THE OPPORTUNITIES OF BUILDING IEEE STANDARDS FOR EUROPE, MIDDLE EAST AND AFRICA

region 8 IEEE

IEEE SECCIÓN ESPAÑA

IEEE

Short Introduction

- Workshop moderated by Oscar M Bonastre
  IEEE Chair Elect 2020-2021 Spain Section

- IEEE as worldwide leader in Standards

- Use Case of Standards

- The panelists

IEEE as the world's leading standards developer

- IEEE has a long-standing reputation as a trusted source of technical and scientific education, information and **standards**.
- IEEE serves as a trusted, **international source of knowledge** and insight to governments and society-at-large about the social responsibilities and **ethical** implications associated with technology.

IEEE as the world's leading standards developer

- One of the **more notable** are the IEEE 802. LAN/MAN group of standards, with the widely used computer networking standards for both wired (Ethernet, aka **IEEE 802.3**) and wireless (**IEEE 802.11** and **IEEE 802.16**) networks.

Use Case of Standards in Spain

- Public Administration. E-government services

SUMA Gestión Tributaria

Diputación de Alicante

- Suma is a public body set up by the Provincial Council of Alicante in 1990. Main mission is to administer and collect the municipal taxes for the town/city councils of the province of Alicante, Spain.

Use Case of Standards in Spain

- Blockchain Standards

Source: Información.

SUMA Gestión Tributaria

Diputación de Alicante

https://www.suma.es/

https://sumainnova.suma.es/

The panelists

- David Law – Distinguished Technologist at HP Enterprise. IEEE representative to EC ICT Standardization Platform, IEEE R8 standards coordinator. UK.
- Clara Neppel. Senior Director of the IEEE Global Office in Vienna. Austria
- Hermann Brand – European Standards Affairs Director IEEE Technology Centre. Austria
- Christopher James, Professor of Biomedical Engineering. Director of Warwick Engineering in Biomedicine, University of Warwick, UK.
- Brian Heinen. Founder, Local Producer Ltd and the Blockchain in Europe Group

Why Standards Matter? Developing standards within IEEE-SA: Process & Governance

David Law <David_law@ieee.org>

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Before I Share my Opinion…

"At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position, explanation, or interpretation of the IEEE."

IEEE-SA Standards Board Operation Manual

What Are Standards?

Standards are published documents that establish specifications and procedures designed to ensure the **reliability** of the materials, products, methods, and/or services people use every day

Standards form the fundamental building blocks for product development by **establishing consistent protocols** that can be universally understood and adopted

Standards establish **compatibility, interconnectivity, interoperability**, simplify product development, and speed time-to-market

Standards make it easier to understand and **compare** competing products

As standards are globally adopted and applied in many markets, they also help with **international trade**

Standards fuel **innovation, the development and implementation of technologies** that influence and transform the way we live, work and communicate

Shipping containers
(The engineer was correct)

Designed and patented in 1950s

- Malcom McLean (Entrepreneur)
- Keith Tantlinger (Engineer)

Tantlinger convinced McLean to give the patents to industry

Began international standardization of intermodal containers

- Enabled vast increase in efficiency
- Simple transferable between road, rail and ships

But many different incompatible container sizes and fittings

- International standardization (ISO)
- Occurred in late 1960s
- Agreed standard container sizes and fittings
- Enabled yet further increase in efficiency

Standards Are Important to users

Customer Choice and Value

Interoperability

No vendor lock-in

Standards Development Organizations

Process of developing a standard is typically facilitated by a **Standards Development Organization** (SDO)

SDOs adhere to **fair** and **equitable** processes that ensure the highest quality outputs and reinforce the market relevance of standards.

SDOs such as IEEE, International Electrotechnical Commission *(*IEC), International Organization for Standardization (ISO), and others offer **time-tested** platforms, rules, governance, methodologies, and services that objectively address the standards development lifecycle, and help facilitate the development, distribution and maintenance of standards.

IEEE Standards Development Process

Idea!

Identify a Technical Committee

Project approval

Develop draft standard

IEEE SA ballot

Standards Board approval

Publication

Revise or withdraw standard

IEEE-SA Takes a Lifecycle Approach

IEEE-SA nurtures, develops, and advances global technologies through a unique lifecycle approach

Open Environment and Proven Processes

- Pre-standards work includes IEEE-SA Industry Connections program

  Industry Connections Security Group

- Proven development process for producing successful and pervasive global standards

  IEEE 802.11™ "Wi-Fi®"

- Market-implementation work includes IEEE Conformity Assessment Program (ICAP)

  IEEE 1588™ Conformity Alliance

IEEE

Close Engagement with Industry

IEEE-SA Corporate Program

- Influence technology development
  - Incubate new technologies, standards and related services in a rapidly changing environment
  - Shape the direction of technology and its market place applications
- Drive the development of corporate standards
  - Gain advanced knowledge by engaging in corporate standards projects
- Network with global thought leaders

IEEE

IEEE R8 Standards Coordination

Standards speakers for events and conferences

Keynote speaker on standards, presentation such as demystifying standards, tutorial on a specific standard or standardization area

Whole standards tracks at events and conferences

Could be multiple speakers, presentations and/or tutorials

Section and student branch events

Could be similar to standards tracks at events and conferences with the added potential to run the Standards Game

Standards events

Local Section work with IEEE-SA to build a standards event

Interested?

Please contact <standards.coordinator@ieeer8.org>


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IEEE Global Ethics Initiative: Putting Principles into Practice

11 October 2019

Dr Clara Neppel
Senior Director, IEEE Global Office Vienna

IEEE
Advancing Technology for Humanity

Life in the Car Era

IEEE and AI and Ethics

Our Work: Putting principles into practice

Community

- 3000 members from all continents
- 40% women
- Participation & endorsement by industry
- Recognition by governments & international organizations

Ethically Aligned Design (EAD)

- Provides guidance for standards, certification, regulation, & legislation for the design, manufacture, & use of A/IS & serves as a key reference for the work of policymakers, industry members, technologists, & educator

"EAD For" Series

- Business
- Artists
- Health
- Parenting
- Advertising
- And more…

Global Standards

- 15 standards projects in development, including **IEEE P7000**, which establishes a process model by which engineers & technologists can address ethical considerations throughout various stages of systems initiation, analysis & design

Certification

Criteria and process for Certification / marks addressing:

- Transparency in A/IS
- Accountability in A/IS
- Algorithmic Bias in A/IS

Education & Learning

- AI & Ethics in Design Business Course
- EAD University Consortium

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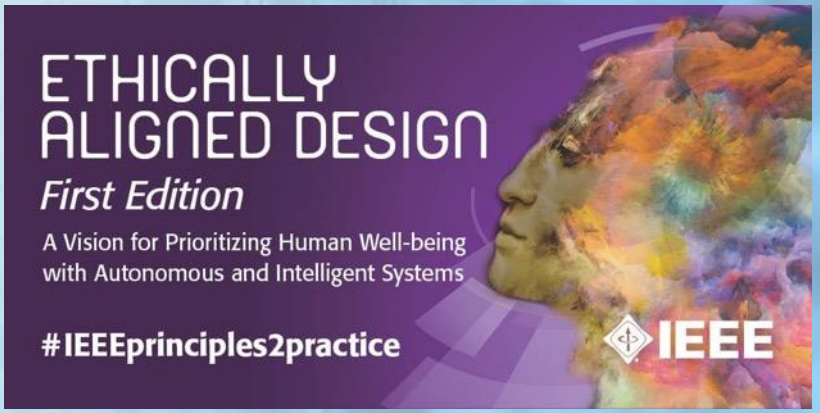
The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems (A/IS)

- **Mission:**
  - To ensure every stakeholder involved in the design and development of autonomous and intelligent systems (A/IS) is educated, trained and empowered to prioritize ethical considerations so that these technologies are advanced for the benefit of humanity
- **Produced Ethically Aligned Design, First Edition**
  - Sets forth scientific analysis and resources, high-level principles and actionable recommendations
  - Provides guidance for standards, regulation or legislation for design, manufacture and use of A/IS the provably aligns with and improves holistic societal well-being
  - Serves as a key reference for the work of policymakers, as well as technologists and educators



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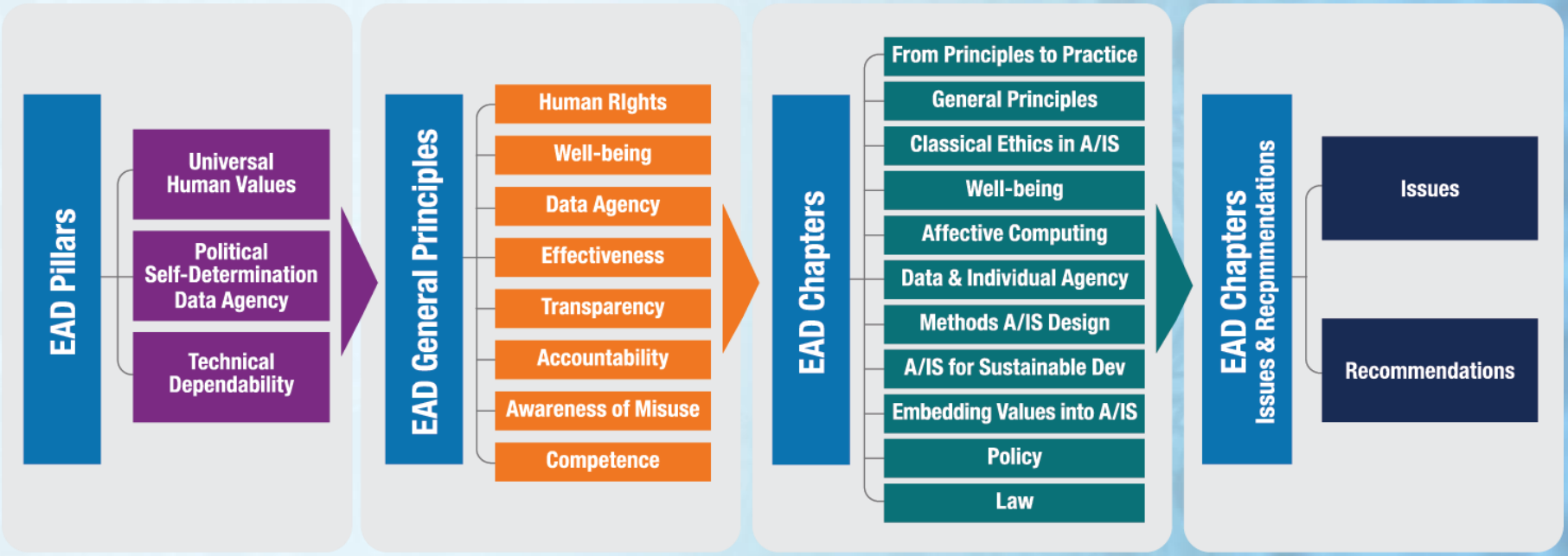
Ethically Aligned Design *Pillars and Principles*



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P7000 Standards

IEEE P7000™ - Model Process for Addressing Ethical Concerns During System Design

IEEE P7001™ - Transparency of Autonomous Systems

IEEE P7002™ - Data Privacy Process

IEEE P7003™ - Algorithmic Bias Considerations

IEEE P7004™ - Standard on Child and Student Data Governance

IEEE P7005™ - Standard on Employer Data Governance

IEEE P7006™ - Standard on Personal Data AI Agent Working Group

IEEE P7007™ - Ontological Standard for Ethically driven Robotics and Automation Systems

IEEE P7008™ - Standard for Ethically Driven Nudging for Robotic, Intelligent and Autonomous Systems

IEEE P7009™ - Standard for Fail-Safe Design of Autonomous and Semi-Autonomous Systems

IEEE P7010™ - Wellbeing Metrics Standard for Ethical Artificial Intelligence and Autonomous Systems

IEEE P7011™ - Standard for the Process of Identifying and Rating the Trustworthiness of News Sources

IEEE P7012™ - Standard for Machine Readable Personal Privacy Terms

IEEE P7013™ - Inclusion and Application Standards for Automated Facial Analysis Technology

IEEE P7014™ - Standard for Ethical considerations in Emulated Empathy in Autonomous and Intelligent Systems

Example: Transparency

P7001: Chair Prof Alan Winfield

*Transparency **means something different** to different stakeholders*

An elderly person doesn't need to understand what her care robot is doing in the same way as the engineer who repairs it.

*Who are the **stakeholders**?*

Experts:

- Safety certification engineers or agencies
- Accident investigators
- Lawyers or expert witnesses

Non-experts:

- Users
- Wider society

Industry-driven

- **Offers a process and defines a series of marks** by which organizations can seek certifications for the processes around A/IS products, systems and services
- **An industry-driven and iterative process** for developing certifications/mark for A/IS
- Initial **outcomes** are focusing on
  - Criteria and process for Certification/Mark focused on **Transparency in A/IS**
  - Criteria and process for Certification/Mark on **Accountability in A/IS**
  - Criteria and process for Certification/Mark focused on **Algorithmic Bias in A/IS**

More information at:

standards.ieee.org/industry-connections/ecpais.html

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Driving Understanding of Standards in Ethics and A/IS

- 38 members from **Standards Bodies, Industry and Government working together** to enhance the understanding of the role of standards in facilitating innovation while addressing problems that go beyond technical solutions to addressing ethics and values
- Identifying collaborative opportunities to **bolster the development and use of standards in supporting technical, business and policy communities** in addressing technical, societal and ethical implications of technology expansion
- Developing a **repository of standards in the AI and A/IS domain—to be live by year end**

For more information

https://ethicsstandards.org/

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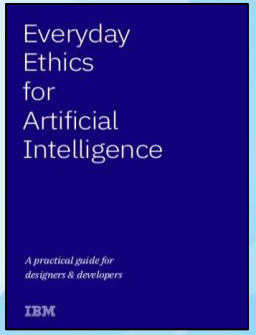
Global reach

Examples

- Consulting with and contributing to AI Positions of
  - European Commission (member of the HL expert group)
  - European Parliament
  - Council of Europe
  - OECD
- UN (via HLP DC, UNESCO, UNICEF and other UN orgs)
- National Governments
- Cities
- Industry
- Associations
- Standard Developing Organizations



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Thank you

Dr. Clara Neppel
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IEEE standards shaping the future of transportation

Dr. Hermann Brand, European Standards Affairs Director, IEEE SA

Standardization Panel, R8 Meeting, Valencia, 11 October 2019

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Before I Share my Opinion…

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IEEE-SA Standards Board Operation Manual (subclause 5.9.3)

Agenda

- Big picture: ICT drives the digital transformation of transportation
- Standards facilitate a smooth transition of the automotive eco-system
- Some existing standards and their evolution
- More in the pipe. Get engaged!

Technology drivers

More
1. connected,
2. automated,
3. intelligent,
4. SWized,
5. electric

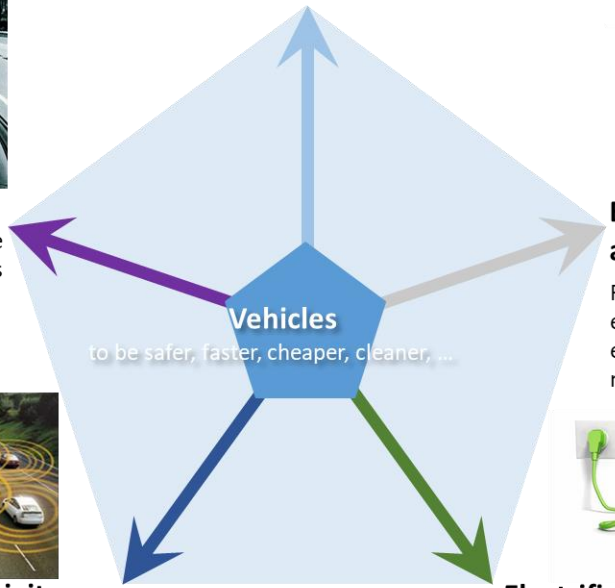
As smart as or even smarter than a human driver

Cognitive Intelligence

Courtesy of Yu Yuan, P2040

Automation
From driver assistance to driverless

Electronification/SWization
Faster evolution, easier production, easier maintenance, more applications, …



Connectivity
V2V, V2I, V2P, V2X, …

Electrification
Electric car, electric bus, electric ship, electric aircraft, …

At the horizon

- ***Drivers** will be **operators** and eventually **passengers***
- There is a shift from **individually owned vehicles** towards **interconnected mobility solutions** used on an **if-and-when needed service (Mobility-as-a Service (MaaS))**
- ***The car as a stand-alone product** will be complemented and partially replaced by **an eco-system of vehicles, infrastructure and service provider platforms cooperating in complex interaction***
- Such a mobility eco system will be in need for **adequate standards**, in order to enable the **smooth integration of its constituents**
- **Leapfrogging L4/L5** or **ADAS Evolution from L2 to L5**?

Challenges for the Automotive/Transportation eco-system

Technology

LIDAR, HD maps, ML/DL,
V2x communication,
Levels of autonomy,
Secure safety,
Cooperative cognitive control,
Fog/cloud computing,
SW Car, Fail-operational,
etc.

Economics

Car sharing,
Mobility as a Service,
Data prosumer,
Data monetization,
etc.

Politics/Society

Safety,
Zero accidents,
Sustainability,
Efficiency,
Alignment with law, moral values and ethical principles,
etc.

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Standards facilitate a smooth evolution of the automotive eco-system

There are **issues which cannot be solved by a single company or by a closed circle of a few companies.**

An **open collaboration platform** in a proven '**safe-harbor**' legal framework for **standardization** is needed,

1. to build **trust**
2. to reduce **risk and cost**
3. to reduce **complexity** and **options**
4. to ensure a smooth evolution of **value networks**
5. to facilitate **economies of scale**
6. to enable **interoperable solutions**.

Typical Wiring Harness in a Car

Cabling is the 3rd highest cost component in a car
- Engine (1st)
- Chassis (2nd)

Harnesses are built **ONE** at a time with 50% of cost in labor

Cabling is the 3rd heaviest component in a car
- Chassis (1st)
- Engine (2nd)

Reducing cable weight has a direct impact on fuel economy!

Reduced Twisted Pair Gigabit PHY – IEEE 802.3 Call for Interest 15

There is a **technical problem!**
There is a **business problem!**

How to **reduce cost?**

How to **reduce complexity?**

How to improve **interoperability?**

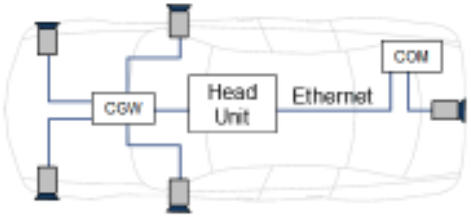
From: Reduced Twisted Pair Gigabit PHY – IEEE 802.3 Call for Interest - March 2012 http://www.ieee802.org/3/RTPGE/public/mar12/CFI_01_0312.pdf

Example: a multi-purpose communication backbone

- **IEEE 802.3ch: IEEE** Std 802.3 to add greater than 1 Gb/s Physical Layer (PHY) in the automotive environment. http://www.ieee802.org/3/ch/P802.3ch_PAR.pdf
- IEEE 802.3 Greater than 10 Gb/s Automotive Ethernet Electrical PHYs *Study Group*.
- IEEE 802.3 Multi Gigabit Automotive Optical PHY *Study Group*.
- Hybrid (optical / electrical) automotive Ethernet data links *Call for Interest*
- **IEEE 802.1**: Many standards related to Time sensitive networking, see http://standards.ieee.org/downloads/TSN_for_Automotive_Networks.pdf
- NOTE: 'Automotive Ethernet' is not restricted to cars, applicable to aircrafts, trains, ships, …

Use Cases for Ethernet and IP Communication

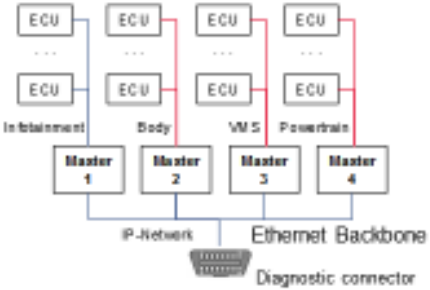
- **Driver Assist Cameras**
  - Cameras on bumpers and mirrors
  - GbE link saves need for compression
  - Reducing latency increases safety
  - Compression artifacts make obstacle detection harder/less reliable



CGW = Camera Gateway

Driver Assist System (start of production: 2013)

- **Ethernet Backbone**
  - Many regions of the car linked together via Ethernet
  - Allows 'data' from one region to be re-used elsewhere in the car
  - GPS navigation can be overlaid on camera data
  - Enables separate CAN bus domains to communicate with each other



Backbone (start of production: ~2020)

Used with permission from Bosch

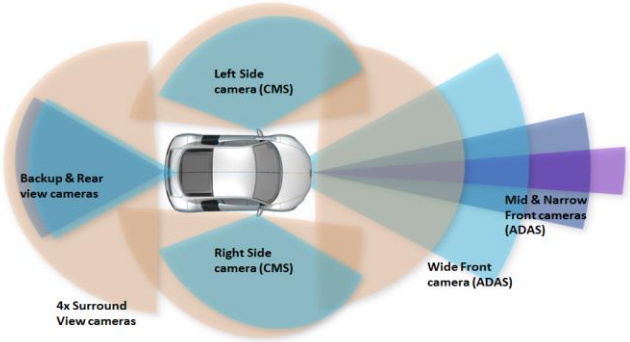
More cameras and other sensors need to be integrated to achieve **higher levels of automation** and ultimately autonomy

The **Ethernet Backbone** serves as basis for **vehicle platform evolution**

From: Reduced Twisted Pair Gigabit PHY – IEEE 802.3 Call for Interest - March 2012
http://www.ieee802.org/3/RTPGE/public/mar12/CFI_01_0312.pdf

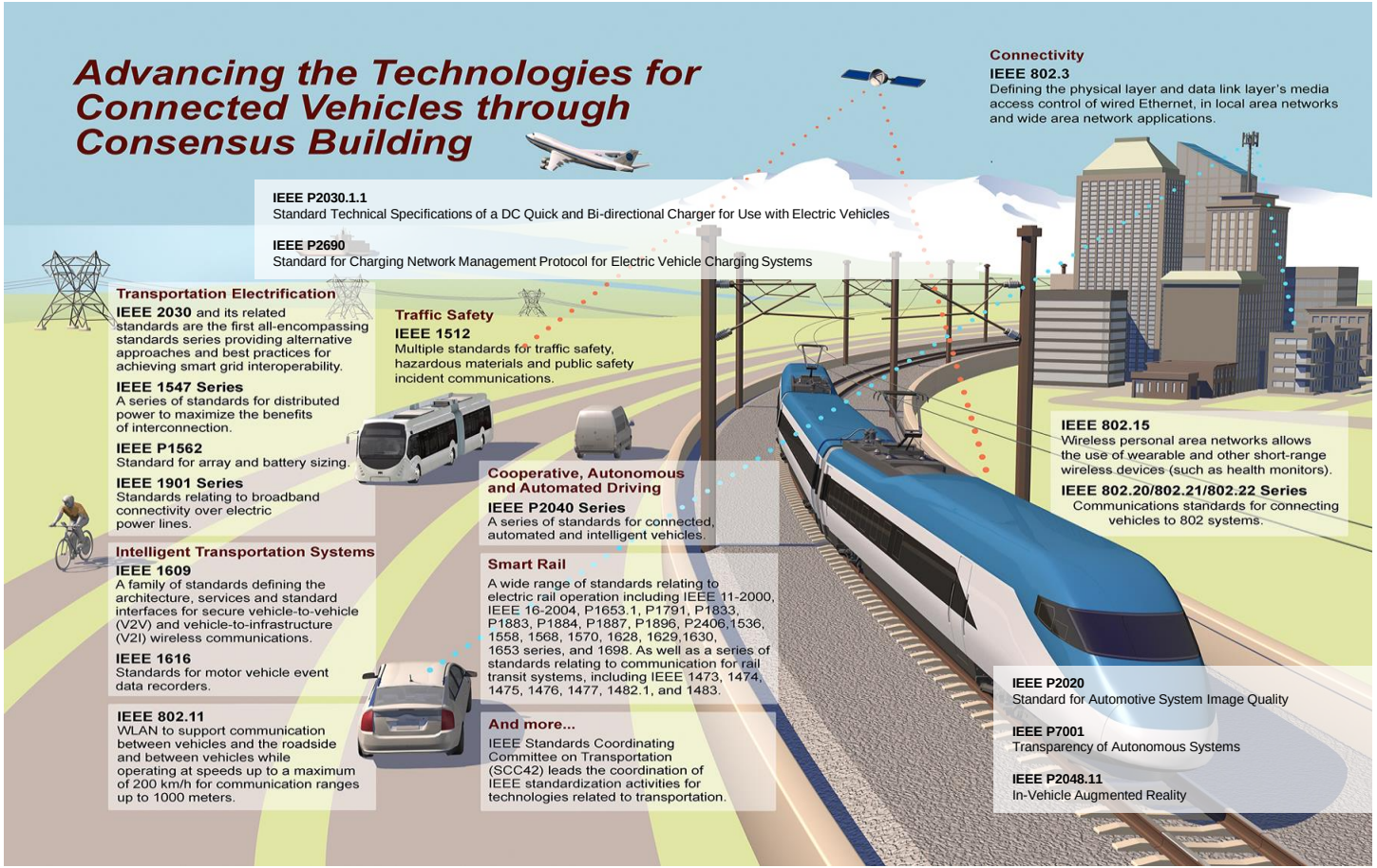
Example: Standard for Automotive System Image Quality

- Another intertwined technical/business problem: How to structure and organize the **value chain/network?**
- Standard for a coherent set of **KPIs to assess automotive camera systems**
- Standard to **measure/test** automotive image quality



Courtesy Texas Instruments

- Whitepaper "**IEEE P2020 Automotive Imaging**" published in 2018
- Standards development kicked off at the **P2020** Meeting in Brussels on 16/17 September 2019 (collocated with AutoSense Conference, see https://auto-sens.com/autosens-brussels/)



IEEE Standards for Transportation

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IEEE automotive standards portfolio

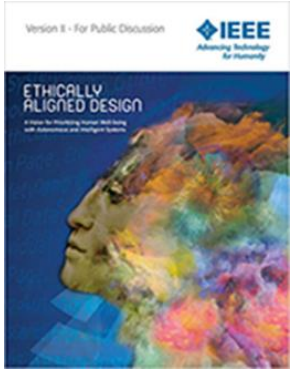
*A few **examples***

e.g. 802.1/802.3: TSN

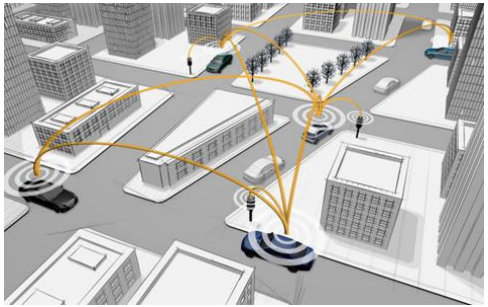
e.g. P2020: Camera image quality test

e.g. 2030.1.1: DC quick charger for EV

e.g. P7001: Data Transparency P7003: Algorithmic Bias, P7011: Trustworthiness of Data



Zero accidents now (in EU): 802.11bd (11p evolution) for ITS G5 (EU) and WAVE (US)



e.g. P2040: Taxonomy, architecture, testing

Standards evolve rapidly in response to technical innovations

EC H2020 EPoSS SRA 2017

To **trade-off technology enablers** for autonomous driving, including

- **Sensors** (camera, radar, LIDAR)
- **Positioning and HD maps**
- **Communication** (a-hoc, cellular, hybrid)
- **AI techniques** (machine learning, deep learning)

sense-plan-act cycle extended

To **build the Digital Infrastructure of road operators** for autonomous vehicles

To **evolve Vehicle Platforms and enable Platform Businesses**

- **Data driven engineering and operation**
- Data Interoperability , ADAS Engineering, Test solutions and validation methods

To **hit the Safety Spot** despite security risks

More projects are in the pipe. Time to get involved!

In Ongoing: for example
- Framework of Knowledge Graphs (P2807),
- Framework and Requirements of Shared Machine Learning (P2830),
- Framework for Depp learning Evaluation (P2841)
- Architectural Framework and Application of Federated Machine Learning (P3652.1)

Approval stage: for example
- A formal model of safe automated vehicle decision making (P2846)
- Exchange/Interoperability Format for Safety Analysis and Safety Verification of IP, SoC and Mixed Signal ICs (P2851)

In drafting stage: for example
- Automotive radar performance metrics and testing
- Secured safety

In exploration stage: for example
- Sensor data fusion and environmental model
- NLP interoperability

Get involved now!

Some important links

- IEEE Standards Association (IEEE SA): https://standards.ieee.org/
- IEEE SA Standards Board: https://standards.ieee.org/about/sasb/index.html
- IEEE SA Membership: https://standards.ieee.org/about/membership/index.html
- IEEE-SA Ethernet & IP @ Automotive Technology Day, 24 Sep 2019 - 25 Sep 2019, Detroit, MI, USA; https://standards.ieee.org/events/automotive/index.html
- Nurturing the Era of e2e Mobility as a Service (MaaS): Standards for Connected and Autonomous Transportation, 2 Dec 2019 (afternoon)- 3 Dec 2019, Munich, Germany: https://standards.ieee.org/events/e2e-maas/index.html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Thank You

IEEE

Advancing Technology for Humanity

IEEE STANDARDS ASSOCIATION

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BACKUP

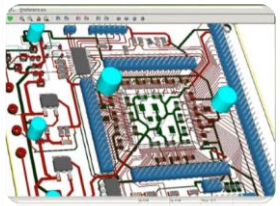
The standardization gap

- A **'standard'** is not just another 'technical publication' to be sold
- **Standardization is collaborative techbiz development** (a business practice)
- **Standardization underpins product development as part of a company's business plan** (cooperative product design)
- *NOTE1: "**Research** transforms money into knowhow, **innovation** transforms knowhow into money"*
- *NOTE2: "A **technology** does not have a value as such. Its value results from being **integrated into a commercial product or service offer**"*
- Standardization MAY be needed to commercialize new technologies/research results, BUT:
  - There is a **window of opportunity** to set a standard
  - A standard specifies only a **small, but essential** part of a product

2 historically grown standardization models

- The **national representation model**
  - Electric grid
  - Industrialization of national economies

- The **global market driven model**
  - The Internet
  - Globalization of industrialized economies



The ‘International’ Standardization System

based on ‘national representation model’

international

ESOs are **recognized by the EU**
ITU is an **inter-governmental body**

European Standards Organizations (ESOs)

regional

national

And many more ….

Global Standards Developing Organizations

based on 'global market driven model'

- Key facilitator for growth of global economy and social model touching billions of lives
- **Standards from W3C, IETF, and IEEE form the Internet's foundation**
  - Not deployed via traditional, national-representation model of standards adoption
  - Instead driven by market momentum to innovate global customers

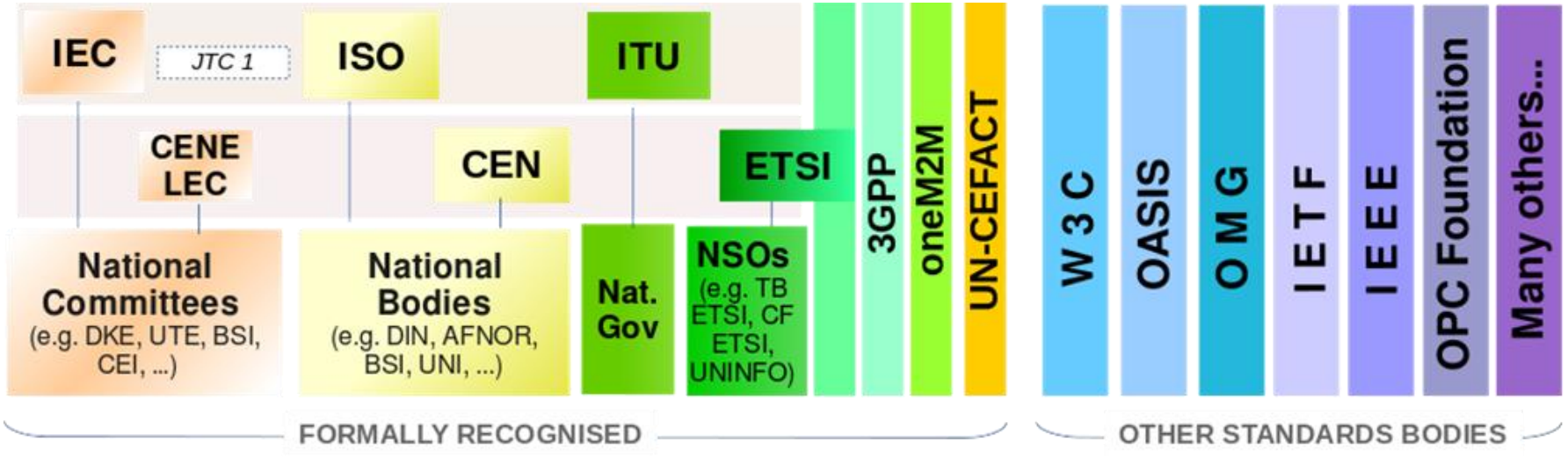
IEEE Advancing Technology for Humanity

IETF

W3C World Wide Web consortium

IEEE

The global standardization ecosystem



Source: Multi-Stakeholder Platform Working Group Digitizing European Industry (MSP WG DEI)

IEEE partners with a number of players to bring collective value

A must to leverage Network Effects and master the Digital Transformation

OCEANIS: Open Community for Ethics in Autonomous and Intelligent Systems, https://ethicsstandards.org/

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Standards in Healthcare Technology

Prof. Christopher James

Professor of Biomedical Engineering & Director, Warwick Engineering in Biomedicine, University of Warwick, UK

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The reality of Healthcare Technology

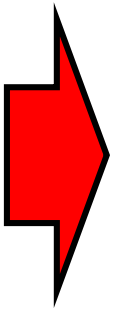
> “Technology systems used daily across hospitals, GP surgeries, care homes, pharmacies and community care facilities don’t talk to each other, fail frequently and do not follow modern cyber security practices. As a result, some people are getting suboptimal care, staff are frustrated and money could be saved and released for the front line.”

UK DoHSC, “The future of healthcare”, Policy Paper, October 2018

Emerging model of Healthcare

Old model of care:

- Focus on acute conditions, reactive management
- Hospital centred, disjointed episodes
- Doctor dependent
- Patient as passive recipient, Self-care infrequent
- Use of tech rare



New model of care:

- Focus on long term conditions, prevention & continuing care
- Integrated with people's lives in homes & communities
- Team based, shared record
- Patient as partner, self-care encouraged & supported
- Dependent on tech & devices

What can state-of-the-art technologies do?

- It’s not just about getting the current systems to work better
- Cutting-edge technologies can support **preventative**, **predictive** and **personalised** care
- E.g. use more data-driven technologies such as Artificial Intelligence to help diagnose diseases or conditions and to gain better insights into treatments
- E.g. use robotics and voice assistants to support people and their carers in rehabilitation, dementia support or medication management

How can it be done?

- To reach this potential we need to focus on getting the basics right
- Getting the digital architecture of the health and care system – the building blocks
- **Open standards**, **secure identity** and **interoperability** are critical to the **safe and successful use of technology**, ensuring that **systems talk to each other** and that **the right data gets to the right place at the right time**

NHS Digital

Why have standards in Healthcare?

- Greater standardisation of data, infrastructure, platforms and APIs will create a health and care system which is **more joined-up**, **safer** and **more efficient**.
- Connected systems ensure that **clinicians have immediate access to relevant and appropriate patient data** from care providers and settings. Data can be communicated between systems with **absolute fidelity**, **eliminating misinformation and misunderstandings**.
- We will also increasingly be able to **provide citizens and patients** with direct and immediate **access to their medical records**.

NHS Digital

Creating an evidence standards framework for digital health technologies

- Developing standards that ensure new technologies are clinically effective and offer economic value
- Make it easier for innovators and commissioners to understand what good levels of evidence for digital healthcare technologies look like
- Digital healthcare technologies must also meet the needs of the health and care system, patients, and users

NICE National Institute for Health and Care Excellence

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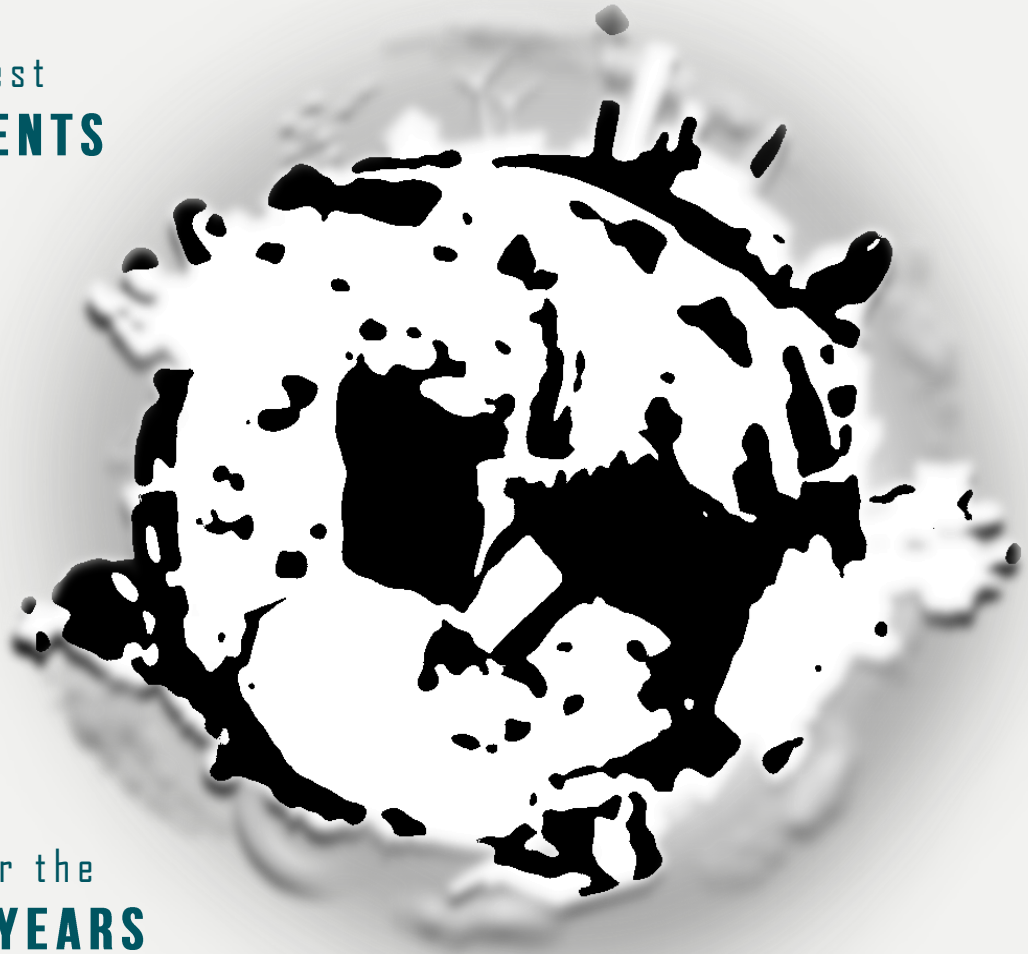
The Need for Blockchain Standards

Brian Heinen. Founder, Local Producer Ltd and the Blockchain in Europe Group

IEEE

the greatest

ACHIEVEMENTS



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AGRI-FOOD VALUE CHAIN

will occur the

NEXT 20 YEARS

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Source: http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf

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NEW TECHNOLOGY + OLD BUSINESS MODEL

= EXPENSIVE OLD ORGANIZATIONS

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NEW TECHNOLOGY + EMPOWERED COMMUNITY = SUCCESSFUL ADAPTATION

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DEMYSTIFYING BLOCKCHAIN SOLUTIONS

Commodification of Trust:

- self-enforcing smart contracts
- IoT solutions

Inclusive Governance Model:

- democratise ownership
- custodian of ecosystem

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INTEROPERABILITY

What and How to Communicate and Connect

- Harmonized Data
- Trustless Conformity
- ‘Stay Relevant’ Intermediation

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INTEROPERABILITY

How Much and When...or If?

- Measurable Added Value??
- Read/ Write Governance - Private, Permissioned, Public and Hybrid
- Scaling and Speed
- Focus: Small Wins, Big Promotions

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STANDARDS

- *Custom metrics/ indicators* for integrating blockchain into value chains*
- *Ecosystem transformation and best practices building upon these standards*
- *Business models created using certified indicators*

**philosophical practice and data interoperability standards - similar to what is found in social impact or ethical standardization platforms like IRIS*

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IEEE BLOCKCHAIN FOCUS

- Engage Stakeholders
- Develop Incubator Programs and Testbeds
- Comprehend Concerns and Barriers
- Communicate Findings for Standards

- standards.ieee.org

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IEEE BLOCKCHAIN STANDARDS PROJECTS

- P2418 Blockchain Series
- P2140 Blockchain Application Standards
- P2141 Decentralised Exchange Framework
- P2143 Cryptocurrency Payments

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IEEE VIRTUAL COMMUNITIES

IEEE Blockchain
Special Interest Group (SIG)

Collabratec
ieee-collabratec.ieee.org

BRIAN HEINEN

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Blockchain Advocacy

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THE OPPORTUNITIES OF BUILDING IEEE STANDARDS FOR EUROPE, MIDDLE EAST AND AFRICA

region 8 IEEE

IEEE SECCIÓN ESPAÑA

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