非線形補償を用いたデジタルコヒーレント無中継光伝送システムの検討

Mitigation of Nonlinear Impairment by Using Digital Back Propagation In Digital Coherent Optical Non-Repeatered Transmission System

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We have theoretically evaluated transmission property and bit error rate (BER) performance of 120Gbps DP-16QAM digital coherent signals, with and without nonlinear compensation by means of the digital back propagation. In case of single channel transmission, the maximum input power set by the fiber nonlinearity could be increased as large as 2.0 dB by using the nonlinear compensation. The improvement has been reduced to 0.6dB in DWDM transmission systems due to disturbance from neighboring DWDM channels.

Figure 1 indicates the BER characteristic for 120Gbps DP-16QAM with single channel transmission, depending on the transmission power without nonlinear compensation. It is clearly seen from the figures in Fig.1 that all two cases the BER deteriorates, pursuant to Tx powers and approaches to specific saturation levels. In other words, achievable BER is dominantly determined by Tx power regardless of received signal level. If we define the maximum Tx power as the power at which BER saturated to 1.0×10^{-2} at -25dBm received power or above. Then the values are +15.2dBm and +17.2dBm for DP-16QAM with and without nonlinear compensation, respectively. Therefore the maximum Tx power is considered to improve by 2.0dB using nonlinear compensation.

Next, we investigated DWDM transmission characteristics. As examples, Figs. 2 (a) and (b) show 8 and 20 DWDM BER characteristics, respectively, with and without nonlinear compensation. In case of Fig.2 (a), the log10 of BER was improved from -1.6 to -2.0 at Tx power +22dBm. In order to estimate effective factor of nonlinear compensation, we increase the Tx power to the value where the BER performance with nonlinear compensation are approached to the BER curve without nonlinear compensation. Then we have found that the effective factor is about 0.6dB. We did the same for 20 DWDM and we have got the same value of 0.6dB. This implies that the 0.6dB improvement will be kept even if the number of DWDM channels increases.

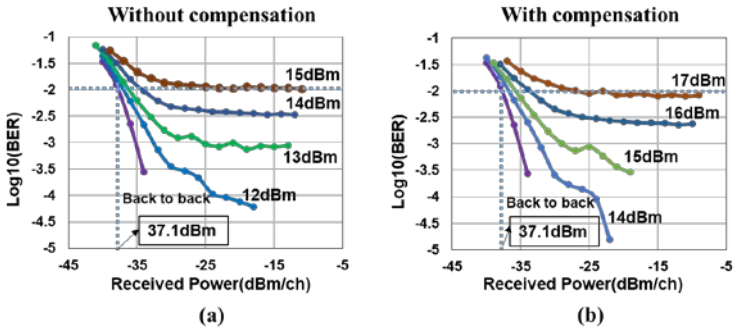

Fig.1 BER characteristic for DP-16QAM.
(a) Without compensation. (b) With compensation.

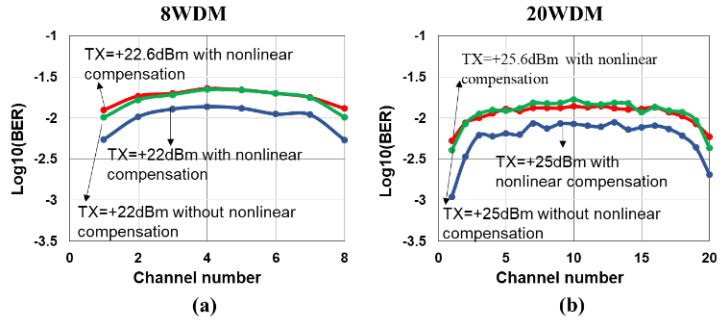

Fig.2 DP-16QAM 8WDM and 20WDM transmission characteristics. Fiber length is 100km. (a) 8WDM. (b) 20WDM.