CIGRE Study committe D2

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG D2.66

NAME OF THE CONVENOR
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TITLE
Low Voltage Power Line Carrier Communications Application

THE WG APPLIES TO DISTRIBUTION NETWORKS: **YES**

ENERGY TRANSITION
3 / Digitalization
5 / Grids and Flexibility

POTENTIAL BENEFIT OF WG WORK
1 / commercial, business, social, economic benefits
3 / likely to contribute to new or revised industry standards
4 / state-of-the-art or innovative solutions or directions

STRATEGIC DIRECTION
1 / The electrical power system of the future reinforcing the End-to-End nature of CIGRE: respond to speed of changes in the industry by preparing and disseminating state-ofthe-art technological advances
2 / Making the best use of the existing systems

SUSTAINABLE DEVELOPMENT GOAL
9 / Industry, innovation and infrastructure

BACKGROUND :

Low Voltage Power Line Communications (LV PLC) are widely used in power distribution grids to build Advanced Metering Infrastructure (AMI), which includes smart meters, public lighting control, and various distribution automation and SCADA applications. Solutions range from lower-bandwidth technologies like PRIME, G3, and IEEE 1901.2 (under 120 kbps) to Broadband Power Line (BPL) solutions that enable packet networks over LV distribution networks, facilitating higher data volume metering and backhauling for smart metering and grid automation.

As smart grid construction advances, power grid companies require improved capabilities for real-time data collection, two-way interaction, remote charge control, and time calibration, necessitating faster and more stable communication technologies. Power line carrier communication PLC has emerged as a solution, with the international standard IEEE P1901.1 introduced in 2018.

A dual-mode scheme combining PLC and micro-power wireless technology (PLC+HRF) enhances communication by addressing signal attenuation and interference in power line channels.

By utilising OFDM modulation, the HPLC+HRF technology doubles the supported nodes from 1,000 to 2,000 and includes a networking routing mechanism for effective communication. Enhanced encryption ensures network security while allowing for efficient physical topology identification and line loss management. Additionally, this technology enables secure access to transformer district devices, fostering advanced operational management, accurate load forecasting, and the transformation of low-voltage power grids into efficient digital networks.

As more powerful and diverse digital devices increasingly penetrate the edges of power grids, the next generation of high-speed power line carrier communication can enhance metre reading success rates, reduce overall line losses, and minimise power outage durations. Additionally, it can facilitate collaboration among source, network, load, and storage systems in transformer districts.

The CIGRE Working Group D2.61, High Voltage Power Line Carrier Communications Current State and Future Application, focuses on modernising HV PLC systems for mission-critical grid applications. This WG differs from D2.61 as the new WG focuses on LV PLC development, which is critical for last-mile connectivity in smart grids amid rising data-intensive applications such as AI-driven time-of-use pricing, prosumer integration, and IoT sensors. LV PLC faces challenges like bandwidth constraints, noise interference, and interoperability gaps, necessitating standardised protocols, dynamic spectrum management, and secure low-latency solutions. While D2.61's research into digital modulation and hybrid communication models provides foundational insights, dedicated efforts remain essential to harmonise LV PLC technologies, ensuring robust last-mile infrastructure to support the electric power industry's evolving telecommunication needs.

PURPOSE / OBJECTIVE / BENEFIT OF THIS WORK :

The objective is to assess the current state of low-voltage power line carrier (LV PLC) communications in power grids worldwide. This includes exploring the applications of next-generation LV PLC in digital and intelligent power scenarios, particularly in service contexts where smart grids expand coverage to users. Key functions of LV PLC will be examined across multiple service domains, including AMI, orderly charging, smart home appliances, and multi-meter reading.

The outcome of this initiative will be a Technical Brochure on LV PLC applications, designed for various professionals involved in planning and implementing telecommunications within power grids. This TB will enable Electric Power Utility (EPUs) to maximize the benefits of LV PLC and accurately define its role in modern power systems.

SCOPE :

The working group will focus on the following areas:

1. Key features, principles, and applications of low-voltage power line carrier (LV PLC) technology.
2. Analysis of the current global landscape of LV PLC, including statistics on its applications.
3. Research into the development trends and emerging technologies in LV PLC.
4. Best practices for implementing power line carrier (PLC) and radio frequency dual-mode solutions.
5. Identification of future application areas for next-generation PLC, along with forecasts for potential scenarios.
6. Frequency allocations and the associated challenges.

DELIVERABLES AND EVENTS

Deliverables Types

Annual progress and activity report to Study Committee
Electra report
Meeting
Technical Brochure and Executive Summary in Electra
Tutorial
Webinar

Time schedule

Q3	2025	Recruit members
Q4	2025	Develop final work plan
Q2	2026	Draft TB
Q3	2026	Final TB
Q1	2027	Tutorial
Q2	2027	Webinar

APPROVAL BY TECHNICAL COUNCIL CHAIRMAN:
Rannveig S. J. Løken
April 26th, 2025