WAMPAC

SCADA and WAMS
Structure and Components

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University of Kurdistan
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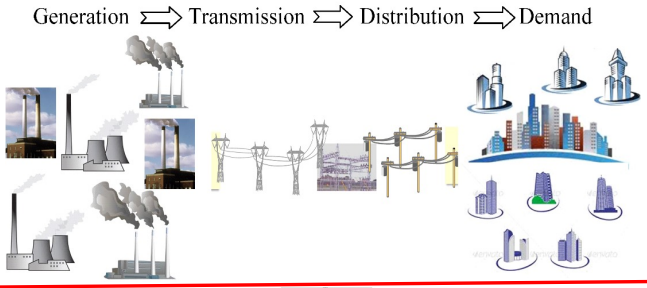
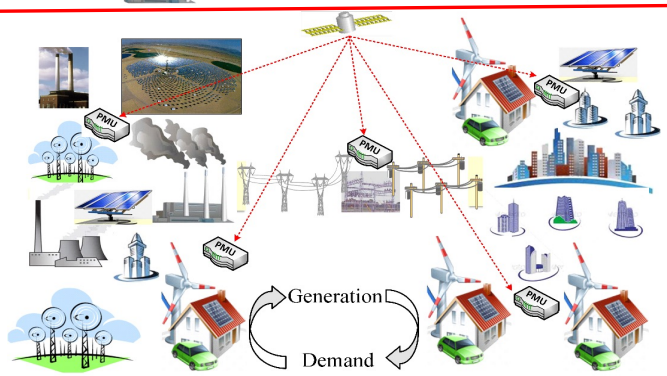
Contents

Conventional and Modern Power Grids

Conventional power grid

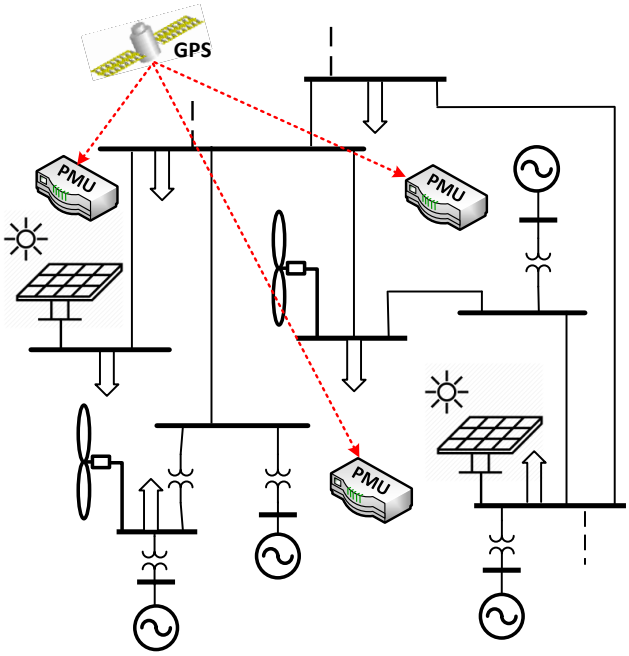


Modern power grid



H. Bevrani, ..., Grid-Connected Converters: Modeling, Stability, and Control, Elsevier, Expected 2022

PMU-based Renewable Integrated Power Grid



H. Bevrani, ..., Grid-Connected Converters: Modeling, Stability, and Control, Elsevier, Expected 2022

Supervisory Control And Data Acquisition (SCADA)

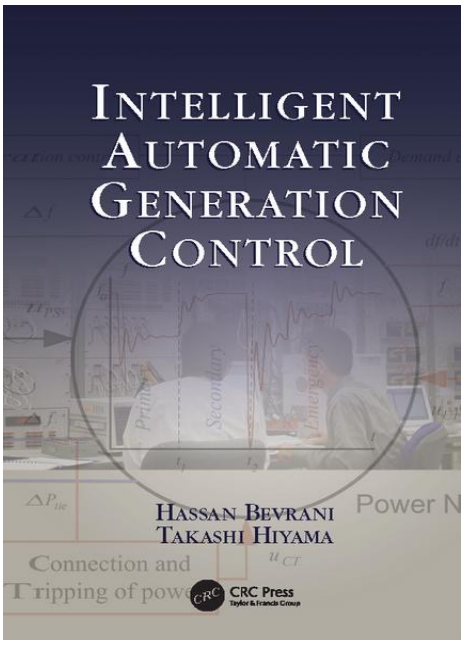
https://www.onupkeep.com/learning/maintenance-tools/scada-system

Reference

Chapter 2:

Automatic Generation Control: Fundamental and Concepts

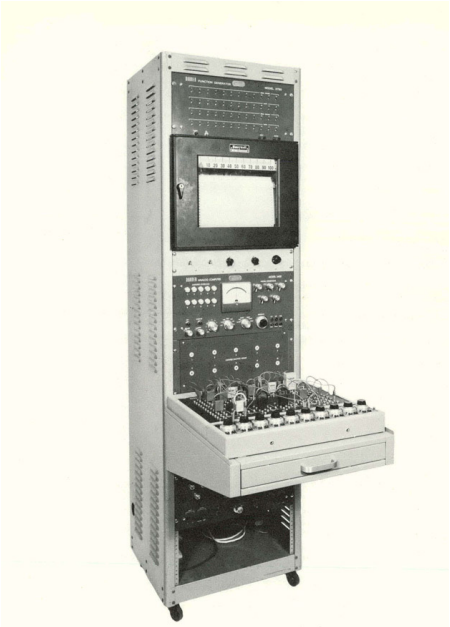
(Pages: 11-15)



SCADA: History

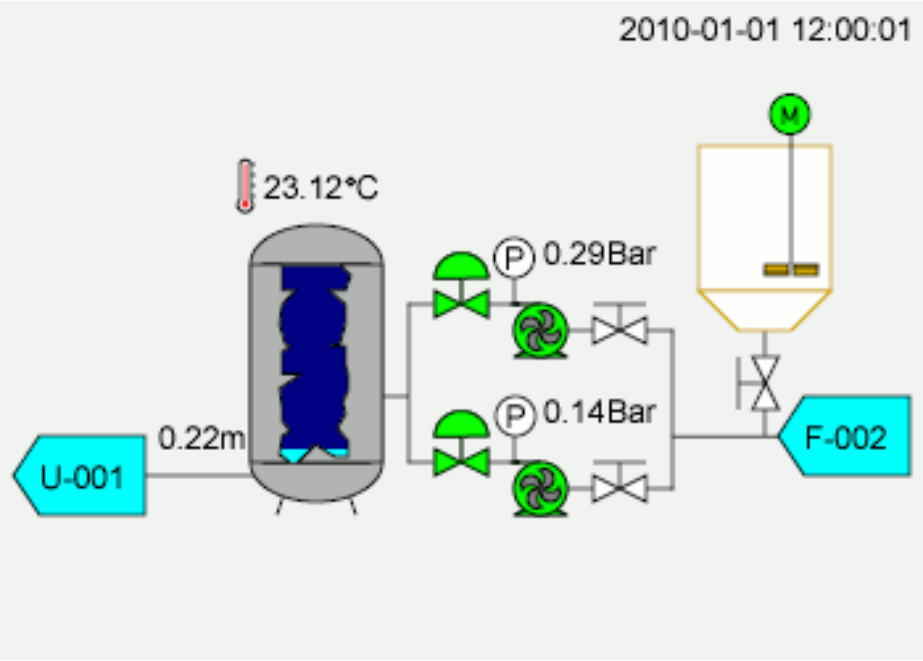
Concept of SCADA was introduced in the mid-20th century. Many manufacturing floors, industrial plants, and remote sites relied on personnel to manually control and monitor equipment via push buttons and analog dials.

https://inductiveautomation.com/resources/article/what-is-scada



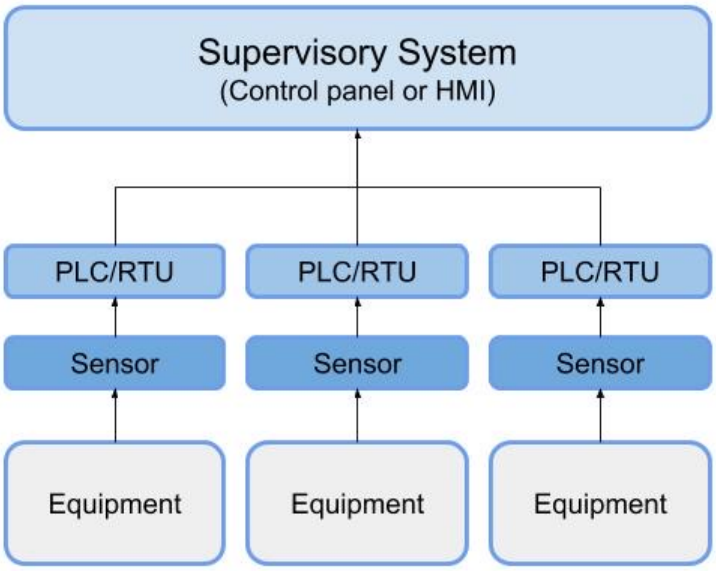
DOE's Office of Scientific and Technical Information (OSTI), Office of Science [Public domain], via Wikimedia Commons

SCADA Mimic Example



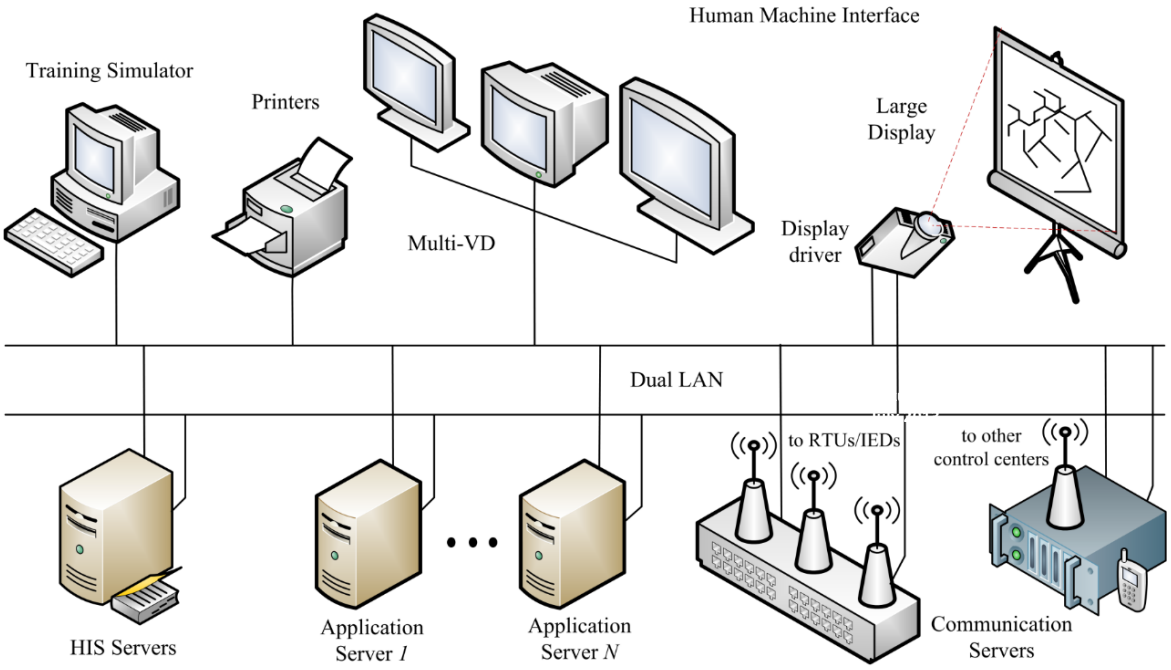
https://upload.wikimedia.org/wikipedia/commons/8/88/Scada_std_anim_no_lang.gif

SCADA: Simplified Structure

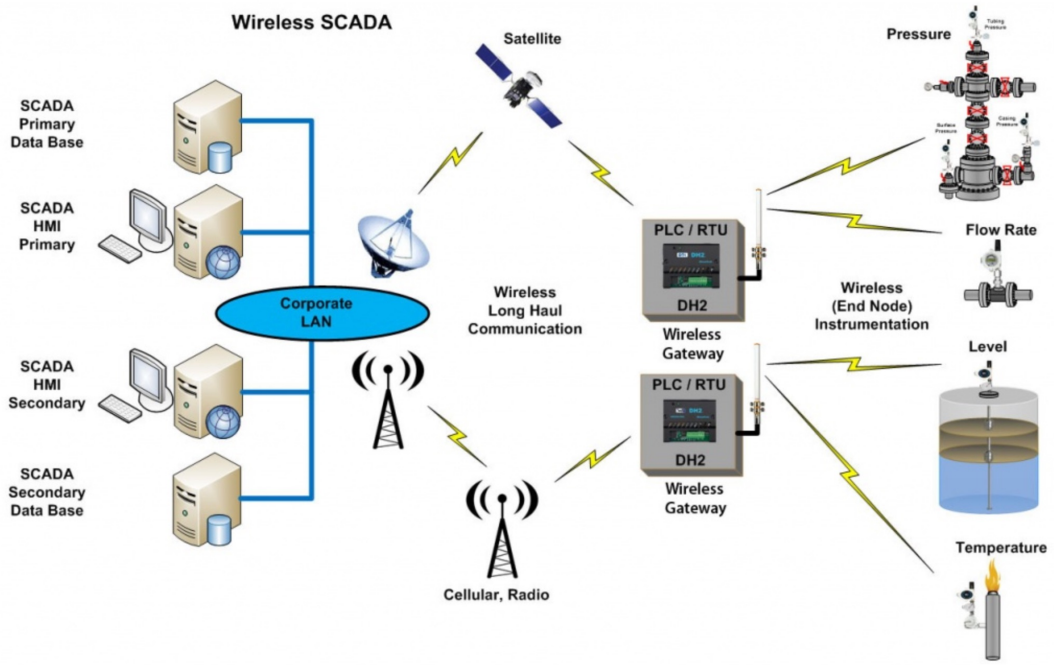


https://www.onupkeep.com/learning/maintenance-tools/scada-system

SCADA: Main Components

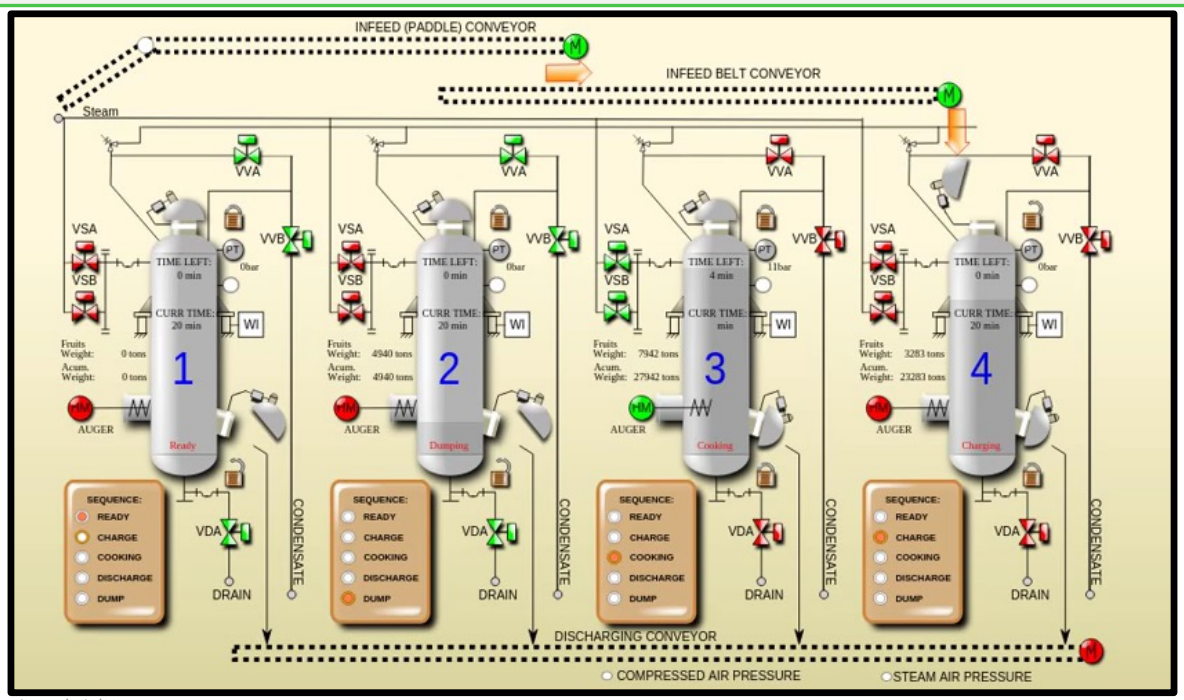


SCADA: Main Components



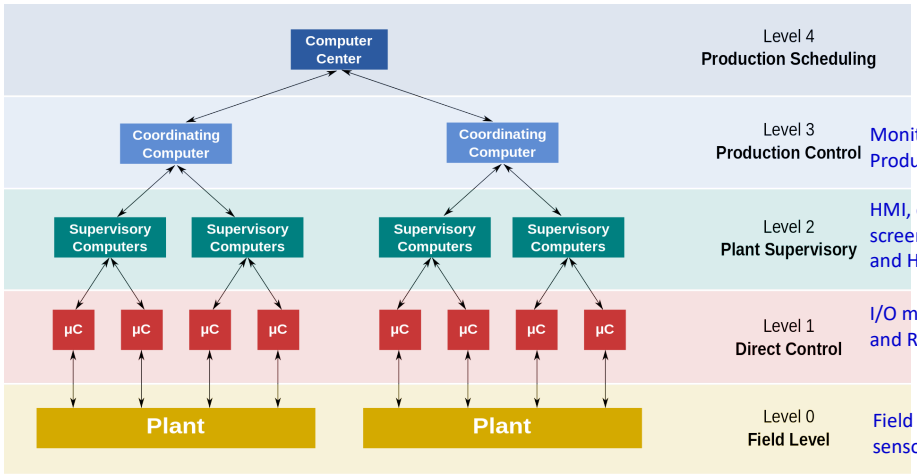
https://www.onupkeep.com/learning/maintenance-tools/scada-system

Human Machin Interface (HMI)



https://en.wikipedia.org/wiki/SCADA#

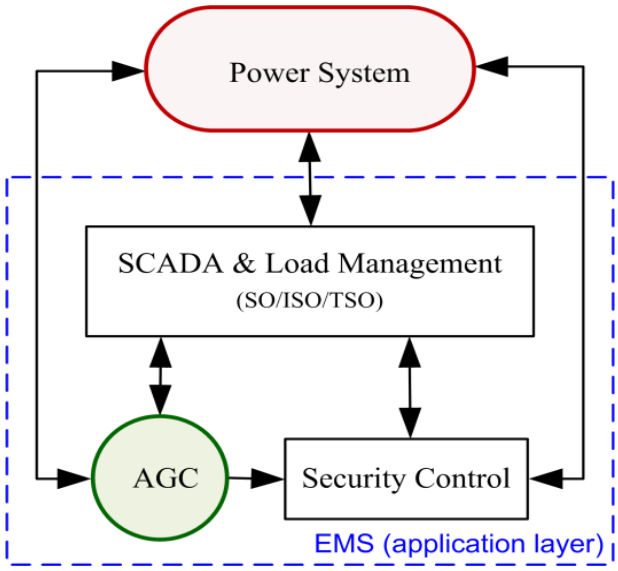
SCADA: Hierarchical Structure



https://en.wikipedia.org/wiki/SCADA

SCADA: Power System Example

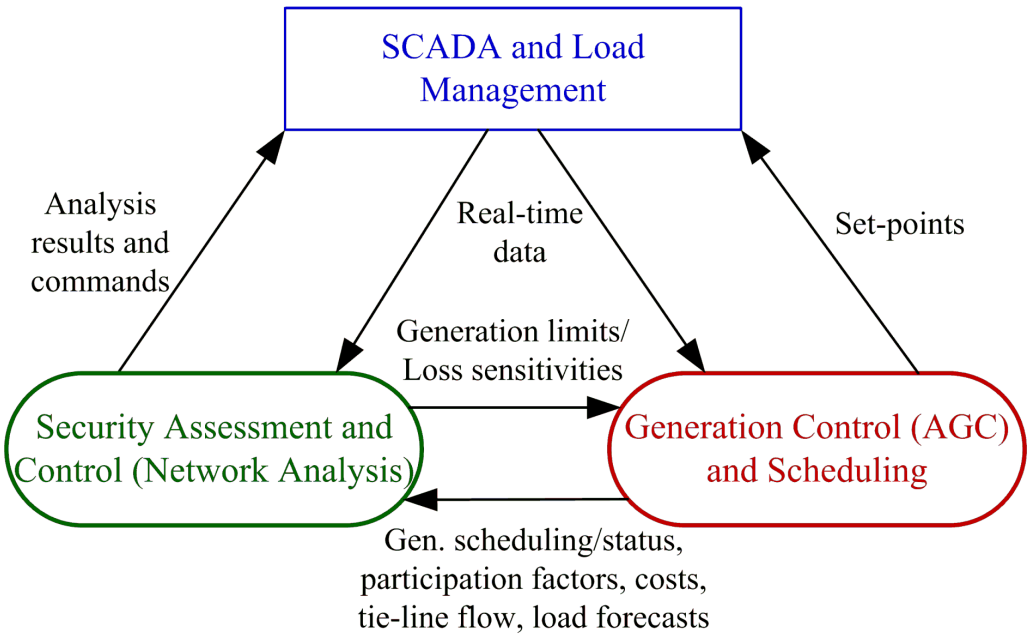
SCADA, AGC, and Energy Management System (EMS)



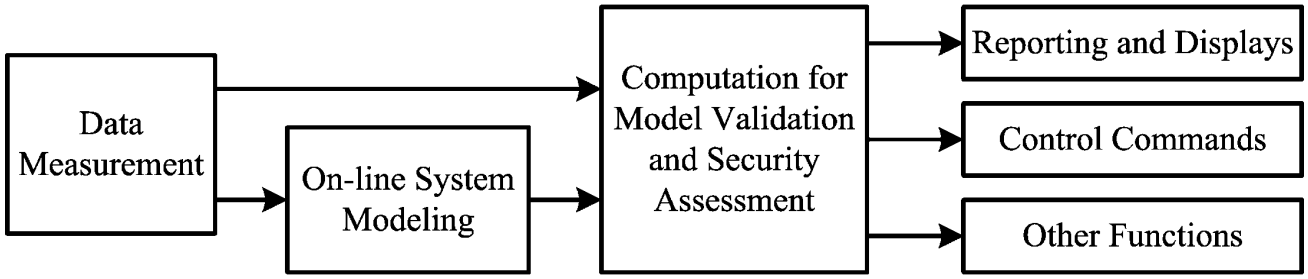
Application layer of a modern EMS

H. Bevrani, T. Hiyama, Intelligent Automatic Generation Control, CRC Press, USA, 2011.

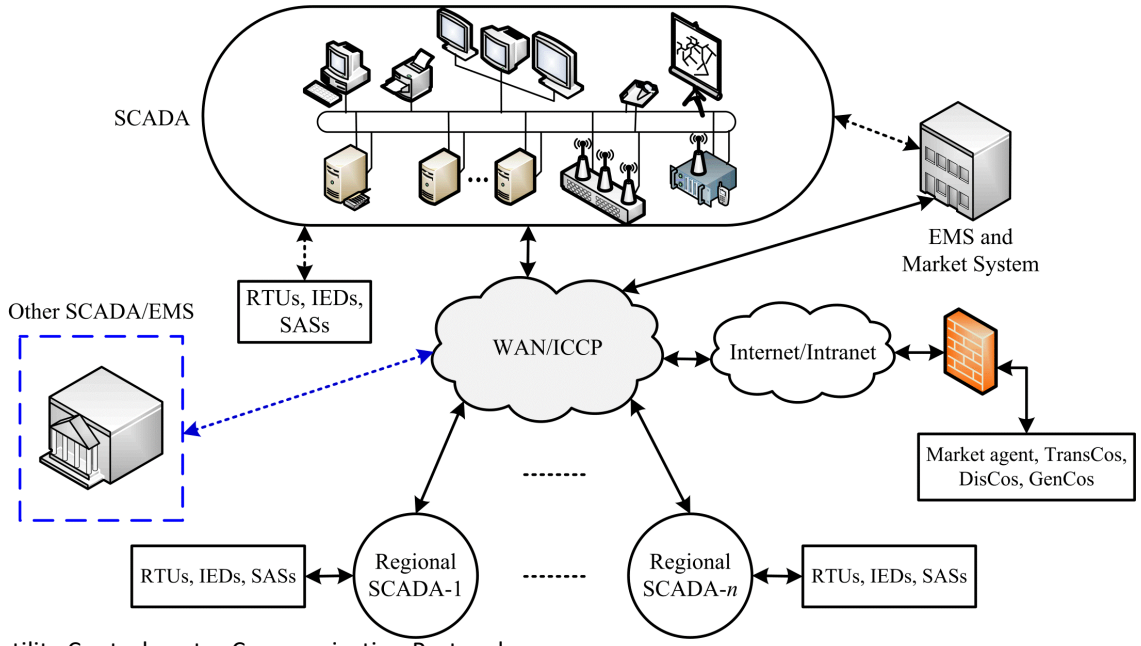
SCADA, Security Control, and AGC



Security Control



SCADA, EMS and Regional SCADA

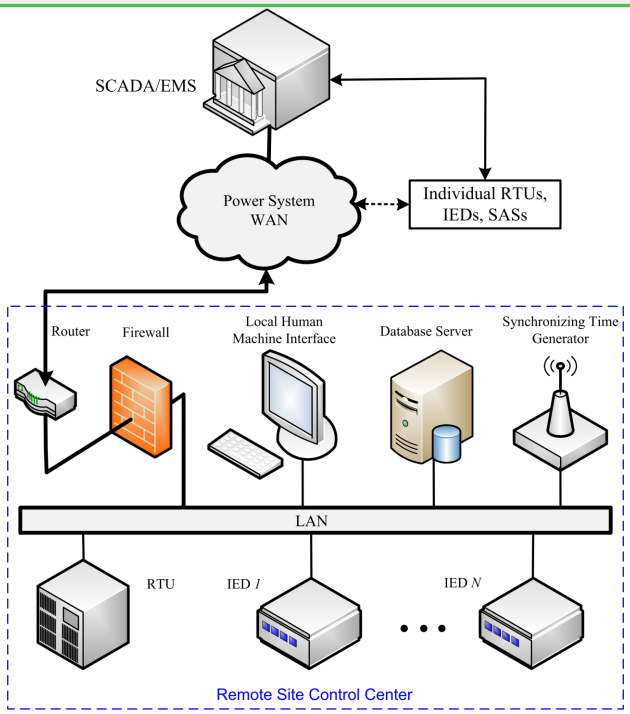


ICCP: Inter-utility Control center Communication Protocol
SAS: Substation Automation Systems

Regional SCADA

A regional SCADA, West Regional Electric Co., Kermanshah (Aug. 2009)

SCADA/EMS and Remote Site Control

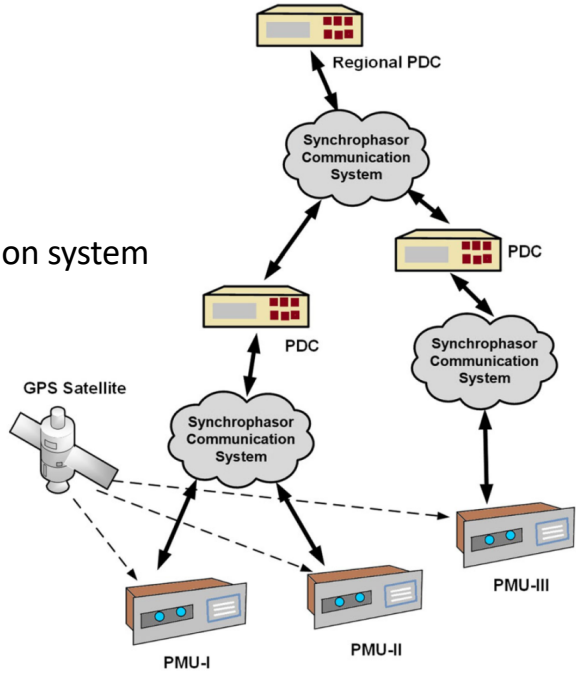


WAMS: PMU+PDC+SPCS

PMU: Phasor Measurement Unit

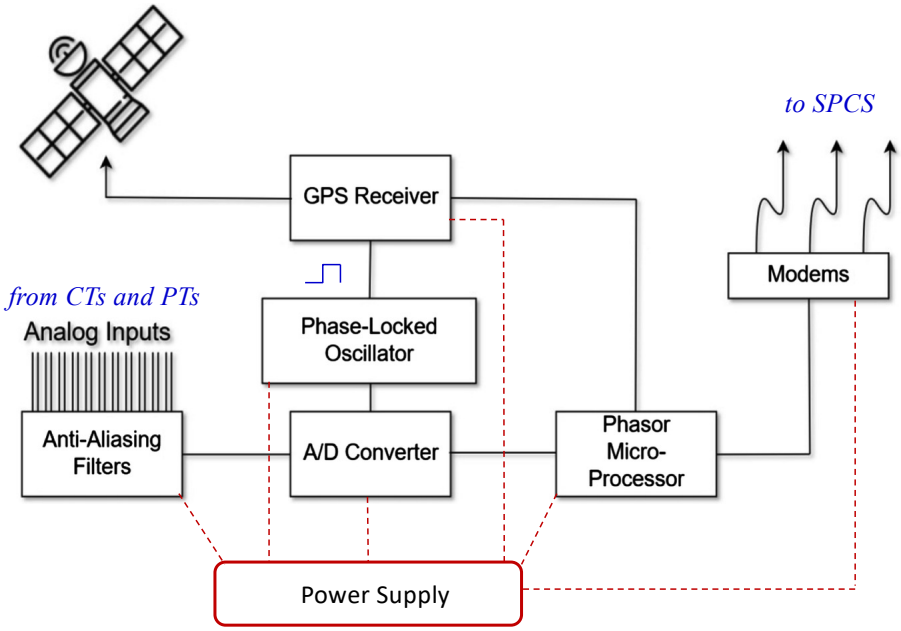
PDC: Phasor Data Concentrator

SPCS: Synchronous phasor communication system

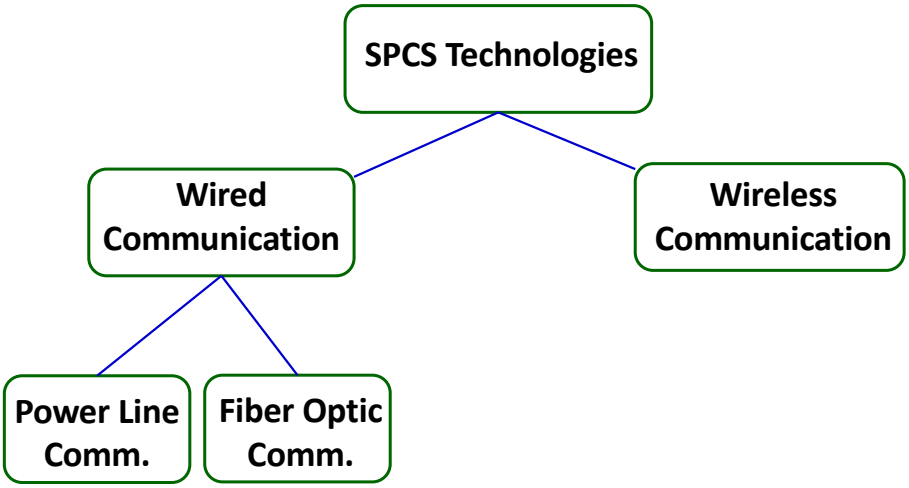


B. Appasani, D.K. Mohanta, A review on synchrophasor communication system: communication technologies, standards and applications, Protection and Control of Modern Power Systems, 2018

PMU Block-diagram

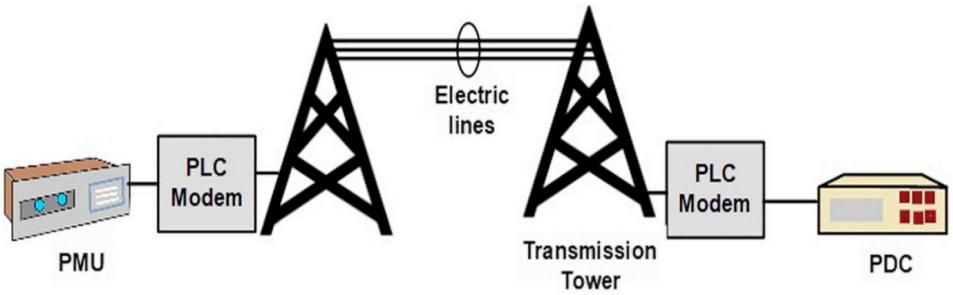


SPCS

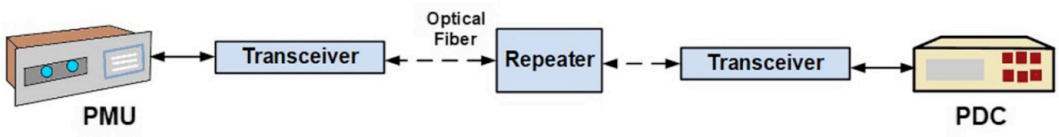


SPCS: Wired Communication

- **PLC**



- **Fiber Optic Comm.**



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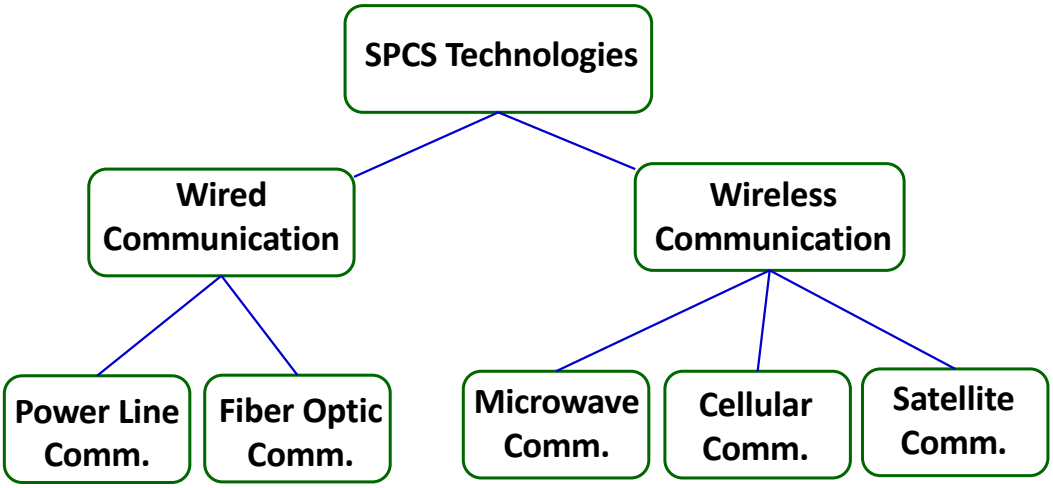
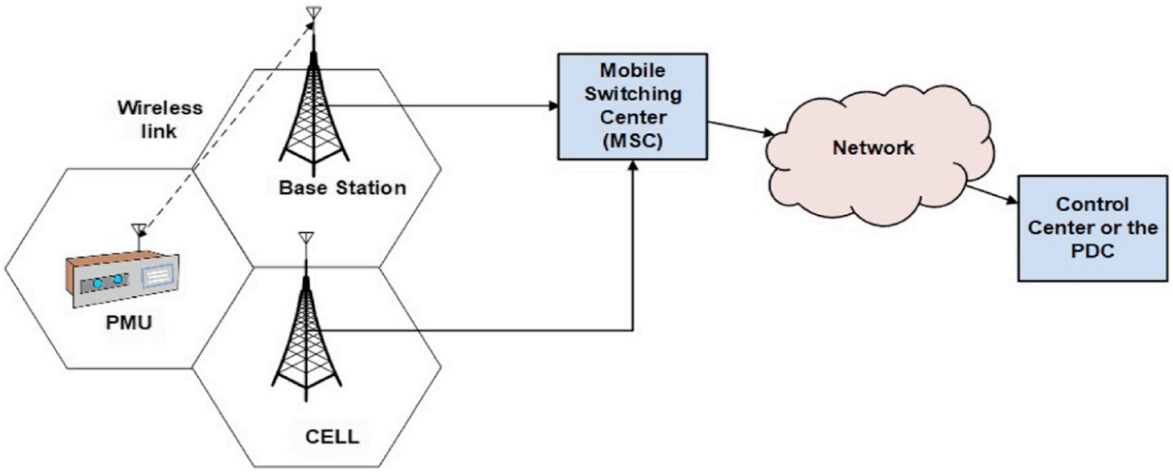
SPCS



SPCS: Wireless Communication

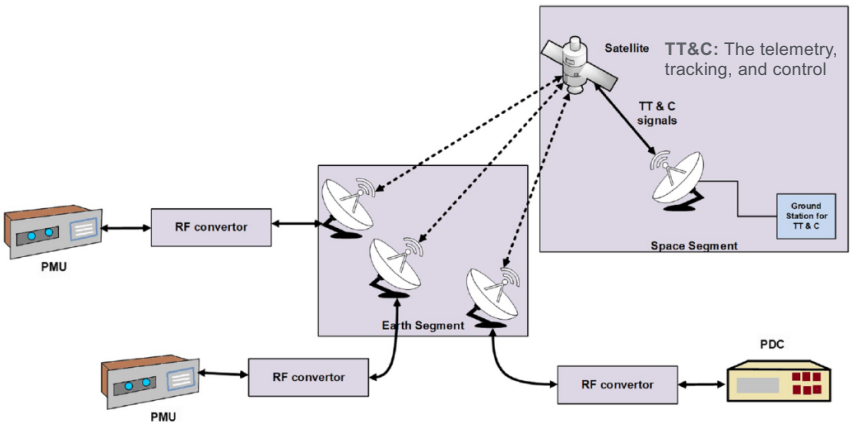
- **Cellular Comm.**



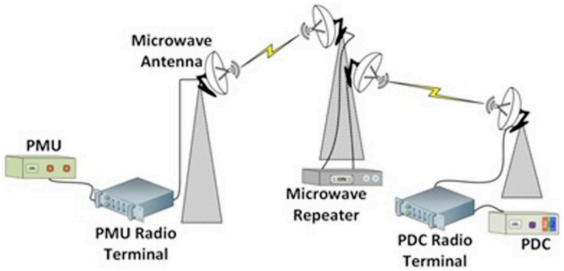
B. Appasani, D.K. Mohanta, A review on synchrophasor communication system: communication technologies, standards and applications, Protection and Control of Modern Power Systems, 2018

SPCS: Wireless Communication

- **Satellite Comm.**

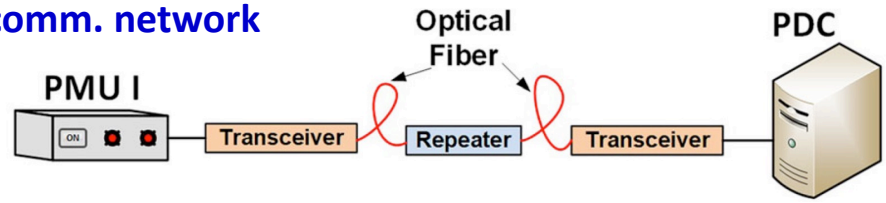


- **Microwave Comm.**

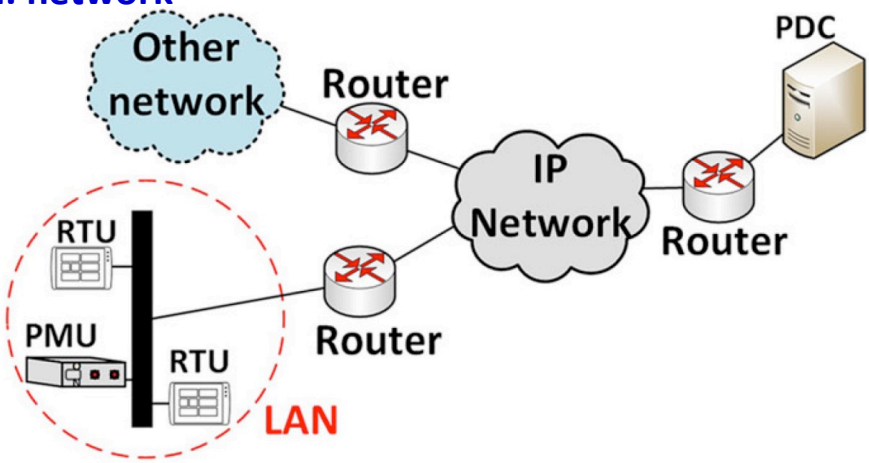


SPCS: Communication Network

- **Dedicated comm. network**



- **Shared comm. network**

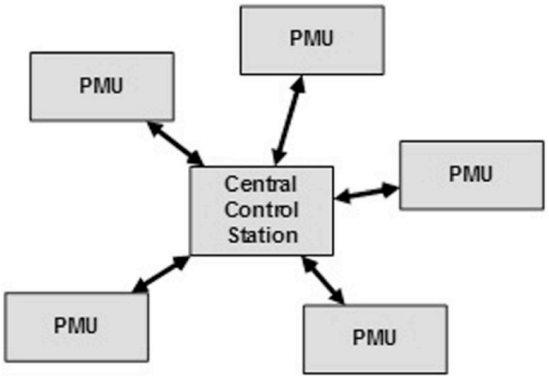


WAMS: Communication Network Architectures

1. Centralized

- **Advantages:**

Easy for data access, coordinated alarming, remedial actions, and administration for data exchange



- **Disadvantages:**

Single node failure

WAMS: Communication Network Architectures

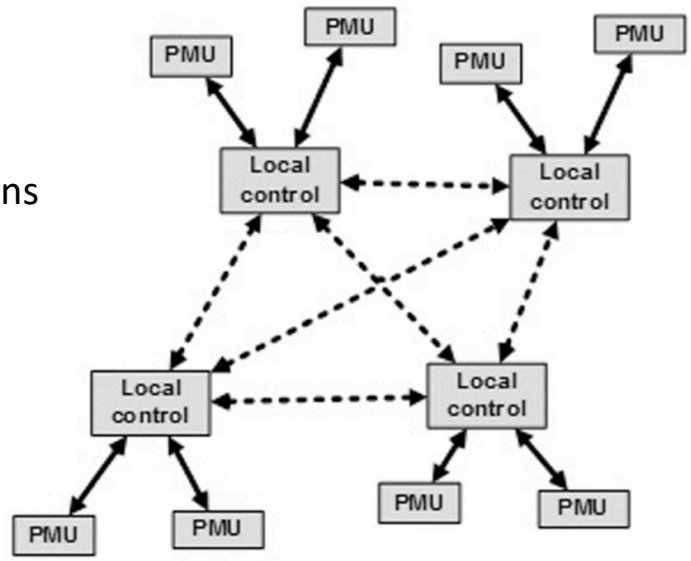
2. Decentralized

- **Advantages:**

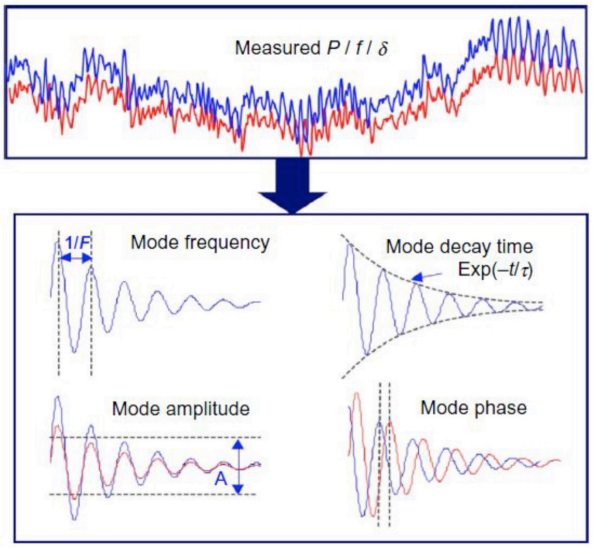
Reliability, regional coordinating functions

- **Disadvantages:**

Limited overall stability analysis, high comm. cost, Complex coordinating, higher implementation costs



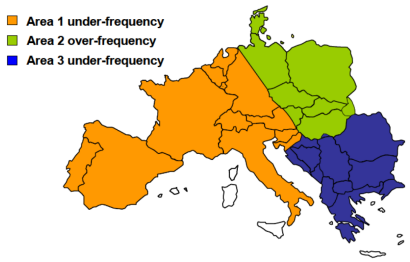
Dynamic information from Small Signal Oscillation Record



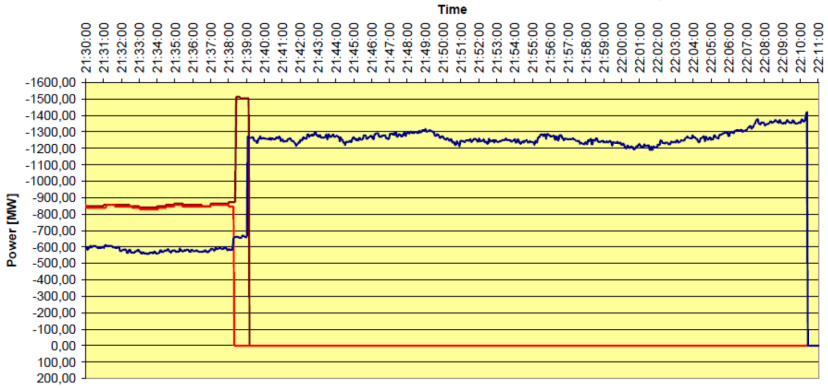
Antonello Monti, Carlo Muscas, Ferdinanda Ponci, Phasor Measurement Units and Wide Area Monitoring Systems: From the Sensors to the System, 2016 Elsevier Inc.

Example: European Blackout in 2006

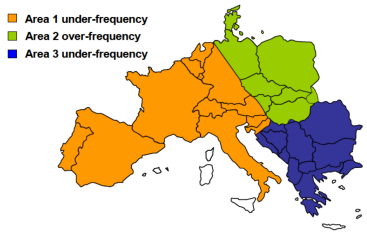
Three islanded areas



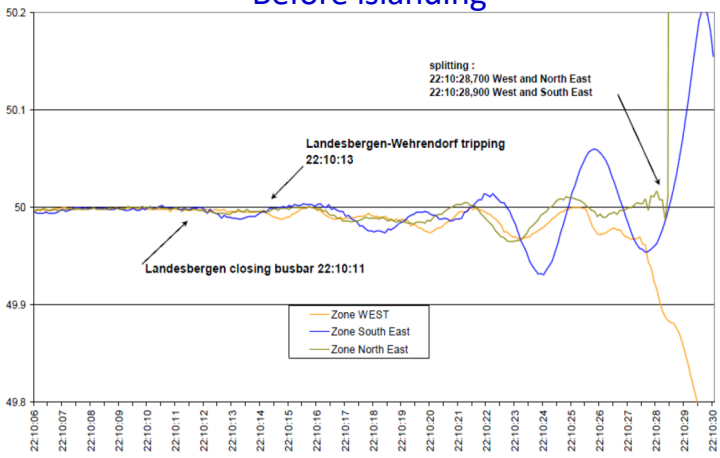
Three 380 kv lines: scheduled outage of two lines and overloading of third one



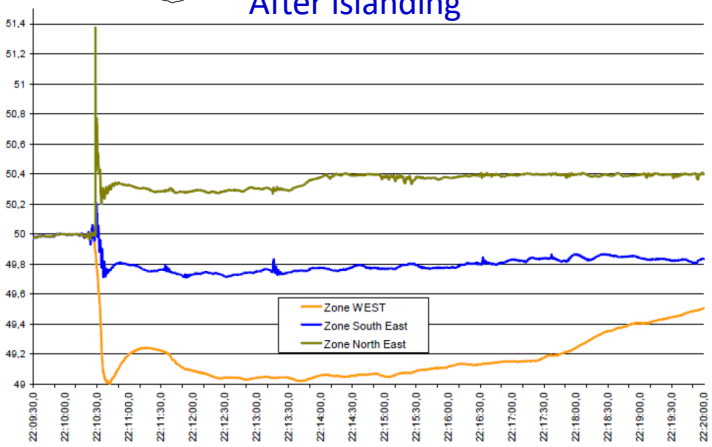
Continue



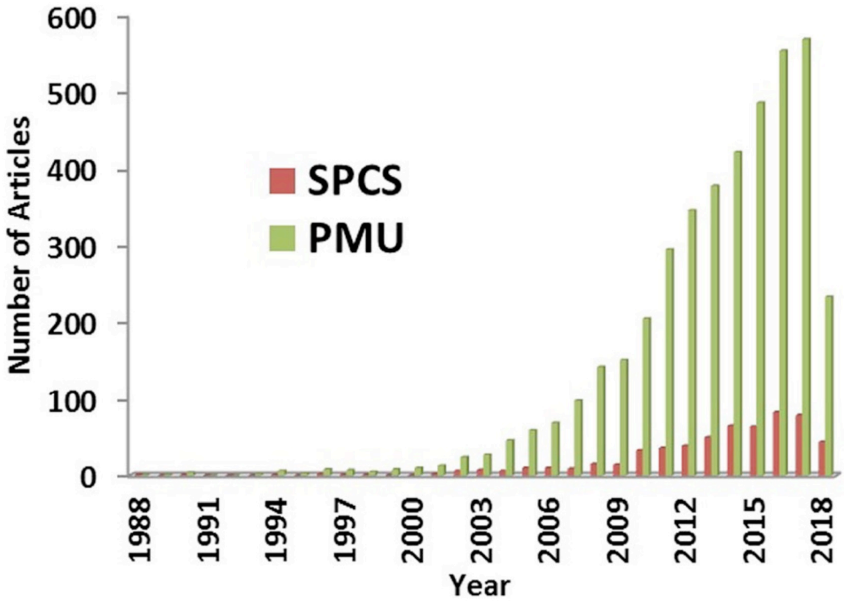
Before islanding



After islanding



Publications on PMUs



SPCS: Synchronous phasor communication system

B. Appasani, D.K. Mohanta, A review on synchrophasor communication system: communication technologies, standards and applications, Protection and Control of Modern Power Systems, 2018

Homework P2-1

Search to Find A Real Application of PMUs

Then write a short report about it

Deadline: **One Week**

Contact e-mail for this Course

- **Please only submit your homework/reports to the following email address:**

bevranih18@gmail.com

- Please use the following term as subject of your email:
  Family Name_HW_P2-1

- For writing a formal email, following video could be useful:
  https://www.aparat.com/v/8iXW9

Thank you!