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1 SCOPE

This specification covers requirements for ADSL Routers for use in traffic signal controllers for communication over digital subscriber lines. The ADSL Routers may also be used with other field devices for communication over digital subscriber lines.

NOTE: Throughout this Specification, a reference to ADSL shall also include ADSL2 and ADSL2+, unless explicitly excluded by context.

This version of the Specification covers the full technical requirements of ADSL Routers for use in RMS’s SCATS network in conjunction with a Private IP-VPN. Requirements not directly related to the design, operation or performance of the ADSL Router, e.g. those related to the RMS Type Approval process, quality assurance, packaging, delivery, warranty and spares are not covered by this version of the specification.

2 REFERENCES AND APPLICABLE DOCUMENTS

2.1 Australian Standards

[1] AS 1768 – Lightning protection
[2] AS/NZS 3100 – Approval and test specification - General requirements for electrical equipment
[4] AS 60068.2.6 – Environmental testing - Tests - Test Fc: Vibration (sinusoidal)
[5] AS 60068.2.29 – Environmental testing - Tests - Test Eb and guidance: Bump
[6] AS 60068.2.30 – Environmental testing - Tests - Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)
[7] AS/NZS 60320 – Appliance couplers for household and similar general purposes
[8] AS 60529 – Degrees of protection provided by enclosures for electrical equipment (IP Code)

2.2 RMS Documents

Nil.

2.3 Other Specifications and Documents

[9] ANSI T1.413 Issue2 – Asymmetric digital subscriber line (ADSL) metallic interface
[10] IEEE 802.1D – MAC bridges
[12] ITU G.992.1 (G.dmt) – Asymmetrical digital subscriber line (ADSL) transceivers
ITU G.992.3 (G.dmt.bis) – Asymmetric digital subscriber line (ADSL) transceivers
– 2 (ADSL2)
ITU G.992.4 (G.lite.bis) – Splitterless asymmetric digital subscriber line
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ITU G.992.5 (G.adsl2plus) – Asymmetric digital subscriber line (ADSL)
transceivers – Extended bandwidth ADSL2 (ADSL2plus)
ITU G.994.1 (G.hs) – Handshake procedures for DSL transceivers
RFC 1483 – Multiprotocol encapsulation over ATM Adaptation Layer 5
RFC 1577 – Classical IP and ARP over ATM
RFC 1901 – Introduction to Community-based SNMPv2
RFC 1902 – SMI for SNMPv2
RFC 1903 – Textual Conventions for SNMPv2
RFC 1904 – Conformance Statements for SNMPv2
RFC 1905 – Protocol Operations for SNMPv2
RFC 1906 – Transport Mappings for SNMPv2
RFC 1907 – MIB for SNMPv2
RFC 1908 – Coexistence between SNMPv1 and SNMPv2
RFC 1909 – An Administrative Infrastructure for SNMPv2
RFC 1910 – User-based Security Model for SNMPv2
RFC 2225 – Classical IP and ARP over ATM
RFC 2364 – PPP over AAL5
RFC 2516 – A method for transmitting PPP over Ethernet (PPPoE)
RFC 2684 – Multiprotocol encapsulation over ATM Adaptation Layer 5
TIA-232 (formerly RS 232) – Interface between Data Terminal Equipment and
Data Communications Equipment employing serial binary data interchange

2.4 Issues of Standards, Specifications and Drawings

It is to be noted that any Australian or other Standard specification, or RMS document,
specification or drawing referred to in this Specification shall be the issue that is current
seven (7) days prior to the close of tenders, including such errata, amendments and
addenda as may be issued from time to time. It shall be the responsibility of the Supplier to
obtain the relevant issues of such documents, specifications and drawings referred to in this
Specification from the relevant issuing bodies.

NOTE: RMS documents, specifications and drawings referred to in this Specification may be obtained from
the tender-issuing office.
2.5 Compliance with Specifications

All equipment and materials, where not otherwise specified, shall be in accordance with Australian Standard Specifications, where such exist, and in their absence, with relevant ITU-T Recommendations, or IETF, IEC or ISO Specifications.

The equipment shall comply with the safety requirements of AS/NZS 3100. The equipment shall also comply with the requirements of the Workplace Health and Safety Act.

2.6 Precedence of Specifications

In the event of conflicts between the referenced specifications, the order of precedence shall be as follows:
(a) this Specification (as amended);
(b) other RMS specifications and documents;
(c) Australian Standard Specifications; and then
(d) ITU-T Recommendations, and IETF, IEC and ISO Specifications.

2.7 Exceptions to Specifications

The Proponent shall clearly tabulate all exceptions to this Specification, if any, under the heading “Exceptions to Specification”.

Notwithstanding any other statements made in any other part of the Proponent’s submission, it shall be deemed that the offered equipment complies fully with this Specification except for the particular points tabulated under the heading “Exceptions to Specification”.

3 DEFINITIONS AND GLOSSARY OF TERMS

For the purposes of this Specification, the following definitions and abbreviations shall apply:

- **AAL** ATM Adaptation Layer
- **AAL5** A network service class of AAL
- **ACMA** Australian Communications and Media Authority; formerly known as ACA (Australian Communications Authority)
- **ADSL** Asymmetrical Digital Subscriber Line. This is a variation of DSL.
- **ADSL2** A newer version of ADSL.
- **ADSL2plus, or ADSL2+** A newer version of ADSL2.
- **ADSL router** A router that also functions as an external ADSL modem
- **ADSL Router(s)** ADSL router(s) covered by this Specification
- **ATM** Asynchronous Transfer Mode
- **Agency** Roads and Maritime Services (of New South Wales)
- **CBR** Constant Bit Rate
Central Manager: A SCATS entity which manages Regional Computers. It facilitates user access and collects logs from Regional Computers.

CRC: Cyclic Redundancy Check

DCE: Data Communication Equipment

DHCP: Dynamic Host Configuration Protocol

DNS: Domain Name Server. An Internet service that translates domain names into IP addresses.

DoS: Denial of Service

DSL: Digital Subscriber Line. This is a generic term for the technology for delivering high bit-rate services over “ordinary telephone lines”.

DTE: Data Terminal Equipment

FTP: File Transfer Protocol

GUI: Graphical user interface

HDLC: High-level Data Link Control

HTTP: HyperText Transmission Protocol

ICMP: Internet Control Message Protocol

IEC: International Electrotechnical Commission

IETF: Internet Engineering Task Force

IGMP: Internet Group Management Protocol

IKE: Internet Key Exchange

IP: Internet Protocol

ISO: International Organisation for Standardisation

ITS: Intelligent Transport/Transportation System

ITU-T: International Telecommunications Union – Telecommunications Division

L2TP: Level Two Tunnelling Protocol

LED: Light emitting diode

MAC address: Media Access Control address

MTBF: Mean Time Between Failures

nrt-VBR: Non-Real-Time Variable Bit Rate

OAM: Operation, Administration, and Maintenance (functions performed by dedicated ATM cells)


PPP: Point-to-Point Protocol

PPTP: Point-to-Point Tunnelling Protocol

PVC: Permanent Virtual Circuit

RAM: Random Access Memory. Assumed to be volatile unless otherwise specified.

RC: Regional Computer

RCM: Regulatory Compliance Mark. Single requirement mandated by the ACMA to replace the A-Tick and C-Tick requirements.

Regional: A SCATS entity which manages traffic signal controllers. Its functions
### Technical Requirements

#### 5.1 General Requirements

**5.1.1 General**

The ADSL Router shall be a single unit of equipment complete with an integral ADSL modem, a network router, and all necessary interfaces for device configuration and interfacing with an ADSL telecommunications service and with the traffic signal controller. The ADSL Router shall be complete with all hardware, firmware and processor capability necessary for providing all of the functions required by this Specification.
NOTE: Refer to Clause 5.1.8 for requirements of an external telecommunications line transient protection unit.

The ADSL Router shall be capable of operating in ADSL, ADSL2 and ADSL2+ environments.

The design of the ADSL Router shall be suitable for the intended applications described in this Specification and for providing all functions required by these applications or specified in this Specification.

The ADSL Router shall include the following characteristics / capabilities.

(a) General features:
   - IP, PPP, Transparent bridging, and multi-protocols;
   - Serial data communications via the Serial Port;
   - Two-level password protection for configuration and management;
   - Static and dynamic IP addressing;

(b) ADSL compliance:
   - ANSI T1.413 Issue 2;
   - ITU G.992.1 (G.dmt);
   - ITU G.992.2 (G.Lite);
   - ITU G.992.3 (G.dmt.bis);
   - ITU G.992.4 (G.lite.bis);
   - ITU G.992.5 (G.adsl2plus);
   - ITU G.994.1 (G.hs);

(c) ATM protocols and encapsulations:
   - PPP over ATM (RFC 2364);
   - Bridged IP over ATM (RFC 1483 / RFC 2684);
   - Routed IP over ATM (RFC 1483 / RFC 2684);
   - Classical IP over ATM (RFC 2225 / RFC 1577);
   - PPP over Ethernet (RFC 2516);
   - VPI range of 0 – 255; VCI range of 32 – 65536;
   - Up to 8 PVCs;
   - AAL5 UBR, CBR and nrt-VBR;
   - OAM F4/F5;

(d) Bridge/Router protocols:
   - IEEE 802.1D (self learning transport bridge);
   - 128 MAC address;
   - Static IP routing (configurable route table);
   - RIPv2 (backward compatible with RIPv1);
   - DHCP server;
   - DHCP client;
- DHCP relay agent;
- PPP automatic reconnect and configurable timeout;
- PPP automatic reconnect on WAN access;
- PAP/CHAP;
- L2TP;
- PPTP;
- Bridge filtering;
- ICMP/IGMP;

(e) Authentication protocols:
- PAP/CHAP;

(f) Firewall facilities:
- Protection policy (with IP and Service group naming and Subnet Masks for policy set up);
- Service/port filtering;
- Inbound and outbound policy;
- Security/hacker log;
- SNMP read-only community string;

(g) Security facilities:
- IKE key management;

(h) Management facilities:
- HTTP;
- FTP
- SNMPv2 (RFC 1901 through to 1910)
- Local configuration and firmware upgrade via Console Port;
- Remote configuration and management via WAN;
- Restore to factory defaults (reset function) via WAN, Console Port (local), or reset pushbutton (local);
- Diagnostics with links to help pages;
- System logging.

5.1.2 Connection, Reconnection and Authentication

5.1.2.1 The ADSL Router shall automatically communicate with the traffic signal controller to obtain the controller’s Site ID Number and other information required for
establishing a network connection to SCATS, upon the connection of a link cable from the traffic signal controller to its Serial Port (refer to Clause 5.2.2 regarding connection ports).

5.1.2.2 The ADSL Router shall automatically initiate and establish a connection to the appropriate VPN for working with SCATS, including user authentication and all link connection negotiations, upon the connection of an ADSL service to its ADSL Port (refer to Clause 5.2.2 regarding connection ports).

For the purpose of connecting to the VPN, the ADSL Router shall be pre-configured with a PPP username and password, where the username is the ADSL Router’s electronic serial number.

Where a different network username has not been configured by the user, the ADSL Router shall use the preset default for connecting to the VPN.

NOTE: A complete PPP username may comprise the subscriber’s username plus a realm unique to the SCATS VPN (e.g. username@scatsvpn.serviceprovider.com.au).

NOTE: Refer to Clause 5.1.7 for requirements for electronic serial number.

Where a different PPP username has been configured by the user, the ADSL Router shall use the user-configured PPP username and password for connecting to the VPN.

5.1.2.3 Upon connection to the VPN, the ADSL Router shall automatically initiate and establish connection to SCATS and the appropriate SCATS Regional Computer that controls the traffic signal controller. This shall be achieved by contacting a SCATS Authentication Server for the IP address of the SCATS Regional Computer, and then establishing connection to the SCATS Regional Computer.

NOTE: Refer to Appendix A for additional details. Refer to Clause 5.2.3 regarding SCATS operation and message formats.

5.1.2.4 The ADSL Router shall persistently attempt to reconnect whenever connection to the SCATS Regional Computer or ADSL telecommunications service is lost, subject to the relevant pre-configured waiting times (refer to Appendix A).

5.1.2.5 The ADSL Router shall monitor its Serial Port connection with the traffic signal controller. If the traffic signal controller has not been transmitting via this Serial Port connection for thirty (30) seconds, the ADSL Router shall check that the connection is still functional and the controller is still communicating.

This shall be done by communicating with the traffic signal controller via the Serial Port connection to obtain the controller’s Site ID Number again. For this purpose, the ADSL Router shall use the Serial Port Configuration that was established as the appropriate configuration for communicating with the traffic signal controller for the current communications session (refer to Clause B.4).

The ADSL Router shall attempt to obtain the controller’s Site ID Number (refer to Clause B.5). Depending on the outcome of the communication attempt, the ADSL Router shall take one of the following courses of action:

(a) If the traffic signal controller responds with a valid error-free response, and the Site ID Number so obtained is the same as that stored in the ADSL Router’s RAM for the current communications session, then no special additional action is required of the ADSL Router. The ADSL Router shall continue to operate
normally and continue to monitor its Serial Port connection with the traffic signal controller in accordance with this clause (Clause 5.1.2.5).

NOTE: In this case, the ADSL Router shall repeat the process of communicating with the traffic signal controller via the Serial Port connection to obtain the controller’s Site ID Number again, should the traffic signal controller continue not transmitting via the Serial Port connection for another thirty (30) seconds.

(b) If the traffic signal controller responds with a valid error-free response, but the Site ID Number so obtained is different to that stored in the ADSL Router’s RAM for the current communications session, the ADSL Router shall forthwith disconnect from the SCATS Regional Computer in an orderly manner but remain connected to the VPN. The ADSL Router shall then recommence the complete connection and authentication process described in Clause 5.1.2 and Appendix A, except that as it is already connected to the VPN, the VPN connection step should be bypassed.

(c) If the traffic signal controller does not respond as described in either paragraph (a) or (b) above, then the ADSL Router shall behave as described in paragraph (a). That is, the ADSL Router shall remain connected to the SCATS Regional Computer (and the VPN), and continue to operate normally and to monitor its Serial Port connection with the traffic signal controller in accordance with this clause (Clause 5.1.2.5).

NOTE: Refer to Appendix B for requirements for communication with the traffic signal controller.

5.1.3 Access Control

Access to all management functions and capabilities, and monitoring or changing the configuration or other characteristics of the ADSL Router shall be by means of username and password. Each username and each password may contain up to 32 alphanumeric characters and symbols.

Two access levels shall be provided, as follows:

(a) Administrator;

(b) Normal User.

The Administrator access level shall have access to all settings and functions.

The Normal User access level shall only have “view-only” access to configuration settings.

5.1.4 User Interface

The ADSL Router shall be configured and managed through the following physical interfaces:

(a) Console Port, for local management and configuration (see also Clauses 5.2.2 and 5.2.4);

(b) ADSL Port, for remote management and configuration (see also Clauses 5.2.2 and 5.2.4).

NOTE: Refer to Clause 5.1.3 for user access control.
The Console Port shall not provide access to WAN except for diagnostic testing under the management functions and capabilities referred to in Clause 5.2.4.

Where Ethernet ports are provided in the ADSL Router in addition to the ports specified in Table 5.2.2, the Ethernet ports shall not provide access to, including visibility of, the configuration settings of the ADSL Router.

All necessary drivers and software for the user interface shall be provided for the ADSL Router. The drivers and software shall be able to operate under Windows® 2008R2 and Windows® 2012.

5.1.5 External Controls

The ADSL Router shall be provided with a mains power switch.

The ADSL Router shall be equipped with a protected hardware reset switch, such as a small recessed pushbutton, for resetting the configuration settings of the ADSL Router to their factory default values (i.e. the preset settings referred to in Clause 5.1.10).

5.1.6 Visual Indicators

The ADSL Router shall be provided with the following visual indicators using light emitting diodes (LED). The LED indicators shall be high intensity types with clear packages and shall provide unambiguous displays with good visibility in direct sunlight.

(a) “Line Available” indicator. This indicator shall be energised when an ADSL line is connected to the ADSL Port of the ADSL Router;

(b) “Connected” indicator. This indicator shall be energised when the ADSL Router is connected to the SCATS network;

(c) “Busy” indicator. This indicator shall flash on and off continuously when the ADSL Router is communicating (both receiving and transmitting) via its ADSL Port. The rate of flashing shall be indicative of the real rate at which communications is occurring, with a higher flashing rate indicating a higher data rate.

5.1.7 Electronic Serial Number

Each ADSL Router shall be provided with a unique electronic serial number. The electronic serial number shall be a 12-digit alphanumeric number. The six least significant digits shall be numeric digits.

5.1.8 Telecommunications Line Transient Protection Unit

5.1.8.1 Each ADSL Router shall be provided with a separate Telecommunications Line Transient Protection Unit.

The Telecommunications Line Transient Protection Unit shall be suitable for installation near the telecommunications line terminal box in a traffic signal controller housing. Alternatively, it shall be suitable for installation on the side or
immediately adjacent to the telecommunications line terminal box in the traffic signal controller housing, with external dimensions not larger than (length x width x height) 90 x 40 x 30 mm.

The Telecommunications Line Transient Protection Unit shall provide for connection to the telecommunications line terminals on the telecommunications line terminal box, for connection to the telecommunications line. It shall also provide a 6P2C (RJ11) socket for connection to the ADSL Router.

The Telecommunications Line Transient Protection Unit shall be tested and approved by a registered testing authority for compliance with the telecommunications line transient protection requirements and other relevant requirements of applicable ACMA Standards. Documentary evidence shall be supplied to confirm the approval.

5.1.8.2 The Telecommunications Line Transient Protection Unit shall provide effective protection against transients and surges present on the telecommunications line connected to the ADSL Port of the ADSL Router.

The protection circuit shall not include fuses with replaceable fuse cartridges; however fusible links may be used.

The protection circuit shall limit the surge voltage presented to the ADSL Router to a safe value.

The insertion loss presented by the protection circuit shall not exceed 2 dB.

An adequate earth connection for the protection circuits shall be provided for bonding to the traffic signal controller housing adjacent to the equipment.

NOTE: For effective surge protection, the earth conductor shall be either multistrand cable or copper braid with an effective cross sectional area of not less than 2.5 mm². The conductor shall be kept as short as is practicable and shall not have any small radius bends. Units with different lengths of earth conductor for different housing types will be required.

5.1.9 Cables

Each ADSL Router shall be provided with the following interface cables:

(a) A Serial Port cable for connecting the traffic signal controller to the Serial Port of the ADSL Router. The cable shall be complete with connectors on both ends for the connection. The connector for connecting to the Serial Port of the ADSL Router shall be a DE-9 female connector. The connector for connecting to the traffic signal controller shall be a 25 pin female Miniature "D" type connector.

Two versions of connectors shall be provided, respectively for connecting to the existing PSC traffic signal controllers and TSC/4 traffic signal controllers. Refer to Appendix C for pin functions and other connector details;

NOTE: The Supplier shall confirm with the Agency as to the quantity of each version of connector/cable to be provided.

(b) A cable for connecting the ADSL Port of the ADSL Router to the Telecommunications Line Transient Protection Unit. The cable shall be ACMA
or AUSTEL approved and complete with connector(s) for the connection. The
connector for connecting to the ADSL Port of the ADSL Router shall be an RJ10
connector. The connection to the Telecommunications Line Transient Protection
Unit shall be either by direct wiring or by a compatible RJ series modular
connector. Where direct wiring is used, suitable crimp lugs shall be used for the
connection.

NOTE: Refer to Clause 5.1.8 for requirements for the Telecommunications Line Transient
Protection Unit.

(c) A power supply cable. Refer to Clause 5.4.2.

The lengths of the cables shall be sufficient for the connection and allow for the proper
routing inside the traffic signal controller housing.

5.1.10 Configuration Data

The factory preset default configuration settings of the ADSL Router shall be in accordance
with settings required by the Agency. The Agency will advise the Supplier of the preset
settings required after such have been tested and confirmed to be suitable. The Supplier
shall forthwith incorporate the required settings into the firmware and provide a copy of the
firmware to the Agency within two (2) weeks of the Agency’s request for same, to enable the
Agency to update installed equipment. The Supplier shall update all undelivered equipment
to the new firmware prior to delivery to the Agency.

NOTE: From time to time, the Agency may change the default configuration settings to suit changes in
network operations or to ensure better operational compatibility. The Supplier shall update the
firmware with the new settings upon a request from the Agency for a firmware update.

Where Ethernet ports are provided in the ADSL Router in addition to the ports specified in
Table 5.2.2, the factory preset default configuration settings shall provide a user configurable
option to disable these Ethernet ports. The default value for this option shall be set to
“disabled”.

The default state for DHCP operation shall be set to “disabled”.

5.1.11 Connectors

All connectors shall be rated for a minimum of 500 insertion and removal cycles without
degradation of the contact performance outside specification.

Except for power supply connectors, all connection pins and contacts in connectors shall
have a minimum of 0.76 micrometres (30 microinches) thickness of gold plating over nickel
in the contact area. The contacts shall be rated with a maximum contact resistance of 15
milliohms.

5.1.12 Reliability

The ADSL Router shall be designed to provide reliable service throughout its life, with a
mean time between failures (MTBF) not less than 40,000 hours.
5.2 System Requirements

5.2.1 System Overview

The ADSL Router is intended to be installed in a traffic signal controller housing to provide a communications link, using ADSL technologies, between SCATS and the traffic signal controller via a copper-wire telephone circuit. Figure 5.2.1 shows such a typical application.

The ADSL Router shall connect to the serial data port of the traffic signal controller and to a telecommunications provider’s ADSL network.

The ADSL Router shall receive SCATS messages from the traffic signal controller, encapsulate these messages in TCP/IP and suitable ADSL protocols, and transmit them onto the telecommunications provider’s ADSL line.

The ADSL Router shall receive ADSL signal from the telecommunications provider’s ADSL line, and decapsulate the SCATS messages embedded in the signal and forward them to the traffic signal controller as serial data.

NOTE: Other ADSL Router functions, such as configuration, management and security, are described elsewhere in this Specification.

![Typical SCATS Traffic Control Network Application](image)

Figure 5.2.1 Typical SCATS Traffic Control Network Application

5.2.2 Interface Connections

The ADSL Router shall provide the interfaces in Table 5.2.2.

Table 5.2.2 Ports to be Provided
### Ports Required

<table>
<thead>
<tr>
<th>Ports Required</th>
<th>Usage</th>
<th>Connector</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial Port</td>
<td>Connection to traffic signal controller</td>
<td>DE-9 (male)</td>
<td>A TIA-232 interface (previously known as RS 232)</td>
</tr>
<tr>
<td>Console Port</td>
<td>Local Terminal, for user management and configuration of the ADSL Router</td>
<td>USB socket</td>
<td>USB 2.0 interface</td>
</tr>
<tr>
<td>ADSL Port</td>
<td>Connection to SCATS via ADSL network</td>
<td>6P2C (RJ11) connector socket</td>
<td>Also used for remote user management and configuration of the ADSL Router</td>
</tr>
</tbody>
</table>

**NOTE:** It is acceptable for the ADSL Router to provide one or more additional Ethernet ports for the connection of other external devices or systems.

The ADSL Router shall act as a DCE when communicating via the Serial Port with the traffic signal controller. The Serial Port shall be a TIA-232 interface capable of interfacing to 10-bit or 11-bit words with even, odd, or no parity, and with a speed of between 300 to 19,200 bits per second (bps) inclusive. The particular settings shall be configurable. The preset default values shall be 10-bit words with no parity at 1,200 bits per second (for HDLC SCATS communications).

**NOTE:** The bit rate settings available shall include 300, 1200 and 9600. In-between or higher bit rate settings are also acceptable.

When interfacing with the traffic signal controller, the ADSL Router shall automatically adjust the configuration of the Serial Router to establish and maintain communications with the traffic signal controller in accordance with Appendix B.

The Console Port shall be a USB port.

Where Ethernet ports are provided in addition to those specified in Table 5.2.2, each of the Ethernet ports shall be a switch port and not a hub port.

**NOTE:** See also the following clauses for additional requirements for Ethernet ports:

- Clause 5.1.4 - for requirements for prohibiting access to configuration settings via these Ethernet ports;
- Clause 5.1.10 - for requirements for a configuration setting to disable these Ethernet ports;
- Cause 5.2.5 - for security requirements.

All connection ports, except the Serial Port and ADSL Port, shall be provided with a removable plastic cover that prevents dust and dirt from entering the port. Each plastic cover shall be durably tethered to the ADSL Router to prevent misplacement or loss when not in use.

### 5.2.3 SCATS Operation and Message Formats

5.2.3.1 The operation of the ADSL Router for working with SCATS and the message formats to be used for such applications shall be in accordance with Appendix A and Appendix B.

Apart from those functions that are specific to interfacing and operating with SCATS, the ADSL Router shall retain all the functions of a “normal” ADSL Router compliant with industry standards.
5.2.3.2 Upon the successful connection to the SCATS Regional Computer that controls the site with the Site ID Number reported by the traffic signal controller, the ADSL Router shall transmit every message sent by the traffic signal controller to the SCATS Regional Computer immediately upon receiving the message on its Serial Port. The ADSL Router shall transmit each such message only once except in accordance with the TCP retry/retransmit mechanism, and shall not otherwise communicate with the SCATS Regional Computer except attempting a reconnection or authentication in accordance with Clause 5.1.2.

NOTE: Refer to Clause 5.2.6 for requirements for latency (for both transmit and receive). Refer to Clause A.4 for additional encapsulation requirements for SCATS messages.

5.2.4 Management capability

5.2.4.1 The ADSL Router shall provide access to all functions including configuration management both locally via the Console Port, and remotely via the ADSL Port using a GUI, except for firmware upgrade.

Firmware upgrade shall be possible via the Console Port only.

NOTE: Access to the configuration settings of the ADSL Router via any Ethernet ports that the ADSL Router may have is not permitted. See Clause 5.1.4.

NOTE: Refer to Clause 5.1.3 for requirements for access control.

Remote access to functions of the ADSL Router shall not use TCP Port 80 or other Well-Known TCP Port Numbers.

5.2.4.2 The user shall be able to remotely reset the ADSL Router to preset defaults.

The user shall be able to reset the serial port parameters of the ADSL Router to preset defaults separately without affecting other setting from the Console Port as well as the ADSL Port.

5.2.4.3 The ADSL Router shall provide a remote loop-back facility to the ADSL Port for signals to be sent/forwarded at the Serial Port. The loop-back shall not cause the Router to “go deaf” and become uncontactable.

When loop-back is active, the following shall apply:

(a) Data (decapsulated) received via the ADSL Port shall be re-encapsulated and transmitted back to the IP address from which the data was received (i.e. looped back to the source);

(b) Data shall not be forwarded to the traffic signal controller via the Serial Port,

(c) Data received via the Serial Port shall be discarded (i.e. not forwarded for transmission via the ADSL Port).

5.2.4.4 The ADSL Router shall provide local and remote diagnostic functions. Diagnostic displays shall be updated at intervals not more than 2 seconds for local access (i.e. via the Console Port), and not more than 10 seconds for remote access (i.e. via the ADSL Port). As the minimum, the information and tests to be provided by the diagnostics shall include:
(a) Connection status for serial link (i.e. via the Serial Port with the traffic signal controller), including word length and parity used, and the messages received and sent;

(b) Connection status for WAN (i.e. ADSL service), including service name, protocol used, and packets and bytes received and sent;

(c) WAN and LAN status, including IP and MAC addresses;

(d) ADSL status, including modulation and protocol used, transmission power, signal-to-noise ratio margin, line attenuation, data rate, latency, number of CRC errors, duration with errors, and duration with loss of signals; information shall be provided for both the upstream and downstream directions;

(e) ATM status, including bytes sent and received, and number of key cells transmitted and received and errors;

(f) Routing table information, including gateways and interfaces;

(g) TCP status, including number of packets and bytes sent and received, packets discarded and reason (e.g. bad checksum, bad header offset, too short), and connections initiated, accepted, established and closed;

(h) Diagnostic tests, including
   - Test the Serial Port connection;
   - Test ADSL synchronisation;
   - Test ATM OAM segment loop back;
   - Test ATM OAM end-to-end loop back;
   - Test ADSL Port connect to ATM;
   - Test PPPoPVC PPPoE connection;
   - Test PPPoPVC PPP layer connection;
   - Test PPPoPVC IP connect to PPP;
   - Ping default gateway;
   - Ping primary DNS.

5.2.4.5 The ADSL Router shall provide a system log, which shall log all event changes including link detection, connection, disconnection, setting up, authentication, failures, IP address acquisitions, and protocol changes.

   The system log shall be capable of forwarding to a Syslog or network management server.

   The system log shall be accessible and may be cleared locally via the Console Port and remotely via the ADSL port.

5.2.4.6 The ADSL Router shall provide a security/hacker log, which shall log all unauthorised attempts and activities in accordance with the Protection Policy. It shall be possible to select the type of activities to be logged and the maximum number of entries to keep in the log.

   The security/hacker log shall be accessible and may be cleared locally via the Console Port and remotely via the ADSL port.
5.2.5 Security Requirements

5.2.5.1 The ADSL Router shall not use TCP Port 80 or any other Well-Known TCP Port Numbers for any of its network connections.

5.2.5.2 The ADSL Router shall provide access control for protection against unauthorised access via the ADSL Port and Ethernet ports that are provided.

NOTE: Access to the ADSL Router shall have username and password protection. Refer to Clause 5.1.3 for requirements.

As the minimum, the access control shall provide the following protection functions:

(a) Service Filtering
Service filtering shall be provided to enable the user to disable service requests from any combination of the following sources of request:

(i) Ping from external network;
(ii) Telnet from external network;
(iii) FTP from external network;
(iv) DNS from external network;
(v) IKE from external network;
(vi) RIP from external network;
(vii) DHCP from external network;

(b) Inbound and Outbound Policy
The Inbound and Outbound Policy shall provide for the filtering of inbound (from the WAN (i.e. ADSL Port)) and outbound (to the WAN) packets based on a set of rules. This shall provide for denying access from and to different sources/destinations. A minimum of four (4) entries respectively for inbound filtering and outbound filtering shall be provided. The filtering for each entry shall be able to be configured based on the following:

(i) IP Address: The IP address or addresses to which the policy applies. Both the source and destination IP addresses will need to be specified. It shall be possible to specify “Any IP address” as the source and/or destination IP address;

(ii) Port Number: The Port number to which the policy applies. Both the source or destination Port number will need to be specified. It shall be possible to select “Any Port”, or the type of Port (such as “HTTP” or “FTP”), as the source and/or destination Ports;

(iii) Protocol: This is the protocol to which the policy applies. It shall be possible to select “All” protocols as a filter criterion;

(iv) Action: The action may be either “Allow” or “Deny”;

(v) Time: It shall be possible to specify when the Inbound and Outbound Policy is applied. The start and end times shall be in Hours:Minutes of a weekday. The default (blank entry) shall be “applicable all times”;

(c) Hacker log
Refer to Clause 5.2.4.6.
5.2.6 Latency

The latency of the ADSL Router shall be not more than 40 ms. For the purpose of this requirement, the latency of the ADSL Router is defined as the larger of the times taken for data received at the ADSL Router’s Serial Port (i.e. TIA-232 port) to appear at its ADSL Port, and for data received at the ADSL Router’s ADSL Port to appear at its Serial Port.

5.3 Mechanical and Physical Requirements

5.3.1 Dimensions

The external dimensions of the ADSL Router shall be not larger than (width x depth x height) 190 x 140 x 80 mm.

5.3.2 Mounting in a Traffic Signal Controller Housing

The ADSL Router shall be suitable for desk top mounting, both in the upright orientation and on its side, on the equipment shelf of the traffic signal controller. Suitable mounting accessories shall be provided by the Supplier to allow the ADSL Router to be installed securely without modification to the traffic signal controller housing and not to become dislodged due to vandalism (e.g. kicking on the housing).

5.3.3 Protective Coating

All printed circuit cards shall be protected from the environment by a conformal coating or a spray on lacquer designed for this purpose. The coating used shall be a solder-through type.

5.3.4 Ventilation

The ADSL Router shall be designed with adequate ventilation by natural convection to allow free air flow for cooling and to prevent condensation inside the housing under all weather conditions.

NOTE: Refer to Clause 5.5.2 for requirements for enclosure protection.

Electric fans, blowers, and similar devices shall not be used to provide the air flow for cooling of parts and ventilation.

5.3.5 Marking

The equipment shall be clearly marked with a permanent and durable label(s) with the following information:

(a) Manufacturer’s identification;
(b) Equipment code or type number;
(c) Date of supply (for warranty claims);
(d) The unique electronic serial number referred to in Clause 5.1.7;
(e) Batch code or other markings to provide traceability under the Manufacturer’s quality management system (Note: the electronic serial number referred to in (d) above may be used for this purpose);
(f) The approval number of the Certificate of Suitability (see Clause 5.5.6);
(g) ACMA RCM approval;
(h) Approval marks of standards to which the equipment complies;
(i) Power supply information;
(j) The RMS type approval number for the ADSL Router.

5.4 Electrical Requirements

5.4.1 Operating Voltage

The ADSL Router shall operate correctly and reliably for mains supply voltages over the range 180 - 280 V r.m.s. and for any variations of frequency in the range 48 - 52 Hz.

The equipment shall not be damaged by mains supply voltages in the range 0 - 280 V r.m.s. and for any variations of frequency in the range 45 - 55 Hz.

NOTE: Refer to Clause 2.5 for requirements for compliance with the electrical safety stipulations of AS/NZS 3100.

5.4.2 Power Supply Configuration

The power supply unit for the ADSL Router shall be an internal circuit within the ADSL Router’s housing.

A type C14 3-pin mains inlet receptacle complying with AS/NZS 60320 shall be provided either on the back or the front of the ADSL Router for the connection of a power supply connector. A matching power supply cable complete with a type C13 connector complying with AS/NZS 60320 shall be provided. The source end of the power supply cable shall be a 10 A 3-pin side-entry power plug complying with AS/NZS 3112, for use with the socket outlet in the traffic signal controller.

5.4.3 Breaks and Brownouts in Mains Supply Voltage

The ADSL Router shall maintain normal operation and shall not be adversely affected by breaks or brownouts in the mains supply of duration up to 5 seconds.

Breaks in the mains supply of duration greater than 10 seconds shall cause the ADSL Router to switch off (i.e. after maintaining operation as required in the preceding paragraph), and restart when the mains supply is restored.

NOTE: The ability of the ADSL Router to continue normal operation for not less than 5 seconds after a break in the mains supply voltage provides an opportunity for the traffic signal controller to have “last-gasp” communications with SCATS.
Where backup batteries are used to provide this function, the batteries shall be of a type suitable for such applications. The service life of the batteries shall be not less than four (4) years.

NOTE: It is expected that breaks and brownouts in the mains supply are infrequent occurrences.

NOTE: Refer also to Clause 5.1.12 for MTBF requirements.

5.5 Environmental Requirements

5.5.1 Ambient Conditions

The ADSL Router shall be suitable for continuous operation in an ambient temperature within the range -10°C to +70°C and with a relative humidity of up to 90%.

NOTE: Each individual functional module of the ADSL Router shall be capable of meeting the requirements in this clause.

5.5.2 Enclosure Protection

The equipment shall have an enclosure protection of not less than classification IP3X in AS 60529.

5.5.3 Surge Protection

The requirements for surge protection shall be as follows:

(a) Surges on Mains Supply Voltage

The equipment shall be designed to withstand transient disturbances and surges induced onto the mains supply, such as by lightning. The equipment shall provide surge protection to withstand the surges specified in AS 1768, Category B, with medium exposure peak amplitudes;

(b) Transient Voltages on Mains Supply Voltage

The equipment shall include effective protection against transients and surges present on the 240 V ac mains due to load switching, operation of power equipment, and lightning discharges. For the purpose of this Specification the equipment shall operate within specification when subjected to random voltage pulses superimposed upon the nominal 240 V a.c. mains supply. The equipment shall be type tested with pulses of the following form:

- Rise time :- 0.25 µs
- Duration :- 50 µs - 200 µs
- Amplitude :- 0-800 V
- Phase :- Variable within 20°-160° and 200°-340°
- Pulse repetition rate :- Up to 1 every 2 s
- Source impedance of pulse generator :- 5 ohms maximum
The pulse can occur with any polarity, i.e. with …
(i) positive polarity on the positive half-cycle; or
(ii) positive polarity on the negative half-cycle; or
(iii) negative polarity on the positive half-cycle; or
(iv) negative polarity on the negative half-cycle.

5.5.4 Fire Hazard

Materials and components used in the equipment shall be selected so as to minimise the risk of fire. In this respect the requirements of Section 6 of AS/NZS 3100 shall apply. All materials used inside the housing shall be of a composition which does not support combustion or has self-extinguishing properties.

5.5.5 Dissimilar Materials

All metallic parts, including screws, nuts and washers, shall be plated or manufactured of non-corrodible material such that dissimilar metals in contact shall have an electro-chemical potential difference not exceeding 0.5 volt.

5.5.6 Certifications

The equipment shall have all necessary certifications in accordance with industry and statutory requirements. In particular, the following Australian statutory certifications shall be provided with the equipment:

(a) Certificate of Suitability
   A Certificate of Suitability issued by the NSW Department of Fair Trading;

(b) ACMA Approval
   The equipment shall be tested by a registered testing authority for compliance with the relevant requirements for connection to the Telecommunications network. Documentary evidence that the equipment complies with all relevant ACMA requirements is required;

(c) RCM Approval
   The equipment shall comply with the ACMA RCM requirements and be certified as such.

5.5.7 Environmental Tests

The equipment shall pass the following environmental tests. The environmental tests shall be performed by a NATA registered laboratory or approved test organisation. If the test facilities are not NATA registered for the types of test to be performed, the Supplier shall furnish a full description of the test facilities and technical expertise of the testing organisation(s) the Supplier intends to use, for approval of RMS before commencement of these tests:
(a) Temperature and Humidity
The equipment shall be operated for 72 hours at an ambient temperature of 70°C and relative humidity of 85% minimum. The equipment operation shall be continuously monitored throughout the test to confirm correct operation of the equipment;

(b) Enclosure Protection Test
The complete equipment shall be tested for compliance with Clause 5.5.2. There is no requirement for the equipment to be operational during the test, but the equipment shall operate correctly after the test.

(c) Immunity to Transient Voltages on Mains Supply Voltage
The equipment shall be tested in accordance with the test conditions described in Clause 5.5.3(b). The equipment operation shall be continuously monitored throughout the tests to confirm correct operation of the equipment;

(d) Bump Test
The equipment, in unpacked condition, shall be subjected to a bump test in accordance with AS 60068.2.29. The severity shall be 1,000 bumps at an acceleration of 98 m/s² (10g) with a pulse duration of 16 ms;

(e) Vibration
The equipment shall be subjected to the vibration tests described in this clause. The test procedures shall be in accordance with AS 60068.2.6 for sinusoidal vibration. For all tests specified in this clause, the amplitude shall be 0.75 mm up to the cross-over frequency, (approximately 8.2 Hz), where the acceleration is 0.2g, and for higher frequencies the acceleration shall be maintained constant at 0.2g.

The operation of the equipment shall be recorded during the tests and its overall performance summarised in the test report.

The tests shall be performed for three (3) mutually perpendicular axes with the equipment in the normal orientation.

For each axis of the tests, the equipment shall be tested with an endurance of 20 sweep cycles over the frequency range 5-55 Hz with an initial amplitude of 0.75 mm. The sweep rate shall be 1 octave per minute.

6 DOCUMENTATION

A detailed technical manual complete with operations, maintenance and specification covering the complete equipment shall be provided for the ADSL Router.

NOTE: The technical manual may be bundled into separate volumes respectively for field and workshop use.

Refer to the supply contract for the quantity of technical manuals to be supplied to the Agency. Where the supply contract does not contain specific requirements for the supply of manuals, a full set of technical manuals shall be provided with each of the first twenty (20) units of equipment supplied to the Agency.
APPENDIX A  SCATS OPERATION AND MESSAGE FORMATS

This Appendix describes the operation of the ADSL Router for working with SCATS and the message formats to be used for such applications.

A.1 General

The ADSL Router shall operate autonomously in providing all functions.

For SCATS operation, the ADSL Router shall connect to a SCATS communications VPN.

A.2 Connection and Authentication

A.2.1 General

Figure A.2.1 provides a simplified overview of the connection and authentication process. Refer also to Clause 5.1.2 and sub-clauses for additional information.

For details pertinent to a reconnection after a break in communications, refer to Clause 5.1.2.5.

For details of the HDLC message format used by SCATS, refer to Appendix B.

For details of message formats to be used by the ADSL Router for communication with the traffic signal controller and SCATS computers, see Clause A.3.
Figure A.2.1 ADSL Router for SCATS – Connection and Authentication Overview

SCATS Communications - Connection and Authentication Overview

1. The ADSL Router must not abort a SCATS connection except when its connection to the traffic signal controller is lost (see Note 2). If the SCATS connection is lost, the ADSL Router must try to reconnect. This will require reconnection to the VPN if the VPN connection was also lost.

2. Refer to the relevant clause regarding monitoring by the ADSL Router of its connection to the traffic signal controller and consequential action in the case of loss of this connection.

3. The first retry shall be carried out after a waiting time of 10 seconds, the second retry 20 seconds, and so on. The waiting time shall be doubled for each subsequent retry, with a maximum value of 5 minutes.

4. Where multiple Authentication Servers (AS) have been configured in the ADSL Router, the latter shall try each AS in the configuration list in turn until successful. After each pass through the list the ADSL Router shall wait 20 seconds before the next pass.

5. This scenario indicates a potential configuration synchronisation issue between SCATS AS and regions.

A.2.2 Communication with Traffic Signal Controller

NOTES:

1. The ADSL Router must not abort a SCATS connection except when its connection to the traffic signal controller is lost (see Note 2). If the SCATS connection is lost, the ADSL Router must try to reconnect. This will require reconnection to the VPN if the VPN connection was also lost.

2. Refer to the relevant clause regarding monitoring by the ADSL Router of its connection to the traffic signal controller and consequential action in the case of loss of this connection.

3. The first retry shall be carried out after a waiting time of 10 seconds, the second retry 20 seconds, and so on. The waiting time shall be doubled for each subsequent retry, with a maximum value of 5 minutes.

4. Where multiple Authentication Servers (AS) have been configured in the ADSL Router, the latter shall try each AS in the configuration list in turn until successful. After each pass through the list the ADSL Router shall wait 20 seconds before the next pass.

5. This scenario indicates a potential configuration synchronisation issue between SCATS AS and regions.
The ADSL Router shall communicate with the traffic signal controller via its Serial Port to obtain the Site ID Number of the traffic signal controller at the commencement of the connection process. Refer to Appendix B for the SCATS message to use and other related requirements.

NOTE: Refer to Clause 5.2.2 for requirements for the Serial Port.

NOTE: Refer to Clause 5.1.2.5 for requirements for monitoring of the Serial Port connection between the ADSL Router and the traffic signal controller, and consequential action in the case of loss of this connection.

A.2.3 Communication with SCATS Authentication Servers

The ADSL Router shall communicate with a SCATS Authentication Server to obtain the IP address and port number of the SCATS Regional Computer that manages the traffic signal controller site.

For the purpose of this clause, the ADSL Router shall be capable of being configured, via user configuration, with the IP addresses of not less than three (3) SCATS Authentication Servers.

A.3 SCATS Message Formats

A.3.1 Communications with SCATS Authentication Server

The ADSL Router shall query the SCATS Authentication Server(s) to obtain the IP address and port number of the SCATS Regional Computer that controls the site with the Site ID Number reported by the traffic signal controller. This shall be done by sending a datagram message (UDP) to the Authentication Server on the ITS port number (default 2012). The SCATS message formats to be used shall be as follows:

(a) **SCATS Regional Computer IP Address Request Format:**
    (ADSL Router to SCATS Authentication Server)
    The message shall contain 6 bytes:
    (i) First two bytes being 0xEC and 0xFD (signature);
    (ii) Next two bytes being 0x01 and 0x00 (IP and port request);
    (iii) Next two bytes are the Site ID Number (low byte first).

    **SCATS Regional Computer IP Address Request**
    
    | 0xEC | 0xFD | 0x01 | 0x00 | LOW | HIGH |
    |------|------|------|------|-----|------|
    | signature | IP address request | TCP port request | Site ID Number (TCS Number) |

    This request shall be sent at 20 second intervals until a reply is received.

(b) **SCATS Regional Computer IP Address Reply Format:**
    (SCATS Authentication Server to ADSL Router)
    The reply UDP message will consist of 12 bytes:
(i) First six bytes are a copy of the request (see (a));
(ii) Next two bytes contain the TCP port number for the Regional Computer (low byte first);
(iii) Next four bytes contain the IP address of the Regional Computer in network byte order (i.e. high byte first).

SCATS Regional Computer IP Address Reply

<table>
<thead>
<tr>
<th>0xEC</th>
<th>0xFD</th>
<th>0x01</th>
<th>0x00</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>signature</td>
<td>IP address request</td>
<td>TCP port request</td>
<td>Site ID Number (TCS Number)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Followed immediately by:

<table>
<thead>
<tr>
<th>LOW</th>
<th>HIGH</th>
<th>HIGH</th>
<th>LOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP port number</td>
<td>IP address</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A.3.2 Communications with SCATS Regional Computer

The ADSL Router shall attempt to establish a permanent service connection to the SCATS Regional Computer that controls the traffic signal controller connected to the ADSL Router by contacting the Regional Computer on the IP address and TCP port number provided by the SCATS Authentication Server (see Clause A.3.1). The SCATS messages to be used shall be as follows:

NOTE: The SCATS Regional Computer listens for a connection on port 2004 by default. When a connection is established, SCATS waits for a configuration message for up to 10 seconds. The connection is dropped if a valid configuration message is not received.

NOTE: If multiple SCATS Regional Computer instances run on a single hardware platform, each instance listens for a connection on a different port. The SCATS Communications Device must be configured by the user to use the port appropriate to the intended SCATS Regional Computer.

(a) Request to Connect to SCATS Regional Computer:
   (ADSL Router to SCATS Regional Computer)

This message shall contain 6 bytes:
(i) First byte = 5 (0x05);
(ii) Next two bytes shall be 0xFFFD (low byte first);
(iii) Next byte = 0 (0x00);
(iv) Next two bytes are the Site ID Number (low byte first).

Request to Connect to SCATS Regional Computer

<table>
<thead>
<tr>
<th>0x05</th>
<th>0xFD</th>
<th>0xFF</th>
<th>0x00</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Site ID Number (TCS Number)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) Response to Request to Connect to SCATS Regional Computer:
   (SCATS Regional Computer to ADSL Router)

This message will consist of 4, 6 or 8 bytes as relevant:
(i) First byte is message length (excluding the first byte);
(ii) Next two bytes is 0xFFFD (low byte first);
(iii) Next byte = 0 (0x00);
(iv) For a 4-byte response:
The response message ends here. This means that, for the application covered by this Specification, the SCATS Regional Computer controls the site with the Site ID Number forwarded by the ADSL Router and can do so using this network connection;
For a 6-byte response:
Next 2 bytes is the Site ID Number (two bytes, with low byte first) of the site that is not controlled by this SCATS Regional Computer. For the application covered by this Specification, this will be the a repeat of the Site ID Number forwarded by the ADSL Router to the SCATS Regional Computer, and it means the SCATS Regional Computer does not control the site;
For an 8-byte response:
Next 4 bytes will be 0xFFFF followed by the Site ID Number (two bytes, with low byte first) of the site that is controlled by this SCATS Regional Computer but not via an IP network connection. For the application covered by this Specification, this will be a repeat of the Site ID Number forwarded by the ADSL Router to the SCATS Regional Computer, and it means the SCATS Regional Computer controls the site, but configuration has not (yet) been made in SCATS to communicate with the site using this network connection.

Response to Request to Connect to SCATS Regional Computer - (Site ID Number Valid and Can Use IP Connection)

<table>
<thead>
<tr>
<th>0x03</th>
<th>0xFD</th>
<th>0xFF</th>
<th>0x00</th>
</tr>
</thead>
<tbody>
<tr>
<td>length</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Response to Request to Connect to SCATS Regional Computer - (Site ID Number Not Valid for this Regional Computer)

<table>
<thead>
<tr>
<th>0x05</th>
<th>0xFD</th>
<th>0xFF</th>
<th>0x00</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>length</td>
<td>Site ID Number (TCS Number)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Response to Request to Connect to SCATS Regional Computer - (Site ID Number Valid but not Configured for IP Connection)

<table>
<thead>
<tr>
<th>0x07</th>
<th>0xFD</th>
<th>0xFF</th>
<th>0x00</th>
<th>0xFF</th>
<th>0xFF</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>length</td>
<td>Site ID Number (TCS Number)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A.4 SCATS Communications via ADSL Router

Once the connection is established between the traffic signal controller and the SCATS Regional Computer (i.e. successful completion of the connection and authentication process described in Clause A.2), it shall be possible for SCATS messages to be sent by the traffic signal controller and received by the SCATS Regional computer, and vice versa.
In addition to the normal encapsulation and decapsulation of payload message for transmission and reception over the various communication links, the ADSL Router shall encapsulate all SCATS messages from the traffic signal controller to the SCATS Regional Computer as follows to form the payload message:

(i) Add a message length byte (i.e. number of bytes to follow this byte);
(ii) Followed by a two byte Site ID Number (low byte first), which shall be the traffic signal controller's Site ID Number (also known as TCS Number);
(iii) Then followed by a flags byte, set to 0x01;

Note: This is the only difference between Controller to SCATS Regional Computer and SCATS Regional Computer to Controller messages. If this flag is not set to 0x01, a NC (Not Connected) alarm is set by SCATS even though communication is established and running satisfactorily.

(iv) Then followed by the SCATS message.

The resultant payload message is illustrated below:

<table>
<thead>
<tr>
<th>Encapsulation of SCATS messages (Controller to SCATS Regional Computer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
</tr>
<tr>
<td>message length</td>
</tr>
</tbody>
</table>

For SCATS messages sent by the SCATS Regional Computer to the traffic signal controller, in addition to the normal encapsulation of payload messages for transmission over the ADSL communication link to the ADSL Router, the SCATS messages will be encapsulated by SCATS Regional Computer as follows to form the payload message:

(i) Add a message length byte (i.e. number of bytes to follow this byte);
(ii) Followed by a two byte Site ID Number (low byte first), which will be the traffic signal controller’s Site ID Number (also known as TCS Number);
(iii) Then followed by a flags byte, which will be set to 0x00;
(iv) Then followed by the SCATS message.

The resultant payload message is illustrated below:

<table>
<thead>
<tr>
<th>Encapsulation of SCATS messages (SCATS Regional Computer to Controller)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
</tr>
<tr>
<td>message length</td>
</tr>
</tbody>
</table>

A.5 SCATS Time Message

Note: This clause (Clause A.5) is for information only. It is not a requirement of this Specification for the ADSL Router to implement the function described in this clause.

A request message is available for use by ADSL Routers for reading the system time of SCATS. It is available for a smart device if it wishes to synchronise its time with SCATS, for fault reporting or time-stamping of log-file records for example.
Where such time information is required by the ADSL Router, the ADSL Router may send the following request message to a SCATS Authentication Server:

**Time Request Message to SCATS Authentication Server**

```
0xEC 0xFD 0x02 0x00
signature  time request
```

The SCATS Authentication Server will provide the following reply:

**Response to Time Request Message from SCATS Authentication Server**

```
0xEC 0xFD 0x02 0x00
signature Year Year Month Day of hours minutes seconds
(low byte) (high byte) (1 – 12) month 0xMM 0xss
```
APPENDIX B  COMMUNICATION WITH TRAFFIC SIGNAL CONTROLLER AND MESSAGE FORMATS

This Appendix describes the operation of the ADSL Router for communicating with the traffic signal controller and the message formats to be used.

B.1 General

The ADSL Router shall communicate with the traffic signal controller to establish the communication mode (i.e. HDLC or non-HDLC) and Serial Port configuration to be used for the communication, and the Site ID Number of the traffic signal controller on commencement of connecting to the SCATS VPN and SCATS. Refer to Figure A.2.1 in Appendix A.

The procedure/methodology to be used by the ADSL Router for this purpose shall be as follows:

(a) Assume one of the possible Serial Port configurations (see Clause B.4);
(b) Assume one of the communication modes (i.e. HDLC or non-HDLC), communicate with the traffic signal controller and check for a valid error-free response. (see Clause B.4);
(c) Repeat steps (a) to (b) as necessary (see Clause B.4);
(d) Communicate with the traffic signal controller to obtain its Site ID Number (see Clause B.5).

B.2 HDLC and Non-HDLC Communication Modes

B.2.1 General

Some traffic signal controllers are capable of communicating in both HDLC and non-HDLC modes. Some traffic signal controllers can only communicate in non-HDLC modes.

Some of those which are capable of communicating in both HDLC and non-HDLC modes can be configured to operate in only one mode or the other, and some switch automatically between the two modes.

B.2.2 HDLC

The general format of HDLC framing used by SCATS consists of the following:

(a) A starting flag byte (0x7E);
(b) Followed by a destination type byte to indicate the destination (0x00 for traffic signal controller);
(c) Followed by SCATS message data up to 45 bytes (excluding starting and terminating flag bytes (0x7E) and excluding additional bytes added in byte substitutions as described in the special note (a) below);
(d) Followed by the Frame Check Sequence - the sequence used is a 16-bit Cyclic Redundancy Check value (2 bytes) calculated over the destination type byte and the message data bytes in accordance with ISO/IEC 3309. The high byte of the CRC is inserted in the frame before the low byte of the CRC; i.e. the low byte of the CRC is the last byte in the frame before the terminating flag byte (0x7E);
(e) Then a terminating flag byte (0x7E). This byte may also serve as the starting flag byte for the following message block.

This is illustrated below:

<table>
<thead>
<tr>
<th>0x7E</th>
<th>0x00</th>
<th>message data</th>
<th>message data</th>
<th>Frame Check Sequence: Cyclic Redundancy Check CRC-16 (2 bytes)</th>
<th>0x7E</th>
</tr>
</thead>
<tbody>
<tr>
<td>starting flag</td>
<td>destination type – Traffic Signal Controller</td>
<td>message data</td>
<td>message data</td>
<td></td>
<td>terminating flag</td>
</tr>
</tbody>
</table>

The following special notes are applicable:

(a) If a byte 0x7E appears in the message data at the transmitter it shall be substituted by a pair of bytes 0x7D5E;
   If a byte 0x7D appears in the message data at the transmitter it shall be substituted by a pair of bytes 0x7D5D;
   If a byte pair 0x7D5E appears in the message data at the receiver it shall be substituted by a single byte 0x7E;
   If a byte pair 0x7D5D appears in the message data at the receiver it shall be substituted by a single byte 0x7D;

(b) The terminating flag byte may also serve as the starting flag byte for the following message block;

(c) In contrast to the standard HDLC frame, there are no address bits and no control bits.

When operating in HDLC mode, the traffic signal controller configures its serial port for the following serial data format:

(a) 1 start bit, 8 data bits, no parity bit and 1 stop bit. This is the 10-bit word format; and

(b) HDLC encapsulation enabled.

To communicate successfully with the traffic signal controller in an HDLC mode, the ADSL Router shall configure its Serial Port to the same parameters (refer also to Clause B.4).

B.2.3 Non-HDLC

When operating in Non-HDLC Mode, the Traffic Signal Controller configures its serial port for the following serial data format:

(a) 1 start bit, 8 data bits, Odd parity and 1 stop bit. This is the 11-bit word format; and

(b) HDLC encapsulation disabled.

NOTE: Accordingly, in a non-HDLC mode, only the “message data” is sent.

To communicate successfully with the traffic signal controller in a non-HDLC mode, the ADSL Router shall configure its Serial Port to the same parameters (refer also to Clause B.4).

B.3 Controller Interface Synchronisation Strings
The ADSL Router shall use the synchronisation message strings described in this clause to establish the Serial Port configuration and communication mode to be used for communicating with the traffic signal controller, by checking for an error-free response from the traffic signal controller to the message.

The following are the message strings to be used by the ADSL Router and the corresponding error-free response expected from the traffic signal controller:

(a) Without HDLC encapsulation

The message string to be transmitted by the ADSL Router shall consist of the following characters (hexadecimal):

```
01 01 01 01 01 01 01 01 01 80 00
```

The expected error-free response from the traffic signal controller should consist of the following characters (hexadecimal):

```
10 followed by 2 bytes;
OR
90 followed by 2 bytes
```

(b) With HDLC encapsulation

Unless otherwise approved by the RMS representative, the message string to be transmitted by the ADSL Router shall consist of the following characters (hexadecimal):

```
7E 00 01 01 01 01 01 01 01 01 01 01 00 00 D9 6E 7E
```

The expected error-free response from the traffic signal controller should consist of the following characters (hexadecimal):

```
7E 00 10 [followed by 2 bytes] 2-byte CRC 7E
```

### B.4 Serial Port Configuration

#### B.4.1 Configurations to be supported

For the purposes of communicating with the traffic signal controller, the following Serial Port Configurations are defined:

<table>
<thead>
<tr>
<th>Serial Port Configuration</th>
<th>Word Length</th>
<th>Parity</th>
<th>Data Rate</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10 bit</td>
<td>No</td>
<td>1200 bps</td>
<td>HDLC use</td>
</tr>
<tr>
<td>2</td>
<td>11 bit</td>
<td>Odd</td>
<td>1200 bps</td>
<td>Non-HDLC use</td>
</tr>
<tr>
<td>3</td>
<td>10 bit</td>
<td>No</td>
<td>9600 bps</td>
<td>HDLC use</td>
</tr>
<tr>
<td>4</td>
<td>11 bit</td>
<td>Odd</td>
<td>300 bps</td>
<td>Non-HDLC use</td>
</tr>
</tbody>
</table>

**NOTE:** The bit rate used by the traffic signal controller is dependent on the model of the traffic signal controller and the software it uses.

Additional Serial Port Configurations may also be defined.

### B.4.2 Selection of Active Configurations
Provision shall be made for each of these Serial Port Configurations to be individually enabled or disabled from the GUI. See Clause 5.2.4. It shall be possible to disable any combination of Serial Port Configurations except that it shall not be possible for all Configurations to be to disabled at the one time.

NOTE: This provides the capability to lock the ADSL Router to one particular Serial Port Configuration.

At power-up and every time on the commencement of connecting to the SCATS VPN, the ADSL Router shall configure its Serial Port for the lowest numbered enabled Configuration.

The ADSL Router shall transmit the relevant (for HDLC or non-HDLC use as appropriate) synchronisation string referred to in Clause B.3 to the traffic signal controller and await a valid response.

If a valid error-free response is received from the traffic signal controller, the ADSL Router shall confirm and save these Serial Port settings in non-volatile storage. The serial data interface format shall be deemed to have been determined and shall be used in subsequent communication with the traffic signal controller.

If no valid error-free response is received from the traffic signal controller, the ADSL Router shall repeat this process at 8 second intervals 3 times.

If a valid error-free response has still not been received from the traffic signal controller, the ADSL Router shall test the next possible data interface format.

The ADSL Router shall test the possible Serial Port Configurations in the following sequence:

- Serial Port Configuration 1 (if enabled); then
- Serial Port Configuration 2 (if enabled); then
- Serial Port Configuration 3 (if enabled); then
- Serial Port Configuration 4 (if enabled); then
- Any subsequent Configurations (if enabled).

If the ADSL Router has cycled through all of these formats and if a valid error-free response has still not been received from the traffic signal controller, the ADSL Router shall repeat the process.

The factory preset default configuration shall be for Serial Port Configuration 1 to be enabled and the remaining configurations disabled. See Clauses 5.1.10 and 5.2.2.

### B.5 Reading Site ID Number

On successful establishment of a compatible Serial Port Configuration and communication mode with the traffic signal controller, the ADSL Router shall communicate with the traffic signal controller to read the Site ID Number of the controller. The data transactions shall be as described in this clause.

For clarity, the data transactions described in this clause are not shown with HDLC encapsulation. If the Serial Port Configuration established has HDLC mode enabled, then the following data transactions shall be encapsulated as described in Clause B.2.2.

The procedure shall be as follows:

(a) The ADSL Router shall send a Controller Identity Request Message to the traffic signal controller to request the Site ID Number of the controller. The Controller Identity Request Message string shall consist of the following 2 bytes:
● **P0110010** SCATS ID Request Message – Byte 1;
  where:
  For non-HDLC operation, P = Odd Parity calculated across the message; and
  For HDLC operation, P shall be set to "0";

● **00000110** SCATS ID Request Message – Byte 2 – Device Type bits are set to "6".

The method for determining the value of the bit “P” in Byte 1 is as follows:

(i) Perform a sum of the total number of “1” bits in the message (excluding the “P” bit);
(ii) If the second least significant bit of the sum is “0”, then set “P” = “1”;
(iii) If the second least significant bit of the sum is “1”, then set “P” = “0”.

For HDLC operation, the value of the bit “P” in Byte 1 shall be set to “0”.

(b) The expected error-free Controller Identity Response Message string from the traffic signal controller consists of the following 5 bytes:

● **P0110010** SCATS ID Response Message – Byte 1;
  where:
  For non-HDLC operation, P = Odd Parity calculated across all 5 message bytes; and
  For HDLC operation, P = “0”;

● **XXXXX11M** SCATS ID Response Message – Byte 2;
● **YYYYYYYY** SCATS ID Response Message – Byte 3;
● **ZZZZZZZZ** SCATS ID Response Message – Byte 4;
● **AAAAAAAA** SCATS ID Response Message – Byte 5.

**NOTE:** The individual bit values represented by the same letter “X”, “Y”, “Z” or “A” above (and below) may be different.

(c) Depending on the value of the bit “M” in Byte 2, the following action shall be taken:

(i) If the second byte is odd (i.e. M = 1) and the last byte (Byte 5) = “00000000”, then Byte 3 and Byte 4 of the error-free response are the high and low bytes of the traffic signal controller’s Site ID Number respectively;

(ii) If the second byte is odd but the last byte (Byte 5) is not “00000000”, then the ADSL Router shall ignore the response and retry by sending the Controller Identity Request Message with Device Type value 0x06 (see paragraph (a) above) to the traffic signal controller;

(iii) If the second byte is even (i.e. M = 0), then the ADSL Router shall ignore the response and retry with a different Device Type value. The possible values for Device Type are 0x06 and 0x07.

The Controller Identity Request Message with Device Type value 0x07 shall be as shown below. See paragraph (a) above for the same message but with Device Type value 0x06.

● **P0110010** (SCATS ID Request Message – Byte 1);
  where :
For non-HDLC operation, P = Odd Parity calculated across the message; and
For HDLC operation, P shall be set to "0",

- 00000111 (SCATS ID Request Message – Byte 2 – Device Type bits are set to “7”).

(d) Where a controller identity request retry has been transmitted, repeat step (c) (i.e. paragraph (c)) above regarding further action.

(e) Repeat steps (c) and (d) above at 5 second intervals until the traffic signal controller’s Site ID Number (TCS Number) is obtained from an error-free response.

The Site ID Number (i.e. TCS Number) shall be in the range 1 to 64999 (decimal) inclusive (i.e. 0x0001 to 0xFDE7).

When a valid error-free response is received from the traffic signal controller, the ADSL Router shall store this Site ID Number together with a checksum in a dedicated location of its RAM for use.

The ADSL Router shall periodically check the stored Site ID Number by re-calculating the checksum and compare the result with the stored value at intervals not longer than 10 seconds. If the calculated checksum does not agree with the stored value, the ADSL Router shall discard the Site ID Number and attempt to re-establish a valid Site ID Number by communicating with the traffic signal controller again to read its Site ID Number.

The ADSL Router shall log all occurrences of corrupted checksum, including the time and date, and both the correct and corrupted Site ID Numbers and checksums in its system log.
APPENDIX C  CONNECTOR PIN FUNCTIONS AND CONNECTIONS

This Appendix provides information on the pin functions of the traffic signal controller’s serial port to which the ADSL Router shall connect, and additional information on the pin connections for the interfacing connector.

C.1 General

Two versions of interfacing connector will be required to be provided with the ADSL Router, for connecting respectively to the existing PSC traffic signal controllers and TSC/4 traffic signal controllers (see Clause 5.1.9(a)).

NOTE: Some older models of traffic signal controllers currently in use may have differing pin functions and require differing connections. The Agency will provide the relevant details to the Supplier if connectors for connecting to such controllers are required.

C.2 Connector for Use with PSC Traffic Signal Controllers

The ADSL Router shall be able to connect to the serial port of the PSC type traffic signal controller which functions as a DTE.

The PSC type traffic signal controller’s serial port uses a 25 pin male miniature "D" connector (designated XM4) and its pin functions are shown in Table C.1. This connector is equipped with latching blocks equivalent to AMP part number 745007-3.

The mating connector on the Serial Port cable provided with the ADSL Router (refer to Clause 5.1.9(a)) for connecting to PSC type traffic signal controllers shall be equipped with spring clip latches that are compatible with the connector on the traffic signal controller.

The connector shall be fitted with a backshell to provide strain relief for the wiring. The backshell shall have an angled cable entry, at approximately 45° to the axial direction of the connector, on the side where connector pins 13 and 25 are located. The connector and cable assembly, when installed onto the serial port XM4 connector of a PSC type traffic signal controller, shall not extend more than 55 mm outward from the connection interface.

NOTE: The angled cable entry shall not be significantly larger than 45°; otherwise the cable may interfere with other adjacent connector(s) in the traffic signal controller housing below the cable.

NOTE: The need for an angled cable entry and a footprint limit is to ensure that the Serial Port cable does not intrude into the zone occupied by other internal equipment installed in some traffic signal controller.

Table C.1 also contains information on the pin connections for the interfacing connector.
### Table C.1 Connector Pin Functions and Connection Information (PSC Controllers)

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Pin Name</th>
<th>Pin Function Signal</th>
<th>Direction</th>
<th>Information for Interfacing Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ground</td>
<td>Protective Ground</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>TxD</td>
<td>Transmitted Data</td>
<td>Out</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>RxD</td>
<td>Received Data</td>
<td>In</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>RTS</td>
<td>Request To Send</td>
<td>Out</td>
<td>Connect to Pin 5</td>
</tr>
<tr>
<td>5</td>
<td>CTS</td>
<td>Clear To Send</td>
<td>In</td>
<td>Connect to Pin 4</td>
</tr>
<tr>
<td>6</td>
<td>DSR</td>
<td>Data Set Ready</td>
<td>In</td>
<td>Do not use – leave open</td>
</tr>
<tr>
<td>7</td>
<td>Common</td>
<td>Signal Common</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>DCD (RLSD)</td>
<td>Data Carrier Detect</td>
<td>In</td>
<td>Connect to Pin 9 (forces 1200bps mode)</td>
</tr>
<tr>
<td>9</td>
<td>V+ Protected</td>
<td>+12V@10mA Out</td>
<td>Out</td>
<td>Connect to Pin 8</td>
</tr>
<tr>
<td>10</td>
<td>V- Protected</td>
<td>-12V@10mA Out</td>
<td>Out</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>-</td>
<td>Unused</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>-</td>
<td>Unused</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>-</td>
<td>Unused</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>-</td>
<td>Unused</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>-</td>
<td>Unused</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>-</td>
<td>Unused</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>-</td>
<td>Unused</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>-</td>
<td>Unused</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Tel</td>
<td>Telephone Line</td>
<td>In/Out</td>
<td>Do not use – leave open</td>
</tr>
<tr>
<td>20</td>
<td>DTR</td>
<td>Data Terminal Ready</td>
<td>Out</td>
<td>Do not use – leave open</td>
</tr>
<tr>
<td>21</td>
<td>Tel</td>
<td>Telephone Line</td>
<td>In/Out</td>
<td>Do not use – leave open</td>
</tr>
<tr>
<td>22</td>
<td>RI</td>
<td>Ring Indicator</td>
<td>In</td>
<td>Connect to Pin 7</td>
</tr>
<tr>
<td>23</td>
<td>-</td>
<td>Unused</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Do Not Use</td>
<td>Do Not Use</td>
<td>Out</td>
<td>Do not use – leave open</td>
</tr>
<tr>
<td>25</td>
<td>-</td>
<td>Unused</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

### C.3 Connector for Use with TSC/4 Traffic Signal Controllers

The ADSL Router shall be able to connect to the serial port of the TSC/4 type traffic signal controller which functions as a DTE.

The TSC/4 type traffic signal controller's serial port uses a 25 pin male miniature "D" connector (designated XM) and its pin functions are shown in Table C.2. This connector is equipped with latching blocks equivalent to AMP part number 747080-2.
The mating connector on the Serial Port cable provided with the ADSL Router (refer to Clause 5.1.9(a)) for connecting to TSC/4 type traffic signal controllers shall be equipped with spring clip latches that are compatible with the connector on the traffic signal controller.

The connector shall be fitted with a backshell to provide strain relief for the wiring. The cable entry into the backshell shall be in the axial direction of the connector. The connector and cable assembly, when installed onto the serial port XM connector of a TSC/4 type traffic signal controller, shall be able to fit into a space within 70 mm outward from the connection interface without undue stress on the connection and mechanical structure of the cable/connector assembly.

Table C.2 also contains information on the pin connections for the interfacing connector.
Table C.2 Connector Pin Functions and Connection Information (TSC/4 Controllers)

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Pin Name</th>
<th>Pin Function Signal</th>
<th>Direction</th>
<th>Information for Interfacing Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ground</td>
<td>Protective Ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>TxD</td>
<td>Transmitted Data</td>
<td>Out</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>RxD</td>
<td>Received Data</td>
<td>In</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>RTS</td>
<td>Request To Send</td>
<td>Out</td>
<td>Do not use – leave open</td>
</tr>
<tr>
<td>5</td>
<td>CTS</td>
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