

Computing at the Edge

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Strategic Marketing for NXP Digital Networking

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Agenda

- Edge Computing Introduction
- Layerscape Processors
- Layerscape Software and EdgeScale
- Edge Computing Applications
- Conclusion



Introduction



Edge Computing Definition

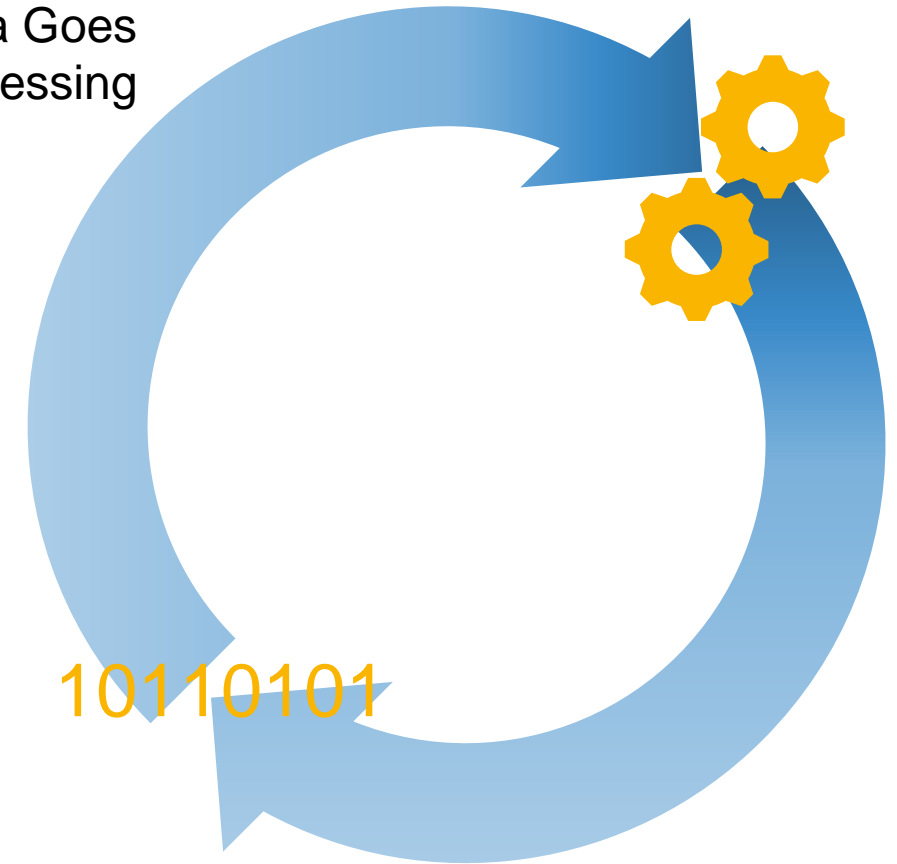
Inclusive

- Computing near the source/sink of data
- AKA moving computing to the data

Narrow

- Applying cloud-computing techniques outside the data center
 - Soft provisioning of compute, storage, networking
 - Virtualization and containerization
 - Service-oriented architecture
 - Orchestration

Data Goes
to Processing



Processing
Goes to Data

Related Concepts

Fog

- For fog adherents, fog nodes are capable participating in distributed analytics
- NXP does not distinguish between fog and edge

Hybrid cloud

- An IT term describing linking private and public clouds
- Analogous to edge computing but unrelated

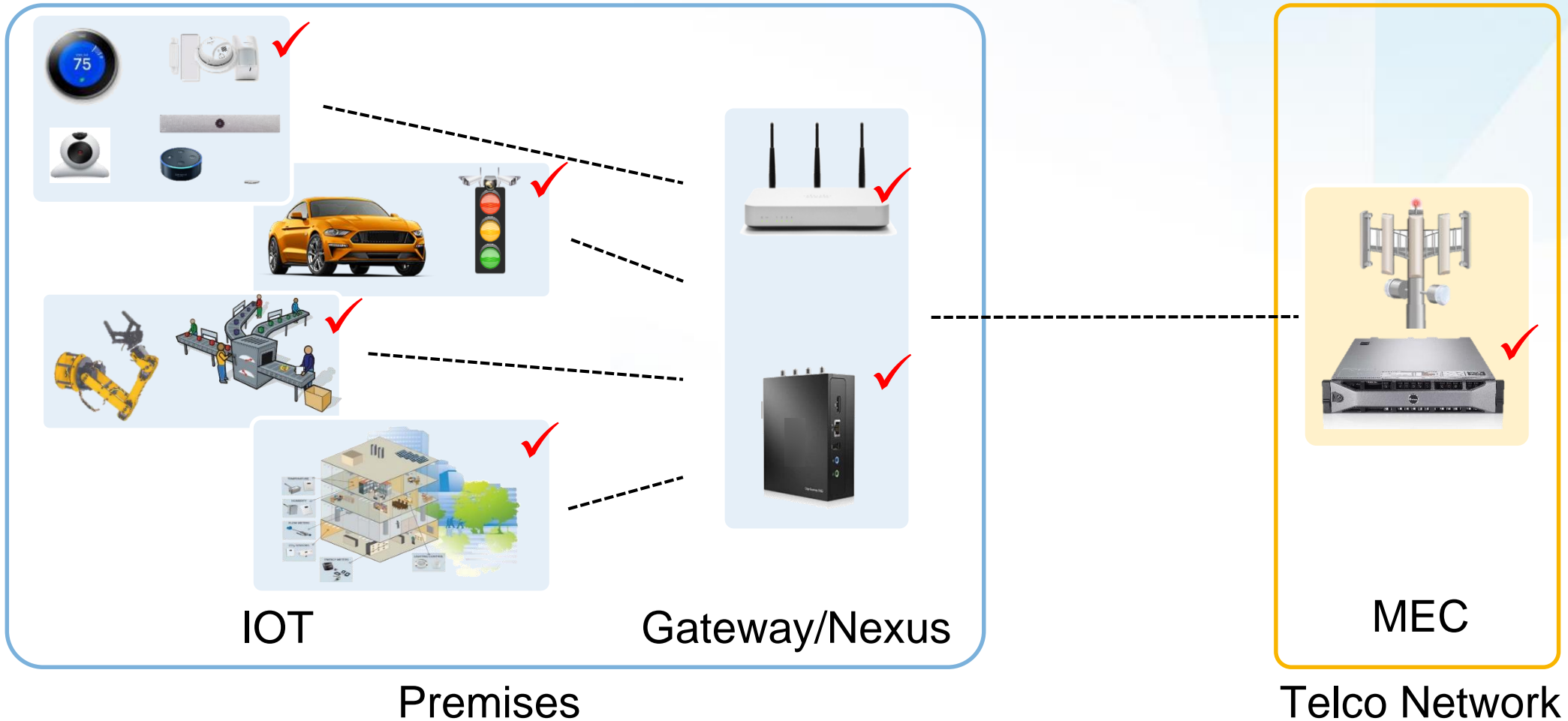
Embedded processing

- General term for computing done in a system without user-loaded software

Internet of Things (IOT)

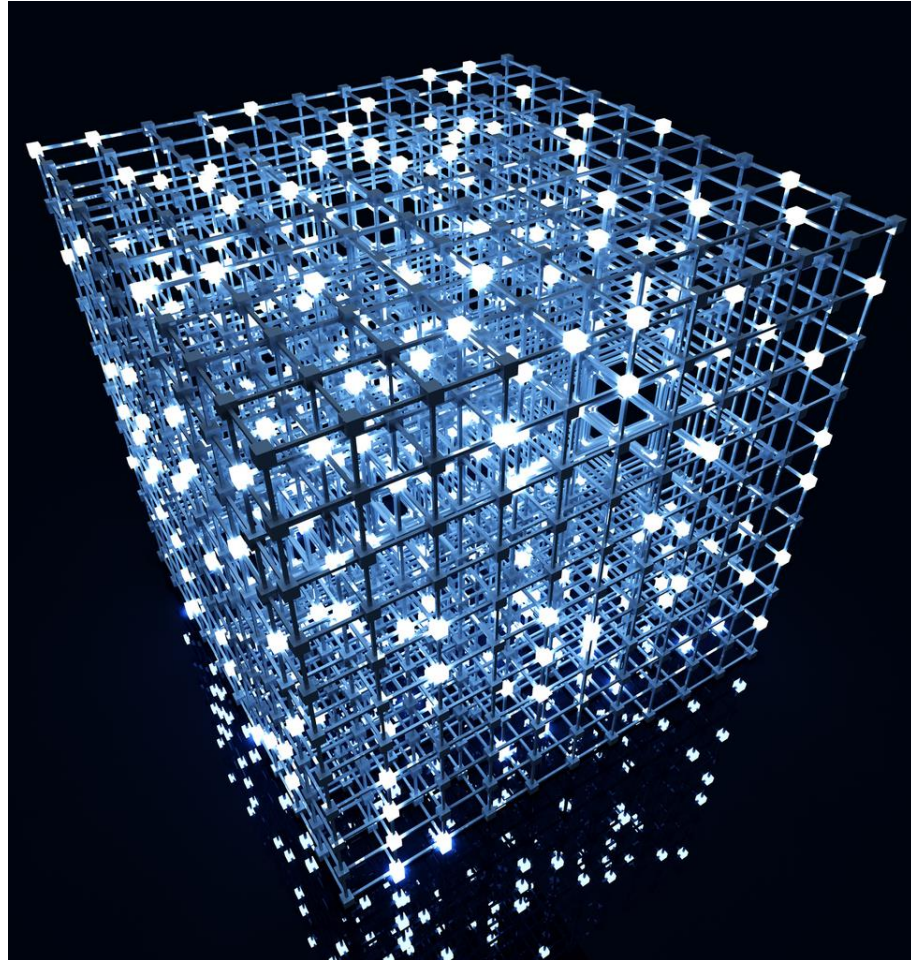
- Narrow: embedded systems with internet connections
- Expansive: any system or device accessible directly or indirectly via the internet
- Complements edge computing

Edge Computing Is On Premises or in the Network



MEC = multi-access (mobile) edge computing

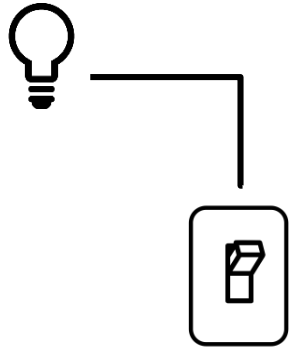
Edge Computing Topologies



- **Self-contained:** Edge node does all computation for a specific machine or IoT endpoint
- **Hub and spoke:** One edge node services multiple machines/endpoint
- **Peer-to-peer:** Loads migrate among nodes with free capacity or the cloud
- **Hierarchical:** Edge node shares computation, e.g.:
 - Endpoint classifies observations (e.g., extracts region of interest, recognizes class of object)
 - Edge node
 - Performs next-level classification (e.g., uniquely identifies object within a class)
 - Predicts/decides next steps
 - Cloud performs longitudinal analysis

Edge Computing Evolutionary Stages

1. Precursor



Local
Command
and Control

2. Cloud Computing



Functions Added
Via Cloud
Computing

3. Re-Localization



Functions in
Cloud Integrated
Locally

4. Local Cloud



Cloud APIs
Implemented
Locally

Pre-Edge Computing

True Edge Computing

Edge Computing Advantages Over Cloud Computing



Reduce Data Transferred



Reduce Latency

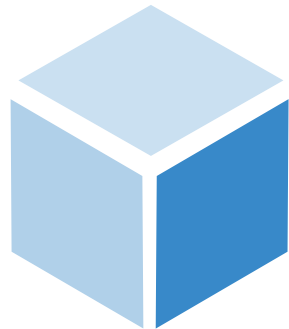
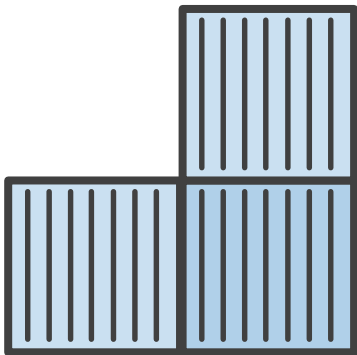
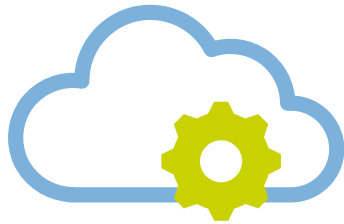


Secure Data Onsite



Edge (and Cloud) Computing Advantages Vs Traditional Embedded

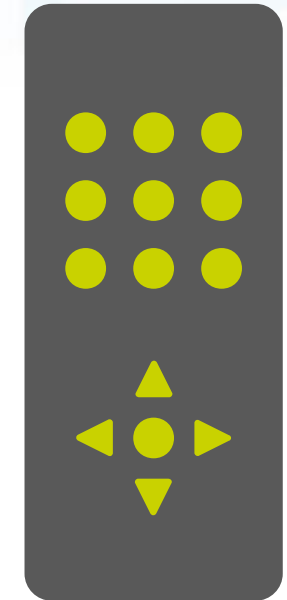
Abstract



Scalable and Elastic



Manageable



Major Edge Computing Players

OEMs/ODMs

Cloud Computing Companies

Telcos



Consumers & Businesses

Complications



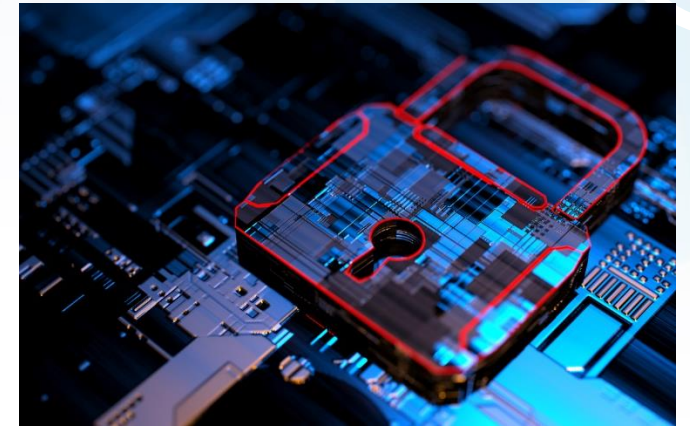
Ecosystem

Abstract programming and deployment models benefit from a standard platform



Manageability

Cloud frameworks help manage applications, but what about far-flung devices?



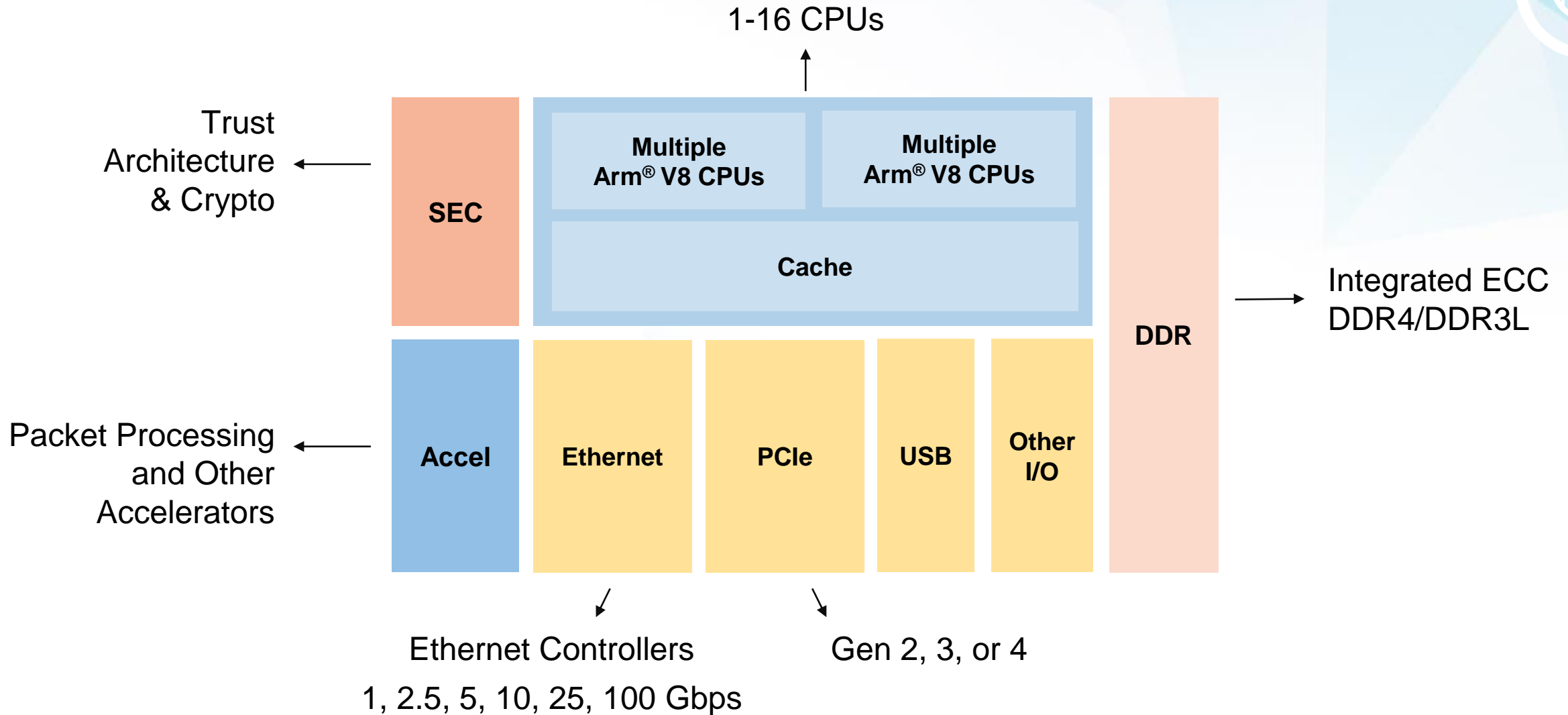
Security

Edge nodes must not be recruited to a thingbot army

Layerscape Processors



Generic Layerscape Block Diagram



Extreme Operating Conditions

10

Year

Continuous operation at high temperature

- Product Life Application Notes
- Extreme **temperature conditions**
 - -40° C cold start
 - 70-85° C ambient operating conditions
 - Up to 125° C junction temperature
- Low power consumption for **fanless designs**
- Small footprint for **space-constrained designs**



Supply Longevity

Industrial applications require product longevity

- Long product lifecycles
- Special product certification required

NXP Industrial Application Processors

- 10 and 15 year supply longevity options
- Formal program with products listed at www.nxp.com/productlongevity



Key Take-Aways

NXP offers a broad portfolio of **Layerscape processors**

Layerscape integrates functions to **reduce system cost and power**

Layerscape delivers **class-leading performance**

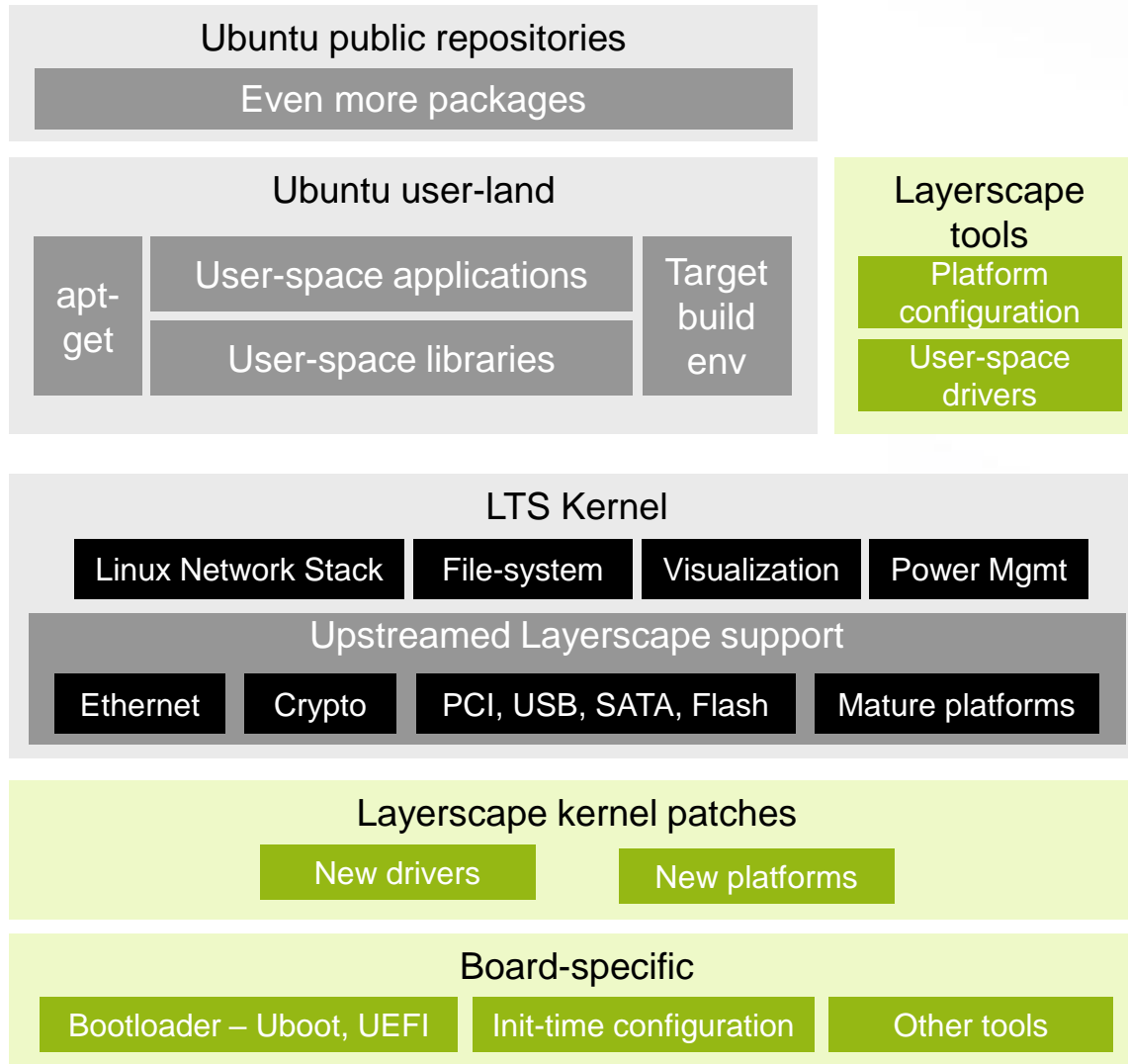
NXP has reference designs and ODM partners to **accelerate customers' time to market**

Layerscape is **robust and available for the long term**

Layerscape Software



Layerscape SDK



• Components

- Freely available from public repositories, no need to download an ISO
- Modularized with discrete boot loaders, user-space libraries, tools, config
- Clean layering, with separate patches identified by platform/IP on top of open-source
- Git updates of periodic releases and interim updates
- Support for 2 recent LTS kernels

• Living with the SDK

- Multiple boot mechanisms with recovery via SD
- Run-time upgrades with apt-get or build from source
- Latest and greatest Layerscape tools and drivers

- **LSDK is not a Linux distribution but a reference integration with a Ubuntu user land**

Management and Security Challenges



Solution: cloud-based management & security for edge

- Manage devices, apps remotely
- Secure provisioning, upgrades

Traditional PC, mobile devices

- Multiple authentication mechanisms
- Cloud based security and application management

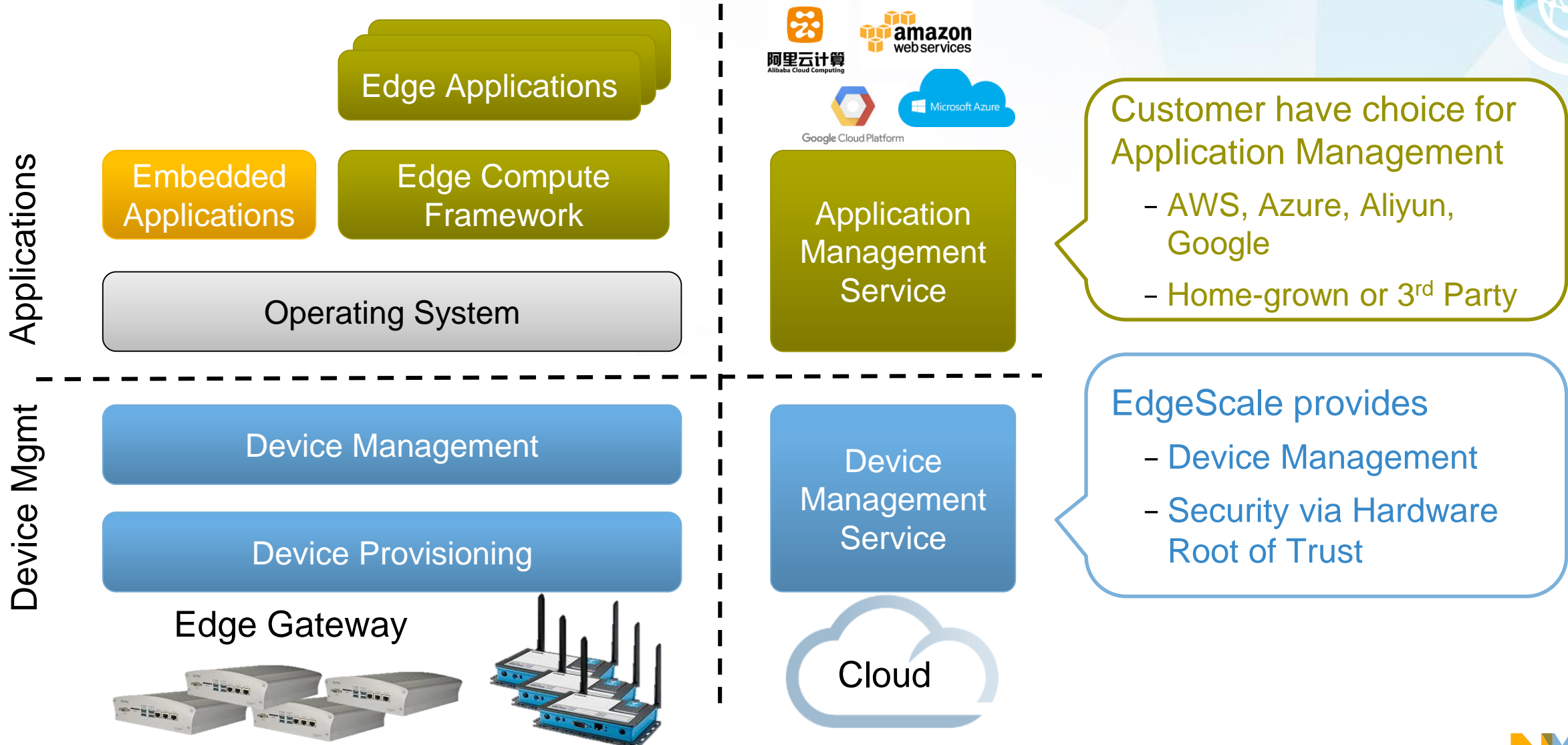
Edge computing devices

- Traditionally embedded devices
- Not physically accessible, or lack display
- Can be many (10s, 100s, 1000s) per manager

EdgeScale



EdgeScale for Device Management



NXP Works With Cloud Companies' Edge Frameworks

- **Amazon Web Services (AWS)**

- Greengrass integrated with Layerscape
- Edge demos using Greengrass and AWS
- EdgeScale integrated with AWS and GG
- <http://media.nxp.com/phoenix.zhtml?c=254228&p=irol-newsArticle&ID=2289486>

- **Microsoft Azure IoT Edge**

- Azure IoT Edge supported on Layerscape
- Focus on secure execution and Docker
- <http://media.nxp.com/phoenix.zhtml?c=254228&p=irol-newsArticle&ID=2334845>

- **Alibaba Cloud (Aliyun)**

- NXP processors uniquely support Alibaba TEE OS
- Alibaba and NXP plan to jointly develop smart manufacturing and smart city applications
- <http://media.nxp.com/phoenix.zhtml?c=254228&p=RssLanding&cat=news&id=2322324>

Key Take-Aways

NXP understands and addresses **key trends**

Embedded systems

IoT and edge computing

NXP understands and addresses **security and device-management challenges**

NXP Trust Architecture

EdgeScale

NXP leads in **collaborating with cloud companies on edge frameworks**

Accelerates NXP customers' time to market

Improves security

Edge Computing Applications





Building Automation

- Killer app is linking systems via an edge-computing nexus
- HVAC + surveillance
 - Start HVAC when employee arrives
- HVAC + weekly weather forecast
 - Plan vs react
- Ingress + egress security cameras
 - Did someone leave behind a backpack?
- Sensors + fire alarm
 - Warn if unusual electric load, items piled up near boilers, etc.

Home Automation



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- Fire/burglary alarm
- Remote unlock
- Security cameras
- Remote doorbell
- Thermostats
- Smart speakers
- How edge computing differs
 - Learning done locally
 - Local intersystem coordination
 - Shared learning (e.g., voice, face recognition)
 - Automation enabled when house offline
 - Privacy



Warehouse Automation

Robots shuttle among shelves

Conveyer belts transport goods

Machines dispense tape and boxes

Edge computing orchestrates everything



Medical and Healthcare Monitoring and Automation

- Surgery robots
 - Parallels factory automation development
 - Edge nodes monitor and analyze sensors
 - Edge nodes coordinate robots
- Patient monitoring
 - Edge computing enables offline analysis
 - Edge computing enables sensor fusion



NXP is Bringing EdgeScale to an Alligator Farm

- Alligator farm has pole- or tower-mounted observation hardware
- Today: firmware updates requires dangling from a helicopter with a PC and cable
- Same constraints apply to industries with remote equipment like oil/gas
- EdgeScale remote management enables low-cost remote updates

NXP Has Shown Enterprise and Retail Video Analytics

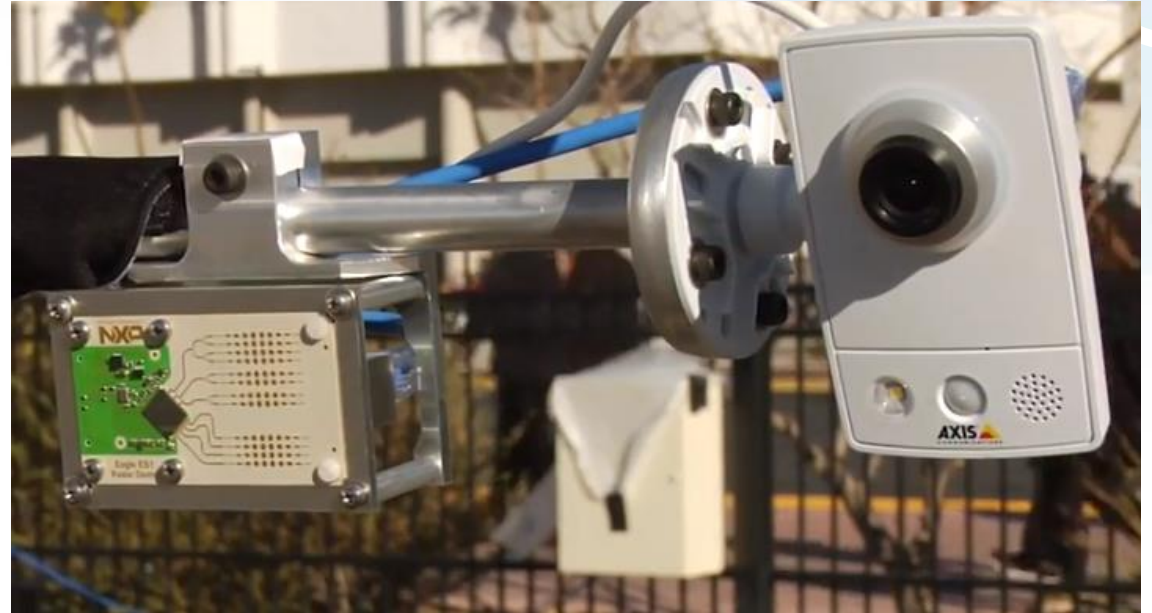
- Customer check-in
 - Face and ID correlation using AI
- Retail analytics using AI
 - Hot spot detection
 - Face recognition
 - Correlate items browsed with shoppers
 - Shoplifting detection



Source: NXP

NXP Is Already Engaged in V2X Development

- Aggregate data
 - Sent by cars
 - Observed by fixed cameras
 - Observed via radar
 - Sent by other V2X nodes
- Analyze and control objects
 - Track objects
 - Predict objects' behavior
 - Control behavior with signaling
 - Manage pedestrian and vehicle queues
- Identify carpool and other violations



Key Take-Aways

Edge computing is **broadly applicable**

AI is a killer app for **edge computing**

NXP is actively developing edge applications **for demonstration and with customers**

Conclusion



How Might Edge Computing Transform the World?

- Bigger role for software in traditionally hard industrial systems
 - Affects what industrial companies offer (e.g., GE Predix)
- Software development becomes more IT-like
 - Abstract
 - Leveraging frameworks, containers/VMs
 - Decouple from hardware
 - Easier to manage
- Bigger role for cloud service providers
- Improved cost, performance, and safety by fusing multiple systems' inputs



How Might AI Transform the World?



Machine-generated models factor in more data than man-made ones

Better models yield better analytics, revealing hitherto hidden insights

New, gee-whiz features (e.g., remote unlocking of your house)

Reduced cost (e.g., predictive maintenance)

Improved safety (e.g., stopping worker without hardhat from entering)

Bigger role for software in traditionally hard industrial systems – Continues the trend that started with replacing analog with digital control

For more on AI/ML, please access a replay of my earlier webinar:

How Might Processors Change?

- Cross-vendor compatibility is increasing owing to:
 - Arm
 - Containers/VMs
 - Frameworks
- Accelerator quirks will be hidden from application software by well-defined APIs
- AI accelerators will become common even in small-scale processors

Summary: NXP Layerscape Offerings

Layerscape: a broad portfolio of Arm-compatible processors integrating I/O

Linux and enabling software

ODM and reference designs

EdgeScale for edge/IoT node management

Cloud framework support

Demos and early-stage success in edge computing

Transform Your Business with Edge Computing and AI Using Layerscape!





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FOR A SMARTER WORLD

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