industrial internet® CONSORTIUM

An Open Membership Consortium **now over 260** companies strong

Modernizing your Industrial Manufacturing Network

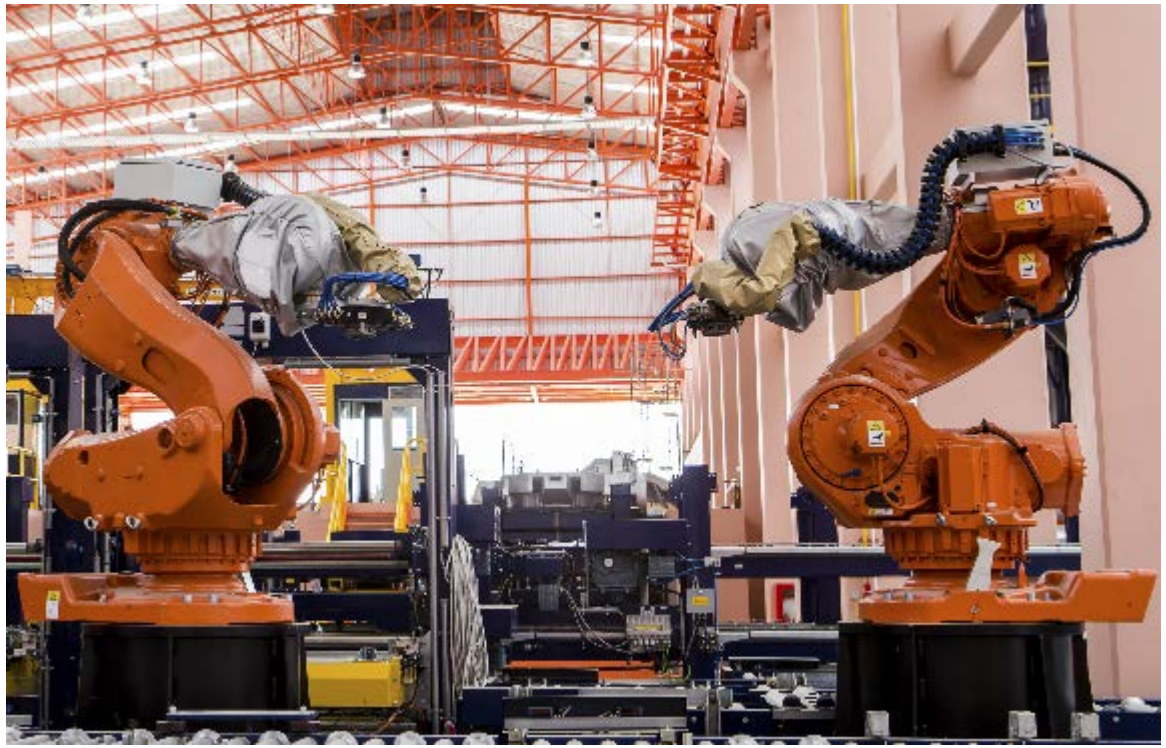
IIC Testbed: Time Sensitive Networks - Flexible Manufacturing for Robotics and Automation Cells

Overview and Status Update

Paul Didier, Cisco Solution Architect, IoT Software Group

December 2017

Elevator Pitch



For Manufacturing Automation and Control and Infrastructure vendors (and soon energy and transportation)

who require deterministic capabilities on the network,

our testbed converges more devices, applications and systems on a single, standard, open, inter-connected network

that is the driver of the IIoT

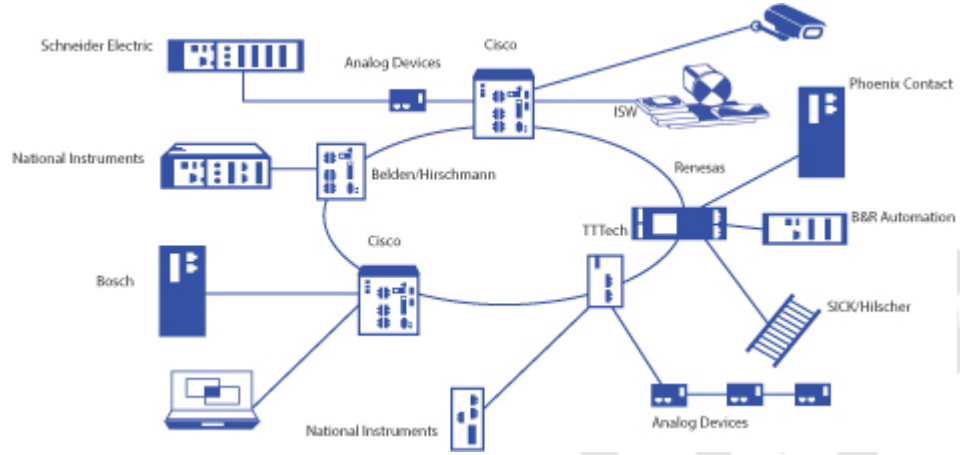
Testbed Innovation and Experimentation

Our **Vision** is to enable Flexible Manufacturing for Industrial IoT and Industrie 4.0 through deployment of open, standard deterministic networks within production facilities.

Our **Goal** is to display the value and readiness of Time-Sensitive Networks (new IEEE standards) supporting real-time control & synchronization of high performance machines

Our Testbed is actively driving accelerated market adoption of this critical IIOT/Industrie 4.0 technology

The Industrial Internet Consortium's Testbed for Time Sensitive Networks - Flexible Manufacturing for Robotics and Automation Cells



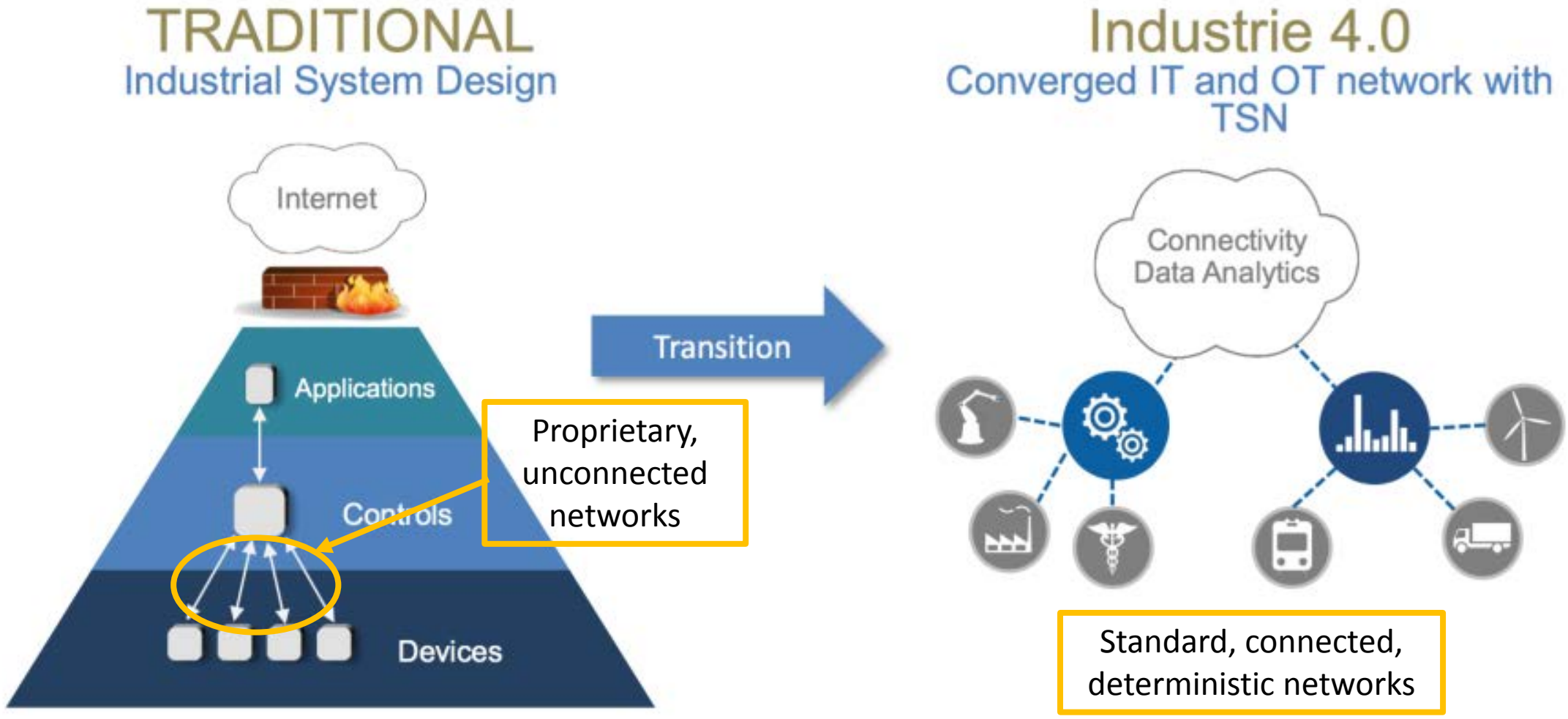
Deterministic Network Benefits

Why Industry is adopting Time Sensitive Networks

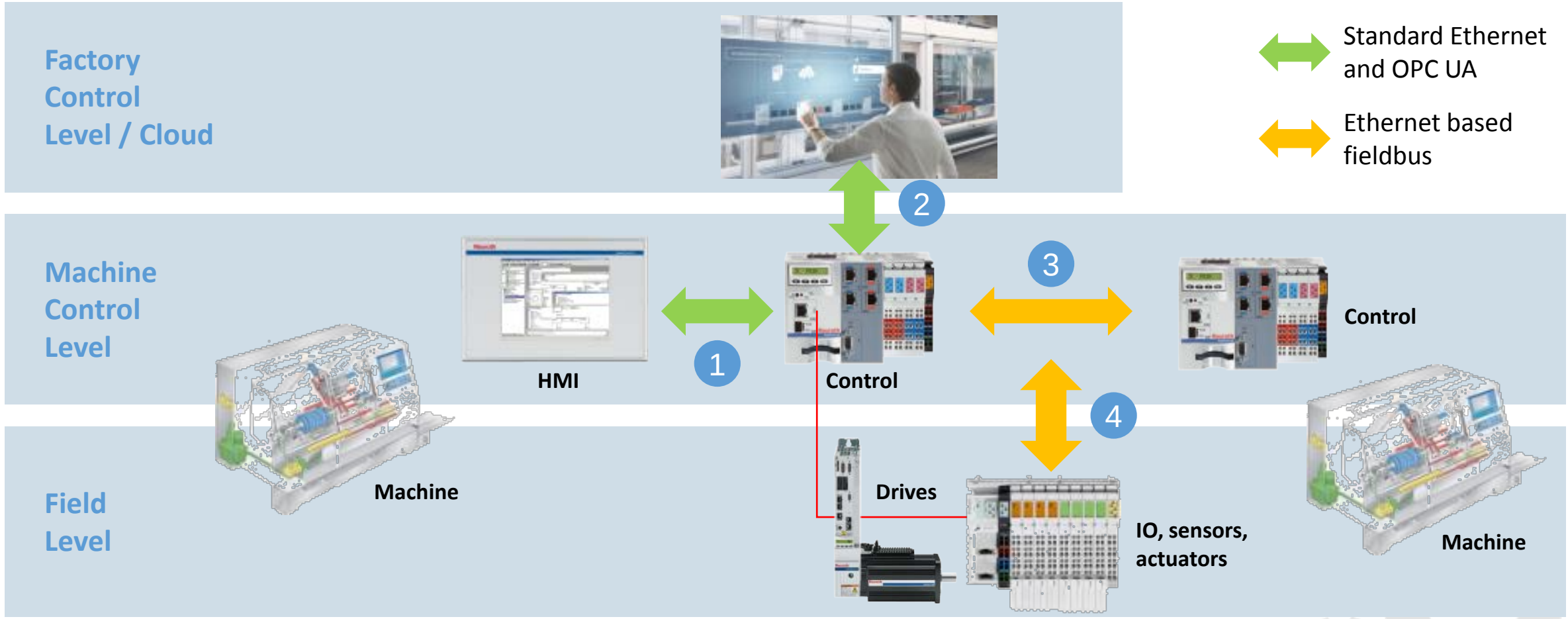
Secure and reliable delivery of data	Guaranteed latency for data delivery	Converged networks save operating costs	Simple system configuration and operation	Open Ecosystem
				intel, Schneider Electric, ABB, National Instruments, Rockwell Automation, Cisco, NXP, TTTech, Xilinx, Wireless, Bosch, Hirschmann, A Belden Brand, GE, Analog Devices

GDP data extracted from the Futurist 2007

Why TSN? IoT Requires Flexible Data Access



Today‘s Communication Topology



1 HMI communication 2 Factory level communication 3 Control to control communication 4 Field level communication

Future Communication Topology

OPC UA TSN

Huge customer benefit in standardized control to control communication

Factory Control Level / Cloud

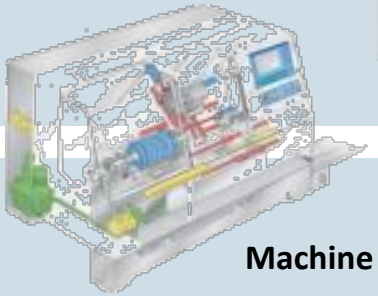
Machine Control Level

HMI

Control

3

Control



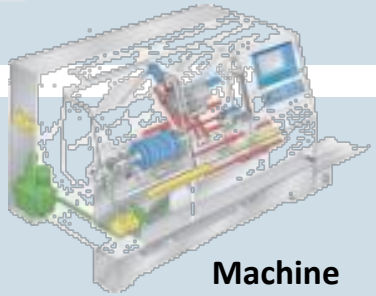
Machine

4

Field Level

Drives

IO, sensors, actuators



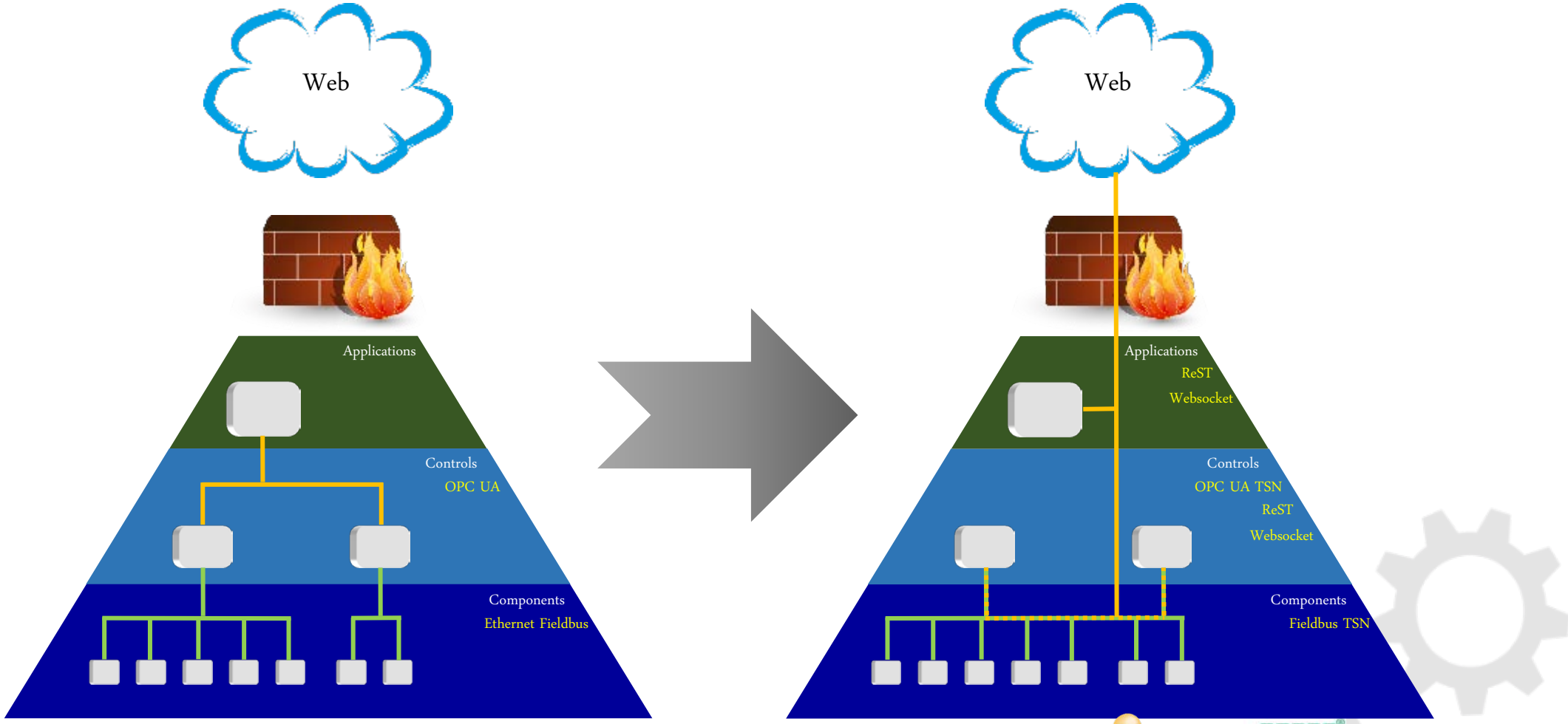
Machine

3 TSN/OPC as widely accepted standard in control to control communication

4 More and more standard communication on field level (Motion, Safety, and standard I/O)

TSN makes standard Ethernet deterministic

TSN converges levels of control and brings standardization to Layer 2 control networks



Why IIC? Role of the Organizations

Testbed and Reference Architectures

- Testbeds to evaluate “full stack” and provide feedback to members and liaison organizations
- Application specific architectures to aid in market adoption
- Outbound marketing to create awareness

Application Layers

- Define data models for end-device communication
- Integration of TSN communications and configuration models into application tools
- Application flow for end-node configuration
- Conformance for data models and end node configuration

TSN Transport Interoperability and Conformance

- Define network services needed by market
- Fill gaps in standards to provide interoperable network configuration services
- Conformance of transport and network services
- Establish certification services

Network standards

- Define standard features to provide Time Sensitive Networking “deterministic communication” capabilities including updates to OSI Layers 1-4
- Assure proper operations and backwards compatibility with IT and OT

TSN Testbed Status

Industrial Internet Consortium Testbed Showcase Winner Q1 2017

Growing ecosystem of TSN vendors at IIC

Driving TSN adoption:

- **2 Best Testbed Awards** 1st IIC Testbed Showcase (Q1 2017) and IoT Solutions World Congress (2017)
- **23 Vendors** participating (chip makers, switches, automation devices and testing products)
- **8 Plugfests** conducted over the last year in US, Austria and Germany
- **2 Testbed locations** at NI in Austin TX and BoschRexroth in Erbach Germany
- **Demonstrations at 6 major shows** (IOT SWC, SPS Drives, Hannover Messe, NI Week, IOT World, DE Forum)
- **Collaboration with multiple standardization bodies**: IEC, IEEE, IETF, AVNU, LNI4.0, OPC and ODVA
- **Marketing material developed**: Brochure, JOI Article, Press Releases

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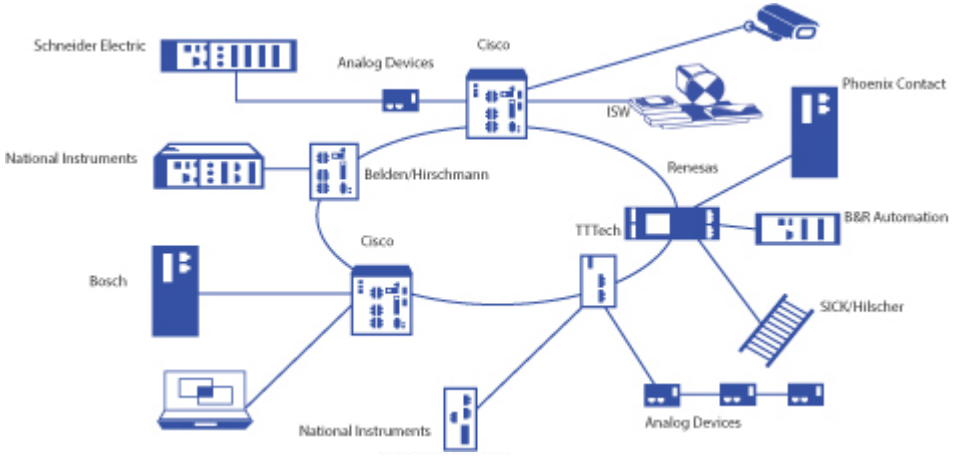

The Challenge

Manufacturing operations have historically deployed non-standard networks or air-gapped (unconnected) networks leaving devices and data much harder or impossible to access.

To implement IoT applications, manufacturers must be confident in network performance at the edge, ensuring connected assets operate as expected. The Challenges for this testbed:

- **Swap Proprietary out for Standard Deterministic Networks**
  No longer require networks with special infrastructure and know-how and do not benefit from innovation in standard networks (e.g. speed, power, size)
- **Converge Air-Gapped Networks**
  Enable Customers, Vendors and Service Providers to deliver IIoT benefits by accessing rich edge networks
- **Simplify and Automate System and Network Configuration**
  Manufacturing requires Operations to manage and run the networks that support Plant applications

What problems do we address?

Accelerate Technology Adoption

Enable Developers to test whether new products interoperate in real plant systems. Display to the ecosystem the business value

Provide feedback to Standards

Give companies insight to standards as they are developed and means to give feedback

Collaboration b/w Chip, Infrastructure, Testing & Device vendors

By including all major technology suppliers, we accelerate the feedback loop

Testbed Associate Participation

The objective of an Associate participation is to allow companies to gain from the Testbed experience without becoming full IIC members. This is aligned with IIC goals of accelerating technology and standards adoption within the broader industrial ecosystem.

Specifically with the TSN testbed, an Associate may:

1. Participate in Testbed meetings and access the Testbed workspace (e.g. Kavi)
2. Participate in Plugfests via “New Member” testing of base TSN functions
3. Claim you are an Associate of the IIC TSN Testbed

There will be no specific fees to participate as an Associate in the TSN Testbed, but they need to sign an NDA and Promotion Agreements before gaining the above.

Associates will not be able to attend IIC meetings, participate in other IIC activities (e.g. Reference Architecture development) or be integrated into the Testbed demonstrator. The IIC nor the Testbed do not issue certificates of compliance, either to members or Associates.

Time Sensitive Networks
for Flexible Manufacturing

"Embracing the goals of the IIC, this testbed is accelerating the adoption of key IIOT technologies thru early standard interoperability testing, collaboration with key technology suppliers and standard organizations."

The Problem

Manufacturing operations have historically been deployed using non-standard network infrastructure or air-gapped (unconnected) networks leaving devices and data much harder to access.

Our Solution

Enhanced Ethernet technology to support real-time control and synchronization of high performance machines over a single, standard Ethernet network, supporting multi-vendor interoperability and integration.

Key Benefits

- Secure and reliable delivery of data
- Guaranteed latency for data delivery
- Converged networks save operating costs
- Simple system configuration and operation
- Open ecosystem

Team

- Over 20 organizations including chip vendors, testing tools, network infrastructure, SW tools and end-device makers
- Collaboration with IEEE, AVNU, OPC, ODVA and others

Industrial Internet Consortium
Testbed Showcase Winner
Q1 2017

Thank you!