NICC ND 1640 V1.1.1 (2010-01)

NICC Document

Architecture for SS7 Signalling Transport Service between PLMNs

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Foreword

This NICC Document (ND) has been produced by NICC Architecture and Requirements WG

1 Scope

This specification defines the generic connectivity of SS7 signalling transport service between UK PLMNs using IP technology. It is intended to support all relevant signalling protocols including, but not restricted to, BICC, ISUP, MAP and CAP.

This specification defines the service architecture and how it is supported by the MSI Common Transport Specification [2] that supports logical network layer point-topoint connectivity with dedicated bandwidth as the transport between communications providers (CPs). This document does not cover the facilities to support a transport function that utilises an IP routed, multi-point, interconnect network. However, it is not intended to preclude the deployment of such a layer 3 routed interconnect between CPs.

2 References

2.1 Normative references

[1] ND1610.

[2] ND1611 "Multi-Service Interconnect Common Transport for UK NGNs".

[3] ND1613 "Management of NGN Interconnect: Transport Service Layer"

[4] ND1628 "Security"

[5] ND1636 "NGN Interconnect – IP Address Allocation "

[6] ND1639 "BICC/IP Connectivity for PLMN/ISDN Services between NGNs"

[7] ND1633 "Next Generation Networks; Element Naming Framework"

[8] Void

[9] Void

[10] ND1012 "Interconnect Stream Control Transmission Protocol (SCTP) and Adaptation Layers"

[11] ND1026 " NGN; MTP3 over IP Interconnect between PLMNs using M2PA Protocol "

[12] ND1701 "Recommended Standard for the UK National Transmission Plan for Public Networks"

[13] ND1704 "End-to-End Network Performance Rules & Objectives for the Interconnection of NGNs"

[14] ETSI TS 133 210 V7.3.0 Digital cellular telecommunications system (Phase 2+);Universal Mobile Telecommunications System (UMTS);3G security;Network Domain Security (NDS)

[15] Void

[16] RFC 3332, September 2002 "Signaling System 7 (SS7) Message Transfer Part 3 (MTP3) - User Adaptation Layer (M3UA)"

[17] RFC 4165, September 2005 "Signaling System 7 (SS7) Message Transfer Part 2 (MTP2) - User Peer-to-Peer Adaptation Layer (M2PA)"

[18] RFC 2474 Dec 1998 Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers

[19] Void

[20] ITU-T Q.705, 03/93 "Signaling System No.7 - Signaling Network Architecture"

[21] ITU-T Q.706, 03/93 "Signaling System No.7 - Message Transfer Part Signalling Performance"

2.2 Informative references

[i.1] SR 001 262 V2.0.0 2004-07 ETSI drafting rules Section 23:- Verbal Forms For The Expression Of Provisions

[i.2] ITU-T Q.703, 03/96 "Signalling Link"

[i.3] ITU-T Q.704, 07/96 "Signaling Network Functions and Messages"

[i.4] IEEE STD 802.1q "Virtual Bridged Local Area Networks"

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

VLAN: Where used in this document the term VLAN refers to an Ethernet Static VLAN

SEPF: Where used the term refers to the fS3 logical component described in this document. Its funcionalities are not necessarily the same as those decribed in ITU specificications by the name Signalling End Point (SEP).

STPF: Where used the term refers to the fS2 logical component described in this document. Its funcionalities are not necessarily the same as those decribed in ITU specificications by the name Signalling Transfer Point (STP).

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

BICC	Bearer Independent Control Protocol
CAP	CAMEL Application Part
CP	Communications Provider
DPC	Destination Point Code
DSCP	Differentiated Service Code Point
ETSI	European Telecommunication Standards Institute
GTT	Global Title Translation
IETF	Internet Engineering Task Force
IP	Internet Protocol
IPSP	IP Signalling Point
INAP	Intelligent Network Application Part
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
ITU-T	International Telecommunication Union – Telecoms
M2PA	MTP2 Peer-to-Peer Adaptation Layer
M3UA	MTP3 User Adaption Layer
MAP	Mobile Application Part
MSI	Multi-Service Interconnect
MTP	Message Transfer Part
NGN	Next Generation Network

PLMN	Public Land Mobile Network
SCTP	Stream Control Transmission Protocol
SS7	Signalling System 7

4 Introduction

This specification forms part of the Next Generation Network, Multi-Service Interconnect (MSI) Release Structure and ought to be read in conjunction with the associated releases of the standard ‘Multi-Service Interconnect of UK Next Generation Networks’

5 Service level functional architecture

The SS7 signalling transport service functional architecture defines the interconnect interfaces for carrying SS7 signalling over the MSIL between two PLMNs with relationship to the PLMNs' internal logical network functions..

5.1 Conventions used in the Architecture Figures

The convention used in labelling the functional architecture is as follows:-

- All logical functions and interfaces are labelled with an alpha/numeric identifier.
- All logical functions' identifiers begin with the letter 'f'.
- All interconnect interfaces' identifiers begin with the letter 'i'.
- The second letter of an identifier (function or interface) indicates if it is associated with the Signalling plane(S) or the Transport plane/Bearer plane (B). 'T' denotes functions or interfaces associated with the MSI Common Transport Specification [2]. E.g. iS2 is signalling plane interface number 2.
- All functions and interfaces that have their own separate technical definitionare labelled with a number unique to the identifier type. E.g. fS1 and iS1 are different defined entities as are iB1 and iB2.
- Multiple instances of separate functions or interfaces that have the same definitions have the same identifier root but are differentiated by appending an alpha letter to the root identifier. e.g. Interfaces with the same root identifier and number and a different suffix letter such as iB1a, iB1b, etc. indicate separate instances of the same interface type and definition.
- Green dash lines between functions indicate logical internal relationships within the PLMN which are not defined.
- Red lines indicate interconnect interfaces for the common transport capabilities in the bearer plane.
- Blue lines indicate service level interfaces that sit on top of the associated underlying common transport capabilities.

5.2 Interconnect Architecture Definition

The SS7 signalling transport service functional architecture defines logical network functions and interconnect interfaces between two mobile networks, PLMA A and PLMN B.It shows the static relationships between functions and the interconnect interfaces between PLMNs. The functional architecture is divided into signalling and transport/bearer planes and defines the properties of the functions and interfaces (see Figure 1 and 2). Note that the functional architecture is capable of being realised within a PLMN in a number of ways and that no physical implementation is implied.

5.2.1 Associated signalling architecture

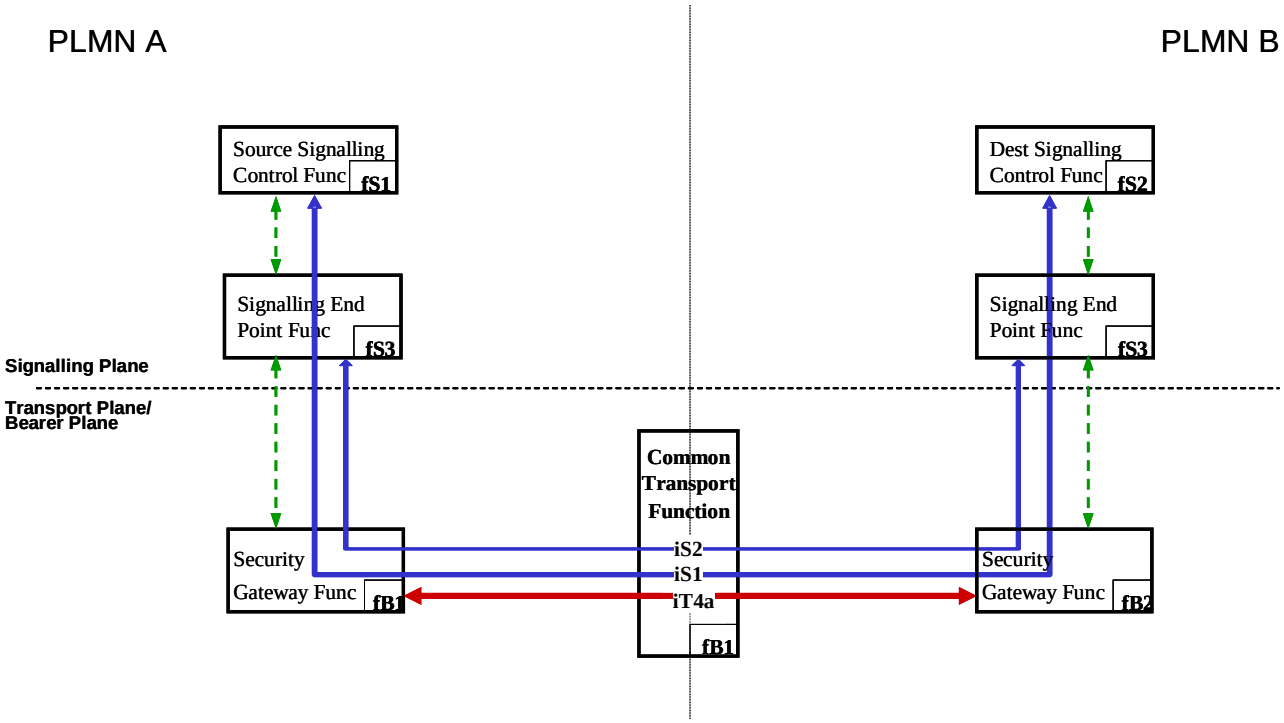

Figure 1: Associated signaling architecture

5.2.2 Quasi-associated signalling – STPF to STPF architecture

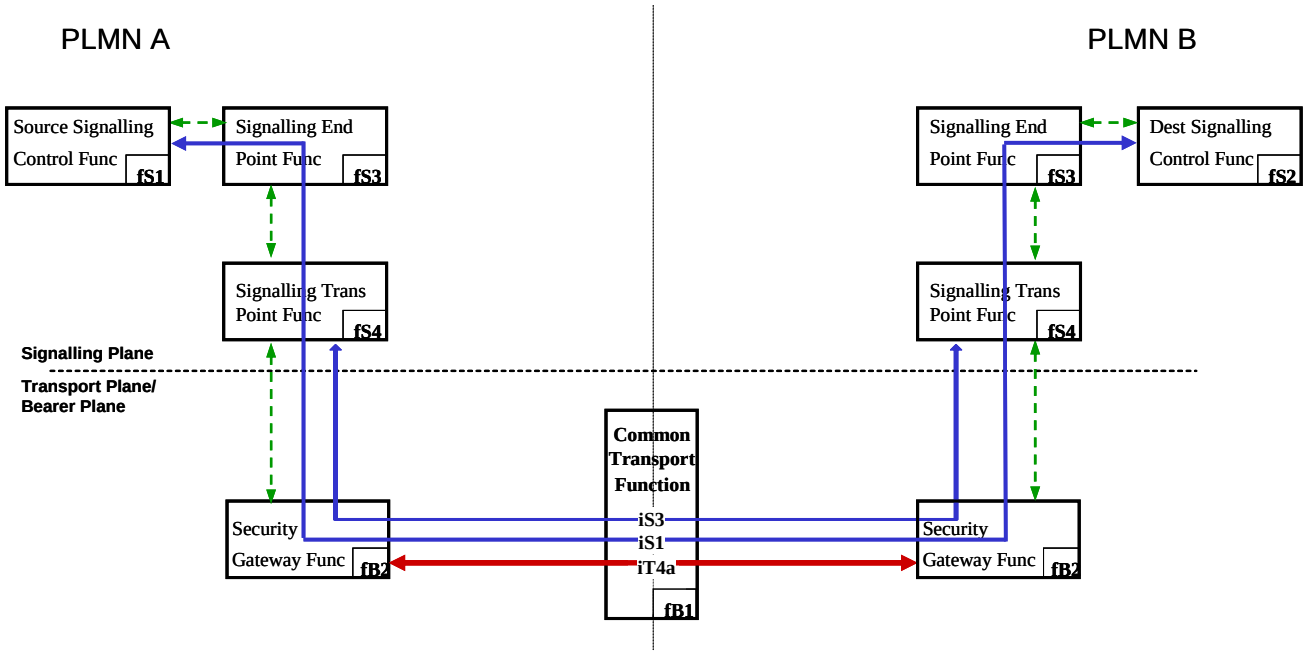

Figure 2: Quasi-associated signalling – STP to STP architecture

5.3 Functional Component Description

5.3.1 Signalling Plane Functions

5.3.1.1 Source Signalling Control Function (fS1)/Destination Signalling Control Function (fS2)

The Source and Destination Control Functions are the users of the signalling transport service specified in this document.

The Signalling Control Functions

a) generate and exchange application signalling protocol messages.

b) interface with SEPFs (fS3) for signalling message delivery.

Depending on the application signalling protocol, the behaviour of the fS1/fS2 varies and is specified in corresponding NDs. For example, in the case where BICC is the transported application signalling, fS1/fS2 are equivalent to fC1/fC2 functions specified in ND1639 [6].

5.3.1.2 Signalling End Point Function (fS3)

The Signalling End Point Function receives application signalling data (i.e. SS7 user part) generated by the Signalling Control Functions and sends signalling messages towards its peer node in the interconnected PLMN (i.e. either a SEPF or STPF) via the transport plane, and vice versa.

The Signalling End Point Function:

a) **Shall** determine the next hop to which a signalling message has to be sent and choose the appropriate underlying transport plane functions for delivery.

b) **Shall** determine whether a received signalling message is destined to itself

c) **Shall** distribute received application signalling data to the appropriate Signalling Control Function which handles that particular SS7 user part.

d) **Shall** provide M3UA IPSP functionalities [16] if it directly interconnects to a SEPF in a peer CP's network

5.3.1.3 Signalling Transfer Point Function (fS4)

The Signalling Transfer Point Function routes signalling messages received from associated SEPFs to its peer in another CP's network and vice versa.

The Signalling Transfer Point Function:

a) **Shall** provide M2PA IPSP functionalities [17] to its peer STPF

b) **Shall** support signalling messages routing based on their Destination Point Codes (DPC)

c) **Shall** support Global Title Translation (GTT)

d) **Shall** support load sharing if multiple SCTP associationsbetween peer STPFs are used.

e) **Shall** be able to identify unauthorised signalling messages as defined in clause 8.2 of ITU-T Q.705 and **may** notify the CP originating the unauthorized message using an interface outside the scope of this document.

f) **Shall** support generation of traffic and usage measurements

5.3.2 Transport Plane/Bearer Plane Functions

5.3.2.1 Common Transport Function (fB1)

This service uses the IP capabilities (iT4) of the common transport specification as defined in ND1611 [2] and in accordance with clause 6 of the present document.

5.3.2.2 Security Gateway Function (fB3)

a) **should** provide access control function between the PLMN and the interconnection space applying policies that only allow IP address and port numbers from agreed sources into the network operator's PLMN and to ensure that only legitimate signalling exchanges are permitted from the CP's PLMN onto the interconnect link.

b) **shall** perform the functions of a Security Gateway as defined in ETSI TS 133 210[14] in accordance with clause 9 of the present document.

5.4 Interface Definitions

5.4.1 Application Signalling Interface (iS1)

The iS1 is the logical interface between Source and Destination Signalling Control Functions which **shall** follow the requirements as defined in NDs for individual application signalling protocols, e.g. ND1639 [6]

5.4.2 Associated Signalling Transport Control Interface (iS2)

The iS2 is the logical interface between SEPFs which carries signalling protocol traffic as well as peer management messages.

5.4.2.1 Reliable signalling message delivery

Application signalling data **Shall** be carried in M3UA[16] data messages as endorsed by the appropriate UK standard, e.g. ND1012[10]. And point-to-point reliable, in-sequence signalling message delivery between peer SEPFs **shall** be provided by the SCTP protocol as specified in ND 1012[10].

5.4.2.2 Management information

Peer SEPFs **Shall** announce management information across the iS2 interface using the appropriate functionalities provided by the M3UA protocol [16] as endorsed by the appropriate UK standard, e.g. ND1012[10].

The management information **Shall** include at least the following information flows:

a) Whether a SEPF is ready to receive signalling or management messages

b) Whether a SEPF is ready to process signalling traffic

c) Unavailability of a SS7 user part

d) an error event associated with an incoming message and the reason

e) transport plane congestion status

5.4.3 Quasi-Associated Signalling Transport Control Interface (iS3)

The iS3 is the logical interface between STPFs which carries signalling protocol traffic as well signalling transport network management information.

5.4.3.1 Signalling link control

a) Signalling link control functionalities **shall** be provided by the M2PA and SCTP protocols.

5.4.3.2 Signalling message routing

The destination SEPF to which a signalling message should be delivered is identified by a unique Point Code allocated to that SEPF. Signalling message routing on the iS3 interface **shall** be provided by the MTP3 protocol as specified in ND1026[11]. Circular routing of messages on the iS3 interface **shall** be detected and stopped.

5.4.3.3 Signalling network management

Signalling network management functionalities, which include signalling traffic management, signalling route management and signalling management, provide the actions and procedures required to maintain signalling service, and to restore normal signalling conditions in the event of disruption in the signalling network, either in signalling links or at Signalling End Point Functions. The exchange of signalling network management information on the interconnect **shall** be provided by the MTP3 protocol as specified in the associated protocol specification.

5.4.4 Transport Interface

5.4.4.1 Use of the Common Transport Function (iT4a)

The iS2/iS3 interface **shall** be carried over the IP capability of the common transport function (iT4a) on one or more individual VLANs reserved for signalling only.

Traffic carried on one such VLAN **shall not** affect the capacity of other VLANs. Each VLAN **may** convey messages associated with one or more signalling associations. The dimensioning of each VLAN **shall** take account of the capacity required for peak load and loads encountered under fault conditions.

5.4.4.2 Signalling VLAN Bandwidth

The bandwidth required for each signalling VLAN **should** be determined by taking account of:

- the signalling application protocol
- the number of signalling paths carried on the signalling VLAN
- the peak signalling rate of each of the signalling paths carried on the VLAN
- the failure modes and required resilience of the signalling VLANs

6 Packet / Frame Marking

In order to introduce new and as yet undefined services to the MSI without changing this service, IP packet marking (DSCP) [18] or Ethernet frame marking are not used. Media and signalling rely on being carried in independent VLANs, each with its own shaped and policed bandwidth, as a service provided by the Common Transport Function [2]. Therefore, these packet marking fields **should** be ignored**.**

7 IP Addressing

7.1 Version of Internet Protocol

This is defined in ND 1636 [5]

7.2 IP Address Ranges

This is defined in ND 1636 [5]

7.3 Network Address Translation

This is defined in ND 1636 [5]

7.4 Signalling IP Address Allocation

An IP subnet **shall** be allocated for each signalling connection between the Security Gateway Functions in each CP's network. Each device, IP interface, or other network element on the connection shall be allocated an agreed IP address from within this subnet.

Each CP **shall** inform the other of the IP addresses to be used to communicate with each relevant security gateway function.

8 RESILIENCE

8.1 Definitions of Terms in this Section

A Signalling Route is a signalling connection between one SEPF in CP A's network and another in CP B's network. A Signalling link is a signalling connection between two interconnected STPFs.

8.2 Signalling Resilience

8.2.1 Associated signalling architecture

Loss of signalling linkconnectivity **shall** be detected by the in-built functionality in the SCTP transport layer which **shall** be configured as defined in ND 1012 [10].

8.2.2 Quasi-associated signalling architecture

A minimum of two physical STPFs **shall** be deployed in each CP's network for interconnect to other CPs. Each STPF **shall** be connected to at least two other STPFs in the other network to form a resilient signalling network. The simplest realisation of this is shown in Figure 2. The routing principles described in annex A.3 of ITU-T Q.705 [20] **shall** be followed..

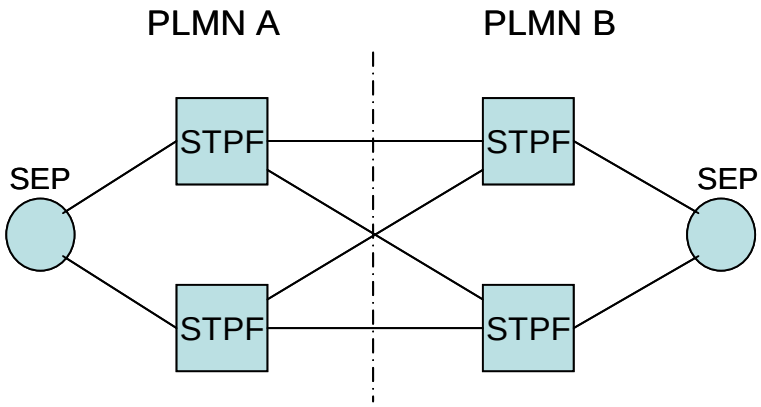

Figure 3: Minimum configuration for resilient quasi-associated signalling architecture

Peer STPFs **shall** be interconnected by a multi-homed SCTP association(s) and loss of signalling link connectivity **shall** be detected by the in-built functionality in the SCTP transport layer which **shall** be configured as defined in ND1026 [11] to meet the SS7 signalling performance requirements. Signalling route resilience **shall** be provided by the in-built functionality in the MTP3 layer.

A minimum of two physical NNIs **shall** exist between interconnected CPs. On configuration of each SCTP association, at least two paths **shall** be mapped into diversely configured service VLANs at each CP's end. CPs **shall** make sure a single node or link failure within its own transport network does not result in the failure of the entire SCTP association. The configuration **should** allow each IP address belonging to the association to communicate with other addresses to minimise the recovery time from a network failure .

9 Security

Signalling trails between PLMNs **shall** be protected from unauthorised access from inside or outside a communication provider’s network. The signalling transport between STPFs **shall** be secured by an IPSec tunnel as required for control plane traffic exchanged between different security domains as specified in ETSI TS 133 210[14]. References to the Security Gateway or SEG should be considered analogous to the Security Gateway Function (fB3) defined in this document. Reference to the 'Za' interface **shall** be considered equivalent to the CP signalling interconnect interface (iT4a) in this document, except that the authentication and encryption rules on iT4a **shall** be configured as defined in ND 1628 [4].

History

Document history

Version	Date	Comment
V1.1.1	January 2010	Final version for publication after CA