Interactive session on
"Smart Grids for Smart Cities"
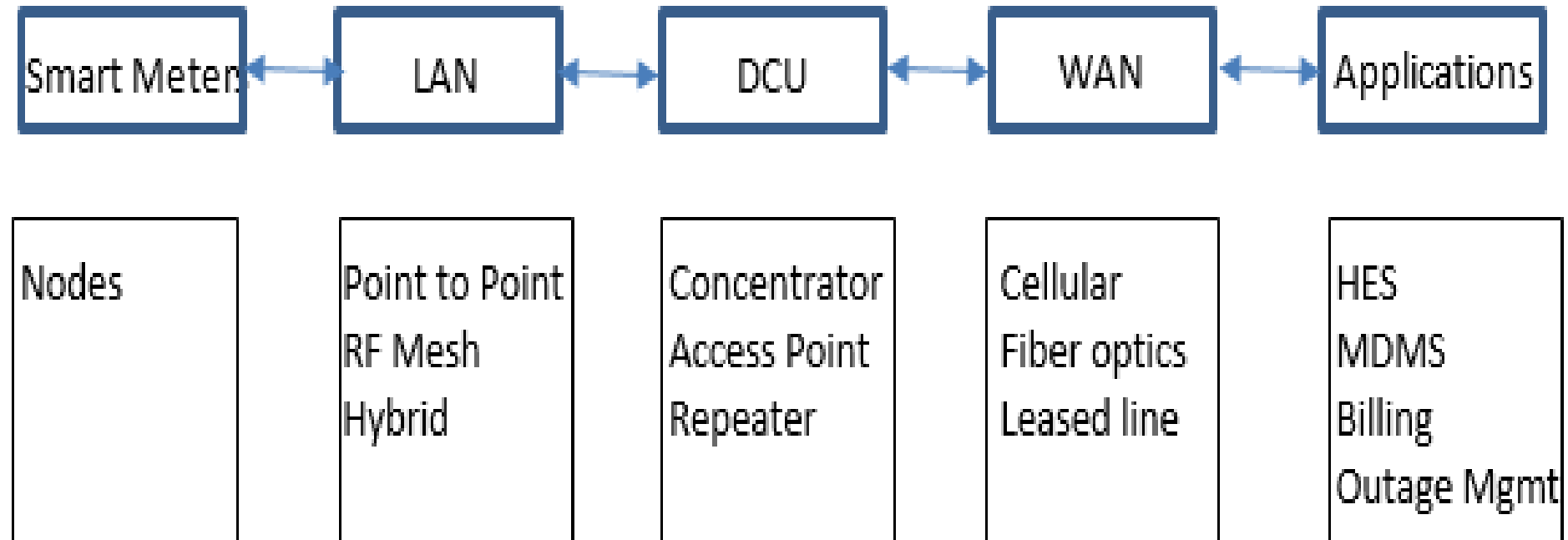30th October 2018
India Habitat Centre, New Delhi

Smart metering System:
"A System Approach rather than a Product"

By: IEEMA Meter Technical Forum (IMTeF)
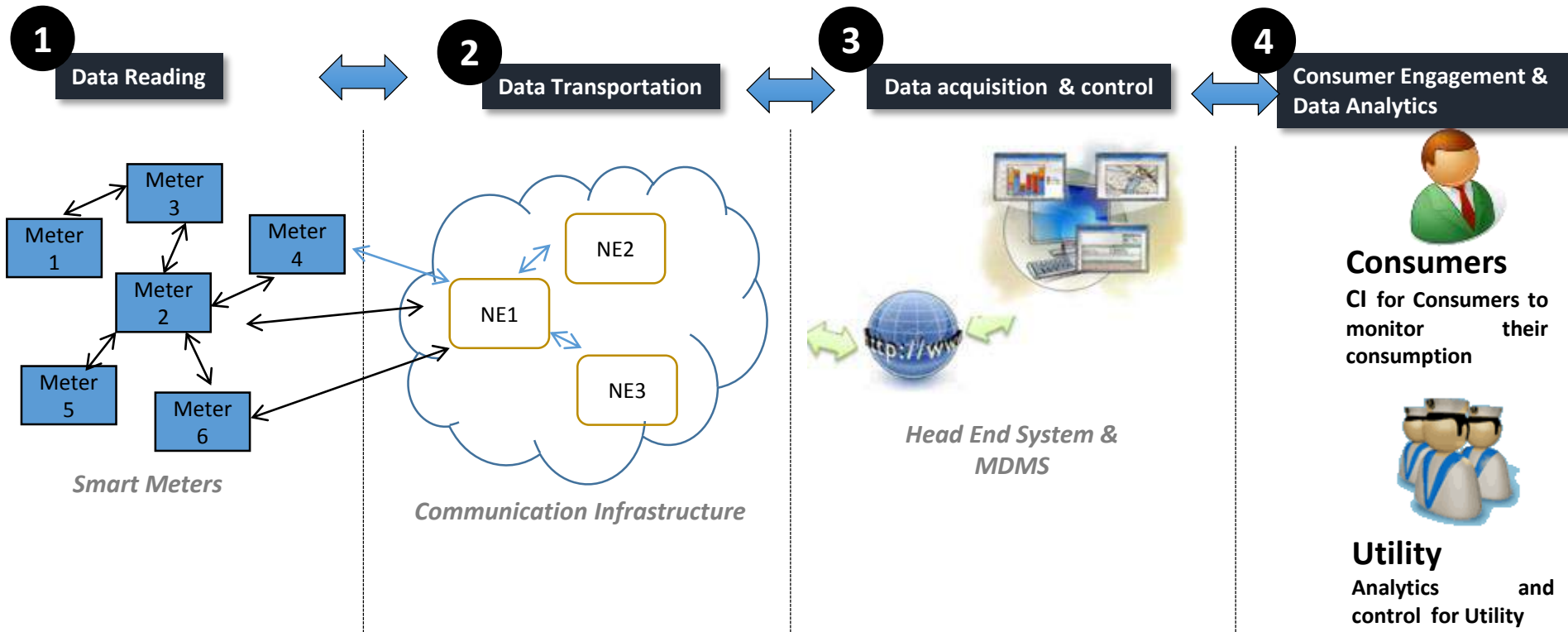
A Forum under IEEMA Meter Division

Jointly Organized by

National Smart Grid Mission
Ministry of Power
Government of India
सत्यमेव जयते

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your link to electricity

Smart Metering System Architecture

Smart Meter	⟷	LAN	⟷	DCU	⟷	WAN	⟷	Applications

Nodes	Point to Point RF Mesh Hybrid	Concentrator Access Point Repeater	Cellular Fiber optics Leased line	HES MDMS Billing Outage Mgmt

What is Smart metering System?

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1 Data Reading

2 Data Transportation

3 Data acquisition & control

4 Consumer Engagement & Data Analytics

Meter 3
Meter 1
Meter 4
Meter 2
Meter 5
Meter 6

Smart Meters

NE2
NE1
NE3

Communication Infrastructure

http://www

Head End System & MDMS

Consumers
CI for Consumers to monitor their consumption

Utility
Analytics and control for Utility

*Smart Metering System / AMI is a crucial part of a **Smart Grid**. It is an integrated system of **smart meters**, **communication networks** and **data management systems** that enables **two way communication** between the utilities and consumer premises equipment.*
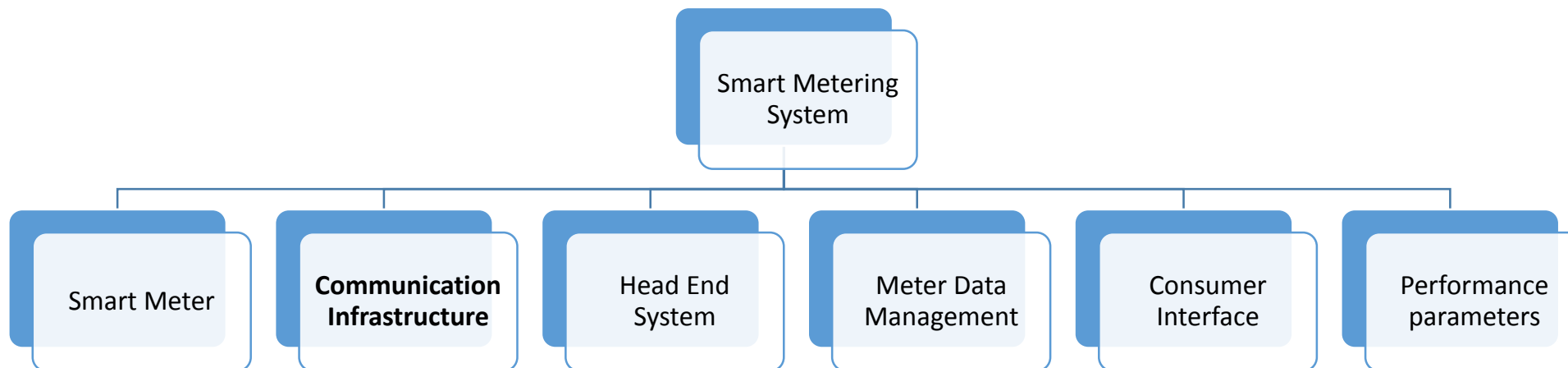
Smart metering system components
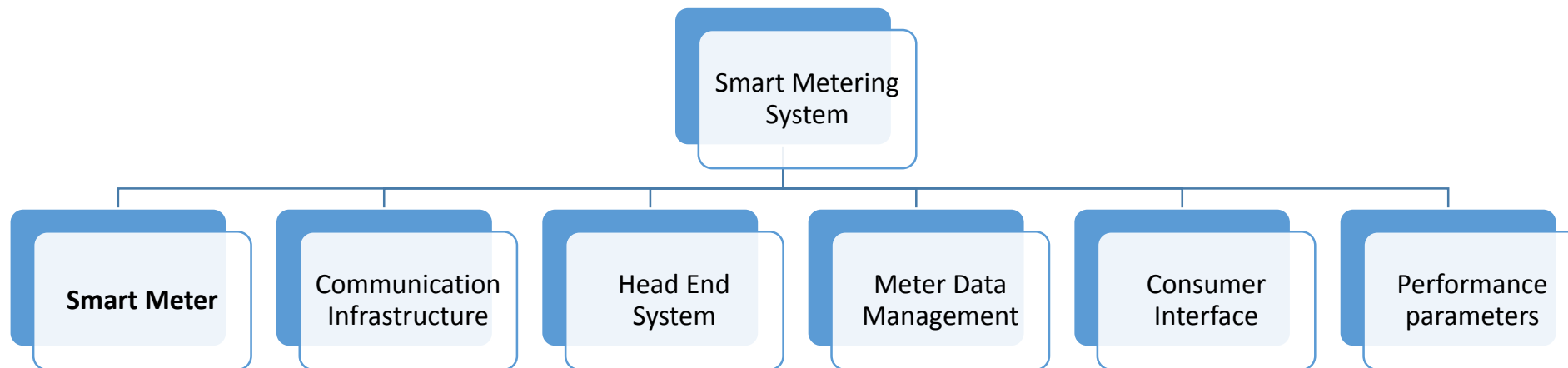
- **Smart Meter (as per IS 16444)**
  - It is an ac static watt hour meter with time of use registers, **internal connect** and **disconnect switches** with **two way communication** capability.
  - It is designed to **measure flow** of forward (import) or **(import)** and reverse **(export)**, store and communicate the same along with other parameters defined in this standard.
  - It shall be **remotely accessed** for collecting data/events, **programming** for select **parameters**.
  - Key parameters should be thought of as per the drivers of utility:
    - Parameters logged in meter
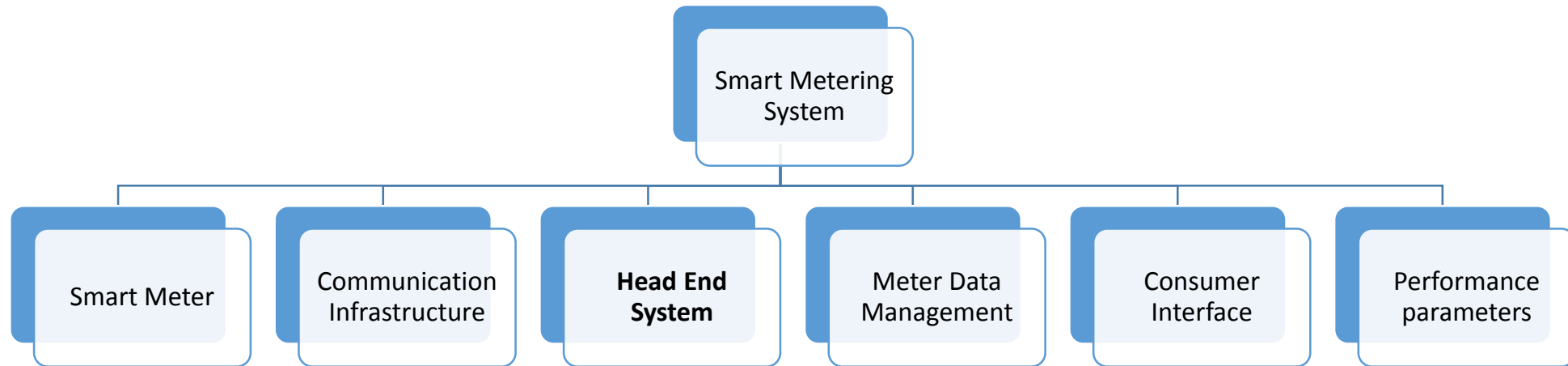   - Tamper immunity/logging

Smart metering components

- **Communication Infrastructure**
  - Communication network is the backbone of Smart Metering System / Advanced Metering Infrastructure. This should be thoughtfully decided and its future scalability should be seen. This needs to be seen w.r.t. its availability, terrain, and addressing multiple applications. Following are the key parameters for same
  - Reliability & Scalability
  - Security
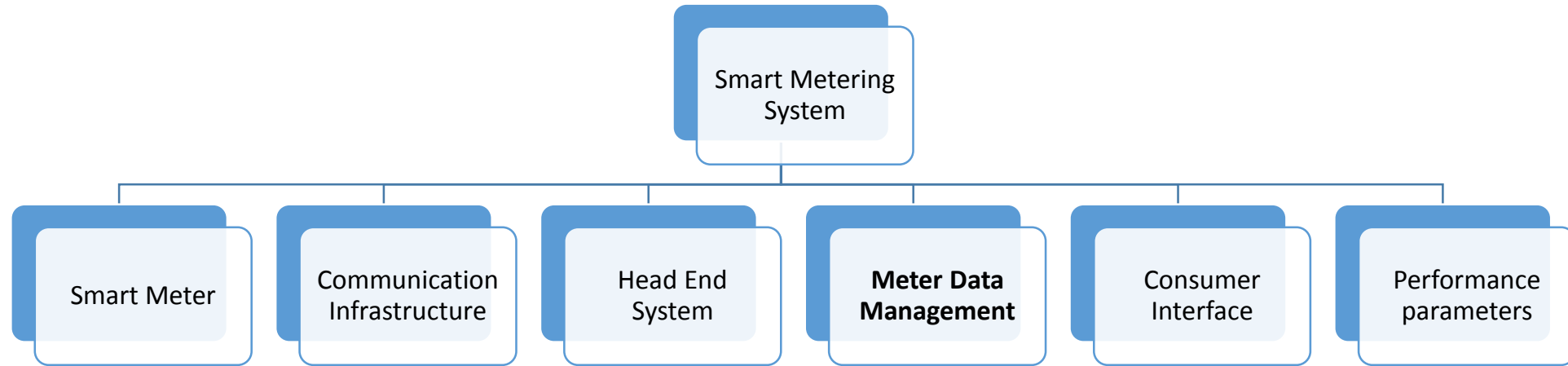 - Multiple applications- DA etc.

Smart metering components

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                    ┌──────────────────┐
                    │  Smart Metering  │
                    │      System      │
                    └──────────────────┘
    ┌───────────┬───────────┬─────┴─────┬───────────┬───────────┐
┌───────┐ ┌───────────┐ ┌─────────┐ ┌─────────┐ ┌──────────┐ ┌────────────┐
│ Smart │ │Communica- │ │Head End │ │ Meter   │ │ Consumer │ │Performance │
│ Meter │ │   tion    │ │ System  │ │ Data    │ │Interface │ │ parameters │
│       │ │Infrastruc-│ │         │ │Manage-  │ │          │ │            │
│       │ │   ture    │ │         │ │  ment   │ │          │ │            │
└───────┘ └───────────┘ └─────────┘ └─────────┘ └──────────┘ └────────────┘
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- **Head End System**
  - HES acts as a acquisition system which stores data of Smart meters (regular pushes/scheduled reads etc.).
  - It should be decided based upon the communication network, robustness & scalability to accommodate present as well as future requirements.
  - Utility shall be able to read/control/upgrade the Smart meters through HES via proper security mechanisms
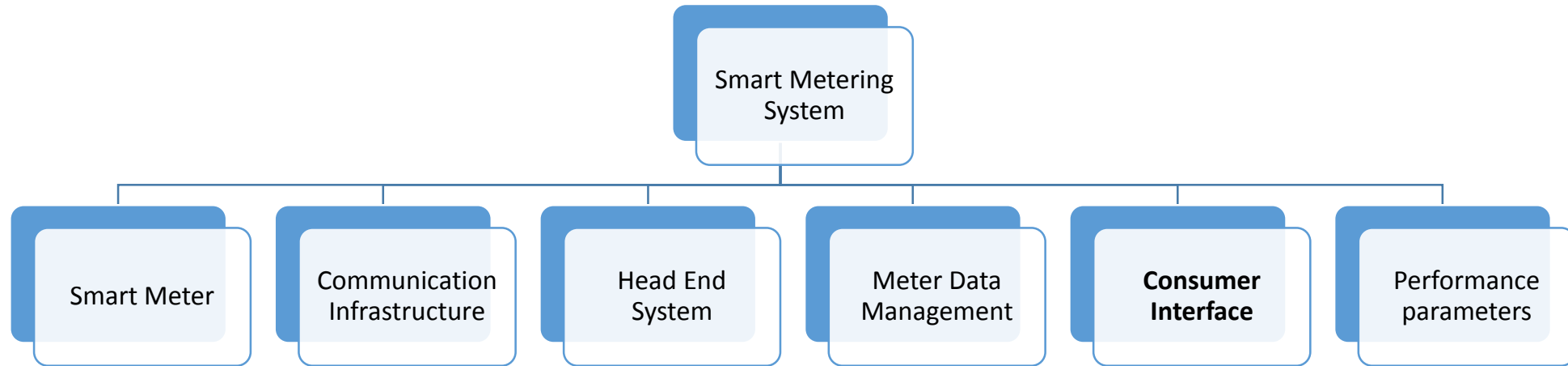
Smart metering components

Smart Metering System

| Smart Meter | Communication Infrastructure | Head End System | **Meter Data Management** | Consumer Interface | Performance parameters |

- **Meter Data Management**
  - MDMs provides utility-specific business logic to automate and streamline the complex billing and data analytics process
  - The critical role of an MDM system is to process granular interval meter data at large volumes very quickly.
  - It does data validation, cleanse and process before making it available for billing and analysis
  - There should provision to do the customization by user on validation, editing and estimation (VEE) on the AMI data.
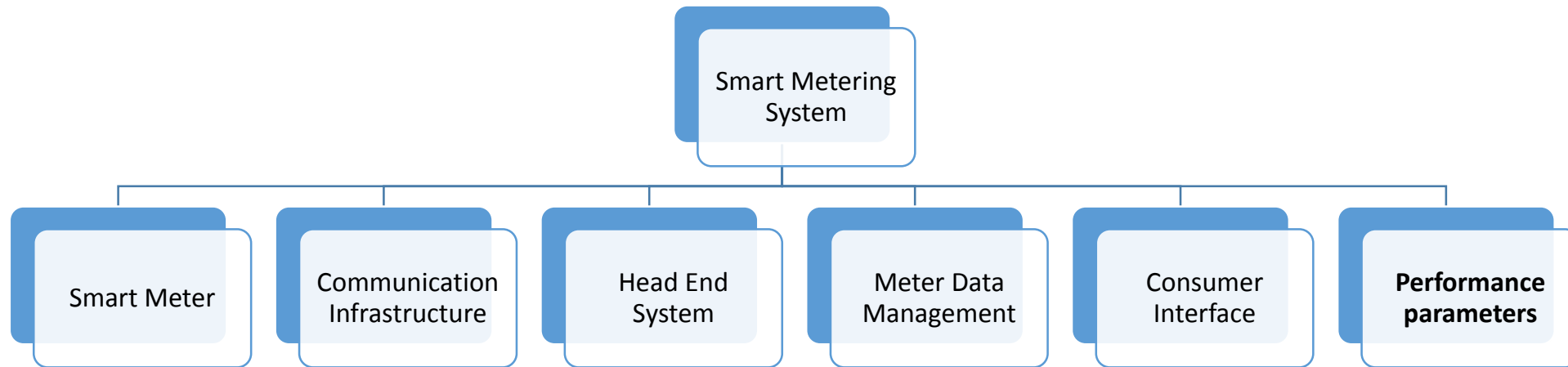
Smart metering components

- **Consumer Interface**
  - The Smart Metering System is a distributed intelligent system, therefore the requirement of CI is very critical. As all the alerts related of availability of power, critical pricing / dynamic pricing shall be made available on CI and consumer has to act based upon his requirement.
  - It should be compatible with the communication infrastructure and Smart Meter. CI can be a mobile device (phone/tablet etc.) or special hardware which have graphical display, easy to understand and provide audible / visual alarm in case of any message / from utility

Smart metering components


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                        Smart Metering
                           System
    ┌──────────┬──────────┬──────────┬──────────┬──────────┐
 Smart Meter  Communication  Head End   Meter Data  Consumer  Performance
              Infrastructure  System    Management  Interface  parameters
```

- **Performance Parameters**
  - To facilitate highly accurate and timely availability of data and alerts from the AMI system, there is a need to define performance parameter other than features and functionality.
  - This will ensure a robust communication network which will help utility in making several decision in distribution segment.
  - The performance levels for daily meter readings, alerts / alarm, on-demand read, etc. meter data availability, should be clearly spelt out and has been agreed upon by both, the communication technology provider and the Discoms as part of SLA (Service Level Agreements)

Smart functionalities

- ## Disconnection mechanism
  - Over current (minimum 105% of Imax in any phase for predefined persistence time)
  - Load control limit (programmable and set by utility)
  - Pre-programmed event conditions (factory set)
  - Disconnect signal from utility control centre
  - In case of pre-paid facility under defined/ agree conditions
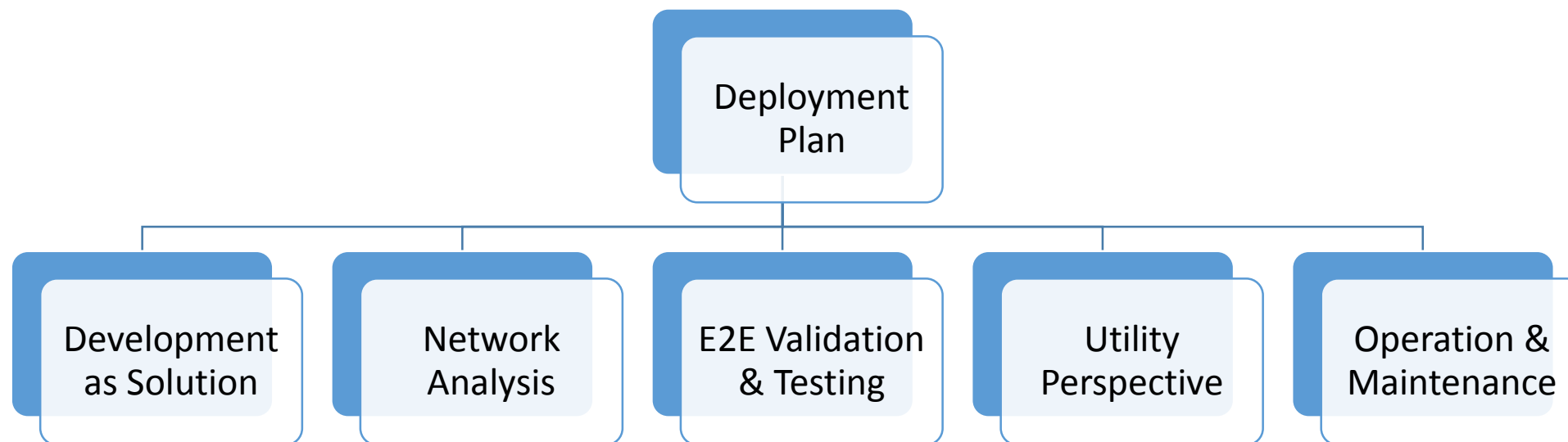
▶ Functionality

- ## Reconnection mechanism
  - The switch re-connection shall be decided by meter locally. It will try to reconnect the load up to predefined time, with predefined interval. If the load is within limits meter shall remain in normal connect mode.
  - If the load is still more than the programmed limits, it will lock out and wait for 30 min (lock out period). After this period the meter reconnect the load and if the load is still beyond the defined limits it shall be repeated with status update to HES
  - All other condition reconnection shall happen through HES
  - In case of prepayment, as per agreed structure with utility

Source: BIS IS16444 Part-I

Smart functionalities

- All connection & disconnection shall also be logged as events.

- Indication of status of Load Switch (that is connected / disconnected) shall be available on display as well as at HES.

- Smart Meters shall respond to:
    - Meter readings on demand from HES
    - Scheduled meter reading from HES
    - Remote Firmware upgrade from HES
    - All programming request from HES

- Smart Meter shall detect "First breath (power on) and Last gasp (power off) condition and communicate to HES.

Deployment Plan – Smart Metering System

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                    ┌─────────────────┐
                    │   Deployment    │
                    │      Plan       │
                    └─────────────────┘
          ┌──────────┬──────────┼──────────┬──────────┐
   ┌──────────┐ ┌──────────┐ ┌──────────┐ ┌──────────┐ ┌──────────┐
   │Development│ │ Network  │ │E2E       │ │ Utility  │ │Operation &│
   │as Solution│ │ Analysis │ │Validation│ │Perspective│ │Maintenance│
   │          │ │          │ │& Testing │ │          │ │          │
   └──────────┘ └──────────┘ └──────────┘ └──────────┘ └──────────┘
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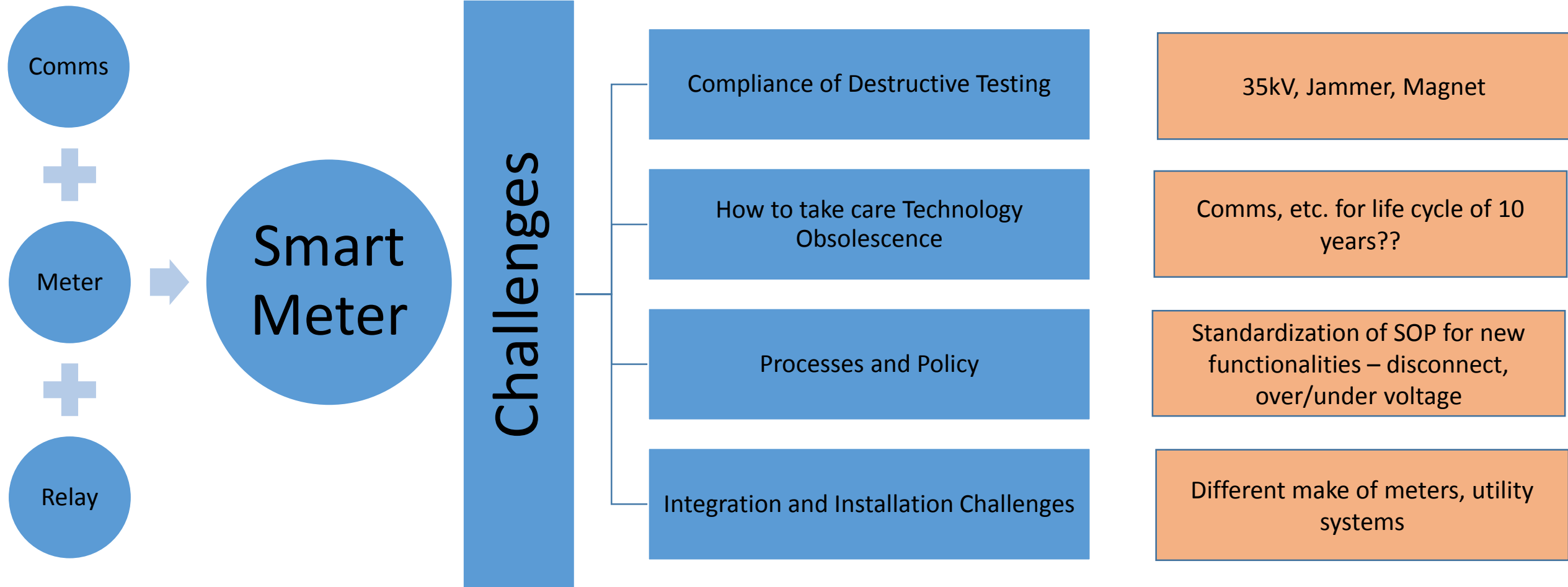
- **Development as Solution**
  - Requirement analysis has to be done at system level considering the end to end smartness of system
  - Operations processes of meter reading/installation/maintenance has to be considered in these analysis
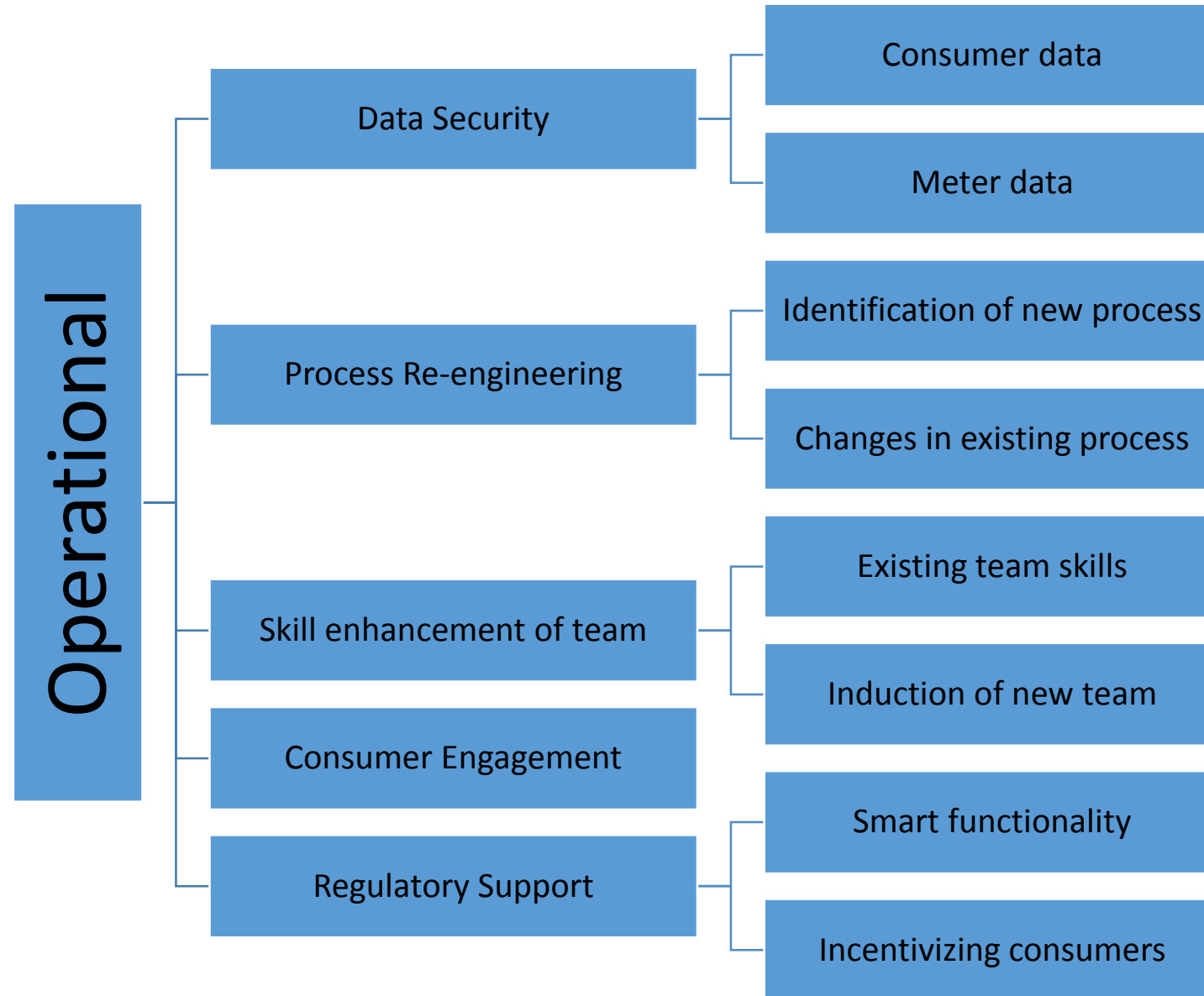
Smart Metering
Challenges

Challenges – Smart Meters

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Comms
+
Meter
+
Relay

→ Smart Meter

Challenges

Compliance of Destructive Testing	35kV, Jammer, Magnet
How to take care Technology Obsolescence	Comms, etc. for life cycle of 10 years??
Processes and Policy	Standardization of SOP for new functionalities – disconnect, over/under voltage
Integration and Installation Challenges	Different make of meters, utility systems

Challenges – Operational

Operational
- Data Security
  - Consumer data
  - Meter data
- Process Re-engineering
  - Identification of new process
  - Changes in existing process
- Skill enhancement of team
  - Existing team skills
  - Induction of new team
- Consumer Engagement
- Regulatory Support
  - Smart functionality
  - Incentivizing consumers

Conclusion

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                    Utility                              Manufacturers
                       |                                      |
   +--------+---------+---------+--------+      +-------------+-------------+------------+
   IT Team   Metering   Procurement  Policy &    Meter          Comms/HES    IT System
             Team       Team         Processes   Manufacturers   Provider     Providers
```

*The **"SMARTNESS"** comes from the entire system component and not just one or two components, hence it has to be seen, design & implemented keeping end to end **System Approach** and not the **Product Approach***
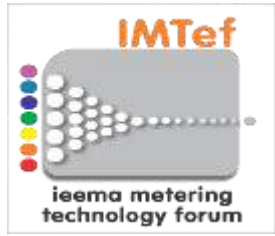
Convenor, IMTeF

Thanks for your Kind Attention & Support