The Effects of Power Ratios for the Joint NOMA and OFDMA Scheme in IM/DD PON System

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Introduction

- As one of the appealing approaches for NG-PON, intensity modulation and direct detection orthogonal-frequency division multiplexing (IM/DD OFDM) PON has potential to significantly improve the network performance by considering more specific granularity like time, frequency and the resistance to physical layer (PLY) impairmentthe utilization of capacity in NG-PON cannot be fully utilized by all the ONUs due to the certain power budgets for the good links are wasted.
- More recently, the NOMA PONs based on OFDM have been widely proposed.
- To maximize the gain of NOMA PON, we group the ONUs based on their SNRs. Then the intra-group ONUs use the conventional OFDM access (OFDMA) to access the OLT.

Principe

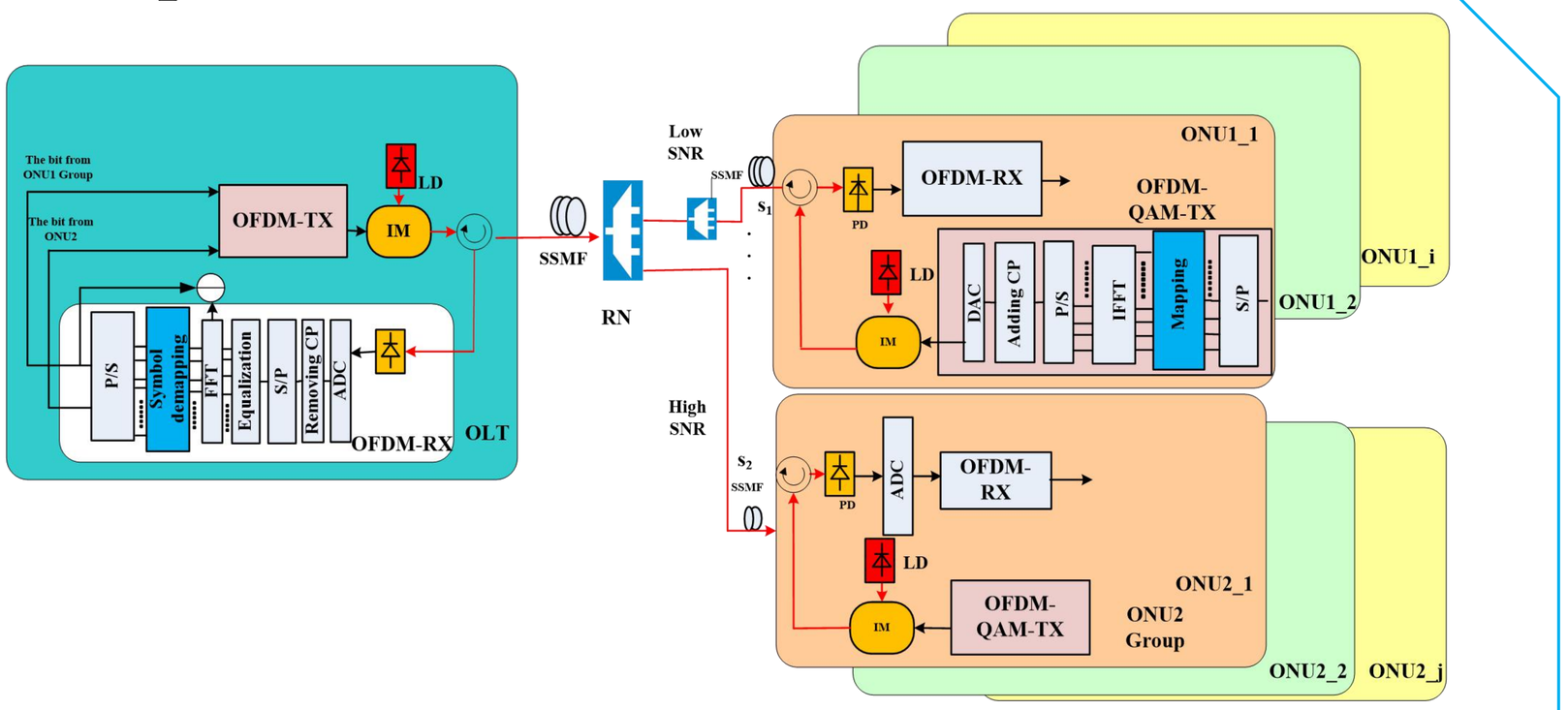

Figure 1. The diagram of joint upstream NOMA and OFDMA in IM/ DD-PON system structure

Fig. 1 shows the IM/DD NOMA PON system combined with the OFDMA scheme. The ONUs with similar channel's SNRs are grouped. The multiple paired ONU groups can fully exploit the significant differences of channel condition. In each ONU group, subcarriers can be divided among multiple ONUs in the upstream direction.

Results

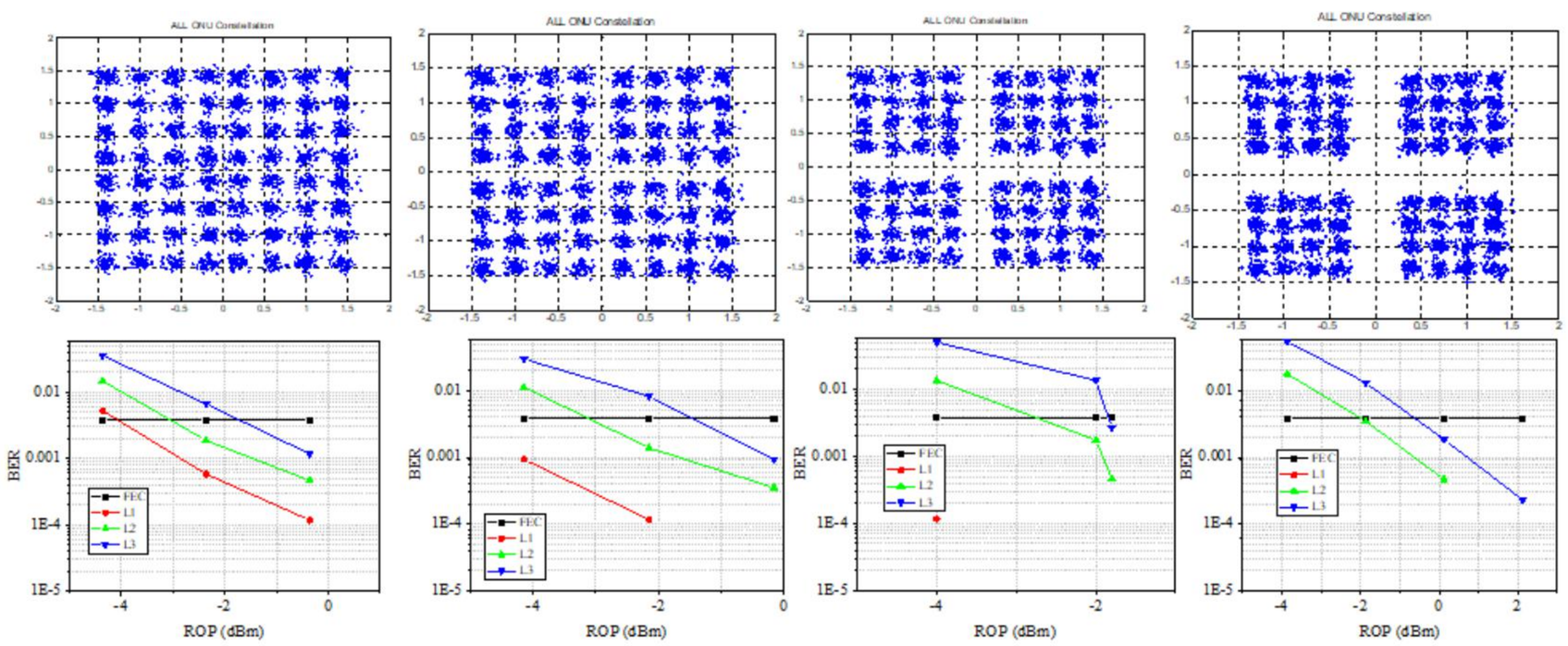

Figure3. The BER vs ROP under BTB when the optical power ratio are 2.4, 2.64, 3, 3.48 in NOMA-PON

When the optical power ratio is 13/5.4,14/5.3, 15/5, and 16/4.6, the general constellation diagram of total ONU is superimposed at OLT and the BER performance of the system are shown in Fig.3.

The 64 constellation points can be regarded as the superimposed constellation by 4QAM of ONU group1 and 16QAM of ONU group2 in accordance with a certain Euclidian distance ratio. It also can be considered the superimposed layer 1(L1), layer2 (L2) and layer3 (L3) 4QAM signal. When the optical power ratio is 2.64, the constellation diagram is approximately uniform 64QAM constellation. Under the BER threshold of HD-FEC, when the optical power ratio is 2.4, the ROPs of L1, L2 and L3 are -4 dBm, -3 dBm and -1.8 dBm, respectively.

When the optical power ratio is 2.64, the ROPs of L2 and L3 are -3.2 and -1.5dBm, respectively. While the BER of L1 layer is far less than the BER threshold. The similar trends can be found when the optical power ratio is 3. When the optical power ratio is 3.48, the ROPs of L2 and L3 are -2 dBm and -0.65dBm, respectively. While the BER of L1 layer is zero at this case. Thus, with the increase of the optical power ratio, the BER of L1 layer decreases gradually.

Conclusion

- The joint upstream NOMA and OFDMA scheme in IM/DD-PON system structure has been proposed.
- The constellation and BER performance are evaluated in different optical power ratio scenarios.