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Belgacom / BELCOMLAB
Rue Carlistraat 2
B-1140 Evere
Belgium

Tel: +32 2 244.58.88
Fax: +32 2 244.59.99
E-mail: belcomlab@belgacom.be

ADSL over ISDN

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1. Preface

The goal of this document is to provide the technical specifications of the User To Network Interface (UNI) for ADSL equipment to be connected to the Belgacom network.

As ADSL may provide a variety of bearer channels in conjunction with other services, this document deals with the ADSL service on the same pair with ISDN BA services.

The UNI technical specifications for the ADSL service, mentioned in this document , are based on the currently relevant international recommendations for ADSL equipment, namely:

- The ANSI T1.413 –1998 Standard
- The ETSI TS 101 388 Technical specification

The UNI technical specifications are in accordance with ANSI T1. 413-1998, with the differences specified for ADSL over ISDN in ETSI TS 101 388 (ETSI DTS-TM-06006) as described below.

2. System reference model

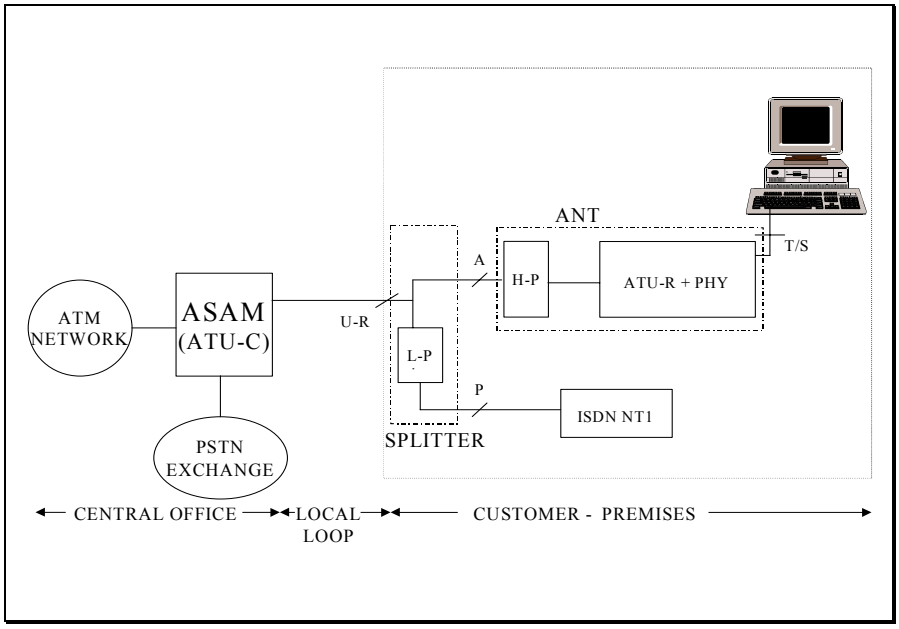

Fig. 1 : System Reference Model

The following main-building blocks can be distinguished :

- ***ASAM*** : the ATM Subscriber Access Multiplexer (including the ADSL transceiver unit at the central office end; i.e. network operator);
- ***ANT*** : the ADSL network termination (which includes the ADSL transceiver unit at the remote terminal; i.e. customer premises);
- ***splitter*** : filter that separates the high frequency signals (ADSL) from the ISDN – BA - signal (frequently called ISDN splitter).
- ***U-R*** : The loop interface U-R carries the ISDN – BA frequencies, multiplexed with the upstream and downstream ADSL signals. The upstream and downstream ADSL signals are DMT (Discrete Multi Tone) modulated.
- ***ATU-C*** : The ADSL transceiver unit at the Central Office side
- ***ATU-R*** : The ADSL transceiver unit at the remote end

3. UNI

The loop interface U-R carries the ISDN – BA service (ISDN) frequency, mulitplexed with the upstream and downstream ADSL- signals. The upstream and downstream signals are DMT (Discrete Multi Tone) modulated.

The U-R-interface connects the ANT (with ATU-R) to the ASAM (with ATU-C) via the copper access network. Normal subscriber line wire is used for this connection.
Physically, the UNI – connection point is situated on the point **U-R** of the system reference model (see fig 1).

The sub – paragraphs mentioned below describe the ATU-R and ATU-C functionalities and requirements in order to establish an ADSL – connection.

The characteristics of the local loop are described in annex A.

3.1. ATU-C functionalities :

The ATU-C complies with section 6 of ANSI T1.413-1198, with modifications for ADSL over ISDN as specified in section 5 of ETSI TS 101 388.

3.2. ATU-R functionalities :

The ATU-R shall comply with section 7 of ANSI T1.413-1198, with modifications for ADSL over ISDN as specified in section 6 of ETSI TS 101 388.

3.3. Operations and maintenance

The ATU-C complies with section 8 of ANSI T1.413-1198
The ATU-R shall comply with section 8 of ANSI T1.413-1198.

3.4. Initialization

The ATU-C complies with section 9 of ANSI T1.413-1198, with modifications for ADSL over ISDN as specified in section 7 of ETSI TS 101 388.
The ATU-R shall comply with section 9 of ANSI T1.413-1198, with modifications for ADSL over ISDN as specified in section 7 of ETSI TS 101 388.

3.5. Online adaptation and reconfiguration

The ATU-C complies with section 10 of ANSI T1.413-1198
The ATU-R shall comply with section 10 of ANSI T1.413-1198.

4. References

[1] ANSI Standard T1.413-1998*, "Network and Customer Installation Interfaces – Asymmetrical Digital Subscriber Line (ADSL) Metallic Interface*", published by the ANSI.

[2] ETSI Technical specification TS 101 388 *"Transmission and Multiplexing ; Access transmission systems on metallic access cables ; Asymmetric Digital Subscriber Line (ADSL) – Coexistence of ADSL and ISDN-BA on the same pair* ", published by ETSI

ANNEX A : Local loop characteristics :

A telecoms cable consists of a number of *cores* surrounded by a layer of insulating material. The cores of such a cable are always grouped in *pairs* of *conductors*.

Cables in the local network are designed so as to ensure optimum transmission and guarantee minimum mechanical resistance. For this reason, the description of cables below consists of a section dealing with electrical characteristics and one dealing with mechanical characteristics.

Mechanical characteristics

- The conductors of a local cable are round, full wires consisting of 98%–99% pure electrolytic copper.
- A conductor is isolated by a layer of synthetic material (usually polyethylene).
- Most conductors have a 0.5 mm or 0.6 mm diameter with a maximum negative variance of 0.01 mm and a positive variance of 0.03 mm.
- The set of conductors is covered by a waterproof extruded cable sheath (usually polyethylene). Under normal circumstances, the cable is also longitudinally waterproof.
- The cable cores are arranged in a specific manner. The two conductors (e.g. of a telephone circuit) must be arranged symmetrically in relation to all other conductors. For this reason, conductors are twisted and placed in coaxial cylindrical layers *(a basic unit consists, for example, of four conductors twisted around one another and from which two telephone circuits can be created; a cross section shows that these four conductors form the corners of a square. The conductors located on two opposite angular points form a pair).*

Electrical characteristics

- Since the signals to be transmitted are changeable electrical voltages, the cable conductor must be a good transmission medium for electrical signals. The important elements are defined for a unit length of one kilometer and are called primary electrical parameters of a conductor. These parameters are kilometer resistance R, kilometer inductance L, kilometer capacity C and kilometer leakance G.

    - ♦ <u>kilometer resistance R</u>
        - ∗ Kilometer resistance is the initial resistance of a one kilometer conductor pair that is looped at the remote end; the value of this parameter is therefore the resistance of a conductor with a length of two kilometers.
            - ⇒ R is 180 Ohm for a conductor diameter of 0.5 mm (at 20°C);
            - ⇒ R is 123 Ohm for a conductor diameter of 0.6 mm (at 20°C).
        - ∗ It should be noted that due to the skin effect, the alternating current resistance is higher than the direct current resistance indicated above.
    - ♦ <u>kilometer inductance L</u>
        - ∗ In a symmetrical pair cable, conductors forming a pair lie very close to one another; kilometer inductance L is therefore very low (approx. 0.5 mH per kilometer).
    - ♦ <u>kilometer capacity C</u>
        - ∗ The capacity between two conductors of the same pair can be measured when the rest of the cable conductors are connected to each other and to an equipotential point of a measuring device. The nominal value of kilometer capacity C is situated between 38.5 nF/km and 50 nF/km at 800 Hz.

- ♦ kilometer leakance G
  - ∗ Kilometer leakance G depends on the frequency concerned and kilometer capacity C. Theoretically, kilometer leakance may be considered as negligible.
  - ∗ G can roughly be calculated with the help of the following formula, in which k has a value between 0.005 and 0.02 (ω = pulsation in rad/s):

$$G = k \cdot \omega \cdot C$$

- The insulation resistance of each conductor in relation to the rest of the conductors (and any shielding) is at least 5,000 MΩ/km.