

Downstream Power Back Off (DPBO)

The development of Triple Play services requires higher bandwidth. Higher bandwidth and substantial performance gain can be reached by deploying DSLAM-s in a remote side cabinet near to the customer premises. There is no problem at clean networks (Figure 1) where all the customers are connected to the same local cabinet.

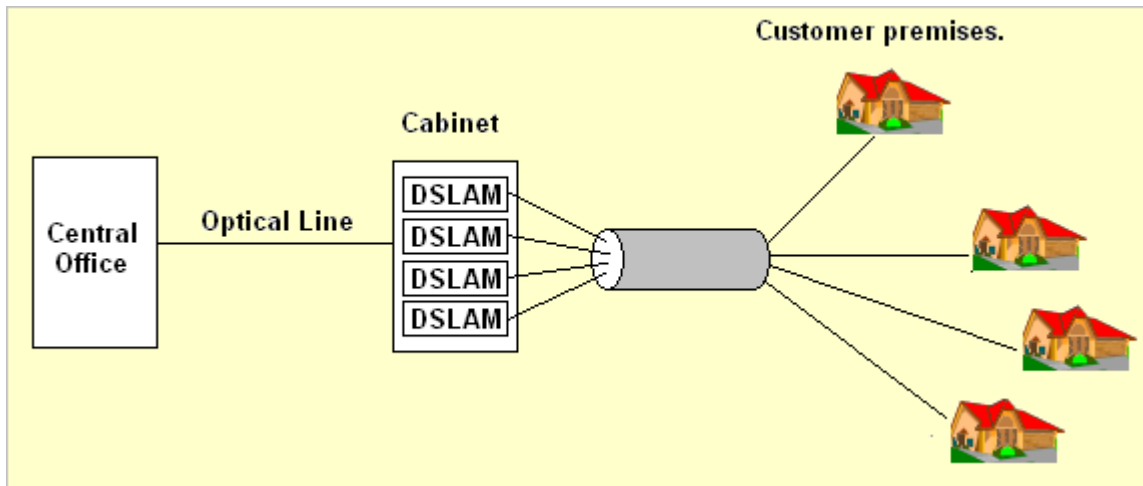


Figure 1

At mixed networks a part of subscriber lines are directly connected to the Exchange and others to the local DSLAM-s. Serious crosstalk problem and service loss may occur if the local DSLAM-s work with full power because in that case there is a considerable level difference between the directly connected and local lines at the flexibility point where the lines are adjoining. (Figure 2)

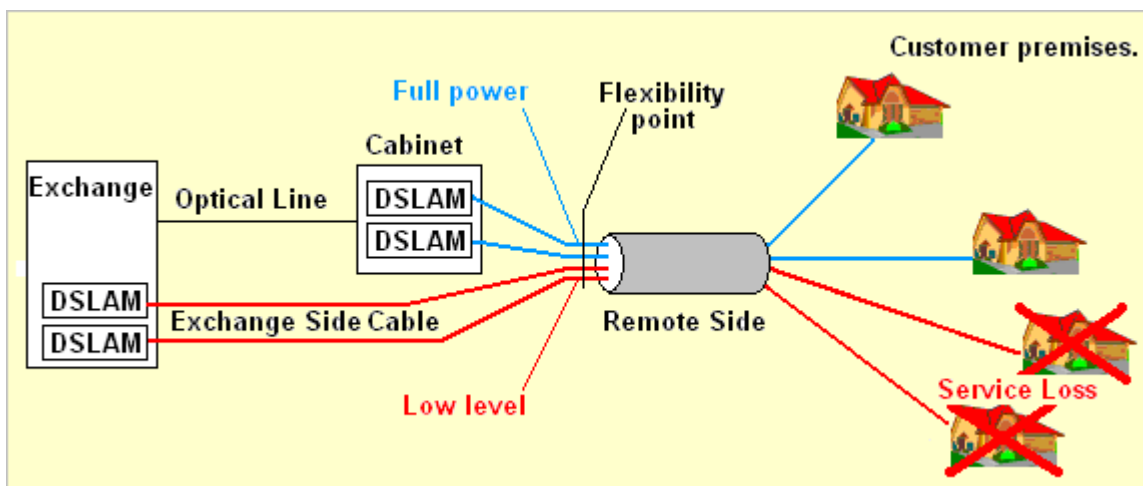


Figure 2

The generally accepted method to protect the directly connected customers is the use of **Spectrum Shaping** or other words Downstream Power Back Off (**DPBO**) at the local DSLAM-s in cabinet.

In case of long Exchange Side cable the usable frequency range is limited for the directly connected customers because beyond a Maximal Usable Frequency (MUF) the level falls below the Minimum Usable Signal (MUS). For frequencies over **MUF** the Exchange cannot allocate any bits any more, there is no need for power reduction.

The key points in local DSLAM programming is the prediction of the attenuated transmitter signal. The predicted attenuation should be calculated by means of a ITU-T recommended cable model consisting of four parameters:

- **ESEL** (Exchange Side Electrical Length)
- **A, B** and **C** constants

$$\text{Attenuation} = (A + B \cdot \sqrt{\text{Frequency}} + C \cdot \text{Frequency}) \cdot \text{ESEL}$$

The **ESEL** depends on the physical length while the other three parameters characterize the frequency behavior of the Exchange Side Cable. The value of **ESEL** is equal with the measured attenuation of Exchange Side Cable at 1 MHz between the Exchange and local DSLAM.

Additionally, a few refinements are added (**MPSD 1**, **MPSD 2**) to avoid unnecessary degradation of the Remote Side performance. (Figure 3)

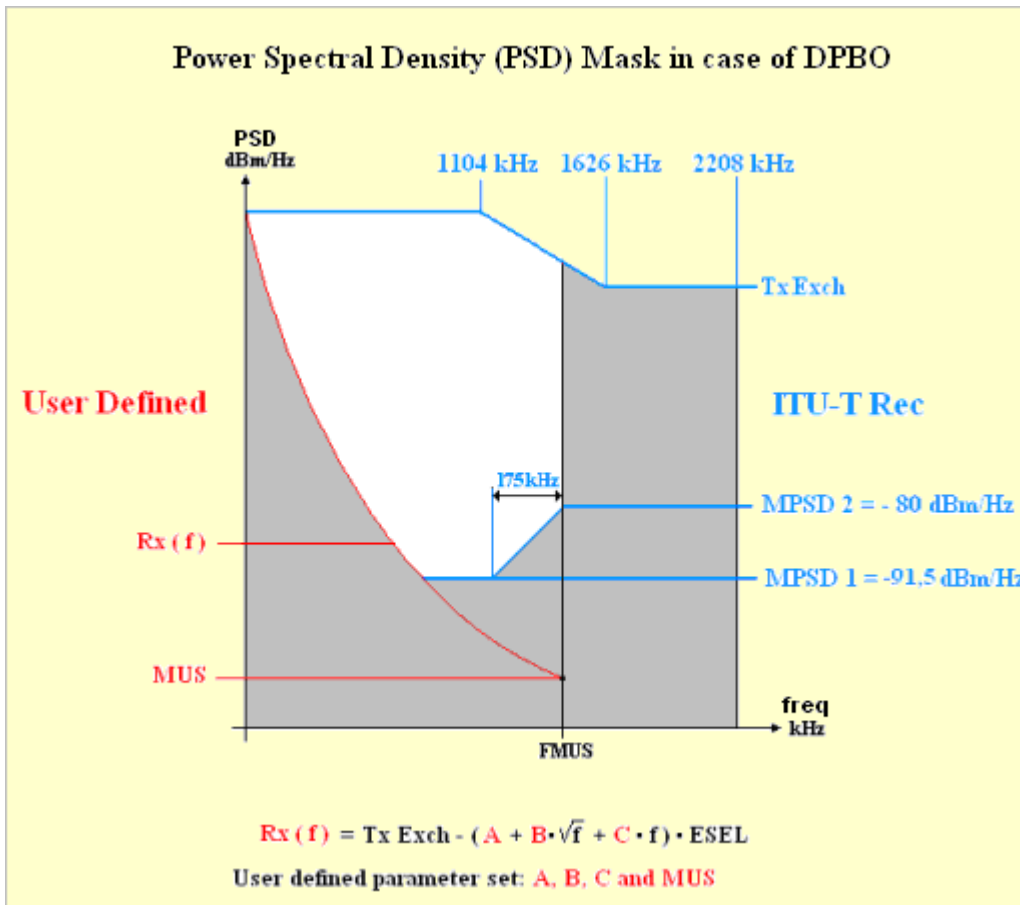


Figure 3

The effect of **Spectrum Shaping** (DPBO) is illustrated in the next figure in case of different **ESEL**-s

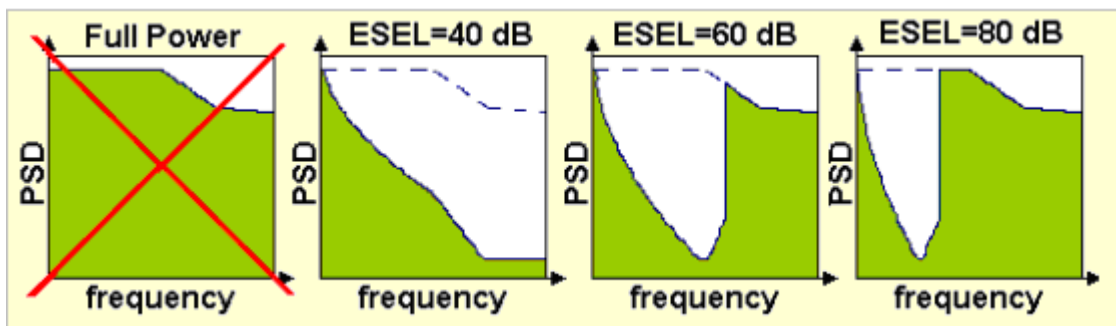


Figure 4

The features of remote side ADSL 2+ lines connected to the local DSLAM-s can be characterized by the Remote Side Electrical Length (**RSEL**). The value of **RSEL** is equal with the measured attenuation at 1 MHz between the Customers and local DSLAM.

The maximum electric length of a Remote Side cable depends on two parameters:

- **ESEL** (As the PSD mask of Local DSLAM is determined by ESEL)
- The required **DATA RATE**

Figure 5 shows the maximum electrical length of Remote Side Cable (**RSEL**) as a function of:

- **ESEL** (in dB on the horizontal axis).
- **DATA RATE** (In kbit/s marked by colors)

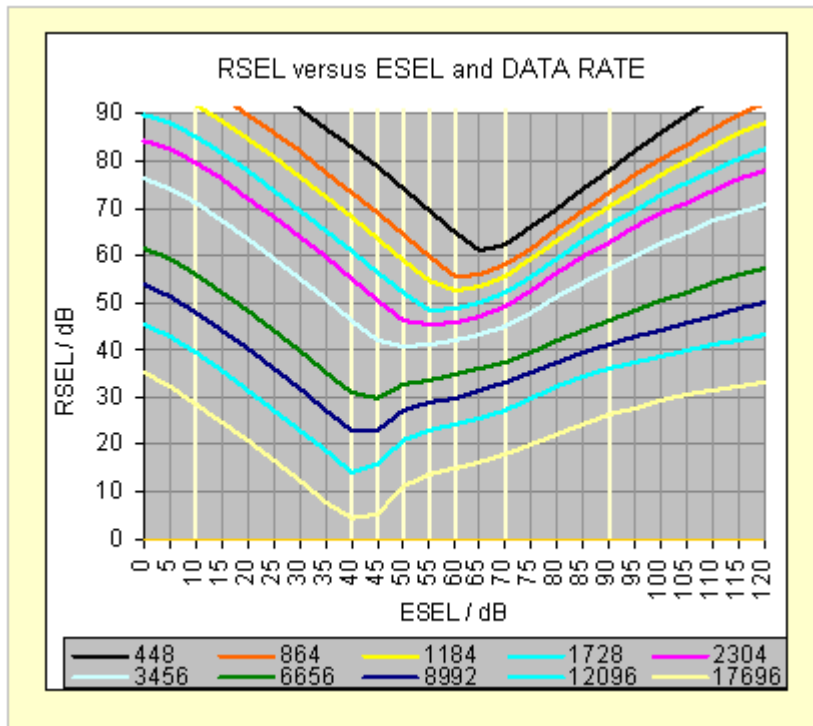


Figure 5

Elektronika instruments like **ELQ 2+** and **ELQ 30** provide two optional programs:

- **ESEL** measurement up to **120 dB** for the programming of **DSLAM**
- **ESEL Dependent Templates** and Achievable Data Rate for the qualification of **Remote Side** cables when Spectrum Shaping (**DPBO**) is applied