Bringing intelligence to the internet of things

Introducing the Intel® Quark™ SE Microcontroller

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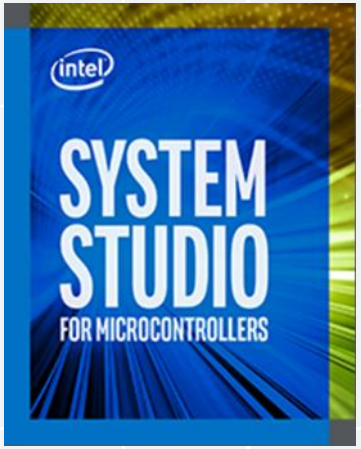
Agenda

- Intel® Quark™ MCU product line
- Intel IoT reference platform and where Quark fits
- Quark SE features including Sensor Hub and Pattern Matching Technology
- Documentation and Collateral
- Parting thoughts

Intel® Quark™ launched Products

Product Class	2015	2016	2017	2018
Intel® Quark™ Processor U-Series — *Discrete ASSPs*	Intel® Quark™ X1000 Series 400MHz X86 core, Low & High Speed Interfaces			
Intel® Quark™ Processor D-Series — *IOT MCUs Intelligent Edge*		**Intel® Quark SE** Atlas Peak/Atlas Creek *Platform* 32MHz; 80kB/384kB, I2C, UART, ADC, SPI, USB, I2S Internal Sensing Hub, Pattern Matching Engine		
Intel® Quark™ Processor D-Series — *IOT MCU Edge*		**Intel® Quark™ microcontroller D1000** 32MHz, 8kB/32kB I2C, UART, ADC, SPI **Intel® Quark microcontroller D2000** 32MHz, 8kB/32kB I2C, UART, DMA, PWM, ADC		



Intel® Quark™ technology connecting your things

Edge analytics combines with a low-power processor for vertical industry innovation

Intel® Quark™ D1000

- Ultra low power, Entry Level
- 32MHz, 32-bit Microcontroller, 32kB Flash, 8kB SRAM
- Software Development Kit with sample apps and libraries
- Pre-validated comms and sensor modules

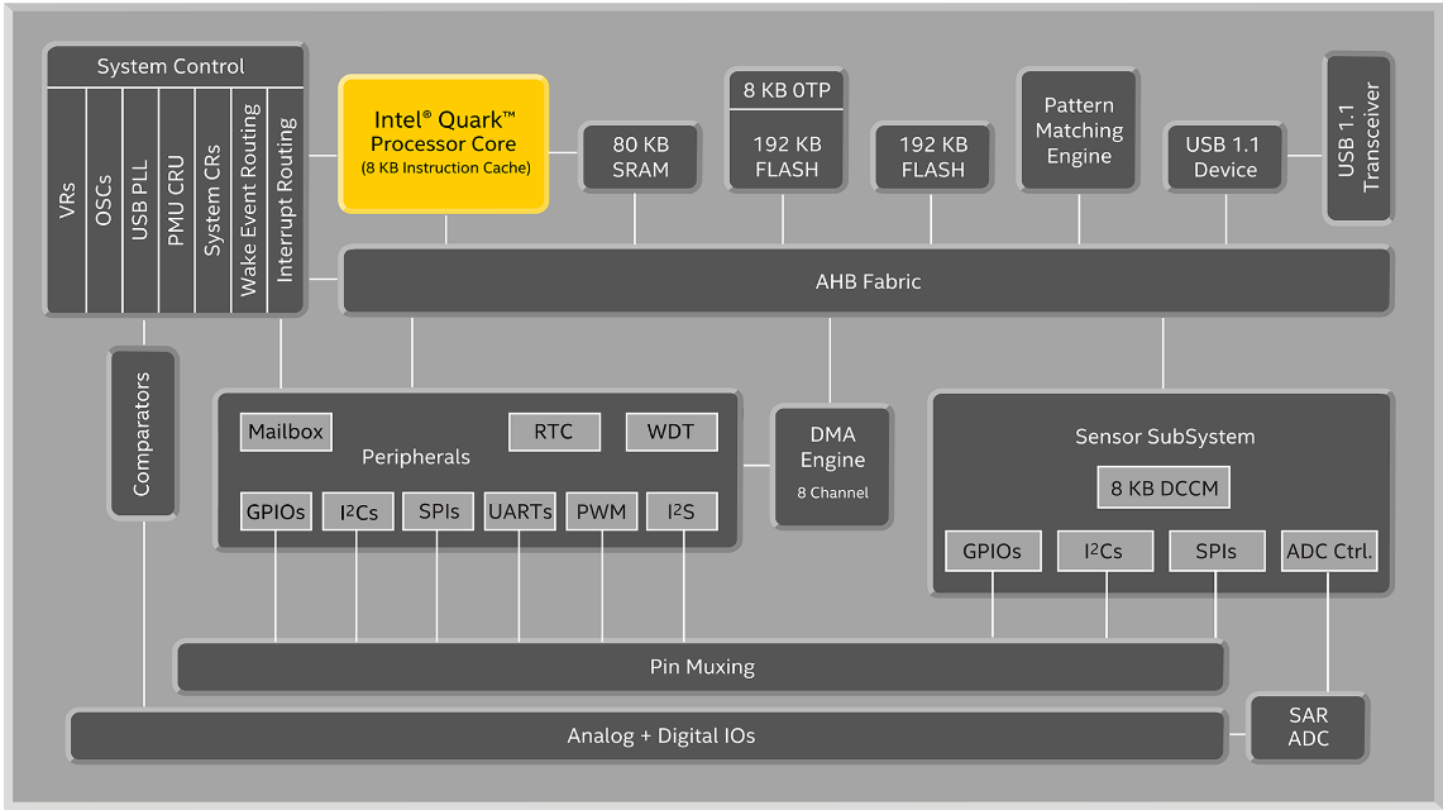
Intel® Quark™ D2000

- Ultra low power, Entry Level
- 32MHz, 32-bit x86 Microcontroller, 32kB Flash, 8kB SRAM
- Scalable Software Development Kit, with sample apps and libraries
- Pre-validated comms and sensor modules
- Full Intel x86 instruction set architecture for compatibility and scalability

Intel® Quark™ SE

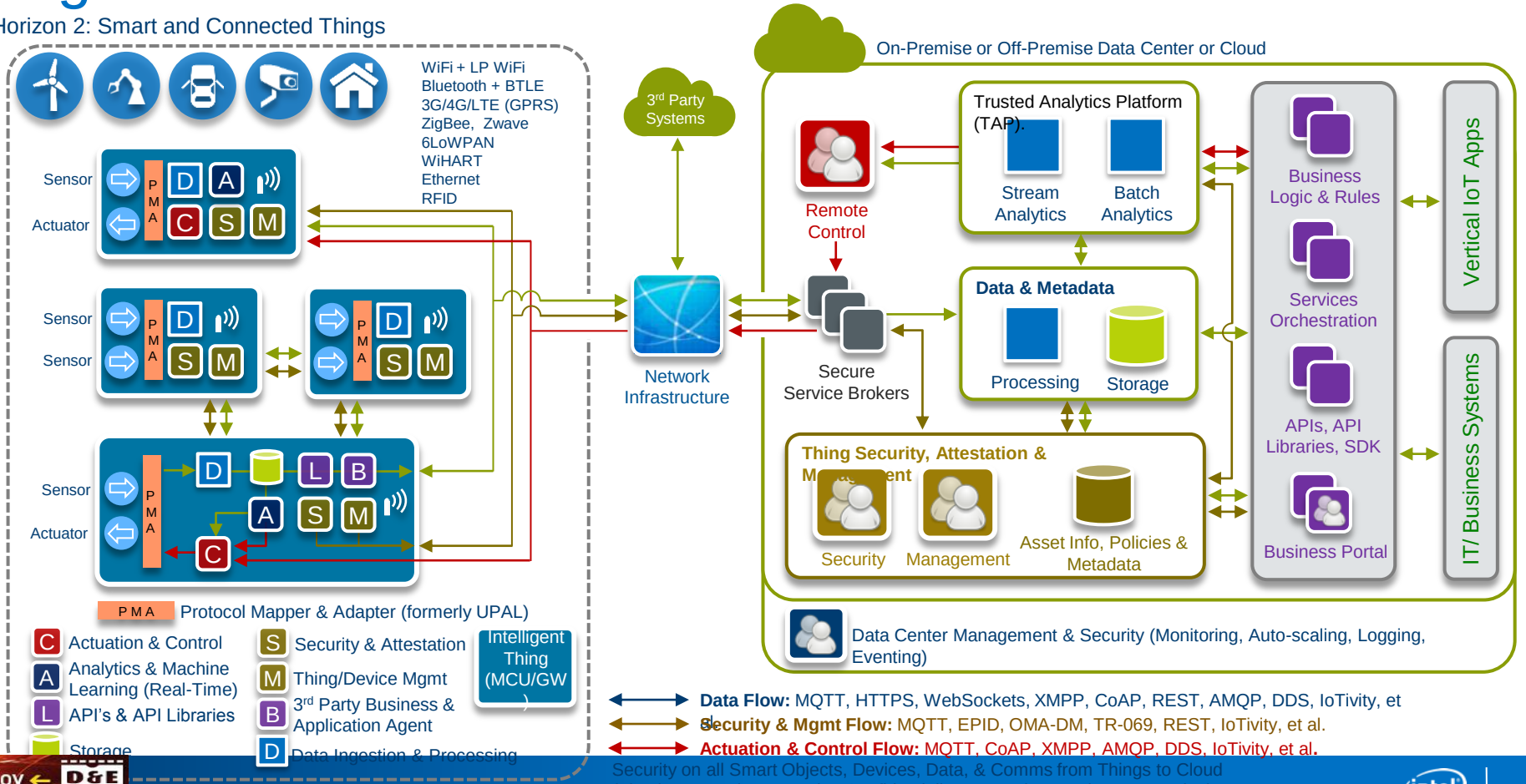
- High-efficiency power consumption
- 32MHz, 32-bit x86 Microcontroller
- 384Kb Flash, 80kB SRAM
- Scalable Software Development Kit, with sample apps and libraries
- Pre-validated comms and sensor modules
- Full Intel x86 instruction set architecture for compatibility and scalability
- Always sensing: always-listening Internal Sensor Hub
- Intelligent: Pattern Matching Technology

Intel® Quark™ se microcontroller Block Diagram



Logical Definition of The Intel® IoT Platform

Horizon 2: Smart and Connected Things

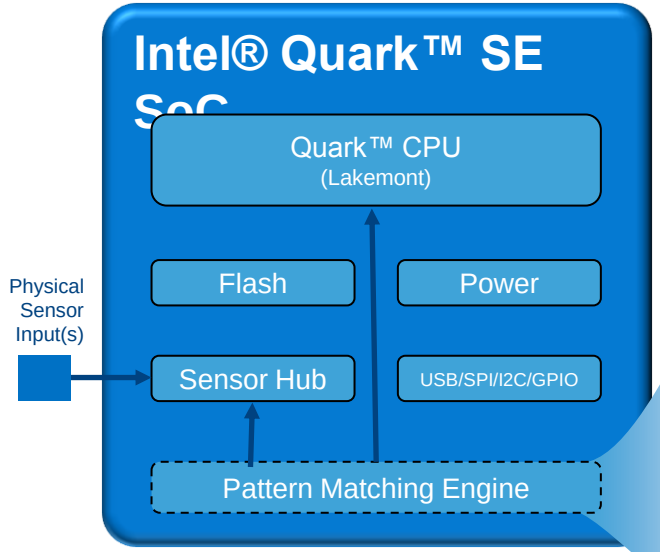


Security on all Smart Objects, Devices, Data, & Comms from Things to Cloud
(Identity Protection, Integrity, Confidentiality, Trusted Execution, Attestation)

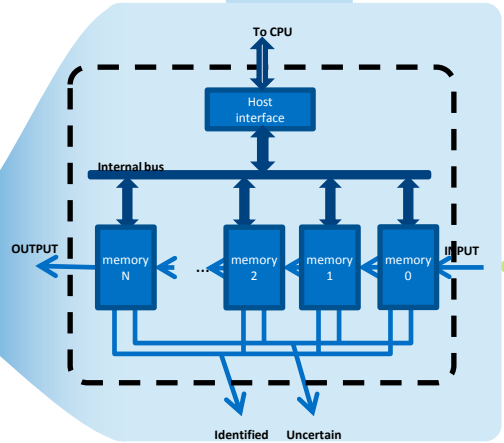
Intel® Quark™ SE Pattern Matching Technology

End-to-End Machine Learning Solution for Edge Analytics

Edge Device
Real-time Sensor Data Classification



Pattern Matching Engine

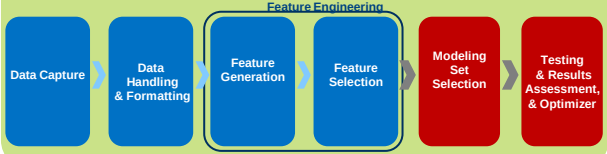


Adaptive Learning
Classifications + raw data from detected anomalies uploaded to server

Server / Cloud Application
Model Creation & Ongoing Learning

Intel® Knowledge Builder Toolkit

Developer tool enabling algorithm learning for Quark™ SE pattern recognition



Model Creation and Refinement
Initial push of model and subsequent model enhancements pushed to device with use

Development Savings Of Up To 75%

→ 2-8 months → down to 3-8 weeks

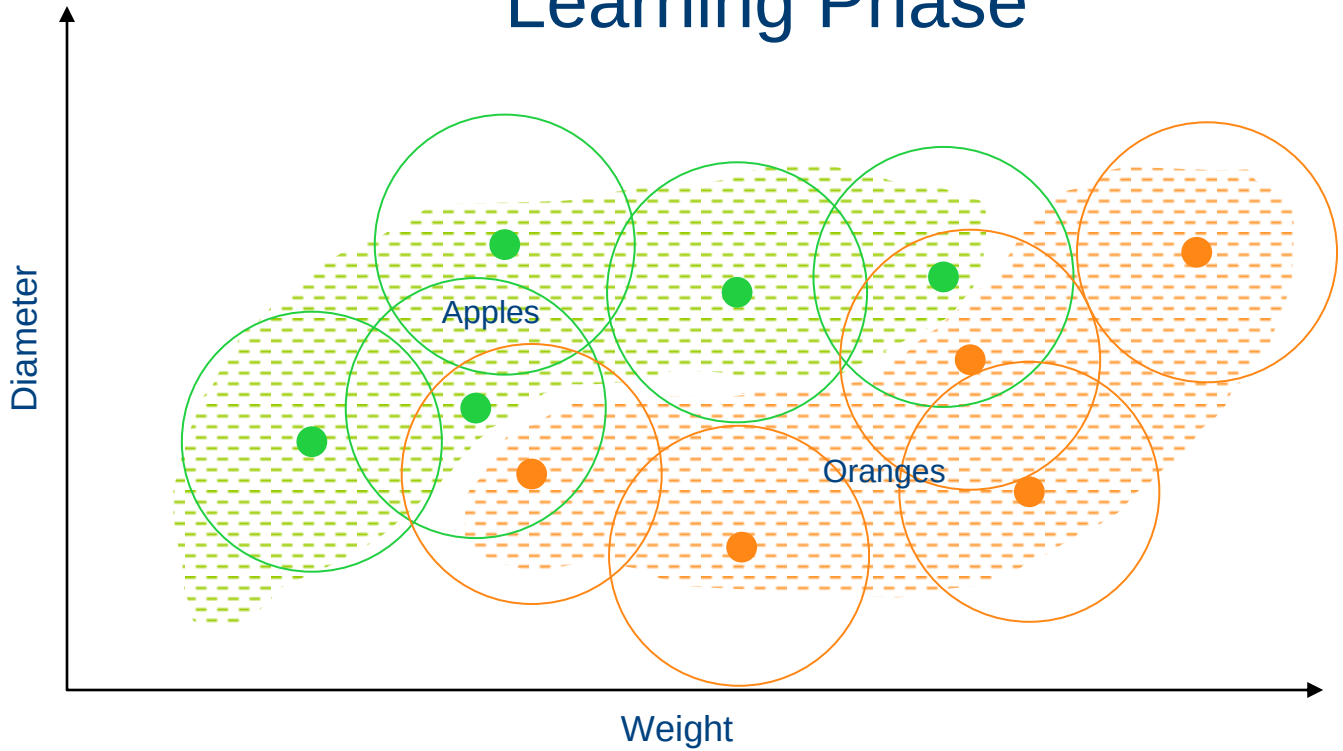
Pattern-Matching Engine

- **Three** states returned by the pattern matching engine
    - Identification, Uncertain or Unknown..

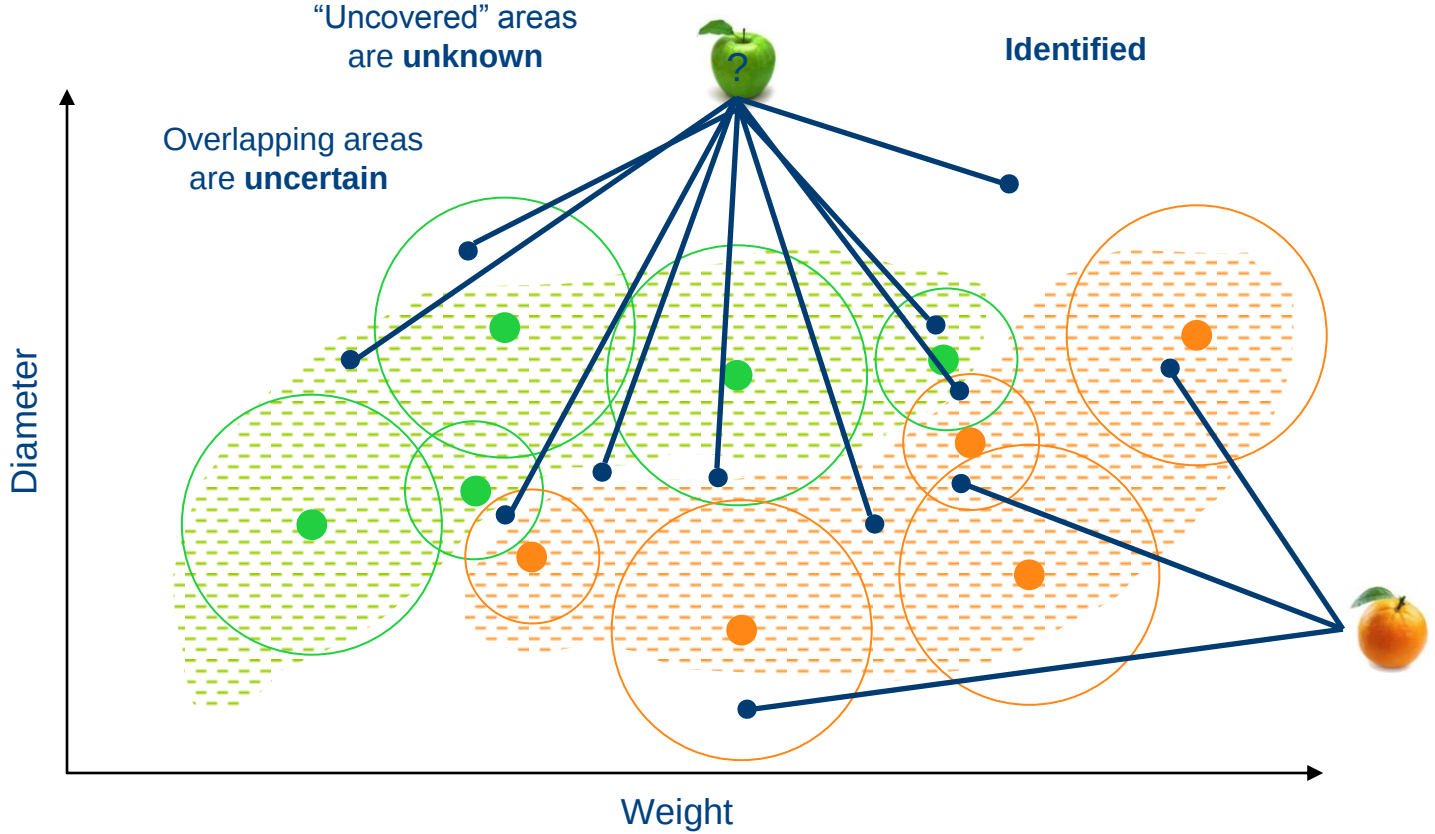
- **Two** types of pattern recognition:
    - **K-Nearest Neighbour (KNN),**
        - Input consists of the Known closest training examples,
        - The entire space is mapped and with a single possible category (i.e. colour code) per position.
        - KNN always gives a response: Closest match (note that the shortest distance value can still be high
    - **Radial basis function (RBF),**
        - Depends on the distance from the origin to correctly classify new instance
        - The space is mapped partially with certain zones being unclassified
        - The zones with multiple mapping are zones of uncertainty.

Example: Apples and Oranges

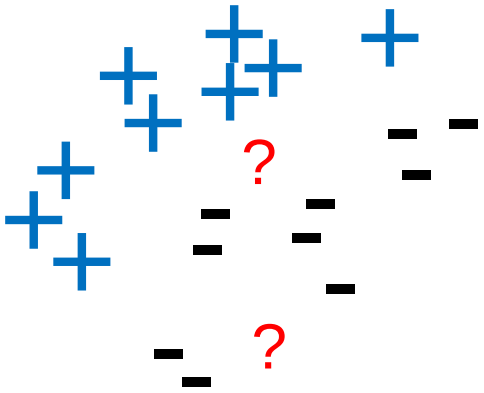
Learning Phase

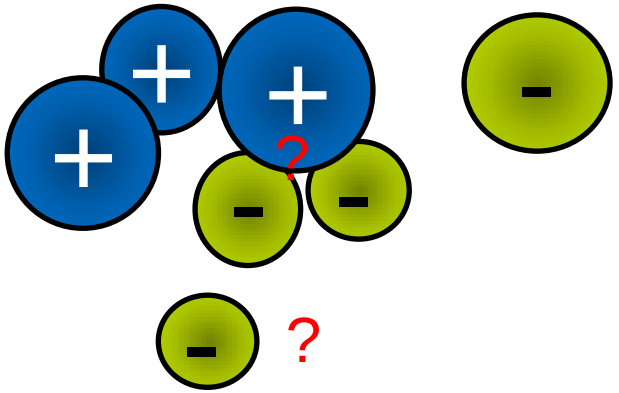


Classification/Recognition phase



Nearest neighbour & Radial Basis Function classifiers: fast algorithms for the associative memory





K-NN. Maps all feature vectors as points in a multidimensional space.
(always return a trained class)

RBF clusters feature vectors and creates influence fields
(may return an “unknown” class)

Documentation and Collateral

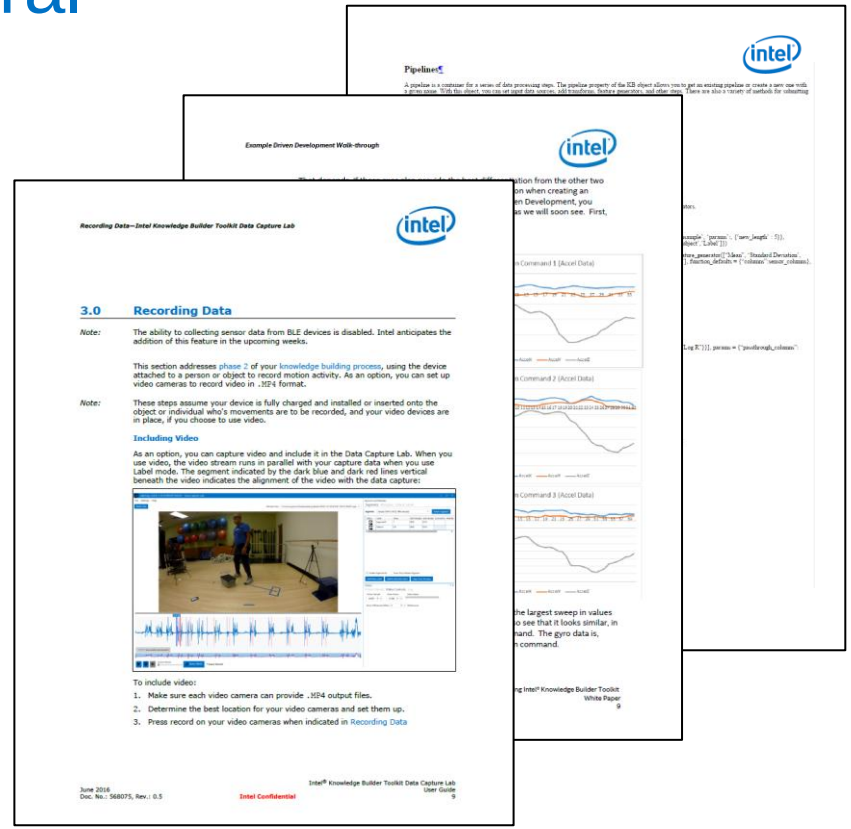
Download

Intel® Knowledge Builder Toolkit

- https://software.intel.com/en-us/intel-knowledge-builder-toolkit

Want to develop code your self?

- https://github.com/01org/Intel-Pattern-Matching-Technology



Whitepapers, User Guides, Templates, Sample Code…

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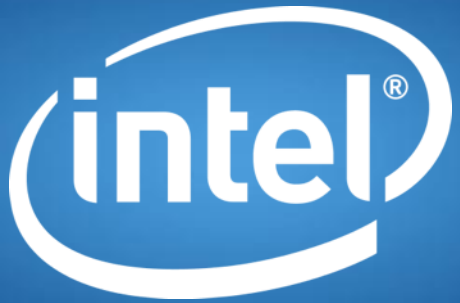
Parting Thoughts……

Making smart decisions takes a lot of processing, which can burn a lot of power….. **The Intel® Quark™ SE microcontroller tackles this power/ performance dilemma with an innovative pattern-matching engine and a smart sensor subsystem.**

Key questions to ask yourself about your next industrial or consumer IOT product…

- Will my product have basic analytics or advanced analytics?
- Is my analytics development process efficient and affordable?
- Can my product easily adapt to customer demands?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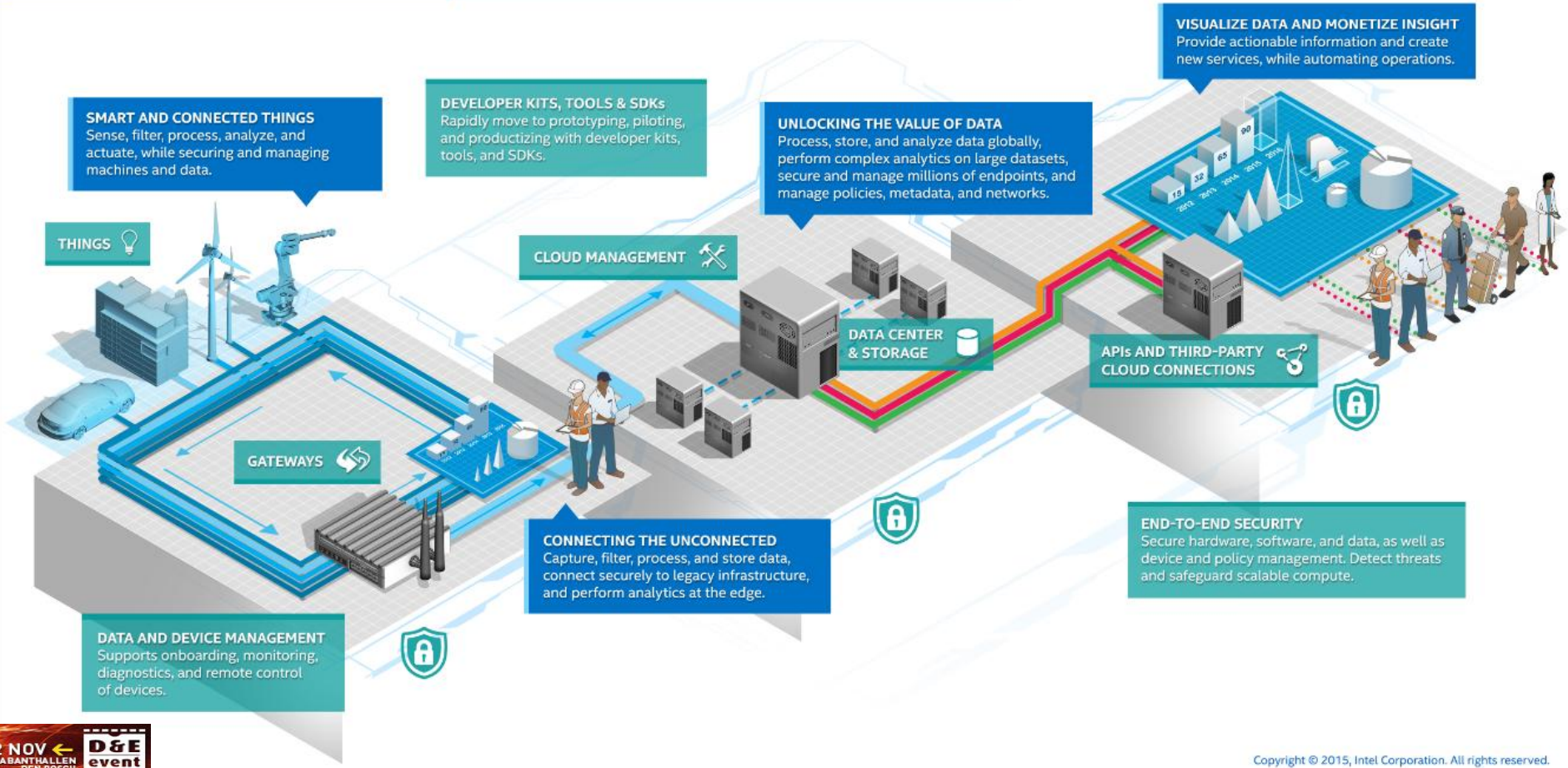
Intel® IoT Platform

Secure, Scalable, Interoperable

The Intel® IoT Platform includes an end-to-end reference architecture and a portfolio of products from Intel and its ecosystem, that work with third-party solutions, to provide a foundation for seamlessly and securely connecting devices, delivering trusted data to the cloud, and delivering value through analytics.



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