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25. Building Competency for Smart Grid Implementation in India

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1. INTRODUCTION

After the term Smart Grid(SG) came to limelight around 6-7 years back, it gave rise to a hope that, it would soon revolutionize the entire electricity domain in the country and change the very 'electricity business model' that has been in place for the past 80 years or so. Although India has a very well defined roadmap [2] to complete the implementation of SG in a phased manner by the year 2027, but the progress so far has been far behind the targets. Few utilities abroad are said to have made significant stride in the implementation of SG like 'Tokyo Electric Power Company' (TEPCO) in Japan, Brazilian electric utility, multiple utilities in North America and Australia. In addition to financial constraints there are some technical and administrative challenges which need to be addressed. This paper is an effort to analyze the critical challenges for smart grid rollout in India. As a case study, the significant observations of Smart Grid Pilot Implementation at CESC, Mysore shall also be discussed in brief.

India's Smart Grid Road Map:

- The GoI through the Ministry of Power (MoP) has set up various agencies to help the
- Electricity utilities in India in adoption of SG like India Smart Grid Forum (ISGF, India
- Smart Grid Task Force (ISGTF) and National Smart Grid Mission (NSGM. The MoP also released the Smart Grid Vision and Roadmap of India earmarking the timelines.

India's Smart Grid Vision is:

"Transform the Indian power sector into a secure, adaptive, sustainable and digitally enabled ecosystem that provides reliable and quality energy for all with active participation of stakeholders"

The key goals from the national smart grid mission for distribution utilities are: -

- Rollout smart grid pilots in project areas by 2017, major urban areas by 2022 and nation-wide by 2027.

- Rollout smart meters for consumer >20kW by 2017, three phase consumers by 2022 and all consumers by 202.
- Reduce the AT&C losses <15% by 2017, <12% by 2022 and below 10% by 2027.
- Further the MoP has allocated 14 Smart Grid Pilot Projects for implementation by various
- State owned distribution utilities.

Table1: Smart Grid Pilot Projects in India

#	Utility	Major Coverage
1	C E S C (Karnataka)	AMI, Outage Management, Peak Load Management, Microgrid and distributed generation with an initial 21,800 consumers in the Mysore City.
2	Andhra Pradesh CPDCL	AMI, Outage Management, Peak Load Management and Power Quality Management with 11,900 consumers in the Jeedimetla suburb of Hyderabad
3	Assam PDCL	AMI, outage management, peak load management, power quality management and distributed generation with 15,000 consumers in the Guwahati area
4	Gujarat VCL	AMI, outage management, peak load management and power quality management with 39,400 consumers in Naroda and Deesa
5	Maharashtra SEDCL	AMI and outage management with 25,600 consumers in Baramati in the Pune district
6	Haryana BVN	AMI and peak load management with 30,500 consumers in Panipat City
7	Tripura SECL	AMI and peak load management with 46,000 consumers in Agartala
8	Himachal Pradesh SEB	AMI, outage management, peak load management and power quality management with 650 industrial consumers in Nahan
9	Puducherry Electric Deptt.	AMI with 87,000 consumers
10	J V V N L (Rajasthan)	AMI and peak load management with 2,600 consumers in Jaipur
11	Chhattisgarh SPDCL	AMI with 500 industrial consumers in Siltara
12	Punjab SPCL	Outage management with 9,000 consumers in Amritsar
13	Kerala SEB	AMI with 25,000 industrial consumers
14	West Bengal SEDCL	AMI and Peak Load Management with 4,400 consumers in Siliguri town in the Darjeeling district.

AMI Architecture :

Advanced metering infrastructure (AMI) is the architecture for automated, two-way communication between the utility's control centre and the smart meter at customers' premise.

The main objective of AMI is to enable two way communications between smart energy meter and Head End System(HES) to enable remote reading, monitoring & control of electrical energy meters (consumer, feeder, DT meters etc.) to serve as repository of record for all raw, validated and edited data.

For AMI various architectures can be employed, the most common being one having data concentrators that collect data from groups of meters and transmit that data to a central server via a backhaul channel.

Key Components of AMI:

- Home area networks
- Smart Meters
- Data Concentrators/Gateways to collect the data from Smart Meters through RF(Zigbee)/PLC
- Data Concentrators/Gateways to send data to the Control Centre via
-

GPRS/OFC Network

- Utilities Control Centre comprising requisite servers and MDMS.

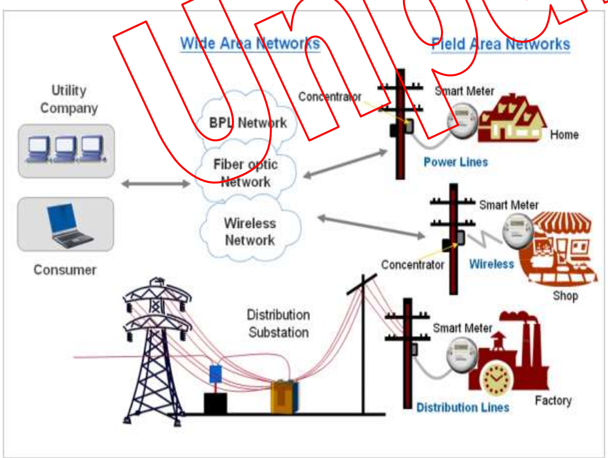

Figure 1: A typical Advanced Metering Infrastructure

AMI architecture has two variants as shown in figure below:

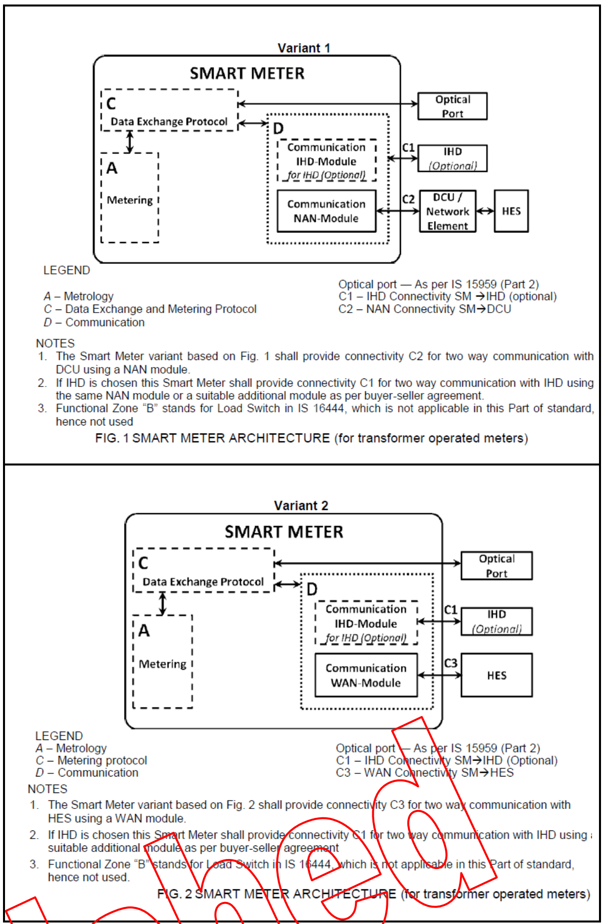

Figure 2: Smart Meter Architecture As Per Is 15959

SPECIFICATION FOR SMART METERS:

Smart Meters are defined to be those which have bidirectional communication provision and have disconnection facility. The specifications of Smart meters are defined in IS15959.

SPECIFICATION FOR COMMUNICATION MODULES:

The NAN, WAN and IHD communication modules that are shown in Figure 1 and Figure 2 are for establishing connectivity with Smart Meter by the external entities such as DCU and HES respectively and optionally with IHD. These are either wired or wireless communication technology, the choice of technology shall be chosen by the buyer based on the technical feasibility best suited for a given geographical area. The communication module(s) may be of PLC or mesh RF for NAN and cellular technologies or OFC technology for WAN.

Challenges:

- Unfortunately there have been issues in most of the Pilot projects.
- The challenges being encountered can be classified into two categories:
- Technical Challenges.
- Financial and administrative constraints.

Technical Challenges:

Table 2: Technical Challenges in Implementation of SG in India

#	Challenge	Way Out
1.	Standardizing Meter Communication Protocol	Although India Government has already published the standards for meter communication protocol (BIS Standard for Smart Meters (IS 16444) published in August 2015, BIS Standard on Data Protocol (IS 15959 Part 2) published in February 2016), still for RF communication module vendor dependency is there. One should be prepared to live with the RF communication module from a fixed vendor in line with Australia.
2.	Integration with other Existing Modules like SCADA, Billing etc	The efforts are required to be assessed and due funds be managed. Consultants may be hired for the assessment
3.	Cyber Security: Discoms have little knowhow	Agencies appointed by GoI like NSGM should issue necessary guidelines.
4.	Data Analytics: Discoms have little knowhow	The voluminous data be used for various functions like sanctioned load violation analysis, Peak hour consumption pattern analysis and DT wise load imbalance analysis for which useful analytical tools like BI & R are
5.	Choosing communication technology (RF/PLC/ Cellular)	Looking at the India demographics a Multi-modal metering communication need to be in place this could be achieved with hybrid communication models based on need and infrastructure.
7.	IPV4 Vs IPV6:	In IPv6 regime, where every meter can have an IP address, the IP metering solution can offer multiple benefits to utilities. This would provide more reliability, scalability, security and capability to monitor and control as they can be

Administrative Challenges:

Table 3: Administrative Challenges in Implementation of SG in India

S.No.	Challenge	Way Out
1.	High cost of AMI: Even if the cost of smart meters get down drastically even then the expenditure is expected to outweigh direct benefits to the utility. However, when societal benefits are factored in, projects can have positive business cases.	The consumers are required to be educated on SG benefits and convinced to be prepared for higher tariff in lieu of improvement in quality of power supply.
2.	Some states have desired to do away with the disconnection feature in the Smart Meters.	MoP & its agencies like CEA have to be categorical otherwise the most important functionality of SG i.e. achieving a balance of supply-and-demand in real time can not be realized.
3.	It needs to be understood that installation of Smart Meter does not fulfil the requirement of SG.	Smart Grid constitutes AMI including the metering system and the HE system. Only Smart Meters may not serve any purpose
4.	Deployment Plan based on monthly Consumption at disperse locations: Rollout of smart metering is being planned on a fast track for consumers with a monthly consumption of 500 kWh and above in Phase-1 by December 2017 and for consumers with monthly consumption of 200kWh and above in Phase-2 by December 2019.	Any meter deployment needs to be done feeder-wise and NOT consumer-wise so that the last mile communication network can be established and maintained at a reasonable cost.
5.	Smart grid projects typically involve big capital investments and long implementation cycles.	Unlike a loss-reduction project it would have a payback period of 20 years or so.
6.	Role of government	For the smart grid to succeed, governments need to play a leading role in mediating the relationship between utility and consumers, better communi-

SG Pilot Implementation at CESC Mysore: A Case Study

CESC Mysore is one of the 14 SG Pilot Implementations in the country.[3,7].

The smart grid functionalities covered under the project are:

- AMI-R(Advanced Metering Infrastructure for Residential Consumers)
- AMI-I(Advanced Metering Infrastructure for Industrial Consumers)
- PLM (Peak Load Management)
- OMS (Outage Management System)
- PQM (Power Quality Management)

A Smart Grid Control Center (SGCC) has been established at Mysore, which includes the Head End System (HES). The data is being fetched from DTR, temperature sensors on transformers, Fault Passage Indicators installed on Feeders, DTUs etc. For this purpose, the various devices have been networked with the HES through the use of RF in meters which communicate with the DCU and DCU sends the data to HES over GPRS. Major functionalities achieved through SG are as follows:

- Remote meter reading
- Remote connect / disconnect capability
- Load curtailment beyond sanctioned limit

The AMI Infrastructure:

Core components of AMI Infrastructure are as under [4,5]:

a) Smart Meters.

b) Data Concentrator Unit (DCU) based Communication Network.

c) Head End System (HES).

d) Meter Data Management System (MDM).

e) Web application with updated on-line data of consumers etc.

For Meter to DCU communication the utility has used Zigbee based RF network while from DCU to HES, GPRS has been used. Although the smart meters used are all open protocol(DLMS), however for communication a proprietary RF Module has been used by the meter manufacturer.

Practical Challenges encountered :

For Consumer and DTR metering the meters deployed are DLMS based, however the RF module used in the meters is proprietary. For communication with the DCUs all the meters are bound to be have the same proprietary RF module.

The system at SGCC is yet to be integrated with other applications like billing and Consumer Care System. For example on account of some issue with the R-APDRP Implementation agency (ITIA), the meter data acquired through smart metering is yet to be used for billing.

RAPDRP system includes the GIS based consumer indexing. Again, because of same reason, a separate GIS has been set up. This required duplication of efforts.

The meters installed on DTRs through R -APDRP were not smart ones; primarily they did not capture the quality of supply (harmonics). So an additional meter has been installed on each of the DTR. This is also a duplication of efforts and a wasteful expenditure.

CONCLUSION

Implementation of Smart Grid may not be immediate paying in terms of Revenue but it is expected to yield huge indirect benefits like:

- Improved collection efficiency

- Peak load management leading to demand-supply match
- Better asset management
- Increased grid visibility
- Self-healing grid
- Renewable integration

Further the utilities could be freed from a total dependency on a particular vendor (for RF Module), only if there are suitable policies within a defined framework to facilitate interoperable systems with minimum limitations.

The voluminous data so gathered could be used for various functions like sanctioned load violation analysis, Peak hour consumption pattern analysis and DT wise load imbalance analysis for which useful analytical tools are available.

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