Technology, an Enabler for the DSO & DET

Technology Reference Models

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Energy transition with an unreversible paradigm shift from the customer lens

- **IT & OT plays an essential role in modernising the grid ("Smart Grid"); and**
- **Building a secure infrastructure needed to;**
- **Bridge the gap between utilities, customers & partners ("Customer Centricity").**

BI-Directional Energy and Information Flow

Smart Grid Framework

ICT Technology Architecture Framework

Cyber Security Framework

Major Disruptors Driving the Smart-Grid Transformation

Unprecedented disruptions greatly challenge the most important mission of electric power utilities: providing safe, secure, and reliable electricity services to customers.

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Increasing Integration of Renewables Sources

Use of solar is increasing

11% in Canada | **38.4%** in US

From 2018 to 2020, installed solar photovoltaic increased 11% in Canada and 38.4% in the United States.

(NCRAN, 2019) (EIA via Statista, 2021)

Capacity sourced from wind is increasing

72% in US

From 2018 to 2020, electricity capacity sourced from wind has increased 72% in the United States.

(Wood Mackenzie, SEIA via Statista, 2021)

Rising Speed of Distributed Energy Resources

Number of electric vehicles on the road

7.8 million in China | **2.1 million** in US

As of 2021, China has 7.8 milion EVs on the road, followed by the United States with 2.1 million EVs on the road.

(IEA, 2022)

Size of microgrid market

14.37 billion in 2021 → **43.93 billion** in 2028

In 2021, the global microgrid market size is about 14.37 billion, and it is projected to reach 43.93 billion in 2028.

(Precision Business Insights via Statista, 2022)

Risk of Reliable Infrastructure

Aging infrastructure and extreme weather patterns threaten the reliability of the electricity grid

4.33 million
Texas customers experienced power outage

On February 16, 2021, winter storm Uri caused power outage to about 4.33 million Texas customers, and about 687,100 customers were still without power two days later.

(poweroutage.us via Statista, 2021)

Electrification Evolution

Electricity generation must increase

2.5 x by 2050

In IEA's net zero pathway, electricity accounts for about 50% of total energy consumption by 2050. Achieving this will require total electricity generation to increase over 2.5 times by 2050. Major effort is needed to reduce carbon emissions in the transportation and industrial sectors.

(IEA, 2021)

Automate
Control
Respond
Detect
Monitor

Smart Grid Technologies & Applications to Mitigate Risks

AMI Advanced Metering Infrastructure

DA Distribution Automation

ADMS Advanced Distribution Management System

DERMS Distributed Energy Resource Management System

& OTHERS

Intermittency of Renewable Energy Sources

Variability of Distributed Load

Unpredictable Environmental Factors

Increased Demand for Electricity

Energy transition with an unreversible paradigm shift from the customer lens…

Eskom

Old paradigm

Deliver unidirectional power from utilities to customers

Dispatch meter reader and connect/ disconnect

Bill once per month with a simple rate structure

Access call center agent services

Smart grid

New paradigm

Bidirectional electricity and information exchange between utilities and customers
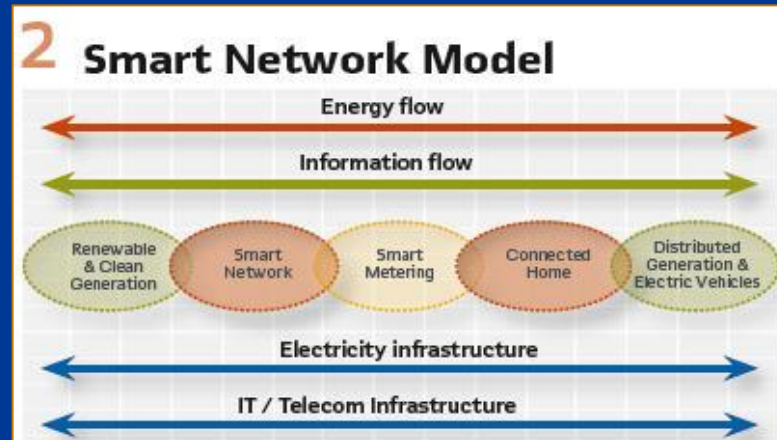
Real-time meter reads and remote connect/ disconnect

Various billing rate plans with more reading frequency

Customer omnichannel platform "Amazon-like" services

INTEGRATION

SOCIAL MEDIA
ICON PACK

1st — Mechanization, water power, steam power
2nd — Mass production, assembly line, electricity
3rd — Computer and automation
4th — Cyber Physical Systems

2 **Smart Network Model**
Energy flow
Information flow
Renewable & Clean Generation — Smart Network — Smart Metering — Connected Home — Distributed Generation & Electric Vehicles
Electricity infrastructure
IT / Telecom Infrastructure

INDUSTRY 4.0
INTERNET OF THINGS

4

Bi-Directional Energy and Information Flow…

- Historically, energy flow was uni-directional – from Distributor to Customer.

- The 'Smart Meter" requires both energy and information flow – needs IP connectivity and creates a Prosumer.

- The complex "Smart Grid" requires bi-directional energy and information flow – built on a strong IP foundation.

- Bi-directional energy flow enables energy trading and optimisation for through the DSO and DET.

- The electricity distributor to adopt a new operating and business model - IP network enables the participation between the prosumer and the distributor.

- Resultant opportunity for Value-Added Services (VAS).
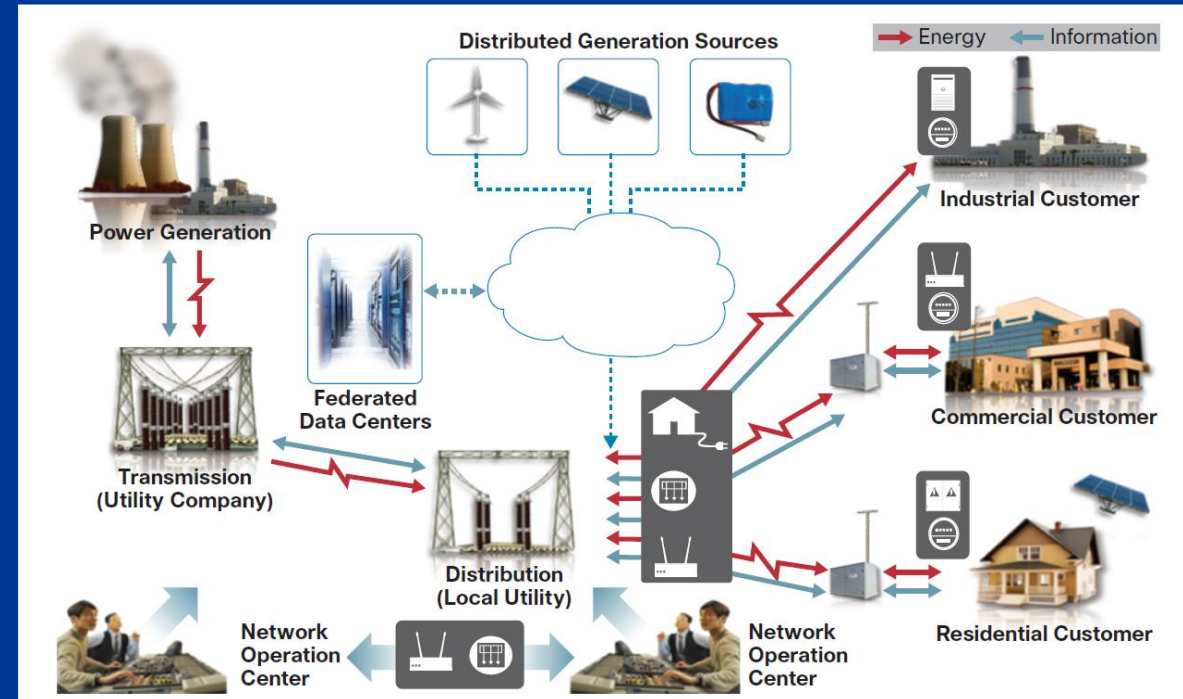
Smart Grid Framework – 3 Step Approach…

Step 1: The foundation for establishing the Smart Grid capabilities is the adoption of an IP Communications fabric, as it provides connectivity and integration between the cyber physical systems:

Step 2: Creating visibility and enabling control of:

- network capacity (i.e., supply and demand optimization)
- power quality and reliability
- load efficiency
- operational efficiency
- clean technology integration

Step 3: Defining Functionality:

Leads to optimisation of the operating and business model which allows an interactive grid that is capable of self-healing, self-balancing, self-actualisation & possibly self-optimisation.
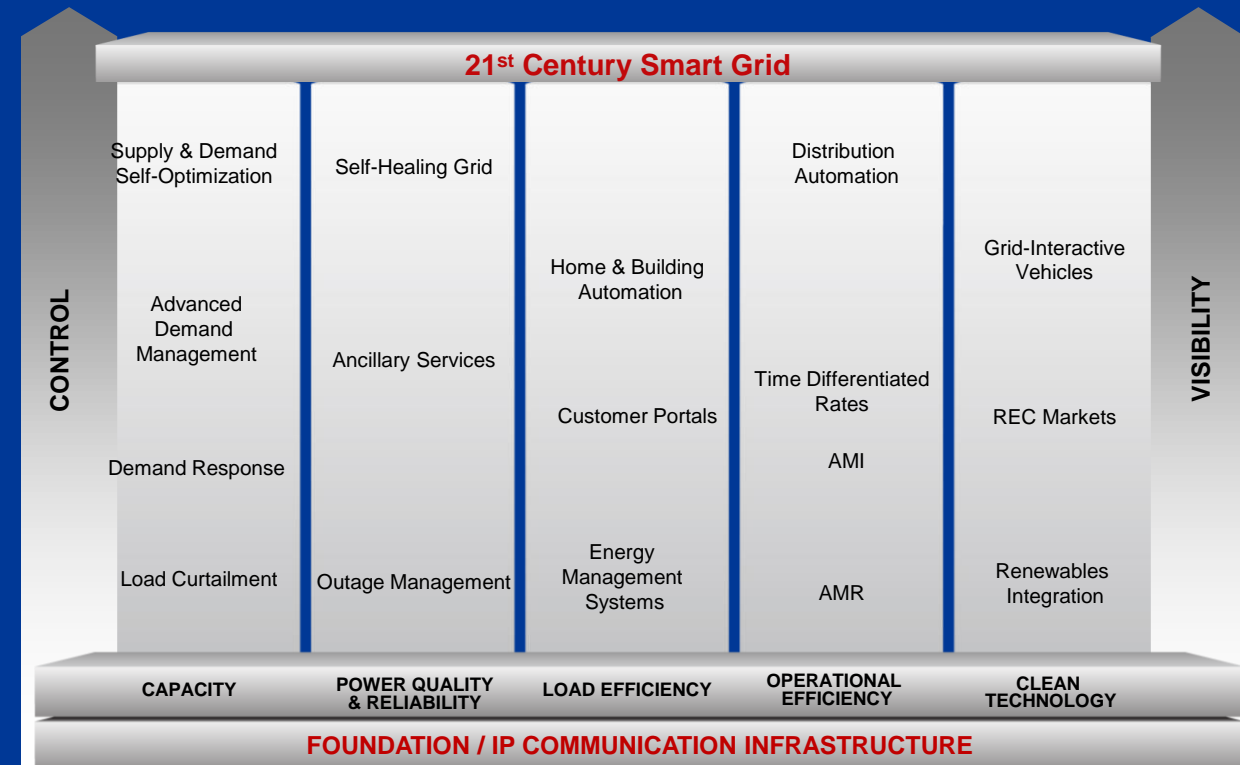
ICT Technology Architecture Framework…

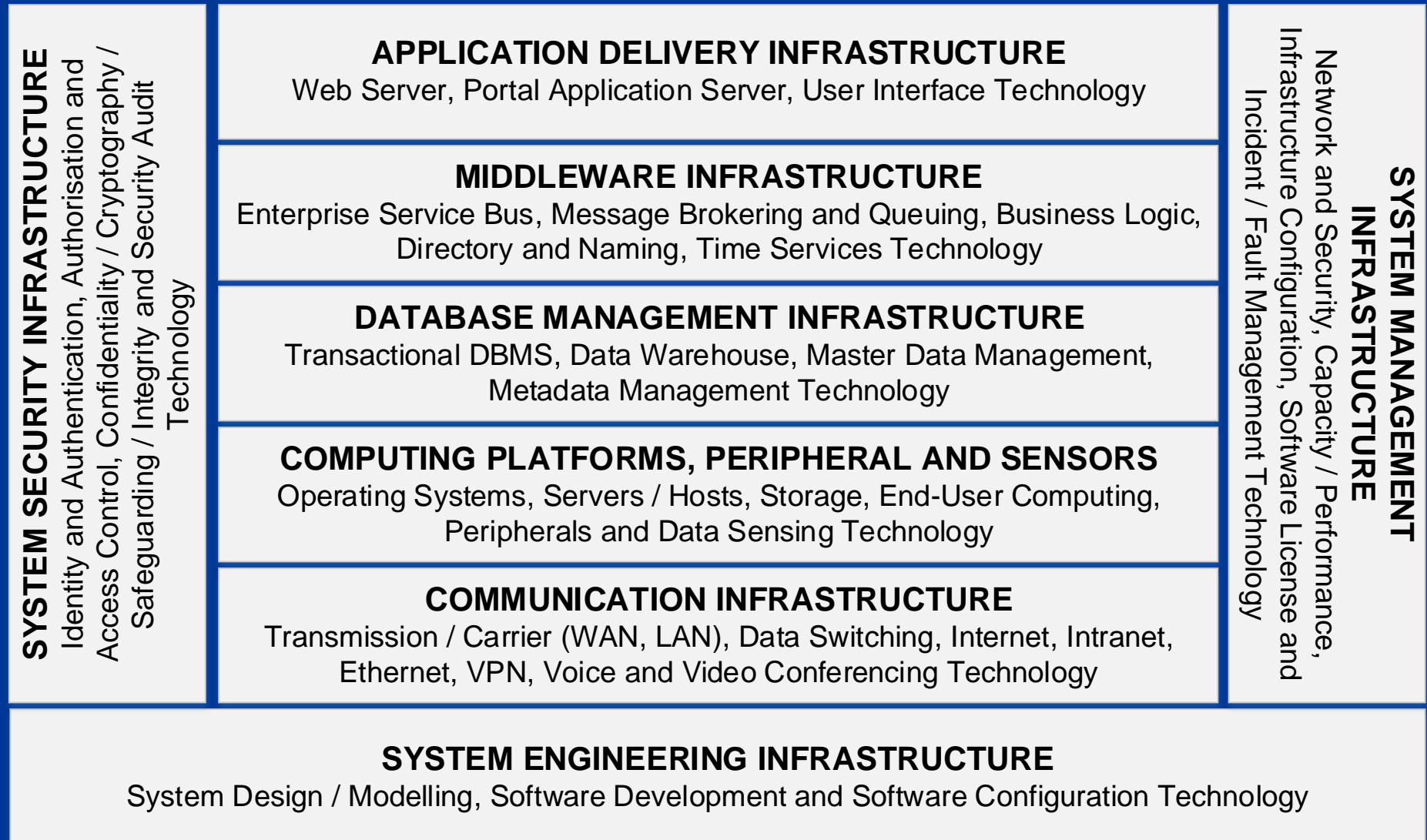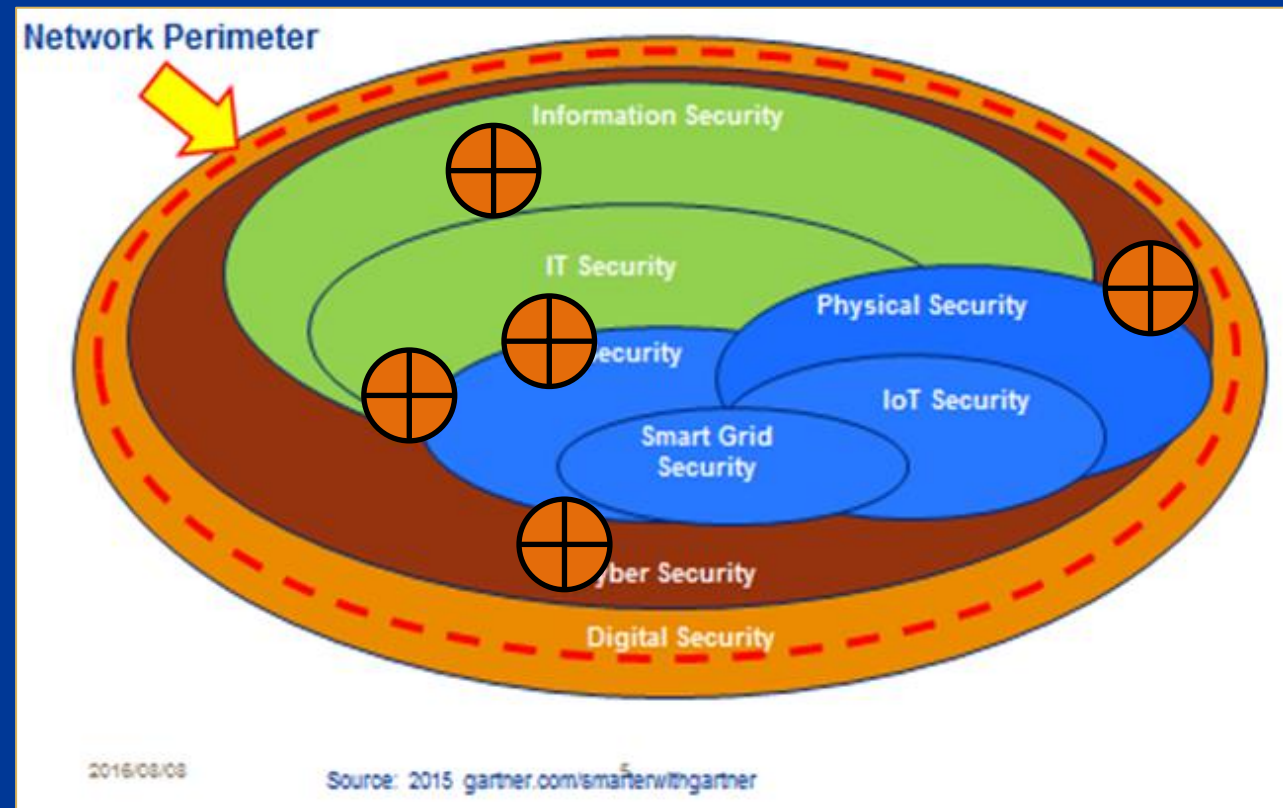The adoption of an ICT Technology framework is critical to the establishment of the DSO/ DET.

SYSTEM SECURITY INFRASTRUCTURE
Identity and Authentication, Authorisation and Access Control, Confidentiality / Cryptography / Safeguarding / Integrity and Security Audit Technology

APPLICATION DELIVERY INFRASTRUCTURE
Web Server, Portal Application Server, User Interface Technology

MIDDLEWARE INFRASTRUCTURE
Enterprise Service Bus, Message Brokering and Queuing, Business Logic, Directory and Naming, Time Services Technology

DATABASE MANAGEMENT INFRASTRUCTURE
Transactional DBMS, Data Warehouse, Master Data Management, Metadata Management Technology

COMPUTING PLATFORMS, PERIPHERAL AND SENSORS
Operating Systems, Servers / Hosts, Storage, End-User Computing, Peripherals and Data Sensing Technology

COMMUNICATION INFRASTRUCTURE
Transmission / Carrier (WAN, LAN), Data Switching, Internet, Intranet, Ethernet, VPN, Voice and Video Conferencing Technology

SYSTEM MANAGEMENT INFRASTRUCTURE
Network and Security, Capacity / Performance, Infrastructure Configuration, Software License and Incident / Fault Management Technology

SYSTEM ENGINEERING INFRASTRUCTURE
System Design / Modelling, Software Development and Software Configuration Technology

Reference: Government-Wide Enterprise Architecture Framework (GWEA)

Cyber Security Framework…

- The 4th industrial revolution necessitates the need for cyber physical system integration.

- This exposes the Operational Technology (OT) landscape to the internet and potentially increases the risk for cyber-attacks.

- Risk mitigation steps against adverse cyber-attacks against are:
    1. Cyber Threat Intelligence (TI) capabilities and tools.
    2. Cyber Threat Intelligence sensors.
    3. Cyber collaboration partners.
    4. Compliance to regulatory standards.

THE NEW SECURITY MODEL

BEFORE   DURING   AFTER

Network Perimeter

Information Security

IT Security

Physical Security

IoT Security

Smart Grid Security

Cyber Security

Digital Security

2016/08/08

Source: 2015 gartner.com/smarterwithgartner

Reference: Gartner (2015)

Thank you