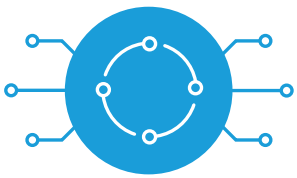
G20 Global Smart Cities Alliance

WORLD ECONOMIC FORUM



MODEL POLICY

Dig Once

Contents

This policy is considered foundational to the G20 Global Smart Cities Alliance policy roadmap's principles of security and resilience. You can find supplementary content on our website to provide practical support for adopting and implementing this policy.

Background

Digital connectivity – or "smart infrastructure" or "digital infrastructure" – is the utility of the 21st century. It underpins every aspect of the modern economy and all aspects of smart cities. This includes cellular wireless – 2G, 3G, 4G and 5G – and Wi-Fi, wired (including full-fibre) technologies, internet of things and emerging non-terrestrial networks such as low-earth orbit satellites.

This importance is only going to grow, and therefore demands a strategic approach to rolling-out digital connectivity. As technology plays an increasing role in all aspects of our lives, economies and societies, reliable and extensive connectivity is essential. Similarly, as innovation is accelerated by new and improved technologies – including 5G, and internet of things – the demands on connectivity will increase.

In addition, economic recovery from COVID-19 can be led by digital infrastructure – as a central pillar for economic investment that drives growth. In the nearer-term, connectivity will continue to play a central role in response to – and recovery from – the disease. Connectivity enables remote-working and learning, e-commerce, digital public service delivery, as well as providing everyday and critical communications.

Despite its importance, the rollout of connectivity in the urban (and rural) environment can be complex. The process features an extensive range of stakeholders, including cities and local authorities, landowners, private-sector connectivity providers, other utility and service providers, and citizens. The interests of all of these stakeholders may not always align. Connectivity rollouts also require engaging with planning and housing legislation and telecommunications regulation. This is often the domain of national governments and can present challenges to local implementation and delivery. Many cities and local authorities are also unfamiliar with the extensive technical detail, nuance and commercial realities of building futureproof connectivity – while connectivity providers are reluctant to invest in network deployments where significant challenges or uncertainty exist.

Recognizing this importance, and these challenges, the Alliance's Digital Infrastructure Taskforce is shaping a policy toolkit to enable the benefits of connectivity. These efforts will go some way to preventing anyone from being excluded from the life-changing and life-improving potential that connectivity can enable. In particular, digital infrastructure is a key enabler for many (if not all) of the sustainable development goals, and is especially relevant to the associated priority of "leaving no one behind".

As a first step, any new developments and major construction projects must have suitable connectivity to facilitate these initiatives from move-in date. Existing buildings must also be connected up. In addition, all construction must engage with the needs and realities of network rollouts – including wireless and wired connectivity. This is the overall intention of this "Dig Once" policy.

How to use this model policy

Digital infrastructure can be a complex policy area, and one that often attracts significant citizen and political attention. In this context, this model policy aims to provide cities with a comprehensive foundation to drive or accelerate digital infrastructure provision. Drawing on best practice from around the world, the model policy could be implemented as a policy in its entirety, used by the city as a guide to shape their wider approach to digital infrastructure, or as a resource to inform the development of internal and standard operating procedures. Some aspects of the model policy may also align with local, regional or national legislation.

Model policy

1 Introduction

Recognizing that connectivity is a fundamental foundation of the digital – and broader – economy, a "Dig Once" policy can ensure that this connectivity (both wired and wireless) is delivered in a strategic way.

The "Dig Once" policy has three broad areas of relevance:

- **New builds and developments:** Ensuring alignment between public- and private-sector constructors, utility companies and connectivity providers to install conduits (and connectivity) during the construction phase. This will guarantee that all future developments are connected up, ensuring that future-proofed "in-ground" connectivity is installed once only.

- **Existing builds and other assets:** Enabling coordination between utility companies and connectivity providers during highways and street works, and other major infrastructure projects, thereby reducing the need for multiple excavations; and allowing efficient installation of conduits and connectivity, including ensuring the provision of all necessary conduits and simple retrofitting.

- **Delivering multi-purpose connectivity:** Conduits have historically played a key role in delivering wired connectivity. However, with next-generation wireless connectivity (including 5G, internet of things and new Wi-Fi technologies), conduits will play a key role in providing the power and connectivity infrastructure needed – in addition to continuing to enable wired connectivity. A "Dig Once" policy will drive and support the rollout of these crucial conduits.

A "Dig Once" policy has relevance to all stakeholders: reducing inconvenience and disruption to citizens, accelerating the rollouts of connectivity providers and reducing the administrative and wider burden on cities and local authorities.[1] It also significantly reduces the cost of connectivity rollouts – with road and street works often representing the majority of deployment costs.

Unlike other policies, a "Dig Once" policy can also provide strong opportunities for measuring success, including through reductions in street works (and associated work such as reinstatements), a drop in citizen complaints,[2] and an increase in the number of properties connected to help address digital inclusion.

Specifically, the benefits of a "Dig Once" policy are to:

- Support and expand continuous digital connectivity services
- Reduce recurring business, community and traffic disruption caused by construction works
- Reduce the barriers-to-entry for connectivity providers, including alternative network providers
- Optimize underground asset space planning and deployment
- Achieve lower re-trenching and repair costs
- Reduce road, utility and other asset depreciation
- Lighten local authority highways team workload in the long-term.

Overall, the policy highlights the central role of the city in ensuring the delivery of connectivity – and that no one is left behind, or excluded, from the potential that it can enable (including in tackling the broader "digital divide"). The city is a key orchestrator here, working in collaboration with the private sector as well as other relevant public bodies – including those responsible for railways and highways.

Connectivity can support, enable and catalyse all priorities of the city, and a "Dig Once" policy also has the potential to accelerate the achievement of these priorities. With both of these aspects in mind, a "policy review" process could be a useful undertaking. A city can then identify and align the varying actors, roles, responsibilities and policies relevant to the provision of connectivity. In joining these up, strong coordination efforts may be needed – with some cities even taking a "master plan" approach.[3]

In this context, any "Dig Once" policy should be a public document in order to identify opportunities for alignment with the work and priorities of other sectors and actors.

2 The fundamentals of digital infrastructure

There is a range of principles that must be considered as first steps that support the specific goals of a "Dig Once" policy, as well as its overall objective of a city and its ecosystem maximizing the installation of foundational digital infrastructure.

2.1 **The city will determine whether to install:**

a. Conduits (whether single or multiple for resilience and accompanying pit infrastructure)

b. Conduits and connectivity infrastructure in partnership with connectivity providers – or via a public-owned network

c. Determine the most suitable mechanism (e.g. franchise agreement, framework agreement, open-access, etc.) to deliver these requirements – and to achieve all necessary outcomes.

2.2 In addition, the city should also require all new public and commercial property developments to have the above elements included at the outset of any plan (including incorporating this requirement in any development or planning approval process). All other city construction efforts should also be assessed with the provision of conduits – and connectivity – in mind. Planning and construction permission should be premised on developers showing what will be built, but also how – including provision for utilities, including connectivity and/or conduits.

2.3 Officials leading digital connectivity efforts in the city will specify the type, size and number of conduits to be installed during any of the above activities. This could be a set of standardized requirements for any connectivity installation to support developers in accurately costing proposals, or agreed in the context of each of any of the above activities. Section six of this model policy provides further technical considerations in relation to conduits.

2.4 The city will identify a list of "notifiable activities" during which the above elements must be installed through standardized requirements. These activities could include new builds, preparatory work for future developments of all types, installation of other utilities or other street works, other major infrastructure projects, or any other work requiring excavation of any public or private land (or carriageway) – or where shared trenches have been opened during the course of other works.

2.5 Permitting processes should be the same across all utility providers, with connectivity providers not subject to separate or particularly onerous requirements (as local regulations allow). This process should be centralized for convenience. The city should also consider expedited or relaxed permitting requirements for providers delivering key connectivity – in accordance with the city's remit.

2.6 A Geographic Information System (GIS) record of all conduits (including under- and above-ground infrastructure) will be developed and maintained by the city, in collaboration with connectivity providers and other stakeholders (including other utility providers, and organizations installing street lighting or other street furniture).

2.7 This record will also play a role in identifying areas under-served by conduit (and therefore, connectivity). This data will be shared with all connectivity providers (and other relevant stakeholders) – via open data (as best practice or, upon request, at zero cost in other instances) and made public, wherever possible – to encourage further network rollout.

2.8 The city should also be mindful of future-proofing connectivity installations. This could include focusing on full-fibre installations for the provision of wired connectivity (as well as backhaul for wireless networks[4]), as well as identifying the role of passive connectivity for future wireless networks (including extensive small-cell rollout for 5G connectivity, and the usefulness of dark fibre in extending networks).

2.9 Digital infrastructure is not solely the preserve of the city. Extensive and high-quality digital infrastructure can only be delivered through meaningful collaboration and engagement with the private sector. The city should explore an appropriate approach based on its needs and priorities – whether public-funded, private-funded or a blended approach.

3 Relationship to wider city policy, strategy and initiatives

Digital connectivity – both wired and wireless – is a key foundation of a smart city. It drives digital transformation, digital public service delivery, and will enable future developments such as 5G, autonomous vehicles and other innovations. It is also a central aspect of digital inclusion, ensuring that no individual or community is excluded from the digital economy – or from the wider benefits that connectivity can enable.

3.1 The city must recognize the importance of digital connectivity in delivering economic, environmental and social benefit to citizens, businesses and all other city stakeholders. The city should consider how the public can be involved to support this initiative to collaborate on achieving the required digital infrastructure outcomes. In addition, a comprehensive assessment of the economic, environmental and social benefits of digital infrastructure would reaffirm its importance for cities and citizens.

3.2 Officials leading digital connectivity efforts in the city should have a cross-organization mandate (recognized and supported by senior management). They must have the authority to ensure connectivity is a central consideration in any new, planned or retrofitted build – or in any of the activities listed in section one of this model policy.

3.3 As part of this mandate, officials leading digital connectivity efforts should identify suitable public assets that could host wireless infrastructure, or that could support the rollout of wired networks.[5] This approach can be particularly important in providing connectivity to under-served populations. Similarly, when commissioning larger developments this process could include considering land and/or roof space built to a specification to house masts or other equipment to deliver wireless connectivity.

3.4 The city should optimize underground asset space planning and implementation, including working with connectivity providers, utility companies and other bodies working to build new or improve the state of existing subsurface infrastructure.

3.5 The city will use (or collect, if not available[6]) local connection data to identify the availability and accessibility of high-quality digital connectivity – both wired and wireless. This data could be used to inform digital inclusion efforts, and broader strategic partnerships with connectivity providers.

3.6 Officials should also consider the merits of public versus private ownership of conduits, digital connectivity and ancillary infrastructure. Cities around the world have explored public, private and blended models depending on their local needs and priorities.

3.7 The city should continually assess their connectivity requirements in order to future-proof its assets. In particular, the city should consider the connectivity requirements of core functions such as traffic signals, CCTV, car parks, on-street parking, air quality, schools, etc. This strategic approach can often align with, and encourage, commercial rollout in an area.

3.8 Related to this, the city should also seek to make available other conduits within its portfolio. This includes conduits managed by public or other transport providers (including conduits on sub-surface and overground rail networks, and serving electric vehicle charging points), and conduit-serving CCTV, traffic systems and other aspects.

4 Governance and process for accountability and compliance

Clear and solid governance arrangements are needed to ensure that digital infrastructure is managed as a strategic asset. Local differences in maturity, complexity and scale of the operating environment will lead to variations in the core model suggested here. City laws and political oversight will also need to be explored in order to ensure the sustainability of the network and associated operations.

4.1 The city should set up a suitable governance process to drive the rollout of digital connectivity. The exact formulation of this must be agreed upon locally, but can range from "steering groups" or similar – with representatives from the city, connectivity providers and other stakeholders – through to "Dig Once Trusts"[7] that manage asset use in a more direct way.

4.2 All conduit and connectivity installations must adhere to all health, safety and wider requirements and regulations – including local policies and broader best practice in relation to fire risk assessments, health and safety requirements, and engaging with related resources, such as asbestos registers.

4.3 Installations should not impact existing utilities, the work of utility or other connectivity providers, and must aim to minimize any disruption to citizens and other stakeholders. This could include leveraging 'behaviour change' approaches, such as levying fees for works undertaken during traffic-sensitive times.[8]

4.4 Connectivity – and conduit – providers must undertake site surveys ahead of commencing connectivity installations. The city may mandate that works cannot begin prior to these surveys being approved by the relevant official.[9]

4.5 If the city intervenes in the provision of private connectivity and builds a network of public conduits, or a public digital infrastructure network, it should be mindful of negatively impacting on the market when leasing this solution to a connectivity provider. Considerations include suitable market pricing, adhering to "state aid" regulations, and not limiting market competition that often can lead to better, and cost-effective, services for citizens.

4.6 The city should identify governance opportunities that could accelerate and support digital infrastructure rollout. This could include a maintenance cost[10] for duct banks (groups of conduits) prorated across providers and coordinated by the city.

4.7 Consideration should also be given to enabling connectivity providers through incentives. For example, allowing in-kind exchanges between providers, allowing providers to trade new conduit for old (including in adherence to all "state aid" requirements), and a "claim it" (for usage, but including all associated maintenance responsibilities) process for any conduit identified during works but without any recognized owner.

5 Ecosystem engagement for trust and value creation

Digital infrastructure has a significant and positive economic and social multiplier effect.[11] High-quality digital infrastructure is the foundation of the digital economy, and enables e-commerce, public service delivery, and remote working and education. It can also be a direct contributor to economic growth through the provision of new (digital) infrastructure arising from capital investment. In order to achieve this potential, shaping and maintaining a digital infrastructure ecosystem – including collaboration between the public and private sectors – is essential.

5.1 The city should aim to develop an "ecosystem of trust", with connectivity providers considered true partners and collaborators in improving the lives and livelihoods of citizens. Similarly, the city should recognize the importance of digital infrastructure and identify and facilitate meaningful collaboration opportunities with connectivity providers – including engaging with the realities of network rollout.

5.2 In maximizing the reach, and positive impact, of digital infrastructure, the city should identify strategic assets that could accelerate or simplify network rollout. This includes leveraging public assets (via public consultation, as needed).,for example, as nodes in a wired network or to host wireless infrastructure. Abandoned assets (in particular, gas or water piping) could also be used to host wired connectivity, such as fibre – thereby minimizing excavations.

5.3 Connectivity providers should recognize the importance of open and collaborative engagement with cities. Commercial sensitivities are recognized, but providers should aim to provide the city with visibility regarding local network planning and rollout – at strategic and operational levels within the local authority. Connectivity providers should also recognize the, often legislative, timescales and frameworks in which public officials operate.

5.4 The city should also work with connectivity providers to understand the relative merits of their installations. In particular, the city should take a strategic approach to the usage of conduits. This could include balancing conduit space between wholesale providers able to connect a large number of properties over the longer-term, with ensuring space for more targeted and smaller-scale providers.

5.5 Connectivity is an essential component in every walk of life. With this in mind, public engagement – and meaningful consultation – with regard to network deployment and rollout is essential. Smart city projects are about people, not technology, and local community engagement is a crucial aspect of their success. Beyond exploring the costs and benefits of digital infrastructure with communities, this engagement can also ensure that no one is left behind from the potential that connectivity (and smart cities more broadly) can deliver.[12]

6 Relationships with industry, utilities and provider stakeholders

The costs of rolling out connectivity can be considerable. Such networks – often led by the private sector – can require significant upfront investment, with civil works in particular representing a notable proportion of any connectivity programme. A "Dig Once" policy could increase efficiencies, improve planning and management of assets, lower costs[13] (including slowing road depreciation), and simplify connectivity rollouts – as well as minimize clashes with other utility or service providers, and reduce disruption to citizens and businesses.[14]

6.1 Connectivity providers should be proactive in identifying opportunities to streamline network rollouts, both in the context of a "Dig Once" policy and more broadly. This could include identifying public assets of strategic relevance to network deployments, sharing network design plans as early as possible to identify areas of alignment with planned city works, and building collaborations with private developers in order to remain alert to potential installation opportunities.

6.2 Developers should be encouraged to strategically incorporate connectivity – and other utilities. For example, by constructing a piped subway to accommodate all services or the provision of ducting for telecoms and electricity. Ownership of any piped subway would be passed over to the relevant authority upon completion of the development, who will manage access for an appropriate fee based on cost. In addition, all new connections in a development could be located in a single area to allow for collaboration amongst utility and connectivity providers.

6.3 Connectivity providers should endeavour to work in a professional manner alongside other contractors, utility companies and other service providers. This will include adhering to all health and safety guidelines and other requirements set by the principal contractor (or similar) on the site.

6.4 Officials should work with developers to support them in recognizing the community and social outcomes of a "Dig Once" policy. This includes the considerable reductions in disruption achieved by avoiding retrofitting installations, limiting disruptions to traffic, increased ease of installation when combined with existing work or open trenches and the considerable commercial opportunities associated with accelerating the rollout of networks (and increasing their customer base).

6.5 The city should explore the range of funding mechanisms used to drive digital infrastructure rollouts. This includes self-funding conduits, developer-funding,[15] rental and rights-of-way fees, building a central fund for conduit maintenance (or for future-proofing connectivity infrastructure) and private sector funders – such as fund managers and institutional investors seeking longer-term returns on investment.

6.6 The city should also identify other opportunities to build strong and productive partnerships with connectivity and utility providers. This could include encouraging the attendance of all known asset owners during excavations for other purposes, or when undertaking trial digs during the course of any development. This would assist providers in understanding the presence, state and situation of any of their assets (including ground conditions).

7 Technical measures to underpin “Dig Once” digital infrastructure

The technical aspects of digital infrastructure are relatively well-developed.[15] Aspects may also be dependent on local planning or other regulations[16] or the local environment and wider context. This is particularly the case for wireless infrastructure and key components such as base stations and towers. The challenge in developing a standard technical specification is to incorporate the requirements of known and unknown users and to provide sufficient capacity and capability without excessive costs.

7.1 The following factors may be considered in developing any technical measures required in implementing the “Dig Once” policy:

1. **Capacity**: Sufficient conduit needs to be installed, and that conduit needs to have sufficient internal diameter, to accommodate future users’ cables and to be segmented to enable conduit to be shared or cables added at a future date. Similarly, wireless infrastructure should have space for expansio.

2. **Segmentation**: Conduit users need to have the appropriate level of separation from each other for commercial, security or operational reasons. This could include incorporating twin ducting, multiple ducting, splitting within ducting or other approaches for resilience.[17]

3. **Access:**[18] Vaults (or chambers) and handholes need to be placed to provide access to conduit and the ability to pull fibre. Vaults need to be spaced to minimize the cost of extending conduits to buildings and other facilities that may be served by fibre. In many installations, chambers are installed at a minimum of every 100m – although shorter distances are preferable wherever possible.

4. **Costs**: Materials beyond those that are likely to be needed will add cost, as will the incremental labour to construct them. Beyond a certain point, trenches need to be widened or deepened to accommodate conduit. The city should also consider installing additional empty conduits for resilience – and consider the potential role of protected and empty trenches (that cannot be built over) for the future provision of conduits.

5. **Robustness**: The materials, construction standards and placement need to reasonably protect the users’ fibre in a conduit, and not unduly complicate maintenance and repairs. PVC-ducting of 100mm is used in many installations, buried at >450mm.

6. **Architecture**: Sweeps, bend radius and vault or chamber sizes need to be appropriate for all potential sizes of fibre. Installation should also consider the location of other utilities. For example, minimizing the siting of digital infrastructure conduit near high voltage utilities due to a risk of interference – and suitable separation from water pipes to minimize water risks.

7. **Life cycle management**: A correctly-installed conduit has a significant lifespan. If conduits are not in use, they can be blocked at each chamber to minimize any potential damage (e.g. dirt or water) travelling between segments. As noted earlier in the model policy, the city should maintain an accurate record of all connectivity assets in a GIS-based platform – and also keep records of which conduit is being used by each provider. This accurate information will minimize the risk of the conduit being damaged during any subsequent street works.

8. **Wider considerations**: When retrofitting, connectivity installations must be to the perimeter of properties – with the final part only installed with landlord permission. Similarly, the city should encourage providers to make efficient use of all infrastructure assets – within the scope of any broader regulation.[19] The city and connectivity providers will also need to work together to identify approaches or policy with regard to interconnection with public and other assets, including interconnection fees, standards and any demarcation points between these assets.

   More broadly, the city should also be mindful of the enabling and ancillary infrastructure needed to deliver connectivity. This includes ensuring access to power supplies and any wider energy infrastructure.

Definitions

Conduit
A tube or other type of channel (including an innerduct or microduct) for fibre optic or other cables that support connectivity, or other services.

Connectivity provider
The organization – public or private – responsible for installing a digital infrastructure network.

Developer
An organization or firm responsible for constructing buildings or other developments.

Development
Any building or other public project requiring construction or physical works – for example, a project to build a new park (or rebuild an existing one).

Digital infrastructure
The components that support broadband, computing and communications.

Full-fibre
A fibre cable terminating at the front door to a private or residential property – and not a combination of fibre and copper, twisted pair or other cabling.

Dark-fibre
Unlit fibre; pre-existing fibre-optic cables that do not have supporting hardware or software to run digital operations.

Geographic Information System (GIS)
An organized collection of computer hardware, software, land information and other resources, including personnel, that is designed to, or assists in, efficiently collecting, maintaining and disseminating all forms of geographically referenced information.

Resilience
Ensuring that digital infrastructure has suitable contingency, fail-safe or other protections to minimize the risk of a loss of connectivity.

Utility company
All persons, firms or corporations in the business of providing electric, gas, natural gas, waterworks or sewage disposal service to consumers.

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About the G20 Global Smart Cities Alliance

Established in June 2019, the G20 Global Smart Cities Alliance on Technology Governance unites municipal, regional and national governments, private-sector partners and cities' residents around a shared set of principles for the responsible and ethical use of smart city technologies. The World Economic Forum, the International Organization for Public-Private Cooperation, serves as secretariat for the alliance.

Through the alliance, global experts from government, private-sector partners and civil society are compiling and analysing policies from around the world to identify model policies necessary for successful, ethical smart cities.

You can find more model policies and more details about the alliance at: https://globalsmartcitiesalliance.org/.

Endnotes

1. United States Department of Transportation, Federal Highway Administration, *Executive Order: Accelerating Broadband Infrastructure Deployment*, 2012, https://www.fhwa.dot.gov/policy/otps/workplan.cfm#ftn15.

2. Department for Digital, Culture, Media & Sport, Department for Transport, *Street Works Toolkit,* 2018, pp.13, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/804471/Street_Works_Toolkit_2.0.pdf.

3. "Connected Community / Smart City TO", *City of Toronto*, n.d., https://www.toronto.ca/city-government/accountability-operations-customer-service/long-term-vision-plans-and-strategies/smart-cityto/.

4. "Paving the Road to 5G with Fiber", Fiber Broadband Association, n.d., https://www.fiberbroadband.org/page/paving-the-road-to-5g-with-fiber.

5. Department for Digital, Culture, Media & Sport, *Local Full Fibre Networks Challenge Fund Guidance*, 2017, https://www.gov.uk/government/publications/local-full-fibre-networks-challenge-fund.

6. Although this may need to be under non-disclosure agreements or similar mechanisms in order to protect the commercial interests of providers.

7. "Dig Once Trusts", *Community Broadband (CBN),* 2017, https://broadband.coop/dot.

8. Transport for London's Lane Rental Scheme applies a daily charge for each day that high-congestion streets are occupied by construction or highway works. However, this charge is removed or reduced if the works take place outside traffic sensitive times. Income generated is used for individual projects aimed at reducing disruption and other adverse effects caused by street and roadworks. See: "Lane rental scheme", *Transport for London*, n.d., https://tfl.gov.uk/info-for/urban-planning-and-construction/our-land-and-infrastructure/lane-rental-scheme?cid=lanerental.

9. Consideration should also be given to commissioning a single company to cross-reference the depth of the existing utility infrastructure – at the time of disconnections or highway surveys being undertaken by the developer – against those supplied. The latter may not always be accurate. See, for example: "Specification for underground utility detection, verification and location", *British Standards Institute*, 20 June 2014, https://shop.bsigroup.com/ProductDetail/?pid=000000000030267400.

10. Sweeris, Bruce, *Pole Line and Duct System Rate Study City of Grand Rapids, Michigan, City of Grand Rapids*, 2020, https://www.grandrapidsmi.gov/files/assets/public/departments/energy-lighting-and-communications/files/pole-line-and-duct-system-rate-study-2020.pdf.

11. Broadband Commission, *The State of Broadband 2019: Broadband as Foundation for Sustainable Development*, 2019, https://www.broadbandcommission.org/publications/Pages/SOB-2019.aspx.

12. In addition to properly assessing the economic, environmental and social multiplier effects of digital infrastructure, cities may also want to explore and evaluate less tangible benefits of digital infrastructure – such as its positive effect on social inclusion.

13. Road and street works account for 70% of the cost of fibre deployment, see: Department for Digital, Culture, Media & Sport, Department for Transport, *Street Works Toolkit,* 2018, https://www.gov.uk/government/publications/framework-for-uk-fibre-delivery-street-works.

14. Ibid.

15. Ministry of Housing, Communities & Local Government, *Data Ducting Infrastructure for New Homes: Guidance Note*, 2008, https://www.gov.uk/government/publications/data-ducting-infrastructure-for-new-homes-guidance-note.

16. As highlighted earlier, this could include – but is not limited to – health and safety at work regulations, fire safety legislation and construction regulations.

17. However, some connectivity providers may refuse to share conduit space with other providers.

18. Access to wireless infrastructure may be subject to local or national legislation.

19. Sharing of infrastructure between providers, or initiatives such as open access, may be constrained by national legislation.

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