글로벌 ICT 표준 컨퍼런스 2023

Global ICT Standards Conference 2023

ICT Standards Insight
Session 2: ISO/IEC's IoT and Digital Twin Standardization

ISO/IEC Standardization strategy on IoT and Digital Twin

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주최 과학기술정보통신부 Ministry of Science and ICT · 특허청 Korean Intellectual Property Office
주관 국립전파연구원 National Radio Research Agency · TTA · IITP · KEA · kista · ETRI

Index

- The context: ISO/IEC JTC 1
- Nature of the Internet of Things (IoT)
- IT/OT Convergence and the IIoT
- Digital Twin
- Strategic Approaches
- Current Status
- Future Directions

SUMMARY

The Internet of Things (IoT) is a system concept that incorporate many IT and, for some applications, OT technologies. IoT systems are network intensive, and data driven.

The processing of this data, through advanced analytics and Digital Twin technologies, provide value and enable a ‘smarter’ world.

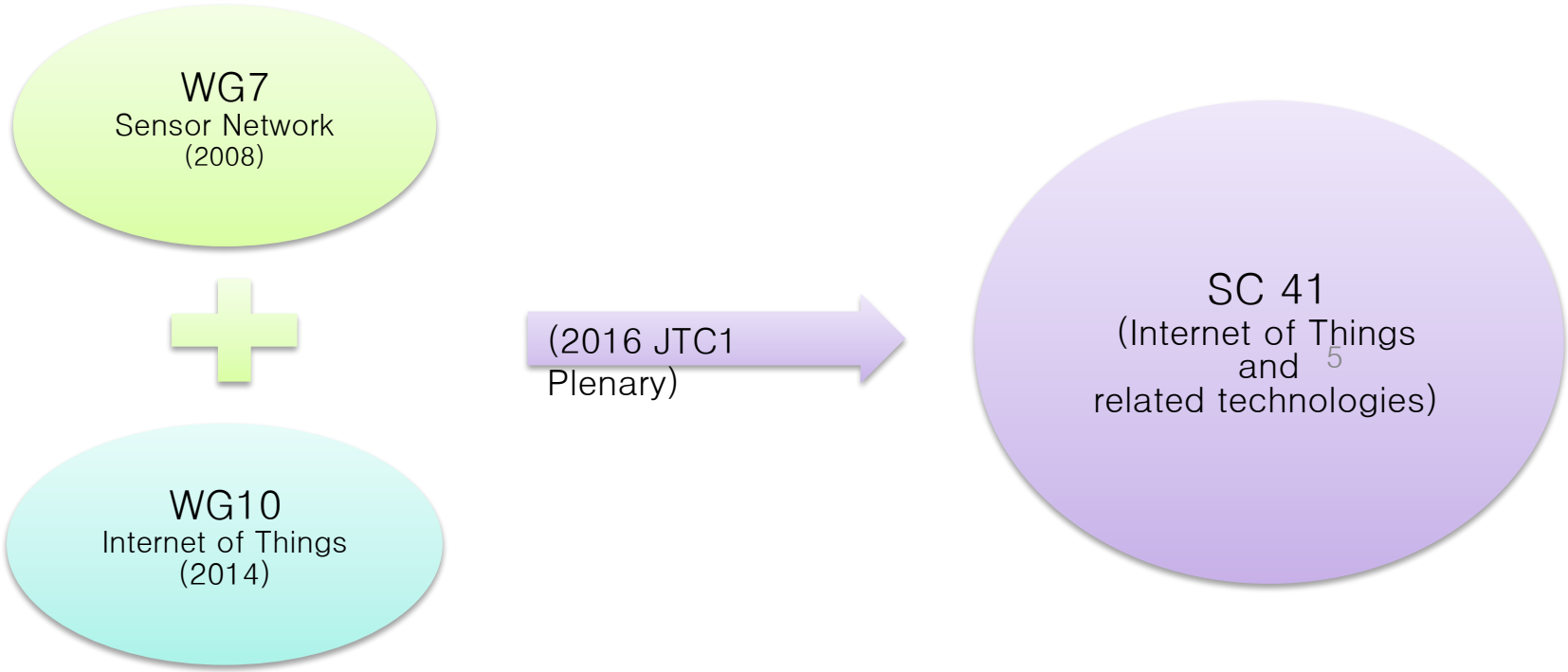
This presentation will outline ISO/IEC JTC 1/SC 41 standardization strategy on IoT and Digital Twin.

Technical Areas	ISO/IEC JTC 1 (Information Technology) Subcommittees and Working Groups
Application Technologies	SC 36 - Learning Technology
Cultural and Linguistic Adaptability and User Interfaces	SC 02 - Coded Character Sets SC 22/WG 20 – Internationalization SC 35 - User Interfaces
Data Capture land Identification Systems	SC 17 - Cards and Personal Identification SC 31 - Automatic Identification and Data Capture Techniques
Data Management Services	SC 32 - Data Management and Interchange
Document Description Languages	SC 34 - Document Description and Processing Languages
Information Interchange Media	SC 23 - Optical Disk Cartridges for Information Interchange
Multimedia and Synthesis	SC 24 - Computer Graphics and Image Processing SC 29 - Coding of Audio, Picture, and Multimedia and Hypermedia Information WG12 - 3D Scanning and Printing
Networking and Middleware	SC 06 - Telecommunications and Information Exchange Between Systems SC 25 - Interconnection of Information Technology Equipment SC 38 - Cloud Computing and Distributed Platforms
Office Equipment	SC 28 - Office Equipment
Green IT	SC 39 – Sustainability, IT and data centres
Programming Languages and Software Interfaces	SC 22 - Programming Languages, their Environments and Systems Software Interfaces
Cybersecurity	SC 27 - Information security, cybersecurity and privacy protection SC 37 - Biometrics
Software, Processes and Systems	SC 07 - Software and System Engineering SC 40 – IT Governance and IT Management WG13 - Trustworthiness
Internet of Things	SC 41 – Internet of Things and Digital Twin
Artificial Intelligence	SC 42 - Artificial Intelligence
Brain-computer interfaces	SC43 - Brain-computer interfaces
Smart Cities	WG 11 - Smart City
Quantum Computing	WG 14 - Quantum Computing

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.

ISO/IEC Definition of the Internet of Things (IoT)

ISO/IEC 20924

3.2.8

Internet of Things

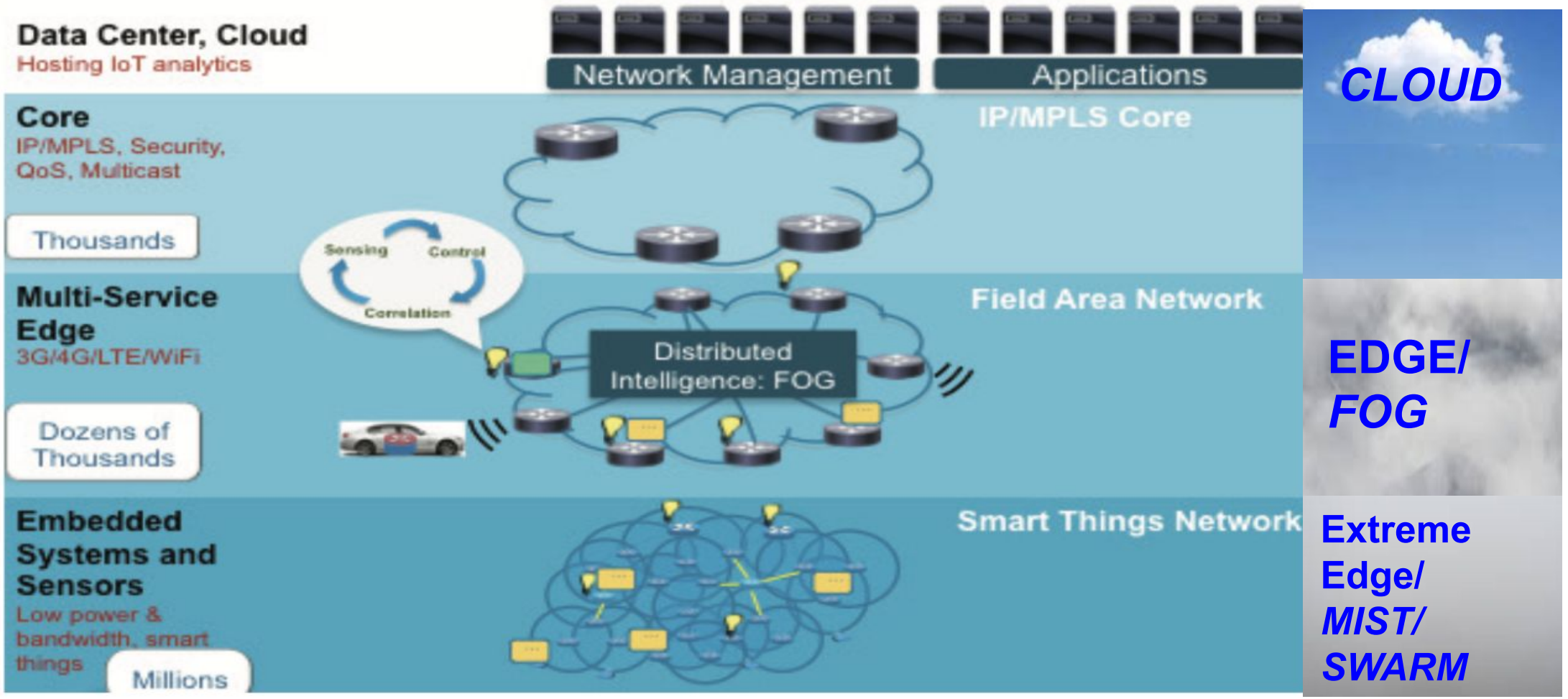
IoT

infrastructure of interconnected entities, people systems and information resources together with services which processes and reacts to information from the physical and virtual world

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.

(Smarts) Sensors

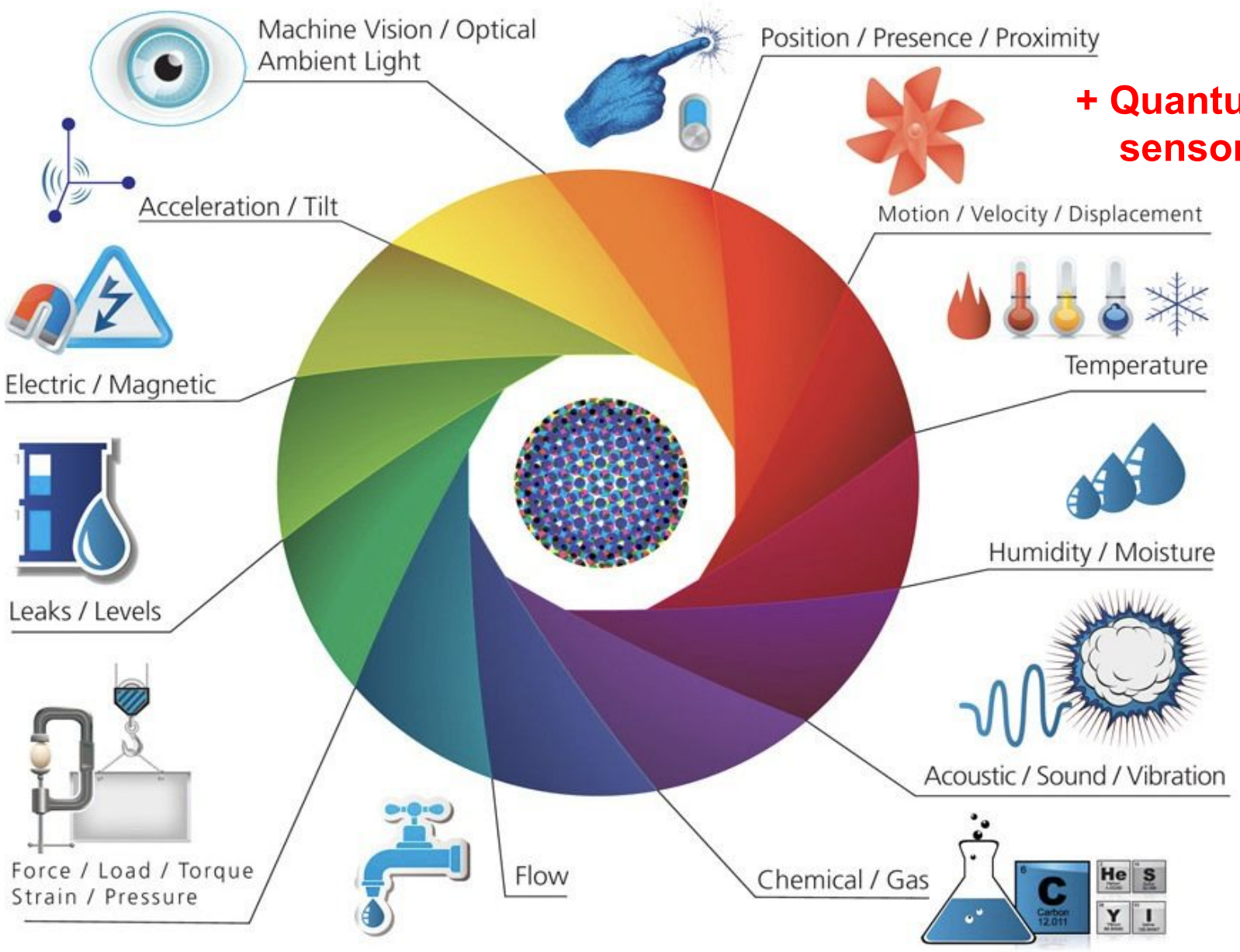
+ Biosensors

sensor (3.3.29) that uses specific biochemical reactions mediated by isolated enzymes, immunosystems, tissues, organelles or whole cells to detect chemical compounds usually by electrical, thermal or optical signals

[SOURCE: Modified from IUPAC GoldBook (DOI: 10.1351/goldbook.B00663)]

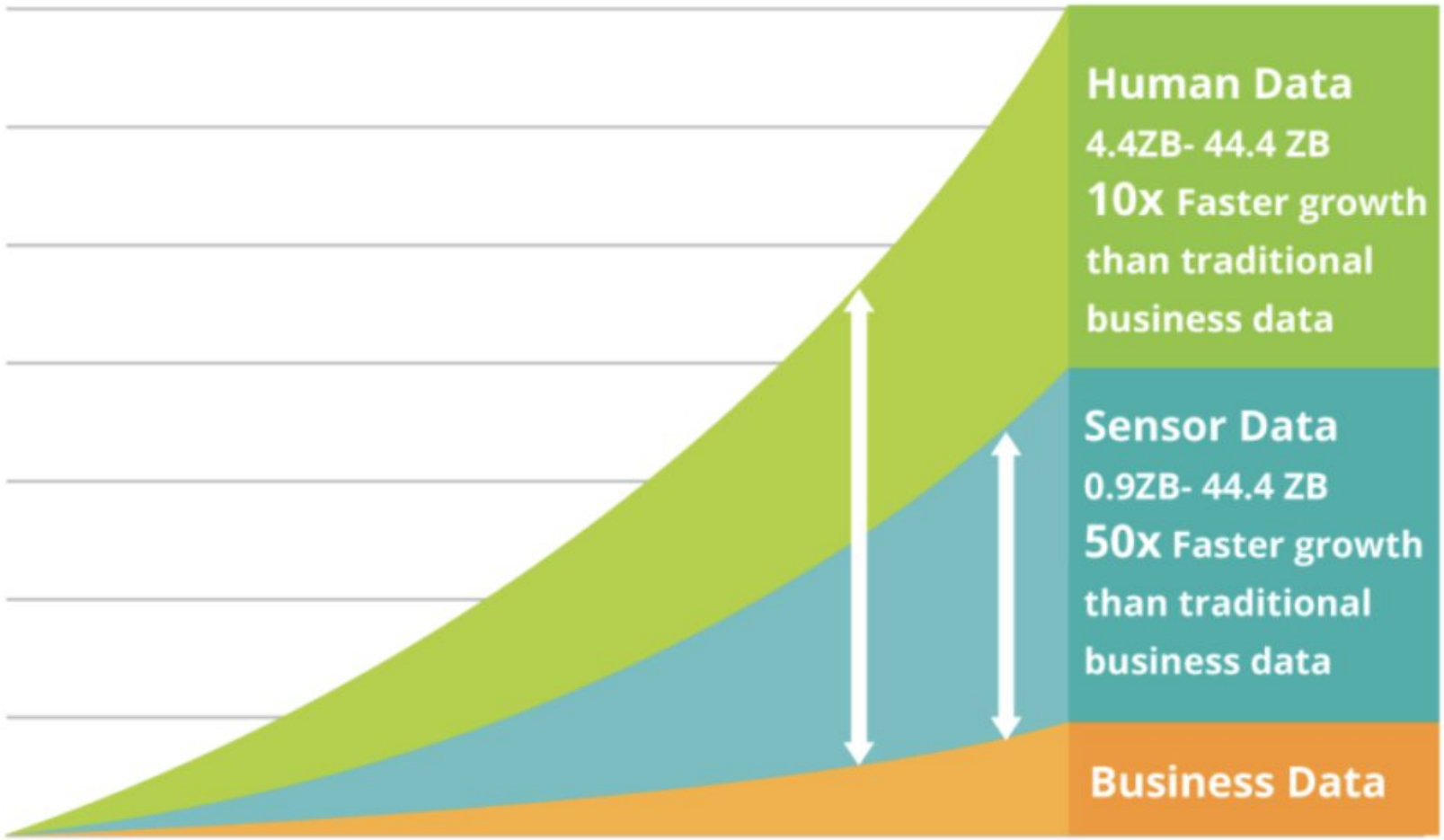
[SOURCE IEC/SEG 12 Biodigital convergence - vocabulary Draft 1.1, 3.2.24]

+ Quantum sensors



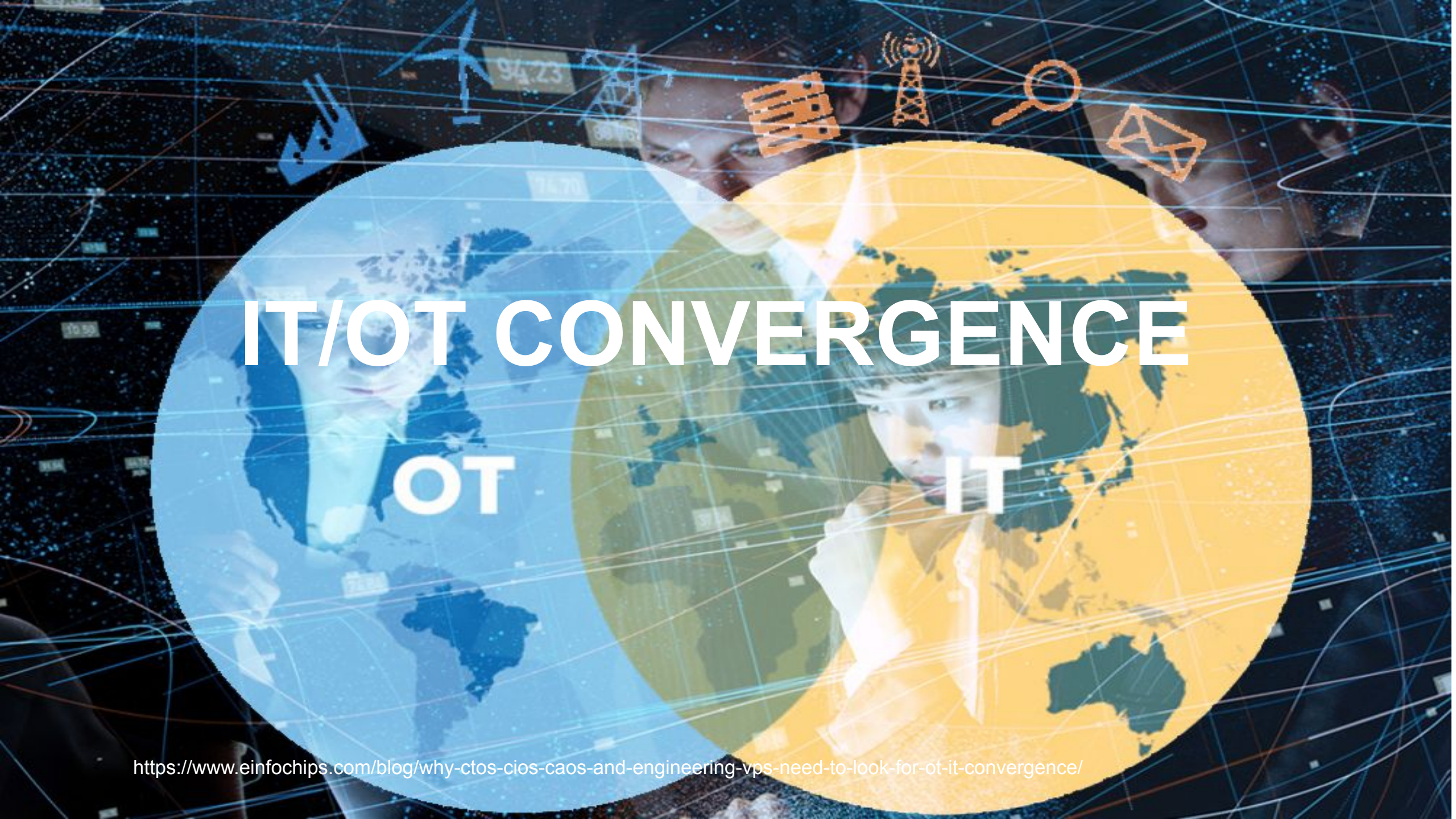
Modified from: https://www.postscapes.com/what-exactly-is-the-internet-of-things-infographic/

DTw and IoT systems are data driven



Source: Inside big data

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



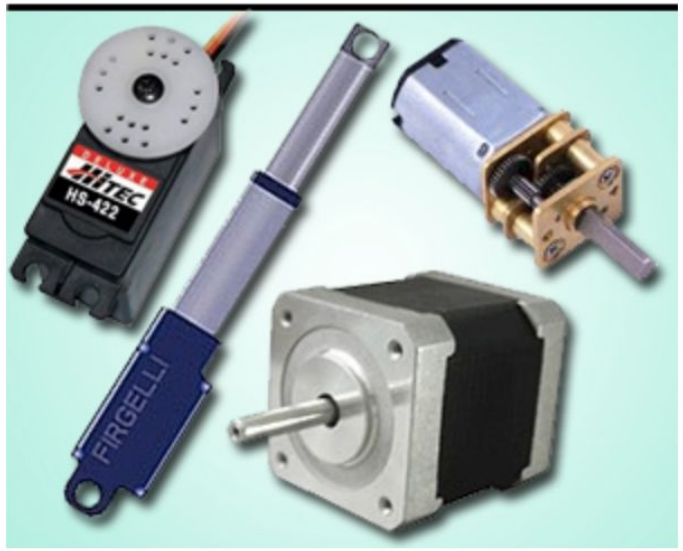
https://www.einfochips.com/blog/why-ctos-cios-caos-and-engineering-vps-need-to-look-for-ot-it-convergence/

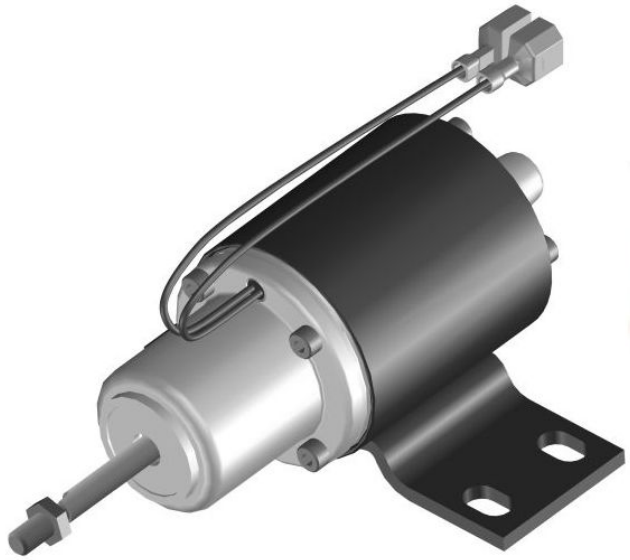
Convergence IT / OT

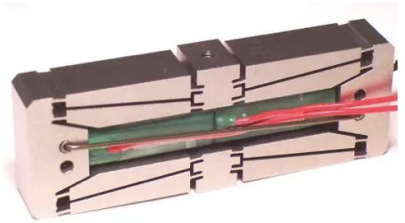
ISO/IEC FDIS 30173

IT/OT convergence is the integration of information technology (IT) systems used for data-centric computing with operational technology (OT) systems used to monitor events, processes and devices and make adjustments in enterprise and industrial operations.

ACTUATORS







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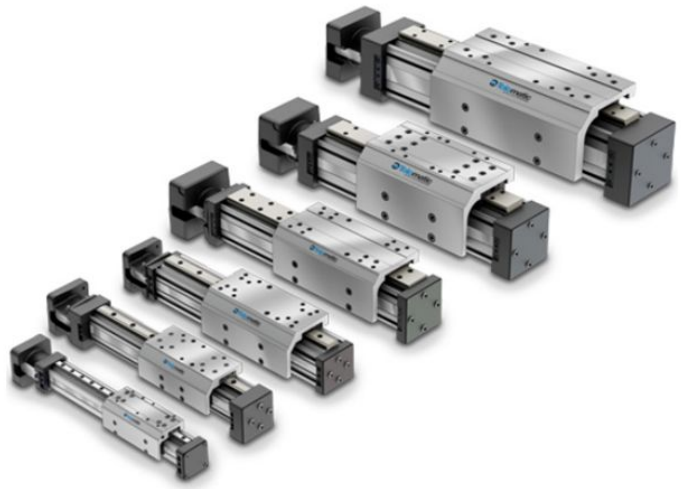
Linear piezoelectric actuator 80 - 2000 µm

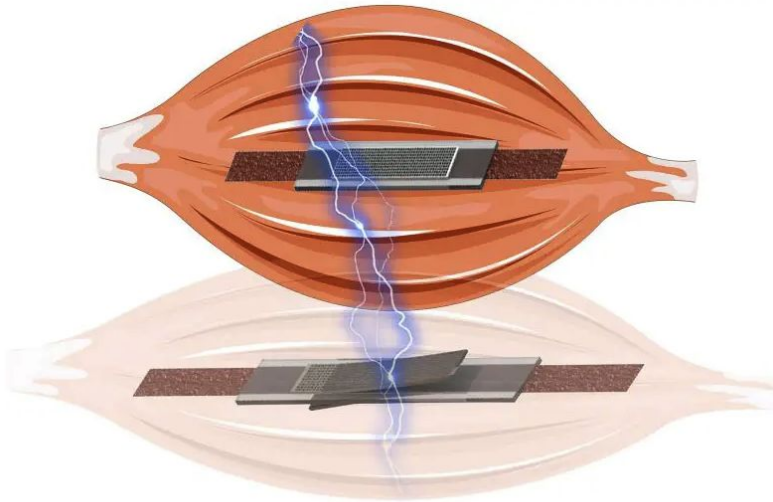
amplified

Sold by:

DSM USA - Tennessee

See contact information





An electric self-sensing and variable-stiffness artificial muscle. Credit: Chen Liu et. al, Advanced Intelligent System

https://scitechdaily.com/bionic-breakthrough-revolutionary-self-sensing-electric-artificial-muscles/

https://parasam.me/2016/05/19/iot-internet-of-things-a-short-series-of-observations-pt-2-sensors-actuators-infrastructure/

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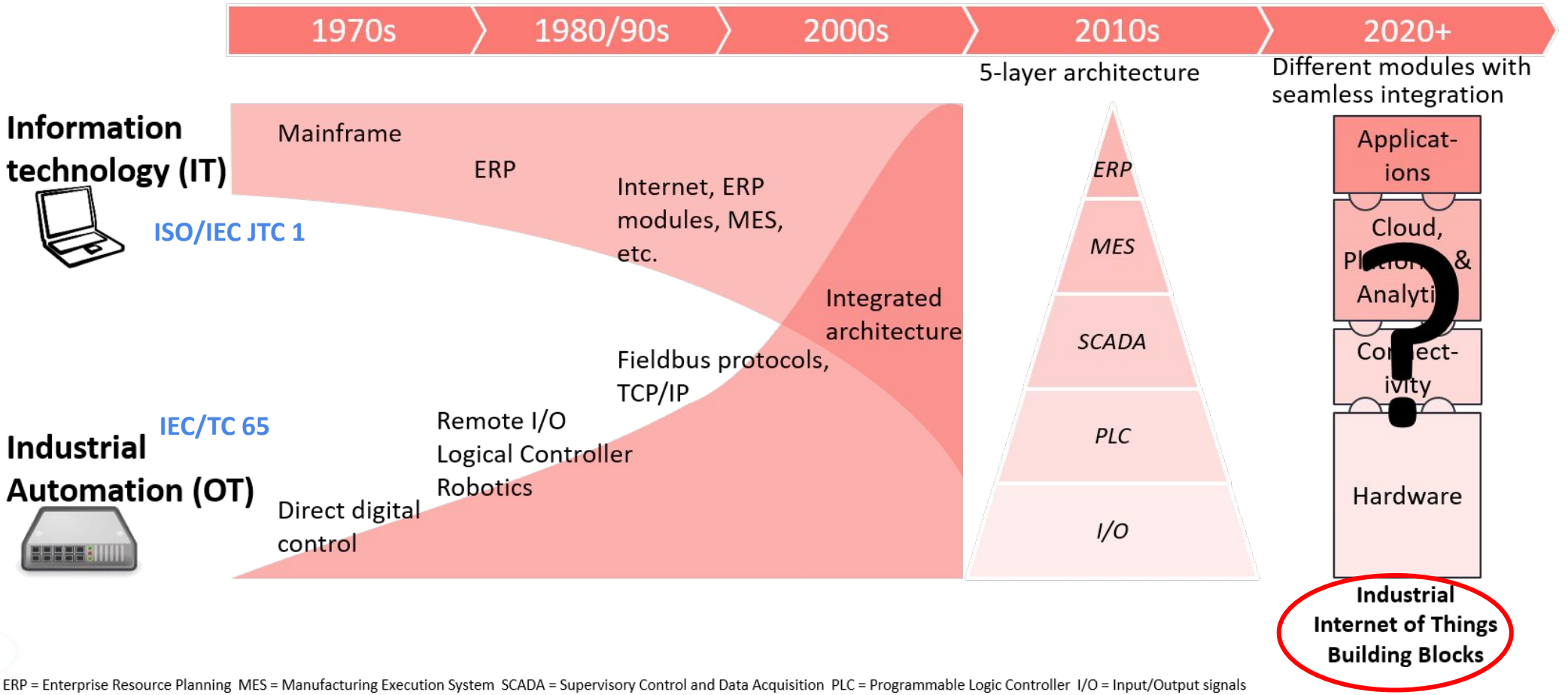
IT and OT Convergence –a view

IOT ANALYTICS

Insights that empower you to understand IoT markets

The evolution of IT-OT convergence

NOTE: Dates are when those mainly evolving technologies were introduced.



ERP = Enterprise Resource Planning MES = Manufacturing Execution System SCADA = Supervisory Control and Data Acquisition PLC = Programmable Logic Controller I/O = Input/Output signals
Source: IoT Analytics

Modified from:
https://iot-analytics.com/5-industrial-connectivity-trends-driving-the-it-ot-convergence/
http://www.forbes.com/sites/louiscolumbus/2016/12/03/industrial-analytics-based-on-internet-of-things-will-revolutionize-manufacturing/#59fa85bc49ac

IoT enable ‘Smarts’

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

SMART
EVERYTHING
EVERYWHERE

ISO/IEC Definition of Digital Twin (DTw)

3.2.8

digital twin

DTw

digital representation of a target entity with data connections that enable convergence between the physical and digital states at an appropriate rate of synchronization

Note 1 to entry: Digital twin has some or all of the capabilities of connection, integration, analysis, simulation, visualization, optimization, collaboration, etc.

Note 2 to entry: Digital twin can provide an integrated view throughout the life cycle of the target entity.

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.

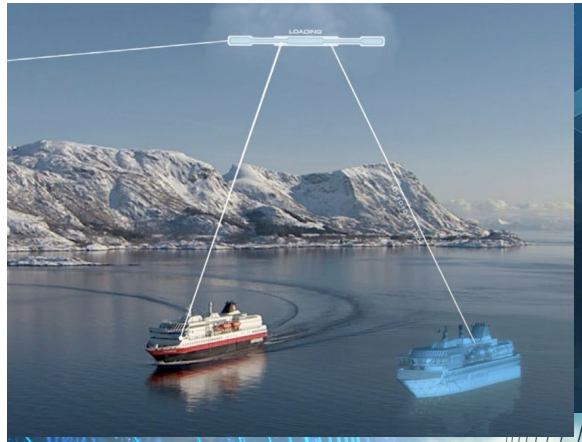
Data from multiple digital twins can be aggregated for a composite view across a number of real-world entities, such as a ship, a bridge, a building, a factory, a supply-chain or a city.

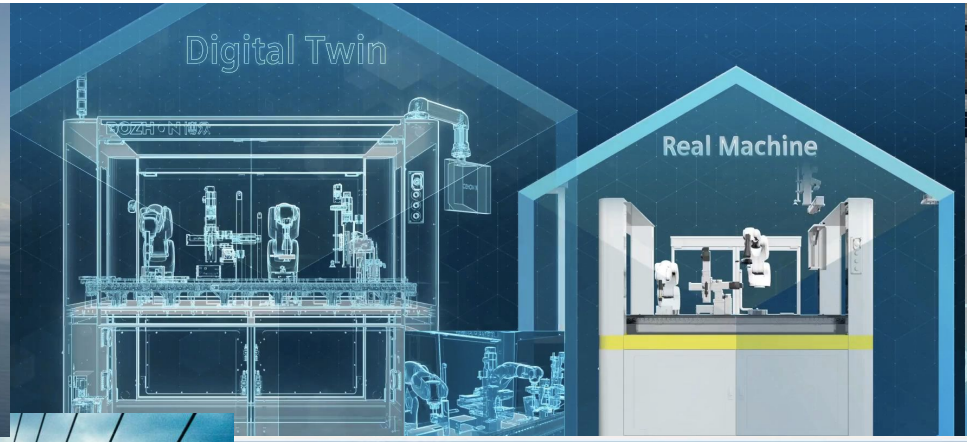
About Digital Twin (DTw)

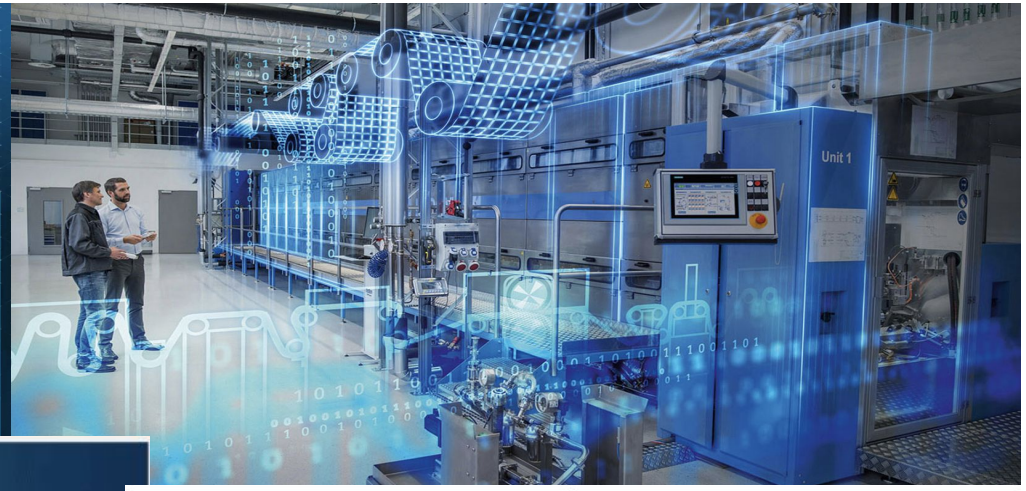
Mirroring is done through synchronization using data streams. The data streams are generated by sensors, but also transactions and other sources (virtual sensors).

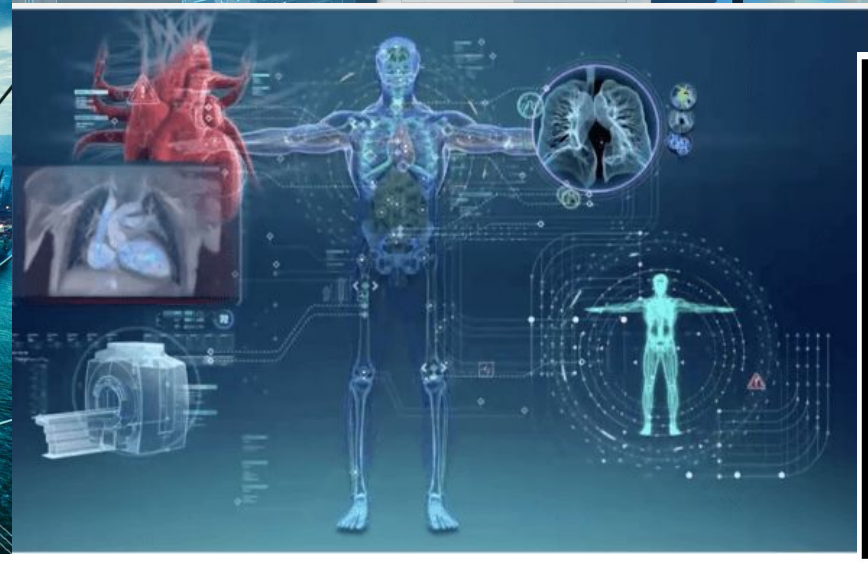
Digital Twin (DT) is an enabler Smart Everything, being based on measurements that creates an evolving profile of the entity or system in the digital world, it provides important insights on system performance, leading to actions in the real world such as a change in system and process design, or optimizing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

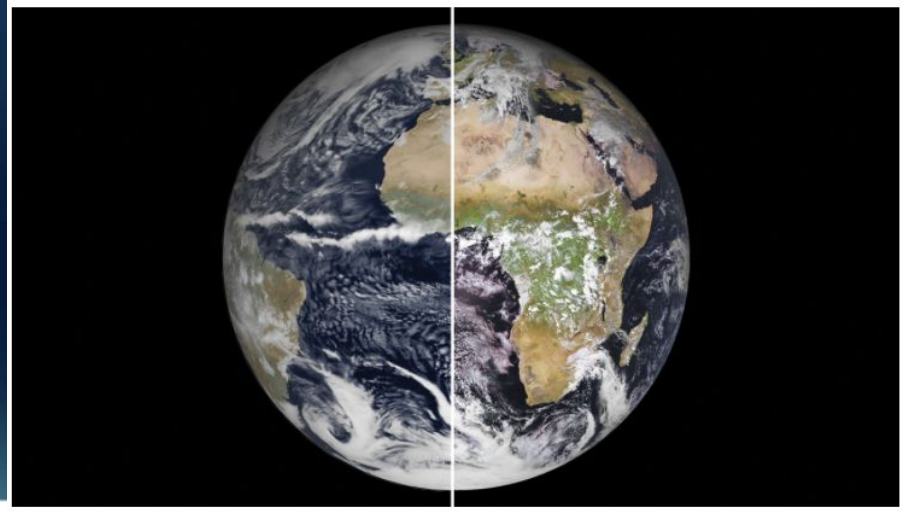
Digital Twin Horizontality











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/

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

‘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’ by regard to:

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

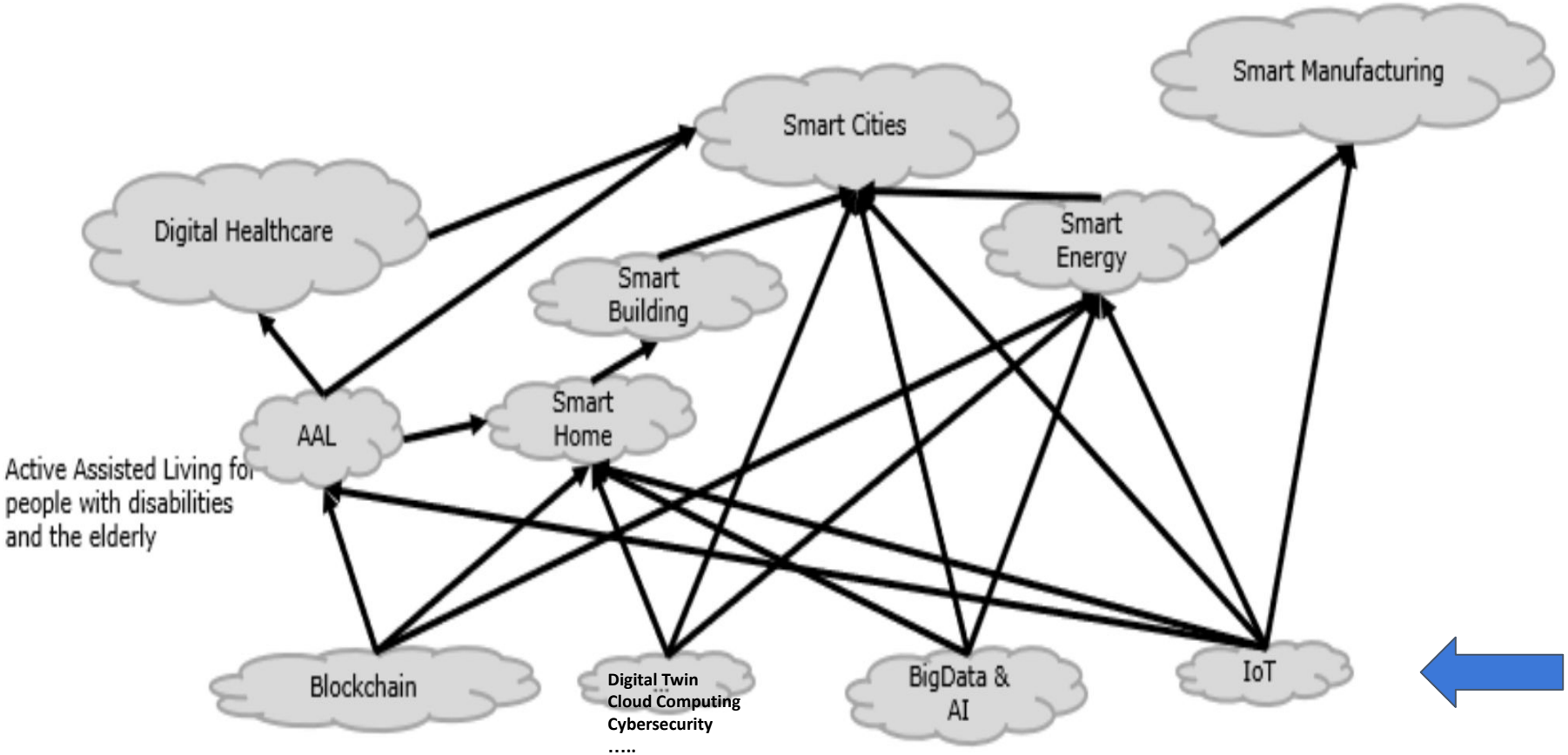
Strategic Approaches

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’

Selected Reference Architectures Relationships



Reference architecture (RA): '*an architecture for making architectures that exhibit known commonalities*'

SOURCE: ISO/IEC JTC 1/AG8 N585, Meta Reference Architecture, Meta Reference Architecture Document (v0.96d), 2022-08-25

Horizontal RA standards

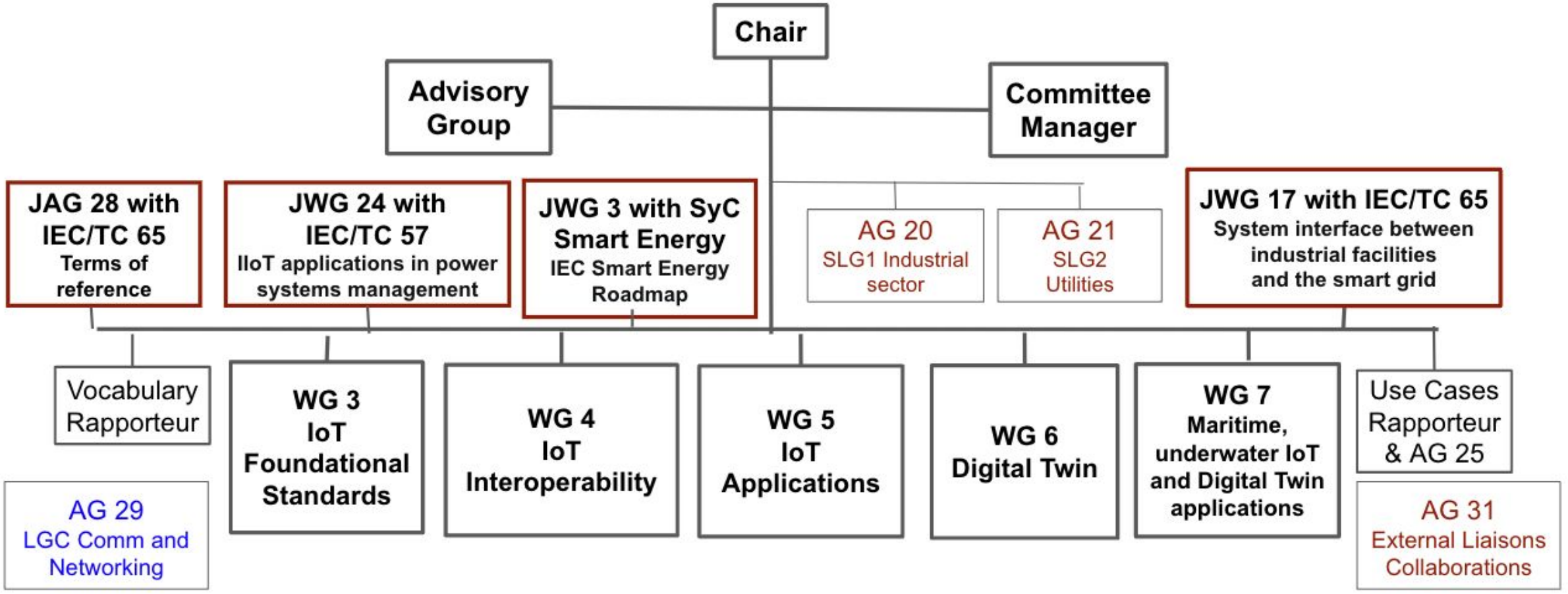
Modified from the JTC 1 (N15208) Draft Meta Reference Architecture for Systems Integration Specification

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 (June 2023)



Published Standards

(TR technical report – TS technical specification)

Foundational

- **20924 2021** IoT - Vocabulary
- **30141 2018** IoT reference architectures
- **30147 2021** Integration of IoT trustworthiness in ISO/IEC/IEEE 15288
- **30164 2020** IoT Edge computing
- **30165 2021** Real-time IoT
- **30166 TR 2020** Industrial IoT

Interoperability

- **21823-1 2020** IoT interoperability - framework
- **21823-2 2020** IoT transport interoperability
- **21823-3 2021** IoT semantic interoperability
- **21823-4 2024** IoT syntactic interoperability
- **30161-1 2020** Data exchange platform for IoT - Requirements & architecture
- **30161-2 2023** Data exchange platform for IoT – Transport interoperabiltiy
- **30162 2023** Compatibility requirements within industrial IoT systems

Application

- **22417 TR 2017** IoT use cases
- **30163 2021** SN-based integrated platform for chattel asset monitoring
- **30169 2022** IoT applications for electronic label systems (ELS)
- **30176 TR 2021** Integration of IoT and DLT/blockchain: use cases
- **30179 2023** IoT system for ecological environment monitoring

Sensor network

- **29182-1 2017** SNRA General overview and requirements
- **29182-2 2013** SNRA Vocabulary and terminology
- **29182-3 2014** SNRA Reference architecture views
- **29182-4 2013** SNRA Entity models
- **29182-5 2013** SNRA Interface definitions
- **29182-6** 2014 SNRA Applications
- **29182-7 2015** SNRA Interoperabiity guidelines
- **20005 2013** Collaborative information processing in intelligent SN
- **30128 2014** Generic SN Application Interface
- **19637 2016** SN testing framework
- **22560 TR 2017** SN - Aeronautics active air-flow control
- **30101:2014** SN and its interfaces for smart grid system

Underwater acoustic network

- **30140-1 2018** UWASN – Overview and requirements
- **30140-2 2017** UWASN – Reference architecture
- **30140-3 2018** UWASN – Entities and interfaces
- **30140-4 2018** UWASN – Interoperability
- **30142 2020** UWASN – Network mgt system overview & requirements
- **30142-2 2020** UWASN – Network management system u-MIB
- **30143 2020** UWASN – Application profiles
- **30171-1 2022** B-UWAN -Overview and requirements

Source: Antonio Kung (FR)

Standards under development

Foundational

- **20924 Ed2** IoT and digital twin – Vocabulary (WG3)
- **30173** Digital twin concepts and teminology (WG6)
- **30141 Ed2** IoT reference architecture (WG3)
- **30168 TS** Generic Trust Anchor API for Industrial IoT Devices (WG3)
- **30149 TS** IoT trustworthiness principles (WG3)
- **30187** Evaluation indicator for IoT systems (WG5)
- **30188** Digital twin Reference Architecture (WG6)
- **PWI 16** Digital Twin – Extraction and transactions of data components (WG6)
- **30186** Digital twin maturity model (WG6)
- **PWI 17** Guidance on IoT and digital twin integrations in data spaces (WG6)

Interoperability

- **30178** IoT Data format, value and coding (WG4)
- **30181** Functional architecture for resource ID interoperability (WG4)
- **PWI 8** IoT and Digital twin Behavioral and policy interoperability (WG4)
- **TR PWI 11** Digital twin correspondence measure of DTw twinning (WG6)

Applications

- **30194 TR** Best practices for use case projects (SC41)
- **30172 TR** Digital twin use cases (WG5)
- **30180** Status of self-quarantine through IoT data interfaces (WG5)
- **30184** Autonomous IoT object identification in connected home (WG5)
- **30189-1 TR** IoT-based cultural heritage management – Framework (WG5)
- **TR PWI 13** IoT Apps for long-distance oil & gas transmission pipeline (WG5)
- **TR PWI 12** Environmental effect of underwater acoustic signalling (WG7)
- **TR PWI** IoT Apps for natural gas distribution system (WG5)
- **TR PWI 10** IoT-based cultural heritage management – Use cases (WG5)
- **PWI** System requirements of IoT-based fixed asset seizure management (WG5)

Underwater

- **30177** Underwater network mgt system (U-NMS) interworking (WG7)
- **30183** Interoperability of UWASNs based on underwater delay & U-DTN (WG7)
- **30185** Interoperability of UWASNs & IPV6 (WG7)

Source: Antonio Kung (FR)

Future directions

- Use the opportunity of the revision of the IoT foundational standards to improve its structure and its integration with standards in related technologies
- Develop a strong set of Digital Twin foundational standards
- Continue to explore how to bring more value out of the collection of standards and work program in the area of Maritime IoT and DTw.
- Develop further, through established JWG, and exploratory JAGs, cooperative work with IEC/TC 65 (Industrial Automation), the IEC SyC on Smart Energy and IEC/TC 57.
- Continue to develop cooperation and partnership with the application domains and sectors
- Explore further cooperations with SDOs

Thank you

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