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The Evolution of the Edge – Why Edge Compute and Networking Should Tightly Integrate into a Cable Edge Cloud

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Agenda

Introduction

What is the Edge?

- Evolution of the edge
- Key players
- Use Cases

Infrastructure Ecosystem for the Edge

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- Cable Headends and Wireless Towers
- Networking and Edge InterConnect
- Alliances and Partnerships

Network Cloud

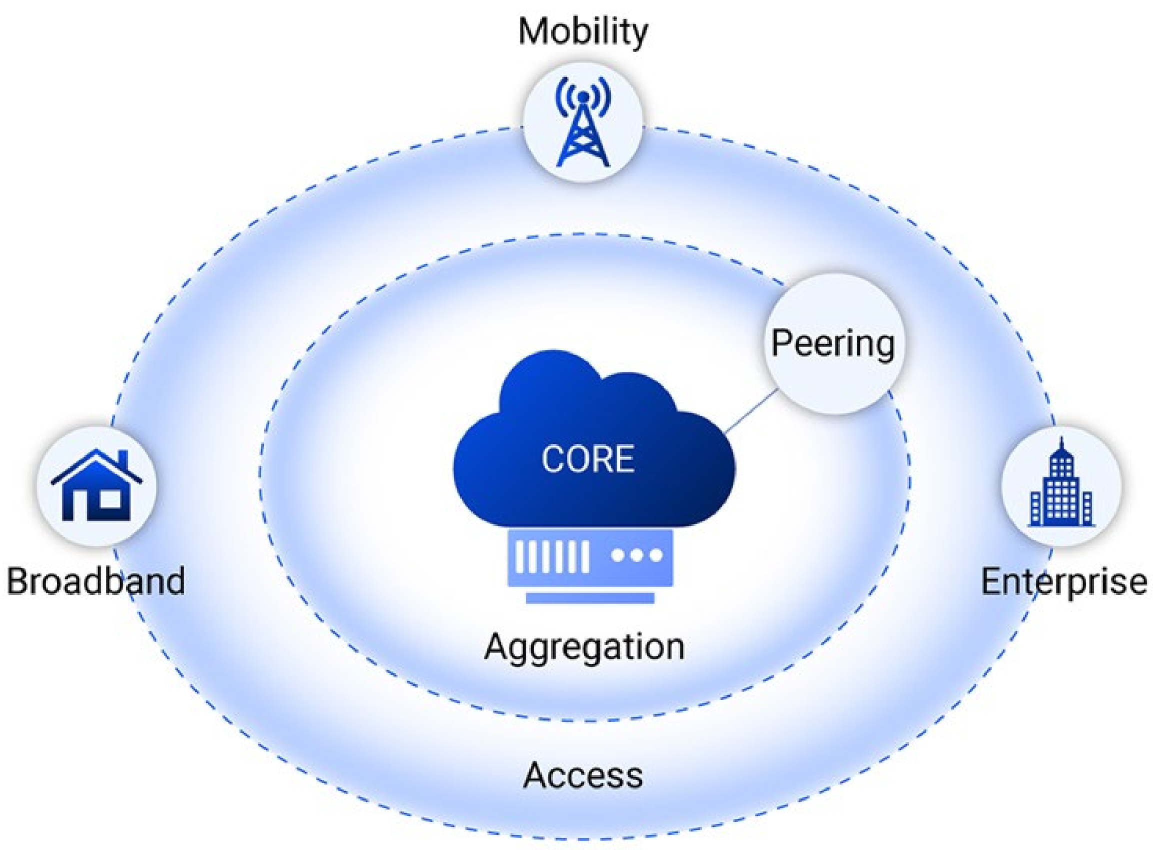
- Evolution of Network Functions
- Edge Cloud Enablers
- Multi-Services Network Cloud Architecture for the Edge

Introduction

- Edge Cloud is not complex in and of itself, nevertheless, the definition is fluid.
- The edge must be solved collectively by the communications providers, network operating system vendors, and the compute providers (the cloud), with a laser focus on consumption, treating the underlying tech merely as tools that can be swapped in and out.
- Many organizations want familiar cloud services brought to the edge where the data they want to process is created, on their choice of infrastructure — and with the flexibility of cloud consumption models.
- Between 2019 and 2028, cumulative capital expenditures of up to $800 billion USD will be spent on new and replacement IT server equipment and edge computing facilities.

What is the Edge?

- There is a biased view that edge and cloud are competing solutions.
- Edge computing is comprised of combinations of systems that span a wide range of locations and conditions and support a diverse set of use cases.
- There's not just one answer to the question of the definition of "edge cloud". Each definition points out a unique and important concept in the world's computing infrastructure.
- Certain use case might demand high-powered Graphics Processing Units (GPU) for AI (Artificial Intelligence), another one might demand low power consumption to lengthen battery life.



Evolution of the Edge

- Historically, all the data and applications the enterprises needed was stored and processed locally in their on-premises data centers.
- Due to these resources being available locally, the latency and bandwidth was not a concern.
- Then as the cloud computing paradigm took off, some of these applications moved to the cloud compute environment while the rest remained on-premises.
- This hybrid cloud model, certainly, has its benefits but as digital transformation is driving enterprise applications and processes to the cloud, and particularly to public clouds the value of having data centers on site diminishes.
- The first generation of distributed edge clouds is being deployed in metro data centers to provide enterprises with a greater choice of compute locations, both within and between countries.

Evolution of the Edge

- The new class of edge-native services will serve an increasingly hyperconnected web of devices that is producing and consuming more and more data.
- AI/ML applications will turn this wealth of data into intelligence far more quickly than humans could and will replace manual steps that introduce friction into processes and experiences.
- At the end of this decade, industry visionaries expect an 'AI of Things' to have emerged, whereby everything in our lives will be able to exchange data with everything else, thereby enabling 'magical' and unprecedented levels of automation.

Key Players

- There are three primary infrastructure service providers that play a significant role in the buildout of the edge cloud:
  - data center operators
  - last mile operators
  - cloud and edge computing service providers
- A vast majority of these computing service providers have allocated significant capital into the development of advanced software management platforms
- The CSPs/ISPs can themselves become providers of cloud infrastructure because they will be placing edge-native clouds across geographic locations in order to effect end-to-end, cloud-based transformations of their access and transport networks.
- Operators are actively partnering with the vendors of disaggregated cloud-native networking solutions to provide a more extensive edge Network-as-a-Service (NaaS) solution leveraging open hardware.

Use Cases

Remote Work

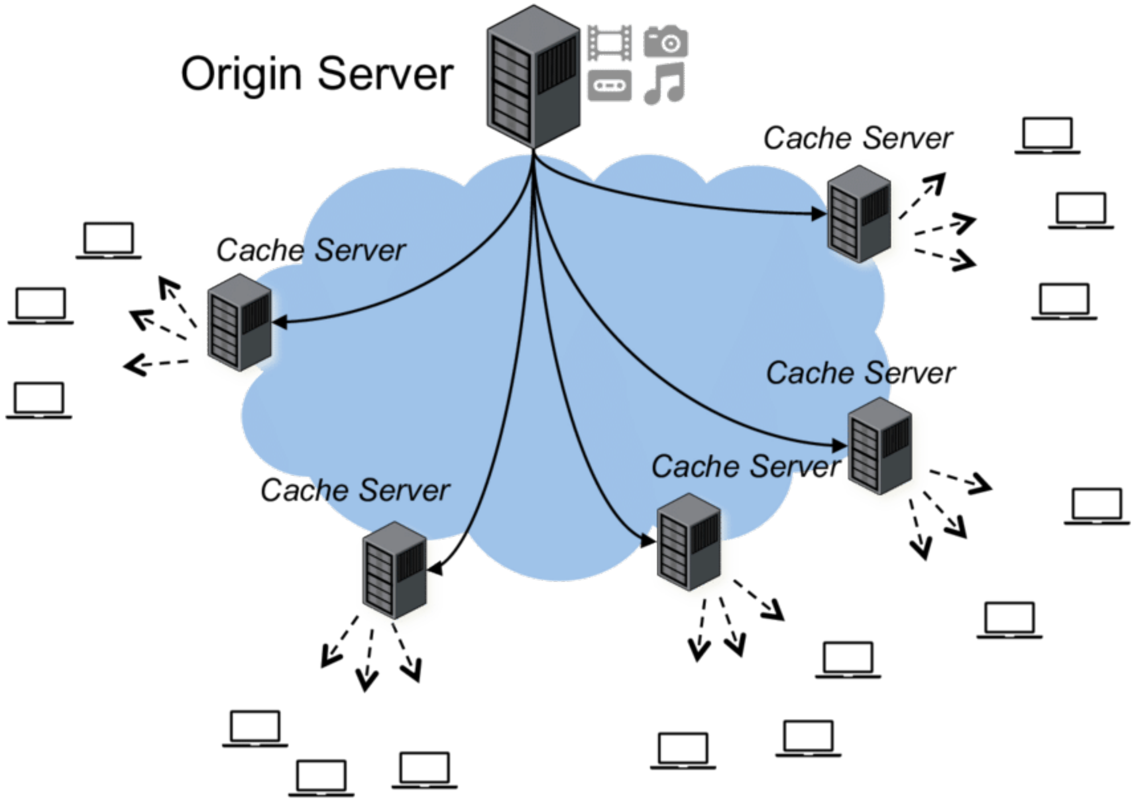
- The Work-from-Home (WFH) trend is here to stay.
- The solution is needed that allows spinning the network functions remotely without having anyone on site thereby easing the requirements for on-premises presence.

Smart City Applications and AVs

- The widespread adoption of autonomous vehicles is inevitable and will require a proliferation of edge computing services along roadways to ensure the cars can navigate properly.
- Small rural towns and villages will need enhanced edge computing capabilities to implement smart city applications.

Content Delivery Networks

- CDN providers are among the pioneers who brought the edge computing capability into production networks ahead of other industries
- Major CDN provider manages and operates a large number of content servers geographically distributed across regions .
- Not only is content retrieval latency reduced, but the network traffic is more distributed and balanced without generating traffic spikes



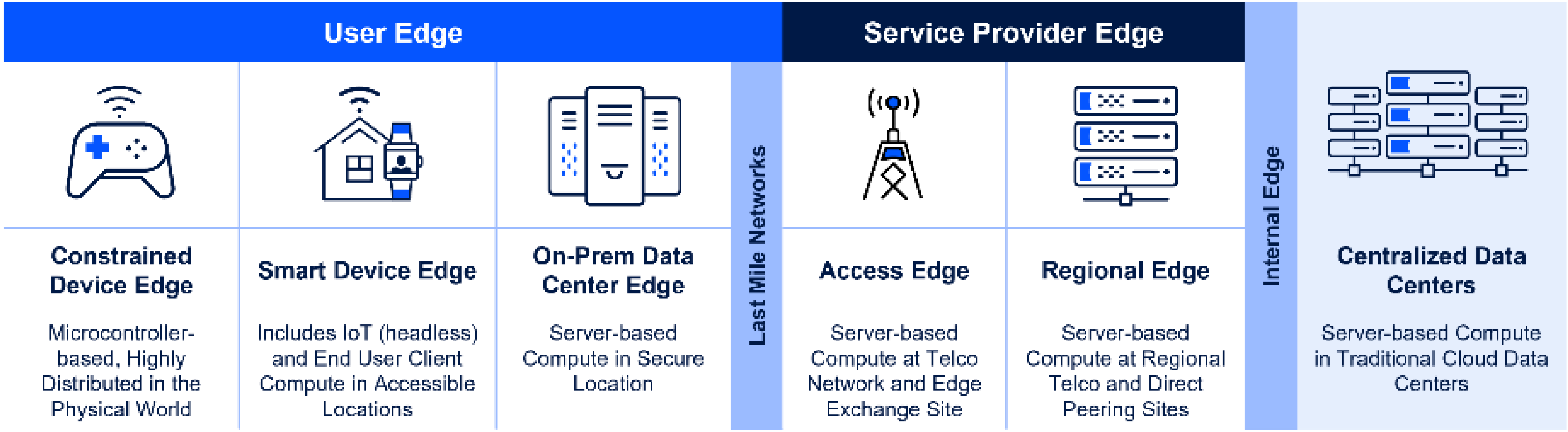
Industry 4.0 Use Case

Precision Agriculture

- The edge cloud construct is increasingly viewed as a key enabler for the "Fourth Industrial Revolution".
- Despite its slow adoption rate, precision agriculture is a great example of this.
- Farmers using precision agriculture tools and applications will generate thousands if not millions of data points.

Infrastructure Ecosystem for the Edge

- At the edge, the physical infrastructure is disparate, vendor-agnostic and comes in various shapes and sizes.
- Data Centers, Cable Headends, Wireless Towers play a huge role.
- Each critical infrastructure component is crucial in and of itself, but they work together as part of a single integrated ecosystem.



Network Cloud

Evolution of Network Functions

- Network Functions were originally deployed on dedicated physical appliances.
- With the widespread adoption of compute and storage virtualization Network Function Virtualization (NFV) initiative started.
- Virtual Network Functions (VNF) ran on x86 servers (on CPU) which was sub-optimal.
- As microservices architecture became increasingly popular, Cloud native Network Functions (CNF) were able to run on the public cloud infrastructure and this enabled further growth.
- However, these NFs still ran on x86 servers.

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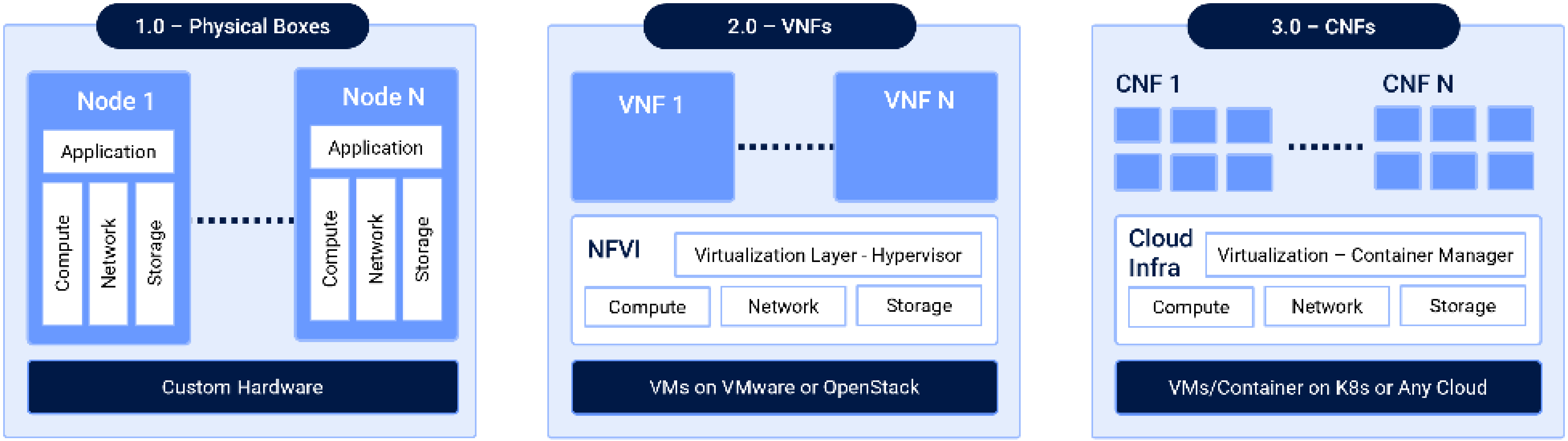


- Proprietary HW platform
- Inflexible network nodes
- Box-specific protocols

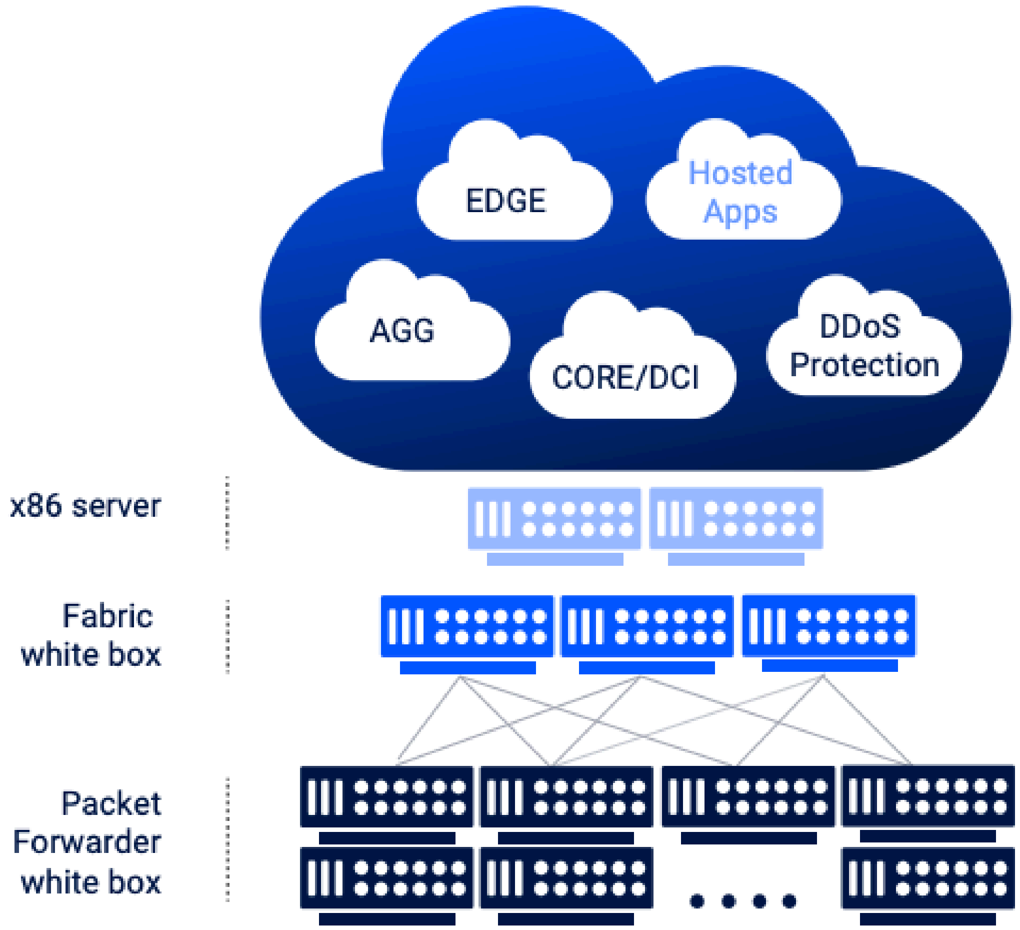
- Monolithic & still customized
- Vendor silos
- CP & UP decoupled

- Carrier DevOps
- Service & Data Decoupled
- Micro-service architecture

Network Cloud

Evolution of Network Functions

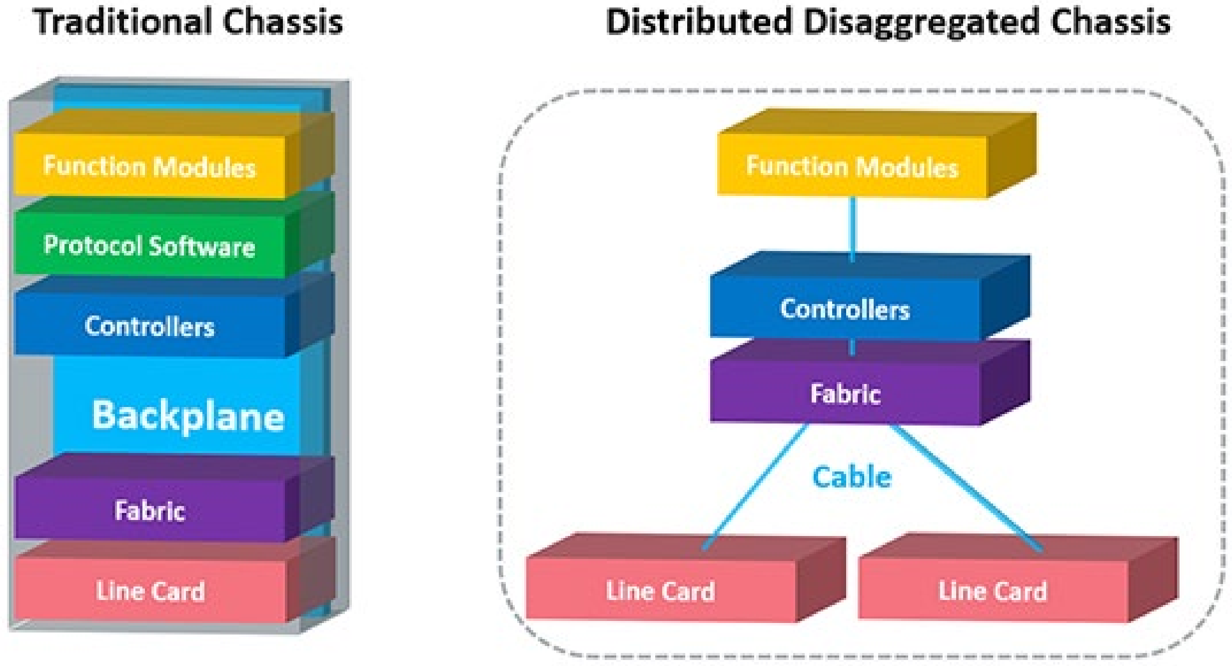
- The offload of the NF to the Network Processing Unit (NPU) on a dedicated Input/Output (I/O) device.
- Similar offer is made by "smart NIC" providers who offload the NF to the Data Processing Unit (DPU) and accelerate it as a result.



Network Cloud

DDC/DDBR Architecture

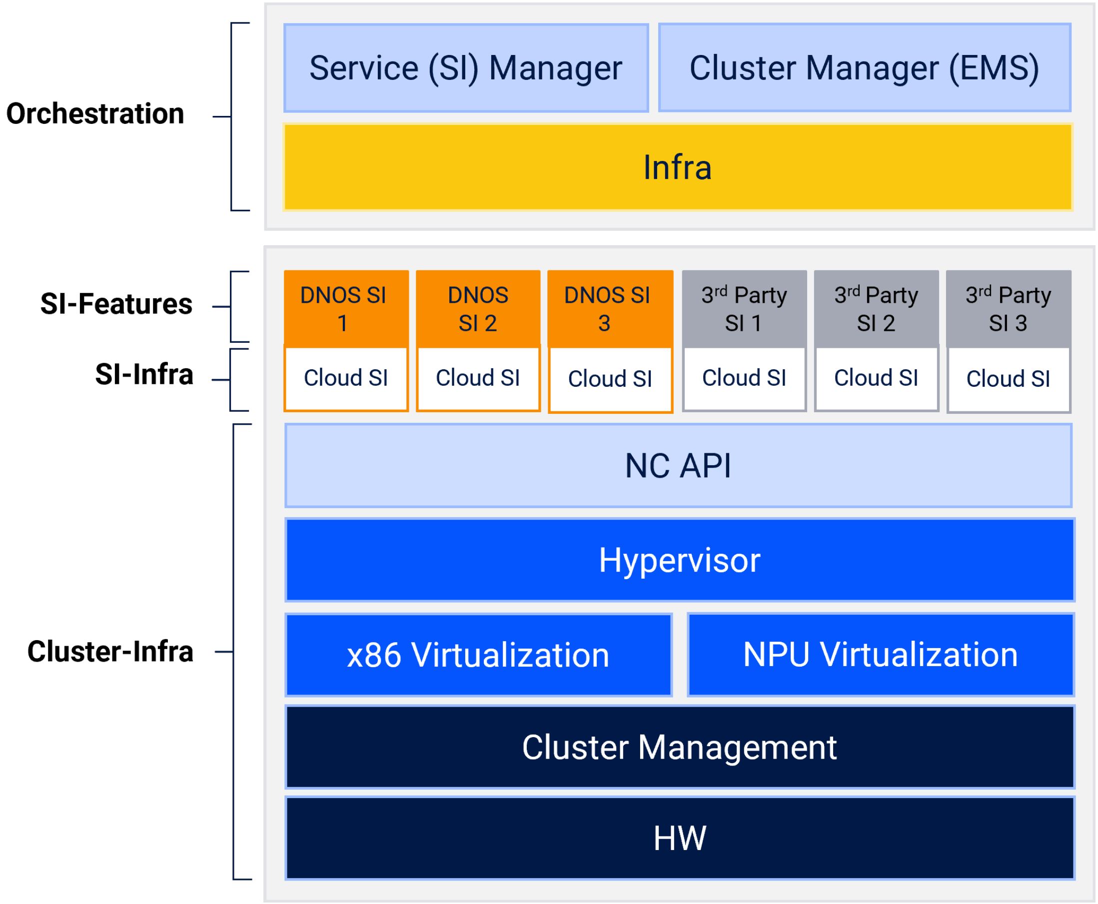
- Based on the whitebox architecture where each component of the standalone monolithic chassis router is distributed into individual components .
- This allows the operators to scale out this re-architected chassis by simply adding whiteboxes that perform fabric and packet forwarding functions.



Multi-services Network Cloud Architecture for the Edge

Software Architecture

- Combining networking and compute resources over a shared, cloud-like infrastructure.
- Allows operators to put greater functionality at the network edge, even with space and power limitations.
- Each networking function, which runs a containerized Service Instance (SI), can be allocated with its required hardware resource (Physical interfaces, NPU, CPU, TCAM, QoS etc.) out of the underlaying shared hardware infrastructure



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Management and control backplane

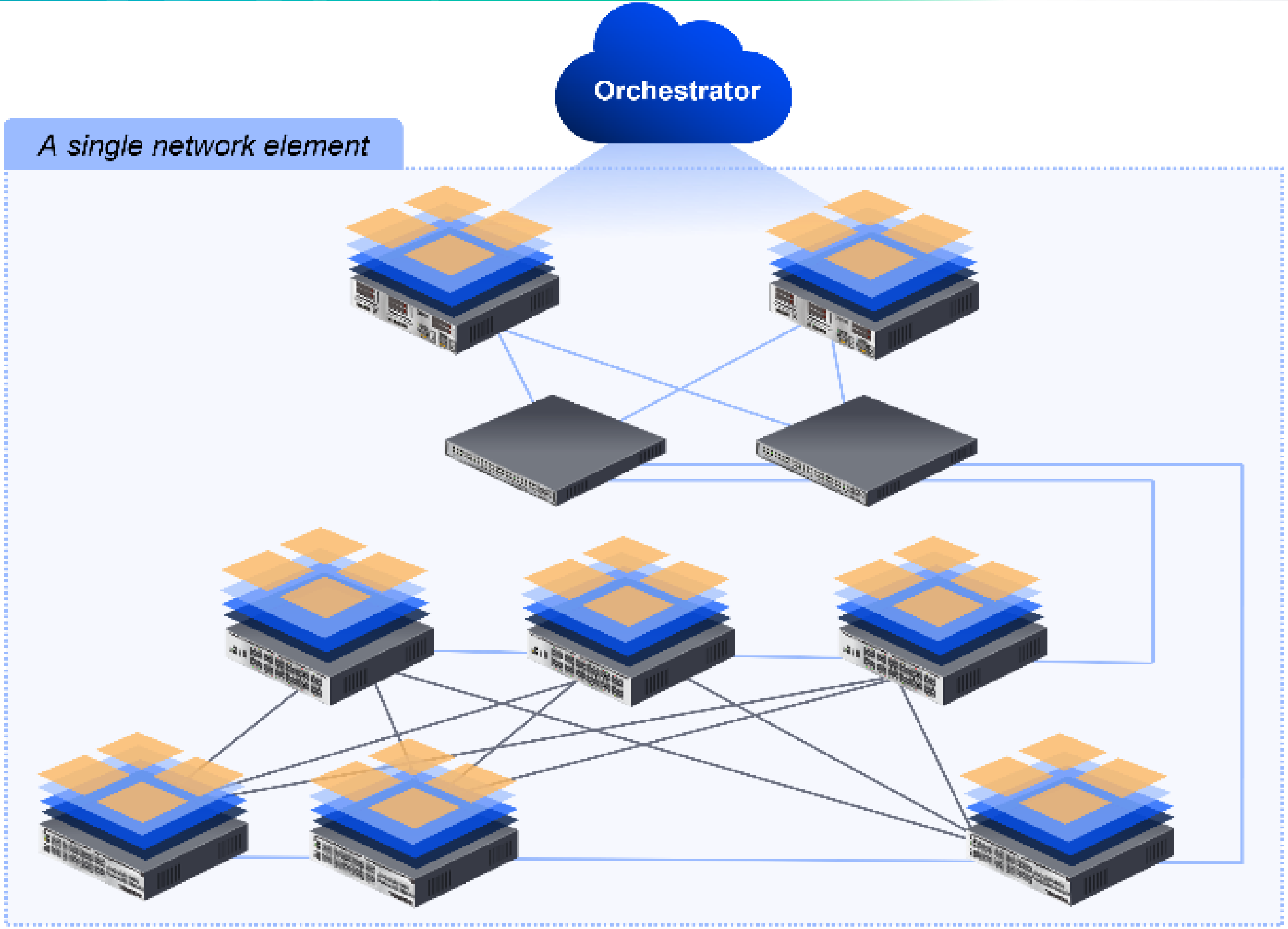
Data backplane

Application services

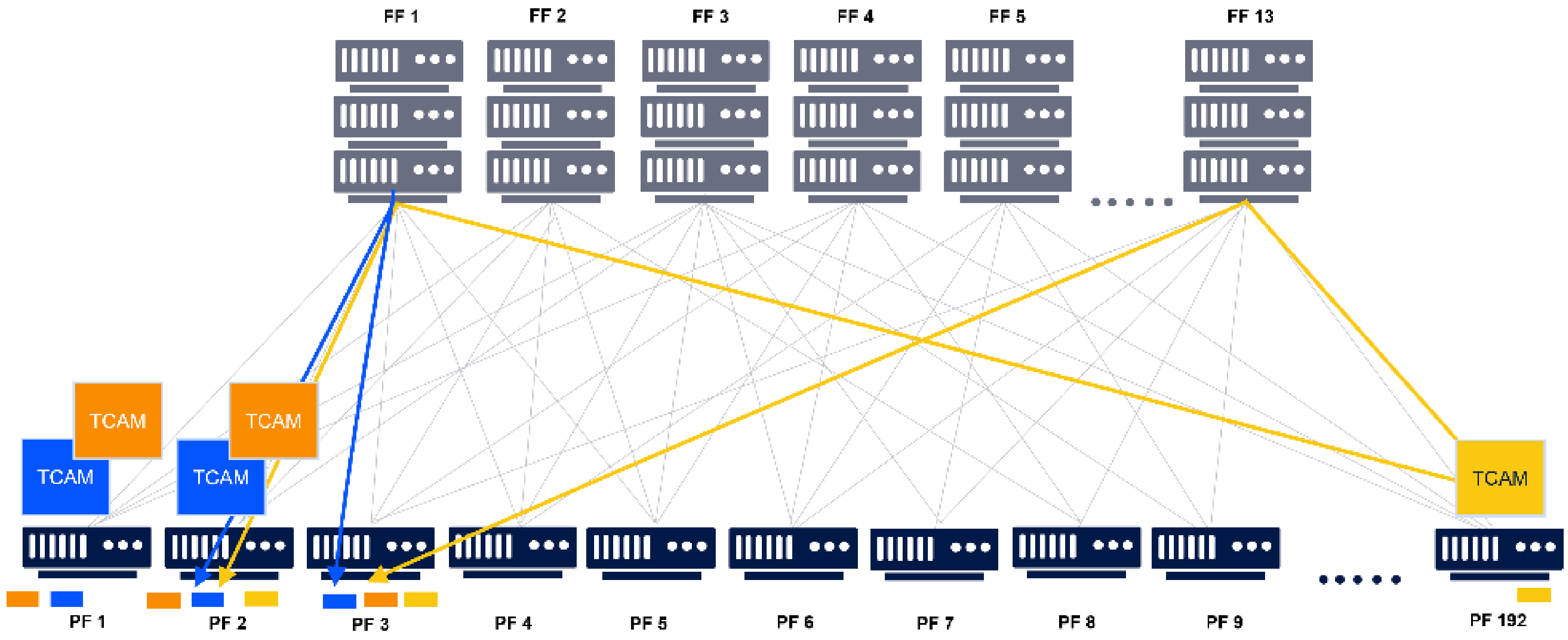
Infrastructure

Platform and orchestration

Base OS



An example of multiple NFs running over the Network Cloud



SI	Maximum rate	Maximum TCAM size
Yellow	100% rate	100% TCAM size
Orange	200% rate	50% TCAM size
Blue	200% rate	50% TCAM size

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A big “Thank you!” to the below individuals for their contributions:

Abishek SureshKumar: Delivery Director, DriveNets, askumar@drivenets.com

Run Almog: Head of Product Strategy, DriveNets, run@drivenets.com

Thor Ramsland

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Thank You!

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