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. Please take into account that modifications can appear at any moment. Therefore, the reader is requested to check regularly 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 (list always available with a request to the e-mail address mentioned in the underneath paragraph).

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STM-4 and VC-4-4c digital leased lines
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0. Document history

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<tr>
<td>1.0</td>
<td>10 DEC 2002</td>
<td>• First version</td>
</tr>
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STM-4 and VC-4-4c digital leased lines

SPECIFICATION USER NETWORK INTERFACE (TRANSMISSION)
1. Introduction

This document contains the technical specifications for the Proximus STM-4 (4 VC-4 into 1 STM-4) and VC-4-4c (1 VC-4-4c into 1 STM-4) digital leased line services.

The digital leased line provides a bidirectional point-to-point digital connection within a STM-4 frame in accordance with ITU-T Recommendation G.707.

The network interface presentation offered to a STM-4 (4 VC-4 into 1 STM-4) and a VC-4-4c (1 VC-4-4c into 1 STM-4) leased lines customer is based on the G957-interface.

The rules applied by PROXIMUS for interfacing the customer's equipment with the PROXIMUS SDH network are based on the G.707 and G.957 ITU-T recommendations. Only Optical interfaces are available. The network cabling follows the standard Proximus rules.

These leased line specifications are based on a generic model as shown in figure 1.

The SDH connection is presented to the customer via an "interface presentation" at the Network Termination Point (NTP) which comprises all physical connections and their technical access specifications that form part of the Proximus SDH leased line network.

This connection includes a series of SDH sections, providing the point-to-point transfer of signals between the terminal equipment of the customer.

The NTP is also the point at which the terminal equipment of the customer is attached to the SDH leased line offering an STM-4 interface; the attachment requirements for the customer's terminal equipment are also mentioned in this document.

The STM-4 (4 VC-4 into 1 STM-4) digital leased line service can be offered everywhere in the SDH Proximus network. The VC-4-4c (1 VC-4-4c into 1 STM-4) digital leased line service can only be offered in the Proximus ZTC and LTC where MSH51c or MSH64 are installed.

Throughout this document, reference is made to several national and international standards; details of these publications are given in annex 2. In addition, the list of the abbreviations which apply to this document, can be found in annex 1.
The drawing represents a point-to-point digital leased lines service.
2. Connection characteristics

The STM-4 (4 VC-4 into 1 STM-4) and VC-4-4c (1 VC-4-4c into 1 STM-4) SDH leased line provide a bi-directional and symmetrical leased line connection of SDH virtual containers, i.e. VC-4 and VC-4-4c, which are transferred transparently throughout the Proximus network, except the N1 bytes.

Signals transmitted across the SDH leased line connections, are subject to restrictions and to impairments such as transfer delay, jitter, wander, etc. This paragraph defines the technical specifications for the bi-directional and symmetrical leased line connections of SDH virtual containers VC-4 and VC-4-4c.

2.1. Common characteristics of STM-4 (4 VC-4 into 1 STM-4) and VC-4-4c (1 VC-4-4c into 1 STM-4) leased line connections

2.1.1. Tolerance of VC timing

The SDH leased line connection shall carry the customer timing with a tolerance of ± 20 ppm (G.783).

2.1.2. Transfer delay for VC-4

The one way end-to-end delay of the SDH leased line is less than (10 + 0,005G) ms, where G is the length of the optical fibres in kilometers. If this length is unknown, the one way end-to-end delay of the SDH leased line is less than (10 + 0,01G) ms, where G is the geographical distance in kilometers.

2.1.3. Transfer delay for VC-4-4c

The one way end-to-end delay will be less than 250 ms.

2.1.4. Jitter

The SDH leased line connection shall operate as specified in this document when the jitter at the leased line input is within the limits given in paragraph 3 ("Network interface presentation").
2.2. Specific characteristics of a STM-4 (4VC-4 into 1 STM-4) leased line connection

2.2.1. Information transfer susceptance

• The STM-4 (4VC-4 into 1 STM-4) leased line connection shall be capable of transferring transparently from 1 to 4 complete bi-directional VC-4 except the N1-byte, provided that the VC-4 is generated according to the specifications mentioned in paragraph 4 ("terminal equipment").

• The structure of a VC-4 is shown in figure 2. The bytes of a VC-4 are transmitted with a frequency of 8 kHz; i.e. the frame length is $125 \times$ s.

![Figure 2](image)

\textit{Figure 2}

\textit{Note: the content of the B3 byte may change at Proximus tandem connection monitoring processes; however, the integrity of B3 parity information is maintained through the VC-4 leased line connection.}

• An AU-4-AIS shall occur at the far end output of the VC-4 leased line connection when a defect occurs along the SDH leased line connection or at the leased line input. [\textit{AU-4-AIS is a STM-N signal in which the entire capacity of an Administrative Unit 4 (AU-4) is set to logic "1".}]

2.2.2. Performance objectives

• The error performance level of a VC-4 leased line connection is specified in terms of errored seconds, severely errored seconds and background block errors; these performance parameters are as those defined in ITU-T Recommendation G.826.
2.3. Specific characteristics of a VC-4-4c (1 VC-4-4c into 1 STM-4) leased line connection

2.3.1. Information transfer susceptance

- The VC-4-4c (1 VC-4-4c into 1 STM-4) leased line connection shall be capable of transferring transparently 1 complete bi-directional VC-4-4c except the N1-bytes, provided that the VC-4-4c is generated according to the specifications mentioned in paragraph 4 ("terminal equipment").
- The structure of a VC-4-4c is shown in figure 3. The bytes of a VC-4-4c are transmitted with a frequency of 8 kHz; i.e. the frame length is 125 μs. • In the figure 3, \( N=4, X=4 \).

\[ \text{Figure 3} \]

Note: the content of the B3 byte may change at Proximus tandem connection monitoring processes; however, the integrity of B3 parity information is maintained through the VC-4-4c leased line connection.

- An AU-4-4c-AIS shall occur at the far end output of the VC-4-4c leased line connection when a defect occurs along the SDH leased line connection or at the leased line input. [AU-4-4c-AIS is a STM-N signal in which the entire capacity of a AU-4-4c is set to logic “1”.

STM-4 and VC-4-4c digital leased lines

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2.3.2. Performance objectives

- The error performance level of a VC-4-4c leased line connection is specified in terms of errored seconds, severely errored seconds and background block errors; these performance parameters are as those defined in ITU-T Recommendation G.826. Network interface presentation.
3. The NTP (STM-4 interface)

The SDH leased line connection is presented to the customer via interfaces at the Proximus Network Termination Points (NTP). This paragraph specifies the NTP technical characteristics; it defines its specifications for the physical section layer, the regenerator & multiplex section layers, and the SDH path layers.

In principle, the NTP of the SDH leased line will be provided with a STM-4 interface, complying with the ITU-T Recommendations G.707 and G.783.

3.1. Physical section layers

The NTP of the SDH leased line shall be provided with one STM-4 optical interface.

3.1.1. STM-4 optical interface

- The optical characteristics of the SDH leased line NTP, equipped with a STM-4 optical interface, are in accordance with ITU-T Recommendation G.957; this SDH leased line NTP interface is designed for operation on single-mode optical fibres.
- The jitter and wander tolerance of the SDH leased line input port, as well as the output jitter and wander generation at the NTP are in accordance with ITU-T Recommendations G.825 & G.783.
- The SDH leased line NTP, equipped with an optical STM-4 interface, shall be provided with two optical sockets, one each for transmit and receive.

The STM-4 boards are connected to the optical fibre. This fibre is terminated onto an optical distribution frame (OSDF, OMDF or cable head). The optical connectors that have to be mounted on the fibre cord relaying the optical distribution frame are of the type optoclip 2.

The Optoclip 2 connectors have the following characteristics:
- attenuation (25°C) :
  - Less than to 0.3 dB.
  - Mean value (measurement on more than 10 samples): < 0.25 dB.
  - After 200 connections/disconnections (15°<T<35°): < 0.4 dB and mean value (measurement on more than 10 samples): < 0.35 dB.
- Return loss :
  - More than 50 dB.
  - Mean value (measurement on more than 10 samples): more than 54 dB.
- Thermal behaviour :
  - Variation in attenuation between -20°C and 50°C: less than 0.004 dB/°C. - Mean value (measurement on more than 10 samples): < 0.003 dB/°C.
3.2 STM-4 regenerator and multiplex section layers

- As the STM-4 signal of the SDH leased line network interface complies also with ITU-T Recommendation G.707, regenerator and multiplex Section OverHead (SOH) information is added to the customer's information payload to create the STM-4 signal.

The rows 1-3 of the SOH are designated as Regenerator Section OverHead (RSOH) while rows 5-9 are designated to be Multiplex Section OverHead (MSOH). This is illustrated in figure 4. The definitions of the SOH bytes (such as A1, A2, JO,...) are mentioned in ITU-T Recommendation G.707.

Currently, the unmarked bytes in the SOH of figure 4, are undefined.

Unscrambled bytes. Therefore care should be taken with their content

NOTE - All unmarked bytes are reserved for future international standardization (for media dependent, additional national use and other purposes).

The unscrambled bytes of figure 4 can not be taken with their content but must be filled by "1" and "0" in alternance.

- Regarding the SOH bytes of the SDH leased line network interface, an overview of their functionalities is given in table 1. Just to be clear, the following definitions apply:

  * **required**: these signals at the interface shall contain valid information as defined by ITU-T Recommendation G.707.
  * **optional**: valid information may or may not be present in these signals; as a consequence, the use of these functions shall be mutually agreed by the customer and Proximus.
  * **not applicable**: this function is not defined at the interface; as a consequence, the customer's terminal and the SDH leased line NTP have to be capable of functioning properly with an incoming STM-4 signal programmed with this "undefined" SOH byte.
### Table 1

<table>
<thead>
<tr>
<th>SOH-byte</th>
<th>functionality requirement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1-A2</td>
<td>required</td>
<td></td>
</tr>
<tr>
<td>JO</td>
<td>optional</td>
<td>By mutual agreement between Proximus and the customer a Section Access Point Identifier may be used, conform to ITU-T Recommendation G.707.</td>
</tr>
<tr>
<td>B1</td>
<td>required</td>
<td></td>
</tr>
<tr>
<td>E1, E2</td>
<td>not applicable</td>
<td></td>
</tr>
<tr>
<td>F1</td>
<td>not applicable</td>
<td></td>
</tr>
<tr>
<td>D1-D12</td>
<td>not applicable</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>required</td>
<td></td>
</tr>
<tr>
<td>K1 &amp; K2(bits 1-5)</td>
<td>not applicable</td>
<td>Required if APS (MSP) is provided</td>
</tr>
<tr>
<td>K2(bits 6-8)</td>
<td>required</td>
<td>MS-RDI is used for MS-FERF and MS-AIS.</td>
</tr>
<tr>
<td>S1 (bits 5-8)</td>
<td>required</td>
<td></td>
</tr>
<tr>
<td>M1</td>
<td>optional</td>
<td></td>
</tr>
<tr>
<td>other bytes</td>
<td>not applicable</td>
<td></td>
</tr>
</tbody>
</table>

#### 3.3. Path layer functions

- The path layer forms the end-to-end connection of the SDH leased line. Two types of VCs are offered by the Proximus STM-4 and VC-4-4c leased line services, namely: VC-4, and VC-4-4c. The formats of these VCs are defined in ITU-T Recommendation G.707. Each VC-n includes a payload and a path overhead (POH).
- Please note that the path overhead of a VC-n, transmitted across the SDH leased line connection, has to be generated and terminated by the customer's terminal equipment. The Proximus SDH leased line shall transport these virtual containers *transparently, except the network operator byte N1*:
  - The N1-byte could be used by Proximus to determine the quality of the received and transmitted VC-4 path signals. The content of the B3-byte may change at the Proximus tandem connection monitoring processes; however, the integrity of the parity information of the B3-byte will be maintained through the Proximus SDH leased line.

#### 3.4. Safety

The SDH leased line NTP complies with the requirements for accessible parts of a SELV circuit (in accordance with EN 60950).

#### 3.5. ElectroMagnetic Compatibility (EMC)

The NTP complies with the EMC requirements which are imposed under the EMC Directive (89/336/EEC).
3.6. TU/VC numbering scheme

The numbering scheme must be compliant to G.707.

The customer and Proximus have to use the above mentioned numbering scheme for his VC-n address, which has to be communicated to Proximus. By doing so, Proximus will be able to offer the customer an enhanced service for his STM-4 and VC-4-4c leased line services.
4. Terminal equipment

The technical characteristics of the customer’s terminal interface have to be in line with the relevant ETSI and ITU-T specifications and recommendations.

At the NTP the customer shall provide Proximus with a grounding connection point. This grounding connection point should be easily accessible, located near the NTP, and shall enable Proximus to attach a 4 mm² (minimum section) ground cable with lug, bolt and washer. The characteristics of the grounding connection point provided by the customer must be conform to article 69 of the actual RGIE; this grounding point shall have a resistance value not exceeding 30 Ohms.

RGIE: Règlement Général des Installations Electriques

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ANNEX 1

Abbreviations

For the purpose of this document, the following abbreviations apply:

AIS
Alarm Indication Signal.

AU-n
Administrative Unit, level n.

AU-4-AIS
Administrative Unit (level 4) Alarm Indication Signal.

BBE
Background Block Errors.

BIP-N
Bit Interleaved Parity, width N.

EMC
ElectroMagnetic Compatibility.

ES
Errored Second.

ETS
European Telecommunication Standard.

ETS
European Telecommunications Standards Institute.

ITU-T
International Telecommunication Union.

ITU-T
Multiplex Section Alarm Indication Signal.

MS-AIS
Multiplex Section Far End Receive Failure.

MS-FERF
Multiplex Section Remote Defect Indication.

MS-RDI
Multiplex Section OverHead. Network

MSOH
Termination Point.

NTP
Plesiochronous Digital Hierarchy. Path

PDH
Overhead. Parts per million.

POH
Réglement Général des Installations Electriques

Ppm
Regenerator Section OverHead.

RGI
Synchronous Digital Hierarchy.

E
Safety Extra Low Voltage. Severely

RSOH
Errored Second. Section Overhead.

SDH
Synchronous Transport Module, level N.

SELV
Tributary Unit Group, level m. Tributary Unit,

SES
level m.

SOH
Tributary Unit, level m, Alarm Indication Signal.

STM-N
Virtual Container, level n.

TUG-m

TU-m

TU-m-AIS

VC-n
## ANNEX 2

### Reference list of standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.825</td>
<td>(3/2000) The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH).</td>
</tr>
<tr>
<td>G.826</td>
<td>(2/1999 &amp; 7/2001) Error performance parameters and objectives for international constant bit rate digital paths at or above the primary rate.</td>
</tr>
<tr>
<td>prETS 300 147</td>
<td>(11/96) Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); Multiplexing structure.</td>
</tr>
<tr>
<td>ETS 300 166</td>
<td>(1993) Transmission and Multiplexing (TM); Physical and electrical characteristics of hierarchical digital interfaces for equipment using the 2048kbit/s based plesiochronous or synchronous digital hierarchies.</td>
</tr>
<tr>
<td>ETS 300 417-3-1</td>
<td>(1997) Transmission and Multiplexing (TM); Generic requirements of transport functionality of equipment; Part 3-1: Synchronous Transport Module-N (STM-N) regenerator and multiplex section layer functions.</td>
</tr>
<tr>
<td>ETS 300 417-4-1</td>
<td>(1997) Transmission and Multiplexing (TM); Generic requirements of transport functionality of equipment; Part 4-1: Synchronous Digital Hierarchy (SDH) path layer functions.</td>
</tr>
<tr>
<td>IEC 169-13</td>
<td>(1976) Radio frequency connectors - part 13; R.F. coaxial connectors with inner diameter of outer conductor 5.6 mm - Characteristic impedance 75 ohms (Type 1.6/5.6)</td>
</tr>
<tr>
<td>EN 60950</td>
<td>(1992) Safety of information technology equipment including electrical equipment.</td>
</tr>
</tbody>
</table>