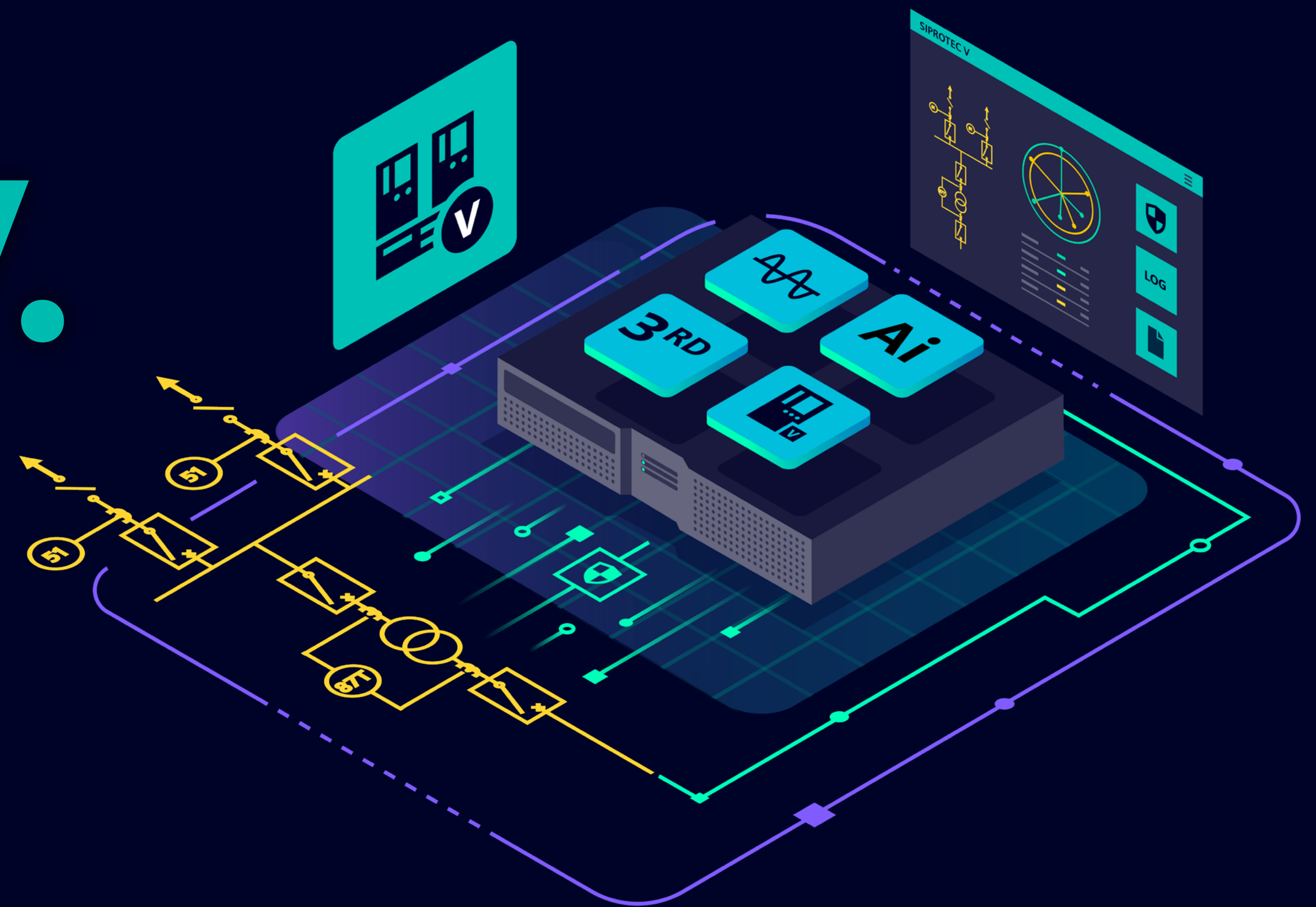


SIEMENS

Go for V. SIPROTEC V.

Virtualized Protection & Control
for substations

Start



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Challenges of modern power grids: Need for accelerating digital transformation

Pressure to double grid capacity

Due to unprecedented electrification demands, utilities are expected to double grid capacity within the next decade.

Modernization pressure

Aging infrastructure must be modernized to maintain system reliability. This requires new technologies, more automation, standardization, and faster rollouts to build a resilient, future-ready grid.

The people factor

Human-capital challenges are mounting: an aging workforce and retirements are creating knowledge gaps, user expectations for speed and transparency are rising, and digitalization is driving demand for new skills.



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Concept and drivers of **virtualization**

Virtualization offers hosting of protection and control algorithms on whitelisted substation-grade computing hardware which enables complete centralization of protection and control of the entire substation.

Scaling the grid at software speed

Virtualized Protection & Control enables easy scaling and expandability by decoupling protection and control functions from dedicated fixed-function hardware and running them on substation-grade computing servers/PCs. This allows utilities to adapt to changing demands – without being tied to fixed-function hardware limitations.

Software-powered. Future-proofed.

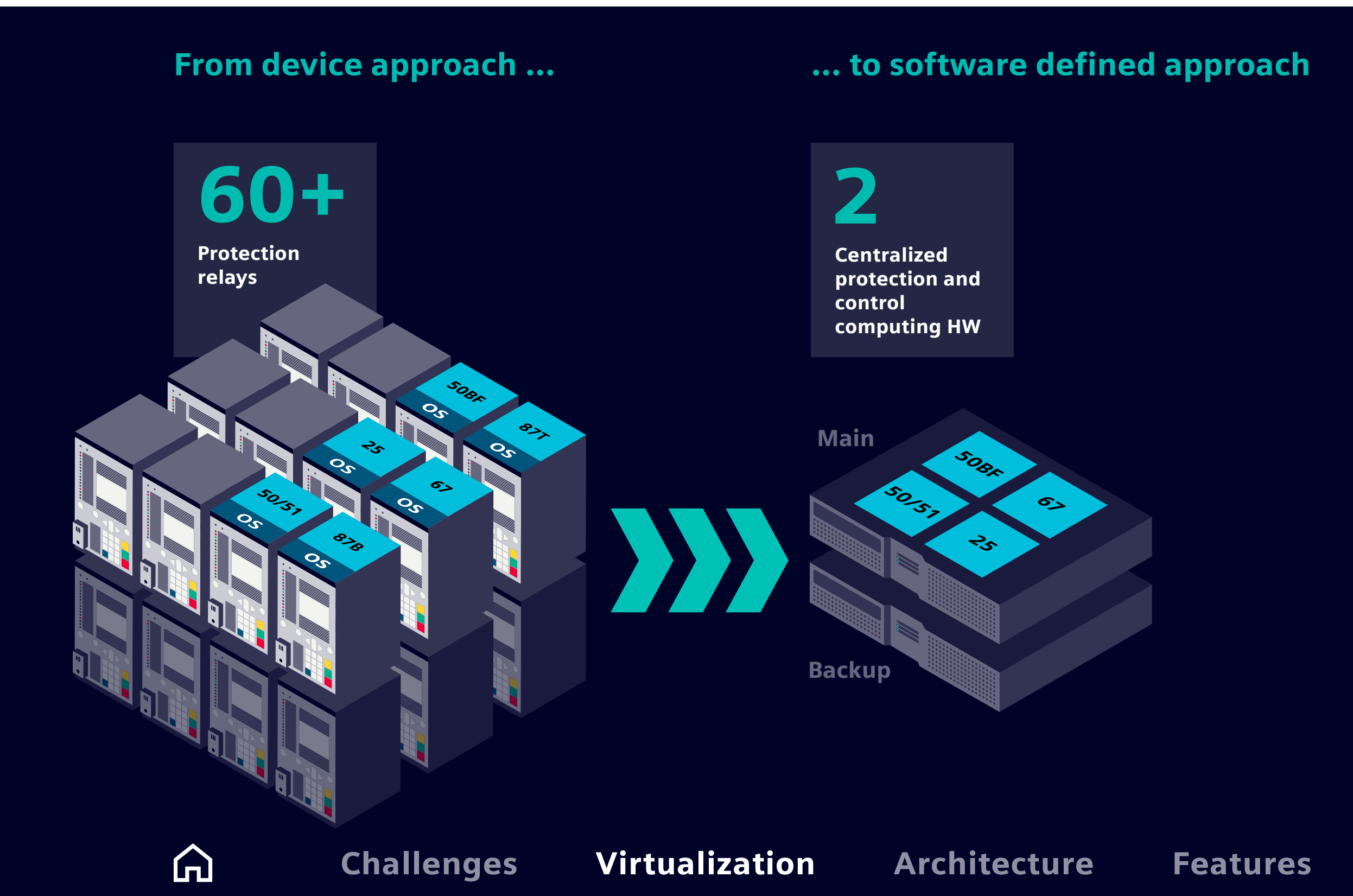
Transitioning from fixed-function hardware to software-based protection simplifies the substation design.

Centralization leads to optimized asset management by streamlining system architecture and reducing hardware variance which in turn simplifies maintenance and lowers spare-parts inventory.

Furthermore, virtualization enables full digital testing of a substation configuration using a digital replica before deployment, simplifying setup, reducing errors, and allowing bay-wise testing and rollout.

Meeting regulatory and security demands

Centralized, software-driven architecture is designed keeping security and simplified patch management in mind, helping customers in their regulatory compliance journey (NERC CIP/IEC 62351).



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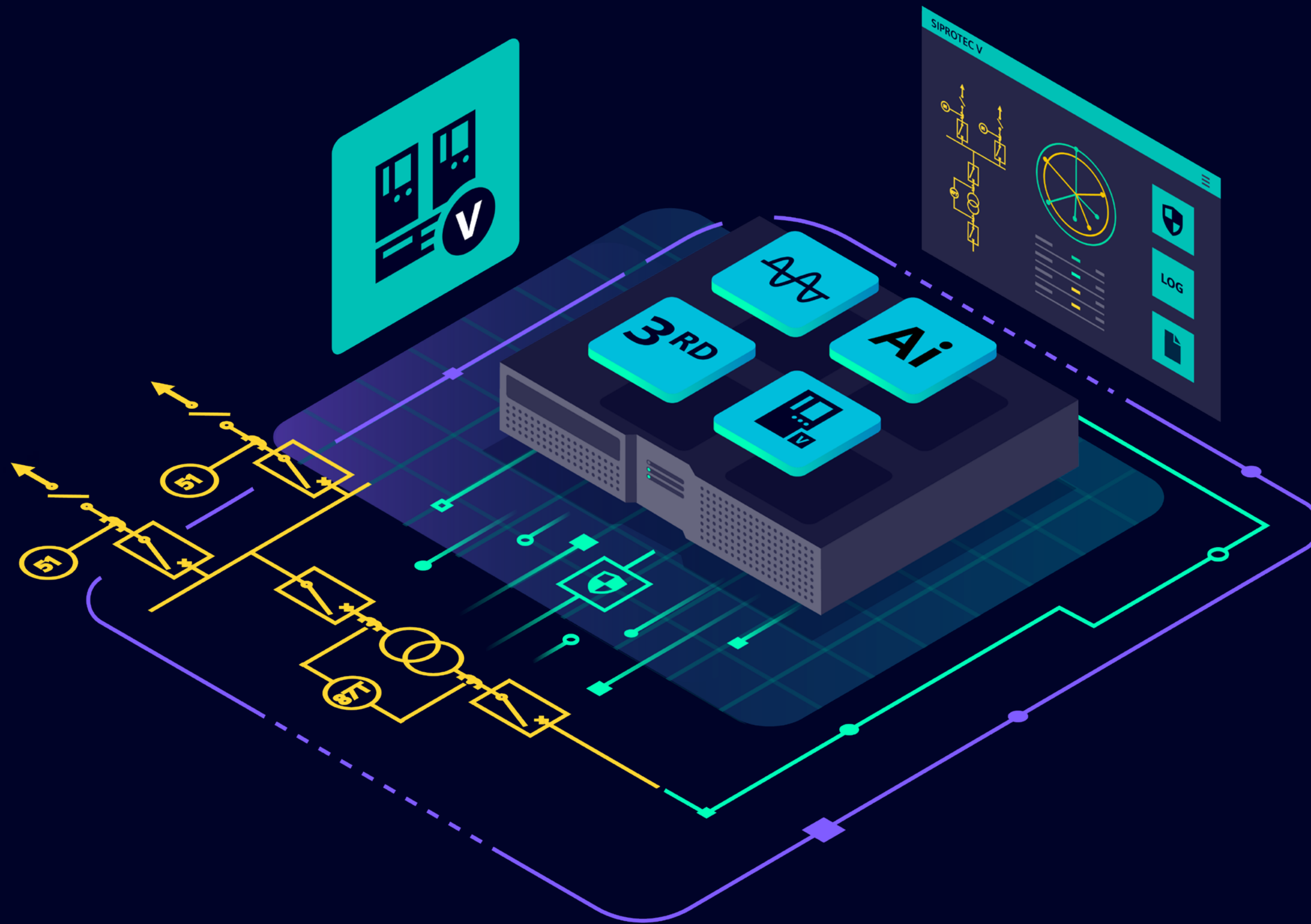
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SIPROTEC V.

Making grids simple, scalable, and secure.



- **SIPROTEC V** is the virtualized version of the trusted SIPROTEC 5 protection and control devices.
- **SIPROTEC V** is designed to centralize 60 virtual IEDs simplifying the substation architecture and operations through device optimization.
- **SIPROTEC V** strengthens the resilience and cybersecurity of critical energy systems by integrating industry-leading security controls. This helps utilities in their journey to meet regulatory requirements (NERC CIP/IEC 62351).

Learn more about the product architecture on the following pages.



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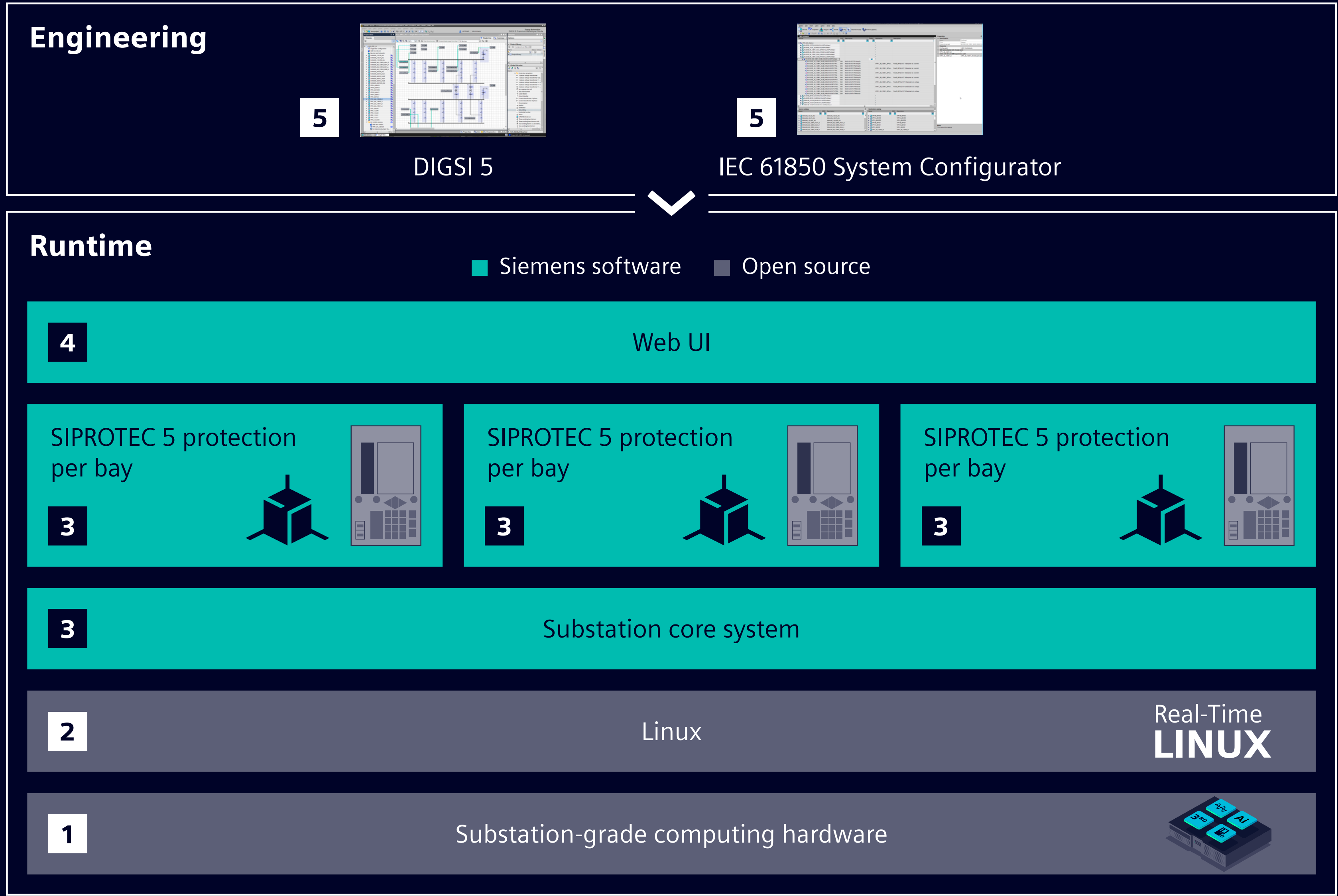
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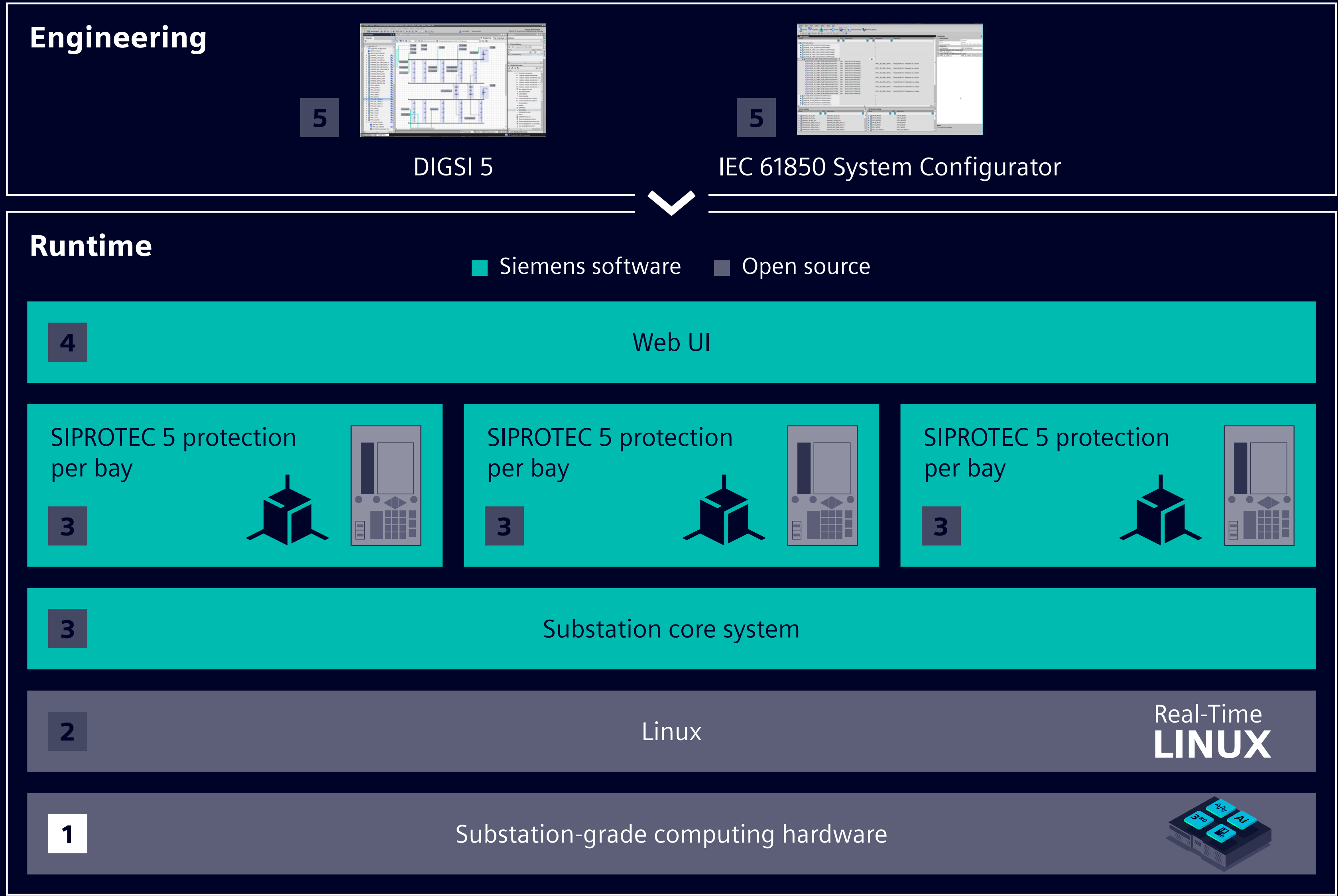
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- 1** Substation-grade computing hardware ➤
- 2** Linux operating system ➤
- 3** Substation core system ➤
- 4** Commissioning and operational views ➤
- 5** Engineering tools ➤

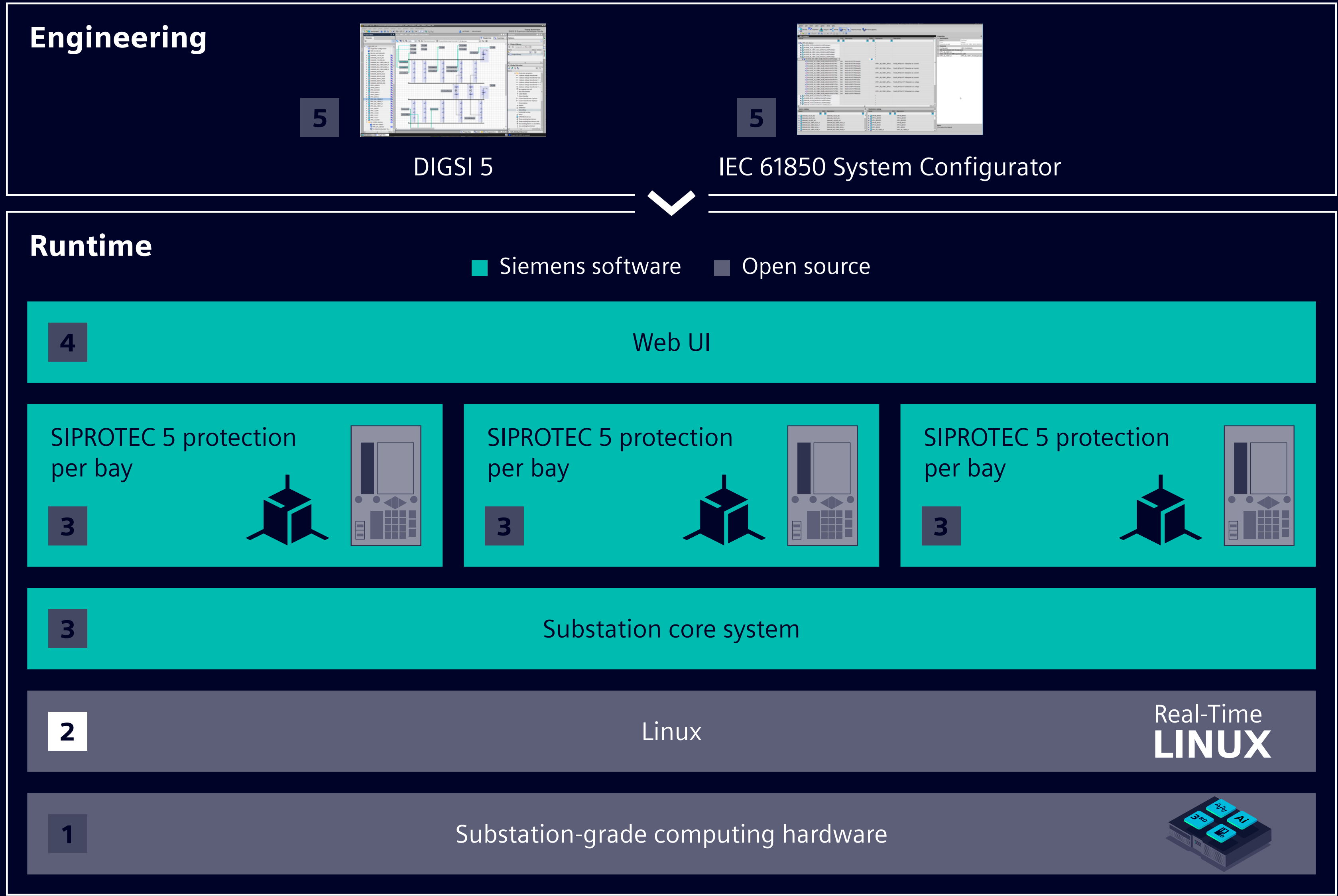


1

Substation-grade computing hardware

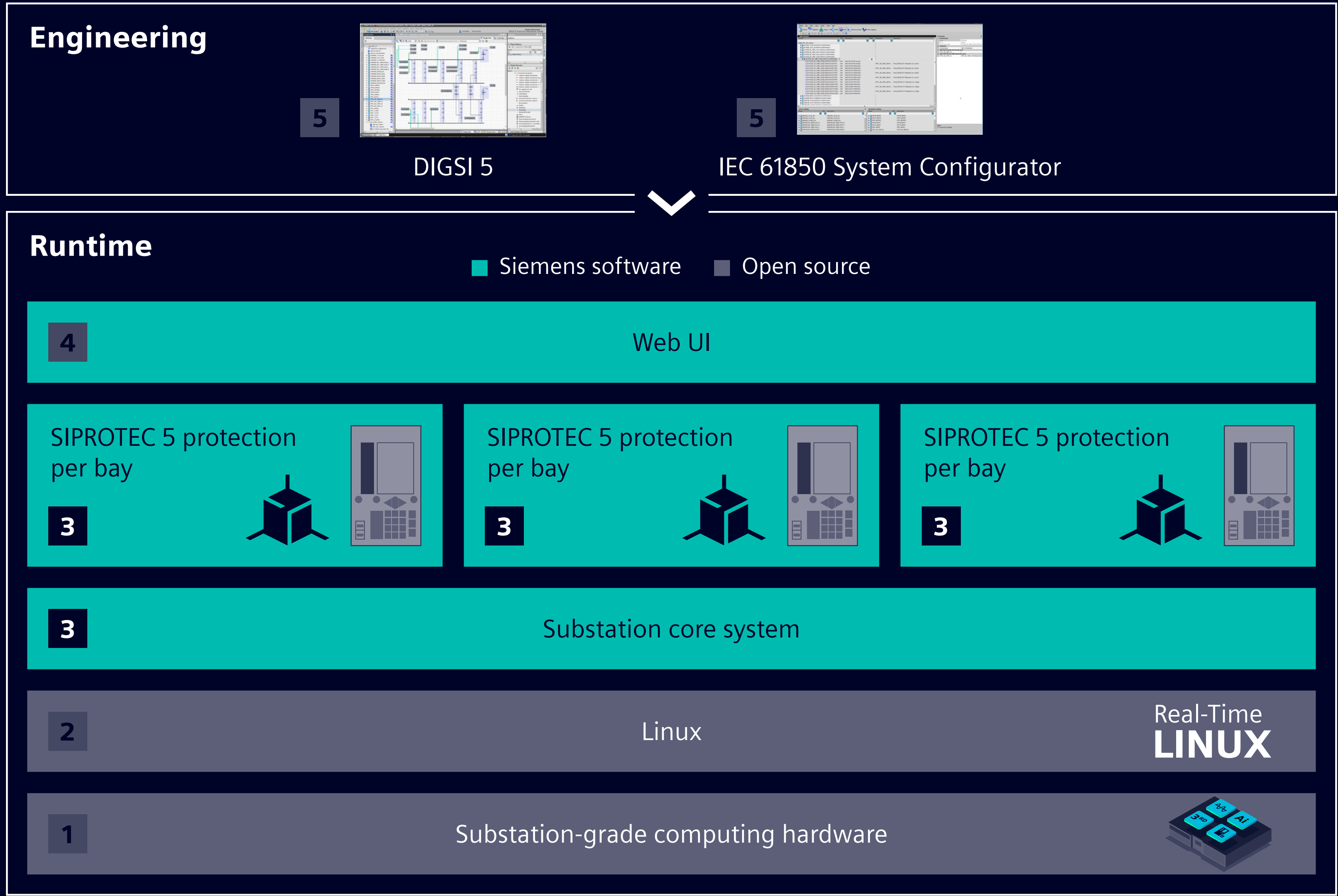
SIPROTEC V leverages the power and flexibility of commercial off-the-shelf server/industrial PC hardware.

- Key hardware features:**
1. Substation-grade hardware – whitelisted and compliant with IEC 61850-3 or IEEE 1613
 2. 1G PRP/HSR communication interface (up to 2 supported)
 3. Secure TPM 2.0 module built-in
 4. Fan-less or fan-based
 5. Performance – 8 cores, 16 cores, or 22 cores
 6. Power supply – single or redundant



2

Linux operating system
Built on a hardened Debian Linux platform with real-time capabilities, SIPROTEC V delivers deterministic performance for critical grid applications.



3

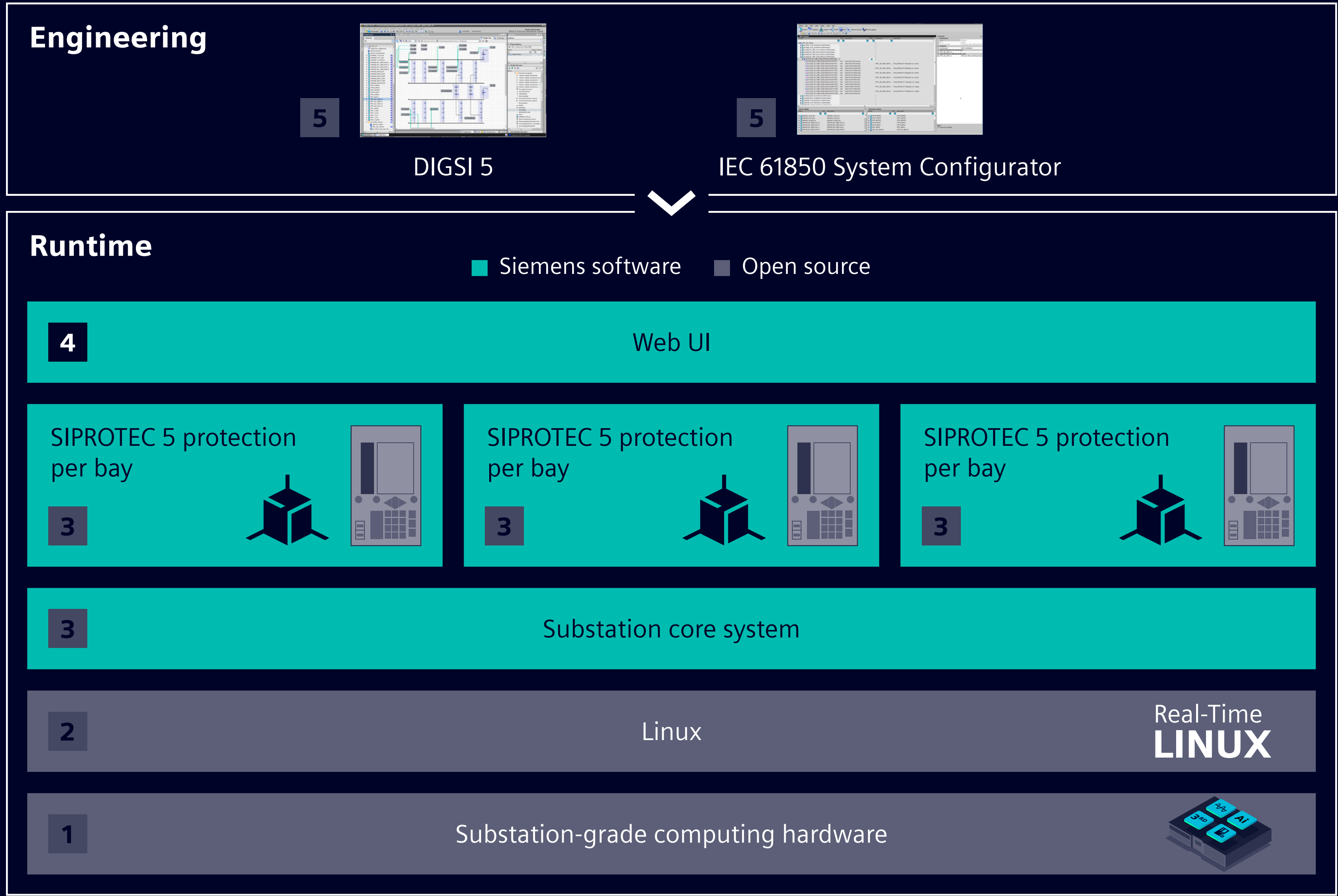
Substation core system

The SIPROTEC V substation core system focuses on centralized services including:

- Lifecycle management that streamlines updates for long-term stability
- IEC 62443-compliant security safeguards
- Time synchronization
- Integrated network management and diagnostics
- License management

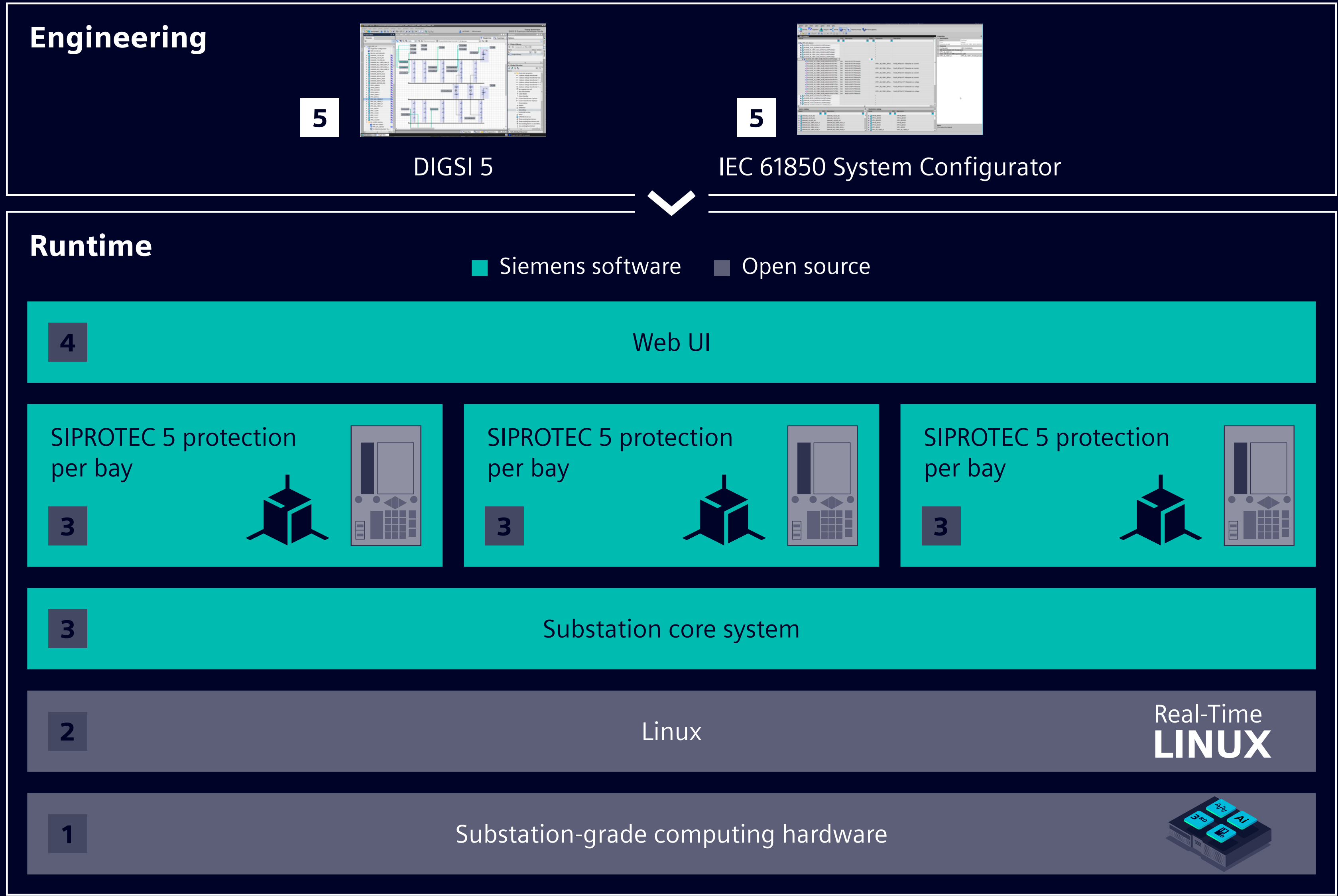
Protection application:

SIPROTEC V combines proven SIPROTEC 5 algorithms with a modular, software-based architecture that scales effortlessly in a bay-wise concept.



4

- Commissioning and operational views**
- Built-in HMI with bay controls for the entire substation
 - Integrated fault recording, logging, measurements, and diagnostics
 - View and/or change protection parameters
 - Lifecycle management of protection and control applications



5

Engineering tools

The engineering process for SIPROTEC V uses the same tools (DIGSI 5, IEC 61850 System Configurator) as SIPROTEC 5 embedded devices. This approach significantly reduces the training effort required to get started, making it easier for users to adapt quickly.

Product features

Base functionalities

- Station-wide SLD for viewing
- Bay SLD with controls
- Event logs
- Fault recorder
- Measurements
- IEC 61850-9-2LE and 61869-9
- IEC 61850 GOOSE
- Advanced logic – CFC
- Time Sync IEEE 1588 slave (Utility profile) + NTP
- PRP redundant communication

Communication protocols

IEC 61850 MMS

Cybersecurity

- Role-based access control
- CIS hardening benchmark
- Syslog
- Certificate management

Current functions

- 50/51 Overcurrent (3-phase)
- 50HS Overcurrent (high-speed)
- 50N/51N Overcurrent (1-phase)
- 50N/51N Overcurrent (ground)
- 51Ns Sensitive ground-fault
- 46 Negative-sequence overcurrent
- 37 Undercurrent

Other functions

- 79 Adaptive dead time auto reclosing
- 79 Automatic reclosing
- 50BF Circuit breaker failure
- 25 Synchrocheck
- 74TC Trip-circuit supervision

Voltage/current functions

- 67 Directional overcurrent (3-phase)
- 67Ns Directional sensitive ground-fault
- 67N Directional overcurrent (ground)

Transformer functions

- 87T Transformer differential
- 46 Unbalanced load
- 49 Thermal overload
- Tap changer controls
- Inrush detection

Line functions

- 21 Distance (1-/3-pole, grounded)
- 21 Distance (isolated, compensated)
- SOTF Switch onto fault
- Fault locator

Busbar functions

87B Busbar differential

Power quality (basic)

- Voltage unbalance
- Voltage variation

Frequency functions

- 81R Rate of frequency change
- 81 Over-/Underfrequency

Voltage functions

- 59, 59N Overvoltage (3-phase or zero-sequence)
- 27 Undervoltage (3-phase)

Capacitor functions

37, 27, 60C Capacitor bank

CFC: Continuous function chart
CIS: Center of internet
GOOSE: Generic object oriented substation event
MMS: Manufacturing message specification
NTP: Network time protocol
PRP: Parallel redundancy protocol
SLD: Single line diagram



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Solution overview – efficient, scalable, and sustainable substations

Traditional substations are built around fixed-function devices, while virtualization focuses on a flexible, software-defined approach that enables greater scalability and optimizes device utilization. At the same time, the compact, software-centric design helps drive sustainability by reducing panel counts and shrinking the overall substation building footprint.

The following comparison illustrates how the shift from traditional to virtualized architectures transforms substation design.

Learn more about the shift
from conventional to virtualized architectures.



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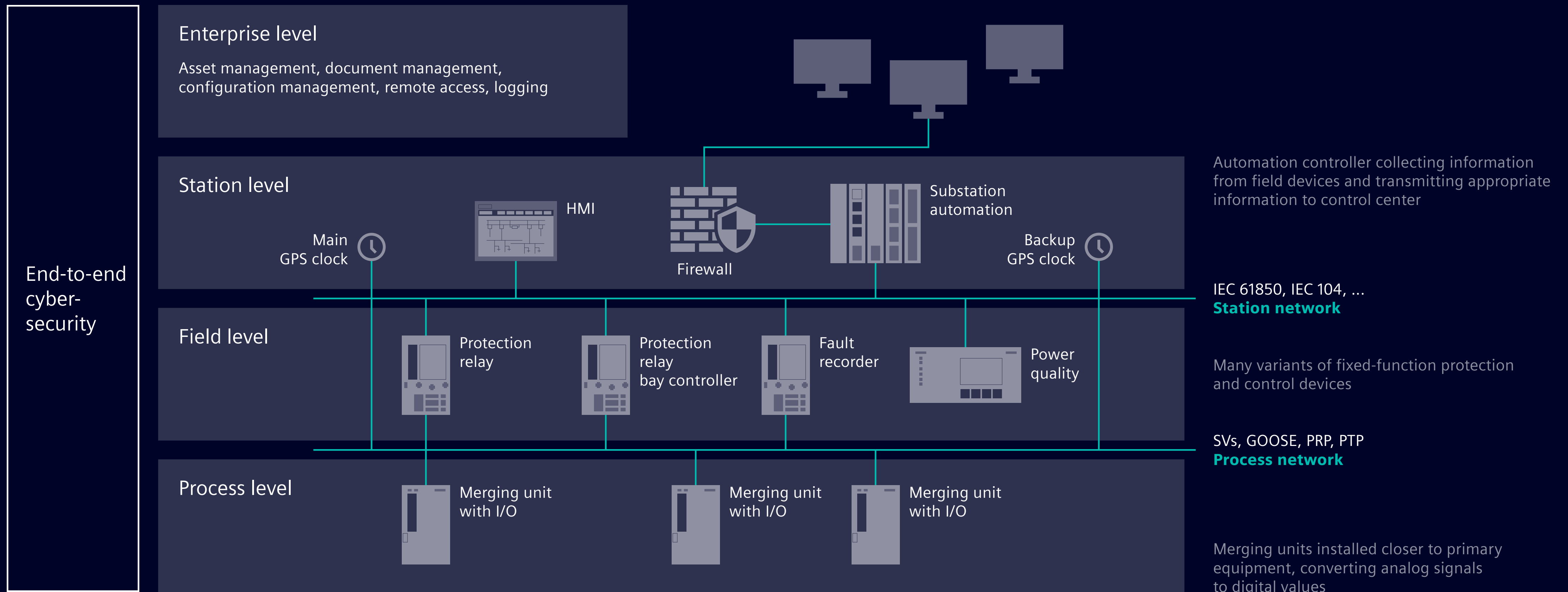
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Solution overview of today's digital substations



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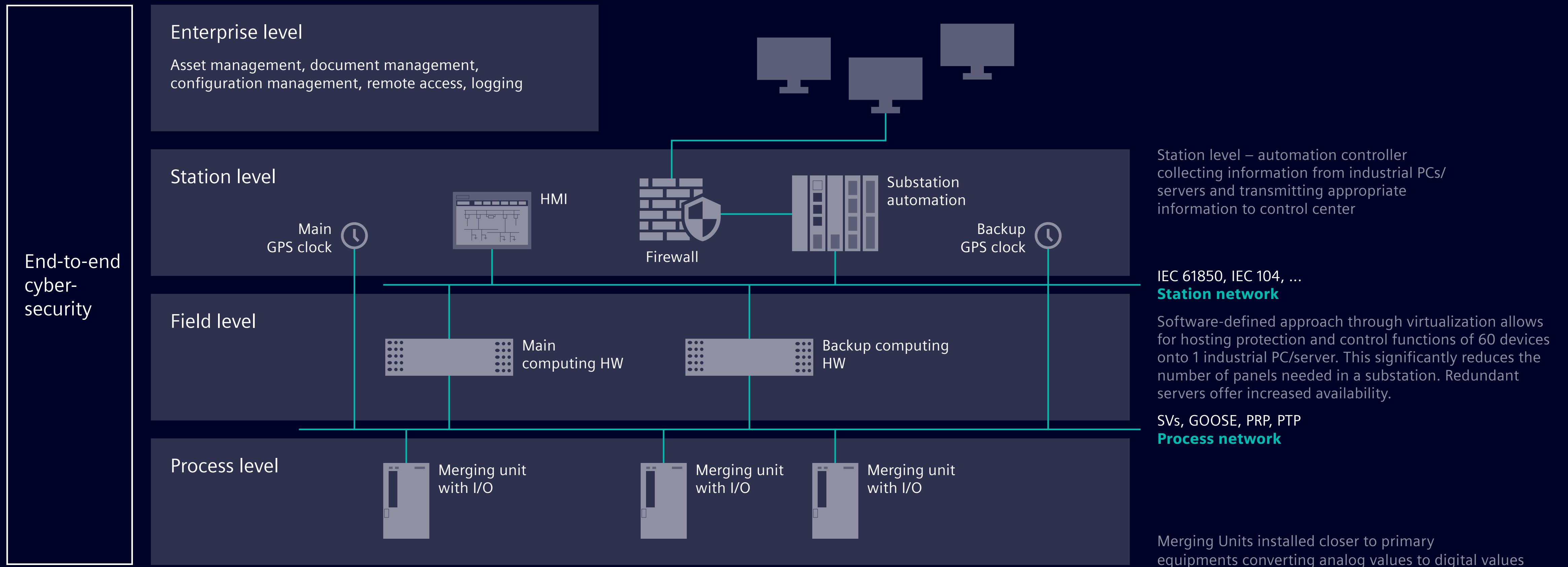
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Solution overview of tomorrow's digital substations



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Go for V! SIPROTEC V – Virtualized Protection & Control Benefits



* Calculations based on a typical project.



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Go for V! SIPROTEC V – Virtualized Protection & Control

Benefits



Go for V! SIPROTEC V – Virtualized Protection & Control

Benefits

Reliability >

Scalability >

Innovation & AI integration >

Simplification >

Sustainability >

Safety and security >

Virtualized Protection & Control

Scalability

SIPROTEC V removes the traditional link between protection and control software and fixed-function hardware, enabling protection and control applications to scale virtually – up to 60 bays on one substation-grade computing hardware.

Go for V! SIPROTEC V – Virtualized Protection & Control

Benefits



Simplification

- **Optimized device management:** Through centralization, SIPROTEC V streamlines system architecture and reduces hardware variance, simplifying maintenance and lowering spare part inventories
- **Comprehensive Pre-deployment Testing:** SIPROTEC V enables full digital testing of a substation configuration using a digital replica before deployment, simplifying setup, reducing errors, and allowing bay-wise testing and rollout.
- **Simpler patch management and maintenance:** Easy to expand by leveraging modular software architecture. Simple adaptation for expansion and operational needs. Configuration and firmware updates can take place bay-wise without interrupting other bays in operation – resulting in increased availability.



Go for V! SIPROTEC V – Virtualized Protection & Control

Benefits

Reliability >

Scalability >

Innovation & AI integration >

Simplification >

Sustainability >

Safety and security >

Virtualized Protection & Control

Safety and security
With RBAC, CIS-aligned hardening, and NERC CIP/BDEW compliance, SIPROTEC V ensures secure, compliant operation of critical energy systems. Placing merging units closer to the primary equipment reduces electrical hazard exposure, while digital pre-deployment testing minimizes commissioning risks.

Go for V! SIPROTEC V – Virtualized Protection & Control

Benefits



Sustainability

Through centralization, SIPROTEC V allows for significant panel reduction, further reducing the substation footprint and enhancing sustainability through less steel, concrete, and copper cabling.

Go for V! SIPROTEC V – Virtualized Protection & Control

Benefits

Reliability >

Scalability >

Innovation & AI integration >

Simplification >

Sustainability >

Safety and security >

Virtualized
Protection
& Control

Innovation & AI integration

SIPROTEC V opens the door for integration of AI applications within the substation, unlocking new insights, predictive analytics, and improved decision-making within a secure, resilient infrastructure.



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Go for V! SIPROTEC V – Virtualized Protection & Control

Benefits

Reliability >

Scalability >

Innovation & AI integration >

Simplification >

Sustainability >

Safety and security >

Virtualized Protection & Control

Reliability

SIPROTEC V combines the benefits of centralization with the use of trusted and proven SIPROTEC 5 protection and control algorithms to deliver reliable performance and resilient operations, ensuring continuity even under challenging grid conditions.



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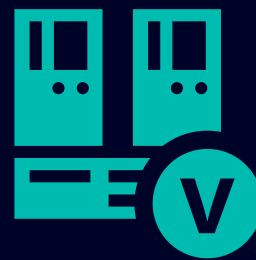


Go for V! SIPROTEC V – Virtualized Protection & Control Highlights



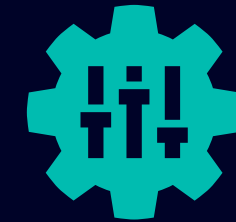
Centralized protection and control

SIPROTEC V enables protection and control applications to scale virtually within a substation – supporting centralization of up to 60 bays.



Proven protection algorithms

SIPROTEC V reuses the trusted and proven SIPROTEC 5 protection algorithms.



Familiar engineering environment

SIPROTEC V is engineered with the same tools as SIPROTEC 5 – DIGSI 5 and IEC 61850 System Configurator.

IEC

IEC 61850 compliant

Full compliance with IEC 61850 standard ensures flexibility and interoperability.



End-to-end cybersecurity

The solution supports role-based access control (RBAC) models and is hardened according to CIS Benchmark guidelines. It also meets the requirements of both the NERC CIP standard and the BDEW whitepaper, ensuring a high level of operational security and compliance.



Station-wide visibility

An integrated HMI enables centralized operation and monitoring of the entire substation.



Bay-wise concept

Life-cycle operations (start, stop, test) can be executed in a single bay without interrupting operations in other bays.

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SIPROTEC V – product delivery and licensing



Licensing details

- **Product delivery:**
SIPROTEC V protection and control software will be pre-installed along with the operating system on whitelisted substation-grade hardware by Siemens. Siemens will deliver a reliable package (Hardware/Software bundle).
- **Software license:**
A software license is required to activate features of interest in SIPROTEC V. The software license management is carried out through license manager (known as function point manager).
- **Function point concept:**
SIPROTEC V uses the same concept of function points for protection and control applications as SIPROTEC 5
- **Licensing type:**
Perpetual + software maintenance



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