INDUSTRIAL EDGE INSIGHTS PLATFORM

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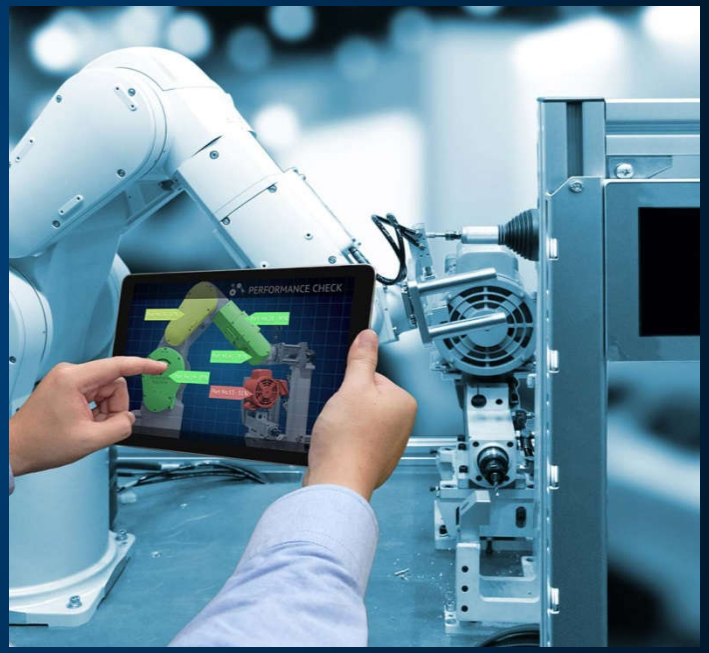
SMART FACTORY: TRANSFORMATION IN THE INDUSTRIAL MARKET

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[1]:

- 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-uptime.com/blog/smart-factory-benefits-manufacturing/

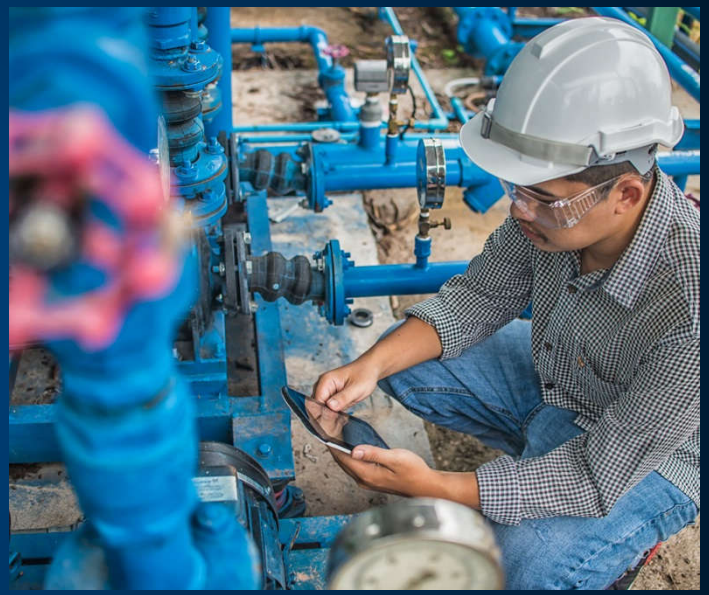
INSIGHTS: WHAT IT IS AND WHY IT IS IMPORTANT

Insights:

- Using reasoning, data analytics, and other decision models to arrive at a decision
- Turning knowledge into compelling findings
- Unlocking the data and using it

Currently, industrial insights are either NOT automated or need to speed up, e.g.,

- Maintaining product quality levels
- Monitoring equipment condition
- Prioritizing maintenance projects

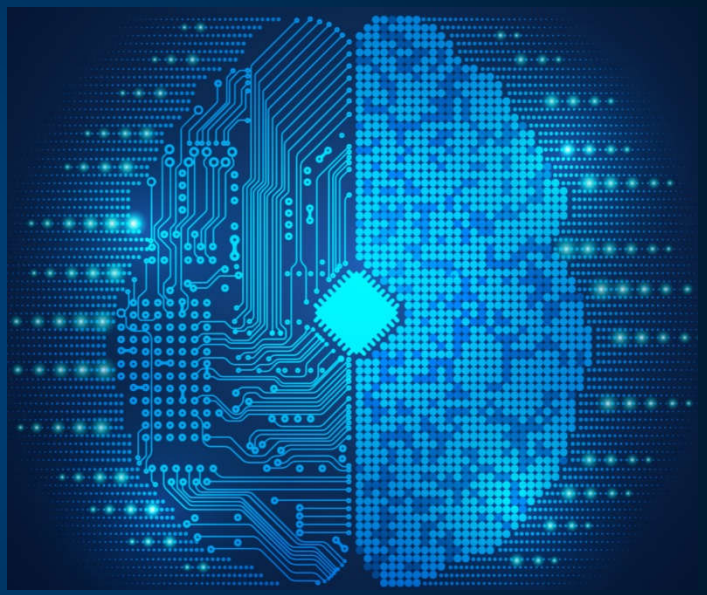


FOR EFFICIENT ON-FLOOR DECISIONS, IMMEDIATE INSIGHTS ARE A NECESSITY

EDGE INSIGHTS FOR IMMEDIATE AND AUTOMATED DECISIONS

Efficient and automated (on the factory floor) decisions require immediate insights with near real-time analysis in ~10ms

Data latency from customers to cloud is too high for taking immediate decisions



IN THE US, THE CLOUD LATENCY IS AROUND 60MS[1]:

US West 63ms

Northeast 66ms

Southwest 70ms

US East 77ms

EDGE-BASED INSIGHTS ARE THE KEY TO ENABLING NEAR REAL-TIME DECISIONS

1- https://www.networkworld.com/article/3095022/who-s-got-the-best-cloud-latency.html

OPPORTUNITIES FOR IMMEDIATE AND AUTOMATED EDGE INSIGHTS

Operational Optimization

- Inline quality control activities (e.g., defect detection using time series data and/or visual data)
- 24/7 monitoring activities (e.g., flare monitoring, process monitoring)

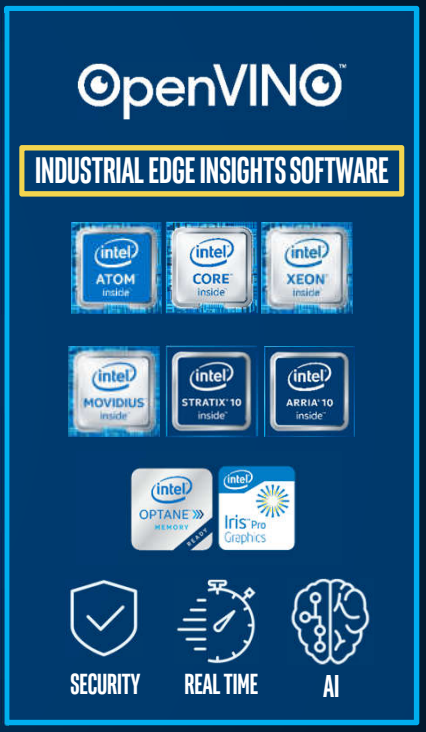
Asset Optimization

- Workload distribution/consolidation across multiple assets
- Reduction or mitigation of unplanned downtime (e.g., predictive maintenance)

INDUSTRIAL EDGE INSIGHTS PLATFORM

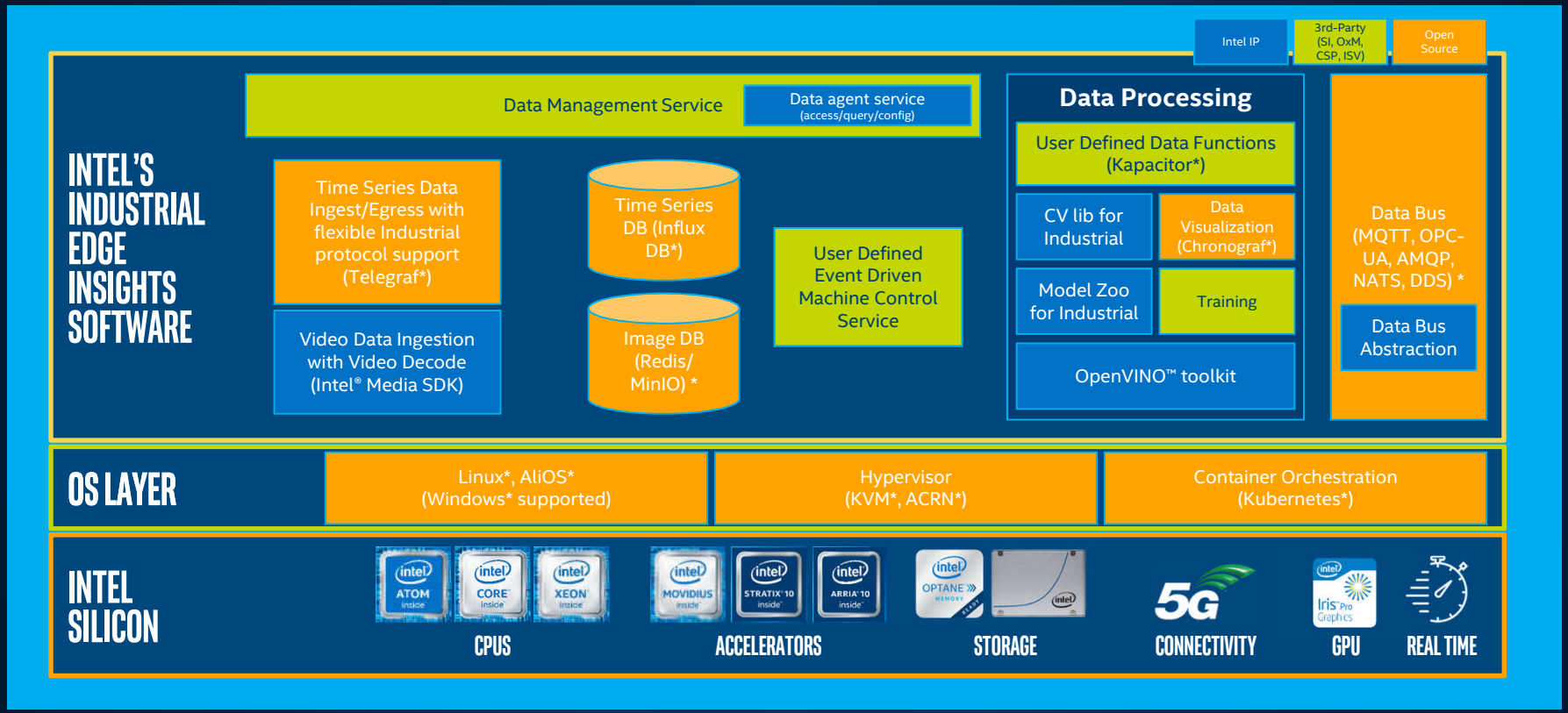
Industrial Edge Insights Platform is a validated hardware-software platform designed to scale from Intel® Core™, to Intel® Xeon® D, to Intel® Xeon® Scalable processors on the edge. It supports Intel® Virtualization Technology (Intel® VT) and Intel® VT-x virtualization technologies, discrete/integrated TPM[1] and firmware TPM.

- Designed for Intel's CPU, GPU, FPGA, and VPU portfolio with hardware ranging from Gateways, Industrial PCs (IPCs), Edge Compute Nodes (ECNs), to Edge Servers
- Computation scales to Intel® Xeon® Scalable processor to consolidate diverse industrial workloads
- Includes Intel's Industrial Edge Insights Software; a modular, field-validated SW product with a message/data bus for machine, video, and audio workloads[2]
- Enables industrial optimized inference and training[2] at the Edge
- Supports Windows*, Linux*, AliOS*
- Offers multitenant microservices support for Azure*, Aliyun*, AWS*[2] cloud connectors
- Features connectors for easy usage of Intel® Media Software Development Kit (Intel® Media SDK), GStreamer, OpenVINO™ toolkit, and Intel® Math Kernel Library (Intel® MKL)



1- Does not apply to PRC
2- Will be available in future Industrial Edge Insights Platform releases
* Other names and brands may be claimed as the property of others.

HIGH-LEVEL VIEW OF INDUSTRIAL EDGE INSIGHTS PLATFORM



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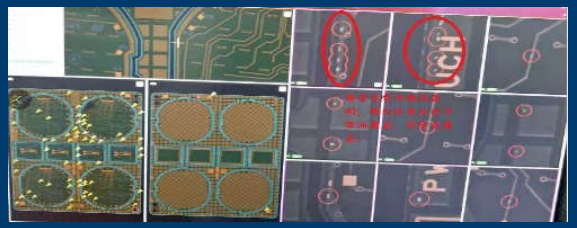
INDUSTRIAL EDGE INSIGHTS PLATFORM USE CASES

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

VALUE PROPOSITIONS OF INDUSTRIAL EDGE INSIGHTS PLATFORM FOR …

… CUSTOMERS / PARTNERS

The platform supports a diverse range of computational (CPU, GPU, FPGA), storage (traditional and Intel® Optane™ technology) , connectivity (traditional and 5G), and device manageability to ease solution development

It provides hardware and software ingredients for fast development and deployment and rapid time-to-market

It includes a software that provides optimized video and time-series data ingestion and an analytics framework on a single platform

It provides a software stack with a $0 license to use and to distribute, which helps our partners to scale their businesses with minimum development investment

… END USERS

Solutions built on the Industrial Edge Insights Platform provide end users with incredible advanced hardware and software that:

- Supports various computational technologies
- Supports standard industrial connectivity
- Can easily scale in function to ingest more data
- Can scale in size to multiple industrial plants
- Detects product quality issues automatically

INTEL'S INDUSTRIAL EDGE INSIGHTS SOFTWARE

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[1] workloads
- containerized ingredients for image processing, storage, and analytics
- support for industrial optimized inference and training[1] at the Edge
- support for Windows*, Linux*, and AliOS*
- multitenant microservices support for Azure*, Aliyun*, AWS[1] 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

1- Available in future Industrial Edge Insights software releases
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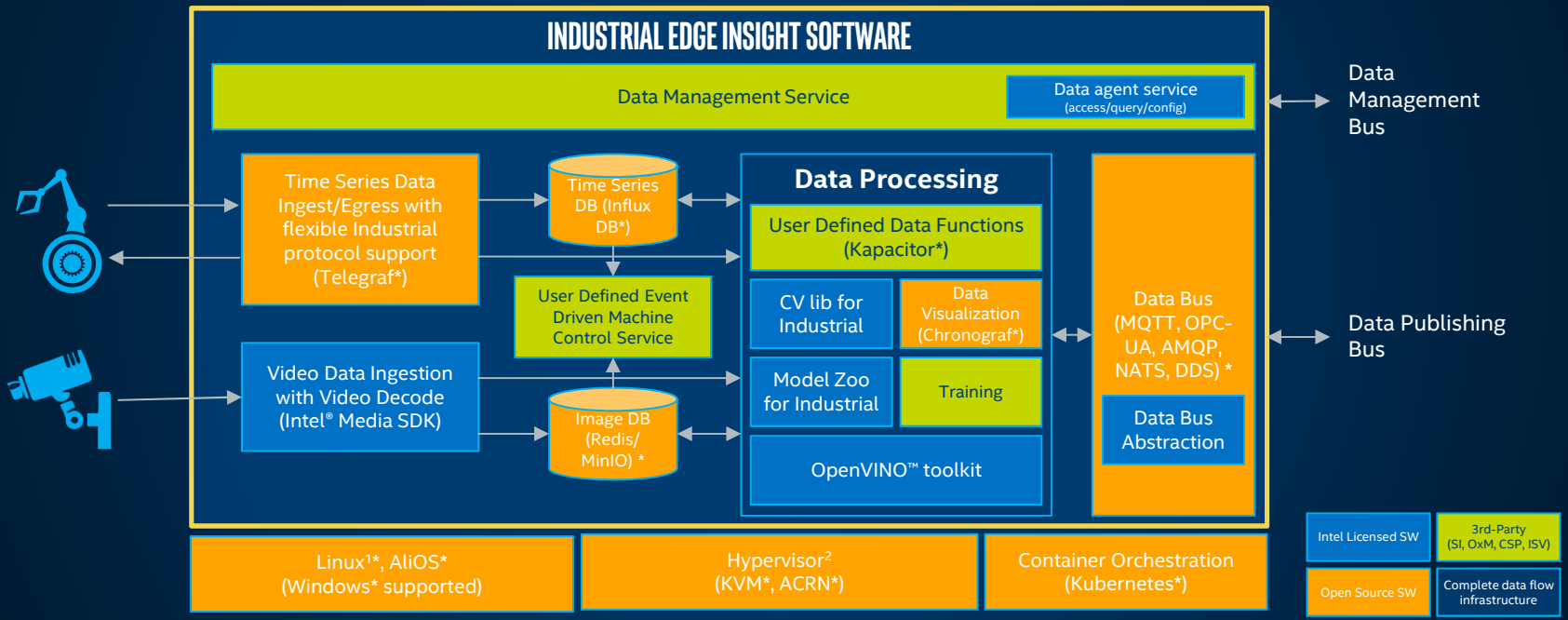
THE ARCHITECTURE OF INTEL'S INDUSTRIAL EDGE INSIGHTS SOFTWARE



THE BENEFITS OF USING INTEL'S INDUSTRIAL EDGE INSIGHTS SOFTWARE FOR ...

... CUSTOMERS / PARTNERS

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

INTEL'S INDUSTRIAL EDGE SOFTWARE FEATURES

VERSION 1.0

Silicon Support

- Intel® Xeon® SP processor (Skylake)
- Intel® Xeon® D processor (Broadwell)
- Intel® Core™ i5/ i7/ i9 processor
- FPGA, Movidius VPUs, SSDs

Key Features

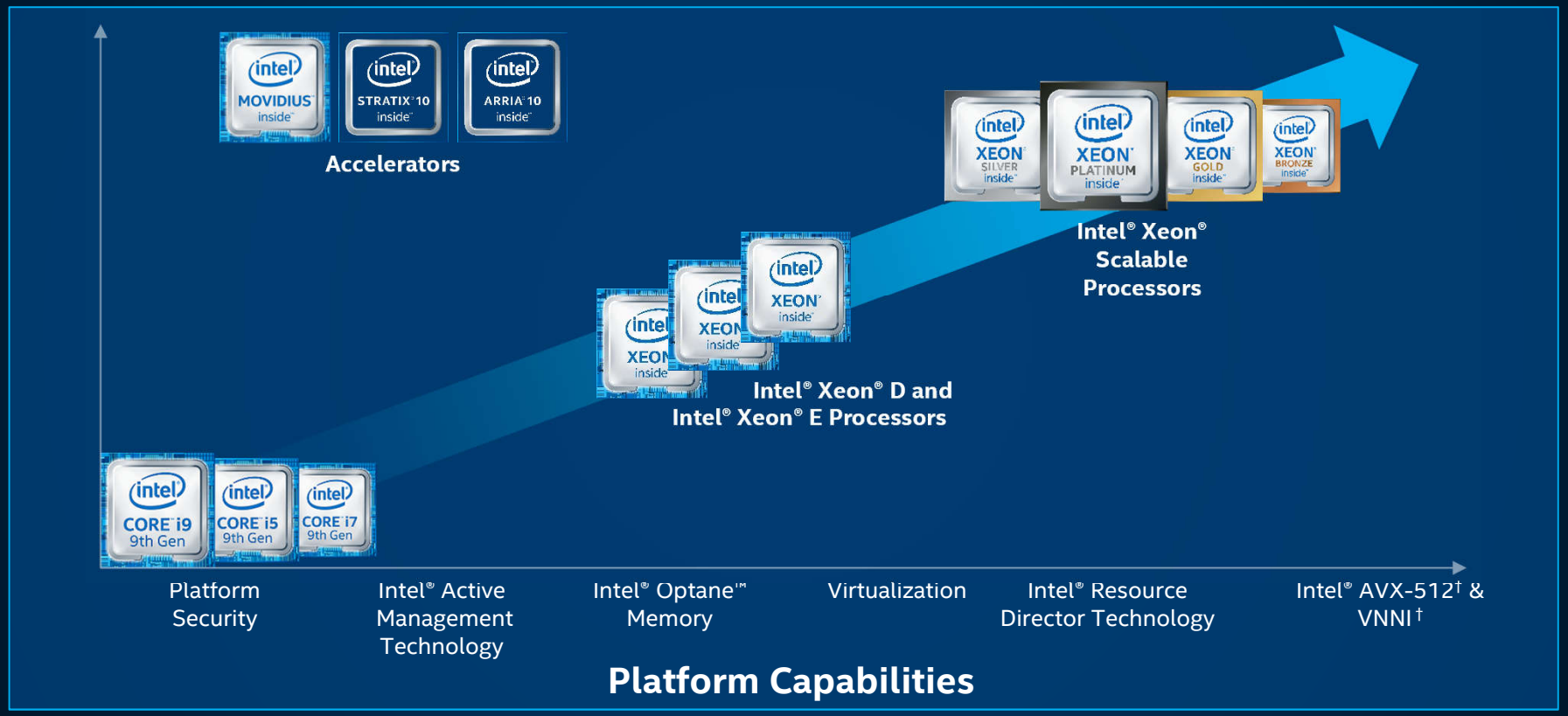
- Time series data ingestion, storage and data analytics
- Video data ingestion (Basler GigE Vision* & RTSP) and storage (Redis* & MinIO*)
- Hardware-accelerated media encode/decode (Intel® Media SDK)
- IA Optimized computer vision inference (OpenVINO™ toolkit)
- Available for use with full suite of PCIe*-based Intel accelerator cards (FPGA, VPU)
- Security enabled (SAFE ratified architecture)

VERSION 1.5

Key Features

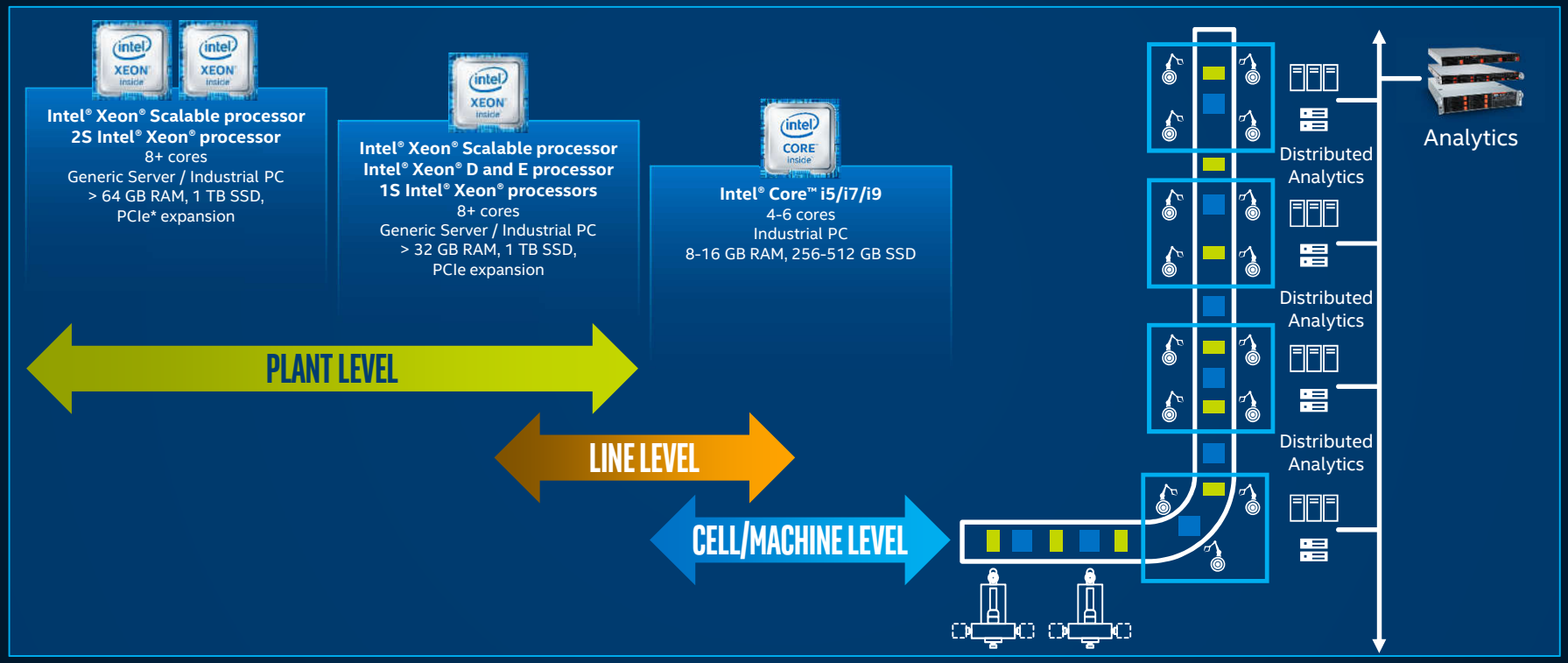
- Validated on Ubuntu* 18.04
- Camera support: Basler* with Gstreamer pipeline, USB camera
- Support for multiple video ingestion streams with improved build time (up to 180 fps WLs)
- ImageStore* optimization for persistent store
- Video analytics support without Kapacitor*
- Machine data use cases with Telegraf*, Kapacitor-based UDF and Data Agent
- Simple visualizer
- OPC-UA pub-sub speed optimization (for machine data)
- Low memory footprint support (max 2GB RAM use cases)
- Support for Docker* registry
- UX/DX improvements (dev mode, selective container builds)

EXAMPLE OF SILICON RECOMMENDATION



†Intel AVX-512 represents Intel® Advanced Vector Extensions 512; VNNI represents Vector Neural Network Instructions

EXAMPLE OF SILICON DEPLOYMENT IN VEHICLE MANUFACTURING



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SCALABLE DEPLOYMENT FOR SMART MANUFACTURING

Local Dashboard/HMI

AI Training Cloud

Cloud-Based Dashboard

AI Training Edge

Scalable Edge Server

- 3rd Party Applications
- Intel's Algorithms
- OpenVINO™ Toolkit
- INTEL'S INDUSTRIAL EDGE INSIGHTS SOFTWARE
- Linux-based OS

Gateway (Time Series Data)

- 3rd Party Agents
- INTEL'S INDUSTRIAL EDGE INSIGHTS SOFTWARE
- Linux*-based OS

Industrial PC (CV/ML/DL)

- 3rd Party Agents
- Intel's Algorithms
- OpenVINO™ Toolkit
- INTEL'S INDUSTRIAL EDGE INSIGHTS SOFTWARE
- Linux Based OS

AI Inference Edge

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

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[1]

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)
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THE ECOSYSTEM FOR INTEL'S INDUSTRIAL EDGE INSIGHTS PLATFORM

WHY CHOOSE INTEL'S INDUSTRIAL EDGE INSIGHTS PLATFORM?

Insights market is a key growth opportunity for the Industrial Solutions Division and Intel

Diverse range of Intel Silicon (CPU, VPU, FPGA, memory) is applicable to the Insights market

Enables customers/partners to easily and quickly complement their End-User product offerings

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

- Manages video streams
- Uses Filter Functions to select Key Frames
- Queues Key Frames to be published on the Data Bus
- Filters are defined by the application developer

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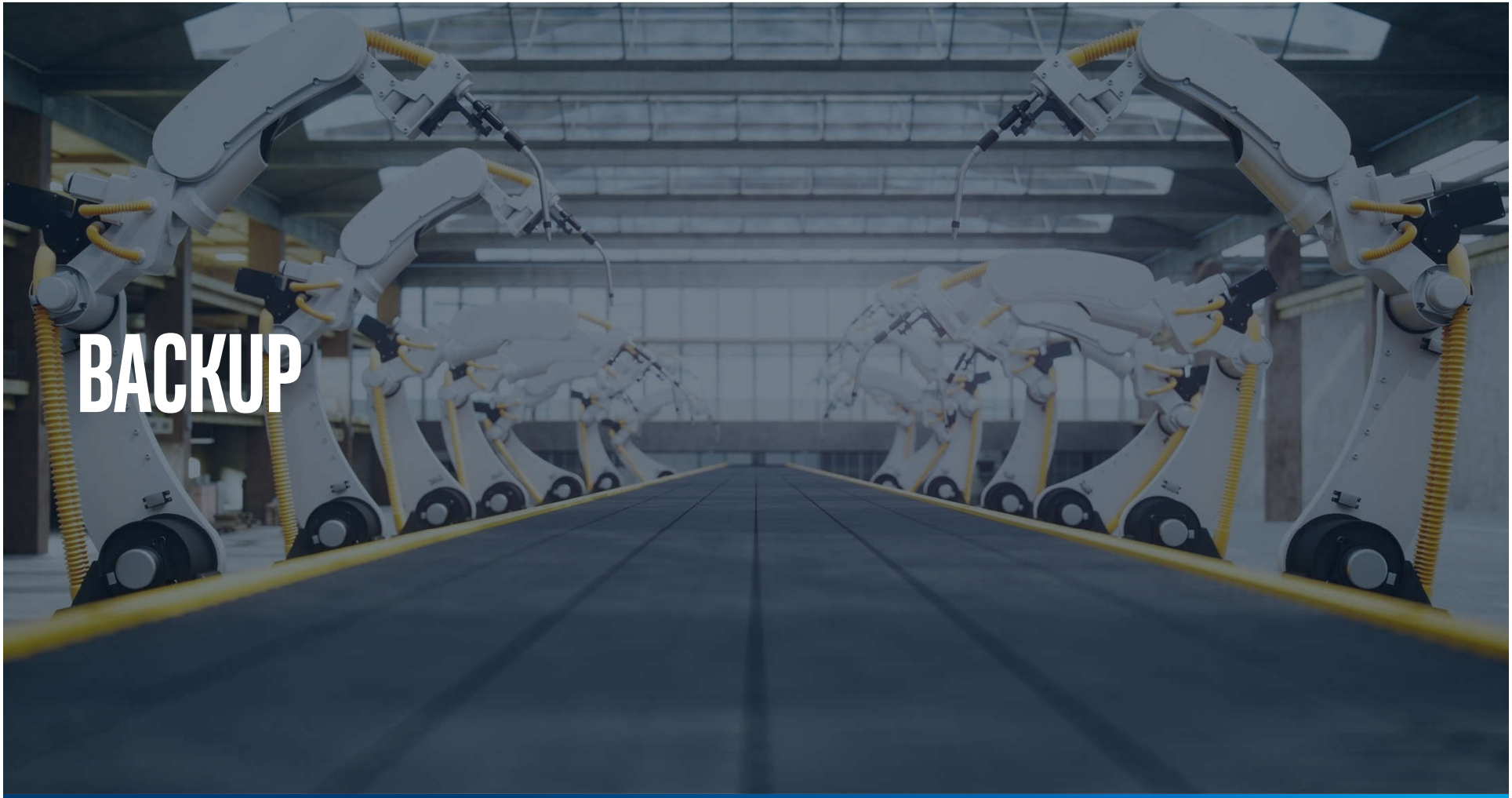
intel®


BACKUP