

The background of the entire page is a satellite-style map of the world with a network overlay. The map is in shades of blue, and the network is composed of numerous thin, light blue lines that connect various points across the globe, creating a complex web of connections. The lines are most dense in the central and eastern parts of the world.

# Building a resilient future

Technology and the COVID-19 economic recovery

December 2020

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## About VMware

VMware software powers the world's complex digital infrastructure. The company's cloud, app modernization, networking, security, and digital workspace offerings help customers deliver any application on any cloud across any device.

Headquartered in Palo Alto, California, VMware is committed to being a force for good, from its breakthrough technology innovations to its global impact. For more information, visit [www.vmware.com/company](http://www.vmware.com/company).

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# Foreword

Debates over the 'future of work' have raged for decades. With each new technology comes the potential for a shift in the way we interact with our work, with our offices, and with each other. In 2020, the 'future' arrived, prompted not by a new technology but a global pandemic, forcing many of us into our homes, and out of the workplace. These shifts won't go away: recent research from VMware found a 128% increase in the proportion of employees across the UK who see remote working as a must-have before starting a role. When Prof Carl Benedikt Frey, director of the programme on the Future of Work at Oxford University, was asked at a recent VMware event about the lessons of the pandemic, he replied simply that "people now see remote work as a prerequisite rather than a perk."



Legacy IT equipment, tied to the perimeter-based office model, has been simply unable to provide the flexible and adaptive infrastructure necessary to keep work pipelines moving during this significant disruption. While broadband and mobile networks held up relatively well, in too many instances neither the public nor private sector had the tools to access applications, data, and services securely from any device, anytime, anywhere.

We already know that some central government departments struggled with the transition to remote working. At the height of the first wave in May, only 20% of staff in DWP were able to work off-site. This was not the case everywhere. Many governments in Europe, where remote working was already widespread, and digital infrastructure more advanced, coped well with moving departments out of the office.

Many of these governments see a dispersed workforce as an opportunity to create more dynamic and adaptive organisations. They know that work will not remain fully remote forever, with some workers never attending a central office. Instead, as we are already seeing, it will be increasingly 'distributed', with workers moving between the home, a central office, and a temporary shared workspace, or even regional 'hub'.

In this regard, the Government's commitment to a new approach to data and digital is very welcome. At a speech to the UK Tech Cluster Group in June, DCMS Secretary Oliver Dowden made clear that adapting to the opportunities offered by the new digital-led post COVID-19 economy, meant "providing world-class, next generation infrastructure, so that everyone can take those advantages and those opportunities wherever they live."

As this report shows, that commitment must mean going beyond what we usually think of as digital infrastructure, such as our broadband and mobile networks, to also include the digital foundations at the level of individual organisations which underpin secure, remote access. These tools and technologies, which include virtualisation and the cloud, are not simply another wave of innovation to be introduced, ad hoc, to the public sector. Instead they are an absolutely crucial form of infrastructure which will bring huge efficiency and productivity benefits to the UK economy.

This Government can lead the country towards this approach, inaugurating cutting edge governance; not a physical collection of buildings and departments but instead a dispersed, adaptive system, able to adjust quickly to new circumstances, challenges, and ways of working. I know that many policymakers, some right at the heart of Government, share this vision.

The benefits are made clear in this report: remote and dispersed working, possibly shared between the home and regional hubs, would allow for a significant cost reduction in the public sector estate. Public sector office space in Wales, for example, costs around a third of the price per person per year than London, at £2,811 compared to £8,548. It is a policy which would literally pay for itself.

A permanent shift towards dispersed working would also benefit the levelling up agenda, with polling suggesting many workers would, if given the opportunity, move out of major cities and into rural and coastal areas.

And we could also see an increase in UK productivity, which has long lagged behind European peer countries. Detaching organisations from specific geographies – many largely urban and southern – could expand the number of potential employees available, tapping into talent hundreds of miles away.

The world of work is rapidly changing. By taking the lead in significantly upgrading its own digital and virtual infrastructure and supporting much of the private sector to do the same, the UK can solidify its place as the world leader in key digital technologies. The ‘future’ has indeed arrived, all that is now needed is a determined and ambitious Government willing to grasp the opportunities on offer.

**Duncan Greenwood , Vice President & General Manager NEMEA, VMware**

# Executive summary

The COVID-19 pandemic has fundamentally and irreversibly altered how we live and work, seriously testing the nation's digital capacity and cybersecurity. The dramatic shift in working patterns caused by the lockdown has been the main driver of this. And this is not just for the short term; a range of sources suggest that these changes will have a lasting impact on levels of remote working, and this in turn could permanently shift the geography of the country.

Whilst this report highlights the real challenges faced by many businesses, and by Government itself, the main argument is that there is now a real opportunity to build resilience in the UK's digital infrastructure. To seize this opportunity, the Government should engage in an active strategy of embracing and facilitating this shift towards remote working as it carries the potential for substantial social and economic benefits, including:

- **Addressing the UK's productivity and pay issues through 'remote' internal mobility** – secure and robust remote working capacity increases an organisation's geographical range of potential employees, and as a result the variety of skillsets that it can access. Better movement of skills across the country could help address the UK's issues around productivity and give Britain a pay rise.<sup>1</sup>
- **Levelling up the country** – a previous report by WPI Economics found that over 75,000 expert graduates were lost from the northern workforce in the 10 years leading to 2017. However, polling suggests that a permanent increase in remote working following the lockdown will move large numbers of people away from cities such as London towards rural areas and seaside towns.<sup>2</sup> As a result, higher earners in various industries could be more likely to live in economically underperforming parts of the country in the future, rather than simply being concentrated in and around London and major cities. This would help improve those local economies and the lives of those in 'left behind' areas.
- **Wellbeing** – with support from employers, remote working can improve work-life balance, help to enhance people's wellbeing and reduce stress, particularly if it allows them more flexibility in where they can live.
- **Green growth** – remote working can reduce the UK's stubbornly high motor vehicle emissions, one of the major barriers to achieving the UK's target of net zero carbon emissions.
- **A more efficient public sector** – the innovative IT solutions which support remote working can improve cybersecurity, facilitate the safe transfer of data between and within organisations, in addition to underpinning more flexible ways of working – helping the Government deliver its vision of a truly digital government.<sup>3</sup> Furthermore, implementing remote working at scale can help the Government continue to save billions of pounds for the taxpayer by reducing the size of the public sector estate.

At present, the digital infrastructure of employers – especially in the public sector – is the major barrier to realising the benefits of remote working, rather than the UK's network infrastructure. For example, many large businesses and public sector organisations with legacy systems use a perimeter-based office model which is unsuited to supporting secure remote working at scale.

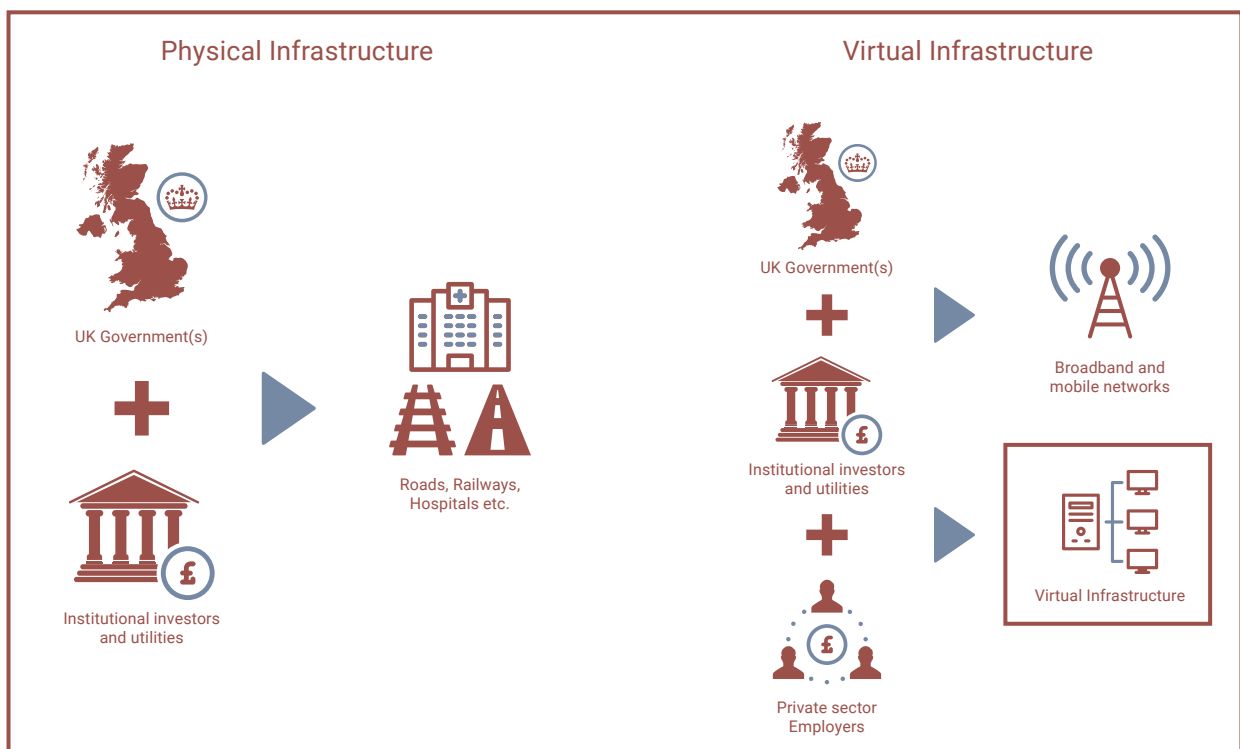
These shortcomings have been laid bare by the COVID-19 crisis, with dire consequences for organisations, workers, customers, and the taxpayer. Polling conducted by Opinium for WPI found that almost 20% of those furloughed believe this happened because their employer lacked the IT infrastructure to support remote working.<sup>4</sup> We estimate that HM Treasury could have paid up to £6bn in furlough payments to staff who were unable to work as a result of poor IT infrastructure.<sup>5</sup>

Many companies have on face value adapted well to the crisis, quickly implementing remote working at scale. However, there are reasons to be concerned that this may have come at the expense of security in some cases, which is a significant risk to take given the deteriorating cyber threat environment. We know from Government-commissioned polling that there is still an absence of basic cybersecurity procedures and technical controls in place across the business population.<sup>6</sup> Any short term savings from not investing in security are illusory - the annual cost of cyber-attacks for a

medium sized business could go up by as much as £5,700 based on the increased rate of attacks seen during the peak of the first lockdown.<sup>7</sup> The potential change in security dimensions attached to working from home mean that fully secured systems and processes based on ‘zero trust’ need to be a default option for all businesses.

These are problems for businesses and organisations – but they are also problems for society at large, particularly as we begin to design solutions to grow our economy out of this crisis. There are concrete actions that the Government can take to ensure that secure remote working capacity can be a reality across our economy. In order for these measures to be put into place, Government and policymakers must first embrace a new understanding of digital infrastructure as also encompassing ‘virtual infrastructure’, meaning secure remote access to data at the level of individual organisations. Subsequently, the Government should request that the National Infrastructure Commission (NIC) develop a strategy which makes a series of recommendations to strengthen virtual infrastructure across the economy.

Figure 1: Virtual infrastructure



Our recommendations:

1. The Government should take the lead in significantly upgrading its own virtual infrastructure.
  - a. We recommend that the Government invests in departments and agencies to ensure that ultimately all desk-based public sector workers can securely and remotely access their data and applications at any time, from any device, anywhere.
2. The Government should actively support the strengthening of virtual infrastructure in the private sector.
  - a. We recommend that the Government update the National Infrastructure Commission’s remit to recognise this new conception of digital infrastructure as a priority area which must be addressed by policy and with Government investment.
  - b. We recommend that a voucher – along the lines of the Cyber Essentials grant – be provided to all, or a subset, of businesses to fund vital upgrades to the virtual infrastructure of the business population.

# Introduction

Governments around the world – including the UK – have taken radical steps to protect their populations from the spread of COVID-19. The stringent social distancing guidelines and regulations imposed on citizens were designed to suppress the spread of the virus, save lives and protect the NHS in the process. These restrictions, as well as the pandemic itself, have impacted society enormously – including by causing huge damage to the economy.

The Office for Budget Responsibility (OBR) recently estimated that the overall fiscal cost of COVID-19 could be £263bn to £391bn according to the OBR.<sup>8</sup> and the IMF suggest that the UK Government will need to borrow £400bn over two years to combat the looming recession.<sup>9</sup> As we leave lockdown, there is no certainty that the recovery from this recession will be swift, with EY suggesting that a full recovery could take up to three years.<sup>10</sup> It is this concern that has led to a policy discussion about how further intervention by Government could help bolster growth as we emerge from this crisis, protecting incomes and livelihoods in the process. It is highly likely that part of this response will be an economic stimulus package which will include Government investment in infrastructure.

This report is a contribution to that policy discussion. There are a broad range of factors that must be considered in devising policy solutions to drive our growth out of this crisis. Three key solutions that are particularly relevant for this report are considered below.

## COVID-19 has disrupted our economy and ways of working

Our economy and society have been permanently changed by the pandemic and resulting lockdown. The mix of businesses that make up our economy will be altered by the fact that some firms and sectors have been better able to weather the storm thus far, as well as how lockdown has altered public behaviour, and consumer demand for certain goods and services. In particular, this report will argue that the norm of a large part of the population commuting to an office five days a week is highly likely to come to an end.

The Government should plan for a recovery built around this world, not the world left behind, and any proposals around infrastructure as a means of stimulus need to be tailored to expected future behaviour.





## The recovery should address our economy's pre-existing weaknesses

The UK economy is severely imbalanced. Growth in wealth and income has been heavily concentrated in London and the South East of England, in large part as a result of the geography of the UK's highly paid sectors including finance, professional services, and technology, and the resulting effect on the price of homes. The Prime Minister has made addressing this disparity one of the core missions of his administration.<sup>11</sup>

Furthermore, the UK suffers one of the worst productivity performances in the OECD, measured by GDP per hour worked.<sup>12</sup> This scenario has been described as a crisis by policymakers and is often blamed for low levels of pay growth.<sup>13</sup> The various explanations posited for the UK's unenviable position include low levels of infrastructure investment relative to other countries, as well as poor levels of internal labour mobility.

In driving our economic recovery from COVID-19, Government should look to 'Build Back Better' and seek solutions which create an economy that delivers higher pay and more prosperity for the whole country.

## We should build a resilient future

This crisis has been a lesson in the need to prepare for hard to predict but high impact events such as pandemics. The extent to which businesses have had pre-prepared continuity plans in anticipation of such events has been highly consequential for their ability to weather this crisis. The economy we rebuild should emphasise organisational and societal resilience in the broadest possible sense, including to risks such as future pandemics, natural catastrophes and systemic cyber-attacks.

## The role of digital technology

In particular, this report will highlight the importance of what we describe as 'virtual infrastructure' as the key to resolving many of these issues by supporting a remote working revolution once the lockdown finishes. A firm Government commitment to strengthening our virtual infrastructure across the public and private sectors should be part of a package of measures to secure a strong recovery as we emerge from the crisis.



# Building digital capacity

## Key points:

- The COVID-19 lockdown policy has drastically increased demand on the nation's digital infrastructure.
- Despite this, our broadband and mobile networks have performed relatively well in the eyes of consumers.
- The key to unlocking a remote working revolution after lockdown is strengthening the digital capacity of individual employers, through tools or technologies such as virtualisation and the cloud which provide secure access to data and applications.

The strength of the nation's digital capacity was brought into sharp focus by the lockdown and resulting guidelines on home working. We can see clearly from a range of data sets that this requirement did indeed lead to a substantial rise in the number people working from home:

- Prior to the lockdown, around 5.1% of employees worked mainly from home according to the ONS.<sup>14</sup>
- A survey by Opinium found that over a quarter (27%) of workers were working from home full time at the end of March.<sup>15</sup>
- According to the ONS, during mid-April 45% of adults in employment said they had worked from home at some point in the last week.<sup>16</sup>
- A survey by Willis Towers Watson found that 62% of organisations now have at least three-quarters of their workforce working remotely – prior to the crisis it was less than 2% of organisations.<sup>17</sup>

Remote working invariably increases the pressure on the broadband and mobile network for a range of reasons, including the fact that people will need to carry out all of their professional interactions virtually, such as through video conferencing software. It also represents a huge challenge for employers – for staff to be able to work from home successfully there needs to be an effective infrastructure in place which enables them to access the correct data and accounts securely. In understanding the UK's capacity to implement remote working, it is helpful to consider evidence around how each of these two elements performed during the first lockdown.

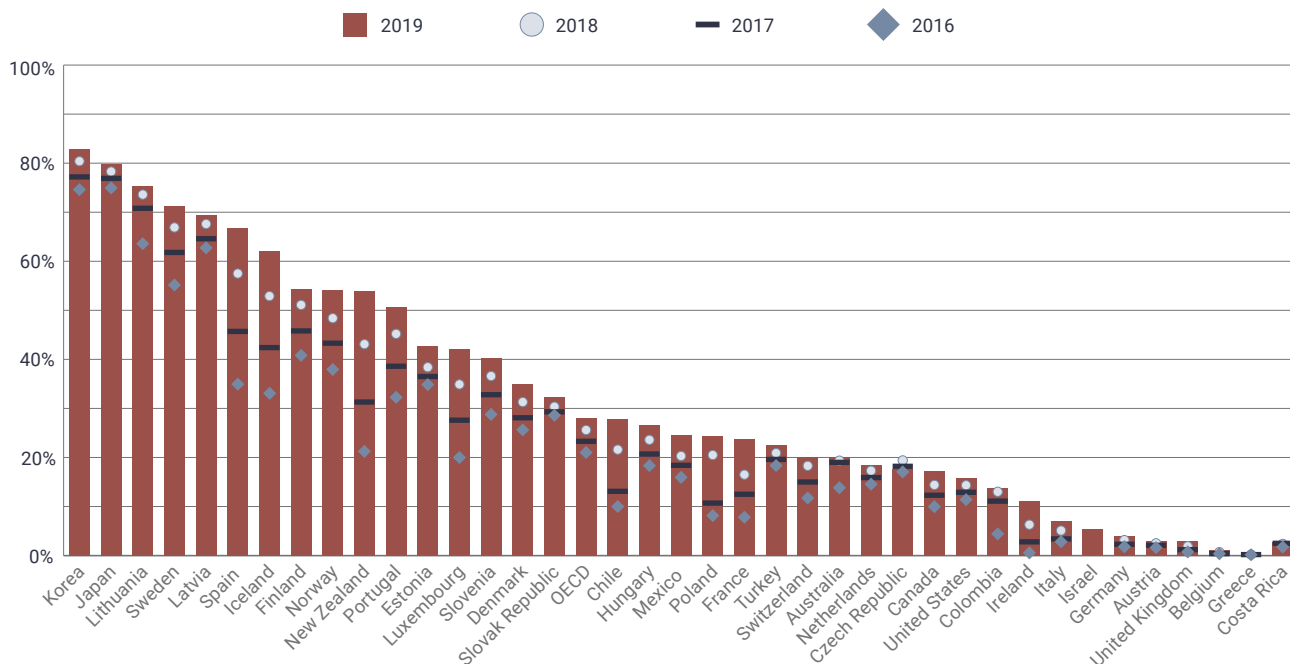
## The network of the nation

When it comes to its network infrastructure, the UK does not compare well to other developed economies. For example, data collected by the OECD suggests that the UK is one of the poorest performers in terms of Full Fibre rollout.

However, there is evidence that the UK's network infrastructure has in fact held up well, despite huge increases in traffic. A survey by EY found that consumers believed that 75% of broadband operators and 73% of mobile operators are performing well during the lockdown with only 7% voicing negative opinions about their broadband and 5% about their mobile network. The same survey found that just 8% of consumers believe that the COVID-19 situation has made them realise they need to upgrade to Full Fibre broadband.<sup>18</sup> On the other hand, polling by Opinium for WPI Economics found that 28% of people who worked remotely during the lockdown had a problem with their broadband connection.<sup>19</sup>

While there is uncertainty about the point at which the demand on our networks is likely to outstrip capacity, it is still important for the UK to invest in its Full Fibre infrastructure, according to the National Infrastructure Assessment.<sup>20</sup> Overall, however, strengthening the UK's digital infrastructure and powering an increase in remote working involves a much broader conversation than simply investment in the capacity of the network. Secure digital foundations at the level of individual organisations also have an important part to play.

Chart 1: Percentage of Fibre connections in total fixed broadband, June 2019



Source: OECD<sup>21</sup>

### Digital foundations in British business and the public sector

There are a number of potential solutions that a business can implement to support their employees to reliably access the data and accounts they require to work from home. Use of cloud storage technology to support remote, mobile working for companies is increasingly commonplace for organisations of all sizes.<sup>22</sup> Remote working can be supported through Virtual Desktop Infrastructure (VDI) (Box 1), which can connect to either a cloud solution or traditional data centre to support working on any app, with any device, anywhere.<sup>23</sup>

#### Box 1: Virtualisation and remote working

Companies such as VMware can support enhanced remote working through a number of ways to deliver improved productivity and security, while utilising an employee’s internet connectivity. This includes using a ‘Virtual Cloud Network’ which allows for applications and data to be accessed from both public clouds and private data centres from any device, any time, anywhere. This reduces the potential for downtime as a result of homeworkers not having the access they need, as well as reducing the potential for security breaches.

Furthermore, technology can provide home workers with the opportunity to prioritise business related traffic for the bandwidth in their home broadband, downgrading or limiting access to non-work related tasks (such as video streaming) that are being carried out on other devices within their household. This can help limit some of the employee frustrations related to connectivity when working that we have highlighted in this report. Furthermore, companies can better secure business specific traffic to the home by means of a central firewall.

This functionality speaks to a potential broader trend highlighted by this report – that the technology being used by an individual to support home working, including network access, is considered as being part of the corporate infrastructure as a consequence of its ultimate value to the business.

There is a good evidence supporting the claim that improving the digital experience of employees can drive company value, improving levels of staff satisfaction, helping firms succeed over their competitors and grow their business.<sup>24</sup> Despite this, and the range of good solutions available, many organisations have failed to put in place the adequate technical and systems measures to support remote working at scale in recent years. The massive increase in remote working required by the crisis has harshly exposed these shortcomings. Experts at VMware working on the ground to support their clients during the crisis confirmed that a number of organisations, particularly (a) those using legacy IT systems and (b) public sector bodies have been inflexible in supporting large numbers of remote workers following the lockdown.

To give some especially severe examples of this, one large public sector organisation had up to half its staff unable to work for a period of time due to the inadequacy of their system in supporting remote working provision. In mainland Europe, there were examples of large parts of local Government, and even one country's justice system, being unable to operate for periods of time as a result of a lack of technical solutions to support them. This led to these organisations needing rapidly to upgrade their systems in a reactive fashion, but not before a period of disruption to services.

In addition to these anecdotal examples, polling by Opinium commissioned by WPI found that IT difficulties with remote working were widespread during the lockdown:



22%

of those working from home during lockdown experienced problems accessing important things from their employer's network that they needed to be able to work (such as files or work email accounts).

Overall  
48%

of people lost half a day or more of work during the lockdown due to IT issues. A quarter (25%) lost a full day or more.

Almost  
20%

of those furloughed at some point during the lockdown believe this happened because their employer lacked the IT infrastructure to support remote working. We estimate that this means around £6 billion in furlough payments could be made as a result of poor implementation of IT infrastructure by employers, based on OBR predictions of the overall cost of the furlough bill by the end of the lockdown.<sup>25</sup>

As we will go on to describe, there are major societal benefits to a new normal of remote working, and there is a public policy imperative for Government to invest in this capacity so these benefits can be realised. The Government must strengthen potential remote working capacity both by pushing ahead with its plans to improve the UK's network infrastructure, but also by identifying how employer systems across the public and private sectors could improve their capacity to support a growth in remote working.

One critical element of this approach is ensuring that capacity is not just *sufficient* but also *secure*. We understand from experts working at VMware that while some companies have on face value been able to scale their remote working quickly in response to the crisis, in some circumstances this has come at the expense of having robust security procedures in place. This is an extremely short-sighted approach. The default for all business activities should be to carry them out in a cyber secure way, in exactly the same way the security and safety are regarded as the default in so many other commercial activities.

# Securing digital capacity

## Key points:

- UK businesses have always faced a significant cyber threat – this has been compounded by a rise in opportunistic attacks resulting from COVID-19.
- Businesses and employees are more vulnerable to cyber-attacks in a lockdown environment.
- Approaches such as zero trust are an essential underpinning of remote access to data.

Beyond pandemics, there are a range of other risks that businesses inevitably face in a modern economy. Cybersecurity risk is a primary example and – prior to the onset of COVID-19 – this regularly topped corporate risk registers.<sup>26</sup> In the UK, companies are 15 times more likely to have a cyber incident than fall victim to a fire or physical theft.<sup>27</sup>

Cyber-attacks and their effects can be systemic and all encompassing, much in the same way as a pandemic. However, they can also be high frequency, low level disruptive events which cause damage in various ways, including:

- **Economic costs** – not just in stolen cash or data, but also lost files, business disruption, diverted staff time, fines, penalties, brand reputation, and compensation resulting from breaches of personal data, as well as costs around incident response and system repair.
- **Breaches of personal data** – cyber-attacks have the potential to result in the compromising of data of employees and customers, potentially violating their rights under legislation such as the General Data Protection Regulation (GDPR).

For these reasons, as well as being a business risk, cybersecurity is also a major public policy concern. Governments around the world have responded with legislation to protect personal data as well as various initiatives to tackle cyber-crime and help individuals and businesses improve their levels of cyber protection.



## Types of cyber-attack

According to VMware Carbon Black<sup>28</sup>, some of the most common types of cyber-attack include the following:



### Cryptojacking

This software hides on a computer or mobile device and hijacks the machine's resources to "mine" cryptocurrencies, generating profit for the attacker. It can take over devices, web browsers and even network servers, and will remain hidden to the user.



### Ransomware

This attack utilizes a Trojan Horse or even a worm (both defined below) to enter a user's device, and will then threaten to leak the victim's data or permanently block access unless a ransom is paid.



### Spyware

This is software that aims to gather information about a person or organisation, often without their knowledge. It may send such information to another entity without consent, can assert control over a device without the user's knowledge, or send such information to another entity with consent via cookies.



### Trojan Horse

A computer program which misleads users of its true intent. It can appear as a legitimate file, such as an email attachment. Modern forms act as a backdoor to provide access into a network to obtain confidential information.



### Virus

A type of software that, when executed, replicates itself by modifying other computer programs and inserting its own code. When this replication succeeds, the affected areas are then said to be "infected" with a computer virus.



### Worm

A standalone software program that replicates itself in order to spread to as many machines as possible. Worms consume bandwidth on the infected network, which can cause major disruptions, but do not corrupt or modify files like a virus.

## Cybersecurity risk before the pandemic

The cyber threat environment prior to the COVID-19 pandemic was one which already carried substantial risks for businesses, their employees and customers.

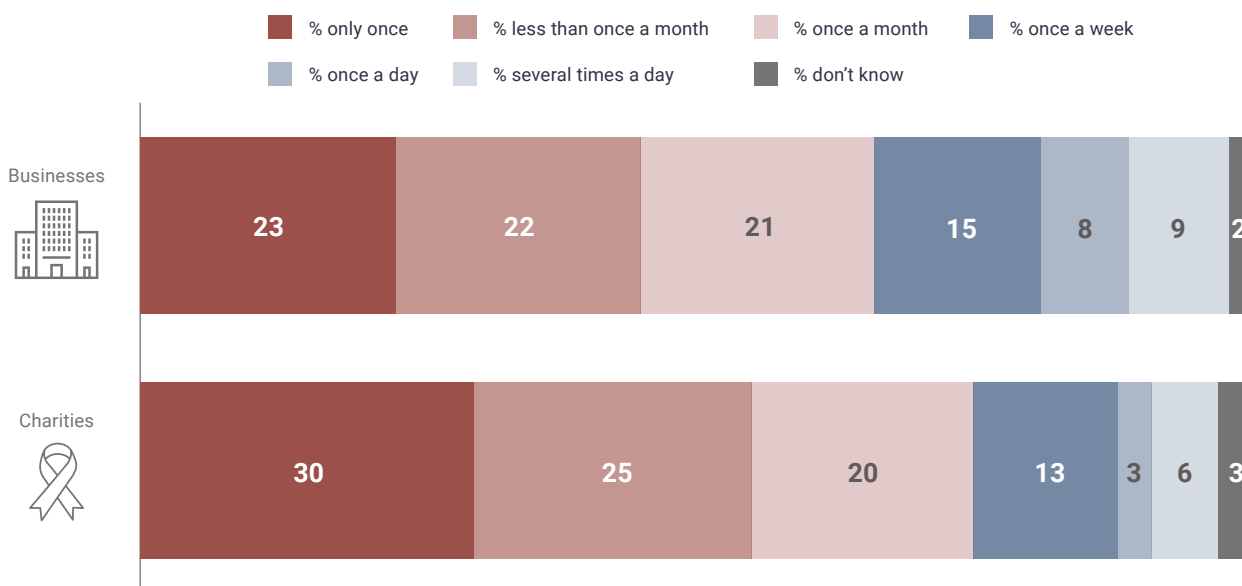
- In polling of businesses across Europe and the USA carried out shortly before the onset of the pandemic, major cyber insurer Hiscox found that the median cost of all cyber events rose from \$10k to \$57k over the previous year, although the number of businesses reporting one or more cyber events fell from 61% to 39%. The median cost ranged from \$7k for a micro business (1-9 employees) up to \$504k for an Enterprise (1000+ Employees).<sup>29</sup>
- In its annual cyber breaches survey, DCMS found that while 54% of businesses had not experienced an attack in the last year, more than half of those who had been attacked identified these attacks as occurring once a month or more.<sup>30</sup>

Despite the serious threat of cyber-attacks, many businesses in the UK have not implemented the basic technical and business process measures to protect themselves. For example, according to DCMS:

- A third of businesses have no security controls on company owned devices such as laptops.
- 62% do not monitor user activity at work.
- 43% have no rules in place for storing or moving personal data securely.<sup>31</sup>

Furthermore, in a poll commissioned by Business in The Community (BITC) in 2019, only a third of SMEs reported having a basic data protection policy.<sup>32</sup>

Figure 2: How often organisations have experienced breaches or attacks experienced in the last 12 months



Bases: 748 businesses that identified a breach or attack in the last 12 months; 134 charities

Source: DCMS Cyber breaches survey 2020<sup>33</sup>

### Quantifying the loss for the average business

Using a range of these findings, modelling for this report suggests that there are significant average annual losses that would be faced by businesses of different sizes due to cyber-attacks. The results of this can be found below:

Table 1: Business financial losses from cyber breaches pre COVID-19

Business size	Micro (1-9)	Small (10-49)	Medium (50-249)	Large (250-999)	Enterprise (1,000+)
Average annual financial loss from cyber-attacks	£1,900	£6,640	£21,400	£62,800	£238,000

Source: WPI Economics modelling of DCMS and Hiscox figures<sup>34</sup>

The financial losses experienced by firms as a result of cyber-attacks will ultimately cause knock-on damage to the economy, siphoning business expenditure away from wages and investment. In extreme examples, cyber-attacks can cause firms to go insolvent. Polling of US businesses by the National Cyber Security Alliance found that 10% of SMEs experiencing a data breach went out of business as a consequence, with 25% filing for bankruptcy.<sup>35</sup>

## Cyber risk and COVID-19

There is some evidence that the COVID-19 pandemic has caused a serious worsening of the cyber threat environment for businesses across several threat vectors. For example:

- Polling WPI commissioned from Opinium found that 15% of those working from home received scam communications (such as emails or texts) about COVID-19.<sup>36</sup> Other sources show that COVID-19 related phishing attacks continue to rise, with a spike of 600% between February and March.<sup>37</sup>
- Cyber threat data gathered by VMware Carbon Black Cloud found that there was an 18% rise in ransomware attacks detected between January and May this year.<sup>38</sup>
- Research by Opinion Matters commissioned by VMware Carbon Black of individuals at board level with cybersecurity responsibility found that 93% had been targeted by COVID-19 related malware.<sup>39</sup>
- In March and April 2020 86,600 COVID-19 related web domains were created which experts deemed to be risky or malicious.<sup>40</sup>

Modelling for this report suggests that there is likely to be a significant average impact on businesses of the increase in cyber-attacks from the COVID-19 pandemic. We have used the 18% rise identified by the VMware Carbon Black Cloud as our central case. However, recognising that other forms of cyber-attacks may have increased at different rates, we present results from two other scenarios of 9% and 27% in order to provide a broad indication of the potential costs of increased cyber-attacks.

Table 2: Increase in business cyber losses during COVID-19 pandemic

Business size	Micro (1-9)	Small (10-49)	Medium (50-249)	Large (250-999)	Enterprise W(1,000+)
Increase under COVID-19 - lower case	£170	£600	£1,900	£5,700	£21,400
Increase under COVID-19 - central case	£340	£1,200	£3,900	£11,300	£42,800
Increase under COVID-19 - upper case	£510	£1,800	£5,700	£17,000	£64,200

The lockdown has also changed the nature of cyber risk. We understand from experts at VMware that it is no accident that attacks which prey on the end user such as phishing emails have spiked during the pandemic. Cybercrime is an innovative business, and hackers have adapted their approach to the vulnerabilities of the new world. When workers are isolated from their colleagues, including IT and technical staff, they are potentially more vulnerable to being influenced into allowing hackers to access their network through emails or texts which may appear to be from trusted sources such as their company or Government agencies. Furthermore, employees and businesses may be using applications with which they are unfamiliar and have not been trained to use in a secure way. In the rush to begin remote working following the lockdown, employees are also more likely to use personal devices for work purposes, which may have inadequate technical security controls.



## What can be done?

The steps that businesses need to take to protect themselves from cyber-attacks have been well identified by experts in the sector. Box 2 sets out the steps taken by companies deemed 'Cybersecurity Trailblazers' according to VMware. Effective modern approaches to cybersecurity – particularly ones which should support remote working - encompass systems which are built on a 'zero trust' approach where the endpoint (or device), identity of the user, and security of the connection are all validated before access to any data is granted. This is a critical element of any secure digital foundation.<sup>41</sup>

### Box 2: Cybersecurity Trailblazers

A Forbes Business Insights report for VMware identified the key traits of the top 10% performing companies in terms of cybersecurity, termed Cybersecurity Trailblazers. These companies:

- Have their security teams involved in all key decisions that affect their IT technology stack from the very start.
- Have initiatives such as zero trust and least privilege as part of their security strategies.
- Ensure their people, processes and tools are well prepared to meet any security challenges.

As well as being better protected from cyber-attacks, these businesses also align their security posture to their business objectives such as maintaining their brand reputation, improving customer service and expanding their products and services.

Source: VMware<sup>42</sup>

## Cybersecurity and remote working

The cyber threat causes damage to the economy, livelihoods and the privacy rights of individuals. For these reasons alone it is rightly a preoccupation of industry and policymakers. However, it also threatens the ability of companies to safely implement remote working at scale and is therefore particularly dangerous in the context of our recovery. In powering the post COVID-19 recovery, the Government should prioritise secure digital foundations among public sector organisations and the broader business population.



# Virtual infrastructure and society

## Key points:

- Remote working could support increased internal labour migration, delivering benefits to the country in productivity and pay, as well as helping left behind towns.
- There are further potential benefits to be had around improving wellbeing and shifting the civil service out of London.
- Government has a role to play in delivering infrastructure – and given the benefits around remote working this should encompass ‘virtual infrastructure’.

The analysis in the previous sections around the gap in secure, digital capacity for businesses in the UK paints a stark picture. But the question remains – what, if anything, should the Government be doing to address this? We argue that the Government has policy levers that it can and should be using to improve the nation’s digital capacity, as there is the potential to secure major benefits for the economy and society.

## Government and infrastructure

The central role of Government is to provide for the public good. In addition to enforcing the law and providing public services, this almost always includes a major role in delivering public infrastructure.

The strict rationale for building one type of public infrastructure or another will vary considerably based on the specific case. Furthermore, the Government’s approach to delivering infrastructure has evolved over the years as the nature of our economies and societies have changed. Broadly speaking however, any justification will rest on satisfying three principles:

1. There are wider societal benefits attached to the delivery of the infrastructure. These are often economic in nature but can also be built around tackling social exclusion or reducing inequality.
2. Without Government intervention, the delivery of this infrastructure would be sub-optimal, and the full potential of the above societal benefits would not be realised.
3. Finally, value for money, or that the nature and scale of Government support for infrastructure must be proportionate to the benefits.

In some circumstances, such as transport infrastructure, Governments play a major role in directly financing and funding the infrastructure project through general taxation. In other cases, they may take a more strategic role in ensuring the policy and regulatory framework helps to unlock private finance for projects from utility companies, banks, and institutional investors.<sup>43</sup> Governments can also have a role in ensuring that the markets for the utilities which manage and deliver infrastructure function effectively for consumers.

## Building the UK’s network infrastructure

To explore a more concrete example, building strong digital infrastructure has been an objective of successive UK Governments. The National Infrastructure Assessment (NIA) in 2018 set out a target for Government of achieving Full Fibre rollout by 2033, stating that the additional bandwidth would be required to support greater household demand, as well as new technologies such as virtual reality, the Internet of Things (IoT), and connected and autonomous vehicles. The NIA also references analysis that previous investment in broadband infrastructure had strengthened economic growth, with OECD countries seeing an increased annual GDP growth of 0.9 to 1.5% for 10% increase in their broadband penetration.<sup>44</sup>

Following on from the recommendations of the NIA, the UK Government set out its analysis that, absent intervention, Full Fibre rollout would take another 20 years and only ever reach three quarters of the population. The speed and extent of this would not deliver the Government's objective of "world class digital infrastructure for the UK, with no part of the country being left behind."<sup>45</sup> Government has utilised the full range of its policy toolkit to support Full Fibre Rollout, as set out in Box 3.

Other countries have gone further on digital infrastructure, with Finland becoming the first country to establish access to broadband as a right in law for each of its citizens.<sup>46</sup>

### Box 3: UK Government policy and Digital Infrastructure

- **Digital Infrastructure Investment Fund** – this £400m investment by the Government is managed by institutional investors Amber Fund Management and M&G Prudential, and is designed to unlock a further £1bn investment from the private sector, all earmarked for Full Fibre rollout projects.
- **Gigabit Broadband Voucher Scheme** – grants of up to £3,500 for rural SMEs to upgrade their premises to Full Fibre broadband, subject to certain conditions.
- **Review of the Access to Infrastructure Regulations** – announced by Digital Minister Matt Warman in June 2020, this proposes to change the rules on the use of 'Passive infrastructure' to support Full Fibre rollout.

Various sources<sup>76</sup>

## Reconceptualising Digital Infrastructure

Delivering Full Fibre rollout and 5G are essential for our modern society, particularly in the context of seeking to grow our economy out of the COVID-19 crisis. However, powering a remote working revolution will require more than this. The benefits of a strong broadband connection will not be realised if an employer's data centre makes it difficult or impossible to access the systems and accounts someone needs to do their job. Indeed, our polling found that of those who expect to work from home after lockdown, a quarter said that a barrier to this would be 'difficulty accessing necessary files or accounts from employer's systems.' This was a more popular answer than poor broadband and mobile connection or lacking the necessary space and equipment at home.<sup>48</sup>

The Government has stated that there now exists "a new public infrastructure" which underpins safe and secure access to data, and that this is crucial to meeting its objectives around digital Government.<sup>49</sup> Along similar lines, the diagram on page 16 shows how we propose to expand the concept of digital infrastructure as also encompassing 'virtual infrastructure', meaning the digital foundations at the level of an organisation which underpin secure remote access.

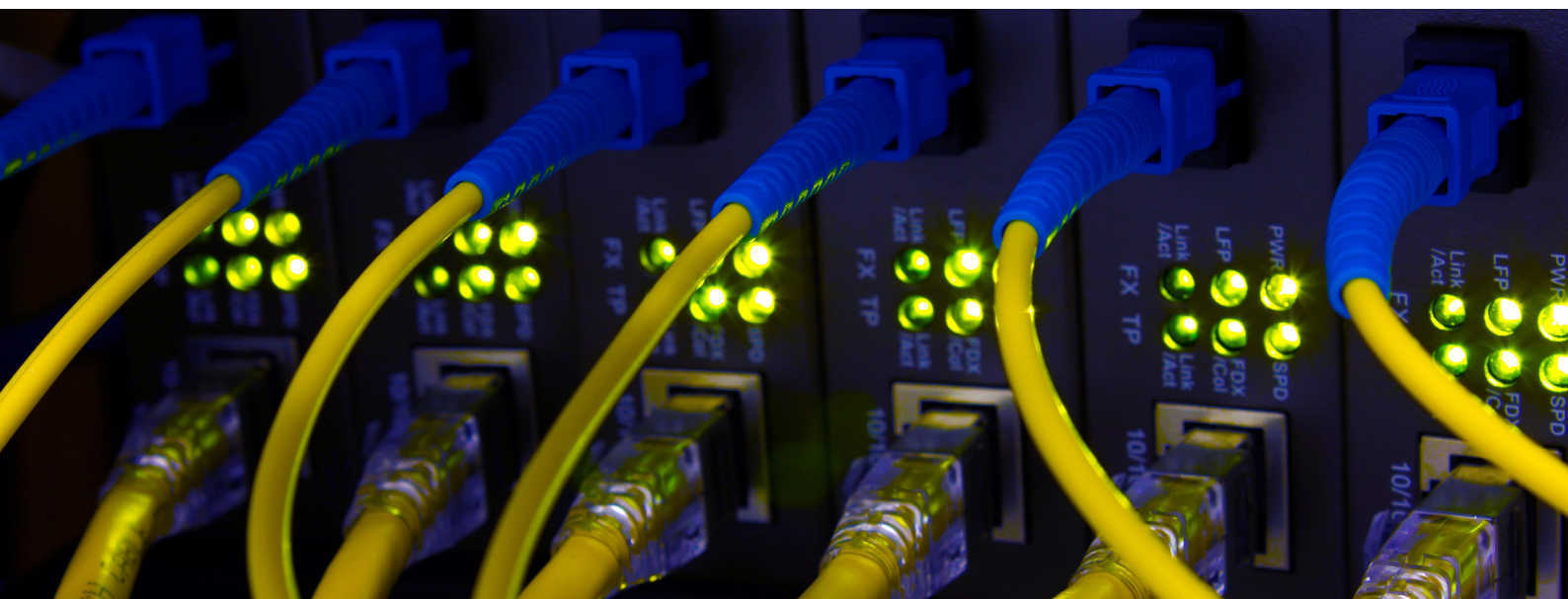
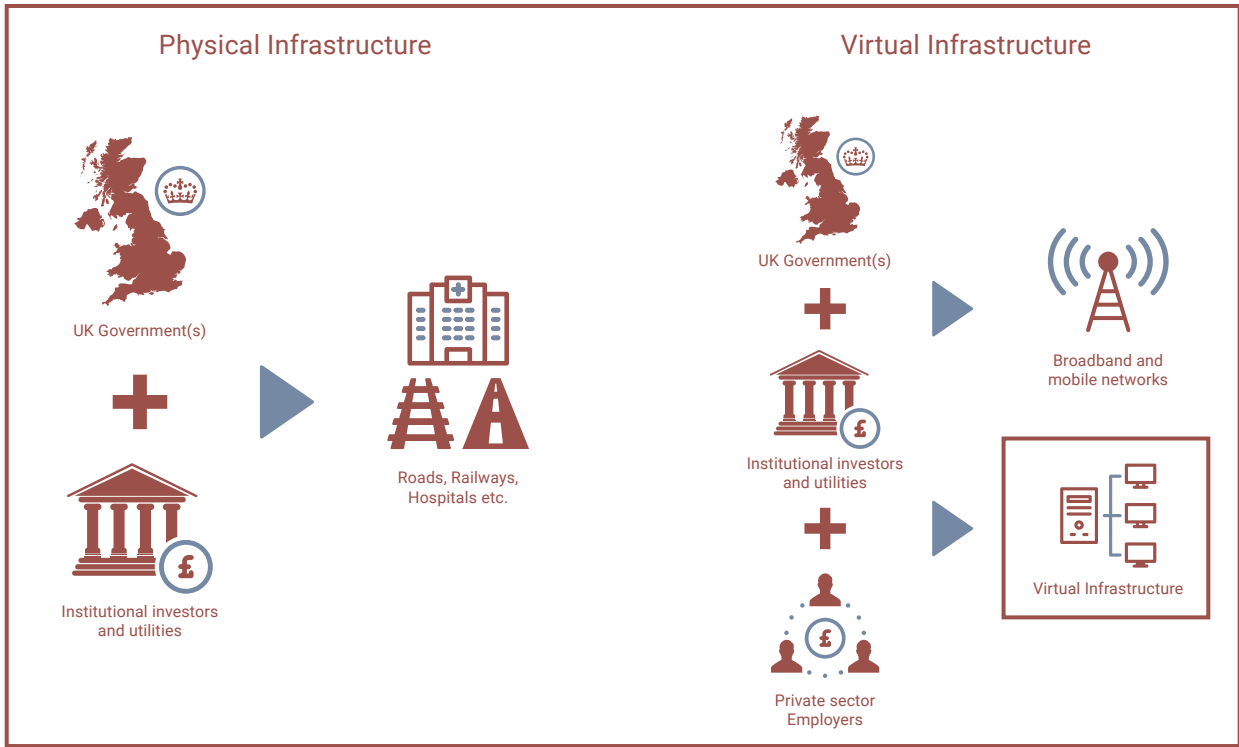
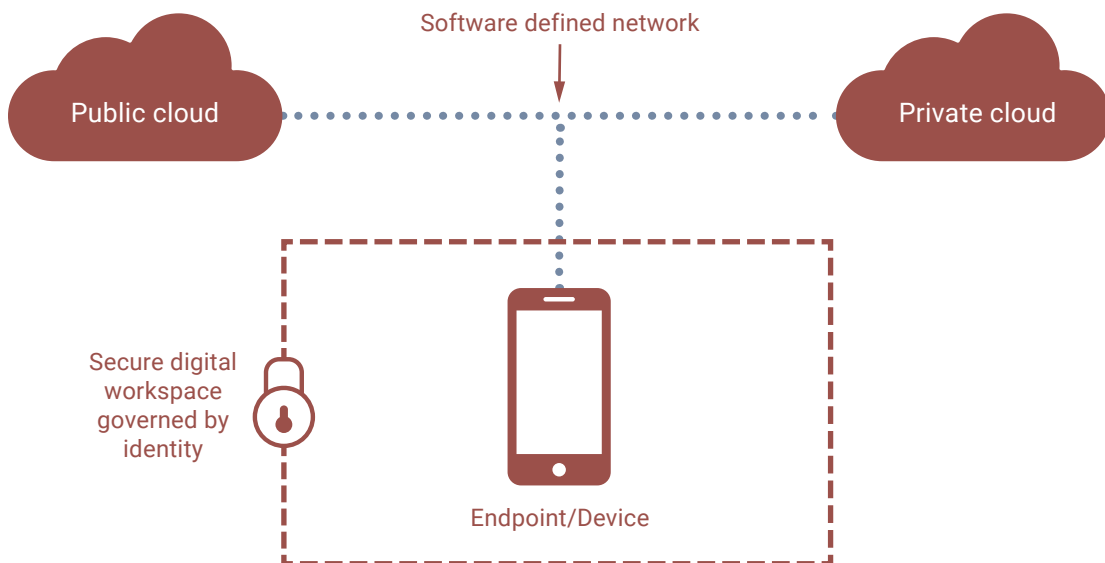


Figure 3: Virtual Infrastructure



Clearly, this is already an area which the Government has some responsibility for as an employer of public sector workers. Based on discussions with experts at VMware, this is also an area in which a lack of secure virtual infrastructure is especially pronounced. In addition to improving the virtual infrastructure of the public sector, we would argue that the Government also has a role in strengthening virtual infrastructure across the whole economy. In order to make this case, it is important to consider virtual infrastructure against the three principles at the start of this chapter, with the particular lens of adapting our economy and society to life after COVID-19.

Figure 4: Virtual infrastructure and remote working



## Remote working as the 'new normal'

The public believes the COVID-19 crisis will cause a permanent change to their working habits, and many will continue to work from home for a much longer period after lockdown. This has been confirmed by a range of sources:

- 45% of the workforce predict a permanent change to their company's approach to flexible working after lockdown.<sup>50</sup>
- A survey of financial market professionals by Deutsche Bank found that 57% thought they would work from home 1-3 days a week once the COVID-19 crisis had receded.<sup>51</sup>
- Deloitte found that 43 per cent of financial services staff expected to work from home for more than two days a week, up from 12 per cent who do currently.<sup>52</sup>

Our own polling carried out by Opinium confirmed these wider findings, with 64% of those who worked from home during the first lockdown stating that they expected to be working from home more frequently afterwards.<sup>53</sup> If supported correctly by policymakers, this is a shift that carries the potential for significant wider societal benefits, which we examine below.

## Labour mobility and productivity

This change in our working habits will in turn cause a fundamental shift in the geography of our country. Much of the data gathered during the lockdown suggests that people will use the opportunity to work from home more frequently in future to relocate to somewhere further from their office.

- Currently, two-thirds of employees (62%) live within 30 minutes of their workplace. However, according to ICM, if working from home was easier and more common this figure would reduce by half (to 36%) and instead two-thirds (63%) of workers would be willing to live up to an hour away from their office.<sup>54</sup>
- While two in five employees currently live in a city, YouGov shows that many of those currently living in cities (41%) would move out to more rural locations if they had the ability to work more flexibly.<sup>55</sup>

If people are more willing to live further away from their office due to remote working, it follows that they will likely also be prepared to work for employers within a much broader geographical range than they are today. In effect, labour will generally become more mobile and geographically flexible, without people needing to move home.

The degree of internal labour mobility is a little discussed but crucial indicator of the success of modern economies. The extent to which people move between jobs and different regions to suit where their skills are most needed is an essential contributor to their productivity, and consequently their pay. This is particularly true when jobs are taken up in more densely populated, more productive parts of the country.<sup>56</sup>

One would assume from the general tone of the policy debate that labour mobility between regions of the UK is higher than ever before. In fact, while it is substantial, it has fallen considerably in recent years among young and renting graduates who have historically always made up the greatest proportion of regionally mobile workers.<sup>57</sup>

Some of the causes of this are relatively benign – the gap between the job and earnings potential of different local authority areas in the UK is in decline. However, there is also evidence that the housing market has a role to play in deterring graduate workers from taking up work in high pay, high productivity areas. In particular, costs in the private rented sector have grown faster in higher productivity areas than other parts of the country, meaning that any pay increase that could be secured from moving region and job is swallowed up in additional housing costs. To put it another way, the differential in earnings after housing costs between local authority areas is getting smaller, reducing the incentive for people to move to jobs in other areas which are more suited to their skillsets.<sup>58</sup> This is bad for the workers themselves, and also has the knock-on effect of damaging the UK economy's overall productivity, which is one of the worst in the OECD.<sup>59</sup>

By significantly increasing the geographical reach of workers and businesses, remote working could provide a route for people to take up new jobs in different local authority areas without having to take the hit of increased housing costs. This could encourage greater labour mobility, improve productivity and give Britain a pay rise as a result.

### Levelling up our towns

While it is common to talk about the economic imbalance of the country in terms of pay and job opportunities as a matter of a north/south divide, the truth is more complex.

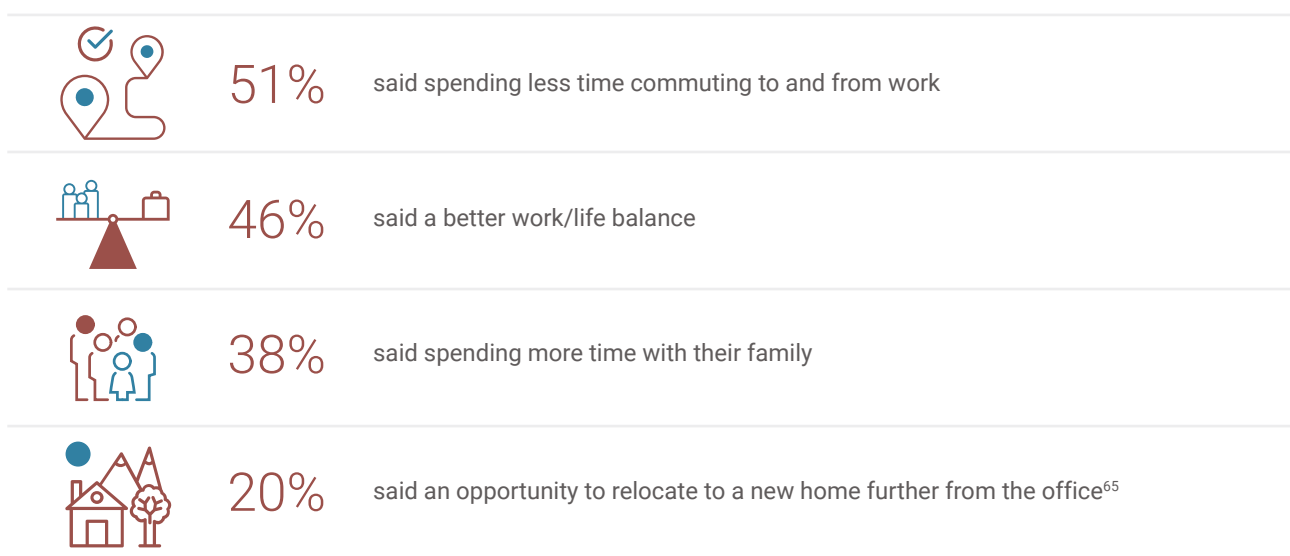
There remains a stark contrast between London and the rest of the country. However, in recent years, there has been a marked improvement in the economic performance of northern and midlands cities such as Nottingham and Manchester, while the economies of towns have been left behind.<sup>60</sup> This gap also appears stark in the context of the COVID-19 recovery, with analysis by the Centre for Towns in February 2020 predicting Gross Value Added (GVA) to grow at 2.2% on average per year in the largest cities, compared with 1.6% average growth for towns.<sup>61</sup>

While no panacea for addressing the imbalances of regional economies, the greater geographical range potential of labour that would be created by more remote working could ensure that the benefits of growth in cities are spread more widely. Those working in high productivity, high pay organisations that are based in cities may be more likely to live further afield in relatively underperforming towns. Indeed, polling found that the number who would live in seaside towns could double if remote working were easier.<sup>62</sup> These areas could therefore benefit from the additional consumption associated with having more high earning professionals living there, and go some way to challenging the relative population decline in our nation's towns.

### Wellbeing

The lockdown has had a demonstrably negative impact on the public's wellbeing and mental health. This is unsurprising given the strict limits placed on our choice of activities, opportunities to socialise with others, as well as our ability to plan for the future.<sup>63</sup>

As previously set out however, home working is one element of the lockdown that people appear keen to continue, at least to a limited extent, once other freedoms they previously enjoyed have been restored.<sup>64</sup> In Opinium polling commissioned by WPI, we asked people who expect to continue working from home following lockdown what the benefits of this were, and outcomes which are closely related to personal wellbeing scored highly.



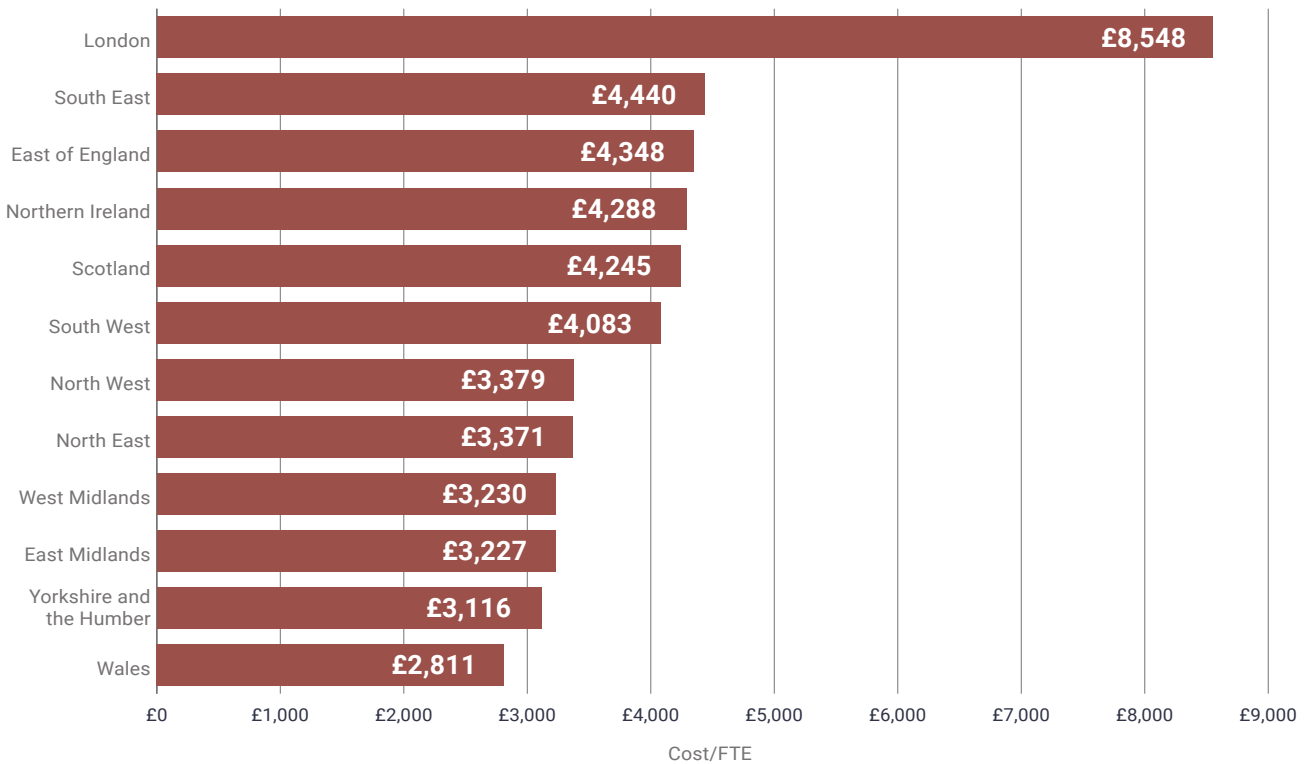
This suggests a potential for population wellbeing benefits from having flexibility with regard to remote working across all businesses, supported by the right infrastructure.

## Reducing the size of the Whitehall estate

The Government has made the efficient use of its estate a key element of its objective to deliver value for money for taxpayers. In 2017-18 alone, hundreds of millions of pounds was generated for the exchequer from the sale of old Government buildings. In the past 10 years, the size of the Government estate fell by a third.<sup>66</sup>

In particular, the Government has stated an objective to move large elements of the civil service out of London, where its presence remains heavily dominated.<sup>67</sup> The drivers here are the levelling up agenda of seeking to spread highly paid workers throughout the country, and the fact of the sheer cost of maintaining office space in the capital (Fig 5).<sup>68</sup>

Figure 5: Public sector office cost (£) per person, per year by region



Remote working at scale could help to free up office space and enable the Government to sell off more disused properties to benefit the taxpayer. We know from experts at VMware that the troubles faced by public sector organisations in responding to the COVID-19 crisis suggests that the digital capacity to support this is not yet in place. Secure remote working can be delivered at a comparatively low cost, and so the potential savings that could be realised by Government are huge when compared to the current cost of office space, especially in London.

## Green Growth

In considering how to support economic growth as we emerge from the crisis, it is vital that any policy and commercial solutions support the UK's ambitions of an economy with net zero carbon emissions. The Prime Minister has committed the Government to delivering green growth, and since the lockdown first began measures have been set out to improve the energy efficiency of Britain's homes,<sup>69</sup> as well as to decarbonise energy intensive parts of the economy such as the heavy industry and automotive sectors.<sup>70</sup> There is strong public support for a green recovery, with a climate assembly backed by six parliamentary select committees, and made up of people designed to be representative of the population at large, declaring their overwhelming support for a greener economy post COVID-19, and suggesting that employers in particular had a responsibility to support employee lifestyle changes which cut emissions.<sup>71</sup>

Many organisations, such as the Committee on Climate Change (CCC) and Green Alliance, have highlighted the potential for increased home working as a positive long term behaviour change that can help deliver the UK's objective of net zero carbon emissions.<sup>72</sup> Surface road transport is a major contributor to the UK's carbon footprint, representing around a quarter of the UK's emissions in 2018. It is also an area where progress in emissions reduction has been limited, with emissions from motor vehicle transport having barely improved compared to 1990. This has happened because progress on improving the technical emissions performance of cars has been offset by large increases in motor vehicle traffic, which now stands at over 500bn vehicle kilometres a year.<sup>73</sup> There is a strong green case for policies which reduce commuting and the use of road vehicles as a result. Better digital infrastructure is needed to support more home working and reduce levels of motor vehicle traffic. As a result, Government support for virtual infrastructure makes not just economic sense, it is fundamentally a much greener policy option in comparison to investing in traditional infrastructure such as roads.

### The UK data centre market

The UK data centre colocation market is one of the country's commercial success stories, with the UK boasting the largest market in Europe. The sector in the UK is expected to reach a size of £6.2 bn in the coming years<sup>74</sup>, with regional clusters present across the country including in Slough, Cardiff and Manchester.<sup>75</sup> Due to the UK's comparative advantage in this space, it is likely that any measures which lead to greater domestic demand for data storage services will cause higher revenue for UK based operations. This could help to strengthen the growth of the data storage sector in the UK even further.





# Conclusion and recommendations

The analysis in this report demonstrates the need for better virtual infrastructure in the UK, by setting out the gaps that exist at present and the benefits of addressing these.

As discussed, the key first step for Government is a conceptual shift towards recognising that laying Full Fibre cable and erecting 5G masts are only one part of the equation when it comes to building strong digital infrastructure for a post COVID-19 economy. Also crucially important is the nation's virtual infrastructure – meaning secure remote access to data and applications in individual businesses and organisations. The Government should take a strategic role in supporting the take up of this infrastructure across the economy to secure the benefits set out in the previous chapter.

## Virtual infrastructure across the public sector

The first step is for Government as an employer to take the lead and significantly upgrade its own virtual infrastructure, by investing in Government departments and agencies to ensure that ultimately all desk based public sector workers can securely and remotely access their data and applications at any time, from any device, anywhere. We know from experts at VMware that there are shortcomings in this part of the economy, as evidenced by the difficulties experienced by many organisations in implementing remote working at scale in response to the lockdown.

In a time of a large hit to the Government's fiscal position, such a move would represent good value for money. For a relatively small ongoing payment for technology and equipment costs, Government could move large numbers of public sector workers to full or part time remote working, supported by reliable and secure technical solutions. This would allow for the elimination of swathes of Government office space which, given the £8,548 cost per head per year for office space for a London based public sector worker,<sup>77</sup> would deliver large savings for the taxpayer. As well as this, such a move could also be used to support a more even distribution of higher paying public sector jobs around the country, driving more income, wealth and consumption to towns in the north and midlands whose economic future is regarded as a priority by this Government.

## Strengthening digital foundations in the private sector

As the option of remote working is insisted upon by more employees to improve their wellbeing, and needed to level up the country and deliver green growth, it is right that the Government considers the virtual infrastructure of private sector companies as an issue of public interest and acts accordingly.

This is a more complex area for Government than simply providing the capital for public sector organisations to invest in virtualisation and cloud services. However, Government does have a record of taking an interest in the technological capabilities of private businesses where there are clear policy reasons for doing so (Box 4), and feel that a strong case can be made.

Ultimately, it will be for Government, under advice from the National Infrastructure Commission (NIC) to decide on what is most prudent in supporting businesses to upgrade their virtual infrastructure, but the crucial first step is a shift in the NIC's remit to recognise this new conception of digital infrastructure as a priority area which must be addressed by policy and with Government investment. Specifically, we recommend that a voucher – along the lines of the Cyber Essentials grant described in Box 4 - be provided to all, or a subset, of businesses to fund vital upgrades to the virtual infrastructure of the business population.

The voucher could cover a range of costs required to support remote working at scale. It could be limited to costs around technologies such as virtualisation and the cloud which allow remote access to data and applications, as well securing the transfer of data. More radically, it could help support a fundamental reimagining of the boundaries of corporate infrastructure, by supporting costs that improve the home environment as a workspace more generally, such as tools to improve internet connection and manage traffic.

Whatever the precise mechanisms used to strengthen public and private virtual infrastructure, this report has highlighted that secure remote working at scale has the potential to bring about a range of benefits around levelling up, improving productivity, delivering net zero, and saving the taxpayer hundreds of millions of pounds in public sector real estate costs. As a result, it is vital that the Government introduces policy solutions which harness the disruptive potential of how we live and work after the crisis.

#### Box 4: Cyber Essentials grant scheme

Cyber Essentials is a Government backed accreditation scheme which allows a business to demonstrate a baseline level of cybersecurity. There are two levels of certification – Cyber Essentials (which is based on a firm’s questionnaire responses) and Cyber Essentials plus (which is based on actual tests of a firm’s IT security systems). Cyber Essentials Plus certification can be a requirement for certain Government contracts, and can also be taken into account when pricing a firm’s cyber insurance premiums.

Both the UK and Scottish Government have made grants available in the past of up to several thousand pounds to support the cost of the assessment required to obtain Cyber Essentials plus certification, with the Scottish Government’s grant scheme ending earlier this year.

Various sources<sup>78</sup>

Our recommendations in full:

1. The Government should take the lead in significantly upgrading its own virtual infrastructure.
  - a. We recommend that the Government invests in departments and agencies to ensure that ultimately all desk-based public sector workers can securely and remotely access their data and applications at any time, from any device, anywhere.
2. The Government should actively support the strengthening of virtual infrastructure in the private sector.
  - a. We recommend that the Government update the National Infrastructure Commission’s remit to recognise this new conception of digital infrastructure as a priority area which must be addressed by policy and with Government investment.
  - b. We recommend that a voucher – along the lines of the Cyber Essentials grant – be provided to all, or a subset, of businesses to fund vital upgrades to the virtual infrastructure of the business population.

# Technical Annex

The below shows the process we went through in order to calculate the figures on cyber losses and furlough expenditure.

## Cyber losses

We used the following sources to calculate our figures:

- Median losses from all attacks for businesses who experienced them (whether they resulted in a breach or not) from the Hiscox Cyber Readiness report 2020. This is broken down by size of business as well as by country.
- Proportion of businesses identifying any breaches, by firm size, from the DCMS cyber breaches survey.
- Increase in attack frequency as a result of COVID-19. This was taken from the data on the increase in ransomware attacks between January and May 2020 captured using the VMware Carbon Black cloud. We provided a range of 9% to 27% as the figure of 18% we received from VMware only showed ransomware, as opposed to all different types of attacks.

## Furlough bill

The polling we commissioned by Opinium suggested that, of those furloughed at some point during the lockdown, around 20% said that their reason for being furloughed was that their employer lacked the IT infrastructure to support remote working. This would indicate that 20% of the estimated £60 bn bill would be incurred as a result of poor IT infrastructure, or £12 bn. However, we think it is reasonable to assume that those who were furloughed for IT reasons were likely furloughed for a shorter period than other groups (such as those whose industries were effectively shut down for a period). As a result, we have conservatively estimated that the actual cost is only 50% of this, and so have used the figure of £6 bn.

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