TITLE **Improvement of the Reference Model for Spectral Management**

PROJECT SPECTRAL MANAGEMENT

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STATUS for decision

When discussing the Reference Model of the first draft of the Spectral Management report in a small group, the need was identified for describing the inside and outside of the Local Loop Wiring in a more neutral way. This will make the Reference Model more general applicable. The following Reference Model and text is proposed as replacement of clause 5:

5. Reference model of the Local Loop Wiring

This clause discribes the reference model of the *local loop wiring* of an access network, from a spectral management point of view. It illustrates that local loop cable sections are asymmetrical in nature, because equipment near the local exchange side may differ from equipment near the customer side.

The Local Loop Wiring (LLW) of an access network includes mainly cables, but may also include a Main Distribution Frame (MDF), street cabinets, and other distribution elements.

From a Spectral Management point of view, signal sources are identified on their location:
CSS: Customer-side Signal Sources
ESS: Exchange-side Signal Sources (such as local exchanges)
RSS: Remote Signal Sources (such as repeaters and optical network units in street cabinets)

5.1 The concept of a Port, the interface the Local Loop Wiring

To give signal sources access to the Local Loop Wiring, their signals enter the LLW by flowing through so-called “ports”. The ports are the interfaces to the Local Loop Wiring, and should therefore be well identified.

The following port-types are defined in this reference model:

- ***LT-port***: The Line Termination port is generally used for connecting an ESS to the LLW.
- ***NT-port***: The Network Termination port is generally used for connecting an CSS to the LLW.
- ***LT.cab-port***: The LT-cabinet port is generally used for connecting an RSS to the LLW, that links this port with an NT-port (or NT.cab-port) elsewhere in the LLW.

- ***NT.cab-port***: The NT-cabinet port is generally used for connecting an RSS to the LLW, that links this port with an LT-port (or LT.cab-port) elsewhere in the LLW.

At least two ports are required for communication. In special cases where access to the LLW at additional *well-identified* ports (such as in street cabinets) is provided for remote active devices (such as repeaters and optical network units), more ports may be involved.

5.2 Bounding Spectral Pollution by limiting signals at the Ports

The signal limits that are summarised in this document, are to limit injected signals as they can be observed at the ports of the LLW.
The signals that many DSL systems generate are asymmetrical in nature. For instance ADSL systems generate different data signals in different transmission directions. ISDN and HDSL systems are symmetrical in their data signals, but their remote DC power feeding is asymmetrical. Therefore different port names are used in the Reference Model to simplify the description of signal limits that are transmission direction dependent.

NOTE 1 Reversing the transmission direction is generally not recommended, and may be implicitly forbidden by asymmetric signal limits at the ports. For example, ADSL systems are designed to maximize self-compatibility when all 'downstream' signals in one cable flow into the same direction. Typically connection of one system the other way round would harm neighbouring systems unacceptably, and is excluded when it violates the limits.

In the case of symmetric signal limits, no further distinction on transmission direction is made. In the case of asymmetric signal limits, the following naming convention is used in this document:

- ***Downstream*** signal limits are mandatory for signals that are injected into an LT-port (or LT.cab-port) of the Local Loop Wiring. LT-ports are usually located at the central office side of the local loop wiring.

- ***Upstream*** signal limits are mandatory for signals that are injected into an NT-port (or NT.cab-port) of the Local Loop Wiring. NT-ports are usually located at the customer side.

For each port, it must be well-identified if this is an LT- or NT-port, and which signal limits are mandatory for these ports.

NOTE 1 An example of unintended reversal of transmission direction may occur when the main distribution frame (MDF) of another licensed operator is not co-located with the MDF of the network owner (at the local exchange). If some of the wire pairs of a distribution cable are used for connecting these two MDF's, then upstream and downstream signals in different wire pairs have to flow in the same cable direction. In such a case, a so-called tie-cable can solve the problem. Such a tie-cable should be fully dedicated to this purpose, and fully *separated* from the standard distribution cables.

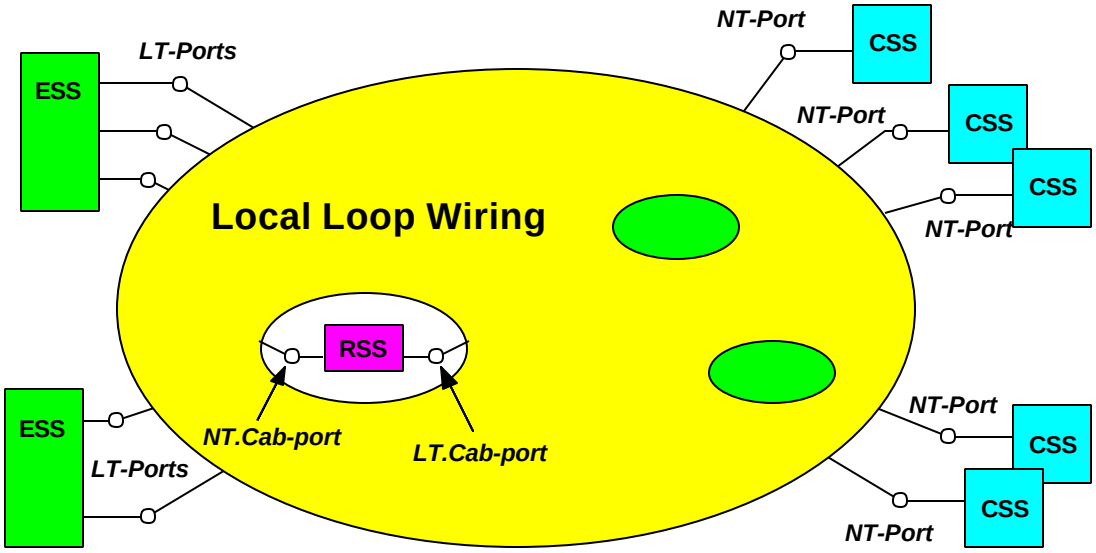
NOTE 2 Signal limits need not be the same for all NT-ports or LT-ports. It is conceivable that the signal limits depend on e.g. the loop length. A specification of this possible length dependence is beyond the scope of this document.

5.3. Reference model

Figure 1 shows a generic reference model of the Local Loop Wiring, from a Spectral Management point of view. The signals of various Signal Sources connected to the LLW flow into the LLW through *well-identified* ports. The following naming convention is used:

- The signals that flow through an *LT-port* into the Local Loop Wiring have their origin in a *Exchange-side Signal So*urce (ESS), such as for instance a local exchange. When signal limits are direction dependent, the signals labelled in this document as *downstream* are intended for injection into these LT-ports, unless explicitly stated otherwise.
- The signals that flow through an *NT-port* into the Local Loop Wiring have their origin in a *Customer-side Signal Source* (CSS). When signal limits are direction dependent, the signals labelled in this document as *upstream* signals are intended for injection into these NT-ports, unless explicitly stated otherwise.
- The signals that flow through an optional *LT.cab-port* or *NT.cab-port* into the Local Loop Wiring have their origin in *Remote Signal Source*s (RSS). Their signal limits may be different from the limits that hold for LT-ports and NT-ports.

This model enables the identification of upstream and downstream directions. Furthermore, a distinction between NT-ports may be made on the basis of the loop length, when specifying signal limits on the ports.



CSS: Customer-side Signal Source
ESS: Exchange-side Signal Source
RSS: Remote Signal Source
LT-port: Line Termination Port, for injecting downstream signals from a ESS.
NT-port: Network Termination Port, for injecting upstream signals from a CSS.
LT.cab-port: LT-cabinet Port, for injecting downstream signals from a RSS
NT.cab-port: NT-cabinet Port, for injecting upstream signals from a RSS

Figure 1. Reference model of the local loop wiring of an access network.

NOTE: "Connecting a Signal Source to a port of the Local Loop Wiring", does not necessary mean "intended for transmission through that local loop wiring". For instance, in-house transmission equipment (such as home-PNA), may use existing in-house telephony wires, so they are also "connected to the local loop wiring". They will (unintentional) inject signals into the Local Loop Wiring via the NT-ports. These signals are subject to the signal limits at the ports.