

Broadband Power-Line Communications: The Channel Capacity Analysis

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Abstract

The power line has been proposed as a solution to deliver broadband services to end users. Various studies in the recent past have reported a decrease in channel capacity with an increase in the number of branches for a given channel type whether it is an indoor or low-voltage (LV) or medium-voltage (MV) channel. Those studies, however, did not provide a clear insight as to how the channel capacity is related to the number of distributed branches along the line. This paper attempts to quantify and characterize the effects of channel capacity in relation to the number of branches and with different terminal loads for a given type of channel. It is shown that for a power spectral density (PSD) between 90 dBm/Hz to 30 dBm/Hz, the channel capacity decreases by a 20-30 Mb/s/branch, 14-24 Mb/s/branch, and a 20-25 Mb/s/branch for an MV channel, LV channel, and indoor channel, respectively. It is also shown that the channel capacity is minimum when the load impedance is terminated in characteristic impedances for any type of channel treated here. It is shown that there could be a significant loss in channel capacity if a ground return was used instead of a conventional adjacent conductor return. The analysis presented in this paper would help in designing appropriate power-line communication equipment for better and efficient data transfer.

Keywords

Branched network; broadband power line; channel capacity; frequency response; indoor channel; low-voltage (LV) channel; medium-voltage (MV) channel; multipath; power-line channel; transfer function