M2M/IoT

in

Smart Cities and Industry 4.0

A Technology overview

Sushil Kumar
Dy. Director General (IoT)

Telecommunication Engineering Center
Department of Telecommunications
Government of India

Telecommunication Engineering Centre

ISO 9001:2008

A brief introduction

- TEC develops telecom product specification and interoperability (Interface) specification for seamless working of telecom networks and devices. These also cover safety and security requirement.

- TEC provides support and advice to DoT on technology, spectrum and licensing related issues and produces standards related documents.

- It strives to enhance Indian contribution in the development of international standards so that the national interests are adequately safeguarded.

Telecommunication Engineering Centre

ISO 9001:2008

- Various divisions in TEC chair the National working Groups (NWGs) corresponding to the study group of ITU-T.
- TEC also chair NWG-5 corresponding to study group 5 of ITU-R, which *inter-alia* deals standards for mobile radio systems.
- TEC is having IPV6 Ready Logo test lab, Specific Absorption Rate (SAR) lab and Next Generation Network (NGN)/ Transport lab.
- Working on Mandatory testing & certification of telecom equipment (MTCTE) to be implemented by 1st Jan 2019.
- TEC also has MRA with Singapore for product certification

Some Challenges of major Indian cities

- **Population :** Approx. 1.28 billion,
  - 32% living in urban areas.
  - 68% in rural area (in 0.65M villages or 0.25M VPs)

- **Migration from rural to urban areas ?**
  - **Reasons :** In search of jobs, better education, health care etc.
  - Around 25-30 people migrate / minute to major India cities.

- Average speed in most of the congested roads / highways – 10-15 Km/ Hr
  - US $ 10 B worth fuel is lost due to congestion every year.
- Waste disposal
- Pollution
- >Crime
- Power
- **Drinking Water shortage** : Non revenue water (NRW) in India: 40 - 65%
  Singapore < 5%, USA : 12- 15%

- Health Care

How to address these challenges efficiently:

➢needs to create **Smart Infrastructure** to manage complexities of public services, reduce expenses, increase efficiency and improve the quality of life.

➢Smart Infrastructure may be in the verticals

- Automotive sector - Intelligent Transport System
- City Surveillance
- Waste management
- Water management
- Power
- Health

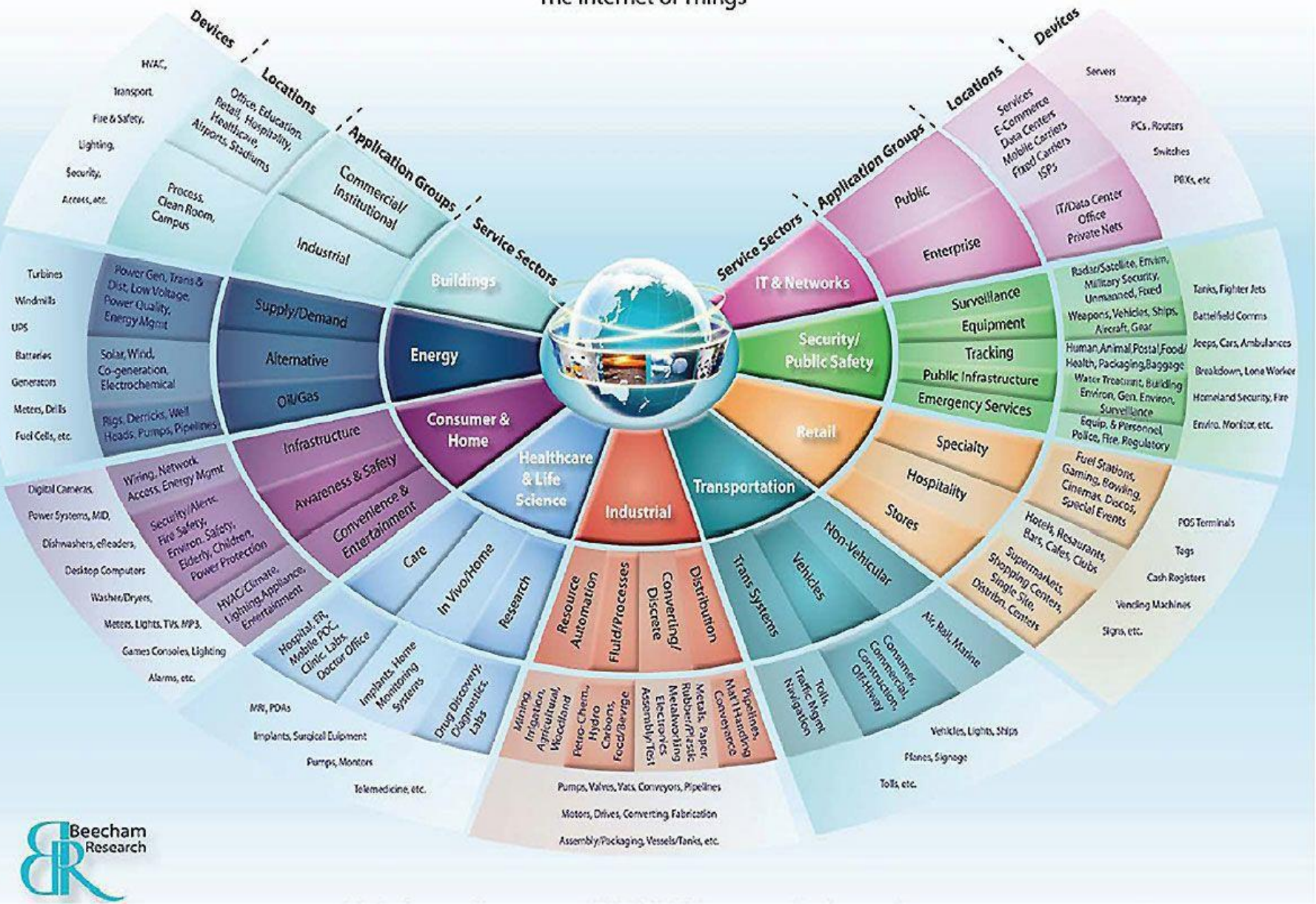
➢ Integrated command & Control centre, DC & DR, Platform to manage data, devices, communication network, gateways etc.

➢ Use M2M/ IoT and ICT to make all the verticals smart - will provide data in real time.

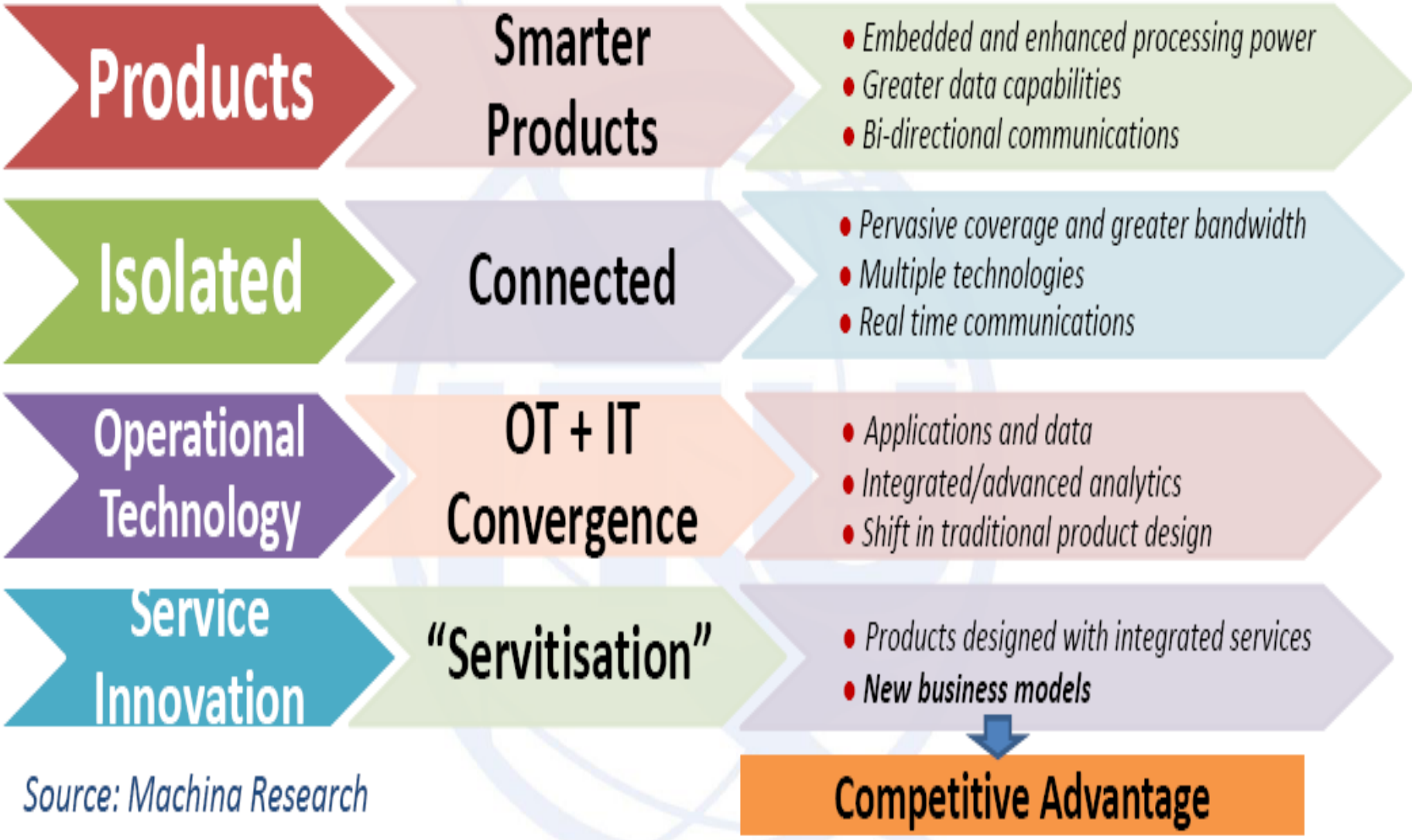
Goal : To improve the quality of life.

ISO 9001:2008

The Internet of Things



Beecham Research



Source: Machina Research

IoT definition as per ITU-T

- ITU-T in its Recommendation ITU-T Y.2060 (06/2012) has defined Internet of Things (IoT), as a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving **interoperable information and communication technologies.**

- ITU-T created a Study Group (SG)-20 in 2015 to study IoT and its applications in Smart cities and communities.

- On the same lines, TEC created National Working Group (NWG)-20 to coordinate and submit contributions in SG-20.

M2M / IoT market: Projections

- 26 billion connected devices globally by 2020, business impact to be worth US$ 4.3 Trillion.
- $1.3 trillion revenue opportunities for mobile network operators

GSMA & Machina research

50 billion connected devices globally by 2020

CISCO / Ericson / ITU

Global projections varies from 26 billion to 50 billion

There may be around 2.6 billion connected devices by 2020 and 8 billion by 2026 and 24 billion by 2032 in India.

TEC TR

Create an ecosystem for 5Billion connected devices in India by 2022

NDCP 2018

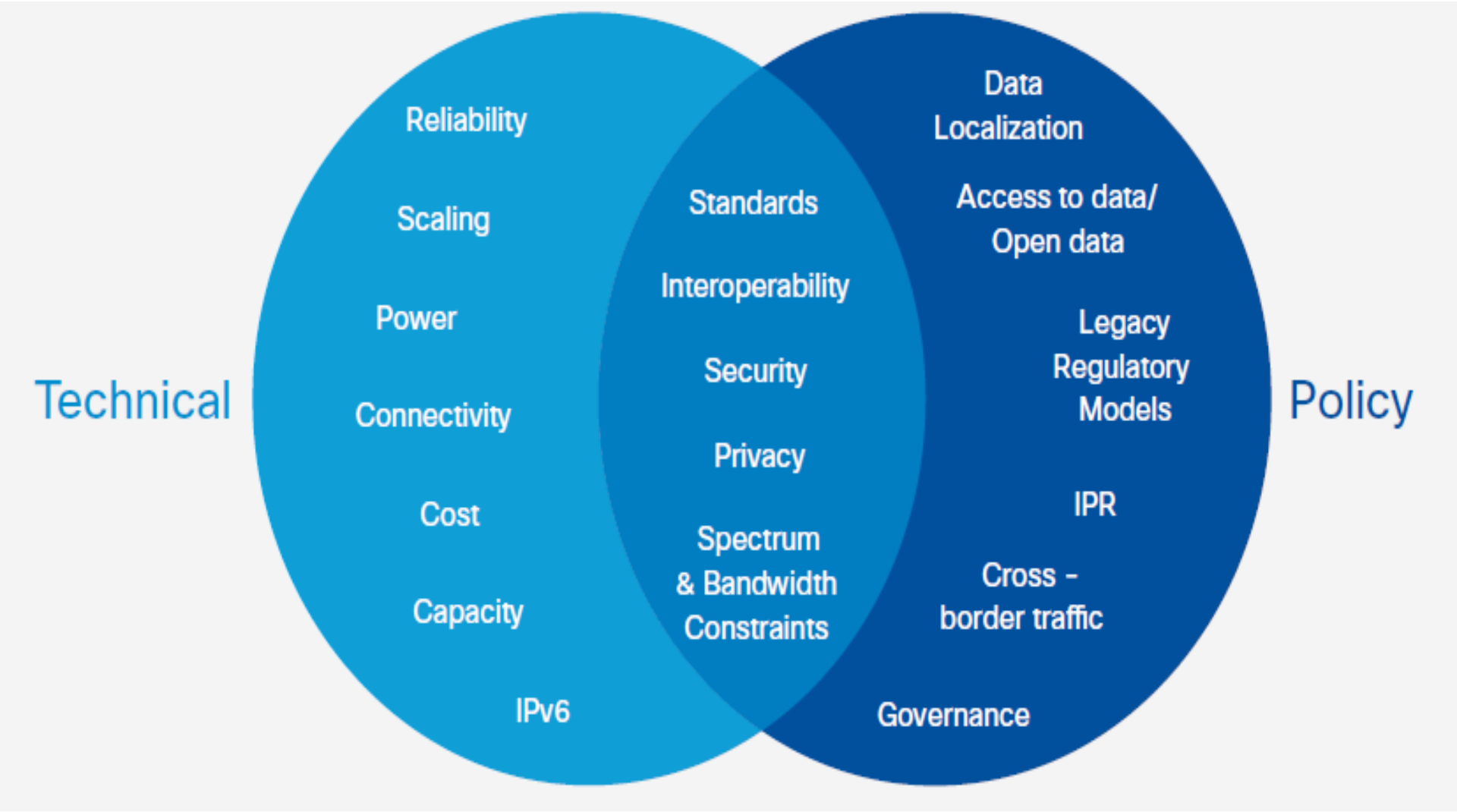
M2M / IoT Applications

S. No.	Industry / Vertical	M2M applications
1.	Smart City	Intelligent transport System, Waste management, Smart Street Light system, Electric vehicle charging, Water management, Smart Parking, Intelligent buildings, Safety & Surveillance, Remote health management, e-ICU
2.	Automotive / Intelligent Transport System	Vehicle tracking, e-call (911 in USA, 112 in Europe), For emergency call 112 adopted in India, V2V and V2I applications, traffic control, Navigation, Infotainment, Fleet management, asset tracking, manufacturing and logistics
3.	Safety & Surveillance	Commercial and home security monitoring, Surveillance applications, Video analytics and sending alerts, Fire alarm, Police / medical alert
4.	Utilities / Energy	Smart metering, smart grid, Electric line monitoring, gas / oil / water pipeline monitoring.

Projections related to communication technologies

- **GSMA study on IoT in 2014 – 40% of the total devices may be connected using SIM and a connection to mobile network.**
- **In MWC- 2016, Ericsson has dropped the number of cellular connected IoT devices in 2020 from their previous estimate of (40%) 20 billion to just over (2%) 1 billion.**
- **In MWC – 2017, Ericson projected 1.5 billion connected devices out of 28 billion, on cellular network by 2022.**
- **In India SIM based devices / Gateways may be around 15-20%.**
- **It shows that the low power wireless network and LPWAN will have a major share in device connectivity.**

Emerging challenges in relation to IoT

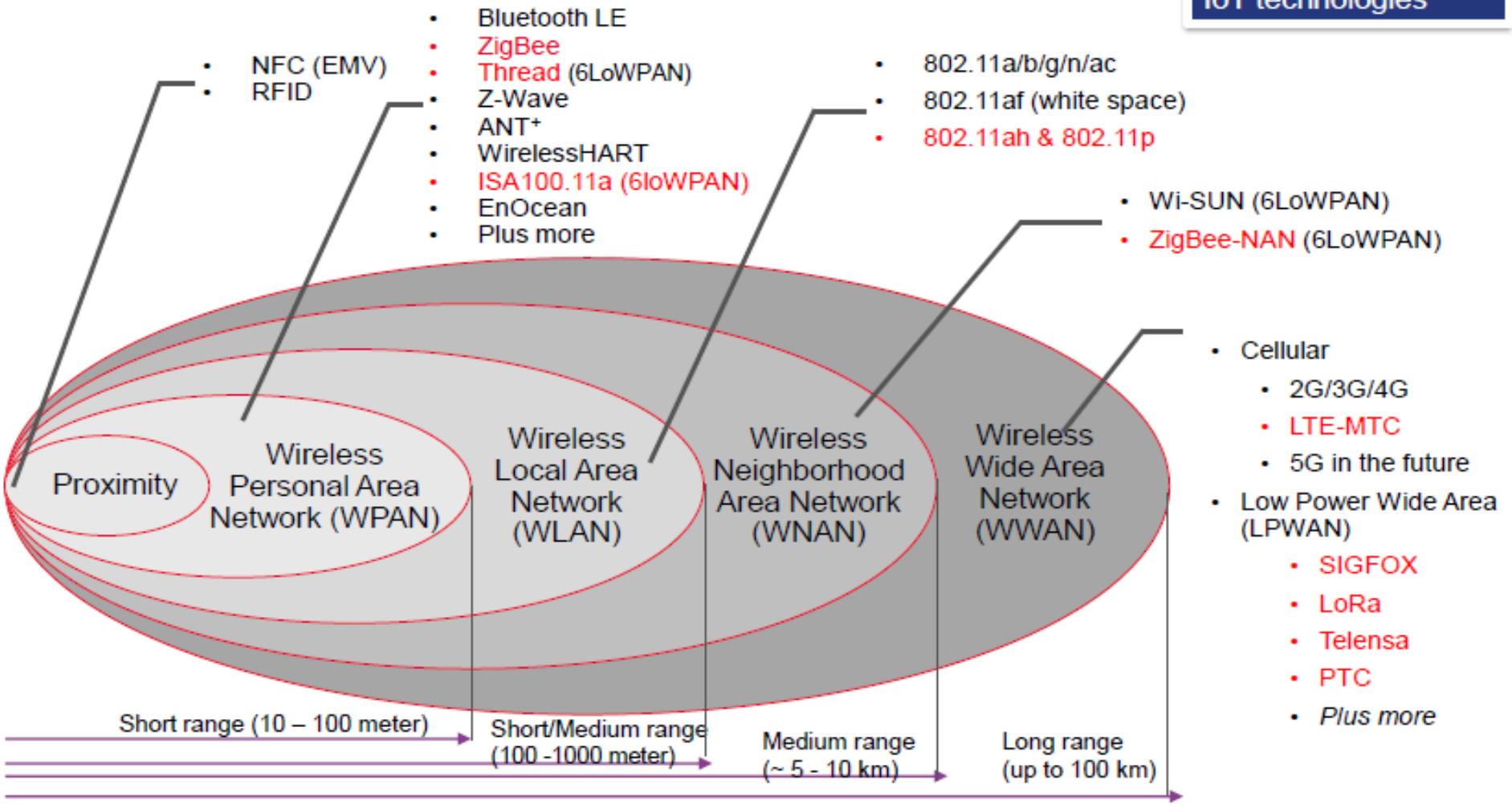


Source: Harnessing the IoT for Global development, ITU, 2016

IoT Key Enabling Wireless Technologies

Heterogeneous Mix of Technologies

Red text – emerging IoT technologies



Note 1: No stringent definition of what is considered WPAN, WLAN, WWAN.
Note 2: What is shown is not a complete list of radio formats

KEYSIGHT

Network QoS requirement

- Communication for M2M/ IoT is different from the voice communication as size of data in M2M may vary from few bytes (meter reading) to several MBs (surveillance video in).

- Services requirement

  - **Timely transmission is of utmost important.**

  - **Communication network is required to be more reliable with low latency**

Big data analytics

- Big data Analytics: Huge amount of data will be generated by the sensors. This raw data has got no value. Big data analytics may be used to create intelligence.

  Intelligence may be used for planning and operational activities.

- Edge computing, Cloud computing
- Facial recognition technologies, AI, Machine learning, deep learning based algorithms

M2M SIM

- **M2M SIM (Embedded SIM) :** The normal SIM card is not suitable for harsh conditions of vehicles like vibrations, temperature, and humidity.

  - Based on GSMA specifications.
  - 5 subscriptions, with Over-the-Air (OTA) provisioning.
  - Temperature variation range is from -40 degree to +125 degree Celsius. Embedded SIM technology offers big opportunities for auto manufacturers as the lifecycle of an eSIM is, around 10-15 years.

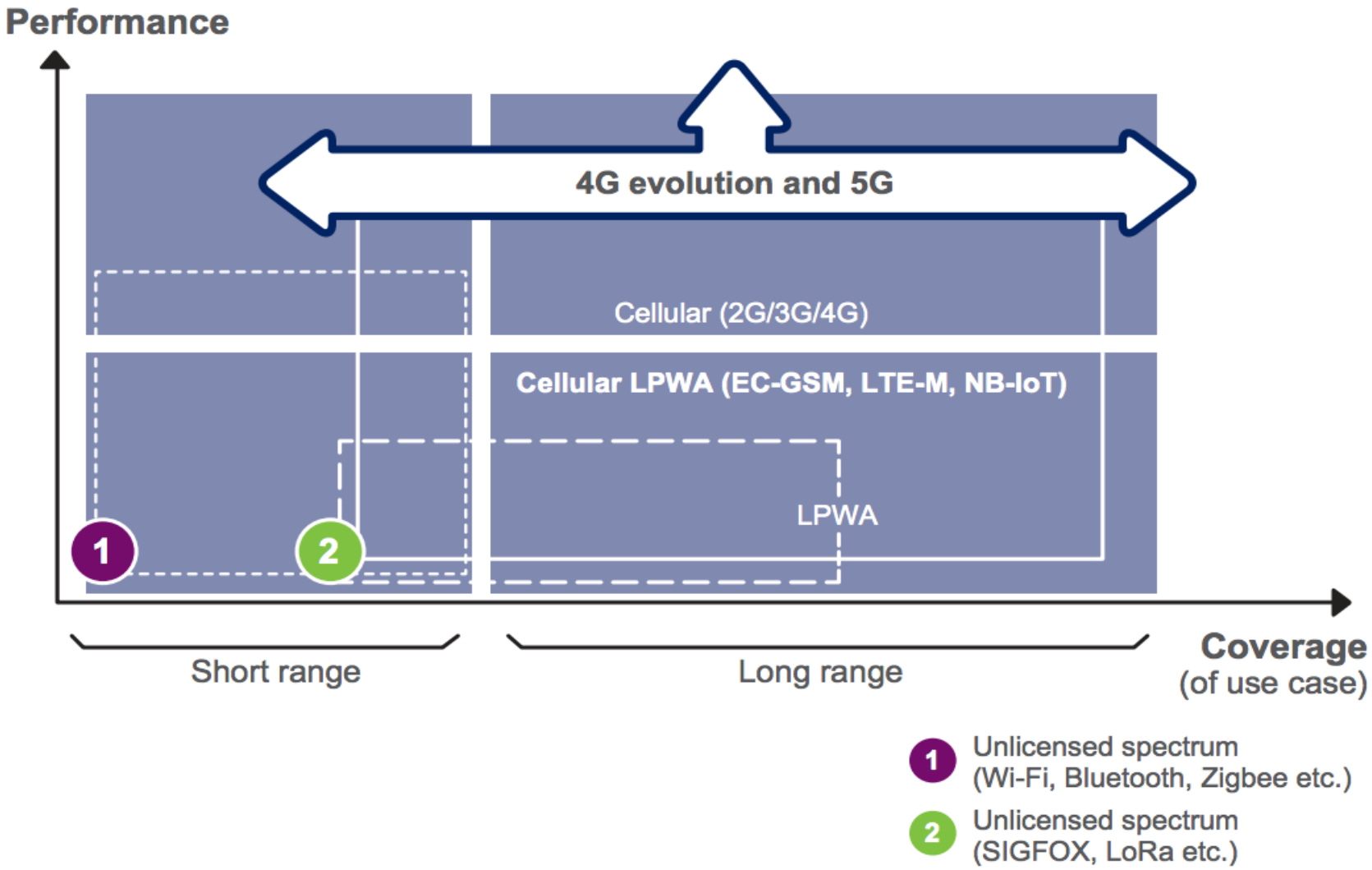
Embedded SIM will be a game changer in IoT domain.

SIM card capabilities in different variant

SIM Type	Consumer	Industrial	Automotive
Temperature	-25 to +85°C	-40 to +105°C	-40 to +125°C
Data Retention	5 Years	12 Years	15 Years
Removable/ Embedded	Removable	Removable/ Embedded	Embedded
Owner	Mobile Operator (MNO)	MNO / OEM	OEM

eUICC and Remote subscription management

- Ecosystem to be created for remote subscription management
- Two nodes to be added to the mobile networks / M2M service providers / OEMs:
- SM-DP (subscription management - data preparer)
- SM-SR (subscription management - secure router)



Source: Cellular network for massive IoT, Ericsson

Near Field Communication (NFC)

Technology / Protocol	Frequency band (s)	Advantages	Limitations	Suitable for
NFC	13.56 MHz	• Consumes less power • Almost instantaneous connectivity between devices • No power is required in-case of passive Tags	• Extremely short range • Expensive • Low information security • Low market penetration	• Healthcare devices • Fitness devices • Smart Metering

Bluetooth Low Energy (BLE)

Technology	Freq	Advantage	Limitations	Suitable for
Bluetooth Low Energy	2.4 GHz	• Mature technology • Easy to implement • Low Power • Powered by coin cell • Longer battery life	• Small data packets	• Healthcare devices • Fitness devices • Smart Metering

Wi-Fi

Technology / Protocol	Frequency band (s)	Advantages	Limitations	Suitable for
Wi-Fi	2.4 GHz / 5 .8 GHz	• Mature technology • High home/office penetration • High data rates achievable • Easy to implement	• Limited range • Poor building penetration • High interference from other sources • Power consumption higher than those technologies that operate in the sub- GHz band	• Base station in Health Clinics • Smart Metering • Home Automation

Cellular Technologies

Technology / Protocol	Frequency band (s)	Advantages	Limitations	Suitable for
Cellular (2G-GSM/EDGE, 3G-UMTS, 4G-LTE)	For India, 900 MHz, 1800 MHz, 2100 MHz and 2300 MHz is allocated.	• Mature technology • Developed by global community of 400+ companies from 39 countries • Rapid deployment • Communication modules are low cost and standardized. • Roaming • Wide availability of Network Infrastructure	• Coverage not 100% • Reliability not the best • Short technology life-cycle (2G, EDGE, 3G, LTE etc.)	• Tele-Health • Remote Health Monitoring • Smart Metering

LPWAN Technologies

- **LPWAN (Low power wide are network) Technologies:** developed to carry a very small data to a large distance. Covers 2-3 Km in city (dense) areas and 12-15 Km in rural (open) areas. Expected battery life : around 10 years.

Low Power, Long range and low bandwidth

Requirement : Low cost and easy deployment
Use cases: Smart metering, Smart farming (transmitting Soil testing data), Smart bin, transmitting pollution sensor data etc.

- **LPWAN technologies may be categorized as :**

Non cellular (Non 3GPP) LPWAN technology : Some organizations / alliances have developed LoRa, Sigfox, Weightless, RPMA etc.

Cellular (3GPP) LPWAN technologies : Based on 3GPP Rel 13 onwards specifications, cellular networks may have LTE MTC, NB-IoT and EC-GSM

Cellular: EC GSM IoT

- Works in 2G Bands
- Advantages-
  - Network infrastructure is backwards-compatible to previous releases to allow the technology to be introduced into existing GSM networks
- Limitations-
  - Eco system is yet to be developed

- Applications-
  - Smart cities & homes
  - Smart utilities
  - Industrial automation
  - Wearables
  - Smart energy
  - Intelligent transport systems

Cellular: NB-IoT

- Works in Conventional LTE cellular bands like 700 MHz, 800 MHz and 900 MHz, and re-farmed 2G bands
- Advantages-
  - Standards based defined by 3gpp, the global standardization organizations supported by a mature global ecosystem
  - wide area ubiquitous coverage
- Limitations-
  - Limited Mobility is not yet supported (limited support based on cell reselection)
  - Voice is not supported
  - Low Data rate applications with link peak DL = 60~100kbps & UL=~50kbps
- Applications-
  - Sensor based applications, with low data rate requirement.
  - Applications not requiring high speed mobility handovers.
  - Systems where devices / sensor measurements are expected to be for long ~10years

Cellular: eMTC

- Works in Conventional LTE cellular bands like 700 MHz, 800 MHz and 900 MHz
- Advantages-
  - Developed by 3GPP a mature global ecosystem
  - Low power consumption
  - Works over existing LTE networks
  - Easily configurable on demand scaling possible
  - Supports full mobility
  - Supports voice through VoLTE
  - high reliability and high carrier-class e2e network security (based on LTE)
- Limitations-
  - Support of higher bandwidth limits the other optimizations possible, compared to NB-IoT and EC-GSM-IoT
- Applications-
  - Wearables,
  - Asset Tracking,
  - Pet Trackers
  - Telematics,
  - KIOSK,
  - Parking,
  - Industry environment monitoring,
  - Connected Healthcare personal & Enterprise equipment
  - Industrial IoT with Emergency Voice call support

DSRC (Dedicated Short Range Communication)

- It is based on **IEEE 802.11p WLAN standards**, called as Wireless Access in Vehicular Environment (WAVE).

- FCC allocated dedicated spectrum in 1999 in 5.825 – 5.925 GHz to ensure public safety operations without interference.

- Working in the frequency range 5.850 -5.925 GHz (with 75 MHz band ie 7 channel of 10MHz each and 5MHz reserved) in USA and with 30 MHz in Europe.

- It Supports **low latency, Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I)** communication.

- Main use :
  - Vehicle Safety service,
  - Commerce transaction via cars,
  - Toll collection,
  - Traffic management.

- **DSRC is in use in USA, Europe, Japan, Korea, Singapore.**

ISO 9001:2008

Cellular V2X (C-V2X) is gaining momentum

Enhanced range and reliability for direct communication without network assistance

Vehicle-to-vehicle (V2V)
e.g. collision avoidance safety systems

Vehicle-to-infrastructure (V2I)
e.g. traffic signal timing/priority

Vehicle-to-pedestrian (V2P)
e.g. safety alerts to pedestrians, bicyclists

Vehicle-to-network (V2N)
e.g. real-time traffic / routing, cloud services

C-V2X specification completed in March 2017

Broad industry support – 5GAA

Several global trials starting in 2017

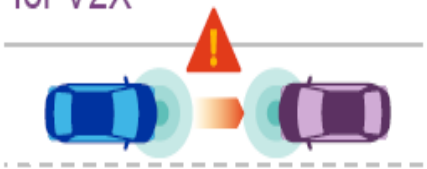
Continuous V2X technology evolution required

And careful spectrum planning to support this evolution

Evolution to 5G,
while maintaining backward compatibility

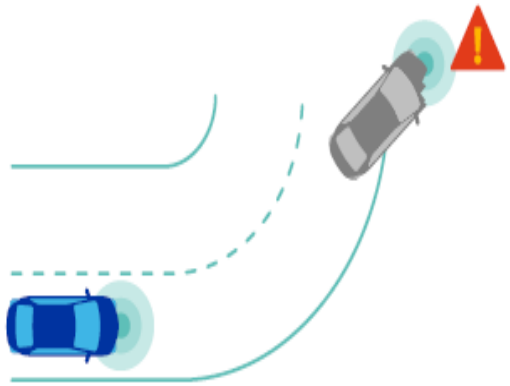
Basic safety
802.11p or C-V2X R14

Established foundation for V2X



Enhanced safety
C-V2X R14/15

Enhanced range and reliability



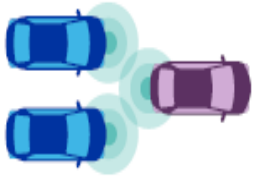
Advanced safety
C-V2X R16 (building upon R14)

Higher throughput

Higher reliability

Wideband ranging and positioning

Lower latency



Key Standards in V2X technologies

Technology	Region	Standard
802.11p	US	IEEE 802.11-2012, IEEE 1609.2 - .4, SAE J2735 and SAE J2945/x series
802.11p	Europe	"ITS-G5", ETSI ITS series
802.11p	Japan	ARIB STD-109
Cellular LTE	Global	3GPP TS 22.185, TS 23.285 for V2X and LTE, and TS 36 series for radio access
Cellular 5G	Global	3GPP TS 22.186; TS 23.501 for network architecture 3GPP 38 series for the radio access

Source: Cellular V2X communication, 5G Americas, March 2018

Evolution in Cellular Technology

1G

Analog

voice capability, limited coverage and mobility

2 kbps

AMPS

2G

Digital

better voice, improved coverage, text messaging

64 kbps

GSM, CDMA

3G

Mobile Data

basic Internet, multimedia, smaller phones

2 Mbps

HSPA, EVDO

4G

Mobile Broadband

high-speed data, smartphones

1 Gbps

LTE, LTE-A

5G

Extreme Speed, Connectivity & Reliability

a platform for future innovation

10+ Gbps

Source: 5G Americas

5G : A unifying connectivity

ISO 9001:2008

Mobile connectivity beyond 2020 : Every thing on wireless

: Extended and enriched wireless services

1. Enhanced Mobile broadband –

- UHD video (4K, 8K) 3D video
- Virtual Reality (VR), Augmented Reality (AR),
- Tactile Internet, Cloud gaming, Broadband kiosks,
- Real time simulation & training
- Remote class room, Hologram

2. Mission critical services (Ultra reliable & low latency communication) –

- Industrial Automation,
- e-health, hazardous environments, rescue missions, etc.
- Self-driving vehicles
- Drones
- Vehicular communication (V2V, V2I, V2P)

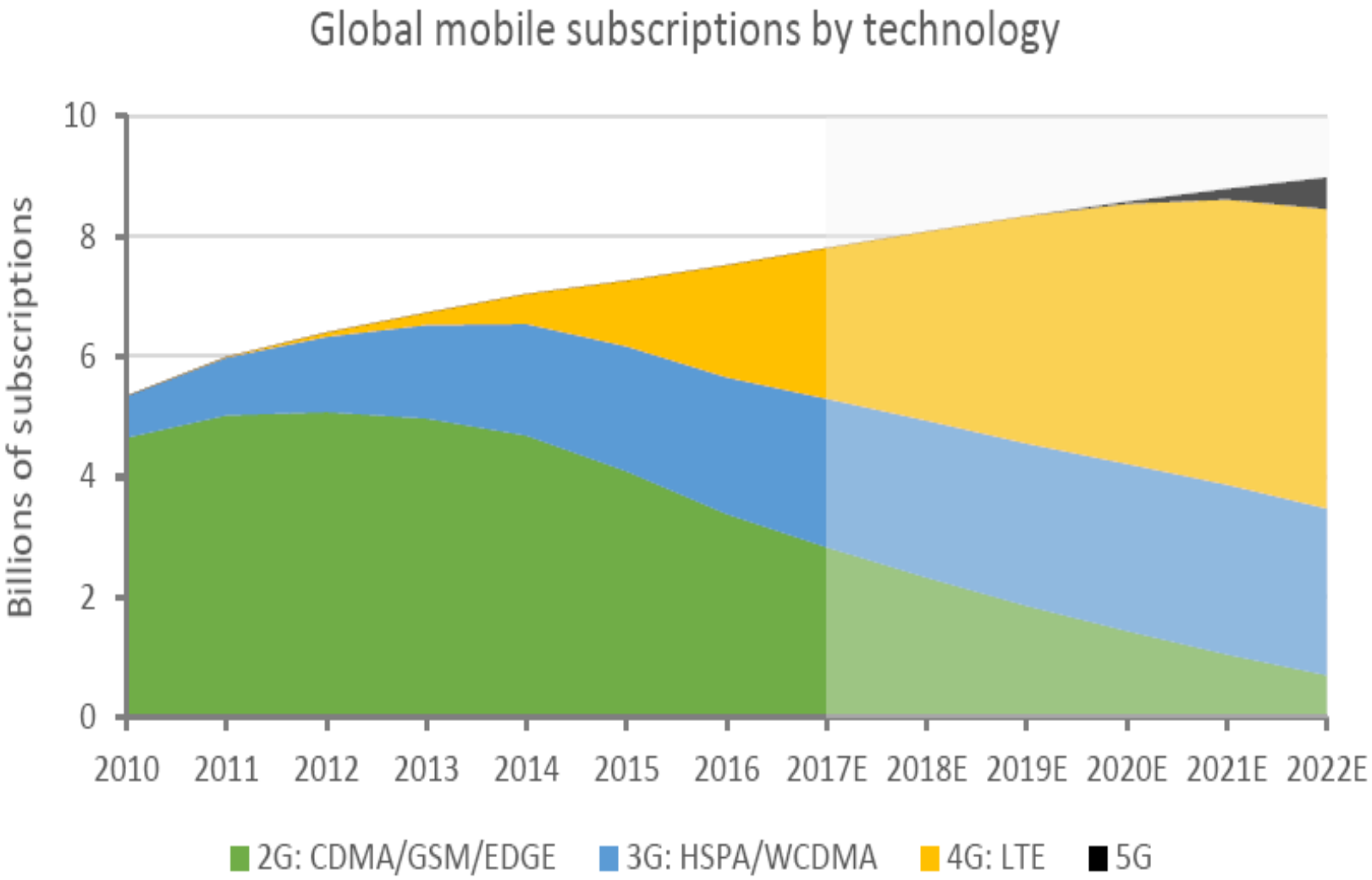
3. **Massive Machine type communication / Massive IoT :**

- Smart home
- Smart city

5G target performance

5G radio access will provide a total solution for wider range of requirements by 2020

- Higher data rate : 100x faster, peak data rate – 10 Gbps
- Reduced latency : RAN latency < 1ms
- Higher system capacity : 1000x per sq Km
- Massive device connectivity : 100x more connected devices



Source: 5G Americas, Nov 2017

Participation in standardization work

International organizations: TEC participates in the programmes of following standardization bodies:

- ITU
- IEEE
- OneM2M
- GSMA
- 3GPP

Indian organizations: collaborates with the following bodies

- BIS (Bureau of Indian Standards)
- TSDSI

ITU activities on IoT and Smart Cities

- ITU-T Study Group -20: Development & implementation of International Standards

- U4SSC: ITU, UNECE and other UN bodies created U4SSC. Released KPIs for for the Smart sustainable cities to establish the criteria to evaluate the ICT´s contributions in making cities smarter and more sustainable

- ITU-T FGDPM: Research & pre standardization work on data processing & management

OneM2M

- OneM2M is a partnership project of ETSI and other SDOs.
- OneM2M was created in 2012 to specify and promote a standards for M2M/ IoT common service layer.
- Layers of OneM2M Architecture:
  - Application Layer
  - Service Layer – provides horizontal services that IoT applications across different industry segments commonly need.
  - Network layer

Important activities in ITU-T SG-20

Study Period : 2017-2020

WP1/20

Q1/20:End to end connectivity, networks, and interoperability, infrastructures and Big Data aspects related to IoT and SC&C

Q2/20**:** Requirements, capabilities, and use cases across verticals

Q3/20: Architectures, management, protocols and Quality of Service

Q4/20**:** e/Smart services, applications and supporting platforms

WP2/20

Q5/20: Research and emerging technologies, terminologies and definitions

Q6/20: Security, privacy, trust and identification

Q7/20: Evaluation and assessment of Smart Sustainable Cities and Communities

Important activities in ITU-T SG-20….

Draft recommendations consented in SG-20 meeting, Sept 2017

1. Common requirements and capabilities of a gateway for Internet of things applications.

2. High-level requirements and reference framework of smart city platform

3. Requirements for interoperability of smart city platforms

4. Requirements of transportation safety service including use cases and service scenarios

5. Requirements and capabilities of Internet of Things for support of wearable devices and related services

6. oneM2M- Functional Architecture

7. Reference architecture for IoT network capability exposure

8. Security capabilities supporting safety of the Internet of Things

Important activities in ITU-T SG-20….

17 draft recommendations consented in SG-20 meeting, Jan 2018.

Some are listed below:

- Internet of Things requirements and technical capabilities for support of accounting and charging.
- Requirements and capability framework for IoT-based automotive emergency response system.
- oneM2M Management enablement (BBF).
- oneM2M- Interoperability Testing
- Requirements and Functional Architecture for Smart Parking Lot in Smart City
- oneM2M- Testing framework
- oneM2M Base Ontology
- oneM2M- Service Layer Core Protocol Specification

Standardization activities in TEC, DoT, India

ISO 9001:2008

M2M / IoT domain

- 11 Multi stake holders working groups have been created in the last 2-3 years.
- Eleven Technical Reports (TRs) have been released in the last 3 years as detailed below:

1. M2M Enablement in Power Sector
2. M2M Enablement in Intelligent Transport System
3. M2M Enablement in Remote Health Management
4. M2M Enablement in Safety & Surveillance Systemss
5. M2M Gateway & Architecture.
6. M2M Number resource requirement and options
7. V2V / V2I Radio Communication and Embedded SIM

M2M/ IoT Standardization activities in TEC, DoT...

ISO 9001:2008

8. Spectrum requirements for PLC and Low Power RF Communications.
9. ICT Deployments and strategies for India's smart cities: A curtain raiser.
10. M2M/ IoT Enablement in Smart Homes.
11. Communication Technologies in M2M / IoT domain

- Technical reports (TRs) are available on www.tec.gov.in/technical-reports

- Work is in progress in Smart cities, Smart Village & Agriculture, Security and M2M Gateway & Architecture working groups (OneM2M specifications)

M2M Numbering scheme : ECC guidelines

Electronic Communications Committee (ECC) had published a report in November, 2013 in Brussels, ensuring the availability of numbering and addressing resource. The conclusions are as given below:

a) The potential number of M2M applications/connections may have a big impact on National Numbering Plans;

b) Reports helps regulators to develop efficient numbering solutions and to avoid numbering exhaustion (existing and new national numbering ranges);

c) Meet the needs of operators and M2M SP and to avoid possible lock-in of M2M users

d) The IP addresses might be a long term solution;

e) The E.164 number length for new M2M numbering range should be as long as possible (maximum of 15 digits including Country Code);

Actionable points emerged from the Technical Reports (TRs):

Some are listed as below:

1. 13 digit M2M Numbering plan for SIM based devices/ Gateways which will co exist with existing 10 digit numbering scheme being used for mobile phones.

   - **DoT has approved this scheme and issued orders to all the TSPs for implementation.**
   - **Five codes of 3 digit each (559, 575, 576, 579 and 597) have been allotted as a M2M identifier.**

2. Embedded SIM & remote subscription management: DoT has approved the use of Embedded SIM with over the air (OTA) provisioning in India.

   Ministry of Road Transport and Highways, India has already included Embedded SIM in AIS140 standard mandated for Vehicle location tracking services (VLTS) to be implemented for consumer vehicles in first phase.

Actionable points emerged from the Technical Reports….

3. Based on TR, additional Spectrum requirement for Low power RF communications in Sub GHz band was recommended and in discussion.

4. Any device / Gateway having direct connectivity with PSTN / PLMN should have static IP (IPv6 or dual stack). **Bureau of Indian Standards (BIS) has mandated IPv6 for Smart meters to be connected on Cellular technologies, IS16444.**

5. Multi protocol gateways.

6. M2M Network architecture and various Service delivery models for providing services in M2M domain.

7. Spectrum requirement for DSRC technology.

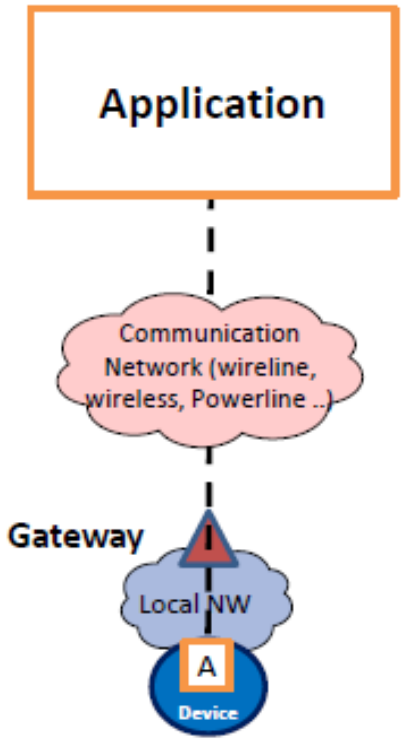
8. Licensing for LPWAN on non cellular technologies, providing public services.

9. Common service layer requirement at the platforms, important for data sharing, Security and interoperability.

oneM2M Architecture Approach

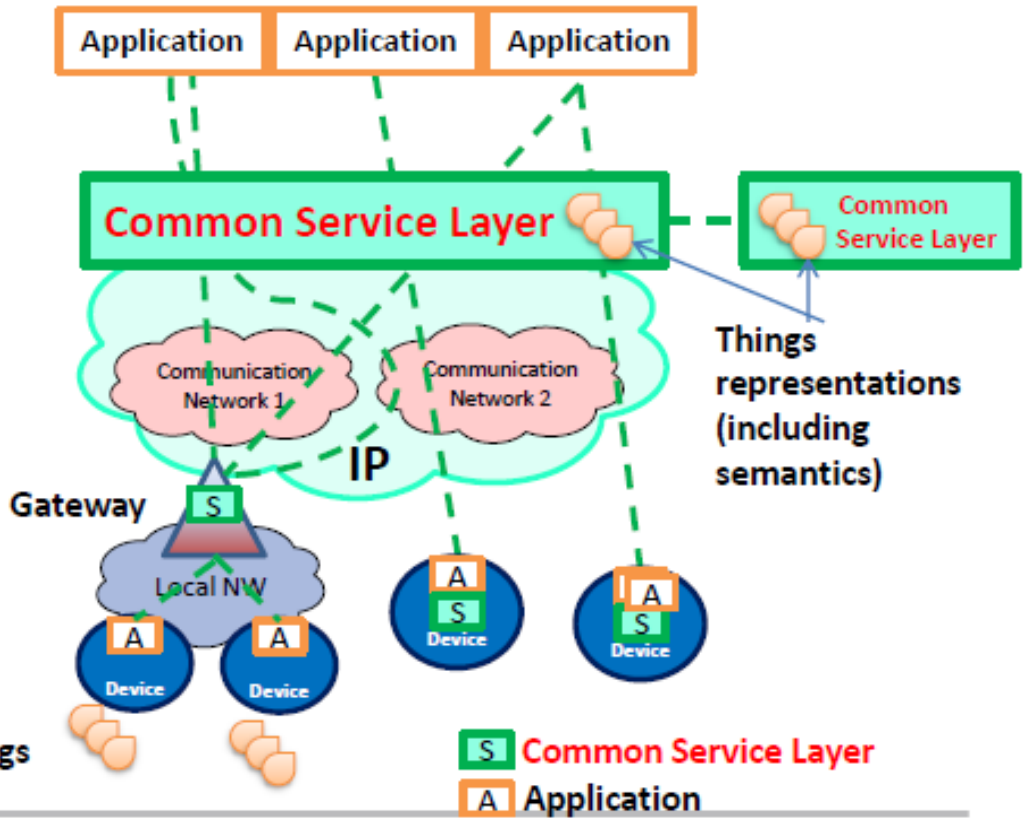
Pipe (vertical)

1 Application, 1 NW,
1 (or few) type of Device
Point to point communications



Horizontal Interoperability (based on Common Service Layer)

Applications share common service and network infrastructure Multipoint communications



Synopsis of delicensed spectrum in Sub GHz band

Country / Region	Frequency Band
North America, Mexico and South America	433.075-434.775 MHz and 902-928 MHz
Africa and Middle-Eastern countries	433.05-434.79 MHz and 863-870 MHz
Europe	433.05-434.79 MHz, 863-870 MHz, 870 – 876 MHz, 915-921MHz
Japan	426-430 MHz and 920-928 MHz
Australia/New Zealand	915-928 MHz
India	433-434 MHz and 865-867 MHz
China	470-510 MHz and 920.5 – 924.5 MHz
Singapore	866 – 869 MHz and 920 – 925 MHz
Hong Kong/Thailand/Vietnam	920 – 925 MHz
Brazil	902-907.5 and 915-928
Philippines	915 – 918 MHz
Malaysia	919 – 923 MHz

Important contributions submitted in ITU-T SG-20

- Based on Indian contribution, template for use cases was approved in SG-20.

- Based on the Technical reports released in TEC, contributions have been submitted in ITU-T SG-20 meetings and are in the work item Y.IoT use cases
  1. Vehicle emergency call system for automotive road safety
  2. Digitization and automation of Vehicle Tracking, Safety, Conformance, Registration and Transfer via the application of e-SIM and Digital Identity
  3. Remote monitoring the health of a patient
  4. Connected Smart homes.
  5. AMI (Advanced metering infrastructure)

- The technical report on "M2M enablement in Remote health management" has been recognized as a valuable information by e-Health expert of ITU-D Study group 2 and has been submitted as a contribution in the ITU- D meeting 7-11 September 2015, Geneva.

Testing and Certification requirements

- Gazette notifications issued. Available on TEC website.

- Regulatory and legal compliance requirements - Devices with communication facility needs testing and certification against

  - EMC (Electro magnetic compatibility),
  - Safety,
  - Technical protocols including Interoperability & Conformance testing,
  - Security
  - Others (SAR, IPv6 or RoHS)

- *Testing will be done in the accredited labs in India*

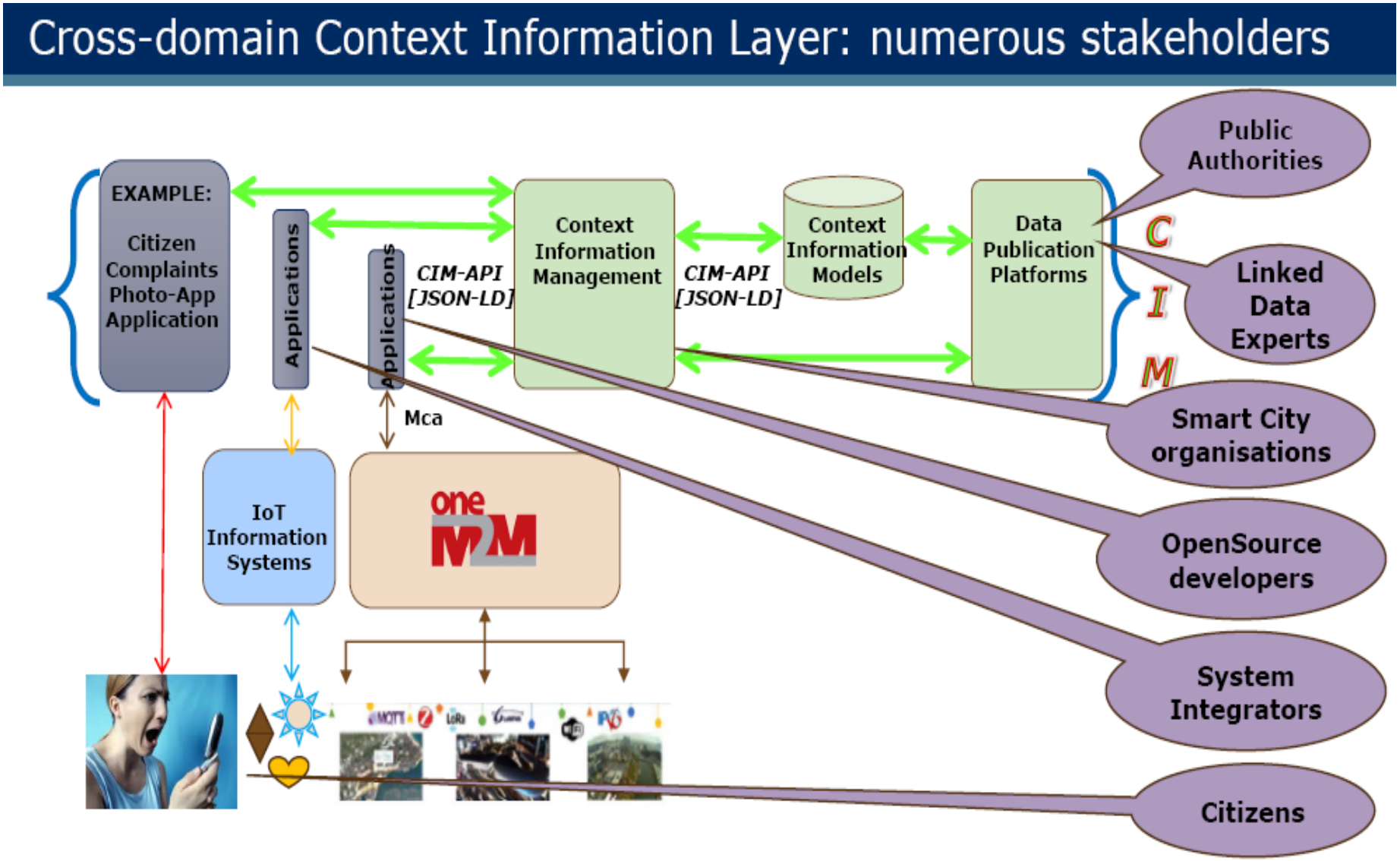
- *In case of MRA (Mutual Recognition Arrangement) with the other countries, devices may be tested there and no need of further testing in India.*

- *To be implemented wef 1st Jan 2018.*

- *ERs framed for the smart devices.*

Test Once : Use any where

Cross domain data utilization



Source: ITU

Naming and addressing in M2M / IoT domain

- M2M Identifiers can be operated on different M2M resource layers:
  - Application identifiers : to identify uniquely applications and services used in the scope of IoT applications.
  - Communication identifiers : to identify uniquely devices in the scope of communications with other devices, including internet-based communications
  - Device identifiers : may be used to uniquely identifying physical / virtual objects

Naming and addressing in M2M / IoT domain….

- Identifiers: M2M service provider use for the M2M resource layers
  - Application identifiers: URI, URL
  - Communication identifiers: IPv4, IPv6, E.164
  - Device identifiers: Handle / DOI, EPC, UPC, OID, IMEI, UUID, MAC, Iccid etc.

Subject is under study in the working group and Technical Report will be released in near future.

M2M/IoT - Policy related activities

- **National Telecom Policy – 2012 :-** thrust on high quality broadband services, Cloud computing, Mobile Internet, IPv6, Machine to Machine communication and telecom equipment manufacturing.

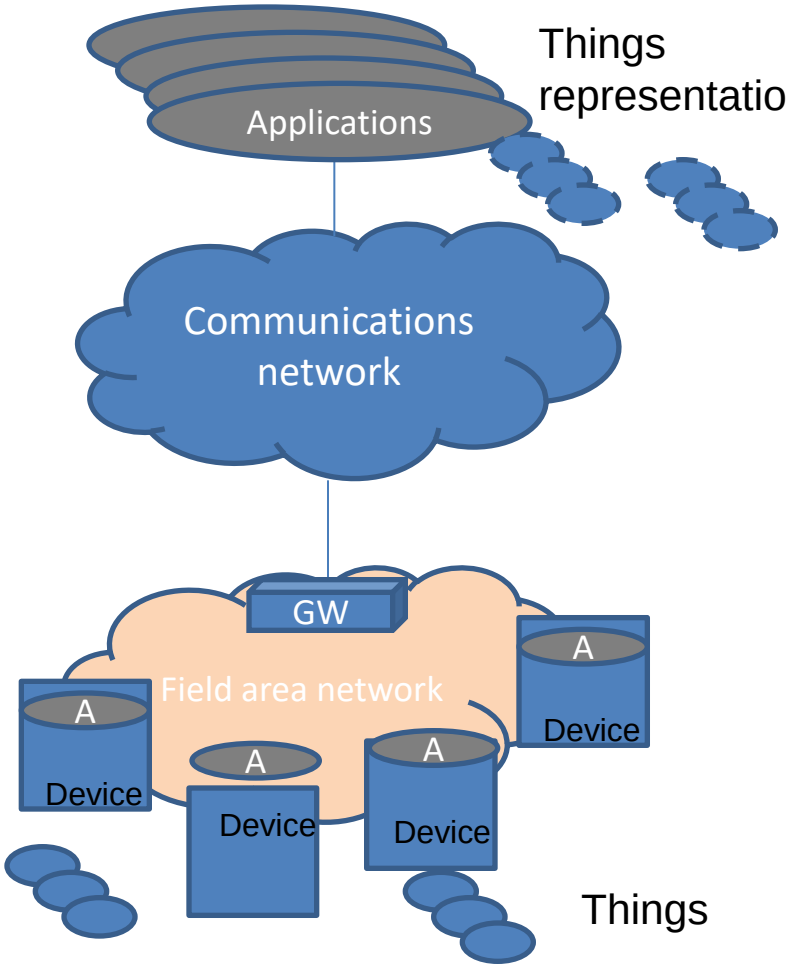
- **M2M Road map** released in May 2015. M2M Service provider policy expected in near future

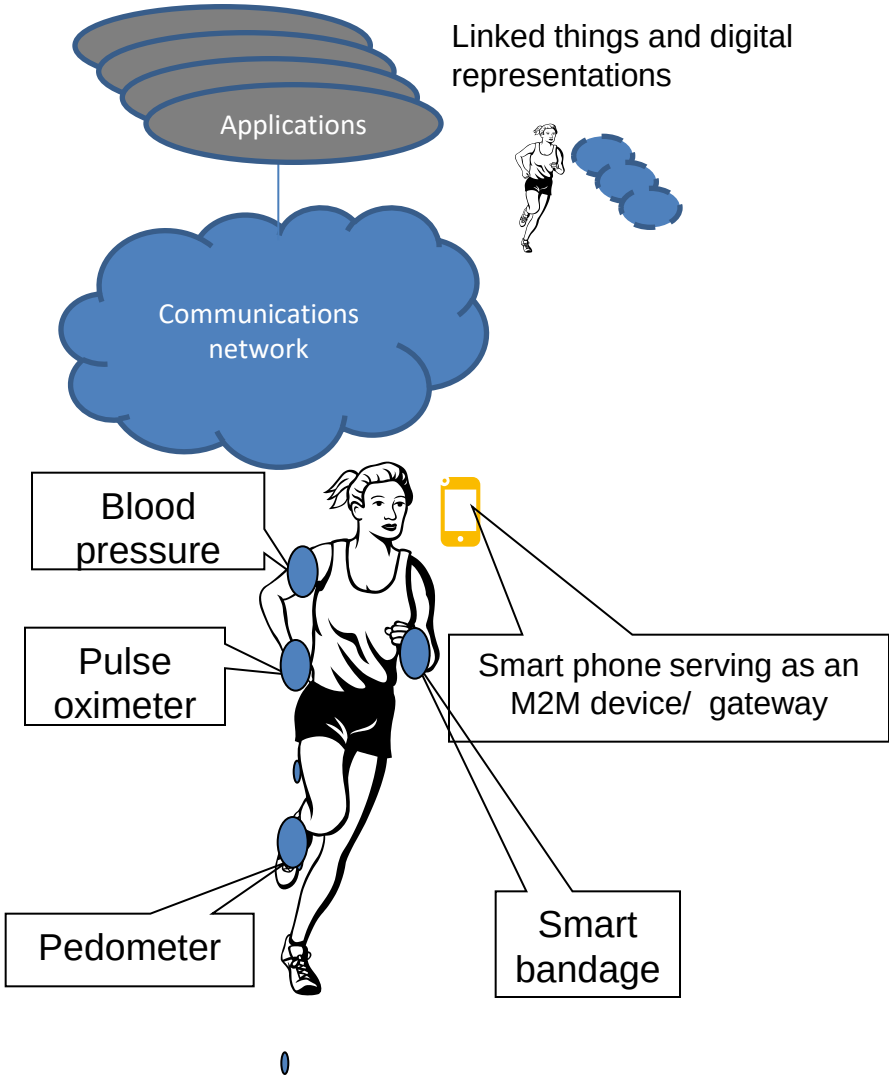
- MVNO policy released.

- **TRAI recommendations on Spectrum, Roaming and QoS related requirements in Machine-to-Machine (M2M) Communications accepted by DoT**

- **National Digital Communication Policy (NDCP) 2018 released. It will focus on strengthening telecom infrastructure, IoT, 5G, AI etc.**

IoT framework for health monitoring : motivation to remain fit





Personal Health Devices : Interoperability Architecture approved by ITU

ISO 9001:2008

Personal Device

- Thermometer 
- Pulse Oximeter 
- Pulse / Blood Pressure 
- Weight Scale 
- Glucose Meter 
- Cardio / Strength 
- Independent Living Activity 
- Peak Flow 
- Medication Adherence 
- Physical Activity 
- Electrocardiogram 
- Insulin Pump 

Aggregation Manager

ISO

IEEE

Bluetooth

USB

ZigBee

Personal Area Network (PAN) Interface

Telehealth Service Center

IHE

HL7

W3C

HL7

IHE

WiFi, 2G, 3G & 4G

Wide Area Network (WAN) Interface

Health Record Network (HRN) Interface

Health Records/Networks

PHR

EHR

NHIN

NIE

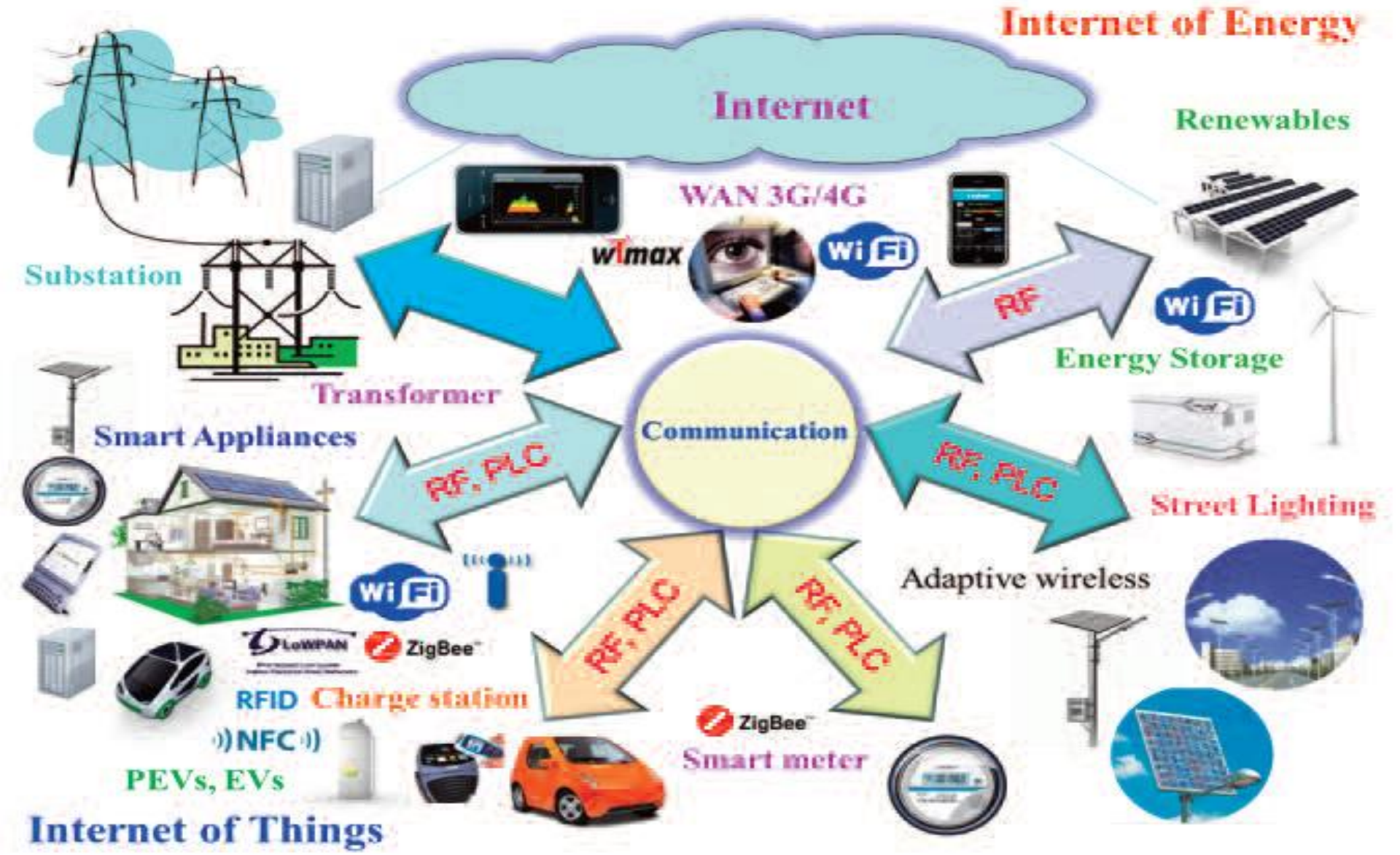
Use Cases in the Power Sector

The power sector has a number of use cases where M2M communications plays a vital part. These include (but are not limited to):

- Automatic Meter Reading (AMR)
- Advanced Metering Infrastructure (AMI)
- SCADA/EMS (Supervisory Control and Data Acquisition/Energy Management System) for TRANSCOS
- SCADA/DMS (Supervisory Control and Data Acquisition/Distribution Management System) for DISCOMS
- Substation Automation and Distribution Automation
- Distributed Generation
- Electric Vehicles Charging
- Energy Storage
- Microgrids
- Home Energy Management/Building Energy Management
- Enterprise Networks

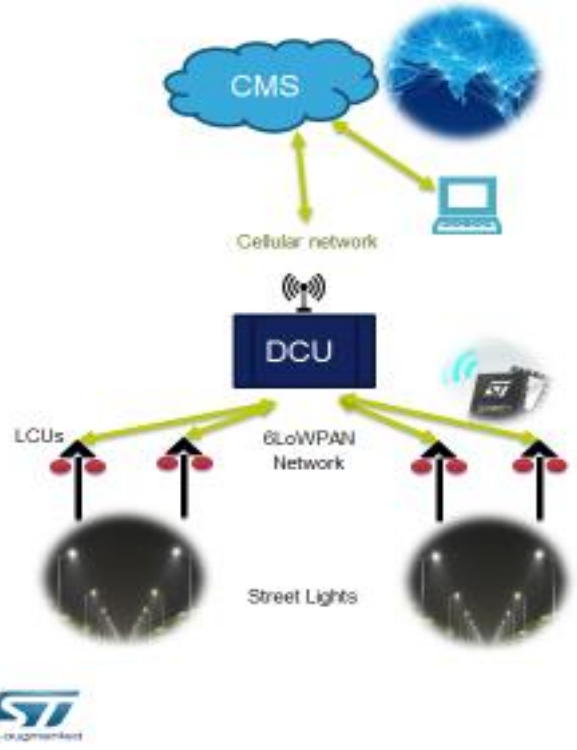
Smart Living

Source: CISCO



Source: IERC 2012

Solar Smart Street Lighting

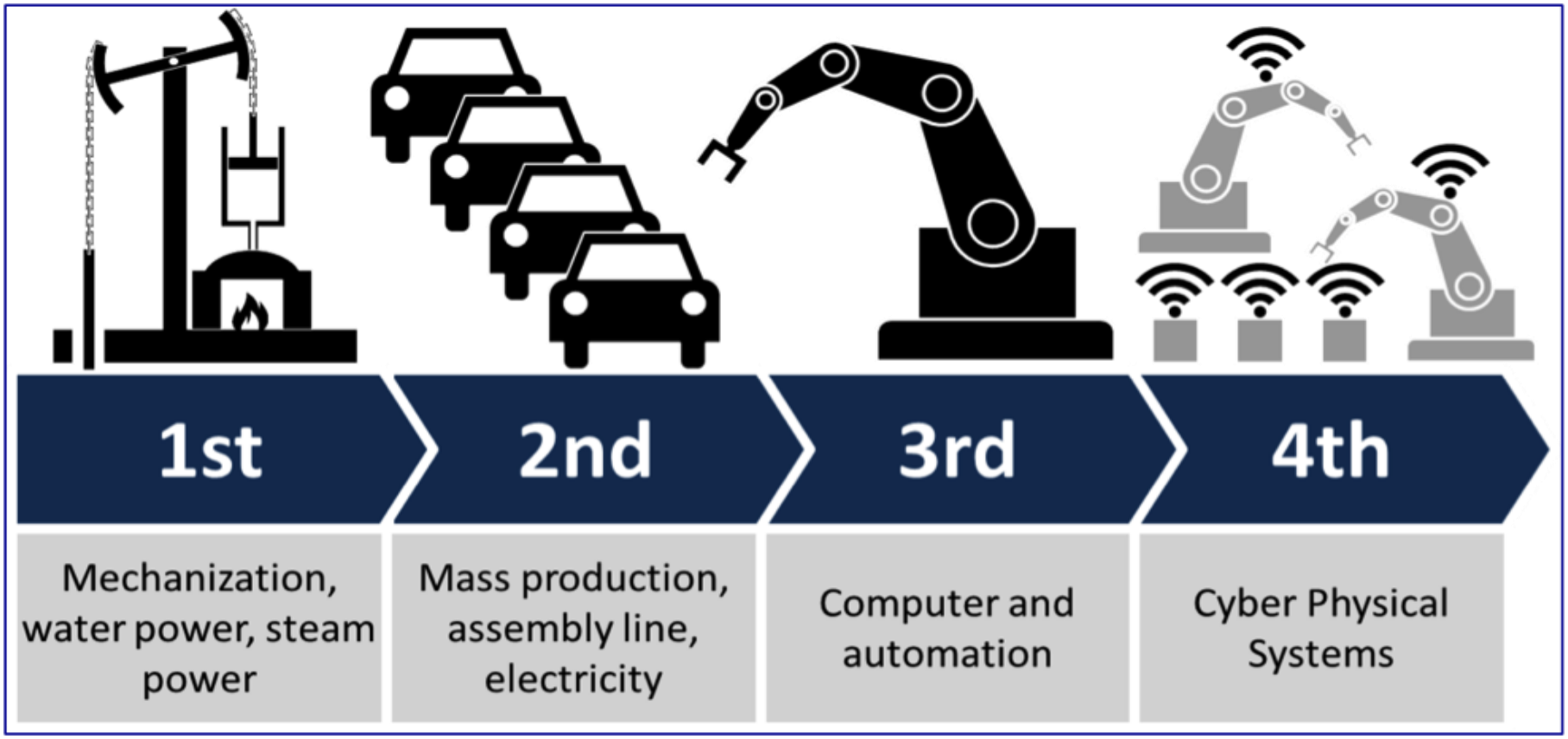


- Solar based connected LED street light solution over 6LoWPAN technologies
- Data concentrator unit (DCU) that controls a group of street lights nodes (LCU) over 6LoWPAN Mesh protocol
- DCU updates data over cloud through GPRS
- Command and Control Centre to monitor and control individual / group of street light nodes

Smart street lighting solutions are also available on other technologies such as Power line communication (PLC) / LoRa WAN.

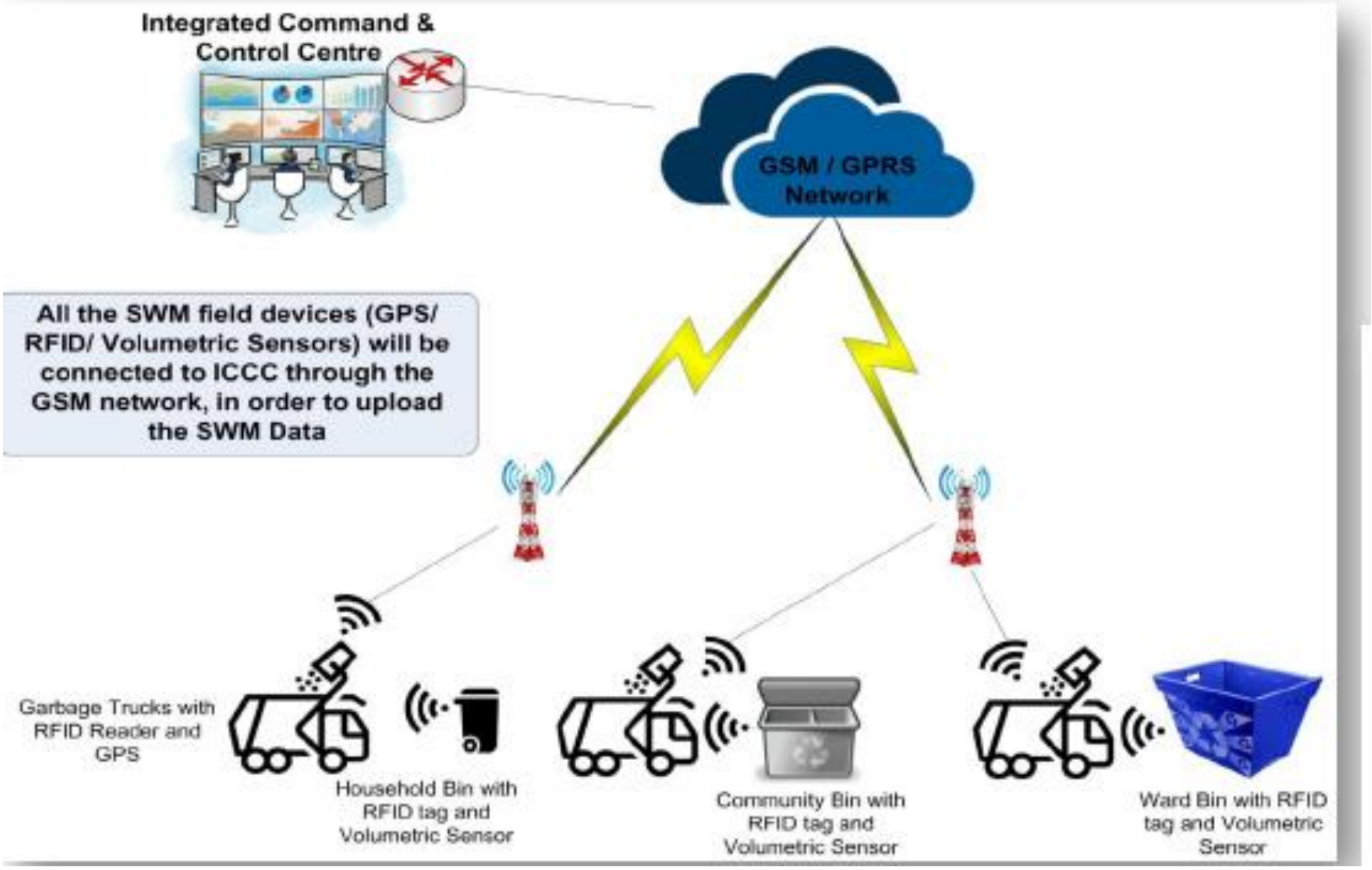
Source: STMicroelectronics

IIoT



Intelligence from the machines may be integrated with ERP, supply chain management system and even Point of sale.

Solid waste management



User Interface

Farmer's name: GPS Location

Image/Video

Lux level

Colour of soil/leaf

pH

Conductivity
Type of soil

Temperature
(Ambient, inside the soil)

Primary macro nutrients
(Nitrogen (N), Phosphorus (P)
Pottasium(K)

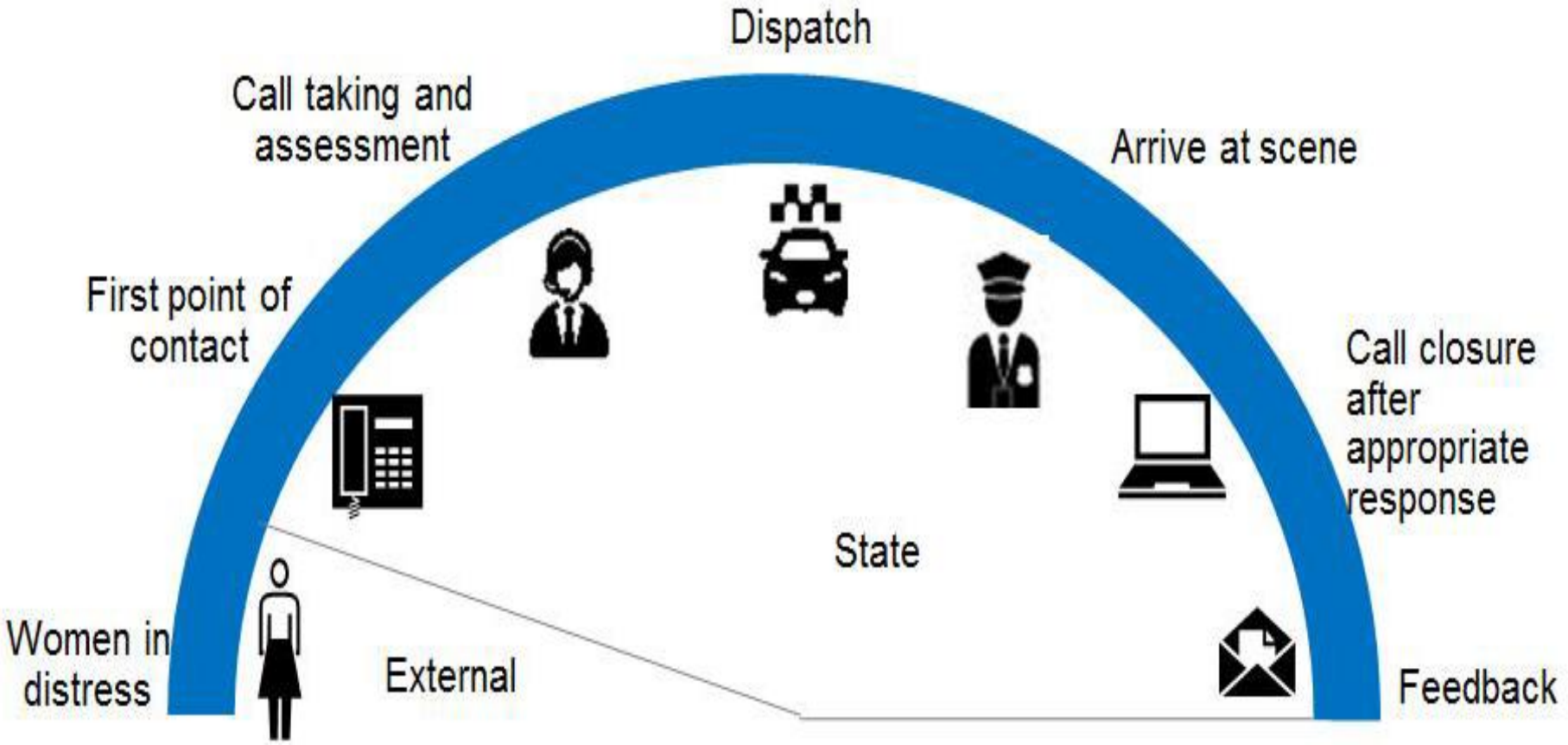
Secondary Nutrients

(Calcium (Ca), magnesium (Mg), and sulphur (S);

Tertiary Micro Nutrients

copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), zinc (Zn), boron (B), and of occasional significance there are silicon (Si), cobalt (Co), and vanadium (V) plus rare mineral catalysts.

Emergency Response system -Process flow for 112



Source: NERS 2015

Call to Emergency call number 112

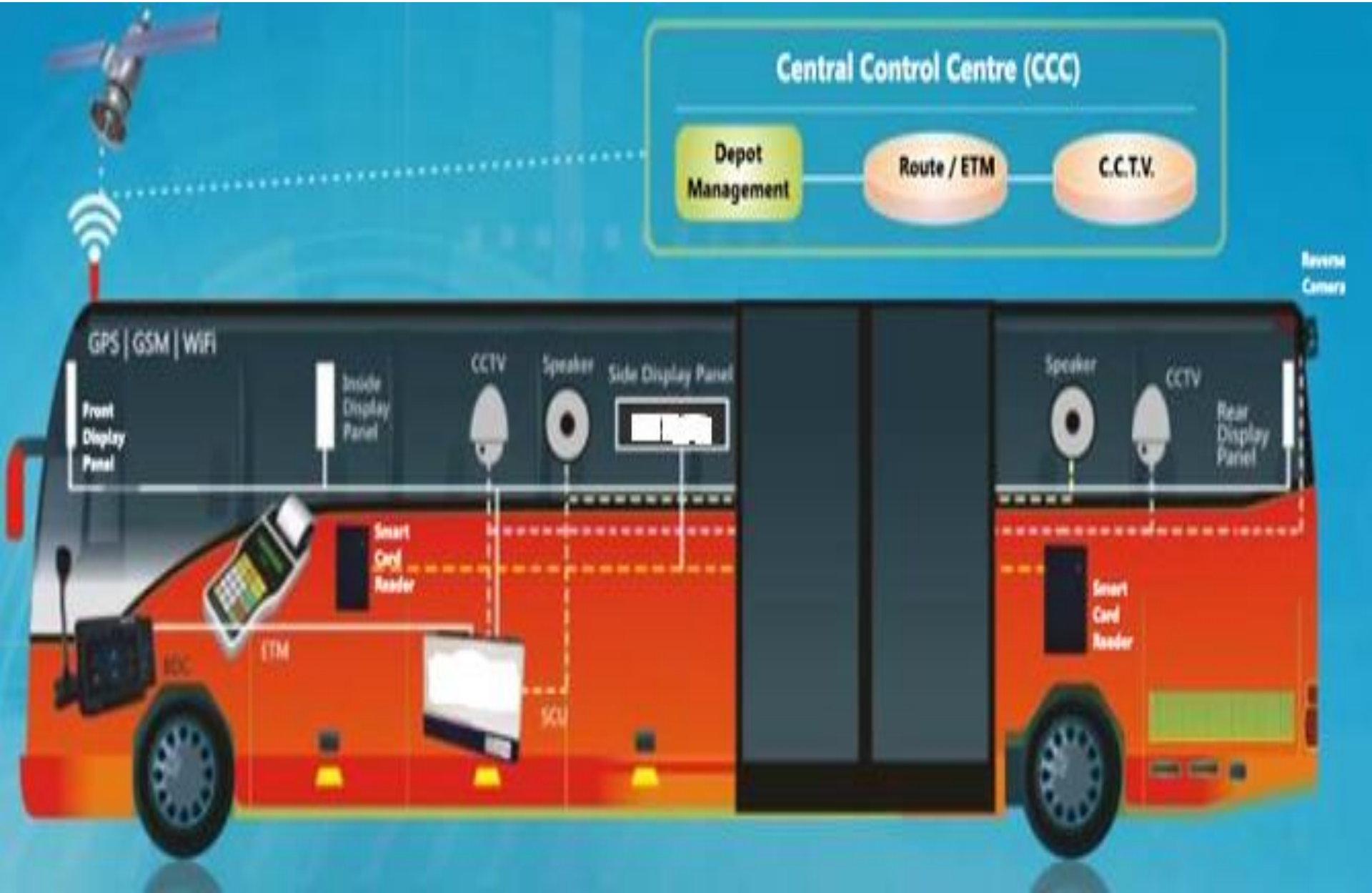
ISO 9001:2008

The input communication channels include:

- **Fixed landline phone**
- **Mobile phone**
- **SMS**
- **Email**
- **Chat**
- **Panic button in public transport**
- **VoIP**
- **Mobile application**
- **Internet of Things (IoT)**

Source: NERS 2015

JNNURM bus


Central Control Centre (CCC)
Depot Management
Route / ETM
C.C.T.V.
GPS | GSM | WiFi
Front Display Panel
Inside Display Panel
CCTV
Speaker
Side Display Panel
Smart Card Reader
ETM
SCU
Speaker
CCTV
Rear Display Panel
Smart Card Reader
Reverse Camera

M2M/ IoT applications in Automotive sector

- Vehicle tracking,
- e-call (911 in USA, 112 in Europe), For e-call 112 adopted in India
- V2X (V2V, V2I, V2N and V2P) applications
- traffic control,
- Navigation,
- Infotainment,
- Fleet management,
- asset tracking,
- manufacturing and logistics

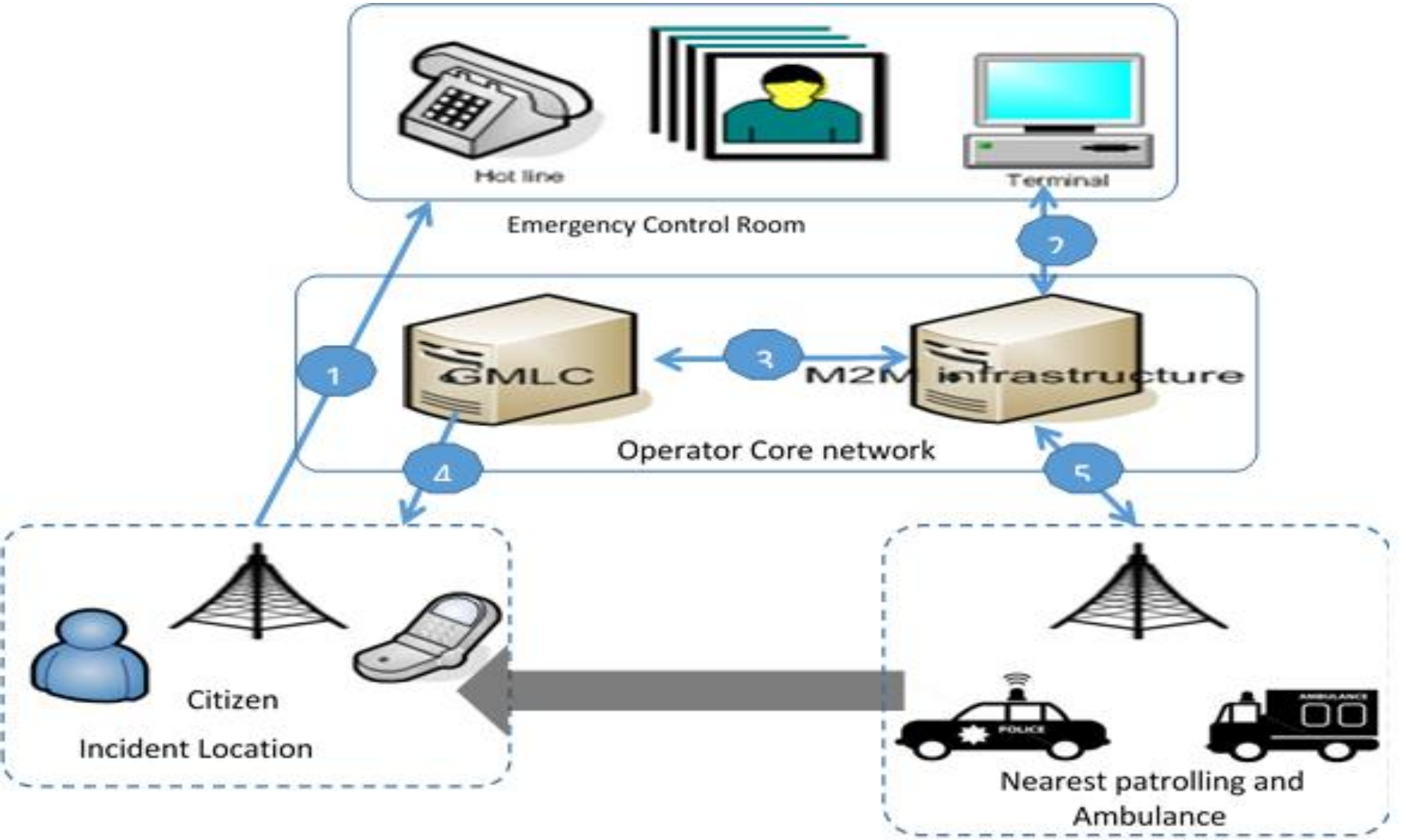
- Waste management
- Smart parking

Connected vehicle scenario

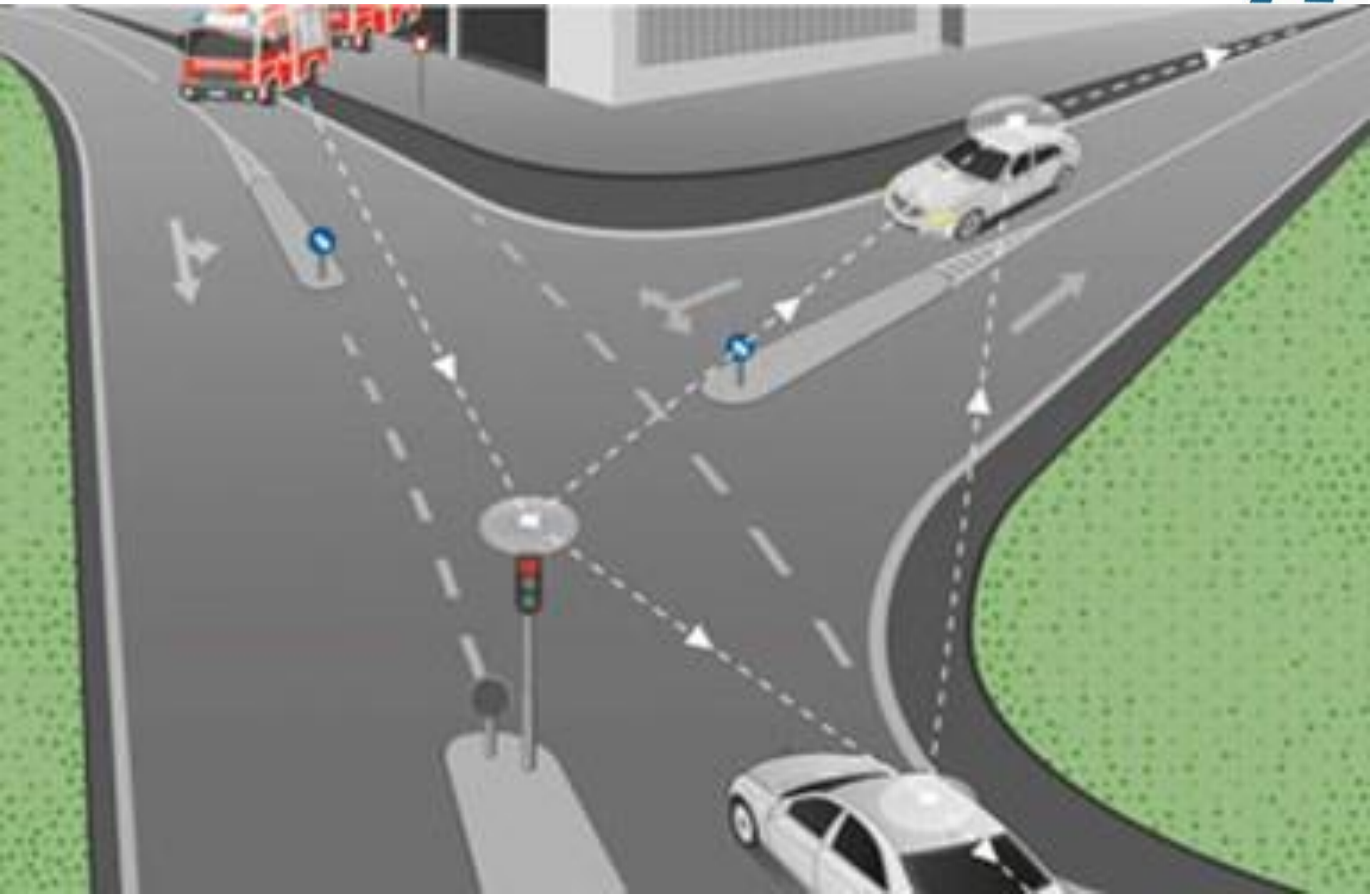
- Vehicle tracking
- Monitoring the vehicle's part for proper designing / running
- Applications to monitor driving patterns and fuel efficiency
- Pay-as-you-drive insurance
- Real-time localized navigation updates (for example, information about the availability of parking spaces)

As per MoRTH directive AIS 140, in the Ist phase all commercial passengers vehicles (around 8 million) should have VLTS device.

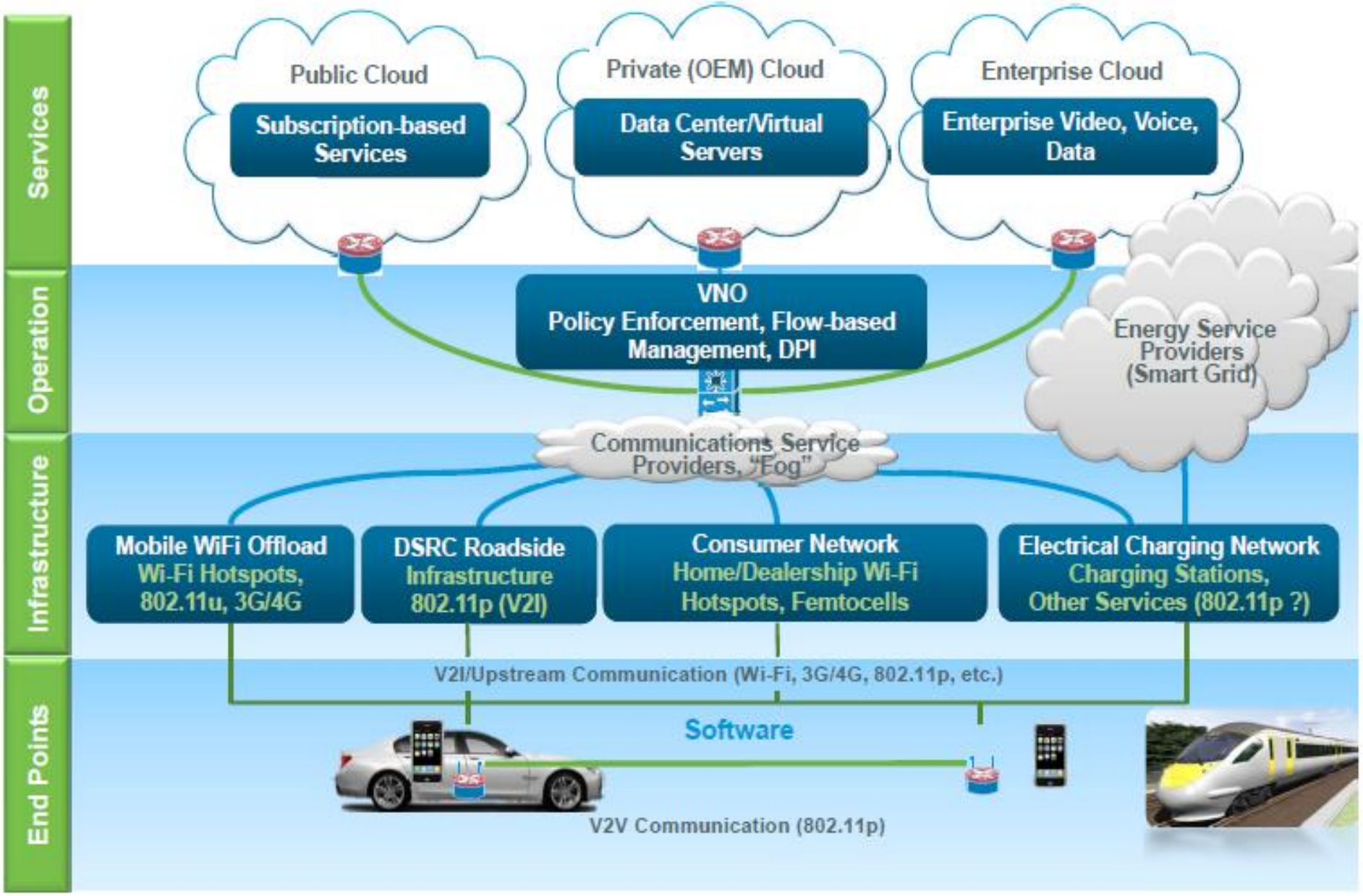
E-call call flow diagram



V2V Communication scenerio



Connected vehicle scenario



Source: CISCO

Proposed Solution – example

360 degree Operation Monitoring & Proactive decision making	**ICCC** - Integrated Command and Control System
Safe and Secure City environment	**City Surveillance** Systems **ECB** -Emergency Call Boxes
Improved Traffic Management & Enforcement	Intelligent Traffic Management System - **ITMS** Adaptive Traffic Management System - **ATMS** ANPR & RLVD Systems , **Smart Parking** System
Citizen Interface	MERA AGRA **Application** **Grievance System** , Digital Signage with City Content
Better Quality of Life	**Solid Waste Management** & **Environmental Sensors** Air quality monitoring

DC / DR	Command and Control Center	Smart Elements

How IoT will add value ?

ISO 9001:2008

➢Surveillance will bring values to the cities as the citizens will feel safe. Real time video analytics may send alerts on the smart phones of police in that area

➢ Wearable health devices may help in monitoring the health parameters especially in rural areas for remote monitoring and advising, help in reducing burden on hospitals.

- **Digital health is the part of health policy released in 2017 in India.**
- **NoFN BW shall be used for extending health services in the rural areas**.

➢ Save electricity by using smart lighting system in cities and homes.

- **Smart street lighting system are being implemented in a no. of cities.**
- **Smart metering projects are in progress.**

➢Share data across verticals to create value.

All these actions will improve the quality of life.

Global survey : Some Smart Cities

ISO 9001:2008

IoT as a Disruptive Technology is leading the next wave of Transformational Change

THANKS

(For detail, see the TR available on www.tec.gov.in/technical-reports/)

Sushil Kumar
+919868131551
sushil.k.123@gmail.com
in.linkedin.com/in/sushil-kumar-98895560