

# A vision for the next wave of connectedness

*Dr. Ing. Konstantinos Karachalios, Managing Director IEEE Standards Association  
and Member of IEEE's Management Council*

*MWC, Barcelona*

*GSM A PSMC, 24 February 2017*



“The two most powerful warriors are patience and time.” ...so remember: great achievements take time, there is no overnight success.

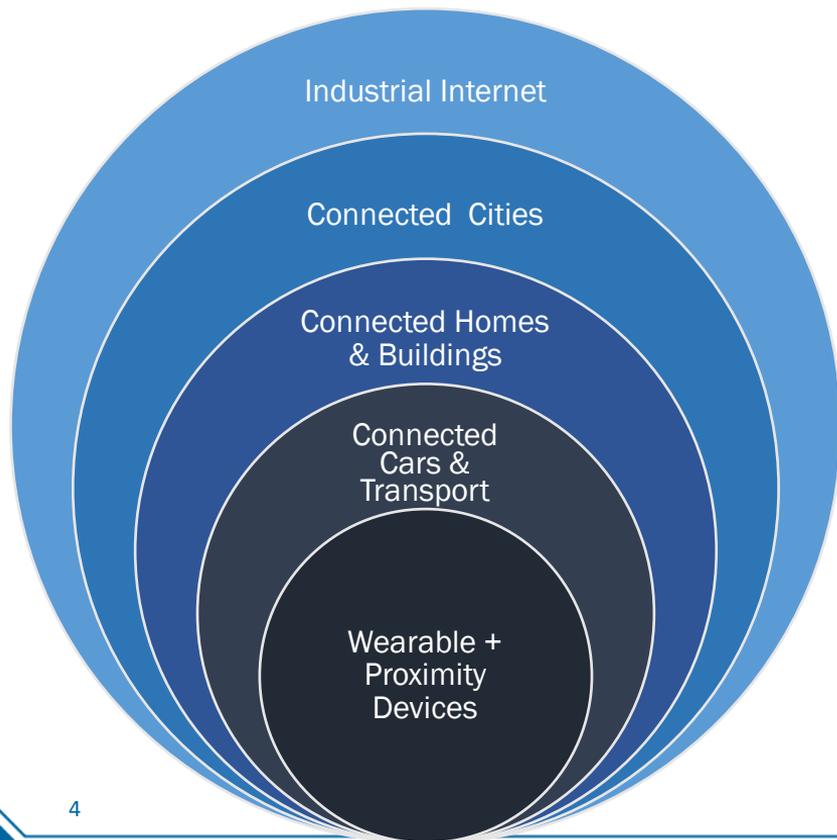
Leo Tolstoy

## From *Mobile is Everything* to *The Next Element*

- ▶ According to [Mobile World Live](#), MWC 2017 top 5 themes are:
  - ✓ Devices
  - ✓ Artificial Intelligence
  - ✓ IoT
  - ✓ 5G
  - ✓ Regulation

# Internet of Things

*Spectrum of Connected Things places increased demand ...*



- By 2018 half the world connected to the internet
- Estimates of projected IoT internet installed devices on the internet by 2020 range from 30B to 70B
- \$15 trillion: the amount the industrial Internet could add to global GDP over the next 20 years (GE)
- The number of IoT developers will grow from 300k in 2014 to 4.5 Million by 2020 – Vision Mobile
- By 2020, there will be 250 million connected cars on the road worldwide (Gartner)
- A connected car capable of generating continuous data streams sends on average 25 gigabytes per hour of data to the cloud (HITACHI)
- Service revenues for the IoT will reach \$500 Billion by 2018 (Harbor Research)

# Autonomous, Connected Vehicles

62% CAGR from 2020 to 2030

## Snapshot Applications

- ▶ Overtaking vehicles
- ▶ Appropriate stopping
- ▶ Proximity of one way traffic flow
- ▶ Rural, unpaved, no lanes
- ▶ Detecting & differentiating between living organisms or obstacles while on auto
- ▶ Car environment and meta data capture
- ▶ Connected Car Services
- ▶ Autonomous Public Transportation (Bus, Trains)

## Connectivity Demand Drivers

- ▶ Cost effective, safer and sustainable road transportation
- ▶ Lower latency for information to make its way back and forth from source to vehicle
- ▶ Vehicle to Vehicle and Vehicle to Infrastructure communications (preferably through short waves)
- ▶ Vehicle to Infrastructure Communications requiring economical or highly functioning solutions that allow for appropriate data capture, assessment and action
- ▶ Mixed reality displays and streams of information impacting latency, bandwidth, integrity

# Immersive Experiences

*Mixed Reality ~40% CAGR over the next 7 years, Telepresence set to grow*

## Snapshot Applications

- ▶ Application of augmented reality smart glasses to reduce production inefficiencies
- ▶ Zero distance connectivity re-defining the way and means we engage with each other
- ▶ Virtual 'AA' style meetings enabling anonymity while allowing participants to address their addictions without a need to share identity
- ▶ Retail experiences allowing for augmented reality and 3D Body processing to help identify appropriate personal sizes, fit and materials as well as identifying appropriate target adverts
- ▶ Healthcare, Entertainment, Automotive & Aerospace, E-commerce & Retail represent strong segments with further practical use cases

## Connectivity Demand Drivers

- ▶ The demand from the video and audio services will place a large demand on network systems and stress current architectures
- ▶ Bandwidth & latency needed to run application/service
- ▶ Significantly higher broadband access speeds
- ▶ New programmable architecture & design to address massive capacity and low latency needs
- ▶ Agility to react instantly to changing application needs

# Smart Cities

**Est. 20% CAGR from 2015 – 2020, \$1.6T by 2020**

## Snapshot Applications

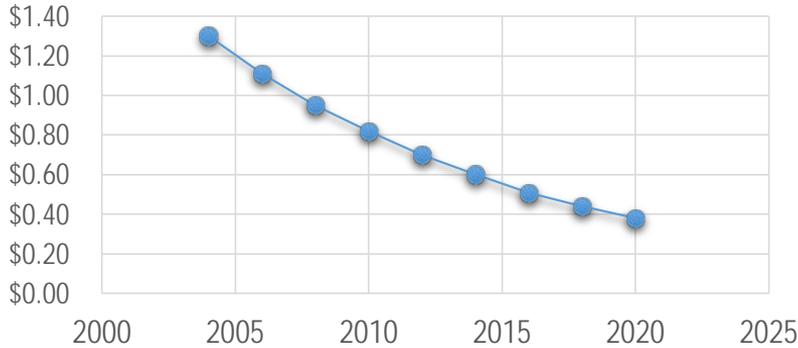
- ▶ Open data ecosystems enabling greater platform innovation
- ▶ Test-bed concepts allowing ability to analyze traffic and pedestrian flows and run simulations
- ▶ Online government services
- ▶ Social innovation and citizen-centric mobile apps for transport, health, municipal services
- ▶ Emergency alert services for improved weather preparation, utilizing smart networks
- ▶ Mixed reality enabled solutions
- ▶ Smart building greening and smart cooling systems (why not learn from Gaudi?)

## Connectivity Demand Drivers

- ▶ 6B – 8B IoT installed Devices in Smart Cities
- ▶ Investments in IoT by Smart Cities nearly \$140B - \$150B by 2020
- ▶ UN estimates that by 2035 nearly 65% of the world population will be living in cities
- ▶ Increase in data and sensor networks
- ▶ “While smart homes and cool personal gadgets get the press, non-glamour applications get the traction. **Connected world will come first to warehouses, trucks, factories, and farms**” (Forrester )
- ▶ Energy conservation and waste management solutions are other factors which are attracting investors and consumers in the market

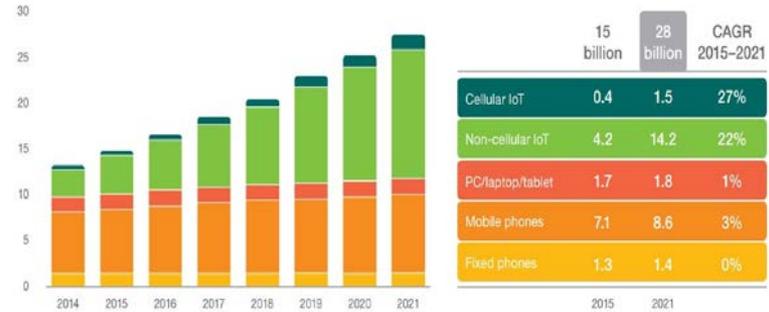
# Reinforcing Market Drivers...

Price of Sensors, 2004 - 2020F

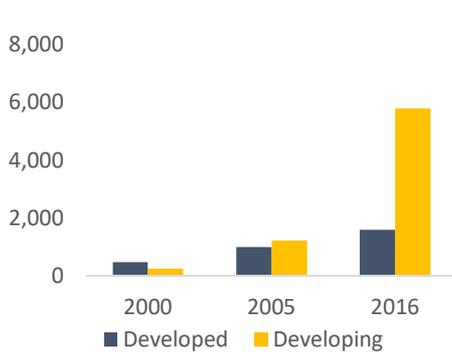


With such a rapid growth rate of IoT devices facilitated by falling cost er unit, enhanced mobile broadband services and 5G development, mobile devices are poised to be outpaced in 2018

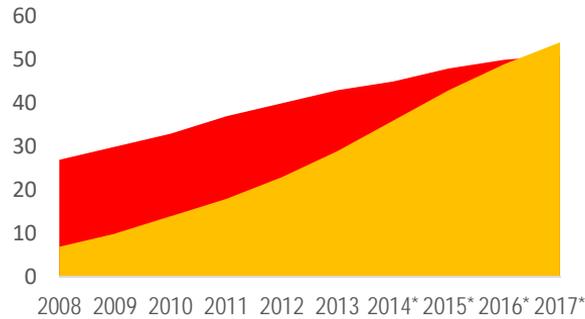
Connected devices (billions)



Mobile-cellular subscriptions (Billions)

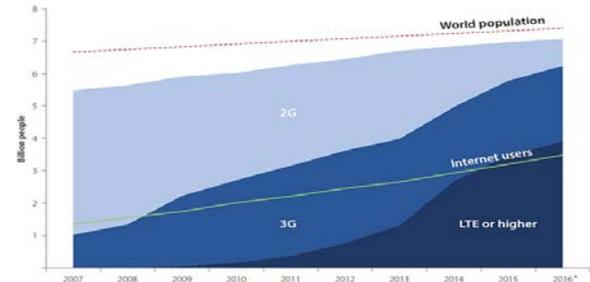


Forecasted Global Broadband Penetration %



■ Fixed-broadband penetration  
■ Mobile internet penetration

Mobile network coverage and evolving technologies



Source: ITU-T, TIA, Ericsson, IEEE

“5G is not only evolutionary, providing higher bandwidth and lower latency than current-generation technology; more importantly, 5G is revolutionary, in that it is expected to enable fundamentally new applications with much more stringent requirements in latency and bandwidth.”

Ashutosh Dutta, Lead Member Technical Staff, AT&T; co-chair of IEEE 5G Initiative

This will leave us with a lot to  
be desired...



# Buzzwords

Intelligent

Connectedness

Contextual

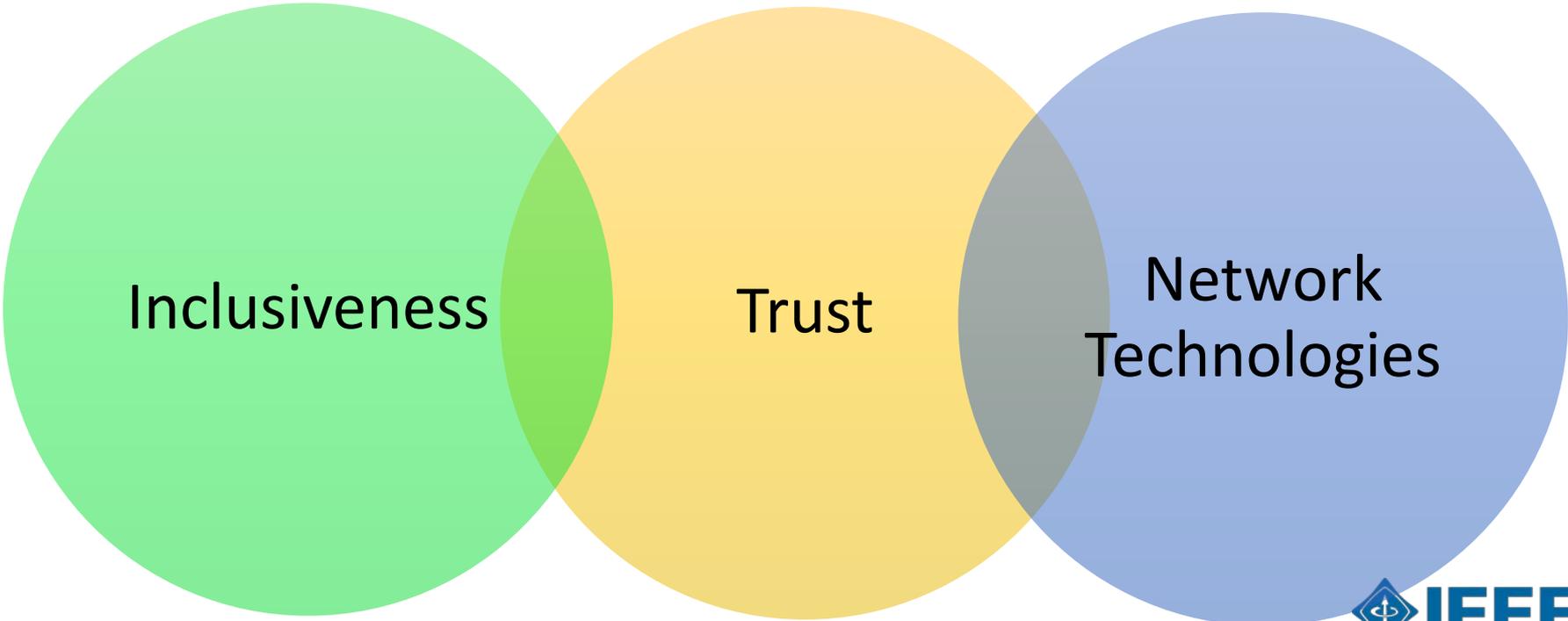
Smart

Communications (talk, listen)



The future requires infrastructure and technology that effectively and economically support our contexts respective business / personal use cases – *and are also inclusive of our values and ethics*

# Connecting Whom, How, With What Means?



# Trust is the Gateway to Connectivity



Beyond Government Intervention: **URGENT need for Self Regulation**

## Rules of Stakeholder Engagement

- ▶ Policies of SDOs
- ▶ Openness
- ▶ Inclusiveness
- ▶ Transparency
- ▶ Affordability
- ▶ Explicit Rules
  - Patent Policies

→ OpenStand, Patent Policy Update

## Consumer & Citizen Trust

- ▶ 5G as a gateway to the internet
  - Conditions of access create power asymmetry
    - Lack of personal data agency
    - Lack of agency of our own identity
- ▶ Softwarization of systems and algorithmic era
  - Accountability + Transparency of algorithms & designs
  - Data, privacy, security, identity

→ IEEE Global Initiative



# Building Trust among Standardization Participants



- ▶ Formally open standard-setting organizations have the prerogative to explicitly articulate their governance responsibilities. People have a right to know what are the rules of engagement in a system as sensitive and as impactful as bottom up, voluntary standardization. For such organizations this includes patent policies that balance the rights of key stakeholders while also preserving the public interest.
- ▶ By not doing so, they would fail to mediate between the exclusionary features of patent law and the open, collaborative nature of standards. If participants operating in a technology field that relies strongly on standards fail to determine the “rules of the game” in advance, then there is an inherent risk of opportunistic behavior. This translates into an unsatisfactory governance framework and would be considered in many other areas of public policy unacceptable.

# IEEE's Position



- ▶ IEEE recognizes that the conditions under which standards will find their application in technical devices depend to an equal extent on how contributors to the standard will be remunerated for their efforts and how standards will find adoption by implementers and used broadly.
- ▶ Moreover, a coherent, and as far as possible self explaining patent policy can decrease transaction costs and establish trust, both critical ingredients for a sustainable standardization ecosystem.
- ▶ To assure the continuation of the virtuous cycle of innovation, IEEE updated its patent policy, making its rules of engagement more explicit and clear. By doing so, IEEE assumed its governance responsibilities at a global level and has taken important steps to live up to its mission to “advance technology for humanity.”

# The rationale of IEEE's Global Initiative

Trust

Inclusive  
ness

Tech

- To move beyond both the fear and the uncritical admiration regarding autonomous and intelligent technologies
- To show that aligning technology with ethical values will help advance innovation with these new tools while diminishing fear in the process

## Time table

*Public launch April 2016*

*First Meeting in The Hague, August 2016*

*Ethically Aligned Design, v1 December 13 2016*

*Second Meeting in Austin/TX in June 2017*

*Ethically Aligned Design, v2 Q4 2017*



# IEEE Global Initiative for Ethical Considerations in Artificial Intelligence and Autonomous Systems



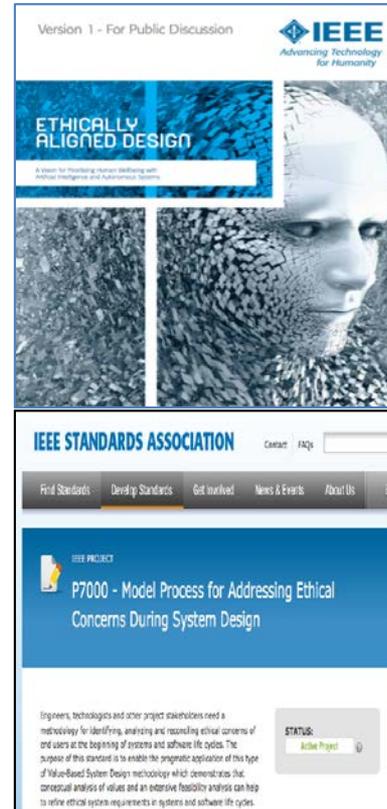
To ensure every technologist is educated, trained, and empowered to prioritize ethical considerations in the design and development of autonomous and intelligent systems



# Key Goals

## Create “Ethically-aligned” autonomous and intelligent systems:

- Incorporate ethical aspects of human wellbeing that may not automatically be considered in the current design and manufacture of AIS technologies.
- To reframe the notion of success so human progress can include the intentional prioritization of individual, community, and societal ethical values.
- By means of practical guidelines and an entirely new standardization ecosystem around ethical design values.



# Our Technology Perspective

Advancing technology for humanity by improving connectivity and connecting the unconnected; helping to close or leapfrog the generational technologies gaps to enable contextual use case realizations.

We see many approaches to helping to achieve this, inclusive of:

- ▶ Enabling market driven use cases to realization of new applications, with much more stringent requirements in latency (e.g., real time) and bandwidth (e.g., streaming) through road mapping, testbeds and market collaborations
- ▶ Providing market participants the ability to realize their expected use cases within their context of next generation telecommunication/5G through our initiatives, societies, conferences, publications and standardization related efforts
- ▶ The benefits promised by 5G cuts across multiple layers, including, software-defined networking (SDN), network-functions virtualization (NFV), and the Internet of Things (IoT).
- ▶ Flexibility, ease of use, dynamic nature of the network, Quality-of-Service (QoS), and anytime/anywhere to end users are some of the benefits for end users in the move to 5G.

# 5G Technical Expectations

Reduced Latency

Ever Increasing Bandwidth

Spectrum Availability & Efficiency

Ever Increasing Speed

Backwards Compatibility

Many more Devices on Network

Lower Power Consumption

Enhanced Data Integrity



# 5G

Digital Senses

Cybersec

Smart Materials

IoT

Blockchain

SDN

Brain

Green ICT

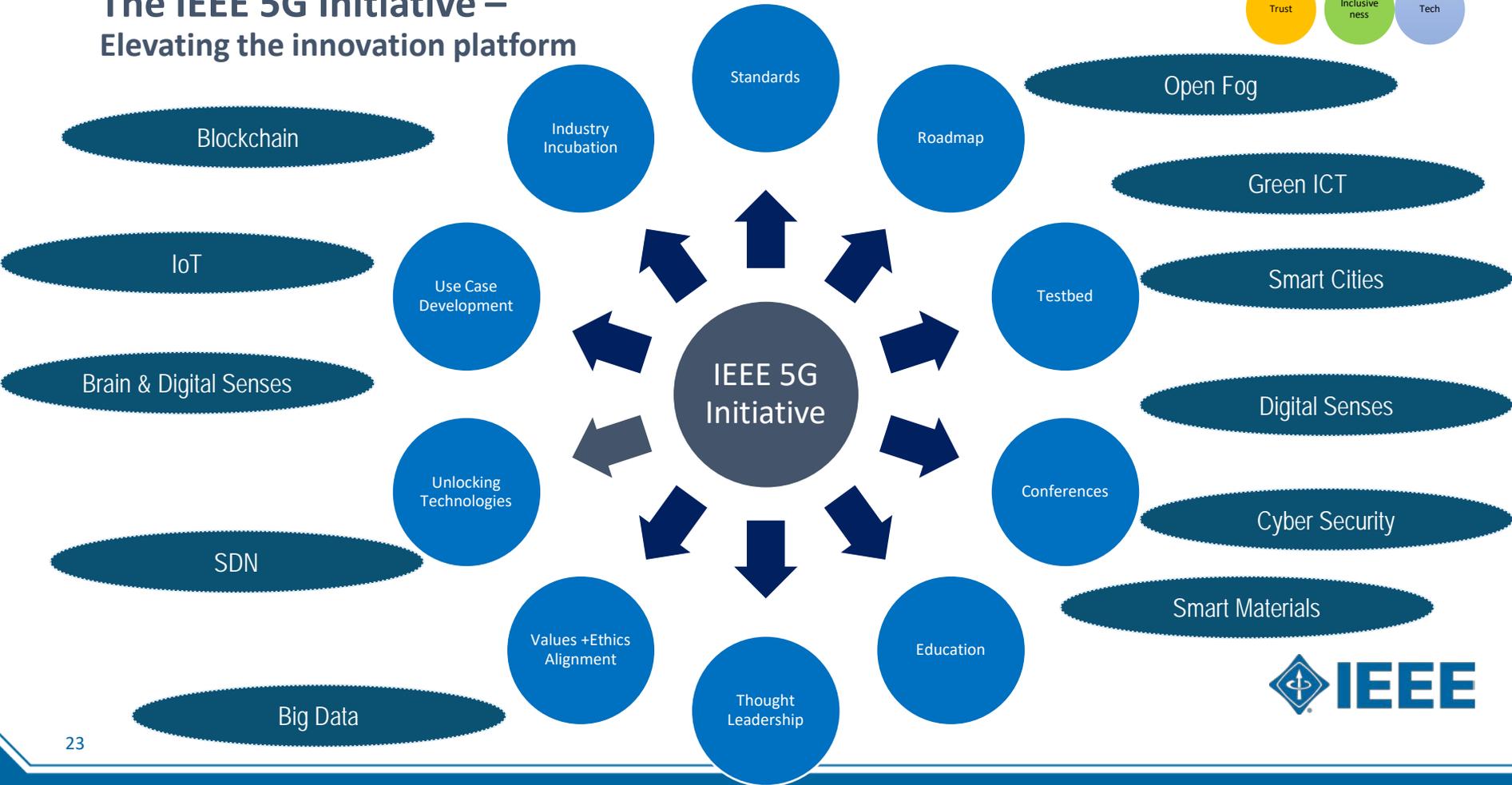
Smart Cities

Big Data

Ethics & Design

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# The IEEE 5G Initiative – Elevating the innovation platform



# A snippet of our standards work...



*IEEE's focus on use case standardization activities that enable digital lives through next generation telecommunications*

Treating Post Traumatic Stress Disorder through Virtual Therapy and Wearable Technologies

Smart Materials will interact with the context & content of Mixed Reality placing greater emphasis on interoperability and interference

Smart Glasses Road map to encourage interoperability and user experience

Tactile internet benefits Mixed Reality adoption through next generation telecommunications

Retail Therapy has a new meaning with Mixed Reality

Smart Utility Tools such as Hats in the Oil & Gas domain that increase the opportunity for greater safety onsite and efficiency

Frugal 5G

SDN/NFV Series - Security, Performance, Reliability, Bootstrapping and Middleware

Open source NFV work

Draft Standard for Tactile Internet: Application Scenarios, Definitions and Terminology, Architecture, Functions, and Technical Assumptions

Standard for an Augmented Reality Learning Experience Model

Artificial Intelligence & Ethics, inclusive of affective computing

Draft Standard for Network-Adaptive Quality of Experience (QoE) Management Scheme for Real-Time Mobile Video Communications

Draft Standard Protocol for Stream Management in Media Client Devices

Draft Standard for Packet-Based Front-haul Transport Networks

Technology & Standards Road-mapping for next generation

Draft for Consumer 3D Printing and Bio-CAD 3D Printing

Draft IoT Architecture road map standardization

Draft Standard for Content Delivery Protocols of Next Generation Service Overlay Network (NGSON)

Draft Standard for Three-Dimensional Model Creation Using Unprocessed 3D Medical Data

Draft Standard Recommended Practice for Network Reference Model & Functional Description of IEEE 802 Access Network

...and many more! 

# Standardizations Opportunities abound across the technology landscape when thinking about next generation telecommunications

Dashboards

Communications

APIs

Interfaces

Information &  
Intelligence

Source code

Objects

Datasets

Ontologies

Interoperability

Indices

Benchmarks

Testbeds

Use Cases

Emulators

Education

Test Cases

Gap Analyses

Roadmaps



# Connecting the Unconnected

## *An Inclusive 5G*



- ▶ A large part of the world is still deprived of broadband connectivity
  - Est. 3-4 Billion people do not have access to Internet
- ▶ Around 95%\* of the unconnected population belongs to developing regions and countries like India, Africa, Brazil, Argentina etc. (Source: ITU)
- ▶ The broadband penetration in rural areas of developing regions is even more marginal
- ▶ Rural area economics
  - Low ARPU
  - Lack of affordable backhaul
  - high energy costs
  - scarcity of electricity



We partner with a number of players in the field of emerging technologies, where we may bring collective value ...



“I suppose leadership at one time meant muscles; but today it means getting along with people.”

Mahatma Gandhi

“What’s always interesting is the stuff we didn’t see coming”

Peter Jarich, Vice President GlobalData

# Thank you

*Konstantinos Karachalios*

*Managing Director*

*IEEE Standards Association*



# Consensus.

We build it.

**Get Connected**

@E: [5Gstandards@IEEE.Org](mailto:5Gstandards@IEEE.Org)

@T: @IEEESA

**Learn More**

@IoT: <http://standards.ieee.org/innovate/iot/>

@5G: <http://5g.ieee.org/standards>

## About Konstantinos Karachalios, IEEE-SA MD

A globally recognized leader in standards development and intellectual property, Dr. Ing. Konstantinos Karachalios is managing director of the IEEE Standards Association and a member of the IEEE Management Council.

As managing director, he has been enhancing IEEE efforts in global standards development in strategic emerging technology fields, through technical excellence of staff, expansion of global presence and activities and emphasis on inclusiveness and good governance, including reform of the IEEE standards-related patent policy.

As member of the IEEE Management Council, he championed expansion of IEEE influence in key techno-political areas, including consideration of social and ethical implications of technology, according to the IEEE mission to advance technology for humanity. Results have been rapid in coming and profound; IEEE is becoming the place to go for debating and building consensus on issues such as a trustworthy and inclusive Internet and ethics in design of autonomous systems.

Before IEEE, Konstantinos played a crucial role in successful French-German cooperation in coordinated research and scenario simulation for large-scale nuclear reactor accidents. And with the European Patent Office, his experience included establishing EPO's patent academy, the department for delivering technical assistance for developing countries and the public policy department, serving as an envoy to multiple U.N. organizations.

Konstantinos earned a Ph.D. in energy engineering (nuclear reactor safety) and masters in mechanical engineering from the University of Stuttgart.

