
ISO/IEC JTC1/SC 41 Webinar
IoT and Digital Twin
Standardization
April 26 & 28, 2022

Webinar objectives

Attendees will learn about achievements related to standardization in the areas of “Internet of Things” (IoT) and “digital twin” (DTw) technologies since the creation of SC41 five years ago.

Consideration will be given to emergent trends and the future work program in relation to these technologies and some of their applications.

Post-webinar publications

The following material will be available after the webinar:

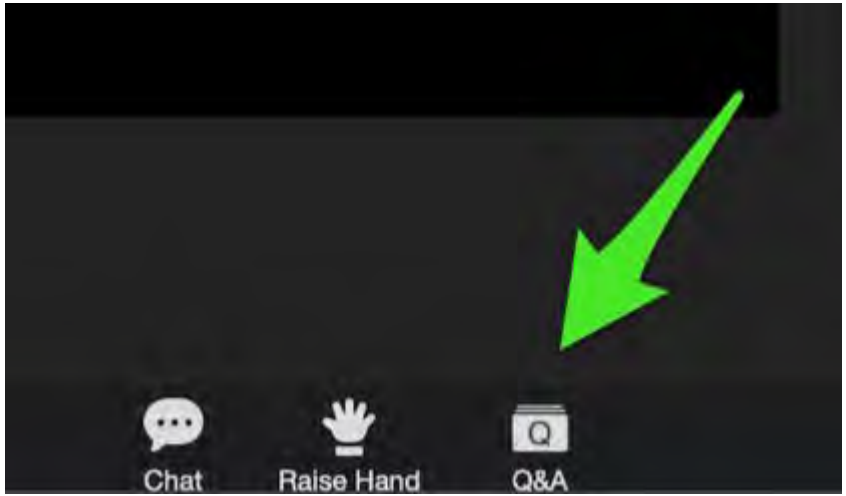
- Presentation material
- Recording
- Edited Q&A

Registered participants will be notified once the material is available.

Questions and answer

Please use the Zoom feature for all your questions.

The webinar program committee and presenters will try to answer your questions asynchronously during the webinar using this Zoom feature.



Program - day 1

12.00-12.15 UTC	Introduction : Dr. François Coallier, ISO/IEC JTC1/SC41 Chair Mr. Philip Wennblom, ISO/IEC JTC1 Chair
12.15-12.35 UTC	IoT and Digital Twin standardization strategy in JTC 1/SC41 Dr. François Coallier, ISO/IEC JTC1/SC41 Chair
12.40-13.00 UTC	IoT Reference Architecture (RA) 2.0 Ms. Erin Bournival, Convener of JTC 1/SC41 WG3 Mr. Eric Simmon, IoT RA Lead Architect Mr. Östen Franberg, IoT RA co-editor

Program - day 1

13.05-13.25 UTC	IoT Interoperability Standardization Dr. Quan Wang, Convener of JTC 1/SC41 WG4 Mr. Antonio Kung Dr. Lan Yamashita
13.30-13.50 UTC	Industrial IoT Standardization Mr. Detlef Tenhagen, Convener of JTC 1/SC41 AG20
13.55 -14.40 UTC	Panel on IoT Trustworthiness Chair: Ms. Erin Bournival, Convener of JTC 1/SC41 WG3 Convener Panelists: Mr. François Coallier, Mr. Antonio Kung, Mr. Asahiko Yamada
14.40 -14.45 UTC	Wrap up

Program - day 2

12.00-12.15 UTC	Introduction : François Coallier (ISO/IEC JTC1/SC41 Chair)
12.15-12.35 UTC	Highlights from the September 2021 SC41 Digital Twin Workshop Dr. Sha Wei, Convener of JTC 1/SC41 WG6
12.40-13.00 UTC	City Information Modelling and Urban Digital Twins Dr. Chunlan Guo, IEC SyC Smart Cities expert
13.05-13.25 UTC	Maritime IoT and Digital Twin Dr. Soo Hyun Park, Convener of JTC 1/SC41 WG7

Program - day 2

13.30-13.50 UTC	IoT and Digital Twin in the Energy Sector Mr. Laurent Guise, IEC SyC Smart Energy and IEC/TC57 Expert, IEC SG12 MG co-convenor
13.55 -14.40 UTC	Closing Panel on IoT Applications and Domain Standards Chair: Dr. Yongjin Kim – Convener of SC41/WG5 Panelists: Dr. Howard Choe, Dr. Kate Grant, Dr. Mingjuan Wu and Mr. Yong-Woon Kim.
14.40 -14.45 UTC	Closure

Introducing ISO/IEC JTC 1

JTC 1/SC41 Webinar on
IoT and Digital Twin standardization
2022-04-26 & 28

Phil Wennblom
ISO/IEC JTC 1 Chair

About JTC 1

- Joint Technical Committee of IEC and ISO
  - “Standardization in the field of Information Technology”
  - Consistent IT deliverables across IEC and ISO
  - Building blocks for global markets that respond to the needs of businesses, consumers, governments, other organizations
- 35 P-members and 65 O-members
- Organized in 23 Subcommittees and 4 JTC 1 Working Groups
- More than 4500 active participants currently developing around 600 standards; more than 3200 published

Technical Areas

- Coded character sets
- Telecommunications and information exchange between systems
- Software and systems engineering
- Cards and security devices for personal identification
- Programming languages
- Digitally recorded media
- Computer graphics, image processing
- Interconnection of IT equipment (home electronics)
- IT security techniques
- Office equipment (printing)
- Coding of audio, picture, multimedia (JPEG, MPEG)
- Automatic ID and data capture (RFID)
- Data management
- Document description, processing
- User interfaces
- IT for learning, education, training
- Biometrics
- Cloud computing
- IT Sustainability
- IT governance
- Internet of Things and Digital Twin
- Artificial Intelligence
- Brain-Computer Interface
- Smart cities
- 3D printing and scanning
- Trustworthiness
- Quantum Computing

JTC 1 Focus

- Horizontal by design, JTC 1 develops information technology standards that are applicable across domains
  - Emphasis on initiating new areas of work at the right time, delivering high quality standards that respond to market trends
  - Track record of acceptance by global markets
- JTC 1 works together with other IEC and ISO TCs and other organizations that are utilizing information technology to develop domain-specific standards
  - More than 400 liaisons (JTC 1 and its SCs)
  - Emphasis on effective cooperation/collaboration

Cooperation/Collaboration

- JTC 1 committees take a Systems Integration approach: developing broadly applicable foundational standards and collaborating with domain specific committees
- Liaisons with European Commission, Ecma, ITU-T
- Program for collaboration with consortia
  - JTC 1 Publicly Available Specification (PAS) process allows qualified consortia to apply for the opportunity to have widely implemented specifications become adopted as ISO/IEC standards, and to cooperate with JTC 1
  - Currently 15 approved PAS submitters, more than 240 international standards published
- IEEE agreements with ISO and IEC allow IEEE standards within the scope of JTC 1 to be considered for approval as ISO/IEC standards
  - IEEE 802.3 (Ethernet) and IEEE 802.11 (WiFi) are examples

Join Us

- JTC 1 welcomes your participation, your collaboration, and your cooperation
- Interested delegates and experts are encouraged to contact their national body or national committee to become engaged
- ISO and IEC Committees are welcome to establish liaisons with JTC 1 and its subcommittees
- Consortia are encouraged to contact the JTC1 PAS mentor team lead, Norbert Bensalem


Smart society
Smart healthcare
Smart transport
Smart territory improvement
Smart payments
Smart buildings
Smart energy
Thank You!
https://www.iot-now.com/2017/09/25/67259-everything-can-smart-key-traits-newest-smart-cities-part-1/

IoT and Digital Twin standardization strategy in JTC 1/SC 41

v 1.0

JTC 1/ SC 41 Webinar on
IoT and Digital Twin standardization
2022-04-26 & 28

François Coallier
Chair, JTC 1/SC 41
francois.coallier@etsmtl.ca

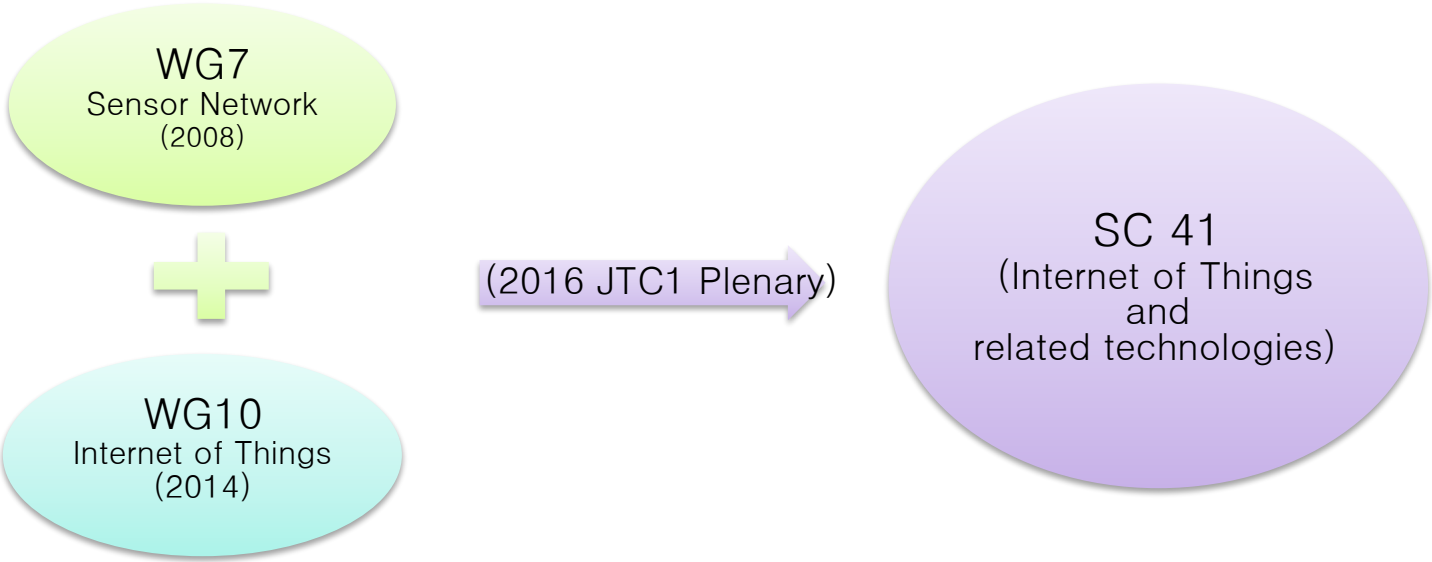
Table of content

- History and mandate
- IoT and Digital Twin concepts
- Strategic considerations
- Strategic directions
- Status
- Future directions
- Annexes: Work Program status and future plenaries

SC 41 establishment - Nov 2016

Resolution 12 – Establishment of JTC 1 Subcommittee SC 41, Internet of Things and related technologies

JTC 1 establishes a Systems Integration entity (see SD 24, Systems Integration Standardization Guidelines) in the form of a new Subcommittee 41 on Internet of Things and related technologies initially comprising the work of JTC 1/WG 7 and JTC 1/WG 10.



November 2020 - addition of Digital Twin

Title: Internet of Things and Digital Twin

Scope:

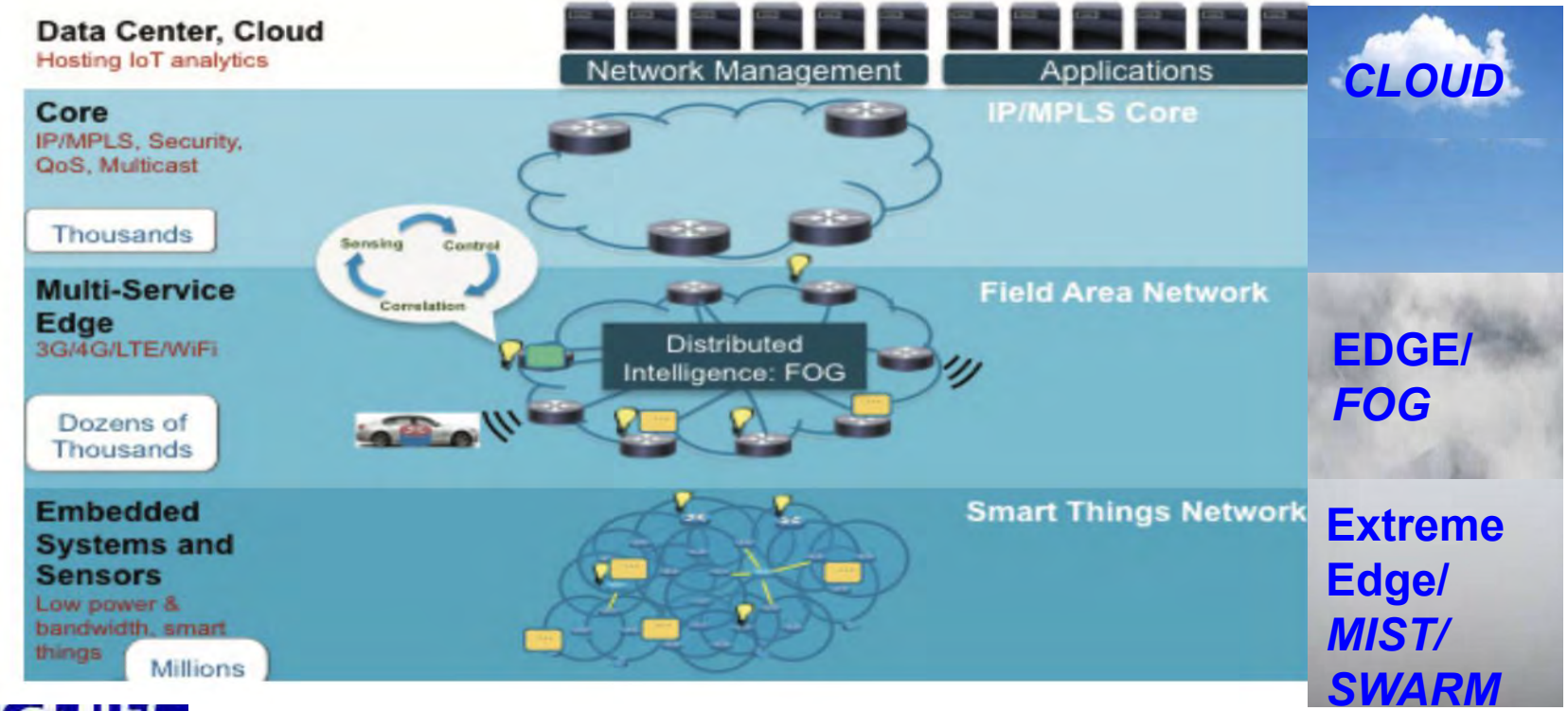
Standardization in the area of Internet of Things and Digital Twin, including their related technologies.

1. Serve as the focus and proponent for JTC 1's standardization programme on the Internet of Things and Digital Twin, including their related technologies.
2. Provide guidance to JTC 1, IEC, ISO and other entities developing Internet of Things and Digital Twin related applications.

About the Internet of Things (IoT)

- The IoT is a system concept that use many technologies that are standardized by other JTC 1 entities and SDOs ranging from networking and Digital Twin to cloud computing and AI.
- IoT systems are software and data intensive as well as network-centric. They can be quite complex, ranging from simple architecture to multi-tier distributed computing cyberphysical systems.
- IoT systems are key enablers of 'Smart Everything'

A Distributed and Network centric System or System of Systems



Modified from: *Fog Computing and Its Role in the Internet of Things*, Flavio Bonomi, Rodolfo Milito, Jiang Zhu, Sateesh Addepalli, Cisco Systems Inc.

IoT enable ‘Smarts’

SC41

https://www.facebook.com/see40/

SMART
EVERYTHING
EVERYWHERE

https://www.iot-now.com/2017/09/25672/59-everything-can-smart-key-trails-newest-smart-cities-part-1/

ISO JTC1 IEC
INFORMATION TECHNOLOGY STANDARDS

About Digital Twin (DTw)

According to Gartner and Deloitte, a digital twin as a digital representation of a real-world entity or system. It is an evolving digital profile of the historical and current behavior of a physical object or process.

The implementation of a digital twin is an encapsulated software object or model that mirrors a unique physical object, process, organization, person or other abstraction. The digital twin is thus based on massive, cumulative, real-time, real-world data measurements across an array of dimensions.

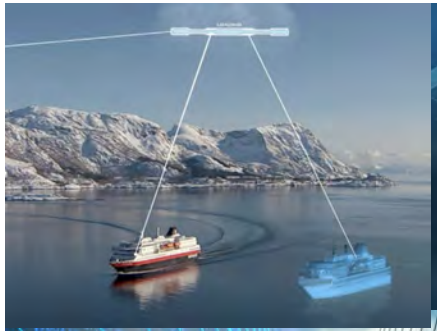
Data from multiple digital twins can be aggregated for a composite view across a number of real-world entities, such as a ship, a bridge, a building, a factory, a supply-chain or a city.

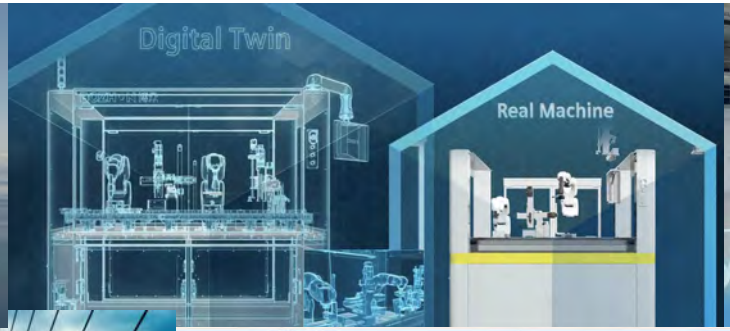
About Digital Twin (DTw)

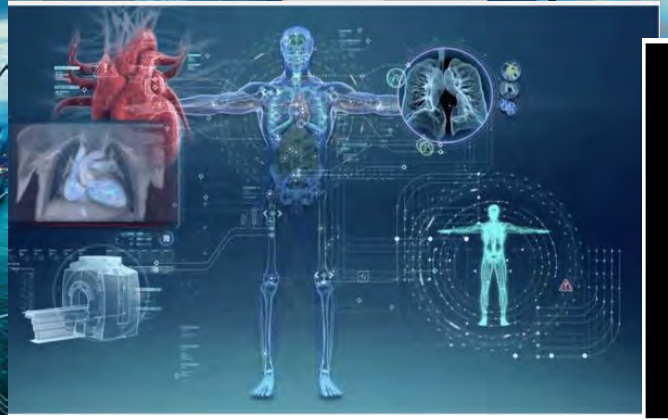
Mirroring is done through synchronization using data streams. The data streams are generated by sensors, but also transactions and other sources (virtual sensors).

Digital Twin (DT) is an enabler Smart Everything, being based on measurements that creates an evolving profile of the entity or system in the digital world, it provides important insights on system performance, leading to actions in the real world such as a change in system and process design, or optimizing business performance.

Digital Twin Horizontality





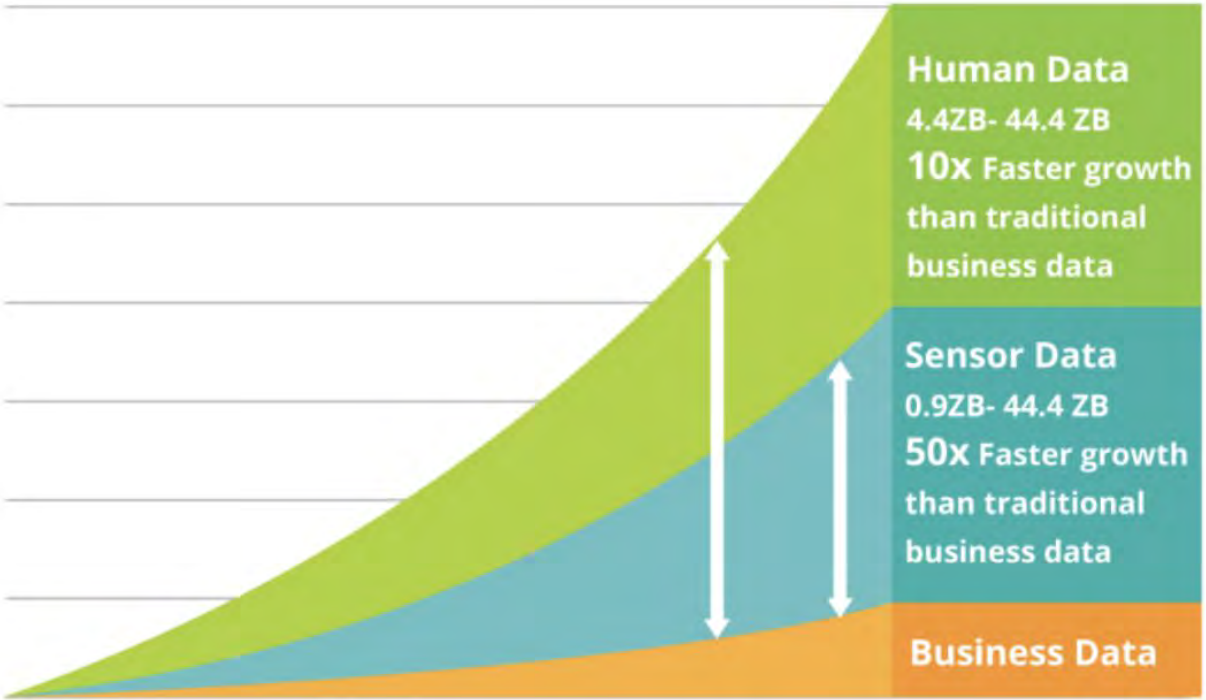


At 1-kilometer resolution, a European climate model (left) is nearly indistinguishable from reality (right). (LEFT TO RIGHT)
ECMWF; © EUMETSAT

https://www.plm.automation.siemens.com/global/cz/webinar/digital-twin-in-manufacturing/68561
https://medium.com/@yashbajaj900/digital-twin-application-in-healthcare-69bf4c0f87e7
https://www.cadalyst.com/collaboration/digital-twin/road-and-bridge-digital-twins-action-four-case-studies-75827
https://www.sciencemag.org/news/2020/10/europe-building-digital-twin-earth-revolutionize-climate-forecasts
https://safety4sea.com/cm-the-digital-twin-concept-explained/

DTw and IoT systems are data driven

https://www.business2community.com/big-data/iot-big-data-ai-new-superpowers-digital-universe-01926411



Source: Inside big data

‘Technologies’ found in IoT and DTw systems

- IoT and DTw architectures (JTC 1/SC 41)
- Sensors, actuators, tags (IEC/TC 72, JTC 1/SC 31,..)
- Networks… (JTC 1/SC 6, IEC/SEG 8, ITU-T,..)
- Cloud computing (JTC 1/SC 38)
- Big Data (JTC 1/SC 42)
- AI (JTC 1/SC42)
- Cybersecurity (JTC 1/SC 27)
- Software and Systems Engineering (JTC 1/SC7)
- ….

Double ‘horizontality’

Therefore, JTC 1/SC41 can be considered as being double ‘horizontal’ bure gard to:

- technologies used in IoT and DTw systems
- application domains or sectors

Strategic Approaches

http://www.nonprofituniversityblog.org/2011/05/strategic-planning-the-right-way/

Strategic Approaches

- Concentrate on foundational standards: vocabularies, reference architectures, interoperability, trustworthiness
- Systematically collect use cases across all application domains to elicit and document standardization requirements
- Have an ‘incubator’ to kick-start domains or sectors applications and cover ‘dead-angles’

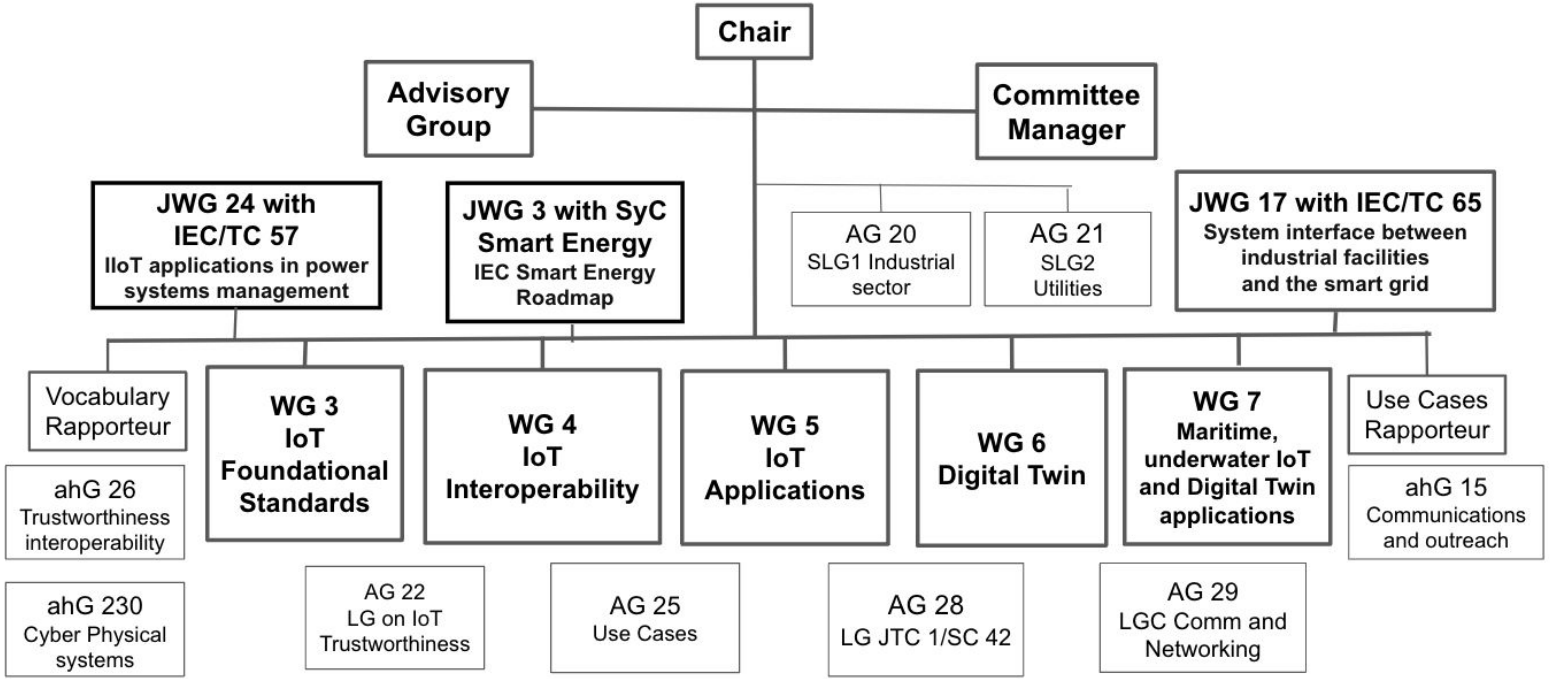
Strategic Approaches

- Coordinate and partner as required with ISO, IEC and JTC 1 entities as well as other Standards Development Organizations (SDOs) that have the mandate and resources to develop standards for technologies used in IoT and DTw systems.
- Coordinate and partner as required with ISO and IEC entities that mandate and resources to develop standards that use IoT and DTw in specific application domains or sectors.

Current Status

SC 41 Structure (November 2021)

ANNEX A



Future directions

- Develop foundational standards for Digital Twins (-> more details at the April 28 session)
- Carry on with the development and update of IoT foundational standards (-> more details in the next presentations)
- Continue to develop cooperation and partnership with the application domains and sectors (-> examples at the April 28 session)
- Explore further cooperations with SDOs


Smart society
Smart healthcare
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Smart territory improvement
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Smart energy
Thank You!
https://www.iot-now.com/2017/09/25/67259-everything-can-smart-key-trai
ts-newest-smart-cities-part-1/

ANNEXES

Annex A
SC41 Work Program Status as of 2022-04

Published Standards - 1

Reference	Title	Year
ISO/IEC 30141	Internet of Things (IoT) - Reference architecture	2018
ISO/IEC 20924 ED2	Internet of Things (IoT) – Vocabulary	2021
ISO/IEC 21823-1	Internet of Things (IoT) - Interoperability for IoT systems - Part 1: Framework	2019
ISO/IEC 21823-2	Internet of Things (IoT) - Interoperability for IoT systems - Part 2: Transport interoperability	2020
ISO/IEC 21823-3	Internet of Things (IoT) - Interoperability for IoT systems - Part 3: Semantic interoperability	2021
ISO/IEC 21823-4	Internet of Things (IoT) - Interoperability for IoT systems - Part 4: Syntactic interoperability	2022
ISO/IEC TR 22417	Information technology - Internet of things (IoT) - IoT use cases	2017
ISO/IEC 29182-1	Information technology - Sensor networks: Sensor Network Reference Architecture (SNRA) - Part 1: General overview and requirements	2013
ISO/IEC 29182-2	Information technology - Sensor networks: Sensor Network Reference Architecture (SNRA) - Part 2: Vocabulary and terminology	2013
ISO/IEC 29182-3	Information technology - Sensor networks: Sensor Network Reference Architecture (SNRA) - Part 3: Reference architecture views	2014
ISO/IEC 29182-4	Information technology - Sensor networks: Sensor Network Reference Architecture (SNRA) - Part 4: Entity models	2013
ISO/IEC 29182-5	Information technology - Sensor networks: Sensor Network Reference Architecture (SNRA) - Part 5: Interface definitions	2013
ISO/IEC 29182-6	Information technology - Sensor networks: Sensor Network Reference Architecture (SNRA) - Part 6: Applications	2014
ISO/IEC 29182-7	Information technology - Sensor networks: Sensor Network Reference Architecture (SNRA) - Part 7: Interoperability guidelines	2015
ISO/IEC 19637	Information technology - Sensor network testing framework	2016

Published Standards - 2

Reference	Title	Year
ISO/IEC 30140-1	Information technology - Underwater acoustic sensor network (UWASN) - Part 1: Overview and requirements	2018
ISO/IEC 30140-2	Information technology - Underwater acoustic sensor network (UWASN) - Part 2: Reference architecture	2017
ISO/IEC 30140-3	Information technology - Underwater Acoustic Sensor Network (UWASN) – Part 3: Entities and interfaces	2018
ISO/IEC 30140-4	Information technology – Underwater Acoustic Sensor Network (UWASN) - Part 4: Interoperability	2018
ISO/IEC 30101	Information technology -- Sensor networks: Sensor network and its interfaces for smart grid system	2014
ISO/IEC 30128	Information technology -- Sensor networks -- Generic Sensor Network Application Interface	2014
ISO/IEC 20005	Information technology - Sensor networks - Services and interfaces supporting collaborative information processing in intelligent sensor networks	2013
ISO/IEC TR 22560	Information technology - Sensor network - Guidelines for design in the aeronautics industry: Active air-flow control	2017
ISO/IEC TR 30148	Internet of things (IoT) - Application of sensor network for wireless gas meters	2019
ISO/IEC 30142	Internet of Things (IoT) - Underwater acoustic sensor network (UWASN) - Network management system overview and requirements	2020
ISO/IEC 30143	Internet of Things (IoT) - Underwater acoustic sensor network (UWASN) - Application profiles	2020
ISO/IEC 30144	Internet of Things (IoT) - Wireless sensor network system supporting electrical power substation	2020

Published Standards - 3

Reference	Title	Year
ISO/IEC 30147	Internet of Things (IoT) - Integration of IoT trustworthiness activities in ISO/IEC/IEEE 15288 system engineering processes	2021
ISO/IEC 30161-1	Internet of things (IoT) - Data exchange platform for IoT services - Part 1: General requirements and architecture	2020
ISO/IEC 30163	Internet of Things (IoT) - System requirements of IoT and sensor network technology-based integrated platform for chattel asset monitoring	2021
ISO/IEC 30165	Internet of Things (IoT) — Real-time IoT framework	2021
ISO/IEC TR 30164	Internet of Things (IoT) - Edge computing	2020
ISO/IEC TR 30166	Internet of Things (IoT) - Industrial IoT	2020
ISO/IEC TR 30167	Internet of Things (IoT) - Underwater Communication Technologies for IoT	2021
ISO/IEC TR 30174	Internet of Things (IoT) - Socialized IoT system resembling human social interaction dynamics	2021
ISO/IEC TR 30176	Internet of Things (IoT) - Integration of IoT and DLT/blockchain: Use cases	2021
ISO/IEC 30162	Internet of Things (IoT) - Compatibility requirements and model for devices within Industrial IoT systems	2022
ISO/IEC 30171-1	Internet of Things (IoT) - Base-station based underwater wireless acoustic network (B-UWAN) - Part 1: Overview and requirements	2022

SC 41 Subgroups

Groups	Main Role
WG 3 (IoT Foundational Standards)	IoT foundational standards including IoT and Digital Twin vocabulary
WG 4 (IoT Interoperability)	IoT interoperability, connectivity, IoT platform, middleware, conformance and testing
WG 5 (IoT Applications)	IoT applications, Uses Cases, tools, and implementation guidance
WG 6 (Digital Twin)	Standardization in the area of Digital Twin
WG 7 (Maritime, Underwater IoT and Digital Twin Applications)	Standardization in the applications of Internet of maritime, underwater and inland waterways things, digital twin and related technologies
JWG 24 (Joint WG with IEC TC 57)	IIoT and digital twin applications in power systems management ※ IEC TC65: Power systems management and associated information exchange
JWG 17 (Joint WG with IEC TC 65)	System interface between industrial facilities and the smart grid ※ IEC TC65: Industrial-process measurement, control and automation
JWG 3 (Joint WG with IEC SyC Smart Energy)	IEC Smart Energy Roadmap ※ IEC SyC SE: Provide systems level standardization, coordination and guidance in the areas of Smart Grid and Smart Energy.

SC 41 Subgroups

Groups	Main Role
AG 20 (SLG on Industrial sector)	Coordinate liaisons activities between all SDO's, internal and external, in the Industrial sector and SC41
AG 21 (SLG on Smart Cities and Utilities)	Coordinate liaisons activities between all SDO's, internal and external, for sectors associated with Smart Cities, utilities and other 'smart' infrastructure and SC 41
AG 22 (LCG on IoT Trustworthiness)	Encourage and assist SC27 to maintain compatibility between their standards and JTC 1/SC41 standards
AG 25 (AG on Use cases)	To identify IoT and Digital Twin use cases and populate the use case template (SC41N0962) with specific information on each use case, and explore how they relate to SC 41's current and potential future work.
AG 28 (AG on JTC 1/SC 42 Liaison Group)	Advise its liaison officers on approach towards the liaison
AG 29 (LCG on Communication and Networking)	To manage the relationship and the liaisons with the following organizations in the area of IoT related communications and networking technologies

SC 41 Subgroups

Groups	Main Role
AHG 14 (Business Plan)	Update and report the SC 41 business plan to the JTC 1 Plenary.
AHG 15 (Communication and Outreach)	Create and maintain the SC 41 Wikipedia pages. Maintain the SC 41 Linked-in site. Create a public repository for outreach materials.
AHG 30 (Cyber physical systems)	Attain a common understanding on CPS concepts Undertake liaison actions with JTC 1 entities considering cyber physical systems. Investigate whether the resulting text can be structured for integration in SMART standards

WG 3 Mission

IoT Foundational Standards

Development of IoT foundational standards, including IoT and Digital Twin vocabulary.

WG 3 Products

Standard	Title	Status	Abstract
ISO/IEC 30141	Internet of Things (IoT) - Reference architecture	Ed 2 CD	This document specifies a general IoT Reference Architecture in terms of defining system characteristics, a Conceptual Model, a Reference Model and architecture views for IoT.
ISO/IEC 20924	Internet of Things (IoT) and Digital Twin - Vocabulary	Ed 3 WD	This document provides a definition of Internet of Things and Digital Twin, along with a set of terms and definitions. This document is a terminology foundation for the Internet of Things and Digital Twin.
ISO/IEC 30149	Internet of Things (IoT) — Trustworthiness principles	Ed 1 CD	This document provides principles for IoT trustworthiness based on ISO/IEC 30141 Internet of Things (IoT) - Reference architecture.
ISO/IEC TS 30168	Internet of Things (IoT) - Generic Trust Anchor Application Programming Interface for Industrial IoT Devices	Ed1 CD	Specification of a generic programming interface for the integration of secure elements within Industrial IoT devices. This includes requirements from industrial usage scenarios and applications. This document also provides guidance for implementation, testing, and conformity validation.

WG 4 Mission

Interoperability

Standardization in the area of IoT interoperability, connectivity, IoT platform, middleware, conformance and testing.

WG 4 Products

Standard	Title	Status	Abstract
ISO/IEC 30178	Internet of Things (IoT) - Data format, value and coding	Ed 1 WD	Define a common formats value and coding for Internet of Things (IoT)
ISO/IEC 30161-2	Internet of Things (IoT) – Data exchange platform for IoT services – Part 2: Transport interoperability between nodal points	Ed 1 CDV	This document specifies the following items for the transport interoperability among nodal points in the IoT data exchange platform (IoT DEP). - Requirements - Functional blocks - Operation mechanism
PNW JTC1-SC41-262	Internet of Things (IoT) – Functional architecture for resource ID interoperability	Ed 1 NP	
PWI JTC1-SC41-8	Internet of Things (IoT) - Behavioral and policy interoperability	Ed 1 PWI	-

WG 5 Mission

IoT Applications

Standardization in the area of IoT applications, Uses Cases, tools, and implementation guidance

WG 5 Products

Standard	Title	Status	Abstract
ISO/IEC 30169	Internet of things (IoT) - IoT applications for electronic label system (ELS)	Ed 1 FDIS	This document specifies the system framework, IoT application model and overall technical requirements for ELS. This document applies to the design and development of the IoT applications for ELS.
ISO/IEC 30179	Internet of Things (IoT) – Overview and general requirements of IoT system for ecological environment monitoring	Ed 1 CDV	This document specifies the Internet of Things system for ecological environment monitoring in the following: - System infrastructure and system entities of the IoT system for ecological environment monitoring for natural entities such as air, water, soil, living creatures - The general requirements of the IoT system for ecological environment monitoring.
ISO/IEC 30180	Internet of Things (IoT) - Functional requirements to figure out the status of self-quarantine through Internet of Things data interfaces	Ed 1 WD	This document specifies the functional requirements to figure out the status of self-quarantine through IoT data interfaces working over a set of hand-held devices, wristbands, and a management system.

WG 6 Mission

Digital Twin

Standardization in the area of Digital Twin

WG 6 Products

Standard	Title	Status	Abstract
ISO/IEC 30173	Digital twin - Concepts and terminology	Ed 1 CD	This document establishes terminology for Digital Twin (DT) and describes concepts in the field of Digital Twin, including the terms and definitions of Digital Twin, concepts of Digital Twin (e.g., Digital Twin ecosystem, lifecycle process for Digital Twin, and classifications of Digital Twin), Functional view of Digital Twin and Digital Twin stakeholders.
ISO/IEC TR 30172	Digital twin - Use cases	Ed 1 CD	This document provides a collection of representative use cases of DT applications in a variety of domains.
PWI JTC1-SC41-5	Digital Twin - Reference Architecture	Ed 1 PWI	
PWI JTC1-SC41-6	Guidance for IoT and Digital Twin use cases	Ed 1 PWI	
PWI JTC1-SC41-7	Digital Twin – Maturity model	Ed 1 PWI	

WG 7 Mission

Maritime, underwater IoT and Digital Twin Applications

Standardization in the application of Internet of maritime, underwater and inland waterways things, digital twin and related technologies

WG 7 Products

Standard	Title	Status	Abstract
ISO/IEC 30142-2	Internet of Things (IoT) - Underwater acoustic sensor network (UWASN) - Network management system - Part 2: Underwater management information base (u-MIB)	Ed 1 FDIS	This document provides the underwater management information base (u-MIB) of an underwater network management system (U-NMS). It specifies the following: – general requirements for constructing u-MIB in U-NMS; – defining the managed objects of the manager and agent u-MIB; – integrating the managed objects of the manager and agent u-MIB
ISO/IEC 30177	Internet of Things (IoT) - Underwater network management system (U-NMS) interworking	Ed 1 WD	The present document specifies the detail information about interworking components in Underwater Network Management System (U-NMS). It provides the following - The intra-working of U-NMS components. - The interworking between terrestrial domain and surface domain - The interworking between surface domain and underwater domain. - The interworking in underwater domain.
PNW JTC1-SC41-263	Internet of Things (IoT) – Addressing interoperability guidelines between heterogeneous underwater sensor networks (UWASNs) based on underwater delay and disruption tolerant network (U-DTN)	Ed1 NP	This document provides addressing interoperability guidelines between heterogeneous underwater acoustic sensor networks (UWASNs) based on underwater delay and disruption tolerant network (UDTN): - Architecture for heterogeneous UWASNs interworking; - U-DTN functions on heterogeneous UWASNs interworking; - Addressing interoperability guidelines between heterogeneous UWASNs.

Joint Working Groups (JWG)

JWG 17 with IEC TC 65 (Industrial-process measurement, control and automation)

System interface between industrial facilities and the smart grid

This work will identify, profile and extend where needed, the standards needed to allow industrial facilities, and the industrial automation systems within such industrial facilities, to communicate with the smart grid for the purpose of planning, negotiating, and managing the flow of electrical power and related information between them.

Joint Working Groups (JWG)

JWG 24 with IEC TC 57 (Power systems management and associated information exchange)

IIoT and digital twin applications in power systems management

To develop Industrial Internet of Thing (IIoT) and digital twin standards for applications in power distribution systems management

Joint Working Groups (JWG)

JWG 3 with IEC SyC Smart Energy

IEC Smart Energy Roadmap

Map the main Use Cases over the relevant systems architectures within the Smart Energy domain. This includes:
- Provide guidelines in offering standard users ways to select a most appropriate set of standards/specifications (either existing or coming, from IEC but possibly coming from other bodies) fulfilling the set of Use Cases. This includes the breakdown of Smart Energy scope into typical systems and system architectures.
- Work with ISO/IEC JTC1 SC41 to introduce IoT and digital twin concepts into the smart energy domain and co-ordinate their integration into Smart Energy standardisation
- Identify and rank possible standard gaps/overlaps/recommendations
- Feed the IEC Smart Energy mapping tool with the above findings

Annex B
Future Plenary Meetings

Future Plenary Meetings

- 2022 May 30 to June 10: Virtual
- 2022 November 28 to December 2: Germany (Confirmed)
- 2023 (May): USA (To be confirmed)
- 2023 (November): China (To be confirmed)
- 2024 (May): Finland (To be confirmed)

ISO/IEC SC41/WG3

30141 Foundational IoT Reference Architecture Edition 2

ISO/IEC JTC1 SC41

2022-04-26

International Electrotechnical Commission

Agenda

- Introductions
- IoT Foundational Standards (SC41 WG3)
- Industry Changes
- Moving from Knowledge to Wisdom
- Benchmark to Foundational Reference Architectures
- ISO/IEC 30141 Edition 2

Erin Bournival

Distinguished Engineer
Dell Technologies
United States

- **Convenor, ISO/IEC JTC1 SC41 WG3**
- **Chair, Industry IoT Consortium (IIC) Healthcare/Standards/Liaison/Vocabulary**
- **Chair, Digital Twin Consortium Healthcare/Life Sciences**
- **Vice Chair and Secretary, INCITS IoT (US mirror to SC41)**
- **INCITS Executive Board member**
- **IIC Steering Committee member**

Osten Franberg

CEO

1Akonsult

Stockholm, Sweden

- **Lead Editor, ISO/IEC 30141 IoT Reference Architecture**
- **Chair, SC41/WG28 Liaison IoT--> AI**
- **Chair, IoT Technical Committee (TK-IoT)**
- **Chair, WG IoT Standards & IoT platforms**
- **Project leader, IoT- House**

Eric Simmon

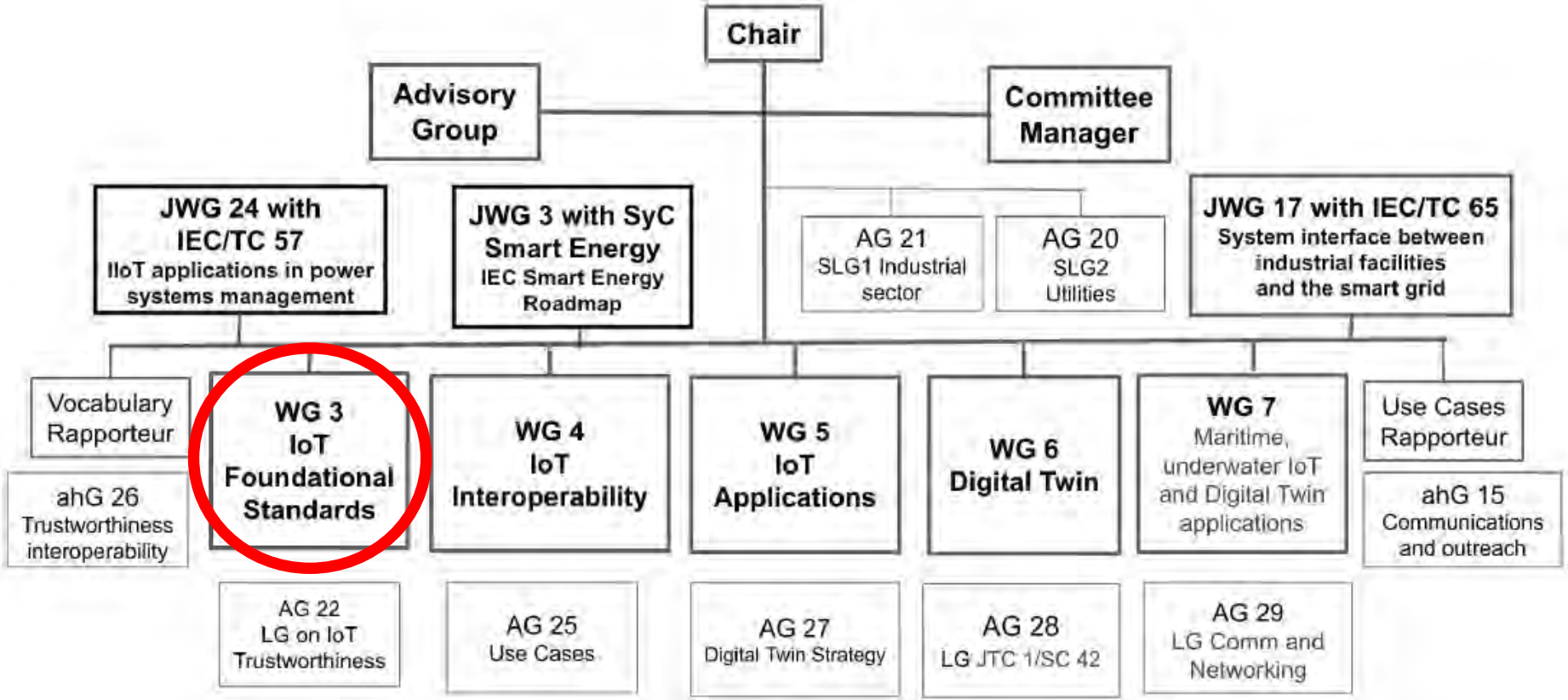
Senior Scientist

National Institute of Standards and Measurement (NIST)

United States

- **Lead Architect, ISO/IEC 30141 IoT Reference Architecture**
- **Project Editor, ISO/IEC 19086-2 Cloud Computing Metrics Model**

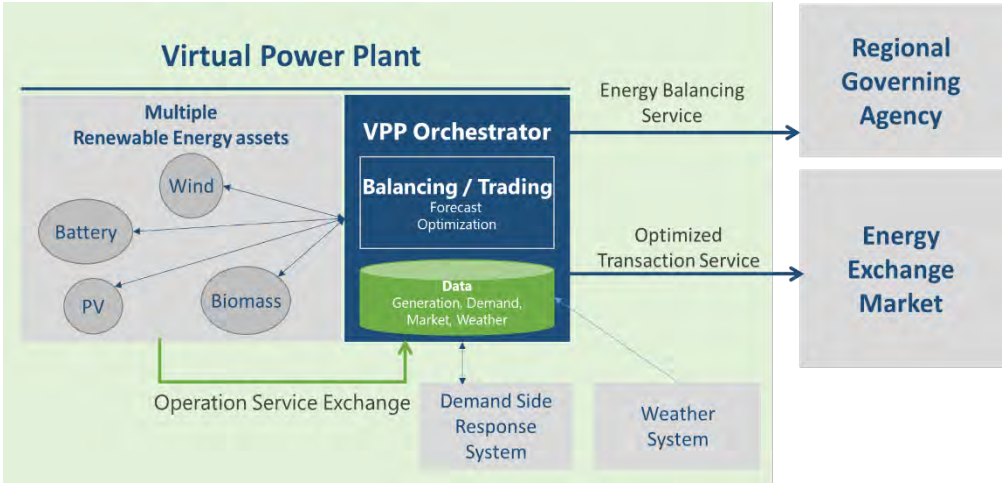
Introducing ISO/IEC JTC1 SC41 WG3



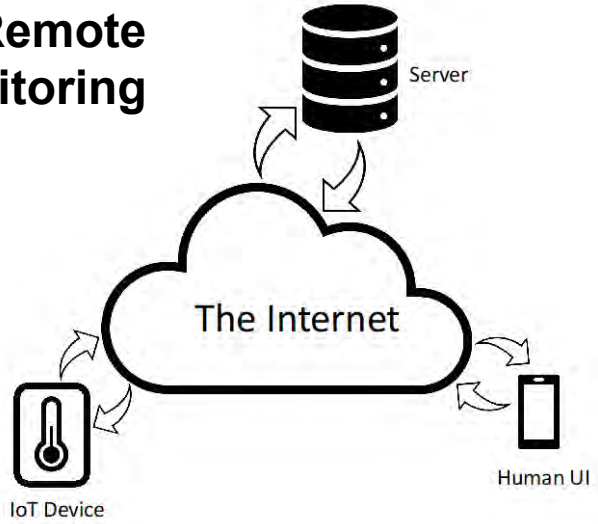
We encourage you to challenge our assumptions and verify for yourself.

Examples – Virtual Power Plant & Remote Monitoring

Virtual Power Plant



Remote Monitoring

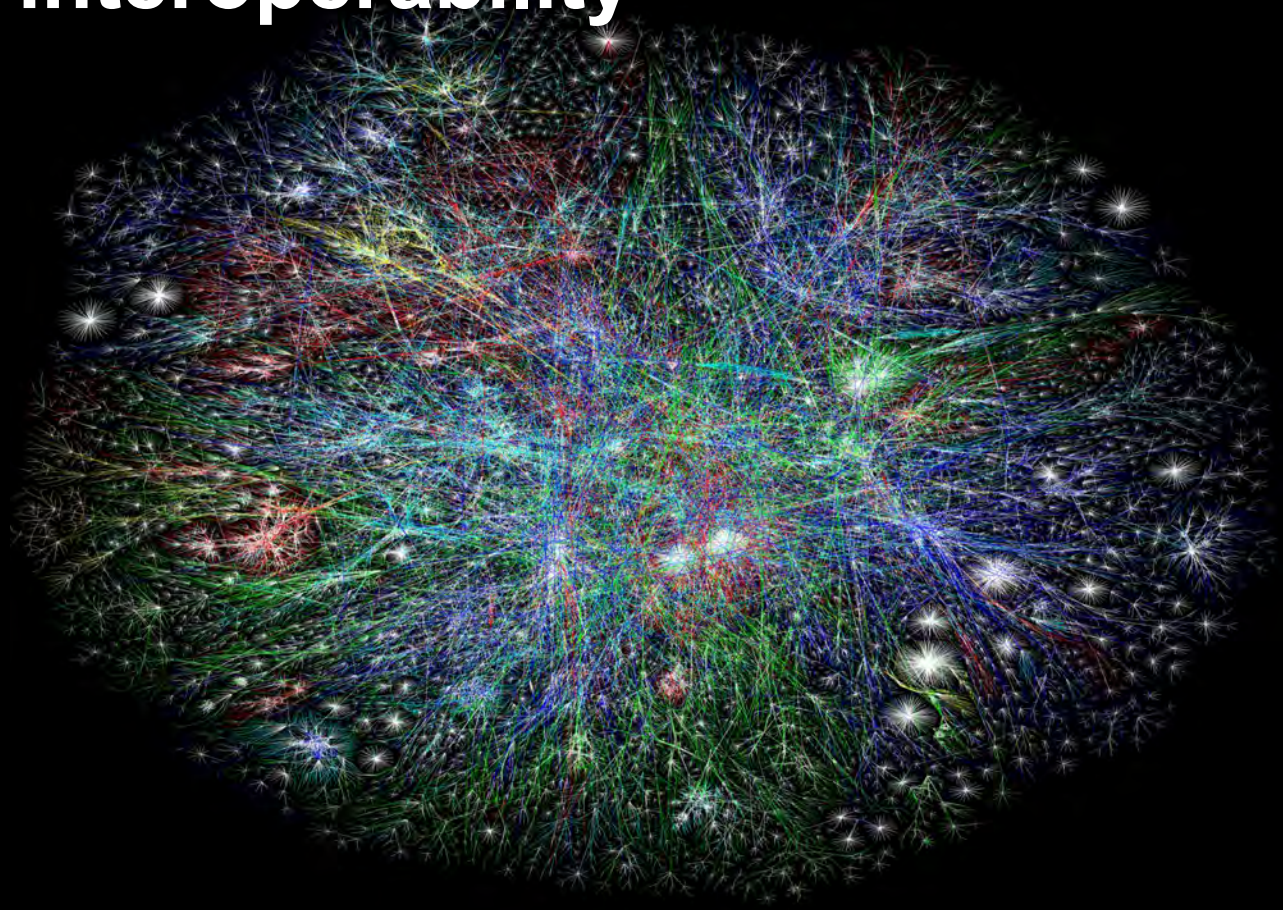



System of System
of systems of systems of systems…

Traditional interoperability

Modern interoperability

The Internet



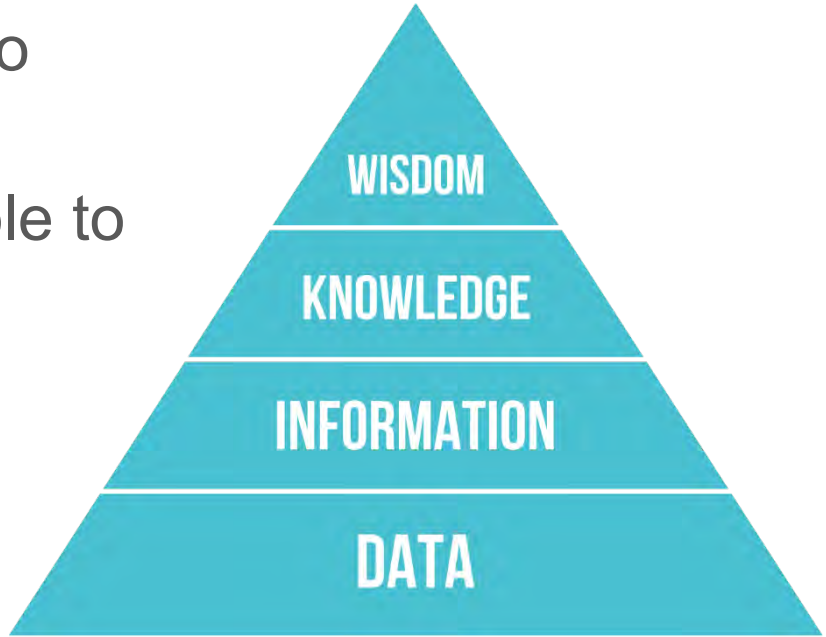
Knowledge vs. Wisdom - DIKW

Wisdom: Knowledge applicable to unknown contexts

Knowledge: Information applicable to known contexts

Information: data + context

Data: symbols



Knowledge vs. Wisdom - DIKW

Wisdom: Knowledge applicable to unknown contexts

Knowledge: Information applicable to known contexts

Information: data + context

Data: symbols

SC41/WG3 IoT RA – ISO/IEC 30141

Define a RAD (Reference Architecture Description) that encompasses all IoT systems to help system architects build systems that meet their requirements.

But first – what is a Reference Architecture Description?

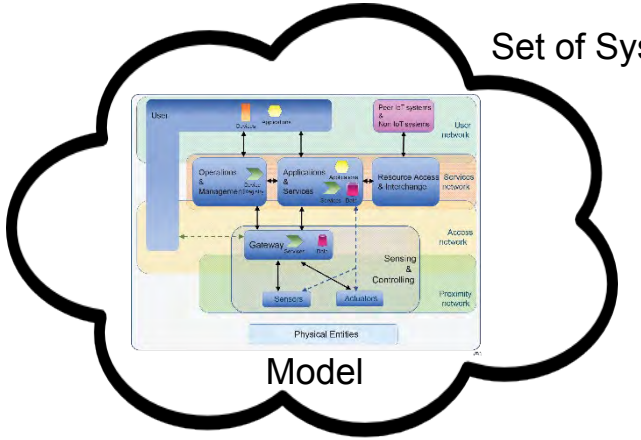
What is a Reference Architecture?

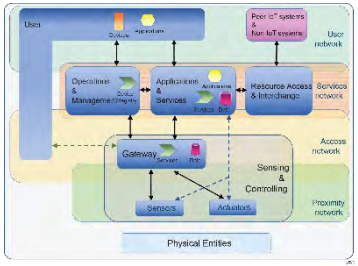
Reference model to analyze and visualize use cases in a technology-neutral manner.

Set of common architectural elements for a particular domain and its general relationships usable to derive a real architecture from it in order to fulfil a defined purpose within this domain.

(Definitions presented in AG8)

Benchmark RA





Model

Set of Systems of Interest

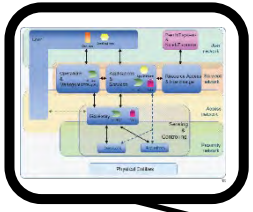
Pattern

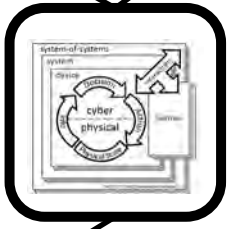
Pattern

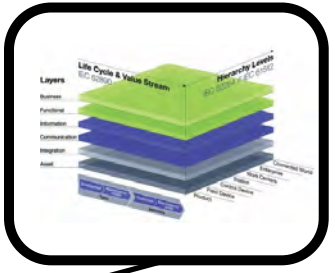
Pattern

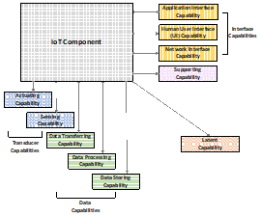
Pattern

Pattern



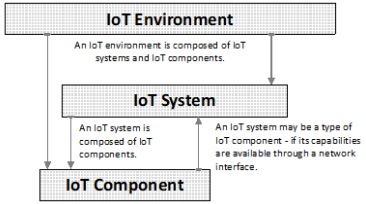






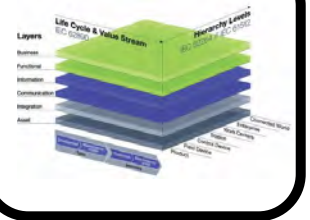
Components are connected together via a many2many **network**

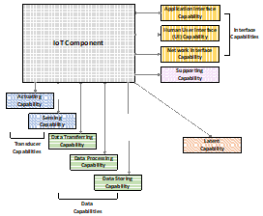
One or more component interacts with the physical world through **sensing and actuation**



Connecting RADs

RAMI 4.0





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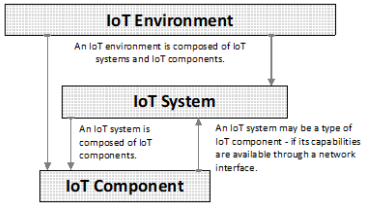
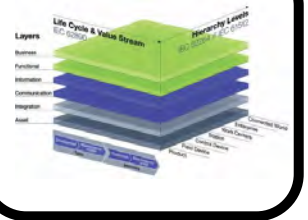
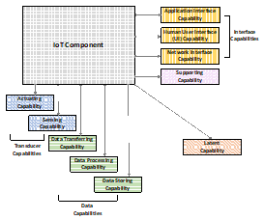


Connecting RADs

RAMI 4.0 -> IoT Pattern
Architects using RAMI 4.0 as a IoT RA pattern should follow the constraints and guidance of both.

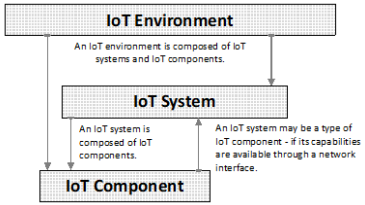
RAMI 4.0





Components are connected together via a many2many **network**

One or more component interacts with the physical world through **sensing and actuation**



30141ED2 - Review and Design

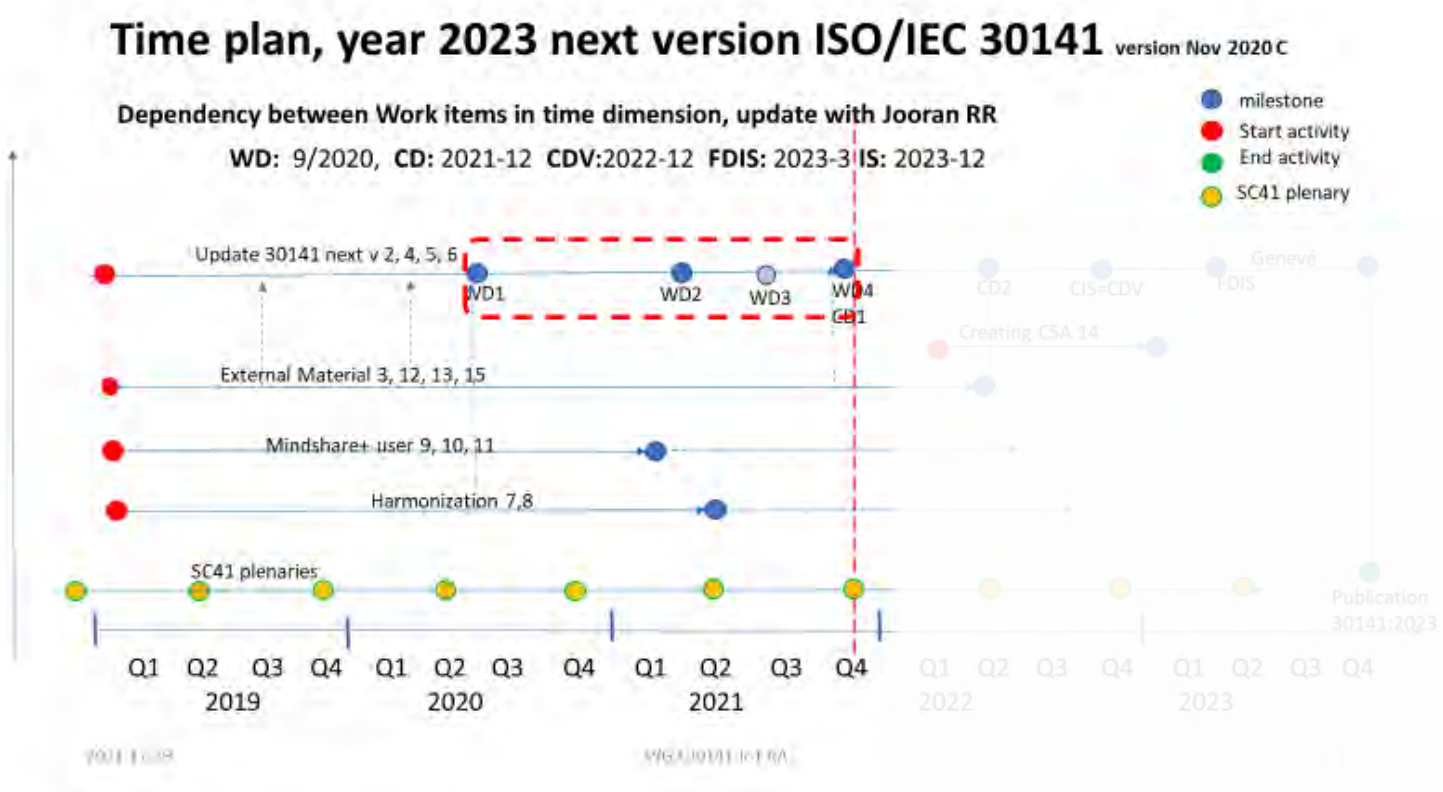
Review stakeholder needs (specific areas of concern):

- Evaluate related Reference Architecture Descriptions
- Interact with experts - Reached out to liaisons and other parties to validate assumptions and expand the sphere of knowledge
- Update vocabulary based on current terms
- Survey related standards and other documentation (e.g. AI/Cloud/Smart Cities)
- Analyze unaddressed comments from ED1

Update structure for ED2

- Conform with 42010
- Align with AG8 for system integration
- Add patterns to support diversity of IoT architecture

Current Progress

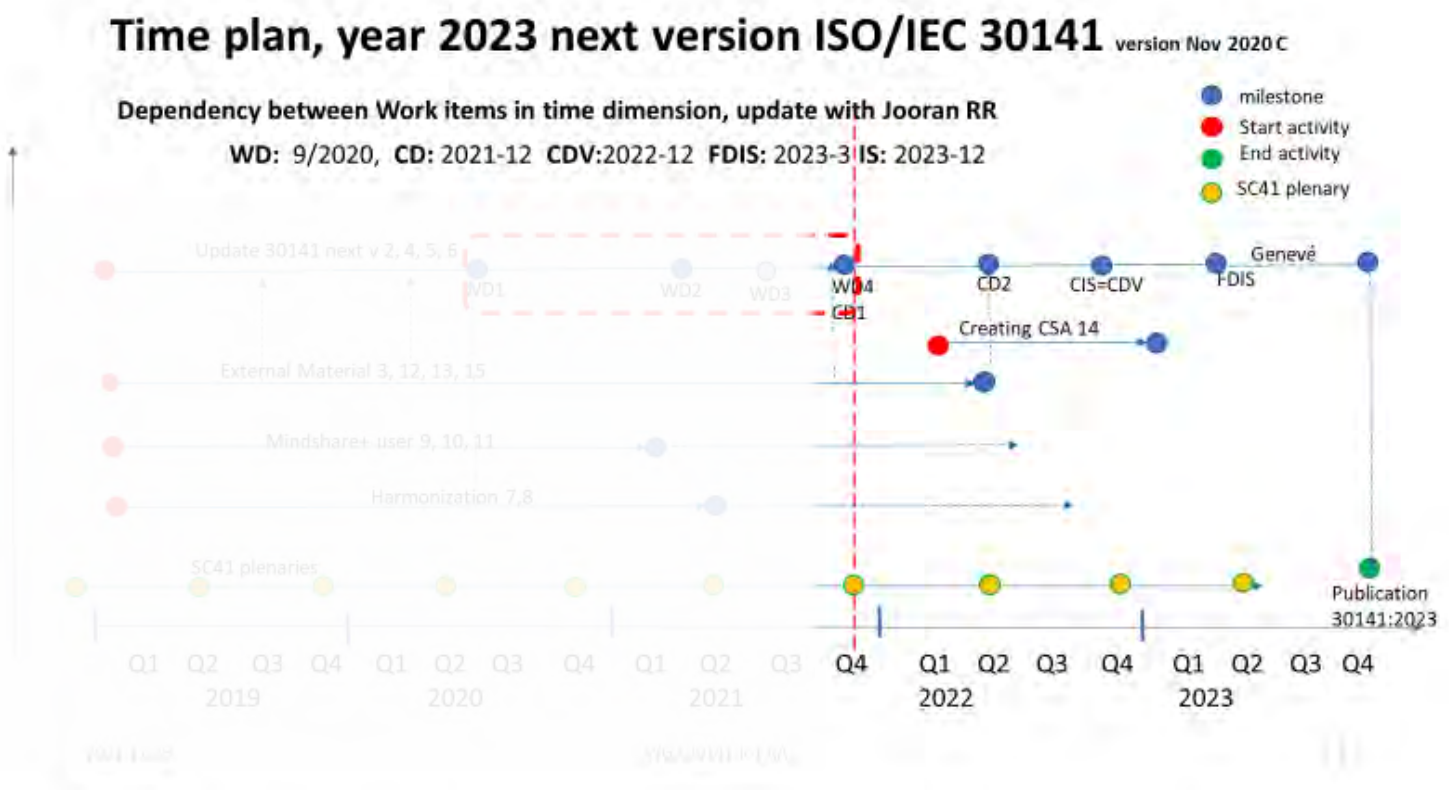


Remaining Issues

Remaining issues awaiting resolution implementation:

- Finishing the Functional Categories
- Understanding the Characteristics – and describing them properly using ISO/IEC/IEEE 42010
- Trustworthiness View – describing using ISO/IEC/IEEE 42010
- Implementing patterns in the Implementation View

Timeline


Time plan, year 2023 next version ISO/IEC 30141 version Nov 2020 C
Dependency between Work items in time dimension, update with Jooran RR
WD: 9/2020, CD: 2021-12 CDV:2022-12 FDIS: 2023-3 IS: 2023-12
milestone
Start activity
End activity
SC41 plenary
Update 30141 next v 2, 4, 5, 6
WD1
WD2
WD3
WD4
CD1
CD2
CIS=CDV
FDIS
Genevé
Creating CSA 14
External Material 3, 12, 13, 15
Mindshare+ user 9, 10, 11
Harmonization 7,8
SC41 plenaries
Publication 30141:2023
Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4
2019
2020
2021
2022
2023

ISO/IEC JTC1 SC41 WG3

International Electrotechnical Commission

SC41/WG 4 and ISO/IEC 21823 Series Standards

Dr. Quan Wang (WSN, China)

Mr. Antonio Kung (CEO Trialog, France)

Dr. Lan Yamashita (TOSHIBA Corp., Japan)

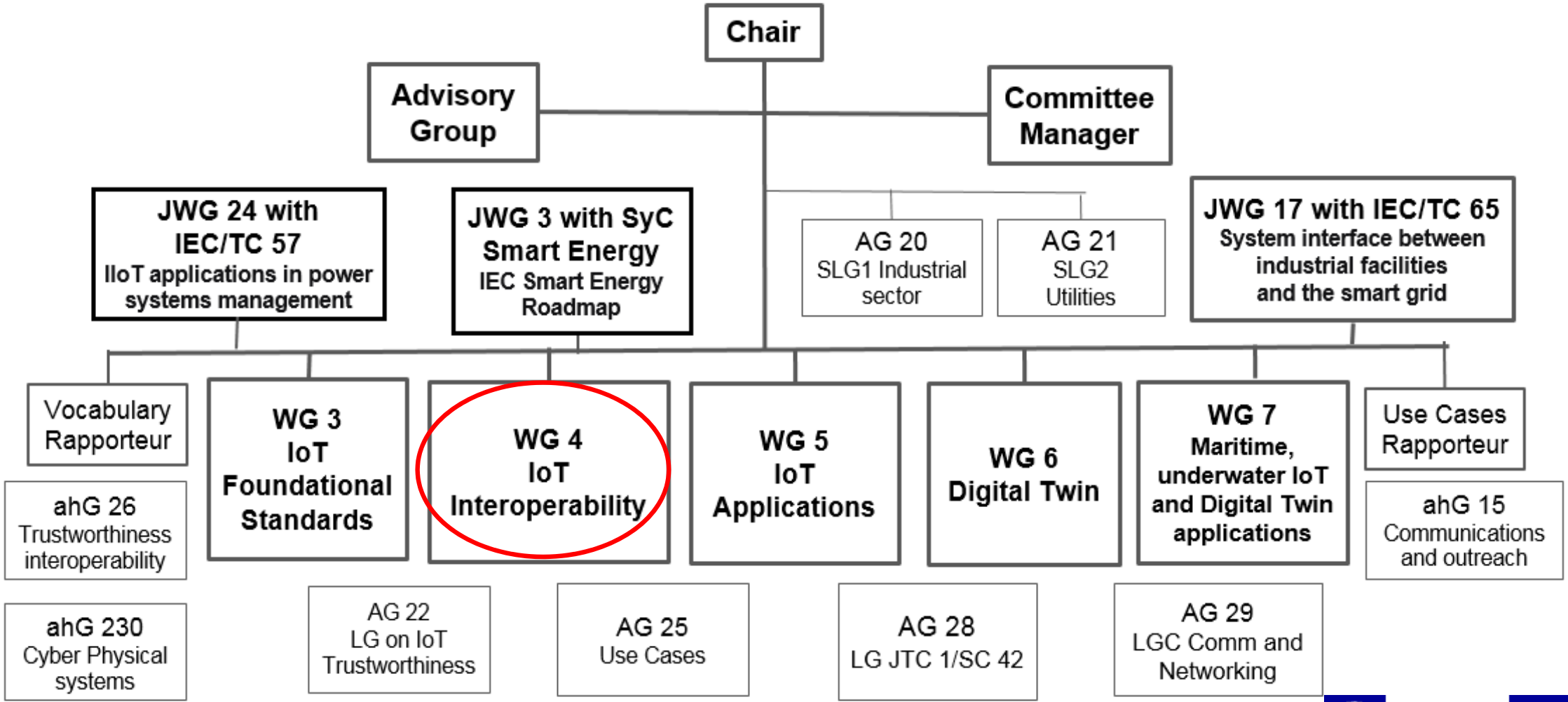
2022-04-26

Outline

1 Introduction of ISO/IEC SC41 WG 4

2 Interoperability for IoT System: ISO/IEC 21823 Series

SC41 Structure



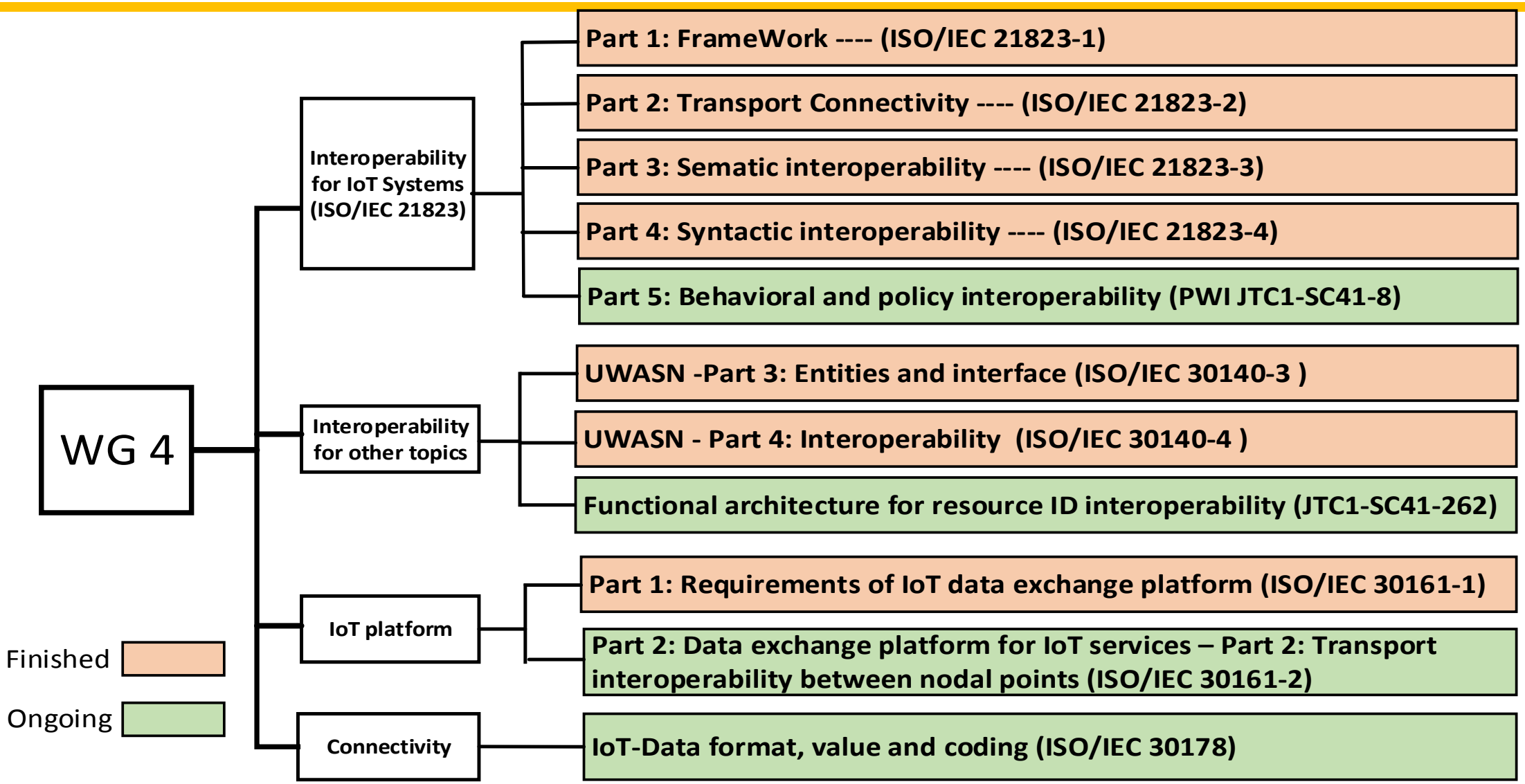
ISO JTC1 IEC
INFORMATION TECHNOLOGY STANDARDS

Overview of WG 4 (IoT Interoperability & Platform)

- **Term of Reference:** Standardization in the area of IoT **interoperability, connectivity, IoT platform, middleware, conformance and testing.**

- **Published Standards:** ISO/IEC 30140-3, ISO/IEC 30140-4, ISO/IEC 21823-1, ISO/IEC 21823-2, ISO/IEC 21823-3, ISO/IEC 21823-4, ISO/IEC 30161-1;

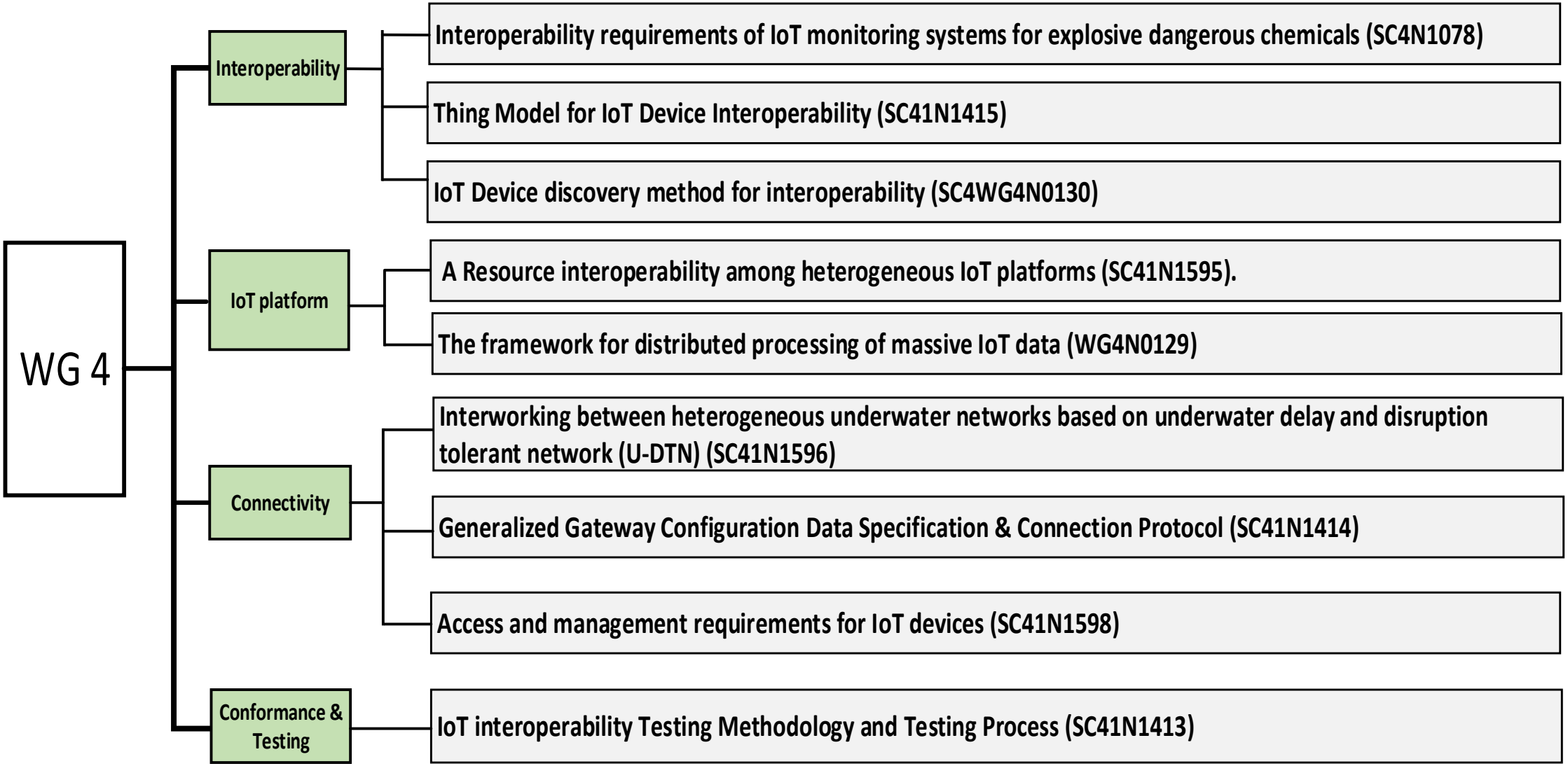
Overview of WG4 projects



Projects under developing

Project No.	Project Name	Editors	Pub Date Target
ISO/IEC 30161-2	Data exchange platform for IoT services – Part 2: Transport interoperability between nodal points	Mr Koichi Ishibashi	March, 2023
ISO/IEC 30178	Data format, value and coding	Mr Östen Karl Frånberg	July, 2024
PNW JTC1-SC41-262	Functional architecture for resource ID interoperability	Mr Young Gab Kim	June, 2025
PWI JTC1-SC41-8	Internet of Things (IoT) - Behavioral and policy interoperability	Mr Antonio KUNG	

Potential projects of WG 4



Outline

1 Introduction of ISO/IEC SC41 WG 4

2 Interoperability for IoT System: ISO/IEC 21823 Series

1. ISO/IEC 21823 Part 1: Framework

ISO/IEC 21823-1: Internet of Things (IoT) -Interoperability for IoT systems - Part 1: Framework

-Editor: Young Sic Jeong (KR) ;

-Co-editors: Min Wei (CN), Jaeho Lee (KR), Jin Young Lee (KR);

-Published on Feb., 2019.

Scope

Provides an overview of interoperability as it applies to IoT systems and a framework for interoperability for IoT systems.

Facts of IoT Interoperability

Describe a general framework for interoperability for IoT systems, which includes 5 facets of interoperability:

Transport; Semantic; Syntactic; Behavioral; Policy.

Facts of IoT Interoperability

1. ISO/IEC 21823 Part 1: Framework

Facets	Aim	Objects	Requirements	Examples
Transport	data transfer between systems	Physical connections Signals	Protocols of data transfer	HTTP/S, MQTT
Syntactic	Receiving data in an understood format	Data	Standardized data exchange formats	JSON, XML, ASN.1
Semantic	Receive data using an understood data information model	Programmatic interface	Common interpretation of data information model	Directories, data keys, ontologies
Behavioural	Obtain expected outcomes to interface operations	Information	Behavioural model(s) of the invoked IoT entity	UML models, pre and post conditions, constraint specifications
Policy	Assurance that interoperating systems follow applicable regulatory and organizational policies	Regulatory and organizational polices and interoperation context	Conditions and control for use and access	Security policies of IoT system stakeholders, restriction on cross-border data transfer, Regulations controlling PII

2. ISO/IEC 21823 Part 2: Transport Interoperability

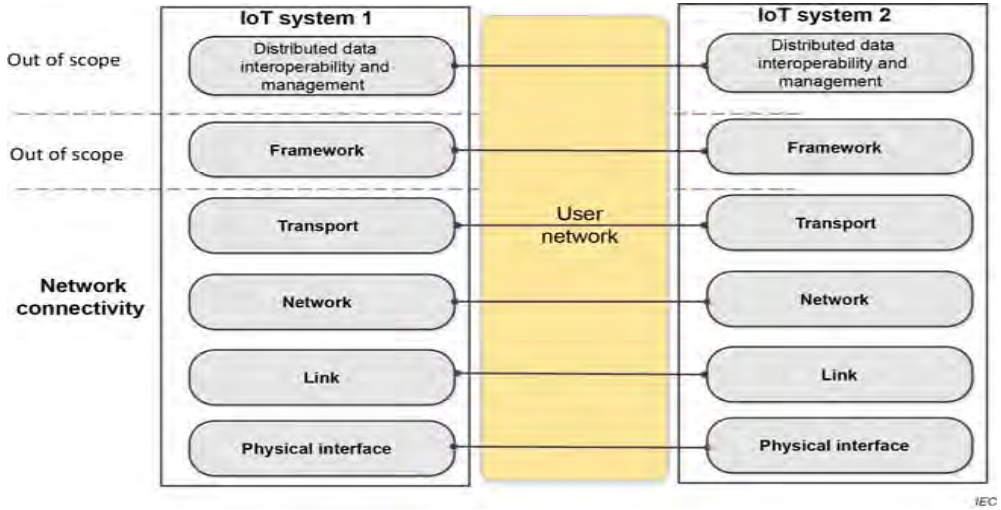
Scope

Specifies a framework and requirements for transport interoperability, in order to enable IoT systems with information exchange, peer-to-peer connectivity and seamless communication:

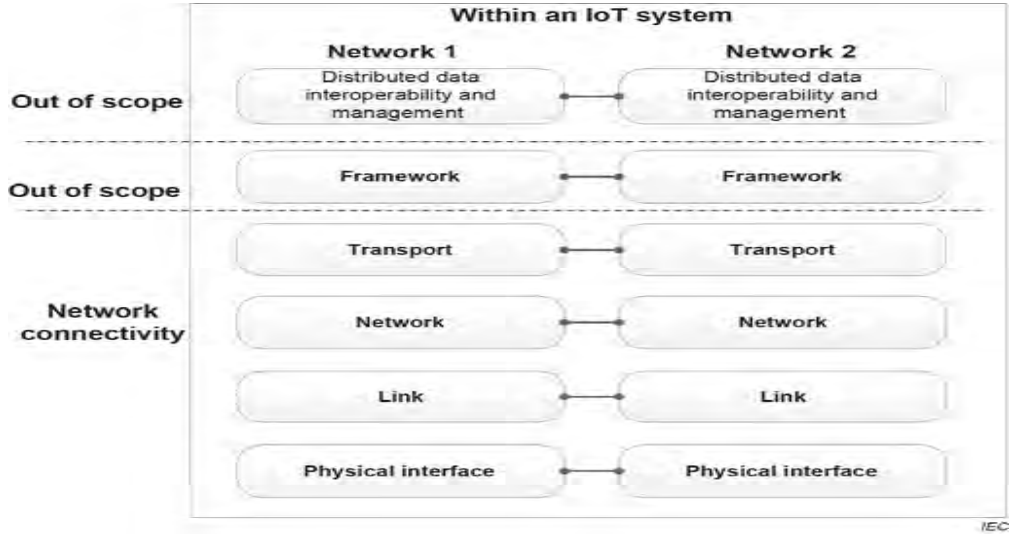
- transport interoperability interfaces and requirements between IoT systems;
- transport interoperability interfaces and requirements within an IoT system.

◆ Editor: Prof Min We;

◆ Published on Apr. 2020.

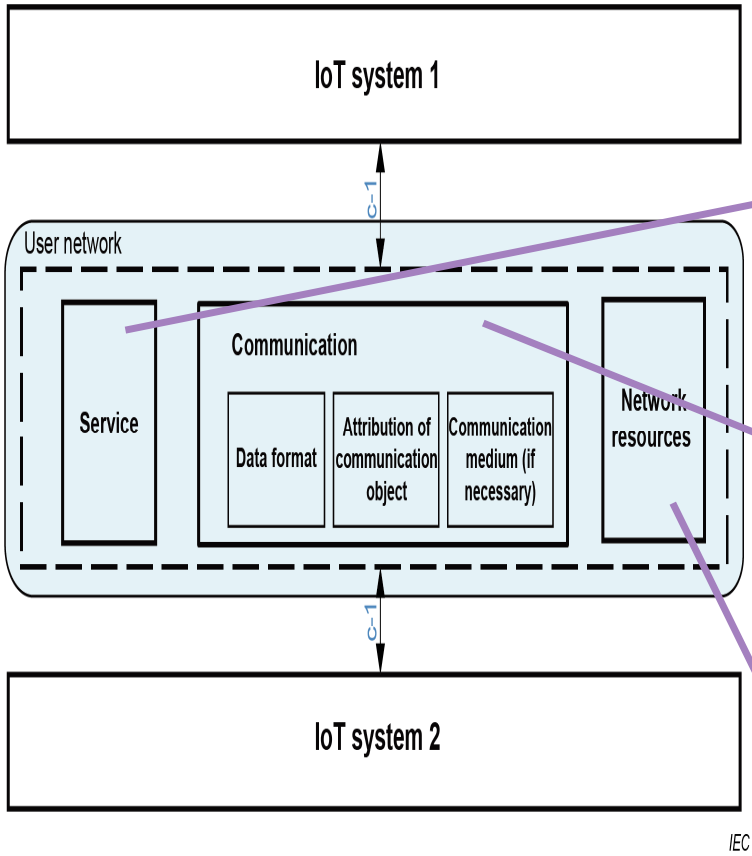


Network connectivity stack model between IoT systems



Network connectivity stack model within an IoT systems

2. ISO/IEC 21823 Part 2: Transport Interoperability



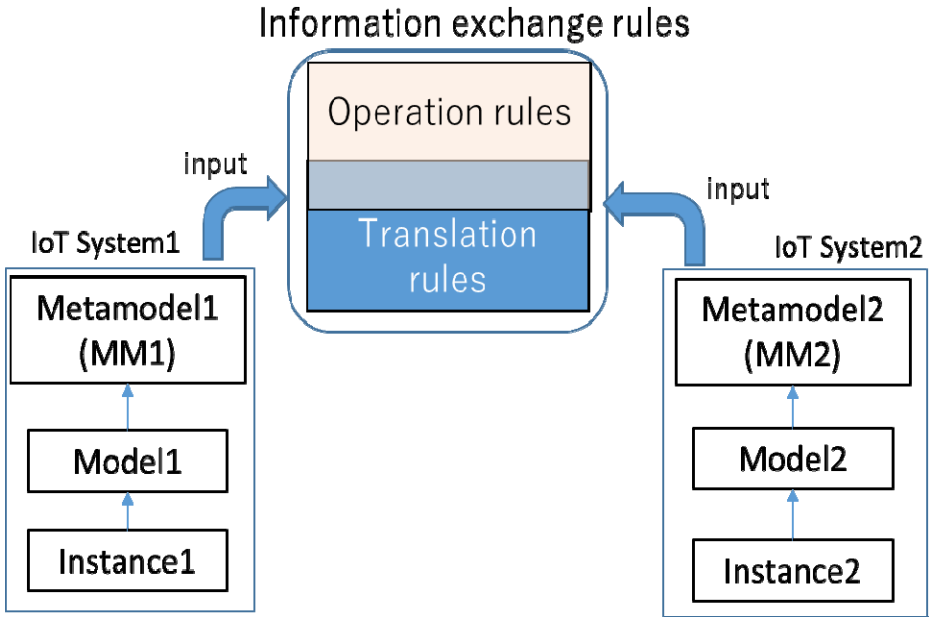
The connectivity between different IoT systems

The related requirements of transport interoperability between different IoT systems:

- **Service-related interoperability:** the interface offered by IoT system 2 to IoT system 1 shall match that expected by IoT system 1, in terms of syntax, semantics and behaviour.
- **Communication-related interoperability:** the communication protocols specify interactions between the communicating entities. The networks need to have the rules for interoperability.
- **Network resource-related interoperability:** the network needs to provide the resources of the network attributes that need to be unified, such as QoS, communication channels, etc.

4. ISO/IEC 21823 Part 4: Syntactic Interoperability

- ISO/IEC 21823-4:2022 Internet of Things (IoT) - Interoperability for IoT systems - Part 4: Syntactic interoperability
  - Editor: Dr. Lan Yamashita ;
  - Co-editors: Prof. Jaeho Lee, Prof Min Wei
  - Published on March 2022
- A model-driven approach to support data exchange between IoT systems and devices using different information models
- Plug and Play-enabled implementations



Scope

- A principle of how to achieve syntactic interoperability among IoT systems which include IoT devices
- Requirements on information related to IoT devices for syntactic interoperability
- A framework for processes on developing information exchange rules related to IoT devices from the syntactic viewpoint

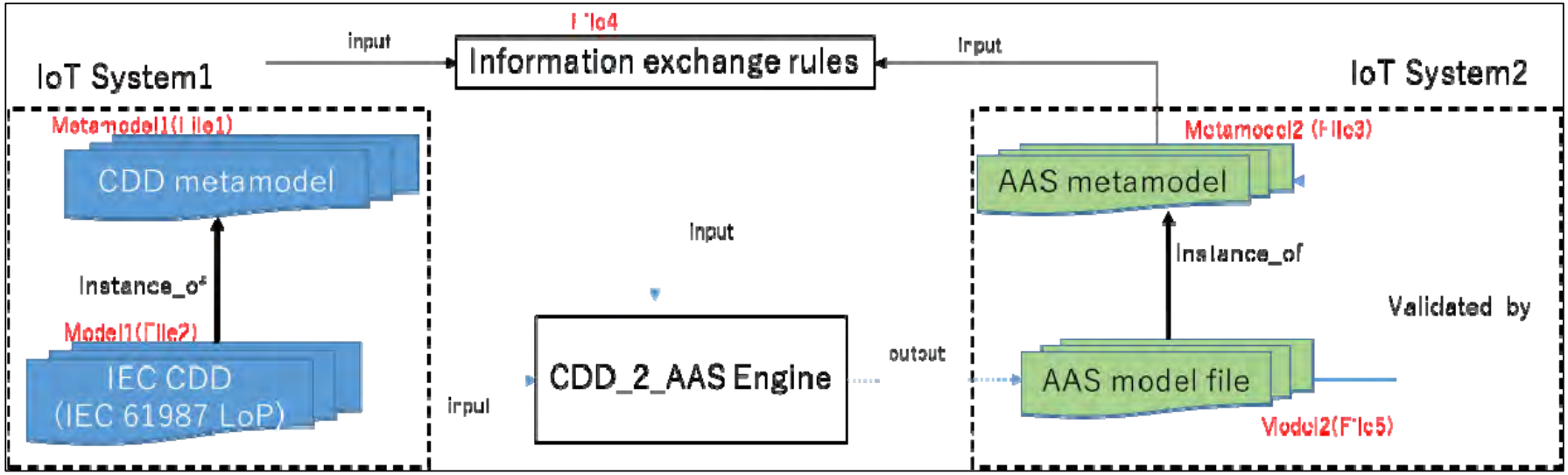
Presented by Dr. Lan YAMASHITA, TOSHIBA Corp.

4. ISO/IEC 21823 Part 4: Use cases

https://github.com/21823-4/usecases/

- Usecase1: Connected Car and Smart city
- Usecase2: IEC CDD and AAS(Asset Administration shell) for I4.0

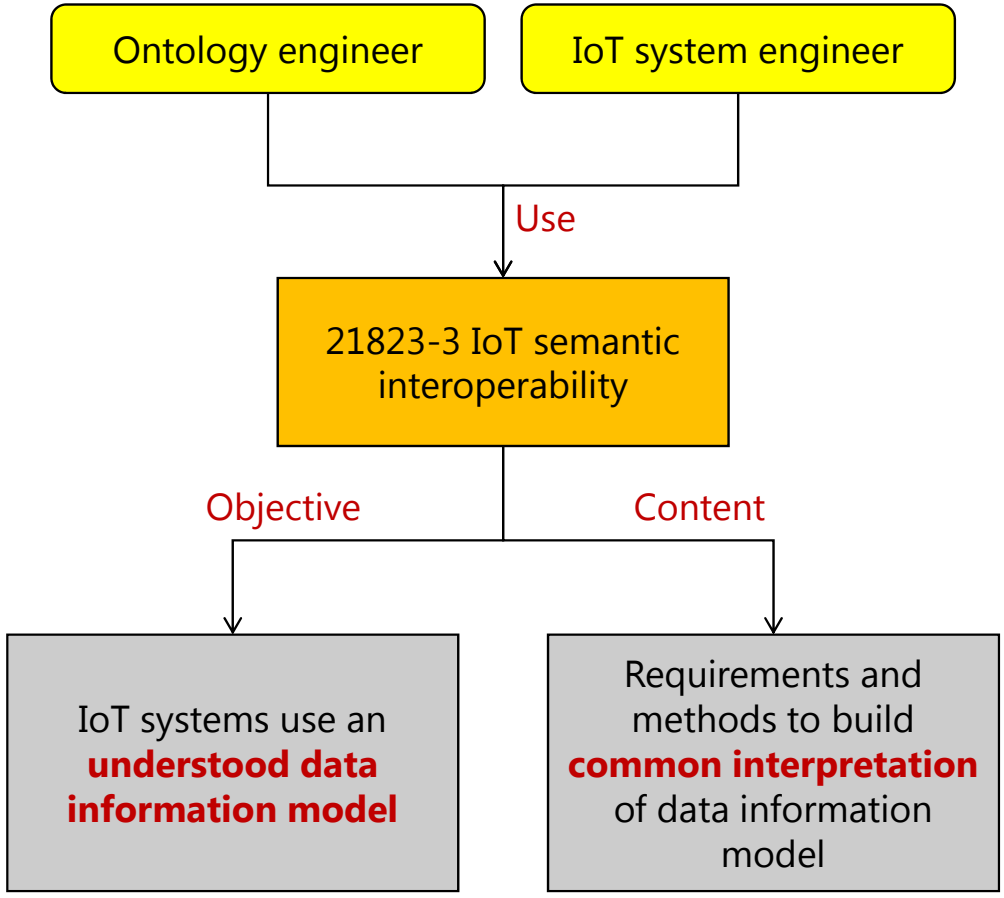
Usecase2: Automatic generation of AAS from IEC CDD for I4.0



Presented by Dr. Lan YAMASHITA, TOSHIBA Corp.

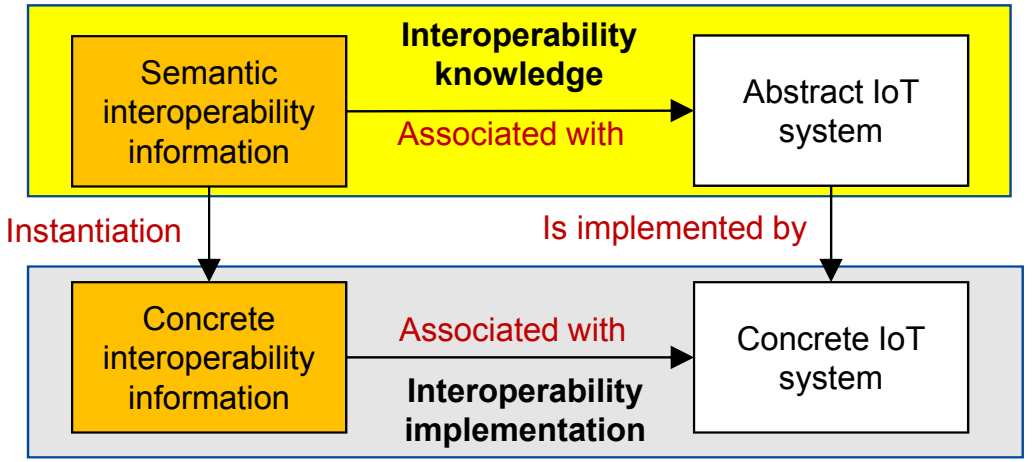
3. ISO/IEC 21823 Part 3: Semantic Interoperability

- ISO/IEC 21823-3 Internet of Things (IoT) - Interoperability for IoT systems - Part 3: Semantic interoperability
  - Editor: Jaeho Lee
  - Co-editors: Antonio Kung, Osten Franberg, Amélie Gyrard
- Published on September 2021.



3. ISO/IEC 21823 Part 3: Semantic Interoperability

- IoT semantic interoperability process
  - Create interoperability knowledge
  - Use it in implementation

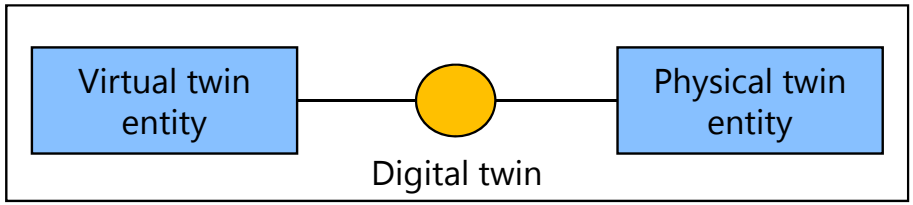


- IoT semantic interoperability lifecycle
  - Ontology
  - Interoperability specification
  - IoT systeme

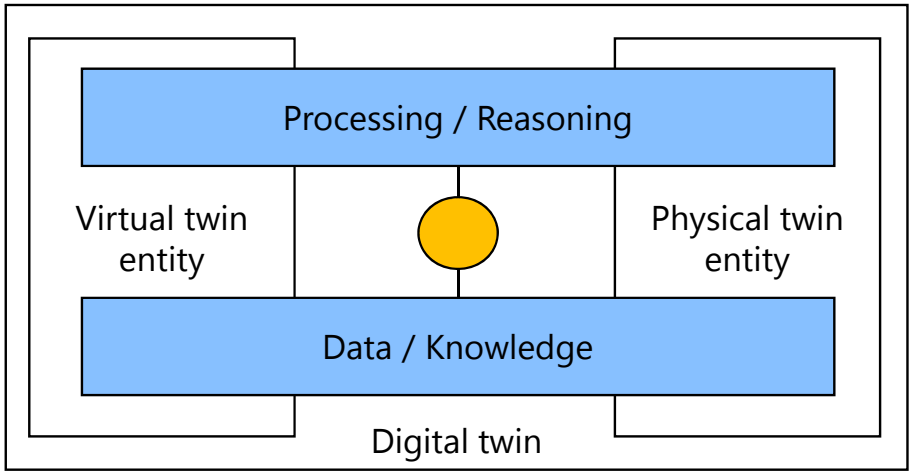
5. PWI: Policy and Behavioural Interoperability

- Preliminary work item (PWI)
  - Editor: Antonio Kung
  - Co-editors: Jan de Meer, Jukka Alve, Karim Tobich, Jaeho Lee, Raul Garcia
- Objective
  - Report on basic concepts for IoT systems and digital twin systems behavioral and policy interoperability. This includes
    - Requirements,
    - Guidance on how to identify points of interoperability,
    - Guidance on how to express behavioral and policy information on capabilities,
    - Guidance on how to achieve trustworthiness interoperability, and
    - Use cases and examples
- Will lead to a proposal for a new standard
  - ISO/IEC 21823-5 Internet of Things (IoT) - Interoperability for IoT systems - Part 5: **policy and behaviroural interoperability**

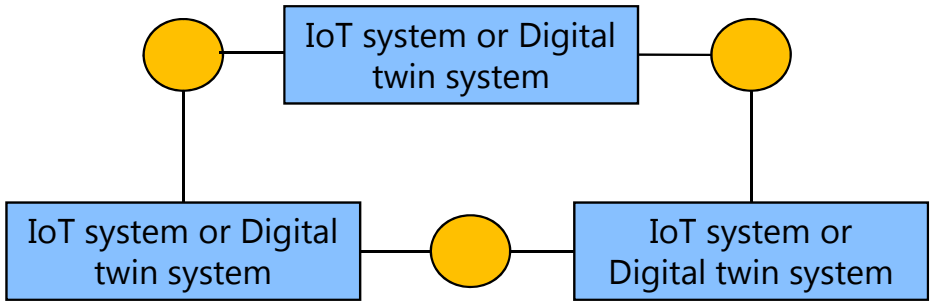
5. PWI: Policy and Behavioural Interoperability



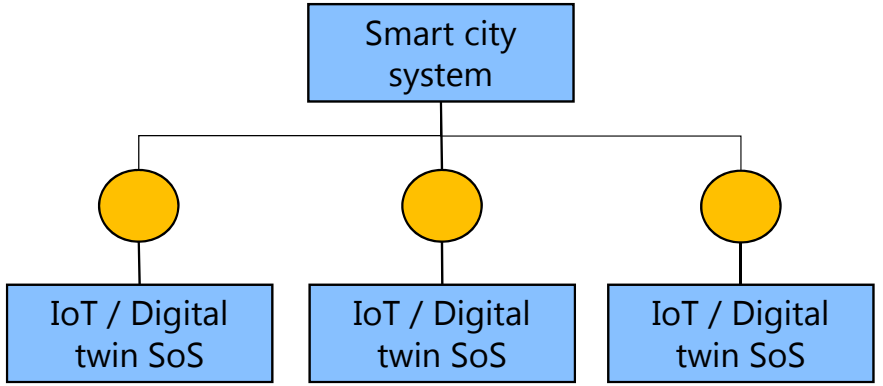
A Digital twin Interoperability case



B Data space Interoperability case



C System of systems (SoS) Interoperability case



D Smart city Interoperability case

Presented by Dr. Mr. Antonio Kung

End
Thanks

“Industrial IoT” Standardization

- in Line with “Industrial Digital Twin”

Mr. Detlef Tenhagen,
Convener of JTC 1/SC41 AG20 “Industrial Sector”
Sectorial Liaison Group (ISO) / (IEC)

JTC 1/SC41 Webinar on
IoT and Digital Twin standardization
2022-04-26 & 28

Author
detlef.tenhagen@harting.com

Industrial IoT Standardization - and Industrial Digital Twin (IDTw)

– An general Overview on Standardisation activities in common context of Liaisons

Content:

- **Introduction JTC1 / SC41 / AG20** - (Strategic) Liaison Group on the Work of SC41 (bidirectional) to Standardization in the Industrial Sector on IoT (IIoT) and Digital Twin
  - – Mandate and Work
  - JTC1 / SC41 / WG5 - TR 30166 Ed1 „Industrial IoT“ (SC41/WG5) → Referenced in Annex
  - JTC1 / SC41 / WG3 - IEC 30141 Reference Architecture (currently under development)
  - JTC1 / SC41 / AG27 & WG6 **- Work on Digital Twin (Strategy and Work) → in Context to AG20 Liaison below:**

  - **Activities in „Industrial IoT and Digital Twin“ – Standardization at SDOs** and Cat.C Liaison

    - IEC TC 65 WG23 - „Smart Manufacturing“
    - IEC TC 65 WG24 - „Asset Administration Shell“
    - IEC TC 3 SC3D - CDD Common Data Dictionary → COMDO Project IEC CDD and ECLASS
    - ISO/IEC JWG 21 - „Semantic View“ on IIoT/ by Standardization

- Other Organizations / Initiatives on „Industrial IoT“ (Non-SDO) – Implementation and UseCases for IIoT
  - IDTA
    - Implementation in IIoT based upon TC 65 WG 24 Work

- Possible future work on IIoT and related standardization

  - Annexes (not presented) : Contact Information IDTA and SCI “Standardization Council”

JTC1 / SC41 / AG20 – Mandate and Work – IIoT + IDTw

Mandate

- Coordinate liaisons activities between all SDO's, internal and external, in the IIoT sector and SC41
- Proactively solicit requirements and uses cases, when applicable, from the SDO's under its responsibility.
- Promote the use of SC41 foundational and core standards by these SDO's.
- If required, assist in the socializing of NWIPs that appears to be relevant to the scope of one or more SDO's within their sector.
- If required, facilitate the set-up of joint projects between these SDO's and SC41.

Expanded to DTw Digital Twin by SC41 Plenary following JTC1 Plenary resolution:

- Industrial View of "Digital Twin" in Smart Manufacturing (TC65 LR) WG23 – especially by WG 24 "Asset Administration Shell"
- Supported by JWG21 Work on "Universal Smart Manufacturing Reference Architecture" in Liaison to ISO TC 184 / IEC TC 65

→ To be as actual primary "focus" inside this presentation in regard to Standardization on IIoT on Light of the most "up-to-date" developments specific in "Industrial Digital Twin" and real Implementation Concepts

SLG1 « Industrial Sector > IoT & Digital Twin » - Mandate

The SDO's under the responsibility of SELG1 are – in scope of Standardization for the industrial Sector on IoT and Digital Twin :

- **IEC TC 65** Industrial-process measurement, control and automation
  → WG23 on „Smart Manufacturing" Fokus for IT/OT Convergence!
  → WG24 on „Asset Administration Shell" Fokus for Digital Twin!
- **ISO TC 184/ SC 1,4,5** → Physical device control, Industrial data, Interoperability, integration, and architectures for enterprise systems and automation applications – also …
- **IEC SyC Smart Manufacturing** → Relevant actvitities in Context of ISO IEC Work on CPS, CPPS, IIoT … (ISO: SMCC Smart Manufacturing Coordination Commitee)
- **ISO TC184 / IEC TC65 - JWG 21 → IEC 63339 IS: URMSM (Unified reference model for smart manufacturing)**

- ISO TC 39 → Machine tools
- ISO TC 261 → Additive manufacturing
- ISO TC 299 → Robotics
- ISO TC 261 → Additive manufacturing
- ISO/TC 10 → Technical product documentation

Further Liaison Exchange to CPS, CPPS, IIoT, … Standardization

ISO/IEC JTC1/SC41/WG5 –
IEC TR 30166 “Industrial IoT”
- A Big Picture

2019/May released

→ Sustained by today by newest developments on Contexts about the “Digital Twin”

→ Especially with relation to IIoT/CPS/CPPS

→ Liaison SC41/TC65

... common developments on Reference Architectures, UseCases, Vocabulary, Ontologies, Semantics, etc.

IEC

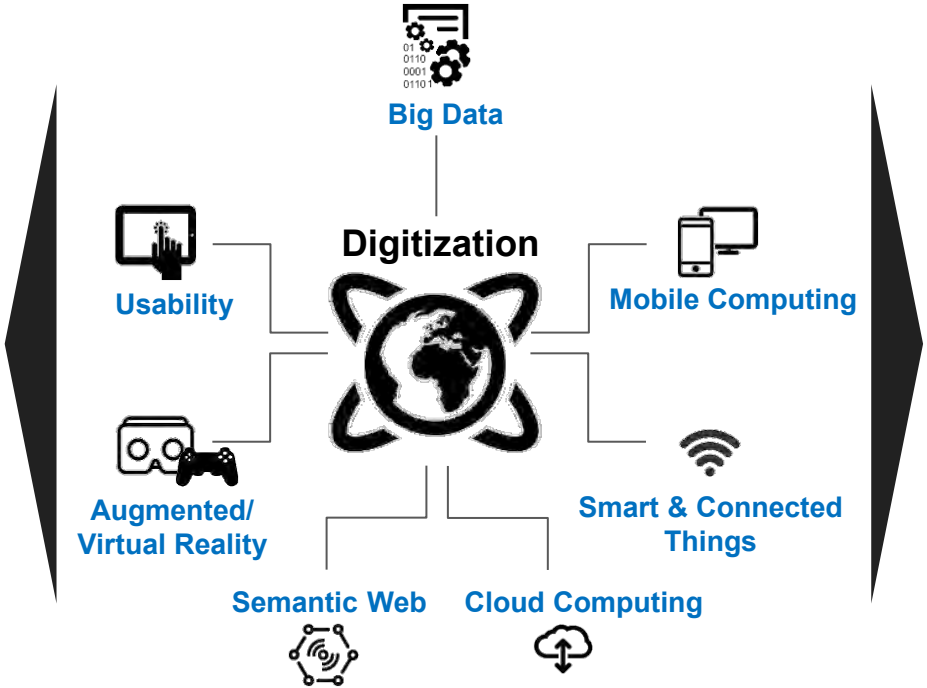
Digitization and Industry 4.0 | broad definitions of terms

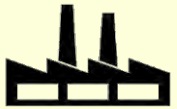
Smart Manufacturing & IIoT in Scope in (JTC1/SC41/AG20 IIoT) could be recognized as a **„Vertical“ to Digital Twin** in a to be developed „View „within a Reference Architecture of DigTwin - To consider in SC41/WG6 on RA Digital Twin NWIP

→ Transforming into the Space of B2C to gain from it and foster standardization: Need for RA and Modelling (i.e. 30141 Views in JTC1/SC41/WG3 – ongoing standardization taking place)

B2C World

- Smartphone
- eCommerce
- Mobile Business
- Social Media
- Digital Entertainment
- Smart Home
- …





B2B World

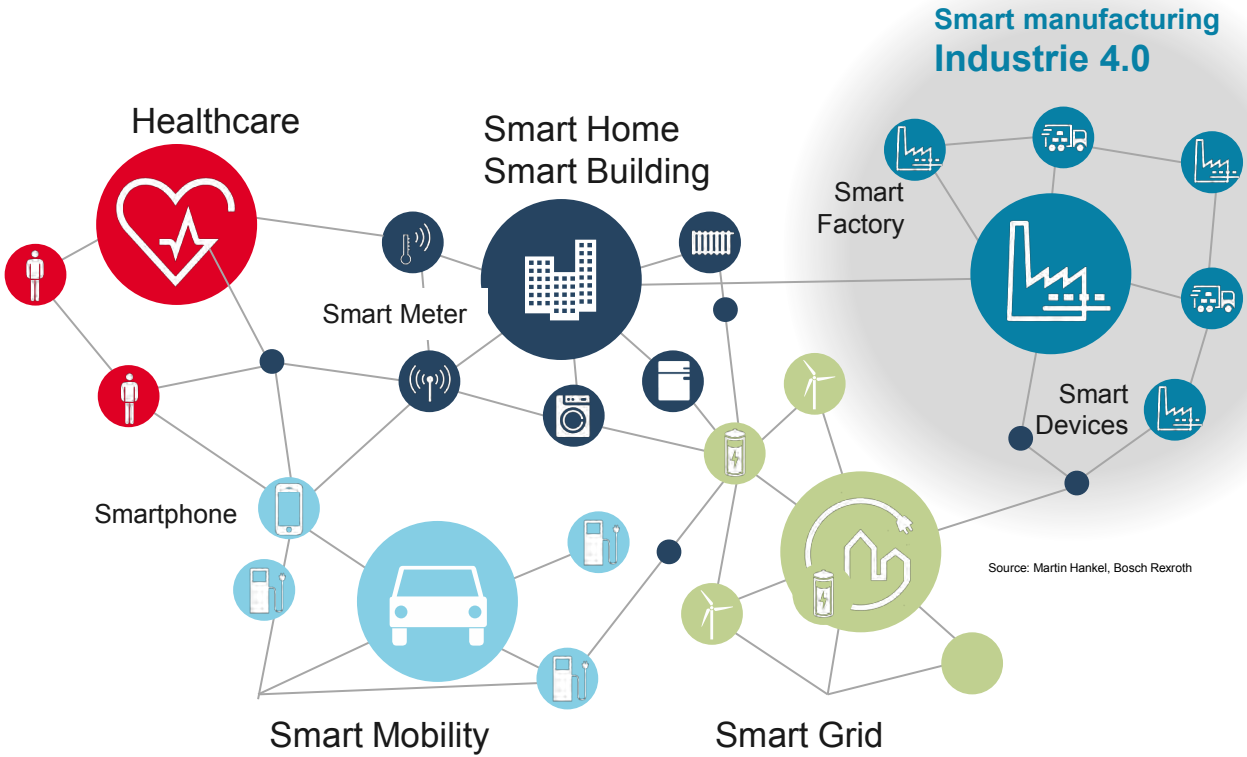
- Connected Vehicles
- Connected Health
- Connected Cities
- …

“Industrie 4.0”

Development | Production | Logistic

Digitization of industrial value chain networks

IoT shares the same principles on all verticals, **Industrie 4.0 (IIoT)** deepens the **concepts for smart manufacturing**



Horizontal integration

Value chain • Life cycle costs • Customized products

Vertical integration

Reconfiguration • Lot size 1 • Apps • Constant change

Integrated Engineering

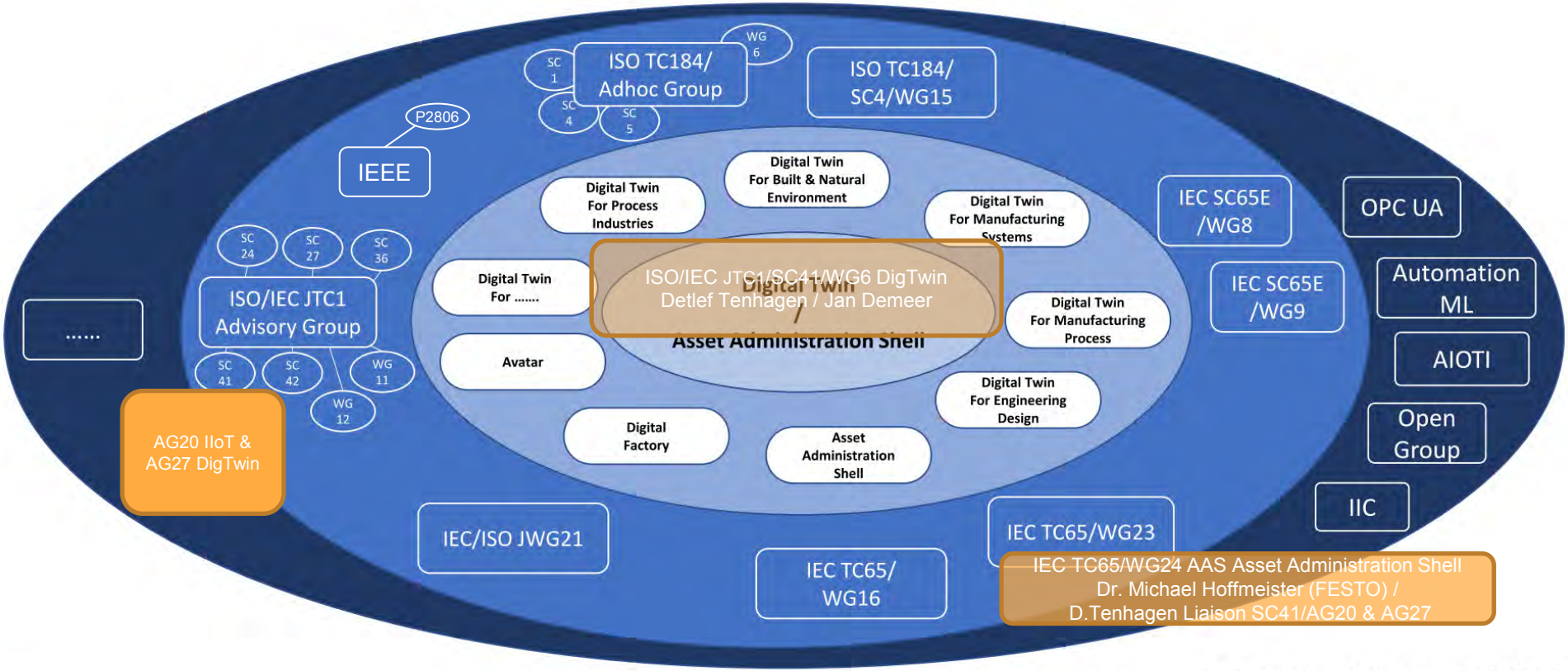
Systems Eng. • along supply chain • Digital factory

Human centricity

Orchestration • Skills • Knowledge management • Training

Partial view of the “**Ecosystem Standards**” for **Industrial IoT and Digital Twin** – Smart Manufacturing as “common denominator”

SC41/AG20 SLG1 context of Development within SC41/WG6 (Digital Twin Standarization) as well as SC41/ AG27 (Digital Twin Strategy)

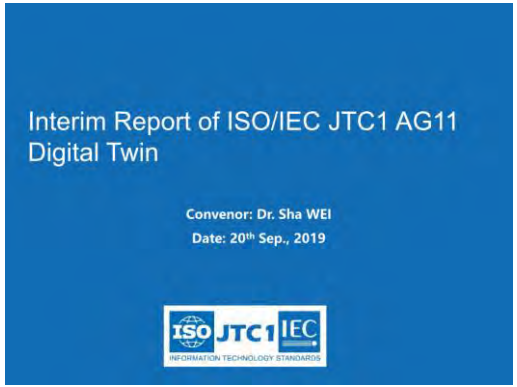


Source: TF8 kick off, Patrick Lamboley, fw: Dr. Michael Hoffmeister, Convener IEC/TC65/WG24 – modified D.Tenhagen

To be consolidated with SM2TF

Definition of Digital Twins

mostly from (very informative):



industrial internet CONSORTIUM (2019)

A Digital Twin is a digital representation of an entity, including all necessary attributes and behaviors, sufficient to meet the requirements of a set of use cases.

NASA

"integrated multi-physics, multi-scale, probabilistic simulation of a vehicle or system that uses the best available physical models, sensor updates, fleet history, etc., to mirror the life of its flying twin".

ISO/ TC184/ SC4/ WG15
ISO CD 23247-1

A Digital Twin is a digital model of a particular physical element or a process with data connections that enable convergence between the physical and virtual states at an appropriate rate of synchronisation.

WIKIPEDIA

A digital twin is a digital representation of a physical entity. By bridging the physical and the virtual world, data is transmitted seamlessly allowing the virtual entity to exist simultaneously with the physical entity.

ISO TC184/ IEC TC 65 - JWG21 Draft TR

"Digital representation of physical individuals as well as of virtual entities in an information framework that interconnects traditionally separated elements and provides an integrated view throughout life cycles (digital twins and digital thread)."

ISO JTC1 IEC
INFORMATION TECHNOLOGY STANDARDS

Industrial Digital Twin – a definition comes first…

Common - **a "digital twin"** is a **model**

which **depicts** an **asset**: **-physical object, -process, -organisation** or **-person (role)**
along its entire life cycle and **continuously optimises** its **properties** and **functions**.

Essential components are always:
... the **"virtual data"**, as a **figure** of a **real asset**
... the **"networking"** of **information sources**
... the **extension** to a **cyber-physical system**

... in **consistent** & **timely data management**

1.) All information is in the product - real & digital combined!

2.) It is available in real time throughout the entire value chain!

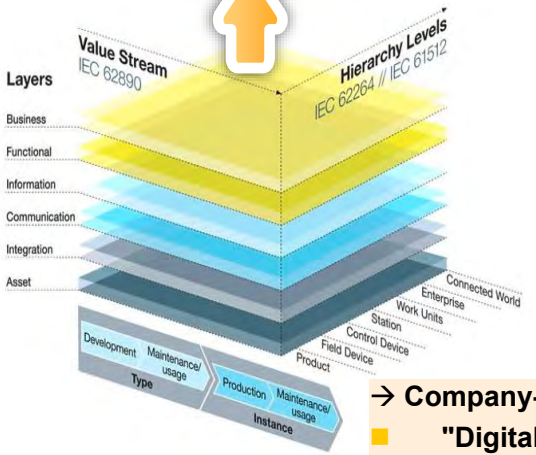
3.) A "seamless communication" is enabled!

4.) A defined and single "truth" is available - at all times!

In the industrial environment, the concept is becoming established and is seen as "the" future-proof model for product creation, company-wide as well as cross-company data exchange throughout the entire product life cycle.

„Digital Twin“ – Industrial Implementation - Overview

The **Asset Administration shell (AAS)**
-is the standardised
implementation of the "digital twin
for the Industry 4.0 reference architecture



Standardised IT representation:
files: Values, type class, parts list, CAD 2D/3D

Symbol:

"Digital Representation„
(Virtual Part)

„Assets“ (

Parts: Products, sub-components - but also: *drawings, documents, real process steps, machines, ...*

Characteristics and advantages of future security for Industries based upon Standards :

- **1.) Standardised interface** “Asset Administration Shell" with **Submodel Components**
- **2.) Worldwide unique identification** of **all components** (type & instance)
- **3.) Information on the product + "added values" for services**

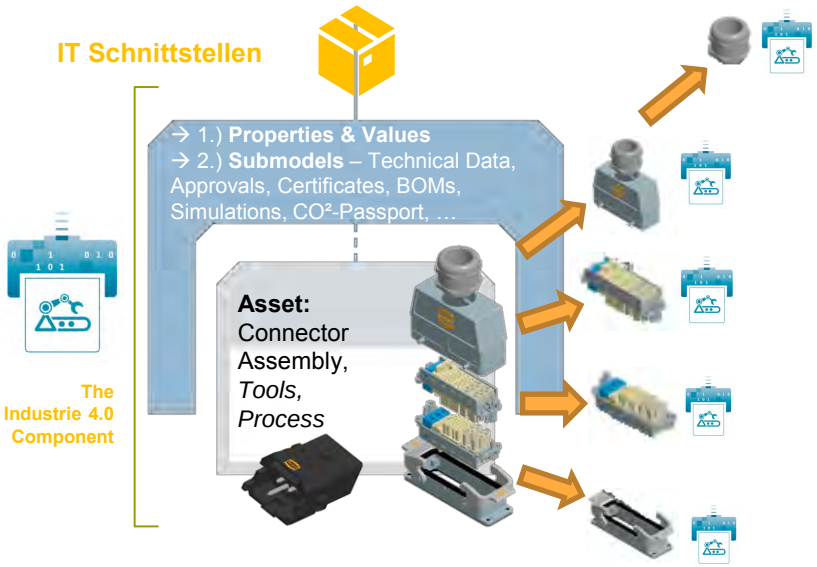
→ **Company-wide** as well as **across suppliers** and **customers:**

- **"Digital representation"** contains the **properties** & **functions throughout** the **whole product life cycle**
  - … has standardised communication (syntax & semantics) – (Generic: SC41/WG6 – OT: TC 65 WG 23/24)
  - … **Allows automation of value-adding processes** (Focus: SyC Smart Manufacturing)
- **Forms** the **basis** for **automated integration** of **digital differentiating Services**
  - ... for CRM, E-Shop, Web: → „Digital Customer Experience“

ISO JTC1 IEC
INFORMATION TECHNOLOGY STANDARDS

Digitaler Zwilling – – Industrial Implementation - Technical Cascade

To implement "digital twins" in conformity with IEC standards and map them in IEC management shells and their submodels:



- **Sub-models** as **unified views of assets** - depending on the use case
- **… Standardised access** to **properties** and **functions** of the **products**
- **… IT Interface = standardized** by **IEC!**
  → … global data exchange (Web)
  → … standardised format (Files)

- … **as "Assembly" they represent administrative shells hierarchically**
  - **These in turn** contain **all the data** for **development** and **production**
  - **… also of the subcomponents**

- **Cascading** allows for:
  → **Complexity reduction**
  → **Interoperability**
  → **Building blocks = "Lego" principle**

IDTA

Adapting IEC TC65 / WG 24 Standardization of 63278-x „Asset Administration Shell“ in the area of „Industrial IoT“ as by Industrial UseCases in focus of Industrial Sector - *fostering the use of IIoT-Standards in public/private Track:*

IDTA Industrial Digital Twin Association

Core technology of Industry 4.0

AAS

ISO JTC1 IEC INFORMATION TECHNOLOGY STANDARDS

- **Submodel template specify, which and how information is described → SCI 4.0 → IDTA**

Standardised submodels form the content of an AAS for a specific assets

Digital Nameplate	contact information	documentation	Module Type Package (MTP)	OPC UA server data sheet
technical data	M-CAD, E-CAD, Fluid-CAD	product carbon footprint	modular simulation, virtual commissioning	capabilities

currently in review/ development

.. and many more in discussion

Mission of the IDTA

Human

Building a global community

For an international standard of the Industrial Digital Twin based upon IEC TC 65 WG24 Work

Technology

Open-Source-Software

AAS for all industrial companies at Eclipse Foundation regardless of their size

Open access to information models

Most comprehensive catalog on Github

Scaling

Market access through matching use cases

The AAS as a future prerequisite for new business with data

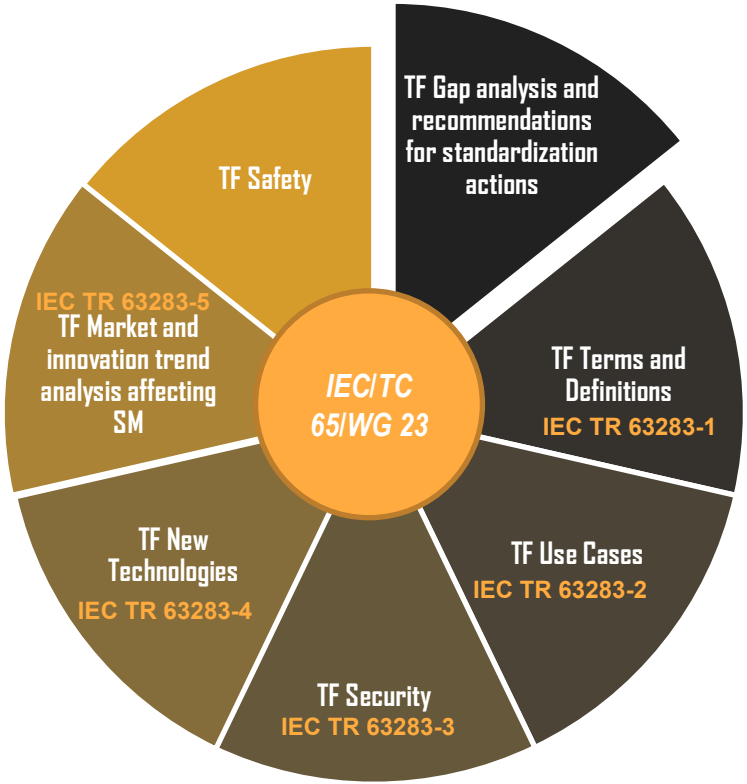
Value creation by training

The IDTA-Academy brings know-how to the public

Gap Analysis Activities
IEC/TC 65/WG 23 recommendations in progress

IEC/TC 65/WG 23 Smart Manufacturing (SM) Framework and Concepts:

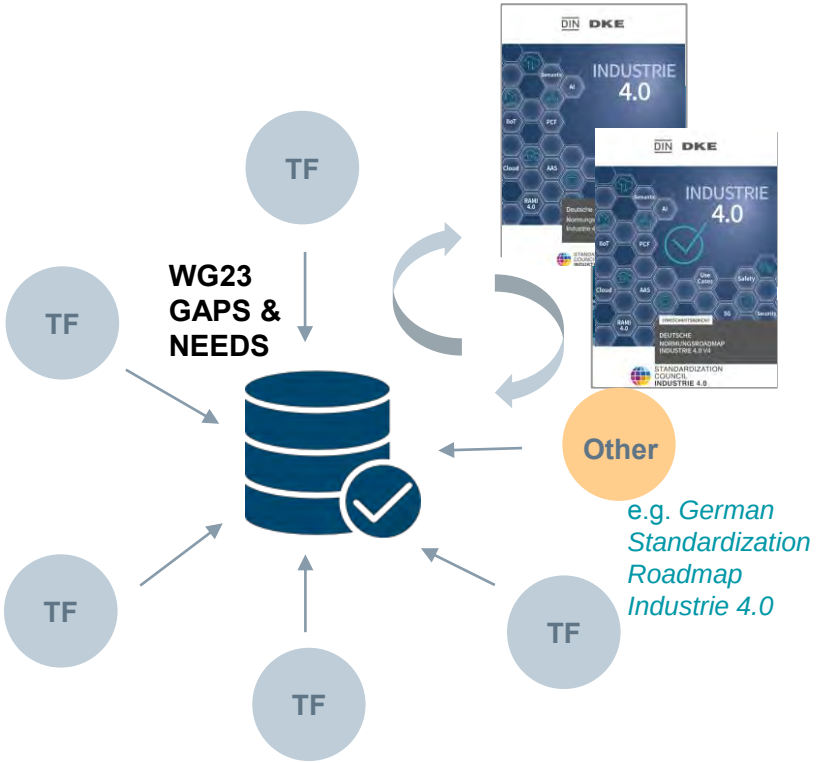
- has the goal to establish a framework for Smart Manufacturing (SM) concepts and standards within the scope of TC 65
- identifies SM concepts relevant for TC65 and analyzes their relations with TC 65 standards;
- collects recommendations within various active Task Forces
- new Task Force “Gap analysis and recommendations for standardization actions” started in December 2022



Gap Analysis Activities
German Standardisation Roadmap Industrie 4.0

IEC/TC 65/WG 23 draft approach includes experience collected in German national committee German Standardization Roadmap Industrie 4.0:

- Analysis of a standardization need/requirement (e.g. author, SDO/SSO origin, document origin, etc.)
- Decision making phase (e.g. decision on actions, priority, etc.)
- Actual formulation of a recommendation (e.g. editor, full vs. split recommendation, destination source, status, instruments for action, etc.)
- Further information (e.g. classification, related committees and consortia, etc.)



Liaison SC41/TC65
AG20 SELG1 – Industrial Sector

SC41

TC65
Industrial-process measurement, control and automation

The Asset Administration Shell (TC65 / WG24)

Dr. Michael Hoffmeister – WG 24 Convenor

IEC
International Electrotechnical Commission

Challenges for models within smart manufacturing

SC41

Example: Production of consumer product

product definition

engineering of product
- Product design
- processes
- machinery & equipment

engineering of production
- build
- commissioning

production operation
- operation
- maintenance
- rebuild

Challenge: Data integration and reuse along the lifecycle

Digital Master Produkt
- Construction
- mock ups
- simulations
- testing

Digital Manufacturing Twins
- M-CAD
- E-CAD
- Fluid CAD
- software
- manual work/ ergonomics
- robotics
- documents
- certificates
- layout planning
- material flow
- logistic simulations

Digital Instance Twins Products
- quality data
- usage data
- rework

Digital Instance Twins Components
- predictive maintenance
- assisted diagnosis
- process analysis
- process optimization
- artificial intelligence
- augmented reality

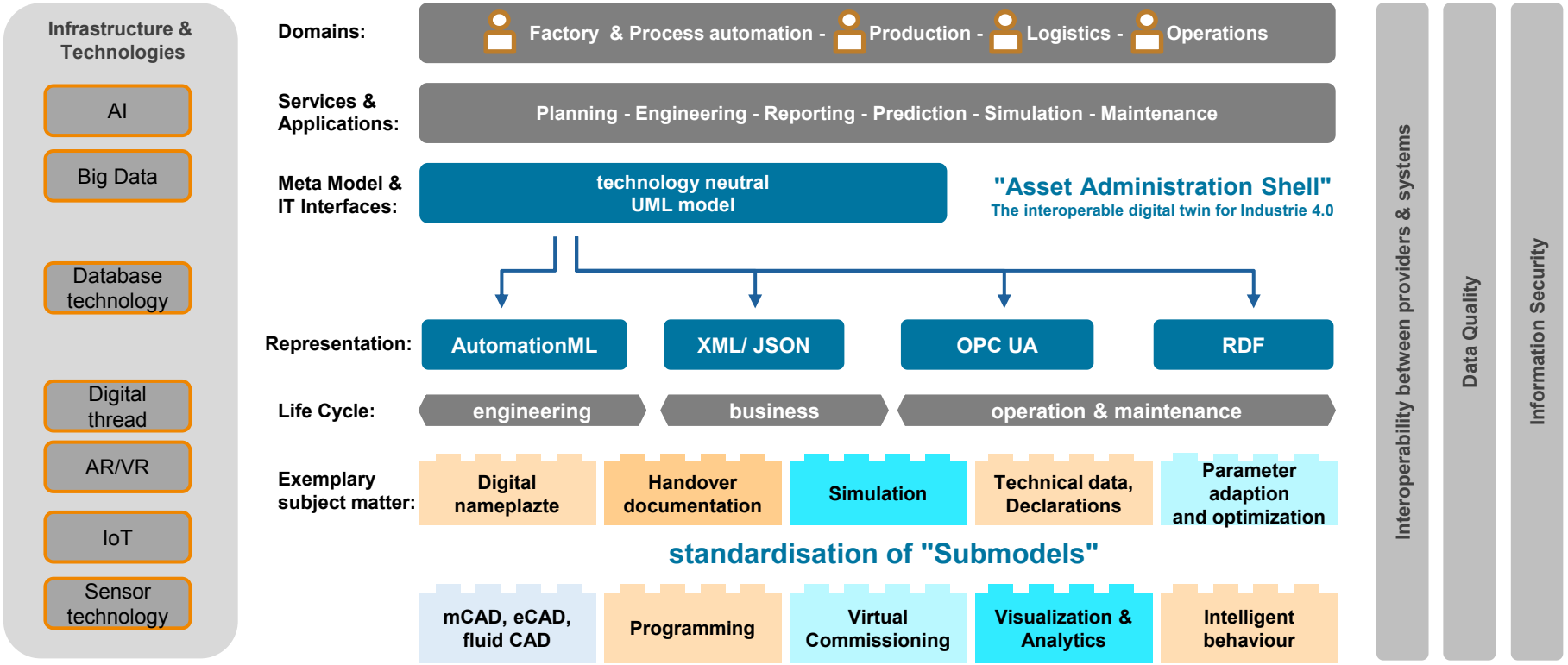
Challenge: Integration and interoperability of large number of components

Digital Twins of automation components
- M/E/F CAD
- function blocks
- documents
- technical data
- intelligent functions

Note: exemplary content, not complete

Original source: PROSTEP 2019

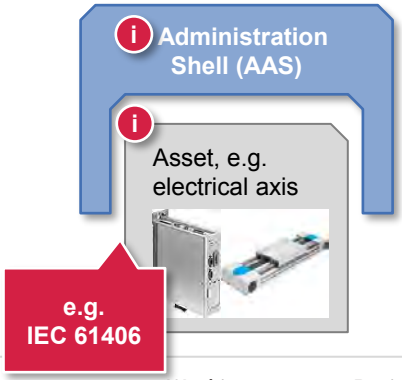
Basic principle of Asset Administration Shell (AAS) in an overall framework, such as common discussed within ISO / IEC groups

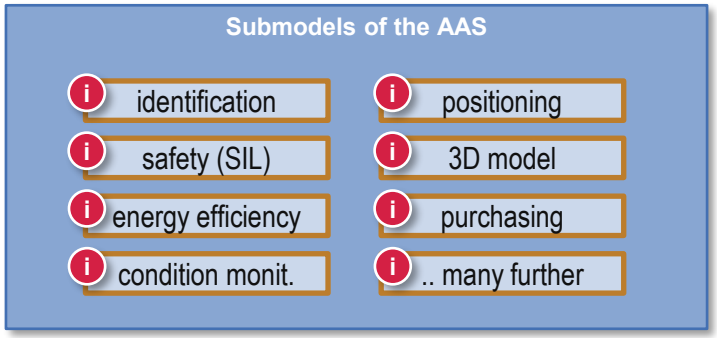


Architecture approach

TC65 / WG 23 and 24 Work → WG24: 62378-1/2/3

IEC TC 3 / SC3D → CDD





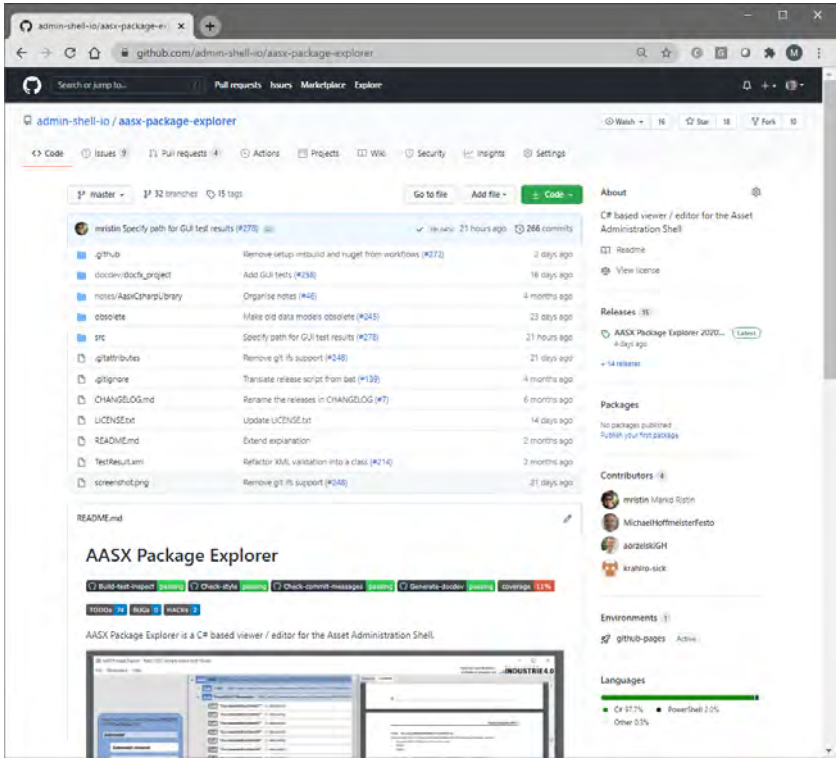
CLASS IEC ISO http://admin-shell.io

Submodel **Positioning**

Endpos. left	[mm]	5
Endpos. right	[mm]	200
Max. velocity	[mm/s]	15
Max. acceleration	[mm/s²]	33
No of completed jobs	[1]	4634
Avg. pos. lag.	[mm]	4.5

Committee	Working Groups	Project Leader	Current Status	Frcst Pub Date	Stability Date
SC 65E	WG 2	Mr Rainer Schrundner	CCDV	2023-03	2024

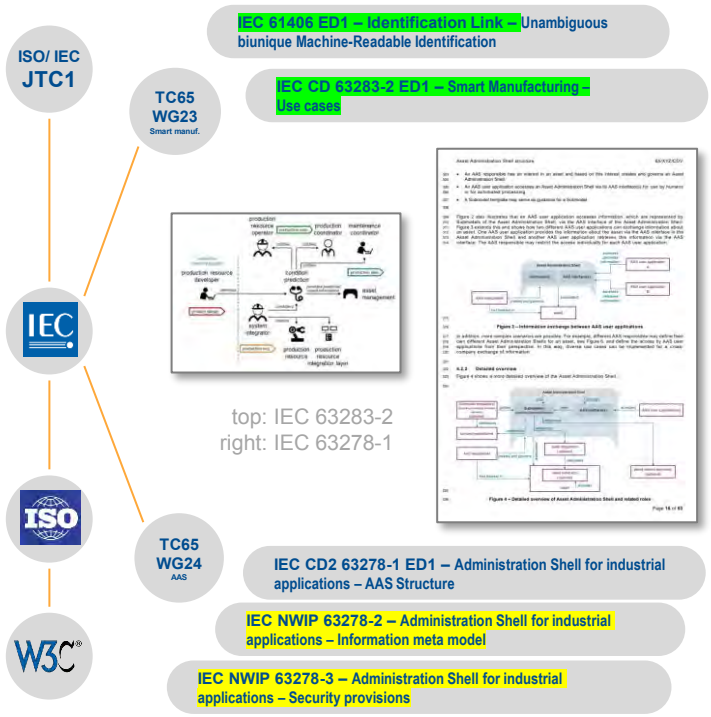
- **“Open Source” technologies and agility** – "used” in IEC TC 65 WG 24 and “Explorer” Toolchain



← „Toolbox“ in Open Source used for the development of reference Implementations in IIoT Sector

← Docker, Windows Presentation Foundation, etc.
← other Tools

Status of international standardization on “AAS”



top: IEC 63283-2
right: IEC 63278-1

- **IEC 63278-1 in CDV stage**
  - important milestone
  - translation and voting by NCs will happen
  - most likely: passing; no more voting before international standard (IS)
  - that is: IDTA activities can be based on an IS
- **IEC 63278-2/3 NWIP in voting**
  - continue progress of WG24 with further projects
- Liason requests with ISO 16400
- **Liaison exchange and contribution to JTC1/SC41/AG20 – Industrial Sector / Digital Twin for RA “Reference Architecture”**
- - Co-Work to SC41/WG3 “Functional View” on IoT RA
- - Co Work to SC41/WG6 - on Digital Twin RA “Reference Architecture” and UC “UseCases”
- **IEC 61406 “Auto-ID” Link** for **IIoT** and (Industrial) **Digital Twin**! developed in TC 65 WG23

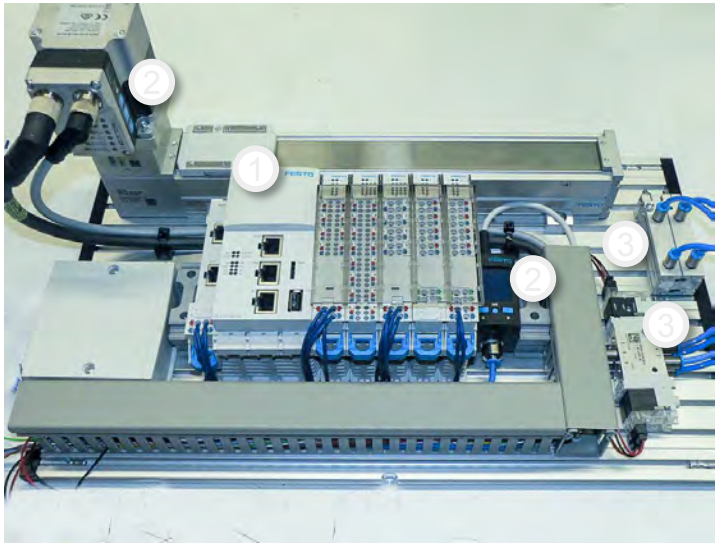
●Demonstration of the implementation (1)
Suitability for existing industrial assets – so “real world” IIoT / IDTw Implementations

Exemplary **typical automation equipment** in factory automation

(1) realtime PLC / edge with execution of **smart manufacturing functions**

(2) **active electrical drives and pneumatic sensors** integrated over multiple technologies with customer-specific parameters

(3) passive pneumatic components with **digital models for engineering and maintenance**



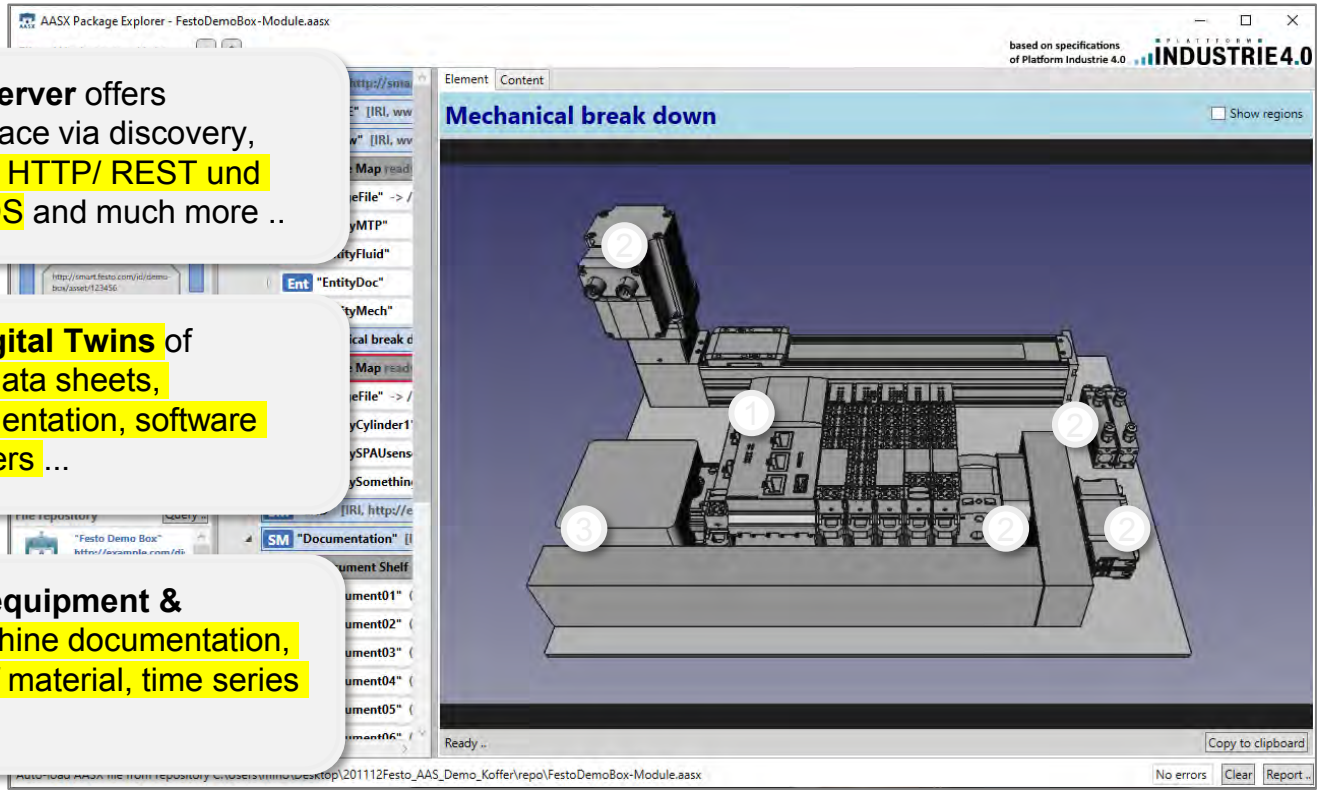
(FESTO Demo box for Asset Administration Shell)

●Demonstration of the implementation (2)
Communication & information aspects for “real world” IIoT / IDTw Implementations

(1) **PLC with AASX server** offers standardized interface via discovery, browser, OPC UA, HTTP/ REST und AMQP/ MQTT/ DDS and much more ..

(2) **Individualized Digital Twins** of components with data sheets, certificates, documentation, software versions, parameters ...

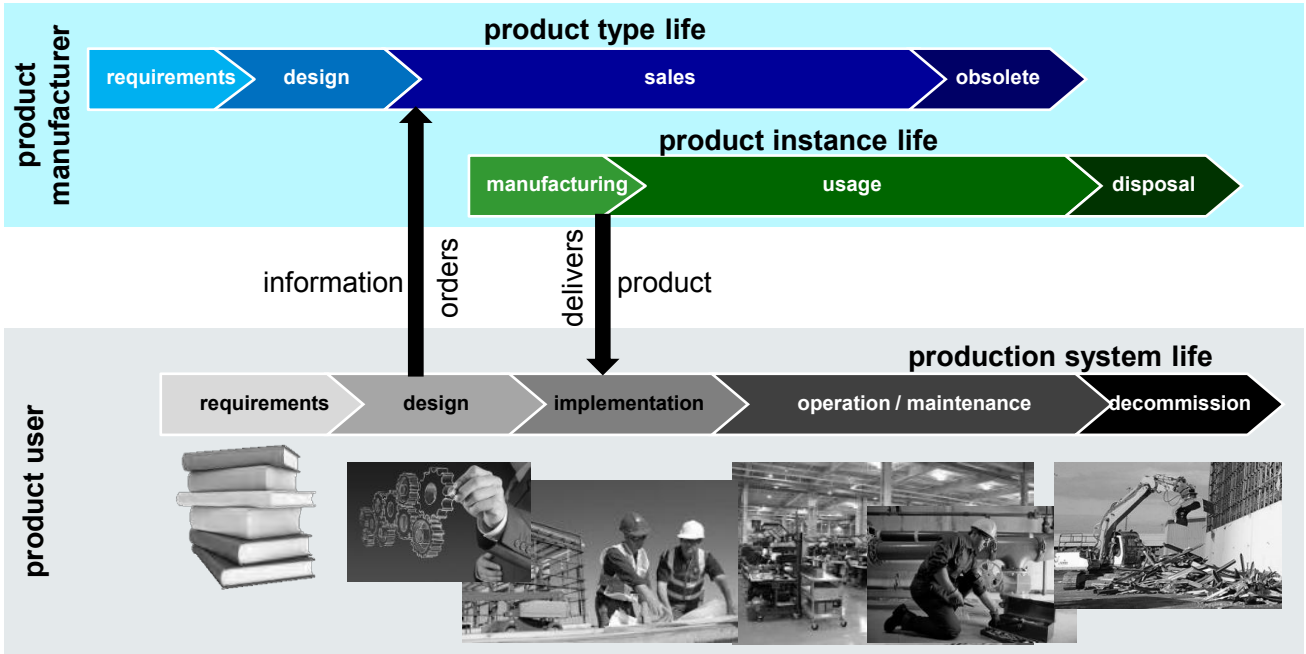
(3) **Digital Twin” of equipment & modules** with machine documentation, schematics, bills of material, time series data ...



(Open Source Tool AASX Package Explorer)

•IEC 63278-1 ED1

Life cycle aspects of the AAS

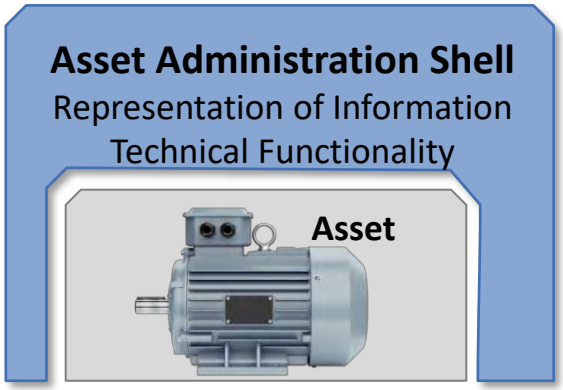


IEC TC65 WG24 IEC 63278-1 CD2 – Example of asset in product and production system life cycles
(asset = automation industry product)
(Note: formatting of this figure is subject to change in CDV)

The perspective of AAS standardization in Germany and IEC

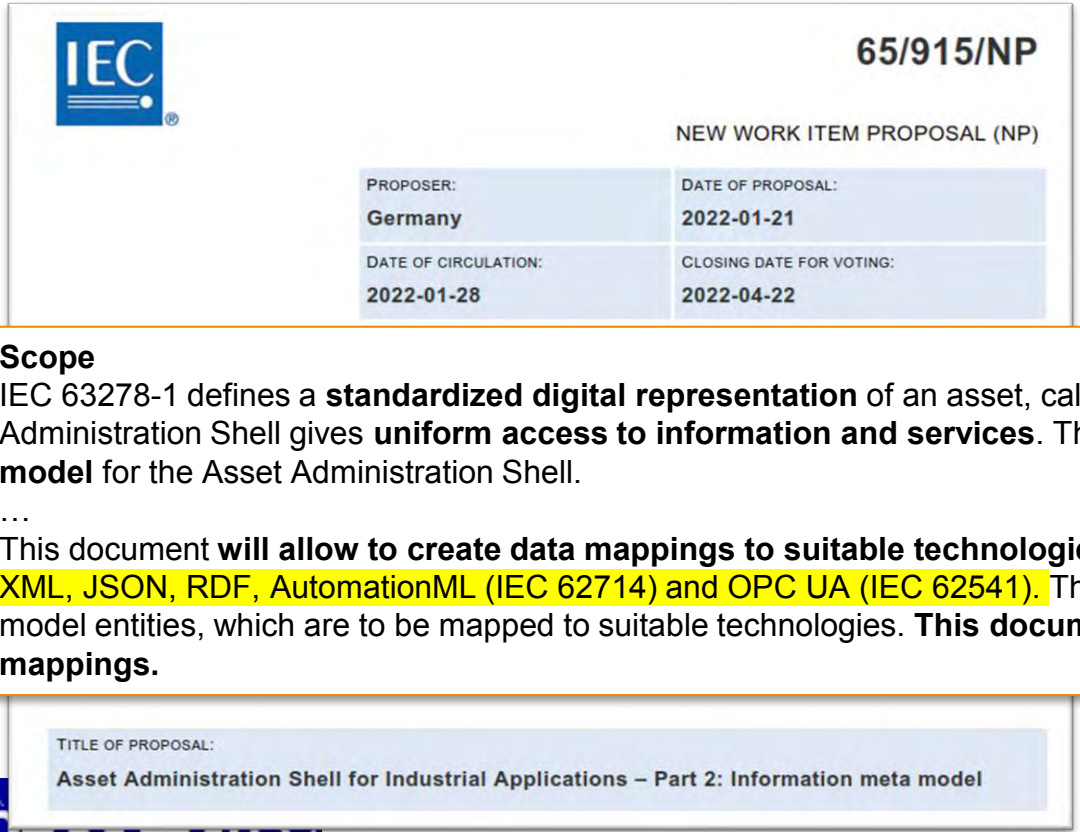
2nd Korea-Germany Joint AAS Standard-based Smart Manufacturing Forum

DR. JENS GAYKO – SCI 4.0
KOREA-GERMANY 2022-03-16



1. Extension of IEC 63278-Series
   - Interaction models
   - Infrastructure services
   - Mechanisms for security
   - …
2. Extension of repositories for semantic properties
   - Including a seamless co-existence of repositories
3. Modelling of aspects of assets / definition of sub-models
   - Digital nameplate
   - …
4. Link to GAIA-X
5. Mapping to different technologies
   - OPC-UA
   - AutomationML
   - …

New Work Item Proposal TC 65 - WG24 - IEC 63278-2
Information Meta Model



IEC

65/915/NP

NEW WORK ITEM PROPOSAL (NP)

PROPOSER:	DATE OF PROPOSAL:
Germany	2022-01-21
DATE OF CIRCULATION:	CLOSING DATE FOR VOTING:
2022-01-28	2022-04-22

TITLE OF PROPOSAL:

Asset Administration Shell for Industrial Applications – Part 2: Information meta model

New work item proposal (NP) for IEC 63278-2

- Information meta model
- Closing date 2022-04-22

Scope

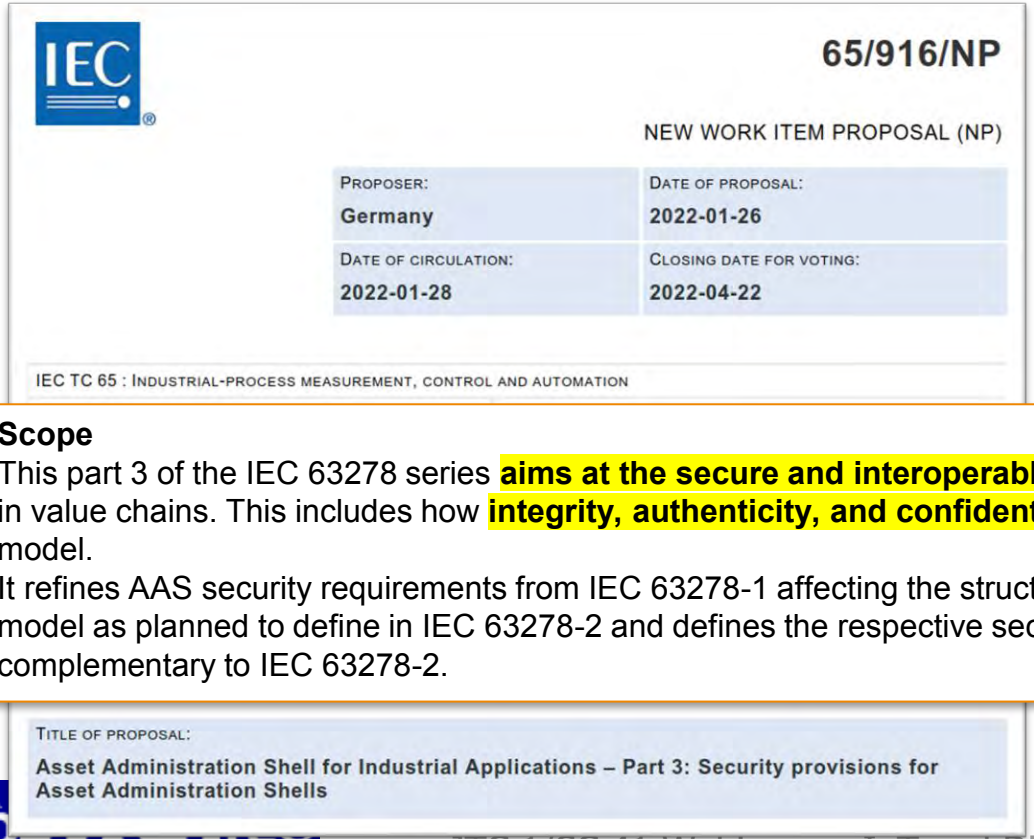
IEC 63278-1 defines a **standardized digital representation** of an asset, called Asset Administration Shell. The Asset Administration Shell gives **uniform access to information and services**. This document **defines an information meta model** for the Asset Administration Shell.

…

This document **will allow to create data mappings to suitable technologies** to be used in life cycle phases of an asset: XML, JSON, RDF, AutomationML (IEC 62714) and OPC UA (IEC 62541). This document will define the information meta-model entities, which are to be mapped to suitable technologies. **This document does not describe individual data mappings.**

New Work Item Proposal TC 65 - WG24 - IEC 63278-3

Security provisions



IEC

65/916/NP

NEW WORK ITEM PROPOSAL (NP)

PROPOSER:	DATE OF PROPOSAL:
Germany	2022-01-26
DATE OF CIRCULATION:	CLOSING DATE FOR VOTING:
2022-01-28	2022-04-22

IEC TC 65 : INDUSTRIAL-PROCESS MEASUREMENT, CONTROL AND AUTOMATION

TITLE OF PROPOSAL:

Asset Administration Shell for Industrial Applications – Part 3: Security provisions for Asset Administration Shells

New work item proposal (NP) for IEC 63278-3

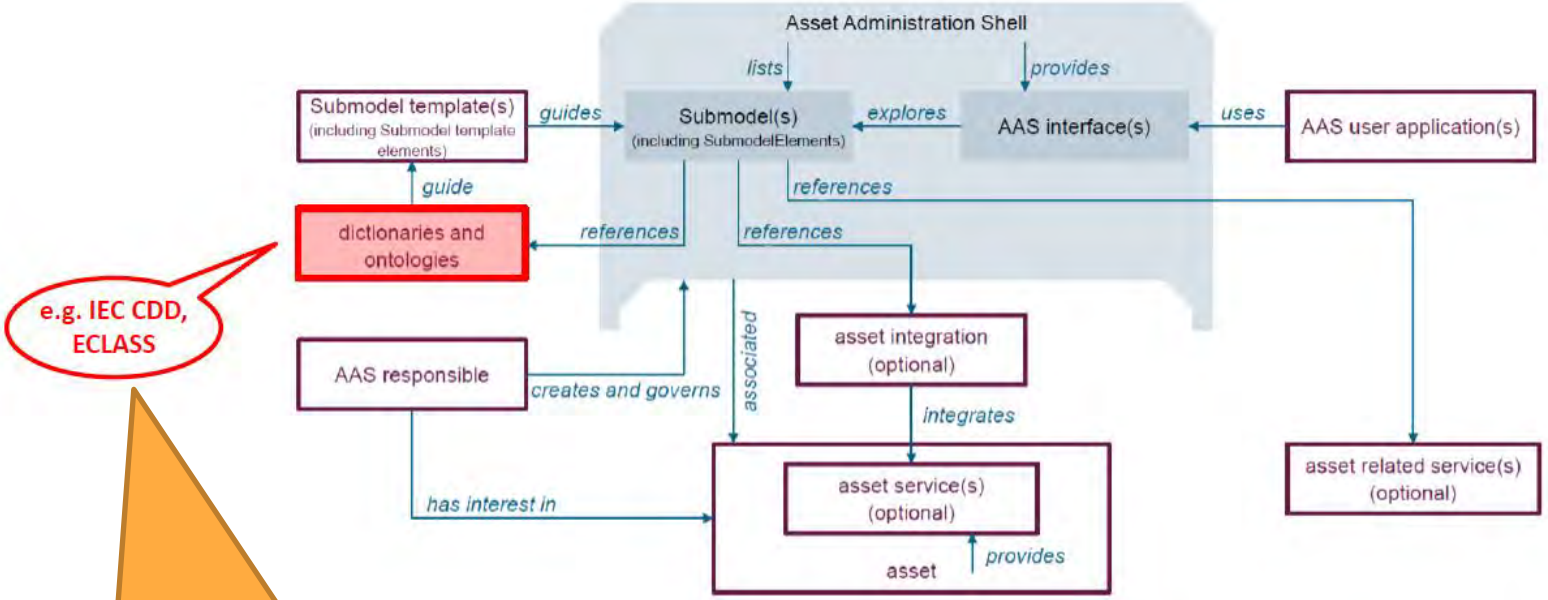
- Security provisions for Asset Administration Shells
- Closing date 2022-04-22

Scope

This part 3 of the IEC 63278 series **aims at the secure and interoperable exchange of information** between stakeholders in value chains. This includes how **integrity, authenticity, and confidentiality** are realized within the AAS information model.

It refines AAS security requirements from IEC 63278-1 affecting the structure of the information model as planned to define in IEC 63278-2 and defines the respective security information model complementary to IEC 63278-2.

IEC63278-1 - AAS: Scope



[Source: draft of IEC 63278-1]

Dictionaries play a central role for semantic interoperability

COOPERATION ON REPOSITORIES FOR SEMANTIC PROPERTIES

CLASS

IEC CDD – Common Data Dictionary

Project COMDO

Status report COMDO project

G. Rossi - IEC/SC 3D secretary

IEC CDD and ECLASS

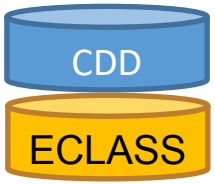
Two dictionaries (databases)

- complementing each other
- based on the same foundation

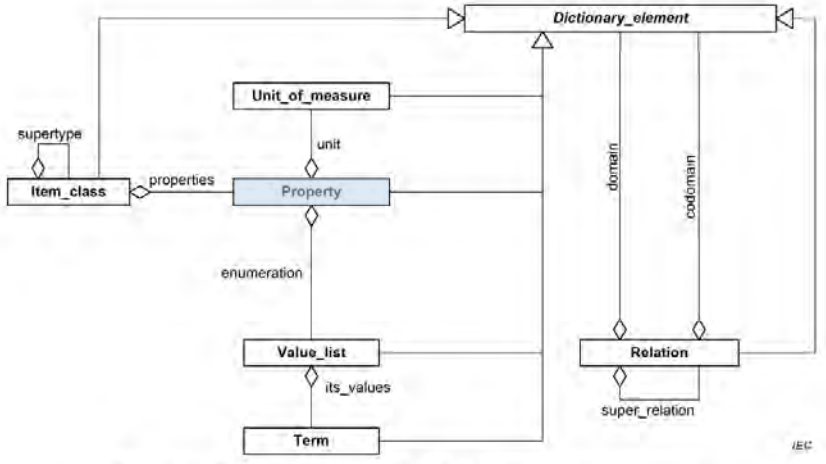
They have a data model based on IEC 61360 and ISO 13584.

They are:

- IEC CDD
- ECLASS



CDD – Common Data Dictionary

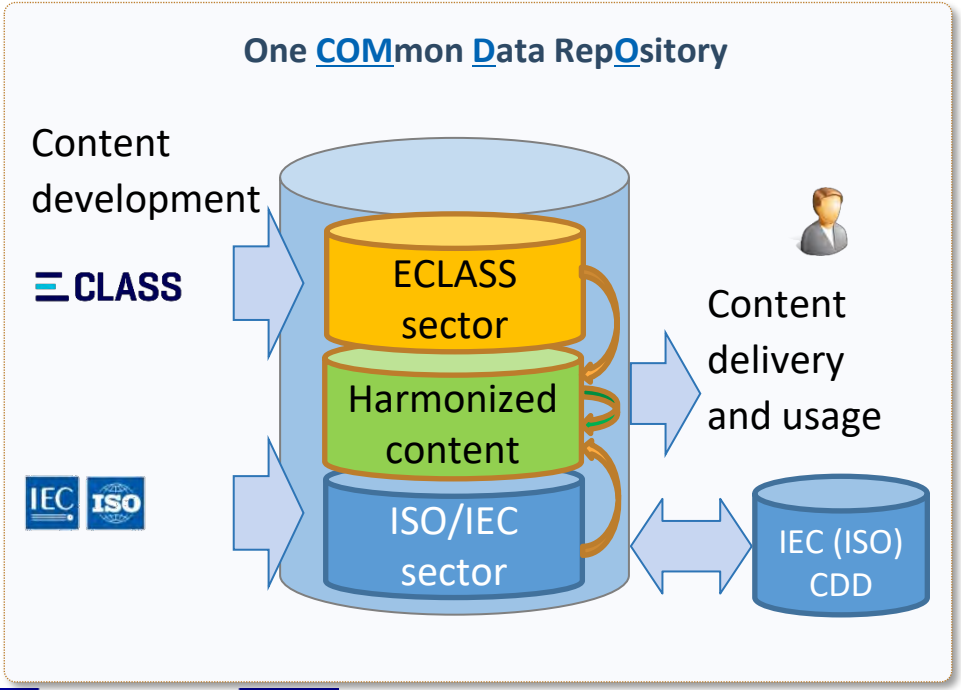


Simplified information model
[Source: IEC 61360-1]

How to achieve consistency among the dictionaries?

New Approach: Projekt COMDO

"To meet customer requirements, a single common data repository is strongly required"

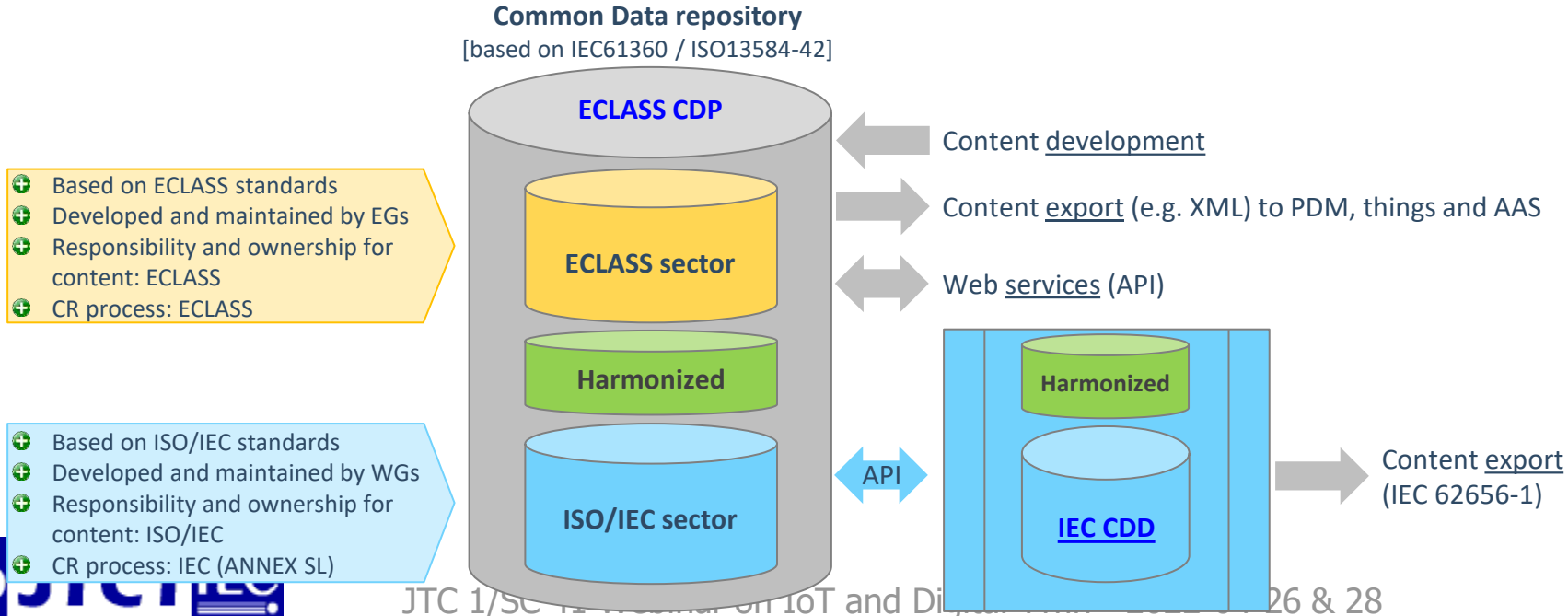


- Integration of high-quality content created and maintained by ISO/IEC TCs based on international consensus
  →No need to decide where to download the CONTENT
- Potential for harmonizing content
  → seamless integration of content from ISO, IEC and ECLASS

COMDO (Common Data Repository): The PHASE 2

In PHASE 2 of the project shall introduce a harmonized sector. Both dictionaries will provide content for this harmonized sector. Content for IEC CDD is developed with the GUI of IEC CDD and via the ECLASS CDP development application.

Synchronization between ECLASS and IEC CDD is performed regularly.



AAS Submodels and the Support by IEC CDD
Summary

- The AAS shall become an international standard developed by IEC/TC 65/WG 24 in IEC 63278-series
- Selected AAS sub-model templates shall also become international standards
  - Example: „Submodel Digital Nameplate“ (developed by IEC/SC 65E/WG 2)
- IEC/SC 3D proposes to develop such selected AAS sub-model-templates as DB-standards with publication in new IEC CDD domain IEC 61360-7
- IEC 61360-7 under ballot
- PT 61360-7 is established
- A publication from IEC/SC 3D similar to the white paper “Modelling the Semantics of Data of an AAS with Elements of ECLASS” is under consideration

2022 Standardization Council Industrie 4.0

Digital Twin Roadmap

a) SC41 DT Workshop Preparation

b) JWG21 URMSM Commenting

c) DKE SemNorm Project 2021

Digital Twin Contributions

IEC/TC65+TC184 JWG21

IEC 63339 URMSM

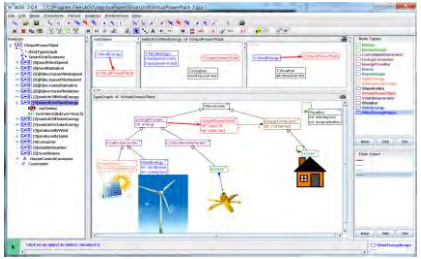
Commenting 65/900/CD

Contributions by Jan de Meer (DE), Olga Meyer (DE), Ulf Carlsson (SE), Sha Wei (CN) and Detlef Tenhagen (SC41 Convenor)

(2022-02-16)

Convergence of Semantic Interoperability based on Semiotic Relationships (Morphisms)

DKE SemNorm, Jan deMeer, ssl.eu GmbH & Prof. Chr. Diedrich, Slide Set 3.11.2020



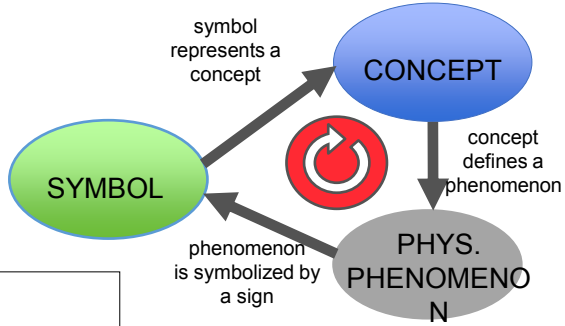
$$F_1 = \frac{1}{m \cdot c_p} \cdot (k \cdot A \cdot (T_\infty - T_H) + \epsilon \cdot \sigma \cdot A \cdot (T_\infty^4 - T_H^4) + \alpha \cdot Q)$$

$$F_2 = \frac{1}{\tau} \cdot (T_H - T_C)$$

OT semantical modelling

Graph&ADT Theories,

Semantics: class of ADT(SPEC)



OT ontological modelling

a) descriptive OWL DL, XML, UML, …

b) axiomatic/predicate/equational logic **SPEC=(S,OP,E)**

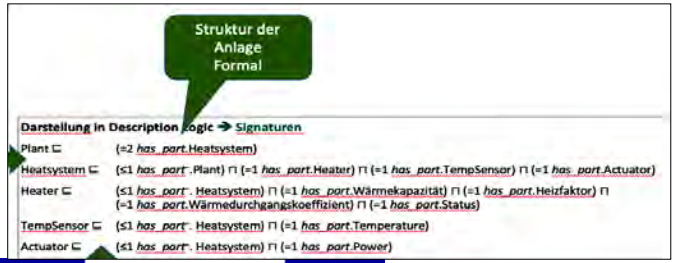
c) standard natural language terms

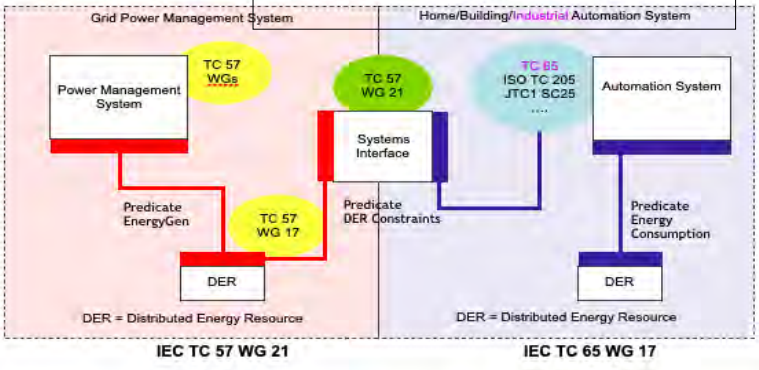
Thing/ Asset

OT/cyber-physical modelling

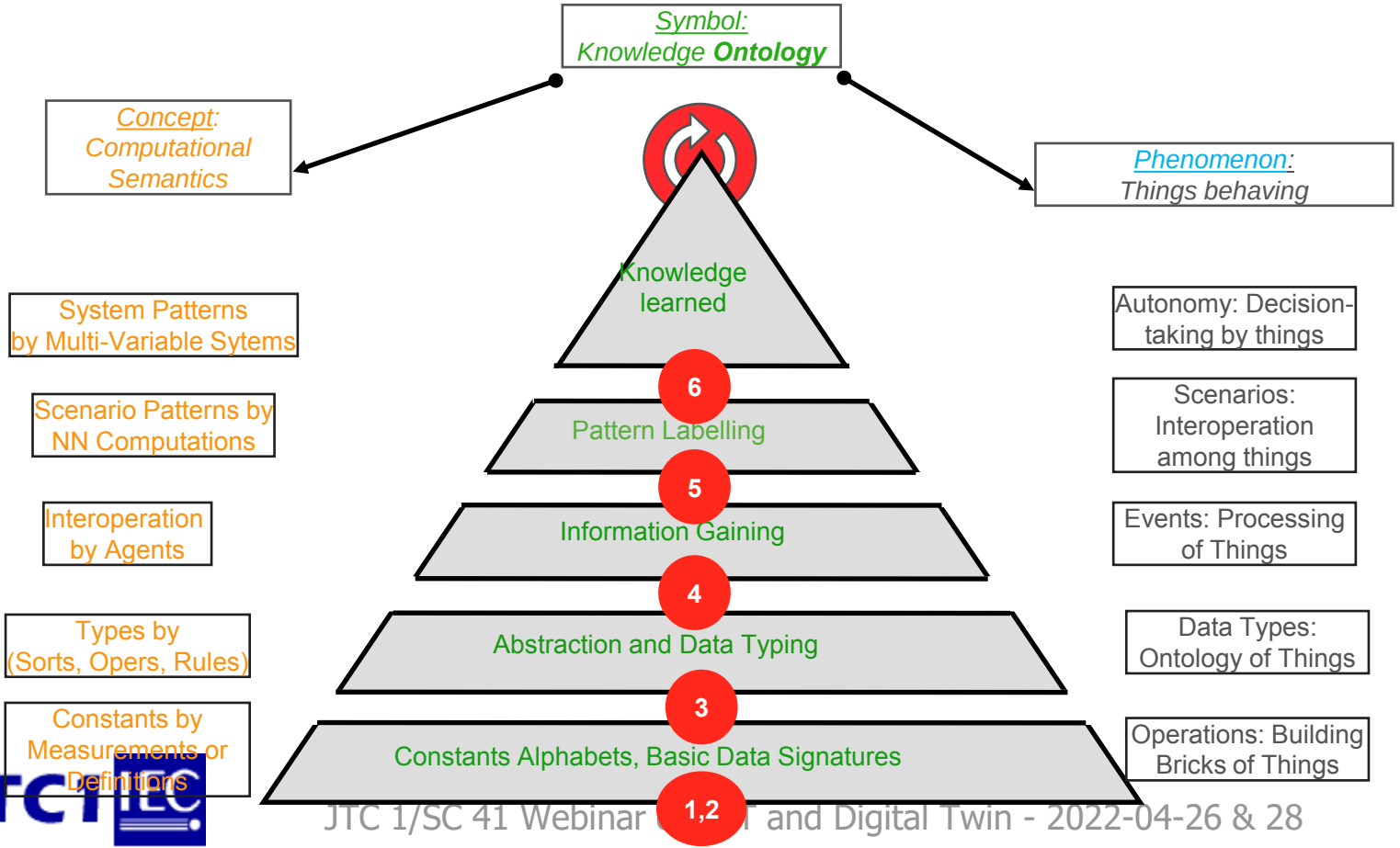
mechanic-electric

Interpretation I of a theory SPEC





Knowledge Ontology (K-Pyramid) explained by the three colored corners of the Semiotic Triangle with Concept & Symbol & Phenomenon




Smart society
Smart healthcare
Smart transport
Smart territory improvement
Smart payments
Smart buildings
Smart energy
Thank You!
https://www.iot-now.com/2017/09/25/67259-everything-can-smart-key-traits-newest-smart-cities-part-1/

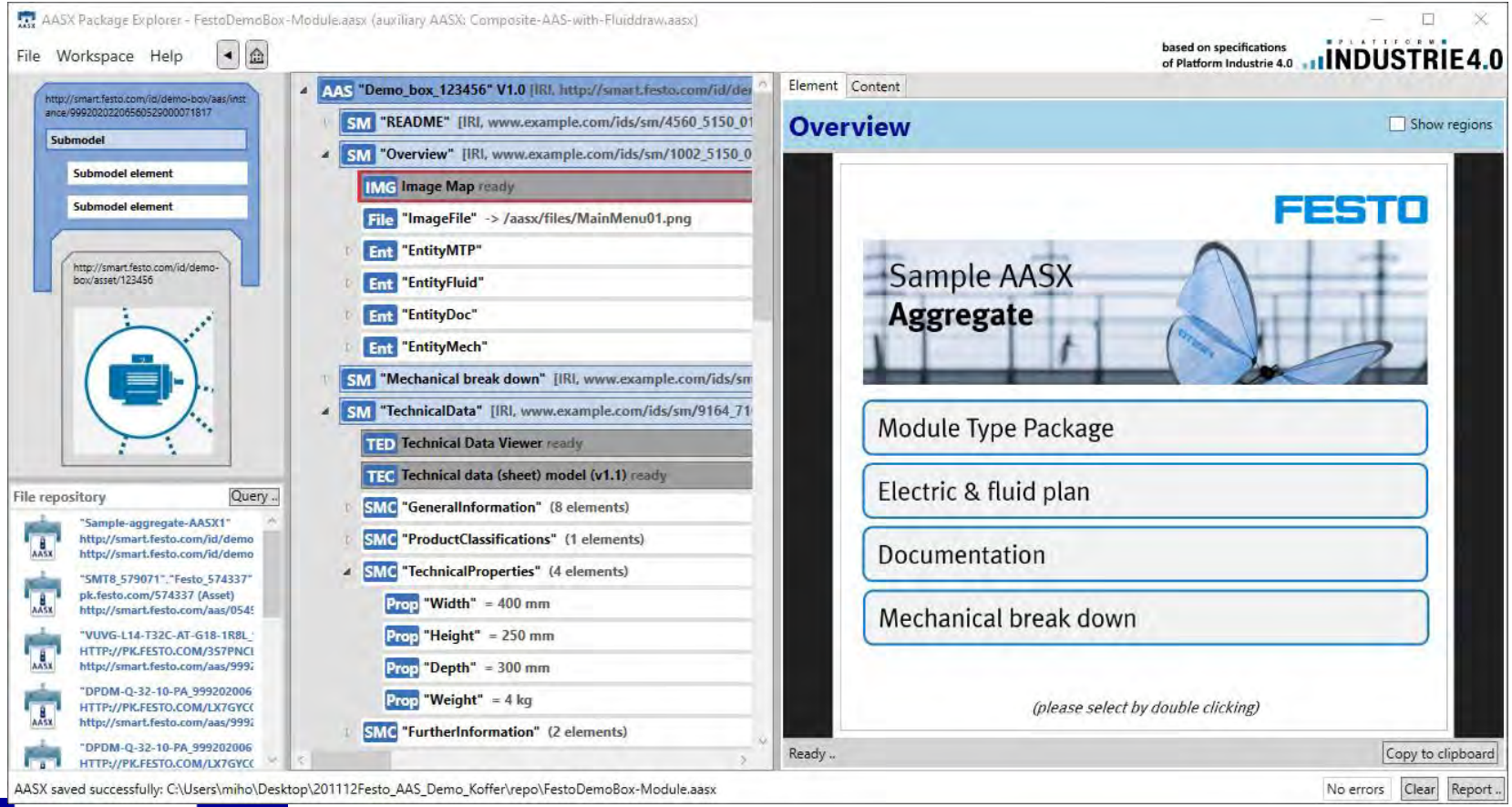
ANNEXES

Contact to: Standardization Council I4.0

Dr. Jens E. Gayko;
Jens.Gayko@vde.com
Standardization Council Industrie 4.0
contact@sci40.com
www.sci40.com

IDTA Contact

●Demonstration of the implementation (3)



Convergence of Semantic Interoperability based on the Semiotic Conceptual Model
DKE SemNorm, Jan deMeer, ssl.eu GmbH

- Concept-related Expression:= artifact of semiotic domain ‚symbol‘
- Concept-related part of a thing:= artifact of the semiotic domain ‚thing‘
- represented phenomenon:= designator to parts of things of the semiotic domain ‚thing‘
  - Concept:= designator of an artifact of the semiotic domain ‚semantics‘ obeying 2 morphisms:
    - in relation with a concept-related expression
    - in relation with a concept-related part of a thing;
  - Domain:= designator of a Knowledge space of the flattened data pyramid (i.e. Information Model?)
    - that comprises the 5 other spaces regarding: Pattern, Information, Data Type, Vocabulary
    - (URMSM Aspects Collection/Dimension?)
  - Context:= ‚Surroundings‘ of things and happenings/events in the environment of things
  - Data:= Alphabet of messages represented by constants, formats, codes etc.
  - Information:= Observation of Probabilistic Events represented by predicates
  - Pattern:= Data Model learned from recognizing pattern similarities
  - Knowledge:= Decision-making Capability represented by cause-effect implications

German Standardization Roadmap Industrie 4.0
Interoperability and Asset Administration Shell in focus

SC41

Progress Report – finalizing
(Hannover Fair 2022)

STANDARDIZATION COUNCIL INDUSTRIE 4.0

- Review of the recommendations for actions addressed in edition 4
- Report on work done related to the recommendations
- Exploration of currently emerging new areas of interesting for edition 5
- Appointment of a steering committee for the review

Edition 5 -
work in progress (2023)

STANDARDIZATION COUNCIL INDUSTRIE 4.0

- Update and review of the activities since the last edition
- Report on the work done regarding the recommendations
- Identification of gaps and formulation of recommendations, including a detailed description of actions taken
- Specific focus on emerging and key standardization areas concerning national needs

See downloads on SCI 4.0 website

ISO/IEC SC41

IoT and Digital Twin Trustworthiness

International Electrotechnical Commission

Agenda

Introductions and current activities:

- Erin Bournival (5 mins)
- François Coallier (5 mins)
- Antonio Kung (5 mins)
- Asahiko Yamada (5 mins)

Trustworthiness Panel (20 mins)

François Coallier

- **Full professor of Software and IT Engineering at the École de technologie supérieure in Montréal, Québec Canada**
- **Chair of JTC 1/SC41 Internet of Things and Digital Twin**
- **Convener of IEC/SEG12 BioDigital Convergence**
- **Former chair of JTC 1/SC7 Software and Systems Engineering**
- **Editor of (soon to be published)** ISO/IEC DTS 5723 Trutsworthiness -vocabulary

Why is ‘Trustworthiness’ important

In the last 20 years:

- Increase in system (and systems of systems) complexity – e.g. 'smartness'
- Systems become more IT intensive (IoT,..), distributed and more ‘cyber’ in nature.
- Systems become more data intensive (BIG Data) and data driven
- Systems integrate more complex technologies, such as AI
- …

What is Trustworthiness?

trustworthiness

ability to meet stakeholders' expectations in a verifiable way

Note 1 to entry:

Depending on the context or sector, and also on the specific product or service, data, technology and process used, different characteristics apply and need verification to ensure stakeholders' expectations are met.

Note 2 to entry:

Characteristics of trustworthiness include, for instance, accountability, accuracy, authenticity, availability, controllability, integrity, privacy, quality, reliability, resilience , robustness, safety, security, transparency and usability .

[SOURCE: ISO/IEC DTS 5723:2021, 3.1.1]

Erin Bournival

Distinguished Engineer
Dell Technologies
United States

- **Convenor, ISO/IEC JTC1 SC41 WG3**
- **Chair, Industry IoT Consortium (IIC) Healthcare/Standards/Liaison/Vocabulary**
- **Chair, Digital Twin Consortium Healthcare/Life Sciences**
- **Vice Chair and Secretary, INCITS IoT (US mirror to SC41)**
- **INCITS Executive Board member**
- **IIC Steering Committee member**

What is IoT Trustworthiness?

- Definition of (general) Trustworthiness
  - ability to meet stakeholder expectations in a verifiable way

- Definition of IoT Trustworthiness
  - trustworthiness of an IoT system with characteristics including security, privacy, safety, reliability and resilience

SC41 Trustworthiness Activities

Within SC41 - Trustworthiness-related standards

- ISO/IEC 30141 IoT Reference Architecture (2nd ed in development)
- ISO/IEC 30147 Integration of IoT trustworthiness activities in ISO/IEC/IEEE 15288 system engineering processes (published)
- ISO/IEC 30149 Trustworthiness Principles (in development)
- ISO/IEC 30168 Generic Trust Anchor API (in development)
- Policy and Behavioral Interoperability (Preliminary Work Item)

Related Trustworthiness Work

Work both internal to and external to SC41:

- ISO/IEC JTC1 SC41 LCG (Liaison Contributing Group) on Trustworthiness (internal)
- ISO/IEC JTC1 SC27 IT Security techniques (via liaison)
- ISO/IEC JTC1 WG13 Trustworthiness (via liaison)
- Others?

YAMADA, Asahiko (JP)

- Affiliation: Invited senior researcher at Cyber Physical Security Research Center, National Institute of Advanced Industrial Science and Technology, JAPAN
- Technical background: system security (SC 27), biometrics (SC 37), and IoT (SC 41)
- WG 3 expert in SC 41
- Editor of ISO/IEC 30147:2021

ISO/IEC 30147: 2021

- Title: Integration of IoT trustworthiness activities in ISO/IEC/IEEE 15288 system engineering processes
- This document
  - Explains why it is difficult to attain trustworthiness in IoT systems, and
  - Supplements activities specified in ISO/IEC/IEEE 15288:2015 System life cycle processes to realize trustworthiness in IoT systems.

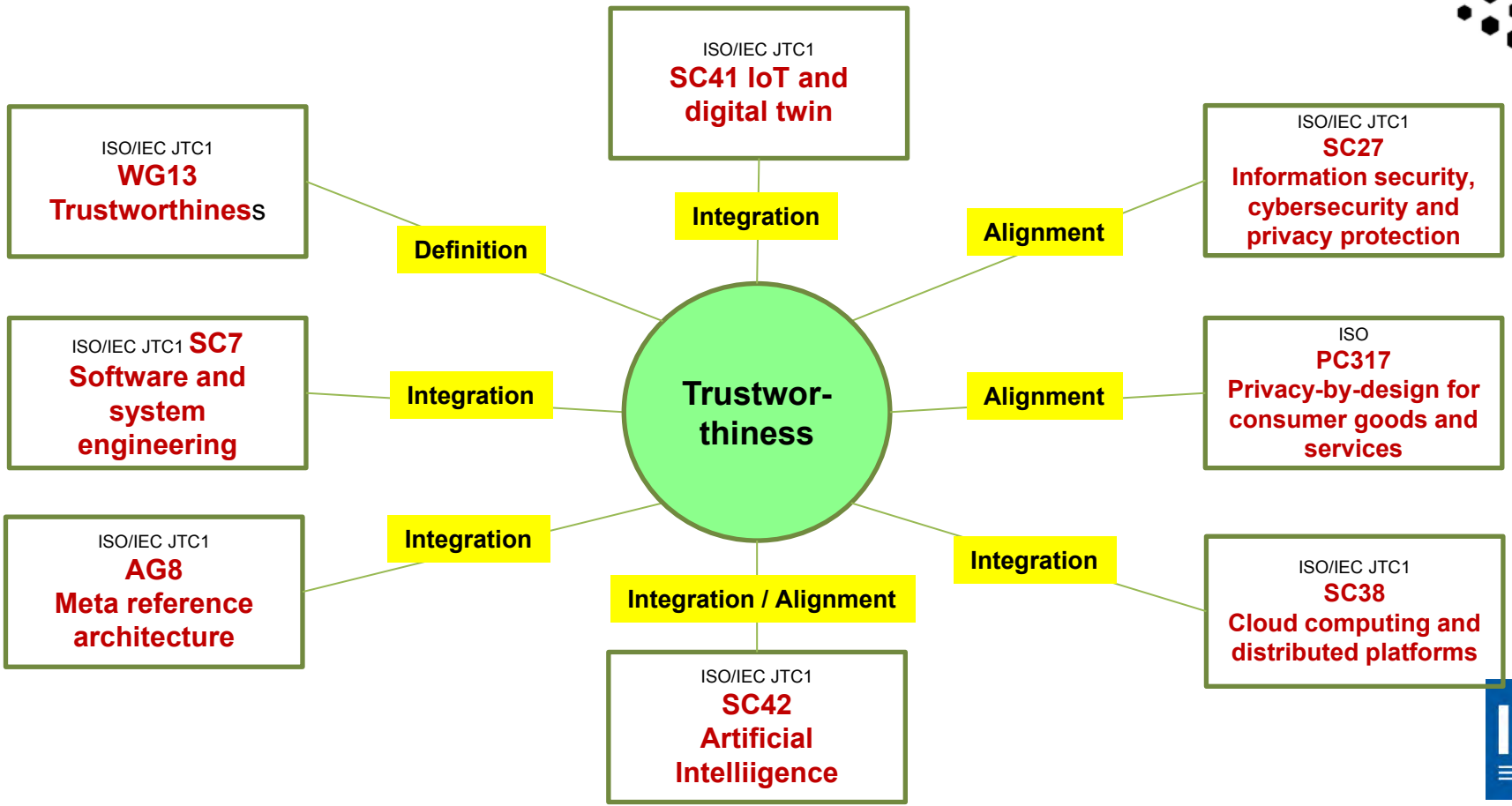
Processes in ISO/IEC/IEEE 15288

- 30 processes are specified in ISO/IEC/IEEE 15288 and categorized into:
  - Agreement processes (2),
  - Organizational project-enabling processes (6),
  - Technical management processes (8), and
  - Technical processes (14).
- These processes can be optionally chosen and applied to any system engineering.
- To each process, tasks and activities are specified to make a system work well.

Speaker

- CEO Trialog
  - IoT systems: Smart meters, Vehicle charging, Connected vehicles
  - Standardisation topics: Architecture, IoT, Digital twin, AI, Trustworthiness, Security and Privacy
- ISO/IEC SC 41 - Internet of things and digital twin
  - 21823-3 Semantic interoperability
  - 30149 IoT trustworthiness principles
  - 30141 IoT reference architecture
  - Behavioral and policy interoperability
  - Guidance for IoT and digital twin use cases
  - Integration of data space
- ISO/IEC SC27 and ISO PC317 – Security and privacy
  - 5896 cybersecurity assurance of complex systems
  - 27550 Privacy engineering
  - 27556 Privacy preference management
  - 27561 POMME – Privacy operationalisation model and methods for engineering
  - 27570 Privacy guidelines for smart cities
  - 27563 Security and privacy in AI use cases
  - 27564 Privacy models
  - 31700 Privacy-by-design for consumer goods and services
- ISO TC22 Automotive
  - 21434 Cybersecurity engineering

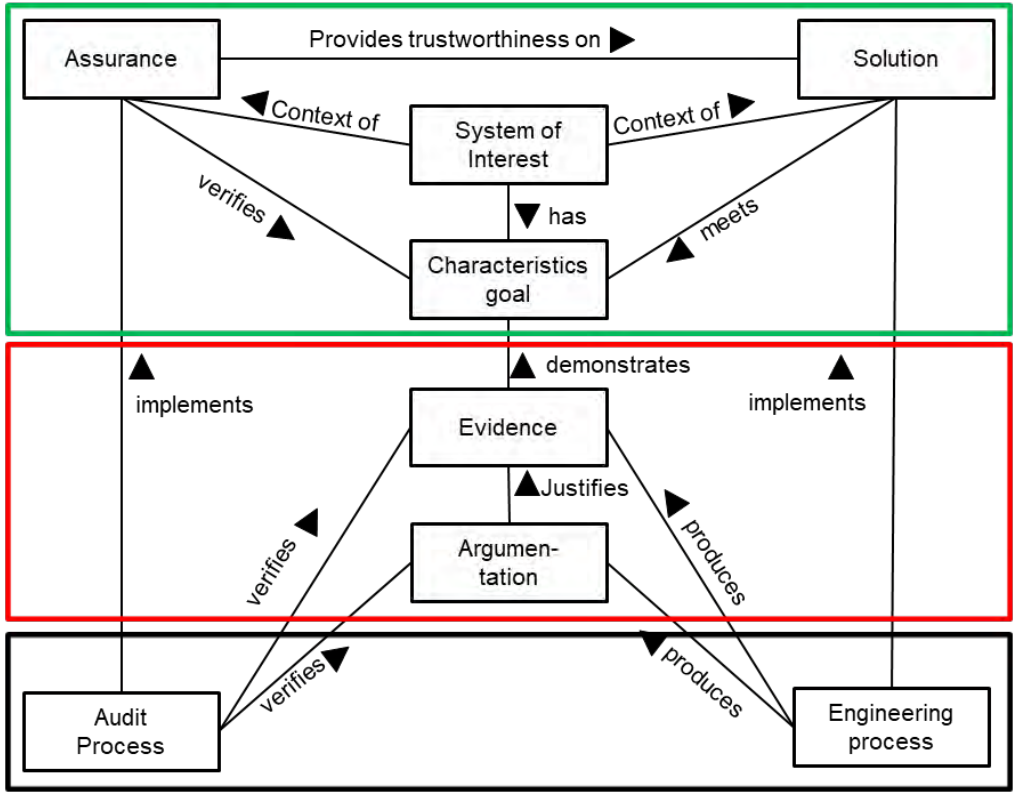
Standardisation Maze

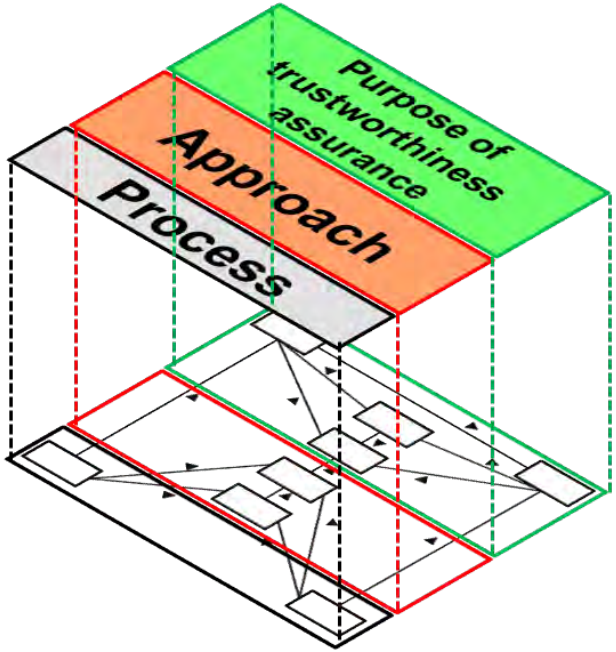


Expert contribution at architecture level

- Characteristics level
  - Architecture representation of trustworthiness
- Operation level
  - Trustworthiness characterization
  - Trustworthiness assessment
  - Trustworthiness engineering
  - Trustworthiness assurance (see next slide)
  - Trustworthiness maturity

Expert contribution: Conceptual model for trustworthiness assurance





Sourced from: PWI 5896
ISO/IEC JTC1 SC27 WG3

On-going projects

- **ISO/IEC 30149 Internet of Things (IoT) - Trustworthiness Principles**
  - Editor: Faud Khan
  - Co-editors: Ekaterina Rudina, Antonio Kung
  - Scope: his document provides principles for IoT trustworthiness based on ISO/IEC 30141 – IoT Reference
  - Committee Draft StageTrustworthiness Interoperability
  - Planned publication date Dec 2023
- **AhG 26 Trustworthiness interoperability**
  - Convenor: Antonio Kung
  - Started in mid 2020 after a joint discussion between WG3 and WG4
  - Concluded in November 2021 with a final report (2021-10-28)
  - Report is an input to PWI IoT policy and behavioural interoperability (SC41/WG4)

Panel

ISO/IEC JTC1 SC41

International Electrotechnical Commission