

ETHERNET NETWORK HARDWARE FOR SUBSTATION SYSTEMS

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PURPOSE AND SCOPE

This specification is for Ethernet Network Equipment for Remote Access using the Remote Asset Management and Monitoring system (RAMM) only. The specification shall cover the Ethernet network equipment provided as part of any Local Area Networks (LANs) for the following applications:

- The Remote Access (RAMM) network to any Substation System including Protection and Control systems.

For clarity, the Ethernet Networks or communications that form an integral part of the following systems are currently excluded from the scope of this specification:

- Any Substation Condition Monitoring or Information Systems
- Substation Control and Protection Systems
- National Grid business LAN
- Operational Telecommunications system (OPTEL)
- Telecommunications services that facilitate inter-substation telecommunications for specific functions. Examples of this are the telecommunications services used to interconnect protection devices at adjacent substations to facilitate the exchange of critical protection measurements or tripping signals and are implemented using signalling based on X21 or C37.94 standards.

PART 1 - FUNCTIONAL AND PERFORMANCE REQUIREMENTS

1 FUNCTIONAL REQUIREMENTS

1.1 General

- 1.1.1 Ethernet communications as defined by international standards shall be used to provide connectivity between Connected Devices or from Connected Devices to a user (server/host to client). TCP/IP, UDP/IP and Ethernet shall be the preferred data transportation protocols but the Network Hardware shall allow the transportation of any protocols that use Ethernet communications or can be encapsulated and transported over an Ethernet Network.
- 1.1.2 Network Hardware with functionality to convert from Ethernet TCP/IP and UDP/IP to other data transport types shall be covered by this specification. This shall include terminal servers, or protocol converters used to facilitate connection of devices that utilise serial, parallel or other legacy protocols and enable these to communicate across an Ethernet and TCP/IP or UDP/IP network.
- 1.1.3 This specification shall also cover media converters or Network Hardware with interfaces that enable any single Ethernet network connection to be formed of different media types or to use alternative media e.g. media conversion from UTP wire to fibre or use of twisted pair cable.
- 1.1.4 The use of bespoke or non standard functionality in Network Hardware shall be avoided especially where this would prevent or compromise:

future extension or restoration of an Ethernet network using an alternative suppliers products.

compromise the performance, functionality or configuration of an existing network.
- 1.1.5 The use of bespoke or alternative media interfaces in Network Hardware to extend Ethernet connections is permitted but shall only be used as defined in section 1.4.
- 1.1.6 Where an existing network is extended or repaired using newer networking devices, these shall be selected to provide backward compatibility and identical or better performance to existing devices.
- 1.1.7 Where a change to the network topology is required, the supplier shall consider the dependencies of the existing connected devices to ensure these are not affected by the changes.
- 1.1.8 Network Hardware used as part of the Network shall use industry standard interfaces or protocols as defined in this specification.

Informative: Typically, replacement could be due to a failure of a Network Hardware device that is no longer available or where no suitable alternative exists or the need to upgrade an existing installation over an extended time period.
- 1.1.9 All Network Hardware shall be capable of being remotely accessed and managed via the same Ethernet network without the need to use supplier specific software applications. The preferred methods are web interface, Secure Shell (SSH) and Telnet.
- 1.1.10 Optical Fibre media and interfaces shall be preferred for interconnections between Ethernet switches as this provides better resilience to electrical noise and will offer faster link loss detection than metallic connections.

- 1.1.11 Alternative interface types for Interconnections between Ethernet switches shall be selected from the defined types in this document and choice shall be dependent on the purpose of the system.
- 1.1.12 Optical Fibre media and interfaces shall be preferred for connection between Ethernet switches and Connected Devices for the same reason stated in 1.1.15. However, the choice of media and interface shall be selected according to the native interface of the Connected Device.
- 1.1.13 Network Hardware e.g. switches, that are used to interconnect Connected Devices shall have Ethernet interfaces that are capable of connecting these at the native speed of the interface fitted to the Connected Device. This shall include the ability to connect to Connected Devices that are provided with Ethernet interfaces that operate at 100 Mbits/s or 10 Mbits/s.
- 1.1.14 Network Hardware equipped with metallic Ethernet ports e.g. switches and routers shall have the ability to auto detect and match the data rate of the port to match the speed of the Ethernet interface of the Connected Device.

1.2 VLAN Functionality

Informative: Virtual LANs or VLANs are an important component in providing “cyber” security and also part of multicast message control.

- 1.2.1 All Network Hardware with functionality to perform switching or routing shall have capability to implement and utilise Virtual LANs (VLAN) and Data Prioritisation.
- 1.2.2 Ethernet ports in LAN switches with VLAN functionality shall be capable of being configured to provide Trunk or Edge port connectivity and tagged or un-tagged VLAN functionality.
- 1.2.3 All Network Hardware capable of undertaking automatic reconfiguration due to a network fault shall be capable of re-converging any VLANs that are affected by the failure.

1.3 Media Interfaces

- 1.3.1 The interfaces for Network Hardware shall be selected using the defined types and applications in this document.
- 1.3.2 Network Hardware capable of communicating over alternative media to provide Ethernet connectivity shall be permissible but shall be subject to the following conditions:
 - a) Shall not be used for remote access to any critical system or function as defined by National Grid.
 - b) The choice of alternative media shall be selected using the defined types and applications in this document.
 - c) For remote access connections, agreement shall be obtained from the National Grid RAMM team prior to selection.
 - d) Shall not be connected to any network unless suitable security controls can be implemented i.e. VLANs.
- 1.3.3 The alternative media interfaces available in Network Hardware technology that are acceptable for consideration using the rules and applications defined by National Grid shall include:

Digital Subscriber Line Ethernet network extenders connected using twisted pair cable

 - a) WiFi wireless Ethernet

b) Low power licence exempt radio

- 1.3.4 The alternative media interfaces available in Network Hardware technology that may be permissible for consideration using the rules and applications defined by National Grid shall include:

E1 or MPLS services

Wimax

Ethernet over power i.e. Powerline

3G Cellular

Satellite

- 1.3.5 The use of alternative media interfaces stated in 1.3.4 for remote access shall be agreed with the National Grid RAMM team as these may require service requests to be raised in order to obtain provision and shall be subject to usage limitations.

- 1.3.6 All Network Hardware with alternative media interfaces shall be provided with physical Ethernet, TCP/IP or UDP/IP interfaces for interconnection with the Network i.e. metallic or fibre optic interfaces.

1.4 Media Interface selection

- 1.4.1 Selection of the media interface to be utilised as part of a network design for any application shall be according to the following rules.

Interface Type	Application	Constraints	Pre selection criteria
Optical Fibre	Any	Shall be provided for infrastructure for New build substations by default Shall be utilised for applications defined as critical	Details of type of optical fibre utilised shall be supplied to National Grid.
Metallic Ethernet (CAT 5/6)	Connecting devices to Network Hardware in the same or closely adjacent cubicle		Fibre preferred where feasible
Metallic Ethernet (CAT 5/6)	Connecting devices to Network Hardware in another location	Non critical applications only Connections shall not exceed 50 metres without referral to RAMM team (see NGTS 3.24.23)	Fibre preferred where feasible Shall meet requirements..
Metallic Ethernet (CAT 5/6)	Interconnections between Network Hardware as part of a system e.g. switches	Not acceptable for critical applications as defined by National Grid	Shall meet requirements. Fibre Preferred
DSL	Connecting devices to RAMM Network in another location	Retro fit or remote site applications only Not acceptable for critical applications as	Shall meet requirements Only where it is not feasible or cost effective to provide Optical Fibre

		defined by National Grid.	or Metallic Ethernet
DSL	Interconnections between Network Hardware or devices at disperse locations e.g. switches	Retro fit and remote site applications only Not permissible for any RAMM connection to protection or control systems.	Shall meet requirements Only where it is not feasible or cost effective to provide Optical Fibre or Metallic Ethernet.
WiFi / Wimax / Licence Free Radio	Connecting devices to RAMM Network in another location	Retro fit or off site applications only Not permissible for any RAMM connection to protection or control systems.	Shall meet requirements Only where it is not feasible to provide Optical Fibre or Metallic Ethernet Only for applications that can tolerate loss of service
WiFi / Wimax / Licence Free Radio	Interconnecting Network Hardware or devices at disperse locations	Retro fit or off site applications only Not permissible for any RAMM connection to protection or control systems.	Shall meet requirements Only where it is not feasible or cost effective to provide Optical Fibre or Metallic Ethernet Only for applications that can tolerate loss of service.
Cellular / Satellite / MPLS / E1	Connecting devices to RAMM Network in another location	Retro fit or off site applications only Not permissible for any RAMM connection to protection or control systems.	Shall meet requirements Only where it is not feasible to provide Optical Fibre or Metallic Ethernet Only for applications that can tolerate loss of service
Powerline Ethernet Extenders	Connecting devices to RAMM Network in another location	Retro fit applications only Not permissible for any RAMM connection to protection or control systems.	Discussion and agreement required with National Grid RAMM Team Shall meet requirements Only where it is not feasible or cost effective to provide Optical Fibre or Metallic Ethernet
Powerline Ethernet Extenders	Interconnecting Network Hardware or devices at disperse locations	Retro fit applications only	Discussion and agreement required with National Grid RAMM team Shall meet requirements Only where it is not feasible or cost effective to provide Optical Fibre or Metallic Ethernet.