

# Metering Asset Management Strategy 2017 – 2022

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Part 3  
Mesh AMI Solution

**PUBLIC**

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## Supporting Documentation

The following document suite comprises the AusNet Services asset management strategy for managing and maintaining equipment assets for advanced metering technologies. These documents shall be annually updated with reviewer feedback incorporated and support the respective FMECA management recommendation approaches.

Document	Version	Review Dates	Owner(s)	Approver
AMI Asset Management Strategy Overview		<b>August 2020</b>	Alan Crockett	Brendan Buckland
Part 1 - Electricity Meters & Metering Equipment	1.0	August 2020	Srikanth Sridhar	Brendan Buckland
Part 2 - WiMAX Asset Management Strategy	3.0	7 August 2020	Alan Crockett	Brendan Buckland
Part 3 - Mesh Asset Management Strategy	2.0	August 2020	Alan Crockett	Brendan Buckland

## Acknowledgments

1. Recommendation's from this strategy will be summarised and managed through the AMI Asset Management Strategy Overview.
2. Figures, volumes and costings referenced to within this document are subject to change. Where a statistic is required the document owner should be contacted for latest information.

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## 1 Overview

The Electricity Distribution Metering Asset Management Strategy (EDM AMS) provides the framework for AusNet Services' management of its metering assets for the period CY 2018 – 2022.

Within the context of the current and forecast status of the assets, it identifies the strategies to operate and support a safe, compliant and efficient metering system.

The EDM AMS consists of a Strategy Overview document, together with the following three attachments describing the specific asset states and strategies for each EDM AMS component:

- Part 1 – Electricity Meters and Metering Equipment: the physical meter, meter firmware, meter program, low voltage current transformers, and associated meter test equipment.
- Part 2 – WiMAX AMI Solution.
- Part 3 – Mesh AMI Solution.

AusNet Services currently manages a fleet of Mesh and WiMAX communications modules, configured with the Utility IQ and PolicyNet firmware, respectively.

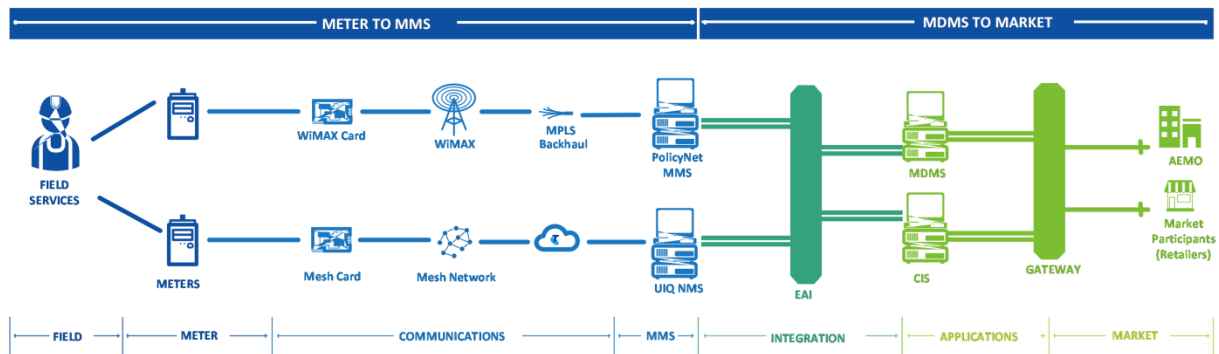


Figure 1: AusNet Service's high level End-to-End AMI solution (Meter to MMS and MDMS to Market).

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## 1.1 High Level Recommendations

The following high-level recommendations are proposed from the Mesh asset management strategy.

No:	Recommendation	Section
1	Bi-annually maintain the FMECA risks set out within this strategy	2.4
2	Maintain mesh spares	4.1.4
3	Maintain pole top spares	4.1.4
4	Monitor mesh failure rates	4.1.5
5	Manage and monitor AP and uAP loading including network design	4.1.6
6	Manage AP5 and uAP5 support	4.1.7
7	Monitor and manage sim card and data volumes	4.3
8	Manage and monitor 3G to 4G mesh migration	5.2
9	Investigate alternative AMI solutions	5.3

## 2 Overview

This document, the EDM AMS for the Mesh AMI Solution, defines AusNet Services' asset management strategy for the end-to-end Mesh metering solution including communications modules, pole top devices (PTD), backhaul network, UIQ Infrastructure, software applications and backend servers and services.

The EDM AMS in general aims to:

1. Ensure the continued safe operation of the metering asset;
2. Lift the capability of the AusNet Services metering and communications solution to be compliant with regulatory obligations;
3. Maintain the asset so that it continues to meet regulatory compliance and business needs in the most efficient manner possible (for optimal total life cycle cost);
4. Enhance and apply the meter capabilities to better manage the AusNet Services' electricity distribution network and position AusNet Services for the future operating and regulatory environment, in alignment with the AusNet Services business plan.



The specific aim of this Part 3 of the EDM AMS is to present the optimum support strategies for the Mesh AMI solution, so that the meter communications are effective in supporting the achievement of all regulatory and business requirements.

### 2.1 Background

After the decommissioning of the 3 G Policy Net AMI technologies, AusNet Services' end-to-end AMI solution is comprised of the Mesh and WiMAX technology. Both AMI technologies utilise different network infrastructures and software applications for the data traffic between meters and data centres and share business services for MDMS to Market as shown in

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AusNet Services has a total fleet of ~745,000 electricity meters which is comprised of ~12,000 Non-AMI and ~733,000 AMI meters (as of August 2017). Currently, 43.1% of the installed AMI metering fleet operate on the Mesh operating system with the remaining 56.6% of AMI meters operating off the WiMAX network (see Table 1 for more details).

The Mesh technology was initially deployed to ~ 270,000 AMI meters with non-functional 3G and WiMAX communication modules during the AMI Remediation Program in 2015/16. At the end of the AMI Remediation Project ~ 300,000 AMI meters were operating on the Mesh technology. The backbone of the Mesh network is currently comprised of 870 Relays and 305 Access Points (AP) installed across AusNet Services' electricity distribution network as shown in Figure 2.

Due to the WiMAX obsolescence (see EDM AMS Part 2), WiMAX communication modules are progressively replaced with Mesh upon site visits of field crews. Additionally, meters of New Connections exclusively receive Mesh communication modules. Consequently, the size of the meter fleet supported by the Mesh network increases annually by ~22,000 meters.

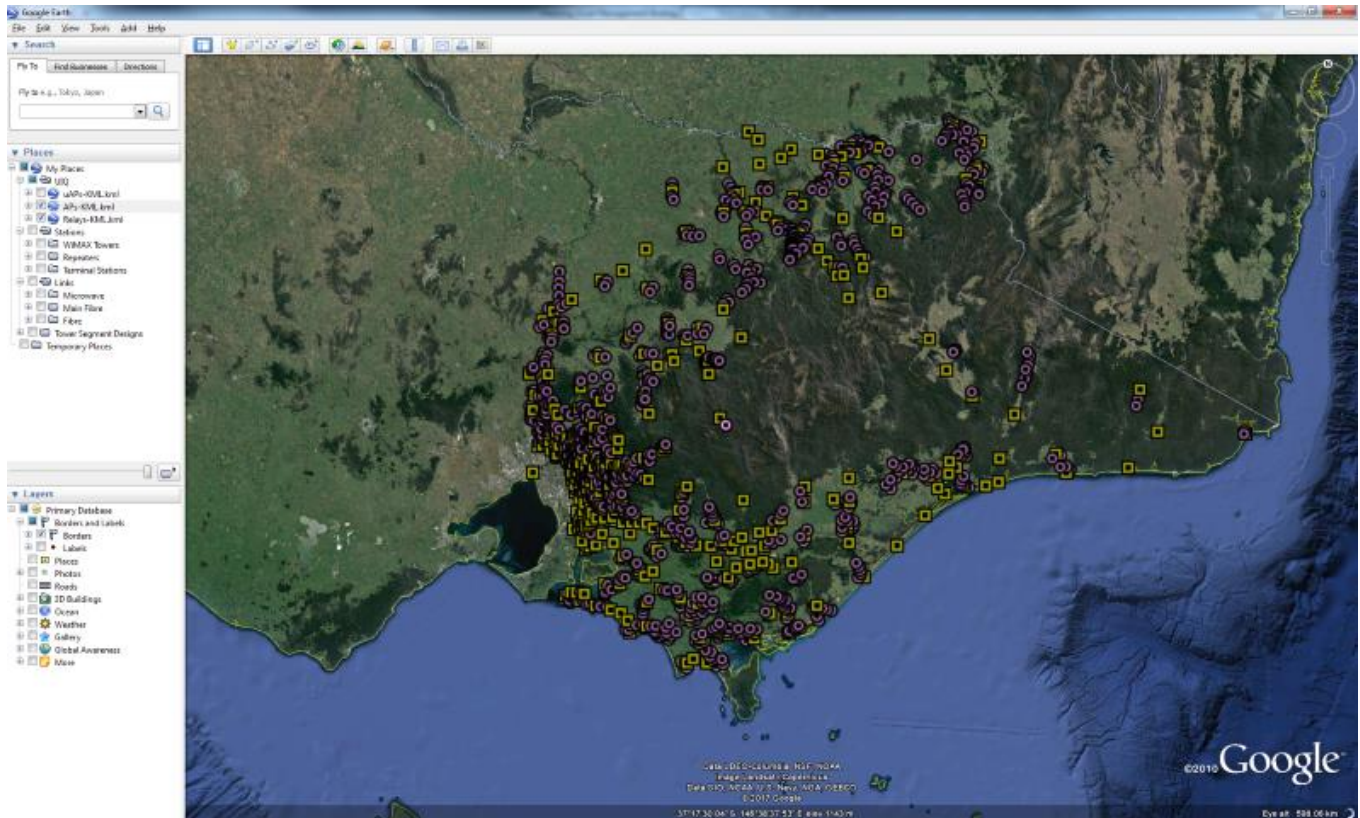


Figure 2: Distribution of Pole Top Devices (AP – pink, Relay – yellow).

## 2.2 Scope

This Meter Asset Management Strategy is applicable to all assets related to the Mesh AMI end-to-end solution including:

- Mesh communication modules and antennas;
- Pole top devices (Relays and APs);
- Telstra's 3G backhaul network;
- Physical network of UIQ appliances; and
- Maintenance and support services.

This Meter Asset Management Strategy excludes Assets related to:

- Metering equipment (subject to Part 1); and
- Mesh WiMAX end-to-end solution (subject to Part 2).

## 2.3 Structure

EDM AMS Document:

0. Overview
1. Metering Equipment
2. WiMAX AMI Solution
3. Mesh AMI Solution

## 2.4 References

[Mesh Asset Management Plan](#) including Asset Structure, FMECA, RACI and support contracts.

### 3 Asset Description

The assets covered in this section include all Mesh assets from the meter communication module to the Meter Management System (MMS) and shared applications and services that are part of the Meter Data Management System (MDMS) to Market function. In the Silver Spring Networks' (SSN) Mesh solution, a meter connects via the communication module to the 3<sup>rd</sup> party backhaul network via Access Points (AP). As shown in Figure 3, this connection can occur either:

- Directly from meter to AP;
- Via Relay to AP;
- Via other Mesh meters to AP; or
- Directly as a uAP.

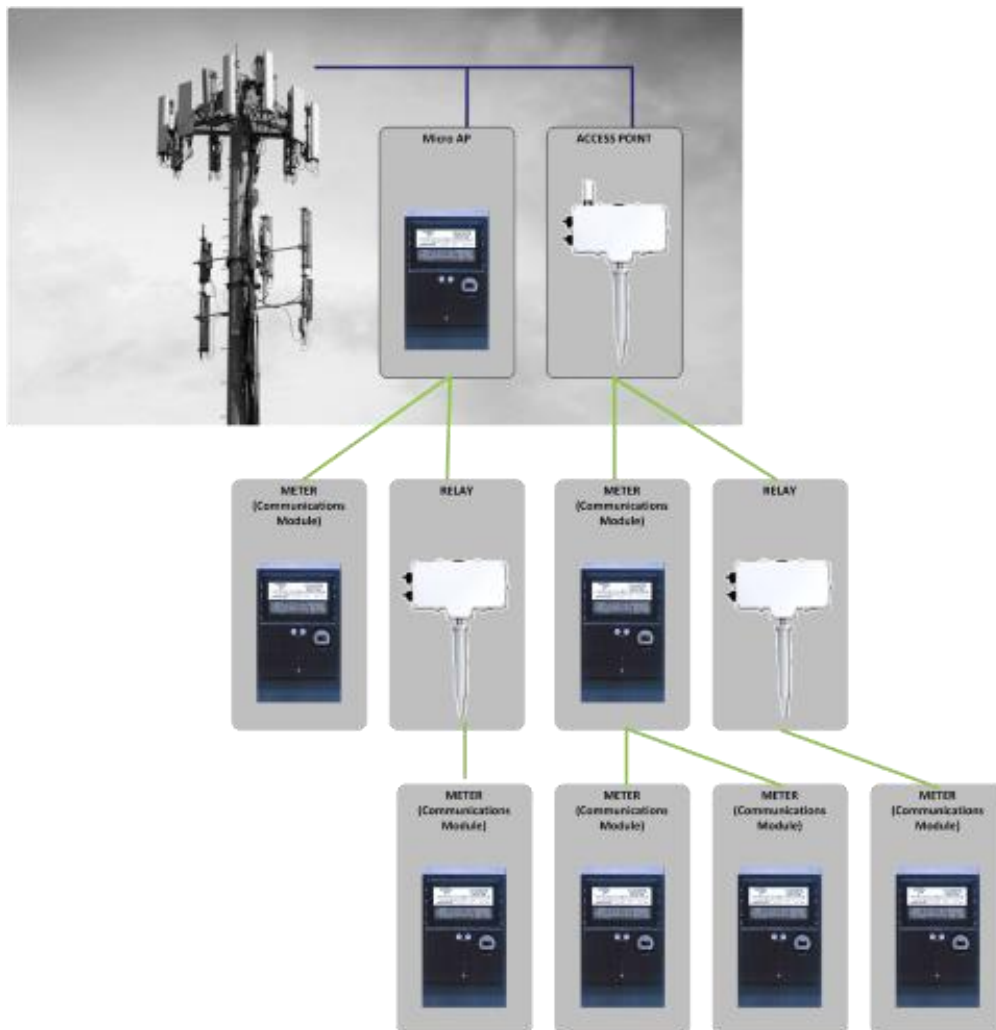


Figure 3 - Mesh Component Topology

The Mesh solution utilises Telstra's 3G wide area network to deliver AMI traffic to the UtilityIQ Meter Management System (MMS) [C-I-C].

The overall physical configuration of the Mesh solution is shown in **Error! Reference source not found.**

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The [Mesh Asset Management Plan](#) encompasses the entire Mesh asset structure from a high level (function, sub-function and system) down to the replaceable units. The following section will provide a description of the individual asset classes and components.

### 3.1 Communication Modules

The AMI meter communications module is an essential component in the end-to-end AMI solution, providing the connectivity between the meter and the communications infrastructure. The modules are the interface to the meters for the collection of meter and distribution network data, and for the delivery of meter programs, firmware upgrades and messages.

The AusNet AMI meter solution requires different and specific communication modules for the Mesh and WiMAX AMI technologies. The communication modules are physically interchangeable on the meter enabling an easy and virtually seamless transition between both technologies. Both communication modules types consist of the following core components:

1. The physical assembly including meter data processor, and transmit and receive communications circuit boards;
2. ZIGBEE component;
3. Embedded firmware (and software) to control meter data and communications between the meter and the Meter Management System (MMS); and
4. Separate, externally mounted and connected RF antenna.

SSN's Mesh technology offers two types of communication modules, the Network Interface Card (NIC) and Micro AP (uAP).

#### 3.1.1 Network Interface Cards – NIC

The Network Interface Card (NIC) is SSN's basic communication module for network end points. The internal 900MHz Mesh radio allows direct communication with all other network devices, i.e. other Mesh meters, APs, Relays and uAPs. Mesh communications cards have an internal antenna and an external antenna port. Furthermore, Mesh communication modules have built in HAN (Home Area Network) functionality that allows customer devices, such as In Home Displays, to directly connect with the AMI meter. The HAN communication is independent of the Mesh network communication.

To date NIC modules have been supplied by SSN only. For AusNet Services, NIC modules come in a transparent enclosure that is designed to support installation in Landis+Gyr 'U' series meters. The volume of AusNet's AMI meters and installed various communication modules as of July 2012 are:

Meter/Module Vendor	Quantity of Meters	LC'd	% LC'd	% Modules	% AMI Meters
AMI Meter/GE WiMAX	227,032	226,590	99.8%	31.0%	31.0%
AMI Meter/L+G WiMAX	188,057	186,295	99.1%	25.7%	25.6%
AMI Meter/Mesh NIC	293,982	287,459	97.8%	40.2%	40.1%
AMI Meter/Mesh uAP	22,270	21,750	97.7%	3.0%	3.0%
AMI Meter/No Module	1,393	0	0.0%	0.0%	0.2%
<b>Total AMI Meters</b>	<b>733,249</b>	<b>722,094</b>	<b>98.5%</b>		
<b>Non-AMI Meter</b>	<b>11,970</b>				
<b>Total Meters</b>	<b>745,219</b>				

Table 1: Volumes of Installed Communication Module Types as of July 2017

Mesh communication modules, i.e. NIC and uAP, are deployed to approximately 43% (~316,000 meter) of all AMI meters. The geographical distribution of AMI communications modules across AusNet's 9 divisions is show in the following table.

Division	AMI Meters	WiMAX cards	NICs	uAPs	Non-AMI Meters
Bairnsdale	52,236	24,404	24,267	3,359	1,023
Beaconsfield	130,340	77,111	51,587	1,525	1,325
Benalla	36,707	15,987	16,119	4,318	571
Leongatha	51,213	20,086	27,699	3,321	933
Lilydale	189,767	127,481	60,896	1,136	3,693
Seymour	21,181	6,339	12,781	1,959	472
South Morang	134,054	89,200	44,137	522	1,482
Traralgon	73,601	36,371	33,441	3,496	1,915
Wodonga	44,150	18,110	23,055	2,634	556
<b>TOTAL</b>	<b>733,249</b>	<b>415,089</b>	<b>293,982</b>	<b>22,270</b>	<b>11,970</b>

Table 2: Installed Communication Modules by Division (as of July 2017).

The annual installation volumes of Mesh communication modules are shown in Table 3. All Mesh communication modules as well as all other SSN network components (uAPs, Relays and APs) are of 4<sup>th</sup> generation (Gen4). In general, SSN network technology is designed to be backwards compatible in recognition that SSN technology will be deployed with assets in the field for 15 years or more.

Year of installation	Communications Module Type	
	NIC	uAP
2015 Actuals	9,911	27
2016 Actuals	266,156	22,096
2017 Actuals	17,915	147
<b>Total</b>	<b>316,252</b>	

Table 3: Currently installed Mesh communication modules by year of installation (as of Aug 2017).

UtilOS is the firmware operating system for Silver Spring NICs, and provides the following functions and features:

- NAN mesh networking logic
- Security
- Time management
- Communications interface to the electricity meter, including:
- Generic Meter Interface (GMI)
- RSM for electricity meters that support Remote Disconnect (or Service Disconnect) and LCS devices

The firmware images for the communication modules are deployed in peer-to-peer mode, i.e. the full firmware image is only issued to a subset of “seed” endpoints. Each endpoint acts as a content cache and server to other endpoints in the network, gradually dispersing the image across the entire endpoint population. This approach relieves network congestion at backhaul and network access point that would otherwise convey many multiples of the firmware image. This peer-to-peer deployment approach applies equally to mesh communications card and meter firmware images.

### 3.1.2 External Antennas and Field Service Unit – FSU

The default configuration of a mesh card uses the internal antenna for all radios (Mesh and HAN). In the minority of cases, external antennas will be installed on NICs that cannot establish a connection with other network devices due to the nature of the meter enclosure (e.g. metal cabinets). Suitable antenna types are the SSN Taoglas antenna and Panorama antenna that are used depending on the installation requirements.





Figure 4: Panorama (left) and Taoglas antenna types (right).

The external antenna mode of a NIC can be enabled (and disabled) via a Field Service Unit (FSU, see Figure 5) which is supported by the SSN software Communications Tester. Pre-activated NICs, i.e. communication modules for which the external antenna mode was enabled in the office or warehouse prior to installation, are marked with a blue dot sticker and are commonly referred to as “Blue Dot Cards”.



Figure 5: SSN Field Service Unit for enabling external antenna mode on NICs.

### 3.1.3 Micro Access Points – uAP

MicroAP's (uAP) are a relatively new development from SSN that are a hybrid of communication module and Access Point (see section 3.2.1). A uAP can simultaneously support 3G, radio frequency (RF) mesh and HAN communications. The modules are outfitted with a cellular modem, MIM (Machine Identification Module) card of form-factor MFF2 and two radios (900 MHz NAN radio and 2.4 GHz HAN radio), and require two external antennas for 3G and Mesh communication. The MIM card is embedded in the circuit board of the communication module and is enabled only for Telstra's 3G network. The uAPs are designed for the edges of networks, hard to reach meters, high-rise buildings, and other specific use cases. MicroAP's can work in several Modes as outlined in Table 4 and can be manually and remotely re-configured to operate in a different mode.

Mode	Description
<b>Micro AP mode (default)</b>	Card operates as an Access Point with both 3G and Mesh radios active. Provides a network gateway for neighbouring mesh devices
<b>Cellular Mode</b>	Card operates 3G radio only – Does not interact with the mesh network.
<b>Mesh Card Mode</b>	Card operates Mesh radio only, behaviour is identical to an ordinary mesh communications card – seeks routes to other Access Points.

Table 4 Micro AP Operational Modes.

### 3.2 Pole Top Devices – PTDs

Pole Top Devices (PTDs) for the backbone of the Mesh network. The two different types of PTDs, Access Points (AP) and Relays, that are currently deployed in AusNet Services' Mesh network will be explored in the following sections. As indicated by the name, PTDs are network devices that are installed on electricity poles. Similar to the meter communication modules, PTDs include Network Interface Cards (NICs) for Mesh communication with other network devices.



Figure 6: Access Point (left) and Relay (right).

#### 3.2.1 Access Points

Access Points (APs, see Figure 1 left) link endpoint devices with utility back-office systems and form the interface between the Mesh network and Telstra's 3G backhaul network. They can talk directly to network endpoints or indirectly via multiple Relays and/or Mesh communication modules.

The APs use Frequency Hopping Spread Spectrum (FHSS) technology and operate in the 915MHz band. APs serve as routers for all data traffic to and from RF mesh network and are pre-configured to establish a tunnel connection to Cisco ISR routers located at AusNet's data centres on startup.

Currently, 302 APs are deployed in the Mesh network. APs can support thousands of Mesh endpoints. There is, however, a trade-off between the number of supported meters per AP and the volume of data per meter that can be processed. The performance limit under the current demand for metering data based on regulatory obligations is at ~5,000 meter per AP.

APs are of generation 4 of SSN Mesh network products and are comprised of:

- Battery;
- Mesh antenna;
- 3G antenna;
- SIM (Subscriber Identity Module) card of 2FF form-factor;
- Mounting board;
- Firmware;
- GPS module and antenna (for AP localisation); and
- Cables.

### 3.2.2 Relays

The Relay (see Figure 1 right) is a repeater device that extends the range of the network. Relays receive signals from other network devices, including APs, meters and other Relays, and retransmits signals at full strength. Similar to APs, Relays also use the Frequency Hopping Spread Spectrum (FHSS) technology operating in 915MHz band.

There are currently 836 Relays deployed in the Mesh network. The distribution of PTDs across AusNet's distribution network is shown in Figure 2. All Relays are of 4<sup>th</sup> generation and are comprised of:

- Battery;
- Mesh antenna;
- Mounting board;
- Firmware; and
- Cables.

### 3.2.3 Network Coverage

APs and uAP operating in uAP Mode require 3G coverage to connect to the backhaul network. All other network devices, NIC communication modules and Relays, rely purely on Mesh coverage to deliver and receive data from APs/uAPs. 3G coverage is (largely) beyond the control of AusNet Services (notwithstanding AusNet Services' ability to select and place equipment and antennas to best take advantage of 3G coverage). Contrary, Mesh coverage depends on the density of deployed and operating Mesh network devices (communication modules and PTDs).

A schematic of the interplay of Mesh and 3G coverage boundaries is shown in Figure 7. While the Mesh coverage area can exhibit holes and islands part of the Mesh coverage area must have some overlap with the 3G coverage.

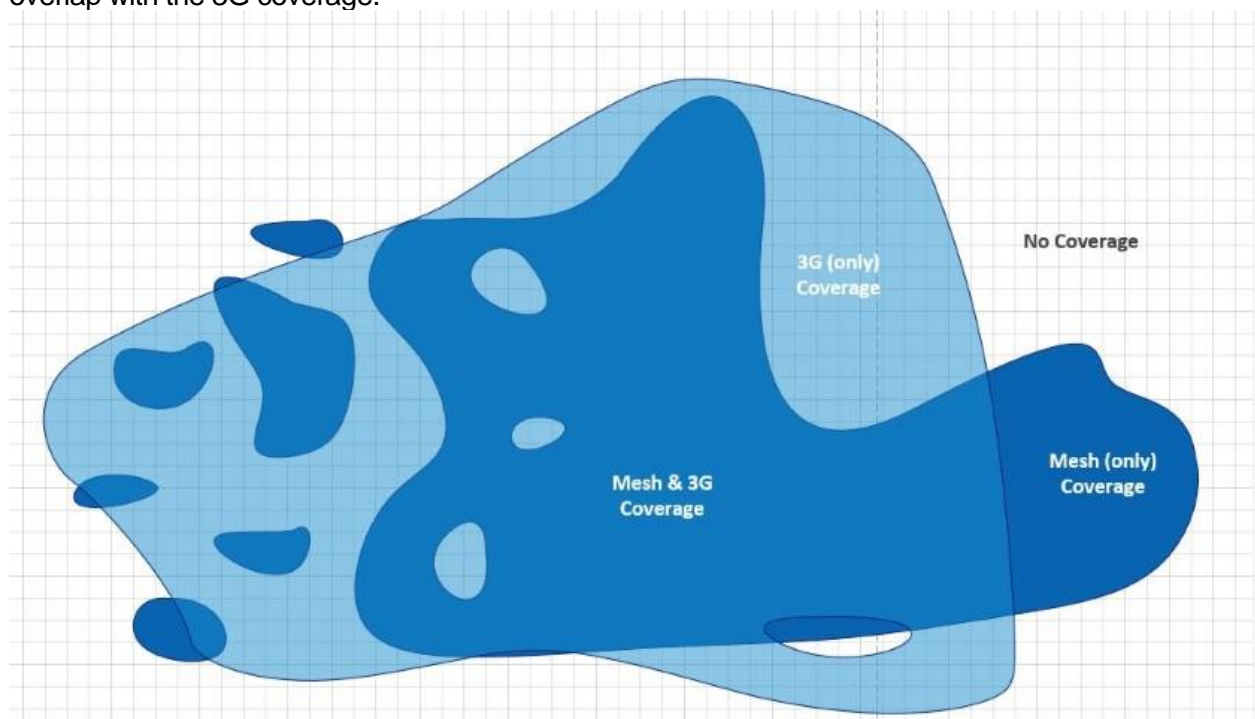


Figure 7 - Interplay of 3G and Mesh coverage boundaries

The entirety of AusNet Services' territory is logically split into four based on the overlap of 3G backhaul and mesh coverage. With each type of area exhibiting several characteristics relating to the installation of new equipment and the potential to expand or contract mesh coverage:

	3G Coverage	No 3G
Mesh Coverage	All Meters have coverage, new meters with NICs (or uAP) will operate from installation.	Meters equipped with NICs will operate from installation. Micro-AP equipped meters will not operate (unless locally reconfigured to be ordinary mesh cards).
No Mesh	<p>New meters with uAPs will operate but not with NICs.</p> <p>Tactical options to create mesh coverage include:</p> <ul style="list-style-type: none"> <li>• Retro-fitting Micro APs to meters</li> <li>• Deploying Access Point to create new mesh coverage</li> <li>• Deploying Relays for extension of existing mesh coverage</li> <li>• Retro-fitting external antennas to extend or enhance nearby mesh coverage</li> <li>• Deployment of additional mesh cards to extend or enhance nearby mesh coverage</li> </ul>	<p>No coverage for any kind of meter.</p> <p>Tactical options to create mesh coverage include:</p> <ul style="list-style-type: none"> <li>• Deploying Relays for extension of existing mesh coverage from neighbouring areas</li> <li>• Retro-fitting external antennas for extend or enhance nearby mesh coverage</li> <li>• Deployment of additional mesh cards to extend or enhance nearby mesh coverage</li> </ul>

Table 5: Characteristics of various network coverage cases.

### 3.3 Backhaul - Telstra Wide Area Network

IPv6 Mesh traffic from the field is IPsec tunnelled at Access Points and Micro AP's and backhauled through cellular IPv4 WAN links of Telstra's 3G network to the MMS. The backhaul network sits between APs/uAPS and AusNet Services' datacentres and is configured to support the high-availability edge network at AusNet's datacentres.

Telstra has indicated they may have to shut down the 3G after 2020, however, no network shutdown date has been officially announced to date.

### 3.4 UIQ Appliances and Physical Network

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#### 3.4.1 Firewall

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#### 3.4.2 Routers

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**3.4.3 Switches**

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**3.4.4 Unified Computing System - UCS**

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**3.5 IT Applications**

The Mesh AMI Application Suite contains 3 key applications that are dedicated to AusNet Services' service offering around smart meter. These are the Meter Management System called UtilityIQ, the Meter Data Management System called Energy IP and the Enterprise Application Integration EAI. There are applications surrounding these core applications that provide support or a key function for this service offering, customer information (SAP CIS), reporting and dash-boarding (Grid-Director/ADW), monitoring and the Business to Business / Enterprise Application Interface (WebMethods). This section covers the Operational Support Systems and AMI dedicated applications.

**3.5.1 Meter Management System – UtilityIQ**

The UIQ Application suit is comprised of several applications that communicate via Java Message Service (JMS) and web services. The individual applications are summarised in Table 8.

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Application	Description	Dependencies
<b>UIQ Gridscape</b>	GridScape is a web-based network management application that operates from a utility's back-office to enable remote, secure configuration and management of Silver Spring-based Distribution Automation (DA) communication networks. GridScape works as the management layer of the DA communication network, which consists of Silver Spring radio frequency (RF) devices. For AusNet, the primary purpose of the GridScape component is to support the call home feature of the MicroAP, which will automatically configure the 6in4 Tunnel Termination Routers (TTR) to allow secure IPv6 communications to the Access Point and upstream mesh radio network	
<b>UIQ TMB (Trap Forwarder)</b>	The Trap Management Broker (TMB) asynchronously captures, displays, and logs traps from network devices and allows users to instantaneously view alert notifications from any network device that supports SNMP. The Trap Forwarder contains an Listener feature to capture and forward all communication between applications and the neighbourhood area network (NAN) through the Access Point (AP).	[C-I-C]
<b>UIQ REG</b>	Registrar is the Silver Spring implementation of a Dynamic Domain Name System (DDNS). Its primary purpose is to collect network registration and update notices from the NICs sent using the DDNS protocol and to serve look-up requests as specified by the DNS RFC (RFC1035). Its secondary purpose is to collect statistics of device activity and display those statistics through a Representational State Transfer (REST) web service interface.	[C-I-C]
<b>UIQ GMR</b>	The Global Meter Reader (GMR) component of AMM manages meter reading jobs, ping jobs, meter program processing, and the generation of meter data and event export files. Multiple GMR instances balance meter reading loads and improve performance. For AusNet, a single instance of GMR will be deployed, but for large deployments (those exceeding 2 million endpoints) multiple GMR instances can be installed on multiple servers.	[C-I-C]
<b>UIQ FPS</b>	The Field Pairing Service (FPS) allows AusNet to install or swap NICs into meters in the field without the need for any field tools. The UIQ back office suite will manage the processes required to complete the provisioning without user intervention unless there is a failure.	[C-I-C]
<b>UIQ JMS</b>	TIBCO Enterprise Message Service™ (EMS) provides JMS functions for a number of Silver Spring applications. TIBCO EMS publishes messages to queues managed by other message services, such as JBoss, through a bridge. For AusNet, JMS queues are used extensively to allow webMethods to react to information and alerts triggered from UtilityIQ.	[C-I-C]
<b>UIQ AMM</b>	Advanced Metering Manager (AMM) is the base platform on which other UtilityIQ products and components are built, and is the core software product. AMM functions allow AusNet Services to do the following:	[C-I-C]



Application	Description	Dependencies
	<ul style="list-style-type: none"> <li>Read utility usage data from electricity endpoints using configurable, automated metering schedules</li> <li>Monitor daily data collections</li> <li>View upcoming and completed metering schedules</li> <li>Configure and schedule for remote services such as disconnects and re-connects</li> <li>Approve meter programs prior to accepting collected data</li> <li>Report on data collection and security</li> <li>Manage assets in the field</li> <li>Troubleshoot unread meters</li> </ul>	
<b>UIQ ESB Server</b>	UtilityIQ provides a packaged version of a third-party product called Mule ESB. ESB is an external integration layer for UtilityIQ that provides web service routing and extended services and APIs, and Mule ESB is required for AMM. ESB Server is an installation and configuration wrapper for Mule ESB.	[C-I-C]
<b>UIQ MPC</b>	Meter Program Configurator (MPC) enables wireless, remote audits and upgrades of meter programs. Specifically, it performs audits and upgrades of AusNet's fleet of Landis+Gyr C12.19 electricity meter programs. These programs are currently managed by Select Solutions on behalf of AusNet services and the same programs used in the PolicyNet MMS are compatible with UtilityIQ MPC.	[C-I-C]
<b>UIQ HCM</b>	Home Area Network Communications Manager (HCM) enables utilities to create and manage Demand Response (DR) programs. A DR program is a contract between a customer and a utility company under which customers can elect to participate in or opt out of DR events that the company sends out during critical peak periods.	[C-I-C]
<b>UIQ NEM &amp; CEPNMS</b>	The Network Element Manager (NEM) and CEPNMS provides advanced network management capabilities based on industry standards, including: <ul style="list-style-type: none"> <li>Fault management to detect problems, alert operators, and provide tools to identify the root cause</li> <li>Performance management to measure performance characteristics and, if necessary, alert operators</li> </ul>	[C-I-C]
<b>UIQ CAAS</b>	Central Authentication and Authorization Service (CAAS) supports single sign-on, and stores user credentials in a local database.	[C-I-C]
<b>UIQ FWU</b>	The Firmware Upgrader (FWU) performs audits and upgrades for UtilOS on mesh devices, and meter firmware on third-party electricity meters.	[C-I-C]
<b>UIQ SAM</b>	FSU-Secure Access Manager (FSU-SAM), enables an administrator to limit the number of secure maintenance links each Field Service Unit (FSU) can establish with the NIC of a targeted endpoint within a configured duration. These secure maintenance links allow critical commands, such as remote disconnects, to be issued from an FSU in the field to the meter firmware securely.	[C-I-C]
<b>SIQ</b>	SensorIQ, a back-office application for data collection and delivery, unlocks real-time and granular data from meters on the network. SIQ configures devices for data collection without requiring changes to the endpoint's programming, supporting a wide range of analytics and event response. This application enables utilities to monitor voltage sags/swells to determine grid efficiency, track and resolve excessive meter temperatures, collect instantaneous power consumption for load disaggregation, track energy and device status to validate demand response events, forecast loads through usage data, and monitor current and power factor.	
<b>DMS</b>	The Device Management Service is the central repository of critical device data.	
<b>Trap Router</b>		
<b>Elasticsearch DB</b>	Elasticsearch is a search engine based that provides a distributed, multitenant-capable full-text search engine with an HTTP web interface and schema-free JSON documents.	

Application	Description	Dependencies
UIQ CT	[C-I-C]	[C-I-C]
Gateway		

Table 6: UIQ Applications.

Other software associated with the Mesh solution includes:

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### 3.5.2 Meter Data Management System (MDMS) – Energy IP

The EnergyIP application processes meter data provided by the MMS application and applies the relevant regulatory validation obligations to the data which is then supplied to the AEMO and the retailers.

- Adaptor – Accepts Data from the MMS
- Cleaner – validates the format of the data
- Archiver - publishes the data to the Energy IP data base
- Billing Cycle Module - Generates billing requests for AEMO, Retailers and Network Billing (Kinetiq)
- Billing Reads processor and dispatcher – fulfils the billing requests and provides estimations and or substitutions where required (Regulatory obligation rules)
- Billing exporters - sends the above transactions to AEMO, Retailers and Network Billing

### 3.5.3 Enterprise Application Interface – EAI

The EAI applications facilitate integration of many different applications across the business as well as between AusNet Services and other participants in the energy market. In particular, EAI is the interface for AMI data between the MMS UIQ (Mesh) and PolicyNet (WiMAX) and the MDMS Energy IP.

### 3.5.4 Monitoring and Reporting

The supporting applications that provide monitoring and reporting for the smart metering solution consists of the AMI Data Warehouse (ADW) that stores the data and Grid-Director that displays the data to which regulatory and business rules/logic were applied. The operational monitoring of the end to end AMI solution is done using the IBM Tivoli monitoring suite.

- Grid Director:
  - Displays ADW data in various formats;
  - Used for reporting and referral purposes;
  - Dashboards of end-to-end solution health trends range from high level reporting to detailed technical metrics;
- Tivoli Suite:
  - Live dynamic tool used to provide monitoring, alerting and alarming of the end to end components of the smart metering solution;
  - Purposed to keep AMI network and applications up and running;
  - ITNM – Discovery of network topology and root cause analysis of network devices based on topology and network components;
  - TNPM – Performance of network devices;
  - SCAPM – Health and performance of applications and their underlying infrastructure and databases;
  - OMNIBUS – Fault and event management;
  - DASH – Network and Application live management dashboards (consolidates the above information);
- ADW - DataStage and Cognos
  - Consolidated reporting solution;
  - Combines data from disparate source operational systems; and
  - Provides a consistent view of AusNet Services' AMI data through a number of Regulatory and Compliance reports.

### **3.5.5 Shared Network Assets**

AusNet Services operates and maintains the IT infrastructure and technologies to support the end-to-end AMI systems to provide the full suite of AMI services and capabilities. The IT Infrastructure broadly leverages both of AusNet Services data centres to house all of the backend systems needed to receive the meter data, perform all necessary computations and then presentation/delivery to market.

**Shared Infrastructure Assets** are defined as systems established by non-AMI initiatives and used by both AMI specific systems as well as corporate systems. These shared infrastructures are deemed to be the base building blocks of an ICT network.

Shared systems that fall into this category are:

- Storage Area Network (SAN) Fabric and Storage
- Data centre facilities (power, cooling and protection)
- Network Security
- Network communications
- Monitoring systems
- Backup system
- Directory Services

### 3.6 Maintenance and Support Services

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## 4 Asset Condition, Replacement Considerations and Strategy

The evaluation of asset “conditions” is largely based on 3 major criteria:

- **Commercial availability, warranty and support.** The ability for a manufacturer to continue selling and supporting an asset in a non-superseded form is a key replacement consideration. This is known as the “product shelf-life” which lasts until the product is eventually removed from the market, as announced by the supplier. The “asset life” goes beyond this, but is contingent upon the supplier’s warranty and support arrangements. It is to be noted that if adequate maintenance procedures are in place the “asset life” can be potentially extended beyond the supplier’s commercial support period, as long as the consequently operational risk of service disruption is managed.
- **Technical capability.** The ability for an asset or technology to continue to deliver the required functions and acceptable performance to meet business requirements is another key replacement consideration. Each part of the end-to-end solution needs to deliver the required function. For example, if the communications RF Head is functional, but does not the Carrier Access Point is not functional then the business requirements cannot be met.
- **Asset integrity.** The ability for an asset to continue to perform its function based on mechanical/material condition and integrity of the asset.

These assessment criteria vary over the age of the assets in terms of:

- reaching the product shelf-life;
- obtaining adequate support agreements;
- likelihood of change affecting an asset’s ability to meet business requirements; and
- physical asset deterioration causing assets to fail.

The following asset condition summaries are an assessment based on one or more of the above criteria.

#### 4.1 SSN Mesh Network Hardware

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##### 4.1.1 Field Hardware Ordering

Field hardware is ordered from the Itron Pricing catalogue. All hardware orders must consider the appropriate bill of materials for installing the infrastructure and what the minimum software licensing is required. Once a fully rendered purchase order has been submitted to Itron, AusNet needs to confirm the Purchase order was accepted and that an expected delivery date has been supplied.

Standard delivery times for hardware sent from Itron is typically 16 weeks plus shipping. Freight options are sea and air and are typically add 4 weeks and 3 weeks respectively. By default freight will always be sea due to cost so the standard delivery lead-time from purchase order acceptance should be considered 20 weeks.

All Itron network devices are comprised of a software and hardware component, which depreciate separately. While the device software depreciation commences with the purchasing of the license, the depreciation of the hardware component will commence upon installation the field.

##### 4.1.2 Field Hardware Warranty

Warranty on all hardware is 12 months for Itron equipment. An optional 6 year extended warranty can be purchased for all equipment, to date AusNet has purchased for extended warranty for all equipment which provides a 7-year hardware warranty on all equipment other than AP and Relay batteries which is 12-month warranty. To ensure warranty is exercised to its fullest warehoused stock should be kept to minimum spares requirements for batteries.

#### 4.1.3 Battery Management

All Access Point and Relays are battery-backed devices for last gasp functionality. Lead Acid batteries are contained within a nonconductive enclosure and have a 12-month warranty period from the equipment being received. There is a possibility that battery spares will be out of warranty prior to equipment being installed, it is therefore recommended that battery spares are kept to a minimum and installed in a logistics first in first out principle. Battery failures to date have been very low, even where the voltage recorded is below the preferred threshold it is unlikely there is a requirement to change these unless they cause the actual pole top device to fail. All remote battery management is completed with UIQ.

#### 4.1.4 Field Hardware Spares

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#### 4.1.5 Mesh Communication Modules - NIC

Mesh communication modules were first deployed in AusNet's AMI meters in October 2015 during the Pilot and mass deployment of Mesh technology as part of the AMI Program. The oldest communication modules are thus 2 years of age. Communication modules, including uAP, have experienced very low failure rates of 0.3% and less (annualised) as shown in Table 7 and .

Communication module faults are identified in SAP CIS via type Z2 notifications. These notifications are raised for logically converted meters that do not deliver data for 3 consecutive days. Once the notification has been received by the Meter Asset Management Team a service order is raised for a field investigation of the fault.

No communication module fault notifications (Z2) are raised for meters that are not logically converted. In these cases, communication module faults would remain unnoticed unless the affected meter is actively monitored by any group in the business (e.g. when meter is selected for logical conversion).

Year	NIC	uAP
2016	0.14%	0.21%
2017	0.33%	0.05%

Table 7: Annualised communication module failure rates for NIC and uAP.

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#### **4.1.6 MicroAP**

Depending on the terrain, AMI meters may be located in areas of minimal to no Mesh network coverage, i.e. not in line of sight to other network devices that are an AP or connected to an AP. In cases where it is considered unfeasible/uneconomical to install PTDs to provide a path out for the affected meter(s) and where the meters are located within coverage of Telstra's 3G network, the installation of a uAP communication module might provide a suitable solution. Typically, uAPs are installed in rural areas with low meter densities and provide access to the backhaul network for usually up to 50 meters (large numbers of meters using the same uAP may compromise the data quality and frequency under which interval reads can be obtained).

uAP modules access the 3G backhaul network via a MIM (machine identification module) card which is embedded in the circuit board. The MIMs are provided by Telstra and are only compatible with Telstra's 3G network (see Section 4.2 for details). MIMs ordered and received from Telstra have to be forwarded to SSN and their uAP production facility in Thailand.

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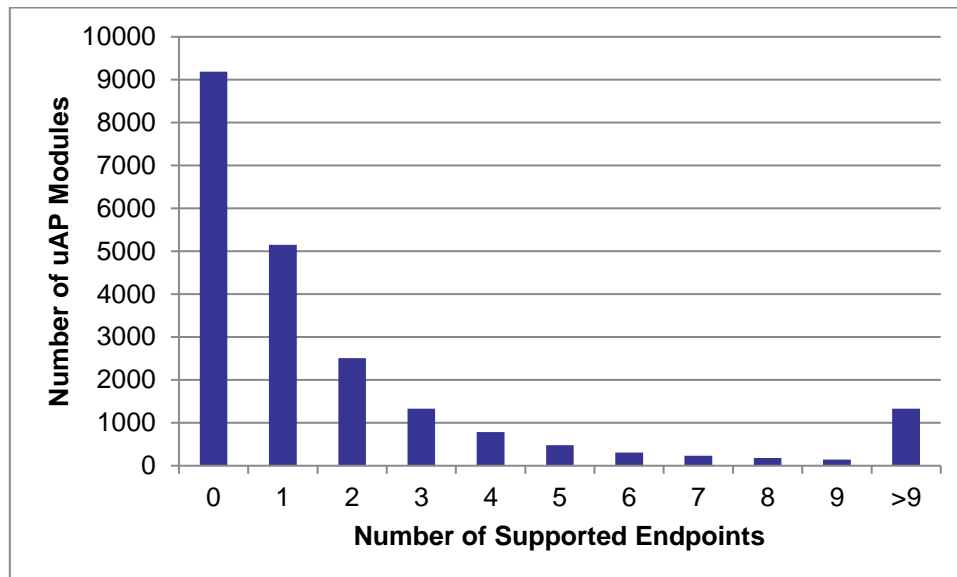


Figure 8: Number of uAP modules supporting various number of Mesh endpoints.

#### 4.1.7 APs

All PTDs including APs and Relays are subject to reactive maintenance only (fix on failure). The health of all APs and Relays is actively monitored via an automated backend job that pings each PTD every 15 minutes. The status of the backbone network is monitored daily to identify PTDs with communication issues. In case of loss of power to a PTD, the device switches to AC battery power and a “on battery event is triggered”. Upon power restoration a “power restore” event is received.

APs and Relays have very low failure rates. Since installation, only one faulty AP has been reported. This AP was located in Upper Beaconsfield and failed after HV injection. HV injections are usually triggered during storms when trees or branches obstruct overground power lines. As a consequence of the transient HV injection, electronic devices in close proximity can fail. While HV injections do happen, the likelihood of an HV injection affecting a pole with PTD is very small.

In the worst case scenario, all meters that use an AP that fails will be offline until the AP is replaced if the affected meters have no alternative path to a secondary access point. Given the 16 week lead time for hardware replacement with SSN, a sufficient number of spare APs should be kept at AusNet at all times. Spare levels of 3% for all PTDs and 1% for all PTD antenna types are recommended by SSN which translates into ~9 APs and 3 Mesh and 3G antennas given the number of deployed APs.

PTDs are currently being installed via the vendor Lend Lease. It is, however, intended to in-house the installation of PTDs through the INS team. Installation of APs is required in areas of new estates to provide AMI infrastructure for upcoming new connections. Ideally, planning for installation of infrastructure for new estates should happen in conjunction with AusNet’s network team.

Currently, 305 APs are deployed in AusNet’s Mesh network as shown in Figure 2.

Technically, AP can theoretically support a maximum of 24,000 endpoints/meters. The high level Mesh network design by SSN is based on a conservative ration of 5,000 meters per AP to ensure additional capacity is present when additional meters are deployed. In practise, it is common to have approximately 1,000-8,000 meters per AP according to SSN. However, larger number of meters may compromise the volume and delivery frequency of meter data (AMI and power quality) that can be handled by a single AP. Depending on various factors, including the 3G signal, link quality and data volume, a data quality limit of 5,000-8,000 meters per AP can be estimated to ensure performance targets are met.

APs that exceed 5,000 supported meters over 2-3 months should be analysed regarding their capability to meet all data-to-market targets for the supported meters. This analysis may then provide an indication if the installation of additional APs for load distribution and load balancing is required. A histogram of APs and their respective volume of supported meters is shown in the Figure 9.

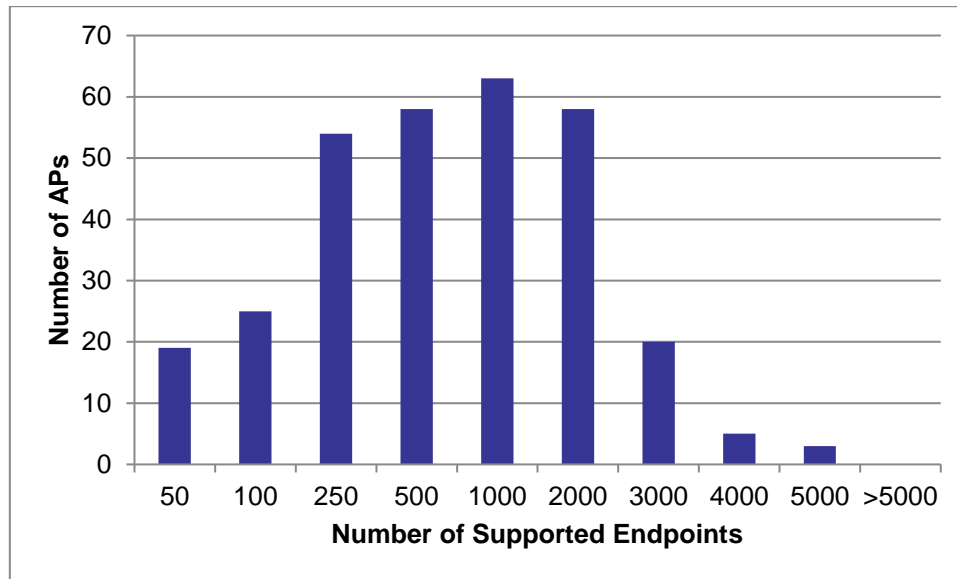


Figure 9: Number of APs supporting various numbers of Mesh endpoints.

As outlined in the EDM AMS – Part 2, the WiMAX solution supporting ~ 57% of AusNet’s AMI meter fleet (~415,000 meters) is expected to operate until 2022. Due to the obsolete nature of the WiMAX technology, a transition of all meters to an alternative AMI technology that is likely Mesh will occur around 2025. Contrary to Mesh, AMI meters communicate directly with one of the 85 WiMAX base stations in AusNet’s distribution network. The WiMAX signal has a maximum extended range of 15 km. Consequently, WiMAX meters are all located in medium to high meter density areas in close proximity to the base stations. Particularly in the Melbourne metropolitan area, individual towers can support up 20,000 meters.

While the WiMAX signal coverage area falls well within the Mesh coverage area, i.e. Mesh infrastructure including Relays and APs is already in place, the expected increase in of meters within the Mesh network may require the installation of additional PTDs to accommodate for the increased volume of meter and power quality data.

APs access Telstras 3G backhaul network via Telstra SIM cards of form factor 2FF (Mini SIM). Similar to uAP modules, SIM cards are ordered from Telstra and forwarded to SSN AP production facility located in Mexico.

Gen4.5 APs are only 3G compatible and will need to be replaced with 4G compatible Gen5 APs in case Telstra is shutting down it’s 3G network. Replacement of the 3G AP SIM with a 4G SIM is not sufficient for upgrading APs since the AP radio component itself is not compatible with 4G technology. Consequently, the only option to upgrade SSN’s AP to 4G is by replacing all Gen4.5 APs with Gen5 APs.

In case of the shutdown of Telstra’s 3G network, all APs will require replacement with Gen5 APs. Simultaneously, the Mesh backbone infrastructure that relies on APs, Relays and uAPs needs to be reviewed regarding the location of PTDs and the requirement for and use of uAPs to reach isolated meters.

PTD assets are currently not yet created and allocated in AusNet’s asset management system SAP. This restricts the ability of the Meter Asset Management team to raise service orders and allocate these to relevant field crews. The current workaround outsources services to PTDs to AusNet’s delivery partner LandLease.

**4.1.8 Relays**

Similar to APs, Relays are subject to reactive maintenance only and are exposed to the unlikely risk of HV injection. Relays are used to extend the Mesh coverage area to reach otherwise isolated meters particularly in areas without 3G signal coverage.

In contrast to APs, Relays only carry a Mesh radio but are not able to directly access the 3G backhaul network. Relays are thus not impacted by the potential shutdown of the 3G backhaul network. Gen5 Relays are offered by SSN but replacement or upgrading of the current Gen4 Relay fleet is not required under the current circumstances.

Currently, 836 Relays have been deployed to the field as shown in Figure 2. As described in the previous section, it is recommended by SSN to keep spare stock levels of 3% for Relays and 1% for Relay Mesh antennas, that is ~ 25 Relays and ~8 mesh antennas for the current number of deployed Relays.

**4.2 SIM and MIM Cards**

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Update: Telstra has now provided an update end of life date of 850MHz 3G for June 2024. AusNet Services has seen a degradation of performance to 3G services in remote areas most likely due to antenna arrays being tuned to 4G services.

AusNet Services will continue to monitor and transition 3G services to 4G services until the end of 2021. At this point, a full deployment to 4G will begin in early 2022 and will have concluded prior to 2023. This will include 320 3G pole top Access Points and the 22,000-microAp installations across the network. It is anticipated that a percentage of the 22,000 endpoints will have already been replaced or converted to endpoint mode prior to the replacement program starting.

<https://www.whistleout.com.au/MobilePhones/Guides/Australian-3G-network-shutdown-what-you-need-to-know>

### 4.3 Backhaul

Telstra 3G services are not offered with coverage or availability assurances. For engineering reliability and availability of the system it should be assumed that any single 3G connection may be inoperable at any point in time but that multiple concurrent failures would be an extraordinary event

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#### 4.3.1 3G Obsolescence

During a Telstra Investor Day on 17<sup>th</sup> November 2016 it was indicated that Telstra will need to retire its 3G network after 2020 (*"You can expect after 2020 that we would need to retire the 3G network and many of the vertical platforms that we've created over a long period of time as the world of networks becomes more software defined."*, <https://www.telstra.com.au/content/dam/tcom/about-us/investors/pdf-e/181116-Investor-Day-2016-Transcript.pdf>). An official announcement of the 3G network shutdown has yet to be announced officially.

In the case of Telstra's 2G network, the network shutdown was announced 1.5 years before the actual shutdown which occurred in December 2016 (<https://exchange.telstra.com.au/its-time-to-say-goodbye-old-friend/>). It can be expected that the time from announcement to shutdown of the 3G network will similarly be in the order of 1-2 years.

The entire Mesh solution will become inoperable with the shutdown of the 3G backhaul network. Consequently, all network devices that directly access the 3G backhaul network, i.e. APs and uAP modules, need to be upgraded to be compatible with 4G or even 5G mobile technology.

At the time of document creation, SSN is not yet offering 5G compatible Mesh hardware and the deployment of Telstra's 5G network is unlikely before 2020. The upgrade to 4G or 5G compatible devices would thus depend on a technology review closer to the announcement of the 3G network shutdown. For the following discussion, it will be assumed that affected Gen4.5 SSN hardware will be replaced with Gen5 device.

Due to the backwards compatible nature of SSN hardware, the hardware upgrade required for 4G compatibility only applies to APs and uAP modules as SSN device of various hardware generations can coexist in the same Mesh network.

All 302 currently deployed APs in AusNet's Mesh network need to be replaced with Gen5 APs. Should the Gen5 APs be installed at the same location as their Gen4.5 predecessor, the AP installation can be simplified as the mounting brackets can be re-utilised.

Existing uAP modules need to be replaced with Gen5 devices if they rely on operating in MicroAP mode for accessing the backhaul network. All other uAP modules that are within Mesh coverage are can be continued to use in Mesh Card mode. The operating mode of uAP modules can be switched remotely from MicroAP mode to Mesh Card mode if the data connection to the meter is stable. Less stable connections require a field visit, however, in such a situation a replacement of the module to a Gen5 uAP might be more suitable as the field visit is unavoidable.

In general, the expected shutdown of Telstra's 3G network is an opportunity to review and potentially restructure the backbone infrastructure consisting of APs, Relays and uAPs. The over usage of uAPs as per initial Mesh network design can be corrected and APs and Relays relocated to optimise the Mesh coverage area.

Additionally, the increased number of meters after transitioning from WiMAX to Mesh should be taken under consideration when upgrading the network backbone.

It might furthermore be feasible to upgrade the Gen4.5 APs and uAP module to Gen5 hardware before the announcement of the 3G network shutdown if a financial benefit arises from the monthly data costs on the 4G network.

It is also possible to remain on the Gen4.5 technology by using the 3G network of a different network provider, i.e. Optus or Vodafone. However, all SIM and MIM cards are limited to be used exclusively in Telstra's 3G network. While it might be reasonably easy to exchange AP SIM cards, uAP MIM cards are embedded on the circuit board and cannot easily be replaced. Consequently, changing network provider would require to replace the majority of uAP modules with modules that feature MIM cards of the alternative network provider. The financial and operational effort in changing network providers is thus comparable with upgrading the backbone devices to Gen5, however, the risk of an eventual shutdown of the alternative service providers 3G network remains. This option should be discarded as it is unlikely to provide a financial benefit.

### 4.4 UIQ Physical Network

The UIQ Physical network is designed with sufficient redundancy so that single points of failure will not automatically cause a breach of regulatory obligations.

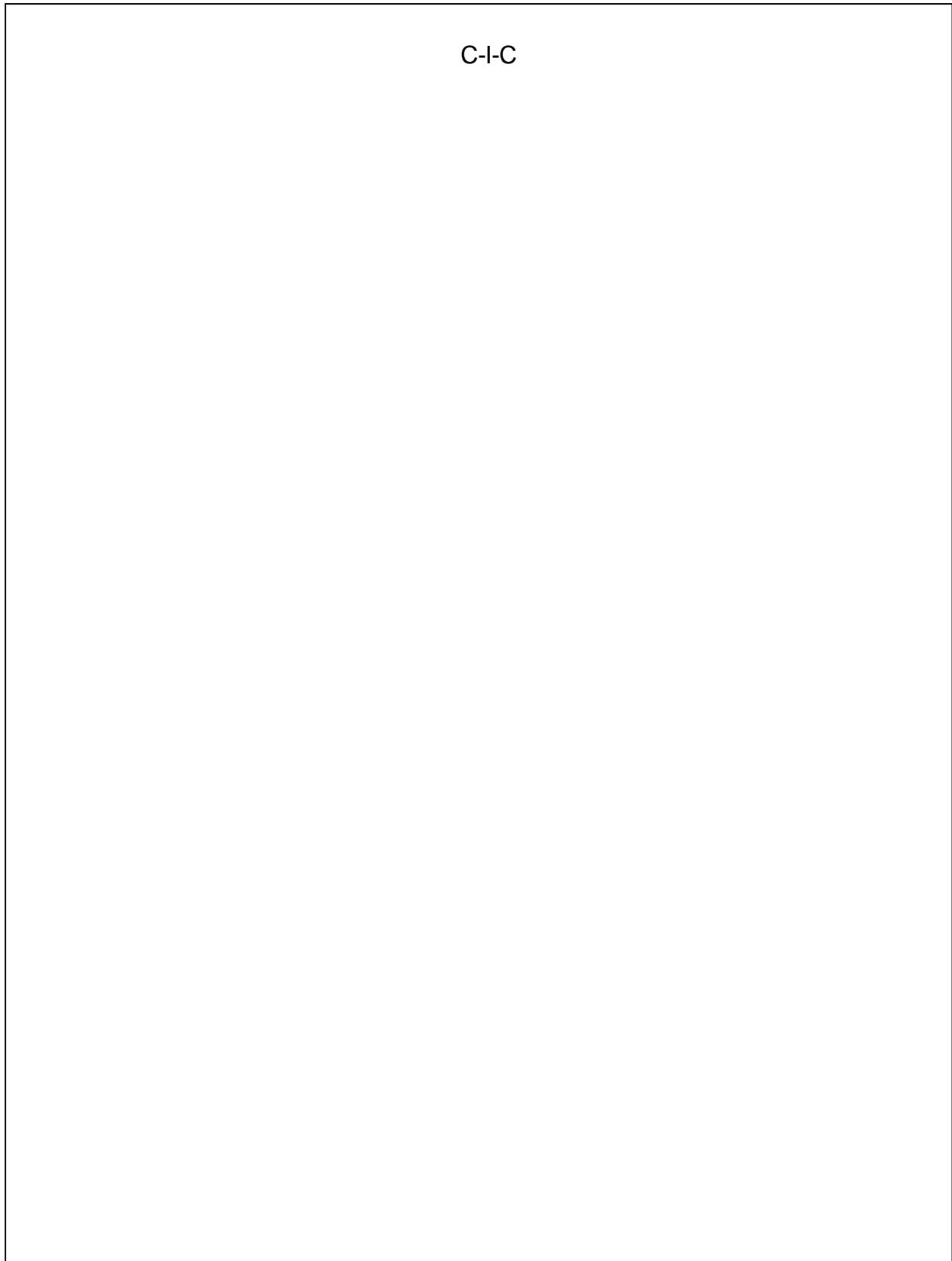
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#### 4.4.1 Routers

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## 4.5 Applications

The software stack of the Mesh solution is comprised of multitude of interrelated and interdependent applications. Figure 1 summarises the major components of the Mesh software building blocks and shows their dependencies.



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#### 4.5.1 UIQ

New versions of the UIQ Suite are released by SSN every 2 years and include a 2-year support window by SSN. The current UIQ version 4.10 will be upgraded to 4.12 version in 2018 with support for the next version lasting until 2020.

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#### 4.5.2 SIQ

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#### 4.5.3 Oracle

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#### 4.5.4 Other Applications

An optimisation tool was developed during the AMI Program that assisted in the analysis and planning of locations for APs and uAP modules. This optimisation tool is still used for network optimisation tasks but has never been productionised. Given the continuous growth of the electricity distribution network and the potential transition of some or all WiMAX meters to Mesh, a sophisticated optimisation tool is required to assist in the planning of the growing Mesh network. This can be achieved by further developing the existing optimisation tool to productionise it or by procuring a commercial alternative with the required functionality to improve ICT's capacity management process for the Mesh network.

### 4.6 Support Agreements

#### 4.6.1 Silver Spring Networks

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#### 4.6.2 Cisco

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#### 4.6.3 Telstra

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#### **4.6.4 Internal Support**

The Mesh solution is internally supported by ICT's DMACS team. The loss of resources would imply a loss of skills and knowledge. However, smart meter Mesh networks are the default technology used by other electricity distribution providers. Consequently, technology knowledge and skills are available in the electricity sector.

## **5 Mitigation and Strategy Summary**

AusNet Services' Mesh network has proven to be a stable and reliable AMI end-to-end solution. Field devices have constant low failure rates and are fixed on failure. The backend UIQ appliance at the datacentres offers multiple layers of redundancy including DR capabilities and fast turnaround times for hardware replacements.

The key risks for the Mesh solution over the upcoming 5-year period, i.e. until 2022, include the obsolescence and expected shutdown of Telstra's 3G network and the impact of SIQ upgrades for Mesh benefits and power quality data on meter data delivery and operating costs.

Future SIQ upgrades, for example for 5-minute power quality interval data and the enabling of additional features, may require upgrades in the NIC firmware and various services and applications of the UIQ software suite due to compatibility reasons. SIQ upgrades can potentially effect AMI meter data delivery either via software dependencies within the UIQ/SIQ software platform or through bugs, for example, in the NIC firmware. The later has the potential to directly impact the delivery of AMI meter data and can cause breach of regulatory obligations.

Additionally, the data volume may increase by 6 times when going from 30 to 5-minute interval data. This or any other increase of data traffic caused by SIQ requires a larger data allowance from Telstra and may require the installation of additional APs to compensate data quality performance issues.

As the SIQ platform is totally separate to AMI meter data, any costs associated with SIQ, i.e. backhaul data traffic, software upgrades incl. testing and upgrading of compatible and dependant applications, and installation of additional backbone devices, have to be covered by the ICT and the Mesh benefits team.

### **5.1 Mesh Metering**

Currently the only mesh metering combination that AusNet uses is the L+G U series meters which can either be field paired or factory paired by L+G through the meter mutting process at manufacture. Itron offer an advanced metering platform that supports not only many meter combinations but also distribution automation and energy efficiency solutions such as street light control. Within the Australian market there are additional metering options that can be used to provide meter diversity and to minimise risks around sole supplier arrangements for metering. Options available for immediate testing would include Secure and EDMI which both offer single phase, multi-phase and CT connect metering. AusNet should seek to test alternative metering technologies to minimise supply risks around sole metering supplier.

### **5.2 3G Obsolescence and SSN Hardware Upgrades**

The shutdown of Telstra's 3G network has not yet been officially announced but is expected to occur after 2020. Similarly, to the shutdown of Telstra's 2G network, it is likely that the 3G network shutdown is announced approximately 1.5 years before the actual shutdown.

The currently deployed SSN hardware in the field is fully dependent on 3G mobile technology for the backhaul of meter data and is limited to the use in Telstra's 3G network exclusively. Three options are conceivable that will guarantee the ongoing compliance of all meters supported by the Mesh network:

1. Phase out of Mesh technology and transition to alternative AMI end-to-end technology;
2. Upgrade of existing SSN hardware to 4G/5G compatible devices; or
3. Continue to operate of 3G network of different network provider.

The first option can be considered unfeasible due to the cost and lack of funding required for full exchange of the current Mesh technology.

The second option involves:

- The physical exchange of all APs;
- The physical exchange of all uAP modules operating in MicroAP mode that rely on direct backhaul network access due to a lack of Mesh coverage;
- The remote change of uAP operating mode of all remotely accessible uAP modules that can operate on Mesh only;
- The manual change of uAP operating mode of all accessible uAP modules that can operate on Mesh only but have an insufficient data connection for a remote change of the operating mode.

Similarly to the second option, the third option – change of network provider – involves the exchange of all uAP modules that are not within Mesh coverage area. The new uAP modules require MIM cards of the new network provider to be embedded in the circuit board. APs do not have to be physically replaced, as the SIM card itself is replaceable. While this reduces the costs for replacement hardware compared to option 2, the risk of a potential 3G network shutdown remains and only delays the upgrade to 4G/5G compatible Mesh devices. Consequently, options 1 and 3 can be disregarded with option 2 the only feasible alternative.

### **Cost Estimate**

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### 5.3 Alternative AMI solutions

While AusNet operates both the Itron mesh solution which has more than 25 million endpoints worldwide and a legacy WiMAX solution that is at end of life other alternative solutions are used and available. There are a number of other mesh solution offerings including point-to-point solutions with most meter manufactures having a proprietary AMI solution to support their meter fleet. Adopting a meter manufacture head end system would tie AusNet into a specific head end system that would support the vendors meter options.

Alternative solutions available also include cellular point-to-point solutions which are a solution that is being used under the AEMC Power of Choice in other states by incoming and existing metering providers. To date these solutions have not been rolled out at scale and are not required to meet the jurisdictional functional specifications rather to meet minimum service levels. Further investigation should be sought on cellular solutions as an alternative to minimise risk around a sole mesh solution.

## 6 Glossary

Acronym / Term	Definition
Access Point (AP)	A Silver Spring Networks device containing a mesh communications interface and a 3G or Ethernet interface. Access Points are typically installed on a power pole or light pole and bridge the mesh network to the WAN.
ADW	AMI Data Warehouse – IT system that permanently archives meter data, events, and other AMI data.
AMI	Advanced Metering Infrastructure
AMM	Advanced Metering Manager – The Silver Spring Networks UtilityIQ component that manages meter data.
CAAS	Common Access and Authentication Service – The Silver Spring Networks UtilityIQ component that manages user authentication and access control.
CEPNMS	Common Execution Platform Network Management System – Silver Spring Networks next generation replacement for the UtilityIQ NEM component.
CT	Communication Tester – Silver Spring Networks PC-based application used with an FSU to manage and diagnose faults in mesh devices.
CIS	Customer Information System (SAP-ISU)
DNS	Domain Name System – an IP protocol that maps domain names (hostnames) to IP addresses.
DDNS	Dynamic DNS
DMZ	De-Militarised Zone – a term used in networking to describe a part of a network that is more exposed to the outside world than the core network. It is typically separated from the core network by a firewall.
DNSP	Distribution Network Service Provider – the role in the NEM that is responsible for electricity distribution, commonly known as a ‘poles and wires’ business. AusNet Services is a DNSP.
DR	Disaster Recovery – the systems and processes used to recover systems and business processes following a major incident or outage.
DSDBI	Victorian Government Department of State Development, Business and Innovation (replaced by the Department of Economic Development, Jobs, Transport and Resources).
EAI	Enterprise Application Integration – specifically webMethods
Firewall	A network device that only allows certain types of traffic to pass through.
FPS	Field Pairing Service – The Silver Spring Networks UtilityIQ component that manages the field pairing of meters with communications cards.

Acronym / Term	Definition
FRMP	Financially Responsible Market Participant – the role in the NEM that is responsible for retailing energy to the end-user.
FSU	Field Service Unit – A Silver Spring Networks device that can connect a laptop or other handheld device to mesh devices for the purpose of managing or diagnosing faults on mesh devices in the field.
FWU	Firmware Upgrader – The Silver Spring Networks UtilityIQ component that manages firmware upgrades on mesh devices.
GMR	Global Meter Reader – A sub-component of UtilityIQ AMM that is responsible for reading meter data from meters.
GridScape	The Silver Spring Networks UtilityIQ component that provides auto-configuration services for MicroAP's and Access Points.
HAN	Home Area Network – the network that connects an AMI meter with devices such as In-Home Displays. For Victorian AMI meters, the HAN uses the ZigBee Smart Energy Profile.
HCM	HAN Communications Manager – The Silver Spring Networks UtilityIQ component that manages HAN devices such as IHDs.
HSM	Hardware Security Module – a purpose built hardware device which provides encryption and authentication key storage and management
IHD	In-Home Display – a device in the home that communicates information about energy consumption to the occupier.
IPSec	An IP security protocol suite that includes mutual authentication and encryption at the IP packet layer.
IPv4	Internet Protocol, version 4
IPv6	Internet Protocol, version 6
JRE	Java Runtime Environment
JMS	Java Message Service
KeySafe	A Hardware Security Module (HSM) from Thales e-Security
LDAP	Lightweight Directory Access Protocol – A protocol for centralised user authentication and access control.
LR	Local Retailer – a role in the NEM that is responsible for the supply of electricity to customers in a local area.
MAC	Media Access Control – a sub-layer of the Data Link Layer (layer 2) in the 7 layer OSI network model, providing addressing and channel access control.
MAC address	A MAC address is a globally unique identifier for network devices.
MDP	Meter Data Provider – the role in the NEM that is responsible for providing meter billing data to the market. AusNet Services is an MDP.
MDM or MDMS	Meter Data Management – IT system that validates and stores meter billing data (EnergyIP)
Mesh	The Silver Spring Networks AMI network, based on a mesh network topology (a self-forming network topology where each node may forward data for other nodes).
Mesh Meter	An AMI meter fitted with a Silver Spring Networks mesh communications card.
Mesh MMS or Mesh NMS	The Silver Spring Networks MMS. See UIQ.
MicroAP	A Silver Spring Networks meter communications card that has an additional 3G network interface and can act as an Access Point.
MMS	Meter Management System – IT system that manages AMI meters, collects meter billing data and events, and forwards this data to systems including MDMS and ADW. The AusNet Services AMI architecture includes two distinct MMS systems - the GridNet <b>PolicyNet</b> MMS and the Silver Spring Networks <b>UtilityIQ</b> NMS.

Acronym / Term	Definition
MPC	Meter Program Configurator – the Silver Spring Networks UtilityIQ components that manages meter programs and meter configuration.
MSATS	Market Settlement and Transfer Solution – the NEM system for exchanging meter data between market participants such as MDP's and FRMP's.
NEM	1. National Electricity Market. 2. Network Element Manager – the Silver Spring Networks UtilityIQ component that performs traditional network management functions (monitoring, reporting and alerting on network performance).
NIC	Network Interface Card – an SSN mesh communications interface card.
NMI	National Meter Identifier – a unique identification number assigned to a service point. Note that a NMI may have more than one physical meter.
NMS (Mesh NMS)	The Silver Spring Networks MMS. See UIQ.
ODR	On-Demand Read – a targeted read of a meter or group of meters, independent of the primary read schedule
PKI	Public Key Infrastructure – hardware and software for managing public-private key based encryption systems.
PolicyNet	The GridNet AMI solution, meter protocol and application layer, including the GridNet MMS.
Relay	A Silver Spring Networks mesh network device typically installed on a power pole or light pole to extend the range or improve the reliability of the mesh network.
RF	Radio Frequency – electromagnetic radio waves in the range of 3 kHz to 300 GHz. Synonym for wireless communication
RPO	Recovery Point Objective – defines the maximum targeted period in which data might be lost from an IT system due to a major incident.
RTO	Recovery Time Objective – targeted duration of time within service must be restored following a major incident.
SaaS	Software-as-a-Service – used to describe applications or IT systems that are physically located outside of the customer's network and accessed via the Internet or dedicated network links. The hardware and software are both managed by the vendor.
Sandbox	
Ship file or Manifest or Device File	A file containing per item details such as serial numbers, MAC addresses, and meter passwords for meters, communications cards, Access Points or Relays
SSL	Secure Sockets Layer – a packet encryption standard
SSN	Silver Spring Networks
UI	User Interface
UtilityIQ or UIQ	The Silver Spring Networks Meter Management System (MMS).
UtilOS	The operating system that runs on Silver Spring Networks mesh devices (mesh communications cards, Access Points and Relays)
WAN	Wide Area Network – specifically the backhaul network used to connect Access Points to the MMS and NMS.
webMethods	The EAI solution used to integrate the AMI system components.
XML	eXtensible Markup Language – a common file format that supports hierarchical data.