6.1. INTRODUCTION

Access networks can have a large number of subscribers, any failure in the service represents significant loss for the service providers. Therefore, fault surveillance and performance monitoring are important issues to ensure the correct transfer of information to the users, and a real time, non-intrusive fault surveillance system is essential to reduce construction and maintenance costs and improving service reliability. In this line, maintenance involves the whole operations required to set up and maintain, within prescribed limits, any element entering into the setting-up of a connection to guarantee the performances of the optical carrier, and locate any fault in the access network.

Accurate and cost-effective signal monitoring technologies are being developed to replace the signal monitoring that is currently done in the electronic domain at many optical-to-electronic-to-optical (OEO) conversion locations in the network. Analog optical signal monitoring that measures optical signal parameters such as channel power, channel center wavelength, and channel optical signal to noise (OSNR) is useful and can provide important information with regard to the health and quality of an optical signal. Moreover, some digital techniques are also used to obtain information about the transmission performance. The cyclic redundancy check (CRC) uses parity bits generated by polynomial encoding of digital signals. Then, decoding algorithms

Transmission Impairments and Supervision

detect errors in the received digital signal. Error correction, if required, may be accomplished through the use of an automatic repeat-request (ARQ) system. Others digital monitoring tests make evaluation of block errors in synchronous networks by means of the bit interleaved parity (BIP-n) mechanism. The network elements monitor the block errors and send information about them to the transmission source end in the backward frames. The detection of errors leads to operation and maintenance signals (OAM) being generated and carried in the frames to the information source. These are basically remote error indication signals (REI). The quality of transmission may also be estimate whether is taking into account the measured BER as a function of received optical power level.

However, the above mentioned monitoring techniques are not sufficient to fully understand the signal quality due to the fact that several failures or impairments can take place in the optical transmission. These are principally: The fiber non-linear effects, power losses, crosstalk, frequency fluctuations, dispersion, noise, failures of amplifiers, transmitter laser power fault and fiber cable break. To have an estimation of all these degradation is an aspect of great importance for design parameters and configuration of the optical networks. Some of these degradations can be measured more easily at optical level. Therefore, in the last years many efforts have been concentrated in the development of transparent supervision systems which carry out monitoring of optical signal in the optical domain without realizing the OEO conversion [Diaz 01].

However, there has not yet been sufficient discussion of the optimum testing method and wavelength, since optical fiber cables only began to be installed in subscriber networks about few years ago. In spite of that, several ingenious strategies have been developed to supervise the quality of the optical signal and fiber-fault identification with certain degrees of transparency. A two-step test procedure is advisable to assure good network performance:

- Network qualification /acceptance.
- Network monitoring.

Both acceptance and monitoring of in-service fibers are possible with the equipment available on the market. This is very important because the optical infrastructure carries aggregate traffic and is shared by different users. There are different techniques for non-intrusive monitoring/supervision and most of them are based on OTDR devices.

Another important aspect that must be taken into account is about the cost of the supervision strategies in FTTH systems. Since the quantity of installed optical fiber will increase rapidly, installation and maintenance costs must be reduced as much as possible. In this chapter, the main characteristics of surveillance systems are defined. The different impairments produced in an access network and several systems built to detect and locate faults are