

IoT Week 2018, Bilbao  
IoT Standards Trends & Convergence Plenary Session  
7 June 2018, 15:30-17:00

**Data Processing and Management to support IoT and SC&C:  
some findings and ongoing studies in ITU-T and AIOTI WG03**

Marco Carugi  
ITU-T SG20 and AIOTI WG03  
Senior Consultant  
[marco.carugi@gmail.com](mailto:marco.carugi@gmail.com)

# Opportunities and challenges of (Big) Data for networks and services

## Process optimization and data monetization via analytics - driving revenue by sharing, analysing and interpreting data, for multiple purposes

- Extraction of tangible business and technology value
- Response and action in real time, improving productivity/business processes, lowering costs
- Long-range forecasts enabling strategic actions - business differentiation
- New/improved business models and service offer, faster, more efficiently and agile

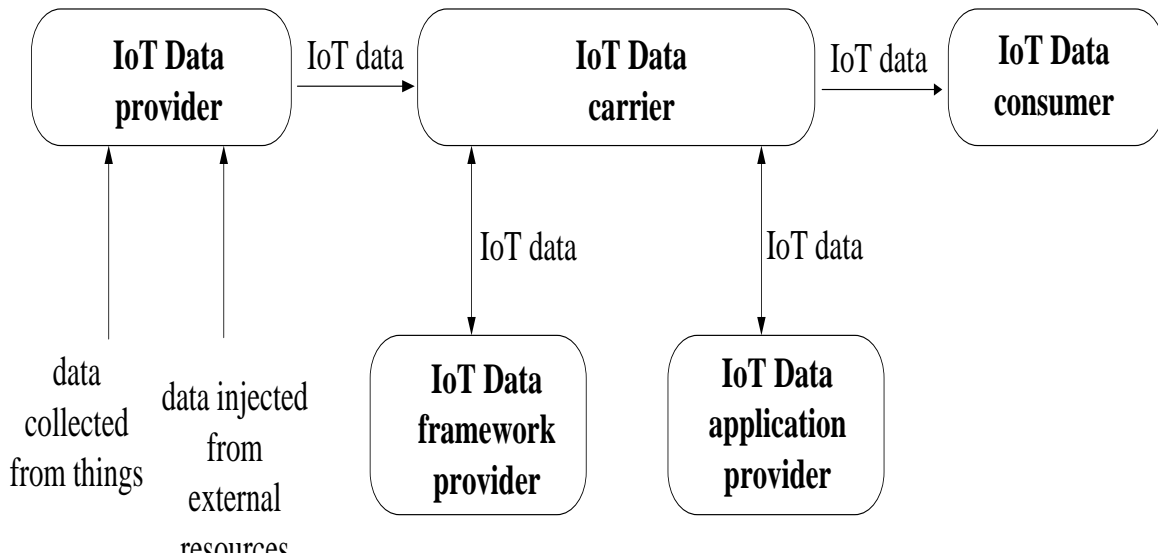
## Some significant challenges

- Dealing with the “V”s of data : Volume, Variety, Velocity, Variability, Veracity
- Discovery of appropriate devices and data sources, and integration of heterogeneous devices, networks and data
- Scalability for large device numbers, diverse and huge data, computational complexity of data interpretation
- Availability and (open) access to data, data query
- Trust, security and privacy of data
- Interpretation (extraction of actionable intelligence from data)
- Massive data mining, efficient processing, flexible learning
- **Other non-technical challenges are also essential (incl. data ownership and data governance)**

# A foundational ITU-T Recommendation on Big Data in IoT:

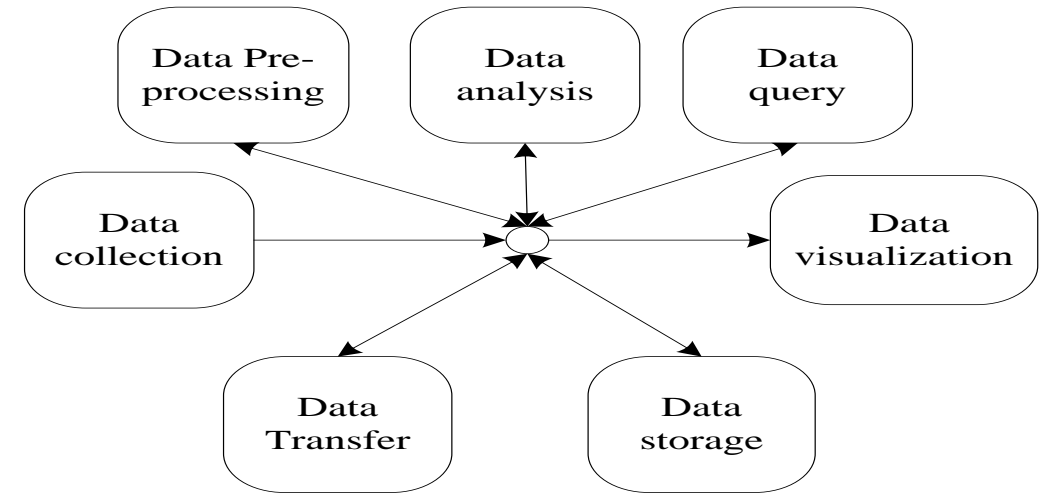
ITU-T Y.4114 “Specific requirements and capabilities of the IoT for Big Data”

**Specific requirements and capabilities the IoT is expected to support to address the challenges related to Big Data**



## The IoT data roles identified in Y.4114

[the key roles relevant in an IoT deployment from a data operation perspective]



**Abstract representation of IoT data operations and related data flows** (diverse concrete IoT deployments do not imply unique logical sequencing of IoT data operations)

*To build on within ITU-T FG-DPM (e.g. “Data sharing” as critical additional data operation)*

# ITU-T Focus Group on Data Processing and Management to support IoT and Smart Cities & Communities (ITU-T FG-DPM)

## *Essential tasks*

- Identify challenges in IoT and smart cities for DPM
- Identify key requirements and capabilities for DPM
- Promote the establishment of trust-based data management frameworks for IoT and SC&C
- Investigate the role of emerging technologies to support data management incl. blockchain
- Identify and address standards gaps and challenges

**1<sup>st</sup> meeting in July 2017 (SG20 is parent SG)**

**1<sup>st</sup> ITU Workshop on Data Processing and Management for IoT and Smart Cities & Communities:** Brussels, Belgium, 19 Feb. 2018

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

*Liaisons/interactions established with numerous SDOs, Fora, Alliances and projects  
E.g. ISO, ETSI ISG CIM, BDVA, various H2020 projects*

# “Use Cases Analysis and General Requirements for DPM” (FG-DPM D1.1): a key entry point for the whole FG-DPM work

## • Objectives

- Identify from DPM perspective - per each use case - ecosystem’s actors and business roles, data characteristics, capabilities, requirements and other
- **Facilitate comparison among different use cases (across single or multiple domains)** to enable common DPM features to be identified/adopted, and facilitate single/cross-domain applications’ implementation
- **Allow creation of new services at little extra cost**
- **Feed other FG-DPM deliverables** (DPM framework, area-specific frameworks, others)

## • Progress so far

- **“Unified DPM Use Case template”** developed and **disseminated to numerous potential DPM use cases contributors (incl. SDOs, Alliances, EU H2020 projects)**
- Numerous DPM use cases collected
- Comparison of DPM use cases started - identifying common/use case-specific requirements
- DPM capabilities’ global picture discussion initiated (WG1, WG2, others)

# Blockchain technology for Data Exchange and Sharing

## Some benefits of Blockchain in IoT

- Efficient ensurance of integrity, authenticity, auditability and traceability of transactions (data) => trust based information transmission
- Decentralized approach (lower maintenance costs)
- Multi-party consensus (data security)
- Distributed approach (multi-party collaboration)
- Enabler of data monetization

## Some limitations of Blockchain in IoT

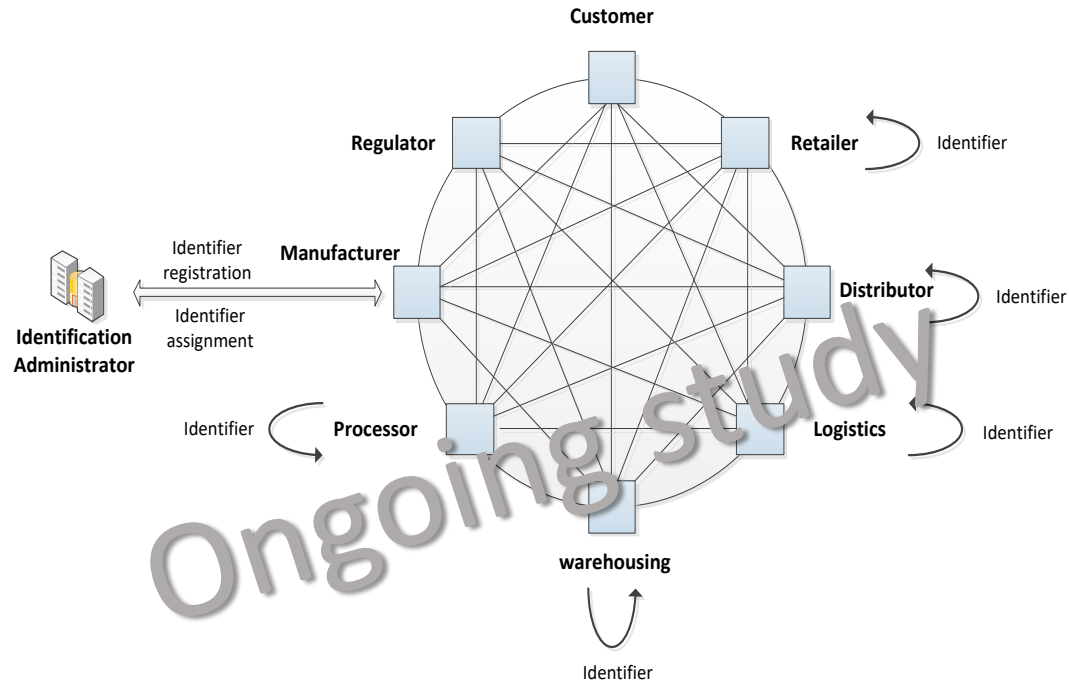
- Not suitable for massive IoT data service transactions and frequent data transmissions
- High performance and capacity requirements not fitting constrained IoT environments
- Big storage capacity needs cannot cope with IoT devices' storage as the blockchain grows
- Data security and privacy is relative

*Source: ongoing FG-DPM D3.6*

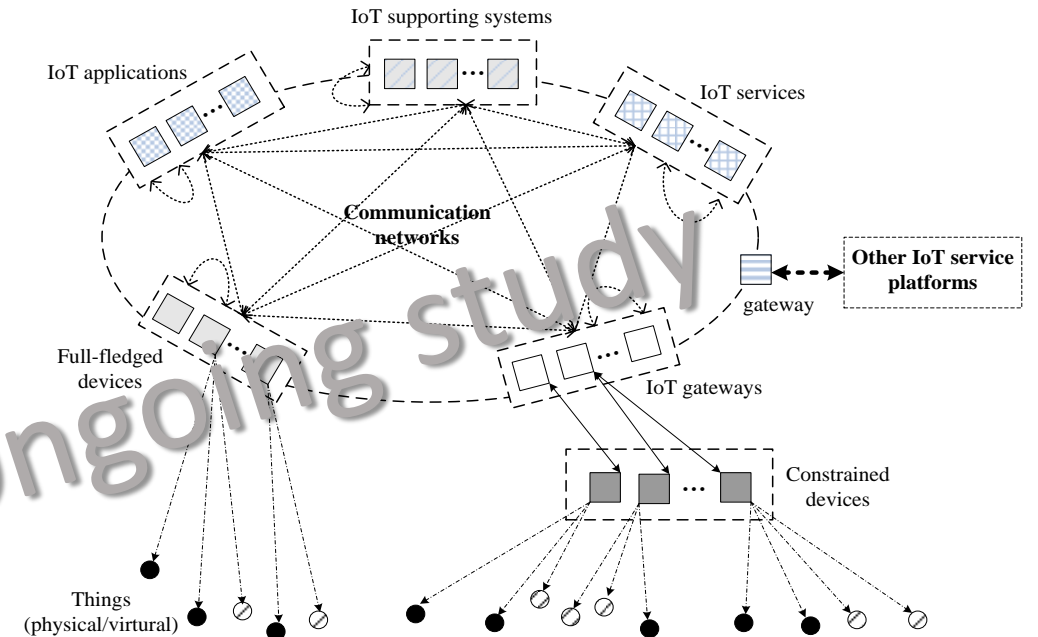
*Blockchain technology fosters a new generation of transactional applications that **establish trust, accountability, transparency and efficiency**. It shows great promises across a wide range of business applications in many fields, including IoT and Smart Cities & Communities.*

# Blockchain technology for IoT in ITU-T FG-DPM and SG20

## Ongoing FG-DPM D.3.6 deliverable



## Ongoing draft Rec. Y.IoT-BoT-fw in SG20



## Blockchain-based supply chain traceability use case

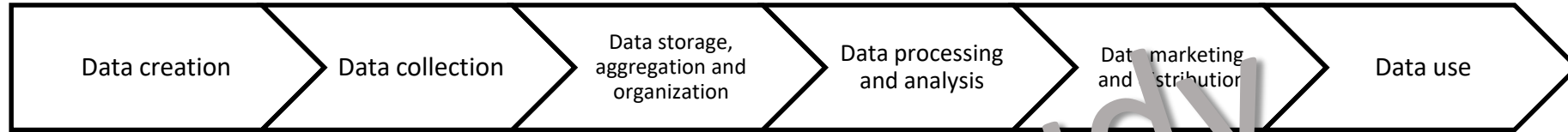
Exchanging and sharing static and dynamic information among the supply chain actors

## Blockchain of things as decentralized service platform

With the increase of connected things and other demands (e.g., trust and transactions), centralized IoT service platforms may become key bottlenecks

# Data Economy, commercialization and monetization (ongoing FG-DPM D5.1)

## Data Core Activities



## Data Support Activities



## Data Value Chain (business perspective)

**Data laws, regulations and policies:** formulation and enforcement of data related laws, regulations and policies

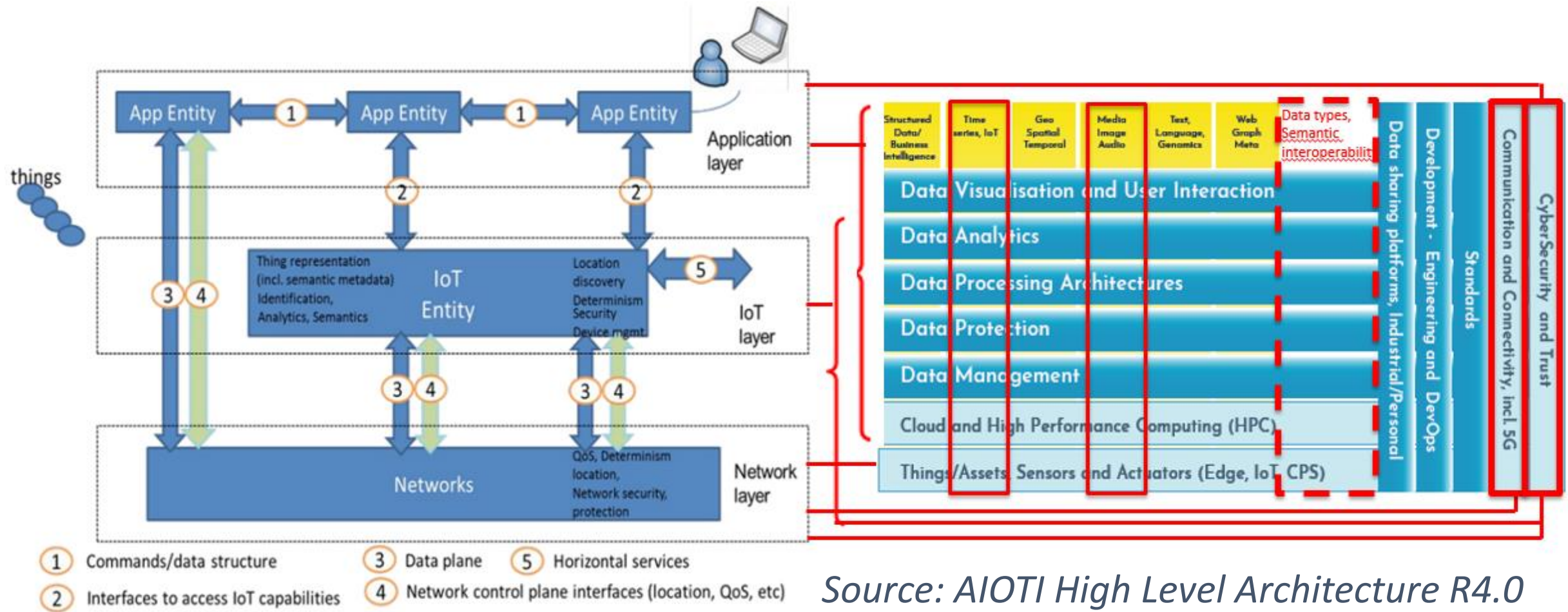
**Data security and privacy services:** provisioning of data related security and privacy services for implementing and enforcing data laws, regulations and policies.

**ICT connectivity and infrastructure services:** provisioning of ICT connectivity and infrastructure services for implementing data value chain activities

*Interaction between FG-DPM WG5 (business perspective on DPM) and FG-DPM WG1/WG2 (technical perspective on DPM)*



# BDVA's BDV Reference Model mapping to AIOTI High Level Architecture



A key step in front of the IoT standardization work plan: Big Data-IoT architectural integration

# Enhancing DPM with Machine Learning (ML) technologies

## Potential of ML for network design, operation and optimization

- coping with massively increased complexity
- enhancing network operations' efficiency and robustness
- increasing network self-organization feasibility
- providing reliable predictions

## As well as potential of ML to enable new advanced applications

## But a number of challenges need to be addressed [beyond trust]

- how to deal with stringent requirements of many applications (latency)
- how to ensure robust ML given small data sets and under latency constraints
- how to deal with distribution of data at different locations and diverse data formats
- usage of distributed learning to have efficient usage of scarce resources
- how to deal with (wireless) channel noise, dynamicity and unreliability
- how to ensure good tracking capabilities
- how to exploit context info and expert knowledge (hybrid ML approaches)

*Source: discussion in initial meetings of ITU-T FG-ML5G*

*ITU-T FG on “Machine Learning for Future Networks including 5G” (FG-ML5G)*

*- created in Nov 2017, SG13 as Parent ITU-T Study Group*

*- a number of challenges and opportunities common to the IoT*

## Initial AI studies within ITU-T SG20 [early stages of development]

- Technical Report on “Artificial Intelligence and Internet of Things” (TR.AI4IoT)
- Draft Rec. Y.SSC-AISE-arc “Reference architecture of artificial intelligence service exposure for smart sustainable cities”

***International coordination on Big Data and AI/ML standardization activities is expected among relevant SDOs, Alliances and Consortia***