Part 1:

Vodafone Response to Ofcom's Call for input on mobile RAN power back-up

March 2024

Part 2: Vodafone's Response to Ofcom's Consultation on Revised Resilience Guidance begins on page 13

Summary

- The primary responsibility for ensuring the reliability of the electricity grid rests with licensed Distribution Network Operators (DNOs) who own and operate the UK network. The single most effective step to improve the reliability of the UK's mobile and fixed communication networks is to better assure the power grid, making it more robust and better able to withstand weather events, while simultaneously improving processes to prioritise mobile sites for restoration should power be lost.

- When the roof leaks, it is better to focus resources fixing the roof, rather than buying buckets. Each pound spent at source on improving the resilience of the electricity grid is likely to be far more effective at safeguarding consumer welfare, than any pound spent on mitigation measures in UK mobile networks. DNOs have recently embarked on a £20BN investment programme to harden the grid. Therefore any resources devoted to mobile power resilience measures need to be proportionate.

- Mobile networks are radio networks that have infrastructure in exposed, elevated locations to maximise coverage quality and usability. These exposed locations are vulnerable to the impact of bad weather. At a practical level, this restricts the ability of mobile networks to act as a network of last resort, with the fixed network often better placed to perform this role.

- The move to digital voice and the resulting lack of power autonomy in the fixed network has put more focus on UK mobile networks, however even in a fixed digital voice environment, the fixed network can function during a power cut, provided consumers can back up their router and ONT. Wider use of small in-home battery units may offer a sensible route to improving communication network resilience to those who value it (and who can fund it directly) or those who need it (landline dependent customers, including Telecare users), who get a BBU supplied by their provider.

- We would caution Ofcom against seeking to conflate the clear public policy question of what level of backup connectivity is desired for public good and the telecoms regulatory question of what threshold of power autonomy must be delivered if MNOs are to be compliant with s.105A-D of the Communication Act. While they may appear similar questions, they are not the same.

- Ofcom must take a technology neutral stance to the issue of resilient connectivity and not prescribe a specific technology solution (e.g. advocating batteries at all RAN sites), leaving that decision to individual providers. Ofcom must remain open to the use of all technologies, including the use of direct to device satellite, which could transform the technology approach to resilience communications within the decade.

- Any cost benefit analysis conducted by Ofcom needs to follow the robust protocols set out in Ofcom's July 2023 Impact assessment guidance[1]. It must consider the effectiveness of first order DNO (and National Grid) resilience spending to assure the electricity grid in comparison to any available second tier MNO mitigation measures. It should consider the adverse impact of funding displacement (with money spent on batteries not spent on 5G investment and other innovations). It also needs to consider the environmental consequences of battery deployment and eventual disposal, as well as alternative measures for resilient communication, including direct to device satellite and the assurance steps possible in the fixed network to maintain its role of network of last resort.

- It is not realistic to expect a full-service mobile experience when grid power is lost. The migration of large amounts of fixed traffic can create mobile network congestion, increasing power consumption at the very time when it should be preserved. A basic, emergency 999 voice/SMS service should be the priority, with all other services provided on a best-efforts basis.

- The best way to improve RAN resilience is to make the power grid more robust. Any alternative mitigation measures require external funding as there are insufficient resources within the sector. Ofcom should be mindful of creating additional obligations in isolation. Due account must be taken of any wider Government initiatives, including the National Infrastructure Commission 2030 project on resilience standards. Funding is a key consideration. Australia and Norway offer best practice examples of state supported MNO resilience. In the alternative, a broad shoulders, cross-sector fund, involving digital platforms maybe worthy of consideration.

[1] https://www.ofcom.org.uk/__data/assets/pdf_file/0034/264697/Statement-Impact-Assessment-Guidance.pdf

Introduction

1. UK businesses and consumers expect reliable communication networks. Our customers depend upon us, and we take great care in delivering a reliable network experience. While it is impossible to avoid all service interruptions, we strive to minimise them. If things do go wrong, we seek to recover quickly and learn.

2. We cannot afford to be complacent, and we continue to recognise the magnitude and range of threats we face each day. From cyber-attacks by hostile state actors to severe weather impacting our sites or the availability of grid power. The threats faced are constantly evolving, so our approach must adapt. We remain vigilant and ever mindful of the need to safeguard the resilience and reliability of our network in all that we do, maintaining our part of the United Kingdom's digital front line for the benefit of our customers and the country.

3. All the work we undertake in maintaining our network resilience is currently funded on a commercial basis without any state or cross industry support. Today, resilience spending on assuring the network has to be found from within existing resources. Building in resilience is an expensive activity and it is inevitable that sensible trade-offs have to be made. Spending very large amounts of capex to safeguard against what may be a 1 in 50 or 1 in 100-year event as a 'just in case' isn't realistic. Certainly, the commercial realities of our market would prevent this money from ever being recovered and would make our services unaffordable to consumers. Instead, we must allocate a finite amount of our budget to sensibly assuring our services, balancing the risks we face with commercially affordable mitigation measures. Despite these resource constraints, we have succeeded in reaching a very high standard in terms of network resilience and service availability.

4. If we are asked to do more, taking on any additional public policy aspirations to provide a public good level of resilience, then we need access to a fair funding settlement. We operate in a highly competitive market with very constrained margins. The financial health of our sector has rightly been a recent area of focus and concern for Ofcom. Absent reform, the current framework doesn't permit any latitude for increasing resilience spending beyond that delivered today. If Ofcom place new obligations upon us without funding support, it will deprive the sector of investment elsewhere, with money diverted away from new services and innovations that could benefit consumers, notably in 5G investment and network transformation.

5. Significant unfunded capex demands have already been placed on our business following the introduction of the Telecoms Security Act, with vendor equipment removed well before the end of its useful economic life. This has all been funded by UK MNOs, with no state funding in the UK. In contrast, in the United States, a federal reimbursement programme was introduced to compensate operators[2] and French providers are now seeking recovery of the costs via the courts[3]. With this backdrop, it is essential that the end output of this project considers not only what, if any, additional mitigation measures might be desirable, but in parallel, sets out how these enhancements are to be paid for, with a fair funding solution delivered alongside. It is our firm view that any new public good resilience obligations without fair funding support are not realistic and will result in long term damage to the UK mobile sector. The competitiveness of the market and long term MVNO deals prevent these costs from being recovered from consumers directly. The increasing dependence of the whole UK economy on connectivity means that there are very clear arguments for external funding to support public good levels of connectivity resilience. Funding any enhancements to mobile network resilience needs broad shoulders, and the UK mobile industry is not sufficiently resourced to deliver it without external support.

[2] https://www.reuters.com/technology/us-needs-3-bln-more-remove-huawei-zte-us-networks-regulator-says-2022-07-15/
[3] https://www.telecomreview.com/articles/telecom-vendors/6954-two-french-telcos-seek-compensation-for-replacing-huawei-kit

We need a joined-up approach: Ofcom, Ofgem and Government together with industry

6. The issue of resilience is a cross sector one and it is right that Government and regulators spend time and effort improving their understanding of the topic, taking steps to ensure the UK is better equipped to handle what might be thrown at us. This is a broad topic, covering supply chains, through to the interdependencies between critical national infrastructures. The National Infrastructure Commission[4] has initiated a project on resilience standards across the energy, transport, digital and water sectors, with the Cabinet Office committed to setting out formal resilience standards for these sectors by 2030.

7. Communication networks and the UK power grid have a very high level of interdependency. Communication networks need grid power to function as intended and the power networks need communication networks to manage their network through remote telemetry and field force co-ordination. In the power industry, given their absolute monopoly position, the Distribution Network Operators (DNOs) can factor in resilience assurance costs within their long-term financial planning and have the head room for those costs to be recovered across the market. In the communications sector, no such funding mechanism exists, with resilience spending having to be sourced from existing constrained margins.

8. Funding support is likely to be a matter for Government (either through direct funding or establishing the legislative basis for a cross-sector broad-shoulders fund). It would not be appropriate for Ofcom to act in isolation by placing unfunded additional obligations on the UK mobile sector. Such action would harm the welfare of the sector, being detrimental to the consumers who rely upon it, as they are likely to miss out on wider network investment in enhanced services like 5G SA. A joined up, cross sector approach is required, one where Government and all relevant sector regulators take co-ordinated steps to improve resilience at a practical level (for example DNO prioritisation restoration for mobile sites). There are likely to be many beneficiaries for mobile network resilience, these include not only consumers, but Government (local and national), large digital platforms, cloud providers and indeed the energy sector itself.

9. As DNOs are critical consumers of connectivity services themselves, a synergistic approach is therefore desirable. It would be very inefficient and result in the creation of material disincentives if Ofcom were to facilitate the power industry building their own single purpose communications networks, with the allocation of DNO direct spectrum on a justification of a lack of power resilience in public mobile networks.

Reliable Grid Power is Key

10. On the whole, the UK grid power has proved very reliable. Outcomes like that experienced following Storm Arwen in November 2021 are thankfully very rare. The best performing DNOs experience an average of around 13 'customer minutes lost' per annum and the worst performing 56 customer minutes lost per annum. This is before any funds are spent by DNOs to improve electricity network resilience. DNOs currently have a 5-year network improvement plan in place[5], funded through the regulated prices, with a bonus scheme in place for exceeding targets. £20bn has been ear-marked for this activity and will drive improvements in both the reliability and the speed of restoration of the UK power networks. When funds are directed to harden the energy network, consumers benefit from the greater availability of all services, not just mobile connectivity. It is in this context that we do not believe it would be proportionate or sensible to equip tens of thousands of UK mobile sites with additional battery back-up capacity to cope with such infrequent outages, which will hopefully reduce even further with greater levels of DNO investment and proactive maintenance.

11. There must be recognition that longer outages, such as those experience with storm Arwen are unlikely to benefit from MNO battery investment. The outage period experienced in such localised outages, would be far longer than any practical battery duration. In these situation, tactical emergency generator deployment is used to restore connectivity in the period before the grid is restored.

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[4] https://nic.org.uk/themes/regulation-resilience/
The UK Government Resilience Framework (HTML) - GOV.UK (www.gov.uk)

[5] https://www.ofgem.gov.uk/publications/ofgem-reveals-landmark-five-year-programme-deliver-reliable-sustainable-energy-lowest-cost-consumers

Restoring Power to Mobile Site more Quickly

12. One key practical step that could be taken now is to develop better plans to restore power networks more quickly. This will include, where appropriate, prioritising restoration of power to affected phone masts (and associated backhaul transmission sites), so that power companies can not only communicate with their workforce on the ground but also communicate with their customers (particularly via SMS). Most importantly, consumers would benefit from continued access to friends, family, and, if needed, emergency services. Vodafone are currently participating in a winter trial with National Grid Power in Cornwall to test out priority site restoration. We are keen to see Ofcom, Ofgem and Government get behind this approach to ensure it happens. We believe there would be a high degree of support amongst consumers for their communication services to be restored as a priority after a power cut occurs. It also allows the DNOs to communicate directly with their consumers and advise them of restoration times and any sensible action they should take.

Network of last resort

13. The fixed copper network has historically fulfilled the role of network of last resort. It maintained a 50v supply that remained independent of grid power, allowing landlines to function during power outages. The infrastructure to support this was funded from across the industry, via a regulatory charging model that built in the cost of this resilience within the cost stack, shared by all providers. The migration to fibre and with it the introduction of digital voice means that this power autonomy is lost. If it is to be replicated, at least in part, then consumers would need to install battery units to back up their routers at home.

14. For those users reliant on digital voice services who do not have in home battery back-up units, the advice remains to use their mobile device, however Radio Access networks have never been designed to perform the role of network of last resort. Many would argue they are ill-suited to this task, as they are configured using infrastructure placed at a vulnerable elevation to maximise coverage, while simultaneously exposed to the elements. In the event of severe weather this positioning increases the chances of damage or disruption. While kit design and strength has improved over the years, it is not infallible to the wrath of mother nature and the option of locating kit in more sheltered locations isn't practical for mobile, with elevation exposure crucial to maximising coverage and the accessibility of services. Even if a power autonomy solution is deployed at a site, there remains a dependency on the backhaul provider matching this power provision in their backhaul configuration to ensure connectivity to the site.

15. In a digital voice environment, the fixed network can still play a significant role in providing resilient communications. There needs to be far greater awareness around the availability and functionality of in-home Battery Back-up Units (BBUs) and the adoption of these units should be encouraged by those consumers who would value them. A growing number of in-home BBUs are now available, with more on the market soon. Many now offer the ability to charge mobile handsets. This option is open to all consumers on a self-provided basis. BBUs are also typically provided by fixed providers free of charge to digital voice consumers who are considered landline dependent. These units can be self-funded and available for less £100 and typically power routers and ONTs for a period of 4 hours or more. This is more than the duration of the typical UK power outage.

UK Mobile is insufficiently funded to deliver Enhanced Public Good Resilience outcomes

16. In mobile, the ROCE problem is acute. Ofcom's own research highlights the severe funding challenges the sector faces, characterised by low returns and severely constrained investment capex[6]. These capex constraints manifest themselves in challenges for 5G rollout (offering standalone 5G over a wider footprint). Any additional resilience

[6] https://www.ofcom.org.uk/__data/assets/pdf_file/0036/248769/conclusions-mobile-spectrum-demand-and-markets.pdf *Overall, significant investment in mobile networks will be required to increase capacity and provide the network quality needed to meet future customer needs. This is in addition to the need to deliver the Shared Rural Network (SRN) and the new regulatory provisions set out by Government to improve network security....*We recognise though, that the current economic climate creates greater uncertainty and challenges to financial performance. This may dampen MNOs' incentives to invest and could slow down the rollout of 5G.

spending makes an already challenging situation significantly worse. There is hard evidence from the South African experience, that money diverted by the mobile industry to minimise the impact of routine load shedding on the power grid has damaged investment in 5G and coverage[7], with investments earmarked for 5G, having to be diverted to battery deployment.

17. Ofcom must not confuse the wider public policy question around what level of power autonomy / network resilience we should aspire to for UK mobile networks (which is a matter for Government and Ofcom) and the separate regulatory compliance question of what threshold must be achieved in order to be compliant with s.105A-D of the Communication Act. These are very different questions. In part Ofcom has acknowledged this fact in its reference to the public policy aspirations needing to be addressed by solutions that may lie beyond the current regulatory and legislative framework. However, there remains a danger that these two separate issues get conflated, leading to regulatory failure.

The Importance of Remaining Technology Neutral

18. There is a danger that in setting out any specific recommendations or obligations, Ofcom is compromising its technology neutrality. By specifying power autonomy durations at cell sites, Ofcom risks favouring a battery-based solution that is both costly and environmentally destructive. It should be left to UK mobile networks to decide how they should configure their networks and Ofcom need to be alive to the possibility of new technology and service innovation playing a much greater role in the future when it comes to delivering resilient communication outcomes. The use of direct-to-device satellite technology has the potential to transform our ability to communicate in circumstances where grid power is lost. In respect of battery provision at RAN sites, it is not just a question of cost, there are number of practical and operational issues that need to be recognised, including:

- Space: battery strings (Lithium or lead acid) take up significant amounts of space that isn't available in all cell sites. Expensive new exterior cabinets (and associated hard standing) might be required (involving additional planning and landowner consents). However some sites have no scope for expansion;

- There are weight limits that make heavy battery deployment impossible at certain roof top locations;

- Given their cost and multiple use capabilities, batteries are often subject to targeted theft, raising the risk of further site damage and vandalism associated with unlawful entry. The added temptation of a greater number of high value batteries on site is likely to cause an increase in these types of incidents. There is an elevated risk of collateral damage to communications kit, with tools like chainsaws, angle grinders and bolt cutters being used at the site, damaging sensitive equipment. ✂.

- Battery performance degrades in colder weather, often at the very times when batteries will be called into use (coinciding with peaks winter storms season);

- Lead Acid and Lithium have a limited lifespan, and need to be carefully disposed of at the end of their life. Lithium also needs to 'cycle' regularly (draining to ~30% and re-charging) to maintain its lifespan. If a power cut occurs during a cycle, then the battery may not be in a fully charged state, limiting the period of power autonomy at the site.

- Lead Acid batteries need to be kept at an optimum temperature to preserve their lifespan. This in turn means sites with large battery strings need to be equipped with air-conditioning to regulate temperature. This negates the use of free-air cooling (which runs our equipment at a far higher ambient temperature). If large battery

[7] https://www.reuters.com/business/media-telecom/south-africa-fights-keep-phone-networks-up-lights-go-out-2023-04-05/

strings are to be deployed then A/C becomes necessary, driving up capital costs and operational costs (higher electrical consumption).

- The established UK Rota disconnect protocols for load shedding in the UK at their higher levels of intensity might not allow sufficient time for batteries to recharge, limiting their usefulness. This problem has been experienced in South Africa, in periods of more intense load shedding.

19. There are recognised global supply chain problem with lithium[8], with scarcity adding to its costs. Lithium demand is expected to increase, with growing demand from the automotive sector. Even with access to unlimited funds, lithium battery deployment would take many years to accomplish and not be possible at all sites (such as those located in street furniture and rooftops).

20. Vodafone through its partner AST (Vodafone has an equity stake in AST) is currently exploring direct-to-device satellite services, which could be used when the terrestrial network is down to provide back-up connectivity. These innovations aren't decades away, they are a credible option that, provided funding is available, could offer a safeguarded connectivity experience before the end of the decade[9]. A direct to device satellite experience would be far more cost effective, offer wide coverage and be far more environmentally sound.

21. There may be ways to reduce the overall cost of battery deployment, by unlocking revenue opportunities through energy trading, utilising suitable sites for Distributed Energy Storage. The number of sites where such deployments are realistic needs to be established and while it can help to reduce costs (providing a revenue stream), it is unlikely to come close to delivering any form of financial self-sufficiency. ✂ From an operational perspective, should energy trading activity deplete the available energy retained in batteries and an unexpected power cut occurs, the usefulness of the battery deployment comes into question. While energy trading may be paused when storms are anticipated, not all power cuts can be predicted. Should this concept ever by introduced at scale in UK, it would likely need Government backing and financial support.

Environmental Considerations cannot be ignored

22. The environmental impact of any solutions needs to be carefully considered. While Ofcom does not (yet) have any statutory duties to consider the environmental consequences of its decisions, Vodafone has very clear fiduciary and environmental commitments that would make it difficult for us to adopt certain technology approaches. We have pioneered renewable power solutions, including the Smart Flower[10] and self-powered masts[11], which harness the power of the wind to boost mobile site power autonomy. We are very keen to minimise the use of diesel generators. They cause CO2 and noise pollution and therefore cannot be used extensively. Mobile providers should be free to select the solution they feel suits their circumstances, network and site configurations best. They must be free to innovate and adapt their approach to complying with s.105A as they see fit, and Ofcom must remain flexible around how it judges compliance.

23. Ofcom must remain mindful not to define technology specifics and instead focus on ideal outcomes to form recommendations (eg. emergency 999 voice and SMS access for X period). If these recommendations exceed today's commercial outcomes, then Ofcom need to identify, with Government the external funding source for this elevated public good level of resilience in UK mobile networks.

[8] https://www.weforum.org/agenda/2022/07/electric-vehicles-world-enough-lithium-resources/
[9] https://www.vodafone.com/news/technology/ast-spacemobile-unfolds-communications-array
[10] https://www.vodafone.co.uk/newscentre/planet/how-the-smartflower-converts-solar-energy-into-electricity-all-day-long/
[11] https://www.vodafone.co.uk/newscentre/videos/vodafones-new-self-powering-mast-goes-live/#:~:text=Vodafone%20switches%20on%20the%20UK's,in%20remote%20and%20rural%20areas.

Why a Fair Funding approach doesn't mean fair share.

24. After detailed consideration, should any enhancements to power autonomy at mobile sites be considered appropriate by Government and Ofcom, then access to fair funding will be necessary. This may involve contributions from Government and potentially large digital communications platforms. The funding approach shouldn't be conflated with the European fair contribution debate[12] which is centred on the need for digital platforms to contribute towards the cost of the network resources their services consume, thus creating a more equitable two-sided market approach to network capacity funding.

25. ✂ Effectively it is the cost of a network resilience insurance policy that benefits a wide range of stakeholders outside the mobile industry. Funding the gap between the commercially funded resilience outcome that we have today and any public good one that may be desired by Government and Ofcom is not something Mobile providers would willingly undertake, and it would not occur absent the introduction of specific requirements. Due to the highly competitive retail mobile market model (including long term wholesale deals with MVNOs), MNOs would be unable to pass on the cost of this to consumers. Instead, planned innovation and network investment spending would have to be redirected to meet the unfunded obligation, harming consumer welfare.

26. Mobile providers would therefore benefit little from this forced expenditure. Instead, a range of other stakeholders, including digital platforms would benefit. It is only right that a wide pool of beneficiaries and those with the broadest shoulders should make a contribute toward this non-discretionary expenditure aimed at achieving public good outcome.

Q&A - RAN Call for Input

CFI question 1: Does this framework accurately capture the factors relevant to assessing what is an appropriate and proportionate measure for MNOs to take with regards to power resilience for RAN cell sites?

The proposed framework appears too focused on RAN cell sites and ignores other potential solutions to providing connectivity when grid power fails. It is vital that technology neutrality is preserved, and a range of alternative connectivity solution remain under active consideration. The framework does not examine where the most efficient place to spend any additional resilience funding would be. For example, £1BN invested by MNOs on enhanced battery provision may provide little if any measurable consumer benefit (with most outages either too short for enhanced battery capacity to be utilised and longer duration incidents like storm Arwen would be well beyond the scope of any battery capability). In these circumstances it is likely to be far more cost effective and beneficial to invest funds to harden the electricity grid, rather than any additional mitigation at mobile cell sites. The end state of Ofgem's ongoing £20BN DNO grid hardening programme needs to be fully considered as it could materially change the impact on consumers, with an even more reliable energy grid expected in the future.

CFI question 2: Do you agree that at a minimum MNO's networks should be able to operationally withstand short term power-related incidents?

MNO power autonomy remains a commercial matter and should be left to individual MNOs to decide. If an elevated public good intervention is deemed desirable, then a fair funding model needs to be offered to deliver that outcome. Ofcom rightly state that their work to date *'suggests the high costs involved in providing a minimum of one hour of backup power resilience at every cell site could mean it is not possible to conclude whether this would be a proportionate measure at this time'*[13] . Greater, consumer funded or landline dependent CP provided use of BBUs in the fixed network (in the digital voice environment) also has a crucial role in helping to sustain a level of connectivity when grid power is lost. Even in

[12] https://www.europarl.europa.eu/RegData/etudes/ATAG/2023/745710/EPRS_ATA(2023)745710_EN.pdf
[13] Call for Input: ensuring power resilience in mobile radio access networks - Para 5.4

circumstances when consumers no longer use or have a landline, but retain broadband, a BBU can power wifi connectivity allowing mobile users to benefit from Wi-Fi calling. Ofcom may wish to consider raising awareness of consumers' ability to purchase of BBU kit to improve their household resilience plans. Consumers should be encouraged to take steps to consider how they respond and prepare for power cuts, with communications only one aspect of household planning. Increasing individual household preparedness and resilience is a strategy deployed in a number of countries to great effect[14], with the concept communicated in a calm and constructive way. It helps to improve citizen self-reliance, allowing public resources to be targeted at the most vulnerable.

CFI question 3: What mobile services should consumers be able to expect during a power outage, what consumer harms should power backup up focus on mitigating and does this vary depending on the type or duration of the outage?

Basic voice and SMS access to the emergency service remain the key services that should be safeguarded. All other data and voice connectivity should be on a best-efforts basis. There remain strong incentives on MNOs to provide as broad a range of services possible, based on the network resources available to them. There may be specific use cases to allow priority access on the network for the emergency services, DNO teams and DNO telemetry and other critical public services. These must be protected, as a loss of power tends to drive up mobile traffic leading to mobile network congestion. Allowing MNOs to carefully manage their traffic load and network resources is critical in a power loss event. 5G is far more energy efficient per Mbit/s carried that earlier generations of mobile carriage. MNOs need to retain the ability to control which spectrum carrier bands to utilise and which to restrict in the event of prolonged power outage. Ofcom guidance should avoid being overly prescriptive and focus on encouraging the availability of emergency access only. Ofcom's revised guidance on Net Neutrality allows MNOs to take action to load balance their networks, for example by temporarily throttling entertainment streaming services in order to prioritise communications services in periods of network congestion resulting from grid power loss.

CFI question 4: What technical choices are available to MNOs to reduce power consumption, and should be considered as part of assessment of appropriate and proportionate measures?

MNO technology is evolving. In the future there is likely to be more remote site management options available to take action to reduce power consumption at sites when power is scarce. This may involve turning off certain carrier bands and limiting capacity to essential services only. The full shut down of kit (beyond standby mode) can reduce its lifespan and cause further network faults when it is rebooted. As RAN kit converges, with one set of kit providing 2G, 4/5G, then there may be less scope to shut off specific kit entirely. However, vendors are increasingly mindful of the growing need to put kit into a low power / dormant state remotely.

CFI question 5: How many sites would it be feasible to upgrade and maintain and why?

Based on the commercial realities of the industry, there is no funding available to upgrade sites, beyond what is currently delivered commercially. There is a regular cycle of upgrades factored into budgets, where batteries are renewed and refreshed. However, if a public good requirement is properly funded and adequate time is allowed, a number of targeted sites could accommodate increased battery provision. ✂. There are of course a number of sites which cannot accommodate any increased battery provision due to physical restrictions at the site.

CFI question 6: Do you consider that providing a minimum of 1 hr backup to all RAN cell sites would to be proportionate to meet the security duties under s.105A to D of the Communications Act 2003?

Ofcom make clear in the CFI that the high costs involved in providing a minimum of one hour of backup power resilience at every cell site could mean it is not possible to conclude whether this would be a proportionate measure at this time. We

[14] For example, see: Canada - https://www.getprepared.gc.ca/cnt/rsrcs/pblctns/pwrtgs-wtd/index-en.aspx - USA: Power Outages | Ready.gov – Australia - https://www.emergencyprepare.com.au/power-outage/ New Zealand: https://getready.govt.nz/en/prepared/household/impacts/no-power

would agree with this conclusion. The ongoing DNO hardening programme and innovations like direct to device satellite could render any funding directed into battery provision obsolete and poor value for money. There may be selected sites that could benefit from enhanced power autonomy, but an every site approach that ignores the benefits of overlapping coverage would not be advisable. Consideration of networks layers is needed. There may not be any need for battery deployment at a street furniture site, where the site was primarily introduced to bolster networks capacity. Such small street furniture sites will typically benefit from the 'umbrella' coverage of an adjacent macro site which will have a differing battery backup configuration. A 'one-size' strategy would not cater for such scenarios.

Should any public good measures be deemed necessary, they need to be appropriately funded. The question of funding needs to be addressed at the outset, before any additional obligations are introduced. Providers should be free to select the solutions that best suit their network, customers and circumstances. It is likely that a mixture of overlapping coverage, enhanced battery provision, direct to device satellite and greater in-home use of fixed network BBUs could all play a part improving UK communication network resilience. We cannot stress enough that securing the funding for these enhancements is critical and this aspect of topic must not be an afterthought.

We would caution Ofcom against seeking to conflate the clear public policy question of what level of backup connectivity is desirable for public good and the telecoms regulatory question of what threshold of power autonomy must be delivered if MNOs are to be compliant with s.105A-D of the Communication Act.

While they may appear similar questions, they are not the same. Ofcom must be mindful not to confuse public policy aspirations with legal guidance. In its acknowledgement that the issue may require solutions beyond the current regulatory and legislative framework – and indeed taking into account its own approach to date – Ofcom makes clear that it is not possible for a universal compliance threshold for 105A-D to be assumed (be it set at 1 hour of power autonomy or otherwise).

It is therefore important to recognise that this CFI is seeking to answer two overlapping but *separate* questions:

I. The first is the public policy question of: what is the minimum level of connectivity continuity in a power cut that it is desirable to maintain for the UK" (ie. what does good look like);
II. The second is the regulatory question of: what is appropriate and proportionate to expect of MNOs in terms of seeking to deliver that minimum level (and what should be the role of the telecoms industry to get there).

While there is obvious overlap between the two questions, as demonstrated by the fact that all UK operators have some (but often different) forms of power resilience already in place, the increasing dependence of the whole UK economy on connectivity means that inadvertent conflation of these two nuanced questions risks regulatory failure.

The traditional equation for considering who should shoulder the cost of a policy intervention is public sector/ industry /consumer However, the industries that benefit from connectivity have multiplied since mobile networks were first rolled out, and now include tech giants, cloud providers, power companies themselves.

Even if Ofcom finds a positive cost-benefit ratio, it does not follow that the cost falls to the mobile industry. Similarly, further public policy questions arise. For example, the sites that are more prone to longer duration power cuts and benefit least from overlapping coverage are usually in rural locations. This means that public policy mitigation measures are more likely to be targeted at those locations. However, asking mobile providers to pay for this would involve a wealth transfer from mobile consumers in urban areas to rural ones. This is very much a political and public policy question, rather than a regulatory one. Government, in consultation with Ofcom, must be the ones to consider these issues. Particularly, if it is deemed that some form of intervention is necessary on a public policy basis, making clear how such intervention is to be funded.

CFI question 7: What cost effective solutions do you consider could meet consumers' needs during a power outage?

Ofcom need to remain mindful of any competition implications that could result from taking an approach that favours one MNO of last resort. Such an approach could undermine the workings of the competitive retail market. Guidance around which basic services to preserve during a loss of power would be helpful, we would direct Ofcom to Emergency Call Access and SMS access in the first instance, with general voice services also a priority (behind 999), with other services delivered on a best-efforts basis. Specific MNOs also have contracts to handle traffic from CNIs and public sector partners that will also have a priority status and this needs to factor in their decision making. They should be free to manage these as is appropriate.

CFI question 8:

a) Is it more cost efficient to increase power backup up to any space, weight, or planning limitations, i.e., increasing power backup as much as is feasible provides the lowest £ per hour?

Where space permits (and external funding support is available), there is a degree of logic to utilising it for additional battery capacity and thus avoiding a cost price step/trigger when additional space is required (with associated planning, ground works and cabinet costs). The space available per site will vary considerably from site to site and it doesn't necessary follow that sites that have under-utilised space are the most in need of additional power autonomy (for example they may be in low power cut risk areas or benefit from overlapping coverage). Lithium batteries tend to be smaller, and their use can create space, and they tend to be lighter than lead acid, however each battery type has its own performance advantages and disadvantages.

b) do the benefits of any power backup solution have diminishing returns, i.e., the benefit per hour decreases as you increase the amount of power backup?

Yes. Additional battery investment would not make sense in locations with good overlapping coverage or in locations with the risk of longer power outages exceeded realistic battery life. For example, upgrading a site from 1 hour to 4 hours in a rural location that is prone to infrequent, but lengthy outages (24Hrs +) is likely to provide very little benefit, particularly if the outage occurs in the middle of the night and batteries have powered down by morning. Tactical generator deployment is often used in these circumstances. In some locations onsite renewables, combined with battery storage might offer a suitable alterative (these have today been considered in locations where grid power isn't available). The use of solar in winter (particularly in the northern half of the UK) creates practical challenges and wind energy is not guaranteed at all times, so these limitations need to be recognised. In some sites, deployment of solar and/or wind options would simply be cost prohibitive.

CFI question 9: Does the mobile market fail to capture the value or importance of power backup, and if so, why?

Yes. Anecdotally, we believe the majority of consumers would be willing to opt for a lower cost service with a provider who has avoided battery costs (assuming they have identical network coverage and QoS) than one at a higher cost, who has made enhanced battery investments. This holds true in an environment where there is generally a high level of confidence in the reliability of the energy grid and where there is well functioning, competitive retail mobile market. Some consumers may value the extra assurance that better battery back-up provides and may be willing to pay a premium for it. However, there simply are not enough of these consumers to fund additional battery investment. In the business and enterprise space, there is a greater willingness to pay, but again this is insufficient to fund investment in power autonomy to public good levels. Ofcom also must consider the impact of long-term wholesale MVNO deals, where the wholesale prices are set years ahead and which lack the scope to reprice to recoup any mandatory resilience spending.

CFI question 10: Should improvements in power backup be focused on solutions at sites which are identified as higher risk of outages?

Sites at the greatest risk of power loss and which benefit less from overlapping coverage should remain the primary focus of power autonomy innovation and improvements. Vodafone already takes this approach on a more informal commercial basis today, factoring in the utilisation of the site, the space available and the frequency of power disruption. In practical terms, this means the sites (usually in rural areas) that are prone to more power outages, have longer power autonomy factored into site design. Often these are low load sites, with a lower power draw, resulting in longer battery duration performance. In our SRN build[15], some sites are entirely off grid, with onsite solar generation and hybrid smart generators deployed. Typically between May and September they can operate off battery and solar recharging, and during the winter months they need to be boosted by smart power generation, with the kit powering on and burning liquid fuel to recharge the batteries. This requires regular site visits to refuel generators with lower carbon biofuels. It is important to stress that specific site circumstances will inevitability play into any decision making on site design, with factors such as site accessibility (for example getting engineering resource to Island locations, taking account of ferry availability) influencing what type of solution is used.

CFI question 11: Why would any requirement lower than a minimum of 1 hour be sufficient in future? What duration do you consider would be sufficient and why?

It may not be possible nor sensible to power all sites for 1 hour due to the costs involved. The expenditure required might not be justified, particularly when improvements in the reliability of the energy grid, the use of priority restoration processes, more extensive use of fixed network BBUs, the introduction of direct to device satellite technology in the medium term and environmental considerations around large-scale battery deployment are all fully taken into account. Ofcom's July 2023 impact assessment guidelines require all these issues to be fully quantified and considered before any decisions are taken. The question of funding must also be addressed upfront to ensure no unfunded obligations are placed on the UK mobile sector. Without this, investment in 5G, coverage and capacity are all at risk.

CFI question 12: Over what time period could industry make upgrades to provide a minimum of 1 hour at every cell site or other cost-effective solutions to address potential consumer harm?

We share Ofcom's view that there is currently insufficient evidence to justify a universal 1-hour requirement. If an obligation of this type was to be introduced and external funding was provided for this level of investment, then in practical terms it would take many years to deliver. A significant number of sites would need to be upgraded to create the space necessary and, in some locations, (particularly roadside locations and rooftops) it may not be physically possible to achieve. The positive impact of overlapping coverage needs to be fully considered in any decision making. It may well be the case that direct to device satellite technology may offer a more expedient route to providing resilient connectivity to UK citizens.

Part 2: Vodafone's Response to Ofcom's Consultation on Revised Resilience Guidance begins on the next page

[15] https://www.youtube.com/watch?v=Z_TjmhWhZZw

Part 2:

Vodafone's Response to Ofcom's Consultation on Revised Resilience Guidance

March 2024

Confidential

1. Vodafone welcomes this opportunity to comment on Ofcom's draft revised guidance on network resilience. The proposed guidance is a vital reference point for all providers when planning and operating communication networks. We appreciate that the guidance is written in such a way as to be flexible, with its intended application across all UK networks regardless of their size, purpose, technology or customer base.

2. It is important to recognise that the guidance is designed to be helpful to all communication providers, offering an understanding of Ofcom's views around the steps communication providers should take to comply with s105A-D of the Communications Act. Given the breadth of providers, topologies, architectures, and the range of technologies used in UK networks, Ofcom must ensure that it takes due account of the individual circumstances of each case where any assessment is required in respect of s105A-D compliance, including taking into consideration the provider in questions circumstances, conduct and overall assurance approach.

3. Vodafone prides itself on the reliability of its network, taking continuous steps to assure the services we provide to our customers. Occasionally thing will go wrong, ether as a result of external events (fire, theft, vandalism, flood or weather) or due to errors when maintenance or updates occur. We always strive to take all reasonable steps to avoid these incidents, however if they do occur, we seek to recover quickly and learn, as we try and avoid any repetition.

   The draft guidance offered is very broad, covering a number of important areas including:

   - Network Design to avoid single points of failure;
   - Power back-up at active fixed network cabinets and Core/Metro sites;
   - Multiple separate Geographic paths for interconnection;
   - Automatic failover functionality for key infrastructure;
   - Control / Management Plane Resilience;
   - Network and Service Transition (inc IT/Software patching/updates);

Q&A - Revised Resilience Guidelines

Question 1: Do you consider the measures in the proposed guidance relating to the resilience of the physical infrastructure domains to be appropriate and proportionate?

We are comfortable that Ofcom's proposed guidance is clear, however Ofcom need to take each compliance assessment case on its merits. If a communication network is subject to criminal or accidental damage (such a fire, flood or cable break), it is likely to have an impact on at least some customers. Mitigation measures are in place to minimise the extent of any impact and processes exist that seek to recover services as quickly as possible. Damage to physical infrastructure at a local access level is likely to result in a direct customer impact and while steps can be taken to minimise that impact, it is unlikely to mitigate all service disruption. If a communication provider has taken sensible and proportionate steps to assure the integrity of their physical network, then this needs to recognised by Ofcom in their assessment of compliance.

Where wholesale suppliers are used, it important that the focus is on owner of the infrastructure, not the purchaser of it, as

that is ultimately where the accountability should rest. Providers can only assure the services they provide within the confines of their own network. While we may seek assurances in our wholesale suppliers around service availability, it is impossible to guarantee this to 100% availability. For example, in respect of the requirement for 4Hr power autonomy at a street cabinet level for fixed access, we have a very limited active presence at the street cabinet level, in relation to "last mile" fixed access, but we do seek assurances from our wholesale partners who operate this infrastructure more extensively.

We operate regional aggregation sites that are geographically spread around the United Kingdom ✂.

While we seek to minimise the impact of weather on our networks through site design and site choice, (e.g. avoiding flood plains), Ofcom needs to recognise that we need to offer services where people work and live. Inevitable this means that some kit, due to location, is more vulnerable than others. Any guidance therefore needs to make the distinguish between reasonably foreseeable events and extreme scenarios.

Question 2: Do you consider the measures in the proposed guidance relating to the resilience at the Control Plane to be appropriate and proportionate?

Please see the answer to Q3 below.

Question 3: Do you consider the measures in the proposed guidance relating to the resilience of the Management Plane to be appropriate and proportionate?

The technical requirements in the guidance are aligned with what is already prescribed by Vodafone's Group Technology Resilience policy. We note that in respect of Control / Management Plane Resilience & Network and Service Transition (inc IT/Software patching/updates) that the proposed guidance sensibly stops short of prescribing any "hard" requirement in these areas, mainly focusing on design principles that are more easily applied to a range of different providers and circumstances. Today Vodafone considers best practices in our approach to these issues and sees no compliance concerns.

Question 4: Do you consider the measures in the proposed guidance relating to communications providers' own managed services to be appropriate and proportionate?

Vodafone is comfortable with the guidance proposed in respect to the services we manage directly. We are mindful of the need to prioritise voice traffic and emergency call access in should events arise which limit or constrain our ability to deliver all traffic forms.

Question 5: Do you consider the measures in the proposed guidance relating to communications providers' arrangements for preparing for adequate process, skills and training to be appropriate and proportionate?

From a business resilience and business continuity perspective the requirements set out in the draft guidance are clear, being aligned to ISO22301 a standard which Vodafone is certified at today. We take steps to ensure all relevant colleagues are aware of what key priorities are in respect to resilience and service availability. We have documented and well-practiced incident management processes and a range of BAU processes design to deal with all service incidents, regardless of their severity.

END