Cloud Evolution and Revolution
Catering for Mission Critical Workloads

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NLUUG najaarsconferentie 2018

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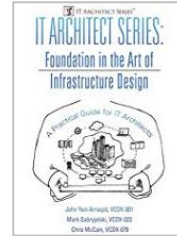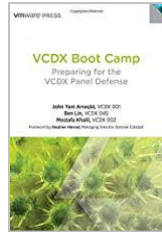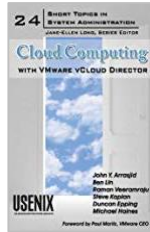
Introductions and Definitions

Goedemorgen and Introductions

John Yani Arrasjid, Virtustream

Author, Speaker, Inventor, IT Architect, Cloud Architect

IT ARCHITECT SERIES™

*Elastic Sky
Hypervisors
Silk Road
Ritmos de Flamenco
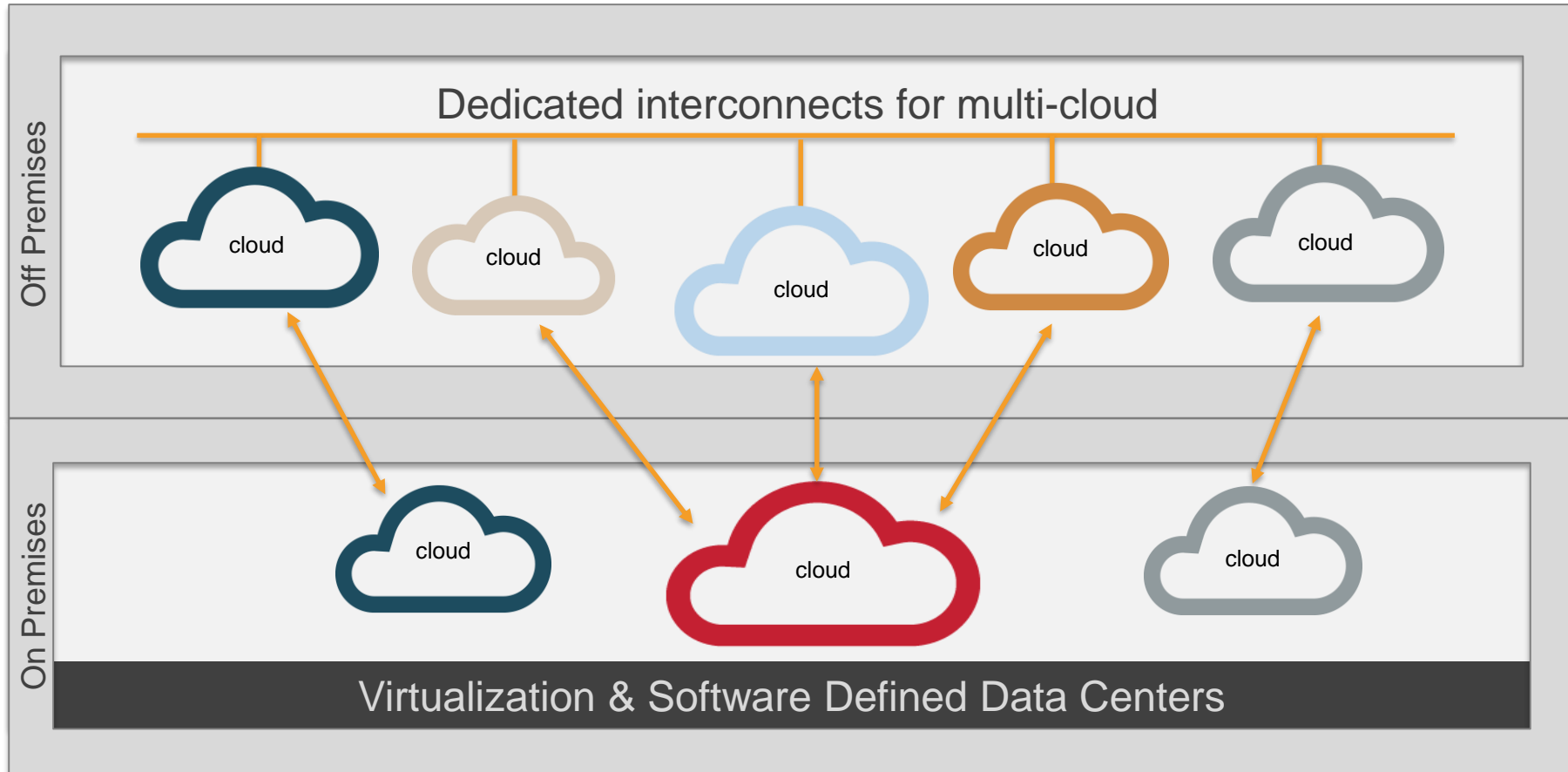The Verandah*

@vcdx001

Agenda

- Today
- Tomorrow
- Roles and Relationships
- Predictions
- Q&A

Cloud Evolution

IoT Mission Critical Workloads

Characterization of Mission Critical Workloads

Characterization	Example	
High availability SLAs	Five 9's availability of a mission critical workload. i.e. redundancy, replication, DTS tech, and managed services	
Assured performance	Right sizing of infrastructure components for a running workload, while removing resource contention.	
Integrated backup with application	Application has a backup and recovery mechanism, reviewed and tested regularly.	
High security, regulatory requirements	PCI DSS COMPLIANT HIPAA Compliant CSA cloud security alliance ISO 27001 Certified FedRAMP AICPA SOC 2 NIST National Institute of Standards and Technology U.S. Department of Commerce	
GEO compliance requirements	Automated prevention using policy engine settings for networking, such as with VMware NSX-T and NSX-V.	

Enterprise Expectations

- Performance
- Availability
- Security/Compliance
- Scalability
- Economics
- Management Services

Trends and New Mission Critical Workloads

New Mission Critical Workloads for Cloud

What does the future hold?

Artificial intelligence

Chatbot

Machine Learning

Internet of Things

Cryptocurrency

Augmented Reality

Data Provenance

Robot Assistants

Block chain

Deep learning

Cyber security

Big Data
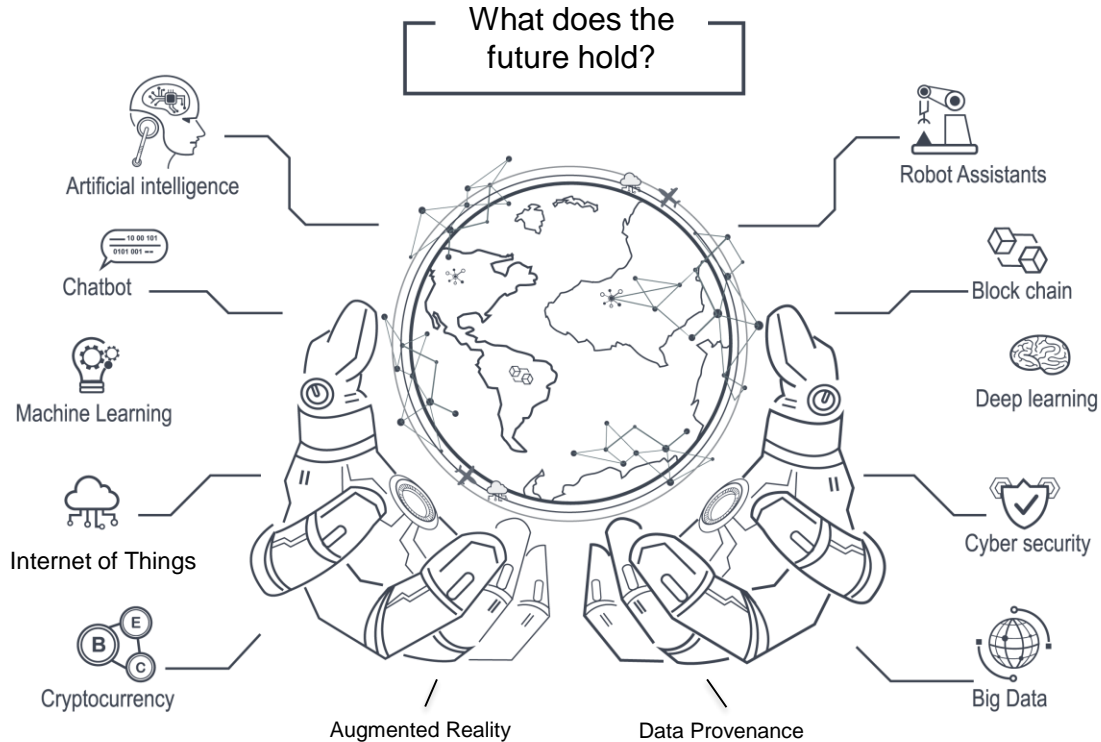
SMART GRID
ELECTRICITY SUPPLY NETWORK
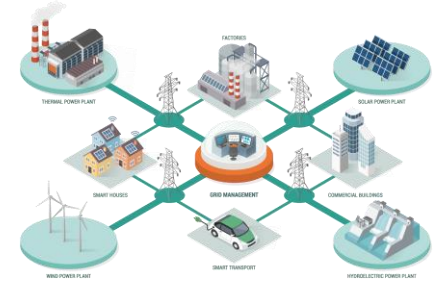
Industrial Internet of Things
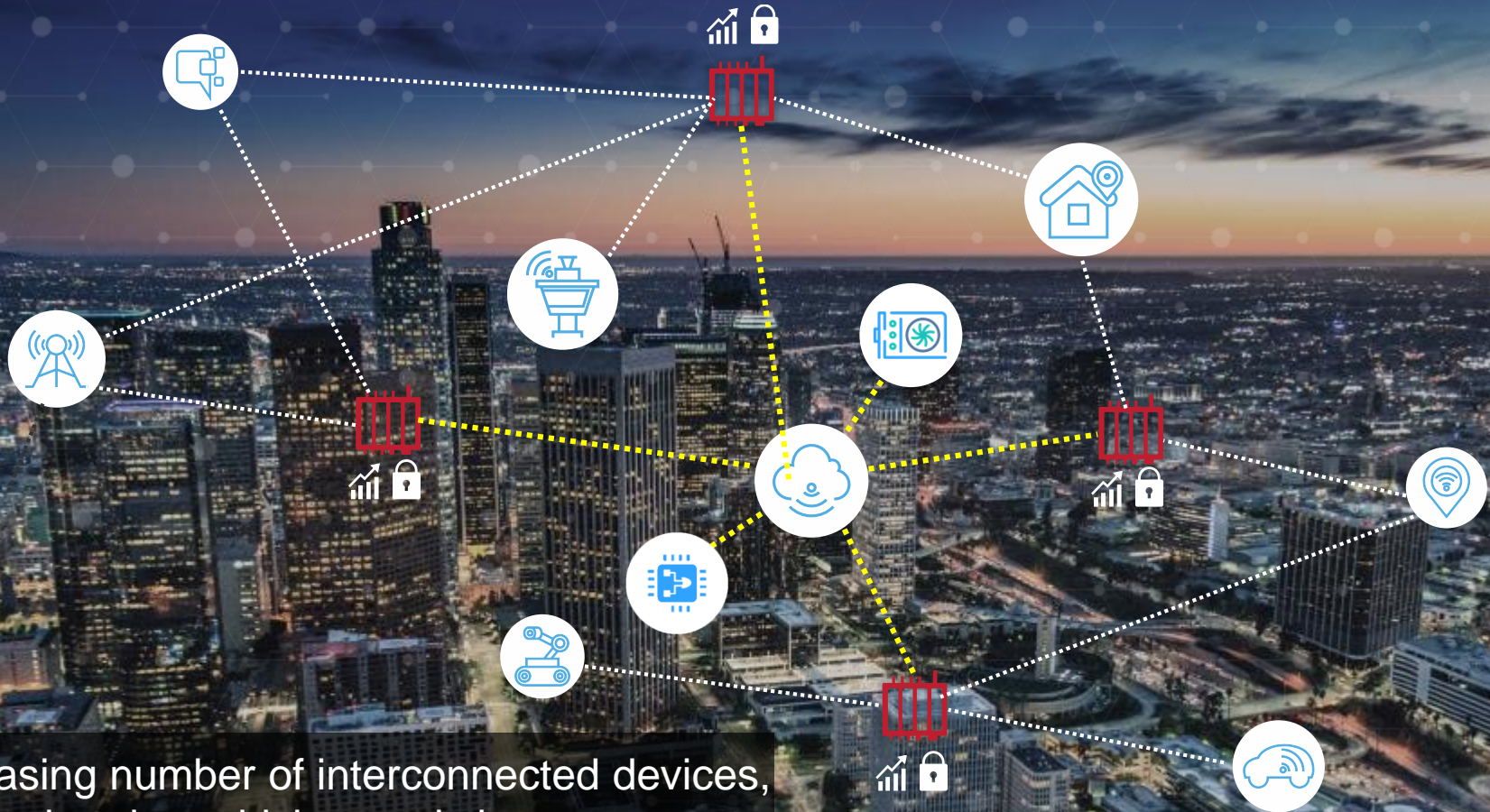
Increasing number of interconnected devices, generating data, driving analytics

Analytics, AI, Genomics, Cloud Robotics, …
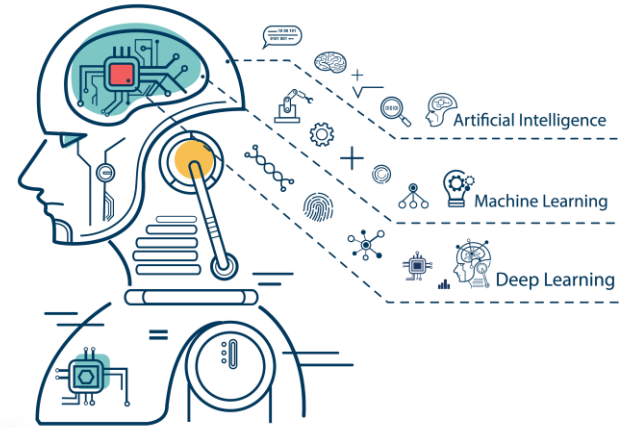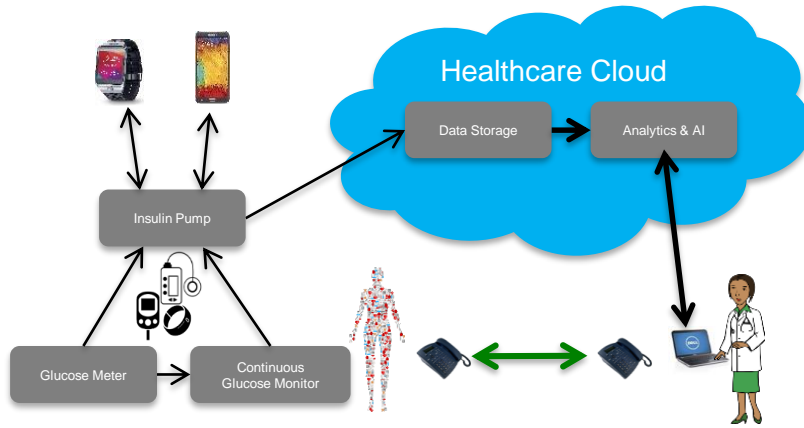
Enterprise Distributed Secure Ledger

San Diego Supercomputer Center Opens New BlockLAB Research Laboratory

| Blockchains | Distributed Ledgers | Digital Transactions | Smart Contracts |

Non-Crypto Currency Blockchain

Example: VMware SBFT (Athena/Concord)

BLOCK CHAIN

DIGITAL LEDGER

Transportation, Mobility

Edge Gateways
(intermediate processing)

Data and Analytics

Data Storage → Analytics & AI → User Interface

Vehicular Cloud

Transportation systems

Environmental Factors

Environmental factors
Weather, Traffic,
Construction

Check schedules, make
reservations and payments
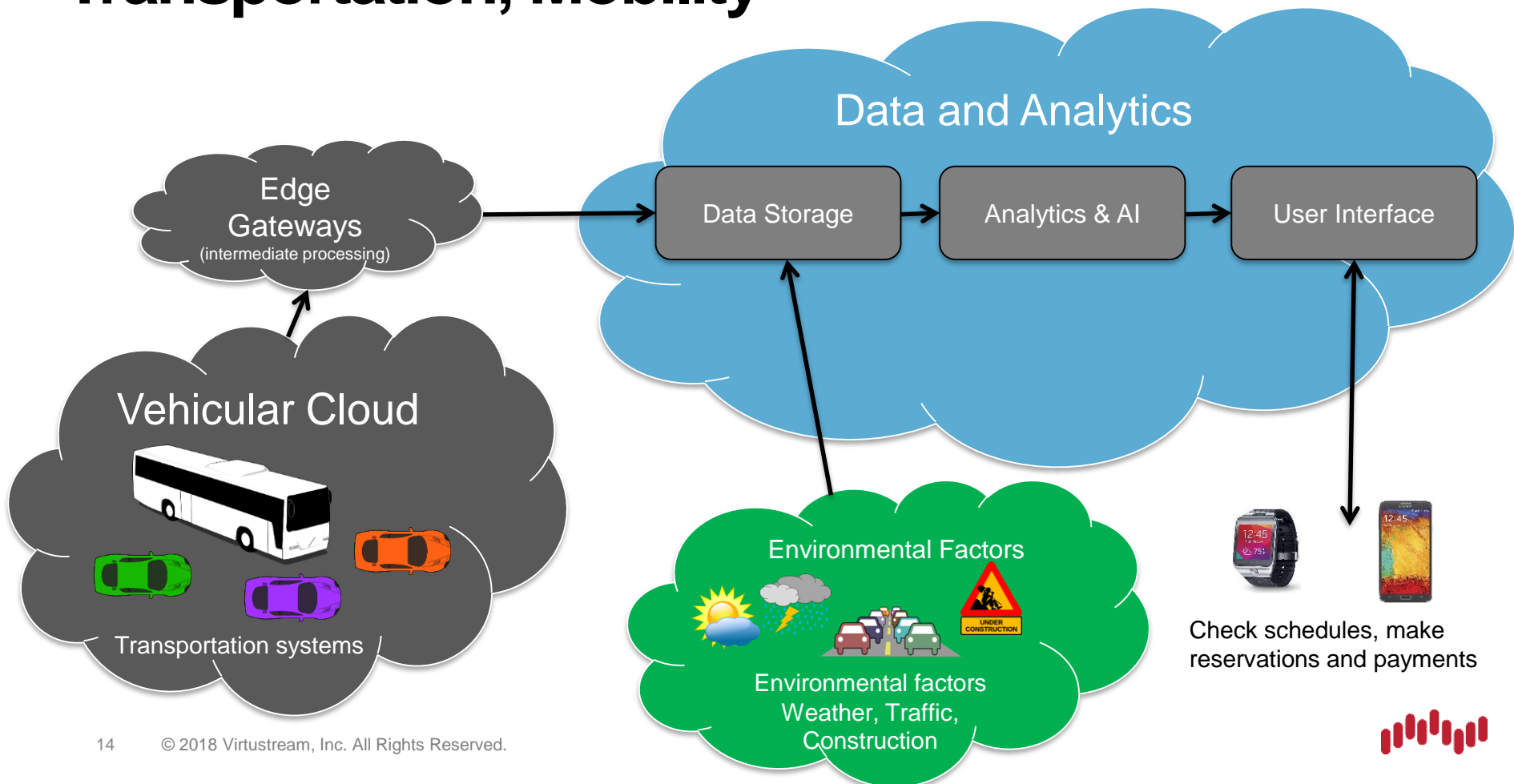
Security Monitoring & Control, from Edge to Cloud

Edge Gateways
(intermediate processing)

Devices

Data and Analytics

Data Storage

Analytics & AI

User Interface

Reference information

Identity approved for access
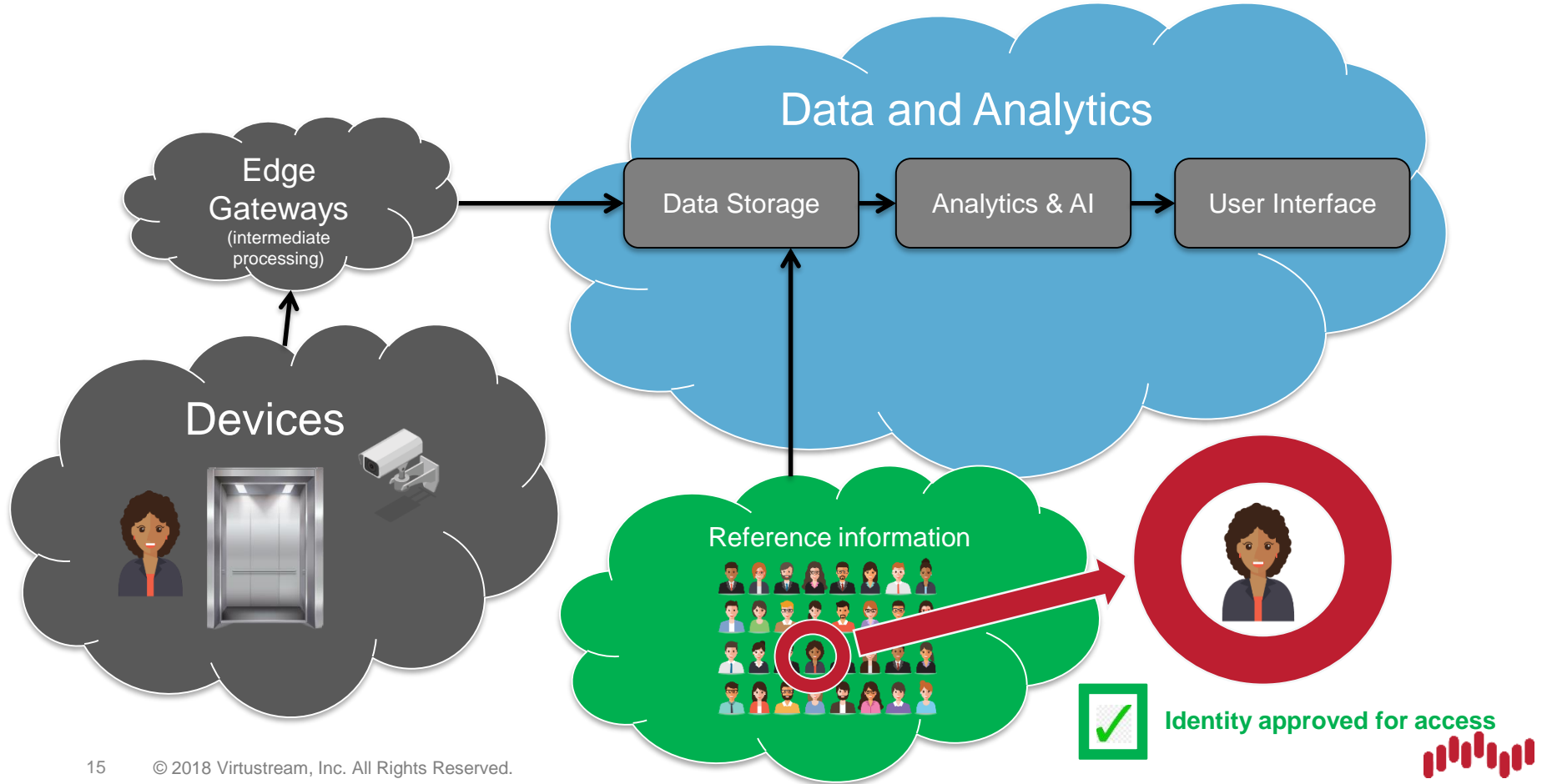
Future Proofing Proactive Patient Care

Non-medical devices to view data from devices or from the cloud

Data and Analytics

Data Storage → Analytics & AI → User Interface

Insulin Pump

Glucose Meter → Continuous Glucose Monitor
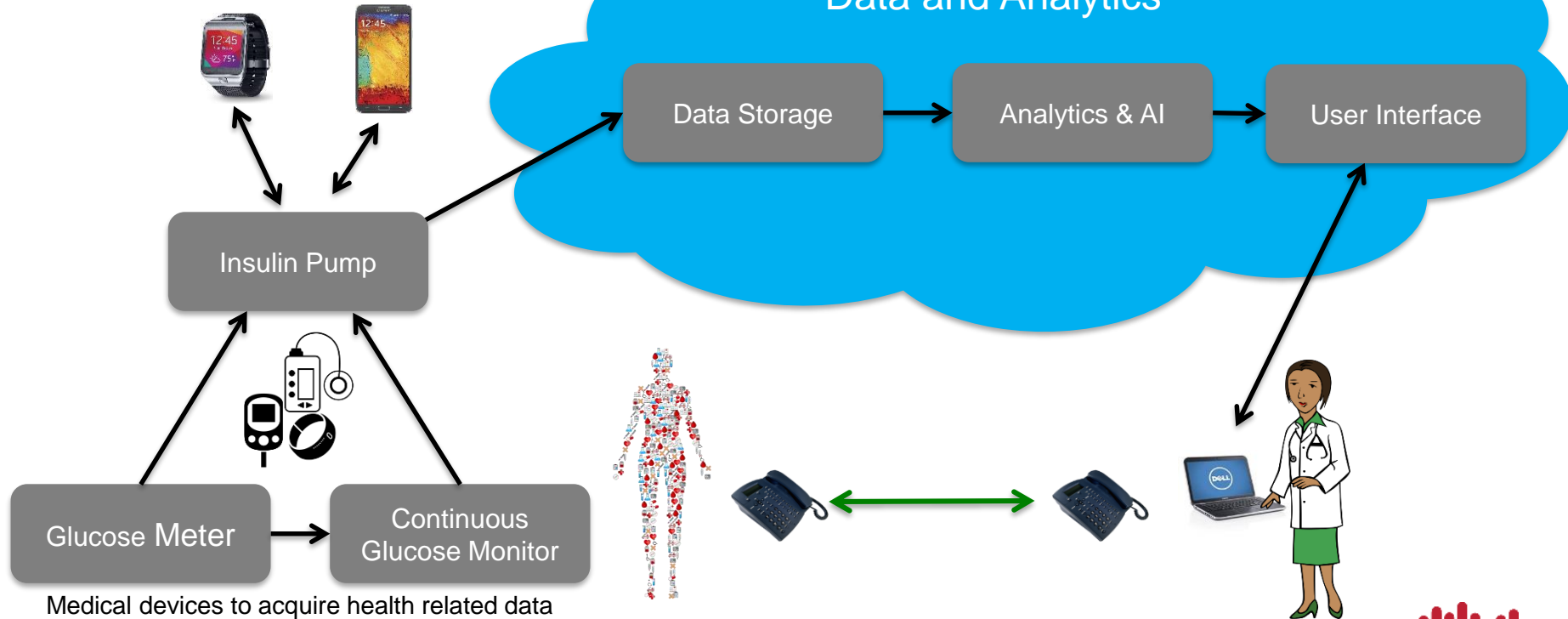
Medical devices to acquire health related data

Future Proofing Proactive Patient Care

Additional Healthcare IoT devices used together for better correlation between cause and effect

Supporting combination of correlation, inference, and reference healthcare information
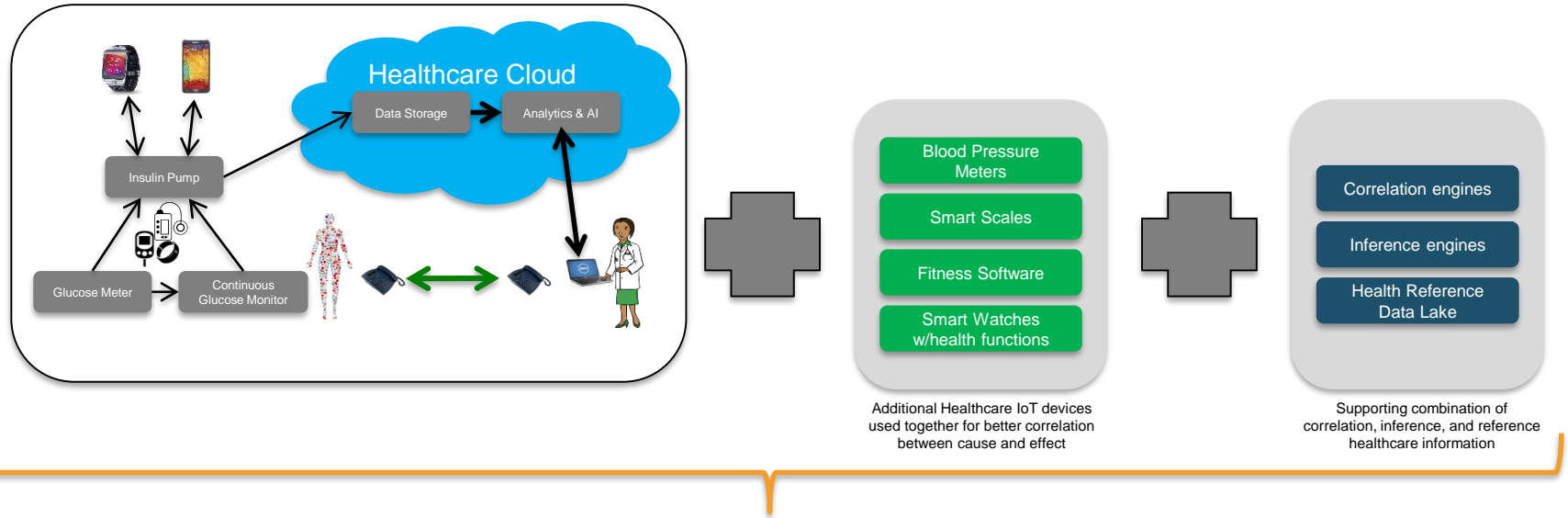
- Increases **pro-active** patient care.
- Correlation engines and inference engines used to **alert a doctor of risk of patient medical complications**.
- Can recommend **extra services based on changing patient conditions**, that will **drive better lifestyle choices**.
- Ability to **analyze patient data** and **assign a baseline** or "score card" so that overtime if a patients score hits a threshold doctors can **take action to prevent critical events** from occurring.

AI Data Flows

Where does cloud fit?

Unknown IoT data for AI engine to provide the next state recommendation

7

Devices (sensor, actuators) **1**

Edge Data

Edge Gateway + Analytics **2**

Data Collection & Storage of Training Data **3**

Deep Learning Training (machine learning algorithms) **4**

Classifier or Inference Engine **5**

Prediction (inference results) **6**

Cloud for Edge Components

Cloud for Data Storage (Systems of Record)

Cloud for Accelerators (Systems of Engagement)

Platform for AI-as-a-Service – Architecture Components

AI Module Library

Telemetry & Reference Data

Cloud for storage of data

AI Model Library / Repository

Platform for AI-as-a-Service

Interface

Deep Learning Model

Cloud for accelerators handling advanced analytics

Deep Learning Model
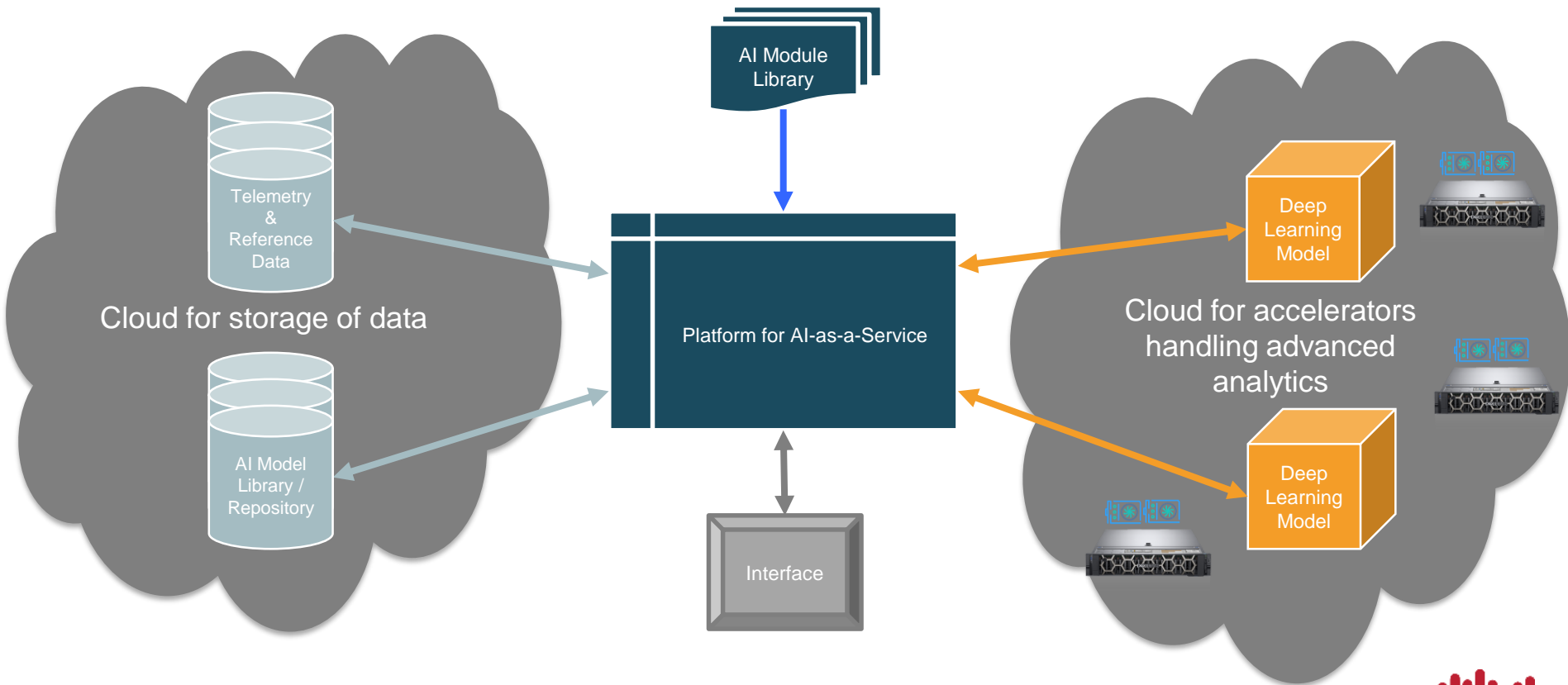
New Compute Elements for Cloud

New HW/SW Elements for Cloud

Software Defined (SDx)

SDI	SDN	EDSL	SDS	FaaS
Software Defined Infrastructure	Software Defined Networking	Enterprise Distributed Secure Ledger (SBFT Blockchain)	Software Defined Storage	Function as a Service

Compute & Memory

GPU
Graphics Processing Unit

VPU
Vision Processing Unit

TPU
Tensor Processing Unit

FPGA
Field Programmable Gate Array

Custom ASICs
Example: Deep Neural Network ASICs

NVRAM

PMem

Storage, Network

SSD

NVMe

100G wired networks

Hybrid Storage Models

M.2 Boss Devices

Smart NICs

5G wireless networks

Evolution of Cloud Roles and Relationships

Roles and Responsibilities

Team Members

Operational Technology (OT)
Protect Revenue Generation

Information Technology (IT)
Protect the Environment

Engineers/Technicians/Operators/Managers

- Standalone apps in support of industrial & environmental monitoring and control
- Closed, proprietary architecture model
- Custom: Event driven, real time, embedded hw/sw
- Control networks, IP based LAN
- Control or monitor physical processes and equipment

CIO/IT

- Interconnected enterprise apps & workers
- Open, standards-based architecture model
- Generic: Enterprise wide infrastructure & apps
- Corporate network, IP based WAN, Multi-Factor Authentication
- Process transactions and provide information

Example IoT Cloud Architecture - IoT Edge Operations and Connectivity
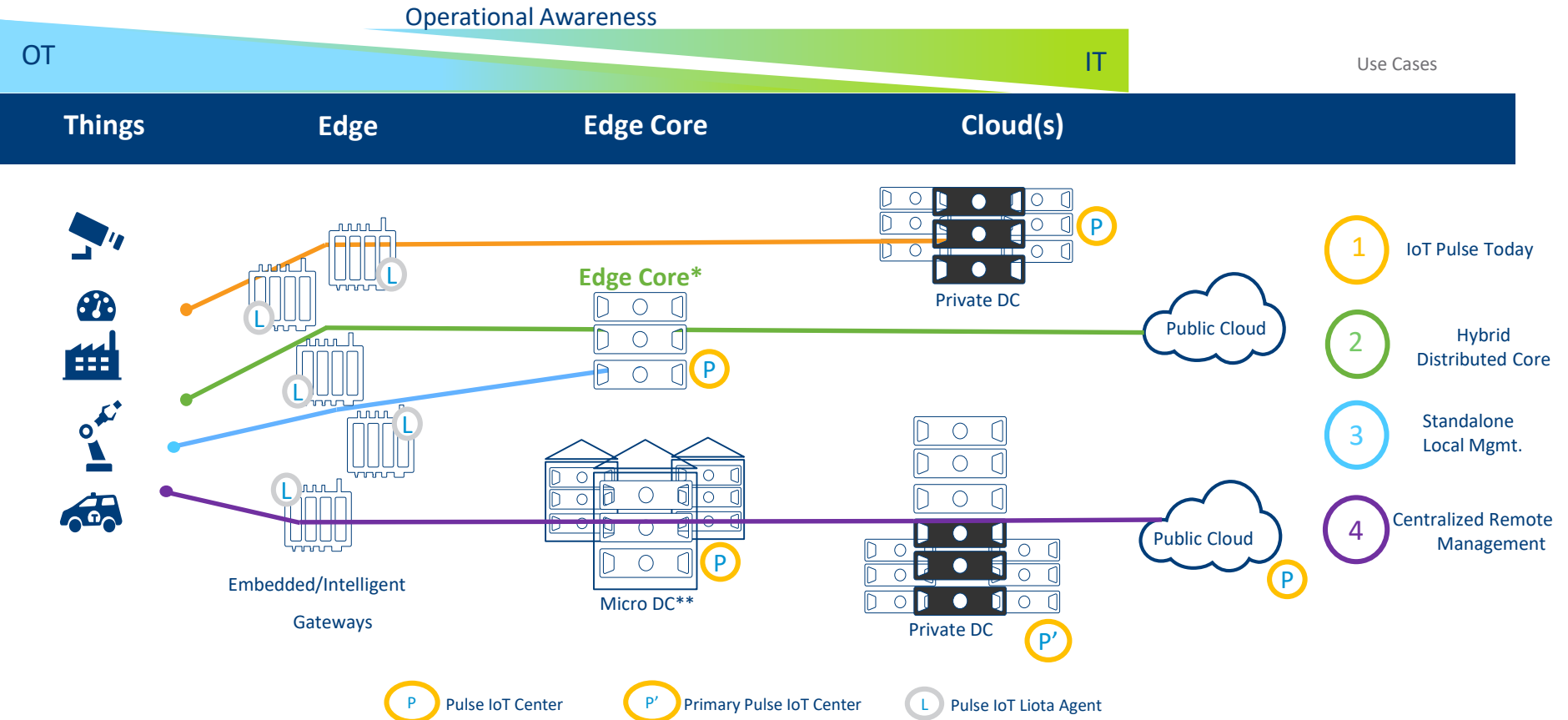
The Future

The Future of Cloud for Mission Critical Workloads

Increased AI workloads (Deep Learning for training & inference)

Increased use of Cloud in support of Industrial IoT

Cloud extensions to support workloads at the Edge

Specialized clouds for specialized classes of mission critical workloads
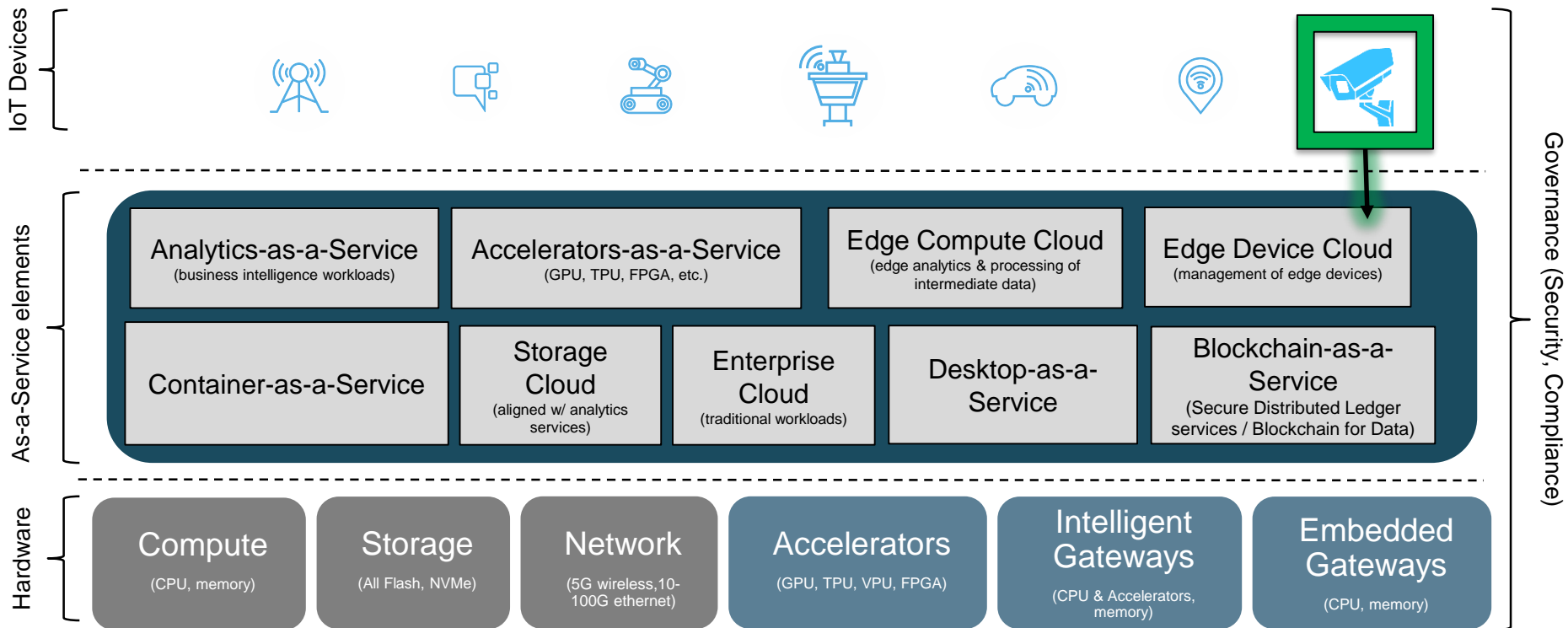
Accelerators will dominate for specialized functions

Increased adoption of higher speed memories; low-latency/high-bandwidth connections between memory & accelerator

Increased wired (100gE+) and wireless (5G) bandwidth, supporting greater data flows between data generation (Edge) and analytics (Edge compute to datacenter and cloud)

Tomorrow's Conceptual Architecture

IoT Devices

As-a-Service elements

| Analytics-as-a-Service (business intelligence workloads) | Accelerators-as-a-Service (GPU, TPU, FPGA, etc.) | Edge Compute Cloud (edge analytics & processing of intermediate data) | Edge Device Cloud (management of edge devices) |

| Container-as-a-Service | Storage Cloud (aligned w/ analytics services) | Enterprise Cloud (traditional workloads) | Desktop-as-a-Service | Blockchain-as-a-Service (Secure Distributed Ledger services / Blockchain for Data) |

Governance (Security, Compliance)

Hardware

| Compute (CPU, memory) | Storage (All Flash, NVMe) | Network (5G wireless,10-100G ethernet) | Accelerators (GPU, TPU, VPU, FPGA) | Intelligent Gateways (CPU & Accelerators, memory) | Embedded Gateways (CPU, memory) |

Innovate

- Declarative infrastructure, based on defined backend policies by the enterprise (infrastructure as code)

- Secure distributed ledger for data provenance

- Cloud orchestration models for new mission critical cloud workloads

- Investigate the relationship between technology advances and society
  - How can tech help?
  - How can tech hurt?
  - Think automation driven by AI
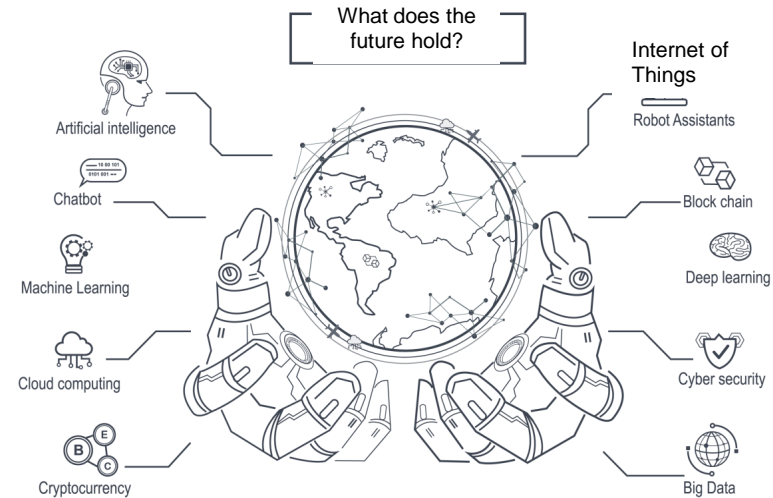
Virtustream – Background

- Virtustream is focused on **mission critical applications in the cloud**

- Utility based measurement and billing based on consumption

  - Virtustream MicroVM (µVM) consumption based utility measurement and billing for compute, networking, and storage

  - Equivalent Virtustream consumption based utility measurement and billing for accelerators like GPUs

- Virtustream uses **Automation and Managed Services** to support **higher SLAs** for mission critical workloads. This will be applied to our AI solutions in the future.

Characteristics of IT vs. OT

Characteristic	Informational Technology (IT)	Operational Technology (OT)
Ecosystem	Dynamic "fluid technology stacks"	Deterministic "as designed, binary"
Owner	CIO and IT	Engineers, technicians, operators, and managers
Goals	Protect the environment	Protect revenue generation
Priority	Confidentiality first (Confidentiality, Integrity, Availability)	Control equates to Safety (Control, Availability, Integrity, Confidentiality)
Function	Support of enterprise apps and workers	Support of industrial and environmental monitoring and control
Scope	General	Specialized based on use cases
Control	Data	Process
System Approach	Interconnected applications	Standalone apps
Architectural Model	Open, standards-based Generic: Enterprise wide infrastructure & apps	Closed, proprietary Custom: Event driven, real time, embedded hw/sw
Connectivity	Corporate network, IP based WAN, Multi-FA	Control networks, IP based LAN
Purpose	Process transactions, provide information	Control or monitor physical processes and equipment
Interfaces	GUI, web browser, terminal and keyboard	Sensors, actuators, and other devices
Examples	ERP, CRM, Business Intelligence	MES, SCADA, ICS