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**Connectivity
& Network
Resilience**

6. Connectivity & Network Resilience

Introduction

6.1 This Chapter sets out ComReg's goals associated with connectivity and network resilience and the high-level objective of ensuring that **end-users have widespread access to high-quality and secure communications** networks, services, and applications. By 'connectivity' ComReg means having access to the necessary ECN to allow for the use of various services and applications. For ComReg, the connectivity of end-users is not about pitting one network technology against another, but rather the widespread, continuous, and high-quality connectivity of end-users.

6.2 The EECC includes a new objective that ComReg, Government and BEREC shall

pursue: *promote connectivity and access to, and take-up of, very high capacity networks including fixed, mobile, and wireless networks, by all citizens and businesses of the Union.* In pursuit of this objective, the EECC also restates the need for a balance between providing adequate incentives to invest in VHCN and the need for regulation.

6.3 Today, the connectivity of end-users has become essential to ensuring social and digital inclusion. It is ComReg's view that end-users can only fully participate in society and the wider economy when their connectivity needs are met. As we become increasingly reliant on digital services, the importance of widespread, continuous, and high-quality connectivity increases.

Strategic Intent 3:

End-Users have widespread access to high-quality and secure communications networks, services, and applications.

What does this look like?

- Widespread availability of ECS and ECN's allows for digital inclusion by all consumers:
 - By 2026, universal coverage of fixed VHCNs is within sight.
 - By 2024, outdoor mobile voice coverage exceeds 99% of the population and outdoor mobile data coverage at speeds greater than 30 Mbps exceeds 85% of the population rising to greater than 95% of the population by the end of 2028⁶⁴.
- Connectivity challenges are addressed and indoor mobile voice services (via mobile connections or Wi-Fi calling) are available to all.
- Networks are secure and can withstand shocks
- EU Objectives for 'Connectivity' of end-users are met

6.4 As our reliance has grown, so too has our dependence on our ECN / ECS and our expectations of what our ECN can and should be able to do. In addition, our acceptance of network outages or inadequate services has diminished. ComReg recognises that some end-users are poorly served and cannot use the range of digital services that others take for granted.

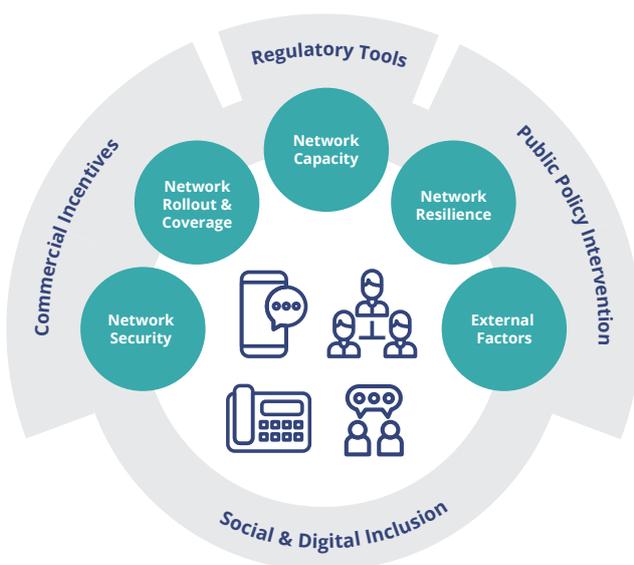
These end-users may suffer from a lack of a reliable fixed network, mobile network, wireless network, or other communications solution at home, at work or on the move.

6.5 ComReg recognises that some of these end-users may suffer from a lack of multiple different reliable networks at the same time (e.g. poor fixed broadband and poor mobile telephony). In addition, some end-users may suffer from poorer services intermittently, due to a range of factors beyond their control. It is also recognised that ensuring everyone can access online and digital services, regardless of where they live or how connect to these services, will be key to driving participation in the digital economy and society.

6.6 Until recently, much of the focus around connectivity and end-user experience centred around the availability of networks and advertised download speed. The growth in remote working has shifted the focus towards other important dimensions of the experience, such as overall QoS, latency, network capacity and security. Our networks and services are also vulnerable to issues such as equipment malfunction, human error, malicious and cyber-attacks, severe weather events and external incidents (e.g. electricity outages). Accordingly, network resilience, reliability, and security ('**NRRS**') is an area that is becoming more important. ComReg's role in this area is to have a holistic understanding of the nature of the various connectivity deficits facing the country.

6.7 Where ComReg has regulatory powers to address these issues, ComReg seeks to use these in a manner that complements its other regulatory powers. Where others (e.g. DECC) have powers, ComReg seeks to support them in that role and act as a knowledgeable regulator, making informed contributions to policy discussions and debate. In some cases, a multi-agency approach is required to address issues relating to connectivity and network resilience (e.g. cyber security, the Mobile and Broadband Taskforce). Figure 9 below sets out the strategic framework relating to this strategic intent.

Figure 9: Strategic Framework



64 This assumes the necessary licences are issued with a commencement date of 1 December 2021

The Essential Nature of Connectivity

Digital Inclusion and Network Coverage

6.8 As noted previously, to fully participate in the economy and society in an efficient way, it is now often essential for an end-user to use digital services (e.g. e-banking, paperless billing, public services, taxation matters). In some areas, where the commercial and economic drivers are not strong enough to drive the investment in high-quality, reliable, and resilient networks, end-users are left relying on networks that cannot fulfil their needs.

6.9 The rise of remote working has placed a greater emphasis on the need for high-quality, reliable, and resilient ECN. Connectivity has been essential for individual remote workers, but also for Irish enterprise to continue operations. This emphasis on remote working will continue to grow over the next five years, as our expectations of our networks evolve. In January 2021 the Government published its Remote Working Strategy, focusing on the development and investment needed to maximise the benefits of remote working. Widespread access to high-quality and secure communications networks, services and applications will be key to unlocking the potential of the Remote Working Strategy.

6.10 The onset of the Covid-19 pandemic has given added impetus to end-user expectations and need for high-quality, reliable, and resilient ECN. Fixed data traffic volumes grew by 64% in 2020, compared to an average annual growth rate of 24% between 2017 and 2019. Fixed and mobile data traffic volumes are now significantly greater than pre-Covid-19 base levels.

6.11 However, there are parts of Ireland that are underserved by high-quality and reliable ECS ECN resulting in some end-users being digitally excluded. Ireland's population density of 70.9

people per km² is considerably lower than the EU average⁶⁵ of 118 people per km². However, in rural areas, the population density is only 27 people per km². As population density decreases, the distance between premises increases, increasing the cost of deploying ECN.

6.12 For ComReg, ensuring all end-users have access to connectivity is not about pitting one network technology against another, but rather the widespread, continuous, and high-quality connectivity of end-users, regardless of the underlying technologies.

6.13 To date, commercial and regulatory levers have driven the rollout of fixed VHCN to 1.47 million premises (households and businesses) across the country. Over the next decade, these commercial and regulatory drivers will likely drive the rollout of VHCN further into rural areas, covering 1.7 million premises. The rollout by National Broadband Ireland, covering 540k premises, will supply VHCN services to the most remote parts of Ireland. ComReg considers that the commercial investment in fibre and mobile network rollout and public investment through the NBP puts us withing touching distance of ubiquitous coverage of high quality fixed and mobile networks by 2026.

6.14 In 2018, ComReg published the results of a connectivity study which considered how best to meet consumers' mobile connectivity needs⁶⁶, estimating future mobile connectivity network costings and the implications for spectrum awards and coverage obligations.

These reports provided an analysis of the challenges, solutions and actions to improve connectivity, including the use of Wi-Fi and native Wi-Fi⁶⁷ to support indoor mobile

⁶⁵ See <https://ec.europa.eu/eurostat/databrowser/view/tps00003/default/table?lang=en>

⁶⁶ ComReg Documents 18/103, 18/103a, 18/103b, 18/103c, 18/103d

⁶⁷ Where consumers have had issues with indoor mobile connectivity, ComReg has advocated for the use of Wi-Fi and Native Wi-Fi calling over a fixed broadband network. Native Wi-Fi calling is a service for smartphones providing the ability to make and receive phone calls over an internet connection with sufficient download speed and latency. ComReg has previously noted that in most instances, native Wi-Fi calling is likely to be the most effective mechanism to improve indoor reception issues.

connectivity and the need for significantly more cell sites than exist today to achieve very high levels of 30Mbps mobile broadband coverage on a geographic basis. In addition, the reports highlight that policy or regulatory interventions that could be used to secure more extensive coverage outcomes would require careful planning, and an extensive exercise to determine the costs and benefits to society.

6.15 In March 2021, the EC presented a vision for Europe's digital transformation by 2030, called Europe's Digital Decade⁶⁸, which builds on the Commission's digital strategy of February 2020, as set out in Explanatory Box 2 below. The EU's digital strategy aims to make this transformation work for consumers, while helping to achieve a climate-neutral Europe by 2050.

Explanatory Box 2: European Commission – Europe's Digital Decade

This vision for the EU's Digital Decade evolves four pillars, each including targets and milestones for 2030:

- **Secure, performant and sustainable digital infrastructures:** By 2030, all EU households should have gigabit connectivity and all populated areas should be covered by 5G; the production of cutting-edge and sustainable semiconductors in Europe should be 20% of world production; 10,000 climate neutral highly secure edge nodes should be deployed; and Europe should have its first quantum computer.
- **Digital transformation of businesses:** By 2030, 3/4 companies should use cloud computing services, big data, and AI; more than 90% SMEs should reach at least basic level of digital intensity.
- **Digitalisation of public services:** By 2030, all key public services should be available online; all citizens will have access to their e-medical records; and 80% citizens should use an e-ID solution.
- **Digitally skilled citizens:** By 2030, at least 80% of all adults should have basic digital skills, and there should be 20 million employed ICT specialists in the EU – while more women should take up such jobs.

The EC note that digital technologies will be the key differentiating factor in a successful transition to a sustainable economy and society after the Covid-19 pandemic ends.

⁶⁸ Europe's Digital Decade: https://ec.europa.eu/commission/presscorner/detail/en/ip_21_983

Network Resilience, Reliability and Security (NRRS)

- 6.16** As reliance on ECS / ECN has grown, it has become critical that end-users can have a reasonable level of assurance as to the continuity and security of the ECS / ECN being provided, regardless of the underlying network technologies.
- 6.17** Network and service outages can cause significant disruption to end-users resulting in economic, financial, and societal losses. While ComReg recognises that ‘force majeure’ events can and will happen, resulting in an unavoidable temporary loss of service, it is essential that all reasonable precautions and processes are in place to ensure continuity of supply.

It is therefore essential that adequate precautions and investments are made to ensure continuity and availability of networks and the services provided over these networks.

Essential Digital Infrastructure

- 6.18** As noted above, ComReg views connectivity in a holistic way, recognising that there are a variety of networks, technologies, and solutions available to people to help fulfil their connectivity needs. In addition to fixed and mobile networks, there are other networks, such as wireless networks and satellite broadband networks, that can help offer connectivity to end-users.
- 6.19** It is ComReg’s view that for consumers and businesses around the country, it is the quality and reliability of ECS/ECN that matters, rather than the means of delivery. Ensuring the widespread availability of these high-quality and reliable services is the focus of ComReg’s strategy. In this context it is ComReg’s goal that **telecommunications networks, technologies, and solutions allow end-users to fully participate in all aspects of society.**

- 6.20** The EECC includes a new objective to promote connectivity and access to, and take-up of, very high capacity networks (VHCN). In pursuit of this objective, the EECC also restates the need for a balance between providing adequate incentives to invest in VHCN and the need for regulation.

Goal 3.1

Telecommunications networks, technologies and solutions allow end-users to fully participate in all aspects of society.

- 6.3.1** To aid economic recovery in the EU following the Covid-19 pandemic, the EC published a Recommendation⁶⁹ calling on Member States to boost investment in VHCN and 5G. The recommendation sets out guidance for developing best practices aimed at reducing the cost of deploying VHCN and ensuring timely and investment-friendly access to 5G radio spectrum, in order to help foster connectivity as a crucial asset for European competitiveness, sustainability and future digital services. The recommendation calls on NRA, BEREC, RSPG and the EC to work together to develop and implement a “Connectivity Toolbox” as a matter of urgency. The Recommendation also sets out a number of key areas for consideration:
- Streamlining permit granting procedures
 - Improving transparency through the single information point
 - Expanding the right of access to existing physical infrastructure,
 - Dispute resolution mechanisms,
 - Reducing the environmental footprint of networks, and
 - Incentives for 5G investment.

⁶⁹ EC Recommendation C(2020) 6270 of the 18th of September 2020.

- 6.21** On 25 March 2021, Member States, agreed on the Connectivity Toolbox⁷⁰, pursuant to the EC Recommendation. The Connectivity Toolbox consists of a set of best practices to allow and encourage the roll out VHCNs.
- 6.22** Over the coming period ComReg will undertake the following tasks:
- **Connectivity Toolbox:** ComReg will consider the relevant best practices that fall within its remit and explore with relevant stakeholders the feasibility and need for the application of these best practices in the Irish context. ComReg will also assist in preparing a report on the status of the implementation of the Toolbox to be submitted to the EC by 30th April 2022.
 - **Geographic Mapping of Networks:** In accordance with Article 22 of the EECC, ComReg will compile and publish a map of each broadband network in Ireland, including forecast coverage. These maps can then be used by consumers, industry, and policy formulation by Government. Internally, these maps will help inform ongoing ComReg projects (e.g. Market Analyses, USO Designations etc.).
 - **Monitor network and technology developments:** Over the coming period it is expected there will continue to be developments and innovations⁷¹ in network technologies that will enhance the end-user experience. It is ComReg's aim to monitor these innovations and facilitate their use where appropriate.

Digital Divide: ComReg will continue to monitor the emergence of digital divides in various ECS markets and in adjacent markets. These insights will help give us a holistic understanding of the connectivity challenges facing end-users and help inform various policy and regulatory decisions made by ComReg.

Supporting Interventions

Goal 3.2

Utilising the regulatory toolkit, ComReg's activities promote connectivity and/or incentivise infrastructure rollout.

- 6.23** ComReg recognises that competitive forces, if left to their own devices, will deliver ECS/ ECN to a certain level and quality. However, achieving high-quality connectivity beyond this level is unlikely to be provided due to the uncommercial nature of network rollout in some geographic areas.
- 6.24** ComReg and Government have a range of regulatory tools available to incentivise infrastructure deployment into areas currently unserved by commercial networks. In this context it is ComReg's goal that **utilising the regulatory toolkit, ComReg's activities promote connectivity and/or incentivise infrastructure rollout.**
- 6.25** ComReg recognises that while its toolkit does include a number of useful and effective tools to enhance connectivity, it also has its limitations in addressing the connectivity problems facing some end-users. Where other public bodies have policy or legislative roles relating to the ECS sector and adjacent markets, ComReg seeks to engage positively with such bodies and contribute to the wider policy setting with DECC and other Government departments.

State Aid and Universal Service

- 6.26** Where the commercial and regulatory levers are insufficient to deploy networks, public funding is bridging the gap to serve remote areas. The EU State Aid guidelines ensure that

⁷⁰ https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=75185

⁷¹ Such developments and innovations are likely to include the rollout of 5G, Low Earth Orbiting satellite broadband, ViLTE (Video over LTE), DOCSIS 4.0 and Small Cells

such funding does not distort competition in the market. Over the last 15 years the Irish Government has invested in ECN through various schemes (See Explanatory Box 3 below), including the awarding of the NBP to National Broadband Ireland.

6.27 While not responsible for the NBP, ComReg does provide technical advice to DECC on the NBP and has seconded staff to DECC to provide such assistance. ComReg recognises that the NBI rollout, over time, may have implications for regulation. At all times ComReg will consider the impact of the NBI rollout on the state of competition in the relevant retail and wholesale markets.

6.28 As discussed in Chapter 5, the purpose of Universal Service is to ensure consumers have access at an affordable price to an available internet access service and to voice communications services, including the underlying connection, at a fixed location. As new networks get rolled out and the NBI rollout advances, the role of a Universal Service and having access to adequate broadband comes into focus. There is ongoing liaison between ComReg and DECC on Adequate Broadband internet access under the EECC and ComReg will keep stakeholders informed as appropriate on this matter.

Explanatory Box 3: Public Investment in Networks

Metropolitan area network (MAN)

The MANs are publicly owned fibre optic networks that allow wholesale and open access to all telecommunication operators. A MAN consists of telecoms ducting and fibre optic cable laid in a ring formation in a metropolitan area and is capable of delivering virtually unlimited bandwidth to 94 towns and cities throughout regional Ireland. In 2004, enet was awarded a 15-year contract to manage the 28 MANs built under Phase I of the MANs infrastructure programme on behalf of the state. In 2009, enet was awarded a second 15-year contract to manage the 60 MANs (covering 66 towns) built under Phase II of the MANs infrastructure programme. Both of these contracts have been extended to 2030 in line with the provisions of the contracts.

National broadband scheme (NBS)

The NBS was co-funded by the European Regional Development Fund (ERDF), and designed to deliver basic, affordable broadband to target areas across the country in which services were insufficient.

Three won the contract and rolled out the NBS scheme on behalf of the DECC. Under EU State Aid rules, this intervention was for a limited duration. The NBS ended following a 68-month operational period in August 2014. Three continue to provide broadband coverage throughout NBS areas on a commercial basis. The Government contributed €79.8 million towards the NBS.

National Broadband Plan (NBP) and National Broadband Ireland (NBI)

The National Broadband Plan is a Government initiative with the aim to connect all of Ireland's communities by dealing with the broadband connectivity challenge in rural areas. Rollout of the NBP was awarded to National Broadband Ireland in 2019. The NBP aims to achieve a minimum of 30Mbps download to all premises that will not be able to access such services through commercial investment alone. Approximately 540,000 premises are included in the Government's plan.

Mobile Coverage

- 6.29** As noted previously, ComReg is in the process of completing the second multi-band spectrum award (**MBSA2**) which will see the release of 470 MHz of harmonised spectrum rights in the 700 MHz Duplex, 2.1 GHz, 2.3 GHz and 2.6 GHz Bands⁷². This includes licences conditions to ensure that within three years of licence issue that, outdoor mobile voice coverage exceeds 99% of the population and outdoor mobile data coverage at speeds greater than 30 Mbps exceeds 85% of the population rising to greater than 95% of the population within seven years of licence issue.
- 6.30** ComReg has previously indicated there may be a case, in the public interest, for more interventionist measures to provide coverage in locations where it would not be commercially viable. However, there are significant policy issues to be addressed, including whether such measures are value for money, how target locations might be chosen, and how any initiative would comply with EU State Aid rules. While it would not be appropriate for ComReg to make policy choices, it can provide expert input to inform consideration of possible mechanisms to secure coverage outcomes beyond market-driven levels.
- 6.31** Meeting the future needs of Irish consumers accessing data hungry applications from mobile devices will likely require not only the improved coverage of mobile networks, but also the ability of consumers and services to move seamlessly between mobile and fixed broadband networks when making a call or using data services. The rollout of fixed networks by commercial operators and NBI and the availability of additional spectrum through future spectrum awards are key enablers to meet this challenge.
- 6.32** As set out in Chapter 5, ComReg has an outdoor mobile coverage map on its website to allow consumers to check operator coverage and expected signal levels at locations around the country. Over the coming period we will

further enhance this map with new features. We are also exploring the publication of a fixed broadband network map, in line with Article 22 in the EECC.

- 6.33** Over the coming period ComReg will also continue to engage with the Mobile Phone and Broadband Taskforce to provide solutions to the broadband/phone coverage deficit, and to investigate how to provide better services for consumers including better use of State assets.

Fixed Network rollout

- 6.34** The Broadband Cost Reduction Regulations ('**BCRR**') came into effect in 2016 with the primary purpose of facilitating and reducing the cost of deploying high-speed public ECN, ultimately to the benefit of businesses and consumers. To date, the BCRR have not been used by Irish operators to any great extent.
- 6.35** ComReg has three functions under the BCRR, namely:
- Ensuring compliance with the BCRR;
 - Acting as national dispute settlement body in the event of disputes arising between network operators in relation to the BCRR⁷³; and
 - Providing a Single Information Point⁷⁴ ('**SIP**') to facilitate access to information regarding statutory permits for civil works required to develop elements of a high-speed public ECN.
- 6.36** ComReg is currently considering whether an enhanced SIP would promote a greater use of the BCRR. However, ComReg notes that the experience of other Member States expressed in the preparation of the Connectivity Toolbox indicates that a fully integrated SIP can involve considerable outlay (both financial and manpower). ComReg has not been made aware of any interest from operators for such an enhanced SIP. We are therefore unsure if the extra effort would justify the cost. Over the coming period ComReg will consider the Connectivity Toolbox best practices that are

⁷² See <https://www.comreg.ie/industry/radio-spectrum/spectrum-awards/proposed-multi-band-spectrum-award/>

⁷³ ComReg's Disputes Handling Process is available on its website – ComReg Doc 16/77r

⁷⁴ See <https://ec.europa.eu/eurostat/databrowser/view/tps00003/default/table?lang=en>

relevant to the SIP and explore with relevant stakeholders the feasibility and need for the application of these best practices in the Irish context.

6.37 The EECC also sets out new provisions relating to co-investment in VHCN. Articles 76 and 79 of the EECC set out arrangements for co-investment agreements between an SMP operator and another operator to build a VHCN or mobile base station, exempting such investments from SMP-type access remedies. The EECC sets down further conditions to be considered by ComReg (e.g. risk sharing and continued access for access seekers) before allowing such co-investment arrangements. Article 79 sets out new powers for the NRA to make access and co-investment offers made by an SMP provider binding, in-lieu of imposing SMP obligations. ComReg will consider any such proposals from industry regarding such co-investment should they arise.

Network Security & Resilience

6.38 The resilience of an ECS or ECN⁷⁵ relates to the ability of that ECN to return to its normal state following a disruptive incident. The resilience of a network can be affected in its core and in its distribution and access sections, all of which can then impact the network operator, its customers, and other providers of ECS and/or ECN who rely on wholesale access or interconnection.

6.39 The interconnectivity and interoperability of networks has become increasingly important, particularly having regard to the overall resilience of networks and assurances around the continuity of services. Resilience is an issue not just for individual networks and services but also because of the increased potential for

problems arising from the interdependence of networks and services. This includes, for example, the interrelationship between mobile and fixed networks.

6.40 ComReg considers whether there is a risk of market failure which could cause operators to underinvest in the security and resilience of networks and services. There is a potential market failure with respect to systemic risks – risks that could affect the whole industry. Investments in mitigating systemic risk would benefit all end-users, not just the customers of the operator making the investment. On the other hand, if all operators are exposed to the same systemic risk, then there will be no competitive disadvantage if the risk crystallises – so there is a reduced commercial incentive to mitigate it.

6.41 Public ECS/ECN are required⁷⁶ to manage the integrity and security of their networks and services. They are also required to take appropriate measures to manage risks to the security of such network or services. Such a risk-based approach should lead operators to prevent, resist, mitigate and recover from threats to security and resilience of networks and services they provide.

6.42 Operators are required to notify ComReg in the event of a breach of security or loss of integrity that has a significant impact on the operation of their networks or services⁷⁷. Where such reports are received, ComReg notifies DECC, the European Network and Information Security Agency ('ENISA') and the public.

6.43 To ensure that network security and resilience is effectively managed, operators should have a comprehensive understanding of all relevant risks to which they are exposed and analyse those risks. In this context, it is ComReg's goal that operators have **appropriate risk-based procedures in place to manage network security and resilience**.

⁷⁵ ComReg's activities in respect of the resilience of ECS and ECN is limited to Reg 23 & 24 of the Framework Directive and Article 40 & 41 of the EECC

⁷⁶ Under Regulation 23 of the Framework Regulations

⁷⁷ See ComReg Document 14/02a and ComReg Document 19/98

6.44 One of the threats to the security and resilience of ECS and ECN is a cyber-attack. As a consequence of the threat of cyber-attacks in Ireland, ComReg collaborates with Ireland’s National Cyber Security Centre (**‘NCSC’**), part of DECC, which is the lead agency for Ireland within the Cyber domain.

Goal 3.3

Operators have appropriate risk-based procedures in place to manage network security and resilience.

6.45 There are many aspects to network security and resilience which do not fall within ComReg’s remit, including data privacy and the protection of IT systems from cyber-attack. A number of other public bodies also have a role in network security and resilience, including DECC, ENISA, Office of the Data Protection Commissioner (**‘ODPC’**), Gardaí and the Defence Forces. The relevant agencies vary according to the issue at hand and its potential impact. Effective engagement with these stakeholders is necessary to ensure appropriate oversight and consistency and to avoid the duplication of activities. In the context of this goal, over the coming period, ComReg intends to undertake the following projects:

- **Collaboration:** ComReg will continue to work with relevant stakeholders where matters of network resilience and security have an impact. ComReg will continue its collaboration with the NCSC, in addition to assisting with the implementation of measures of the NCSC’s National Cyber Security Strategy 2019 – 2024⁷⁸ where ComReg were asked to assist.
- **Network Resilience Project:** ComReg is currently engaging in an assessment of the risk management practices of ECS/ECN providers. The project focuses on issues in the different components of ECS/ECN network elements, for both fixed and mobile networks and services.
- **Network Resilience Forum:** ComReg will seek to establish a Network Resilience Forum among the ECN providers, to share and discuss best practice. The work of the Network Resilience Project will be used in the analysis of network incidents to identify if there are any systemic risks.
- **Network Operations Annual Report:** ComReg will continue to publish an annual network operations report relating to its activities.
- **ENISA Report:** ComReg will continue to report incidents to ENISA on an annual basis, in line with its statutory obligations.