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(TSG/INFO/019)

UK INTERCONNECT USE OF SIGNALLING FOR PACKET-BASED PSTN/ISDN

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UK INTERCONNECT USE OF SIGNALLING FOR PACKET-BASED PSTN/ISDN

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0.2 Contents

0.3 History

Revision	Date of Issue	Description
Issue 1 Draft 1	14th November 2002	Initial version
Issue 1 Draft 2	12th December 2002	Updated according to review comments recorded at the TP Working Party meeting on 11th December 2002.
Issue 1 Draft 3	11th March 2003	Updated according to review comments recorded at the TP Working Party meeting on 4th February 2003.
Issue 1 Draft 4	30th May 2003	Updated according to review comments recorded at the TP Working Party meeting on 30th April 2003.
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Issue 1 Draft 6	6th April 2004	Correction of definition of SACK frequency. Issue raised in TP WP e-room.
Issue 1 Draft 7	19th May 2006	Copyright statement amended. INFO and SPEC reference replaced by ND reference. Removal of detailed content relating to M2PA and the signalling transport of BICC. Normative references re-numbered.
Issue 1 Draft 8	22nd June 2006	Updated according to review comments received by e-mail from UK participants, prior to June 9th.
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Issue 1	31st July 2006	Approved for issue.

0.4 Issue Control

SECTION	ISSUE	DATE
All	Issue 1.0 Draft 1	14th November 2002
All	Issue 1.0 Draft 2	12th December 2002
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All	Issue 1.0 Draft 7	19th May 2006
All	Issue 1.0 Draft 8	22nd June 2006
All	Issue 1.0 Draft 9	26th July 2006
All	Issue 1.0	31st July 2006

0.5 Normative References

[1] ND1012:2006/06 (PNO-ISC/SPEC/012 Issue 2) Interconnect Stream Control Transmission Protocol (SCTP) and Adaptation Layers for UK Interconnect

0.6 Informative References[1]

[2] T. Dierks, E. Rescorla, “The TLS Protocol, Version 1.1,” RFC 4346, IETF, April 2006

[3] S. Kent & K. Seo, “Security Architecture for the Internet Protocol,” RFC 4301, IETF, December 2005

[4] S. M. Bellovin, J. Ioannidis, A. Keromytis, R. Stewart, “On the use of Stream Control Transmission Protocol (SCTP) with IPsec,” RFC 3554, IETF, July 2003

[5] A. Jungmaier, E. Rescorla & M. Tuexen, “TLS over SCTP,” RFC 3436, IETF, December 2002.

[6] ND1005:2000/08(PNO-ISC/SPEC/005 Issue 3), C7 Interconnect Message Transfer Part (MTP)

[7] ND1107:2001/10 (PNO-ISC/INFO/007 Issue 3.1) UK Interconnect use of SCCP and MTP

[8] R. R. Stewart, et al., “Stream Control Transmission Protocol,” RFC 2960, IETF, October 2000

[9] J. Loughney, M. Tuexen, Ed., J. Pastor-Balbas, “Security Considerations for Signaling Transport (SIGTRAN) Protocols,” RFC 3788, IETF, June 2004.

[10] G. Sidebottom, et al., “Signalling System 7 (SS7) Message Transfer Part 3 (MTP3)-User Adaptation Layer (M3UA),” RFC 3332, IETF, September 2002.

[11] T. George, et al., “SS7 Message Transfer Part 2 (MTP2) - User Peer-to-Peer Adaptation Layer (M2PA),” RFC 4165, IETF, September 2005.

[1] Internet-Drafts are temporary IETF documents and may be made obsolete or superseded within 6 months of publication. They are listed for purely informational purposes.

0.7 Glossary of terms

0.7.1 Abbreviations

ASP	Application Server Process
ATM	Asynchronous Transfer Mode
BICC	Bearer Independent Call Control
B-ISUP	Broadband - ISDN User Part
IETF	Internet Engineering Task Force
IP	Internet Protocol
ISC	Interconnect Standards Committee (replaced by TSG WP)
ISDN	Integrated Services Digital Network
IPSP	IP Server Process
ISUP	Integrated Services User Part (of SS7)
ITU-T	International Telecommunications Union - Telecommunications standardization sector
IUP	Interconnect User Part
M2PA	MTP 2 Peer-to-peer Adaptation layer
M3UA	MTP 3 User Adaptation layer
MTP L1	Message Transfer Part Level 1
MTP L2	Message Transfer Part Level 2
MTP L3	Message Transfer Part Level 3
NICC	Network Interoperability Consultative Committee
PDU	Protocol Data Unit
PLMN	Public Land Mobile Network
PNO	Public Network Operators (replaced by TSG)
PNO-ISC	Public Network Operators' – Interconnect Standards Committee (replaced by TSG)
PSTN	Public Switched Telephone Network
RFC	Request for Comments
RTD	Round Trip Delay
RTO	Retransmission TimeOut
RTT	Round Trip Time
SCCP	Signalling Connection Control Part (of SS7)
SCTP	Stream Control Transmission Protocol
SEP	Signalling End Point
SG or SGW	Signalling GateWay
SGP	Signalling Gateway Process
SMP	Significant Market Power
SPR	Signalling Point with Relay functionality
SS7	Signalling System number 7
SSCOP	Service Specific Connection Oriented Protocol
STP	Signalling Transfer Point
SUA	SCCP User Adaptation layer
TC	Transaction Capabilities
TDM	Time Division Multiplexing
TFC	TransFer Controlled (MTP Network Management message type)
TI-SCCP	Transport Independent SCCP
TLS	Transport Layer Security
TP	Transport Protocol
TSG	Technical Steering Group
UK	United Kingdom of Great Britain and Northern Ireland
VCI	Virtual Circuit Identity
WP	Working Party

0.7.2 Definitions

IPsec	Security Architecture for the Internet Protocol

0.8 Scope

The purpose of ND1119 is to give information about the signalling application and signalling transport protocols specified in reference /1/. These signalling protocols are standardised for use across a UK national interconnect between Public Networks, in order to support packet-based PSTN/ISDN services.

This document was originally written to support the use of SCTP to carry BICC. The UK specification for BICC was completed, but it was agreed in NICC that this would not be published. Hence any references to BICC in this issue of ND1119 should be disregarded.

0.8.1 Future Work Items

See section 2.1.1 for future work items.

END OF ND1119 §0

1 Introduction

This document provides information supplemental to that specified in reference /1/ for interconnect use of IP.
The information is structured according to whether it concerns signalling applications, signalling transport or is general to both.

The information is intended for use by designers of signalling applications that require use of signalling transport protocols, as well as for use by network operators needing to engineer signalling transport networks and to configure signalling applications for UK national network interconnect.

This document will be revised as necessary and in accordance with the NICC/TSG workplan to include information appropriate to enhancements to the relevant signalling protocols.

END OF ND1119 §1

2 General

This section gives general information about Signalling Networks for packet-based PSTN/ISDN services.

2.1 Guidelines on Interconnect Network Architectures

Note that the term ‘packet-based’ does not exclusively mean IP technologies, however this section covers only IP technologies.

In general there will be two types of network using IP technology:

- hybrid networks of TDM and IP, having evolved from TDM-only networks
- IP-only, being new entrants to the market

A pair of IP-only networks might wish to use an IP-based signalling transport interconnect to avoid the addition of any TDM technology, although if this isn't possible (for whatever reason), then there remains the last resort of implementing a SS7 TDM interconnect.

A pair of hybrid networks might wish to use an IP-based signalling transport interconnect to overcome, for example, bandwidth limitations or to avoid SS7 over TDM (conversion).

An interconnect between an otherwise IP-only and a hybrid network might use either TDM or IP-based signalling transport interconnects, depending on what is mutually possible. Or there might even be regulatory pressure on SMP hybrid networks to provide a signalling transport gateway as a service to IP-based start-ups.

The diagrams that follow show the logical topology of the signalling transport networks. The topology and construction of the underlying physical, IP or transmission networks are not described and are outside the scope of this document.

2.1.1 Network architectures supported by UK interconnect standards

The configurations supported by the current UK interconnect standards are:

- M3UA client-server model, exemplified in section 2.1.2

The TP WP may study the following when the relevant IETF documents are stable and as required by the TSG:

- M3UA peer-to-peer model, exemplified in section 2.1.3
- Standardisation of M2PA for UK national interconnects. See section 2.1.4
- Standardisation of M3UA extensions for SG to SG for UK national interconnects. See section 2.1.4

2.1.2 Quasi-associated (STP or SGW) signalling - STP one side

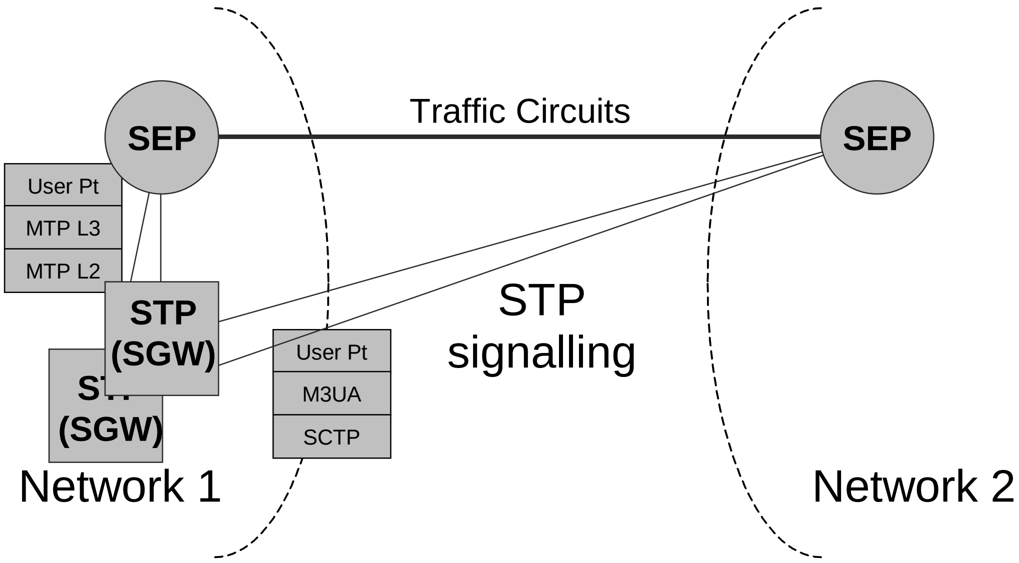

Figure 2-1 – Quasi-associated Signalling - STP one side

This asymmetrical network architecture arises if Network 1 provides a signalling gateway or some signalling gateways as a service for Network 2. The means of interconnect is the M3UA in client-server mode.

This configuration is supported by the current UK IP-based interconnect standards.

2.1.3 Associated signalling

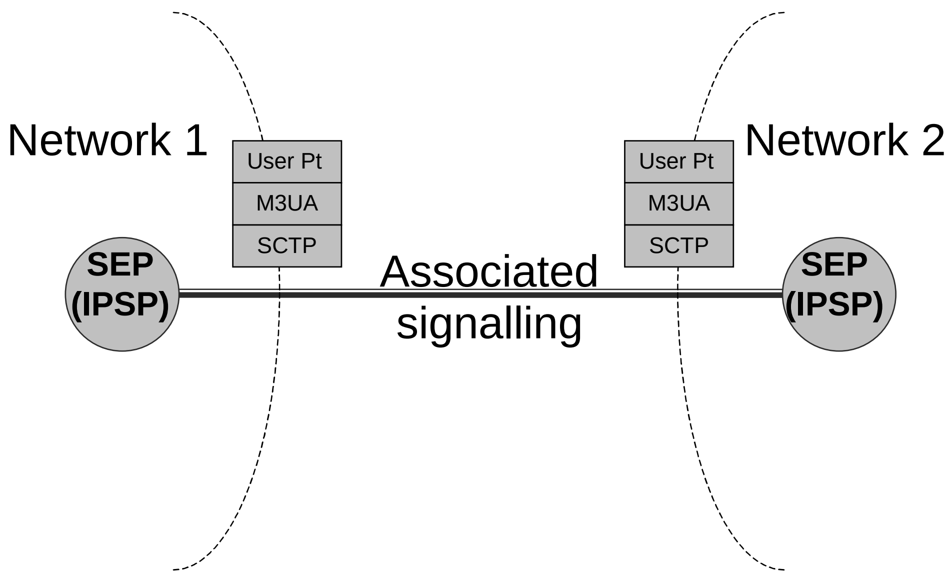

Figure 2-2 – Associated Signalling

This is the basic scenario, where the means of interconnect is the M3UA in peer-to-peer mode. The technology type of the interconnected networks could be TDM, with ISUP as the signalling application and IP as the signalling transport.

This configuration is NOT supported by the current UK IP-based interconnect standards, because the peer to peer model of reference /10/ requires clarification by the IETF or, if this is not forthcoming, by the UK TP Working Party.

2.1.4 Quasi-associated (STP) signalling - STP each side

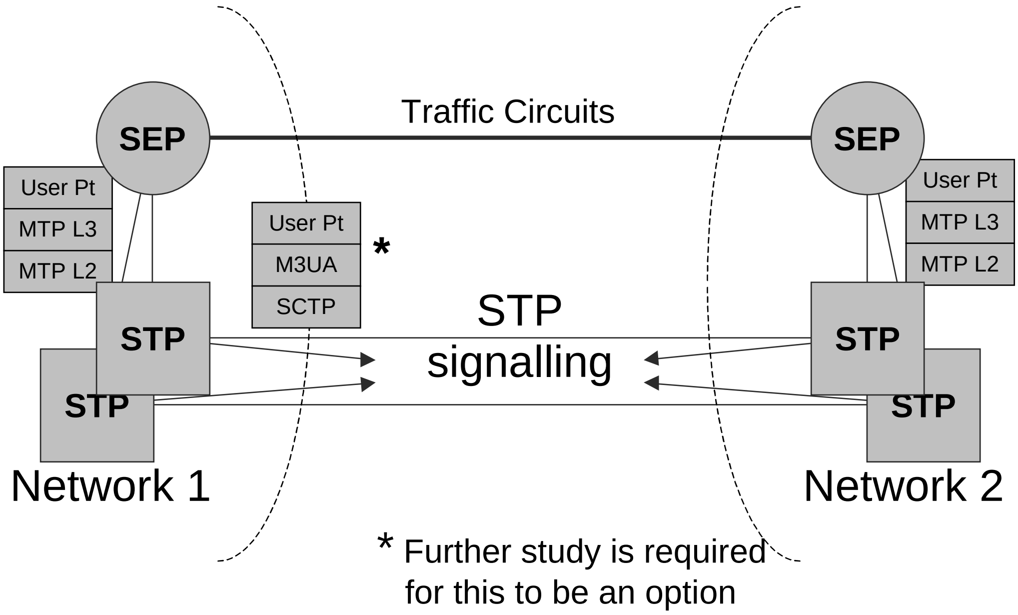

Figure 2-3 – Quasi-associated Signalling - STP each side

The means of interconnect in this scenario is M3UA in an extended peer-to-peer mode. The nodes that are shown as STPs could instead be SPR nodes, with SCCP as the signalling application, which would be a typical arrangement for interconnect between UK PLMNs.

This configuration is NOT supported by the current UK IP-based interconnect standards, because reference /10/ does not support SG to SG.

2.2 Guidelines on IP Security Choices

It is expected that security for the underlying IP network will be provided by some or all of the following techniques:

- Physical access control
- IPSec - see reference /3/
- TLS (Transport Layer Security) - see references /2/ and /5/

The standardisation of security measures is outside the scope of this document, however if TLS is chosen, then the effect on the SCTP data payload should be taken into account.

The potential problems of IPsec compared with TLS are that:

- Re-keying has the potential to cause interruption to service
- Management re-configuration requires potentially significant manpower.

These potential problems arise because each multi-homed SCTP association results in multiple security associations. For further information and proposed solutions, see references /4/ and /9/.

The recommended default is currently outside the scope of this document, pending work in ETSI on security.

2.3 Guidelines on IP Address Assignment

Only selected combinations of IP addresses and Port identities should be allowed.

END OF ND1119 §2

3 Signalling Application Protocols

This section gives information about Signalling Application Protocols for packet-based PSTN/ISDN services.

Information, if any, about signalling application protocols for packet-based PSTN/ISDN is to be written by the AP Working Party.

END OF ND1119 §3

4 Signalling Transport Protocols

This section gives information about Signalling Transport Protocols for packet-based PSTN/ISDN services.

4.1 Protocol Architectures

The following options are considered to be appropriate for UK interconnects for packet-based PSTN/ISDN. Of course, other choices may be used by bi-lateral agreement.

4.1.1 Bearer-related Protocol Architectures

Bearer-related MTP User Part			
MTP3	MTP3b	M3UA	MTP3
	SSCOP		M2PA
MTP2	AAL5	SCTP	SCTP
MTP1	ATM	IP	IP
Option A	Option B	Option C	Option D

Figure 4-1 – Bearer-related Protocol Architectures

Option A, using the MTP3, MTP2, MTP1 stack will be maintained as a signalling transport option. It is suitable as a last resort for implementing an interconnect (e.g. for low signalling load) and it is supported by references /6/ and /7/.

Option B includes MTP3b in order to cater for more complex networks. SSCOP itself does not support alternative routing, and this was felt to be a significant limitation. This option is no longer being actively considered for UK interconnects for packet-based PSTN/ISDN.

Option C is supported by reference /1/. Currently M3UA is more appropriate to a protocol architecture shown in sections 2.1.2 or 2.1.3, whilst M2PA is more appropriate to the protocol architecture shown in section 2.1.4, because M3UA is currently unable to support STP traffic. That is to say, M3UA is currently not specified for use between SGWs. In principle, M3UA supports SEP to SEP (peer to peer) as well as SEP to SGW (client server), but it is not always clear how to interpret some of the M3UA requirements in the SEP to SEP case. The standardisation of option C was given higher priority than option D, due to the relative maturity of the IETF documents, and is therefore the default signalling network architecture for UK interconnects for packet-based PSTN/ISDN.

Option D is not yet supported for UK Interconnects. Although it is the simplest method of using IP to carry signalling and the IETF document (reference /11/) is simple in concept, this option is an answer to a specific problem (e.g. wideband links), rather than a general answer to interconnect.

Note that the option of SCTP without MTP3 was excluded, because it is only appropriate in a fully IP environment, where interworking with TDM networks is not required.

4.1.2 Non-bearer-related Protocol Architectures

TC			
SCCP			
MTP3	MTP3b	M3UA	MTP3
	SSCOP		M2PA
MTP2	AAL5	SCTP	SCTP
MTP1	ATM	IP	IP
Option A	Option B	Option C	Option D

Figure 4-2 – Non-bearer-related Protocol Architectures

The information in section 4.1.1 is equally applicable to these options.

TI-SCCP and SUA are not required, provided MTP3 or MTP3b functionality is available, but they may be considered in future. SUA is not currently identified as a UK interconnect requirement.

4.2 SCTP Timers and Parameters information and guidelines on choosing values

The default timer and parameter values in reference /8/ are not appropriate in a SS7 environment, so the following values are recommended for UK interconnect (PSTN replacement):

4.2.1 RTO.Initial

This is the value to use for RTO until an RTT measurement has been made.

100 milliseconds.

4.2.2 RTO.Min

This is the minimum value that RTO may take.

10 milliseconds.

4.2.3 RTO.Max

This is the maximum value that RTO may take.

200 milliseconds.

4.2.4 RTO.Alpha

This is a parameter that contributes to the calculation of the value to be used for RTO.

1/8

4.2.5 RTO.Beta

This is a parameter that contributes to the calculation of the value to be used for RTO.

1/4

4.2.6 Valid.Cookie.Life

This is the time allowed completely to setup an association. The value of this parameter has no direct effect on the grade of service of the signalling network.

60 seconds.

4.2.7 Association.Max.Retrans

This is the maximum number of retransmission attempts for a given association, which may comprise multiple paths. Its value should be greater than 'Path.Max.Retrans' (see 4.2.8).

10 attempts per association.

4.2.8 Path.Max.Retrans

This is the maximum number of retransmission attempts on a single path. It is effectively the maximum number of accumulated RTO delays experienced by a single message.

5 attempts (per destination address).

4.2.9 Max.Init.Retransmits

This is the maximum number of attempts at initialising an association. The value of this parameter has no direct effect on the grade of service of the signalling network.

8 attempts.

4.2.10 HB.interval

This timer values governs the 'Heartbeat' procedure, which gives protection against latent faults. It is functionally equivalent to the MTP signalling link test procedure, which has a periodicity of 3 to 6 seconds.

3 seconds

4.2.11 SACK period

This is the maximum delay before generating an acknowledgement after receipt of a packet containing aDATA chunk.

0 milliseconds (i.e. no artificial delay is to be added).

4.2.12 SACK frequency

This defines how often a SACK is generated for every n packets received containing one or more DATA chunks within the SACK period.

1 (i.e. every packet containing any data chunks is to be acknowledged individually).

4.2.13 MTU Size

This is the maximum size of each packet in any transmission, specified in octets.

1500 is suitable assuming that the transmission is using Ethernet.

4.2.14 Consequences of choosing either IPv4 or IPv6 address types

The 'INIT' and 'INIT ACK' chunk sizes are large enough to accommodate multiple IP addresses, however they do have a finite size, so if the number of IP addresses configured is large, then it is important to check that they do not exceed the chunk size. IPv6 addresses, being larger than IPv4 addresses, will reach the limit sooner.

4.3 Guidelines for choosing the number of SCTP paths to a given destination

The chosen number of IP addresses for a given association should be a number that is supported by the implementations at each end of that association.

A node should make use of multiple IP addresses if known for multi-homing. Whether this is done within the SCTP or is initiated by the SCTP's user is implementation dependent.

4.4 Guidelines for M3UA

4.4.1 Use of M3UA 'Error' message type

A permitted option is to provide the supported version in the 'diagnostic information' parameter of the Error message.

4.4.2 Nodal congestion control

There is a greater risk of nodal overload with IP-based signalling transport, because the available bandwidth between a pair of nodes is no longer constrained to 64kbit/s. Therefore the importance of effective nodal congestion controls is even greater than for SS7 signalling transport. The following clauses give guidance on the signalling protocol options by which a node might notify other nodes that it is (at risk of) being overloaded by the presented signalling load.

For the network configuration shown in 2.1.2, the important elements are:

- The SGP and ASP are aware of their local nodal load, such an implementation-dependent means can either make them send SCON messages or cause a reduction in the credit window of their underlying SCTP association;
- The ASP informs the User Parts using the MTP-STATUS_Indication, if either it receives SCON messages or an implementation-dependent mechanism indicates excessive occupancy of the underlying SCTP association;
- The User Part has an effective method of reducing its outgoing signalling traffic
(this requirement is the same as for SS7 signalling transport);
- The SGP either sends TFC messages concerning the AS's own pointcode or causes a reduction of the rate at which its underlying MTP Level 2 acknowledges incoming MSUs, if either it receives SCON messages or an implementation-dependent mechanism indicates excessive occupancy of the underlying SCTP association.

4.4.3 M3UA message distribution failure at the Signalling Gateway

The behaviour if no active ASP is available is a nodal function, but the layer management should be informed if the received messages are discarded. The use of buffering is not appropriate, because it may cause excessive signalling delay.

4.4.4 M3UA load-balancing across associations

Assuming that:

- all associations have an equal end-to-end bandwidth and latency for all paths;
- equal processing capacity is provided across all ASPs;

then M3UA should use an algorithm that produces an even distribution for transmitting message across associations.

Any variance from the above assumptions needs to be negotiated.

4.4.5 Guidelines for choosing the number of M3UA streams

If delivery in sequence is NOT required (equivalent to SCCP protocol class 0), then only 1 stream need be used in addition to stream 0, without incurring 'head of line' blocking. (Stream 0 should not be used for data transfer.)

END OF ND1119 §4

END OF ND1119