

IOTWeek

Dublin — June 20-23, 2022

ITU-T standardization activities on the Internet of Things

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GLOBAL VISION:

IoT TODAY AND BEYOND

IOTForum

ITU and Digital Transformation

IoTWeek

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ITU is the UN specialized agency for information and communication technologies (ICTs)

ITU ROLE:

To facilitate peaceful relations, international cooperation between peoples, and economic and social development by means of efficient telecommunications services



Collaborations:

Joint IEC-ISO-ITU Smart Cities Task Force, United for Smart Sustainable Cities initiative, oneM2M, tmforum, Joint IEEE-ITU Global Observatory for Urban Intelligence, LoRa Alliance, AIOTI ...

JCA-IoT and SC&C:

Joint Coordination Activity on IoT and Smart Cities and Communities

ITU-T Study Group 20:

ITU Study Group on IoT and Smart Cities and Communities



ITU-T Study Group 20 (SG20): *IoT and Smart Cities and Communities*

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Working structure (Questions)

Q1/20 Interoperability and interworking of IoT and SC&C applications and services

Q2/20 Requirements, capabilities and architectural frameworks across verticals enhanced by emerging digital technologies

Q3/20 IoT and SC&C architectures, protocols and QoS/QoE

Q4/20 Data analytics, sharing, processing and management, including big data aspects, of IoT and SC&C

Q5/20 Study of emerging digital technologies, terminology and definitions

Q6/20 Security, privacy, trust and identification for IoT and SC&C

Q7/20 Evaluation and assessment of SC&C

Regional Groups



Africa Region



Americas Region



Arab Region



EECAT Region

Joint Coordination Activity



Joint Coordination Activity on Internet of Things and Smart Cities and Communities (JCA-IoT and SC&C)

Maintenance of the **IoT and Smart Cities Roadmap**:

<https://www.itu.int/net4/itu-t/landscape/?topic=0.78&workgroup=1&searchValue=&page=1&sort=Relevance>

Focus Groups



Focus group on Artificial Intelligence (AI) and Internet of Things (IoT) for Digital Agriculture (FG-AI4A)



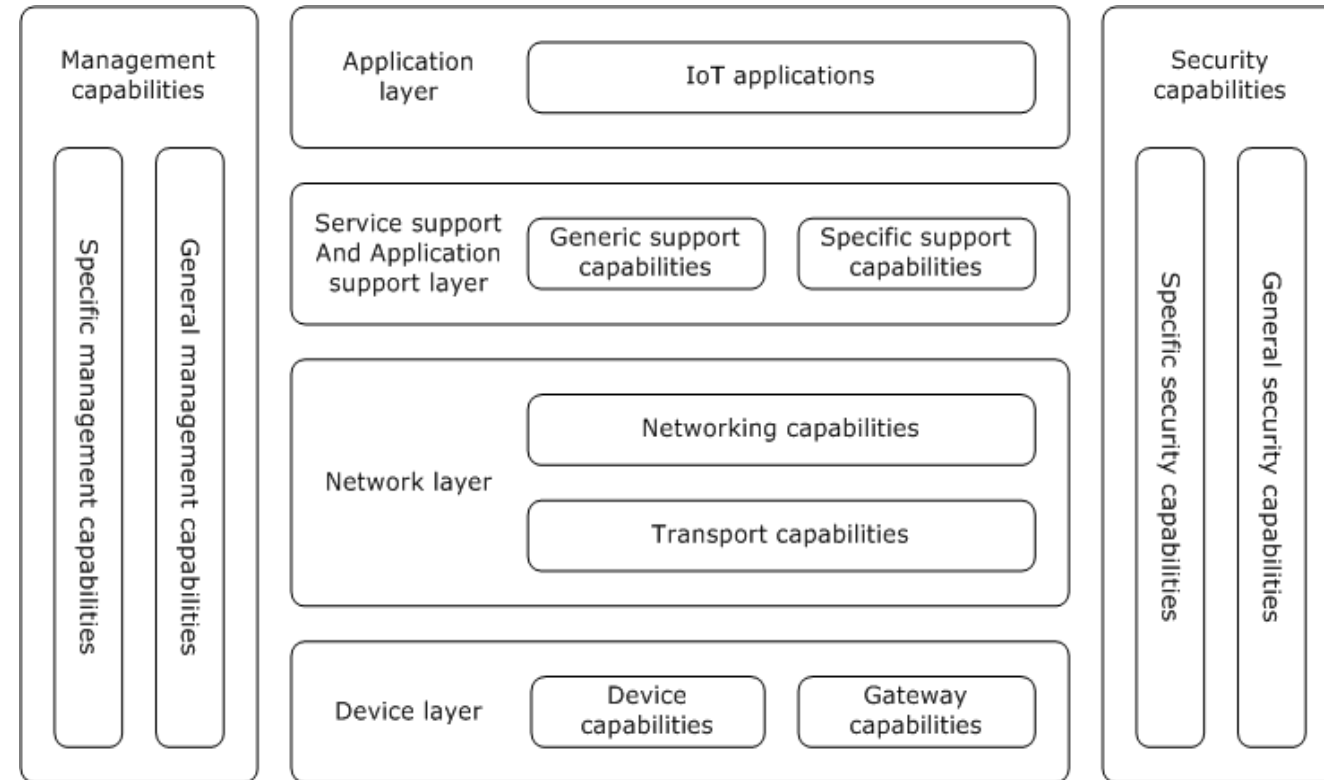
Focus Group on Data Processing and Management to support IoT and Smart Cities & Communities (FG-DPM) [concluded]

ITU-T IoT Reference Model

Capability view of the Internet of Things

- Application capabilities
- Service Support and Application Support capabilities
- Network capabilities
- Device and Gateway capabilities
- Cross-layer Management Capabilities
- Cross-layer Security Capabilities

Common and application specific capabilities



Source: ITU-T Y.4000

Foundational ITU-T Recs on IoT include:

Y.4000 Overview of the IoT

Y.4100 Common requirements of the IoT

Y.4401 Functional framework and capabilities of the IoT

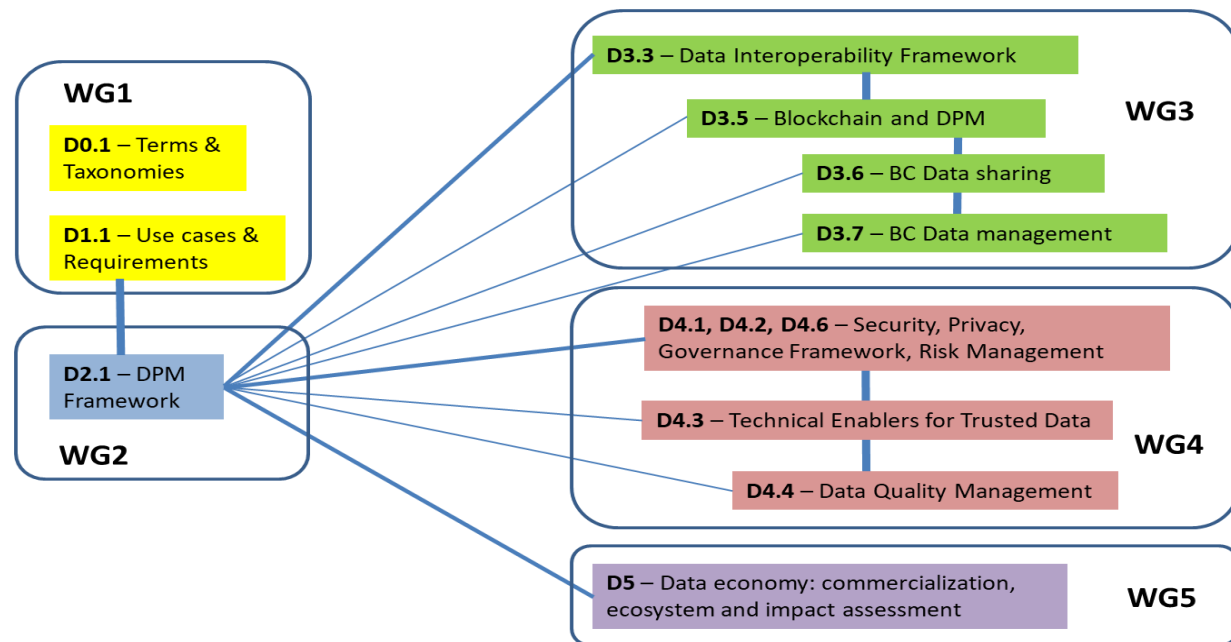
The IoT is expected to benefit from the integration and convergence of ICTs and a number of emerging technologies, including but not limited to:

- Machine to Machine Communications
- Advanced Sensing and Actuation (robotics and more)
- Cloud, Edge and Distributed Computing (towards computing continuum/ computing and network convergence)
- Softwarization (software defined networking, network functions virtualization, microservices, ...)
- Data Management (abstraction, processing, sharing, exposure, quality management, governance and more)
- Artificial Intelligence/Machine Learning (distributed and federated – edge, network, applications)
- Digital Twins (network, applications, local and federated digital twins)
- Distributed Ledgers (Blockchain and decentralized infrastructures)
- Semantics and ontologies
- Advanced Networking (autonomous networks and swarm computing, time determinism, flexible addressing and routing, network slicing, network programmability, satellite-terrestrial network integration, ...)
- Advanced technologies for Security, Privacy and Trust (for data, infrastructure, applications - incl. future Quantum computing-based capabilities)

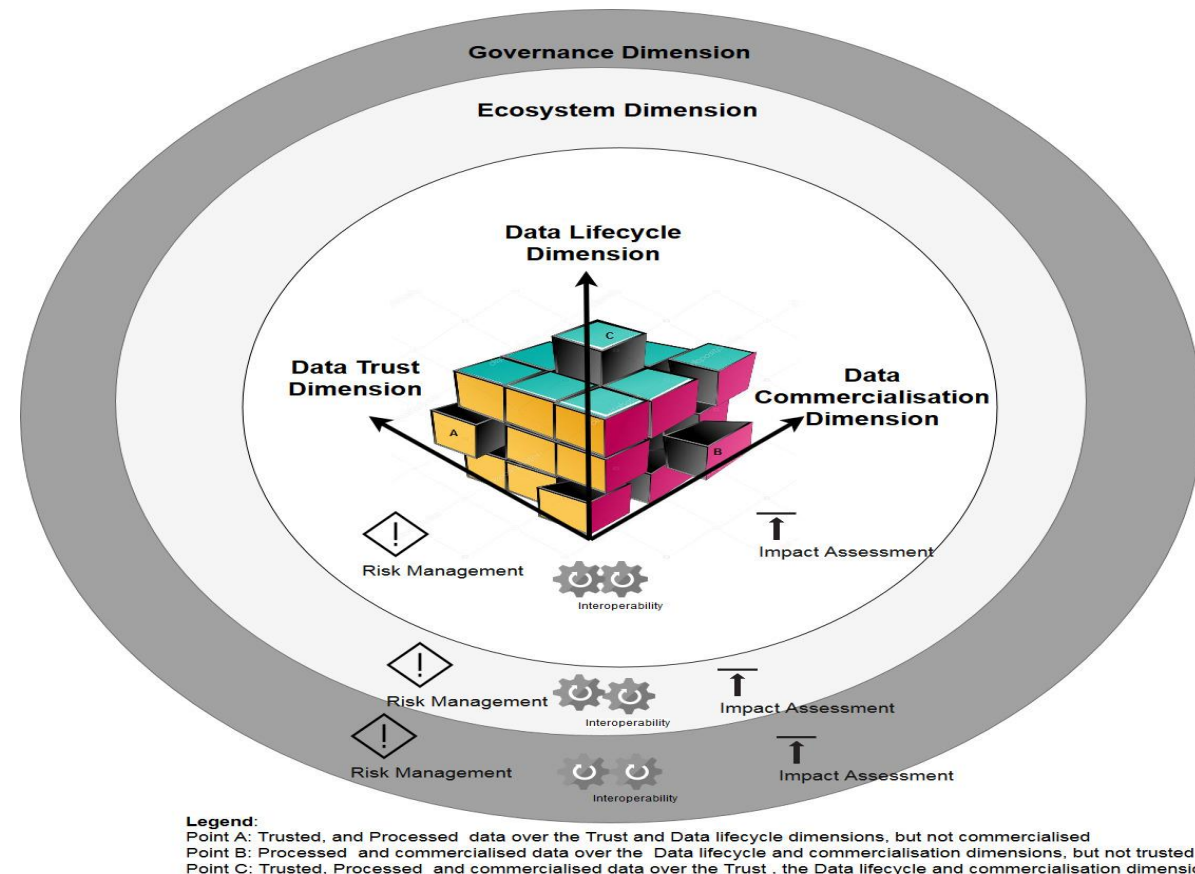
IoT and Smart Cities standardization will reuse as much as possible the standards developed in the different technology areas, but needs also to address lacks and issues coming from their integration in IoT systems and from the (common and application domain specific) requirements of IoT and Smart Cities ecosystems' stakeholders

ITU-T Focus Group on Data Processing and Management for IoT and SC&C (FG-DPM) [2017-2019]

WG1	Use Cases, Requirements and Applications/Services
WG2	DPM Framework, Architectures and Core Components
WG3	Data Sharing, Interoperability and Blockchain
WG4	Security, Privacy and Trust including Governance
WG5	Data Economy, Commercialization and Monetization



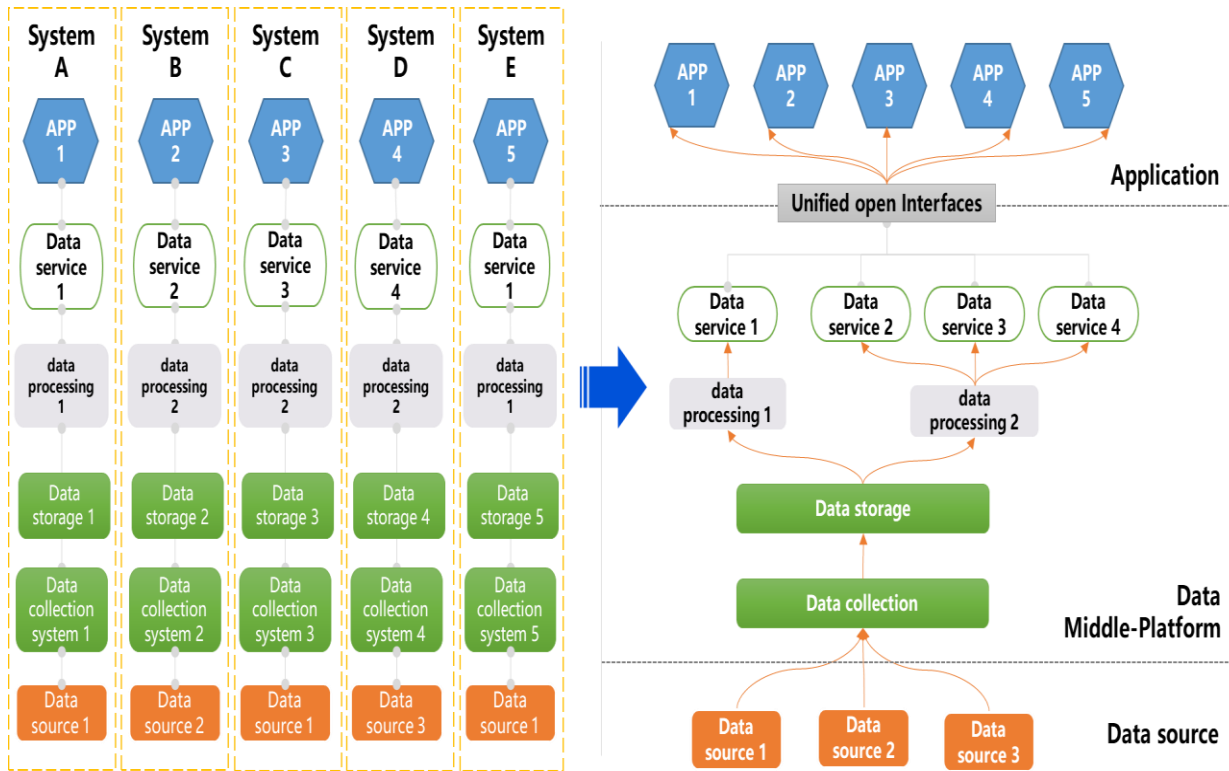
DPM (Data Processing and Management) Framework



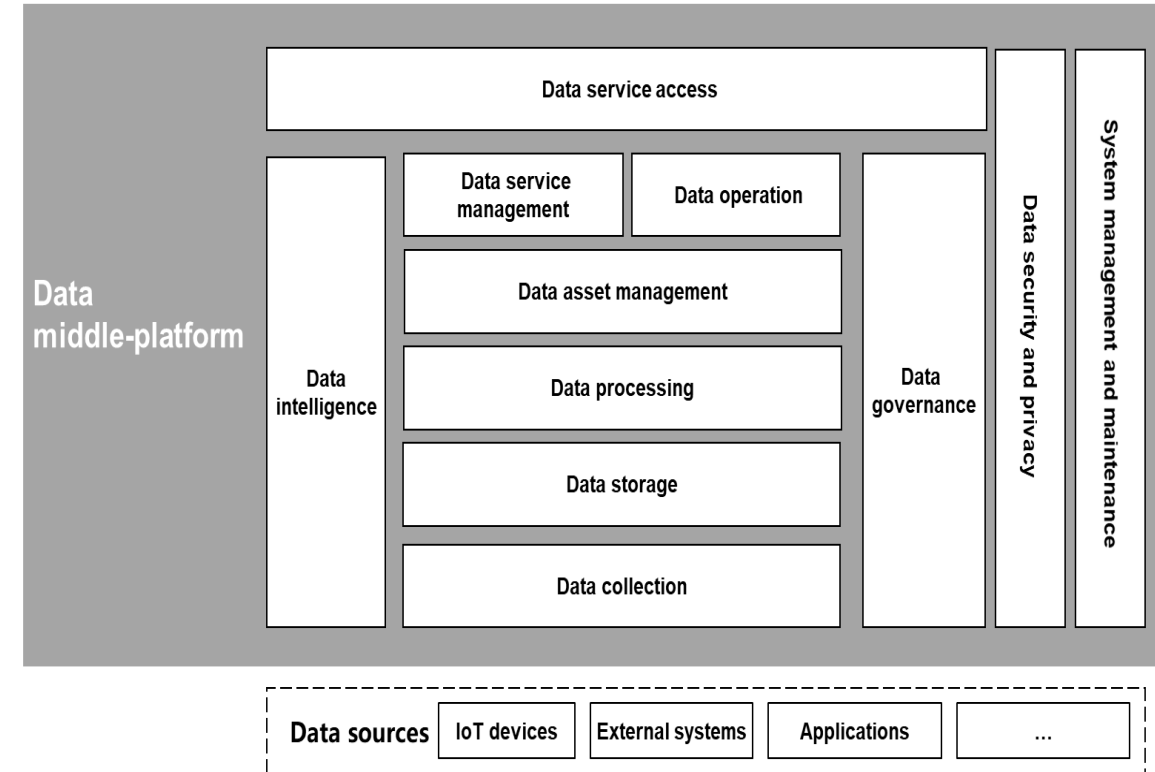
SG20 (focus in Q4/20) is progressing data studies for IoT and S&C, building on the FG-DPM achievements and more

Example of ongoing SG20 studies on data: Y.data-MPOTWeek

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Integration of vertical systems with data middle-platform



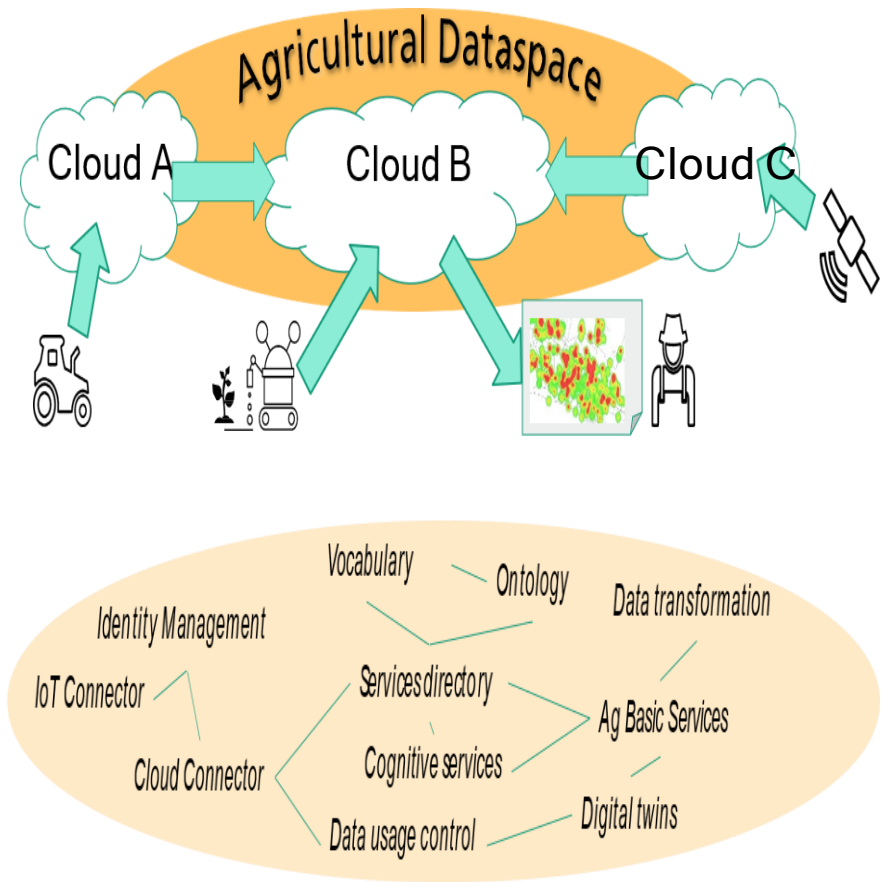
Capability framework for data middle-platform

Breaking down silos, abstracting generic data models, provisioning of unified data management and governance, increasing data processing efficiency, exploring data value, promoting data openness and sharing, delivering high quality data services

Dataspaces and the need of standardization

- the agricultural domain example

- The Agricultural Dataspace is created between cloud solutions, among which the farmer can choose flexibly
- The interaction between solutions of different manufacturers requires **novel and standardized approaches** for basic services of digital cooperation of individual platforms



Source: Fraunhofer IESE

ITU-T FG-AI4A (started March 2022)

The Focus Group on AI and IoT for Digital Agriculture will explore the potential of emerging technologies incl. AI and IoT in supporting data acquisition and handling, improving modelling from a growing volume of agricultural and geospatial data, and providing effective communication for interventions related to optimization of agricultural production processes. It will also examine key concepts, and relevant gaps in current standardization landscape related to agriculture, and will underscore the best practices and barriers related to the use of AI and IoT-based technologies within this domain.

WG-GLOSS	Glossary
WG-AS	DA Use Cases and Solutions
WG-DAM	Data Acquisition and Modelling for DA
WG-Roadmap	Mapping and Analyzing AI and IoT standards related Activities in DA
WG-ELR	Ethical, legal and regulatory considerations for AI use in agriculture
WG-CO	Collaboration and Outreach

AI/ML for networks and applications

Foundational AI/ML standards for networks – by SG13, with significant inputs from FG-ML5G

- ITU-T Y.3172 (2019), *Architectural framework for machine learning in future networks including IMT-2020.*
- ITU-T Y.3173 (2020), *Framework for evaluating intelligence levels of future networks including IMT-2020*
- ITU-T Y.3174 (2020), *Framework for data handling to enable machine learning in future networks including IMT-2020.*
- ITU-T Y.3176 (2020), *Machine learning marketplace integration in future networks including IMT-2020.*
- ITU-T Y.3179 (2021), *Architectural framework for machine learning model serving in future networks including IMT-2020*
- Supplement 55 to ITU-T Y.3170-series (2019), *Machine learning in future networks including IMT-2020: Use cases*

Published/ongoing specs in different ITU-T SGs

ITU-T FG on Autonomous Networks – started in 2020

- The 1st FG-AN deliverable has promoted the SG13 Y.Supp-AN-Use cases, *Use cases for Autonomous Networks*

AI/ML for applications

- **Published/ongoing specs in different ITU-T SGs (incl. SG20)**
- **Various ITU-T FGs work on the adoption of AI in specific application domains**, including health (FG-AI4H), autonomous and assisted driving (FG-AI4AD), digital agriculture (FG-AI4A), Natural Disaster Management (FG-AI4NDM), Environmental Efficiency for AI and other Emerging Technologies (FG-AI4EE).

The SG13 draft Supplement Y.Supp.aisr on AI standardization roadmap is collecting all detailed activities on AI/ML in ITU-T.

Perspective of collaboration on AI and Data for IoT with JTC1/SC41 (new SC41 AG)

Artificial Intelligence of Things (AloT), a combination of AI, data and IoT, creates intelligent things that learn from the generated data and use these insights to make autonomous decisions with distributed and lightweight AI technologies to enable intelligence on the edge as well as to achieve more efficient and real-time IoT operations, improve human-machine interactions and enhance data management and analytics.

- AI at the edge
- Lightweight AI/ML (TinyML)
- Distributed Artificial Intelligence-as-a-Service (DAIaaS)
- Decentralization with blockchain
- Predictive Analytics and Real Time Processing with Accurate Decision

SG20 Correspondence Group for AloT (CG-AIoT) – Jan to Dec 2022, extendable

1. Guidelines for future AloT standardization
 - a) Study AloT technologies and features from a standardization perspective
 - b) Conduct gap analysis of existing standardization efforts on AI and IoT
 - c) Identify clear direction for AloT standardization and potential work items
 - d) Organize webinars/workshops on AloT
2. Develop a Technical Paper containing technical insights and direction for AI powered IoT standardization to stimulate SG20 activities.

Edge Computing studies

Edge Computing for IoT (ITU-T SG20)

- **Y.4208 IoT requirements for support of edge computing**
- **Y.4122 Requirements and capability framework of the edge computing- enabled gateway in the IoT**
- **Ongoing: Framework of decentralized service by using DLT and edge computing technologies for IoT devices**

Edge Computing network aspects (ITU-T SG13 (Future Networks) and SG11 (Signalling))

- Y.3109 QoS assurance-related reqts and framework for virtual reality delivery using mobile edge computing supported by IMT-2020
- Y.3526 - Cloud computing - Functional requirements of edge cloud management
- Q.5001 - Signalling requirements and architecture of intelligent edge computing
- Q.5003 - Signalling requirements and architecture for federated multiaccess edge computing
- Ongoing-work items

Edge Computing applications (ITU-T SG16: Multimedia)

- F.743.10 Requirements for mobile edge computing enabled CDNs
- F.743.12 Requirements for edge computing in video surveillance
- F.743.13 - Requirements for cooperation of multiple edge gateways
- F.749.11 Requirements of civilian unmanned aerial vehicles enabled mobile edge computing
- H.644.4 Architecture for mobile/multi-access edge computing enabled CDNs
- Ongoing-work items

Edge Computing security aspects (ITU-T SG17: Security) and Edge Computing energy efficiency aspects (ITU-T SG5: Environment, climate change and circular economy)

- Ongoing-work items

Computing and Network Convergence basic studies in ITU-T SG13 (Future Networks)

- **Y.IMT2020-CNC-req** Requirements of computing and network convergence in IMT2020 network and beyond
- **Y.IMT2020-QoS-CNC-req** QoS assurance-related requirements and framework for computing and network convergence supported by IMT-2020 and beyond
- **Y.M&O-CNC-fra** Management and orchestration related requirements and framework for computing and network convergence in IMT-2020 networks and beyond

Cloud specific

- **Y.CAN-req** Cloud computing - Functional requirements of computing-aware networking

NGN evolution specific

- **Y.2501** Computing power network – Framework and architecture
- **Y.ARA-CPN** Computing power authentication scheduling architecture
- **Y.NGNe-O-CPN-reqts** Requirements and framework of NGNe orchestration enhancements for supporting computing power network

Other 4 ongoing items related to CNC are progressed in ITU-T SG11 (Signalling) [3] and SG17 (Security) [1]

Draft definition of “Computing and Network Convergence (CNC)”: *Computing and network resource joint optimization based on awareness, control and management over network and computing resources*

Application scenario examples [Y.IMT2020-CNC-req]

- Low latency and high computing requirements, e.g. AR/VR
- Service consistence, e.g. Connected Cars
- Huge Scientific Data Applications

Other emerging requirements imposed on Networks from a large diversity of IoT applications have to be addressed by the network-level standardization

Digital Twins for IoT and cities (SG20)

- **ITU-T Y.supp.DTw-concept-usecase**: “Concept and use cases of a digital twin in smart sustainable cities” [concept, common vocabularies and use cases of digital twins in smart sustainable cities from a maturity perspective; challenges and opportunities for digital twins in smart sustainable cities]
- **ITU-T Y.DT-interop** : “Interoperability framework of DT systems in smart cities and communities” [three aspects: data interoperability, data processing and infrastructure]
- **ITU-T Y.dtf-reqts** : “Requirements for digital twin federation in smart cities and communities”
- **ITU-T Y.scdt-reqts** : “Requirements and capabilities of a DT system for smart cities” ” [to analyze use cases and develop strategies by conducting simulations]
- **ITU-T Y.dt-smartfirefighting** : “Requirements and capability framework of DT for smart firefighting” [usage of real-time interaction between digital and physical world to develop and optimize rescue strategies]
- **ITU-T Y.dt-ITS**: “Requirements and capability framework of DT for intelligent transport system” [to support intelligent transportation applications such as transportation planning and traffic optimization]

Digital Twins for networks (SG13)

- **Y.DTN-Caplevel** Digital twin network - Capability level and evaluation methods [definition of capability level of DTN, dimensions and indicators of DTN's capability level , evaluation methods]

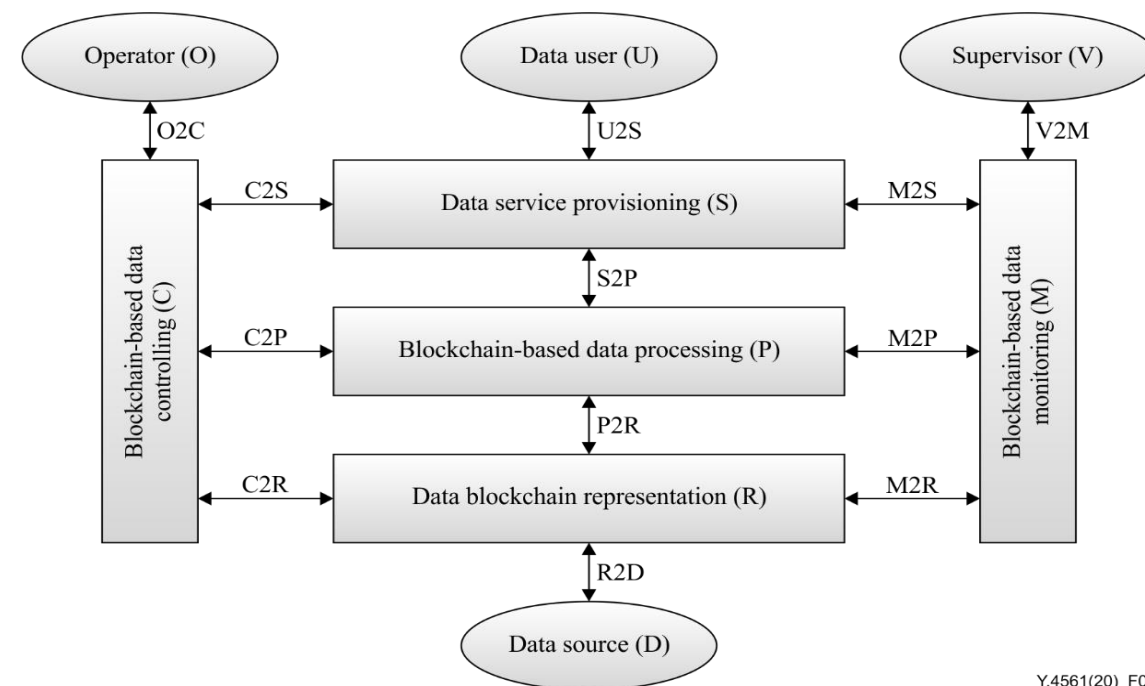
Other studies expected from diverse viewpoints

Collaboration with relevant SDOs would be very beneficial, considering we are at the beginning of the international standardization efforts in this critical area which is definitely booming (projects, alliances, market)

Blockchain-enabled capabilities

Blockchain for IoT and cities (SG20)

- Y.Suppl.62 (07/2020) - *Overview of blockchain for supporting IoT and SSCs in data processing and management aspects*
- Y.4560 (08/2020) - *Blockchain-based data exchange and sharing for supporting IoT and SSCs*
- Y.4561 (08/2020) - *Blockchain-based data management for supporting IoT and SSCs*
- Y.IOT-BC-reqts-cap - *IoT requirements and capabilities for support of blockchain*
- Y.BC-SON - *Framework of blockchain-based self-organization networking in IoT environments*
- Y.dec-IoT-arch - *Decentralized IoT communication architecture based on information centric networking and blockchain*
- Y.IoT-BoT-peer - *Capability and functional architecture of peer of blockchain of things*
- Y.IoT-DES-fr - *Framework of decentralized service by using DLT and edge computing technologies for IoT devices*



Y.4561(20)_F02

Generic reference model of
blockchain-based data management [Y.4561]

Other Blockchain studies in different ITU-T SGs, including

- **Decentralized Infrastructures (SG13 Future Networks)**

Y.2086 (under AAP) - *Framework and Requirements of Decentralized Trustworthy Network Infrastructure*



- **Episode #1:** Digital twins in cities co-organized with the IEC and ISO
- **Episode #2:** IoT-based automotive emergency response system
- **Episode #3:** Smart sustainable city architectures: challenges and opportunities co-organized with oneM2M
- **Episode #4:** Smart Cities: a step towards digital transformation in Latin America co-organized with Regional Telecommunications Technical Commission (COMTELCA)
- **Episode #5:** Smart sustainable cities maturity model and impact assessment co-organized with Austrian Economics Center
- **Episode #6:** Smart City Platforms co-organized with China Information Communication Technologies Group (CICT), Electronics and Telecommunications Research Institute (ETRI) and Spanish Association for Standardization (UNE)
- **Episode #7:** Crowdsourced Systems: A people-led paradigm co-organized with Bournemouth University
- **Episode #8:** Network capabilities and emerging technologies to support IoT-enabled verticals co-organized with CICT, China Mobile, China Unicom, EADN, Huawei, OKI and Tencent
- **Episode #9:** Addressing the Security Risks of Digital Transformation on IoT co-organized with ITU-T Study Group 17
- **Episode #10:** The role of digital technologies on aging and health co-organized with Pan American Health Organization (PAHO)
- **Episode #11:** Blockchain-based data management for supporting Internet of things and smart cities and communities co-organized with Open & Agile Smart Cities (OASC) and United Nations University (UNU)
- **Episode #12:** Interoperability of IoT and satellite data for Earth observation supporting sustainable development co-organized with Mandat International and World Meteorological Organization (WMO)
- **Episode #13:** Architecting the Web of Things coordinated with the Web of Things WG of the World Wide Web Consortium (W3C)
- **Episode #14:** Accelerating agricultural digital transformation through AI and IoT coordinated with Food and Agriculture Organization (FAO) and International Organization for Standardization (ISO)
- **Episode #15:** Smart city platforms for an integrated management in smart sustainable cities



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Thank you!

Find more:

<https://www.itu.int/en/ITU-T/studygroups/2022-2024/20/Pages/default.aspx>

<https://www.itu.int/net4/itu-t/landscape#?topic=0.78&workgroup=1&searchValue=&page=1&sort=Revelance>

<https://www.itu.int/en/ITU-T/ssc/Pages/default.aspx>

<https://www.itu.int/en/ITU-T/webinars/dt4cc/Pages/default.aspx>

<https://toolkit-dt4c.itu.int/>

<https://www.itu.int/en/ITU-T/studygroups/2022-2024/13/Pages/default.aspx>

iotweek.org

A relevant collaboration example: the Joint IEC-ISO-ITU Smart CitiesTask Force

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Objectives of J-SCTF (started in Oct 2020)

- To build synergies on ongoing work in ITU-T, IEC and ISO related to smart cities and communities
- To maximize efforts in order to identify new areas of cooperation related to smart cities and communities
- To develop a holistic view on smart cities and communities taking into consideration the scope, areas of work and expertise of ITU-T, IEC and ISO to support smart cities and communities development

Three Task and Finish groups active till now

- T&F group 1 on 'Developing a holistic view of smart cities'
- T&F group 2 on 'Mapping exercise on the existing SDOs work in SSCs'
- T&F group 3 on 'Working on SDGs and link with smart cities activities'