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Smart Partitioning and IoT System Development

COLM PRENDERGAST

Director of IoT Cloud Technology

07/12/2016

Introduction

- Value Creation & Smart System Partitioning
  - IoT Enabling Effect & Value Creation.
  - IoT Value Loops.
  - What does “Smart” Mean in the Context of IoT ?
  - Smart Partitioning - Examples.
  - Value Creation & Smart System Partitioning – Brief Summary
- Rapid Development of IoT Systems
- Summary.

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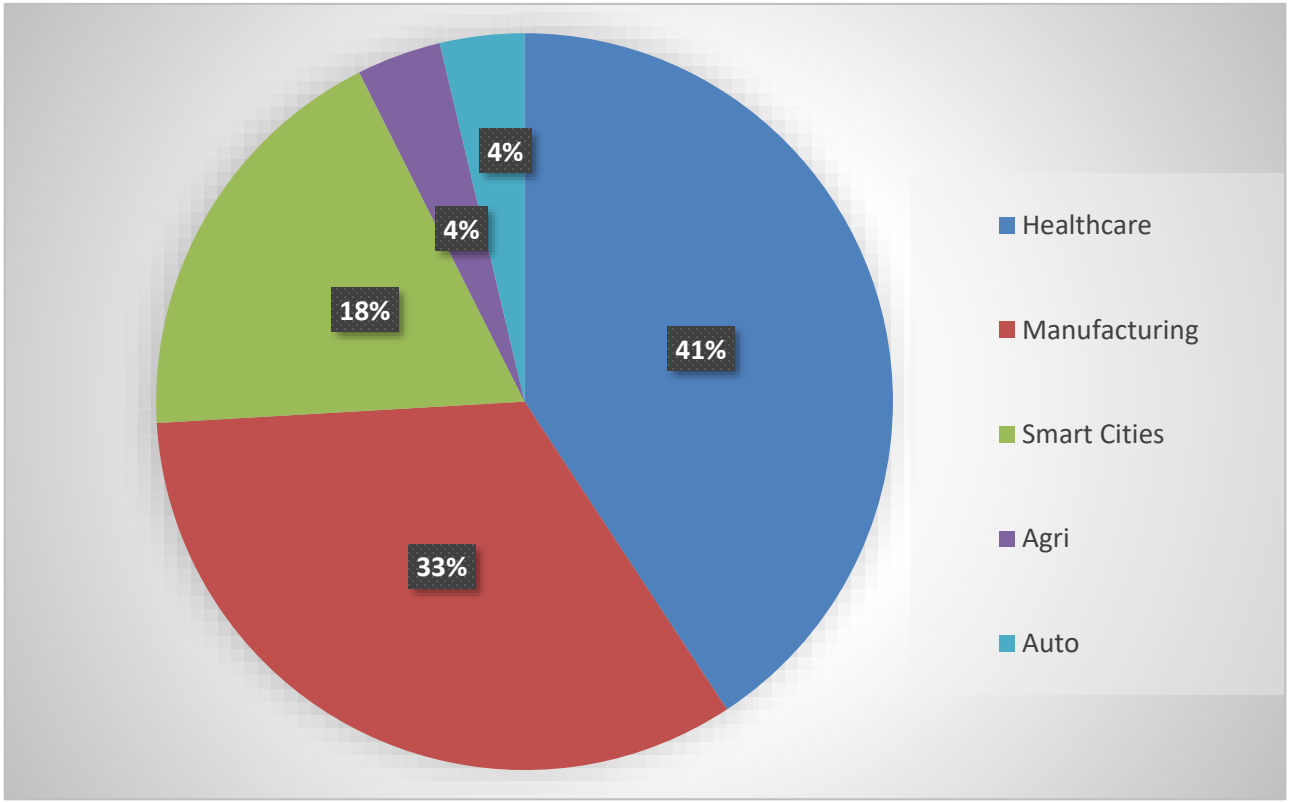
The IoT Enabling Effect and Value Creation

The IoT Enabling Effect and Value Creation

Total IoT Economic Value Impact in 2020
Total $2.7T (McKinsey) driven by
Healthcare and Manufacturing



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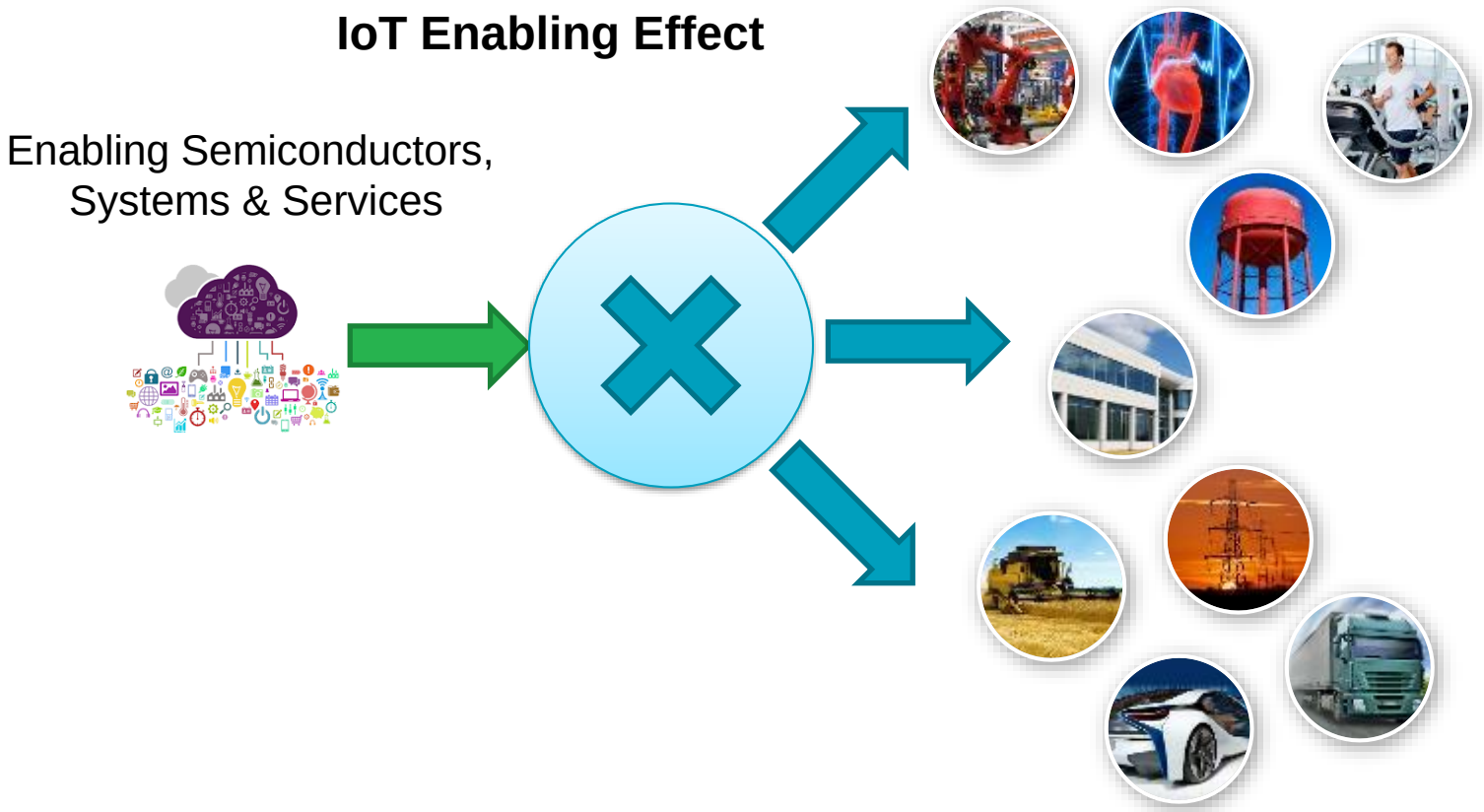
The IoT Enabling Effect and Value Creation



- **$2.7T OpEx saved through instrumenting applications in Healthcare and Manufacturing.**
- **Substantial Growth Opportunities for the Enabling Supply Chain.**

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IoT Value Loops

IoT Value Loops.

- How will this IoT Multiplier Effect be enabled ?

- By knowing when and how to change behaviour.

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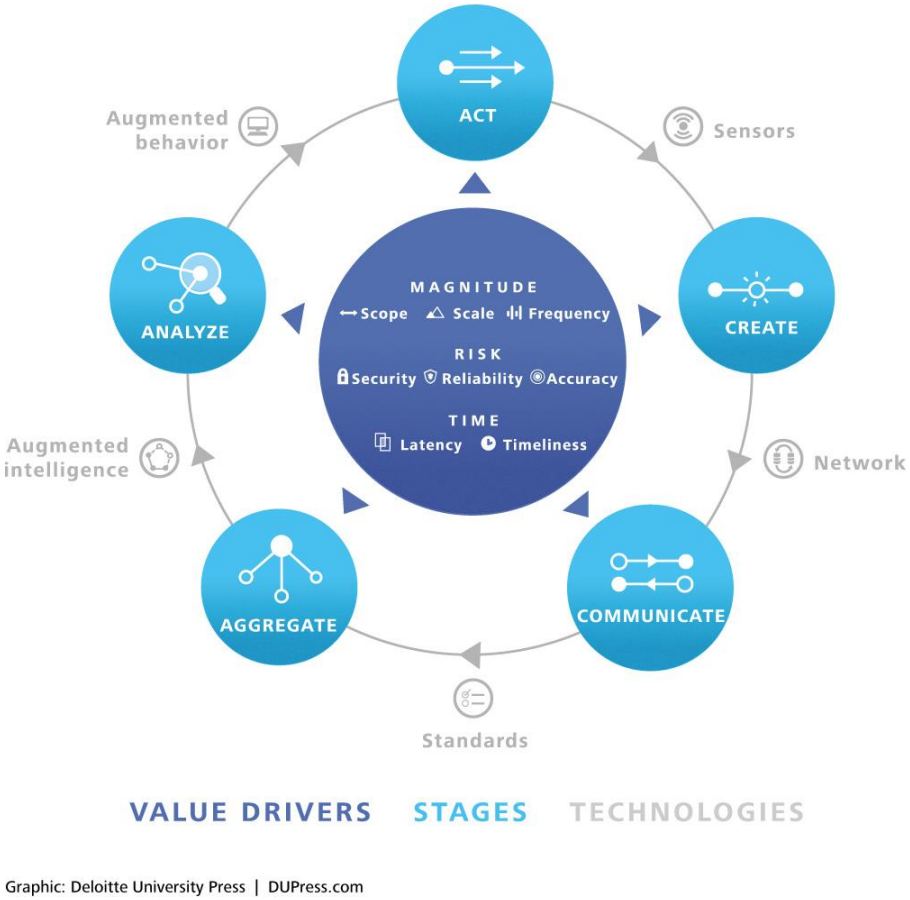
- Overall Solution Value comes from being able to modify behaviour to effect desired outcome.
  - Requires a loop to monitor and ultimately change the system behaviour.

Figure 1. The Information Value Loop



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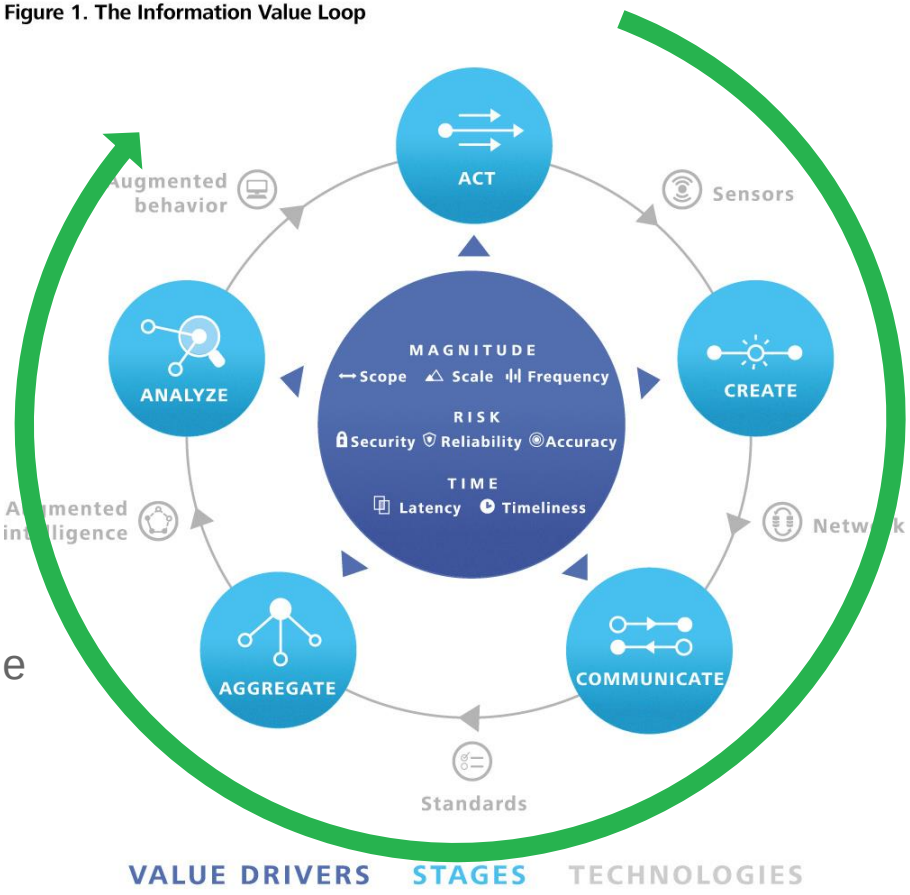
IoT Value Loops.

- How will this IoT Multiplier Effect be enabled ?
- By knowing when and how to change behaviour.
- Overall Solution Value comes from being able to modify behaviour to effect desired outcome.
  - Requires a loop to monitor and ultimately change the system behaviour.
- Before behaviour can be modified through action, the system must be analyzed so that the most appropriate action can be taken.

Figure 1. The Information Value Loop



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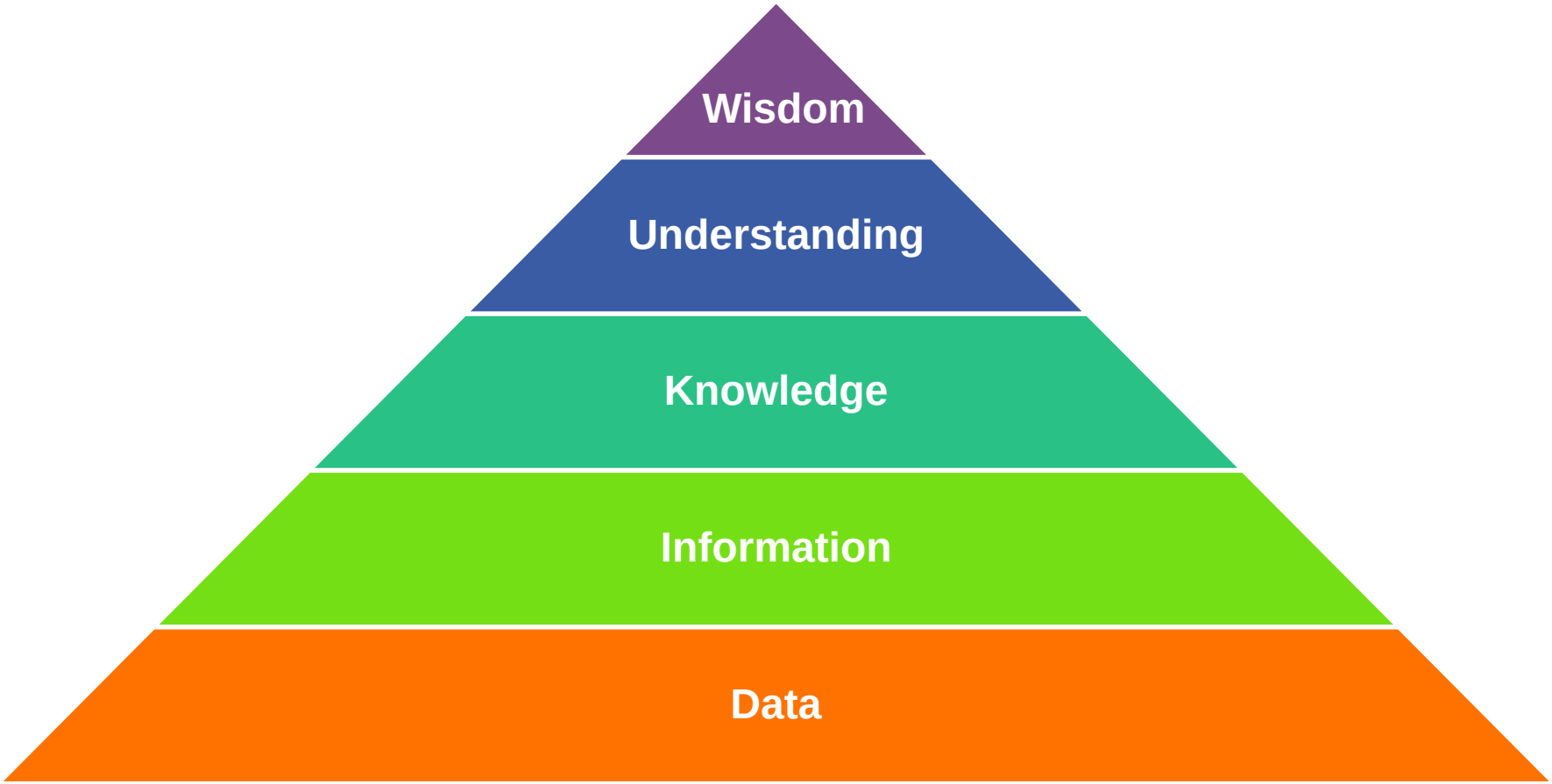
DIK(U)W and Value Creation

- Through the journey around this Value Loop sensor data is transformed into progressively more meaningful and actionable information.



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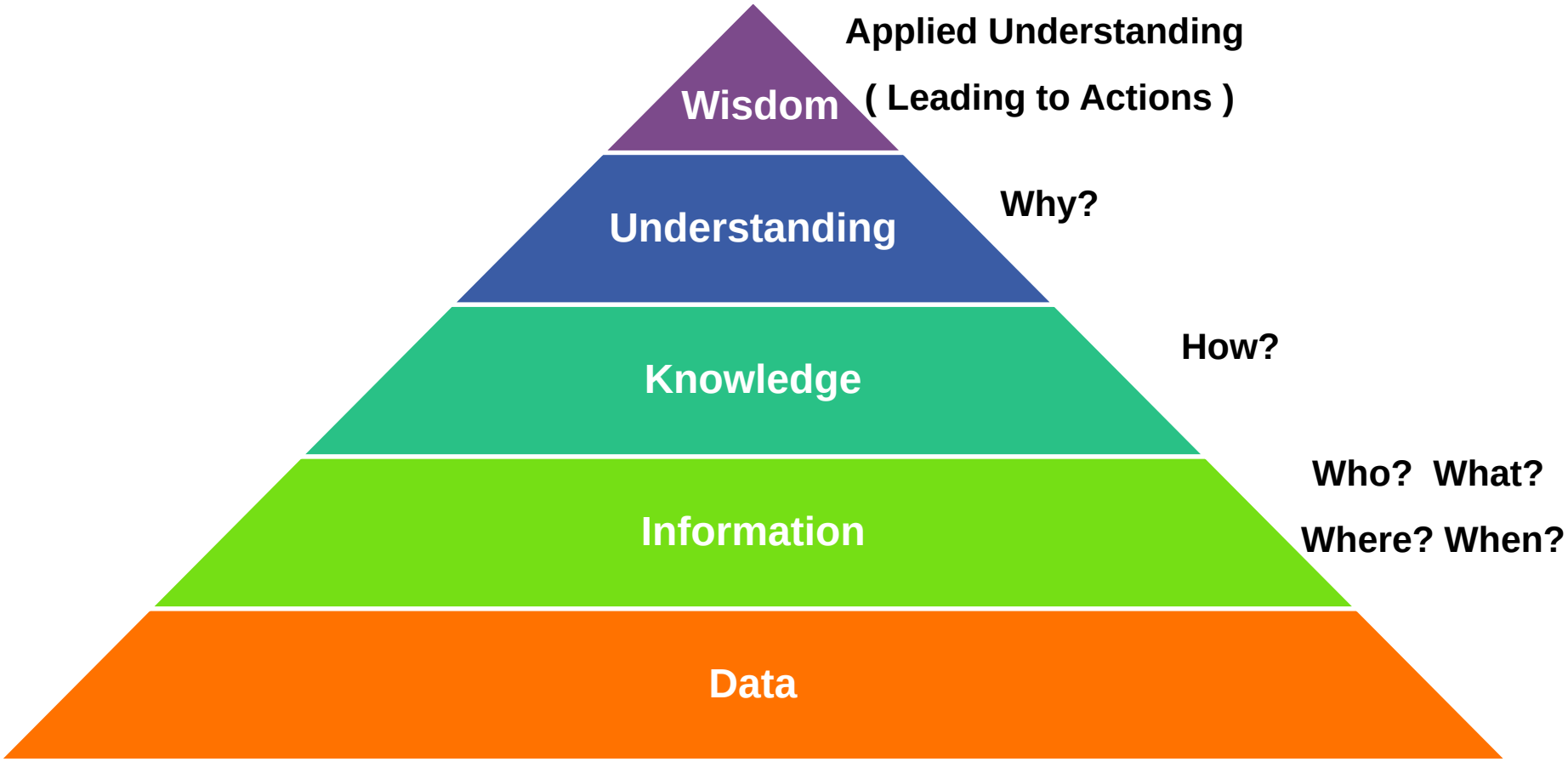

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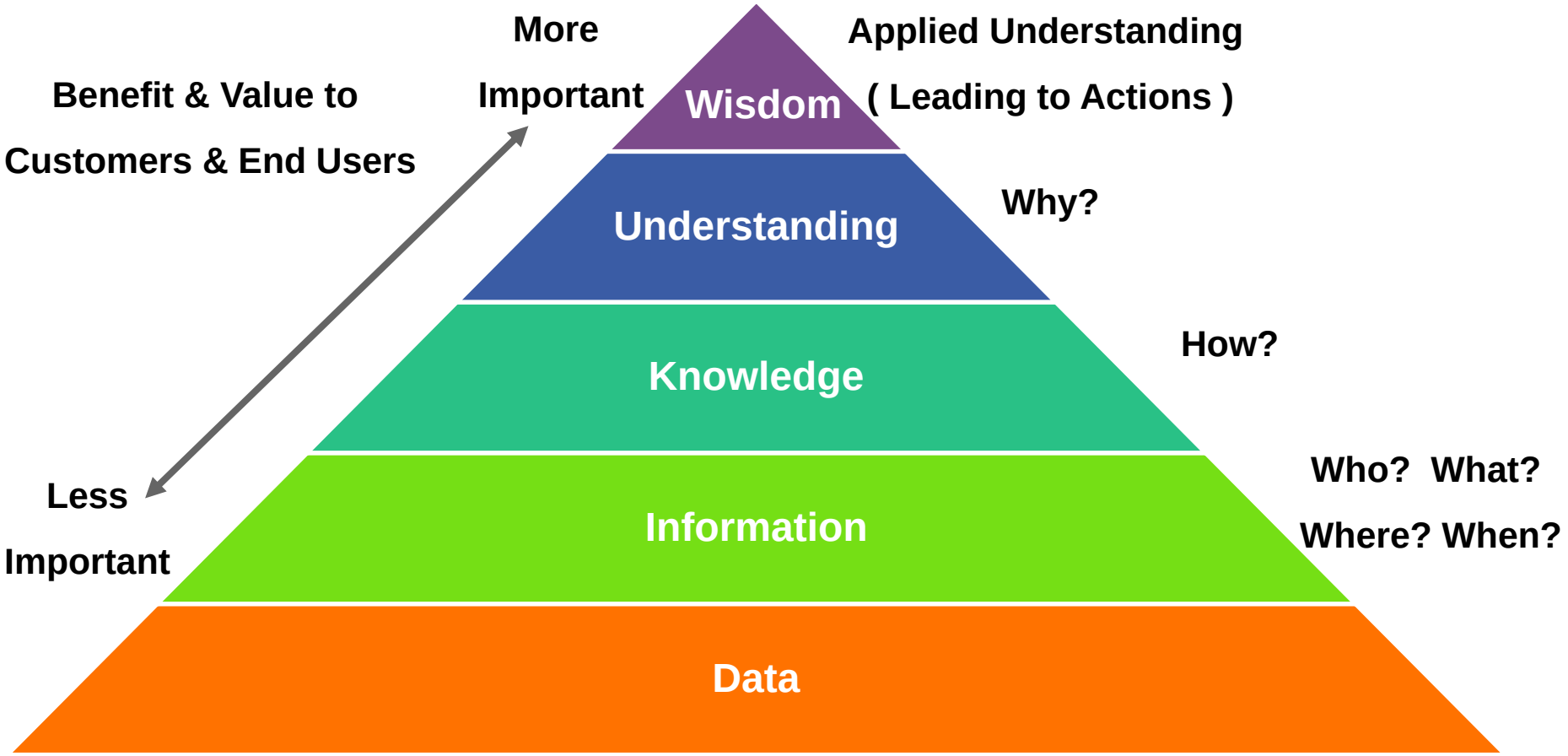

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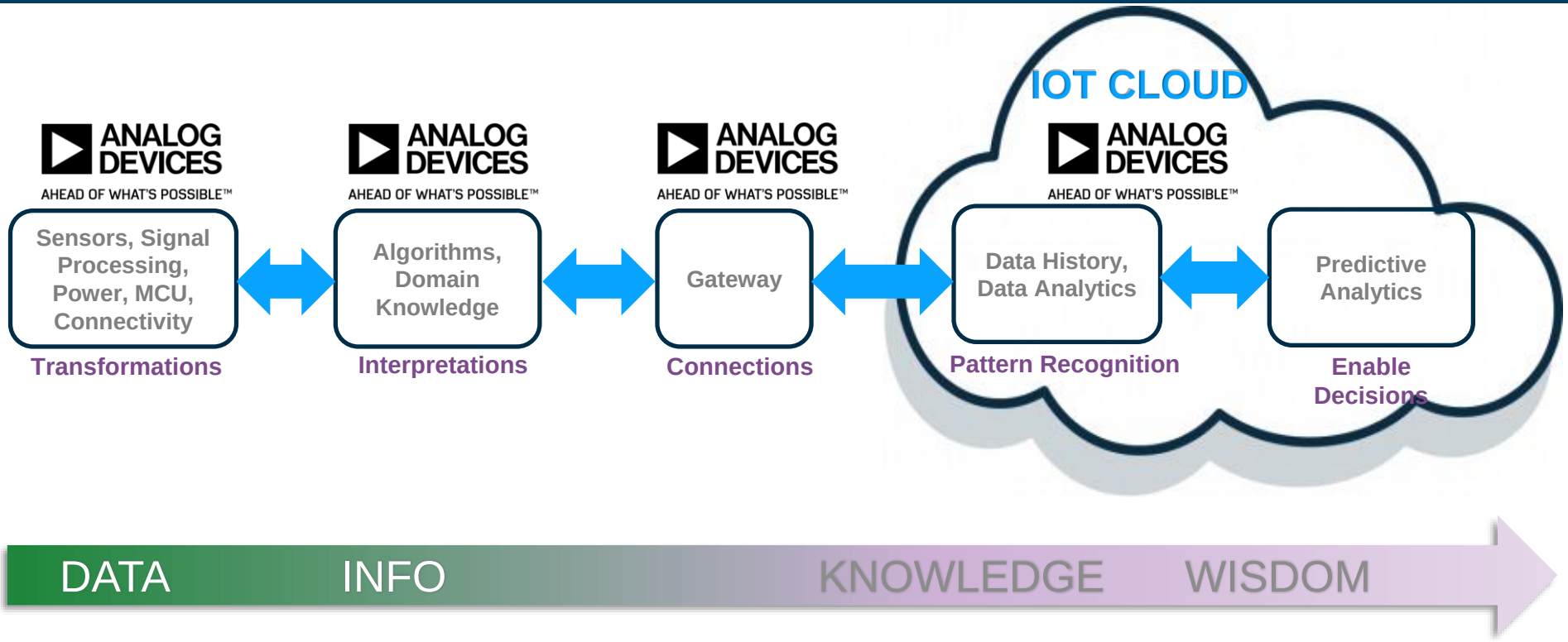
What does "Smart" Mean in the Context of IoT ?

IoT Signal Chain – Enabling DIKW Value Creation



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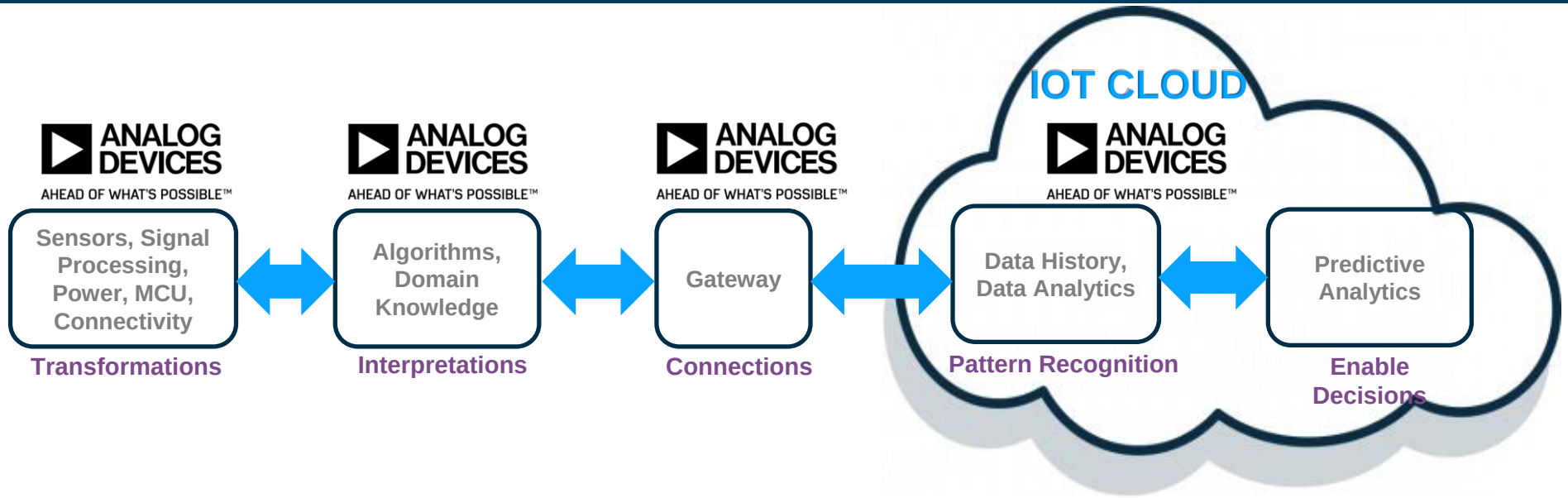

DATA INFO KNOWLEDGE WISDOM

- IoT enables increasing automation of this DIKW process, thereby enabling more efficiencies.

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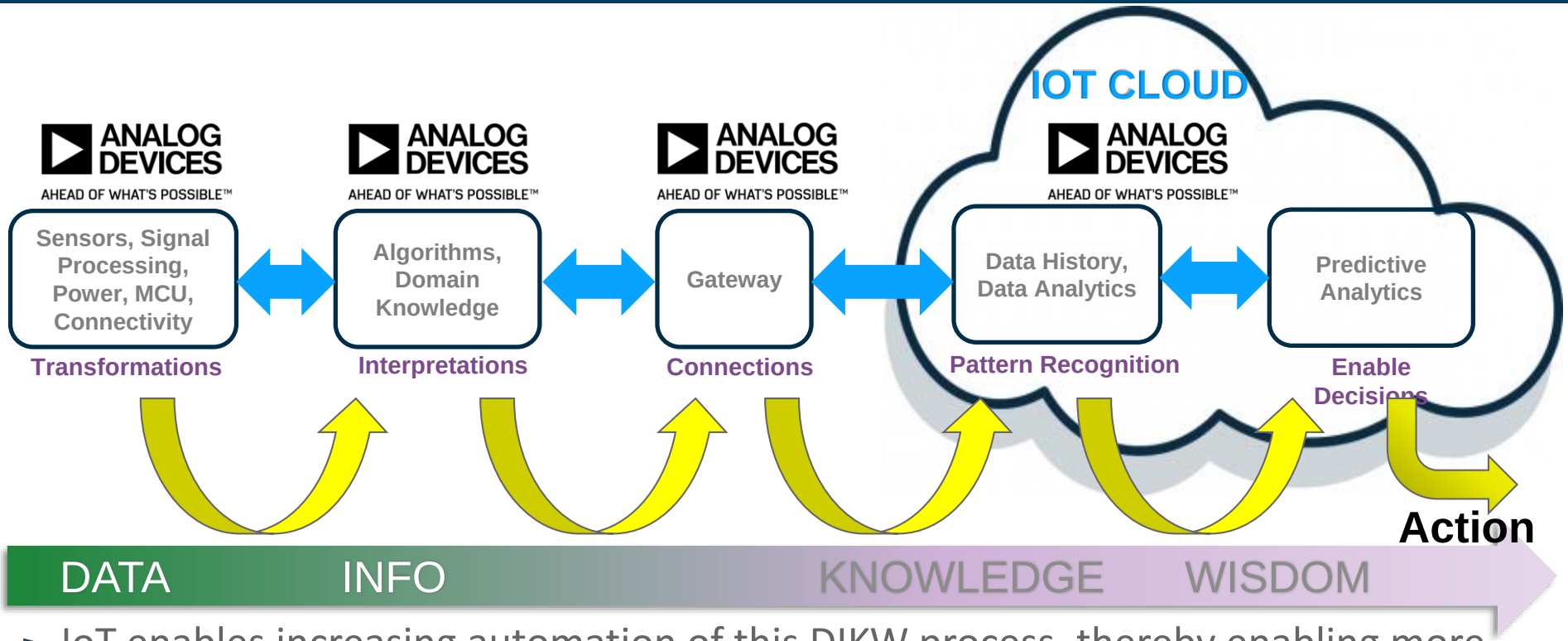
IoT Signal Chain – Enabling DIKW Value Creation



- IoT enables increasing automation of this DIKW process, thereby enabling more efficiencies.
- Every transformation step is a “SMART” step, it provides more valuable insights.
- Every “SMART” step is an opportunity to create & capture value.

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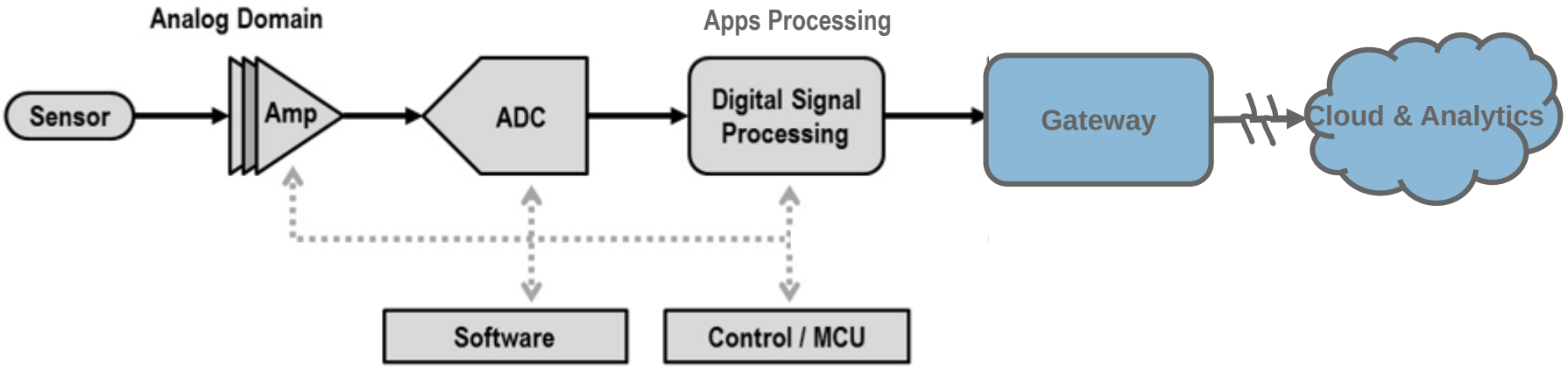
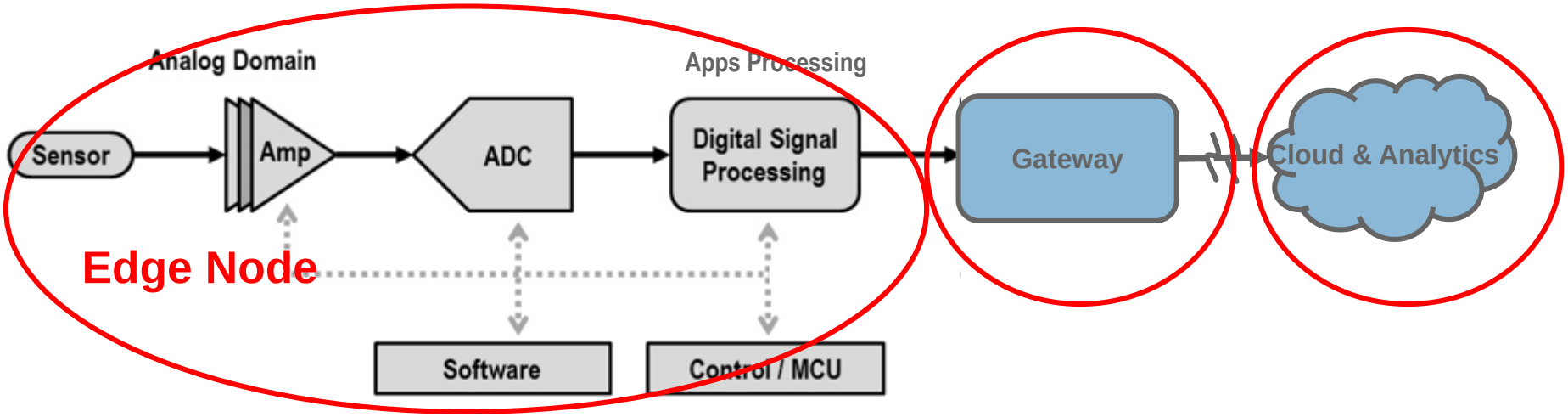
IoT Signal Chain – Partitioning Tradeoffs



sensing processing comms cloud analytics

IoT Signal Chain – Partitioning Tradeoffs



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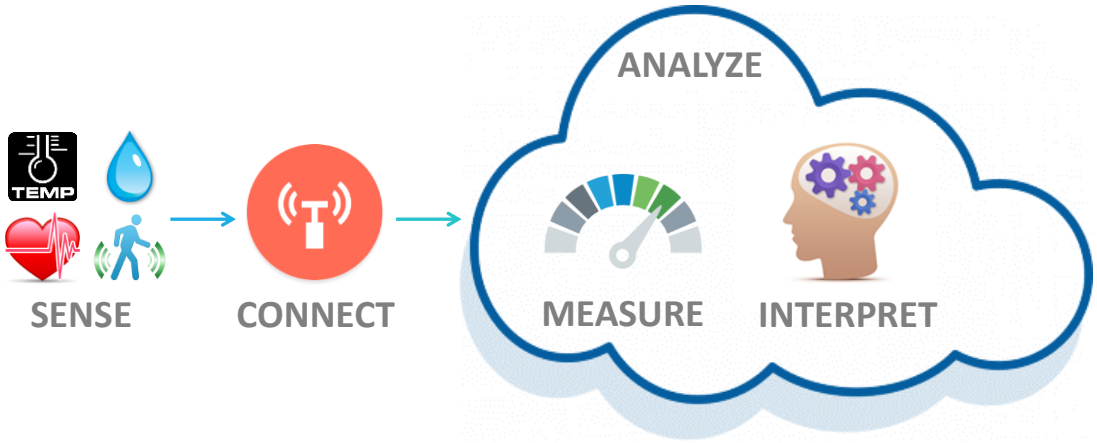
Smart Partitioning - IoT Evolving to More Intelligence at the Node

TODAY

- Data stays data: never generate wisdom and knowledge at the node
  - Power hungry and bandwidth intensive to convert and send all data



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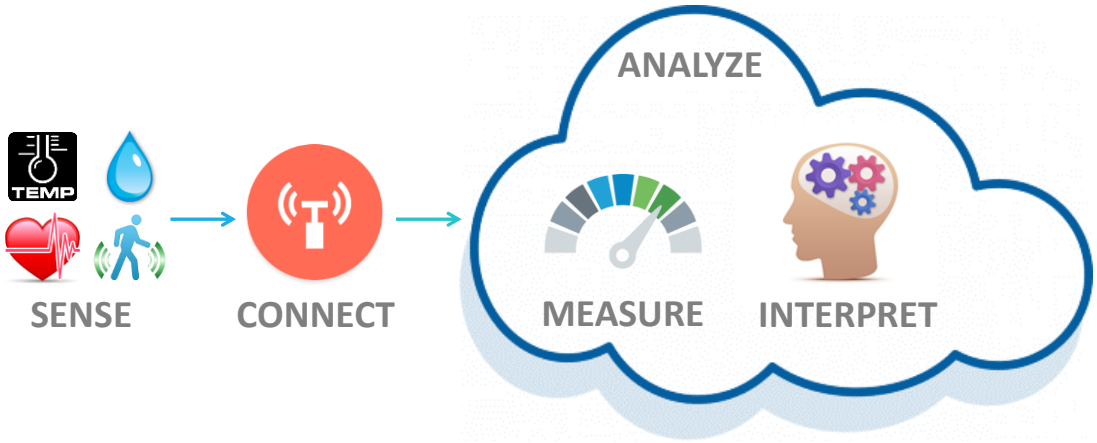
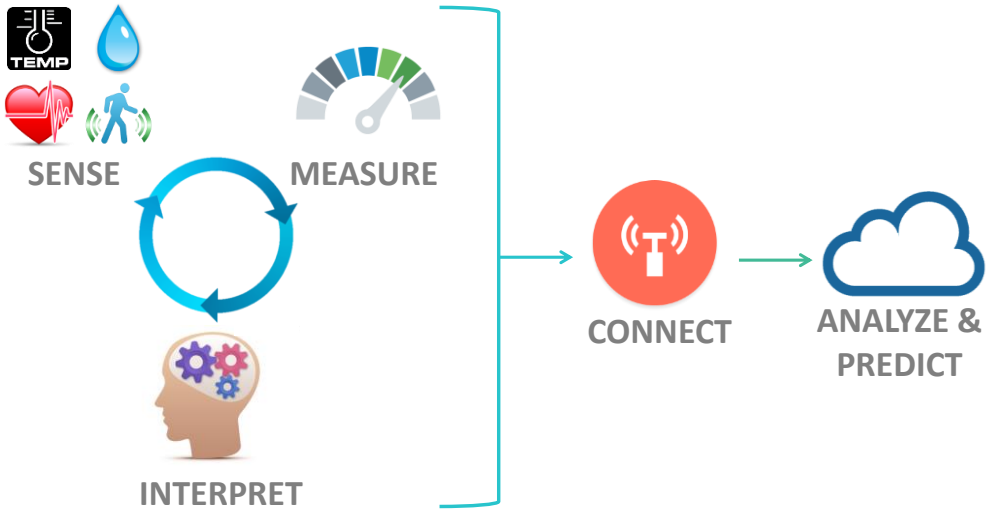


TOMORROW

- Intelligent "Smart" Sensing: node turns data into information
  - Lowers overall power consumption, lowers latency, reduces bandwidth waste
  - Enables move from reactive IoT → predictive & real-time IoT
  - Important in Smart Healthcare, Smart City, and Smart Factory



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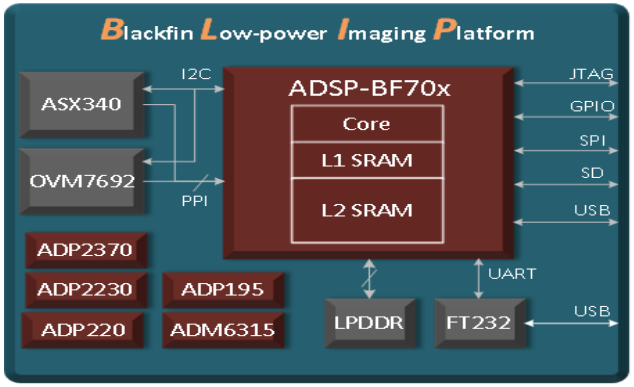
Smart Partitioning - Examples

Smart Partitioning Example – Remote Occupancy Sensing

- Video-based Occupancy Sensing (using BLIP – Blackfin Low Power Imaging Platform).
  - Edge Based Video Analytics to detect the presence and behaviour of humans and vehicles.
  - Only the Occupancy Information is transmitted – Higher Value, Low Bandwidth.



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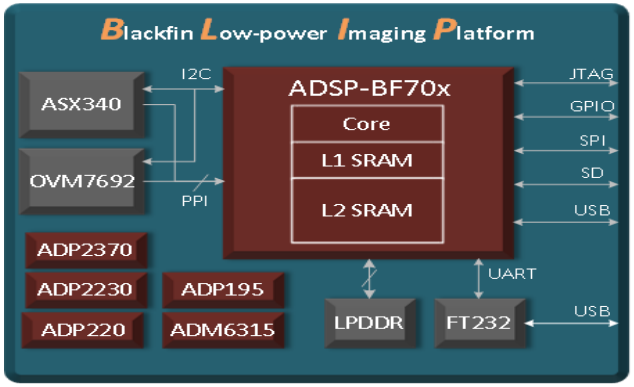

- **"Smart Node" can significantly reduce the amount of data being transmitted.**
- **Only Send the insights that the Customer / End User cares about.**

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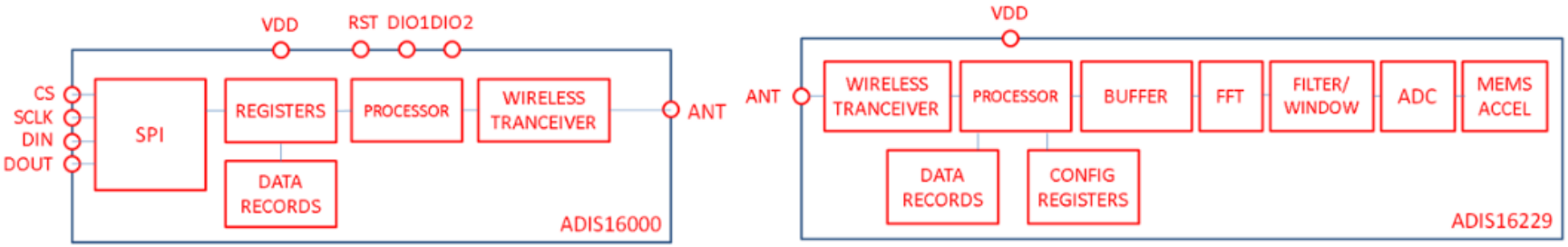
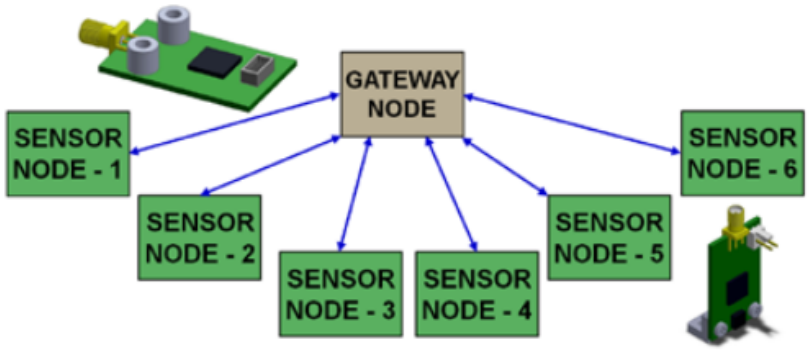
High Accuracy Vibration Sensing

- Smarter Edge Nodes - Vibration Sensors with Build-in Analytics ADIS16000/ADIS16229 Remote Vibration Monitoring System



MEMS-Based Sensor Node (ADIS16229) with 928 MHz RF Link to Gateway Controller (ADIS16000)



Six Remote Sensor Nodes Autonomously Detect/Collect/Process Data and Wirelessly Transmit to a Central Controller Node.

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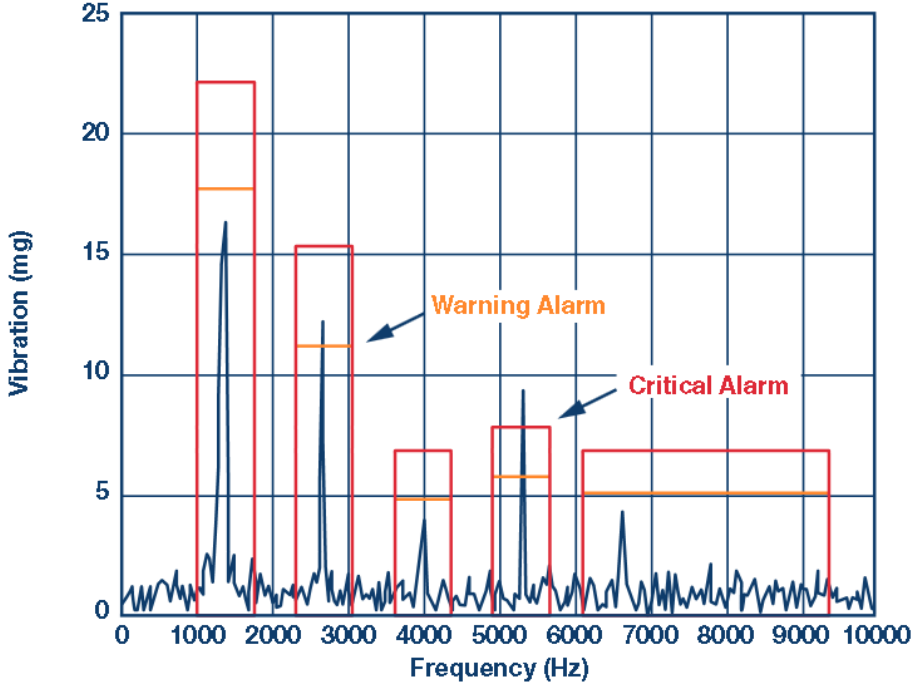
High Accuracy Vibration Sensing

- Node-based Analytics – Real-time FFT Analysis to Identify Potential Failures
- In Addition to Vibration Data and Frequency Content, Alarms Can Be Generated



Embedded FFT analysis with programmable filtering and tuning control.

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Value Creation & Smart System Partitioning – Brief Summary

Value Creation & Smart System Partitioning – Brief Summary

- Realizing the promise of IoT Economic Benefits will require solutions that can close Value Loops to efficiently modify System Behaviour.
- Automation of the Data-Information-Knowledge-Wisdom (DIKW) processes is key to understanding how to efficiently modify behaviour, enabling Value Loops.
- Conventional wisdom today suggests that processing in IoT systems should be done in the cloud
  - Moving processing to the edge enables “smarter” sensors and information extraction closer to the source.
- All of these systems must provide actionable insights to customers.
- We will now turn to how we can provide these insights to customers.

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Rapid Development of IoT Systems

Analog Devices IoT – Addressing the Top Obstacles to IoT Adoption.

Concept → Prototype → Test → Validate → Pilot → Scale → Lifecycle Management → End-of-Life

Top Obstacles to IoT Adoption & Digital Transformation

Complex Integration	56%	prefer fully integrated and validated solutions over separate best-of-breed vendors
Need to Automate Extraction of Insights and Resulting Actions	42%	pick analytics tools as most important enabler
Data Overload	40%	cite data management as #1 capability they need to improve
Expanded Security Vulnerability	76%	cite security is an important element of IoT implementation
Siloed Networks	25%	have experienced increased network strain when implementing IoT initiatives

Ease of Use

Smart Partitioning

Security

Sources: Cisco IoT Purchase Process Global Study January 2015, Forrester Research study commissioned by Cisco November 2014, IDC Futurescape: Worldwide IoT Predictions Dec 3, 2014

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IoT Security Controls

Initial Deployment	Authentication	Communications Channel	Access Control	Software Management	Storage	Supply Chain
Tamper and Side Channel Protection	Secure and Mutually Authenticated Channel	Message Authentication	Authentication, Privacy, and Access Management	Secure Coding Practices	Memory Protection	Authorized Distribution Channels
Identity and Root of Trust	Credential and Privilege Management	Timestamping	Key and Certificate Management	Virtualization	Key Protection	Track and Trace
Trusted Processor and Execution	Remote Monitoring	Physical Layer	Scan Chain and Failure Analysis	Software Containers	Data Masking and Loss Prevention	Spare and Maintenance Supply Continuity
Local and Remote Provisioning	Secure Boot	Entropy and Encryption	Log/SIEM and Digital Forensics	Predictable Holistic Behavior Environment		Counterfeiting, Trojans, IP Piracy, and Overbuilding
	Software Attestation	Interface Security and Firewalls	Intrusion and Anomaly Detection	Revision Control Odometer and EOL		
	Direct Anonymous Attestation			Verification and Obfuscation		
	Signatures and Certificates			Updates and Patches		
				Device/Network Analysis and Threat Intelligence Exchange		

- A variety of Controls and Countermeasures are needed in IoT Systems.
- Goal: Increase the attack cost to unprofitable levels.

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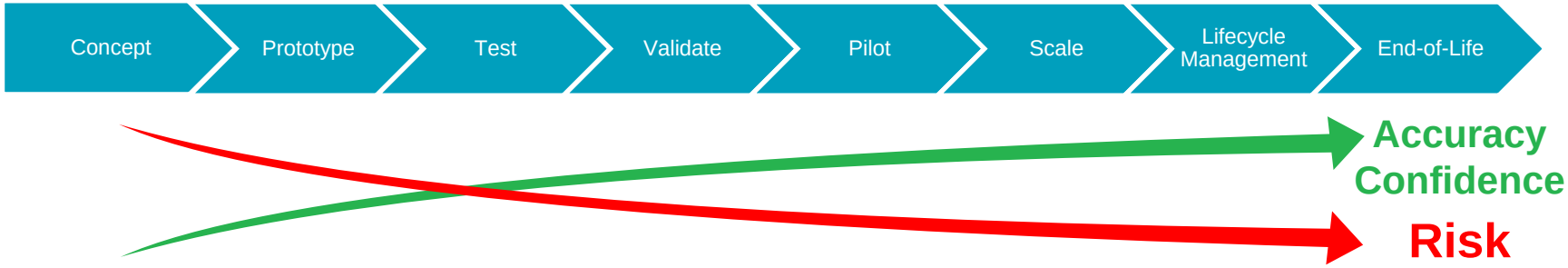
Analog Devices IoT – Accelerating Customer Development - Challenges.

Product Development & Lifecycle Phases.



- Customers want a seamless progression from Product Concept to Scale & Beyond.
- Focus on their Value, not making our (vendor) solutions work.
- Becoming System Integrators.
- Minimize Risk – especially at Transitions.
- Maximize Reuse from Prototype to Production and between different developments.
- Significantly Improve Time to Prototype / MVP & Scale.
  - Tools must be easy to use & enable end-product to be easy to use.

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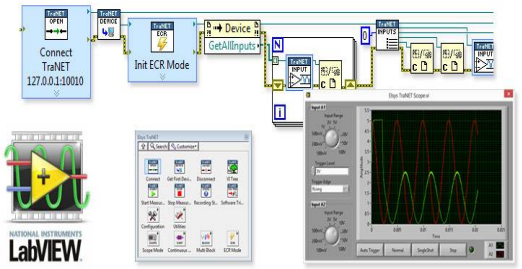
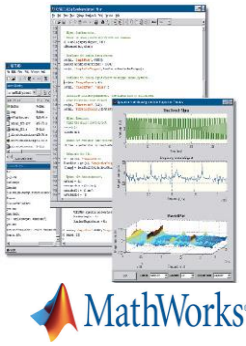
Analog Devices IoT – Customer Concept Development.

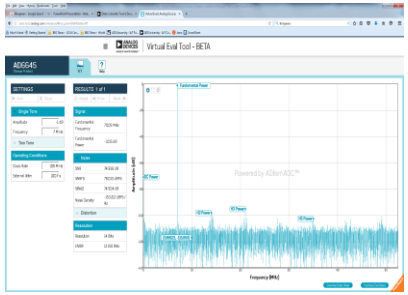
Concept | Prototype | Test | Validate | Pilot | Scale | Lifecycle Management | End-of-Life

Concept Development: Edge Simulation Tools & ThingWorx Cloud Platform





HTTP REST / MQTT



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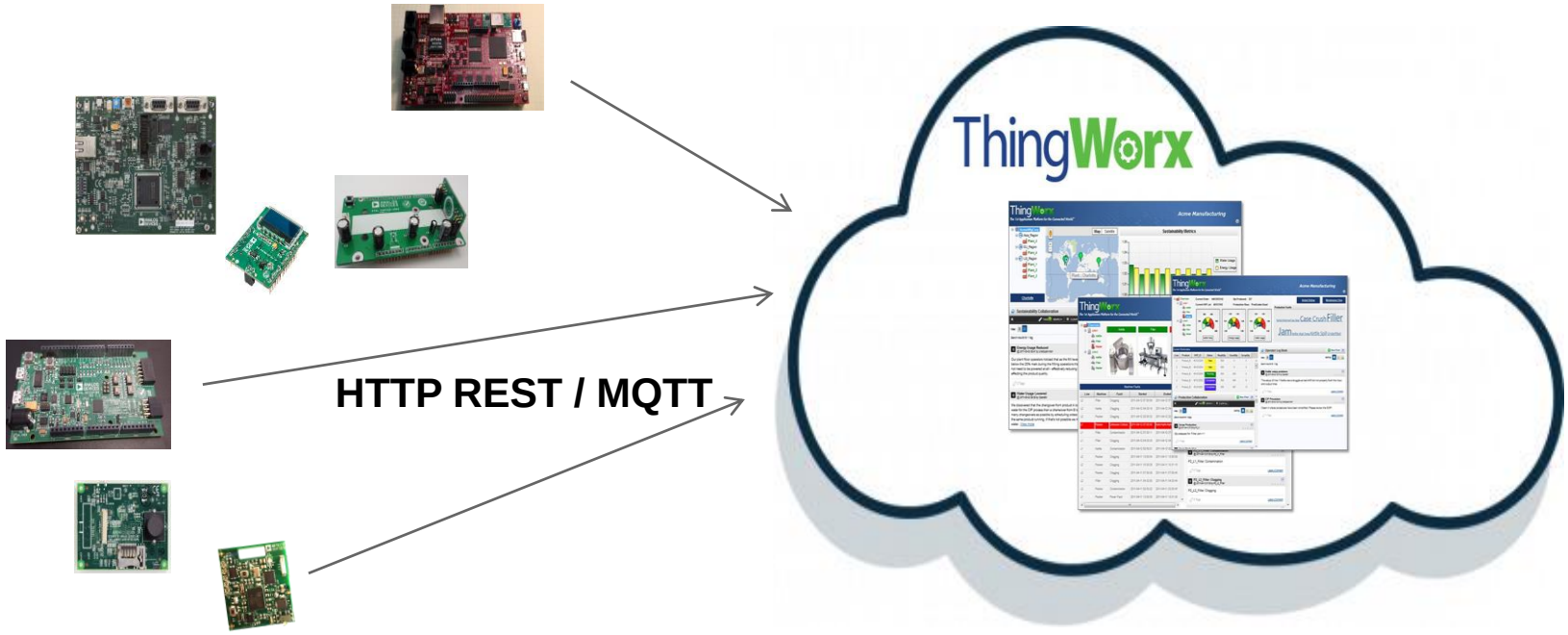
Analog Devices IoT – Customer Prototype Development.

Concept | Prototype | Test | Validate | Pilot | Scale | Lifecycle Management | End-of-Life

Prototype Development: Edge Development Kits & Cloud Platform



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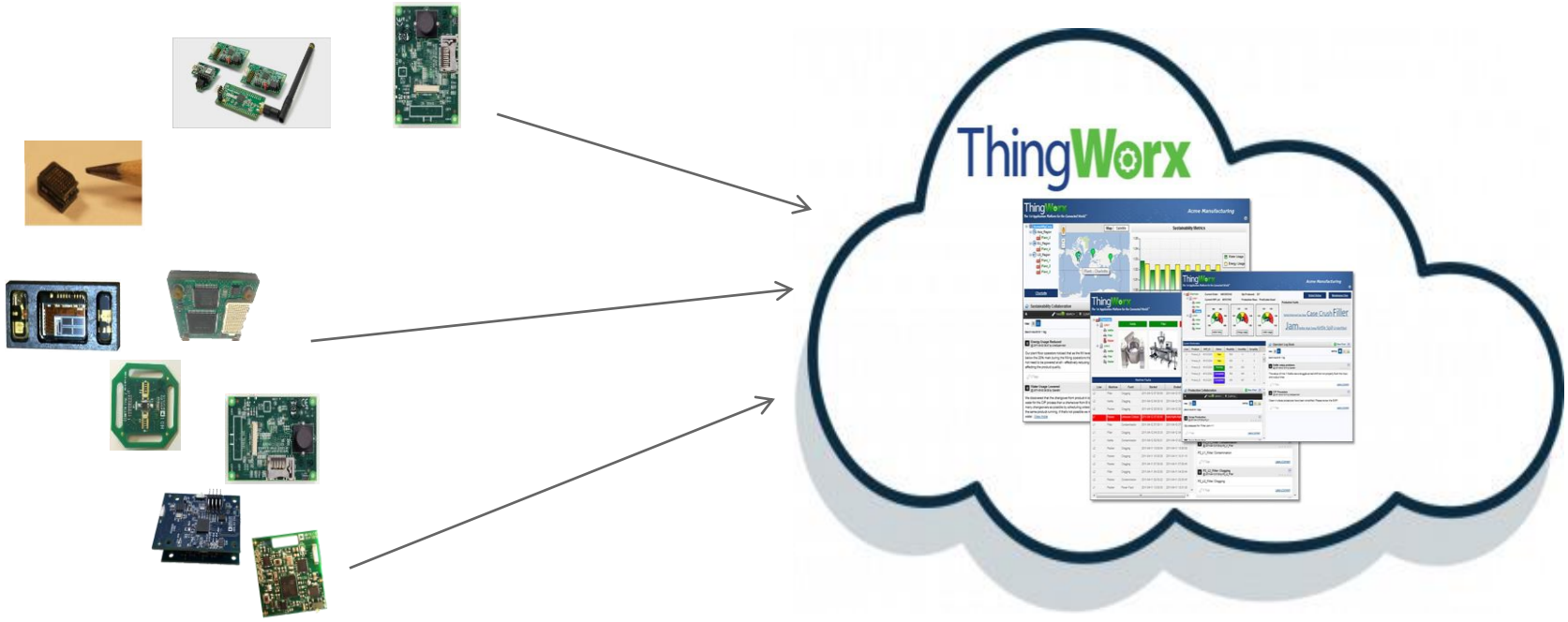
Analog Devices IoT – Pilot Development and Production Scale.

Concept | Prototype | Test | Validate | Pilot | Scale | Lifecycle Management | End-of-Life

Pilot Development and Production Scaling: Edge Modules / Custom Design

Cloud Platform



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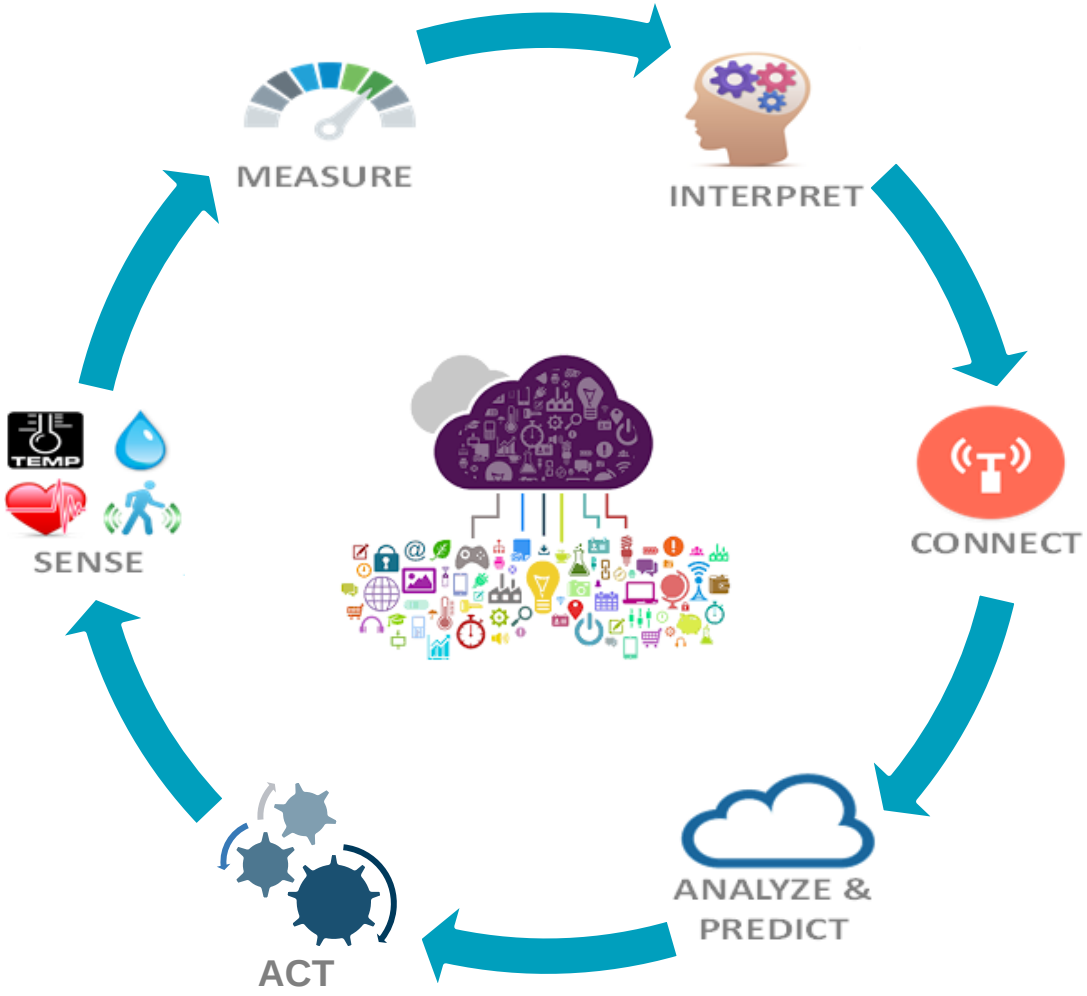
Analog Devices IoT – Enabling the Information Journey



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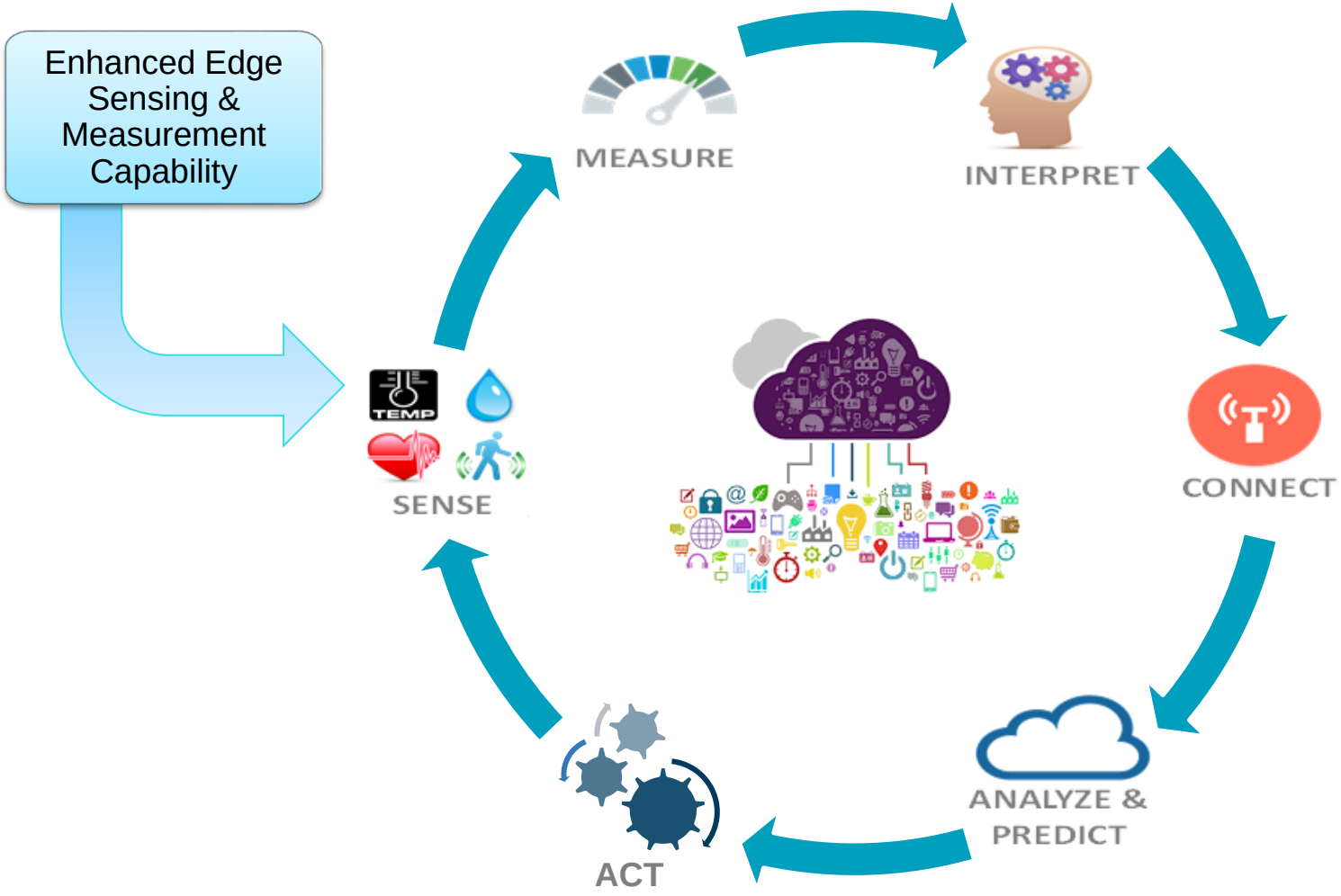

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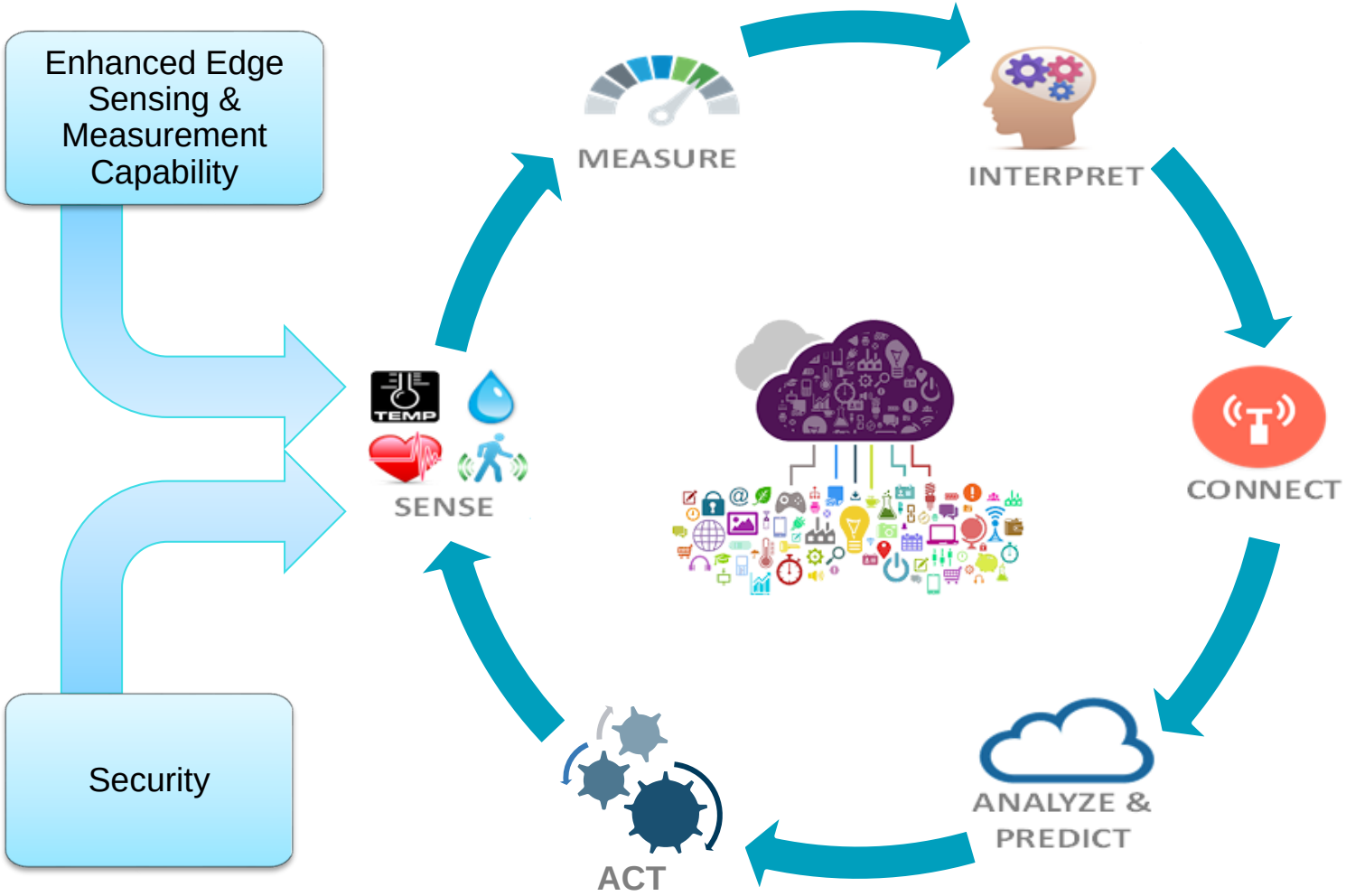

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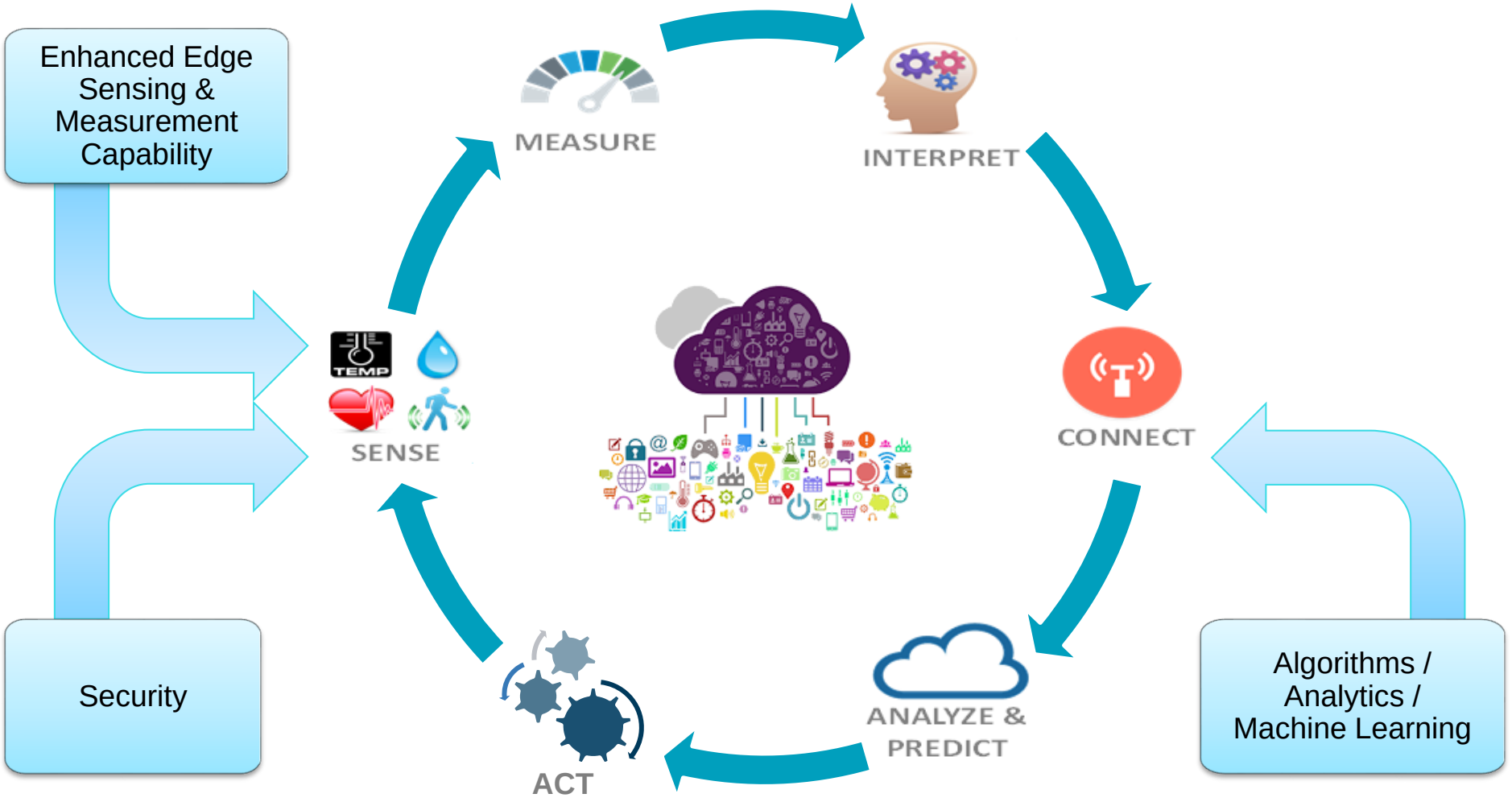

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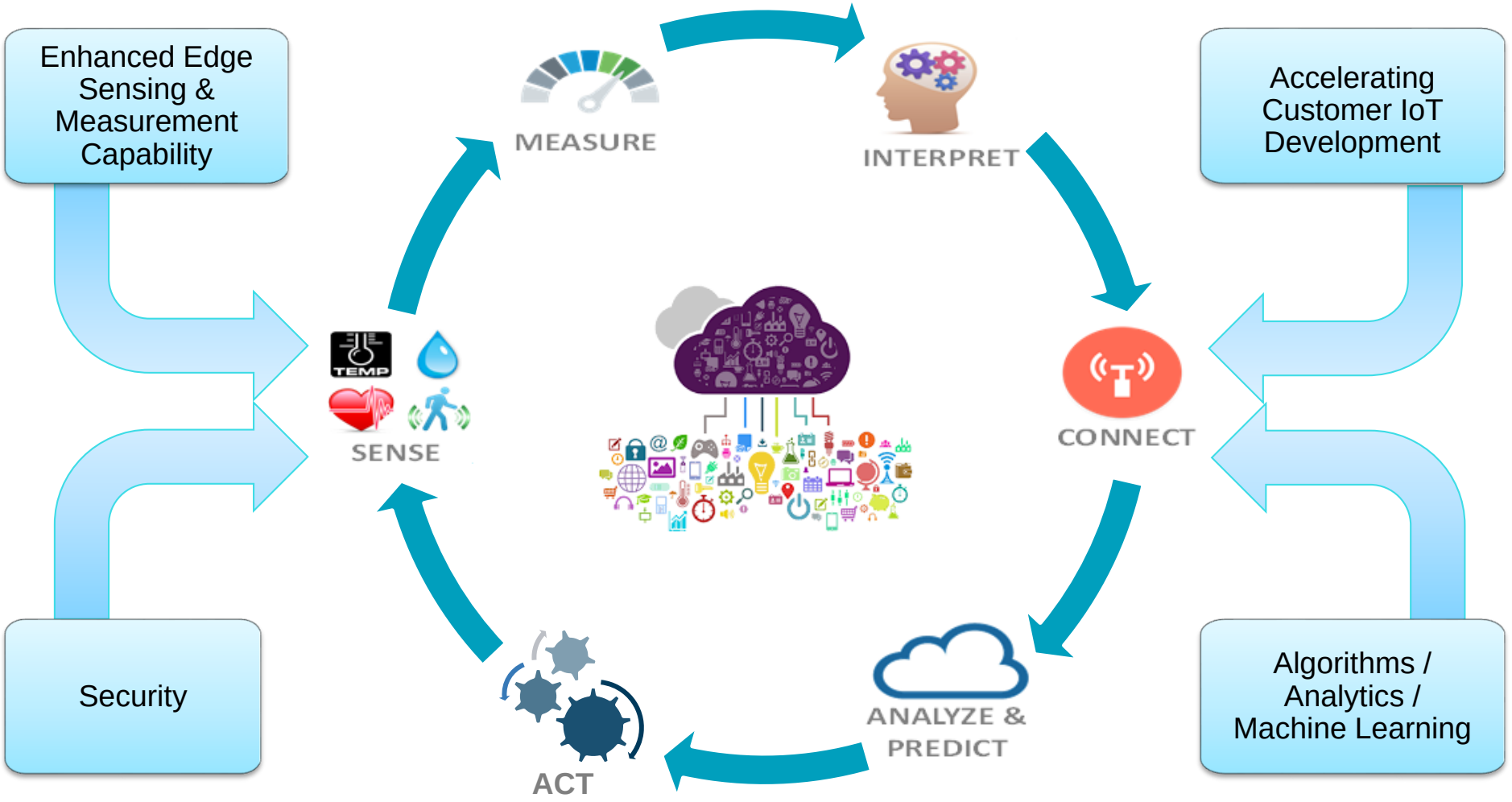

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Analog Devices IoT – A Window into ADI's Technology

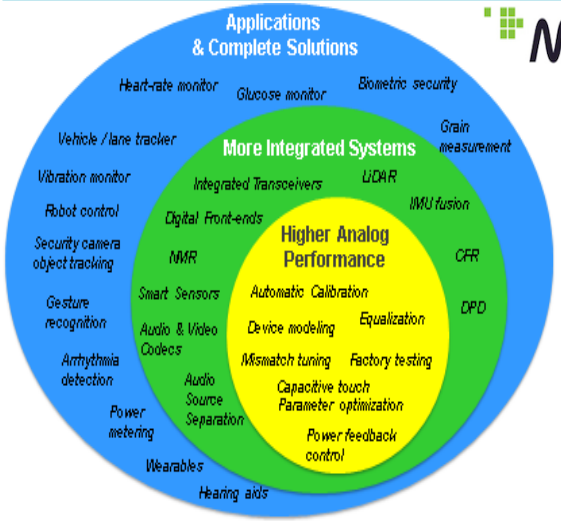
Partners

ConsumerPhysics
Prophecy Sensorlytics
LifeQ
PTC
amazon web services
HEXOSKIN WEARABLE BODY METRICS
QlikView
ThingWorx A PTC Business
MathWorks
Microsoft Azure
ARM
mbed

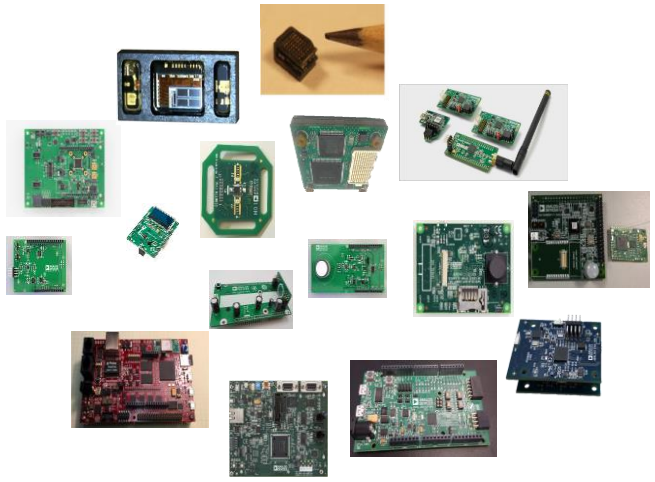
Customer Applications

Algorithms

metroic
SNAP sensor



Hardware & Software



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Summary

Summary

- IoT Enabling Effect with be responsible for substantial Economic Impacts in the coming years.
- Realizing this Impact will require solutions that can close Value Loops to efficiently modify System Behaviour.
- Automation of the Data-Information-Knowledge-Wisdom (DIKW) processes is key to understanding how to efficiently modify behaviour, enabling Value Loops.
- The sophistication and scope of IoT systems allow many options for implementing DIKW processing trade-offs depending on the Application / Use Case.
- Conventional wisdom today suggests that processing in IoT systems should be done in the cloud
  - Moving processing to the edge enables “smarter” sensors and information extraction closer to the source.

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