

Opportunities and challenges of open vRAN in a global market



Red Hat

intel

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Contents

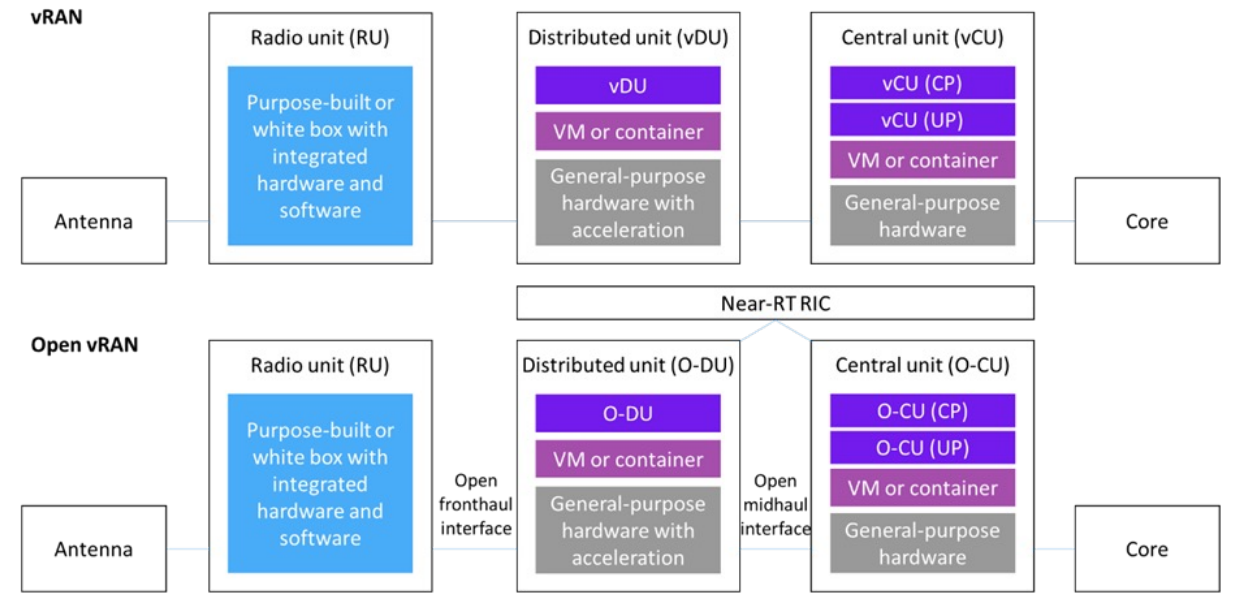
- Introduction to open vRAN and its key benefits
- Open vRAN: the global perspective
- The open vRAN opportunity by regions
 - North America
 - Latin America
 - Europe, Middle East and Africa
 - Japan (Asia & Oceania)
- Red Hat and Intel enable the transition to open vRAN

Introduction to open vRAN and its key benefits

Introduction to key concepts






- **Virtual RAN** disaggregates the base station hardware and software to run the baseband software function on generic commercial off-the-shelf (COTS) servers. A further evolution is to run RAN functions as microservices on containers instead of VMs and to adopt cloud principles such as development and operations (DevOps) and GitOps.
- **Open RAN** describes the opening of interfaces within the radio access network domain and, in particular, the interface between the two main elements that constitute the base station: the radio unit (RU) and the baseband unit (BBU), known as the fronthaul interface.
- **RAN functional disaggregation** describes the separation of the baseband unit into a central unit (CU) and a distributed unit (DU), offering new architecture options and more possibilities in terms of distribution or centralization of resources.

vRAN and open vRAN simplified architectures



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Key benefits of open vRAN

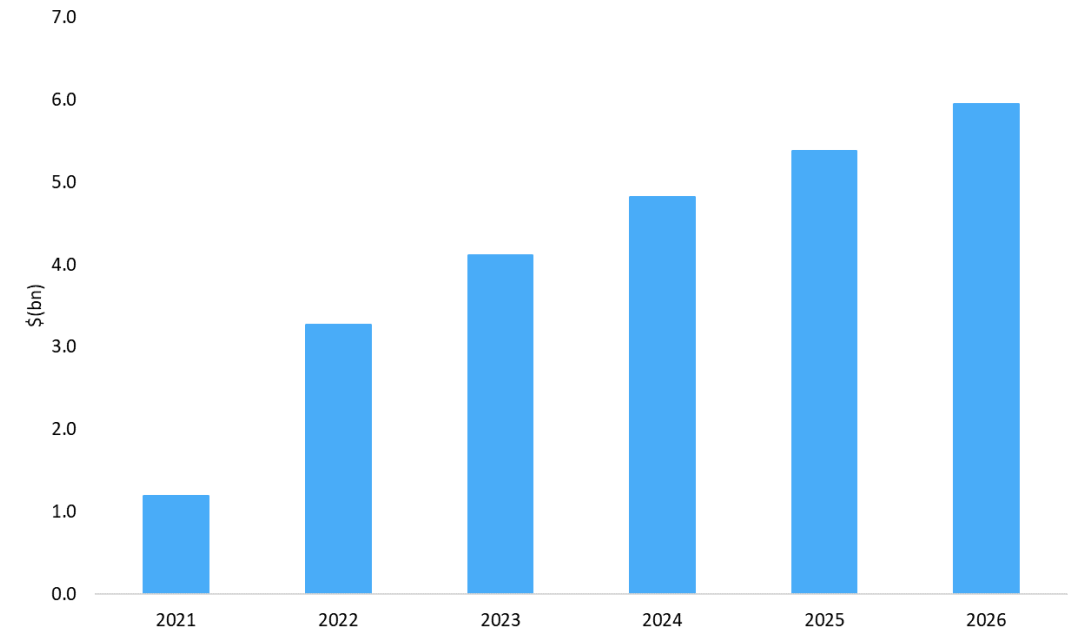
| Expected benefit | How is it realized? |
|--|---|
| Flexibility, scalability, and optimization of resources  | <ul style="list-style-type: none"> • Scale-in and scale-out easily via the addition of VMs or container-based resources, enabling the capacity of the network to be precisely adapted to actual demand in real time. • A horizontal cloud platform across access, edge, and core will play a critical role, ensuring consistency and reducing integration efforts. |
| Easier and faster innovation  | <ul style="list-style-type: none"> • Installation, configuration, updates, and upgrades are software based so can be introduced to the market faster and in a continuous manner. • It is possible to benefit from innovation from the broader IT/cloud community in terms of both hardware (including silicon) and software (including open source). |
| Greater vendor diversity  | <ul style="list-style-type: none"> • A larger choice of suppliers is available with new entrants. • Disaggregation enables the supply of different components from different vendors and the selection of best-of-breed components from specialists in each area (COTS hardware, acceleration, virtualization, vRAN software), instead of having to buy an end-to-end integrated system from a single supplier. |
| Lower total cost of ownership  | <ul style="list-style-type: none"> • The use of COTS servers and of common infrastructure across domains (RAN, core, OSS/BSS) reduces capex. • The pooling and sharing of hardware resources enables increased resource utilization and the simplification of cell sites, which in turn means a small footprint and rent and fewer site visits. • Automation is necessary to deploy and maintain vRAN. A zero-touch approach to automation is the desired state to realize the reliability and resilience and for self healing and scaling of a highly distributed system. |
| Simplify operations and improve operational agility  | <ul style="list-style-type: none"> • Automated service provisioning reduces human intervention and associated costs. • Service providers are able to manage and maximize the lifecycle of their RAN. • Simplified workflows reduce complexity and ensure reliability. |

Open vRAN: the global perspective

Global market

- Though open vRAN is still in its early development, there is a strong open vRAN momentum, seen in the membership of and participation in organizations such as the O-RAN Alliance and the Telecom Infrastructure Project (TIP), the number of trials and deployments, and service providers' announcements of their commitment to adopting open RAN.
- Omdia forecasts that open vRAN will represent a market of \$5.9bn in 2026 or 15.9% of the total RAN market.
- Open vRAN will be the fastest growing segment within the RAN market, driven by greenfield deployments in leading markets such as the US, Japan and Germany as well as brownfield deployments by tier-1 and tier-2 service providers around the world.
- Early deployments are an opportunity for Red Hat and Intel to validate and demonstrate the solutions and capabilities they offer to support a service provider's RAN transformation.

Open vRAN revenue forecast, 2021-2026



Source: Omdia

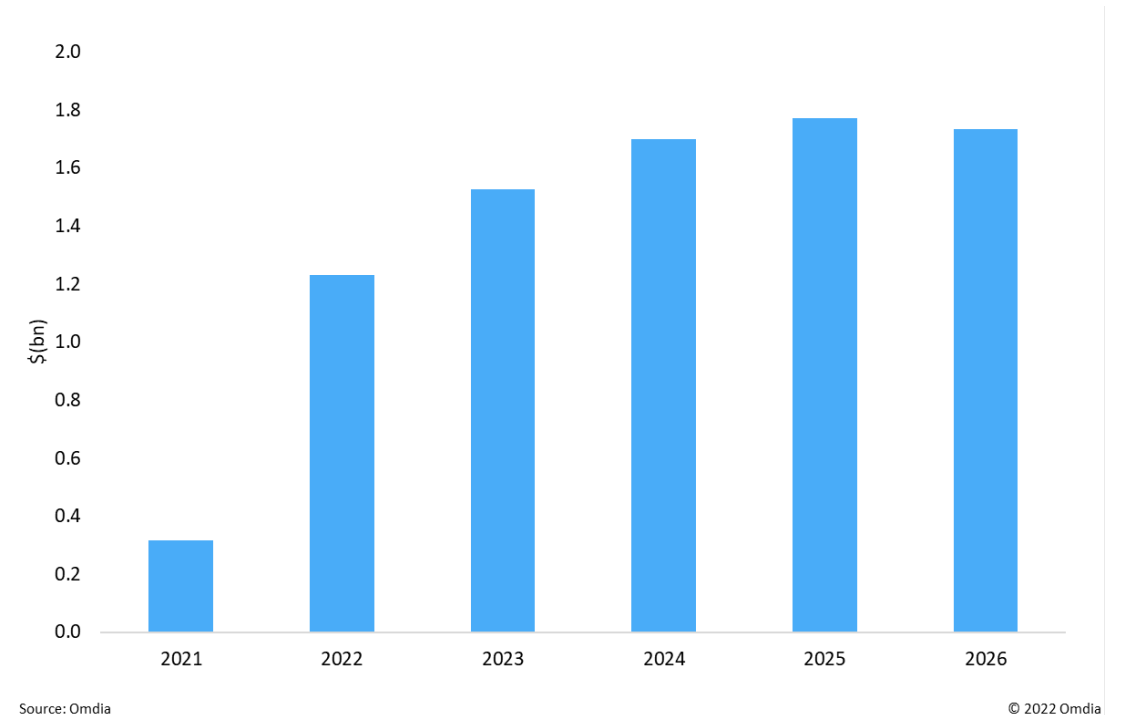
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The open vRAN opportunity by regions

North America

- In North America, policy makers are keen to support the development of a local ecosystem of suppliers, and to bring connectivity to rural communities.
- Over the last few years, to reduce dependencies on China and reduce vulnerabilities in telecom infrastructure, the US Government has banned Chinese vendors and voted funds to sponsor the purchase and deployment of open RAN equipment.
- Another key reason for service providers in this region to adopt open vRAN is to bring connectivity to underserved areas. Both the US and Canada are extremely vast territories, and they have a relatively high percentage of population living in areas with no or only limited access to broadband.
- In North America, investments in open vRAN will grow from \$0.3bn in 2021 to \$1.7bn in 2026 driven initially by spending from greenfield service provider DISH Wireless, and then adoption by tier-1 incumbents, as well as tier-2 service providers.

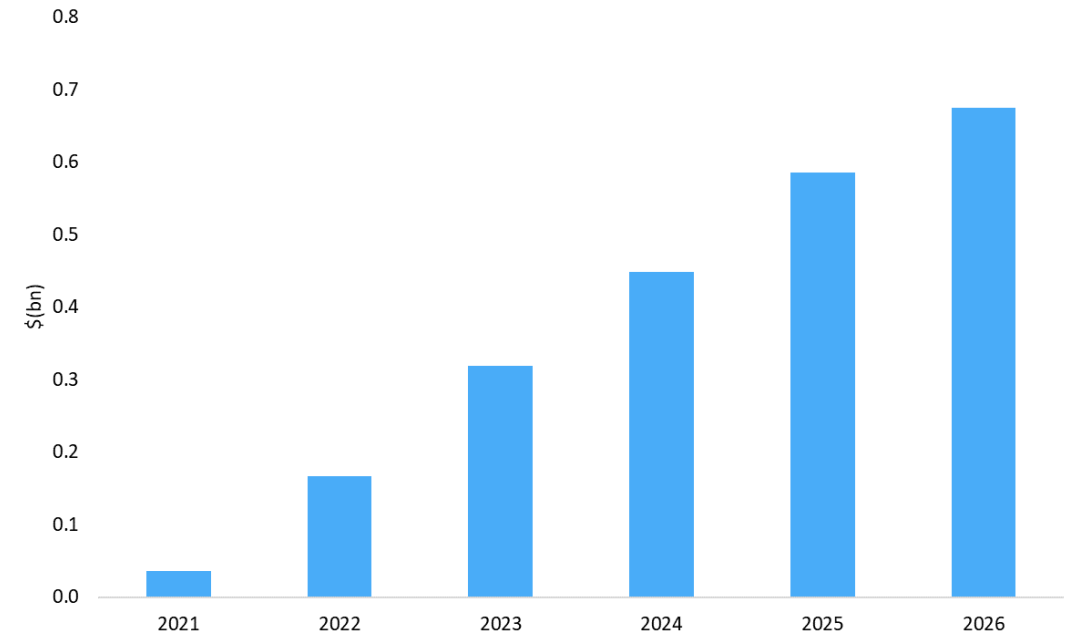
Open vRAN revenue forecast, North America, 2021-2026



Latin America

- In Latin America, service providers look for innovative solutions to boost mobile penetration, handle traffic growth and deliver services more efficiently.
- Bringing MBB services to the millions of unconnected people in rural and remote villages in the region is both challenging and costly. The terrain is often difficult and access to high-quality fiber for fronthaul and backhaul connectivity is limited. Furthermore, given the lower ARPU in rural areas, the return on investment is over a much longer period.
- Service providers can achieve their objectives by evolving their RAN to be more disaggregated, open, and programmable and by using cloud-native platforms which will enable new revenue-generating services and shorten time to market.
- Omdia forecasts that open vRAN investment in the region will grow from \$40m in 2021 to \$700m in 2026 driven primarily by the investment from tier-1 service providers like Telefónica.

Open vRAN revenue forecast, Latin America, 2021-2026



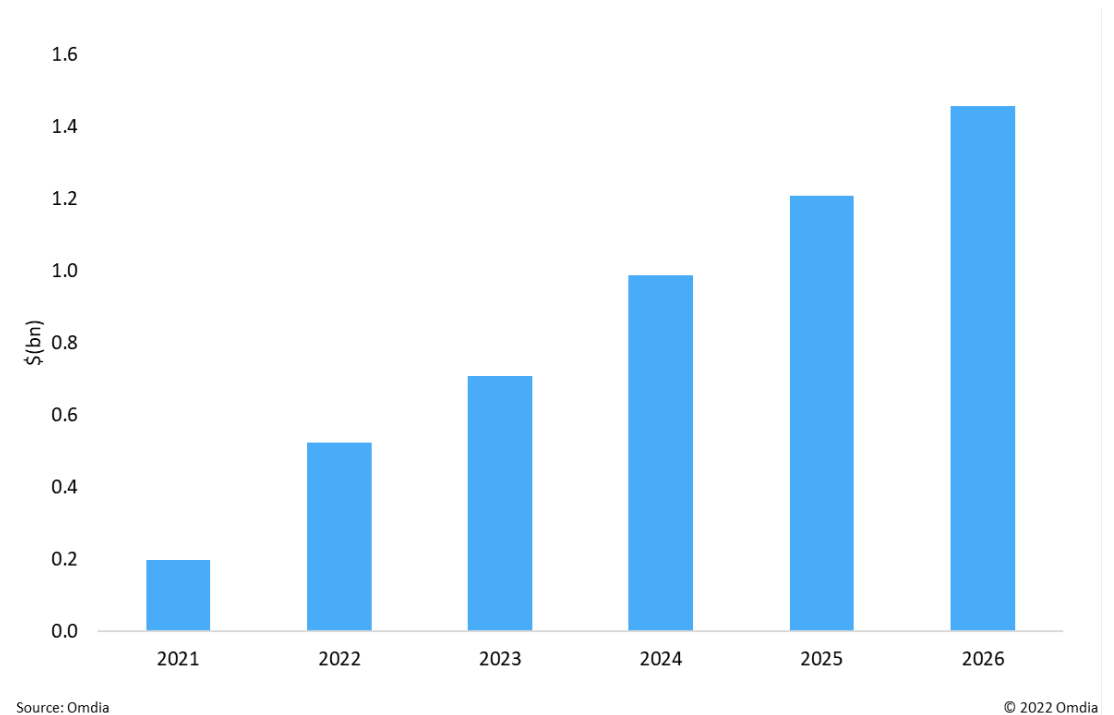
Source: Omdia

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Europe, Middle East and Africa

- Service providers are willing to diversify their supply chain, and countries have committed public funds to support open vRAN :
 - The UK Government plans to attract new suppliers into the market and accelerate the development and deployment of open-interface solutions. Ambition is to carry 35% of the UK’s mobile traffic over open and interoperable RAN by 2030.
 - The German Government is providing funding to support the establishment of a lab to develop and test open RAN technologies, support the rollout of open RAN trials in two testbed cities, and support projects to stimulate the ecosystem.
- In Europe, DT, Orange, Telefónica, TIM and Vodafone are working together to define and develop open RAN solutions. An MoU group similar to the European one was formed by Middle East service providers : du, Etisalat, Mobily, Saudi Telecom and Zain.
- Omdia forecasts open vRAN revenue in EMEA will reach \$1.5bn in 2026, from \$0.2bn in 2021.

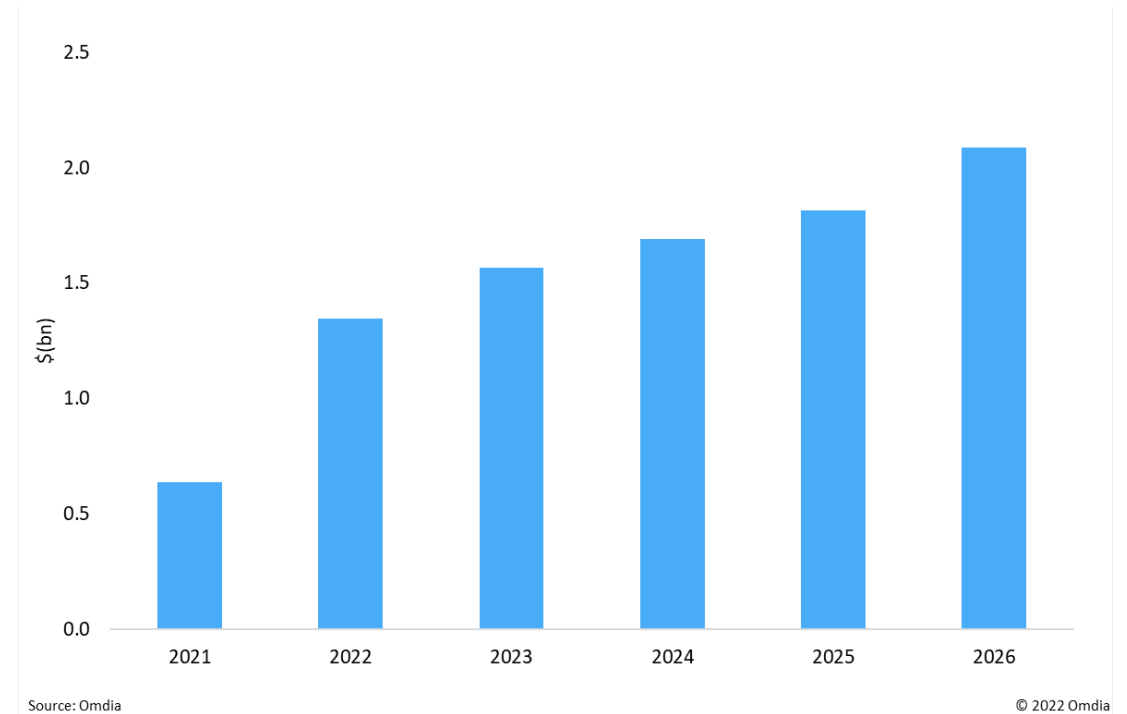
Open vRAN revenue forecast, EMEA, 2021-2026



Japan (Asia & Oceania)

- In Japan, the favorable market environment and appetite for innovation explains early adoption of open vRAN. Japan is:
 - A mature and advanced telecom market and an early adopter of the latest technologies such as 5G and virtualization.
 - A quality-focused market where service providers invest in the best available solutions and the most advanced functionalities rather than being low-cost oriented.
 - A country where fiber infrastructure is widely available enabling centralized architectures and vRAN baseband resources pooling.
 - The country of Rakuten Mobile, the pioneer in open vRAN.
- Asia & Oceania is the largest RAN market in the world and Omdia expects this region to also be the largest market for open vRAN. Omdia forecasts service providers in the region will spend \$2.1bn on open vRAN in 2026, from \$0.6bn in 2021, with Japan the first country in the region to adopt open vRAN at scale, and others to follow.

Open vRAN revenue forecast, Asia & Oceania, 2021-2026



Red Hat and Intel enable the transition to open vRAN

Red Hat and Intel: open vRAN enablers

1

Red Hat is a leading participant in the open ecosystem

Red Hat joined the O-RAN Alliance in 2018 with a primary focus on cloudification and orchestration.

Red Hat is one of the world's leading providers of carrier-grade open-source solutions.

The company is also one of the top contributors to OpenStack and Kubernetes.

2

Red Hat brings a complete portfolio of solutions

Red Hat's portfolio for vRAN includes Red Hat® Enterprise Linux®, Red Hat OpenStack® Platform, and Red Hat OpenShift® Container Platform® that makes network functions run in a cloud environment.

Together these solutions enable service providers to design, deploy, and orchestrate DU and CU VNFs or CNFs.

3

Red Hat and Intel: a close partnership

Red Hat collaborates closely with Intel to provide a pre-integrated open platform for vRAN and cloud-native RAN combining Red Hat's virtualization layer with Intel's silicon and software.

Intel supplies critical components including its Xeon processors for general compute, hardware accelerators, and the FlexRAN reference architecture used in most open vRAN deployments globally.

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Get in touch

Americas

E: customersuccess@omdia.com

08:00 – 18:00 GMT -5

Europe, Middle East & Africa

E: customersuccess@omdia.com

8:00 – 18:00 GMT

Asia Pacific

E: customersuccess@omdia.com

08:00 – 18:00 GMT + 8