Our Fibre Assets

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CHORUS

1.0 Introduction

Our Fibre Assets is our IFP Investment Report. It is a comprehensive document describing our assets, investment planning and operations. It outlines our plans for the three years from January 2022, known as Regulatory Period One (RP1). This introduction provides context for the report.

1.0 Introduction

1.1 Our history

Chorus is New Zealand's largest communications infrastructure provider. We manage assets that make up the new fibre network serving New Zealand's urban areas and older copper network in rural areas. Our assets include fibre and copper cables, ducts, poles, towers, network buildings, broadband electronics and IT systems.

Chorus was formed as a standalone company to deliver Ultra-Fast Broadband (UFB) in partnership with government. A public-private partnership was formed between Telecom (where Chorus was a business unit) and the government, with our demerger from Telecom New Zealand in late 2011 to become a stand-alone listed company.

The UFB contract has been administered for the government by Crown Infrastructure Partners (CIP). This has included extensive government oversight of the separation from Telecom, the UFB rollout and our fibre products and business plans.

Our assets and how we manage them has evolved since we were established. At first our priority was building the fibre network. As build phase nears conclusion we are transitioning to the 'operate and maintain' phase.

The UFB contract called, the Network Infrastructure Project Agreement (NIPA), included an obligation to maximise uptake, with a target of achieving 20% uptake by 2020. The network build was a success and the pace of uptake has exceeded all expectations.

Our expenditure plans enable us to complete roll out of the UFB initiative, continue with efficient network extension, connect more consumers, keep pace with growing demand, and sustain network quality. Increasing connection numbers is beneficial to us, Retail Service Providers (RSPs) and consumers because it spreads network build costs across a larger number of connections, reducing cost per connection. Our plans allow for growing demand while continuing to extend our network, connect more consumers and sustain quality of service we propose to invest in capital expenditure and operating expenditure.

Our main capital expenditure (capex) categories are:

- extending the network
- installations for connecting consumers to the network
- sustaining and enhancing the network
- adding network capacity
- our IT systems and support.

Our main operational expenditure (opex) categories are:

- customer
- network
- support.

This report covers Fibre Fixed Line Access Services (FFLAS) in areas we're subject to price-quality regulation. Section 5 of the Telecommunications Act 2001 defines the regulated service FFLAS as "a telecommunications service that enables access to, and interconnection with, a regulated fibre service provider's fibre network [subject to specified exclusions]."

Services that are within the scope of FFLAS are described in our modelling and cost allocation report by reference to the Commerce Commission's description of FFLAS services.[1]

Key exclusions from FFLAS are:

- **copper services** – telecommunications services provided, in any part other than a part located within a consumer's premises or building, over a copper line, or a telecommunications service used exclusively in connection with such a service
- **most backhaul services** – transport services provided beyond the specified Point of Interconnection (POI).[2]

[1] Commerce Commission, Fibre Input methodologies – Main final decisions Reasons paper, 13 October 2020, pp 45-46 (https://comcom.govt.nz/__data/assets/pdf_file/0022/226507/Fibre-Input-Methodologies-Main-final-decisions-reasons-paper-13-October-2020.pdf).

[2] The Commission prescribes the specified points of interconnection under section 231 of the Telecommunications Act and made its first determination last year. These specified POIs establish the fibre handover points and define the upstream boundary of a regulated fibre service provider's fibre network.

The first part of this report describes the network and introduces our assets, and how we manage them, including asset management improvements identified. Separate chapters then step through each expenditure area providing detailed information about how our assets are managed, our plans and forecast expenditure during the first regulatory period (RP1).

1.2 Our fibre network

Our network consists of a large interconnected system of fibre cables that carry digital information. As well as cables we own supporting assets that join the cables together and connect the fibre from the main network to homes and businesses. We classify our network assets into three layers:

- **layer zero** – supporting infrastructure such as poles, manholes, ducts and buildings
- **layer one** – fibres and passive optical splitters
- **layer two** – network electronic devices.

In very simple terms our network assets perform these tasks:

- fibre cables carry digital information in the form of optical pulses
- the fibre cables are buried in ducts underground (accessed via manholes) or mounted onto poles aboveground
- fibre cables are connected using joints, terminations and splitters
- the optical pulses carried through fibre cables are decoded and aggregated by network electronic devices
- the fibre connectors and electronic devices are housed in network buildings, cabinets and homes.

We use our IT assets to plan, monitor, provision and manage the network.

1.2.1 Network architecture

Our network was built using Fibre to the Home (FTTH) architecture, the infrastructure needed to provide network services. In this section we describe at a high level, the assets that are created when we build and extend the network.

1.2.2 Fibre cables

Optical fibre can carry large amounts of information over long distances. A fibre cable is an assembly of one or more optical fibres. Cables are mainly installed outside so must be able to withstand temperature changes, wind and earthquakes.

We classify our fibre cables or routes depending on how critical the fibre is (i.e. how many consumers it serves):

- **core fibres** – are the most critical routes laid between large urban areas and where traffic is expected to increase. All core routes have dual paths – where two physically separate fibre cables are used independently of each other – to increase resilience
- **regional fibres** – laid between network buildings, these similarly have dual paths
- **access fibres** – laid between local network buildings and consumer premises, these paths enable connections.

In practice, a cable will often include multiple categories of fibre, but they are often separated into different tubes within the cable.

Fibre cables are laid past every premises in UFB areas, and between population hubs. This is done in a few different ways:

- **directly buried underground** – cables are laid directly in the ground
- **ducted underground** – cables are blown, pulled or inserted through the duct which is buried in the ground
- **submarine** – cables are laid underwater on the seabed
- **aerial**– attached to poles above the ground
- **internal** – installed in equipment rooms within network buildings or consumer premises
- **lead-ins** – fibre cable extends from FTTH infrastructure and terminates in a premise.

1.2.3 Ducts, manholes and poles

Ducts are buried in the ground or embedded in a structure. They allow fibre cables to be installed without excavation. We use a variety of ducts that range in diameter between 3mm and 200mm. We own old ducts made from earthenware, concrete and cast-iron but today, we only install ducts made of plastic and steel. We install ducts in areas where capacity is likely to grow, or fibre cables are high-risk and warrant extra protection.

Manholes are covered openings that provide access to buried ducts, cables and joints. Manholes vary in size from small plastic enclosures centimetres deep to large concrete chambers meters below ground. We currently install manholes made of plastic or aluminium. Manholes are installed in places where access to fibre is likely. A manhole is more cost effective and safer than repeated excavation.

Poles are designed to carry cables above ground. They are typically between six and nine metres tall and installed around 40m apart. We have between 210,000 and 280,000 poles, most of which are made of locally sourced softwood. Poles are mostly used to carry a lead-in from a fibre access terminal to the consumer's premises.

1.2.4 Joints, termination equipment, splitters and cabinets

We use joints to connect two fibres together. A joint is a plastic enclosure with fibre management trays that join individual fibre strands, and support and seal the cable covering. The physical size of the enclosure depends on the number and size of the fibre cables to be connected.

We use termination equipment to separate individual fibres from cables in a way which protects the fibres. They come in different shapes and sizes depending on where they are installed, and the number of fibres involved. Fibre termination equipment has a range of different names, but is usually grouped into the following categories:

- Optical Fibre Distribution Frame (OFDF)
- Fibre Flexibility Points (FFP)
- Fibre Access Terminals (FAT).

Splitters take a signal from an Optical Line Terminal (OLT) in a building or cabinet and separate it into multiple paths so it can be extended to each consumer. They are located in access sites and FFPs.

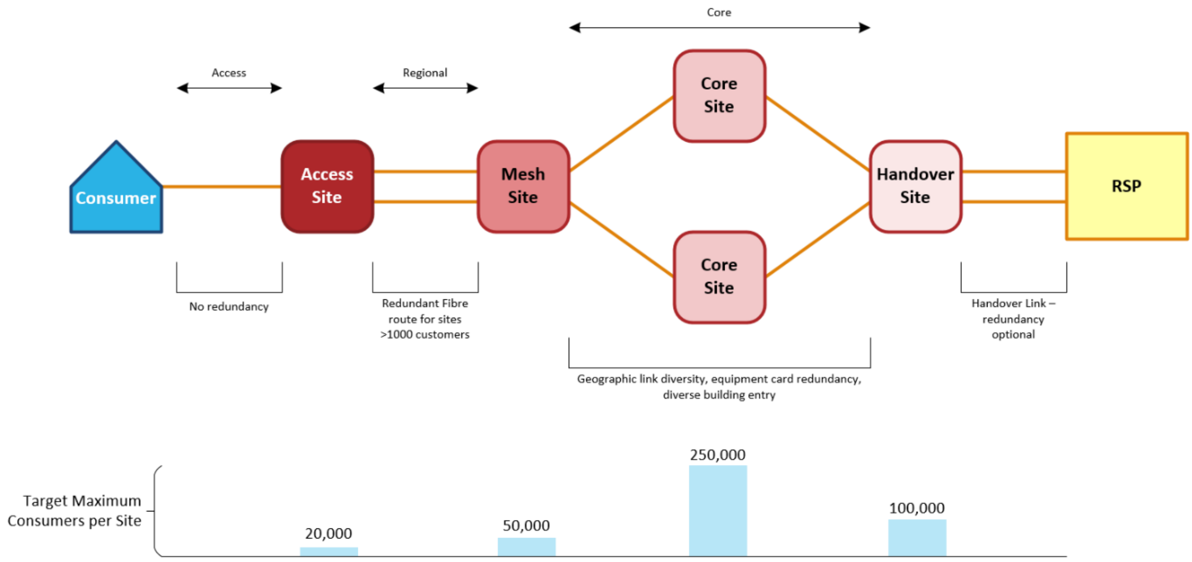
Cabinets are usually found by the side of the road. They house termination equipment, splitters and network electronic devices. Cabinets are usually connected to Alternating Current (AC) power and require cooling.

1.2.5 Network buildings and engineering services

We manage over 2,500 network sites that house the electronic equipment needed to run our copper and fibre networks.

1.0 Introduction

Figure 1.1: Fibre to the Home architecture showing redundancy levels for network elements



Our network buildings or sites have different functions and purposes, and we classify a site according to the highest-order function that it serves (Figure 1.1).

- **access sites** – host equipment used to connect consumers to the network. This is the broadest category and captures all our buildings
- **mesh sites** – concentrate traffic from multiple access sites (as well as being directly connected to some access customers themselves and containing access functions). They can serve up to 50,000 consumers
- **core sites** – concentrate traffic from multiple mesh sites. They house the large-capacity switches and the equipment for national transport. They can serve up to 250,000 customers. Core sites will also contain mesh and access functions
- **handover sites** – handover data traffic to RSPs. A handover always occurs in a building with a core or mesh function.

Engineering services is the equipment that powers network equipment and maintains environmental conditions within acceptable limits. Our engineering services equipment is in network buildings and cabinets.

1.2.6 Network electronics

Our network electronic devices decode, and aggregate optical signals sent through fibre cables. We categorise those electronics into three types: access, aggregation and transport. Within each of those types there is a further distinction between optical network electronics, and element management platforms.

Access electronics deliver fibre broadband services to consumers. The electronics required to deliver these services are:

- **Optical Network Termination (ONT)** – devices in customer premises. ONTs provide a connection between the fibre network and the consumer's premises
- **Optical Line Terminal (OLT)** – devices located in network buildings or roadside cabinets. OLTs provide connectivity to consumers over the fibre access network. They consist of rack-mounted equipment and terminal cards.

The aggregation network provides connection between OLTs and handover links to RSPs. It comprises switches (rack-mounted equipment with interface cards) and the links between them.

Transport equipment provides high-capacity connectivity over long distances between aggregation nodes and OLTs. It comprises rack-mounted equipment supporting transmission links over core, transport and access cables. The transmission link is usually built with spare channels which remain available to provide additional capacity as needed. We use transport technology that is highly scalable, it provides significant data capacity while maintaining low latency and bit error rates.

Element management platforms are software systems that communicate with electronic devices in the network. They manage the devices allowing services to be provided to consumers, and monitor network operation.

1.2.7 IT assets

We define an IT asset as any information, software or hardware we use for our business activities. We have over a hundred IT systems that enable us to deliver network services and manage our day to day business activities. Our IT systems are broken down into domains that serve either:

- **network and customer** – systems and platforms that help us run the network and interact with our customers
- **business** – systems and platforms needed for our day to day business activities.

1.3 How we manage our assets

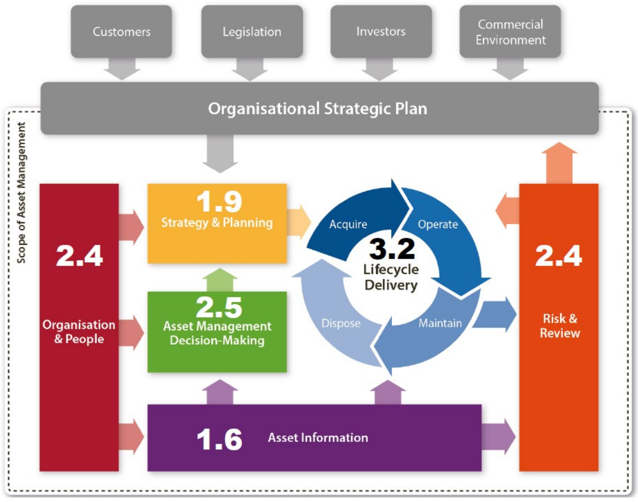
We are in the process of developing more comprehensive strategic approaches to managing our physical and IT assets. Our current approach follows our recently formalised asset management policy.

We have completed an asset management capability assessment and developed a roadmap to help us move forward. For that, we engaged Asset Management Consulting Limited (AMCL), an Institute of Asset Management-endorsed assessor. The assessment was driven by our changing asset management needs, as we move from building to operating the fibre network.

AMCL assessed our asset management capability against internationally recognised frameworks, and international benchmarking – specifically:

- ISO55001, an international asset management system standard
- its own Asset Management Excellence Model, that builds on ISO55001 and looks at an organisation against 39 different subjects which align with the asset management landscape agreed by the Global Forum for Maintenance and Asset Management.

Figure 1.2: Results of the AMCL asset management assessment © 2014 Institute of Asset Management



The assessment indicated that our capabilities are on a similar level to other organisations at our stage of maturity (Figure 1.2). Our strength was lifecycle delivery: we also scored well on organisation and people, risk and review, and asset management decision making. Our key areas identified for improvement were asset information and, asset strategy and planning. These findings reflect that to date we've been focussing on building the network and cost management.

Below we explain each area of asset management capability assessed and the improvement initiatives within each area. We also highlight our RP1 priority improvements within each of the capability areas, which are:

- **asset information** – develop an asset information management strategy and an asset information management framework, and beginning to implement asset information system improvements
- **strategy and planning –** scope improvements to our planning and decision-making, including to adapt to our new regulatory arrangements, adopt an asset management strategy, implement a review and upkeep cycle for our asset management documentation that will support accountability, improve capability and further inform improvement priorities

- **lifecycle delivery** – develop a reliability strategy suitable for the transition from a contractual to regulatory investment framework
- **organisation and people** – review whether and how we should further evolve our operating model as build activity winds down and, installation and connection activity eases.

1.3.1 Asset information

RP1: Develop an asset information management strategy and an asset information management framework, and beginning to implement asset information system improvements.

Higher-quality records mean we can manage our investment better. We distinguish between management of our physical assets (the physical infrastructure and electronics deployed in the network) and our IT assets (the systems and processes that we use to manage and operate the network).

1.3.1.1 Physical assets

Our physical asset information is stored in several systems with the majority contained in NetMap, which has a geospatial focus, and our Fixed Asset Register, which supports financial accounting.

Today, we have seven detailed Portfolio Asset Management Plans (PAMPs) covering each type of physical asset. These were developed through 2018 - 2019 and helped us build on and better structure our previous asset management plans.

We have PAMPs for access electronics, aggregation and transport, ducts and manholes, poles, fibre cable, engineering services, and property. Each PAMP describes the asset, its population and condition, describes relevant risks and outlines our investment plans.

1.3.1.2 IT assets

IT asset management is set out in twelve domain plans that encompass both network and customer domains. This helps us run the network and interact with our customers, and the business domains, which address the systems and platforms we need for our day-to-day activities.

Each domain plan describes the assets within it, outlines our asset management approach and explains our investment plans across the three areas:

- product development
- customer experience and optimisation
- lifecycle and compliance.

1.3.1.3 Improvement initiatives for asset information

This is a priority area for us. The key initiatives that we'll continue working on in RP1 include:

- developing an asset information management strategy
- creating a management framework to set out asset management roles, responsibilities, and information ownership
- reviewing our asset information and how it is collected and stored
- continuing implementation of information change management (which should follow similar processes to physical assets in the lifecycle delivery)
- instigating data standards for static and dynamic data across our asset information systems, building towards asset information standards
- articulating asset hierarchies, including alignment between fixed (financial) assets and physical assets.

1.3.2 Strategy and planning

RP1: scope improvements to our planning, including to adapt to our new regulatory arrangements; adopt an asset management information strategy.

RP1: implement a review and upkeep cycle for our asset management documentation that will support accountability, improve capability and further inform improvement priorities.

Effective asset management, maintenance and development underpin our vision to make New Zealand better. We need to understand our assets and systems, to optimise our business and keep delivering good outcomes.

Our Chief Executive Officer (CEO) recently approved an updated Asset Management Policy. Our asset management objective is to "optimise our assets to Make New Zealand Better, deliver effortless customer experience, and innovate for growth to ensure we maximise the long-term value for our customers and shareholders, while minimising our total cost of ownership."

To achieve that objective, the policy guides us to:

- plan and implement the way we invest in and operate assets in a way that optimises costs against the risks and the required standard of network performance
- base our asset management decisions on a detailed understanding of our assets, including their condition, location, function, capacity and performance
- invest in the right technology at the right time to consistently deliver the level of performance we've committed to providing.

1.3.2.1 Physical and IT assets

Our asset objectives are geared at making sure that we:

- focus on customer outcomes and service
- provide direction to asset investment planning
- improve justification for expenditure on assets
- provide evidence and confidence that spend is targeted at delivering the right performance
- reflect service attributes that customers value.

1.3.2.2 Improvement initiatives for strategy and planning

We are currently working on developing our strategic approach to managing both our physical and IT assets. During RP1 we will start to:

- expand and enhance our asset management framework as our capability grows
- demonstrate linkages between customer, product, asset planning and delivery life cycles, with a focus on linking product and asset life cycles
- take stock of our existing asset management systems documentation and work to integrate and synthesise different parts of it
- develop a quality management framework and strategy, to make sure our documentation continuously improves
- ensure that our asset management objectives are in the right place and used at the right time, so we prioritise investments and effort in a way that maximises value.

1.3.3 Asset management decision making

RP1: scope improvements to our decision-making, including to adapt to our new regulatory arrangements.

Our asset management decision-making processes begin with the annual five-year planning process each year. They are underpinned by a monthly capex approval forum and regular evaluation of the projects that we're focussing on, whether they are delivering and how they are tracking against budget.

Each five-year plan sets a capital spend budget split out by investment categories. These categories give a high-level view of capex spend (for example, one category is UFB communal) and align to our regular market releases. Behind each of these investment categories are a series of decision packets, which is a grouping of expenditure with a similar outcome.

The Chorus Capital Council (CCC) is an executive governance forum where business cases requesting capital for investments are taken for approval. It is made up of the CEO and Chief Finance Officer (CFO), and the members of the Chorus executive responsible for other functional units – product, customer and network operations (CNO) and technology. The forum is chaired by the Financial Controller.

The CCC meets monthly and operates as the final approval gate between planning and delivery.

Business cases typically pass through stages of discovery, initiate, design, build and (only if required) reauthorisation. The CCC process can occur at multiple stages of a business case: for example, an investment manager could request approval from CCC to initiate (high-level opex and capex), design (more detailed requirements and design), or build.

1.3.3.1 Improvement initiatives for decision making

We are currently scoping the work to improve asset management decision making.

Areas we aim to spend more time on are the discovery, initiate and design phases of projects, to increase certainty on costs and decrease the chance of overspend.

1.3.4 Lifecycle delivery

RP1: develop a reliability strategy suitable for the transition from a contractual to regulatory investment framework.

1.3.4.1 Physical assets

Our physical asset lifecycle has four stages.

Planning – our investment planning is based on our business wide strategies, performance standards, asset information, and asset management objectives. To ensure our planning is effective we work with business and delivery teams to understand their needs and align these with the asset management needs. Our capital investments can be grouped into:

- **growth** - this relates to the creation of new assets to meet increasing traffic demands or to support connecting customers
- **extend** - this relates to the creation of new assets by increasing the footprint of the network
- **enhance** - this includes adding resilience to the network, reducing our risk profile and developing new products
- **sustain** - this is to keep the network running at current standards. It includes replacing end of life assets and ensuring compliance to health and safety regulations.

Delivery – during the delivery stage we aim to deliver capital investments safely and cost-effectively. We use an outsourced model for the delivery of all our build and maintenance work. We use a tender process to ensure build and maintenance work is cost effective. Our Field Service Providers (FSPs) are required to comply with detailed health and safety guidelines and to work to high quality standards. We continually challenge and improve our project planning, project management, and construction capability to deliver the required quality and reliability to customers.

Maintain and operate – when it is cost-effective, we maintain our network assets through fault response and scheduled maintenance. We monitor network traffic to ensure we are providing a high-quality service to consumers. When it is cost effective, we use preventative maintenance to identify and repair assets before they fail. We also use reactive maintenance which involves replacing assets when a fault is identified.

Retire and dispose – when assets reach the end of their life, we dispose of them efficiently, safely and with consideration of environmental impacts.

1.3.4.2 IT assets

Our IT asset management follows a similar lifecycle, as follows:

- **plan –** the IT lifecycle starts with strategic planning across the business to determine what systems and capabilities are needed, how to procure or improve them, and how they will be funded.
- **develop/acquire –** we then purchase, build, lease or license the assets and systems we need.
- **integrate –** the systems are installed and introduced into our IT environment. This includes integrating the assets with other systems, establishing support and operations processes and specifying user access.
- **maintain/upgrade –** systems are maintained and upgraded in order to maximise the value of the asset and extend its life. We update and overhaul our IT assets when necessary to mitigate risks and reduce support costs.
- **retire –** once a system has reached the end of its useful life, the last phase is asset retirement. This involves updating asset records, cancelling support agreements, terminating license renewals and initiating the planning for replacement assets.

Our lifecycle, risk and compliance investments ensure the continued and effective operation of assets. This work involves tracking the attributes of the assets that require upgrade or replacement over time.

1.3.4.3 Improvement initiatives for lifecycle decision-making

The work on asset management information described above will help to strengthen our lifecycle capability. In particular:

- we are working to demonstrate linkages between customer, product, asset planning and delivery life cycles, with a focus on linking product and asset life cycles. That will also feed into strategic thinking on our longer-term funding requirements
- we plan to develop a reliability strategy that is appropriate for a transition from a contractual to a regulatory investment framework. It will need to encompass network architecture, asset reliability, and failure modes (analysis of what might fail) as well as regulatory and customer requirements
- we will look to develop a full end-to-end process for strategic investments and consider whether we can improve our approach to project prioritisation.

1.3.5 Risk and review

Assurance activities give the business and stakeholders confidence that the likelihood and impact of unexpected events is reduced. They also create a framework to identify and action opportunities for improvement.

For each physical or IT asset type, the relevant PAMP or Domain Plan will identify the key risks, and a mitigation strategy to minimise their impact. There are existing risk registers across different areas of the business.

Physical network assets: For assets deployed in the physical network, that analysis is driven by how critical they are. The simplest measure of that is how many consumers are impacted if they fail: core and mesh sites require redundant dual path fibre links and electronic diversity.

RSP traffic is handed over at the same sites across UFB1 and UFB2/2+. We try to minimise the length of single path routes and ensure that no single element failure impacts over 3,000 customers. This results in most towns with more than 1,000 premises requiring dual fibre paths to their handover switch.

We require a permit to work before work can commence on critical assets, which lets us assess the impact of possible issues.

IT assets: the IT Asset strategy recognises that the primary driver of lifecycle investment is the management of risk across our systems and asset domains.

We have defined a list of tier one systems, which are considered critical in the delivery of our core services. These systems have higher risk levels and require investment so that the technology in place is sufficiently robust and reliable.

In terms of process, a Chief Technology Office (CTO) risk forum meets monthly. It uses the board-approved framework for impact, likelihood, treatment and reporting to raise and assess both new and existing IT risks at those meetings.

Investment plans are informed by a regular assessment of risk: in particular, all risks with a high or critical rating are presented bi-monthly to the CTO leadership team for acceptance of treatment, specific directional guidance or approval to proceed with investment or expenditure.

1.3.5.1 Improvement initiatives for risk and review

Over RP1 we will aim to:

- develop a business-wide assurance framework, encompassing our external audits, quality audits conducted of and by our FSP, management system audits and existing internal audits
- consolidate our existing risk registers with a view to removing duplication and making sure they are properly integrated
- develop and implement a formal risk management training programme that incorporates the overarching risk management framework and its key concepts
- develop an asset risk assessment framework, including a standard approach to lifecycle assessments, and then apply it to our decision-making.

1.3.6 Organisation and people

RP1: review whether and how we should further evolve our operating model as build activity winds down and, installation and connection activity eases.

This category of asset management sits mostly with our CTO and certain Customer and Network Operations (CNO) teams.

Our operating model for asset management starts with our business strategy that is set by our executive team. This flows down to our CTO that is responsible for strategic asset management functions including designing network architecture and establishing our technology capabilities. It is also responsible for capital projects for IT and network electronics.

Among other things, CNO manages and oversees design, build and maintenance activities that are physically carried out by FSPs. Similarly, when CNO activities are directly related to capital projects some of the internal labour costs are capitalised, other CNO activities are covered by our Support Opex.

Day to day operational asset management happens within CNO. CNO asset management activities include:

- **property operations** - manage and maintain our network property portfolio, including engineering services assets and co-location services. They undertake programmes of site optimisation and deliver ongoing asset maintenance and upgrade programmes through to major site upgrade investment projects. This area also includes our corporate office accommodation - maintaining existing landlord relationships and developing solutions that support our future ways of working
- **physical network planning** – produce high level physical network infrastructure plans for the current and future capacity and capability requirements of our network. This capacity demand is based on proactive network monitoring of the existing network and forecasting future demand. In addition, the planning team provide support and consultation on network capacity and capability impact for legacy and new service offerings
- **programme controls and logistics** – ensures key projects and programmes are delivered on time and budget by enabling the co-ordination of key foundational project management compliance activities, workflow processes and ensuring an efficient and effective materials supply chain to support our business operations
- **infrastructure programme office** – programme and project management relating to the build of network in response to the expansion of our geographic footprint, increasing network capacity, proactive maintenance along with moving and removing legacy network and governance of network records
- **network scoping –** deliver accurate quoting for customer requests in new property developments, network relocation requests and complex installations. This also involves early engagement with our planning group to highlight areas where capacity of the network is being optimised to its full capacity and relief planning is required.

We have an outsourced model for delivery of build and maintenance activities. These activities are managed within CNO, but the physical work is carried out by our FSPs.

1.3.6.1 Improvement initiatives for organisation and people

We are reviewing our operating model as build activity winds down and installation and connection activity eases. In the asset management context, that will involve:

- working through how to best leverage the relative expertise of the FSPs and aligning FSP innovation with our own strategy
- developing and refining a Responsible, Accountable, Supporting, Consulted and Informed (RASCI) matrix, and working to link role definitions to the operating model and asset management framework
- developing and implementing a capability framework, alongside the continued implementation of our existing learning management system, so that we can analyse gaps and better target development.

1.4 Our expenditure

In the remainder of this document we describe our assets and how we manage them in more detail. We outline how our plans will change over the coming years as we transition from the build to the operate phase.

We have structured this document around our expenditure areas and their sub-categories. There are five capital expenditure chapters and three operational expenditure chapters.

The report describes how assets are created through Network Extensions and Installations. The bulk of the detail is in the recurring capex chapters, Network Sustain and Enhance, Network Capacity and IT and Support, these chapters describe our asset management approach and outline risk as it relates to each asset type. The remaining chapters describe the opex required to run our business and keep the network operating at current levels.

Unless stated otherwise we present costs based on the following conventions:

- **calendar year** – all information is on a calendar year basis. This means figures will not match our financial reporting (which uses a June year-end) but should align with future revenue control and regulatory information disclosure years
- **2020 base year** – all prices are expressed using 2020-dollar values
- **real historical** – historical figures are expressed in real terms, with Consumer Price Index (CPI) adjustments to bring values up to 2020-dollar equivalent values
- **constant price forecasts** – forecast figures do not have CPI or real price effects (see below) added. This allows us to show expenditure trends independent of economy-wide movements in input costs or dollar values
- **real price effects** – forecast figures exclude real price effects. In our regulatory templates we separately forecast movement in the real price of key inputs. We intend for real price effect forecasts to be locked into our revenue setting but expect CPI impacts will be adjusted for actual outturn inflation
- **capex forecasts** – capital expenditure is presented excluding Interest During Construction (IDC). In our regulatory templates we separately model IDC[3] and the timing shift for converting capex to Value of Commissioned Assets (VCA). We expect VCA will be used for revenue setting
- **historical capex and first half 2020 -** historical capex (from 1 January 2016 to 31 December 2019) and January 2020 to 30 June 2020 is consistent with our annual reports. We have generated calendar year values by adding together relevant financial half-year amounts
- **unallocated historical** – historical capex and opex is presented on an unallocated basis – i.e. including all Chorus expenditure. We have taken this approach because allocation is not yet settled
- **2025 and 2026 forecasts** - our current business planning process only takes our detailed planning to 30 June 2025. To extend the forecast for calendar year 2025 and 2026 we have applied a high-level approach to project the forecast forward, with bottom-up and top-down sense checking to adjust for anticipated step changes
- **fibre access costs** – our proposal is for PQ FFLAS only. All our figures are based on our working interpretation of the scope of PQ FFLAS and of how shared costs should be allocated. In both cases (FFLAS scope and cost allocation) our approach is consistent between this proposal and our current (November 2020) modelling of the opening value of our Regulated Asset Base (RAB)
- **forecast lease costs** – our forecasts (starting in 2021) present lease costs together with opex – i.e. using a cashflow view – to support clear explanations of trends. Lease costs are also included in opex per connection figures. In practice, we capitalise lease costs consistent with NZ IFRS 16. Lease costs will be capitalised for revenue setting purposes, consistent with IM requirements
- **historical lease costs** – historical figures are presented with the lease accounting treatment in place at the time. We adopted NZ IFRS 16 accounting standard in July 2017, from which time lease costs are shown as capex. For earlier periods, operating leases are shown as opex and finance leases are shown as capex consistent with NZ IAS 17
- **narrative categories**[4] – we present forecast and historical expenditure using narrative categories. For historical opex we have mapped expenditure from recorded categories to narrative categories at a cost-centre level.

[3] If underlying capex forecasts include IDC we zero rate IDC in the regulatory template.
[4] We refer to narrative categories interchangeably with expenditure categories or areas.

1.0 Introduction

2.0 Extending the Network

Extending the Network adds new assets into our portfolio by installing fibre past more properties. The three Extending the Network sub-categories are the final stage of the UFB communal build, new property developments and augmentation which includes infill and extensions to communities that did not meet the UFB threshold.

3.0 Installations

Each new installation to the network requires duct, fibre and network electronic assets to enable a consumer to access network services. Our expenditure on installations is highly demand driven. Our sub-categories are standard installations to homes and businesses and complex installations which are for organisations with specific requirements.

4.0 Customer Opex

Our Product, Sales and Marketing (PSM) team that is responsible for innovation and marketing and the work carried out by our CNO team that is related to installations and provisioning.

5.0 Network Sustain and Enhance

We sustain the network by investing in maintenance and adding resilience. Sometimes we need to move or relocate network assets. Maintenance investment is to replace assets that have reached the end of their life or, when it is cost effective, extend the life of an asset. Our four expenditure sub-categories are field sustain, site sustain, relocations and resilience.

6.0 Network Opex

Network Opex keeps the network running. It covers maintenance work on our fibre network and network buildings, operating costs which are the day-to-day costs like electricity and network operations which includes our Network Operations Centre (NOC).

7.0 Network Capacity

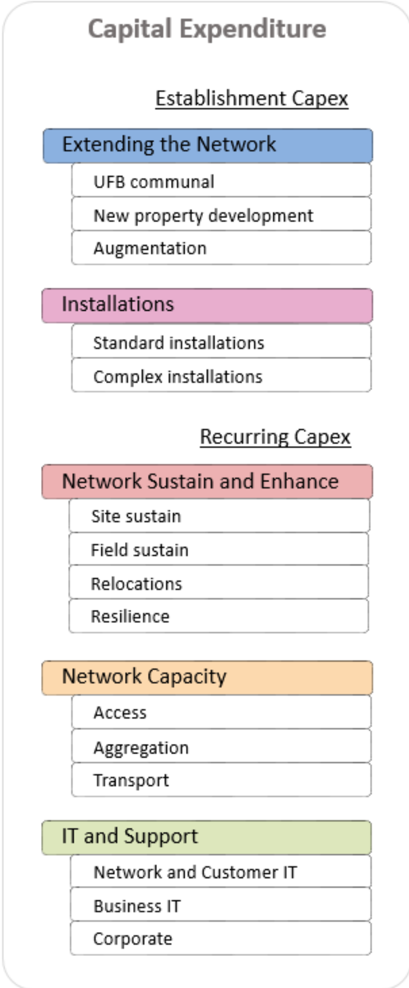
The demand for data is driven by the volume of connections on the network and the amount of data that each consumer needs. Network traffic has been growing at an exponential rate and capacity is added to stay ahead of growth and sustain congestion-free performance. This requires investment in the three types of network electronics that are our expenditure sub-categories: access, aggregation and transport.

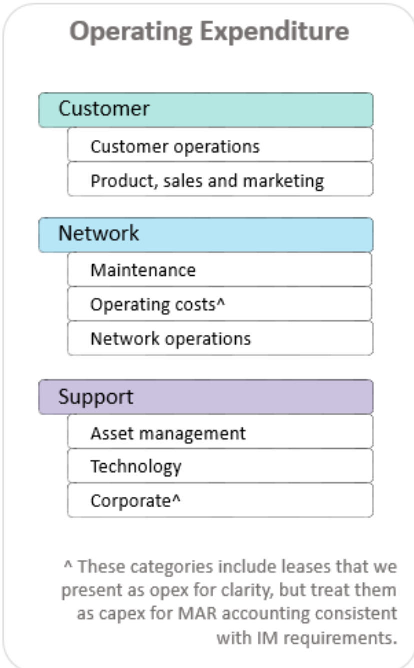
8.0 IT and Support

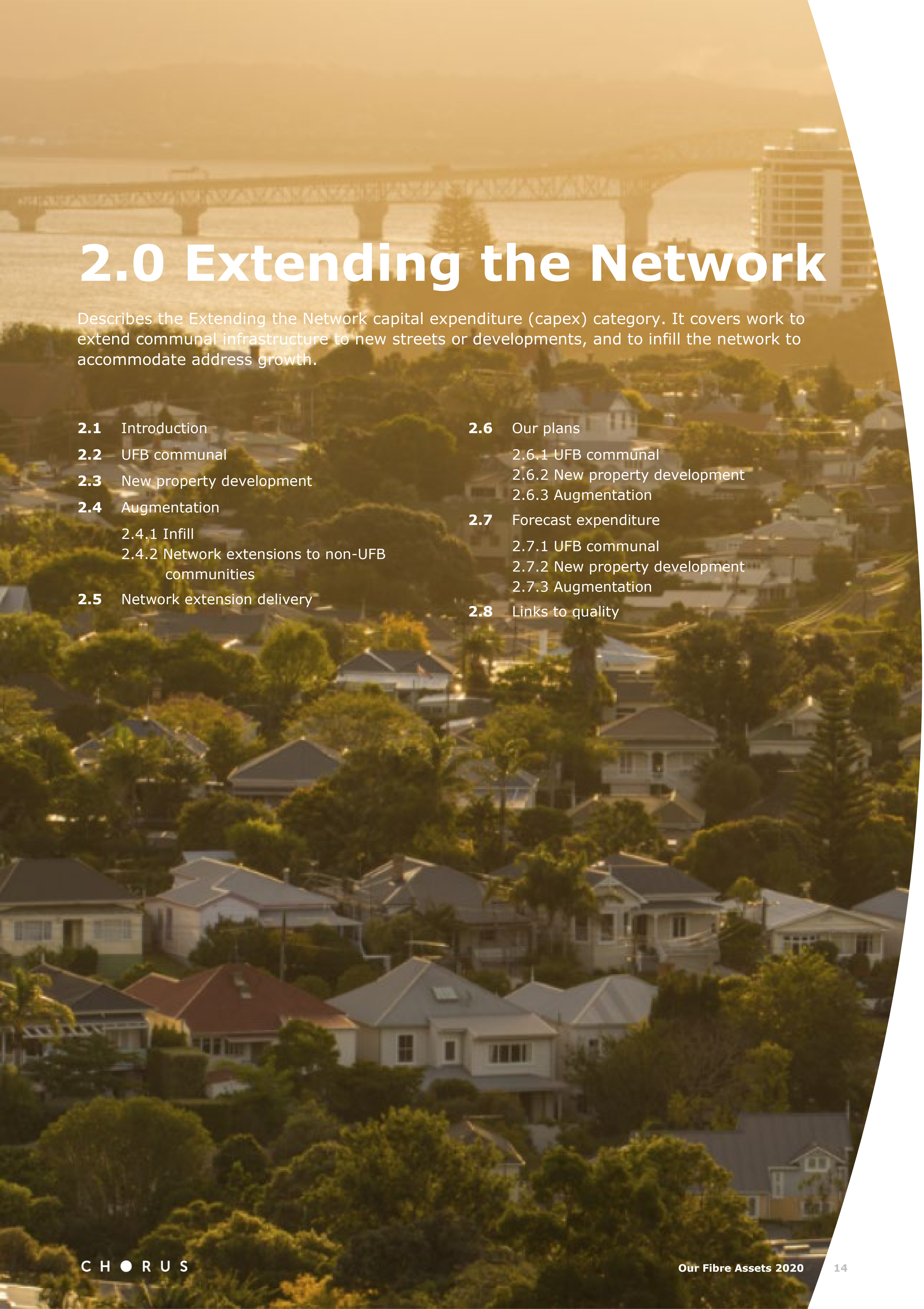
The IT systems and platforms we use to run our business. Our network IT monitors and manages the network. We also use IT assets to perform day to day business activities such as email and customer billing. Our expenditure sub-categories are business IT, network and customer IT and corporate. Our corporate capex is for office refurbishments of our leased office buildings and capitalised innovation spend.

9.0 Support Opex

Our functional teams and our corporate offices. It includes asset management and the cost of maintaining our IT software licences and support contracts.





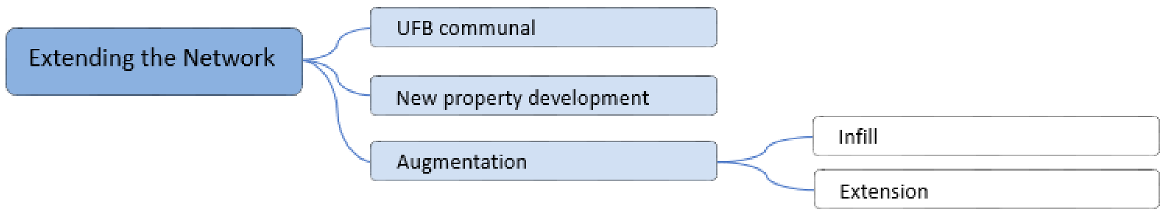


2.0 Extending the Network

Describes the Extending the Network capital expenditure (capex) category. It covers work to extend communal infrastructure to new streets or developments, and to infill the network to accommodate address growth.

2.0 Extending the Network

Figure 2.1: Extending the Network expenditure, as a proportion of total first regulatory period (RP1) capex



2.1 Introduction

Our Extending the Network expenditure area has three sub-categories:

- **UFB communal** – the final part of the Ultra-Fast Broadband (UFB) build as contracted with the Government under the Network Infrastructure Project Agreement (NIPA)
- **new property development** – laying fibre as part of new property developments
- **augmentation** – this includes infill which is building the network to premises within the existing UFB footprint and extending the network to towns or communities that did not meet the threshold for the UFB 2/2+ contract.

We are the largest partner in the Government's UFB initiative to make fibre broadband available to approximately 87% of New Zealanders. Smaller UFB contracts were awarded to Local Fibre Companies (LFC) in Christchurch, Waikato, Bay of Plenty, Taranaki, Manawatu-Whanganui and Northland. Our agreement (NIPA) with Crown Infrastructure Partners (CIP) defines rules about our network extension activities within the UFB footprint.

We have nearly finished the UFB build, laying fibre past 88.4% of planned premises. We plan to finish the UFB2/2+ build in 2022. Communal fibre or Fibre to the Home (FTTH) is the infrastructure from an exchange along the street to a property, enabling relatively straightforward installation and connection to the network.

Extending the network makes fibre available to new consumers. It involves installing fibre in a street or property development, establishing a connection back to a local exchange, and providing enough splitters, access ports, aggregation and transport capacity to begin serving connection demand. The process of network extension adds assets to our portfolio.

2.2 UFB communal

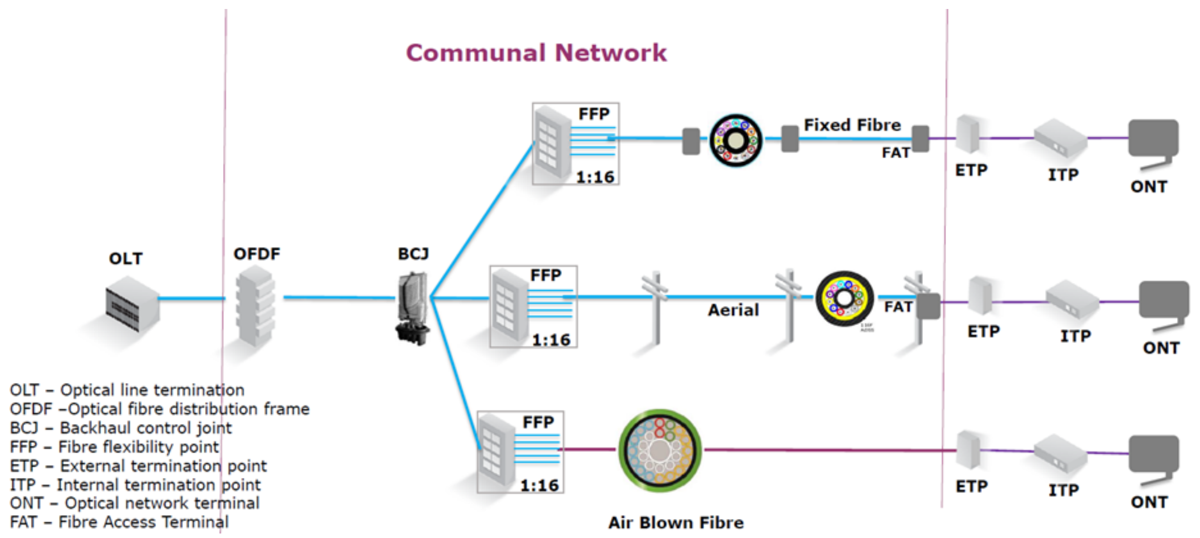
Our UFB build commitment is to install fibre network infrastructure past a defined number of properties as outlined in our agreement with CIP. The UFB programme has been funded and contracted in three stages called UFB1, UFB2 and UFB2+. UFB1 build is complete and UFB2/2+ will be completed in 2022.

Our agreement with CIP sets our performance standards for network delivery. We designed our network architecture to meet or exceed the standards.

The UFB build involves establishing FTTH network architecture. This involves laying fibre between optical fibre distribution frames in exchange sites to fibre access terminals near consumer's premises. This requires laying fibre routes, building manholes so fibre and duct can be accessed, and establishing fibre links with transport and aggregation devices to ensure there in enough network capacity to enable consumer connections. Expenditure on new network electronic devices deployed as part of network extensions is allocated to network capacity. We don't need to build new exchange sites as we use space in existing sites that we manage as part of the copper network.

Figure 2.2: Components of the UFB communal network

Network architecture



We use a metric called cost per premises passed[1] (CPPP) to monitor the cost of the build. During 2012 CPPP was over $3,500, since then CPPP has fallen and since 2018 has been around $1,550. The CPPP fell as the rollout transitioned from central business district (CBD) to urban and suburban areas. This was due to the cost of civils, reinstatement and traffic management (which were more expensive in dense CBD and urban areas), greater use of aerial deployment, difference in premises frontages, and changes in network architecture and contracting methodology.

We outsource the labour of network extensions to Field Service Providers (FSPs) (e.g. Downer, Ventia, Electronet). This means that our plans are reliant on our FSPs delivering work as scheduled.

Our RP1 proposal includes the conclusion of UFB2/2+ communal build activity. This is expected to cost $40 million and will enable connection to a further 27,000 premises. This process of building the network expands the UFB footprint, adds assets to our portfolio and enables customer connections.

2.3 New property development

New property developments or subdivisions are an opportunity for us to increase the number of premises served by our fibre network. There is competition for subdivision contracts in all fibre areas.

FSPs work closely with developers to complete the build work for new property developments. We are responsible for the network inside the development, but usually the developer will deploy some of our duct or cable during the development. We perform all consumer installations to the communal network. This work is described in the Installations chapter.

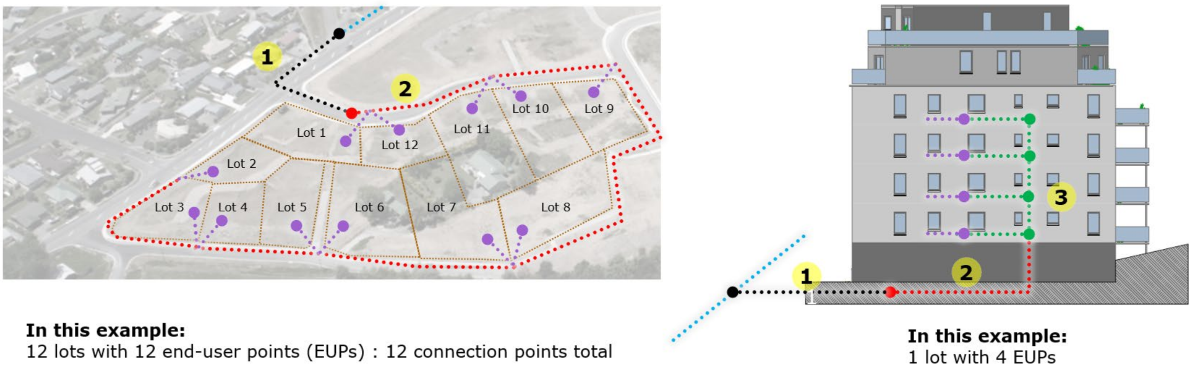
Our new property development expenditure is demand driven, based on property development activity and our success at winning contracts. The build work for a network extension to a new property development involves:

- **the civil work to lay the fibre within the development** – we typically have an agreement with developers to lay the cable while we perform the technical tasks like jointing
- **the feeder lay** - this varies in cost depending on the proximity of the development to spare network capacity and the communal architecture used (aerial, underground etc).

[1] The CPPP metric is a Fibre Fixed Line Access Services (FFLAS) nominal figure.

Figure 2.3: Types of new property development

SDU Developments (Horizontal) | **MDU Developments (Vertical)**



In this example:
12 lots with 12 end-user points (EUPs) : 12 connection points total

In this example:
1 lot with 4 EUPs

Key	Description
	Communal network (not in New Property Development CAPEX)
1	1. Feeder component
2	2. Lot reticulation
3	3. Unit reticulation
	Consumers connection (not in New Property Development CAPEX)

We usually charge for extensions to new property developments. The charge varies depending on the complexity of the work involved, the size of the development based on the number of possible consumer connections and whether the development is in a UFB1 or UFB2/2+ area. The expenditure included in our proposal is net of any capital contributions received from developers.

Any cost related to subsequent orders for installations and connections from new property developments are captured within installations expenditure.

2.4 Augmentation

We currently complete two types of augmentation activity: infill and network extensions to non-UFB communities.

2.4.1 Infill

Infills are network extensions within the footprint of the existing fibre network. New address creation is the main driver for infill growth. This occurs when new properties are developed after the communal network was deployed.

A list of the types of infill are described in table 2.1.

Infill build activity adds fibre, duct and network electronic assets to the network.

Table 2.1: Types of infill

Infill type	Description	Example
Unserved	Address points did not exist or were not detectable when the communal network was deployed	
Orphaned	The capacity allocated to an address point has been used for another premises	
Third-party	Third-party pole changes require construction of new assets to create communal pathways	
Consumption	The existing connections have consumed the available capacity and the network needs to be extended to serve growth areas.	

2.4.2 Network extensions to non-UFB communities

There continues to be demand for fibre services outside of the UFB footprint commissioned through our UFB government contracts. For example, we have recently been awarded additional government contracts (e.g. Provincial Growth Fund) to build the fibre network from Fox Glacier to Lake Hawea and from Te Anau to Milford Sound.

We have identified approximately 350 other small towns and communities greater than 50 premises that are outside the UFB footprint. They represent the next tier in community size from UFB2+ and include around 75 communities with greater than 150 premises (e.g. Castle Point, Riversdale Beach, Glenorchy and Middlemarch). These towns were large enough to warrant UFB rollout (based on UFB2 and UFB2+) but missed out on funding due to the high cost of the transport links required. We do not have any committed plans to build extensions to these towns and communities.

Our proposal includes community extensions that result from a specific community request or contribution (e.g. Ngarimu Bay). Often the dwellings in these communities are built on large plots of land, the distance between properties and from a property to the road is greater than found in urban areas. This can considerably increase the CPPP.

We have included all known government programmes into our forecasts (as at June 2020). However, we do not have visibility of the timing or scope of future government programmes to extend the network. For example, the government has recently announced funding for shovel ready infrastructure. We have applied with projects focused on increasing the reach of the UFB network and improving network resilience, but to date we have not secured any new funding. If successful in the future, we would bring Crown funded programmes into our forecast as and when they emerge.

We forecast minimal non-UFB network extension activity, but there are several drivers that could change our plans:

- **community initiatives** – occasionally, communities will come together to self-fund extension of the network outside government programmes
- **lifecycle** – sometimes, it will become economic to extend the fibre network in preference to reinvesting in legacy networks. This can be prompted by a combination of demand growth and asset end of life
- **resilience** – if we lay fibre to increase network resilience near a community, it can change the economics of building a network extension and provide the infrastructure required for consumers near to the new fibre routes to connect to the network. At this stage we have not formed a view of the scale or timing of any such work.

If any of these drivers did change our plans during RP1, we would consider submitting an individual capex proposal to the Commerce Commission.

2.5 Network extension delivery

UFB communal extensions are planned well in advance. Once work has been awarded to a FSP to construct, fibre flexibility points are loaded into our iTools work management system. This allows for tracking of design and build related tasks against baseline dates and acts as a document repository relating to the build activity. Our FSPs work to detailed design specifications to ensure that FTTH architecture is robust and resilient.

New property developments and infills are prompted by a customer request. This starts a process which involves activities throughout our business. In the case of a new property development the customer is a developer or a homeowner subdividing their property. Infill requests also come from Retail Service Providers (RSPs) prompted by a consumer asking to connect to the network.

Our Customer and Network Operations (CNO) team manage the process of network extensions. They commission the work using our IT systems which share information about the status of the work between our teams and the FSP. FSPs carry out the design and build work required for infills.

New property developments are more complex as the developers usually carry out the civil component of the build while the FSPs perform the technical tasks for fibre and duct.

When the build work is complete, we update the information in NetMap relating to our assets and the new addresses which the network serves.

2.6 Our plans

2.6.1 UFB communal

During RP1 we are planning to complete our UFB build commitments. This involves building the FTTH architecture past the remaining UFB2/2+ premises, including any change requests from now until build completion.

Our network build directly enables us to provision fibre access services to consumers. Transport upgrades enable us to maintain/improve the availability of fibre services and the performance of those services.

Our aim is to build a resilient network which will provide consumers with high-quality network services.

2.6.2 New property developments

New property developments are demand driven. Our success at winning contracts to build network extensions to new property developments enables us to increase the proportion of the population that has access to high quality network services.

2.6.3 Augmentation

As the UFB build out comes to an end, we have forecast minimal spend for network extension activity beyond the UFB footprint.

Our intention is to help more rural communities to connect to the fibre network where it makes economic sense to do so. We will continue to work with the government and communities to deploy fibre to further communities.

Infill activity is demand driven. We will continue to complete infill work when requested to ensure consumers can connect to the network and benefit from fibre services.

2.7 Forecast expenditure

During RP1 our expenditure forecast for extending the network is $70.7 million (Figure 2.4). Since 2012 our spend on extending the network has been heavily focussed towards deploying the UFB Communal network. Build activity peaked in 2019 and we expect to complete the delivery of existing contracts in 2022. This is reflected in the fall in spending. We expect to spend slightly more on new property developments and augmentation going forward[2].

2.7.1 UFB communal

This spend is for the remaining UFB2/2+ build to a further 27,000 premises[3]. Our forecast for UFB communal is based on build schedules and agreed prices with our FSPs. There is a high level of certainty as costs are driven by existing contractual obligations.

The only specific forecasting risk relates to change requests raised from our FSPs for unplanned costs not reflected in designs.

COVID-19 poses a delivery risk as some of our build activities are restricted at higher alert levels. This is unlikely to materially influence our spending but change our expected completion dates.

The volume of UFB build and installations field activity will fall during RP1, in response to this we are planning on restructuring our approach to this work. The impact of the restructure on FSP costs for network extensions is uncertain.

2.7.2 New property development

Our forecast for new property developments is demand driven. We use a volumetric price x quantity model:

- we estimate the number of new property developments using our demand models which use MBIE consent forecasts for expected market growth and our historical volumes
- for cost purposes, we assume an average of historical new property development costs.

[2] Our current business planning process only takes our detailed planning to 30 June 2025. To extend the forecast for calendar year 2025 and 2026 we have applied a high-level approach to project the forecast forward, with bottom-up and top-down sense checking to adjust for anticipated step changes.
[3] As of October 2020, there are still over 100,000 premises contracted. We expect around 27,000 will remain at the start of RP1.

2.0 Extending the Network

Figure 2.4: RP1 expenditure for Extending the Network showing unallocated historical spending

Extending the Network capex

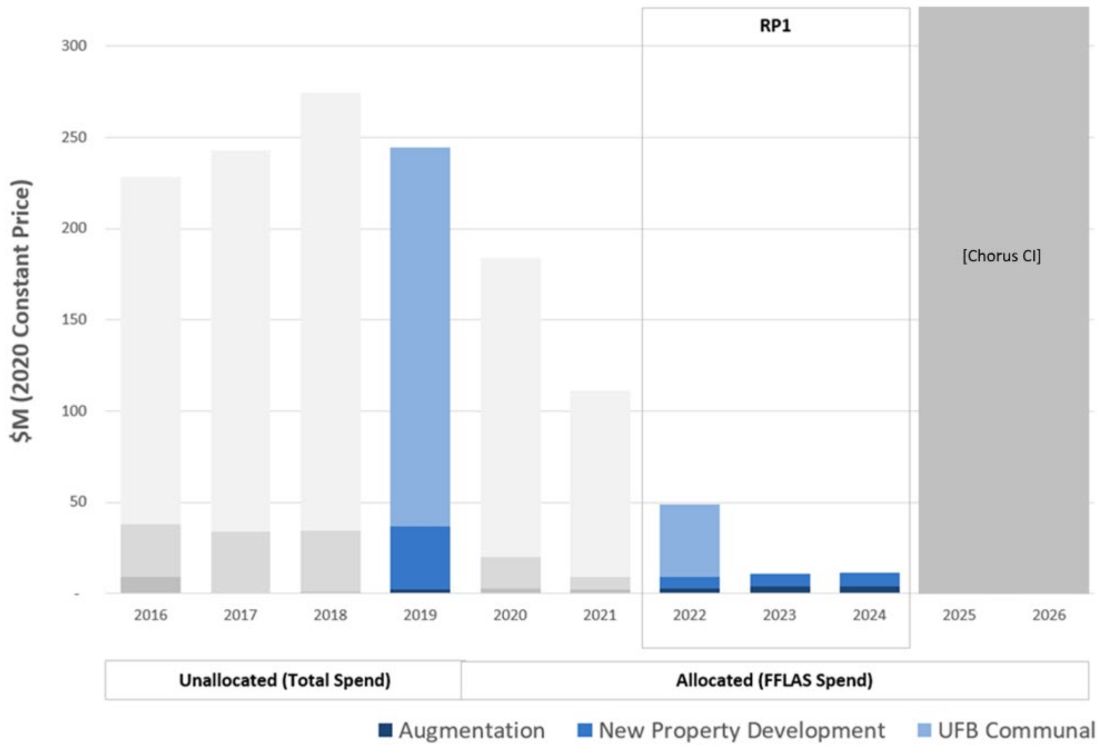


Table 2.2: New property development pricing table for UFB areas

Type	UFB1 fibre [Chorus CI]	UFB2 fibre [Chorus CI]
Single Dwelling Unit (SDU) <=2(UFB1)/4(UFB2) land parcels		No fee for SDU with <= 4 defined geographical sites + GST per premises for any new premises with > 4 defined geographical sites
Multi Dwelling Unit (MDU) <=2(UFB1)/4(UFB2) land parcels		No fee for MDU with <= 4 defined geographical sites + GST per MDU + per tenancy reticulated for any new premises with > 4 defined geographical sites
SDU adjoined to UFB/UFB2		As per non-UFB/UFB2 areas, standard or non-standard/high cost development
MDU adjoined to UFB/UFB2		As per non-UFB/UFB2 areas, standard or non-standard/high cost development

We charge for extending the network to new property developments. Our government contracts stipulate price caps for these charges for projects within the UFB2/2+ footprint (Table 2.2). Our forecast is net of all capital contributions.

Our main forecasting risk for new property developments is the uncertainty related to forecast volumes. Volumes are dependent on many factors, including our contract win-rate and market factors such as rates of population growth and volumes of building consents

2.7.3 Augmentation

Our forecast for network extensions to non-UFB communities is based on the small number of projects that are likely to proceed. Our forecasts use an assessment of the length of the fibre lay from the community to the closest point of interconnect to the fibre network, and an average cost rate per metre based on our historical build costs.

If additional projects become viable during RP1 we will seek to fund this by the individual capex mechanism.

For network extensions to our list of 350 'urban like' localities, our capital governance processes will ensure that we will allocate the available funds in the most efficient way. We will also bid for alternative funding (such as from government, councils or other groups) on a project by project basis.

Our forecast expenditure for infill activity is relatively small. It is based on historical data and adjusted to align the rate trend with new property development volumes as they are the underlying driver of new address creation.

All network extensions are different. This adds some uncertainty to our forecasts because of variations in:

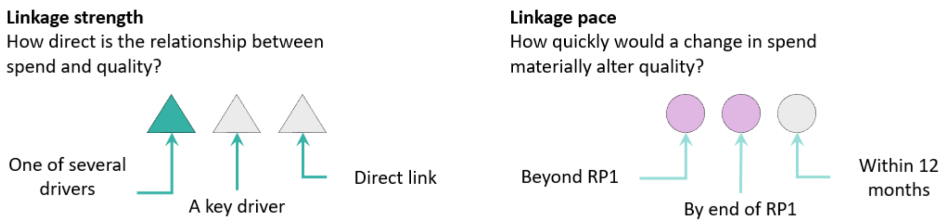
- the presence of other utilities like gas/power/water
- ground conditions (soil types/presence of rock etc.)
- surface reinstatement types (asphalt, concrete, grass)
- the availability of existing aerial infrastructure (and conditions for accessing that infrastructure)
- how much of our pre-UFB infrastructure could be used for UFB deployment
- traffic management
- council fees.

2.8 Links to quality

Each discussion of linkages between expenditure and quality includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment.

More detail on synergies between projects and programmes, and capex and opex trade-offs can be found in the Investment Summary of Our Fibre Plans under the heading 'linkages, synergies and trade offs'.

Table 2.3: Links between Extending the Network and our quality dimensions



Dimension(s)	Area	Strength	Pace
Availability and faults	**Extending the Network | all** **Installations | all** The initial build quality of our network will influence Layer One reliability over coming decades. Additionally, without overbuilding the network, some planned downtime is required for short periods when growing the footprint of our network		
Customer service	**Installations | all** **Extending the Network | all** Installs make up a declining portion of connection activity. Installs and extensions are when we have our most direct interaction with customers.		
Provisioning	**Extending the Network | augmentation** Sometimes provisioning involves infill work to expand network coverage and capacity to accommodate organic growth in premises passed.		

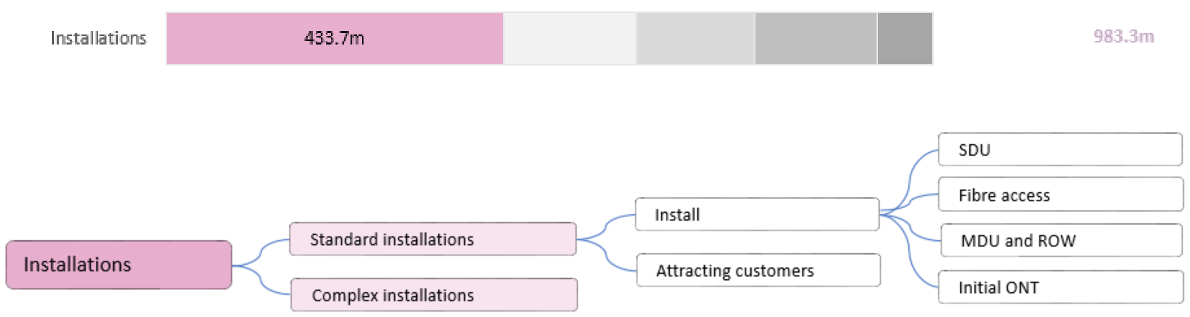
3.0 Installations

Describes the Installations capital expenditure (capex) category. It covers work to establish the physical link between the communal network and an Optical Network Terminal (ONT) at an end point. It includes associated provisioning and incentive costs.

3.0 Installations

Figure 3.1: Installations expenditure as a proportion of total first regulatory period (RP1) capex

Installations capex



3.1 Introduction

Installations[1] expenditure arises from requests from our Retail Service Provider (RSP) customers to connect consumers to the fibre network or our managed migration programme which targets addresses without a fibre lead-in installed. Our regulatory category of installations and its two sub-categories, standard installations and complex installations, have been created for the purpose of our RP1 proposal. They are based on our expenditure forecasting approach and have a different definition than terms used in the Network Infrastructure Project Agreement (NIPA).

Our two installations sub-categories are:

- **standard installations** – to residential and business consumers. Standard installations have several types – single dwelling units (SDUs), multi-dwelling units (MDUs), rights of way (ROWs) or fibre access extensions. Optical network terminals (ONTs), Hyperfibre access and attracting customers are also allocated to standard installations.
- **complex installations** – where additional design and planning is required to facilitate the installation. We use this categorisation because they are managed differently from standard installations.

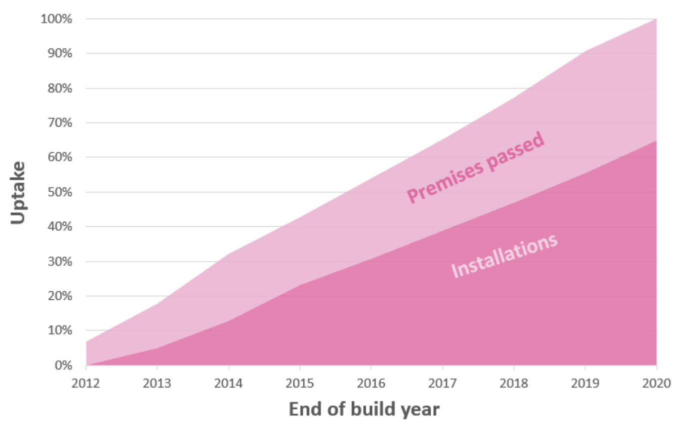
As part of the Ultra-Fast Broadband (UFB) rollout, we have built Fibre to the Home (FTTH) network infrastructure to over a million premises. An installation is the work needed to take fibre from the network to a consumer, it includes building a fibre lead-in and installing an ONT in the consumer's premises.

When the installation is complete a connection to the network can be established. Installation is a physical task and the connection is provisioned electronically.

Each premises passed is a potential connection to the fibre network. We began completing fibre installations in 2013 and have installed a fibre lead-in to over 60%[2] of consumers served by the network (Figure 3.2).

Figure 3.2: Fibre uptake showing the percentage of installations and premises passed since 2012

Fibre uptake



We aim to install and connect as many customers as possible to our fibre network as there are three important benefits to our business:

[1] We use the word 'installations' in this chapter to describe expenditure to connect customers. This is the same expenditure addressed by the connections capex mechanism.
[2] As at June 2020.

- the cost of running the network is spread across more customers, reducing operating cost per customer
- operating two networks, copper and fibre, is expensive. As we migrate customers from copper to fibre, we will be able to turn off parts of the copper network and reduce our operating costs
- building the network was a significant investment and we receive a return on our investment when customers connect to the network.

3.2 Standard installations

Installation activity is prompted by a consumer requesting to connect to the network or the managed migrations programme. Installations involve building fibre lead-ins that join FTTH architecture to the premises, installing an ONT in the premises and provisioning network service for the consumer.

Most consumers upgrade to fibre over a few years but there are always some late adopters. Our aim is to get as many consumers connected to the fibre network as there is competition for customers from wireless service providers. To help drive take-up of fibre we have a process called managed migrations. This process actively promotes fibre by going door to door to premises that currently do not have a fibre lead-in. This supports our aim to migrate as many consumers from copper to fibre to reduce the costs of running two networks, especially where the number of copper customers in an area is low. Our managed migration programme has seen 50% of targeted premises connect to the fibre network within six months.

In some cases, a consumer requests a connection where we have already installed a fibre lead-in. We call these cases intact connections; they occur when an existing customer changes to a different service. When a request comes from an intact connection, we can provide network service without performing an installation build.

Costs of an installation are on labour, duct, fibre and ONTs. All installations add assets to our portfolio. Many of the cost elements are consistent across all installation types but vary depending on the scale of the work involved. Labour is the most significant cost category.

On average, an installation to a SDU is simpler and cheaper than building the cabling backbone and building distribution enclosure required to connect to a MDU or a ROW. The scale and cost of installations to MDUs and RoWs goes up as the number of drop-off points increase and more materials and technician time is required. The cost variation in SDUs is driven by the deployment type (aerial or duct) and distance of the fibre lead-in.

Table 3.1: Cost categories associated with the Installations expenditure area

Installation costs

Cost Category	Description
Field technician costs	Rates agreed in our contracts with our Field Service Providers (FSPs) (i.e. building the fibre lead-in, travel to the premise, installation of the ONT)
Labour costs	The internal labour cost required to connect consumers and manage orders using our IT processes
IT costs	An allocation of IT costs for systems involved in order processing
Materials	Cost of fibre, duct, cables and ONTs which are the physical assets required for a connection
Managed migrations	Rates agreed in our contracts with door to door marketing companies

In the case of an intact connection, the fibre lead-in and ONT are already in place so the only cost is provisioning. An exception to this is a Hyperfibre connection, which requires the installation of a new ONT inside a consumer's premises. The Hyperfibre service also requires the installation of a new port card in the local exchange. The first Hyperfibre customer prompts this installation which is used for subsequent connections until the card is full.

In addition to the above we also complete fibre access network extensions to enable consumer connections, for example, extending fibre to non-building access points called smart locations. Smart locations include traffic lights, CCTV, cell sites and electronic billboards. We expect this to be a growth area as we move into RP2.

3.3 Complex installations

We design and build complex installations for specific business requirements. Complex installations solutions are common for cell sites, hospitals, schools, banks and large office complexes that need a dedicated connection. They can involve extensive design, cable hauling and traffic management activities.

The cost of complex connections depends on the level of service required. Adding resilience by creating connections to multiple exchanges and using diverse routes increases the complexity and the cost (Figure 3.3).

Due to the high costs involved, we sometimes ask for a contribution toward the costs of complex installations based on the scale of the work required. The level of expenditure presented in our proposal is net of these capital contributions.

Part of our expenditure on complex installations during RP1 involves working with the Rural Connectivity Group to build fibre routes to mobile sites. This is a major contract and is one of the departures from the approved business plan that we have included in our proposal.

We treat the costs of disconnecting customers from the network as operating expenditure.

Figure 3.3: Examples of resilience and diversity built as part of complex installations

Complex installations

Diagram 1 –basic resilience
- Single exchange
- Diverse route

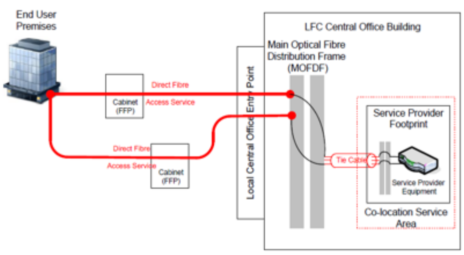


Diagram 2 – improved resilience
- Single exchange
- Diverse route
- Diverse entry to premises

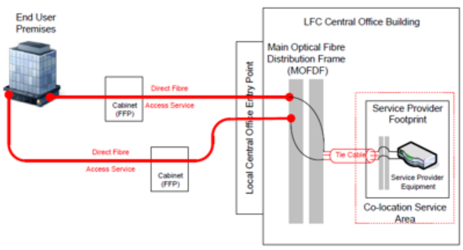


Diagram 3 – greater resilience
- Diverse entry to single exchange
- Diverse route
- Diverse entry to premises

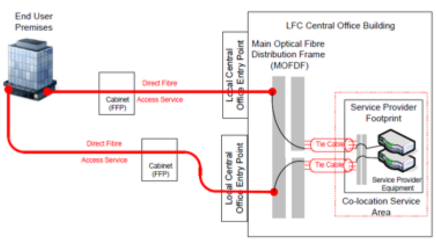
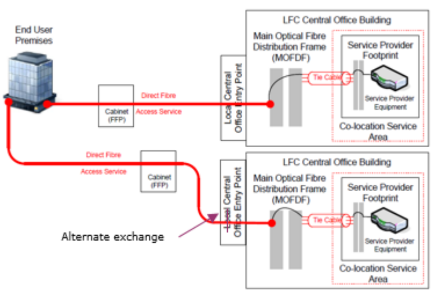


Diagram 4 – highest resilience
- Different exchanges
- Diverse route
- Diverse entry to premises



3.4 Attracting customers

Our goal is to attract customers to connect to our fibre network and use Fibre Fixed Line Access Services (FFLAS). Our marketing and customer incentives aim to:

- encourage migration to fibre as part of our copper to fibre strategy
- encourage offnet households to connect to our network
- optimise consumer experience by moving customers up the portfolio of fibre plans
- retain customers on our network, given the availability of alternative services.

Previous examples of incentives include modem credits for copper to fibre migrations and fibre plan upgrades. Incentives are typically provided via RSPs to encourage their customers to convert to or upgrade their fibre service.

We have a contractual commitment with the Crown to prioritise the fibre network, including obligations to promote fibre and support fibre uptake.[3] These obligations survive the expiry of the UFB1 contract in 2019 and are replicated in the UFB2/+ contract. Our incentive programme and marketing activities support these obligations and will continue through RP1.

Incentives are designed to reduce the consumer inertia that exists, even when fibre services deliver better outcomes in terms of performance or cost.[4] They also help overcome the barrier to fibre adoption associated with the install process.

Using incentives to increase fibre connections is beneficial to us, RSPs and consumers because it spreads network rollout costs across a larger number of connections, reducing cost per connection. Our network architecture is flexible to meet current and future uptake, so customer incentives help bring our network to an efficient level of uptake more swiftly. Once consumers have experienced fibre services, they tend to stay with fibre.

Upgrade incentives similarly reduce inertia associated with switching plans. Moving consumers to higher-performance plans improves their experience and increases our average revenue per consumer which in turn reduces the cost recovery required from FFLAS customers that haven't upgraded.

We invest in incentives at a level that provides a net positive return on investment. We recognise fibre adoption generates consumer surplus over and above our return, but our investment case does not rely on this.[5]

We forecast incentive spend based on the cost per incentive, multiplied by forecast uptake rates.

Our installations focused incentives are capitalised. Opex related to our other marketing campaigns is discussed in the Customer Opex chapter.

3.5 Installation delivery

An installation is prompted by a connection request from a consumer or our managed migration programme. The process has several steps and involves activity throughout our business, it starts with a consumer ordering fibre broadband from their choice of RSP.

The order request is logged on our IT system which informs our customer and network operations (CNO) team who manage the installation process. The system tracks the order through various stages and triggers several automatic activities that share information on the status of the order with the RSP and the FSP carrying out the installation work.

A scoping visit may be required to determine the type of installation that is required (SDU, MDU or RoW). If a network extension is required, we organise the necessary consent, design and build work in partnership with the FSPs.

If fibre is available at the address, the FSP assigns a technician who follows the ABC process:

- **agree** – meet with the consumer to describe the connection process and agree an install plan
- **build** – build the fibre lead-in from the from the network to the boundary of the property and install an ONT
- **connect** – meet the customer and complete the internal work and ensure that the network service is working.

[3] Network Infrastructure Project Agreement, Chorus Limited and Crown Fibre Holdings Limited, Schedule 2 Commitments.
[4] The Behavioural Insights Team, Behavioural Biases in Telecommunications, A review for the Commerce Commission 2019.
[5] See, for example, Sapere, *Estimating the Wider Socio-economic Impacts of Ultra Fast Broadband for New Zealand* (August 2017), [56]. https://www.srgexpert.com/wp-content/uploads/2018/03/Estimating-the-wider-socio-economic-impacts-of-UFB-for-NZ-final.pdf

To speed up our installations and improve our customer service we have instigated a fibre in a day process. For simpler installations, the ABC process is completed in a single visit for fibre in a day installations.

When the build is complete, we update NetMap (our internal fibre record system) with information about the new assets.

If an ONT is already in place our CNO team can connect the consumer without visiting the property.

Finally, our IT systems automatically invoice the RSP for any one-off installation charges for example the cost of a complex installation and recurring billing for the monthly rental begins.

3.6 Our plans

Our ambition is to connect one million consumers to the fibre network by the end of 2022. Our plans for standard and complex installations are the same, to carry out as many installations and connect as many consumers as possible.

During RP1 we expect to carry out an average of 55,000 standard installations and around 2,300 complex installations per year. We will work towards this by continuing to promote fibre through our marketing activities and using incentives for late adopters. A sustained focus on installations will enable us to connect consumers to the network and achieve our ambition.

We are using our managed migrations programme to promote the benefits of the fibre network and encourage uptake in Specified Fibre Areas. Our aim is to turn off copper services in these areas using the Copper Withdrawal Code.

When all premises in UFB areas have had fibre installations, the only remaining source of new installations will be the result of extending the UFB network, through new property developments or augmentation activities.

We are expecting an increase in higher speed fibre products through RP1 including Hyperfibre, which requires an upgrade of ONTs which is reflected in our spending.

Installations and connections are core to our business. We aim to meet our performance targets for provisioning and to continue to improve our customer service by completing more fibre in a day installations.

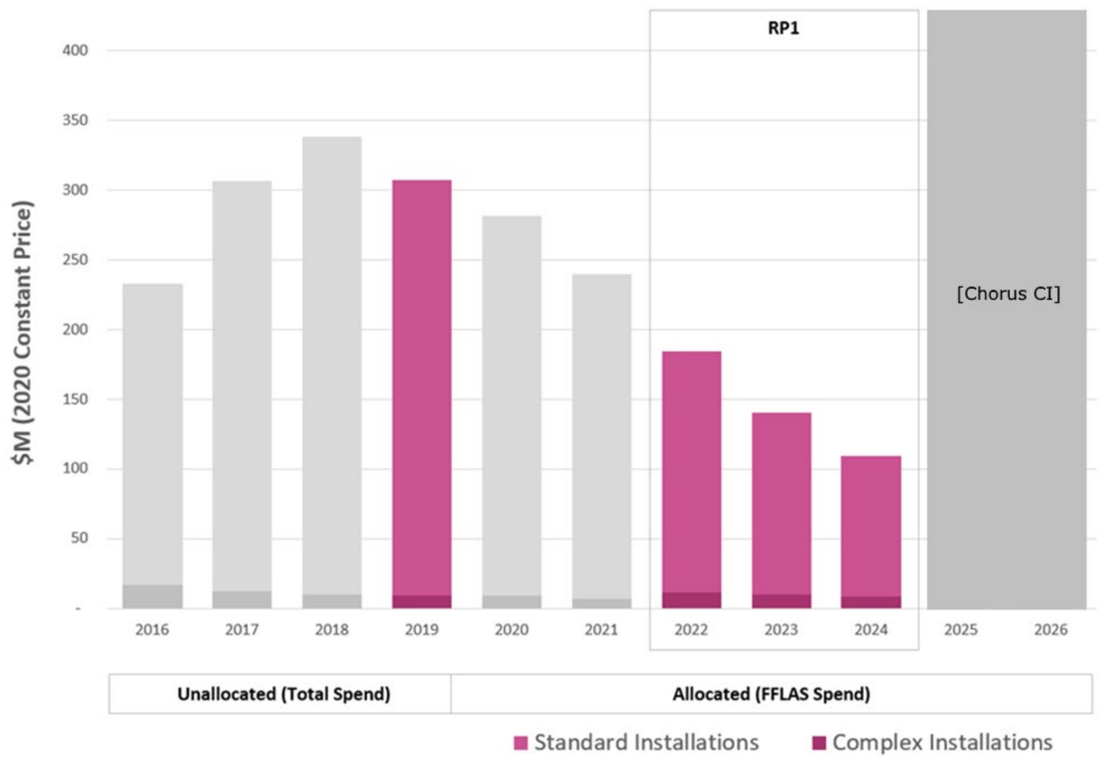
3.7 Forecast expenditure

Our spend on installations has been increasing year on year as we built the fibre network and demand for connections grew. Installation numbers peaked in 2019 and we expect our expenditure to fall over time as migration to fibre services reaches saturation. During 2025 and 2026 we expect our standard installation spending to [**Chorus CI**][6].

Although installations are in decline, this will remain our largest capex spend area during RP1, where we expect to spend $433.7 million on installations.

Figure 3.4: RP1 expenditure for Installations showing unallocated historical spending

Installations capex



3.7.1 Standard installations

Our standard installations forecast is calculated using a volumetric price x quantity model, where price is the cost of new installations and quantity is the relative volume.

The number of forecast installations is highly demand driven. We estimate installation volumes using a demand model. The key demand forecasting tasks for installations are growth in fibre consumers as a share of the overall broadband market and how this translates into new connections. More detail on our approach to demand forecasting can be found in the Demand report of Our Fibre Plans.

The cost of installations depends on the scale of the work involved. From experience we know the average cost of different installation types. We have grouped together installations types with a similar cost. The model does not consider regional cost variation.

[6] Our current business planning process only takes our detailed planning to 30 June 2025. To extend the forecast for calendar year 2025 and 2026 we have applied a high-level approach to project the forecast forward, with bottom-up and top-down sense checking to adjust for anticipated step changes.

We use several assumptions as part of our forecasting for standard installations:

- this expenditure area is heavily reliant on consumer demand, which is inherently unknown
- installation volumes are dependent on the rate of uptake of premises passed by the network (faster uptake may result in more installations prior to RP1 reducing the pool of remaining premises to be connected during RP1)
- the historical deployment mix of installation types is a valid indication of what the mix will be in the future. There is uncertainty of where demand for fibre installations will come from. This reduces our ability to estimate the installation types for premises that have been passed by the network where an installation has not yet been completed
- the average installation cost will change over time due to change in the mix of installation types
- there are assumptions built into the forecast [**Chorus CI**] when negotiating contracts with our FSPs. These are generic assumptions across all expenditure areas where FSPs are used to provide services.

The volume of UFB build and installations field activity will fall during RP1, in response to this we are planning on restructuring our approach to this work. The impact of the restructure on FSP costs for installations is uncertain.

3.7.2 Complex installations

Our forecast for complex connections also uses a price x quantity model. Price and volumes are based on historical data with an adjustment for movement in overall total active connections.

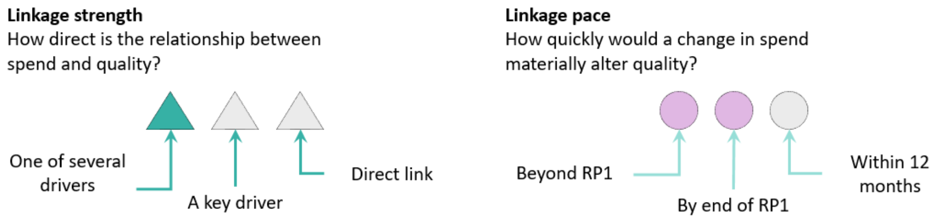
There is a moderate level of uncertainty in the forecast expenditure for complex installations during RP1 related to our assumptions. Our historical expenditure on very high cost installation types has been volatile but volumes have been declining which reduces our exposure to forecasting risk. Lower cost business fibre installations are more stable and higher volume, which reduces the risk of a few very high cost projects increasing in total programme cost.

3.8 Links to quality

Each discussion of linkages between expenditure and quality includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment.

More detail on synergies between projects and programmes, and capex and opex trade-offs can be found in the Investment Summary of Our Fibre Plans under the heading 'linkages, synergies and trade offs'.

Table 3.2: Links betweek Installations capex and quality dimensions



Dimension(s)	Area	Strength	Pace
Availability and faults	**Extending the network | all** **Installations | all** The initial build quality of our network will influence layer one reliability over coming decades. Additionally, without overbuilding the network, some planned downtime is required for short periods when growing the footprint of our network	▲▲△	●○○
Customer service	**Installations | all** **Extending the network | all** Installs make up a declining portion of connection activity. Installs and extensions are when we have our most direct interaction with customers.	▲▲▲	●●●
Provisioning	**Installations | all** The most complex provisioning activities involve establishing new installations or installing new ONT capability.	▲▲▲	●●●

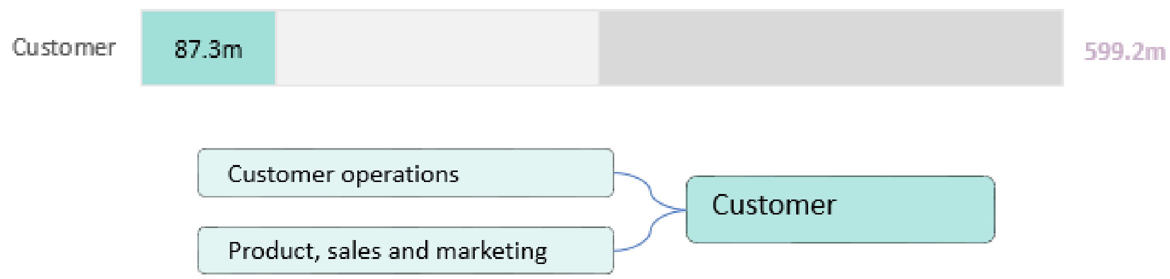
4.0 Customer Opex

Describes the Customer Opex category. It covers expenditure on products, sales and marketing and the cost of customer operations.

4.0 Customer Opex

Figure 4.1: Customer Opex as a proportion of total first regulatory period (RP1) opex.

Customer Opex



4.1 Introduction

Customer Opex covers our Product, Sales and Marketing (PSM) teams and the customer-facing teams in Customer and Network Operations (CNO).

4.2 Product, sales and marketing

Our PSM spend includes the internal labour needed to manage our product development, and marketing strategies and the cost of running marketing campaigns.

This sub-category includes:

- marketing campaigns, branding and advertising
- consumer, market and data insights
- product management
- account management and sales/service
- growth and innovation.

Our business strategy is to win market share for the fibre network and grow new revenue streams. This driver requires investment in marketing and customer centric product development. Fibre connection growth rates are slowing as fibre penetration reaches saturation and wireless competition increases. The remaining potential consumers in UFB1 areas tend to be late adopters who are harder to convert to a fibre connection. To reach these potential customers we are investing in targeted incentives and marketing activity.

Targeted activity needs a high level of support from the business to provide accurate data, customise offers and direct marketing material to have the highest impact possible. To support these activities, we invest in consumer research to gain market insights on what they need and are seeking from broadband connections. More detail on this can be found in the Engagement report in Our Fibre Plans.

We have a contractual commitment with Crown Infrastructure Partners (CIP) to prioritise the fibre network as part of the Ultra-Fast Broadband (UFB) rollout, including obligations to promote fibre and support fibre uptake. Some of our marketing spend is capitalised to installations. These activities are described in the attracting customers section of the Installations chapter.

Migrating the remaining customers from copper to fibre is beneficial as it allows us to switch off parts of the copper network, reduce the cost per connection of the network and maximise the utilisation of the investment in the fibre network.

Our marketing activity includes:

- **managed migrations** – targeted installs to drive fibre uptake

- **customer incentives** – targeted incentives to drive new fibre connections and upgrades to higher speed connections[1]
- **business lines** – review and planning for business products and door knocking to drive copper to fibre migration for businesses
- **advertising and communication activity** – brand campaigns to highlight the value of fibre in the market
- **marketing automation** – investing in platforms to integrate data to provide better insights and more targeted consumer campaigns
- **copper withdrawal** – in some Specified Fibre Areas (SFAs) this requires targeted direct marketing.

Our consumer, market and data insights team undertake market research to inform our strategy. We need to know how consumers feel about competitive products and technology changes, so we can remain nimble and react to market changes quickly.

Our account management team maintains our relationships with our Retail Service Providers (RSPs). This is our key point of connect with the consumers of our products. We use this connection with consumers to understand how the range of products and services in the market are received.

Our product management team manages our product set. They develop new products and strategies to grow adoption of our services based on market and consumer trends. They link technology capabilities with market demands by working with the Insights team and our technology specialists.

Technology is constantly evolving, and it is difficult to predict the type and number of new products that will be required. Instead our proposal allows for continuous product innovation to meet current and future consumer needs.

Recently we have set up a small growth and innovation (G&I) team responsible for driving our strategic direction of generating new revenues and building a sustainable future. The team collaborates horizontally across the business, and with partners and customers to identify, validate and scale new business opportunities and enhance the organisation's adaptive and learning capabilities. For a more detailed description see the Investment Summary of Our Fibre Plans.

4.3 Customer operations

Our customer operations spend is mainly on internal labour. We split our CNO spending across all three opex categories. The CNO teams covered in customer operations opex are:

- consumer connect teams
- business connect teams
- fibre field operations team
- complex fibre project teams
- managed migrations
- fibre initiatives.

The customer operations spend relates to the teams that connect consumers by managing installations and provisioning network services. The work involves actively managing each order from start to end, through liaising with RSPs and our Field Service Providers (FSPs), tracking the status of each order in our IT systems, and trouble-shooting any issues.

Our customer operations include contracted door to door marketing companies that deliver our managed migrations campaigns and project teams set up to manage orders that require detailed planning such as Multi-Dwelling Unit (MDU), Right of Way (RoW), or complex installations.

These CNO teams are focused on delivering excellent customer service and are responsible for the delivery of contractual, legislative and regulatory requirements.

A significant portion of customer operations activity involves managing FSPs as they build fibre lead-ins from the communal network to consumer premises. With most connections already on the network by the start of RP1, we expect to see a decrease in installation volumes.

We have forecast a decrease in customer operations workload reflecting the reduction in connection volumes. The customer operations team will still need to manage the process of migrating late adopters off the copper network in fibre areas, complex fibre delivery, MDU and RoW installations and continued project work.

[1]1 Our costs for customer incentives in this sub-category are for marketing of incentives. The costs of incentives are capitalised under NZ IFRS 15 and captured in our Installations expenditure, Standard installations sub-category.

4.4 Our plans

4.4.1 Product sales and marketing

We plan to reconsider our resource capability needs in PSM in the early part of RP1. At that point it will be clearer what the transition from build to operate means for PSM. We expect there will be drivers to continue to innovate and look to offer new products to the market. This has the benefit of maximising the value derived from our fibre investment and continuing to improve the quality of the network services we provide. We expect that we will be able to deliver these plans while keeping our PSM spending at current levels.

As fibre uptake is already over 60%, it becomes increasingly difficult and costly to migrate late adopters to the fibre network. We will continue to work with multiple advertising mediums (e.g. social media, broadcast media, publications) to reinforce the value of fibre.

During RP1, our plan is to maximise fibre penetration by migrating customers from our copper network and win new customers to fibre, grow our fibre footprint through new property developments, promote faster fibre speeds so that customers can gain the greatest benefits from the fibre network, and develop new products and services that create value for consumers.

To do this we will:

- continue to promote fibre uptake via marketing the benefits of fibre to the market through a combination of advertising campaigns as well as direct communication
- provide financial incentives to RSPs to encourage them to drive fibre adoption through their activities, both to their existing copper broadband customers and the broader market, as well as encouraging faster speed fibre adoption
- work with late adopters directly to migrate them from the copper network onto the fibre network, including door-knocking and other direct campaigns to encourage fibre adoption
- where fibre adoption is very high, this will allow us to undertake copper withdrawal to move the last adopters to fibre and realise cost efficiencies
- work with all stakeholders to develop new ideas for new products to meet the future needs of consumers.

4.4.2 Customer operations

Installation volumes have already peaked but future installation activity is expected to require more detailed planning due to the complexity of the work involved. For example, the UFB2/2+ footprint is more geographically spread, which means that there are fewer locally based field technicians, this increases the cost of 'no shows', e.g. where the installation crew arrives at the agreed time and the consumer is not present to enable installations.

The focus will move to managing complex installations, new products, the remaining customers on copper who are more reluctant to move to fibre, the process for customers moving addresses, and switching between alternative RSPs and/or data plans.

During RP1 and beyond our plans for customer operations reflect:

- connections will be more complex in nature where more consideration is required for installation design and implementation
- that the UFB footprint will have a larger geographical spread
- we will migrate the final customers off the copper network. We encourage late adopters to connect to fibre through door to door campaigns. These usually result in several connections in an area at the same time
- as we migrate the final customers off the copper network, there will be a shift to managing a fully intact network (i.e. where fibre lead-ins and Optical Network Terminals (ONTs) have already been installed), with the main activities moving to supporting customers moving addresses and switching between alternative RSPs and/or service plans.

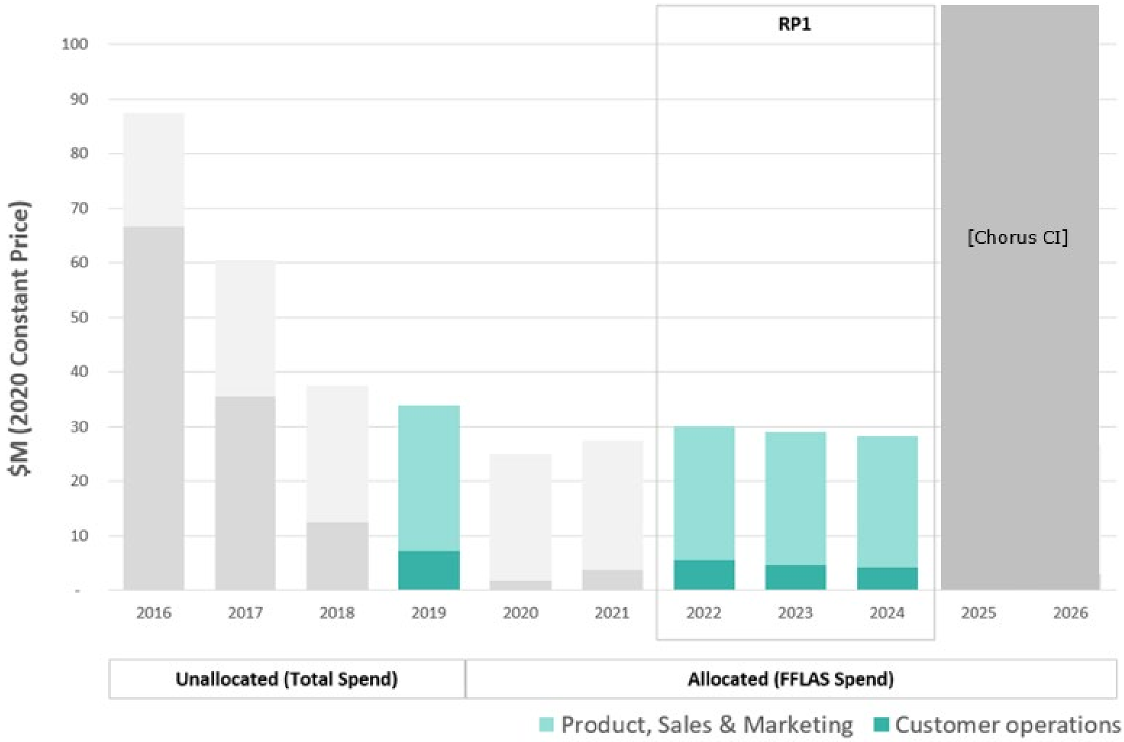
4.5 Forecast expenditure

Historically our PSM spend increased as our build progressed, and the pool of potential customers grew. Our PSM spend is likely to remain relatively stable as we continue to develop new products and promote the benefits of fibre broadband. During RP1 and beyond the volume of work related to installations and extending the network will fall, we expect that customer operations costs needed to manage this work will decline[2].

During RP1 our forecast expenditure for Customer Opex is $87.3 million.

Figure 4.2: RP1 expenditure for Customer Opex showing unallocated historical spending

Customer Opex



4.5.1 Product sales and marketing

We plan our future marketing based on the success of previous campaigns and our targets for connecting customers to the network. Our PSM forecast expenditure is built from our plans and the known costs of delivering marketing campaigns. It has two key cost elements: the marketing campaigns and internal labour. We assume that there will be no significant change in labour or marketing costs.

Our forecast for marketing campaigns is relatively risk free as we have an obligation to promote fibre services. There is some uncertainty based on how well our campaigns will be received and the type of campaigns we will run toward the end of RP1, as we cannot plan specific campaigns too far into the future.

Internal labour is the most material part of our PSM expenditure. We forecast this based on current spend. Development in innovation and technology will result in new products being offered to the market. We expect our new product development costs to increase during RP1. Our workforce assumptions will change as and when projects develop, we have assumed an increase in workforce will be required as we build capability within the business. We expect that this will be reduced from FY2024 when there will be a clear resourcing model in place.

[2] Our current business planning process only takes our detailed planning to 30 June 2025. To extend the forecast for calendar year 2025 and 2026 we have applied a high-level approach to project the forecast forward, with bottom-up and top-down sense checking to adjust for anticipated step changes.

This introduces some uncertainty into our forecast, but it is minimal because most fluctuations in cost are related to capitalised labour for specific projects delivering future value.

4.5.2 Customer operations

Customer operations opex costs are have fallen over time mainly due to implementation of accounting policies that resulted in us capitalising the internal labour cost associated with customer installations and connections, and acquisition/retention activities. During RP1 and beyond we expect our customer operations costs to decrease as the network build activity reduces.

Our forecast for customer operations labour has been developed by a combination of high-level activity driver analysis and management judgement on the roles required, their cost and the level of capitalisation, specifically:

- current roles were analysed by key installation and connection activity and role numbers predicted on that basis
- management judgement is applied to allow for factors such as increasing complexity of connections, copper to fibre migration, limitations in the high-level activity drivers, anticipated system and process efficiencies. We expect that new products will be increasingly automated
- the role forecast is then valued for gross labour and capitalised labour for the relevant period.

We have assumed a decrease in headcount reflecting anticipated decline in installation and connect volumes. This is supported by maintaining capability in non-transactional roles and a programme of system and process efficiencies.

We capitalise a large proportion of customer operations costs involved in customer installations as the processes are an integral part of building and installing fibre service leads, acquiring new customers and ensuring the asset is operating as expected.

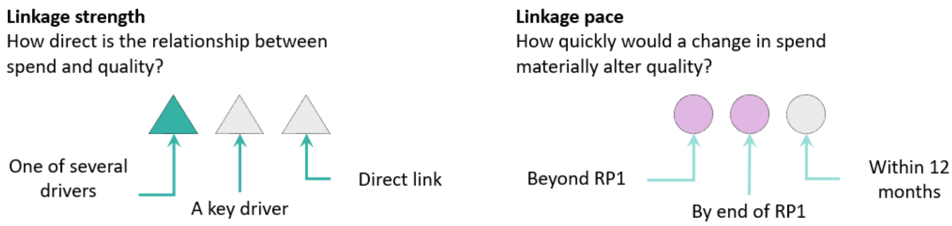
Our labour rates contain both a variable component (labour) and a fixed component (IT systems and property costs). As workloads decrease, our ability to capitalise our fixed operating costs also decreases. So, although we are forecasting a declining trend in our workforce and related costs, there is a corresponding increase in operating costs because fixed costs can no longer be capitalised.

4.6 Links to quality

Each discussion of linkages between expenditure and quality includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment.

More detail on synergies between projects and programmes, and capex and opex trade-offs can be found in the Investment Summary of Our Fibre Plans under the heading 'linkages, synergies and trade offs'.

Table 4.2: Links between Customer Opex and our quality dimensions



Dimension	Area	Strength	Pace
Customer service	**Customer | all** Our customer-facing operations, and our product, sales and marketing activities have direct links to customer satisfaction.		
Switching	**Customer | customer operations** We have obligations to provide a smooth transfer of service from one RSP to another, reducing barriers to fibre access and switching.		
Provisioning	**Customer | all** Customer operations team handles provisioning tasks that require more complex coordination		
Ordering	**Customer | all** Need to keep customers and RSPs informed about what product offerings we have available and when. Communication is important to explain and smooth processes.		

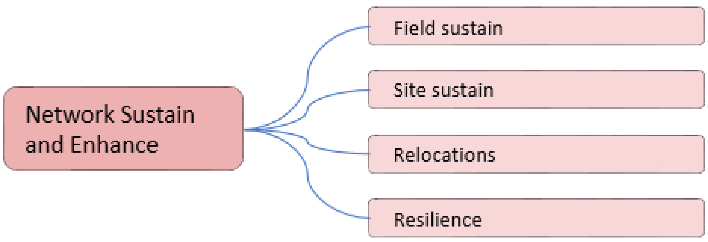
5.0 Network Sustain and Enhance

Describes the Network Sustain and Enhance capital expenditure (capex) category and covers investment in physical network assets.

5.0 Network Sustain and Enhance

Figure 5.1: Network Sustain and Enhance expenditure as a proportion of total first regulatory period (RP1) capex

Network Sustain and Enhance capex



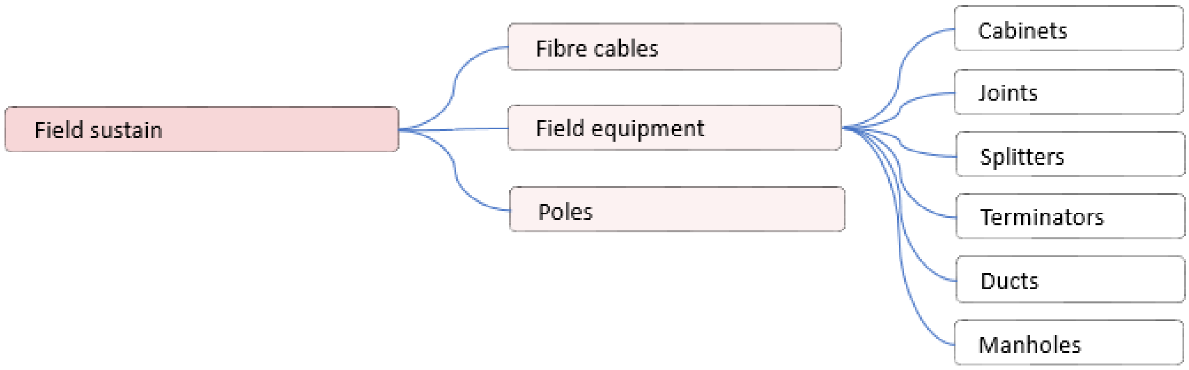
5.1 Introduction

Network sustain and enhance is the capex required to keep the network running. Sustain activities involve upgrading and replacing assets to maintain network performance and enhance activities are designed to improve network performance or reduce the chance of outages.

Network sustain and enhance has four expenditure sub-categories:

- **field sustain** – upgrading or replacing network assets
- **site sustain** – upgrading current network buildings and maintenance of our network buildings and engineering services
- **relocations** – moving network infrastructure
- **resilience** – increasing network resilience to reduce the chance of outages.

Figure 5.2: Assets managed under the field sustain sub-category



5.2 Field sustain

Our fibre network is comprised of thousands of assets across New Zealand. We manage each asset type according to their own characteristics.

During RP1 we plan to spend $60.3 million in capex on field sustain. This spending is to sustain the network by fixing or replacing assets. This is capex as the spend is on lengthening the life of assets or installing replacement assets.

To describe our asset management, we have grouped our assets into three portfolios based on their function and how they are managed:

- **fibre assets** – fibre cables, the equipment that joints, terminates and splits fibre strands and roadside cabinets which house our assets
- **ducts and manholes** – we use a reactive approach to the maintenance of these assets
- **poles** – poles are managed separately as they are legacy assets and require a specific asset management approach.

This section steps through the three portfolios describing each asset type and our asset management approach. Our plans and expenditure forecasts for RP1 are described together.

5.2.1 Fibre assets

Our fibre cable portfolio covers fibre cables, cabinets, joints, termination equipment and splitters. The following sections describes each asset type and condition, then explains our asset management approach to this portfolio.

5.2.1.1 Fibre cables

Asset description and population

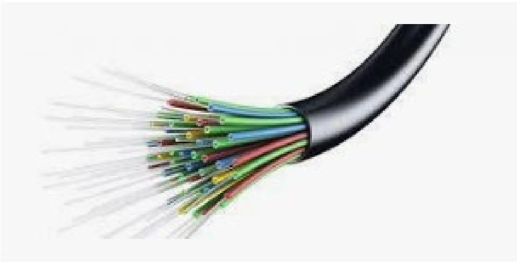
A fibre cable is an assembly that contains one or more optical fibres. A cable provides passive optical connectivity between fibre end points that are connected to network electronic devices. The electronic devices send light signals carrying information through the connected fibre cables. Fibre cables have a very large bandwidth, and relative to copper cables can carry large amounts of information, at faster speeds and over longer distances.

Optical fibre strands are individually covered with an acrylate polymer coating or cladding, that provide the fibres with mechanical and optical protection. The construction of our cables follows one of two methods:

- **slotted core** – older cables that have a central strength member and a support form with cavities or slots that carry a group of fibres. We have around 3,200 km[1] of slotted core cables
- **loose tube** – where several fibre strands are housed inside a support tube, one or more tubes make up a cable. We have around 120,000 km[1] of loose tube fibre cable. Most of our fibre network uses newer loose tube fibre cables.

Figure 5.3: Optical fibre cable

[1] Asset population figures in this chapter are estimated as of June 2019.



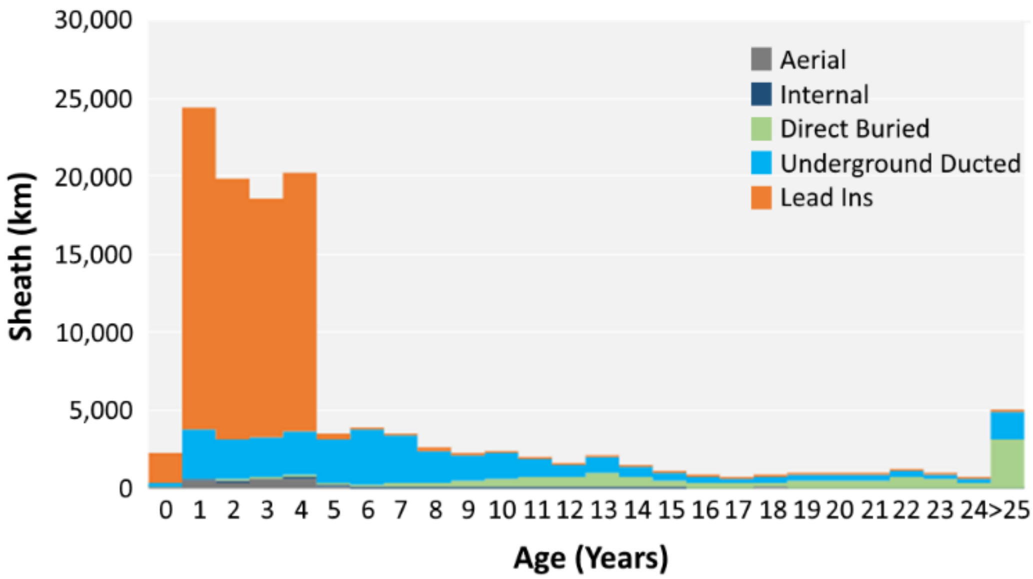
Our fibre cables are deployed in several ways depending on the situation. We use different cable constructions to ensure protection of the fibre strands inside. The main deployment types are:

- **direct buried underground** – fibre cables that are ploughed, trenched or drilled directly into the ground at the correct depth. Replacing direct buried cable or increasing the number of fibres requires a whole new lay. The cable must have a strong outer sheath to protect the fibres
- **submarine** – fibre cables that are laid underwater on the seabed. The cable must have a strong outer sheath to protect the fibres
- **ducted underground** – fibre cables that are pulled, air blown or inserted through a duct laid in the ground. This method allows relatively easy replacement or augmentation. The outer sheath does not need to be as strong as direct buried cable as the duct provides additional protection
- **aerial** – fibre cables that are attached to poles above the ground. The sheath protects the fibres so must be able to withstand wind loadings, span tension, snow loading, and be UV protected
- **internal** – fibre cables installed in equipment rooms within network buildings or consumer premises. In network buildings, specialised trunking is used to manage the large volume of internal cables. In consumer buildings, internal fibre is installed in risers and ceiling spaces
- **lead-ins** – fibre cable that extends from the Fibre to the Home (FTTH) infrastructure and terminates in a premises. In residential areas they usually have eight or less fibre strands but will have a higher fibre count if they terminate in a large building with multiple drop off points.

When installed, we expect fibre cables to have a 20 year life expectancy.

In 2018 we undertook an exercise to assess the age of the assets in our portfolio. As we move to the manage phase, we are planning on improving our asset management capabilities which includes a plan for updating our asset information.

Figure 5.4: Age and type of fibre cables (data gathered in 2018)



Most of our fibre cables were installed as part of the UFB rollout and are relatively young. Fibre lead ins are built as part of the installations process and are less than ten years old. Our slotted core fibre is coming to the end of life and accounts for most of the fibre that is over 25 years old.

Asset condition

The condition of fibre cable is determined by its age, type of construction and the degree to which the cable trench has impacted the cable (tight bends in the cable, stretching, crushing, moisture, land movement, etc.). The quality of the installation, ground conditions and the maintenance of the fibre route influences the operational life of a fibre cable.

The ageing process generally shows up as fibre cuts or increasing optical loss over time along the fibres. We identify faults in fibre cables using a system called the Element Management Platform which monitors fibre performance and triggers an alarm if a fibre is cut. The main factors involved in the ageing of fibre cables are:

- **construction** – the individual fibres have a polymer coating to provide them with mechanical and chemical protection from their surroundings. Over time industry practice for cable construction has changed with advancements in manufacturing and material technology
- **installation** – the expected life of a cable can be compromised by damage during installation or incorrect installation. We minimise the occurrence of such issues by maintaining training and competency standards
- **physical damage** – cables can receive unplanned cuts as a result of digging or other activity within the trench area or due to rodents. Washouts and land subsidence, storms, floods and earthquakes, road works, and vandalism can all cause 'trench ageing', or damage or break sections of cable. We manage trench ageing by carrying out regular route surveys of all core fibre routes to inspect for damage
- **retraction** – our oldest slotted core fibre cables, installed between 1981 through to 1992 are susceptible to retraction. As fibre cables retract, they tend to pull away at joints and termination points, this impairs functionality and can eventually lead to the fibres breaking. We believe that all the slotted core cable installed in the period 1981-92 will exhibit gradual degradation and we need to continue replacing it
- **delamination** – the individual fibres in slotted core cables are coated with a polymer. Water entering the cable over time causes the polymer coating to swell, and under certain conditions, the polymer may delaminate from the glass strand. This can lead to bending of the fibre strand and optical loss.

5.2.1.2 Joints, termination equipment and splitters

Asset description and population

We use joints to connect or splice separate fibre strands. Joints are plastic enclosures with fibre management trays. They house the joint in individual fibre strands and protect the cable sheath. The size of the enclosure depends on the number and size of the fibre cables to be connected.

We joint fibre strands for several reasons:

- if the drum length of cable is not long enough to reach the desired distance
- extending an existing cable to reach further
- joining several smaller cables to a larger cable
- reducing the fibre count of a cable, to continue with a smaller fibre count cable
- jointing fibres on an Optical Fibre Distribution Frame (OFDF).

We use different types of joints depending on the age, the use and the number of cables being joined.

In a fusion joint, the ends of the individual fibre strands are aligned in a machine, cleaned and then melted/fused together. Fusion joints are permanent and result in little optical loss. We use fusion joints in long haul fibre situations.

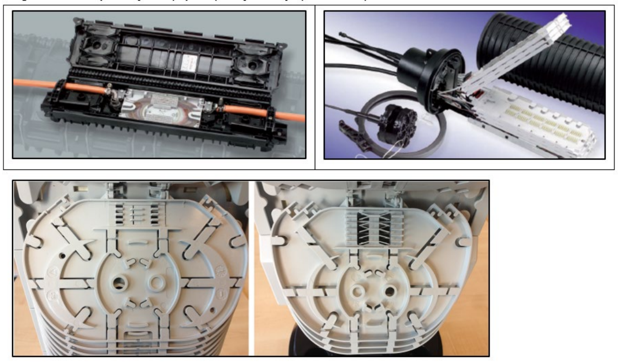
In a mechanical or connector joint, an optical connector is attached to the end of each fibre strand to be jointed. The strands are then aligned and held together by the connector. Mechanical splicing is quick and easy, and the joint can be disconnected and re-connected. This joint results in higher optical loss and must be kept clean.

A fibre joint enclosure allows two or more cable sheaths to be joined. Individual fibres are fusion spliced on plastic swing trays within the joint assembly. Simple joints connect fibres straight through, for example, one 96 fibre sheath to another, while others provide the ability to establish spur cables, for example jointing a 96-fibre cable into two 48-fibre cables.

Our network contains several types of joint enclosure. They organise the fibre and allow the fibre sheaths to enter the joint itself via a sealed gland arrangement in the base. A stack of fibre trays to support a group of fibre strands and their joints. A dome style sealable lid protects the joint assembly from environment and physical damage. We use Fibre Infrastructure System

Technology (FIST) joints in the access networks, and Fibre Optic Splice Closure (FOSC) joints in the core and regional networks.

Figure 5.5: Examples of joints



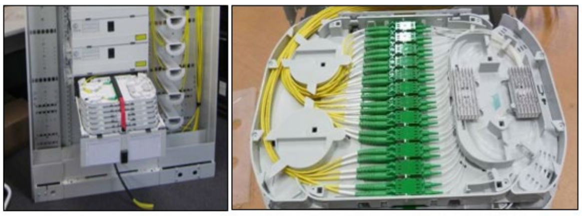
We use termination equipment to separate individual fibres from cables in a way which protects the fibres. Our terminating equipment has evolved over time and has become smaller, better performing and cheaper. Terminating equipment comes in various shapes and sizes but it can be grouped into three categories:

- Optical Fibre Distribution Frame (OFDF)
- Fibre Flexibility Points (FFP)
- Fibre Access Terminals (FAT).

OFDFs present individual fibre strands for joining or connecting. They provide the connection point between the outside underground/aerial fibre cables and the internal fibre cables that connect to network electronic devices. An OFDF has a line side where the incoming fibre cables terminate and an outgoing side to the equipment rows.

The typical OFDF comprises of a system of splice/joint draws/trays, a system for fibre cable management consisting of rings and trunking, and the equipment that connects the various fibre strands together. The nature of an OFDF means that there is a joint/splice between the incoming outside fibre cable/strands and the internal fibre cable/strands. The joints in the fibre strand can be a fusion joint, mechanical joint or a connector joint and the OFDF has features to support different joint types. We have over 90,000[2] OFDF draws/trays and shelves.

Figure 5.6: Examples of access optcal fibre distribution frames



FFPs are termination enclosures that also house the splitters which transition the fibre lead-ins to be delivered to premises. Cabinet-based FFPs were installed during the first three years of the UFB rollout. From year three we started installing Air Blown Fibre Flexibility Points (ABFFPs) which are FFPs located in underground pits. This transition resulted in build cost savings by reducing the total distance of 26 way micro-duct. We subsequently moved to a waterproof underground model, using a 1 to 16 splitter. We have over 13,000[2] FFPs.

In areas with high growth we are considering rearranging the network by extending the reach of splitters further into the existing network. This work would involve upgrading existing FATs to house splitters to optimise the use of existing fibre cables.

Figure 5.7: Examples of Air blown fibre flexibility points

FATs terminate fibre cables within the access distribution network and extend fibre lead-ins to consumer premises. A fibre cable extends from a FFP to the FAT and provides the connection interface for several fibre lead-ins. The difference between a Flexibility Point and an Access Terminal is that the latter does not house a splitter. We have over 48,000[2] FATs.

We use splitters to take the optical signal from an Optical Line Terminal (OLT) and turn the signal into multiple paths (split the optical signal) and extend it to a consumer. Splitters can create 32, 16, 8, 4 or 2-way splits, this is referred to as the split ratio. In the first three years of the UFB build, we mainly installed one to

[2] Asset population figures in this chapter are estimated as of June 2019.

32-way splitters in passive FFP above ground cabinets. In year four we moved to a more distributed splitter arrangement using a one to 16-way splitter. These one to 16 splitters are housed in ABFFP enclosures located underground. A splitter introduces loss in the optical path, the greater the split ratio the greater the loss between the incoming and outgoing signal.

Our most common splitter is a one to 16 and we have over 67,000[3]. This makes up most of our splitter population.

Asset condition

Our fibre joint assets are largely new and experience few faults, benefitting from the low-touch status of the network. Joints don't appear to degrade with age, though they can be vulnerable to damage, when a technician is working on the joint tray.

Our termination equipment is relatively young and is in good condition. The exception to this is where the quality of build practice associated with running cables between OFDF trays has been poor. We target good practice through training courses, standards and accreditation of Field Service Providers (FSPs).

Most of our splitters are relatively new as they were installed as part of the UFB build. There are no known condition issues with splitters.

5.2.1.3 Cabinets

Asset description and population

Cabinets are usually found by the side of the road. They house termination equipment, splitters and network electronic devices. There are two classes of cabinets:

- active cabinets have AC power and engineering services. We have approximately 7,000[3] active cabinets that serve the copper and fibre networks. Expenditure for engineering services located within cabinets is described in the site sustain sub-category
- passive cabinets are unpowered. We have approximately 5,000[3] passive cabinets[4].

Our cabinets terminate fibre, so are a type of termination equipment but we consider them as a separate fleet for asset management purposes.

We have a range of active fibre cabinets dating back to the mid-1980s when fibre was first deployed and the electronics in the cabinet provided voice services over copper. Today the electronics in cabinets provide fibre services. There are three broad categories of active fibre cabinet depending on what generation of electronics are housed within the cabinet:

- **active legacy fibre cabinets** (fibre in, copper out) - these cabinets house legacy electronics and deliver services to customers using copper cables. Fibre cable is terminated in the cabinet, but the electronics serve the copper network
- **active Fibre to the Node (FTTN) cabinets** (fibre in, copper out, or mix of copper/fibre out) - were installed for FTTN and house an OLT. A fibre feeder cable provides service to the OLT in the cabinet, but the electronics are used to deliver broadband services over copper distribution cables to consumers
- **active Fibre to the Home (FTTH) cabinets** (fibre in, fibre out) - house OLT with a Gigabit-enabled Passive Optical Network (GPON) shelf for FTTH. Fibre cables are terminated in the cabinet and the electronics deliver the fibre services.

Figure 5.8: Examples of cabinets

Asset condition

Cabinets are a long-life asset. Most of our cabinets have a metal casing and are in reasonable condition. Some of our oldest cabinets are experiencing corrosion, making the shelter ineffective. These assets are nearing end of life as they are unable to cope with the power and cooling requirements of modern equipment.

Fibre assets - Asset management objectives

Our asset management objectives for our fibre cable portfolio are:

Health and safety - we are committed to taking all reasonable steps to ensure a safe and secure

[3] Asset population figures in this chapter are estimated as of June 2019.

4 Some of our cabinets house equipment that serves the copper network or are shared assets that provide both copper and fibre services. We manage these assets together. The expenditure planned for these assets to support FFLAS is addressed through cost allocation. For more information see our Modelling and Cost Allocation Report.

environment for all our stakeholders. Our health and safety objective for our fibre assets is to minimise injuries to the public and our field technicians resulting from working with fibre or on the roadside.

Customer service - we are committed to providing excellent network service to our customers. Our customer service objective is that we maintain customer service levels established in the Network Infrastructure Project Agreement (NIPA).

Network performance - we are committed to meeting our network performance objectives established under the NIPA and that continue into RP1. These include technical levels of service that must be achieved by the UFB network. Performance of our fibre assets contribute to our performance against downtime objectives. Our objectives in this area include:

- installation that is consistent with service level descriptions contained in the NIPA
- to meet service availability targets set out in the NIPA
- no large communities are isolated as a result of a single fibre cut
- meet our internal measures for reactive repair of fibre faults and order processing times.

Cost performance - our key cost performance objective is to minimise whole-of-life costs at an appropriate level without compromising network performance.

Capability - our aim is to seek continuous improvement in our asset management capabilities and competencies. This includes developing our skills, knowledge competencies, systems and tools to support fact-based whole lifecycle decisions to help achieve our service and cost performance objectives. Our key objective in this area is to adopt a system for monitoring the condition/performance of fibre cable to support prioritisation of renewals or maintenance works.

Lifecycle management

Our strategy for our fibre assets is:

- replace existing assets when faults are identified
- continue the Fibre Route Survey (FRS) to identify damaged fibre cables
- replace older slotted core routes.

We manage our fibre assets using a lifecycle approach:

Planning - we plan for a small amount of investment to sustain current fibre assets. This includes the FRS which is a proactive programme that aims to identify potential faults on Core fibre routes. We replace faulty fibre as refurbishment is not cost effective.

Delivery - our FSPs carry out maintenance activities in line with the Field Services Agreement (FSA), they source materials, obtain local authority permissions and consents, and commit sub-contractor resources before the work can commence.

Operate and maintain - we use both preventative and reactive maintenance for our fibre assets. Our preventative work in the fibre asset portfolio includes our annual FRS and work we are carrying out to replace old slotted core cables. Most of our maintenance work for our fibre assets is reactive. Reactive maintenance is work undertaken when faults are reported by customers or in response to alarms generated in the network.

Retire or dispose - we retire and dispose of assets when they approach the end of their useful life. In the case of fibre cables, we abandon them in the ground if direct buried, or if the cable is inside a duct, we remove the old cable after pulling in the new one and transferring the traffic. Removing the old cables is preferable as it frees up space in the duct for future cables. Some of our oldest cabinets are reaching the end of life. When they are retired, we recycle the materials where possible.

Risk management

Our risk management processes support us to provide high quality network services and ensure public safety.

We have identified several risks that relate to our fibre assets, these are described in the table 5.1 along with our management plan.

Table 5.1: Asset risk and management plan for fibre assets

Risk	Management plan
Slotted core cables – issues with degradation as outlined earlier.	Continue to prioritise replacement of worst affected cable sections. Since some of these cables are shared with Spark, we coordinate with them for condition information and replacement planning.
Fibre cables damaged as a result of land movement (e.g. natural disaster or accidental damage during civil works).	Key mitigation measures include: reducing the number of customers impacted by a single cut cable event, contribute to utility location platform databases to reduce accidental damage, focus on correct placement of route marker posts, ensure cables are laid at correct depth, and regular route surveys on our core and regional fibre routes.
Aerial cables are damaged by storms, UV, accidental traffic damage and vandalism.	We manage this risk through initial design and build of aerial cable to appropriate standards.
Hands in the Network: the situation where legitimate work on network elements by our service technicians results in an unexpected outage to an adjacent service.	Mitigated by continuous improvement in the following areas: technician training, work processes, quality of products; network architecture to reduce the number of points in the network where work is required and requiring a 'permit to work' before work can commence on critical assets. This allows us to assess the impact of issues that may arise, and time shift the work or schedule an outage if required.
Roadside cabinets are subject to weather, vandalism, flooding and accidental vehicular damage.	Mitigation is based on continuous improvement: Siting cabinets sensibly when first built, i.e. not placing them in vulnerable traffic locations, in the way of foot traffic or areas that are at risk of flooding Improving the quality of the cabinet outer shell for long life, and high security Improving the ability of the cabinet to keep out vermin, etc.

5.2.2 Ducts and manholes

Our second asset portfolio in the field sustain sub-category is ducts and manholes. We describe each asset type and then explain our approach to managing them.

Ducts - Asset description and population

Our ducts provide an enclosed, protective passage for cables. Ducts can be underground or embedded in or attached to structures (like bridges or buildings). Once installed, ducts allow cables to be placed without additional excavation. Ducts may also be attached to poles to provide protection, where there is a transition between underground and aerial routes.

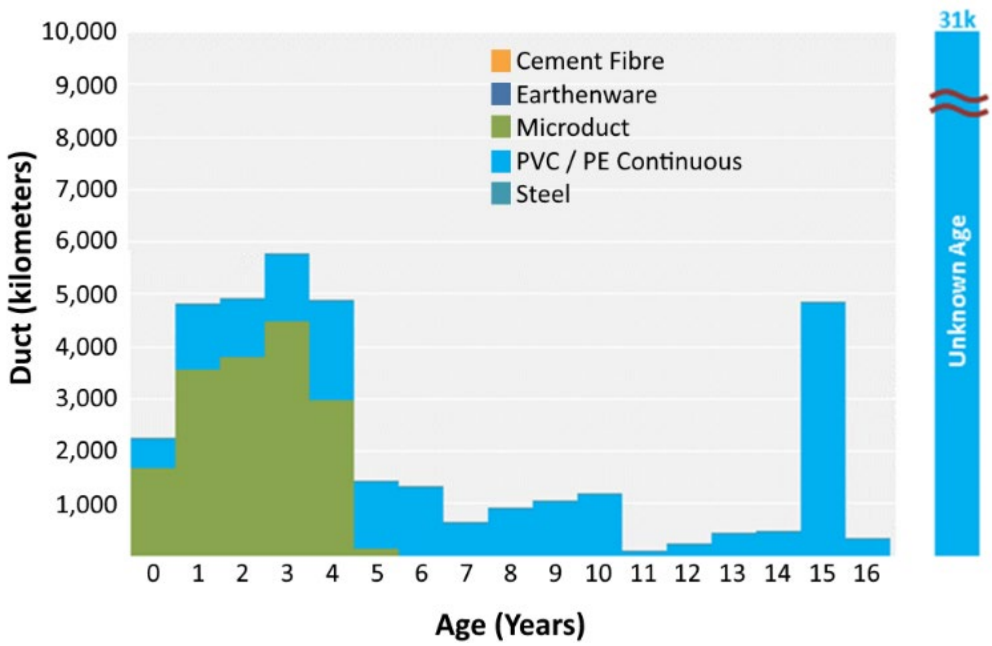
We have more than 66,000[5] kilometres of ducting across the country made up of numerous types of ducts. Diameters vary from 3mm to 200mm.

Our portfolio of ducts includes:

- earthenware ducts that were deployed between 1900 and 1940
- cast iron ducts that were deployed between 1940 and 1950
- cement fibre ducts that were deployed between 1940 and 1960

[5] Asset population figures in this chapter are estimated as of June 2019.

Figure 5.9: Age and type of ducts (based on 2018 data)



- PVC ducts were used from the late 1960s and became common in the 1970s. We continue to use both PVC ducts and PE continuous ducts
- galvanised steel trunking systems (Unistrut) were used from late 1980 and are still used today
- microduct is a key component of the Ultra-Fast Broadband (UFB) build. Microduct can be configured to allow us to optimise the network capacity in different locations. Our microduct population ranges from 1-way (used for lead-ins) up to 26-way (1-way fits a single fibre cable while 26-way fits 26 fibre cables), with these two types make up nearly 80% of the population.

We have limited data on the age for ducts installed before 2000. We used microduct extensively during the UFB rollout, it makes up the majority of duct installed in the last ten years.

Asset condition

Ducts are long life assets. They are mostly installed underground, and we expect them to last indefinitely if not disturbed. Ducts attached to poles have a shorter life expectancy because they are exposed to the elements and are at greater risk of disturbance and vandalism. We tend to replace them when poles are upgraded as damage during removal makes them unsuitable for reuse.

Duct faults tend to be identified when we reuse a duct to add or remove fibre. The number of faults detected increased between 2009-2015, during the FTTN build project and the first three years of UFB1 when fibre was installed into commercial areas using existing duct infrastructure. This was due to increased activity around the ducts and the requirement to use ducts that had latent damage. This damage needed to be repaired to enable the network rollout.

Since 2015, we have seen year on year reductions in faults. We expect this trend to continue as we complete the UFB rollout and the volume of field activity declines to a steady state.

Some of the issues that can result in a shorter lifespan in ducts are:

- deformation due to over-compaction or traffic loading
- tree roots entering a duct
- older steel ducts in coastal locations can become corroded. We have used some existing steel ducts for road crossings. To mitigate the risk of corrosion we install direct buried style microduct, which has

additional outer sheath protection, inside existing steel ducts

- ducts are subject to the same environmental risks as direct buried cables, including slips and washouts, earthquakes, and civil activity. We are a contributing member of a utility location platform, B4UDIG[6], to help mitigate this risk. When a party contacts B4UDIG regarding working in the vicinity of our network, it is provided with plans and location information. However, damage does still occur, and if not reported, may not be discovered for many years.

Manholes - Asset description and population

Manholes are covered openings that provide access to buried ducts, cables and joints. We install manholes in places where access to fibre is likely to be needed because manholes are more cost effective than repeated excavation.

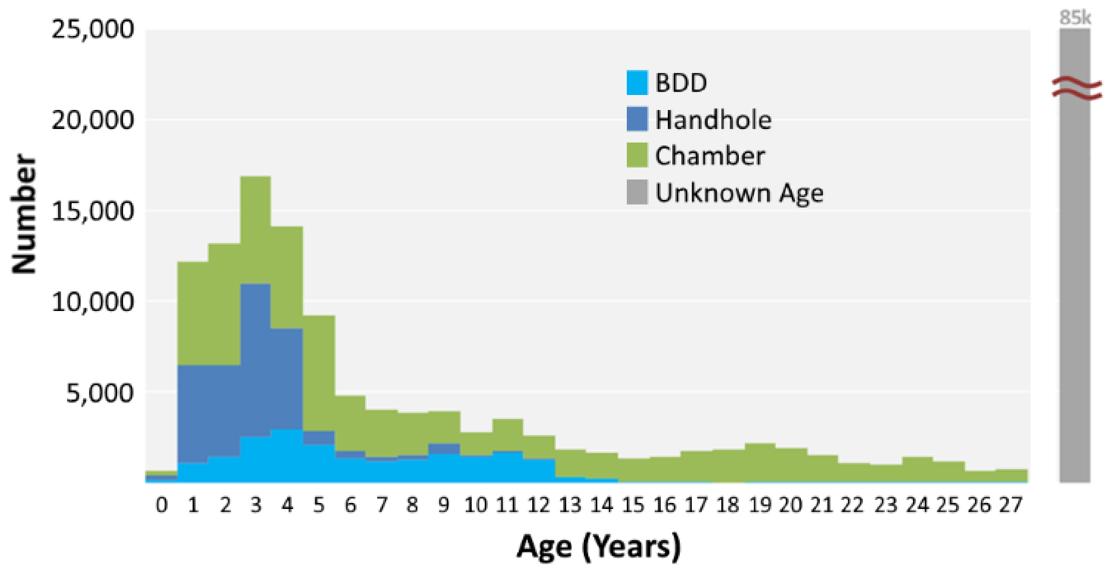
Manholes have two components, a pit and a lid. Pits vary in size from small plastic enclosures centimetres deep to large concrete chambers meters below ground. Before 1970, we built pits from poured concrete or brick, in the 1990s we used aluminium and pre-formed plastic pits were introduced in the 2000s. Buried Direct Distribution (BDD) pits were first used in 1991 to support adjustments to copper cable access architecture. We have replaced some of these pits with larger chambers to accommodate fibre.

Lids provide access to pits. Our lids are different shapes (circular, square, rectangular, triangular, and oval) and materials (aluminium, concrete, plastic, cast iron, galvanised iron and steel). Modern manholes are pre-formed, and factory produced which helps to standardise strength and reduce installation work.

We use two classes of manhole: roadway and footway strength. To reduce the cost and risks associated with accessing them (for example, working on roads) we prefer to place manholes in the berm

Roadway strength manhole designs are certified by a registered civil engineer. This ensures that the designs comply with roading authority and local council standards. All new roadway rated manholes have aluminium pits. Footway rated manholes are either plastic or aluminium, and range in size from small hand holes with single joints to larger pits that house cable joint enclosures. The frames on new manholes can be adjusted up/down within a limited, pre-specified range.

Figure 5.10: Age and type of manholes (based on 2018 data)



[6] Customers can log a cable locate query by using the B4UDIG platform, thus enabling customers to check what is underground before they dig or excavate. This not only avoids damaging underground telecommunications, power, water and gas services, but it also ensures the safety of the people working on the project.

We installed thousands of manholes as part of the UFB rollout, these manholes are less than ten years old. We do not know the age of a significant proportion of our manhole assets (~85k) because the data was not populated in NetMap when the physical plans were digitised. Most of them are BDD or chambers, and we believe they were installed pre-1990.

We have approximately 250,000[7] pits and manholes in our network.

Asset condition

We build manholes to two standards, a roadway standard and a footway standard. Damage can be caused to manholes built to footway standards when they are driven over by a vehicle. We treat repair or renewal of broken manholes as urgent due to health and safety implications and the risk of lids dropping onto cables in the manhole. When we are notified of an urgent fault a technician is dispatched to the field within two hours.

Older cast iron manhole lids can be a slip hazard, we make our manholes safe by replacing or repairing them when problems are identified.

In a recent field audit of the condition of manholes we identified that 18% of manholes had issues and required remediation. To address this, we are implementing a condition assessment programme where each manhole is inspected, every 10 years. We intend to use a proactive maintenance approach to faults we identify. During RP1 we will develop our internal capability to manage this programme. Initial inspections will be opex in nature, remediation will be either opex or capex depending on the work that is required.

Asset management objectives

Our asset management objectives for ducts and manholes are:

Health and safety - our health and safety objectives for ducts and manholes is that there should be no fatalities or permanent injuries resulting from working around ducts or manholes, no injury to the public caused by damaged manholes and no injury to public caused by slip prone manholes. To achieve our objectives, we make manholes safe by replacing or repairing them when the problems are identified. To reduce the risk to our staff and the public, we ensure that all technicians performing excavations are trained for working around underground services.

Customer service - our customer service objective for ducts and manholes is that sustained loss of service should not result from a condition-driven asset failure. We fix damaged assets as quickly as possible so that network disruption is kept to a minimum.

Network performance - our network performance objective is that sustained loss of service should not result from a condition-driven duct or manhole failures. We achieve this objective by taking immediate action when damage is identified.

Cost performance - our cost performance objective is to minimise the whole lifecycle cost of manholes at an appropriate level of risk. We achieve this by identifying potential cost reductions through engineering investigation and by improving our procurement to optimise long term supply contracts. We are also focusing on using existing duct capacity by changing cable and equipment configurations and clearing duct of redundant copper cables.

Capability - our capability objective is that there is skilled workforce and inventory available to implement our work plans.

Lifecycle management

Our overall strategy for ducts and manholes is:

- reduce health and safety risk by immediately repairing or replacing broken assets
- upgrade existing assets when access is required
- fix or replace assets when faults are identified
- use the existing duct to add network capacity when possible.

Planning - we do not plan for new ducts or manholes independently, instead they are created through our network extension activities. Our expenditure on new ducts and manholes is allocated to extending the network and installations. When we forecast growth in demand for fibre services for areas within our existing footprint, we consider whether it is possible to use existing ducts for laying cable.

Delivery - designs for placement of manholes and duct consider the location of other utilities, road authority requirements and the level of protection required by network standards (more depth equals greater protection, but at higher cost).

The duct we use meet internal specifications and industry standards. All products are on the Chorus Network Specified Products (CNSP) list. They are purchased by our FSPs from approved suppliers and

[7] Asset population figures in this chapter are estimated as of June 2019.

distributors where holdings are readily available. The advantage of this process is to reduce stock and delivery lead times, better enabling FSPs to respond to sudden demand shocks. CNSP materials are not directly purchased by us or held in our inventory.

Our construction activities are carried out by FSPs under the FSA. We use additional providers to maintain competitive tension and to ensure resources are available.

Operate and maintain - we use a reactive approach to duct maintenance. Failures are identified by field technicians or reported by the public. We are developing a manhole condition survey which will inspect each manhole every ten years. Any issues identified during the inspection will be remediated. We repair manholes when it is cost effective to do so, this activity is opex. Maintenance is carried out by our FSPs.

We do not maintain spares for this portfolio as all modern ducts are readily obtainable via our procurement processes.

Retire or dispose - we do not proactively replace or dispose of duct routes. If a duct breaks in multiple positions, we abandon the broken duct and build a new one alongside. We no longer install ducts that contain asbestos, but we keep records of legacy ducts in NetMap to ensure that when they are accessed hazardous materials are handled in accordance with Chorus Hazard Control Plan HCP111. We retire or dispose of a manhole by connecting the ducts that pass through it and then filling it with soil to eliminate the risk of collapse.

Risk management

The criticality of ducts and manholes varies according to the fibre routes they support. The assets that support core routes are more critical than those supporting access routes because they serve more consumers.

We have identified several risks and management plans related to ducts and manholes (Table 5.2).

Table 5.2: Asset risk and management plan for ducts and manholes

Risk	Management plan
Damage is caused to ducts and the cables within resulting in loss of service.	We have diverse duct routes into many exchange buildings. Core cables are generally installed into deep ducts to afford greater protection. Any civil activity that damages the duct is less likely to damage the core cable. Ducts are themselves a risk mitigation strategy for the fibre cable, providing physical protection from most risks. We proactively undertake repair work when damage to ducts is identified. We contribute to the B4UDIG platform to provide information about buried assets to parties planning building work in those areas.
Above ground duct routes are at greater risk of damage due to environmental exposure and civil activity.	This risk is mitigated by using specific UV rated duct, and protective riser guards. We proactively replace damaged ducts identified as part of the pole tag and test programme.
Limited data is available in NetMap on individual age for ducts installed prior to the year 2000.	Age is not used as a proxy for the condition of ducts. The cost of populating these fields from the hardcopy plans has been assessed as prohibitive compared to the benefits provided.
Cast iron manhole covers can be a slip risk.	When we are notified of an urgent issue a technician is dispatched to the field within two hours.
Although we install locks and security bolts sometimes our aluminium BDD lids are stolen, this is a health and safety concern.	When we are notified of an urgent issue a technician is dispatched to the field within two hours.

5.2.3 Poles

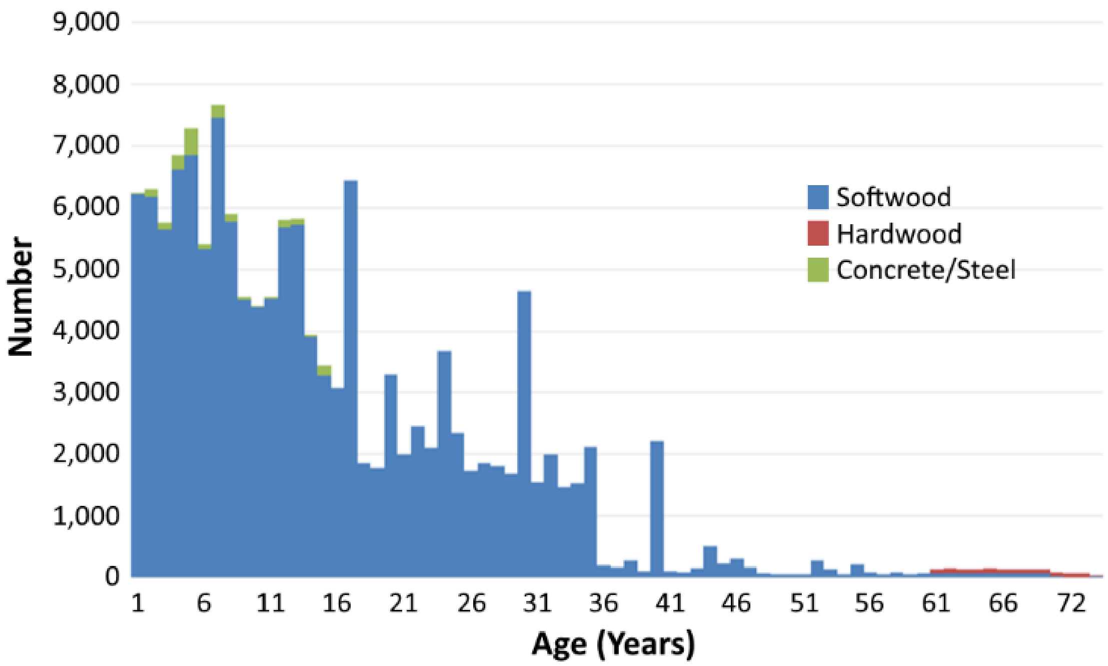
Asset description and population

Our poles carry cables above ground. Most of our poles were installed in urban areas for the copper network. Our poles are shared assets carrying both copper and fibre cables. In some areas we share poles with lines companies, entering lease arrangements[8], some shared poles are owned by us and others are owned by lines companies. We use poles as it is cheaper to add new fibre cables to existing poles than to build new underground routes.

Our poles are typically between six and nine metres tall and installed around 40m apart. We have between 210,000 and 280,000[9] poles, approximately 98% of which are made from locally sourced softwood. We expect our softwood poles to have a lifespan of around 40 years. The other 2% of poles are hardwood or concrete and steel and have a longer life expectancy.

Our pole population is reducing overtime as we underground cables. Undergrounding is mainly driven by lines companies in areas where we share poles. We may also underground cable in response to customer requests or as a cost-effective solution when poles need replacing.

Figure 5.11: Age and type of poles (based on data from the tag and test programme)



Asset condition

Pole condition is related to age and the degree of exposure to the elements. Historically we inspected our poles but did not keep consistent condition data. To address this, we started a test and tag programme in July 2017. We have now tested approximately 80% of our poles.

Our test and tag programme uses a colour coding system. Red poles have reached the end of their life - about 4% of our poles are categorised as red. We replace 'red' poles within three months of testing (or within seven days if they are a fall risk). A yellow tag means a pole is approaching end of life - around 15% of our poles are 'yellow' and are scheduled for retest in two years. A green tag means the poles are expected to have significant remaining life and will be retested at five-year intervals until they reach the 'yellow' criteria.

[8] Although leases are capex, we treat them as opex in our proposal to support clear explanation of trends and the impact of NZ IFRS 16.

[9] The asset information relating to our population of poles is improving as we gather information as part of our poles test and tag programme.

Our hardwood pole population has the largest proportion of red tags. This is unsurprising given the whole population is over 50 years of age. Despite this, more than 30% of our hardwood poles were found to have significant remaining life (i.e. green tagged). About 95% of our concrete and steel poles also have significant remaining life, because they are generally younger and have a longer life expectancy.

Asset management objectives

Our asset management objectives for poles are:

Health and safety - poles are overhead assets and present a risk to our workforce as well as the public. We are committed to taking reasonable steps to ensure a safe and secure environment. Our health and safety objectives are that no injuries should be caused by pole failures and that all poles works are carried out by technicians who are qualified and competent.

Customer service - poles are low criticality, but failure can sometimes result in loss of network service. Our customer service objectives are that no sustained loss of network service should result from pole or pole-top equipment failures.

Network performance - our network performance objectives are that no services should be interrupted by end of life pole failures and no sustained loss of service should result from pole reattachments.

Cost performance - our cost performance objectives are to design, construct, and maintain poles to minimise lifecycle costs, while meeting required levels of performance. Specifically, we aim to continue to assess undergrounding as an alternative to end of life pole renewal and ensure that our pole testing processes are optimised.

Capability - we have identified gaps in our asset management capability in relation to our poles. The first step towards improving our capability was to start the test and tag programme. We aim to improve our asset management capability, knowledge and data, systems and tools to support delivery of efficient outcomes. Our objectives are improving the poles data set to support planning, performance analysis and forecasting. We are also increasing our understanding of risk associated with our poles by starting to develop asset health and criticality measures to support systematic and well-informed risk management.

Lifecycle management

Our asset strategy for poles is to:

- clear the backlog of replacements before RP1 starts and then continue with steady state replacement
- improve our asset information with the tag and test, and retest programmes
- underground fibre when it makes economic sense
- improve our asset management capabilities to reduce risk.

We manage our poles using a lifecycle approach:

Planning - our plans focus on replacing end of life poles and poles hardware. We identify poles that need replacing during the tag and test programme or when a fault is reported.

Delivery - replacement poles and hardware must meet current AS/NZS 4676:2000 standards. We mainly install softwood poles, but we use concrete or steel poles when the ground conditions would significantly reduce the life of a wooden pole.

We outsource the construction and installation of poles as described by the FSA. While the primary responsibility for quality control over construction work lies with our FSPs, we carry out regular quality checks and inspections on projects.

Operate and maintain - our maintenance approach for poles uses preventative and reactive models. Preventative maintenance covers the end of life replacements identified during the tag and test programme. The programme involves a pre-climb test, visual inspection and a strength test using an acoustic tester. We use visual inspection of the poles and attachments against defined criteria, looking for cracking, splitting, visible rot, plant growth, etc.

We have two types of testing programmes, initial and retest. The initial test is used to capture and set a base line for the condition of the pole assets. During the initial phase of the tag and test programme we have tested 85,000 poles per year, this will be completed in June 2021. We prioritised urban areas for initial tests.

The retest programme began in October 2019. When a pole reaches 15 years, we will retest it every five years until it reaches the 'yellow' criteria after that it will be retested every two years. The number of tests will peak prior to RP1, in the period when both the initial and retest programmes are underway.

Testing will reduce to a steady state level of about 56,000 retests per year. This data is a key input to our pole renewal programme and is used to develop future retest regimes. We store the data in NetMap.

We complete reactive maintenance when hardware has failed or become loose from a pole. We identify poles that need fixing or replacing during inspections or when a fault has been reported. Road accidents are usually the cause of pole faults. The work is carried out by our FSPs. We carry out reactive maintenance works to minimise the impact to network services and reduce public safety risk.

Retire or dispose - we decommission poles at the end of their useful life. Decommissioned poles may be sold as a functioning asset, sold as scrap, disposed of to a waste management facility, or re-used by us elsewhere as an in-service asset or a spare. When a pole is removed, we update NetMap and the Fixed Asset Register to reflect the change.

There are instances where a pole is no longer required to support our network but is still needed by a third-party such as an EDB. When this happens, we usually provide the pole to the distribution business by deed.

Risk management

Our risk management processes are directly related to our ability to provide high quality network services and ensure public safety. Our poles are critical assets in relation to health and safety, but they have low criticality for service provision as they tend not to support core or regional routes.

When we know the condition of our poles, we can manage them efficiently through their lifecycle. Meaning we can sustain a population of good condition poles at a low cost.

Table 5.3: Asset risk and management plan for poles

Risk	Management plan
We have a standard hazardous pole identification process, but historically not every pole was tested until there was a need to climb. Some pole testing had not been captured into the database.	We introduced the tag and test programme to capture the high-quality data needed to manage end of life pole replacement.
Poor preservative treatment was used for early softwood poles, resulting in shortened life.	We are proactively replacing at-risk poles as determined by inspection and testing.
Inadequate clearance has been provided to some aerial lines, causing risk to assets and vehicles.	All new corridors are installed at the correct height.
A significant number of poles are not recorded in NetMap, and some old pole records remain in NetMap although the poles have been removed from service.	We have made changes to NetMap so there can only be one pole per pole site.
There is incomplete data in NetMap including pole type and installation dates.	During the tag and test programme we are collecting more comprehensive and accurate data on the pole assets, resolving many of the data quality issues (primarily around age and ownership).

5.3 Our plans for field sustain

5.3.1 Fibre assets

The driver for our fibre maintenance spend is to keep the network running at current service levels. During RP1 our plans focus on our slotted core fibre routes. We will continue to replace slotted core fibre and improve our knowledge of fibre degradation on these routes. Part of this work will include improving testing and recording of fibre loss measurements.

We will carry out the annual FRS to reduce the failure risk on the most critical fibre routes. We also plan to continue the maintain service fibre programme which is our reactive maintenance for fibre assets.

5.3.2 Ducts and manholes

The majority of duct and manhole spend during RP1 will be to extend the network to meet UFB2/2+ commitments and new property developments. The need for these is driven by the requirements for fibre cable to enable network extensions and installation that enable consumer connections. This will continue to the completion of the UFB build.

For areas where we forecast growth in demand for fibre services within our existing footprint our plan is to consider whether it is possible to use existing ducts for laying cable or whether using aerial cable is an option. We use existing ducts where capacity is available. Aerial ducting is only considered if there are existing usable poles and where it is cost effective. If these options are not available or suitable, we install new microduct.

We plan to develop a manhole condition survey working towards inspecting each manhole every ten years.

Our plan is to minimise the need for maintenance of our ducts and manholes without compromising health and safety or network performance.

5.3.3 Poles

The average life of a pole is around 40 years, so we aim to replace 2.5% of our pole population every year. However, results of the tag and test programmes show that we need to replace about 14% of poles before RP1 in order to catch up to the level of 2.5%[10] replacement per year.

The number of poles we need to replace is slowly increasing as the tag and test programme is identifying poles for replacement quicker than we are completing replacements. Addressing the backlog is currently constrained by available supply of installers. We are engaging with our FSPs to increase capacity to meet the increased demand.

During RP1 we plan to test around 84,000 poles and proactively replace [**Chorus CI**] poles (around 2.5% of the total population per year). By the end of RP1 we aim to have no end of life (red) poles and that poles nearing end of life (yellow) will make up less than 10% of our pole population. Any retesting of poles under the tag and test programme of work is treated as opex.

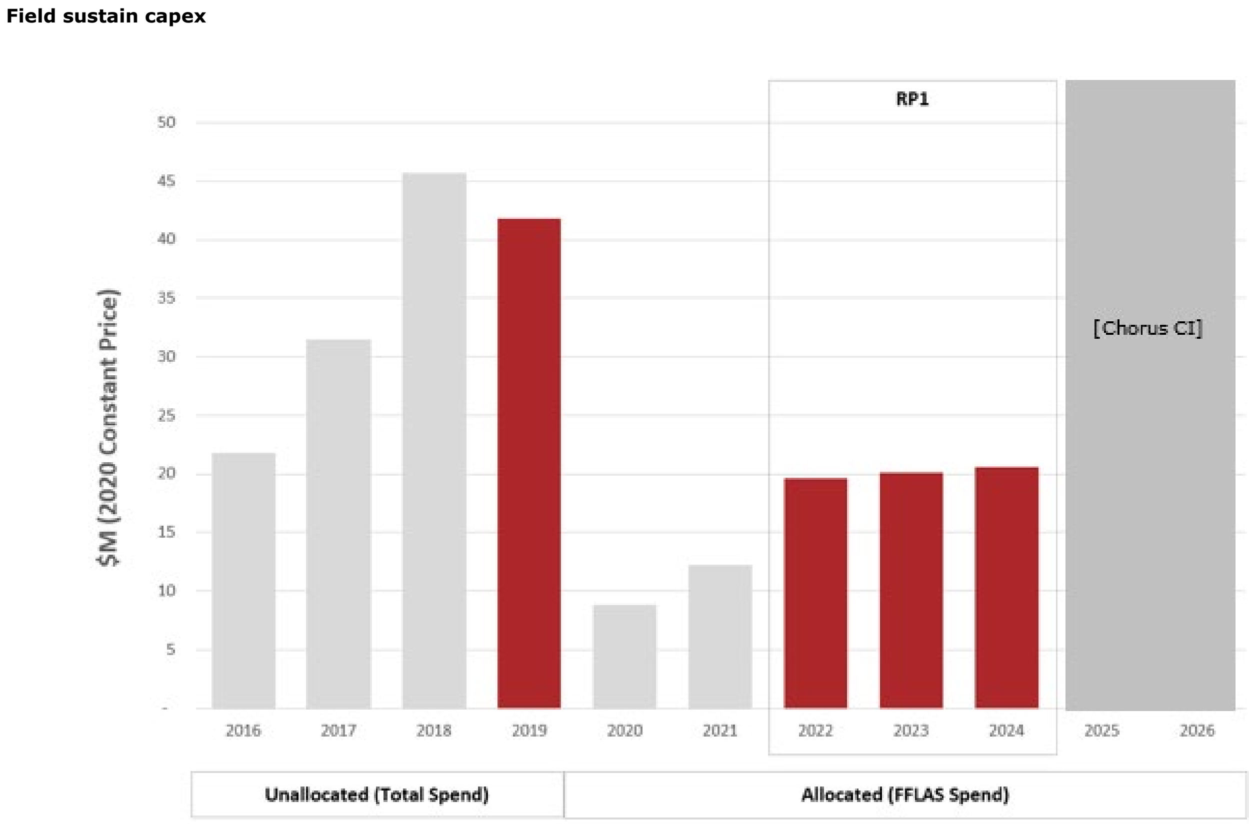
As well as our preventative pole replacement we also reactively replace poles that have failed (mostly caused by vehicle crashes).

5.4 Field sustain forecast expenditure

Our Fibre Fixed Line Access Services (FFLAS) expenditure on field sustain was low while we were building the network and the infrastructure was new. During RP1, we are expecting the expenditure associated with the maintain service fibre programme to increase slightly. As our fibre network ages, we anticipate our network will require more maintenance[11].

[10] This is before any allocation to FFLAS and covers the whole network.
[11] Our current business planning process only takes our detailed planning to 30 June 2025. To extend the forecast for calendar year 2025 and 2026 we have applied a high-level approach to project the forecast forward, with bottom-up and top-down sense checking to adjust for anticipated step changes.

Figure 5.12: RP1 expenditure for field sustain showing unallocated historical spending



5.4.1 Fibre assets

Our RP1 forecast for field sustain is $60.3 million, $57.2 million of this is for the maintain service fibre programme. This programme covers maintenance across all three of our asset portfolios. It also includes the replacement slotted core fibre routes, including fibre cables and the supporting elements of duct and manholes.

We use a volumetric price x quantity approach to forecast expenditure on our fibre assets where the unit rate is multiplied by a forecast work volume. For the maintain service programme the volume is based on historical information. The network is still growing so we adjust our volume forecasts based on the estimated number of consumers that will be protected after maintenance work is carried out. The unit rate is based on our experience of sustaining the copper network.

There are some assumptions in this forecast that can introduce risk:

- the forecast assumes that the number of consumers protected increases as more consumers migrate from our copper network to our fibre network and as our network ages
- the unit costs are based on the current trend of sustaining our copper network as we do not currently have enough data from our fibre network to inform the forecast due to its age
- as our fibre network ages, it becomes more susceptible to third-party and environmental impacts. We will identify the extent of this impact as our fibre network matures.

5.4.2 Manholes and ducts

Our maintenance expenditure for ducts and manholes is included as part of the maintain service fibre programmes described above.

5.4.3 Poles

Our RP1 expenditure forecast for poles is $3.1 million.

We forecast expenditure using a volumetric price x quantity approach. The unit costs are based on contracted rates adjusted for inflation. Poles are purchased by FSPs on a call off contract. The average unit price[12] (across all regions) was approximately [**Chorus CI**] in 2019, which includes delivery to depots. There is some variation across regions reflecting slight differences in the contracted price and the mix of pole types.

We estimate preventative replacements using results of the tag and test programme, known failure rates and the number of planned tests.

Reactive replacement volumes are low. We forecast reactive replacement volumes using historical trends.

There are several assumptions and limitations to our forecasting for expenditure on poles:

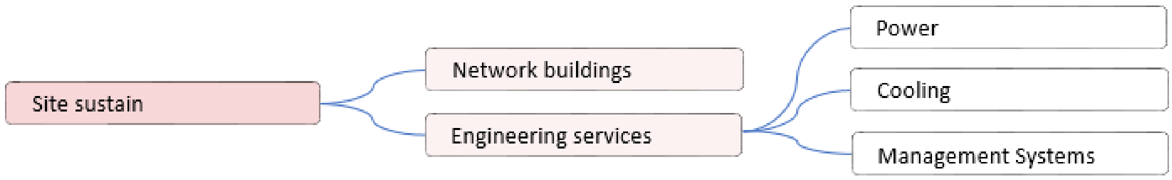
- our forecast used an estimated number of poles as the actual number will be unknown until the tag and test programme is complete
- we assume that the volume of fibre lead-ins is based on historical trends and will remain constant if poles are repositioned
- councils may carry out Overhead to Underground (OHUG) projects which may see the pole stock reduce over time. This is an unknown and may impact on the accuracy of our forecast.

Our capex activities are replacing poles because they have reached end of life or have been damaged. When we fix damaged poles or pole hardware, this activity is opex.

We are planning a restructure of field services during RP1 due to the decline in volume of UFB build and installations activity. The impact of the restructure on FSP costs for in field maintenance work is uncertain.

[12] Based on unallocated nominal estimates.

Figure 5.13: Assets managed under the site sustain sub-category



5.5 Site sustain

Our site sustain expenditure is related to the maintenance of our network buildings and engineering services.

This section describes our plans, expenditure and asset management approach to our network buildings and engineering services.

5.5.1 Network buildings

Asset description and population

We manage over 2,500[2] network buildings that house the electronic equipment needed to run our copper, radio and fibre networks.

Our oldest network buildings were built in 1912. As our networks have grown more buildings have been added to our portfolio, but we haven't needed any significant new network buildings since the late 1990s.

Today our focus is on maintaining existing buildings and disposing of or optimising buildings that are no longer required.

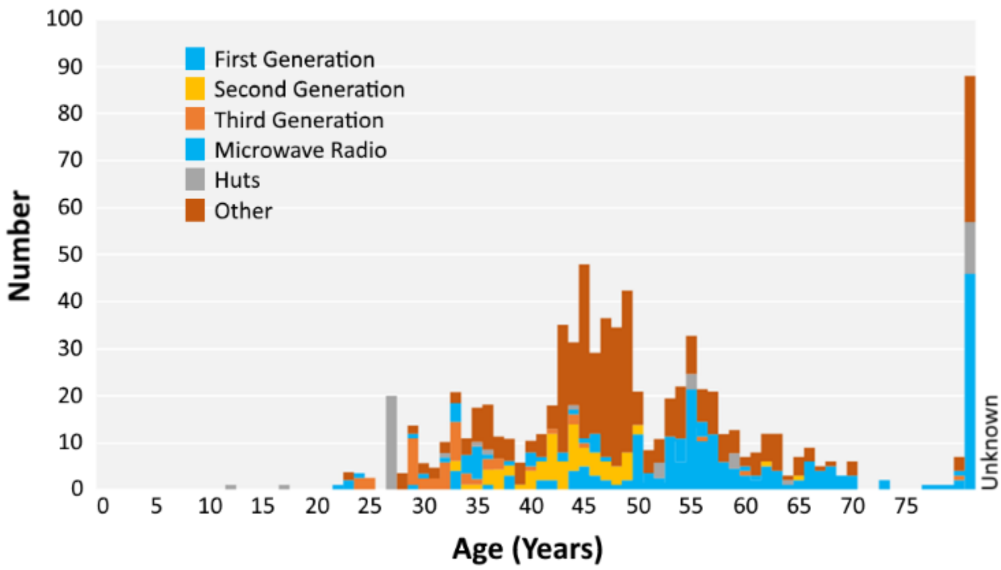
The equipment housed in network buildings can perform one or more functions:

- **access** – this is the most common building use in our network. Access sites host the equipment used to connect consumers to the network, such as Optical Line Terminals (OLTs). Access sites can be buildings, huts or similar. Cabinets are the next level into the access network and are discussed in the fibre assets section. We have over 2,500[13] sites with copper or fibre access functions
- **mesh** – these are buildings that have a function that concentrates the network traffic from several access buildings, including consumers directly connected to the building. The number of access consumers dependent on a building containing the mesh function are limited to 50,000 (maximum) in a region (with planning based on population forecasts for 2040). We have 45[13] buildings that provide a mesh function
- **core** – core buildings contain the large switches that aggregate traffic from several buildings with a mesh function. A core building always contains a mesh and access function. Core buildings house large capacity aggregation switches and national transport devices. Core buildings serve up to 250,000 customers, but all core sites are one of a pair to protect against a single core aggregation switch failure. We have 12[13] buildings that have core functions
- **handover** – these are in buildings where we hand over data traffic to Retail Service Providers (RSPs). A handover function always occurs in a building with a mesh or core function. Up to one hundred thousand consumers are dependent on each handover site. We have 40[13] buildings that provide a handover function for UFB services.

The average age of our buildings is approximately 50 years.

[13] Asset population figures in this chapter are estimated as of June 2019.

Figure 5.14: Age and generation of network buildings (based 2018 data)



Our network buildings portfolio includes the assets that are contained within our buildings which include systems to protect our staff, contractors and the network, for example:

- **security** – our larger buildings are monitored by our Security Operations Centre (SOC). We monitor 1,200 access points through electronic and manual means
- **gas** – we use detection systems as dangerous gases can accumulate in cable wells. The gases create health and safety issues for those staff or contractors working in or near confined spaces. Our gas detection systems detect for methane, carbon monoxide, carbon dioxide and hydrogen sulphide (which is primarily found in the Rotorua region due to geothermal activity). We are considering whether to update or replace our gas detection systems
- **fire** – we protect our network and staff by installing fire alarms. The annual Building Warrants of Fitness (BWoF) require that we keep the fire systems current. Most of our sites comply with this requirement, however there are a few older fire alarm systems that are obsolete and require replacement.

Asset condition

We consider the condition of our buildings based on the following criteria:

- the criticality rating of the asset
- the condition of the asset using inputs from physical inspections, desktop appraisals, historical maintenance spend, and failure rates for similar assets
- the target functionality required from the asset
- the remaining life of the asset
- compliance with legislative obligations i.e. will the asset come out of compliance <2 years from now.

We have programmes of work related to managing our health and safety obligations, including maintaining building warrants of fitness and building security, identifying and minimising hazards (asbestos and gas). For earthquake strengthening we have targeted exceeding 34% of NBS IL3 and we have a programme in place to achieve this outcome. We are currently reviewing this approach.

We undertake Condition Assessment Reports (CARs) to rate the condition of our buildings against a set of criteria and identify defects. CARs are undertaken yearly at core sites and mesh sites. Roughly 750 of our buildings are assessed each year.

Asset management objectives

Our asset management objectives for our network buildings are:

Health and safety - our aim is to ensure a safe and secure environment for our people (including employees and contractors) and anyone who is in the vicinity of our property. We are committed to reducing health and safety risk by actively managing and maintaining security and systems to manage and reduce risk to our staff and Field Service Providers (FSPs).

Customer service - our objective is that no sustained loss of service should result from a building failure. Our buildings house equipment that is critical to network provision, so we are continuing to use both a preventative and a reactive approach to maintenance to reduce the risk of asset failure.

Network service - our objective is that no sustained loss of service should result from a building failure.

Cost performance - our cost performance objective for network buildings is to deliver high quality network services at an efficient cost. To do this we are developing programmes of work based on performance objectives and asset health analysis to optimise spend. We are improving cost estimates and systems that evaluate options and manage delivery costs.

Capability - we are working to improve our property asset management capability. As part of this work we have introduced Site Development Plans (SDPs) that will enable us to develop advanced asset management plans for our core and mesh sites with an aim to improve utilisation.

Lifecycle management

Our long-term strategy for network buildings is to reduce the population as we migrate consumers from the copper to the fibre network. In the meantime, we are investing in our buildings to ensure that they meet code requirements for earthquake strengthening.

We manage our buildings through the asset lifecycle:

Planning - our plans are to maintain our buildings to protect the critical assets that they house. As we migrate customers from copper to fibre, we replace copper assets with fibre assets which tend to have a smaller footprint. We are also developing SDPs to provide a structured development plan for our alternative sites programme. This programme aims to improve the building fabric, add additional IT suitable footprint and update the power and cooling infrastructure. Asset information stored in SPM Assets supports the planning of our maintenance activities and investment programmes.

Delivery - we have an outsourced model for the delivery of building maintenance.

Operate and maintain - we use both preventative and reactive maintenance strategies for our network buildings.

We have a proactive maintenance programme to strengthen buildings to at least 34% of IL3 in line with the Building Act 2004. Work is underway to determine the appropriate course of action for each building.

When faults in buildings are identified we use reactive maintenance to fix them.

Retire or dispose – we are reviewing the age and location of our network buildings, with a view to transferring equipment to other locations and exiting sites where it makes economic sense. Our buildings have a useful life of 50 years, and many have surpassed this milestone and require significant investment to maintain. Our RP1 expenditure includes an asset life assessment of all significant buildings in UFB areas and investing in maintenance where this is the best option. We have an established retirement process for our buildings and sites.

Some of our exchange buildings house equipment that has become obsolete and is no longer performing a useful network function (i.e. older copper technology). As part of the assessment of each building, any costs associated with the decommissioning of equipment or the exiting of sites is treated as opex. We are working towards removing obsolete equipment to free up space, release power and cooling capacity and reduce maintenance costs.

Risk management

The criticality of our network buildings depends on the functions performed by the equipment in each building. Buildings containing the handover and mesh function have high criticality as they are not duplicated. The sites that contain core functions are of high importance but are duplicated to ensure network resilience. Mesh functions in buildings not containing handover or core functions are less critical as they concentrate data from fewer customers. Access buildings are the least critical.

Table 5.4: Asset risk and management plan for network buildings

Risk	Management plan
We currently have several buildings that do not meet 34% of IL3 and are considered earthquake prone buildings.	We are continuing with our programme of strengthening. Some buildings will be retained and brought up to code, other buildings will be sold or retired when we no longer need to support the copper network.
We have asbestos in several buildings and sites.	We have standard processes to minimise the risk to staff of exposure to asbestos. When we identify sites that have not had an asbestos assessment one will be carried out.
We are considering our approach to our older buildings, as some of them may need replacing over the next 10 years.	We are allocating all our buildings into building families and will develop long-term programmes of work to extend or end the life of the buildings to optimise our business return.
Eight of our buildings in UFB areas are owned by Spark[14].	We have implemented the alternative site programme to reduce our dependency on these sites.

5.5.2 Engineering Services

Asset description and population

Engineering services is the equipment that powers network equipment and maintains heat levels within acceptable limits. Our engineering services equipment is in network buildings and roadside cabinets.

Our engineering services assets support both the fibre and copper networks. Fibre assets require less power and air-conditioning, so as we migrate our customers from copper to fibre services, we expect our expenditure in this area to fall.

Our engineering services portfolio includes the following equipment:

AC mains and main switch board – is the power supply from the local line companies. AC power is the primary energy source in our network, powering the electrical equipment critical to our systems. AC power system infrastructure comprises of a main switchboard, AC distribution board and reticulation cable, automatic transfer switch, earthing and lightning protection, standby generators with fuel storage and Uninterruptible Power Supplies (UPS).

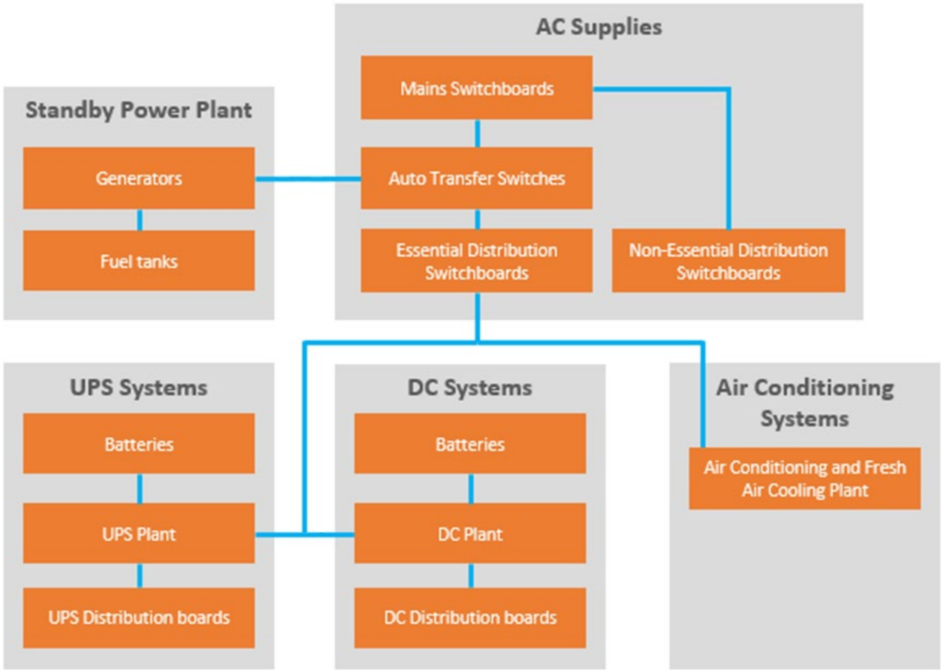
DC rectifiers – DC power systems are used to provide uninterrupted power to equipment that needs DC power. Its main functions are to convert AC power to DC power and to charge and maintain the DC plant backup battery system to keep the plant running in the event of a power failure. DC power systems also monitor and control the power output to the equipment, and trigger alarms when necessary. These systems provide surge protection and provide an extra layer of protection for the equipment being powered. The DC power system comprises a DC power plant, battery reserves, primary and secondary DC distributions, inverters/converters, and alternative energy systems.

Air-conditioners – we use several types of air-conditioning units to maintain temperatures within acceptable limits:

- window mounted units combine an air handler and condenser in one housing. We use them in smaller or less important sites
- refrigerant-based air conditioning (known as mid-sized split systems) consist of an indoor air handler and outdoor units separated by interconnecting pipework. We use these systems at sites where air conditioning is only required to operate during office hours or when the room temperature exceeds the set point. Most of our network sites rely on these systems
- chilled water systems are coupled with process coolers (where temperature and humidity control are needed) or air handlers (where only temperature control is required). We use these large capacity systems at sites that require continuous temperature control.

[14] Although leases are capex, we treat them as opex in our proposal to support clear explanation of trends and the impact of NZ IFRS 16.

Figure 5.15: Types of engineering services equipment



Engineering services management systems - these comprise of a Building Management System (BMS) that is used in the Courtenay Place exchange building and the Network Management System (NMS). These systems control and monitor the building's mechanical and electrical equipment, including ventilation, power systems, cooling systems, fire systems and security systems.

Battery banks – smooth the DC supply, stabilise the voltage and provide backup in case of mains failure.

Standby generators – provide the AC power required to keep the network running if AC mains power is not available.

Fuel tanks – supplementary fuel for emergency back-up.

Asset condition

Condition information is obtained by contractors carrying out network maintenance routines or responding to reactive maintenance callouts and is communicated to us by phone, email, or recorded in our Capital Action Tool (CAT). We decide what maintenance is necessary for each issue raised in the CAT at monthly meetings.

Asset management objectives

We have initiatives that aim to improve our management and performance of our assets in each of our priority areas.

Health and safety - we actively manage and maintain our AC and DC power plant to eliminate risk to field technicians. We check that our FSPs and suppliers meet our health and safety expectations. We are focussed on reducing critical risks that could result in serious injury or fatality.

Customer service - we are committed to maintaining our engineering services equipment to sustain network availability and reliability.

With our alternative sites programme, we are creating suitable infrastructure to power and cool our network space enabling both our UFB equipment to be housed and colocation customers access to install their equipment in our sites.

Network service - we are prioritising corrective and preventive maintenance to monitor and optimise the operating efficiency of our assets.

Cost performance - we aim to deliver high quality network services at an efficient cost. To do this we are developing programmes of work based on performance objectives and asset health analysis to optimise spend.

We are improving cost estimates and systems that evaluate options and manage delivery costs. We are improving our understanding of the cost of our engineering services infrastructure to support charging for colocation services. We are proactively retiring systems that are no longer needed in order to make our asset portfolio cost-effective.

Capability - we are planning on improving our asset management capabilities for engineering services. We are continuing to implement the findings from the SDPs for 60 sites to improve our understanding of engineering services assets, and to develop advanced asset management plans for each building.

Lifecycle management

Our strategy for engineering services is to deliver high quality network performance by:

- continuing to monitor our engineering services assets to optimise operating efficiency and identify faults
- reviewing site loads, equipment types and age to retire engineering services assets that are no longer required or upgrade to provide increased capacity
- carrying out reactive maintenance to resolve faults.

Planning - the creation of engineering services assets is driven by network extensions and lifecycle issues. Our plan for existing engineering services is to replace assets when they become unsafe, obsolete or cost more to maintain than to replace. This ensures that our assets are reliable and meet legislative requirements.

Delivery - our engineering services assets are managed under the Building and Engineering Services contract. New products must be CNSP listed. Our standards for engineering services assets are based on the Telecommunications Industry Association TIA-942 standard. Our FSPs are responsible for carrying out any build or maintenance work.

Operate and maintain - we use both preventative and reactive maintenance for our Engineering Services assets. Our programme of preventative maintenance includes:

- our standby power plant undergoes a minor service routine every 24 months and a major service routine every 200 hours run time or 24 months, whichever is the greater
- we run our standby power plant every two/four weeks using an automated test. A failure during the test results in a reactive callout for repairs
- our reserve Valve Regulated Lead Acid (VRLA) 12V mono block batteries are tested at eight years and scheduled for retests or replacement based on test results. VRLA 2V cell batteries undergo their first test at ten years. The testing regime includes solar system batteries. Batteries are replaced when testing concludes that battery capacity is less than 85%.

We carry out reactive maintenance when faults are identified. Our Field Services Agreement (FSA) includes defined response times that vary based on the criticality of the alarm.

Our main reactive work types are responding to low-fuel alarms, replacement of failed rectifier modules, and repairs to standby generators. DC Power plant account for 40% of the reactive faults followed by AC power plant at 30%.

Retire or dispose - when making choices about the end of life for engineering services assets we consider whole of life cost, health and safety and project management. When we retire an asset we try to re-use, sell or recycle to reduce waste.

Risk management

Our engineering services assets are critical to the delivery of network services. We have developed a list of risks and their mitigation strategies (Table 5.5).

Table 5.5: Asset risk and management plan for engineering services

Risk	Management plan
Our AC Power System assets are aging, and a number are near end of life or at capacity.	We undertake regular inspections of these assets and maintain our hazardous good certification. As part of the Chorus Hub sites initiative, we have reviewed the capacity of our AC power plant to ensure it is adequately sized. We automatically test run every engine alternator regularly to ensure they are working. We are assessing and taking actions to mitigate health and safety risks associated with switchboards, insecure doors and exposed copper buses.
Our DC Power System assets including Rack Power Plant rectifier module failures (low risk), and battery failures due to age, open cells, short circuiting, (low risk).	We have processes in place to test and service this plant to reduce the impact of failure and manage the aging risk. As part of the Network Management System replacement we are working on putting in place automated battery management condition monitoring. Our architecture protects against DC rectifier failures by providing redundant capacity.
We have Air Conditioning plant that is critical to the longevity and availability of the UFB services.	We undertake regular servicing and inspection of our air-conditioning systems to reduce the risk of failure, and or refrigerant loss to the environment. We have selected network electronics that can operate at higher temperatures, without degrading operational life or availability to reduce operational costs by allowing us to increase network room temperature.

5.6. Our plans for site sustain

5.6.1 Network buildings

Our plans for RP1 are to continue to use both preventative and reactive approach to network building maintenance. One key priority in this expenditure area is the requirement to meet health and safety standards through upgrading earthquake risk buildings, management of asbestos and ensuring security and fire systems remain supported.

Our expenditure is expected to remain steady apart from large projects with specific outcomes:

- **Courtenay Place refurbishment** – a staged upgrade of building infrastructure with an estimated total investment of $13.8 million[15]. Works include upgrades to air-conditioning, electrical services, and engine alternators, seismic improvement works, window remediation and a lift upgrade. We plan to complete this project in 2024
- **alternative sites** – a multi-year programme of work to enable reduced dependency on key Spark sites. Works include the upgrade and capacity increase of key power and engineering services. We have carried out this work at 25 sites and expect this programme to be completed in 2023.

5.6.2 Engineering services

Our engineering services assets are critical to network provision and have a high health and safety risk. To reflect this, we plan to prioritise corrective and preventive maintenance to reduce the risk of asset failure.

Our engineering services expenditure in RP1 is required to build capacity for consumer connections and data growth, continued lifecycle management of generators, fuels systems, batteries and air conditioning and the refresh of infrastructure in our Courtenay Place site.

For RP1, a notable area of spend is on the replacement NMS resulting from Spark closing its Public Switched Telephone Network (PSTN) network.

Some cost saving opportunities are expected to arise when we decommission assets as part of copper to fibre migration. We are exploring the potential to increase room temperatures in our network buildings from our current 22°C setpoint to 28°C to reduce cooling energy costs.

[15] Unallocated nominal dollars

5.7 Site sustain forecast expenditure

During 2016-19, we were focused on the UFB build so our aim was to minimise site sustain investment and resolve only reactive building and tenure issues. The trend in spending reflects the alternative site programme which is expected to peak in 2021 and tail off towards the end of RP1[16].

5.7.1 Network buildings

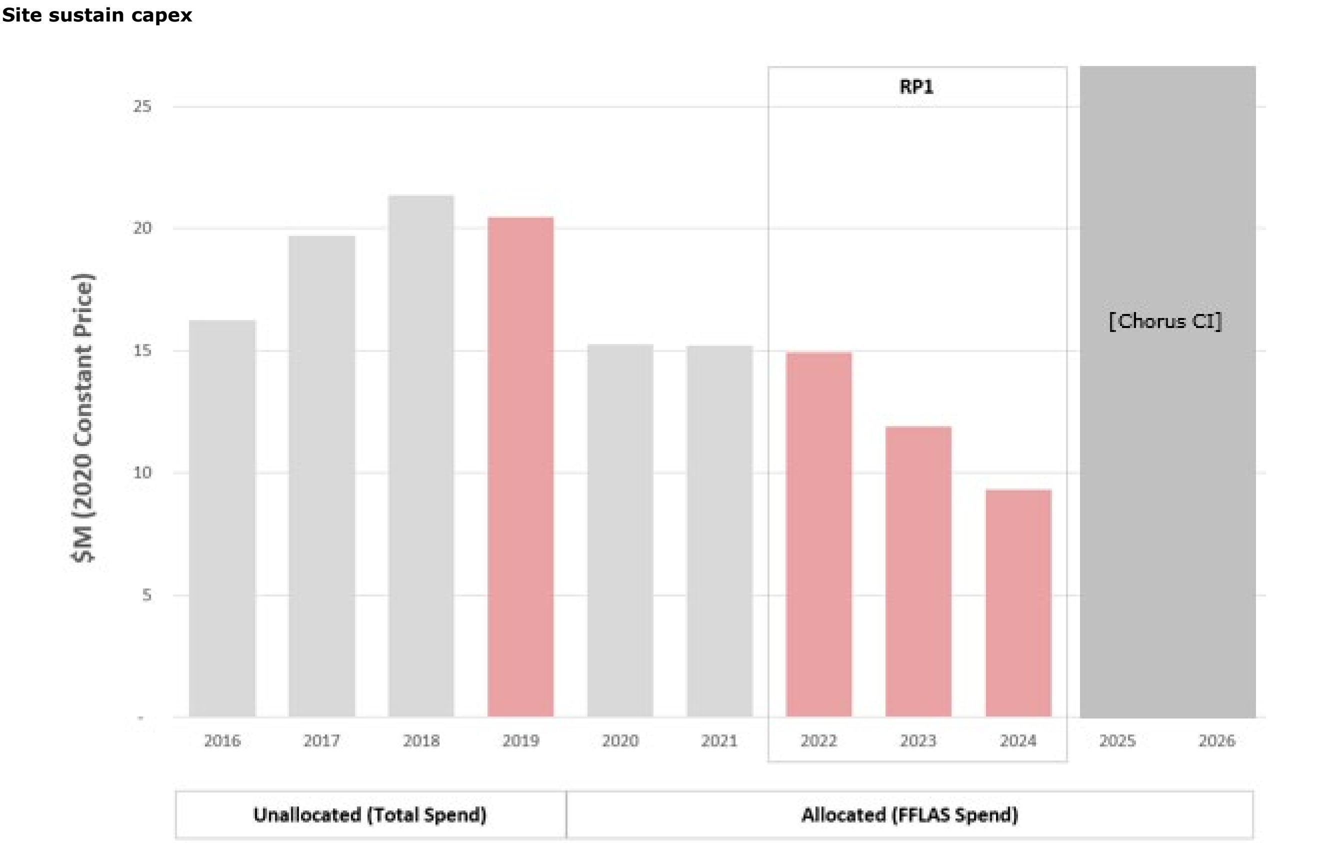
Our RP1 forecast expenditure for Site sustain is $36.2 million, $19.6 million of this is for network buildings. Most of the forecast for network buildings was calculated using a volumetric model price x quantity.

The price is based on rates from our supplier contract prices, average deployment costs or supplier estimates. The volumes are estimated based on the CAR and the status of existing systems in buildings.

Some assumptions and risks linked to this forecast are:

- our buildings were built to house copper assets, which need more space than fibre network electronics. As a result, we have more floor space, and land area, than we require
- the prices used in the forecast for network building maintenance are based on estimated quotes from suppliers. The actual price of each job may vary substantially due to unexpected complexities that may arise.

Figure 5.16: RP1 expenditure for site sustain showing unallocated historical spending



[16] Our current business planning process only takes our detailed planning to 30 June 2025. To extend the forecast for calendar year 2025 and 2026 we have applied a high-level approach to project the forecast forward, with bottom-up and top-down sense checking to adjust for anticipated step changes.

5.7.2 Engineering services

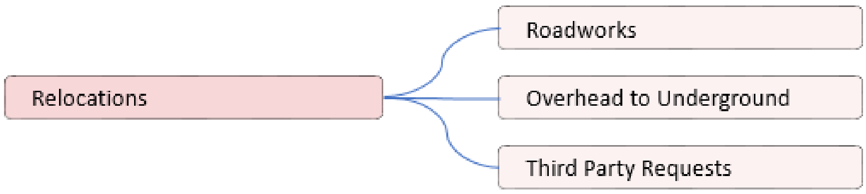
During RP1 our forecast expenditure for engineering services is $16.6 million.

Our expenditure forecast for engineering services is mainly calculated using a volumetric approach price x quantity. Price is set by commercial agreements or estimated using historical information and costs which are benchmarked against a typical installation. Equipment costs (DC power plant, batteries and air conditioners) are based on market prices. Volumes are based on historical replacement rates adjusted for an assumed increase driven by network capacity.

There are some uncertainties and assumptions that introduce risk into this forecast:

- for DC power systems, the volume assumes the number of DC rectifiers and batteries expected to exceed their life in RP1. The forecast can also be influenced by the number of cabinet batteries that fail and migration rates
- with AC power systems, the volume assumes replacement based on the number of buildings that exceed the age of 50 years, but the age of some buildings are unknown.

Figure 5.17: Works managed under the relocations sub-category



5.8 Relocations

Sometimes we are required to move network elements and we call this work relocations. We relocate the network for three reasons: roadworks, Overhead to Underground (OHUG) and third-party requests.

5.8.1 Roadworks

We are obligated under the Telecommunications Act 2001 to relocate the network if requested by a road controlling authority (NZTA/local councils). Roadworks refers to the relocation and rebuilding of the network in response to road changes. It can be triggered by any change to road layout including new road construction, new utilities (e.g. water mains), bridges or road seal replacement.

The relocation works ensure that our network elements remain accessible and protected from damage. As a result, roadworks performs a key network function, to reposition or rebuild parts of the network to maintain network integrity.

We receive capital contributions for roadworks. Under the Telecommunications Act, NZTA contributions fund labour and materials used during construction. Local councils pay the full cost. In some cases, we replace lower capacity elements with greater capacity ones when a roadwork is requested. The cost difference between the lower and greater capacity elements, referred to as 'betterment', is not chargeable to NZTA or councils. Our forecasts are net of any capital contributions received.

5.8.2 Overhead to underground

When it is necessary or economic, we remove cables from poles and install replacement routes in underground ducts.

OHUG works involve installation of new fibre network elements when electricity distribution ('lines') companies remove their poles and they underground the power network. We are then required to remove the network elements that rely on the poles and establish a new fibre route underground.

Historically lines companies had power poles down one side of the street and our (and our predecessor company) poles were on the other side. We therefore lease many poles from lines companies. Some of our agreements for the use of power poles require us to undertake undergrounding works when the lines companies direct us.

5.8.3 Third-party requests

We are occasionally requested to relocate network elements for practical or cosmetic reasons. For example, if a cabinet is blocking the development of a new driveway.

These types of requests are lower volume and are ad-hoc in nature and require planning, design and delivery on a case-by-case basis. We receive capital contributions for some third-party requests.

5.9 Our plans for relocations

Relocations work is largely reactive, and demand driven. For roadworks the demand is a function of roadworks activity requests made by NZTA or councils. Civil construction forces us to relocate network infrastructure more frequently in the urban areas that were built in the early years of the UFB build. Consequently, more recent network growth in smaller communities does not result in a significant increase in relocations expenditure.

Third-party work is driven by requests, e.g. to move part of our network close to a shared driveway.

OHUG works are reactive to lines companies works. We plan based on a mixture of known lines companies works, and historical run-rate. Individual projects are created as required and draw down from the programme budget.

5.10 Relocations forecast expenditure

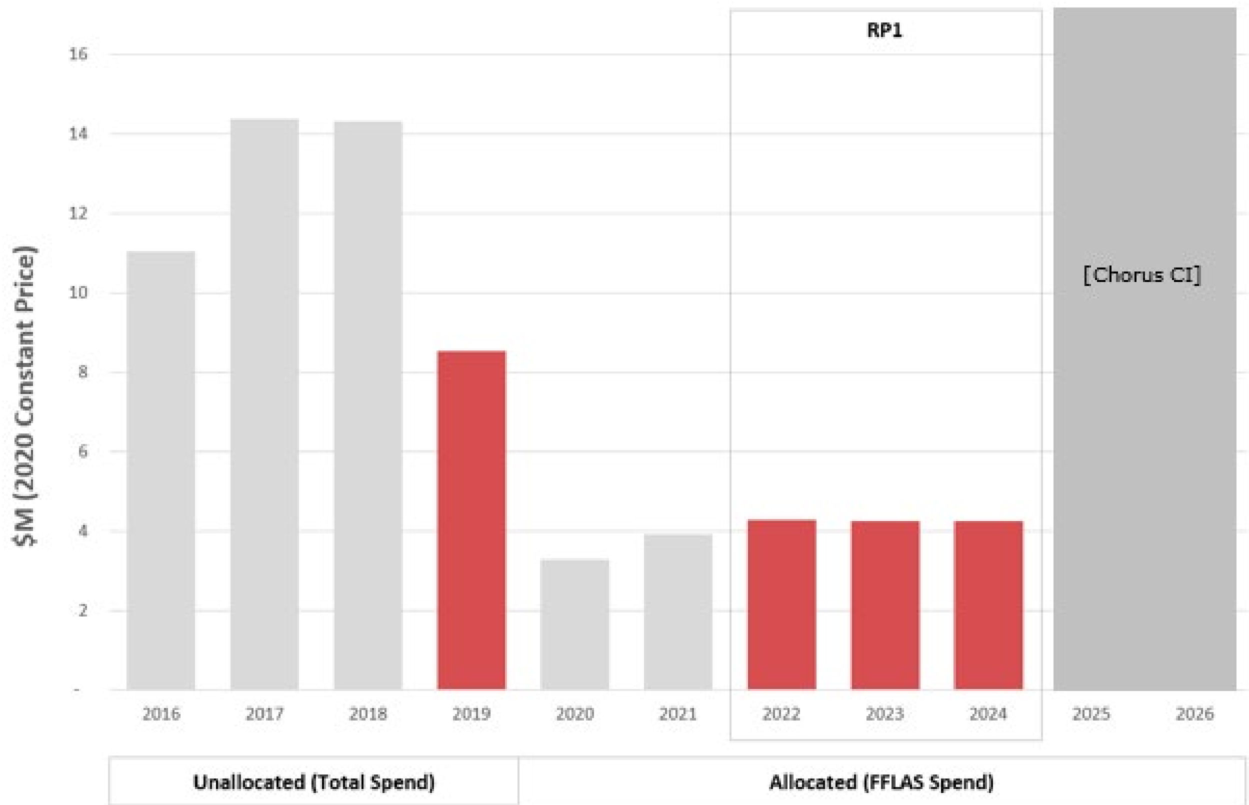
Expenditure on relocations is demand driven. We expect our spending to remain steady over time[17].

Relocations cost are forecast at $12.8 million in RP1.

Relocations costs for individual projects vary depending on the scale and type of affected network elements. We use costs set under our Field Services Agreement (FSA) for different types works. We have assumed that these costs [**Chorus CI**]. This is a forecast risk as our FSA is due to expire in 2022.

Figure 5.18: RP1 expenditure for relocations showing unallocated historical spending

Relocations capex



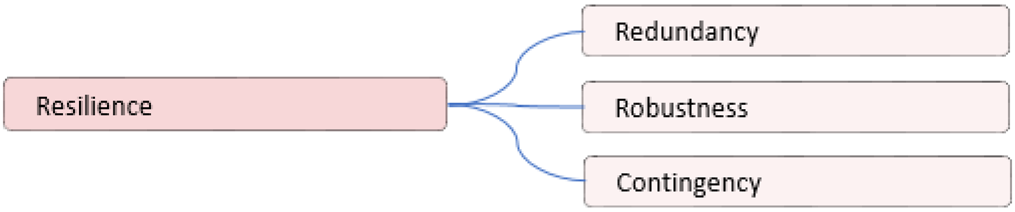
[17] Our current business planning process only takes our detailed planning to 30 June 2025. To extend the forecast for calendar year 2025 and 2026 we have applied a high-level approach to project the forecast forward, with bottom-up and top-down sense checking to adjust for anticipated step changes.

For roadworks, our forecast expenditure is based on historical average costs and volumes. Where we have received additional information from NZTA or local councils (i.e. if they inform us of their plans for motorway/highway development), we adjust our forecasts accordingly. For example, recent announcements by the Government for shovel ready projects have had a flow-on impact to forecast roadworks activity.

The nature of this work is reactive, and the historical trend of both spend and volumes are a fair indication of future activity. Our forecasting assumption is that the proportion of roadworks activity for the fibre network will continue to grow as the UFB footprint expands and UFB2/2+ is completed.

For OHUG relocations, the primary driver for this work is lines companies' undergrounding work programmes. Expenditure is based on historical information, with an overlay for known lines companies' projects.

Figure 5.19: Work managed under the resilience sub-category



5.11 Resilience

As we transition from the build to the management phase, we will increase our focus on enhancing the network. This means increasing its capabilities and resilience so that it can better serve the needs of consumers. We expect to increase our expenditure to enhance the network over time.

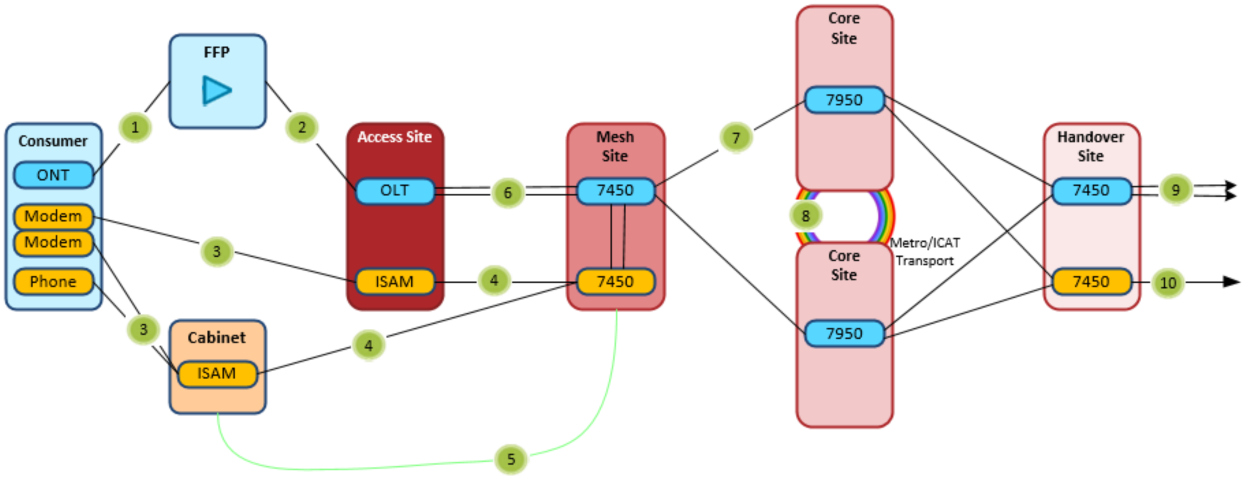
Resilience is our ability to keep the network running when assets fail. Fibre assets are exposed to damage from weather, earthquakes, land subsidence and slips and third parties (such as diggers). Our resilience work means that the network can keep working even when an asset fails. This requires careful planning and expenditure on architecture, technology, buildings and fibre.

We invest in three types of resilience: redundancy, robustness and contingency. These are described in table 5.6.

Table 5.6: Example of resilience used in the network

Method	Description	Examples
Redundancy	Providing extra capacity or backup so connectivity is sustained if a single component or system fails or taken out of service (e.g. for planned works)	Backup power supply Capacity headroom Dual fibre paths Geographically alternative fibre routes Multiple cables in the same duct servicing an exchange area
Robustness	Upgrading major components or systems to reduce their risk of failure	Seismic upgrades, dual path fibre.
Contingency	Putting measures in place to support rapid recovery	Critical spares Rapid response technicians

Figure 5.20: Layer one failures and numbers of affected end users[18]



	Location	Failure Discussion	Affected End Users
1	Distribution Fibre	Single connections. Failure involves truck roll and repair. 24 to 48 hours.	1
2	Feeder Fibre	Multiple customers on single fibre connections. Failure involves truck roll and repair. 24 to 48 hours.	16-32
3	Distribution Copper	Single connections. Failure involves truck roll and repair. 24 to 48 hours.	1
4	ISAM Uplink	Single fibre uplink. Fibre cut 24 to 48 hours repair.	< 384
5	Ethernet DMR uplink	Radio path uplink. 24 to 48 hours repair. Can be affected by atmospheric conditions with reduced service performance.	< 384

	Location	Failure Discussion	Affected End Users
6	OLT Uplink	Dual fibre uplink. Non-diverse path. Fibre cut 24 to 48 hours to repair.	< 4096
7	FDS backhaul	Dual fibre uplink. Generally diverse. Fibre cut 24 to 48 hours to repair.	< 50,000
8	Metro/ICAT Transport	Fibre rings built. Services can be constructed with diverse paths. Fibre cut 24 to 48 hours to repair.	< 100,000
9	UFB RSP Handover	Single or Multiple Fibre Handover (RSP Choice).	< 15,000 (no hard limit)
10	EUBA RSP Handover	Single Fibre Handover.	< 15,000 (no hard limit)

One of our resilience techniques is to build dual fibre paths. To do this we duplicate the fibre paths that have a high impact. If one path fails on a dual path, connectivity can be maintained using the other. The UFB NIPA[19] has specific layer 1 and layer 2 availability requirements and average down time requirements. To meet these requirements during the UFB1 build we utilised dual fibre paths between core and mesh sites.

Establishing resilience for UFB2 towns is more complex because the towns are a long way from aggregation switches. Traffic from the OLTs to the handover must travel over a long fibre path. The risk of a fibre cut increases with cable length. Direct buried fibre in rural areas is more susceptible to cuts and damage than fibre cable in ducts in cities.

If there is only a single fibre path back to the handover and the fibre cable is cut, then the UFB2 town is isolated and network services are lost. A second fibre route is sometimes long and expensive. In some cases, building a second route may not be possible over the whole length or route, usually because there is only one road into an area (e.g. Takaka, Bluff, Akaroa, etc). Fibre and transport system preparedness has been achieved for more than 90 UFB2 areas. The most notable is a 45km fibre lay providing a dual path robustness for the Far North area.

5.11.1 Managing resilience

We have resilience standards for our network architecture:

- **contractual quality standards** - we are required to meet targets for network availability as specified in the NIPA. These requirements continue through RP1. The NIPA requires availability of 99.99% of the year (equivalent to up to 48 hours downtime per year for each line). The NIPA also sets a maximum number of consumers that could be affected by a

[18] Intelligent Service Access Manager (ISAM).
[19] Network Infrastructure Project Agreement, Chorus Limited and Crown Fibre Holdings Limited.

single layer one or layer two element failure, and the maximum number of consumers that can be supported by a single point of interconnect (POI) of 3,000 customers. The NIPA also requires all towns with 3,000 premises or above to have dual path

- **architecture standards** - our architecture specification (CADS0046 section 4.4) requires that communities greater than 1,000 should have dual path fibre routes. Communities between 100 and 1,000 premises are provided with dual path fibre if possible and may be part of other diverse activity
- **service level agreements** – our contracts with Retail Service Provider's (RSPs) include availability targets.

New resilience projects are planned by considering risk and impact of network infrastructure. Impact is the time when the network is unavailable, and the number of consumers served. We install duplicate assets when the impact is significant.

The network aggregates traffic (from consumers) as it approaches the various handovers, so the impact of a failure is greater closer to the handovers. We add resilience at core and mesh sites, this involves ensuring that the buildings are highly secure and that the network electronics are reliable, we also have dual mains power supplies, diesel generators and battery backups.

As our network grows it becomes more cost efficient to close loops in the network and incrementally add redundancy. For example, when planning extensions to the physical network we can consider routes that achieve improved network resilience using existing infrastructure. When possible, we avoid areas which could present a hazard to the infrastructure such as areas of land slips and erosion to ensure maximum availability.

5.12 Our plans for resilience

Our main plan for resilience is an ongoing programme of work to ensure that no single element failure impacts over 3,000 consumers. This results in most towns with over 1,000 premises requiring dual fibre paths to their Handover Point (POI). This programme of work began in 2019.

We are also carrying out an audit to verify that exchanges on the national core transport network do not have any significant common fibre routes.

We are developing a potential network resilience programme as an individual capex proposal. This proposal would include a programme of improvements for single site resolution times. There could also be other programmes we consider for an individual capex proposal, for further resilience, including accelerating route diversity work and investing in targeted exchange enhancements.

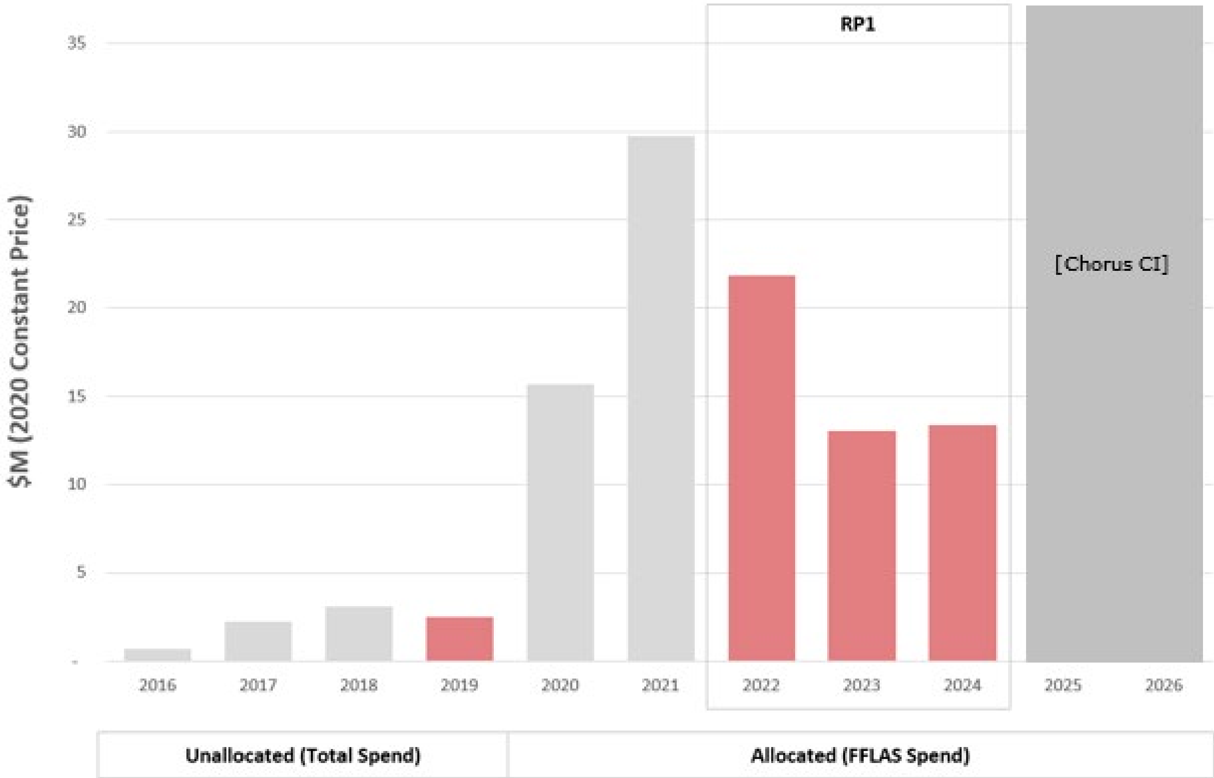
5.13 Resilience forecast expenditure

Prior to 2020 most network resilience was built as part of the UFB rollout. As a result of winning UFB2, several major projects were commenced to establish capacity for UFB2 and provide for UFB robustness.

In 2019, we started delivering on our 10-year programme for ongoing resilience in support of our 'always on' objective and customer quality expectations. The peak in 2021 and 2022 is due to work on the Fox Glacier to Haast to Lake Hawea fibre feeder and Te Anau to Milford Sound fibre feeder.

Figure 5.21: RP1 expenditure for resilience showing unallocated historical spending

Resilience capex



During RP1, we have forecast $48.2 million of FFLAS capex for resilience[20].

Our forecast is calculated using a volumetric model price x quantity. Price is based on historical information using the average price for each deployment type at February 2019. We have assumed costs based on previous build activity. Health and safety and NZTA compliance requirements are pushing this cost higher and this creates some risk and uncertainty in our forecast. We have adjusted the price [**Chorus CI]** when the new Field Services Agreement (FSA) contract starts in [**Chorus CI]** 2022 ([**Chorus CI]** in FSA costs is built into the forecast).

The quantity is based on our planned resilience programmes and some additional capacity reactive projects. The forecast for reactive projects is based on our demand modelling assumptions.

The forecast includes investment to build resilience infrastructure for most UFB2/2+ town/community with 1,000 or more premises. This is a forecasting risk as this is a ten-year programme and executing more quickly will result in increased funding required in RP1.

Contractual penalties with (Crown Infrastructure Partners) CIP in the case of us not meeting our commitments to Crown are not a part of the forecast.

We have identified potential resilience projects that are not in our forecast due to uncertain scope and timing. If these projects are brought forward into RP1 we would consider an individual project approval.

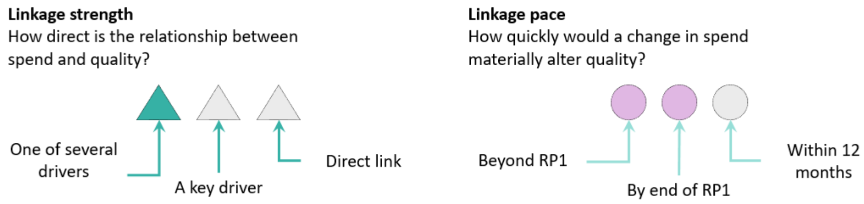
[20] Our current business planning process only takes our detailed planning to 30 June 2025. To extend the forecast for calendar year 2025 and 2026 we have applied a high-level approach to project the forecast forward, with bottom-up and top-down sense checking to adjust for anticipated step changes.

5.14 Links to quality

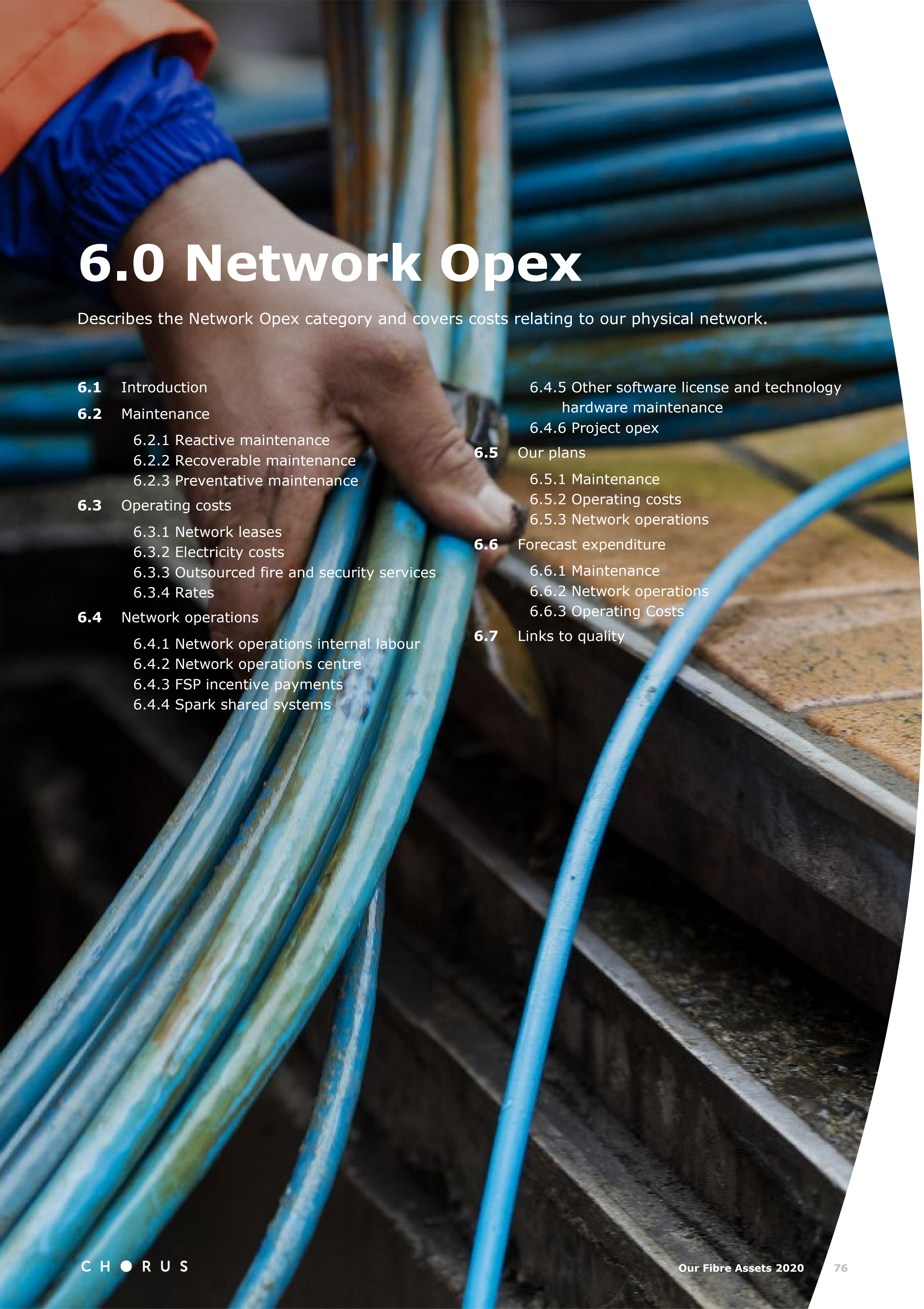
Each discussion of linkages between expenditure and quality includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment.

More detail on synergies between projects and programmes, and capex and opex trade-offs can be found in the Investment Summary of Our Fibre Plans under the heading 'linkages, synergies and trade offs'.

Table 5.7: Links betweek Sustain and Enhance capex and quality dimensions



Dimension(s)	Area	Strength	Pace
Availability and faults	**Network sustain and enhance | resilience** Investment in resilience can reduce the risk of widespread downtime events.		
Availability and faults	**Network sustain and enhance | field sustain** Replacing or refurbishing in-field assets reduces layer one downtime risk.		
Availability and faults	**Network sustain and enhance | site sustain** Replacing or refurbishing site assets reduces layer two downtime risk.		
Availability and faults	**Network sustain and enhance | relocations** Relocation work protects network elements.		
Customer service	**Network sustain and enhance | all** Asset replacement and refurbishment and investment in resilience sustain our low fault and downtime rates, which support customer satisfaction.		

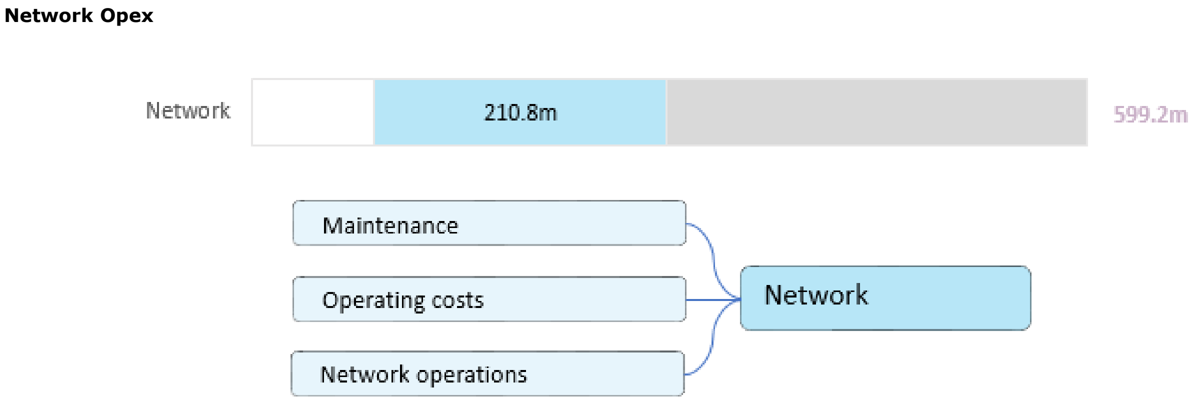


6.0 Network Opex

Describes the Network Opex category and covers costs relating to our physical network.

6.0 Network Opex

Figure 6.1: Network Opex as a proportion of total first regulatory period (RP1) opex



6.1 Introduction

Our Network Opex keeps the network running at current service levels. It includes spending on three sub-categories:

- **maintenance** - the outsourced costs of physical network inspection and repairs, including materials
- **operating costs** - costs related to running the network including electricity and leases
- **network operations** - the labour costs of running the Network Operation Centre (NOC), the assure service desk, the Security Operations Centre (SOC), customer billing, escalations and other customer facing network services.

6.2 Maintenance

Our maintenance sub-category covers three types of maintenance activity:

- **reactive** - fixing or repairing broken network-related assets and replacing broken assets
- **recoverable** - maintenance work for which some or all of the costs can be recovered
- **preventative** - routine inspections and any resulting repairs.

Most of our maintenance opex is on reactive maintenance, with a small amount of recoverable and preventative maintenance. We expect preventative maintenance activity to increase going into RP2 as our fibre assets age and we improve our asset management processes.

6.2.1 Reactive maintenance

We use reactive maintenance to upgrade an asset, make it safe or secure, or to reduce the chance of asset degradation, or address an operational failure and restore service. We identify the need to restore assets when a fault occurs (usually when it is reported by a consumer), via inspections or when an alarm is generated.

Our reactive maintenance opex is largely Field Service Provider (FSP) related. In addition to repairs of physical network and network electronics, it also includes the cost of FSPs repairing supporting engineering services infrastructure such as air conditioning units, power supplies and batteries and the cost of repairs to network buildings.

Our reactive maintenance spend is necessary to restore service after an outage.

Reactive maintenance also includes consigned fibre materials used by our service companies for reactive fault fixes.

6.2.2 Recoverable maintenance

Recoverable maintenance covers work for which we recover some (or all) costs from other parties. It includes network damage caused by third parties, faults not related to our network and maintenance of assets shared with Spark.

It is not always possible to identify the cause of a fault until it has been investigated. When a fault is reported, a FSP technician is dispatched via the relevant IT systems. The technician visits the site, identifies and repairs the fault as appropriate. If no fault is found or the fault is on part of the network belonging to a Retail Service Provider (RSP) or a consumer, we pay for the fault repair and then charge this to the respective RSP. If the fault is caused by third-party damage to our network (for example during construction activity), we pay to fix the fault and attempt to identify the third-party that caused the damage to recover the cost from them. We are unable to fully recover the cost of third-party network damage when the party responsible for the damage is unknown, refuses to accept responsibility or is unable to pay.

6.2.3 Preventative maintenance

We use preventive maintenance to reduce the likelihood of asset failure by identifying potential failures and dealing with issues before they arise. Preventative maintenance activity is important to us as it allows us to minimise the chance of unforeseen disruption to network services.

Our preventative maintenance activities include:

- condition assessment work, such as preventative testing and inspection of poles
- the Fibre Route Survey (FRS) which is a proactive programme that aims to identify potential faults on core fibre routes
- property maintenance where issues are identified through condition assessment reports. These costs are shared between the copper and fibre networks
- cable locate services to provide information to third parties on location of cables, pipes and other utility assets around proposed dig sites. These costs are also shared.

Our current approach to maintenance for pits and manholes is reactive, however, we are intending to move to a condition assessment programme where each pit/manhole is regularly inspected, every ten years. Any identified remediation will be proactively undertaken. We expect that this programme will develop during RP1, as we need to build internal capability to manage this and increase field resources.

Our fibre network is relatively young, and our preventative maintenance capacity is currently under development. We expect spending to grow in this area during RP2.

6.3 Operating costs

The operations network sub-category includes:

- network leases
- electricity costs
- SOC
- fire protection and building compliance services
- rates.

6.3.1 Network leases

Some of our infrastructure is shared with other organisations. We enter lease arrangements for these assets and our spending on leases is capitalised as 'right of use' assets.[1] The expenditure on leases is closely aligned with network opex.

Our most significant spending on leases in the area of network opex are:

- Spark sites that relate to the exchange buildings that we share with them. These cover around 36 sites on the cost side (where we are in Spark sites) and around 640 sites on the revenue side (where Spark is in our sites)
- poles from lines companies which carry our fibre cables and equipment. Our pole lease costs will increase as we continue to extend the network and connect customers
- rights of way and other network-related assets
- Cook Strait fibre and other smaller leases that typically relate to transport of network traffic.

Lease capex is recorded at the time new leases are established, based on a Net Present Value (NPV) calculation across the life of the lease.

[1] Although leases are capex, we treat them as opex in our proposal to support clear explanation of trends and the impact of NZ IFRS 16.

The opex charges for these network leases are also captured in this area of spend. These charges relate to running costs such as cleaning or maintenance.

6.3.2 Electricity costs

The electricity cost required to power the network electronics and air-conditioning units in exchange buildings and cabinets.

6.3.3 Outsourced security and fire services

We outsource the security and fire services for our network buildings.

Our security operations centre is overseen by some internal labour and staffed by our service contractors. Our outsourced security contractors manage all aspects of security in relation to network operations. Their activities include maintenance and monitoring of security systems and CCTV feeds, management of access cards, locks and keys for our sites and ad hoc security related investigations (e.g. theft of our cable).

We also have an outsourced agreement for fire protection and building compliance services.

6.3.4 Rates

We are liable to pay rates for our network-related buildings, and infrastructure rates for our underground network. Infrastructure rates account for around 80% of our rate payments and will increase as we continue to extend the network. Land and infrastructure rates tend to increase at a rate that is greater than inflation each year. This is treated as passthrough costs as per the IMs.

6.4 Network operations

Our network operations sub-category includes:

- network operations internal labour
- NOC
- FSP incentive payments
- project opex
- shared Spark systems
- other software license and technology hardware maintenance.

6.4.1 Network operations internal labour

We split the cost of our Customer Network and Operations (CNO) teams across all three opex areas. The key teams covered by network operations are described here.

The national field capabilities teams manage the quality and performance of FSPs and ensure network standards are maintained.

Operate customer teams are responsible for:

- customer billing for network related activities such as damages, new property developments, network relocations, associated credit management and payment assurance for provisioning and assure activity performed by FSPs
- stakeholder and third-party complaint management
- customer escalations manage consumer escalations and issues through to resolution
- managing our social media and general customer enquiries.

Operate network teams:

- manage faults (assure) and interruption events
- provide provisioning support
- manage the SOC
- manage the move of existing network within boundary
- assist customers with location of our network through physical network services and provision of network plans.

6.4.2 Network operations centre

The outsourced NOC provides support and workforce management. It is based in India and Level 2 support resources are based in Hamilton. A Master Services Agreement (MSA) contract makes up most of our NOC costs. It includes expenditure for:

- operations support for the alarm management of our network electronics
- complex software and hardware technical support and maintenance service, including network configuration
- equipment repair and return service in support of the network electronics.

The MSA was renewed for three years in September 2019 with little change to costs. We will renegotiate the MSA during RP1 [

Chorus CI].

6.4.3 FSP incentive payments

Most of our Field Services Agreements (FSAs) includes a retention scheme based on quarterly performance against key performance indicators. This incentive scheme is designed to ensure FSPs maintain high performance levels. It involves an at-risk amount which will be a penalty to retention costs if the FSP underperforms and a reward for excellent performance.

6.4.4 Spark shared systems

Chorus started out as a business unit within Spark (then Telecom) before demerging in 2011. We still have some shared systems. We have been working to exit these legacy systems and create our own capability. The separation plan was reviewed and signed off by Ministry of Business, Innovation and Employment (MBIE).

Our expenditure on shared systems is relatively static. The remaining legacy systems support the copper network, so expenditure is substantially non-FFLAS (fibre fixed line access services). During RP1 we expect our costs to remain broadly static.

This history is important as our spending in recent years has been to facilitate the separation and development of our in-house capabilities, as well as paying costs to Spark for the ongoing use, hosting and support of shared systems during the transition, including the Spark network operations centre.

6.4.5 Other software license and technology hardware maintenance

Our hardware maintenance costs are contracted to suppliers of hardware such as firewalls, routers and switches. It also includes repair and return costs for IT network hardware. We also pay our software license providers for maintenance services, where appropriate.

Our costs are driven by the roadmaps for physical devices and licensed virtual devices, historical negotiated costs and our contracts with vendors for repairs and returns.

6.4.6 Project opex

Our network operations sub-category includes opex that supports various capital projects. Although these costs are presented as part of the FFLAS forecast for network opex, they are not included in this chapter as they are best described in conjunction with the relevant capex project to provide additional context around the nature of the costs. This content can be found in the Extending the Network, Installations and Sustain and Enhance chapters.

6.5 Our plans

6.5.1 Maintenance

During RP1 our plans for maintenance are to continue with a predominantly reactive approach. Our expenditure on field maintenance activity will increase slightly with time as total fibre connections are a key driver of costs i.e. more fibre connections to maintain.

We expect the total profile of reactive maintenance cost to remain relatively consistent year on year. However, shared maintenance costs relating to network property is likely to increase with time.

6.5.2 Operating Costs

In the leases space, we are planning to reduce the extent of shared space with Spark and our RP1 forecast incorporates reductions in space we take in Spark exchanges. We also have an ongoing programme of work to optimise our network property-related costs which includes our network leases (shared costs). The benefit of this is potential savings in lease-related expenditure. However, FFLAS expenditure is unlikely to decrease as more shared costs are needed to support fibre.

As we migrate customers from copper to fibre, we expect this to have a favourable impact on our total expenditure on electricity. However, FFLAS expenditure is expected to stay at a similar level as more shared costs are needed to support fibre assets such as network electronics.

We also expect our total rates expenditure to increase with time as our fibre infrastructure grows. Rates are treated as a pass-through cost under the IMs.

We expect the other costs in this space to remain fixed overtime with a slight inflationary uplift.

6.5.3 Network operations

We do not plan to make changes to the way we manage our network operations during RP1. All costs in this category are relatively stable and recurring except for CNO capital project opex which we expect to decline going into RP2 as our level of capital investment continues to decrease.

Our plans are driven by the demand for installations and connections which peaked in 2019. We expect the decline in build activity will result in an overall reduction in workload related to assure, billing, general queries and escalations. However, since some of the internal labour supports declining installation and connection activity, our ability to capitalise internal labour also decreases. As a result, our expenditure will remain relatively steady.

Having reduced workload presents the opportunity for consolidation of work effort and supporting systems. Our customers and consumers have multiple contact channels available to them. We aim to simplify our systems to make customer interactions smoother.

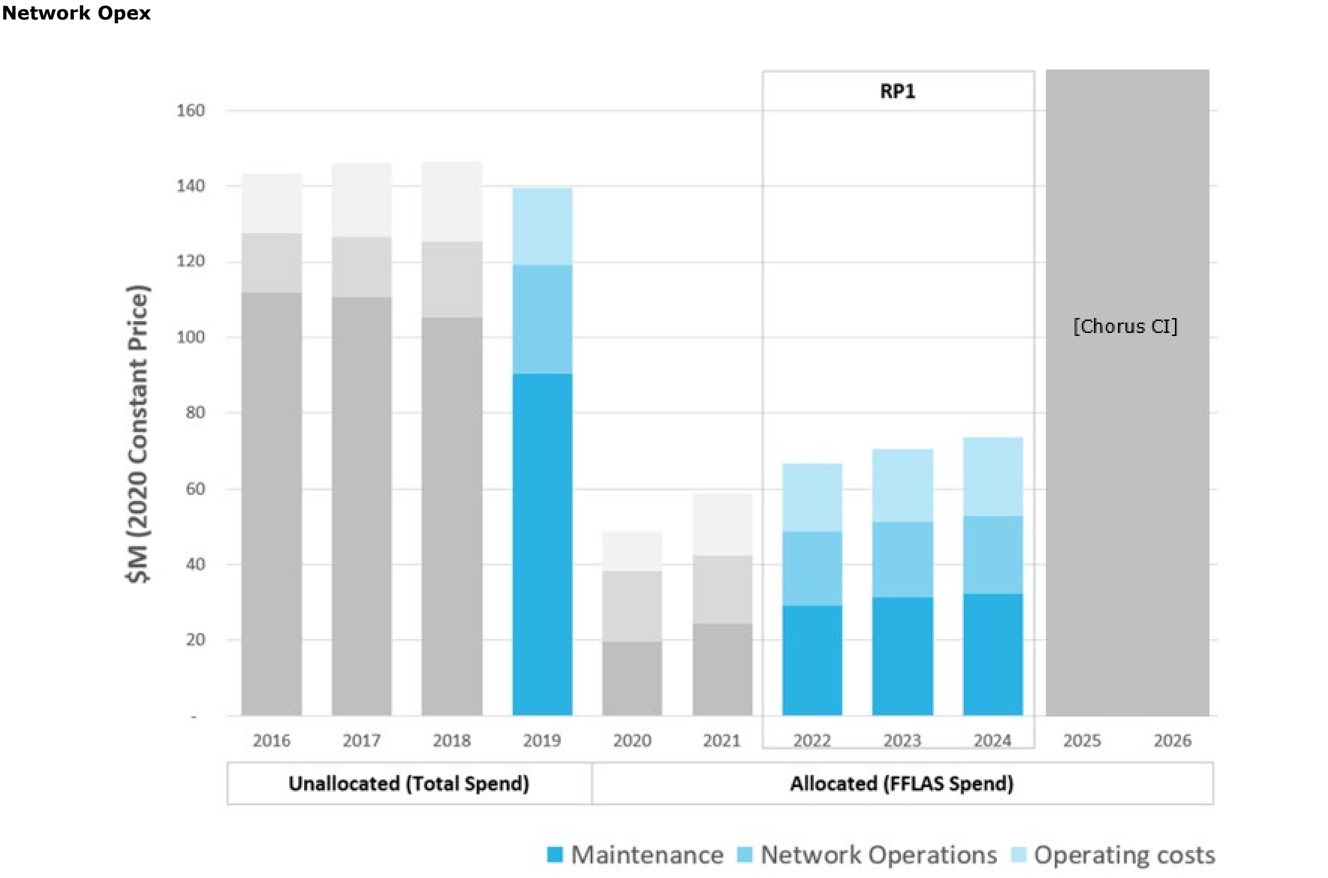
Providing better data quality and facilitating information transfer between our FSPs and our customers will help reduce activity further.

6.6 Forecast expenditure

Our historical spending is linked to demand for our services. FFLAS maintenance spend has been low due to the age and scale of the network. Our spending on maintenance and operating costs will slowly increase as the network grows and more shared costs are needed to support the fibre assets. Expenditure on network operations is likely to remain steady as a reduction in activity is offset by the increase in FFLAS allocation[2].

During RP1 our expenditure forecast for Network Opex is $210.8 million.

Figure 6.2: RP1 expenditure for Network Opex showing unallocated historical spending



[2] Our current business planning process only takes our detailed planning to 30 June 2025. To extend the forecast for calendar year 2025 and 2026 we have applied a high-level approach to project the forecast forward, with bottom-up and top-down sense checking to adjust for anticipated step changes.

6.6.1 Maintenance

As the fibre network build has progressed and more consumers have connected, the number of reported faults has increased, and the costs associated with managing the network have grown. We expect our maintenance costs to continue to grow as more consumers connect to the fibre network and we carry out further network extensions.

We predominantly use price x quantity models for our maintenance expenditure forecasts. We believe this approach is appropriate as it allows us to perform more detailed forecasting than a run-rate or a base step trend forecast. Prices are based on historical information and contracts with our FSPs. Volumes are related to fault rates which influence work volumes and therefore spending.

We forecast reactive maintenance opex using a price x quantity model. The price is determined by using a historical average of actual FSP unit costs for similar jobs. There are two components to quantity:

- **fixed fault quantities** – the fixed part of the model considers the main network so the number of faults in a cabinet area tends to remain constant as the network infrastructure does not change
- **variable quantities** – variable faults vary directly with the number of consumers connected to the network.

The forecast for customer network repairs and third-party damage is derived in a similar price x quantity manner as described above for reactive maintenance. Customer network related repairs are 100% billable to third parties which has a downstream allocation to our FFLAS forecast.

Our forecast for third-party network damages include instances where we can recover our costs of repairs from the relevant party, and instances where no cost recovery is possible. In either case, the fibre network is impacted, and therefore both contribute to our FFLAS forecast.

We use price x quantity to forecast preventative maintenance cost for manholes, poles and pits inspection, and remediation work. We have used historical failure rates of pits and manholes to inform the volumetric component of the remediation forecast. Property related preventative maintenance is forecast based on a combination of information received from condition assessment reports and historical run-rate.

Our maintenance forecasts use several key assumptions:

- the historical fibre network fault rate is representative of future fault rates
- fibre connection forecasts
- our steady-state fault rate will not change significantly in RP1. Our fibre fault rate reduced from 2016 to 2017 as a result of optimisation activities. Since then the fault rate has been relatively stable and we believe this is representative of likely outcomes in RP1. Without further preventative investment, in subsequent regulatory periods we may start to see impacts of network degradation as the fibre network ages
- service level targets will not change and will continue to be met based on our current mix of reactive and preventative maintenance spend
- average price per truck roll (this is a fee charged by our FSPs) is consistent with the historical price, however this has been adjusted for inflation [**Chorus CI**]. Build and installation activity is expected to reduce during RP1, there is some risk that this will increase average price per truck roll.

We test the accuracy of our maintenance forecasting by using sensitivity analysis:

- **fault rate (quantity)** – we varied the fault rate over 6 month, 12 month, 24 month and 36 month time periods and found that using 12 month historical fault rates was the best approach. This yields lower fault rates and costs compared to prior time periods and is broadly consistent with our anticipated long run trend
- **cost per truck roll (price)** – we tested costs for 6 month or 12 month averages and found that the six-month range was the best approach. This uses new FSP rates effective from 1 July 2019.

6.6.2 Network operations

Network operations cost is expected to remain relatively stable as our build activity falls and we change our focus to network operator. Since these costs are largely shared in nature, we expect the FFLAS portion of these costs to increase with time as our fibre network grows.

Our forecast for the NOC is based on the pricing structure of the MSA. [**Chorus CI**]. The headcount required to run the NOC is driven by fault volumes and complexity, and the introduction of new technology and/or products.

Spark shared system costs, software license maintenance and hardware maintenance costs are forecast based on fixed contractual agreements with suppliers.

We have used historical performance to inform the forecast for our service company incentive expenditure. Our best performing FSPs reached [**Chorus CI]**% performance in prior periods and our expectation is that in RP1 all FSPs will deliver this level of performance. Therefore, we have forecasted to spend [**Chorus CI**]% of the potential bonus available to service companies over RP1. [**Chorus CI**].

6.6.3 Operating costs

Our operating costs are expected to remain relatively constant as increases in demand for network capacity are offset by efficiency savings.

Our lease costs are forecasted on a bottom-up basis. We believe this approach is appropriate as it allows us to factor in adjustments such as our property optimisation programme which removes some of our equipment from Spark exchanges. Operating costs related to our leases for items such as cleaning are forecasted on a basis consistent with the lease agreement.

We have used a price x quantity approach for forecasting electricity costs as it allows us to account for several adjustments.

Price is formed by assuming key grid exit point spot prices available on the futures market apply for our electricity costs (note while we partially hedge our exposure to electricity prices at the time of five year planning the majority of the RP1 period had not yet been hedged). We adjust the assumed price based on an analysis of the historical difference between the price we incurred and the actual price at key grid exit points.

Quantity is based on monthly electricity consumption from the previous year. The base consumption is adjusted to account for:

- the removal of cabinets as consumers move off copper connections
- the increased energy efficiency of fibre connections compared to copper connections
- higher consumption in Hyperfibre connections
- Spark removing some of their network electronics from our exchanges.

There is some uncertainty in our forecasting because only two grid exit points are traded on the futures market, limiting the data we can use for our forecasting. We mitigate this risk by adjusting our forecast based on the historical difference between actual and traded prices.

We use hedge contracts to reduce our exposure to variations in electricity prices. Our current contracts are included in our forecasts and we assume that similar arrangements will be made during RP1 although the prices available at the time of contracting are likely to be different to those assumed.

Our forecast for rates is based on our current buildings and infrastructure assets and includes an increase due to builds that are near completion.

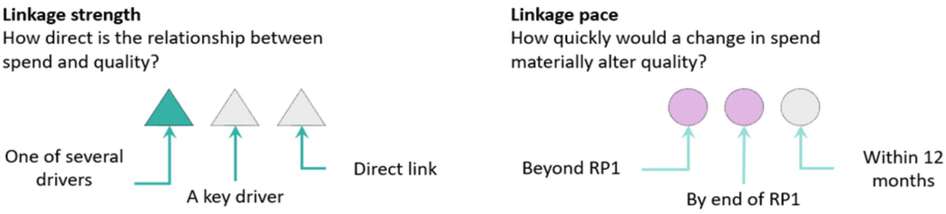
All other costs in this area are forecasted on a run-rate basis as the costs are steady and recurring in nature.

6.7 Links to quality

Each discussion of linkages between expenditure and quality includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment

More detail on synergies between projects and programmes, and capex and opex trade-offs can be found in the Investment Summary of Our Fibre Plans under the heading 'linkages, synergies and trade offs'.

Table 6.1: Links between Network Opex and our quality dimensions



Dimension(s)	Area	Strength	Pace
Performance	**Network | network operations** Our network operating centre (NOC) monitors and manages network operation, including technical support and escalation.		
Performance	**Network | operating costs** Investment in capacity can impact power and cooling needs and increase the fibre access share of exchange space.		
Availability and faults	**Network | maintenance** Network maintenance directly addresses downtime through preventative (e.g. inspections) and reactive (e.g. repair and restoration) activities.		
Availability and faults	**Network | network operations** Our NOC monitors and manages network operation, including technical support and escalation.		
Customer service	**Network | all** Our fault-response work and network operations impact customer experience and satisfaction.		

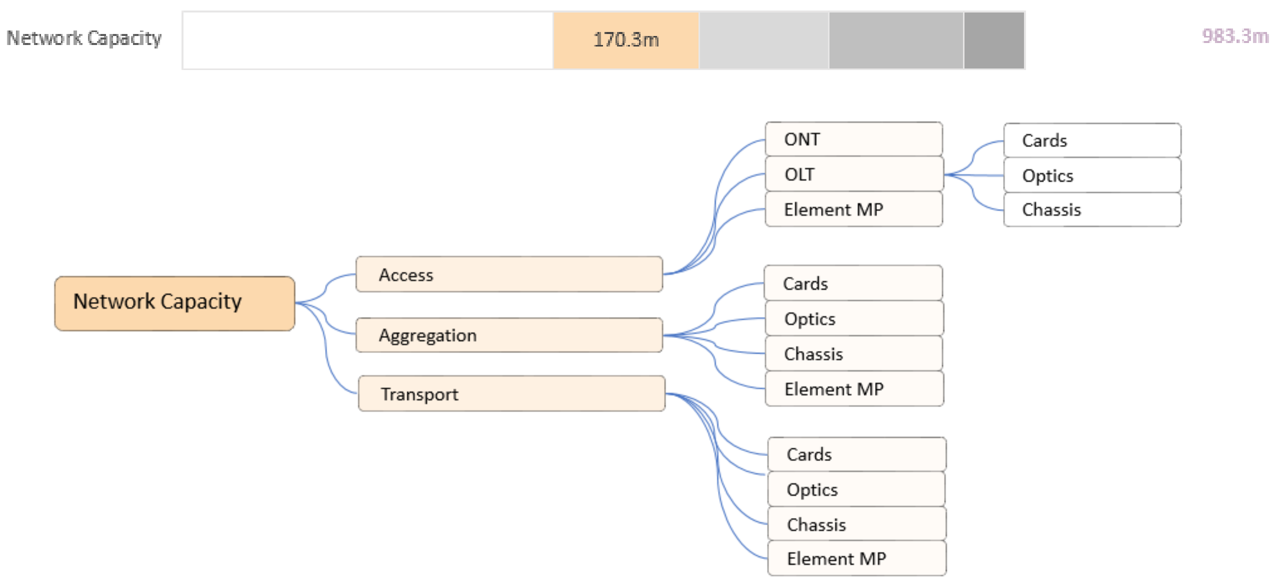
7.0 Network Capacity

Describes Network Capacity capital expenditure (capex) category. It covers ongoing investment in network electronics and associated systems to optimise for capacity growth and lifecycle requirements.

7.0 Network Capacity

Figure 7.1: Network Capacity expenditure as a proportion of total first regulatory period (RP1) capex

Network Capacity capex



7.1 Introduction

Network Capacity is a measure of the amount of data electronic devices can connect, aggregate and transport through the network. We use network electronics to decode and aggregate data and provide a network connection from consumers to a handover point in network buildings. Our aim is to send data or traffic through the network quickly and efficiently to provide high-quality broadband services.

Our network electronics require hardware and software components. Hardware relates to the physical device we use to provide network services. Operating software runs on each device and our element management platforms manage the flow of information and user interaction with the network elements.

In addition to our live assets, we invest in environments that replicate the network and are used to test and develop technologies without impacting our customers.

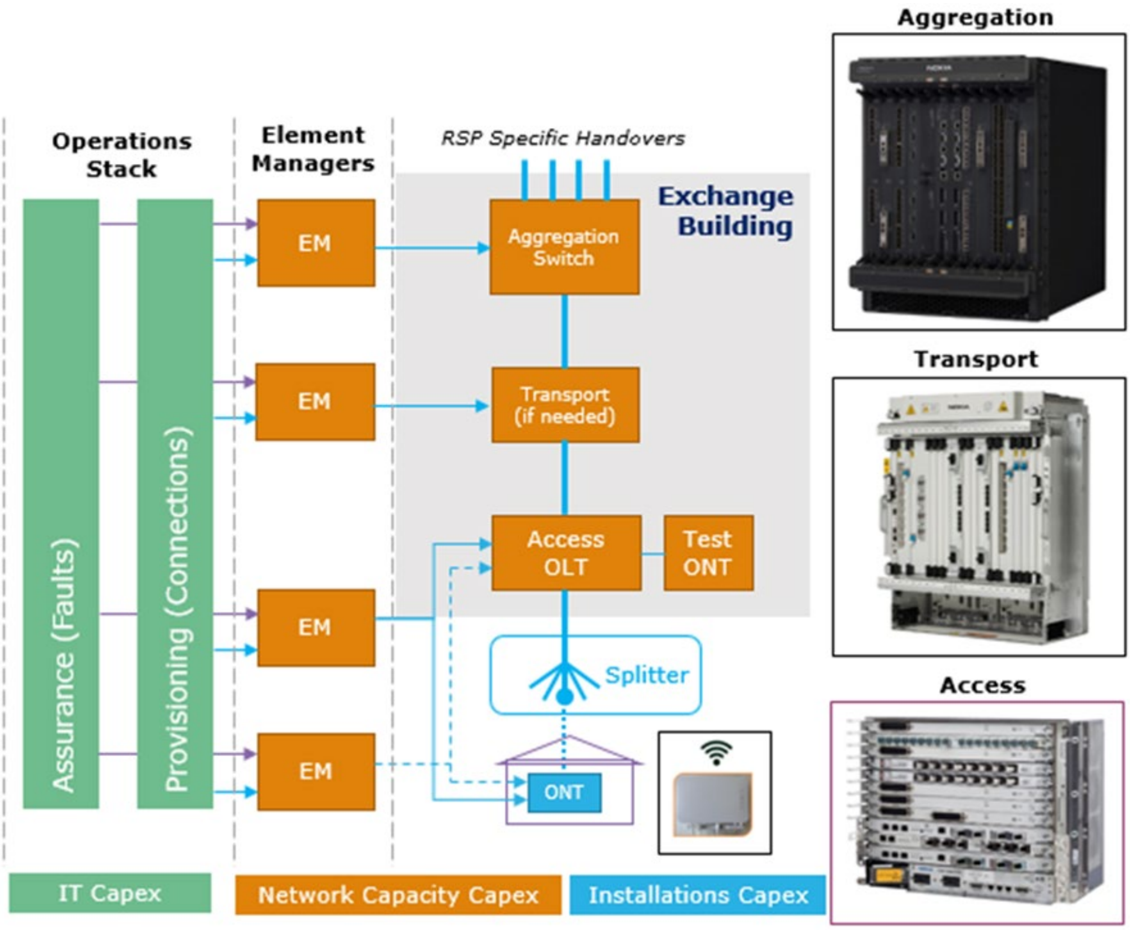
Expenditure in network electronics reflects the pace at which technology evolves. This drives a short asset lifecycle and the need to add capacity to the network to provide a congestion-free service. It is highly demand driven.

There are three types of network electronics; access, aggregation and transport. These are our three expenditure sub-categories.

Although the three types of network electronics have different functions, they are built with similar components:

- **chassis/shelves** are the physical enclosures mounted into an equipment rack in the exchange that other components are installed into
- **controller cards** are installed into chassis/shelf slots, they determine what functions can be supported
- **line cards** are installed into chassis/shelf slots to provide ports for capacity and/or specific functions
- **pluggable optics** are the interface between fibre and network electronics. They convert electrical signals from the port in the line card into an optical signal.

Figure 7.2: Network electronic assets



7.2 Access

Access electronics enable consumer connections to the fibre network. They include two types of hardware, Optical Network Terminals (ONTs) and Optical Line Terminals (OLTs) and the software which manages the configuration and alarms called an Element Management Platform.

ONTs are installed in consumer premises to provide new connections to the fibre network. Investment in new ONTs is driven by customer connections and allocated to installations in full. Expenditure to replace faulty ONTs and those reaching the end of their lifecycle is allocated to network capacity. ONTs are managed by the same processes as the other network electronics.

OLTs provide fibre connections from transport to access routes and enable broadband services using Gigabit-enabled Passive Optical Network (GPON) ports. They are located in network buildings or cabinets. Fibre cables connected at the GPON ports communicate via passive splitters with up to 16 ONTs. This allows up to 2,048 connections per shelf (8 line cards, 16 ports, 16 splits). Although shelf capacity allows for a maximum of 2,048 connections, typically utilisation is round 1,500 connections due to geographic density.

We use element management platforms to communicate with electronic devices in the network. They manage the functions and capabilities of the network elements, allowing services to be provided to consumers. They also perform routine audits to determine the operational condition of the elements, which informs asset management processes. For example, ONTs report quality statistics every 15 minutes and contact the element manager immediately if they have a state change (e.g. if the power is turned off). This generates a huge amount of data, managed by our IT systems.

We have over 800,000 ONTs deployed. Some of the first generation ONTs are coming to the end of their lifecycle. Currently, spend for replacement ONTs is allocated to Installations. When we transition to the management phase, we expect replacement ONTs to be managed in the same way as the other network electronics.

We tend to replace our network electronics before they break because of the pace of change in technology.

Chassis/shelves have the longest life of hardware at 8-12 years. We have over 1,000[1] OLT chassis deployed. These house nearly 2,000 controller cards, which have a 5-year lifespan and tend to be replaced once during the life of the chassis they are installed into. Our OLTs house nearly 8,000 line cards, which have a similar life to controller cards of 5-8 years. Our OLTs house over 100,000 pluggable optics; they are our most common component. Their lifespan is usually dictated by compatibility with line cards.

7.3 Aggregation

Aggregation technology provides points of interconnect for Retail Service Providers (RSPs).

Aggregation switches are the hardware and service configuration capabilities that deliver broadband services. Switches direct the traffic that is received onto our network from retail service providers to the correct access network to provide a connection to a consumer. The network aggregates many access services onto retail service provider handover links. This process is managed by an element management platform.

As network traffic grows, we increase the capacity of the network to ensure that it remains uncongested and reliable. This is part of our contractual commitment to provide a congestion-free network.

We have nearly 80 aggregation chassis deployed, housing around 300 controller cards, 600 line cards and over 5,000 pluggable optics.

7.4 Transport

The optical transport network is the 'backbone' of our network, transporting large amounts of data over medium to long distances. Traffic carried includes broadband uplinks[2] for our access electronics, inter-nodal links for our aggregation switches, mobile linking and a range of other legacy services. We note that not all of our services are regulated Fixed Fibre Line Access services (FFLAS) and shared transport expenditure is addressed by cost allocation.

Transport assets have shelves or racks where a variety of cards are placed to build transmission links for core, regional and access routes. We build transmission links with spare channels to provide capacity scaling as needed using traffic cards and pluggable optics. Expenditure on channel expansion is needed when all the channels are consumed on a specific transmission link.

We use highly scalable transport technology that can provide significant data capacity while maintaining low latency and low bit error rates. It enables a range of real-time applications that our consumers expect, such as online gaming and streaming services. Currently, the interfaces on our transport devices support a range of capacity rates including 100 Gbps data throughput and are resilient to maximise service availability.

We have deployed over 500 transport chassis, which house around 1,200 control cards, 2,500 line cards and over 8,500 pluggable optics.

7.5 Managing network capacity

7.5.1 Asset management objectives

Expenditure in network electronics is focused on maintaining a reliable and congestion-free network, which enables an uninterrupted network service for consumers. We have instigated several network performance initiatives to contribute to meeting network performance objectives:

- maintain hardware spares to allow timely replacement of failed electronics
- maintain continuous manufacturer support for element management platforms, primarily through regular upgrades

[1] Asset populations at June 2020.
[2] The link between the OLT and the aggregation switch it is connected to.

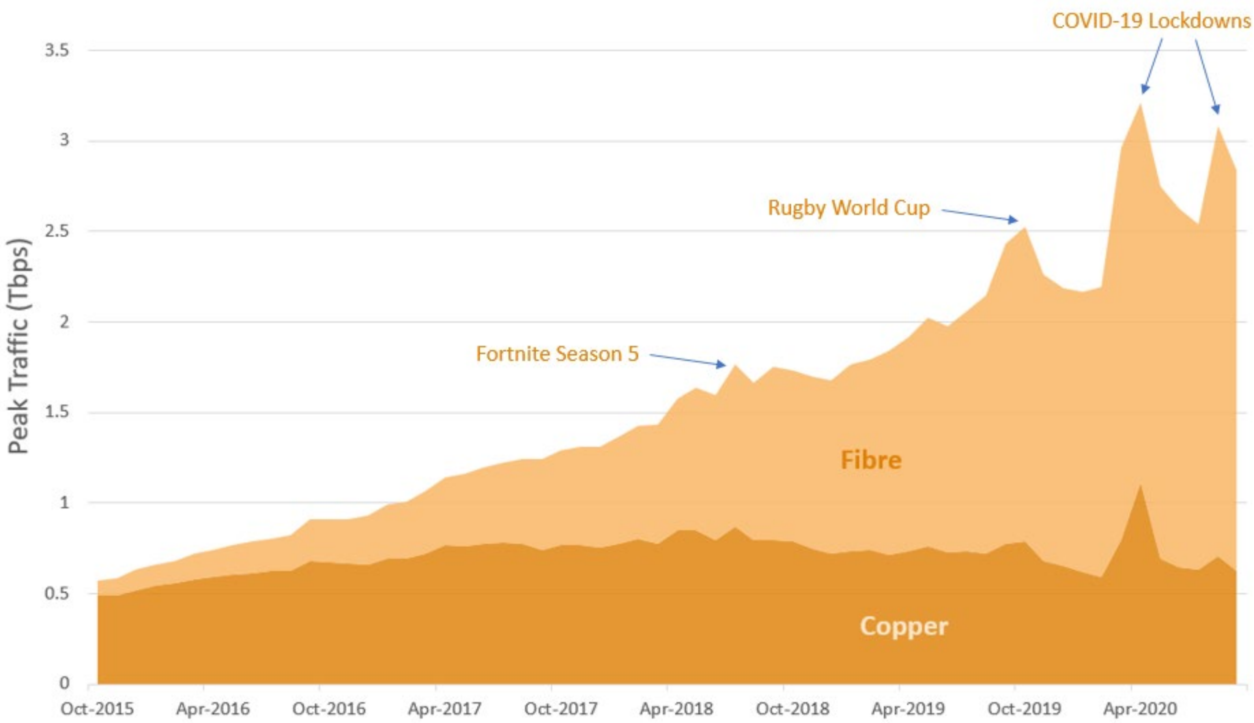
- replace hardware based on technological obsolescence to provide customers with access to faster network services
- support rollout of new, faster hardware by ensuring element management platforms are kept up to date
- invest in equipment with proven high mean time between failures
- optimise replacement timing for hardware and software to ensure software remains in support and enables the benefits of newer, faster hardware to be recognised
- proactively replace equipment in a manner that avoids age related faults and facilitates the introduction of new technology
- develop our skills, knowledge, competencies, systems and tools to support achievement of our service and cost-performance objectives
- monitor network for capacity and increase as required to maintain congestion-free status
- monitor service performance to levels defined in the Network Infrastructure Project Agreement (NIPA), e.g. frame delay, and remediate any issues causing systemic failure against those levels
- introduce new technology to provide cost efficient capability to cope with continued traffic growth.

7.5.2 Lifecycle management

We manage network capacity assets through the delivery lifecycle stages: Planning, delivery, maintain and operate and retire. This requires capex for:

- **growth** – investment to enable new connections and meet traffic growth
- **expand** – investment to expand the footprint of the network
- **enhance** – investment to improve the service. This includes investment to deliver new products or capabilities or to reduce risk by increasing resilience
- **sustain** – investment aimed at keeping the network operating at current standards. This includes replacing end-of-life assets and investment to maintain compliance.

Figure 7.3: Growth in bandwidth over time showing spikes relating to specific events



Our capex for network electronics is mainly driven by growth in the number of customers connected to the network and amount of data (traffic) moved through the network.

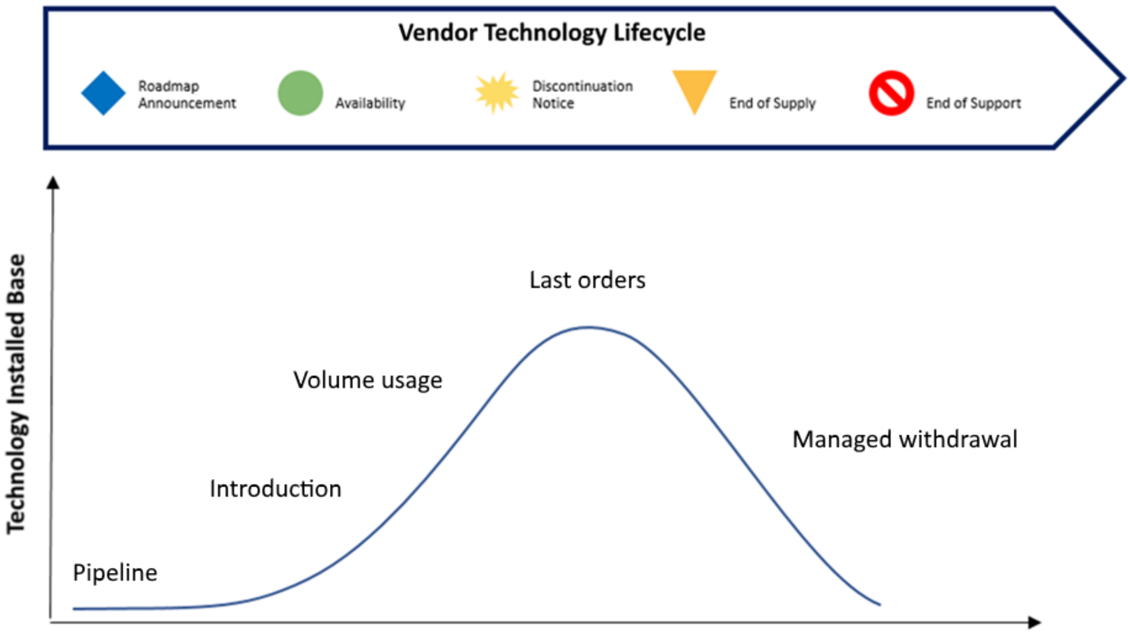
Growth in consumer connections requires investment in OLTs to increase port capacity and ONTs to enable each connection.

Traffic growth is driven by new connections and increasing Average Throughput Per User (ATPU). We expect ATPU to grow from 2.8 Mbps at the end of 2020 to 7.2 Mbps by the end of 2024. This expectation is the dominant driver for our expenditure on aggregation and transport electronics during RP1. To keep up with this growth, we increase network capacity by deploying network electronic devices enabled with the latest technology.

In recent years, there has been a growing number of drivers of bandwidth demand. These include software releases of online games such as Fortnite, streaming of sporting events like the rugby world cup and the increase in video conferencing that resulted from the COVID-19 lockdown. This trend means that we need to ensure there is adequate head room. To do this we build network capacity in advance of growth to ensure that services remain available.

Network technology progresses through the product lifecycle very quickly, driven by customer demand and competition. Evolving technologies force us to develop products faster, which shortens the product lifecycle. Often upgrades by our suppliers require us to upgrade our own software or hardware.

Figure 7.4: Vendor technology lifecycle



Our network electronic assets are relatively young as they were deployed as part of the Ultra-Fast Broadband (UFB) initiative. Rapid technological development means that the assets often become obsolete before their design lives are reached. Asset replacement is driven by optimisation and obsolescence, which results in a short asset life of 2-15 years. Consequently, sustain capex for replacing assets is low.

Our focus is on managing the purchase of technologies as efficiently as possible. New technology tends to be expensive, but bulk purchases can prove cost effective over time, due to upgraded capabilities.

We maintain software within support and introduce new capability through periodic upgrades. Element management platform versions are generally supported by the manufacturer for two years as part of the initial purchase, after which extended support must be procured. This ensures we remain in support and can deploy newer, faster optical network electronics as needed. At times the upgrade may be deferred beyond the two years where a step change in the performance of new electronics is anticipated.

As vendors reduce support for technologies, replacement and maintenance costs increase and we switch to alternative technology. This ensures that capacity is added ahead of growth to sustain congestion-free performance and that technologies are optimised to retain support, add features and enable cost-effective growth.

Table 7.1: Management of the technology lifecycle

Stage	Description	Actions
Pipeline	New technologies available to solve new problems or support growth more cost effectively than existing technologies	Match requirements with capabilities of available technology Undertake business case analysis and feasibility
Introduction	Specific technologies chosen and introduced for use in the network including integration with other network and IT systems	Procurement Capability introduction project to onboard to Chorus network, systems and operational roles
Volume usage	Build and grow the network using network equipment	Capacity planning Build programme planning Manage in-life upgrades as required (software)
Last orders	Vendors announce the end of sale and manufacture of equipment	Last time purchase of current technology Planning for network equipment retirement/replacement
Managed withdrawal	Vendors no longer offer technical support, repair services or capability with new software	Remove/retire network Migrate or remove services Pipeline review for replacement technology begins

7.5.3 Risk management

Environmental/physical risk is low for network electronics as they are contained in secure buildings where air quality and temperature are controlled. The real-time monitoring of network electronic devices means that we know immediately when a fault happens.

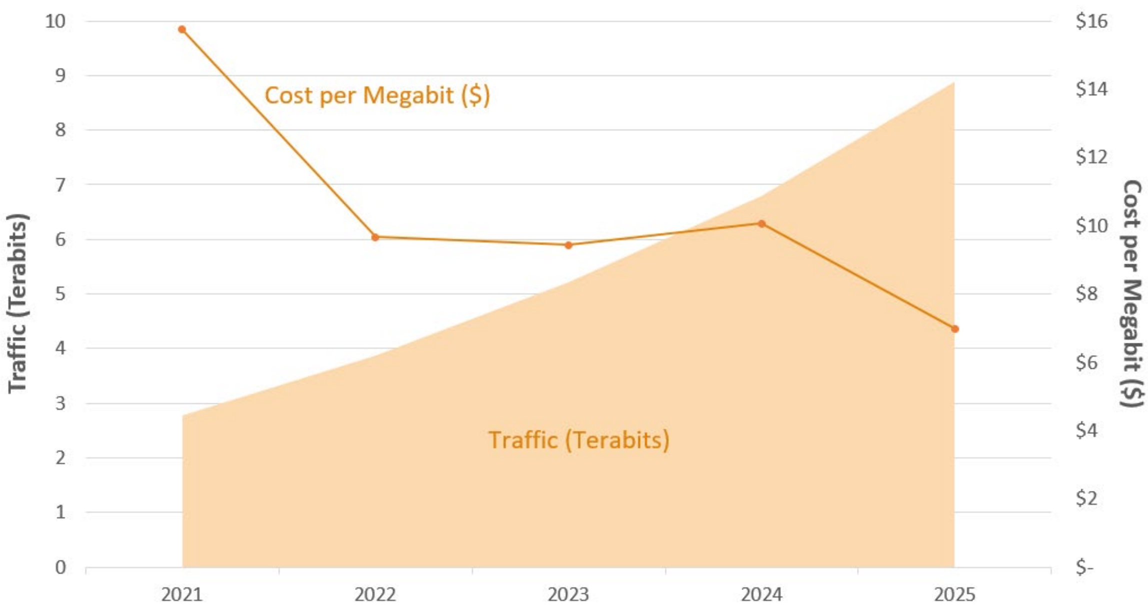
Access electronics are critical to the fibre network and failure or unavailability have a high impact on performance. To mitigate this risk, we specify minimum design standards to ensure that the network is reliable. OLTs require electricity to operate and for cooling. We mitigate the risk of failure due to power cuts by providing back-up battery power that can provide power for at least 24 hours.

The greatest risk with our aggregation assets is related to updates from our vendors, which can impact the interoperability of the electronic devices. We manage this risk through regular communication with our vendors.

Transport links are critical to the delivery of network services. To reduce risk of failure we have established detailed architectural and site requirements to provide resilience.

We mitigate the risk of hardware and software failures by extensive testing in our laboratory environments before deployment.

Figure 7.5: Cost of investment in Network Capacity[3]



7.6 Our plans

In the past our investment in all three sub-categories has been driven by UFB coverage and connecting new customers. Going forward there are three key drivers of capex: traffic growth, lifecycle renewals and new product sets. Capex spend in network electronics can have multiple benefits. For example, lifecycle renewal provides benefits through new capability for products, larger capacity for growth and continued vendor support. When we invest in new technology, we get step changes in capacity, which means capex does not linearly follow traffic increases.

Our expenditure on network electronics during RP1 is designed to provide adequate network capacity and make the network faster and more reliable. We also need to continue investment in new technology to improve services for consumers.

If we continue to invest in existing technology, the exponential growth in traffic demand exposes us to significant increased capex. We are introducing next generation switches and their cards to enable the latest functionality. These provide higher capacity per unit cost, which limits the rate of increase in future spending (see figure 7.5).

We have some specific plans for our network capacity sub-categories.

[3] This graph is based on unallocated aggregation numbers by financial year but is indicative across Network Capacity.

7.6.1 Access

The final stages of the UFB2/2+ build will require expenditure for new equipment, including OLT shelves and line cards. Network electronics installed at the beginning of the UFB build are nearly ten years old and coming toward the end of their lifecycle. This will require investment in replacement OLT ports. We are planning this lifecycle investment for 2022 and 2023. These replacement cards are newer technology, which can also support Hyperfibre connection growth.

Once we have deployed these cards, there will be a large base of Hyperfibre capable cards in the network, which will result in limited additional line card growth in 2024. [

Chorus CI]. Continued growth in throughput will start to cause individual uplinks to expire and need upgrading.

7.6.2 Aggregation

Our most significant expenditure in aggregation is to ensure that the network remains congestion-free. This means securing technology that can meet growing traffic demand, including catering for Hyperfibre. In 2020, a new family of high-density aggregation switches and cards were introduced. These devices will provide excess network capacity, which will be consumed over the coming years as demand grows. The phasing of lifecycle management will generate a slight increase in spend from 2023.

7.6.3 Transport

Our plans for transport include the investment required for the final part of the UFB build. We are also planning to grow the capacity of regional and core routes for layer 2 aggregation. We are expecting to see growth in the uptake of Hyperfibre and are planning on upgrading our transport links to provide capacity for these services. This will result in an increase in spending in 2023. Finally, we will continue to replace assets ahead of their end of life as part of our usual lifecycle management and have plans to increase diversity through some secondary transport paths.

7.7 Forecast expenditure

During the UFB build our expenditure on network capacity was relatively constant as we installed network electronics ahead of installations. Network Capacity expenditure related to build and connection activity peaked in 2016 and our expenditure has fallen as a result. During RP1 our spending is expected to increase to keep pace with the growth in connections and network traffic, as well as being driven by the age of equipment requiring lifecycle replacement. Our spending on access electronics is expected to be lower in 2024 due to phasing of lifecycle upgrades in 2022-23. [

Chorus CI][4].

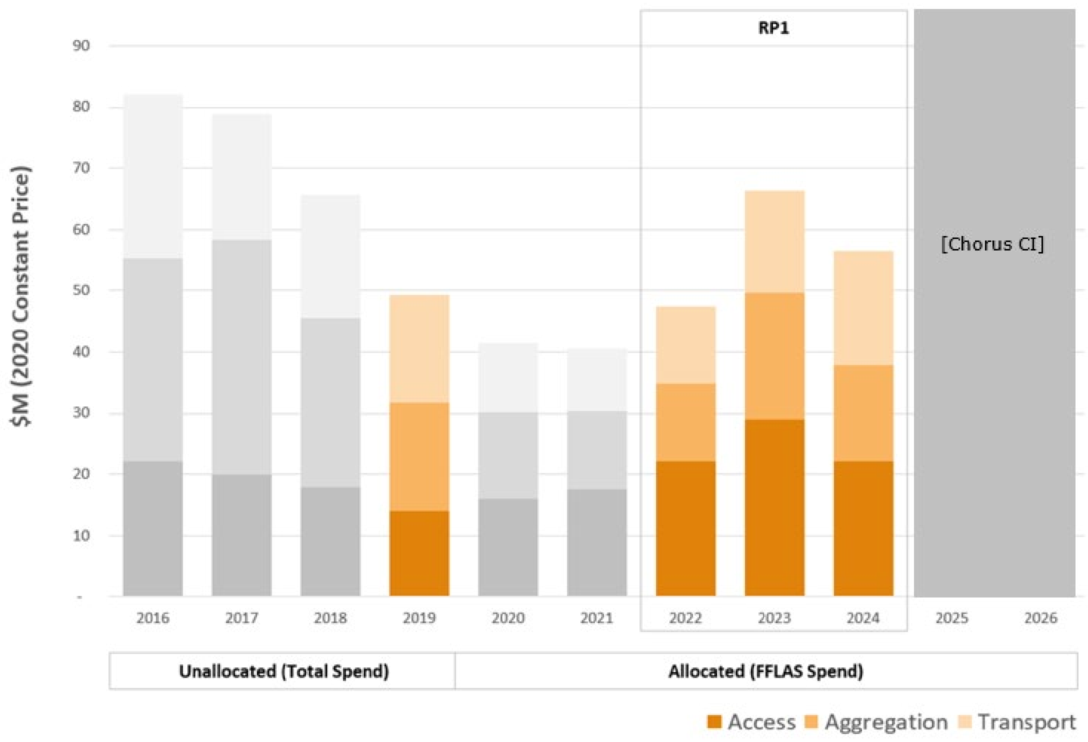
Our RP1 forecast expenditure for Network Capacity is $170.3 million.

We use the same forecasting approach for all our network capacity sub-categories. Expenditure on network electronics is driven by demand. Growth rates are forecast by our Network Technology team based on the connection forecasts developed by our Product Sales and Marketing team. A more complete description of our demand modelling can be found in the Demand report of Our Fibre Plans. We take the growth forecast and adjust for anticipated changes in consumer usage (caused by device technology evolution, high bandwidth applications), population mobility and planned sporting/cultural events etc.

[4] Our current business planning process only takes our detailed planning to 30 June 2025. To extend the forecast for calendar year 2025 and 2026 we have applied a high-level approach to project the forecast forward, with bottom-up and top-down sense checking to adjust for anticipated step changes.

Figure 7.6: RP1 expenditure for Network Capacity showing unallocated historical spending

Network Capacity capex



Our best view at present is that the current data growth trend will continue, at an average of 30-40% per year. We aim to maintain the capacity in the network 7-9 months ahead of anticipated demand to take account of one-off events and build lead-times.

Our capex forecasts use a volumetric price x quantity model, where price is the unit cost and quantity is our forecast of the volume of network electronics required to meet our plans

The cost of hardware, software and labour are defined in the contracts with our suppliers and service companies. Our core contractual agreement provides a three-year purchasing framework [

Chorus CI]. The current contract expires in December 2021. We have assumed [

Chorus CI].

As well as our contracts, we use other ad-hoc arrangements when necessary. These include 'bulk purchase' contracts that we use to achieve additional savings depending on the demand, discount opportunity and the available capex.

Quantities are derived from our forecasts for demand for connections and traffic growth, the expected replacement cycle due to the age of existing assets and a forecast rollout of new Chorus and vendor products.

We need to make several assumptions as part of forecasting. This creates some risk relating to the uncertainty of our forecasts:

- the most significant assumption in our forecast is that network traffic will continue to grow at the historical rate. This is uncertain. If network traffic grows at a higher rate than we have estimated, we will need to spend more on network electronics to keep the network uncongested
- we are exposed to unfavourable changes in exchange rates because core vendor pricing is in US dollars. We use derivative financial instruments to reduce our exposure to this
- our forecasts are based on unit costs outlined in our core supplier contracts. These are due for renewal

just before the regulatory period begins and may change

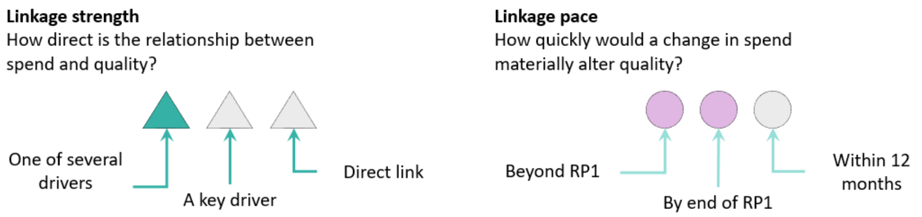
- our costs are partially driven by specific programmes, such as Hyperfibre. The uptake of future products is based on the behaviour of consumers and is inherently uncertain
- our assumptions about asset lifespan are based on historical products, but new products may have different lifespans. However, we tend to replace our equipment ahead of its end of life due to demand growth requiring us to upgrade to higher capacity equipment.

7.8 Links to quality

Each discussion of linkages between expenditure and quality includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment.

More detail on synergies between projects and programmes, and capex and opex trade-offs can be found in the Investment Summary of Our Fibre Plans under the heading 'linkages, synergies and trade offs'.

Table 7.2: Links between Network Capacity and our quality dimensions



Dimension(s)	Area	Strength	Pace
Performance	**Network capacity | all** We manage aggregation port utilisation through ongoing aggregation Network Capacity investment. A major change in RSP points of interconnection would also shift aggregation port utilisation patterns. Aggregation capacity investment has knock-on impact on transport needs. We invest in new transport links or link capacity to stay ahead of demand. Our access network is designed to minimise the need for physical reconfiguration. We stay ahead of bandwidth growth through technology investment. We will sustain investment to meet growing demand as connections grow and as ATPU increases. Even without bandwidth growth, we would invest for lifecycle (reliability and vendor support) and product evolution.		
Availability and faults	**Network capacity | all** The age, built (or configured) quality and capacity of our network electronics influences layer two reliability. We build in a certain amount of duplication in high customer concentration areas to protect services. Investing in non-production environments allows us to test changes to give confidence they will be delivered as seamlessly as possible into the live network.		

Table 7.2 continued

Dimension	Area	Strength	Pace
Customer service	**Network capacity | all** Our investment in network capacity ensures the performance of our network supports customer satisfaction.		
Switching	**Network Capacity | all** There is a connection with market share of RSPs. Switching could require new ports for different RSPs to manage their demand.		
Provisioning	**Network capacity | access and aggregation** Network management systems are needed to facilitate provisioning. Sometimes provisioning involves providing new access coverage or capacity.		

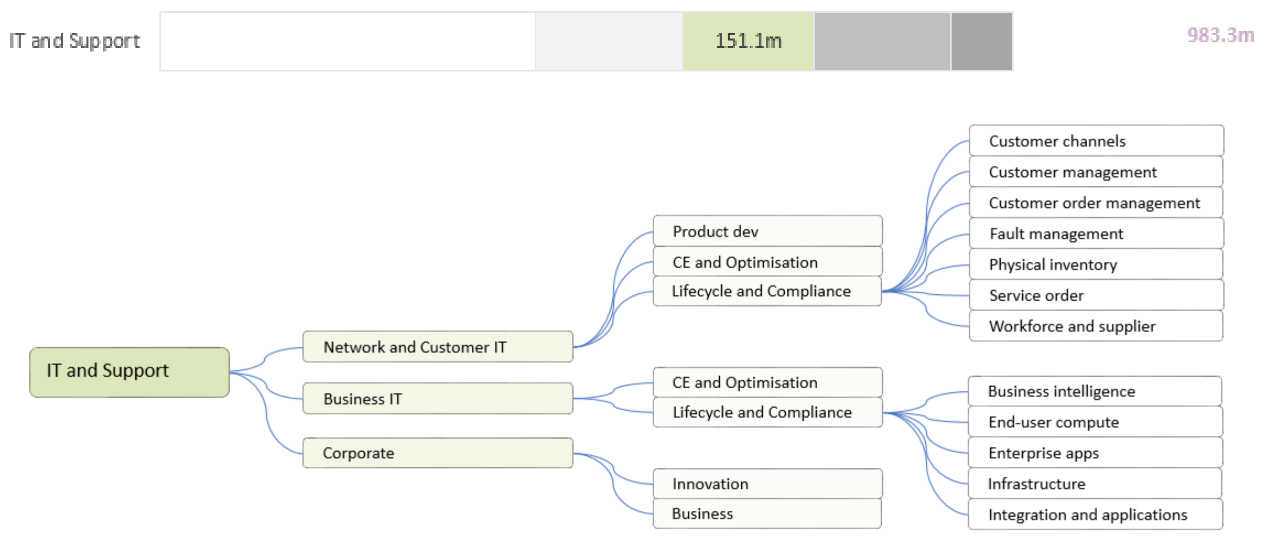
8.0 IT and Support

Describes IT and Support capital expenditure (capex) category. It covers investment in our information technology systems, plus corporate opex. Corporate capex includes our longer horizon product development to meet future consumer needs.

8.0 IT and Support

Figure 8.1: IT and Support expenditure as a proportion of total first regulatory period (RP1) capex

IT and Support capex



8.1 Introduction

This chapter is predominantly focused on IT expenditure, which is broken into two sub-categories, network and customer IT and business IT. It also describes our regulatory sub-category of corporate expenditure.

We define an IT asset as any information, software or hardware we use for our business activities. We have over 100 IT systems that enable us to deliver network services and manage our day to day business activities.

Our IT systems are broken down into several domains that serve either:

- **network and customer** – systems and platforms that help us run the network and interact with our customers
- **business** – systems and platforms needed for our day to day business activities.

We manage IT capital expenditure consistently throughout the business. Our third-level expenditure categories for IT are related to how we manage our IT expenditure:

- product development
- customer experience and optimisation
- lifecycle and compliance.

In this chapter we explain our overarching IT management approach as that is how our expenditure is grouped. We then discuss our IT systems at the domain level for both network and customer IT and business IT, describing systems and platforms that perform specific tasks. We introduce our corporate sub-category. Finally, we describe our plans, expenditure forecasts and links to quality.

8.2 Managing IT expenditure

We manage our IT investments through three categories:

- **product development** – investment to develop new products or product enhancements to improve our fibre broadband services for consumers. This category only relates to the network and customer IT domain
- **customer experience and optimisation** – investment in platforms and systems to improve our management of, and our interactions with, our customers, to optimise our internal business processes, support our customers and manage our network. Customer experience and optimisation relates to both network and customer IT and business IT domains

- **IT lifecycle and compliance** – the management of current IT systems through their lifecycle, from planning to replacement. IT lifecycle and compliance relates to both network and customer IT and business IT domains.

To ensure that our IT investments are prudent we align with industry best practice by:

- ensuring governance is in place across our programmes with accountable executives for delivery and outcomes
- tracking capital through governance processes including Chorus Capital Council (CCC) and the quarterly capex review
- using Independent Quality Assurance (IQA) processes for large and complex investments
- applying the Chief Technology Office (CTO) risk management framework for all investments
- using peer review for specification and design projects
- seeking feedback through our customer consultation processes to help inform our product roadmaps.

8.2.1 Product development

Our product development capex is focused solely on the network and customer IT domains. Broadband technology is constantly evolving. Our Product, Sales and Marketing (PSM) team is responsible for developing new products to meet the needs of our customers.

When planning for product development, we review the connection volumes and revenue that result from changes in IT investment. We look at the ease of use of our products by our customers, including the uptake of digital channels and movement in key operational metrics like cancellations and errors.

The needs of our customers are changing over time. We are focused on understanding their needs and those of consumers. We use our product management system, involving considerable customer engagement and consumer research to do this. The key phases of our customer engagement in product development are explained in the Engagement report of Our Fibre Plans.

Part of our product development involves an internal review to test the feasibility of the proposed product initiatives. This is to ensure initiatives can be delivered efficiently and are financially viable. We prioritise initiatives based on industry consultation, feasibility, financial viability (cost versus benefits) and an assessment of the systems that will be impacted.

The level of investment required to meet consumer and Retail Service Provider (RSP) product requirements is difficult to predict, in part because they are driven by RSPs. As a result, future products can only be identified, with certainty, when a scope is agreed. Due to this limitation, we do not define explicit initiatives beyond 12 to 18 months. Instead, we assume an overall work volume based on historical delivery and expected requirements.

8.2.2 Customer experience and optimisation

Our customer experience and optimisation expenditure is for IT systems and platforms used to deliver network services to consumers, customers and staff. This covers both network and customer IT and business IT domains.

We survey our customers, consumers and new property developers to understand the quality and value of changes delivered.

We plan to optimise the experience of our customers by:

- integrating and automating processes to reduce human overhead, intervention and errors
- improving information quality to provide faster processes and better insight for decision making.

Part of our investment is in near-real-time data and analytical tools, and the IT infrastructure needed to support them. These tools provide customer insights into product development, identify new business opportunities for data management, including marketing insights to improve engagement with customers, provide early warnings about deployment and service problems, and track our interactions with customers to ensure we are delivering a consistent experience.

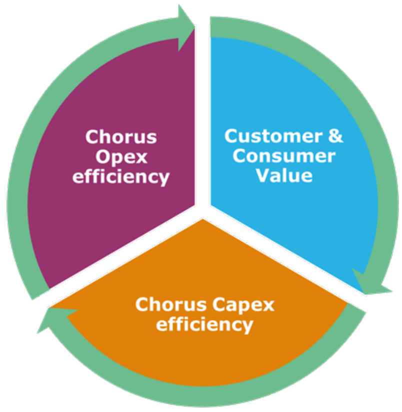
Our IT investments increase our efficiency and benefit our customers, suppliers and our internal operations but the nature of our investments means that it is difficult to quantify benefits over long timeframes. Three benefits which we consider as part of our planning are (Figure 8.2):

- **opex efficiency** – developing new IT systems or improving existing IT capability to reduce or avoid operational costs. For example, improving and automating our processes to reduce human overhead, intervention and errors

- **customer and consumer value** – developing new IT systems or improving existing IT capabilities to digitise and automate business process to increase efficiency. For example, improving processes and capability to deal with emerging issues that impact RSP and consumer experience (e.g. detecting when Optical Network Terminals (ONTs) are powered off, changing our fibre fulfilment processes to connect a customer in a single day, using social media channels to respond to consumer feedback)
- **capex efficiency** – investment in IT capabilities to make our build, installations and maintenance activities more efficient. For example, establishing data and analytics, and machine learning capability to support investment decisions for proactive network maintenance.

Any cost benefits that result from IT investments are reviewed and accepted by finance and budgets are altered accordingly. Expenditure on customer experience and optimisation is expected to continue in line with historical trends.

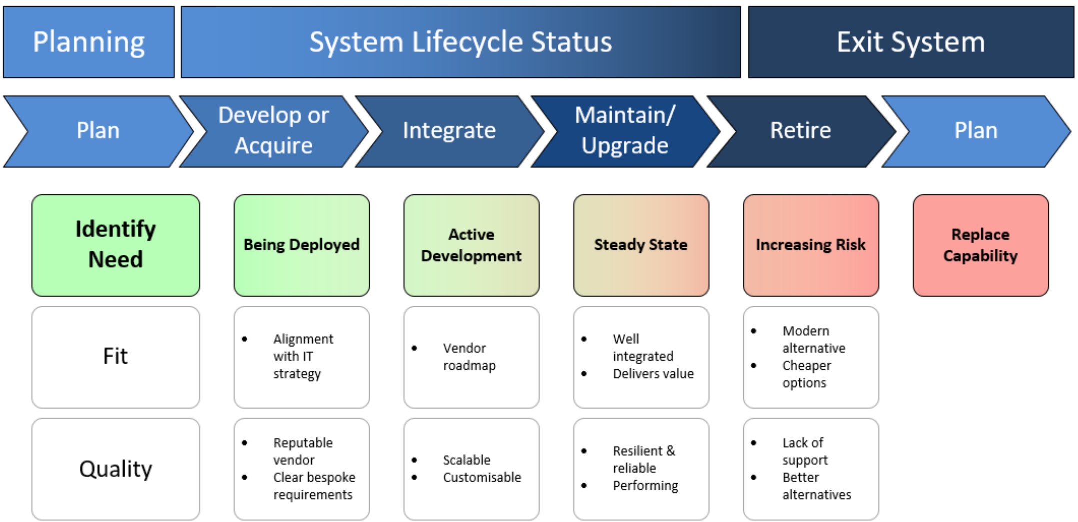
Figure 8.2: IT planning wheel of benefits



8.2.3 IT Lifecycle and compliance

Our lifecycle, risk and compliance investments ensure the continued and effective operation of assets (Figure 8.3). This capex covers both network and customer IT and business IT. We track the attributes of assets that require upgrade or replacement over time, as well as working with suppliers to understand product roadmaps.

Figure 8.3: IT asset lifecycle



We measure the quality of service provided across all IT functions based on several metrics (service level agreements) including the availability of support of key software and hardware, the cost of support and the exit and consolidation of legacy equipment and suppliers. Compliance investments are required to meet legal requirements (like health and safety) and board-mandated risk tolerances. For example, investments required to improve our cyber-security.

The primary driver for lifecycle investment is risk management. We use a risk management framework to help prioritise IT investment. Risk is measured according to the impact and likelihood of systems failures and investment is targeted at systems with a high likelihood of failure or where failure would have catastrophic impact.

We have defined tier one processes which are critical for the delivery of our services. Our board has a low tolerance for downtime on systems and platforms supporting these processes. The systems and platforms that support tier one processes require investment to ensure technology is robust and reliable.

Our tier one processes are:

- a customer's ability to contact us
- our ability to take an order and connect a customer
- our ability to take and resolve a fault reported by a customer.

To mitigate risk in the IT space we have a continuous programme of lifecycle upgrades and capacity expansions to our physical compute equipment and the software that runs IT infrastructure. We have duplicated infrastructure across datacentres. If one of the datacentres goes off-line, data is not lost. We have support and incident arrangements in place to ensure that lost data is restored quickly.

Historically, our lifecycle investments have been dominated by our move to standalone systems following separation from Spark. Most of this work is now complete and as our standalone systems mature, we expect increased opportunity for system and process optimisation.

8.3 Network and customer IT

This section explains our network and customer IT domains that are managed through our lifecycle and compliance approach. For an explanation of how we manage product development and customer experience and optimisation see the first section in this chapter.

8.3.1 Customer channels

Our customer channel systems provide for consumer and RSP access and system integration for core business processes, including customer order management, fault management and billing functions.

These systems include websites and integration points that allow consumers, RSPs and approved third parties to gain access to our data, view product information, place orders, report issues and interact with the billing and payments process.

The customer channel systems are vital in:

- network availability and feasibility
- provisioning of both copper and fibre services
- fault management process for customer faults, network damage, service restoration and network/service status
- billing interactions
- information sharing e.g. products and services.

8.3.2 Customer management

Our customer management systems focus on customer relationship management functions, and they:

- capture all interactions with our customers so we can understand and manage these relationships effectively
- track the workflow of customer interactions by interfacing with phone, email and web-based channels
- manage sales transactions from opportunity through to order and bill
- provide marketing capability for campaigns and communications to our consumers.

8.3.3 Customer order management

Customer Order Management (COM) systems manage the process of taking requests from customers and organising, tracking, and fulfilling them. They perform the administration of all business processes related to orders for our copper and fibre services.

The COM systems are vital in:

- network/service availability and feasibility
- providing information for service restoration and network protection.

COM systems are generally split by copper/fibre. Copper products and services are legacy systems hosted in Spark, whereas fibre systems are generally hosted within our datacentres. Fibre orders which require a technician to visit a customer site currently rely on the legacy system in Spark for processing orders for field tasks. We are working towards developing systems to bring these services in-house.

8.3.4 Fault management

Fault management is a group of systems that support the diagnosis, management and resolution of consumer faults on behalf of RSPs. These systems return network service to consumers, in the event of a fault or service degradation.

The fault management systems are vital in:

- providing a means for RSPs to do initial fault diagnosis, triage and fault reporting
- the management of fault tickets, including scheduling appointments for technicians to carry out repair and feedback when repairs are complete
- passing network related tickets of work to our Network Operations Centre (NOC)
- assembly of tickets of work for Field Service Providers (FSPs) to enable restoration of services at consumer premises.

8.3.5 Physical inventory management

Our physical inventory management domain is comprised of two distinct areas: physical network inventory and location. This domain allows us to understand where our physical network is located (e.g. cables, ducts, poles and the connectivity back to exchanges) and the connection status of addresses and locations. This enables services to be provisioned by our technicians or repaired when there is a fault or service degradation.

The Physical Network Inventory (PNI) systems hold the theoretical model of our physical networks. This includes representation of the network's duct, copper, fibre, poles, and manholes. The PNI systems are vital in:

- planning network capacity
- network design and build
- network availability and feasibility
- provisioning of network services
- fault management processes for service restoration and network protection
- asset management.

We have Geospatial Inventory Systems (GIS) and relational database inventory systems. These allow us to plan our network against the model of the existing network, create financial models based on our physical assets, and provision and repair our network.

Our location systems and processes contain both logical and physical representations of location at an address level. Customers order their service by location, which is directly linked to the network records. Location information is shared across several systems in various formats.

8.3.6 Service order management

Service Order Management (SOM) systems contain resource and inventory information for our network services. RSPs use the information obtained from the SOM when they place an order, investigate a fault, or update their products. The systems allocate resources, such as capacity on exchange equipment and network routing information, to RSP orders, translating product offerings into service delivery.

The SOM systems provide two essential business roles:

- **resource management** – the SOM acts to co-ordinate and allocate our fixed asset resources so that a customer order can be broken-down into the discrete elements required to connect a consumer and deliver network services from the RSP to our network
- **inventory records** – the SOM is the master inventory for our electronic configurations and profiles which are used with resources to create network services, e.g. how the broadband connection from an individual consumer is routed across the network to the allocated RSP handover point and what bandwidth/speed has been assigned.

The information is requested and presented through the SOM, as part of workflow processing, reporting or via specific Application Programme Interface (API) calls. The SOM bridges the technical service delivery across our network and translates a product offer into specific outcomes.

8.3.7 Workforce management and supplier gateway

Our workforce management and supplier gateway systems distribute work to our FSPs so that field technicians can install or repair faults and restore network service. The systems also manage visibility of FSP schedules so that field resources can be assigned to appointments and provide information back to RSPs on the status of jobs. Most of the systems are legacy (some are over 25 years old) and are in the process of being replaced.

All FSP work passes through these systems, therefore it is a critical component supporting our network services. These systems also have a role in providing reporting for payment and reconciliation for FSPs.

8.4 Business IT

This section explains our business IT domains that are managed through our lifecycle and compliance approach. For an explanation of how we manage customer experience and optimisation, that relates to business IT, see the first section in this chapter.

8.4.1 Business intelligence

Business intelligence is a process that transforms raw data into meaningful and useful information.

Our business intelligence systems can handle large amounts of information to help identify and develop new business opportunities and provide historical, current and predictive views of business operations.

Business intelligence systems have three components:

- **a data repository** – to gather and store data
- **analytical tools** – to analyse data, this includes machine learning capabilities
- **reporting tools** – to enable users to access data and visualise results.

8.4.2 End-user compute

End-user compute systems enable our staff to access business and operational support IT applications through computers and laptops. Applications include word processing, email, and video messaging. Expenditure on end-user compute includes the day to day IT equipment used by all our functional teams in our corporate offices.

The domain includes the following system categories:

- **desktop and application delivery -** unified communications and application delivery platforms which staff and contractors use to access our IT systems and applications
- **endpoint** - the physical devices such as screens and keyboards used by staff to access our IT systems and applications
- **other processes** – miscellaneous processes including user access management and provisioning, visitor registration kiosks
- **Microsoft services** – migrating from or maintaining on-premises Microsoft services to Microsoft 365.

As a result of COVID-19, there has been investment brought forward from FY2022 to FY2021 for the Virtual Desktop Infrastructure (VDI) systems used by staff in the office to allow for the increased requirement for video conferencing.

8.4.3 Enterprise applications

Enterprise applications are a group of systems that support the organisation at an enterprise level across various business units.

The domain includes the following system categories:

- **billing management** – systems that support the end to end billing process, e.g. disputes management, invoice generation and payment gateways
- **finance** – applications that support business functions such as finance and reporting
- **HR management** – systems that support our people and culture team and the human resources function, i.e. payroll, employee self-service
- **other** – systems that support the project management office and user access management.

8.4.4 Infrastructure

IT Infrastructure assets are the hardware systems supporting our applications. They include core inter-system connectivity, protection/security, computation and data storage. The bulk of these systems reside in datacentres. We use both physical and cloud-based infrastructure. Our dedicated infrastructure located in Spark datacentres is known as 'Chorus Island'.

The main components of IT Infrastructure are:

- data storage, for example of email
- the firewall, load balancing and security capabilities
- the core internal interconnect switching and routing of inter-system messaging
- the interconnection between our internal systems and all external parties
- the 'Chorus Island' infrastructure maintained in Spark datacentres
- the Chorus compute located in the cloud.

Licencing for use of software managing our datacentre equipment and various systems is continuously refreshed and kept up to date or replaced as appropriate for business as usual support or as required by project activity.

8.4.5 Integration and applications

The IT integration and applications systems connect or allow transfer of data between systems. They help us automate and streamline our processes.

The integration and applications domain provides several functions:

- we use over 100 IT applications, which are hosted on both physical and cloud servers. Integration platforms support the interconnectivity of these applications
- file transfer is used to transfer files between internal systems and to our contractors and suppliers
- contact centre telephony manages customer interactions and integrates with data sources.

8.5 Corporate

Our corporate capex sub-category includes accommodation, office equipment and ring-fenced capex to support longer horizon product investment.

We have a portfolio of leased corporate office locations across New Zealand[1]. There are four main office buildings (Auckland, Hamilton, Wellington, and Christchurch) as well as a customer experience lab in Auckland. The costs associated with refits, make good and office equipment are included within our corporate property capital expenditure.

Costs are driven by changes to our leases. The leases for these sites have remaining terms ranging from two to ten years depending on whether renewal options are taken.

We also accommodate a small number of staff (<30) in smaller regional satellite offices. These offices are located within our network buildings or space leased within a Spark exchange.

8.5.1 Innovation

As the UFB build programme nears completion and we transition into a new regulatory model, it is becoming increasingly important to leverage our assets and capabilities to meet the future needs of consumers.

Our investment builds capability and will create value in the following areas:

- longer horizon product development to evolve our fibre access services to meet future needs
- leveraging new and emerging technologies to improve fibre access services or reduce costs
- grow revenue streams that spread our fixed costs and help us sustain attractive fibre access pricing.

We manage this investment through our Chorus X programme. Through Chorus X, our innovation programme is focussed on management of opportunities through ideation, exploration, validation and commercialisation. It aims to incubate and accelerate innovative ideas to ensure they meet market need and drive desired benefits at scale. One recent example is our Hyperfibre product. When it is available to the market, it will be provided for in business as usual investment plans, as is the case for Hyperfibre in RP1. Until that point, ring-fenced funding allows early development to progress in a timely manner.

8.6 Our plans

8.6.1 Network and customer IT

Our planning for investments in network and customer IT is managed through our management categories.

During RP1 our investments in product development will be driven by RSPs looking to upgrade their products and to improve efficiency and consumer outcomes. To achieve this, we intend to improve and refine our product offerings and RSP support tools. This will

[1] Although leases are capex, we present them as opex in our proposal (in line with information request A28.1), as the cashflows are recurring and this avoids confusing spikes in the presentation of our capex caused by the NZ IFRS 16 treatment.

include the development of new products such as Artificial Intelligence (AI), automated transport, and real-time video streaming. Product development investment leads to new or improved systems or network services and we expect the number of products offered to consumers to grow as fibre connections increase.

Our customer experience and optimisation investments will be used to develop our systems with the aim of being more customer-centric to meet growing consumer and retailer needs. The increase in customer connections and bandwidth means that we need to develop solutions that can respond to emerging customer or volume-driven problems. Our customer experience and optimisation investments aim to automate or correct business processes to reduce labour costs and external costs. During RP1 we are planning to upgrade, consolidate or replace platforms to minimise or reduce licencing and other variable cost inputs (e.g. telephone, transaction fees).

Our lifecycle and compliance expenditure will fund several major software upgrades including:

- our SOM, which activates products on our fibre network
- the replacement of a major component of our fault management systems
- the middleware software supporting our fibre customer order manager that manages customer orders.

These software upgrades are essential to keep the network operating at current service levels.

8.6.2 Business IT

Our plans for business IT are managed through two of our management categories.

During RP1 our plans for customer experience and optimisation are to improve data integration between our systems, to support improved information workflow and to avoid data duplication. We are planning on using cloud-delivered applications, infrastructure and systems to optimise and improve the functionality, efficiency and usability of our business IT systems.

IT investment is an enabler of our shift from build to operate and our developing asset management capability. The Asset Management Consulting Limited (AMCL) capability improvement roadmap entails development and integration of asset information and asset management systems to improve asset management performance (cost, risk, service quality). These plans involve a combination of costs for people and systems. The work here will involve a mixture of upgrading and expanding capability of existing systems and investing in new systems, where necessary. Examples include:

- smart asset monitoring for our locations and equipment (buildings, cabinets and poles). This will increase the condition-based visibility of buildings and engineering facilities for proactive asset management
- improving our view of asset performance and lifecycle management to better understanding how our assets are performing over time including their failure rates and condition
- corporate and financial tools to better model various financial scenarios over longer periods of time.

Our plans for lifecycle and compliance expenditure include a capital purchase relicencing of our integration and API platforms which expires in 2021 and ongoing upgrades of our datacentre hardware.

8.6.3 Corporate

During RP1 our plans are to keep business-related corporate expenditure steady.

We plan to use our innovation funding to develop new products to ensure that our services meet the future needs of consumers.

This investment is focussed on the longer term and is ring-fenced to ensure it is not displaced by shorter term priorities. This is particularly important as we have operated with very tight funding constraints.

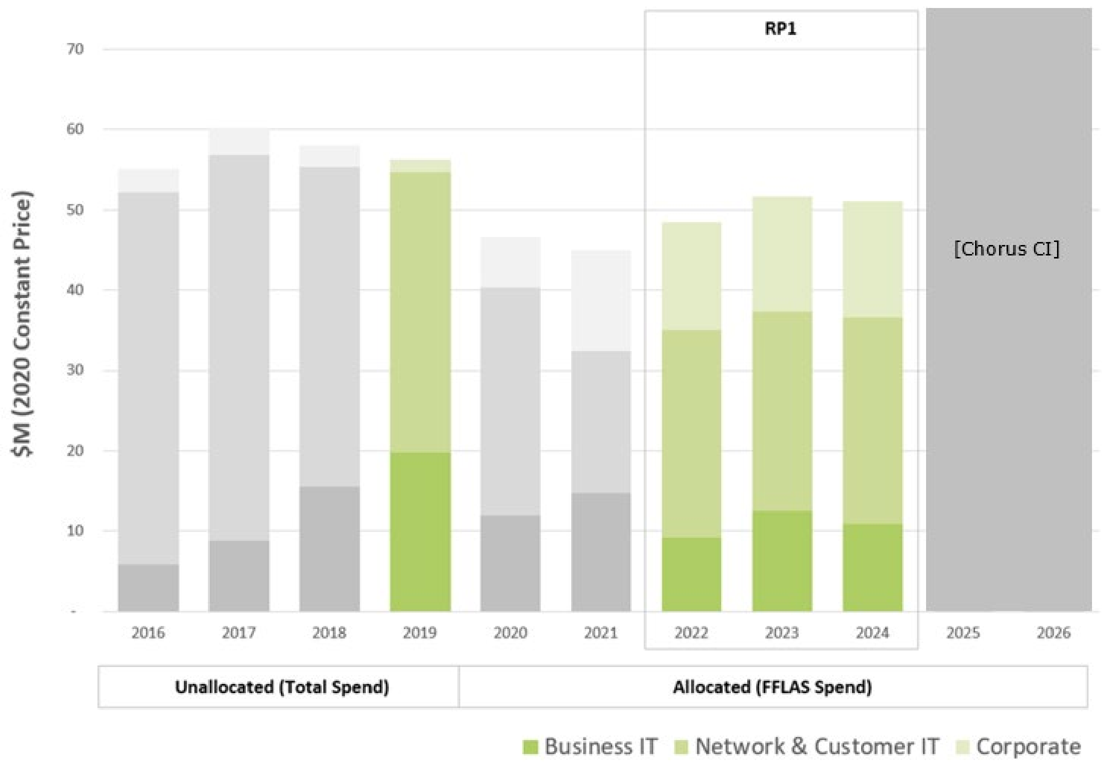
8.7 Forecast expenditure

Our historical IT investments have been driven by the managed transition and exit from Spark. These projects have required large multi-year investments. We sequence IT capability, shifting investment between network and customer IT and business IT. For example, our network and customer IT spending peaked between 2016 and 2017 due to the establishment of new copper fulfilment (~$40 million[2]), assure trouble ticketing (~$5 million[2]) and new digital channels (~$9 million[2]). We sequenced this so 2018 to 2019 focused on the billing system developments (~$20 million[2]) in business IT. There are also similar spend increases in business IT in 2021 and 2025 as a result of the four-yearly relicencing of a key piece of integration software[3].

Our investment in consumer products and services will increase to keep pace with developments in technology and the expectations of our RSPs and consumers. Our expenditure on accommodation is expected to remain steady from 2022.

Figure 8.4: RP1 expenditure for IT and Support showing unallocated historical spending

IT and Support capex



[2] These project costs are quoted as estimated unallocated nominal dollars.
[3] Our current business planning process only takes our detailed planning to 30 June 2025. To extend the forecast for calendar year 2025 and 2026 we have applied a high-level approach to project the forecast forward, with bottom-up and top-down sense checking to adjust for anticipated step changes.

8.7.1 IT expenditure

During RP1 our expenditure forecasts for network and customer is $76.5 million and $32.5 million for business IT.

Our forecasts for both expenditure sub-categories are based on our experience of previous IT investments which have taught us that:

- labour (both internal and contractors) accounts for approximately 90% of IT investment costs. This is driven by market conditions, external labour market, and our ability to retain appropriate skills in our teams
- direct software costs are in the region of 5-10% of investments. They are driven by market conditions and are impacted by product cycles
- hardware costs are typically low (2-5%).

The cost of delivering IT solutions is forecast using a 'bottom-up' approach that considers previous similar project costs and uses an estimation tool that accounts for:

- **existing system impacts** – the number of integration points with our current systems indicates the level of complexity with increasing costs for design and testing
- **data impacts** – the need for data migration and/or cleansing
- **business change** – the likely level of change required to implement and integrate the solution (a significant driver of this is internal project team costs)
- **project duration** – a key driver of internal project team costs
- **user impacts** – likely need for integration, migration and change management (RSPs and FSPs)
- **contingency** – general risk allowances to cover scope and cost uncertainties.

Estimating the cost of IT capital investments over the medium-term is difficult because of the uncertainty related to the speed that technology evolves and, in the network and customer IT product development area, our dependence on RSP and supplier roadmaps.

Our forecasting assumes that increases in internal and external labour costs are absorbed by improvements in productivity and efficiency improvements and that we will maintain historical ratios of delivery versus required capital spend.

One uncertainty relating to our IT expenditure forecasts is the potential Microsoft datacentre. In May 2020, Microsoft announced the intention to open a New Zealand datacentre, which means our plans may need to be revised. Timelines have not been put forward for when the datacentre would open but it is likely to be within RP1. Investment decisions prompted by this development will have implications for our capex/opex split.

Our infrastructure plan, and its associated cost forecast, has assumed expenditure to support the existing physical datacentres, including upgrades, replacements and capacity planning. We will need to reassess these plans to ensure that we are positioned to take advantage of any in-country cloud capability. Considerations will include:

- cost of the service, which is yet to be known
- date of availability of the service, also unknown
- which applications could be supported on a cloud datacentre
- the cost of migration
- whether we should migrate all applications, maintain the existing physical datacentre or create a hybrid solution.

The outcomes of these considerations could change the forecast both in terms of costs and timings, but also whether the spending is on capex development of the existing physical datacentre or opex for a new cloud-based solution.

8.7.2 Corporate expenditure

Our corporate expenditure during RP1 is $42.1 million. This covers both business and innovation (longer term investment in consumer products and services).

Innovation, focusing on meeting the future needs of consumers, is the most significant part of our corporate expenditure. The spending is aimed at increasing our innovation capabilities. We have assumed our innovation expenditure will be 3.7% of total capex, which is slightly higher than global Research and Development (R&D) benchmarks – recognising that R&D is a subset of innovation.

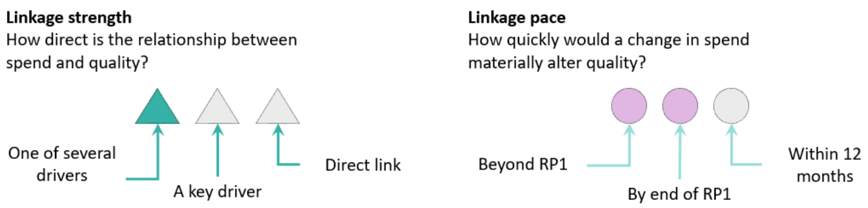
The smaller part of this sub-category relates to expenditure for office equipment, refits and refurbishment. Our forecast is based on historical spending, the costs are known and planning around spending is in our control. As a result, uncertainty is low, where headcount/floor space requirements remain static. We expect costs to remain relatively stable throughout RP1. Some of our office leases are due for renewal during RP1. We have not forecast for expenditure for an office move, but this introduces a small risk to our forecast.

8.8 Links to quality

Each discussion of linkages between expenditure and quality includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment.

More detail on synergies between projects and programmes, and capex and opex trade-offs can be found in the Investment Summray of Our Fibre Plans under the heading 'linkages, synergies and trade offs'.

Table 8.1: Links between IT and Support and our quality dimensions



Dimension(s)	Area	Strength	Pace
Availability and faults	**IT and support | all** Our network and customer systems coordinate management of the network, including fault response activities. Our business IT systems provide the infrastructure and integration to support them.		
Customer service	**IT and support | all** Our systems support our network operations and customer interactions, including installations, connections, fault restoration and billing.		
Switching	**IT and support | all** Automated switching activity uses systems developed, maintained and enhanced through our network and customer IT investment, supported by our business IT infrastructure and integration.		
Provisioning	**IT and support | all** Automated provisioning activity uses systems developed, maintained and enhanced through our network and customer IT investment, supported by our business IT infrastructure and integration.		
Ordering	**IT and support | all** Automated ordering activity uses systems developed, maintained and enhanced through our network and customer IT investment, supported by our business IT infrastructure and integration.		

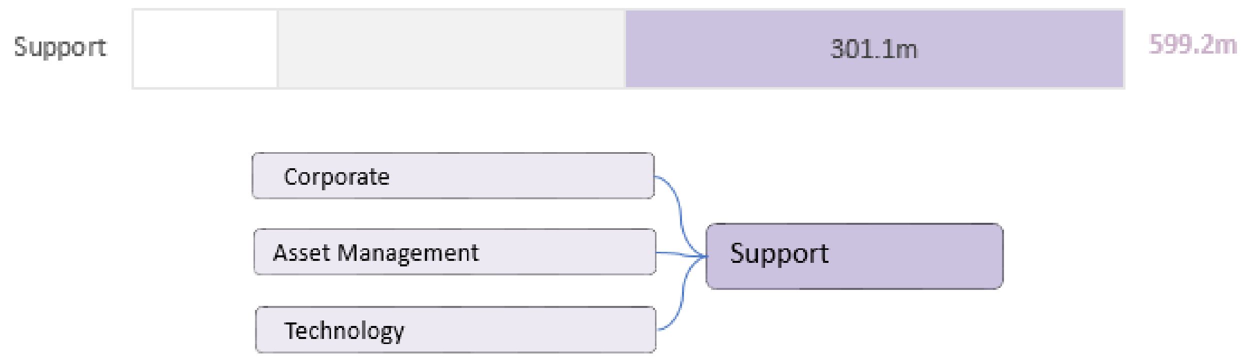
9.0 Support Opex

Describes our Support Opex category and covers expenditure on asset management, corporate functions and operating costs for IT systems.

9.0 Support Opex

Figure 9.1: Support Opex as a proportion of total first regulatory period (RP1) opex

Support Opex



9.1 Introduction

Our Support Opex covers three expenditure sub-categories:

- **corporate** - our functional teams, accommodation and other expenses, such as insurance, office expenses and regulatory levies
- **asset management** - internal labour costs for Chief Technology Office (CTO) and Customer and Network Operations (CNO) that support our asset management processes and operations
- **technology** - support contracts, IT services and licences for our IT systems.

This chapter describes the three sub-categories and then explains our plans and expenditure forecasts

9.2 Corporate

The corporate sub-category covers the internal labour costs of our corporate teams, accommodation and other items such as insurance, office expenses and regulatory levies.

9.2.1 Corporate teams

Our corporate teams provide the following functions:

Our board provides governance and oversight for all business activities. The board meets on a monthly basis to offer strategic direction and guidance. Board committees meet less-frequently and focus on specific accountabilities:

- audit and risk management committee
- nominations and corporate governance committee
- people, performance and culture committee.

Our executive team is responsible for our corporate strategy and management of our business. It is accountable to the board. Our executive assistant/administration team support the executive team as well as the general running of the business.

Our finance team leads financial planning, financial control, management accounting and internal/external reporting. They are also responsible for:

- cash and liquidity management, long term funding, credit rating, capital management and financial risk management
- investor relations, integration of finance, communication and market disclosure requirements of a publicly listed company
- preparation of the first regulatory submission for Fixed Fibre Line Access Services (FFLAS) and managing the organisational change for implementation of the new regulatory framework
- a partnerships team that supports all areas of the business to get the best possible commercial and operational outcomes.

Our economics and modelling team are responsible for providing economic and modelling insights.

Our people and culture team contribute to the future of the business through developing strategic people and capability plans and ensuring we have the right operating model in place. Specifically, this team is responsible for:

- organisational development (learning and development, wellbeing, recruitment, diversity and inclusion)
- the transformation team that is responsible for the successful delivery of our transformation programme that will lead to improved efficiencies, customer experience and growth opportunities
- workforce transformation - developing future operating models and workforce requirements
- business partnering
- reward and recognition transformation including payroll and systems support.

Our general counsel's office enable legal, regulatory and governance outcomes that support our strategic business ambitions. This includes:

- regulatory and competition team that provides legal and regulatory support on the obligations that govern our services and the way we interact with our customers and competitors. This team also supports the development of the new regulatory framework for FFLAS
- the corporate and commercial team covers corporate governance including stock exchange listing rules and Companies Act requirements, support for our board and board committees, all contracting with customers, suppliers, Crown and bank funders, product development, disputes and litigation, property law, intellectual property, privacy and health and safety
- our regulatory and policy affairs team are responsible for engaging with external stakeholders to manage the regulatory and policy environment and for supporting the business to ensure we comply with regulatory requirements
- Risk, Internal Audit and Compliance (RIAC) which advises on risk management, fraud, whistleblowing and internal audit and maintains our compliance program including compliance with our regulatory obligations, codes of ethics and other policies.

The nature of our business operations is changing, however, there will always be a requirement for key core corporate functions. Overtime we expect that the size and organisation of our teams will flex to align with the rest of the business.

9.2.2 Accommodation

All our staff are housed in corporate office locations across New Zealand[1]. Our ongoing corporate costs include the rental of our corporate sites, and the costs of operating these buildings (e.g. power, cleaning, maintenance, lease charges, security etc).

We have implemented a hot-desk system in parts of our Auckland and Wellington offices, which requires less office space per person and provides greater flexibility to our employees. We anticipate that reductions in office space due to flexible working would be partly offset by increased equipment spend for staff to set up alternative workstations.

During the initial COVID-19 lockdown we maintained our business functions as our employees worked from home. As we transition back into our offices, we are being flexible with our working patterns.

9.2.3 Other

We have several other material cost items that are covered in the corporate sub-category:

- **regulatory levies** – fees for the Telecommunications Development Levy (TDL), telecommunications regulations levy and building block model levy each of which is treated as passthrough costs as per the Input Methodologies (IMs)
- **audit fees and services** – fees for the statutory audit, half-year review, information disclosure, internal controls audit, three yearly regulatory audit, TDL audit, telecommunications service obligations audit and general advice
- **consultancy and legal services** – charges to bring in specialist expertise for project work or advice
- **insurance** – fees for insurance to cover material damage, business interruption, directors and officers, and general insurance premiums
- **office expenses** – communication costs, printing, postage, stationery etc.

[1] Although leases are capex, we treat them as opex in our proposal (in line with information request A28.1), as the cashflows are recurring and this avoids confusing spikes in the presentation of our capex caused by the NZ IFRS 16 treatment.

9.3 Asset management

Our asset management sub-category covers expenditure for our CTO and some of our CNO teams.

9.3.1 Chief technology office

CTO is reponsible for defining, planning and executing our technology strategy, planning and ensuring network capacity and coverage, deploying new network technologies, delivering IT change and operating our technology. CTO's labour costs are primarily capitalised to projects, with contractors almost exclusively brought in for capital projects. The remaining 'opex-focused' resources (~40% of total permanent headcount) covers:

- investment and asset management
- strategic planning and governance
- data and analytics and business insight
- technology supplier management
- technology operations and security
- customer experience.

As we move from network-build and installation to network-operator, there is a shift in focus from physical asset creation to asset management.

As the fibre network was being built, our focus was on developing the network and the supporting IT systems capability to manage the volumes of fibre orders and fibre traffic. Now that those are in place, our focus shifts to the management of the assets that make up the layer 1 and layer 2 network and the IT systems that support it.

We are also transitioning to an agile delivery operating model. Rather than waiting for several IT or network changes to accumulate before making improvements, we will look to make smaller changes more frequently. This allows for efficiency benefits to be realised earlier and reduces the risk of system faults when new capability is deployed.

We will continue to operate a centralised model that holds our suppliers to account for the systems that they integrate into the network. Our suppliers remain responsible for the quality and performance of the systems they have delivered via contractual terms we build into supplier agreements.

The CTO team is also responsible for IT and network electronics related capital projects. Project opex covers the discovery project costs, close out activities and migration activities that cannot be capitalised. Examples of other projects-related opex spend include decommissioning legacy systems, minor data migration and supplier cost for incident solution.

9.3.2 Customer and network operations

The planning and infrastructure teams of CNO manage network build requests as part of new property developments, network extensions, network relocations and plan network capacity increases. They are responsible for designing and building the network and managing our records of the physical network.

Our aim is to have network capacity in place ahead of demand. We work closely with our planning, scoping, scheduling and investment teams all the way through to our Field Service Providers (FSPs), who provide the physical design and build activities for Chorus.

The CNO capability teams provide a range of services designed to improve our business operations and our customer service. Our business resilience team is responsible for all health and safety requirements, business resilience, business continuity, environmental sustainability and ensuring our FSPs are meeting their legal obligations.

The CNO activities covered by Support Opex include:

- **optimisation and insights** – build and run robotic automations, re-design business processes, deliver reporting and insights services, manage change into our FSPs and our offshore partners, and provide learning support for technical change through face to face and online delivery
- **stakeholder consenting and acquisition** – ensures that correct property and regulatory rights are gained to enable us to build, connect and operate our network. We also facilitate a favourable ongoing environment by forming stakeholder relationships, sitting on national and local bodies, reviewing and submitting on district plans and local bylaws
- **contract management** – manages contractual relationships with FSPs and the Crown and ensure contract compliance that enables the successful build and operation of our network
- **property operations** – manage and maintain our network property portfolio, including engineering services assets and co-location services. CNO undertakes programmes of site optimisation and delivers ongoing asset maintenance and upgrade programmes through to major site upgrade

investment projects. This area also includes our corporate office accommodation - maintaining existing landlord relationships and developing solutions that support our future ways of working

- **physical network planning** – produce high level physical network infrastructure plans for the current and future capacity and capability requirements of our network. This capacity demand is based on proactive network monitoring of the existing network and forecasting future demand. In addition, the planning team provide support and consultation on network capacity and capability impact for legacy and new service offerings
- **programme controls and logistics** – ensures key projects and programmes are delivered on time and budget by enabling the co-ordination of key foundational project management compliance activities, workflow processes and ensuring an efficient and effective materials supply chain to support our business operations
- **infrastructure programme office** – programme and project management relating to the build of network in response to the expansion of our geographic footprint, increasing network capacity, proactive maintenance along with moving and removing legacy network and governance of network records
- **network scoping** – deliver accurate quoting for customer requests in new property developments, network relocation requests and complex installations. This also involves early engagement with our planning group to highlight areas where capacity of the network is being optimised to its full capacity and relief planning is required
- **health, safety and environment** – enable the strengths of our people and our partner networks and serve our customers in an evolving work environment.

When CNO activities are directly related to capital projects, the internal labour costs are capitalised.

9.4 Technology

The technology sub-category is the spend required to keep our business IT and network and customer IT running effectively. We use over 100 systems and applications as part of our usual business activities. These include applications, virtual desktops (VDI) and hardware that manage our network and support how we interact with our customers.

Our expenditure is on software and hardware licenses, supplier support and maintenance, and outsourced IT services:

- **application and hardware licences** – we are sometimes required to contract for the licensing of our software or hardware. We also pay subscription costs for cloud-based software for our integrated platforms such as VDI, email and analytical tools
- **support and maintenance** – we outsource for specialist support for our applications including proactive maintenance and fault restoration. The cost is mainly for technicians and consultants to fix faults. This includes extended support costs to allow continued use, as well as ongoing payments to Spark for hosting and support of our legacy shared systems
- **outsourced IT services** – we outsource IT services for scale, expertise and/or cost. This includes IT service management functions such as service desk, security management, change management, incident and problem management, and capacity management.

9.5 Our plans

9.5.1 Corporate

During RP1 spending on our corporate teams will remain relatively constant. The corporate functions act as support for the operational functions of the business, the size of these teams will flex both up and down to reflect the needs of the business.

Our plans are to adjust both the size and capability of teams to help deliver our strategy. The scale of our corporate teams will be aligned to our strategic plans of winning in fibre, optimising non-fibre assets and growing new revenues. In some areas we will need to increase capability and capacity of the team to meet the regulatory requirements and future business needs. In other areas there will be cost reductions related to the fall in build activity.

We are reviewing our operational processes to optimise and digitise where this will result in cost efficiencies. Any efficiency savings will be partly offset by any additional support required for future regulatory and compliance activities.

9.5.2 Asset management

We have been working with Asset Management Consulting Limited (AMCL) to assess and develop our asset management processes. After an initial assessment of our current asset management practices, we have developed a roadmap to help us improve our capabilities. A detailed description of this is included in the introduction of this report. We will need additional resources to manage our asset management development.

We have several upcoming initiatives looking to deliver system and process improvements across the business. The primary focus is on streamlining end-to-end processes, enhancing the quality of our data and improving customer experience.

We are developing our asset management capabilities and expect our spending, both in the CNO and CTO space, to reflect this over time.

9.5.2.1 Chief technology office

Embedding our new asset management processes and growing our internal capability will be a key focus throughout RP1. This will be done in parallel with implementing new IT capability to support asset management, as well as preparation for our RP2 submission.

During 2020 we have started a transition to a new operating model based on agile practices. We expect this operating model to continue to evolve throughout RP1, with key evolutionary changes likely to result in operations and security functions being more closely aligned with change and delivery functions. A key principle of our operating model is preference of permanent staff over the use of contractors, whilst dedicating resources to technology platforms to grow and retain our intellectual property (IP).

While there will always be a portion of the IT market that will continue to be contracted (i.e. highly technical roles such as solution architects), the proportion of permanent to contract staff is forecast to shift. We expect total headcount numbers remain flat.

9.5.2.2 Customer and network operations

The key initiatives for CNO are:

- **FSPs integration programme** – this programme will establish new means to integrate with our FSPs for fibre ordering and all assure activities
- **reporting and data** – we would like to enrich operational information with the data that already exists via our technology suppliers. This includes alarm analytics and predicting access network performance to enable proactive activity that will improve customer experience
- **automation** – several of our operating processes involve some manual handling. We are increasing automation in these areas. The next tranche of processes with work underway include new property development transactions, complex fibre delivery (business), contract administration and network damages.

As we transition from the build to the operate phase, we expect an overall reduction in workload. This reduction in workload presents the opportunity for consolidation of work effort and supporting systems, some of this reduction will be offset by an increase in asset management capabilities.

9.5.3 Technology

We expect our technology spending to remain constant during RP1. Over the past five years we have been migrating off IT platforms hosted in the Spark environment. This has resulted in a decrease in expenditure for licensing, hosting and management fees. This has allowed us to reduce our reliance on Spark and redirect our spending into supporting new rather than legacy systems. We expect use of Software as a Service (SaaS) and cloud services to increase over time.

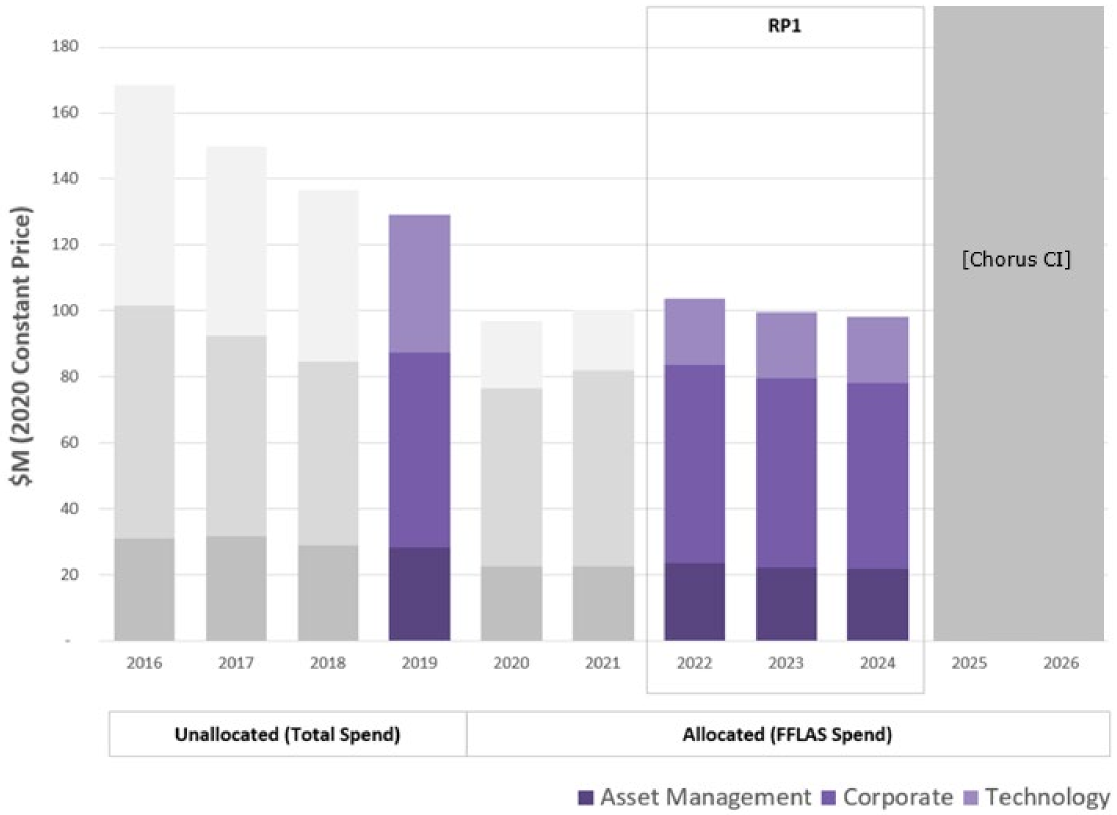
Our strategy around digital and end to end optimisation will require increased licencing, application support and SaaS costs as IT capability is introduced or enhanced. This will optimise our non-technology operations and maintenance budgets. For example, robotic automation, data and analytics costs including machine learning and Artificial Intelligence (AI) will be offset by reductions in labour costs across the business.

9.6 Forecast expenditure

Historically, our corporate and asset management expenditure has been driven by our network build activities. As we come toward the end of the build phase our corporate expenditure will be relatively stable as we reallocate some of our internal resources from managing network build to improving our asset management capabilities[2].

Figure 9.2: RP1 expenditure for Support Opex showing unallocated historical spending

Support Opex



Our technology opex has reduced over time as we have reduced our reliance on Spark and capitalised a greater proportion of spending (for provisioning and customer retention related expenditure). The decline in spending also reflects that prior to 2019 the costs of the Network Operations Centre (NOC) were captured within the technology spend but these have since been reclassified. From 2020, we expect our technology expenditure to be more stable.

During RP1 our forecast expenditure for Support Opex is $301.1 million.

Most Support Opex is forecast using a Base-Step-Trend (BST) methodology. We forecast each element of our opex spending separately. The most material expenditure for support opex is the cost of our corporate teams, the CTO and the fixed technology costs that cover licences and support. In this section we have focused on the most material elements.

[2] Our current business planning process only takes our detailed planning to 30 June 2025. To extend the forecast for calendar year 2025 and 2026 we have applied a high-level approach to project the forecast forward, with bottom-up and top-down sense checking to adjust for anticipated step changes.

9.6.1 Corporate

The forecast for our corporate expenditure follows a BST methodology. Corporate operating costs are enduring by nature, and the FY2019 actual spend has been used to establish the base position.

We believe that FY2019 is a reasonable and efficient basis for our corporate expenditure, given it reflects arrangements that have been in place since demerger, and the intervening cost pressures and market scrutiny. For example:

- a revenue shock for copper services which drove sharp cost reductions
- since our inception, we have been directing resources at building the fibre network. This has driven sustained cost control for all activities
- we have built the fibre network under commercial arrangements that incentivise and drive us and our suppliers to be efficient
- we are building a new network and it will take time before revenues catch up to costs. During this phase our investors will continue to expect us to limit discretionary investment and sustain tight cost control
- fibre services are not a traditional monopoly (with full market share and no viable substitutes) so we have an incentive to keep costs low and prices competitive.

Any step changes reflect known adjustments in forecast expenditure.

We have forecast the future structure of support based on strategic decisions across the business. As different strategies are implemented, the support structure will flex over time.

9.6.2 Asset management

Our forecast expenditure for the CTO teams reflects the period of relative stability and predictability we are entering with regards to our IT systems and network planning. A BST approach is taken to forecasting our labour. Baseline forecasts are adjusted for changes in headcount and salaries, contractor daily rates and capitalisation rates.

Our forecast expenditure for CNO teams focused on network planning and build are based on build volumes. During RP1 fewer resources will be required for network build and planning. There will continue to be a base level of planning and delivery resource required to meet business as usual volumes for network extensions, relocations and resilience.

Other areas of CNO use a BST methodology for forecasting, as they are less linked to the volume of activity that is happening in the business. For example, there will always be teams covering the activity of optimisation and insights, contract management, property operations and business resilience. This follows a similar trend as our corporate forecast. FY2019 actuals are used as a base and adjusted for any known changes.

9.6.3 Technology

Approximately 70% of our technology costs are fixed, usually by way of fixed term contracts of 1-3 years with a small number of suppliers. Our forecasts for these costs are low risk and cost will remain constant unless the business ceases to use the applications or services.

There is some uncertainty in our technology forecast as some contracts are due for renewal in 2021 which could impact our plans:

- major change is extremely unlikely as it requires significant investment
- contracting strategy is to cap pricing and provide certainty through term. Benchmarking against other providers is used to determine parity in market
- current strategy is to re-fix costs via re-contracting over similar or improved terms.

The remaining 30% of costs are variable. These are forecast using a price x quantity model where volumes are related to headcount, service desk tickets and the number of servers in use and price is the unit costs as determined in supplier agreements. Again, there is very little opportunity to change costs without significant business changes. The true variable component is typically only 15% of the variable cost. Where we determine we are subject to growth, we look to commercially cap a variable cost and make it fixed.

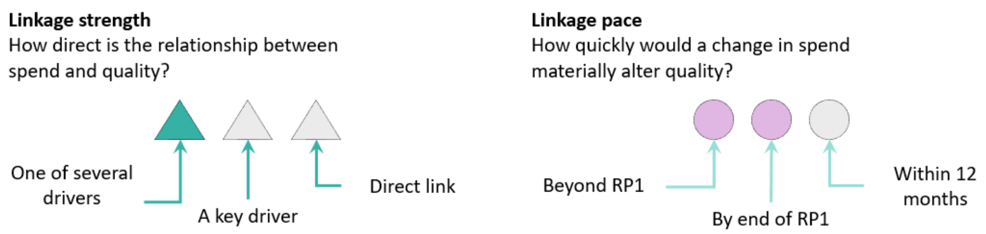
Our technology forecasts are net of amounts capitalised to capex projects and to Installations when they relate to service desk time spent on new connections and customer retention activities.

9.7 Links to quality

Each discussion of linkages between expenditure and quality includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment.

More detail on synergies between projects and programmes, and capex and opex trade-offs can be found in the Investment Summary of Our Fibre Plans under the heading 'linkages, synergies and trade offs'.

Table 9.1: Links between Support Opex and our quality dimensions



Dimension(s)	Area	Strength	Pace
Performance	**Support | asset management** Our engineering teams manage network capacity.		
Availability and faults	**Support | asset management** Our engineering teams manage network risk.		
Availability and faults	**Support | technology** We can't take or fix faults without working and well-supported IT, including licensing, hosting and support.		
Customer service	**Support | asset management** Our engineers aim to align network quality and performance with customer and consumer preferences over time.		
Customer service	**Support | technology** We can't take or fix faults without working and well-supported IT, including licensing, hosting and support.		
Switching	**Support | technology** Our switching activities require working and well-supported IT, including licensing, hosting and support.		
Provisioning	**Support | technology** Our provisioning activities require working and well-supported IT, including licensing, hosting and support.		
Ordering	**Support | technology** We can't take orders without working and well-supported IT, including licensing, hosting and support.		

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