# Digital Deployment

Vodafone Group Plc

vodafone

# Introduction

## Europe is on its way to becoming a Gigabit Society.

How quickly and effectively this happens depends on whether the policy environment in Europe facilitates digital network deployment and enables investors to earn a return on capital.

The majority of governments and policymakers across Europe understand how critical it is that consumers and businesses alike are connected to the latest high-speed fixed and mobile digital networks.

However, much of this investment in fibre and next-generation mobile networks has yet to take place. Investment depends critically on whether the policy environment supports the opportunity to build competing, new digital national infrastructures – and earn a return for shareholders.

We believe our Digital Deployment report is the first publication to focus on a comprehensive set of supply-side factors that determine the incentive to invest in infrastructure, illustrating how specific government policies can impact deployment.

Vodafone has drawn on its direct experience in 12 EU markets in compiling this report, comparing investment scenarios and business cases for deployment. This overview can provide governments, policymakers and regulators with an indication of which barriers to Digital Deployment could be addressed in each Member State, while also pointing to best practice across Europe.

Vodafone welcomes discussion on the topics covered in this report. Please contact: Stephen Pentland, Vodafone Group, at stephen.pentland@vodafone.com

# A note from Joakim Reiter

## Digital Deployment in Europe and beyond

Digitalisation has become synonymous with growth, competitiveness and improving the livelihood of citizens everywhere. On the cusp of the next technological leap offered by 5G, Internet of Things and artificial intelligence, all countries are striving to propel their digital society, allowing for a whole host of socially and environmentally beneficial applications, underpinned by world-class gigabit fixed and mobile networks. It is for a good reason, since these networks are a necessary precondition to achieve Europe's digital vision.

Yet Europe – like many other countries and regions in the world – is facing an investment gap in order to realise the fast rollout of such gigabit infrastructure. In the EU alone, the Commission has estimated that this gap amounts to no less than €150 billion.

In this light, it should be more urgent and important than ever to make the best possible use of available, albeit limited, private and public infrastructure capital. The reality, however, is that operators willing and able to invest are still navigating a thicket of economic, logistical and regulatory challenges on their journey to deploying digital communication services. This makes deployment more costly and slower than would otherwise be the case, frustrating the expressed objective of countries to promote digitisation, to the detriment of citizens.

Our Digital Deployment report offers a comprehensive analysis to untangle all of the different factors that inflate the costs and slow down the rollout of next-generation fixed and mobile networks across a number of European markets. Some of these factors – as well as their effects – are well known, like spectrum and licenses or regulation of markets. Other factors have often been afforded less attention than they deserve, such as ducts and poles access, dark fibre and power. Yet others remain stubbornly under the radar, despite their at times significant impact: burdensome and slow planning permissions, or construction permits, arbitrary EMF requirements that are inconsistent with both international standards and the practice in other EU Member States, unnecessary tower height restrictions, access to cables in buildings and many more.

We believe that this report is the first of its kind. It identifies and explains what we consider the six most important categories of factors in deploying digital networks, and highlights examples of best practice. We are encouraging governments and policymakers to work with us and the rest of the industry to address these factors and consider how policies can be better adapted and coordinated to ensure the best possible environment for investing in, and swiftly delivering, next-generation digital communications services.
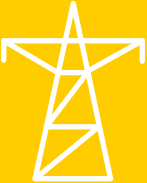
**Joakim Reiter**
Group External Affairs Director, Vodafone Group Plc

# Digital Deployment key dimensions

We have identified six key policy aspects that, we believe, impact investors' abilities to deploy competing fixed and mobile digital networks in a given market.

Governments and policymakers can stimulate investment by examining their policies in each of these areas in comparison with peers and ensuring they have a plan to adopt best practice.

## 1 Passive infrastructure

What passive infrastructure is available in the territory (ducts and poles, dark fibre and power) and can investors get access to it?

**Fixed incumbents' ducts and poles**

**Ducts and poles of utility companies**

**Dark fibre**

**Publicly-funded infrastructure**

**Power**

**Policy recommendation**

In the absence of NGNs, investors should have easy and predictable access to passive infrastructure (ducts and poles, dark fibre and power) to allow cost-effective construction of nationwide next-generation fibre networks.

## 2 Active infrastructure

Does the incumbent telecom operator provide commercial wholesale offers? Is there regulated access to their next-generation network (NGN) assets, or the opportunity to co-invest in NGN build-out?

**Commercial wholesale access**

**Regulated NGN access**

**NGN-sharing agreements**

**Policy recommendation**

Where the incumbent national operator is deploying NGN, investors should be able to harness the NGN to support new competing networks, through commercial wholesale offers, regulated access to the NGN assets, or through co-investing in NGN build-out.

## 3 Access and permissions

How quick and easy is it to get planning permission and construction permits, access to rooftops and in-building cabling?

**Planning/construction permits**

**Rooftop access**

**Access to in-building cabling**

**Policy recommendation**

Planning authorities should review rules and practices to ensure that operators can get quick and easy approvals for planning permission and construction permits, and easy access to rooftops and in-building cabling.

## 4 Spectrum licences

How much spectrum is made available, how much are licensees charged to use it and can operators easily renew existing licences?

**Mobile spectrum supply**

**Upfront fees**

**Ease of renewal**

**Policy recommendation**

Spectrum licensing authorities should ensure harmonised spectrum bands are fully cleared and made available in good time, that award procedures and reserve prices do not artificially increase prices, that annual fees reflect monitoring costs only and that licensees are able to easily renew licences in ongoing use.

## 5 Build costs

Are rollout obligations reasonable? Are subsidies available? Are operators able to save costs through sharing? Do constraints on tower heights or electromagnetic frequency (EMF) limits inflate build costs?

**Mobile roll out obligations**

**Cost-sharing (co-investment)**

**State subsidies**

**Tower height limits**

**EMF limits**

**Labour costs**

**Policy recommendation**

Licensing authorities should ensure that network rollout obligations are reasonable and affordable, that subsidies for uneconomic areas are available to all investors, that operators are able to save costs through network sharing and that tower heights or EMF limits are not unnecessarily restrictive compared to other European markets.

## 6 Operating costs

How do site rental, rates, power, annual spectrum fees or taxes impact running costs for operators?
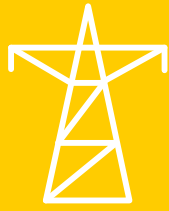
**Site rental**

**Local authority rates**

**Power**

**Annual spectrum fees**

**Government taxes**

**Import tariffs**

**Policy recommendation**

Relevant ministries should seek to moderate the pricing of critical input services for networks, including site rental, rates, power, annual spectrum fees and taxes.

# 1 Passive infrastructure

All telecommunications networks – whether mobile or fixed – rely on modern nationwide high speed optical fibre connectivity. Where this is not already widespread, an investor will need to roll out its own fibre network and this will require regulatory support. To install its own fibre cost-effectively, it will need access to all existing ducts and poles originally constructed by the incumbent national phone operator or other utilities; other publicly-funded infrastructure, such as radio towers erected for emergency services; and electrical power.

Where fibre cabling is already installed, cost-effective access to dark fibre is essential in order to create an active fibre network at the lowest possible cost. In all of these cases, it is important that investors can access accurate information recording the locations and availability of all passive facilities so that they can plan installation works efficiently, and that the host provider provides timely access to facilities.

## Fixed incumbents' ducts and poles

### ? Why is it important?
Building a national broadband telecoms network typically requires hundreds of thousands of kilometres of optical fibre cabling and many thousands of mobile base stations. Deploying this infrastructure from scratch is expensive and time-consuming. Historically, a country will have had just one state telephone company, which already built assets such as underground ducts to carry cabling or poles to support telephone wires. Where these assets exist, they can be reused so that competing fibre cabling can be deployed quickly and cost-effectively, without the need to dig up roads and pavements or construct new routes. Economies of scale can be maximised, assuming ducts have spare capacity for new cable and duct owners allow new cabling to be installed on reasonable terms.

### ✓ What is best practice?
In best-performing markets, alternative operators can access ducts and poles with no practical limitations. Given there is typically no competition in ducts and poles, regulation ensures that access is available on non-discriminatory, cost-oriented terms up to the customer premises entry point, while an accurately maintained database allows installers to quickly and reliably plan their deployment.

### ⇅ What is the variation?
Whether access obligations apply, and whether they are non-discriminatory, depends on the market. In all markets where information is available, duct access is cost-oriented, whereas for poles, access is either cost-orientated (based on historical or current costs) or on commercial terms.

Regulation for most markets extends up to the customer premises entry point, but some are undecided or stop at the street cabinet. Whether ducts and poles are used in practice, and whether regulations require capacity to be kept spare and for repairs to be possible, varies by markets. Differences are also observed on whether limitations are placed on exactly what use can be made of the ducts and poles by the access seeker.

## Ducts and poles of utility companies

### ? Why is it important?
In addition to state telephone companies, in many markets utility companies historically also constructed their own ducts and poles. These can be shared by a new fibre operator, ensuring that civil works can be minimised and competing fibre can be deployed quickly and cost-effectively. This can maximise economies of scope, assuming there is spare duct capacity and the duct owner provides straightforward access on reasonable terms.

### ✓ What is best practice?
In best-practice markets, national regulation is in place to help network providers gain access to, and share, the duct and pole infrastructure of utility companies in an effective and timely manner. Access permits are granted on equivalent terms to the utility and with limited conditions. Guidance on cost allocation and pricing ensures that civil works costs are divided appropriately and fairly, leading to cost savings for all sharing partners.

### ⇅ What is the variation?
The extent of sharing regulations, of coordination of civil works and on pricing guidance varies between markets, although very few markets have cost-saving rules enshrined in law.

---

**Policy Recommendation**
Digital Deployment can be improved by ensuring the incumbent provides access to ducts and poles on reasonable commercial or regulated terms, that are non-discriminatory and cost-oriented, supported by a reliable database listing the location and have the available capacity of assets.

**Policy Recommendation**
Digital Deployment can be facilitated by ensuring there is national regulation providing strong support for sharing and coordinating access to existing utility passive infrastructure, including procedures and pricing methodologies.

## Dark fibre

### ? Why is it important?
Where an established operator has already installed an optical fibre network, the most cost-effective way for a competing operator to build its own high-speed network will typically be to lease one or more of the unused optical fibres in the fibre cable bundle. A competing operator can install its own optical transmission equipment on each end of these 'dark' fibres and start transporting data traffic from one location to another. Leasing dark fibre allows networks to be built quickly and cheaply, with the freedom to choose what traffic capacity is provisioned on the fibre connection and what services are carried. Dark fibre is particularly important for rural areas, where ducts are unlikely to exist.

### ✓ What is best practice?
In best-performing markets, there are multiple competing fibre networks, resulting in competitive dark fibre offerings and ubiquitous access – quite often because of the wide availability of duct access. In the absence of competitive markets, strict regulation of the incumbent is warranted, requiring it to provide access on non-discriminatory, cost-oriented terms. Incumbent fibre owners will have accurate and easily available online databases of fibre end-points and spare capacity to allow prospective new investors to quickly plan and execute deployment.

### ⇅ What is the variation?
Access to dark fibre for backhaul on non-discriminatory terms is a requirement in most markets, but there is greater variation where the access is for residential broadband. Where information is available, pricing tends to be cost-oriented, but in some markets, there are limitations on what the dark fibre can be used for and only a minority have an online database.

**Policy Recommendation**
The exploitation of dark fibre is an important dimension in accelerating the deployment of competing digital networks – particularly where ducts and poles are not available – as long as access can be secured easily, on non-discriminatory and cost-oriented terms, and without limitations on use.

## Publicly-funded infrastructure

### ? Why is it important?
Administrations can help minimise operators' network rollout and operating costs, reducing the construction of duplicate or redundant facilities by ensuring that any publicly-funded infrastructure is made available for mobile operators at cost. This can include mobile towers, buildings suitable for housing telecom equipment, and ducts or dark fibre for facilitating high-speed connections. This should encompass communications infrastructure and facilities constructed to support emergency services, public protection and disaster recovery, in addition to transport, healthcare and other relevant operations.

### ✓ What is best practice?
In best-performing markets, national and local authorities take a consistent approach to ensuring that there are obligations making all relevant public sites available to competing operators on open, fair and free-of-charge or on cost-oriented bases.

### ⇅ What is the variation?
Markets vary in the extent to which authorities have any obligation to provide access, whether there is regional consistency or whether exemptions exist and how the access costs are set (with the majority being on commercial rather than cost-orientated terms). Some Member States provide access to publicly-funded infrastructure but not buildings, which severely limits the deployment of mobile rooftop masts.

**Policy Recommendation**
Public authorities should ensure open access to all relevant public infrastructure and sites on a consistent national basis and free-of-charge or on cost-oriented terms.

## Power

### ? Why is it important?
Digital communications use electronic equipment at the majority of points throughout the network to send, receive and process data signals. This equipment needs to be connected reliably to the national electricity grid, using power cabling from a grid power source directly to the site of the equipment. For efficient and inexpensive network deployment, this must be within a reasonable distance from the site location to minimise the length of the installed power cabling.

### ✓ What is best practice?
In best-performing markets, there is a well-established and dense national power network within easy reach of deployed network infrastructure, particularly in rural areas. Operators are not required to incur additional connection costs, regardless of the distance to the nearest supply point or the need for transformers to be installed or additional cable to be laid.

### ⇅ What is the variation?
The reach of electricity grids varies by country, impacting the incremental investment needed to connect digital network infrastructure. Where the availability of suitable power was a constraint when a network was first rolled out, the percentage of rural sites varies from zero to 80%.

**Policy Recommendation**
The electricity distribution sector needs to have obligations to supply services that correlate with the rollout obligations being placed on mobile operators.
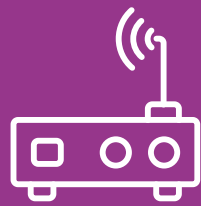
# 2 Active infrastructure

Where the latest fibre networks are already being rolled out in a market, a cost-effective approach calls for collaboration between investors in one form or another. Options include commercial wholesale deals with the national operator, co-investing in a shared next generation network or gaining access to the national network under regulated terms.

## Commercial wholesale offers

### ? Why is it important?
Where a player has already invested in a NGN, it will generally be more cost-effective for a competitor to agree to buy wholesale capacity on that network, when there are multiple suppliers. NGN works allow operators to configure capacity and service quality flexibly to meet their own needs and the needs of any wholesale customers, providing flexibility and freedom for competing providers while offering economies of scale and lower unit costs for all parties.

### ✓ What is best practice?
In best-performing markets, commercial wholesale offers currently available on the market can cover more than 70% of households and have been widely taken up. This indicates that access providers and access seekers find such offers mutually attractive. They are an important first step to deploying networks with competitive prices and on reasonable terms. Such agreements support a variety of services, without restrictions on what can be deployed.

### ⇅ What is the variation?
Markets vary in terms of whether the incumbent provides commercial wholesale offers at all, the extent of which these can cover households with fibre, and whether the terms are considered reasonable and usable by access seekers. Very few markets are considered competitive for leased lines, which likely affects the availability of good commercial offers.

## Regulated NGN access

### ? Why is it important?
In some markets, suitable commercial offers from a NGN operator are not available, or there is no effective way for a new operator to make use of existing passive facilities (such as ducts or poles). In these cases, the regulator may need to get involved and work with the NGN operator to define regulated access terms for a new operator. This will specify the pricing and other terms that the NGN operator is obliged to offer.

### ✓ What is best practice?
In best-practice markets where the market is not competitive, access to incumbent active infrastructure (such as leased lines, terminating segments on FTTx networks and active backhaul) will be regulated effectively. This ensures other operators can have fair and reasonable access on non-discriminatory and current cost-oriented terms, while ensuring there is appropriate reward for the access provider.

### ⇅ What is the variation?
It is encouraging that in most EU Member States – particularly those not considered competitive – incumbents have obligations to provide access to leased lines on non-discriminatory and cost-oriented terms. Variation is much higher regarding the terminating segment on FTTx networks and active backhaul, but when access obligations exist, they are always on non-discriminatory and cost-oriented terms.

**Policy Recommendation**
Competition should be encouraged by ensuring that NGN operators provide suitable commercial wholesale offers to access seekers on reasonable terms.

**Policy Recommendation**
When the market is not competitive, and if passive remedies are not effective, regulation on the incumbents' active networks should ensure that incumbents leased lines and active backhaul products can be accessed on non-discriminatory and cost-oriented terms.

## NGN-sharing agreements

### (?) Why is it important?

Given the high costs involved in building Next Generation Networks (NGN), there are benefits to be gained by all those interested in investing in NGN if they can agree to share the costs of construction and operation and share the use of the network. NGN allows capacity and service quality to be configured flexibly to meet the needs of all sharers, providing freedom for competing providers while offering economies of scale and lower unit costs.

The new European Telecommunications law (or "Communications Code") promotes co-investment as a way for multiple parties to deploy infrastructure that makes efficient use of resources and saves cost. Network sharing can allow operators to scale up and increase coverage, but it must still ensure that sufficient levels of competition in the market remain as fixed incumbents can gain significant market dominance through sharing.

### (✓) What is best practice?

In best-practice markets, co-investment and network sharing are only permitted in pro-competitive formats, ensuring the benefits of network sharing and incentives are preserved in the future. Clarity on the national government position is important for investors, and authorities should be prepared to take action to prevent uncompetitive network sharing rather than allow market dominance to emerge.

### (↑↓) What is the variation?

Co-investment in fibre is mixed across markets, with most markets permitting it under varying conditions while in others it remains untested.

**Policy Recommendation**
Authorities should support pro-competitive network sharing agreements, supported by clear positions from Governments.

# 3 Access and permissions

Rolling out digital networks requires a variety of approvals and permits, allowing trenches to be dug, fibre to be laid, equipment to be installed and masts and radio antennas to be erected. The time and cost to secure these approvals and permits from respective national, regional and local authorities can have a critical impact on how quickly and reliably operators can deploy their networks.

Approval procedures should be efficient and standardised across local authorities. A specialist regulator or adjudicator should also be empowered to act quickly to resolve any disputes and help minimise application rejection rates. Approval criteria should be objective and with realistic considerations in relation to rolling out networks to serve residential buildings, schools and hospitals.

## Planning/construction permits

### ? Why is it important?
Building broadband networks can involve digging trenches in roads and pavements to lay optical fibre and cabling, constructing buildings to house electronic equipment and erecting mobile masts and installing antenna systems on building rooftops to enable mobile signals to be transmitted. Many of these activities require permissions from local authorities prior to carrying out construction work or erecting structures. Securing planning permissions or construction permits promptly and reliably is vital to ensure that network operators can deploy their network according to plan, without delay or excessive administrative effort or cost.

### ✓ What is best practice?
In best-practice markets, permissions and permits are granted promptly, under predictable and standardised nationwide procedures and conditions, free of exceptional constraints (for example, where the construction involves longer distances, residential buildings, schools or hospitals). Permissions and permits remain valid for 10 years or more, and automatic renewals will apply on municipality permissions for ongoing network development.

### ⇅ What is the variation?
Variation in policies for 5G deployment, macro sites, fibre and small cells is significant – only a minority of markets have a national policy in place. Granting permissions on site locations varies from no restrictions to local variations to restrictions on residential buildings, schools or hospitals. In the case of larger macro sites, the rate of planning application rejections is zero, and regulatory bodies also help to resolve disputes.

However, for fibre deployment, up to 10% of applications can be rejected and there is not always an effective regulatory authority. The time to obtain permissions also varies greatly for both macro sites and fibre deployment, as some markets take up to ten times longer to grant permissions than others. Similarly, the cost associated with applications also varies significantly – for macro sites, the cost can be one hundred times greater in some markets than the costs in others, while for fibre, it can be four hundred times greater. Planning procedures for small cells, if they exist at all, may or may not be any easier than for macrocells, or fit for purpose.

## Rooftop access

### ? Why is it important?
To provide mobile signals in urban areas, and to maximise the coverage provided by each transmitter, operators typically install mobile transmitter equipment on the rooftops of high buildings. Normally this would require permission from local authorities and so it is important that any authorisation regime is simple and straightforward, allowing quick, cost-effective and straightforward deployment.

### ✓ What is best practice?
In best-practice markets, rooftop deployments do not require a permit and no artificial regulatory limitations exist regarding proximity to schools or hospitals. National consistency on requirements – with a relevant regulator to resolve disputes in a timely, transparent and effective manner – will also dramatically help, together with modest application fees.

### ⇅ What is the variation?
There is extensive variation in the time to obtain rooftop access planning with some markets taking six hundred times longer to grant permissions than others, and the associated cost of such rooftop access can be four hundred times greater in some markets than in others. Rejection rates range from zero to 20% of applications. Restrictions on locations vary, with either no restrictions or restrictions on residential buildings, school, hospitals or others. Few markets have a national policy in place that would prevent local variations, although almost half of the markets have a regulatory body to resolve disputes.

**Policy Recommendation**
Planning permissions should be granted on a national level and with an effective (telecom) regulator to manage appeals. The process needs to be simple and harmonised across agencies with minimal costs, time delays and restrictions.

**Policy Recommendation**
Rooftop access should ideally be permit-free. If a permit is required, it should be managed on a consistent national basis avoiding local variations, with an effective regulator to manage appeals. The process needs to be simple and harmonised across agencies, with limited time delays and restrictions.

**In-building cabling**

### ⑦ Why is it important?

Broadband networks need to extend all the way to users in their homes, offices or other locations. Where users are located in multi-storey apartment blocks or commercial premises, networks will need to pass through common parts of the buildings, typically through pre-installed in-building cabling systems. This cabling forms a natural bottleneck and will likely be under the control of a private landlord. Ensuring straightforward access to in-building cabling, as well as modernising the cabling – from copper to fibre – will make it easier for providers to connect customers. Similar access arrangements are also needed where the network operator plans to install a mobile transmitter site on the premises' rooftop.

### ✓ What is best practice?

In best-practice markets, regulation is in place that requires operators or developers to provide sufficient access to in-building cabling and fibres to enable competition. When accessing infrastructure belonging to an incumbent or player with significant market power, this should be free of charge or on a cost-oriented basis, while other operators would have symmetrical obligations under fair and reasonable terms. Basing the price on the incremental cost of the co-use of in-building cabling also creates an incentive for other operators to deploy networks.

### ⇅ What is the variation?

Variation exists on whether there is an obligation to provide access to in-building cabling and if there is any national guidance and pricing methodologies for it. Costing approaches are very mixed, ranging from no charge, to commercial or cost-oriented terms.

**Policy Recommendation**
National Regulatory Authorities should develop regulation requiring the modernisation of in-building cabling, ensuring sufficient numbers of cables and symmetric access to cables.
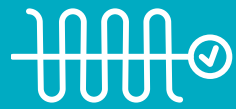
# 4 Spectrum licences

Timely access to adequate amounts of harmonised mobile radio spectrum is essential to deploying mobile networks. A range of frequency bands are needed to achieve wide-area signal coverage and ensure sufficient capacity to support customer data traffic volumes.

Restrictions in the availability of suitable spectrum will impact network coverage, quality of service and the data speeds experienced by users. It will also require operators to find ways to try to compensate, which can sometimes lead to the construction of additional transmitter sites at additional cost. Scarcity of spectrum supply, as well as inefficiently-designed award procedures and high reserve prices, can all drive up the cost of securing access to frequency bands – in turn driving up the costs of deployment.

While a few regulators provide access to spectrum bands in perpetuity, many regulators still issue fixed-term licences that typically expire after 15 years. This creates considerable uncertainty for investors, because there is little clarity as to whether ongoing investment in networks towards the end of the licence period will be able to generate a payback. Spectrum licensing authorities should therefore ensure that:

- harmonised spectrum bands are fully cleared and made available in good time;

- award procedures and reserve prices do not artificially increase prices; and

- licensees are easily and predictably able to renew licences for ongoing use.

## Mobile spectrum supply

### Why is it important?
Mobile operators use mobile radio frequencies to carry data traffic between mobile devices and the nearest transmitter site in the mobile network. Meeting the rapidly growing demand for mobile traffic – while maintaining service quality – means that mobile operators need permission to operate radio equipment across an increasingly wider range of radio frequencies. These frequencies need to be within specific globally harmonised spectrum bands so that devices can operate reliably across multiple regions. New frequency bands are also needed to support new technologies, such as 5G.

### What is best practice?
Best-practice markets are clearing and releasing the 700 MHz band and the full 3.4 – 3.8 GHz band in good time for operators to secure a nationwide share of spectrum via auction and prepare for 5G network rollout. The European Commission has set 2020 as the deadline for the release of 700 MHz spectrum, which may require the timely relocation of terrestrial TV services. Current assignment in the 3.4 – 3.8 GHz band may require the surrender of unused licences to the regulator, and fixed wireless or defence-related services to be relocated to more suitable bands.

### What is the variation?
Some Member States will miss the Commission target for 700 MHz by up to two years, and some will make substantially less than 400 MHz available for 5G capacity services, resulting in scarcity and higher 5G service costs.

**Policy Recommendation**
National regulators should fully clear and award all harmonised spectrum in time to allow operators to take advantage of new technologies and support from devices, including 700 MHz and 3.4 – 3.8 GHz by 2020.

## Upfront fees

### Why is it important?
Mobile operators need to obtain licences from national regulators to be allowed to operate radio network equipment in specific mobile frequency bands. In awarding these licences, regulators will often require licensees to pay an initial 'upfront' fee. The level of these fees varies significantly across Europe, from millions to billions of Euros. Excessively high spectrum fees divert operators' free cash away from network deployment and can increase levels of debt and cost of borrowing. High fees can result from artificially restricted supply, high reserve prices, poor auction design or setting spectrum aside for particular players. Defining a multi-year payment plan for initial fees can help smooth cash flow, but is fundamentally unhelpful because the liability of the future payments sits on a company's balance sheet and can also encourage ill-disciplined auction bidding, thereby increasing costs.

### What is best practice?
In best-practice markets, regulators ensure early clearance and award of the full harmonised bands, set reserve prices based on the opportunity cost of the next-best use and at a price that is high enough to deter frivolous bidding yet low enough to allow price discovery. They adopt a tried-and-tested auction format that gives bidders transparency and minimises risk, and avoid setting spectrum aside for particular players without clear legal justification, allowing the market to determine efficient price levels.

### What is the variation?
European mobile operators have, on occasion, paid up to five times more than the European average benchmark for spectrum, with prices ranging up to four times that of the cheapest market for the 800 MHz spectrum and up to one hundred times that of the cheapest market for 2.6 GHz and 3.5 GHz spectrum bands.

**Policy Recommendation**
Regulators should prevent artificially driving up spectrum fees by avoiding scarcity, setting reasonable reserve prices and ensuring that the auction design is fair, efficient and transparent.

## Ease of renewal

### ? Why is it important?

In a few markets worldwide, operators can secure perpetual rights of use for spectrum bands. However, in most European Member States, it is still common for licences to expire within 15 to 20 years after award. Often, the conditions determining whether and how the licences might be renewed are not clearly defined, which creates uncertainty for licensees, discourages investment during the latter years of the licence and often results in additional renewal costs.

### ✓ What is best practice?

In best-performing markets, regulators allow economically productive licences either to be renewed under simple administrative terms or to be converted into perpetual licences. Regulators are also mindful of the negative impact of high renewal costs on investment and retail pricing. They may also consider renewal arrangements that encourage further justifiable investment, such as increases in future coverage obligations, in return for free-of-charge licence renewals.

### ⇅ What is the variation?

Mobile operators face many different approaches in relation to renewal, depending on the Member State. While some regulators facilitate administrative renewal, some regulators use renewal as an opportunity to extract additional rents from the sector, either through high renewal fees or through re-auctioning the spectrum. Sometimes new obligations are imposed that can involve increased coverage or increased annual licence fees.

**Policy Recommendation**
Regulators should recognise the importance of licence and service continuity, and adopt measures to reduce the risk and cost of licence extensions in return for ongoing commitments for the spectrum to be intensively used by the licensee.

# 5 Build costs

Population or geographic network rollout obligations, typically included in spectrum licences, are a major determinant of mobile network build costs. Reaching the last few percentage points of a population involves installing additional towers in very sparsely populated parts of the country, with higher build costs per tower and typically very low revenues per tower. Regulations governing maximum tower heights and EMF emissions also affect costs, causing operators to build more towers to achieve a coverage than would otherwise be necessary.

Licensing authorities should ensure that:

- network rollout obligations are reasonable and affordable;

- state subsidies for uneconomic areas are available to all investors;

- operators are able to save costs through network sharing; and

- tower heights or EMF limits are not unnecessarily restrictive compared to other commonly accepted European standards.

More generally, governments can contain costs by ensuring the adequate availability of skilled workers, and therefore reasonable labour rates, while minimising import tariffs.

## Mobile rollout obligations

### Why is it important?
Mobile users want to be able to use mobile broadband services wherever they happen to be. Politicians also want their country's citizens to all be able to access mobile services, regardless of where in the country they live. However, whether a return on investment in mobile networks can be achieved or not depends critically on location – remote areas with very few customers will not generate the level of revenue needed to recover the costs that would be incurred, and therefore would be loss-making. To address this, regulators often attach rollout or coverage obligations to national mobile licences, and licensees will then effectively cross-subsidise between urban areas and rural areas. One effect will be higher retail prices for all consumers than would otherwise be the case. The more challenging the uneconomic obligations, the greater the burden on customers in general.

### What is best practice?
In best-performing markets, coverage obligations will be informed by cost-benefit analysis, allowing required subsidies to be estimated and a clear mechanism to ensure the subsidy can be realised – this can take a number of forms, including an explicit subsidy award or reduced spectrum fees. The rollout obligations will also be practically achievable. Regulators ensure obligations are fairly distributed, may allow operators to share obligations and ensure that subsidies do not reinforce the position of any particular player over time. Related factors such as restrictions on maximum tower heights are also taken into consideration.

### What is the variation?
Coverage obligations vary between approximately 90% and 98% population coverage. Some regulators also specify rail or road coverage, while some allow variations between players.

## Cost-sharing/co-investment

### Why is it important?
Sharing common parts of mobile networks between competing mobile operators allows players to reduce their cost of deployment. There are degrees of sharing, including 'passive' towers (where competitors each install their separate mobile equipment on the same transmitter tower); RAN sharing (where competitors share the use of the installed Radio Access Network equipment), and spectrum sharing (where players combine their frequencies and operate common shared radio capacity). The deeper the degree of sharing, the greater the degree of cost savings, but the less freedom sharers have to pursue independent network and coverage strategies, which can lead to competition concerns.

### What is best practice?
In best-practice markets, regulators have a clear position permitting voluntary commercial co-investment and network sharing agreements between operators, while also ensuring backstop conditions are in place to prevent exclusive sharing where it might disadvantage another operator in the market or prevent sharers from having some degree of independence in pursuing their strategies.

### What is the variation?
The majority of markets support mobile tower sharing without restrictions but burdensome conditions do exist in some markets. Sharing active mobile equipment is permitted in the majority of markets, but the conditions can be limited or onerous. Others offer unrestricted sharing, while for some, it is still untested. Spectrum sharing is untested in some markets, while others permit it under certain conditions. Some ban it outright.

**Policy Recommendation**
Regulators should use cost-benefit analysis to estimate the cost of meeting increasing obligations and design approaches to ensure the fair, effective and affordable assignment and delivery of obligations.

**Policy Recommendation**
Regulators should permit voluntary commercial sharing agreements between operators, but ensure they prevent exclusive sharing where it might damage competition.

## State subsidies

### Why is it important?
Rolling out mobile broadband network infrastructure to uneconomic regions requires subsidies of some form. Where operators have to cover the subsidy themselves, this will be reflected in higher service pricing for customers as a whole. Alternatively, subsidies from the state can be used to target investment in uneconomic areas without impacting pricing and affordability of services at a national level. State subsidies can take many forms, including cash awards, discounts or rebates on licence fees, or state funding of common assets such as towers. Careful thought must be given to ensuring the subsidy mechanism is efficient and fair.

### What is best practice?
Current best-practice is for the state to award subsidies by open tender and for funded assets to be open on a cost-orientated basis to all operators. Nevertheless, there is a risk that repeated subsidies can reinforce the position of the market leader. Making rebates available to all operators may be a better way to ensure wider participation in rural coverage. Subsidies should prioritise 'upstream' elements (ducts and poles, mobile towers) to maximise competitive benefits.

### What is the variation?
While subsidies are widely used for fixed services, mobile examples are limited but do include free-of-charge licence renewals in a minority of markets and rebate lots proposed in one market. Fixed subsidy levels vary widely where markets can spend one hundred times the amount of others on a per capita basis.

## Tower height limits

### Why is it important?
When operators are designing their networks, they first focus on providing coverage and then add capacity as traffic volumes grow. The most cost-effective way to provide coverage is to minimise the number of towers needed, maximising the reach of the signal from fewer towers. This is achieved by installing the mobile transmitter antennas at the greatest possible height on the tower. However, in some EU Member States, planning rules limit the maximum tower height permitted, restricting how far mobile signals can travel and increasing the number of towers needed to ensure coverage. Conversely, relaxing height limits helps operators keep the number of towers needed to a minimum, keeps total network costs down and improves coverage and 'not spots'.

### What is best practice?
In best-practice markets, there are minimal restrictions on tower heights (either in legislation or in practice) so that operators can choose how to install antennas to achieve optimal signal reach and coverage at minimal cost. Furthermore, the application procedure will be standardised nationwide.

### What is the variation?
Variations exist between markets in terms of whether restrictions are defined, the level of tower height specified and whether restrictions occur in practice. There can also be variations in requirements at city, local, regional and national levels. These can result in tower height limits being a moderate or significant issue when deploying networks.

## EMF limits

### Why is it important?
International standards define the upper limits for the strength of EMF or radiated power that is permitted from mobile base stations. The international standards are based on expert independent assessment of potential health risks, but regulation is set nationally. In those countries where national regulations are stricter than the accepted European standards, operators are required to operate their transmitters at reduced power levels, resulting in reduced base station capacity, weaker mobile signals, poorer call quality and increased investment in additional base stations to compensate.

### What is best practice?
Best-practice is to adhere to common standard European limits based on 1999/519/EC and international guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

### What is the variation?
Most markets adhere to the European standards. However, a small number of Member States choose to set limits for their particular market that can be up to 100 times more restrictive than the ICNIRP level. This delays network roll out and the ease of providing new technologies and services like 5G to customers.

## Labour costs

### Why is it important?
Building fixed broadband networks can involve laying tens of thousands of kilometres of optical fibre cabling and installing equipment, buildings and street cabinets. Mobile networks typically comprise between 5,000 and 25,000 base stations distributed nationwide, with coverage provided using a mix of rooftop sites in towns and cities or on purpose-built towers or masts. Building, operating, maintaining and upgrading these networks is highly labour intensive. Having access to a sufficient, suitably trained labour force at appropriate labour rates is critical to ensuring timely and affordable network roll out and operation.

### What is best practice?
In best-practice markets, there is a healthy labour market with sufficient capacity and skills and at labour rates that are in line with the national economy so that networks can be rolled out in in a timely and cost-effective way.

### What is the variation?
Labour costs vary significantly across Europe. This is a result of a combination of factors, including the level of supply of capable labour in the market, the broader economy and minimum wage obligations, and therefore play a major role in determining operators, cost structure in many markets.

---

**Policy Recommendation**
Where there is political or regulatory desire for telecoms networks to cover uneconomic areas, regulators should facilitate state subsidies, awarded on a competitive basis and ensure open access on cost-oriented terms. Subsidies should prioritise 'upstream' elements to maximise competitive benefits. USOs only need to be used once state aid as a tool has been exhausted.

**Policy Recommendation**
Authorities should minimise restrictions on mobile tower height wherever possible in order to improve signal quality and minimise network costs, with a consistent nationwide approach and minimal local variations.

**Policy Recommendation**
Member States with additional restrictions should consider harmonising with the common European standards based on 1999/519/EC and ICNIRP.

**Policy Recommendation**
Regulators and their responsible ministries should have programmes to stimulate the supply-side of the labour force that will result in a strong, vibrant and well-trained labour force able to build and operate telecoms networks cost-effectively.

# **6** Operating costs

Mobile networks need access to many thousands of premises, sites or towers nationwide. The levels of rent for land or sites as well as local rates have a major impact on running costs. Networks also require large amounts of power and, accordingly, electricity prices are an important cost driver. Some regulators also charge significant annual fees for spectrum licences, often with no explicit link to costs or economic justification.

Along with other government charges and taxes, these can result in a significant increase in operating costs. National and local authorities should therefore seek to moderate the costs of critical inputs, including site rental, rates, power, annual spectrum fees and taxes.

## Site rentals

**Why is it important?**
A mobile operator will typically lease space from a landlord on a tower or rooftop site in order to install its antennas and electronic equipment unless the operator has erected or acquired towers or masts of its own. Where the state or local authorities have suitable sites, they can play a critical role in providing easy and affordable access to facilitate cost-effective building and operation. They should also seek moderate prices for private landlord lease rates.

**What is best practice?**
In best-practice markets, authorities provide access to their premises at lease rates calculated to recover costs, rather than to generate additional rental income from the operator.

**What is the variation?**
There is a significant variation across Europe in the lease prices, where average monthly costs can be three times higher for macro sites in some markets than others, while for rooftops the average monthly cost in some markets can be five times higher than others.

**Policy Recommendation**
Authorities should seek to make suitable public premises available, and encourage moderate private lease rates, in order to moderate mobile deployment costs.

## Local authority rates

**Why is it important?**
Local authorities often raise revenue for local services by charging municipal fees or 'rates' for local property and premises, based on the rateable value of the property or premises. Where authorities choose to apply rates to telecom network installations (towers, cabinets, etc.) they are arbitrarily increasing the cost of running mobile networks.

**What is best practice?**
Best-practice is to exempt telecom network installations from municipal fees or rates charges, on the basis that they provide benefits to society.

**What is the variation?**
While some countries do not impose any rates on sites, other countries charge as much as the equivalent of 30% of the cost of site rental.

**Policy Recommendation**
Authorities should keep municipal fees to a minimum, reflecting the essential nature of telecom networks.

## Power

### ? Why is it important?
Mobile networks require large quantities of electricity sourced from the national electricity grid and on the lowest possible tariff appropriate for an essential national service.

### ⊘ What is best practice?
In best-performing markets, operator tariffs are regulated in recognition of the critical importance of the services provided and kept to a minimum.

### ⇅ What is the variation?
Access to power tariffs in some markets is five times higher than others.

## Annual spectrum fees

### ? Why is it important?
Where spectrum licences have already been awarded under a competitive market-based approach such as an auction, the primary rationale for the regulator levying annual spectrum fees should be to cover the regulator's costs of monitoring and licence administration. Alternatively, regulators may use annual licence fees in lieu of upfront spectrum award fees, at a level reflecting the opportunity cost of the spectrum to alternative users. Some authorities use annual fees primarily as an opportunity to increase state revenues, with no direct justification or obvious link to incentivising efficient use of spectrum.

### ⊘ What is best practice?
In best-practice markets, annual spectrum fees are used to recover administrative costs, or to act as an ongoing administrative incentive charge (in lieu of auction fees), based on robust opportunity cost analysis. Annual fees are not used as an arbitrary means to raise state revenues.

### ⇅ What is the variation?
Annual licence fees vary and in some markets they can be hundreds of times higher per MHz per population for one spectrum band than in others.

---

**Policy Recommendation**
Electricity consumption represents a major element of operating costs for mobile networks — operators should have access to the lowest possible tariffs commensurate with the critical national nature of the services they provide.

**Policy Recommendation**
Annual spectrum fees should take into account the upfront fees already paid at licence award and should be set to achieve specific relevant objectives, including licence administration and incentivising efficient spectrum uses.

vodafone