IOTWeek

Dublin — June 20-23, 2022

IoT standardization strategy in ISO/IEC JTC 1/SC 41

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

GLOBAL VISION:
IoT TODAY AND BEYOND

IOTForum

ISO/IEC JTC 1/SC 41

Title: Internet of Things and Digital Twin

Scope:

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

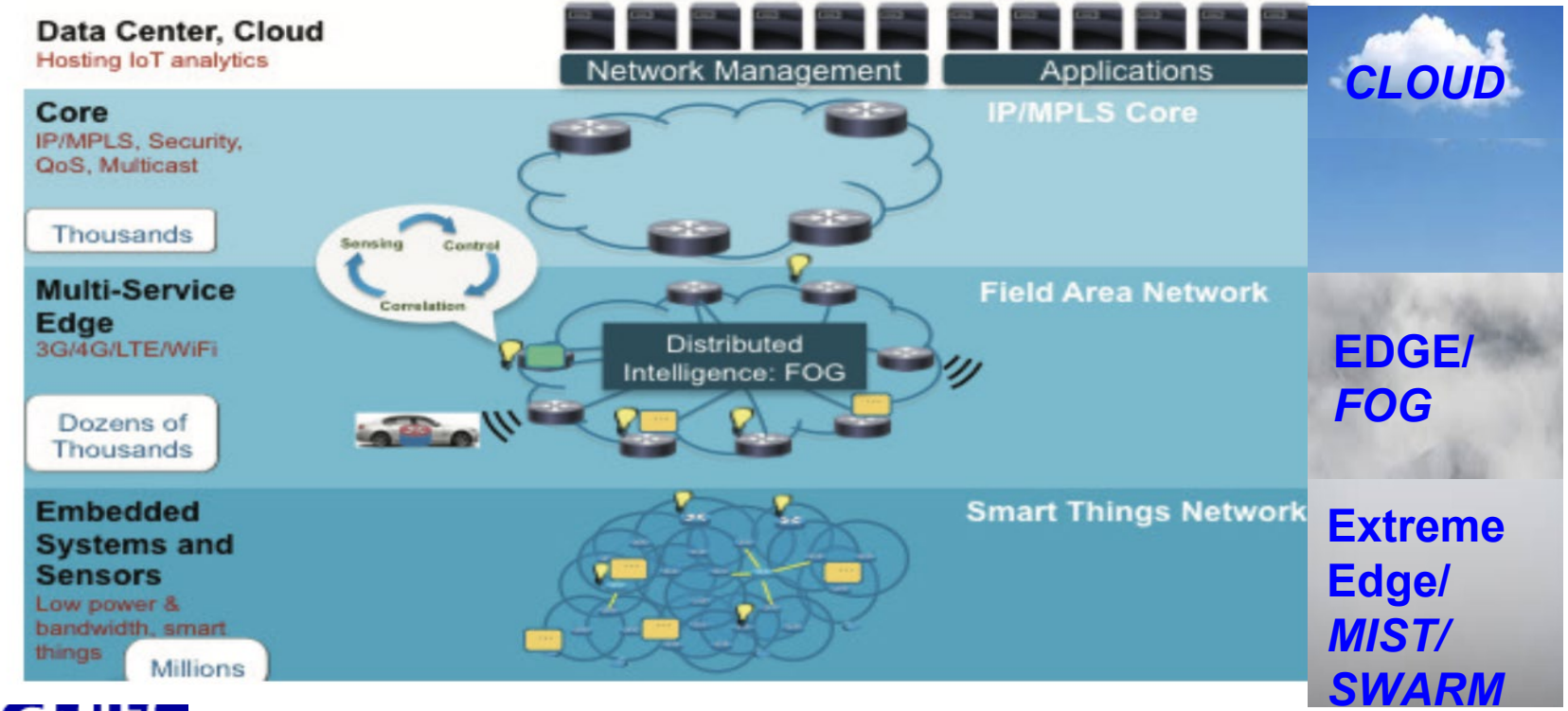
1. Serve as the focus and proponent for JTC 1's standardization programme on the Internet of Things and Digital Twin, including their related technologies.
2. Provide guidance to JTC 1, IEC, ISO and other entities developing Internet of Things and Digital Twin related applications.

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 Iand 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 11 - Flexible Magnetic Media for Digital Data Interchange 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

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'

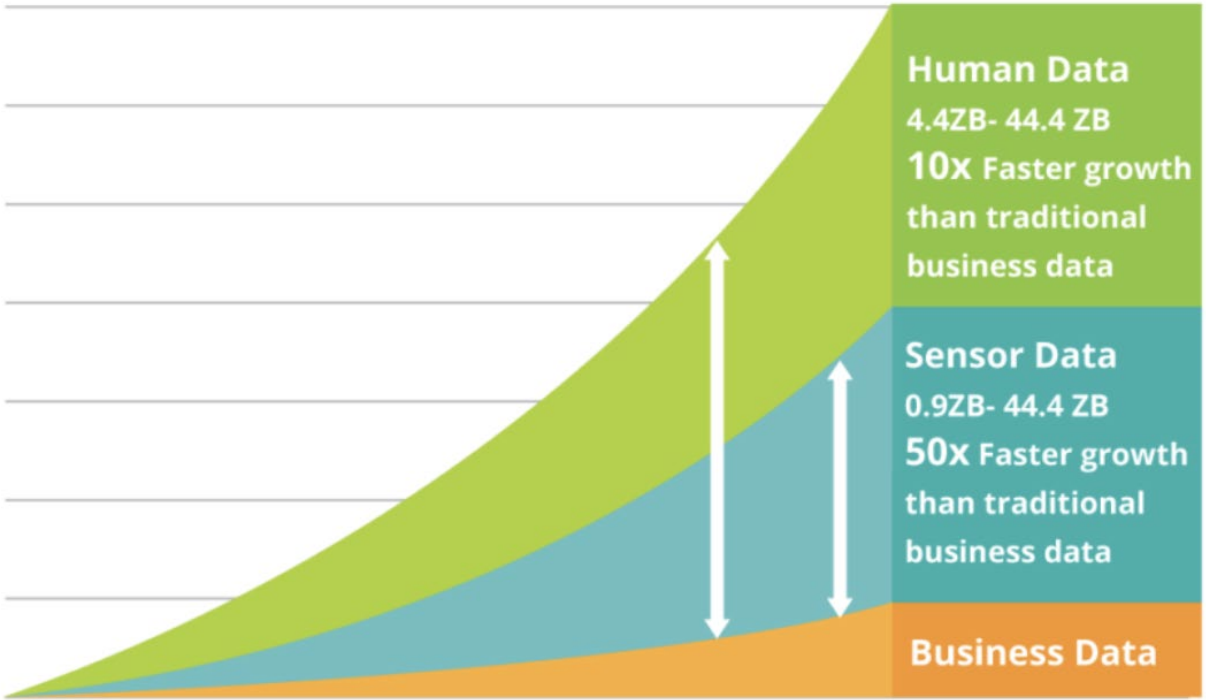
A Distributed and Network centric System or System of Systems



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

IoT systems are data driven

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



Source: Inside big data

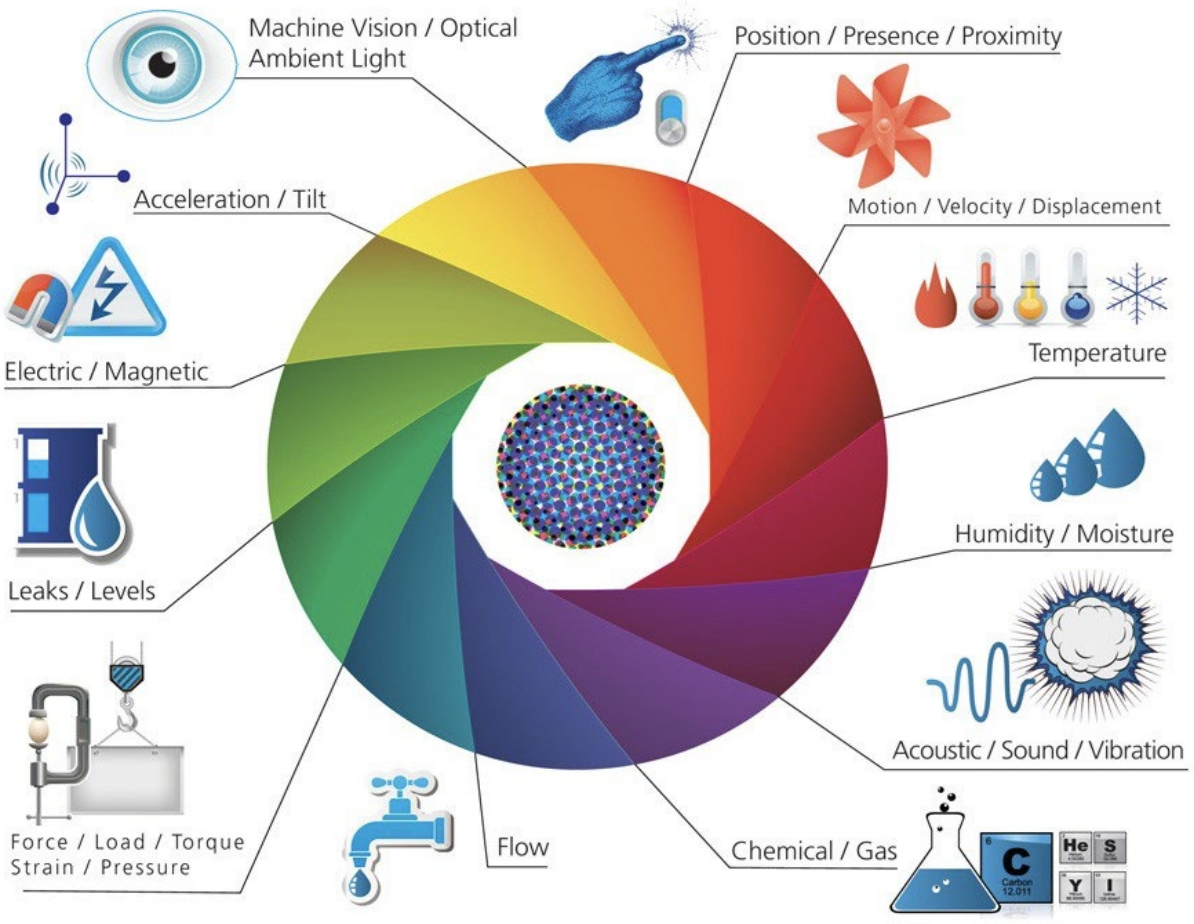
+ Biosensors

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 Base document Biodigital convergence - vocabulary Draft 0.5, 3.2.25]

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



Sensors

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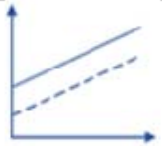
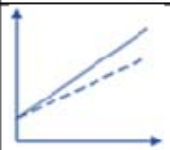
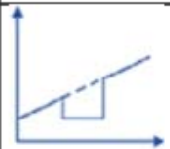
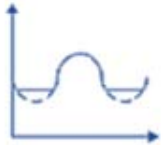
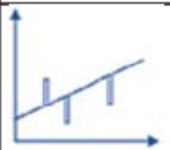
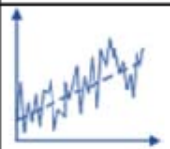
Physical Sensors Variability

Sensor Types	Examples
Flow	Differential Pressure, Electromagnetic, Ultrasonic
Level	Mechanical, DP, Magnetostrictive, radio frequency
Temperature	RTD, Thermistor, Thermocouple,
Displacement	Potentiometric, LVDT, Capacitive, Photoelectric
Acceleration	Accelerometer, Gyroscope
Image	CMOS,CCDs
Chemical	Ionization, Infrared, Semiconductor
Biosensor	Electrochemical, SPR,LAP
Others	Mass, Force, Humidity, Viscosity

Smart sensors -Sukanta Bhattacharyya, https://www.slideshare.net/suki1801/smart-sensors-17199690

SENSORS ERRORS

ENVIRONMENTS (ADAPTED FROM [19]).

Error	Description	Example
Constant or offset error	The observations continuously deviate from the expected value by a constant offset.	
Continuous varying or drifting error	The deviation between the observations and the expected value is continuously changing according to some continuous time-dependent function (linear or non-linear).	
Crash or jammed error	The sensor stops providing any readings on its interface or gets jammed and stuck in some incorrect value.	
Trimming error	Data is correct for values within some interval, but are modified for values outside the interval. Beyond the interval, the data can be trimmed or may vary proportionally.	
Outliers error	The observations occasionally deviate from the expected value, at random points in the time domain.	
Noise error	The observations deviate from the expected value stochastically in the value domain and permanently in the temporal domain.	

Pérez-Castillo, Ricardo et al. "Data Quality Best Practices in IoT Environments." *2018 11th International Conference on the Quality of Information and Communications Technology (QUATIC)* (2018): 272-275.

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ISO JTC1 INFORMATION TECHNOLOGY STA

KEY CHALLENGES WITH TIME SERIES DATA QUALITY

VALIDITY

- Out of Range
- Impossibly Quick Changes
- Interpolation method mismatched to the measurement acquisition device
- Inaccurate timestamp order
  - Unsynchronized clocks
  - Delayed signals
- Divergence despite high correlation

COMPLETENESS

- Empty fields
- Missing metadata which is central to the analysis of the data such as unit of measure, state of the associated system
- Missing “foreign keys”
- Missing provenance
  - Has this data been interpolated
  - Is this a derived measurement, if yes, what is the source(s)

PRECISION

- Sampling inconstant with the Nyquist rate
- Over precision based on the sensor acquiring the measurement

TIMELINESS

- Latency mismatched to the actual time during which a process or event occurs

https://medium.com/hashmapinc/discovering-the-keys-to-solving-for-data-quality-analysis-in-streaming-time-series-datasets-8d8780fa7ecb

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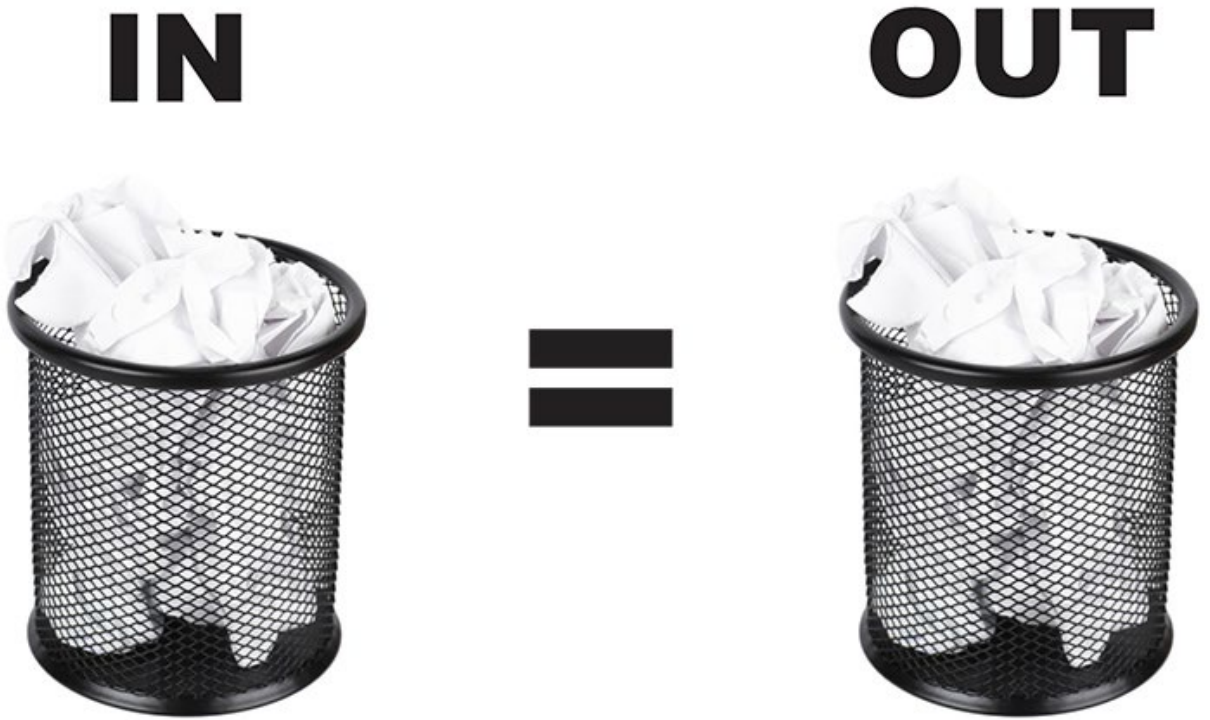
ISO JTC INFORMATION TECHN

GIGO = Garbage In Garbage Out

Many IoT systems are safety and/or mission critical



https://thestratizen.co.ke/?p=686

See also: https://www.atlasobscura.com/articles/is-this-the-first-time-anyone-printed-garbage-in-garbage-out

‘Technologies’ found in IoT systems

- IoT and DTw architectures (JTC 1/SC 41)
- Sensors, actuators, tags (IEC/TC 72, JTC 1/SC 31,..)
- Operation Technologies (OT) / industrial controls (IEC/TC 65)
- Networks… (JTC 1/SC 6, IEC/SEG 8, ITU-T,..)
- Cloud and distributed computing (JTC 1/SC 38)
- Big Data (JTC 1/SC 42)
- AI (JTC 1/SC42)
- Blockchains (ISO/TC 307)
- Cybersecurity (JTC 1/SC 27)
- Software and Systems Engineering (JTC 1/SC7)
- ….

IoT standardization need to be coordinated with SDOs working in these technical areas

JTC 1/SC 41 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 have the mandate and the resources to develop standards that use IoT and DTw in specific application domains or sectors.

IoT enable ‘Smarts’

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

SMART
EVERYTHING
EVERYWHERE

https://www.iot-now.com/2017/09/25/67259-everything-can-smart-key-traits-newest-smart-cities-part-1/

ISO JTC1 IEC
INFORMATION TECHNOLOGY STANDARDS

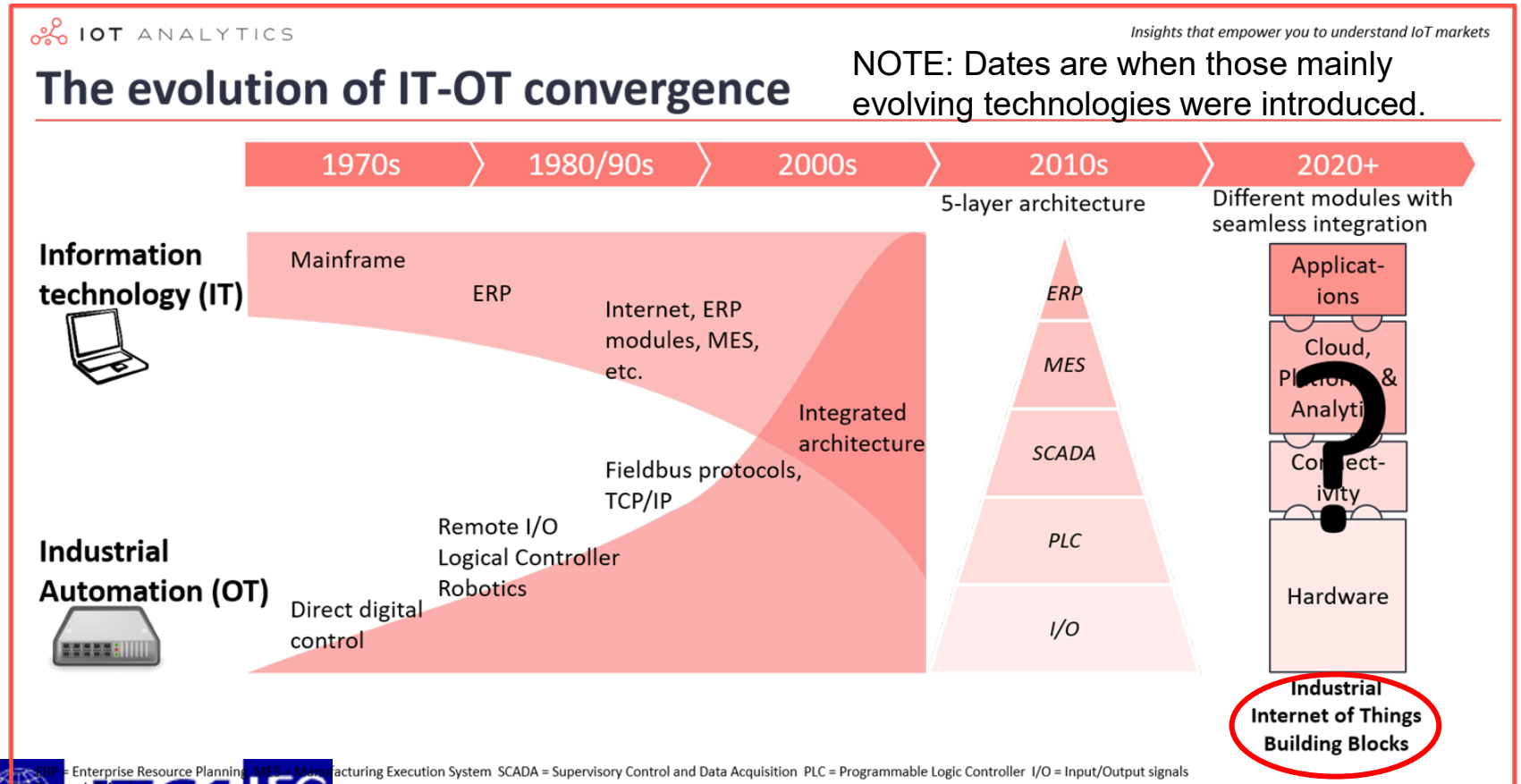
IoT Standards must address the needs of a wide-range of application domains

Need	Industry sector							
	Manufacturing	Automotive	Smart building/ life safety	Asset/ utility mgmt	Smart grid	Consumer IoT	Entertainement	Transportation
Mobility	55	98	10	50	10	55	80	97
Ultra low latency (<10ms)	95	100	85	5	5	15	15	95
Autonomy	95	100	100	7	100	50	45	100
Security	100	100	100	90	100	25	30	100
Local network bandwith	100	100	90	10	10	35	90	100
WAN network bandwith	35	30	55	15	10	55	90	45
Peer-to-peer communication	80	90	85	10	50	90	85	100
Prioritization	100	100	15	45	90	10	55	45
Self-organization discovery	60	50	20	95	40	65	90	60
Artificial intelligence/ machine learning	100	60	100	65	85	45	60	95

IEC Whitepaper on Edge Intelligence, 2017-10, http://www.iec.ch/whitepaper/pdf/IEC_WP_Edge_Intelligence.pdf

Feature is of utmost importance for the industry

IT and OT Convergence –a view



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

JTC 1/SC 41 Strategic Approaches

- 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.
- Systematically collect use cases across all application domains to elicit and document standardization requirements

JTC 1/SC 41 Strategic Approaches

- Concentrate on foundational standards: vocabularies, reference architectures, interoperability, trustworthiness
- Have an ‘incubator’ to kick-start domains or sectors applications and cover ‘dead-angles’

Some pertinents IoT standards/projects

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Industrial IoT

ISO/IEC TR 30166 ED1 - Internet of Things (IoT) – Industrial IoT

ISO/IEC 30162 ED1 Internet of Things (IoT) - Compatibility requirements and model for devices within industrial IoT systems

ISO/IEC TS 30168 ED1 Internet of Things (IoT) - Generic trust anchor application programming interface for industrial IoT devices

ISO/IEC 62872-2 ED1 - Internet of Things (IoT) – Application framework for industrial facility demand response energy management

IoT Systems Architecture

ISO/IEC 30141:2018 Edition 1.0 (2018-08-30) - Internet of Things (IoT) - Reference architecture

ISO/IEC TR 30164 ED1 - Internet of things (IoT) - Edge Computing

ISO/IEC 21823-1, 2, 3 & 4 - Internet of Things (IoT) - Interoperability for IoT Systems (first 4 parts published)

ISO/IEC 30165 - Internet of Things (IoT) – Real-time IoT Framework

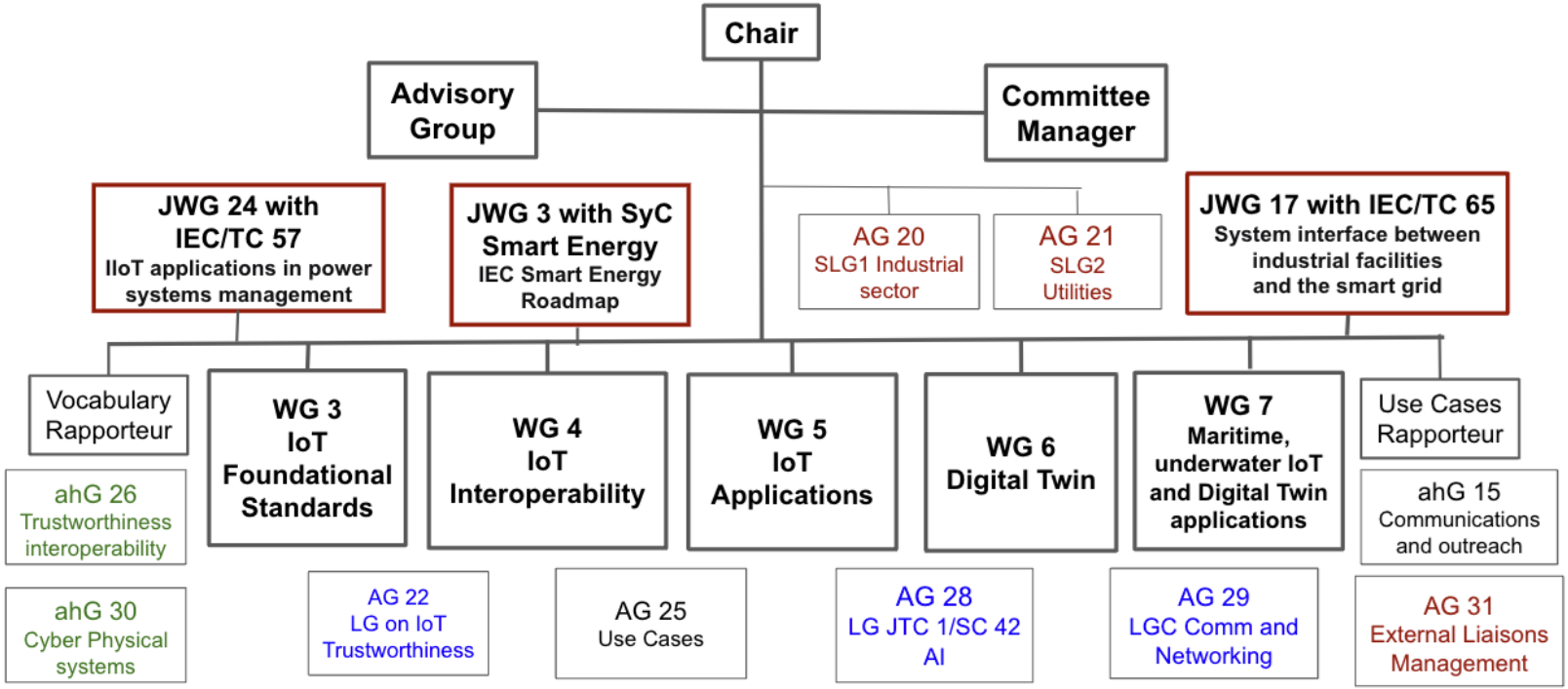
ISO/IEC 30147 - Internet of Things (IoT) – Integration of IoT trustworthiness activities in ISO/IEC/IEEE 15288 system engineering processes

ISO/IEC 30149 ED1 - Internet of Things (IoT) – Trustworthiness Principles

ISO/IEC 30178 ED1 -Internet of Things (IoT) - Data format, value and coding

Current Status

SC 41 Structure (June 2022)



Current Digital Twin Projects

ISO/IEC 20924 ED3

Internet of Things (IoT) and Digital Twin – Vocabulary

ISO/IEC 30173 ED1

Digital twin - Concepts and terminology

ISO/IEC 30172 ED1

Digital twin - Use cases

PWI JTC1-SC41-5

Digital Twin - Reference Architecture

PWI JTC1-SC41-7

Digital Twin - Maturity Model

Which are the key IoT and Edge computing Standardisation challenges that need to be handled by SDOs with high priority? (A personal view)

A few standardization challenges

- IT/OT convergence (IIoT):
  - Standards convergence (further collaborations with IEC /TC 65)
  - Cyber Physical IoT systems (AhG 30)
  - Resilience of IoT systems and system of systems that affect the ‘real’ world (AG 22)
- Sensor Data and Data Stream Quality Management (AG 31)
  - -> Virtual sensors?

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Thank you!

Find more:

https://www.iec.ch/dyn/www/f?p=103:7:0::::FSP_ORG_ID:20486

iotweek.org