industrial internet CONSORTIUM

Industrial Internet: Opportunities, Failures & Standards

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IIC Steering Committee member

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INDUSTRIAL INTERNET CONSORTIUM

An Open Membership Consortium **now about 250** companies strong

IIC Founders, Contributing Members, & Large Industry M

IIC Founding and Contributing Members

IIC Small Industry Members

IIC Small Industry Members


IIC Nonprofit, Academic, & Government Members

"A fundamental new rule for business is that the Internet changes everything."

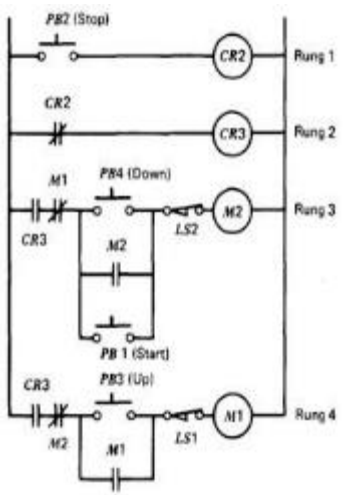
-Bill Gates, 1999

Or has it?

Discrete Manufacturing

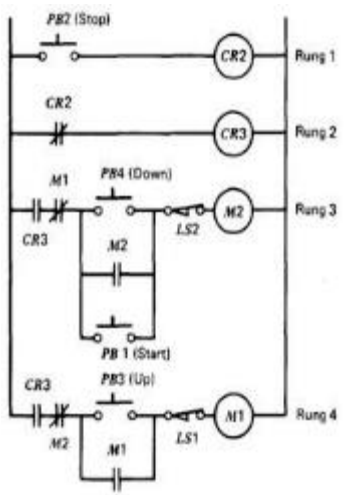
1980

Debugging a Modicon 584 Programmable Controller



2014

Debugging a Modicon 584 Programmable Controller



Energy Management

1950

Energy grids delivered power,

not information

2014

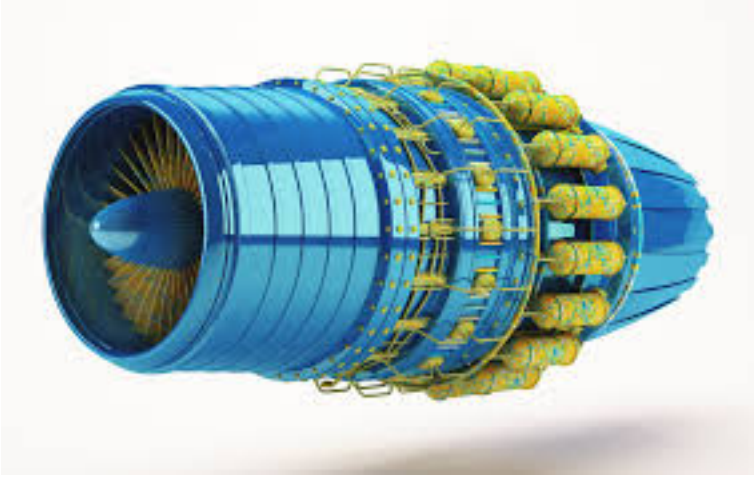
Energy grids deliver power,

not (much) information

Aviation

1960

Jet performance data is downloaded by hand



2014

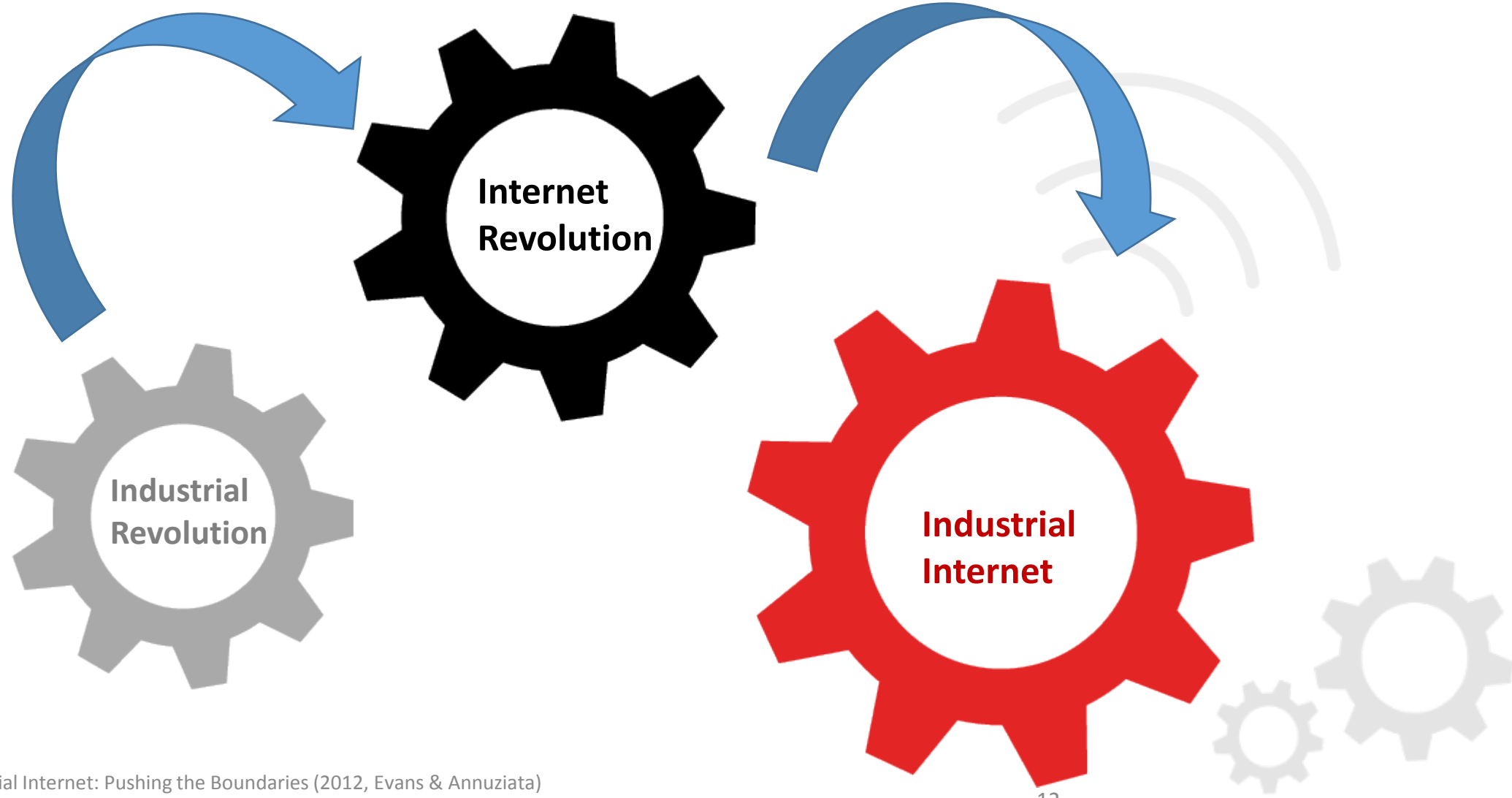
Jet performance data is downloaded by hand

Yes, there are efficiencies and new integration points.

But we have a long way to go.

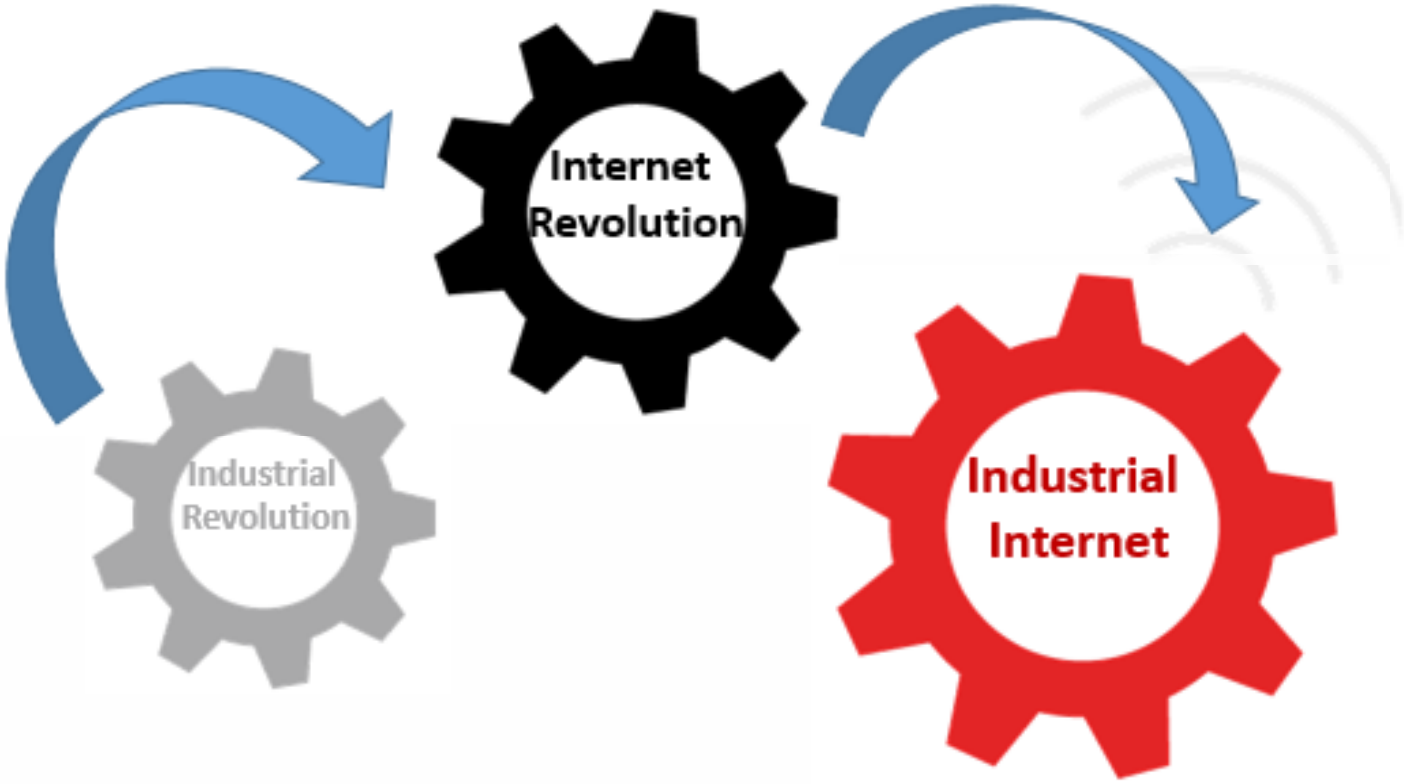
*"**Internet Thinking**" is key to Smart Manufacturing, Smart Connected Products, and Smart Product Data*

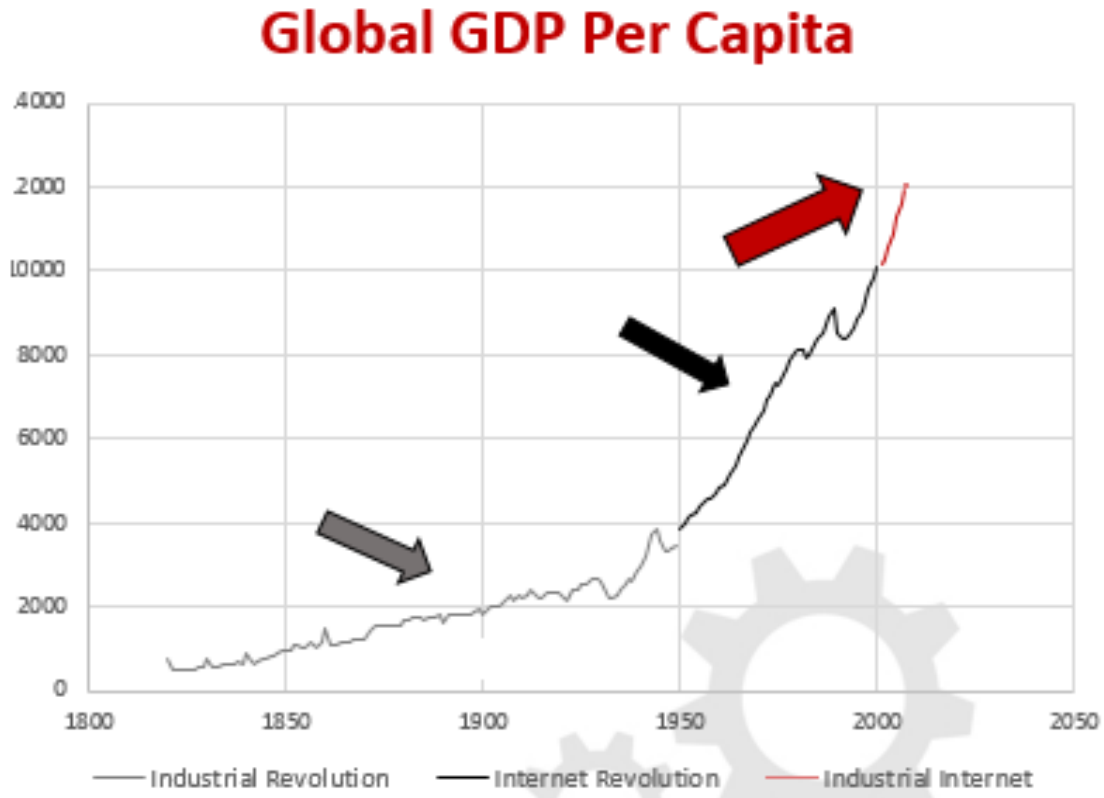
Disruptive Technologies lead to Transformational Chang



Adopted from Industrial Internet: Pushing the Boundaries (2012, Evans & Annuziata)

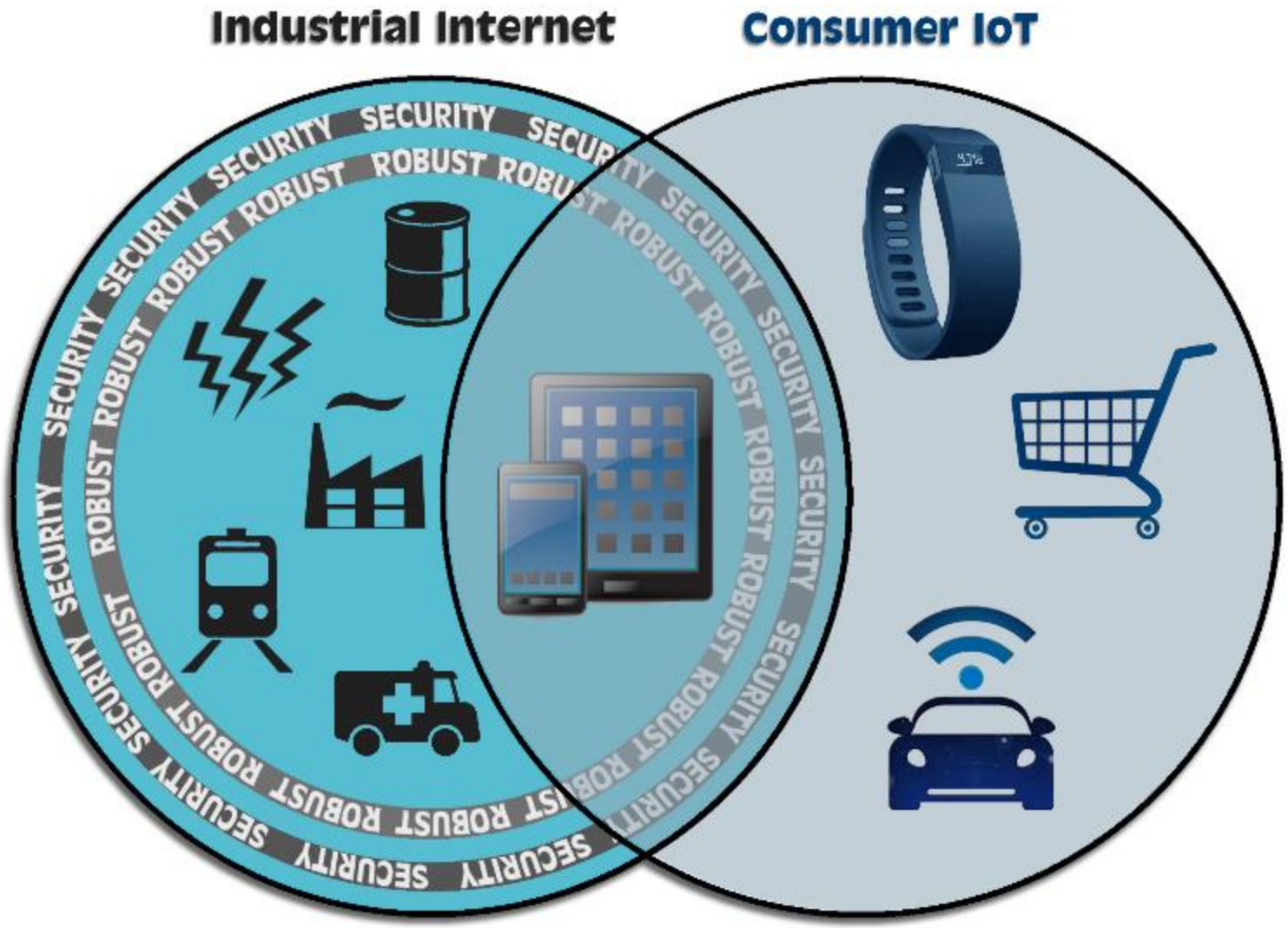
The Industrial Internet is leading the next economic revo





GDP data extracted from the Futurist 2007

There are key differences between the Industrial Internet and Consumer IoT



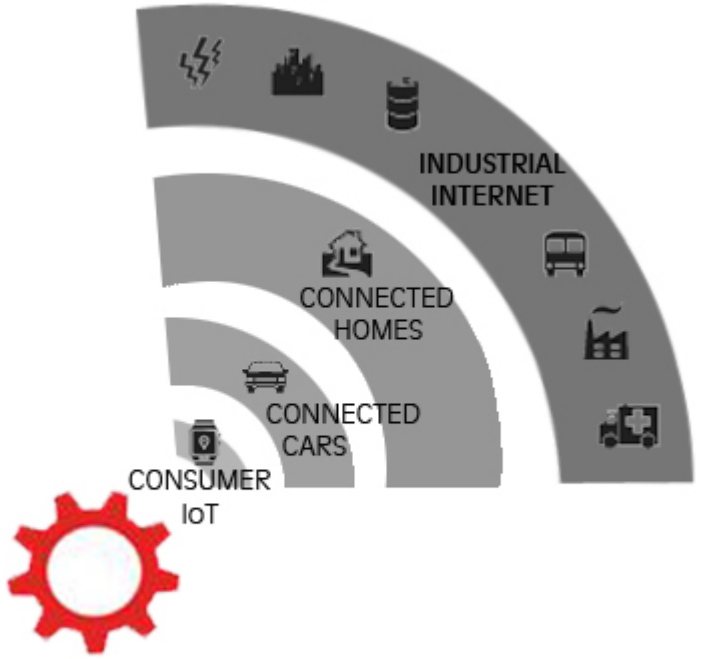
The Industrial Internet

Industrial Internet:

An internet of things, machines, computers and people…

enabling intelligent industrial operations…

using advanced data analytics for transformational business outcomes.



THE INTERNET OF THINGS LANDSCAPE

The Measurable Outcome will be in the Trillions of Dollar

- GE: $32.3 trillion opportunity representing 46% share of GDP today.
- Cisco: Internet of Things (IoT) will increase private sector profits 21% and add $19 trillion to the global economy by 2020
- Gartner: IoT product and service suppliers will generate incremental revenue exceeding $300 billion in 2020.
- McKinsey Global Institute: $33 trillion operating costs of key affected industries could be impacted by IoT

Sources: GE, Cisco, Gartner, McKinsey

Making Sense of the Numbers

Revenue Generation

- Revolutionary new products & services → Creating new markets
  → Changing the way the world works

New Operational Efficiencies that drive down costs

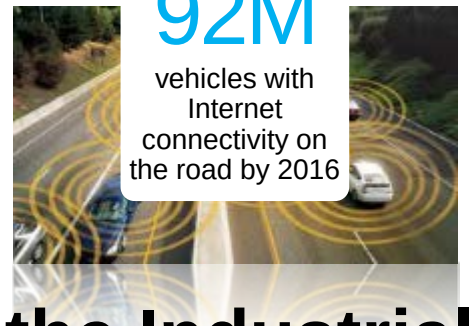
- Workforce productivity gains → digitization of tasks, better deployment of resources
- Reduced maintenance costs → predictive maintenance
- Material, energy savings → reduced need for product over-engineering
- Reduced waste → Precision monitoring to predict and control machines

Improved Customer Satisfaction

- Improved service levels → fewer unplanned disruptions

Opportunities across every industry

$30B
fuel cost saving in aviation industry



92M
vehicles with Internet connectivity on the road by 2016

$63B
productivity improvement in healthcare

Beyond the numbers, the Industrial Internet is changing *how things work.*

$66B
fuel cost saving in gas powered fleets

68%
decrease in crime rates with video surveillance

$90B
reduction in Cap X in oil & gas exploration and development

Source: Industrial Internet: Pushing the Boundaries (2012, Evans & Annuziata)

Yet there are current roadblocks to widespread adoption

59% of IT Pros Say They **Haven't Started Preparing** for Expected Data Increase

73% of Companies Have **Not** Made **Concrete Plans** for the Industrial Internet

3% of IoT Professionals Say **Connectivity** is the Biggest Challenge

Many Countries Have **Insufficient Conditions** to Support **Widespread Adoption**

Data Standards are Largely **Proprietary**, **Works-in-Progress**, or **Non-Existent**

The Industrial Internet: A $32 trillion opportunity

14% of IoT Professionals Say **Security** is the Biggest Challenge

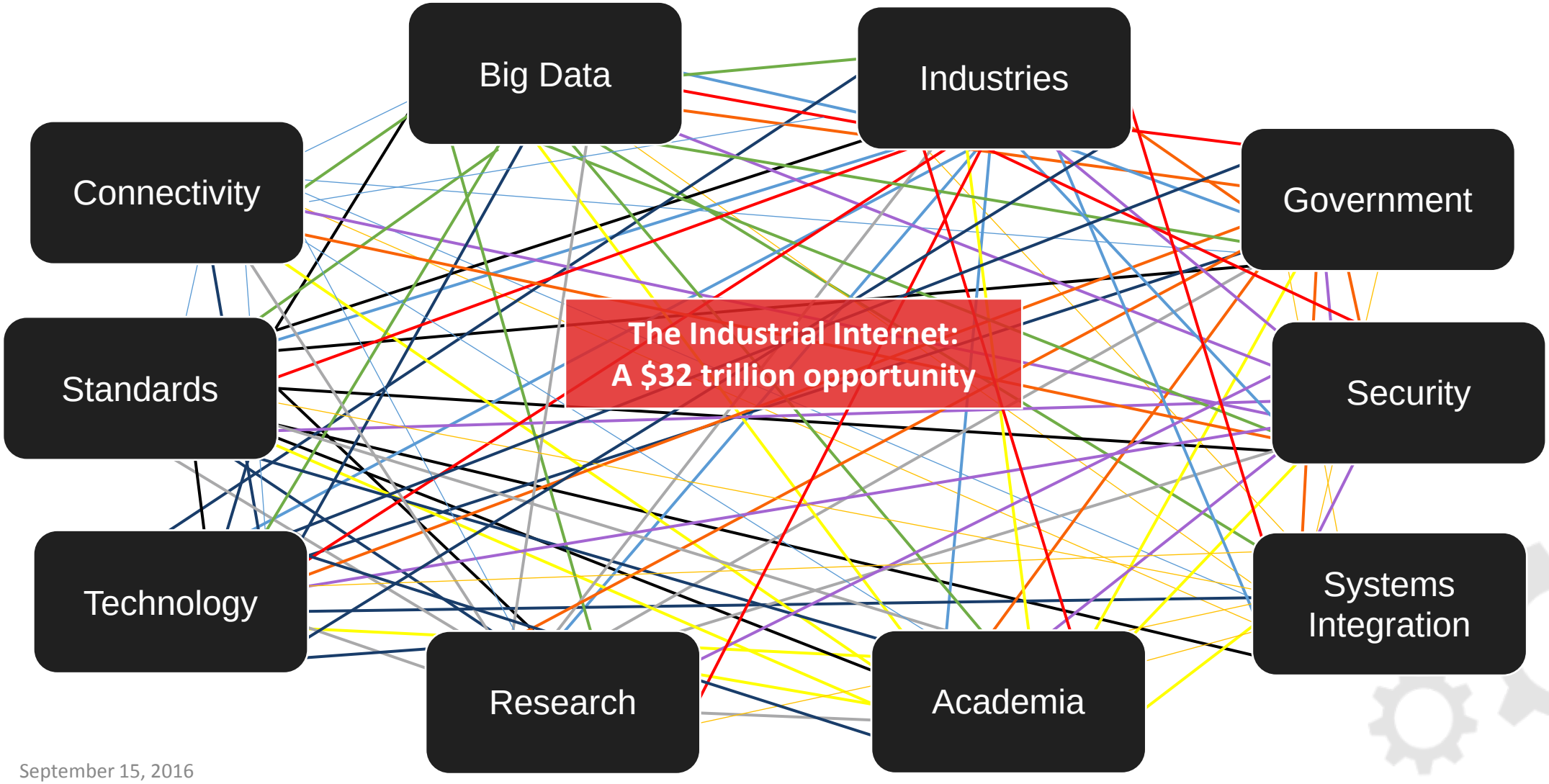
70% of IoT Professionals Say **Interoperability** is the Biggest Challenge

36% of Executives Say **System Barriers** Between Departments **Prevent Collection** and Correlation of Data

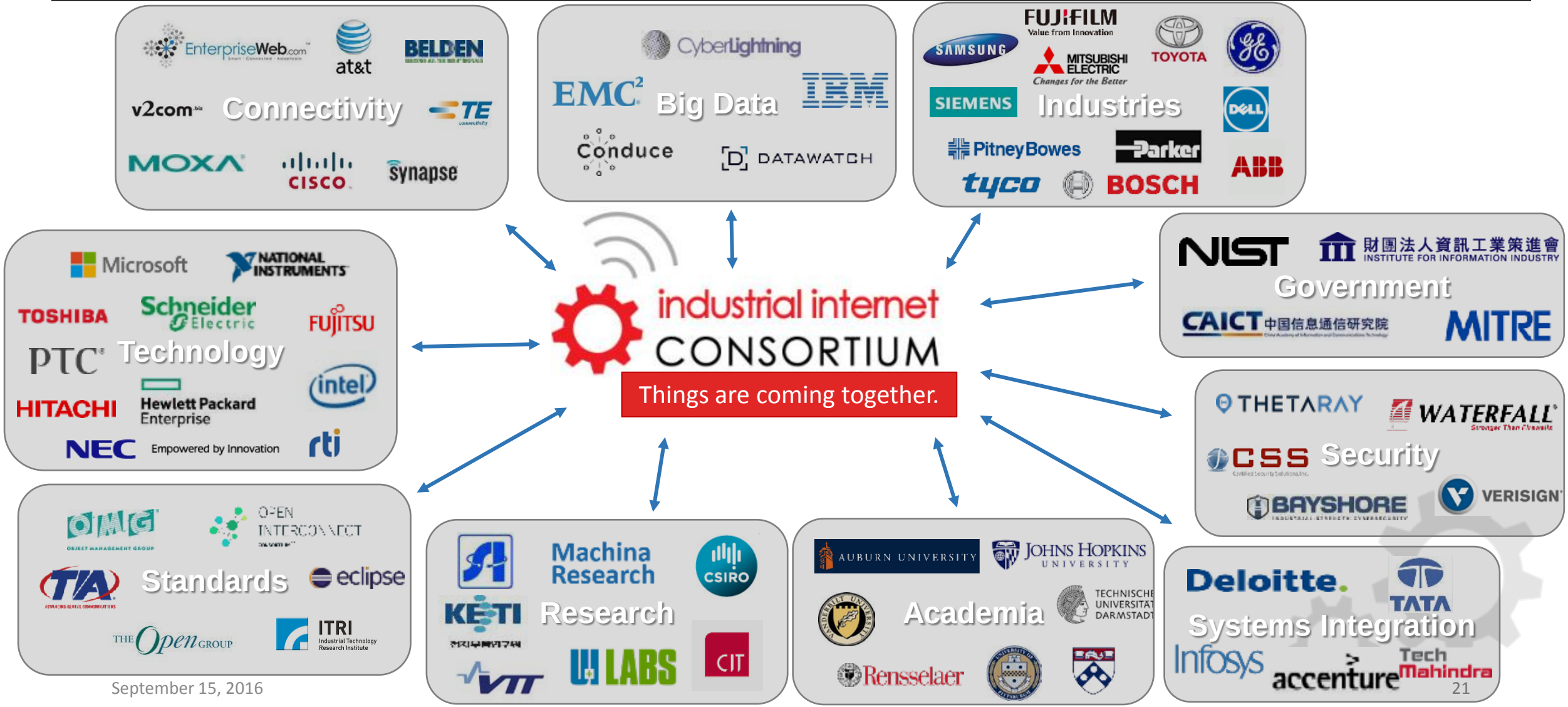
Research into the Industrial Internet has **Only Existed** in the **Past 3 Years**

Urgent Need to **Refocus Education** to Prepare for the **Upcoming Digital Workplace**

Adoption is Hampered in a Disconnected Environment



The IIC: Things are coming together



Industrial Internet Consortium

Mission

To **accelerate growth** of the Industrial Internet by **coordinating ecosystem** initiatives to connect and integrate objects with **people, processes and data** using common architectures, interoperability and open standards that lead to **transformational business outcomes**.

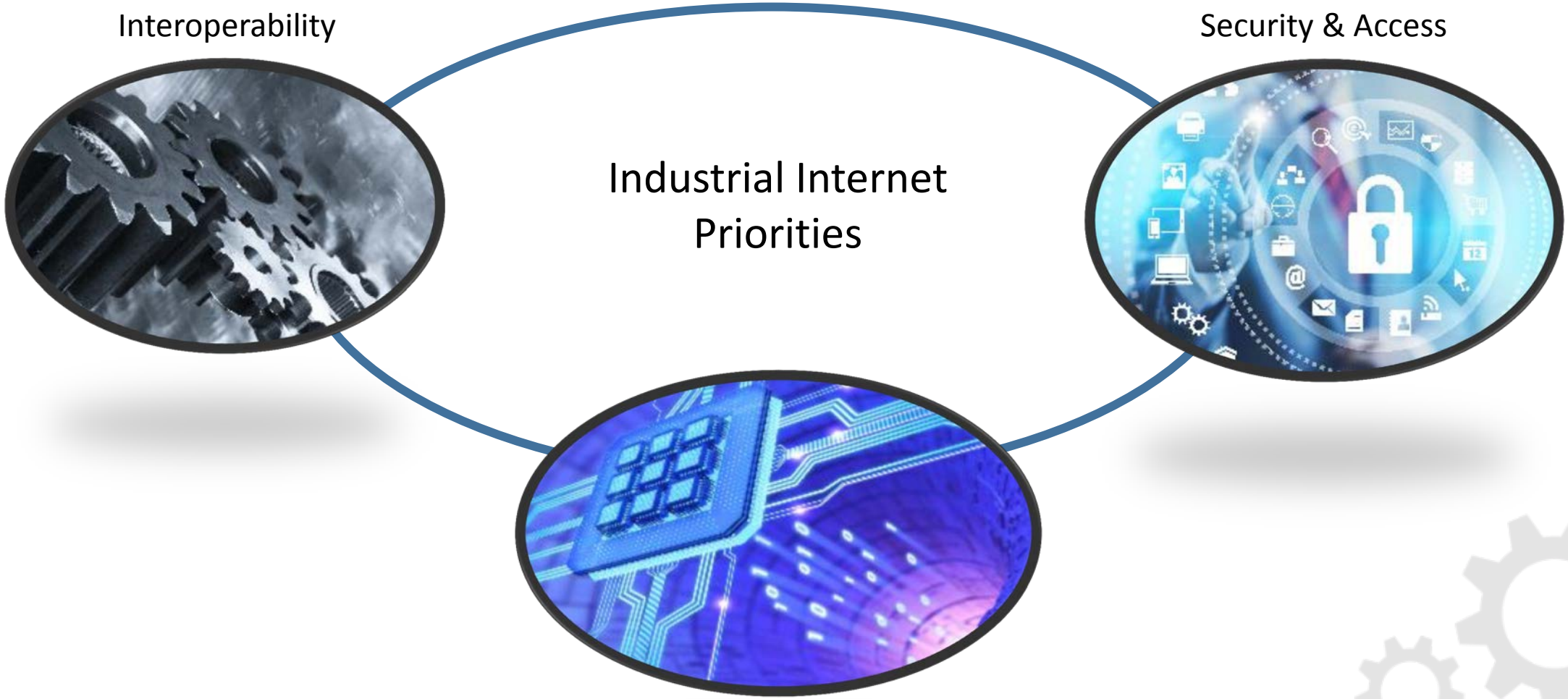
Launched in March 2014 by five companies:

at&t CISCO GE IBM intel

About 250 Member Organizations
Spanning 30 Countries

The IIC is an open, neutral "sandbox" where industry, academia and government meet to collaborate, innovate and enable.

Focused on Advancing the Industrial Internet



The IIC and Standards Organizations

The IIC is ***not*** a standards organization. We evaluate and organize existing standards to :

- advocate for open standard technologies, and
- influence the global standards development

The IIC has a formal Liaison team that evaluates potential formal agreements with other organizations.

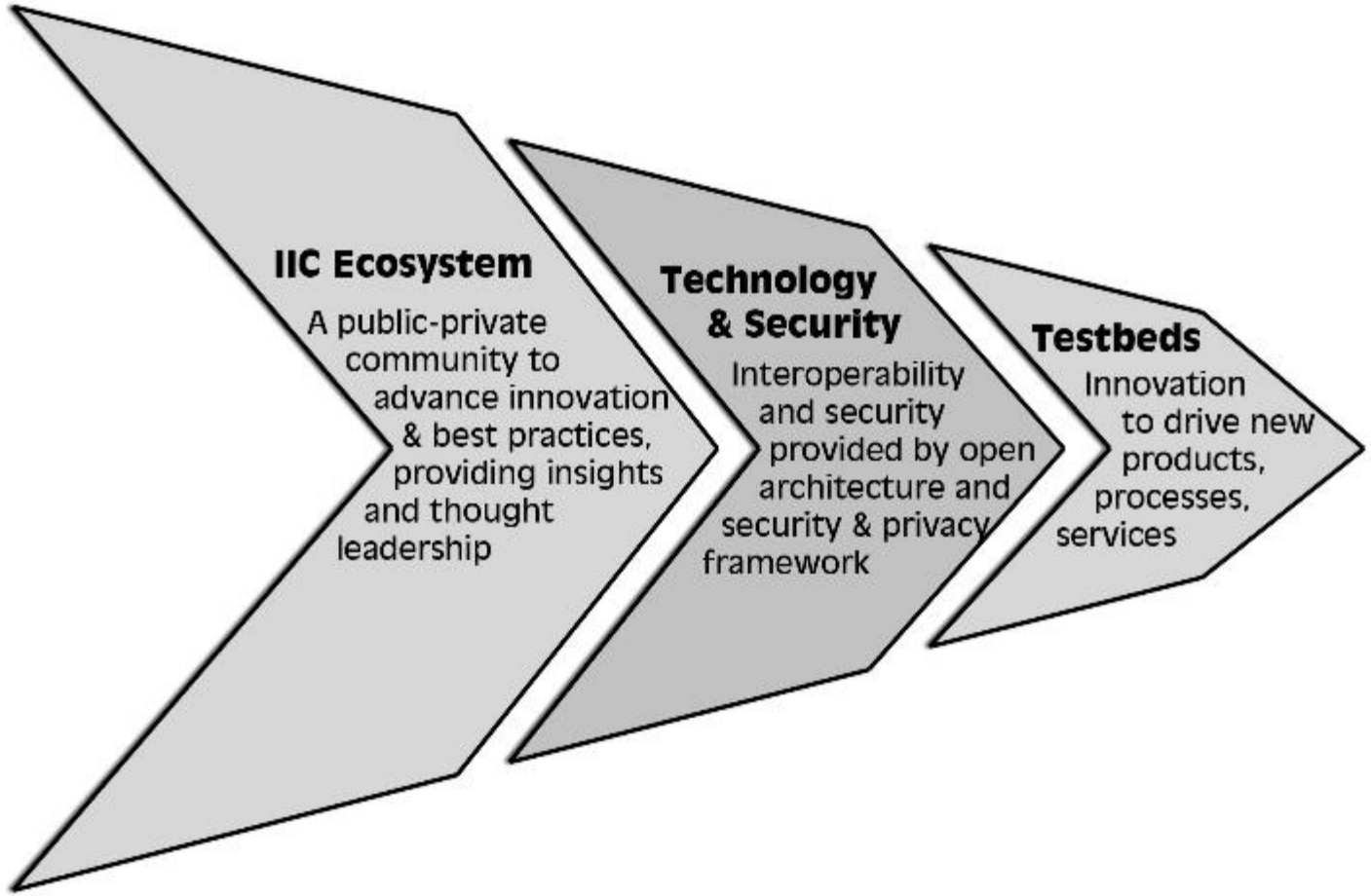
We are an open membership organization and we work collaboratively on an informal basis with many other organizations, including Industrie 4.0.

The Technology Working Group is currently:

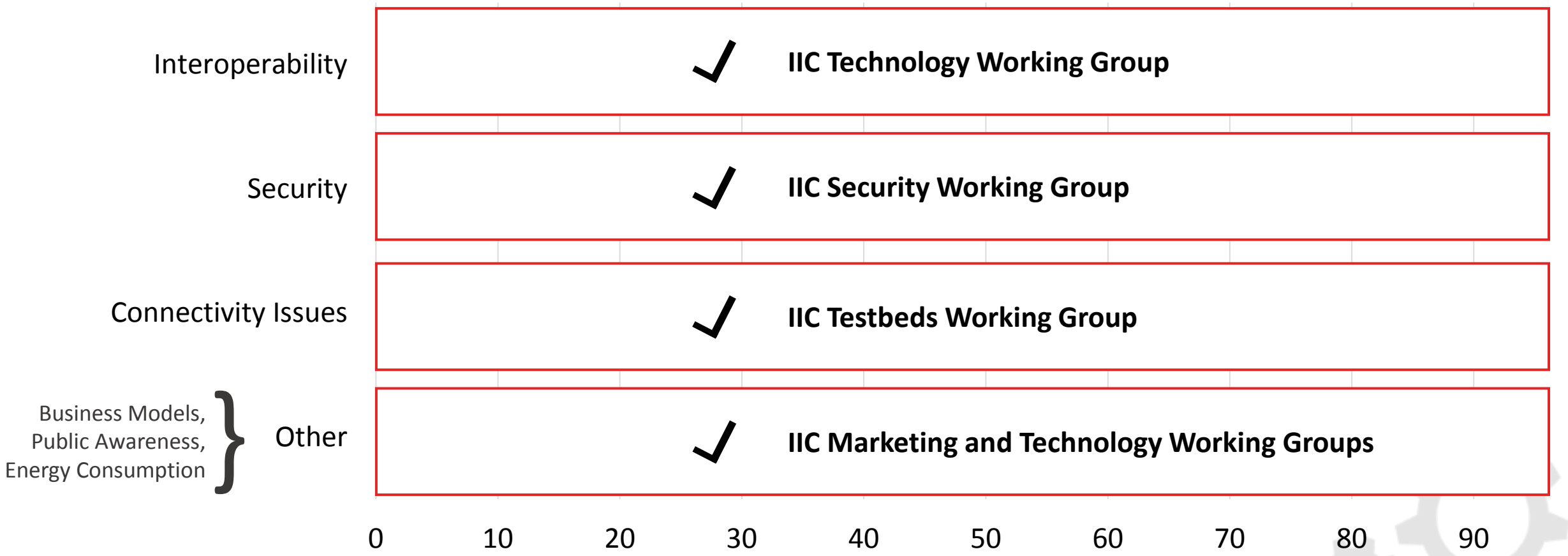
- Evaluating existing standards
- Identifying requirements for the Industrial Internet

IIC Formal Liaisons as of June 2015

The IIC has three primary areas of activity: Community Engagement, Technology & Security, and Testbeds

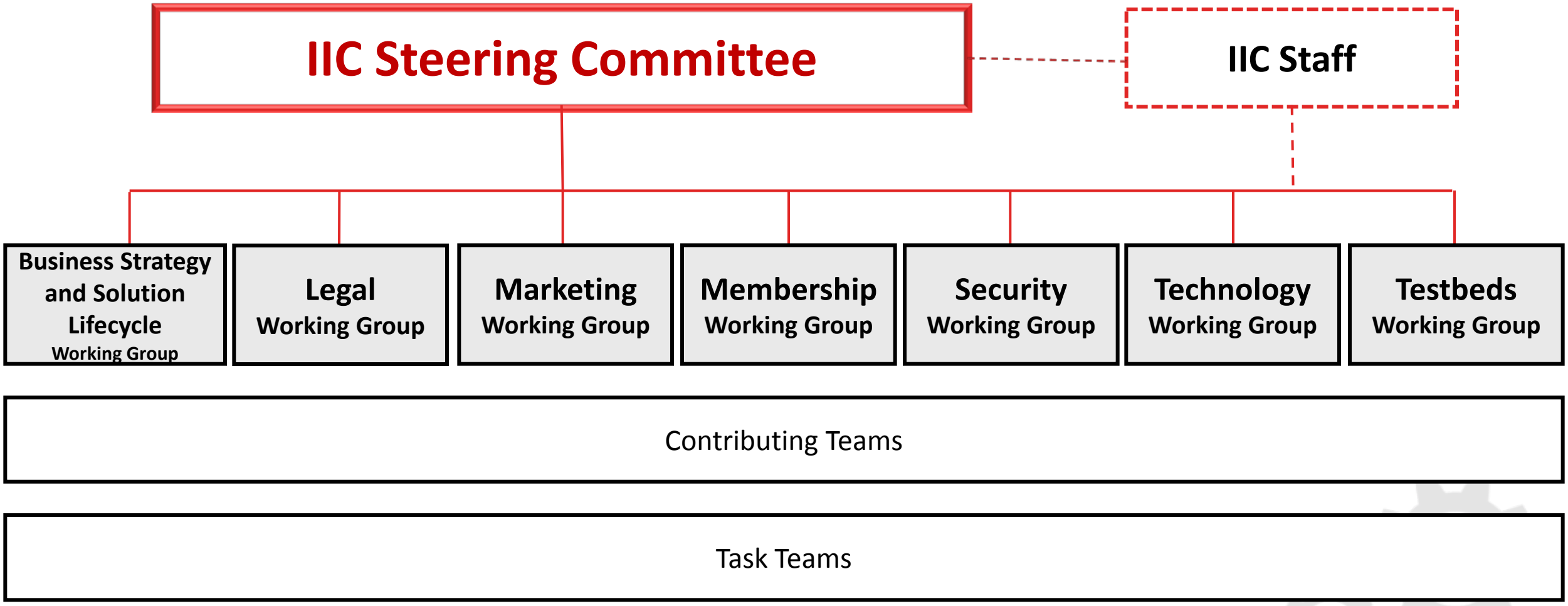


What is the Biggest Challenge Facing the Industrial Inter



Source: IoT Nexus

How We're Organized



Current Steering Committee

Mr. John Tuccillo
IIC SC Chairman
Senior VP of Global Industry & Government Affairs
Schneider Electric

Dr. Tanja Rueckert
IIC SC Vice-Chair
Executive VP IoT and Customer Innovation Unit
SAP

Dr. Jacques Durand
Director of Standards and Engineering
Fujitsu

Mr. Jeff Fedders
Chief Strategist, IoT Group Strategy & Technology Office
Intel

Mr. K. Eric Harper
Senior Principal Scientist
ABB

Mr. Robert Martin
Senior Principal Engineer
Mitre

Mr. Don O'Toole
Business Development Executive, IBM Watson Internet of Things
IBM

Mr. Greg Petroff
Chief Experience Officer
General Electric

Dr. Stan Schneider
CEO
Real-Time Innovations, Inc.

Mr. Dirk Slama
Director of Business Development
Bosch Software Innovations

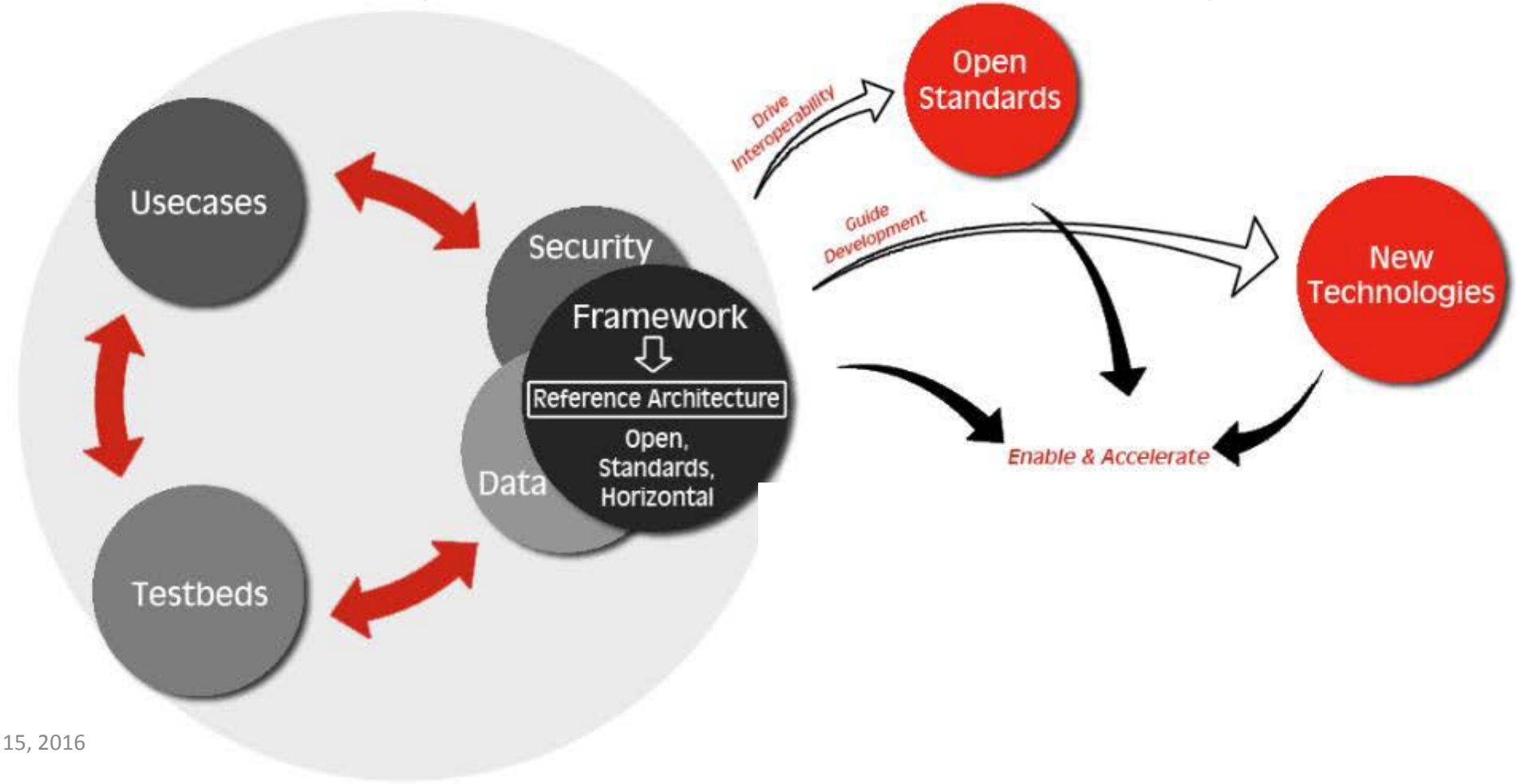
Dr. Richard Soley
Executive Director
Industrial Internet Consortium

Dr. Said Tabet
Chief Architect for IoT Solutions
EMC

Mr. Wang Xuemin
Director, Standardization and Industry Department
Huawei

Collaboration within the Industrial Internet Consortium

IIC Working Groups have individual charters, inter-related outcomes both within the Working Groups and with external organizations.



Technology Working Group

Charter: To define and develop common architectures, by selecting from standards available to all, from open, neutral, international, consensus organizations and reviewing relevant technologies that comprise the ecosystems that will make the industrial internet work.

The Technology WG presently has 14 teams:

Architecture Task Group
Intelligent and Resilient Controls
Reference Architecture Editing Contributing Group
Connectivity Task Group
Distributed Data Management & Interoperability Group
Industrial Analytics Task Group
Dynamic Composition & Coordination
Innovation Task Group
IT & OT Task Group
Liaison Task Group
Standards & Interoperability Task Group
Safety Task Group
Verticals Taxonomy
Vocabulary Task Group

Industrial Internet Reference Architecture

- **First major deliverable by the IIC Technology Working Group**
  - **110-page document published and released to public July 2015, Version 2 Underway**
- **Goal:** To align the industry to a common end-to-end Industry IoT reference architecture with clearly defined constituent components and interfaces between them so that:
  - Vendors can deliver interchangeable IoT components that are interoperative with those provided by other venders;
  - Customers can use the reference architecture as a blueprint, based on which to build and/or select technologies and solutions from venders for their IoT implementation.
- **Requirements addressed:**
  - Concise and comprehensive description of the end-to-end IoT architecture for the industrial internet industry space
  - Clear definition of constituent components and interfaces between the components
  - High-level functional requirements for each of the components
  - Identification of existing or to be developed technologies for these components
  - Inspired and validated by core use cases
  - Implemented and tested in an IIC testbed

Security Working Group

Charter: To define a security and privacy framework to be applied to technology adopted by the IIC. The framework will establish best practices and be used to identify security gaps in existing technologies.

Current Priorities:

- Build End-to-End Security Use Cases
- Apply Security Use Cases to each of the Use Case Groups
- Derive requirements from each Use Case
  - Identify what is common (architectural)
  - Identify what is one-off (application-specific)
- Design Secure Integration Framework based on combined use cases (with Technology Team) - II Security Framework v1.0
  Near completion…
- Build testbeds - Testbed Evaluation Documentation

Testbed Working Group

Charter: To accelerate the creation of testbeds for the Industrial Internet.

IIC Testbed Lifecycle Phases

Current Priorities:

- Assist members in identifying, defining and gaining approval for their testbeds
- Identify and communicate funding resources for IIC testbeds
- Provide processes and infrastructure for efficient & effective operations

Current Publicly Announced Testbeds

Example IIC Testbed: Track & Trace

Industrial Internet Consortium Member participants:

- Bosch, TechMahindra, Cisco, National Instruments

Market Segment

- Industrial Manufacturing
- Power Tool Fleet Management

Goal

- Manage smart, hand-held tools in manufacturing, maintenance and industrial environments

Features & Commercial Benefits

- Asset Management, Work Management
- Integration with Factory Manufacturing Systems
- Improved Safety and Operational Performance
- Monitor/Control Quality

Example IIC Testbed: Communication and Control for Microgrid Applications

Collaborators

- Leads: RTI, National Instruments, Cisco
- With: CPS Energy (San Antonio), Southern Cal Edison, Duke Energy, SGIP

Market Segment

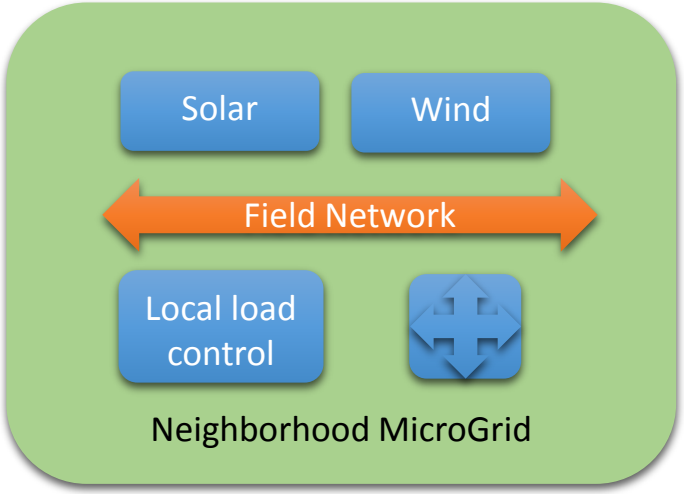
- Energy Industry

Goals

- Introduce the flexibility of real-time analytics and control to increase efficiencies and ensure that power is generated accurately and reliably to match demand

Features & Commercial Benefits

- Enable efficient integration of solar and wind into the grid
- Create a dynamic, open marketplace for smart grid vendors
- Prove the viability of a real-time, secure DataBus distributed-control architecture in real-world grids



Example IIC Testbed: International Future Industrial Inter (INFINITE)

Participants:

- Members: EMC Corporation and Cork Institute of Technology
- Other Participants: Vodafone, Irish Government Networks, Asavie, and Cork Internet Exchange

Market Segment:

- The scale and scope of the project means INFINITE can be used across a wide and diverse range of industries and sectors

Solution:

- Completely virtual domains that are able to be connected via mobile networks
- A solution that allows multiple virtual domains to securely run via physical network.

Commercial Benefits:

- Ideal for mission-critical systems
- Industrial Internet applications in an environment that resembles real-world conditions

Example IIC Testbed: Condition Monitoring & Predictive Maintenance

Member Participants:

- IBM and National Instruments

Market Segment:

- Predictive maintenance cuts across multiple market segments like power plants, manufacturing, process, mining, transportation, aerospace, and defense

Goals:

- Develop new predictive maintenance analytics modeling techniques
- Document standard and secure architecture patterns and data formats for predictive maintenance in the Industrial Internet era

Commercial Benefits:

- Increase equipment uptime and prevent catastrophic failures
- Provide condition monitoring data to experts thru the cloud

Example IIC Testbed: High-Speed Network Infrastructure

Member Participants

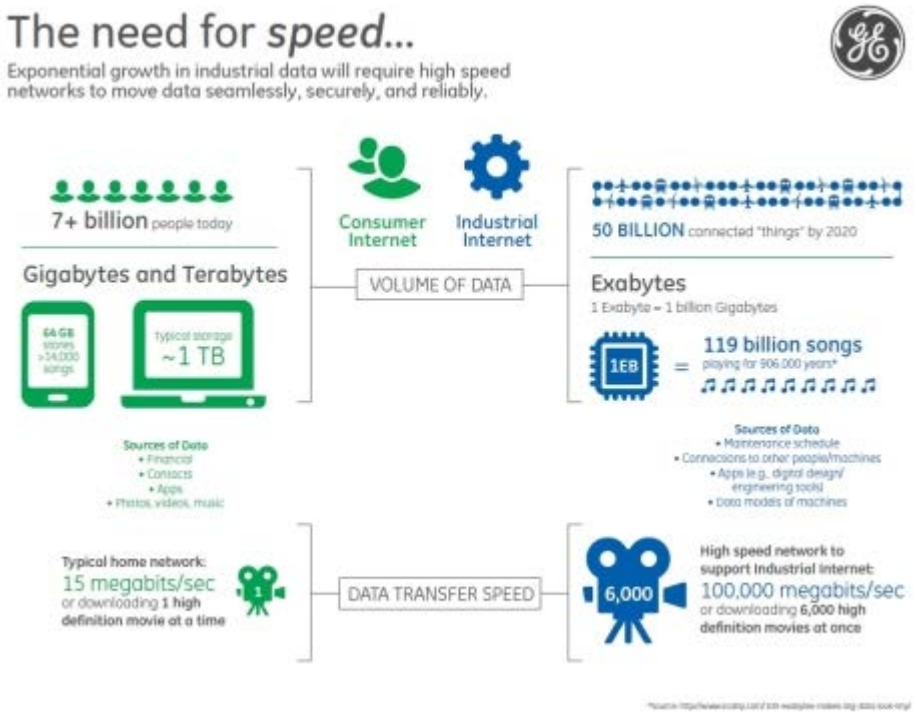
- General Electric, Cisco, Accenture, Bayshore Networks

What is the High-Speed Network Infrastructure?

- It transfers data at 100 gigabits per second to support seamless m2m communications and data transfer across connected control systems, big infrastructure products and manufacturing plants
- 100 gigabits per second is the equivalent of downloading more than 6,000 movies at a time on a typical Internet connection for home computers or mobile devices

Commercial Benefits

- With the 100 gigabit line, industries can instantaneously connect and control machines located thousands of miles away.



Business Strategy & Solution Lifecycle (BSSL) Working

Charter: To provide guidance and best practices for all aspects of developing and operating an Industrial Internet solution: business-case creation, architecture design, technology selection, implementation, testing, rollout and operations.

Goals:

- Help companies leverage the potential of the Industrial Internet
- Increase return on investment, manage project risks more efficiently, and establish a foundation for evaluating solutions and their compliance.
- Provide a foundation for defining Industrial Internet Systems certification and compliance programs, to be shared within and outside of the Industrial Internet Consortium.
- Business Strategy for Industrial Internet of Things Task Group
- Use Cases Task Group

Marketing Working Group

Charter: To establish the Industrial Internet Consortium as a community that champions innovation in connected intelligent machines and processes.

Current Priorities:

- Ensure that the strategy of the IIC is carried out
- Increase market awareness of the Industrial Internet and the IIC
- Create compelling new content around innovation that is happening/innovation to come
- Focus on thought leadership and vertical markets

Why Participate in the Industrial Internet Consortium?

- Collaborate and network with like-minded leaders of the Industrial Internet: Small and large technology innovators, vertical market leaders, researchers, universities, and governments
- Drive innovation and grow your business by creating new industry use cases and testbeds for real-world applications
- Join with industry innovators in setting the technology and security direction and requirements for the Industrial Internet
    - Define and develop the reference architecture, frameworks, and security necessary for interoperability
    - Influence the global development standards process for internet and industrial systems
- Participate in the sharing and exchange of real-world ideas, practices, lessons, and insights

The Future

How will we reduce jet engine failure & maintenance costs?

How will we minimize unplanned factory downtime?

How will we save lives through better patient care?

Things are coming together.

How will we reduce passenger fatalities?

How will we reduce waste of natural resources?

industrial internet CONSORTIUM

Community. Collaboration. Convergence.

Things are coming together.

www.iiconsortium.org

Infinite Use Cases

Blue Light

Smart City

Smart Building

First Responder

Cloud Factory

Air Quality

All Running Discretely on Infinite TestBed

Use Case Overview

Blue Light

The HSE National Ambulance Service (NAS) is continually working to improve the care provided to patients and to provide much faster access to care.

Goals:

Improve understanding and efficiency of ambulance dispatch, deployment, and operations through the application of data analytics

Examination of emergency services behaviour at the individual level (a single respondents) and at group level (city, hospital, groups of respondents), through ambulance trajectory data.

Use Case Overview

First Responder

To develop an IoT Emergency Response Solution that would enable next generation monitoring of an emergency response situation.

Enabling real time information flow could lead to improved decision-making based on immediate feedback and information as events unfold.

3 Remote System Components

First Responder

ANALOG DEVICES

1 Central Hub

- UWB Radio Ranging Reference Anchors
- Main computer/ central processing

2 Arm Unit

- UWB Radio Ranging
- Bluetooth Radio
- Comm. to Hub
- Battery

3 Boot Module

- IMU
- Processor Board
- Bluetooth Radio
- Battery