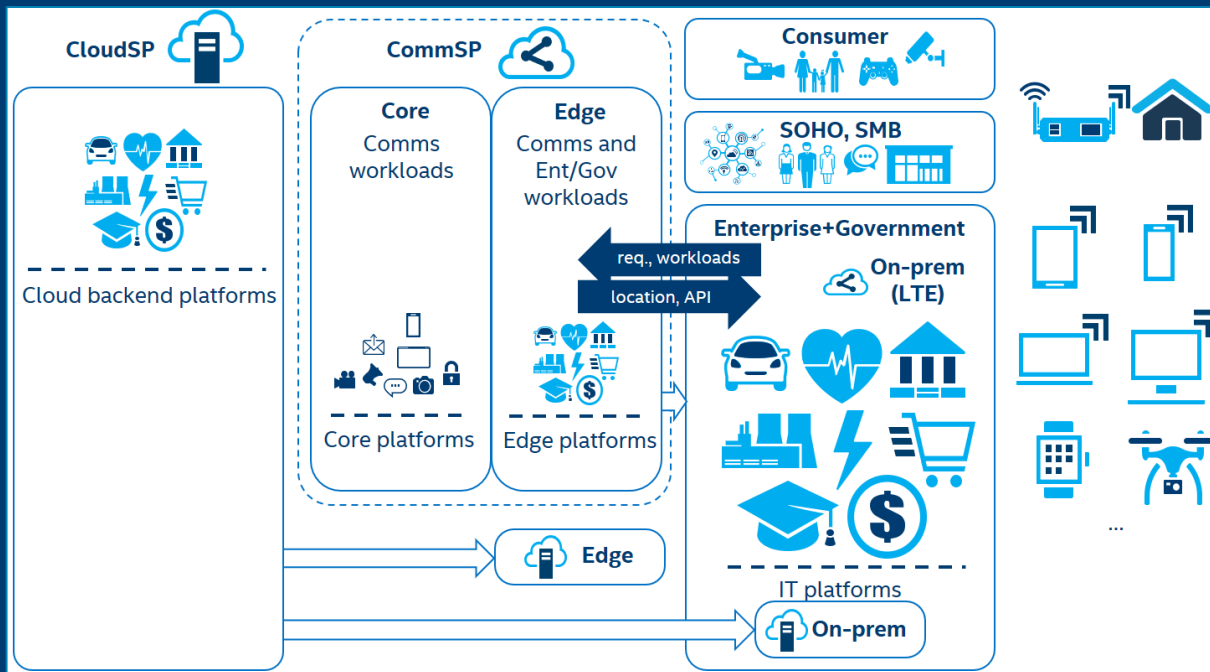# Delivering the Foundation for 5G: A Cloud Native Approach

Petar Torre, Principal Engineer, Intel Corporation

Dana Nehama, Director Product Management Cloud Networks, Intel Corporation
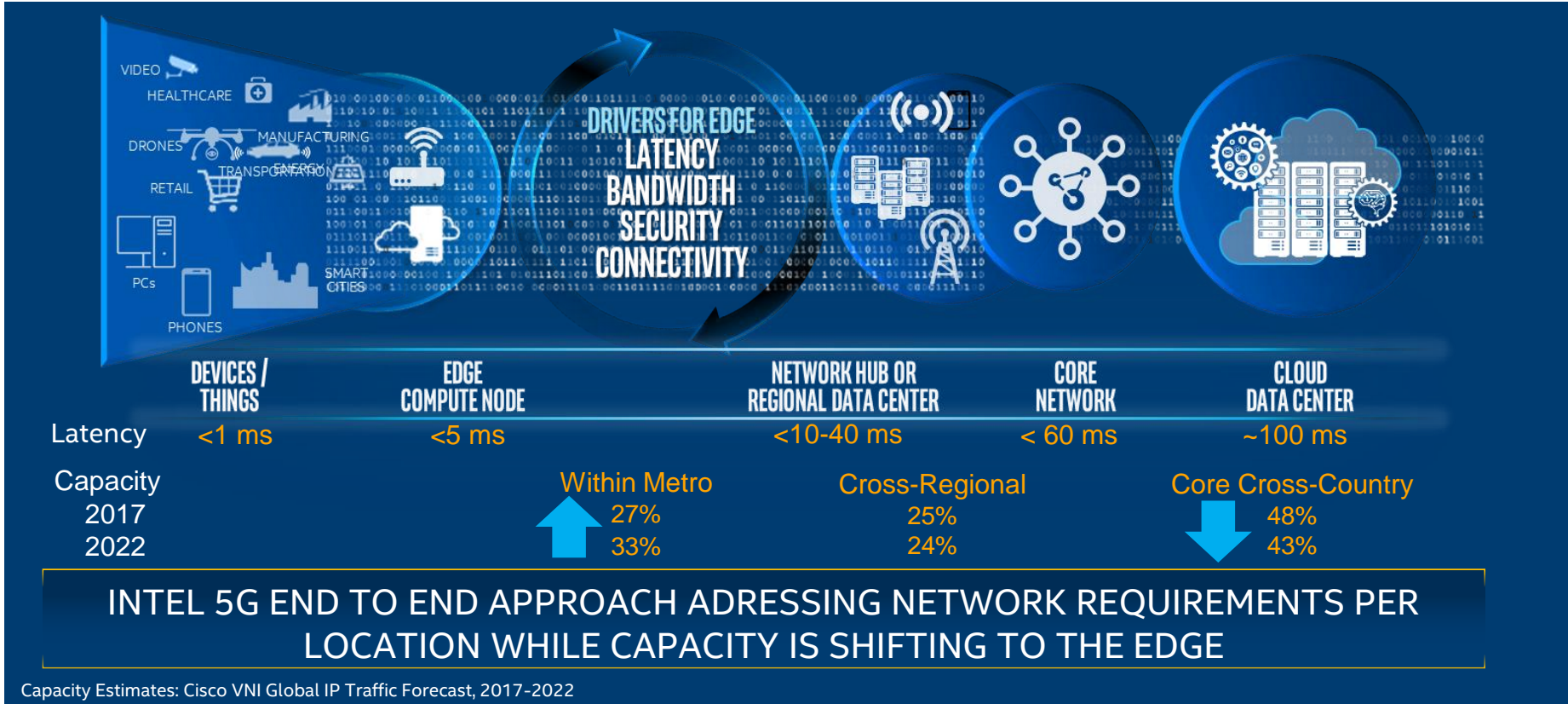
14 Oct 2019

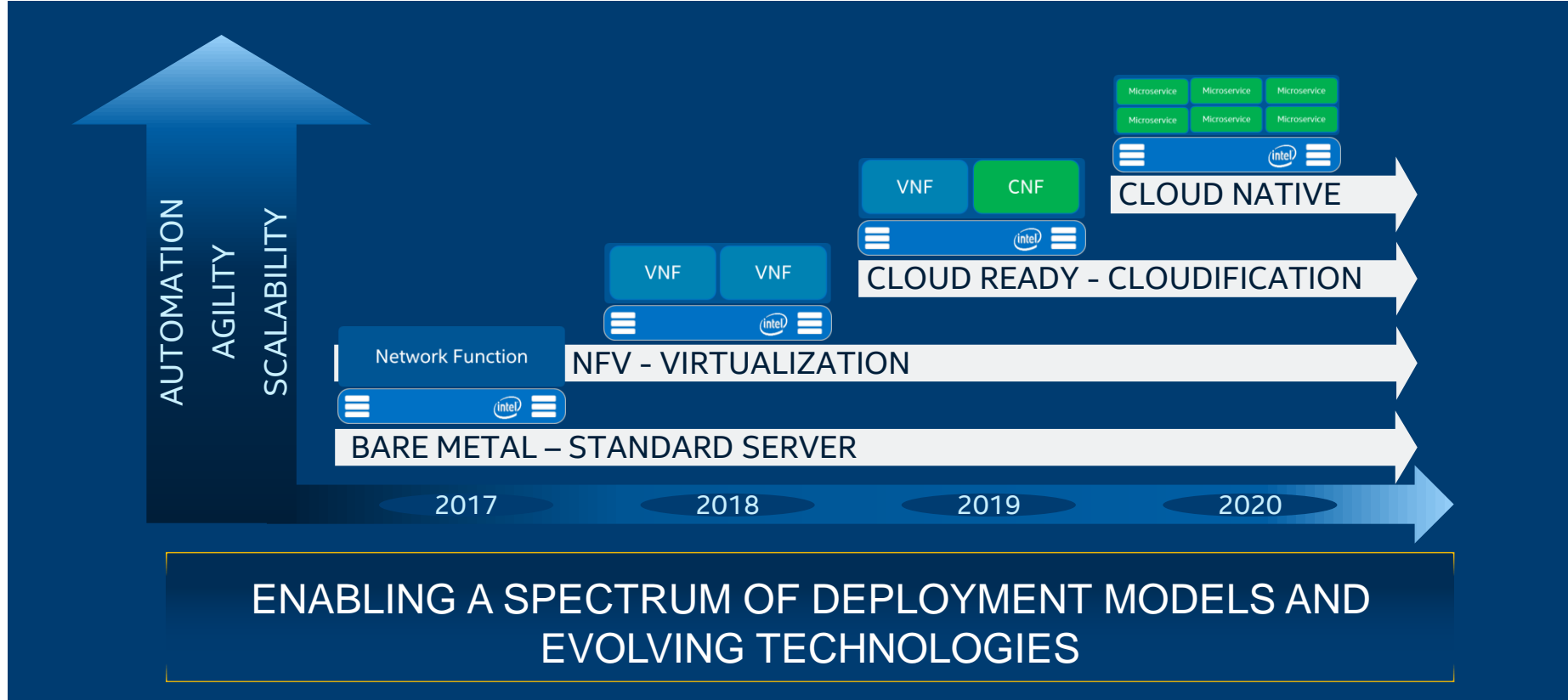# Market Dynamic – Visualizing CommSP (Core and) Edge Trends

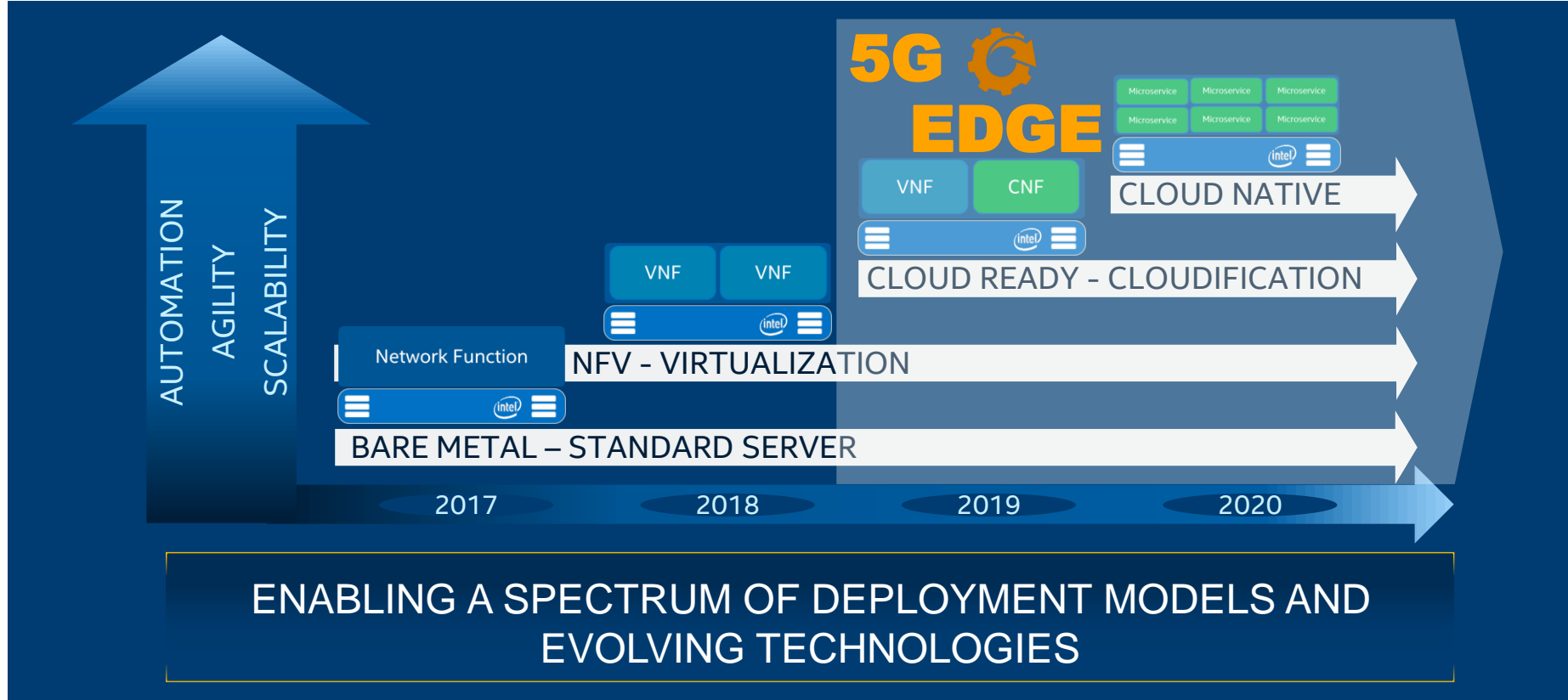**COMMUNICATION SPs NEED TO FULLY TRANSFORM AND BRING NEW INCREMENTAL SERVICES FOR CUSTOMERS, SOHO AND SMB**

End to End Network Transformation

DRIVERS FOR EDGE
LATENCY
BANDWIDTH
SECURITY
CONNECTIVITY

	DEVICES / THINGS	EDGE COMPUTE NODE	NETWORK HUB OR REGIONAL DATA CENTER	CORE NETWORK	CLOUD DATA CENTER
Latency	<1 ms	<5 ms	<10-40 ms	< 60 ms	~100 ms
Capacity		Within Metro	Cross-Regional		Core Cross-Country
2017		27%	25%		48%
2022		33%	24%		43%

INTEL 5G END TO END APPROACH ADRESSING NETWORK REQUIREMENTS PER LOCATION WHILE CAPACITY IS SHIFTING TO THE EDGE

Capacity Estimates: Cisco VNI Global IP Traffic Forecast, 2017-2022

(intel) 3

Network Transformation Begins with Network Platform Transformation

ENABLING A SPECTRUM OF DEPLOYMENT MODELS AND EVOLVING TECHNOLOGIES

Network Transformation Begins with Network Platform Transformation

5G EDGE

Microservice · Microservice · Microservice
Microservice · Microservice · Microservice

VNF · CNF

CLOUD NATIVE

CLOUD READY - CLOUDIFICATION

VNF · VNF

NFV - VIRTUALIZATION

Network Function

BARE METAL – STANDARD SERVER

AUTOMATION · AGILITY · SCALABILITY

2017 · 2018 · 2019 · 2020

ENABLING A SPECTRUM OF DEPLOYMENT MODELS AND EVOLVING TECHNOLOGIES

5

Difference between Appliance and Tenant/Cloud

Virtual Appliance:

Telco (on-prem) Cloud:

tightly coupled

Non-resilient monolithic App
Carrier Grade Platform
Carrier Grade HW

Tenant control

PaaS
API

Provider control

Resilient decomposed App
Platform
HW

CNCF Cloud Native Definition v1.0

CLOUD NATIVE COMPUTING FOUNDATION
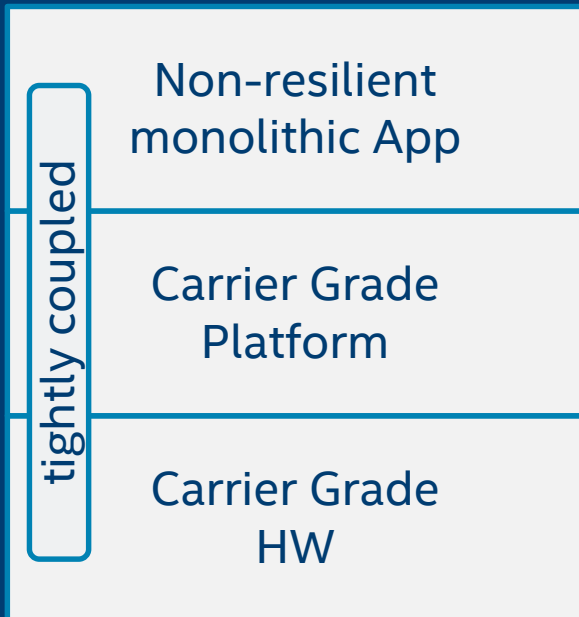
Cloud native technologies empower organizations to **build and run scalable applications in modern, dynamic environments** *such as public, private, and hybrid clouds. Containers, service meshes, microservices, immutable infrastructure, and declarative APIs exemplify this approach.*

These techniques enable **loosely coupled systems that are resilient, manageable, and observable.** *Combined with* **robust automation***, they allow engineers to make* **high-impact changes frequently and predictably with minimal toil***.*

The Cloud Native Computing Foundation seeks to drive adoption of this paradigm by fostering and sustaining an ecosystem of open source, vendor-neutral projects. We democratize state-of-the-art patterns to make these innovations accessible for everyone.

Adopt Cloud Native Practices

FOUNDATION FOR ENABLING NETWORK FLEXIBILITY, AGILITY AND SCALE

INFRASTRUCTURE
FACILITATE DELIVERY

AUTOMATION
STANDARD INTERFACES
SCALABILITY
HIGH PERFORMANCE
SECURITY
CONTAINERS & VM

CLOUD NATIVE
EXPLOIT THE CLOUD

DYNAMICALLY MANAGED
PORTABLE
STATELESS
SCALABLE
RESILIENT
DECOMPOSED
CNF & VNF

OPERATION
ENABLE RAPID INNOVATION

CONTINUOUS INTEGRATION
CONTINUOUS DEPLOYMENT

NEW TECHNIQUES AND PRACTICES UNLOCK THE CLOUD NATIVE PATH TO NETWORK TRANSFORMATION

Address Challenges in Cloud Native Orchestration

INDUSTRY GAPS

KUBERNETES NETWORKING

DATA PLANE ACCELERATION

RESOURCE MANAGEMENT
(ENHANCED PLATFORM AWARNESS)

TELEMETRY

EASE OF DEPLOYMENT

Address Challenges in Cloud Native Orchestration

INDUSTRY GAPS

- KUBERNETES NETWORKING 🔒
- DATA PLANE ACCELERATION 🔒
- RESOURCE MANAGEMENT (ENHANCED PLATFORM AWARNESS) 🔒
- TELEMETRY 🔒
- EASE OF DEPLOYMENT 🔒

SOLUTIONS

- MULTUS
- CNI USERSPACE CNI DPDK
- CNI SR-IOV DPDK
- CNI BOND-CNI
- Node Feature Discovery (SR-IOV; Intel® Advanced Vector Extensions etc.)
- CPU Manager for Kubernetes (CMK)
- Native Huge page support for Kubernetes
- Device Plugin (SR-IOV, GPU, Intel® QuickAssist Technology)
- Topology Manager (NUMA)
- collectd
- Deployment Scrips (Helm, Ansible)

ECOSYSTEM ADOPTION

kubernetes

GitHub
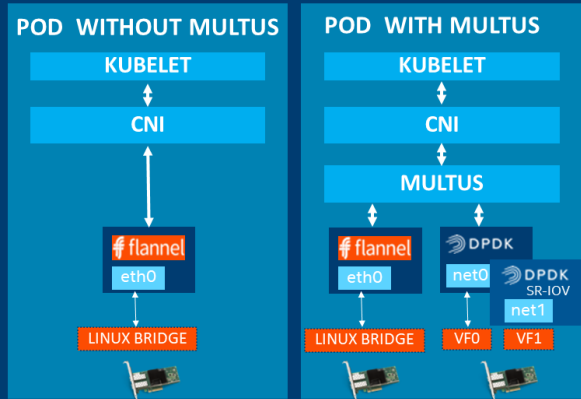
CNI

HELM

intel

Faster. Easier. Optimized.

intel select solution

EXPERIENCE KITS

https://networkbuilders.intel.com/network-technologies/container-experience-kits

Kubernetes Networking – New Developments

MULTUS

POD WITHOUT MULTUS
- KUBELET
- CNI
- flannel / eth0
- LINUX BRIDGE

POD WITH MULTUS
- KUBELET
- CNI
- MULTUS
- flannel / eth0
- DPDK / net0
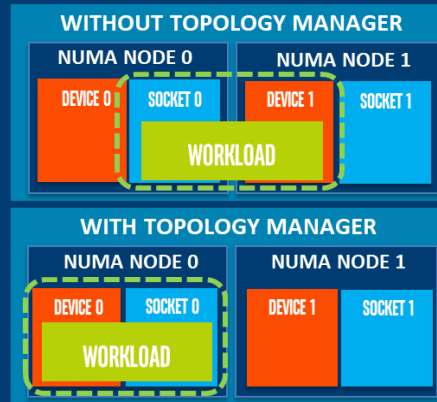- DPDK SR-IOV / net1
- LINUX BRIDGE
- VF0
- VF1

Address the need for multi network interfaces

Multus is a "meta – plugin"

Attach multiple interfaces via CNI plugins: macvlan, ipvlan, SR-IOV, OVS-DPDK, VPP etc.

Open Source – K8s Network Plumbing WG

TOPOLOGY MANAGER NUMA AWARNESS

WITHOUT TOPOLOGY MANAGER

NUMA NODE 0
- DEVICE 0
- SOCKET 0

NUMA NODE 1
- DEVICE 1
- SOCKET 1

WORKLOAD

WITH TOPOLOGY MANAGER

NUMA NODE 0
- DEVICE 0
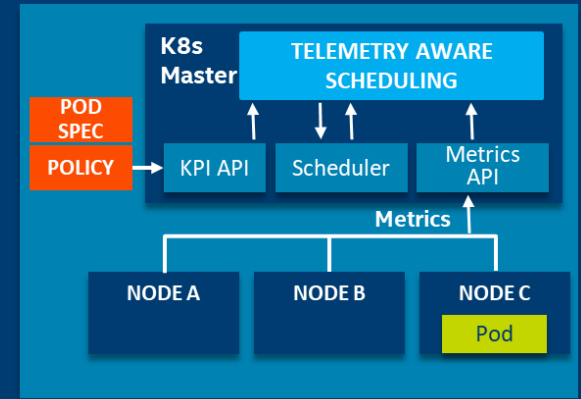- SOCKET 0

NUMA NODE 1
- DEVICE 1
- SOCKET 1

WORKLOAD

Address performance sensitive applications

Optimal NUMA topology resource allocation

Start w CPU Manager and Device Manager

In Kubernetes 1.16

TELEMETRY AWARE SCHEDULING

K8s Master
- TELEMETRY AWARE SCHEDULING
- POD SPEC
- POLICY
- KPI API
- Scheduler
- Metrics API

Metrics

- NODE A
- NODE B
- NODE C
  - Pod

Consider telemetry to schedule workloads

Apply a policy to make scheduling and de-scheduling decisions.

Under development

Take Away

Intel is collaborating with the industry to enable and advance solutions for the transforming 5G network

Intel end-to-end product line provides the flexibility, agility, performance optimization foundational to 5G adoption

Visit networkbuilders.intel.com for more information:
https://networkbuilders.intel.com/network-technologies/network-transformation-exp-kits
https://networkbuilders.intel.com/network-technologies/container-experience-kits

EXPERIENCE KITS   (intel) select solution

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