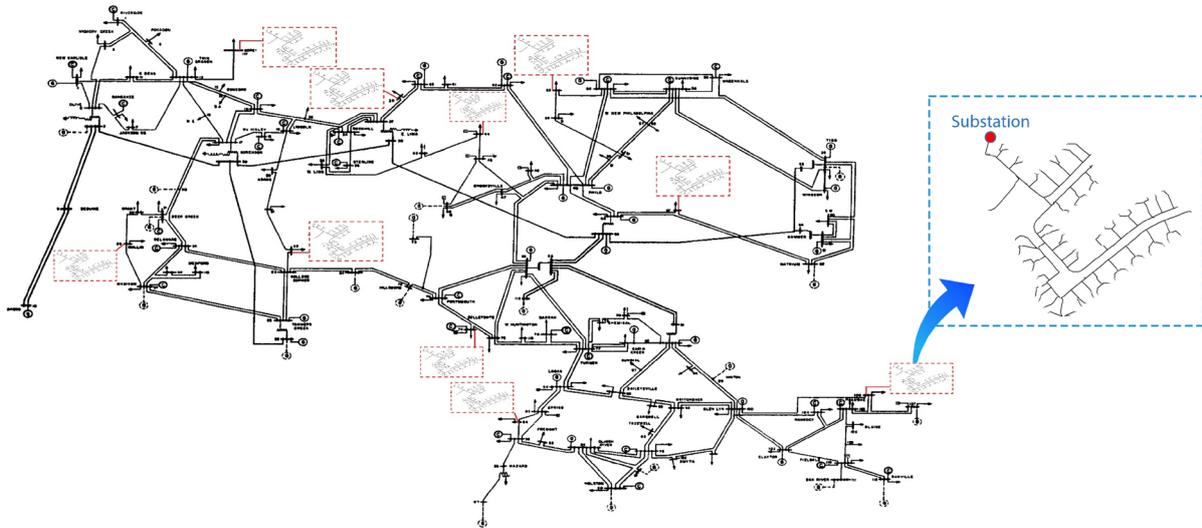


# Real-Time Simulation of Over 100,000 Nodes of T&D Systems

OPAL-RT's ePHASORSIM engine has achieved the real-time transient stability simulation of large-scale transmission-distribution (T&D) power grids. Forty instances of IEEE European Low Voltage Test Feeder are stitched to the IEEE 118 bus transmission system to synthesize a new test case that has over 108,000 nodes. The real-time simulation of such a massive power grid uses nine CPU cores on which the computations are dispatched in parallel. The experimental results on an OP5600 simulator verify the performance and scalability of the synthetic system and the simulation engine.



## WHY IS THE DYNAMIC SIMULATION OF T&D CRUCIAL?

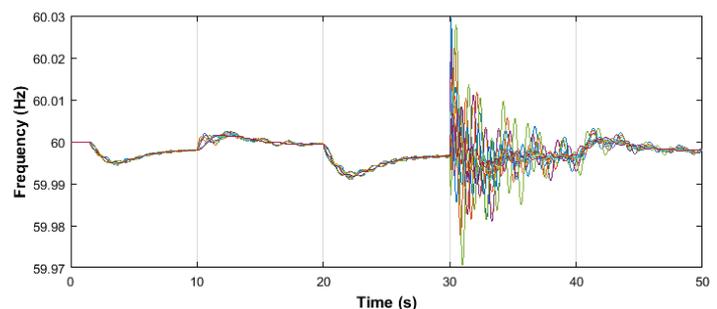
In today's modern power systems, with large microgrid penetration in the distribution networks, the power transfer between transmission grid and distribution system can be bidirectional. As distribution networks become increasingly dynamic, transient stability simulation of T&D systems will be required for wide area control and protection studies, dynamic state estimation tools, and coordination between TSO and DSO.

## WHAT ARE THE CHALLENGES IN SIMULATING T&D SYSTEMS?

The dynamic simulation of a T&D system is a challenge for today's power system simulation tools. First, the size of a T&D system in terms of its total number of nodes is massive, making its mathematical modeling computationally burdensome. Second, most tools support transient stability simulations to a limited extent; some are designed only for transmission systems, some are limited to balanced systems only, while others can simulate either balanced or unbalanced mode (but not both at the same time).

## THE SOLUTION FOR DYNAMIC SIMULATION OF LARGE-SCALE T&D SYSTEMS

The topology of T&D systems are well suited for applying a coarse-grained parallelism. ePHASORSIM benefits from this characteristic to partition such T&D systems into one transmission and several distribution subsystems, and simulate each of them independently. The electric distance among the distribution subsystems will also confirm the validation of this partitioning.



### ABOUT OPAL-RT TECHNOLOGIES

OPAL-RT is the world leader in the development of PC/FPGA Based Real-Time Digital Simulator, Hardware-In-the-Loop (HIL) testing equipment and Rapid Control Prototyping (RCP) systems to design, test and optimize control and protection systems. used in power grids, power electronics, motor drives, automotive industry, trains, aircraft and various industries, as well as R&D centers and universities.