External Service Description
COLT
ATM and Frame Relay Services

Prepared By

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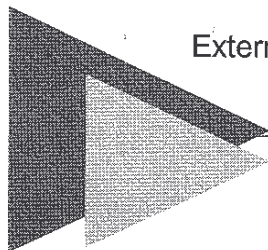
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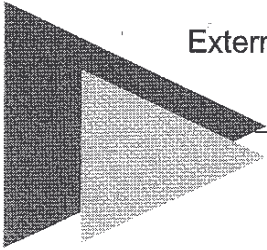Daryl Szebesta   Director, Data and Systems Outsourcing

Synopsis

This document is the service description for COLT's ATM and Frame Relay
product range. The services described in this document are subject to
availability and may be modified from time to time. COLT standard Terms
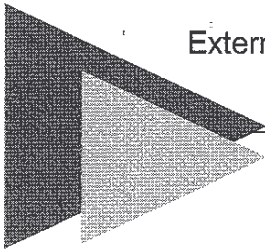and Conditions apply.

1   Introduction

This document describes all the service features and functionality of the COLT ATM and Frame Relay Portfolio.
The service description describes all variants of the ATM and Frame Relay portfolio and is relevant for both domestic and international versions of the product.

2   COLT ATM and Frame Relay Services Overview

COLT's ATM and Frame Relay portfolio provides customers with a flexible and reliable data connectivity service.

ATM is a layer 2 service, providing the customer with the flexibility and scalability of a cloud network but with the deterministic quality of service and security of a leased line. This makes it a cost effective choice for networking sites over a traditional leased line service and ideal for those who prefer to build and manage their own networks.

COLT's ATM and Frame Relay portfolio including COLT Frame Relay and COLT ATM allows customers to 'mix and match' their traffic types with different service types over one single network ensuring the maximum efficiency and reducing the administration and costs of running multiple networks.

ATM is a standards based technology, which has been designed from the start to accommodate the simultaneous transmission of data, voice and video. All information, regardless of how it is structured, is sent in a common format across the ATM network. ATM and Frame Relay are transparent to the protocols operating within the customers network. Therefore it is straightforward to build an efficient infrastructure to route all the data including legacy protocols.

2.1   Service

The COLT ATM and Frame Relay Portfolio

COLT ATM & Frame Relay Services					
Service	Frame Relay	Frame Relay – ATM Interworking	ATM		
Service Class Available	UBR+	VBRnrt 3	VBRnrt 3	VBRnrt	VBRnrt 3	CBR
Additional Services	Multi-Service Switch				
	Integrated Internet Access				
	Online Reporting Portal				

Figure 1 - COLT ATM and Frame Relay Portfolio Options

2.1.1   COLT ATM
This service is UNI conforming to ATM Forum UNI specification version 3.1 [Ref. 3]
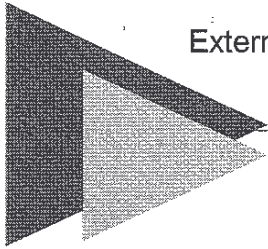
2.1.2 COLT Frame Relay

This is COLT's Frame Relay service. All Frame Relay traffic is transported across the COLT network within ATM cells.

The COLT core network operates in ATM mode. Frame Relay frames entering the network are divided into fixed length 53 byte cells and passed through the core network according to the established ATM standards. ATM is a far more efficient way of passing data through a network than Frame Relay.

The benefits of this approach include:

- ➤ **Lower delays** - Variable size frames must be received entirely at each switch before being re-transmitted while the small ATM cells are quickly received and re-transmitted.
- ➤ **Precise control of shared bandwidth** - Cell switching within the network improves fairness amongst users by allowing very precise control of bandwidth allocation. It doesn't matter if one user is sending very long data frames and another is sending very small data frames as they both will realise a fair allocation of trunk bandwidth in proportion to their contracted bandwidth
- ➤ **Flow control** - Managing fixed length cells against variable length frames provides better mechanisms to predict and act upon network loading, congestion avoidance and performance control.

2.1.3 Frame to Cell Inter-working

COLT offers service inter-working between ATM and Frame Relay as standard supporting the Frame Relay Forum standards FRF8 and FRF5. This seamless inter-working between ATM and Frame Relay enables the optimum flexibility in the network. Customers can mix and match their ATM and Frame Relay ports as required based on their bandwidth and CPE requirements ensuring they benefit from the maximum cost efficiencies.

2.2 Benefits and key messages.

The COLT ATM and Frame Relay service has a number of key features and benefits to offer to customers requiring a data network. A summary of some of these is given below.

Feature	Benefit
Flexible network topology	Customers only need a single physical connection to the network from each site. PVC's are logical rather than physical connections. Therefore it is no longer necessary to provide and manage a large number of ports at each site to construct a large data network.
Single network	ATM provides a single network for all traffic types – voice, data and video. This integration of networks allows for improved efficiency and manageability. If the customer requires a service that needs a highly variable bit rate on demand, COLT ATM and Frame Relay can provide it.
Scaleable	Customers are able to grow or reduce their bandwidth requirements to suit their business and application needs.
Bandwidth Granularity	ATM and Frame Relay are not constrained by the bandwidth limitations of SDH and can therefore offer a granular service allowing customers to purchase only the bandwidth they require.
Legacy Protocol Support	ATM and Frame Relay are layer 2 technologies and as such

Feature	Benefit
	are transparent to the protocols operating in the customer network or of the data sent across the COLT network thus enabling the support of layer 3 legacy protocols.
Multiple circuits over a single access port	Customers do not require multiple interfaces or equipment. The access port can be logically separated into a number of virtual circuits.
Integrated voice, video and data over a single physical access	A number of service types are available for both ATM and Frame Relay, these can be mixed across the port to ensure different traffic types are managed most effectively.
Integrated Internet Access	Integrated, fast and economical Internet access through the addition of a single PVC direct to the COLT Internet service making use of the existing ATM access port. Alleviating the need for a second physical access to site.
Built in Resilience	Provided over COLT's carrier class SDH network. The ATM switches are configured to ensure full redundancy.
Security	The use of PVC's is analogous to private circuits and that analogy extends to security. The creation of PVC's between customer sites creates a Virtual Private Network, which is equally secure as the physical equivalent
Burst Capability	Options of bursting up to 10:1 are available for the VBRnrt service allowing customers who have bursty traffic to benefit from additional bandwidth when they need it. Pricing is available on request.
Quality of Service	COLT provides absolute bandwidth and delay guarantees on a range of service types.
Flexible traffic engineering	Customers who understand their traffic patterns, demand guaranteed bandwidth and require control over how their data is distributed over their WAN can use the flexible approach of building PVC's and using the different categories of service to ensure their network is optimised for all their traffic types. When there is a need or traffic patterns change, PVC's can quickly be shifted, cancelled or upgraded to avoid minimal disruption
Cell to Frame inter-working	Allows optimum flexibility, customers can mix and match their Frame Relay and ATM ports as they wish.
Enables new applications.	As a result of the services high speed and the integration of traffic types, ATM will enable the creation and expansion of new applications such as multimedia to the desktop

3   The COLT Network
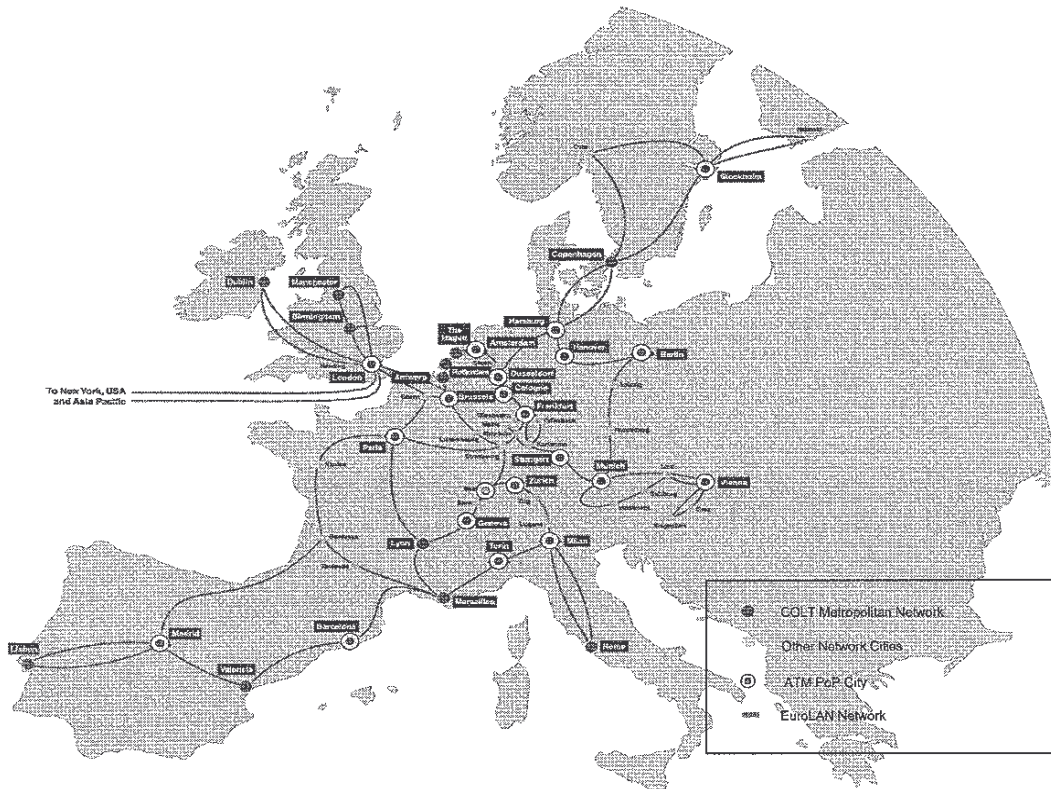
Figure 2 - COLT Network and ATM PoPs

COLT has a long-distance transmission network "the COLT EuroLAN" which spans over 15,000 kilometres of fibre-optic infrastructure laid in protective ducts.

The COLT network links up COLT's city networks that have over 9600 buildings directly connected by COLT local fibre-optic infrastructure in 13 countries across Europe. These countries are: Austria, Belgium, Denmark, Republic of Ireland, France, Germany, Italy, Netherlands, Portugal, Spain, Sweden, Switzerland and UK. Also, a PoP exists in New York which is connected to the European network via separate transatlantic links.

All customer sites are connected to this network either directly using COLT fibre or COLT DSL, or via a 3rd party transmission link. Partner packet networks interconnect to this network at key points to provide efficient global coverage.

3.1   ATM deployment

COLT deploys over 30 carrier grade ATM switches in its network. Each switch is connected to at least two other switches ensuring that the network is fully redundant and if any one link should fail the alternative link is provisioned to be able to carry all the traffic. All redundant links are diversely routed.

4   COLT ATM and Frame Relay Service

4.1   Structure of COLT ATM and Frame Relay Services

At present COLT ATM and Frame Relay services are available over a User to Network Interface (UNI). This means that all associated Customer Premise Equipment (CPE) e.g. Routers, will need to be provided by the end customer. Also customers will be required to conduct their own traffic shaping, noting that COLT reserves the right to reject traffic that exceeds the traffic contract.

4.1.1   ATM

ATM is a standards based transport protocol that enables the integration of voice, video and data applications over a high quality digital infrastructure, combining the throughput and delay performance of private wire with the bandwidth efficiency and flexibility of packet switching.

ATM is highly flexible, supporting legacy as well as new service technologies.

4.1.2   Frame Relay

Frame Relay traffic is transported across the network within ATM cells. Frame Relay is particularly suited for Local Area Network (LAN) based applications since it can carry bursts of data at the full site access speed without requiring the customer to contract for large and uneconomical bandwidth reserves.

Typically Frame Relay is used for sub 2Mbps intra-site connectivity requirements and will support most standard applications that can tolerate a level of delay.
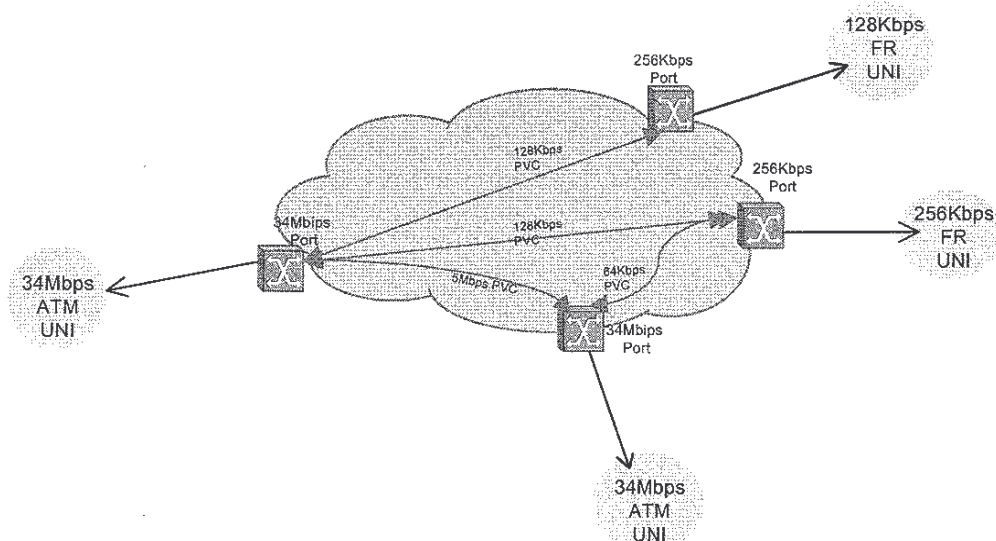
4.1.3   Core Components of a typical network.

Figure 3 - Core Components of ATM and Frame Relay Service
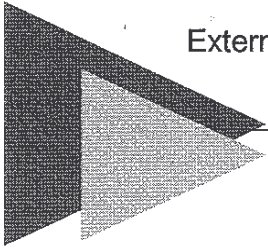
4.2 Access Ports

In order to pass and receive traffic to and from COLT's data network, access ports are required at each end of the circuit. To enable optimum access to the network, customers should select a port size that suits their individual traffic profile.

The following Access Ports are supported as standard within the COLT ATM and Frame Relay Portfolio.

Port Size	COLT Frame Relay	COLT ATM
64 Kbps	✓	✗
128 Kbps	✓	✗
256 Kbps	✓	✗
512 Kbps	✓	✗
1024 Kbps	✓	✗
1984 Kbps	✓	✗
2 Mbps	✗	✓
2x2Mbps*	✗	✓
3x2Mbps*	✗	✓
4x2Mbps*	✗	✓
34 Mbps	✗	✓
45 Mbps	✗	✓
155 Mbps	✗	✓

Table 1 - Access Port Options

* note these options have been made available to ensure that connectivity costs when using 3rd party OLO tails are kept to a minimum. This is not available for sites where connectivity is on-net or via DSL connectivity. In order to provide these options COLT utilises ATM IMA technology, which in some cases will have a distance limitation. Please refer to the section on service access types for further information.

Access circuits are dependent on the tail circuit availability in any one country and will be driven by the customer access port requirements.

4.3 PVC/PVP

COLT ATM and Frame Relay Services provides point to point connections across the ATM network in the form of Permanent Virtual Circuits (PVCs) or Permanent Virtual Paths (PVPs). More than one PVC can be set up from a single port.
Customer traffic is transported via a pre-defined connection across the network. The connection is established at the time of subscription and remains established independent of traffic activity. PVC's are permanent in that connections are not set up or torn down for a single transmission.
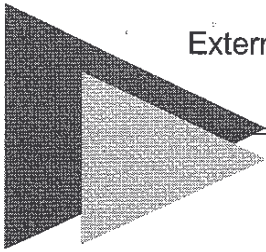
Whereas hundreds of PVC's can be supported per ATM UNI (up to 65,000), the number of PVPs supported is limited. On an E1 UNI the limit is 16; on E3, DS3 and STM-1 the maximum is 225).

Currently there is no price differential between the two options, customers are advised however, to use PVCs where possible to maximise port utilisation.
Uni-directional, bi-directional, symmetrical and asymmetrical connections are available.
➤   COLT's default is to implement PVC's as bi-directional symmetric circuits.

4.3.1   Bandwidths

The following PVC's are supported as standard with pricing on the latest price list, other bandwidths may be available by request to the product manager.

PVC	COLT Frame Relay	COLT ATM	PVC	COLT Frame Relay	COLT ATM	PVC	COLT Frame Relay	COLT ATM
16 Kbps	✓	✗	11 Mbps	✗	✓	30 Mbps	✗	✓
32 Kbps	✓	✗	12 Mbps	✗	✓	31 Mbps	✗	✓
64 Kbps	✓	✗	13 Mbps	✗	✓	32 Mbps	✗	✓
128 Kbps	✓	✗	14 Mbps	✗	✓	33 Mbps	✗	✓
192 Kbps	✓	✗	15 Mbps	✗	✓	34 Mbps	✗	✓
256 Kbps	✓	✗	16 Mbps	✗	✓	35 Mbps	✗	✓
384 Kbps	✓	✗	17 Mbps	✗	✓	40 Mbps	✗	✓
512 Kbps	✓	✓	18 Mbps	✗	✓	50 Mbps	✗	✓
768 Kbps	✓	✓	19 Mbps	✗	✓	60 Mbps	✗	✓
1024 Kbps	✓	✓	20 Mbps	✗	✓	70 Mbps	✗	✓
2 Mbps	✗	✓	21 Mbps	✗	✓	80 Mbps	✗	On request
3 Mbps	✗	✓	22 Mbps	✗	✓	90 Mbps	✗	On request
4 Mbps	✗	✓	23 Mbps	✗	✓	100 Mbps	✗	On request
5 Mbps	✗	✓	24 Mbps	✗	✓			
6 Mbps	✗	✓	25 Mbps	✗	✓			
7 Mbps	✗	✓	26 Mbps	✗	✓			
8 Mbps	✗	✓	27 Mbps	✗	✓			
9 Mbps	✗	✓	28 Mbps	✗	✓			
10 Mbps	✗	✓	29 Mbps	✗	✓			

Table 2 - PVC Bandwidth Options

4.3.1.1   COLT Frame Relay
The total of bandwidth sizes of all the PVC's at a particular port must not exceed the capacity of that access port, i.e. the Access Port may not be oversubscribed.

As standard the port size is dimensioned so that it is twice the sum of all the PVC CIR's presented at that port. The maximum aggregated PVC CIR is limited to 75% of the port speed. Non standard dimensions are available subject to the bespoke process.

4.3.1.2   COLT ATM
As standard the total of bandwidth sizes of all the PVC's at any one port may not exceed the capacity of that access port. However it may be possible to overbook the port on application through the bespoke process. It should be noted that in this case, although the sum of SCR may exceed the physical bandwidth of the port, the SCR of each individual PVC must still be
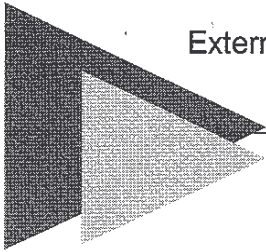
lower than the physical bandwidth. The port will police the traffic entering the network, and based on the service class may discard or tag cells exceeding the traffic contract.

4.3.2   Service Class

COLT ATM and Frame Relay Services can provide customers the quality of service most suited to their applications through a number of different service classes, the characteristics of which define the quality of service the customer can expect and should be closely matched to the traffic types it is expected to carry across the network.

PVC's are managed with agreed QoS and traffic parameters for:
- Constant Bit Rate (**CBR**),
- Variable Bit Rate, non real-time (**VBRnrt**)
- Unspecified Bit Rate (**UBR+**) traffic.

Service class is assigned on a PVC basis, allowing multiple PVCs of different service types to be transmitted over the same Access Port.

4.3.2.1   Constant Bit Rate (CBR)

The CBR service is optimised for real-time applications such as voice and video. Typically these traffic types require minimal cell loss and minimum delay, as they are not generally bursty in nature it is efficient to assign a fixed bandwidth.

CBR queues in the ATM network are very short to limit the jitter and latency introduced by each switch. CBR is not recommended for bursty applications

4.3.2.2   Variable Bit Rate non real time (VBRnrt.1)

The VBRnrt service transports variable rate information to support applications that do not require the highly deterministic delay performance of CBR. The customer subscribes to a traffic contract, which specifies the service parameters. Any traffic presented to the network outside of these contract parameters will experience discard on ingress to the Network.

Currently COLT deploys VBRnrt.1 as standard with an MBS of 300 cells.

4.3.2.3   Variable Bit Rate non real time version 3 (VBRnrt.3)

Similar to VBRnrt.1, VBRnrt.3 tags the cells that exceed the SCR and sends them into the COLT network as opposed to discarding them. Cells that are tagged are deemed as lower priority to the other VBRnrt traffic and in the unlikely event of network congestion, they will be dropped in preference to the other 'conformant' traffic. All traffic presented above the PCR will be discarded, cells below the PCR and above the SCR will be tagged at ingress to the network.

As standard burst ratios available are 2:1, 3:1, 5:1 and 10:1.

4.3.2.4   Unspecified Bit Rate (UBR+)

This service class is intended for non-delay sensitive applications such as LAN interconnect. This is currently only available for COLT's Frame Relay service. UBR is a best efforts delivery service.
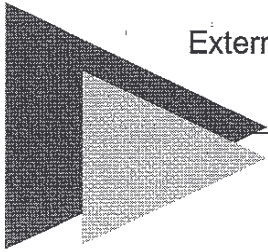
UBR+, unlike UBR does allow for a Minimum Cell Rate (MCR) to be set. COLT sets the MCR at the customers required bandwidth as standard.

4.3.2.5   Service Class Availability by service.

Service Class	COLT Frame Relay	COLT ATM/Frame Relay Inter-working	COLT ATM
CBR	✗	✗	✓
VBRnrt.3	✓	✓	✓
VBRnrt.1	✗	✗	✓
UBR+	✓	✗	✗

Table 3 - Service Class Availability

Frame Relay to ATM Inter-working will use VBnrt.3 category of service as a default.

4.3.3   Service Parameters

COLT's ATM and Frame Relay service supports the ATM forum concept of traffic contracts. All traffic entering the network is controlled (policed) in order to ensure that all QoS guarantees are maintained for all users.
The traffic contract is defined in terms of a combination of the following connection service descriptors.

➤   Peak Cell Rate **(PCR)**
This is the maximum rate at which the network agrees to transfer information across a PVC.
➤   Sustainable Cell Rate **(SCR)**
This is the maximum average cell rate that bursty traffic can be sent.
➤   Maximum Burst Size **(MBS)**
Specifies the number of cells that may be transmitted at the peak cell rate and still be conformant to the traffic contract. COLT's standard MBS is 300 cells.
➤   Cell Delay Variation Tolerance **(CDVT)**
Specified in seconds and determines the amount of cell 'clumping' which can be accepted by the service switch buffers. The ATM layer functions (e.g. cell multiplexing) may alter the traffic characteristics of ATM connections by introducing Cell Delay Variation. When cells from two or more ATM connections are multiplexed, cells of a given ATM connection may be delayed while cells of another ATM connection are being inserted at the output of the multiplexer. Similarly some cells may be delayed while physical layer overhead or control cells are inserted. Variation in cell delay can result in cells having some spacing variability and should therefore be limited by the CPE and the maximum value allowed to ingress at a customer interface is defined by the cell delay variation tolerance.

4.3.4   Bursting on ATM and Frame Relay
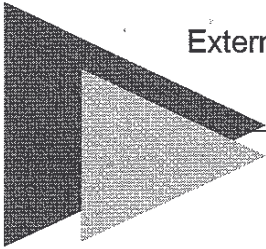
COLT's ATM VBRnrt.1 standard service has been set to PCR=SCR in order to guarantee service quality to the customer.

Bursting capability is available on VBRnrt.3 up to a ratio of 10:1 with a MBS of 300 cells for those customers who require more flexibility.

Standard ratios of PCR to SCR are 1:1, 2:1, 3:1, 5:1 and 10:1 Other ratios may be available on application to the product manager.

For Frame Relay where a Committed Information Rate (CIR) is agreed, customers are assured of a specific throughput. Bursting is set as standard at 2:1 but can be allowed up to port speed upon request and subject to additional costs. COLT reserves the right to discard cells exceeding the CIR to reduce network congestion.

The service is defined for the customer sending cells with Cell Loss Priority (CLP) bit set to CLP=0. If the customer chooses to send cells with CLP=1, then performance objectives for the service may not be met and CLP=1 cells may be selectively discarded.

4.3.5   Traffic Policy

Traffic policing is carried out by the ATM network on a per connection basis at the ingress to the network to ensure the traffic contract is adhered to by the customer.

4.4   Customer Interface

COLT's ATM service offers a User Network Interface conformant to the ATM Forum UNI specification version 3.1[Ref. 3]. The support of Switched Virtual Connections (SVC), or the ILMI, is not currently offered, and this part of the specification is not applicable to COLT's service offering.

The service supports ATM cells conforming to the cell structure defined in the ATM Forum, User Network Interface specification (UNI) Version 3.1 [Ref. 3] and in ITU-T Recommendation I.361 [Ref. 4]. F4/F5 Operation and Maintenance (OAM) flows, as defined in ITU-T Recommendation I.610 [Ref. 6], are initially passed transparently across the Network and not acted upon

The Header Error Check (HEC) field is generated and used in accordance with ITU-T Recommendation I.432 [Ref. 5]. Cell payload bytes are scrambled in accordance with ITU-T Recommendation I.432 [Ref. 5].

Two levels of Permanent Virtual Connections (PVCs) can be supported at the UNI:
Virtual Channel Connection (VCC) which consists of a single connection established between two ATM VCC end-points.
Virtual Path Connection (VPC) which consists of a bundle of VCC's carried transparently between two ATM VPC end-points.

Both VCCs and VPCs are offered on a point-to-point basis.

The following tables summarise the access port options available for ATM and Frame Relay.
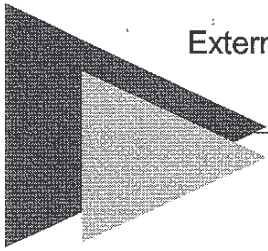
4.4.1 COLT Frame Relay

Port Speed	Presentation Options	Physical Termination	FR UNI Standard
64, 128, 256, 512, 1024 & 1984 kbit/s	X.21 (V.11)	Female Sub-D 15 pin	ITU-T Q.933 ANSI T1.617a Annex D Frame Relay Forum LMI
	V35	Female Sub-D 35 pin	
	G.703/G.704	BNC, 75Ohm, unbalanced 120Ohm balanced on Krone or RJ45	

Table 4 - Frame Relay Presentation Options

Note: For off network connections, the interface will be dependent on the third party provider.

4.4.2 COLT ATM

Port Speed	ATM Cell Mapping	Physical Characteristics and Framing	Physical Termination	ATM UNI Standard	Maximum Cell Throughput Data Rate
2Mbps (E1)	G.804	G.703 G.704	BNC, 75 Ohm, Unbalanced 120 Ohm Balanced on Krone or RJ45	ATM UNI Version 3.1	1920Kbps
34Mbps (E3)	G.804 direct or PLCP	G.703, G.832 (direct) Or G.703, G.751 (PLCP)	BNC, 75 Ohm, Unbalanced	ATM UNI Version 3.1	33.920Mbps (direct) or 30.528Mbps (PLCP)
45Mbps (DS3)	G.804, direct or PLCP	G.703, G.832 C-bit parity/M23	BNC, 75 Ohm, Unbalanced	ATM UNI Version 3.1	44.210Mbps (direct) or 40.704Mbps (PLCP)
155Mbps Electrical	G.707	G.703, I.432	BNC, 75 Ohm, Unbalanced	ATM UNI Version 3.1	149.76Mbps
155Mbps Optical	G.707	G.957, I432	SC, ST, FC/PC single mode	ATM UNI Version 3.1	149.76Mbps

Table 5 - ATM Presentation Options

* Where STM-1 optical presentation is requested COLT will use single-mode fibre. Customers requiring multi-mode presentation are required to provide all necessary converters.

Note: For off network connections, the interface will be dependent on the third party provider.

4.4.3   ATM and Frame Relay National and COLT SDSL network

COLT will be presenting this service as ATM wires only in the first instance. To ensure full inter-working capability between the COLT service and the customer equipment, the customer will need to ensure their CPE supports the following;

4.4.3.1   SHDSL Specification

➤ SHDSL (TC-PAM line code) ITU-T G.991.2 standard, Annex A(N. America) and Annex B (Europe)
➤ Embedded Operation Channels (EOC)
➤ Data rate:192Kb/s ~ 2.312 Mb/s for 2-wire mode
➤ Auto-adaptation to the DSLAM bit rate

4.4.3.2   ADSL Specification

➤ ANSI T1.413 Issue 2
➤ ITU G.992.1 (G.dmt)

Customers should ensure that their CPE is configured with a PCR value that does not exceed the value of the upstream bandwidth.

4.5   Service Access Types

4.5.1   Directly connected to the COLT transmission network - 'ON-net'

Where a customer building is directly connected to the COLT network, COLT will provide the transmission equipment in the customer premise; this is termed an 'ON-net' building.

In this case the access line for service is provided as a physical bi-directional 2Mbps, 45Mpbs or 155Mbps pipe. The physical pipe determines the maximum size of the service bandwidth that can be provisioned before it is necessary to upgrade the pipe to the next size.

A typical deployment for ON-net utilises SDH in order to ensure high availability. The access design is the same for all port speeds and is shown schematically as per figure 4.
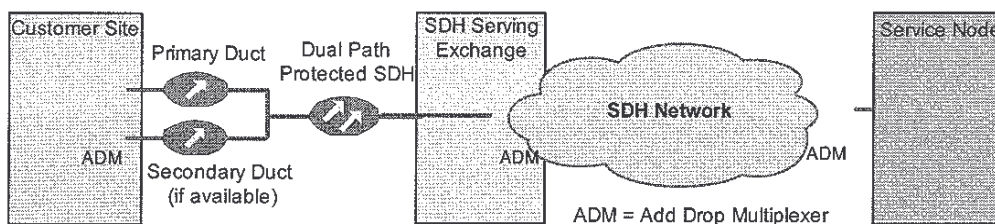
Figure 4 - COLT SDH Access Design

Each access to a customer site uses a ring architecture and diversely routed fibres where possible. SDH provides the capability to switch between circuits where there are two separate circuits, known as automatic protection switching, access connectivity can be restored within 50ms in case of failures.

Within the core each node is parented to at least two other nodes using COLT's own backbone which are themselves protected using the same method as in the access network
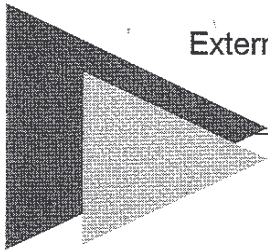
to ensure an highly resilient highly available network. The core network typically running at availability levels of 99.999%.

4.5.2 Directly connected to the COLT DSL Network

In a number of countries COLT uses DSL connectivity direct to the customer premises via unbundled local loop. Bi-directional bandwidths of 256Kbps, 512Kbps, 1Mbps, 1.5Mbps & 2Mbps are available COLT SDSL sites support a maximum of 16 PVC connections.

PVC speeds quoted are inclusive of the ATM/FR overhead.

4.5.3 Connected to the COLT network via 3rd Party Transmission tail ('OLO tail') OFFnet

This option is logically the same as the ON-net case but the local loop, from the nearest COLT transmission PoP to the customer premise, is provided by a 3rd Party (usually the incumbent PTT).

The physical pipe between the nearest transmission PoP and the customer premise varies depending on the bandwidth requirements of the customer and the 3rd Party OLO chosen in the country. Options may range from 64k to 155Mbps and have to be selected site by site. Typically services will be delivered in Europe as one of the following:
➢   2Mbps
➢   2x2Mbps –IMA technology*
➢   34Mbps (& 45Mbps in certain cases)
➢   155Mbps
For sites outside Europe, such as USA and Japan, the options may be different.

4.5.3.1   IMA

IMA allows COLT to multiplex several E1's together to provide bandwidth between 2Mbps and 7.5Mbps. This has several advantages for the customer, reducing the cost of the third party tail, whereby an E3 would usually be required and potentially reducing the CapEx for a customer where a smaller router may now be used.

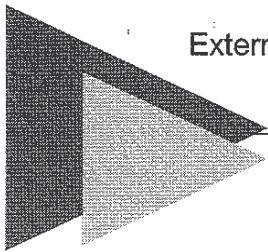The maximum number of E1's supported with IMA technology is currently limited to 4.

There is an impact on the bandwidth available when using IMA, the table below highlights the available bandwidth to a customer when IMA is used.

Number of E1's	Maximum Transport Bandwidth
2 x E1	3808 Kbps
3 x E1	5712 Kbps
4 x E1	7616 Kbps

Table 6 - Available Access Bandwidth with IMA

*ATM IMA technology in certain cases may have distance limitations, the maximum length of the underlying SDH Ring should not exceed 2000km. Implementations where the customer site may exceed this, or is outside of the COLT country where the serving ATM PoP is located should be validated by the COLT bespoke process.

4.5.4   ATM and Frame Relay National

This option is logically the same as the ON-net case but the local loop, from the nearest DSLAM PoP to the customer premise is based on an interconnect service provided to COLT by a 3rd Party (usually the incumbent PTT.

It allows COLT, in most cases, to create an uncontended DSL based ATM connection to link the customer to the COLT network. Customers benefit from superior network reliability with COLT's absolute bandwidth and delay guarantees, providing a low cost access method for small to medium sized offices where OLO tails are prohibitively expensive

Permanent Virtual Circuits (PVC) are also built between customer sites to create a Virtual Private Network (VPN). This allows seamless interworking between multi-branch offices, and is as secure as the leased line equivalent for linking sites. PVC speeds quoted are inclusive of the ATM/FR overhead.

ATM and Frame Relay National sites only support a single PVC connection to another site, for example this would be back to a hub site.

To ensure full compatibility any CPE chosen by the customer to be used with wires only ATM and Frame Relay DSL services should be conformant to the DSL specifications provided in the Customer Interface Section

4.5.5   Access to COLT via Partner Packet Network

To provide global coverage, that is access to sites in Eastern Europe, Asia Pacific, US outside of East Coast, Middle East and Africa, COLT has agreements with a number of partners to use their packet networks as cost-effective access mechanisms to the ATM and Frame Relay network. The service does not change when using a partner network although the service levels may differ.

If a site is connected using this method, it is important to note that the customer is responsible for any internal cabling.

4.6   Features and Functionality

4.6.1   Integrated Internet Access

Internet access is available as a chargeable service option on the ATM and Frame Relay network. Using the same physical Access Port, a separate PVC will be built across the COLT ATM network to a gateway router to the COLT IP network.

Due to the nature of the Internet, Integrated Internet PVCs will be mapped to the UBR+ category of service (MCR=CIR=0) as standard. The sum of the PVC bandwidths at any one site including Internet PVCs must not exceed the Access Port size.

The packet loss and latency for the Internet enabled PVC across the COLT network will be the same as that for the COLT InterAccess product.

ATM and Frame Relay National sites are restricted to a single PVC connection and thus will not be eligible for Integrated Internet Access.

Additional service options are available with Internet Access, they should be ordered using the InterAccess Order Form stating explicitly that this is for Integrated Internet Access with ATM and Frame Relay.

Options Available	Comments
PA Address Space	Up to 8 public addresses
PI Address Space	If the customer has their own address range (and this can support AS number)
Routing	Either Default Gateway(static) or BGP
Domain Name	Transfer of customer domain to COLT DNS ownership
Primary DNS	Master DNS, where COLT will host and administer the domain zone file on behalf of the customer
Secondary DNS	Slave DNS, where customer is responsible for zone file administration and COLT regularly polls the customer DNS server for any zone file updates.
Reverse DNS	Only available to customers who have their domain name/s hosted by COLT
SMTP Relay	COLT will route outgoing mail from customer (authenticated on IP address range)
SMTP Backup	COLT provide backup mail host for inbound customer mail to store when the customer server is unreachable.

Table 7 - Additional Options with Integrated Internet Access

The packet loss and latency for the Internet enabled PVC across the COLT network will be the same as that for the COLT InterAccess product.

4.6.2   Resilience & Redundancy options

4.6.2.1   Shadow PVC

Shadow PVCs can be built to protect for a failure at a primary hub site or a site of critical importance. Usually these are built from a branch site to a second hub or disaster recovery site. Normally this will result in two PVC's per branch site terminating at the primary and the backup site. In the event of a failure at the primary site, the primary PVC will no longer be usable to the customer and the customer can then switch the traffic to route via the shadow PVC to the disaster recovery site. It is the customers responsibility to switch their traffic to the shadow PVC.

Shadow PVC's will typically be provided as UBR or VBRnrt at 1% of the primary PVC speed, however it will also be possible to provide a shadow PVC at the full speed, this will be reflected in the cost.

4.6.2.2   Business Continuity

Business continuity allows the customer to have access links and ports pre-provisioned into their sites and have a bandwidth and connectivity plan built and registered with COLT. In the event that service needs to be turned on quickly, due to say the failure of an alternate supplier, COLT can implement the plan and have the whole customer network up and running within 24 hours of request.

4.6.3 Multi-Service Switch

A customer located Multi-Service Switch is available as an additional option to the ATM and Frame Relay bandwidth services within the ATM and Frame Relay portfolio providing a cost effective, scaleable solution to off-net sites or customers requiring multiple services or interfaces over a single access circuit.

4.6.3.1 Customer Benefits

Typically for customer sites which are not directly connected to the network, COLT would provide service using a third party OLO circuit. Where a customer requires multiple services or access ports to an off-net site, multiple OLO tails would have been required in the past, proving costly for the customer. The Multi-Service Switch will allow a single (OLO) access circuit to be sourced to the customer site and will then break this down to a number of customer facing access ports and interfaces which can be utilised for different applications.

The Multi-Service Switch also allows the customer the flexibility to perform local switching, breaking down the bandwidth and directing it at different parts of the business, partners or other companies in the same building and as such may prove a viable solution for multi-tenanted offices who require flexible bandwidth.
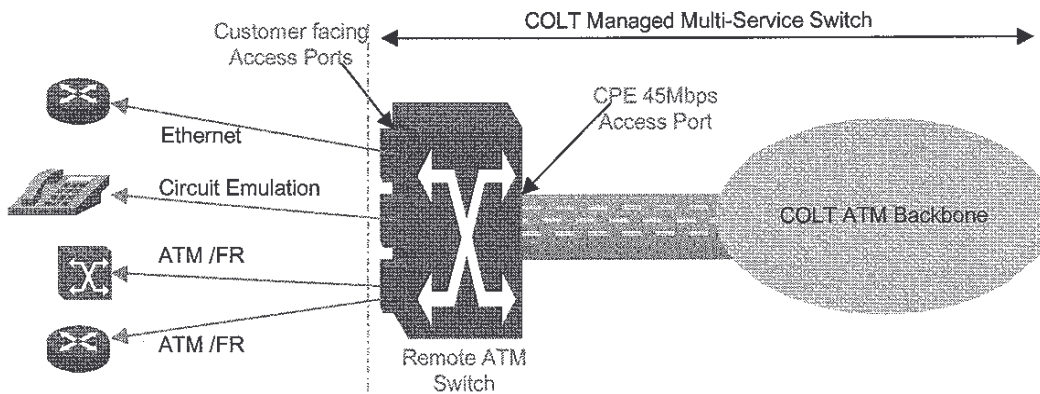

Figure 5

Figure 6 - Multi Service Switch

4.6.3.2 Service Options

This multi-service switch is customisable by the end customer to support a variety of network requirements. Simply select the base package to reflect the site connectivity bandwidth then choose from a number of resilient and additional interface options.

Base Package Options

Base Package	7270 base STM-1 uplink	7270 base E3 uplink
power, switching, control redundancy	included	included
local spares	included	included
remote access device	for COLT management purposes	

Table 8 - MSS Base Package

Redundant Options for the access link

Redundant Uplink Option	Prt/Slot per card
STM-1 Electrical	1
E-3	3

Table 9 - MSS Redundant options

Customer Interface Options

Customer interfaces	Prt/Slot per card
STM-1 Optical	1
DS-3	3
E-3	3
E1 FR X.21	16
E1 CE	8
Ethernet (bridged)	4

Table 10 - MSS Interface options

This service is managed by COLT using the same management system that COLT uses for it's own ATM backbone. A remote access router is included in the base package to ensure that the COLT NOC can dial into the switch to troubleshoot in the unlikely event of failure.

Due to the nature of a customisable solution, this service should be validated via the bespoke process at this stage. Sites that are located outside of COLT Countries should be referred to the Product Manager.
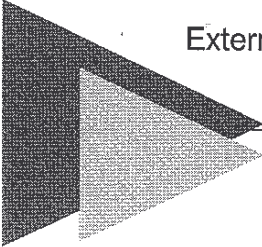
There is a limit of 5 cards per Multi-Service Switch, this includes cards used on the redundant Uplink Option.

4.7 Performance objectives

COLT offers a Service Level Agreement (SLA) for ATM and Frame Relay [Ref. 2] which offers customers service delivery and fault handling guarantees with appropriate compensation schemes for non-delivery of promised services. Some high level information is provided here, however for the latest SLA please refer to the COLT Intranet or request a copy from your Account Manager.

4.7.1 Target Network Performance

The following table shows core network PoP to PoP typical round trip delays for the ATM backbone. These are based on actual measured performance but should only be considered as an indicative guide for cell delay.

ms	AT	BE	CH	DE	ES	FR	IT	NL	SE	UK
AT		40	30	15	50	25	30	40	40	30
BE	40		30	25	40	15	35	5	50	15
CH	30	30		15	35	15	5	30	15	25
DE	15	25	15		35	10	20	25	25	20
ES	50	40	35	35		25	40	40	60	35
FR	25	15	15	10	25		20	20	35	10
IT	30	35	5	20	40	20		30	45	25
NL	40	5	30	25	40	20	30		50	10
SE	40	50	15	25	60	35	45	50		45
UK	30	15	25	20	35	10	25	10	45	

Table 11 - Typical PoP to PoP round trip delay in milliseconds

Cities:
AT = Vienna; BE = Brussels; CH = Zurich; DE = Frankfurt; ES = Madrid; FR = Paris; IT = Milan; NL = Amsterdam; SE = Stockholm; UK = London

The transmission delays calculated is for the Round Trip Time (RTT) i.e. outward and return route. To calculate the one way transmission delay one must divide these figures in this matrix by 2. This does not account for re-routing in the case of a problem.

4.7.2   Service Availability

Service Availability is defined in full in the COLT ATM and Frame Relay SLA, which is a separate document [Ref. 1] and includes details of the rebates if targets are not met. This section gives a summary of the annual availability targets.

4.7.3   Fault Handling

Fault handling is defined in full in the COLT ATM and Frame Relay SLA, which is a separate document [Ref. 1] and includes details of the rebates if targets are not met. This section gives a summary of the repair targets.

Faults may be reported via the local telephone numbers as set out in the service user documentation, 24 hours a day, 365 days a year. The period when the Service was not Available, will be measured from the time such condition is reported by the Customer, and a trouble ticket is opened by COLT, to the point when COLT resolves the trouble ticket and informs the Customer that the Service is available. The Customer shall be deemed to have been informed of Service Availability if COLT has unsuccessfully tried to contact the Customer.

Reduced charges apply where targets are not met as specified in the COLT ATM and Frame Relay SLA, unless the ability to repair a fault is outside the control of COLT.

Note: where COLT personnel or COLT dispatched contract personnel are unable to gain immediate access to the customer premise equipment or network cabling within the customer premise then any associated SLG for time to repair or availability shall not be valid.
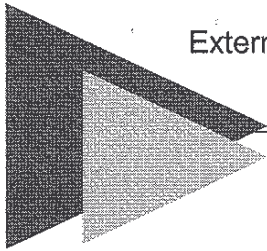
4.7.4 Service Delivery Guarantee

COLT ATM and Frame Relay offers the target delivery lead-times shown in table 12.

Target Delivery Lead time	Target Delivery
Provision Time – On-Net sites	30 Working Days
Bandwidth / Connectivity Provision and Modification*	1 Working Day

Table 12 - Target Delivery Lead Times for Buildings connected to COLT Network

Note: provision requests and changes can only be made within normal working hours of 8.30am to 5pm local time.

For sites outside Western Europe, typical lead-times for local access delivery follow. Note that these times are indicative only and are subject to confirmation by COLT. Also some third party suppliers are unable to confirm delivery times until a firm order has been placed.
Typical Delivery Lead Times for sites not directly connected to COLT Network are shown in Table 13.

Target Delivery Lead times for Global Service	Typical Lead times
Europe (Eastern)	30-90 Working Days
USA (All)	60-120 Working Days
South America	60-120 Working Days
Australia	20-40 Working Days
Hong Kong	20-60 Working Days
India	20-60 Working Days
Singapore	20-40 Working Days
China & Taiwan	20-120 Working Days
Middle East	60-120 Working Days
Japan	30-60 Working Days

Table 13 - Typical lead times for Sites not directly connected to the COLT network

COLT Promise Date (CPD)
After placing an order, a promised date of delivery will be confirmed to you in writing within 5 Working days for Customer sites connected to the COLT network. This date is referred to as the COLT Promised Date (CPD).[Is the date confirmed within 5 working days? I know we say this but including posting time do these get to the customer within 5 days? Would we be better to say sent within 5 Working days? If changes, needs to be done in SLA too]
For non-connected buildings, a feasibility study is required before a COLT Promise Date (CPD) can be set. For some global sites where the third party tail provider is unable to guarantee the provision dates, an Estimated Provision date will be provided rather than a COLT Promised Date (CPD). This will normally be provided within 10 working days.

4.8 Security

With ATM PVC's, it is impossible for another COLT customer, via their own access, to either intercept or send data from or to another customer's site. This is because logical channels are configured and routed by COLT from its management centre. Hence, if a malicious user attempted to send data to an unauthorised site (assuming a valid VPI/VCI was known), the traffic would be discarded at the ingress node, as no connection would have been established to support this traffic.
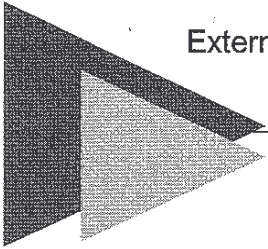
COLT ATM and Frame Relay Services are layer 2 technologies. Each PVC is completely independent so there is no risk of other customers accessing your data or Denial of Service attacks such that plague the Internet or IP based services

The physical security of our buildings is based on defined internal standards according to the operations housed within the building and access is strictly controlled. All areas within COLT buildings are secured, by means of an electronic access control system to ensure that access is only gained in a controlled way on a needs basis. All people must hold an appropriate pass card while on COLT premises.

Non COLT People are not allowed on COLT premises without being expected, with arrangements made for entry and vouched for by a COLT host or verified by the security guard in guarded buildings.

5   Service Management

5.1   General

The network is managed pro-actively by COLT. However, facilities are obviously available to enable the customers to request service as well as report problems. Dedicated units in each of the COLT countries around Europe provide these facilities. Contact details are communicated to the customer through the hand-over documentation issued when installation is complete.

When failures do occur, the customer is kept informed of progress with regular updates until the problem is resolved at which point it is confirmed with the customer that the problem is resolved.

The customer care centres (or more specifically the Network Control Centres) provide support for customer fault reporting 24 hours per day, 365 days per year.

5.2   Order Handling

5.2.1   Service Provision

Service provision needs to be viewed as two distinct activities:

- Initial provision of the service to the customer premises combined with initial configuration of the network. (See New Service Order.)
- Subsequent enabling of service features, functions and interfaces as well as service changes following initial installation. (See Modify Existing Service.)

5.2.1.1   New Service Order

The customer may place orders for the service via their account executive and/or local customer care unit. Any orders should be placed using the standard COLT ATM and Frame Relay order forms [Ref. 2]. It is important that this form is used as all the information requested on the form is critical to provision of the service. Non-completion of (or incomplete information on) this form will result in the order being delayed.

During provision, customers will be provided with regular updates via the customer care unit and/or account executive.
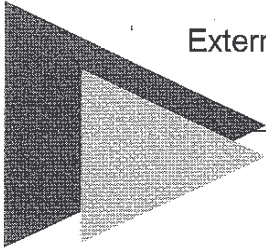
5.2.1.2   Fixed Line Access

The standard lead-time for the service is 30 working days from placement of order for connected buildings. Where buildings are not currently connected, a feasibility check is required.

The minimum rental period for any access port is 1 year. Minimum PVC rental period is 30 days if no physical change to the access line is required to change the bandwidth, i.e. PVC can be changed by configuration and does not require the access port to be upgraded.

If a change to the access port is required (e.g. 2M to 45M), then the minimum rental period for the change is 1 year.

5.2.1.3   Modify Existing Service

Customers are able to request the following changes to service. The implementation of most changes is chargeable and the change may mean there is a new rental applicable:

(i)   Category A modifications

Modifications, which fall into this category, require physical changes to the equipment delivering service.   Examples include increasing the size of the access line to accommodate increases in PVC bandwidth outside of the existing access line. This is regarded as a new provision in terms of lead-times.

(ii)   Category B modifications

Modifications, which are configuration changes, which can be done remotely, are classed as category B. Examples are changes in PVC bandwidth, which do not require physical changes to the access port and additions of new PVC's to a site. Note: for change of PVC bandwidth not requiring physical change to the access line: bandwidth charges are subject to a minimum 30 day charging period, so if customers request to reduce bandwidth at a particular site, the charge will only decrease once 30 days has elapsed from the previous change. If customers increase their bandwidth the increased charge will apply immediately.

(iii)   Category C modifications

Emergency out of hours configuration changes (i.e. Category B modifications outside normal working hours). These are subject to higher charges than normal Category B changes.

For requirements outside this constraint the product manager should be contacted.

5.2.2   Cessation of Service

The cessation of service is within 30 working days from request by the customer. Request for cessation of service may be subject to cancellation charges in accordance with COLT standard terms and conditions of COLT ATM and Frame Relay. Should the customer cancel their order part way through installation, COLT reserves the right to raise a cancellation charge

5.3   Service Maintenance and Problem Handling

The network is pro-actively monitored by COLT and maintained on an end to end basis.
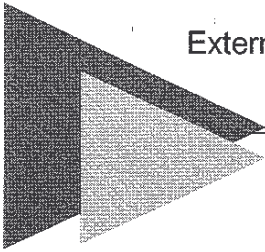
At provision time customers will be issued with a reference for their PVC's and Access Ports. The customer should only report faults using the PVC reference. A problem may be reported to any of the fault reporting points within COLT, the contact numbers will also be specified in the hand-over pack. Fault escalation is initiated when estimates indicate potential SLA violations.

When planned works is required, customers are normally notified 2 weeks (14 calendar days) in advance. Where possible planned works takes place in a regular maintenance window between 14:00 to 15:00 on Sundays. In exceptional circumstances emergency work may have to be carried out, where this is the case it is intended to give 72 hours notice. Planned work will not exceed 10 hours per year.

5.4 Billing

5.4.1 General

Customers have the option of being billed monthly or quarterly. The customer bill is available on paper or CD ROM. Initially this product will be billed separately and not consolidated with other products. The customer bill will detail:

- Access Port installation charges
- Access Port rental charges
- PVC installation charges
- PVC rental charges
- Multi Service Switch installation charges
- Multi Service Switch rental charges
- Other charges and credits
- Discounts where applicable

Customers are provided with a single Freephone point of contact for all service enquiries including billing enquiries. For detailed billing enquiries customers can be transferred to a specialised billing duty.

5.4.2 Billing Structure

- All installation charges are billed once the service has completed installation or part thereof.
- All rental charges are billed in advance, where no option is indicated, monthly billing will be set as default.
- Volume and term discounts are available.
- Invoices are calculated on a pro rata daily basis with a billing granularity of 1 day.
- Any moves, changes or modifications will incur one off charges.
- If at anytime the PVC bandwidth is changed, the minimum billing period will be 30 days.
- Invoices will be billed in Euros, except for the UK, Switzerland, Denmark and Sweden where invoices will be in local currencies.

5.5 Customer Reporting

Customers have the option to subscribe to an on-line account which will allow access to a number of reports on the status of the network. These include information on

> ➢ PVC and Access Port Utilisation
> ➢ Cell Discards/Loss
> ➢ Network Latency

Using this information, customers will be able to assess their current and future network requirements.
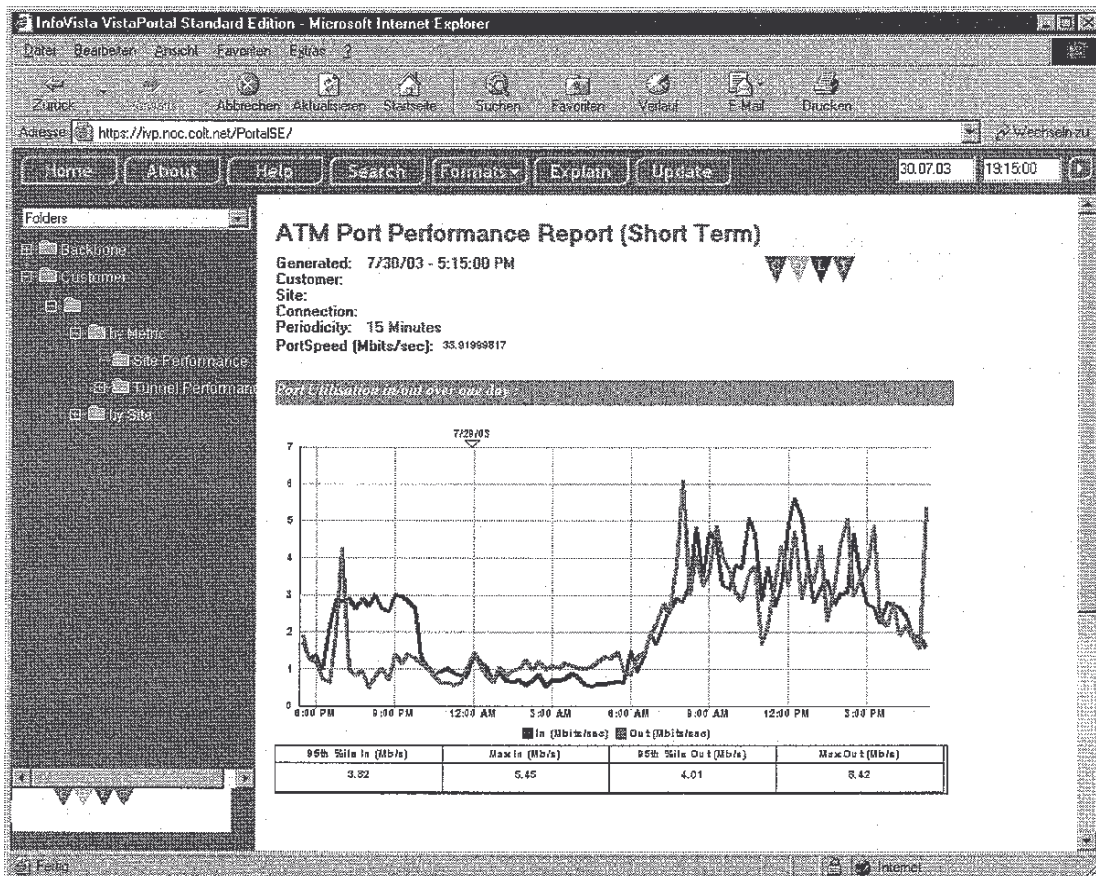
Figure 7 - Example Access Port Performance Report

Performance Report.

The performance report is available for both Access Ports and PVC's. The report is also viewed in two different timelines; as a short-term report (over the past 24 hours and 1 week) and a long-term report (over a month). Information provided, includes utilised bandwidth over measurement period, peak bandwidth in that period, and contracted bandwidth. Information is also provided on the cell error rate if applicable.

Cell Delay report

A report will be made available to all on-line reporting subscribers which will show the current delays experienced in the COLT ATM network on a PoP to PoP basis.

6   Glossary

ABR	Available Bit Rate service
ATM	Asynchronous Transfer Mode
CBR	Constant Bit Rate
CDV	Cell Delay Variation
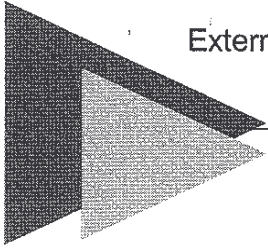
CDVT   Cell Delay Variation Tolerance
CIR   Committed Information Rate (FR)
CLP   Cell Loss Priority
CPD   COLT Promise Date
CPE   Customer Premise Equipment
EIR   Excess Information Rate (FR)
HEC   Header Error Check
ILMI   Intermediate Local Management Interface
LAN   Local Area Network
MAN   Metropolitan Area Network
MBS   Maximum Burst Size
MCR   Minimum Cell Rate
MIR   Minimum Information Rate (ATM)
NNI   Network to Network Interface
NRZ   Non Return to Zero
NTE   Network Terminating Equipment
NTP   Network Termination Point
OAM   Operation And Maintenance
PBX   Private Branch Exchange
PCR   Peak Cell Rate
PDH   Plesiochronous Digital Hierarchy
PIR   Peak Information Rate (ATM)
PLCP   Physical Layer Convergence Protocol
PT   Payload Type
PVC   Permanent Virtual Connection
QoS   Quality of Service
SCR   Sustainable Cell Rate
SDH   Synchronous Digital Hierarchy
SIR   Sustainable Information Rate
SLG   Service Level Guarantee
STM   Synchronous Transfer Mode
SVC   Switched Virtual Connections
UNI   User Network Interface
VBR   Variable Bit Rate
VBRnrt   Variable Bit Rate Non Real Time
VBRrt   Variable Bit Rate Real Time
VC   Virtual Channel
VCC   Virtual Channel Connection
VCI   Virtual Circuit Identifier
VP   Virtual Path
VPC   Virtual Path Connection
VPI   Virtual Path Identifier
VPN   Virtual Private Network

7 References

[1] ATM and Frame Relay Service Level Agreement
[2] COLT ATM and Frame Relay Order Form
[3] ATM Forum, User Network Interface specification (UNI) Version 3.1
[4] ITU-T Recommendation I.361, B-ISDN ATM Layer Specification
[5] ITU-T Recommendation I.432, B-ISDN UNI - Physical Interface Specification.
[6] ITU-T Recommendation I.610, B-ISDN Operation and Maintenance Principles and Functions.

END OF DOCUMENT.

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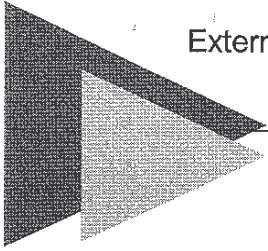
1. Introduction

This document sets out the service levels and compensation schemes encompassing the full and total liability of COLT with regard to COLT ATM and Frame Relay service and is to the exclusion of any other SLA which may be in other contracts with COLT for any element of this service.

2. Service Description

The ATM and Frame Relay VPN service consists of COLT ATM and COLT Frame Relay. These are described in the ATM and Frame Relay Service Description. Terms used in this SLA are defined in the Customer Service Agreement (CSA) and the Service Description.

3. Service Delivery Guarantee

ATM and Frame Relay offers the following standard target delivery lead-times:

Target Delivery Lead Times for Customer Premises connected to COLT Network

Order Type	Target Delivery time
Provision Time – On-Net Connected Buildings	30 Working Days
Bandwidth / Connectivity Provision and Modification*	5 Working Days

* where port capacity is available

For sites not directly connected to the COLT network (Off-net) typical lead-times for local access delivery follow. Note that these times are indicative only and are subject to confirmation by COLT where possible. Also some third party suppliers are unable to confirm delivery times until a firm order has been placed.

Typical Delivery Lead Times for sites not connected to COLT Network

Target Delivery Lead times	Typical Lead times
Europe (Western)	30-90 Working Days
Europe (Eastern)	30-90 Working Days
USA (All)	60-120 Working Days
South America	60-120 Working Days
Australia	20-40 Working Days
Hong Kong	20-60 Working Days
India	20-60 Working Days
Singapore	20-40 Working Days
China & Taiwan	20-120 Working Days
Middle East	60-120 Working Days
Japan	30-60 Working Days

COLT Promise Date (CPD)

After placing an order, a promised date of delivery will be confirmed to you in writing within 5 Working days for Customer sites to be connected directly to the COLT network. This date is referred to as the COLT Promised Date (CPD).

For non-connected buildings, a feasibility study is required before a CPD can be set. For some Off-Net sites where the third party tail provider is unable to guarantee the provision dates, an Estimated Delivery Date (EDD) will be provided rather than a CPD. This will normally be provided within 10 working days.

If COLT does not provide Service to you by the CPD and COLT cannot demonstrate the delay to be caused by circumstances beyond its control, you will have the right to claim compensation as set out in Table A

Table A : Service Delivery Guarantee - Compensation as percentage of Site Installation Fee for Western Europe

Working Days past CPD	Percentage of Site Installation Fee
2 to 5	5%
6 to 10	15%
>11	25%

Claims are subject to an upper limit of €8000 per network

4. Fault Handling Guarantee – Service Availability

PVC availability is defined in table B for the different categories of sites the Service offers.

Table B: PVC Availability Targets and Guarantees per Site Type

Availability	Target Availability
On-net Sites	100%
Off-Net Tier 1*	100%
Off-Net Tier 2*	99.90%

* See Definition of Terms for a detailed explanation

Service availability is assessed on a per PVC basis and will be deemed to be satisfied if the Service is available at the COLT service interface (NTP)

demarcation point at the customer site. Therefore, COLT guarantees the Access Circuits on the COLT Network and the Availability of the COLT Backbone Network. The COLT service ends at the UNI, unless the service includes a COLT Multi-Interface Switch, in which case the service ends at the customer facing access port on the Multi-Interface Switch. COLT is not responsible for the service on the customers side of the UNI or Multi-interface Switch, the customers CPE or any service loss resultant from non-compliant traffic shaping

The Service is defined as unavailable when packets are not able to be transmitted between the COLT demarcation points at both ends of the connecting PVC.

COLT operates a pro-active fault repair process, which is tracked by the trouble ticket system. Availability for each PVC on the COLT network is calculated as:

$$[1 – ((\text{Unscheduled downtime in measurement period})/(\text{Total time in measurement period}))]*100\%$$

The measurement period is a twelve month period from the delivery date and each subsequent anniversary of the delivery date and reduced charges apply where targets are not met. Downtime is measured on the trouble ticket system, as the time between tickets opened when an agreed fault has been identified and when they are closed when Service is restored.

The period when the Service was not available will be measured from the time such condition is reported by the Customer, and a trouble ticket is opened by COLT, to the point when COLT resolves the trouble ticket and informs the Customer that the Service is available. The Customer shall be deemed to have been informed of Service Availability if COLT has unsuccessfully tried to contact the Customer. If the performance level falls below these levels stated in the measurement period, the Customer will have the right to claim compensation as follows in Table C. Availability is assessed per PVC and not as an entire network across all customer sites.

Table C1 – PVC Availability Guarantee

Availability	Rebate Invocation Point
On-net Sites	99.95%
Off-Net Tier 1*	99.85%
Off-Net Tier 2*	99.80%

Table C2 – PVC Availability Guarantee - Compensation

Availability	Reduction in Annual Rental charge of Affected PVC
0.5% below Invocation Point	5%
1.0% below Invocation Point	15%
1.5% below Invocation Point	20%
2.0% below Invocation Point	30%

Note: for SLG's which offer reduce charges against rental for a PVC the maximum total cumulative reduction is 30% of the total annual rental for the site. For sites connected using a third party NNI this will be limited to 20% of the total annual rental of the affected PVC. This would include any claims against Repair targets

Specific exclusions to this compensation scheme are disruptions to Service caused by either Planned Works, or Loss of Service caused by faults in Access Circuits where DSL has been used to deliver a Service. For the purposes of this calculation, a Service shall not be considered as unavailable during Maintenance Windows, and during any periods in which a Service is not usable due to an event of Force Majeure, failure of customer equipment and power supplies, or the acts or omissions of customer's or any third partys' employees or agents (not within the reasonable control of COLT).

The Service will be deemed to be available when the Site to which it is connected is able transmit or receive information, except where this failure is caused by a fault at another site or the acts, fault or omission of the Customer, its employees, agents or contractors.

Service will not be deemed to be unavailable, for the purposes of this SLA if such unavailability arises from, or is otherwise caused by:

a) The Customer requesting COLT to test the Service and no failure in Service is detected or reported

b) The Service being modified or altered in any way at the Customer's request in accordance with this Agreement

c) Any suspension of the Service in accordance with the terms of the Agreement

d) A failure or fault of the Customer equipment or application, e.g. personal computers or software failures

e) The failure of the Customer to give COLT reasonable access to COLT equipment and any part of the Service upon being requested to do so by COLT for the purposes of investigating and rectifying any failure

f) The Customer failing to operate the Service in accordance with the terms of the Agreement

g) Customer induced or attributed failure or outage

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h) During any planned works or maintenance windows

Note: COLT reserves the right to charge for customer located faults. This charge shall not exceed 1000 Euro per trouble ticket raised.

5. **Maintenance Windows**

In order to optimise the network and maintain its high performance COLT may need to arrange maintenance windows. To minimise the impact of these, we will try to schedule these outside of working hours at a time that is mutually convenient. When planned works are required, customers are normally notified 2 weeks (14 calendar days) in advance. Where possible, planned works takes place in a regular maintenance window between 14:00 to 15:00 GMT/BST on Sundays. In exceptional circumstances emergency work may have to be carried out. When this is required it is intended to give 72 hours notice for the emergency maintenance window. Planned work will not exceed 24 hours per year.

6. **Fault Handling**

Faults may be reported via the local telephone numbers as set out in the Service user documentation, 24 hours a day, 365 days a year. Reduced charges apply where the Target Time to Repair (TTR) for Service Affecting Faults are not met as specified in table D, unless the ability to repair a fault is outside control of COLT. For example, immediate access is not given to equipment on customer premise.

Table D: Time to Repair (TTR) Targets

	On-Net	Off-Net Tier 1	Off-Net Tier 2
Target Time to Repair	4 hours	8 hours	12 hours

If the performance level falls below these levels, in a calendar month COLT fails to meet the above target, the Customer will have the right to claim compensation as follows in Table E for the affected month. Time to repair or restore service is assessed per PVC to a site and not as an entire network across all customer sites.

In the case where a PVC is between two different types of access i.e. On-Net and Off-Net, the worst case TTR applies.

Table E : Service Repair Guarantee – Compensation

Hours greater than Target Time to Repair	Reduction in Monthly rental charge of Affected PVC
0-3 hours	5%
3-4 hours	10%
4-6 hours	15%
6-8 hours	20%
>8 hours	25%

Note: for SLG's which offer reduce charges against PVC rental in a calendar month the maximum cumulative reduction is 50% of the monthly recurring PVC rental.

Repair times for Non-Service Affecting Faults are excluded from this compensation scheme, and will be mutually agreed on a case-by-case basis. As a guideline, COLT will aim to repair faults of this nature within three Working Days.

ATM and Frame Relay National and COLT DSL sites are excluded from this scheme.

7. **ATM and Frame Relay National and COLT DSL**

Sites served by ATM and Frame Relay National and COLT DSL are subject to a separate SLA scheme, which varies by country. Time to Repair is based on Off-Net Tier 1 target except France, which is based on a 4-hour target. All delivery times are EDD and exempt from SLG compensation.

Table F: ATM and Frame Relay National & COLT DSL - Service Level Guarantee

Country	Availability*	Hours greater than Target Time to Repair *	Reduction in Monthly rental charge of affected site**
UK	99.8%	> 6 hours	5%
France	99.8%	> 4 hours	5%
Sweden	98.5%	> 24 hours	5%
Belgium	99.8%	> 16 hours	5%
Netherlands	99.8%	> 16 hours	5%
Spain	98.5%	> 16 hours	5%
Italy	98.5%	> 16 hours	5%

*- faults caused by the PSTN (Telephone) line, carrying the DSL line, malfunctioning are exempt from compensation.

** relates to TTR guarantee.

Compensation against service availability should be claimed using Table C: Service Availability, only where an availability target is provided for ATM and

Frame Relay National in Table F above and is limited to a maximum of 5%.

Note: for ATM and Frame Relay National and COLT DSL connected sites, a Round Trip Delay (ms) of 90ms (UNI to UNI) applies except to Spain or any contended service.

8. **Target Packet Loss Ratio**

The packet loss target across the COLT backbone network is given below:

Table G: Target Packet Loss Ratio - COLT Frame Relay

Parameter	COLT Frame Relay UBR+	COLT Frame Relay VBRnrt
Max. Packet Loss Ratio	1 in 10^5	1 in 10^5

Table H: Target Packet Loss Ratio - COLT ATM

Parameter	COLT ATM CBR	COLT ATM VBR-nrt
Max. Packet Loss Ratio	1 in 10^{10}	1 in 10^7

Table I: Packet Loss Guarantee

Average Packet Loss Ratio	Reduction in Monthly Rental Charge of Affected PVC
>1%	1% per day that ratio is exceeded. Maximum of 5% of Monthly Rental

Note ATM and Frame Relay National sites are excluded from this compensation scheme.

9. **Typical Network Transit Delays**

The Network Transit Times (Round Trip Delay) are measured from UNI to UNI over a national PVC

Table J: Cell Transfer Delay Guarantee

Location	Cell Transfer Delay (ms)
Austria	50
Belgium	50
Denmark	50
Ireland	50
France	50
Germany	50
Italy	50
The Netherlands	50
Portugal	50
Spain	50
Sweden	50
Switzerland	50
UK	50

Note: for ATM and Frame Relay National, a Round Trip Delay (ms) of 90ms (UNI to UNI) applies except to Spain or any contended service.

Table K: Round Trip Delay Guarantee – Compensation for a PVC

Average Round Trip Delay	Reduction in Monthly rental charge of Affected PVC
> 10% higher	1% per day that RTD is exceeded. Maximum of 5% monthly rental

Note: ATM and Frame Relay National sites are excluded from this compensation scheme.

Table L: Typical Round trip Transit Delays between countries (UNI to UNI)

ms	AT	BE	CH	DE	ES	FR	IT	NL	SE
AT									
BE	90								
CH	90	95							
DE	80	80	75						
ES	100	95	105	105					
FR	85	75	85	75	85				
IT	95	100	100	82	115	95			
NL	95	72	100	85	95	80	95		
SE	100	120	100	110	135	115	110	115	
UK	90	80	90	82	95	70	90	72	110

Countries: AT = Austria; BE = Belgium; CH = Switzerland; DE = Germany; ES = Spain; FR = France; IT = Italy; NL = Netherlands; SE = Sweden; UK = United Kingdom

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Figures are based on On-Net tails or OLO (Other Licensed Operator) tails used for the last mile access. Round Trip Delay figures measured using a packet size of 53 bytes.

Table M: Typical Round trip Transit Delays (PoP to PoP)

Location	Round Trip Delay (ms) from London
New York	110
Los Angeles	160
Singapore	210
Hong Kong	260
Tokyo	360

Note: ATM and Frame Relay National sites are excluded from this target.

10. Submitting Claims

It is the customers responsibility to submit a claim against the SLA, and all claims must be submitted in writing to the relevant COLT Account Executive assigned to the customer within 3 months of the failure.

Where there is a conflict of data produced by the customer and COLT with respect to a claim, data produced by COLT shall be binding.

Compensation is usually paid as a credit against future rentals.

11. Cancellation of Service

Request for cessation of Service may be subject to cancellation charges in accordance with COLT standard terms and conditions of COLT ATM and Frame Relay Services.

If applicable, all cancellation charges will be billed to the customer within 90 working days from the date of cancellation

Cancellation Prior to Service Commencement

If an order is cancelled, or significantly modified (e.g. changes in address; Service type; point of presence or presentation) prior to the CPD, notwithstanding COLT's other rights pursuant to the Agreement, COLT reserves the right to claim reasonable costs incurred as a result of cancellation or modification. The amount charged will be dependent on the number of days prior to the CPD that the cancellation or modification is received from the customer as set out in Table N below.

Table N: Cancellation Charges prior to service commencement.

Number of Working Days before CPD	Percentage of Installation Charge payable on Services provided by Access Circuits on the COLT Network (On-net)	Percentage of Installation Charge payable on Services provided by Access Circuits not on the COLT Network (Off-Net)
0-1	100%	100%
2-5	75%	90%
6-10	50%	80%
11-20	25%	70%
21-30	0%	50%
31-40	0%	25%
More than 40	0%	0%

Where installation charges are not payable or are discounted, COLT will charge the cancellation charges above against the standard Installation charges.

Additionally COLT reserves the right to recover any costs associated with network or infrastructure builds or obtaining wayleaves that have been incurred on behalf of the customer prior to the time of the cancellation.

Cancellation after Commencement of Service

If Service is cancelled after the CPD the cancellation charges will be the outstanding charges for the remaining period that has been committed to contractually, or as otherwise specified in the product specific literature.

If you have any problems understanding any of the information contained within this document please contact your local COLT sales representative.

Recommendation: Store this document in a safe place.

12. Definition of Terms

Access Circuit or Access Line	Connection from customer site to COLT packet node.
COLT Backbone Network	COLT's core packet network.
COLT Promised Date (CPD)	The date on which we promise to provide Service to you.
COLT DSL	Services provided over COLT's DSL network
EDD	Estimated Delivery Date - When no CPD has been given and is a best endeavours date with no compensation scheme for late delivery.
ATM and Frame Relay National	COLT's ATM and Frame Relay service using third party wholesale DSL as an access mechanism.
Global Site	Customer site in countries where Service access is delivered by Global Partner packet network.
Global Partner	A partner network which COLT use in the delivery of ATM and Frame Relay services to customer sites outside of COLTs footprint.
Maintenance Window	A period of time when the Service is planned to be unavailable which has been notified by COLT in advance.
Network Terminating Point (NTP)	The termination of the COLT Network that provides the customer interface point.
Non-Service Affecting Fault	A fault or condition that is not a Service Affecting Fault.
On-Net Sites	Customer sites connected direct to the COLT transmission network
Off-Net Tier1	Off-Net circuit supplied in a COLT country Austria, Belgium, Denmark, Ireland, France, Germany, Italy, The Netherlands, Portugal, Spain, Sweden, Switzerland, UK
Off-Net Tier2	Off-Net circuit supplied outside of a COLT country
Packet Loss	The percentage of packets lost by you across the COLT Network per month.
PVC (Permanent Virtual Connection)	A virtual connection provisioned between two access points on the ATM network
SLG	Service Level Guarantee, being the applicable compensation for a breach of the SLA
Working Day	Monday to Friday from 8.30 am to 5.00 pm excluding Public Holidays.

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