Grid Controller of India Limited

SCADA as Critical Grid Infrastructure - Operational Benefits and the relevance of indigenization

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NRLDC, Grid-India)

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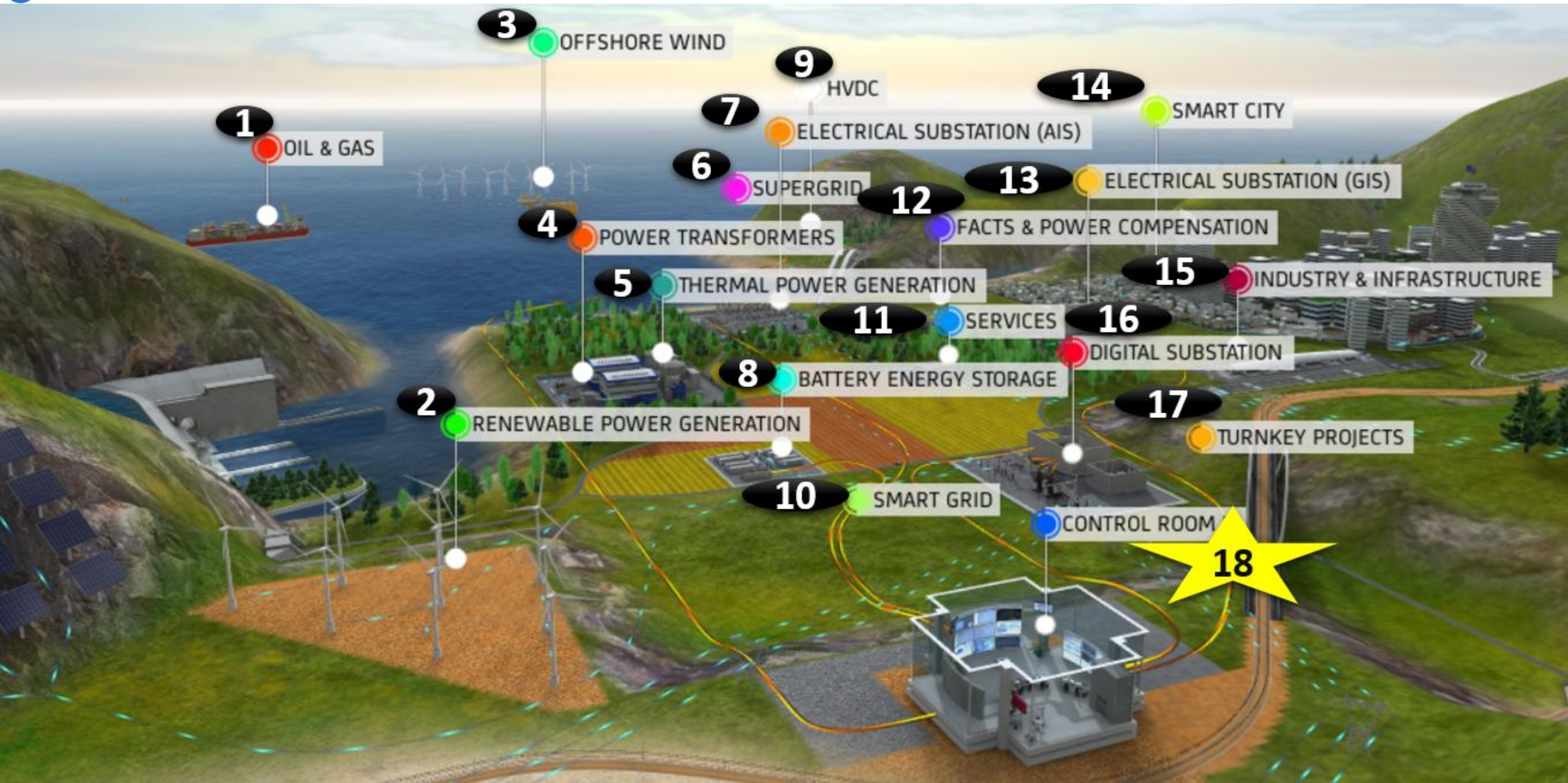
Energy Sector Scenario – Major Areas



Rapid Expansion in Indian Electricity Grid

Installed Generation Capacity – 5,51,994 MW

Transmission Lines –

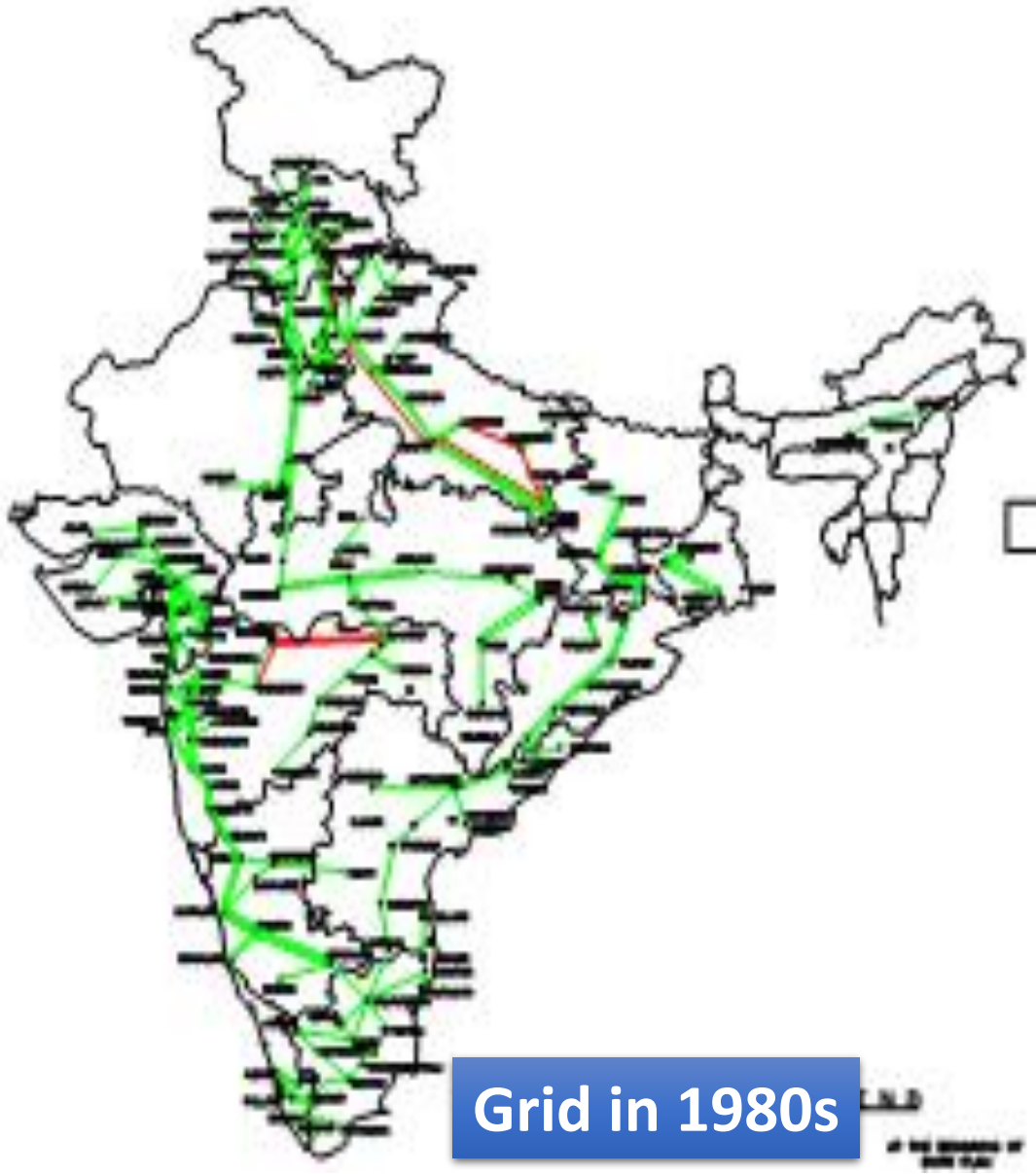
+/- 800kV HVDC: 9,655 ckm

+/- 500kV HVDC: 9,432 ckm

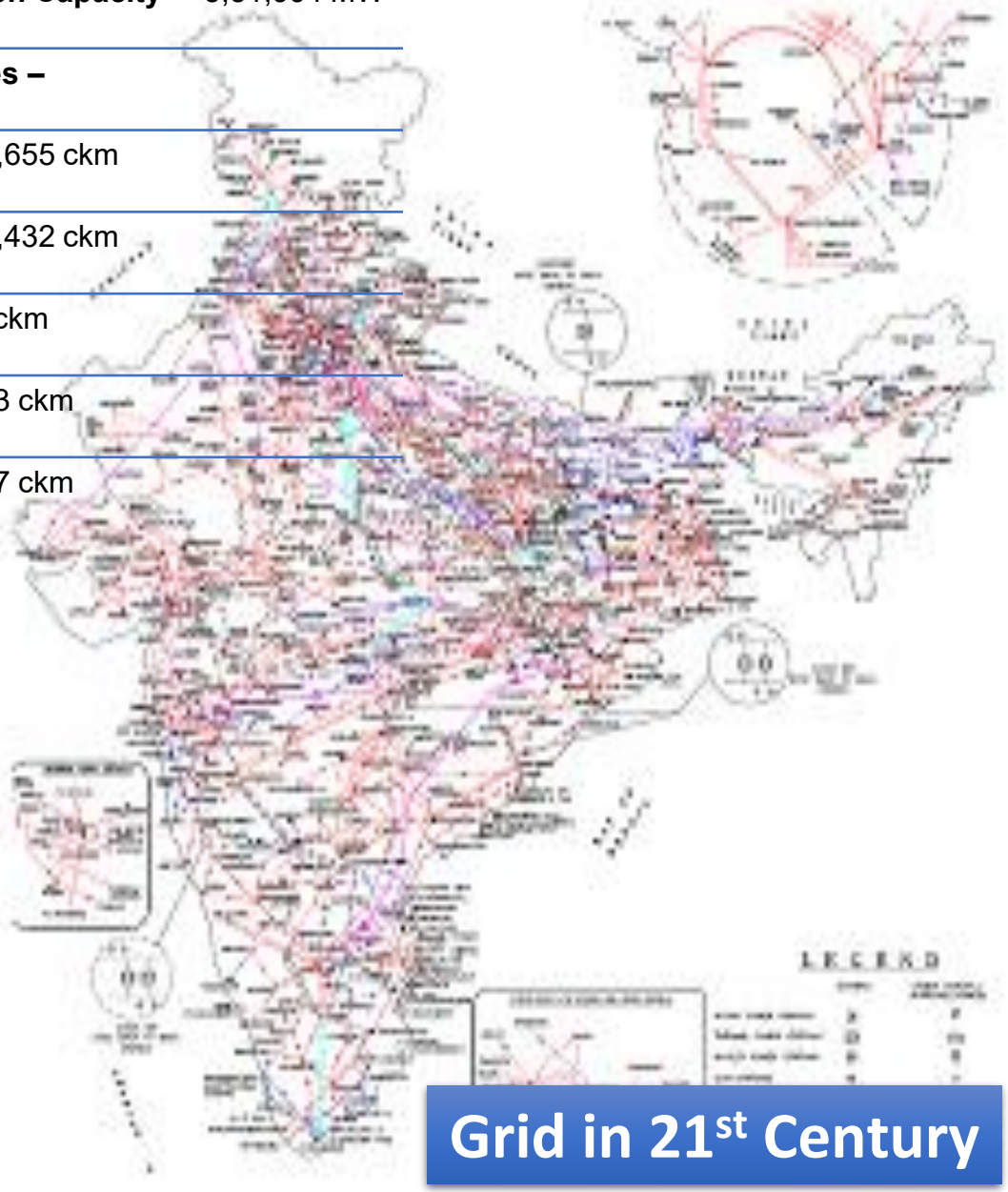
765kV AC: 63,479 ckm

400kV AC: 2,11,613 ckm

220kV AC: 2,16,127 ckm

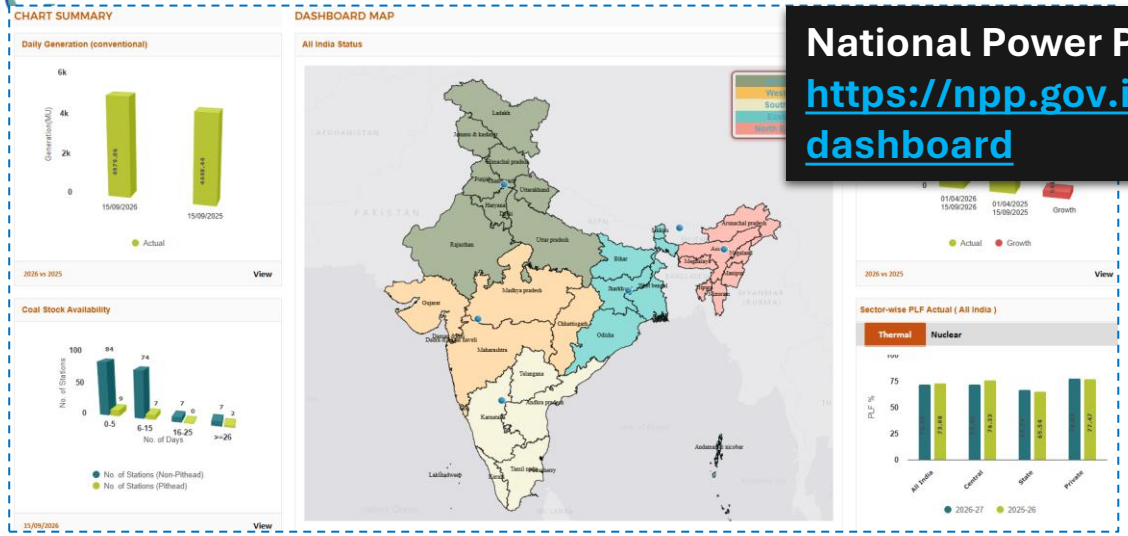


Grid in 1980s

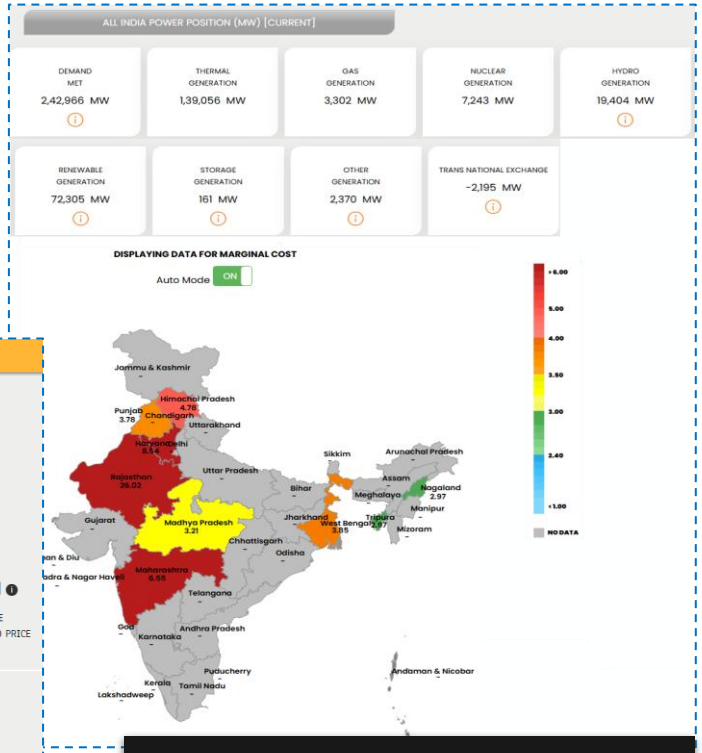


Grid in 21st Century

Power System Data available in Public Domain – Web Portals

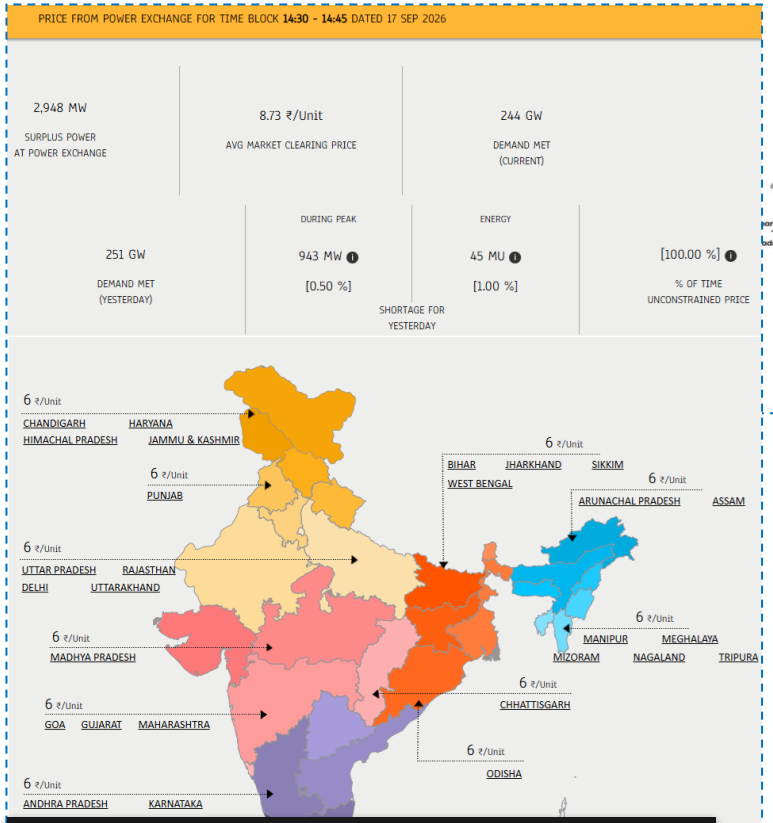


National Power Portal (NPP) by CEA: https://npp.gov.in/dashBoard/cp-map-dashboard



MERIT Portal by Grid-India: https://npp.gov.in/dashBoard/cp-map-dashboard

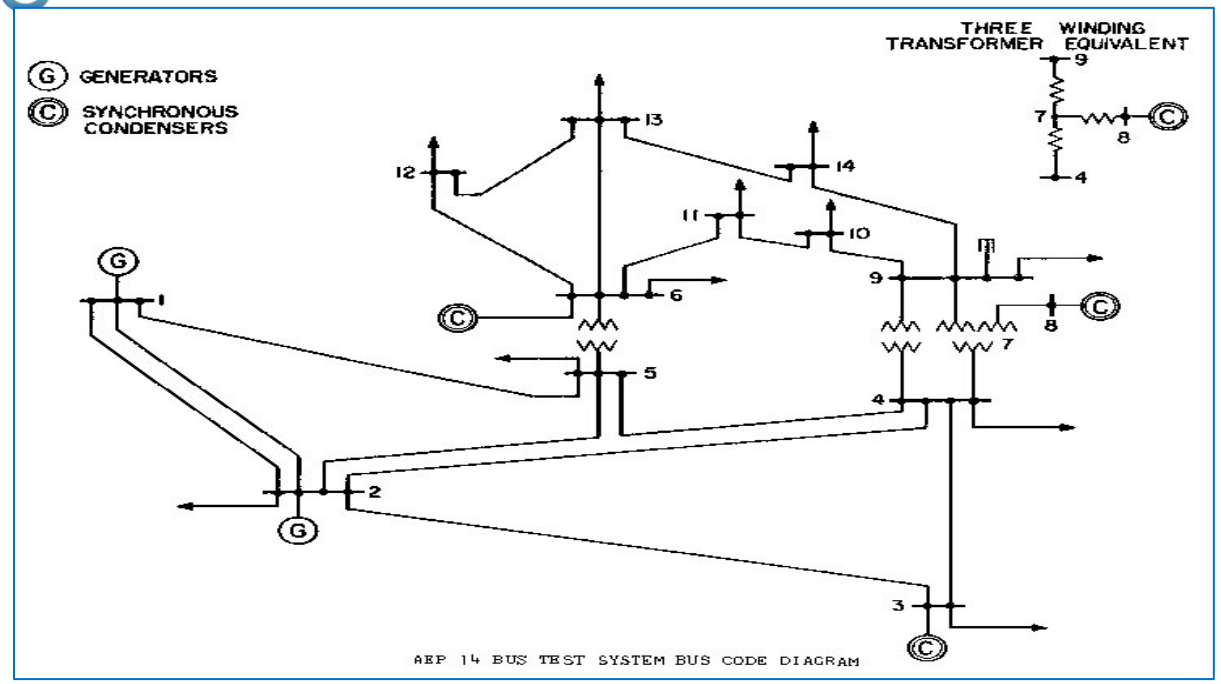
India Climate & Energy Dashboard by Niti Aayog: https://www.iced.niti.gov.in/



Vidyut Pravah Portal by Grid-India: https://vidyutpravah.in/

..... Several Other Portals

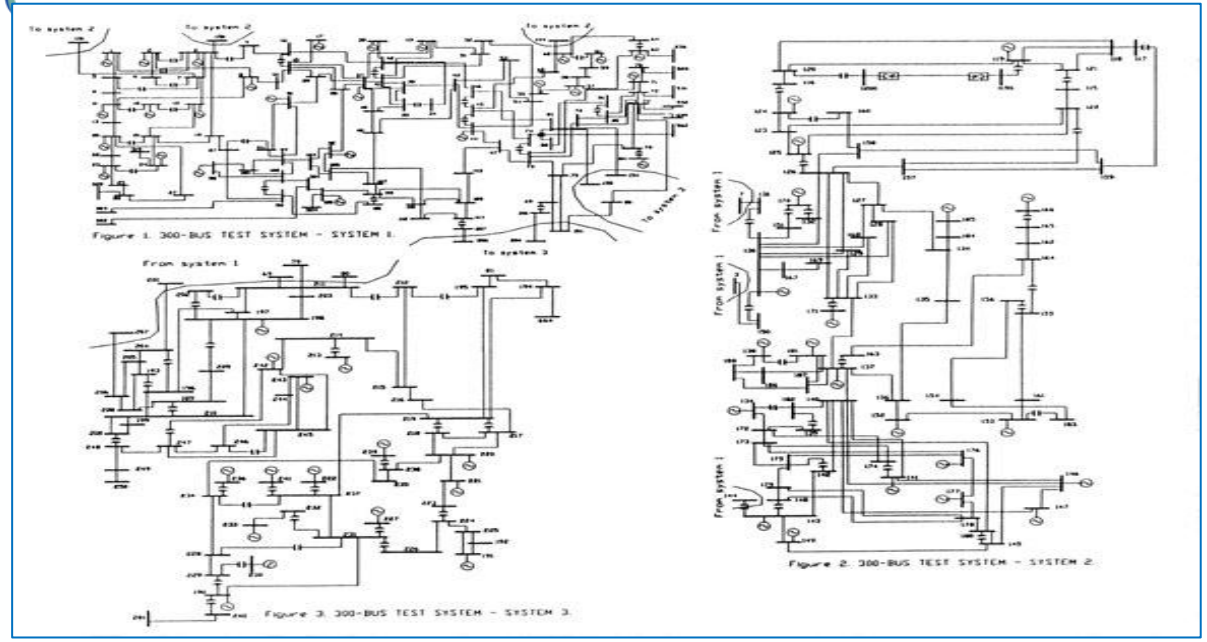
Earlier – Simpler Networks



- Use of Legacy DA System
- Simpler tools (AC Net Ana)
- Slower response – acceptable
- Accuracy – Ok
- Only overload analysis
- Storage - Limited data

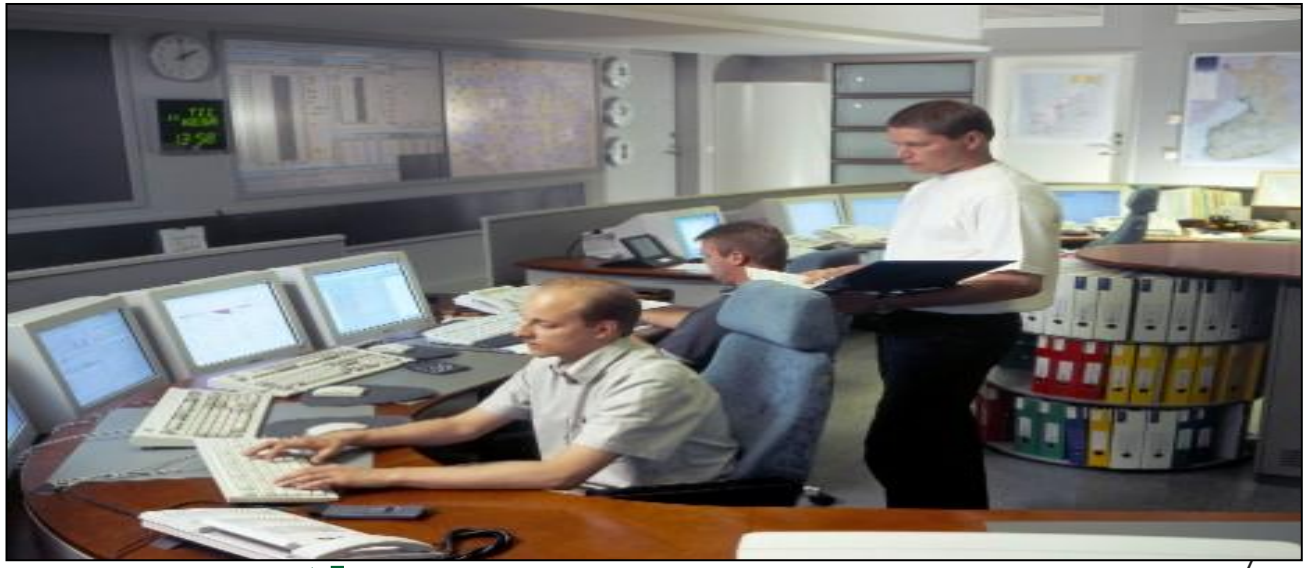
- Small Size Systems
- Simpler Analysis
- Systems not so heavily loaded

Now – Complex Networks



- Faster and reliable data acquisition
- Better Analytical tools (Dyn. Ana.)
- Accuracy – Ok
- Storage -- Huge data

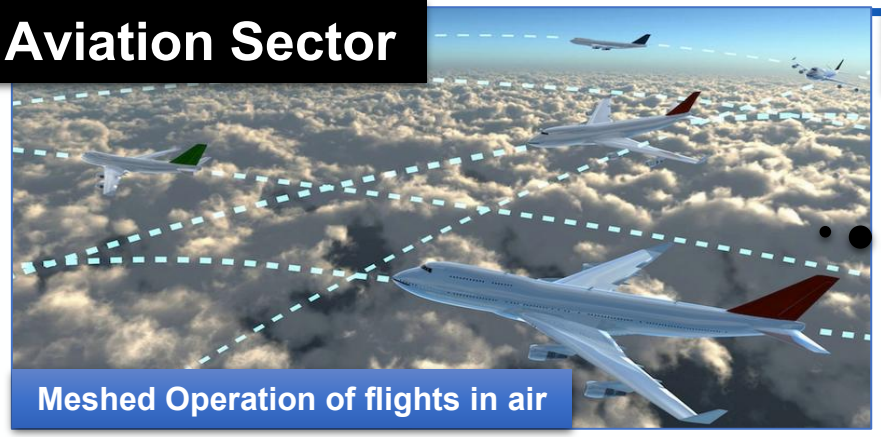
- Large and Complex Systems
- Heavily loaded systems
- Close to limits
- More complex, fast and accurate analysis



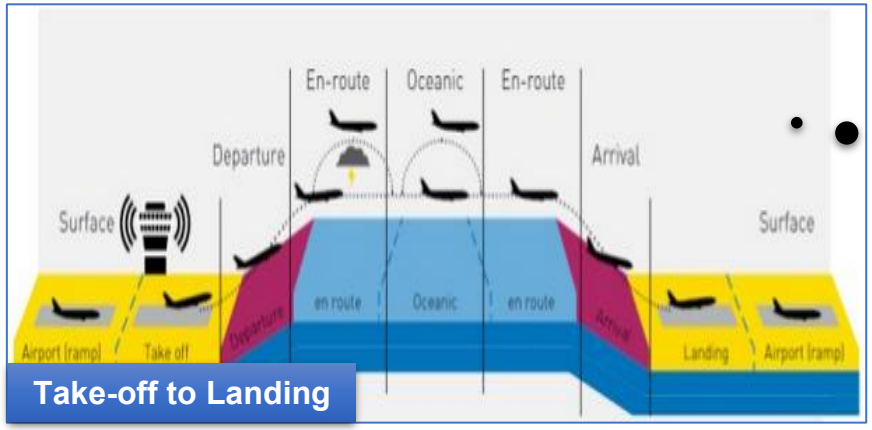
Automation for better grid operations

Managing Power System Network – Through Control Centres

Aviation Sector



Meshed Operation of flights in air



Take-off to Landing

Air Traffic Control Room

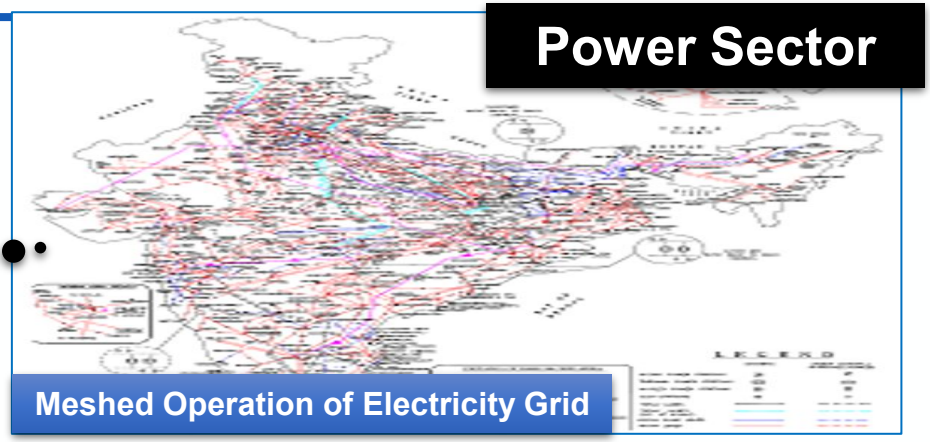
Analogous Operations

Mission Critical
Complex Operations

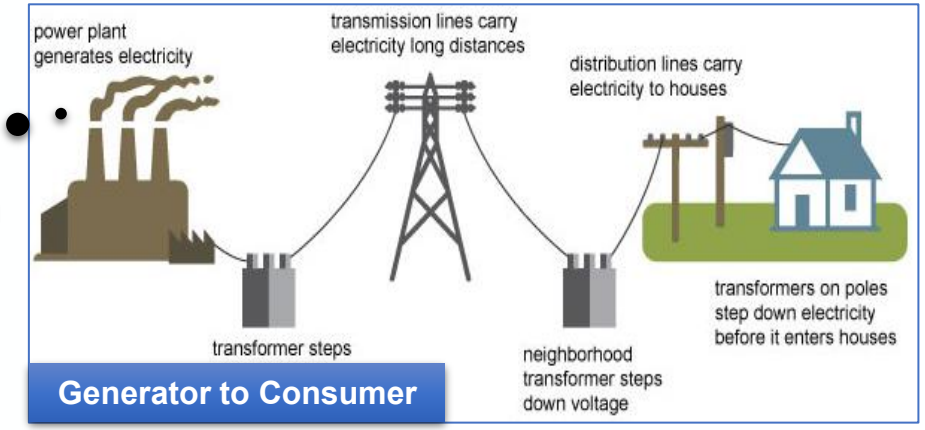
Beginning till End
Coordination

State-of-the-Art Control
Centres of National
Importance
(with specialized
hardware/software
systems)

Power Sector



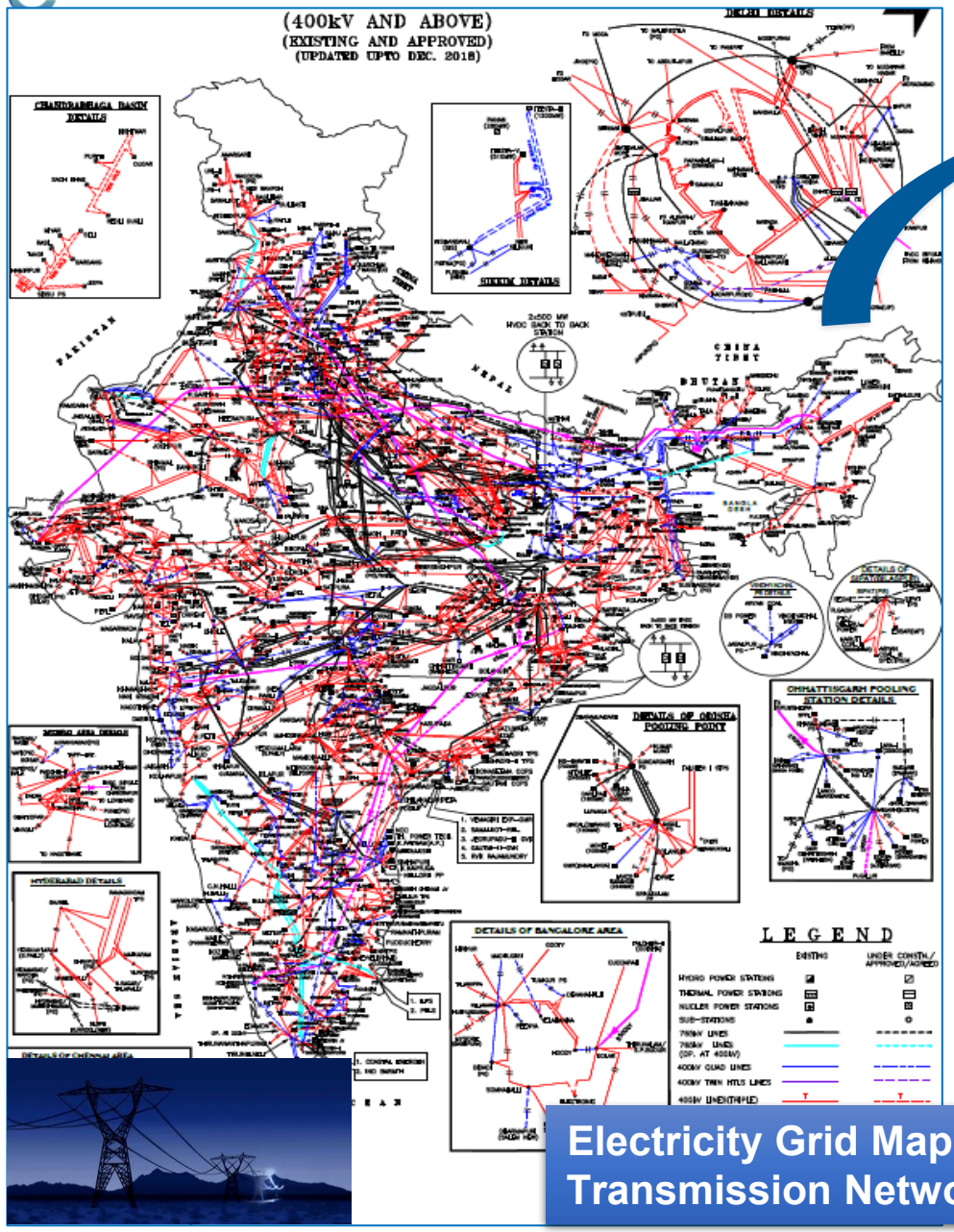
Meshed Operation of Electricity Grid



Generator to Consumer

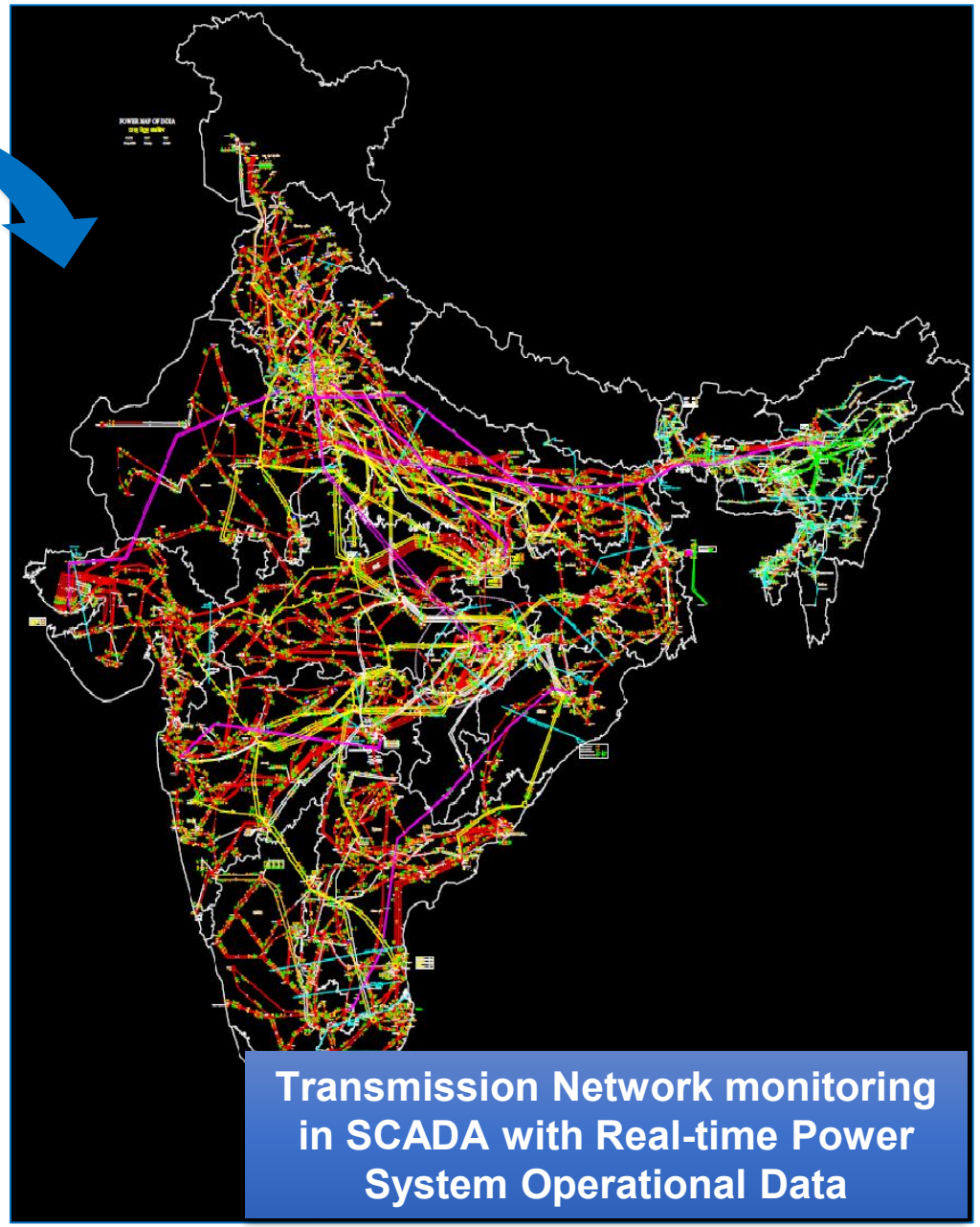
Load Despatch Centres

Managing Power System Network – Monitoring through SCADA



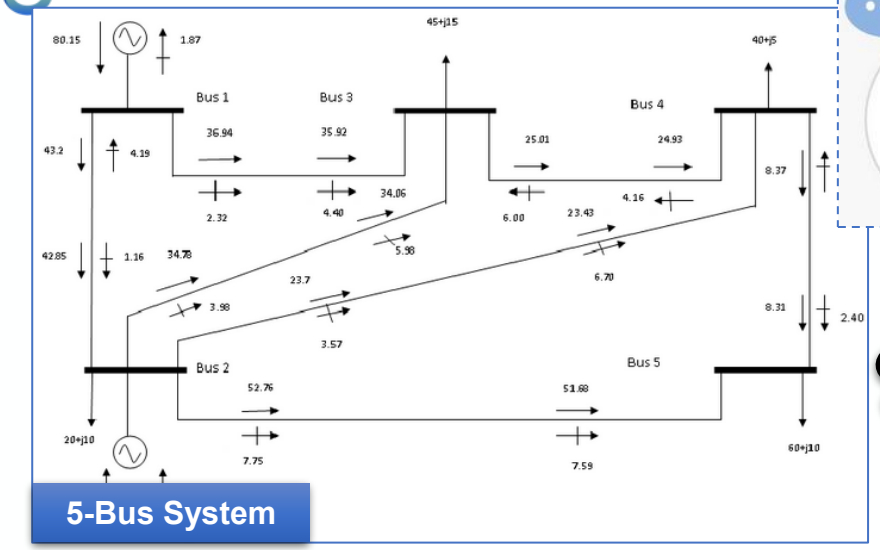
Electricity Grid Map (or Transmission Network)

Real-time Data Acquisition from Substations to Control Centre



Transmission Network monitoring in SCADA with Real-time Power System Operational Data

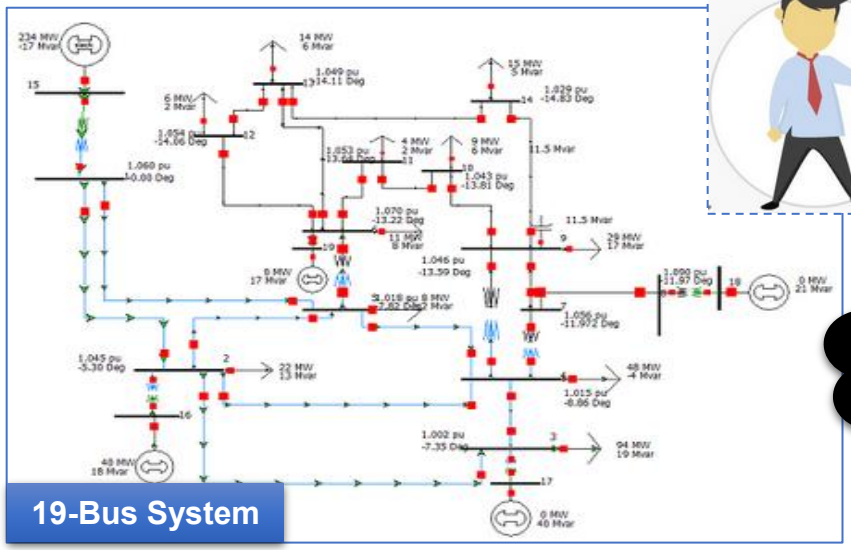
Managing Power System Network – Decision Support using EMS



5-Bus System

Grid Operator

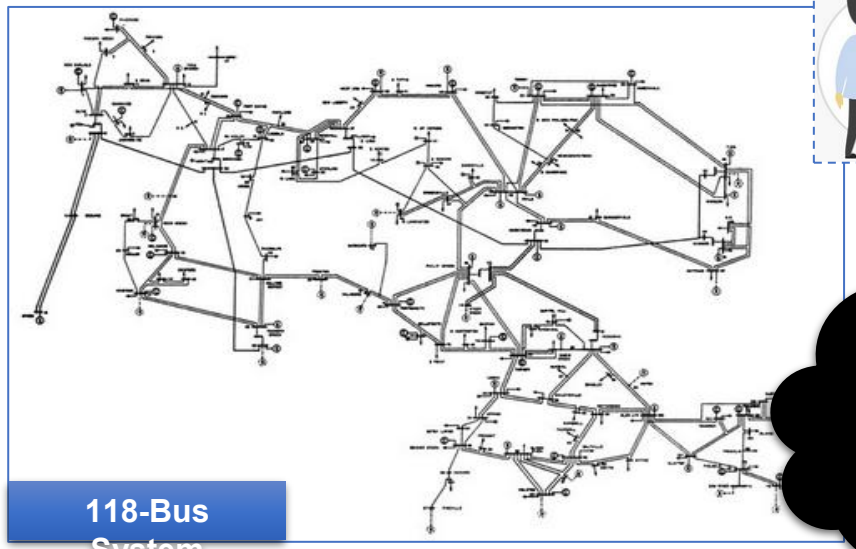
Can easily manage



19-Bus System

Grid Operator

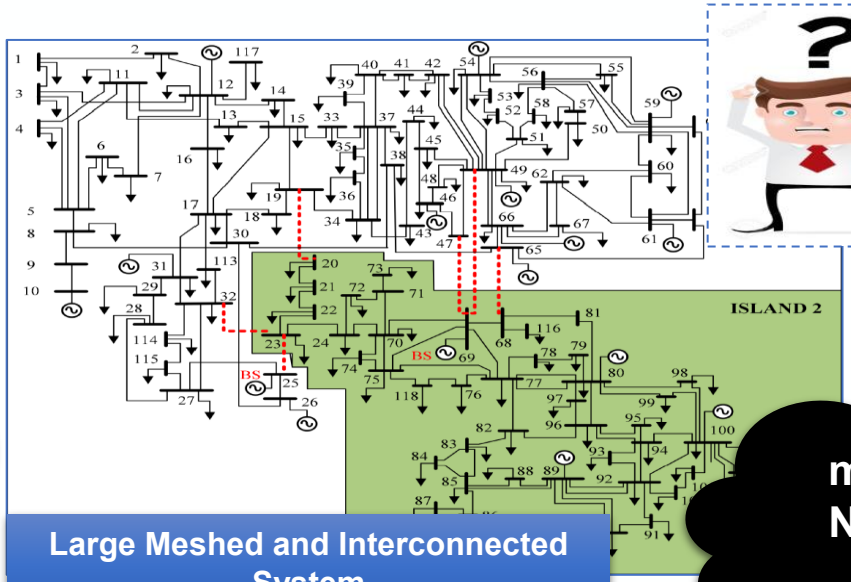
Can easily manage using my experience



118-Bus System

Grid Operator

Can manage using some simple power system software tools

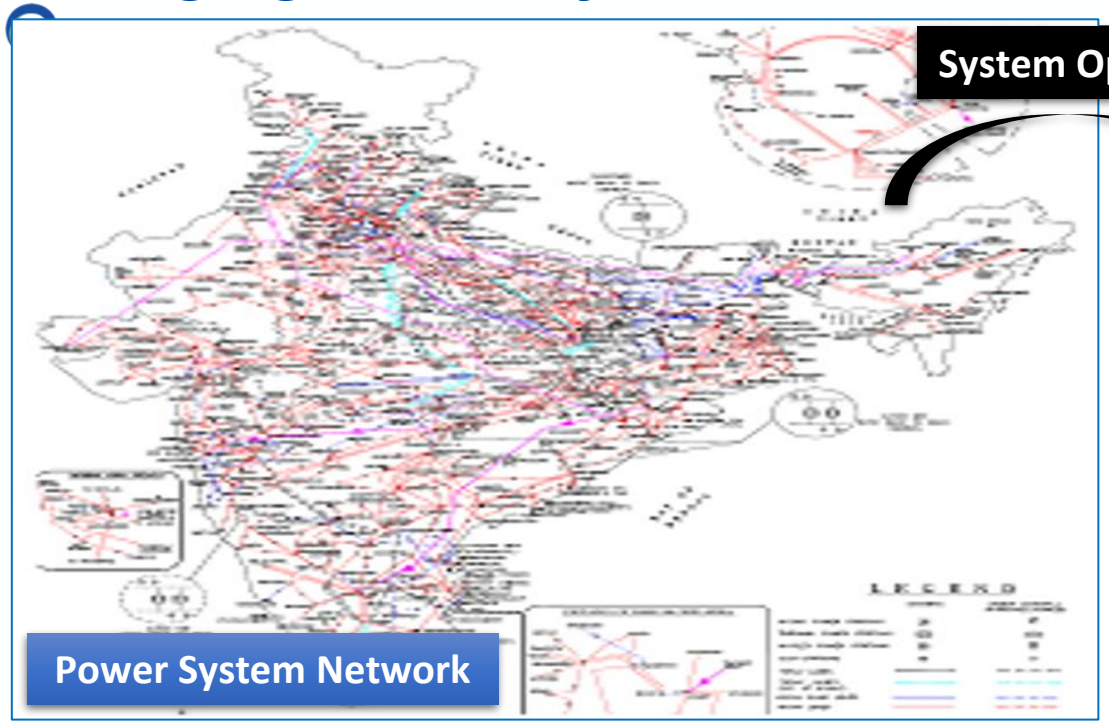


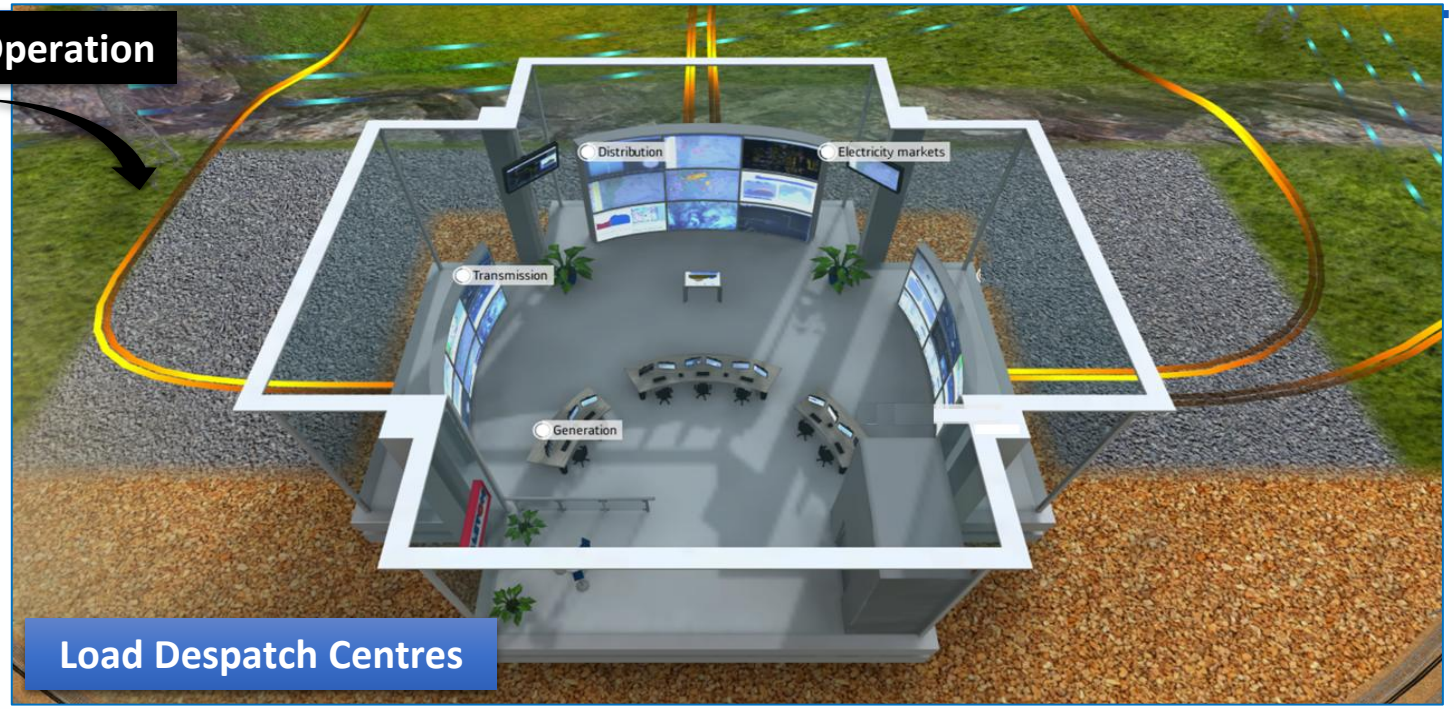
Large Meshed and Interconnected System

Grid Operator

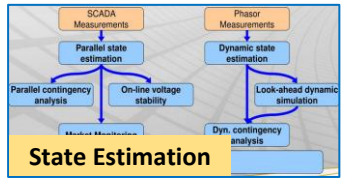
Cannot manage….. Need some decision support tools

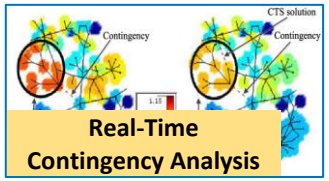
Managing Power System Network – Decision Support Tools accompanying SCADA

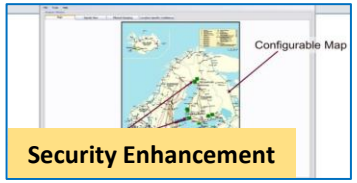


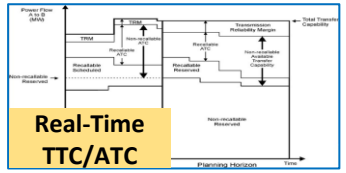


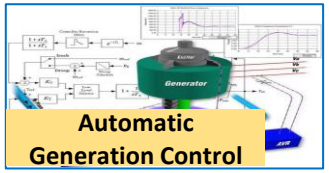
- What if an element trips
- How much power flow to allow in this corridor
- What control to operate to maintain voltage within limits
- What control to operate to maintain line flows within limits
- Where to change load/generation to reduce overloading
- What is optimum generation dispatch to bring economy
- How to maintain frequency within the prescribed band
- ……. Other considerations

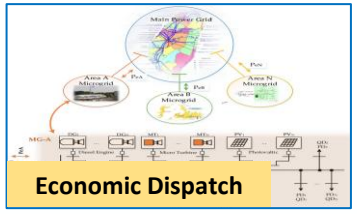






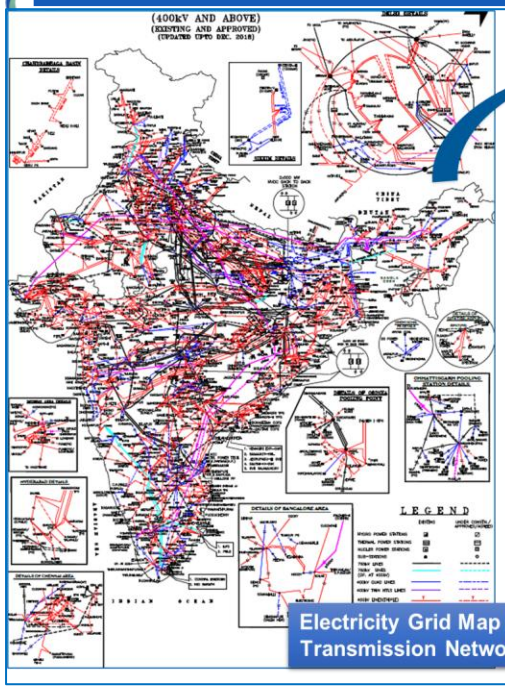






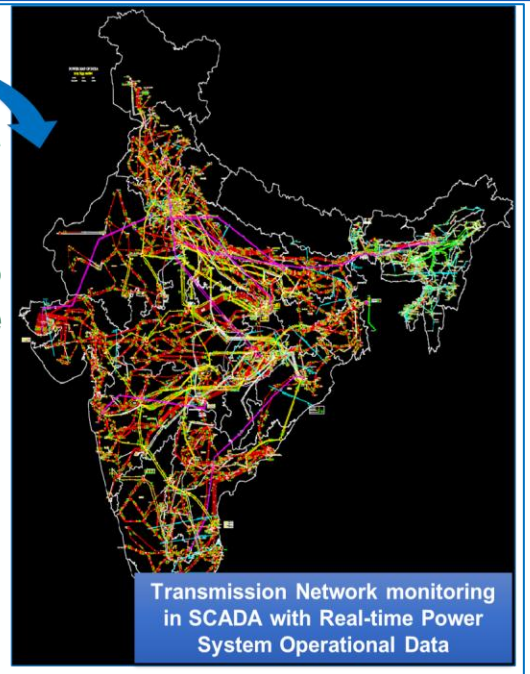
EMS applications act as Decision Support Tools

Managing Power System Network – SCADA & EMS

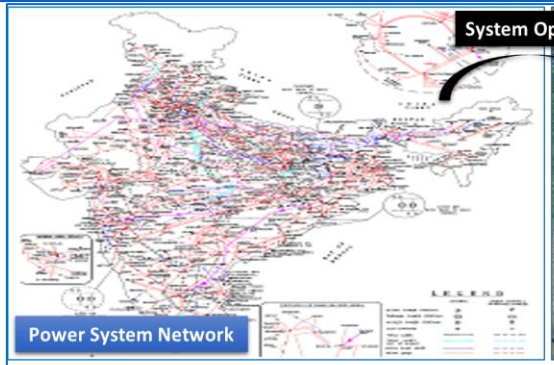


Electricity Grid Map (or Transmission Network)

Real-time Data Acquisition from Substations to Control Centre



Transmission Network monitoring in SCADA with Real-time Power System Operational Data



Power System Network

System Operation

Load Despatch Centres

What if an element trips

How much power flow to allow in this corridor

What control to operate to maintain voltage within limits

What control to operate to maintain line flows within limits

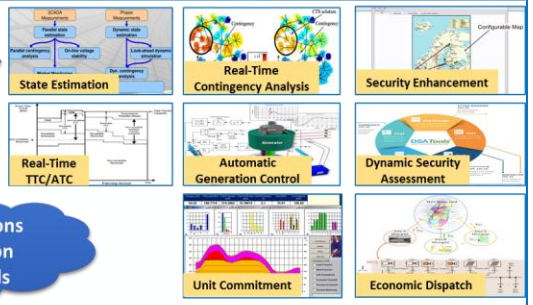
Where to change load/generation to reduce overloading

What is optimum generation dispatch to bring economy

How to maintain frequency within the prescribed band

..... Other considerations

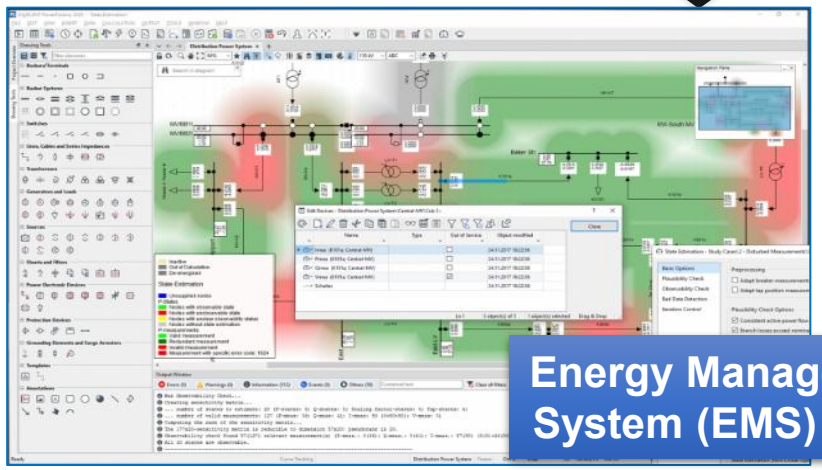
EMS applications act as Decision Support Tools



Monitoring

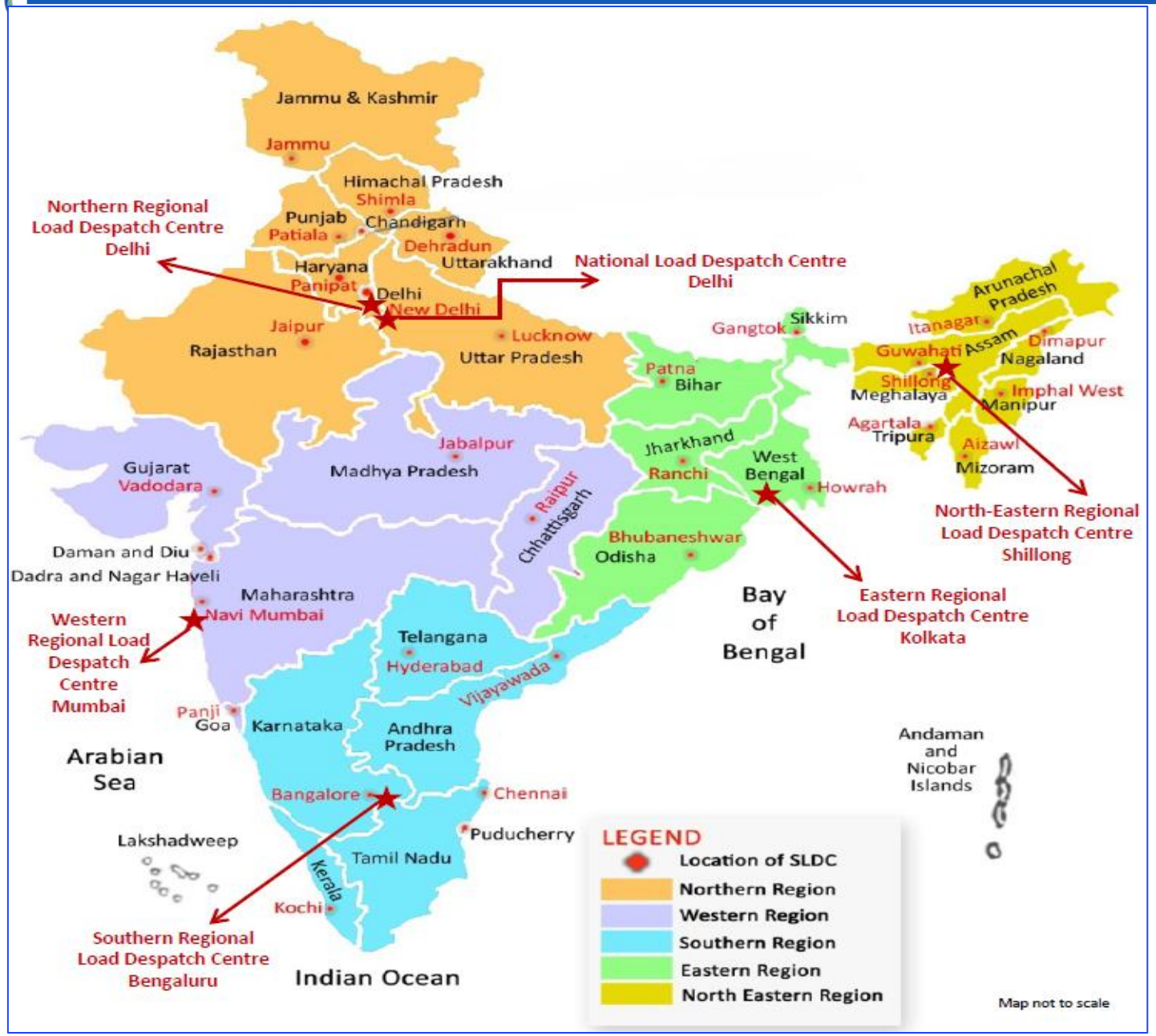
Supervisory Control & Data Acquisition System

Decision Support



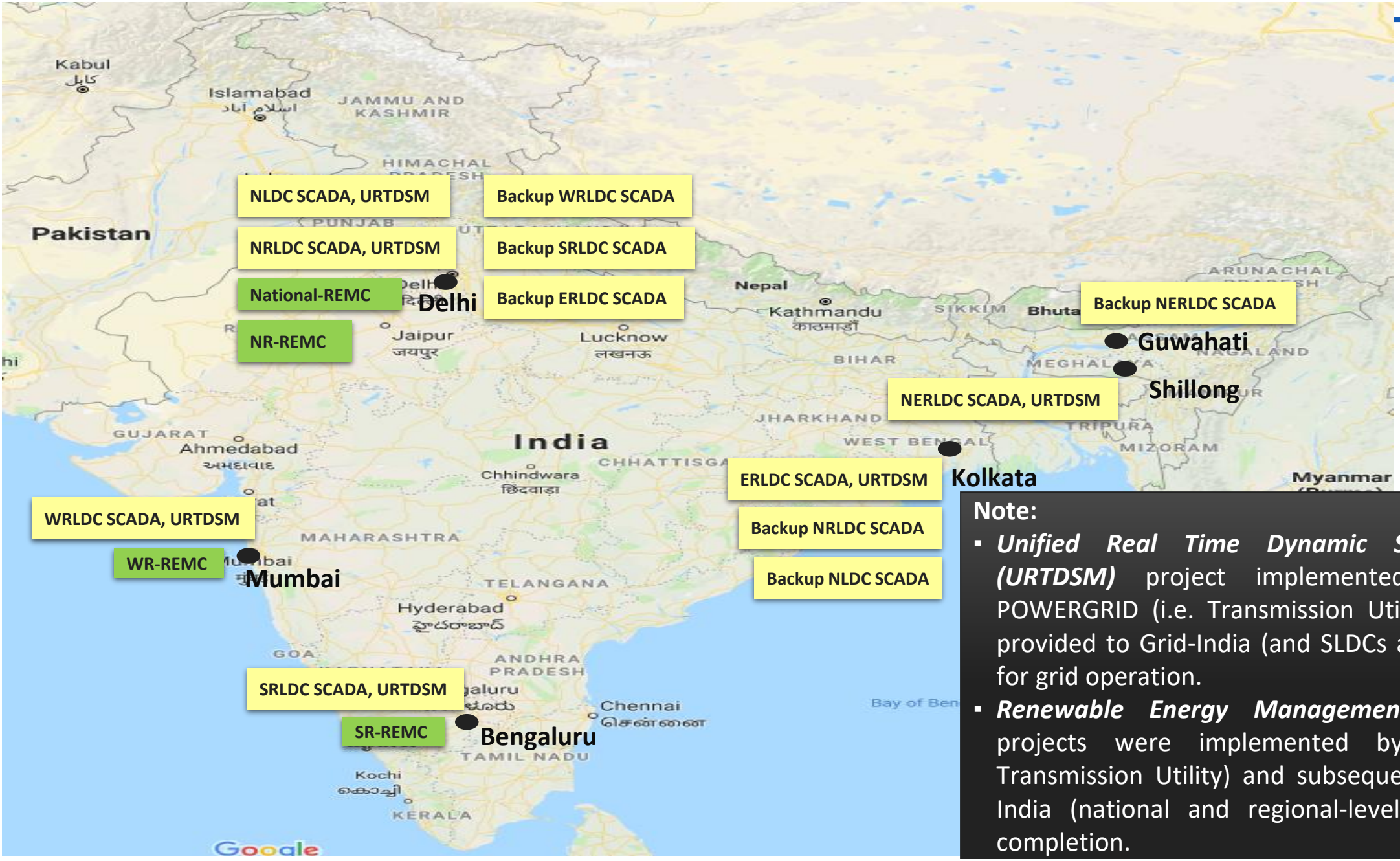
Energy Management System (EMS) Tools

Load Despatch Centres of India – With SCADA/EMS Systems



- ❑1 National Load Despatch Centre (NLDC)
- ❑5 Regional Load Despatch Centres (RLDCs)
- ❑35 State Load Despatch Centres (SLDCs)
- ❑11 Renewable Energy Management Centres (REMCs)

Load Despatch Centres of India – SCADA/EMS Systems (Under Grid-India)



Note:

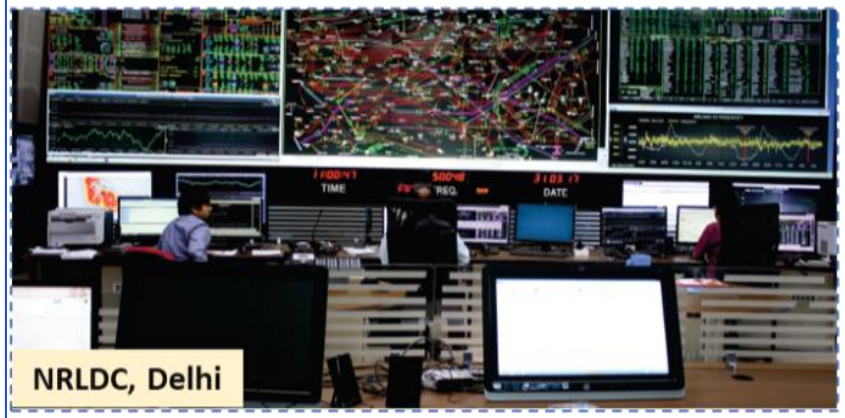
- ***Unified Real Time Dynamic State Measurement (URTDSM)*** project implemented and owned by POWERGRID (i.e. Transmission Utility) and the data is provided to Grid-India (and SLDCs also) as an obligation for grid operation.
- ***Renewable Energy Management Centres (REMCs)*** projects were implemented by POWERGRID (i.e. Transmission Utility) and subsequently owned by Grid-India (national and regional-level REMCs only) after completion.

Load Despatch Centres of India – Transition with Time

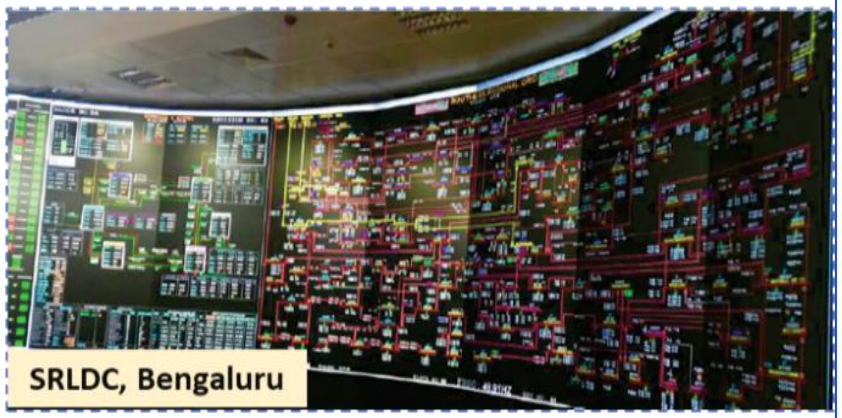
RLDCs in 1980-2000 period

ERLDC, Kolkata

NERLDC, Shillong

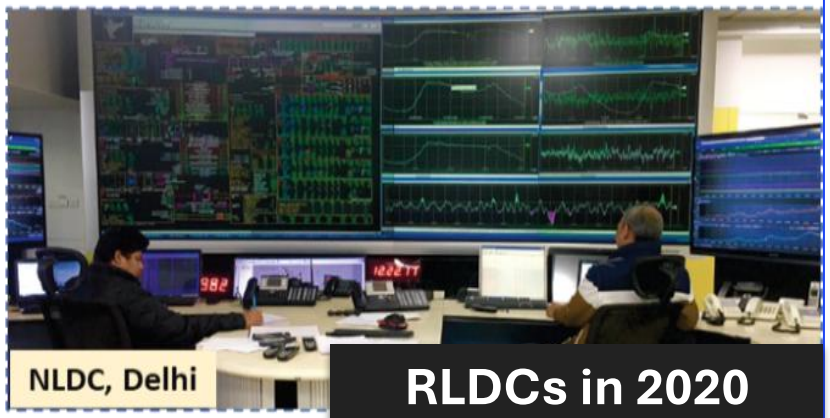


NRLDC, Delhi



SRLDC, Bengaluru

WRLDC, Mumbai



NLDC, Delhi

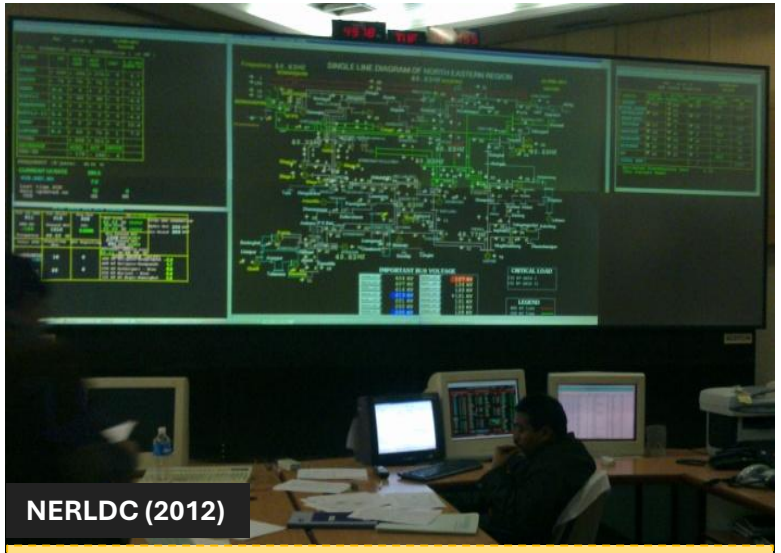
RLDCs in 2020

Load Despatch Centres of India – Control Rooms of Grid-India

National Load Despatch Centre, Delhi

Northern Regional Load Despatch Centre, Delhi

Southern Regional Load Despatch Centre, Bengaluru



North-eastern Regional Load Despatch Centre, Shillong

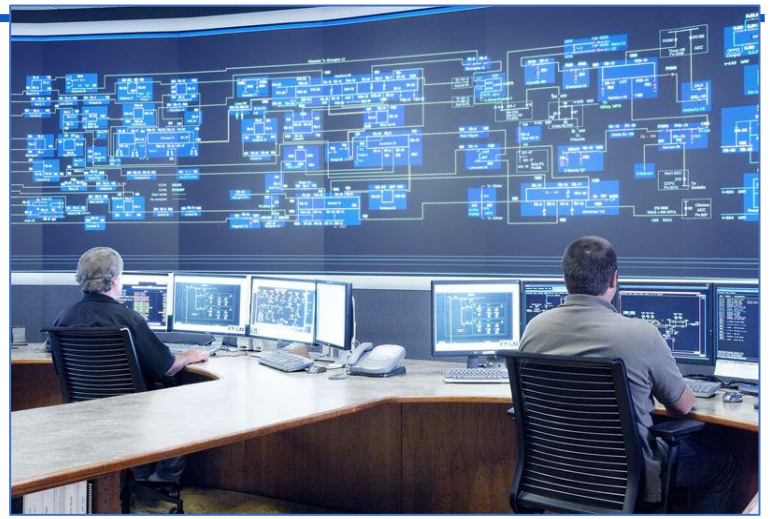
Western Regional Load Despatch Centre, Mumbai

Eastern Regional Load Despatch Centre, Kolkata

Load Despatch Centres – International Glimpses

Spain

Bhutan



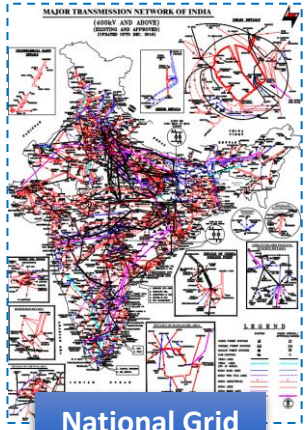
France

New York

United Kingdom

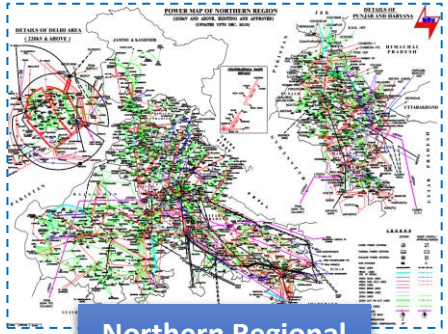
California

Load Despatch Centres of India – National/Regional Level

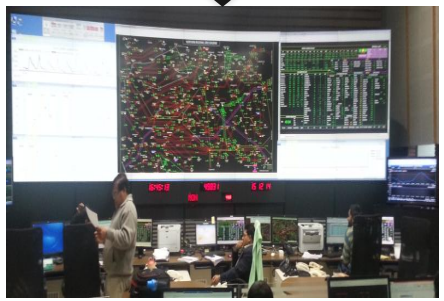


National Grid

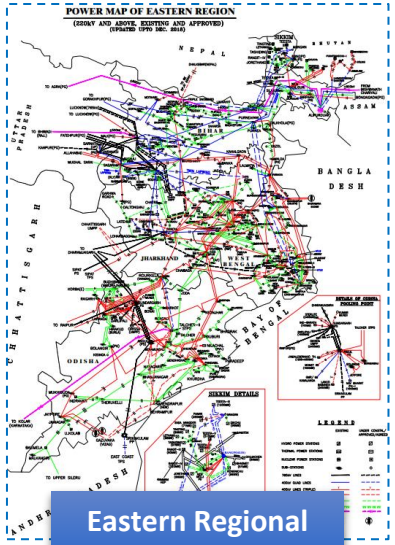
NLDC



Northern Regional Grid

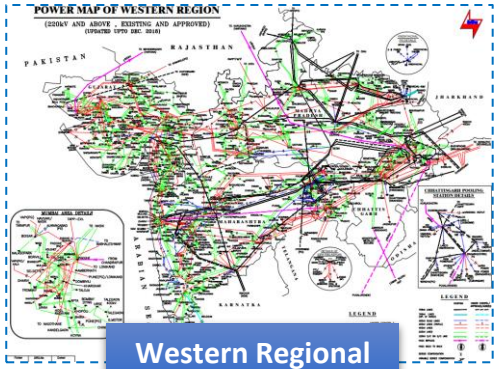


NRLDC



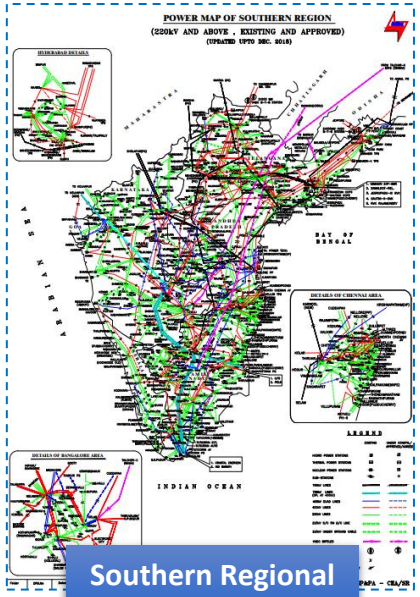
Eastern Regional Grid

ERLDC

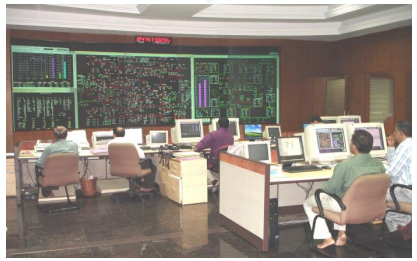


Western Regional Grid

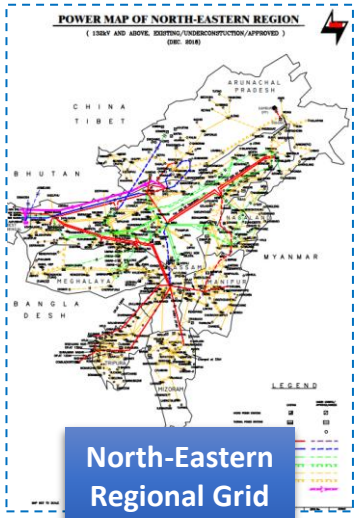
WRLDC



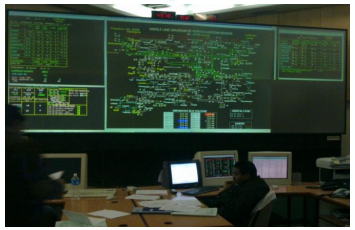
Southern Regional Grid



SRLDC

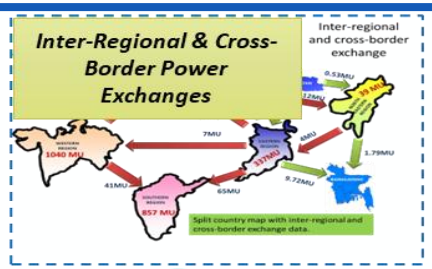


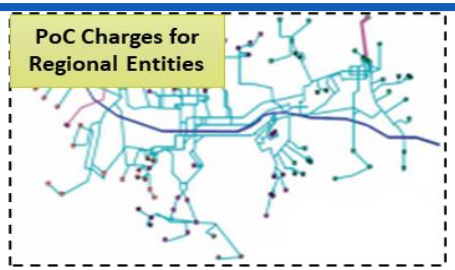
North-Eastern Regional Grid



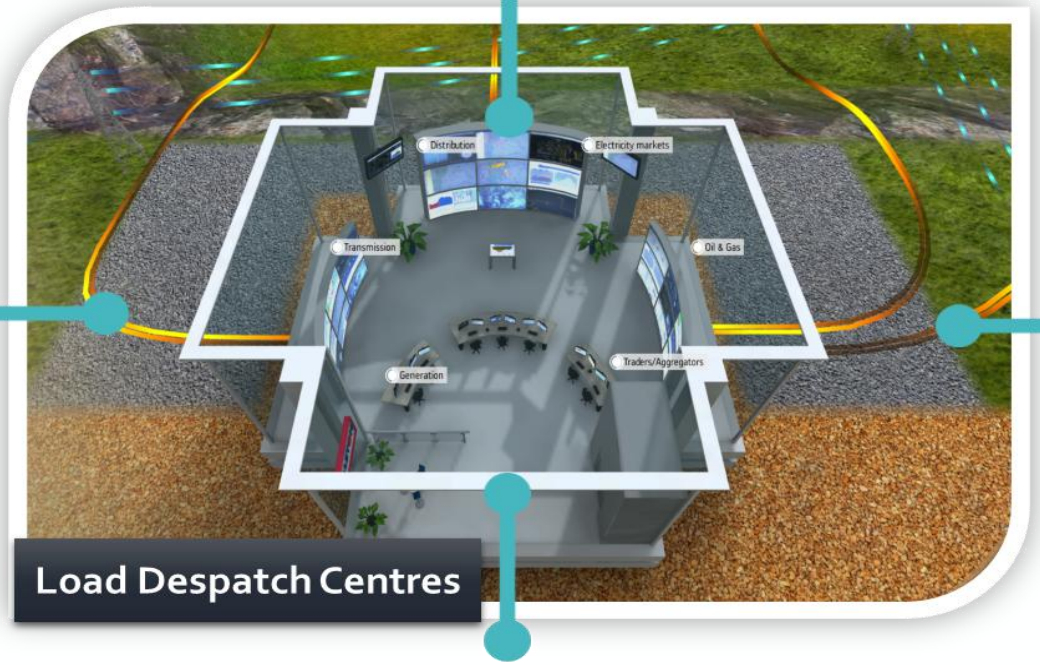
NERLDC

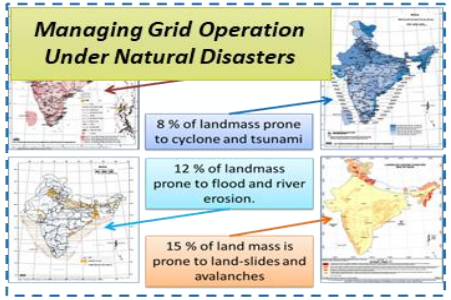
Load Despatch Centres of India – National/Regional Level

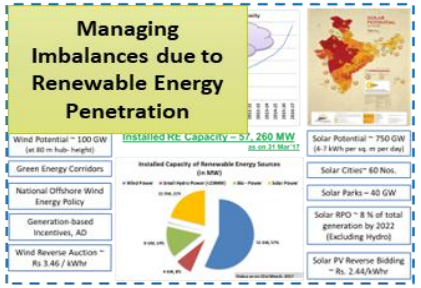


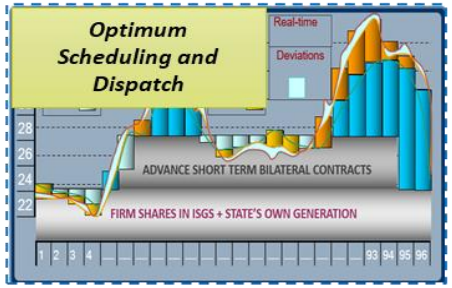


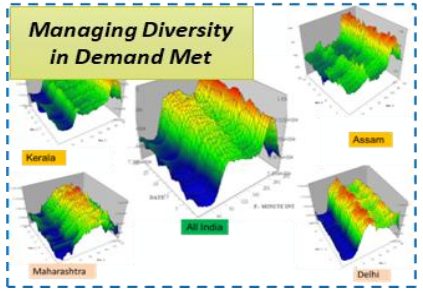
Typical Functions of a Load Despatch Centre (example of NLDC shown)

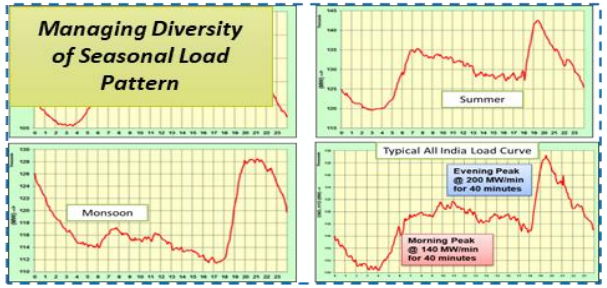


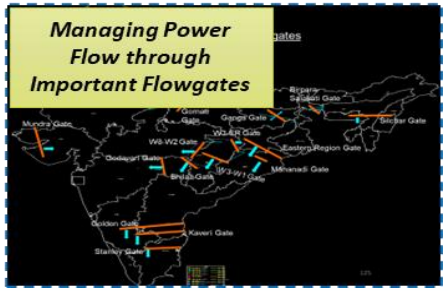






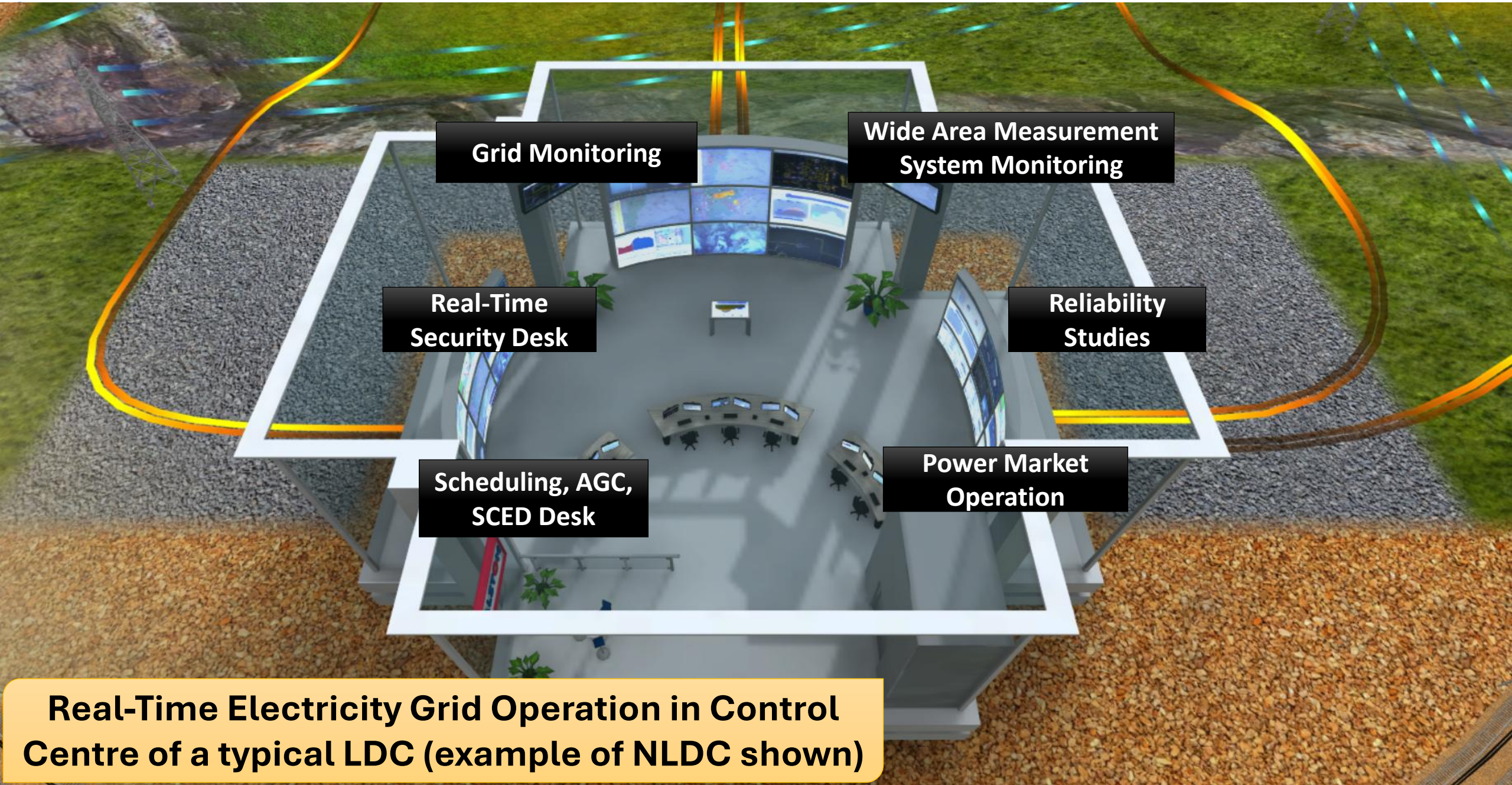






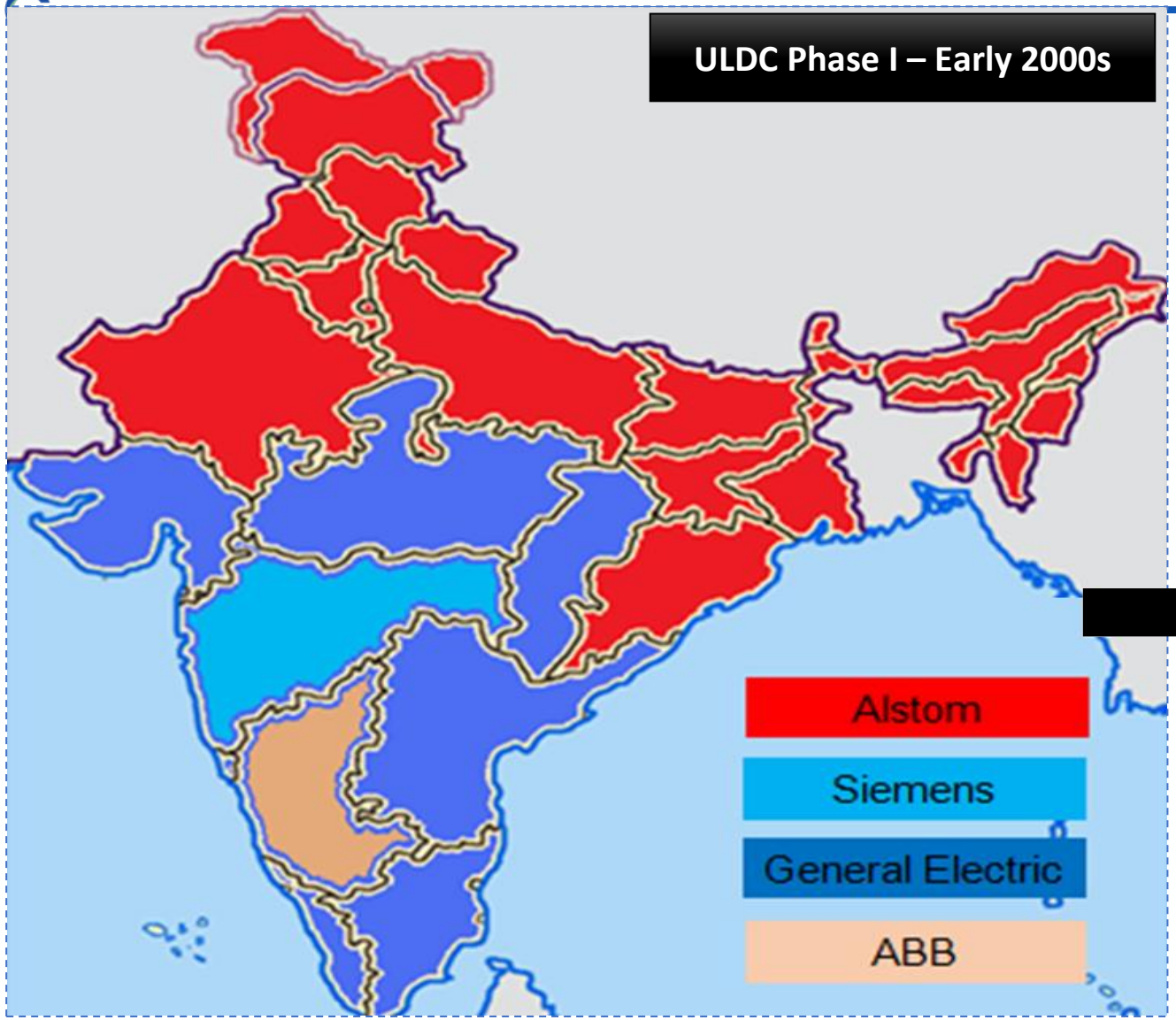
..... Several Other Functions

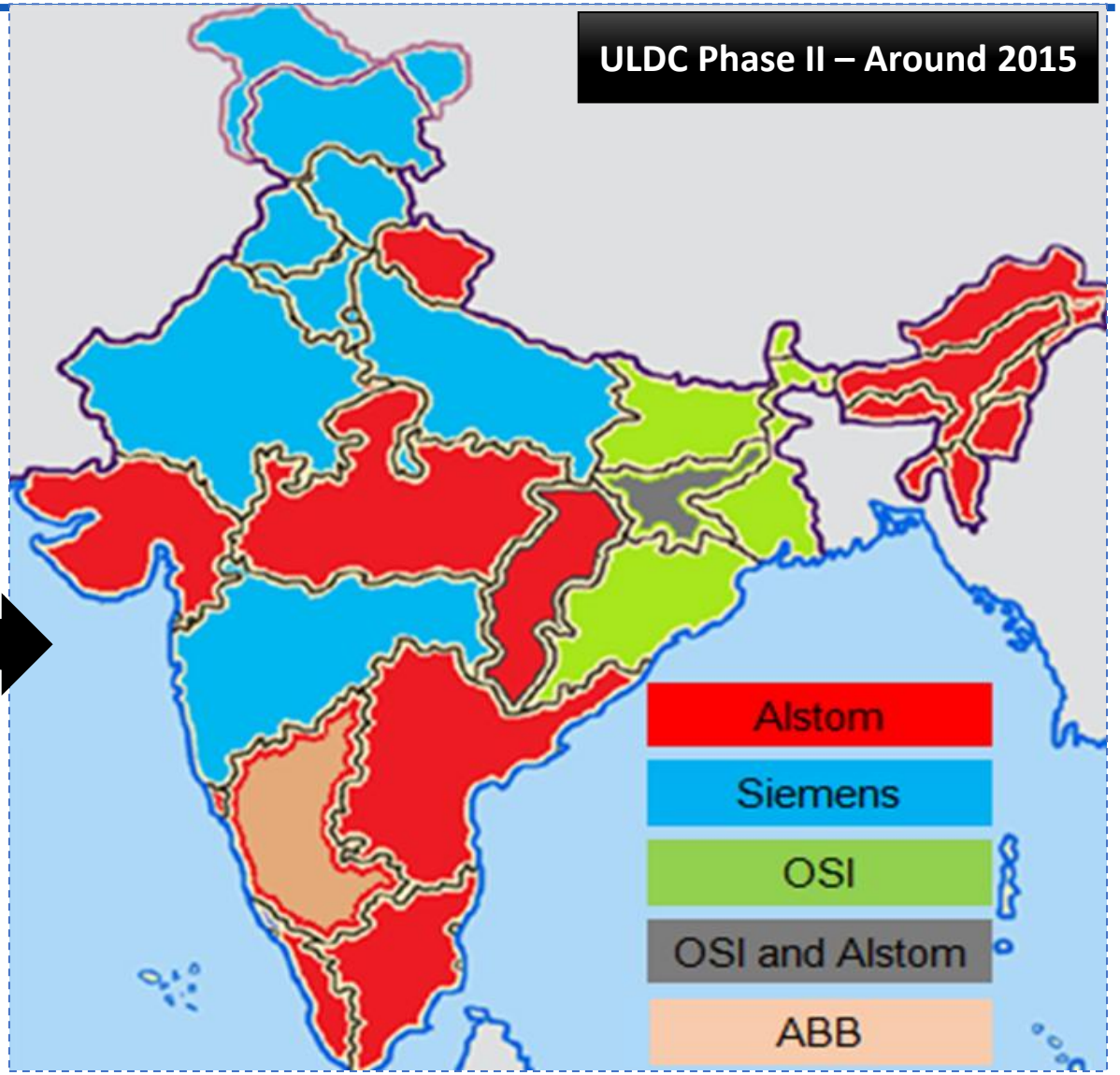
Load Despatch Centres of India – National/Regional Level



Real-Time Electricity Grid Operation in Control Centre of a typical LDC (example of NLDC shown)

Load Despatch Centres of India – Multivendor Systems



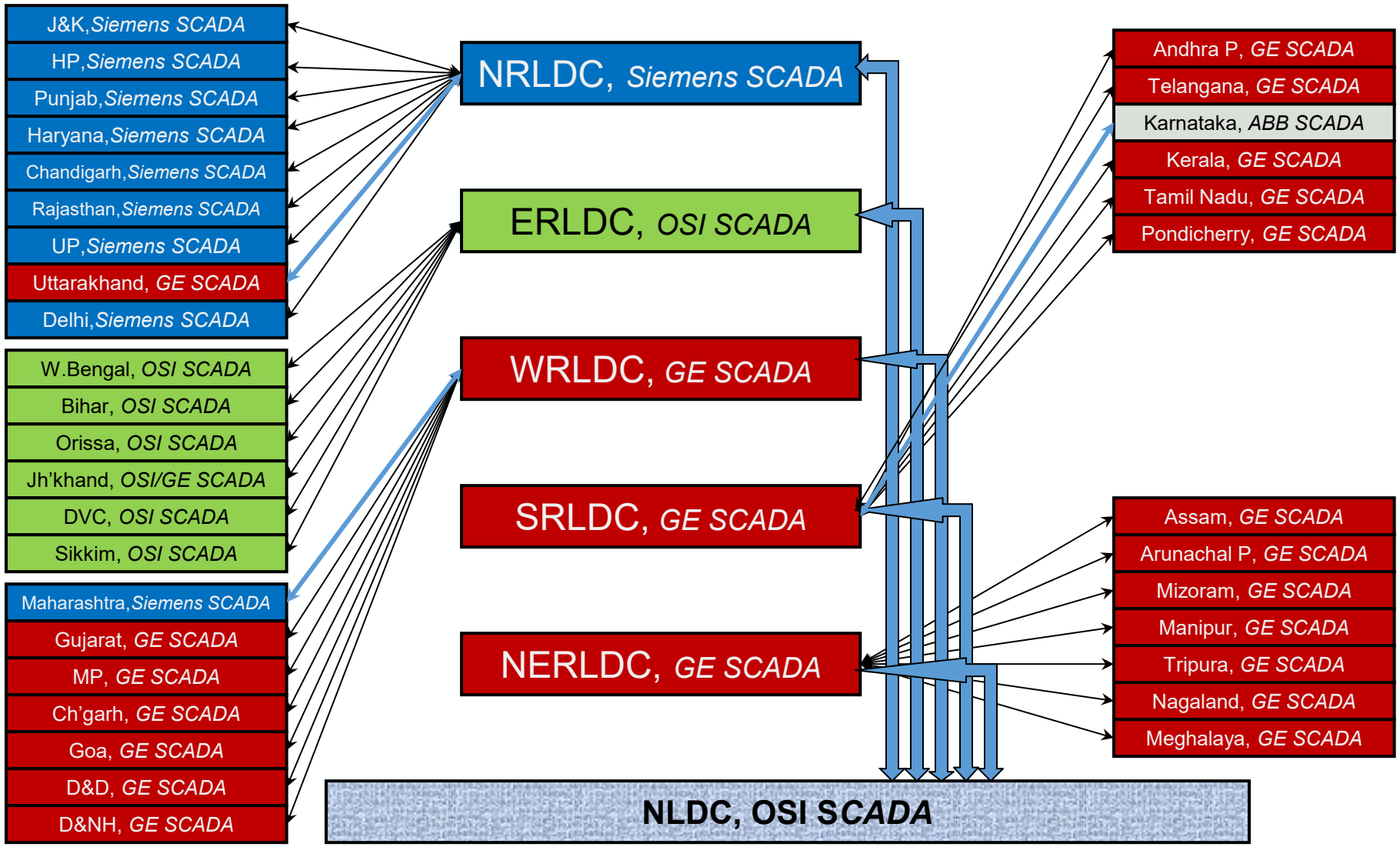


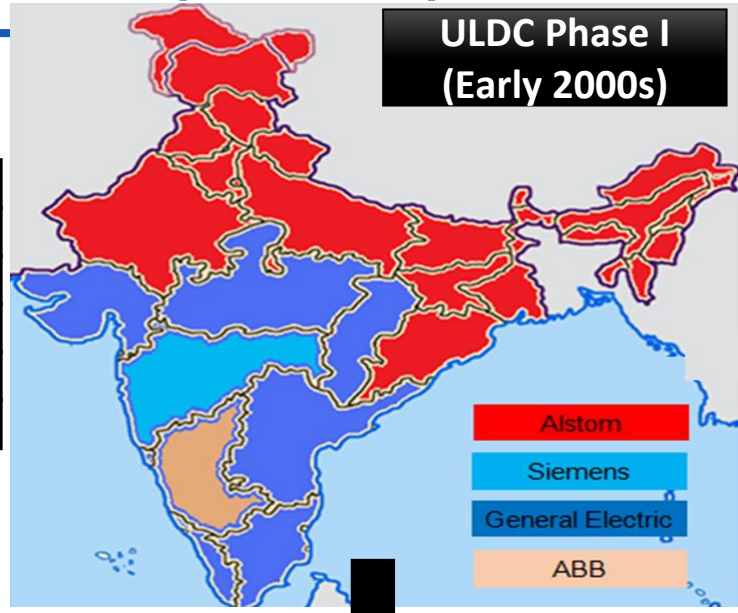
- ULDC is "Unified Load Despatch & Communication Scheme" for unified upgradation of systems
- ULDC Phase III under progress to replace all the systems between 2024-28 period.

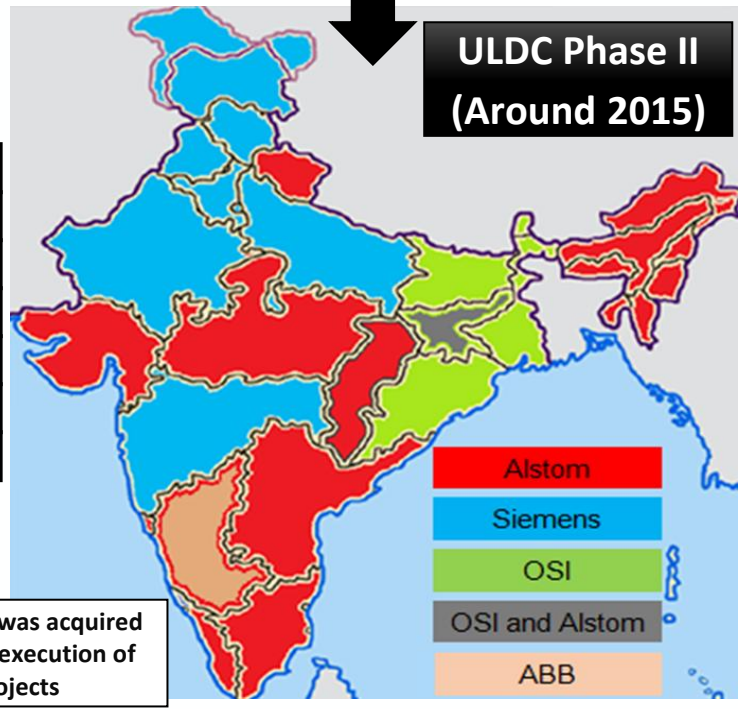
Note: Alstom was acquired by GE during execution of the projects

Load Despatch Centres of India – Multivendor Systems (Contd.)

Data Exchange between LDCs on ICCP protocol



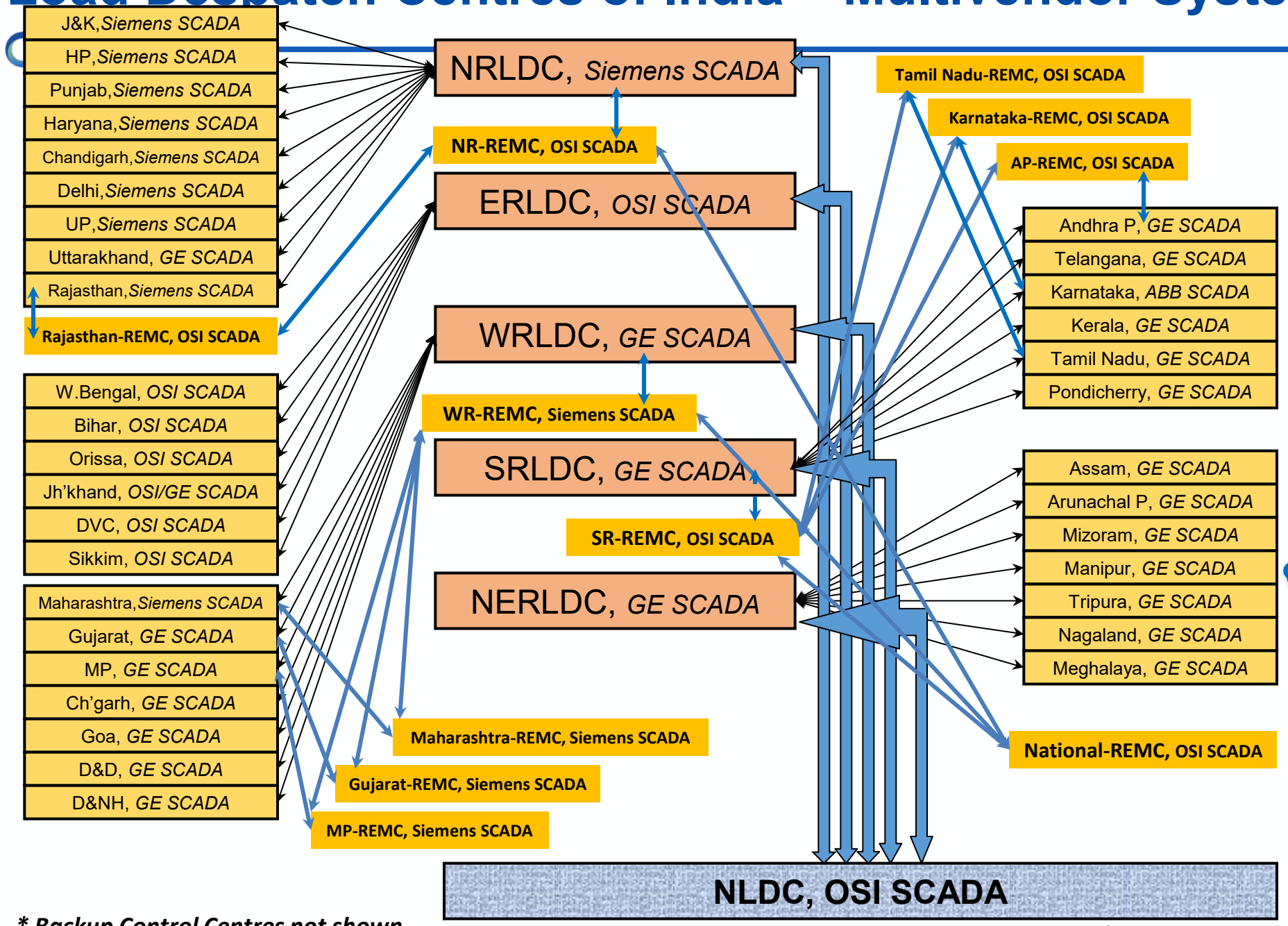




** Backup Control Centres not shown*

Note: Alstom was acquired by GE during execution of the projects

Load Despatch Centres of India – Multivendor Systems (Contd.)



Data transfer between several Load Despatch Centres –

- *National Load Despatch Centre*
- *Regional Load Despatch Centres*
- *State Load Despatch Centres*
- *Renewable Energy Management Centres (National, Regional and State Level)*

Renewable Energy Management Centres (REMCs) also shown

** Backup Control Centres not shown*

* Tentative illustration

Load Despatch Centres of India – Cost of Control Centre SCADA Infrastructure

Sl. No.	Region	Gross Block Central Portion (₹ Crore)	Gross Block State Portion (₹ Crore)	Gross Block Total (₹ Crore)	Commercial Operation Date
1	Southern	127.74	417.35	545.08	01-07-2002
2	Northern	260.31	311.04	571.34	01-08-2002
3	North-Eastern	119.16 (incl. 104.85 crore grant)	78.25 (incl. 70.40 crore grant)	197.41 (includes 175.25 crore grant)	01-08-2003
4	Eastern	141.59	193.63	335.23	01-09-2005
5	Western	105.76	71.26	177.03	01-02-2006
6	**Total**	**754.56**	**1,071.53**	**1,826.09**	
	Note: Provisional figures of investment in ULDC Phase 1 project by POWERGRID which includes SLDCs and RLDCs. (**Source:** https://powermin.nic.in/sites/default/files/uploads/Task_Force_Report.pdf)				

ULDC Phase-1 (RLDCs and SLDCs)

Sl. No.	Load Despatch Centre	Cost (₹ Crore)	Commercial Operation Date
1	NLDC Phase-1	16	Feb-2009
2	NLDC Phase-2	23	Mar-2022
	Note: Figures does not include the costing towards consultancy charges by POWERGRID and civil renovation works.		

NLDC Phases

Sl. No.	Load Despatch Centre	Cost (₹ Crore)	Commercial Operation Date
1	URTDSM Phase-1	240	31-Dec-2015
2	URTDSM Phase-2	--	Under planning stage.
	Note: Figures include the cost of package 1 (National, ER, NR and NER) of 158 crores and package-2 (WR & SR) of 82 crores.		

URTDSM Phases

Sl. No.	Load Despatch Centre	Cost (₹ Crore)	Commercial Operation Date
1	NRLDC	11.9	31-Dec-2015
2	ERLDC	11.2	31-Mar-2016
3	WRLDC	8.9	28-Mar-2016
4	SRLDC	13.1	24-Mar-2016
5	NERLDC	13.3	06-Jan-2017
	Total	**58.4**	
	Note: Figures do not include the cost of SLDCs portions, consultancy charges and civil renovation works.		

ULDC Phase-2 (RLDCs Portion; SLDCs portion not shown)

Sl. No.	Load Despatch Centre	Cost (₹ Crore)	Commercial Operation Date
1	SR-REMC *(Tamil Nadu, Andhra Pradesh, Karnataka and SRLDC REMC)*	53	Between Jan-2020 to Feb-2020
2	WR-REMC *(Maharashtra, Gujarat, Madhya Pradesh and WRLDC REMC)*	43.79	Between Jan-2020 to Jun-2020
3	NR-REMC *(Rajasthan, NRLDC REMC and NLDC REMC)*	28.94	Between Jul-2020 to Dec-2020
	Total	**125.73**	
	Note: Figures does not include the costing towards consultancy charges by POWERGRID and civil renovation works.		

REMCs – National, Regional & State Level

Sl. No.	Load Despatch Centre	Cost (₹ Crore)	Commercial Operation Date
1	Northern Region	729	LoA awarded in Aug-2024.
2	Eastern Region	437	LoA awarded in Aug-2024.
3	Southern Region	375	LoA awarded in Oct-2024.
4	Ladakh SLDC cum REMC	80	LoA awarded on 25-Jun-2024.
	Total	**1,621**	
	Note: WR project under tendering stage and NER project under planning stage.		

ULDC Phase-3 (RLDCs and SLDCs)

Regulatory Policies and Framework for SCADA System in LDCs

ग्रिड-इंडिया GRID-INDIA

Electricity Act – 2003

* Section – 2 (54) : Definition of Real time Operation – Information to be available

"real time operation" means action to be taken at a given time at which information about the electricity system is made available to the concerned Load Despatch Centre;"

* Section 28(e) : RLDC Responsible for Real Time Operation

"be responsible for carrying out real time operations for grid control and despatch of electricity within the region through secure and economic operation of the regional grid in accordance with the Grid Standards and the Grid Code."

Electricity Act 2003

Indian Electricity Grid Code

* Section 4.6.2 : Reliable and efficient speech and data communication systems shall be provided by USERS.

"Reliable and efficient speech and data communication systems shall be provided to facilitate necessary communication and data exchange, and supervision/control of the grid by the RLDC, under normal and abnormal conditions. All Users, STUs and CTU shall provide Systems to telemeter power system parameter such as flow, voltage and status of switches/ transformer taps etc. in line with interface requirements and other guideline made available by RLDC. The associated communication system to facilitate data flow up to appropriate data collection point on CTU's system, shall also be established by the concerned User or STU as specified by CTU in the Connection Agreement. All Users/STUs in coordination with CTU shall provide the required facilities at their respective ends as specified in the Connection Agreement."

Indian Electricity Grid Code

Draft Connection Agreement, CEA

Draft Connection Agreement

* Clause 1.1 (C) : Applicant is responsible for data communication & to provide facilities for voice & data communication / DCP to RLDC communication CTU responsibility / Applicant to provide up to DCP.

"The applicant or inter-State transmission licensee shall provide necessary facilities for voice & data communication for transfer of real time operational data such as voltage, frequency, real and reactive power flow, energy, status of circuit breaker & isolators positions, transformer taps and other parameters from their station to Data Collection Point(DCP) of CTU as per IEGC. CTU may provide access to applicant's data transfer through communication network in case spare channels are available on mutually agreed terms. The location of DCP of CTU shall be the nearest station connected electrically where wideband communication capacity of POWERGRID is available. Additional communication system from DCP to the concerned RLDC shall be the responsibility of CTU; however, its cost shall be borne by the applicant. The responsibility of data transfer shall be that of the applicant."

Grid Standards, CEA

Central Electricity Authority (Grid Standards) Regulations, 2010

* Clause 15 (1): Operational Data during normal operation and during grid incidents and grid disturbances.

"All real time operational data as required by the Appropriate Load Despatch Center shall be furnished by the Entities."

Technical Standards for Connectivity of the Grid, CEA

Central Electricity Authority (Technical Standards for Connectivity of the Grid) Regulations, 2007

* Clause 6 (3) The requester and user shall provide necessary facilities for voice and data communication and transfer of on-line operational data, such as voltage, frequency, line flows, and status of breaker and isolator position and other parameters as prescribed by the Appropriate Load Despatch Centre.

Regulatory Policies and Framework for SCADA System in LDCs (contd.)

CENTRAL ELECTRICITY REGULATORY COMMISSION
NEW DELHI

PREAMBLE

File No. L-1/210/2016/CERC Dated: 15th May 2017

The Central Commission has been assigned the function to regulate inter-State transmission of electricity and to specify the Grid Code having regard to Grid standard under clause (c) and (h) of sub-section (1) of Section 79 of the Electricity Act, 2003. Communication system forms the backbone of the inter-State transmission of electricity and smooth operation of the power system. Keeping in view the importance of the communication system in a vast meshed network at the National, Regional and State level in India, a need has been felt to specify the regulations regarding Communication System for inter-State transmission of electricity., The purpose of the regulations is to lay down the rules, guidelines and standards to be followed by various persons and participants in the system for continuous availability of data for system operation and control including market operations. Further, the regulations deal with the planning, implementation, operation and maintenance and up-gradation of reliable communication system for all communication requirements including exchange of data for integrated operation of National Grid.

NOTIFICATION

In exercise of the powers conferred under Section 178 of the Electricity Act, 2003 (36 of 2003), read with clause (c) and (h) of sub-section (1) of Section 79 and all other powers enabling it in this behalf, the Central Electricity Regulatory Commission makes the following regulations, namely:

1. SHORT TITLE AND COMMENCEMENT:

(i) These regulations may be called the Central Electricity Regulatory Commission (Communication System for inter-State transmission of electricity) Regulations, 2017.

(ii) These regulations shall come into force w.e.f. 1.7.2017.

2. DEFINITIONS AND INTERPRETATIONS:

(i) In these regulations, unless the context otherwise requires, -

a) "Act' ... time;

b) "An ... ation, the services ... intaining power ... for load following

Central Electricity Regulatory Commission (Communication System for inter-State transmission of electricity) Regulations, 2017 –
effective from 01st July 2017

[भाग III—खण्ड 4] भारत का राजपत्र : असाधारण 17

सेल्यूलर	जीपीआरएस/3जी/4जी/एनबीआईओटी/एमपीएलएस	ईटीएसआई, 3जीपीपी कॉमप्लायंट
एमपीएलएस–टीपी:		जी.8110, 8112, 8113.1, 8113.2, 8121, 8121.1, 8121.2, 8131, 8151, 8152.
एमपीएलएस-आईपी:		मानक उद्योग कार्यप्रणाली के अनुसार

पी.सी.कुरील, सचिव

[विज्ञापन–III/4/असा./472/19]

CENTRAL ELECTRICITY AUTHORITY

NOTIFICATION

New Delhi, the 27th February, 2020

No. Comm._Std./PCD/CEA.—Whereas the draft of the Central Electricity Authority (Technical Standards for Communication System in Power System Operations) Regulations, 2020 was published in six newspaper dailies, as required by sub-section (3) of section 177 of the Electricity Act, 2003 (36 of 2003) read with sub-rule (2) of rule (3) of the Electricity (Procedure for Previous Publication) Rules, 2005, inviting objections and suggestions from all persons likely to be affected thereby, before the expiry of the period of forty-five days, from the date on which the copies of the newspaper containing the said draft regulations were made available to the public;

And whereas copies of the said newspapers containing the said draft regulations were made available to the public on the 26th March, 2019;

And whereas the objections and suggestions received from the public on the said draft regulations were considered by the Central Electricity Authority;

Now, therefore, in exercise of the powers conferred by sub-section (1) of section 177 of the Electricity Act, 2003 (36 of 2003) read with clause (b) of section 73 of the said Act, the Central Electricity Authority hereby makes the following regulations, namely: -

CHAPTER I

PRELIMINARY

1. **Short title and commencement.**–(1) These regulations may be called the Central Electricity Authority (Technical Standards for Communication System in Power System Operations) Regulations, 2020.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. **Definitions.** – (1) In these regulations, unless the context otherwise requires, -

(a) "Act" means the Electricity Act,2003 (36 of 2003);

(b) "Authority" means the Central Electricity Authority established under sub-section (2) of section 70 of the Act;

(c) "automatic generation control" means capability to regulate the power output of selectable units in response to total power plant output, tie-line power flow, and power system frequency;

(d) "bulk consumer" means a consumer who avails supply at voltage of 33 kV or above;

(e) "communication channel" means a dedicated virtual path configured from one node to another

(f) ... a

(g) ... on ... er- ... ng ... ate ... eir

Central Electricity Authority – (Technical Standards for Communication System in Power System Operations) Regulations, 2020
effective from 29th February 2020

Some other documents approved as procedures/guidelines under the Central Electricity Regulatory Commission (Communication System for inter-State transmission of electricity) Regulations, 2017 in January 2024 –

- Guidelines on Availability of Communication System (Order - dated 19.01.2024)

- Guidelines on Interfacing Requirements (Order - dated 19.01.2024)

- Procedure on Centralized Supervision of Quick Fault Detection & Restoration (Order - dated 19.01.2024)

- Procedures on Maintenance & Testing (Order - dated 19.01.2024)

Cyber Security – Guidelines/Regulations for Power Sector by CEA released in 2021 and 2026

File No.CEA-CH-13-12/4/202

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
सूचना प्रौद्योगिकी एवं साइबर सुरक्षा प्रभाग
Information Technology & Cyber Security Division
****

विषय : CEA (Cyber Security in Power Sector) Guidelines, 2021.

CEA is mandated to prepare 'Guidelines on Cyber Security' in Power Sector under the provision of regulation (10) of the Central Electricity Authority (Technical Standards for Connectivity to the Grid) (Amendment) Regulations, 2019. Guidelines on Cyber Security in Power Sector incorporating the cardinal principles has been prepared by CEA. In compliance to the provision of the above regulation, **CEA (Cyber Security in Power Sector) Guidelines, 2021** are issued for compliance by all entities listed in the clause 2.3 (Applicability of the Guidelines) of the guidelines.

Encl: Guidelines on Cyber Security

07/10/21
(V.K Mishra)
Secretary CEA

CEA (Cyber Security in Power Sector) Guidelines, 2021
(https://cea.nic.in/wp-content/uploads/notification/2021/10/Guidelines_on_Cyber_Security_in_Power_Sector_2021-2.pdf)
-- Issued in form of guidelines

Guidelines to Regulations in 5 years interval by CEA

CEA (Cyber Security in Power Sector) Regulations, 2026
(https://cea.nic.in/wp-content/uploads/notification/2026/08/Cyber_Regulations_Notification.pdf)
-- Regulations effective from 01-Apr-2027

CENTRAL ELECTRICITY AUTHORITY

NOTIFICATION

New Delhi, the 31th July, 2026

F. No. CEA-HY-91-19/8/2024-Cyber Security Division.—Whereas public notices advertising the draft of the Central Electricity Authority (Cyber Security in Power Sector) Regulations, 2025 were published in six newspaper dailies, as required by sub-section (3) of section 177 of the Electricity Act, 2003 (36 of 2003) read with sub-rule (2) of rule 3 of the Electricity (Procedure for Previous Publication) Rules, 2005 for inviting objections and suggestions from all persons likely to be affected thereby, before the expiry of the period of thirty days, from the date on which the copies of the said draft regulations were made available to the public;

And whereas copies of the said newspapers containing the public notices and the said draft regulations on the website of the Central Electricity Authority were made available to the public on 07th October 2025;

And whereas the objections and suggestions received from the public on the said draft regulations were considered by the Central Electricity Authority;

And whereas Ministry of Electronics and Information Technology has accorded its concurrence to make these regulations in respect of the Cyber Security for power sector.

Now, therefore, in exercise of the powers conferred by sub-section (1) of section 177 read with clause (c) of section 73 of the Electricity Act, 2003(36 of 2003), the Central Electricity Authority hereby makes the following regulations relating to Cyber Security in power sector for ensuring safe and secure operation and maintenance of electrical plants and electrical lines, namely: –

Chapter I

Preliminary

1. **Short title and commencement** - (1) These regulations may be called the Central Electricity Authority (Cyber Security in Power Sector) Regulations, 2026.

(2) These regulations shall come into force with effect from 1st April 2027:

Provided that the Regulations 5(9), 5(24), 5(33), 5(39), 6(2) and 6(7) shall come into force on such dates, as may be specified by the Authority through separate orders with prior approval of the Central Government.

2. **Scope and extent of applicability** - (1) These Regulations shall apply to -

(a) all the entities which own, operate, or manage Operational Technology infrastructure associated with the interconnected power system and their Information Technology infrastructure that is physically or logically connected to such Operational Technology infrastructure, for their existing as well as upcoming infrastructure:

espect of generating companies, captive generating plants, and organisations System, these regulations shall be applicable only where such entities have an MW or more:

at the entities having an installed capacity of less than 50 MW are encouraged num baseline cyber security controls outlined in the "15 Elemental Cyber icro, Small and Medium Enterprises" issued by Indian Computer Emergency

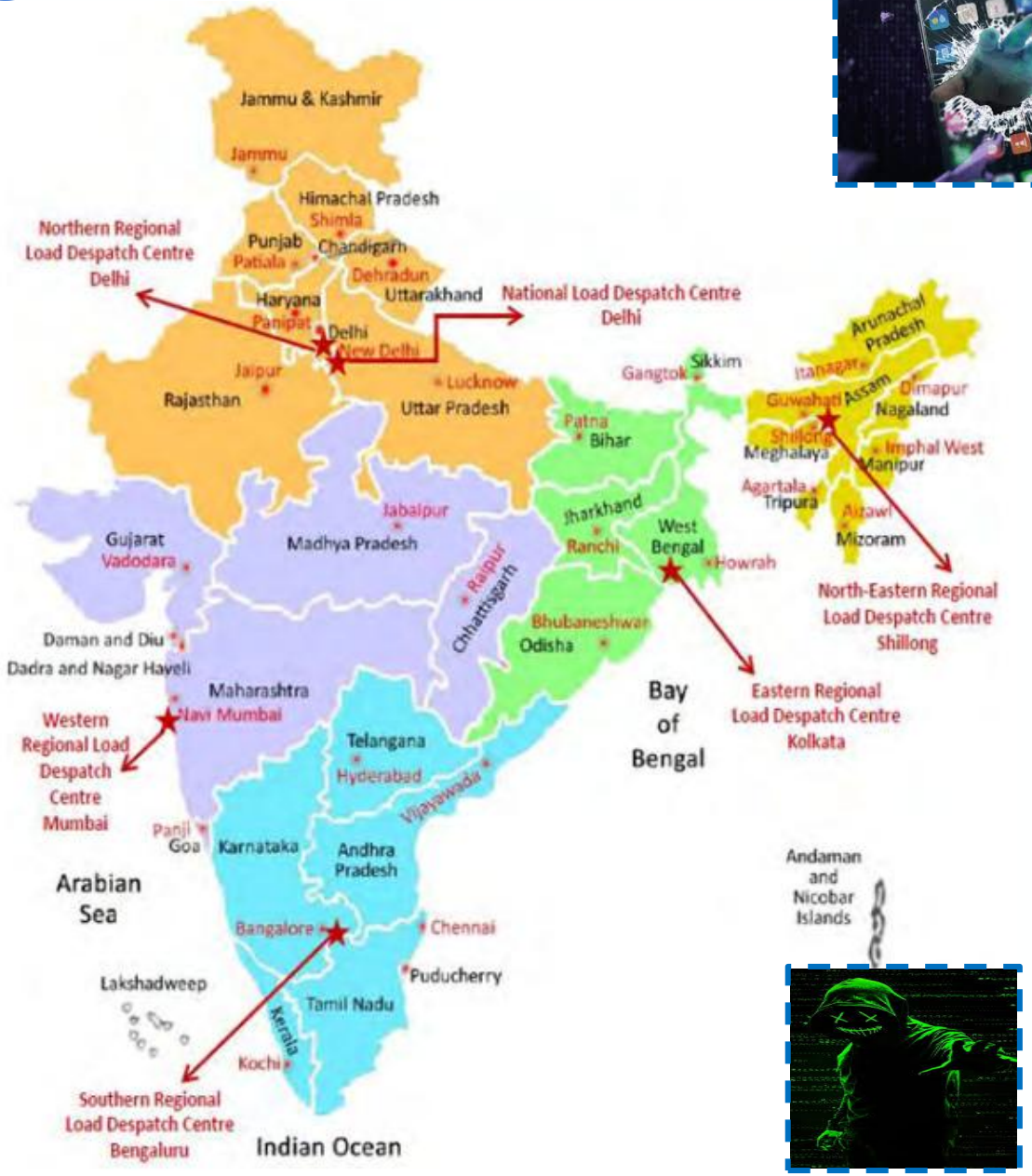
es and over the counter platforms, except regulations 6, 11, and 12.

vith the regulations 11 and 12 of these regulations as applicable.

regulations, unless the context otherwise requires -

Cyber Security – For Critical Load Despatch Centres

Mission Critical Control Centres of National Importance



National Load Despatch Centre

Regional Load Despatch Centres

State Load Despatch Centres

Renewable Energy Management Centres – National/Regional and State Level

Web Based Energy Scheduling

Unified Real Time Dynamic State Measurement (URTDSM)

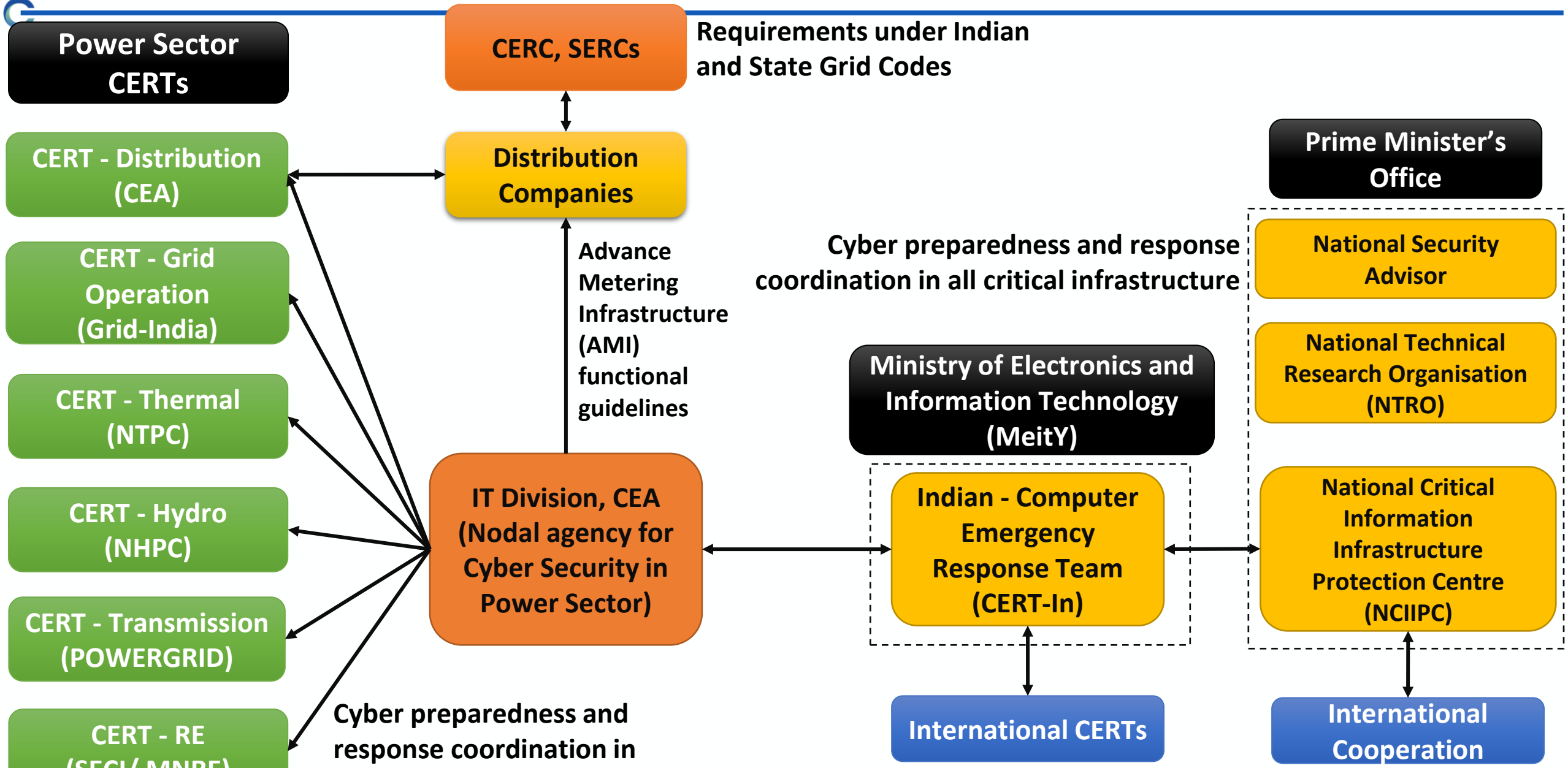
National Transmission Asset Management Centre (POWERGRID)

Regional Transmission Asset Management Centres (POWERGRID)

Cyber Security – Key entities for Power Sector

Sl. No.	Entity	Formed by	Remarks
1	Indian Computer Emergency Response Team (CERT-In)	MEITY, Government of India	❑ **Early warning and response** to cyber security incidents ❑ To have **collaboration at National and International level** for information sharing on mitigation of cyber threats ❑ Regularly issues **advisories** ❑ Publishes **Security Guidelines** ❑ Conducts **workshops and training** programs
2	6 (six) sectoral CERTs formed/nominated namely – ❑ Thermal ❑ Hydro ❑ Transmission ❑ Grid Operation ❑ RE and ❑ Distribution	Ministry of Power, Govt. of India	❑ **Ensuring cyber security** in Indian Power Sector ❑ Sectoral CERT has **prepared their sub-sector specific model** Cyber Crisis Management Plan(C-CMP)
3	Cyber Swachhta Kendra (operated by CERT-In)	CERT-In	❑ **Botnet** cleaning ❑ **Malware** analysis ❑ Issues **alerts and vulnerabilities**
4	NCIIPC (formed through IT Act)	Government by India	❑ Nodal Agency in terms of **Critical Information Infrastructure Protection** ❑ Unit of NTRO ❑ Works under Prime Minister's Office
5	Central Electricity Authority (CEA)	Government of India	❑ Frames **guidelines for Cyber Security** in Power Sector
	……. more		

Cyber Security – Key entities for Power Sector (contd.)



Source: https://www.ceew.in/publications/making-advanced-metering-infrastructure-resilient-electric-power-grid-security

Cyber Security – Establishment of SOC by Grid-India based on CEA guidelines on cyber security released in 2021

Article 5. Cyber Security Requirements

a) The Responsible Entity shall have an Information Security Division (ISD), headed by CISO.

b) The Responsible Entity shall ensure that the ISD must be functional on 24x7x365 basis and is manned by sufficient numbers of Engineers having valid certificate of successful completion of course on cyber security of Power Sector from the Training Institutes designated by CEA.

c) The Responsible Entity shall ensure that ISD

1) has on-boarded Cyber Swachhta Kendra(CSK) of CERT-In, if they have public IPs.
2) has timely acted upon the advisories, guidelines and directive of NCIIPC, CSK, CERT-In and Sectoral CERTs,
3) has deployed an Intrusion Detection System and Intrusion Prevention System capable of identifying behavioural anomaly in both IT as well as OT Systems.
4) shares reports on incident response and targeted malware samples with CERT-In,
5) updates the firmware/software with the digitally signed OEM validated patches only.
6) enables only those ports and services that are required for normal operations. In case of any emergency the procedure as laid in Access management be followed.
7) maintains firewall logs for the last 6 months duration. Firewall logs shall be analysed and all critical and high severity comments shall be addressed for effective closure.
8) retains document of FAT, SAT test results and report/ certificate of carried out for compliance of Government Orders and Cyber Security
9) maintains all cyber logs and cyber forensic records of any incident fo 90 days.

* FAT, SAT must include comprehensive cyber security tes component/equipment/system to be delivered/delivered at site.

** 90 days from date of the commissioning of the system/recovery incident, whichever is later.

Can be fulfilled through SOC

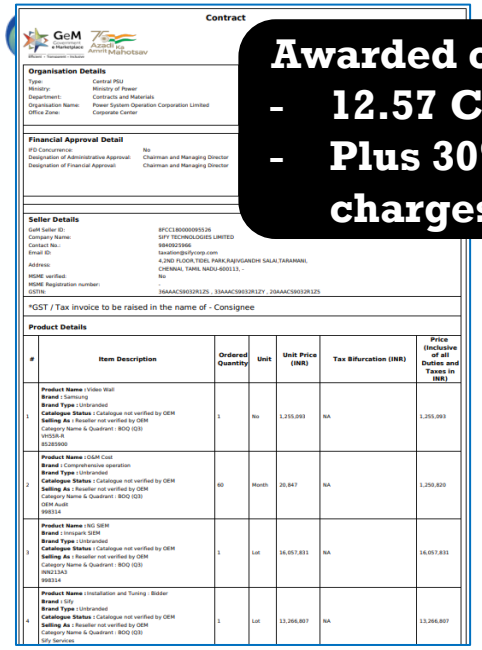
Provision for Security Operations Centre (SOC)

Security Operations Centre

CEA (Cyber Security in Power Sector) Guidelines, 2021

https://cea.nic.in/wp-content/uploads/notification/2021/10/Guidelines_on_Cyber_Security_in_Power_Sector_2021-2.pdf

Cyber Security – Security Operations Centre (SOC) at Grid-India for NLDC/RLDCs



Contract

GeM

Organisation Details

Type:	Central PSU
Ministry:	Ministry of Power
Department:	Contracts and Materials
Organisation Name:	Power System Operation Corporation Limited
Office Zone:	Corporate Center

Financial Approval Detail

IFD Concurrence:	No
Designation of Administrative Approval:	Chairman and Managing Director
Designation of Financial Approval:	Chairman and Managing Director

Seller Details

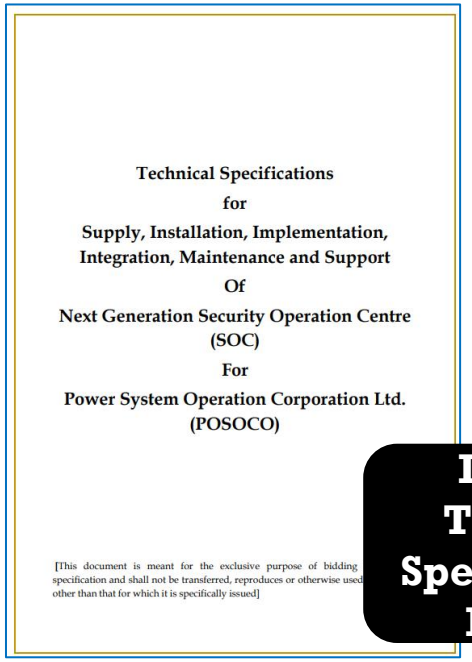
GeM Seller ID:	8FCC180000095526
Company Name:	SIFY TECHNOLOGIES LIMITED
Contact No.:	9940925966
Email ID:	taxation@sifycorp.com
Address:	4,2ND FLOOR,TIDEL PARK,RajIVGANDHI SALAI,TARAMANI, CHENNAI, TAMIL NADU-600113, -
MSME verified:	No
MSME Registration number:	-
GSTIN:	36AAACS9032R1Z5 , 33AAACS9032R1ZY , 20AAACS9032R1Z5

*GST / Tax invoice to be raised in the name of - Consignee

Product Details

#	Item Description	Ordered Quantity	Unit	Unit Price (INR)	Tax Bifurcation (INR)	Price (Inclusive of all Duties and Taxes in INR)
1	**Product Name :** Video Wall **Brand :** Samsung **Brand Type :** Unbranded **Catalogue Status :** Catalogue not verified by OEM **Selling As :** Reseller not verified by OEM Category Name & Quadrant : BOQ (Q3) VH55R-R 85285900	1	No	1,255,093	NA	1,255,093
2	**Product Name :** O&M Cost **Brand :** Comprehensive operation **Brand Type :** Unbranded **Catalogue Status :** Catalogue not verified by OEM **Selling As :** Reseller not verified by OEM Category Name & Quadrant : BOQ (Q3) OEM Audit 998314	60	Month	20,847	NA	1,250,820
3	**Product Name :** NG SIEM **Brand :** innspark SIEM **Brand Type :** Unbranded **Catalogue Status :** Catalogue not verified by OEM **Selling As :** Reseller not verified by OEM Category Name & Quadrant : BOQ (Q3) INN213A3 998314	1	Lot	16,057,831	NA	16,057,831
4	**Product Name :** Installation and Tuning : Bidder **Brand :** Sify **Brand Type :** Unbranded **Catalogue Status :** Catalogue not verified by OEM **Selling As :** Reseller not verified by OEM Category Name & Quadrant : BOQ (Q3) Sify Services	1	Lot	13,266,807	NA	13,266,807

Awarded on GeM Portal
- **12.57 Cr**
- **Plus 30% AMC charges for 5 years**



Technical Specifications

for

Supply, Installation, Implementation, Integration, Maintenance and Support

Of

Next Generation Security Operation Centre (SOC)

For

Power System Operation Corporation Ltd. (POSOCO)

[This document is meant for the exclusive purpose of bidding specification and shall not be transferred, reproduces or otherwise used other than that for which it is specifically issued]

Detailed Technical Specifications Framed

Security Information & Event Management (SIEM)

Security Orchestration, Automation and Response (SOAR)

Network Behaviour and Anomaly Detection (NBAD)

Database Activity Management

User and Entity Behaviour Analytics (UEBA)

OEM Details

General Shift Resources (normal working hours) Till 6 months after GoLive	16x6 (8 hrs two Shifts per day excluding Sunday)	24x7 (3 Shifts per day) Resources (no.)
One L3	One L2 in each shift	One L1 in each shift

Shifts Schedule for Vendor

Manpower Deployment by Vendor

Sl. No.	Job Profile	Qualification and Skills
1	L1	❑ **B.E. / B.Tech. / MCA.** ❑ **More than 3 years of IT experience**, out of which at least 1 years will be on Security domain and in dealing with SOC systems on proposed OEM
2	L2	❑ **B.E. / B.Tech. / MCA.** ❑ **More than 5 years of IT experience**, out of which at least 3 years in dealing with SOC systems and operations (SIEM, log monitoring, event correlation, analysis etc.). ❑ Professional certification (1 or more of the following) such as CEH/OSCP/CCSP + OR OEM certifications for the product being proposed as part of the solution ❑ Should have experience in simulated SOC environment like cyber range
3	L3	❑ **B.E. / B.Tech. / MCA** ❑ **More than 8 years of experience** in network and IT security field, out of which at least 5 years in managing SOC systems and operations (defining strategy around security monitoring, incident management, regulatory compliance, process improvement etc). ❑ Must have experience in delivering large and complex security projects. ❑ Understanding of vulnerabilities, threats, risks, compliance and other aspects of security governance. ❑ Excellent interpersonal, co-ordination and problem-solving skills. ❑ Working knowledge of SIEM, SOAR, threat trends and vectors and experience creating rules, alerts, content and reports in the OEM proposed solution. ❑ Should have experience of having served as Project Lead/ Team Lead in a service contact of similar size and scale for more than two year. ❑ Should have experience in simulated SOC environment like cyber range (certification to be attached along with) ❑ Current (not future/or planned) Certification are preferable (1 or more of the following) a. CISSP/ CISA/ CISM/ OSCP/CEH/CHFI b. SANS GIAC certification in Cyber Defense or Incident Response and Forensics.

Indigenization of OT/IT Systems – Benefits and Relevance

- GRID-INDIA has undertaken significant ***indigenisation efforts in software development for its operations***.
- Efforts are aimed towards –
  - ***Reducing dependence on proprietary*** systems
  - Strengthening ***data sovereignty***
  - Enabling ***greater operational control***, and
  - Supporting secure and scalable digital infrastructure.

Automatic Generation Control (AGC)

- AGC operationalized across more than 85,000 MW of generation capacity spanning 84 power plants since 2021.
- AGC platform and associated functionalities extensively customized to suit Indian grid requirements through indigenous technical development and pilot projects in 2017-2019.
- Have enabled India to establish one of the world's largest AGC-enabled synchronized power systems.
- Enables automatic minute-to-minute regulation of system frequency and generation output, thereby improving frequency control, operational reliability, and stability of the Indian power system.

Security Constrained Economic Dispatch (AGC)

- SCED implemented through significant indigenous development and engineering efforts in 2019.
- Resulted in ***cumulative national savings exceeding ₹4,000 crore since April 2019*** through optimized and secure generation dispatch.
- Has been incorporated into the scheduling framework of the IEGC, reflecting its strategic importance to grid operations.
- Enables maximized dispatch of economical generation resources while simultaneously honouring transmission security constraints, thereby providing a national-level optimization layer for power system operations.

Security Constrained Unit Commitment (SCUC)

- Customized Security Constrained Unit Commitment (SCUC) framework was implemented specifically for Indian system conditions.
- Optimization and operational software framework were developed indigenously.
- Supports large-scale renewable energy integration, optimal utilization of thermal flexibility, and efficient management of short-term resource and reserve adequacy.

RE Forecasting

- Indigenous RE generation forecasting tool is being developed by Indian Institute of Technology Bombay for week-ahead, day-ahead and intraday RE forecasting at plant, state, regional and national level.
- Includes regional scale weather forecast in collaboration with National Centre for Medium Range Weather Forecasting (NCMRWF) and Indian Institute of Tropical Meteorology (IITM).
- National Institute of Solar Energy (NISE) is developing tool for hybrid day ahead and intraday solar weather forecast based on Numerical Weather prediction (NWP) model, Satellite images and All Sky Imager (ASI) Camera in collaboration with RE developers and Grid-India.
- ***Migration of Weather forecast data from European Centre for Medium Range Weather Forecast (ECMRWF) to NCMRWF for RE generation forecast under progress.***

Tertiary Reserves Ancillary Services (TRAS)

- Indigenous Market Clearing Engine for market-based Tertiary Reserve Ancillary Services (TRAS) was developed and operationalized in 2023.
- Enables the Indian power system to seamlessly manage operational uncertainties affecting grid frequency, including renewable energy forecast deviations, demand fluctuations, and extreme weather events

National Open Access Registry (NOAR)

- Integrated platform accessible to all stakeholders in the power sector, including open access customers (both sellers and buyers), power traders, power exchanges, National/Regional/State LDCs and others.

**** Information updated till May-2026***

Indigenization of OT/IT Systems – Steps from Govt. Level

No. A-1/2026-FSC
Government of India
Ministry of Power

Shram Shakti Bhawan, Rafi Marg,
New Delhi, dated 22.07.2026

OFFICE MEMORANDUM

Subject: Minutes of Meeting on Indigenisation of Supervisory Control and Data Acquisition (SCADA) System - regarding

The undersigned is directed to forward herewith the minutes of the meeting chaired by Secretary (Power) on "Indigenisation of Supervisory Control and Data Acquisition (SCADA) System" held on 08.07.2026 at 10:30 AM, for information and necessary action.

Encl: as stated

To:
1. Chairperson, CEA
2. CMD, Grid India
3. CMD, Powergrid

Copy to:
1. PPS to Secretary (Power)
2. PPS to AS (Thermal)
3. PPS to JS (Thermal)
4. PPS to JS (Distribution)
5. PPS to JS (Trans)

Attended by members from MoP, CEA, POWERGRID, Grid-India, CSIRT-Power and PFC

Draft Minutes of the meeting held under the Chairmanship of Secretary (Power) on 08.07.2026 at 10:30 AM on Indigenisation of Supervisory Control and Data Acquisition (SCADA) System – reg.

A meeting was held under the Chairmanship of Secretary (Power) on 08.07.2026 on above-mentioned subject. The meeting was attended by Senior Officers of the Ministry of Power (MoP), Central Electricity Authority (CEA), Powergrid and Grid India. The list of participants is at **Annexure**.

2. CEA made a detailed presentation on the Report of the Committee (constituted by CEA) on **"Formulation of Trajectory of Indigenisation of SCADA System"**. CEA briefed that Committee had reviewed the present status of SCADA systems and formulated the roadmap for their indigenization, keeping in view of MoP's direction- "SCADA system not to be imported beyond 2030".

3. Chairperson, CEA stated that the application of indigenously developed SCADA systems is not limited to Load Dispatch Centres and that MeitY may also be consulted for consolidation of demand for SCADA hardware components and development of indigenous vendors for these items. He also highlighted the importance of creation of an in-house SCADA development team, preferably in Grid India, being the end user of the system.

4. CMD, Grid India informed that the estimated cost of SCADA / EMS software development cost is about Rs. 90-120 crore. He suggested that, instead of procuring the IPR for a single software solution, multiple indigenous developers may be selected through an Expression of Interest (EOI), with seed funding support, to promote competition and avoid monopolistic dependence. He further informed that Grid India would contribute about 25% of the funding requirement through its R&D budget and provide technical know-how, testing support and utility-scale validation for the developed applications.

that indigenous SCADA solutions had already been
tions and supported the timelines proposed by CEA and
tribute approximately 25% of the funding requirement
ovide testing infrastructure for development of indigenous

digenous SCADA vendors were already available in the
and that utilities had started incorporating such solutions

ed that while software testing facilities are available with
STQC and RTU testing can be carried out at CPRI, dedicated IEC 62443-compliant

Meeting held on 08-Jul-2026 on Indigenization of SCADA system at Shram Shakti Bhawan, New Delhi

Sl. No.	Description	Responsible entity
1	Indigenous SCADA/EMS to be developed till 2029; stop SCADA/EMS import beyond 2030.	Grid-India
2	Dedicated SCADA system development cell to be established with Grid-India	Grid-India
3	Consortium based approach to be adopted under guidance of CEA and Grid-India.	CEA and Grid-India
4	Expression of Interest (EoI) to be floated to select multiple developers.	CEA and Grid-India
5	Consortium to be supported through Govt. funding. And R&D funds of Grid-India/POWERGRID.	MoP, Grid-India and POWERGRID
6	Development of CIM based information model conforming to IEC 61970/61968 standards to ensure interoperability.	CEA, Grid-India and POWERGRID
7	Govt. supported testing and validation ecosystem to be established for hardware/ software.	Grid-India, POWERGRID and CPRI
8	Pilot implementation of indigenous SCADA/EMS Hardware and Software	CEA, Grid-India and POWERGRID
9	Monthly review meeting to be held under chairmanship of Secretary (Power) to monitor progress.	MoP

Indigenization of OT/IT Systems – Steps from Govt. Level (contd.)

ग्रिड-इंडिया
GRID-INDIA

ग्रिड-इंडिया
GRID-INDIA

ग्रिड कंट्रोलर ऑफ इंडिया लिमिटेड

(पूर्व विदित पावर सिस्टम ऑपरेशन कार्पोरेशन लिमिटेड)
केन्द्रीए कार्यालय, अभियांत्रिकी विभाग

सन्दर्भ: CC/Engg/Indigenous SCADA/2026/2(R-1) दिनांक: 28 July 2026

Subject: *Constitution of Working Group for Indigenous SCADA/EMS software & hardware development -reg*

A meeting on the Indigenous Development of SCADA/EMS system was held under the Chairmanship of Secretary, Ministry of Power (MoP), on 08 July 2026. Subsequently, a follow-up meeting was held at MoP, Shram-Shakti Bhawan, New Delhi on 21st July 2026 under chairmanship of Additional Secretary (Thermal) wherein it was decided to (i) constitute a Working Group comprising of members from MOP, CEA, MeitY, POWERGRID and GRID-INDIA for indigenous development of SCADA/EMS system, and (ii) constitute a dedicated Indigenous SCADA/EMS software/application Development Cell within GRID-INDIA for long-term project management, maintenance and future upgradation of the indigenous SCADA/EMS system.

Based on nominations received from concerned ministry/departments, the following Working Group and Working Subgroup for Indigenous SCADA/EMS software & hardware development have been formed:

Sl. No.	Member/Representative from	Name	Designation & Department
1	GRID-INDIA	Sh. R. K. Porwal (Chairman of Working Group)	Director, System Operation, Corporate Center
2	Ministry of Power (MoP)	Sh. Pranav Tayal	Director; Head of Section, URSI-I, UR&SI-II and Distribution
3	CEA	Member from CEA	
4	POWERGRID	Member from POWERGRID	
5	GRID-INDIA	Sh. B. S. Roy	CGM, Engineering, Corporate Center
6	GRID-INDIA	Sh. Rakesh (Member Convener)	GM, Engineering, Corporate Center
Subgroup for Software			
7	CEA	Sh. Arjun Agarwal	Asst. Director, PSCD Division
8	MeitY	Dr. Om Krishan	Scientist-E
9	POWERGRID	Dr. Sanjay Kumar	Manager, GA&C
10	GRID-INDIA	Sh. Ankur Gulati	DGM, SCADA, NLDC
11	GRID-INDIA	Sh. Mohneesh Rastogi	DGM, Engineering, CC
12	GRID-INDIA	Sh. Rohit Shukla	Manager, SCADA, NLDC
Subgroup for Hardware			
13	CEA	Sh. Mohit Mudgal	Dy. Director, ET&I Division
14	MeitY	Dr. Om Krishan	Scientist-E
15	POWERGRID	Sh. Awa	
16	GRID-INDIA	Sh. Ashu	

Circular from Grid-India dated 28-Jul-2026

- **Working group for Indigenous SCADA/EMS Software and Hardware development**
  - Comprises of members from MoP, CEA, POWERGRID and Grid-India.
  - Members from MeitY included in sub-groups of Hardware & Software.

- **Responsibilities of the Working Group/Subgroup –**
  - Provide overall ***project guidance*** and strategic oversight.
  - ***Review progress*** of project and facilitate inter-organizational coordination.
  - ***Monitor implementation*** of the roadmap and resolve key policy issues.
  - Project review and ***assessment of developer's progress*** and guidance.

- **Software Subgroup**
  - Monitor software development activities.
  - Review technical deliverables, implementation timelines, testing, and certification.

- **Hardware Subgroup**
  - Monitor indigenization of hardware components required for SCADA/EMS.
  - Review technical deliverables, implementation timelines, testing, and certification.
  - Recommend technical standards and report progress to the Working Group.

Indigenization of OT/IT Systems – Steps from Govt. Level (contd.)

ग्रिड-इंडिया
GRID-INDIA

ग्रिड-इंडिया
GRID-INDIA

ग्रिड कंट्रोलर ऑफ इंडिया लिमिटेड

(पूर्व विदित पावर सिस्टम ऑपरेशन कार्पोरेशन लिमिटेड)
केन्द्रीए कार्यालय, अभियांत्रिकी विभाग

सन्दर्भ: CC/Engg/Indigenous SCADA/2026/1 दिनांक: 27 July 2026

OFFICE ORDER No. 01/2026

Subject: *Constitution of Indigenous SCADA/EMS Software/Application Development Cell of GRID-INDIA-reg*

A meeting on the Indigenous Development of SCADA/EMS system was held under the Chairmanship of Secretary, Ministry of Power (MoP), on 08 July 2026, wherein it was decided to (i) constitute a committee comprising of MOP, GRID-INDIA, POWERGRID, CEA and MEITY for indigenous development of SCADA/EMS system, and (ii) constitute dedicated Indigenous SCADA/EMS software/application Development Cell within GRID-INDIA for long-term project management, maintenance and future upgradation of the indigenous SCADA/EMS system.

Pursuant to the nominations received from the concerned divisions, the following executives are hereby nominated as members of the Indigenous SCADA/EMS Software/Application Development Cell with immediate effect:

Sl. No.	Name	Designation & Department	Region
1	Sh. Rakesh **(Head of the Cell)**	GM; Engineering	Corporate Center
2	Sh. Ankur Gulati	DGM; SCADA	NLDC
3	Sh. Akhil Singhal	DGM; SCADA	NRLDC
4	Sh. Mohneesh Rastogi	DGM; Engineering	Corporate Center
5	Sh. Rohit Shukla	Manager; SCADA	NLDC
6	Sh. Ashutosh Kumar	Dy. Manager; Engineering	Corporate Center
7	Sh. Vikas	Dy. Manager; Engineering	Corporate Center
8	Sh. IVSSR Hemanth Kumar	Dy. Manager; SCADA	WRLDC
9	Sh. CVS Yugesh	Dy. Manager; SL	SRLDC

The cell shall undertake necessary steps towards indigenous development of SCADA/EMS system in coordination with the committee/Sub-committees.

This Office Order has been issued with approval of competent authority.

27/07/26
बी. एस. रॉय
मुख्य महाप्रबंधक
(अभियांत्रिकी)

Office Order from Grid-India dated 27-Jul-2026

- **Indigenous SCADA/EMS Software Development Cell –**
  - Comprises of members from Grid-India establishments such as Corporate Engineering, NLDC, NRLDC, WRLDC and SRLDC.
  - Shall undertake necessary ***steps towards indigenous development of SCADA/EMS system*** in coordination with other committee(s) or sub-committee(s).

- **Set of applications identified by software development cell for Indigenous development *(as shown in table on right)*.**
- **Draft Expression of Interest has been prepared and currently under review process.**

Sl. No.	Set of applications for Indigenous Development
1	SCADA
2	Load Shed Support (LSS) /ADMS
3	ICCP Communication
4	CFE Communication
5	Historian (Information Storage, Retrieval & Reporting) System along-with GUI
6	PDS & Test bench for FEP, SCADA and ICCP Integration
7	Web Server Application - Software for Data Replica
8	Web Server Application - Software for Web Server
9	EMS Functions - State Estimator
10	EMS Functions - Contingency Analysis
11	EMS Functions - Security Enhancement
12	EMS Functions - Optimal Power Flow
13	EMS Functions - Outage Scheduler
14	EMS Functions - Transmission Line/Corridor Capability Monitor (TCM)
15	EMS Functions - Short Circuit Analysis
16	EMS Functions - Automatic Generation Control (AGC)
17	EMS Functions - Load Forecasting
18	Dynamic Security Assessment (DSA) Software
19	Dispatcher Training Simulator (DTS)

Indigenization of OT/IT Systems – Steps from Govt. Level (contd.)

(INVITATION FOR EXPRESSION OF INTEREST)

GRID CONTROLLER OF INDIA LIMITED

(GRID-INDIA)

(A Government of India Enterprise)

Invites

Expression of Interest (EOI)

For

Development of Indigenous Supervisory Control and Data Acquisition (SCADA) and Energy Management System (EMS) Software/Applications for Load Despatch Centres of India

"Draft Expression of Interest (EoI)" prepared by Grid-India

- *50 crores funds may get sanctioned based on milestone based approach.*
- *5 software developers may get selected.*
- *10 Crores funding to each developer may get allotted.*

Activity	Major Activities of Project	Activity Duration in months	Start Month of Activity	Completion Month of Activity
A	EOI Invitation	Day 0 (zero)		
B	EOI evaluation, clarifications & shortlisting of developers for Indigenous development of SCADA/EMS system	5 Months	1st Month	5th Month
C	Kick-Off of SCADA EMS Indigenous development project, Finalization of functional specifications	5 Months	6th Month	11th Month
D	Signing of Memorandum of Agreement (MoA) with developers of Indigenous SCADA/EMS development	1 Month	12th Month	12th Month
E	Submission of Advance Bank Guarantee by developers	1 Month	12th Month	12th Month
F	Advance Payment (@ 30%)	1 Month	12th Month	12th Month
G	[MILESTONE-1] (Payment: 30%) Design, Development & Demonstration of Database structure/schema for Power System Database for SCADA/EMS applications	15 Months	12th Month	27th Month
H	Establishment of Indigenously developed SCADA/EMS application Testing Platform	4 Months	12th Month	16th Month
I	[MILESTONE-2] (Payment: Functional Testing Activity Software/Applications			
J	VAPT and Source Code Aud of conformity for CIM Com interoperability with SCAD			
K	[MILESTONE-3] (Payment: Successful Certification & C Indigenous SCADA/EMS ap Centers			

"Draft implementation timeline" for each developer

(#Note: The below allocation is on a per-developer basis.)

Sl. No.	Set of applications for Indigenous Development	% Weightage	Allocated Fundst [in Lakhs]	Initial Advance Payment (30%) after Submission & Validation of Bank Guarantee [in Lakhs]	[MILESTONE-1] Payment (30%) after application development & demonstration [in Lakhs]	[MILESTONE-2] Payment (30%) after functional testing [in Lakhs]	[MILESTONE-3] Balance Payment (40%) after Successful Indigenous development Certification [in Lakhs]
1	SCADA	5%	50	15	15	15	20
2	Load Shed Support (LSS) /ADMS	1%	10	3	3	3	4
3	ICCP Communication	3%	30	9	9	9	12
4	CFE Communication	2%	20	6	6	6	8
5	Historian (Information Storage, Retrieval & Reporting) System along-with GUI	5%	50	15	15	15	20
6	PDS (including CIM compliant database development) & Test bench for FEP, SCADA and ICCP Integration	5%	50	15	15	15	20
7	Web Server Application - Software for Data Replica	2%	20	6			
8	Web Server Application - Software for Web Server	2%	20	6			
9	EMS Functions - State Estimator	10%	100	30			
10	EMS Functions - Contingency Analysis	10%	100	30			
11	EMS Functions - Security Enhancement	10%	100	30			
12	EMS Functions - Optimal Power Flow	5%	50	15			
13	EMS Functions - Outage Scheduler	3%	30	9			
14	EMS Functions - Transmission Line/Corridor Capability Monitor (TCM)	5%	50	15			
15	EMS Functions - Short Circuit Analysis	5%	50	15			
16	EMS Functions - Automatic Generation Control (AGC)	10%	100	30			
17	EMS Functions - Load Forecasting	2%	20	6			
18	Dynamic Security Assessment (DSA) Software	5%	50	15			
19	Dispatcher Training Simulator (DTS)	10%	100	30			
		100 %	1000	300			

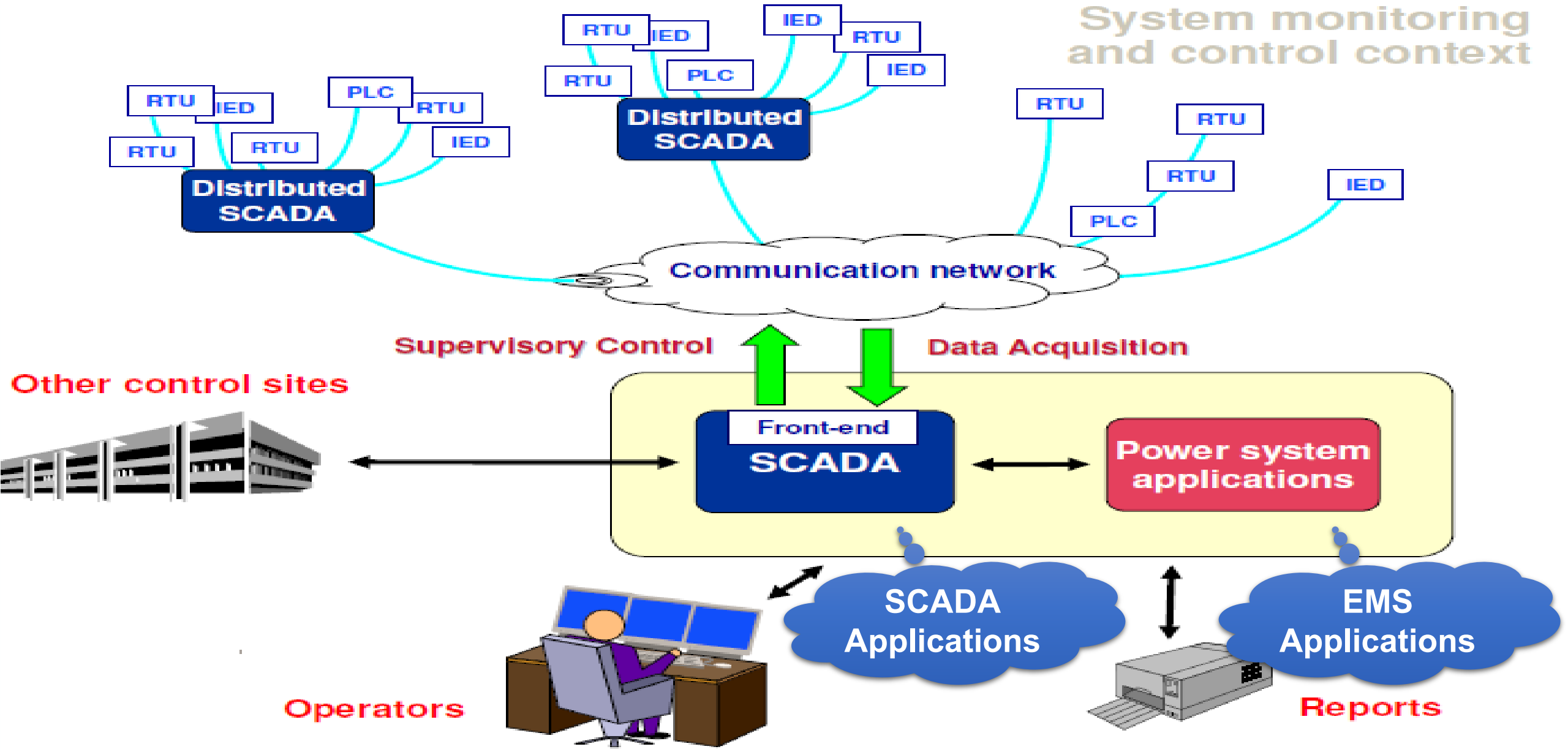
"Draft funds disbursal plan" for each developer

Year wise payment rele

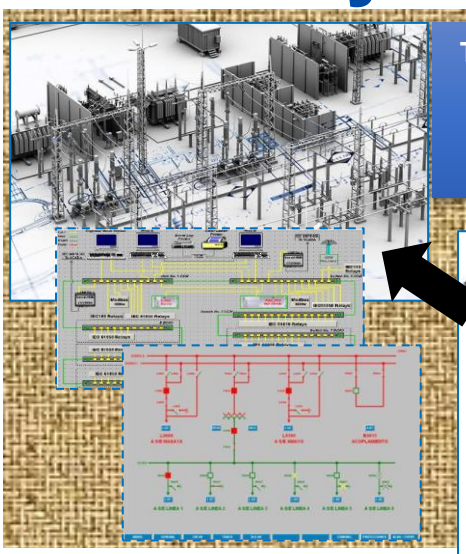
Payment Year	Activity/Milestone# for Payment	Activity	Year-wise Total	Activity	Year-wise Total
Year-1	EOI Invitation, Evaluation, Developer Shortlisting, Methodology of Database development, Finalization of functional requirements for SCADA/EMS Applications	0	0	0	0
	Advance Payment (@ 30%of Allocated Fund)	3.00	3.00	15.00	15.00
Year-2	Milestone-1(a) Design, Development & Demonstration of Database structure/schema of PDS & SCADA Application	0.75	1.50	3.75	7.50
	Milestone- 2(a) Functional testing of PDS & SCADA Applications	0.75		3.75	
Year-3	Milestone-1(b) Design, Development & Demonstration of Database structure/schema of EMS Application	2.25	8.50	11.25	42.50
	Milestone-2(b) Functional testing of EMS Applications	2.25		11.25	
	Milestone-3(a) Performance testing & certification of PDS & SCADA Applications	1.00		5.00	
	Milestone-3(b) Performance testing & certification of EMS Applications	3.00		15.00	
Total (Ten Crore per developer or Fifty Crore for five developers after adjustment of advance payment to each developer on achievement of pre-specified milestones)		10.00	10.00	50.00	50.00

"Year-wise payment release plan" for developers

SCADA Functioning – System Monitoring & Control Context

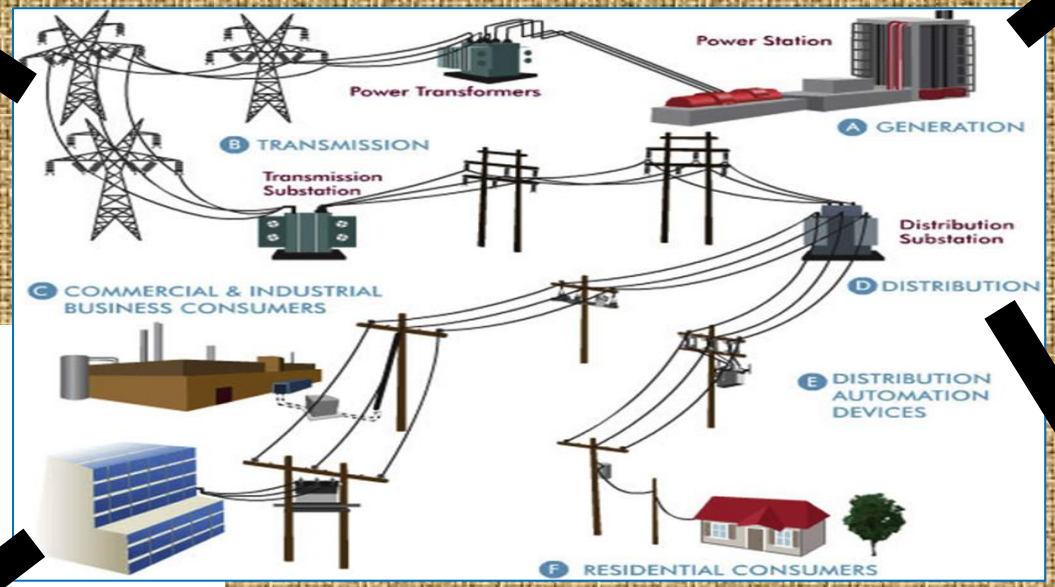


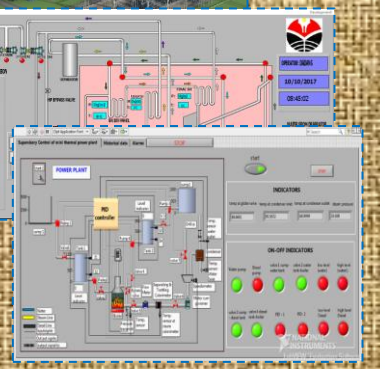
Power System Organization

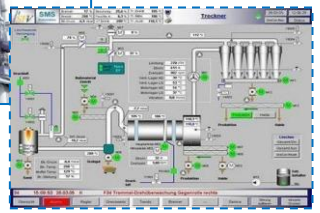


Transmission Substation SCADA Systems

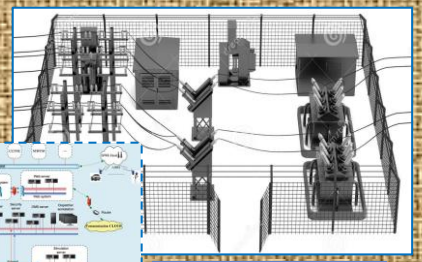
Generating Station SCADA Systems

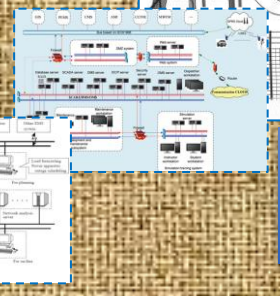






Industrial SCADA Systems



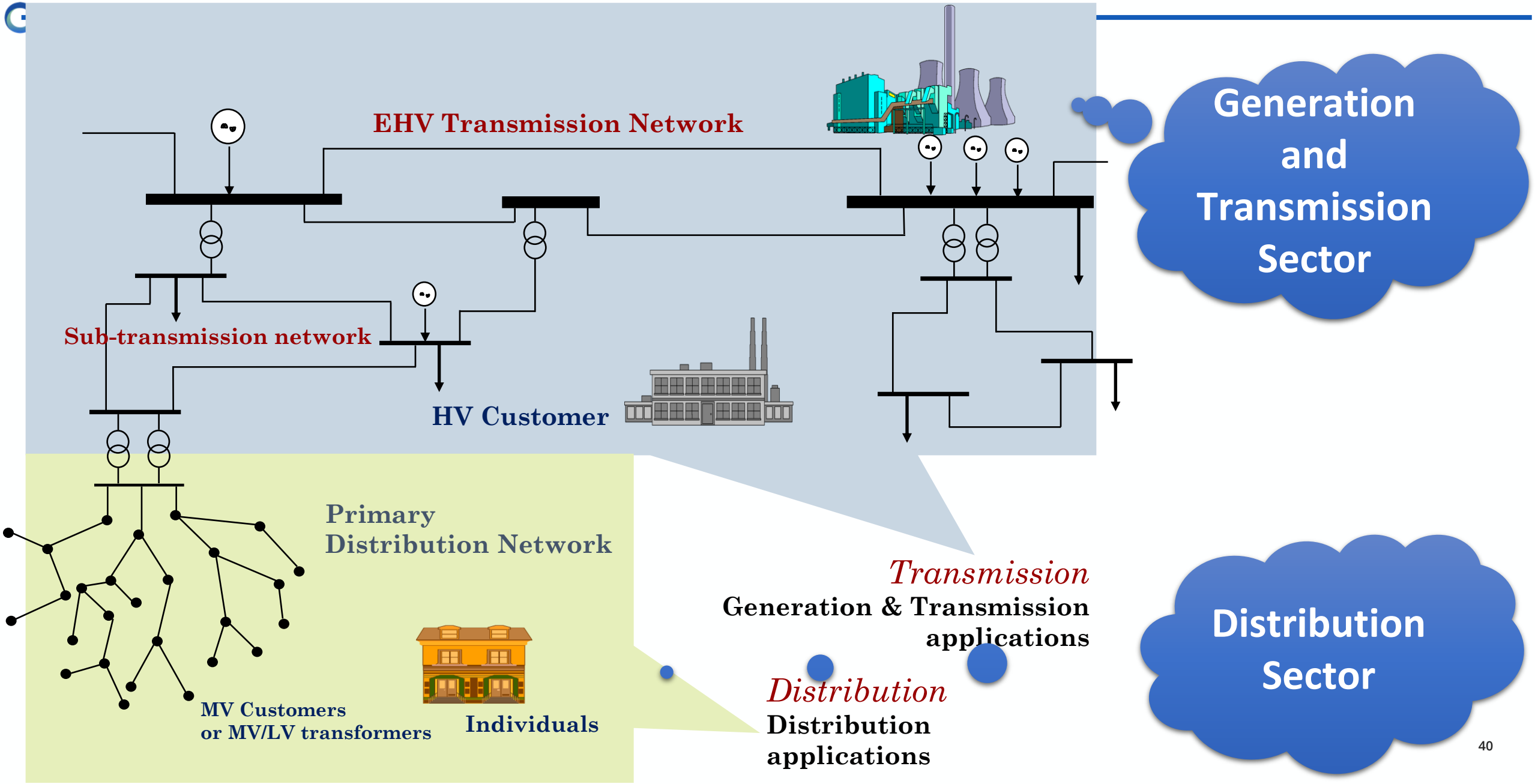


Distribution Station SCADA Systems

"Power System Operational Data" transferred to Load Despatch Centres (or "Grid Control Centres" or "Network Control Centres")

Control Centres Level SCADA *(Generation, Transmission and Distribution Applications)*

Power System Organization (contd.)



SCADA Systems – Components and Measurements

Power system analog measurements	Weather related analog measurements
Voltage (kV)	Temperature
Active Power (MW)	Humidity
Re-active Power (MVAr)	Wind Speed
System Frequency (Hz)	Wind Direction
Tap Position (OLTC)	Pressure
Angle Measurement (θ)	Luminosity
..... various other measurements	*..... various other measurements*

Analog Measurements from the field

Power system digital measurements	Power System events digital measurements
Circuit Breaker Status (OPEN/CLOSE)	Relay contacts
Isolator Status (OPEN/CLOSE)	Sequence of Events (SoE)
Local/Remote Setting Status	
..... various other measurements	*..... various other measurements*

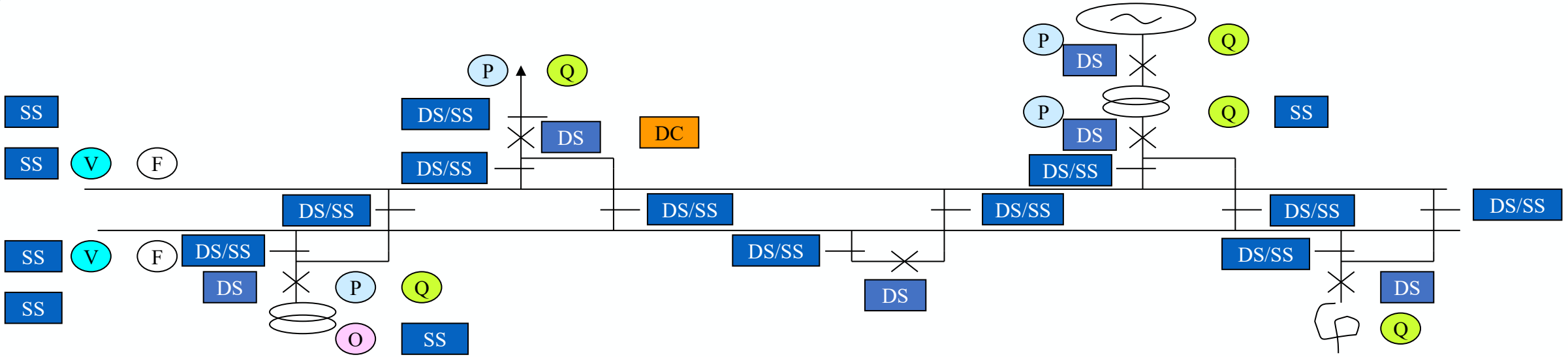
Digital Measurements from the field

- Statistics related to quantum of real-time power system operational data reporting at SCADA Systems of NRLDC.

- **ULDC Phase 2 System in Northern Regional Load Despatch Centre (NRLDC) –**
  - **Nos. of stations:** 2,254
  - **Stations at 765kV level:** 50
  - **Stations at 400kV level:** 257
  - **Total analog points:** 1,79,565
  - **Total digital points:** 1,25,584

- **Northern Regional Renewable Energy Management Centre (NR-REMC) –**
  - **Nos. of stations:** 200
  - **Solar stations:** 192
  - **Wind stations:** 9
  - **Battery Energy Storage System (BESS) stations:** 10
  - **Total analog points:** 48,817
  - **Total digital points:** 41,229

Data Acquisition Principle



P **MW** Q **MVAR** O **TAP POSITION**

F **FREQUENCY** V **VOLTAGE**

SS — SINGLE STATUS
ISOLATOR POSITION, PROTECTION,
LOSS OF VOLTAGE

DS — DOUBLE STATUS
ISOLATOR/CIRCUIT BREAKER POSITION

DC — DIGITALCONTROL
CIRCUIT BREAKER CONTROL

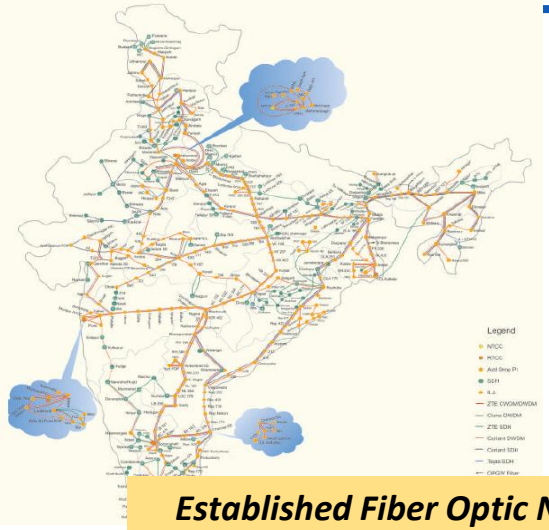
In SAS-based stations and stations with deployment of new RTUs, Isolators are also being modeled as Double-Status

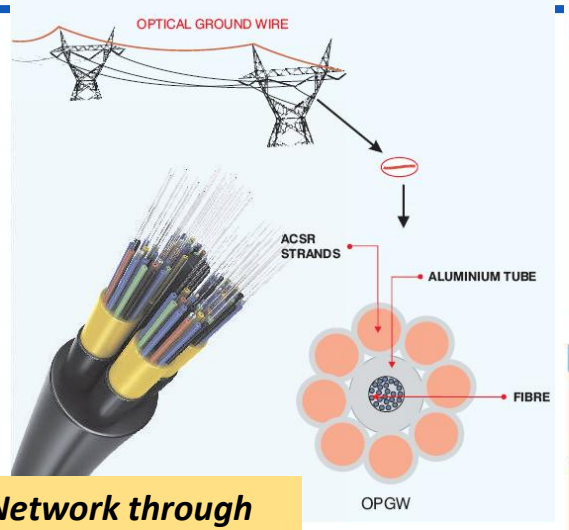
Communication System – Media

Type of Media	Examples
Guided Media	· Twisted pair · Co-axial metallic cable · **Optical fiber** · **Power line carrier communication** · Telephone based systems (dial-up, ISDN, etc.)
Un-guided Media	· **Satellite (or VSAT)** · Radio (VHF, UHF, etc.) · Microwave · Cell-phone · Paging

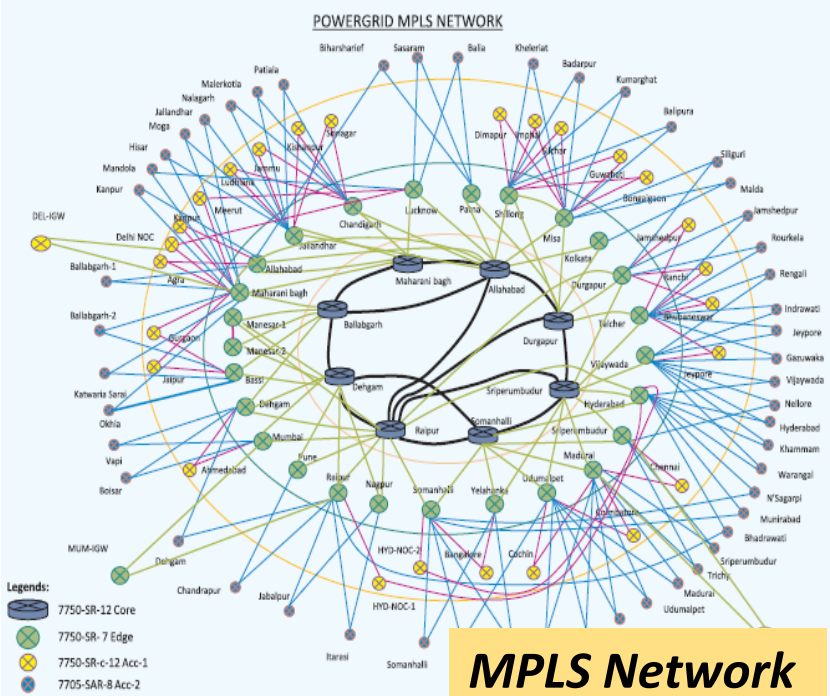
Guided (wired)		Unguided (wireless)	
Utility owned	**Leased**	**Utility owned**	**Leased**
· Power line · Dedicated line · Optical fiber · Twisted pair · Co-axial cable	· Leased telephone · TV cable	· Spread spectrum radio · MAS radio	· Paging system · Cellular phone · Satellite

Media of Communication

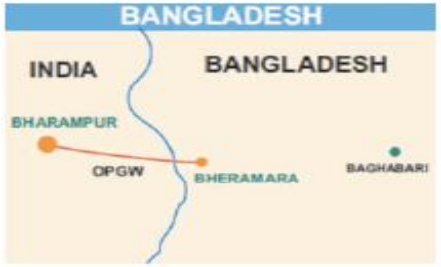




Established Fiber Optic Network through Optical Ground Wire (OPGW)



MPLS Network



International Data links (existing/ proposed)

Communication System - Protocols

Various communication protocols used in power system SCADA are as follows –

- Transfer Control Protocol/Internet Protocol (TCP/IP)
- Modbus
- IEC 60870-5-101/103/104
- Distributed Network Protocol 3 (DNP3)
- Inter Control Centre Communication Protocol (ICCP)
- Ethernet
- IEC 61850
- IEEE C37.118 – Synchrophasor Standard

Site to Control Centre

Control Centre to Control Centre

Within a Substation

Unified Real Time Dynamic State Measurement (URTDSM) System – PMU Based

Communication Protocols widely used in Power System SCADA

IEC 60870 Standards Family

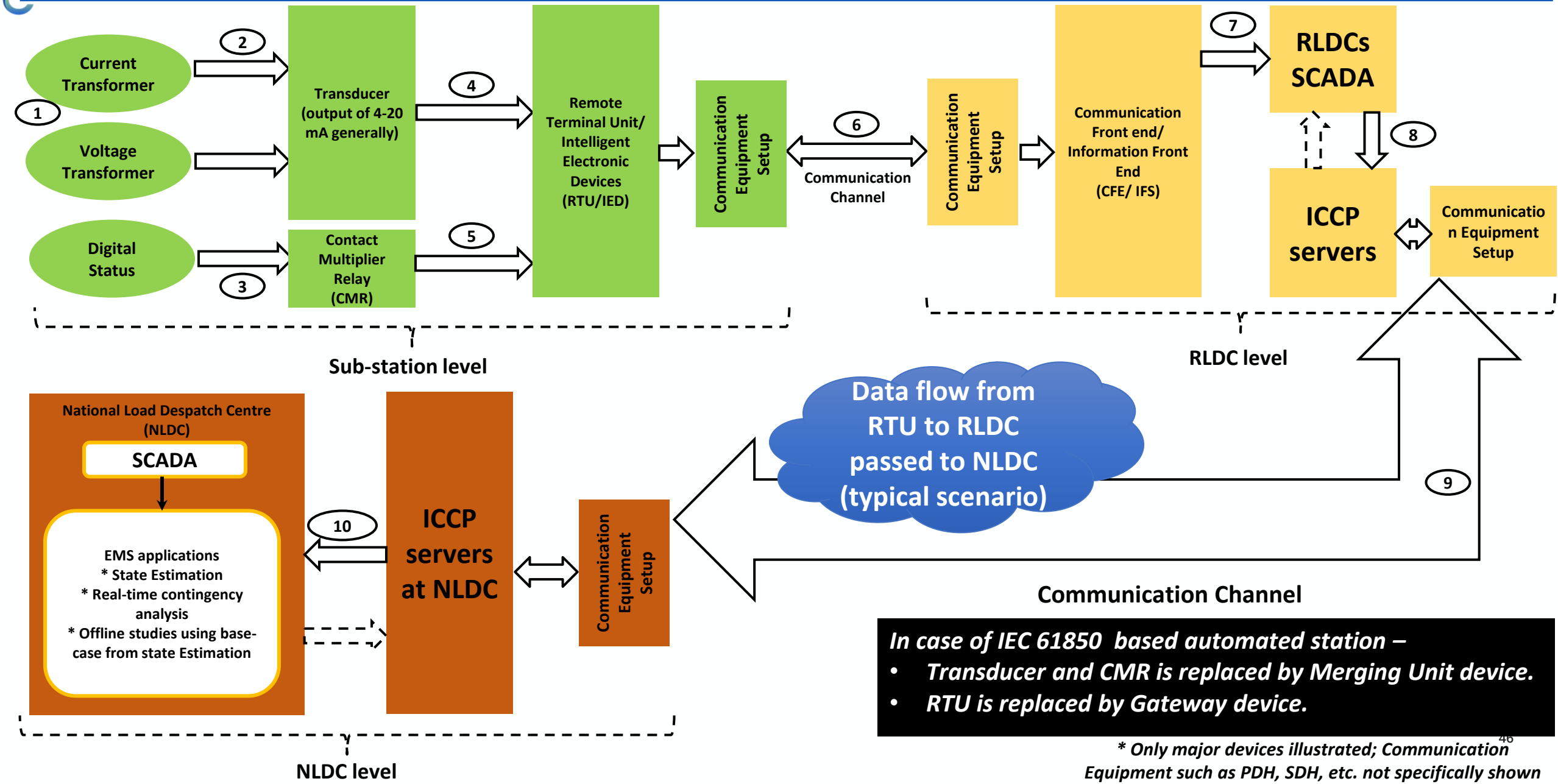
- The International Electrotechnical Commission 60870 standards define systems used for telecontrol (Supervisory Control and Data Acquisition).

List of IEC 60870 Parts	Description
IEC TR 60870-1-1:1988	General considerations. Section One: General principles
IEC 60870-1-2:1989	General considerations. Section Two: Guide for specifications
IEC TR 60870-1-3:1997	General considerations - Section 3: Glossary
IEC TR 60870-1-4:1994	General considerations - Section 4: Basic aspects of telecontrol data transmission and organization of standards IEC 870-5 and IEC 870-6
IEC TR 60870-1-5:2000	General considerations - Section 4: Influence of modem transmission procedures with scramblers on the data integrity of transmission systems using the protocol IEC 60870-5
IEC 60870-2-1:1995	Operating conditions - Section 1: Power supply and electromagnetic compatibility
EC 60870-2-2:1996	Operating conditions - Section 2: Environmental conditions (climatic, mechanical and other non electrical influences)
IEC 60870-3:1989	Interfaces (electrical characteristics)
IEC 60870-4:1990	Performance requirements

List of IEC 60870 Parts	Description
IEC 60870-5-1	Transmission Frame Formats
IEC 60870-5-2	Data Link Transmission Services
IEC 60870-5-3	General Structure of Application Data
IEC 60870-5-4	Definition and Coding of Information Elements
IEC 60870-5-5	Basic Application Functions
IEC 60870-5-6	Guidelines for conformance testing for the IEC 60870-5 companion standards
IEC TS 60870-5-7	Security extensions to IEC 60870-5-101 and IEC 60870-5-104 protocols (applying IEC 62351)
IEC 60870-5-101	Transmission Protocols - companion standards especially for basic telecontrol tasks
IEC 60870-5-102	Transmission Protocols - Companion standard for the transmission of integrated totals in electric power systems
IEC 60870-5-103	Transmission Protocols - Companion standard for the informative interface of protection equipment
IEC 60870-5-104	Transmission Protocols - Network access for IEC 60870-5-101 using standard transport profiles
IEC TS 60870-5-601	Transmission protocols - Conformance test cases for the IEC 60870-5-101 companion standard
IEC TS 60870-5-604	Conformance test cases for the IEC 60870-5-104 companion standard

List of IEC 60870 Parts	Description
IEC 60870-6-1	Application context and organization of standards
IEC 60870-6-2	Use of basic standards (OSI layers 1–4)
IEC 60870-6-501	TASE.1 Service definitions
IEC 60870-6-502	TASE.1 Protocol definitions
IEC 60870-6-503	**TASE.2 Services and protocol**
IEC 60870-6-504	TASE.1 User conventions
IEC TR 60870-6-505	TASE.2 User guide
IEC 60870-6-601	Functional profile for providing the connection-oriented transport service in an end system connected via permanent access to a packet switched data network
IEC 60870-6-602	TASE transport profiles
IEC 60870-6-701	Functional profile for providing the TASE.1 application service in end systems
IEC 60870-6-702	Functional profile for providing the **TASE.2 application service** in end systems
IEC 60870-6-802	**TASE.2 Object models**

Data transfer from Site to Control Centres – RTU on IEC 101/104 protocol

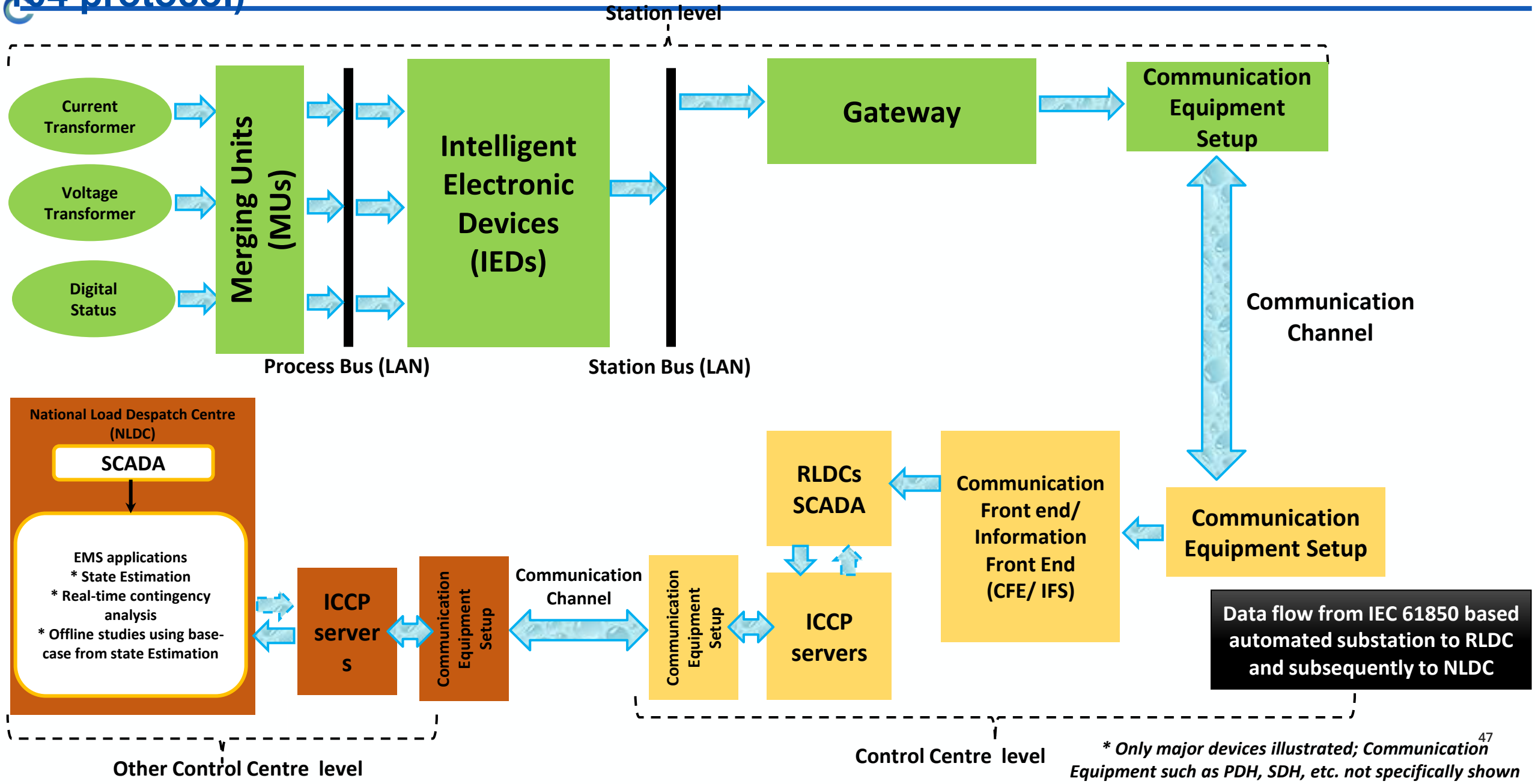


In case of IEC 61850 based automated station –

- *Transducer and CMR is replaced by Merging Unit device.*
- *RTU is replaced by Gateway device.*

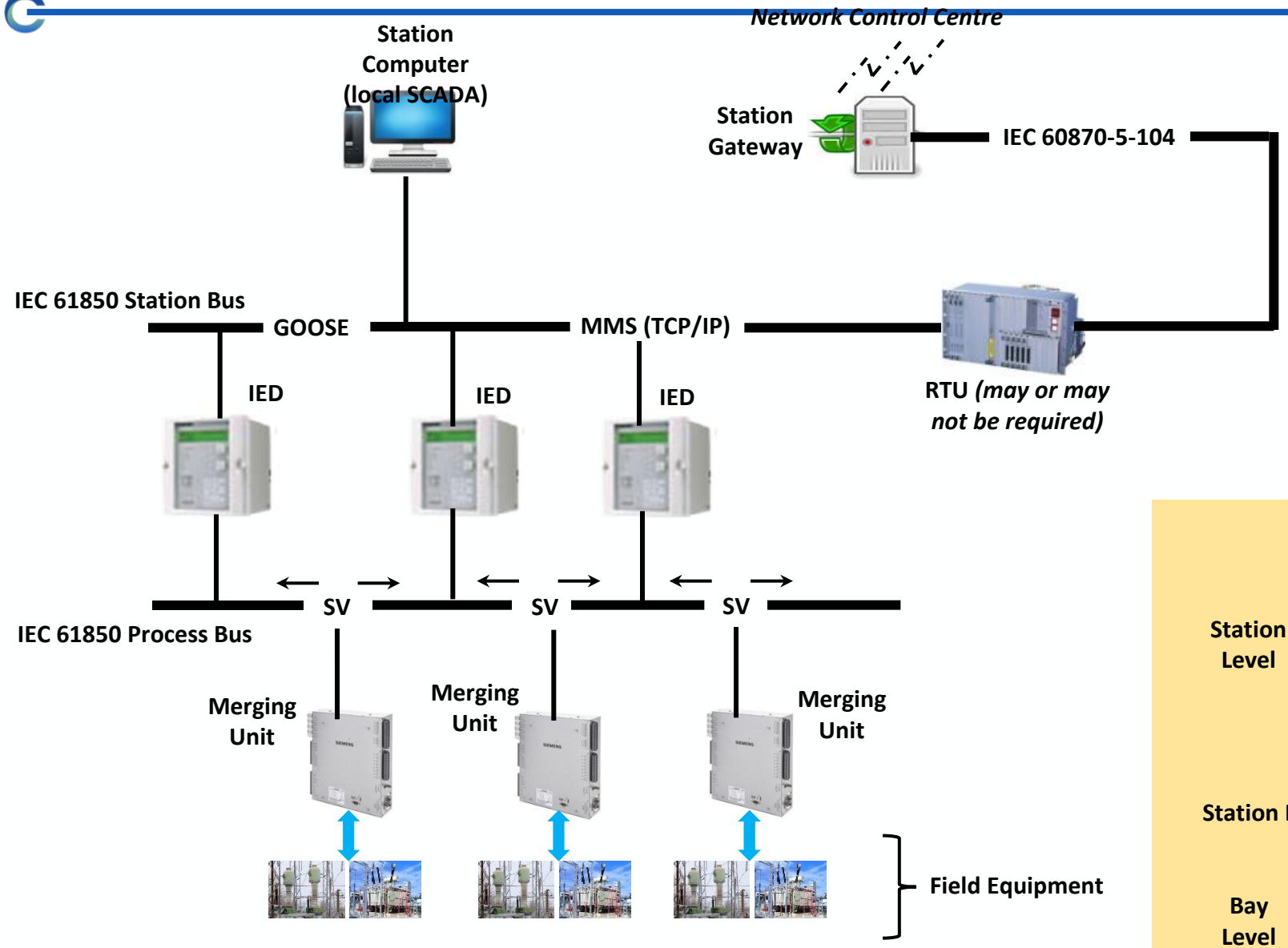
** Only major devices illustrated; Communication Equipment such as PDH, SDH, etc. not specifically shown*

Data transfer from Site to Control Centres – SAS Based Stations (Typically on IEC 104 protocol)



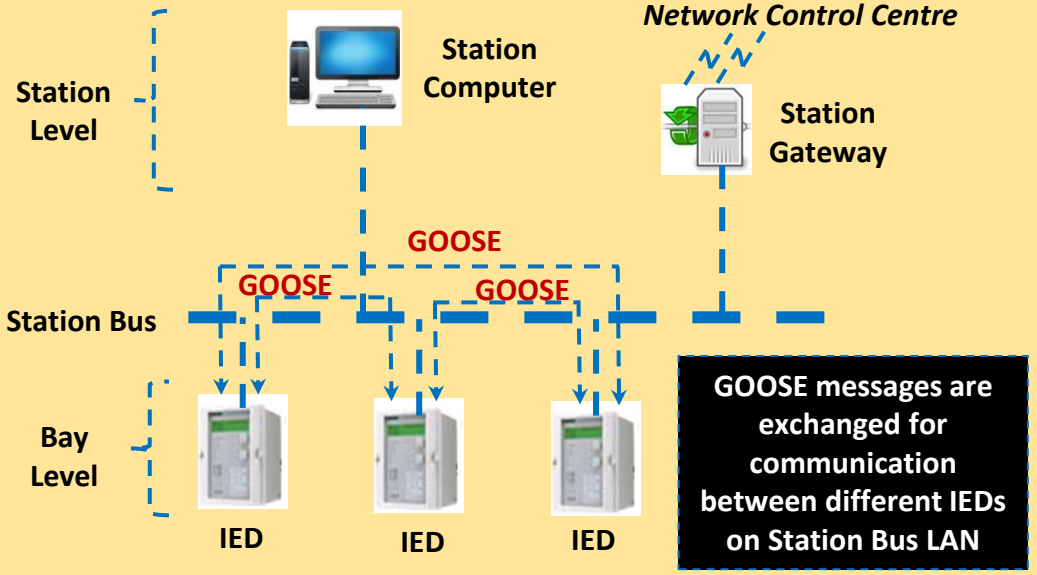
** Only major devices illustrated; Communication Equipment such as PDH, SDH, etc. not specifically shown*

Data Acquisition from IEC 61850-Based Station



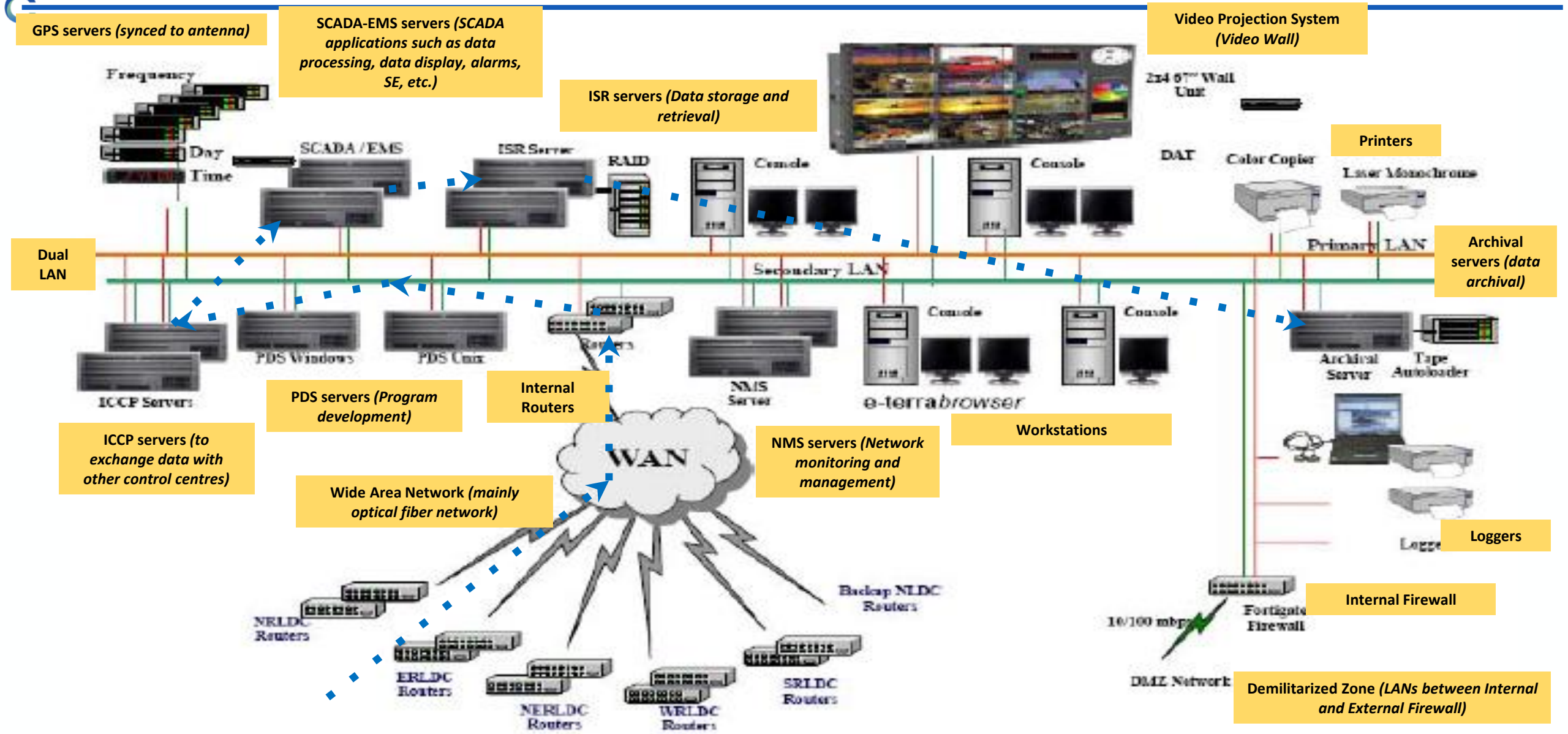
GOOSE: Generic Object Oriented Substation event
MMS: Manufacturing Message Specification
SV: Sampled Value

Reporting to SCADA/RTU – Communication



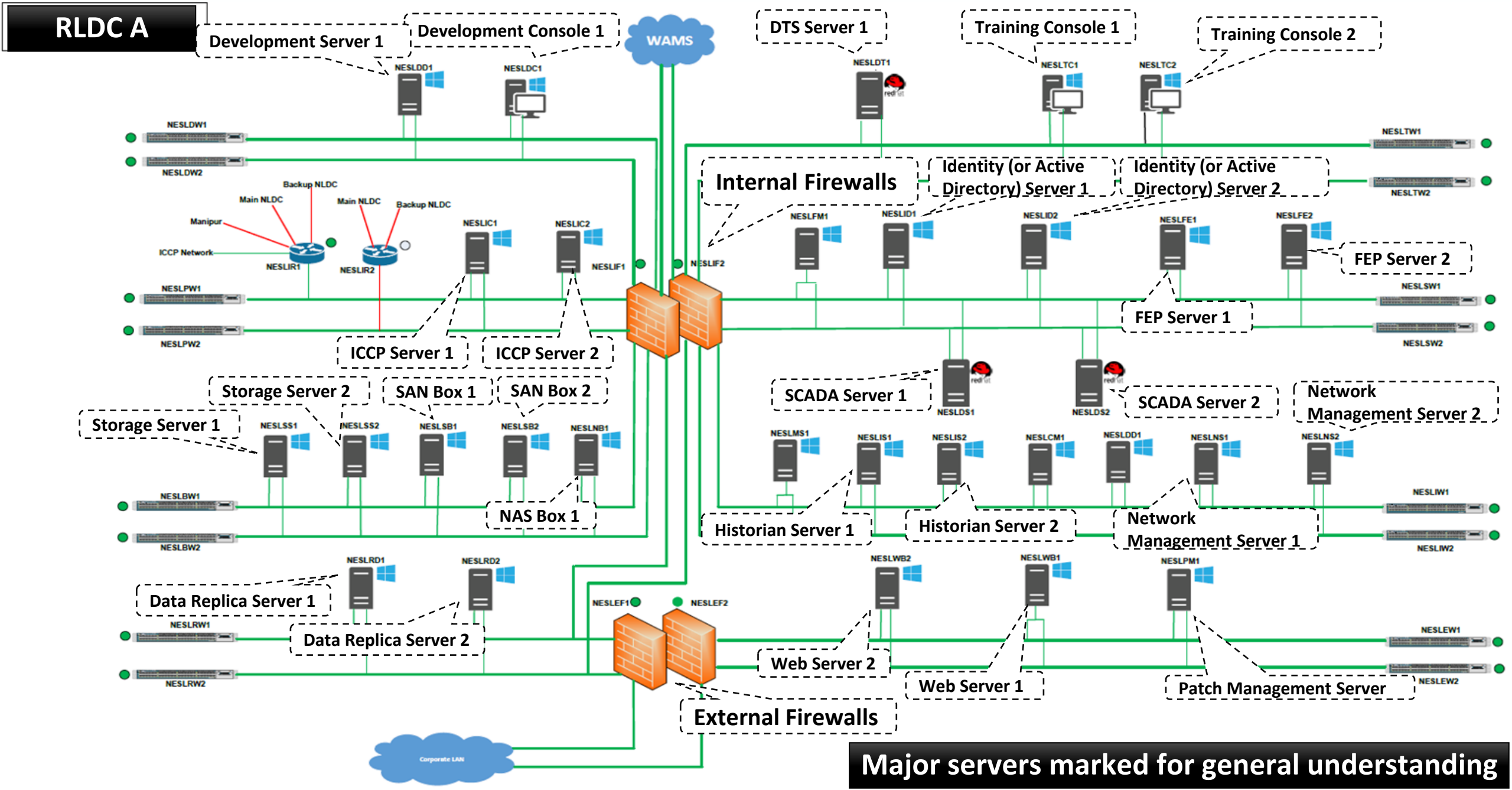
GOOSE messages are exchanged for communication between different IEDs on Station Bus LAN

SCADA System during 2000-2015 – Simpler Architecture (Example of NLDC)



No direct RTU/SAS reporting to NLDC at present except for Automatic Generation Control purposes in few stations

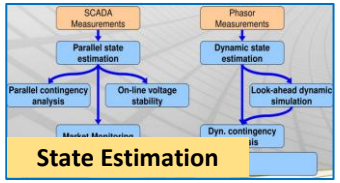
SCADA System in ULDC Phase-2 implementation – Segregated Architecture based on functionalities



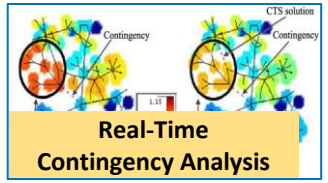
Major servers marked for general understanding

Energy Management System Tools – Accompanied with SCADA

- **Energy Management System (EMS)** is a computer based tool to help manage power system operations.
- The system collects, coordinates, analyses and disseminates operational power system information to serve as a decision support tool for power system operation personnel.
- A Supervisory Control And Data Acquisition (SCADA) system is a part of the EMS system which provides for the monitoring and telemetry of status information for power system equipment.
- **Why do we need EMS functions ?**
  - Help grid operators in decision making.
  - Gives scientific logic for any actions.
  - Gives warning for any emergency situation.
  - Power system can be analysed for different operating conditions.
  - To get a *base case* for further Analysis.

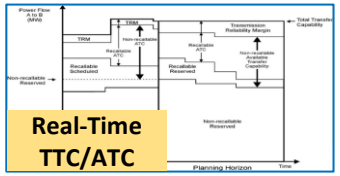


State Estimation

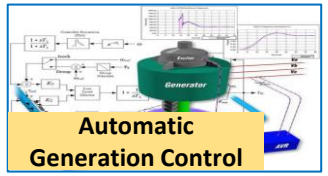


Real-Time Contingency Analysis

Security Enhancement

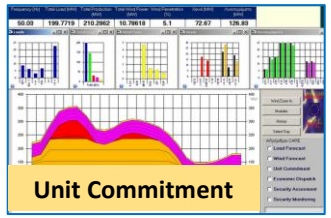


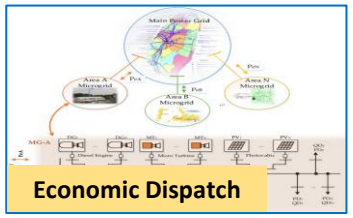
Real-Time TTC/ATC



Automatic Generation Control

Dynamic Security Assessment


Unit Commitment



Economic Dispatch

EMS applications act as Decision Support Tools

Classification based on Operations

Operation Scheduling
- Load forecasting
- Inflow forecasting
- Unit commitment
- Hydro scheduling
- Hydro Thermal Coordination
- Interchange scheduling
- Current operating plan
- Outage scheduling

Load Generation Balance
- Operation monitoring
- Automatic Generation Control (AGC)
- Economic Despatch (ED)
- Reserve monitoring
- Load-shed /Restoration
- Production costing

Power System Analysis
- Network Topology
- State estimation
- Contingency analysis
- Optimal power flow
- Transmission loss sensitivity factors
- Post disturbance analysis

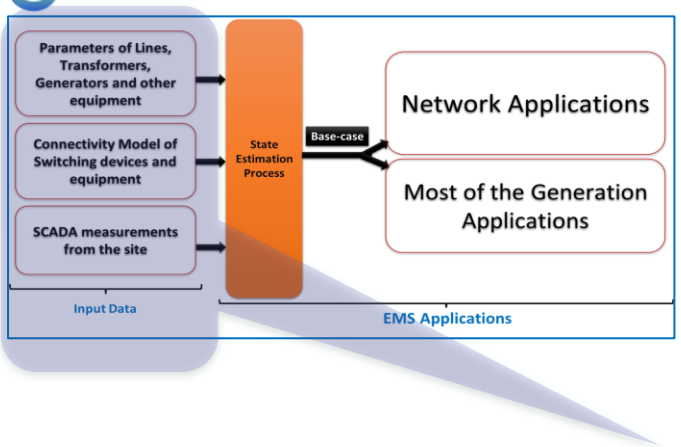
Classification based on Time-Domain

Pre Dispatch Functions
- Load Forecasting/Inflow forecasting
- Resource Scheduling And Commitment
- Network Outage Planning

Real Time Operation
- State Estimator
- Real Time contingency analysis
- Real Time Security Enhancement
- Real Time Generation Control
- Voltage Var Dispatch

Post Dispatch / off line activities
- Dispatcher training Simulator
- Other features like – Historical Data Recording, Historical Information Management, Sequence Of Events, Load Flow Studies etc.

Inputs required for EMS Applications

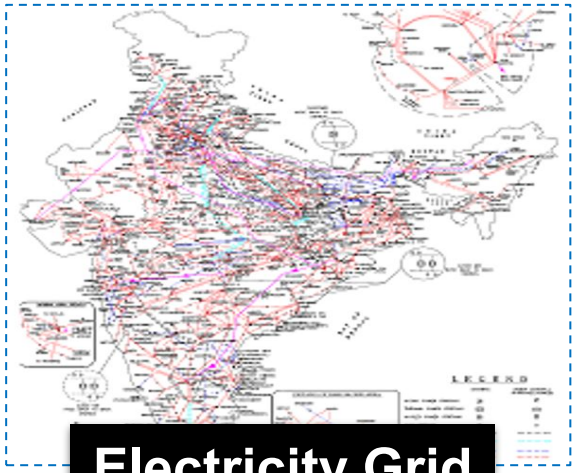


- ❑ Real-time Data:
  - Active Power
  - Reactive Power
  - Frequency
  - Voltages
  - Breaker OPEN/ CLOSE Status
  - Isolators OPEN/ CLOSE Status
- ❑ Static Data (one time):
  - Ratings and Parameters of equipment
  - Equipment connectivity info (Single Line Diagram)

- ❑ Real-time Data:
  - Active Power
  - Reactive Power
  - Frequency
  - Voltages
  - Breaker OPEN/ CLOSE Status
  - Isolators OPEN/ CLOSE Status
- ❑ Static Data (one time):
  - Ratings and Parameters of equipment
  - Equipment connectivity info (Single Line Diagram)

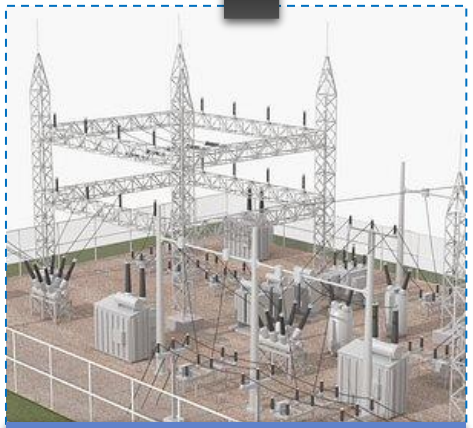
- ❑ Static Data (one time):
  - R, X and B of transmission line
  - Line Length
  - Conductor Type
  - R, X and B of Conductor Type
  - Equipment connectivity info (Single Line Diagram)
  - ….. Others

- ❑ Real-time data:
  - Available from respective substations itself
- ❑ Static Data (one time):
  - Load Type
  - Nominal Load MW
  - Power Factor
  - ….. Others



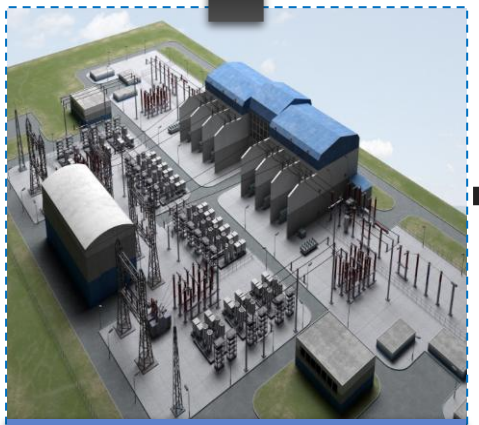
Electricity Grid

=



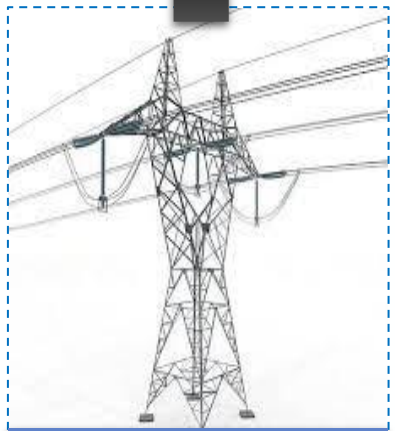
Substations (containing equipment such as Transformers, Reactors, STATCOMs, SVCs, Buses, Breakers, Isolators, etc.)

+



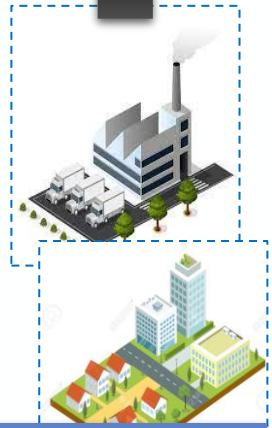
Generating Stations (containing equipment such as Transformers, Reactors, Generating Units, Buses, Breakers, Isolators, etc.)

+



Transmission Lines (conductors on towers connecting different stations)

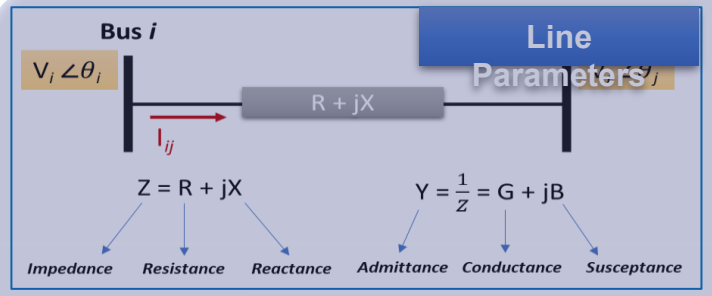
+



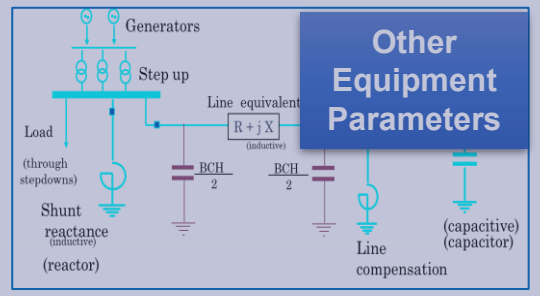
Loads at Distribution Stations Level (Domestic, Commercial, Industrial, etc.)

Inputs required for EMS Applications (contd.)

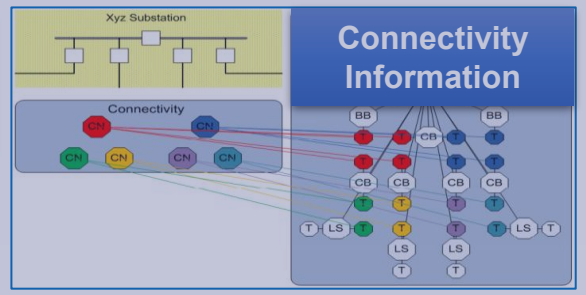
One-time collection (offline)



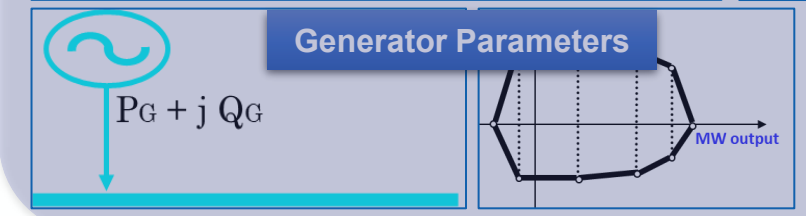
Line Parameters



Other Equipment Parameters



Connectivity Information



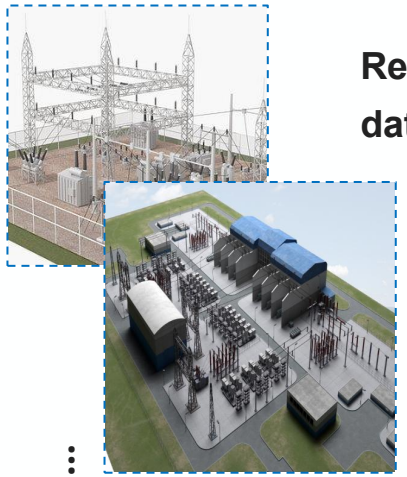
Generator Parameters

..... Others

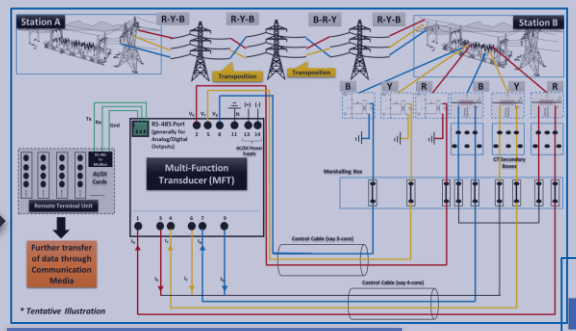
Others

❑ Network Database in SCADA-EMS System

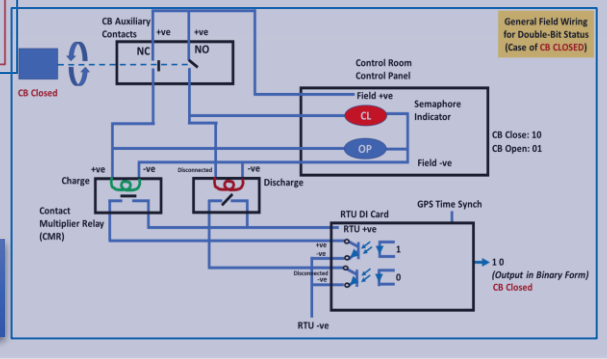
Measurements (in SCADA) are mapped on respective devices (in Network Database)



Real-time data transfer

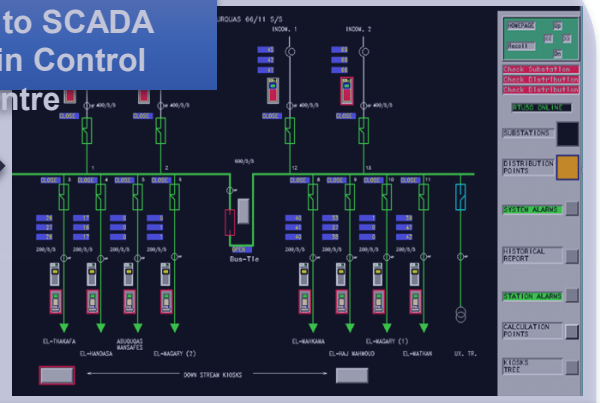


Analog data collection at site (wiring diagram)



Digital data collection at site (wiring diagram)

Transfer to SCADA System in Control Centre



❑ SCADA Measurements in SCADA-EMS System

Inputs & Outputs in State Estimation Process

Power System

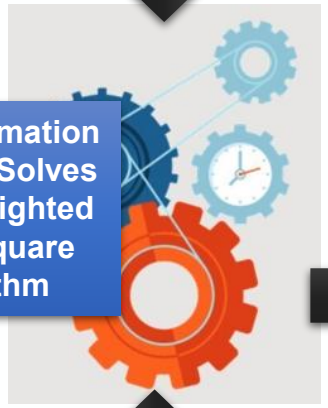
- Analog Measurements – MW, MVAR, kV, Hz, etc.
- Digital Measurements – OPEN/CLOSE Status of switching devices (i.e. Breakers & Isolators)

Major Inputs

State Estimation

Network Database (already existing static values)

Input 2



State Estimation Process: Solves using Weighted Least Square Algorithm

Input 1

SCADA Measurements

Processing

Basecase (containing complex voltages, Load/Generation Profile)

Grid Operation in Control Room

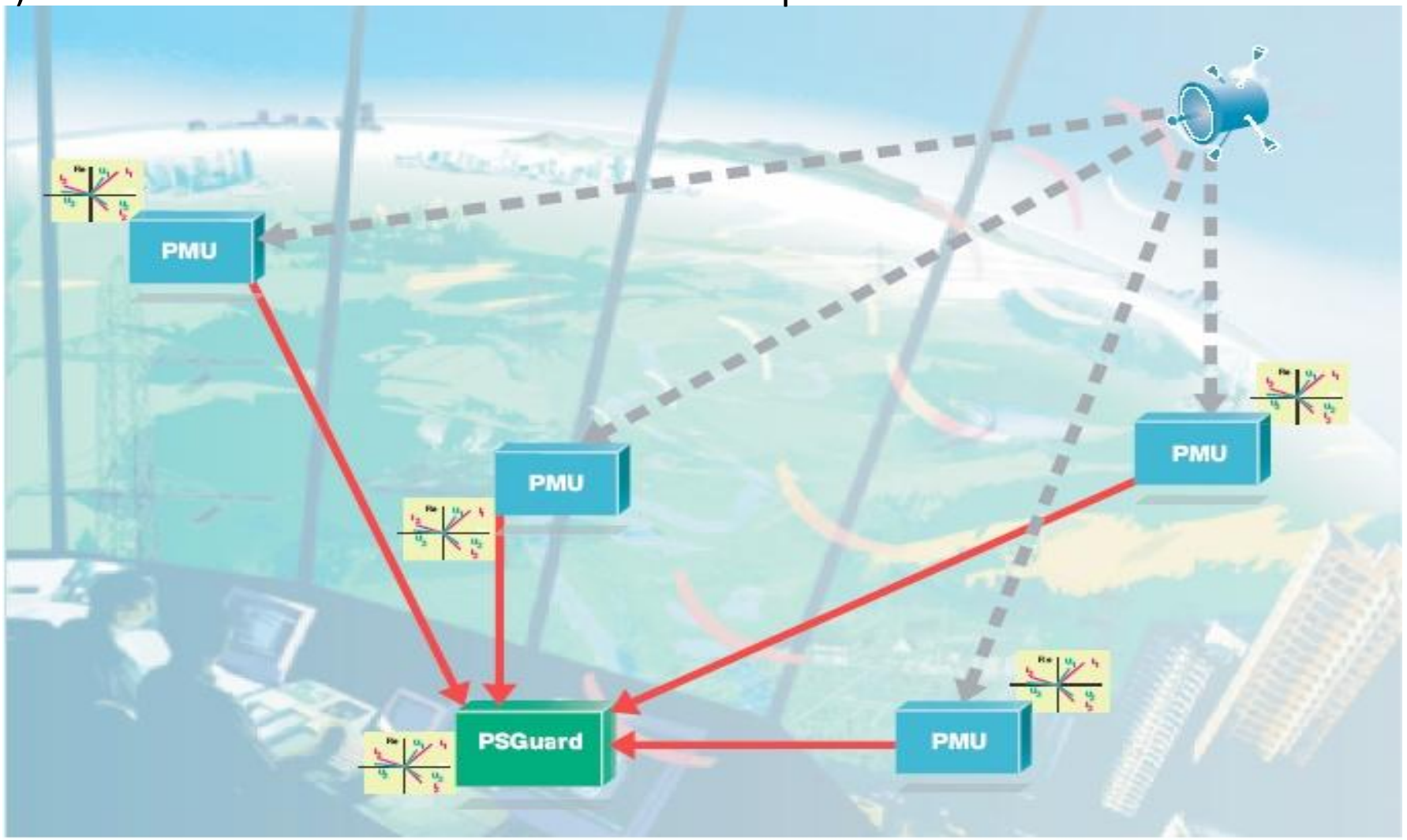
- Can run other EMS applications for decision support such as follows –
- Contingency Analysis
- Optimal Power Flow
- TTC/ATC Calculations
- Dynamic Analysis
- ….. Others

Outputs

Wide Area Measurement System (WAMS)

Phasor Measurement Units (PMUs) are installed to monitor the **PHASORS** and process the data to aid control and corrective actions.

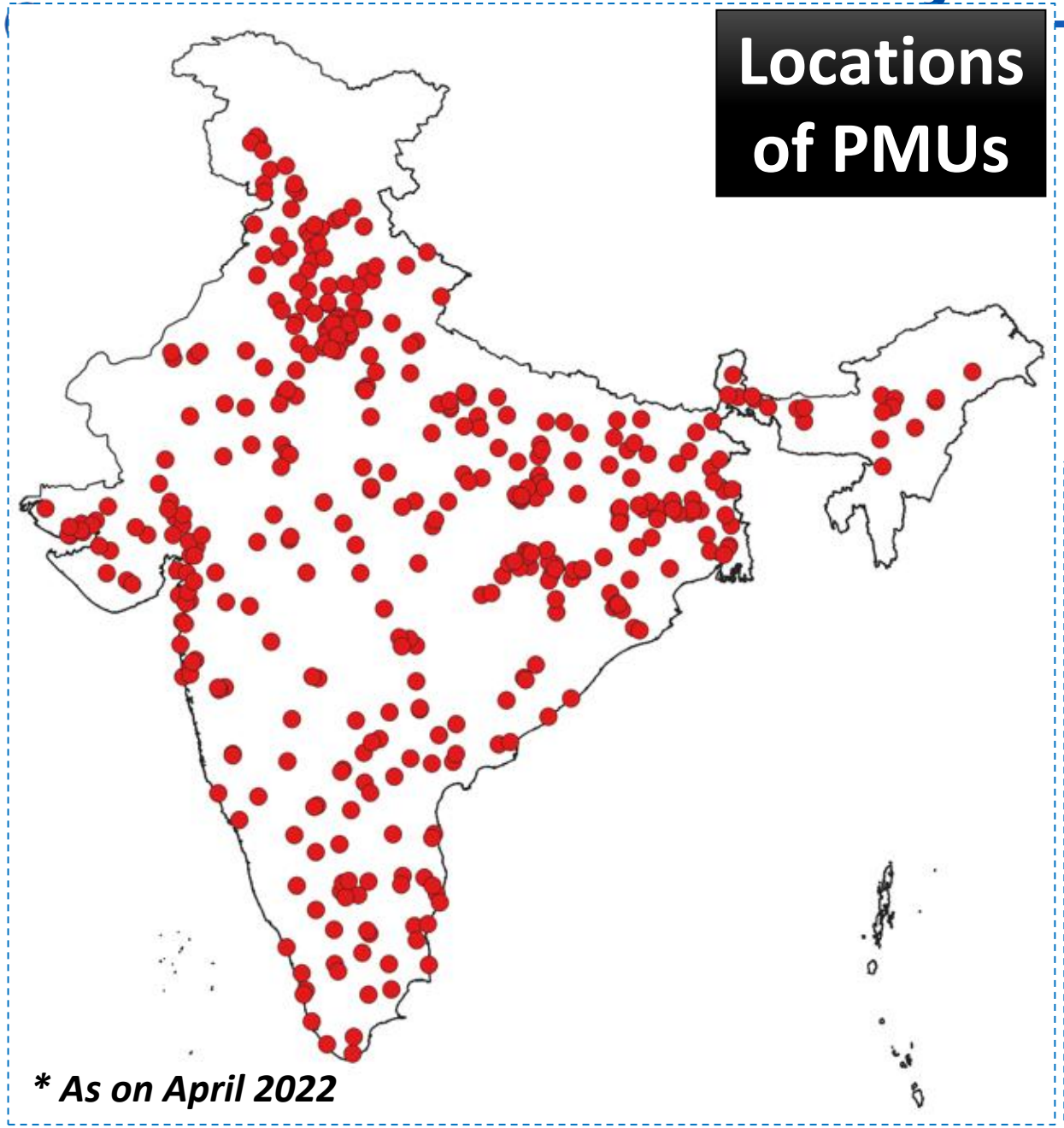
Wide Area Measurement (WAM)



63 PMUs deployed under Pilot project.

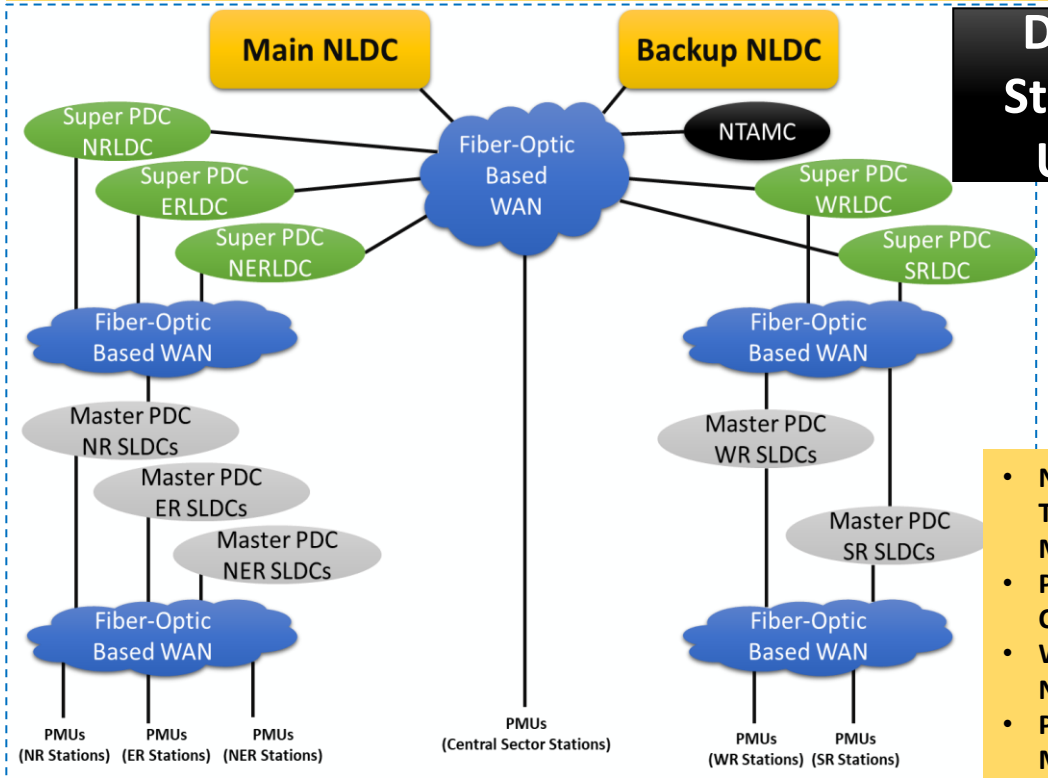
*Around 1,400 PMUs deployed in **URTDSM phase 1 project** of POWERGRID.*

Wide Area Measurement System (contd.)



Region	Nos. of Stations	Nos. of PMUs
Northern Region	114	405
Eastern Region	72	291
Western Region	70	402
Southern Region	68	254
North Eastern Region	14	51
Total	**338**	**1,403**

Note: Data mentioned above as on April 2022.



- **NTAMC: National Transmission Assets Management Centre**
- **PDC: Phasor Data Concentrator**
- **WAN: Wide Area Network**
- **PMU: Phasor Measurement Units**

Wide Area Measurement System (contd.)

- Next generation measurement technology.
  (voltages, currents, frequency, frequency rate-of-change, etc)

- Higher resolution scans (e.g. 30 samples/second).
  - *Improved visibility into dynamic grid conditions.*
  - *Early warning detection alerts.*

- Precise GPS time stamping.
  - *Wide-area Situational Awareness.*
  - *Faster Post-Event Analysis.*

"MRI quality (3-D color) visibility of power system, compared to X-ray (2-D b/w) quality visibility of SCADA" – ***Terry Boston (PJM)***

Data Resolution in case of Phasor Measurement Units

Wide Area Measurement System – Benefits/Usages

Improve Security

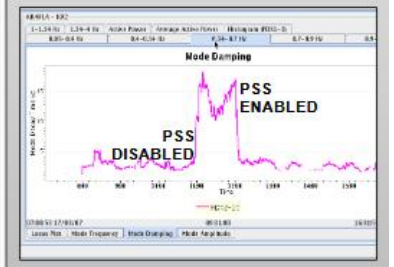
- EARLY WARNING OF INSTABILITY
- SITUATIONAL AWARENESS
- ISLANDING RECOVERY
- BLACKSTART
- SELF-HEALING GRID

Increase Transfer

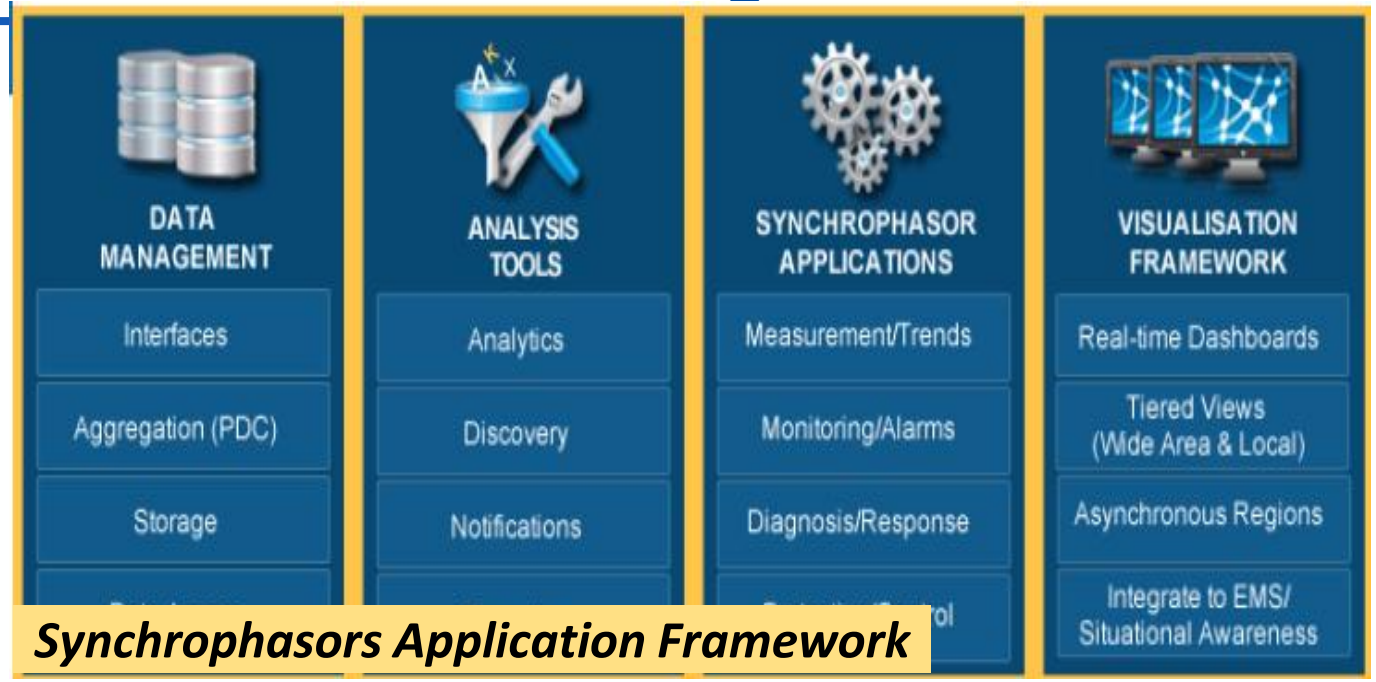
- RELIEVE DAMPING CONSTRAINTS
- STATE ESTIMATION & CONTINGENCY ANALYSIS
- IDENTIFY LINE PARAMETERS

System Analysis

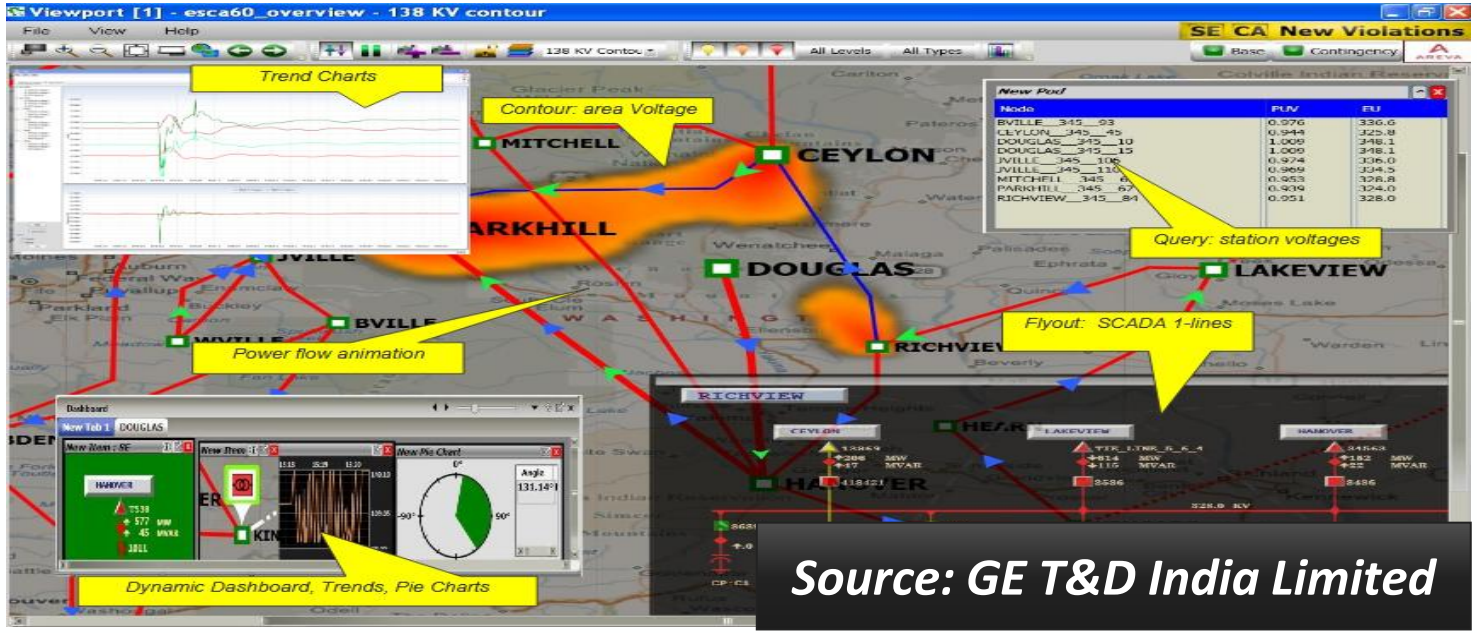
- PSS TUNING
- PLANT COMMISSIONING
- POST-EVENT ANALYSIS
- IMPACT OF RENEWABLES
- IDENTIFY DYNAMICS ISSUES



PMU based analysis



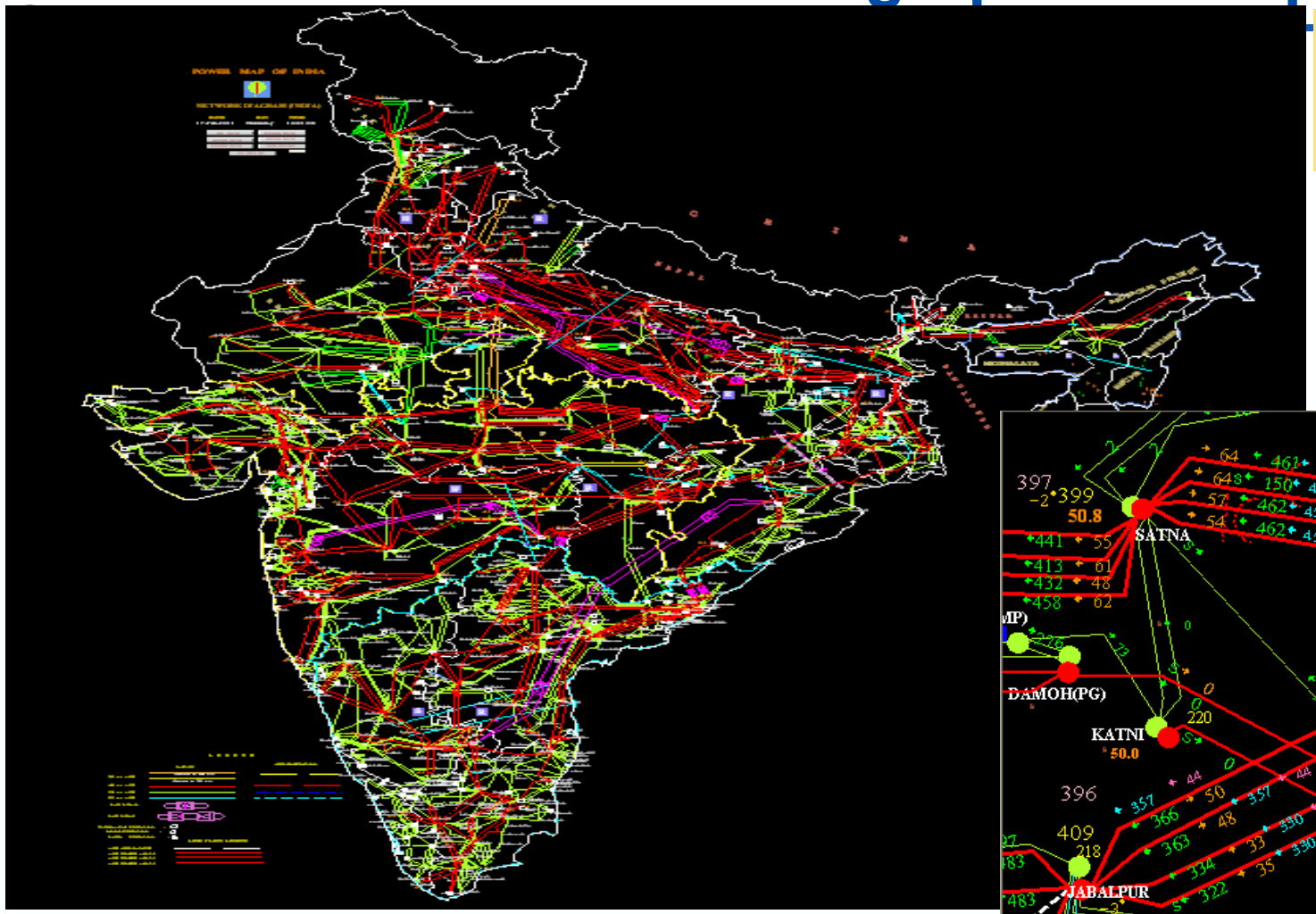
Synchrophasors Application Framework



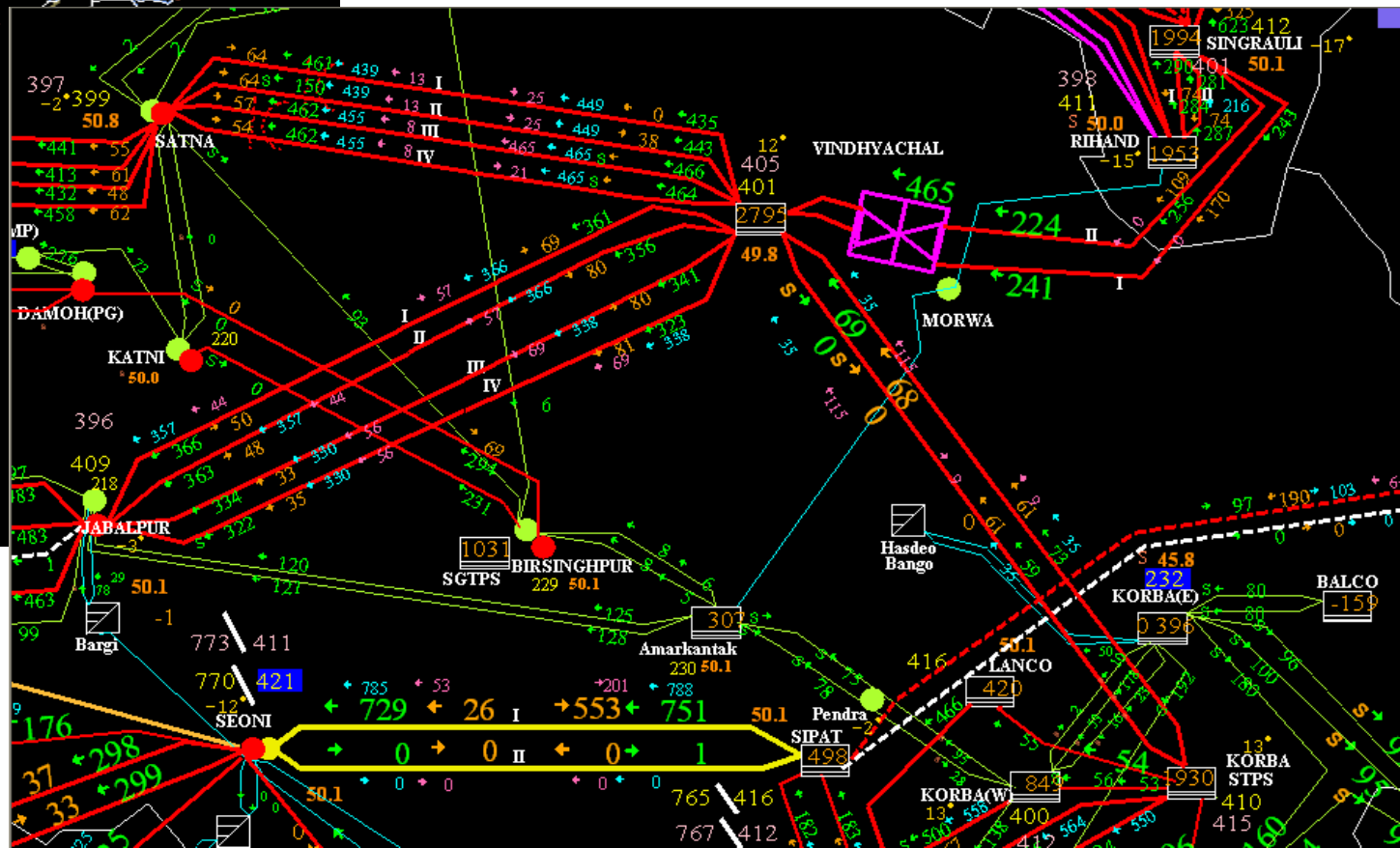
Situational Awareness Tools

Source: GE T&D India Limited

Visualization of Data – Geographical Displays (such as All India Map)

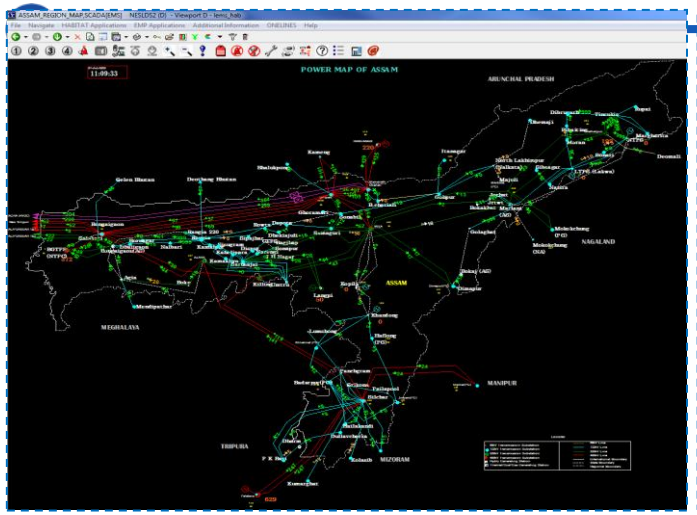


Zoom-Out View

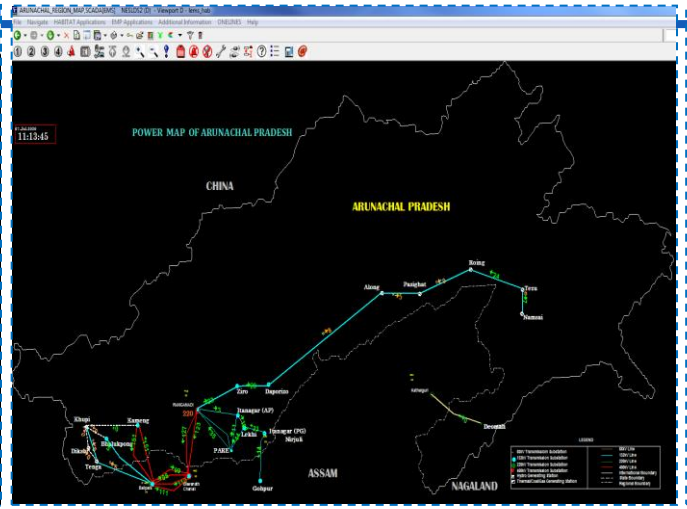


Zoom-In View

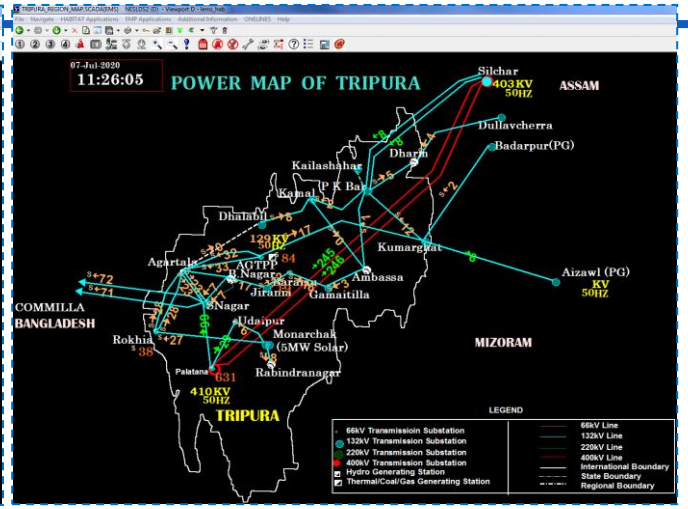
Visualization of Data – Geographical Displays (such as State Maps)



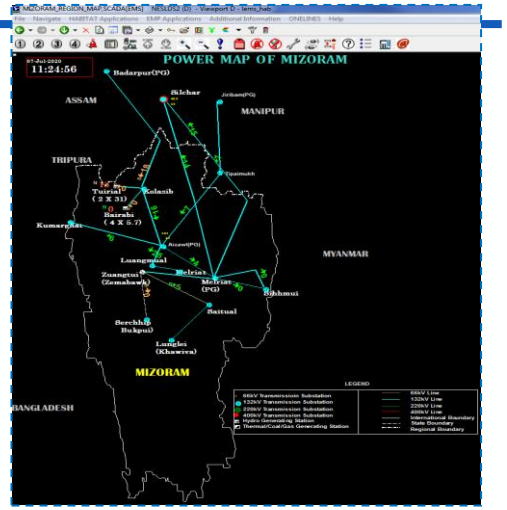
Assam



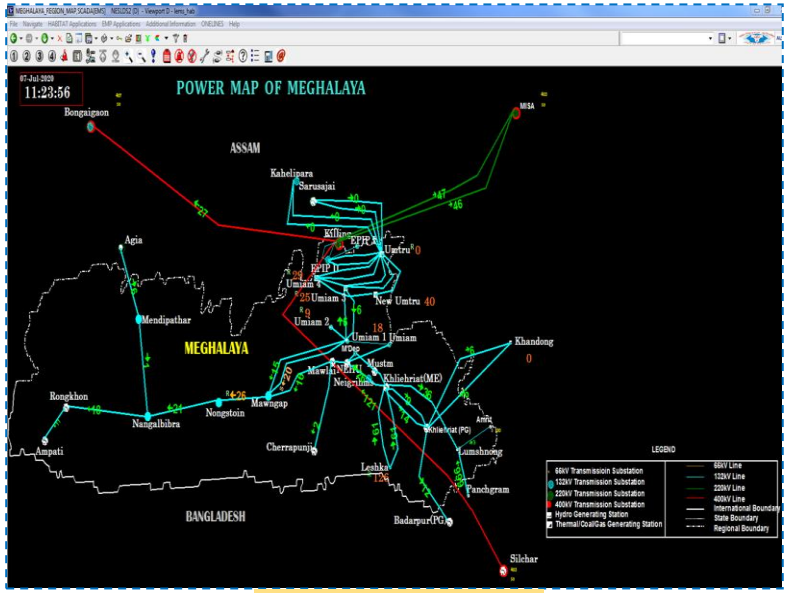
Arunachal Pradesh



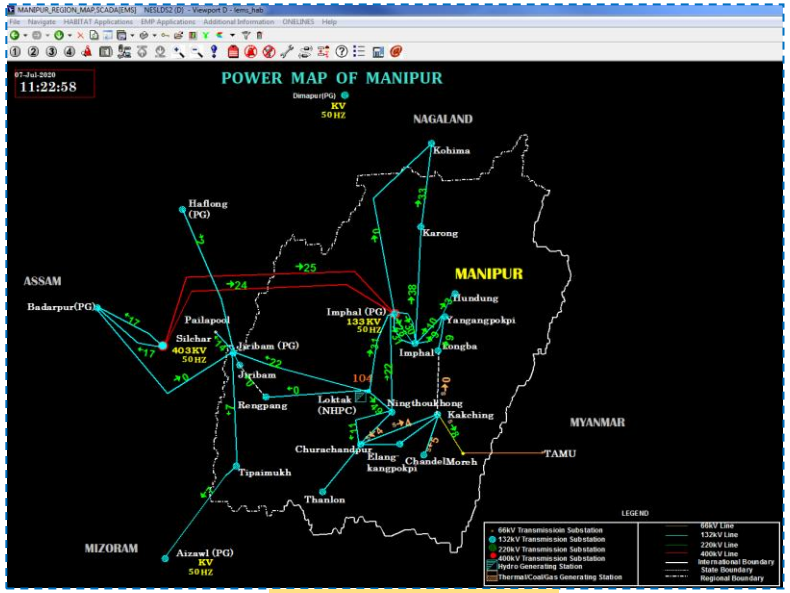
Tripura



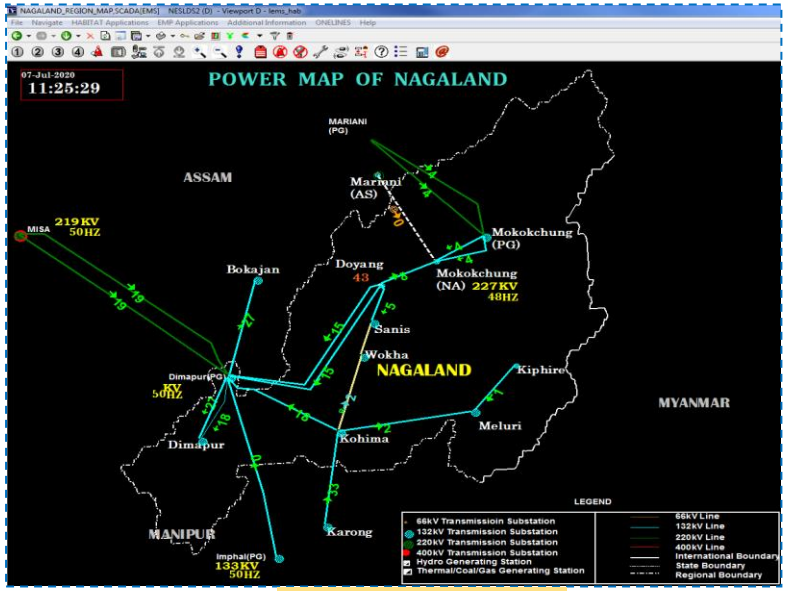
Mizoram



Meghalaya

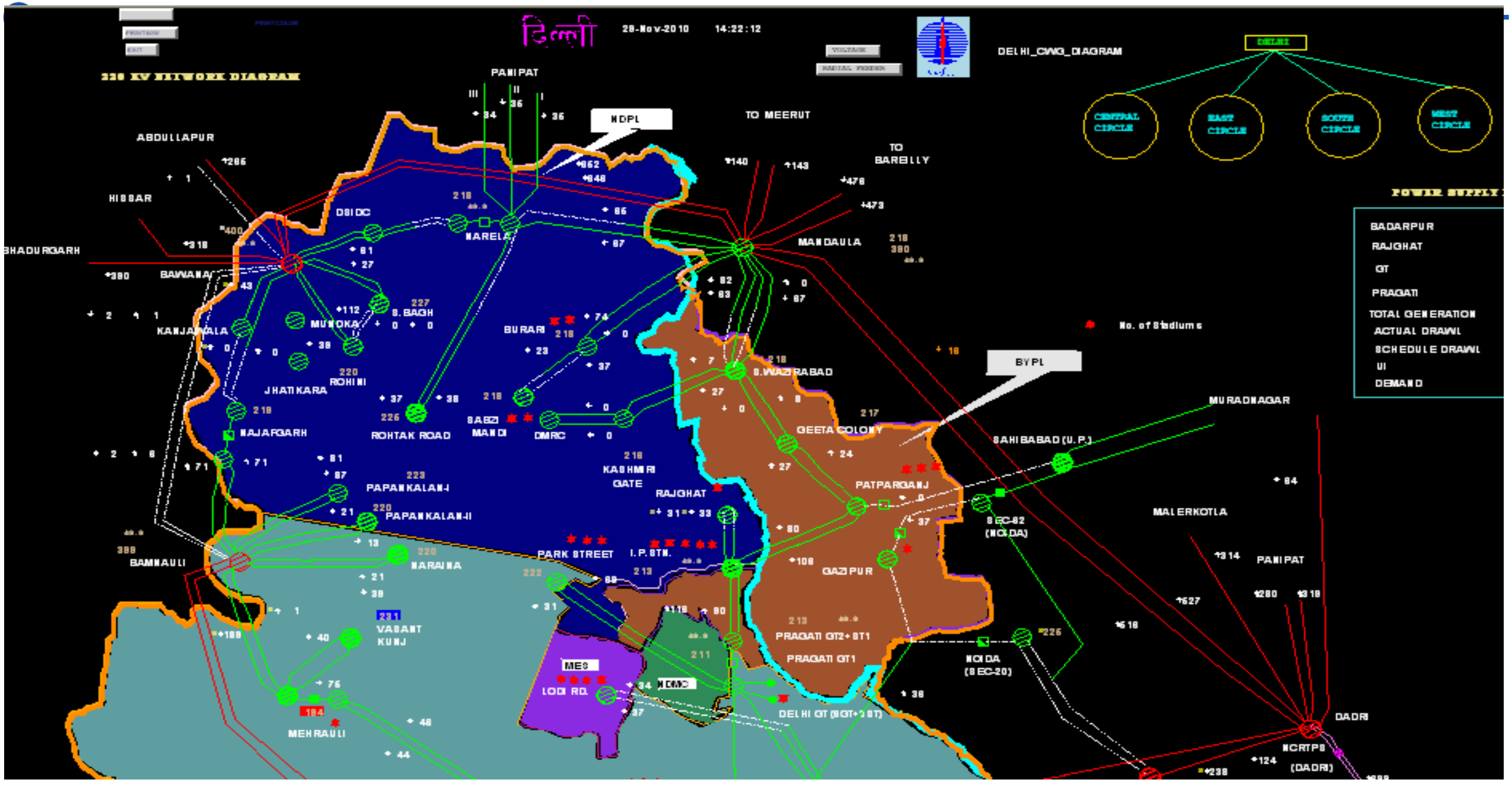


Manipur

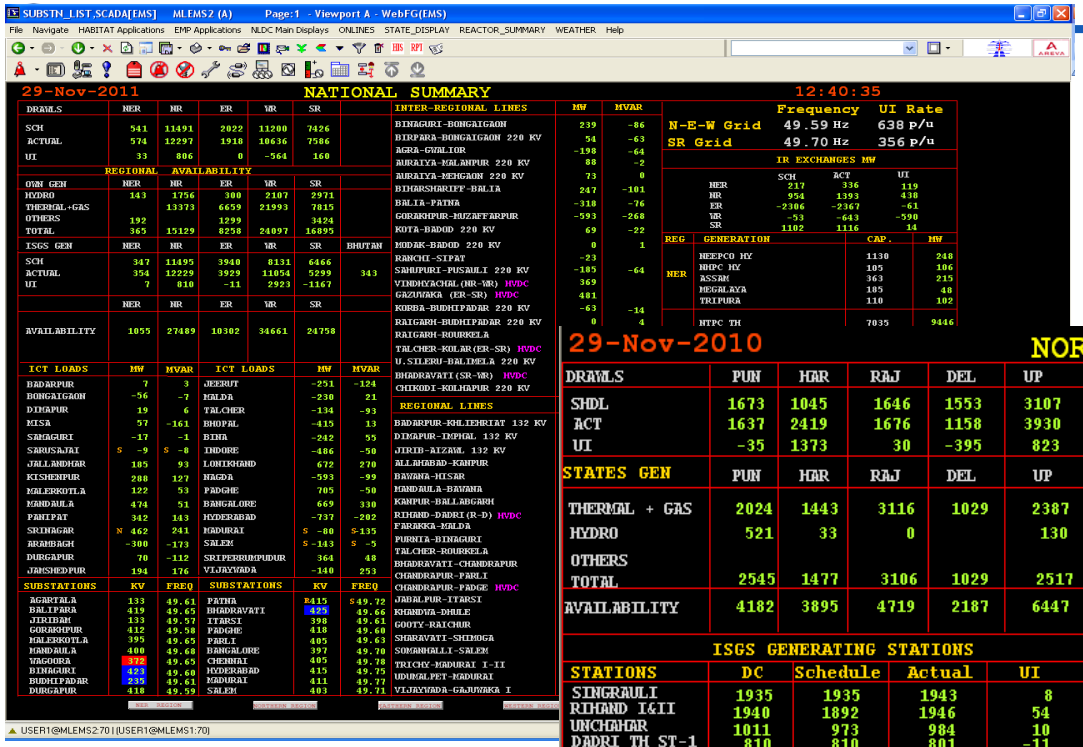


Nagaland

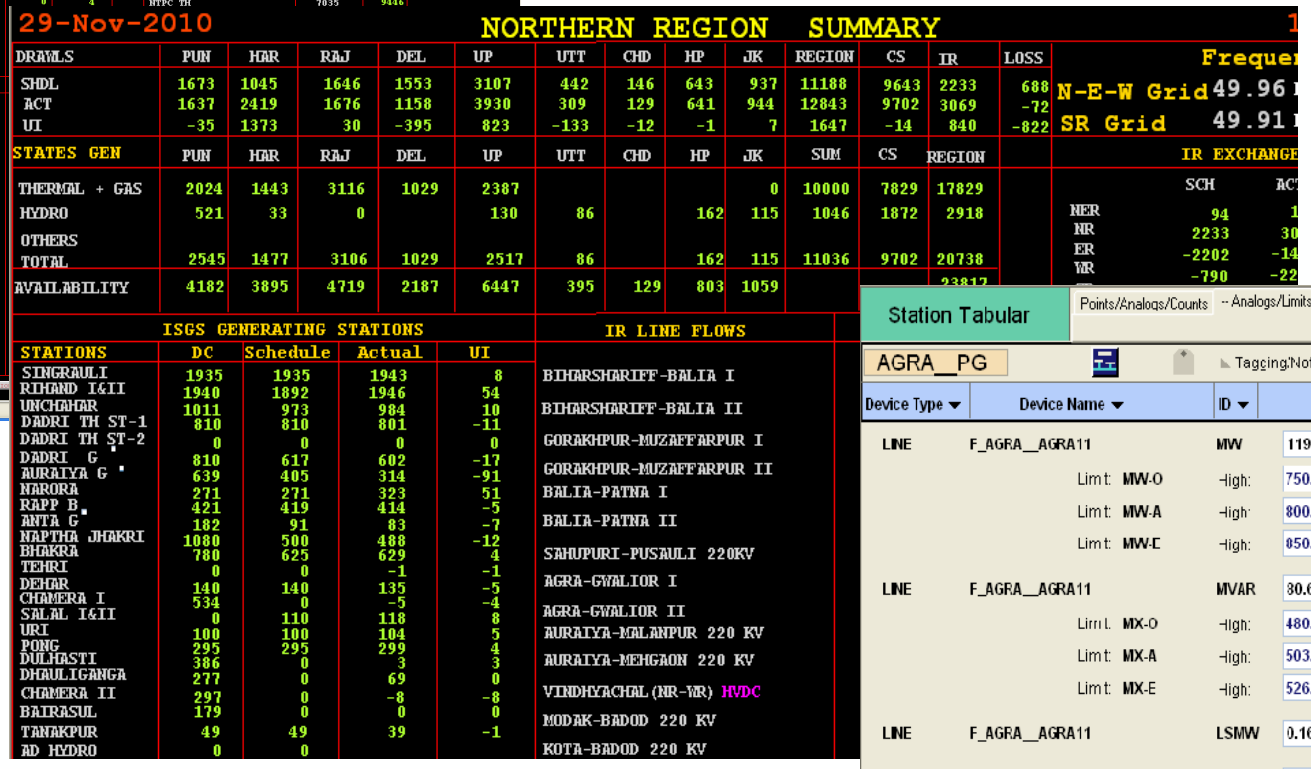
Visualization of Data – Geographical Displays (such as City Map of Delhi)



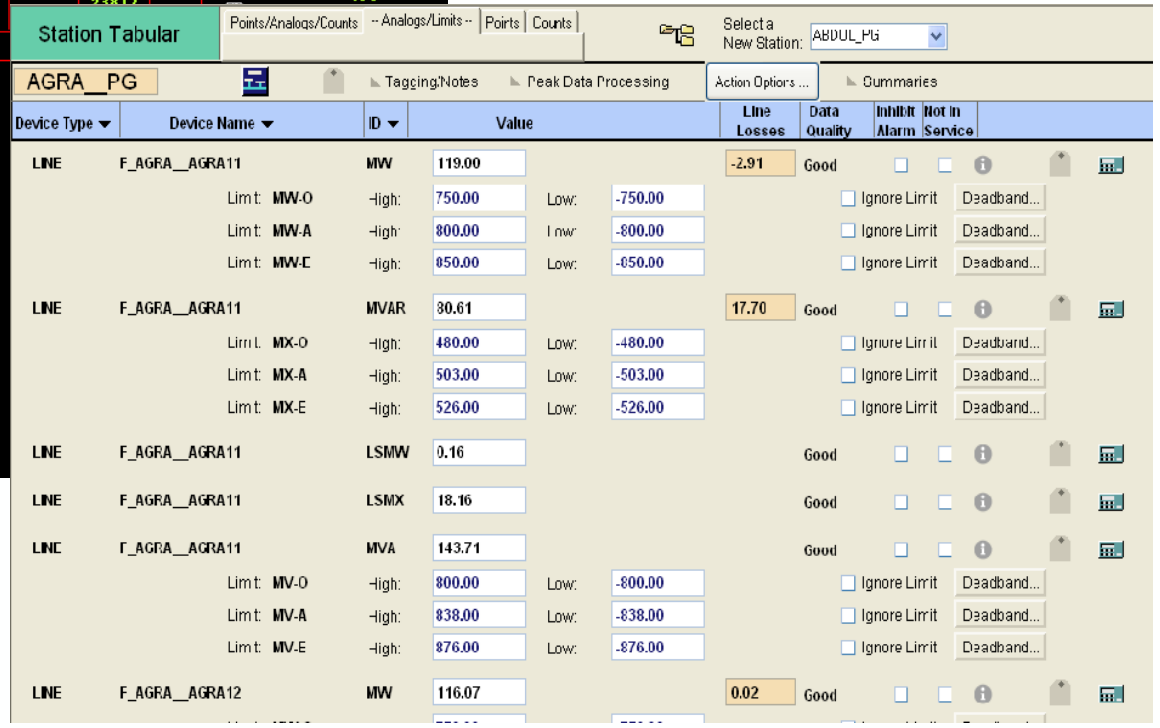
Visualization of Data – Tabular Presentation



National Summary

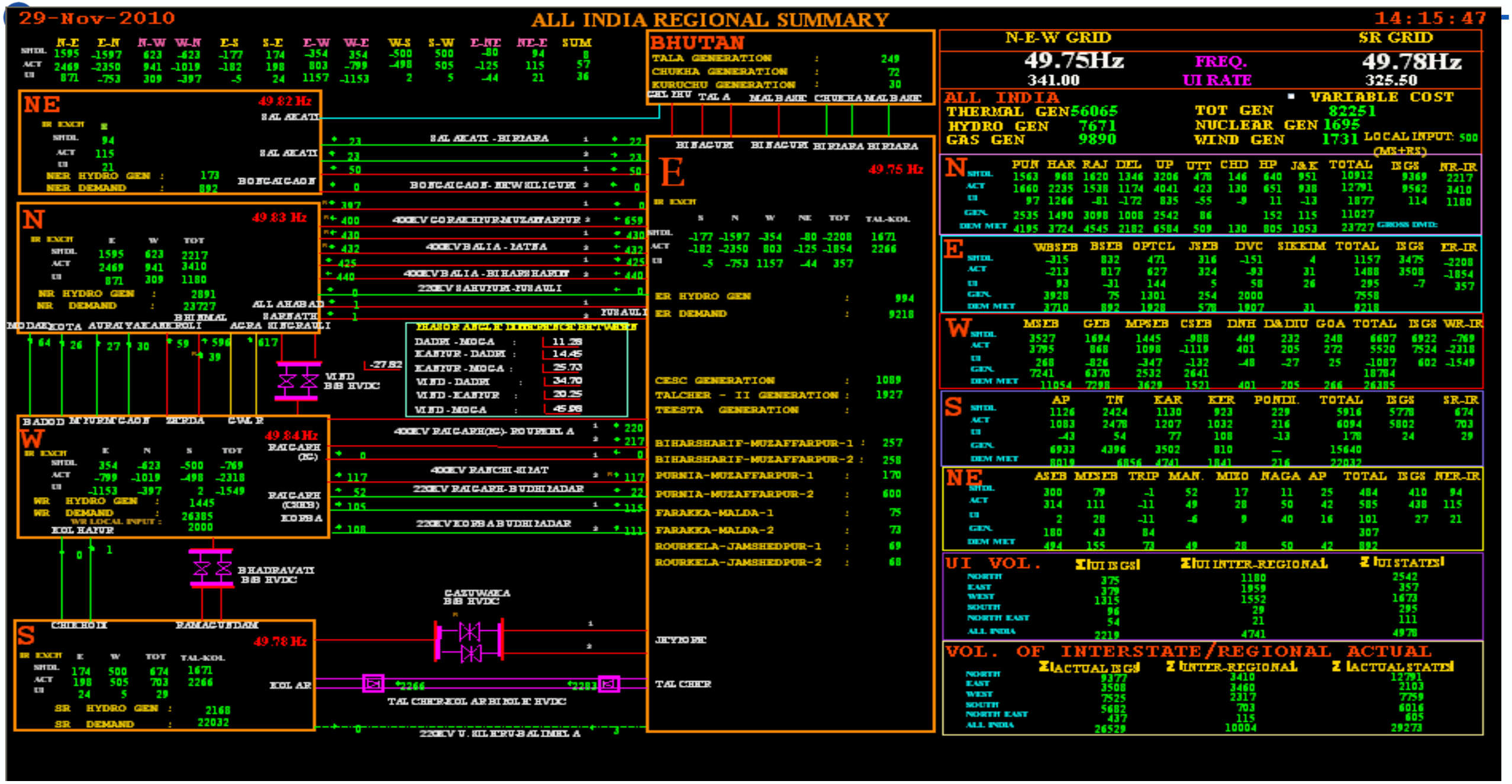


Regional Summary



Station-wise Data Summary

Visualization of Data – Control Area Tie Line Representation



Visualization of Data – Outcome for Grid Operators

- **Value addition** in skill set of Grid Operator
- Improves operator **situational awareness** of current and future wide-area operating conditions under various operating scenarios
- Enables power system operators or reliability coordinators to make **informed corrective or preventive controls** to improve system security and reliability, and to prevent potential large-scale cascading outages
- Allows operators, regional coordinators, and power system engineers to perform the **replay and engineering analysis** of existing large system disturbances
- Enables **early detection** of potential system disturbances so that operators may implement protective measures rapidly and avoid cascading events
- **Strengthens** grid reliability and robustness
- **Reduces the economic impacts** of cascading outages to member companies and their customers

Visualization of Data – Display Building Guidelines by Bureau of Indian Standards

भारतीय मानक IS 18058 : 2023
Indian Standard

सुपरवाइजरी कंट्रोल और डाटा एक्वेज़िशन (स्काडा) सिस्टम डिस्प्ले के लिए दिशानिर्देश

Guidelines for Supervisory Control and Data Acquisition (SCADA) System Displays

ICS 33.200

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April 2023 Price Group 12

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This Indian Standard has been developed from Doc No.: LITD 10 (17093).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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No of Amendments :	0
Technical Department :	Electronics and Information Technology Department
Technical Committee :	LITD 10 (Power System Control and Associated Communications)
Language :	English

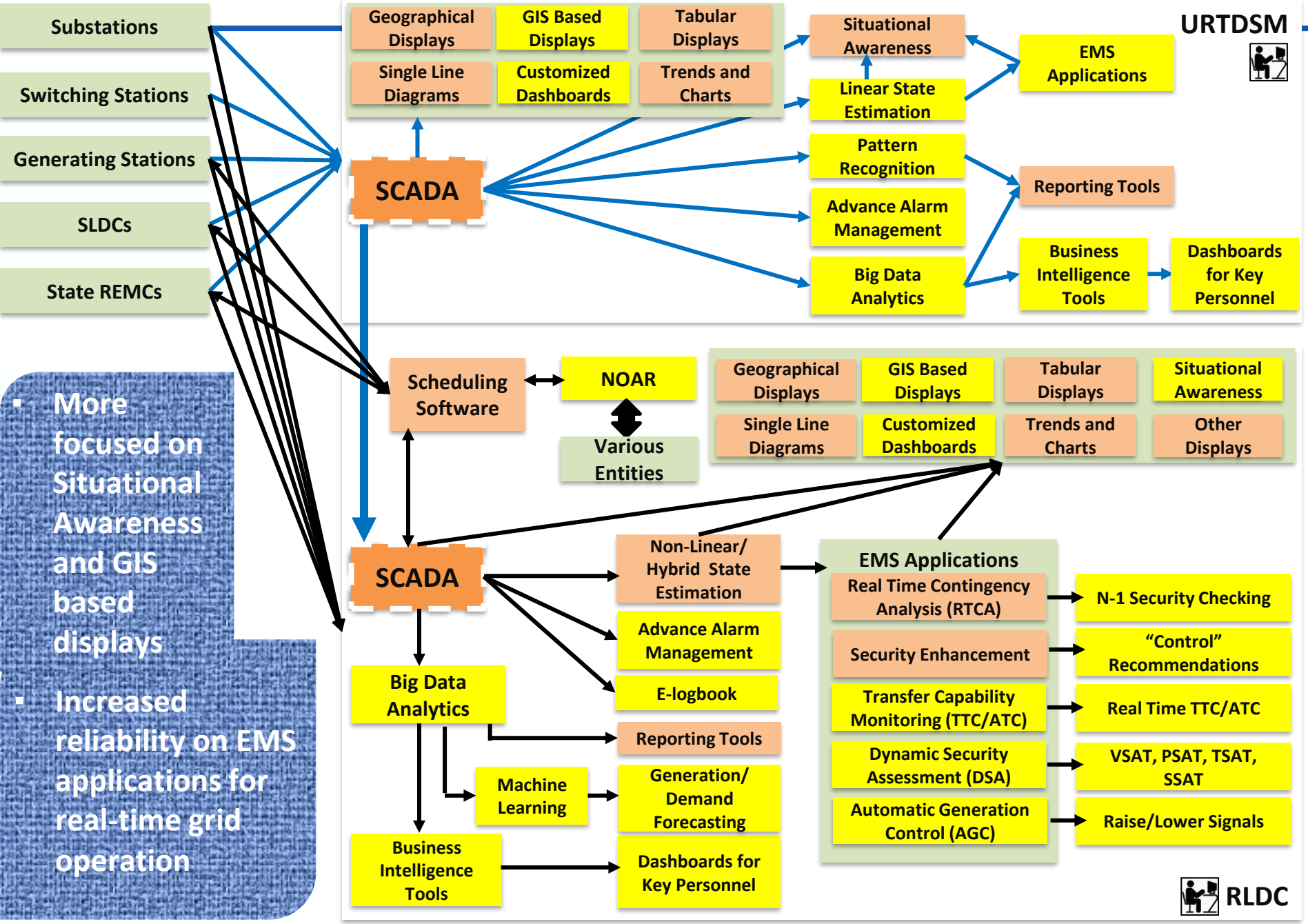
Group :	Electronic and Telecom equipment, components and devices
Sub Group:	Power system control and communication
Sub Sub Group :	Power System Control and Communications
Aspects:	Code of Practice
Degree of Equivalence:	Indigenous

- ❑ **BIS Standard (IS 18058 : 2023)**
- ❑ **Included in Technical Specifications of ULDC Phase III**

- ***Standard released in April 2023 by BIS***
  - ✓ ***41 pages***
  - ✓ ***12 sections***

Details available on web-link:
https://www.services.bis.gov.in/php/BIS_2.0/bisconnect/standard_review/Standard_review/Isdetails?ID=Mjg2OTM%3D

Structure of SCADA/EMS Systems at Regional Level – Future Vision (tentative)

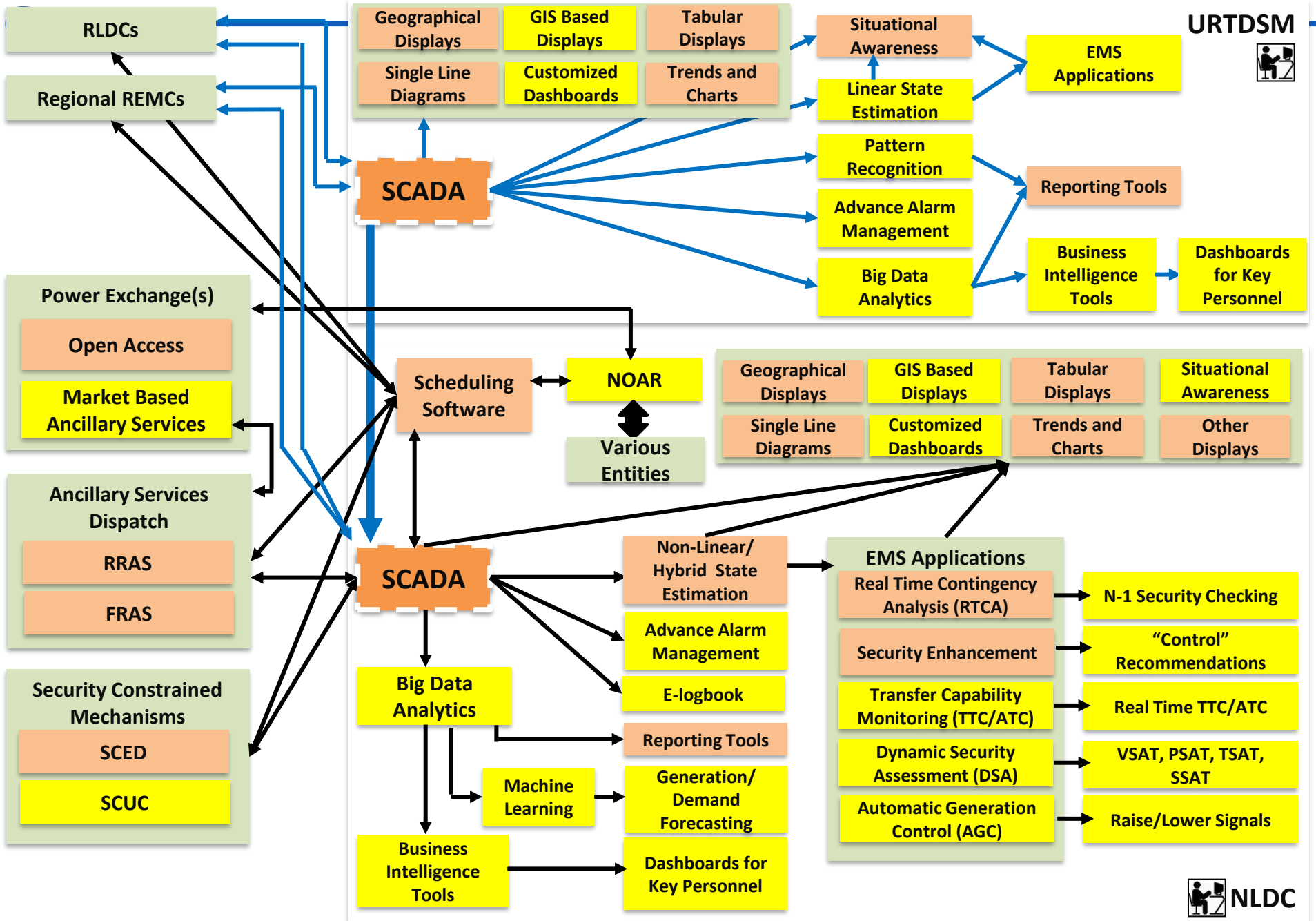


- More focused on Situational Awareness and GIS based displays
- Increased reliability on EMS applications for real-time grid operation

Future vision towards URTDSM (PMU based SCADA) structure

Future vision towards SCADA-EMS structure

Structure of SCADA/EMS Systems at National Level – Future Vision (tentative)

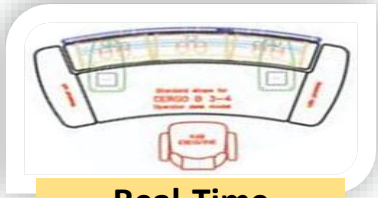


Future vision towards URTDSM (PMU based SCADA) structure

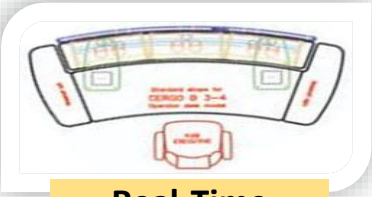
Future vision towards SCADA-EMS structure

Load Despatch Centres – Future Vision (Tentative)

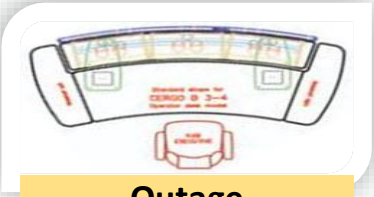
Video-wall



Real-Time Monitoring Desk

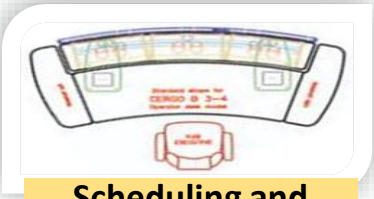


Real-Time Security Desk

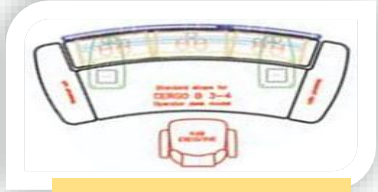


Outage Coordination Desk

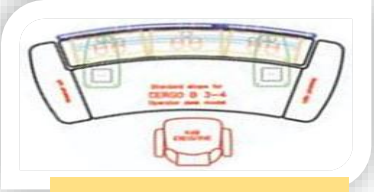
Renewable Energy Management Desk



Scheduling and Forecasting Management Desk



Ancillary Services Desk



Market Monitoring Desk

Generation Applications Desk (Extended Operator Workplace)

System Operator Desk

Network Applications Desk (Extended Operator Workplace)

THANK YOU!