

Verandering zonder Compromissen

PAC als Fundament
van Betrouwbaarheid

8 april 2026





Digital Substation of the Future (DSofF)

Dr. Alex Ştefanov

Director CRoF, Associate Professor, Chartered Engineer
Themadag CIGRE B5



April 8, 2026

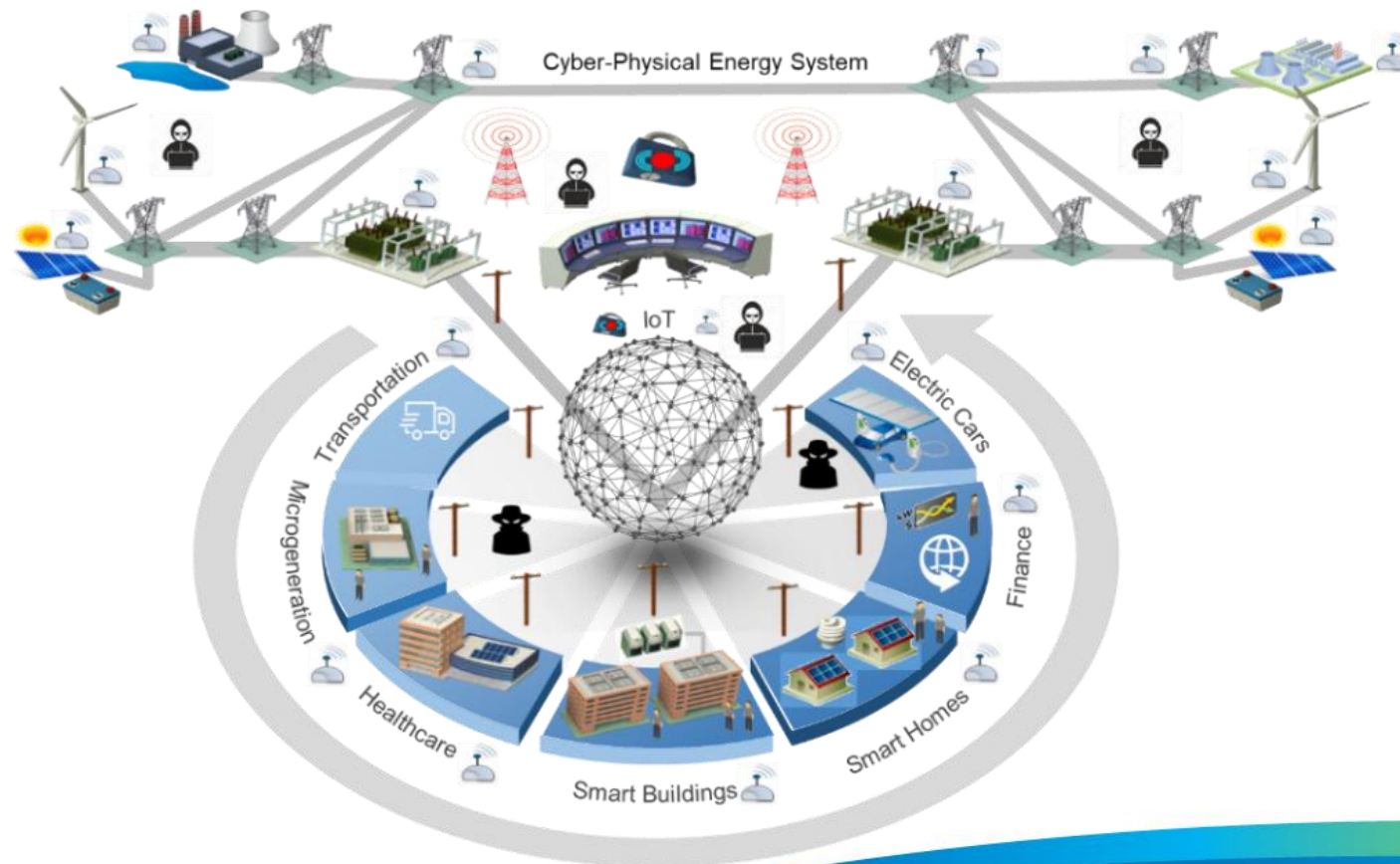
About Me / Bio

- **Associate Professor** at TU Delft since May 2019
 - Cyber security of power grids (transmission, distribution & grid edge)
 - Cyber-physical system resiliency, cyber resilience
 - Control Room of the Future (CRoF) and next generation grid operation
- **Senior Engineer** at NovoGrid in Dublin, Ireland: 2018 - 2019
- **Professional Engineer** at ESB Networks (Irish Distribution System Operator): 2015 - 2018
 - Future Networks, Operations
- **Chartered Engineer** (CEng MIEI), Institution of Engineers of Ireland



Why Control Room of the Future (CRoF) & Digital Substation of the Future (DSoF)?

- Energy transition: decarbonisation, decentralisation and digitalisation
- Change the way we operate power grids (T&D systems)



Control Room of the Future (CRoF) Vision



Control Room of the Future (CRoF) Technology Centre at TU Delft

Director: Dr Alex Stefanov, e-mail: A.I.Stefanov@tudelft.nl

● Vision

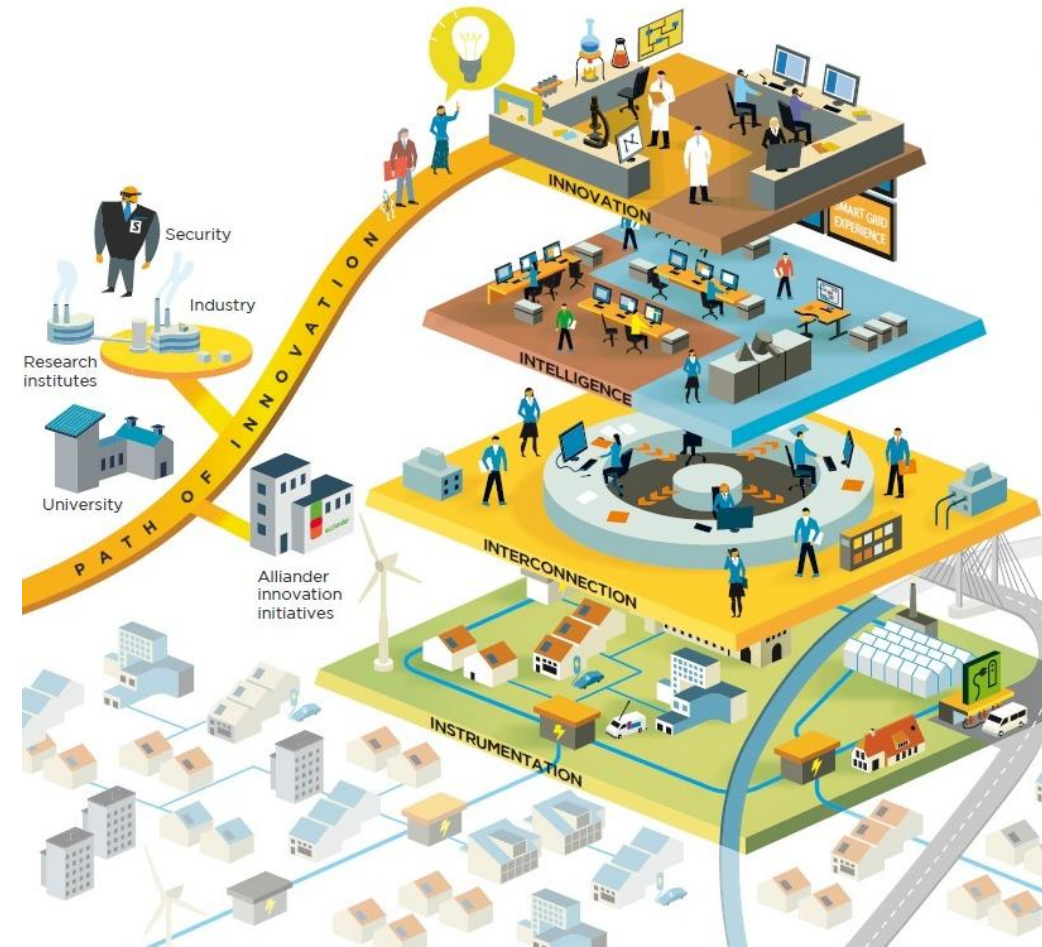
- Future power grid is intelligent (AI), resilient and cyber secure

● Facility for Research, Development & Demonstration

- CRoF is unique, future-ready and multi-domain experimental setup
 - ✓ Neutral ground for power grid operators (TSOs, DSOs) & vendors
 - ✓ Hub for future power grid technologies

● Research

- Intelligent power system operations
 - ✓ Future control of power systems
 - ✓ **Cyber security**
 - ✓ Digital twins
 - ✓ Artificially intelligent assistants
 - ✓ **Operational & cyber resilience**



Source: alliander.com

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Digital Substation of the Future (DSoF) at TU Delft: ESTELAR Project

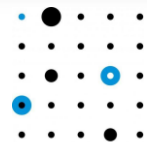
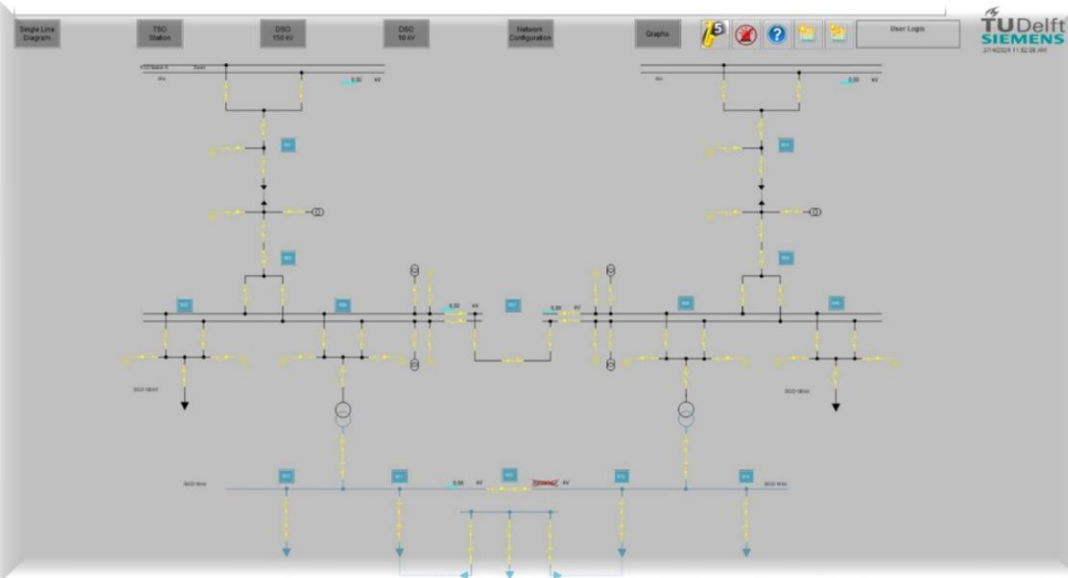
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TU Delft Digital Substation (150 kV / 10 kV)



TSO/DSO 150 kV / 10 kV SLD - Digital Substation & RTDS



ENCS

DIGITAL SUBSTATION OF THE FUTURE (DSOF)

Next Generation Substation Automation

- Digital Twins & PAC vs. vPAC
- Cloud Solutions & Edge Computing
- Cyber Security & Cyber Resilience

Meer weten?

Contact
TU Delft, Alex Ștefanov, a.i.stefanov@tudelft.nl
Siemens, Corné de Hoogh, corne.de-hoogh@siemens.com

Digital Substation of the Future (DSoF) at TU Delft: ESTELAR Project

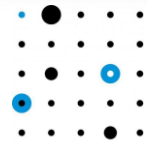
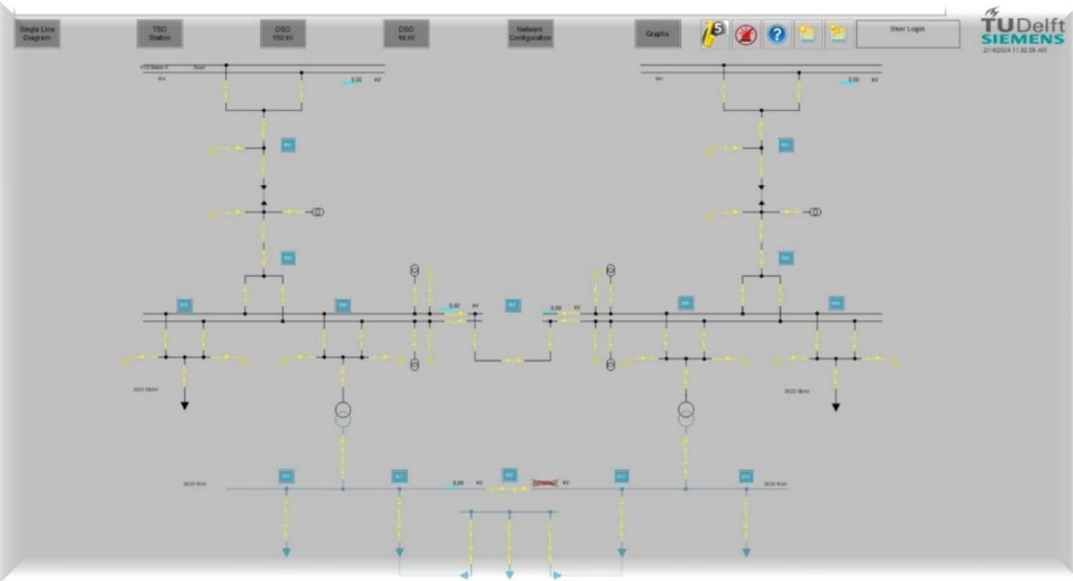
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TU Delft Digital Substation (150 kV / 10 kV)

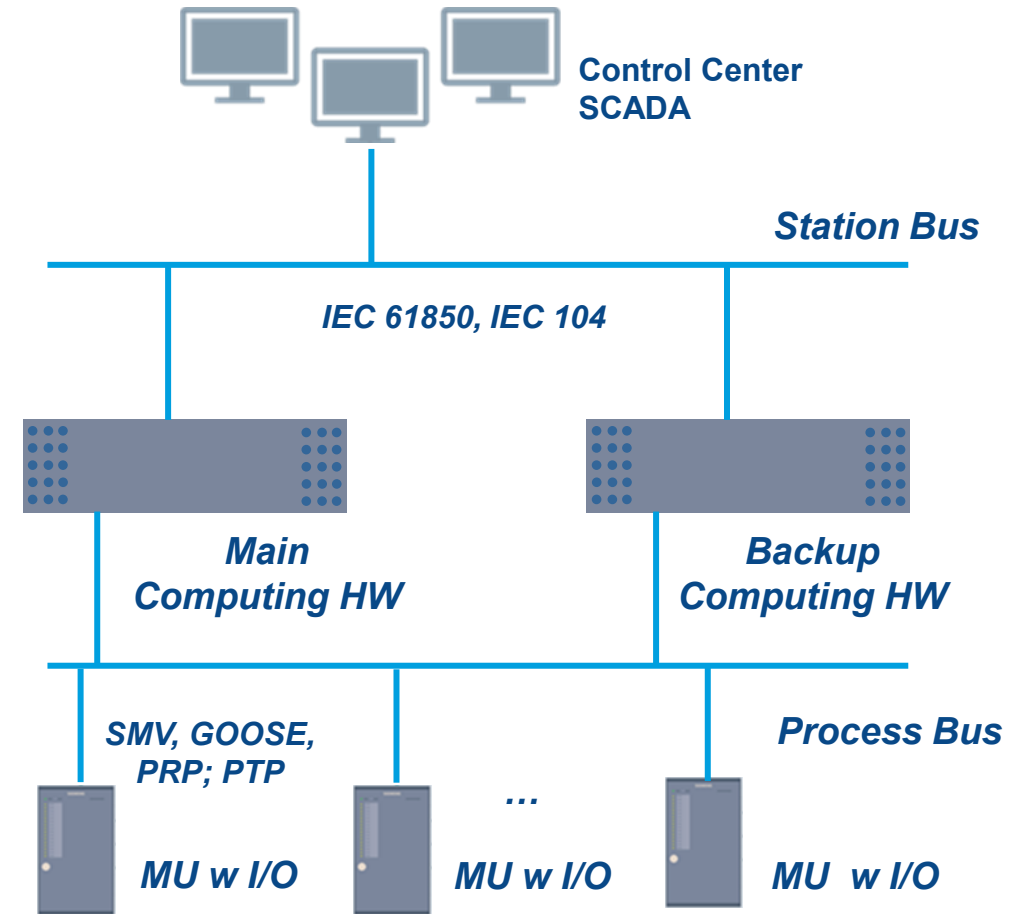
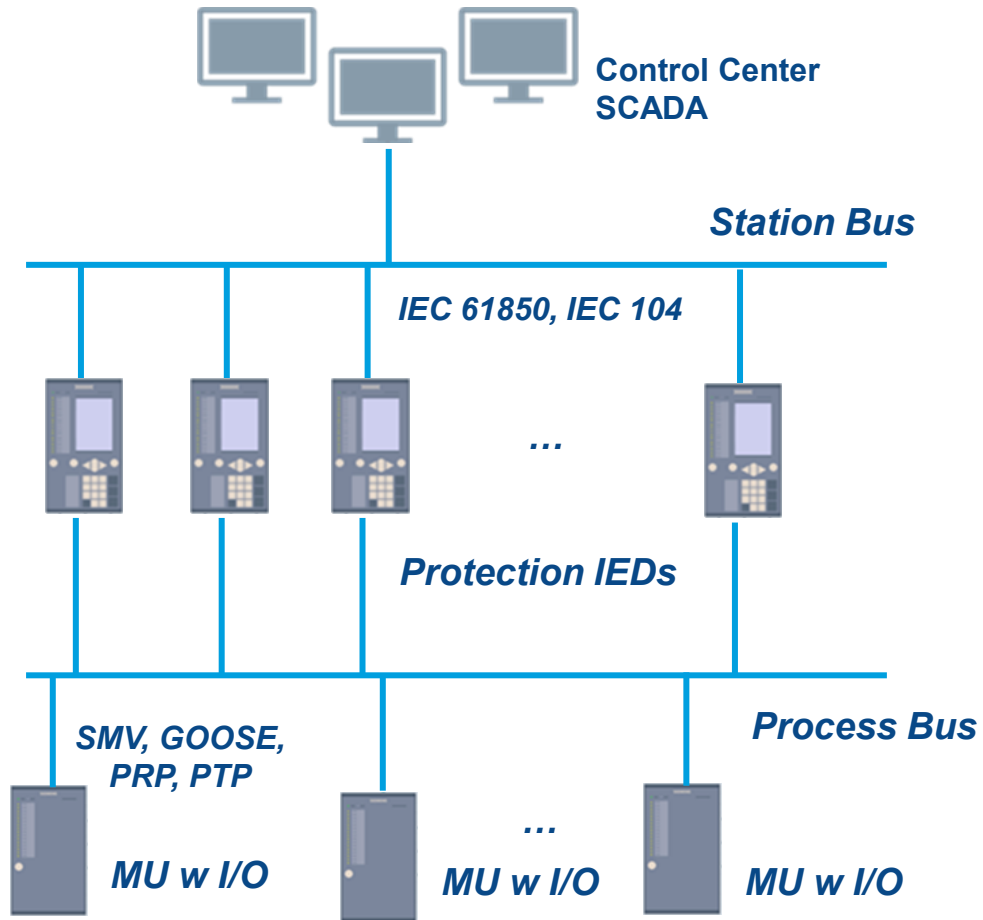
TU Delft Real-Time Digital Simulator (RTDS)

TSO/DSO 150 kV / 10 kV SLD - Digital Substation & RTDS

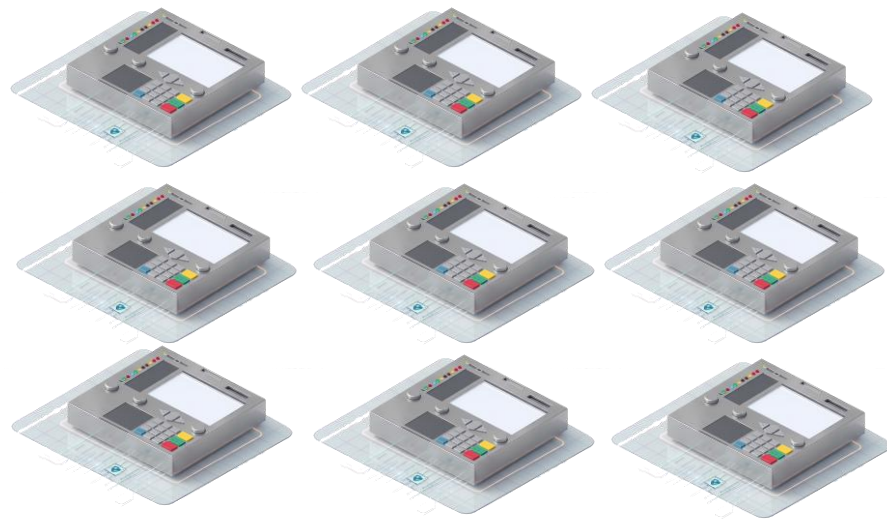


ENCS

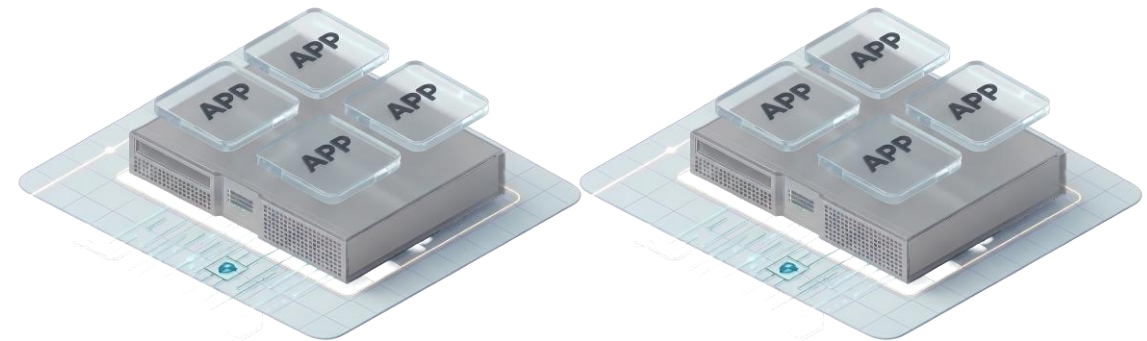
ESTELAR Digital Substation of the Future: PAC to vPAC



ESTELAR Digital Substation of the Future: PAC to vPAC



60+
Protection relays



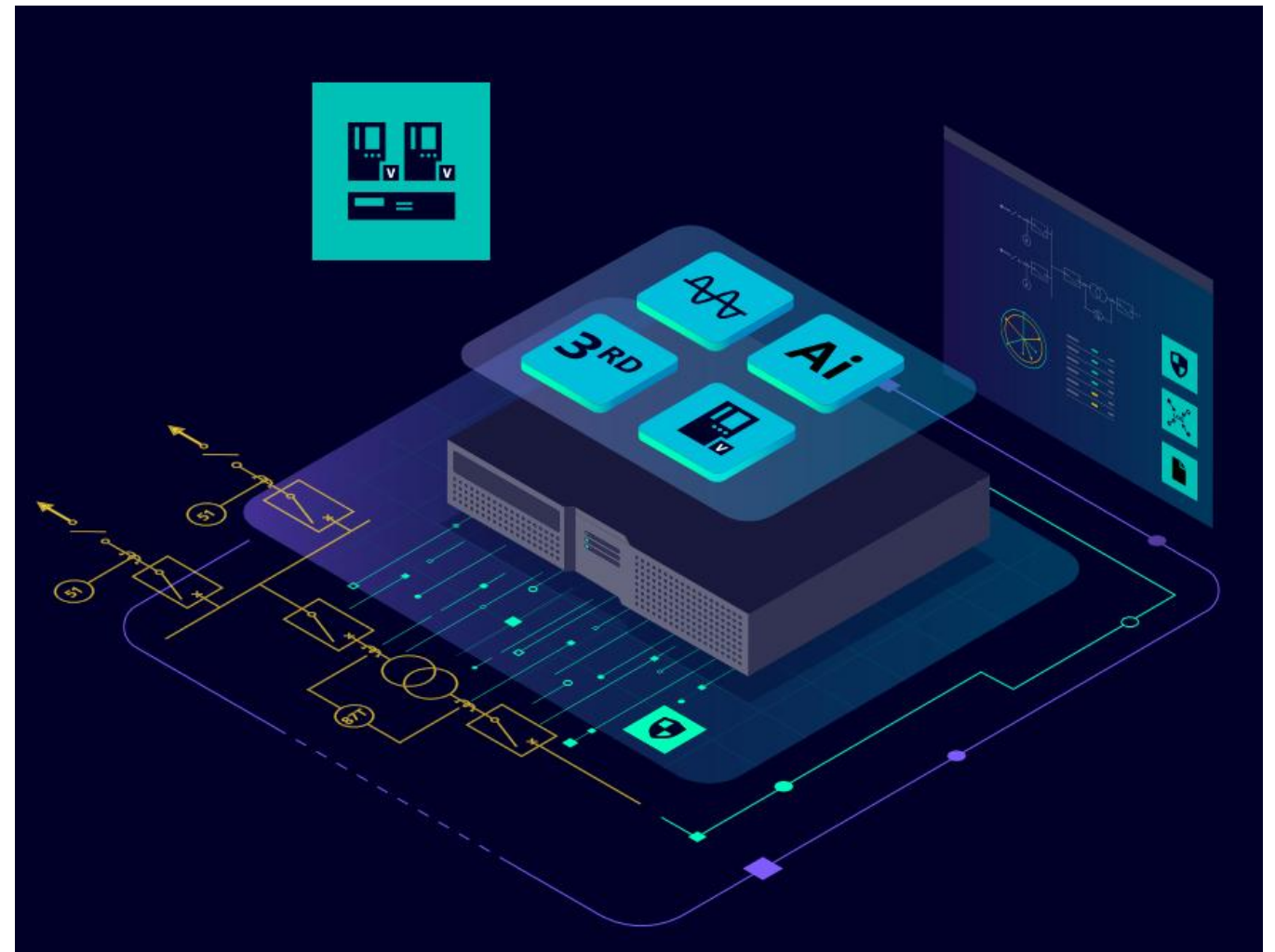
Main

Backup

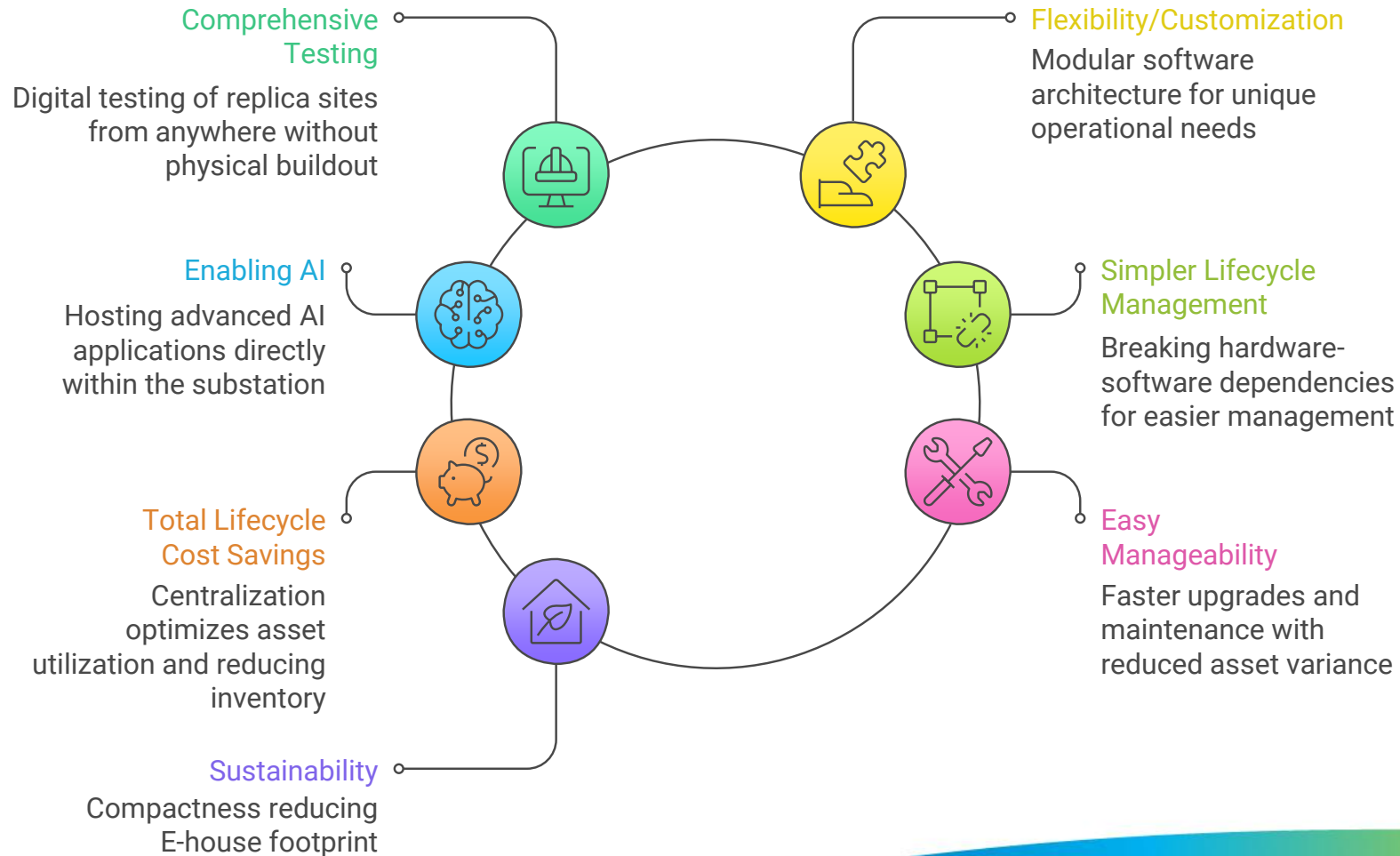
2
Centralized Protection, Automation & Control
computing HW

ESTELAR Virtual Protection, Automation & Control

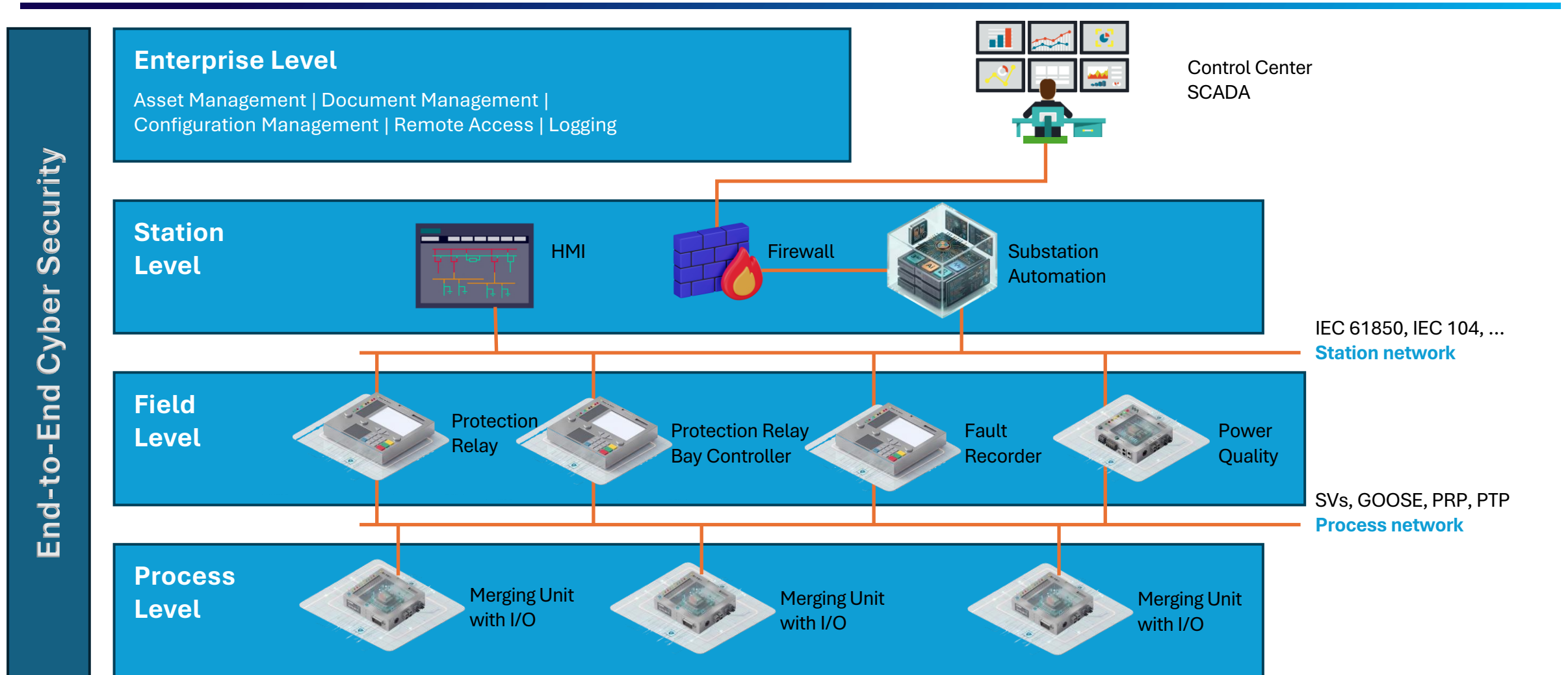
- Substation automation systems
 - Power quality, fault recording, AI, etc.
- HMI with substation-wide visibility
- vPAC software
 - All protection bays
 - Substation core system
- Linux with real-time kernel
- Independent hardware IEC61850 certified



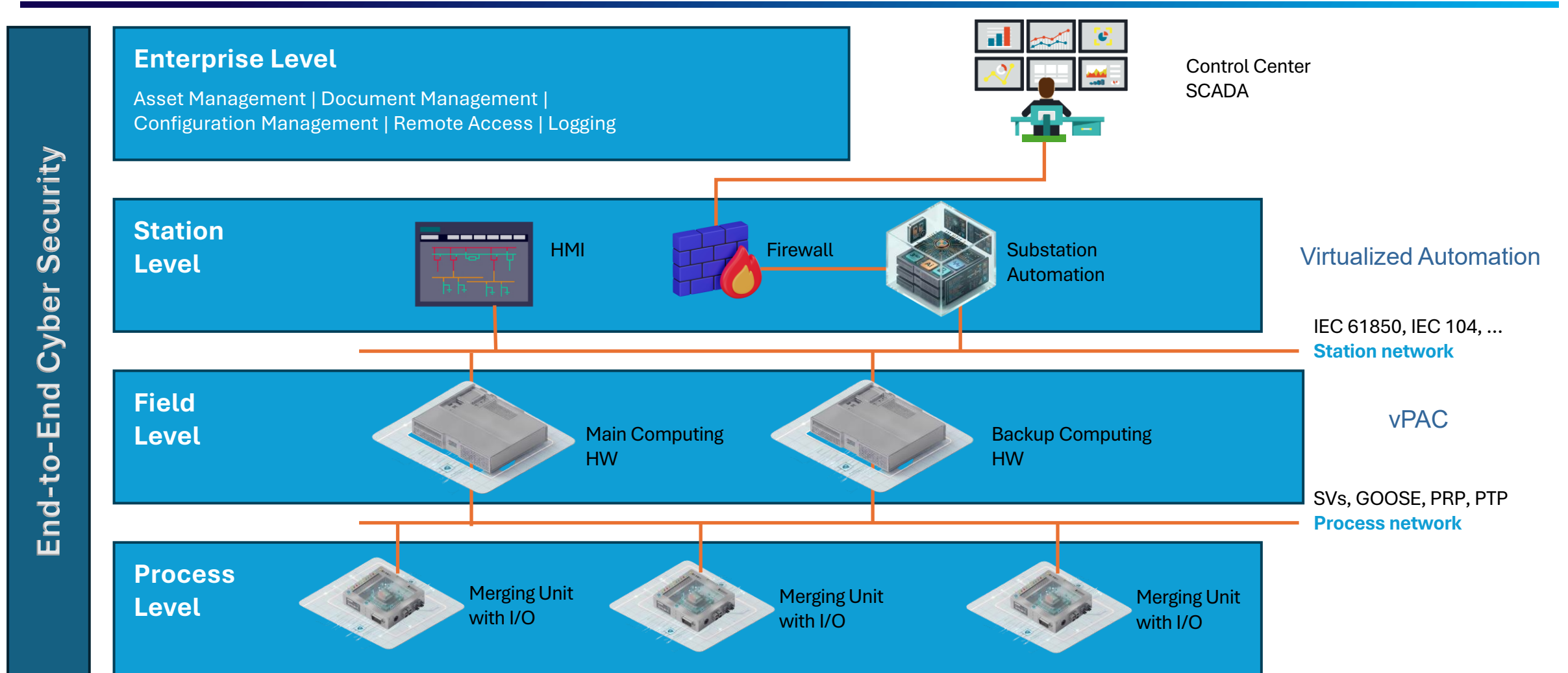
ESTELAR Virtual Protection, Automation & Control



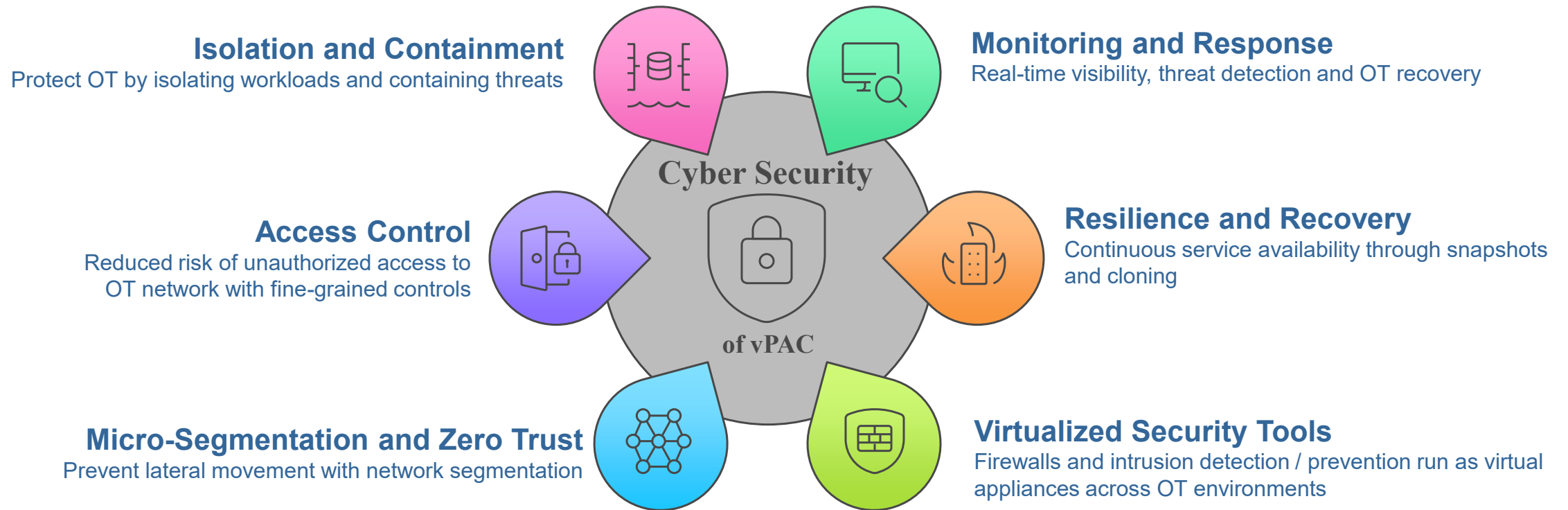
Virtual Protection, Automation & Control



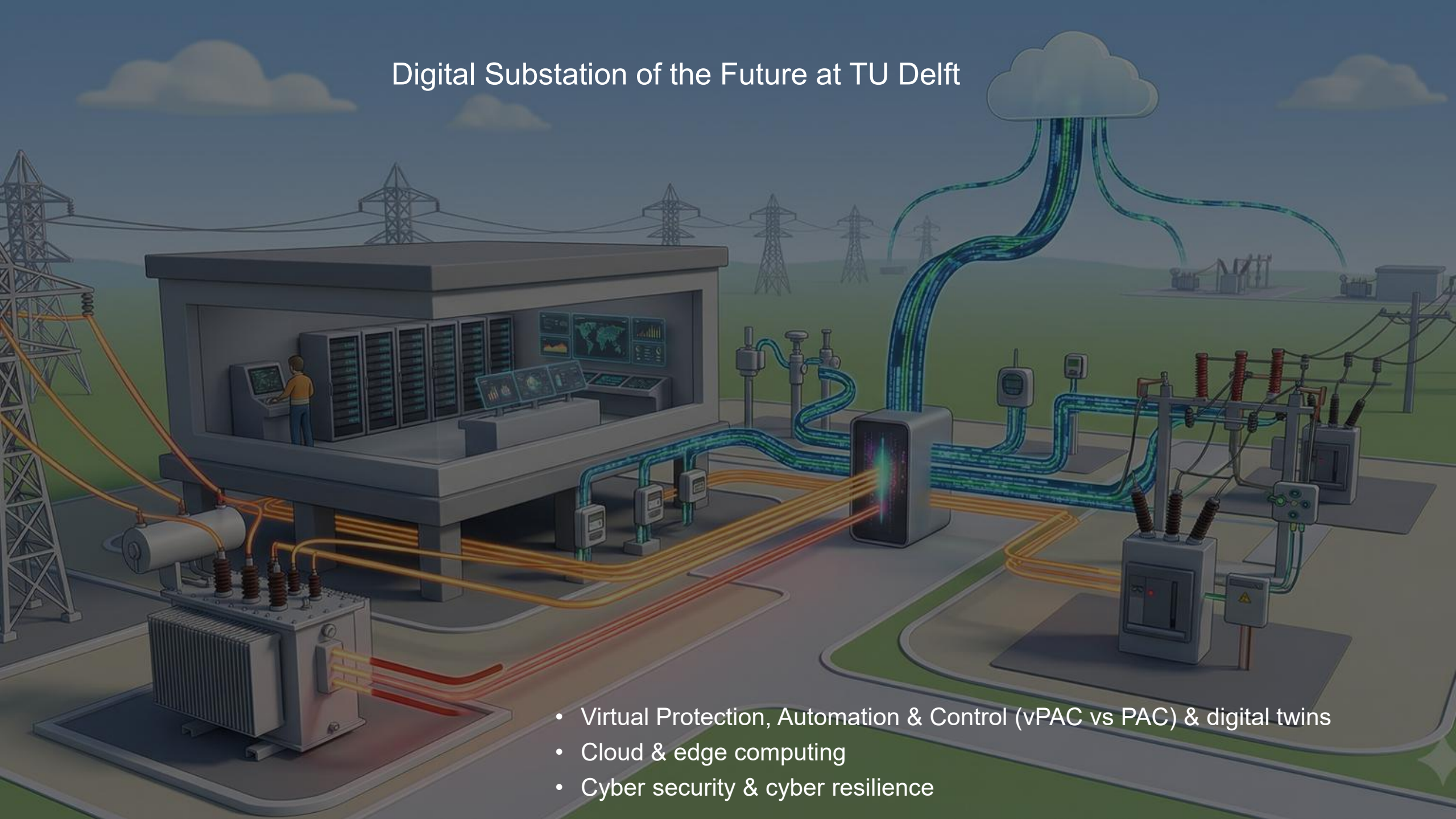
ESTELAR Virtual Protection, Automation & Control



ESTELAR Cyber Security of Software-Defined Protection & Control



Digital Substation of the Future at TU Delft



- Virtual Protection, Automation & Control (vPAC vs PAC) & digital twins
- Cloud & edge computing
- Cyber security & cyber resilience

Thank You!



Dr. Alex Ştefanov

Associate Professor, Chartered Engineer (CEng MIEI)

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Cyber Resilient Power Grids ([LinkedIn](#))

Control Room of the Future ([LinkedIn](#))

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Estelar

THANK YOU!

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