



SIN 385

Issue 2.7

July 2009

Suppliers' Information Note

For The BT Network

IP Clear Service Description

Each SIN is the copyright of British Telecommunications plc. Reproduction of the SIN is permitted only in its entirety, to disseminate information on the BT Network within your organisation. You must not edit or amend any SIN or reproduce extracts. You must not remove BT trademarks, notices, headings or copyright markings.

This document does not form a part of any contract with BT customers or suppliers.

Users of this document should not rely solely on the information in this document, but should carry out their own tests to satisfy themselves that terminal equipment will work with the BT network.

BT reserves the right to amend or replace any or all of the information in this document.

BT shall have no liability in contract, tort or otherwise for any loss or damage, howsoever arising from use of, or reliance upon, the information in this document by any person.

Due to technological limitations a very small percentage of customer interfaces may not comply with some of the individual characteristics which may be defined in this document.

Publication of this Suppliers' Information Note does not give or imply any licence to any intellectual property rights belonging to British Telecommunications plc or others. It is your sole responsibility to obtain any licences, permissions or consents which may be necessary if you choose to act on the information supplied in the SIN.

This SIN is available in Portable Document Format (pdf) from: <http://www.sinet.bt.com/index.htm>

Enquiries relating to this document should be directed to: help@sinet.bt.com

CONTENTS

1. INTRODUCTION	3
2. SERVICE AVAILABILITY.....	3
3. BT IP CLEAR SERVICE DESCRIPTION	3
3.1. GENERAL SERVICE CHARACTERISTICS	3
3.2. ACCESS PVCs	4
3.2.1. Leased Line access.....	4
3.2.2. Ethernet access.....	5
3.2.2.1 General.....	5
3.2.2.2 Ethernet in the First Mile (EFM).....	6
3.2.3. DSL.....	6
3.3. ROUTING OPTIONS	7
3.4. CLASS OF SERVICE NOT ENABLED: IP PRECEDENCE AND DSCP MODEL.....	8
3.5. CLASS OF SERVICE ENABLED: IP PRECEDENCE MODEL.....	9
3.6. CLASS OF SERVICE ENABLED: DSCP MODEL.....	9
3.7. CLASS OF SERVICE AND INTERFACE FRAGMENTATION (FRF.12)	10
3.8. IP CLEAR FLEX (2MBIT/S AND BELOW)	11
4. INTERFACE DESCRIPTIONS.....	12
4.1. 64, 128, 256, 512, 1024 & 2048 KBIT/S	12
4.2. 2048 KBIT/S (G.703 INTERFACE)	12
4.3. 34.368 MBIT/S.....	13
4.4. 155.520 MBIT/S.....	13
4.5. 10/100 MBIT/S.....	13
4.5.1. General.....	13
4.5.2. 10Mbit/s EFM.....	14
4.6. 1000 MBIT/S.....	14
4.7. DSL.....	15
5. PHYSICAL ARRANGEMENTS	15
5.1. PHYSICAL LOCATION OF CONNECTORS	15
5.2. NTE POWER SUPPLY REQUIREMENTS	15
5.2.1. 64, 128, 256, 512, 1024 and 2048 kbit/s.....	15
5.2.2. 34 and 155 Mbit/s	15
5.2.3. 10/100 and 1000 Mbit/s	16
5.2.4. DSL.....	16
6. REFERENCES	16
7. ABBREVIATIONS.....	17
8. HISTORY.....	19

TABLES

Table 1. IP Clear access rates	4
Table 2. Admissible DLCI values.....	5
Table 3. BGP timer values supported by the BT MPLS network.....	8
Table 4. IP Precedence Marking scheme	9
Table 5. DSCP Precedence Marking Scheme (based on RFC2597 ^[37]).....	10
Table 6. FRF.12 fragment size settings for IP Clear accesses	11
Table 7. Mapping of TDM time slots to delivered bandwidth on IP Clear Flex (2Mbit/s and below). 11	
Table 8. Gigabit Ethernet NTE technical specification	14

1. Introduction

This Suppliers' Information Note (SIN) describes BT's IP Clear service, which utilises MPLS technology to provide an IP Virtual Private Network capability. The service offers access options using Leased Line, Ethernet or DSL accesses, with various rates depending on the access mechanism. This document provides information about the service for use by Customer Premises Equipment (CPE) manufacturers and developers.

2. Service Availability

The BT IP Clear service will cover mainland Britain and Northern Ireland (the UK License area), subject to available network capacity.

Ethernet access availability is restricted to be within a given distance from the Network Point of Presence and also depends upon the required resilience. Further detail is specified in the IP Clear Product Description.

Geographic availability of DSL access will be made available on the BT Broadband website. DSL access to IP Clear will only be provided over BT-provided direct exchange lines. There are also technical limitations depending on factors such as the length of the local loop that may restrict ADSL delivery to some users.

For further information please refer to <http://www.sinet.bt.com/usenum.htm>

If you have enquiries relating to this document, then please contact : help@sinet.bt.com

3. BT IP Clear Service Description

3.1. General Service Characteristics

The BT IP Clear Service provides both a physical access and a logical connection to a defined IP VPN hosted on BT's Multi-Protocol Label Switching (MPLS) platform. Scaleable VPNs can be constructed using IP Clear connections only or a combination of IP Clear and IP Enabled access types. Logical access to single or multiple VPNs is supported per physical access using individual Frame Relay encapsulated Permanent Virtual Circuits, Ethernet VLAN accesses or DSL PVCs. The service is designed to provide any-to-any IP connectivity within a customer defined VPN and as such only supports IP version 4 traffic. The IP Clear service offers a range of available access rates. All Leased Line PVCs employ Frame Relay as the layer 2 encapsulation for the Customer's IP traffic.

The access speeds currently supported (or planned) are listed in Table 1. Note that for Ethernet accesses the contracted data rate may be below the access rate; in this case traffic should be shaped on egress at the CPE, and will be policed on ingress to the network. Permitted traffic rates are given in Section 3.2.2.

IP Clear Access Rates		IP Clear interfaces
64 kbit/s		X.21
128 kbit/s		X.21
256 kbit/s		X.21
512 kbit/s		X.21
1024 kbit/s		X.21
2048 kbit/s *		X.21 or G.703
34 Mbit/s		G.703
155 Mbit/s		G.957 optical
10 Mbit/s		10BaseT electrical
100 Mbit/s		100BaseT electrical
1000 Mbit/s		1000Base-SX optical
256 kbit/s	(upstream rate-adaptive between 64 and 256kb/s)	ADSL
512 kbit/s	(upstream rate-adaptive between 64 and 256kb/s)	ADSL
1024 kbit/s	(upstream 256kb/s)	ADSL
2048 kbit/s	(upstream 256kb/s)	ADSL

(* using X.21 interface. Where X.21 is not available, a framed G.703 interface may be offered providing a useable bit rate of 1984 kbit/s)

Table 1. IP Clear access rates

3.2. Access PVCs

3.2.1. Leased Line access

For leased line accesses this service supports the encapsulation of IP v.4 data packets using a Frame Relay framing structure that conforms with the Frame Relay Forum User-to-Network Interface (UNI) specification FRF 1.2 ^[1] the ITU-T Recommendation I.233 ^[2] and the IETF specification RFC 2427 ^[3] for multi-protocol encapsulation over Frame Relay.

The service employs unnumbered IP interfaces within the BT domain, such that all IP addressing relating to a Customer's IP-VPN is associated with the Customer's equipment and network domains.

The IP Maximum Transmission Unit (MTU) value supported by the service is 1500 bytes. Any IP packet forwarded to the service larger than 1500 bytes will be fragmented unless the D/F bit is set within the IP header, in which case the packet will be discarded.

Leased line accesses support a Frame Relay Local Management Interface (LMI) capability per physical access that complies with either ITU-T Q.933 Annex A ^[4] or ANSI T1.617 Annex D ^[5] (as selected by the Customer at time of order)

Access to individual VPNs from an IP Clear access is achieved by the use of Frame Relay PVCs. Multiple VPN connections are supported from an IP Clear access, with each connection using an individual PVC with an associated Data Link Connection Identifier (DLCI). The DLCI allocated to each VPN connection is allocated at time of subscription and is assigned by default to "101" for the first connection and "10n" for nth DLCI connection provided, per single physical access.

Alternatively DLCI values can be specified by the Customer from the value range detailed in Table 2 .

IP Clear DLCI values	
0	Reserved for channel signalling
1 - 15	These numbers are reserved
16 - 979	Admissible values for Customer DLCIs
980 - 991	Reserved for management connections
992 - 1023	These numbers are reserved

Table 2. Admissible DLCI values

3.2.2. Ethernet access

3.2.2.1 General

For Ethernet accesses the service supports the encapsulation of IP v4 data packets using IEEE 802.3^[24] Ethernet framing, with 802.1q^[25] VLAN trunking protocol for accesses with multiple VPNs.

Where a single VPN connection is provided on an Ethernet access, data will be sent without the VLAN Id field being set in the Ethernet header, i.e. the link will not be configured as an IEEE 802.1q^[25] VLAN trunk.

Multiple VPN connections are supported on an Ethernet access by configuring the access as an IEEE 802.1q VLAN trunk with each VPN using an individual VLAN associated with a VLAN ID. The VLAN ID associated with each VPN connection will be allocated by BT at the time of subscription. VLAN IDs cannot be specified by the customer.

The IP Clear service will support Ethernet access with the following interfaces (see SIN360^[27]):

- Ethernet: IEE 802.3^[24] at 10Mb/s.
- Fast Ethernet: IEE 802.3 at 100Mb/s.
- Gigabit Ethernet: IEEE 802.3 at 1000Mbit/s.

The access data rate of each Ethernet access will be 10, 100 or 1000Mbit/s as per the IEEE 802.3^[24] standard. However, the customer will subscribe to a Committed Data Rate (CDR) for each access that defines the maximum rate at which the customer may send or receive data packets to/from the network. The customer will not be able to burst above the CDR defined for each access. The available CDR values are specified in Product Definition for IP Clear.

The service employs numbered IP interfaces between the BT domain and the CPE router equipment. These addresses will be provided by the customer, and require a point-to-point IP subnet with a mask of /30 (255.255.255.252). The higher (even) IP address will be used for the CPE equipment and the lower (odd) for the network.

The IP Maximum Transmission Unit (MTU) value supported by the service is 1500 bytes, any IP packet forwarded to the service larger than 1500 bytes will be discarded.

The customer equipment connected to the service should appear to BT's network as a layer 3 IP router and should present a single 802.3 MAC address. Traffic to all other devices within the customer site should be routed via this device.

No spanning tree mechanism is used on the access link. Customers should not configure their equipment to send spanning tree packets (or other 802.x control packets) on the access circuit.

DiffServ Code Point (DSCP) Class of Service is supported on 10M, 100M and 1G Ethernet Access. Previously 100M Ethernet Access did not support Class of Service for IP Precedence based IP VPNs (ie all traffic will be marked as Class 3 on ingress to the network), although IP Precedence based CoS is supported on Gigabit Ethernet accesses.

3.2.2.2 Ethernet in the First Mile (EFM)

The IEEE 802.3ah-2004 Ethernet in the First Mile (EFM) standard defines additional specifications for Ethernet broadband technologies supporting speeds from 2Mbs-1 to 1Gbs-1 using physical layers of either twisted-pair copper cabling or single-mode optical fibre.

IP Clear's realisation of EFM is focus on delivering Ethernet-over-copper, offering symmetrical bandwidths up to 10Mbs⁻¹ over single to multiple bonded voice grade copper pairs, otherwise referred to as a Metallic Path Facility (MPF), using standards based 2BASE-TL technology,

- EFM only supports Standard access.
- EFM supports up to 8 MPF pairs to deliver the required bandwidth. The installed number of MPFs varies according to the required bandwidth, the distance from the local serving exchange and line characteristics.
- Policing & shaping of traffic to a contracted bandwidth will be performed at points of ingress and egress throughout the network.
- IEEE 802.3^[24] Ethernet framing, with 802.1q^[25] VLAN trunking protocol for EFM access with single or multiple VPNs.
- CoS Policy per Access (CPPA) applies to EFM access whether supporting single or multiple VPNs . CPPA means a single CoS policy will be applied across the whole access.
- EFM access provides an uncontended access bandwidth to the customer VPN.
- EFM access is available on IP VPNs configured for DSCP CoS and supports EF, AF & DE traffic class types.

The EFM access data rate and a requisite number of MPF pairs are delivered to meet the customer subscribed Committed Data Rate (CDR) . The CDR defines the maximum rate at which the customer may send or receive data packets to/from the network. The customer will not be able to burst above the CDR defined for each access. Where a customer requires an increase in CDR , this will most likely result with augmenting the MPFs to support an increase of bandwidth. The available EFM access CDR values are 2M, 4M, 6M,8M,10M for IP Clear.

The service employs numbered IP interfaces between the BT domain and the CPE router equipment. These addresses will be provided by the customer and require a point-to-point IP subnet with a mask of /30 (255.255.255.252). The higher (even) IP address will be used for the CPE equipment and the lower (odd) for the network.

3.2.3. DSL

The ADSL service is based on the BT DataStream Office Product. As a service option, either an uncontended or a contended service will be provided to the customer's premises.

The offered End User Data Path (EUDP) options are 286kbit/s (rate-adaptive), 576kbit/s (rate-adaptive), 1,152kbit/s and 2,272kbit/s downstream, based on ATM cell based bandwidth (including headers). Upstream ATM cell rate is 288kb/s for fixed rate options, but for rate-adaptive service the upstream rate will depend on the length and quality of the line (see SIN347^[28]).

As detailed within the DataStream SIN 347^[28], upstream traffic must be shaped by the end customer equipment to ensure that the ATM traffic does not peak above the upstream modem speed.

Each customer has a single PVC from the Customer access router to the ADSL access router. The ATM layer VP will be presented at the End User interface with VPI=0. Within the VP the data channel will be presented on VCI=38.

For all new supply of DSL access the encapsulation mode for the ATM PVC will be PPPoA (AAL5 Mux) according to RFC2364^[38]. OAM should be configured on the customer CPE as specified in SIN347^[28]. For existing sites, configured prior to December 2005, encapsulation mode for the ATM PVC from the customer site should be set to AAL5 with SNAP according to IETF RFC1483^[23]. OAM should be configured on the customer CPE as specified in SIN347^[28].

It should be ensured that the customer site router can negotiate with the DSLAM and hence determine the upstream end user rate and traffic-shaping mode. If not, then this parameter will have to be hard configured.

3.3. Routing Options

Both Static Routing and Dynamic Routing (eBGP) options are supported for exchanging routing information between the PE and CE.

A number of enhanced service reliability options for IP Clear are offered between the customer NTE and BT's MPLS network. For more information regarding these options, refer to the contact points given in Section 2 of this document.

The dynamic routing option requires that the attached CPE(s) run an external BGP session across a *multihop* link in accordance to RFC 1771 A Border Gateway Protocol 4 (BGP-4)^[22]. For Ethernet access all resilient sites use dynamic resilience in accordance with the above RFC. This requires the attached CPE(s) to run an external BGP session between LAN interfaces, not using *multihop*.

This external BGP session supports the end to end transparency of BGP standard communities. The following communities are carried transparently by IP Clear

- Any AS in the first 2 bytes of the community attribute
- Excluding core ASNs (2856, 12641)

That is, the following are allowed

- 0:0 to 2855:65535
- 2857:0 to 12640:65535
- 12642:0 to 65535:65535

Two accesses forming a resilient connection can be in different BGP AS (Autonomous System). Each BGP connected site within a VPN should use a different AS number. IP Clear uses both "Deterministic MED" and "Always Compare MED". BT can recommend the AS numbering plan for customer sites or the customer may select their own. Any AS number selected by the customer must either be in the Private AS number range [64521 - 65535]¹ or is registered to them by a Regional Internet Registry e.g. ARIN (Canada, United States, islands in the Caribbean Sea and North Atlantic

¹ Dial access is currently assigned AS 64512 and the IP Clear design has reserved AS values in the range [64513 - 64520] for unspecified future platform use.

Ocean) or RIPE NCC (Europe, the Middle East, Central Asia) and must be unique for each site within a VPN.

The dynamic resilience options do not support true load sharing. As such the BGP configuration on the CPE should set MED (Multi-Exit Discriminator) values for all route prefixes which are announced to the MPLS network. This enables the customer to control which connection will be used to send traffic from BT's MPLS platform to them for each individual prefix that they advertise.

iBGP Multipath will be configured as default on all accesses. Customers with more than one access advertising the same routes would receive flow based loadsharing of inbound traffic across up to 4 paths (accesses). To be able to use iBGP Multipath the following must be true:

- Weights are equal
- Local-preference is equal
- AS-PATH is same. Note that entire AS-PATH should be identical
- Origin is same
- MEDs are equal

Any of the foregoing can be used to override iBGP Multipath. The use of unequal path load sharing allows accesses, which are parented on different PoPs thereby possible having different path lengths, to have approximately equal distribution of sessions.

It must be noted that "loadsharing" is session based and depends upon the source and destination IP addresses as to which path is taken; it does not take session bandwidth into consideration.

"loadsharing" will work optimally if there are large numbers of sessions; there is a risk that with traffic will be unequally routed if very small numbers of sessions are present. Access should always be of equal bandwidth.

Note that iBGP Multipath will only control inbound sessions to the multi access site. The Customer must control outbound traffic by configuration on their site

The BGP timer parameters supported by the BT network are given in Table 3. These timers may be negotiated between the network and the CPE equipment if the CPE supports this. The minimum values that should be set in the CPE are defined below. If the CPE does not support negotiation then the service defaults should be used.

Timer	BT Service Default	Minimum Value Permitted
BGP neighbour keepalive timer	60 seconds	10 seconds
BGP neighbour hold timer	180 seconds	3 × keepalive timer

Table 3. BGP timer values supported by the BT MPLS network

When using BGP to advertise routing information to the network, each site will be subject to a pre-agreed maximum number of routes that it can advertise. This number of routes should not be exceeded; the network will disconnect sites that advertise more than the agreed number.

3.4. Class of Service not Enabled: IP Precedence and DSCP Model

Where CoS features are not enabled, IP Clear accesses do not support by default the use of IP Precedence bits in the headers of Customers' IP packets. Any IP Precedence bit values that are set will be reset to BT's Class 3 (Default) precedence marking for transport across the network. By default the network will not re-instate the original precedence bit value.

3.5. Class of Service Enabled: IP Precedence Model

Where CoS features are enabled under the IP Precedence CoS model, IP Clear accesses support the use of IP Precedence bits in the headers of Customers' IP packets in order to provide prioritisation of Customer data according to the values employed in the Precedence bit.

The BT MPLS network supports prioritisation into 3 discrete IP Classes of Service:

- Class One
used for low-jitter, low-delay application requirements such as Voice over IP
- Class Two
used for data prioritised over 'general' traffic or data with underlying application performance requirements such as video
- Class Three
used for general data

In order for the BT MPLS network to handle Customer traffic according to its appropriate Class setting, the Precedence bit in the IP headers of Customer data should be set according to the following scheme:

IP Precedence		IP VPN Class of Service	In/Out of Contract Marking
Value	Binary		
6	110	2	In
5	101	3	In
4	100	1	In

Table 4. IP Precedence Marking scheme

The precedence value of Customer traffic submitted to the MPLS network will be set to the same value on egress from the network. Any received precedence value settings that are not in accordance with the above Precedence Marking scheme will be re-marked to Class 3 on egress.

On an Ethernet access, bits 4-6 of the ToS field (the last 3 bits of the DSCP) must be set to zero on the CPE for Class 1 and Class 2 traffic; these bits will be set to zero for all traffic on egress.

3.6. Class of Service Enabled: DSCP Model

Where CoS features are enabled under the DSCP (DiffServ Code Point) CoS model, IP Clear accesses support the use DSCP bits in the headers of Customers' IP packets in order to provide prioritisation of Customer data according to the values employed in the Precedence bit.

The BT MPLS network supports prioritisation into 3 discrete IP Classes of Service:

- Class One/Expedited Forwarding
used for low-jitter, low-delay application requirements such as Voice over IP
- Class Two/Assured Forwarding
used for data prioritised over 'general' traffic or data with underlying application performance requirements such as video. Up to four discrete AF classes are available to segregate Customers' prioritised or performance-sensitive data traffic
- Class Three/Default (or "Best Efforts")
used for general un-prioritised data

When supporting EF on a DSL access the CPE must be configured for MLPPP and fragmentation will be applied to IP packet.

In order for the BT MPLS network to handle Customer traffic according to its appropriate Class setting, the DSCP bit in the IP headers of Customer data will be processed according to the following precedence marking scheme:

Marking on BT Network			Classification	
Binary	Octal	Ingress/Egress treatment (In/Out of Contract)	DiffServ Code Point	Class
101000	5-0	In	EF	Class 1
101110	5-6	In	EF	Class 1
100000*	4-0*	In		Class 2/AF4
100010	4-2	In	AF41	Class 2/AF4
100100	4-4	Out	AF42	Class 2/AF4
100110	4-6	Out	AF43	Class 2/AF4
011000*	3-0*	In		Class 2/AF3
011010	3-2	In	AF31	Class 2/AF3
011100	3-4	Out	AF32	Class 2/AF3
011110	3-6	Out	AF33	Class 2/AF3
010000*	2-0*	In		Class 2/AF2
010010	2-2	In	AF21	Class 2/AF2
010100	2-4	Out	AF22	Class 2/AF2
010110	2-6	Out	AF23	Class 2/AF2
001000*	1-0*	In		Class 2/AF1
001010	1-2	In	AF11	Class 2/AF1
001100	1-4	Out	AF12	Class 2/AF1
001110	1-6	Out	AF13	Class 2/AF1
000000	0	In	DE	Class 3

*= DSCP Class Selector/Truncated DSCP value

Table 5. DSCP Precedence Marking Scheme (based on RFC2597 ^[37])

The precedence value of Customer traffic submitted to the MPLS network will be set to the same value on egress from the network. By default, any received precedence value settings that are outside of the DSCP framework will be re-marked to Class 3/Default on egress.

3.7. Class of Service and Interface Fragmentation (FRF.12)

Where an IP Clear service is ordered in conjunction with Class of Service (CoS) that includes Class 1, FRF.12 fragmentation will be enabled in order to support Class 1 effectively at access bandwidths of below 2Mbit/s (X.21 interface) or 1984 kbit/s (G.703 interface). The fragment sizes defined in the configuration of FRF.12 settings will vary according to the bit rate of the Access. FRF.12 settings will need to be configured on the Customer CE Router to match those configured on the BT network.

IP Clear Access speed	FRF.12 Fragment size (bytes)
256 kbit/s	300
512 kbit/s	400
1024 kbit/s	800

Table 6. FRF.12 fragment size settings for IP Clear accesses

3.8. IP Clear Flex (2Mbit/s and below)

A variant of IP Clear is available (based on a 2Mbit/s physical delivery) that offers flexible bandwidth to the Customer. This service employs the use of a 2Mbit/s service with G.703 interface only (i.e. the IP Clear X.21 interface is not supported for Flex).

Bandwidth is delivered to Customer sites at rates of below 2Mbit/s through the use of specific TDM time slot combinations, configured on the Network Terminating Equipment (NTE) of the IP Clear service. Each time slot is equivalent to 64kbit/s of bandwidth, with 31 time slots supported on the 2Mbit/s service providing a maximum of 1984 kbit/s.

Customer Routers connected to the IP Clear Flex service typically require configuration to take account of TDM time slot configuration (and its configured bandwidth) on the IP Clear Flex service.

Specific time slots are used to deliver flexible bandwidth at intermediate steps between 64kbit/s and 1984 kbit/s. The range of possible bandwidths, and their mapping to time slot values as supported by the BT MPLS network, is as described in Table 7. Please note that not all bandwidth options are commercially available, please consult the IP Clear Production Description.

Time Slots (G703 2Mb Flex service)	Delivered Flex Access Bandwidth	FRF.12 Fragment size (bytes)	Time Slots (G703 2Mb Flex service)	Delivered Flex Access Bandwidth	FRF.12 Fragment size (bytes)
1	64 kbit/s	N/A	1 to 17	1088 kbit/s	800
1 & 2	128 kbit/s	N/A	1 to 18	1152 kbit/s	900
1 to 3	192 kbit/s	N/A	1 to 19	1216 kbit/s	900
1 to 4	256 kbit/s	300	1 to 20	1280 kbit/s	1000
1 to 5	320 kbit/s	300	1 to 21	1344 kbit/s	1000
1 to 6	384 kbit/s	300	1 to 22	1408 kbit/s	1100
1 to 7	448 kbit/s	300	1 to 23	1472 kbit/s	1100
1 to 8	512 kbit/s	400	1 to 24	1536 kbit/s	1200
1 to 9	576 kbit/s	400	1 to 25	1600 kbit/s	1200
1 to 10	640 kbit/s	500	1 to 26	1664 kbit/s	1200
1 to 11	704 kbit/s	500	1 to 27	1728 kbit/s	1200
1 to 12	768 kbit/s	600	1 to 28	1792 kbit/s	1200
1 to 13	832 kbit/s	600	1 to 29	1856 kbit/s	1200
1 to 14	896 kbit/s	700	1 to 30	1920 kbit/s	1200
1 to 15	960 kbit/s	700	1 to 31	1984 kbit/s	N/A
1 to 16	1024 kbit/s	800			

Table 7. Mapping of TDM time slots to delivered bandwidth on IP Clear Flex (2Mbit/s and below)

Where a Flex service is ordered in conjunction with Class of Service (CoS) that includes Class 1, FRF.12 fragmentation will be enabled in order to support Class 1 effectively at configured access bandwidths of below 1984 kbit/s. The fragment sizes defined in the configuration of FRF.12 settings

will vary according to the configured bit rate of the service. FRF.12 settings will need to be configured on the Customer CE Router as well as on the BT network. Note that FRF.12 fragmentation is not required at the full line rate to support Class 1. Fragment sizes are shown in Table 7. Where a value is shown then fragmentation must be configured; these are recommended upstream fragment sizes.

4. Interface Descriptions

IP Clear access connections support the following types of customer interface:

1. 64, 128, 256, 512, 1024 & 2048 kbit/s
X.21^[6] electrical presentation.
2. 2048 kbit/s (G.703^[9])
Where X.21^[6] is not available from BT due to geographical coverage an alternative G.703^[9] presentation may be offered with G.704^[14] framing, providing a data path with 1984 kbit/s of usable bandwidth.
3. 34 Mbit/s
G.703^[9] presentation with G.751^[13] framing.
4. 155 Mbit/s
G.957^[12] optical presentation with G.707^[14] framing.
5. 10/100 Mbit/s
RJ-45 connection with IEEE 802.3^[24] Ethernet at 10 or 100Mb/s, in half or full duplex mode.
6. 1000 Mbit/s
1000Base SX optical presentation with IEEE 802.3^[24] Gigabit Ethernet framing.
7. DSL
Analogue BT-provided PSTN direct exchange line.

4.1. 64, 128, 256, 512, 1024 & 2048 kbit/s

The service supports customer access at 64, 128, 256, 512, 1024 and 2048 kbit/s which conform to ITU-T Recommendation X.21^[6]. Electrical characteristics for this interface are specified in ITU-T Recommendation X.27^[7], and ISO4903^[8] defines the mechanical connector arrangements.

Frame Relay encapsulation is as described in IETF RFC 2427 (“Multiprotocol interconnect over Frame Relay”)^[3]. Cyclic redundancy checking (CRC) must be disabled.

4.2. 2048 kbit/s (G.703 interface)

The service supports customer access at 2048 kbit/s using an ITU-T Recommendation G.703^[9] electrical presentation (where X.21^[6] is not otherwise available from BT). The Layer 2 framing structure employed over this interface conforms with ITU-T Recommendation G.704^[10] and provides a useable 1984 kbit/s of bandwidth.

HDB3 line coding is used as defined in ITU-T Recommendation G.703^[9].

Frame Relay encapsulation is as described in IETF RFC 2427 (“Multi-protocol interconnect over Frame Relay”)^[3]. Cyclic redundancy checking must be disabled.

The physical presentation of this service is via a pair of unbalanced BNC 75 Ohm female BNC coaxial connectors, one for each direction of transmission. The connectors conform to the general requirements of BS 9210 N0001 : Part 2 : 1982 ^[11].

4.3. 34.368 Mbit/s

The service supports customer access at 34 Mbit/s whose electrical characteristics conform to ITU-T Recommendation G.703 ^[9]. Frame structure is as defined in ITU-T Recommendation G.751 ^[13].

Frame Relay encapsulation is as described in IETF RFC 2427 (“Multi-protocol interconnect over Frame Relay”) ^[3].

The physical presentation of the service is via a pair of unbalanced 75 Ohm female BNC coaxial connector’s one for each direction of transmission ^[11]. HDB3 line coding is used as defined in ITU-T Recommendation G.703 ^[9].

The CPE E3 Serial card must support 16-bit cyclic redundancy checking.

4.4. 155.520 Mbit/s

The service supports customer access at 155.520 Mbit/s using an optical interface conforming to ITU-T Recommendation G.707 ^[14] for the SDH Network Node Interface. This interface is presented via an optical single-mode fibre connection as described in SIN 333 ^[29] conforming to ITU-T Recommendation G.957 ^[12] for SDH optical requirements. The optical fibre presentation at the UNI conforms with BS EN 60825-1 ^[17] and BS EN 60825-2 ^[18] as a class 1 laser product.

The interface operates over Single-Mode optical fibre conforming to ITU-T Recommendation G.652 ^[19] and presents an SDH based frame structure as described in SIN333 ^[29], “SDH Customer Interfaces at the STM n level”, conforming with ITU-T Recommendation G.707 ^[14].

The optical connector is FC type conforming to BS EN 186110 : 1994 ^[20]. The connector is Physical Contact (PC) polished. This combination is commonly known as an FC/PC connector. Non Return to Zero (NRZ) line coding is used as specified in ITU-T Recommendation G.957 ^[12].

The signal at the UNI is derived from a 1310nm-wavelength long haul SDH class laser (L-1.1) as specified in ITU-T Recommendation G.957 ^[12]. The NTE optical transmitter provides a signal power level of between –10dBm and –15dBm to interface with the attached CPE receiver. The NTE optical receiver has a sensitivity in the range –10dBm and –34dBm.

In order to operate the IP-VPN service, the Customer must install a Packet Over SONET /SDH (POS) card in their CPE Router configured to support SDH framing and connect it to the optical presentation at the User-Network Interface (UNI).

The CPE POS card must be configured to support 32 bit cyclic redundancy checking and should support G.707 – compliant SDH framing and the Frame Relay encapsulation mechanism defined in IETF RFC 1662 ^[15]. The Path Trace setting should not be enabled.

The CPE POS card connected to the IP Clear service at 155.520 Mbit/s must support Payload Scrambling as defined in Section 6.5 of ITU-T Recommendation G.707 ^[14] and RFC 2615 ^[21].

4.5. 10/100 Mbit/s

4.5.1. General

The interface is the Network Termination Point (NTP), i.e. the point of connection between the BT Network Terminating Equipment (NTE) and the CPE interface. The Customer Interface consists of

an RJ-45 type socket. The customer provides the category 5 connecting cords between the NTE and their own CPE. The maximum cable length is 100m.

The RJ-45 type connector is as specified in the 10BaseT and 100BaseT IEEE 802.3u/x ^[30]^[31] specifications. Attention is drawn to the Intellectual Property Rights (IPRs) set out in the preface of this agreed International standard. It is the responsibility of the CPE supplier to ensure that they have the necessary rights from the owner of the IPR. The IPR owner has stated that they are willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world.

Both speeds will be provided using BT LAN Extension Service 100 (see SIN311 ^[26]), but will be configured on installation to the appropriate speed and duplex setting.

4.5.2. 10Mbit/s EFM

The EFM Network Terminating Equipment is capable of bonding up to 8 MPF pairs based upon Standard IEEE 802.3ah. Each MPF pair will terminate on a standard NTE5 faceplate and a separate cable assembly will connect each NTE5 to the supplied EFM NTE.

The customer interface is a 10/100BASE-TX port presented via a RJ45 type connector. The customer will require an RJ45 category 5 cable to connect EFM NTE to their own CPE, where the maximum cable length is 100m.

4.6. 1000 Mbit/s

Gigabit Ethernet conforms to the IEEE 802.3 ^[24] standard.

The interface is the Network Termination Point (NTP), i.e. the point of connection between the BT Network Terminating Equipment (NTE) and the CPE interface. The Customer Interface consists of a Dual SC type 1000Base SX fibre interface. The customer provides the fibre patch connectors between the NTE and CPE, the maximum fibre length is 550m.

The SX type connector is as specified in the Gigabit Ethernet IEEE802.3z ^[32] specification. Attention is drawn to the Intellectual Property Rights (IPRs) set out in the preface of this agreed International standard. It is the responsibility of the CPE supplier to ensure that they have the necessary rights from the owner of the IPR. The IPR owner has stated that they are willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world.

Protocol	Gigabit Ethernet IEEE 802.3z ^[32]
Line Rate	1.25 Gbit/s
Maximum Bit Error Rate	10 ⁻¹²
Power Requirement	Mains voltage 50 Hz AC input, 50 watt
Customer Fibre Connector	SC type
SX Fibre (Customer provided)	Multi-mode 850nm, 50/125 or 62.5/125 micron
SX Fibre Maximum Delivery Distance	550 m from NTE's SX port
Operating Temperature	0° to 40° C
Laser Safety	Class 1 under all conditions as per IEC 825-1 ^[33]
AUTONEGOTIATION	ON

Table 8. Gigabit Ethernet NTE technical specification

4.7. DSL

The physical aspects of the End User Interface are described in SIN346^[34]. ATM details are provided in SIN347^[28].

The BT DataStream NTE is presented as a “wires-only” interface compliant with ITU G.992.1^[35] (“G.DMT”) and is described in SIN346^[34].

The Customer ADSL CPE (CE) router must have at least one ADSL port to provide connectivity. It is noted that the current IP Clear DSL product (as based on BT DataStream Office) only supports a single ADSL interface (with one VC). An ADSL splitter/filter will be required (one for each extension) if the voice channel on the line is to be used for telephony, including use by FAX. The splitter/filter is not supplied as part of service.

Note: The solution does **not** support bonding of multiple DSL links using MLPPP with a single CPE.

5. Physical arrangements

5.1. Physical Location of Connectors

The User–Network Interface (UNI) is located at the connector on the BT Network Terminating Equipment (NTE) with a connector on the Customer side as described in the relevant part of Section 4 of this document.

5.2. NTE Power Supply Requirements

The NTE is locally powered and will require either a single or dual local mains 50Hz AC supplies (dependant on access rate).

The NTE will be installed in accordance with standard BT practises in agreement with the Customer.

5.2.1. 64, 128, 256, 512, 1024 and 2048 kbit/s

Various types of NTE may be installed, some of which require an A.C. mains power source and others a –50V D.C. power supply. Power consumption varies, dependent on the type of NTE, from 5 Watts and 20 Watts. The –50V D.C. supply can be provided by BT, or by the Customer. A Customer supplied A.C. mains power source will be required close to the installation to operate the –50V D.C. power supply, or to power the NTE directly, dependent on NTE type.

Where the NTE is powered by a Customer provided –50V D.C. power supply, the NTE will be supplied with a connection lead which will be presented as wires–only. As power supplies can vary slightly in output voltage and other electrical characteristics, the NTE should be connected to power supplies conforming with British Telecommunications Network Requirements (BTNR) 2511^[16].

Customer supplied power supplies for connection to this service shall conform with the relevant safety standards in force.

5.2.2. 34 and 155 Mbit/s

The NTE is locally powered and will require at least one A.C. mains supply. For certain NTE types, the Customer can be supplied with a battery back–up option.

5.2.3. 10/100 and 1000 Mbit/s

The NTE is powered from the normal domestic mains supply, standard CEE 22 (IEC 320^[36]) inlets which are fitted to the rear panel of the NTE. The appropriate mains cord is supplied.

The power consumption of the BT NTE is typically 50 watts.

The EFM NTE is DC powered (12V) and supplied with an external power supply, power consumption typically 20 watts.

5.2.4. DSL

The service boundary only extends to the Master Telephone Socket and does not include internal wiring. Thus no additional power is required for an NTE.

6. References

[1]	Frame Relay Forum implementation agreement 1.2, "User-to-Network (UNI) Implementation Agreement", April 2000
[2]	ITU-T Recommendation I.233, "Frame Mode Bearer Services", March 1993
[3]	IETF RFC 2427, "Multiprotocol Interconnect over Frame Relay", September 1998 (replaced RFC 1490)
[4]	ITU-T Q.933 Annex A, "Digital subscriber signalling system No. 1 (DSS 1) – Signalling specifications for frame mode switched and permanent virtual connection control and status monitoring", October 1995
[5]	ANSI T1.617 Annex D, "Digital Subscriber System No. 1 DSS1 Signalling Specification for Frame Relay Bearer Service", Revised 1997
[6]	ITU-T Recommendation X.21, "Interface between Data Terminal Equipment and Data Circuit-terminating Equipment for synchronous operation on public data networks", September 1992
[7]	ITU-T Recommendation X.27, "Electrical characteristics for balanced double-current interchange circuits operating at data signalling rates up to 10 Mbit/s", October 1996
[8]	ISO 4903 15 Pole DTE/DCE Interface Connector and Contact Number Assignments, 1989
[9]	ITU-T Recommendation G.703, "Physical/electrical characteristics of hierarchical digital interfaces", October 1998
[10]	ITU-T Recommendation G.704, "Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 kbit/s hierarchical levels", October 1998
[11]	BNC Connector complying with Figure 2 of BS 9210 N0001:Part2:1982
[12]	ITU-T Recommendation G.957, "Optical interfaces for equipments and systems relating to the synchronous digital hierarchy", July 1999
[13]	ITU-T Recommendation G.751, "Digital multiplex equipments operating at the third order bit rate of 34 368 kbit/s and the fourth order bit rate of 139 264 kbit/s and using positive justification", November 1998
[14]	ITU-T Recommendation G.707, "Network node interface for the synchronous digital hierarchy (SDH)", October 2000
[15]	IETF RFC 1662, "PPP in HDLC-like Framing", July 1994
[16]	BTNR 2511 Interface of Telecommunications Equipment – nominal 48 volt negative D.C. power supply, latest issue

[17]	BS EN 60825 – 1 : 1994 Safety of Laser Products Part 1 Equipment Classification
[18]	BS EN 60825 – 2 : 1995 Safety of Laser Products Part 2 Safety of Optical Fibre Communications Systems
[19]	ITU-T Recommendation G.652 – Characteristics of a single-mode optical fibre cable. March 1993
[20]	BS EN 186110 : 1994 Sectional specification. Connector sets for optical fibre and cables type FC.
[21]	IETF RFC2615, “PPP over SONET/SDH”, June 1999 (obsoletes RFC1619)
[22]	IETF RFC 1771 “A Border Gateway Protocol 4 (BGP-4)”, March 1995
[23]	IETF RFC 1483, “Multiprotocol Encapsulation over ATM Adaptation Layer 5”, July 1993
[24]	IEEE 802.3, Standards for Local Area Networks: CSMA/CD Access Method
[25]	IEEE 802.1q, Recommendations for Virtual LANs
[26]	SIN 311, BT LAN Extension Service 100 – Service Description
[27]	SIN 360, Ethernet Customer Interfaces – Interface Characteristics
[28]	SIN 347, BT DataStream Office & BT DataStream Home
[29]	SIN 333, SDH Customer Interfaces at the STM-N Level (where N =1,4,16)
[30]	IEEE 802.3u, Standards for Local & Metropolitan Area Networks – Supplement: Media Access Control (MAC) Parameters, Physical Layer, Medium Attachment Units and Repeater for 100Mbit/s Operation, Type 100Base-T
[31]	IEEE 802.3x, Standards for Local and Metropolitan Area Networks: Specification for 802.3 Full Duplex
[32]	IEEE 802.3z, IEEE standards for Gigabit Ethernet in the LAN/WAN, 1998
[33]	IEC 825-1, International Electrotechnical Commission (IEC) Standard – Safety of Laser Products Part 1
[34]	SIN 346, BT ADSL Interface Description
[35]	ITU–T Recommendation G.992.1, Asymmetrical Digital Subscriber Line (ADSL) transceivers
[36]	IEC 320, International Standardized Appliance Connectors
[37]	IETF RFC 2597 “Assured Forwarding PHB Group”, June 1999.
[38]	IETF RFC 2364 "PPP Over AAL5"

For information on where to obtain these referenced documents, please see the document sources list at <http://www.sinet.bt.com/docsources.htm>.

7. **Abbreviations**

AAL5	ATM Adaptation Layer 5
ADSL	Asymmetric Digital Subscriber Line
AF	Assured Forwarding
ANSI	American National Standards Institute
AS	Autonomous System
ATM	Asynchronous Transfer Mode
BGP	Border Gateway Protocol
BTNR	British Telecommunications Network Requirements
CE	Customer Edge

CoS	Class of Service
CPE	Customer Premises Equipment
DF	Do not Fragment bit
DLCI	Data Link Connection Identifier
DSCP	DiffServ Code Point
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
EUDP	End User Data Path
FRF	Frame Relay Forum
HDB3	High Density Bi-polar 3
IETF	Internet Engineering Task Force
iBGP	internal Border Gateway Protocol
IP	Internet Protocol
IPR	Intellectual Property Rights
ITU-T	International Telecommunication Union
LMI	Local Management Interface
MAC	Medium Access Control
MED	Multi-Exit Discriminator
MPLS	Multi-Protocol Label Switching
MPF	Metallic Path Facility
MTU	Maximum Transmission Unit
NRZ	Non-Return to Zero
NTE	Network Terminating Equipment
PC	Physical Contact
PE	Provider Edge
PHB	Pre-Hop-Behaviour
POS	Packet Over SONET/SDH
PPP	Point-to-Point Protocol
PSTN	Public Switched Telephone Network
PVC	Permanent Virtual Circuit
RFC	Request For Comment
SDH	Synchronous Digital Hierarchy
SIN	Suppliers' Information Note
SONET	Synchronous Optical NETwork
TDM	Time Division Multiplexing
ToS	Type of Service
UNI	User/Network Interface
VC	Virtual Channel
VCI	Virtual Connection Identifier
VLAN	Virtual Local Area Network
VP	Virtual Path
VPI	Virtual Path Identifier
VPN	Virtual Private Network

8. History

Issue	Date	Revision changes
Issue 1.0	19 September, 2001	First Issue
Issue 1.1	08 October 2001	Correction to quoted standard in section 4 item 3
Issue 1.2	08 November 2001	Addition of 512 kbit/s rate on X.21 interface.
Issue 1.3	06 February 2002	Addition of 64 & 128 kbit/s rates on X.21 interface.
Issue 1.	27 February 2002	Addition of 3.3 to clarify use of dynamic resilience option.
Issue 2.0	12 July 2002	Addition of the Flex service section 3.6 refers Clarification of the use of IP Precedence bits section 3.4 & 3.5 refer
Issue 2.1	07 May 2003	Addition of Ethernet and DSL access options. Modified FRF.12 fragment sizes for IP Clear Flex. Approval Requirements statement removed, information available via SINet Useful Contacts page.
Issue 2.2	05 August 2003	Text and title format changes Section 3.4 to 3.8. Detail added to reflect support of DSCP Class of Service model (Section 3.6).
Issue 2.3	26 October 2004	CoS Enabled, DSCP Model description clarified.
Issue 2.4	02 December 2004	Addition of BGP Standard Community Attributes transparency, iBGP Multipath, "Always Compare MED"
Issue 2.5	06 May 2005	Correction of DSL shaping parameters in Table 1. Change to PPPoA encapsulation with optional Radius Server authentication for DSL service. Clarification of advice for customer's DSL splitter/filter.
Issue 2.6	17 January 2007	Amendments to GiGE interface – Autonegotiation needs to be set to 'ON'. BGP enhancements on DSL. Typos corrected and redundant information removed.
Issue 2.7	10 July 2009	Addition of Ethernet in First Mile (EFM) Access Option utilising Local Loop Unbundling. Includes Section 3.2.2.2, 10Mbit/s EFM at Section 4.5.2 and additional power information at Section 5.2.3.

< END >

We would be grateful if you would spend a few minutes to complete an online customer satisfaction form at www.sinet.bt.com/happy.htm