Internet Of Things: 10 years later. Facts and Vision

Patrick Wetterwald
Cisco CTAO
IOT standards and Architecture
pwetterw@cisco.com

What Is the Internet of Things?

*"**The Internet of Things** is the intelligent connectivity of physical devices driving massive gains in **efficiency, business growth, and quality of life**."*

The 5 Waves of Connectivity

Framework of Our New World

Business and Societal Impact

1990

3 M Users

Wave 1

CONNECTIVITY FOUNDATION

Email

Web Browser

Search

1997

76 M Users

Wave 2

BUSINESS

Networked Economy

Efficiency / Optimization

E-commerce

Digital Supply Chain

2004

745 M Users

Wave 3

PEOPLE

Connecting, Communities, Sharing, Contributing

"Global Brain"

Web 2.0

Social

Mobility

Cloud

Video

Collaboration

2010

2.4 B Users/Things

Wave 4

THINGS

Connecting The Unconnected

Big Data / Analytics

Sensors Everywhere

Machine-to-Machine

Pervasive Intelligence

Data in Motion

Security

NOW - 2020

1.5 T + Users/Things

Wave 5

CONVERGENCE

Digitize Society

Singularity

Man/Machine

New Breed Apps & Interfaces

Embedded / Seamless

Wearable Devices

Big Data Wisdom

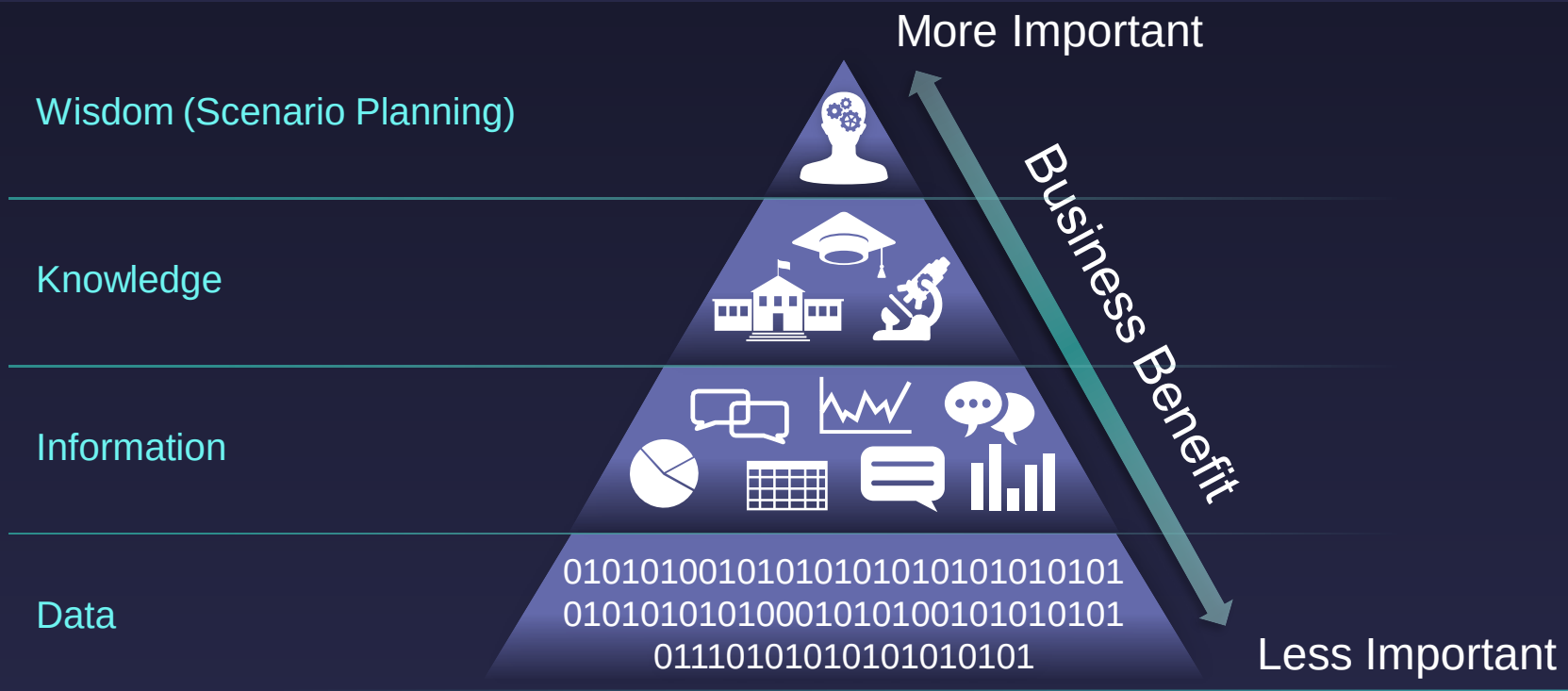
Predictive

Enhance Outcomes

IOE - People, Machines, Process Analytics

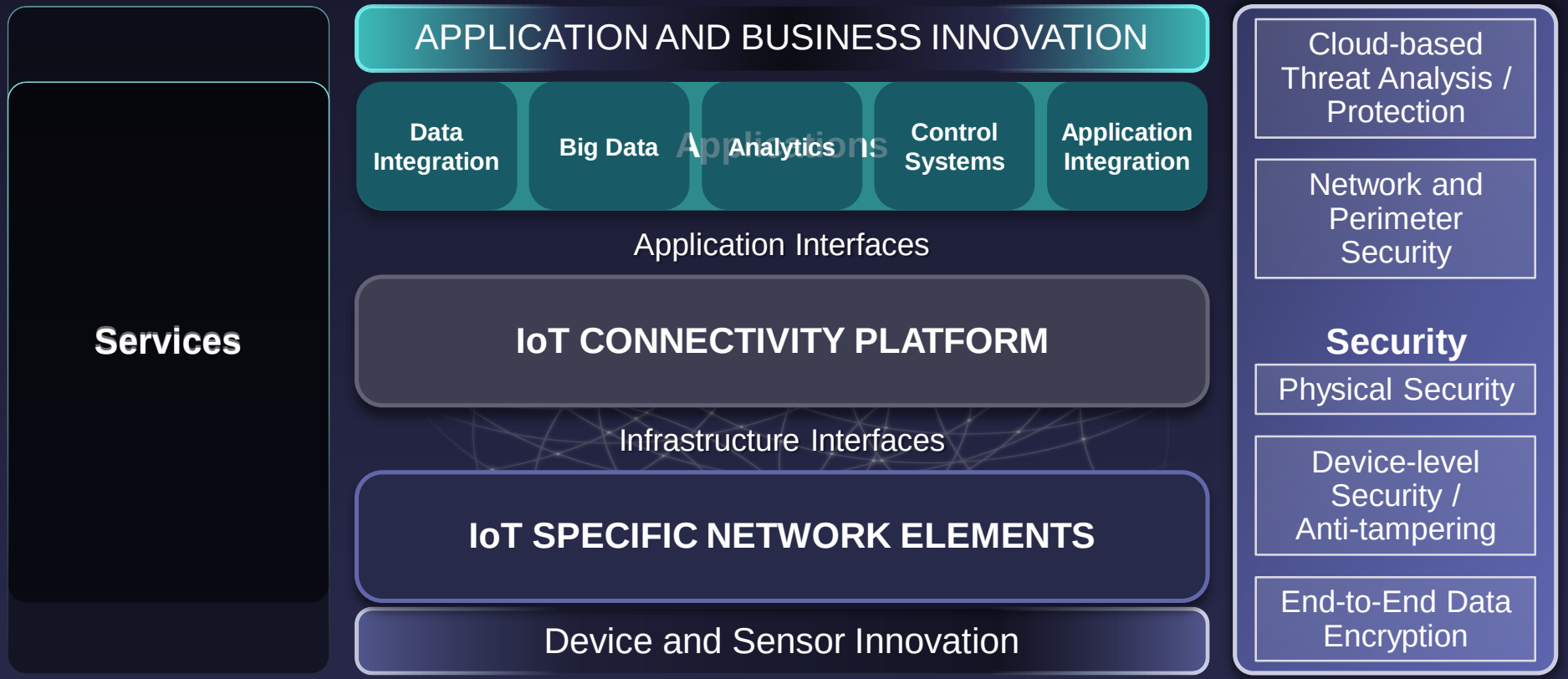
More, Faster & Intelligent Connections

IoT Transforms Data into Wisdom



Big Data becomes Open Data for Customers, Consumers to Use

But It Also Adds Complexity



It brings new challenges: Data Aggregation

500 Gigabytes

Data generated by an offshore oil rig **weekly**

1.1 Billion

Data points generated by sensors **daily**

1000 Gigabytes

Data generated by an oil refinery **daily**

10,000 Gigabytes

Data generated by a jet engine every **30 minutes**

2.5 Billion Gigabytes

Data generated worldwide **daily**

90% of the world's data

Has been created in the last **2 years!**

Condition Monitoring and Large Scale Monitoring

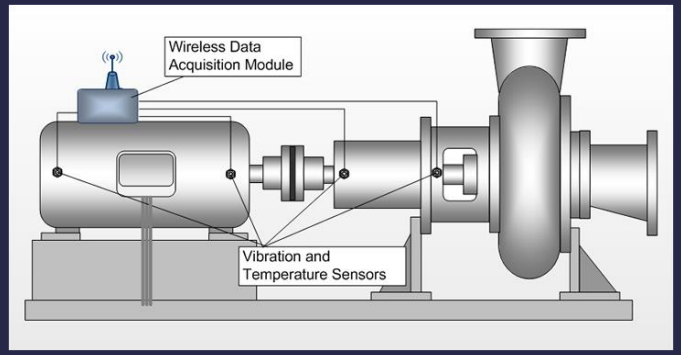
Not Process Control but “Missing Measurements”

- Reliability and availability are important, which implies
- Scheduling and admission control

Scalability

- 10’s of thousands of new devices

Deployment cost factor is key



For Emerson this is the **second layer of automation**:

Typically missing are the measurements you need to monitor the condition of the equipment--temperature, pressure, flow and vibration readings you can use to improve site safety, prevent outages and product losses, and reduce maintenance costs of equipment such as pumps, heat exchangers, cooling towers, steam traps and relief valves.

Customer Experience with the Connected Car

Consumers will Trade Personal Data for a Better Driving Experience

74%

would allow driving habits to be monitored to save on insurance/ service maintenance

65%

would share height/weight, driving habits and entertainment preference for a more custom driving experience

Source: Cisco Systems Inc., 2013

"This is about a business change, to make our manufacturing facilities more flexible, more agile and more lean"

Kirk Gutmann GM Global Information Officer, Manufacturing and Quality

It’s a Game Changer in all technical domains

Architecture

Addressing

Security

RF Allocation / Planning

Gateways

Low Power

Determinism

Wireless

Standardization

Regulation

Privacy

Deployment models

Sustainability

Analytics

Learning Machines

Standardization

IoT SDOs and Alliances Landscape (Technology and Marketing Dimensions)

Addressing and Gateways

Where are we?

IPv6 for the IOT is a must (same as radio technologies)

➔ ETSI ISG IP6 best practices documents

IPv6 up to the end device

➔ Close but not yet there

➔ IETF 6lowPan, 6lo

Gateways ➔ will be your (our) next nightmare:

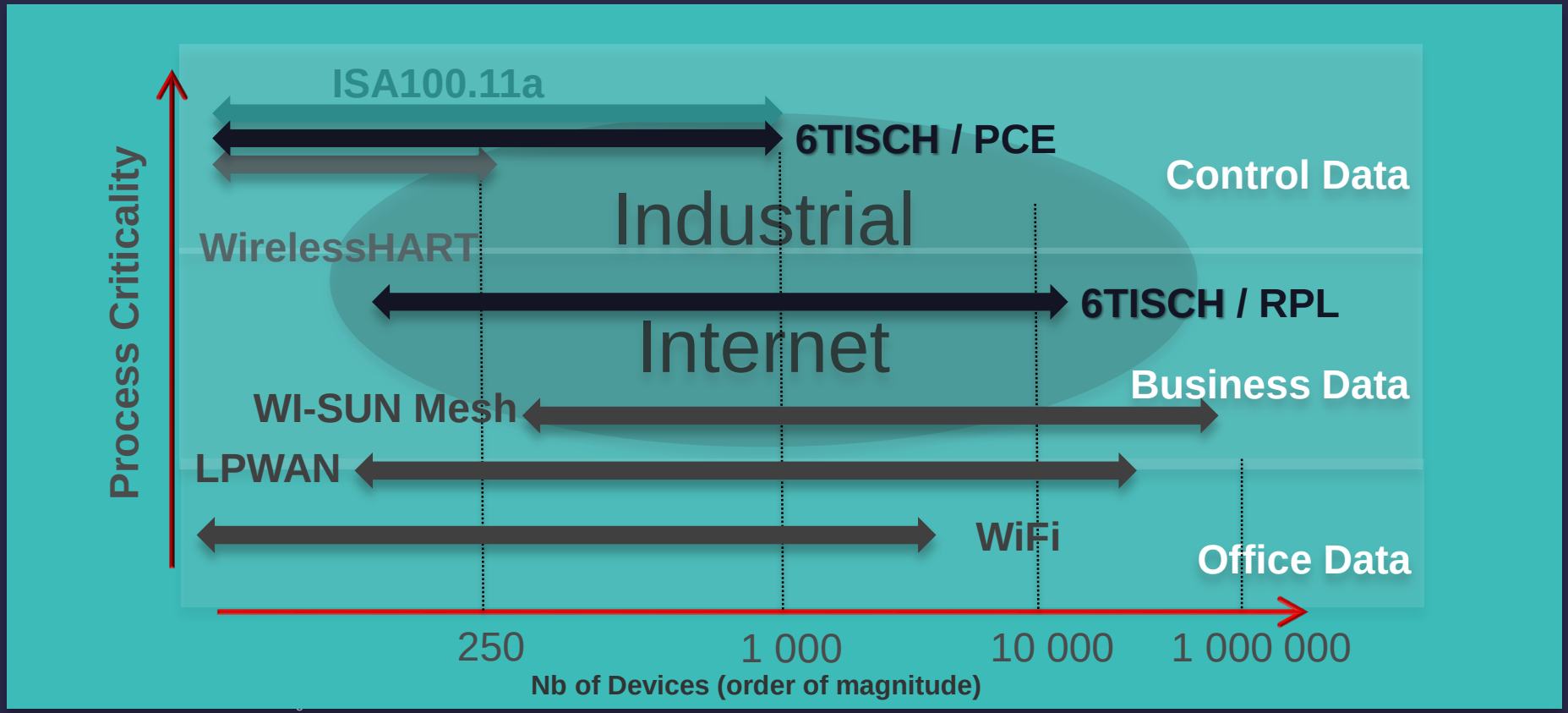
Manageability (maintenance, configuration, deployment…)

Energy consumption

Security: Breaking end to end security, Network entry point.

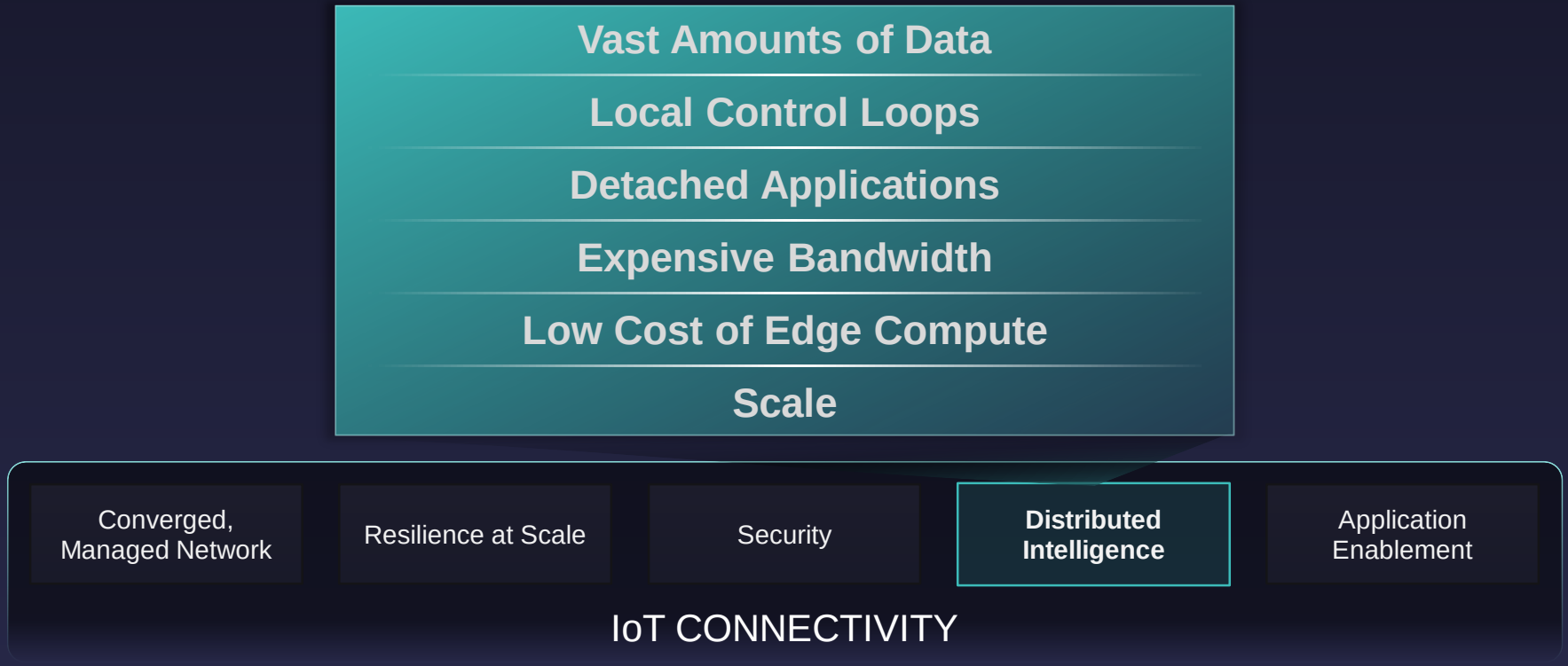
Wireless

Technologies for the Industrial Internet



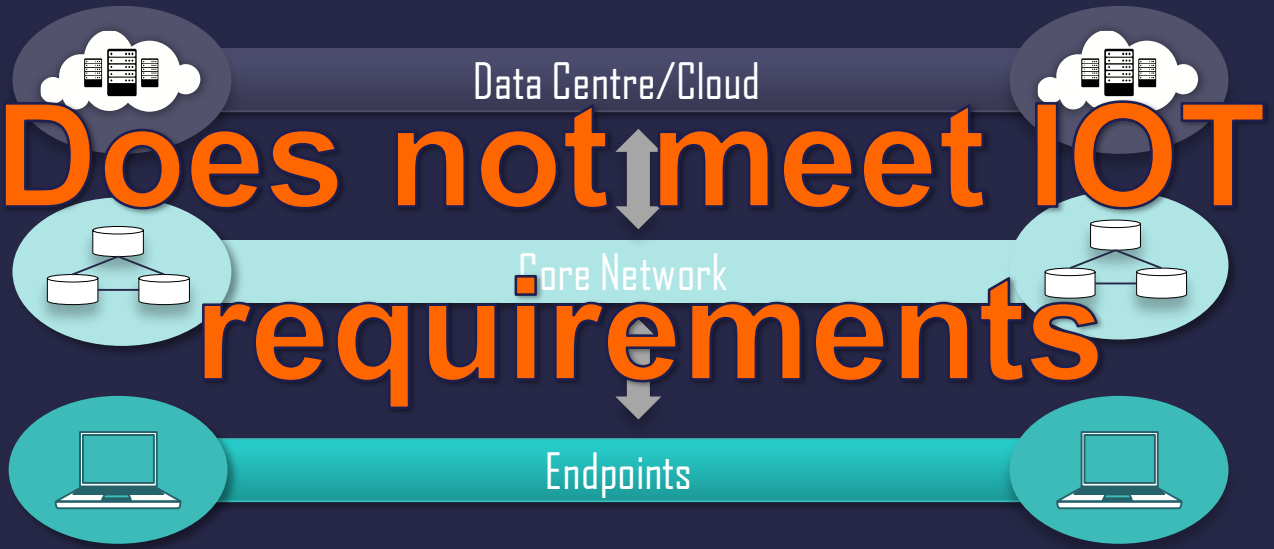
Distributing Intelligence

Why Distributed Intelligence?



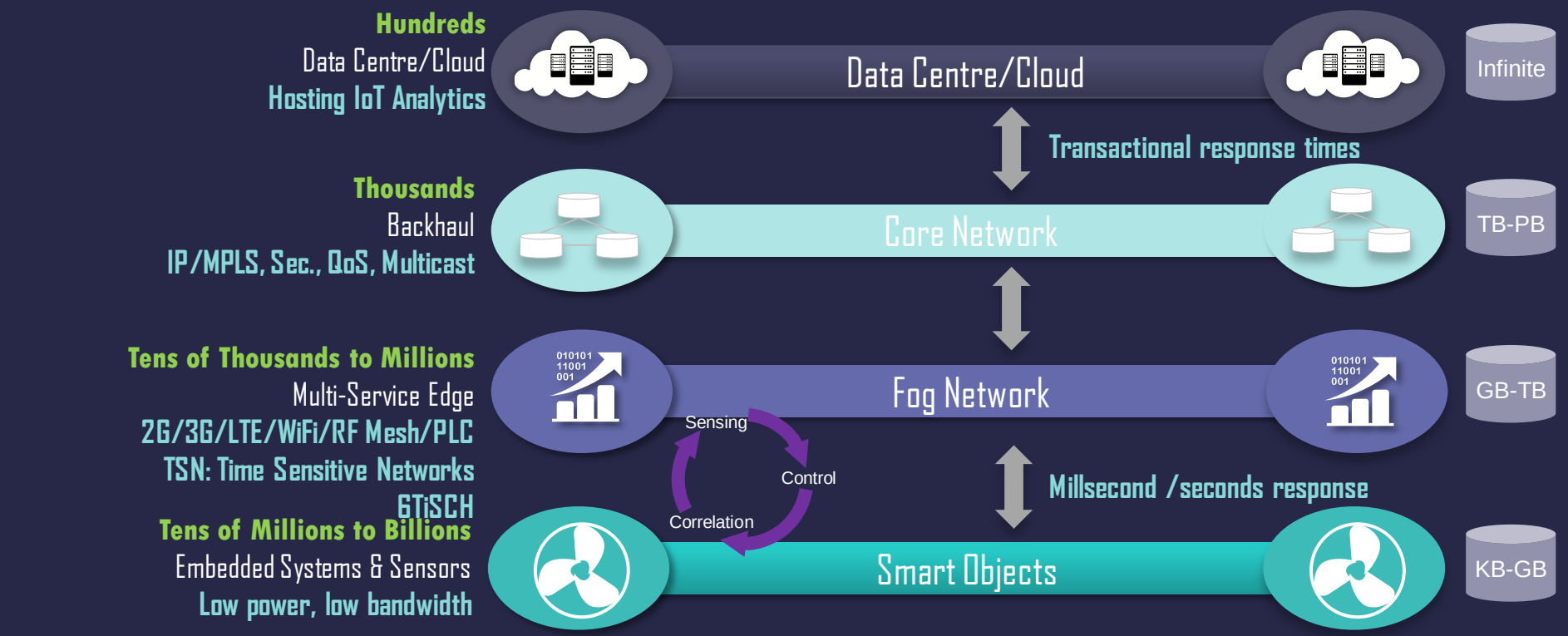
Traditional Computing Architecture

Terminal-Mainframe, Client-Server, Web



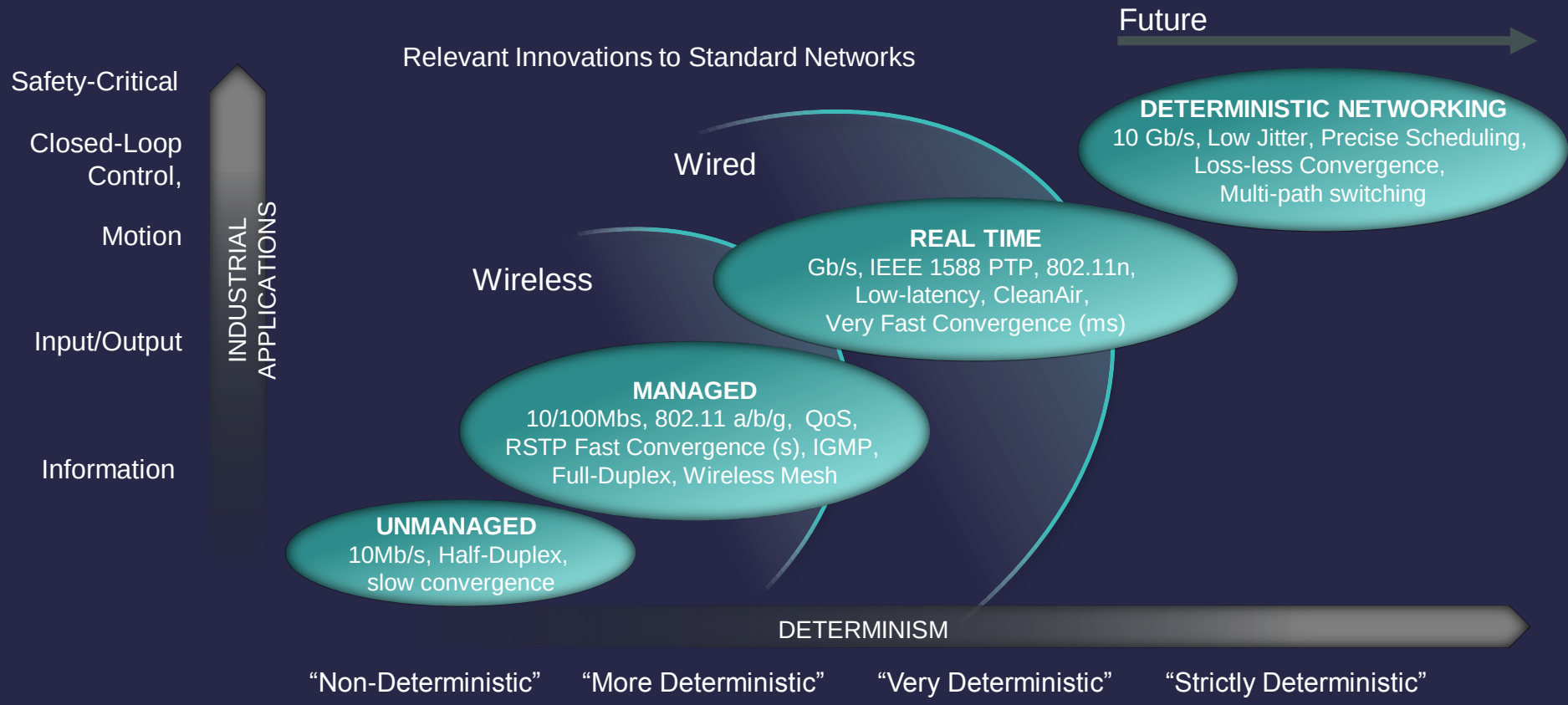
IoT and Fog Computing Architecture

Data Points, Variety & Velocity, Security, Resiliency, Latency



Need for more determinism

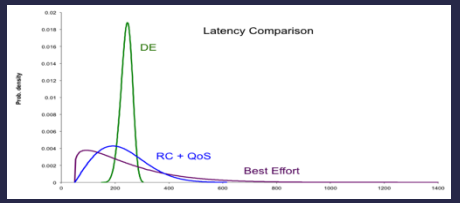
Industrial Intelligence Requires Evolution



Deterministic Ethernet

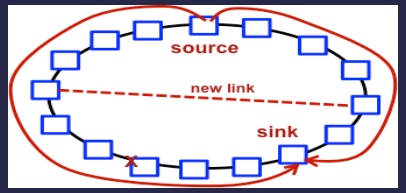
Characteristics for Real time applications

- Low Latency & Packet Jitter
  - Measured in microseconds



Automation & Control
Rate Constrained
Best Effort

- Control traffic immune from impact of other traffic
- Guaranteed delivery & resiliency



Multiple Deliveries

- Time Synchronization
  - Measured in nanoseconds

ARINC

TÜV Rheinland of North America, Inc. C US

Example Deterministic Ethernet use cases today for controls

Wind Turbines

- Safety certified control system (integrated approach to networking and control)
- Reduced total cost of ownership for end user from higher availability of system

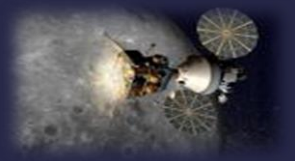
Oil and Gas

- Process control system
- Expanded existing control system with determinism
- Cost-effective to operate, simple to upgrade and maintain

Automotive
(from 2016)

- Automotive in-vehicle network for control
- High performance, cost-effective, weight reducing from integrating safety and non-safety traffic on one network

Space



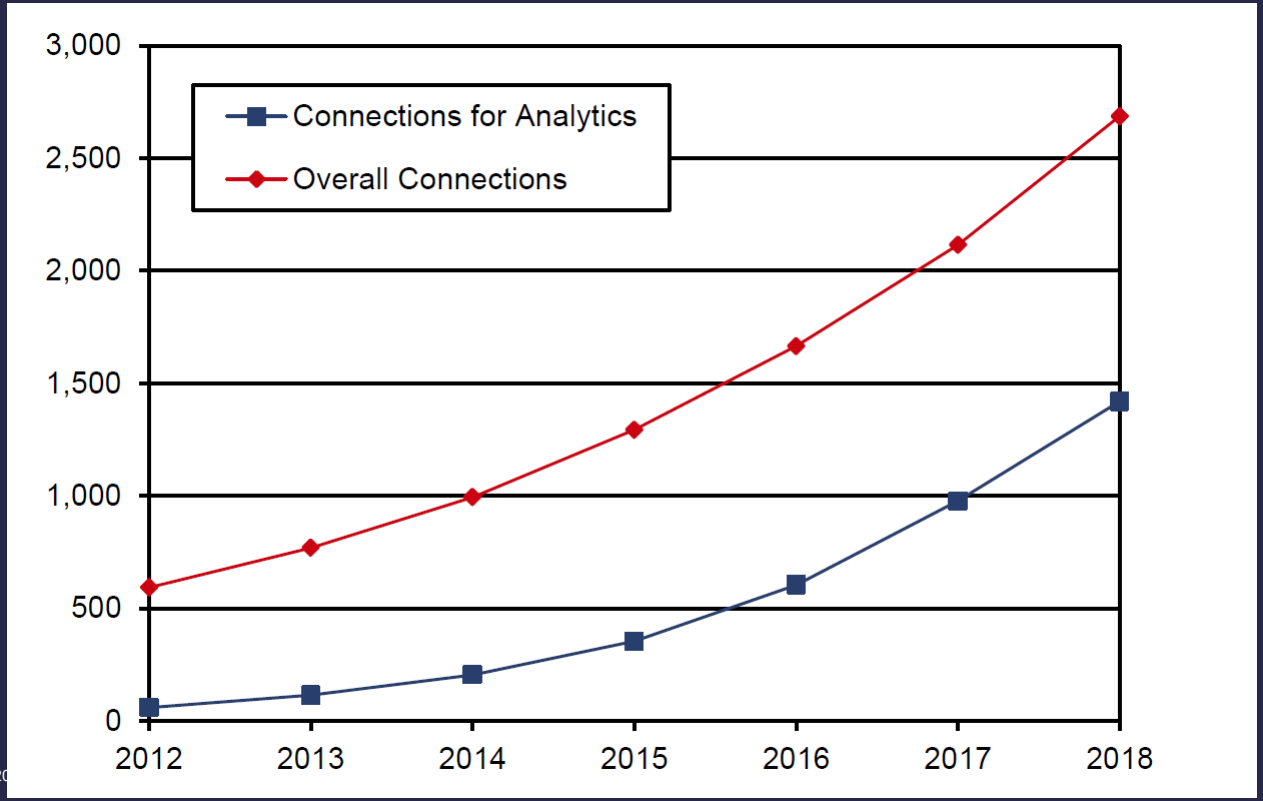
- Spacecraft backbone Network, redundant fail- operational network
- Enabled robust network where maintenance is not an option

Aerospace and Defence

- Avionics Backbone network, simple redundant mechanisms that fulfill fail operational requirements
- Enabling highest performance

Analytics

Analytics vs. Overall M2M connection ratio *



15M to 115M Analytics related connections*

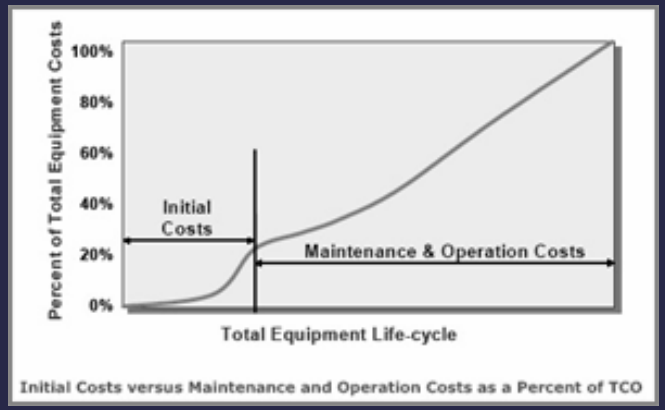
Classical Monitoring only doubles

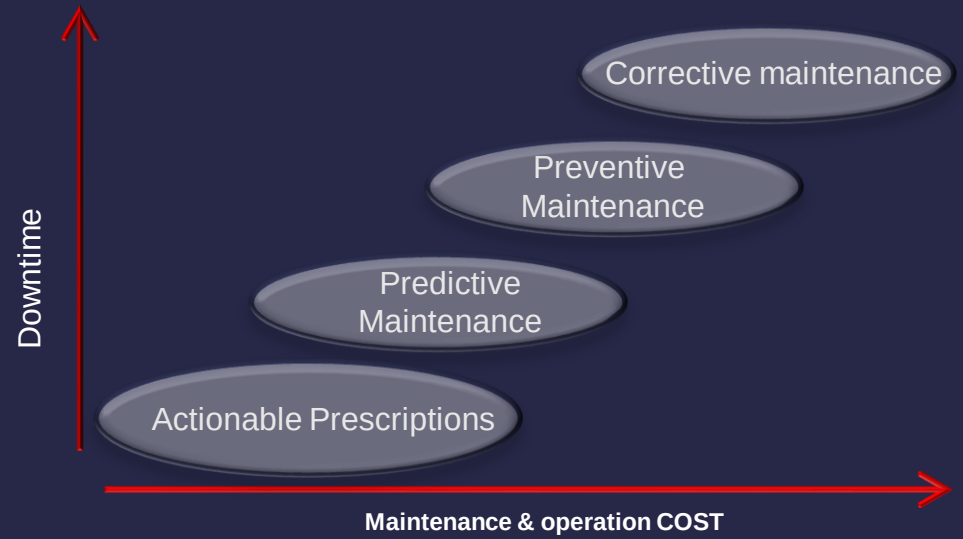
Analytics related M2M connections surge

* Source: ABI Research

Industrial Internet Application: OPEX reduction

Maintenance and operation represent 75% of the Total equipment cost

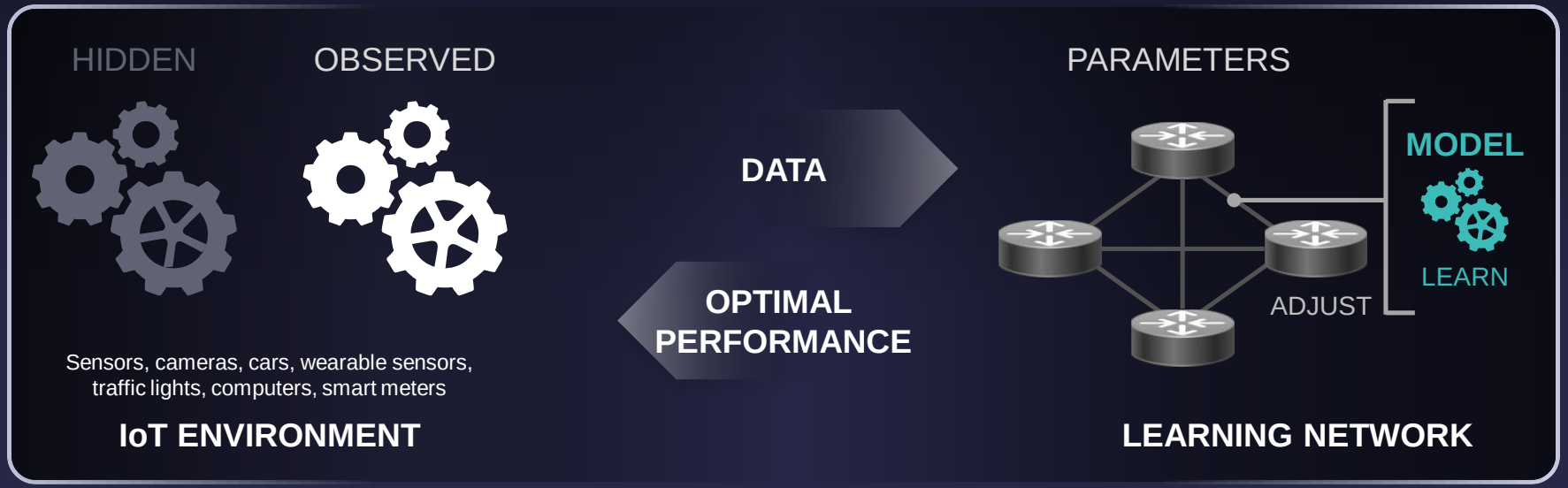




➔ Deployment of Wireless sensors is seen as an efficient solution

Self Learning Networks

Learning Networks Enable Scale



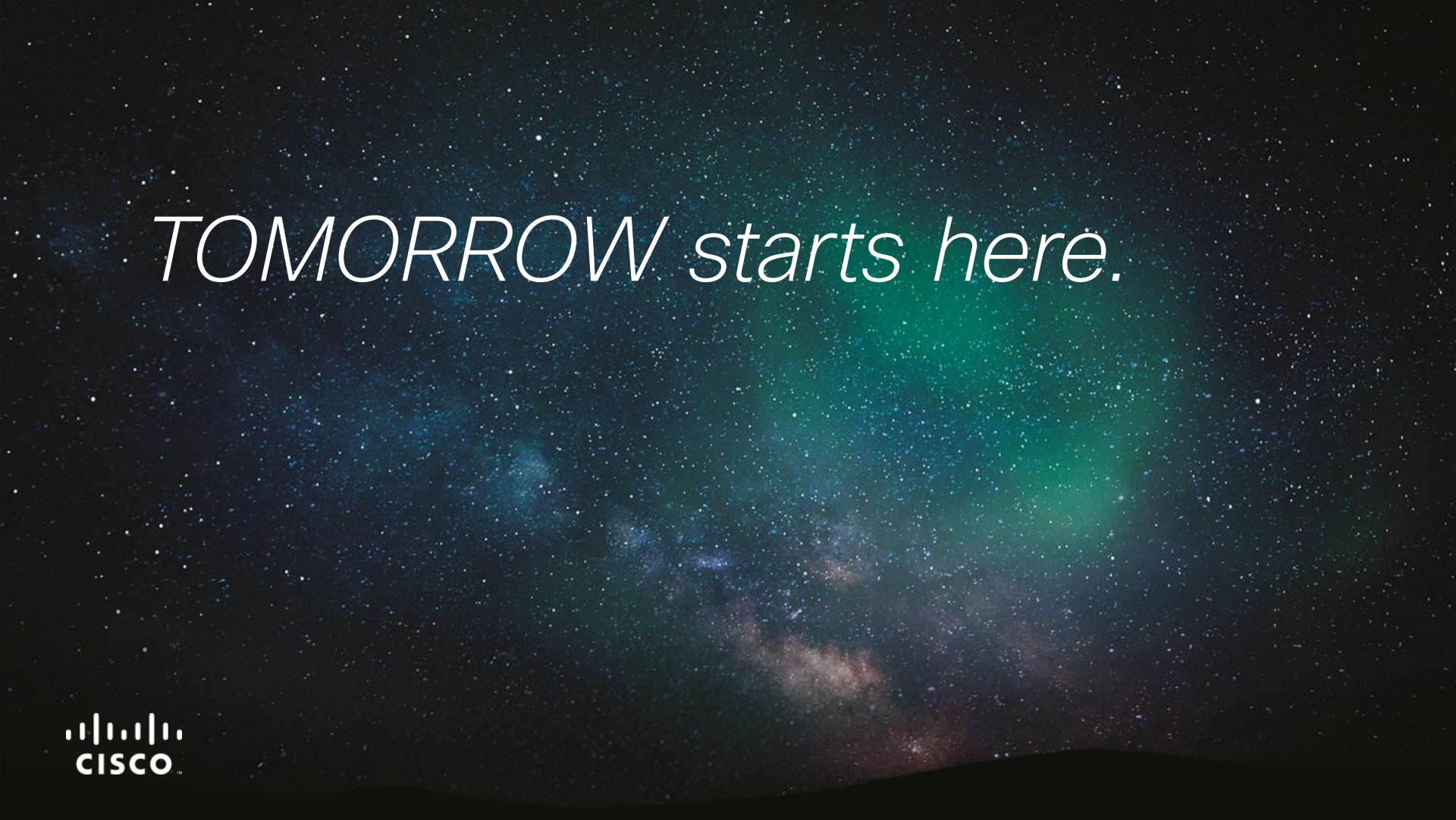
PREDICTIVE PERFORMANCE ANALYSIS

ANOMALY DETECTION

ADAPTIVE SECURITY

Key Take away

IOT requires Innovation and new Paradigms not only in communications:
Real Time requirements: Deterministic Networking
Distributed Intelligence: Fog Computing
Self learning networks: Intelligent Networks (IA)
(Big) Data processing: Analytics
…


TOMORROW starts here.
cisco