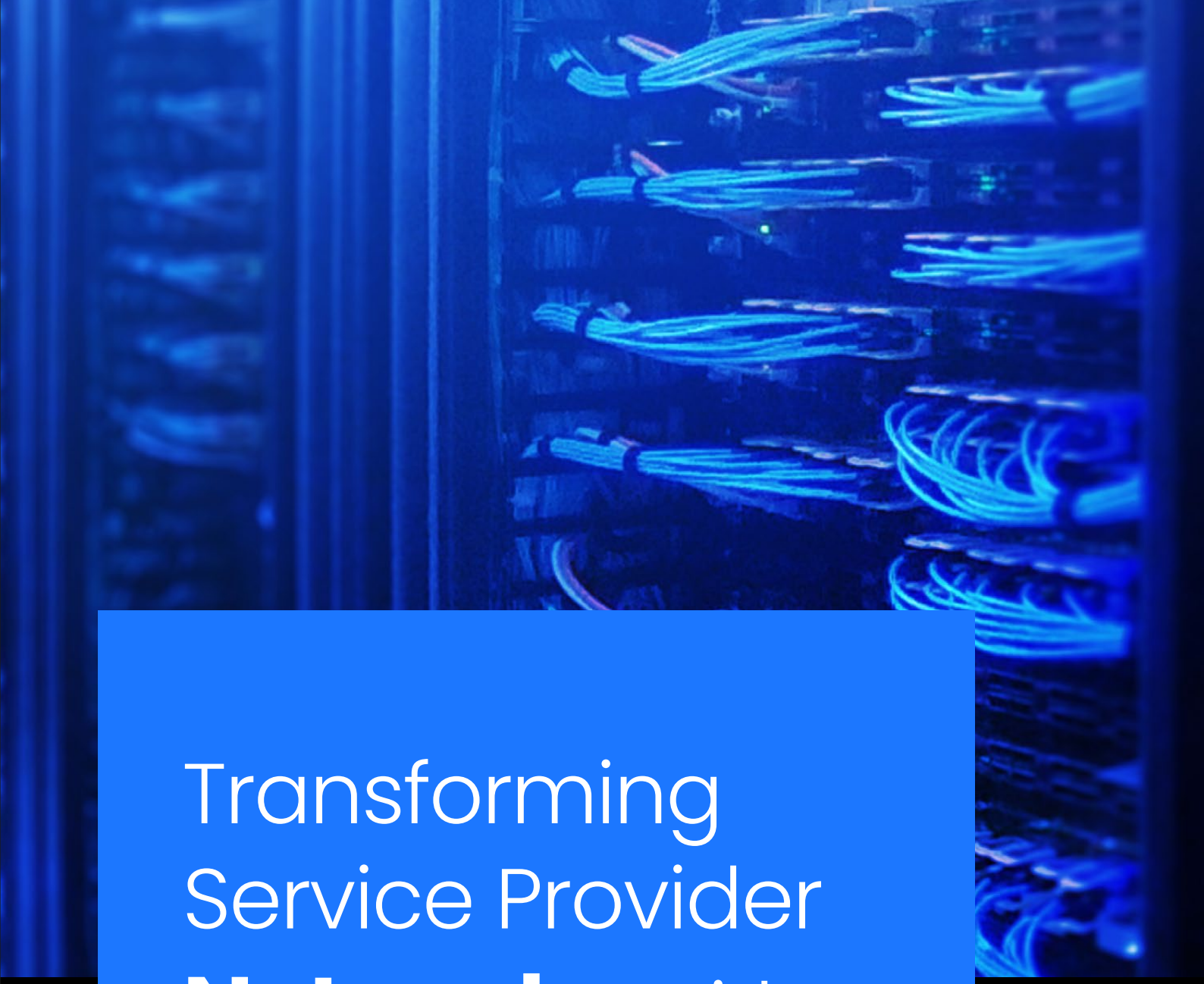

Transforming Service Provider **Networks** with **Disaggregation**

DRIVENETS

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INTRODUCTION

In an era where digital transformation is not just a buzzword but a vital pivot, service providers (SPs) are reevaluating their network architectures. With the relentless growth of data traffic, driven by a surge in high-bandwidth applications and a global uptick in connectivity demands, traditional network models are being pushed to their limits.

As SPs grapple with challenges such as network scaling, operational complexity and increasing network costs, a revolutionary network architecture is gaining momentum – Distributed Disaggregated Chassis (DDC). Representing a shift towards a more open and disaggregated network transport technology, DDC enables "building networks like cloud."

Historically, SPs have relied on integrated/ monolithic solutions from established vendors. These solutions often come as a package in which hardware is coupled with proprietary software. While such solutions offer reliability and support, this approach has its drawbacks. It limits flexibility, ties SPs to specific vendors (vendor lock-in), and often comes with a premium price tag. Moreover, innovation progresses at the pace of the vendor, not the SP.

Network disaggregation separates the hardware from the software in network elements, allowing SPs to extend their vendor selection criteria beyond the traditional chassis-based parameters of reliability and support. With disaggregation, SPs gain more control over their network architecture – from the network operating system (NOS) and chassis hardware, all the way to ASICs and optics – empowering multiple vendors and multiple product mixes. SPs are less dependent on a single vendor's roadmap and can innovate and adapt more rapidly to market changes. This shift is not just technological but also strategic, altering how SPs plan and execute their long-term networking strategies.

Leading service providers such as AT&T and KDDI have already made significant deployments of DDC solutions across their live networks using DriveNets Network Cloud. Their efforts align with other network operators like Comcast, Vodafone, MTN, Telefonica and Orange, which also are adopting open and disaggregated networks. SPs that already have implemented disaggregated solutions have achieved cost reductions, accelerated innovation, and improved scalability.

DriveNets was one of the first vendors to be awarded a Telecom Infra Project (TIP) Requirements Compliant Ribbon for a Distributed Disaggregated Backbone Router solution. In October 2023, in collaboration with AT&T, UfiSpace, HPE and Intel, DriveNets' contribution to the Open Compute Project (OCP) DDC specification version 3 was accepted. Based on DriveNets Network Cloud architecture, this latest version specifically addresses mobile backhaul infrastructure, as well as Ethernet networking for high-performance AI workloads in large-scale clusters.

WHAT IS **DDC**

Distributed Disaggregated Chassis (DDC) is an innovative networking architecture for building large-scale routing systems. DDC delivers similar functionality as traditional monolithic routers but with better scalability and flexibility. DDC introduces two key innovations: the disaggregation of software and hardware components, and the ability of NOS software to unify dozens of distributed white boxes to operate as a single network entity.

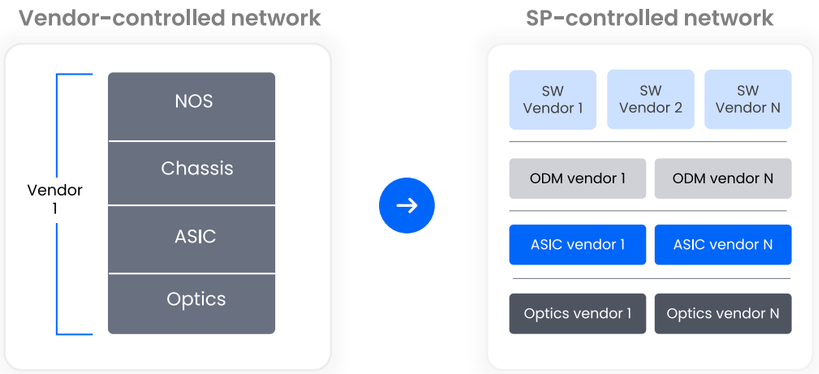
WHY DDC FOR NETWORK SERVICE PROVIDERS?

Service providers recognize the changing landscape of the networking industry. Traditional hardware-centric solutions are unable to meet the rapidly increasing volume of IP endpoint traffic from the access network. In addition, over-the-top (OTT) services and the dominance of hyperscalers have impacted revenue. In response, SPs are actively searching for a new, flexible, scalable and cost-effective networking solution.

DDC KEY FEATURES

01 Disaggregation / Separation

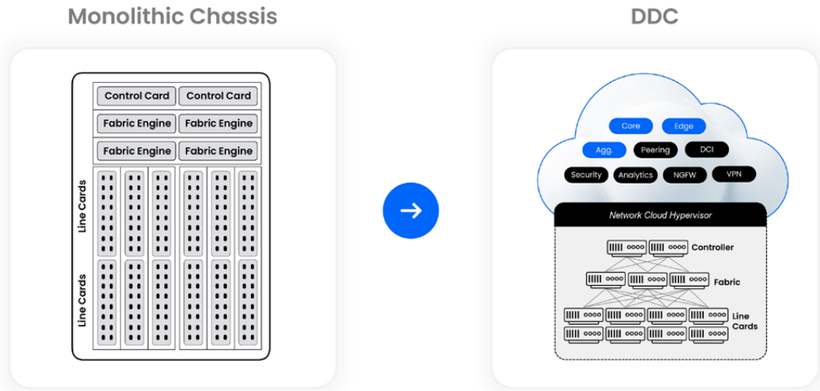
DDC breaks up the traditional monolithic chassis into separate hardware (HW) and software (SW) building blocks, while carrying out the main functions of traditional monolithic networking hardware. Disaggregation enables service providers to manage hardware and software independently, and thereby mix and match HW and SW from multiple vendors to increase cost savings. In addition, the disaggregated approach enables SPs to enhance resilience by supporting component upgrades or replacements without impacting the entire network.



02 Unified System Design

With DDC, traditional chassis hardware is broken down into separate, standardized building blocks. Each component, such as line cards, fabric cards or controllers, is transformed into white boxes not bound by any chassis limitation. This network design enables service providers to build routers of any size across all network domains by using the same cost-effective white boxes. Additionally, this unified approach significantly reduces planning, procurement, and operational efforts.

Breaking traditional chassis architecture into a cluster of standard building blocks using a unified white box design.



> **White boxes offer AT&T a capital savings of about 10X compared to traditional chassis and line card architecture.**
>
> **John Gibbons, AVP of Network infrastructure Services, AT&T**

03 Network Operating System (NOS) and a Single Network Entity

In a DDC cluster, an array of multiple distributed white boxes are used to build a large-scale router. This architecture combines the best of both centralized and distributed characteristics. On the one hand, individual distributed components enhance resilience and minimize the impact of failures (aka blast radius). On the other hand, the cluster's NOS software orchestrates the entire cluster, regardless of size, as a single network entity that is easy to manage and operate.

DDC BENEFITS **FOR SERVICE PROVIDERS**

EXPEDITED NETWORK MODERNIZATION

Software-Based Innovation – Cloud-Native Architecture

DDC represents a paradigm shift in network architecture, driven by software-based innovation. By leveraging cloud-native principles, DDC offers a level of flexibility and agility previously unattainable in traditional network setups. This approach allows for rapid deployment of new services and easier integration with third-party applications.

Collapsed Networking Layers

A key advantage of DDC architecture is its ability to streamline network infrastructure by collapsing multiple networking layers into a more simplified structure. This collapsing of layers not only drives down complexity but also reduces latency, improves performance, and lowers operational costs.

Field-Proven Solution

DDC is not just a theoretical advancement; it has been tested and proven in multiple real-world scenarios. This field-proven technology demonstrates its reliability and effectiveness in managing the diverse and dynamic requirements of modern networks, ensuring that service providers can confidently transition to DDC with minimal risk.

INCREASED SERVICE PROVIDER CONTROL

No Vendor Lock-In – Diverse ASICs, HW, SW and Optics

One of the fundamental benefits of DDC is the elimination of vendor lock-in. SPs can mix and match any suitable components from a wide range of available ASICs, hardware, software and optics vendors. This versatility ensures that service providers are not restricted to specific brands or technologies, fostering a competitive and innovative ecosystem tailored to their needs.

Incremental Scalability

By stacking low-cost white boxes for incremental capacity upgrades, like in cloud environments, SPs can scale out the DDC cluster whenever needed, one white box at a time. This approach avoids unnecessary up-front investments, supports efficient capital expenditure (CapEx) management, and ensures that the network grows with demand.

Sustainability and Circular Economics

DDC contributes to reduced environmental impact and promotes a more sustainable approach to network management by optimizing resource utilization and extending the lifespan of existing infrastructure.

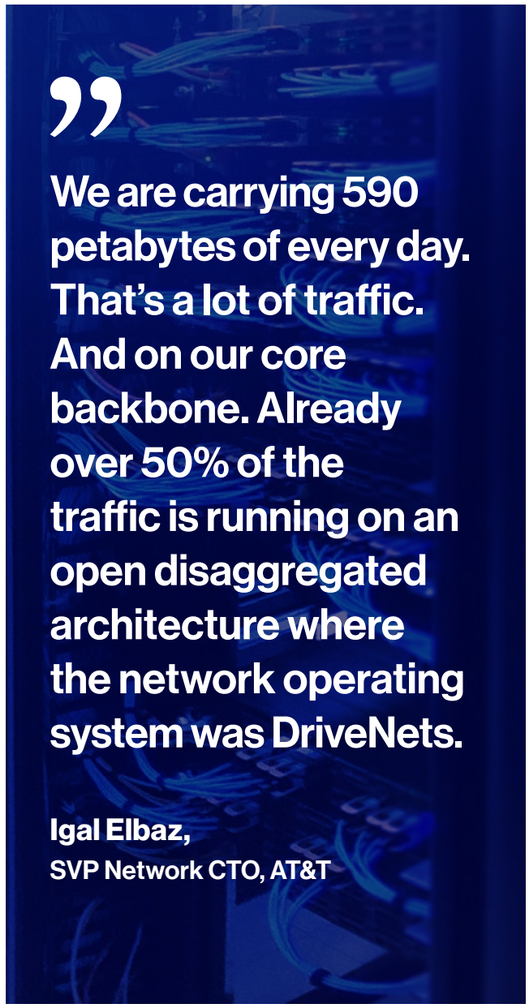
> **The TCO improvement is about 20% when we disaggregate**
>
> **Jean Louis Le Roux,**
> EVP International Networks, Orange

> Traffic going into the network is growing about 30% year over year.
>
> **Igal Elbaz,**
> **SVP Network CTO, AT&T**

AT&T, ORANGE, & TELEFONICA ON DISAGGREGATED CLOUD-NATIVE NETWORKING

DriveNets hosted a panel for analysts and media at MWC23 in order to explain its work and allow industry leaders to share their progress on disaggregated networking. Members of the panel included: Igal Elbaz, SVP & Network CTO at AT&T; Ido Susan, Co-Founder and CEO of DriveNets; Jean Louis Le Roux, Executive Vice President for International Networks at Orange; and Cayetano Carbajo, VP for Core, Transport and Service Platforms at Telefónica.

Elbaz discussed several key trends and strategic shifts in networks. Firstly, he noted that traffic entering the network is increasing at a substantial rate, approximately 30% year over year. This surge is driven by customers from all segments increasingly using cloud services, necessitating a seamless networking experience that can be accessed from any location. To address these evolving demands, AT&T developed a new approach and architecture designed for scalability and efficiency. This strategy is anchored in three fundamental principles. The first is convergence, with the company focusing on constructing a multi-service converged edge, extending the principle of convergence right down to the access level. The second principle is openness, which fosters flexibility, cost advantages, and enhanced network intelligence. Lastly, the concept of cloudification is pivotal, as AT&T endeavors to integrate cloud-architecture principles across every facet of its network, aiming to replicate the dynamism and scalability that are hallmarks of cloud environments.



SIMPLER NETWORK OPERATIONS

01 Unified HW – Core to Edge

DDC advocates for a unified hardware approach across the entire network, from core to edge, enabling the same standard white boxes to be used across all network domains. This HW unification simplifies the network architecture, streamlines management, and reduces the complexity associated with operating diverse systems. While DDC clusters contain numerous distributed white boxes, their control plane is centralized and managed as a single network entity.

02 Simplified Warehousing

Network components are reduced from tens of HW/SW elements to two white boxes and a single software package. With fewer unique parts to store and manage, service providers can benefit from reduced inventory costs and a more efficient supply chain.

03 Higher Availability

By its design, DDC enhances network availability. Its distributed nature and redundancy mechanisms ensure continuous operation, minimizing downtime and ensuring reliable service delivery. Maintenance is easily accomplished by replacing individual white boxes, thereby eliminating the need for cumbersome forklift chassis replacements and disruptive maintenance windows.

Jean Louis Le Roux, Executive Vice President of International Networks at Orange, outlined several key challenges and requirements currently facing Orange's network. Central to these is the imperative of cost efficiency, specifically targeting a reduction in the total cost of ownership (TCO). Another significant factor is scalability, with network traffic experiencing an annual increase of 30-40%. In line with global environmental concerns, Orange also is committed to sustainability, setting an ambitious goal to reduce its carbon footprint by 45% by 2030. Furthermore, the need for on-demand services is growing, especially among B2B customers who require the ability to order, upgrade, or downgrade services swiftly and effortlessly. This leads to a necessity for greater flexibility and elasticity within the network, essentially encapsulating all the aforementioned requirements.

To address these multifaceted challenges, Orange has embraced the concept of router disaggregation, recognizing it as a comprehensive solution. Decided upon in 2022, this strategic move represents a significant shift away from merely considering theoretical approaches towards practical implementation and experimentation. The process began with switches and is now extending to core / provider (P) and peering / provider edge (PE) routers, reflecting a proactive approach in adapting to the evolving demands of network management and customer needs.

”

In order to achieve cost efficiency, scalability, environmental sustainability, and on-demand functionality, we require elasticity in our networks. To meet these requirements, disaggregation is the solution

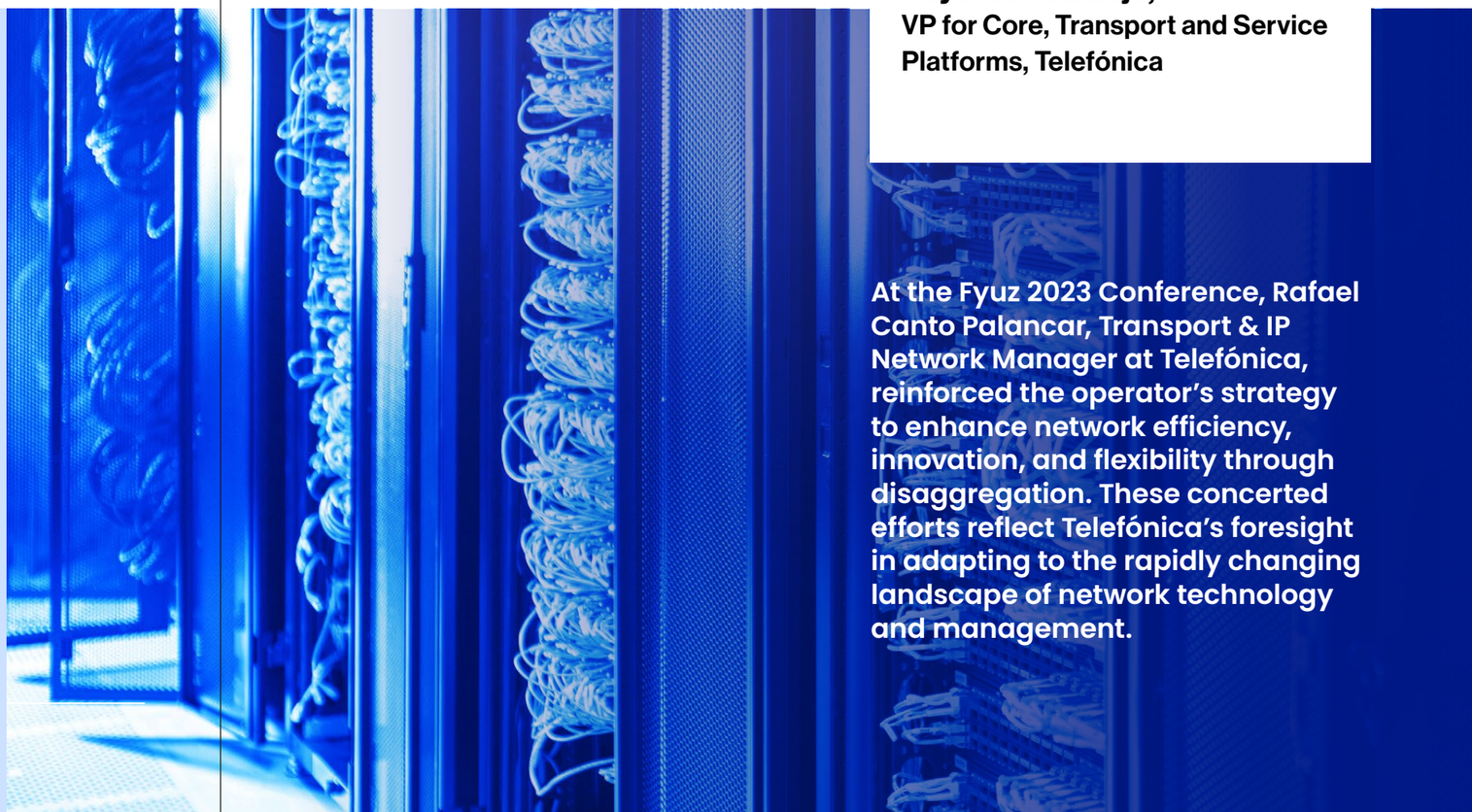
Jean Louis Le Roux,
EVP International Networks, Orange

Cayetano Carbajo, Vice President for Core, Transport and Service Platforms at Telefónica, elaborated on the operator's strategic push towards disaggregation and cloudification, driven by a confluence of factors. Key among these is the desire to separate innovation cycles, thereby leveraging the rapid advancements in software. This shift also encourages increased competition by allowing more vendors to enter the market, effectively lowering barriers to entry. Telefónica's commitment to this approach is evident in its comprehensive application across all network domains, ranging from access to the core, as exemplified by the UNICA project.

”

We are pushing for disaggregation in all the network layers...when decoupling the software and the hardware you can have different innovation cycles and software cycle could be faster and you can bring new things to the network in a faster way."

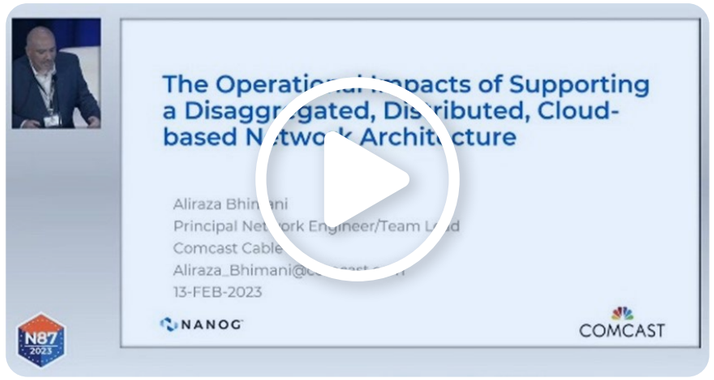
Cayetano Carbajo,
VP for Core, Transport and Service Platforms, Telefónica



At the Fyuz 2023 Conference, Rafael Canto Palancar, Transport & IP Network Manager at Telefónica, reinforced the operator's strategy to enhance network efficiency, innovation, and flexibility through disaggregation. These concerted efforts reflect Telefónica's foresight in adapting to the rapidly changing landscape of network technology and management.

OPERATIONAL IMPACTS OF **DDC NETWORK ARCHITECTURE**

Aliraza Bhimani, a principal network engineer at Comcast Cable, gave an insightful presentation on "The Operational Impacts of Supporting a Disaggregated, Distributed, Cloud-Based Network Architecture" at NANOG 87 (2023) in Atlanta. He presented some of Comcast's insights from working with the DDC/DDBR (Distributed Disaggregated Chassis/Backbone Router) architecture, sometimes referred to as "virtual chassis," and discussed how disaggregation helps simplify Comcast's operational complexities.



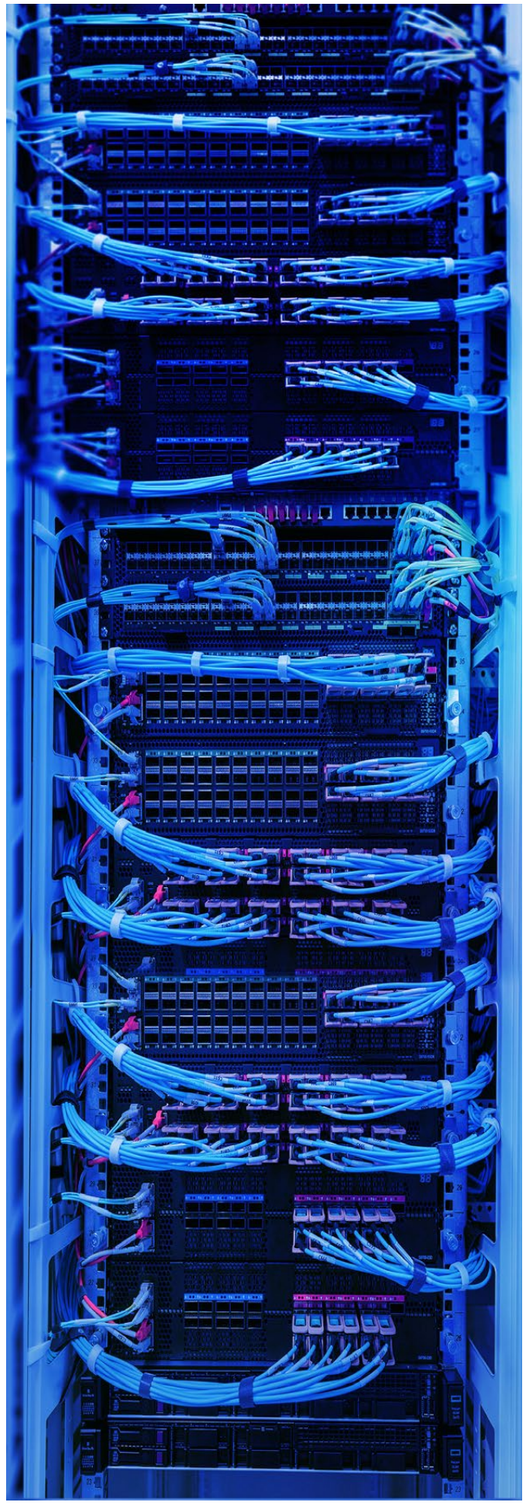
He related to the actual DDC/DDBR implementation tested by Comcast. Thanks to a streamlined user experience enabled by an orchestration platform, this implementation removed the major concern of expected complexity for managing a multi-device cluster of white boxes vs. a single-chassis device.

A key point raised was the improved sustainability offered by standard white boxes. These devices can be purposed to implement different network functions at different scale, and, as such, enjoy extended lifespans in any production network. While this was something that could not have been tested in the lab, it is already clear that this is an attribute that cannot be obtained with single-purpose, monolithic, chassis-based router implementations.

At the end of the session, he shared some impressive numbers relating to the operational impact of implementing DDC/DDBR. "With this disaggregated solution we were able to reduce power consumption by 48% when compared to traditional routers. We also increased port capacity by 2.5 times when compared to traditional routers," he said.

Comcast shared its experience in a paper that dives into how cable operators can leverage open transport building blocks across different segments of their transport networks (access, aggregation, backbone). It also explores how operators can implement concepts of real DDC/DDBR architecture, while utilizing orchestration, automation, and analytics.

Comcast also touches upon how operators can overcome operational challenges and pitfalls while proactively positioning themselves for future disaggregated network solutions.



REPORTED TCO SAVINGS WITH NETWORK DISAGGREGATION

AT&T

"White boxes offer AT&T a **capital savings** of about **10X** compared to traditional chassis and line card architecture."

KDDI

"...**reduce the power consumption** by about **46%** and the **rack space** by about **40%** compared to the traditional routers in KDDI production networks."

COMCAST

"...**reduce power consumption** at a **48%** reduction when compared to traditional routers."

Telefónica

"My preliminary idea was this will be consuming more but modularity is helping us and instead of having a whole chassis we have modular, and we have measured **15% to 20% energy reduction**"

orange™

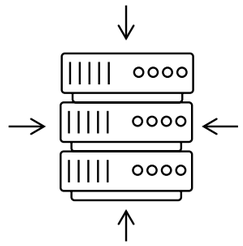
"**The TCO improvements** is about 20% when we disaggregate."

KDDI CASE STUDY

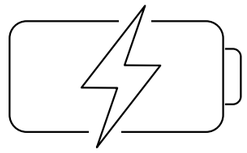
In 2021, KDDI joined forces with other service providers to pioneer open and disaggregated solutions for IP networking under the Telecom Infra Project (TIP). In the initial phase, TIP released the Distributed Disaggregated Backbone Router (DDBR) solution. In 2023 KDDI announced the commercial deployment of its DDBR powered by DriveNets. These routers now manage live internet traffic as internet gateway peering routers.

KDDI emphasizes two key benefits – the freedom to create an optimal hardware configuration, and the ability to share hardware resources across multiple network domains. These advantages help to significantly reduce power consumption, capital equipment costs, and rack space. In fact, according to KDDI the new solution remarkably can reduce power consumption by up to 46% and rack space by up to 40% compared to traditional routers in its production networks.

Up to
↓40%
Rack Unit Size Reduction



Up to
↓46%
Less Power Consumption



SUMMARY

Distributed Disaggregated Chassis (DDC) has emerged as a key solution for modernizing service providers' network infrastructure. DDC leverages cloud-native architecture and software-based innovation to streamline operations and enhance flexibility. Network disaggregation shifts the balance of power back into the hands of SPs, allowing them to achieve significant total cost of ownership (TCO) savings.

Real-world applications of DDC can be seen through case studies of major telecom companies such as AT&T, Orange, and Telefonica. Detailed analyses of the operational and economic impacts of DDC are illustrated by case studies of Comcast and KDDI. These insights show a clear picture of how DDC is reshaping the landscape of network infrastructure, offering a path towards more efficient, scalable, and cost-effective network management.

DRIVENETS