

**ADVANTECH**

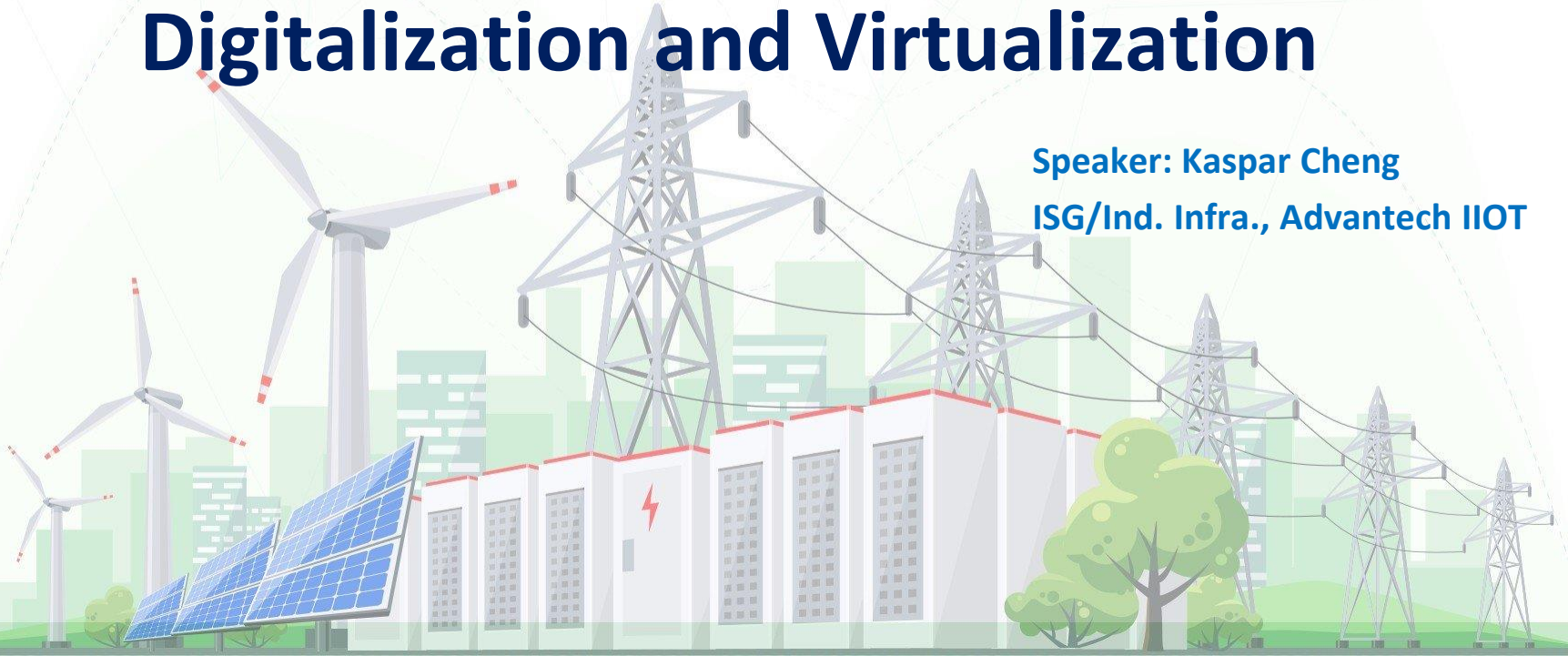
*Enabling an Intelligent Planet*



# Exploring the Benefits of Smart Substation Digitalization and Virtualization

**Speaker: Kaspar Cheng**

**ISG/Ind. Infra., Advantech IIOT**



# Energy Demands

Rapidly  
expanding demand  
for energy

Net Zero by 2050

Dramatic growth  
in renewable  
energy

Intermittent Energy Supply

Decentralization  
of energy

Operational Complexity



Oil Energy



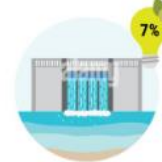
Coal Energy



Gas Energy



Nuclear Energy



Hydropower Energy

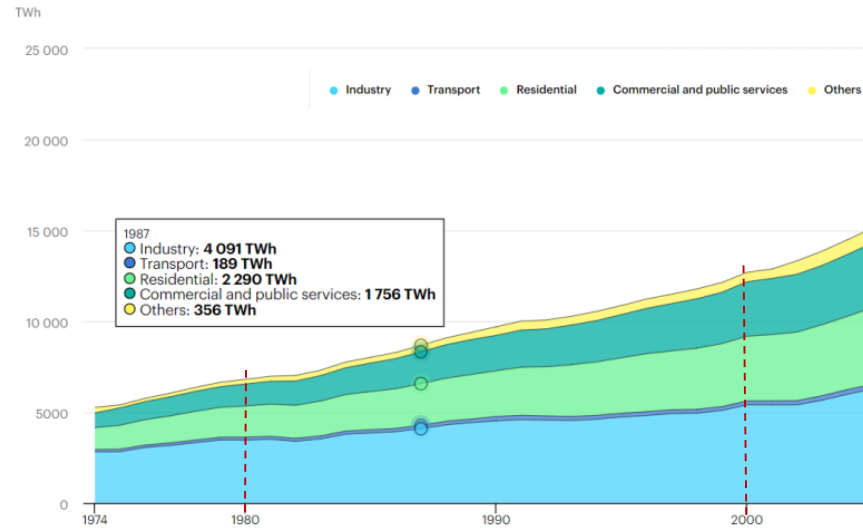


Wind Energy



Solar Energy

World electricity final consumption by sector, 1974-2019



# Challenges in Substation

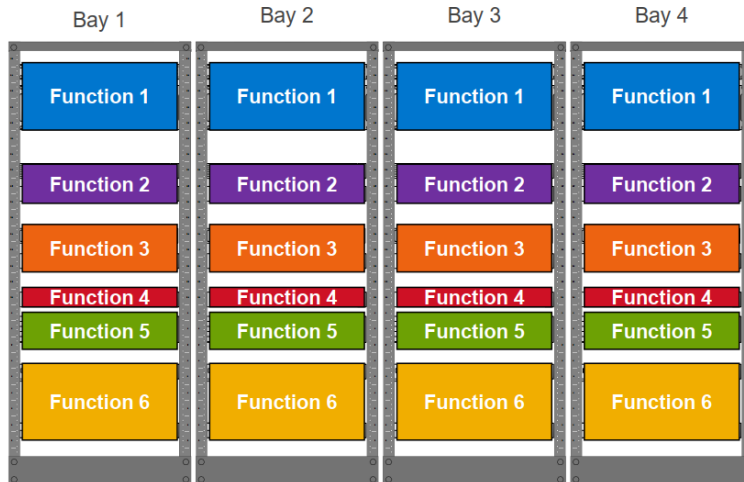
## Cost

Devices, Cabling, Labor, Footprint

## Efficiency

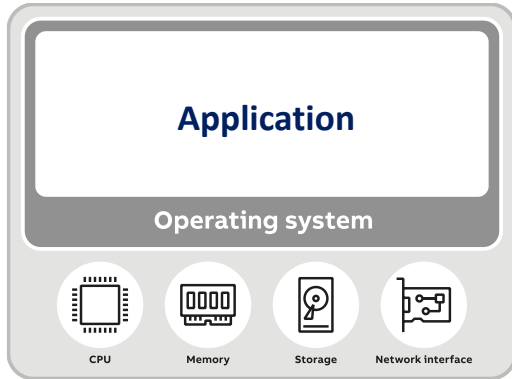
Data Analysis, Flexibility, Management

**3R (Reliability, Redundancy, Resiliency) + Cyber Security**



# What is virtualization?

## Without Virtualization

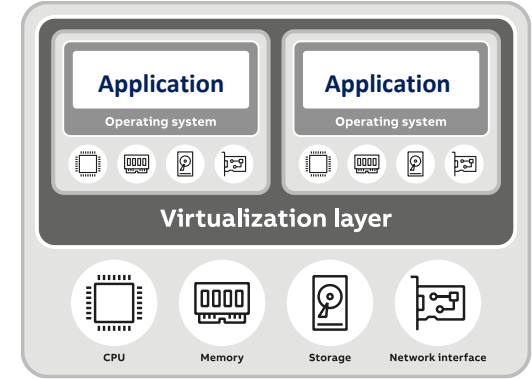


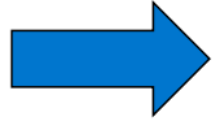
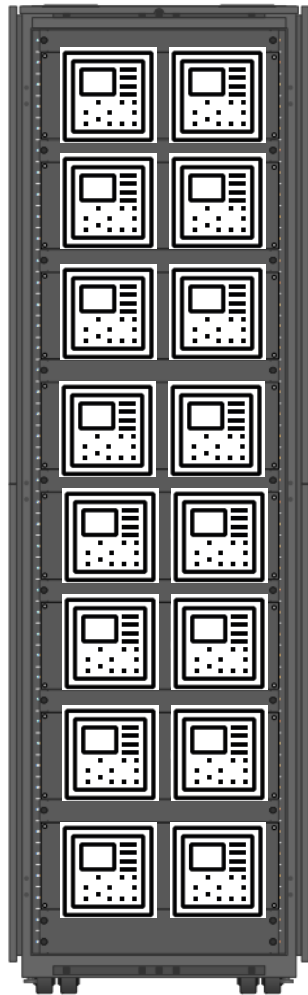
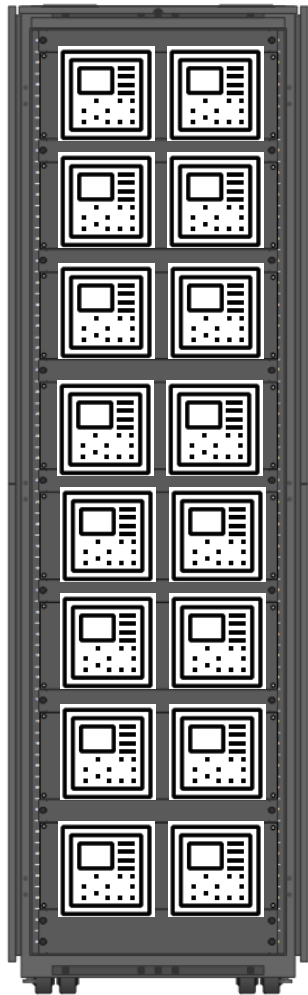
Virtualization enables the hardware resources of a single computer—processors, memory, storage and more—to be divided into multiple virtual computers.

Technology is not new – well proven and widely used –

Only thing changing now is the fact that virtualization platforms can guarantee **real-time performance**

## Powered With Virtualization

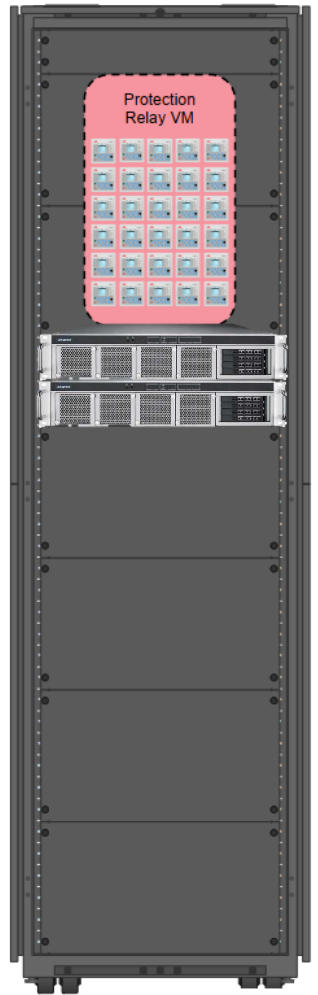




Replace dozens of protection relays

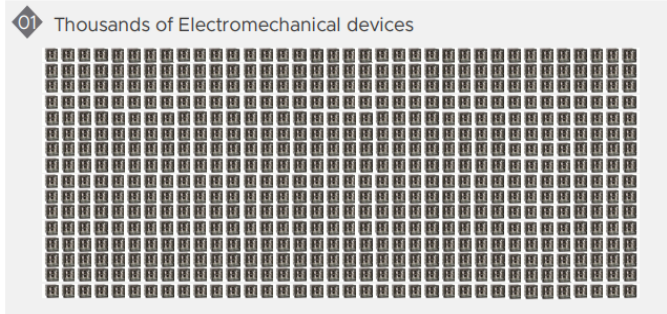
Consolidate other legacy substation devices

Prepare for emerging workloads

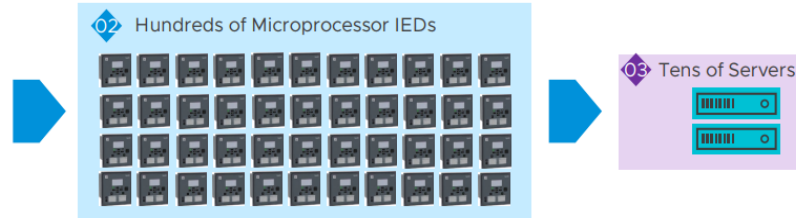
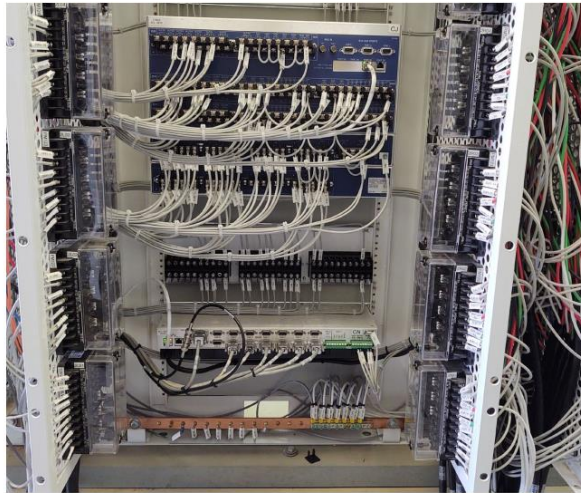




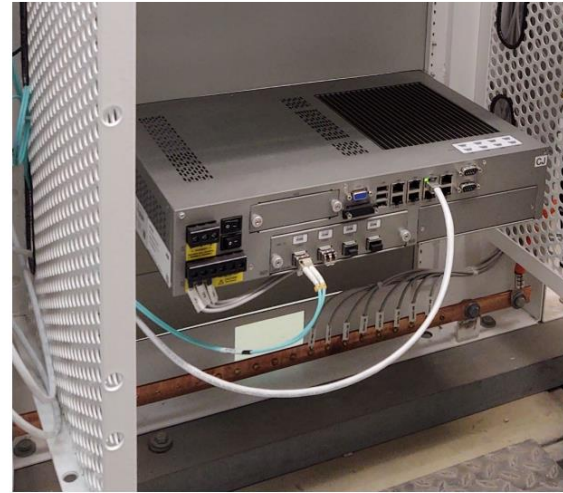
# It's on the way...



Present



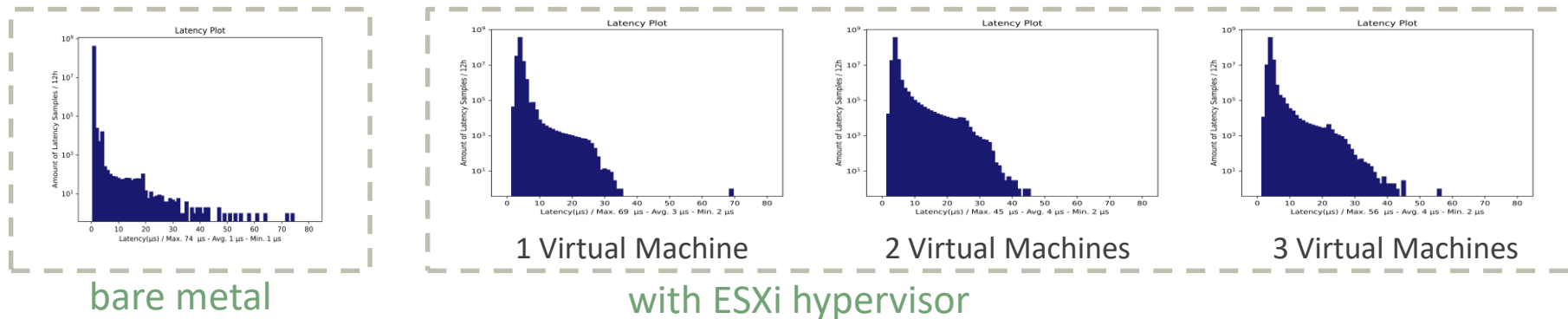
Future



# High Performance with Workload Consolidation / Standardization

Running real-time (e.g. Protection) and non-real-time (e.g. SCADA) workloads together

Identical latency between bare metal and VMware hypervisor configured for low-latency performance



- Histograms above show time added by hypervisor (measurements with Cyclicttest)
- VMware enables real-time performance with a simple GUI selection
- VMs are isolated - real-time workloads can run adjacent to non-real-time on the same host
- Keeping maximum hypervisor latency under 120μs
- Long-duration tests (30, 60, 180 days) are continuously being performed

# vPAC (virtual Protection Automation Control)

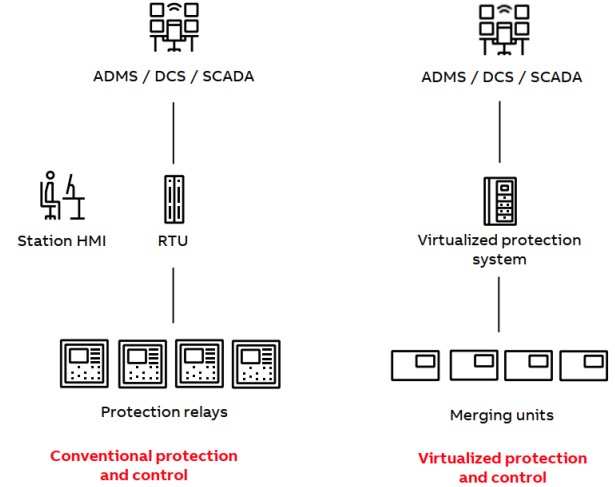
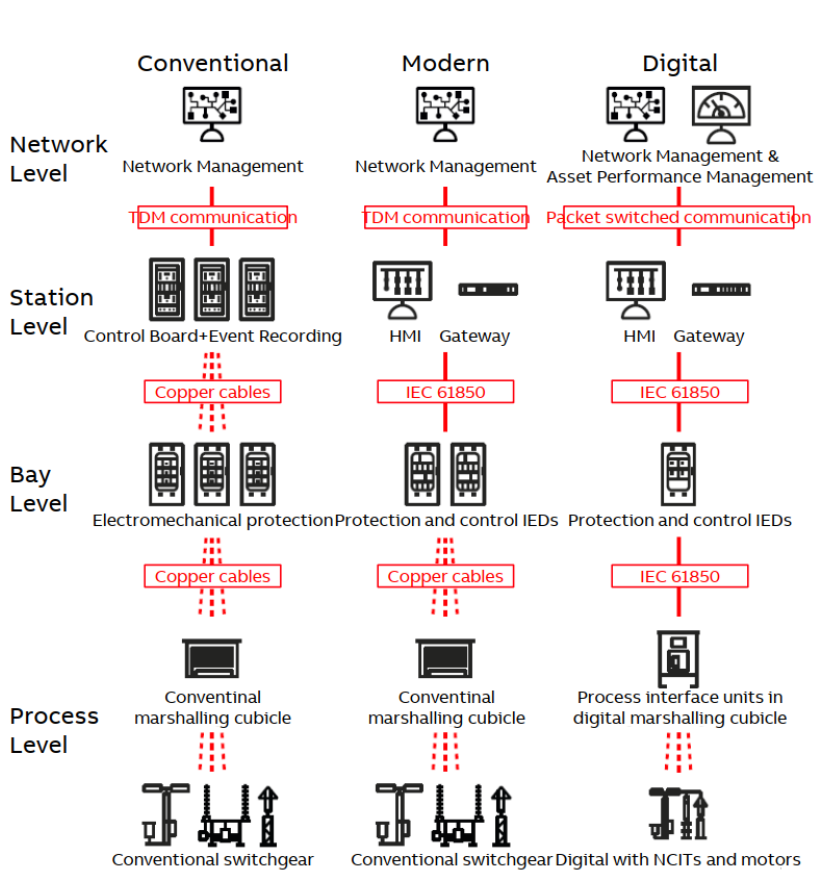
## Customer-Driver Ecosystem

Driving standards-based, open, interoperable, and secure software-defined architecture to host protection, automation, and control solutions for power system substations.





# ABB SCC 600 SW



## Protection virtualization technology: the utilities revolution

ABB Virtual Protection Automation and Control (VPAC): Servers sizes

Minimum size	Large size
<p><b>Minimum size</b></p> <ul style="list-style-type: none"> <li>- 1 VM with SSC600 SW</li> <li>- Can handle 30 streams SV</li> <li>- Hypervisor Linux KVM or VMware ESXi 7.x/8.x</li> </ul> <p>Ideal for 30 streams SV under a single configuration/VM, running on a Hypervisor.</p>	<p><b>Large size</b></p> <ul style="list-style-type: none"> <li>- 1-3 VMs with SSC600 SW + spare cores, 3rd party apps</li> <li>- Can handle 90 streams SV</li> <li>- Hypervisor Linux KVM or VMware ESXi 7.x/8.x</li> </ul> <p>Ideal for 30-90 streams SV up to 3 VM's, or splitted HV/MV functions in different VM's, 3rd party vendors running on a Hypervisor.</p>
Minimum size	Large XL size
<p><b>Minimum size</b></p> <ul style="list-style-type: none"> <li>- 1 VM with SSC600 SW + spare cores, 3rd party apps</li> <li>- 2 VM's with SSC600 SW + 1 core spare</li> <li>- Can handle 60 streams SV</li> <li>- Hypervisor Linux KVM or VMware ESXi 7.x/8.x</li> </ul> <p>Ideal for 30-60 streams SV under 2 VM's, or splitted HV/MV functions in different VM's, running on a Hypervisor.</p>	<p><b>Large XL size</b></p> <ul style="list-style-type: none"> <li>- Up to 4 VM's with SSC600 SW, or mixed with 3rd party vendors</li> <li>- Can handle 90 streams SV</li> <li>- Hypervisor Linux KVM or VMware ESXi 7.x/8.x</li> </ul> <p>Ideal for 30-90 streams SV up to 4 VM's, or splitted HV/MV functions in different VM's, 3rd party vendors running on a Hypervisor.</p>

# GE eLumina

## Customer Outcomes

Rapid Project Delivery	Maximized Performance	Robust & Resilient Design	Compact Footprint	Digital Analytics
<p><b>+150</b> Configurable SW modules</p> <p><b>30%</b> faster cycle</p>	<p><b>+10x</b> computing platform power</p>	<p><b>80%</b> fewer wires</p> <p><b>100%</b> automatic testing</p>	<p><b>50%</b> smaller footprint</p> <p><b>40%</b> fewer cabinets</p>	<p>Built with <b>operational analytics, Cyber-secured</b></p>

Designed to address today's and tomorrow's grid challenges

## GE Introduces eLumina™ Control System HVDC Control System for the New Grid

- Maximized System Availability & Reliability:** Increased system availability through modular architecture, enhanced system availability, and comprehensive testing.
- High Performance:** Fast HVDC solution to respond to a wide range of digital control system requirements, high speed processing, and reduced risk.
- Compact Footprint:** Using a modular approach, the compact footprint reduces the physical footprint by up to 50%.
- Proven Software and Optimized Delivery:** eLumina™ Suite provides a proven HVDC application software and delivery model that allows to reduce 30% reduction in delivery cycle.
- Introducing eLumina™ Explorer:** Modern HVDC user interface, Real-time visualization, Configuration and commissioning, and Analytics for network fault security.
- eLumina™ Analytics:** An analytics platform, enabled by the digital control system, that provides insights into the system's performance and helps optimize the system.

## GE Introduces eLumina™ Control System HVDC Control System for the New Grid

Leandro

- eLumina™ Platform:** Controls Platform Digital Substation
- eLumina™ Suite:** HVDC Software Single Source of Truth Model Brilliant SW Factory
- eLumina™ Explorer:** Real-time monitoring Data visualization Events logging
- eLumina™ Analytics (Digital Ready):** Insights via analytics engine Advanced visualization

## Network Interface Cabinet - NIC

The digital hub coordinating all communications between the HVDC system elements. Interconnects control and protection racks and digital substation via duplicated optical networks

- Two NICs are required for a Pole or a Bipole
- Proven and ruggedized gigabit optical ethernet network switches (GE S20 family)
- All network paths are duplicated via PRP or from source
- IEEE158.8 v2 PTP is used to provide an accurate (1us) time system
- Type-tested for compliance with HVDC substation level requirements dictated by IEC61850-3
- Low power, thermally efficient and reliable design
- High reliability, full optical interconnections, no media converters

- GE Reason RT430 Precision Time Clock
- GE Reason S20 Industrial Ethernet Switches
- IEC61850-compliant industrial servers
- Optical Communication Patch Panel

Fully optical ruggedized digital communication Hub

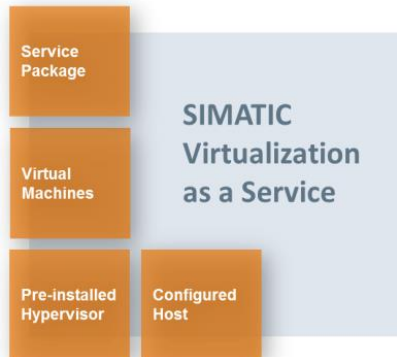
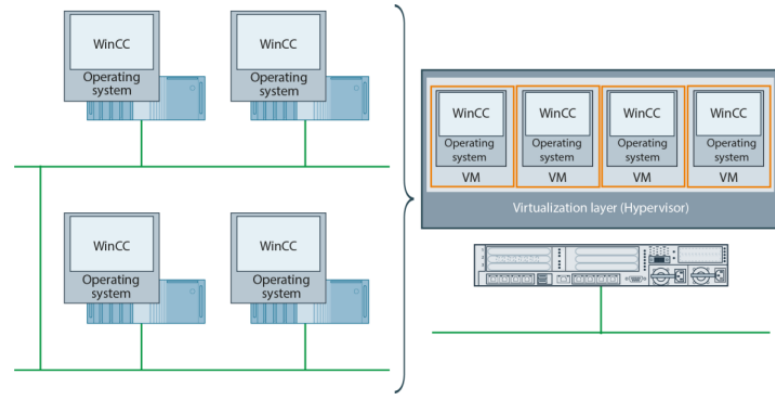
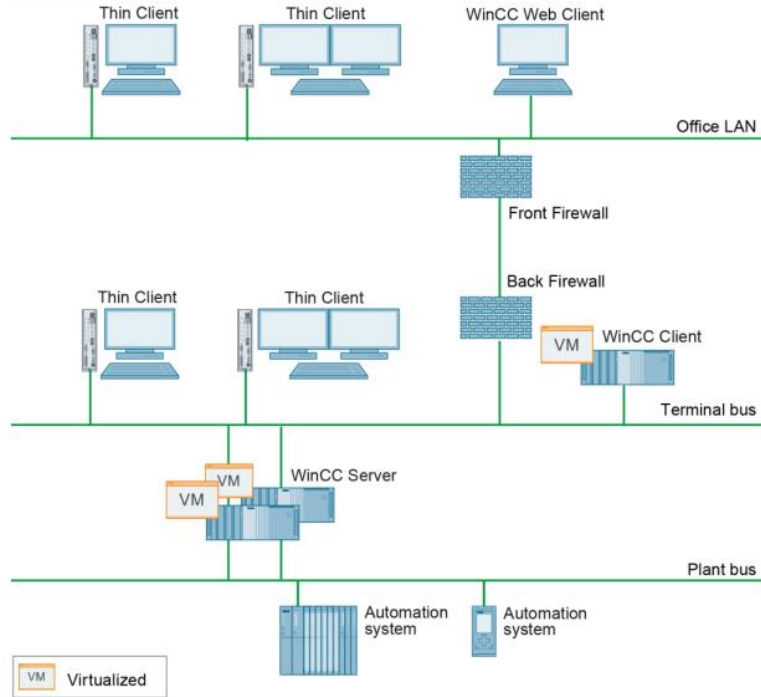
REMOTE INTERFACE CABINET

LEARN MORE

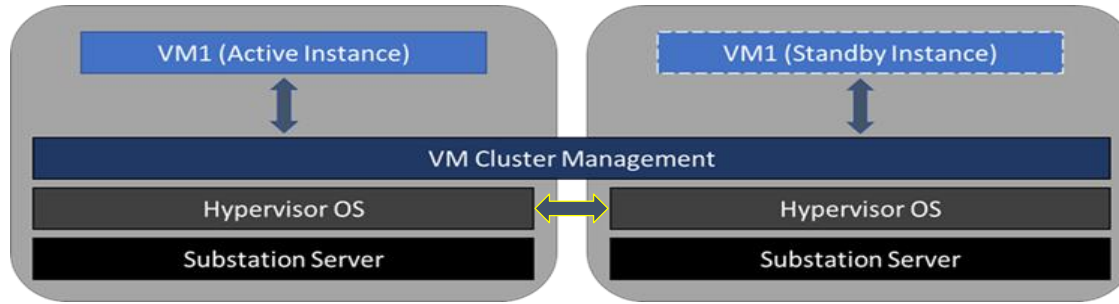
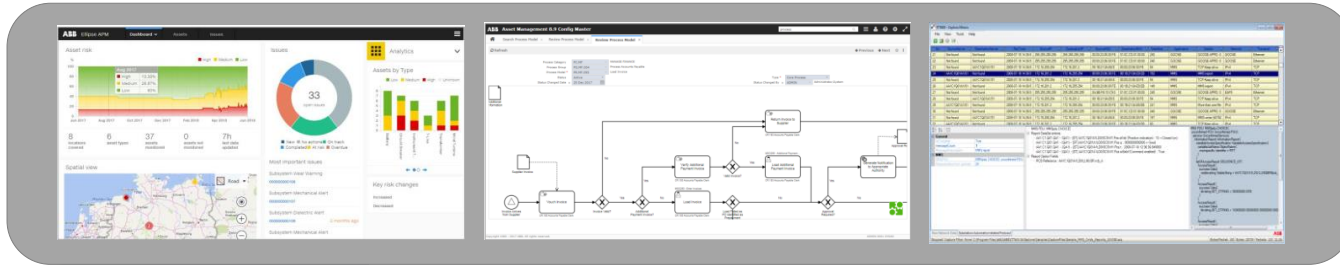
# Siemens WinCC Virtualization

## WinCC system architecture in virtual environment

Figure 3-1



# vPAC Architecture



## CSP (Common Substation Platform)



# ECU Product Position

ECU-4784



**Legacy CSP Server**

**Proven H/W Platform**  
(GHASS Applied)

**Complete Solution**  
(EXP, API, OS, VMKH)

**Entry HW Solution**  
(Atom, Legacy platform)

ECU-479

13<sup>rd</sup>, Raptor Lake



**CSP/VPR Server**

**ECU-4784 Upgrade**  
(Computing, I/O Bandwidth)

**RAS Improvement**  
(Hot Swap Power & RAID SSD)

**Flexibility for Local CTOS**  
(CPU, Memory, Storage, EXP)

ECU-579



**SW-Defined VM Server**

**Energy Server Grade**  
(Support 20+ Cores, VMs)

**Leading Technology**  
(IPMI, Security, \*SR-IOV)

**Incremental Market**  
(Digital Substation, Protection)



# ECU Product Key Feature

## IEC 61850-3 & IEEE 1613 Certified 2U RM System



**100-240 Vdc/Vac, 48VDC Redundant Power Option**

**DI/DO, Isolated COM, SFP, TPM Option**

**HSR/PRP, IEEE 1588 v2, IRIG-B, SNMP v2.0**

**Fanless (-25~70°C)**

**Redundant Fan (-20~60°C)**

**Intel RSTSW RAID**

**High Speed HW RAID 0/1/10**

**iBMC/IPMI, VMware ESXi 7, \*SR-IOV + HSR/PRP**

Compatible with mainstream virtualization technology according to the customer's test result, not Advantech's official announcement

Co-working with VMware's team to support ESXi on Intel hybrid core (P + E) architecture

**ADVANTECH**





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