Asset Management Plan

Telecommunications Bearer Network

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Authorisations

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Review cycle	2.5 Years	

Responsibilities

This document is the responsibility of the Metering and Asset Strategy Team, Tasmanian Networks Pty Ltd, ABN 24 167 357 299 (hereafter referred to as "TasNetworks").

The approval of this document is the responsibility of the General Manager, Strategic Asset Management.

Please contact the Metering and Asset Strategy Leader with any queries or suggestions.

- Implementation All TasNetworks staff and contractors.
- Compliance All group managers.

Record of revisions

Section number	Details
	Initial release

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Glossary of Terms

AC	Alternating Current
ACMA	Australian Communications and Media Authority
ADSS	All Dielectric Self Supporting Optical Fibre Cable
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
CAPEX	Capital Expenditure
DC	Direct Current
DNS	Domain Name System
E2E	End-to-End
ERP	Enterprise Resource Planning
ESTI	European Telecommunications Standards Institute
GIS	Geographic Information Systems
GPS	Global Positioning System
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
IPDV	IP packet Delay Variation
IPER	IP packet Error Ratio
IPLR	IP packet Loss Ratio
IPTD	IP packet Transfer Delay
IT	Information Technology
ITU	International Telecommunication Union
ITU-T	International Telecommunication Union - Telecommunication Standardization Sector
LAN	Local Area Network
MAC	Medium Access Control
MAN	Metropolitan Area Network
MPLS	Multiple Protocol Layer Switching
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
NER	National Electricity Rules
NMS	Network Management System
NOCS	Network Operation and Control System
OPEX	Operational Expenditure
OPGW	Optical Ground Wire
OPUC	Optical Underground Cable
OSI	Open Systems Interconnection
OSI Model	An international layered model for the interconnection of information technology and/or telecommunication based networks and devices
PDH	Plesiochronous digital hierarchy

PLC (1)	Programmable Logic Controller
PLC (2)	Power Line Carrier
PoE	Power over Ethernet
R19	Regulatory Submission Period from financial years 2019 to 2024
REPEX	Replacement Expenditure
RF	Radio Frequency
SAN	Storage Area Network
SAP	System Applications Products
SCADA	Supervisory Control and Data Acquisition
SDH	Synchronous digital hierarchy
TCP/IP	Transmission Control Protocol/Internet Protocol, the suite of protocols that govern the Internet and Internet based networks
TDM	Time Division Multiplexing
TESI	Tasmanian Electricity Supply Industry
TIMS	Telephone Information Management Systems
TMR	Trunk Mobile Radio
TOTEX	Total Expenditure which is equal to Capital Expenditure + Operational Expediture
VoIP	Voice over Internet Protocol
WAN	Wide Area Network
WDM	Wave Division Multiplexing
Wi-Fi	An acronym to describe IEEE 802.11 standard based wireless networks
WLAN	Wireless Local Area Network

1 Purpose

The purpose of this document is to describe for Telecommunications Bearer Network and related assets:

- TasNetworks' approach to asset management, as reflected through its legislative and regulatory obligations and strategic plans
- The key projects and programs underpinning its activities
- Forecast CAPEX and OPEX, including the basis upon which these forecasts are derived

2 Scope

2.1 Inclusions

The scope of this Asset Management Plan document includes, but is not limited to, the following prescribed telecommunications assets:

2.1.1 Optical bearers

2.1.1.1 Optic fibre cables

The specific bearer used for the connection of optic fibre terminals.

2.1.1.2 Optic fibre terminals

The equipment used to communicate via an optic fibre cable.

2.1.2 Microwave radio bearers

2.1.2.1 Digital radio systems

Wireless communication equipment which includes:

- the radio terminal
- antenna
- feeder equipment

2.1.3 Power line carrier equipment

Telecommunications transmitted over an electrical power transmission line.

2.1.4 Multiplexing equipment

Equipment used to aggregate and disaggregate individual telecommunications circuits across a main telecommunications bearer.

2.1.5 Network supervisory equipment

Equipment used to capture status and alarms and provide control capability to onsite equipment.

2.1.6 Network synchronisation equipment

Precision timing equipment used to maintain synchronism of the telecommunications equipment and nodes on the entire network.

2.1.7 Ethernet equipment

The Ethernet equipment includes the following assets:

- Routers
- Switches
- Gateways
- Firewalls
- IEEE 802.11/Wi-Fi wireless networking equipment
- Ethernet cabling including patch cabling and patch panels
- Ethernet equipment racks, cabinets and mounting equipment
- Media converters, transceivers and other Ethernet/Wi-Fi equipment

2.2 Exclusions

The scope of this Asset Management Plan document excludes:

- Non-Prescribed telecommunications assets and systems
- Prescribed assets covered under other Telecommunications portfolio asset management plans
- Transmission and distribution electricity network operational and management systems
- Transmission and distribution electricity network Supervisory Control and Data Acquisition systems
- TasNetworks' assets and sites covered by the Facilities group
- Virtual and/or physical servers and associated storage access networks (SAN).
- Operating systems and associated supporting software such as anti-virus, patch-management, DNS and Windows Active Directory Services
- Corporate and Administrative Information Technology systems and assets managed by the Information Technology group

3 Strategic Alignment and Objectives

3.1 Overall business objectives

This asset management plan has been developed to align with both TasNetworks' Asset Management Policy and Strategic Objectives. This management plan describes the asset management strategies and programs developed to manage the Telecommunications Bearer Network, with the aim of achieving these objectives.

For these assets the management strategy focuses on the following objectives:

- Safety will continue to be our top priority and we will continue to ensure that our safety performance continues to improve
- Service performance will be maintained at current overall network service levels, whilst service to poorly performing reliability communities will be improved to meet regulatory requirements
- Cost performance will be improved through prioritisation and efficiency improvements that enable us provide predictable and lowest sustainable pricing to our customers
- Customer engagement will be improved to ensure that we understand customer needs, and incorporate these into our decision making to maximise value to them

- Our program of work will be developed and delivered on time and within budget

3.2 Strategic asset management objectives

- Present an overview of the telecommunications management systems asset populations;
- Manage business risk presented by the assets to within acceptable limits;
- Achieve reliable asset performance consistent with prescribed service standards;
- Assess the risks specific to the assets and identify corresponding risk mitigation strategies;
- Ensure the effective and consistent management and coordination of asset management activities relating to the assets throughout their life-cycle;
- Ensure our team members are trained, authorised and competent to undertake their work activities;
- Demonstrate that the assets are being managed prudently throughout their life-cycle;
- Ensure asset management issues and strategies, as they relate to the assets, are taken into account in decision making and planning; and
- Define future operational and capital expenditure requirements of the assets.

4 Asset Information Systems

4.1 Systems

Prescribed telecommunications asset data and information is currently stored and managed using the following systems and methods:

- Autodesk AutoCAD and Microsoft Visio drawings stored within the Information Management systems. Each telecommunication site has a detailed set of drawings including:
    - site drawings
    - building drawings
    - rack layout drawings
    - schematic diagrams
    - wiring diagrams
    - manufacturer drawings
- Excel Spreadsheets for information such as krone termination details
- Network Management System software as detailed in section 5
- Geographic Information System (GIS) used for fibre optic cable management
- The Australian Communications and Media Authority (ACMA) radio frequency (RF) database and associated RF Hazard folders
- A Microsoft Access database that is scheduled to be replaced by a SAP based ERP system in 2018

4.2 Asset Information

The asset data for TasNetworks' Network Management Systems Assets has been well documented and detailed using the current Asset Information systems TasNetworks' has in place.

5 Description of the Assets

5.1 Telecommunications Bearer Network overall description

TasNetworks owns and manages a telecommunications bearer network.

The telecommunications network is the base platform upon which the Tasmanian Electricity Supply Industry (TESI) realises its communications needs. The network is a fully integrated platform consisting of Microwave Radio, and Optical Fibre bearers supporting the provision of SCADA, protection, data and voice telephony services across TasNetworks. Some of the difficult to access locations utilise low bandwidth power line carrier systems as either their primary or backup communications bearer. The network is considered a critical operational component of the Tasmanian Electricity Network.

The bearer network is designed and operated to provide high performance in terms of the circuit availability. In maintaining compliance with National Electricity Rules, diversity options are provided where necessary to further increase the system performance. The network is an integrated system of assets. The assets are categorised to their functional types as detailed below:

- **Optical Fibre Cables –** The specific bearer used for the connection of optical fibre terminals;
- **Optical Fibre Terminals –** The equipment used to communicate via an optical fibre cable;
- **Digital Radio –** Wireless communications equipment which includes the radio terminal,
- antenna and feeder equipment installed at a site;
- **Multiplexing equipment –** equipment used to aggregate and disaggregate individual communications circuits across the main telecommunications bearers;
- **Power Line Carrier –** Communications transmitted over an electric power frequency transmission line.
- **Network synchronisation system –** equipment used to maintain synchronisation of the network components throughout the entire network.
- **Network supervisory equipment –** equipment used to capture alarms and current operational data and provide control capabilities to onsite equipment.
- **Ethernet equipment and systems –** This equipment consists of data networking equipment using Ethernet technology. This also includes equipment based on IEEE 802.11/Wi-Fi networking equipment.

These assets are built on top of the assets described in the Telecommunications Site Infrastructure Asset Management Plan.

The use of optical fibre and microwave radio strategically caters for both a diverse route and diverse media into electrical infrastructure sites as well as allowing TasNetworks to take advantage of the superior capacity offering of optical fibre. The strategy for the design of the network components is to best support the telecommunications requirements of the electricity network, and to leverage additional value where possible.

The current network is built on a traditional digital circuit switched technology known as Time Division Multiplexing (TDM). Modern communication systems have a greater focus on packet switching technologies such as Ethernet and the newer equipment purchased has a component of Ethernet operating alongside the TDM portion.

5.2 Telecommunications network bearer systems

5.2.1 Optical fibre cables

Optical Fibre Cable is a communications media used to transmit information over glass fibres using pulses of light from one point to another over great distances.

The electricity industry in Tasmania first began using optical fibre in the late 1980's when the Tribute Power Station was built.

As part of the installation of the transmission line from Farrell Substation, an Optical Ground Wire (OPGW) was installed containing 4 singlemode optical fibres.

Optical fibre cables provide a secure medium to facilitate the communications between TESI infrastructure sites (generation, transmission and distribution sites and office locations).

Optical fibre cable is classified by the following parameters:

- Cable design specification
- Cable construction and physical installation category
- Armouring and sheaths
- Number of cores
- Connector terminations
- Mode of operation (singlemode or multimode)

The capability and reliability of the optic fibre cables is dependent on the quality of the installations (including joints and splicing) and the equipment installed on each end of the cables.

The major categories of optical fibre cables are discussed in this section.

5.2.1.1 Optical ground wire (OPGW)

TasNetworks current practice for new transmission lines and where appropriate on existing transmission lines, OPGW is installed instead of overhead earth wires. The OPGW offers both lightning protection for the transmission lines as well as a high speed telecommunications services. The optic fibres are installed inside metallic tubes surrounded by the primary earthing conductor strands. This provides the additional benefit of mechanical armour and protection of the optical fibres.

Where available, TasNetworks' OPGW is used for the main communication trunking between substation sites and therefore the optical fibre used is singlemode. Older installations generally include 12 optical fibres (although Farrell to Tribute contains only 4 fibres) whilst the newer installations include 24 or 48 fibres. In the future, Sections of the OPGW will form the optical core of the communications network replacing a portion of the microwave infrastructure. Newer OPGW designs have well in excess of 48 fibres expanding the capabilities of this technology.

In the future, TasNetworks' will be investigating the use of OPGW on the distribution network feeders where it is practical and beneficial to do so for both lightning and electrical protection and SCADA applications.

This asset management plan only considers the optic fibres within the OPGW itself for telecommunications applications. TasNetworks management of the conductor portion of the OPGW conductor assembly itself is covered under the Transmission Line Conductor Assemblies Asset Management Plan. In the future, on the distribution network, OPGW conductors will be covered under the Distribution Conductor Assemblies Asset Management Plan.

5.2.1.2 All dielectric self-supporting (ADSS)

All dielectric self-supporting optical fibre cables are used in aerial applications where OPGW is not suitable. This is used mainly on distribution feeders and occasionally retrofitted on transmission line towers.

ADSS optical fibre cables are used by TasNetworks as trunking cables between substation and power station sites. The optical fibres are singlemode and the cables usually only contain 12 fibres per cable.

5.2.1.3 Optical underground cables (OPUG)

TasNetworks' use of OPUC varies, and is usually used to extend the ADSS or OPGW cables from the substation gantry to the communications room. In these situations, the fibres will be singlemode. The fibre count is usually the same as the OPGW or ADSS that the OPUC is extending from the gantry.

TasNetworks also uses OPUC for communications between buildings in the same vicinity, or for extending communications from a power station/substation to a repeater site which is visible from the main telecommunications bearer network. A combination of singlemode and multimode cables are used depending on the application and system requirements. For singlemode cables, typically range from 6 cores to 96 cores for these types of installations. For multimode cables, the core counts in use by TasNetworks are 6, 12 or 24 core cable configurations.

5.2.1.4 Building and riser cables

Building and riser cables are generally employed for communications between floors of buildings and inside buildings. TasNetworks utilises a number of building optical fibre cables for the provision of both singlemode and multimode services within buildings. The core counts vary between 6 and 48 cores for both multimode and singlemode optical fibre cables.

Riser cables are also used within power station environments, in particular, underground power stations to the surface infrastructure. These optical fibre cables may be either singlemode or multimode with fibre counts from 6 to 48 cores.

5.2.1.5 Asset age profile and asset count

The current fleet of telecommunications optical fibre cables age profile and asset count are shown in the following tables and graphs.

Table 1 - Telecommunications Optical Fibre Cables

Telecommunications Optical Fibre Cable Type	Average Age of Cables (Years)	Number of Assets
ADSS	19.72	10
Building	12.75	15
OPGW	12.39	45
OPUC	10.88	50
Riser	7.82	1
Total		**121**

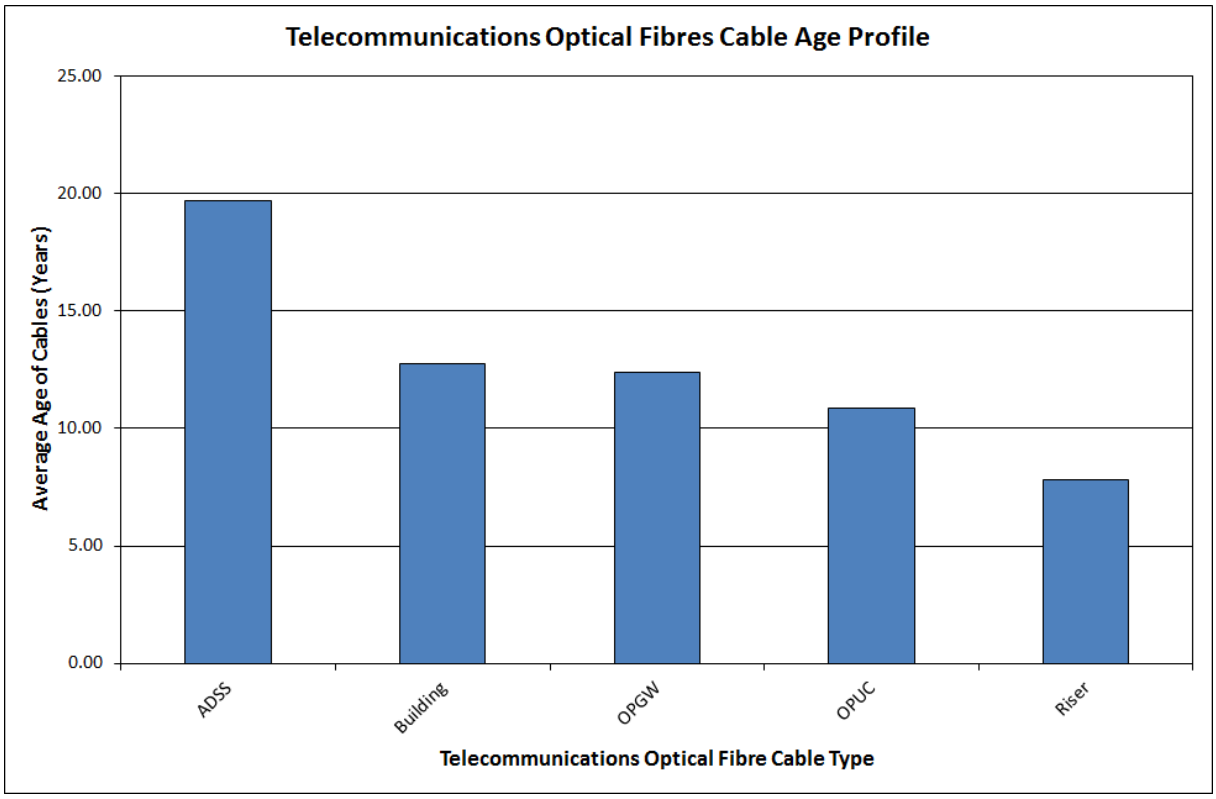

Figure 1 - Telecommunications Optical Fibres Cable Age Profile

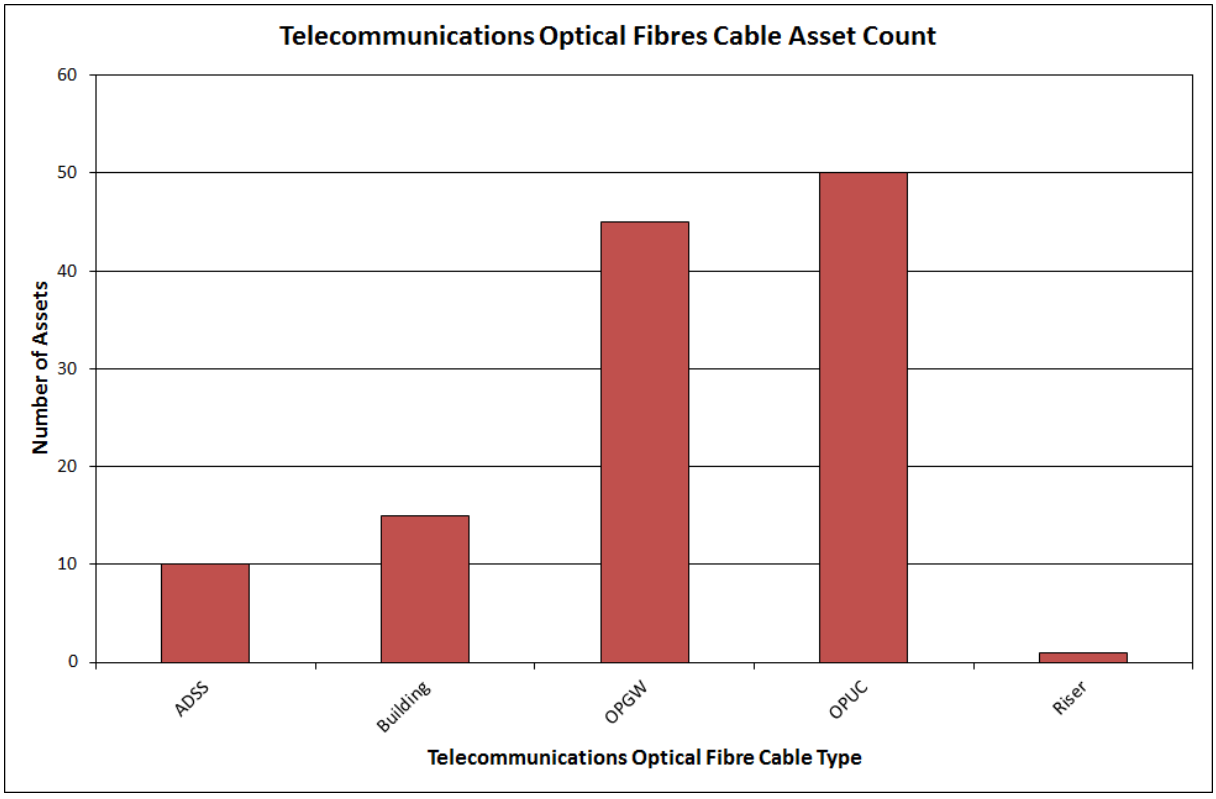

Figure 2 - Telecommunications Optical Fibres Cable Asset Count

5.2.2 Optical fibre terminals

5.2.2.1 Optical fibre bearer network description

Optical fibre communications systems are digital in nature. Since the development of modern fibre optic technology, fibre optic systems have achieved enormous increases in capacity to the point where other telecommunications link systems fall well short of being able to compete in terms of capacity.

Similarly, the use of optical fibre as a major telecommunications transport medium within TasNetworks has increased greatly over the past 20 years due to the installation of various optical fibre cables throughout the transmission network. Optical fibre cable allows the implementation of much higher data rates than what is possible through the digital radio medium.

The optical network can be divided into two sections, the core, and the access systems. Dedicated optical multiplexers have been installed to cater for the core and larger access systems with some of the smaller outer systems utilising an optical interface card in the standard TasNetworks multiplexer system. The assets for these smaller optical link systems are considered alongside the multiplexer equipment.

5.2.2.2 Optical terminal equipment family

The dedicated optical fibre terminals are based on Nokia Siemens Networks equipment – Surpass HiT 70xx family of products.

5.2.2.3 Core components

The strategic vision for the optical network core comprises of the links from Chapel St through to Lindisfarne and around the network to John Butters Repeater via Waddamana, Palmerston, Hadspen, Georgetown, Sheffield, Farrell and Queenstown Substations, with a spur from Sheffield via Ulverstone to Burnie Substation. At present the core is installed from Chapel St to Palmerston (via Lindisfarne) and from Sheffield to Farrell substations. The Sheffield – Ulverstone – Burnie link is also complete. Work is presently progressing on the Farrell – Queenstown – John Butters link and the Georgetown – Sheffield link.

The optical systems deployed by Transend as the core equipment are the HiT 7035 systems.

5.2.2.4 Access components

The access components of the network provide the connection between the core and the subscriber services. All other optical fibre systems deployed by Transend are utilised for access by connecting outer sites into the core system.

Three variations of the HiT 70xx family of products have been installed as access components. The HiT 7020, 7030, and 7050 units provide the service in a compact chassis. The 7020 has a capacity of up to STM-4 (622 Mbps) whilst the 7030 and 7050 will provide up to STM-16 (2.5Gbps). The HiT 7050’s production was discontinued in 2008.

The HiT 70xx family of equipment has in some cases replaced older Nokia optical fibre equipment. The Nokia DF2-8 (which provides up to 8Mbps) is still in use between Poatina Portal and Poatina Repeater. This system was installed in 2003.

5.2.2.5 Asset age profile and asset count

The current fleet of telecommunications optical terminal equipment age profile and asset count are shown in the following tables and graphs.

Table 2 - Telecommunications Optical Terminal Equipment

Telecommunications Optical Terminal Equipment Type	Average of Equipment Age (Years)	Number of Assets
HiT 7020	6.57	4
HiT 7025	6.32	6
HiT 7030	6.16	19
HiT 7035	5.46	30
HiT 7050	11.25	14
HiT 7065	1.60	2
HiT 7080	8.82	1
HiT 7300	6.51	9
Nokia DF2-8	17.15	3
Total		**88**

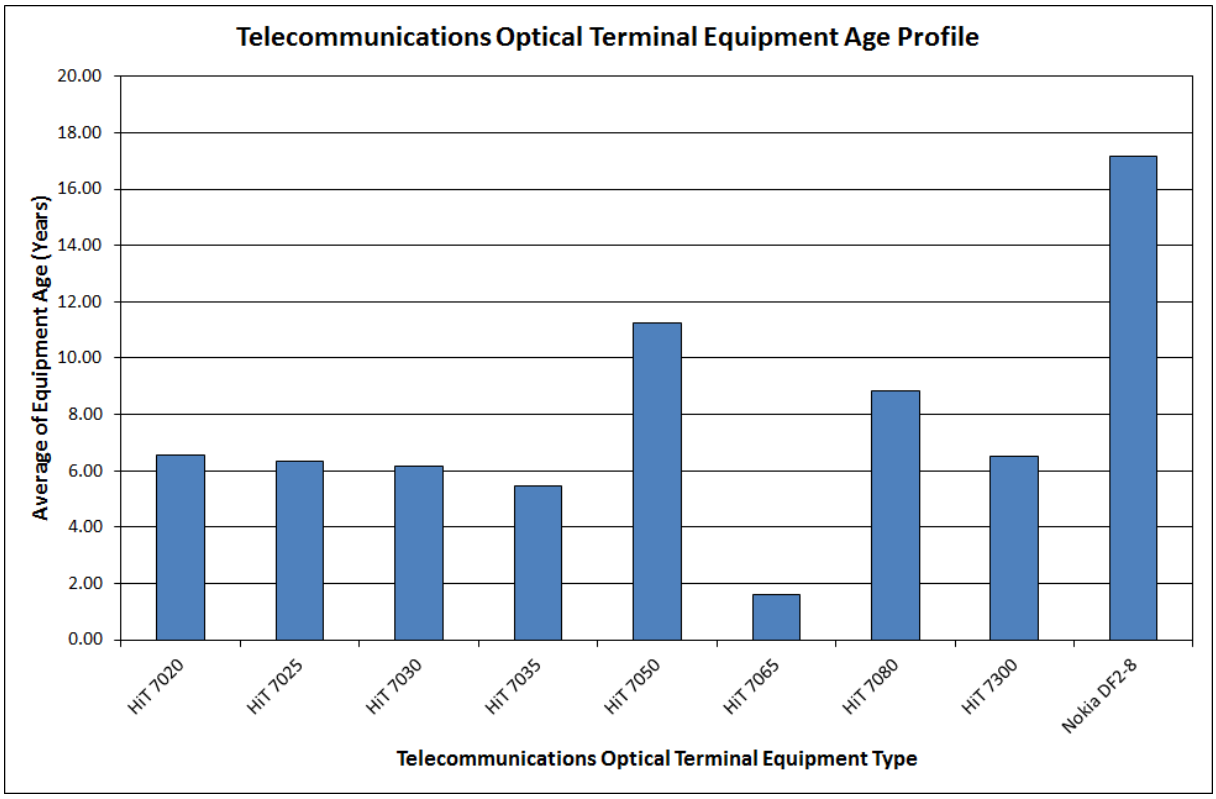

Figure 3 - Telecommunications Optical Terminal Equipment Age Profile

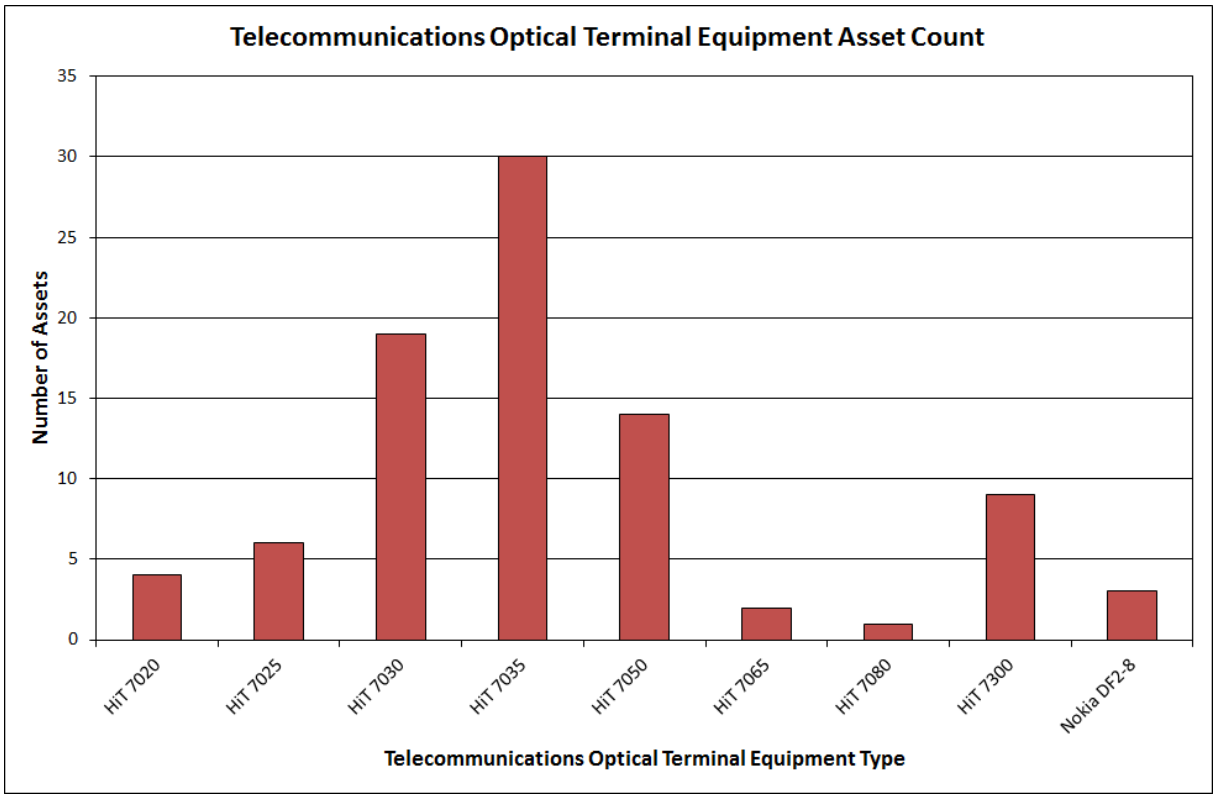

Figure 4 - Telecommunications Optical Terminal Equipment Asset Count

5.2.3 Digital radio systems

Carrier grade microwave radio systems define the core of the TasNetworks' telecommunications network, and are an important technology for the spur microwave radio links. The microwave radio systems (frequency above 1GHz) installed in the network range in capacity from 2Mbps up to 155Mbps. The radios are designed for reliably carrying telecommunications circuits providing high availability end to end for the individual telecommunications circuits.

In addition to the microwave bearers, TasNetworks also operates various lower frequency bearers offering lower capacity. These range from the single channel radio systems to 1168kbps radio links.

The radio systems are generally line of site, point to point systems; however, some of the lower frequency links may be designed to cater for a small obstruction.

TasNetworks' radio systems are based on licensed frequencies offering some control over interference from other sources. Radio licenses are maintained on an annual basis. Common frequency bands utilised by TasNetworks are 6GHz, 8GHz, 10.5GHz, and 11GHz.

Radio links can be classified as long-haul microwave systems (used in the radio backbone), short-haul microwave systems (use as spur links) or low capacity radio systems. The long-haul systems generally operate at frequencies in the wide channel bands below and including 7.5GHz whilst the short-haul systems operate at frequencies above 7.5Ghz.

The higher radio frequencies may be more susceptible to atmospheric and rain fading effects over longer distances. These effects are considered during the system design to minimise their impact on the system performance.

The radio links used by TasNetworks by frequency band are described in the following table and graph.

Table 3 - Telecommunications Digital Radio Equipment Asset Count Based on Frequency Bands

Telecommunications Digital Radios Frequency Bands	Number of Assets
1.5 GHz	1
10.5 GHz	4
11 GHz	37
18 GHz	8
23 GHz	1
6 GHz	18
7.5 GHz	2
8 GHz	13
80 GHz	1
900 MHz	2
Total	**87**

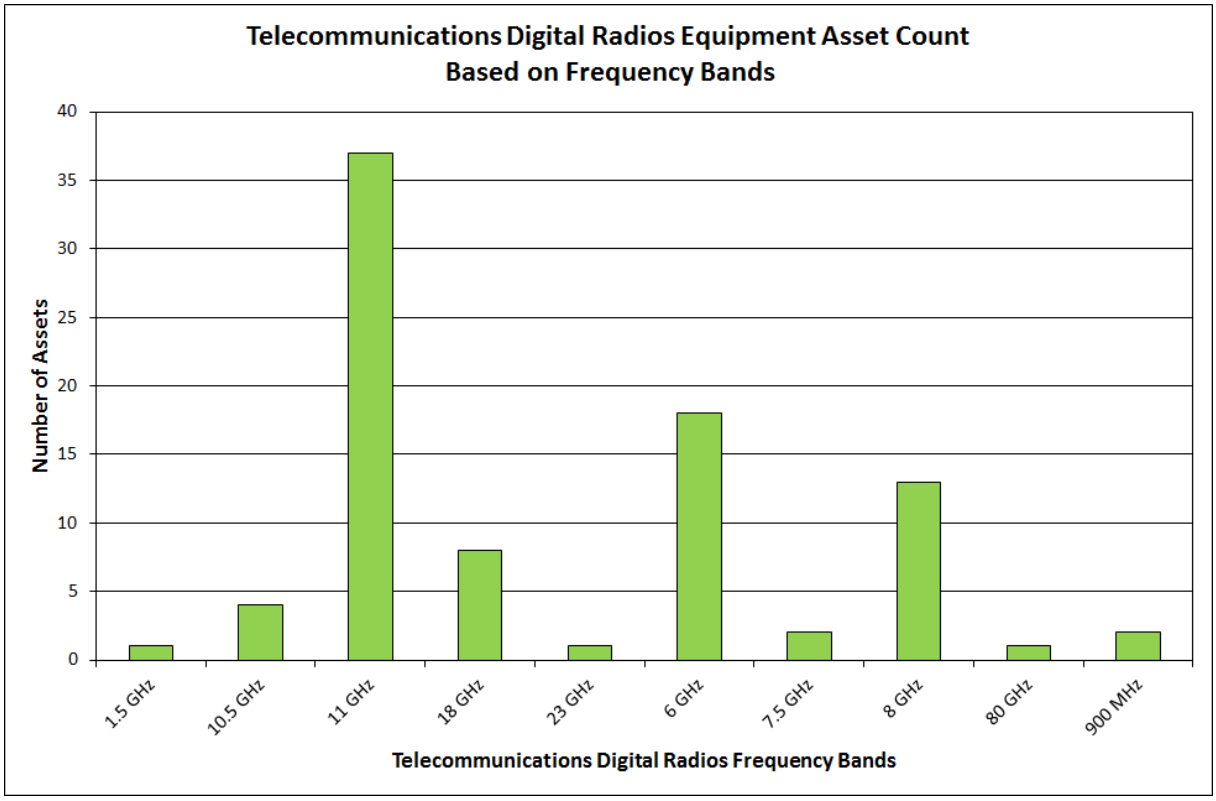

Figure 5 - Telecommunications Digital Radio Equipment Asset Count Based on Frequency Bands

5.2.3.1 Digital Radio Systems Signal Security Configurations

The radio systems deployed in the telecommunications bearer network are afforded different levels of equipment and system protection. This protection is used to make sure the radio systems performance is maintained to optimum levels and to enable maintenance on offline equipment when required. The different levels of protection are integrated into the radios' design and manufacture and are classified as:

- **1+0 Unprotected**
- **1+1 Hot Standby:** The radio is provided with two transmitter and receiver pairs with a hitless changeover to the secondary equipment should a fault occur on the primary. This purely provides equipment protection;
- **n+1 frequency diverse:** This setup provides a secondary transmitter and receiver operating on a different frequency pair to the primary equipment frequencies. This provides equipment protection and mitigates the risk of a frequency related link fade; and
- **Space diverse:** This setup provides either a hot standby or frequency diverse radio with a secondary receiver operating on the same frequencies through a second antenna on the telecommunications tower. The space diversity the risk of multipath fading affecting the link performance.

The risk of multipath fading is determined from examination of the terrain beneath the radio path in conjunction with the radio path length.

The different radio system configurations based on the signal security configurations is described in the following graph and table.

Table 4 - Telecommunications Digital Radio Equipment Asset Count Based on Signal Security Configuration

Telecommunications Digital Radios Signal Security Configuration	Number of Assets
1+0	11
1+1 Frequency Diverse	16
1+1 Hot Standby	57
1+1 Frequency Diverse/Space Diverse	2
1+1 Space Diverse	1
Total	**87**

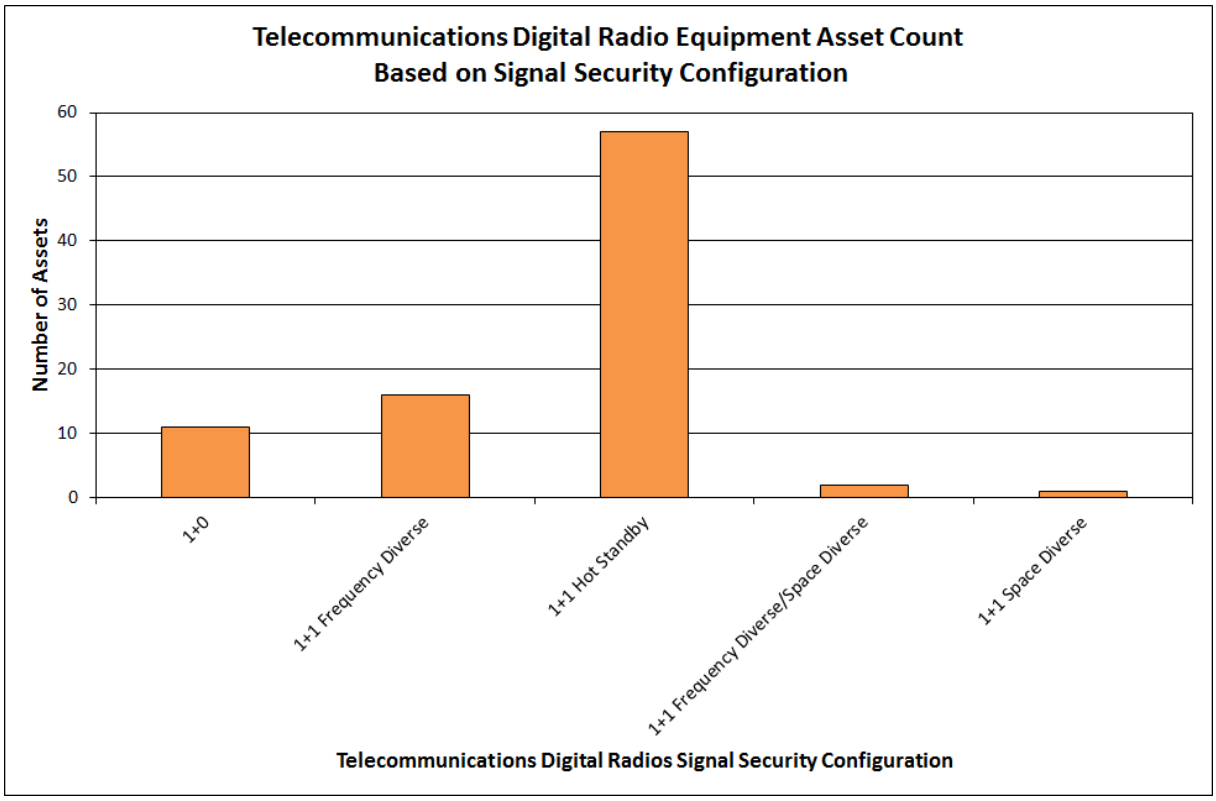

Figure 6 - Telecommunications Digital Radio Equipment Asset Count Based on Signal Security Configuration

5.2.3.2 Digital radio system components

Each radio system and link comprises of the following components:

- The radio terminals at each end. In the event of split systems, this includes both outdoor and indoor components;
- Any radio system hot standby switches;
- feeder cables;
- waveguides;
- cable tails;
- antennas; and
- The radio path itself (frequency allocation and path obstruction management).

5.2.3.3 Long-haul radio systems

TasNetworks' microwave radio backbone utilises long-haul microwave radio's operating an STM-1 (155Mbps) bearer in an n+1 configuration. The standby bearer is utilised as an itinerant bearer (being low priority traffic the itinerant bearer traffic is shut down and replaced by the traffic on the main bearer in the event of a failure on the main bearer). In order to operate in an n+1 configuration, the radio systems must operate using frequency diversity (all of the bearer channels operate on a separate licensed frequency channel within the radio's frequency band).

5.2.3.4 Short-haul radio systems

Short-haul radios are provided on the network outside the backbone. The installations of the short-haul radios range from the early 2Mbps radios to the latest version of STM-1 radio. A number of these radio links are provided as 1+0 (unprotected bearer) however the majority of the systems employ a 1+1 (hot-standby) configuration. All future radio installations will utilise 1+1 hot-standby as the minimum configuration due to the increased criticality of the circuits.

In order to minimise the rain fading effects encountered at higher microwave radio frequencies, TasNetworks' telecommunications systems generally utilise spur radios at 7.5GHz, 8GHz, 10.5Ghz and 11GHz. Some of the shorter, more robust radio paths may utilise the 18GHz bands. There is one spur radio link currently operating in the 1.5GHz band.

5.2.3.5 Low Capacity Radio Systems

TasNetworks operate low capacity radio in the 900MHz frequency band for some of the last mile radio links. The MDS 960D are the older models providing 384 kbps and are being phased out, whilst the newer low capacity radios are the Aprisa XE radios providing a capacity up to 1024 kbps.

5.2.3.6 Telecommunications Digital Radio Equipment Asset Age Profiles and Asset Count

The age profiles and asset counts of TasNetworks' Digital Radio Equipment are shown in the following tables and graphs.

Table 5 - Telecommunications Digital Radio Equipment Age Profile and Asset Count

Telecommunications Digital Radios Equipment Type	Average of Equipment Age (Years)	Number of Assets
Aprisa XE (1.5 GHz)	5.82	1
Aprisa XE (900 MHz)	8.82	2
Codan 7700 (10.5 GHz)	13.82	4
Codan 7700 (7.5 GHz)	15.82	2
Codan 8800 (23 GHz)	10.82	1
Fujitsu FRX3 (6 GHz)	1.09	18
iPasolink (11 GHz)	2.23	25
iPasolink (18 GHz)	1.79	8
iPasolink (8 GHz)	2.12	5
iPasolink (80 GHz)	1.07	1
NEC 2500 (8 GHz)	19.82	1
NEC 970D (8 GHz)	22.39	7
Pasolink (11 GHz)	7.82	12
Total		**87**

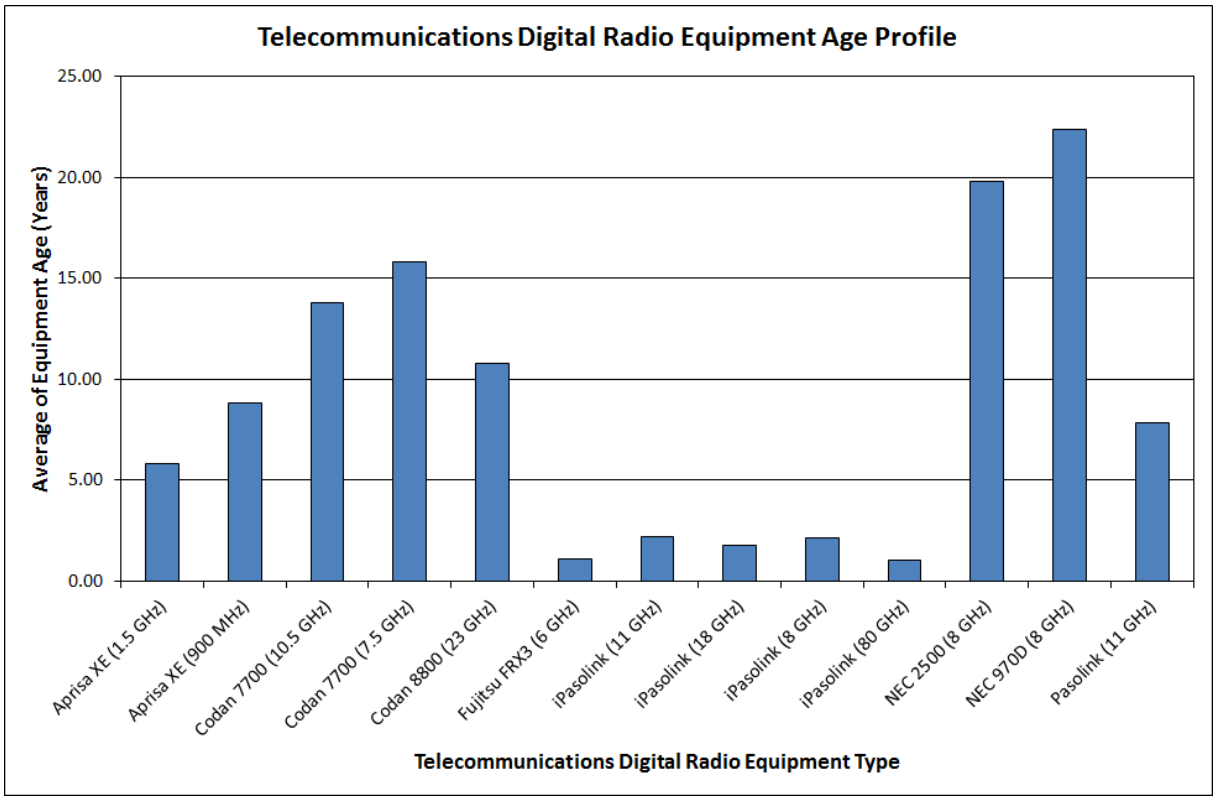

Figure 7 - Telecommunications Digital Radio Equipment Age Profile

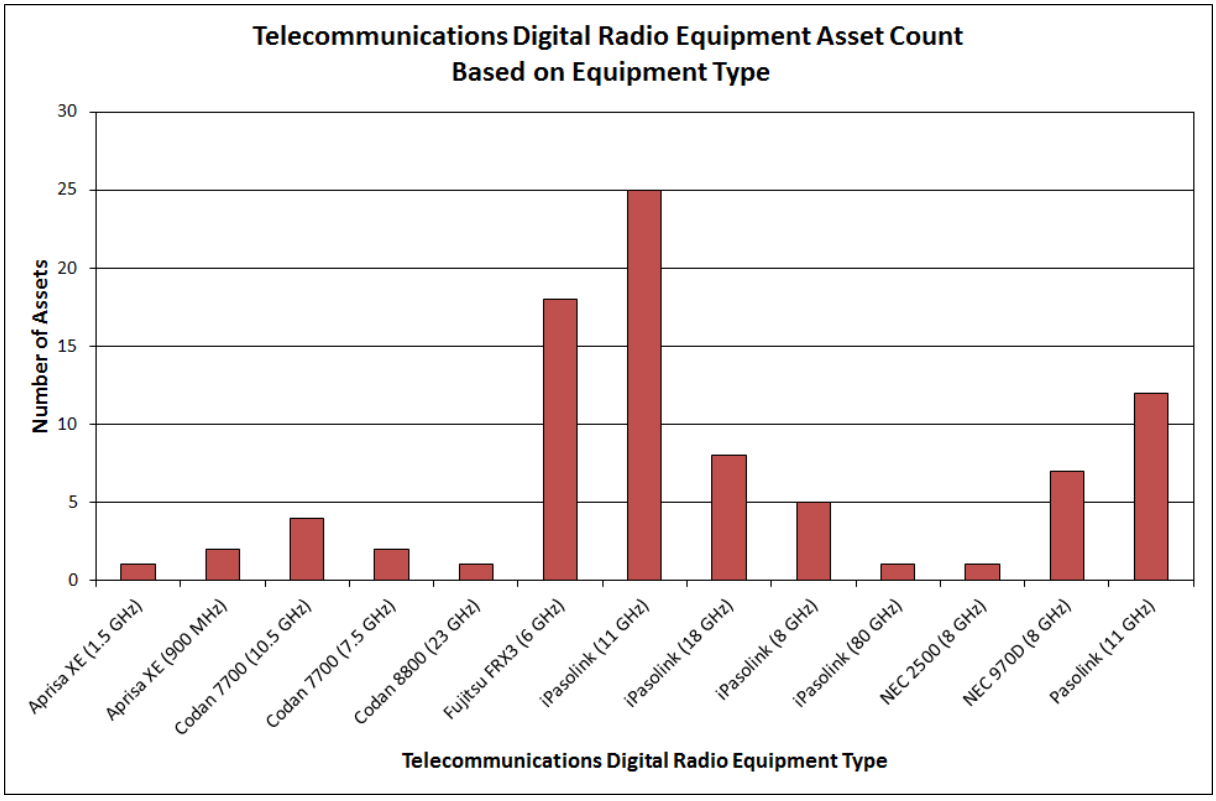

Figure 8 - Telecommunications Digital Radio Equipment Asset Count Based on Equipment Type

5.2.4 Power line carrier

Power line carrier (PLC) is a technique for transferring critical telecommunications circuits over the conductors of electric power transmission lines. This option is used when the choice of optical fibre or microwave radio is not possible or feasible.

The power line carrier equipment includes the following components at each end of the electric power transmission line:

- the power line carrier terminal equipment;
- the power line carrier coupling equipment; and
- the line traps.

Telecommunications technology continues to advance and the demands placed on the technology move with the overall industry advancements. With power line carrier being a very narrow band bearer, the medium for communications becomes a significant barrier to the higher bandwidths. This, in turn, prevents the full variety of telecommunications services from being offered on this type of bearer.

The bandwidth restriction is determined by the poor frequency response of the electric power transmission lines. Alternating current power transmission lines in Australia are designed for the power system frequency of 50Hz and not to the frequencies required for telecommunications carriers. The systems currently in use by TasNetworks operate with 2 channels each providing 1 circuit for protection and 1 circuit for SCADA or telephony on each system.

The theoretical maximum capacity of modern power line carrier equipment is 256kbps, however, the actual transmission line characteristics and installation conditions will most likely reduce this figure dramatically. TasNetworks' use of power line carrier bearers is currently restricted to the Mersey Forth region where power line carrier is the backup telecommunications bearer.

5.2.4.1 Asset age profile and asset count

The current fleet of telecommunications power line carrier equipment age profile and asset count are shown in the following tables and graphs.

Table 6 - Power Line Carrier Equipment

Power Line Carrier Equipment Device Types	Average of Equipment Age (Years)	Number of Assets
Dimat OPC-1	21.82	10
Total		**10**

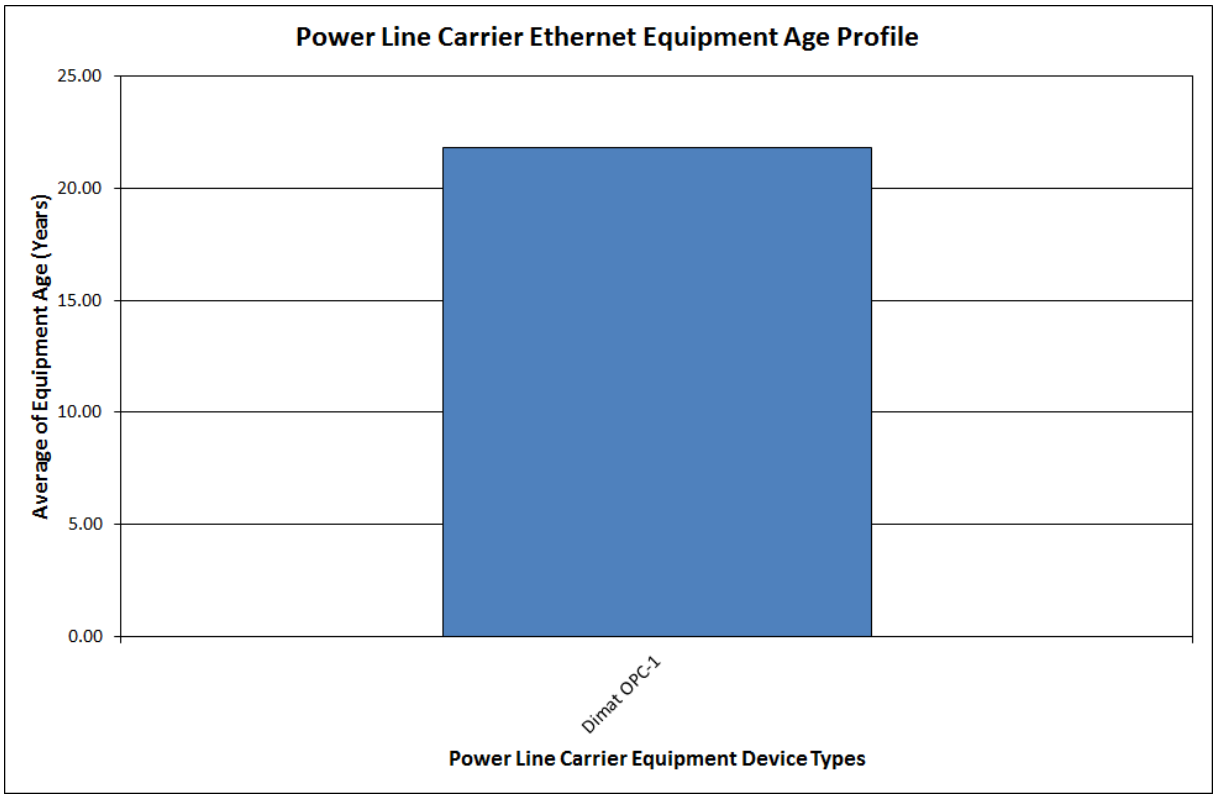

Figure 9 - Power Line Carrier Ethernet Equipment Age Profile

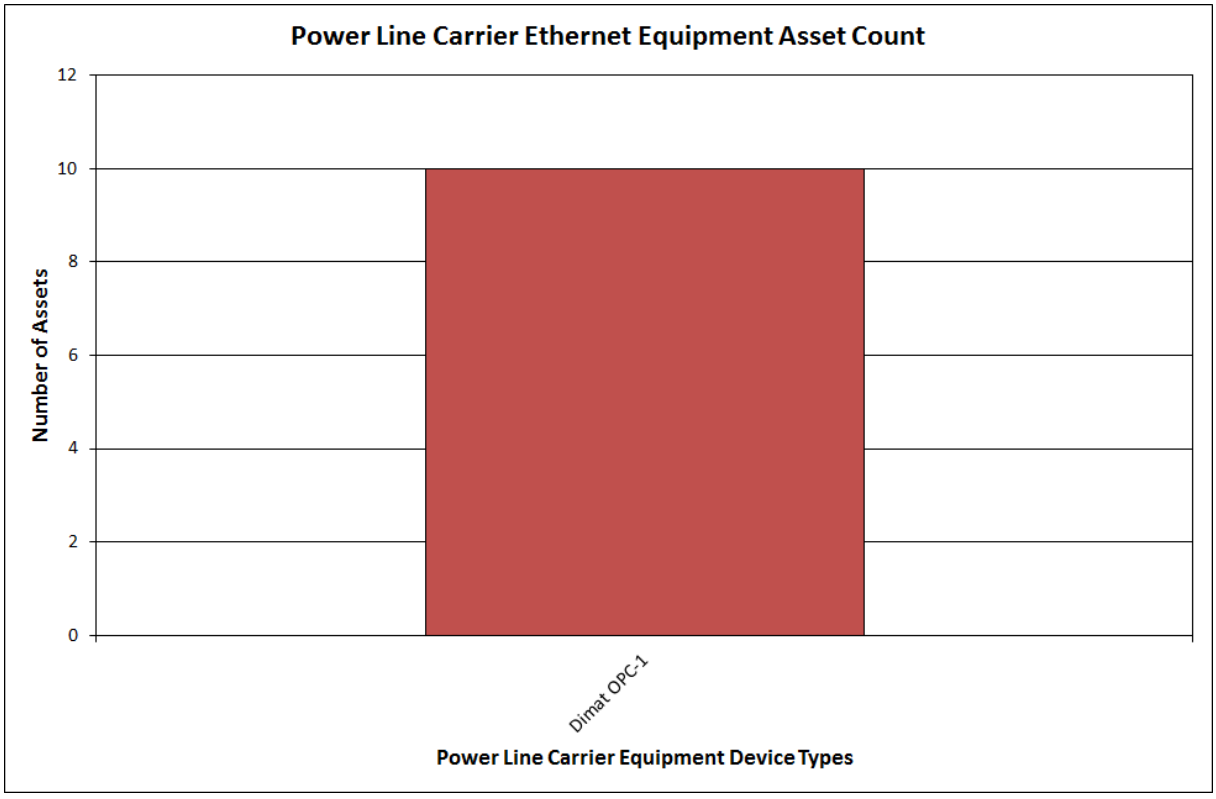

Figure 10 - Power Line Carrier Ethernet Equipment Asset Count

5.2.5 Multiplexing equipment

Multiplexing equipment is used to aggregate a large number of circuits into a single digital data stream for transmission across a digital radio or optical fibre bearer. Depending on the card configurations in the multiplexer chassis, the equipment can provide transport services, cross-connection services and the integration of individual channels of differing interfaces into the data stream. The multiplexing equipment is the basis for the data/channel switching around the network.

The current multiplexing equipment is based on the ITU-T G.703 standard for PDH portions and on ITU-T G.707 for the SDH interfaces; however, the proprietary portions of the standards contribute to the overall feature set of the equipment. The standards approach to the interfaces means that the equipment from various manufacturers will interact with each other, but the full features incorporated in the proprietary sections) usually don't transfer. For this reason, the multiplexer units comprise a part of the multiplexer system, and where possible the multiplexer system comprises only fully compatible units. Any multiplexer upgrades are undertaken as the complete system or as carefully managed staged upgrades.

TasNetworks' multiplexing system is based on the Nokia Siemens Networks FMX suite of products. The FMX products comprise the individual circuit interfaces, the cross connect equipment, low capacity optical fibre bearer channels, PDH and SDH transport interfaces. From an asset management perspective, the multiplexer is considered as a unit comprising the chassis and all of the included cards.

5.2.5.1 Asset age profile and asset count

The current fleet of telecommunications multiplexing equipment age profile and asset count are shown in the following tables and graphs.

Table 7 - Telecommunications Multiplexing Equipment

Telecommunications Multiplexing Equipment Device Types	Average of Equipment Age (Years)	Number of Assets
MDS MX2000	15.96	7
Nokia Mux/Changeover	13.82	2
Siemens FMX Shelf	11.11	190
Total		**199**

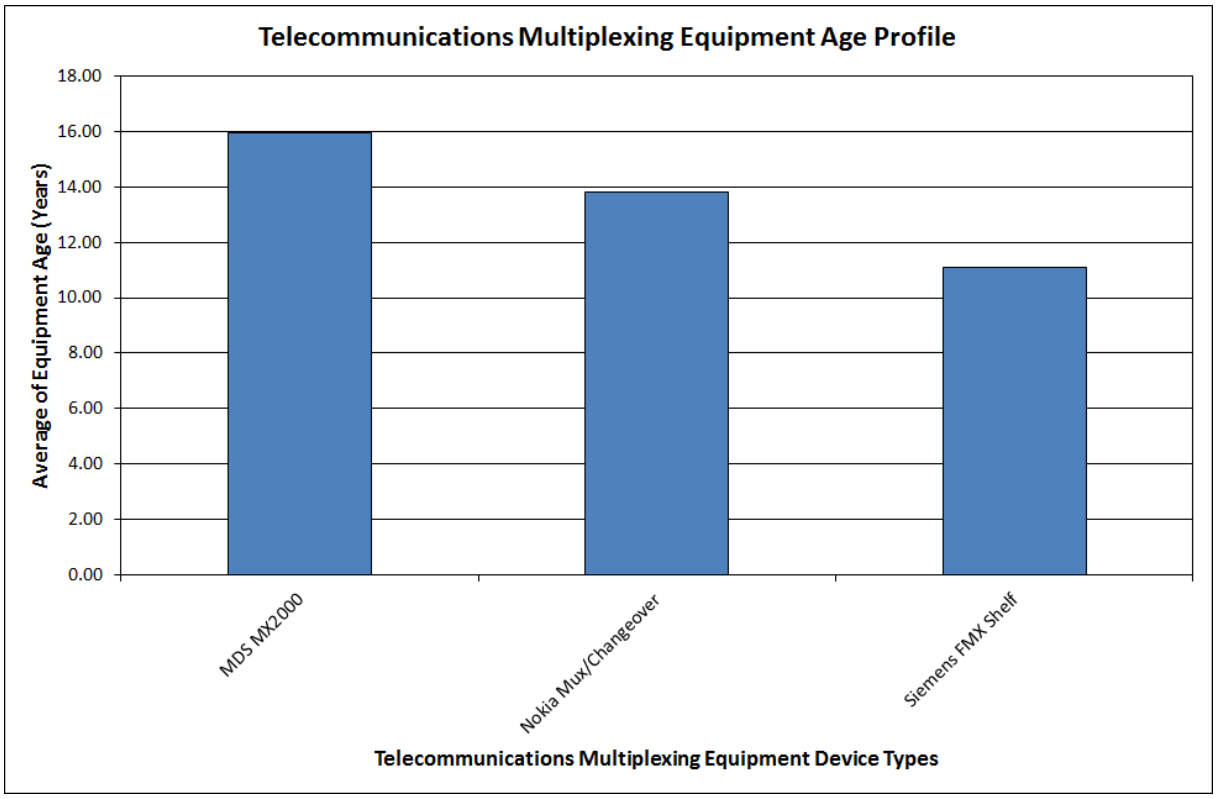

Figure 11 - Telecommunications Multiplexing Equipment Age Profile

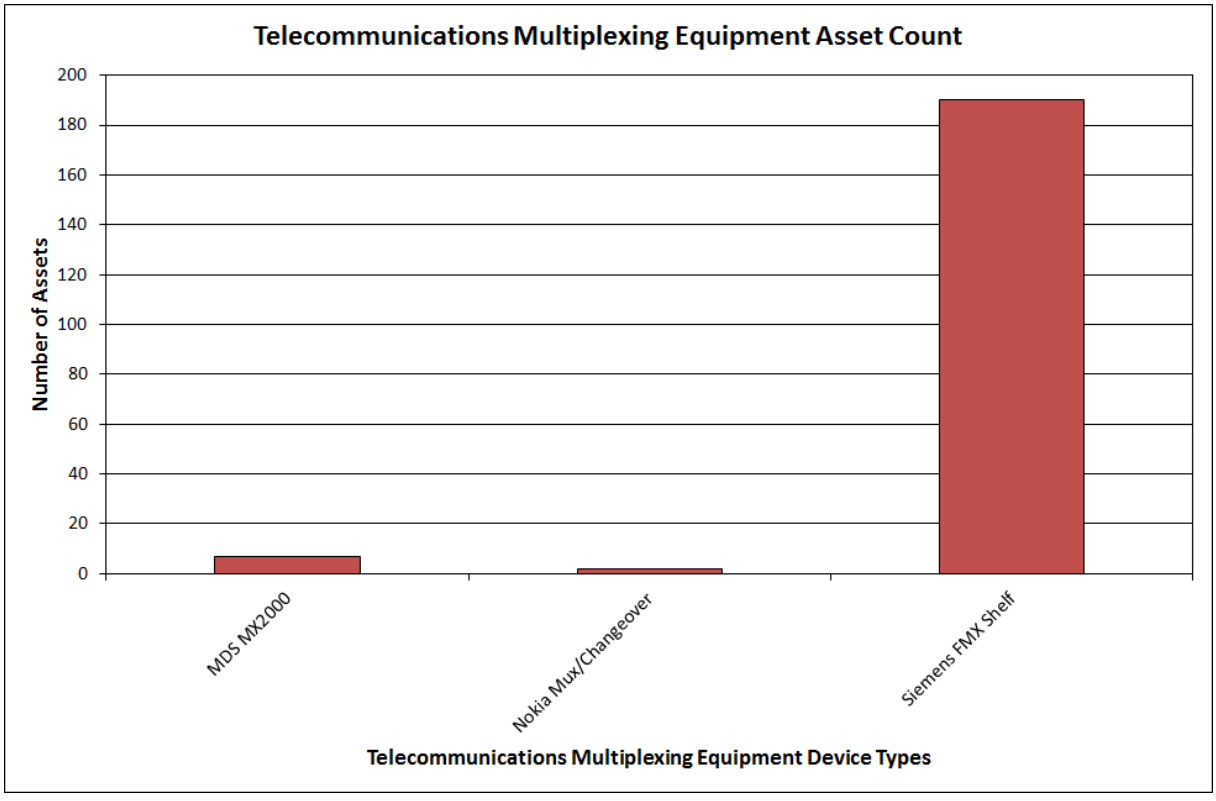

Figure 12 - Telecommunications Multiplexing Equipment Asset Count

5.2.6 Telecommunications Network Supervisory Equipment

The supervisory equipment provides a number of alarm and control monitoring points for efficient network surveillance. The supervisory system comprises the data gathering and the networking equipment and includes the Data Communications Network (DCN) enabling the signalling to be returned to, and sent from, the control system servers. The DCN is the main management system for monitoring the bearer network components, the physical infrastructure and the overlay networks (such as the telephone system).

The supervisory system components are:

- The Programmable Logic Controllers (PLCs);
- Supervisory system Ethernet Routers; and
- Supervisory system Ethernet switches

5.2.6.1 Programmable Logic Controllers (PLCs)

The alarm monitoring network is established utilising a master/slave PLC arrangement.

5.2.6.1.1 Master PLCs

The master PLCs communicate directly with the alarm management server over the DCN. The Siemens S7-300 is installed as the master PLC unit at sites designated as master sites in the supervisory network. Each master PLC can have a total of 16 slave PLC units. There is 1 S7-300 PLC at each of the master supervisory sites.

5.2.6.1.2 Slave PLCs

The Siemens S7-200 PLCs are provided as slave PLC units providing details of alarms to one of the master PLCs for notification to the telecommunications network management system. The TasNetworks' Telecommunications network utilises Siemens S7-200 PLCs.

5.2.6.2 Supervisory Interfacing Equipment

5.2.6.2.1 Siemens SISA GK/E

The Siemens SISA GK/E provides the Ethernet conversion at the sites to establish the QD2 management interface required by the Siemens FMX and PLC equipment. The Siemens SISA GK/E unit is installed at sites designated as master sites in the supervisory network. There are master sites in the network with a Siemens SISA GK/E unit installed.

5.2.6.2.2 Siemens OSUR

The Siemens OSUR provides a QD2 conversion and distribution to the various assets requiring management at the sites. The QD2 conversion alters the master/slave configuration as appropriate. The Siemens OSUR is utilised at sites designated as master sites in the supervisory network. The QD2 interface provides for the management of the multiplexer equipment. There are selected master sites in the network with a Siemens OSUR installed. Each master site is capable of managing only 32 independent multiplexer shelves.

5.2.6.3 Supervisory Ethernet Equipment

5.2.6.3.1 Supervisory system Ethernet routers

5.2.6.3.1.1 Cisco 2600 routers

In order to provide the network for the remote alarm gathering and system review of the telecommunications system, a secured telecommunications supervisory Ethernet system has been established. The network uses standard IT networking hardware which generally has a service life of 5 years as outlined in the Ethernet Bearer System Asset Management Plan. The Cisco 2600 router product was the first of the devices deployed for the implementation of the network from 2003. A project for the replacement of the 10 remaining Cisco 2600 routers will be undertaken in

5.2.6.3.1.2 Cisco 2811 routers

The Cisco 2811 Router is a later generation device which fits the network as an adequate replacement (with full compatibility) for the 2600 router. One 2811 router has been installed in the network in expanding the DCN to Waddamana substation however these devices are no longer available. This Router will not be replaced in the DCN router replacement project.

5.2.6.4 Asset age profile and asset count

The current fleet of telecommunications supervisory equipment age profile and asset count are shown in the following tables and graphs.

Table 8 - Telecommunications Supervisory Equipment

Telecommunications Supervisory Equipment Device Types	Average of Equipment Age (Years)	Number of Assets
Cisco 2811 Router	7.81	1
Cisco 2900 Router	3.81	15
Siemens S7-200 PLC	10.82	109
Siemens S7-300 PLC	13.54	11
Siemens SISA GKE	13.36	11
Siemens SISA OSUR	13.54	11
Total		**158**

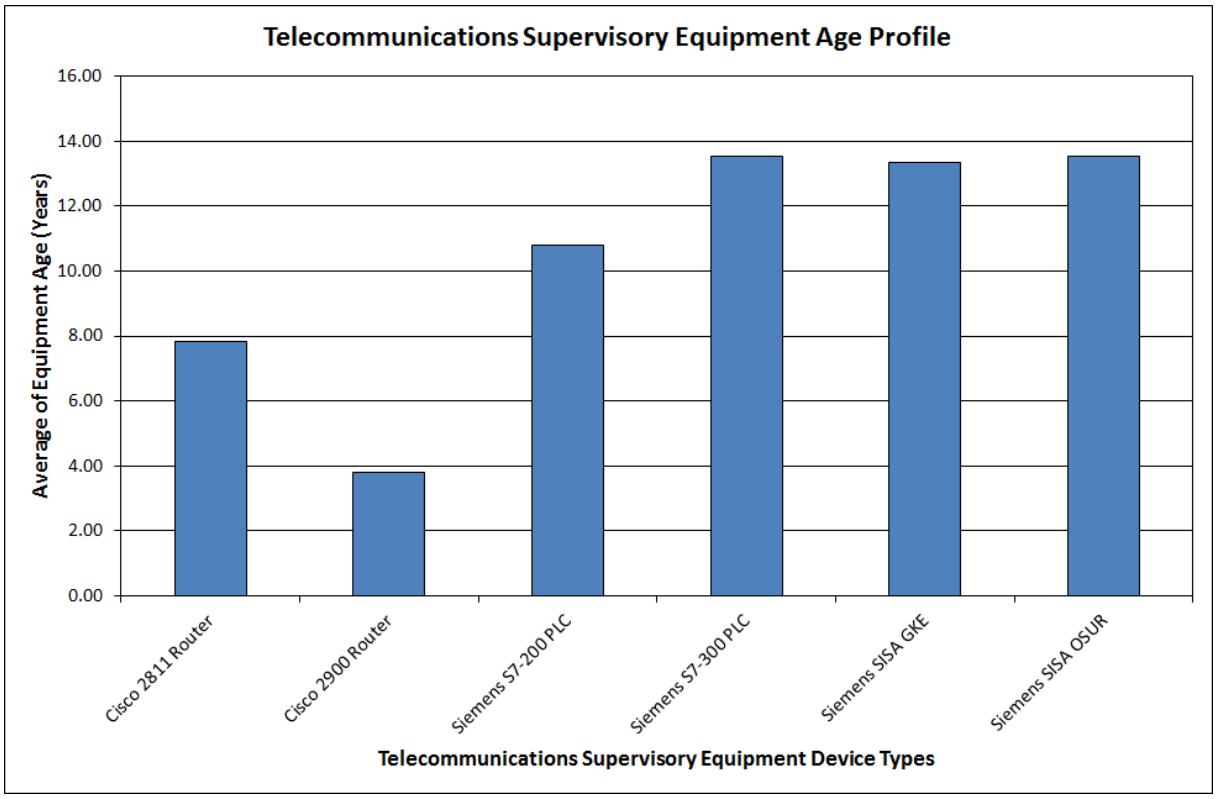

Figure 13 - Telecommunications Supervisory Equipment Age Profile

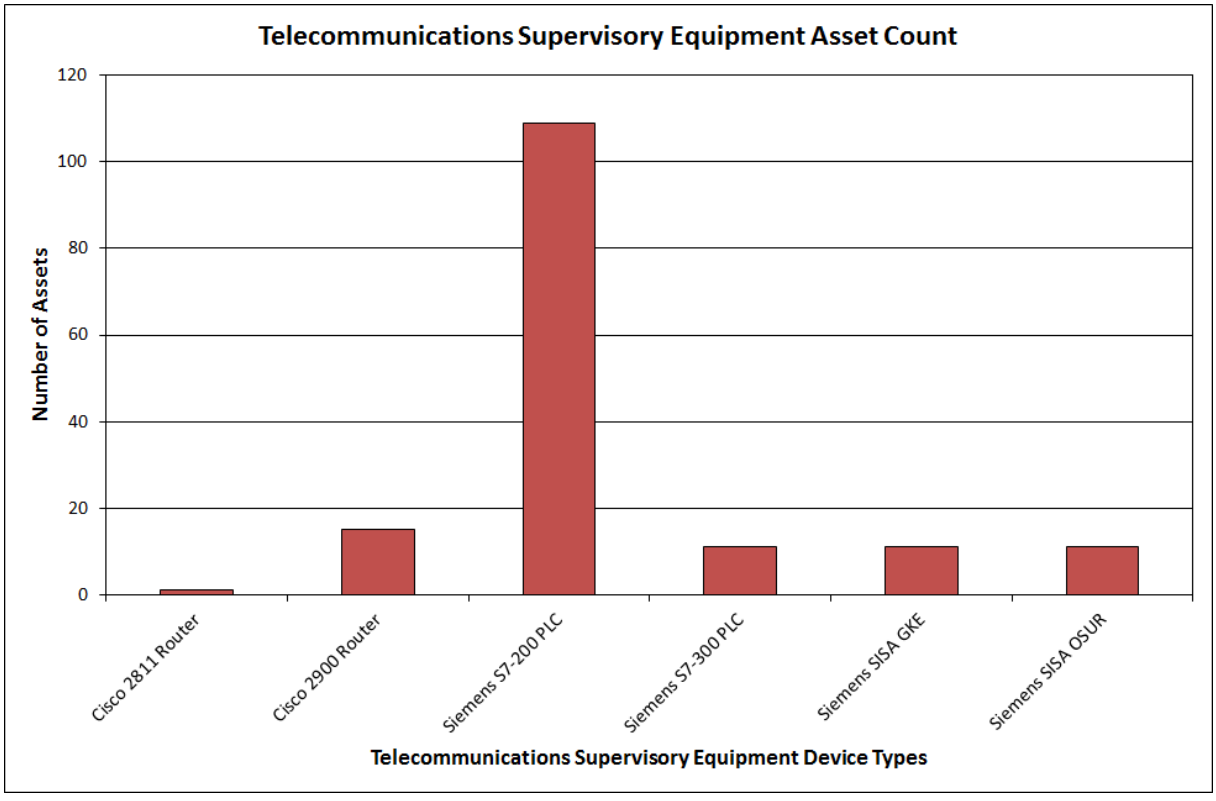

Figure 14 - Telecommunications Supervisory Equipment Asset Count

5.2.7 Network Synchronisation/Timing Equipment

With the bearer network based on the Synchronous Digital Hierarchy (SDH) technology, a high quality, stable network timing system is crucial for the ongoing operation of the network. In order to maintain a stable synchronisation system, 12 stabilised GPS referenced timing sources are deployed. The GPS timing sources utilised by TasNetworks are atomic stabilised Primary Reference Clocks (PRC) enabling the telecommunications network to meet the ITU-T G-811 network Primary Reference Source performance standard. The timing sources utilise atomic Rubidium to offer a minimum accuracy of:

- 1 part x 10^{-12} (24 hour average); and
- 2 parts x 10^{-10} (5 minute average)

The other use for these precision clocks is to provide a primary reference the real time clocks of devices connected to the telecommunications network. This information is critical for timestamping which needs to be accurate to at least a millisecond.

The timing synchronisation system is vital to maintaining a safe, secure and reliable telecommunications network. The network device clocks are designed to synchronise to a hierarchy of sources (based on proximity and accuracy) which ensure at all times that time synchronisation is achieved across the entire telecommunications network.

The network utilises 3 different models of the Primary Reference Clocks each complying with the ETSI recommendation for a Primary Reference Clock (EN 300 462-6-1 V1.1.1). These clocks are:

- Symmetricom OT-21e
- Timesource 3600
- Timeprovider 100

A description of these standard clock models is provided in the following sections.

5.2.7.1 Current standard makes and models

5.2.7.1.1 Symmetricom OT-21e

The Symmetricom OT-21e is the oldest of the timing sources on the TasNetworks' telecommunications network. It was originally manufactured by Datum, however was replaced by the Timesource 3600 following the acquisition of Datum by Symmetricom.

The Symmetricom OT-21e provides up to 10 balanced output ports and 2 balanced input ports for the distribution and synchronisation of the telecommunications network. The Symmetricom OT-21e is deployed at 7 sites at the core of the TasNetworks telecommunications network.

5.2.7.1.2 Timesource 3600

The Timesource 3600 is the replacement to the Symmetricom OT-21e and is the largest of the current range of timing sources deployed on the TasNetworks' telecommunications network. Similar to the Symmetricom OT-21e, the Timesource 3600 provides up to 10 timing outputs. However, the timing outputs of the Timesource 3600 are unbalanced, meaning a dedicated unbalanced to balanced signal converter is required for each of the utilised timing source output ports. As with the Symmetricom OT-21e, the Timesource 3600 is deployed at the core of the network, however these clocks are only utilised at 3 sites.

5.2.7.1.3 Timeprovider 100

The Timeprovider 100 is a small GPS clock solution suitable for use in synchronous islands and remote locations. The Timeprovider 100 has 4 unbalanced outputs. This clock is currently used at 2 sites which originally operated as synchronous islands.

5.2.7.1.4 Asset age profile and asset count

The current fleet of network synchronisation equipment age profile and asset count are shown in the following tables and graphs.

Table 9 - Network Synchronisation/Timing Equipment

Network Synchronisation/Timing Equipment Device Types	Average of Equipment Age (Years)	Number of Assets
Datum OT-21e	13.39	7
Timeprovider 100	5.61	5
Timesource 3600	10.56	4
Total		**16**

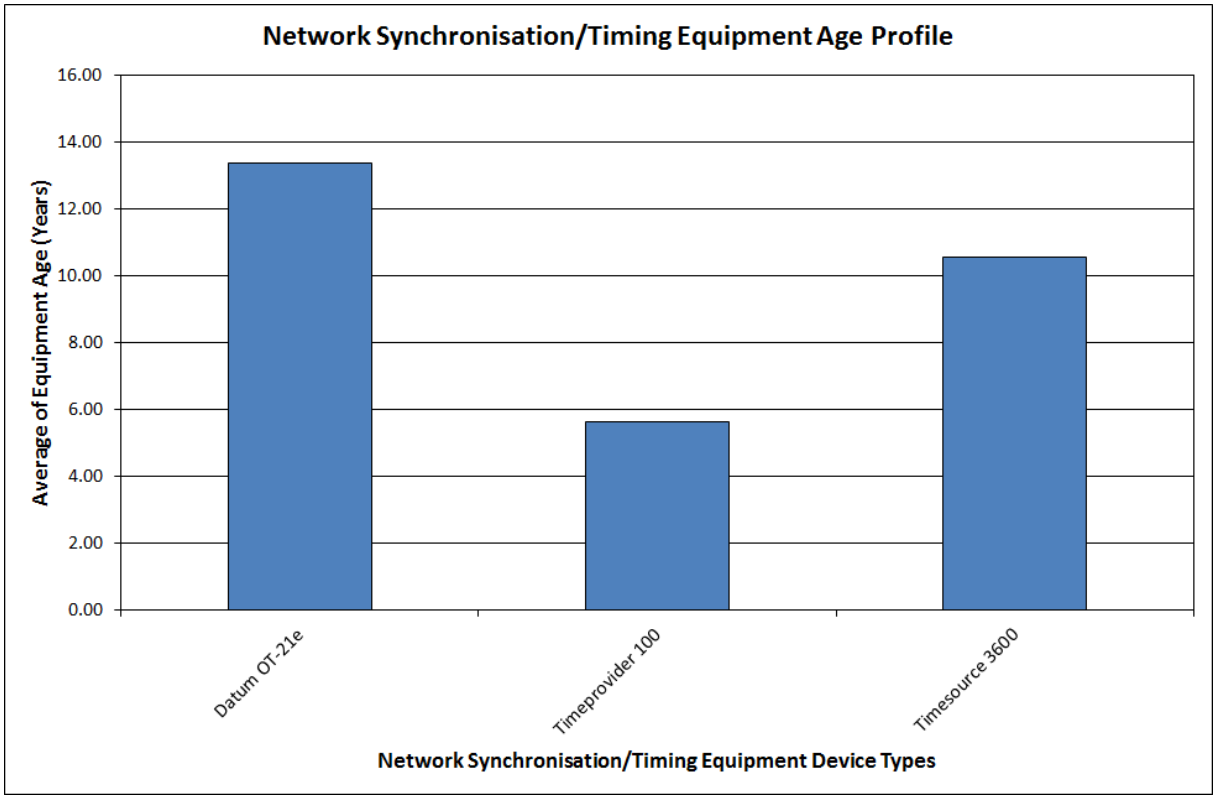

Figure 15 - Network Synchronisation/Timing Equipment Age Profile

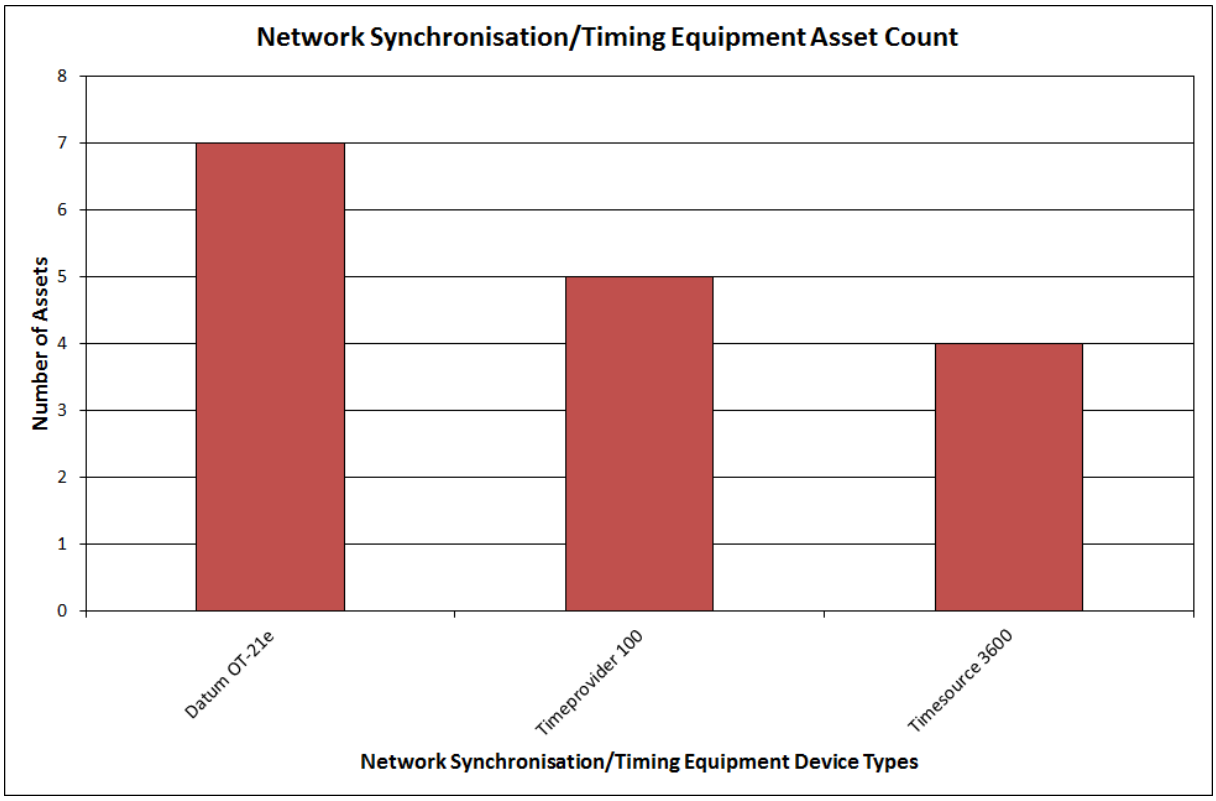

Figure 16 - Network Synchronisation/Timing Equipment Ethernet Equipment Asset Count

5.3 TasNetworks Ethernet Systems

5.3.1 Overall description

TasNetworks' utilises the following Ethernet based networks in the following major categories:

- **Corporate data network –** Ethernet networking for corporate and administrative purposes throughout TasNetworks;
- **IEEE 802.11 Wireless Networking/Wi-Fi –** this is a wireless extension to the corporate data network;
- **NOCS network –** central Ethernet networks for the NOCS infrastructure; and
- **Carrier Ethernet MLPS Network –** Carrier grade Ethernet transport services.

These 4 main Ethernet based networks are supported by the telecommunications bearer network via the provision of managed services or via direct connections using dark fibres on the TasNetworks' telecommunications bearer network.

These main network categories are described in the following sections.

5.3.1.1 Corporate data network

The TasNetworks' Corporate Data Network has been designed and constructed to provide high performance data services for the following corporate applications:

- Data communications between Ethernet based equipment such as:
    - computers (workstations and servers);
    - printers, multifunction centres, and plotters;

  - network attached storage;
  - smart televisions and displays;
  - building security systems;
  - power monitors; and
  - other Ethernet based devices.
- VoIP based telephony equipment which is covered under the Telecommunications Telephony and Voice Systems Asset Management Plan.
- Connection of IEEE 802.11 wireless networking access points and security gateways to the corporate data network.

The corporate data network includes Ethernet equipment and cabling to facilitate the connection of:

- Data centres;
- Local and remote work sites and offices;
- IP Telephony networks;
- Computer and data networks;
- Connections to external organisations (AEMO for example) and;
- Internet router equipment.

5.3.1.2 IEEE 802.11 Wireless Networking

The IEEE 802.11 Wireless networking equipment is an extension of the corporate data network providing secured access to:

- TasNetworks' provisioned corporate mobile devices and mobile computers;
- A secured contractor network; and
- A secured guest network.

All have different security access permissions and isolation levels to reduce the risk of unauthorized access and privilege escalation. This is especially critical for these networks as they have range outside TasNetworks' sites on unlicensed radio bands.

5.3.1.3 NOCS network

The NOCS networks are secured LAN environments setup for the operational control system of the transmission and distribution electricity networks. The network includes high levels of redundancy, physical security, and cyber security measures. Firewalls are used to secure and segregate this network from the corporate data network and external data networks (AEMO and AEMO registered generators).

The age profile and asset counts for NOCS Ethernet equipment are shown in the following table and graphs.

Table 10 - NOCS Ethernet Equipment

NOCS Ethernet Equipment Device Types	Average of Equipment Age (Years)	Number of Assets
Cisco ASA5520	3.40	4
Cisco CGS2520	4.11	4
Cisco IE-3000-8TC	4.81	11
Juniper EX2200-C-12P-2G	3.40	2
Juniper EX4200	4.81	1
Juniper EX4300-48P	3.40	2
Juniper EX4500	3.40	2
Juniper J2350	6.32	10
Juniper J6350	6.32	3
Juniper SRX240	3.03	53
Juniper SRX550	2.27	2
NSN 6610 (S215)	6.82	1
NSN 6610 (S312)	6.07	2
NSN 6615 (S323)	5.81	33
NSN 6615 (S332)	6.49	20
NSN S311	6.32	2
RAD RICi 4	9.48	18
RAD RICi 8	8.10	14
Site Data Cabinet	4.84	20
Total		**204**

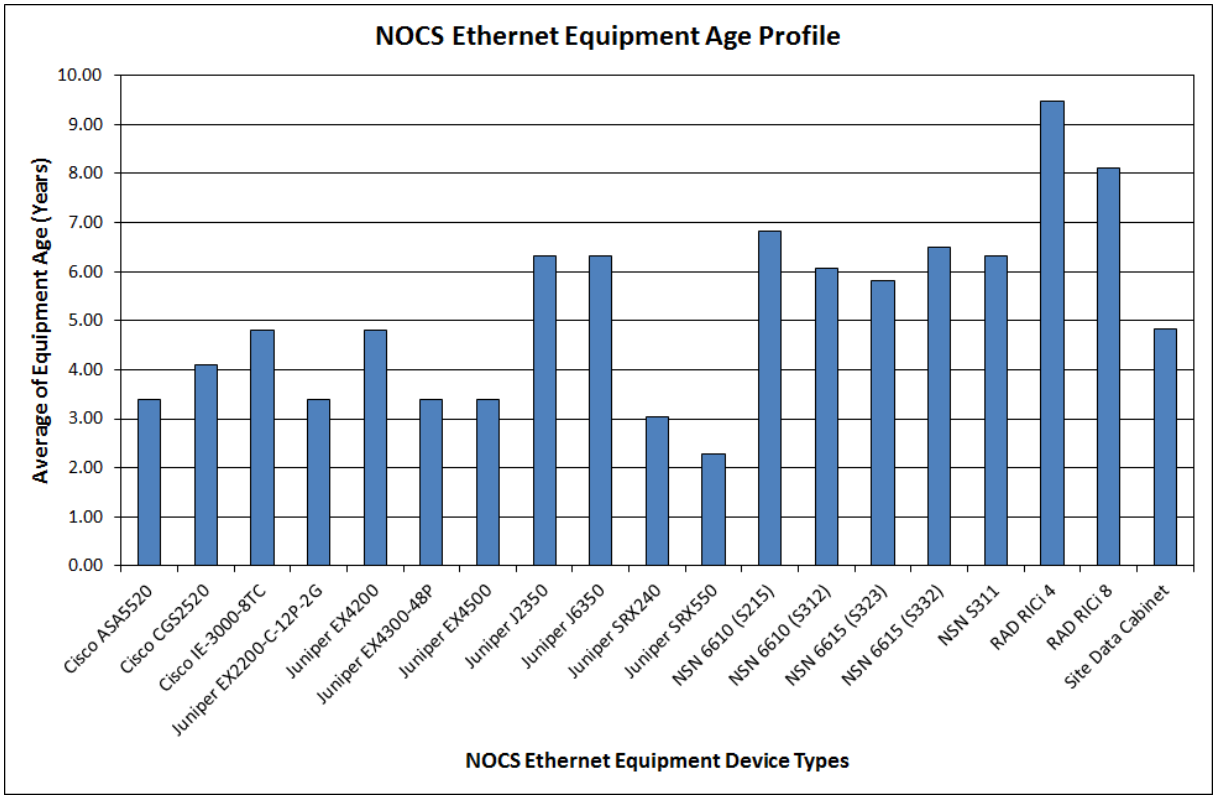

Figure 17 - NOCS Ethernet Equipment Age Profile

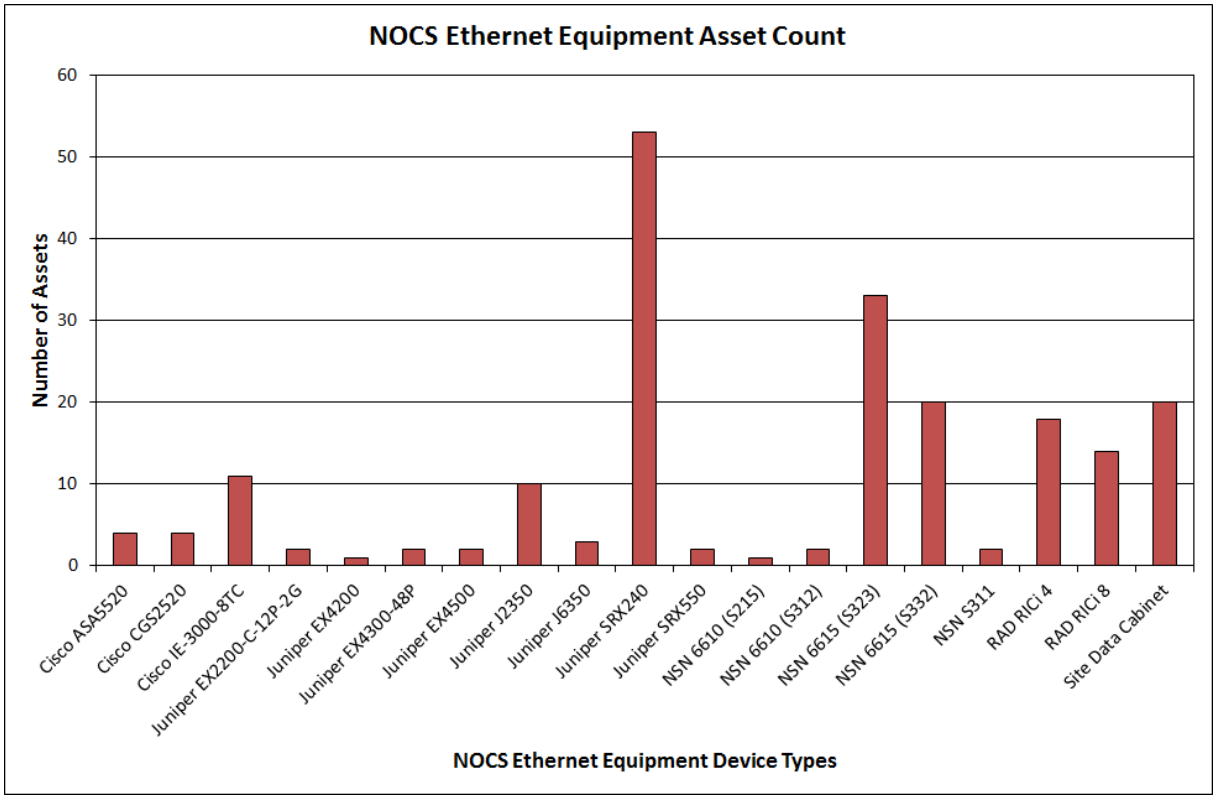

Figure 18 - NOCS Ethernet Equipment Asset Count

5.3.1.3.1 NOCS Distribution Zone Substation Ethernet Network

The NOCS Distribution Zone Substation Ethernet Network is an operational Ethernet network connecting selected zone substation for operational SCADA use. This network also connects to NOCS.

The age profile and asset counts for the NOCS Distribution Zone Substation Ethernet network equipment are shown in the following table and graphs.

Table 11 - NOCS Distribution Zone Substation Ethernet Network Equipment

NOCS Distribution Zone Substation Ethernet Network Equipment Device Types	Average of Equipment Age (Years)	Number of Assets
Cisco IE-3000-8TC	4.52	12
Total		**12**

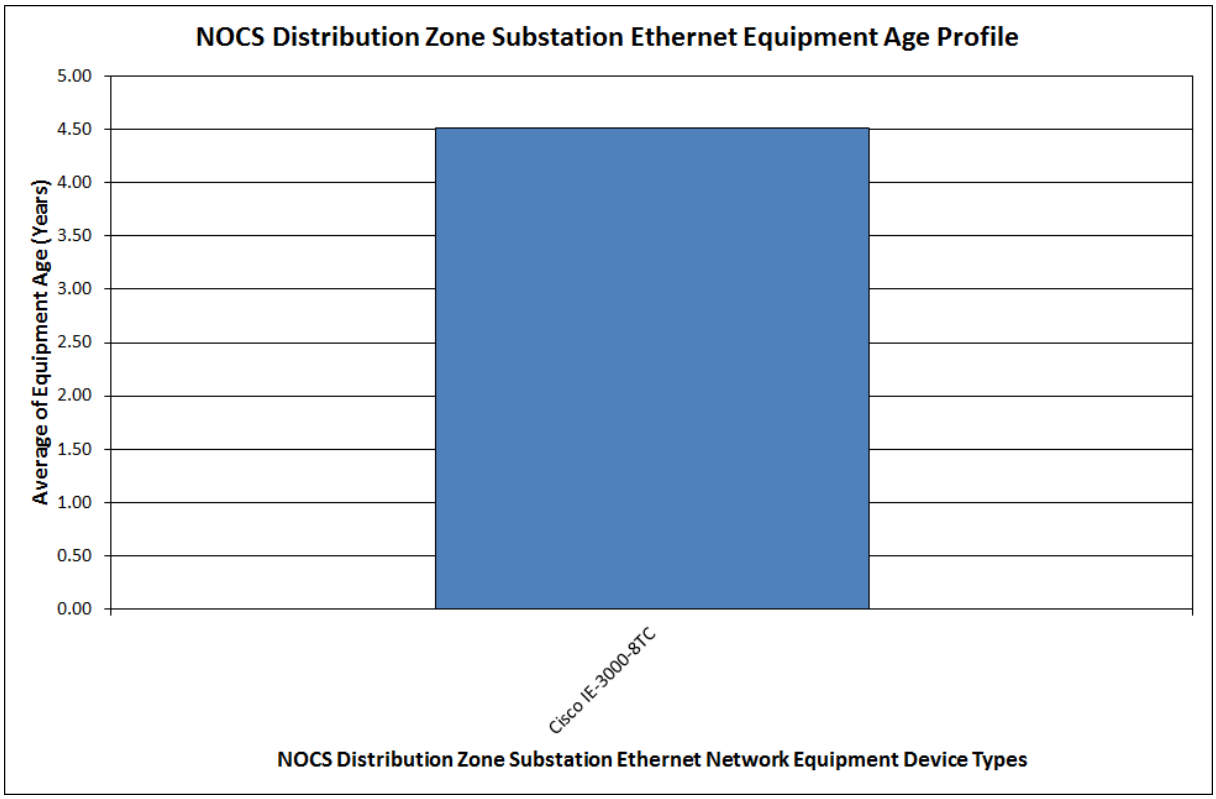

Figure 19 - NOCS Distribution Zone Substation Ethernet Equipment Age Profile

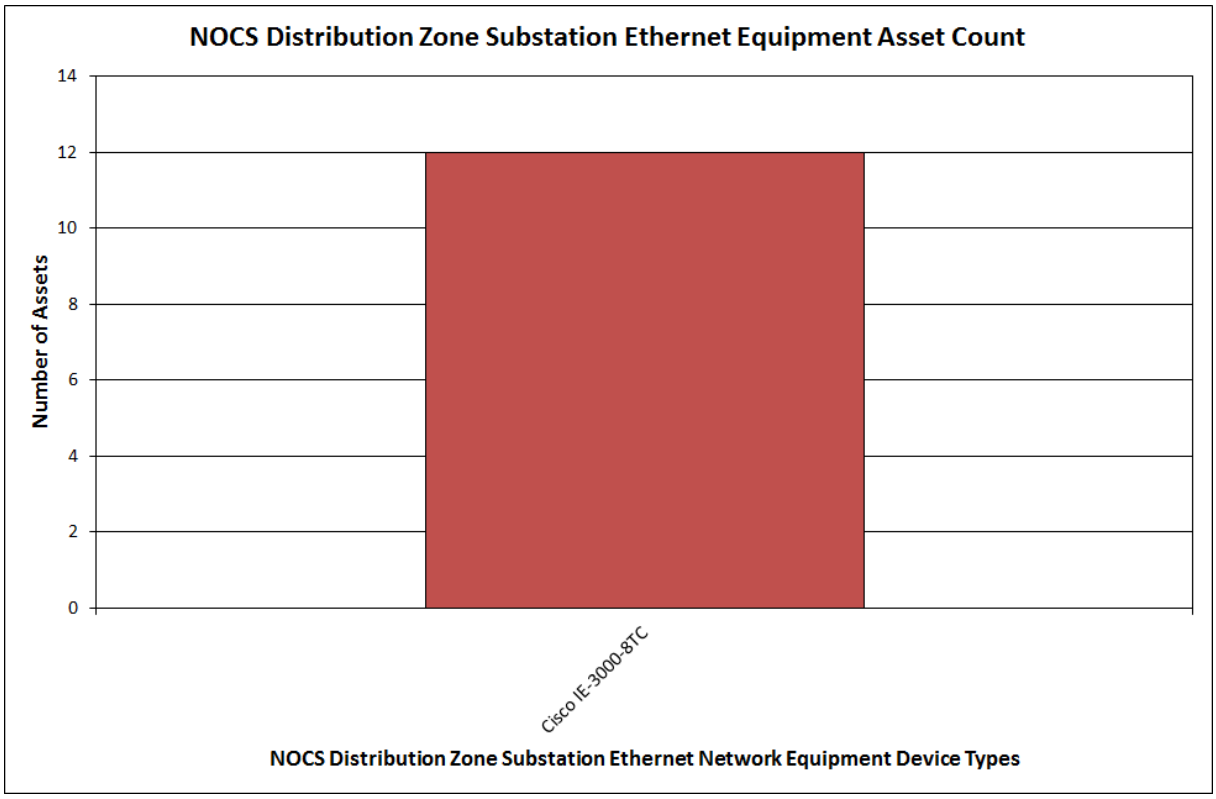

Figure 20 - NOCS Distribution Zone Substation Ethernet Equipment Asset Count

5.3.1.4 Carrier Ethernet MPLS network

The carrier Ethernet MPLS network provides a high availability Ethernet transport service over which the multiple virtual networks can operate. The network separation features available in the carrier Ethernet network allows the secure provision of these transport services to multiple subscribers over the same network infrastructure. Separated networks are implemented on the carrier Ethernet infrastructure for the TasNetworks' corporate data communications network, the internal telephony and voice network, security network and the operational substation WAN. The carrier Ethernet infrastructure is used for other WAN applications where appropriate.

The age profile and asset counts for the Carrier Ethernet equipment are shown in the following table and graphs.

Table 12 - Carrier Ethernet Equipment

Carrier Ethernet Equipment Device Types	Average of Equipment Age (Years)	Number of Assets
Juniper ACX1100	0.56	1
Juniper EX4200	4.81	1
Juniper J2350	6.31	1
Juniper J6350	6.31	1
Juniper MX104	0.98	6
Juniper MX5	1.06	1
Juniper SRX240	2.53	62
Juniper SRX550	1.23	14
NSN 6610 (S215)	6.81	1
NSN 6610 (S312)	6.06	2
NSN 6615 (S323)	7.06	2
NSN 6615 (S332)	6.60	19
NSN S311	6.31	2
Total		**113**

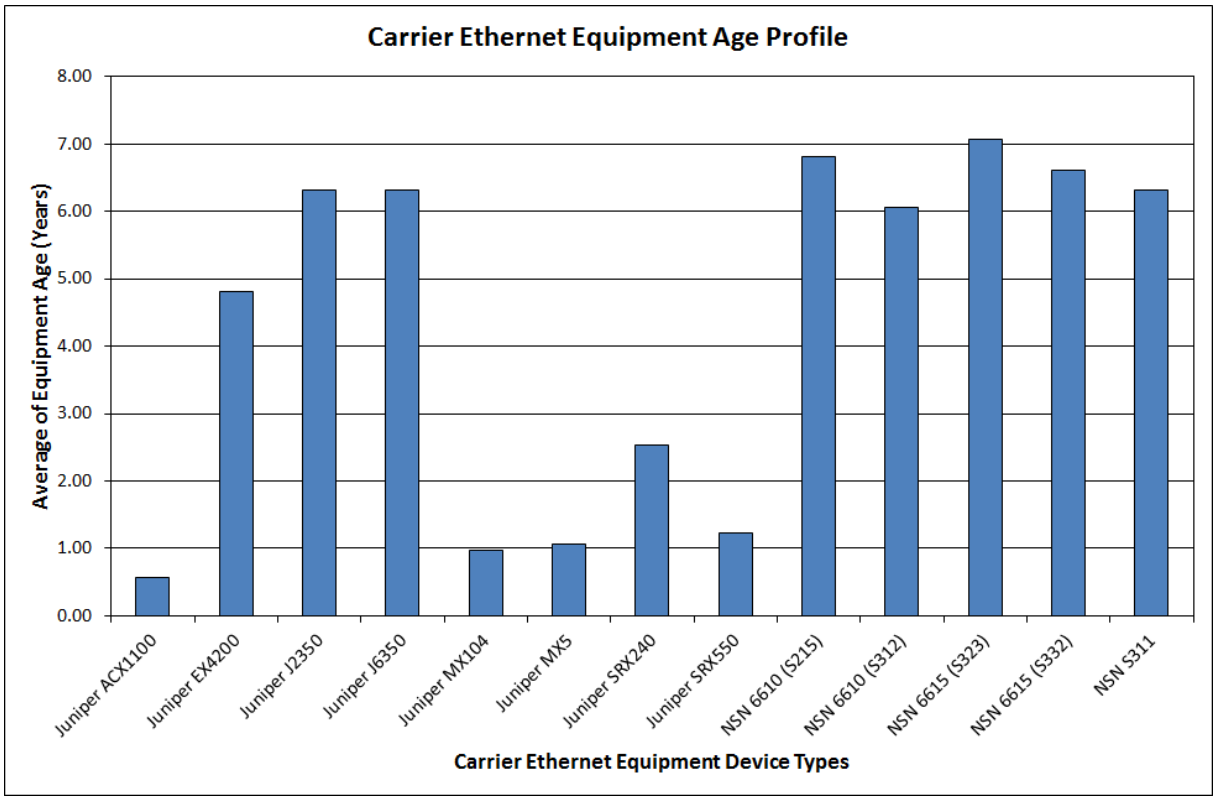

Figure 21 - Carrier Ethernet Equipment Age Profile

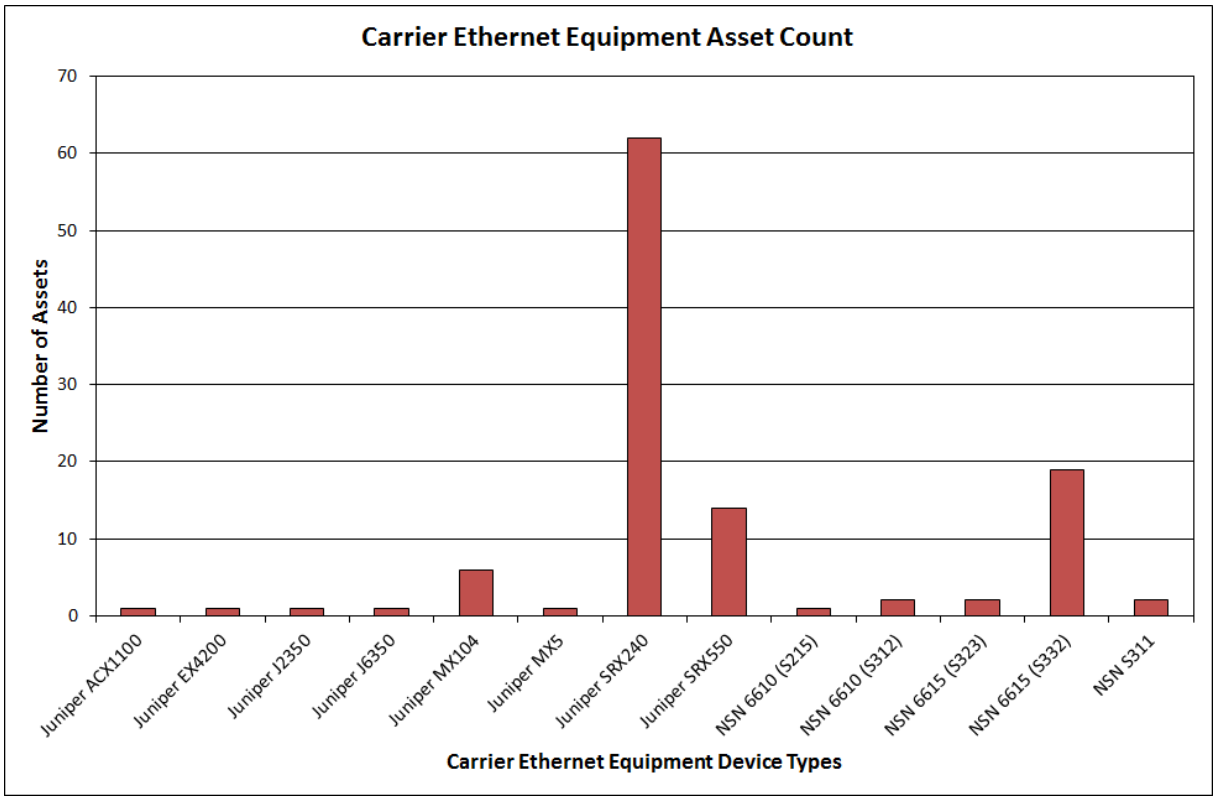

Figure 22 - Carrier Ethernet Equipment Asset Count

5.3.1.5 Ethernet extenders

In addition to the above Ethernet networks, there are direct Ethernet channels on the TasNetworks' multiplexers used to connect the Ethernet Infrastructure to the Telecommunications Bearer Infrastructure where required.

The age profile and asset counts for the Ethernet extenders are shown in the following table and graphs.

Table 13 - Ethernet Extenders

Ethernet Extenders Device Types	Average of Equipment Age (Years)	Number of Assets
RAD RICi 4	9.48	18
RAD RICi 8	8.10	14
Total		**32**

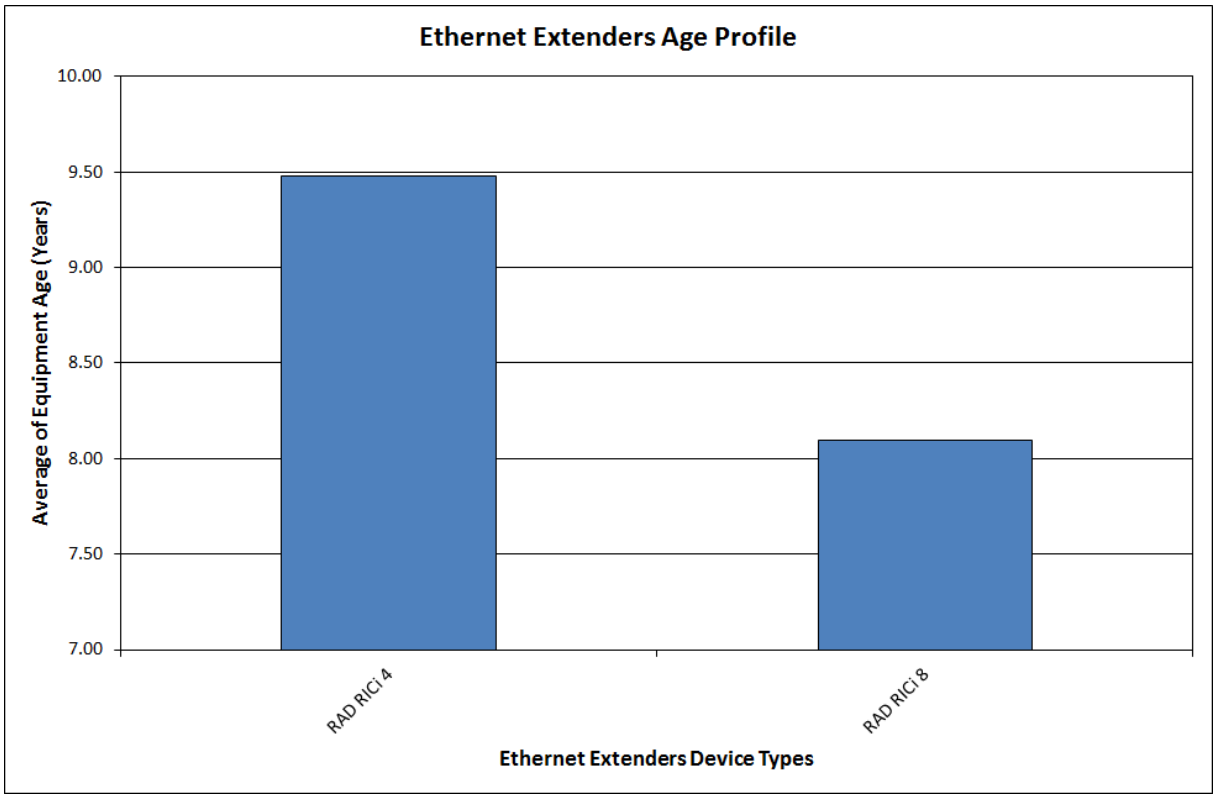

Figure 23 - Ethernet Extenders Age Profile

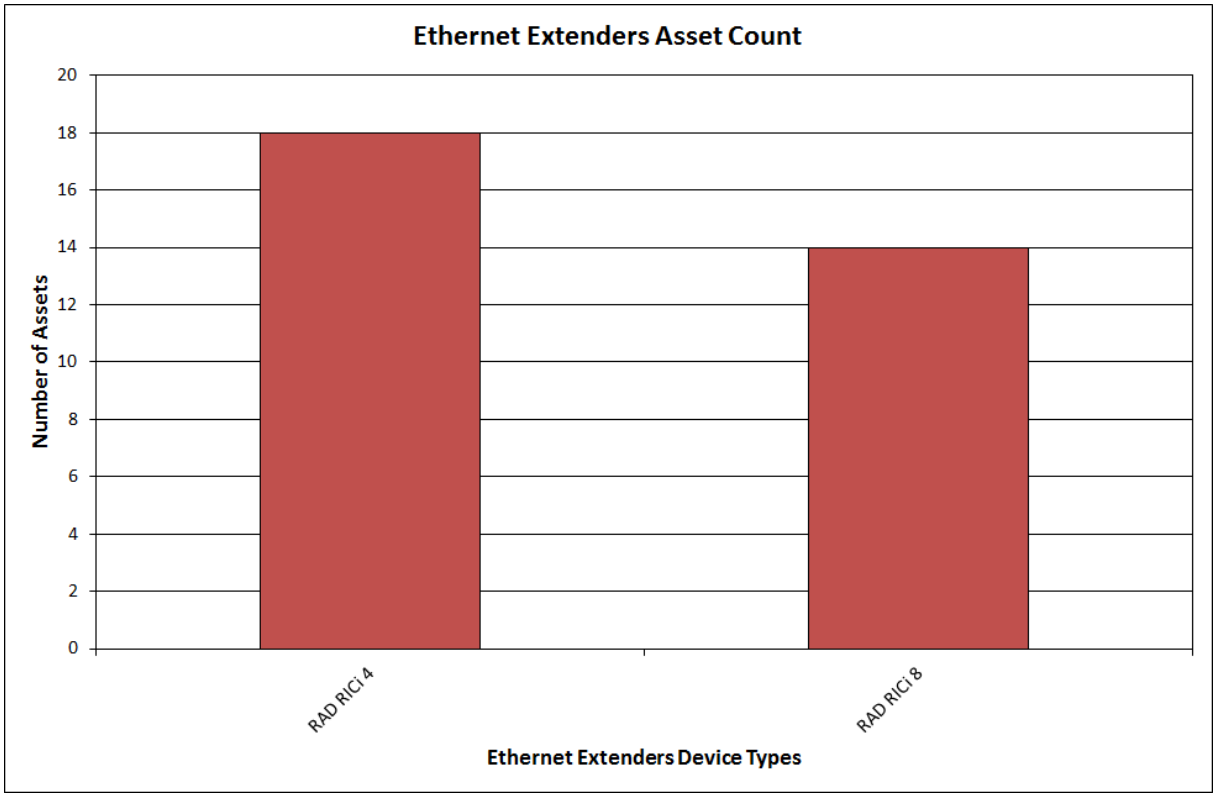

Figure 24 - Ethernet Extenders Asset Count

5.3.2 Ethernet systems asset types and applications

5.3.2.1 Ethernet Switches

Ethernet switches provide a central connection point for Ethernet services such as corporate computers, security cameras, PoE IP telephone handsets, building management systems and other Ethernet devices. The switches, usually installed in the patch rooms where the building cabling terminates, are used as the central component facilitating the construction of the Local Area Network (LAN). Ethernet devices terminate on the switch via the building cabling (usually the Category 6a twisted pair standard).

The LAN construction relies on the high speed links provided by optical fibre in order for the LAN to be extended beyond the immediate area. The use of optical fibre allows the LAN to operate between buildings, and between some sites for services that require a single LAN segment across multiple sites.

The switch hardware facilitates the provision of virtual LANs (VLANs). Use of VLAN tagging allows a single switch entity to provide multiple Ethernet segments from the same infrastructure providing flexibility in the network and restricting broadcast domains.

In the Carrier Ethernet MPLS network, the concept of VLAN tagging is further expanded to allow dual tagging with the C-tag distinguishing the customer, and the S-tag being used for the customer's independent service. This concept works for the customer on the fringe of the MPLS network, allowing the extension of the customer's connection from the MPLS core.

Different models of Ethernet switches are provided in the network for various switch function types. These functions are described in the following sections.

5.3.2.1.1 Ethernet switches by function

5.3.2.1.1.1 Access switches

The access switches are provided as the main connection point for the individual client nodes at the site (such as computers and telephones). These switches are often provided with the Power over Ethernet (PoE) ports in order to ensure that telephone handsets can be powered from the switch with no additional power supply required at the desk.

5.3.2.1.1.2 Distribution switches

Distribution Switches are used to ensure that packets are properly routed between subnets and VLANs and provide access layer aggregation points. The distribution layer provides policy-based routing and firewalling functions. Distribution level devices generally include OSI model layer-3 managed switches and routers.

Distribution switches in this context do not refer to the electricity distribution network.

5.3.2.1.1.3 Ethernet routers

Ethernet routers generally exist on the edge of the network distribution to provide a clear boundary to traverse from one network to another. They provide the functions for traffic directing between network segments and provide basic security functionality including restricting broadcast domains.

The Carrier Ethernet Routers provide the high speed backbone for delivery of customer services over the bearer network. By providing the MPLS functionality, the network can provide a robust

carrier grade service to multiple customers allowing full network separation over common network infrastructure.

5.3.2.2 IEEE 802.11 Wireless Networking Equipment

5.3.2.2.1 IEEE 802.11 Wireless Network Controller

The wireless LAN controller is provided as a central network controller for the wireless access points. The controller simplifies the deployment of access points, network operation and management and maintains a consistency of service throughout the wireless network. The controller also introduces greater security measures.

5.3.2.2.2 IEEE 802.11 Wireless Access Points

Wireless access points provide the wireless signalling for interfacing with the IEEE 802.11 wireless devices. The implementation of the access points is designed to maximise the wireless network coverage in the targeted areas. The wireless access points are connected to the main LAN infrastructure using the building cabling (current category 6a twisted pair cables) back to the Ethernet switches.

5.3.2.3 Ethernet extenders

Ethernet extenders are used in the carrier Ethernet network to extend a customer connection from the switch at a location to the remote site. The Ethernet extenders convert the Ethernet interface into a serial or TDM interface for connecting to the Telecommunications bearer network. The units allow the aggregation of 2 Mbps channels allocated for Ethernet usage.

5.3.2.4 Equipment racks and patching

The equipment racks installed in the communications rooms and cupboards provide standard 19 inch mounting rails with the appropriate cable management verticals each side of the cabinet. The standard patch panel now installed is the angled type allowing greater access to the cable management fingers on either side.

The cabling infrastructure services the Ethernet requirements for the telecommunications sites including the core trunk cabling, and for telecommunications system management. The cabling infrastructure is installed to the Category 6a twisted pair standard.

5.3.3 Standard makes and models

To reduce the risk of bespoke designs, TasNetworks uses standardised set of makes and models where possible. This simplifies maintenance and operation of the Ethernet networks and minimises the diversity of spares increasing operational efficiency.

The corporate Ethernet network, NOCS network, and IEEE 802.11 wireless networks are predominantly Cisco based equipment. The carrier Ethernet network predominantly uses Juniper based equipment. The reasons for using two different makes for the carrier Ethernet and the corporate Ethernet is to provide manufacturer based diversity so that if there is a major flaw or vulnerability in one make of equipment, it will reduce the probability of both networks being compromised due to a manufacturing/firmware issue.

RAD Ethernet extenders are used to connect the Ethernet equipment to the multiplexers on the TasNetworks' telecommunications bearer network. These are used to extend the reach of the Ethernet and IP based networks to remote sites that do not have dark fibres.

The Equipment racks and patching are all Panduit systems with vertical cable management and angled patch panels for easy access to the ports for technical staff.

6 Standard of Service

6.1 Telecommunications Bearer Network

6.1.1 Technical Standards

Performance levels of TasNetworks' Telecommunications Bearer Network is based on the definitions in the ITU standards (International Telecommunications Union) and assessed using internal performance monitoring measures.

6.1.2 Performance Objectives

The performance target for telecommunications circuit availability for operational traffic is at 99.99% availability at the 2 Mbps.level (as defined in ITU-T G.826).

The provision of operational grade services requires the most stringent performance measures with:

- Fault response of 1 hour
- Fault restoration target MTTR of 4 hours

Availability of 99.99% on digital operational circuits

6.1.3 Key Performance Indicators

TasNetworks monitors the performance of the Telecommunications Bearer Network through the TasNetworks' Telecommunications Network Management System. The fault response is initiated with Telecommunications Operations and recorded in the Telecommunications Network Management System as a fault. Equipment failures are rectified, whilst system failures are subject to an investigation to establish the root cause and recommend remedial strategies to reduce the likelihood of similar system failures occurring in the future.

The record of equipment failures is maintained in the Telecommunications Network Management System enabling internal performance monitoring and trending of all telecommunications equipment related faults or defects. This allows equipment design faults and poor component performance levels to be identified and adequately addressed.

6.2 Telecommunications Ethernet Systems

6.2.1 Technical Standards

Performance levels of TasNetworks' Ethernet Systems are derived from the ITU standards for Quality of Service and Network Performance as the minimum parameters for the network. ITU-T Y.1541 details the performance of a network for various Quality of Service (QoS) classes. The network is specified to perform to the QoS Class 0 standard of ITU-T Y.1541. The performance parameters exclude the packetisation delay caused through the use of serial links.

6.2.2 Performance Objectives

6.2.3 Operational grade Ethernet services

TasNetworks' operational Ethernet network performance has been designed and operated to achieve the following performance targets:

Table 14 - TasNetworks' ITU-T Y.1541 Operational Ethernet Performance Targets

Performance Parameter	Acronym	QoS Class 0 Values
IP Packet Transfer Delay (latency)	IPTD	100ms
IP Packet Delay Variation (jitter)	IPDV	50ms
IP Packet Loss Ratio	IPLR	1×10^{-3}
IP Packet Error Ratio	IPER	1×10^{-4}

The service availability target for operational Ethernet services has been set at 99.95% uptime.

6.2.4 Carrier grade Ethernet services

The performance levels for the carrier grade Ethernet services are targeted at the following performance levels.

Table 15 - TasNetworks' Carrier Ethernet Performance Targets

Performance Parameter	Value
Fault Response Time	1 hour
Fault Restoration/Mean Time To Repair (MTTR)	4 hours
Service Availability	99.95%
Latency	30ms
Jitter	25ms

6.2.5 Key Performance Indicators

6.2.5.1 Operation of the Ethernet Systems

TasNetworks monitors the performance of the Telecommunications Ethernet Systems through the TasNetworks' Telecommunications Network Management System. The fault response is initiated with Telecommunications Operations and recorded in the Telecommunications Network Management System as a fault. Equipment failures are rectified, whilst system failures are subject to an investigation to establish the root cause and recommend remedial strategies to reduce the likelihood of similar system failures occurring in the future.

The record of equipment failures is maintained in the Telecommunications Network Management System enabling internal performance monitoring and trending of all telecommunications equipment related faults or defects. This allows equipment design faults and poor component performance levels to be identified and adequately addressed.

6.2.5.1.1 Equipment built-in fault logging

Managed Ethernet Equipment used by TasNetworks' has internal fault logging features in the device firmware and/or operating systems. TasNetworks' utilises these records for root cause analysis and rectification of Ethernet system faults.

6.2.5.2 Software factors

The Ethernet switching and routing equipment used by TasNetworks use proprietary closed source firmware and/or operating systems which affects the security and performance of the Ethernet equipment and the overall IP networks.

TasNetworks' actively manages the device firmware so that they are always at the latest patched versions and in a supported state.

7 Associated Risk

7.1 Risk Management Framework

TasNetworks has developed a Risk Management Framework for the purposes of assessing and managing its business risks, and for ensuring a consistent and structured approach for the management of risk is applied.

An assessment of the risks associated with the Telecommunications Bearer Network has been undertaken in accordance with the Risk Management Framework. For each asset in this class the assessments have been made based on:

- Condition of Telecommunications Bearer Network in service across the network
- Criticality of Telecommunications Bearer Network and associated assets
- Probability of failure (not meeting business requirement)
- Consequence of failure
- Performance
- Regulatory compliance
- Safety risk
- Environmental risk
- Customer

Due to the level of risk identified in some of the assessment criteria, a requirement to actively manage these risks has been identified.

The proposed programs of work in this Asset Management Plan will manage the risks to TasNetworks at an acceptable level in accordance with the TasNetworks' Risk Management Framework. An overall risk matrix for the Telecommunications Bearer Network program of work is detailed in the following section.

7.2 Risk Matrices for the proposed program of work and assets

7.2.1 Optical bearers

7.2.1.1 Optical fibre cables

Table 16 - Telecommunications optical fibre cable assets risk matrix

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Customer	Not addressing poor asset performance will likely result in telecommunications system outages which may result in subsequent power system compliance issues. This results in poor service to connected customers.	Possible	Minor	Low	Low
Environment and Community	There is unlikely to be any significant risk to the environment and community.	Rare	Negligible	Low	Low
Financial	There is a minor risk to TasNetworks' financial position.	Unlikely	Minor	Low	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Network Performance	Poor condition assets due to lack of vendor support or supplier issues adds increased risk of non-compliance of prescribed services and increase risk of outages. Degraded optic fibre cable may cause communication errors and outages. Lack of sales support and systems spares may limit support staff ability to repair faults. Failed communications may cause SCADA and protection systems to not operate as intended affecting effective control of the power system. Lack of management systems support will prevent operations staff from monitoring and managing the telecommunications assets. Protection systems that rely on the telecommunications network may not operate correctly compromising the clearance of faults and power system stability.	Possible	Moderate	Medium	Low
Regulatory Compliance	Non-compliance with National Electricity Rules. A decline in network availability affects the ability of TasNetworks to maintain compliance with the National Electricity Rules. Risk of non-compliance with current Telecommunications Acts/Codes/Standards due to poor asset management and increase telecommunications network downtime.	Possible	Moderate	Medium	Low
Reputation	There is unlikely to be any significant risk to TasNetworks' reputation.	Rare	Negligible	Low	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Safety and People	There are unlikely to be any significant safety or people risks.	Rare	Negligible	Low	Low

7.2.1.2 Optical terminal equipment

Table 17 - Telecommunications optical terminal equipment assets risk matrix

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Customer	Not addressing poor asset performance will likely result in telecommunications system outages which may result in subsequent power system compliance issues. This results in poor service to connected customers.	Possible	Minor	Low	Low
Environment and Community	There is unlikely to be any significant risk to the environment and community.	Rare	Negligible	Low	Low
Financial	There is a minor risk to TasNetworks' financial position.	Unlikely	Minor	Low	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Network Performance	Poor condition assets due to lack of vendor support adds increased risk of non-compliance of prescribed services and increase risk of outages. The lack of vendor support and software/firmware patching risks cybersecurity issues and unpatched vulnerabilities. Lack of sales support and systems spares may limit support staff ability to repair faults. Failed communications may cause SCADA and protection systems to not operate as intended affecting effective control of the power system. Lack of management systems support will prevent operations staff from monitoring and managing the telecommunications assets. Protection systems that rely on the telecommunications network may not operate correctly compromising the clearance of faults and power system stability.	Possible	Moderate	Medium	Low
Regulatory Compliance	Non-compliance with National Electricity Rules. A decline in network availability affects the ability of TasNetworks to maintain compliance with the National Electricity Rules. Risk of non-compliance with current Telecommunications Acts/Codes/Standards due to poor asset management and increase telecommunications network downtime.	Possible	Moderate	Medium	Low
Reputation	There is unlikely to be any significant risk to TasNetworks' reputation.	Rare	Negligible	Low	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Safety and People	There are unlikely to be any significant safety or people risks.	Rare	Negligible	Low	Low

7.2.2 Microwave radio bearers

7.2.2.1 Digital radio systems

Table 18 - Telecommunications digital radio systems asset risk matrix

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Customer	Not addressing poor asset performance will likely result in telecommunications system outages which may result in subsequent power system compliance issues. This results in poor service to connected customers.	Possible	Minor	Low	Low
Environment and Community	There is unlikely to be any significant risk to the environment and community.	Rare	Negligible	Low	Low
Financial	There is a minor risk to TasNetworks' financial position.	Unlikely	Minor	Low	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Network Performance	Not addressing future telecommunications network needs for prescribed services for both microwave radio and fibre optic systems may cause compliance issues with the National Electricity Rules. One system may not have enough capacity to adequately back up the other system if it fails. Failed communications may cause SCADA and protection systems to not operate as intended affecting effective control of the power system. Protection systems that rely on the telecommunications network may not operate correctly compromising the clearance of faults and power system stability.	Possible	Moderate	Medium	Low
Regulatory Compliance	Non-compliance with National Electricity Rules. A decline in network availability affects the ability of TasNetworks to maintain compliance with the National Electricity Rules. Risk of non-compliance with current Telecommunications Acts/Codes/Standards due to poor asset management and increase telecommunications network downtime.	Possible	Moderate	Medium	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Reputation	There are unlikely to be any significant risk to TasNetworks' reputation.	Rare	Negligible	Low	Low
Safety and People	There are unlikely to be any significant safety or people risks..	Rare	Negligible	Low	Low

7.2.3 Power line carrier bearers

Table 19- Telecommunications power line carrier systems asset risk matrix

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Customer	Not addressing poor asset performance will likely result in telecommunications system outages which may result in subsequent power system compliance issues. This results in poor service to connected customers.	Possible	Minor	Low	Low
Environment and Community	There is unlikely to be any significant risk to the environment and community.	Rare	Negligible	Low	Low
Financial	There is a minor risk to TasNetworks' financial position.	Unlikely	Minor	Low	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Network Performance	Not addressing future telecommunications network needs for prescribed services for both microwave radio and fibre optic systems may cause compliance issues with the National Electricity Rules. One system may not have enough capacity to adequately back up the other system if it fails. Failed communications may cause SCADA and protection systems to not operate as intended affecting effective control of the power system. Protection systems that rely on the telecommunications network may not operate correctly compromising the clearance of faults and power system stability.	Possible	Moderate	Medium	Low
Regulatory Compliance	Non-compliance with National Electricity Rules. A decline in network availability affects the ability of TasNetworks to maintain compliance with the National Electricity Rules. Risk of non-compliance with current Telecommunications Acts/Codes/Standards due to poor asset management and increase telecommunications network downtime.	Possible	Moderate	Medium	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Reputation	There are unlikely to be any significant risk to TasNetworks' reputation.	Rare	Negligible	Low	Low
Safety and People	There are unlikely to be any significant safety or people risks..	Rare	Negligible	Low	Low

7.2.4 Multiplexing systems

Table 20- Multiplexing systems assets risk matrix

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Customer	Not addressing poor asset performance will likely result in telecommunications system outages which may result in subsequent power system compliance issues. This results in poor service to connected customers.	Possible	Minor	Low	Low
Environment and Community	There is unlikely to be any significant risk to the environment and community.	Rare	Negligible	Low	Low
Financial	There is a minor risk to TasNetworks' financial position.	Unlikely	Minor	Low	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Network Performance	Poor condition assets due to lack of vendor support adds increased risk of non-compliance of prescribed services and increase risk of outages. The lack of vendor support and software/firmware patching risks cybersecurity issues and unpatched vulnerabilities. Lack of sales support and systems spares may limit support staff ability to repair faults. Failed communications may cause SCADA and protection systems to not operate as intended affecting effective control of the power system. Lack of management systems support will prevent operations staff from monitoring and managing the telecommunications assets. Protection systems that rely on the telecommunications network may not operate correctly compromising the clearance of faults and power system stability.	Possible	Moderate	Medium	Low
Regulatory Compliance	Non-compliance with National Electricity Rules. A decline in network availability affects the ability of TasNetworks to maintain compliance with the National Electricity Rules. Risk of non-compliance with current Telecommunications Acts/Codes/Standards due to poor asset management and increase telecommunications network downtime.	Possible	Moderate	Medium	Low
Reputation	There is unlikely to be any significant risk to TasNetworks' reputation.	Rare	Negligible	Low	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Safety and People	There are unlikely to be any significant safety or people risks.	Rare	Negligible	Low	Low

7.2.5 Network supervisory equipment

Table 21- Network supervisory equipment assets risk matrix

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Customer	Not addressing poor asset performance will likely result in telecommunications system outages which may result in subsequent power system compliance issues. This results in poor service to connected customers.	Possible	Minor	Low	Low
Environment and Community	There is unlikely to be any significant risk to the environment and community.	Rare	Negligible	Low	Low
Financial	There is a minor risk to TasNetworks' financial position.	Unlikely	Minor	Low	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Network Performance	Poor condition assets due to lack of vendor support adds increased risk of non-compliance of prescribed services and increase risk of outages. The lack of vendor support and software/firmware patching risks cybersecurity issues and unpatched vulnerabilities. Lack of sales support and systems spares may limit support staff ability to repair faults. Failed communications may cause SCADA and protection systems to not operate as intended affecting effective control of the power system. Lack of management systems support will prevent operations staff from monitoring and managing the telecommunications assets. Protection systems that rely on the telecommunications network may not operate correctly compromising the clearance of faults and power system stability.	Possible	Moderate	Medium	Low
Regulatory Compliance	Non-compliance with National Electricity Rules. A decline in network availability affects the ability of TasNetworks to maintain compliance with the National Electricity Rules. Risk of non-compliance with current Telecommunications Acts/Codes/Standards due to poor asset management and increase telecommunications network downtime.	Possible	Moderate	Medium	Low
Reputation	There is unlikely to be any significant risk to TasNetworks' reputation.	Rare	Negligible	Low	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Safety and People	There are unlikely to be any significant safety or people risks.	Rare	Negligible	Low	Low

7.2.6 Network synchronisation equipment

Table 22- Network synchronisation equipment assets risk matrix

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Customer	Not addressing poor asset performance will likely result in telecommunications system outages which may result in subsequent power system compliance issues. This results in poor service to connected customers.	Unlikely	Moderate	Medium	Low
Environment and Community	There is unlikely to be any significant risk to the environment and community.	Rare	Negligible	Low	Low
Financial	There is a minor risk to TasNetworks' financial position.	Unlikely	Minor	Low	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Network Performance	Lack of sales support and systems spares may limit support staff ability to repair faults. Failed communications may cause SCADA and protection systems to not operate as intended affecting effective control of the power system. Protection systems that rely on the telecommunications network may not operate correctly compromising the clearance of faults and power system stability.	Possible	Moderate	Medium	Low
Regulatory Compliance	Non-compliance with National Electricity Rules. A decline in network availability affects the ability of TasNetworks to maintain compliance with the National Electricity Rules. Risk of non-compliance with current Telecommunications Acts/Codes/Standards due to poor asset management and increase telecommunications network downtime.	Possible	Moderate	Medium	Low
Reputation	There is unlikely to be any significant risk to TasNetworks' reputation.	Rare	Negligible	Low	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Safety and People	There are unlikely to be any significant safety or people risks.	Rare	Negligible	Low	Low

7.2.7 Ethernet equipment

Table 23 - Ethernet equipment assets risk matrix

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Customer	Not addressing poor asset performance will likely result in telecommunications system outages which may result in subsequent power system compliance issues. This results in poor service to connected customers.	Possible	Minor	Low	Low
Environment and Community	There is unlikely to be any significant risk to the environment and community.	Rare	Negligible	Low	Low
Financial	There is a minor risk to TasNetworks' financial position.	Unlikely	Minor	Low	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Network Performance	Poor condition assets due to lack of vendor support adds increased risk of non-compliance of prescribed services and increase risk of outages. The lack of vendor support and software/firmware patching risks cybersecurity issues and unpatched vulnerabilities. Lack of sales support and systems spares may limit support staff ability to repair faults. Failed communications may cause SCADA and protection systems to not operate as intended affecting effective control of the power system. Lack of management systems support will prevent operations staff from monitoring and managing the telecommunications assets.	Possible	Moderate	Medium	Low
Regulatory Compliance	Non-compliance with National Electricity Rules. A decline in network availability affects the ability of TasNetworks to maintain compliance with the National Electricity Rules.	Possible	Moderate	Medium	Low
Reputation	There is unlikely to be any significant risk to TasNetworks' reputation.	Rare	Negligible	Low	Low

Risk Category	Risk	Likelihood	Consequence	Untreated Risk Rating	Residual Risk Rating
Safety and People	There are unlikely to be any significant safety or people risks.	Rare	Negligible	Low	Low

8 Management Plan

8.1 Historical

Previously, the Telecommunications Bearer Network and Telecommunications Ethernet Systems were under two Transend Asset Management Plans.

The Telecommunications Ethernet Systems will now be merged into the TasNetworks Telecommunications Bearer Network Asset Management Plan.

8.2 Strategy

8.2.1 Maintenance Plans

The performance of the telecommunications bearer network is supported by preventative maintenance practices and corrective maintenance activities. All telecommunications assets are continually monitored through the supervisory and management systems and periodically tested to ensure they are providing an optimum level of performance.

8.2.1.1 Preventative Maintenance

8.2.1.1.1 Telecommunications bearers

The preventative maintenance activities done on the telecommunications bearers are done on a site basis to optimise efficiencies in conducting the activities. These activities are done at the following intervals.

8.2.1.1.1.1 6 monthly maintenance routines

- Done in conjunction with site infrastructure routine maintenance where appropriate.
- Inspecting of equipment filters, cleaning and replacement of filters as required.
- Inspecting static desiccants on waveguides and replacing when required.

8.2.1.1.1.2 2 yearly maintenance routines

- Includes 6 monthly routines
- Inspecting radio paths for obstructions and testing critical performance measures of the radio systems

8.2.1.1.2 Ethernet equipment

8.2.1.1.2.1 6 monthly maintenance routines

- Check firmware/software of equipment and apply appropriate updates as required.
- Inspecting of equipment filters, cleaning and replacement of filters as required.

8.2.1.2 Corrective Maintenance

For prescribed telecommunications services, there are strict requirements with regards to response times for faults. The target for faults that can potentially impact prescribed services is 4 hours. Where prescribed services are not going to be adversely affected, the corrective actions can be deferred for optimal results.

The initiators for corrective maintenance, include, but are not limited to, the following events:

- Telecommunications supervisory system alarms
- Defects detected during periodic routine testing and inspections
- A critical firmware/software upgrade

8.2.2 Preventative Maintenance versus Corrective Maintenance

Due to the complex electronic nature of telecommunications equipment, there is limited preventative maintenance that can be done on these assets in terms of the hardware. The best preventative activities are making sure that the environment and installation are within the manufacturer's specifications.

Keeping device firmware and software up-to-date is essential to maintain the security of the telecommunications assets and to make sure that these devices are visible to the management and supervisory systems.

Corrective activities increase as these assets approach the end of their economic and useful lives and upgrades and replacements need to take these factors into account.

Manufacturer support periods need to be taken into account for maintenance purposes and for strategic spares as lack of vendor support will increase the likelihood of reactive asset replacements.

8.2.3 Planned Asset Replacement versus Reactive Asset Replacement

Ideally, planned replacements and upgrades of assets for telecommunications equipment are preferred over reactive replacements for the following reasons:

- Reduction in risk of make and model fragmentation and non-standard designs which will make prudent asset management more difficult and costly. This is also due to unsupported equipment not being available on the market and running out of strategic spares.
- Reactive replacements cannot be scheduled in the most efficient way in terms of resources and outages.
- Risk of more than one asset failing at the same time causing a snowball effect of cascading failures and costly replacements.
- Reactive replacement may have to be done during periods where emergency rates and penalty rates apply increasing the cost significantly.
- Economy of scale does not work. Ordering a small quantity of the same device costs significantly greater than ordering larger quantities.

8.2.4 Non Network Solutions

There are no Non Network Solutions to manage these asset classes.

8.2.5 Network Augmentation Impacts

TasNetworks' requirements for developing the power transmission and distribution system, and the telecommunications network that supports them, are principally driven by these elements:

- Demand forecasts
- New customer connection requests
- New generation requests
- Network performance requirements
- National electricity rules (NER) compliance

- New applications for prescribed telecommunications services to support the transmission and distribution networks

Augmentation and modification of the transmission and distribution electricity networks will place greater future demand on the prescribed telecommunications network. This is due to new technologies in protection, control and metering of the power system and advanced data acquisition applications which use telecommunications systems to transfer data, information and signals. These modern systems need a reliable, compliant and secure telecommunications network to operate correctly and remain compliant with the National Electricity Rules.

8.2.6 Regulatory Obligations

The requirements of the Telecommunications Networks under the National Electricity Rules include but are not limited to the following sections of the National Electricity Rules:

- Section 4.11 Power System Security Support
- Schedule 5.1.2.1 Credible contingency events clause (d)
- Schedule S5.1.9 Protection systems and fault clearance times clause (d)

The telecommunications bearer network must also satisfy the requirements of the AEMO (Australian Energy Market Operator) Standard for Power System Data Communications (Version 1.2 Final).

The Telecommunications Bearer Network and Ethernet assets are required to provide critical communications services for the safe, secure and reliable operation of the transmission and distribution network. Their failure would not enable TasNetworks to comply with obligations under the NER in terms of protection system performance and maintaining suitable network control functionality.

Non-compliance with the National Electricity Rules risk TasNetworks' ability to participate in the National Electricity Market (NEM).

8.2.7 Program Delivery

The needs assessment and options analysis for undertaking an asset management activity is documented in the Investment Evaluation Summary for that activity.

The delivery of these activities follows TasNetworks' end to end (E2E) works delivery process.

8.2.8 Disposal Plan

Replaced or removed equipment is decommissioned and removed from sites as part of the capital replacement projects. Assets required for the business are retained for system spares, whilst all other equipment is offered to educational institutions and other relevant bodies for training purposes. Equipment that is no longer wanted or required by the business will be disposed of appropriately.

8.3 Capital programs and projects

8.3.1 Replacements and upgrades

8.3.1.1 Network synchronisation equipment

8.3.1.1.1 R19 01770 Telecommunications Bearer Systems - Timing Sources Replacement Program

This program of work is for the replacement of the primary precision timing sources/clocks on the telecommunications network.

The primary clocks and associated equipment provide a precise timing source to equipment on the telecommunications network. The synchronism of time based telecommunications protocols need a precise set of clocks to keep them synchronised within a narrow time window to ensure synchronism and error free communications. The primary clocks are also used for precise time stamping of telecommunications operational data.

The timing sources are synchronised with the Global Positioning System (GPS) satellite atomic clocks.

The current fleet of primary clocks/timing sources are at the end of support, low on strategic spares, and are experiencing failures at the current rate of 1 clock failure per year. This will only increase over time and risk a major telecommunication outage and loss of synchronism.

This program will replace the current fleet of primary clocks to a common supported make and model with the required amount of strategic spares to keep the telecommunications network in synchronism.

8.3.1.2 Microwave radio bearers

8.3.1.2.1 R19 01748 Telecommunications Bearer Systems - Staged Spur Radio System Replacement/Upgrade Program

The spur radio links are radio links that branch off the backbone microwave radio and optic fibre networks. The current fleet of spur radios at various frequencies are at the end of their support dates with vendor support limited or no longer available.

To ensure continued reliability and the required level of service, these radios will be replaced with supported spur radio systems under this program of work.

8.3.1.2.2 R19 01562 Telecommunications Bearer Systems - Staged Backbone Microwave Radio System Replacement Project

The backbone radio network is complimentary to the optic fibre and power line carrier bearer networks. The backbone radios were replaced in the current Transend revenue reset period R14.

This project is a forecast for the revenue reset periods after R19 when these radios are due for replacement. By this time they will be no longer supported or supplied by the manufacturer and will be highly reliant on system spares. This project needs to be in place for the backbone radio network to remain operational at the required level of service.

8.3.1.3 Optical bearers

8.3.1.3.1 R19 01617 Telecommunications Bearer Systems - Staged Optical Systems Replacement Program

This program of work is for the replacement of the optical terminal equipment at the ends of the fibre optic cables. The current fleet of optical terminal equipment is at the end of its support period and is due for replacement. To maintain the required levels of reliability, this equipment needs to be replaced in the R19 regulatory period.

8.3.1.4 Multiplexing and supervisory equipment

8.3.1.4.1 R19 01501 Telecommunications Bearer Systems - Multiplexer and Supervisory Systems Replacement Program

This program of work is for the replacement of the multiplexing equipment and the supervisory programmable logic controllers (PLC) equipment. Due to the scale of this program, this work was started in the current regulatory period and continuing into the R19 regulatory period.

The multiplexers currently in the fleet are no longer being manufactured and the current supplier is no longer making spare parts. The current fleet of multiplexers does not have the required optic fibre connections for modern numerical protection relays and signal converters are used as interfaces adding another point of failure. This program of work is for the replacement of the current fleet of multiplexers to a modern supported product with the required interfaces for modern telecommunications equipment and numerical protection relays.

The supervisory PLCs are now approaching the end of their support periods also. The availably of spare parts and support for modern industrial/SCADA communications protocols will become an issue. The modern equivalents of these PLCs will be supported and have PLC modules/cards that support modern industrial/SCADA protocols. The availability of cards and spare parts will no longer be an issue while the product is supported.

8.3.1.5 Ethernet equipment

8.3.1.5.1 Telecommunications Bearer Systems - Ethernet Systems Replacement/Upgrade Program

This program of work is for the replacements and upgrades of the Ethernet equipment assets which have a support period of 5 years. For vendors with shorter support periods, TasNetworks has engaged with vendors to provide at least 5 year support periods. Unsupported Ethernet equipment no longer receives firmware/operating system upgrades which expose the business to security risks that can compromise TasNetworks and potentially the operation of the power system.

The evolution of Ethernet equipment is currently at a rapid pace with new security technology, new feature sets, and greater speed and capacity. This will be critical as more operational and commercial data is travelling on TCP/IP networks. There is also the rapid adoption of modern Voice over Internet Protocol systems which use Ethernet as their primary interface. To keep up, TasNetworks' Ethernet systems need to be kept up to date and in a supported state at all times.

8.3.1.5.2 R19 00875 Telecommunications Bearer Systems - Ethernet Systems – Distribution

This program of work is for the replacements and upgrades of the Ethernet equipment assets at distribution zone substations which have a support period of 5 years. For vendors with shorter support periods, TasNetworks has engaged with vendors to provide at least 5 year support

periods. Unsupported Ethernet equipment no longer receives firmware/operating system upgrades which expose the business to security risks that can compromise TasNetworks and potentially the operation of the power system.

The evolution of Ethernet equipment is currently at a rapid pace with new security technology, new feature sets, and greater speed and capacity. This will be critical as more operational and commercial data is travelling on TCP/IP networks. There is also the rapid adoption of modern Voice over Internet Protocol systems which use Ethernet as their primary interface. To keep up, TasNetworks' Ethernet systems need to be kept up to date and in a supported state at all times.

8.3.2 Augmentations

8.3.2.1 R19 01804 Telecommunications Bearer Systems - Backbone Microwave Radio Capacity Improvement Project

The main driver of this project is to improve the capacity of the backbone microwave radio bearer network for future uses of the TasNetworks' telecommunications network. This is to keep up with prescribed telecommunications service demand and to cater for new end device technologies and applications on the TasNetworks' telecommunications network.

The microwave radio backbone network is the main redundant bearer network for the optic fibre and power line carrier bearer networks. It is essential that this backbone keeps up to the increasing demands of new SCADA and power system protection and control technologies which have increased demands on the TasNetworks' telecommunications network.

8.3.2.2 R19 01771 Telecommunications Bearer Systems - Site Diversity Improvement Program

The main driver for this project is to improve fault tolerance and reduce downtime on select telecommunication links on the TasNetworks' Telecommunications network. In order to fulfil the protection requirements under the National Electricity Rules for power system protection, path diversity is required for the telecommunication links linking teleprotection schemes.

The TasNetworks' telecommunications networks uses 3 primary bearers for protection circuits:

- optical fibre;
- microwave radio; and
- power line carrier

For each transmission and critical distribution teleprotection scheme, at least 2 diverse communications paths are required, ideally with a combination of the following types of diversity:

- media diversity;
- path and/or special diversity; and
- manufacturer diversity

Some sites on our telecommunications networks do not fully meet these requirements due to geographical or other technical issues. This project aims to address these issues to maintain compliance with the National Electricity Rules.

8.4 Operational and maintenance programs

8.4.1 Preventative maintenance programs

8.4.1.1 R19 01886 Telecommunications Bearer Systems - Telecommunications Bearer Services Preventative OPEX Program

This program of work includes the routine maintenance and operations of the telecommunications bearer network assets. These, include, but are not limited to, the following assets:

- Microwave radio systems
- Optic fibre cables
- Optic fibre terminals
- Optic fibre patching equipment and panels
- Waveguides
- Telecommunications copper cables
- ACMA licences

8.4.1.2 R19 02264 Telecommunications Bearer Systems - Multiplexer Systems Preventative OPEX Program

This program of work includes the routine maintenance and operations of the telecommunications multiplexer assets such as circuit and configuration changes, routine testing and other activities.

8.4.1.3 R19 02266 Telecommunications Bearer Systems - Ethernet Systems Preventative OPEX Program

This program of work includes the routine maintenance and operations of the telecommunications Ethernet and IEEE 802.11/Wi-Fi assets.

8.4.2 Corrective maintenance programs

8.4.2.1 R19 02263 Telecommunications Bearer Systems - Telecommunications Bearer Services Corrective OPEX Program

This program of work includes the reactive/fault maintenance, repairs, testing and operations of the telecommunications bearer network assets. These, include, but are not limited to, the following assets:

- Microwave radio systems
- Optic fibre cables
- Optic fibre terminals
- Optic fibre patching equipment and panels
- Waveguides
- Telecommunications copper cables

8.4.2.2 R19 02265 Telecommunications Bearer Systems - Multiplexer Systems Corrective OPEX Program

This program of work includes the reactive/fault maintenance and operations of the telecommunications multiplexer assets such as fault response and non-routine repairs and testing.

8.4.2.3 R19 02267 Telecommunications Bearer Systems - Ethernet Systems Corrective OPEX Program

This program of work includes the reactive/fault maintenance and operations of the telecommunications Ethernet and IEEE 802.11/Wi-Fi assets such as fault response and non-routine repairs and testing.

9 Summary of Programs

An overall view of the programs of work described in this asset management plan, including volumes and financial information, is located in the following document:

Telecommunications Bearer Network Asset Management Plan Summary, Record Number: R0000855689, http://reclink/R0000855689

10 Related Standards and Documentation

The following documents have been used to either in the development of this management plan, or provide supporting information to it:

1. Australian Energy Market Commission, National Electricity Rules (Current Rules), http://www.aemc.gov.au/Energy-Rules/National-electricity-rules/Current-Rules
2. Australian Energy Market Operator, AEMO - Final Determination - Standard for Power System Data Communications Version 1.2, https://www.aemo.com.au/-/media/Files/Electricity/NEM/Network_Connections/Transmission-and-Distribution/AEMO-Standard-for-Power-System-Data-Communications.pdf
3. TasNetworks Telecommunications CAPEX/OPEX Budget Long Term, R0000768704, http://reclink/R0000768704
4. TasNetworks Corporate Plan - Planning period: 2017-18 to 2021-22, R0000745475, http://reclink/R0000745475
5. TasNetworks Strategy on a page 2017-18, R0000764312, http://reclink/R0000764312
6. TasNetworks Business Plan 2017-18, R0000779008, http://reclink/R0000779008
7. TasNetworks Roadmap – 2025, https://www.tasnetworks.com.au/customer-engagement/submissions/
8. TasNetworks Zero Harm Policy, https://www.tasnetworks.com.au/about-us/policies/zero-harm/
9. TasNetworks Risk Management Framework, R0000238142, http://reclink/R0000238142
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