Wide Area Monitoring and Protection

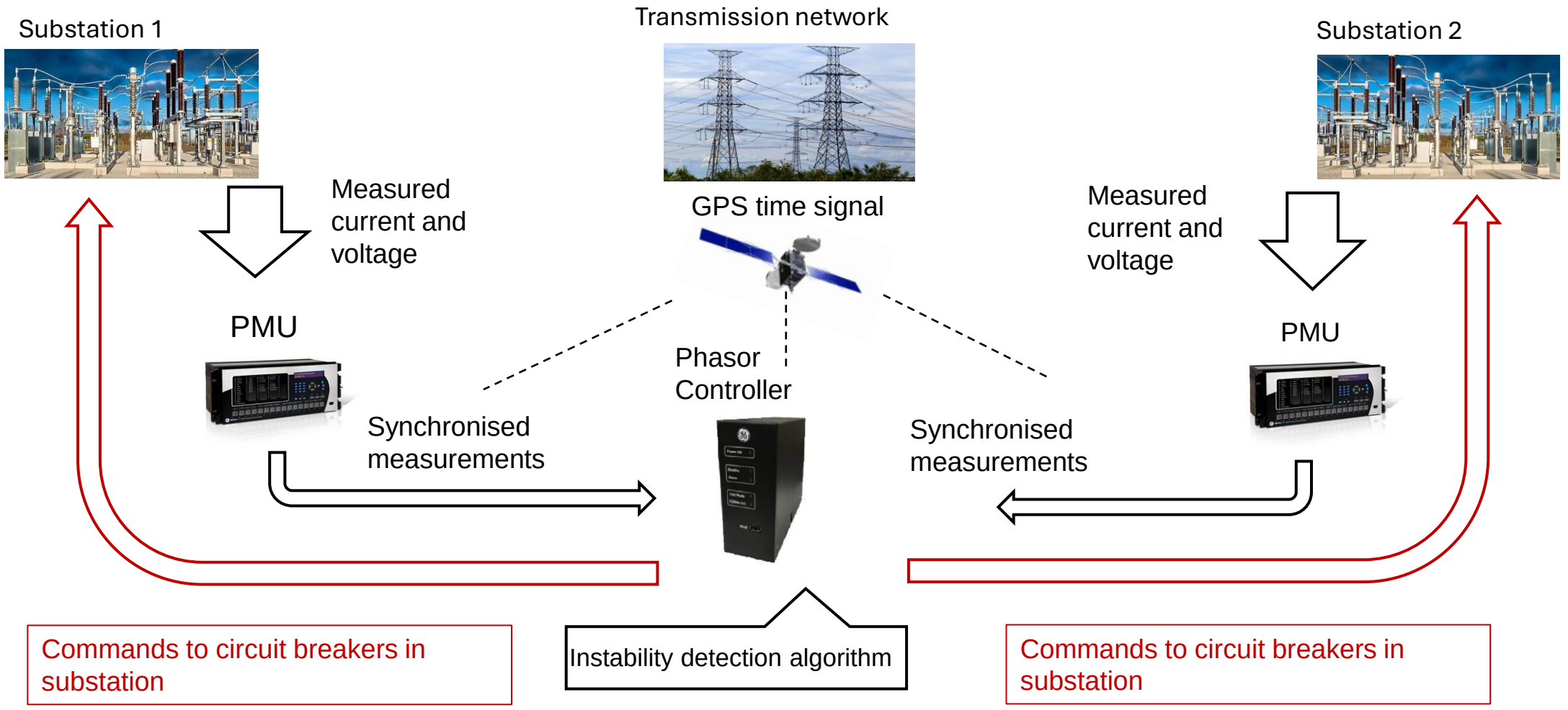
M. Popov, TU Delft
J. Van Ammers, GE Vernova

TU Delft Delft University of Technology

05 May 2025

Source: TSO TenneT

Real-time application of PMUs



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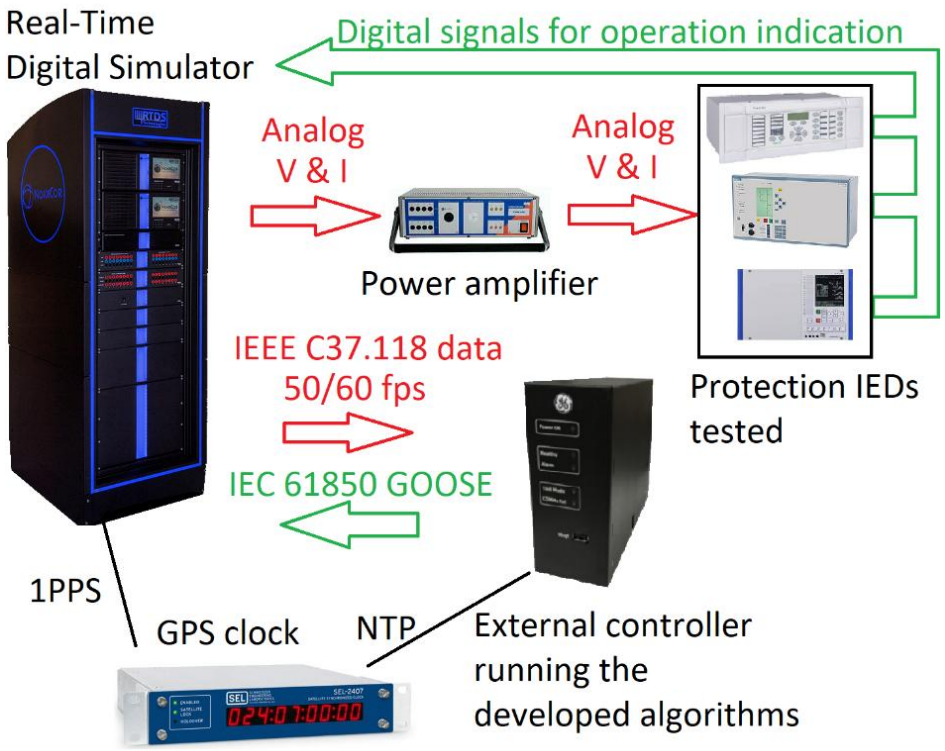
Substation images: https://www.pinterest.com/pin/858428378953096585/ Transmission network image: https://www.tdworld.com/overhead-transmission/article/20972742/linevision-launches-asset-health-model-for-utility-transmission-lines

PMU application – Out-of-Step Protection



RESEARCH ARTICLE

Out-of-Step Protection Based on Discrete Angle Derivatives

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TU Delft

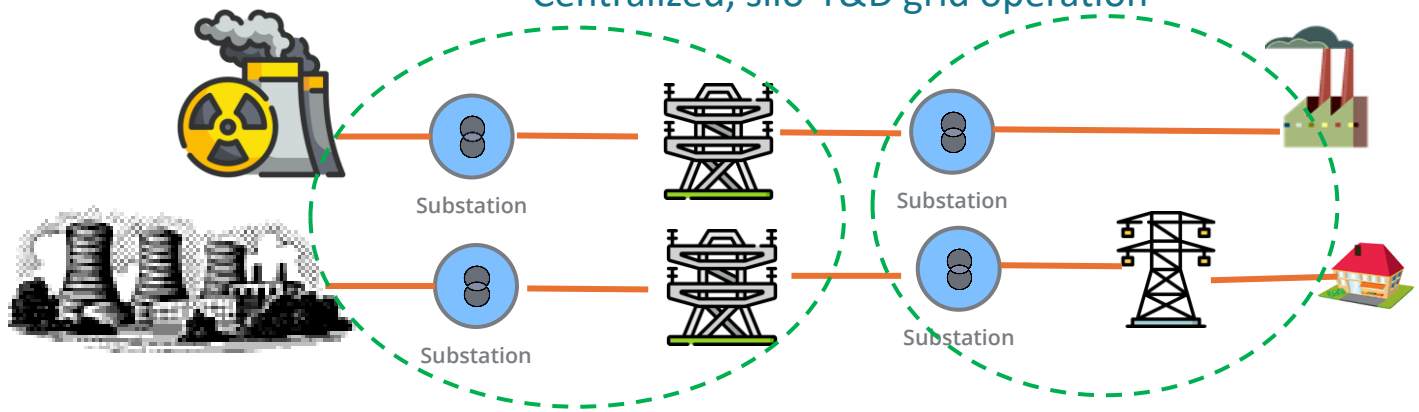
M. Popov: Power swing detection and prevention in future networks with high penetration of renewable energy, NWO Take off, Grant 19279 (2022)
Consortium: TSO TenneT, Stedin, Alliander, GE Vernova

Dynamic System Rating with Distributed Edge Intelligence

(new project: TU Delft / TenneT/ GE Vernova)

Conventional

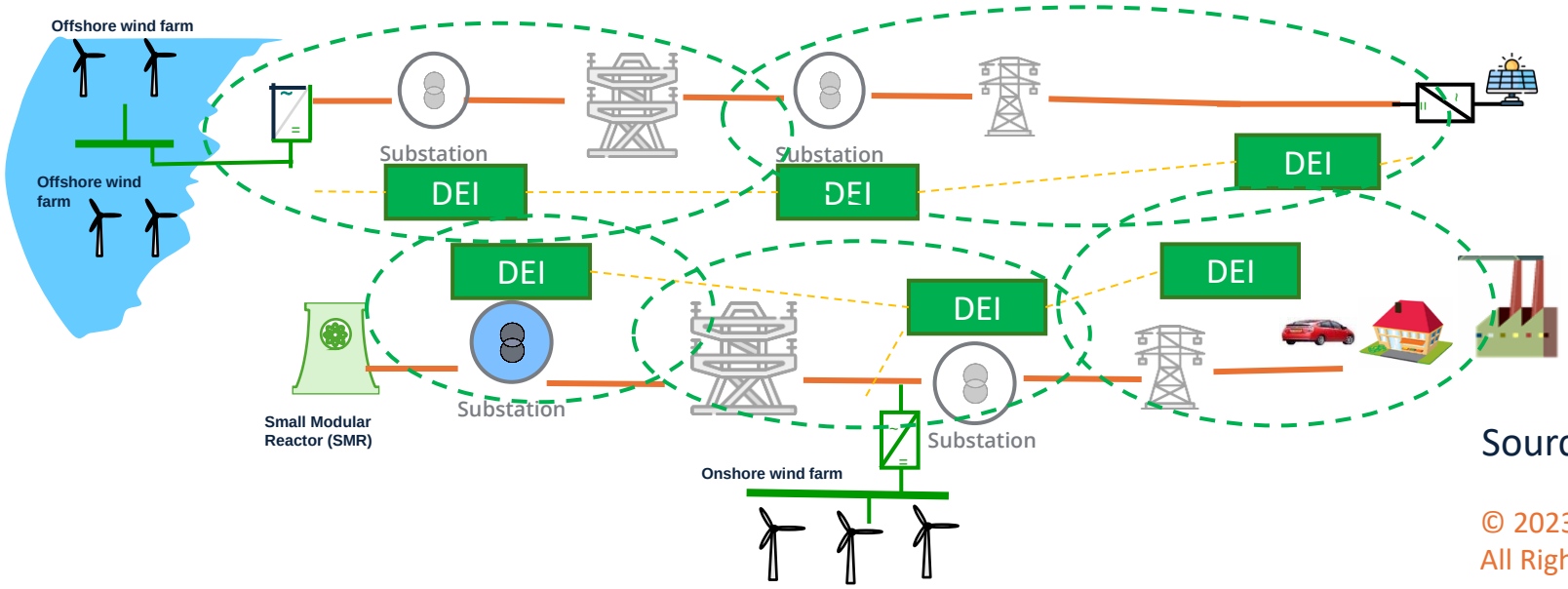
Centralized, silo-T&D grid operation



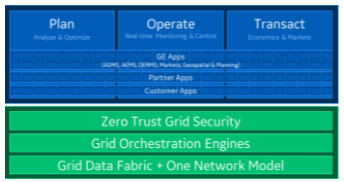
Grid Operation & Controls
(sec-mins)

Grid of the Future

Resilient & fast zones of grid controls (10ms-100ms)



Grid Operation & Orchestration
(sec-mins)



DEI Distributed Edge Intelligence

Source: GE VERNOVA