This specification describes the situation of the Proximus network and services. It will be subject to modifications for corrections or when the network or the services will be modified. The reader is requested to check with the most recent list of available specifications that the document in one's possession is the latest version.

Proximus can't be held responsible for any damages due to the use of a version of this specification which is not included in the most recent list of available specifications.

Whilst every care has been taken in the preparation and publication of this document, errors in content, typographical or otherwise, may occur. If you have remarks concerning its accuracy, please write to "BELCOMLAB" at the address shown on the support page and your remark will be transmitted to the right Proximus department.

The User Network Interface Specifications published via Internet are available for your information but have no official value. The only documents with an official value are printed on a specific paper.

If you want to get an official version of this User Network Interface Specification, please order it by sending your request to:

Proximus / BELCOMLAB
Rue Carlistraat 2
B-1140 Evere
Belgium

tel: +32 2 244.58.88
fax: +32 2 244.59.99
E-mail: belcomlab@Proximus.be

Internet Protocol
(IP) Connectivity

Table of Contents

1. INTRODUCTION 1

2. IP TECHNOLOGY.....2

2.1. Model.....2
2.2. IP Packet Layout 2
2.2.1. Version 2
2.2.2. IHL.....2
2.2.3. TOS 3
2.2.4. Datagram Length 3
2.2.5. Identification, Flags and Fragment Offset 3
2.2.6. Time To Live (TTL).....3
2.2.7. Protocol 4
2.2.8. Header Checksum 4
2.2.9. Options 4
2.3. Addressing 4

3. IP NETWORK IMPLEMENTATION 5

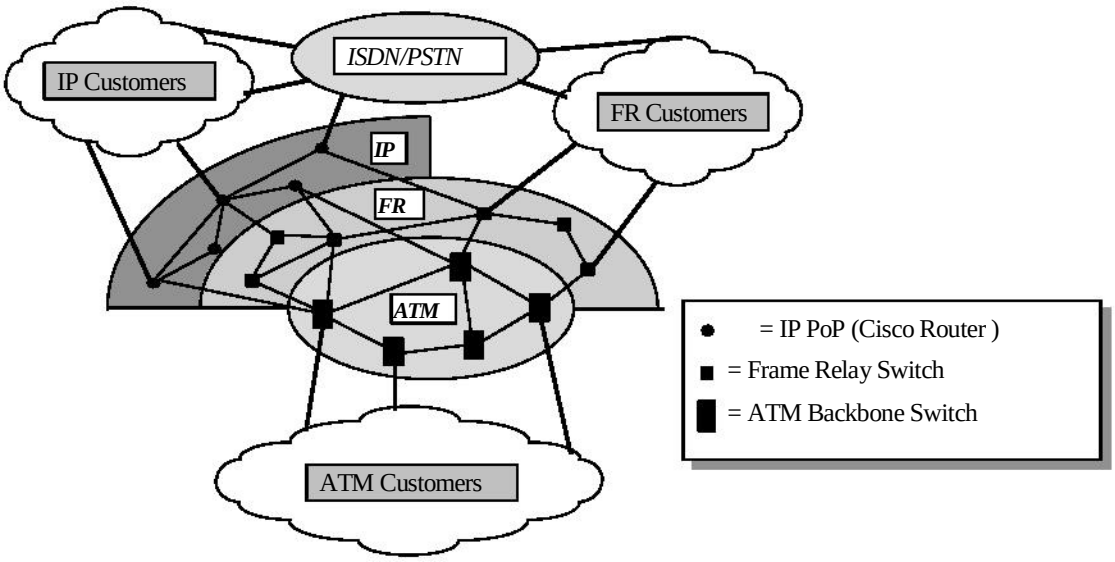
3.1. IP Network.....5
3.2. Addressing and Routing.....7
3.2.1. IP Addressing.....7
3.2.2. Routing 7
3.3. Performances.....8
3.3.1. Throughput 8
3.3.2. Transit Delay 8

4. REMOTE ACCESS CONECTIVITY SERVICE (RACS) 9

5. TERMS AND ACRONYMS 11

1. Introduction

The customer gets access to the IP network over an access line between the customer site and the access port on the IP PoP of Proximus, or via a dial up connection (PSTN/ISDN).



The access line is provisioned by the leased line service of Proximus and is specified as such elsewhere.

2. IP Technology

2.1. Model

The reference model used in this specification is based on the RFC 791 document.

The Department of Defence (DoD) has developed a network based on packet switching technology. The network has started up in 1969 under the name of Arpanet.

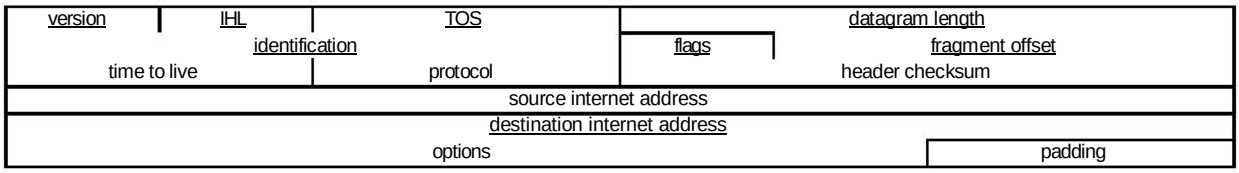
Due to problem for using different kinds of protocols or MTUs (Maximum Transmission Units) at different speeds, the « Defence Research Project Agency » started the design of a new protocol set; the so called TCP/IP (Transmission Control Protocol / Internet Protocol).

IP is a network layer protocol designed to facilitate the interconnection of heterogeneous networks. The IP implementation is as follows :

- IP is a connectionless protocol that routes datagrams over the network(s) (at Local Area Network and Wide Area Network levels);
- There is no sequencing, the sequencing of the datagrams is provided by higher layers;
- IP can be implemented with any data link or network access protocol;
- IP provides a standard addressing scheme that spans all networks;
- IP provides fragmentation to accommodate different network maximum transmission unit sizes; • IP is widely available and not vendor proprietary.

IP is a data transmission technique that combines the high speed and low delay of circuit switching with the port sharing and dynamic bandwidth allocation.

2.2. IP Packet Layout



2.2.1. Version

The version indicates the format of the IP header. This field allows for evolution of the protocol. The current version is 4.

2.2.2. IHL

The Internet Header Length specifies the length of the IP header in 32-bit words (4 bytes). The default is 5 (20 bytes). This is the IP header size without options.

2.2.3. TOS

The Type Of Service field indicates the requested delay, throughput and reliability.

If these services are not available, they will not be provided, the data is sent as good as possible. Most routers and hosts will ignore the TOS field.

2.2.4. Datagram Length

This field indicates the total length of the datagram, measured in bytes. It includes the header and the data portion. It is suggested that networks and routers can handle datagrams of up to 576 bytes.

2.2.5. Identification, Flags and Fragment Offset

A unique identification (not a sequence number) is usually provided by the upper layer protocol. If not provided, IP will generate one. It is used in the fragmentation/reassembly process.

The flag consists of 3 bits :

- bit 0 : reserved, must be zero;
- bit 1 : do not fragment bit (0 = may fragment, 1 = may not fragment);
- bit 2 : more fragments (0 = last fragment, 1 = more fragments).

The fragment offset is only relevant for the DATA portion of the datagram. It does not include the IP header. It is expressed in units of 8 bytes. It specifies the offset of the first byte of DATA this fragmented datagram transports compared to the whole segment.

Note : TCP header is considered as DATA by the IP layer.

2.2.6. Time To Live (TTL)

The time to live area indicates a hop-count. It specifies how many routers/gateways the packet may pass before being discarded.

The sender specifies a number in this field and each router will decrement it by 1. If the number = 0, the packet will be discarded. The default value is 15.

2.2.7. Protocol

The protocol number identifies the upper layer the datagram should be sent. In TCP/IP only matching protocols can be used (TCP --- TCP, UDP --- UDP).

The main protocols are :

- 1 ICMP Internet Control Message Protocol
- 6 TCP Transmission Control Protocol
- 17 UDP User Datagram Protocol
- 8 EGP Exterior Gateway Protocol
- 9 IGP Interior Gateway Protocol
- 29 ISO transport class 4
- 89 OSPF a special IGP

Other protocols exist but are not so widely used.

2.2.8. Header Checksum

The header checksum in the IP header only covers the IP header. The DATA portion (TCP header + message) is NOT covered. The header checksum is re-computed in each router. The IP header is split into 2 bytes (half-words).

2.2.9. Options

The options are : no operation, security (DoD), loose source routing, record route, strict source routing and internet timestamp.

2.3. Addressing

Due to the interconnection of networks, a global address scheme had to be defined. An internet address is composed of a network address concatenated with a host address. Each network has a unique network address. All host connected to the same network share the same network address. Routers have as many addresses as they have networks attached to them.

Addresses are composed of 4 bytes and are represented in decimal dotted notation. Three address classes are defined :

- CLASS A : network address 1 -> 126

- CLASS B : network address 128.1 -> 191.254

- CLASS C : network address 192.1.1 -> 223.254.254

These 3 classes can coexist together in one network.

3. IP Network Implementation

The Proximus's IP Connectivity Service is based on a meshed network built on Cisco equipment.

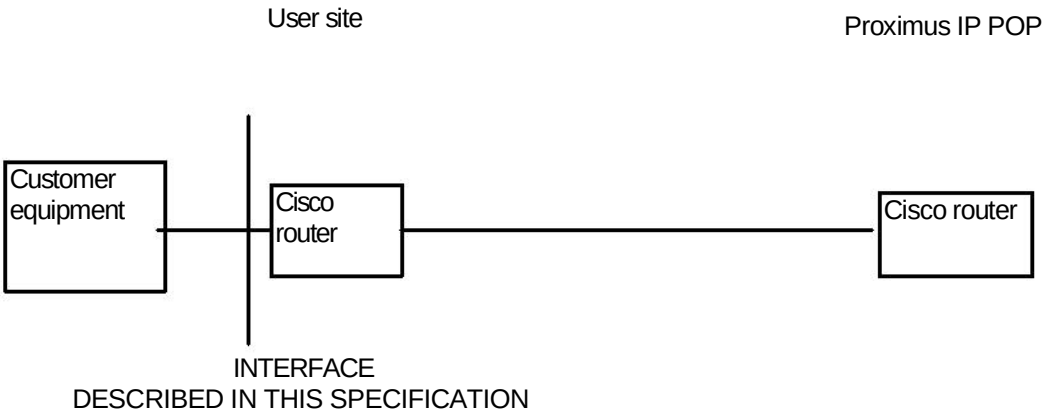
3.1. IP Network

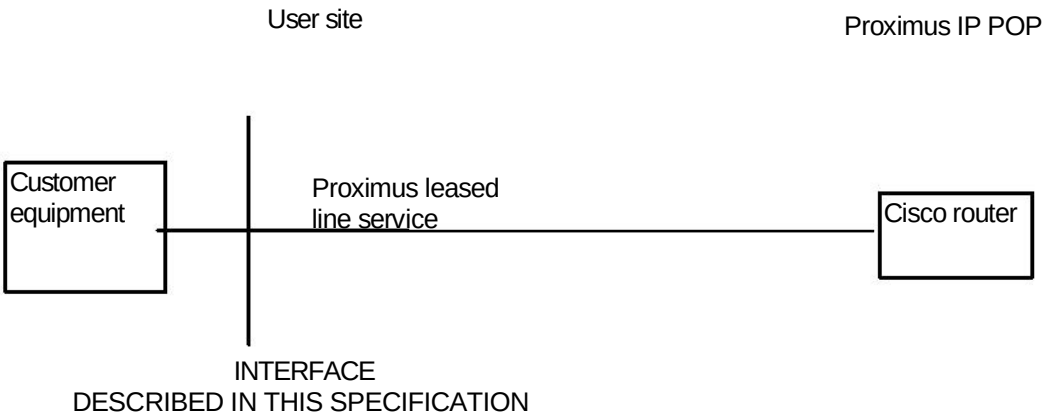
IP Connectivity is available via digital leased lines from 64 kbps to 2 Mbps as it is the case on the Frame Relay Connectivity Service. High end to end performance is reached by using high speed digital transmission links between the nodes. In this sense, throughput and propagation delays will be minimised in order to obtain a similar level of performance as existing in a leased line based backbone.

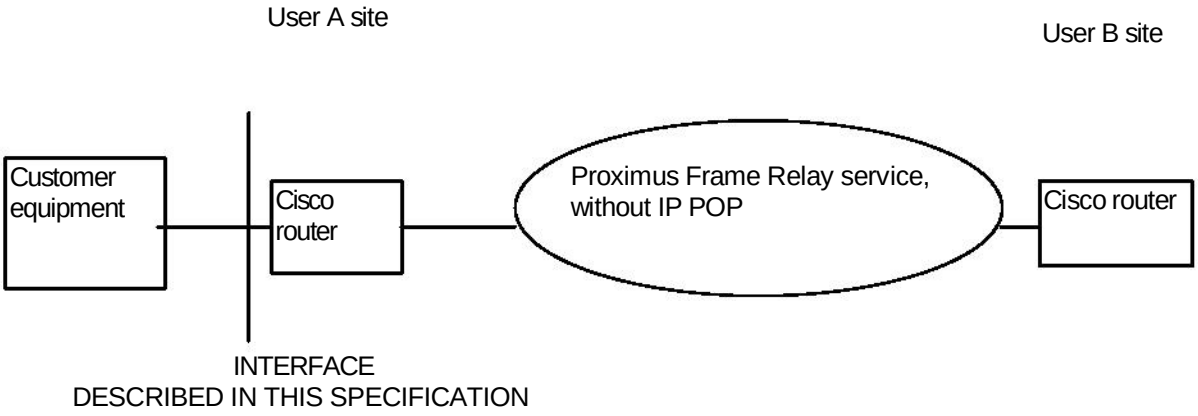
In keeping with the Proximus's strategy of full standards compliance, Cisco routers (model dependent) support the following standard media and interface types :

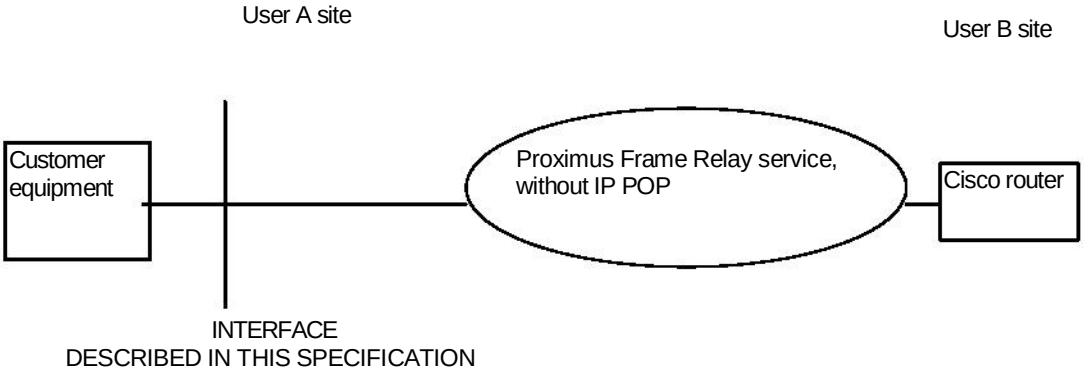
- Ethernet (IEEE 802.3 and Type II);
- Token Ring (IEEE 802.5);
- Fiber Distributed Data Interface (FDDI);
- Synchronous serial (HSSI, V.35, RS-232, RS-449, G.703, G.704, X.21);
- HDLC (High Level Data Link Control) : first, major remark: **Cisco's HDLC is a proprietary**, enhanced version of HDLC, and is not compatible with standard HDLC. This means only Cisco equipment can be used for HDLC access. HDLC will only be supported on dedicated equipment, and only after testing with the customer equipment.
- Frame Relay (RFC 1490);
- Integrated Services Digital Network (ISDN).

Those interfaces are offered in following access configurations:









Note that additional to those configurations, also backup ISDN dial up can be provided by Proximus.

3.2. Addressing and Routing

This section describes the IP address assignment policy for the IP network and talks about routing.

3.2.1. IP Addressing

Most customers will use IP Connectivity Service to communicate between their different sites (non-Internet traffic). Some customer may want to have communications between one or more of their sites and the world-wide Internet through private or public gateways (« Internet traffic »). Since multiple private or public Internet gateways on the Proximus IP network should be accommodated, great care should be taken when routing messages coming from / going to the Internet.

Addressing and routing problems will be avoided by the following Proximus « rules of conduct » :

- *IP network address(es) that is(are) used for transport of data packets across the network should be unique on this backbone.*
- *IP addresses for transport of data packets across the network need to be officially by the Internet Community or will be assigned by Proximus according to RFC 1918. These addresses can be used for customer-hosts and/or for tunnel entry/exit (source/destination) points. The number of addresses (host numbers) assigned to a customer-site will depend on realistic indications on the number of customer-hosts to be connected to the network.*
- *« non-Internet traffic » (data packets travelling between sites connected to the network) can travel across the network (without being tunnelled) as long as RFC 1918 or official Internet addresses are used.*
- *« Internet traffic » (data packets travelling across the network from or towards the Internet through « private » Internet gateways) needs to be tunnelled.*
- *Non-official Internet IP addresses can be re-used on the network for non-Internet traffic as long as tunnelling in RFC 1918 addresses is used.*
- *Internet traffic coming from or going to the public network-Internet gateway can be transported over the network without being tunnelled as long as officially obtained Internet addresses are used.*

3.2.2. Routing

- Customers may use there own (local) routing protocol (e.g. RIP);
- The IP network will use a minimal set of routing protocols (OSPF) on the backbone network for simplicity and performance reasons.

Therefore, routing tables obtained by customer routing protocols should be redistributed by the network routing protocols and vice versa. To minimise redistribution problems and for security reasons, static routing can be used on a customer access network (if no load balancing is required on redundant access circuits).

3.3. Performances

3.3.1. Throughput

At the current time, the throughput is not contractually guaranteed.

3.3.2. Transit Delay

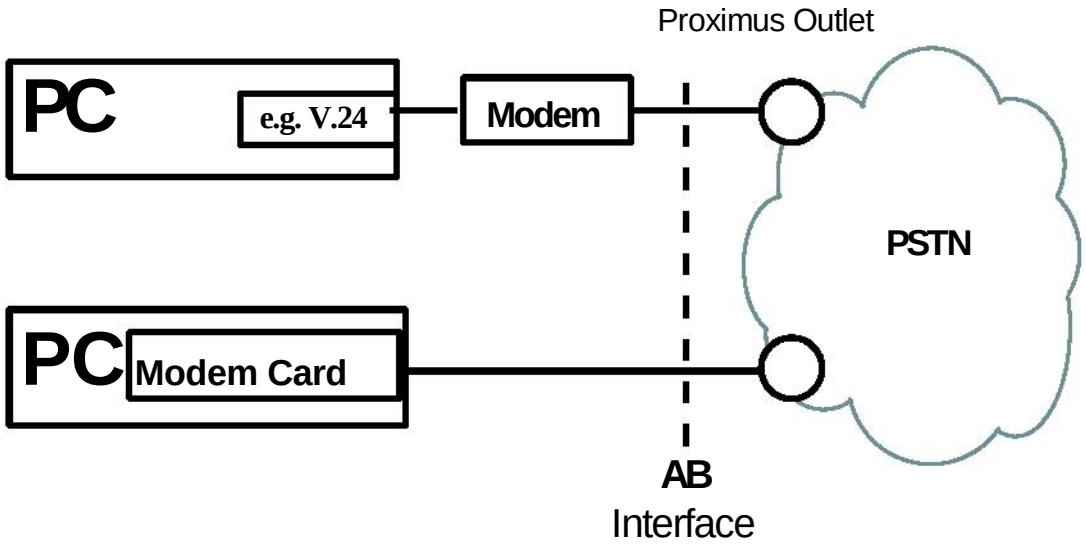
The transit delay is the delay between the time at which the first bit of the packet is sent by the source and the time at which the last bit of the packet is received by the destination. This parameter is particularly important in the case of « real time » applications (for these applications, the packet length is short, typically 64 bytes).

For example, for a 64 bytes' length packet, Proximus guarantees a maximum delay of 50 msec for zonal communications and 80 msec for interzonal communications. Other cases can be evaluated by Proximus (specific packet length or statistical distribution of the packet lengths).

4. Remote Access Conectivity Service (RACS)

The RACS is used by a dial-up user to connecte to the IP network. The connection can be made via PSTN or ISDN.

- **via PSTN**



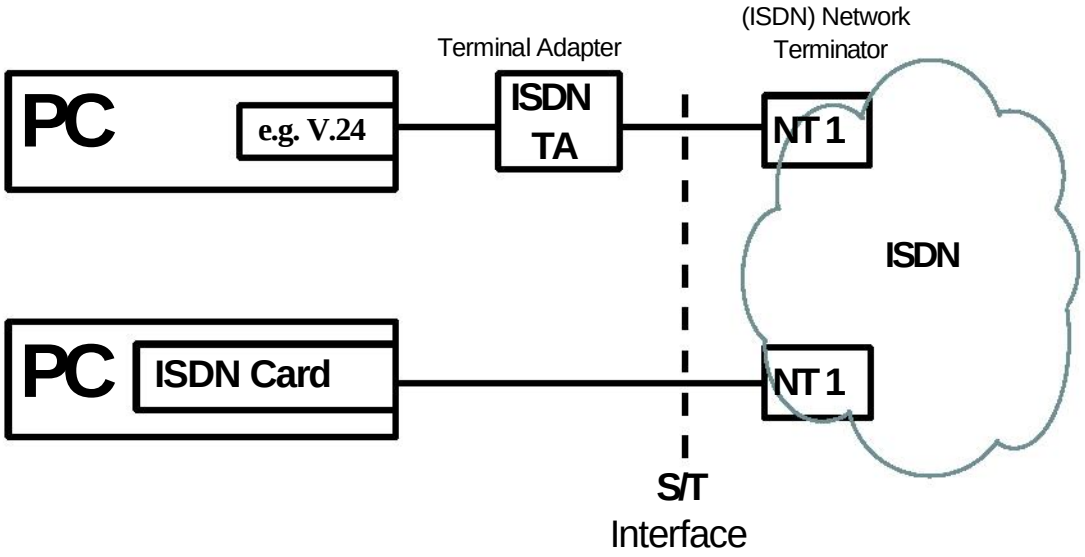
PSTN is used at customer premises to get access to the IP network. In this case, the service supports the following types of transfer :
Asynchronous transfer modulation: ITU-T V.34 (28.8kbps, 33.6kbps), V.FC (28.8kbps), V.32terbo (19.2kbps), ITU-T V.32bis (14.4kbps, 12kbps, 9.6kbps, 7.2kbps, 4.8kbps), ITU-T V.32 (9.6kbps, 4.8kbps), ITU-T V.22bis (2.4kbps), ITU-T V.22 (1.2kbps), ITU-T V.90 (56kbps)
V.Fast modulation (19.2kbps) is not supported.

Error correction & data compression: ITU-T V.42 & V42bis, MNP 3 & 5.

The layer 2 protocol used is PPP : Point to Point Protocol (RFC 1661)

- **via ISDN**

ISDN is used at customer premises to get access to the IP network. In this case, the service supports the following types of transfer :



Physical layer: The S/T interface is the ISDN connector PROXIMUS delivers to the customers (the NT1 is always provided by PROXIMUS).

Control plane: Proximus ISDN service compliant
User plane :In the case of IP connections trough ISDN the layer 2 B channel protocol used is PPP : Point to Point Protocol (RFC 1618 : PPP over ISDN).

Rem : V.110 and V.120 are other **B channel layer 2 protocols** mainly used to connect slower pre-ISDN communications devices to high speed ISDN lines. They are not supported to connect to the IP Network.

5. Terms and Acronyms

ATM :	Asynchronous Transfer Mode
FR :	Frame Relay
IP :	Internet Protocol
ISDN :	Integrated Services Data Network
LAN :	Local Area Network
NAS :	Network Access Server
PoP :	Point Of Presence
PPP :	Point To Point Protocol
PSTN :	Public Switched Telephone Network
RFC :	Request For Comments
TCP :	Transmission Control Protocol
WAN :	Wide Area Network