



Interactive session on “Smart Grids for Smart Cities”

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Communication technologies for AMI : RF Mesh

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National Smart Grid Mission
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Agenda

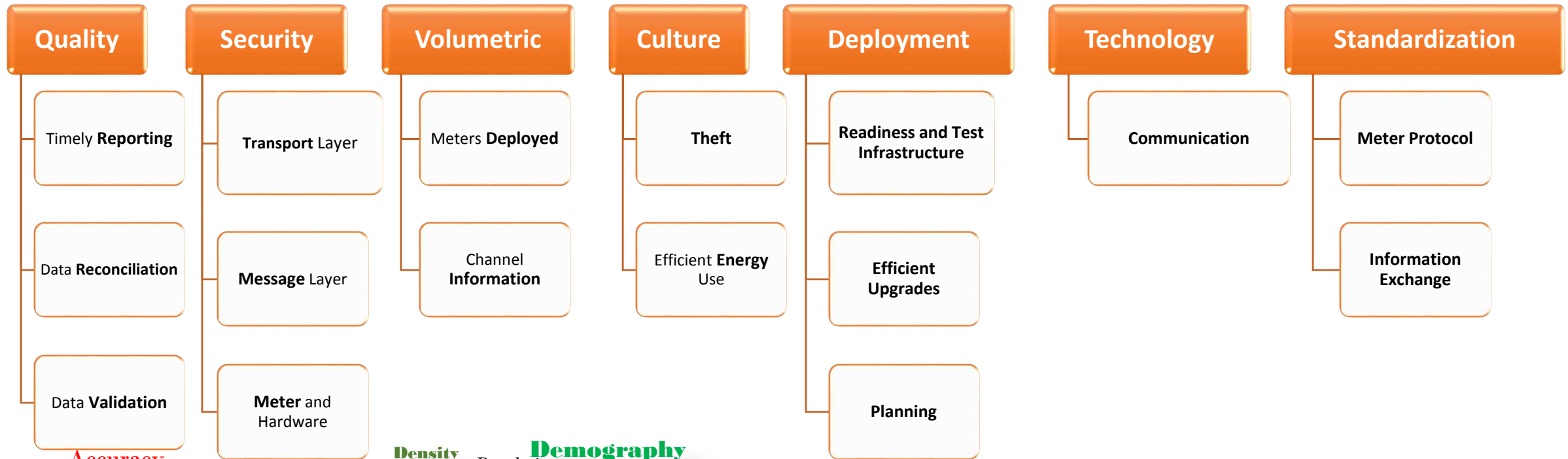
Communication technologies

- RF Mesh
- PLC Communication
- Cellular or P2P communication

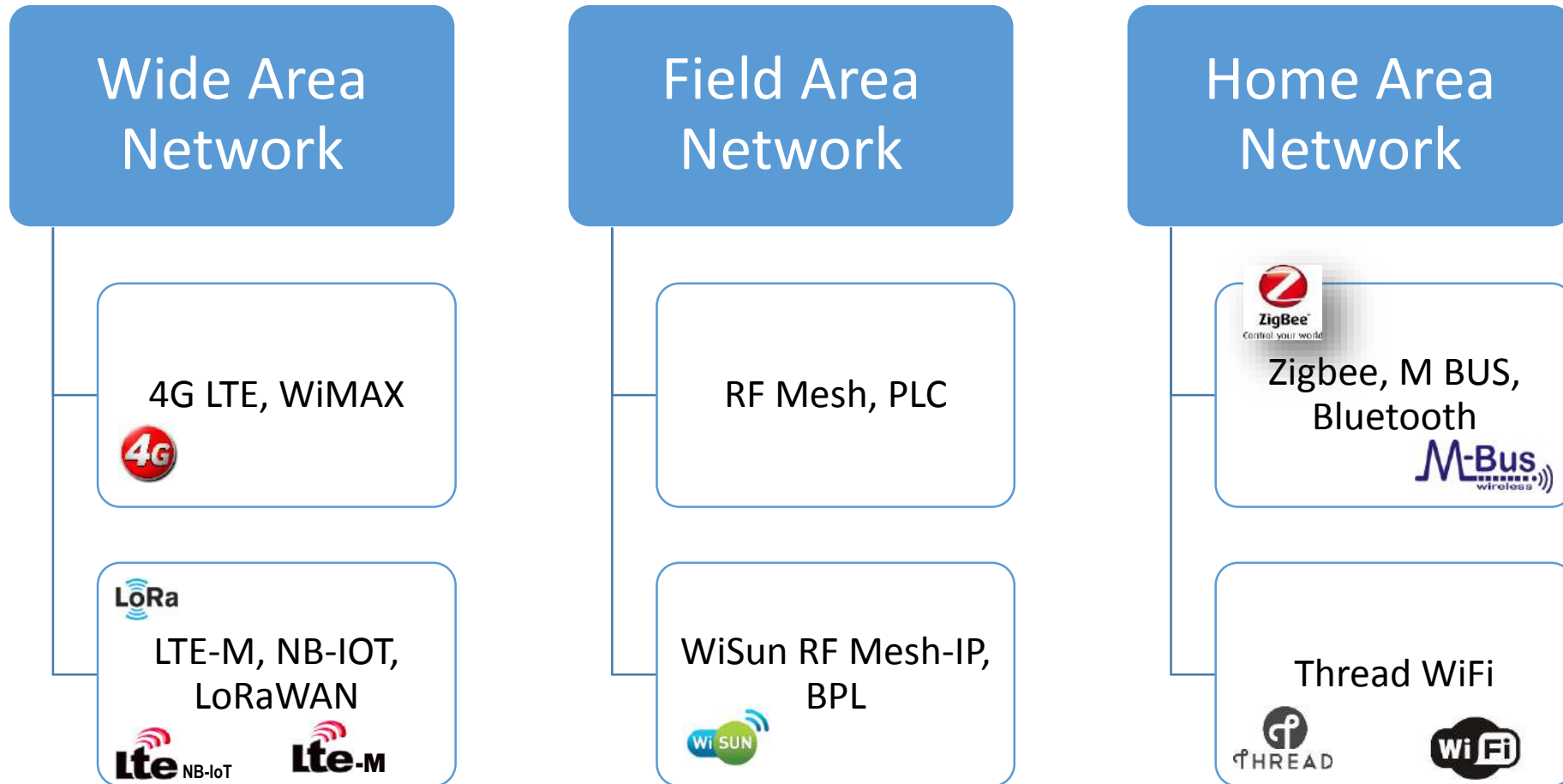
Choosing the right communication technology – topics for consideration

Conclusion

Need of Smart Metering

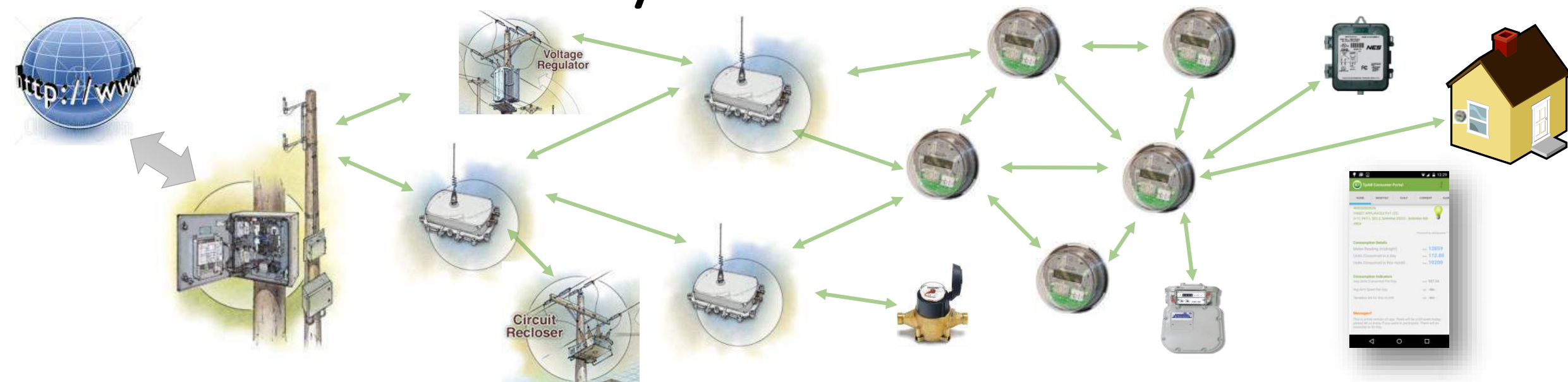


Communication Technologies in Smart Metering



Communication technologies: **RF Mesh**

RF Network Layers



WAN

Utility Core

- DCUs
- Network Entry/Exit Point
- TCP/IP 10/100 Mbps

FAN

Network Equipments

- Routers
- AMI/DA communication
- 802.15.4g
- Peer to Peer Mesh

NAN

End Point Network

- Multi-Utility Metering
- Direct Load Control
- 802.15.4g
- Peer to Peer Mesh

Consumer Interface

- Mobile Apps
- Consumer Portal
- SMS
- Demand Response

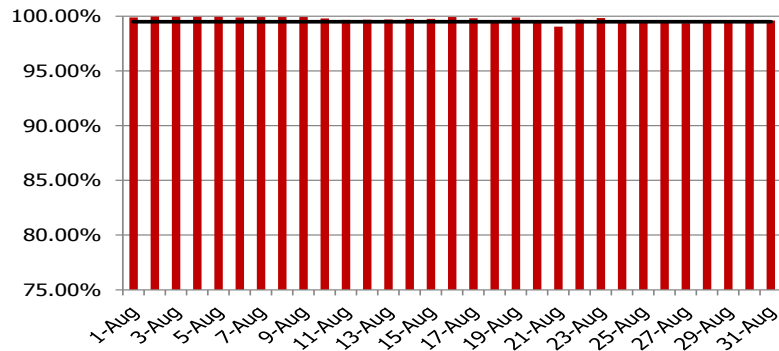
RF Mesh Pillars for Success

Self Forming

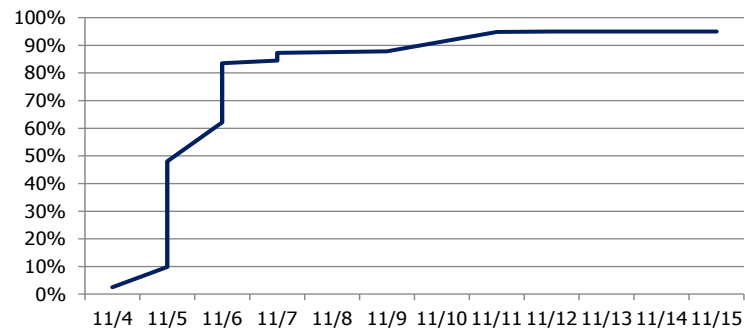
Intelligent Routing

Safe & Reliable

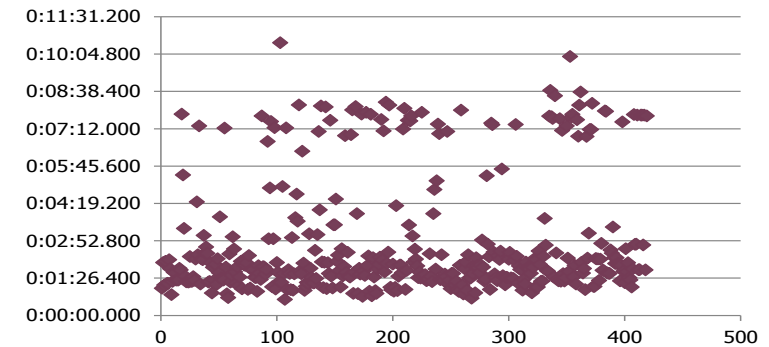
Fault Tolerant



99.5% load survey interval
and daily reads for over 20M
meters daily



4M+ firmware updates
completed over-the-air



10K+ commands executed
daily amongst customer base

**RF Mesh is a reliable network providing performance that meet strict utilities
SLA's**

RF Canopy Network Elements

865 – 867MHz license free band : WPC Certified

Self- forming, Self- healing, Secure network

Extensive network performance management system

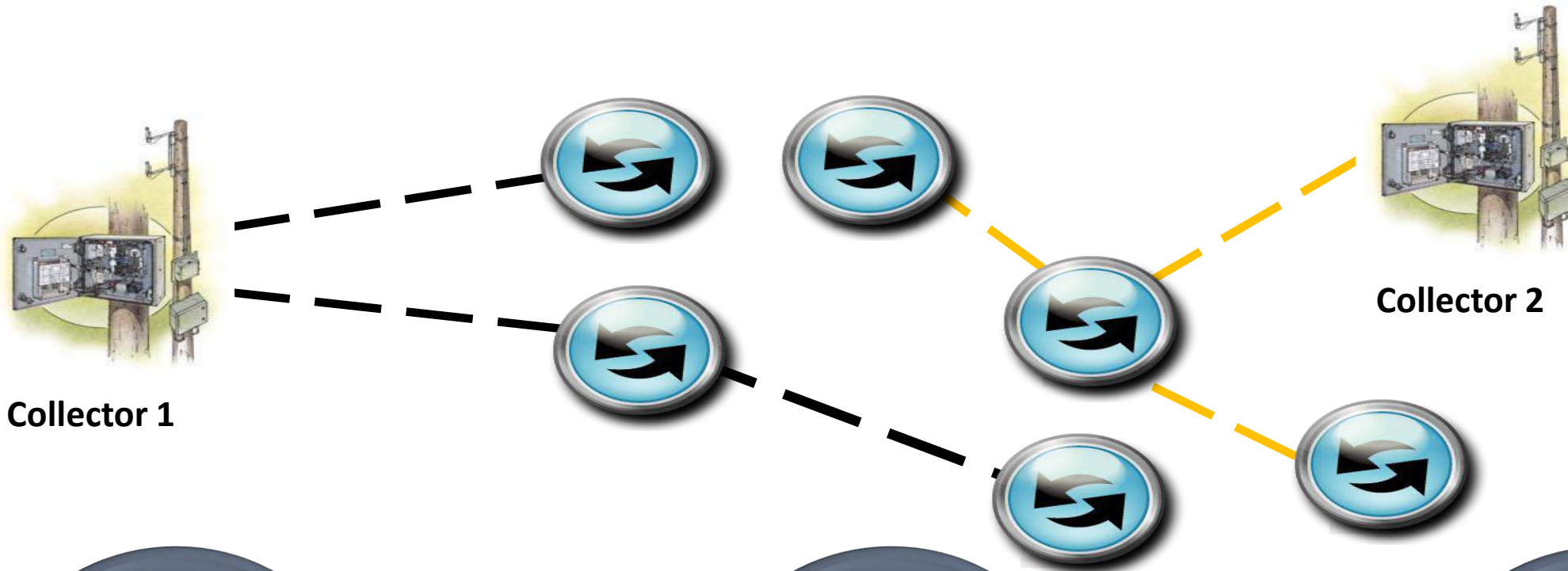
Network Equipments : Router

- Extends the reach of the network to the DCU
- Acts as a network “repeater”
- Power Backup

Collector

- Supports OFC, Ethernet, GPRS, backhaul communication
- Adequate memory storage
- Power Backup

Intelligent Network (always searches for strongest path)

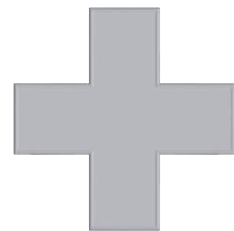


Collector 1

Collector 2

Self Forming

- Endpoints learn neighbors
- Endpoints initiate communication



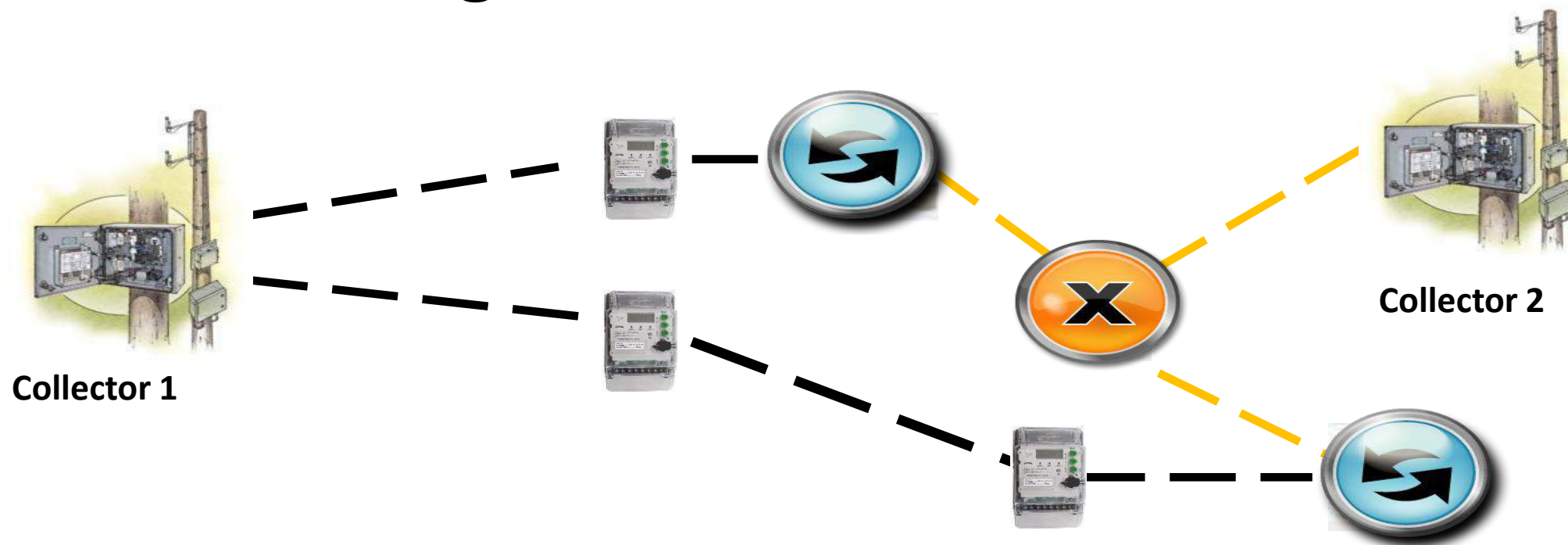
Intelligent Routing

- Maintains neighbor list
- Availability, Layer



Fault Tolerant

Self Healing Network (Show does not stop, when one path breaks)



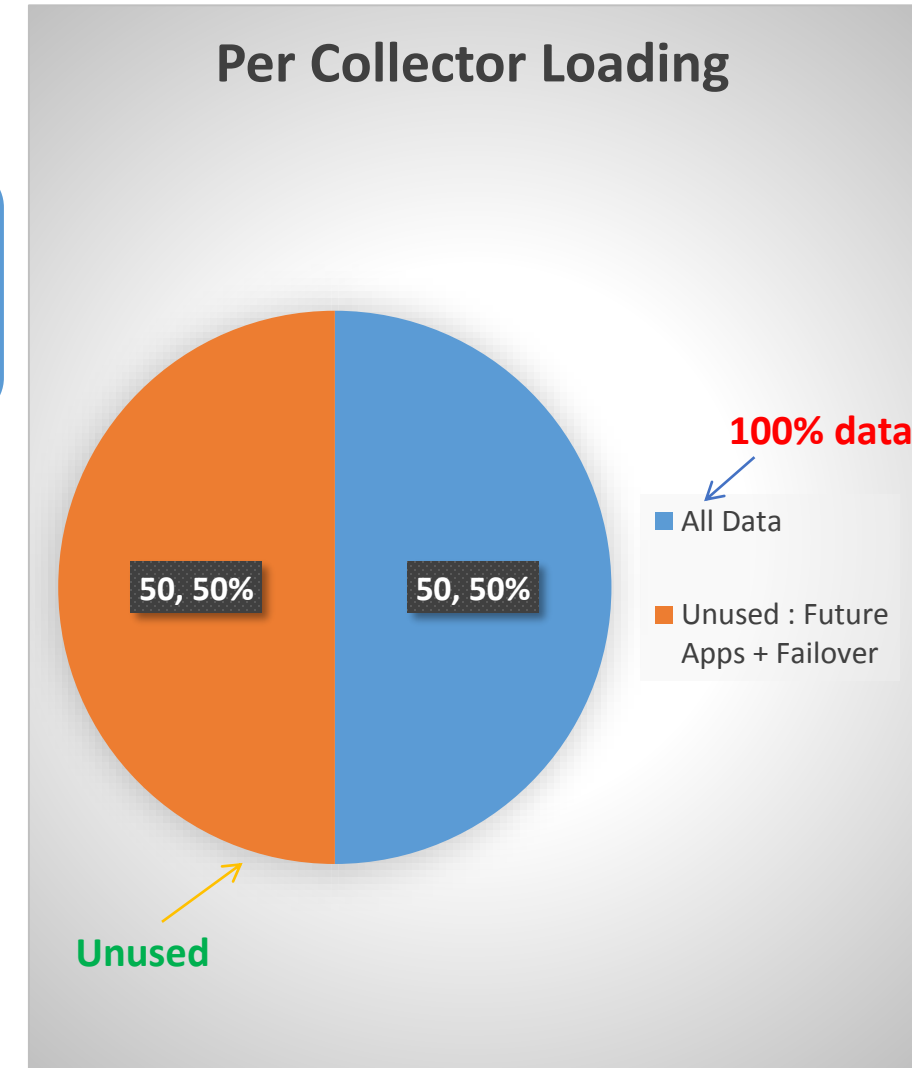
Fault Tolerant

- Endpoints choose alternate path
- Self Healing

Scalable 'Future Ready' Network

Network Designed : 50% of capacity

- One DCU can take load of other DCU a/c Failover
- Upgradeable to support future applications like HAN, DA etc...
- Topography + SLA requirement main deciding factor of N/W design



RF Mesh an overview..

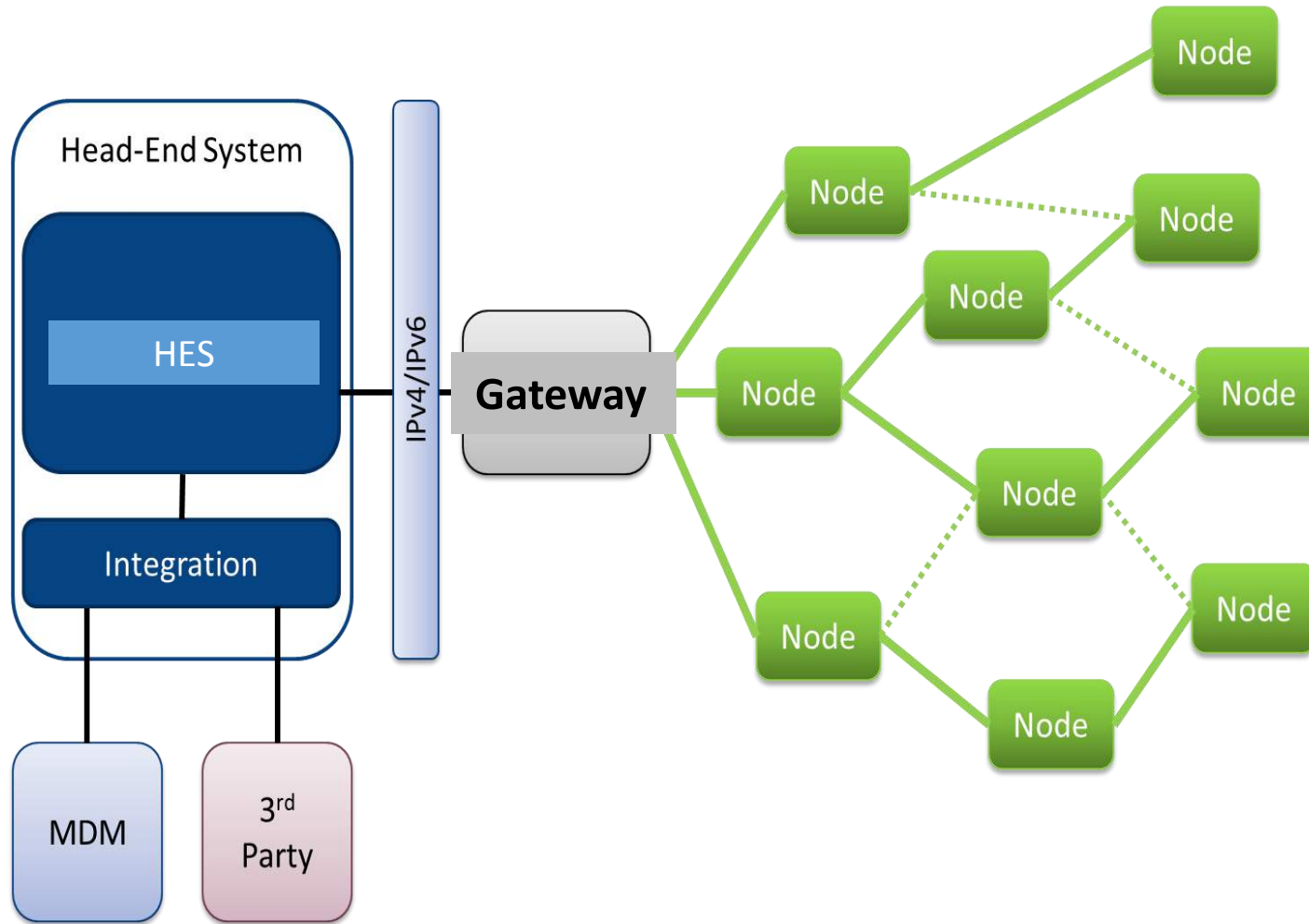
Advantages

- Robust and reliable communication technology
- At rural areas more cost effective than PLC
- Data bandwidth can be relatively easily adapted to use case needs
- Independent of electricity network as communication media
- Future Ready- End to end IPv6 RF solution fully based on open standards is available – WI SUN standards

Disadvantages

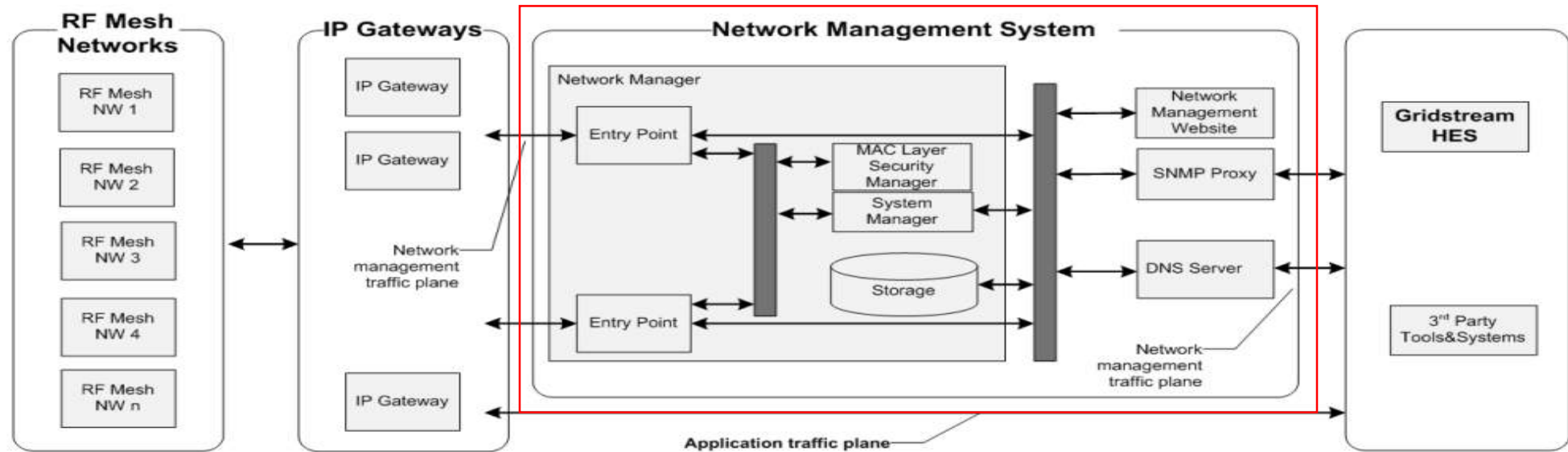
- Available frequency bands and low Tx power limit the use in certain conditions
- No dedicated SM frequency band available
- Installation costs for meters in basements can be high
- Changing ambient conditions (trees, buildings, ..) can cause maintenance need und unstable communication network conditions

System Overview - RF Solution Architecture



- RF technology based on Routers and Collectors
- HES SW solution
- Secure & interoperable interfaces based on open standards.

Network Management System



What does it do?

- Database and user GUI
- Track and monitor the RF Mesh
 - RF Gateway and
 - RF Node
- Logging of statistical data from the mesh nodes

Success Stories - TEPCO Japan

27M

E N D P O I N T S

5 Billion

DB INSERTS /Day

MULTI MODAL METERING

120,000 Meter Deployment / Week

CAPABLE OF 1200K DEVICE REMOTE FIRMWARE UPGRADE SIMULTANEOUSLY



Success Stories - Brazil Light

Largest smart grid project in South America.

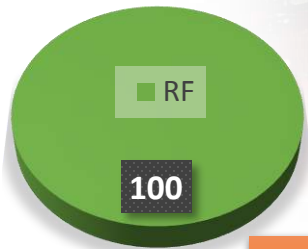
Advance **anti-tampering** meters.

Multiple frequency intervals required for better energy management.

Robust AMI infrastructure

Support of **legacy metering protocol** for meter data exchange.

DA support.



100% RF deployment.

Communication technologies: **PLC**

Power Line Communication- An overview

Definition

- Power-Line Communication is a communication method which **uses existing low and medium voltage power lines or indoor electrical wiring** to transmit data

Different type of PLC Technologies available

- PLC- Very low data speed
- G3 PLC- IPv6 compliant with high data speed (160kbps approx.)
- PRIME- Narrow band communication with high data speed; driven through PRIME Alliance
- BPL- High Data Speed (in mbps)

PLC communication- An overview

Advantages

- Robust and reliable
- Coverage in built-up area
- Lowest TCO in high density areas
- Low installation cost in basements and indoors

Disadvantages

- Dependency on wiring network
- Need of separate data concentrator
- Data concentrator HW and installation cost
- Power consumption is on high side than RF
- Regular maintenance and clean up needed

Communication technologies:

Cellular

Cellular Communication- An overview

Definition

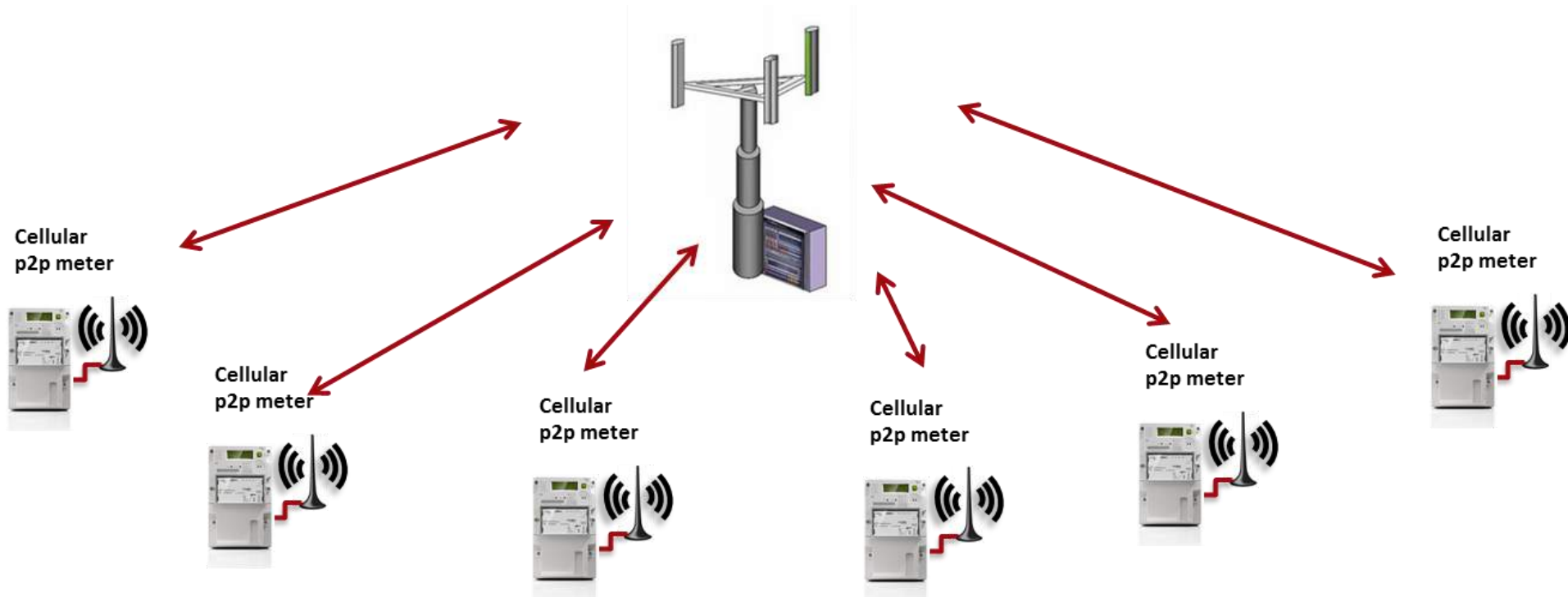
- Cellular networks are based on neighboring “cells” (fixed-location base-stations) that allow **mobile** devices to maintain a **seamless connection**, even while moving from one cell to another.

Considered under WAN technologies as

- 3G, 4G, 5G*
- LTE-M, LTE NB-IOT, WiMAX

P2P Solution today

- Typically 2G/3G/4G LTE communication



Cellular Communication- An overview

Advantages

- Easiest migration from old to new generation smart metering
- SLA levels- dependent on 3rd parties and demography
- High data speed, Low latency
- Easy scalability

Disadvantages

- Cost- OPEX + CAPEX
- Installation cost, when external antenna needed (e.g. basement)
- Dependency on telecom operators - subscription fee and subscription management
- TCO is dependent on telco's pricing policy

Cellular communication.. Way Ahead

In the future LTE & NB-IOT evolution can be a game changer

- NB-IoT and LTE-M are new unproven technologies with an initial 3GPP standard and there is no empirical evidence to support performance claims.
- They were originally conceived for IoT sensors, delivering 100 bytes per day, but are now positioned for electricity metering requiring 15- 20kBytes per day.
- Most Operator Network roll-outs are in the very early stages with some still laboratory based.

High Opex and Capex Measures

- Legislative roaming rules may decrease the operating costs
- eUICC (embedded SIM) may reduce initial subscription fee

**Telco's will play a key role
in P2P communication**

What should be considered when choosing communication technology

Road Ahead – Smart Way

Handling **Large Volume**

Virtual Grid

Scale Strategy

Choosing **Communication** Technology

Outage Management

Automated Mechanism
For AMI System
Upgrade

IPV6 Based Network

Prepay Smart Meter As
An Option

Standardizing Meter
Communication Protocol

Measures to **Handle Losses**

Educating Consumers
about AMI benefits

CEA mentioned **Minimum SLAs**

- a. **LP data read for of 90% of meters daily; monthly 99%**
- b. **ODR with 90% of meters read in 30mins**
- c. **Outage detection in 5 mins for 90% of meters**
- d. **OTA FW upgrade for 90% meters in 12 hours**
- e. **Tamper alert of 99% meters in 15mins.**

Choosing the right communication technology

Communication is a key factor for successful smart metering; Furthermore, it builds the foundation for the development of Smart Grids and IoT

TCO- Total Cost of ownership

- Meter price is a minor part of the lifecycle costs → **TCO** (Total Cost of Ownership) should be the key criteria
- Capex
- Opex
- SLA

When selecting communication technology, consider TCO and future development

Examples of parameters affecting TCO

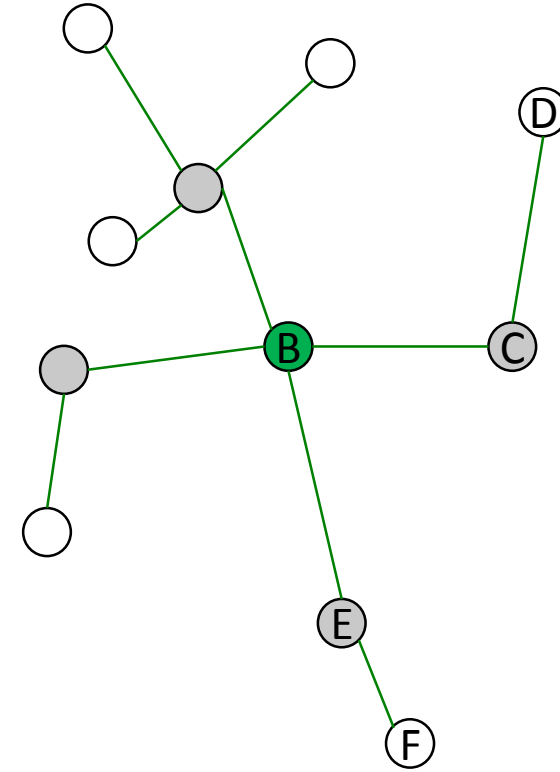
- Meter price
- SLA level, maintaining SLA level
- Device failure rate
- Device energy consumption
- Product availability timing

A great number of parameters affect the final TCO

- Successful first time installation
- Time spent on installation site
- Upgradeability of field products
- Auxiliary communication infrastructure needed
- Software licences and subscription fees
- Support for distribution network maintenance
- Openness and flexibility for new applications

Migrating to next generation Comms technology

- Migration from the current smart metering solution to the latest technology will be a challenge requiring special expertise
- All repeating devices (both PLC and RF mesh) require careful planning to avoid collapse in SLA levels
- P2P communication is infra ready, dependency on existing telco and SLA's need to be carefully evaluated



Whatever the communication technology will be, careful planning is critical



Thank you for your attention