ITU / FAO workshop – Cultivating tomorrow : Advancing digital agriculture through IoT and AI

Session 2 : Seeds of standardisation – Nurturing Digital Inclusion in Agriculture

Emerging technologies (IoT and ICT) for sustainable growth in Agriculture: Challenges and the Standards

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Need of Digital transformation in rural areas

- The United Nations (UN) estimates that around 68% of the world population (expected to be around 9.7 billion) will live in urban areas by 2050 resulting in massive urbanisation and reduction in land for agriculture.

- To address the challenges due to massive urbanisation, it is required to create smart infrastructure by using Emerging technologies such as IoT, ICT, AI/ ML in various verticals such as health care, education, **agriculture**, aquaculture, Automotive, power sector, waste management etc. Some of these verticals will be the part of Smart cities / Smart villages as per their need.

It will help in achieving UN sustainable development goals, such as 1 (no poverty), 2 (Zero hunger), 3 (Good health and well being), 4 (Quality education), 5 (Gender equality) in the rural areas.

Expected smart services in Agriculture and related verticals

Vertical	Smart applications
Agriculture	Smart irrigation, weather monitoring and forecasting, precision agriculture, remote crop monitoring, remote monitoring of soil quality, smart warehousing, logistics and distribution, remotely controlled irrigation.
Livestock farming	Animal production, animal tracking, remotely monitoring of the health of animals
Aquaculture	Water quality (dissolved oxygen, ammonia, pH, etc.) management, Intelligent feeding, aquatic animal health management
Food processing	Production & storage, better food safety, wastage reduction
Automotive	Vehicle tracking (Tractor, harvesting machines etc.), e-call, asset tracking

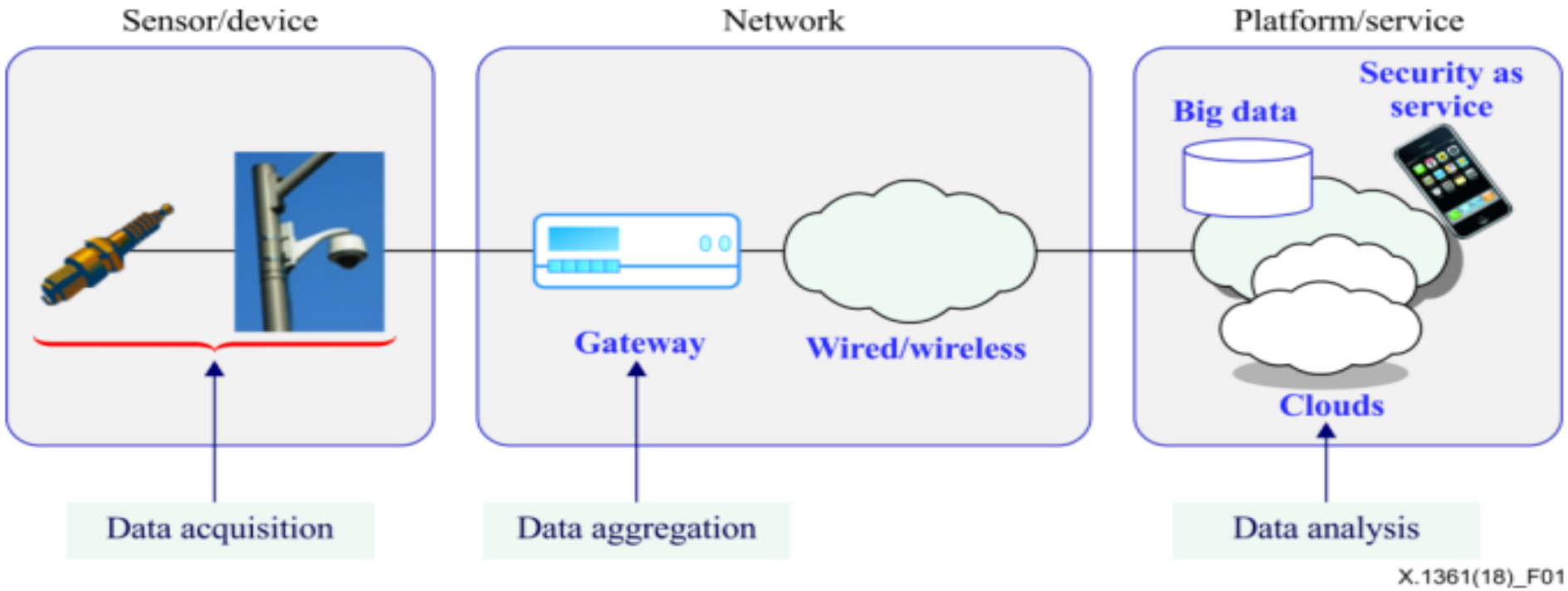
Expected smart services in Agriculture and related verticals

Vertical	Smart applications
Energy	Renewal energy sources like solar, biomass and connecting to smart micro grid, smart distribution network, smart metering, smart grid, electric line monitoring, gas / oil / water pipeline monitoring, smart street lighting
e-Governance	Citizen centric services like birth / death certificate, electronic attendance in government projects, connecting police station, banks, post offices, etc.
Health care	Tele-medicine, remote diagnostics, remote monitoring of a patient after surgery (e-health), medication reminders, e-ICU based applications
Education	Tele-education, e-attendance (biometric)
CCTV based real time Public Safety System	Public safety applications using CCTV cameras at various locations across the village along with public address system, emergency/fire alert applications etc.

The role of IoT and ICT in various applications in rural areas

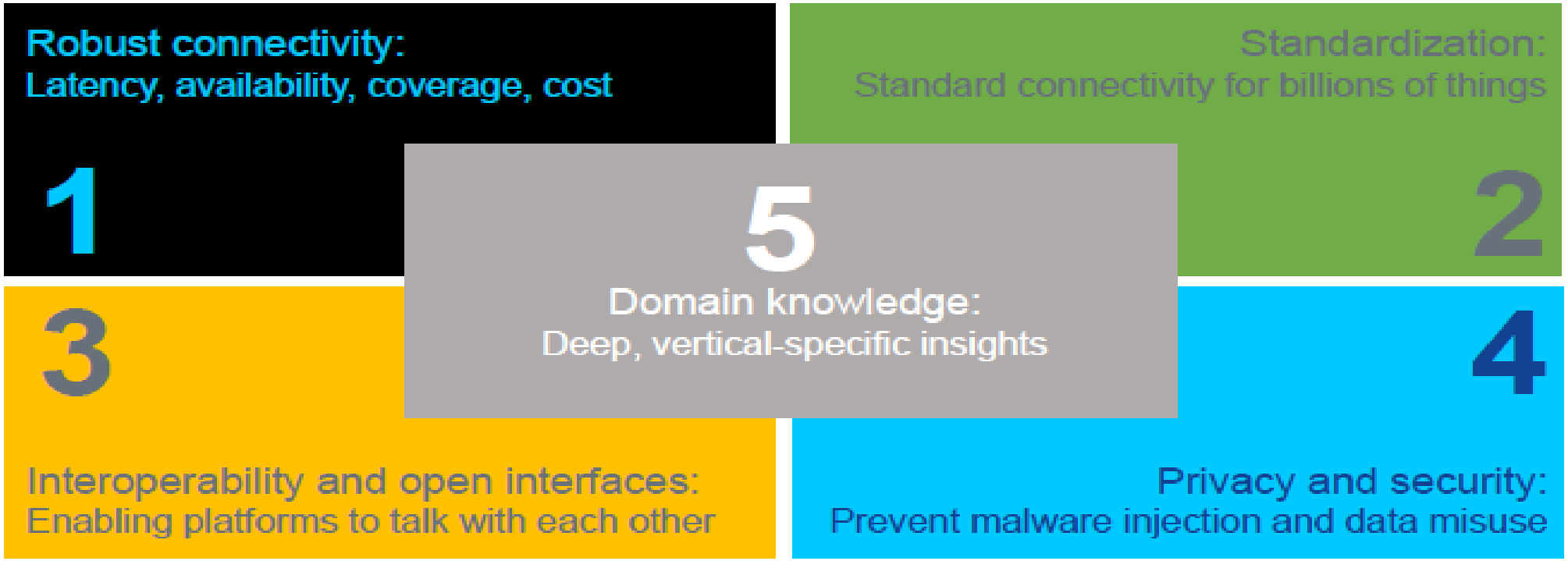
Source: ITU

IoT Functional Architecture



- **ITU** 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**".
  [Source: ITU-T Y.2060 (06/2012)]

Five main challenges have to be overcome for IoT



IoT standardization activities and progress, ITU, Oct 2017

Nearly 40% of the economic impact of IoT requires interoperability between IoT systems

Standards support the sustainable transformation

Importance of Global Standards

Manufacturers, network operators and consumers all benefit from international standards:


Essential for international communications and trade


Driving competitiveness, efficiency and innovation


Providing interoperability and economies of scale


Lower prices and increased availability

DoT policy initiatives on M2M/ IoT & 5G

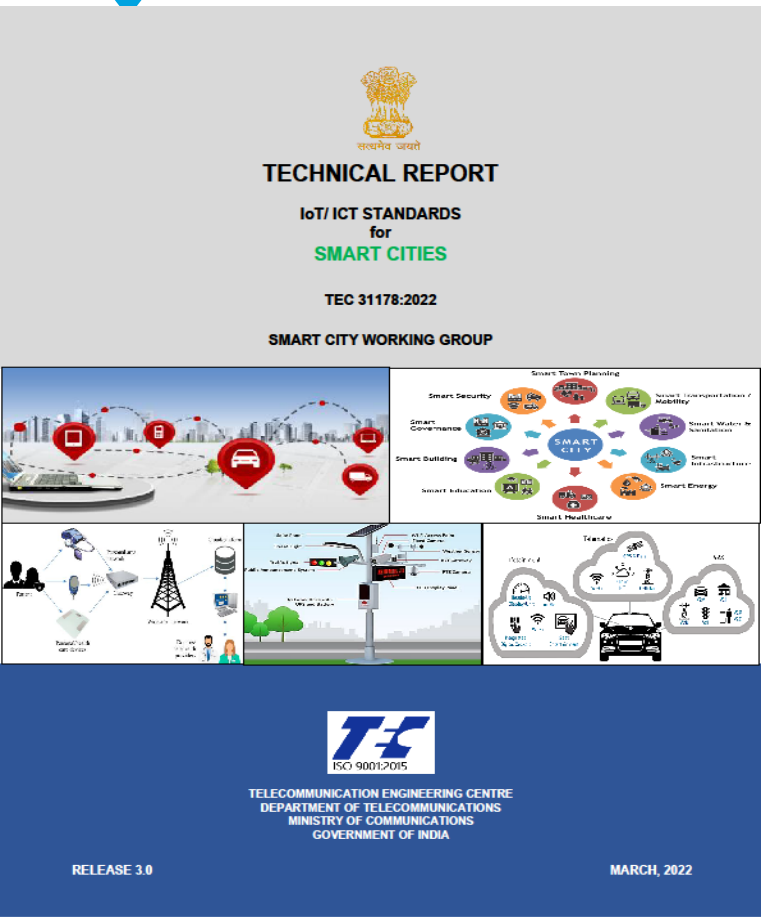
- **National Digital Communication Policy (NDCP)-2018** released by Department of Telecom (DoT) in 2018. Some of the salient features available in this policy are:
  - Creating a roadmap for emerging technologies and its use in the communications sector, such as **5G, Artificial Intelligence, Robotics, Internet of Things, Cloud Computing and M2M**
  - Establish a multi-stakeholder led collaborative mechanism for coordinating transition to Industry 4.0
  - Developing market for IoT/ M2M connectivity services in sectors including **Agriculture**, **Smart Cities, Intelligent Transport Networks, Multimodal Logistics, Smart Electricity Meter**, Consumer Durables etc. incorporating international best practices
- 100 5G Use case Labs are being provided in technical institutions for R&D, Innovations, Start Ups and MSMEs.
- National Telecom M2M Roadmap released in 2015.
- M2M Service provider registration policy released in Feb 2022 and further updated in 2023
- Telecommunication Engineering Centre (TEC), technical wing of DoT is working in M2M/ IoT domain since 2013 for finalizing specifications in sync with global SDOs.

DoT/ TEC initiatives in M2M/ IoT domain

- TEC created a frame work for developing specifications with multi stake holders and also in sync with global SDOs such as ITU, ISO/ IEC, ETSI, oneM2M, 3GPP, NIST etc.
- released twenty one technical reports in M2M/ IoT domain covering various verticals, communication technologies, EMF radiation from IoT devices and IoT Security with the outcome intended to be used inpolicies/ standards policies/ standards

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 Systems**
5. M2M **Gateway & Architecture**
6. M2M **Number resource requirement** and options
7. **V2V / V2I Radio Communication** and **Embedded SIM**
8. **Spectrum requirements for PLC** and **Low Power RF Communications**.
9. ICT Deployments and strategies for India's **Smart Cities**: A curtain raiser

DoT/ TEC initiatives in M2M/ IoT domain



10. M2M/ IoT Enablement in **Smart Homes**
11. **Communication Technologies** in M2M / IoT domain
12. Design and Planning **Smart Cities** with IoT/ ICT
13. M2M/ IoT **Security**
14. **IoT/ICT Enablement in Smart Village & Agriculture**
15. Code of practice for **Securing Consumer IoT**
16. **Emerging Communication Technologies** and Use cases in IoT domain
17. IoT/ ICT Standards for **Smart Cities**
18. Framework of **National Trust Centre for M2M/IoT Devices and Applications**
19. **Security by design for IoT device manufacturers**
20. **EMF radiation** from IoT/ M2M devices
21. **Technologies and Standards for Intelligent Transport System,**

https://tec.gov.in/M2M-IoT-technical-reports

- ***TEC Initiatives in M2M/ IoT Domain- An overview***

Indian initiatives in ITU-T SG-20 and related Groups

- Significant contributions in the following Standards of ITU-T SG-20

1. ITU-T Y Suppl. 53 (12/2018) on IoT Use cases
2. ITU-T Y Suppl. 56 (12/2019) on Smart City Use cases
3. ITU-T Y. 4218 (05/2023) on IoT and ICT Requirements for deployment of Smart services in rural community.
4. ITU-T Y Suppl. 76 (09/2023) Use cases of IoT based Smart agriculture

- Following contributions have been submitted in FG AI4A meetings and presented
  a. *Applications of Drones, AI and IoT in Cashewnuts farming*
  b. *IoT based Farmland Surveillance System with Disease Detection in Paddy Crops*
  c. *Artificial Intelligence-based Disease Identification in Wheat Crops*

Use cases at (a) & (b) above are based on the projects carried out in VIT Chennai and (C) in ICAR Delhi.

All the three use cases have been approved by the Focus group and included in its document

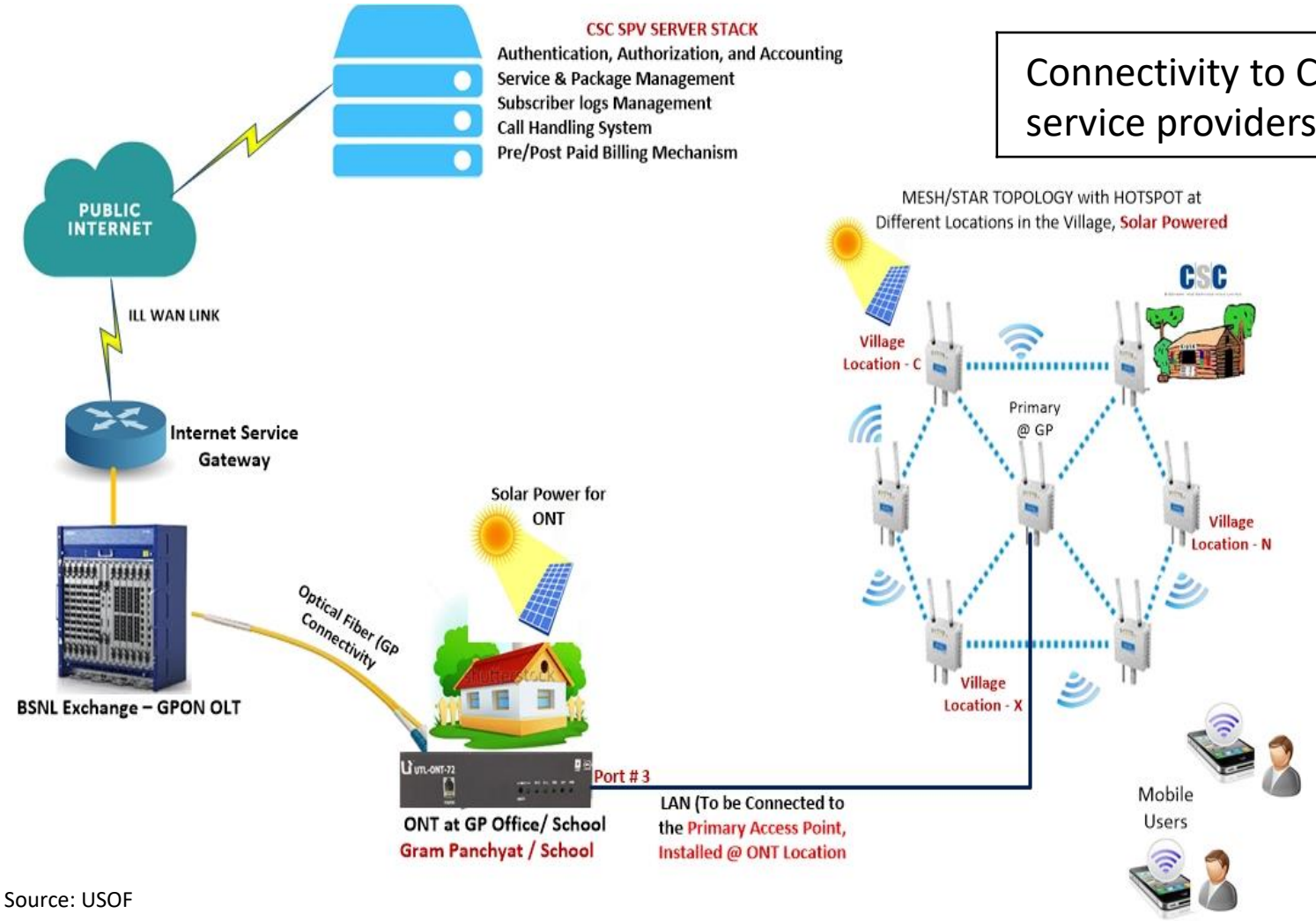
IoT and ICT requirements in rural communities

- It is required to have high-speed communication network with a transmission capacity of 1 Gbps in the backhaul for a population of around 1000 persons [**ITU-T L.1700**].
  - This level of bandwidth may be easily created on optical fibre network, which may be further extended to provide around 100 Mbps bandwidth in a village or for a cluster of 2 – 3 adjacently located villages.
  - Provisions may be made in the transmission equipment to upgrade the bandwidth to 10 Gbps in the backhaul and 1Gbps in the village for future requirements.

- Connectivity may be further extended using OFC, Wi-Fi hotspots, radio link etc. depending upon the terrain.

- This connectivity may be used for commissioning new mobile towers (BTS) to provide mobile coverage (2G to 5G) and Low Power Wide Area Networks (Cellular / non cellular).

Connecting rural areas on high speed network in India (Bharat Net)



Connectivity to Cellular / LPWAN service providers

- 100 Mbps bandwidth has been provided on OFC at the Gram panchayats which may be used for extending connectivity for creating smart infrastructure in various verticals.
- Around 0.2 Million GPs connected.

Source: USOF

Important related standards

- ITU-T Recommendation **Y.4218 (05/ 2023) "IoT and ICT requirements for deployment of Smart Services in rural community"** has covered (a). Introduction to smart rural communities, (b). Smart services in rural communities, (c). ICT and IoT requirements for deployment of smart services in rural communities etc. referring following important standards also

  Recommendation ITU-T **L.1700 (2016),** ***"Requirements and framework for low-cost sustainable telecommunications infrastructure for rural communications in developing countries."***

  - Related supplements for developing low-cost sustainable telecommunications infrastructure for rural communications in developing countries:
    - » ITU-T L Suppl. 22 using optical fiber cable,
    - » ITU-T L Suppl. 23 using radio links,
    - » ITU-T L Suppl. 29 using cellular technologies,
    - » ITU-T L Suppl. 30 using cellular network with capacity transfer,
    - » ITU-T L Suppl. 31 using satellite systems

Important related standards

- ITU-T Y. 4101 Common requirements and capabilities of a gateway for Internet of things applications
- ITU-T Y.4450 Overview of Smart Farming based on networks
- ITU-T Y. 4418 Gateway functional architecture for Internet of things applications
- ITU-T Y. 4553 Requirements of smartphone as sink node for IoT applications and services
- ITU-R M.2441-0 :Emerging usage of the terrestrial component of International Mobile Telecommunication (IMT)
- ITU-R M.2440-0 (10/2018), The use of the terrestrial component of International Mobile Telecommunications for narrowband and broadband machine type communications

Important related standards

- ITU-T Y.4500-1 (01/2018), *oneM2M Functional architecture*
- ITU-T Y Suppl. 53 (12/ 2018) IoT Use cases

- ITU-T Y. 4408 Capability framework for e-health monitoring services
- ITU-T Y.4103 Common requirements for Internet of things (IoT) applications

- ITU-T L.209 (02/2022), *Requirements for fibre optics network terminal box (FON)*

- ITU-T X.509 (10/2019) and cor.1 (10/2021), *Public-key and attribute certificate frameworks*

- ETSI TS 103 645 Cyber Security for Consumer Internet of Things: Baseline Requirements

- ITU-T Y Suppl. 76 (09/2023) Use cases of IoT based Smart agriculture

Strategies Towards Universal Smartphone Access

ITU/ UNESCO Broadband commission report, Nov 2022

Strategies Towards Universal Smartphone Access

- ITU/ UNESCO Broadband commission report Strategies towards universal Smart phones access published in Sept 2022 mention

1. Around one third of the global population still cannot or do not access the Internet in spite of 97% of the global population having the mobile data coverage.

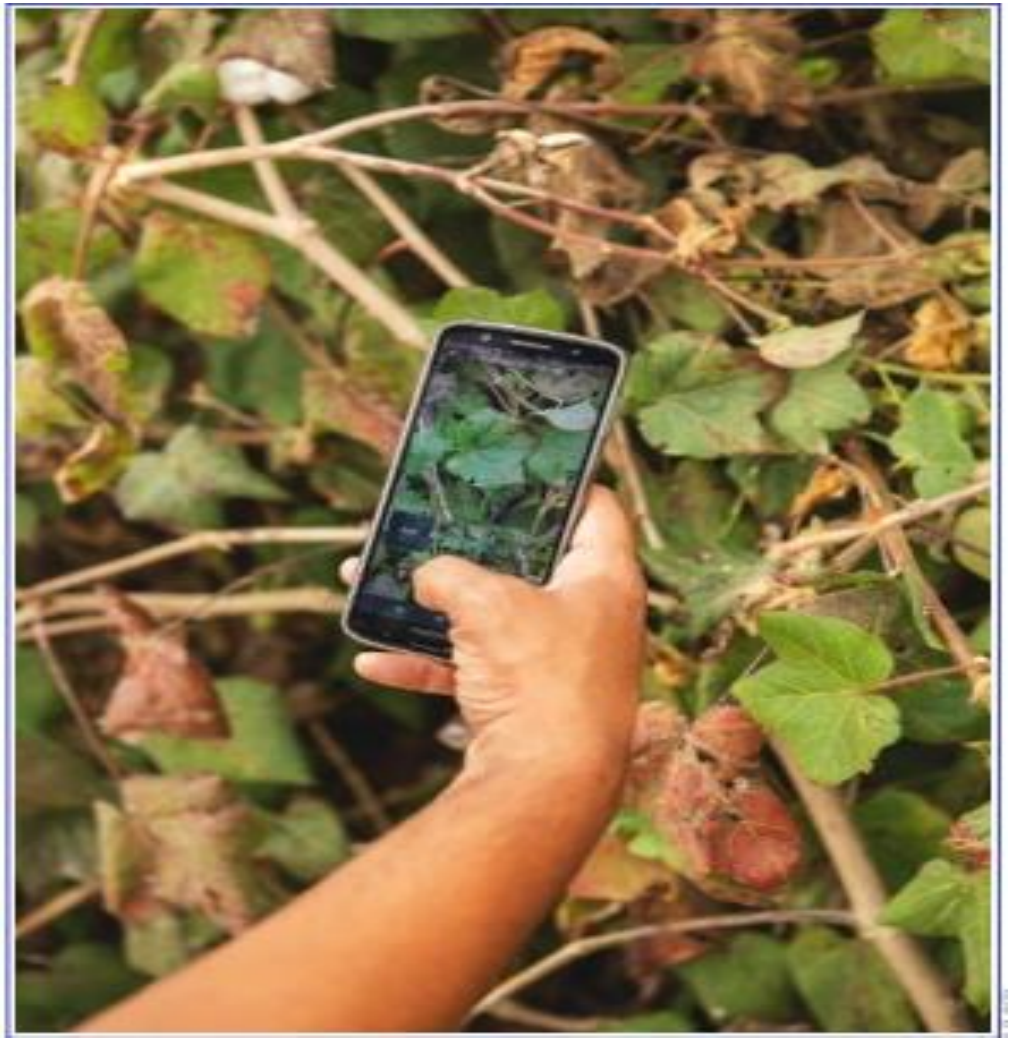
2. Gap in mobile data coverage in the developed and least developed countries is around 6% whereas in number of Internet users it is above 43% (Internet users in the developed countries are around 92% whereas in least developed countries it is around 36%).

3. Less number of Internet users are due to non-affordability of smart phones.

Some of the advantages of using IoT & ICT in Agriculture

1. Soil management such as measuring pH level, moisture content, nutrients, can be performed by using IoT devices having related sensors, so that farmers can plant seeds according to the soil quality.
2. Water management can be efficiently performed using IoT to reduce the water waste.
3. Unmanned Aerial Vehicles (UAVs) with sensors and camera may enable surveillance of the crop field.
4. UAVs with sprayer may be used to handle locust attacks.
5. Crop monitoring can be performed to observe the growth of crops.
6. The increase of productivity, reduces manual work, time and makes farming more efficient.
7. Crop sales may be increased in the global market. The farmer can be connected to the global market without the restriction of any geographical area.

Smartphone-based AI apps



- Smart phones may be used to take the various type of images and a digital library may be created.
- AI algorithms as a powerful tools can be used to analyze, process, and generate insights from large image datasets.
- They can help automate tasks that would be time-consuming or difficult for humans to perform, and they can improve accuracy and efficiency in a variety of applications.
- Some mobile apps being used in Agriculture for various use cases -
  - Kisan Suvidha , AgroStar, CropX, Plantix , Sowing App etc.

Some of the advantages using IoT & ICT in other verticals in rural areas

Fisheries

IoT technology may be used to monitor the water quality as well as vital parameters (temperature, pH, turbidity, carbonates and bi-carbonates, ammonia, etc.) related to health and development of fishes in aquaculture.

Healthcare

Smart devices like Thermometer, SPO2 meter, portable ECG machines with Bluetooth connectivity may be used to monitor the patients remotely by the doctors as there may be shortage of beds in the hospitals, in particular during pandemics. ITU-T Y 4408, Y Suppl. 53 may be referred.

Tele-education

- Smart classrooms may be created in villages having connectivity with other educational institutions around the world
- Student's drop-out rate may be reduced
- Distance and adaptive learning is possible, thus reducing the need to move to towns or cities to achieve better quality of education
- Various applications and remote participation platforms assist in organizing virtual classes

Takeaways

- Standardisation is a collaborative efforts at national as well as global level.
- Use of interoperable standards provides economies of scale and the infrastructure developed so will be sustainable for a long time.
- Related work items in progress in ITU-T SG-20 for the development of standards
  - Y.IoT-SFFS : Requirements and Reference functional model of IoT-based smart forest firefighting system
  - Y.IoT-Soil : Requirements of IoT-based soil environmental protection and remediation
  - Y.Sup.SmartAqua-usecases : Use cases of IoT based Smart Aquaculture
  - Y.sup.EdgeIoT-usecases : Use cases of edge computing based Internet of Things

THANKS