act. Regulatory authorities at the state level are often referred to as public utility commissions or public service commissions. There is significant variation in regulatory approaches among state jurisdictions.

As of 2017, the largest nationwide facilities-based mobile wireless service providers were Verizon and AT&T with 35 and 34 per cent of market share respectively, followed by T-Mobile with 17 per cent, Sprint with 13 per cent, and U.S. Cellular with just over 1 per cent. [1]

In the past, the FCC used the total element long-run incremental cost approach to set price ceilings for unbundled local loops and interconnections services. In recent years, the FCC has decided, where appropriate, to forbear from regulating aspects of the wholesale access telecommunications market, namely mandated access and wholesale pricing. Where there is competition or competitive pressure present for services provide dedicated point-to-point transmission of data at guaranteed speeds and service levels using high-capacity connections (business data services), the FCC has removed unnecessary government intervention to allow market forces to continue working to spur entry, innovation, and competition.

With regard to telecommunications traffic, the FCC has adopted a “bill-and-keep” methodology as a default framework and the ultimate end state for all intercarrier compensation traffic in an effort to drive greater efficiency in the operation of telecommunications networks and promote the deployment of IP-based networks. [2] Currently, originating and long-distance carriers pay no fees whatsoever for calls/traffic that terminate on other carriers’ networks. With bill-and-keep, a carrier looks to its end users, rather than other carriers and their customers, to pay for the cost of its networks. [3]

Summary of wholesale fixed services subject to regulation in the U.S. (source: Ovum) [4]

Wholesale fixed regulation

Service		Required to offer	Cost methodology
Voice interconnection	Public switched telephone network origination and termination	Yes	Cost-based
Wholesale access	Wholesale line rental	No	n/a
	Carrier selection and preselection	Yes	n/a

	<i>Leased lines</i>	<i>No</i>	<i>n/a</i>
<i>Wholesale broadband services</i>	<i>Bitstream</i>	<i>No</i>	<i>n/a</i>
	<i>Local loop unbundling (LLU)</i>	<i>Only in the narrowband market, not in the broadband market</i>	<i>Commercial negotiation</i>
	<i>Sub-loop unbundling (SLU)</i>	<i>No</i>	<i>n/a</i>
	<i>Fibre bitstream</i>	<i>No</i>	<i>n/a</i>
	<i>Fibre unbundling</i>	<i>No</i>	<i>n/a</i>
	<i>Physical infrastructure access</i>	<i>Yes</i>	<i>Commercial negotiation</i>
	<i>Dark fibre</i>	<i>No</i>	<i>n/a</i>

Regulatory environment and market composition

The U.S. telecommunications sector is subject to regulation at both the federal and the state level,⁶³ which has resulted in a regulatory framework that varies throughout the country. [6] Historically, incumbent local exchange carriers (ILECs), which enjoyed a monopoly status prior to the deregulation of local markets, tend to be highly regulated at both levels, while competitive carriers tend to be subject to lighter regulatory requirements at the federal level and to varying degrees of regulation at the state level. [6] Wireless carriers are primarily regulated by the Federal Communications Commission (FCC). [6] The FCC regulates interstate and international communications by radio, television, wire, satellite and cable in all 50 states, in the District of Columbia, and in U.S. territories. It is an independent government agency responsible for implementing and enforcing U.S. communications law and regulations. [7]

The key piece of legislation governing the U.S. telecommunications industry is the 1996 *Telecommunications Act* (the Act). One of the main objectives of the Act is to promote and facilitate competition in the local telecommunications market; it includes a requirement for incumbent local exchange carriers (ILECs) to provide interconnection services and unbundled network elements to competitive carriers and the resale of their telecommunications services at regulated rates. When carriers do not agree on efficient pricing of unbundled network elements through negotiation, the Act requires state commissions to be responsible for setting those prices.

The FCC develops pricing policies and rules for the retail and wholesale interstate access rates charged by carriers; the intercarrier compensation rates⁶⁴ that carriers charge each other; and the rates, or rate methodologies, for the resale of local exchange services, unbundled network elements, and interconnection that incumbent carriers charge competitive carriers. [8] The FCC

⁶³ The focus of this document is the federal regulatory environment.

⁶⁴ Intercarrier compensation rates are charges that one carrier pays to another carrier to originate, transport, and/or terminate telecommunications traffic.

also ensures compliance with pricing rules, and conducts formal or informal investigations of carrier charges, practices, classifications and regulations. [8]

At the state level, intrastate wireline telecom providers are regulated by state public utility commissions (PUCs) or public service commissions (PSCs). Some PUCs also regulate limited aspects of wireless companies or interconnected Voice over Internet Protocol (VoIP) providers. Intrastate wireline services are generally licensed by individual state PUCs; the licensing rules tend to vary widely among states. [9] State PUCs generally establish rates associated with the origination and termination of local and intrastate traffic, while the FCC establishes rates associated with interstate traffic. Wireless carriers rely on privately negotiated agreements to set rates for traffic on their networks. [6]

In recent years the FCC has made efforts to encourage the deployment of advanced telecommunications capability to all Americans by removing barriers to infrastructure investment and by promoting competition in the telecommunications market. Recent data indicates that the digital divide has indeed been narrowing in the U.S. For instance, the total number of Americans with access to at least 250 Mbps download/25 Mbps upload broadband grew in 2017 by more than 36 per cent, while the number of rural Americans with access to same broadband speeds increased by 85.1 per cent. [10] The FCC considers the performance benchmark for fixed service to be 25 Mbps/3 Mbps; that speed is deemed to meet the statutory definition of advanced telecommunications capability by enabling users to originate and receive high-quality voice, data, graphics, and video telecommunications. [10]

In the U.S., wireless carriers are primarily regulated by the FCC. States are precluded from regulating the rates charged by wireless carriers, though they do impose consumer protection requirements. [6] As of 2017, there were four facilities-based mobile wireless service providers in the U.S. that are typically described as operating on a nationwide scale: AT&T, Sprint, T-Mobile, and Verizon Wireless. Verizon and AT&T were the largest service providers, with 35 and 34 per cent of market share respectively, followed by T-Mobile with 17 per cent, Sprint with 13 per cent, and U.S. Cellular with just over 1 per cent. [1]

While none of the four can be described as having a truly ubiquitous network, all have networks that cover at least 90 per cent of the U.S. population with long-term evolution (LTE).⁶⁵ Collectively, the four nationwide providers account for over 400 million connections. There are also a multitude of other facilities-based mobile wireless service providers throughout the U.S., many of which provide service in a single, often rural, geographic area. [1] The largest mobile virtual network operator (MVNO)⁶⁶ is TracFone Wireless, a subsidiary of America Movil, with approximately 23 million subscribers in 2017. [1]

Findings of the Wall report [11]

⁶⁵ LTE is a fourth generation wireless communications standard designed to provide up to ten times the speeds of third generation networks for mobile devices.

⁶⁶ MVNOs are operators that do not own any network facilities but instead purchase mobile wireless services wholesale from facilities-based service providers and resell those services to consumers.

The Wall report described the FCC's approach to wholesale rate setting prior to 2011 as a total element long-run incremental cost (TELRIC) methodology for default price ceilings for ULL and interconnection services. Notably, individual state regulators were able to set wholesale prices themselves using a cost model of their choice, so long as it was based on the principles of TELRIC, a forward-looking, incremental cost-based pricing methodology to which a reasonable allocation of forward-looking joint and common costs is added. The FCC did not allow the recovery of embedded costs in excess of economic cost, ILECs' opportunity costs, subsidies, and/or retail costs. This differed from conventional incremental costing methodologies, where no common costs are included.

The FCC required state commissions to use TELRIC to set rates for unbundled network elements and support structures; however, the FCC also recognized that in some cases it may not be possible for carriers to prepare, or the state commission to review, economic cost studies within the statutory time frame for arbitration. The FCC therefore provided proxies on which carriers could base their interim arbitrated rates, in order to provide an approach to establishing prices on an interim basis that would be faster, administratively simpler, and less costly than a detailed forward-looking cost study. [12]

The FCC initially set local loop default proxy price ceilings for each state in 1996 at an average of \$16.36. The FCC also set a default proxy price range for the usage-sensitive component of unbundled local switching of between 0.2 cents and 0.4 cents per minute of use. However, each state was able to set prices for wholesale unbundled loops and other unbundled network elements. The FCC advised state regulatory agencies to use percentage mark-ups rather than directly attributable costs as a forward-looking way of allocating shared and common costs. The FCC also recommended that mark-ups be kept relatively low on certain critical network elements, such as local loop and co-location. The Wall report found that, in practice, the mark-ups used by state regulators were not consistent, although they were generally between 15 per cent and 35 per cent. Prices for local loops varied widely among states.

With regard to pole attachments, the FCC has developed formulas based on actual, historical accounting costs to set price ceilings for attachments by cable operators and telecommunications carriers to poles owned by ILECs and investor-owned electric utilities. Again, state regulators are able to adopt their own costing approaches. In 2011 the FCC revised its price formula for pole attachments by telecommunications carriers, reducing rates to promote the deployment of broadband services.

The Wall report found that the range of mandated wholesale services had been shrinking. At the time of the report, the FCC had no requirement for ILECs to offer wholesale broadband services or fibre access to competitive carriers. The report noted that, as a result, costing methodologies arising from the transition from copper to fibre facilities were generally of less concern in the U.S. than in the other countries surveyed (the U.K., Australia, Sweden, Germany and France).

The U.S.'s approach to wholesale rate-setting methodology since 2012

In 2011, the FCC embarked on a series of steps to reform the regulatory telecom environment to ensure that all consumers would have access to advanced telecom and information services. Among them was the creation of the Connect America Fund (CAF) to preserve and advance

voice and robust broadband services, both fixed and mobile, in high-cost areas of the nation that the marketplace would not otherwise serve.

A more recent regulatory change is the FCC's decision to forbear from regulating certain aspects of mandated access and wholesale transport pricing. The FCC has also decided to phase in, ending in 2020, the transition of certain intercarrier traffic to the "bill-and-keep" framework discussed below—a market-based methodology whereby carriers recover the cost of their network through end-user charges, which are potentially subject to competition.⁶⁷ Further, ILECs must provide other carriers access to network elements on an unbundled basis at cost-based rates, although the FCC has discretion to refrain from applying this requirement in markets deemed to be competitive. [6] The FCC has finalized rules to address arbitrage and fraud within the intercarrier compensation system related to access arbitrage and proposed additional rules (results pending) to address fraud related to telephone calls made to toll-free numbers. This is complemented by a number of orders in which the FCC has decided to forbear from regulating transport services that provide dedicated point-to-point transmission of data at guaranteed speeds and service levels, known as business data services (BDS). [6] Fibre unbundling is not currently subject to regulatory obligations, which gives ILECs an incentive to upgrade their local networks. [13]

⁶⁷ The OECD defines bill-and-keep as a pricing scheme for the two-way interconnection of two networks under which the reciprocal call termination charge is zero – that is, each network agrees to terminate calls from the other network at no charge. [26]

Bill-and-keep

As part of a broader regulatory reform that began in 2011, [2] the FCC made changes to the methodology used for all intercarrier compensation traffic, including wireline voice calls, wireless calls, and data bound for an Internet service provider. [14] The new methodology—bill-and-keep—applies to terminating end office switching and, in some cases, terminating tandem switching and tandem switched transport for price cap ILECs, and to terminating end office switching for rate-of-return ILECs. It is based on the principle that a carrier looks to its end users rather than to other carriers and their customers to pay for the cost of its networks. Bill-and-keep arrangements are akin to the model generally used to determine who will bear the cost for the exchange of IP traffic, whereby providers bear the cost of getting their traffic to an exchange point with other providers that is mutually agreeable. This methodology ensures that consumers pay only for services that they choose and receive, and eliminates the opaque, implicit subsidy system under which consumers currently pay to support other carriers' network costs. It imposes fewer regulatory burdens, reduces arbitrage⁶⁸ and competitive distortions inherent in the current system, and eliminates carriers' ability to shift network costs to competitors and their customers. [2] The FCC noted that the bill-and-keep methodology reduces the costs and uncertainty that arise when the FCC and/or state regulators must choose a uniform positive intercarrier compensation rate, which requires complicated proceedings based on factors such as elasticity of demand for subscriptions and usage, and the nature and extent of competition. The FCC further noted that state proceedings under the previous TELRIC regime have been complicated and time consuming, resulting in the costs which outweighed the benefits. [2]

With regard to termination of access traffic, the bill-and-keep methodology includes a recovery mechanism that is based on two components:

- definition of the revenue ILECs are eligible to recover (Eligible Recovery), and
- specification of ways in which ILECs may recover Eligible Recovery through limited end-user charges. Competitive local exchange carriers are able to recover a decreasing fraction of their lost intercarrier revenues through such charges.⁶⁹
 - Carriers are permitted to recover a limited portion of their Eligible Recovery from their end users through a monthly fixed charge called an Access Recovery Charge (ARC). The FCC limited the annual increase in consumer ARCs to \$0.50 per month.
 - The FCC does not place the entire burden of access recovery on consumers. Instead, consumer and single-line business recovery are balanced with recovery from multi-line businesses.

⁶⁸ Arbitrage refers to the simultaneous purchase and sale of an asset to profit from an imbalance in the price, resulting from market inefficiencies. [28]

⁶⁹ The FCC found that competitive carriers have generally been found to lack market power in the provision of telecommunication services. Since their end user charges are not subject to comparable rate regulation, those carriers therefore should be free to recover reduced access revenue through regular end user charges. [2]

- To protect consumers, including those in states that have already rebalanced rates through prior state intercarrier compensation reforms, the FCC adopted a Residential Rate Ceiling that prohibits imposing an ARC on any consumer paying an inclusive local monthly phone rate for basic service of \$30 or more.
- Although the FCC did not adopt a business rate ceiling, it took measures to ensure that multi-line businesses' total subscriber line charges plus ARC line items are just and reasonable.
- To recover Eligible Recovery, ILECs subject to price cap can implement monthly end-user ARCs. Five annual increases are permitted, of no more than \$0.50 per month for residential/single-line business consumers, for an ARC of no more than \$2.50 in the fifth year and thereafter; and no more than \$1.00 per line for multi-line business customers, for an ARC of no more than \$5.00 per line in the fifth year and thereafter, provided that (1) any such residential increases do not result in regulated residential end-user rates for basic voice service that exceed the \$30 Residential Rate Ceiling; and (2) any multi-line business customer's total subscriber line charges plus ARC does not exceed \$12.20. The FCC noted that not all carriers would elect to charge the ARC, or be able to do so, partly because of competitive pressures.
- To recover Eligible Recovery, rate-of-return ILECs can implement ARCs with six annual increases permitted, of no more than \$0.50 per month for residential/single-line business consumers, for an ARC of no more than \$3.00 in the sixth year; and no more than \$1.00 per month per line for multi-line business customers for an ARC of \$6.00 per line in the sixth year and thereafter, provided that (1) such increases would not result in regulated residential end-user rates for basic voice services that exceed the \$30 Residential Rate Ceiling; and (2) any multi-line business customer's total subscriber line charges plus ARC does not exceed \$12.20.
- Competitive local exchange carriers, which are not currently subject to the FCC's end-user rate regulations, may recover reduced intercarrier revenues through end-user charges. [2]

The FCC also set out a plan for the transition to bill-and-keep for certain terminating traffic, which provides rate-of-return carriers, whose rates are typically higher, with additional time to transition. For carriers subject to price caps, and for competitive local exchange carriers that benchmark to those carriers' rates, the FCC set out a six-year period for the transition to bill-and-keep rates, ending 1 July 2018. For rate-of-return carriers, and for competitive local exchange carriers that benchmark to their rates, the period of transition is nine years, ending 1 July 2021. [2]

Regarding jurisdictional implementation, the FCC decided that states must implement the bill-and-keep methodology and oversee intrastate rate reductions during the transition period, as well as interconnection negotiations and arbitrations. States are also responsible for determining the point at which bill-and-keep applies and the point at which a provider is responsible for

delivering its traffic to another provider—the network “edge”—for purposes of bill-and-keep. [2]

Forbearance of mandated access and wholesale transport pricing

In recent years, the FCC has decided to forbear from regulating aspects of the wholesale access telecom market. Given the intense competition present in the market for BDS, [15] the FCC has decided to remove unnecessary government intervention and allow market forces to continue working to spur entry, innovation, and competition. [15]

Until 2017, ILECs that provide lower-speed legacy wholesale transport offerings over traditional copper wires, referred to as time-division multiplexing (TDM), were subject to *ex ante* pricing regulation.⁷⁰ [16] In a 2019 forbearance decision, [17] the FCC found that ILECs’ price caps were subject to decades-old network obligations that required them to provide their competitors with dedicated transport services between wire centres within their local networks that had not been modified for many years. Since then, the FCC has found that imposing pricing and other regulations on lower-speed BDS transport services has led to harmful market distortions. It has therefore decided to eliminate such regulatory intervention in this area. In a separate decision in 2019, following a petition from ILECs, the FCC also indicated that two specific obligations imposed on ILECs subject to price caps will be forborne from regulation. One of these required ILECs to unbundle two-wire and four-wire analog voice-grade copper loops, including the attached TDM equipment; the other required ILECs to offer for resale, at wholesale rates, telecommunications services that it offered at retail rates to non-carrier customers. [18] The FCC’s rationale for forbearance was that sweeping changes in the communications marketplace since the passage of the Telecommunications Act of 1996 have led to an increase in migration towards newer, next-generation wireline and wireless networks and VoIP services. The FCC noted that these regulatory obligations had led to ILECs preserving outdated technologies and services, resulting in a slower transition to next-generation networks and services. [18]

The FCC has forborne from regulating aspects of the telecom industry in a number of other instances. For example, in 2007, following a petition filed by AT&T, the FCC forbore from price regulating two specific categories of telecommunications services: packet-switched broadband services capable of transmitting 200 kbps or greater in each direction, which route or forward packets, frames, cells, or other data units based on the identification, address, or other routing information they contain; and non-TDM-based, optical transmission services, which include networking, optical hubbing, and optical transmission services. [19]

Pole attachment rates

Under U.S. law, utilities have a duty to provide telecom carriers’ or cable operators’ access to physical infrastructure. Prices are determined through commercial negotiations, though the FCC has established maximum rate guidelines using a cost-based approach. Companies can negotiate rates, terms and conditions. [13]

⁷⁰ The term “*ex ante*” refers to predictions of various indicators ahead of an event.

Historically, the FCC has primarily relied on private negotiations among pole owners and attachers, rather than specific access rules, to ensure just and reasonable rates, terms, and conditions. However, over time, a number of issues have arisen because the cost of deploying a broadband network depends significantly on the costs that service providers incur to access poles and other infrastructure, largely due to the number of disputes and to high litigation costs. In addition, there has been a growing concern with the lack of reliable, timely, and affordable access to physical infrastructure, particularly utility poles, which has proven a significant barrier to deploying wireline and wireless services. As a result, in 2011 the FCC issued an order which addressed that issue through a number of actions, including an adjustment to the definition of “costs” so that it yields a new just and reasonable rate that recovers the same portion of pole costs as the current cable rate. Wireless providers were also given the same entitlement as other telecom carriers with regards to rates. [20]

The FCC decided to employ two formulas to determine the recurring pole attachment rate paid by telecommunications carriers (there is a separate formula for rates paid by cable operators) which, depending on the relative magnitude of capital and non-capital costs would yield relatively higher or lower rates. The higher of the two rates is the rate the pole owner is allowed to charge for attachment to its poles. One rate formula is based on a FAC methodology which recovers costs that the pole owner incurs regardless of the presence of attachments. In this case, the portion of the fully allocated cost reflected in the formula varies with the number of attachers. This first formula is expected to yield the higher of the two rates in most cases. The other rate formula is based on the principles of cost causation that underlie a marginal cost rate, without defining “cost” as equivalent to “marginal cost” or “incremental cost” per se. In other words, a customer that incurs a cost pays a rate that covers that cost. For purposes of identifying a lower bound for the telecom pole rental rate, capital costs are excluded from the definition of the cost of providing space. Maintenance and administrative expenses, are included in the definition of cost for the lower bound telecom rate formula. That cost does not vary with the number of attachers. Although the FCC does not permit utilities to recover 100 per cent of apportioned, fully allocated costs through the new telecom rate, pole owners are allowed to charge a recurring pole rental rate that reflects some contribution to capital costs, aside from those recovered up front through make-ready fees. [20]

In recent years, ILECs had argued that their pole ownership relative to the share owned by electric utilities was declining, and that the pole attachment rates they paid had increased while pole attachment rates for cable and telecommunications attachers, excluding ILECs, had decreased, with a resultant decline in bargaining power for ILECs vis-à-vis electric utilities. The FCC ultimately concurred with this argument. In 2018, it decided that, for new and newly-renewed pole attachment agreements between utilities and ILECs, it should be presumed that ILECs are situated similarly to other telecommunications attachers, are entitled to comparable pole attachment rates, terms, and conditions, and should be charged no more than the pole attachment rate for telecommunications attachers calculated in accordance with the FCC rules, subject to this rebuttal presumption. The FCC also allowed for rebuttals in instances in which ILECs continue to possess greater bargaining power than other attachers (for example, in geographic areas where the ILEC continues to own a large number of poles). [21]

Interconnection

Due to concerns about arbitrage and fraud within the intercarrier compensation system, in 2018 the FCC issued an additional notice of proposed rulemaking related to call interconnection, which aimed to address arbitrage related to telephone calls made to toll-free numbers. In 2019, the FCC adopted rules to update the intercarrier compensation regime to eliminate access arbitrage.

In the case of toll-free calls, the FCC proposed to cap database query rates on a nationwide basis at the lowest rate currently charged by any local exchange carrier subject to price caps. In addition, the FCC proposed to explicitly limit chargers to one database query charge per call, regardless of how many providers are in the call path or how many database queries are actually conducted. [22] Based on the idea that each carrier should be responsible for the costs of those parts of the call path which it has discretion to choose, the FCC proposed to move interstate and intrastate originating toll-free, end office, tandem switching, and transport access charges to bill-and-keep. As with all intercarrier compensation traffic, carriers would be allowed to negotiate private agreements that departed from bill-and-keep, but would not be allowed any originating end office, tandem switching and transport charges related to toll-free traffic. [22] The FCC sought comments on the proposed approach and is currently considering next steps.

To further update the intercarrier compensation regime, the FCC adopted rules intended to eliminate financial incentives to engage in access stimulation (also known as traffic pumping).⁷¹ Those rules require an access-stimulating local exchange carrier, rather than the interexchange carriers,⁷² to be financially responsible for the delivery of calls from an intermediate carrier to its end office or the functional equivalent.

Wholesale mobile regulation

As resellers of mobile wireless services, MVNOs in the U.S. operate on the basis of commercial agreements with facilities-based providers. Such agreements generally arise when an MVNO has better access than the host facilities-based service provider to certain market segments, such as low-income consumers or consumers with low-usage needs, and is better able to target such segments. [24] As resellers of services offered by facilities-based service providers, MVNOs are not considered licensees and are not required to seek permission from the FCC to operate. In addition, many MVNOs are privately held companies that do not publically report financial or subscriber data. As a result, estimates vary and the FCC does not have an exact figure for the number of MVNOs that offer services in the U.S. [25]

⁷¹ Access stimulation occurs when a local exchange carrier with a relatively high switched access rates enters into an arrangement to terminate calls, often in a remote area, for an entity with a high call volume operation, such as a chat line.

⁷² Interexchange carriers refers to telecom carriers that use the exchange access or information access services of other telecom carriers for the provision of telecommunications.

Glossary of terms/definitions

Access stimulation: Occurs when a local exchange carrier with a relatively high switched access rates enters into an arrangement to terminate calls, often in a remote area, for an entity with a high call volume operation, such as a chat line.

Arbitrage: Refers to the simultaneous purchase and sale of an asset to profit from an imbalance in the price, resulting from market inefficiencies ([Source](#))

ARC: Access Recovery Charge

Allows ILEC to recover a portion of the revenues lost through FCC required reductions to access rates.

BDS: Business data services

Ex ante: Refers to future events, such as the potential returns of a particular security, or the returns of a company. ([Source](#))

FAC: Fully allocated costs

Costs associated with a service, including the cost of employees' salaries and benefits, space, equipment, materials, and other costs necessary to perform the service. ([Source](#))

FCC: Federal Communications Commission

U.S. federal telecommunications regulatory authority

ILEC: Incumbent local exchange carrier

Intercarrier compensation rates: Charges that one carrier pays to another carrier to originate, transport, and/or terminate telecommunications traffic.

Interexchange: Interexchange carriers refers to telecom carriers that use the exchange access or information access services of other telecom carriers for the provision of telecommunications.

IP: Internet Protocol

LRIC: Long-run incremental cost

LTE: Long-term evolution

A fourth generation (4G) telecommunications standard used for transferring data over cellular networks. It supports data transfer rates of up to 100 Mbps downstream and 50 Mbps upstream. ([Source](#))

MVNO: Mobile virtual network operator

Operators that do not own any network facilities but instead purchase mobile wireless services wholesale from facilities-based service providers and resell these services to consumers

PUC/PSC: Public utility commission/Public service commission

A regulatory body in each U.S. state that governs public utilities, including some telecommunications services.

TDM: Time-division multiplexing

Process that transmits two or more streaming digital signals over a common channel. ([Source](#))

TELRIC: Total element long-run incremental cost

Common measure applied by telecommunications regulators to set access prices with the help of cost-based measures. ([Source](#))

ULL: Unbundled local loops

A regulatory access requirement whereby an incumbent network provider is required to lease elements of the network (e.g. copper loops) to competitors, to enable the competitors to provide a service in competition to the incumbent. The physical wire connection between customer and company is often referred to as the “local loop” and was historically owned by the incumbent local exchange carrier. ([Source](#))

VoIP: Voice over Internet Protocol

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