Third ITU Workshop on "Data Processing and Management for IoT and Smart Cities & Communities" (Seoul, Korea (Rep.of), 14 January 2019)

ITU-T FG-DPM Activities and Deliverables

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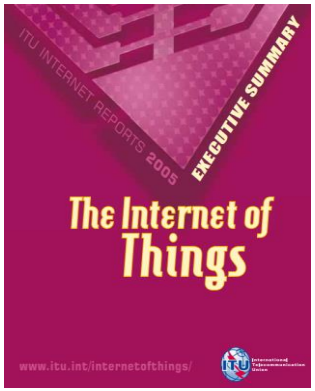
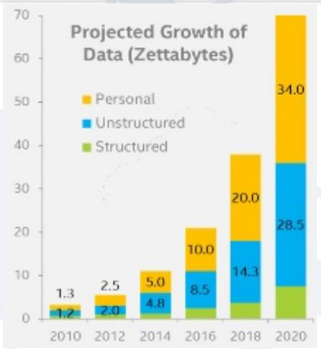
IoT and Data – Artificial Intelligence of Things (AIoT)

Extension of IoT Applications



https://www.itu.int/osg/spu/publications/internetofthings/InternetofThings_summary.pdf

Data Explosion

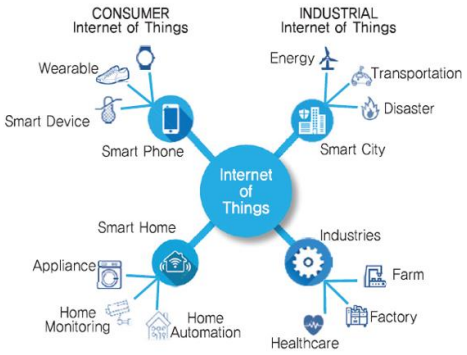


Leverage the massive amount of data

Artificial Intelligence of Things

- **AI:** Data-based learning
- **Big Data:** Capture, storage, analysis of data
- **IOT:** Data Collection through IoT

From Connecting Devices to Creating Value

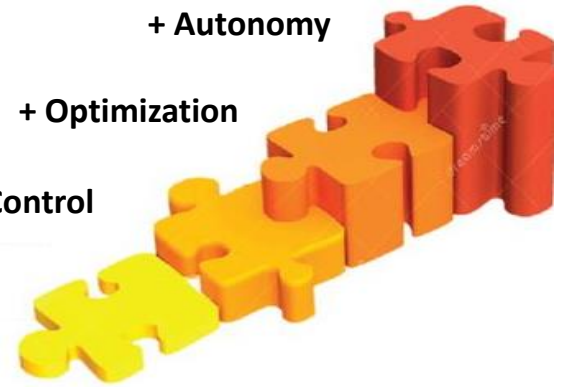


Identification/Sensing

+ Remonte Control

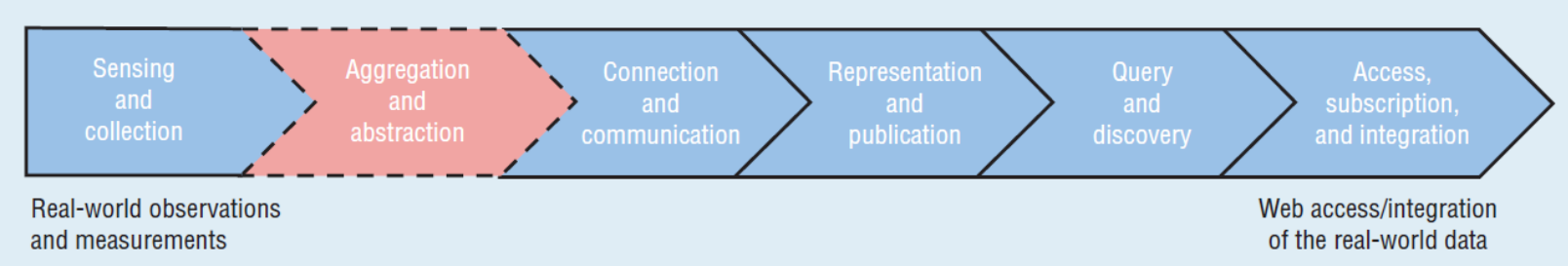
+ Optimization

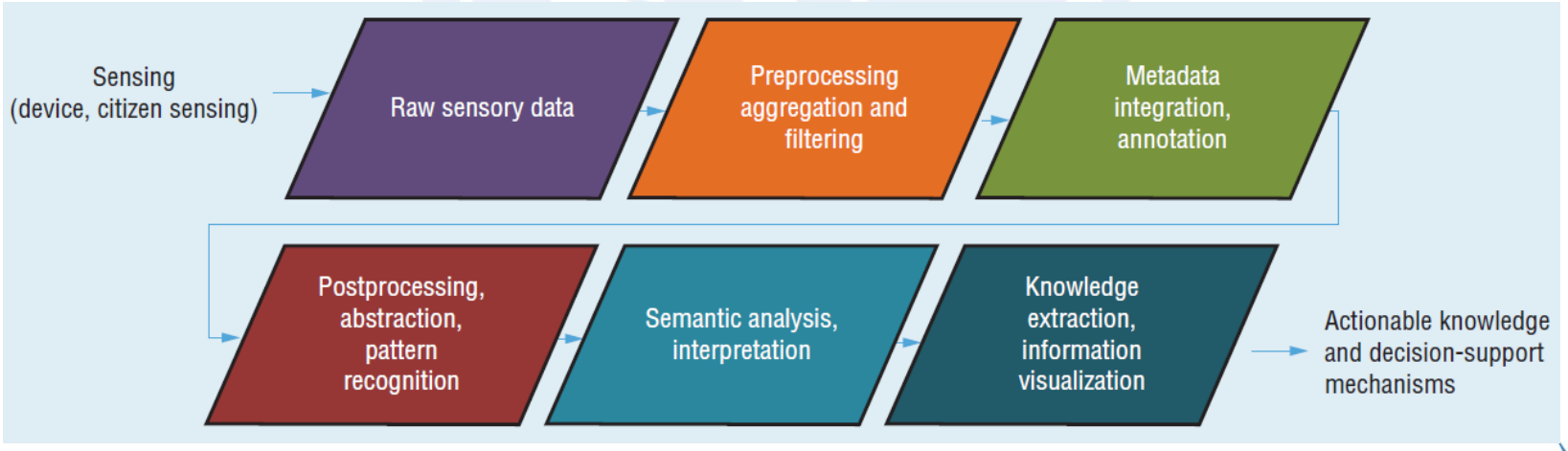
+ Autonomy



From Data to Actionable Knowledge

- The data production and access chain





"From Data to Actionable Knowledge: Big data challenges in the WoT," IEEE Intelligent System, 2014

ITU-T FG-DPM

- **Parent study group**: ITU-T SG20 (IoT and SC&C)
- **Established**: ITU-T SG20 meeting (Dubai, 22 March 2017)
  - 1st Forum on Data Management (Transforming data into value)

- **Open to all stakeholders** (ITU members & non-members)
- **Overall objectives**:
  - promote the establishment of trust-based data management frameworks for IoT and SC&C
  - investigate existing and emerging technologies
  - Identify and address standardization gaps and challenges

FG-DPM: Terms of Reference

- To study, review and survey existing technologies, platforms, guidelines and standards for **data processing and management** including data format in support of the mandate of SG20;
- To recognize and highlight the various perspectives for the future of **data driven eco-environments**;
- To promote **security and trust** within data management frameworks;
- To identify and study **data protection** techniques;
- To facilitate cross-cutting **data interoperability** issues and point the way to the development of efficient and scalable approaches to managing systems data;
- To study **meta-data**;
- To study **trust in data management** frameworks including digital identification and certification;
- To investigate **the role of emerging technologies** to support data management and emerging trends including **blockchain**;
- To identify challenges in the standardization activities for data processing and management.
- To establish liaisons and relationships with other organizations which could contribute to the standardization activities for data processing and management.

FG-DPM: Focus group structure

WG	Title	Chair
WG1	**Use Cases, Requirements and Applications/Services**	Mr Martin Brynskov (Open and Agile Smart Cities Initiative)
WG2	**DPM Framework, Architectures and Core Components**	Mr Steve Liang (OGC), Mrs Hakima Chaouchi (Telecom SudParis)
WG3	**Data sharing, Interoperability and Blockchain**	Mrs Liangliang Zhang (Huawei)
WG4	**Security, Privacy and Trust including Governance**	Mr Robert Lewis-Lettington (UN-HABITAT)
WG5	**Data Economy, commercialization, and monetization**	Mr Okan Geray (Smart Dubai), Mr Abdulhadi AbouAlmal (Etisalat)

Initial Plan for FG-DPM Deliverables – 1

WG	Deliverables
All	• D0.1 - DPM Terms and Definitions, Taxonomies
WG1	• D1.1 - Use Cases Analysis and General Requirements for DPM • D1.2 - IoT and SC&C Applications and Services using DPM
WG2	• D2.1 - DPM Framework for Data-driven IoT and SC&C • D2.2 - DPM Functional Architectures • D2.3 - Data Modeling and Formats Specification for DPM ✓ D2.3.1 Technical report on data format for IoT and smart city ✓ D2.3.2 Technical report on web based microdata format for IoT and smart city ✓ D2.3.3 Technical report on metadata format for IoT and smart city • D2.4 - Technical Report on Data Analytics • D2.5 - Technical Report on Data Visualization • D2.6 - Framework of Meta Data Management • D2.7 - Framework of Data Life Cycle Management

Initial Plan for FG-DPM Deliverables – 2

WG	Deliverables
WG3	• D3.1- Framework of Open/Private Data • D3.2 - Technical Enablers for Open Data Platform • D3.3 - Technical Report on Data Interoperability • D3.4 - Technical Report on Data sets Interoperability • D3.5 - Overview of IoT and Blockchain • D3.6 - Bockchain-based Data Exchange and Sharing Technology • D3.7- Using blockchain to improve data management
WG4	• D4.1 - Framework of Security and Privacy in DPM • D4.2 - Privacy Management in Smart Cities • D4.3 - Technical Enablers for Trusted Data • D4.4 - Data Quality Management for Trusted Data • D4.5 - Data Governance Framework for IoT and SC&C • D4.6 - Risk Assessment Framework for DPM in IoT and SC&C

Initial Plan for FG-DPM Deliverables – 3

WG	Deliverables
WG5	• D5.1 - Modeling of Data Economy for value creation and Stakeholders identification • D5.2 - Business models, commercialization and monetization to support data economy • D5.3 - Data economy impact assessment, policy and sustainability implications • D5.4 - Data economy regulatory framework
All	• D0.2 - DPM Standards Roadmap

Previous FG-DPM Meetings

1st meeting: 17-19 July 2017 (Geneva)

2nd meeting: 20-25 October 2017 (Geneva)

3rd meeting: 19-23 February 2018 (Brussels)

4th meeting: 1-3 May 2018 (Cairo)

Previous FG-DPM Meetings

5st meeting: 17-20 September 2018 (Tunis)

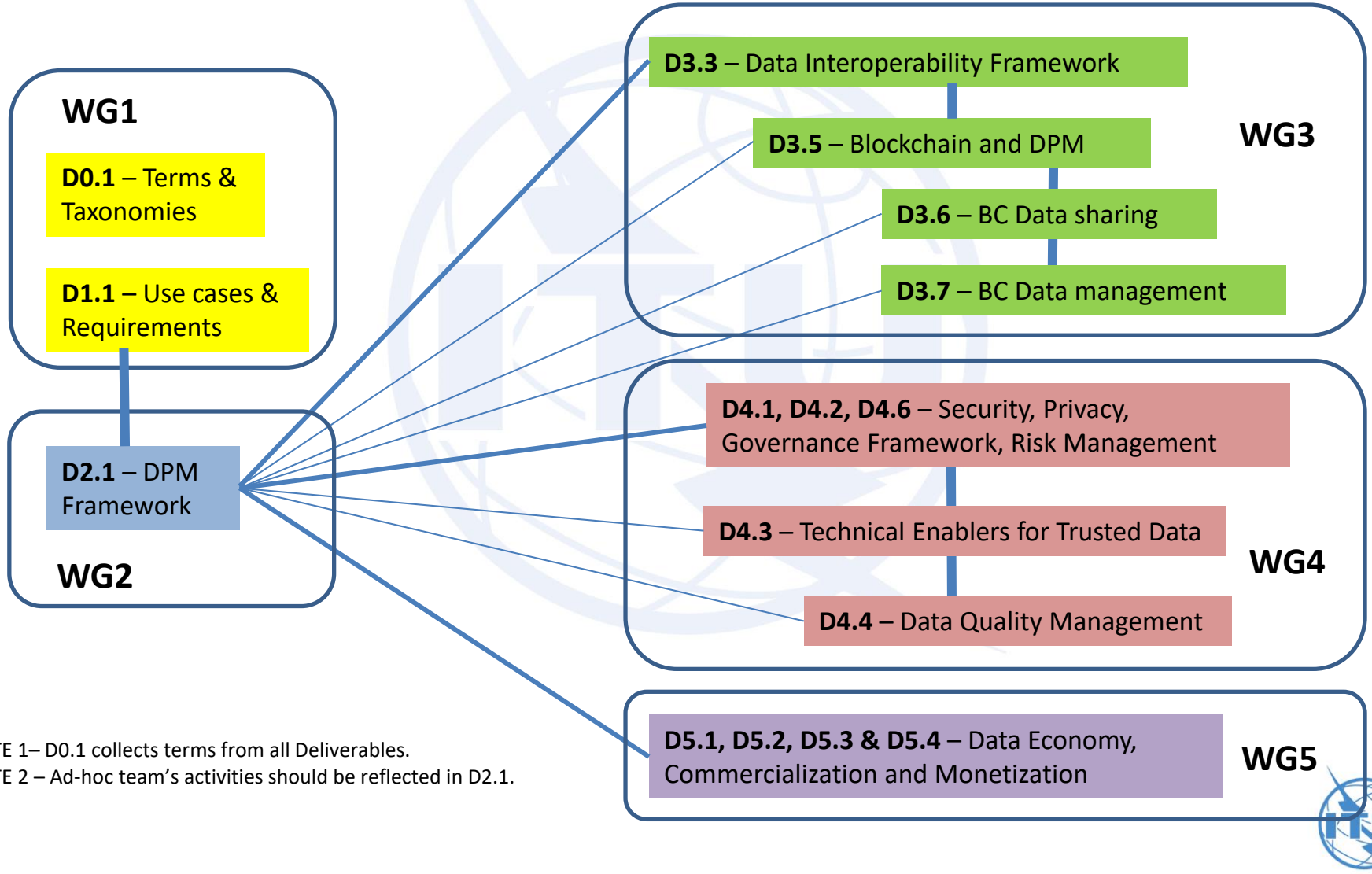
Meeting	1st	2nd	3rd	4th	5th
Input docs	60	45	39	25	37
Output docs	13	23	23	22	24
Meeting report	O-012	O-034R1	O-042	O-085	O-110R1
Remote participants	31	11	13	20	10
Total participants	101	40	40	42	38

1st workshop: 19 February 2018 (Brussels, EC)

https://webcast.ec.europa.eu/workshop-on-data-processing-and-management-for-iot-and-smart-cities

2nd workshop: 17 September 2018 (Tunis)

FG-DPM Working Deliverables – 1



NOTE 1– D0.1 collects terms from all Deliverables.
NOTE 2 – Ad-hoc team's activities should be reflected in D2.1.

FG-DPM Working Deliverables – 2

Del.	Title	Output document
D1.1	TS - "Use Cases Analysis and General Requirements for DPM"	FG-DPM-O-103
D2.1	TS - "DPM Framework for Data-driven IoT and SC&C"	FG-DPM-O-089R1
D3.3	TR - "Framework to support data interoperability in IoT environment"	FG-DPM-O-091
D3.5	TR - "Overview of Blockchain for supporting IoT and SC&C in DPM aspects"	FG-DPM-O-092
D3.6	TS - "Blockchain-based data exchange and sharing technology"	FG-DPM-O-093
D3.7	TS - "Blockchain Based Data Management"	FG-DPM-O-094
D4.1	TR - "Framework of Security and Privacy in DPM"	FG-DPM-O-096
D4.2	TR - "Privacy Management for DPM in IOT and Smart Cities"	FG-DPM-O-097
D4.3	TS - "Technical Enablers for Trusted Data"	FG-DPM-O-098
D4.4	TR - "Data quality management for trusted data"	FG-DPM-O-099
D4.6	TS - "Risk Management in DPM for IoT and smart cities"	FG-DPM-O-100
D5.1, D5.2, D5.3, D5.4	TS - "Data Economy Impact, Commercialization and Monetization"	FG-DPM-O-087

TS: Technical Specification, **TR**: Technical Report
Output documents of the Tunis meeting

Ref) **List of deliverables**

FG-DPM Working Deliverables – 3

Deliverable	Title	Output document
D0.1	TS - "Data Processing and Management for IoT and Smart Cities and Communities: Vocabulary"	FG-DPM-O-072
D2.3.1	TR - "Data format in IoT and smart city"	FG-DPM-O-044
D2.3.2	TR – "Web based Microdata formats for IoT and Smart city"	FG-DPM-O-008
D2.3.3	TR - "Metadata format in IoT and smart city"	FG-DPM-O-009
D3.2	TS - "SensorThings API – Sensing, a cross-domain IoT data model and RESTful API"	FG-DPM-O-018

TS: Technical Specification, **TR**: Technical Report

Ref) **List of deliverables**

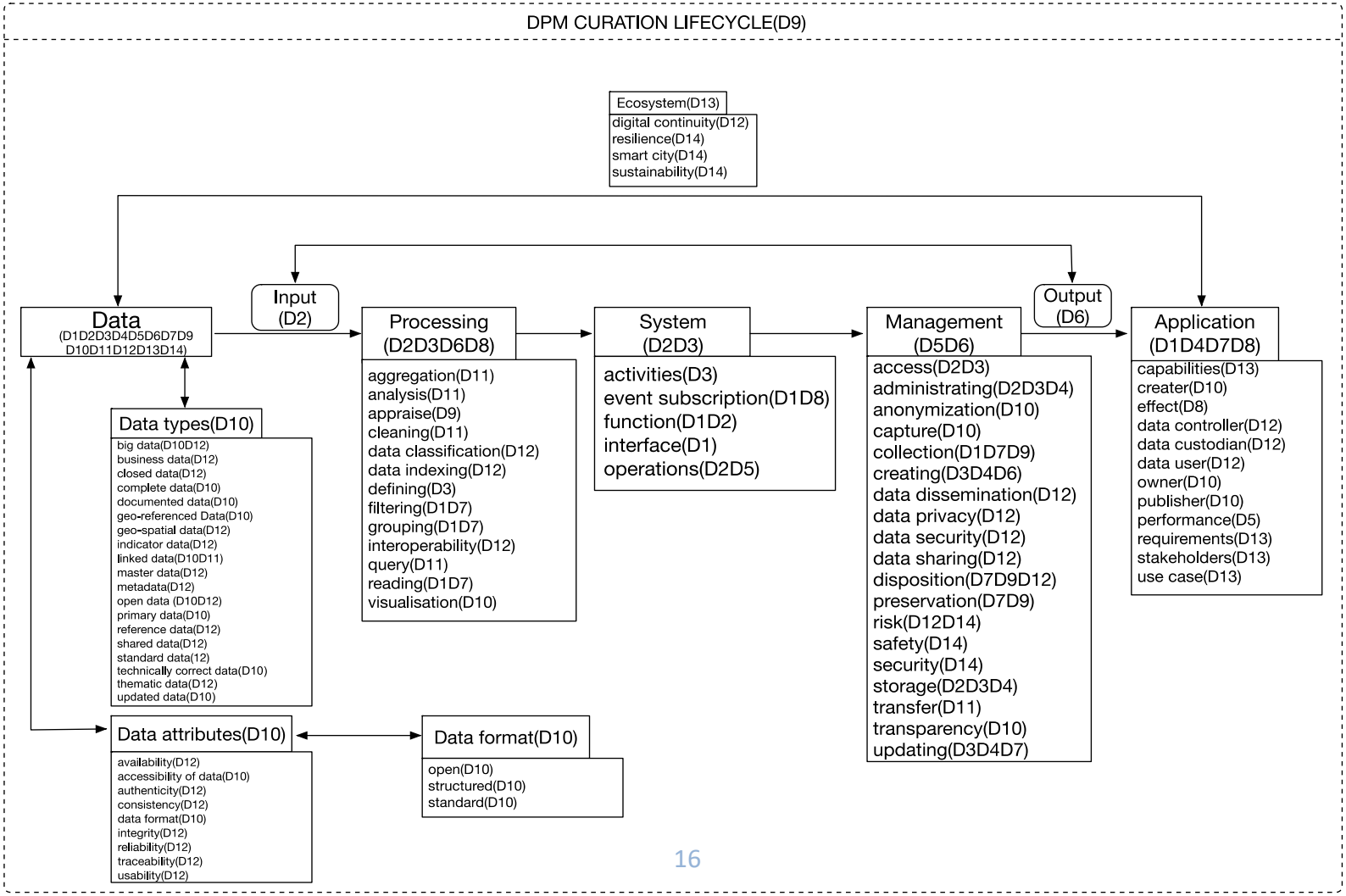
Output documents before the Tunis meeting

D0.1 (Data Processing and Management for IoT and Smart Cities and Communities: Vocabulary)

- Provides a set of core terms and associated definitions arranged in alphabetical order to reflect the basic and general concepts used in the DPM IoT and SC&C domain.
- Aims to encourage a mutual and consistent understanding of, and a coherent approach to, the activities relating to DPM, and the use of uniform terminology.

DPM Taxonomy

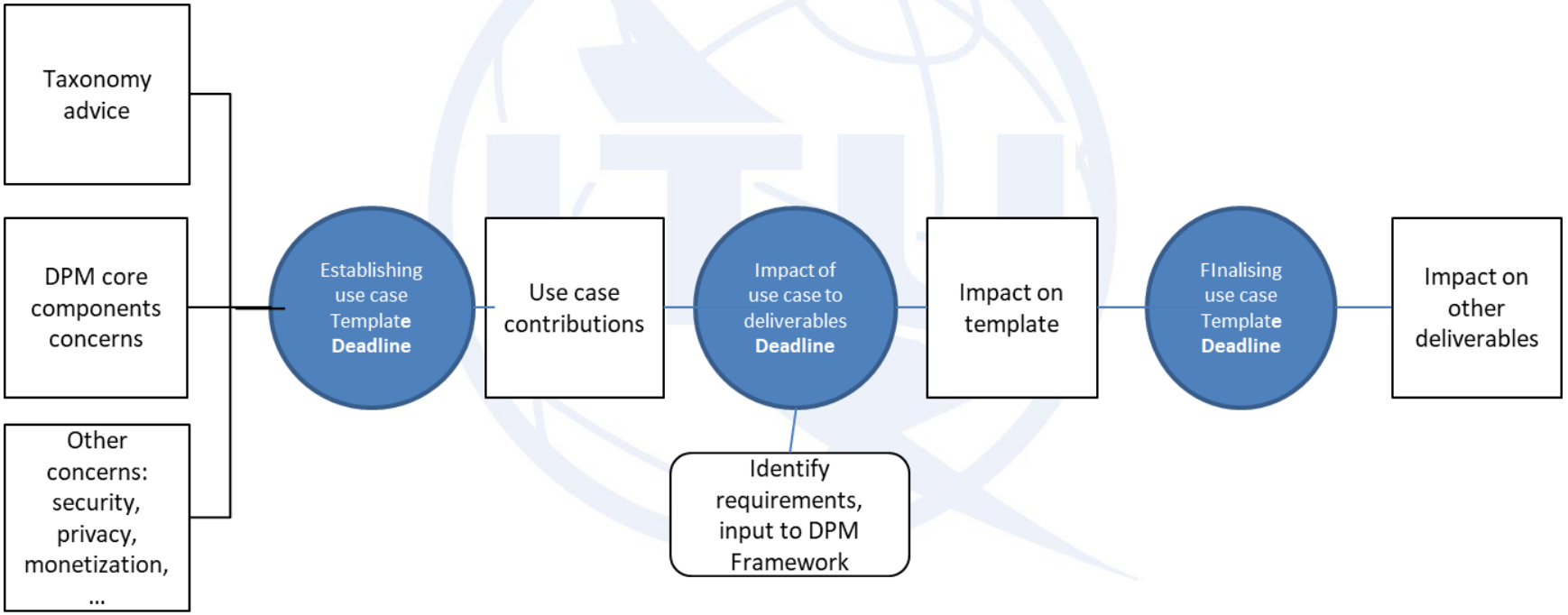
(from perspectives of data ecosystem model based on integration of digital continuity model and lifecycle model)



D1.1 (Use Cases Analysis and General Requirements for DPM)

- **Unified use case template for DPM**
  - Ecosystem
  - Scenario
  - Data characteristics, quality and formats
  - DPM capabilities considerations
  - Governance and data life cycle considerations
  - Requirements
  - Architecture considerations
- **General requirements for DPM capabilities**

Use case development process



D2.1 (Data Processing and Management Framework for Data-driven IoT and Smart Cities and Communities)

- An introduction to the principles of DPM in IoT and smart cities and communities;
- Overview of the DPM actors and business roles in IoT and smart cities and communities;
- The areas of concerns of DPM in IoT and smart cities and communities from functional and non-functional perspectives;
- A high level DPM framework in IoT and smart cities and communities from a capability perspective.

The ad-hoc team on “Global picture of DPM capabilities”

- Aims to develop a comprehensive picture of the main common DPM capabilities
- The picture is expected to
  - summarize the key macro-functionalities for the support of the use cases identified by WG1
  - be an essential input for the full development of the DPM framework study in progress within WG2
  - taking into account - as applicable and at their greatest extent – the capability-related studies progressed by WG3, WG4 and WG5

Data value chain

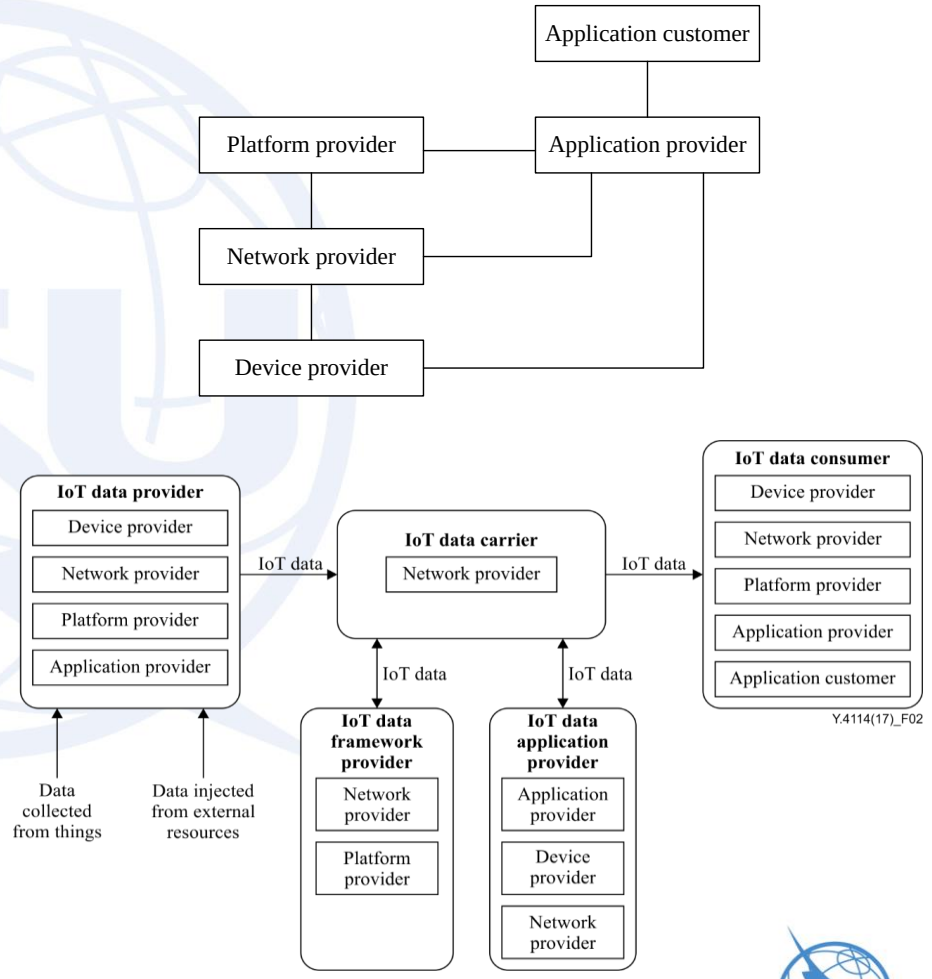
Data Core Activities

Data Support Activities

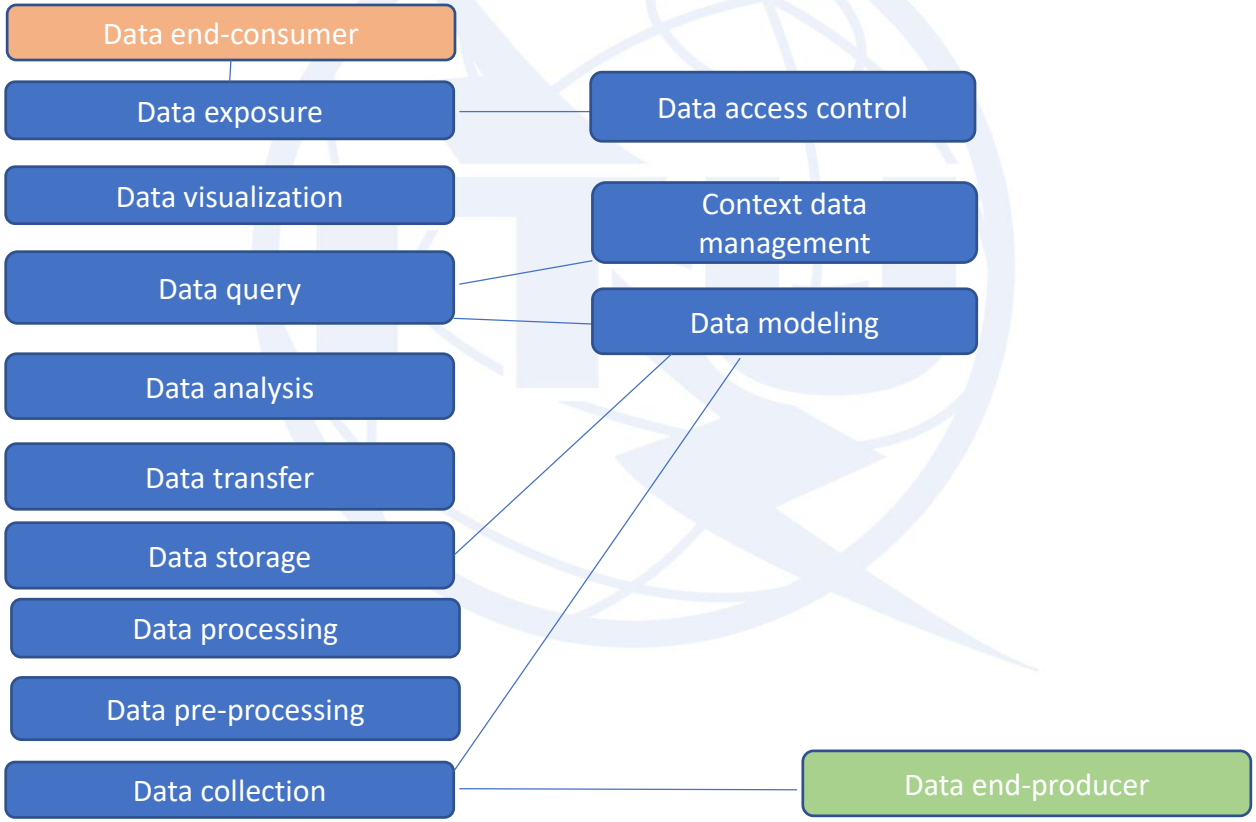
Data ecosystem

- Stakeholders: roles and actors (WG1)
  - Stakeholder roles and responsibilities
  - Stakeholder relationships

- Stakeholders (W5)
  - Data creators, collectors and aggregators
  - Advertising organizations
  - Data related services providers
  - Regulatory organizations
  - Data skills
  - SDOs



DPM capabilities global picture draft (initial figure)

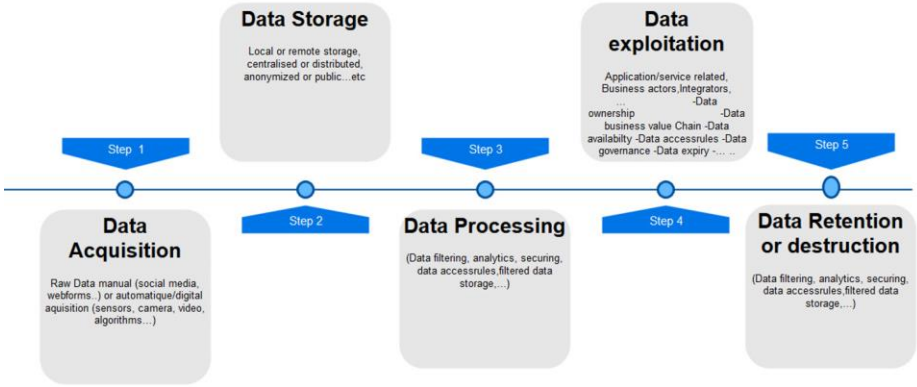


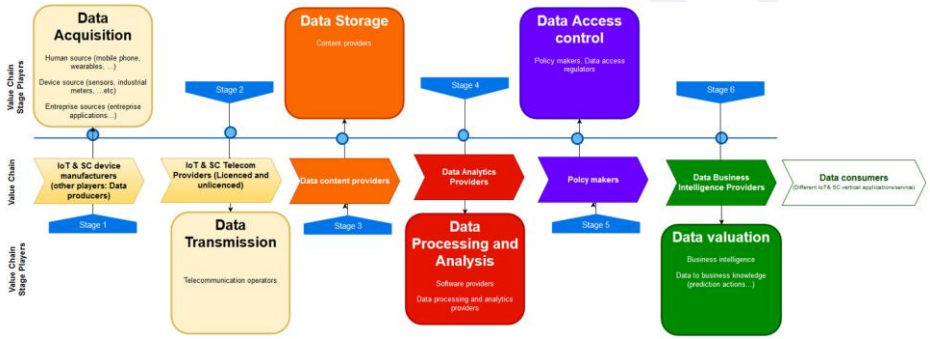
Expected contributions to D2.1

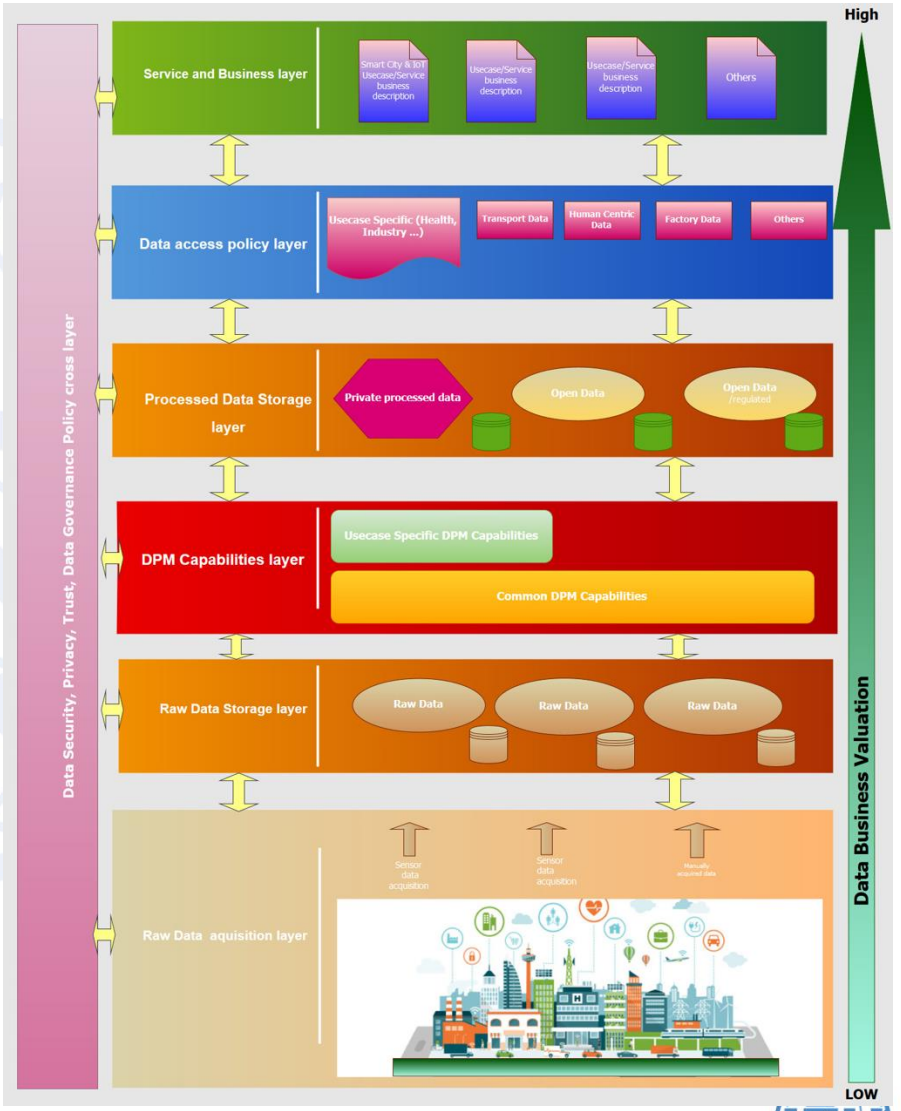
- **WG1**
  - Key concepts of DPM, DPM Taxonomy considering other WGs deliverables
  - A complete set of common DPM capabilities based on analysis on use cases and capabilities requirements, a short description of individual capability
- **WG2**
  - Design principles to DPM framework diagram and a detailed proposal on the DPM layered architecture
- **WG3**
  - A diagram and related description on open data, data interoperability and data sharing
  - Importance of Blockchain technology to support data sharing
- **WG4**
  - The diagram and related description on security, privacy, trust including governance
  - Enabling technologies for data security, data privacy, data trust
  - Importance of risk management and data governance
- **WG5**
  - A description for stakeholders and interactions among them in a DPM value chain
  - DPM impact analysis for value creating from data à provide a link with data economy

DPM Framework

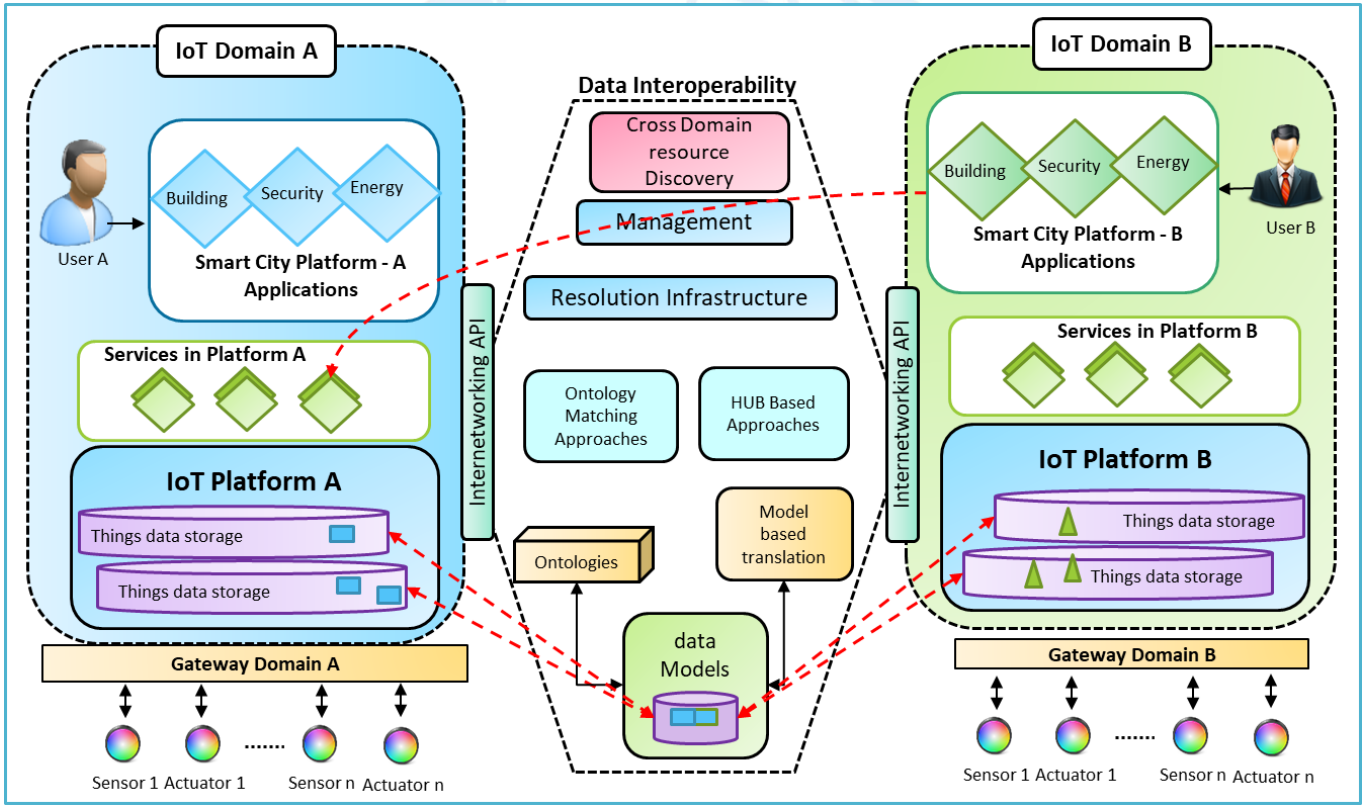
- To be discussed







D3.3 (Framework to support data interoperability in IoT environment)



D3.5, D3.6 and D3.7 (Blockchain)

D3.5 (Overview of IoT and Blockchain)	• Analysis on blockchain aspects of DPM for IoT and SC&C, including concepts, key characteristics, various models, use cases, standards, etc. • Analysis on the solutions of using blockchain as a decentralized database for IoT and SC&C • Analysis on the effects when using blockchain for IoT and SC&C, include positive and negative effects • Analysis on the roles of blockchain techniques in DPM for IoT and SC&C applications.
D3.6 (Bockchain-based Data Exchange and Sharing Technology)	• Analysis on the roles of blockchain in data exchange and sharing. • Identify the challenges for blockchain-based data exchange and sharing • The blockchain operations to support IoT data, especially for resilience, sharing, and auditable protection IoT data. • How blockchain can change the future of IoT, e.g. how blockchain can change the future of IoT, especially in relation to device identity and data integrity.
D3.7 (Using blockchain to improve data management)	• Use cases in E-Government and other aspects • Requirement analysis including service requirement and functional requirement • Blockchain-based enabler for data management • Key block chain technologies applicable for data management • Data management operation and flow

D4.1, D4.2 and D4.3 (Security, Privacy and Trust in DPM)

D4.1 (Framework of Security and Privacy in Data Processing Management)	• Defines a framework for security and privacy in data processing management for data-driven IoT and smart cities and communities.
	  • provides a description of the current framework in terms of data processing management.
	  • provides a rationale for a higher level ecosystem viewpoint for data security and privacy management in smart cities is elaborated.
	  • explains the framework and provide guidance use.

D4.2 (Privacy Management for DPM in IoT and Smart Cities)	• Provides a landscape of privacy in smart cities • Describes ecosystem and roles from a privacy management viewpoint taking into account D4.1 • Describes operational processes, taking into account D4.1 on operational principles • Specifies privacy preservation solutions in smart city applications
D4.3 (Technical Enablers for Trusted Data)	• the definition of trusted data, including its attributes and process • the requirements of technical enablers for trusted data

D4.4, D4.5 and D4.6 (Trusted data, Data governance, Risk management)

D4.4 (Data quality management for trusted data)	• data quality management to provide trusted data provisioning in ICT infrastructures and services.
	  • Data Quality Management Overview
	  • Quality of Data Assessment Overview
	  • Provisional processes for data quality management
	  • Data quality provisions for trusteed data
	  • Data quality maturity model

D4.5 (Data Governance Framework for IoT and SC&C)	• Puts up a data governance framework for deploying data governance for IoT and SC&C. • Explains how such framework can be used to ensure multidimensional stakeholders' interests and concerns about responsibilities, rights and benefits for date-related processes in IoT and SC&C.
D4.6 (Risk Management in DPM for IoT and smart cities)	• Data processing and management in Smart Cities and IoT generates uncertainty; • Risks linked to data processing and management in Smart Cities and IoT generates other risks that also must be managed and forecast. • Multiple laws and regulations already exist in specific areas/countries/on specific cybersecurity or privacy topics, private sector proposes cyber-norms, but there is still a lack of consensus; • Lack of confidence in Telco to manage the data

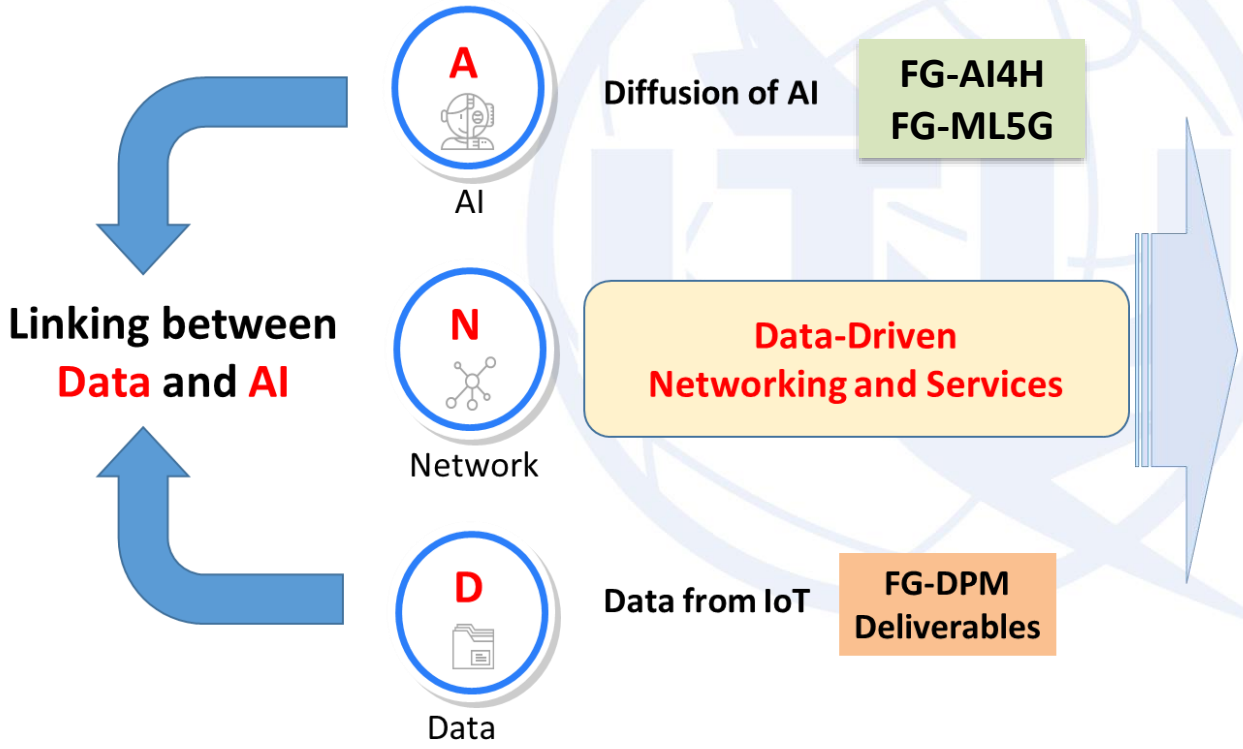
D5.1, D5.2, D5.3 and D5.4 (Data Economy Impact, Commercialization and Monetization)

D5.1 (Modeling of Data Economy for value creation and Stakeholders identification)	• Describe concepts and features for value creation in data economy models • Identify stakeholders in data economy • Analyze data value chain including stakeholders involved in data economy, monetization and commercialization
D5.2 (Business models, commercialization and monetization to support data economy)	• Analyze existing IoT and SC marketplaces for value creation • Identify roles and requirements for data monetization and commercialization considering emerging marketplaces and various data categories • Define business models for data monetization and commercialization • Provide use cases of data monetization and commercialization
D5.3 (Data economy impact assessment, policy and sustainability implications)	• Formulate an economic impact assessment framework for data • Assess drivers of impact of data processing and management on economy • Identify economic inputs, outputs, and outcomes • Identify linkages and quantification aspects for economic impact assessment • Formulate a high-level policy guidance for data economy growth and related innovation • Identify enablers of sustainability and provide related guidance
D5.4 (Data economy regulatory framework)	• Identify regulatory and legal aspects and implications for DPM

Recent Progress and Future Plans

- **Reported 1st year activities** to the SG20 May meeting
  - Approved the extension of FG-DPM lifetime
  - Two more FG-DPM meetings (March or May and July 2018)
- **Finalize Phase 1 deliverables**
  - Candidate deliverables (D1.1, D2.1 and other ones)
- Make progress for other deliverables
  - Prioritize deliverables and concentrate them
  - If necessary, merge multiple deliverables
- Promote related activities
  - Workshops, liaisons (Collaborating with other groups)

Impact of FG-DPM Deliverables



Standardization of Data-Driven ICT

- Common features, but unlimited number of solutions

- Fregmentization
- Assembling

Data-driven AIoT

DATA SOURCES

Actuators
Sensors
Devices
...
Social Media
Location

DATA PROCESSING AND MANAGEMENT

DATA COLLECTION
Filtering
Pre-processing
Storing
Ingestion

DATA DISCOVERY
Data Fusion
Enrichment
Modelling
Indexing
Annotation

AI-BASED MECHANISMS

DATA ANALYTICS
Data Semantic
Meta-data Management
Reasoning Contextual Data

DATA PROTECTION
Anonymize
Masking
Transformation
Sharing Control

DATA PUBLICATION
Publication
Open Data Sharing
Personal Data Sharing
Visualization and Report

Data Security, Privacy and Trust Management

Data Processing, Management & Analytics Infrastructure

APPLICATION-BASED ANALYTICS

Discovery and Exploration
Decision Management
COGNITIVE
Reporting and Analytics
Predictive Analytics and Modelling

AI-based DEEP Analytics

APPLICATIONS & SOURCES

Smart Home
ITS
...
Healthcare

Collection → Ingestion → Discovery & Cleansing & Integration → Simple Analysis & Publication → Application-specific Analysis → Delivery

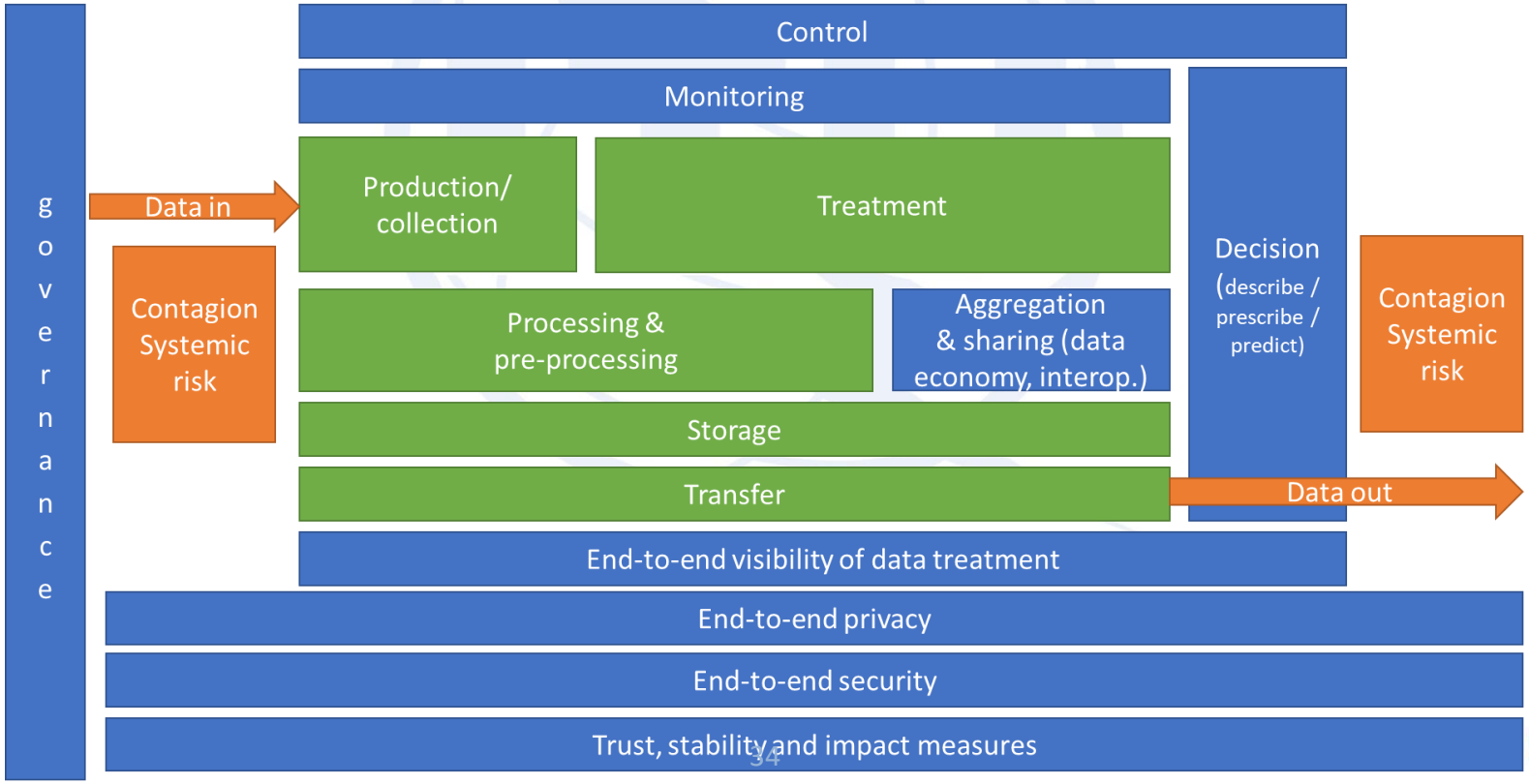
Data Security, Privay, Trust and Governance for trustworthiness in AIoT

Trustworthiness encompasses the concerns of **security, privacy, safety, reliability and resilience**, which are too often addressed separately and in isolation in risk management approaches. (NIST CPS Framework)

Trustworthiness in AIoT

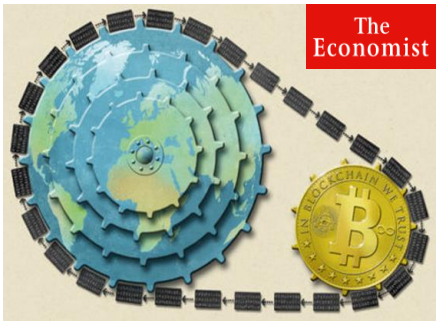
Trust is an essential element in Big Data and Analytics for **Intelligence**.

"**Trust** is the **oxygen** which will breathe life into the IoT. Industry needs to show **data** is safe and that it is properly treated." (source: www.techuk.org.)



Source: ITU-T FG-DPM Ad-hoc group (by Nathalie Feingold)

BLOCKCHAIN - Internet of Value



A machine for creating trust

- The currency in the Internet is **data**.
- Revolutionizes how transactions are recorded
  - a **decentralized digital ledger** that records transactions
  - builds **trust** with **accountability** and **transparency**

The **IoV** is as a platform of the next generation Internet that enables various types of assets to be digitalized and represented as digital value using **Blockchain**.

New Data Economy

The world's most valuable resource

Data-driven services

An intelligent nerve that facilitates the **data trading**, **data exchange** and **data management** that facilitates the **business** development, at the same time that satisfies the **regulations**

→ Build a **Data Economy Ecosystem** that offers **lawfully and GDPR compliance by default**

Concluding Remarks

- **Data is the new Oil**
  - Data of the people, by the people can be data for the people.
  - DPM is an essential element in emerging converged technologies (**IoT, Big Data, Analytics**).
- ITU-T **FG-DPM**
  - Pave the way for standardization on data ecosystem and services
  - Accelerate ITU-T SG20 activities
  - Closely collaborate with other groups in ITU and related SDOs


ITU