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Multi-Service NGN Interconnect Common Transport

Version 1.2.1

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Normative Information

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CONTENTS

1 INTRODUCTION

This specification forms part of the Next Generation Network, Multi-Service Interconnect Release Structure and should be read in conjunction with the associated releases of the standard 'Multi-Service Interconnect of UK Next Generation Networks' [2].

2 DOCUMENT SCOPE

This document defines the common transport function for supporting multi-service interconnects between Next Generation Networks within the UK. This document defines the functional architecture for the common transport and specifies the protocols and interfaces that support TDM, ATM and managed IP type services on the same transmission.

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

ATM.....Asynchronous Transfer Mode
CBR.....Constant Bit Rate
CP.....Communications Provider
CSFF .....Client Signal Fail Frame
CTF .....Common Transport Function
CTFI.....Common Transport Function Interface
ETSI .....European Telecommunication Standards Institute
IEEE.....Institute of Electrical & Electronic Engineers
IP .....Internet Protocol
ITU-T .....International Telecommunication Union - Telecoms
GFP .....Generic Framing Procedure – ITU-T G.7041[15]
MAC .....Medium Access Control
NGN.....Next Generation Network
OAM .....Operations Administration and Maintenance
PSTN.....Public Switched Telephone Network
QoS .....Quality of Service
SDH.....Synchronous Digital Hierarchy
TDM.....Time Division Multiplex
VC .....Virtual Circuit
VLAN .....Virtual Local Area Network

4 COMMON TRANSPORT FUNCTION (CTF)

The NGN interconnect that supports multiple services is built around a common, multi-purpose transport function that provides a number of transport capabilities via two transmission technologies. This common NGN Interconnect transport function is represented in Figure 1 which shows the transport function (fB1) offering the following transport capabilities:

a) Internet Protocol transport
b) Ethernet transport
c) ATM transport
d) TDM transport

The transport function offers some or all of the above capabilities via the following transmission technologies:-

i) SDH (Figure 2)
ii) Ethernet Physical (Figure 3)

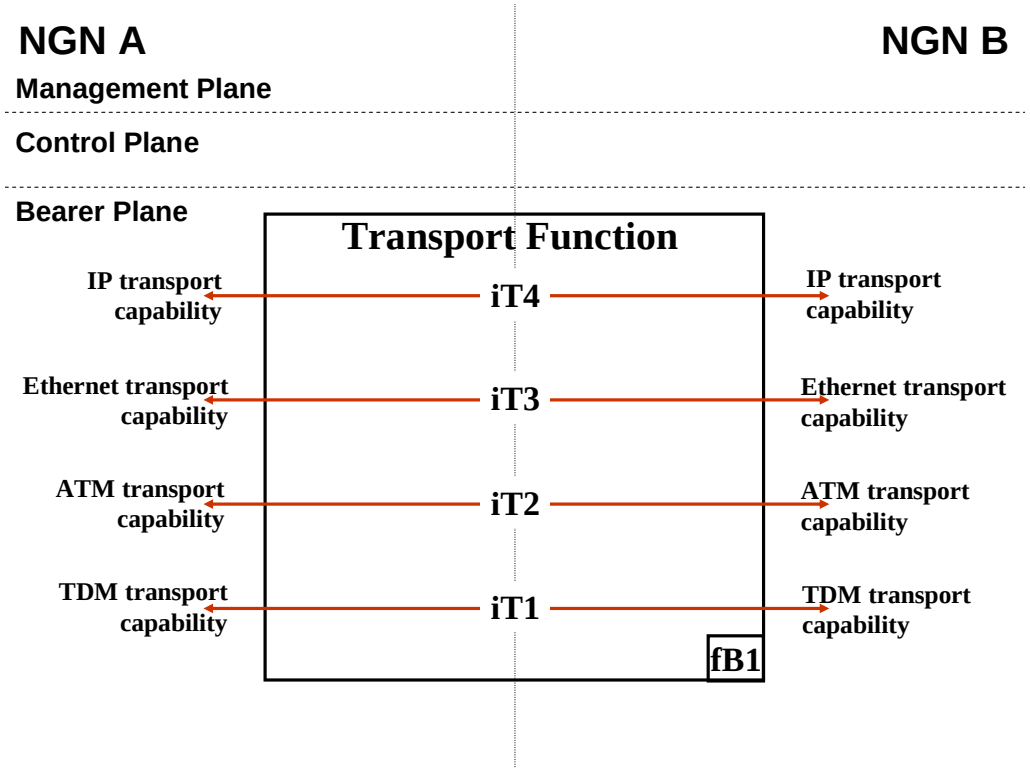

FIGURE 1: COMMON TRANSPORT FUNCTION

Table 1 gives the transport capability / transmission technology compatibility matrix and the associated attributes.

Transport Capability	Transmission Technology	Capability Attributes
TDM	SDH only	Bandwidth partitioned by SDH virtual container
ATM	SDH only	Bandwidth partitioned by SDH virtual container
Ethernet	SDH	Bandwidth partitioned by SDH 'n x virtual containers'. Ethernet encapsulated by GFP Ethernet VLANs each configured with fixed bandwidth, the total fitting within the underlying 'n x virtual containers' bandwidth.
Ethernet	Ethernet Physical	Ethernet VLANs each configured with fixed bandwidth, the total fitting within the underlying Ethernet physical bandwidth.
Internet Protocol	SDH or Ethernet Physical	IP service partitioned by underlying Ethernet VLAN and associated fixed bandwidth allowing IP services with overlapping IP addresses on separate VLANs.

TABLE 1: TRANSPORT CAPABILITY / TRANSMISSION TECHNOLOGY COMPATIBILITY AND ATTRIBUTES

The transport function provides the physical termination of one or more of the transmission systems, to one or more NGNs. It also provides the framing of the transmission bit streams to provide separate virtual pipes called ‘trails’.

A trail is a topological construct, which can be monitored, that exists between a single (trail termination) source point and a single (trail termination) sink point, and follows a fixed network routing between these points over the lifetime of the trail (under failure-free conditions). Trails can only exist in either connection oriented – connection switch or connection oriented –packet switch mode networks. Trails do not exist in connectionless-packet switch mode networks. Note that there is a 1:1 relationship between a connection and a trail in the point to point case.

From the service perspective the transport layer provides trails which have the following characteristics:-

a) Separacy at the IP protocol level, i.e. overlapping IP address spaces and packet marking schemes **may** be used on separate trails.

b) Separacy at the framing level, i.e. support of non-IP services e.g. ATM.
c) Static and policed bandwidth allocation to transport trails.

4.1 CTF Characteristics

The following are characteristics of the Common Transport Function (CTF) and its interfaces, as shown in Figure 1:-

a) The CTF supports multiple services. The services are clients of the CTF. The CTF **should** support multiple trails per Common Transport Function Interface (CTFI) physical port.
b) The CTF **need not** offer resilient transport.
    i. The physical transmission used by the CTF **may** offer protection.
    ii. The service interconnect **may** offer a resilience mechanism e.g. the Service interconnect **may** use multiple CTFIs.
c) This Common Transport Function only provides point-to-point connectivity between communications providers.
d) The CTF **should** use one of two transport types:
    - Ethernet with associated bandwidth policy enforcement, where a VLAN tag can be used as a form of 'connection identifier'. (Note - in its normal sense a VLAN is a restricted broadcast domain and is not a trail under the strictest definition of the term, but is functionally equivalent for the purposes of this interconnect. A VLAN can serve as an instance of a trail in the context of this interconnect specification.)
    - SDH Virtual Containers
e) The CTFI encapsulation and its labelling scheme **shall** transparently transport the services.
f) It **shall not** be possible for a communications provider to impersonate another communications provider by using labels belonging to that other communications provider.

g) Trails & labels (including VLAN tags) **must** be statically provisioned (i.e. not dynamically signalled).

4.2 Prohibited Connectivity

The following connectivity is specifically prohibited:-

a) Trails from the same physical port of the border function that go via different physical instances of the CTF **shall** be prohibited.
b) Border Functions **shall not** behave as intermediate CTF switches. That is trails **shall** start and terminate on a border function and **shall not** transit an intermediate border function.

4.3 Guaranteed Bandwidth and QoS for the services.

Each trail **shall** have its bandwidth policed to prevent contention for bandwidth (also known as bit rate) between trails. The CTF **shall** police the trails so that services **can not** impact upon the performance of other services. Bandwidth sharing between trails **shall** not be permitted.

This policing (and associated queuing systems for packet based CTFIs) are complex (i.e. QoS is complex). Therefore each trail **shall** only use CBR/hard/peak dimensioned bandwidth partitioning across the CTFI and **shall not** over-subscribe the CTFI. This greatly simplifies the QoS implementation, reduces the risk of error and eases fault detection.
Future development of the CTF may support more sophisticated QoS models if there are clear requirements for this.

4.4 Transport Services Protocol Stacks

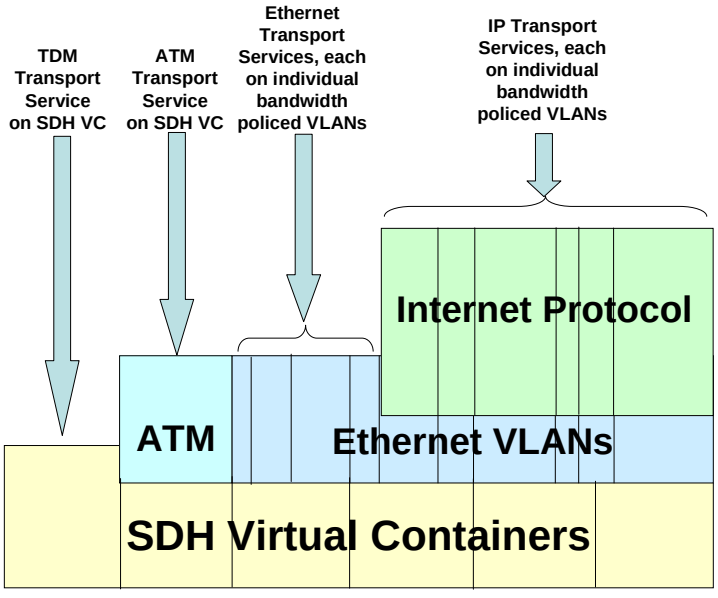

FIGURE 2: TRANSPORT SERVICES SUPPORTED BY SDH TRANSMISSION TECHNOLOGY

The dotted vertical lines in figures 2 & 3 represent the partitioning of the protocols into separate trails (including the use of VLANs in Ethernet in the context of this interconnect specification) by use of labels of different values.

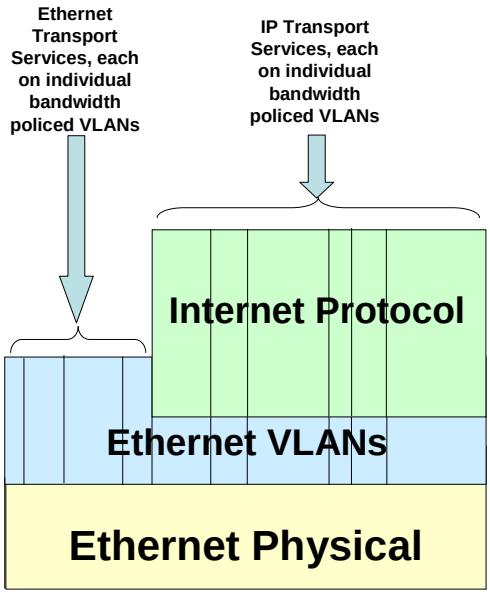

FIGURE 3: TRANSPORT SERVICES SUPPORTED BY ETHERNET TRANSMISSION TECHNOLOGY

4.5 Network Synchronisation

SDH transmission between networks **should not** provide network synchronisation**.** This is in line with the current SDH interconnect on legacy PSTNs in the UK.

For interconnects using Ethernet over fibre, there is currently no standard for conveying network synchronisation.

Unless deriving synchronisation via some other interconnect interface type, networks **should** synchronise against their own network clock that is compliant to ITU-T G.811 [11].

5 IP TRANSPORT CAPABILITY SPECIFICATION – IT4 –

5.1 iT4 - Layer 1 for IP Transport Capability

5.1.1 Physical Interface Options

The layer 1 options for the IP transport capability are:

1. Ethernet mapped into SDH interconnect as per SDH INTERCONNECT BETWEEN UK LICENSED OPERATORS, TECHNICAL RECOMMENDATION [3] using ITU-T G.7041 [15] framed GFP.

2. 10 Gigabit Ethernet IEEE802.3ae [12] options (not mandatory):

Transceiver Type	**Wavelength**	**IEEE Standard**	**Maximum Distance/Cable Type**
10GBASE-SR	850 nm	802.3ae	300 m over 50-micron 2000 MHz*km multimode fibre
10GBASE-LR	1310 nm	802.3ae	10 km over single-mode fibre
10GBASE-ER	1550 nm	802.3ae	40 km over single-mode fibre
10GBASE-LW	1310 nm	802.3ae	(STM-64 variant WAN Phy) Single-mode fibre
10GBASE-EW	1550 nm	802.3ae	(STM-64 variant WAN Phy) Single-mode fibre

3. IEEE Gigabit Ethernet Options IEEE802.3 [6] (not mandatory):
    a. 1000BASE-SX: 62.5 um multimode fibre: up to 275 m
    b. 1000BASE-LX: 9/10 um single-mode fibre: up to 10 km
    c. 1000BASE-T: Category 5 cable: up to 100 m

5.1.2 Protection Mechanisms

SDH Multiplex Section Protection (MSP) **may** be used to provide "across the floor" protection for the SDH layer 1 interconnect option. Native Ethernet layer 1 options do not have equivalent protection mechanisms so IEEE 802.3ad [8] Link aggregation **may** be used.

5.1.3 GFP Client Signal Fail Frame (CSFF)

Where GFP is used CSFF **should** be used to indicate failure of the far-end Ethernet connectivity where:
Upon receiving a CSFF signal the SDH/GFP function **shall** "take down" (remove carrier or light) for the Ethernet connection only if all VLANs connectivity on that Ethernet has failed.

5.2 iT4 - Layer 2 for IP Transport Capability

"Ethernet" **shall** be the layer 2 used for IP services and the following Ethernet standards **shall** be followed:

1. IEEE 802.1q [7] VLAN tagging. Different IP services will be placed in different VLANs. The VLAN ids **shall** be agreed on a bi-lateral basis between CPs.

2. IEEE 802.3ad [8] Link aggregation **may** be used to provide load sharing and protection (which usually takes seconds to detect failure) (Note using 802.3ad to provide protection is not a standardised Ethernet feature.)
3. Rapid Spanning Tree Protocol (IEEE 802.1w) [13] **shall not** be used to provide protection as this is not a secure protocol to operate inter-CP.
4. IEEE 802.1p priority marking [10] **should not** be used. The CTF will be dimensioned to not drop or contend traffic at the point of interconnection. Individual operators **shall** be responsible for policing traffic onto the point to point interconnect to ensure it is not overloaded. Traffic **must** be policed per VLAN (i.e. per service) to ensure congestion/overload of a single service does not impact the performance of other services. Per VLAN queuing **may** give the best performance isolation between services but is not a requirement.
5. IEEE 802.1ag "Connectivity Fault Management" [14] **may** be used when available to provide per-VLAN Ethernet OAM. This **may** be used by Border Functions to indicate failure of Ethernet connectivity on a per-VLAN basis.

5.3 iT4 – Connectivity Check Protocol

IP Border Functions, using the IP CTF **may** use IP ping to check IP connectivity across iT4.

5.4 iT4 - SDH Transport Option Protocol Stack

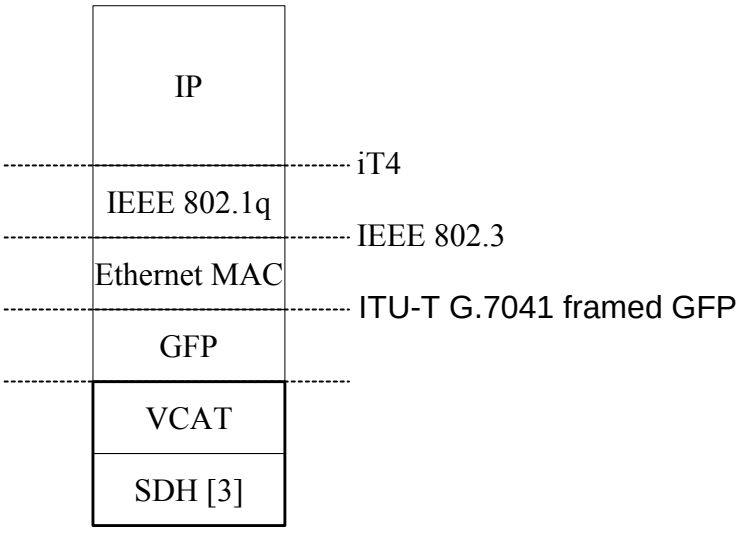

FIGURE 4: IT4 SDH TRANSPORT OPTION PROTOCOL STACK

5.5 iT4 - Ethernet Transport Option Protocol Stack

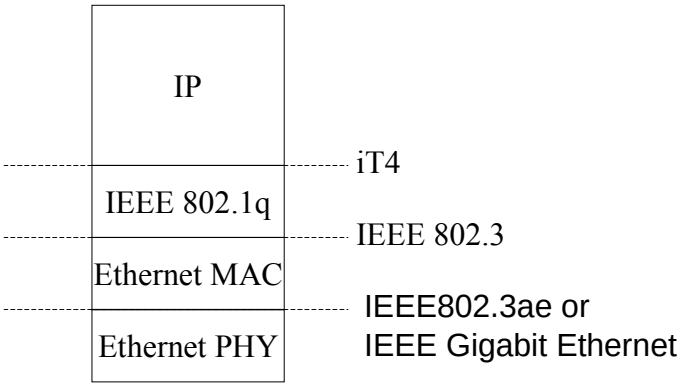

FIGURE 5: IT4 ETHERNET TRANSPORT OPTION PROTOCOL STACK

6 TDM TRANSPORT CAPABILITY– IT1

The mapping of TDM clients **shall** be as defined in SDH INTERCONNECT BETWEEN UK LICENSED OPERATORS, TECHNICAL RECOMMENDATION [3].

7 ATM TRANSPORT CAPABILITY – IT2

ATM **shall** be mapped as per INTERCONNECT BETWEEN UK LICENSED OPERATORS, BASED UPON PERMANENT ATM CONNECTIONS, TECHNICAL RECOMMENDATION [4].

8 MULTI-SERVICE PROTOCOL STACKS

8.1 Multi-Service (iT1,2,4) over SDH Protocol Stack

Figure 6 shows the protocol stack for IP, ATM and SDH services over an SDH based transport function.

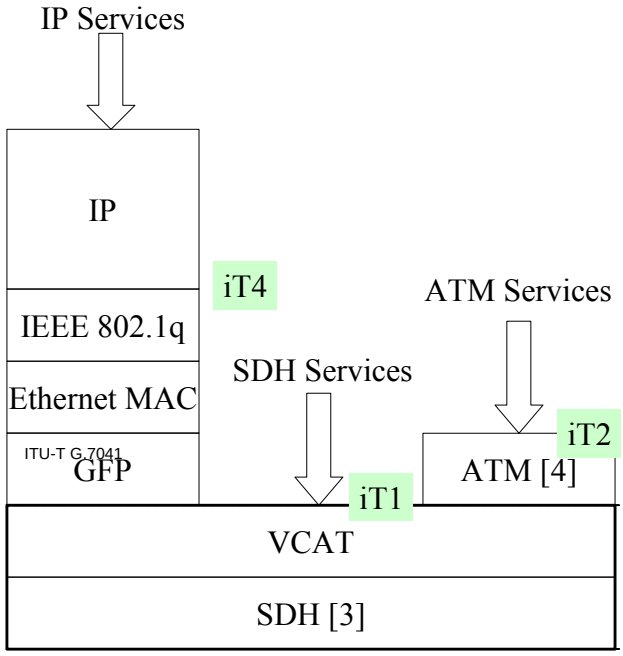

FIGURE 6: MULTI-SERVICE PROTOCOL STACK

8.2 Multi-Service (iT1,2,3,4) over Ethernet Protocol Stack

Since Ethernet standards do not yet support SDH and ATM there is no option to implement SDH or ATM over Ethernet. Only IP services **shall** be supported over the Ethernet transport function.

9 ETHERNET TRANSPORT CAPABILITY – IT3

This release of the NGN Interconnect common transport **shall not** support an Ethernet transport capability for Ethernet services. Later releases of this specification **may** support Ethernet services using IEEE 802.1ah [5] (also known as "Provider Backbone Bridging" and "MAC-in-MAC").
Note that due to GFP's limitation of an 8 bit multiplexer field it **may not** be a suitable mechanism to support future Ethernet services interconnection where each SDH VC **may** be supporting thousands of customers.

10 SECURITY

The CTF **cannot** provide authentication or privacy for its clients (services). It is recommended that clients (services) using the CTF **should** provide their own authentication and privacy functions.

MAC filtering **shall** be implemented to prevent infinitely circulating Ethernet packets, e.g. CP A **cannot** receive CP's B Ethernet packets from CP C and CP B **cannot** route Ethernet packets to CP C via CP A.

The Ethernet Spanning Tree Protocols **shall not** be used between CPs.

11 NAMING, NUMBERING & ADDRESSING

11.1 IP Transport Capability

11.1.1 IP Addressing

The IP addresses used by the IP client of the IP transport capability is a service specific issue which will be described in the service specific documents.

11.1.2 Ethernet VLANs used to provide IP transport capability

VLAN Tag addressing
The VLAN tag **shall** be identified by the VLAN ID (VID). Per IEEE 802.1Q, this has 12 bits, allowing the identification of 4096 VLANs within a given Ethernet. VID of 0 **shall** be used to identify priority frames and value 4095 (FFF) **shall** be reserved. The maximum possible VLAN configurations **shall** be 4,094.

There **shall** be no centrally-administered VLAN-tag space for the UK, and the addressing of VLANs **shall** be done through bilateral agreement. Each interconnect point **shall** represent a separate VLAN-space, although network operators **should** give due consideration to how the VLAN separation will be maintained within their network, particularly between the Border Functions and Common Transport Function. This **may** be achieved via tag switching or physical separation.

The assignment of VLANs to interconnect relationships **shall** be service specific, with a given service requiring one or more VLANs. For example, a voice interconnection **shall** require two VLANs, one for control and one for media; if the commercial arrangements were such that each network operator owned their own capacity, this would imply that up to four VLANs could be required for the interconnect as a whole.

12 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]	ND1610	Multi-Service Interconnect of UK Next Generation Networks	All Active Releases	NICC
[3]	ND1125	SDH INTERCONNECT BETWEEN UK LICENSED OPERATORS, TECHNICAL RECOMMENDATION	Issue 6 2000-9	NICC
[4]	ND1122	INTERCONNECT BETWEEN UK LICENSED OPERATORS, BASED UPON PERMANENT ATM CONNECTIONS, TECHNICAL RECOMMENDATION		NICC
[5]	802.1ah	Provider Backbone Bridges	Draft	IEEE
[6]	802.3	Local and metropolitan area networks--Specific requirements--Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications	2002	IEEE
[7]	802.1q	Virtual Bridged Local Area Networks	2003	IEEE
[8]	802.3ad	Aggregation of Multiple Link Segments (Now part of 802.3)	2002	IEEE
[9]	802.1ad	Draft Standard for Local and Metropolitan Area Networks-- Virtual Bridged Local Area Networks--Amendment 4: Provider Bridges	2005	IEEE
[10]	802.1p	Virtual Bridged Local Area Networks	2003	IEEE
[11]	G.811	Timing characteristics of primary reference clocks	1997-09	ITU-T
[12]	802.3ae	Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications	2005	IEEE
[13]	802.1w	Part 3: Media Access Control (MAC) Bridges: Rapid Configuration (Now part of 802.1d - Media Access Control (MAC) Bridges 2004)	2001	IEEE
[14]	802.1ag	Draft Standard “Connectivity Fault Management”	2005	IEEE
[15]	G.7041	Generic Framing Procedure	2005-8	ITU-T

13 12 DOCUMENT HISTORY

Issue Number	Date	Reason for update
Issue 1	02/05/2006	Authorised for publication on the Ofcom web site at TSG07 and NICC55.
Issue 2	11/10/2007	On TSG 28-day approval completing 9th November 2007, when the correct version numbering will be inserted.
V1.2.1	06/12/207	Converted unedited from Issue 2 to V1.2.1 to comply with the new ND numbering rules, for publication on the NICC web site.

14 ANNEX A: CONNECTIVITY EXAMPLES

Figure 7 shows examples of permitted connectivity where the square boxes represent IP border functions that combine the adaptation and trail termination functions. The small circles on the square boxes represent physical ports.

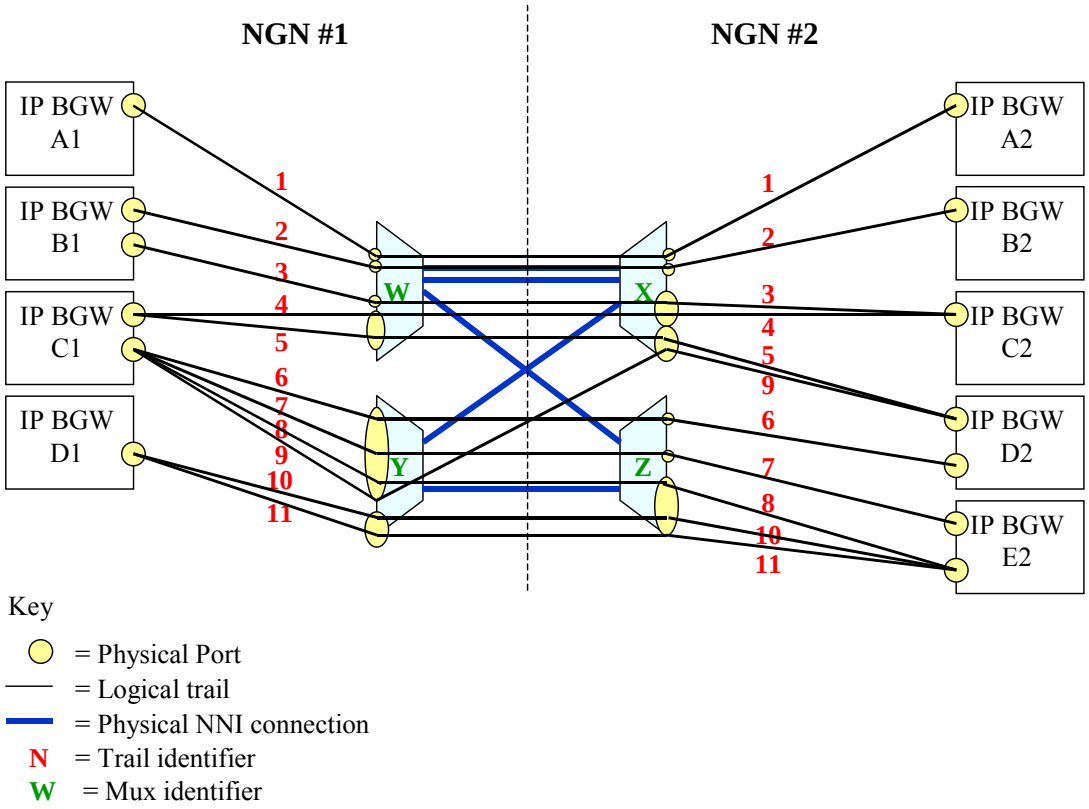

FIGURE 7: TRANSPORT FUNCTION CONNECTIVITY EXAMPLES

15 ANNEX B: IT4 - SDH TRANSPORT OPTION MULTIPLEXING HIERARCHY

Figure 8 shows the multiplexing hierarchy for the iB1 SDH transport Option. This shows there **may** be many IP services supported by many VLANs supported by many GFP flows etc.

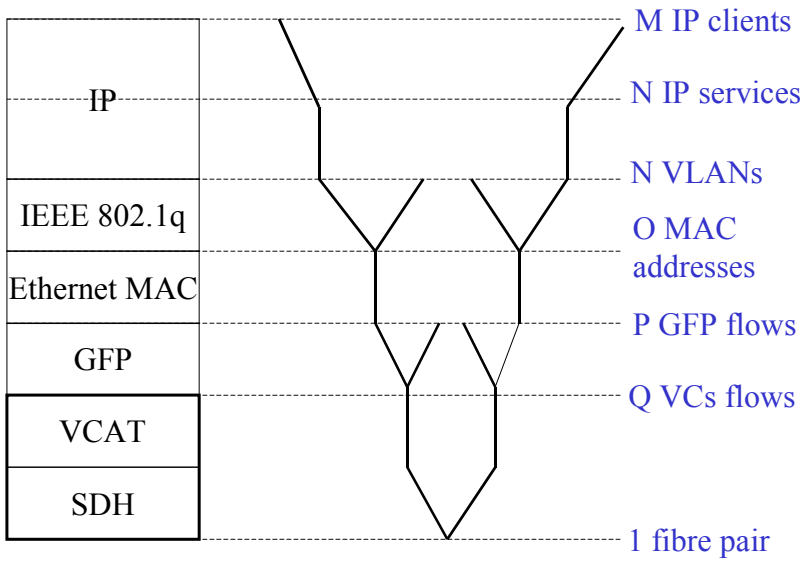

FIGURE 8: IT4 SDH TRANSPORT OPTION MULTIPLEXING HIERARCHY

16 ANNEX C: IT4 - ETHERNET TRANSPORT OPTION MULTIPLEXING HIERARCHY

Figure 9 shows the multiplexing hierarchy for the iB1 Ethernet transport Option.

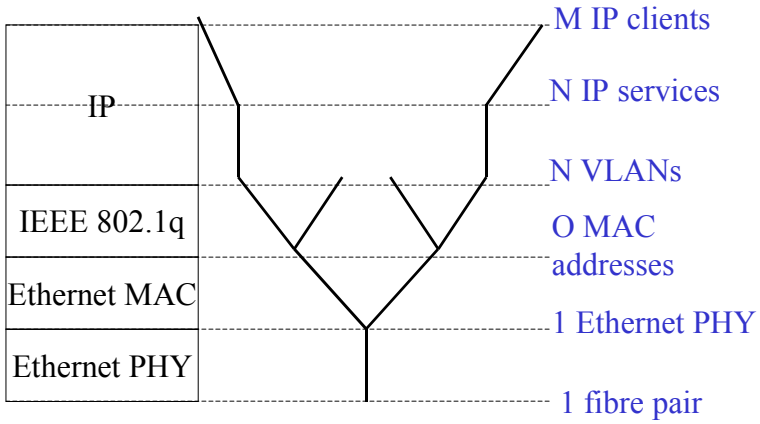

FIGURE 9: IT4 ETHERNET TRANSPORT OPTION MULTIPLEXING HIERARCHY

17 ANNEX D: MULTIPLEXING HIERARCHY FOR THE MULTI-SERVICE PROTOCOL STACK.

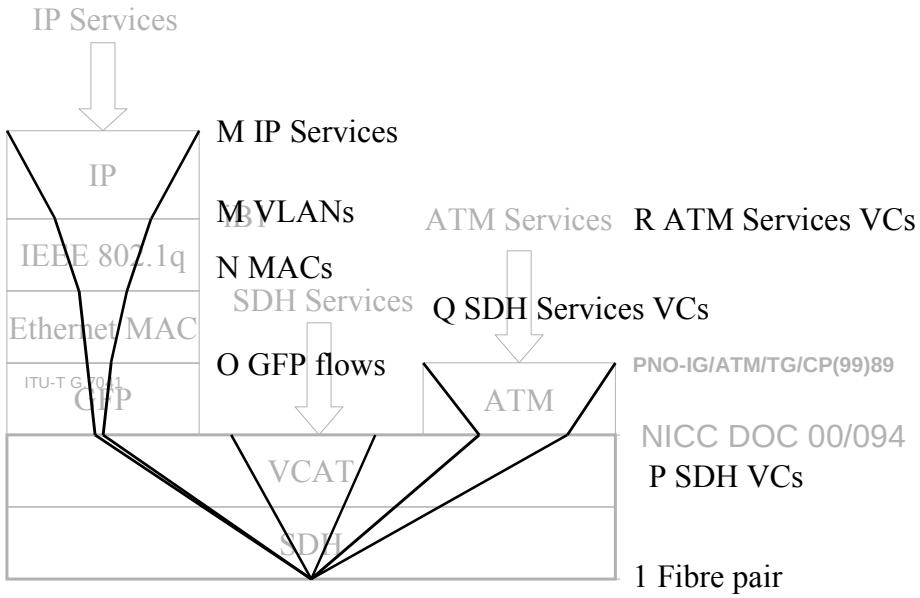

FIGURE 10: MULTIPLEXING HIERARCHY FOR THE MULTI-SERVICE SDH PROTOCOL STACK.

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