IoT in Indian Electricity Transmission & Distribution Sectors

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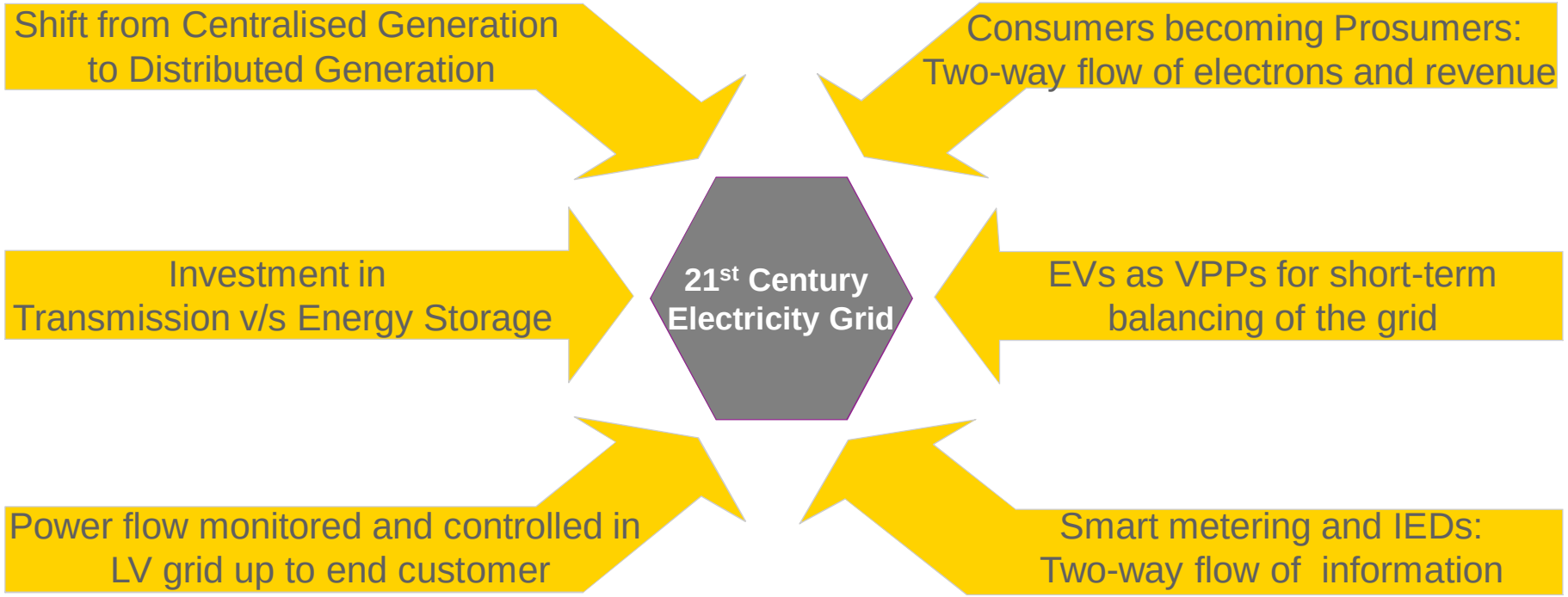
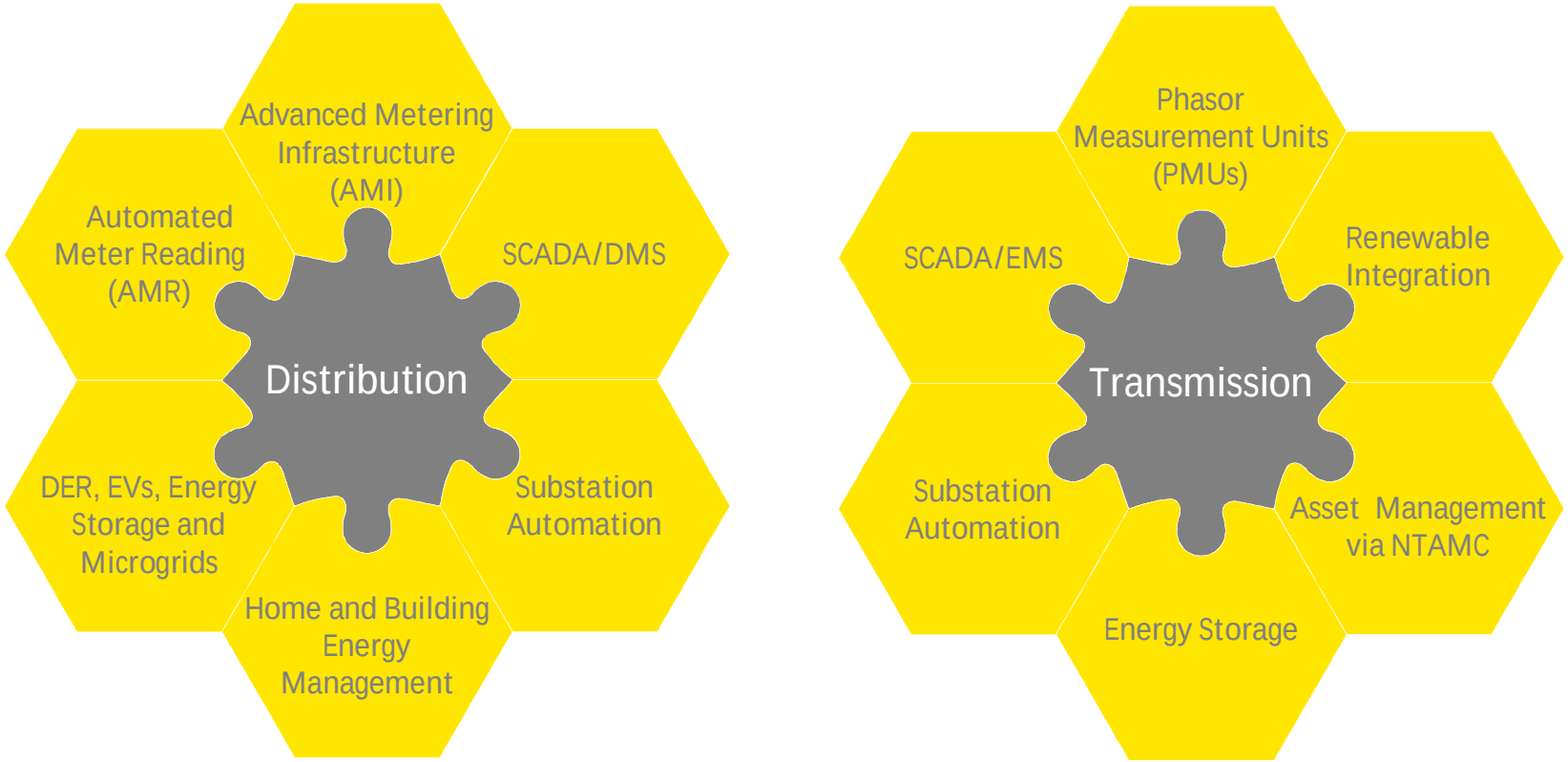
How does the 21st century grid operate?



Two-way flow of electrons, information and revenue is making the grid more complex! Increased automation and IT is leading to a more vulnerable grid prone to cyber attacks.

What does IoT means to Indian Distribution & Transmission Utilities?



While Indian transmission utilities are much more advanced in adopting IoT, distribution utilities are at the threshold of adopting novel technologies for operating the grid.

Deep diving into a key Distribution use case in India: Advanced Metering Infrastructure (AMI)

Challenge

- High electricity theft
- Low billing efficiency
- High human errors
- Inability to perform real time energy accounting
- Increasing tariff
- Low customer satisfaction

Solution

- Remote reading of consumption data and events
- Remote control of electricity supply to premises
- Time of Use tariffs for managing peak demand
- Capability to switch from post-paid to pre-paid
- IPv6 mandated for smart meters
- Low-CAPEX business models to reduce financial strain
- Revenue sharing business models for a win-win situation for DISCOM, Industry and Customer
- Analytics: Consumption Patterns, Load Forecasting, Infrastructure Investment, Outage Detection, Voltage Anomalies etc.

IoT network deployed for smart meters must be leveraged for other low throughput, low power applications such as Distribution Automation, Home/Building Automation, Demand Response, Street Light Automation, etc.

Deep diving into a key Transmission use case in India: Phasor Measurements Units (PMUs)

Challenge

- Lack of granular data
- Steady state data from EMS/SCADA is insufficient
- Inability to prevent cascaded failures leading to blackouts
- Reduced grid stability
- Low transmission line capacity utilization

Solution

- Granular data (10s of samples per second) measurement from PMUs
- Synchronised phasor measurements
- OPGW for low latency communication from PMUs to PDCs and control centres
- NLDC storage capacity expansion for petabyte data transfer
- Analytics: System Disturbance Characterisation, Oscillatory Stability Management, Event Forensics, Dynamic Model Validation etc.

India has one of the most complex electricity grid and has benefitted from one of the world's largest PMUs deployment thereby reducing the threat and scope of blackouts!

Lessons learnt from initial IoT projects in Indian power sector

Communication for AMR	• GSM, CDMA and ZigBee: Low data reliability of 50-60% • **Need integrated smart meters using IPv6-based RF/PLC/Cellular communications**
RAPDRP	• Program was 100% funded by Central Government • **Need utility's skin in projects!** • **IPDS and DDUGJY launched with only 60% funding from Central Government**
Business Models	• High CAPEX discouraged DISCOMs from undertaking AMI projects • **Need low-CAPEX business models based on 'Leasing and Services' & 'Revenue Sharing' Models**
Smart Grid and Smart City Missions	• DISCOMs and Municipal Corporations have parallel and redundant last mile communication networks • **Yet to see unification of ideas between DISCOMs and Municipal Corporations**
Capacity Building	• Many smart grid pilots did not taken off • **Need component-specific capacity building for smart grids** • **NSGM provisioned USD 1.2 million for 2 years for capacity building**

Challenges in IoT in the Indian Power Sector

1	Lack of sufficient RF spectrum for interplay between smart grids and smart cities
2	Lack of successfully implemented innovative business models in power sector
3	Absence of guidelines on cyber security for IoT devices deployed in power sector
4	Lack of understanding of majority of utilities about core aspects of IoT
5	Absence of IPv6-based last mile connectivity demonstrations in power sector
6	Absence of harmonization between smart grids and smart cities from an IoT perspective
7	Absence of interoperability in IoT devices in power sector

Interoperability: The Achilles Heel of IoT in India

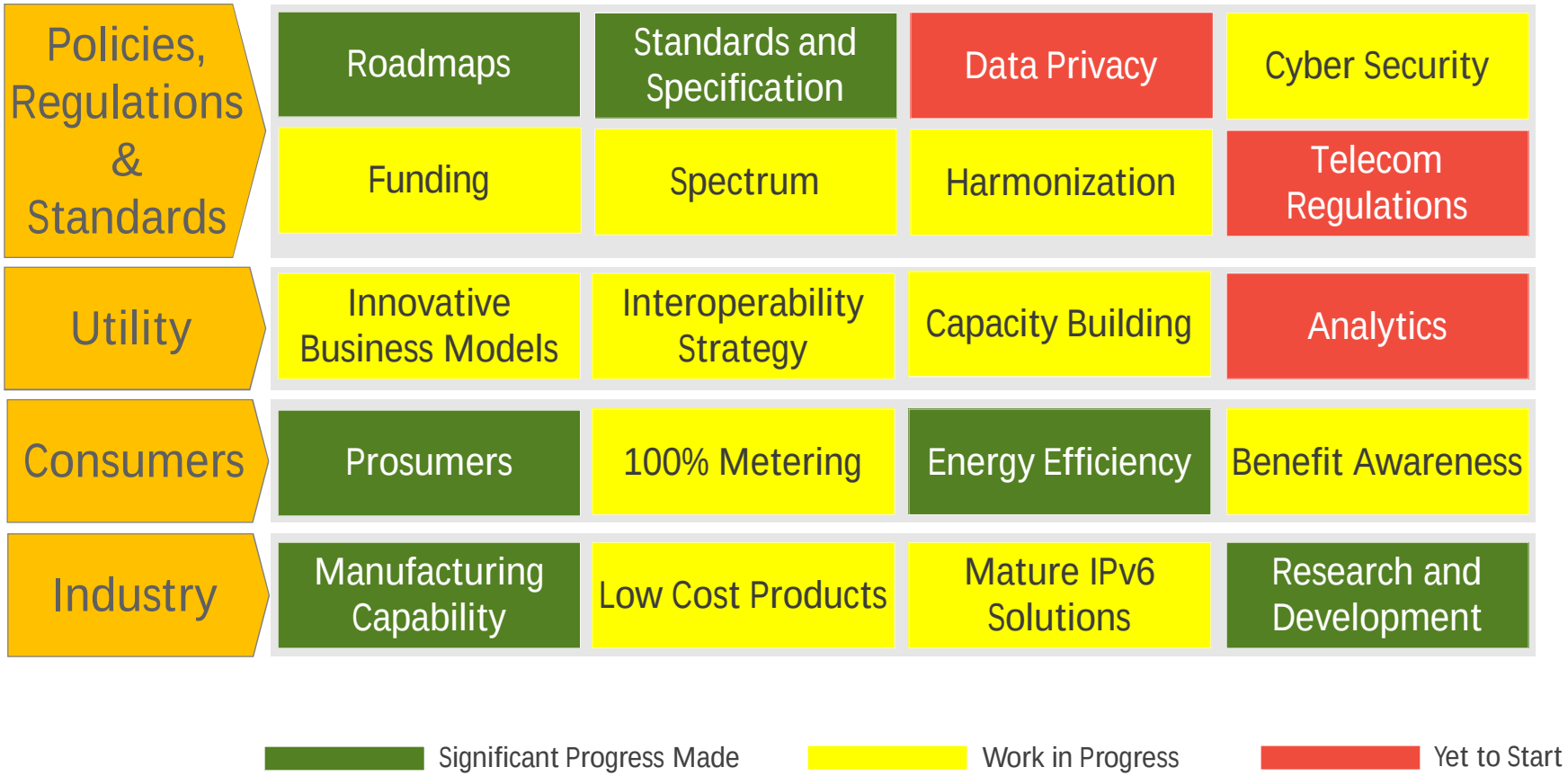
Vendor lock-in	Partial vendor lock-in	No vendor lock-in
Same (fixed) equipment manufacturer	Multiple meter manufacturers	Multiple meter manufacturers
Same (fixed) NIC manufacturer (could also be proprietary)	Same (fixed) NIC manufacturer (could also be proprietary)	Multiple NIC manufacturers (if a standardised communication technology is chosen)
Not scalable	Scalability will be a function of capability of NIC manufacturer	Most scalable (as additional equipment and NIC can be purchased from multiple manufacturers)
High system lifetime cost if multiple equipment and NIC manufacturers are chosen in subsequent tenders (as each would require different mesh elements and HES)	Moderate system lifetime cost (No equipment manufacturer-lock in; but is a NIC manufacturer lock-in)	Least system lifetime cost (No manufacturer lock-in)

How is India standing up to the IoT challenge in the power sector?

DoT	v Planning to expand the existing unlicensed spectrum (865-867 MHz) by allocating 10-12 MHz v Planning to regulate frequency bands for PLC communications (0-500 KHz for NB PLC and 2-20 MHz for BPL) v Mandated IPv6 for all devices being deployed from December 2017 v Would issue regulations for using TVWS technology soon
MoP & Regulators	v Decided to set up 11 REMCs for monitoring renewable generation thereby leading to a reliable grid v Regulators are becoming more receptive towards approving innovative business models
BIS	v Issued smart meter standards (IS 16444 and IS 15959 Part 2) v Formulating standards for PMUs and cyber security for power systems v Formulating standards for IoT and Smart Infrastructure (covering smart grids and smart cities)
DISCOMs	v Considering standards-based IPv6 solutions for last mile connectivity for smart meters and smart grids
Industry	v ISGF conceived the idea of using of Wi-Fi for smart metering v ISGF formulated business model for smart metering based on 'Leasing and Services' v EY formulated business model for smart metering based on 'Revenue Sharing' v Industry is working closely with DoT for launching new IoT products

IoT Enabling Framework in Indian Power Sector

Scalable, Reliable, Cost-Effective, Secure, Low-Latency and Interoperable IoT devices



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