Tutorial on
Power Line Carrier Communications in Transmission and Distribution Power Grids: New Stage in Evolution

As soon as the first power transmission lines were built, people mused upon task of its application for information transmission. In most cases power line is the shortest path between electrical substations and is a ready-made transmission medium. The first power line carrier channels appeared over 100 years ago and are still widely used in today's power grids. According to rough estimates, more than 250 thousands PLC channels over transmission power lines are in operation today worldwide. High voltage PLC used for voice, data and teleprotection signals transmission. For various reasons, modems for medium voltage distribution power grids do not have prevalence, but smart power meters with integrated PLC modems for low voltage networks are sold in millions. All three power line communications technologies are based on completely different methods of channels creating and coupling to the phase conductors, but named as PLC, which often leads to confusion. In this session two directions of communications over electrical lines are considered – High voltage PLC for transmission power lines and Medium voltage PLC modems for distribution power grids. New stage in evolution of these technologies is shown.

To date, there is a difficult situation in the form of a deficit of specialists who would have good theoretical knowledge of HV PLC. There are two reasons for this - rapid development of other telecommunications systems over the past 20 years, which superseded PLC channels and a long time to replace equipment in high voltage power grids - from 15 to 20 years. Thus, one generation of specialists left industry, and the new people have not come or moved to other areas of telecommunications and IT. But market shows, that HV PLC is still popular in power grids and to this day and retain their positions. The purpose of this work is to show, how the technology with more than hundred-year history can be applied in modern electrical grids in digitalization paradigm, what problems exist, ways of their solution, new approaches to establishment of high voltage power line carrier channels.

During 30 years different companies have been involved in research and development of medium voltage PLC modems. But in large-scale this task is still unresolved. This is due to the fact that distribution networks have a very complex structure. There are narrowband and broadband PLC modems for MV power grids. Narrow band modems are low bitrates; BPLC modems are the most suitable for MV power lines of a few hundred meters in length. At the same time, the entire infrastructure modems and coupling devices is quite expensive. In this work it is proposed to apply for medium voltage networks the approaches implemented in wideband digital PLC for high voltage transmission lines, which would allow creating modems with few megabit per second transmission speed and transmission distance of kilometers. Various methods of coupling to transmission medium, modems interoperability and data routing are considered.

Topics of interest:

- Power line carrier communications in telecommunication networks of power grid companies
- 100 years history of PLC in high voltage transmission power grids. Outdated technology or inherent part of electrical grid infrastructure?
- High voltage PLC - total recall. Types and parameters of HV PLC channels
- High voltage power line as transmission medium. Modelling of power lines in WinTrakt software

- From classical to digital substation. How to integrate HV PLC in future infrastructure of HV digital substation? New stage in evolution – wideband digital PLC with packet switching
- New challenge – there are too many of them. Problem of HV PLC spectrum utilization and overload
- PLC modems for medium voltage power grids. Types and technologies
- Conceptual issues of PLC modems applications for MV segment. Coupling to MV power lines
- Low bit rate narrow band PLC, short haul broadband PLC. Take a different course - wideband HV PLC approach for MV networks
- MV wideband modems interoperability and data routing issues

Organizer(s):

Anton G. Merkulov, PhD, SMIEEE
Almaty Power Engineering and Telecommunications University, Kazakhstan
E-mail: anton.merkulov@ieee.org