Conclusion

The proposed hybrid approach is particularly interesting because it permits to multiply the number of users served by the same access network, so that the number of the central offices can be reduced, as well as related operational expenditures. However, the length of the optical link should be accordingly increased to reach the farthest users: this seems to be a critical limitation of the hybrid system because the power splitter decreases the optical power budget, due the high insertion loss.

It is well known that coherent systems have a better sensitivity with respect to direct detection systems so a coherent receiver can be used to partially compensate for such a penalty. However, an important aspect for an access optical network is its cost effectiveness: in order to improve the cost of the proposed system, the same optical source (multi-wavelength laser) is used both to generate upstream carriers and as local oscillator; in this way, duplication of the lasers is avoided at the OLT as well as the necessity of dedicated circuits for carrier frequency recovery.

At the end user terminal, an RSOA modulator is used in upstream, in order to implement a low cost “colorless” transmitter, that is a transmitter capable to be connected to an arbitrary port of the remote node, independently on the corresponding wavelength. In regular direct detection systems, the extinction ratio is usually maximized in order to improve the signal to noise ratio. This was not possible in the proposed systems, due to the chirp effects generated by high current excursion in the RSOA. The chirp would introduce a frequency offset between upstream and local oscillator carriers, which would detrimentally affect the performance of our system, where no frequency recovery circuits are present for cost reasons.

This thesis verified the excellent performance of the coherent WDM, even in presence of very low extinction ratios in upstream. For compatibility reasons with installed cables and legacy fiber access systems, the proposed WDM PON exploits bidirectional propagation on a single fiber.

A drawback is the performance can strongly be affected by in-band crosstalk due to reflections arising into the optical fiber (Rayleigh back-scattering) or at the connectors interface. To counteract this effect, Manchester coding is used in the upstream direction to reduce the signal power in the low frequency range. In this way the cross talk caused by the reflection of the seed light, whose line-width is a few tens of MHz, can be eliminated by means of a high pass filter at the OLT receiver. In order to use a simple circuit to recover the phase difference between local oscillator and upstream signal, the AC coupled receiver also requires the use of differential encoding.

We modeled the OLT receiver, including the phase recovery circuit, and verified by numerical simulation the high resilience to the reflection noise (-10 dB of cross talk are achievable with negligible penalty while conventional systems can scarcely tolerate -25 dB). On the other hand, the simulations highlighted the need to design the high pass filter with a frequency response as steep as possible, which is not a critical issue.

As conclusion, the proposed system can be certainly proposed as high performance solution for a high capacity but cost effective access network.