迎向 2020 數位製造新時代，思科數位化轉型架框下的創新

數位化製造與工業 4.0, 思科數位化轉型架框與創新, 結論與案例

錢小山

首席技術顧問

思科大中華區解決方案架構事業部

二〇一九年十二月

迎向 2020 數位製造新時代，思科數位化轉型架框下的創新

數位化製造與工業 4.0, 思科數位化轉型架框與創新, 結論與案例

"No country is ever successful in the long term... without a really strong and vibrant manufacturing base"

"沒有一個真正強大和充滿活力的製造基地，從長遠來看，沒有哪個國家能成功！"

Allan Mulally

(Former Ford CEO)

Cisco **IMPACT**

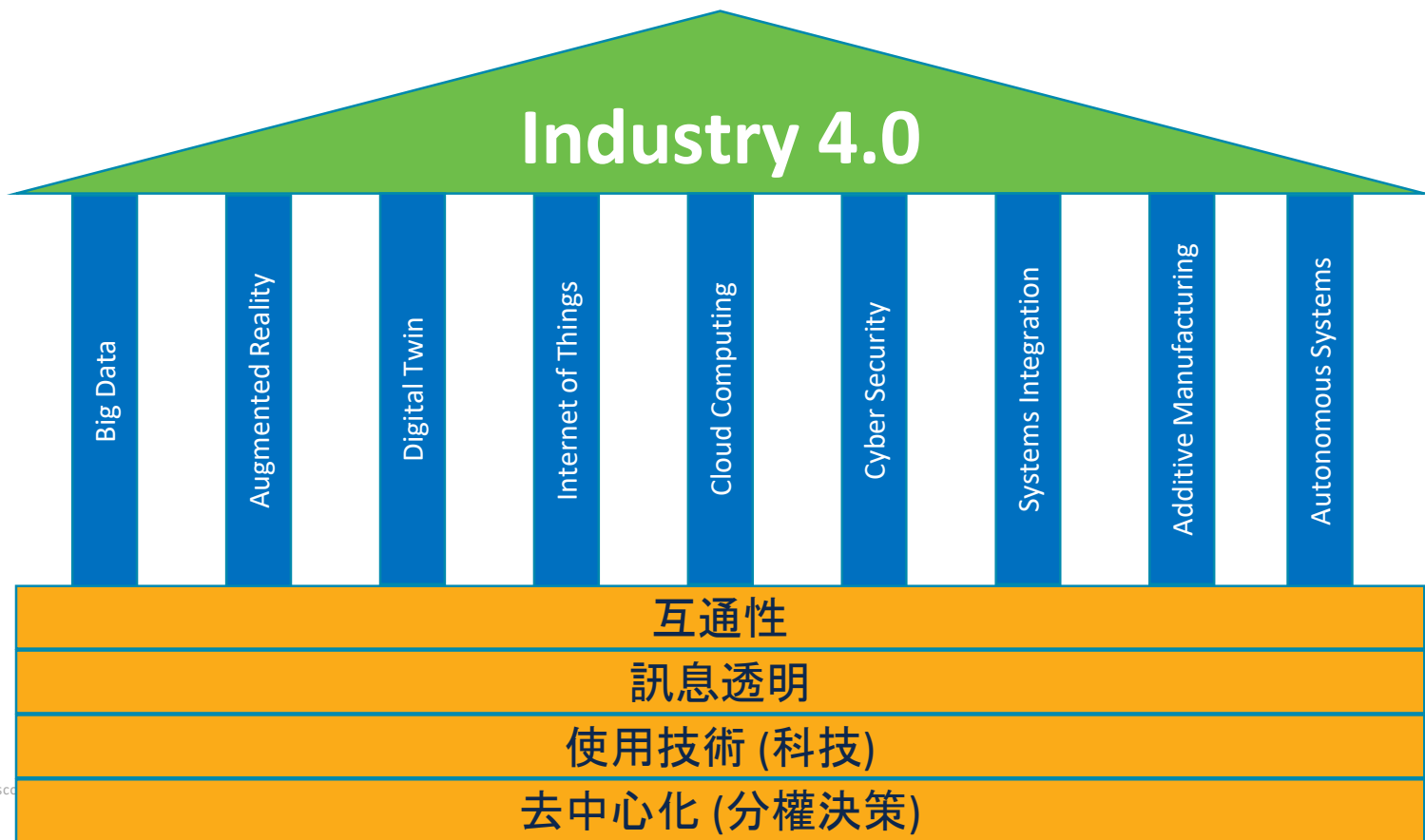# 數位化製造與工業 4.0？

提高機器利用率
更快地推出新產品
降低返工率

減少機器停機時間
更快地從故障中恢復
減少庫存

實體與數位安全
預測性維護
供應鏈可視性

- 可視性 → 洞察 → 行動 (流程)
- 連接設備以收集數據
- 使用收集的數據來挖掘原本未知的訊息以獲取新知
- 使用新的知識來：
  - 改善產品質量
  - 有彈性的按需生產產品
  - 批量生產環境下達成客製化生產
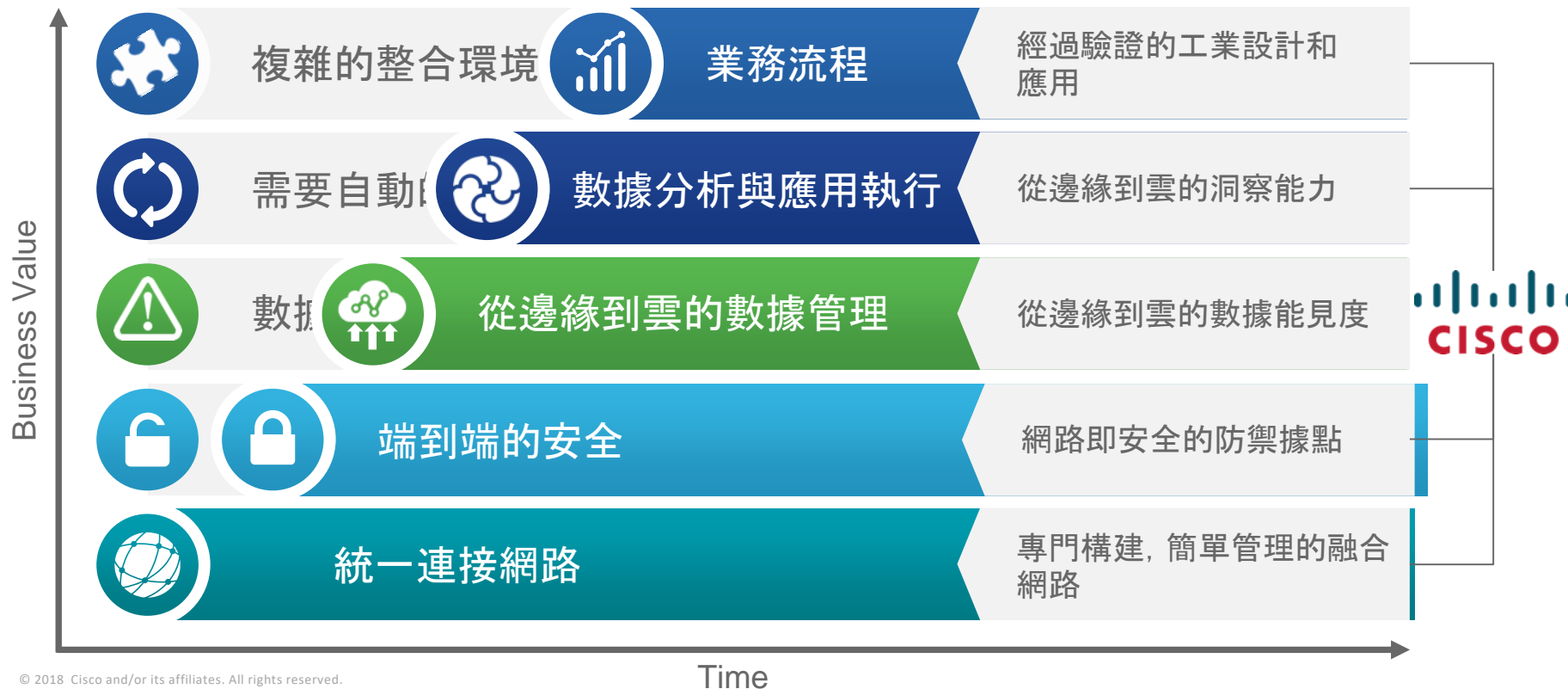 - 通過預測維護來執行生產計劃.
- 通過提高銷售利潤來衡量成功

工業 4.0 的組成區塊

Industry 4.0

Big Data

Augmented Reality

Digital Twin

Internet of Things

Cloud Computing

Cyber Security

Systems Integration

Additive Manufacturing

Autonomous Systems

互通性

訊息透明

使用技術 (科技)

去中心化 (分權決策)

迎向 2020 數位製造新時代，思科數位化轉型架框下的創新

數位化製造與工業 4.0, **思科數位化轉型架框與創新**, 結論與案例

數位化的挑戰與思科的解決方案

Business Value

Time

複雜的整合環境　業務流程　經過驗證的工業設計和應用

需要自動□　數據分析與應用執行　從邊緣到雲的洞察能力

數□□　從邊緣到雲的數據管理　從邊緣到雲的數據能見度

端到端的安全　網路即安全的防禦據點

統一連接網路　專門構建, 簡單管理的融合網路

數位化的旅程與思科的定位
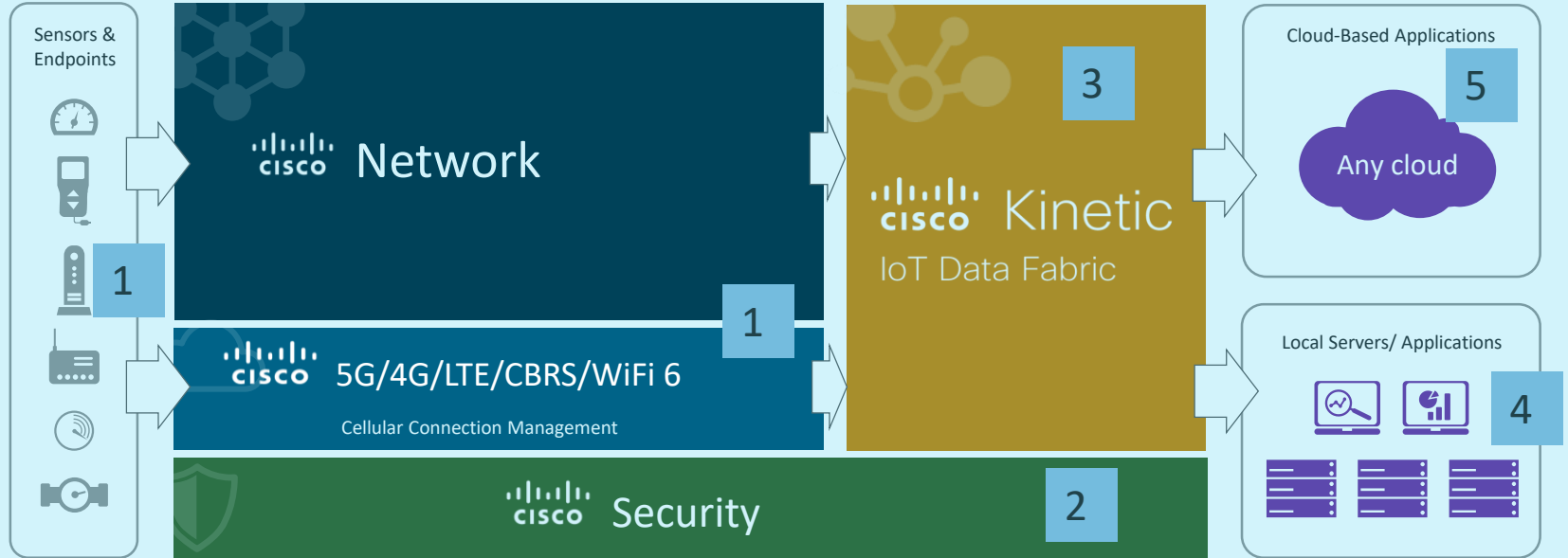
6. Eco-System (SolutionPlus) Partner & SI

思科的數位化架框

Apps	AI/ML 數據分析與人工智慧 **3**	Cloud Service eXchange 雲服務交換 **5** Collaboration 協作
Compute	Distributed Architecture For Virtualization 絕對分散的虛擬化架框 **3**	Data Center and Cloud 多資料中心與多雲架構 **4**
	3 Edge Computing (IoT Data Fabric : Cisco Kinetic Platform) 思科網路動力數據處理平台	
Connected Infrastructure	**1** 超感知無線網路	
	2 安全解決方案	
	1 超感知有線網路	
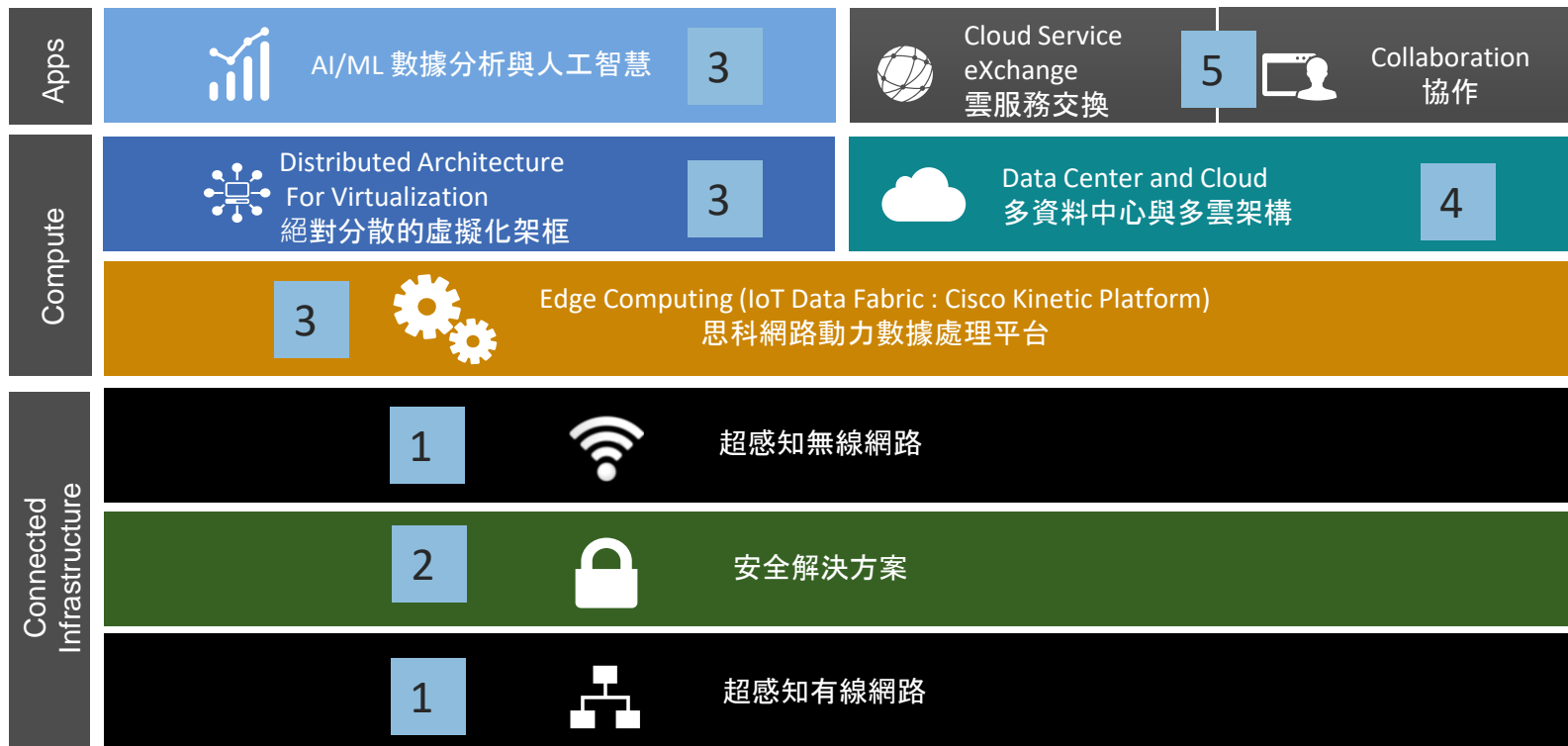
超感知有線網路

WHAT IS IT

Unified Converged Network

CHALLENGE

Complex network silos creating downtime, data isolation and vulnerabilities. Inflexible and high TCO.

"Network issues took us hours and sometimes days to troubleshoot. The downtime associated with these issues was extremely costly." *- Dave Gutshall – Harley Davidson*

CRITICAL NEEDS

- Converged Network for Flexible Connection
- Rapid Fault Isolation
- **Resiliency**
- **Ease of use**
- **TSN**
- **網路切割**

CISCO PORTFOLIO

IE 2000, 3000 CGS2000

IP67

IE 4000

IE 5000

Cisco Prime

CGR 2000

ASR 903

ASR 902

Industrial Switching

Industrial Routing

BUSINESS OUTCOMES

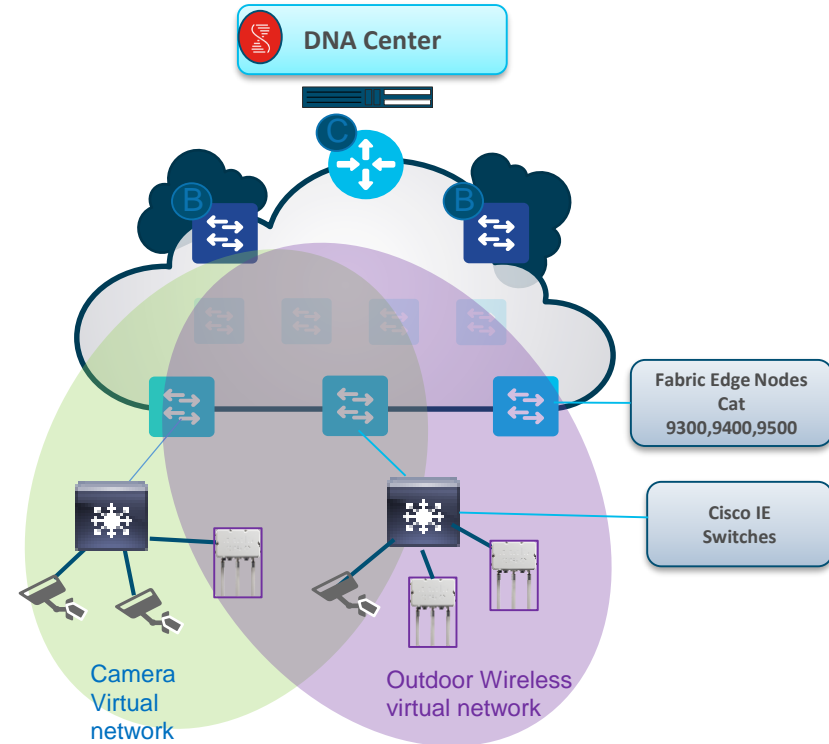**Operation Improvement**

Reduced Downtime

IT/OT 端到端的網路切割

SDA Enterprise customer needs for IE

- Fanless
- No air conditioning
- Gigabit
- POE
- Support for Cisco Enterprise management tools and processes

Use cases for Enterprise with IE

- Outdoor / parking lots
- Warehouse/distribution
- Roadway – state or county
- Public Safety / first responders
- Ports / airports

DNA Center

Fabric Edge Nodes Cat 9300,9400,9500

Cisco IE Switches

Camera Virtual network

Outdoor Wireless virtual network

IE Switches extend the SDA beyond Fabric Edge

數位化的安全解決方案

WHAT IS IT

Pervasive Physical and Cyber Security for the OT

CHALLENGE

Ranks annually among top three targeted industries for cyber attacks

"…a number of cyber espionage campaigns discovered in 2014 targeted key sectors—such as manufacturing—that use industrial control system (ICS) technologies to automate physical processes." *- Symantec Internet security Threat Report 2015*

CRITICAL NEEDS

- **Identity Services**
- Physical Security
- **Machine / controls security**
- **Secure Remote Access**
- **ISA-99**
- **MUD**

CISCO PORTFOLIO

IR Portfolio

Cisco ASA H
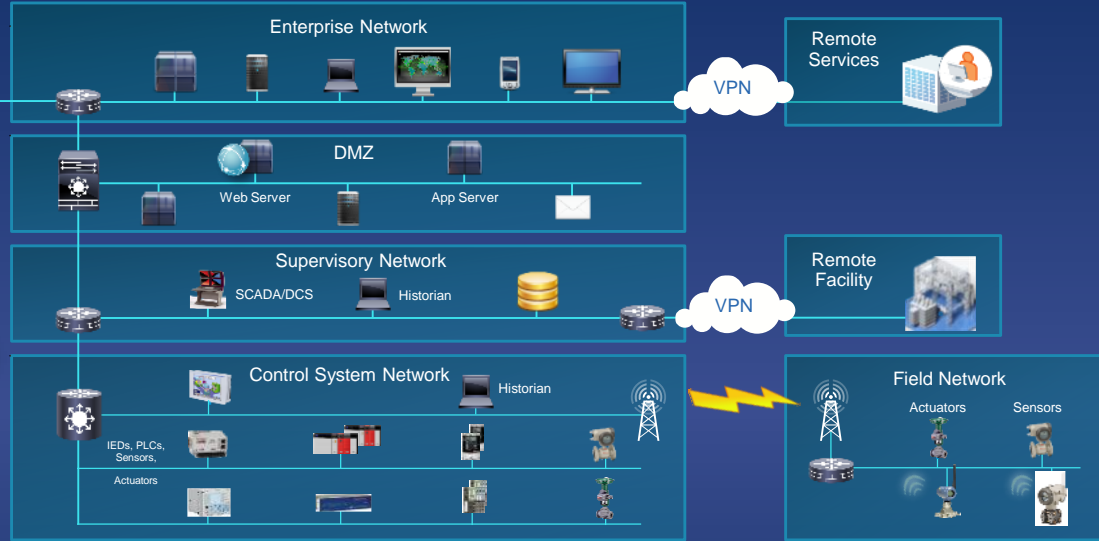
Video Surveillance Manager

Physical Access Manager

IE Portfolio

Cisco ISE

Software Defined Segmentation (TrustSec)

AMP, Sourcefire Defense Center, Cloud Security

IP Cameras

Cyber Security

Physical Security

BUSINESS OUTCOMES

Reduced Risk

Reduced Downtime

IEC-62443/ISA-99 工業安全架框

新的物聯網安全標準 – MUD (Manufacturer Usage Descriptions)

Addresses visibility and segmentation challenges for IoT devices

RFC 8520
March 19, 2019
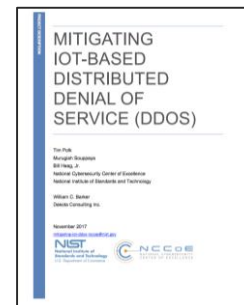
https://datatracker.ietf.org/doc/rfc8520/

https://www.nccoe.nist.gov/projects/building-blocks/mitigating-iot-based-ddos

MUD 架構

IoT Asset

Network Devices

MUD Controller

MUD File Server

1

MUD-URL in
LLDP/DHCP /
802.1X

2

MUD-URL

3

MUD Controller
fetches policy
recommendation

5

access
controls
deployed

Policy
recommendation is
translated to access
control lists
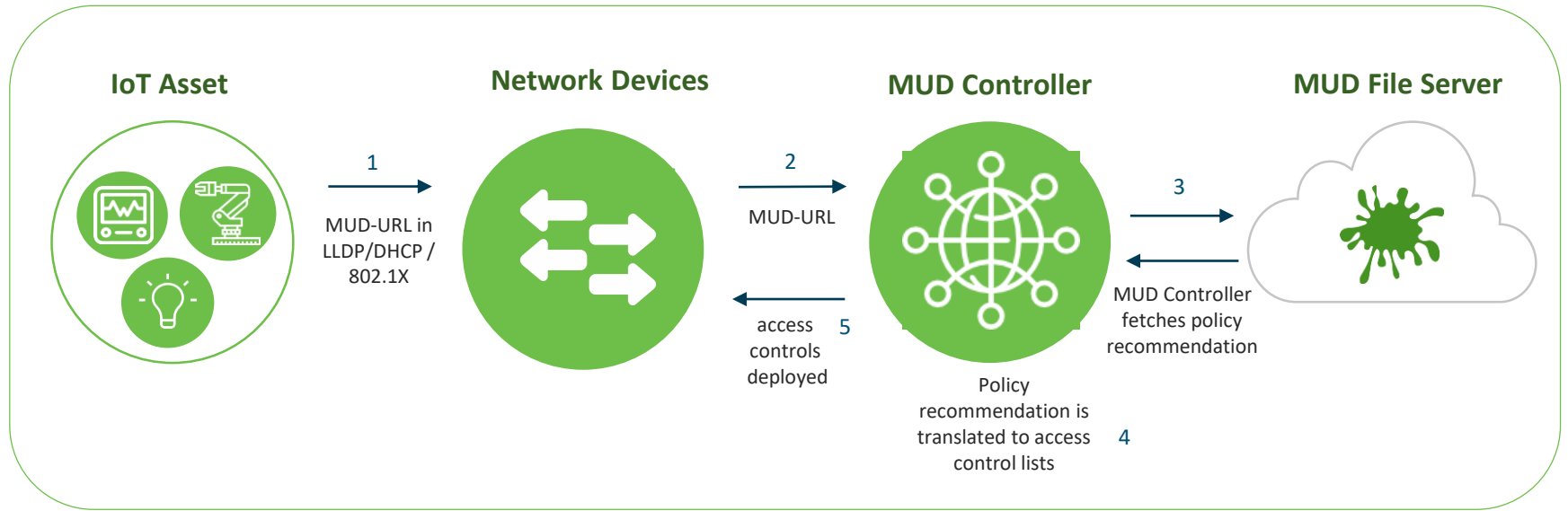
4

超感知無線網路

Unified Wireless for Mobile Visibility and Productivity

CHALLENGE

Lack of mobile visibility and access to machines and tools. Disparity between wired and wireless networks.

"In the factory, the ability to locate major parts and tooling on a timely basis is critical… WiFi LBS will streamline our production environment, by not having to replicate tooling and pieces of gear.." *- Jim Farrecker - Boeing*

CRITICAL NEEDS

- **Centralized Management**
- Reliability
- Simple Deployment
- **Integrated Security**
- Lower Total Cost vs. Ad Hoc Deployments
- **Location-Based Services**
- **5G Integration**

CISCO PORTFOLIO

Field AP 1552

Manufacturing WGB/AP (Rockwell)

Industrial AP IW 3700/6300 802.11ac/ax

Mobile IP Gateway

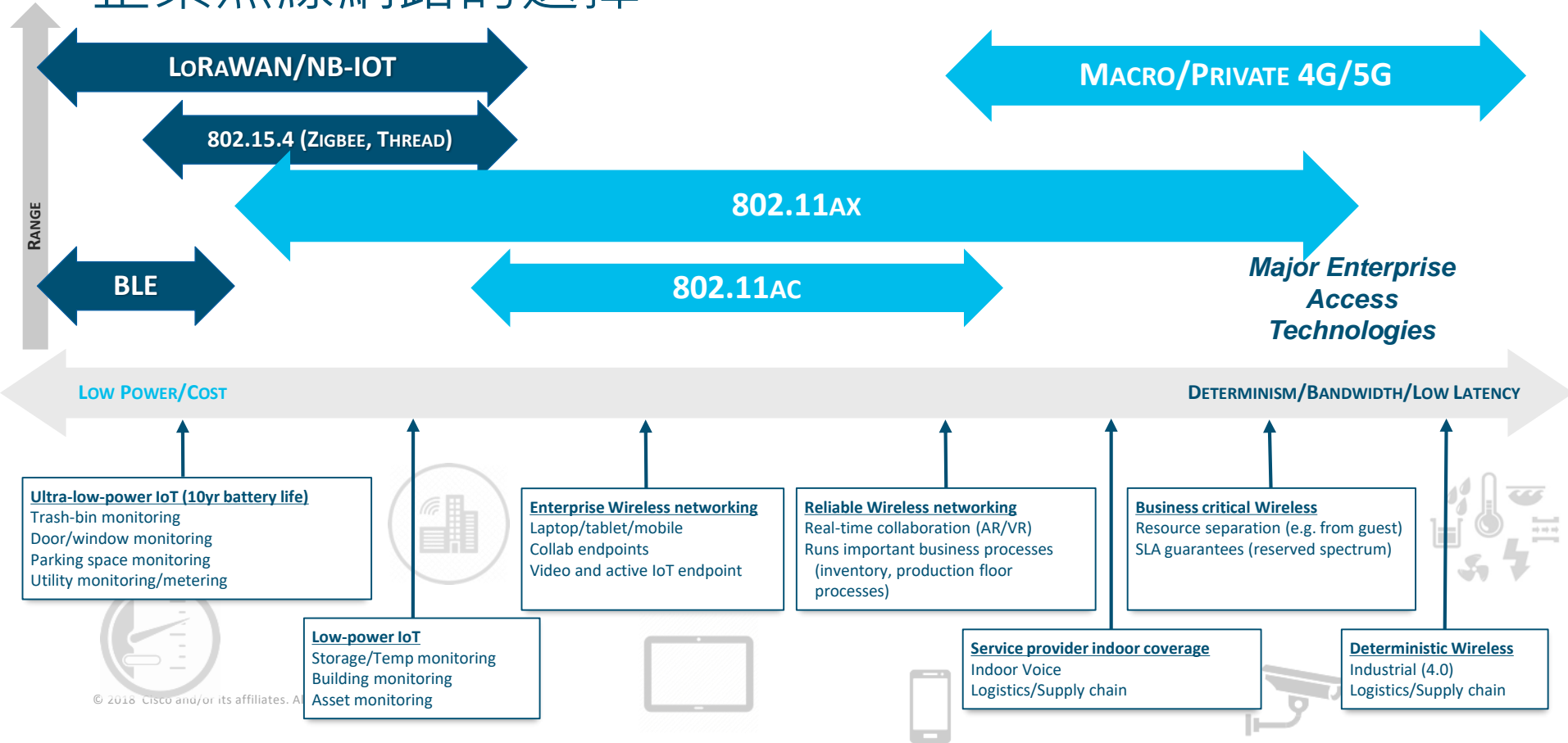RFID and BlueTooth for Location-Based Services
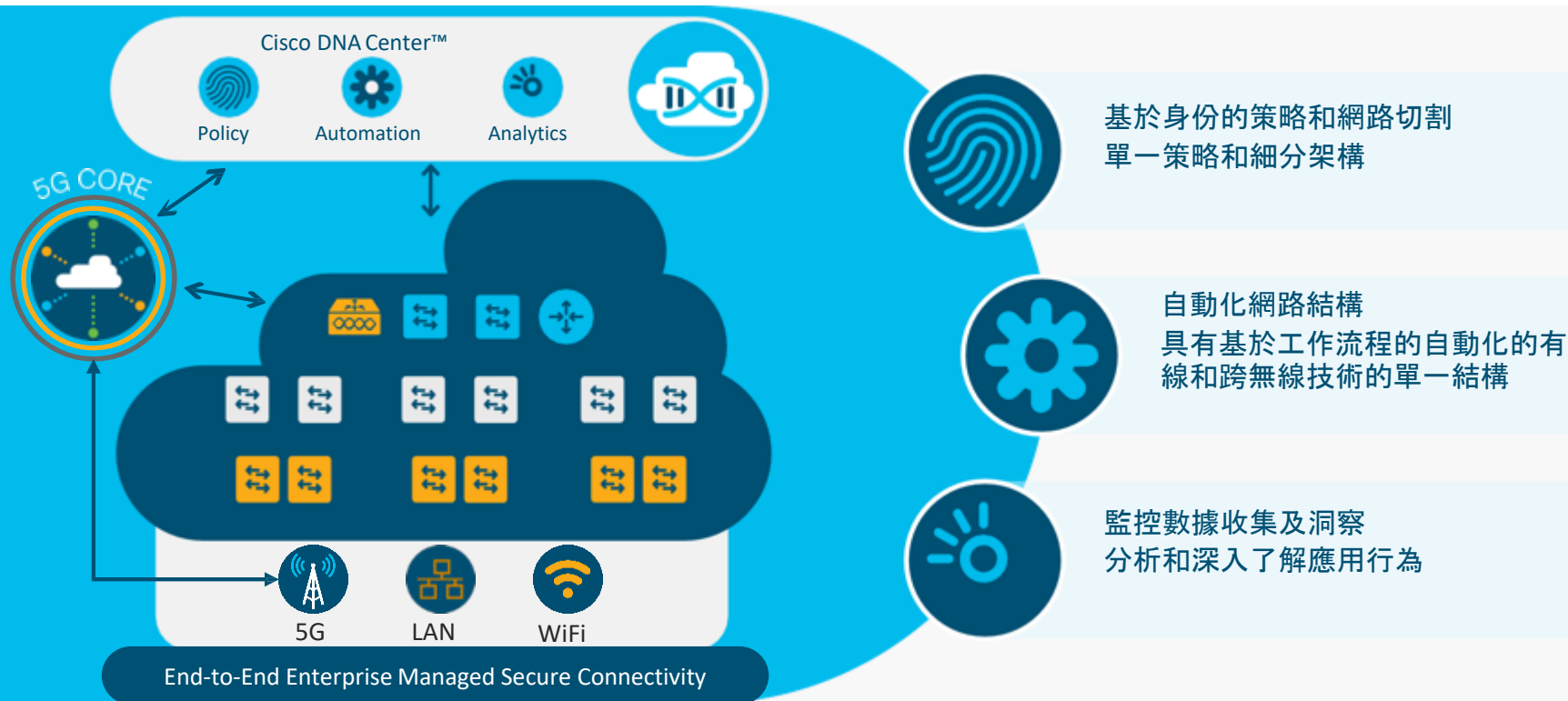
BUSINESS OUTCOMES

Reduced Downtime

OEE Improvement

企業無線網路的選擇

RANGE

LoRaWAN/NB-IoT

802.15.4 (Zigbee, Thread)

Macro/Private 4G/5G

802.11ax

BLE

802.11ac

Major Enterprise Access Technologies

Low Power/Cost

Determinism/Bandwidth/Low Latency

Ultra-low-power IoT (10yr battery life)
Trash-bin monitoring
Door/window monitoring
Parking space monitoring
Utility monitoring/metering

Low-power IoT
Storage/Temp monitoring
Building monitoring
Asset monitoring

Enterprise Wireless networking
Laptop/tablet/mobile
Collab endpoints
Video and active IoT endpoint

Reliable Wireless networking
Real-time collaboration (AR/VR)
Runs important business processes
(inventory, production floor
processes)

Service provider indoor coverage
Indoor Voice
Logistics/Supply chain

Business critical Wireless
Resource separation (e.g. from guest)
SLA guarantees (reserved spectrum)

Deterministic Wireless
Industrial (4.0)
Logistics/Supply chain

5G 與企業網路 (WiFi 6) 的融合

Cisco DNA Center™

Policy

Automation

Analytics

5G CORE

5G   LAN   WiFi

End-to-End Enterprise Managed Secure Connectivity

基於身份的策略和網路切割
單一策略和細分架構

自動化網路結構
具有基於工作流程的自動化的有
線和跨無線技術的單一結構

監控數據收集及洞察
分析和深入了解應用行為

製造行業的 5G
將企業網路訪問策略拓展到 5G 行動網路中

問題 企業在 5G 網路上缺乏對企業流量的可見性和控制力。 企業能定義策略和安全性的能力有限。

解決方案 使企業能夠使用與管理企業 IT 相同的工具來管理其在 5G 網路上的設備, 策略, 流量與服務設備。 這是能通過動態 MNO 網絡API完成的。

好處| 服務部署的敏捷性| 將相同的IT 網絡, 安全策略應用於 5G 網路上的設備, 提高 SLA 的透明度

固網/行動網一致性網路訪問策略

企業實現敏捷業務下發

企業IT在企業控制器中定義固、移訪問策略,下發策略、集中監控、運維。

Customer premises

Enterprise

Policy

LAN

Wifi + CBRS

Apps

Security

Ent. Portal DNA-C

SP Domain

Unified Domain Center

Mobile Functions

Mobile Control Plane

5G/4G/LTE/CBRS/WiFi 6

Network Cloud UPF

APPs

10-20ms

Low latency
Superior QoS
Enterprise Security

Macro RAN

漢諾威工業展5G展區

基於 5G 的 AGV小車

基於 5G 的 機械臂

基於 5G 的 六腳蜘蛛

基於 5G 的 在線過程控制

基於 5G 的智慧工廠

5G基站

5G基站

運營商

IP Switch

APIC-EM

ISE

NDP

DNA Center

MEC

MEC及雲化處理

企業IT在企業控制器中定義固、移訪問策略，下發策略、集中監控、運維。

資料中心

APIC APIC APIC

VM VM VM

5G: 低延時、AR互動、工控/伺服業務
WiFi 6: 非高即時性、高流量、IoT資料獲取類業務

Edge Computing (IoT Data Fabric : Cisco Kinetic)
思科網路動力數據處理平台

WHAT IS IT

Embedded Switching, Security & Compute to Enable Connectivity and Edge Data Capture and Analytics

CHALLENGE

Lack of visibility to OT data (temp, torque, hours, etc) to monitor and predict Operation downtime.

"We have cases where downtime is costing over $20,000 per minute. The ability to predict service requirements will have a tremendous impact." - *Rick Schneider – NA CEO FANUC Robotics*

CRITICAL NEEDS

- Smart Device Monitoring,
- **Data-in-Motion Visibility**
- **Scalable data acquisition**
- Enterprise security compliance and policy
- Open Machine Architecture
- **Time-sensitive deterministic communications**

CISCO PORTFOLIO

- GMM
- DCM
- EFM
- IND
- Cloud Based

- IOx
- HyperFlex Edge/UCS Server
- IR809/829/1101
- IE4000
- CGR1000

BUSINESS OUTCOMES

Operation Improvement

Reduced Downtime

The Future Of Computing Is At The Edge

"企業生成的數據中約有 10% 是在傳統的集中式數據中心或雲的 <外部> 創建和處理的。Gartner 預測，到 2025 年，這一數字將達到 75%"

https://www.gartner.com/smarterwithgartner/what-edge-computing-means-for-infrastructure-and-operations-leaders/

在工業物聯網中邊緣計算是第一要務
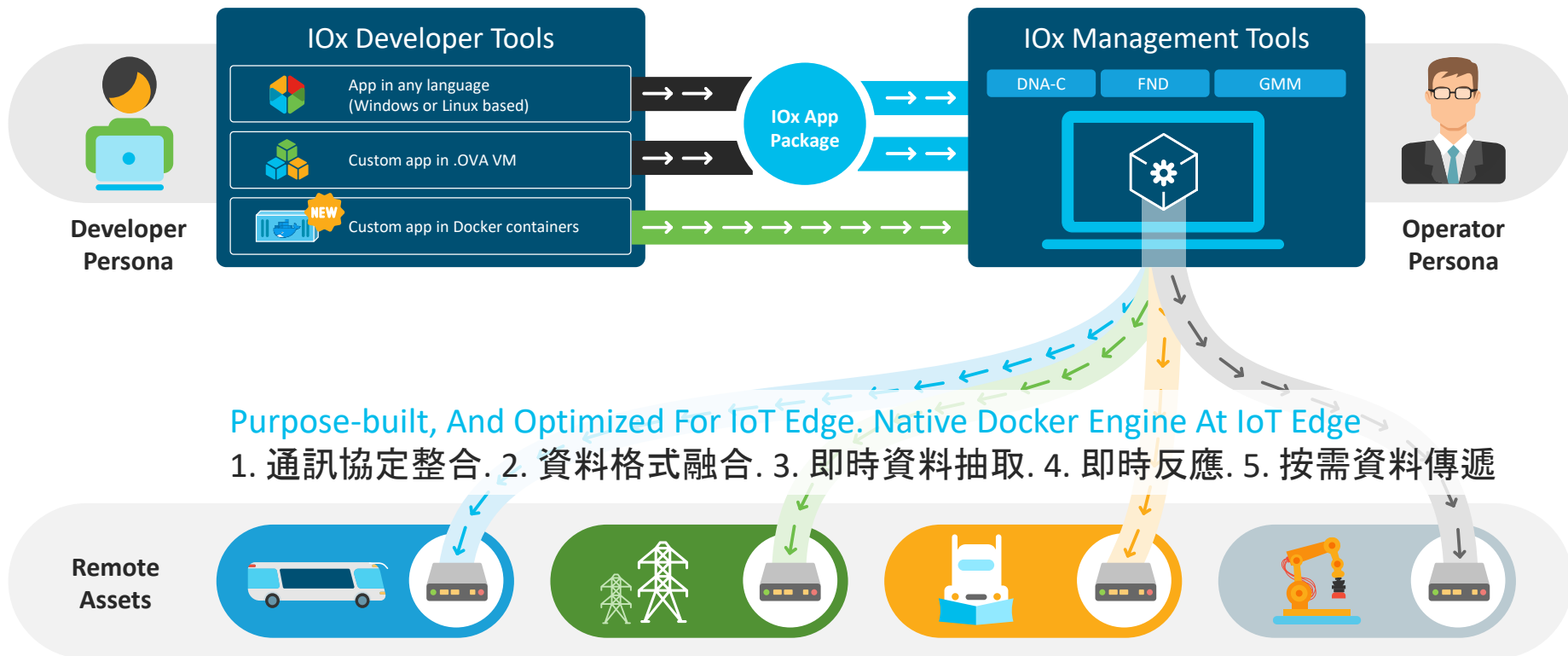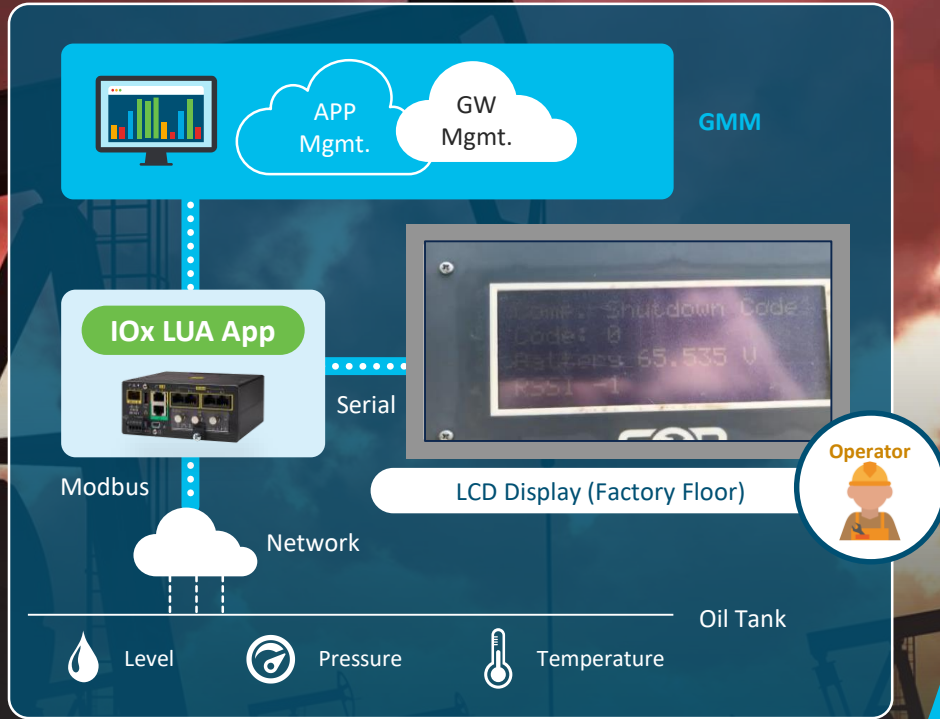
30% 的工作負載部署具有延遲和頻寬需求

40% 的大型企業將邊緣計算整合到其 2021年項目中

45% 的物聯網設備數據的存儲，處理，分析和移動到 2020 年，將接近網路的邊緣或就在邊緣

邊緣計算的目的 : 在最近的地方做最適當的反應

IOx Developer Tools

App in any language (Windows or Linux based)

Custom app in .OVA VM

NEW Custom app in Docker containers

IOx App Package

IOx Management Tools

DNA-C | FND | GMM

Developer Persona

Operator Persona

Purpose-built, And Optimized For IoT Edge. Native Docker Engine At IoT Edge
1. 通訊協定整合. 2. 資料格式融合. 3. 即時資料抽取. 4. 即時反應. 5. 按需資料傳遞

Remote Assets

Data Center and Cloud
多資料中心與多雲架構

WHAT IS IT

Data center and secure cloud platform for virtual management of test, quality and traceability data worldwide

CHALLENGE

Unified, scalable compute at the data center and secure cloud access for offsite data and analytics

CRITICAL NEEDS

- Real-time visibility
- Higher security
- Improved integrations
- **Faster ramp up of new Workload – 80 % less time**

CISCO PORTFOLIO

- Data Center Compute
- Data Center Security
- Data Center Switching
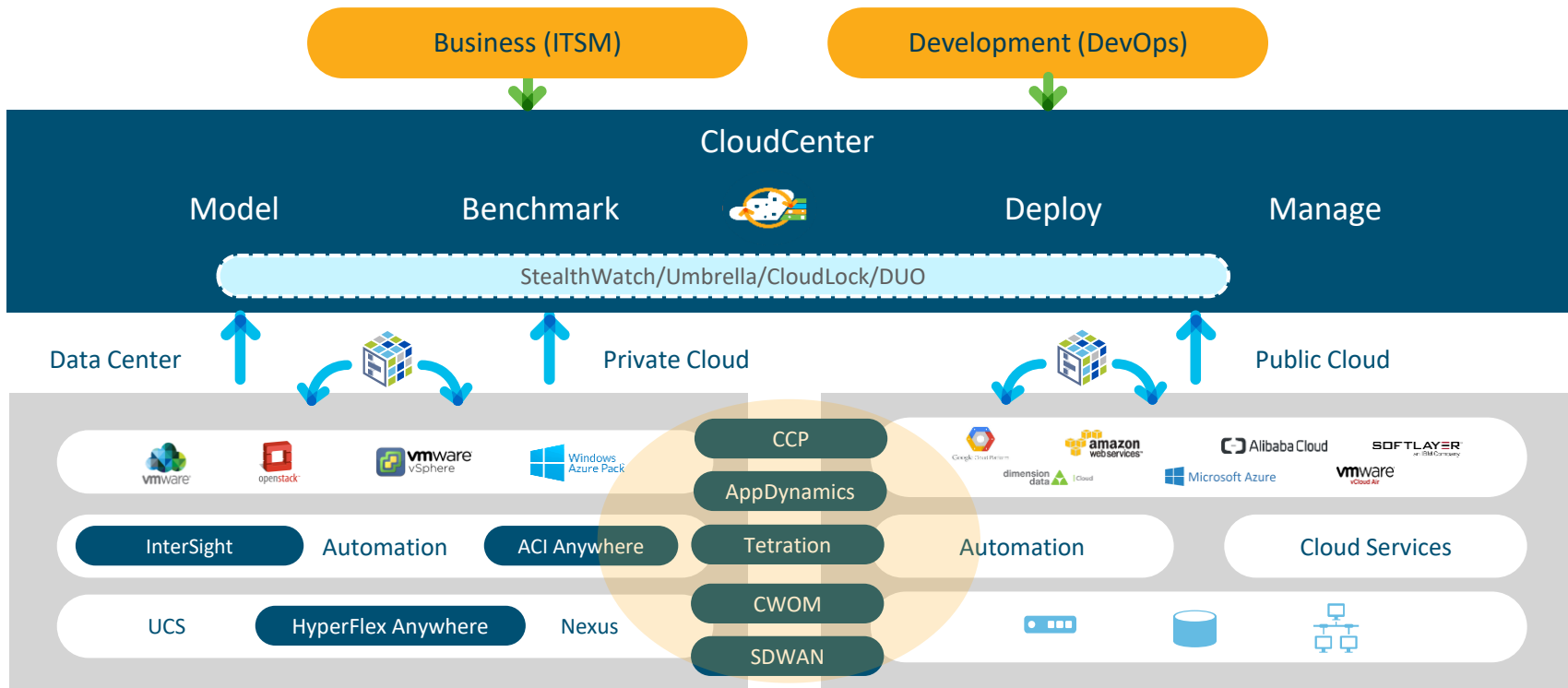- Cisco CloudCenter

BUSINESS OUTCOMES

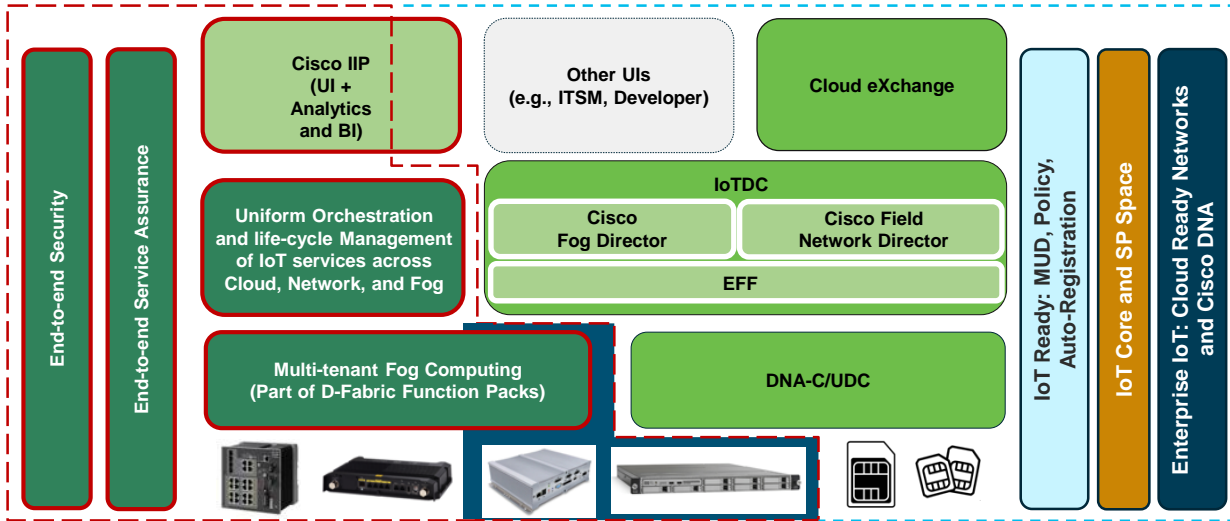**Operation Improvement**

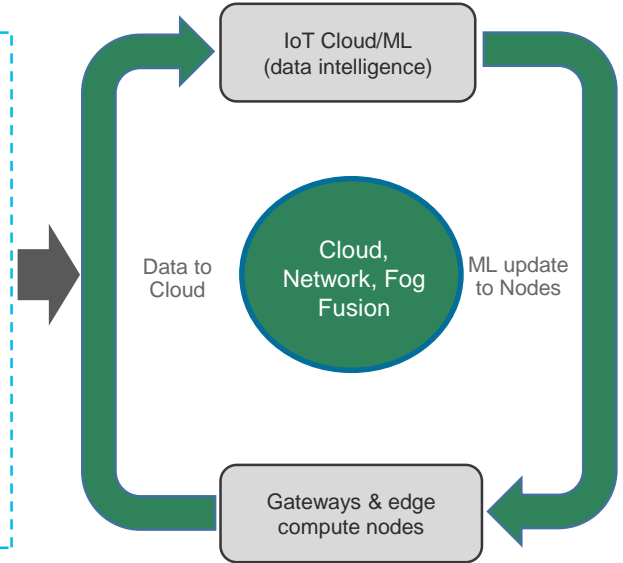**Reduced Downtime**

多資料中心與多雲的 IT/OTaaS 自動化架構

IT/OTaaS 架框

D-Fabric Core

D-Fabric Extended Integration and Automation

End-to-end Security

End-to-end Service Assurance

Cisco IIP (UI + Analytics and BI)

Uniform Orchestration and life-cycle Management of IoT services across Cloud, Network, and Fog

Multi-tenant Fog Computing (Part of D-Fabric Function Packs)

Other UIs (e.g., ITSM, Developer)

Cloud eXchange

IoTDC

Cisco Fog Director

Cisco Field Network Director

EFF

DNA-C/UDC

IoT Ready: MUD, Policy, Auto-Registration

IoT Core and SP Space

Enterprise IoT: Cloud Ready Networks and Cisco DNA

IoT Cloud/ML (data intelligence)

Data to Cloud

Cloud, Network, Fog Fusion

ML update to Nodes

Gateways & edge compute nodes

Fog Nodes (both Cisco and non-Cisco) **Applications (both Cisco and non-Cisco)**

MFG | Cities | Smart Grid | O&G | Enterprise Services | Assets | Fleets | Buildings | Field Ops | Residential Services
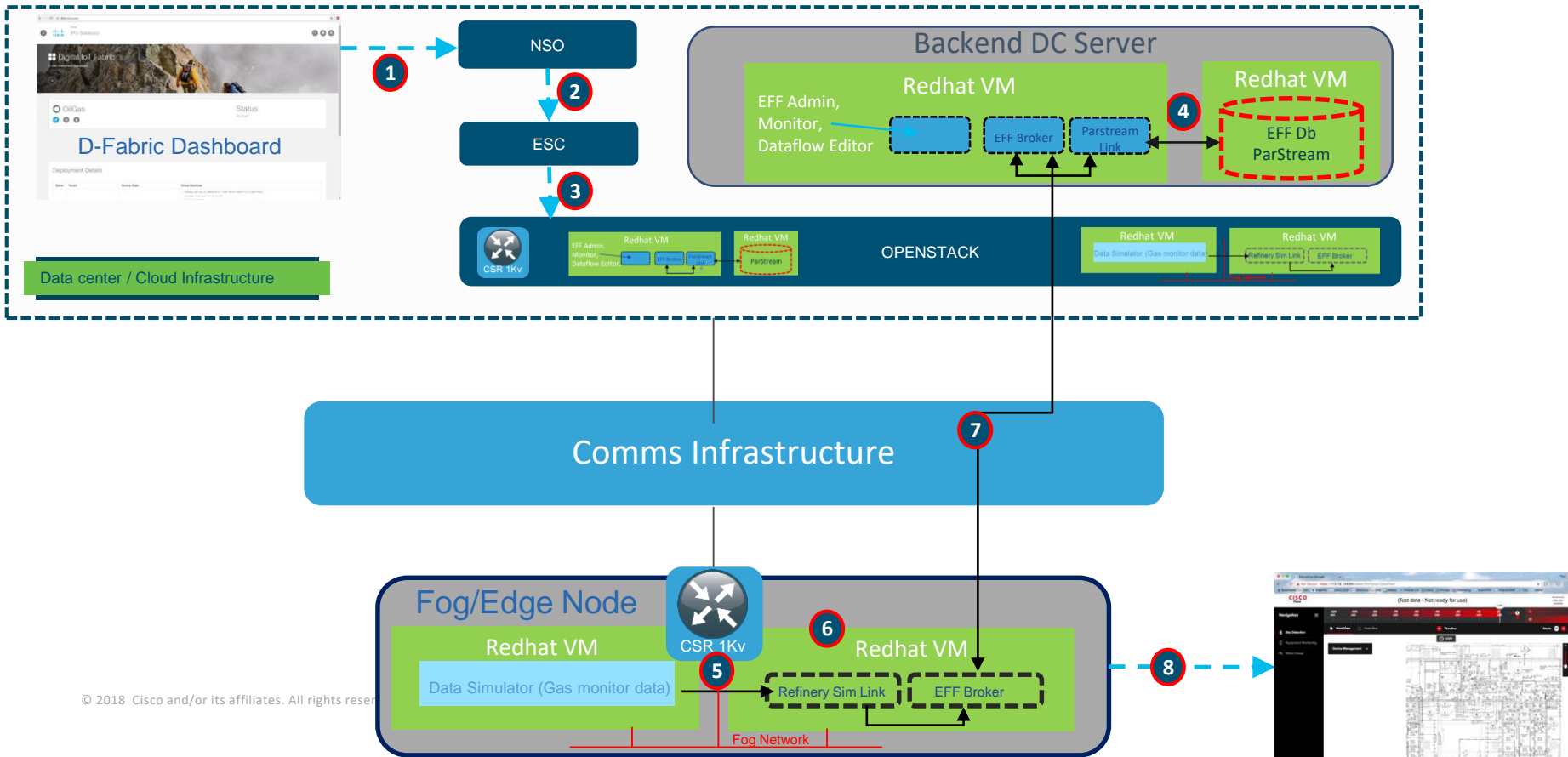
D-Fabric:
Depends neither on Cisco HW nor SW or 3rd parties (open and flexible)

YANG:
- Services
- Devices
- Things (MUD)

IT/OTaaS 流程

Distributed Architecture For Virtualization
絕對分散的虛擬化架框

WHAT IS IT

Massively reduce the number of plant floor PCs to improve efficiency and reduce risk.

CHALLENGE

Hundreds of PCs for data collection, interfacing to machine Each one independently managed, patched, recovered, secured

"…each machine has its own flavor of laptop and software required for tooling changes or updates. Maintenance has to carry around a set of laptops, each with its own OS, software, and hardware that differs depending on their machine. Most laptops have outdated software, hardware, and have security vulnerabilities." - Plant Engineer - Major Automotive Manufacturer

CRITICAL NEEDS

- Reduction in Operating Systems
- Reduce hardware footprint
- Reduced attack footprint
- Headless workstations
- Thin or Zero Clients
- **Flexible Edge Analytics**
- Scalable Compute
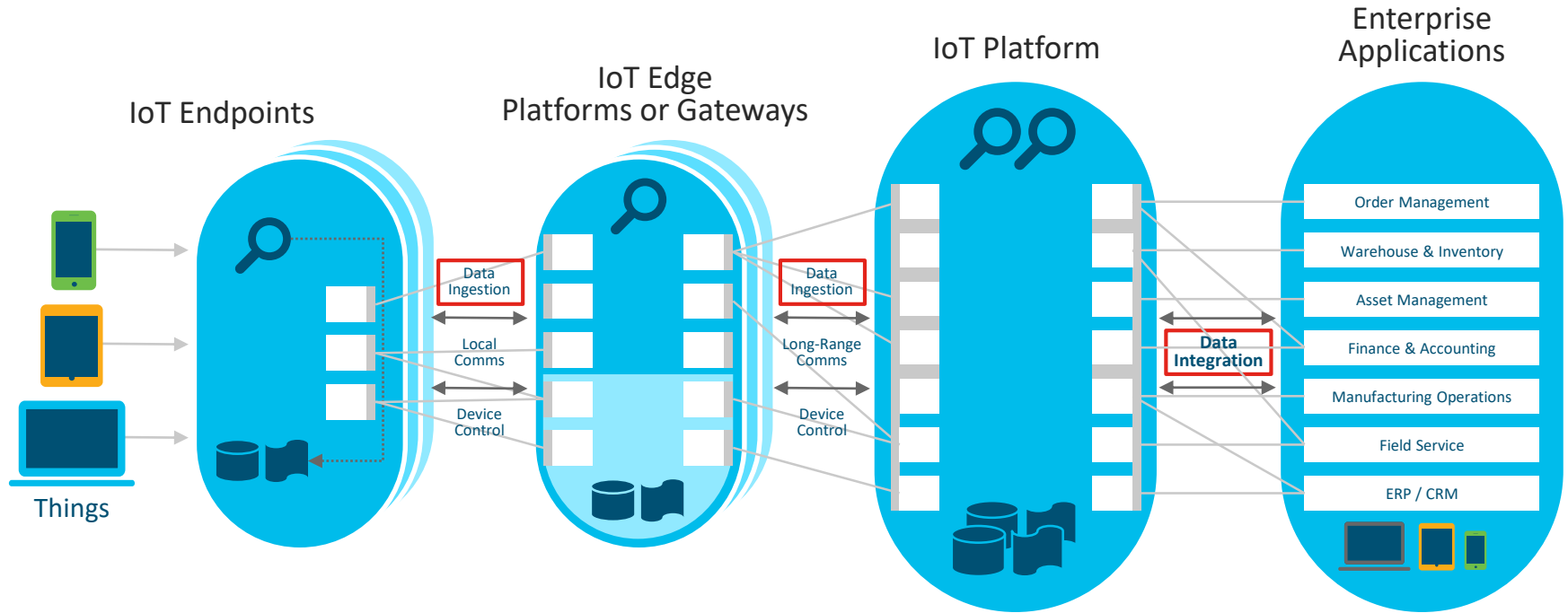
CISCO PORTFOLIO

IE 4000

UCS/HyperFlex

Switching

Compute

BUSINESS OUTCOMES

Reduced Risk

Reduced Downtime

工業物聯網之旅（完全分佈式）

IoT Endpoints

Things

IoT Edge
Platforms or Gateways

IoT Platform

Enterprise
Applications

Data
Ingestion

Local
Comms

Device
Control

Data
Ingestion

Long-Range
Comms

Device
Control

Data
Integration

Order Management

Warehouse & Inventory

Asset Management

Finance & Accounting

Manufacturing Operations

Field Service

ERP / CRM

In **80%** of cases, **50%** of the budget is for Integration

Required a Cross-Domain Innovated Infrastructure

思科超融合平台 – HyperFlex (2 → 64)
絕對分散的虛擬化架框

混合雲移動性和服務平台

工作負載安全保障平台

混合應用性能監控平台

雲化管理

工作量及監控平台

Core

Cloud

人工智慧與機器學習之訓練平台
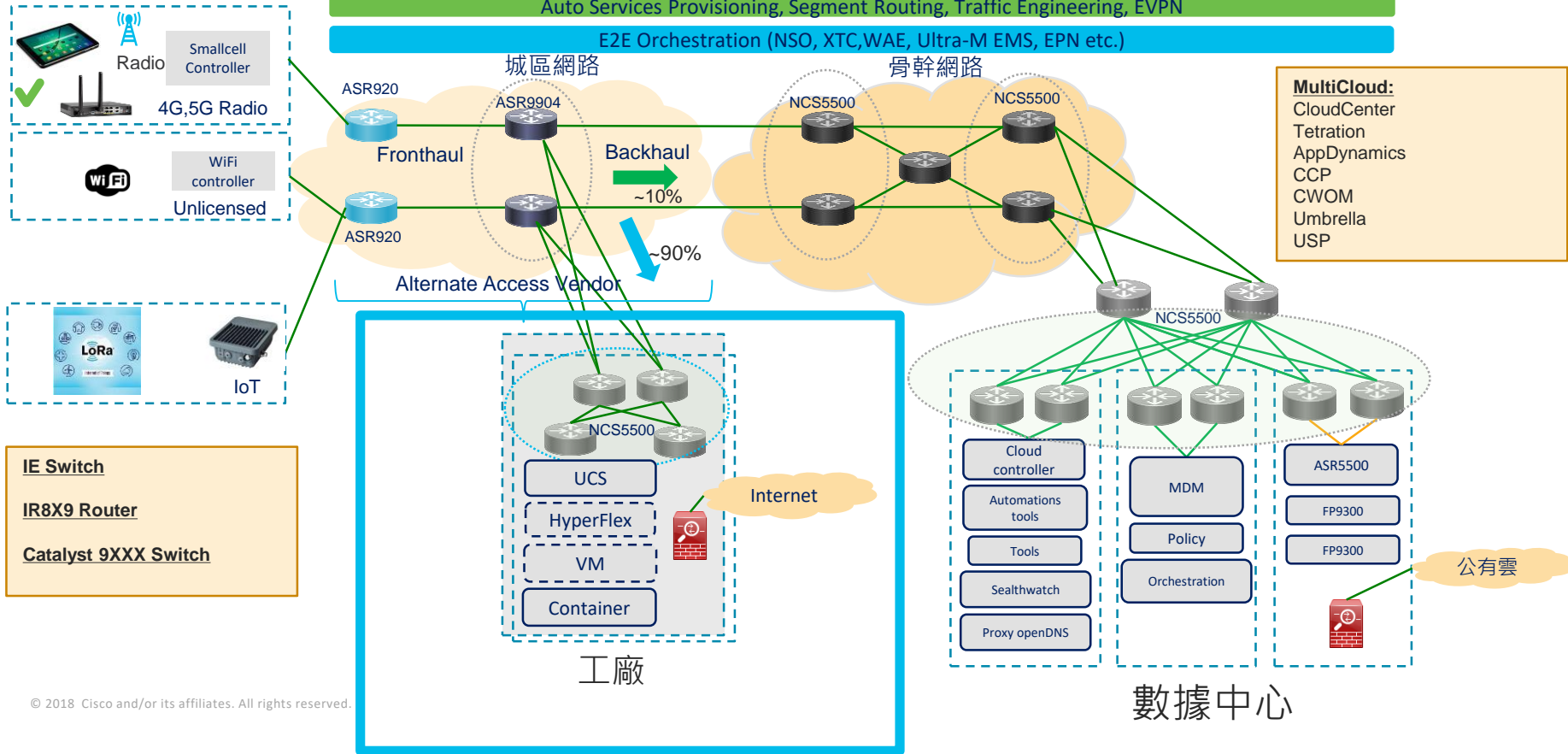
支持微服務和容器

Edge

人工智慧與機器學習之邊緣推理平台

現代化的漸進式擴展基礎架構

下一代邊緣管理平台
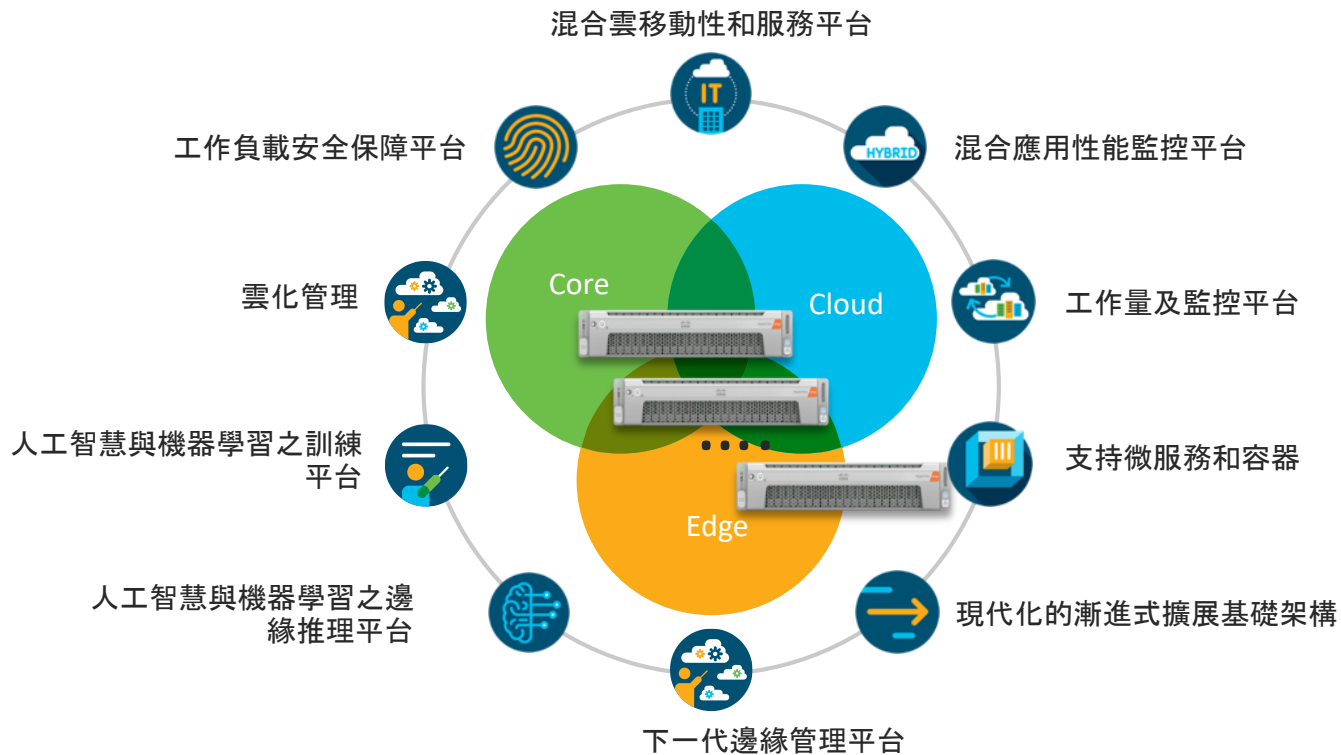
端到端分佈式虛擬化架構

Auto Services Provisioning, Segment Routing, Traffic Engineering, EVPN

E2E Orchestration (NSO, XTC,WAE, Ultra-M EMS, EPN etc.)

Radio

Smallcell
Controller

4G,5G Radio

WiFi
controller

Unlicensed

LoRa

IoT

IE Switch

IR8X9 Router

Catalyst 9XXX Switch

城區網路

ASR920

Fronthaul

ASR920

ASR9904

Backhaul

~10%

~90%

Alternate Access Vendor

骨幹網路

NCS5500

NCS5500

NCS5500

NCS5500

NCS5500

UCS

HyperFlex

VM

Container

Internet

工廠

MultiCloud:
CloudCenter
Tetration
AppDynamics
CCP
CWOM
Umbrella
USP

Cloud
controller

Automations
tools

Tools

Sealthwatch

Proxy openDNS

MDM

Policy

Orchestration

ASR5500

FP9300

FP9300

公有雲

數據中心

AI/ML 數據分析與人工智慧

WHAT IS IT

Harness the power of AI/ML to quickly solve assembly machines production and quality issues

CHALLENGE

Capture production data in realtime to see opportunities to cycle down machines or adjust supply chain

CRITICAL NEEDS

- **Cloud to Edge Solutions with Multi-tiers Analytics**
- Limited access to data
- Factory floor machine downtimes

CISCO PORTFOLIO
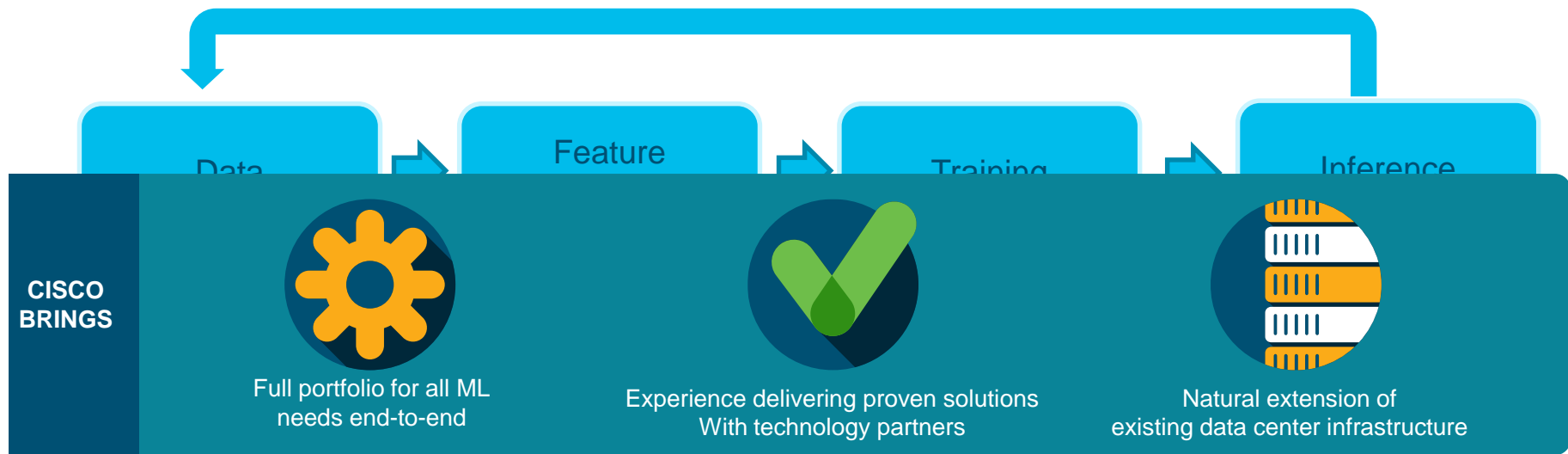
Fog

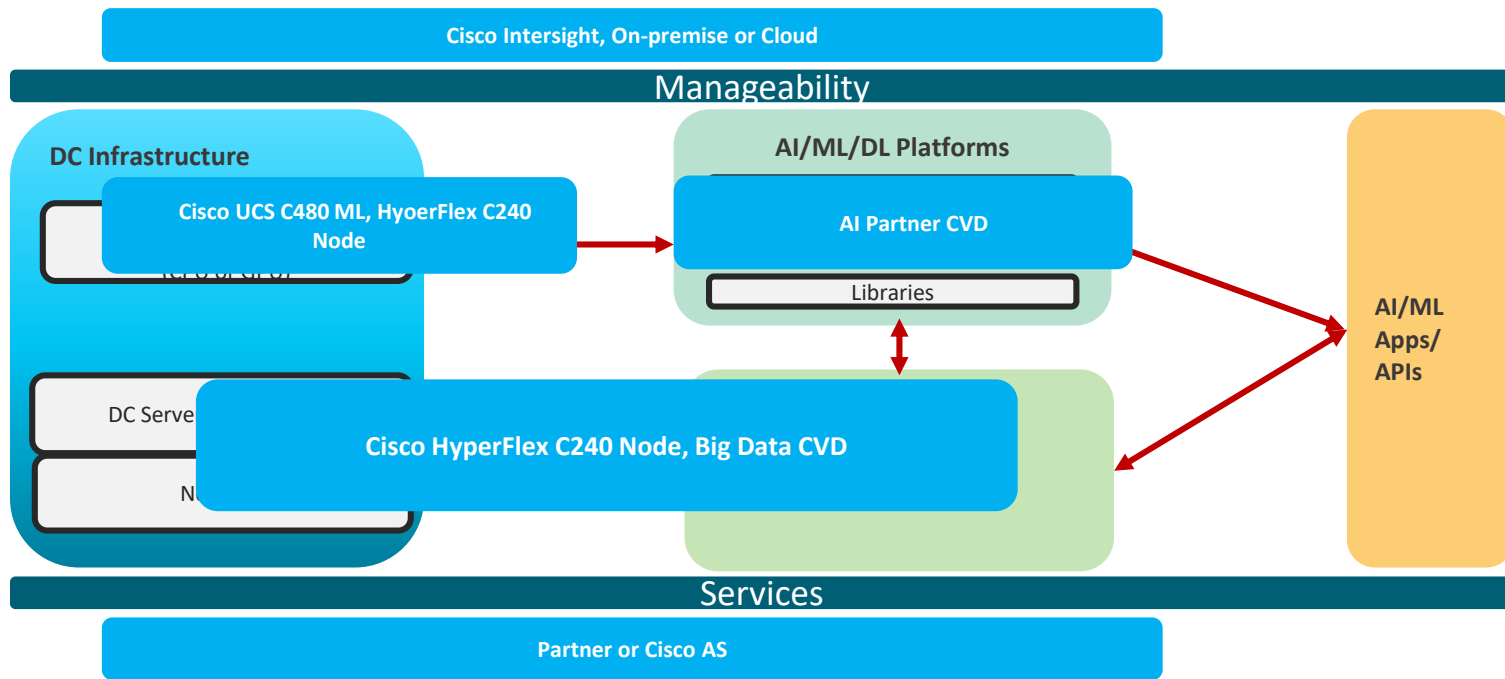**Container & KubeFlow**

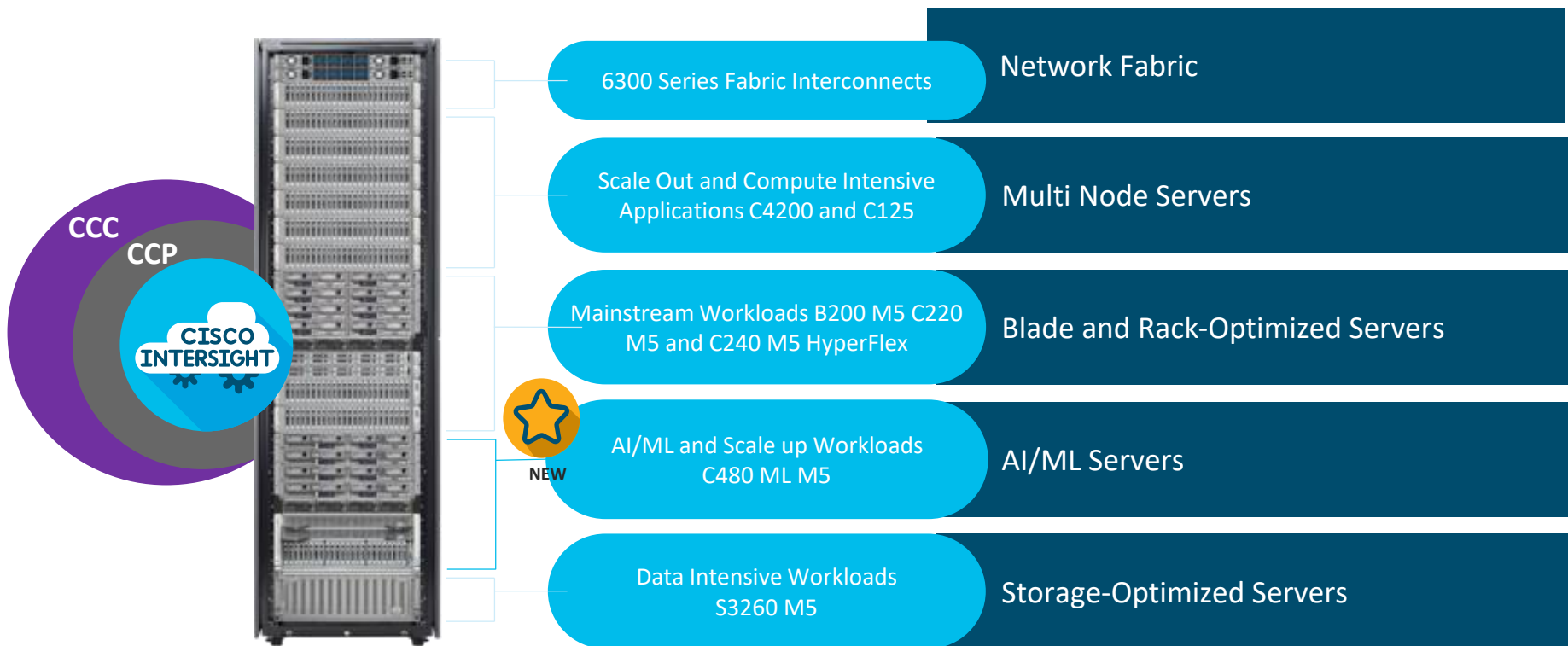**AI/ML Platform**

BUSINESS OUTCOMES

OEE Improvement

Reduced Downtime

思科的 AI / ML 方法

Data → Feature → Training → Inference

CISCO BRINGS

Full portfolio for all ML needs end-to-end

Experience delivering proven solutions With technology partners

Natural extension of existing data center infrastructure

思科人工智慧解決方案的建議

Cisco Intersight, On-premise or Cloud

Manageability

DC Infrastructure

Cisco UCS C480 ML, HyoerFlex C240 Node

DC Serve

N

AI/ML/DL Platforms

AI Partner CVD

Libraries

Cisco HyperFlex C240 Node, Big Data CVD

AI/ML Apps/ APIs

Services

Partner or Cisco AS

搭配好的示例：多雲世界中的 AI 架構

6300 Series Fabric Interconnects	Network Fabric
Scale Out and Compute Intensive Applications C4200 and C125	Multi Node Servers
Mainstream Workloads B200 M5 C220 M5 and C240 M5 HyperFlex	Blade and Rack-Optimized Servers
AI/ML and Scale up Workloads C480 ML M5	AI/ML Servers
Data Intensive Workloads S3260 M5	Storage-Optimized Servers

NEW

CCC
CCP
CISCO INTERSIGHT

Cloud Service eXchange
雲服務交換

WHAT IS IT

Platform for enabling data sharing and process optimization across Upstream/DownStream to maximize efficiency and quality

CHALLENGE

Globalization increases Upstream/Downstream dependency. Optimization of is required to meet customer delivery, customization needs.

"…any effort by a plant manager to fix a technical problem in one plant has the potential to make things worse… So most of our focus is in trying to make the total supply chain work."
– Tom Linebarger –CEO Cummins

CRITICAL NEEDS

- **B2B2C Portal**
- Single platform for both process and performance metrics
- Exposes excesses/shortages across the supply chain network
- Collaboration & tracking movement of inventory across nodes

CISCO PORTFOLIO

Cisco Multi-Cloud Service Exchange Platform

BUSINESS OUTCOMES

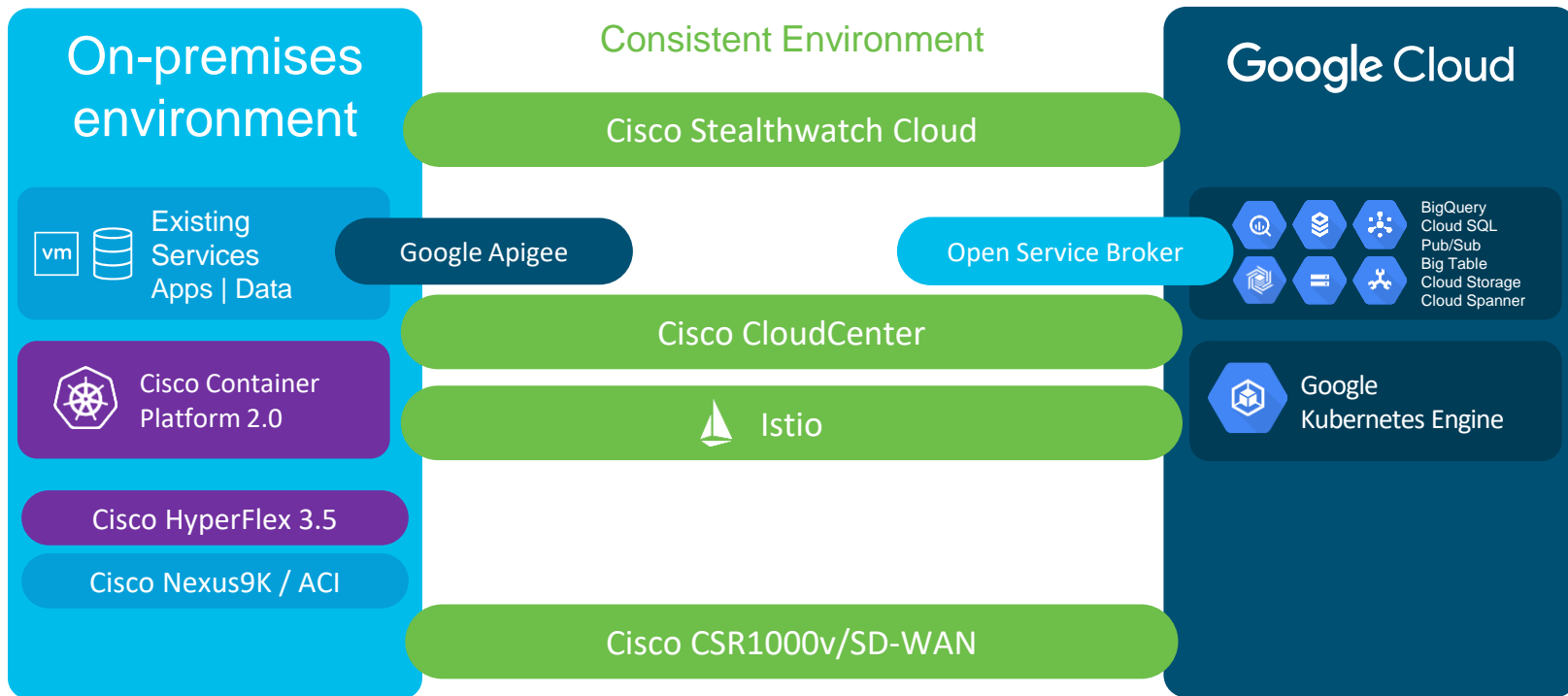Improved Inventory

NPI Improvement
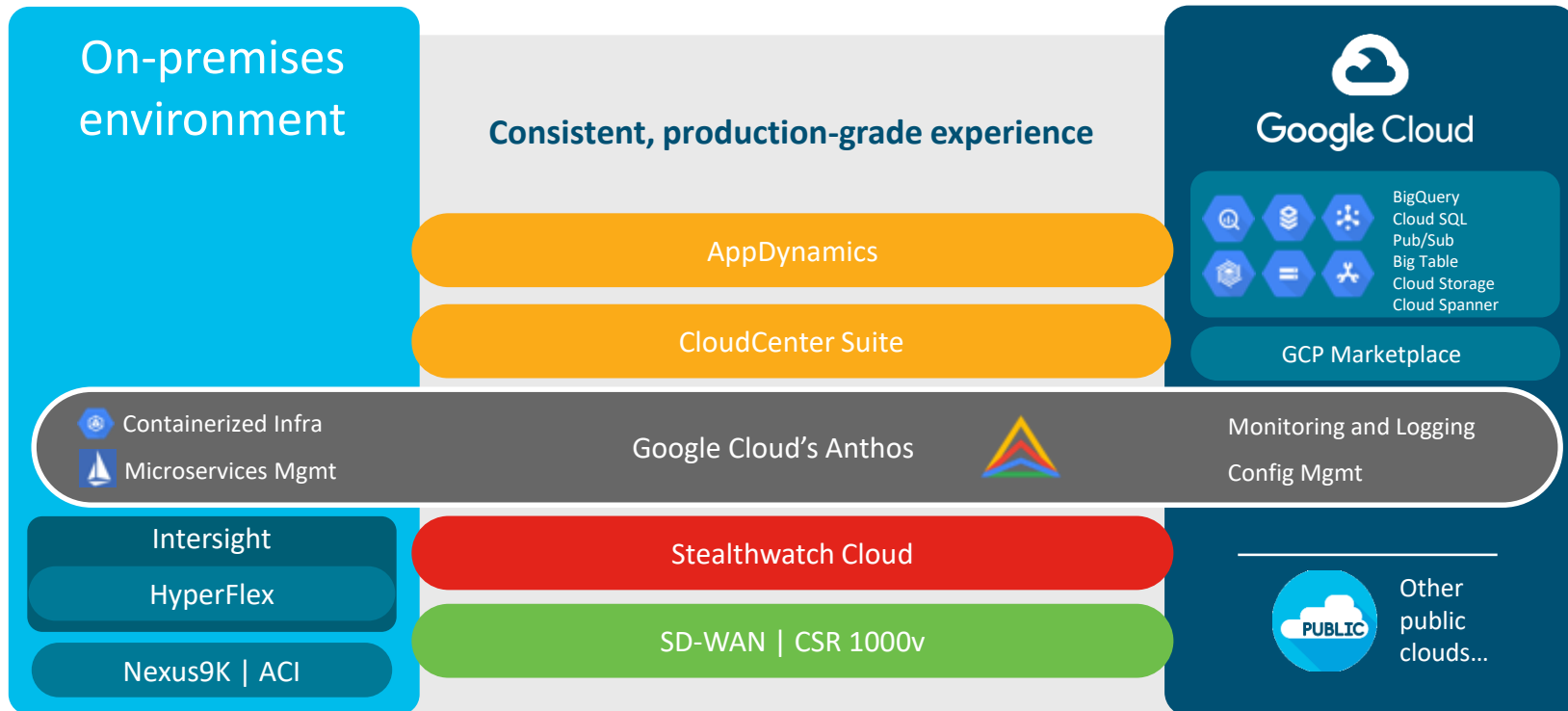
Reduced Downtime

Reduced Energy Use

Reduced Defects
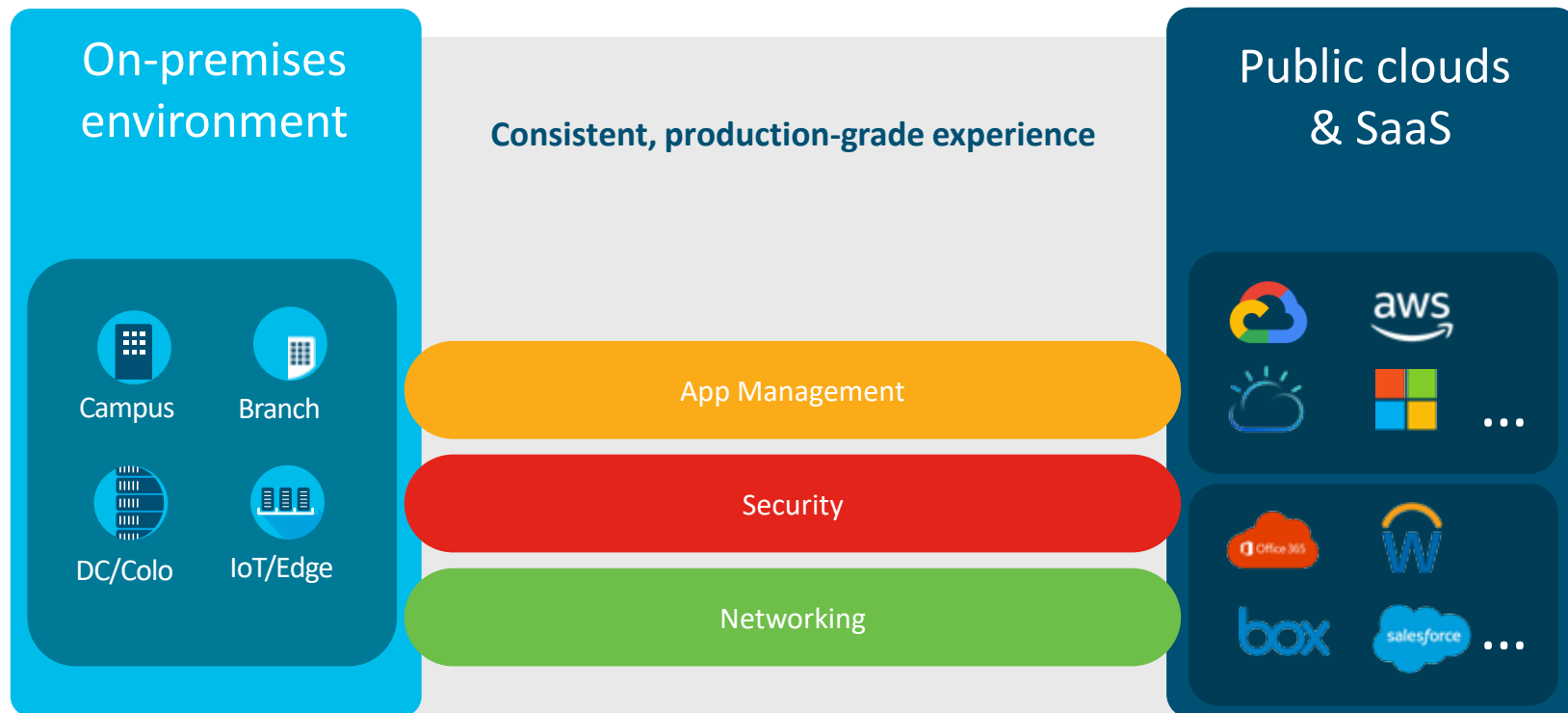
基於 HyperFlex 的 Cisco-Google 混合雲

On-premises environment

Google Cloud

Consistent Environment

Cisco Stealthwatch Cloud

Existing Services Apps | Data

Google Apigee

Open Service Broker

BigQuery
Cloud SQL
Pub/Sub
Big Table
Cloud Storage
Cloud Spanner

Cisco CloudCenter

Cisco Container Platform 2.0

Istio

Google Kubernetes Engine

Cisco HyperFlex 3.5

Cisco Nexus9K / ACI

Cisco CSR1000v/SD-WAN

基於 HyperFlex 的 Cisco-AWS 混合雲

On-premises environment

Consistent, Production-grade environment

aws

AppDynamics

Stealthwatch Cloud

Cisco CloudCenter

Elastic Container Registry

Cisco Container Platform

Identity and Access Management (IAM)

Amazon EKS

Cisco HyperFlex / UCS

Cisco CSR1000v/SD-WAN

EC2 / EBS

Cisco Nexus9K / ACI

VPC

Legend:　　Optional　　Mandatory

基於 HyperFlex 的 Google Anthos 混合雲

On-premises environment

Consistent, production-grade experience

Google Cloud

AppDynamics

CloudCenter Suite

BigQuery
Cloud SQL
Pub/Sub
Big Table
Cloud Storage
Cloud Spanner

GCP Marketplace

- Containerized Infra
- Microservices Mgmt

Google Cloud's Anthos

Monitoring and Logging

Config Mgmt

Intersight

HyperFlex

Stealthwatch Cloud

SD-WAN | CSR 1000v

Nexus9K | ACI

PUBLIC

Other public clouds…

SXP − An B2B2C Portal

Internal Users

External Users

Service Gateways

Private Clouds

Public Clouds

SXP

API Management

System of Engagement

Portal as a Service

Marketplace Services

B2B Integration Brokerage

InData

Service Orchestration

Identity & Access Management

API Management

Devices Inside & Outside Corporate Environments

Service Gateways

Enterprise Applications

salesforce.com

workday.

3rd Party Cloud Services

Collaboration
協作

WHAT IS IT

Video, Voice and Digital Signage Solutions that Enable Business Collaboration

CHALLENGE

Experts in remote locations and need for design and engineering collaboration. Visibility to key metrics on the plant floor

CRITICAL NEEDS

- **Remote Expert Access**

- Real-time visibility to plant metrics

- Cost effective voice communications

CISCO PORTFOLIO

- Cisco IP Video

- Librestream Virtual Collaboration

- Rugged VOIP Phone Systems

- Digital Signage

- Webex

BUSINESS OUTCOMES

OEE Improvement

Reduced Downtime

工業級協作平台

Cisco Instant Connect

On-Premise Push-To-Talk for the Connected Factory

- "Always on" mobile communications
- Wireless, ruggedized IP Phones
- Wireless access points and controller
- Android Smartphones
- Leverage Connected Factory Wifi

Connected Factory Benefits

Reduce operational costs while improving communications and OEE response

- No recurring monthly service fees
- Convert rising cellular OPEX to CAPEX
- Connect staff with unified devices
- Virtual on-site services give fast response and control

Connected Factory ROI

Size of Business	Group/Individual PTT Users	Estimated ROI vs. 2-5 year typical contract costs
Small	10 to 25	2 years
Medium	26 to 100	1 Year
Large	100 or more	6 months

迎向 2020 數位製造新時代，思科數位化轉型架框下的創新

數位化製造與工業 4.0, 思科數位化轉型架框與創新, **結論與案例**

工業 4.0 的九大支柱

Big data
Digital twin
Cloud computing
Internet of things

Additive Manufacturing
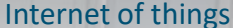
End-to-End Cyber Security

Systems Integration

Connected Assets

Autonomous Robots

Co-Botics

AGV

工業 4.0 – 思科和九大支柱

Big Data

組織正在或將要創建大量未被利用的數據。該數據可用於為業務改進和增長釋放價值。

示例：在 Lordan 部署了Cisco Kinetic, 以使用本地化數據幫助提高OEE性能。

Augmented Reality

向工作人員提供其他可視數據, 以幫助改進流程和產品。一個例子是使用已連接的眼鏡, 以幫助操作員正確地安裝組件。將虛擬現實提升到一個新的水平, 它可以測試人體工程學之類的東西而無需建立實體連接。

Ciscoi Webex Teams 與 RealWear 和客戶一起在遠程專家場景中完成 AR 解決方案。

Simulation/Digital Twin

在虛擬世界中討論新想法可能比構建物理原型更具成本效益。此處的一個示例是在CAD系統上模擬生產線/流程, 以在實時部署之前進行測試。

示例：Cisco UCS 與鹿特丹港通過創建數字雙胞胎來改善港口運營.

Internet of Things

互聯網連接設備的快速增長帶來待開發的新數據。例如, 部署傳感器以監測資產狀況或能源使用情況。

示例：帶有 Mazak 的思科工業交換機提供資產狀態監控, 性能提高17%。

工業 4.0 – 思科和九大支柱

Cloud Computing

通常使用第三方託管服務來降低成本和復雜性，同時提供靈活性和可擴展性。這裡的一個示例可能是將雲計算服務用於定期測試工作流，而不是構建內部服務器基礎結構。

示例：思科UCS與一家光學設備製造商合作，以安全地從遠程機器捕獲數據並將其傳輸到基於雲的分析引擎。

Cyber Security

所有這些新的互連系統都必須得到充分保護，以防止不必要的入侵。這可能包括增強的防火牆，惡意軟件檢測和網路切分。

示例：為 SugarCreek 開發和部署了一個端到端的思科安全體系結構。

Systems integration

更好地連接系統和硬件，以共同推動價值增長。思科互聯製造基礎架構和 CPwE (思科驗證設計)

Additive Manufacturing

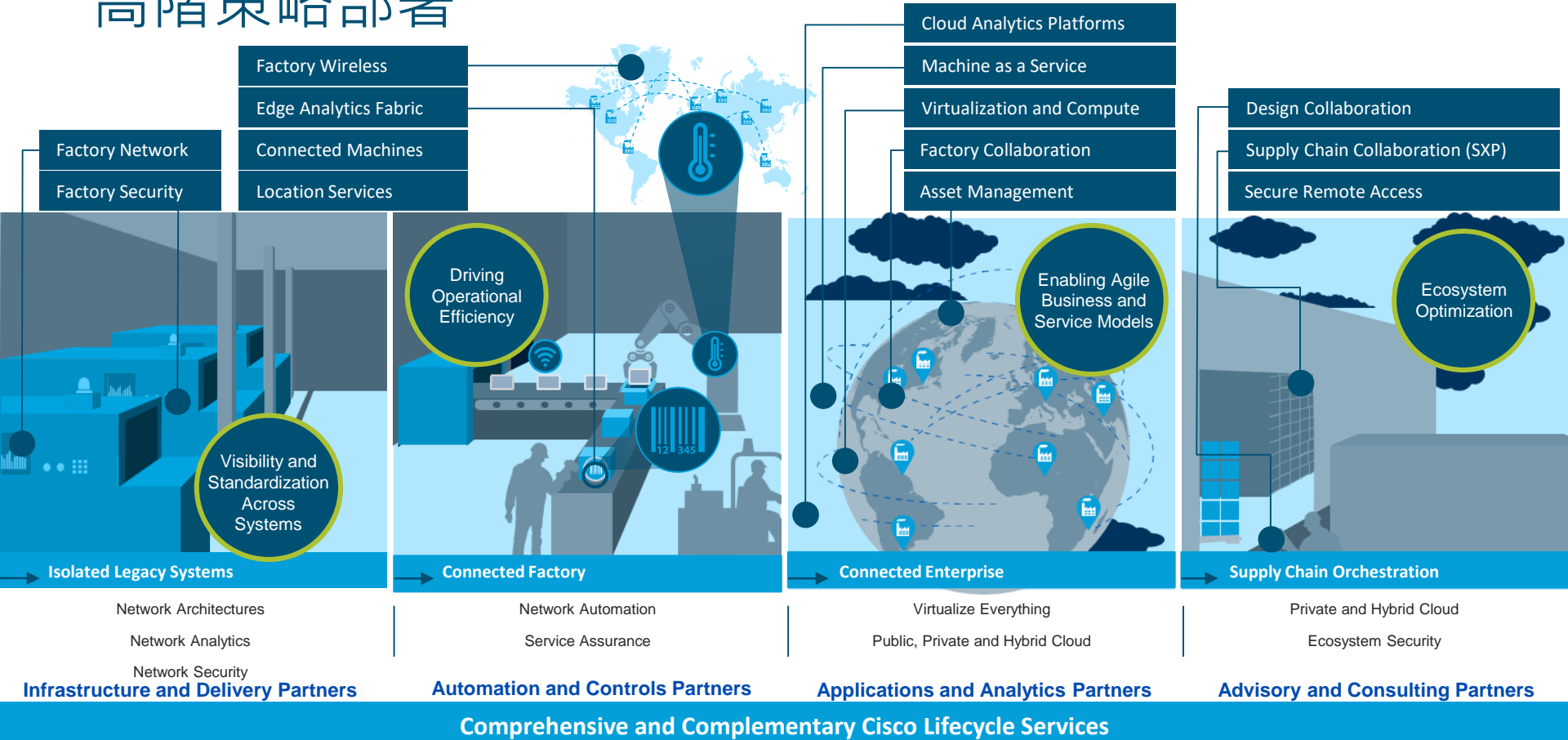使用 3D 打印機可以使組件更快，更輕且更便宜。增材製造還可以用於維護和維修業務，在該業務中，替換零件可以在本地製造，而不是從源頭運送。

示例：思科 IT/OTaaS 架構可以提供客製化的服務。

工業 4.0 – 思科和九大支柱

Autonomous Systems

諸如機器人技術和人工智能之類的技術已經發展到這樣一個階段，即系統可以根據任務進行獨立操作而無需頻繁的人為干預。這可以是製造機器本身，也可以是工廠內的交付平台，例如工廠內的自動駕駛載台。

示例：在 Cutter＆Buck 部署 Cisco 網路基礎架構以支持機器人縫紉機。

思科工業物聯網網路產品組合

Industrial Switching

IE 1K,2K,3K,4K,5K, CGS

IoT Gateways
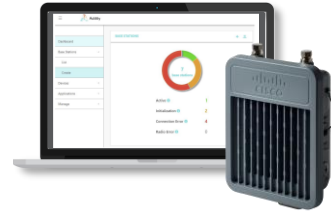
819-MNA, IR807, IR809, IR829

Industrial Routing

ASR 902U/903U/920U,
CGR 1000, CGR 2000

Cisco Resilient Mesh

IR500, DevNet

Low Power Wide Area Wireless

LoRaWAN
IXM Gateway

Industrial Wireless

AP1552, IW3702

Industrial Security

ISA 3000

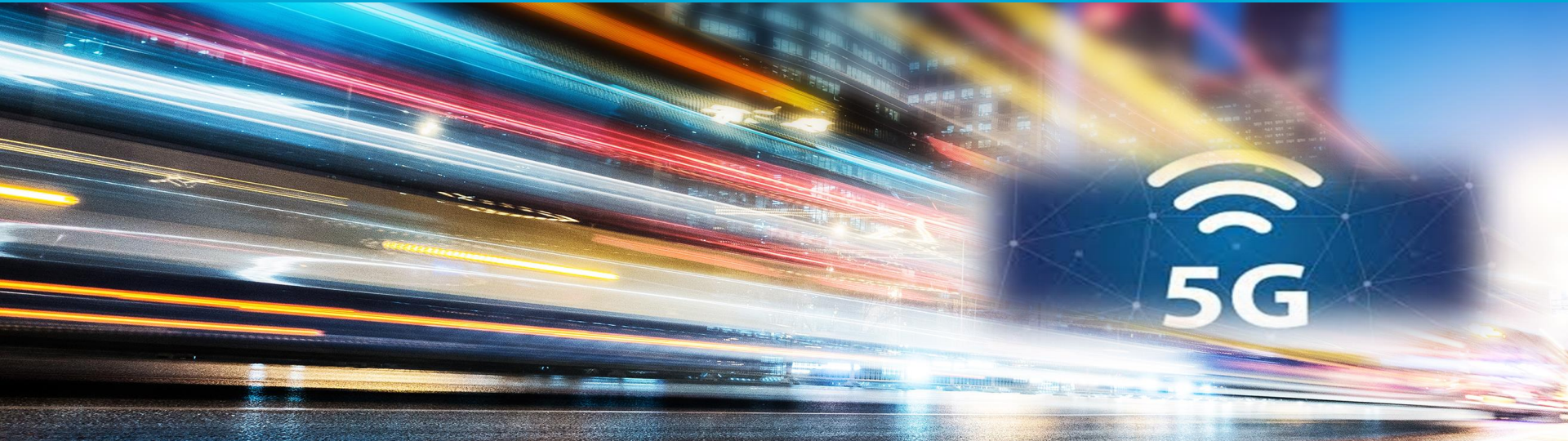## Embedded IoT

ESS, ESR

Edge Computing

IOx
IC 3000

Management & Automation

Field Network Director
Industrial Network Director

Thanks