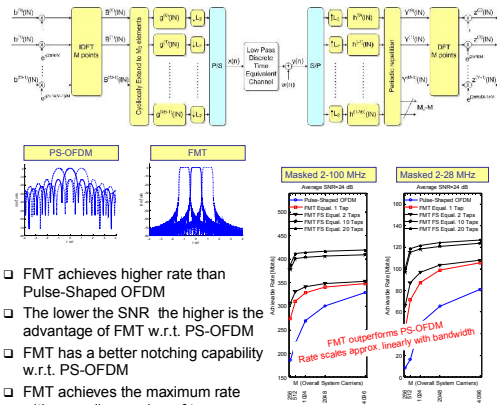


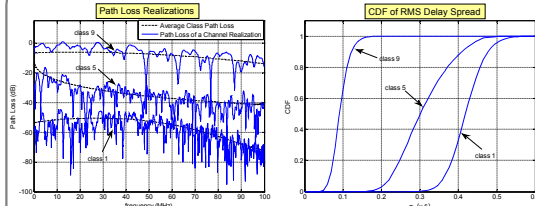
Abstract

High speed power line communications require the design of advanced modulation techniques and the use of statistically representative channel models. We have developed adaptive filtered multi-tone (FMT) modulation and orthogonal frequency division multiplexing (OFDM) schemes. We have also implemented two channel simulators based either on a top-down or a bottom-up statistical approach.

Filtered Multi-Tone Modulation



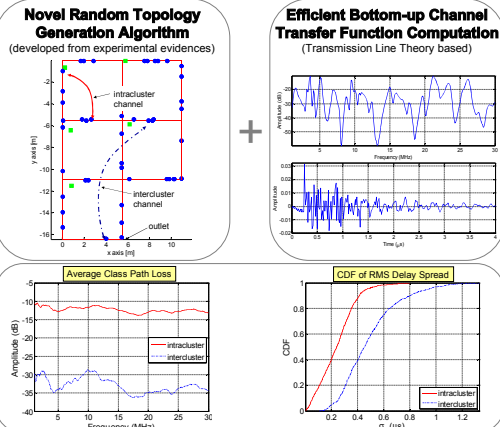
Statistical Bottom-Up Channel Model



- Obtained introducing variability into the Dostert Zimmermann multipath propagation model
- Analytical formulation of the Power Line Channel Transfer Function
- It can generate channels belonging to several classes of capacity (3 shown in the plot) consistent with measurements
 - Fast and straightforward channel generation
 - Low computational effort

> A.M. Tonello, "Wideband Impulse Modulation and Receiver Algorithms for Multiservice Power Line Communications," *EURASIP Journal on Advances in Signal Processing*, vol. 2007, pp. 1-14.
 > P. Pagani, M. Tlich, A. Zeddani, A. Tonello, F. Pecile, S. D'Alessandro, G. Mijic, and K. Kriznar, "PLC Channel Transfer Function Models for the OMEGA ICT Project," in *Proc. of ICT-Mobile Summit 2009*, June 2009.

Statistical Top-Down Channel Model

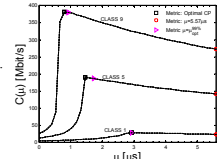


- It keeps all the **topological information** about generated channels
 - cable types and interconnection structures
 - outlets and loads arrangement
- It allows **novel channel classifications** and studies based on nodes location
 - intercluster and intracluster classes

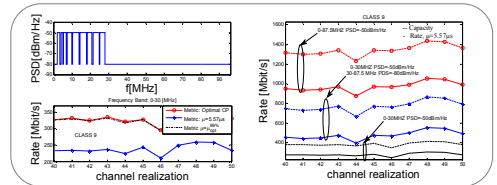
> A.M. Tonello and F. Versolatto, "New Results on Top-down and Bottom-up Statistical PLC Channel Modeling," in *Proc. Third Workshop on Power Line Commun. (WSPCL-2009)*, October 1-2 2009, Udine, Italy.
 > F. Versolatto and A.M. Tonello, "Analysis of the PLC Channel Statistics Using a Bottom-up Random Simulator," in *Proc. of IEEE Int. Sym. on Power Line Commun. And its Applications (ISPLC 2010)*, Rio De Janeiro, Brazil, March 29-31 2010.

Adaptive OFDM

- The achievable rate (AR) is a function of the CP duration
 - The optimal CP is obtained maximizing the AR, i.e.
- $$C(\mu) = \frac{1}{(M + \mu)T} \sum_{k=1}^K \log_2(1 + SINR^{(k)}(\mu))$$
- $$\mu_{opt} = \arg \max_{\mu=0, \dots, J_{CP}-1} C(\mu)$$
- To lower the complexity we propose to adapt over a small set of CP values. **For each channel class we have found a near optimal CP value studying the statistic of the optimal CP.**



$$\mu_{opt, CLASS 1}^{99\%} = 2.93 \mu s \quad \mu_{opt, CLASS 5}^{99\%} = 1.73 \mu s \quad \mu_{opt, CLASS 9}^{99\%} = 0.93 \mu s$$



> A.M. Tonello, S. D'Alessandro, L. Lampe, "Bit, Tone and Cyclo Prefix Allocation in OFDM with Application to In-Home PLC," in *Proc. of IEEE RSP Wireless Days 2009*, Dubai, United Emirates, Nov. 2009, pp. 1-5.
 > S. D'Alessandro, A.M. Tonello, L. Lampe, "Bit-Loading Algorithms for OFDM with Adaptive Cyclo Prefix Length in PLC Channels," in *Proc. of IEEE Int. Sym. on Power Line Commun. and its Applications (ISPLC 2009)*, Dresden, Germany, March 29 - Apr. 1 2009, pp. 177-181.