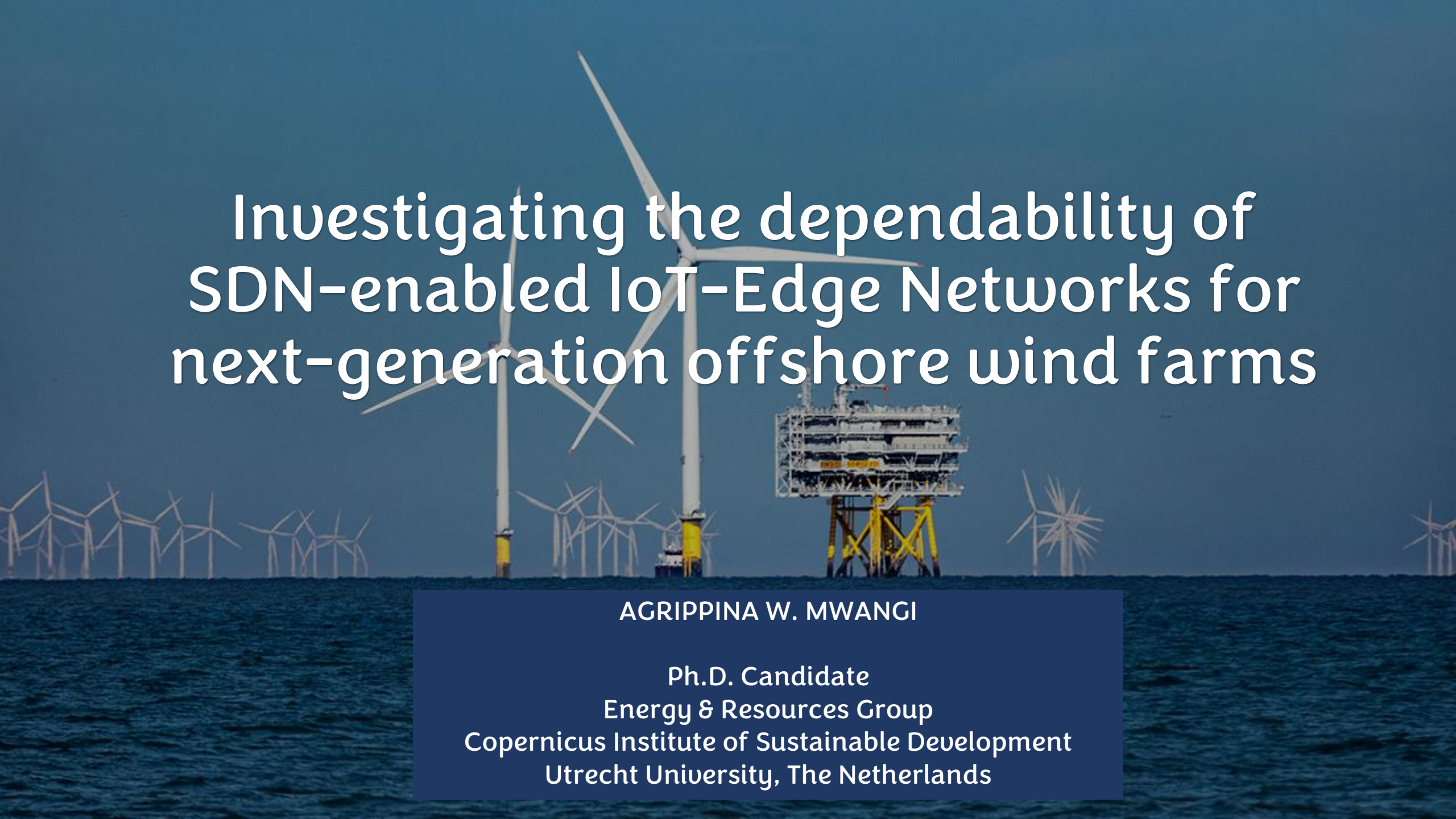

Investigating the dependability of SDN-enabled IoT-Edge Networks for next-generation offshore wind farms

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InnoCyPES

Innovative Tools for Cyber-Physical Energy Systems

Utrecht University

AGRIPPINA MWANGI

Marie Curie early-stage researcher in smart grid communication whose work focuses on the adoption of IoT/Cloud technologies in the design of next-generation smart grid OT networks. Has a background in telecommunications and electronic engineering with extensive industrial experience in enterprise-wide networks and SDN. Seeks to contribute to research in reliability evaluation and performance assessment of emerging communication network trends for smart grids.

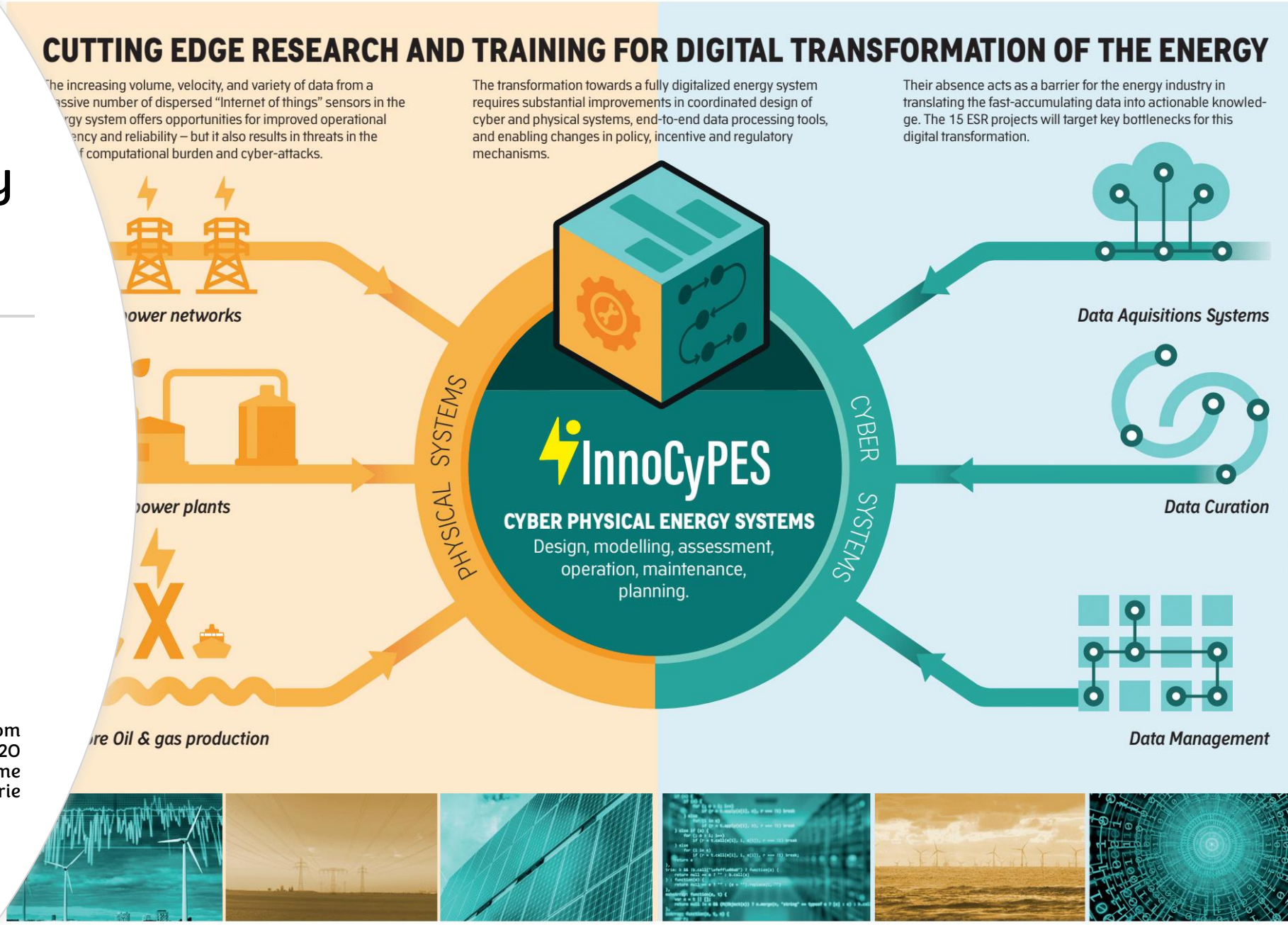
Trained Telecommunication Engineer

Design resilient OT networks for extreme environments

Innovative Tools for Cyber-Physical Energy Systems (InnoCyPES)

Data Acquisition Systems

(ESR1 → WP1)



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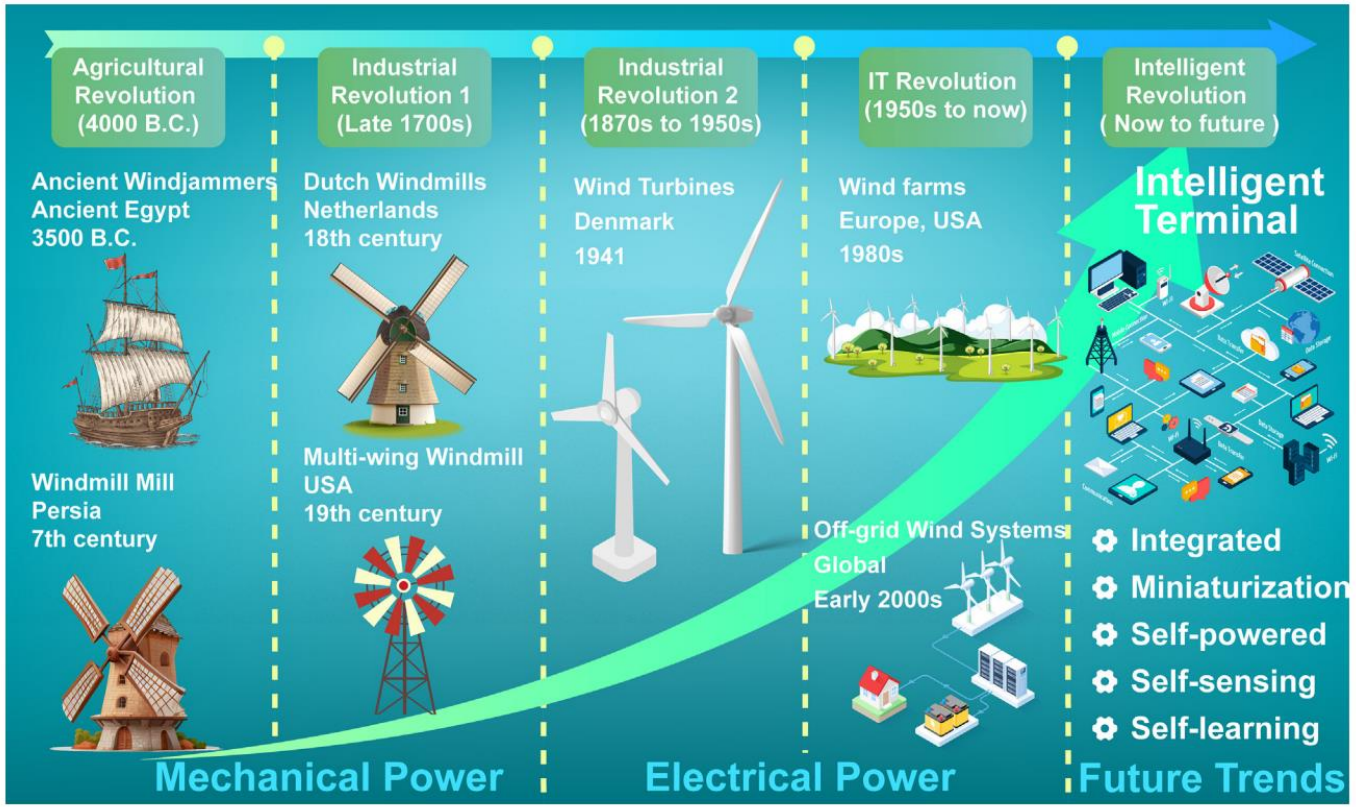
Ørsted EDF TU Delft

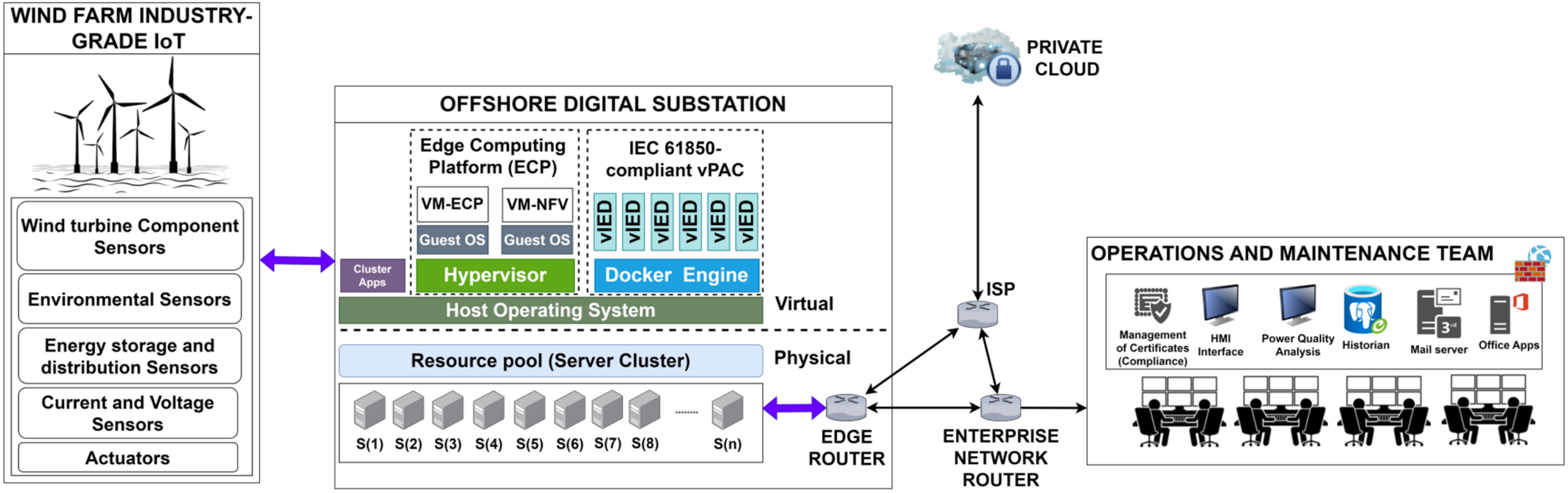
IoT Network Design and Reliability Evaluation for the Renewable Energy Sector



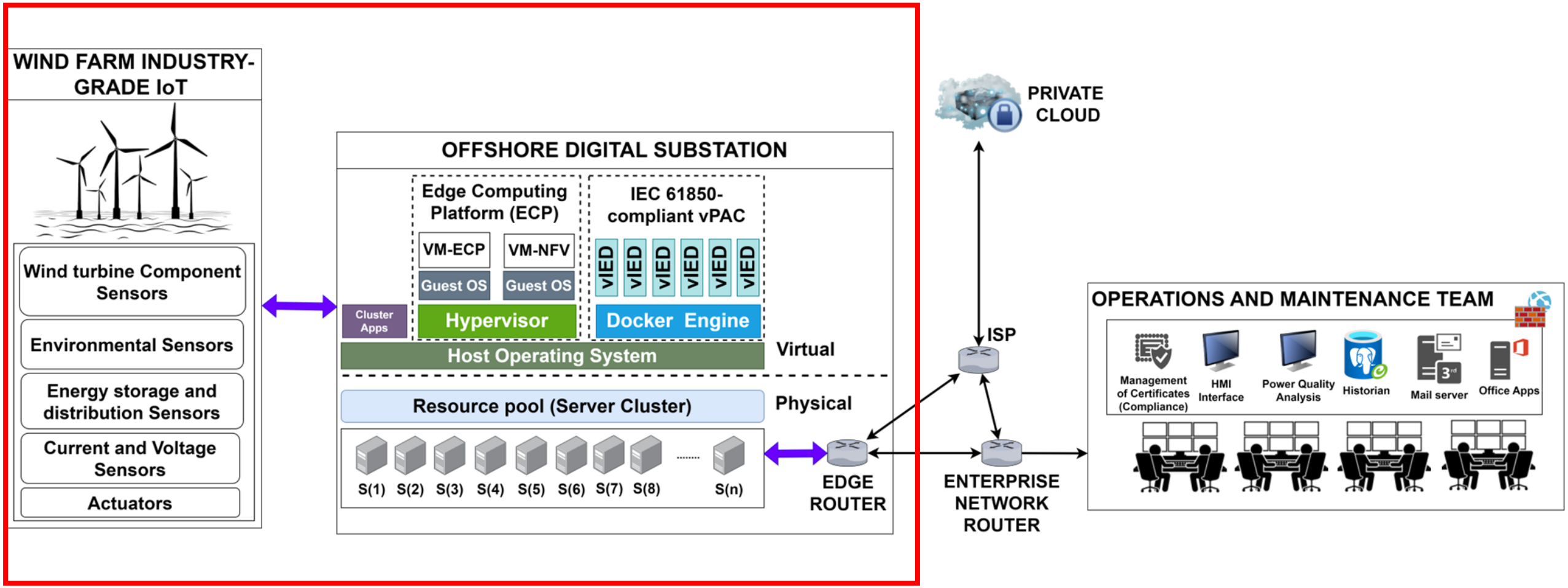
- IoT for machine-to-machine communication in offshore wind farm management[1] (Inter-turbine communication)
- Operations and maintenance of offshore wind farms[2] (10-20% wind farm's LCOE)

1. H. Wang, B. Xiong, Z. Zhang, H. Zhang, and A. Azam, "Small wind turbines and their potential for Internet of Things applications," Iscience, vol. 26, no. 9, 2023
2. C. A. Walford, "Wind turbine reliability: understanding and minimizing wind turbine operation and maintenance costs.," tech. rep., Sandia National Laboratories (SNL), Albuquerque, NM, and Livermore, CA . . . , 2006

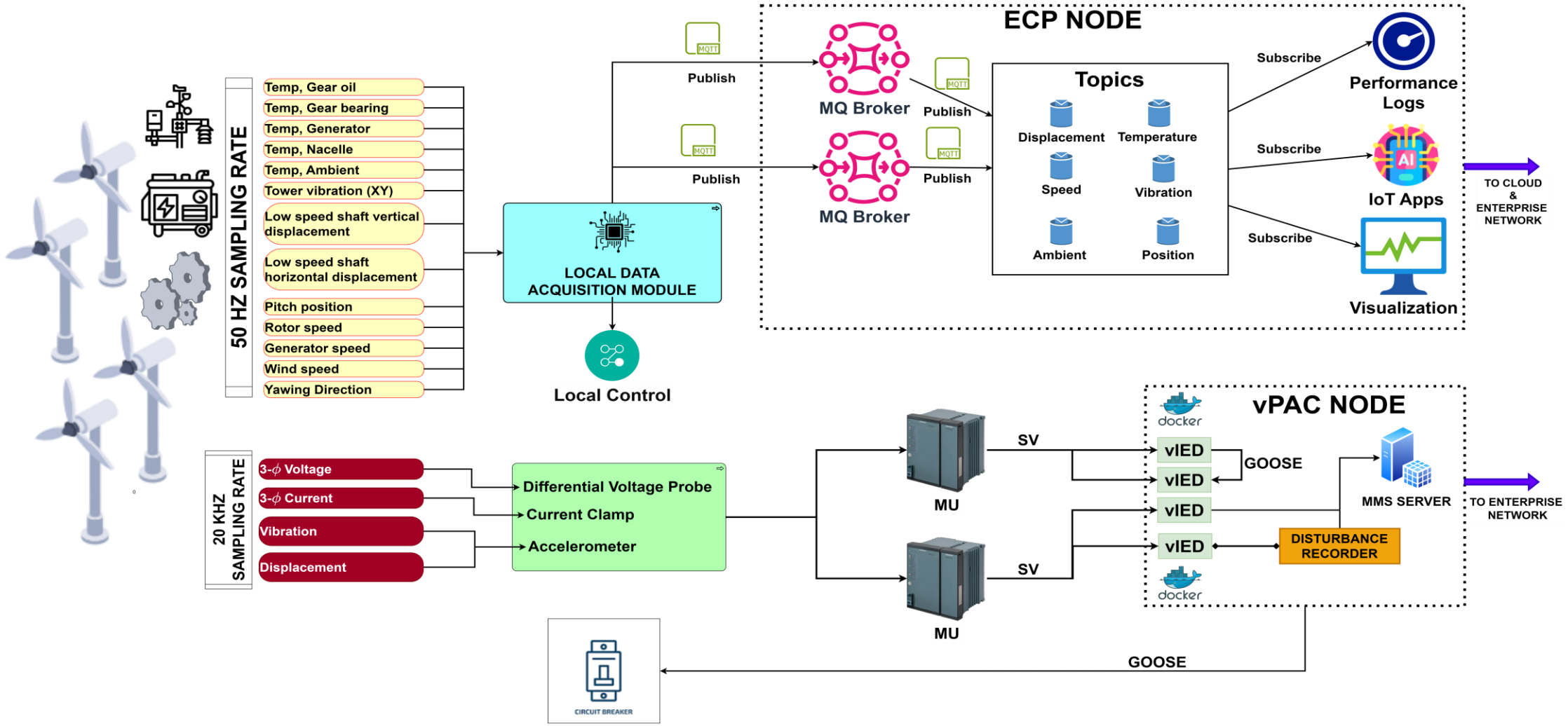
IT/OT architecture for the next generation IEC 61850-compliant offshore wind farms



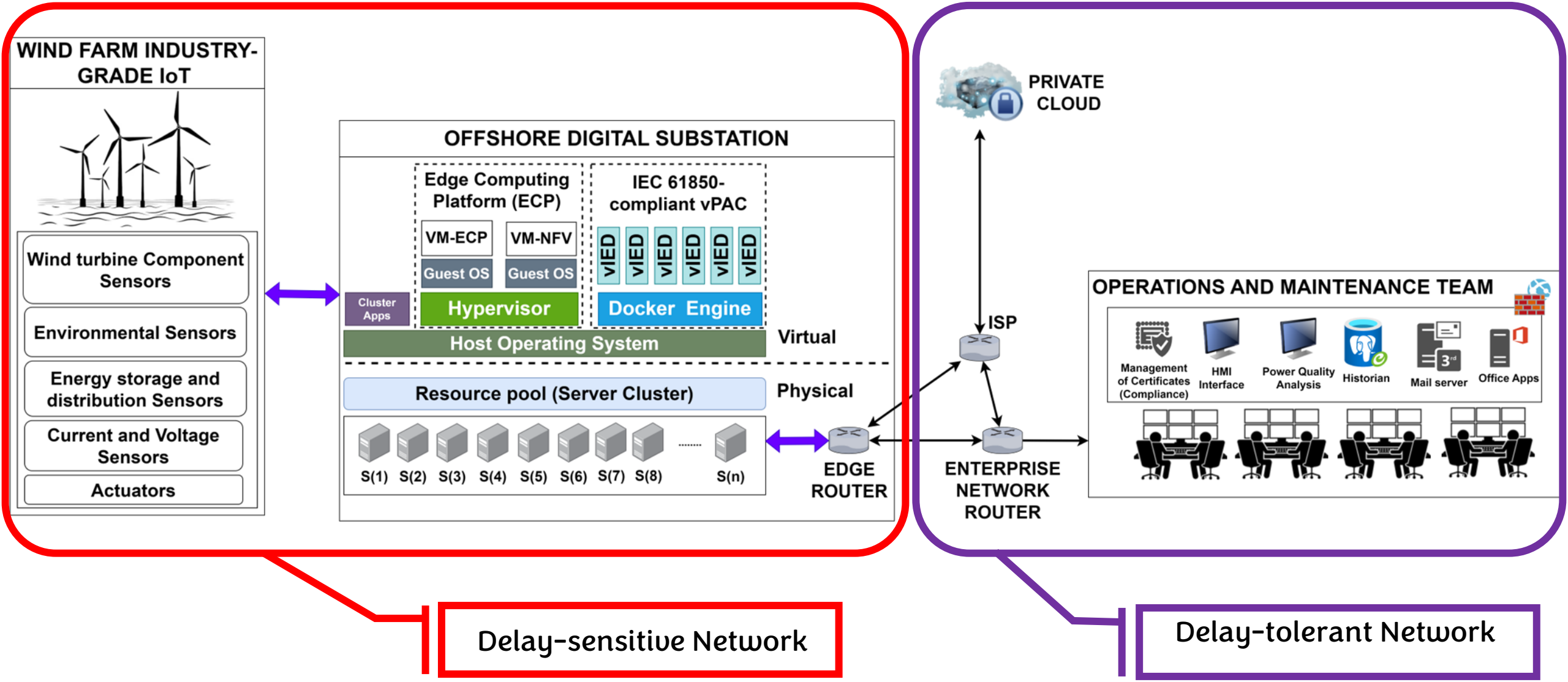
IT/OT architecture for the next generation IEC 61850-compliant offshore wind farms



IoT Adoption for the next-generation IEC 61850-compliant offshore wind farms

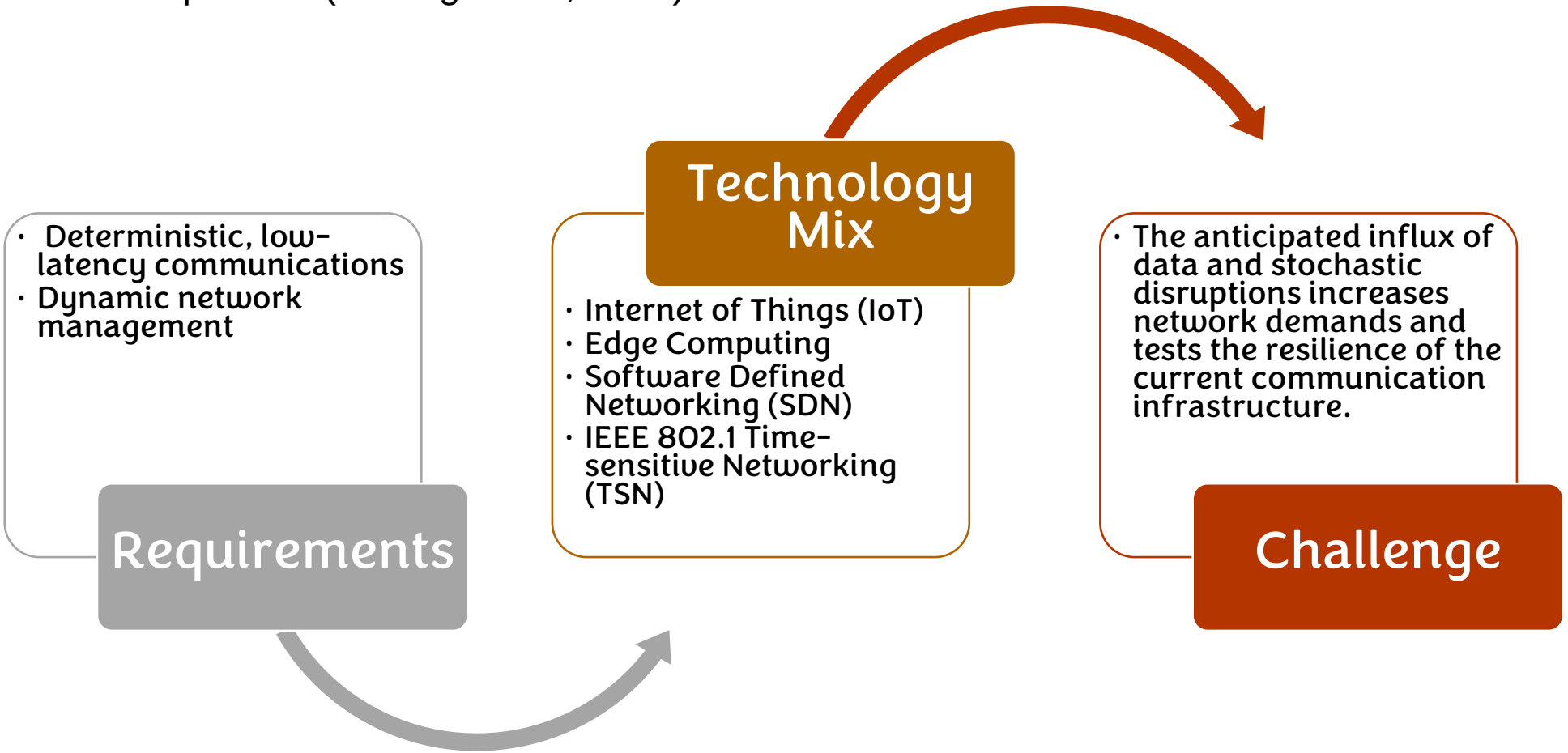


Network Design



IoT Network Design

“The sensor data of different types are sampled at very high rates, change often, and require a real-time response.” (Mwangi et. al, 2023)

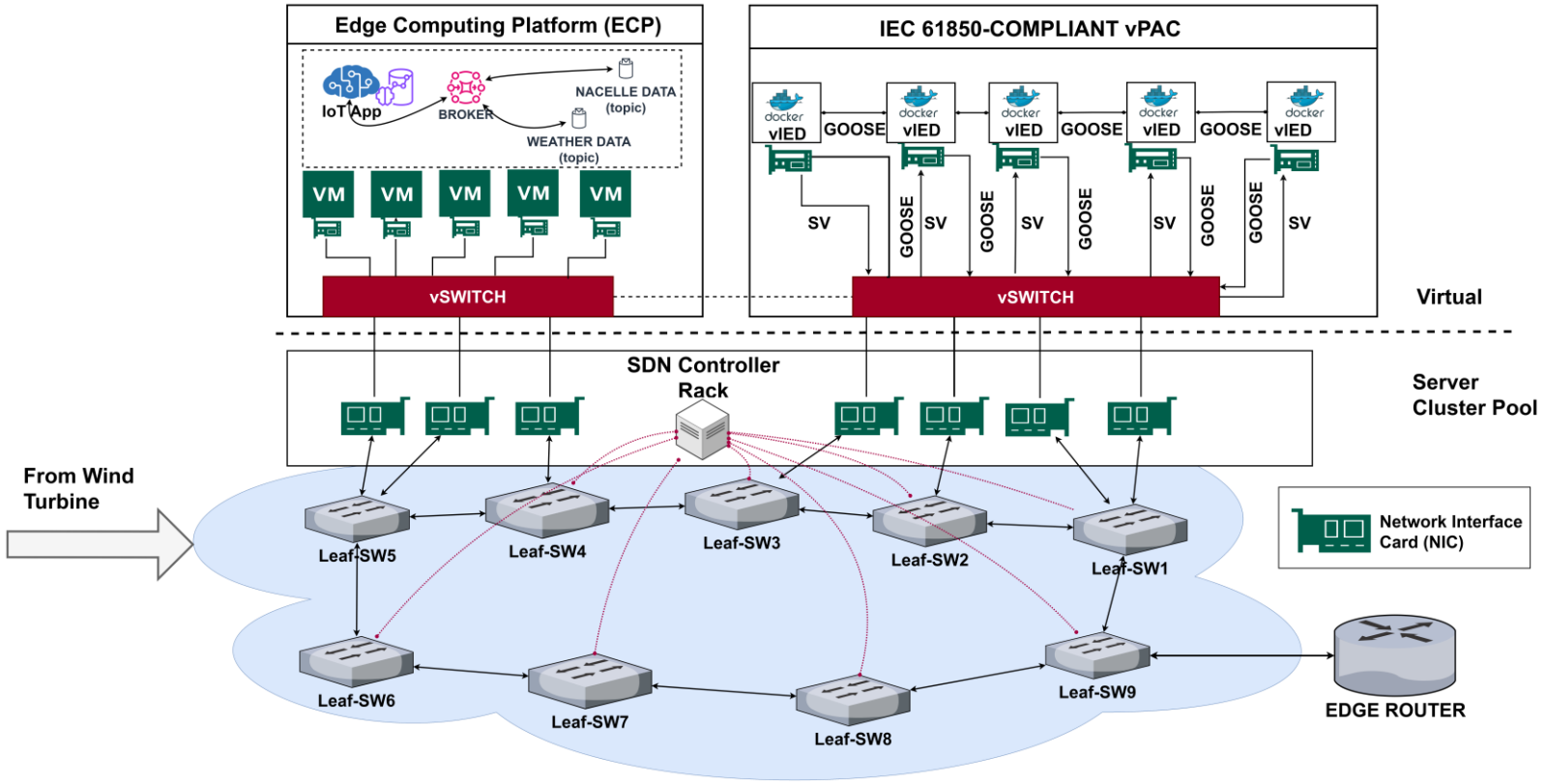


A. Mwangi, K. Sundsgaard, J. A. Leiva Vilaplana, K. V. Vilerá and G. Yang, "A System-Based Framework for Optimal Sensor Placement in Smart Grids," *2023 IEEE Belgrade PowerTech*, Belgrade, Serbia, 2023, pp. 1-6, doi: 10.1109/PowerTech55446.2023.10202987.

EDF Secondment

Investigating the dependability of SDN-enabled IoT-Edge Networks for next-generation wind farms

Why should wind farm developers adopt the proposed IT/OT architecture? Can they trust it to run efficiently? What will be the impact on O&M?



EDF Secondment

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Innovative Tools for Cyber-Physical Energy Systems

Investigating the dependability of SDN-enabled IoT-Edge Networks for next-generation wind farms

Application Scenario

What could go wrong?

- Security breaches
- Integration complexities
- Failure concerns
- Resource intensity

Methodology I

Designing a homogeneous continuous time Markov chain (HCTMC) system model to determine the system reliability and availability

Methodology II

Design a proof-of-concept in the Smart Grid Lab to test performability (Sensitivity analysis)

Goal

A design tool that will guide the developers on the proposed IT/OT architecture in offshore wind farms

Best practices

Risk portfolio

Acknowledgement

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