



# INTEL EDGE INSIGHTS SOFTWARE

## RAPID DEPLOYMENT OF ANALYTICS PIPELINES

Industrial Solutions Division, Intel



# GE EDGE & CONTROL SYMPOSIUM

## INTEL EDGE INSIGHTS SOFTWARE WORKSHOP

### TODAY'S SCHEDULE

Intel Industrial Developer Program

Intel Vision for Industrial Workloads and Applications

Intel Computer Vision Deep Learning with OpenVINO\*

Building and Deploying Visual Industrial Solutions on the Edge Insights Software Stack

Building and Deploying Time Series Industrial Solution on Edge Insights Software



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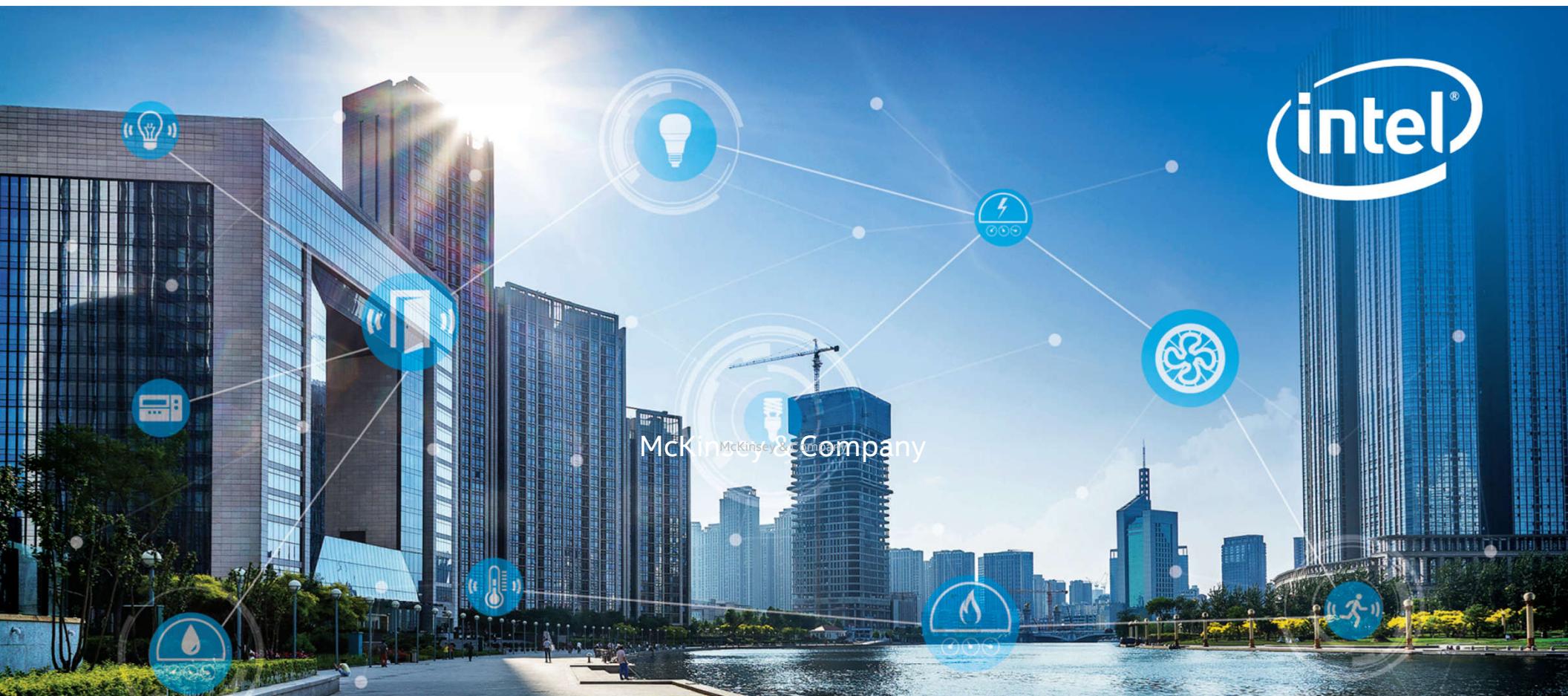
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# VISION FOR INDUSTRIAL IOT



The background of the slide is a blurred photograph of an industrial environment. A robotic arm is visible on the left, and a cutting or welding process is taking place in the center, creating bright sparks and light. The colors are warm, dominated by yellows, oranges, and blues.

THE ECONOMY IS POWERED  
BY THE INDUSTRIAL SECTOR

THE INDUSTRIAL PC IS ITS DIGITAL FOUNDATION

The economic impact of factory IoT applications forecast to reach **\$1.2 Trillion** by 2025<sup>1</sup>

1) McKinsey & Company, The Internet Of Things: Mapping The Value Beyond The Hype. [Link](#)

# INDUSTRIAL REVOLUTION 4.0

1<sup>ST</sup>



1760'S

Steam, Water  
Mechanized  
Production

2<sup>ND</sup>



1860'S

Electrification, Oil,  
Mass Production

3<sup>RD</sup>



LATE 1900'S

Invention of the  
Electronic Systems

4<sup>TH</sup>



NOW

Invention of the  
computerized network

# INTEL TECHNOLOGY FOR INDUSTRIAL IOT/INDUSTRY 4.0



## Open Platform

built with interfaces and APIs that enable integration with legacy systems and devices and with platforms from multiple vendors.



## Interoperability

is designed into IA CPUs to offer backward compatibility to help SW and application reuse thus reducing development time and resources.



## Performance at the Edge

that enables near-real-time analytics, local decision making, and tighter process controls.



## Advanced Security

for trusted data from edge to cloud and protection from costly attacks.



## Scalability

for varying levels of gateway performance, with a broad range of support from Intel® Quark™, Intel® Atom™, Intel® Core™ and Intel® Xeon® processor D and E families.



## Manageability

for secure remote upgrades and services.



## Faster, More Flexible Deployment

with a platform that supports your choice of operating systems and ecosystem applications.

# INTEL IS PARTNERING WITH THE ECOSYSTEM

# ECOSYSTEM PARTNERS

IOT EQUIPMENT  
BUILDERS

IOT SOLUTION  
PROVIDERS

IOT TECH  
PROVIDERS



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# MANUFACTURING'S NATURE IS CHANGING



ANALOG  
OPERATED  
INDUSTRY

INSTRUCTION  
OPERATED  
INDUSTRY

SOFTWARE  
OPERATED  
INDUSTRY

DATA  
OPERATED  
INDUSTRY

# WHAT IS AN INDUSTRIAL PC?



RUGGEDIZED DESIGN  
WIDER OPERATING TEMPERATURE  
EXPANSION OPTIONS  
DUST/WATER /IMMERSION-PROOF  
ENHANCED EMI FILTERING  
INDUSTRIAL GRADE COMPONENTS

TYPICALLY LASTS 7-10 YEARS  
**PURPOSE BUILT FOR A FACTORY**

Photo source: Intel® IoT Solutions Alliance Solution Directory

Internet of Things Group



# INDUSTRIAL MANUFACTURERS REQUIRE INDUSTRIAL COMPUTE TODAY



The plant floor is a source of, and is powered by, data



Factories function more efficiently to reduce costs



Manufacturing flexibility matches consumer demands



Equipment management to improve quality

## Optimized Production

An oil & gas refiner utilizes data collected through IPCs in the refinery & commodity market prices to now create a daily refining plan (was weekly)

## Product Defect Detection

A manufacturer is using an IPC to detect product quality issues immediately – at the machine!

## On-Demand Manufacturing

A FMCG company adjusts its mass-market production to switch products without line switching to match its digital strategy & grow revenue

## Predictive Maintenance

Semiconductor maker monitors vibrations on equipment fans to predict fan failures – realizes higher equipment reliability & higher product yield



# CASE STUDY: REPLACING LEGACY FACTORY IPC

A beverage company upgraded to Microsoft® Windows 10, maintaining its existing I/O cards and completing the transition in less than half the time estimated to create a custom solution.

A manufacturing company migrated its operations to a new, more reliable SCADA system while retaining their existing application software.

# INDUSTRIAL EDGE COMPUTE IS TRANSFORMING

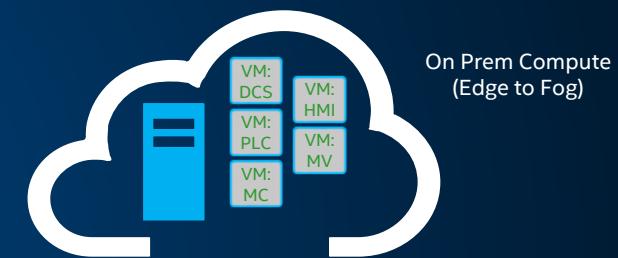
FROM THIS...

PROPRIETARY, SPECIALIZED, MONOLITHIC



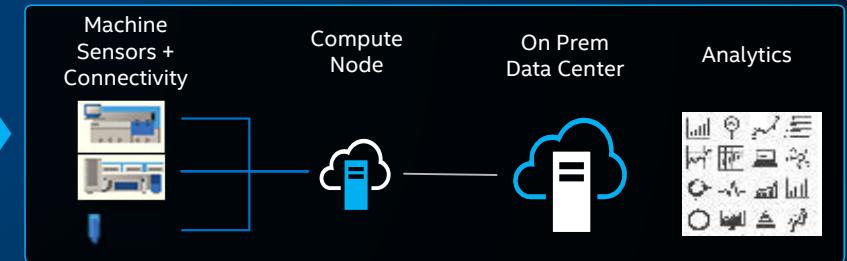
TO THIS...

VIRTUALIZED, OPEN, INTEROPERABLE



Control

Analytics



ENABLED BY TECHNICAL PILLARS OF TRANSFORMATION

VIRTUALIZATION

SECURITY

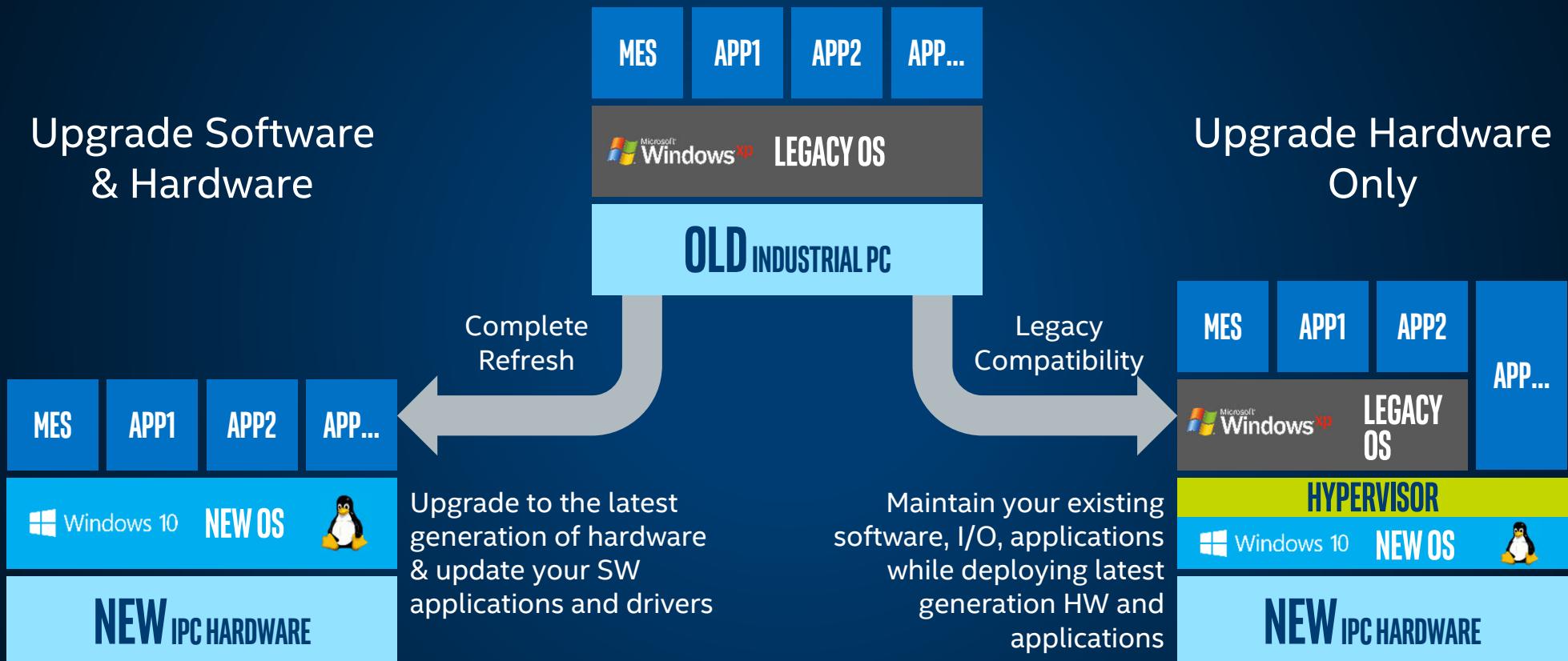
SAFETY

ANALYTICS (A)

MACHINE VISION

REAL TIME

# TWO PATHS TO UPGRADE YOUR INDUSTRIAL PC



\* Other names and brands may be claimed as the property of others.

## PRODUCTION

Control & Automation  
Improve Yield  
Reduce Downtime  
Optimization

## QUALITY

Quality Management  
Process Control

## INVENTORY

Supply Chain Tracking  
Location Sensors



## MAINTENANCE

Scheduled Downtime  
Augmented by Sensor-based Monitoring

## SAFETY

Worker Safety Program  
Safety Tracked Offline

## REGULATORY

System Compliance  
Operational Conditions

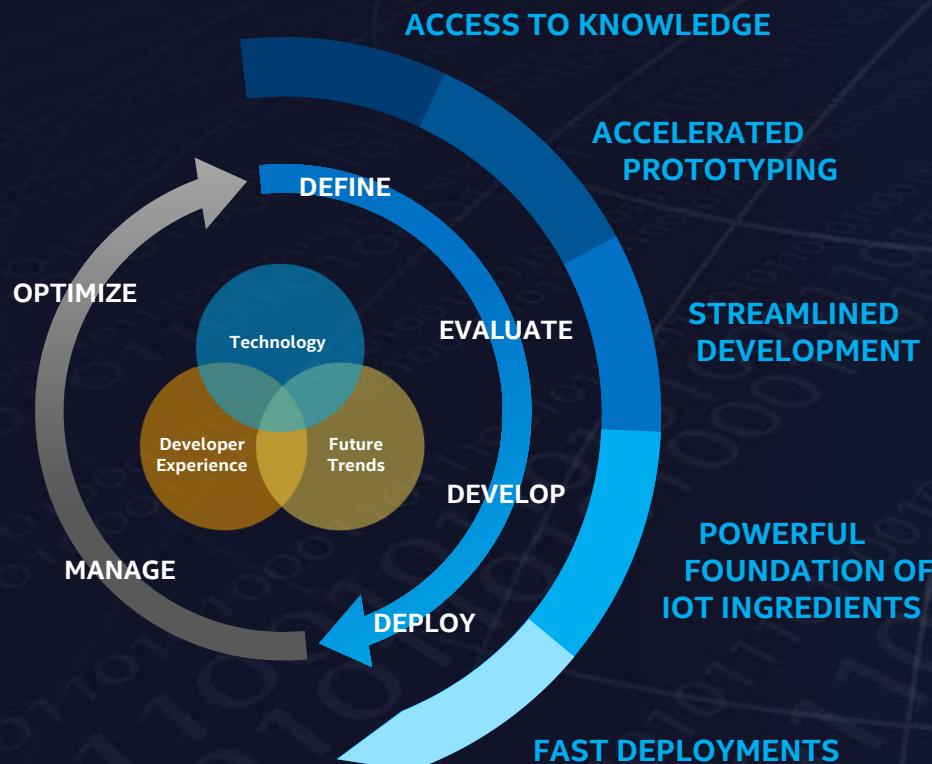


# THE INTEL DEVELOPER PROGRAM



# ENABLING NEW DEVELOPER OPPORTUNITIES

## The Developer's Journey



## What Intel Brings

- Common and seamless Developer experience
- Start to finish technologies for robust solutions
- Simplified path to develop and deploy products, systems, solutions
- Reusability, extensibility, portability, future proof

# DELIVERING A UNIFIED, SEAMLESS IOT DEVELOPER EXPERIENCE

A photograph of a man with dark skin and short hair, wearing glasses and a light blue button-down shirt. He is focused on a small electronic device with wires, possibly a sensor or a microcontroller, which he is holding in his hands. He is wearing a black wristband on his left wrist. The background is a blurred laboratory or workshop environment with various equipment and cables visible.

**DEEP  
INVESTMENT**  
**ACCELERATING**  
**AMAZING**  
**SIMPLIFIED**

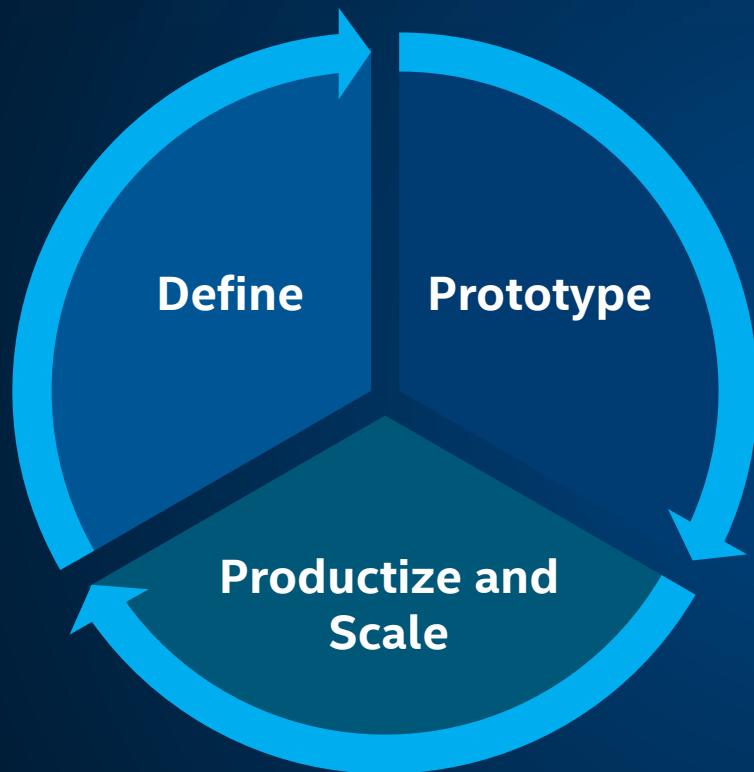
in understanding,  
addressing IoT  
developer challenges

the development  
process

out-of-box  
experiences

for ease of use,  
consistency, and  
compatibility

# ENGAGING THROUGH ALL PHASES OF DEVELOPMENT



## EVENTS

Virtual/Tradeshows  
(Global IoT DevFest)



## WORKSHOPS

Hands-On Training



## PROMOTION

Showcase Reference Implementations  
IoT Innovators sharing Expertise



## ENGAGEMENTS

ISV Engagement  
App Enablement  
Architecture Conversion

INTEL DEVELOPER ZONE FOR IOT:

# CENTRAL RESOURCE FOR E2E SOLUTION SUPPORT

Training, How-Tos,  
Documentation, Forums, Support

Development Kits, SDKs, Libraries, Sensor  
Drivers, APIs, Tools

Code Samples and Tutorials,  
End-to-End Reference Implementations

Guides for Productization and  
Commercialization



## Reference Implementations

Learn about IoT solutions and how developers can use Intel® technology to connect the world.



Create a People  
Counter  
Application



Develop an  
Intruder  
Detection  
System



Build a Store  
Traffic Monitor



Create a Facial  
Recognition  
Access  
Application

## Industries

Intel is powering IoT for global market opportunities and enabling change across industries.

Smart Video | Industrial Automation | Retail | Smart Home



[software.intel.com/iot](http://software.intel.com/iot)



A photograph of two men in a factory. The man on the left is older, wearing a blue hard hat, safety glasses, and a light blue button-down shirt. He is pointing towards a large, complex industrial machine made of metal and plastic components. The man on the right is younger, wearing a white hard hat, a dark blue tie, and a light blue dress shirt. He is holding a silver laptop and looking at it while also looking at the machine. They appear to be engaged in a technical discussion. The background shows the interior of a modern factory with various pipes, structures, and lighting.

OPENVINO®\* AND INTEL® MEDIA SDK\*



EMERGENCY RESPONSE



FINANCIAL SERVICES



MACHINE VISION



CITIES/TRANSPORTATION

# VIDEO BASED ANALYTICS

## USING COMPUTER VISION AND DEEP LEARNING IS GROWING RAPIDLY



AUTONOMOUS VEHICLES



RESPONSIVE RETAIL



MANUFACTURING



PUBLIC SECTOR

# INTEL® DISTRIBUTION OF OPENVINO™ TOOLKIT

Take your computer vision solutions to a new level with deep learning inference intelligence.



## What it is

A toolkit to accelerate development of **high performance computer vision & deep learning inference into vision/AI applications** used from edge to cloud. It enables deep learning on hardware accelerators and easy deployment across multiple types of Intel® platforms.

## Who needs this product?

- Computer vision, deep learning software developers
- Data scientists
- OEMs, ISVs, System Integrators

## Usages

Security surveillance, robotics, retail, healthcare, AI, office automation, transportation, non-vision use cases (speech, text) & more.



**HIGH PERFORMANCE, PERFORM AI AT THE EDGE**

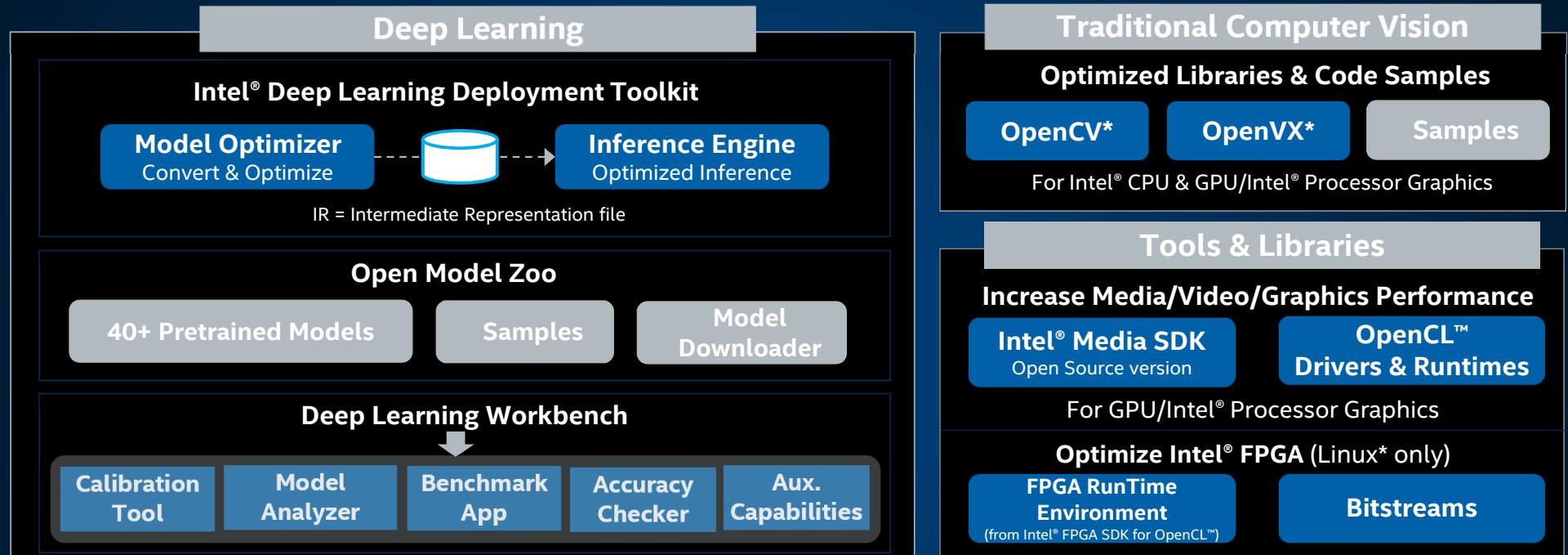
**STREAMLINED & OPTIMIZED DEEP LEARNING INFERENCE**

**HETEROGENEOUS, CROSS-PLATFORM FLEXIBILITY**

**Free Download ▶ [software.intel.com/openvino-toolkit](http://software.intel.com/openvino-toolkit)**

**Open Source version ▶ [01.org/openvinotoolkit](http://01.org/openvinotoolkit)**

# WHAT'S INSIDE INTEL® DISTRIBUTION OF OPENVINO™ TOOLKIT



**OS Support:** CentOS\* 7.4 (64 bit), Ubuntu\* 16.04.3 LTS (64 bit), Microsoft Windows\* 10 (64 bit), Yocto Project\* version Poky Jethro v2.0.3 (64 bit), macOS\* 10.13 & 10.14 (64 bit)

Intel® Architecture-Based Platforms Support



Intel® Vision Accelerator Design Products & AI in Production/Developer Kits

An open source version is available at [01.org/openvino/toolkit](http://01.org/openvino/toolkit) (some deep learning functions support Intel CPU/GPU only).

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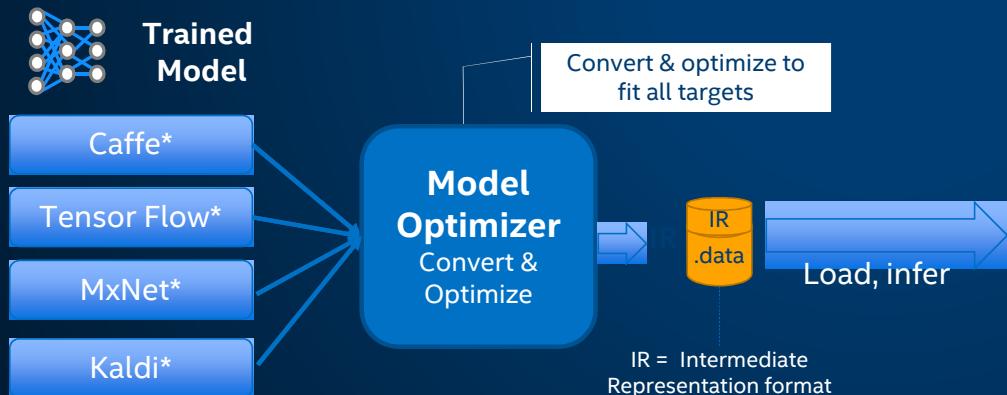


# INTEL® DEEP LEARNING DEPLOYMENT TOOLKIT

## TAKE FULL ADVANTAGE OF THE POWER OF INTEL® ARCHITECTURE

### Model Optimizer

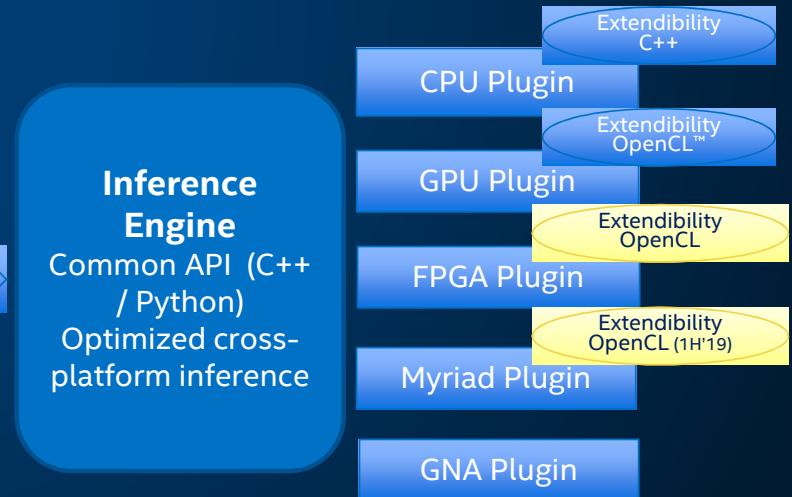
- **What it is:** Preparation step -> imports trained models
- **Why important:** Optimizes for performance/space with conservative topology transformations; biggest boost is from conversion to data types matching hardware.



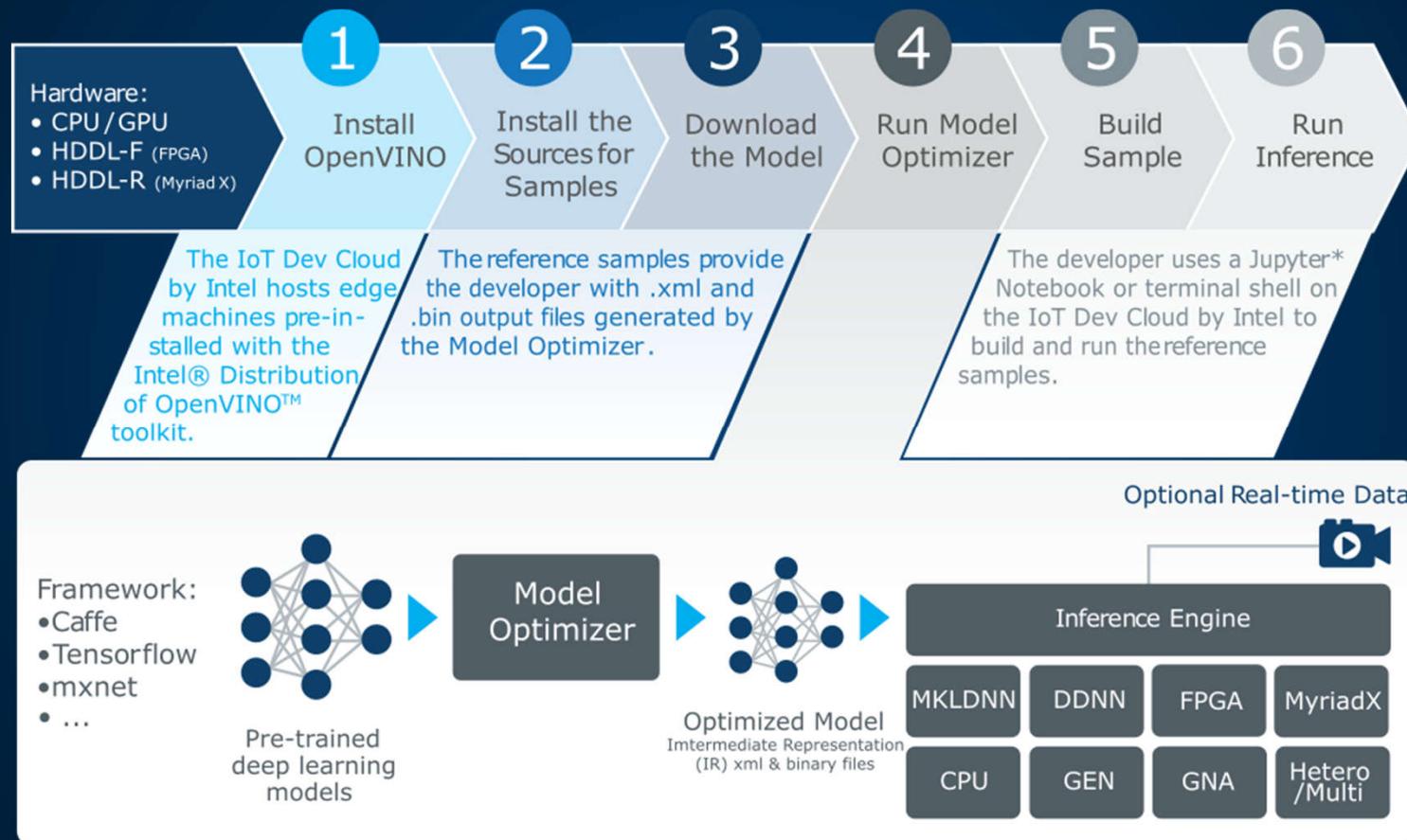
GPU = Intel CPU with integrated graphics processing unit/Intel® Processor Graphics

### Inference Engine

- **What it is:** High-level inference API
- **Why important:** Interface is implemented as dynamically loaded plugins for each hardware type. Delivers best performance for each type without requiring users to implement and maintain multiple code pathways.



# DEVELOPER WORKFLOW



# BENEFITS OF INTEL® DISTRIBUTION OF OPENVINO™ TOOLKIT

MAXIMIZE THE POWER OF INTEL® PROCESSORS: CPU, GPU/INTEL® PROCESSOR GRAPHICS, FPGA,VPU



## ACCELERATE PERFORMANCE

Access Intel computer vision accelerators.  
Speed code performance.  
Supports heterogeneous execution.



## INTEGRATE DEEP LEARNING

Unleash CNN-based deep learning inference using a common API, 40+ pretrained models, & computer vision algorithms. Validated on more than 100 public/custom models.



## SPEED DEVELOPMENT

Reduce time using a library of optimized OpenCV\* & OpenVX\* functions, & 15+ samples.  
Develop once, deploy for current & future Intel-based devices.



## INNOVATE & CUSTOMIZE

Use OpenCL™ kernels/tools to add your own unique code. Customize layers without the overhead of frameworks.

**Deep learning revenue** is estimated to grow from \$655M in 2016 to **\$35B** by 2025<sup>1</sup>.

<sup>1</sup>Tractica 2Q 2017

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# INTEL AS BEST CHOICE FOR VISION SOLUTIONS

Deliver High Performance Computer Vision & Deep Learning  
Transform Data & Results into Artificial Intelligence

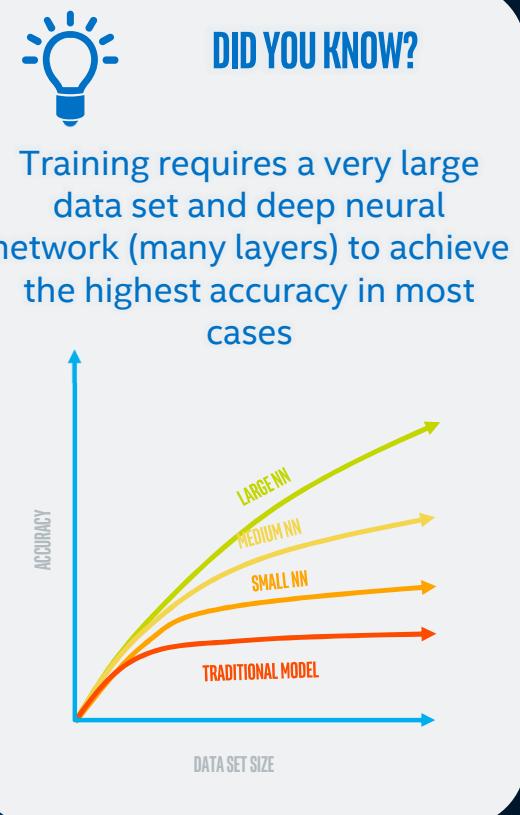
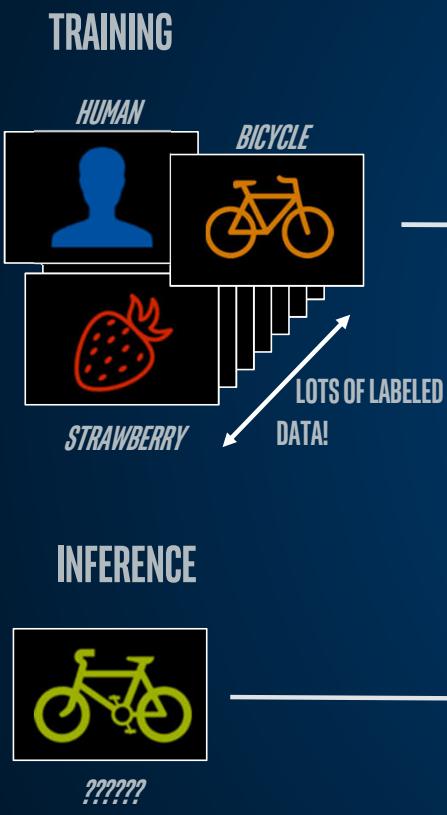
**Intel offers the broadest portfolio of hardware and software that help you**

- Accelerate workloads for a wide range of solutions and vertical use cases
- Increase application performance through Intel accelerators and flexible heterogeneous architectures<sup>1</sup> (CPU, CPU w/integrated graphics (GPU), FPGA, and Vision Processing Units (VPU))
- Drive power, cost and development efficiencies to designs and applications for cameras, gateways, network video recorders, and servers
- Enable deep learning capabilities for smarter, faster analytics—transform data into artificial intelligence for competitive advantage



<sup>1</sup>Certain technical specifications and select processors/skus apply. See [product site](#) for more details.

# DEEP LEARNING: TRAINING VS. INFERENCE



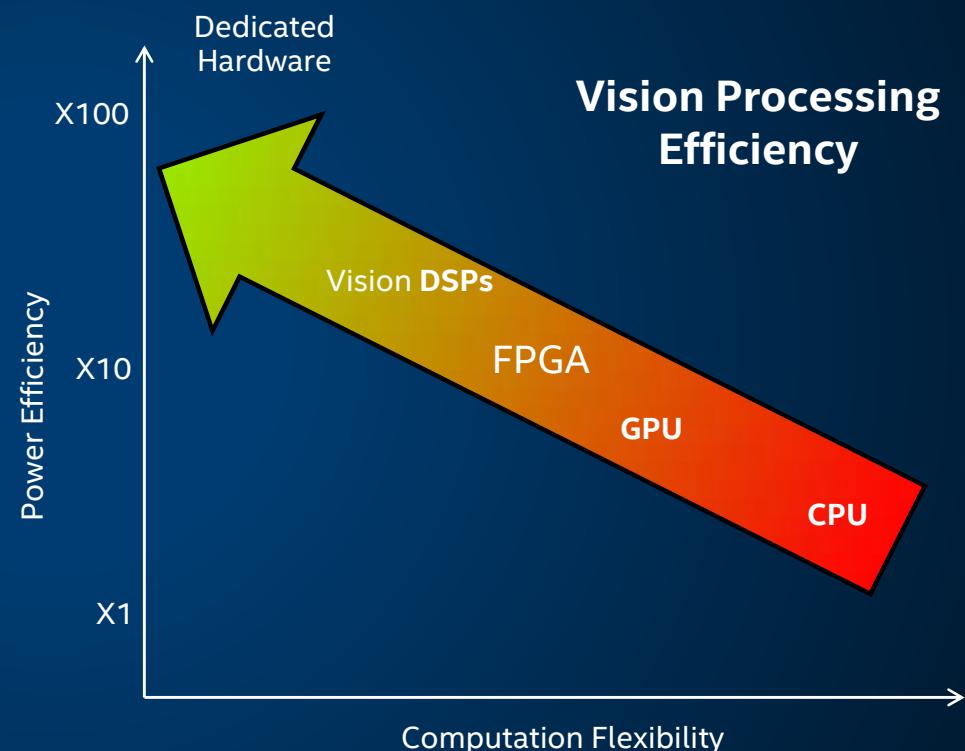
# CHOOSING THE “RIGHT” HARDWARE

## Power/Performance Efficiency Varies

- Running the right workload on the right piece of hardware → higher efficiency
- Hardware acceleration is a must
- Heterogeneous computing?

## Tradeoffs

- Power/performance
- Price
- Software flexibility, portability



# INTEL COMPUTER VISION PORTFOLIO

## EXPERIENCES



## TOOLS

Intel® Parallel Studio XE  
Intel® System Studio  
Intel® SDK for OpenCL™ Applications

Intel® Media SDK / Media Server Studio  
Intel® Distribution of OpenVINO™ toolkit

## FRAMEWORKS



theano



Caffe



## LIBRARIES

Intel® Data  
Analytics  
Acceleration  
Library

Intel®  
Distribution for python

Intel® Nervana™ Graph



Intel® Math Kernel Library

Movidius Stack

## HARDWARE



Compute



Memory & Storage



Networking



Visual Intelligence

UNLEASH  
**FULL**  
POTENTIAL

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# WHAT'S INSIDE THE INTEL DISTRIBUTION VS OPEN SOURCE VERSION

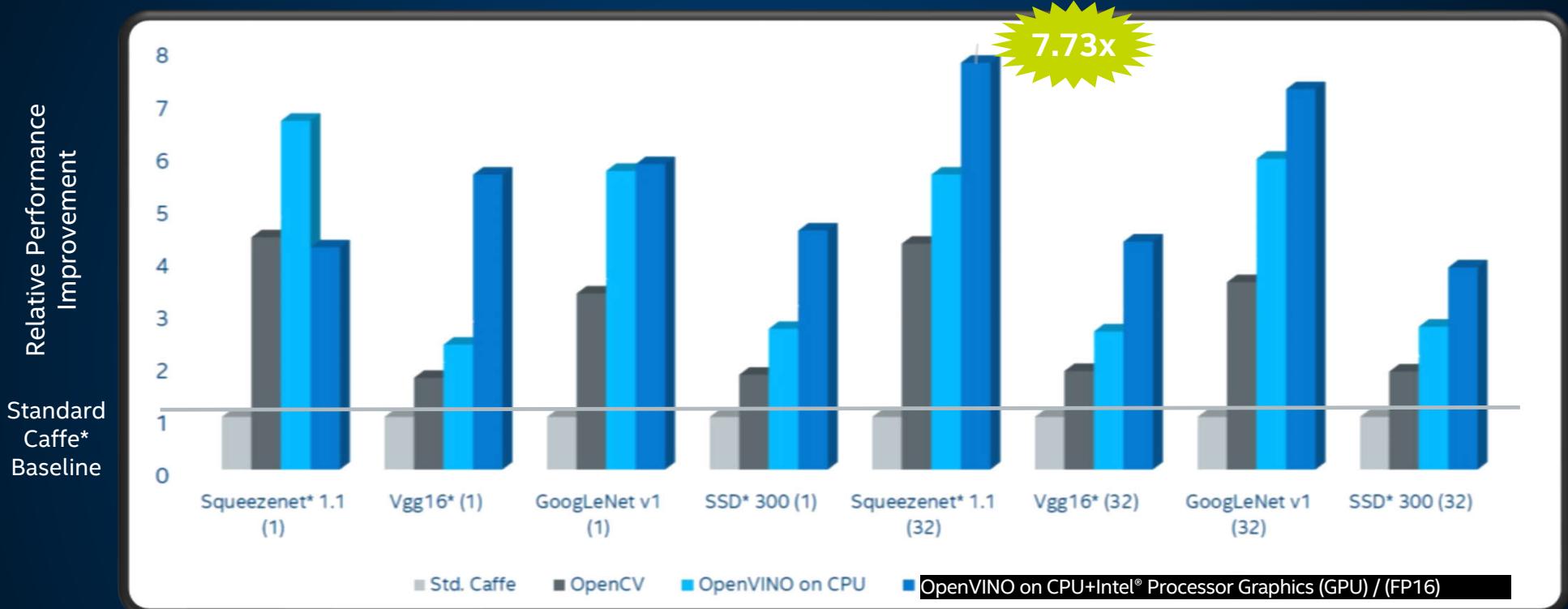
Tool/Component	Intel® Distribution of OpenVINO™ toolkit	OpenVINO™ toolkit (open source)	Open Source Directory
Installer (including necessary drivers)	✓		
<b>Intel® Deep Learning Deployment toolkit</b>		✓	
Model Optimizer	✓	✓	<a href="#">/opencv/dldt/tree/2018/model-optimizer</a>
Inference Engine	✓	✓	<a href="#">/opencv/dldt/tree/2018/inference-engine</a>
Intel CPU plug-in	✓ Intel® Math Kernel Library (Intel® MKL) only <sup>1</sup>	✓ BLAS, Intel® MKL <sup>1</sup> , jit (Intel MKL)	<a href="#">/opencv/dldt/tree/2019/inference-engine</a>
Intel GPU (Intel® Processor Graphics) plug-in	✓	✓	<a href="#">/opencv/dldt/tree/2019/inference-engine</a>
Heterogeneous plug-in	✓	✓	<a href="#">/opencv/dldt/tree/2019/inference-engine</a>
<b>Intel GNA plug-in</b>		✓	<a href="#">/opencv/dldt/tree/2019/inference-engine</a>
Intel® FPGA plug-in	✓		
<b>Intel® Neural Compute Stick (1 &amp; 2) VPU plug-in</b>	✓	✓	<a href="#">/opencv/dldt/tree/2019/inference-engine</a> 
Intel® Vision Accelerator based on Movidius plug-in	✓		
40+ Pretrained Models - incl. Model Zoo (IR models that run in IE + open sources models)	✓	✓	<a href="https://github.com/opencv/open_model_zoo">https://github.com/opencv/open_model_zoo</a>
Samples (APIs)	✓	✓	<a href="#">/opencv/dldt/tree/2018/inference-engine</a>
Demos	✓	✓	<a href="https://github.com/opencv/open_model_zoo">https://github.com/opencv/open_model_zoo</a>
<b>Traditional Computer Vision</b>			
OpenCV*	✓	✓	<a href="https://github.com/opencv/opencv">https://github.com/opencv/opencv</a>
OpenVX (with samples)	✓		
Intel® Media SDK	✓	✓ <sup>2</sup>	<a href="https://github.com/Intel-Media-SDK/MediaSDK">https://github.com/Intel-Media-SDK/MediaSDK</a>
OpenCL™ Drivers & Runtimes	✓	✓ <sup>2</sup>	<a href="https://github.com/intel/compute-runtime">https://github.com/intel/compute-runtime</a>
FPGA RunTime Environment, Deep Learning Acceleration & Bitstreams (Linux* only)	✓		

<sup>1</sup>Intel MKL is not open source but does provide the best performance

<sup>2</sup>Refer to readme file for validated versions



# INCREASE DEEP LEARNING WORKLOAD PERFORMANCE ON PUBLIC MODELS



Fast Results on Intel Hardware, even before using Accelerators

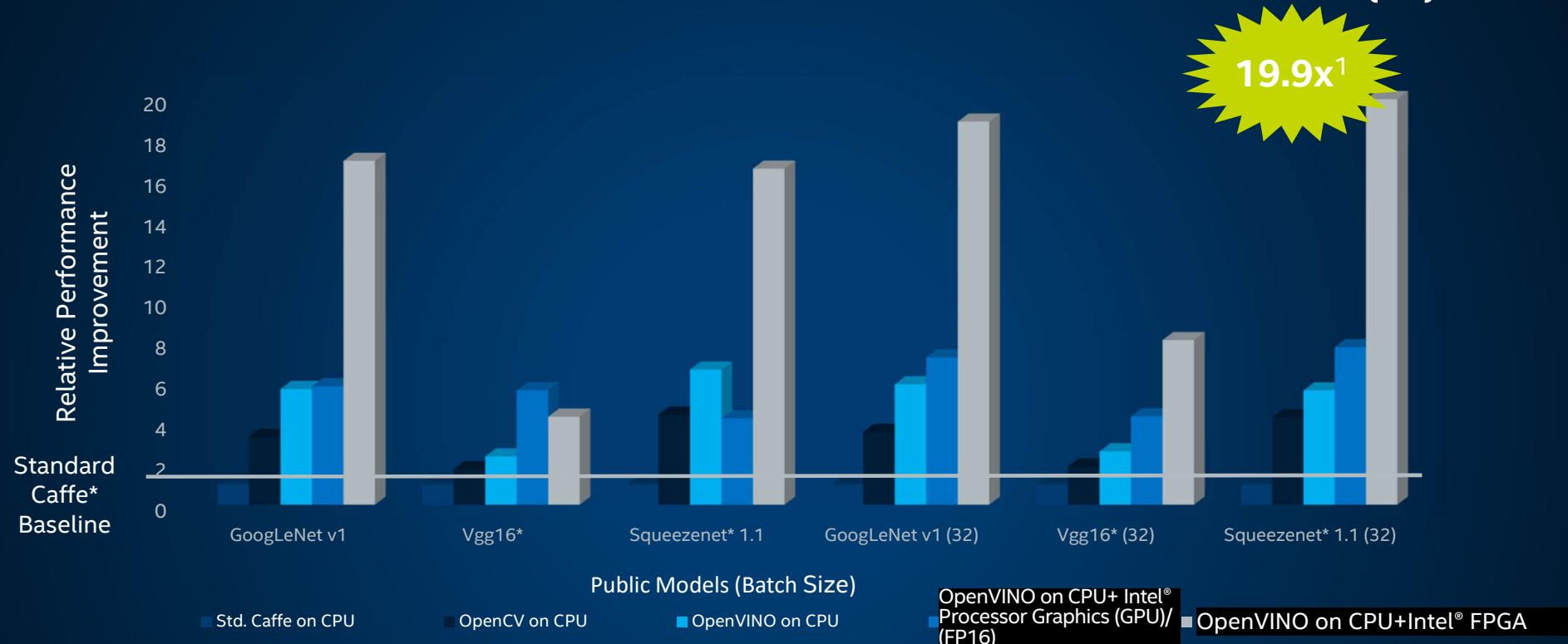
<sup>1</sup>Depending on workload, quality/resolution for FP16 may be marginally impacted. A performance/quality tradeoff from FP32 to FP16 can affect accuracy; customers are encouraged to experiment to find what works best for their situation. The benchmark results reported in this deck may need to be revised as additional testing is conducted. Performance results are based on testing as of April 10, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure. For more complete information about performance and benchmark results, visit [www.intel.com/benchmarks](http://www.intel.com/benchmarks).

**Configuration:** Testing by Intel as of April 10, 2018. Intel® Core™ i7-6700K CPU @ 2.90GHz fixed, GPU GT2 @ 1.00GHz fixed Internal ONLY testing, Test v312.30 – Ubuntu\* 16.04, OpenVINO™ 2018 RC4. Tests were based on various parameters such as model used (these are public), batch size, and other factors. Different models can be accelerated with different Intel hardware solutions, yet use the same Intel software tools.

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## INCREASE DEEP LEARNING WORKLOAD PERFORMANCE ON PUBLIC MODELS: COMPARISON OF FRAMES PER SECOND (FPS)



Get an even Bigger Performance Boost with Intel® FPGA

<sup>1</sup>Depending on workload, quality/resolution for FP16 may be marginally impacted. A performance/quality tradeoff from FP32 to FP16 can affect accuracy; customers are encouraged to experiment to find what works best for their situation. Performance results are based on testing as of June 13, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure. For more complete information about performance and benchmark results, visit [www.intel.com/benchmarks](http://www.intel.com/benchmarks). Configuration: Testing by Intel as of June 13, 2018. Intel® Core™ i7-6700K CPU @ 2.90GHz fixed, GPU GT2 @ 1.00GHz fixed Internal ONLY testing, Test v3.15.21 – Ubuntu\* 16.04, OpenVINO 2018 RC4, Intel® Arria® 10 FPGA 1150GX. Tests were based on various parameters such as model used (these are public), batch size, and other factors. Different models can be accelerated with different Intel hardware solutions, yet use the same Intel software tools.

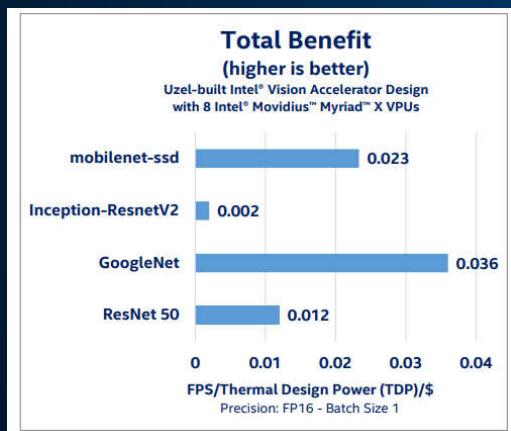
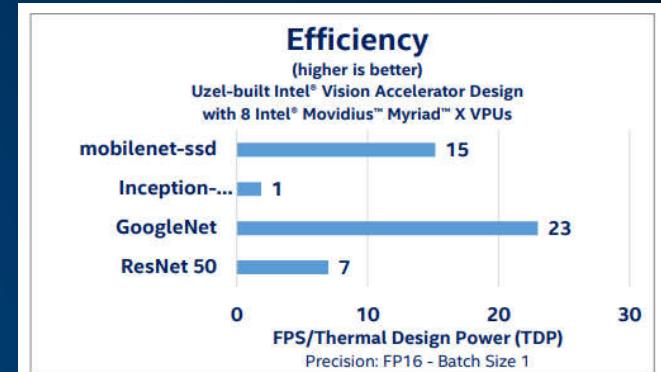
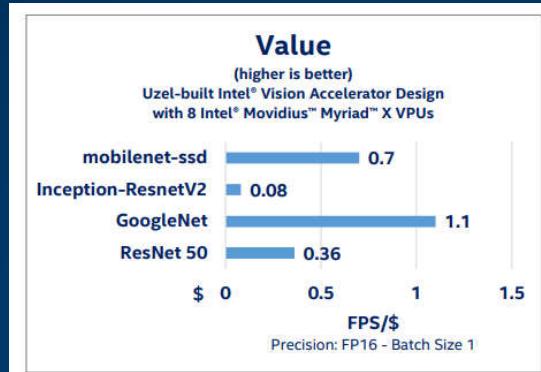
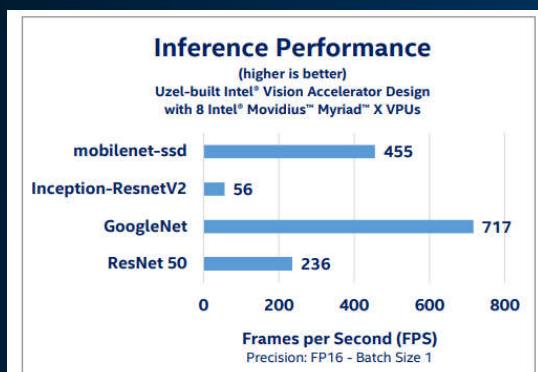
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# NEW BENCHMARKS FOR HDDL ACCELERATORS - JUNE 2019

INCREASE DEEP LEARNING MODEL PERFORMANCE WITH INTEL® MOVIDIUS™ VPU & INTEL® DISTRIBUTION OF OPENVINO™ TOOLKIT

LOCATION: [INTEL® DISTRIBUTION OF OPENVINO™ TOOLKIT PRODUCT SITE](#) > HARDWARE > PERFORMANCE BENCHMARKS



Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Learn more at [intel.com](#), or from the OEM or retailer. Performance results are based on testing as of March 29, 2019 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure. Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information, see [Performance Benchmark Test Disclosure](#).

**CONFIGURATIONS:** Testing by Intel as of March 29, 2019. See slide 59 for configuration details.

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# SPEED DEPLOYMENT WITH PRETRAINED MODELS & SAMPLES

## Pretrained Models in Intel® Distribution of OpenVINO™ toolkit

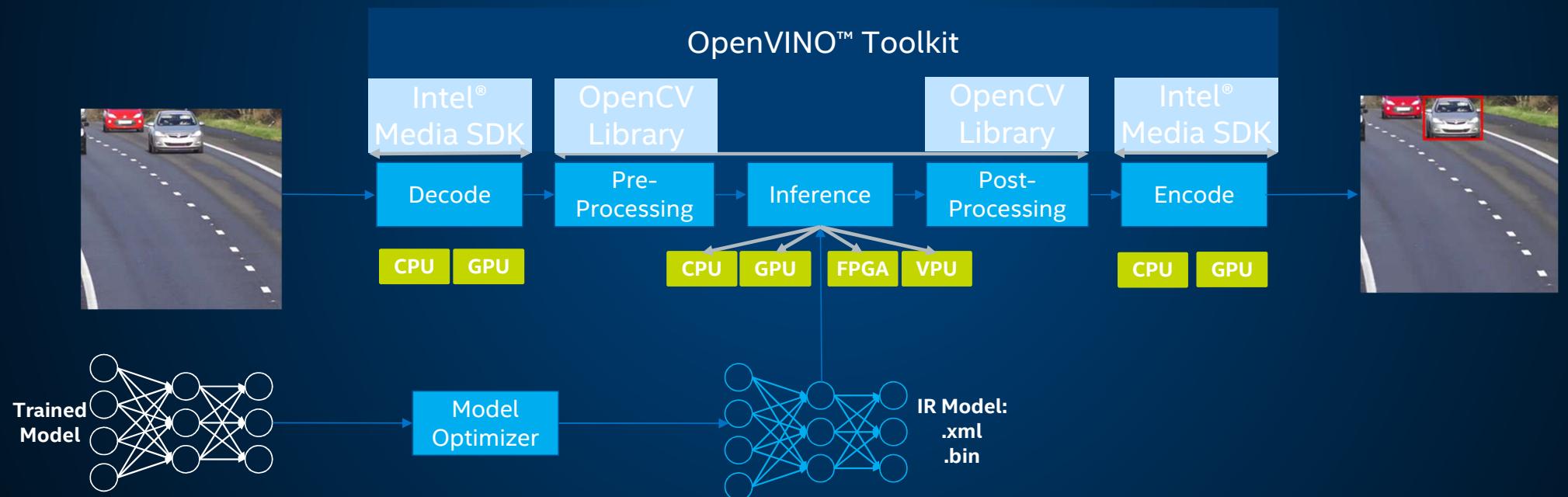
- |  |   |   |
|--|---|---|
| <ul style="list-style-type: none"><li>▪ Age &amp; Gender</li><li>▪ Face Detection—standard &amp; enhanced</li><li>▪ Head Position</li><li>▪ Human Detection—eye-level &amp; high-angle detection</li><li>▪ Detect People, Vehicles &amp; Bikes</li><li>▪ License Plate Detection: small &amp; front facing</li><li>▪ Vehicle Metadata</li><li>▪ Human Pose Estimation</li><li>▪ Action recognition – encoder &amp;</li></ul> | <ul style="list-style-type: none"><li>▪ Text Detection &amp; Recognition</li><li>▪ Vehicle Detection</li><li>▪ Retail Environment</li><li>▪ Pedestrian Detection</li><li>▪ Pedestrian &amp; Vehicle Detection</li><li>▪ Person Attributes Recognition Crossroad</li><li>▪ Emotion Recognition</li><li>▪ Identify Someone from Different Videos—standard &amp; enhanced</li><li>▪ Facial Landmarks</li><li>▪ Gaze estimation</li></ul> | <ul style="list-style-type: none"><li>▪ Identify Roadside objects</li><li>▪ Advanced Roadside Identification</li><li>▪ Person Detection &amp; Action Recognition</li><li>▪ Person Re-identification—ultra small/ultra fast</li><li>▪ Face Re-identification</li><li>▪ Landmarks Regression</li><li>▪ Smart Classroom Use Cases</li><li>▪ Single image Super Resolution (3 models)</li><li>▪ Instance segmentation</li><li>▪ and more...</li></ul> |
|--|---|---|

## Binary Models

- |   |  |   |
|---|--|---|
| <ul style="list-style-type: none"><li>▪ Face Detection Binary</li><li>▪ Pedestrian Detection Binary</li></ul> | <ul style="list-style-type: none"><li>▪ Vehicle Detection Binary</li></ul> | <ul style="list-style-type: none"><li>▪ ResNet50 Binary</li></ul> |
|---|--|---|

# WORKFLOW OF APPLYING OPENVINO IN CV APPLICATIONS, ACCELERATE STREAMING PERFORMANCE

Using Intel® Media SDK and the OpenVINO™ toolkit together enables customers to build high performance, intelligent vision solutions.



# INTEL® MEDIA SDK

## API to Access Intel® Quick Sync Video: Hardware Accelerated Encoding, Decoding, and Processing

- H.265 (HEVC)
- H.264 (AVC)
- MPEG-2 and more
- Resize, scale, deinterlace
- Color conversion, composition
- Denoise, sharpen, and more

## Benefits

- Outstanding performance
- Rich API to tune encoding pipeline
- Future proofed: support new processor without code changes

## Targeting Digital Security and Surveillance, Connected Car Applications, and More



Smart Camera

Car Infotainment and  
Cluster Display

using



Intel Atom®, Pentium®, and Celeron®<sup>1</sup>

Embedded Linux\*



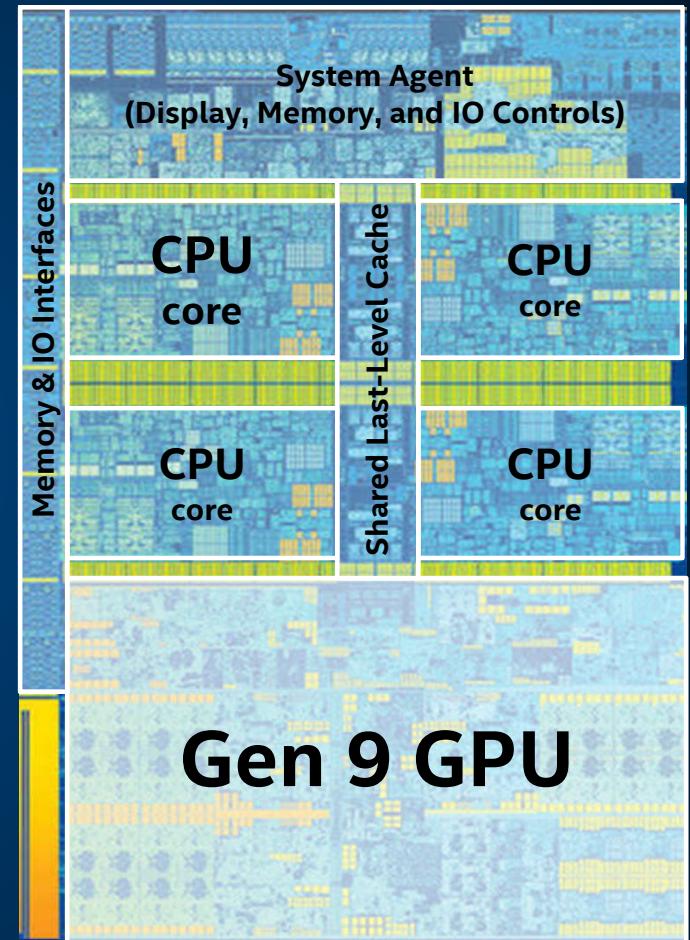
<sup>1</sup> Intel® Celeron® Processor N3350, Intel® Pentium® Processor N4200, Intel Atom® E3930, E3940, E3950 processors

# INTEL INTEGRATED GRAPHICS

**Gen** is the internal name for Intel's on-die GPU solution. It's a hardware ingredient with various configurations.

- Intel® Core™ Processors include Gen hardware.
- Gen GPUs can be used for graphics and also as general compute resources.
- Libraries contained in the Intel® Distribution of OpenVINO™ toolkit (and many others) support Gen offload using OpenCL™.

*6<sup>th</sup> Generation Intel® Core™ i7 (Skylake) Processor*



# PUTTING IT ALL TOGETHER

A major challenge is to get all these tool and libraries to work together in the best possible way to minimize development time and optimize system power/performance.

A good way to abstract that workload is using an end-to-end pipeline

## Computer Vision



## Deep Learning



## Media



### SDKs



Optimized CV  
Capabilities  
of



Intel® Deep Learning  
Deployment Toolkit



Intel® Media SDK

### Tools

Compiler, Analyzers, Debuggers



OpenCL™ SDK

### Libraries

IPP



TBB



OpenCL™ MKL-DNN



Intel® MKL  
DAAL



python<sup>®</sup>  
Intel distribution



# CALL TO ACTION AND RESOURCES

Download ▶

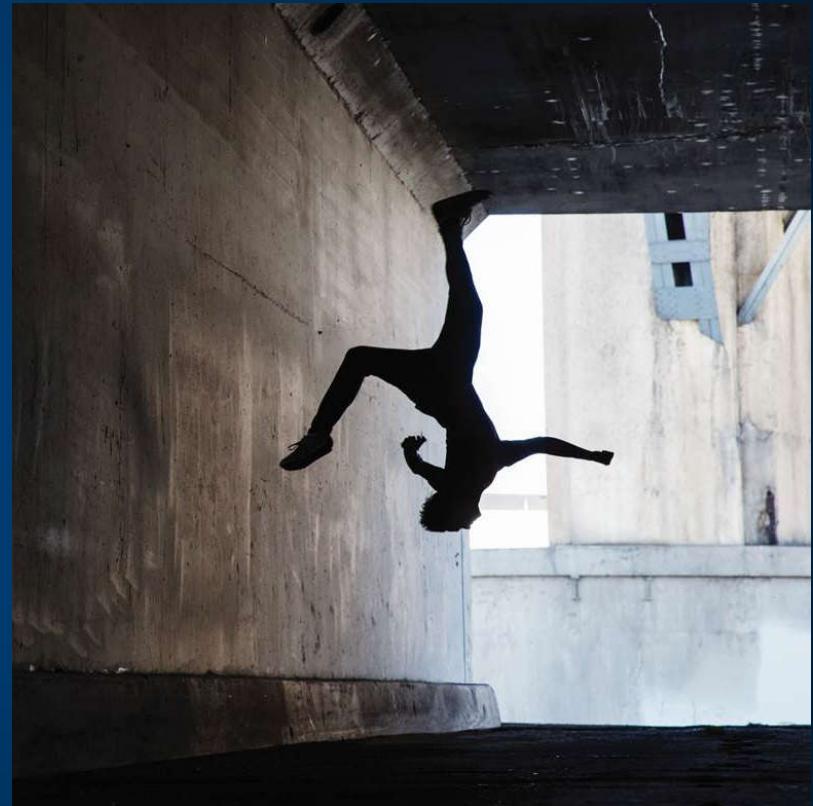
[Free Intel® Distribution of OpenVINO™ toolkit](#)

Get started quickly with:

- [Developer resources](#)
- [Online webinars, tool how-tos & quick tips](#)
- [Hands-on developer workshops](#)

Support

- Connect with Intel engineers & computer vision experts at the public [Community Forum](#)



Select Intel customers may contact their Intel representative for issues beyond forum support.



# IOT DEV CLOUD BY INTEL®



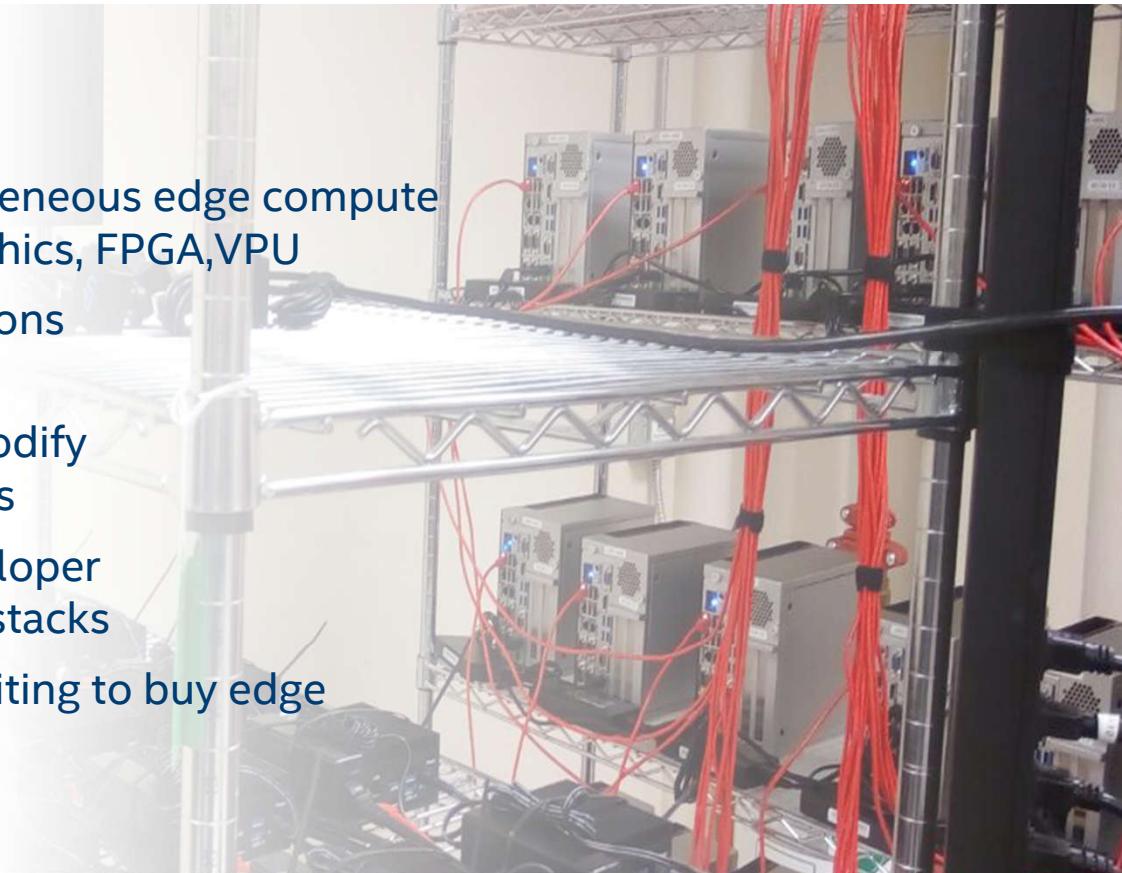
# INTEL IOT DEVELOPER CLOUD |

CLOUD-BASED HETEROGENEOUS  
EDGE DEVELOPMENT ENVIRONMENT

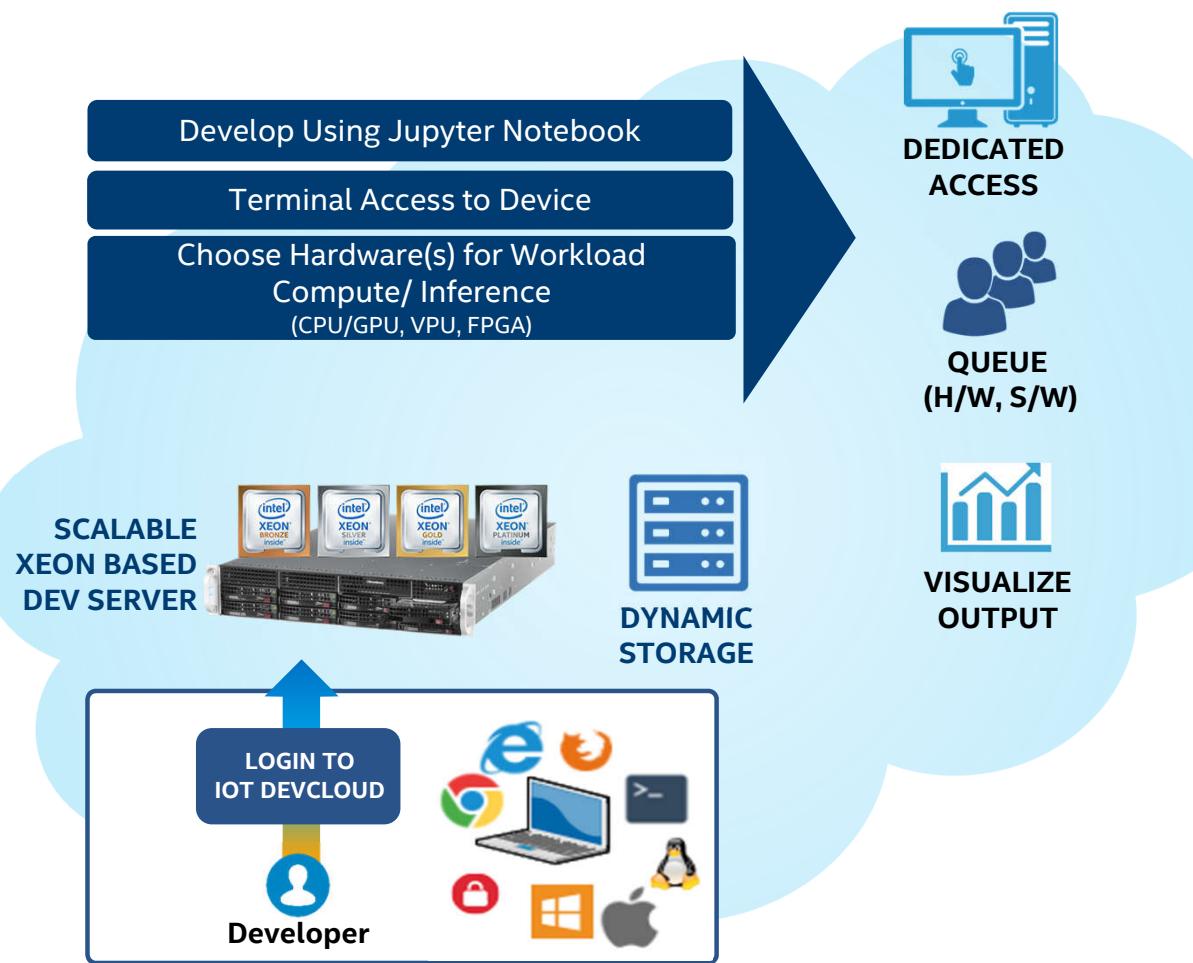
## KEY BENEFITS

Easily evaluate the power of Intel's heterogeneous edge compute processors: CPU, CPU with Integrated Graphics, FPGA,VPU

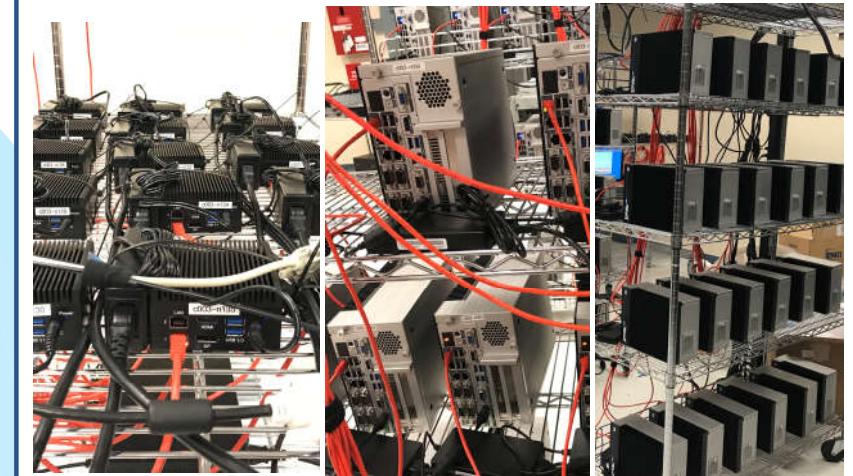
- Learn to develop vision inference solutions with OpenVINO™ toolkit
- Get started with complete examples, modify and upload your own models/workloads
- Evaluate and compare various IoT Developer Kit offerings, software stacks and edge stacks
- Getting started immediately without waiting to buy edge hardware



# INTEL IOT DEVELOPER CLOUD



## IOT DEVKITS, RRKS, OXM HARDWARE



- Pre-installed s/w stacks (OS, SDK, Tools)
- 50G Dynamic storage allocated to all users
- Metering, Profiling tools available to easily evaluate hardware
- Examples to easily get started

# AI: IN PRODUCTION REGISTRATION

## Signup for Access to the Intel® IoT DevCloud

**Sign Up Here:** <https://colfaxresearch.com/iot-devcloud/>

**Intel's Registration Passcode:**

NY091140N74W

**Code Valid From:**

SEPT 10, 2019, 00:01 AM UTC

**Code Valid To:**

Sept 12, 2019, 11:59 PM UTC

**Account Activation:**

Now

**Account Deactivation:**

SEP 21, 2019, 11:59 PM UTC



# DEFECT DETECTION DEMO

Software and Services Group  
IoT Developer Relations, Intel





# INTEL EDGE INSIGHTS SOFTWARE RAPID DEPLOYMENT OF ANALYTICS PIPELINES

Industrial Solutions Division, Intel

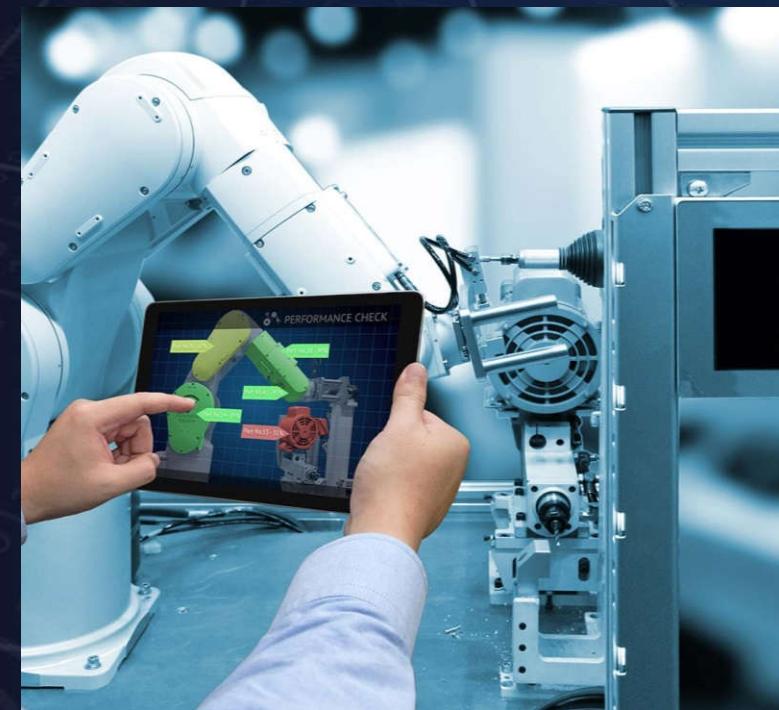
# TRANSFORMATION IN THE INDUSTRIAL MARKET

Smart factory is one of the outcomes of Industry 4.0.

It employs artificial intelligence, robotics, analytics, workload consolidation, and IoT to transform raw data into immediate (near real-time) **insights**.

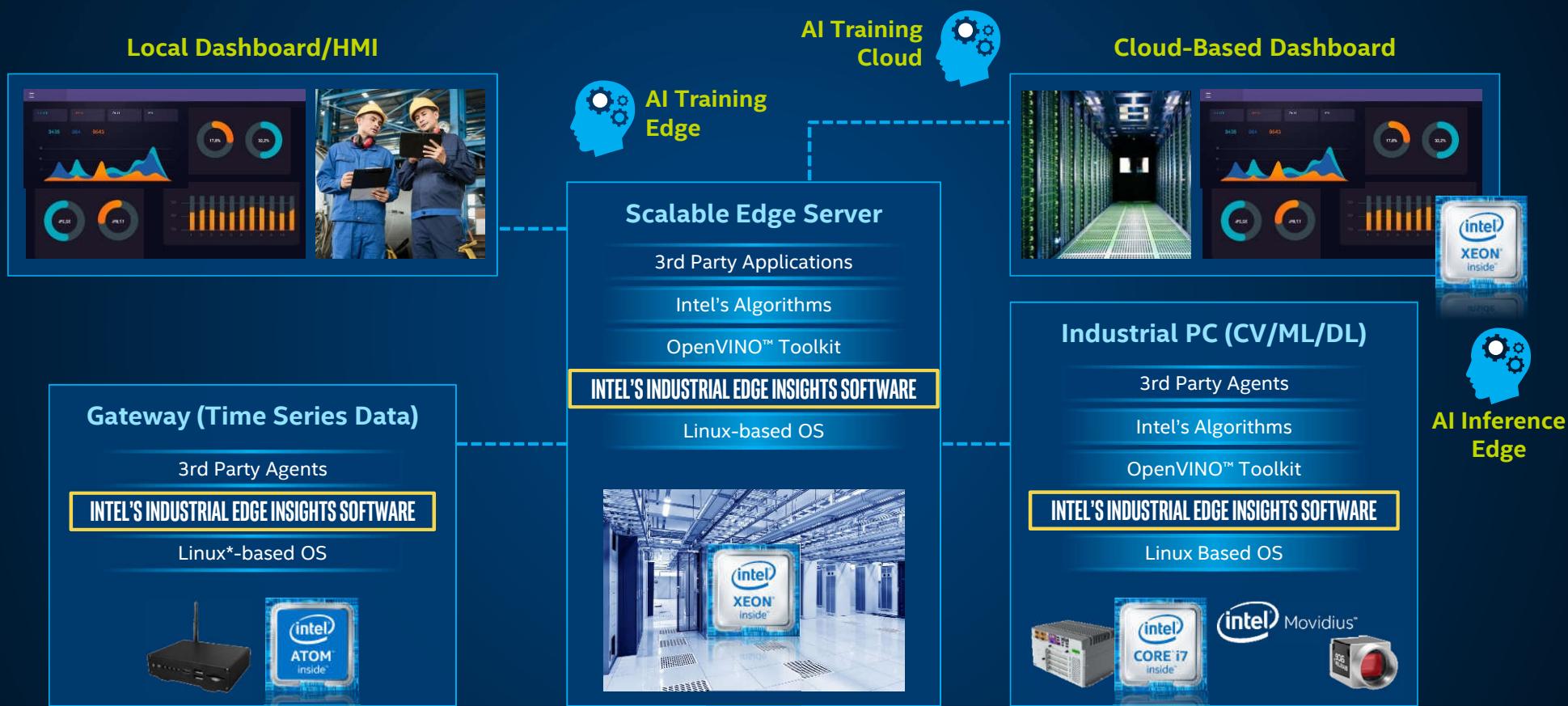
**The benefits of smart factories are many<sup>1</sup>:**

- Leaner process
- Maximum flexibility
- Improved predictability
- Increased agility
- Proven productivity



1. "Smart Factory and Its Benefits on Manufacturing Industry," Infinite Uptime August 21, 2018 <https://infinite-upptime.com/blog/smart-factory-benefits-manufacturing/>

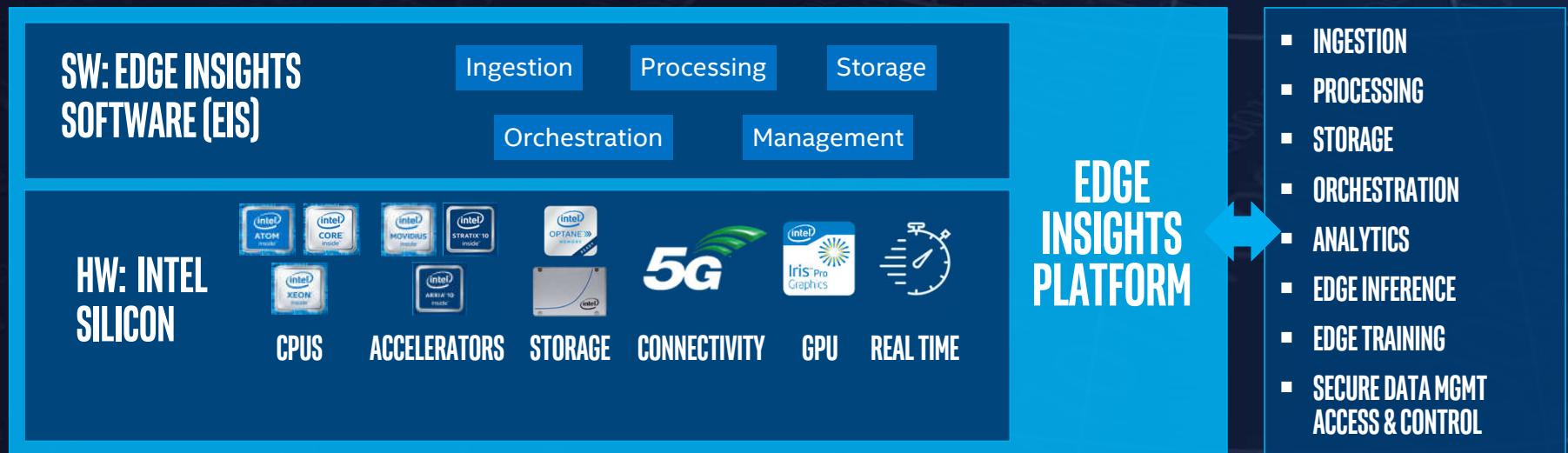
# ANALYTICS PIPELINES FOR SMART MANUFACTURING



\* Other names and brands may be claimed as the property of others.

# INDUSTRIAL EDGE INSIGHTS PLATFORM

Edge Insights Platform is both HW and SW designed to enable secure **ingestion**, **processing**, **storage**, **orchestration** and **management** of data, and near real-time (~10mS) event-driven control, across a diverse set of operating systems (OS) and industrial protocols.



Other names and brands may be claimed as the property of others.



# INTEL INDUSTRIAL EDGE INSIGHTS SOFTWARE

## A SOFTWARE STACK FOR RAPID DEPLOYMENT OF TIME SERIES AND VIDEO ANALYTICS

### PRODUCT VENDORS

**It provides validated and tested smart manufacturing software ingredients** for fast development and deployment and rapid time-to-market

**It provides optimized video and time-series data ingestion and an analytics framework** on a single platform that is validated and tested by Intel

**It is a \$0 license to use and distribute**, which helps our partners to scale their business with minimum development investment

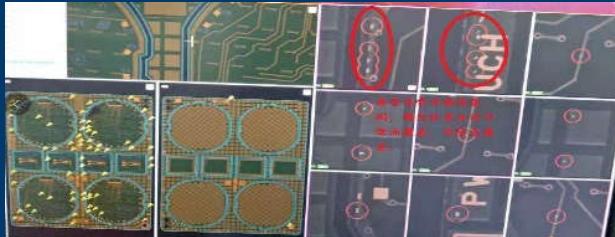
### END USERS

**Products with the software ingredients provide end users with incredible advanced insights and analytics to perform tasks such as:**

- Detecting defects using AI, ML, and DL
- Performing predictive analytics
- Enhancing their productivity and scale
- Optimizing their industrial processes
- Reducing maintenance and upkeep cost

# INDUSTRIAL EDGE INSIGHTS PLATFORM USE CASES

## DEFECT DETECTION



Package, part, or surface defects detection using AI and vision technology

- Inline quality control/assurance
- Reduce production losses and cost
- Reduce customer returns

## PREDICTIVE ANALYTICS



Predicting future outcomes based on historical data

- Predict product quality
- Predict equipment maintenance
- Prevent costly maintenance
- Predict yield fluctuation

## MANUFACTURING PRODUCTIVITY



Identifying opportunities/processes to improve on

- Monitor and improve factory production efficiency
- Monitor and identify production line constraints
- Monitor worker safety

APPLICABLE FOR BROWNFIELD AND GREENFIELD SITES AND INFRASTRUCTURES

# TWO INGESTION PIPELINES: VIDEO & POINT DATA

## VIDEO INGESTION SERVICES

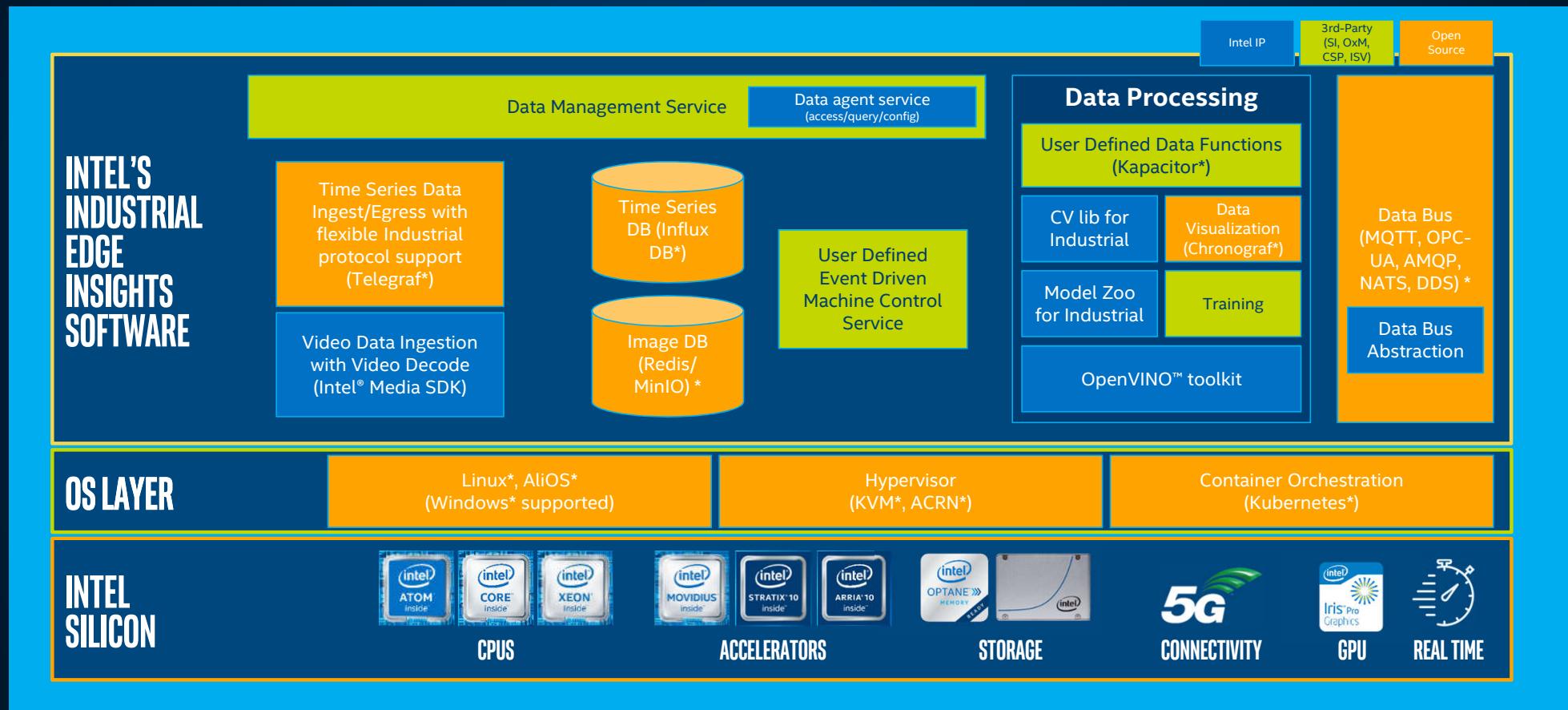
- ia\_video\_ingestion – this service is responsible for initializing the video input sources, which may be streaming RTSP sources (like a RTSP camera) or video files may be used as a source.
- ia\_imagemstore – responsible for storing select frames of the video input
- ia\_video-analytics – responsible for performing inference or other types of analysis on the video frames

## POINT DATA INGESTION

- ia\_telegraf – responsible for collecting point data and sending it to the database
- ia\_data\_analytics – responsible for classifying the readings and sending alerts and monitoring to external applications



# HIGH-LEVEL VIEW OF INDUSTRIAL EDGE INSIGHTS PLATFORM



\*Other names and brands may be claimed as the property of others.



# INTEL'S INDUSTRIAL EDGE INSIGHTS SOFTWARE

**OpenVINO™**

**intel** FPGA **Movidius**  
an Intel company

AliOS  Windows



Industrial Edge Insights Software is a product-quality software stack designed to enable secure ingestion, processing, storage, orchestration and management of data, and near real-time (~10mS) event-driven control, across a diverse set of operating systems (OS) and industrial protocols.

## The software provides:

- modular message/data bus for machine, video, and audio<sup>1</sup> workloads
- containerized ingredients for image processing, storage, and analytics
- support for industrial optimized inference and training<sup>1</sup> at the Edge
- support for Windows\*, Linux\*, and AliOS\*
- multitenant microservices support for Azure\*, Aliyun\*, AWS<sup>1</sup> cloud connectors
- connectors for easy usage of Intel® Media Software Development Kit (Intel® Media SDK), GStreamer, OpenVINO™ toolkit, and Intel® Math Kernel Library (Intel® MKL)
- support for Intel's CPU, GPU, FPGA, and VPU portfolio with hardware ranging from Gateways, Industrial PCs (IPCs), Edge Compute Nodes (ECNs), to Edge Servers
- \$0 binary distribution (OBL) to Intel's ecosystem partners

<sup>1</sup>- Available in future Industrial Edge Insights software releases

\*Other names and brands may be claimed as the property of others



# STEP 1A: VIDEO INGESTION

This module ingests video frames from a video source like video file or basler/RTSP/USB camera using gstreamer pipeline and publishes the (metadata, frame) tuple to the data bus.

## RESPONSIBILITIES OF VIDEO INGESTOR

- The Video Ingestion module starts capturing frames from Basler camera / RTSP camera (or video file) and sends the frames to the Trigger Algorithm.
- Uses Trigger Functions to select Key Frames
- Queues Key Frames to be published on the Data Bus
- Triggers are defined by the application developer

```
./docker_setup/config/algo_config/factory_pcdbdemo.json
1  {
2    "ingestor": {
3      "video_src": "./test_videos/pcb_d2000.avi",
4      "encoding": {
5        "type": "jpg",
6        "Level": 100
7      },
8      "loop_video": "true"
9    },
10   "filter": {
11     "name": "pcb_filter",
12     "queue_size": 10,
13     "max_workers": 5,
14     "training_mode": "false",
15     "n_total_px": 300000,
16     "n_left_px": 1000,
17     "n_right_px": 1000
18   }
19 }
```



# CAPTURING VIDEO FROM CAMERA OR FILE SOURCES

**Step-1.a:** The Video Ingestion module starts capturing frames from Basler camera / RTSP camera (or video file) and sends the frames to the Trigger Algorithm.

```
"data_ingestion_manager": {
    "ingestors": {
        "video": {
            "vi_queue_size": 5,
            "streams": [
                {
                    "capture_streams": {
                        "cam_serial1": {
                            "video_src": "rtspsrc location=\"rtsp://localhost:8554/\" latency=100 ! rtph264depay ! h264parse ! mfxdecode ! videoconvert ! appsink",
                            "encoding": {
                                "type": "jpg",
                                "level": 100
                            },
                            "img_store_type": "inmemory_persistent",
                            "poll_interval": 0.2
                        },
                        "cam_serial2": {
                            "video_src": "rtspsrc location=\"rtsp://localhost:8554/\" latency=100 ! rtph264depay ! h264parse ! mfxdecode ! videoconvert ! appsink",
                            "encoding": {
                                "type": "jpg",
                                "level": 100
                            },
                            "img_store_type": "inmemory_persistent",
                            "poll_interval": 0.2
                        },
                        "cam_serial3": {
                            "video_src": "rtspsrc location=\"rtsp://localhost:8554/\" latency=100 ! rtph264depay ! h264parse ! mfxdecode ! videoconvert ! appsink",
                            "encoding": {
                                "type": "jpg",
                                "level": 100
                            },
                            "img_store_type": "inmemory_persistent",
                            "poll_interval": 0.2
                        }
                    }
                }
            ]
        }
    }
}
```

# STEP 1B: POINT DATA INGESTION

Point Data mode allows the ingestion of time series based like sensor readings that have a time stamp

## SERVICES IN POINT DATA MODE

- Telegraf is used to read multiple data formats and store them in InfluxDB
- Uses Trigger Functions to select Key Frames
- Queues Key Frames to be published on the Data Bus
- Triggers are defined by the application developer

```
./docker_setup/config/algo_config/factory_pcdbdemo.json
1  {
2    "ingestor": {
3      "video_src": "./test_videos/pcb_d2000.avi",
4      "encoding": {
5        "type": "jpg",
6        "Level": 100
7      },
8      "loop_video": "true"
9    },
10   "filter": {
11     "name": "pcb_filter",
12     "queue_size": 10,
13     "max_workers": 5,
14     "training_mode": "false",
15     "n_total_px": 300000,
16     "n_left_px": 1000,
17     "n_right_px": 1000
18   }
19 }
```



# STEP 2: TRIGGER ALGORITHM

- The Trigger Algorithm will determine the relevant frames that are to go to the Classifier.
- To create a custom trigger
  - Create a class derived from BaseTrigger
  - Override the constructor, `__init__()`
  - Enumerate the supported ingestors
  - Override the `on_data()` function, which is called when for each video frame.
  - Use OpenVINO or other libraries or methods to analyze the video and decide whether to pass it to the classifier or not.

```
import logging
import cv2
import numpy as np
from . import BaseTrigger

class Trigger(BaseTrigger):
    """Bypass trigger to send all the frames without any trigger logic to
    select key frames.
    """

    def __init__(self, training_mode):
        """Constructor.
        """
        super(Trigger, self).__init__()
        self.log = logging.getLogger(__name__)
        self.training_mode = training_mode
        self.count = 0
        self.startSignal = True

    def get_supported_ingestors(self):
        return ['video', 'video_file']

    def on_data(self, ingestor, data):
        """Process video frames as they are received and call the callback
        registered by the 'register_trigger_callback()' method if the frame
        should trigger the execution of the classifier.

        Parameters
        -----
        ingestor : str
            String name of the ingestor which received the data
        data : tuple
            Tuple of (camera serial number, camera frame)
        """
        if self.training_mode is True:
            self.send_start_signal(data, -1)
            cv2.imwrite("./frames/" + str(self.count) + ".png", data[1])
        else:
            # Send trigger start signal and send frame to classifier
            if self.startSignal:
                self.send_start_signal(data, -1)
                self.startSignal = False
            # Sending Frames to Store
            self.log.debug("Sending frame")
            self.send_data(data, 1)
```

# STEP 3: KAPACITOR

- Capacitor subscribes to the Meta Data stream. All the streams in InfluxDB are subscribed as default by Capacitor.
- Capacitor is configured by TICKscript
- Capacitor is an alert and monitoring system
- Intel Edge Insights Software uses Capacitor to subscribe to data coming into InfluxDB, passing it to a Classifier and then writing the results back to Influxdb.
- This workflow is defined in a TICK script. Users and define their own TICK scripts.

The following handlers are currently supported:

[Alerta](#): Sending alerts to Alerta.

[Email](#): To send alerts by email.

[HipChat](#): Sending alerts to the HipChat service.

[Kafka](#): Sending alerts to an Apache Kafka cluster.

[MQTT](#): Publishing alerts to an MQTT broker.

[OpsGenie](#): Sending alerts to the OpsGenie service.

[PagerDuty](#): Sending alerts to the PagerDuty service.

[Pushover](#): Sending alerts to the Pushover service.

[Sensu](#): Sending alerts to Sensu.

[Slack](#): Sending alerts to Slack.

[SNMP Trap](#): Posting to SNMP traps.

[Talk](#): Sending alerts to the Talk service.

[Telegram](#): Sending alerts to Telegram.

[VictorOps](#): Sending alerts to the VictorOps service.

# STEP 4: CLASSIFIER

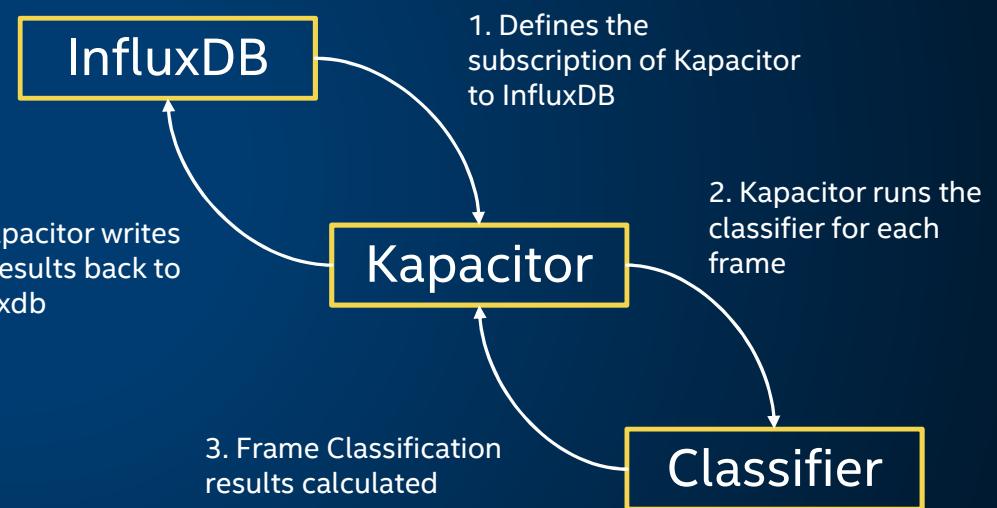
The Classifier UDF (User Defined Function) receives the Meta Data from Kapacitor. It then invokes the UDF classifier algorithm.

The Classifier Algorithm is defined by the application developer.

OpenVINO is used for deep learning based visual inspection.

## TICK Script

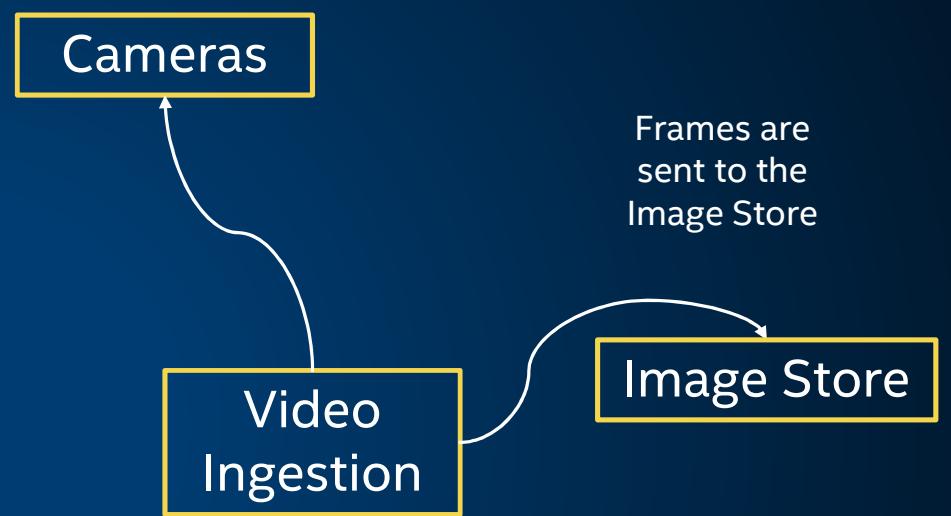
1. Defines the subscription of Kapacitor to InfluxDB
2. Kapacitor runs the classifier for each frame
3. Frame Classification results calculated
4. Kapacitor writes the results back to influxdb



# DATA AGENT

Responsible for initializing the stream manager to listen to the data going into InfluxDB

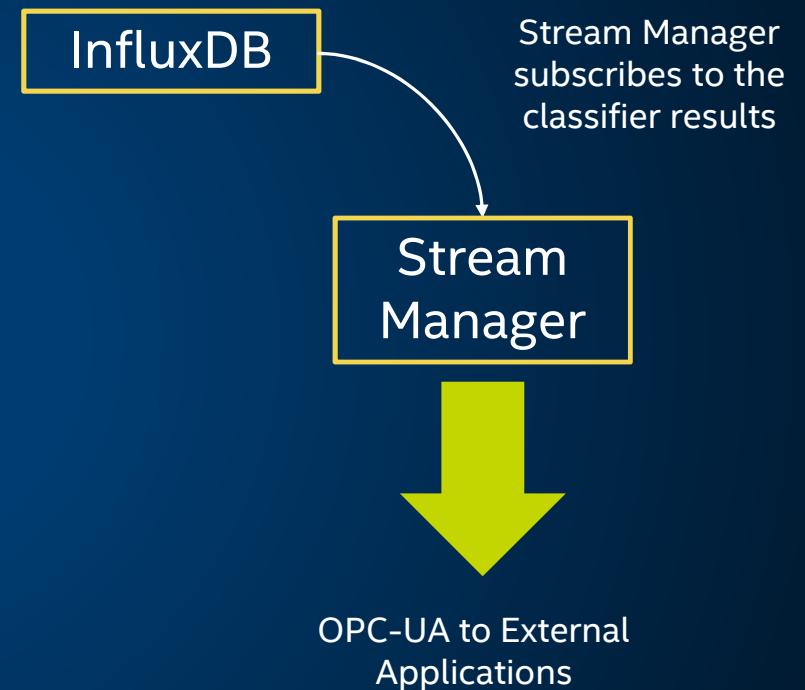
Runs a gRPC server for connection to the ImageStore



# STEP 10: STREAM MANAGER

The Stream Manager subscribes to the Classified Results stream. The policy of stream export is set in the Stream Manager.

The data is published over OPC-UA to an external OPC-UA server and can be integrated into the existing environment and 3<sup>rd</sup> party applications.



# IMAGE STORE AND DATA AGENT

## IMAGE STORE

Redis - in-memory data structure store, used as a database, cache and message broker

Minio - Open Source, Enterprise-Grade, Amazon S3 Compatible Object Storage

## DATA AGENT

Responsible for initializing the stream manager to listen to the data going into InfluxDB

Runs a gRPC server for connection to the ImageStore

# STEP 12: RESULT PUBLISHED TO EXTERNAL APPLICATIONS

The Classified result is published in  
the OPC-UA message bus and  
available to external applications

# VISUALIZE THE DATA WITH CHRONOGRAF

Chronograf lets you visualize the results of a query to the time series database.

Measurements can be grouped by intervals, single point data, or data over time.



# JWIPC RRK: EDGE INSIGHTS RFP READY KIT



## AI-Ready AIO Gateways/Industrial PCs

- Intel's Industrial Edge Insights Software
- Intel® OpenVINO™ toolkit
- AliOS Things\* and Link Edge\* Ready
- Intel® Atom™, Intel® Core™, Intel® Xeon™ Processors
- Fan or Fanless, Rugged Configurations
- 2-4x PCIe\* (Altera® or Intel® Movidius™ technology)
- 2-4x COM 6x USB3.0
- 2.5" HDD Hot Plug
- 2-4x Ethernet (PoE)
- Ubuntu\*, CentOS\*, Windows\*, or Yocto\* Ready<sup>1</sup>

1- OpenVINO™ Toolkit OS Support: CentOS\* 7.4 (64 bit), Ubuntu\* 16.04.3 LTS (64 bit), Microsoft Windows\* 10 (64 bit), Yocto Project\* version Poky Jethro v2.0.3 (64 bit)

\* Other names and brands may be claimed as the property of others.



# IEI TANK-870-Q170



The IOT Client Foundational Kit will provide **manageability**, **performance**, and a **scalable rapid path to market** solution that will support advanced **computer vision** and **deep learning** usages.

[http://eshop.usa.ieeworld.com/usa/items.php?CA=2&sub\\_CA=24](http://eshop.usa.ieeworld.com/usa/items.php?CA=2&sub_CA=24)

<https://software.intel.com/en-us/blogs/2018/06/13/introducing-the-tank-aiot-developer-kit>

## PCIE SLOTS THAT WILL SUPPORT HDDL-F (FPGA) AND HDDL-RC (MYRIAD X)

Core i5  
Fanless  
8GB of RAM  
1TB HDD  
2x PCIe x8  
Dual LAN with TSN support  
WIFI  
I/O Ports: 4x USB 3.0, 4 x USB 2.0, 4x RS-232, 2x RS-232/485, 8-bit DIO, 1x Line-out, 1x Mic-in  
Operating Temp: -20°C~60°C

# VISION ACCELERATION KIT + HDDL-R

## POWERED BY IEI\*

- Specialized Processors designed for high-performance machine vision at low power
- 8 VPUs x 16 SHAVE cores (Streaming Hybrid Architecture Vector Engine)
- Supports multiple network topologies (GoogLeNet, ResNet, etc.)
- Two Memory Banks (DDR4, 8GB in total)
- Preinstalled Intel® Distribution of OpenVINO™ toolkit
- Get started quickly with samples



TANK-870-Q170



# IEI\* TANK AIOT DEVELOPER KIT

- High-performance computer vision Applications
- Industrialized Design
- Intel® Core™ or Intel® Xeon™ Spec.
- Extendible with PCIe\* AI Accelerators
- Preloaded with the Intel® Distribution of OpenVINO™ toolkit



# INTEL INGREDIENTS IN INDUSTRIAL AUTOMATION

Data Center

Compute Performance  
I/O intensive



Factory server

Compute Performance  
I/O intensive



Industrial PC

Compute Performance  
Visualization/ UX  
RT Perf



PLC/PAC

I/O intensive  
Form Factor Sensitive  
RT Perf



HMI

Compute Performance  
Visualization/ UX  
Form Factor Sensitive



Remote IO

I/O intensive  
RT Perf



Robots

Compute Performance  
I/O intensive  
RT Perf



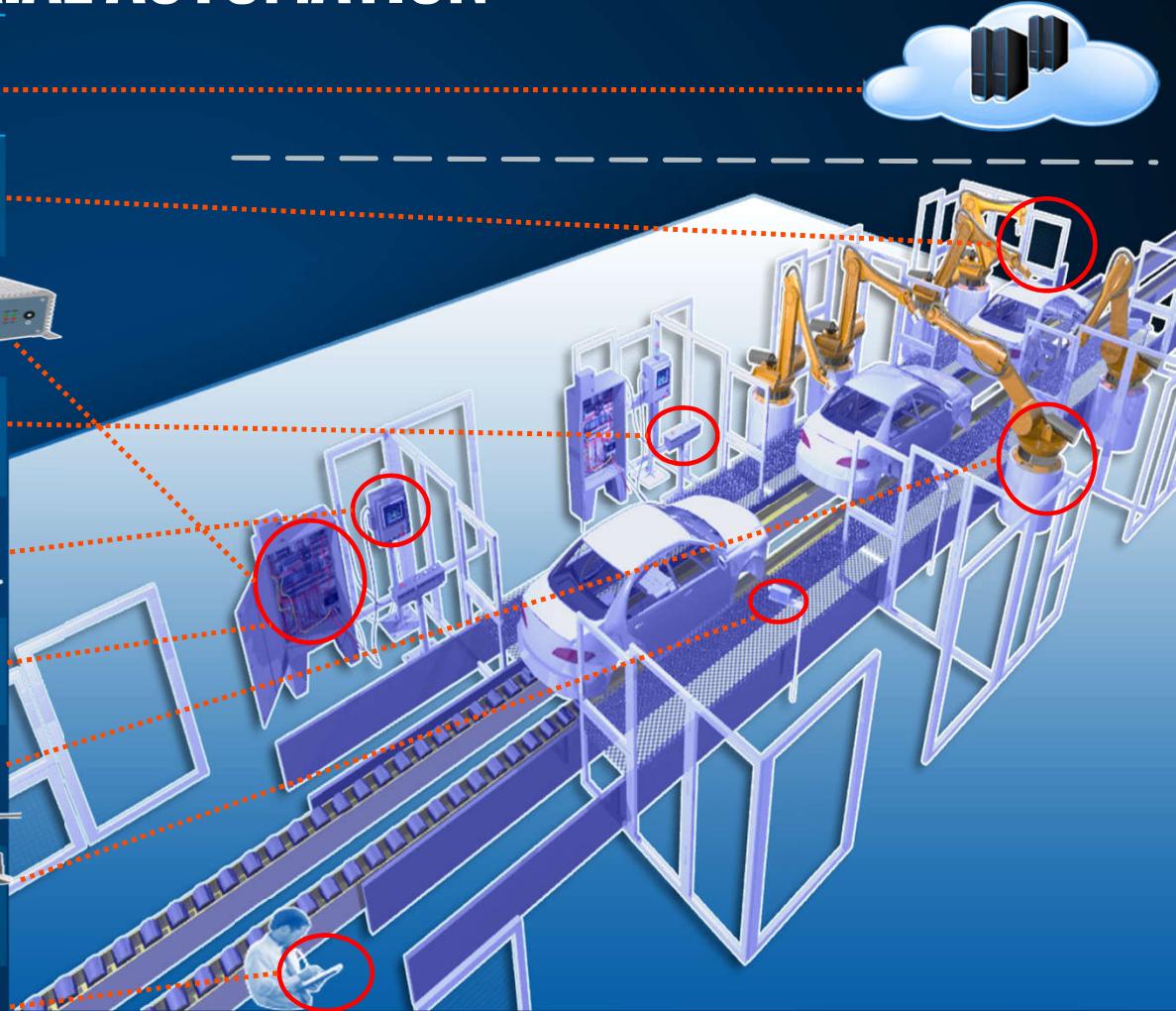
Machine visions

Compute Performance  
Form Factor Sensitive



Mobile workforce

Visualization/ UX  
Form Factor Sensitive



# VERIFIED SWAPPABLE IPC READY TO RUN



**ADLINK TECHNOLOGY, INC.**  
PRODUCTS: RK-630/IMB-M43-C236 RK-630/IMB-M43H  
LEARN MORE:  
<https://www.adlinktech.com/>



**ARBOR**  
PRODUCTS: FPC-7903  
LEARN MORE:  
<https://www.arbor-technology.com/>



**AXIOMTEK CO., LTD**  
PRODUCTS: IPC962-511-FL IPC962-512-FL  
LEARN MORE: <http://www.axiomtek.com/>



**DFI INC.**  
PRODUCTS: KU173 SD631  
LEARN MORE: <http://www.dfi.com/>



**IBASE TECHNOLOGY INC.**  
PRODUCTS: CMI203-991 AMI222  
LEARN MORE: <https://www.ibase.com.tw/>



**IEI INTEGRATION CORP.** PRODUCTS:  
TANK-870AI TANK-870e-H110 LEARN MORE: <https://www.ieeworld.com/>



**LEX COMPUTECH CO., LTD.**  
PRODUCTS: CI170A  
LEARN MORE: <http://www.lex.com.tw/>



**NEXCOM INTERNATIONAL CO., LTD**  
PRODUCTS: NIFE300P2E LEARN MORE: <http://www.nexcom.com/>



**QUANMAX INC.**  
PRODUCTS: RAK-400 LEARN MORE: <http://www.quanmax.com/>

Photo source: Intel® IoT Solutions Alliance Solution Directory





# **MIGRATE TO A NEW INDUSTRIAL PC TODAY**

Avoid Obsolescence, Improve Security  
and Be Prepared for the Future

# RESTRICTED ZONE NOTIFIER

