

Item: 21

Policy and Resources Committee: 20 September 2022.

Orkney Digital Connectivity Strategy and Delivery Plan.

Joint Report by Chief Executive, Corporate Director for Enterprise and Sustainable Regeneration and Corporate Director for Neighbourhood Services and Infrastructure.

1. Purpose of Report

To consider the Orkney Islands Digital Connectivity Strategy and route map for delivery of a gigabit capable network in Orkney.

2. Recommendations

The Committee is invited to note:

2.1.

That, on 18 May 2021, when reconsidering the development of a community wide digital strategy, the Policy and Resources Committee recommended:

- That the Executive Director of Development and Infrastructure should procure the services of a specialist consultant to develop a Digital Strategy for the islands that recommended a clear strategic plan to deliver a gigabit capable network.
- That the remit for the consultancy should focus on the following matters:
 - Network planning to deliver gigabit connectivity to 100% of the Orkney community.
 - Assessment of the options for the Council network post Scottish Wide Area Network (SWAN) and whether it can deliver both cost savings and income generation to the Council and assist the establishment of a viable network covering all of the Orkney Islands.
 - Assessment of the options to provide sustainable connectivity solutions to those areas where geography and distance create physical challenges, particularly the outer islands.
- That the Executive Director of Development and Infrastructure should submit a report, to the Committee no later than December 2021, presenting a draft Orkney digital strategy and delivery plan.

2.2.

That the assessment of the options referred to above included the following:

- Determine options to realise plans for delivering gigabit connectivity.

- Determine sources of finance for connectivity solutions optimising the use of Government grants and quantify funding gaps.
- Evaluate the extent of the ability of national solutions (e.g. R100 and Gigabit Broadband scheme) to deliver for Orkney communities.
- Recommend a route map for delivery having assessed the above.

2.3.

That, following competitive tendering, the Council engaged Plum Consulting to support development of a digital infrastructure investment case for Orkney.

2.4.

The recommendations and main findings of the report provided by Plum Consulting, as detailed in sections 4 and 9 of this report.

2.5.

That, at this stage, the Council remains committed, in principle, to remaining part of the SWAN contract at the forthcoming renewal, subject to formal confirmation when the details regarding procurement are agreed and shared with partners.

2.6.

That, as part of the second phase of the Council's management restructure, a post of Graduate Trainee Project Officer was approved in order to provide additional resources to support the Council's connectivity priorities.

2.7.

The options for delivery of a gigabit capable network in Orkney, as detailed in section 11 of this report, with the preferred option being Option 5, namely a hybrid approach.

It is recommended:

2.8.

That, in order to support the Council's strategic objective to establish gigabit capable networks covering all of Orkney, Option 5, a hybrid approach, be approved, namely that the Council should facilitate commercial telecoms infrastructure investment and stimulate market demand, rather than taking a role as a telecoms operator itself.

2.9.

That the Council take a leadership role in raising awareness of the R100 voucher scheme, including the provision of advice and support to individuals, community groups and telecom providers, to support the development of gigabit capable telecom networks for all of Orkney.

2.10.

That the Corporate Director for Enterprise and Sustainable Regeneration and the Corporate Director for Neighbourhood Services and Infrastructure prepare and submit an application to the UK Government for Project Gigabit funding to deliver fibre infrastructure to all eligible Council sites.

2.11.

That the Corporate Director for Enterprise and Sustainable Regeneration and the Corporate Director for Neighbourhood Services and Infrastructure should consult with local and national communication operators on the benefits of accessing gigabit hub infrastructure and the impacts this may have on commercial network roll out plans in Orkney.

2.12.

That the Corporate Director for Enterprise and Sustainable Regeneration and the Corporate Director for Neighbourhood Services and Infrastructure should submit a report, to the Policy and Resources Committee, on the outcome of the consultation, referred to at paragraph 2.11 above, and the principle that commercial operators may access any Council owned Gigabit hub infrastructure, including terms and conditions of such an agreement.

3. Background

3.1.

On 18 May 2021, when reconsidering the development of a community wide digital strategy the Policy and Resources Committee noted:

- That, on 16 February 2021, when considering a community wide digital strategy, the Policy and Resources Committee recommended that the Executive Director of Development and Infrastructure should procure the services of a specialist consultant to develop a Digital Strategy for the islands that recommended a clear strategic plan to deliver a gigabit capable network.
- That, on 2 March 2021, when considering the recommendation detailed above, the Council resolved that development of a Digital Strategy for the islands be referred back to the Policy and Resources Committee for further consideration.
- That, despite many years of political comment from the Scottish Government, it remained unclear what the Reaching 100% programme would deliver in Orkney, although it was highly likely that, as a result of current Government funding proposals, Orkney would remain well below the next generation of broadband speeds at gigabit levels.
- That Orkney's wholesale broadband infrastructure was solely operated and utilised by the UK's largest national provider of telecommunications and therefore, while domestic consumers might contract with different market providers, those providers essentially rebadged the same infrastructure, which made changing provider of broadband unlikely to delivery any major improvements in speed.

- That 5G technologies could offer a viable route to provide both high speed fixed wireless access and 4G services to Orkney, with trials ongoing to determine technical and financial viability.
- That the Council was part of a Scottish Government-subsidised IT network, the SWAN network, which provided connectivity to 14 premises on the islands, with the contract due to end in 2022/23, thereby creating an opportunity to investigate cost-effective alternatives that could provide faster and more reliable internet connections..

3.2.

The Committee recommended:

- That the Executive Director of Development and Infrastructure should procure the services of a specialist consultant to develop a Digital Strategy for the islands that recommended a clear strategic plan to deliver a gigabit capable network.
- That the remit for the consultancy should focus on the following matters:
 - Network planning to deliver gigabit connectivity to 100% of Orkney.
 - Assessment of the options for the Council network post SWAN and whether it can deliver both cost savings and income generation to the Council and assist the establishment of a viable network covering all of the Orkney Islands.
 - Assessment of the options to provide sustainable connectivity solutions to those areas where geography and distance create physical challenges, particularly the outer islands.
 - Determine options to realise plans for delivering gigabit connectivity.
 - Determine sources of finance for connectivity solutions optimising the use of Government grants and quantify funding gaps.
 - Evaluate the extent of the ability of national solutions (e.g. R100 and Gigabit Broadband scheme) to deliver for Orkney communities.
 - Recommend a route map for delivery having assessed the above.
- That the Executive Director of Development and Infrastructure should submit a report, to the Committee no later than December 2021, presenting a draft Orkney Digital Strategy and delivery plan.
- That the Council should continue to engage with both the Scottish Government and the UK Government to enable the greatest possible roll-out of fibre through all available schemes and funding opportunities.

4. Orkney Islands Digital Infrastructure Investment Case

4.1.

Following competitive tendering, the Council engaged Plum Consulting to support development of a digital infrastructure investment case for Orkney. The focus of the study included network planning and development of commercial options, to support a target of 100% gigabit capable connectivity. The analysis undertaken was based

on information provided up to March 2022 by the Scottish Government on the geographical distribution and number of properties due to be upgraded to receive superfast services. The assessment also took into account current and future requirements across both the public and private sectors. A copy of the final report is attached as Appendix 1.

4.2.

The consultants were provided with information of the Council's current network, its fibre infrastructure and services procured as part of the SWAN network. Officers shared details of the proposed roll out of infrastructure by Openreach under the Scottish Government's R100 programme and mapping indicating the extent of roll out of superfast services throughout Orkney and premises eligible for voucher funding to support their own solutions.

4.3.

To ensure an accurate and independent analysis of connectivity in Orkney, the consultants were provided with contact details for local wireless network services provided by Cloudnet IT Solutions, Norsenet, BT Openreach and Faroese Telecom.

4.4.

The consultants confirmed the Council view that, despite the promise of mass connectivity with the major gap funding initiatives from Government's R100 and Project Gigabit, these had as yet failed to deliver gigabit connectivity results for Orkney's residents. The R100 programme can be seen as insufficiently ambitious with its original focus on superfast connectivity. The consultants also argue that the scale of gap funding is insufficient – given the economic challenges in building fibre to the premises in rural areas of Scotland. They concluded that based on the information available at the time of analysis there remains continued significant doubt as to whether the R100 programme will deliver on gigabit needs in Orkney.

4.5.

The consultants further stated that the UK Government's Project Gigabit has also attracted its share of criticism, with concerns from investors on overbuild potential, changing plans, and procurement complexities associated with the programme. In addition, the current focus is largely towards supporting Fibre to the premises (FTTP) roll-out in England. Whereas Government vouchers are an option they are supplier-led: they depend on suppliers' willingness and appetite to build with gap funding (and some commercial interest). Should the Council determine it wishes to seek funding to improve its fibre infrastructure, it will require to tailor any application to Government to the specific challenges and market facing rural island communities.

4.6.

It should be noted that the UK Government is working collaboratively with the Scottish Government on how funding could be used to provide greater speeds and coverage. The Council has been actively lobbying both Governments seeking full fibre connections for all with a particular focus on Orkney's outer islands.

5. BT Openreach Build Programme

5.1.

According to current plans Openreach will invest without subsidy to install some fibre in Kirkwall. Under contract by the Scottish Government under the R100 programme they will build fibre to an estimated 2,100 premises throughout Orkney. At a conservative level, Openreach FTTP deployment will cover around 35% of all Orkney Islands premises (by around 2026, according to Openreach plans).

5.2.

In addition they have been contracted by the Scottish Government to build and operate subsea fibre between a number of islands, as detailed in Appendix 2 to this report. It should be noted however that whilst being provided with significant capital funding for the subsea fibre, anyone wishing to access this infrastructure will have to pay standard commercial charges. Smaller companies, such as those operating within Orkney do not have access to the level of working capital to secure the cheapest backhaul charges.

6. Local Network Investment Plans

Aside from Openreach, only limited network alternatives presently exist. Modest (10Mbps broadband) packages are available from two local companies, principally Cloudnet and Norsenet – regional infrastructure-based Wireless Internet Service Providers – who provide Fixed Wireless Access (FWA) solutions. The Scottish Government, as part of the R100 programme, has approved funding to Cloudnet to invest in a full fibre solution on Papa Westray. Cloudnet have indicated a willingness to work with communities to develop their own community network solutions using the R100 voucher scheme (with a preference for fibre solutions ahead of fixed wireless access where viable).

7. Public Sector Networks

7.1.

Many of Orkney's public services (including NHS Orkney, Orkney Islands Council, and schools) are connected to the existing SWAN network (currently administered by Capita plc). For Orkney Islands Council, the SWAN network delivers secure interconnections and internet access at the Council headquarters and 14 schools, mostly on the isles. SWAN connections are either via fibre or, where fibre is not available, purpose built point-to-point fixed wireless / microwave links across the islands

7.2.

The SWAN network in Orkney is meeting requirements in terms of connectivity and security. As with the wider market, public sector users progressively are seeking access to better performance. While connectivity at the Council Headquarters comprises two 500Mbps connections, performance at schools is currently 20Mbps to

30Mbps. As the SWAN contract is due for renewal at the end of March 2023, 50Mbps connections have been specified at these locations for the next contract.

7.3.

The roles that SWAN plays in providing connectivity and access to the Council are seen as positives by the consultants – in particular in delivering secure Internet Access, cybersecurity monitoring, filtering and protection. Service performance and traffic security is monitored from a 24/7 network operations centre service across SWAN.

7.4.

Those other Council sites whose connectivity is not served by SWAN use Council operated WAN connections to link them to the Council Headquarters. These are either via council fibre or council fixed wireless / microwave links. The extent of Council fibre is limited at present to only Kirkwall and Stromness areas, and only to a few sites.

7.5.

For both the SWAN network and the Council operated WAN, the fixed wireless / microwave technology is cost effective but susceptible to faults, normally due to bad weather or wear and tear. Rectifying faults can be problematic due to location of equipment on masts in remote locations.

7.6.

In addition, Ofcom licensing regulations require equipment to be manufactured to specified frequencies, which can delay the delivery of replacement parts and lead to faults lasting for several weeks or months

7.7.

As more use is made of online technologies, more emphasis needs to be placed on high bandwidth and reliability. Fibre is not prone to weather conditions and can provide excellent bandwidth, 10Gbs+. Performance of fibre connections are superior to both fixed wireless and broadband – fixed wireless connections such as microwave can “lag” due to what is termed “latency” (literally the time for a signal to travel) and broadband connections are not suited for bidirectional communications (upload bandwidth is a fraction of download bandwidth). Fibre also lasts for many years unlike microwave which needs replacing on a 5/6 year rolling programme.

8. Scottish Government R100 Update

8.1.

In late August 2022, the Scottish Government unveiled an extension of its existing R100 contract with BT (Openreach), which will see a further £36m being invested to cover an additional 1,488 rural properties with a gigabit-capable FTTP network.

8.2.

Of the 1,488 properties, 1,151 are in Orkney, bringing additional coverage to Hoy, Westray, Shapinsay, Eday, South Ronaldsay and some parts of the Orkney mainland. To accommodate the additional properties, the Scottish Government has extended the build programme up to 2028.

8.3.

The addition of these properties into the main R100 contract means there will be a commensurate reduction in the number of properties eligible for support under the Scottish Government Broadband Voucher scheme.

9. A Possible Solution to reduce the Orkney Digital Divide

9.1.

It is clear that the Council and the wider community, need to see a significant improvement of telecom infrastructure in Orkney beyond that currently being planned through private sector investment or public sector programmes if a gigabit capable network is to be realised.

9.2.

Based on the mapping information provided by the Scottish Government at the time of this analysis (March 2022) over 2,000 properties in Orkney were to be reliant on voucher schemes. The Scottish Broadband Voucher Scheme will provide funding of up to £5,000 to help homes and businesses not in scope of either Reaching 100% (R100) contracts or planned commercial investment to obtain superfast broadband where providers may not ordinarily go. However, and crucially, the scheme is supplier-led: they depend on suppliers' willingness and appetite to build with the funding available. In many cases the level of funding is inadequate to cover the costs to deliver the required connection speeds and the onus is on the individual to apply for funding and arrange installation.

9.3.

Based on the geographical spread of properties eligible for full vouchers and the number of vouchers available in Orkney the consultants concluded that if aggregated a fixed wireless network could be built and operated, but there would be insufficient funding from vouchers alone to cover the costs of a full fibre solution.

9.4.

The UK Government has recognised that a gigabit capable network is unlikely to be commercially viable in areas such as Orkney. GigaHubs are part of 'Project Gigabit', the UK Government's £5bn programme. Over the next 3 years, up to £110m of government funding will be invested into providing gigabit connectivity to up to 7,000 rural public sector buildings including schools, GP surgeries, libraries and other public buildings. Up to 100% funding is available under this scheme.

9.5.

The GigaHubs model works by providing funding towards infrastructure build for eligible public sector buildings and where investment cases are clear. GigaHubs is designed to bring new fibre right into the heart of communities, providing 'hubs' from which industry can connect surrounding homes and businesses. The opportunity therefore arises that GigaHubs can be used firstly to improve the Council's own internal network, but then to create a connectivity foundation to support the delivery of Internet access to the wider Orkney community by private providers.

9.6.

With limited gigabit access connectivity in place in Orkney, the consultants have recommended the optimum technical solution that meets the needs of both the public sector and wider community to be a hybrid technology approach to delivering a gigabit capable network using a combination of full fibre to local hubs, and private sector led gigabit capable fibre or wireless networks from local hubs to end user premises.

9.7.

With such a hybrid approach, they estimated a total capital outlay requirement of £11.4m, covering new build fibre to Council properties funded through the Gigabit Hub programme, and fibre and/or wireless networks built by commercial providers partially funded through aggregation of the R100 voucher scheme.

10. The Commercial Case

10.1.

The consultants provided an assessment of an investment case for the building and operation of a gigabit capable network that demonstrated that under the scenario based on the mapping information provided by the Scottish Government for the R100 programme in Orkney in March 2022, a sustainable business model was feasible, subject to access to sufficient capital funding, based on customer demand and the likelihood of little or no infrastructure competition.

10.2.

With the most recent announcement from the Scottish Government on the addition of over 1,000 properties on Orkney to the main R100 delivery programme, the financial analysis undertaken by the consultants can no longer be relied upon, and the business case demonstrating the investment case for the building and operation of a gigabit capable network covering all of Orkney will require to be re-examined.

11. Option Appraisal

11.1. Do nothing

11.1.1.

The Council could consider that current Government initiatives, principally British Telecom's (BT) commercial investment plans in Kirkwall, the Scottish Government's contract with BT Openreach to deliver subsea fibre and fibre to approximately 3,000 premises combined with a voucher scheme for those not part of the BT contract to be sufficient to deliver an adequate solution for Orkney.

11.1.2.

The voucher scheme would remain for residents and business although it rests with the individual to proactively apply and seek an individual solution. It would be unlikely to deliver aggregate solutions and would be limited by private commercial operators willingness and capacity to deliver.

11.1.3.

With this option, the Council would continue to utilise SWAN services and would remain reliant on microwave and fixed wireless access infrastructure, along with minor levels of fibre utilisation in Kirkwall and Stromness. There may be scope for some Gigabit connectivity solely for internal use but probably at a limited scale and with no benefit to the community.

11.1.4.

This approach would fall well short of the Council's aspirations for a 100% gigabit capable network for Orkney.

11.2. Continue to lobby and support R100 voucher roll out

11.2.1.

The Council could consider increasing its efforts to lobby for parity of provision of communication infrastructure in Orkney to both the UK and Scottish Government.

11.2.2.

In addition, the Council could offer to provide advice and support for individuals and community groups to maximise the outcomes from the R100 voucher scheme. This could include support – particularly in the islands to develop community solutions based on the aggregation of voucher values. This may help facilitate more efficient and robust network solutions.

11.2.3.

This will be unlikely to deliver a gigabit capable network throughout Orkney although may increase the number of households accessing vouchers providing superfast services. It would further provide an opportunity for those islands seeking to facilitate local network improvements. It is not known if the funds would be sufficient to justify investment in fibre solutions for each island.

11.2.4.

Under this option the Council could continue to pay for SWAN network services or apply for funds to build out fibre to its own premises.

11.3. A full scale public sector only solution

11.3.1.

The Council could apply for funding to support the build of fibre to its own properties under UK Government digital support programmes such as Project Gigabit or the Gigabit Hubs. This would greatly increase network security and reduce reliance on less robust wireless infrastructure. Internet access would still be delivered via the utilisation of SWAN, but all of the current fixed wireless and microwave links could be superseded by fibre connectivity such as Gigabit Hubs.

11.3.2.

The Council would retain SWAN services as the principal vehicle for secure access and connectivity to other public bodies and the Internet. The need for SWAN delivered connectivity to Schools and other Orkney Locations could be reviewed once alternative services are available, but the role of SWAN as an essential part of the solution would remain – particularly for secure external connectivity.

11.3.3.

It would not result in improved network coverage or services to individuals or communities in Orkney.

11.3.4.

As the current contract for SWAN is due to end in March 2023, any plans regarding SWAN will depend on the outcomes of a procurement for a new contract which is still in progress at a national level.

11.4. A full Council owned and commercially operated network

11.4.1.

The Council could consider applying for UK Government funds to install fibre to its own properties (and other public sector properties) and using this infrastructure to build out an Orkney wide network to provide a gigabit capable network throughout Orkney.

11.4.2.

This approach would give the Council the option of investing in either the ownership and operation of local internet services to the community or the possibility of making the network available for another entity to operate.

11.4.3.

Should the Council pursue this approach the Council would take on all of the risks associated with the provision of commercial broadband services and/or the risks of finding a commercial operator willing to lease/use the Council funded network.

11.4.4.

The Council would become the de-facto public network operator in this arrangement, akin to the role that BT and Openreach plays. In this role, the Council would need to operate a 24/7 network operations centre, avail itself of engineering resources and operate a small fleet of vehicles to support these operations and repairs across Orkney. It would need to investigate the best way to provide timely support to isles and resource accordingly. Failures and technical issues would require swift and effectively resolution to ensure that the reputation of the Council is not impacted. Furthermore, it would need to establish a way to operate in a retail/commercial space. This would be at significant risk to the Council and would not align with the recommended best practice as advised by the Digital Office.

11.5. A hybrid approach

11.5.1.

The Council could consider establishing Gigabit Hubs by applying for UK Government funding towards fibre build for eligible public sector buildings. Those buildings offer an opportunity to bring new fibre right into the heart of communities for the first time, providing 'hubs' from which industry can connect surrounding homes and businesses.

11.5.2.

This approach offers a route that provides a gigabit-capable connection to a public building but with the added benefit that internet service providers could, subject to appropriate terms being agreed, access fibre from the public building and invest in and build their own networks from which residents and businesses within a given area can access. This would be at commercial risk to the internet service providers.

11.5.3.

This would allow providers to utilise the fibre infrastructure delivered but the service they would operate would remain in their control, isolated and physically segregated from the Council's own secure internal network. There would be some requirement for the Council to facilitate controlled physical access to network rooms but these circumstances would be limited.

11.5.4.

Given the segregation and limitation of risk to the Council by avoiding taking on responsibility as a commercial provider but allowing overcapacity in the Council's network infrastructure to be designed into the solution as a vehicle to provide the essential fibre backhaul to providers.

11.5.5.

Locations would be planned to focus on key eligible Council premises in areas unlikely to benefit from actual delivery of fibre via R100.

11.5.6.

For this option to be effective in delivering private network services it would have to be sufficiently attractive to commercial Internet Service Providers. It is therefore recommended that the Council should consult with local internet service providers.

12. Recommended Route Map for Delivery

12.1.

The recommended approach for the Council to consider is the hybrid model, Option 5 as detailed in section 11.5 above.

12.2.

A proposed route map to support delivery of an improved connectivity for all of Orkney could be segregated into two separate, but parallel, workstreams:

- Firstly, consideration of investment to improve the Council's Internal Network, via better SWAN connections, new Gigabit Hubs or improved Council infrastructure. This could create a backbone to support better community connectivity.
- Secondly, the main actions to support/facilitate the delivery of a commercially owned and operated network for those areas of Orkney excluded from current commercial network improvements or the R100 main contract.

12.3. The Council's Internal Network Workstream

12.3.1.

The Council will continue to maintain and improve its Internal Network via normal governance routes of the ICT Corporate Replacement Programme and the Capital Programmes. This will allow improvements to be made to both the Council Fibre and Fixed Wireless / Microwave network infrastructure, as part of these programmes, subject to capacity from current budgets. This will allow for some improvements to the fibre network in Stromness, as well as improvements to connectivity and resilience within Kirkwall's network. Delivery of improvements and replacement is an ongoing programme, repeated annually. Larger scale works will be considered by following the Capital Project Appraisal process.

12.3.2.

The Council currently accesses SWAN services as part of the Pathfinder North partnership of local Councils in Northern Scotland. Due to the current contract ending in 2023, the Pathfinder North partnership is waiting for the SWAN Management Board to advise on the outcome of the new contract, which the Scottish Government will award. Current work is in progress within the Partnership to plan a way forward, and within options for the Council being drawn for consideration by the Policy and Resources Committee in due course.

12.3.3.

The Council is actively investigating the use of an additional Internet Access Route to supplement the current SWAN links. This is to improve security of the Council network by diverting traffic from Guest Wi-Fi sources in Schools and Libraries from the SWAN network. This is expected to be delivered in late 2022 and funded from current resources.

12.3.4.

The Council could submit an application to the UK Government for Gigabit Hubs to be rolled out to Council locations across Orkney. The work required to lay fibre to locations currently not supplied would allow a major upgrade to the Council Network and additionally create an opportunity for third party Internet Service Providers to utilise spare physical infrastructure. The application process would commence in late 2022 with rollout expected to run from 2023 up to 2028, subject to successful application.

12.4. The Orkney Community Digital Delivery Workstream

12.4.1.

The Council will work with local telecom operators to establish their plans, priorities and capabilities to develop commercial network solutions. It is proposed that discussions commence in early 2023, with a delivery timetable to be developed as an outcome of this.

12.4.2.

In preparation for the expected shortfall in community connectivity due to any market failure of R100, the Council will develop an awareness campaign for residents and community groups on the availability of the R100 voucher scheme for properties outwith the scope of the main R100 programme. Delivery of this will be towards the end of 2022/early 2023.

12.4.3.

The Council will continue to lobby UK and Scottish Governments for equitable access to digital connectivity for all of Orkney's residents and Council services will work constructively and collaboratively with telecom operators to facilitate fibre build out programmes.

12.4.4.

The establishment of Gigabit hubs at key eligible locations throughout Orkney will create the opportunity for the commercial networks referenced in section 11.3.1 above to benefit significantly as delivery commenced. This will allow these providers easier reach to addresses in the vicinity of these not served by R100.

12.4.5.

Additional advice and guidance will be provided to community groups in developing their own gigabit capable network solutions. Delivery of this will be completed towards the end of 2022/early 2023.

13. Human Resource Implications

An additional post (Graduate Trainee Project Officer) was approved in the Phase 2 Council restructuring in order to provide additional resources to support the Council's connectivity priorities. The post has not yet been recruited to but will be in due course.

14. Links to Council Plan

14.1.

The proposals in this report support and contribute to improved outcomes for communities as outlined in the Council Plan strategic priority theme of Connected Communities.

14.2.

The proposals in this report relate directly to Priority 1.8: Lobby for access to Superfast Broadband of the Council Delivery Plan.

15. Links to Local Outcomes Improvement Plan

The proposals in this report support and contribute to improved outcomes for communities as outlined in the Local Outcomes Improvement Plan priority of Connectivity.

16. Financial Implications

16.1.

The cost of undertaking the study was £20,000. The costs were met by grant received by the Council from the Department of Digital, Culture Media and Sport as part of the 5G New Thinking trials.

16.2.

The report is not asking for any money at this stage. The recommendations suggest a hybrid approach which involves using public sector buildings as "hubs". There will be costs associated with this approach but no clarification on who will meet these costs. Officer time, and their costs, will also be required in leading this digital roll out. These costs would need to be met from within existing service budgets. Given the technical nature of the report a detailed risk assessment, including identifying the Council's exposure to cost should be completed.

17. Legal Aspects

In the event of an application to the UK Government for Project Gigabit funding being successful, any conditions attached to the provision of such funding would require to be observed.

18. Contact Officers

John W Mundell, Interim Chief Executive, extension 2101, Email john.mundell@orkney.gov.uk

Gareth Waterson, Corporate Director for Enterprise and Sustainable Regeneration, extension 2103 , Email Gareth.waterson@orkney.gov.uk

Hayley Green, Corporate Director for Neighbourhood Services and Infrastructure, extension , Email hayley.green@orkney.gov.uk

Kenny MacPherson, Head of Property, Asset Management ad IT, Email Kenny.macpherson@orkney.gov.uk

Shona Croy, Strategic Adviser (Renewables and Connectivity), extension 2853, Email shona.croy@orkney.gov.uk

Thomas Aldred, Interim ICT Services Manager, extension 2152, Email Thomas.aldred@orkney.gov.uk

19. Appendices

Appendix 1: Orkney Islands Digital Infrastructure Investment Case.

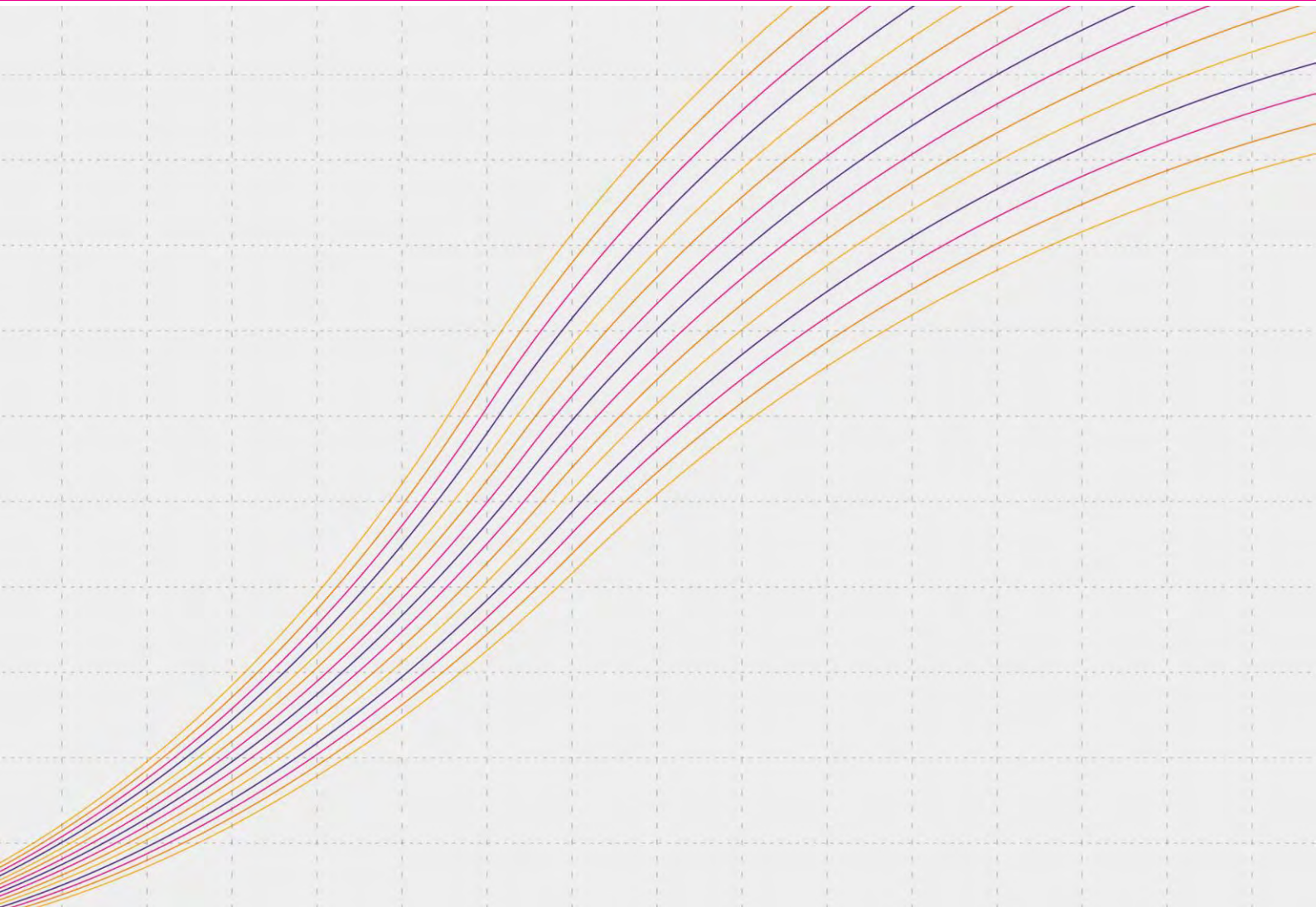
Appendix 2: BT Subsea fibre build.



Orkney Islands Digital Infrastructure Investment Case

February 2022

Prof. Ian Corden PhD CEng FIET, Sarongrat Wongsaroj MSc MA





Plum Consulting

Plum is a leading independent consulting firm, focused on the telecoms, media, technology, and adjacent sectors.

The firm applies consulting experience, industry knowledge, rigorous analysis, and its clients' understanding and perspective to address challenges and opportunities across regulatory, policy, commercial, and technology domains.



Our assessment

We were engaged by Orkney Islands Council (OIC) to support development of a digital infrastructure investment case for the region (project reference: OIC/PROC/1329).

Our focus has included network planning and development of commercial options, to support a target of 100% gigabit capable connectivity for the region.

With our assessment, we have taken into account requirements across both the public and private sectors.

Contents

Executive summary	4
1 Background	6
1.1 The Orkney Islands	6
1.2 Digital connectivity: current state	7
1.3 Submarine fibre cable connectivity	7
1.4 Gap funding situation	8
1.5 Regulatory issues	9
1.6 Market dialogue	10
2 Market requirements	11
2.1 B2C and B2B needs	11
2.2 Public sector needs	11
2.3 Coverage requirements	12
2.4 Gigabit service take-up levels	13
3 Network architecture	14
3.1 Broadband services	14
3.2 Network design principles	15
3.3 Access network	17
3.4 SWAN network	19
3.5 Local access aggregation	19
3.6 Backhaul	19
3.7 Internet peering and colocation (backbone interconnect)	20
4 Financial assessment	21
4.1 Funding assumptions	21
4.2 Cashflow analysis	22
5 Concluding remarks	23
5.1 Key observations	23
5.2 Roadmap for implementation	23
5.3 Recommendations	24
Glossary of terms	25
About the authors	26
Appendix A Key assumptions	27

Executive summary

Our scope with this paper has been limited, consistent with our contracted brief, to focus on development of an investment case, supporting 100% gigabit capable broadband connectivity for Orkney.

The Orkney Islands is part of the United Kingdom: an archipelago of small islands located around 10 miles off the north east coast of the Scottish mainland in the North Sea. The Islands are home to a new £65m hospital, plus a number of schools, colleges, and public offices. Major economic sectors include health and social care, agriculture and fishing, and public services, with tourism cutting across. Virtually all of the region is classified as 'very remote rural', with around 13k premises located across 990km² of land area. Around 35% of these are located in the main town of Kirkwall.

Orkney is currently ranked as one of the UK's most poorly served broadband areas, especially in terms of gigabit per second broadband speeds.

Less than 2% of Orkney premises are able to access gigabit rates (via Openreach FTTP), with around 66% of premises able to access superfast (30Mbps), and c. 20% of premises accessing just 10Mbps or less.

Market scale and rural location should not be impediments to gigabit access.

The pandemic has made it very clear that remote access to modern broadband is essential, and it is well-known through numerous professional studies that digital broadband connectivity is an enabler for economic growth in modern service-based economies. Further, any impediment to fixed access broadband roll-out is a direct inhibitor to deployment of 5G and modern wireless networks as these need high speed links for core network connectivity.

With the remote location of Orkney Islands, backhaul costs are a major factor (i.e. cost of data conveyance from Orkney Islands to main internet backbone colocation hubs in Scotland).

Despite the promises of mass connectivity with the major gap funding initiatives from Government: R100 and Project Gigabit, these have as yet failed to deliver full gigabit connectivity results for Orkney's residents.

Consequently, proactive dialogue with Government is required, supported by an investment case meeting a clear gigabit capable coverage ambition – set at 100% of premises by Orkney Islands Council.

Some public sector needs in Orkney are met via the SWAN public services network which is being tendered for renewal¹. SWAN is supported by bitstream access services, in the same way that all other segments are (but implements particular security and quality standards through use of SD-WAN technology). Adequate quality in access network bitstream performance is therefore a key issue across all segments. Other public sector needs are met with FWA or FTTP access links which connect to OIC's main office which acts as a SWAN hub.

The UK market is influenced by a number of government initiatives and regulatory actions. Broadly, these include developments in regulatory pricing affecting FTTP products, gap funding to support build-out in more rural areas, and new spectrum licensing and access – supporting regional access for wireless systems in new radio bands.

¹ SWAN connectivity is provided to OIC's main office, plus 15 schools.

We recommend a hybrid technology approach using a combination of full fibre FTTX to local hubs, and gigabit capable wireless FWA from local hubs to end user premises.

With such a hybrid approach, we estimate a total capital outlay requirement of c. £11.4m, covering new build on FTTX fibre for FWA hubs and FWA site deployments. With take-up towards 100% over 5 years, given the remote location of the Orkneys, and the likelihood of little or no infrastructure competition,

Our investment case assessment shows that a sustainable business model is feasible, subject to access to sufficient capital funding – which is likely to require gap funding or significant subsidy.

Operational costs will be driven significantly by backhaul charges. Therefore, we have assumed use of long distance submarine cable based leased line bitstream services to provide connectivity between a main exchange point on Orkney and an IP peering colocation site based in Aberdeen, Scotland. Resilience could be provided at additional cost, via overland backhaul circuits. Given the need for development on wayleaves and rights of access, we would expect a complete build programme to take around 4-5 years. This however is subject to access to adequate capital funding. We recommend that administrative issues are examined, as this is longer than we have seen in other regions, with similar scale.

Key recommendations:

- We recommend that public services are maintained via the SWAN network, and that focus is placed on developing gigabit capable connectivity to premises, with supporting infrastructure. As access connectivity is improved, we would expect the SWAN network to make use of this over time.
- As a priority, OIC should look into reports of inefficiency in planning and administration with its own processes, relevant to roll-out of telecoms infrastructure.
- We see value in OIC taking a leadership role in roll-out of a market awareness campaign to end users, to drive up awareness of the social, economic, and commercial benefits of connectivity for the region. This should be made region-specific, but could usefully leverage previous activities such as the work done under UK GigaTAG². This will promote take-up of digital services, and a sustainable telecoms business in region.
- We see OIC as facilitating telecoms infrastructure investment and stimulating market demand, rather than taking a role as a telecoms operator itself. Precedent suggests that the latter can lead to conflicts with private operators to the detriment of the market. Local intervention can, however, be valuable in some cases (e.g. driving down backhaul charges). Operation is best carried out by commercial operators in our view.
- We recommend that OIC takes a leading role in facilitating the development of new local FTTX and long distance backhaul connectivity, leaving access network development focus to the market (supported by gap funding).
- Development of proactive dialogue with both the Scottish and UK Governments will be important, to position a strong case for gap funding for Orkney. We note, however, that the R100 and Project Gigabit programmes come with a level of due process to be followed, though Governments actively encourage dialogue. Dialogue with Openreach, Cloudnet and other interested telecoms infrastructure-based operators will also be important – to establish committed build levels.
- It may be prudent to assess how phased build-out of gigabit connectivity could bring most significant benefits at an early stage. We recommend that build areas are targeted with consideration of scale of social and economic benefits that could accrue with access to new high quality broadband services.

² See: <http://www.broadbanduk.org/2021/06/17/the-gigatag-publishes-its-final-report/>

1 Background

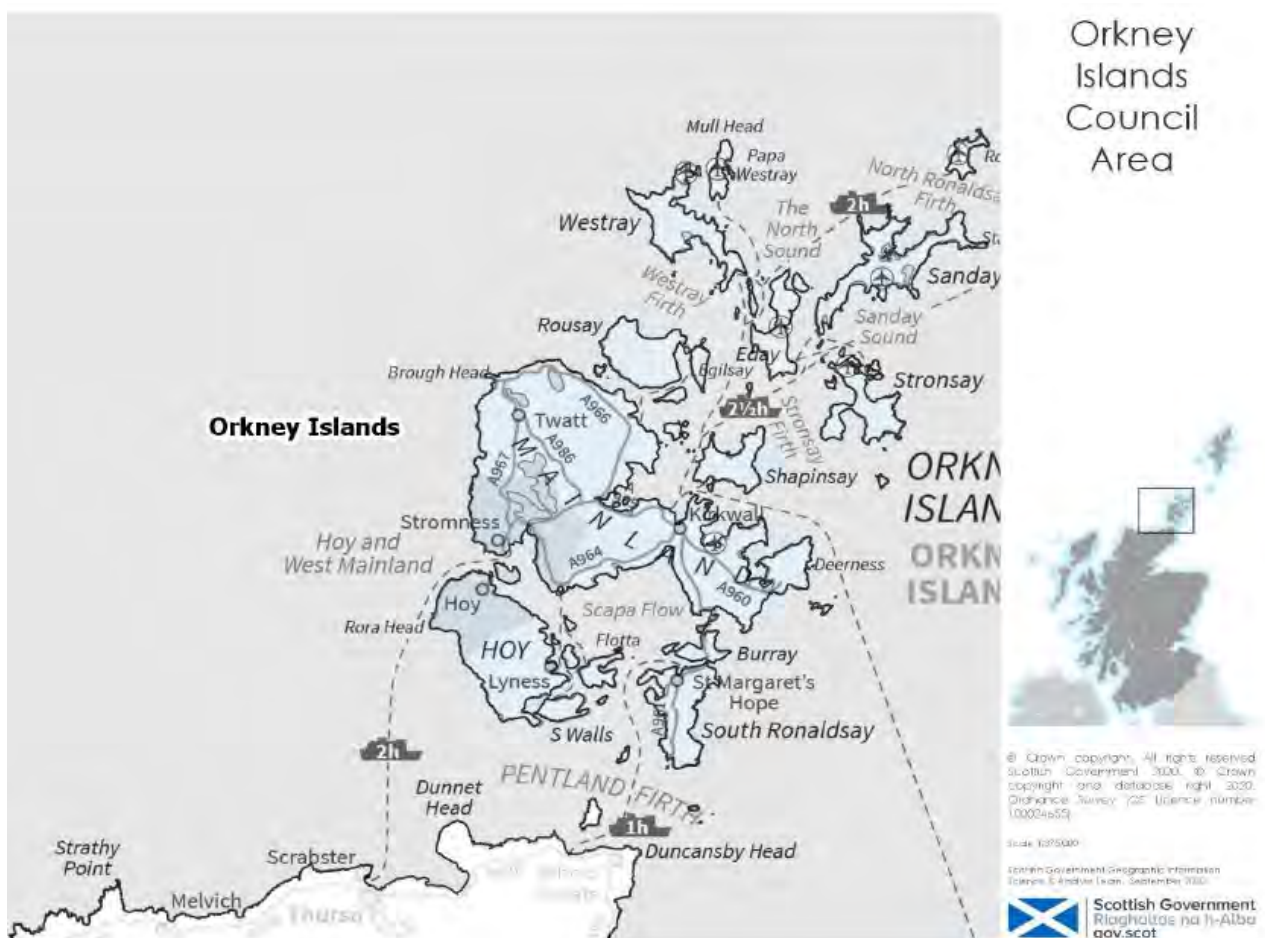
1.1 The Orkney Islands

The Orkney Islands (see Figure 1.1) is part the United Kingdom: an archipelago of small islands located around 10 miles off the north east coast of the Scottish mainland in the North Sea, across the Pentland Firth. Virtually all of Orkney is classified as 'very remote rural'³, with the exception of Kirkwall ('very remote small town').

Key industries on Orkney include renewable energy development, tourism, farming, manufacturing, food production, and fisheries and aquaculture. Major economic sectors include health and social care, agriculture and fishing, and public services, with tourism cutting across⁴. The islands are home to a number of schools and colleges covering the full range of education to tertiary level. There is also the new £65m Balfour hospital, opened in 2019, located in Kirkwall and managed by NHS Orkney.

Population stands at c. 22,400⁵, total dwellings at c. 11,442, and c. 1,600 business sites, with a significant proportion of total Orkney population resident around the main town of Kirkwall.

Figure 1.1: Map showing the Orkney Islands⁶



³ <https://www.gov.scot/publications/scottish-government-urban-rural-classification-2016/pages/2/>

⁴ https://strathprints.strath.ac.uk/75705/1/FAI_2020_Orkney_Islands_Economic_Review.pdf

⁵ <https://www.nrscotland.gov.uk/files/statistics/council-area-data-sheets/orkney-islands-council-profile.html>

⁶ <https://www.gov.scot/publications/local-authority-maps-of-scotland/>

1.2 Digital connectivity: current state

Orkney is currently ranked as one of the UK's most poorly served broadband areas, especially in terms of gigabit per second⁷ broadband speeds. Less than 2% of Orkney premises are able to access gigabit rates (via Openreach FTTP), with around 66% of premises able to access superfast (30Mbps), and c. 20% of premises accessing just 10Mbps or less (typically due to long copper line distances, line and duct quality, and/or challenging terrain in some areas).

According to current plans⁸, Openreach will install some FTTP fibre in Orkney. Coverage is expected in Kirkwall, and other areas. At a conservative level, Openreach FTTP deployment will cover around 35% of all Orkney Islands premises (by around 2026, according to Openreach plans).

Aside from Openreach, only limited alternatives presently exist. Modest (10Mbps broadband) packages are available from Cloudnet – a regional infrastructure-based WISP altnet – which provides FWA solutions and has been an innovator using TV White Space (TVWS) technology⁹. With Openreach as the majority provider of wholesale broadband services in Orkney, and with its limited infrastructure, there is little alternative for end users: retail choice on the Openreach network does not, in reality, provide much choice at all.

Orkney's public service users (including the hospital, council, and schools) use the existing SWAN network services (currently administered by Capita plc). Premises access to the SWAN network is enabled via 'standard' broadband IP connections, though these are currently ordered and installed under the main SWAN contract. The SWAN network includes a purpose built point-to-point microwave backbone across the islands^{10,11}.

Market scale and rural location should not be impediments to gigabit access. The pandemic has made it very clear that remote access to modern broadband is essential, and it is well-known through numerous studies^{12,13} that digital broadband connectivity is an enabler for economic growth in modern service-based economies.

Further, any impediment to fixed access gigabit broadband roll-out is a direct inhibitor to deployment of 5G and modern wireless networks as these need gigabit links for core network connectivity.

All of this leaves no firm commitment for 100% gigabit access network coverage for Orkney residents.

1.3 Submarine fibre cable connectivity

Orkney (Skaill) is currently connected to the Scottish mainland (Dunnet Head) via the 'Northern Lights' subsea fibre cable, operated by BT since 2008, with an expected end of service by 2033.

⁷ Gigabit per second broadband speeds (or higher) are widely seen by industry and UK Government as the target level for modern connectivity. This evidenced clearly throughout the UK with billions of pounds now being invested in full fibre demand, and Government's own £5bn Project Gigabit. At an international level, some countries are attaining yet higher broadband levels (e.g. in Switzerland, 10Gbps broadband is becoming the national standard).

⁸ <https://www.openreach.com/fibre-broadband/where-when-building-ultrafast-full-fibre-broadband>

⁹ TVWS technology makes use of unused TV radio bands to provide broadband access services. Whilst regarded as innovative, the technology is generally not seen as a mainstream solutions meeting modern broadband requirements. Other fixed wireless access (FWA) technologies are typically deployed when gigabit capability is demanded.

¹⁰ The SWAN public service network (PSN) contract includes a number of services available to public sector users, with economy of scale as a key concept. At a network architecture level, SWAN is built upon a network of networks (NoN) concept with central core capability (including domain management, core data network, BSS/OSS), with end to end service assurance (service levels, virtual seamless network regardless of underlying physical networks) and network security implemented via a secure core, adherence to common standards, and managed access.

¹¹ https://web.archive.nationalarchives.gov.uk/ukgwa/20100304104621/http://www.cabinetoffice.gov.uk/media/142379/vdn_report.pdf

¹² Koutroumpis, P: <https://www.ofcom.org.uk/research-and-data/telecoms-research/broadband-research/economic-impact-broadband>

¹³ Corden, I: <https://www.5gruralfirst.org/wp-content/uploads/2019/10/5G-RuralFirst-New-Thinking-Applied-to-Rural-Connectivity-1.pdf>

Orkney is also served by the Shefa-2 cable (Manse Bay and Ayre of Cara in Orkney to Banff in Scotland), operated by Shefa (Faroese Telecom).

Some resilience in these connections exists, with two connections to UK mainland and also to Denmark via the Shetland / Faroe Islands subsea network, although there is some history of cable breakages due to fishing trawlers and ships' anchors operating in the region.

Additional subsea fibre optic cables serving Orkney are expected to be laid during 2022, as part of the R100 programme; this includes connectivity between a number of the islands.

1.4 Gap funding situation

Despite the promises of mass connectivity with the major gap funding initiatives from Government: R100 and Project Gigabit, these have as yet failed to deliver gigabit connectivity results for Orkney's residents.

The R100 programme has been delayed with legal challenges, and can be seen as insufficiently ambitious – with its original focus on superfast connectivity. Some would also argue that the scale of gap funding was insufficient – given the economic challenges in building FTTP in rural areas of Scotland. There remains continued doubt as to whether the R100 programme will deliver on gigabit needs in Orkney¹⁴ (R100 only pledges to deliver on superfast needs).

UK Government's Project Gigabit¹⁵ has also attracted its share of criticism, with concerns from investors and altnets on overbuild potential, changing plans, and procurement complexities. In addition, the programme's current focus is largely towards supporting FTTP roll-out in England.

Whereas Government vouchers are an option, and these have been well-received across the UK rural market in general – given their flexibility, there are eligibility issues: the R100 SBVS¹⁶ provides only limited gap funding if superfast connectivity is planned, and none if superfast is in place. The UK Government's GBVS¹⁷ goes some way further, offering funding if connectivity is less than 100Mbps and no gigabit network is planned and funded. Subject to eligibility, GBVS and SBVS vouchers can be 'stacked' to provide funding of up to £6,500 per residential premises and up to £8,500 for business premises. Perhaps most crucially, voucher schemes are supplier-led: they depend on suppliers' willingness and appetite to build with gap funding (and some commercial interest).

Commercial interest levels will depend on investment case viability and available resources, and commercial interest will naturally fall to more populated areas, where investment cases are more secure (unless gap funding is committed).

This situation points to a need for proactive dialogue with Government, if regional needs are to be met.

Specifically, dialogue to secure sufficient gap funding will be required.

¹⁴ https://www.orkney.gov.uk/Files/Committees-and-Agendas/Policy-and-Resources/PR2021/SPPR19-05-2021/103_Orkney_Digital_Strategy.pdf

¹⁵ <https://www.gov.uk/government/publications/project-gigabit-delivery-plan-autumn-update>

¹⁶ <https://broadband.gov.scot/>

¹⁷

1.5 Regulatory issues

1.5.1 Fixed access regulation

From a regulatory standpoint, there are challenges too. Since Ofcom's publication of the Wholesale Fixed Telecoms Market Review (WFTMR¹⁸) in 2021, there has been substantial concern from industry as to lack of support for altnets and their investors, especially in 'Area 3' (more rural areas), despite their spending billions of pounds on new network build programmes. This essentially results in potential pressures for altnets with their investment models.

More recently, Ofcom has cleared Openreach's 'Equinox' offer¹⁹, which introduces price discounts for its FTTP bitstream products at the wholesale level. Whilst on the one hand this has potential to drive down retail prices to benefit end users (as reduced FTTP wholesale prices will enable reduced FTTP retail prices), it could also drive some altnet providers out of the market (as they may not enjoy economies of scale in building networks that Openreach has access to), ultimately affecting consumers and limiting competition. Legal challenges on 'Equinox' are ongoing and it remains to be seen whether Ofcom will shift its position, although it seems unlikely.

Openreach is unlikely to build in all regions, and its executives have publicly stated that they do not see themselves as the only provider of FTTP infrastructure. No doubt, Openreach will build where it sees fit, and altnets will continue to have an important role in the market.

A more effective course of action for ISPs in the near term will be with novel commercial models, and right technologies for the job, supported by relevant areas of policy and regulation.

1.5.2 Wireless sector regulation

On the wireless side of the industry, things are rather brighter.

Since Ofcom published its Wireless Innovation Statement in 2019²⁰, commercial wireless operators have sought to exploit regional spectrum sharing with a variety of new commercial models. These include wholesale 4G mobile access via neutral hosts, and deployment of leading edge gigabit FWA solutions – enabled with 5G chipset based products operating in the 3.8-4.2GHz band, as the supply chain continues to develop.

Ofcom has further set out its broad approach towards spectrum management in a recent statement²¹. Licensing for FWA equipment in the 26GHz band is expected later in 2022.

These developments enable commercial deployments of novel fixed wireless access radios capable of supporting gigabit speeds over link distances of several kilometres, with appropriate system designs.

¹⁸ <https://www.ofcom.org.uk/consultations-and-statements/category-1/2021-26-wholesale-fixed-telecoms-market-review>

¹⁹ <https://www.ofcom.org.uk/consultations-and-statements/category-3/openreach-proposed-ftp-offer>

²⁰ <https://www.ofcom.org.uk/consultations-and-statements/category-1/enabling-opportunities-for-innovation>

²¹ https://www.ofcom.org.uk/_data/assets/pdf_file/0017/222173/spectrum-strategy-statement.pdf

1.6 Market dialogue

1.6.1 Dialogue with Openreach

We are grateful to BT and Openreach (Robert Thorburn, Partnership Director) who supported dialogue for this paper. We discussed a number of areas including FTTP build plans for Orkney, backhaul, and gap funding. We appreciate that some areas remain commercially sensitive, and that it was not possible to discuss these. Key points from our dialogue are listed below:

- In some cases, the R100 programme is supporting FTTP build-out, including areas in Orkney Islands (see Figure 2.1). Openreach has committed FTTP build plans for Kirkwall.
- The R100 programme is already supporting new subsea cables²², including in Orkney.
- Investment initiatives should be supported by an awareness campaign led by OIC targeting end users, to clearly lay out the social, commercial, and other benefits that come with gigabit connectivity – to ensure good take-up on services where they are built.
- Planning and administration activities as relevant to telecoms infrastructure in Orkney are in some cases restrictive.
- Openreach continues to seek ways in which best returns for investments in gigabit networks can be attained, and is supportive towards gigabit developments in Orkney and other regions.

1.6.2 Dialogue with Cloudnet

We spoke with Greg Whitton (CEO, Cloudnet IT Solutions Limited), and are grateful for the dialogue. Cloudnet is an altnet telco operator with interests in Orkney. The company offers internet connection services in the region using FWA and TVWS technologies. It is also interested in rolling out FTTP, subject to feasibility with an investment case. Key points from our dialogue are listed below:

- Planning for sites and wayleaves in Orkney can sometimes be challenging. Cloudnet is looking to acquire code powers from Ofcom, and would welcome OIC's support in rendering efficient site access and planning applications.
- Recent applications for microwave licences in the region from EE have caused a restriction for local operators seeking these (i.e. radio spectrum 'congestion').
- There was agreement that public intervention is needed to support the case for gigabit rollout in region, and the UK Government's Project Gigabit is seen as a key programme which should be leveraged.

We note that Project Gigabit comes with a number of prescribed terms and conditions as it stands, together with established public procurement and market engagement processes.

²² See: <https://www.openreach.com/fibre-broadband/where-when-building-ultrafast-full-fibre-broadband>

2 Market requirements

We see principally two categories of demand for digital connectivity in the region, with: (i) B2C and B2B users, and (ii) public sector users, currently serviced by the SWAN public service network.

Whereas some in the industry continue to question the demand for gigabit access data services, the trend in data usage is clearly upwards, with annual growth levels of fixed access broadband data usage in the UK market sustained at around +30% CAGR²³. Key traffic growth drivers include streamed video and gaming, with indirect drivers as high resolution smart TVs and devices, and shifts in social behaviour.

With fibre networks offering asset lives of decades once deployed, network designs must be able to provide good headroom for future demand. Another factor is user experience: with gigabit services, time taken for downloads is much faster than with legacy superfast connections, resulting in little or no buffering and satisfied users.

Gigabit capable networks are widely seen as an important investment for the future. If one assumes a demand level of 100Mbps as one reference point in today's market, with +30% CAGR over 10 years, the equivalent reference point after 10 years will be 1.3Gbps. Traffic is clearly growing, and future-proof networks, ideally with long asset lives, are seen as effective solutions.

2.1 B2C and B2B needs

With over 90% of Orkney's businesses employing fewer than 10 employees, the B2B sector is firmly driven by SME needs, which tend to be similar to B2C needs. In today's markets, larger businesses tend to require point to point FTTP links to support symmetric traffic links in excess of 1Gbps, with robust service level agreements and contracting.

As with the wider UK market, B2C and B2B demand in the region is driven by the need for gigabit connectivity to the public internet.

2.2 Public sector needs

The SWAN contract is well-established, having been awarded to Capita in 2014. It is intended to provide secure and resilient digital connectivity to public sector entities across Scotland including schools, hospitals, and council and government, with service integration and cost efficiencies via economies of scale²⁴. SWAN provides a variety of VPN-like services for users, including connectivity, technical design, help-desk, reporting, security services, and billing.

SWAN is up and running in Orkney, and is largely reported to be meeting requirements in terms of security and resilience, although it is now lacking in terms of cost efficiency and access network data throughput capability (by virtue of data rate limitations in access networks – many of which in Orkney are via bespoke fixed wireless, running at around 20-30Mbps).

²³ <https://www.ispreview.co.uk/index.php/2021/03/openreach-shows-increase-in-uk-data-traffic-over-past-year.html>

²⁴ SWAN was developed following the McClelland report of 2011, focused on review of public sector ICT services. A key principle noted in the report was use of shared services and common infrastructure. However, ICT and networking has changed significantly in the last 10 years, with novel developments in neutral hosts and cloud native solutions, this has become the norm. Cost efficiency with such contracts can now therefore be debated.

It should be noted that the UK Government and others are progressively moving away from the public service network (PSN) approach (now somewhat dated), as it is deemed that the public internet is suitable for the vast majority of the work that the public sector does (with suitable security and other measures in place)²⁵.

As with the wider market, public sector users progressively are seeking access to gigabit connectivity. Access network capabilities are thus a limitation with the SWAN network.

The SWAN contract is due for renewal before March 2023²⁶.

Aggregated demand on the SWAN network in Orkney currently reaches up to around 650Mbps across dual 500Mbps links.

2.3 Coverage requirements

With virtually no gigabit access connectivity in place in Orkney, we assume a greenfield access build requirement (excluding Openreach planned FTTP build), addressing 13,042 * 65% premises. (We assume Openreach planned build at 35% of Orkney premises).

Population and dwellings are distributed across the main Electoral Ward areas as shown in Table 2.1.

Table 2.1: Orkney total population and dwellings by Electoral Ward areas²⁷

Orkney Electoral Ward area	Population (2020)	# dwellings (2020)	# dwellings (% total)
East Mainland, South Ronaldsay and Burray	4,040	1,884	16%
Kirkwall East	4,841	2,546	22%
Kirkwall West and Orphir	4,017	2,022	18%
North Isles	2,241	1,367	12%
Stromness and South Isles	2,625	1,463	13%
West Mainland	4,636	2,160	19%
Total	22,400	11,442	100%

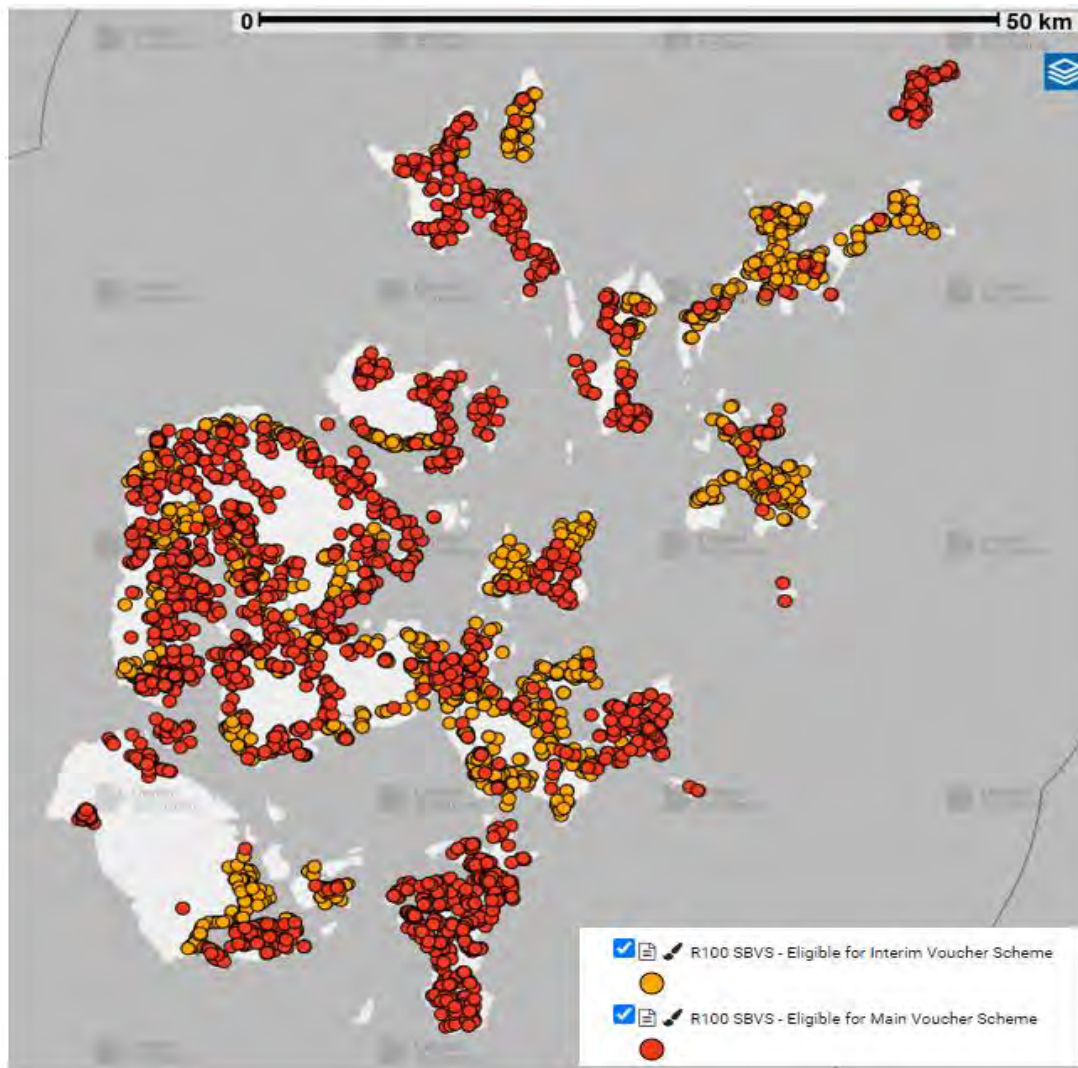
The Orkney Islands cover a total land area of 990km². Maximum radial distance on land from Kirkwall is around 50km (North Ronaldsay).

Openreach planned FTTP build areas include Kirkwall and other parts of Orkney. Openreach is expected to build FTTP to some, but not all areas. Figure 2.1 shows premises eligible for SBVS vouchers.

²⁵ <https://governmenttechnology.blog.gov.uk/2017/03/16/a-secure-future-for-psn-assurance/>

²⁶ <https://www.find-tender.service.gov.uk/Notice/019970-2021>

²⁷ <https://statistics.gov.scot/home>

Figure 2.1: Premises eligible for SBVS vouchers^{28,29}

2.4 Gigabit service take-up levels

Gigabit network investment cases are typically developed with take-up assumptions at around 50% after several years of operation. No firm data on this exists, as the UK market is still developing. For Orkney, we would expect take-up at these levels or higher, given the remoteness of the location, and the value to users of good internet connectivity (assuming retail prices in line with general UK FTTP prices; note that take-up tends to decline depending not only on price and broadband speed, but on level of improvement in broadband speed – less improvement contributes to less take-up).

²⁸ Data accessed by kind permission of The Scottish Government, Feb. 2022.

²⁹ The SBVS will provide two distinct levels of subsidy:

A 'one off' voucher worth up to £5,000 to help deliver a permanent broadband connection to those properties for which there is no roll-out of superfast broadband planned. Also known as a main voucher.

A 'one off' voucher worth up to £400 to help deliver an interim connection to those properties for which there is roll-out of superfast broadband planned from 2022 onwards. Applications for interim vouchers must be received by 31 March 2022. Properties in more difficult-to-reach locations may be eligible for an additional subsidy of £250. This is based on rurality and non-standard status of the installation. Also known as an interim voucher.

In some cases, rural addresses may be eligible to combine Scottish Government funding of up to £5,000 with funding from the UK Government's Gigabit Broadband Voucher Scheme (GBVS) which provides £1,500 for rural homes and £3,500 for rural businesses. If this is the case, chosen suppliers take this into account automatically and manage this.

3 Network architecture

We describe below our approach to network design to support the investment case. Further details are provided in Appendix A. Our focus is towards build-out of gigabit capable access networks and supporting FTTX and leased backhaul infrastructure. Both communities and public sector users are reliant on good quality access for all services. The existing SWAN network provides connectivity over IP access networks in the same way that internet service is provided for B2C and B2B users, albeit under different commercial and contracting terms (see section below on SWAN network).

We recommend a hybrid FTTX / FWA / FTTC approach for network development, balancing cost and performance. Whereas FTTP build-out is essentially 'the gold standard' for gigabit services, FTTP network deployment is both capital intensive and time consuming.

Modern gigabit capable FWA radio systems can provide more cost-effective solutions and rapid roll-out, especially in remote areas. These however are vulnerable to wind, corrosion and power outages.

FTTC networks are not gigabit capable, but may suffice as interim solutions where gigabit capable FWA cannot be deployed and end users have only very poor broadband services (e.g. <10Mbps). Evidence from the UK market shows that end users welcome improvements in broadband service, depending on current levels (e.g. access to ultrafast or superfast broadband is generally welcomed if service is only available at <10Mbps levels).

3.1 Broadband services

It is worth noting how broadband services are defined. Internet data is consumed in various ways, with various digital applications and services at the user level (e.g. PC email and file exchanges, two-way video calls, IPTV and music streaming, and B2B applications such as file servers or datacentres). The majority of internet traffic around the world today is driven by demand for video services.

Internet data is typically delivered in 'bursts', even when streaming services (e.g. Netflix) are consumed. This is due to the use of 'data buffering': memory in local applications which acts to 'smooth' the flow of data to the end user application. When internet connections are too slow, and buffers run to empty, this is seen by users as the familiar rotating dots symbol on TV or PC screens – showing that more data is required. In such cases, user services are disrupted until more data can be delivered.

Internet data rates can be measured principally in two ways: peak or average. Peak refers to the 'instantaneous' maximum 'burst' data rate possible with any given network design (i.e. 'line' speed), and average is the measured average data rate over some defined time period – with all the data rates ups and downs.

There is also the issue of network contention. To save cost, most networks are designed with some contention (or oversubscription ratio) built in. This is not unlike the practice of over-selling aircraft seats in the airline industry: at very busy times, some unlucky customers get 'bumped' (i.e. cannot access the service due to high demand). In network designs, contention is designed in with assumptions on network usage in practical situations: statistically, there is some probability associated with all connected customers in a local area wanting internet at the same time, at the same quality level, at the busiest time. Network design with well-engineered use of contention allows network backhaul to be implemented cost efficiently. We assume an access:backhaul contention level of max. circa 60:1 in our design, in line with typical industry practice. Contention levels can be scaled as networks evolve (at some cost of course).

With some ambiguity in the market with advertised data speeds, we refer to the gigabit technical specification adopted by BDUK in the Project Gigabit programme³⁰:

- Gigabit capable line speeds (products) are defined as those with an access line speed (i.e. peak rate) of 1Gbps, minimum download speed at 330Mbps at busy hour, and minimum upload speed of 200Mbps (for 95% of the time). Link latency is also specified at 10ms or below (at the 95% level).

3.2 Network design principles

Cost structure and commercial viability for the network as a whole will depend on the network architecture.

Therefore, in line with market requirements for Orkney, we make a number of assumptions on technical design, costing, dimensioning, and location of key network elements such as local aggregation points, backhaul gateways, backhaul trunking, and IP backbone interconnect peering sites.

We assume that core network functions (e.g. BSS/OSS/NMS) will be housed in data centres, with connectivity via the public internet, and via cloud services.

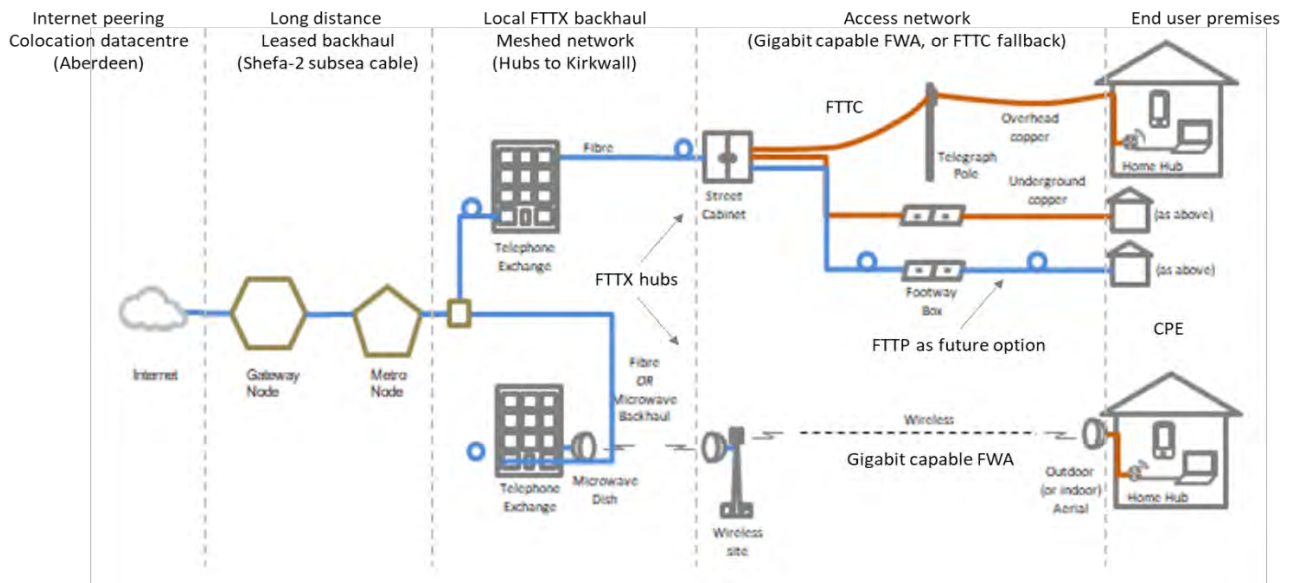
Overall, we assume that architecture will consist of the following key network domains, consistent with industry good practice:

- Access network: FWA sites providing gigabit capable connections to end users' premises;
- Local FTTX backhaul and aggregation: (often called local or main exchanges) where local connections are aggregated onto higher capacity network trunks;
- Long distance backhaul, via Shefa-2: network trunks connecting local aggregation sites with internet backbone connection sites;
- Internet hubs: major colocation datacentres (typically located in main cities across the UK), where local network providers are able to physically interconnect with the global internet (i.e. connect to other main network operators providing IP peering interconnections).

An illustration of network architecture with key elements is shown in Figure 3.1.

³⁰ BDUK Supplier Briefing: Project Gigabit Technical Specification, 2021. Note: whilst Project Gigabit funding comes with a number of requirements including design to support wholesale access, this is somewhat ambiguous and is being addressed progressively in the market.

Figure 3.1: End to end internet network architecture (illustrative)³¹



OIC premises locations are distributed across Orkney Islands, as shown in Figure 3.2. We assume that selected OIC premises are used as FTTX end points, with local backhaul meshed back to Kirkwall. Mean distance between OIC sites is estimated at 3km (for new FTTX fibre mesh). The figure shows illustrative FTTX network links, with cost dimensioning assumptions. In our model, number of hub sites is estimated at around 100, based on FWA capacity requirements.

Figure 3.2: OIC premises locations are distributed across Orkney Islands (illustrative)



³¹ Source: BDUK, 2021. We assume gigabit FWA connections are deployed in the main, with new fibre links supporting FTTC connectivity in areas where FWA deployments are not feasible. Such an approach provides gigabit capable core network capability for the Orkney Islands, with FWA access links.

Key design and costing assumptions are laid out in Appendix A, with summaries on technical approach below.

Our network design assumptions are based on our own extensive experience in working with numerous FTTP and FWA operators in the UK market, and hence on practical situations.

3.3 Access network

Capital investment and operational cost levels at the access network level are driven by coverage and capacity requirements to premises, which in turn depend on backhaul point locations, link capacity levels, and distances to premises.

3.3.1 FTTP option

FTTP PON technology uses fibre splicing and splitting, enabling 'fan-out' of fibre at the local level. This can provide cost-efficiencies through reductions in trenching, ducting, and cabling costs. Typical splitter ratios at the access network level are 1:64.

Any greenfield FTTP new build programme incurs significant financial outlay driven by civil works costs for trenching, ducting, and cabling. Typical roll-out approaches in the UK market include FTTP build with clustering on premises and incremental build to reduce capital costs as much as possible.

Civil works costs can vary according to terrain types (typical trenching costs range from £10/km for soft earth to £100/m for hard rock, asphalt road or pavement).

With the significant requirement on civil works with FTTP roll-out, deployment can be both expensive and prolonged.

Therefore, we exclude new FTTP build in our assessment.

3.3.2 Gigabit capable FWA option (with interim FTTC solution as back-up)

Fixed wireless access (FWA) technology with point to multi-point connectivity (P2MP) provides an alternative to FTTP. Whilst FTTP technology provides good resilience, once deployed, with asset lives of 20-30 years, FWA can be much quicker to market and cost-efficient: no trenching is required at the access network level towards user premises.

Use of FWA is now well-established in the UK market, with many systems deployed using the 5.8GHz radio band, consistent with Ofcom regulations. Any implications on radio spectrum congestion will depend on usage and access levels at the local level. Radio access systems operating in this band, however, do require line of sight access between main radio towers and end user premises. FWA solutions of this type have typically supported user internet connections at superfast speeds (i.e. around 30Mbps).

A number of advanced software tools (e.g. WISDM³², developed by Wireless Coverage Limited in the UK) are now available to support accurate and efficient development of FWA radio designs.

Recently, newer FWA radios have become commercially available supporting gigabit connectivity. These developments are based on 5G chipsets (instead of legacy 4G LTE and 802.11 chipsets), and are supported by recently introduced regulations from Ofcom, enabling FWA radio operation in the 3.8-4.2GHz licensed and

³² See: <https://www.wirelesscoverage.com/>

60GHz licence exempt bands. The 26-28GHz licensed 5G band is also of interest for FWA operation, and Ofcom is expected to introduce licensing for outdoor use in the UK market during 2022.

Whereas FWA radios operating at the 26-28GHz and 60GHz bands can typically support radio links over just tens or hundreds of metres, 3.8-4.2GHz systems can support gigabit connections to around 10km.

Capital cost per connected premises (CPCP) for FWA solutions can be well under £1k, and significantly less than with FTTP access networks.

All this said, it is important to note that FWA and FTTP technologies are not directly comparable.

Radio systems can suffer from interference, asset lives will be lower than with full fibre, and per-site operational costs can be higher.

Therefore, we assume that in some cases, FWA access networks will be displaced by FTTC in the interim. In these cases, we assume similar costs for DSLAM and FTTX installation. FTTC will of course run over legacy copper circuits, with new fibre to the DSLAM, equivalent to new fibre to the FWA basestation site (FTTX).

3.3.3 Satellite option

Whilst the various so-called new LEO satellite initiatives (e.g. OneWeb, Starlink, Swarm) have attracted some attention of late, in our view these remain commercially unproven and unsuitable to deliver gigabit services at acceptable price and quality points.

As with many investors and independent observers, we continue to take the view that satellite-based communications systems are useful in limited niche situations including for use in: maritime and aeronautical cases, developing regions, areas prone to instability, and war zones.

3.3.4 Hybrid option

A hybrid access network, based on well thought out application of both FTTX and FWA technologies, can provide an effective solution, with most appropriate use of each technology according to regional market demands and conditions.

FWA technology is well-suited to more rural areas, where sparsely located premises can be linked to FWA radio sites.

FTTP technology is more effective in urban areas, where premises are clustered together and distances to main exchanges are limited.

In our hybrid option, we assume that FTTP build in the Kirkwall area and in some additional areas³³ is already committed by Openreach, and is therefore excluded from our assessment.

We assume FWA gigabit radio local access links using the 3.8-4.2GHz band to premises across all new build regions.

We assume that a fibre to the hub (FTTX) model is used, where hubs are either FTTC local cabinets, or FWA radio base sites (fibre mesh model to FWA basestation sites and FTTC nodes, to reduce FTTX build costs).

³³ See: Figure 2.1.

We recommend that OIC takes a key role in facilitating fibre to these hubs, with associated backhaul, essentially enabling the local access market to provide FWA and FTTC connections to end users premises. This approach also supports new FTTP build if required as a *future option*.

3.4 SWAN network

The Scottish SWAN network, using SD-WAN technology and a privately developed microwave link core, is used in Orkney to provide resilient and secure connections to public sector users including the hospital, GP surgeries, schools, and council offices.

The current SWAN solution is reported by OIC to be satisfactory in terms of technical performance, although access network connections, which are supported via public internet IP connections, are reported to be cost-inefficient – due to the connection charges on these which fall under the existing SWAN contract terms.

The SWAN contract is expected to be opened up for renewal shortly, with replacement expected by 2023.

Existing SWAN access services are limited by underlying access network data speed capabilities. Services up to 1Gbps are available (where gigabit links are available)³⁴. Given that SWAN is deemed to offer satisfactory service (excepting with access network data speeds), our focus in the investment case is towards development of gigabit access network connectivity, with supporting backhaul. Access connectivity into SWAN is a somewhat separate commercial matter.

3.5 Local access aggregation

There are 23 Openreach local exchanges reported for Orkney, supporting LLU unbundling at the physical and bitstream level. As FTTP is rolled out, local exchanges are typically bypassed and replaced with gateway cabinets as a more cost-efficient option.

Therefore, we assume one main headend exchange located in Kirkwall, acting as a main gateway to access network facilities, and with direct connection to the backhaul network – which provides data conveyance to a major backbone internet colocation facility located on the Scottish mainland. Hence, we assume new fibre build from the headend exchange in Kirkwall to all FTTC / FWA sites (fibre cabling FTTX mesh model).

3.6 Backhaul

Gigabit access requires gigabit backhaul. Typically, backhaul nodes are implemented with scalable multiples of 10Gbps in full fibre networks.

We assume that internet backhaul is provided by third party suppliers on the open market, with most cost-efficient solutions adopted.

Backhaul is designed with one 10Gbps link supporting 2000 access users each with 5Mbps daily average busy traffic (typical contention ratio at around 66:1 on 330Mbps streamed products).

Multiples of 10Gbps links (e.g. Openreach EAD-10000 circuits) are then used to support backhaul for the whole of Orkney, with connectivity between the headend main exchange in Kirkwall and a major internet colocation backbone hub on the Scottish mainland (for IP traffic peering).

³⁴ See: <https://www.scottishwan.com/media/1244/swan-catalogue-services-31.pdf>

Overland backhaul to main colocation hubs proves prohibitively costly, as these hubs are located only in major cities. Using Openreach EAD circuits at open market rates, we estimate annual costs at around £250k pa (including 1+1 link resilience, and Openreach price supplements for FTTP access backhaul), plus around £100k connection charges.

Therefore, we recommend backhaul via the Shefa-2 subsea cable operated by Faroese Telecom. This provides connectivity from Orkney to Banff in Scotland. Limited overland backhaul connectivity in Scotland is then feasible to the IP peering facility located in Aberdeen.

3.7 Internet peering and colocation (backbone interconnect)

The UK as a whole is home to over 400 datacentres providing plenty of colocation (IP peering) opportunities. Many of these however are located in England, with nearly 200 in London alone.

In Scotland, the main datacentres are located in Glasgow, Edinburgh, and Aberdeen³⁵.

Aberdeen hosts 3 colocation datacentres.

We assume that interconnect equipment will be installed at the peering site; further details in Appendix A.

³⁵ Scottish Government advised us that the Scottish Futures Trust has developed plans for development of a number of new datacentres across Scotland. See: <https://hostinscotland.com/storage/180/Shortlist-Site-Selection-Revision-1-September-2021.pdf>; <https://hostinscotland.com/storage/179/Longlist-Site-Selection-Revision-1-September-2021.pdf>

4 Financial assessment

Our financial assessment is not exhaustive, and is intended to provide a level of accuracy as is typical in strategic investment cases for illustration of viability (as opposed to rigorous due diligence, supporting investment decisions).

Assumptions supporting our analysis are provided in Appendix A.

4.1 Funding assumptions

We spoke with a number of stakeholders during the course of our analysis, including Orkney Islands Council, BT, Openreach, Cloudnet IT Solutions Limited (Orkney altnet), and the Scottish Government. Many stated that further gap funding is best sought via the UK Government's Project Gigabit.

Whilst the R100 programme is providing some support for new submarine cables and some FTTP build in Orkney³⁶, the programme has been largely focused towards superfast build.

We agree that Project Gigabit provides a substantial pool of available funding (i.e. £5bn overall, of which £1.8bn is currently committed, for the UK as a whole), but caution that access to this comes with a number of prescribed technical and commercial requirements, and a rigid procurement process. In essence, 'intervention in the intervention' (i.e. some bespoke dialogue and agreement for Orkney gigabit funding) might be required to secure progress in this direction. We also note that Project Gigabit funding is mentioned alongside statements towards coverage for 85% of the UK's premises by 2025. Given that c. 80% of premises in the UK fall outside of the F20 (or rather F19) programme and are being built with private investments, this statement does not say so much. Around 20% of the UK's c. 30m premises fall in rural areas.

Overall, we would expect that a mix of public and private funding will be used to deploy gigabit capable connectivity across Orkney. Given the difficulty of investment cases in rural areas, we would expect that commercial investors would provide a relatively small proportion of funding (e.g. 10%) if any, with overall funding provided by government gap funding.

In our financial assessment, we examine the level of total funding required for gigabit capable build out across Orkney, excluding Openreach planned build (assumed at 35% of premises). Our assessment includes new build and operations for access networks, FTTX local backhaul, operations and peering, and long distance backhaul to Aberdeen (required for IP peering). Total funding could come from vouchers and project gap funding.

Below, we set out an investment case, with aggregated total costs supporting new gigabit network deployment with full coverage (i.e. to 65% of Orkney premises, excluding already committed Openreach build assumed at 35% of all Orkney Islands premises), and revenues based on retail pricing³⁷. This is provided to indicate the sustainability of any investment: there is little point in funding build-out with significant capital from any sources if long term operational costs cannot be supported by a healthy stream of ongoing revenues.

The cashflow analysis also provides an indication of the time for any build project to break even.

³⁶ See: <https://www.gov.scot/news/superfast-broadband-subsea-work-to-start/>

³⁷ We assume modest retail margins over wholesale prices, given the remoteness of the location.

4.2 Cashflow analysis

Results from our analysis are provided below in Figure 4.1 (base case, 65% prems FWA / FTTC build outside Kirkwall, FTTX to main exchange, meshed).

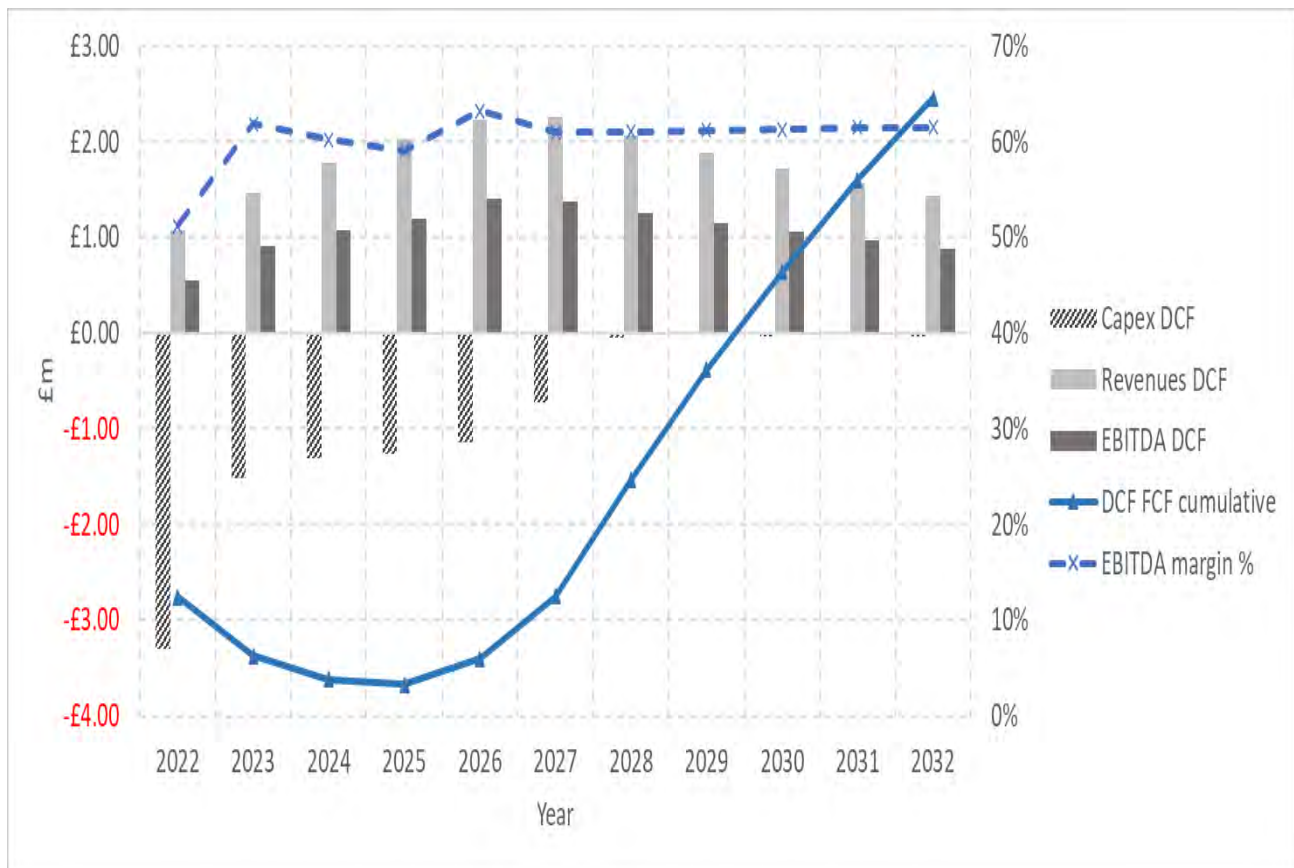
We assume no subsidies on CPE equipment throughout (i.e. customer pays).

Mesh 'density' is set in our model at 50%, meaning that a fully meshed local FTTX backhaul network is not implemented.

We define full meshing where each FWA/FTTC hub site would be connected to four others, as in a grid mesh. With fewer hub-hub connections, partial meshing arises. In the lower limit, the mesh would become a daisy chain network.

We recommend that some meshing is retained, to ensure resilience, and balanced capital outlay.

Figure 4.1: Free cashflow analysis (connectivity to all premises, excluding already committed build)



In the base case, break-even is attained at around year 8, and peak funding sits at £3.67m.

EV/EBITDA at year 10 sits at around 5.8, in line with telecoms industry benchmarks.

5 Concluding remarks

5.1 Key observations

- For the base case as modelled (65% FWA coverage, % total Orkney premises), cost per connected premises (CPCP) (blended) sits at £1.1k.
 - We estimate total capex at around £11.4m;
 - Capital costs could be reduced with a lower level of meshing on the FTTP network, or with use of point to point microwave links to provide link resilience (i.e. failover).
 - Peak funding is £3.67m (DCF, at year 4);
 - EBITDA margin is positive and healthy at around 60%, in line with efficient altnet operators, indicating that a sustainable wholesale business is feasible (subject to customer take-up, capital funding, and overall cashflow feasibility, as above).
- Roll-out of full fibre for all remainder 8.4k premises on Orkney (100% FTTP, 0% FWA) is likely to be cost prohibitive. We estimate total capex for the remainder 65% FTTP roll-out in excess of £50m (i.e. average CPCP >£5k).
- FTTP network costs are driven significantly by greenfield trenching and cabling costs. Once deployed however, FTTP networks are able to be upgraded with new headend equipment to accommodate years of traffic growth; FTTP cables will typically sustain asset lives of 20-30 years or more.
- FWA networks are more sensitive to traffic growth demands. Our assessment is dimensioned at just over 60 premises per FWA site, in line with typical industry practices and the Project Gigabit technical specification (1Gbps peak, 330Mbps streaming), i.e. contention per site at 66:1. If lower contention levels are required, additional capex investment for the FWA network would be required over time.

5.2 Roadmap for implementation

FTTP and FWA networks are typically managed with phased build-out programmes. This ensures focus on particular areas, which may accord with communications plans and resource management.

Network build-out rates vary considerably according to technology types used and area density and terrain types. FWA technology will typically support faster network roll-outs, and rural areas will tend to require longer build programmes than urban centres. For a hybrid programme with phased area build, in a predominantly rural area, such as Orkney, we would estimate a build-out programme of around 4-5 years, based on typical industry programme rates (on passed and connected premises), and requirements for wayleaves and access rights.

Openreach's current plans³⁸ indicate that FTTP build for Kirkwall is planned from 2021 to 2026.

Prior to any build-out programme, capital will need to be raised, designs done, suppliers engaged, and any public gap funding secured via due process.

³⁸ See: <https://www.openreach.com/fibre-broadband/where-when-building-ultrafast-full-fibre-broadband>

5.3 Recommendations

- We note that the SWAN contract is being tendered for renewal (covering the whole of Scotland). Given that the SWAN network is currently reported to be meeting technical requirements, we are not recommending any associated actions. With SWAN access dependent on quality of local access network connectivity, we recommend that focus is maintained on improving local access network quality, whilst commercial matters with SWAN (including access circuit pricing and overall contracting to requirements) are dealt with separately.
- Whereas the current SWAN network includes a purpose built core, costs associated with leverage (or rebuilding) of this will be lower than for new build at the access network level. As public services networks are progressively moving towards use of the public internet (with security and quality requirements implemented via SD-WAN technology), we recommend that the SWAN core is replaced in due course with a fibre based core (given reported problems with microwave links due to weather conditions). If the new SWAN contract is based on use of the public internet, then a common fibre core would be required and would afford some cost synergies. We recommend that core and access network developments are considered carefully alongside any developments in SWAN to maximise synergies.
- Given that much of Orkney is very rural, we recommend a hybrid FTTX/FWA/FTTC access network approach. This approach will support timely roll-out to premises, and efficient use of capital investment.
- Take-up objectives should be supported with an awareness campaign, led by OIC, targeted at consumers, showing the social and commercial benefits of gigabit connectivity.
- Gap funding is presently available via the Scottish R100 programme and UK Government's Project Gigabit, as well as with gigabit vouchers (supplier- and therefore market- led). All of these initiatives require due process to be followed: procurement bids must be assembled and won. That said, in our dialogue with both the Scottish Government and UK DCMS / BDUK, dialogue with both public and private sector entities is not only welcomed, but actively encouraged. Therefore, we recommend that OIC ensures that proactive dialogue is leveraged to promote requirements and access to funding for Orkney.
- Backhaul costs (from Orkney to main internet peering and colocation sites) represent a significant element in the investment case, and need to be optimised. We recommend that dialogue with Openreach is pursued to seek more efficient pricing on EAD circuits (subject to regulatory limitations). The Shefa-2 long distance submarine cable is likely to present a more attractive backhaul option than with overland circuits. Therefore, pricing from Faroese Telecoms for Shefa-2 submarine cable based backhaul is used in our assessment.
- We heard from two stakeholders that OIC's own planning and administrative processes are restrictive in regard to development of gigabit connectivity for the region. We recommend that this is looked into as a priority.
- Finally, our P&L assessment indicates that a viable telco operation is feasible for the whole of Orkney, with key metrics in line with modern efficient telcos making use of novel technologies and commercial models (e.g. cloud-native core networks), subject to take-up levels which we assume as trending to 100% towards the five year point and beyond (rationale: single wholesale network for the region, limited infrastructure competition).

Our focus in this work has been towards development of an investment case supporting 100% gigabit capable rollout for Orkney.

Glossary of terms

A non-exhaustive glossary of terms used is provided below.

Acronym / term	Description
Access network	Part of a telecoms broadband internet network that connects end user premises to local hubs or exchanges
B2B	Business to business (market segment)
B2C	Business to consumer (market segment)
Backhaul network	Part of a telecoms broadband internet network that connects local hubs or exchanges to main internet backbone peering sites (typically located at major cities)
Capex	Capital expenditure
CPE	Customer premises equipment
DCF	Discounted cash flow
DSLAM	Digital subscriber line access multiplexer (used to connect FTTC fibre to digital copper lines)
EBITDA	Earnings before interest, taxes, depreciation, and amortisation
EV	Enterprise value
FCF	Free cash flow
FTTC	Fibre to the cabinet (supporting xDSL services over copper line to premises from hubs)
FOTP	Fibre to the premises (full fibre)
FTTX	Fibre to the local hub (supporting FWA or FTTC from the hub to the premises)
FWA	Fixed wireless access (wireless broadband last mile)
GBVS	Gigabit Broadband Voucher Scheme implemented by UK Government
Gigabit capable	A network capable of supporting gigabit line speeds, in line with BDUK technical specifications
ISP	Internet service provider
Mesh	A network architecture where nodes are connected with 1+N redundancy to provide failover link resilience. Greater redundancy provides greater network resilience at greater capital cost.
Opex	Operating expenditure
P&L	Profit and loss
SBVS	Scottish Broadband Voucher Scheme implemented by Scottish Government
SD-WAN	Software defined WAN
SME	Small to medium enterprise (market segment)
SWAN	Scottish Wide Area Network (network supporting public services)
WAN	Wide area network

About the authors

Professor Ian Corden PhD CEng FIET

Ian is a Director and an established independent consultant in the telecoms/TMT/digital sectors, bringing over 30 years of experience gained through global consulting and industry. He has worked across the full industry lifecycle from start-ups and investor funding, through strategic planning, to hands-on engineering and programme delivery.

He has supported clients extensively in the UK and internationally, in strategy, policy, due diligence, and programme delivery projects on FTTP, 5G, and FWA gigabit radio networks.

His consulting approach is with high impact projects that make a real difference, combining insight, pragmatism, practical experience, and hands-on delivery, yielding optimal value for clients.

Formerly with PwC TMT Strategy London, Nokia, Oracle, and Bell Labs, his experience spans both technology and commercial domains and includes: consulting sales and business development, management of the professional services firm, strategy development and business planning, policy and regulation, consultation responses, digital strategies, regulatory and commercial cost modelling, radio spectrum planning and valuation, investment planning, M&A advisory, due diligence, CTO/CIO advisory, performance and process improvement, procurement and bid development, network and IT systems transformation, and large scale technology programme management. His client base includes national and local governments, industry bodies, regulators, telcos, ISPs, enterprises, vendors, investors and law firms.

During the early part of his career, he worked in new systems and was awarded the Bell Labs President's Prize for R&D and product development at Bell Labs NJ USA. Ian holds PhD and BSc (1st Class Hons, IET Prize) degrees in Telecommunications and Electronic Engineering, plus PgD in Management and Finance, UK Chartered Engineer, Fellow IET, and VC of the techUK Communications Infrastructure Council.

Ian is a Visiting Professor at The University of Surrey, a role providing commercial and industry support to the Faculty of Engineering and Physical Sciences.

Contact: driancorden@gmail.com; +44 (0) 7834 591 240.

Sarongrat Wongsaroj MSc MA

Sarongrat Wongsaroj is a Principal and specialises in economic research and analysis in the fixed and mobile communications industries. An expert modeller, Sarongrat has led quantitative works in projects to assess policies in the telecommunications industry.

Sarongrat holds an MA(Oxon) in Economics and Management from Balliol College, University of Oxford, and an MSc in Mathematics and Physics from University College London.

Appendix A Key assumptions

Our key assumptions supporting our financial assessment are provided below.

We assume that FTTP is committed build by Openreach in some areas, with new hybrid FTTX/FWA/FTTC networks deployed in all other Orkney areas. In the longer term, further FTTP could be built out progressively.

- FWA / FTTC access network (Orkney areas outside Openreach planned build):
 - Leading edge gigabit capable radio (5G chipset based FWA, operating in the 3.8-4.2GHz shared access bands) is employed (with at least 2x2 MIMO), with technical design to gigabit capable data speeds commensurate with UK Government's Project Gigabit Technical Specification.
 - FTTC (non- gigabit capable) as *fallback option* in cases where gigabit capable FWA is not viable.
 - Premises outside Kirkwall Ward areas: 8,474.
 - We assume 66 premises maximum per FWA radio site supporting 1Gbps peak, 330Mbps burst average streaming, 5Mbps daily average traffic per premises. Range per site = 2.5km; maximum area coverage per radio site = 20km².
 - Total site count for whole of Orkney, based on coverage = 990km² / 20 = 50 FWA radio sites.
 - Taking capacity into account, total site count = 8474/66 = c. 130 FWA radio sites.
 - Cost per FWA radio site, including mast, FWA radio equipment and power cabling: £15k.
 - Cost per DSLAM site, as fallback option: £15k.
 - FWA radio site / FTTC site local FTTX backhaul: full fibre from Kirkwall main exchange to each radio site: average fibre cable run at 3km (meshed site to site). FWA local fibre backhaul cost = £20k/km. This cost could be reduced if P2P microwave links were used for local backhaul.
 - We assume partial meshing on the FTTX network (at 50%), i.e. every FWA/FTTC site is connected by 2 FTTX links. This balances capital outlay with resilience.
 - CPE and premises installation costs (rooftop antenna, modified router, and technical install at premises): capital cost of £250 per connection total, including radio planning cost. CPE costs borne by customers, not capitalised.
- Core network BSS / OSS and cloud services + data centre costs:
 - Local data centre / cloud opex: £10k pa.
- Backhaul and trunking:
 - Local connectivity from access networks is aggregated at the main exchange level.

- There are 23 Openreach local exchanges³⁹ across Orkney, supporting LLU unbundling at the physical and bitstream level. As FTTP is rolled out, local exchanges are typically bypassed and replaced with gateway cabinets as a more cost-efficient option. Therefore, we assume one main headend exchange located in Kirkwall (with backhaul to main internet backbone colocation hubs).
- Backhaul from Orkney overland to main Scottish internet colocation sites proves prohibitively expensive. Therefore, we assume backhaul (from Orkney to Banff to Aberdeen) is provided via a combination of overland and subsea leased circuits:
 - We assume 10Gbps leased line per link, supporting 2000 users each with 5Mbps daily average busy traffic (typical contention ratio at around 60:1).
 - Overland backhaul provided using leased bitstream services with pricing based on Openreach EAD-10000^{40,41} (10Gbps) products. Annual cost per 40km link at £12k. Two legs required on distance, Banff to Aberdeen is 60km, with 1+1 redundancy for resilience. Total overland backhaul cost: £48k pa per 2000 premises, 13,042 premises on Orkney, hence $7 * £48k = £336k$ pa.
 - Subsea backhaul is available with the Shefa-2 subsea cable (operated by Faroese Telecom) which runs directly from Orkney (Ayre of Cara) to the Scottish mainland (Banff, around 60km from Aberdeen). Total subsea backhaul cost: £71k pa per 10Gbps bitstream circuit⁴².
- We assume that internet IP peering takes place at a colocation data centre (global internet connection) located in Aberdeen⁴³.
 - Colocation data centre IP peering interconnect site costs: £12k pa;
- Contingency costs:
 - We assume +10% contingency costs across all items.

³⁹ Detailed information on Openreach exchanges is not in the public domain. We have used available public sources. See: https://www.ofcom.org.uk/_data/assets/pdf_file/0021/190029/local-exchanges-data.pdf

⁴⁰ <https://www.openreach.co.uk/cpportal/products/pricing>

⁴¹ EAD: Openreach Ethernet Access Direct products provide point to point bitstream data connectivity between sites (i.e. access network gateways to colocation datacentres for IP backbone connectivity). See: <https://www.openreach.co.uk/cpportal/products/ethernet/ethernet-access-direct>

⁴² See: <https://www.lightwaveonline.com/business/market-research/article/16654174/myriad-factors-conspire-to-lower-submarine-bandwidth-prices>; <https://www2.telegeography.com/hubfs/2018/Presentations/APRICOT-2018-Submarine-Cable-and-Capacity-Pricing-Trends-in-Asia-Pacific.pdf>. Shefa-2 cable pricing provided by Faroese Telecom.

⁴³ The UK has a number of major colocation data centres where IP peering takes place between major telecoms carriers. Backhaul costs from access networks may be distance dependent, depending on datacentre locations and commercial terms at the carrier to carrier level. Major data centres in Scotland are located in Glasgow, Edinburgh, and Aberdeen. See: <https://discover.cloudscene.com/market/data-centers-in-united-kingdom/all>

© 2022 Plum Consulting London LLP, all rights reserved.

This document has been commissioned by our client and has been compiled solely for their specific requirements and based on the information they have supplied. We accept no liability whatsoever to any party other than our commissioning client; no such third party may place any reliance on the content of this document; and any use it may make of the same is entirely at its own risk.

SCOTTISH ISLES FIBRE OPTIC CABLE PROJECT

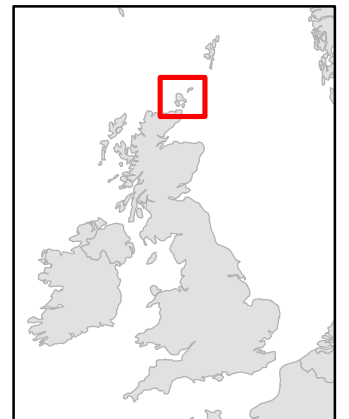
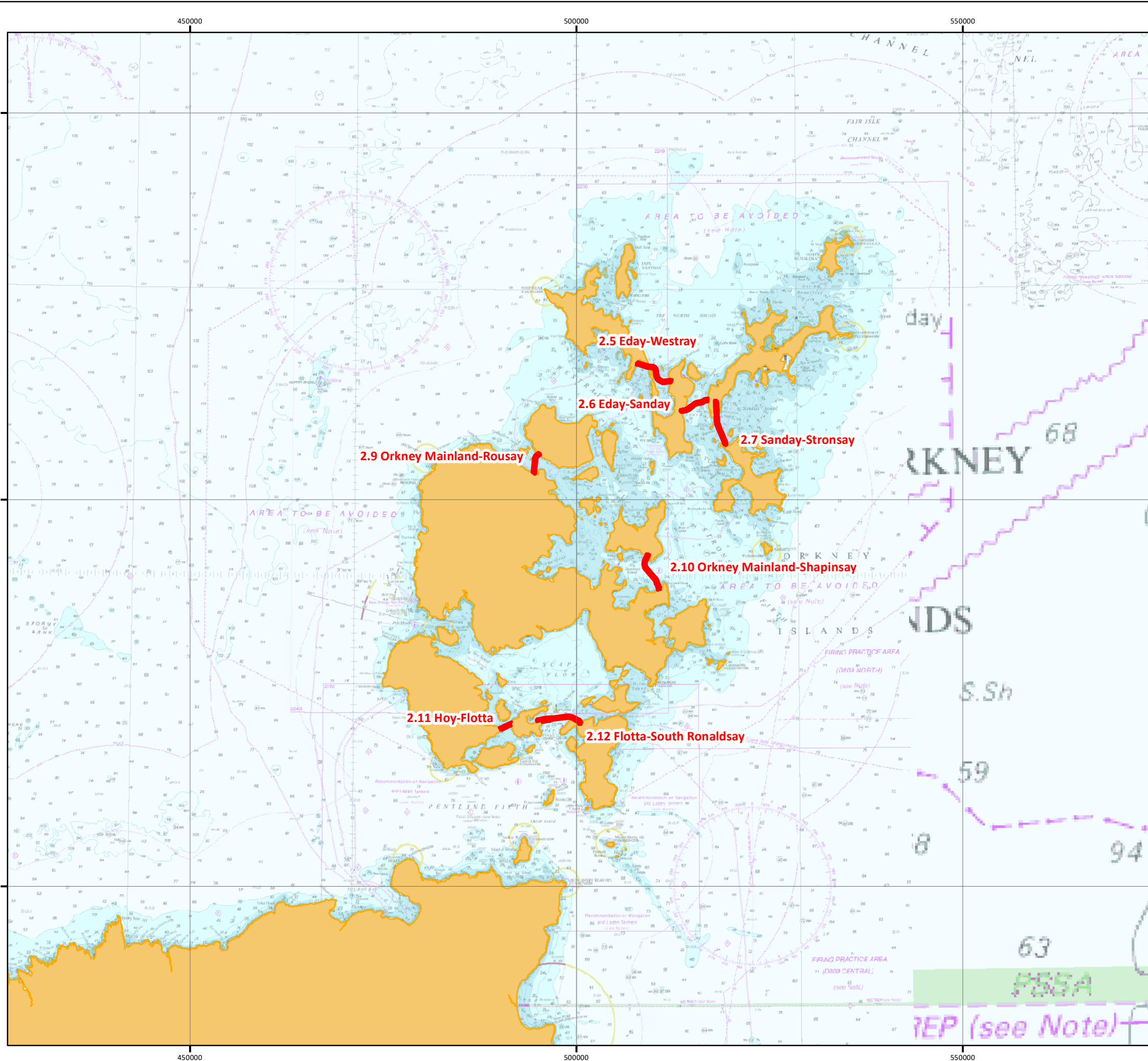
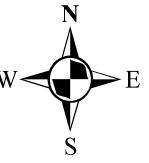
LOCATION OVERVIEW Cable Application Corridors - Orkney

Drawing No: P2308-LOC-001_OR

A

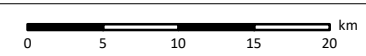
Legend

 Cable Route Application Corridor



NOTE: Not to be used for Navigation

Date	14 May 2021
Coordinate System	WGS 1984 UTM Zone 30N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	ONS; MarineFind; ESRI;
File Reference	J:\P2308\Mxd\01_LOC\ P2308-LOC-001_OR.mxd
Created By	Chris Dawe
Reviewed By	Abigale Nelson
Approved By	Paula Daghish



© Metoc Ltd, 2021
All rights reserved.