NEC White Paper
Open & Virtualized
– The Future of Radio Access Network –

1. TIMES ARE RAPIDLY CHANGING IN THE TELECOM MARKET

5G networks were designed to facilitate a connected world. Enhanced Mobile Broadband (eMBB) has been the first use-case supported and Ultra Reliable Low Latency Communications (uRLLC) and Massive Machine Type Communications (mMTC) will soon follow. The primary motivation is the transformation cost-saving potential and 5G is expected to offer Communication Service Providers (CSPs) an opportunity to stay ahead of a declining yield curve.

The new 5G technological capabilities will redefine business models and generate entirely new revenue streams for CSPs. At the same time it will support in overcoming deep-rooted challenges they are currently facing:

OPERATION COMPLEXITY	TECHNOLOGY UNCERTAINTIES	CUSTOMER CHURN
The usage of cost effective and data driven Automation powered the AI/ML, Open API, Analytics and DevOps will transform network operational management	The growth of optimized cloud and virtualization of network functions brings much needed flexibility, programmability and elasticity to support network slicing	A new set of digital services will rapidly increase digital engagement and increase customer retention through offering consumers personalized and intelligent service

Evolution of network to 5G and the potential to transform

While it is clear that 5G offers a path to an improved cost per bit, it is imperative to focus on actively developing business cases that deliver a step-change in revenue. It is equally important to have a clear view on what it will take to support 5G transformation including reaching its full potential and the optimal journey to achieve that ambition.

Various areas require upfront investment including central clouds / edge clouds. Fiber densification and transport network optimization is required to improve latency. Network Automation based on AI/ML powered by an efficient End-to-End Orchestration will support operational efficiencies. However, a core network that relies on a Service-Based Architecture (SBA) and introducing Control and User Plane Separation (CUPS) only begin to touch the surface of 5G's E2E transformational impacts.

Radio Access Network (RAN) evolution already presents existing challenges – Centralized RAN (C-RAN) opened the doors to a centralized management of radio resources, relying on a pool of baseband units in a co-collocated facility shared between base stations. The base station main functions are divided into Radio Unit (RU), Distributed Unit (DU) and Centralized Unit (DU) to optimize processing between radio functionalities and baseband computation. The convergence of networks into IT, network functions virtualization (NFV) has started a long time ago in the core, and the disaggregation of the network is now taking place at the radio elements. The virtualization trend evolved C-RAN to Cloud RAN, a virtualized radio access network (vRAN) that coordinates CU/DU functions from a datacenter using NFV and SDN technologies, allowing to deliver capacity where needed dynamically.

The new generation of Mobile Networks, is expected to transform end user experience of the networks and significantly further complicating CSPs' landscape.

2. THE DISRUPTIVE POTENTIAL OF OPEN vRAN

Alongside virtualization and complementing the disaggregation movement inside the RAN environment, another disruptive and powerful technology shift has emerged: open interfaces, supporting independent innovation in different RAN network elements.

Cloud RAN enables the Software-defined infrastructure with the use of Commercial Off-The-Shelf (COTS) servers or white-boxes to deploy network functionalities. In the Open RAN approach, the architecture leverages the use of "white-box" hardware servers that can work flexibly with software-defined radio network functions like DU or CU and open interfaces to avoid vendor lock-in.

Like previously experienced in the IT world, an open ecosystem significantly increases competitiveness of the CSP, will fosters innovation. Open vRAN has the potential to specifically mitigate the 5G rollout challenges and improve:

- **Total Cost Ownership (TCO)**: Allowing a more balanced control between Capital Expenditures (CAPEX) and Operating Expenses (OPEX) investments, as virtualized functions will be deployed dynamically according to needs, aligning capacity with demand;

- **Time-to-Market:** NFV decreases the cost of deploying a new SW version or feature, allowing CSPs to test and innovate at a lower risk. DevOps, continuous integration and development become a reality;

- **Operational efficiency:** Automating the provisioning and full lifecycle management (scaling, healing, and upgrades) of RAN elements and services, will allow the spectrum to be used more efficiently; capacity will also be managed on demand providing the necessary agility and cost savings needed for new services. Open interfaces will support the deployment of best-of-breed network elements that better address network requirements in specific locations, avoiding a typical "one-size fits all" that brings additional operational complexity to setup, configure and fine-tune;

- **'Plug and play'** – Removing proprietary solutions and single-vendor constraints will allow new market entrants – typically best in class – to provide revolutionary solutions to specific areas of the network. The success of this environment will depend on vendor collaboration and a strong ecosystem.

Open ecosystems has the potential to **break vendor lock-in**, enabling CSPs to select the best in class hardware and software solution for their network. Combining the benefits of virtualization with interoperability solutions across different vendors, Open vRAN will significantly disrupt the ways in which radio mobile networks are built. This transformation journey has already started in the core network and it will soon extend to the Radio network.

3. THE CSP'S PERSPECTIVE – KEY BUYING FACTORS

Broadly, CSPs are following Rakuten Mobile case-study with strong and active interest. CSPs are interested to see how successful it will be due to challenges such as scalability, reliability and capacity to handle all traffic loads. The first steps to adoption are already taking place with trials and strategical live implementations happening around the world to explore and harness the benefits of a fully virtualized Open RAN.

> *CSPs recognize Open vRAN's potential to disrupt the existing marketplace - helping* **break vendor lock-in,** *driving* **TCO savings** *and* **accelerating innovation**

A recent analyst study conducted on behalf of NEC, engaged with several industry leading players and global operators to understand their perspectives and expectations of Open vRAN adoption. It has identified a set of common drivers and concerns in adopting Open vRAN:

DRIVERS	
Breaks vendor lock-in	Increases competition
Fosters Innovation	Simplified Operations
Emergence of a New Cost Base	

CHALLENGES	
Fronthaul connectivity	Ease of Integration
Performance & Feature Parity	
Maintenance of Legacy networks	
Interoperability & Scalability	

A consistent view among CSPs is that a **system integrator** will play a fundamental role in the future network architecture – irrespective of in-house capabilities. In fact, System Integrator capabilities are part of a broader transformation that needs to happen at CSP's organizational, such as, **upskill existing talent, re-designing the operating model, management of network issues and redefining vendor selection and management frameworks**.

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*91% of interviewees expressed **interest in Open vRAN.** However, the path to adoption is less clear.*

CSPs generally believe it will take 1-2 years to trial Open vRAN before deploying in the live network. However, there are a number of use cases that might accelerate the adoption of Open vRAN:

Another key decision point is the extent of virtualization and this depends on: traffic loads, network density, spectrum availability, fronthaul connectivity, computing power and geographic conditions.

4. NEC DRIVES OPEN vRAN ADOPTION

NEC, along with its fully owned subsidiary Netcracker, is a leader in the integration of IT and network technologies providing highly reliable communications networks to CSPs.

By leveraging their extensive portfolio and proven expertise, NEC is uniquely positioned to understand and respond to the challenges mobile networks are facing with the arrival of virtualization and RAN disaggregation.

NEC 5G Vertical Business Platform
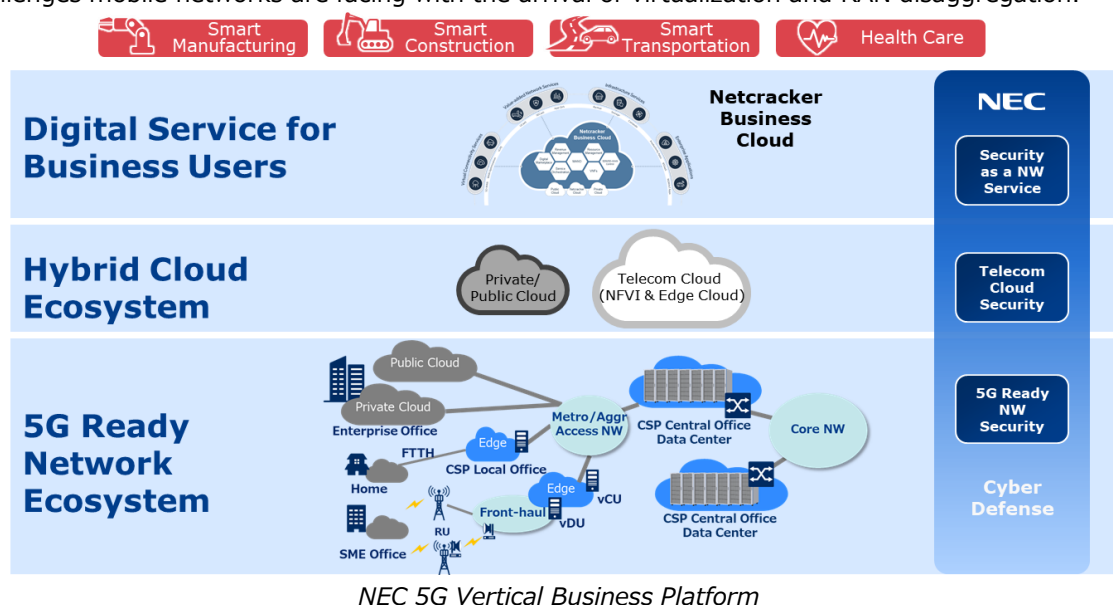
NEC brings together the best vRAN software, RU's and xHaul equipment with various types of cloud and management elements from broad industry partners by expanding NEC Vertical Business Platform best-of-breed ecosystem benefits to Open vRAN. NEC/Netcracker's E2E orchestration capabilities benefit from maximizing its real commercial NFV deployment experience.

Pioneer in Open vRAN

NEC was one of the early adopters of Open vRAN. Being part of the first commercial rollout of Open vRAN in Japan, NEC became the first global reference, leveraging its vast experience in RAN technologies and IT & network system integration. Leading the 5G open architecture, NEC offers open and standardized RF hardware and E2E system integration services with selective software stacks and transport systems at all layers based on open standards. NEC is leading multiple projects on5G Open vRAN around the world.

Simplified evolution to 5G with Open vRAN compliance

NEC currently provides the RU (Radio Unit) for 5G base stations that comply with O-RAN fronthaul specifications, established by the O-RAN Alliance. 5G is expected to require significant small-coverage base station devices. The characteristics of NEC's RU are ideal for this deployment as they are compact, lightweight and power efficient, reducing installation and operational costs. NEC's RUs connect with vCU/vDU through an open interface as per Open vRAN standards. This enables CSPs to select distinct vendors for RU and vDU/vCU across both the hardware and software. In addition, NEC's RUs support Open RAN specification for transport portfolios which provide CSPs with a range of deployment options.

Advanced orchestration enabling a multivendor ecosystem

One of the major advantages of Open vRAN is the ability to choose multiple vendors for different elements of the

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RAN solution. Orchestration is a key solution component to fully automate and manage the network service. Netcracker solution is a market leader in Domain Orchestration, NFV Orchestration and Service Orchestration.
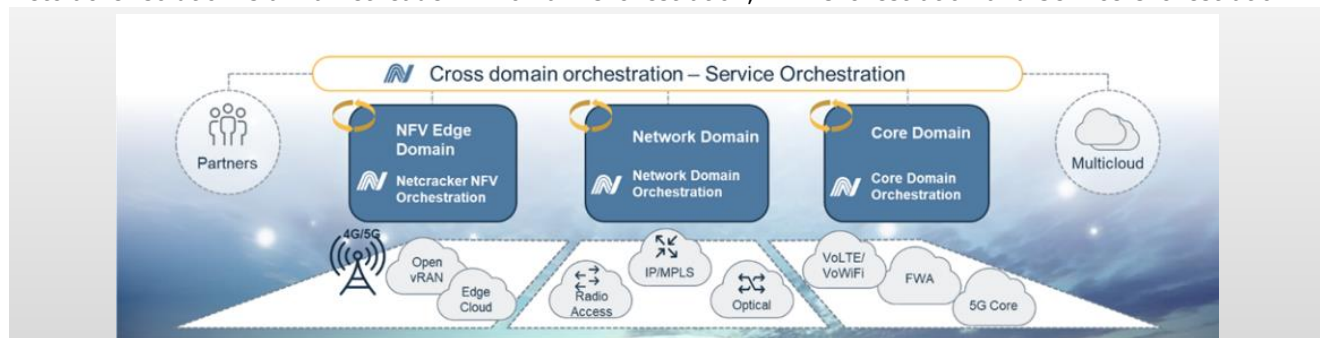
Netcracker's cross domain Service Orchestration also facilitates the transition from traditional RAN architectures to Open vRAN, providing CSPs with a unified service layer to bring together the various virtual and physical domains of the network.
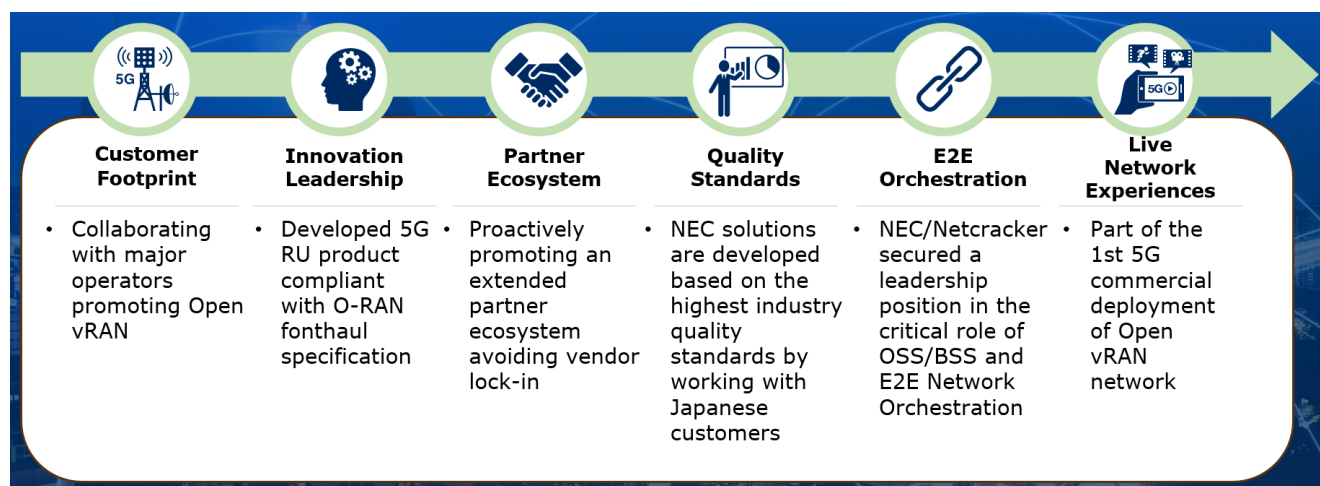
Strong system integration expertise accelerating Open vRAN adoption

To achieve the goal of an open, interoperable radio access network, the role of a **System Integrator** is fundamental to ensure its success. NEC is a leading system Integrator covering all aspects from requirements, design, inter-operability testing, and quality assurance through to post deployment management.

The analyst study highlighted a common consensus amongst CSPs - as Open vRAN matures and gains mass adoption, there is a clear role for a System Integrator to deploy services. In the long-term CSPs can continue to rely on the System Integrator or build their own in-house capabilities.

5. CONCLUSIONS

Without question, Open vRAN architecture provides a disruptive approach to the way mobile networks are built. The potential benefits are significant and wide-reaching from avoiding vendor lock-in to transformational cost reduction potential. CSPs are broadly demonstrating an appetite for Open vRAN and it is clear that in the next 4-5 years it will be launched in commercial networks, transforming the way CSPs will deploy and monetize 5G. Open vRAN is no longer purely a strategy for Greenfields, it is a clear and viable solution for brownfield operators which has the potential to address densification or coverage challenges in areas that were not financially justifiable with traditional network.

Customer Footprint	Innovation Leadership	Partner Ecosystem	Quality Standards	E2E Orchestration	Live Network Experiences
• Collaborating with major operators promoting Open vRAN	• Developed 5G RU product compliant with O-RAN fonthaul specification	• Proactively promoting an extended partner ecosystem avoiding vendor lock-in	• NEC solutions are developed based on the highest industry quality standards by working with Japanese customers	• NEC/Netcracker secured a leadership position in the critical role of OSS/BSS and E2E Network Orchestration	• Part of the 1st 5G commercial deployment of Open vRAN network

NEC is widely recognized for their industry leading Quality, Reliability, and Technical innovation and these traits have been passed to NEC's Open vRAN solutions accelerating their position as a market leader:

With an established footprint in both IT and Network sectors, NEC is uniquely positioned to be the leading **Systems Integration player in Open vRAN**. NEC's expertise and ongoing commitment to delivering radio access network solution across various technologies including 2G/3G and 4G has supported in establishing a market leading position in 5G open architecture.   Strong RF expertise & Telco system integration capabilities have positioned NEC as a critical partner to support CSPs in navigating and shaping their network strategies and exploring new ways of deploying innovative services and business models to transform the future telecoms industry,

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