



**HIGHWAY**



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# Smart Factory of the Future:

Private 5G + Mobile Cloud = Industry 4.0 Automation

**intel.**

#IntelAIatExplore



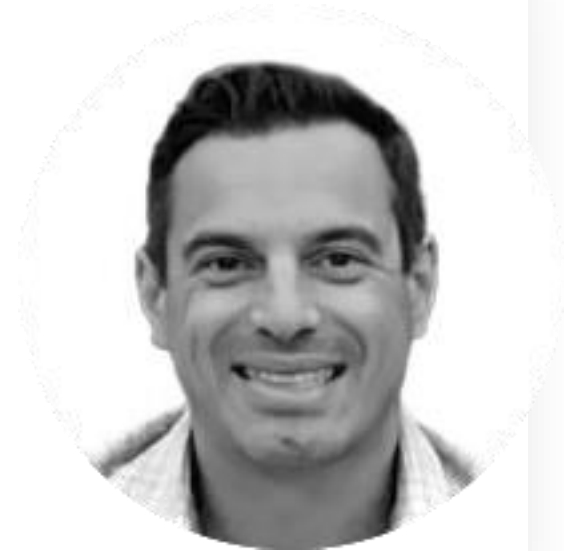
# Speakers



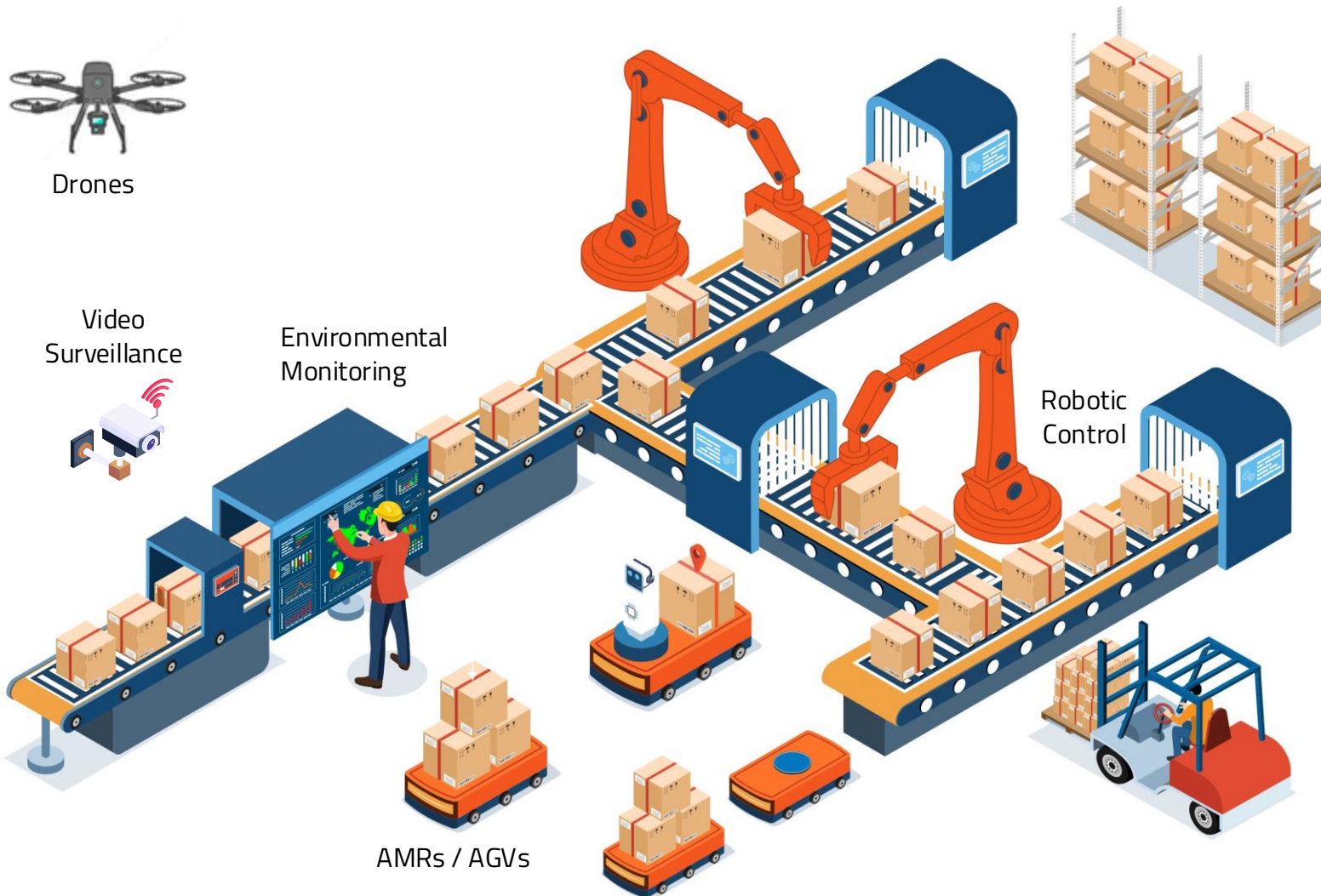
**Edwin Verplanke**  
Sr Principal Engineer



**Serge Maskalik**  
Co-Founder



# Industry 4.0 Challenges



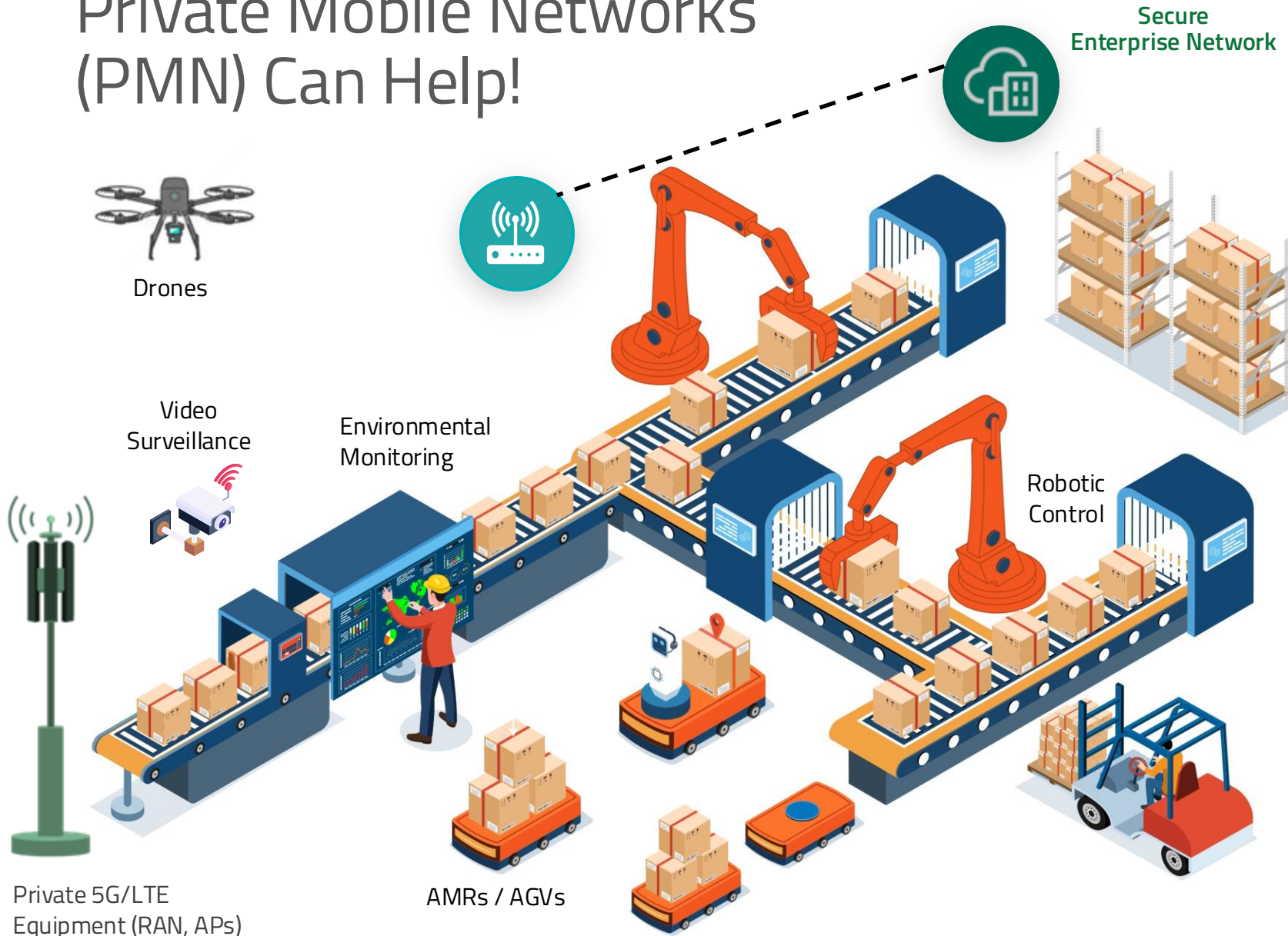
## POWERING NEW APPLICATIONS

- Autonomous Mobile Robots (AMRs)
- Automated Guided Vehicles (AGVs)
- Drones
- Smart warehousing

## INTEGRATING VARIED HARDWARE

- New and legacy
- Indoor and outdoor
- Scalability
- Interference
- Clutter
- Ever-changing plant floor plans

# Private Mobile Networks (PMN) Can Help!



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- Reliable mobile connectivity
- Indoor + outdoor coverage
- Seamless IT and telco integration
- Full operational visibility

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# PMN for Factories: How & Why

- Indoor deployment across the manufacturing plant
- Optimized for equipment mobility and factory clutter
- Easy to operate: AI-powered and cloud managed
- Integrated with existing enterprise networks





# PMN for Factories: Case Study

## Customer pain points

- Lack of reliable coverage indoor + outdoor

## Use cases

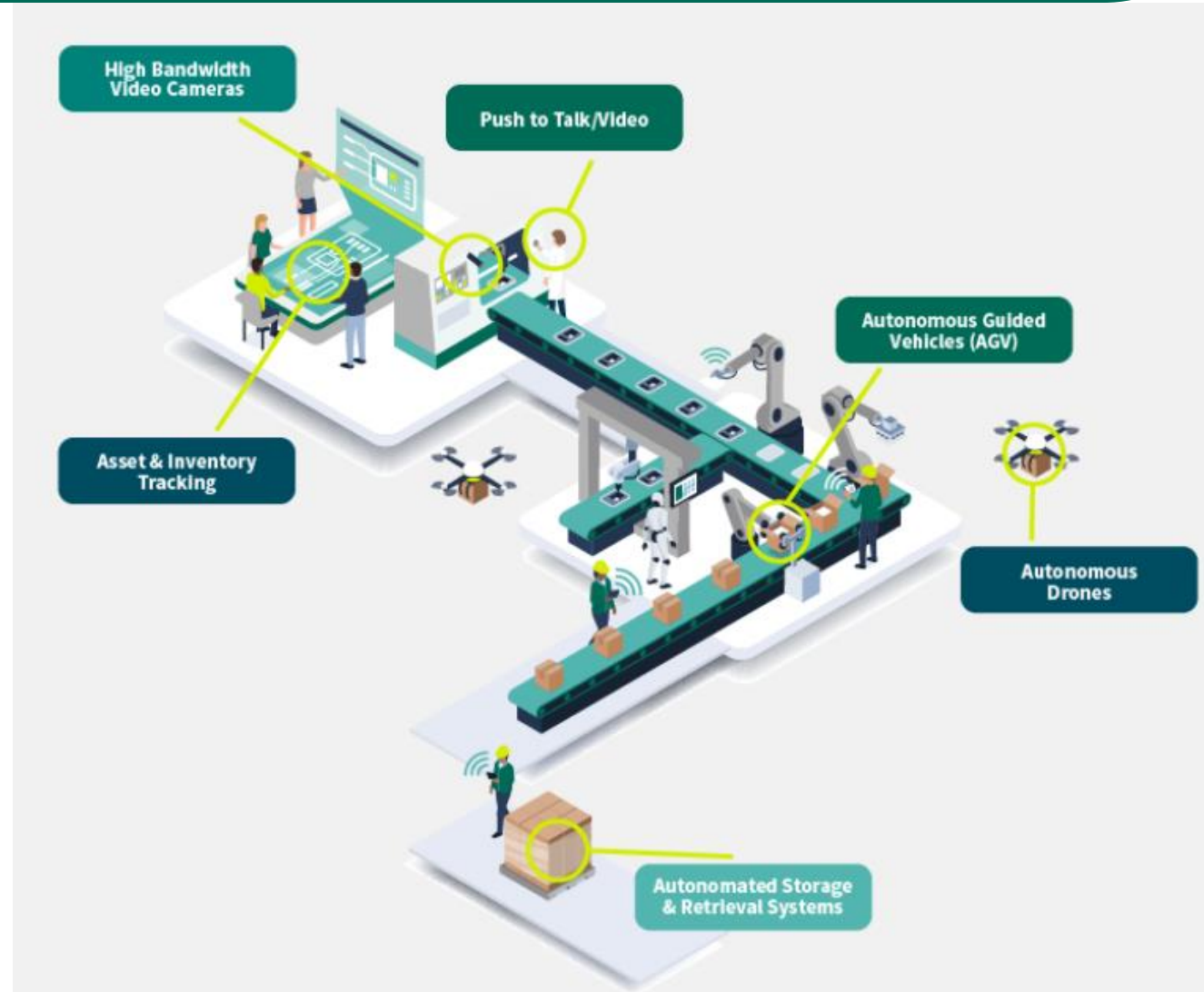
- Inspection and quality control (iPads)
- Automated machinery (Sierra, Cradlepoint)
- Asset/inventory tracking (Zebra, Android, iOS)

## Technical outcomes

- Extensive coverage over 83,000 sq ft with NO wireless dead spots
- Always-on, low latency, reliable wireless
- Improved operational efficiency

## Business outcome

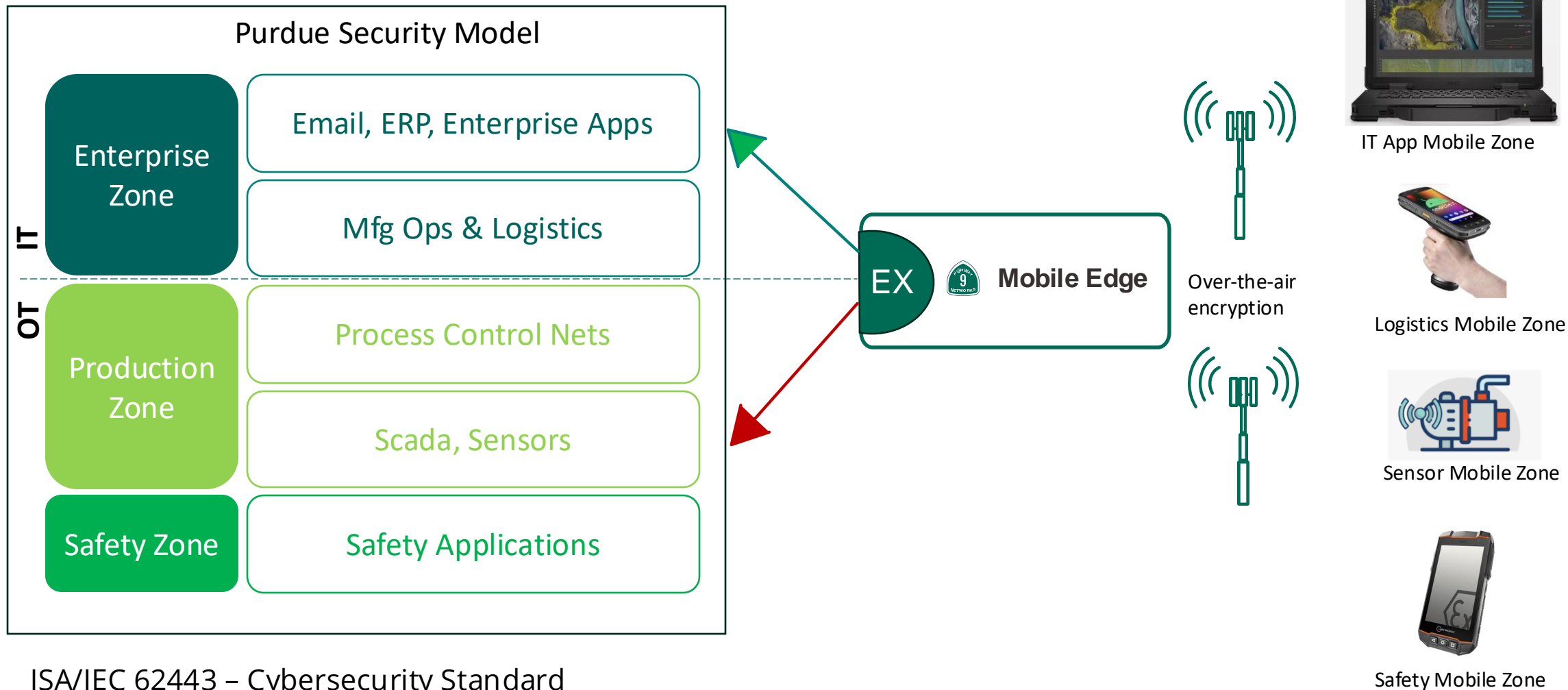
- Improved productivity by digitizing & automating inspection & QC operations





# PMN for Factories: IT/OT Security

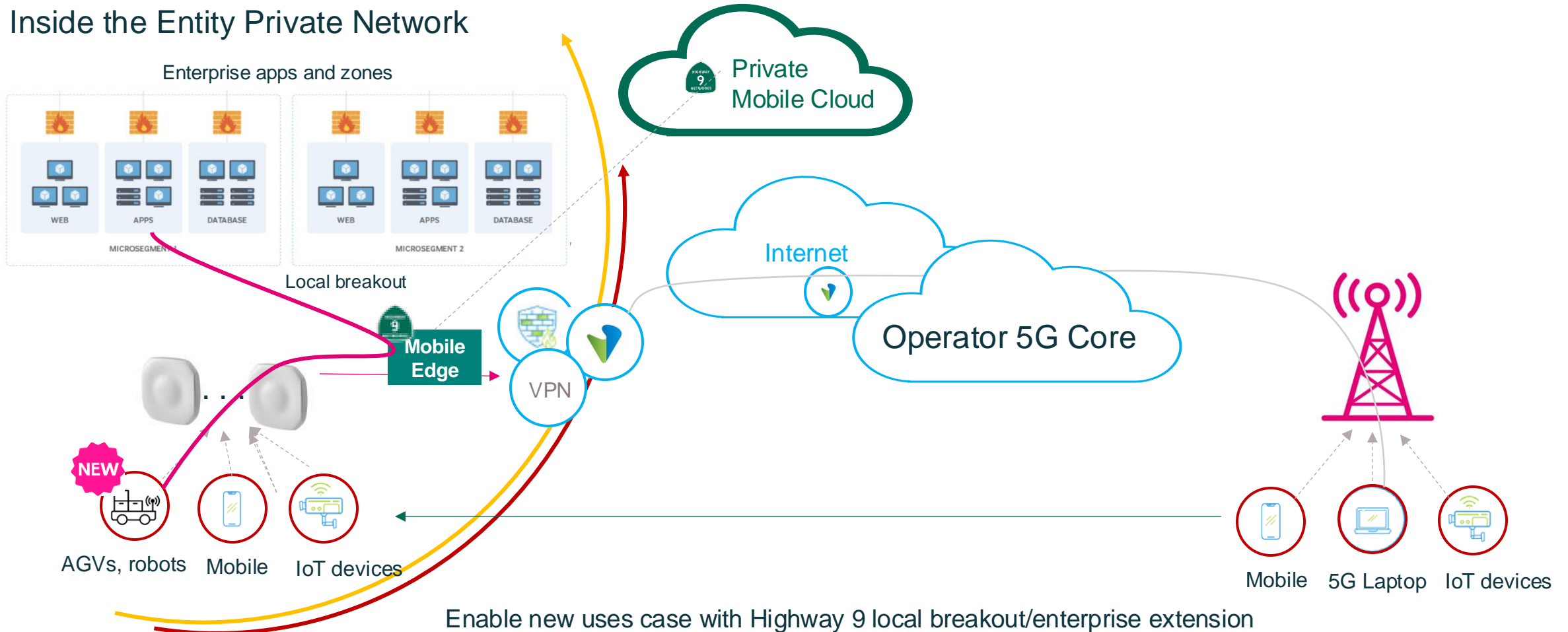
Design Partners: Oil & Gas, Pharma, Energy





# Extending Carrier Coverage inside the Factory

## Inside the Entity Private Network





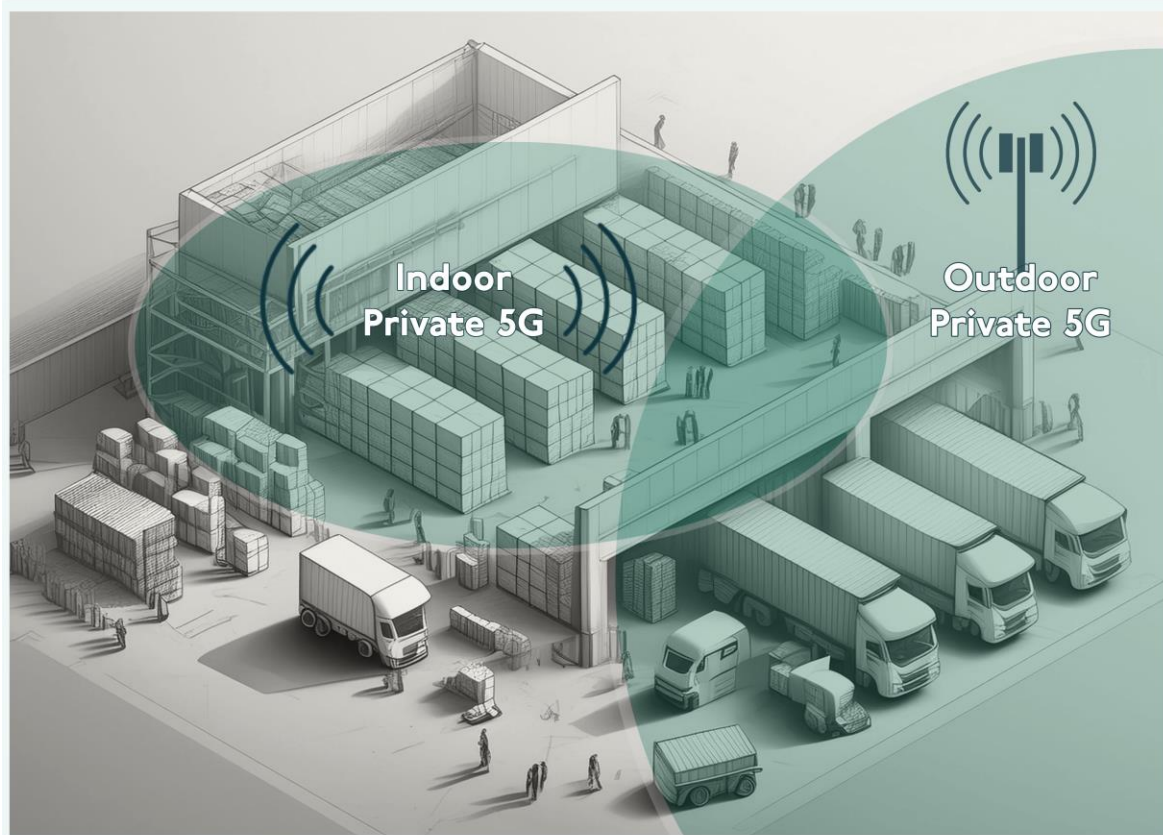
# PMN for Factories: How & Why

- Full outdoor coverage for product control, supply chain, other use cases
  - Material Shipping & Receiving
  - Quality Control
  - Car Tracking & Inventory
- Optimized for wide range mobility and pervasive outdoor coverage
- Best TCO for outdoor coverage removing the need for trenching, fiber, ruggedized switches etc.





# PMN for Factories: Outdoor Coverage



## 1) Factory equipment/conveyor line maintenance

- assembly line torque wrenches (put the car together)
- AGVs that carry the automobile casted bodies

## 2) Supply chain (planning, operations, inventory)

- Receiving dept with truck containers with materials
- iPads in truck container haulers
- Zebra scanner – integrate mgmt plane

## 3) Facilities

- Sensors - requires outdoor and indoor
- Temp, carbon, air, using zigbee, 2.4GHz wifi, zwave – tech sprawl
- Highway9 Networks provides migration to cellular / compatibility plan

## 4) Quality Control team: end of production line

- iPads + QC workflows
- Car inventory control by test track
- Vehicle telemetry and diagnostics on track

## 5) Security

- Badge readers, timecard machines
- LPR – license plate recognition
- Security Cameras
- Remote gates – conserve on fiber, rugged switch, many wifi APs





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# Mobility solution for Industry 4.0 – Highway 9 Mobile Cloud powered by Intel

**intel.**

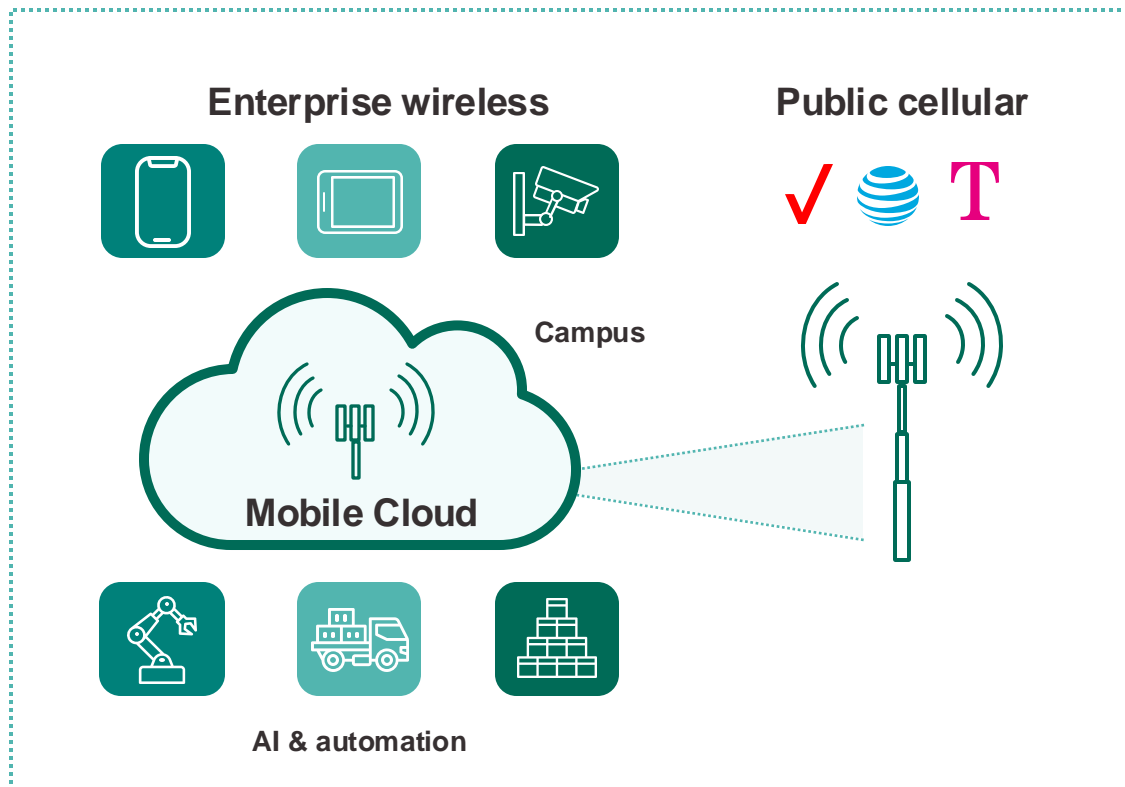
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# Mobile Cloud — A New Approach

The AI-enabled factory with everywhere, always-on mobile coverage requires a mobile cloud



Built on **private mobile network** – superior range, security, perf, mobility



**Easy to deploy** integrated stack – SIM, SAS, radio, network config + control



Seamless **IT & telco integration** – with IT infra + policies, across major carriers



Reliable, high-performance data and control network for **smart AI** devices

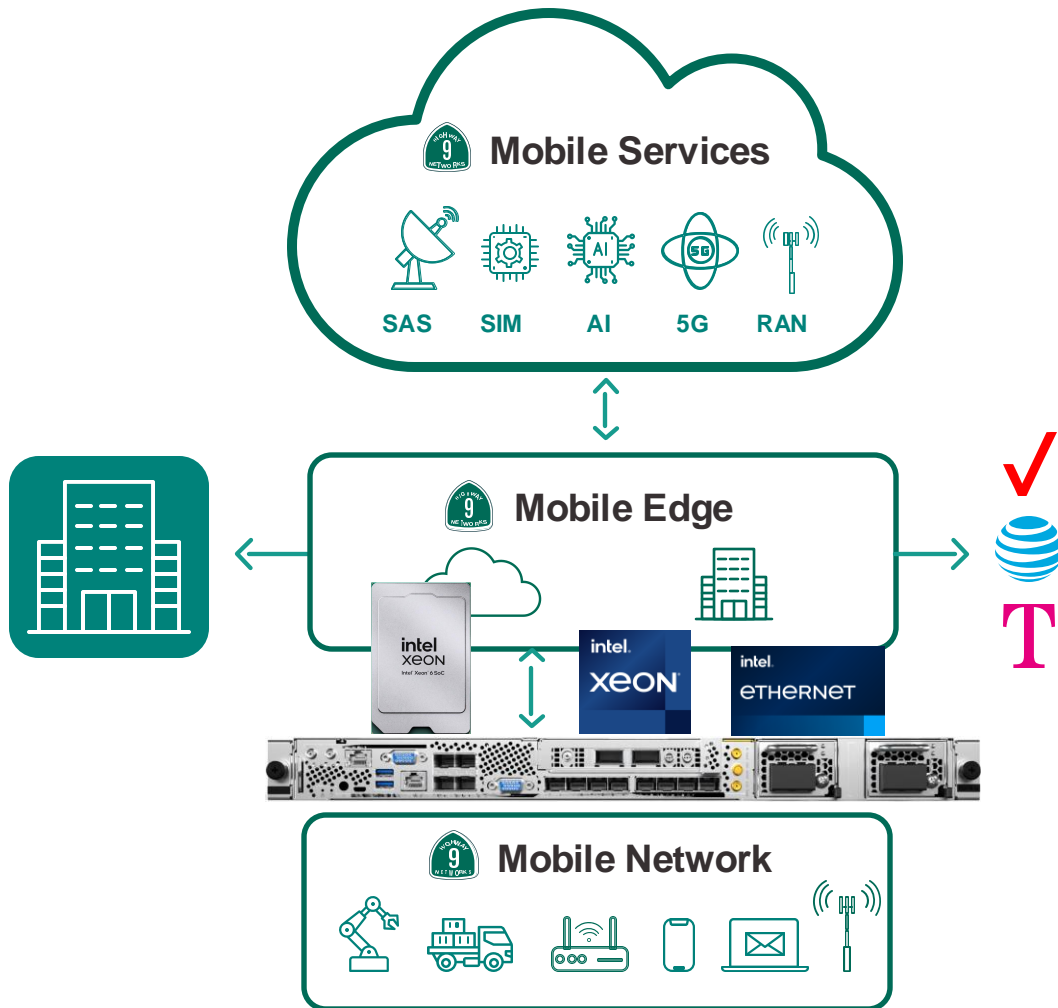


**Cloud-based** 360° command + control including AI-powered services and partner integration





# Highway 9 Mobile Cloud



## Mobile Services

- Cloud microservices, 360° visibility, control
- IT/OT/telco single pane of glass
- User-defined Virtual Mobile Zones (VMZ)



## Mobile Edge

- Distributed, scale-out 4G/5G packet cores
- Integration with enterprise IT, telco operators



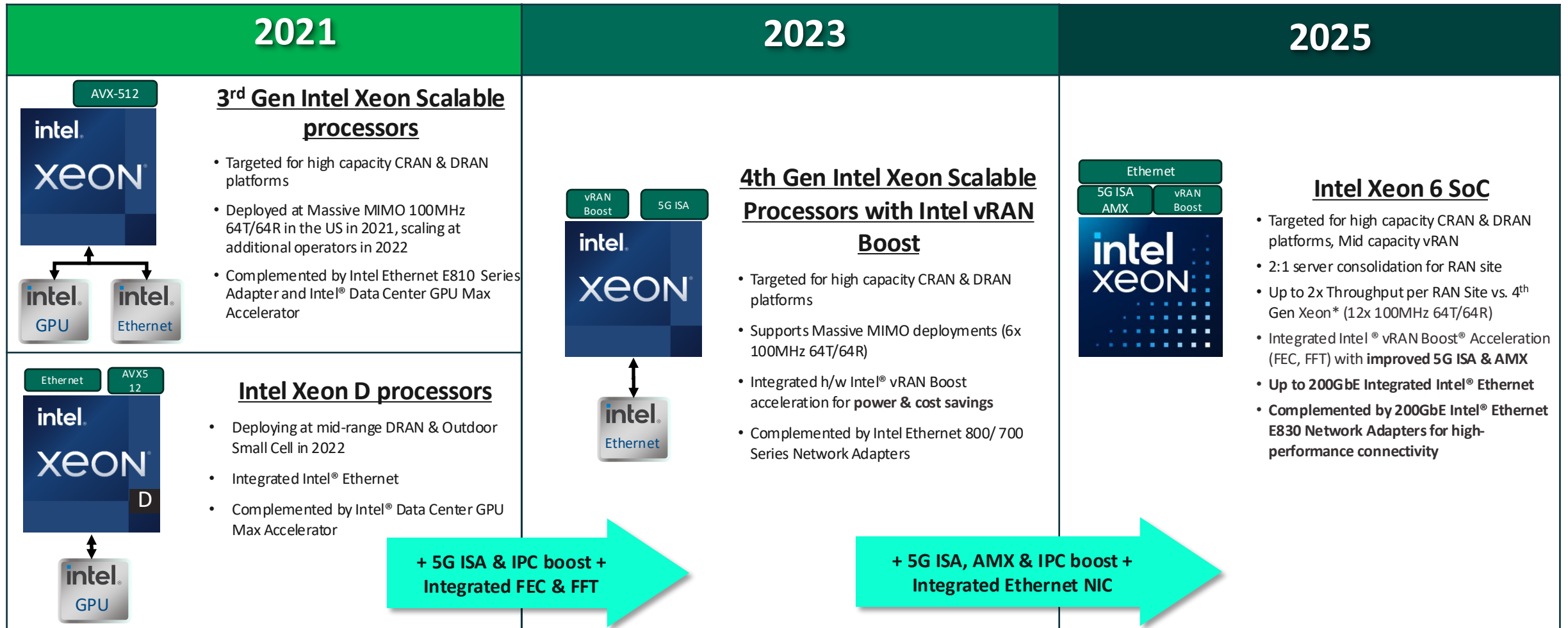
## Mobile Network

- Best-in-class LTE/5G RAN, CPE, eSIM
- AI-driven intelligent machines

## intel. The physical appliance leverages

- Accelerated crypto performance based on the 4th Gen Intel® Xeon® 6 Scalable processors using Intel® AVX-512
- IA accelerated DPDK for fast packet processing
- Improve overall network throughput using Intel® Ethernet Network Adapter E810 cards packet processing capabilities

# Edge Server Evolution with Integrated Private 5G Support



Intel® Xeon® 6 SoC with Intel® vRAN Boost Delivering Up to 2x Throughput per RAN Site Gen over Gen  
Provides Cloud Native Agility & Intelligent Automation

\*Results have been estimated based on internal Intel analysis and are provided for informational purposes only. Any difference in system hardware or software design or configuration may affect actual performance.



# The Processor Built for the Edge

Consistent Architecture from Edge to Cloud

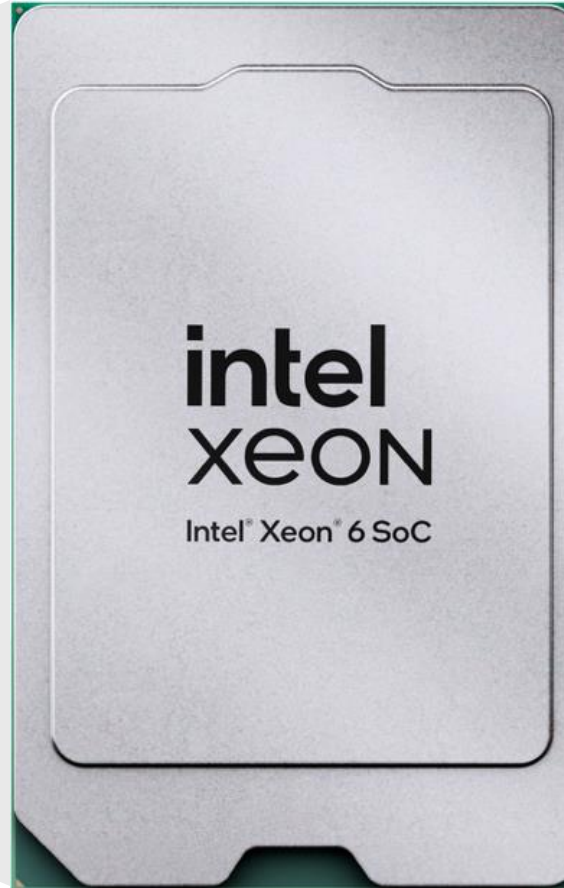
## Compute Optimized

Compute  
Scalar & data parallel workloads

Memory  
Low latency, high bandwidth

IO  
High bandwidth PCIe Gen 5

RAS  
Server grade robustness



## Edge Optimized

Security  
Confidential AI enabled

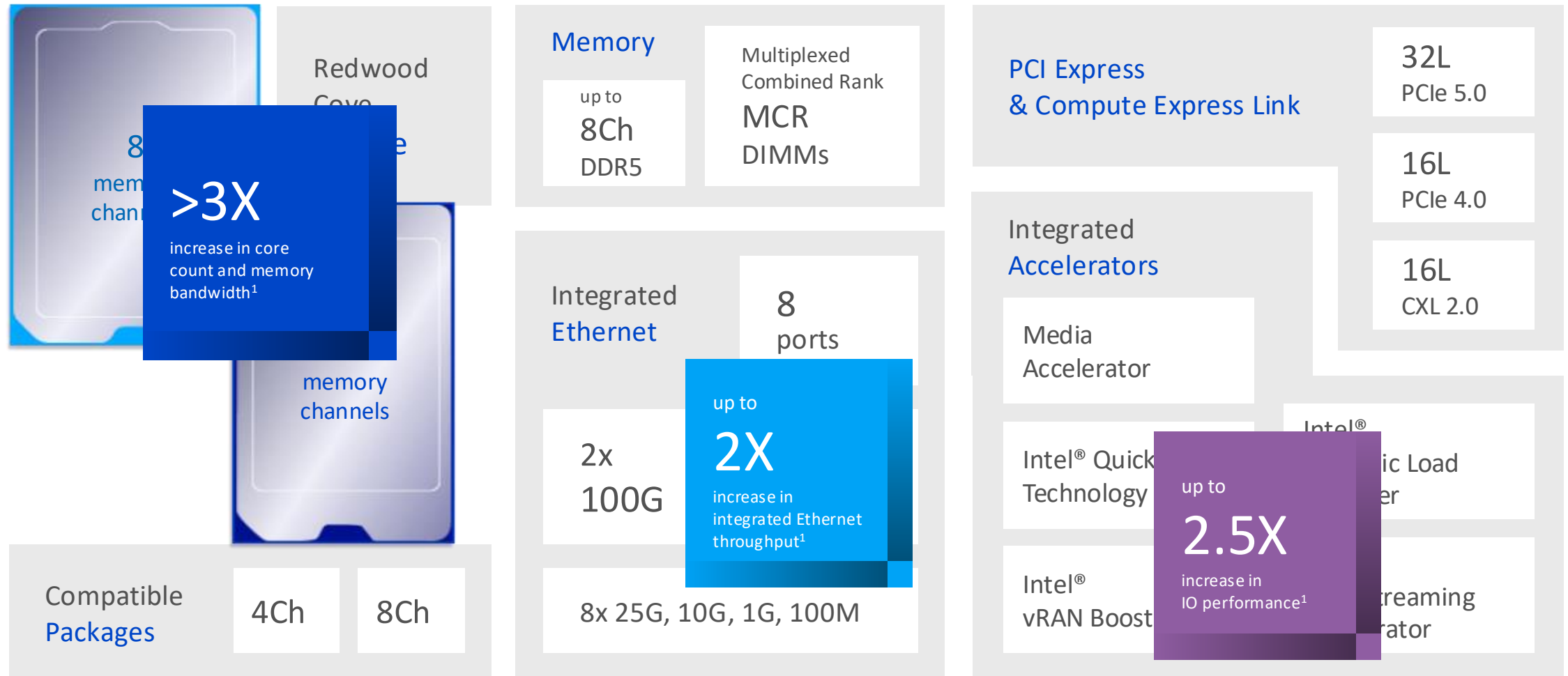
Scalability  
Multiple edge systems  
based on one architecture

Integration  
Ethernet and accelerators

Form Factor  
Optimized for space and  
power constrained environments

Intel® Xeon® 6 SoC

# Scalable Architecture, Integrated Form Factor





# Integrated AI Acceleration

Support for VNNI and Intel® AMX

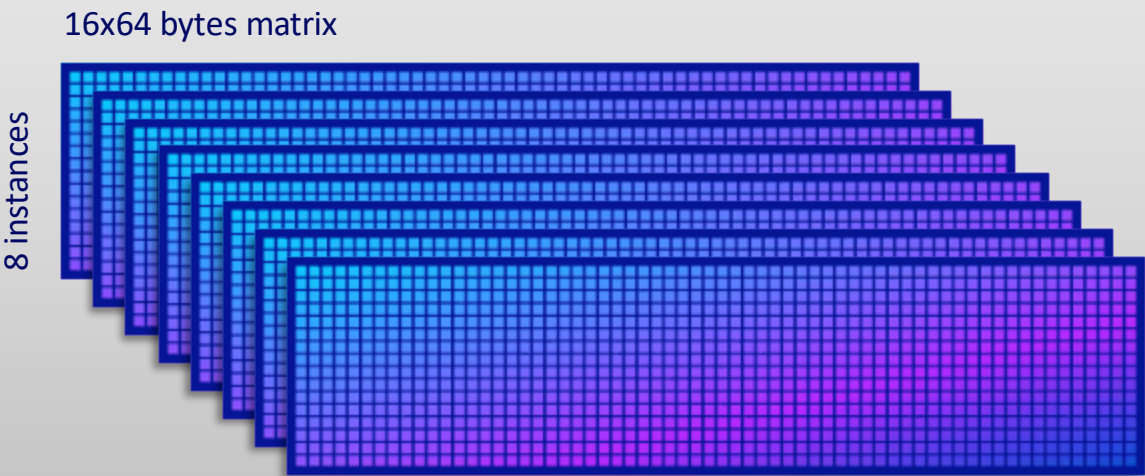
Support for FP16

Increased inflight memory requests/BW<sup>2</sup>

	Intel® Xeon® D 2899NT processor (AVX512 VNNI)	Intel® Xeon® 6 SoC (Intel® AMX)
Resnet-50 (images/sec) <sup>1</sup>	Baseline	Over 8X
Vision Transformer <sup>1</sup>	Baseline	Over 6X

1. Results estimated based on internal Intel testing as of 5/18/24 using preproduction silicon. Results may vary.  
2. In comparison to AVX512 VNNI.

## Intel® Advanced Matrix Extensions (Intel® AMX)

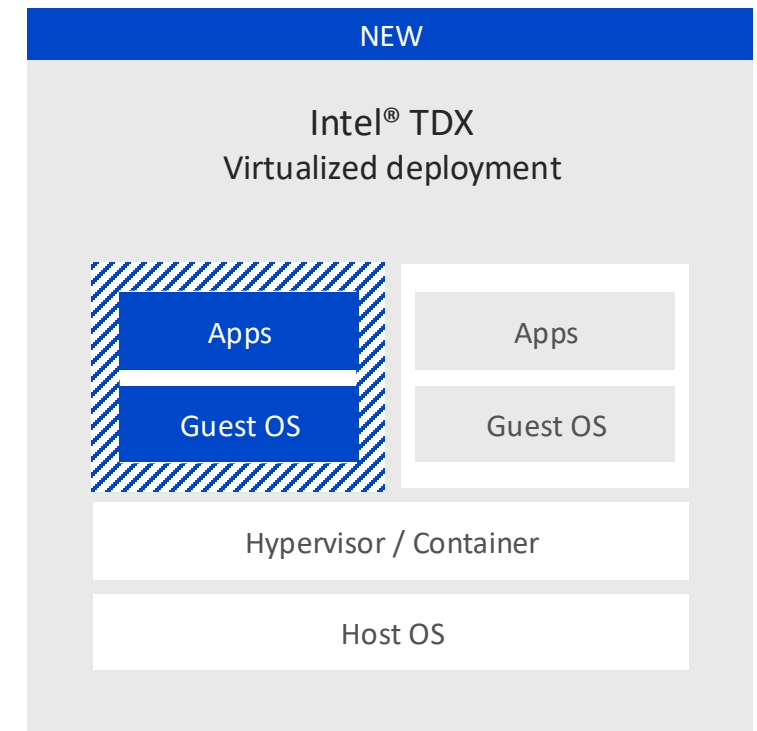
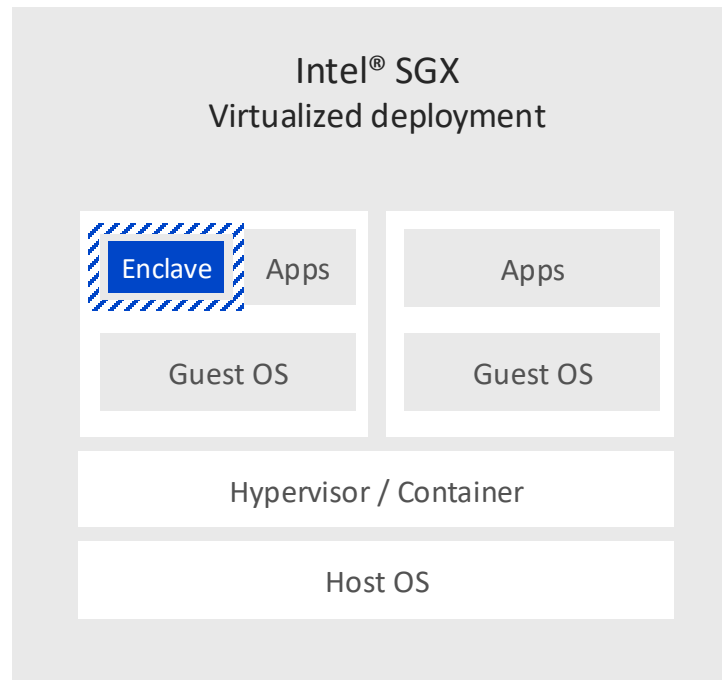
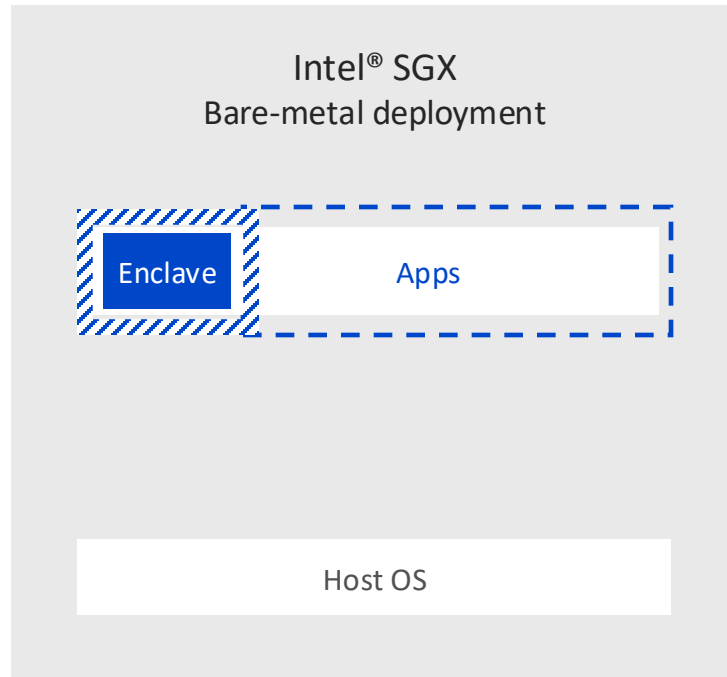


Store bigger chunks of data<sup>2</sup>

Instructions compute larger matrices  
in a single operation<sup>2</sup>

# Intel® Software Guard Extensions (Intel® SGX) & Intel® Trust Domain Extensions (Intel® TDX)

## Broad Array of Confidential Computing Options



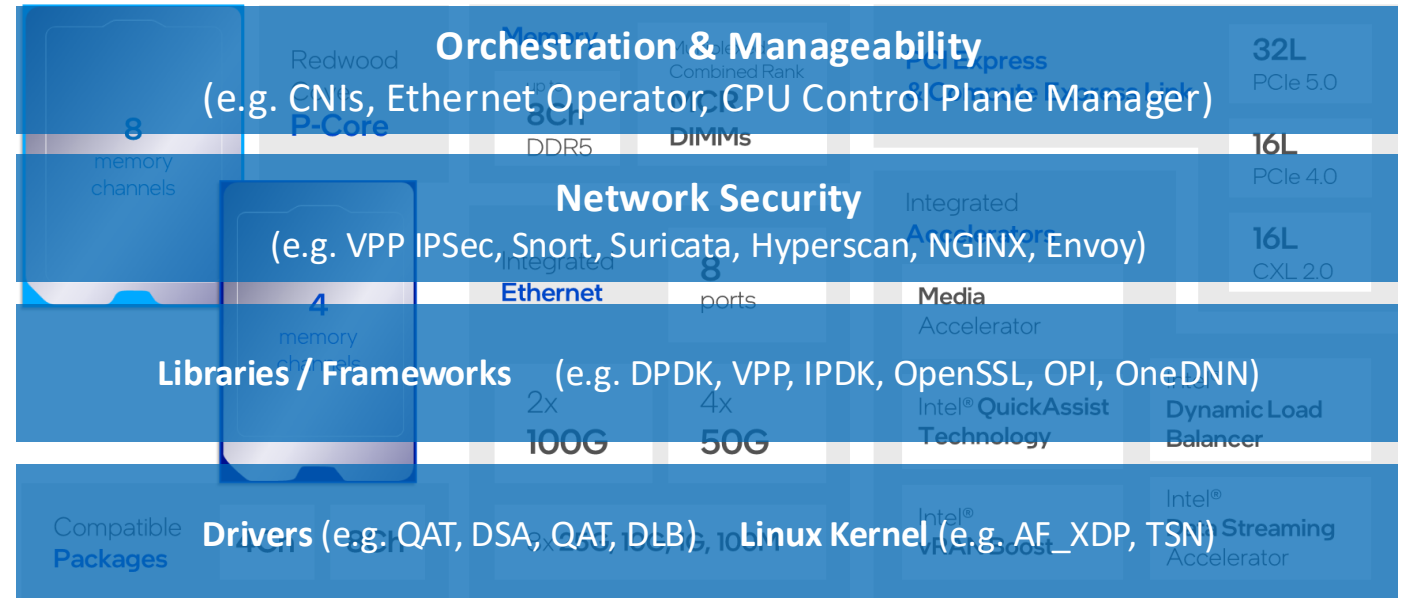
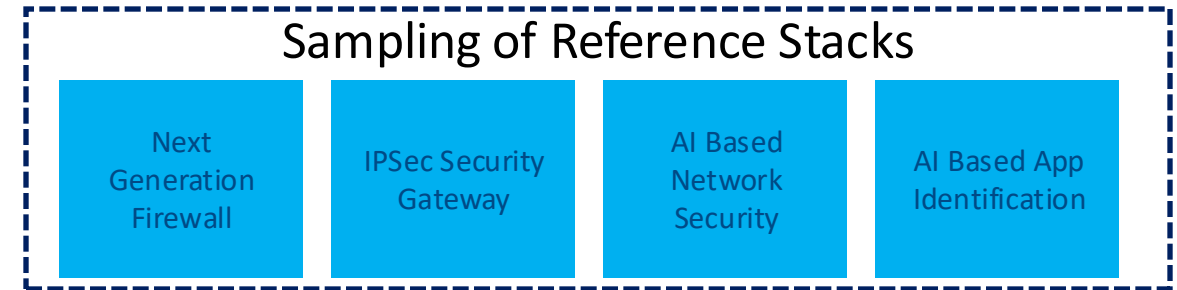
# Software Strategy: Built on Open-Source Foundation

## Open-Source Contributions

- Innovation within key open-source projects
- Maximize underlying hardware capability (accelerators, instructions sets)
- 15+yrs of silicon enabling optimization of standard network functions

## Reference Stacks

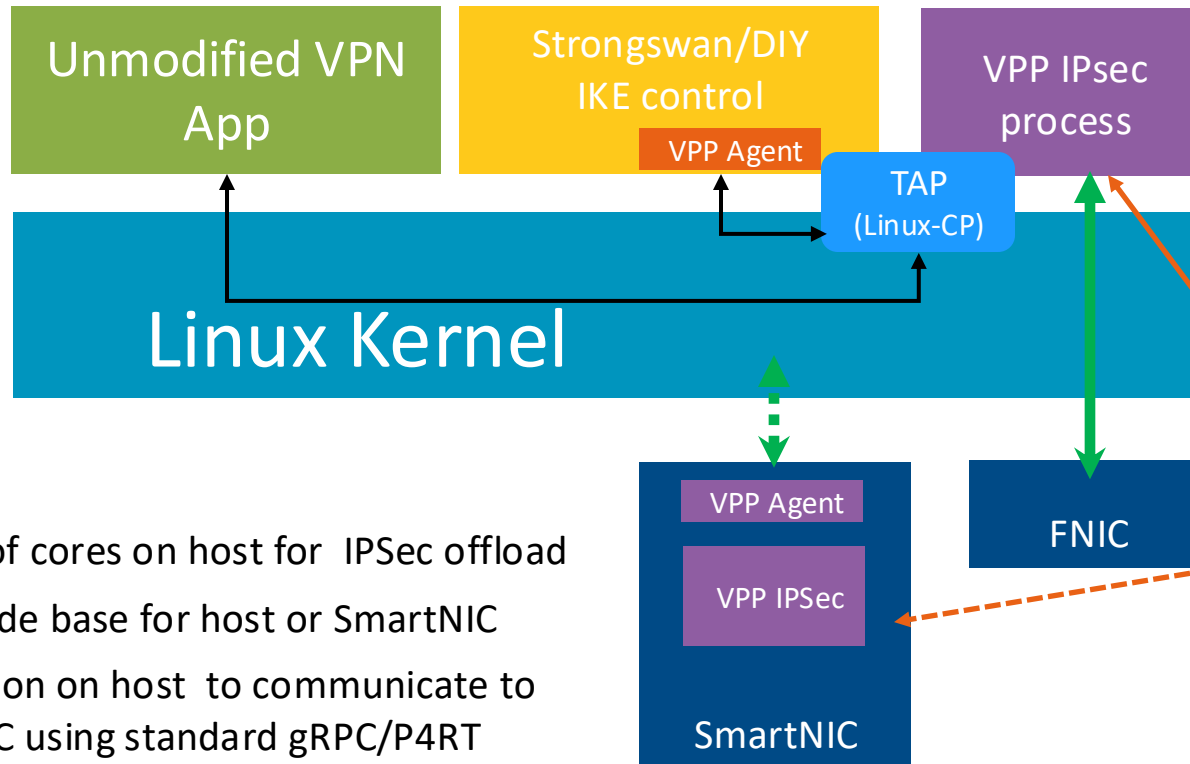
- Representative workload show-casing Intel's latest ISA and accelerators
- Ease TTM and R&D complexities of latest HW with abstraction and performance
- Targetable across NEX hardware roadmap (CPUs, FNIC, SmartNIC)





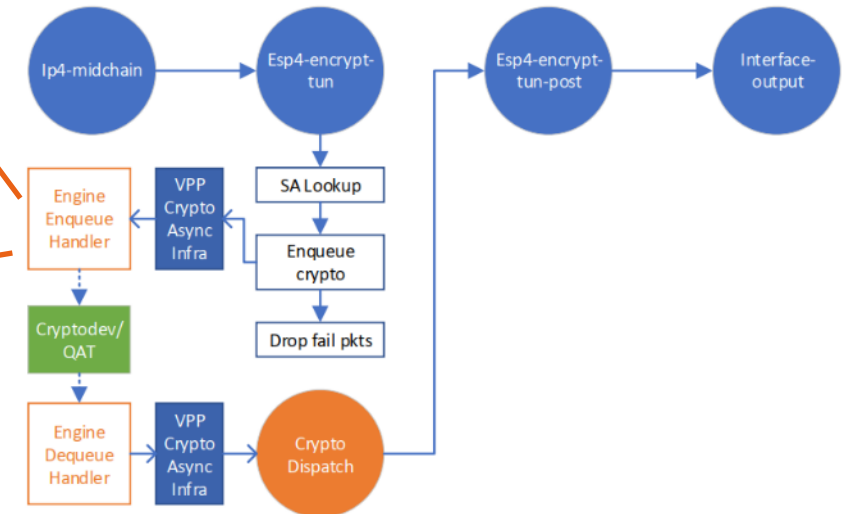
# IPSec Innovation with FD.io VPP

(use of industry Linux/Strongswan control plane)



- Small # of cores on host for IPSec offload
- Same code base for host or SmartNIC
- Application on host to communicate to SmartNIC using standard gRPC/P4RT
- Diverse set of session offload APIs and IPSec APIs at OPI are being standardized.

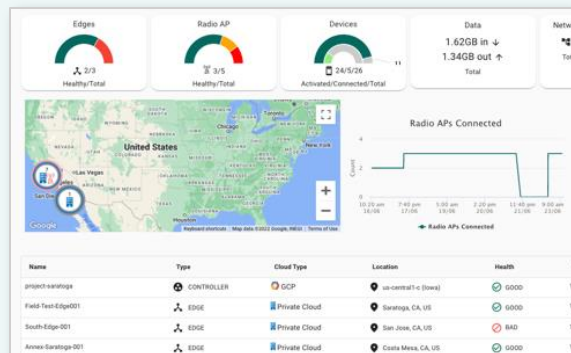
- VPP IPsec >8x Kernel IPsec
- StrongSwan IKE plug-in to ease adoption
- Widely adopted and commercially deployed
- ISA optimized SW and/or underlying QAT
- Routes all other traffic to OS network stack
- “Fat-pipe” support via Async SW or HW assist



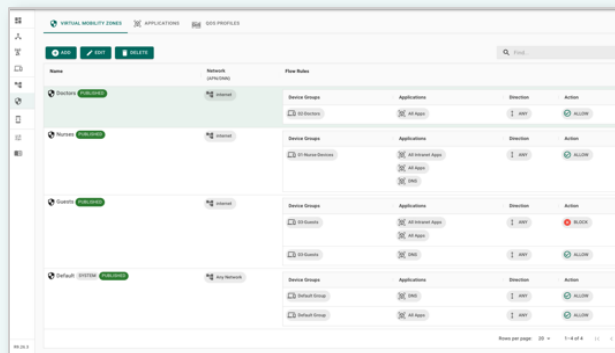
Intel Technology Guide: FD.io VPP-SSWAN



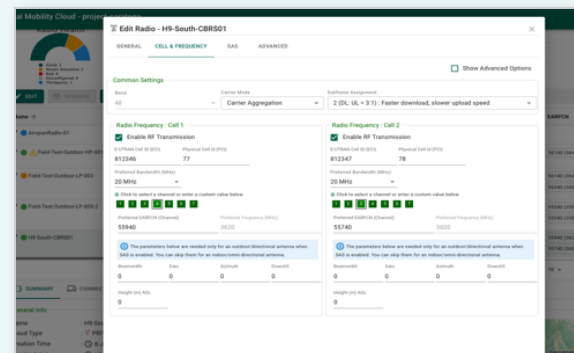
# Mobile Cloud Demo



**360° dashboard across properties and sites**



**Virtual Mobile Zones for user-defined use cases**



**Automated on-boarding for new deployments**



**360° visibility and Day 2 operations**

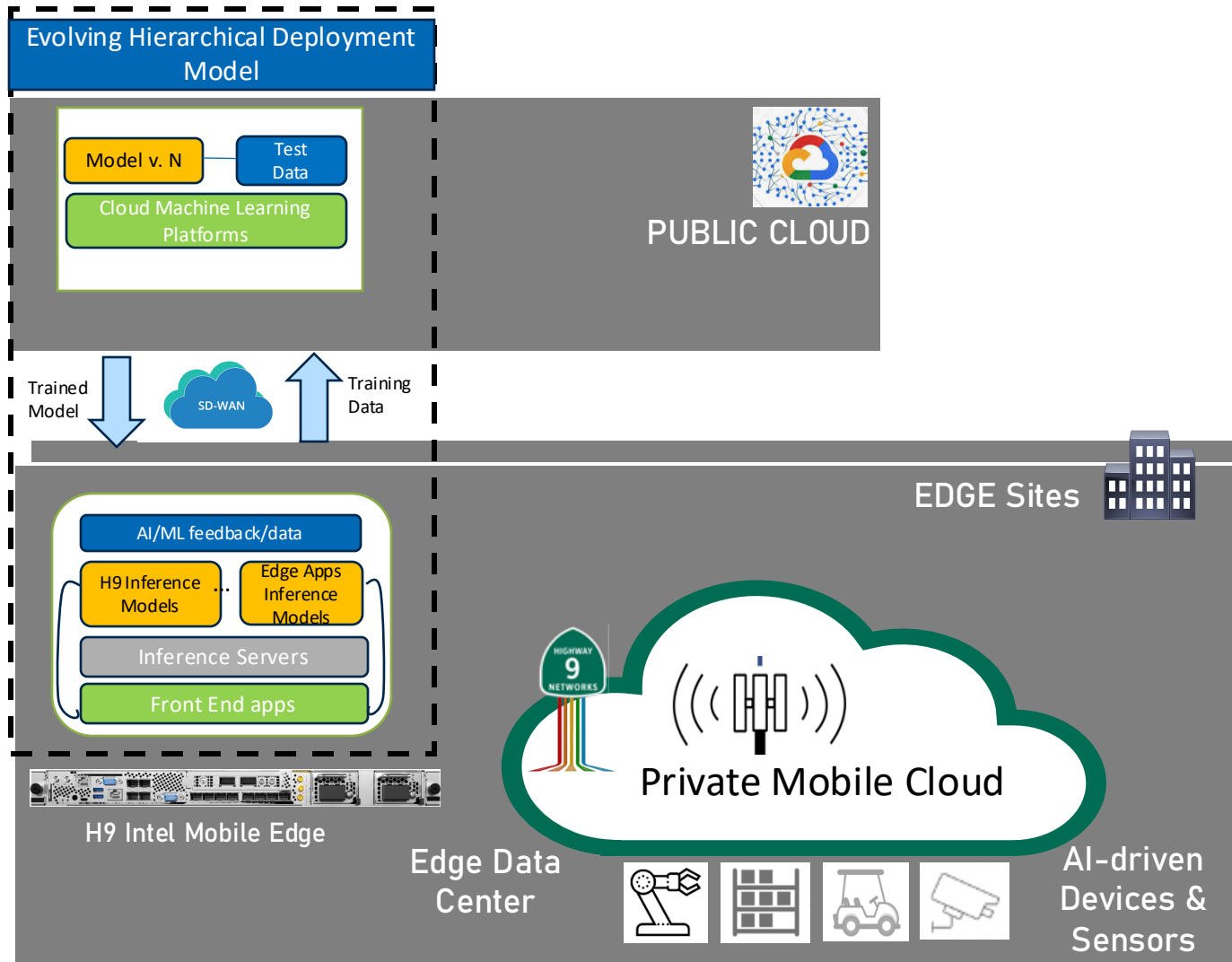
Seamless automation, deployment & control

# Q&A





# Private Mobile Cloud for Edge AI



**Highway 9 Networks** **Always-on, everywhere wireless infrastructure – industry 4.0.**

1. ROUTE traffic from 5G devices to right app/inference engines
2. QOS to AI traffic over air and local network
3. H9 MOBILE AI SERVICES for smart location tracking, application detection, anomaly detection
4. AUTO-LABELING of data w/ location, anomaly, application...
5. EDGE SECURITY point of enforcement to/from the devices



# Benefits of Intel® Accelerator Engines

## Intel® QuickAssist Technology (Intel® QAT)

Up to

84%

fewer cores to achieve same connections/s on NGINX with built-in QAT vs. out-of-box software

## Intel® Dynamic Load Balancer (Intel® DLB)

Up to

96%

lower latency at the same throughput for Istio-Envoy Ingress with Intel® DLB vs. software for Istio Ingress gateway

## Intel® Data Streaming Accelerator (Intel® DSA)

Up to

1.7x

higher IOPs for SPDK-NVMe with built-in Intel® DSA vs. ISA-L software

## Intel® In-Memory Analytics Accelerator (Intel® IAA)

Up to

2.1x

higher RocksDB performance with Intel® IAA vs Ztsd software

## Intel® Advanced Matrix Extensions (Intel® AMX)

Up to

8.6x

higher speech recognition inference performance with built-in AMX BF16 vs. FP32

Accelerators enable step function performance beyond base architecture

# Transition to Software

- Needs to be aligned with the Wireless / Mobile Cloud Application
- Contributions across layers (DPDK/VPP/Linux/TADK/Hyperscan)
  - Aligned to the platform – maybe block diagram that show how we enable all the various features ie. DLB/DSA/QAT/....
- More specific to the wireless / mobile cloud:
  - IPSEC? TLS?
  - TADK/Hyperscan for DPI?