# INTRODUCTION TO CLOUD SYSTEMS

Lecture 10 – SE-O reference implementation – Edge OpenVino video streaming

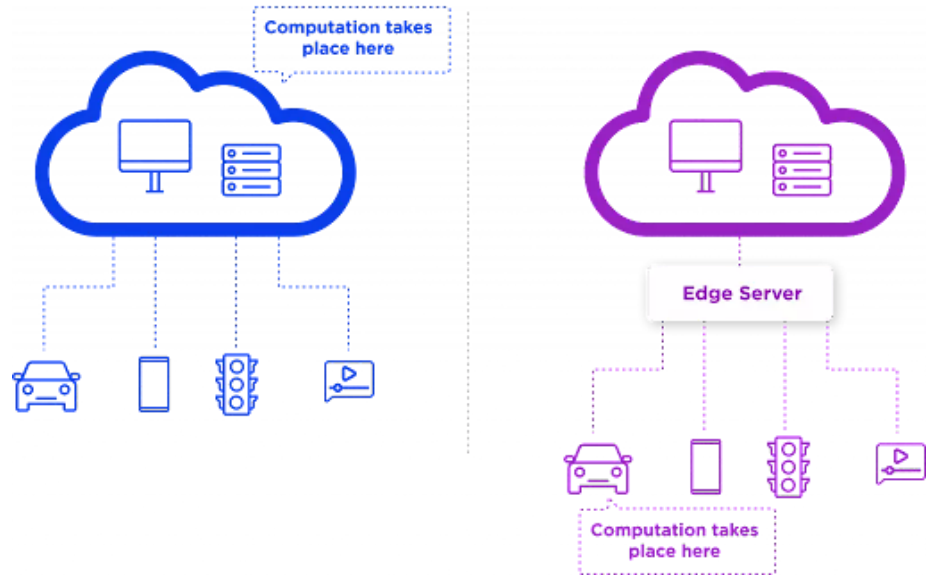# INTEL SE-O – Intel Smart Edge Open

What is Intel Smart Edge Open?
Intel® Smart Edge Open is an edge computing software toolkit for building platforms optimized for the edge. Platforms created with Intel® Smart Edge Open can host a wide range of services, from network functions such as 5G RAN and 5G core, to AI, media processing, and security workloads.

Intel®
Smart Edge
Open
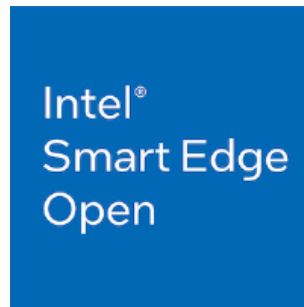
# INTEL SE-O – Intel Smart Edge Open

Edge platforms are resource constrained compared to cloud platforms. They require higher network performance and more autonomy, have strong hardware affinity, and face significantly more threat vectors.



https://forum.huawei.com/enterprise/es/edge-computing-vs-cloud-computing/thread/1006187-100261

# INTEL SE-O – Intel Smart Edge Open



Intel® Smart Edge Open addresses the challenges of creating edge platforms by providing a toolkit of functionality selected from across the cloud native landscape, extended and optimized for the edge.
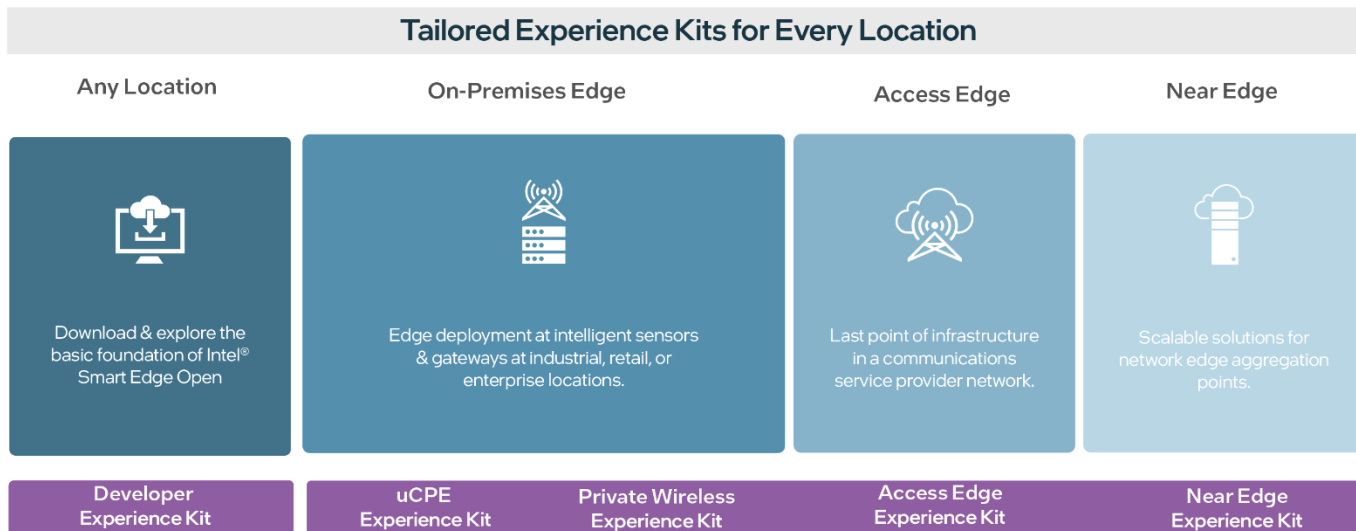
# INTEL SE-O – Intel Smart Edge Open

As cloud architectures disaggregate in the era of 5G, new edge locations are emerging as prime candidates for compute workloads that can deliver capabilities and experiences previously not possible. These new edges include the enterprise, locations within the telco infrastructure, and hyperscaler points of presence:

- The on-premises edge: Typically located in an enterprise.
- The access edge: Located at or near a 5G base station.
- The near edge: Aggregation point hosting a distributed UPF (user plane function).
- The regional data center: Hosting a next generation central office with wireless wireline convergence.

# INTEL SE-O – Intel Smart Edge Open

Intel® Smart Edge Open experience kits offer a starting point to create platforms for these emerging edge locations. Experience kits combine 5G capabilities and cloud-native components to simplify the deployment of complex network architectures, significantly reducing development time and cost.
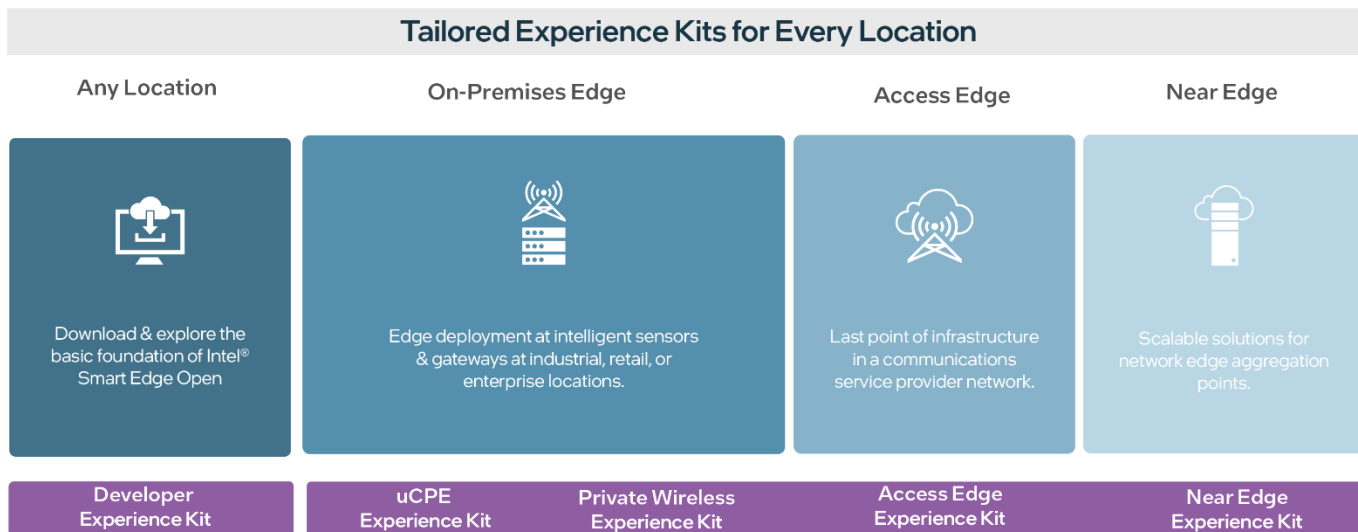
# INTEL SE-O – Intel Smart Edge Open

## Tailored Experience Kits for Every Location

| Any Location | On-Premises Edge | Access Edge | Near Edge |
|---|---|---|---|
| Download & explore the basic foundation of Intel® Smart Edge Open | Edge deployment at intelligent sensors & gateways at industrial, retail, or enterprise locations. | Last point of infrastructure in a communications service provider network. | Scalable solutions for network edge aggregation points. |
| Developer Experience Kit | uCPE Experience Kit / Private Wireless Experience Kit | Access Edge Experience Kit | Near Edge Experience Kit |

https://intelsmartedge.github.io/docs/product-overview/

**Developer Experience Kit**: A foundational kit for exploring the possibilities of Intel® Smart Edge Open that provides the base capabilities you need to run typical containerized edge services, including networking, security, and telemetry. If you are new to building edge platforms, this may be your starting point.

# INTEL SE-O – Intel Smart Edge Open

**Tailored Experience Kits for Every Location**

| Any Location | On-Premises Edge | Access Edge | Near Edge |
|---|---|---|---|
| Download & explore the basic foundation of Intel® Smart Edge Open | Edge deployment at intelligent sensors & gateways at industrial, retail, or enterprise locations. | Last point of infrastructure in a communications service provider network. | Scalable solutions for network edge aggregation points. |
| Developer Experience Kit | uCPE Experience Kit / Private Wireless Experience Kit | Access Edge Experience Kit | Near Edge Experience Kit |

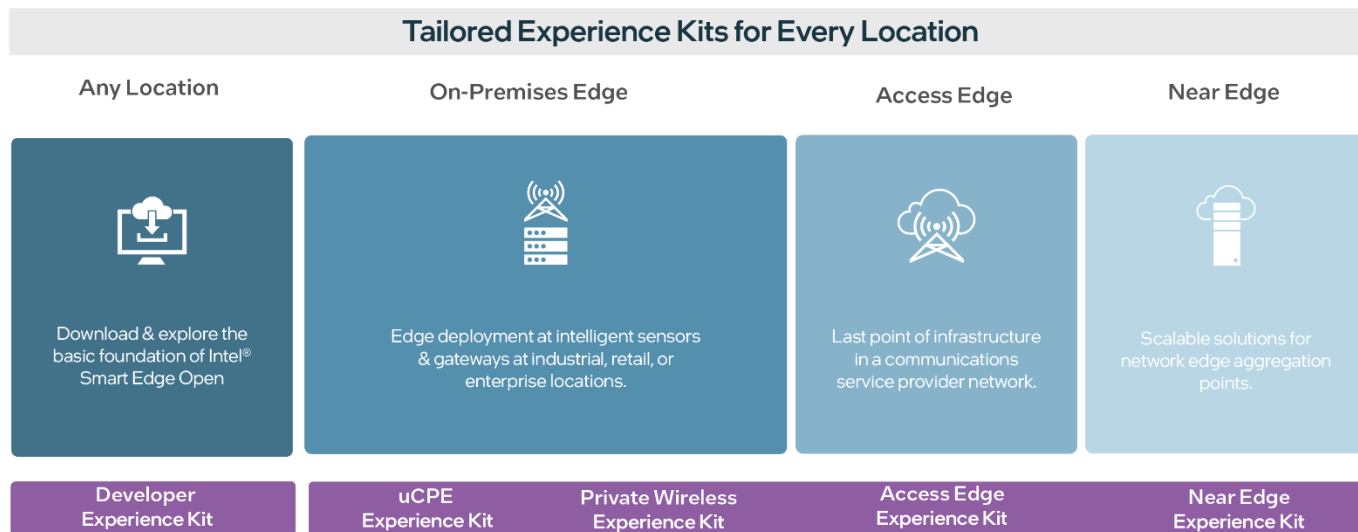https://intelsmartedge.github.io/docs/product-overview/

**5G Private Wireless Experience Kit** with Integrated RAN: A kit for creating enterprise private wireless solutions with a containerized 5G radio access network and core.
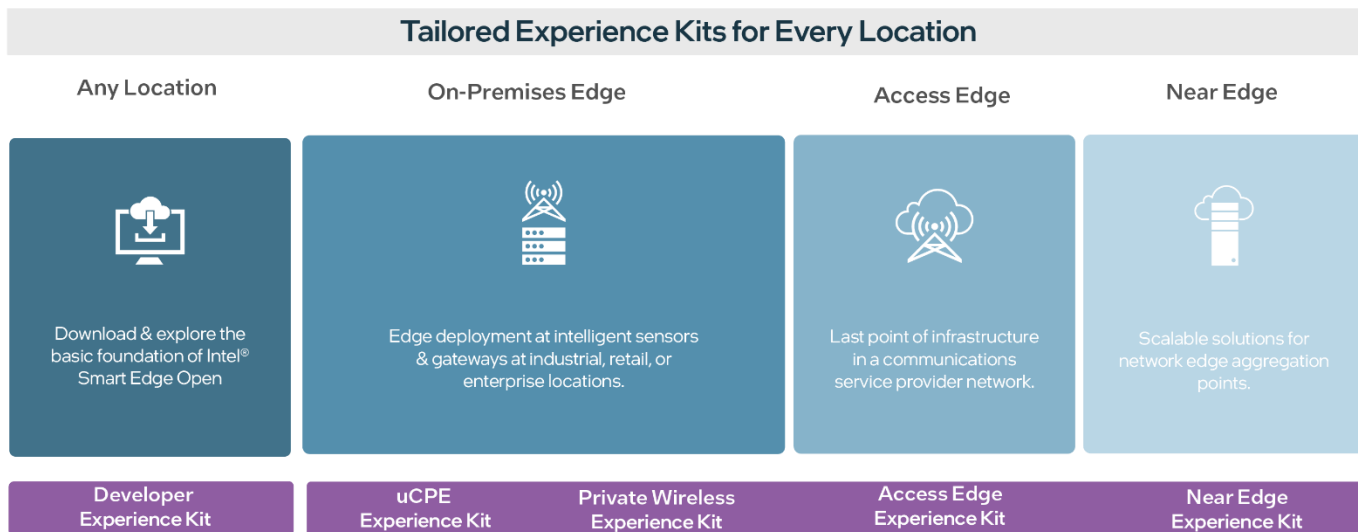
# INTEL SE-O – Intel Smart Edge Open



**Tailored Experience Kits for Every Location**

| Any Location | On-Premises Edge | Access Edge | Near Edge |
| --- | --- | --- | --- |
| Download & explore the basic foundation of Intel® Smart Edge Open | Edge deployment at intelligent sensors & gateways at industrial, retail, or enterprise locations. | Last point of infrastructure in a communications service provider network. | Scalable solutions for network edge aggregation points. |
| Developer Experience Kit | uCPE Experience Kit / Private Wireless Experience Kit | Access Edge Experience Kit | Near Edge Experience Kit |

https://intelsmartedge.github.io/docs/product-overview/

**uCPE Experience Kit:** Enables a secure access service edge (SASE) deployment for applications with SD-WAN and firewall capabilities.

# INTEL SE-O – Intel Smart Edge Open

**Tailored Experience Kits for Every Location**

| Any Location | On-Premises Edge | Access Edge | Near Edge |
|---|---|---|---|
| Download & explore the basic foundation of Intel® Smart Edge Open | Edge deployment at intelligent sensors & gateways at industrial, retail, or enterprise locations. | Last point of infrastructure in a communications service provider network. | Scalable solutions for network edge aggregation points. |
| Developer Experience Kit | uCPE Experience Kit / Private Wireless Experience Kit | Access Edge Experience Kit | Near Edge Experience Kit |

https://intelsmartedge.github.io/docs/product-overview/

**Access Edge Experience Kit:** The starting point for building O-RAN compliant edge platforms.

**Near Edge Experience Kit:** The starting point for building edge platforms that reside in a telco cloud.

# INTEL SE-O – Intel Smart Edge Open
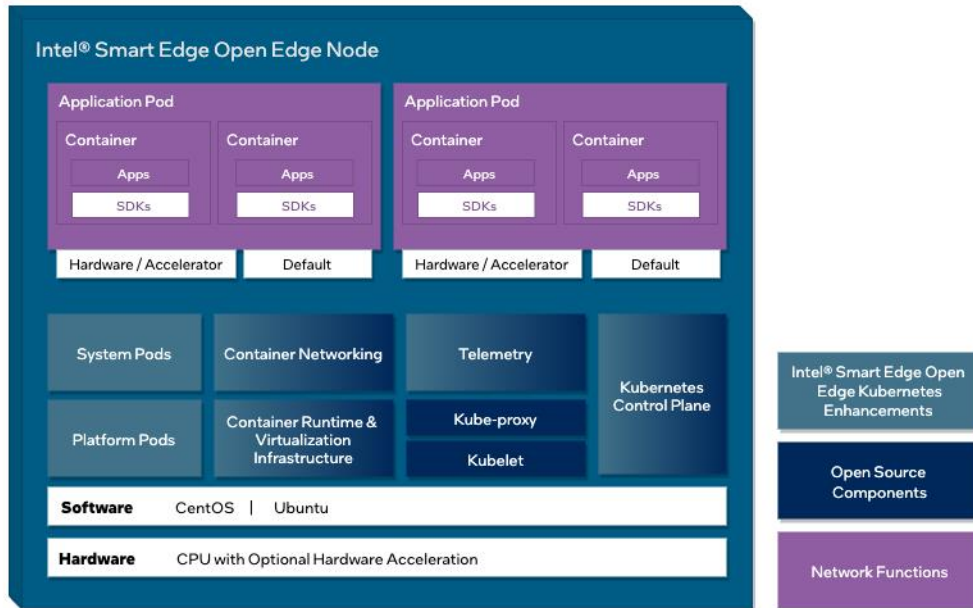


Experience kits are built on top of Kubernetes. Experience kits customize and extend the Kubernetes control plane and edge node with microservices, third-party applications, extensions, and optimizations. The control plane node and one or more edge nodes form an Intel® Smart Edge Open edge cluster.

# INTEL SE-O – Intel Smart Edge Open

**Control Plane**

The Intel® Smart Edge Open control plane is used to configure edge nodes and the services that run on them. Functions of the control plane include:

Configuring the hardware platform that hosts applications and network functions

Configuring 4G, 5G, and Wi-Fi network functions

Detecting hardware and software capabilities of the edge cluster and using that information to schedule applications and network functions

Setting up network and DNS policies for applications and network functions

Enabling collection of hardware infrastructure, software, and application monitoring

Exposing edge cluster capabilities northbound to a controller

In a single node cluster deployment, control plane services co-exist on the same physical node as the edge node.

# INTEL SE-O – Intel Smart Edge Open

## Edge Node

The Intel® Smart Edge Open edge node manages the edge services, including the APIs used to discover those services. Features of the edge node include:

- Support for the Docker container runtime and virtualization infrastructure (libvirt*, Open vSwitch (OVS), etc.) to support VMs.
- Platform pods consisting of services that enable the configuration of hardware resources on the node for a particular deployment, operators for accelerators and device plugins enabling hardware resource allocation to an application pod.
- System pods consisting of services that enable reporting the hardware and software features of each node to the control plane, providing resource isolation service for pods and DNS service to the cluster.

# INTEL SE-O – Intel Smart Edge Open

## **Edge Node**

The Intel® Smart Edge Open edge node manages the edge services, including the APIs used to discover those services. Features of the edge node include:

- Agents that expose edge node configuration to the control plane services (DNS, 4G, 5G, Wi-Fi and Telemetry)
- Telemetry for the edge node at the hardware, operating system, infrastructure, and application levels.
- Support for real-time kernel for low latency applications and network functions like 4G and 5G base station and non-real-time kernel.

# INTEL SE-O – Reference Implementation

Intel created several example solutions to serve as reference implementations (RIs) for the Intel® Smart Edge infrastructure. These RIs address identified use cases for an edge cloud infrastructure, in different industry segments. Application developers in ISV or end-user organizations can install and study these RIs, and use them as a base for their own applications.

A set of RIs have been created and hosted in the [Intel® Developer Catalog](). To access these RIs, you will need to create an Intel Developer Catalog account and then search the catalog for "Intel® Smart Edge Open".

# INTEL SE-O – Reference Implementation

One of RI:

[Wireless Network-Ready Intelligent Traffic Management](): this RI is designed to detect and track vehicles and pedestrians. It provides the intelligence required to estimate a safety metric for an intersection. The goal is to use the collected intelligence to adjust traffic lights and optimize traffic flow at an intersection.
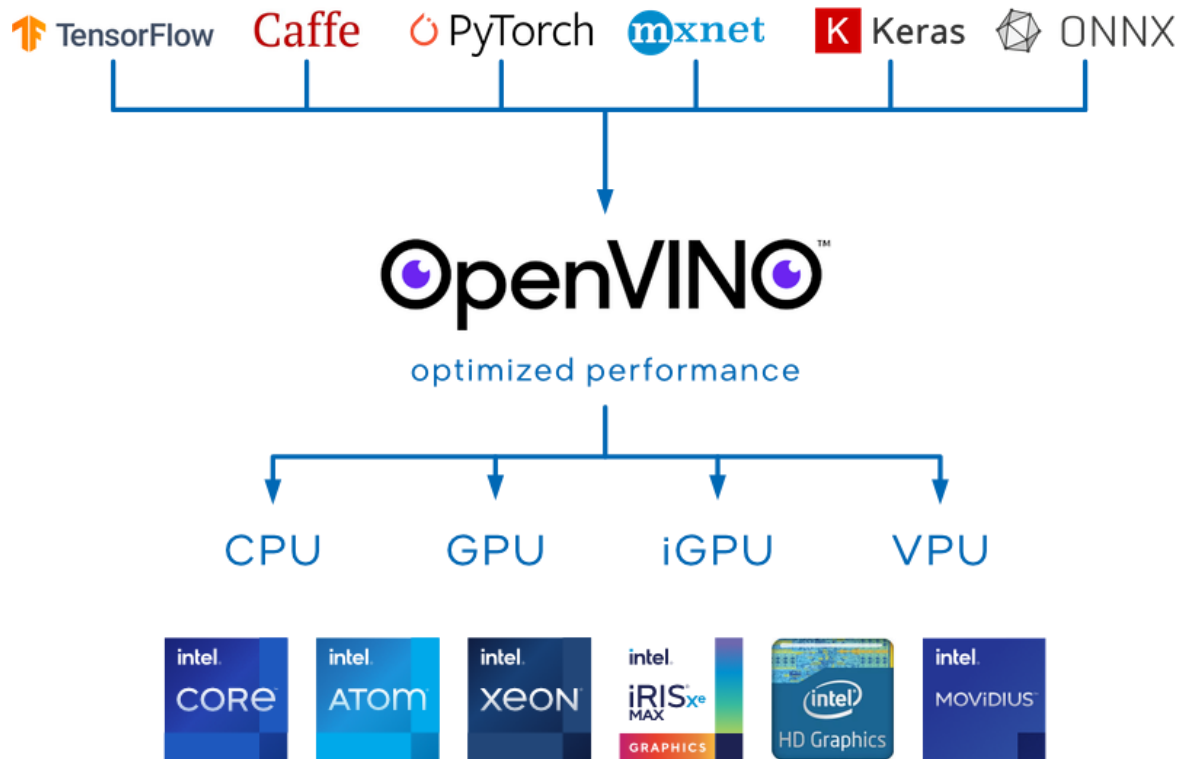
# INTEL SE-O – OpenVino

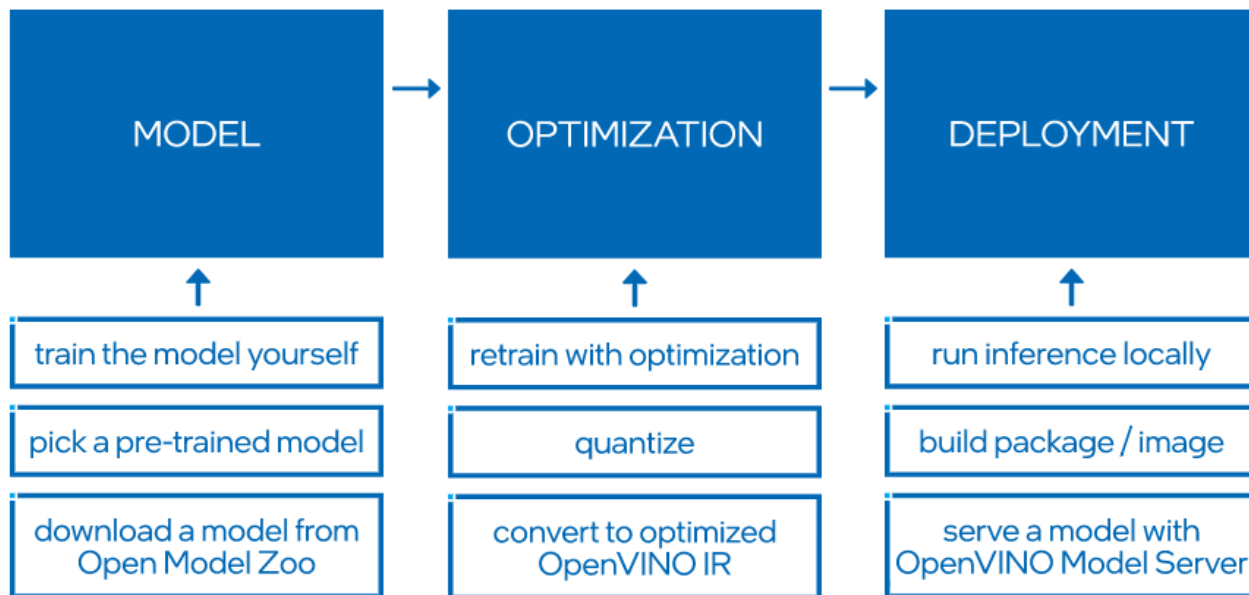OpenVINO™ is an open-source toolkit for optimizing and deploying AI inference.

- Boost deep learning performance in computer vision, automatic speech recognition, natural language processing and other common tasks
- Use models trained with popular frameworks like TensorFlow, PyTorch and more
- Reduce resource demands and efficiently deploy on a range of Intel® platforms from edge to cloud
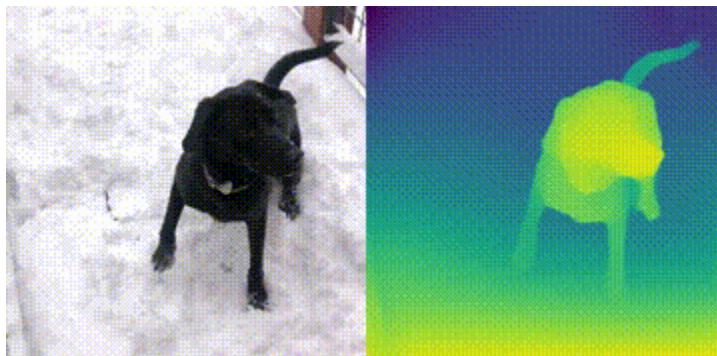
# INTEL SE-O – OpenVino



https://docs.openvino.ai/2021.4/index.html

# INTEL SE-O – OpenVino



https://docs.openvino.ai/2021.4/index.html

# INTEL SE-O – OpenVino

Quick start example

https://mybinder.org/v2/gh/openvinotoolkit/openvino_notebooks/HEAD?filepath=notebooks%2F201-vision-monodepth%2F201-vision-monodepth.ipynb



https://docs.openvino.ai/latest/get_started.html