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Management of the General Connectivity of PSTN/ISDN Service Interconnect for UK NGNs

Issue:- *Issue 1*

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Normative Information

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1 INTRODUCTION

NGN interconnect management processes are those processes that are required to plan, establish and operate an NGN interconnect, and account for its usage. They are additional to the processes and procedures for actually using the interconnect.

This document identifies the processes, and associated data, needed to maintain operability of a generic connectivity for PSTN/ISDN service across a Next Generation Network, Multi-Service Interconnect.

2 DOCUMENT SCOPE

The scope of this specification is restricted to the management aspects of Purple Release PSTN/ISDN interconnect; the architecture and specification of generic connectivity for PSTN/ISDN service sessions are specified in [2], and the protocol and procedures for establishment of such sessions are defined in [3].

This document specifies management activities that require co-ordination between the two CPs operating the interconnect. Only processes that change significantly in the evolution from TDM interconnect to NGN interconnect are included. Only management activities relating to the operation of the PSTN/ISDN service are specified in this document; for management activities relating to the Transport Connectivity layer see [4].

3 DEFINITION OF TERMS USED IN THIS DOCUMENT

3.1 Key Words

The key words “shall”, “shall not”, “must”, “must not”, “should”, “should not”, “may”, “need not”, “can” and “cannot” in this document are to be interpreted as defined in the ETSI Drafting Rules [1].

3.2 Abbreviations

ACC	Automatic Congestion Control
ATM	Asynchronous Transfer Mode
CDR	Call Details Record
CP	Communications Provider
CPS	Carrier Pre-Selection
DTMF	Dual Tone Multi-Frequency
ETSI	European Telecommunication Standards Institute
GNP	Geographic Number Portability
IA	Indirect Access
IP	Internet Protocol
ISDN	Integrated Services Digital Network*
ISUP	ISDN User Part of C7 signalling
ND	NICC Documentation
NGN	Next Generation Network
NGNP	Non-Geographic Number Portability
NICC	Network Interoperability Consultative Committee
PSTN	Public Switched Telephone Network*
QoS	Quality of Service
RTP	Real-time Transport Protocol
SDH	Synchronous Digital Hierarchy
SIP	Session Initiation Protocol
SIP-I	SIP with encapsulated ISUP
TDM	Time Division Multiplex
TISPAN	Telecoms & Internet converged Services & Protocols for Advanced Networks
UK	United Kingdom
URI	Uniform Resource Identifier
VLAN	Virtual Local Area Network

* PSTN and ISDN when used with the term ‘service’ defines the replication of the service set applied to NGNs rather than the legacy networks themselves.

4 DOCUMENT STRUCTURE

The Purple Release NGN interconnect work [6] has only been scoped for the PSTN/ISDN emulation service, but the need to provide underlying transport functions that generically supported a range of services is recognised. This is represented in a number of functional layers as shown in figure 1. The transport layer provides physical connectivity based on various transmission technologies, e.g. SDH and Ethernet Physical. The transport capability layer offers a number of transport types with various characteristics, e.g. TDM, ATM, and IP to the services they support.

Although the scope of this Purple Release NICC work is confined to IP interconnect for the PSTN/ISDN emulation service, there is not one but many PSTN/ISDN interconnect products at the service level, e.g. Standard calls, CPS, Number Portability, Number Translation Services. To avoid redefining these products for the NGN environment, a PSTN Service Connectivity layer is defined that can serve these interconnect products and to connect them to the underlying transport capability. This layering is shown in Figure 1.

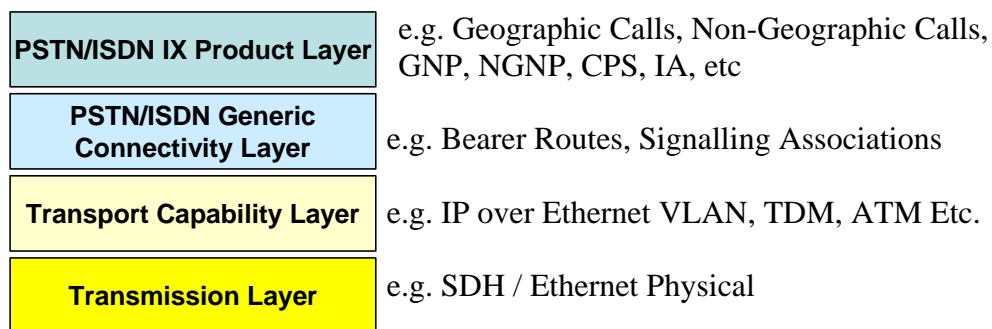


Figure 1:- Layering of functions for PSTN over a Multi-service Interconnect

Figure 2 shows interconnect functional layers overlaid with the broad areas of management activity. This document is concerned with the management activities at the PSTN/ISDN Connectivity Layer. For management areas related to the Transport Capability Layer see [4].

The section of this document where the management area is addressed is indicated in figure 2.

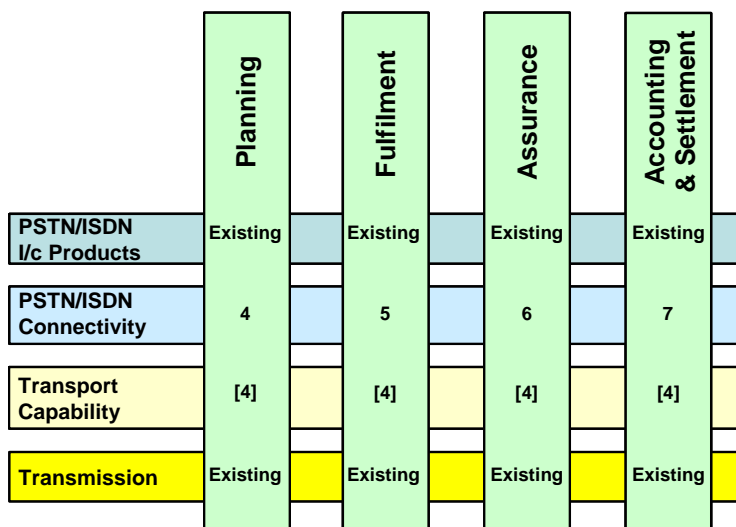


Figure 2:- Structure of NGN Interconnect Management areas

Note for clarity; [4] in figure 2 is a reference, not a section in this document. The numbers 4, 5, 6 and 7 refer to sections in this document.

5 PLANNING

5.1 Sizing of PSTN/ISDN VLANs

5.1.1 Signalling VLANs

5.1.1.1 A single Signalling VLAN to a single Session Control Function (via a single Signalling Border Function)

Where there is only one connection between CPs, it **shall** be dimensioned to carry all the signalling traffic flowing between the CPs. In this scenario, signalling resilience **shall** be given consideration.

5.1.1.2 Single Signalling VLANs to Different Session Control Functions (via Signalling Border Function)

Where there are two or more VLANs all terminating on different Session Control Functions, each VLAN **shall** be dimensioned to carry all the signalling traffic flowing between the two CPs.

5.1.1.3 Multiple Signalling VLANs to the Same Session Control Function (via Signalling Border Function)

Where the VLAN is one of two or many VLANs terminating on the same Session Control Function, each VLAN **shall** be dimensioned to carry all signalling traffic flowing between the CPs to the appropriate Session Control Function(s) within the terminating CPs network.

Some measure of co-operation between CPs will be required to achieve dimensioning of the VLANs.

5.1.2 Media VLANs

5.1.2.1 Single Media VLAN to Media Border Function

Where this is the only connection between CPs, this VLAN **shall** be dimensioned to carry all the traffic flowing between the CPs. In this scenario, media resilience **shall** be given consideration.

5.1.2.2 Single Media VLANs to Different Media Border Functions

Where this VLAN is one of two or many VLANs all terminating on different combinations of Border Functions, each VLAN **shall** be dimensioned according to planning rules to carry all traffic flowing between these Border Functions, including accounting for traffic redirection following planned outages. Dimensioning also needs to take account of resilience to unplanned failures according to agreements between CPs.

5.1.2.3 Multiple Media VLANs to the Media Border Function

Where the VLAN is one of two or many VLANs terminating on the same Media Border Function, each VLAN **shall** be dimensioned to carry all traffic flowing between the CPs to the appropriate destination within the terminating CPs network, accounting for traffic redirection following planned outages. Dimensioning also needs to take account of resilience to unplanned failures according to agreements between CPs.

Some measure of co-operation between CPs will be required to achieve dimensioning of the VLANs.

5.1.3 Detailed VLAN SIZING

5.1.3.1 Detailed Signalling VLAN Bandwidth Sizing

This aspect is subject to ongoing modelling and is still under consideration with Consult21.

See also section 7.7.

5.1.3.2 Detailed Media VLAN Bandwidth Sizing

This aspect is subject to ongoing modelling and is still under consideration with Consult21.

See also section 7.7.

6 FULFILMENT

6.1 Information exchanged prior to service establishment

This section identifies information which **may** be exchanged between CPs operating the NGN interconnect prior to service establishment. A subset of this information may also be exchanged prior to changing details of the interconnect (for example, bandwidth).

6.1.1 General Background

Item 6.1.1.1 Company name and address

Item 6.1.1.2 Contact (name, address, phone, mobile, email) details for:
Commercial,
Technical,
Operational,
Fraud & Security,
Order reference number,
Billing queries.

Item 6.1.1.3 Ready for service target date.

6.1.2 Transmission and Transport

These aspects are covered in ND1613 [4].

6.1.3 PSTN/ISDN Connectivity

Item 6.1.3.1 **Interconnect equipment configuration details**

Type, model, build and location of the point of handover for the Edge Session Controller

Type, model, build and location of the point of handover for the IP Media Border Function

Type, model, build and location of the point of handover for the Signalling Border Function - Note this information **may** be withheld for security reasons.

Item 6.1.3.2 **Interconnect configuration approval test**

Has configuration been type approved for interconnection?

Name of Approver

Date of approval
Constraints on approved use

Item 6.1.3.3 **Use of Transport layer**

Mapping of IP subnet/VLAN(s) to transmission infrastructure identifiers (e.g. fibre numbers) as listed in ND1613 [4].
Mapping of signalling to IP subnet / VLAN(s)
Mapping of media to IP subnet / VLAN(s)

Item 6.1.3.4 **Addressing Information**

Agreement on who is providing IP addresses (Section 7.2 ND1612 [2]).
IP subnet addresses and allocation
SIP and RTP port ranges
SIP URI to IP mapping
P-Charging-Vector (including Originating Inter-Operator Identifier and icid-gen-addr).

Note on the use of P-Charging Vector: P-Charging-Vector values received across this interconnect might not have been generated by the interconnecting node, or even the interconnecting network. However, on initial interconnect establishment between two CPs, it may be valuable to swap the network identifying component of the P-Charging-Vector, as this information may not otherwise be known to the other party. It is recommended that CPs additionally exchange the icid-gen-addr of the interconnected nodes. This could assist future fault resolution, and could potentially assist interconnect testing.

Item 6.1.3.5 **Media characteristics**

Voice codec and packet size (for supported values see [2])
DTMF digit transport mechanism (currently only in-band)
Support of T.38 or V.150 required (currently not supported)
Silence suppression used (currently not supported)

Item 6.1.3.6 **Protocol support**

SIP transport protocol and version
SIP profile supported.
IPsec profile supported

Item 6.1.3.7 **Other technical information**

Confirm support for ISUP ACC or Adaptive ACC congestion control.
Is Overlap signalling required? Note – *en-bloc* signalling is the default.
Call Identity information.

6.1.4 *PSTN/ISDN Product*

Please refer to the Interconnect Contract that exists between CPs for information on the following aspects –

- Product and Service types
- PSTN and ISDN routing level information
- Bearer services
- Capacity forecasts

7 ASSURANCE

7.1 IP Media Border Function isolation

ND1612 [2] contains a full detailed explanation of the management procedures in this section.

Where a failure affects an interconnect-controlling functional node on the sending side of a call, then the sending network **should** detect this failure and **should** avoid routing calls across the interconnect. If a failure affects signalling or media paths across the interconnect, the sending side **may** detect this situation (by the mechanisms defined in [2]) and the sending end will avoid the failed interconnect. Where a failure affects a functional node on the remote side of an interconnect, the sending side **may** detect this by the consequent failure of either the signalling or the media path, and will avoid routing calls across the interconnect.

Where communication has been lost between the receiving IP Media Border function and its Edge Session Control Function, the sending side may not be able to detect this before routing a call across an interconnect. The mechanism for rejecting such calls is defined in [2], and uses SIP 503 responses.

From an interconnect management perspective, the receipt of a 503 response **should** be reported via an alarm. If a subsequent SIP Invite, sent after the 'Retry-After' timer defined in [2] has expired, is successful, the alarm **should** be cleared. Persistence of 503 responses **should** raise the severity of the alarm, and operational intervention **may** be needed to correct the fault.

Once the fault has been rectified in the receiving network, operational staff should be aware that traffic **cannot** flow again until the current 'Retry-After' timer has expired.

7.2 Overload Protection Mechanism

ND1612 [2] contains a full detailed explanation of the management aspects in this section.

The Media Stream (iT4b) [2] is protected from overload by the Bandwidth Management Function, and hence the IP Media Border Function is also protected from overload (assuming correct dimensioning).

Although Bandwidth Managers **may** protect Edge Session Controllers from having to control too many simultaneous sessions, the limiting factor for an Edge Session Controller is not normally the number of simultaneous sessions, but rather the rate at

which sessions are set up, i.e. the rate at which Invites are received. The Signalling Border Function **may** provide some protection against such signalling overload, but this is not one of its intended functions, and most Signalling Border Elements will transport more traffic than the Edge Session Controller can handle; further a single Edge session Controller may receive traffic from several Signalling Border Functions.

In the absence of overload control mechanism native to SIP, the ISUP ACC or Adaptive ACC mechanism **should** be used to allow an Edge Session Control Function to request a reduction in the rate it receives traffic from across an interconnect. See reference [2] section 4.4.2.7; use of UK-ISUP ACC and reference [3].

In initial service establishment CPs **should** verify that the interconnecting network supports the reduction of traffic on receiving ACC. If the ACC procedure is not supported sufficiently to protect the receiving Edge Session Controller, it **may** be necessary to restrict the traffic across the interconnect by imposing a low bandwidth on the media across the interconnect.

7.3 Emergency Calls that Require Priority Treatment

The identification of these calls is covered in ND1612 [2].

7.3.1 Identification of Priority Calls

Examples of priority destination numbers are:

- 999
- 112
- 18000 (Text Phone)
- others agreed bilaterally by the CPs.

Calls to other numbers **may be** identified as priority calls by setting the priority indication in the signalling as defined in reference [3].

7.3.2 Treatment of Priority Calls

On detecting that a call is a priority call, the originating Session Control Function **shall** set the priority indication in the signalling as defined in reference [3].

A priority call **shall not** be discarded due to Call Gapping or other overload protection mechanisms, as specified in [2], unless the overload is caused by the volume of priority calls.

7.3.3 Reservation of Capacity for Priority Calls

This is detailed in ND1612 [2], however the following information **may** be used.

CPs **shall** agree a mechanism to avoid discarding priority calls across Next Generation Network interconnects due to congestion of media paths.

Such a mechanism **may** be:

- reserving bandwidth for priority calls, the specified default in reference [2];
- allocating separate routes for priority calls;
- some other bilaterally agreed means.

7.4 Graceful Removal of Traffic

7.4.1 Overview

For operational reasons it may be necessary to remove traffic from a media path, e.g. before deactivating an IP Media Function. To achieve this, traffic **shall** be allowed to decay over the connection for a time T_{decay} , after which traffic still using the connection **may** be cleared. Following expiry of timer T_{decay} remaining calls **should** be examined to check they are not life-line calls. This **may** be done manually. The remaining calls **may** be cleared by using the procedures for call release defined in [2] and [3].

During the traffic decay period the Edge Session Control Function **shall** avoid originating new sessions using the specified media path, and **shall** reject received session invites using the procedure defined in [2]. Existing PSTN/ISDN connections using the media path **shall not** be affected before expiry of timer T_{decay} , and may complete normally before that time.

7.5 Information passed for fault reporting

Management processes between CPs need to exist to allow the CPs to inform one another about faults impacting the interconnect, to react to the faults, minimise the fault impact and correct the underlying problem.

7.5.1 Fault Categorisation

Faults at the PSTN/ISDN Service Connectivity layer can be categorised as being related to the:

- Signalling interface (iT4a) [2];
- Media transport (iT4b) [2];
- Signalling Control (iC1) [2]; or
- Media stream (iB1) [2].

7.5.2 Examples of Faults

Examples of faults in each category are given below:

Signalling interface (iT4a):

- Failure of signalling transport.

Media stream transport (iT4b):

- Failure of media transport.
- Congestion of media transport.
- Isolation of IP media border function.

Signalling Control (iC1):

- Circular routing.
- Unsupported media type requested.
- Invalid traffic/product type received (e.g. emergency call received when not supported across the interconnect).
- Routing errors.

Media stream (iB1):

- Deterioration of call quality.
- One-way speech path.

7.5.3 Information to report per fault category

Table 1 shows a typical information report. Further details and information can be found in the relevant O&M manual.

Item	iT4a	iT4b	iC1	iB1
Item 6.1.1.1 Company name and address	Y	Y	Y	Y
Item 6.1.1.2 Contact (name, address, phone, mobile, email) details	Y	Y	Y	Y
Item 6.1.1.3 Ready for service target date.				
Item 6.1.3.1 Interconnect equipment configuration details				
Item 6.1.3.2 Interconnect configuration approval test				
Item 6.1.3.3 Use of Transport layer	Y	Y	Y	Y
Item 6.1.3.4 Addressing Information	Y	Y	Y	Y
Item 6.1.3.5 Media characteristics			Y	Y
Item 6.1.3.6 Protocol support			Y	
Item 6.1.3.7 Other technical information			Y	
Item 6.1.4.1 Product and Service types			Y	
Item 6.1.4.2 PSTN and ISDN routing level information			Y	
Item 6.1.4.3 Bearer services			Y	
Item 6.1.4.4 Capacity forecasts		Y	Y	Y
Item 7.5.3.1 Details of the actual problem, including which service(s) are affected.				
Item 7.5.3.2 When did the problem start?				
Item 7.5.3.3 Is it intermittent or affecting every call, time of day, high or Item 6.5 low traffic volumes?				
Item 7.5.3.4 If a routing problem, are the calls failing or being routed incorrectly?				
Item 7.5.3.5 Exchange of fault references.				
Item 7.5.3.6 Where appropriate, calling and called number details.				

Table 1. This table contains examples of fields that may be completed. Some fields are left blank for this example only.

7.6 Monitoring and reporting of Call Quality

CPs **should** track call quality within their networks, and (as far as possible) on calls to and from interconnected networks. End-to-end call quality **may** also be measured. Activities which CPs could undertake to track QoS levels could be: automatic periodic QoS test calls across various portions of the network and across NGN interconnects; RTP signalling monitoring; QoS level recording in CDRs, maintaining a method for customers to report call quality problems.

Where call quality falls below the expected quality, and particularly where National Transmission Plan [5] criteria are not met, the condition **shall** be treated as a fault and investigated, including reporting the fault to interconnect partners.

7.7 Monitoring of VLAN Capacity Usage

This aspect is subject to ongoing modelling and is still under consideration with Consult21.

See also section 5.1.3.

8 ACCOUNTING AND SETTLEMENT

8.1 Start of Charging

No change is proposed to the current arrangements for the start of charging.

However it should be noted that SIP provides two signals which could be used in conjunction with the call charging function:

- i) the 200 OK message to the INVITE, which is analogous to the ISUP Answer message and in SIP-I carries the encapsulated ISUP Answer message, and
- ii) the Acknowledgement message to the 200 OK message, which has no equivalent in ISUP.

CPs **should** note the presence or absence of a 200 OK Ack on answered calls. While the absence of a 200 OK Ack is a condition which can occur, for example if the calling party clears down before the answer signal reaches the originating Call Server, persistent or high volumes of answered calls missing 200 OK Acks could indicate misuse, and CPs **should** treat such conditions appropriately, and inform affected interconnect partners.

9 REFERENCES

Ref no.	Document Reference	Title	Version	Publisher
[1]	SR 001 262	ETSI Drafting Rules Section 23:- Verbal Forms for The Expression Of Provisions	2.0.0 2004-07	ETSI
[2]	ND1612:2006/06	Generic IP Connectivity for PSTN/ISDN Service between UK Next Generation Networks	1	NICC
[3]	ND1017:2006/07	Interworking between Session Initiation Protocol (SIP) and UK	1	NICC

[4]	ND1613:2006/12	ISDN User Part (UK-ISUP) Management of NGN Interconnect: Transport Connectivity Layer	1	NICC
[5]	ND1701:2006/03	Recommended Standard for the UK National Transmission Plan, NICC.	5	NICC
[6]	ND1610:2006/06	Multi-Service Interconnect of UK Next Generation Networks	1	NICC

10 DOCUMENT HISTORY

Issue Number	Date	Reason for update
Issue 1	1/12/2006	Initial issue for publication on the Ofcom NICC web site.

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