
NETWORK TRANSFORMATION:
ARE WE READY FOR 5G AND EDGE CLOUDS?
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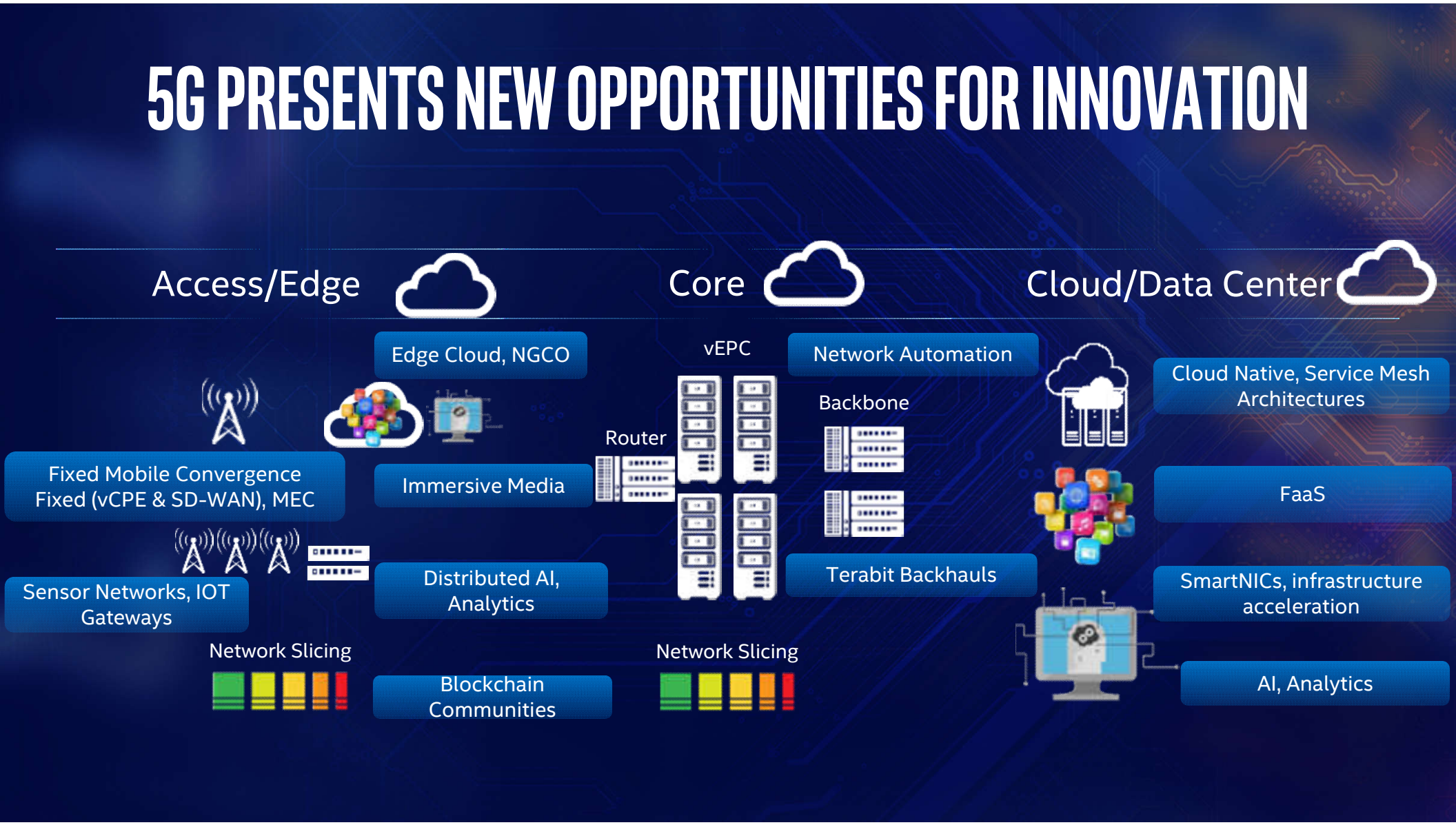
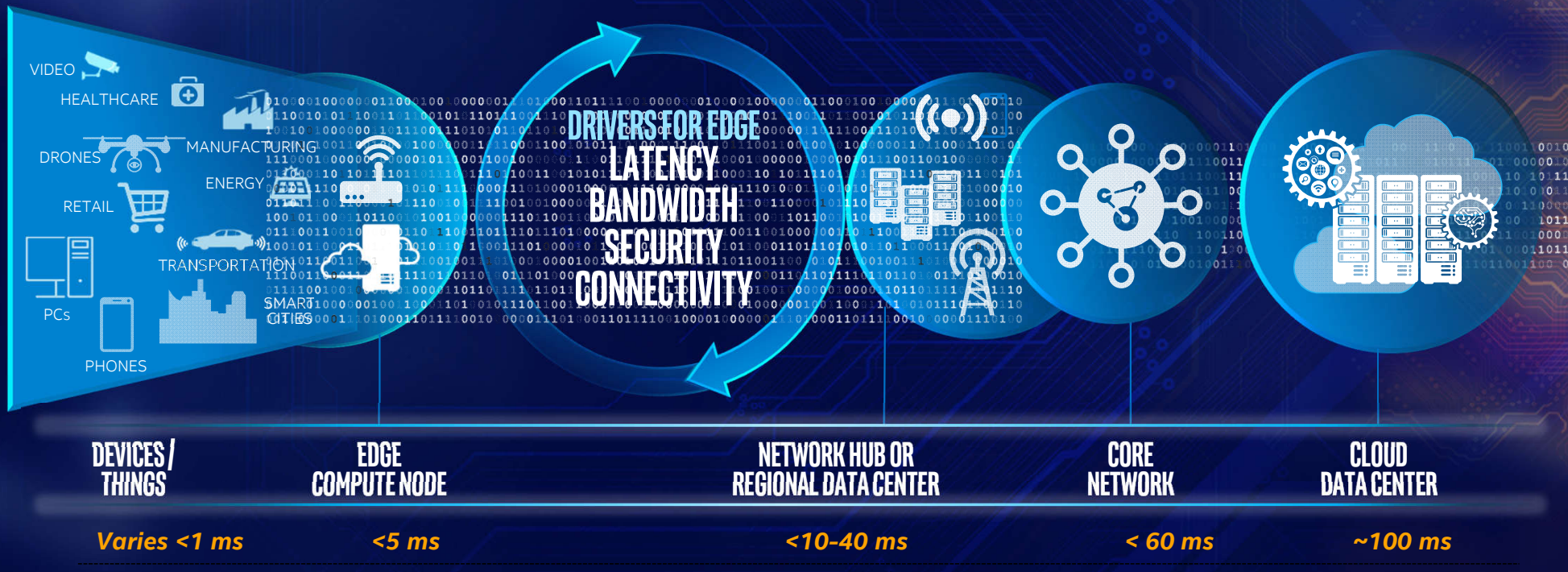
# 5G PRESENTS NEW OPPORTUNITIES FOR INNOVATION



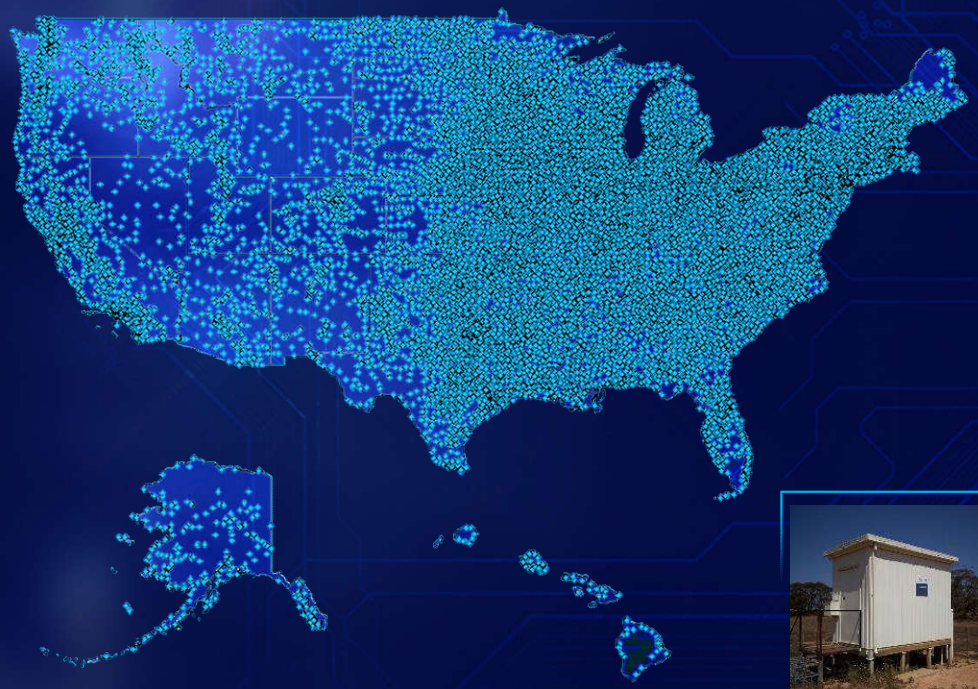
# DATA DRIVES EDGE COMPUTING




| DEVICES / THINGS | EDGE COMPUTE NODE | NETWORK HUB OR REGIONAL DATA CENTER | CORE NETWORK | CLOUD DATA CENTER |
|---|---|---|---|---|
| *Varies <1 ms* | *<5 ms* | *<10-40 ms* | *< 60 ms* | *~100 ms* |

# GROWTH OPPORTUNITY AT THE EDGE

## TODAY'S CENTRAL OFFICES (COs) = LEGACY EQUIPMENT





**US:** **~20,000 COs**[1]
**China:** **~70,000 COs**[1]

Transformation of the Central Office at the Edge

www.intel.com/ngco

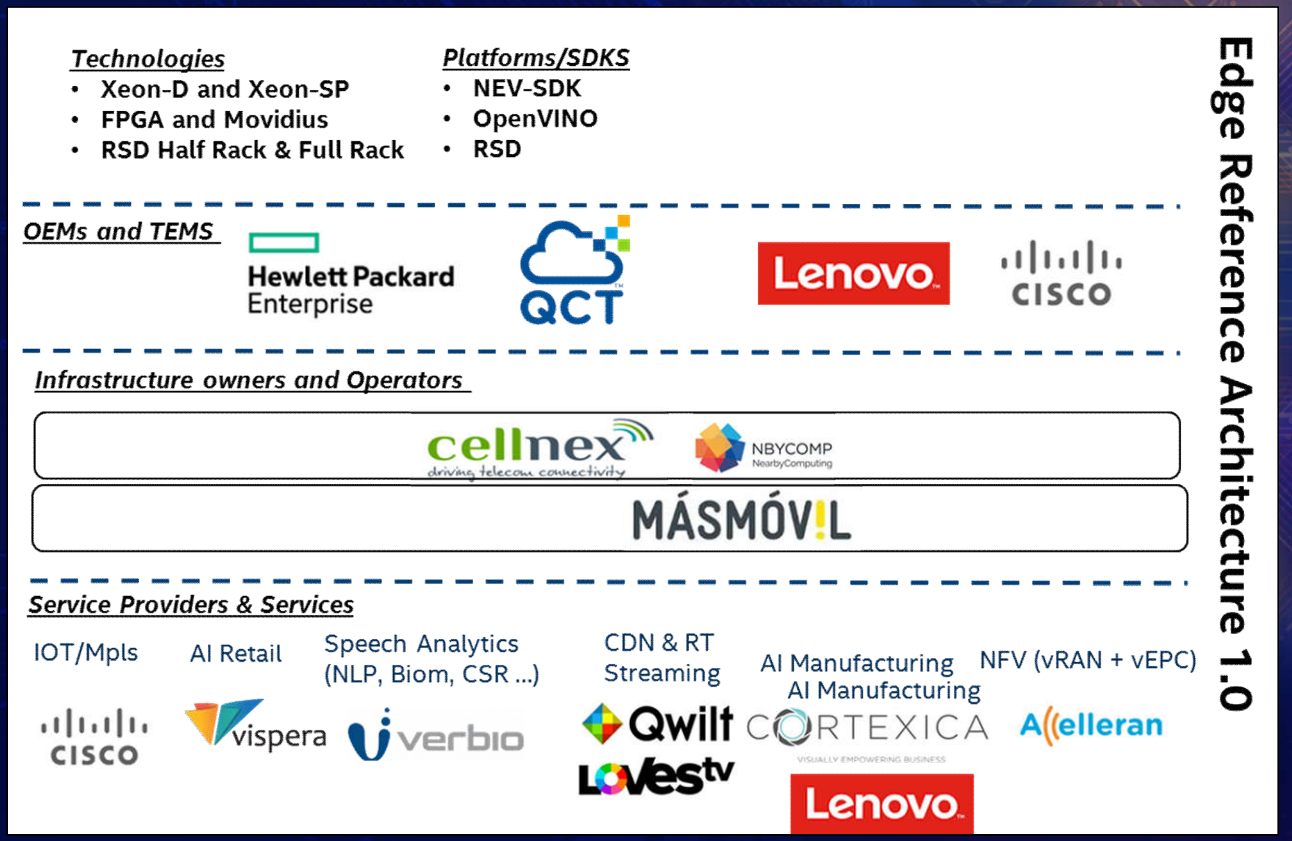
[1] Source: Intel estimates based on 3rd party data

# EDGE SERVICES READY AND DEPLOYABLE

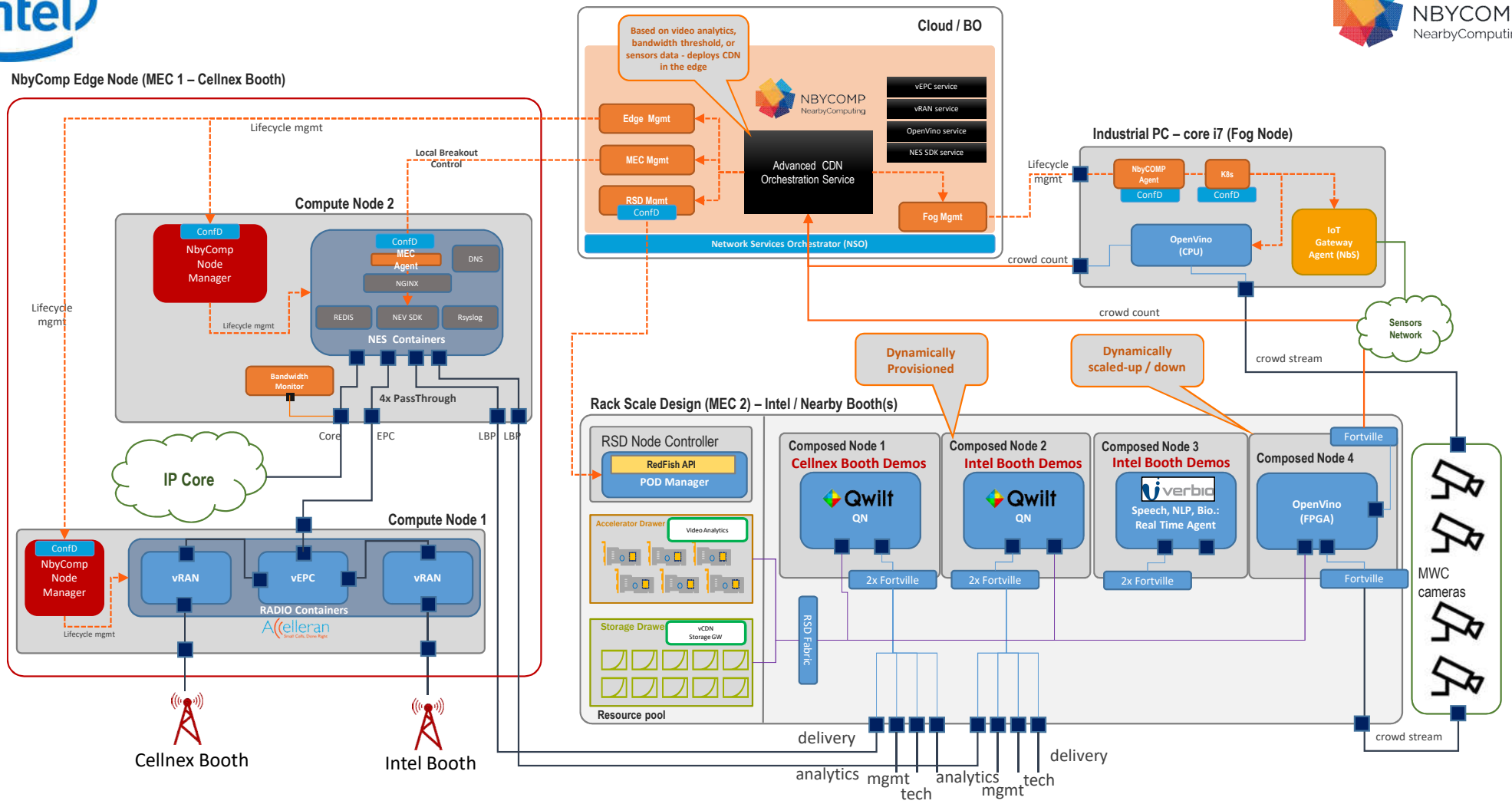
Edge use case demo, connecting three eco-system partner booths at MWC 2019

**Capabilities**

1. Shows e2e distributed edge
2. All fully orchestrated
3. Uses vRAN + vEPC edge for client access
4. MEC for traffic steering
5. Industrial Edge for IOT example
6. RSD composable node
7. Dynamic scaling of FPGAs on RSD
8. Video analytics and OpenVINO
9. Multi-tenant & multi-service (speech, CDN, retail, surveillance)



# EDGE SHOWCASE AT A GLANCE



# KEY ARCHITECTURE TENETS FOR NETWORK INFRASTRUCTURE

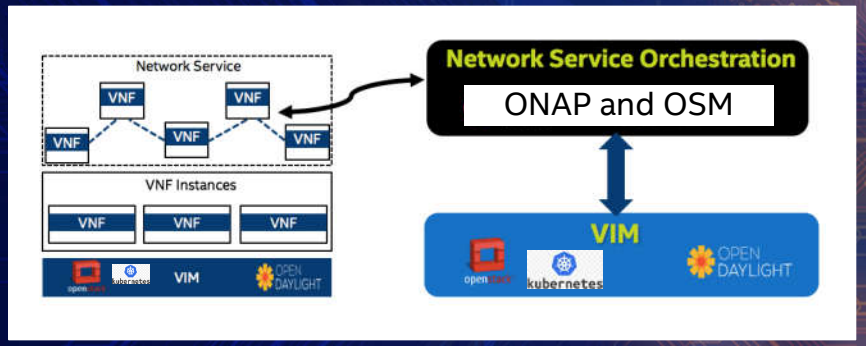
| New ISA, Arch & µArch improvements | Mesh & Coherent Interconnects | Virtual Switch, Workload acceleration | Crypto, Compression, Analytics/ML |
|---|---|---|---|
| CORE | CPU FABRIC | FPGA | ACCELERATORS |

Perf/Watt/$$

Scale Up

Closed Loop Automation

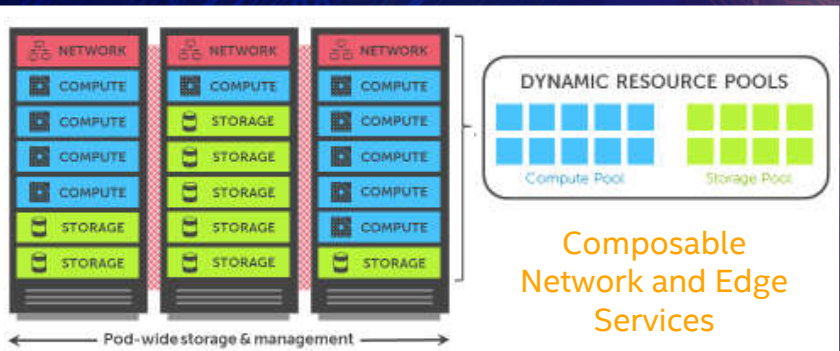
Orchestration & Automation




**Intel Xeon Server Platforms**


*Deliver TCO and Scale*

Scale Out



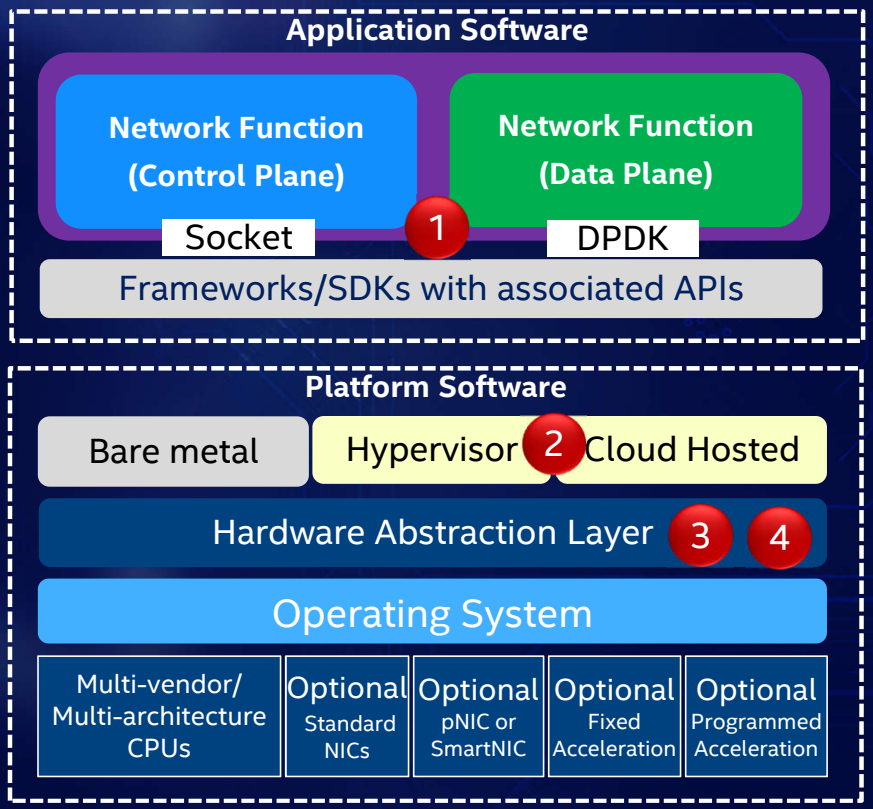

Composable Network and Edge Services

Disaggregation and Cloud Native Increase Share of Wallet (RSD)

# NETWORK TRANSFORMATION: 3 PAIN POINTS

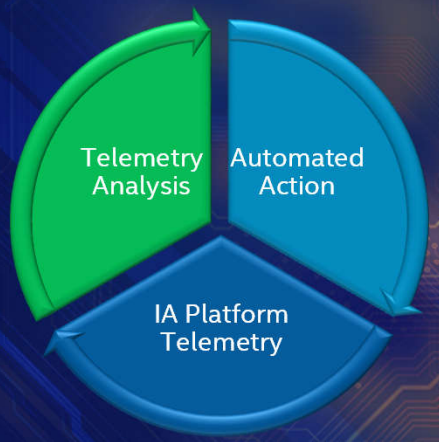
- Cloud Native Network Services: Deliver Performance and Flexibility
- Orchestration and Closed Loop Automation: Automate the Network
- Edge Services Platform: Securely on-board and manage new Edge Services

# VNF DISAGGREGATION

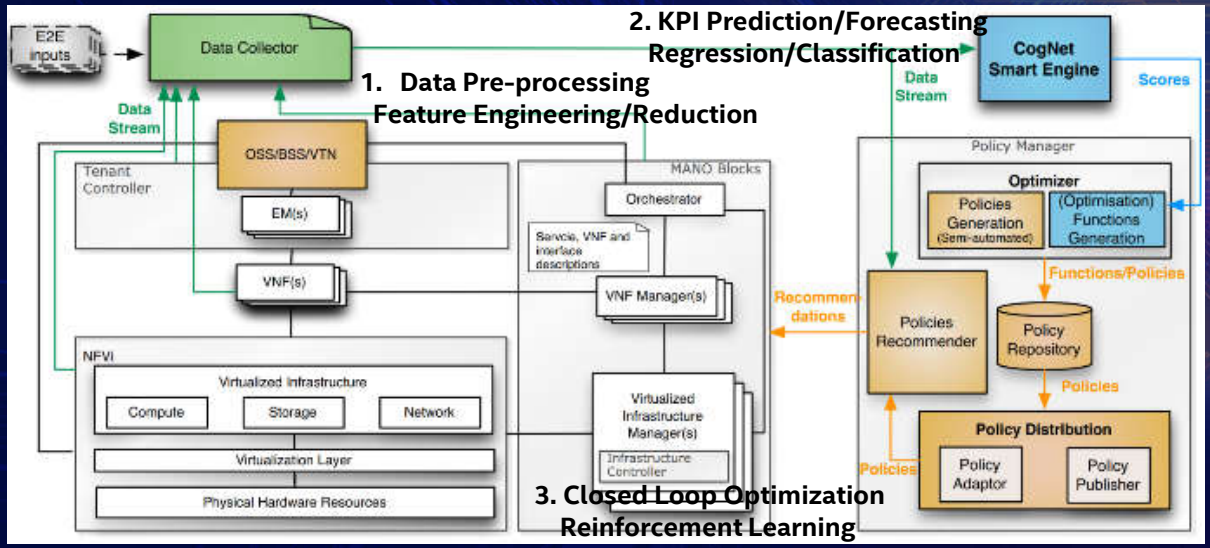



1. VNFs abstracted from platform by using “Socket” and “DPDK”
   - Vendor specific drivers and virtualized drivers hidden from VNFs
   - Frameworks can help with abstraction through startup configuration data and conditional code
2. Virtualized environments are constrained/throttled by para-virtualized interfaces (e.g. VirtIO, VMXNET3, ENA, ..)
   - Update to VirtIO (***VirtIO1.1***, ***VirtIO_crypto***)
   - Innovation in emerging Adaptive Virtual Function (***AVF***)
3. HW features adopted quicker via User Space innovation
   - User space drivers on top of OS generic device support (e.g. Linux VFIO or newer ***VFIO_mDev***)
   - Use of upcoming Kernel fast path ***AF_XDP***
4. DPDK de-facto NIC and HW acceleration abstraction within a multi-architecture and multi-vendor environment

# NFV CLOSED LOOP AUTOMATION




- Efficient Network Management is one major challenge for NFV
- Machine learning can play an important role in addressing this challenge by analyzing gathered data for various purposes:
  - Fault Detection/Prediction
  - Dynamic Resource Allocation
  - Security Threats Alert
  - Performance Degradation Detection
  - Demand Prediction




"Cognet: A Network Management Architecture Featuring Cognitive Capabilities," *Proc. Euro. Conf. Networks and Commun.*, June 2016

# OpenNESS

## Services Enablement Platform for the On-Premise & Network Edge

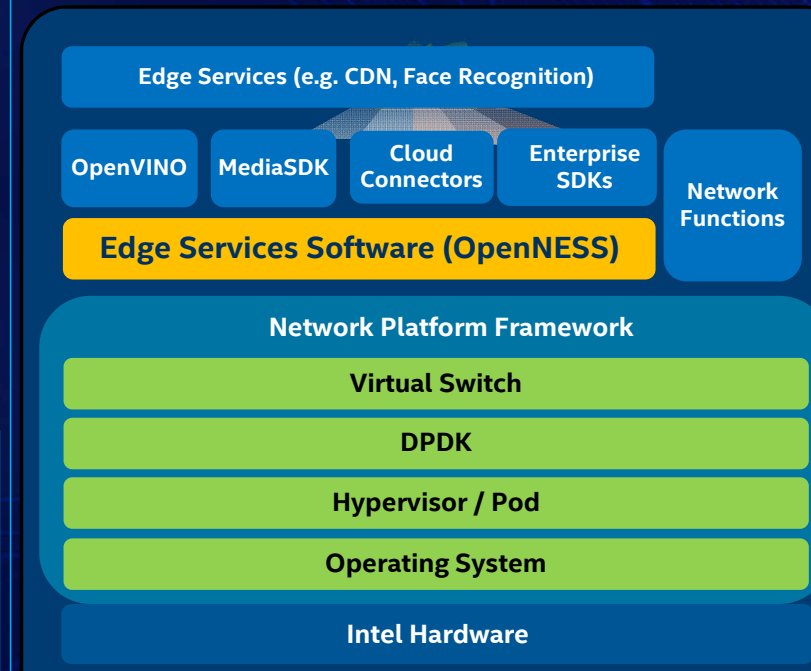
### Edge Services Software

Enables access termination, traffic steering, multi-tenancy for services, service registry, service authentication, telemetry, application frameworks …


### Controller Software

Enables Appliance discovery and control, exposed via standardized APIs and includes a web-based GUI for easy application onboarding

Data Center / Cloud




Compute/Network/Storage


Service Orchestration

# INTEL PROVIDES A COMPELLING PLATFORM ROADMAP

PERFORMANCE

POWER

**INTEL® XEON® SCALABLE PROCESSORS**

UP TO ~**600Gb/s** PACKET PROCESSING ON A DUAL SOCKET PLATFORM

**~1.7X** IMPROVEMENT COMPARED TO PRIOR GENERATION

**INTEL® XEON® D PROCESSORS**

UP TO **~200Gb/s** PACKET PROCESSING

20W – 110W

INTEGRATED ETHERNET & ACCELERATION

**INTEL® ATOM™ PROCESSORS**

UP TO **40Gb/s** PACKET PROCESSING

7W – 32W

INTEGRATED ETHERNET & ACCELERATION

## PLATFORM TECHNOLOGIES

Intel® Silicon Photonics

Intel® OPTANE™ DC SOLID STATE DRIVE

Intel® FPGA

Intel® Ethernet Controller

Intel® OPTANE™ DC PERSISTENT MEMORY

Intel® QuickAssist Technology

# ENABLING NETWORK TRANSFORMATION

## INVEST
OPEN SOURCE AND STANDARDS

3GPP A GLOBAL INITIATIVE · 5GAA Automotive Association · CLOUD FOUNDRY

CLOUD NATIVE COMPUTING FOUNDATION · DPDK · ETSI World Class Standards

katacontainers · kubernetes

ONAP · OPEN DAYLIGHT · Open Source MANO

openstack · OPNFV · OvS Open vSwitch · fd.io

## INDUSTRY COLLABORATION
INTEL® NETWORK BUILDERS

**300+** Members

**30+** Comms SPs

**82+** POCs/Trials/Deployments Based on Member Solutions

**126+** Network Builder University Program Members

**38+** Network Edge Ecosystem Program Members

## intel select solution

### NFVI
NETWORK FUNCTIONS VIRTUALIZATION INFRASTRUCTURE

intel XEON PLATINUM inside

HUAWEI · QCT · Lenovo

NOKIA · redhat · ubuntu

### UCPE
UNIVERSAL CUSTOMER PREMISES EQUIPMENT

intel XEON inside

ADVANTECH · Lanner · PREMIER

Silicom Connectivity Solutions · SUPERMICRO · ubuntu

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

# SUMMARY

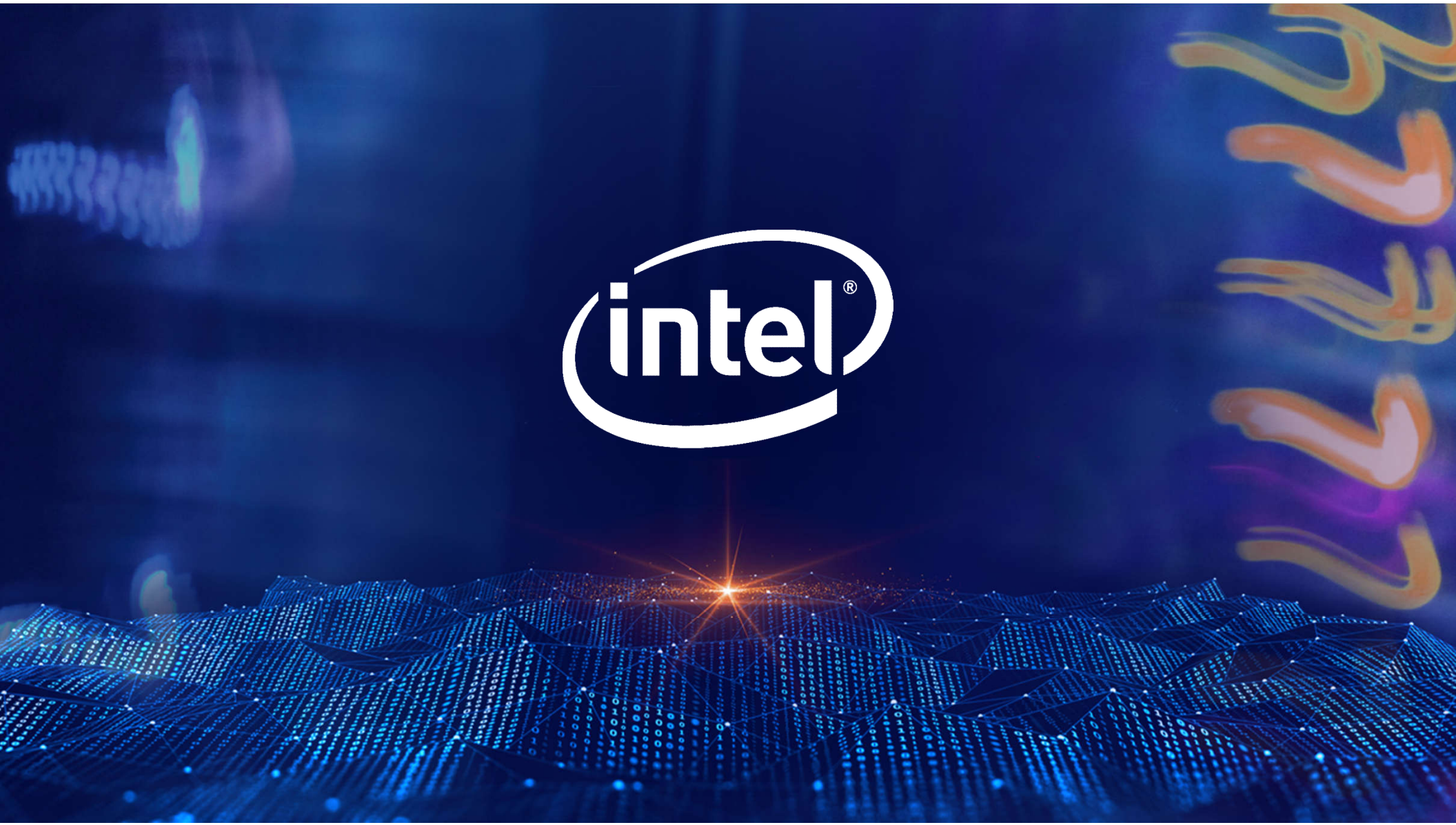
5G is here and now. Edge is the Epicenter of new services and innovation.

Edge & 5G are accelerants to Network Transformation that is underway.

Need to address the 3 key painpoints discussed today with urgency.

Intel is investing in 5G E2E and committed to network transformation.

Let's collaborate and REALIZE the true potential of 5G.


intel