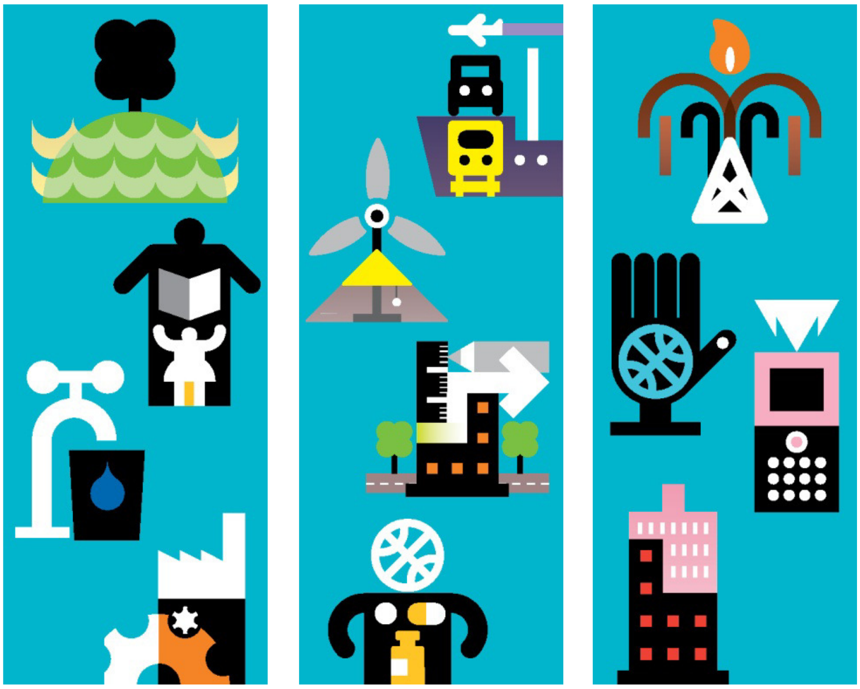

RIIO-ED1 SSEPD Operational Services Benchmarking

Final

June 2013

Scottish and Southern Energy Power Distribution

Mott MacDonald

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Final Version	26th June 2013	SCM	RH	AT	Updated with latest document names for SSEPD documentation. Comments added on overall IT strategy
Final Version RevA.1	26th June 2013	ART	SCM	ART	Minor amendment for client comment dated 26/6/2013

Contents

Executive Summary

Introduction to Scope of Work

Mott MacDonald undertook a review of the operational communications and operational IT services within Scottish and Southern Energy Power Distribution. The operational services were defined as:

- **Operational Telecommunications Services (Op-Tel) –** the telecoms services supporting the operational applications and processes associated with monitoring, controlling, operating and protecting the power network and its constituent parts. These services are often referred to as Op-Tel services.
- **Operational Support Services** – this category represents the telecommunications services that support applications related to the maintenance and service support of the power network i.e. field maintenance staff. These services are closely related to the Operational Services defined above and again represent both voice and data services, often including mobile radio, Automatic Vehicle Location (AVL) etc.

Specifically the review included the following areas:

- The Supervisory Control And Data Acquisition (SCADA)/control centre and other Real Time Systems (Electrical Network Management and Control {ENMAC}, Supply Interruption Management System {SIMS}, Small World etc.)
- Mobile working (operational Information Technology {IT} systems for field based staff)
- Customer services (including user interfaces and social media interaction)
- Strategy for smart metering data integration and manipulation
- Other Op-Tel services including tele-protection and black-start

To this end Mott MacDonald either met with or called the following people to discuss their respective areas:

- John Robertson: SCADA/control centre and other Real Time Systems (RTS)
- Ian Freemen: Smart metering data integration and manipulation
- Richard Westwood: Customer Services - Emergency Service Centre (ESC) North
- Tina Riley: Customer Services - Emergency Service Centre (ESC) South
- Richard Dickson: Field and site operations manager – SSE Telecom (SSET)
- Sandy Peebles: Network Engineer - SSE Telecom (SSET)

The review was split into two main areas:

- Benchmarking
- Strategy review

Benchmarking - Utility Industry Trends

Time Division Multiplexing (TDM) based platforms (Synchronous Digital Hierarchy {SDH} /Plesiochronous Digital Hierarchy {PDH}) are still the dominant technology base for Transmission System Operators (TSOs), with Distribution Network Operators (DNOs) more readily migrating service to Internet Protocol (IP) based platforms Where existing telecoms switches are reaching end of life status, they are being replaced by Multi Service Platform systems that support both TDM and IP Multi-Protocol Label Switching

(MPLS) services. There is a clear recognition that migration to IP based services is inevitable[1]. However in the area of time-critical applications (i.e. tele-protection) there is significant reluctance to migrate to a technology that many utility experts consider unable to meet their stringent timing requirements.

- Many utilities are now migrating SCADA to IP
- Many utilities are carefully identifying and transferring those tele-protection services which can operate within an IP environment (driven by local Public Telecom Operators {PTOs} Next Generation Network migrations to IP based technology – e.g. BT21CN in the United Kingdom {UK})
- Newer networks (particularly Central / Eastern Europe) are fully IP based

Op-Tel policy definition remains a local activity (in country / in region), regardless of the structure of the business, or the structure of the communications infrastructure.

Many utilities have migrated away from Private Mobile Radio (PMR) for workforce communications, and utilise mobile phone networks instead. Drivers for this include:

- Mixed voice and acceptable data capability of handsets (with General Packet Radio Service {GPRS} / advanced third generation mobile services {3G+})
- Improved customer interface – field force can contact customers directly
- Competitive and preferential bulk tariff deals available within some markets
- Multiple service providers and network roaming provide an increased (and acceptable) level of resilience
- Network coverage continues to increase with many countries experiencing close to 100%

Others have retained their PMR capability and a backup service for when mobile is not available.

Automatic Vehicle Location (AVL) systems are used increasingly, creating more efficient workforce allocation and response to incidents and SSEPD is working on implementation of a GPS tracking system within its vehicles.

Benchmarking - SSEPD

SSEPD compares well to the benchmark utilities in terms of its technology implementation. For services such as tele-protection the company uses traditional TDM based signalling protocols which run on a mixture of fibre, microwave and leased circuits. Migration to IP is not being considered for tele-protection; instead SSEPD is looking at PDH/WDM technology as existing equipment reaches end of life. This is very much in line with the majority of utilities in other markets.

In terms of the RTS network, IP has been pushed out to the FEPs and is planned to be extended out as to the various RTUs starting this year.

[1] IP has become the standard network communication protocol, replacing TDM based networks. Given this fact it seems likely that current TDM technology, including SDH, will eventually be replaced by IP technology. Driven by the technical obsolescence of existing equipment in utility networks, there is pressure to move to the latest technology available – which is IP based.

A mixture of voice, mobile and PMR systems are utilised as part of operational and field dispatch services; again in line with other utilities.

The issue of migrating to Internet Protocol for tele-protection services is one that is likely to cause vigorous debate within the utility industry for years to come. Successful pilot implementations of IP based tele-protection have been run. However it is recognised that for many utilities IP technology has not yet been proven to meet the rigorous requirements for tele-protection (at least for the most demanding, higher voltage tele-protection circuits). SSEPD's consideration of moving to SDH/ Wave Division Multiplexing (WDM) would be a valid solution that would avoid issues of equipment obsolescence for a significant time period.

Strategy document review

Three strategy documents were reviewed – the RTS strategy and the smart metering strategy, as well as an overall IT strategy document that links the RTS strategy and smart metering strategy together, and places them within SSEPD's wider business context. These documents show that SSEPD is developing its functional capabilities in the right direction: the increased use of IP in the SCADA network and the recommendation for a new application-architecture as part of the introduction of smart metering.

The RTS strategy paper proposals put forward are heading in the right strategic direction. The proposed enhancements and new applications will facilitate future developments and changes to the operation of the distribution network.

One area of concern for SSEPD relates to the significant increase in volume of information that smart metering will make available, as well as policy issues as to what data can be used, and in what manner (i.e. security and privacy of data). These issues are the same for all utilities and SSEPD has made it clear it is well aware of this. As regulatory policy and the technology are developed SSEPD will need to adapt its strategies for smart metering and Real Time Systems (RTS), as well as other areas, to meet the changing demands that arise from the data being made available.

Given the current state of smart metering policy regulation, SSEPD has addressed the likely impacts to its systems as much is reasonable, given the uncertainties surrounding implementation.

1 Scope of work

1.1 Benchmarking

Mott MacDonald's operational IT and communications benchmarking data is taken from a review of utility providers from Europe, Africa, Asia Pacific and North America conducted in 2010. The benchmarking exercise focused on what services each utility provided, the technology deployed and each utility's staffing levels. The data pool did not directly examine the cost of providing operational telecoms. Mott MacDonald has found that absolute cost data varies widely across companies especially, in terms of measurement and local labour costs.

Part of the data set addresses the technology deployed by utilities to support their operations. One of the challenges facing utilities is the requirement to transition from PDH/SDH systems to IP based systems; either due to life expired communications equipment requiring replacement, or the actions of external service providers withdrawing services (e.g. BT 21CN). In addition there is a continuing tension between the need for reliable communications and the cost of maintaining in house systems. Our data allows a comparison between Scottish and Southern Energy Power Distribution's current position and how other utilities are progressing in tackling these issues.

The benchmark considered three key areas:

- Technology Platform
- Sourcing of services and the balance of in-sourced and out-sourced services
- Resourcing by function, comparing the staff deployed across utilities

Mott MacDonald used a combination of a standardised questionnaire and one-on-one interviews (both face to face and on the telephone) to gather the required data for Operational Telecom and IT. The main focus of the data gathering activity was:

- Basic data regarding services provided
- Basic data regarding technology deployed.
- Service delivery methodologies
- Staff numbers in each functional area

Mott MacDonald notes that almost all data was received through the interview process. The questionnaire was used only to provide some initial, high level information.

1.2 Strategy review

Mott MacDonald also undertook a review of SSEPD's development strategies for the systems and activities listed above.

- Business plan assurance: Review and comment on strategy papers that will be used in support of SSEPD'S Ofgem submission. Review is to see that the business plans are well justified and meet Ofgem's criteria and consider the stakeholder (customer) engagement process.

- Cost benefit analysis: Review certain high value / higher profile investments to a prescribed method of cost benefit analysis advised by Ofgem.

Note that the cost benefit analysis is being done as a separate piece for work for SSEPD and will be provided in a separate set of deliverables.

The following documents were received and reviewed:

- SSEPD Overall IT Strategy Supporting Paper
- Smart Metering Data Integration Supporting Paper
- Operational Applications Supporting Paper
- Justification Paper for BT 21st Century High resilience / Low Latency protection circuit provision

2 Benchmarking of Operational Services

2.1 Utilities involved in benchmarking exercise

Mott MacDonald undertook a benchmarking exercise of the operational IT and communications technology of utility providers, and focused on what services each utility provided, the technology deployed and each utility's staffing levels. The utilities involved, and including SSEPD, are shown in Table 1 below:

Utility	Region	Country
Utility A	South America	Brazil
Utility B	Western Europe	United Kingdom
Utility C	Middle East	UAE
Utility D	South America	Brazil
Utility E	North Africa	Libya
Utility F	Canada	Canada
Utility G	Western Europe	Spain
Utility H	Central Europe	Latvia
Utility I	Western Europe	United Kingdom
Utility J	North America	USA
Utility K	Central Europe	Romania
Utility L	Asia Pacific	Australia
Utility M	South Africa	Republic of South Africa
SSEPD	Western Europe	UK: Southern England and Scotland

Table 1: Utilities participating in Mott MacDonald benchmarking

Each of the utilities was involved in a variety of utility business activities. Some operated stand-alone utility telecom (U-Telco) operations for the provisioning and delivery of all telecom services. This is shown in Table 2.

Utility	Vertically Integrated	LIBERALISED MARKET				
		Gx	Tx	Dx	Supply	U-Telco
Utility A				✓		
Utility B				✓	✓	✓
Utility C	✓					
Utility D		✓	✓			
Utility E	✓					
Utility F			✓	✓		✓
Utility G				✓	✓	
Utility H	✓					
Utility I			✓			
Utility J			✓		✓	
Utility K			✓			✓
Utility M	✓					
SSEPD				✓		

Gx: Generation. Tx: Transmission. Dx: Distribution

Table 2: Details of scope of operations for each utility

Table 3 below shows the turnover, number of employees and number of customers for each of the utilities. It is noted that SSEPD (i.e. SEPD and SHEPD) only has been included as part of this exercise (as opposed to the wider SSE group).

Utility	Turnover (£ M)	Employees	Customers (M)
Utility A	1,572	4,000	2.2
Utility B	8,500	3,500	5.0
Utility C	N/A	N/A	1.0
Utility D	2,499	4,724	54.0
Utility E	N/A	N/A	1.2
Utility F	2,986	7,485	1.3
Utility G	6.052	4,281	10.0
Utility H	610	4,534	1.2
Utility I (Gas & Elec.)	1,447 + 3483	10,211	11.0 + 11.0
Utility J (Gas & Elec.)	3,703 + 4,669	17,895	3.4 + 3.3
Utility K	N/A	N/A	N/A
Utility M	6,430	19,615	4.5
SSEPD (SEPD & SHEPD)	SEPD: 578 SHEPD: 302	SEPD: 1,361 SHEPD: 735	SEPD: 2.8 SHEPD: 0.74

Table 3: Details of utilities: Turnover, Employees, Customers

Data is for SSEPD for 2011/2012 period. Headcount excludes corporate overheads

Supplementary Data

In a subsequent unrelated piece of work Mott MacDonald has carried out a study for a major European utility operator with nine electrical distribution operations in six countries. This was not a formal benchmarking exercise but data in several specific areas (mobile voice communications and outsourcing) is relevant to this work for SSEPD and has been referenced where relevant.

2.2 Underlying technology supporting operational telecom services

Mott MacDonald's benchmarking study found optical fibre is the dominant physical infrastructure for operational network services. This figure is growing year on year, and there is a trend, particularly for Transmission System Operators (TSOs), to install fibre/OPGW as standard during new power network build and/or earth wire replacement. Microwave technology also is deployed on a large scale, particularly for Distribution Network Operators (DNOs).

The breakdown of technology for all the utilities in the benchmarking is shown in Figure 1. Note that this breakdown includes both in-house and outsourced services.

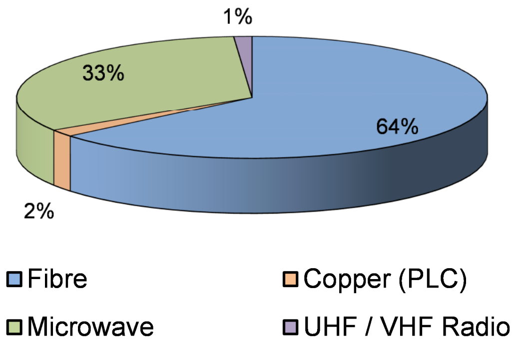

Figure 1: Breakdown of underlying technology for Operational Telecom Services

For a number of overseas utilities, narrow-band Power Line Carrier (PLC) is used extensively. In our analysis this is included under copper due to the similarities with copper private wires (e.g. limited bandwidth circuits such as 300Hz – 3.4KHz and the analogue nature of the transmission line). It is noted that SSEPD do not have PLC of this type.

Figure 2 shows the breakdown by technology by utility:

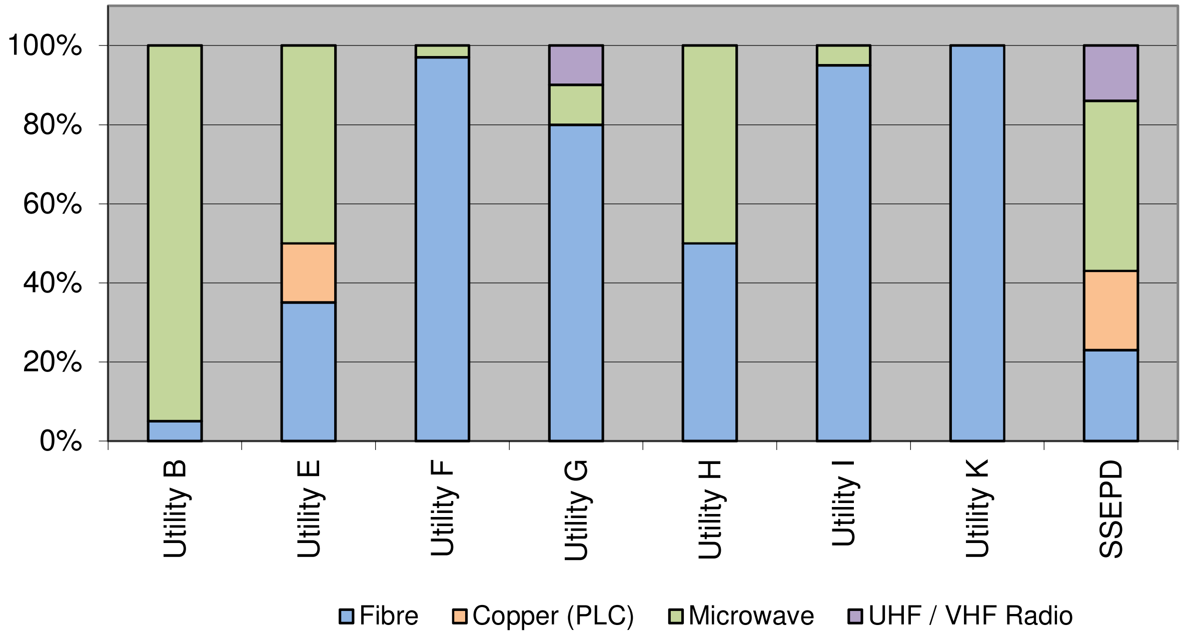

Figure 2: Underlying technology type deployed by utility for Op-Tel

For SSEPD Mott MacDonald has been able to determine that a combination of technologies have been used to build the SSEPD operational network:

- Fibre
- Microwave
- BT leased circuits
- UHF/VHF

The estimate for the core network is that the ratio of microwave to fibre is about 65% to 35% (i.e. about 2 to 1).

BT circuits make up approximately 15% of the tele-protection circuits in the North. In the South the percentage is significantly higher and is estimated at around 65% of the tele-protection circuits.

The access network for SCADA in both the north and south is carried on a mixture of UHF telemetry, rented circuits, SSEPD pilot cables and TSAT.

Based on this data and discussion with SSE Telecom the following proportions are estimated for the different network elements based on a balance of number of end points and services carried, e.g. UHF telemetry reaches many end points but carries only one service.

- Fibre 23%
- Microwave 43%
- BT leased circuits/Copper 20%
- UHF/VHF 14% (used for RTUs connectivity)

Mott MacDonald's comparison with other operators showed that TSOs tend to have a higher proportion of fibre than DNOs. SSEPDs mix of technology is entirely consistent with other DNOs:

- SSEPD uses a lot of leased copper (BT) circuits when compared internationally (specifically in the South where BT is able to provide circuits). It is important to note that rented circuits are not as available to other utilities in different geographies. Therefore it is common for all communication requirements to be met by the utility itself.
- It can be seen that utilities are moving to greater use of fibre as PLC/Copper is replaced at the end of its life.
- Microwave is still a current technology and it is worth noting that mobile networks use microwave extensively in the access network. Microwave is particularly popular over large geographic distances.

The common challenge for the future is the increasing demands for data communications in the distribution network and the migration from legacy protocols to IP.

2.3 Tele-protection transmission protocol

It is not surprising to find that for most of the utilities sampled TDM services (PDH/SDH) are still the preferred transportation method for tele-protection services, as shown in Figure 3.

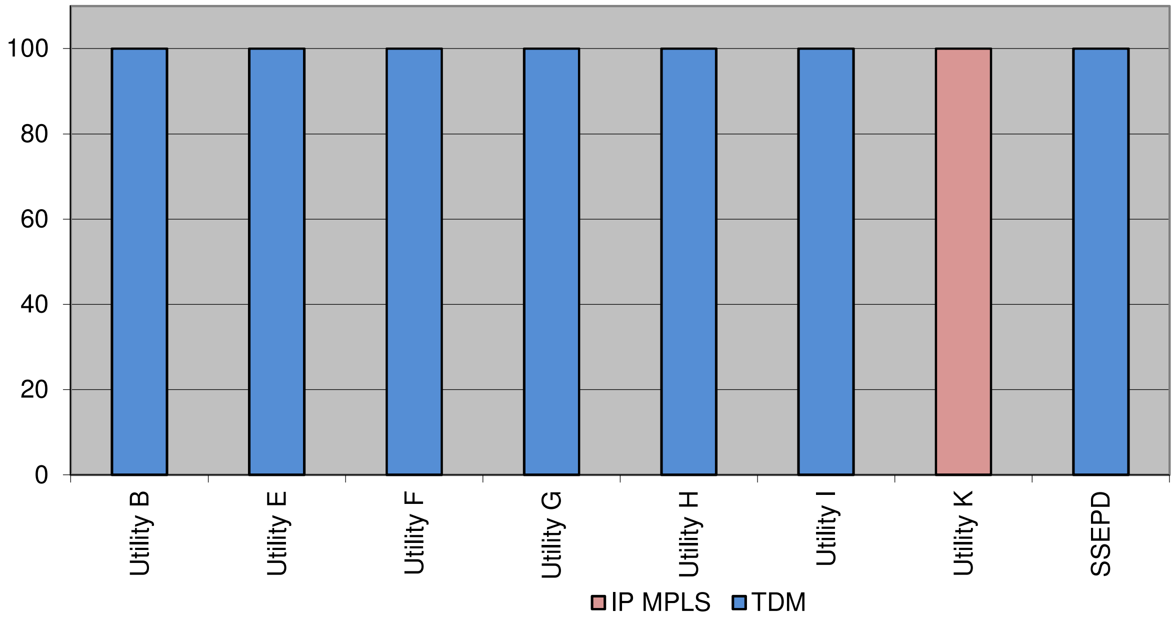

Figure 3: Tele-protection transmission protocol by utility

However, IP MPLS is being adopted for the more modern networks (specifically in emerging market regions) which are not faced with having to support legacy protocols.

Utility F is conducting IP trails at present with a view to migrate towards more IP services over the next 5 years.

Where utilities have to upgrade multiplexer hardware without time to conduct IP performance trials, they are adopting Multi-Service Access Node (MSAN) technology which supports both TDM and IP based services. This provides a manageable migration path and also supports convergence of Op-Tel and Corporate Communications Services across the same network infrastructure. Both Utility G and Utility I have adopted this approach.

SSEPD currently uses a combination of PDH and SDH protocol. The network in the North was described as a figure of 8 with Perth as the central point of the "8". Microwave is used to extend out from the fibre rings to the network end points.

SSET notes that some of the Nokia SDH equipment in the network is coming towards end of life and there are plans to move to PDH/WDM (optical waves over fibre) for tele-protection services.

Many utilities are highly resistant to mixing tele-protection and IP/MPLS and SSEPD are consistent with this view: IP is not used for tele-protection and there are no plans to move to IP at this time.

BT's 21CN

21CN refers to the roll out of BT's next generation communications network which replaces Public Switched Telephone Network (PSTN) with Internet Protocol (IP). Whilst changing the communications protocol used on the existing network assets, it also accelerates the replacement of copper communications circuits with non-metallic optical fibre.

Distribution Network Operators (DNO's) make extensive use of non IP BT products to provide communications to their protection devices. The principal characteristics of these non IP products being:

- Low latency, signal propagation;
- Defined routing, deterministic.

It should be noted that while these characteristics are not defined in the BT product descriptions and contracts, they are inherent in technology used to deliver the existing services, i.e. Time Division Multiplexing (TDM). Given the critical nature of the communications requirements for protection devices the industry is not in a position to compromise these requirements.

The 21CN network is based on the Ethernet protocol and as such has a number of technical limitations which make it difficult to meet the requirements of the electricity utility industry. Consequently the industry has been in consultation with BT and OFCOM, since the advent of 21CN, with the objective of defining a suitable alternative for those non-IP products currently in use.

To date BT has not defined a timescale for the replacement of the non-IP services used by the industry for protection; also it has not defined a suitable IP based alternative service. The alternative IP based solutions are being discounted by the utility industry as they do not meet their requirements, and are expensive and/or complex to implement.

This situation has left the utility industry unsure of how to mitigate the risks associated with migration of the current BT circuits to a packet based technology. Ideally whatever is finally proposed and implemented will meet the requirements of the utility industry as a whole. The timescale and investment required for this mitigation are significant and likely to be required in the next regulation period, therefore provision should be made in lieu of any clear statement by BT.

2.4 SCADA Control networks

For SCADA, there has been a greater acceptance and adoption of IP based services, and whilst currently TDM services account for 84% of the underlying technology within the sample group, this is expected to decline to 60% over the next few years or so as utilities migrate their SCADA services to an IP platform.

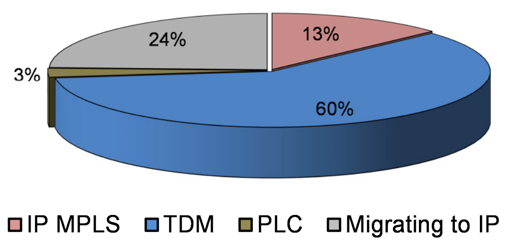

Figure 4: Breakdown of protocol for SCADA control networks

By 2015 it is anticipated that 37% of SCADA services within the sample group will be delivered over IP. Within this period, other utilities will have commenced trials on IP based SCADA services and decisions on implementation taken. Figure 5 shows the technology used for SCADA networks by utility.

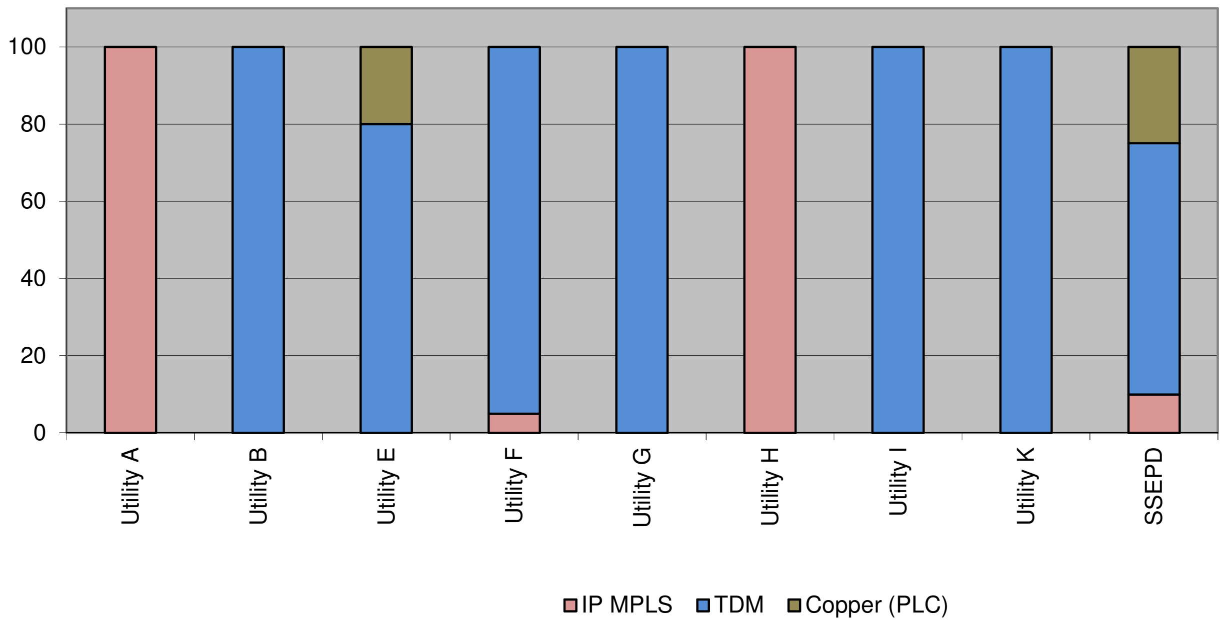

Figure 5: Breakdown of protocol for SCADA control networks by utility

Mott MacDonald notes that SSEPD's RTS network utilises IP across the network, down to the FEPs. Currently the interfaces to the FEPs are legacy technology (including BT circuits):

- 30 FEPs
- 13% of circuits use the TSAT satellite system (112 circuits into 4 FEPs)
- 70% of circuits from RTUs into FEPs are radio
- 17% of circuits from RTUs into FEPs are copper (note that this includes BT leased circuits as well as SSEPD own cables)

SSEPD states that these connections from the RTUs will start to migrate to IP in 2013. This policy of migration is being followed by other utilities as the opportunity arises and is consistent industry practice. As SSEPD already has plans to start this migration it is well positioned compared with the international benchmarks.

2.5 EHV/HV / LV Automation

Utilities in Europe and Africa refer to voltages above LV as MV. In the UK the terminology within power distribution networks is:

- HV: 22kV, 11kV, 6.6kV
- EHV: 33kV

For this report we have adopted the UK terminology.

DNOs have identified the need to deploy greater automation into their distribution networks (ref. Figure 6). For many, the simplest solution has been to implement GPRS services.

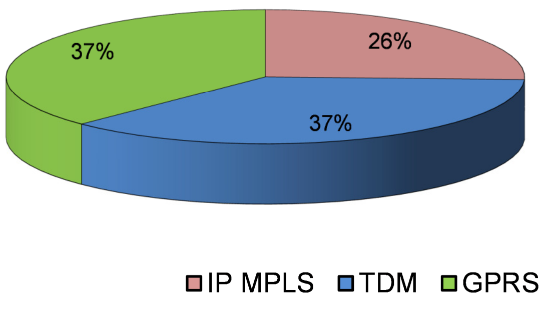

Figure 6: Breakdown of protocol for EHV/HV / LV automation protocol

Within the sample group, all the DNOs (Utility A, B, E, F, G and H) are using either IP MPLS or GPRS as the predominant technology platform for automation. Note that utility F is in a process of migrating from TDM to IP based services, as shown in Figure 7.

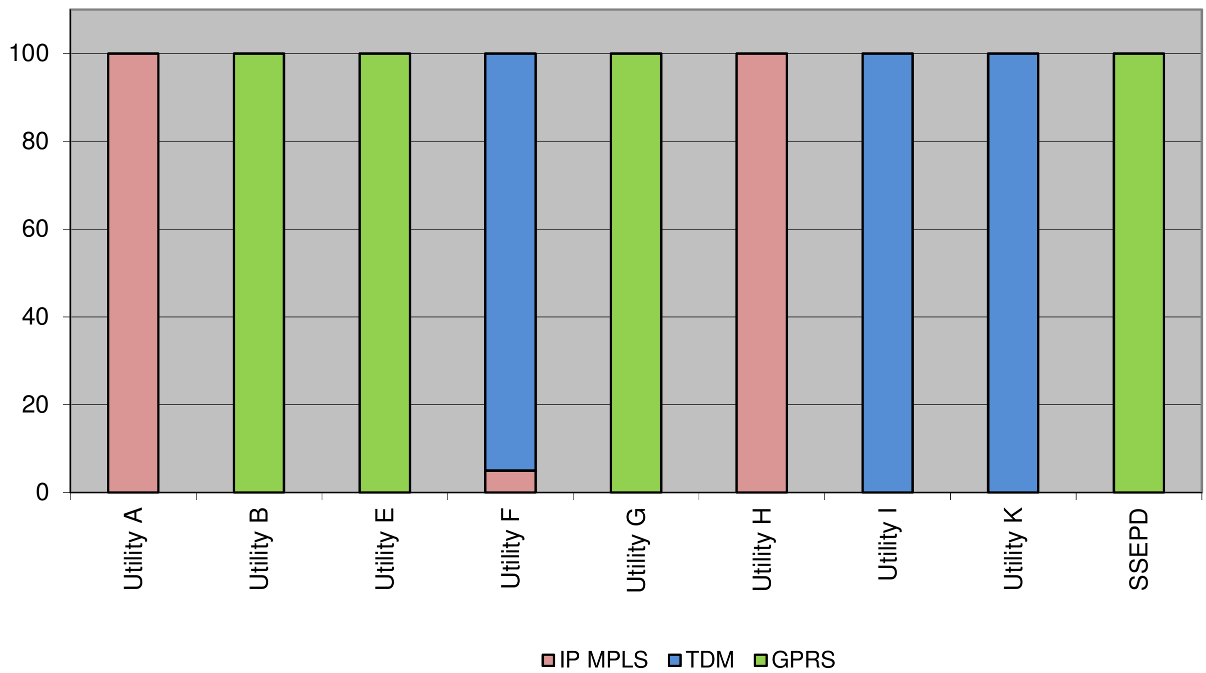

Figure 7: Breakdown of protocol for EHV/HV / LV automation protocol by utility

It is interesting to note that Utilities I and K, both Transmission System Operators (TSOs), conduct their automation using TDM services. This is because most TSOs have extensive SDH/SONET solutions in place which reach the majority of transmission assets within the network, and hence available capacity within this network can be utilised easily.

GPRS is used as a collective term for data transmission over 2G and 3G mobile networks. SSEPD has point-to-point telemetry in place and utilises GSM modems and the Paknet system. Mott MacDonald notes that Paknet is a separate radio based wireless packet data system operated by Vodafone using legacy protocols and technology. For the purposes of the benchmarking Paknet is included as GPRS technology.

SSEPD uses 2G technology in the North and Paknet in the South. The RTS strategy document states that the 2G is to be upgraded to 3G or later technology. SSEPD's implementation of EHV/HV / LV automation is in line with other utilities.

Mott MacDonald recently carried out an unrelated piece of work for a major European utility operator. It was found that where similar HV automation schemes have been implemented GPRS is the preferred solution.

IP is not used for EHV/HV / LV automation within SSEPD, in line with the majority of utilities in the benchmarking.

2.6 Operational Voice

Fixed Voice Services

Mott MacDonald notes that fixed Operational Voice services (i.e. communications between substations, technical facilities and the control centre/s etc.) tend to be delivered over the Operational Telecommunication networks. As a result, the majority of Operational Voice within the sample group remains TDM based, as shown in Figure 8.

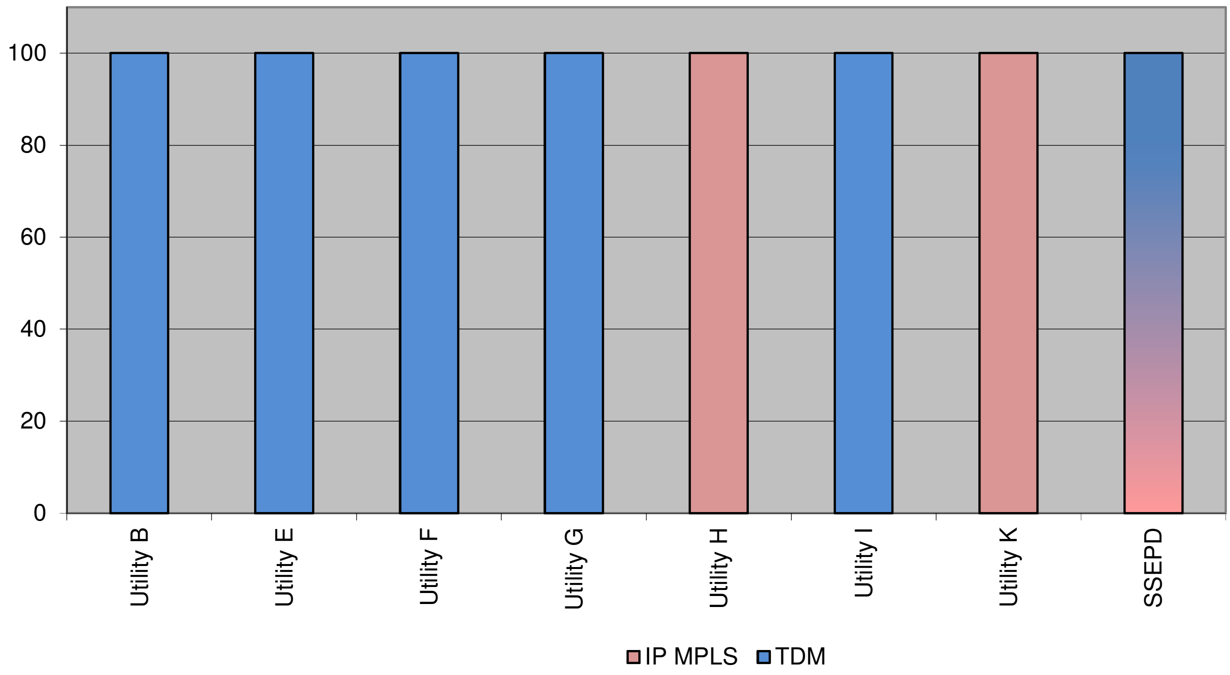

Figure 8: Breakdown of protocol for operational voice by utility

The exceptions to this are utilities H and K. H stated that they are in the process of migrating to IP. Utility K uses a subsidiary U-Telco to deliver Operational Voice. The U-Telco delivers this as part of its corporate voice service to the utility; the service is IP based, virtually segregated from the other IP services on the network.

Whilst the TSOs have extensive Operational Voice networks, the DNOs (driven by the relatively low number of MV substations compared with the large number of LV substations) have 'thinner' Operational Voice networks and rely more heavily on mobile telephony services. There is evidence that some utilities within the sample group (Utility E is one) have made special arrangements with the local mobile network operator to support closed user group operation (CUGs) between workforce engineers at preferential tariffs.

For SSEPD, while Op-Tel phones use PDH/TDM, they do connect through an IP backbone at some point. The PMR system also interfaces into an IP system (AVAYA). Consequently for SSEPD the Op-Tel fixed and mobile voice is shown as a blend of TDM and IP (this is illustrated in the gradient colouring in Figure 8).

Commercial functions, such as the call centre, use Voice over IP (VoIP) while the Emergency Service Centre (ESC) uses TDM.

Mobile Voice Services

For mobile communications to field staff there is a migration by UK and international utilities from PMR to mobile phone networks for both voice and mobile data services. This is because over the last 10 years, network coverage has increased, mobile bandwidth has increased (from simple SMS capabilities to higher capacity 3G/4G data services) and operational cost has decreased. This means that procuring commodity services has become more attractive than operating and maintaining in-house mobile radio networks. It is recognised that many utilities remain nervous about the reliability and availability of mobile operator networks during times of emergency and natural disaster, and these services are sometimes supplemented with satellite phone systems to provide an essential mobile communication service during such events. Table 4 below shows the usage of PMR and mobile phones by utility.

	PMR	Mobile Phone (Voice)
Utility A	No	Yes
Utility B	No	Yes
Utility D	Yes	No
Utility F	Yes	No
Utility G	No	Yes
Utility H	Yes	Yes
Utility I	No	Yes
Utility K	No	Yes
SSEPD	North and South	North and South

Table 4: Breakdown of PMR and mobile usage by utility

The PMR system in the South is understood to be in re-deployment and Mott MacDonald is unsure if it is actually operational at this time.

Mott MacDonald recently carried out an unrelated piece of work for a major European utility operator which reviewed their operations over nine utility operations in six countries. All the operations used mobile phones for non-operational communications. Three operations used PMR and indicated that they did not consider mobile phones satisfactory for operational use. One operation was in the process of transferring from PMR to mobile phones for all mobile communications.

Within SSEPD mobile services are also part of the Op-Tel services and Vodafone is SSEPD's provider of choice. There is a direct link into Vodafone operations that is used during service disruption such as storms. This allows an exchange of information regarding power supply outages and power supply status of mobile phone base stations and is intended to assist Vodafone to maintain service and SSEPD to maintain supply to base stations.

The SSEPD PMR system is point to point and uses Team Simoco equipment. Channels are IP out to IP blades at the edge of the fixed network where the RF connection starts. It is noted that SSEPD looked into discontinuing use of all PMR. However there are occasions when mobile coverage can be compromised and PMR has been re-instated use of PMR in both the South and North regions.

That said within the industry there is a clear shift away from maintaining PMR systems. Those organisations retaining PMR justify this decision on the grounds of reliability and availability in the event of power outages. This would support the decision by SSEPD to maintain PMR, especially in the north of Scotland where weather conditions are extreme and public infrastructure is less robust.

SSEPD's implementation of mobile voice services is consistent with industry practice and is designed to meet the requirements of the local geography.

There are indications that in some countries a discussion between government and the utility industry is resulting in a review of communication provisions as an aspect of critical national infrastructure and the maintenance of civil resilience.

2.7 Blackstart services

As with fixed Operational Voice services, Blackstart services tend to be delivered over the Operational Telecommunication networks. The technology platform is therefore the same as the Operational Voice platform (predominantly TDM based).

The fixed voice services are augmented with mobile voice solutions. Many utilities use the local mobile service provider to supply their mobile communications needs. Section 2.6 provides further details of mobile voice services. This challenge is addressed by utilities through the use of satellite phones, limited (in deployment terms) PMR or specially designed 'communications trailers' which can be deployed quickly to a location to deliver local communications.

From the benchmark sample, it is clear that there are no key trends in this area, other than each utility reviewing the various communications methods available and designing and implementing a solution that addresses their individual country risk profile. Decisions are influenced on the type of service availability within the market place, the geographical topology within the country which impacts network coverage, co-ordination with local civil defence organisations etc.

For SSEPD blackstart services include a combination of generator and battery services providing backup anywhere from 72 hours to 14 days. This approach is UK utility practice and is consistent with Ofgem's approach to critical national infrastructure.

Additionally SSEPD has a supply of satellite phones (>100) available as required.

2.8 Ownership of operational telecommunications network

From the utilities questioned in the benchmarking there is a high level of network ownership (ref. Figure 9).

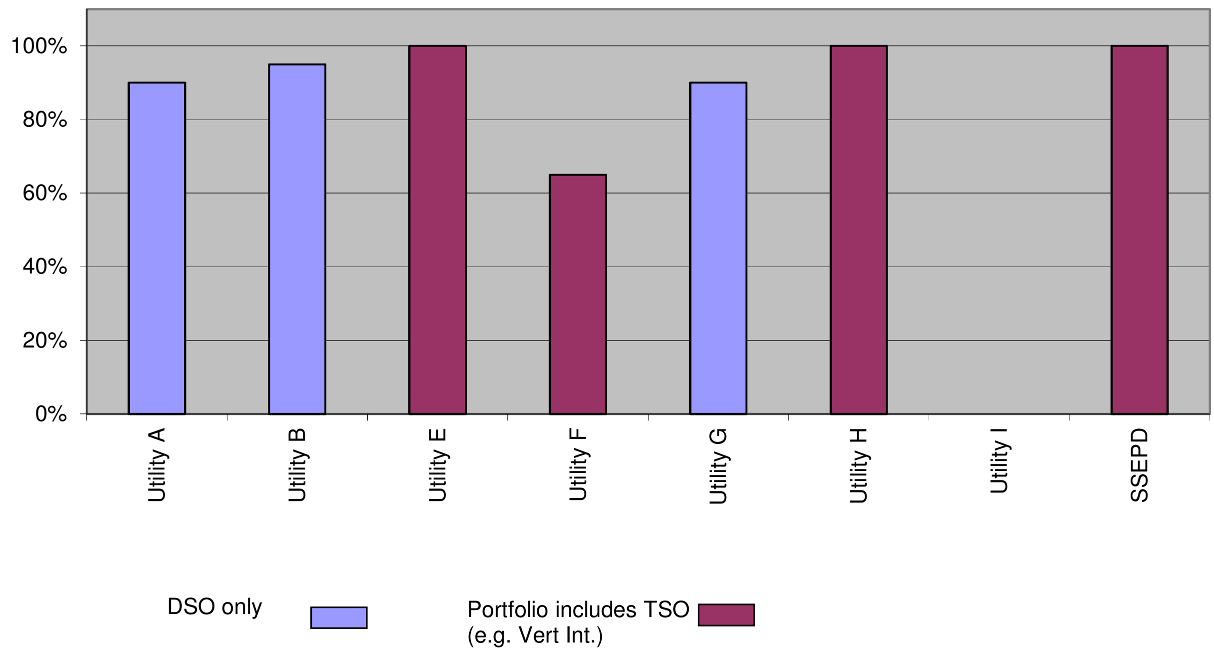

Figure 9: Network ownership by utility (split between TSOs and DNOS)

It is interesting to note that those utilities which are involved in transmission as part of their portfolio of services (Utilities E, H, and K – F is the exception) in general have a marginally higher network ownership profile than distribution only businesses (Utilities A, B and G). This is generally due to two key reasons:

- Easier access to commoditised services from the PTO; the EHV/HV and LV plant is more likely to be located closer to telecoms services than the higher voltage transmission plant which is often routed away from population centres
- The type of communications services required by the DNO are usually less onerous in performance standards (less stringent latency requirements) than those required for tele-protection by the TSO, and hence can be provided more cost effectively from the local PTO than by building dedicated in-house networks (often for lower bandwidth applications)

Utility I have completely outsourced its Op-Tel network to a service provider and therefore is shown as having 0% network ownership.

SSEPD owns large parts of its network infrastructure; but also utilises BT circuits (refer to Section for 2.2 for further detail). However Mott MacDonald has taken a view that all of these circuits should be considered in-house. This is because SSEPD operates and manages the circuits as part of their overall communications provision. In effect SSEPD retains design authority and management of all aspects of the Op-Tel network.

2.9 Sourcing of operational telecommunications services

As detailed in Figure 9, the pure DNOs are more likely to source services from a 3rd party service provider (Utilities A, B, and G). These services are selected as either leased line circuits, used to extend network reach where it is uneconomical for the utility to build out dedicated network, with services overlaid and managed by the utility itself, or a managed service where the service provide delivers some form of service over the circuit, or provides an enhanced service wrap. This is shown for each utility in Figure 10.

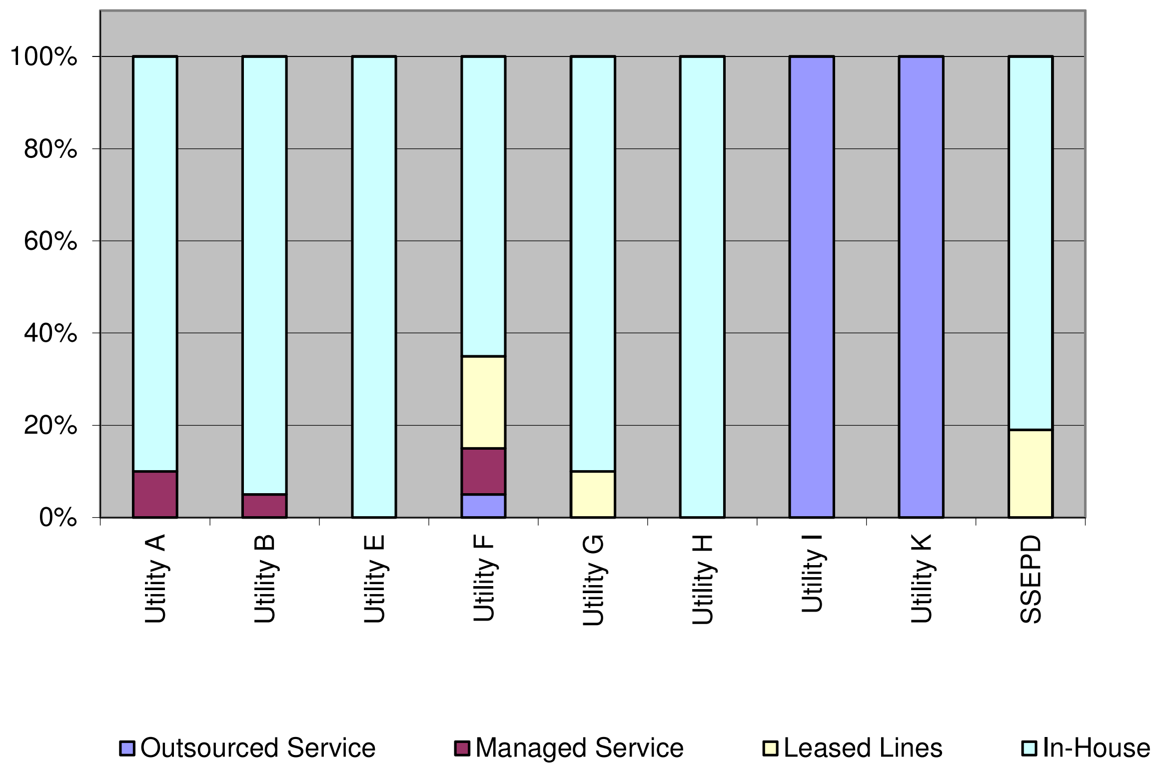

Figure 10: Sourcing of operational telecommunications services by utility

Utilities I and K (both TSOs) outsource all of their Op-Tel services. However, it should be noted that this is not the same outsource arrangement as occurs within the Enterprise market. In both cases, the telecoms network and assets are owned by the utility. Secondly, the outsourced service providers are either subsidiary companies of the parent utility (a U-Telco), or have evolved from the parent utility into a fully formed Public Telecoms Operator. Again, in both cases, utility telecoms engineering staff have been transferred from the parent utility into the U-Telco organisation, so the utility remains confident that the appropriate skills exist within the outsource service provider to service the utilities specialist requirements.

Using the data from Figure 2 for SSEPD, it is assumed that 50% of copper is outsourced and SSET estimates that 40% of fibre is outsourced (it is understood that SSEPD also uses dark fibre obtained from a number of providers including B-Sky-B, BT and C&W). It is also assumed that Microwave and UHF/VHF are 100% in-house. This means that approximately 19% of SSEPD's Op-Tel network is carried on leased infrastructure. Again SSEPD's profile, in terms of leased infrastructure, is in line with the other benchmark utilities.

2.10 Resourcing operational telecommunications services

The benchmark group provided information on resource head count for their Op-Tel services. The resources have been categorised into four groups; Engineering, Administration, Management and Other (generally represents contract labour), as shown in Figure 11.

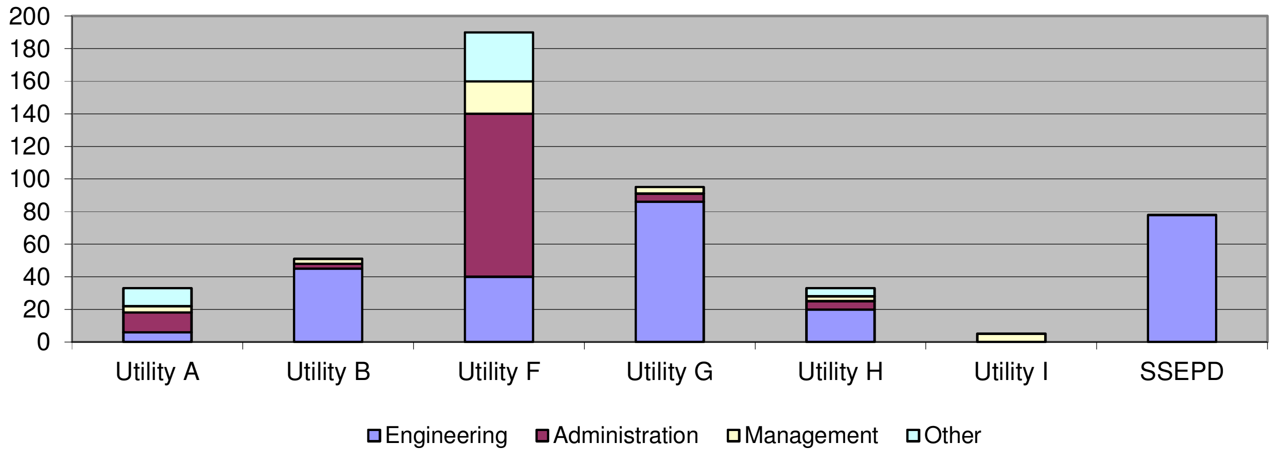

Figure 11: Total Resourcing for Op-Tel by utility

The key observation is that for Utility I, where Op-Tel services are outsourced, there is only a management function retained within the Utility to support the Op-Tel service.For SSEPD the headcount data provided is shown in Table 5:

Functional Area	Management	Staff	Total
RTS	1	15	16
ESC North		1	1
ESC South		1	1
SSET			60
Total			**78**

Table 5: SSEPD resourcing for Op-Tel services

In calculating headcount allocated to Operation services the following assumptions have been made:

- One third of the RTS team is of 24 allocated to supporting other part of the SSE Group. This leaves 16 allocated to Op-Tel support.
- One third of the 180 people in SSET are allocated to support Op-Tel services – for a total of 60
- Only 1 person in ESC North and 1 person in ESC South is allocated (on a shift basis) to supporting Op-Tel field support.

Cost benchmarking for Op-Tel services across utilities in different countries is difficult to determine, due in large part to differences in national salary structures as well as recruitment policies[2]. However a comparison of organisational performance can be made by looking at the number of customers supported per staff member. Figure 12 shows this data for the utilities in the benchmarking and SSEPD.

[2] In some African utilities it is a matter of policy to over-staff certain functions to provide training to as large a pool of people as possible. It is expected that these people will then move on into the wider economy.

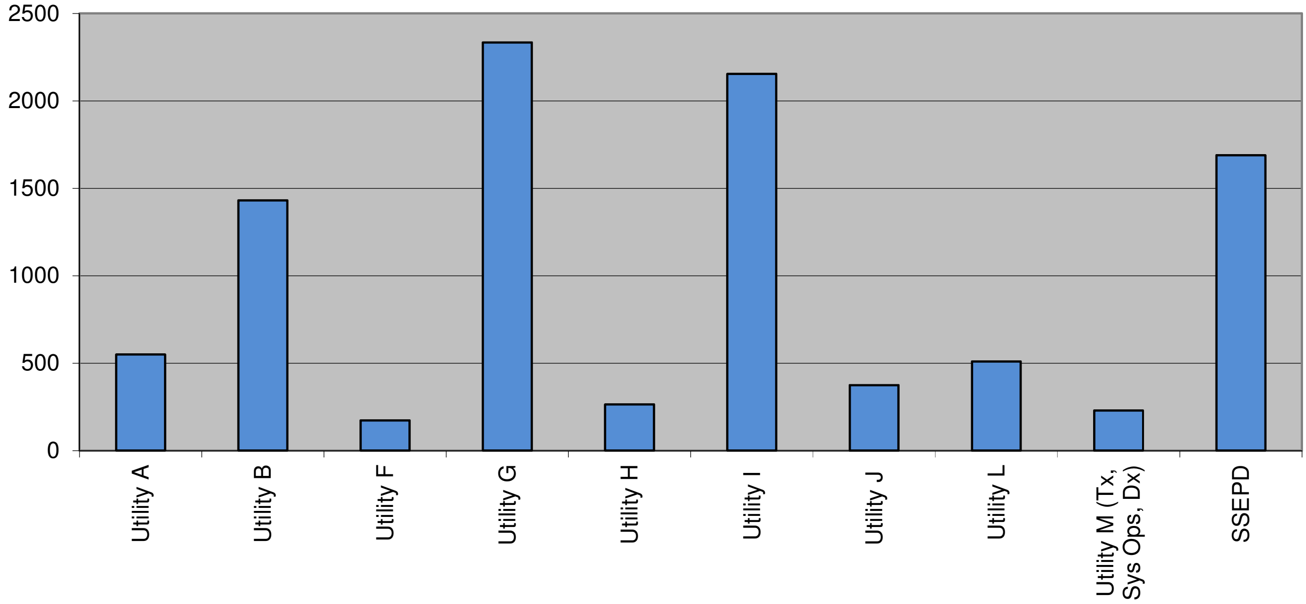

Figure 12: Number of customers supported per staff member

Utilities A, B, G and SSEPD are DNOs only and the data shows that SSEPD is at the upper end of the benchmark sample. This illustrates that SSEPD efficiency is at the higher end of the utilities benchmarked in terms of their ability to provide services to their customer base.

2.11 Op-Tel Policy Definition

It can be seen from the Table 6 that responsibility for defining Op-Tel Policy is driven locally. This is common for all the utilities within the sample group, and is regardless of whether the utility is part of a multi-national organisation or not.

Op-Tel Policy Owner			
	Is the Utility part of a Multi-National Organisation?	**Is the Op-Tel Network separate from the Corporate Communications Network?**	**Policy Definition**
Utility A	No	Yes	Local
Utility B	Yes	Yes	Local
Utility C	No	Yes	Local
Utility D	Yes	Yes	Local
Utility E	No	Yes	Local
Utility F	No	No - shared infrastructure, separated virtually	Local
Utility G	Yes	No - shared infrastructure, separated virtually	Local but elements migrating to Group
Utility H	No	No - shared infrastructure, separated virtually	Local
Utility I	Yes	Yes	Local
Utility K	No	Yes	Local
SSEPD	No	Yes, however some of the underlying infrastructure is shared	Local – within Power Distribution

Table 6: Op-Tel policy ownership for each utility

It can also be seen, that regardless of whether the Op-Tel network is separate from the Corporate Communications network or operates across converged / shared infrastructure, there is no impact on where policy definition occurs; indeed Op-Tel is considered by all utilities as such a fundamental part of the Critical National Infrastructure that local factors have to be considered in implementing policy.

Utility G has adopted shared services for many of its organisational functions and has recently decided to identify areas of Op-Tel policy which can be defined at group level. In the short to medium term, engineering decisions will still be made locally, but where it is feasible, a companywide framework for Op-Tel will be defined and implemented.

Within SSEPD the policy for Operational Telecom Services are set within the Networks division (which contains both Distribution and SSET).

2.12 Operational support service technology platform

For the majority of the utilities sampled, their OSS services are delivered across the corporate communication networks. Three utilities identify some use of the Op-Tel network to support some OSS services and this is assumed to be due to the availability of spare bandwidth for inter site communications.

It can be seen from Table 7 that mobile voice is considered a commodity service and is delivered by the local in-country service provider.

OSS Service Platform				
	Delivered over Op-Tel Network	**Delivered over Corporate Comms Network**	**Delivered over common Op-Tel / Corporate Comms Network**	**Delivered by external service provider**
Utility A	Yes	Yes	No	Mobile Voice
Utility B	No	Yes	No	Mobile Voice
Utility D	Yes	Yes	No	None
Utility F	Yes	Yes	No	Mobile Voice
Utility G	No	No	Yes	GPRS, GSM, UMTS, Satellite
Utility H	No	No	Yes	None
Utility I	No	Yes	No	Mobile Voice
Utility K	No	Yes	No	Unknown
SSEPD	No	No	Yes – in core infrastructure	Mobile Voice, Satellite also available

Table 7: OSS service platforms by utility

2.13 Adoption of Automated Vehicle Location (AVL)

There is evidence that utilities are beginning to adopt AVL technology to support improved despatch of work flow and quicker resource response to incidents (ref. Table 8). Although this is not widely deployed across the sample group, those utilities that utilise such services report anecdotal operational efficiencies and benefits.

	AVL Technology Implemented
Utility A	No
Utility B	No
Utility D	No
Utility F	Yes
Utility G	No
Utility H	Yes
Utility I	Yes
Utility K	No
SSEPD	In development

Table 8: AVL Technology Implementation by utility

At this time SSEPD is working on developing an appropriate GPS tracking system for its vehicles which is compatible with operational and business needs.

2.14 Technology platform between dispatch operators and field force

For business as usual activities (i.e. non-emergency operation), there is a migration by utilities from PMR to mobile phone networks for both voice and mobile data services (reference section 2.6 – Mobile Services - for further details).

Technology Platform for Communications between Dispatch Operator and Field Force					
	PMR	**Mobile Phone (Voice)**	**Mobile Phone (Data)**	**Satellite**	**E-Mail**
Utility A	No	Yes	No	No	Yes
Utility B	No	Yes	Yes	No	No
Utility D	Yes	No	No	No	No
Utility F	Yes	No	No	No	No
Utility G	No	Yes	No	Yes	No
Utility H	Yes	Yes	No	No	Yes
Utility I	No	Yes	No	No	No
Utility K	No	Yes	Yes	No	No
SSEPD	Yes	Yes	No	Yes	No

Table 9: Technology platforms for dispatch and the field force by utility

It is noted that SSE Telecom utilises a Remedy ticketing system as part of its management of the field force. A separate, manual system is used currently by the RTS team for declaring a fault.

2.15 In-sourcing and outsourcing

Our benchmarking study identified three general models of provision for Operational Telecommunications in the utilities studied. There can be an organisational overlap with the corporate IT function and the degree of separation between the functions and their position within the organisation varies with different structures. These can be characterised as:

1. Vertically integrated utilities operate IT and Op-Tel in-house, in separate divisions
2. Liberalised utilities look to outsource their IT functions, while retaining control over OT
3. Multi geography utilities provide IT as a group function, OT remains under each Op-Co

1. Vertically integrated utilities operate Corporate IT and Op-Tel in-house, in separate divisions

- Traditional organisations – often Government owned, vertically integrated – maintain control of their own assets with little or no outsourcing
- Op-Tel and Corporate IT operate on a shared physical network infrastructure
- IT services tend to be managed as part of general support services, separate from operations
- OT services are part of the utility's operations group and operate their own network

2. Liberalised utilities look to outsource their corporate IT functions, while retaining control over Op-Tel

- Utilities in liberalised markets structure corporate IT and Op-Tel in the same way as vertically integrated organisations –in separate organisations
- However corporate IT services are typically out-sourced
  - Network services are managed on the utility's own assets – some 3rd party assets may be used (dark fibre, leased lines)
  - Applications (e.g. desktop) may be outsourced to a separate company
- There will be some differences between which services fall under Op-Tel versus IT (voice communications are retained by Op-Tel)

3. Multi geography utilities provide corporate IT as a group function, Op-Tel remains under each Op-Co

- Utilities that operate across different geographies move to provide IT services as a group function, along with other support services (HR, Finance, etc.)
- The corporate IT services can be outsourced to a regional or global IT service provider, with IT policy driven by the Group Company
- Op-Tel services remain within the control of each utility operating company – ensuring alignment of operations with operational assets

- As with the previous model there will be some differences between which services fall under Op-Tel versus corporate IT (voice communications are often held under Op-Tel)

SSEPD does not fit neatly into any of these models. Corporate IT is provided on a group basis but is not outsourced to a third party supplier. This is a clear policy of the SSE group.

Mott MacDonald carried out an unrelated piece of work for a major European utility operator which reviewed their operations over nine DNO utility operations in six countries. We also found that there was no single model of Op-Tel provision in all operations.

- Seven operations provided Op-Tel in-house, owing all the relevant assets and being responsible for design and support of the services.
- One operation owned the assets and outsourced design, management and support to an internal group company
- One operation owned the assets and outsourced control and management to an external company with performance measured against an SLA.

Within SSE, the operational telecommunication services are provided internally by SSE Telecom (SSET). Outsourcing is done for some of the support activities required:

- Labour such as rigging
- Maintenance of certain high capacity equipment (e.g. DWDM, SDH) is done by third parties (assumed to be qualified maintenance personnel for vendors or qualified service companies) under the supervision of SSE Telecom.

Against this background SSEPD's approach is entirely consistent with general industry practice:

- Assets are owned by the company
- Design support and management of Op-Tel services is fully in-house
- Where external services are procured (e.g. mobile phones, leased line circuits, dark fibre, some labour activities) they are integrated monitored and managed in house

3 Review of strategy documents

3.1 Review of strategy documents

As part of the review of SSEPD's strategy documents in support of RIIO ED1, the following documents were received and reviewed:

- SSEPD Overall IT Strategy Supporting Paper
- Smart Metering Data Integration Supporting Paper
- Operational Applications Supporting Paper
- Justification Paper for BT 21st Century High resilience / Low Latency protection circuit provision

3.2 Operational Telecoms

Overall IT Strategy Supporting Paper

The overall IT strategy paper makes clear the linkages between SSEPD's wider business objectives as defined by RIIO and the proposed actions laid out in the two strategy documents: smart metering and operational applications. For each of the key applications, and for smart metering, the document identifies the high-level development requirements that SSEPD plans to undertake over the coming years.

SSEPD's proposals seek to provide an up to date IT platform which supports business objectives and provides the capability to implement new applications. It will provide flexibility to accommodate the as yet un-foreseen societal and technical developments which will occur in the 8 year period of RIIO-ED1.

Operational IT Applications

John Robertson provided a detailed description of the RTS functionality as well as the supporting systems involved. The key systems identified were:

- SIMS – outage management system, owed by IT, currently has limited potential for significant future development
- Power-On – GE SCADA system, passes network reference data to SIMS
- PLACAR – asset database, manually updated by the engineers.
- PROMIS – Project delivery system
- GIS – Geographic Information System, contains view of physical location of network equipment

Real Time Systems

With regards to the RTS strategy paper, the proposals put forward are heading in the right strategic direction. The proposed enhancements and new applications will facilitate future developments and changes to the operation of the distribution network.

The “ever-green” update policy for the RTS servers, operating systems and Oracle database software of regular upgrades to maintain compatibility is now a standard practice for critical IT systems. This is considered best practice and is implemented by most users of similar systems. The risks of not adopting this policy are that a point will be reached where one element becomes unsupported and replacement will require upgrades of all other elements amounting to a total system replacement. Mott MacDonald has seen the results of not adopting an “evergreen” policy and recognises SSEPD’s sound approach.

From the connectivity diagram in section 3.8.2 of the RTS strategy, it is clear that better integration of the control room systems and data is required. Making these changes in the next 2-3 years will facilitate better management of the current networks but also future changes in the operational philosophy of distribution networks as more and more generation is connected and distributed active control technologies are deployed.

As the networks become more complex the task of managing them needs to be made as easy as possible for the control engineers. This is also being addressed through the proposals with more functionality being added into the DMS for reporting, analysis, switching etc.

One concern that Mott MacDonald has (and one which SSEPD has also expressed verbally) but is not noted in the RTS proposal, is the potential for an ‘overload’ of information from new and upgraded telemetry. As much as it is desirable to have as much information as possible, the issue of alarm processing arises. The DNO control rooms receive thousands upon thousands of alarms daily and this is only set to get worse as networks get busier and more visible.

There are several strategies to managing this flood of information. Alarm processors can be hard to develop and even harder to maintain so they tend not to be used much in control rooms. Another approach which we believe has been employed in another utility’s control room is to control the routing and display of the alarms. Here the alarms are routed directly to the control engineer in charge of the area of network in question. Mott MacDonald believes it is a feature of GE’s ENMAC/Power On system. SSEPD should consider highlighting these issues in the proposal with suggested measures for managing increasing levels of information and data by control engineers.

Managing the work load of the control engineer is important contribution to safe operation of the network; specifically the implementation of systems which reduce the risk of human error. PowerOn Mobile will contribute to this objective by managing and recording transactions at each stage of a switching sequence. In Section 5.2 of the RTS strategy, the application of PowerOn Analysis providing pseudo-telemetry is definitely a benefit.

SSEPD are working with early forms of active network management (such as the Orkney RPZ scheme) and it can be anticipated that similar developments will occur during the RIIO review period. The strategy of developing the PowerOn system and closely coupling its functions and databases provides a sound platform to develop new and innovative applications.

In Sections 4.5.3 and 4.6.3 of the RTS strategy it is unclear whether these projects will run simultaneously or consecutively. However the table of expenditure for these projects these projects is allocated over the whole 10 year period with various projects running concurrently. Mott MacDonald recommends that the detailed project plan takes account of the need for stable continuous operation of the system while the new applications are implemented. It is unclear whether the costs are for hardware and software only and whether provision is included for staff training.

Finally Mott MacDonald agrees that the systems need to develop to accommodate new and innovative solutions which SSEPD will consider in the next review period. These systems underpin many of the proposals in the ED1 Reliability Output paper. *Communications Systems*

In the future increasing importance has to be placed on better metering and visibility on distribution and LV networks which is being addressed here through the replacement and upgrading of communications technology out on the networks. Reliable communications is also imperative to the successful operation of active network management (such as the Orkney RPZ scheme) so it is in SSEPD's interests to invest in the communications network should they intend to deploy more ANM.

SSEPD's real time systems are essential to maintaining safe and secure operations and therefore need to be maintained in an up to date condition. Section 6 of the RTS strategy identifies a number of elements in the communications chain (UHF radios, 2G modems) and SCADA RTUs that are nearing the end of their economic life (20years+). It is identified that spares are unobtainable or in short supply and that manufacture support is no longer available. Replacement is therefore the only supportable option.

It is noted that the SCADA system replacement communications and RTUs will be IP based and this is consistent with current industry products and utility practice. The bench mark data identifies that new and replacement SCADA systems are now all IP based.

Tele-protection Systems

Section 10.6 of the RTS strategy identifies the need to replace obsolete intertripping equipment. It is recommended that this will need to be linked into the BT21CN initiatives (refer to section 2.3 of this report for more detail on BT21CN). SSEPD's mitigation strategy for BT21CN is to use rented 2Mbit Megastream circuits. The requirements for the replacement of analogue circuits and the replacement of terminal equipment appear in both papers.

The interface costs for connecting the analogue intertripping equipment to the new Megastream circuits is included in the cost estimates in the BT21CN paper.

SSEPD recognises that BT is likely to discontinue the Megastream product at some point in the future (BT has no planned withdrawal date) and will have to develop a viable alternative ahead of this.

3.3 Smart Metering

Ian Freeman provided a detailed description of the SSEPD smart metering strategy to date.

This paper is written against a background of uncertainty in the overall smart metering programme where many issues are still being resolved. Ofgem have acknowledged that it may be a further 12 to 18 months before any details of the rollout, implementation, data privacy and other issues are clarified.

Therefore this paper represents a statement of intent as to how SSEPD intends to use the data available and the benefits which it hopes to be able to offer to customers. In reviewing this paper Mott MacDonald recognises the external uncertainties and considers that it is a good attempt to establish a strategy which will need to be kept under review.

Given the current state of understanding around smart metering, the strategy document provides as much detail as can be realistically provided. What is included is a high-level re-design of the software architecture for the various systems deployed. The design recommends implementing technology layers to simplify the overall system design and help in the implementation of new systems. The layers defined are:

- A common user interface
- A service based application delivery layer
- An integration layer

Additionally, given the need to continue to develop the smart metering strategy and work with the overall smart metering programme, Mott MacDonald recommend that an estimate of the effort required for tracking the programme and reviewing and developing the SSEPD strategy is included in this document.

Mott MacDonald recommends that the following issues be incorporated into SSEPD's smart metering strategy as it is developed further:

Implementation Dates

The national smart metering programme has formally announced a delay of 12 months in the implementation of the communications and data company (DCC) and a concomitant delay in the overall rollout of smart meters. This minor change should be reflected in this paper to ensure that the latest timescales are aligned with RIIO period.

Facilitating Rollout and Supporting Suppliers.

Given the degree of uncertainty that surrounding the roll-out programme there is no clarity as to the degree to which installation will be co-ordinated on a geographical basis. SSEPD's resources required to respond to problems raised by installers may vary if the rollout is co-ordinated or started in different places by different suppliers. The strategy paper does not identify the assumptions which have been made in this area and how they affect the ramp up or ultimate level of staff required. There a risk that the number of staff will need to be higher than estimated to cover a wide geographic spread of network issues from the start of the rollout.

Network Connectivity

The strategy paper identifies that SSEPD will need to demonstrate that the use they propose to make of any meter data will protect customer privacy and meet government rules which are yet to be defined. It is not clear to SSEPD exactly what format data will be provided by suppliers (retailers) and how it will be processed. The assumptions being made should be noted in the document.

This mapping of customers to the LV network is fundamental to the successful use of Smart metering data, for outage management and network planning. This paper notes that current models at LV do not have the degree of accuracy required to use effectively the smart metering data and identifies the activities required to improve the LV model. This data model will be required to process both consumption data and outage data.

This work is central to the successful exploitation of Smart Meter data. When sufficient clarity around the timing, availability and format of smart meter data is achieved this work should be expedited. The close linkage of existing data, the real time systems and customer data bases will benefit SSEPD and facilitate successful use of the smart meter data available.

Customer Service Benefits – "Keeping the lights on"

Based on the argument developed in this paper it reasonable to assume that the power outage message will be available from the day the first meter goes live and that processes need to be in hand to manage this message. This could be as early as 2015.

The strategy paper appears to be built on the assumption that the outage data will identify the address of the customer (or the UPRN). Mott MacDonald is concerned that there a risk that the data will be rendered anonymous when it is passed to SSEPD, or aggregated at the feeder or substation level. Any risks that the data will not be in a useful form should be identified.

The strategy paper notes that the receipt of accurately time stamped power outage notifications will assist with regulatory reporting. This opens up a potentially complex argument regarding the start time for measuring customer outage durations. It also has potential implications for out of hours response to outage alerts from Smart Meters, and the need to mobilise staff to respond on site to faults which have not been directly notified by customers.

The paper raises the interesting possibility that Smart Metering may lead to a reduction in customer calls for a power outage as they rely of the automated process. This appears to have implications for the fault handling process and how communication is maintained with customers regarding planned restoration times and the provision of standby generators. It is suggested that there should be a reference in this document to the need to modify customer contact processes and communications channels. There is also the potential for informing customers of power outages before they become aware of the problem (e.g. where the customer is not at home).

The strategy paper recognises that outage notification is likely to be identified as an advantage of smart meters and “sold” as a benefit to consumers by government and suppliers. There is a risk that consumers’ expectations will exceed what can be achieved. It is recommended that this paper refers to, or recommends the development of, a customer communication strategy to manage these expectations.

List of definitions

2G:	Second generation mobile services
3G(+):	Third generation mobile services that include the ability to handle data communications. 3G+ refers to more advanced versions of the technology that can support higher bandwidth data communications.
ANM:	Automated Network Management
AVL:	Automatic Vehicle Identification
BT:	British Telecom
BT21CN:	British Telecom's name for their IP enabled next generation nation-wide network. Upgrade to the existing network is significantly progressed.
CUG:	Closed User Groups
DNO:	Distribution Network Operator
DWDM:	Dense Wave Division Multi-plexing. Higher capacity version of WDM.
EHV:	Extra High Voltage (33kV)
ENMAC:	Electrical Network Management and Control – GE's distribution management system
ESC:	Emergency Service Centre
FEP:	Front End Processor
GPRS:	General Packet Radio Service. A packet oriented mobile data service on the second generation (2G) and third generation (3G) mobile telephone systems
GSM:	Global System for Mobile communications
HV:	High Voltage (1kV – 33kV)
IP:	Internet Protocol.

(IP) MPLS	(Internet Protocol) Multi-Protocol Label Switching
IT:	Information Technology
LV:	Low Voltage (<1kV)
MSAN:	Multi-Service Access Node
MV/LV:	Medium Voltage/Low Voltage
OFCOM:	Telecom Regulatory Authority
OPGW:	Optical Ground Wire
Op-co:	Operational Company – refers to the main utility operations (distribution and/or transmission and/or generation depending on the utility)
Op-Tel:	Operational Telecommunications - telecoms services supporting the operational applications and processes associated with monitoring, controlling, operating and protecting the power network and its constituent parts
OSS:	Operational Support Services
PMR:	Private Mobile Radio. Used by emergency services, etc.
PDH:	Plesiochronous Digital Hierarchy
PLC:	Power Line Carrier
PSTN:	Public Switched Telecom Network – general term for the public telephone network
PTO:	Public Telephone Operator
RTS:	Real Time Systems
RTU:	Remote Telemetry Unit
SCADA:	Supervisory Control And Data Acquisition.

SDH:	Synchronous Digital Hierarchy
SIMS:	Supply Interruption Management System
SEPD:	Southern Electric Power Distribution
SHEPD:	Scottish Hydro Electric Power Distribution
SSE:	Scottish and Southern Energy – Group Company
SSEPD:	Scottish and Southern Energy Power Distribution Company (combination of SEPD and SHEPD)
SONET:	Synchronous Optical NETworking. Effectively the same as SDH but used in the USA and Canada
TDM:	Time Division Multi-plexing. Refers to legacy technology as compared to current packet switching technology
TSAT:	Telemetry and Data Transfer via Satellite
TSO:	Transmission System Operator.
UMTS:	Universal Mobile Telecommunications System. A third generation mobile cellular technology
UHF/VHF:	Ultra High Frequency/Very High Frequency – Radio communications
UPRN:	Universal Premises Reference Number
U-Telco:	Utility-Telco – separate telecom organisation providing telecom services to a utility
VoIP:	Voice over Internet Protocol. Refers to telephone calls made over Internet Protocol (can be the public Internet or a private network using IP)
WDM:	Wave Division Multi-plexing.