



# Scaling IoT Solutions

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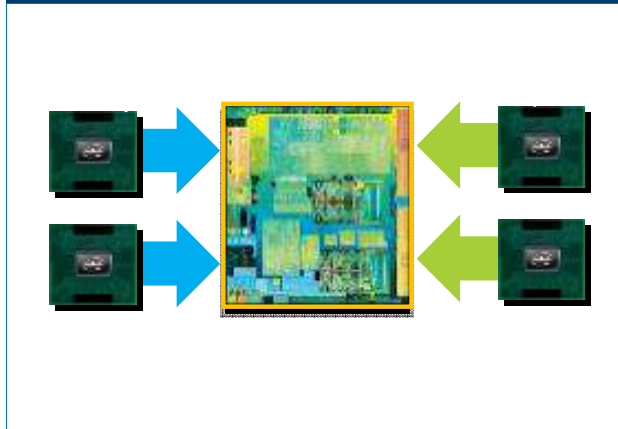
**April 2016**

# Intel Strategic Vectors

## MOORE'S LAW



## INTEGRATION



## SHARED IP



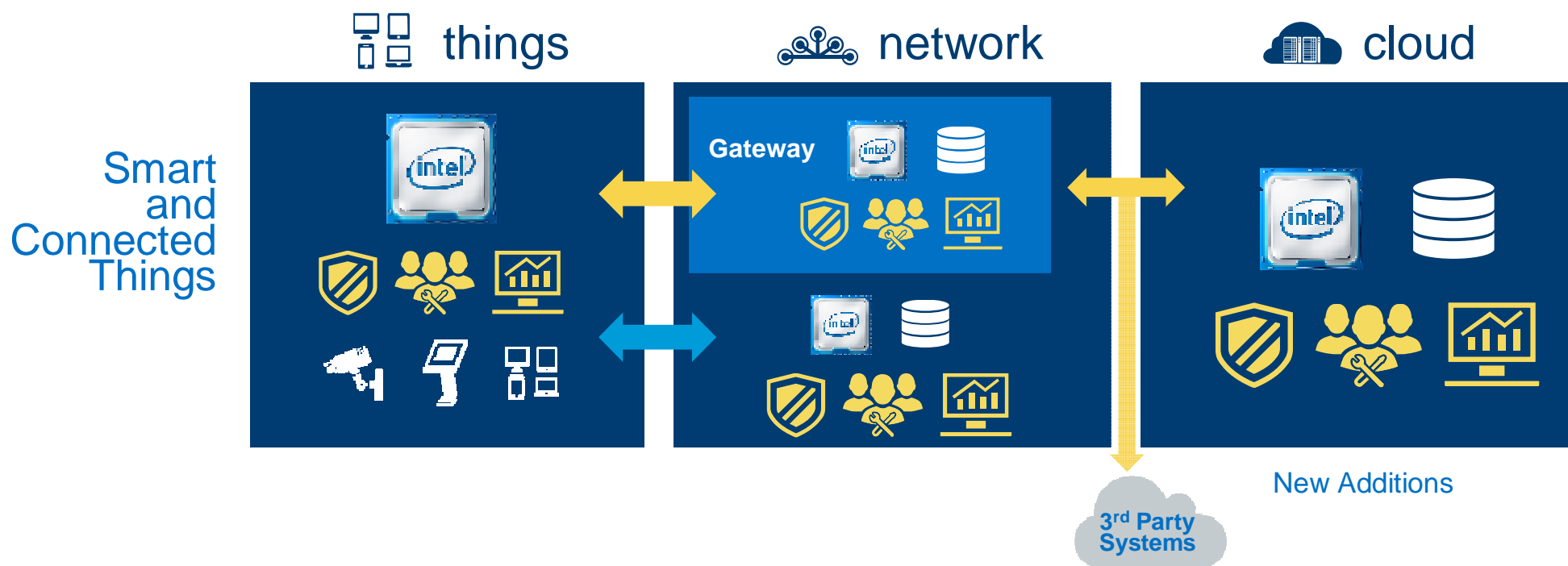
Our highest shareholder value will come from a strategy that uses our core assets to move into profitable, complementary markets

# Evolution of the Cloud

*Today*  
**Cloud driven by People**

*Tomorrow*  
**Cloud driven by Things**

# Cloud driven by Things

















# Internet of things

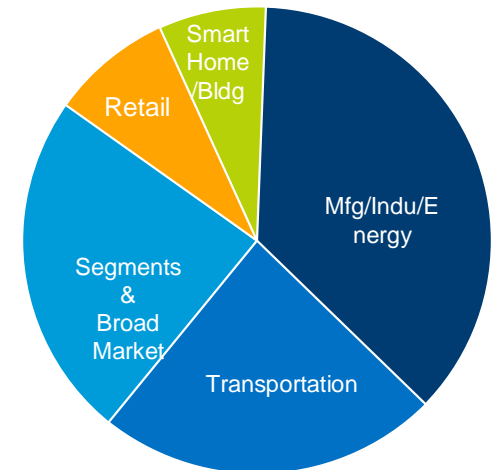
- Retail Solutions
- Transportation & Automotive
- Industrial & Energy
- Markets & Channels Acceleration



# IOTG Opportunity and Segments

Retail	Transportation & Automotive	Mfg/Indu/Energy	Markets & Channel Acceleration
 Transactional Retail  Visual Retail	 Software Defined Cockpit  Autonomous Vehicles	 Smart Mfg  Energy  Building Automation	 DSS  Gaming  Health  MAG  Print Imaging

## IOTG Market Opportunity



'16 SAM = \$15-\$18B

CAGR is '10-'14 SOM revenue; MSS is calculated with '14 SOM & silicon revenue SAM;

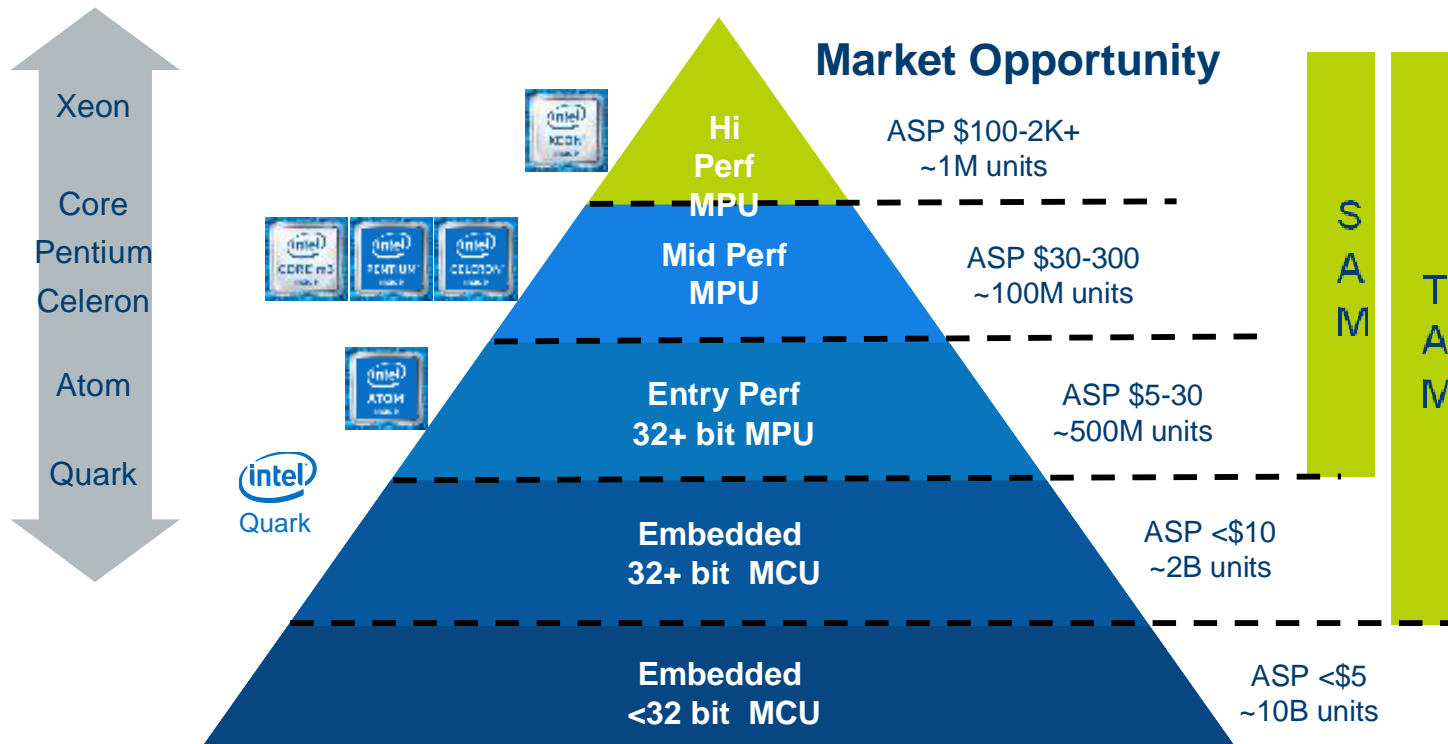
SAM is 32bit+ MPU/ASSP/ASIC with non-focused MPU/ASSP/ASIC devices removed; based on IDC 2015 eMPU report

\* 2014 Forecast

## WIND RIVER



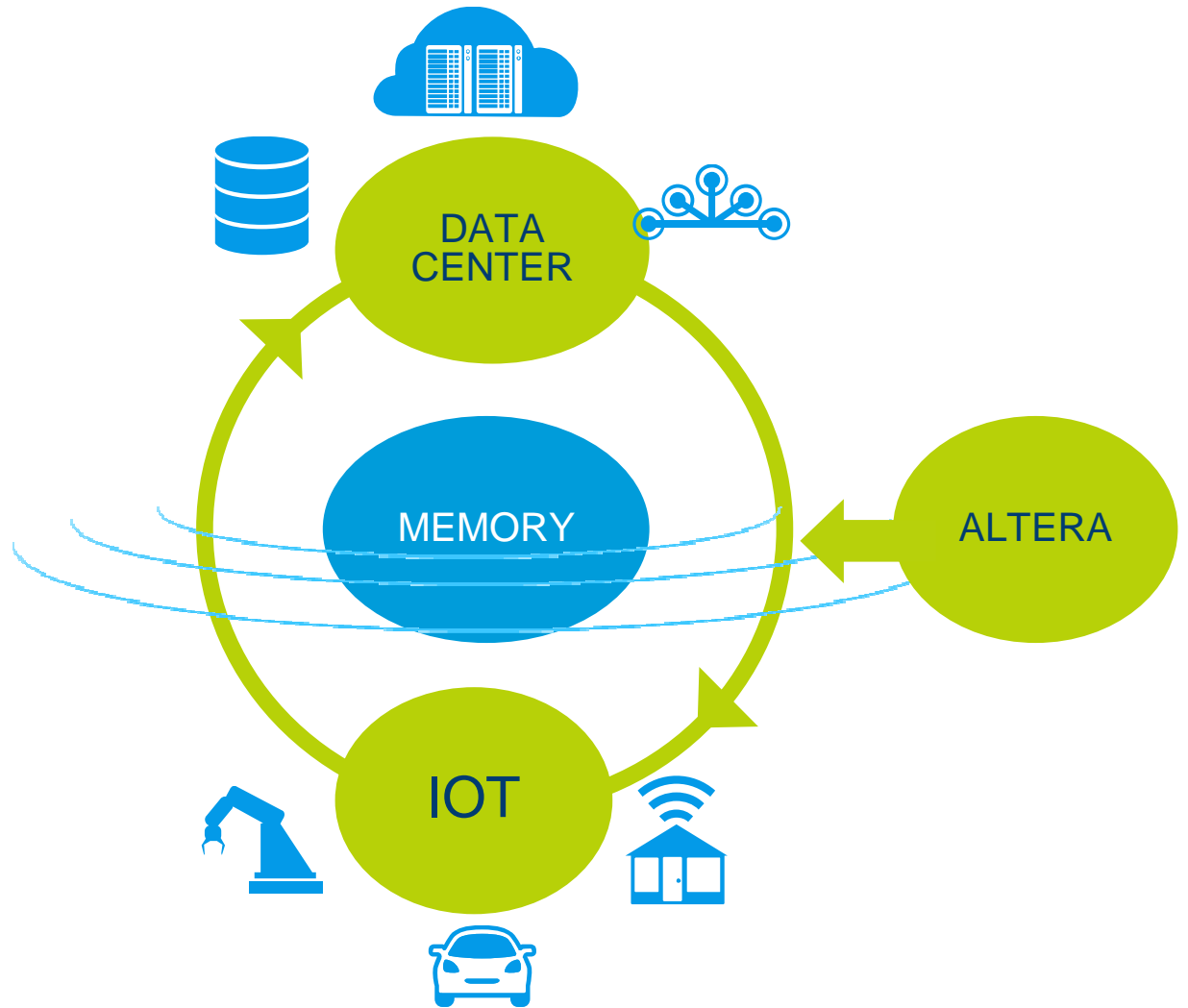
# IoTG Leverages Multiple CPU Families



Source: IDC, IHS, Gartner, Intel

MPU includes MPU, and core based ASSP/ASICs

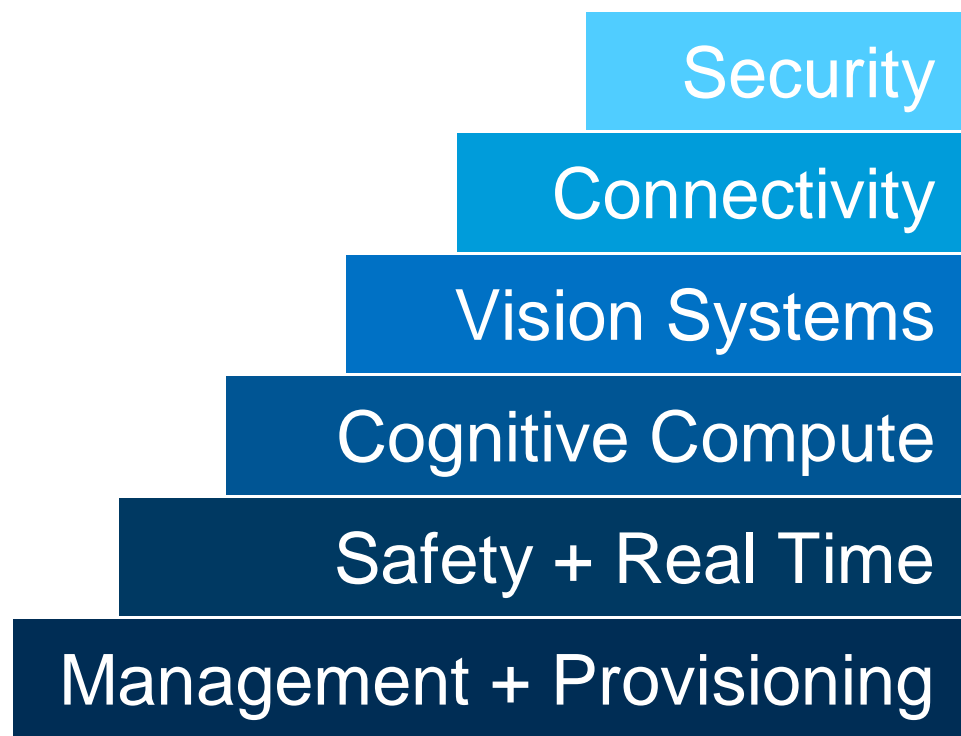
# ALTERA



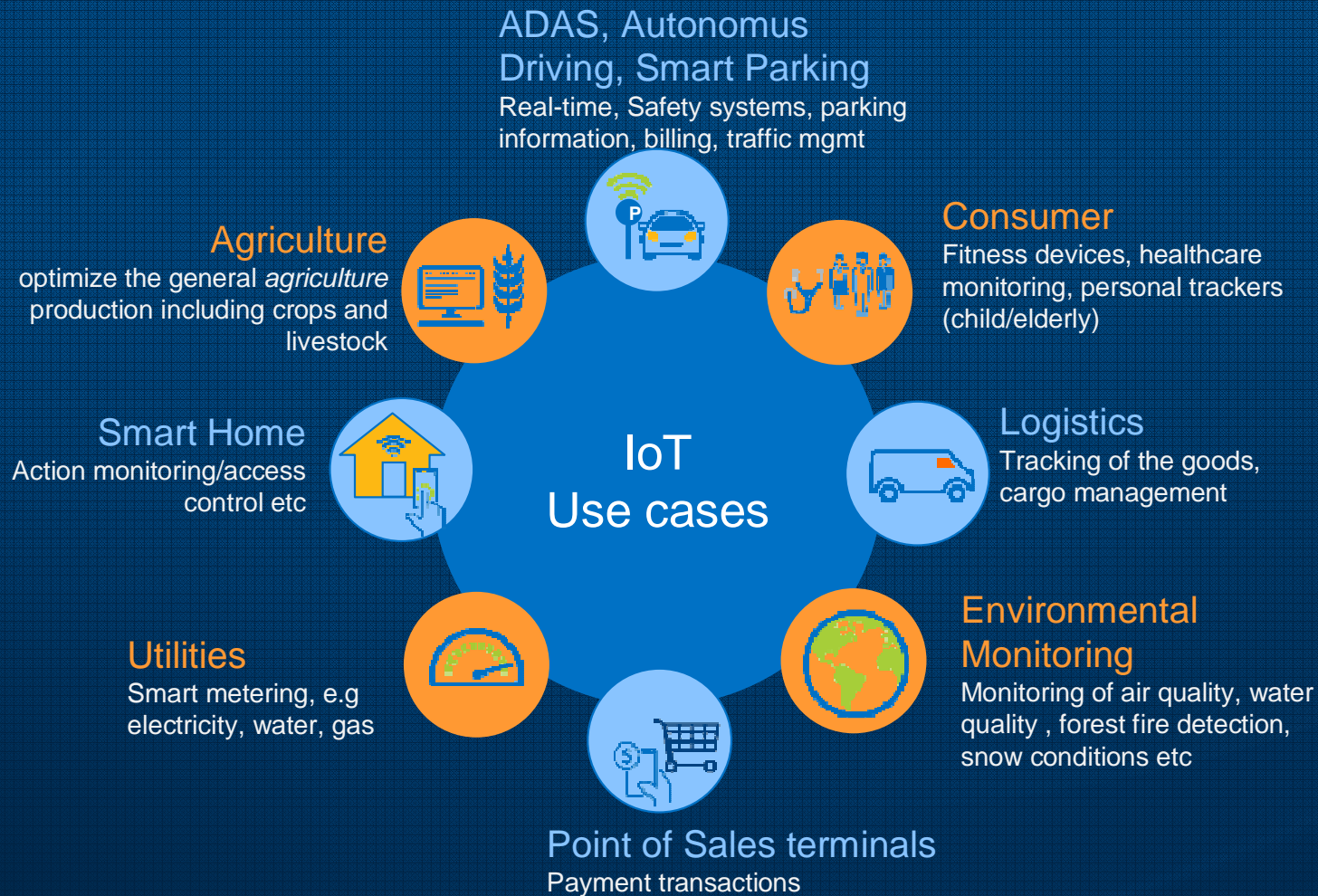
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# IOT Key Platform Capabilities



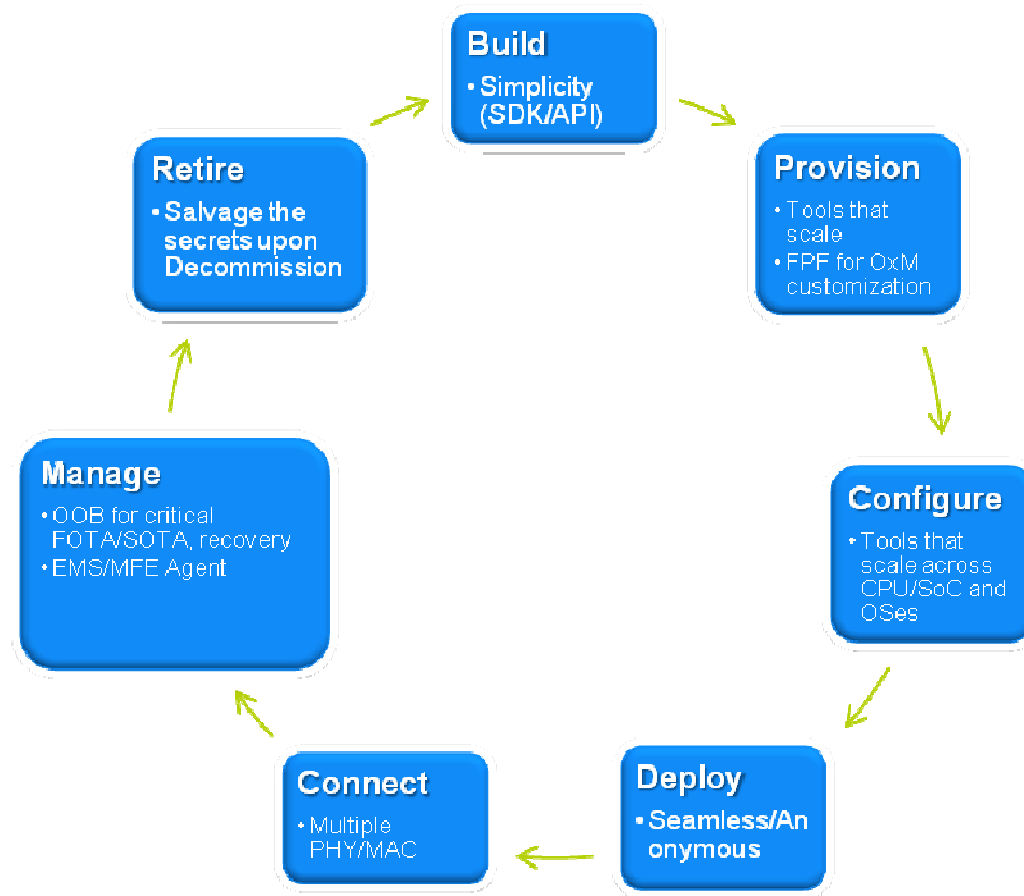
# IoT use cases: examples



# Why is Security critical in IoT?

- IoT Explosion
  - About 1 trillion connected machines and devices by 2022.
  - <http://theinstitute.ieee.org/ieee-roundup/opinions/ieee-roundup/the-explosion-of-the-iot-for-business>
- End2End security (Sensors, Edges, Gateways-data/content/API/payment/Analytics, Cloud)
- Anatomy of IoT hacks is radically different
  - <http://www.networkworld.com/article/2977094/internet-of-things/anatomy-of-an-iot-hack.html>
- Privacy is interwoven
  - The devices are intended to network but remain anonymous for service transactions/billing, etc.
- Protection Profile
  - Devices, identity, data at rest, data in transit.....

# Typical IoT Device Life Cycle

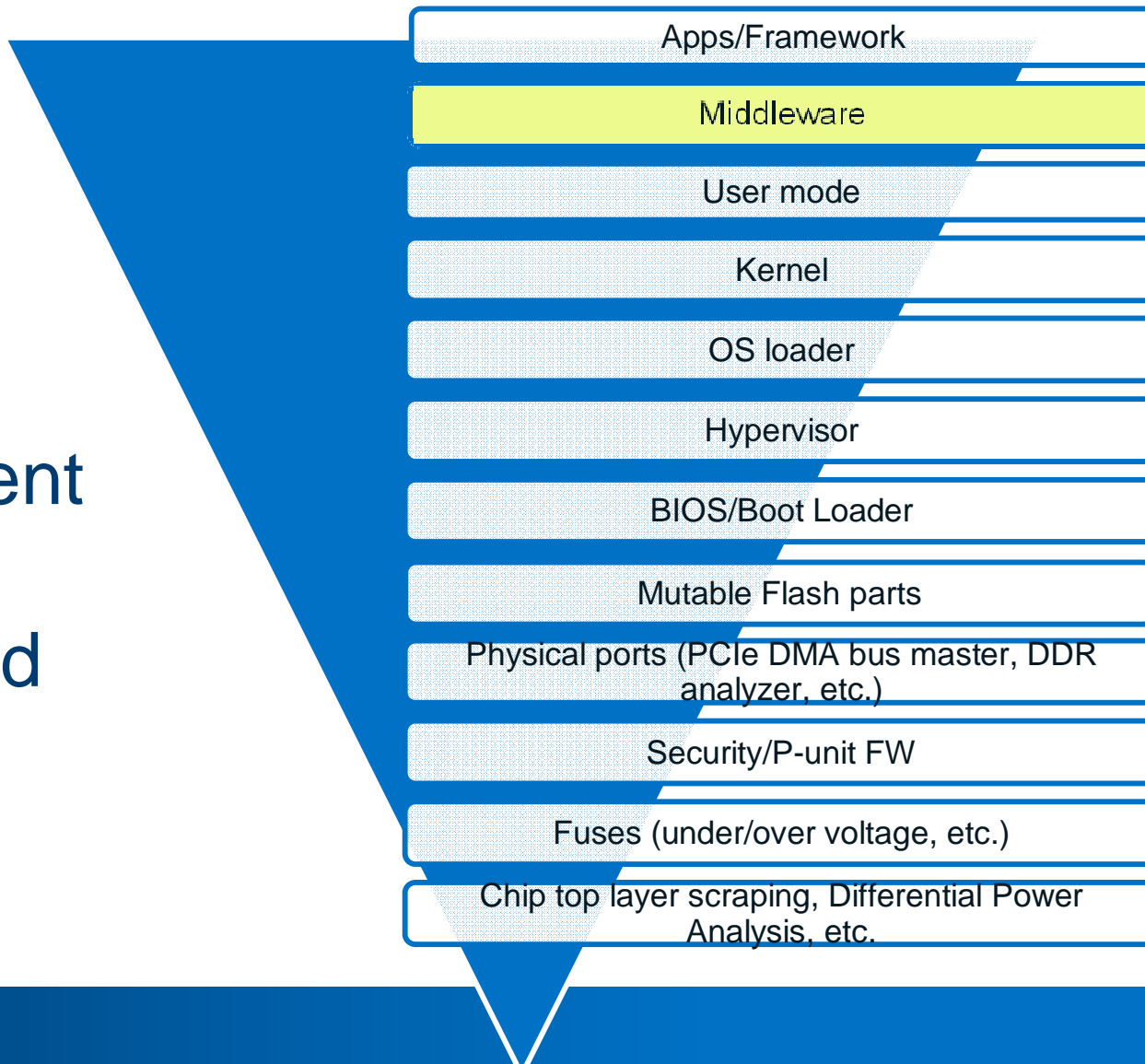


Requirements aligned/evolving throughout the device life cycle.

(..How to retire/decommission a device, Kill Pill etc., ..)



# Prevalent Attack Pyramid

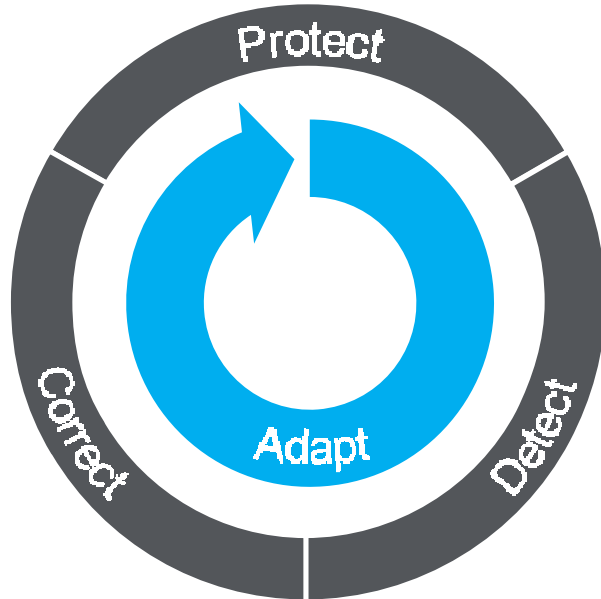


Volume of attacks is high with low complexity

Volume of attacks is low with high complexity

# Addressing the Threat Defense Lifecycle

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**Protect** – products and assets from tampering and misuse within the supply chain, while operating, and after deactivation



**Detect** – identity of hardware and software, the integrity of running software, the presence or absence of malware, the use of unauthorized services or applications, and verification of the safe deactivation of the device



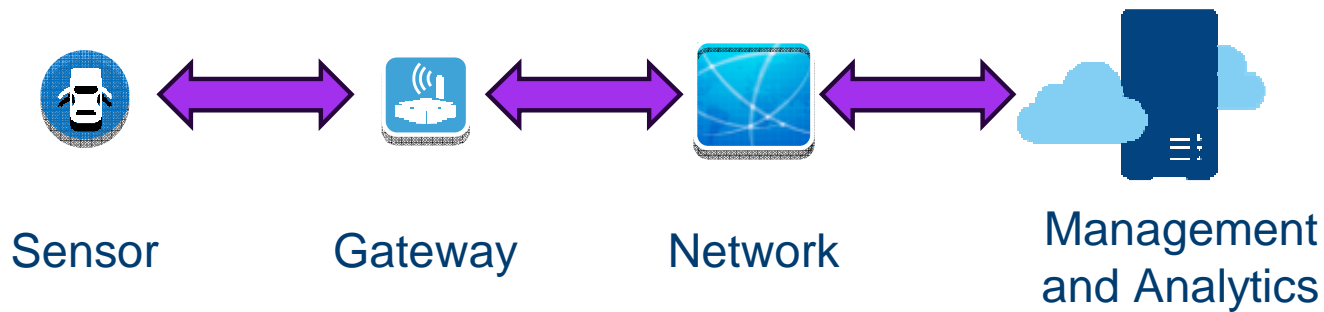
**Correct** – loss of integrity, without regard to the genesis of the loss, through the execution of a predefined corrective action plan that preserves current operations and data



**Adapt** – Apply insights immediately throughout an integrated security system.

# IoT Isn't That New

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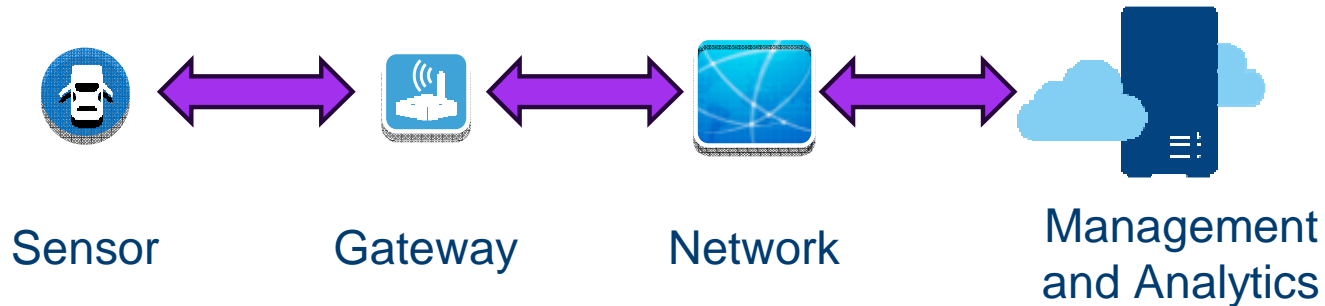


Each device has to address the threat defense lifecycle

Simple goal, get data from sensor, send it up to analytics and then do something based on that analysis

# Basic Blocks

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At each component there are a set of capabilities necessary:

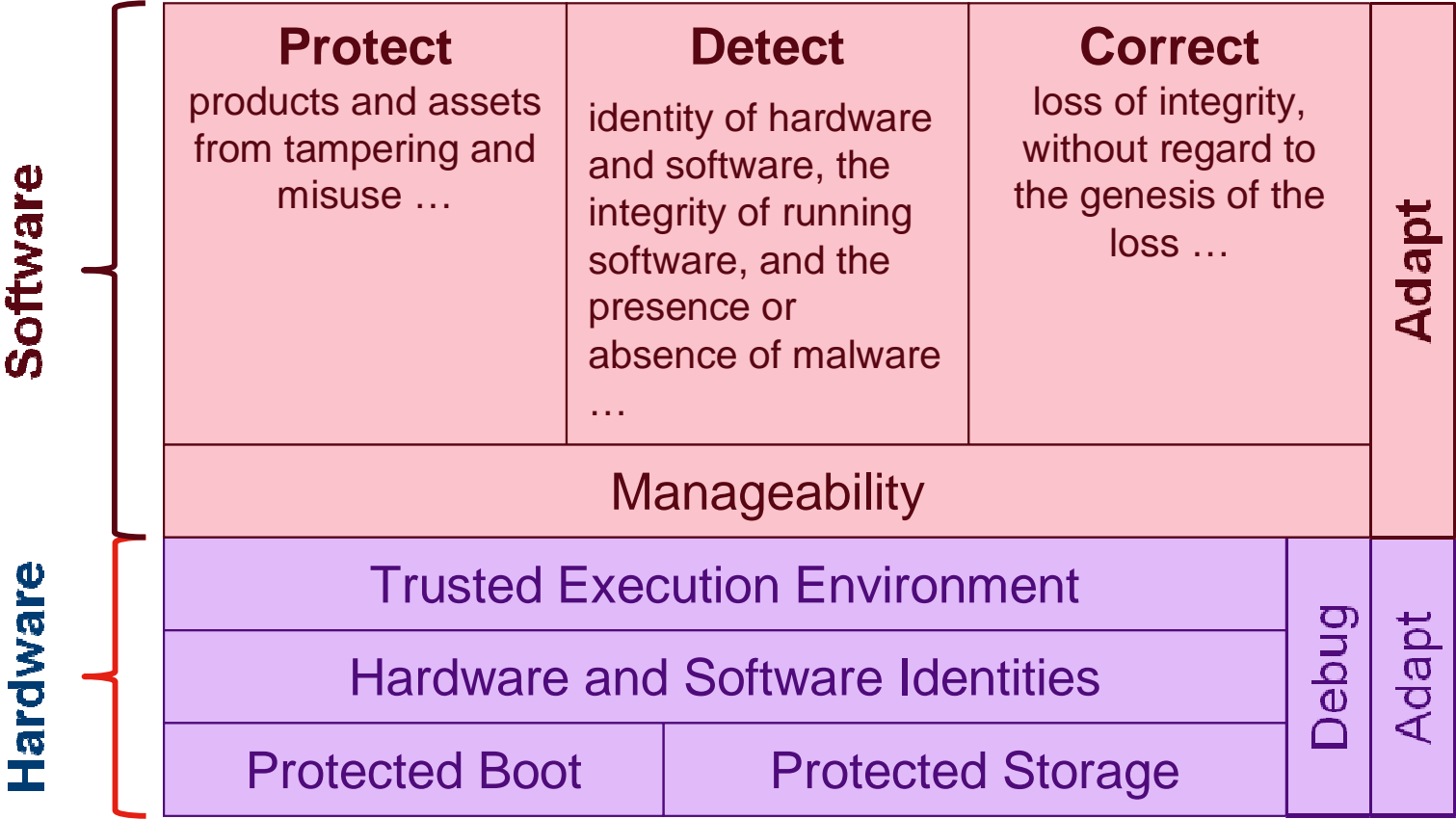
- 1 Hardware and Software identification
- 2 Trusted Execution Environment

TEE includes protections for booting and storage

- These capabilities enable:
- data protection: protected execution and protected keys
- Whitelisting: identification and protected execution



# Basic Block Architecture



# Hardware security building blocks

## Device Identity

- Immutable. Enhanced Privacy ID (EPID) or
- Platform Trust Technology (PTT) or TPM

## Protected Boot

- Hardware Root of Trust
- Secure/Verified Boot & Measure boot

## Secure Storage of secrets (keys and data)

- Using the PTT or TPM
- Using Isolated security engine

## Remote Attestation

- Verified Boot & Measure boot

## Secure Debug

- JTAG lock/unlock and ports

## Trusted Execution Environment

- Runtime isolated/protection for OS

## Crypto Accelerators and Counters

- AES, SHA, ECC, Secure Clock, Monotonic Counters, True RNG

## Protected Memory

- Memory Scrambling/Encryption
- Isolated Memory Regions

# IOT – A BIG PART OF 5G



5G  
USE CASES



BROADBAND EXPERIENCE  
EVERYWHERE, ANYTIME



MEDIA  
EVERYWHERE



SMART VEHICLES,  
TRANSPORT & INFRASTRUCTURE



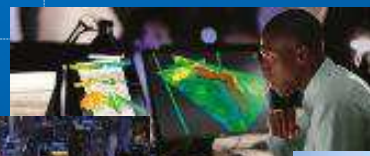
CRITICAL CONTROL  
OF REMOTE DEVICES



INTERACTION  
HUMAN-IOT



# IOT Market: 5G





# Partnerships are Critical

**2x**  
members  
**100+**

IOT Equipment  
BUILDERS



IOT Solution  
Providers

**2x**  
members  
**215+**

IOT Tech  
PROVIDERS

## Standards and Consortia

IPR Policy      Cloud-Native approach

Industry Standards + Open Source Solutions = Interoperability

NIST    SAP    Schneider Electric

Reference Architecture and Testbeds Approved Intel® IoT Platform Fully Compatible with both

Reference Architecture + Framework and Testbeds = Interoperability

# KEY Takeaways

Unmatched Horizontal Assets (Moore's Law, IP Reuse...)

Virtuous Cycle of Growth with Data Center: Next Wave of Cloud Driven by Things

Driving Disciplined Focus on Key Verticals

\$18B Opportunity Market Opportunity

IOT capabilities driven by the intersection of IT and OT

# Risk Factors

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