Evolution of the BNG in Asia and Oceania

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Summary

While 5G monetisation is foremost in the thoughts of many telecom industry players, the COVID-19 pandemic has underscored the global need for constant, reliable broadband connectivity. For operators to increase the speed and scalability of their broadband roll-out, the telecom industry must undertake an architectural shift that embraces distributed compute resources and cloud-native functions. Once this shift is under way, operators must complement it with operational and cultural change. This is a technological shift that requires educating and empowering the workforce with new skill sets and mindsets so they can best leverage cloud-native environments. Only then will operators be able to accelerate the development and delivery of new value-creating services.

In the broadband access network, one outcome of the shift to cloud-native and distributed architectures is the development of cloud-native broadband network gateway (cnBNG) solutions. cnBNG solutions offer greater scalability, programmability and flexibility than traditional appliance-based broadband network gateways (BNGs) that are tightly coupled hardware and software. Today, operators are discovering benefits by deploying traditional BNGs in a distributed fashion. While a distributed deployment enables more efficient routing of network traffic, it is challenged with appliance scalability and management complexity. To solve scalability challenges, operators can phase in cnBNG solutions that scale quickly through control/user plane separation (CUPS) and can be optimised more frequently as operators support these deployments with continuous integration/continuous development (CI/CD) work practices. Embracing these work practices should also facilitate easier adoption of future innovations, such as the deployment of fixed-mobile convergence (FMC) solutions. For these reasons, incorporating support for distributed, cloud-native architectures into their BNG strategies now is an important step for operators to optimise their broadband investments, with up to 30% TCO savings, and deliver new, monetisable services.
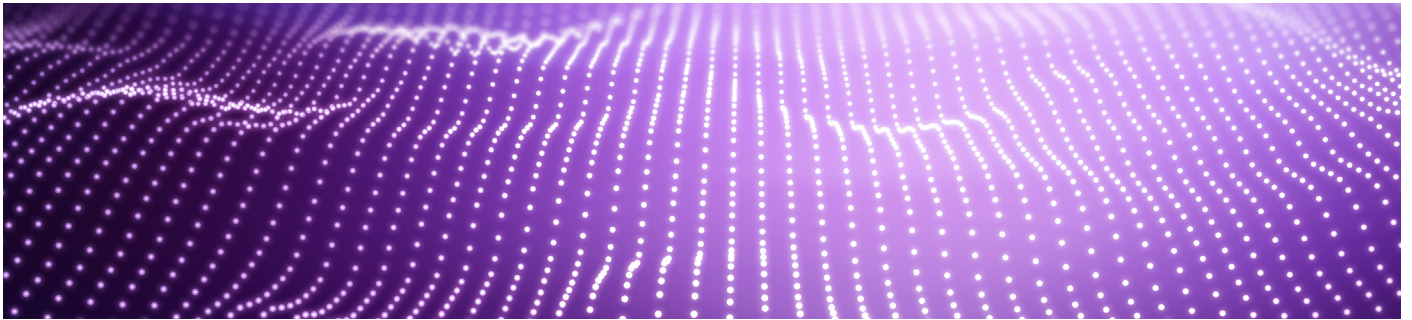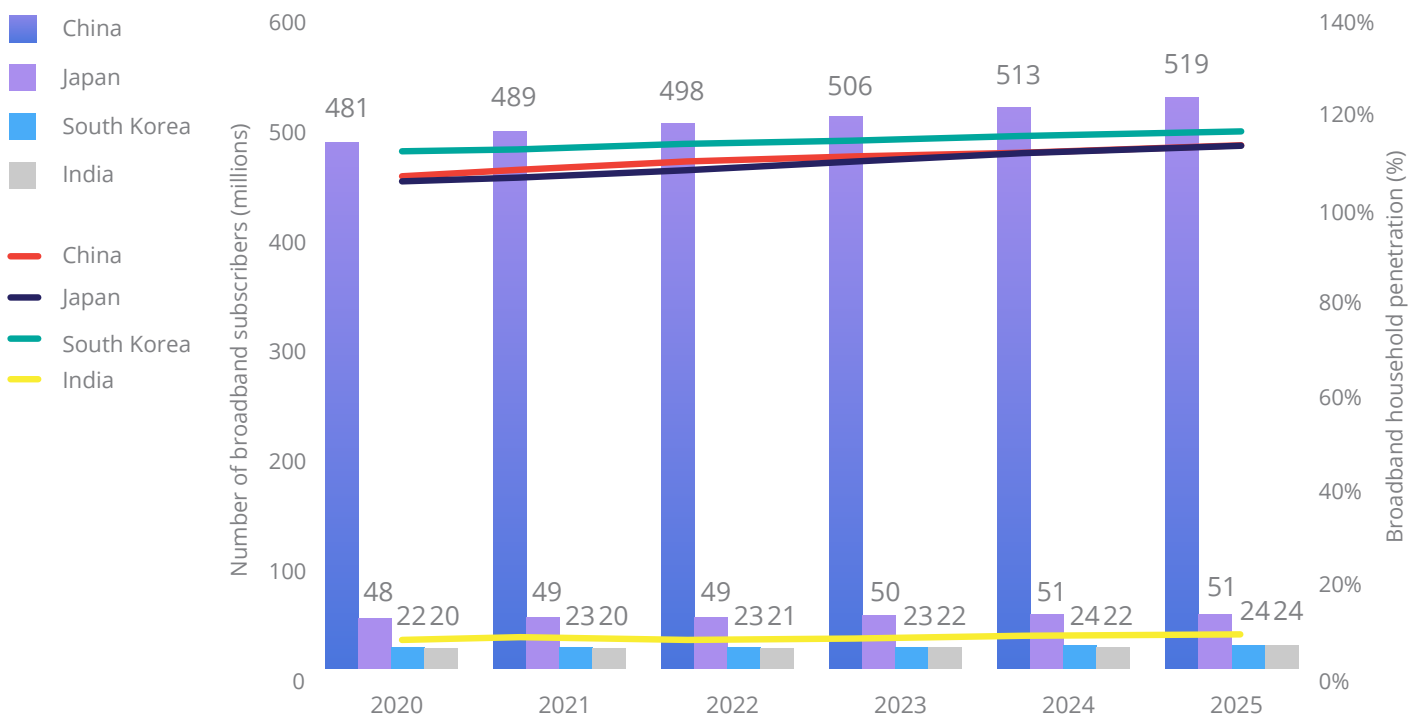
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Evolving parameters for the broadband access network

Broadband overview in Asia & Oceania

In Asia & Oceania there is no one picture that can capture the variety of broadband coverage in the region. While Omdia expects mobile subscriptions in the region to reach 5.7 billion in 2021, broadband subscriptions are set to reach just under 670 million. As **Figure 1** shows, of those broadband subscriptions, 86 percent are located in four countries: China, Japan, South Korea, and India.

Figure 1: Top four countries in Asia & Oceania by number of broadband subscriptions, 2020–25

Source: Omdia World Fixed Subscriptions Forecast

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These broadband subscriptions are an important segment for service providers, as in Asia & Oceania network operators generated $268.5billion in revenues in 2020. Highly developed markets such as Japan, South Korea, and Australia have all had broadband household penetration rates of more than 90 percent since 2016. These markets can more rapidly expand broadband subscriptions and increase revenue from bundling additional services with broadband connectivity.

Less developed markets in the region include India and Indonesia, which in 2020 had penetration rates below 20 percent. For these markets there is long-term revenue-growth potential for operators investing in broadband network deployments that can go on to support additional revenue-generating services. With only 20 million subscriptions across a population of nearly 1.4 billion people, India is a prime example of how even a small increase in broadband penetration could generate a large number of new subscriptions.

Commoditisation and services driving renewed broadband focus

The year 2020 had a marked effect on the lived experience of billions of people around the world. We had to change the way we went about our lives and both our professional and social interactions changed from in-person to virtual. Globally, we relied on service providers to continue to be connected and support interaction with work, family, and friends in a new version of everyday life. The increased dependence on connectivity has added to the growing perception of network and data services as public utilities. Networks had to support an upsurge in videoconferencing and over-the-top (OTT) traffic brought on by national and local lockdowns. In Asia and Oceania, OTT video subscriptions rose by 22 percent to more than 550 million. This upsurge in distributed traffic put pressure on the resilience and stability of network connections. It also increased the importance of fiber networks, which are better able to cope with the increased number of concurrent users and applications requiring connectivity.

The place of the traditional BNG in the network
The BNG is the gateway that aggregates data traffic from commercial and residential broadband subscribers before routing it to the rest of the network. The BNG function has traditionally tied to specialised hardware provided by major routing equipment vendors. Traditional BNGs combine all the software and hardware required to manage the BNG in one closed appliance. The traditional BNG deployment model requires that operators invest in BNG nodes months or years in advance in line with expected demand for their services.

Forecasting demand is not a perfect science and there is always the risk of either over-provisioning and thus underutilising appliance-based BNGs, or under-provisioning and thus over-subscribing services. In either case, the result is non-optimal use of capital expenditure (CapEx). The lifecycle management of appliance-based BNGs are also more demanding. Traditional BNGs require manual and individual attention to install, configure, and/or reconfigure, because each node maintains its own control plane. This is a very time-consuming process and prone to human error, especially for larger broadband networks with hundreds or thousands of nodes, hence increasing the operating expenditure (OpEx).

The technology landscape is changing and the BNG must also evolve

For more than a decade, network operators have been looking to increase the flexibility and agility of their networks by moving to network functions virtualisation (NFV) and software-defined networking (SDN). NFV allows operators to move away from network hardware lifecycles and match more commoditised hardware with programmable software functions. These promised to be more agile and speed up operators' innovation and deployment cycles. While initial deployments of NFV did not fully deliver the flexibility and agility operators hoped for, they did begin the process of disaggregating software functions from dedicated hardware.

Disaggregation by itself is not enough. Embracing network wide SDN and shifting to a decentralised network architecture is also required. A core capability delivered by SDN is CUPS. The next step involves monolithic VNFs (software equivalents of the appliances they replaced) evolving into cloud-native network functions (CNFs). CNFs deliver the effective, agile, and scalable solution that operators have been looking for, and push operators to adopt a more automated, innovative, and iterative organisational structure.

Industry moves to BNG disaggregation, cloud-native software, and distributed solutions
In Omdia's 2020 NFV and Edge survey, 96 percent of operators indicated they had begun implementing NFV and cloud-native architectures within parts of their network. Half of operator respondents to Omdia's 2020 Carrier SDN Adoption survey had begun adopting SDN. Operator adoption of SDN has predominantly focused more on the network core, which has higher traffic loads than in the access networks.

As operator familiarity grows with NFV and SDN solutions, they are extending these solutions to additional network domains to enhance end-to-end automation, scalability, and elasticity. Operators are also realising that they can move beyond replicating a hardware appliance with a monolithic software application. This increased understanding is leading to the introduction of CNFs and corresponding architectural evolution.

Cloud-native architectures are underscored by three tenets:
1.   Microservices and composability
2.   Containerisation and portability
3.   Observability

Cloud-native solutions are composed of containerised microservices. Microservices come together to build a function that then gets containerised to operate by itself or in concert with others. CNFs are designed to be easily deployed and dynamically scale to address service needs. As demand shifts, the CNFs adjust as well, scaling out by adding more instances for increases in demand and scaling-in for when demand decreases. CNFs' inherent observability is important for operators to better monitor and manage network resources.

Meanwhile, operators are looking to optimise their operations by distributing workloads and building intelligence throughout their networks. Pushing compute resources further out into the edge network will support more latency-sensitive applications. More distributed edge compute functions can also optimise the costs for transporting data by routing it more efficiently.

Figure 2: Example of distributed BNG deployment and a cloud-native cnBNG stack
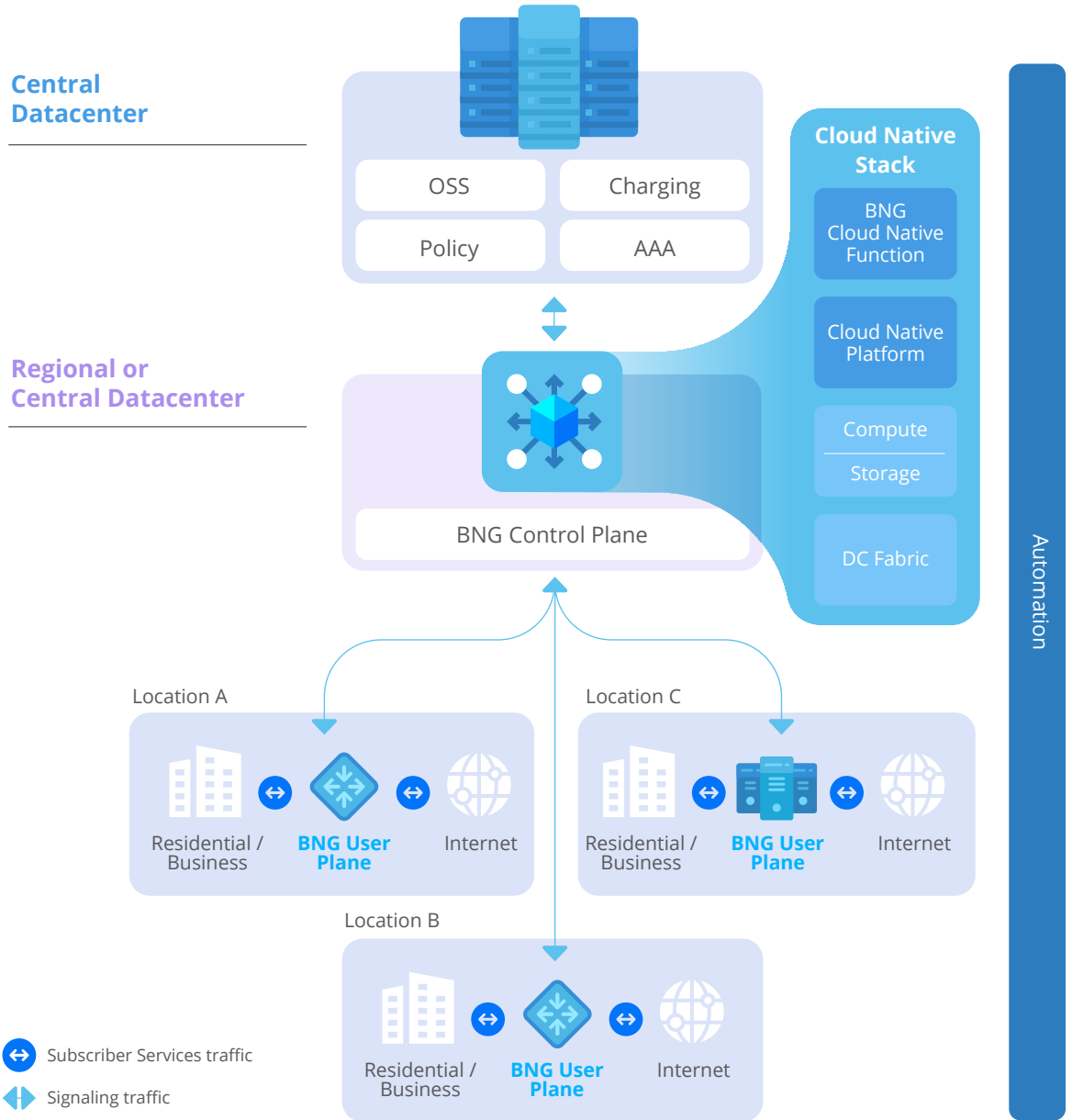
Source: Cisco

Service providers investing in their broadband access network today should look at factors beyond supplying fixed connectivity. There is a long-term trend for network operators to converge wireless and wireline services, also known as fixed-mobile convergence (FMC). This will deepen the relationship between radio and broadband access networks, allowing services and applications to roam between them. Work is already advancing in 3GPP, the Broadband Forum (BBF), the Open Networking Foundation (ONF), and other organisations to define specifications for an access gateway function (AGF) that delivers this convergence. In time, BNGs will also need to support the AGF.

How cloud-native architectures change cost models

Operators are under increasing cost pressure

Even before COVID-19, operators were under pressure to expand and distribute the capacity of their broadband networks to support increases in network traffic. The increases in data traffic also drives up service providers' data transport costs, providing little in return. According to Omdia's communication provider revenue and CapEx tracker, between 2017-2019 Asia and Oceania fixed-network operators grew their revenue by 4 percent (CAGR), reaching $260 billion (USD) in 2019. Comparatively, fixed broadband subscriptions increased by 25 percent over the same period of time (Omdia World Fixed Subscriptions Forecast).

Meanwhile, the cost of additional broadband roll-out remained high, with fixed network operator capital intensity (CapEx as a proportion of revenues) of 17–18 percent between 2017 and 2019. Even operators with limited need to invest in the civil engineering costs of laying fiber in the ground have high CapEx costs. Omdia calculates Telstra, a major operator in Australia, has a fixed network capital intensity in 2019 at 14.8 percent only 3.6 percent below the region's average, even with Australia's National Broadband Network (NBN) laying the broadband lines.

What efficiencies do operators want in the broadband access network?
Because of the cost pressure network operators are under, they are looking to every part of the network for efficiencies to help drive their transformation. Omdia's 2020 Carrier SDN Adoption survey indicates that for BNGs and broadband access networks in general, operators are particularly focused on OpEx improvements (45 percent of respondents) and CapEx reduction (39 percent of respondents).

Figure 3: Operator expectations for changes in CapEx, OpEx, and revenue generation in the fixed access network

Revenue Generation
16%

CaPex reduction
39%

OpEx Improvements
45%
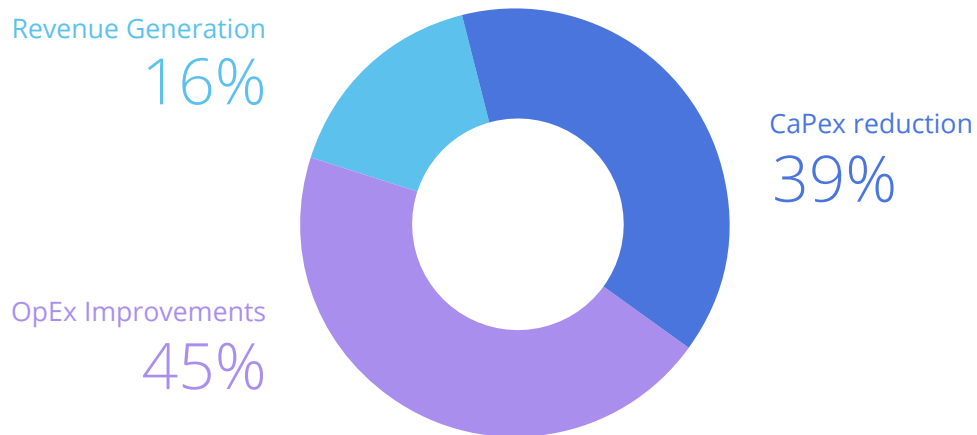
Source: Omdia Carrier SDN Adoption survey 2020

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The cloud-native BNG cost model

With the disaggregation of software from hardware, cnBNG solutions offer more flexible cost models. Deployments can be scaled in a 'pay-as-you grow' model, whereby operators pay for additional software licences as their subscribers grow, rather than investing in software licences in advance. This pay as you grow model does still require network operators to have the right hardware-infrastructure resources to support the expanding software footprint in advance. Several BNG vendors already support this form of software purchasing model.

The flexibility in software deployment can also be mirrored in hardware choice. In certain brownfield BNG situations, network operators may be able to repurpose already-deployed BNG hardware to support cnBNG nodes. Alternatively, operators may consider using cnBNG software with common off the shelf (COTS) hardware. The amount of savings these options could deliver ranges between 15 and 70 percent, according to estimates shown to Omdia by BNG vendors including Benu networks, Cisco and RtBrick. These estimates are conditioned on the scale of the cnBNG deployment, the hardware mix deployed, and the ability to repurpose existing hardware assets in the network. Furthermore, the larger the cnBNG deployment scale, the greater the potential savings.

Software-driven scalability, automation, and innovation in the cnBNG
As BNG solutions embrace CUPS and become more cloud native, operators will increasingly be able to realise operational efficiencies. A benefit of CUPS architecture is that operators can use a handful of control-plane cnBNG nodes to configure their user-plane nodes. This could mean a few control plane nodes configuring potentially hundreds or thousands of user plane nodes in a large network.

Cloud-native control planes can dynamically scale to support the required number of user planes. This is enabled by a microservices-based, containerised, software architecture and orchestrated by Kubernetes, making the cnBNG capable of dynamically scaling the usage of compute server resources. The flexibility inherent in cloud-native architectures can accelerate innovation in the network through the adoption of continuous integration/continuous development (CI/CD) processes. CI/CD enables operators to introduce more frequent software updates without disrupting services. Instead of making one or two software updates a year, operators can roll out updates much more frequently. This can be especially important when bringing new services to market or addressing security issues. The time between innovation and service delivery is accelerated as operators can cascade software updates from the control plane.

Additionally, cnBNGs enable operators to embrace greater levels of automation. Cloud-native functions offer observability with a level of granularity as defined by operators themselves. Since operators can define the information and events they want to monitor, they are empowered to better target the data they gather to then use to optimise their networks and processes. In this manner, data collection actively facilitates the adoption of AI/ML for continuous improvement and auto-remediation policies. Implementing true AI/ML is an iterative process, which will take time to fully enact. However, in the mid-long term AI/ML will be key for operators to optimise their networks in real-time, and deliver long-term service differentiation.

Enabling AI/ML adoption across the network is a key priority for Asia and Oceania service providers. According to Omdia's telecoms AI contract tracker India, China, Japan, and Indonesia make up four of the top five countries where service providers have been investing in telco AI deals between October 2019 and December 2020. Most of these deals involved implementing AI/ML to support operator network and customer data analysis. As operators start to have more confidence in insights taken from these AI/ML analytics platforms, they will be able to turn these insights into automated actions that have a direct impact on the network. cnBNG aids these efforts by exposing more data from the broadband access network for analysis.

Operators must update their organisation and skillsets to realise the greatest cnBNG savings
Operators adopting cloud-native solutions require software competencies more akin to those of cloud providers such as AWS and Microsoft Azure. Operators show signs they are struggling to acquire these competencies. CI/CD implementation is a barometer for operator readiness to deploy and consume cloudnative software solutions. In Omdia's 2020 NFV and Edge adoption survey, Omdia polled operators about their implementation of CI/CD and only 22 percent of respondents indicated they were implementing CI/CD. This is just one percent more than respondents in 2019. The lack of progress indicates how difficult operators are finding the organisational transition to support more software-based networking.

Organisation transformation may be difficult, but the benefits are certainly real. One provider, Telenor, with operations across Scandinavia, South-Eastern Asia, and Pakistan, has been especially aggressive in updating their workforce skill sets. Telenor has been part of the vanguard for implementing automation across its networks and operations since 2015. In 2020, Telenor reduced its global CapEx to 13 percent, down from 16 percent in 2019. Telenor's 16 percent CapEx was already noteworthy as it is below the average operator capital intensity of 17-18 percent, having been achieved through years of adopting and implementing automation and virtualisation technologies.

As part of Telenor's comprehensive transformation plan it reskilled approximately 6.4% of its workforce in 2019, which helped it maximise the benefits of its technology changes. These benefits translated into an OpEx decrease of 7 percent on a constant currency basis in 2020. Reskilling remains key to Telenor's continued transformation efforts as in 2020 it provided another 7 percent of its global workforce with training in cloud and virtualisation, automation, and additional areas. Other operators are also seeing significant benefits from adopting cloud-native solutions. M1, a network operator in Singapore, managed to automate their provisioning by 85 percent after adopting cloud-native software practices in its back-end systems.

Informed by the total cost of ownership (TCO) models shown to Omdia by Cisco and other vendors, Omdia expects that initial cnBNG deployments will realise TCO savings of around 10–30 percent over a 5 year period. This range is at the lower end of the vendor estimates going up to 70 percent, as Omdia seeks to account for training and one-off project costs that are necessary to realise longer-term savings as operators integrate cnBNG deployments with legacy assets. Larger deployments of cnBNG are more likely to hit the upper portions of this estimate as the benefits amplify in scaled deployments where the ratio of control planes to user planes is greater. For operators choosing to implement cnBNG cloud native software on COTS hardware, there is the potential for additional savings. However, operators need to balance this with the challenge of integrating several vendors.

The distributed BNG cost/benefit

Distributed architectures allow network decisions to be taken closer to the end user. This allows operators to route traffic more efficiently for the specific needs of each use case, so that each service receives the most optimal and efficient treatment. This efficiency can in turn lead to reductions in traffic transport costs. Cloud-native architectures complement distributed deployments, by enhancing the scalability and flexibility of the solutions. By separating the control plane from the user plane, nodes distributed deeper throughout the network will host the user plane while the control plane can remain centralised. This simplifies the management of distributed deployments, as operators needs to only configure a handful of control plane nodes to manage the distributed deployments, while an appliance based distributed deployment would mean service providers would need to configure every single node.

Based on a model supplied by Cisco for a distributed cnBNG deployment, Omdia expects that operators could realise TCO savings of up to 30 percent from increased transport routing efficiency, and through simplifying network management. There are clear TCO savings to be made through using distributed architectures to more efficiently route traffic, as illustrated in Cisco's model. The potential savings will increase with the scale of distributed deployments and rise in subscribers and data rates.

Some operators may hesitate to embrace distributed deployments for a multitude of reasons. Evaluating and timing new investments, integrating and managing new cnBNG nodes alongside existing legacy assets, organisation knowledge and skills gaps or managing increased overheads as they transition—are each important considerations for operators. Any initial hesitations should be weighed against short, mid, and long-term TCO benefits along with future opportunities and innovation by enabling a greater distribution of AI/ML use cases across the network. When matched with cloud-native architectures, distributed deployments also benefit from faster innovation cycles, as their simplified management makes it easier for operators to rollout changes and optimisations. This will include future network upgrades to support (FMC).

How will operators build long-term broadband revenue?

Operators need to develop and deploy services faster to gain customers

Asia and Oceania operators need to add additional value to broadband connections if they are to grow long-term revenue streams. This is just as applicable to greenfield operators such as Reliance Jio in India as it is to established operators such as Telstra that find themselves in more heavily penetrated countries like Australia. **Figure 4** highlights several services that global operators are intending to virtualise. Gaming services, for instance, require lower latencies to support enhanced quality of service—meaning they have a lot to gain from distributed architectures and their support for optimal traffic routing. Beyond over-the-top (OTT) video, this is the largest consumer stream that network operators are currently pursuing in Asia and Oceania.

Several operators are currently developing these services, including SK Telekom (South Korea), AIS (Thailand), and Singtel (Singapore), which announced a joint venture in 2020 to capture the region's 800 million gamer market.

Figure 4: Smart home features that operators plan to virtualise within the network
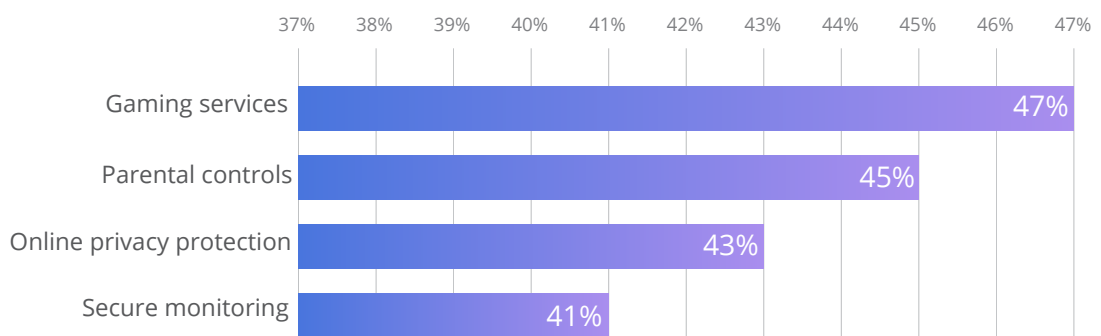
Note: n=101

Percentage of respondents

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Source: Omdia Smart Home survey 2021

For operators, improving time to market is a significant driver for their virtualisation strategies and the adoption of cloud-native solutions. 83 percent of operator respondents in Omdia's NFV and Edge Adoption 2020 survey agree that the strategy of using software to develop and commercialise new services faster as a significant factor in their virtualisation strategy (**Figure 5**). The programmable and flexible nature of software gives operators greater control over their network, increases the speed of innovation, and speeds up the monetisation of their network services.

Reliance Jio conveyed this vision to investors very effectively in 2020. Jio Platforms, the digital services arm of the business, attracted more than $20 billion (USD) of investment from strategic investors, Facebook, Google, and others across April–July 2020. Seeing great opportunity, JioFiber, the broadband infrastructure part of the business, also received $1 billion (USD) of investment in November 2020 from the Abu Dhabi Investment Authority for its network build-out. JioFiber aims to connect 50 million Indian households with fiber broadband services. To put that in context, in 2020 India recorded only 20 million broadband subscriptions. Investors are betting on Reliance Jio's ability to connect those 50 million households, and to add additional value to those connections through the services developed within Jio Platforms. A distributed architecture would support these services by facilitating network traffic to use the optimal path to applications hosted in the best access location to deliver the best subscriber experience. Meanwhile, cnBNG will allow operators to configure the distributed user plane more rapidly to support additional applications and minimise the time to market for new services.

Figure 5: How significant are the following drivers for your virtualisation strategy?
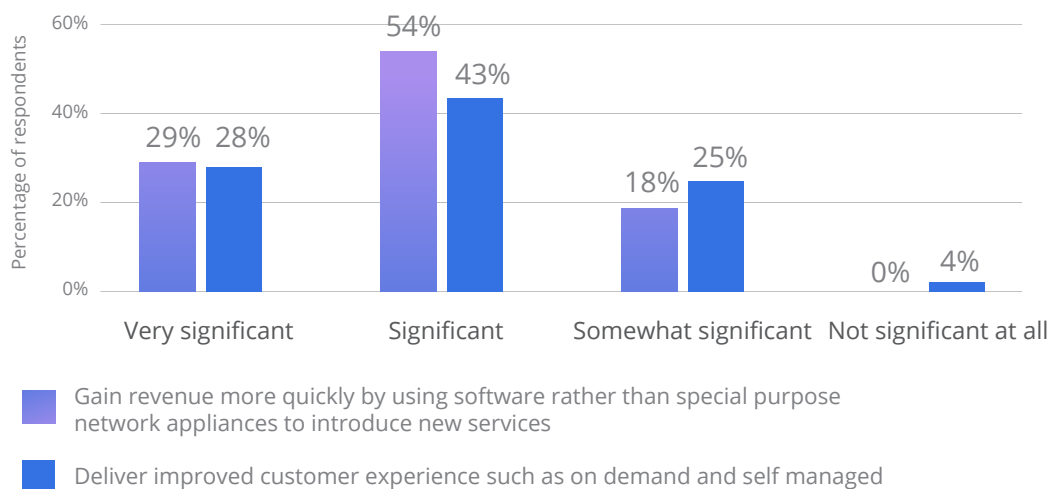
Note: n=102   © 2021 Omdia

Source: Omdia NFV & Edge survey 2020

Service providers need to improve customer experience to avoid churn

Operators are looking to virtualisation and the implementation of cloud-native networking to deliver improved customer experiences (see **Figure 5**). CNF's programmability and composability make them adaptable, so they can evolve with the demand for new services. Moreover, CNFs increased observability supports monitoring, automation, and optimisation capabilities, helping network operators address alerts, optimise deployments, and ultimately improve their customer experiences.

Conclusion

Build for the long term to achieve the full benefits of cnBNG and distributed deployments

There are several routes for operators to adopt cnBNG and the wider architectural shift to cloud-native and distributed architectures. In the wider context of their networks' continued evolution, operators should invest to enable long-term flexibility and innovation. The larger the network that migrates from traditional BNGs to cnBNGs, the greater the benefits of scale and reduction in time to integrate and innovate new services. The sooner operators implement cloud-native architectures with supporting distributed infrastructure, the sooner they begin optimising data transport costs and can begin supporting new services with greater network intelligence.

An operator's investment in new technologies must be supported by complementary investment in their people to drive the necessary organisational change for operators to become digital service providers. For smaller operators with legacy BNG footprints, they may find it more difficult to make this change and adopt new technology where it does not match their current skillset mix. We believe there is still great value in doing so, but their path will be different. Vendor partners and systems integrators will be critical for smaller operators, helping to navigate the network planning and build process, especially where talent to manage cloud-native solutions is lacking.
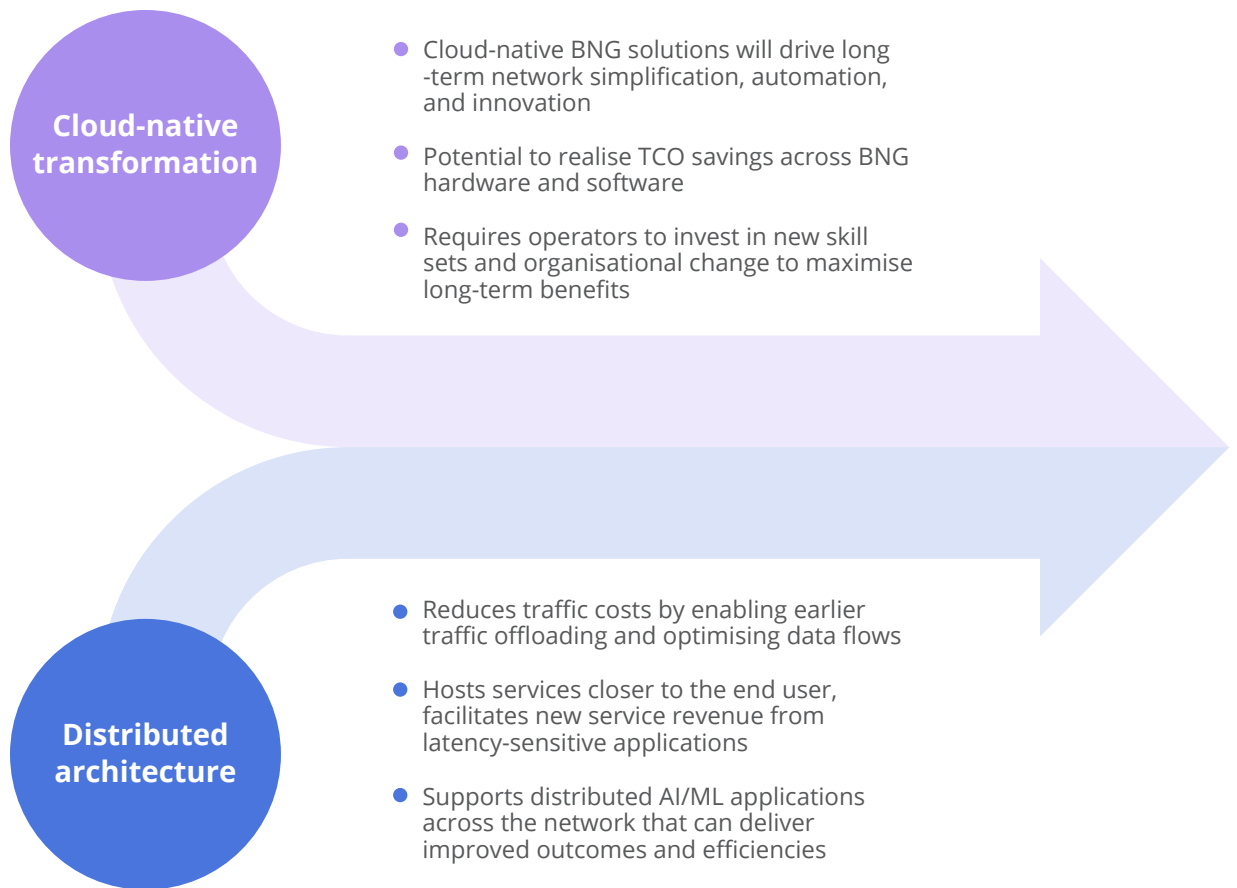
Operators' choices will be heavily influenced by their existing infrastructure. Operators with larger legacy BNG footprints, such as Singtel in Singapore, need to determine how they will balance their current BNG hardware infrastructure so they can support new cnBNG deployments. Like all existing operators, they have to balance the cost implications of expanding the distribution of their current hardware footprint, with the increased revenue potential of supporting distributed network use cases and edge compute services.

Operators need to invest proportionately in their organisational structure to support cloud-native solution adoption to derive the greatest benefit from their cnBNG deployments. The proportion of investment will be different based on the size of the operator as smaller operators will have a much higher human to machine investment ratio. Operators will need to continue supporting existing broadband customers while they migrate to cnBNG solutions. Splitting the transition into logical phases, like employing a regional migration model, is one approach currently being favoured by Deutsche Telekom. Deutsche Telekom's strategic roll-out of its Access 4.0 with a disaggregated BNG platform in Europe is being employed to limit the risks of transitional disruption for its customers.

Operators where broadband penetration is low, such as India and Indonesia, but with ambitious plans to expand should prioritise solutions that enable the lowest TCO and greatest scalability. They should partner with vendors that can support investment models linked to disaggregation and subscription growth, leading to more efficient CapEx. Thus, these operators with fewer legacy assets should prefer cloud-native solutions over less scalable appliance based BNGs.

Each operator's path forward will be different, but every operator needs to ensure that their decisions allow for long-term vendor flexibility so that future network and vendor transformations can be more easily realised. Adopting cloud-native architectures actively supports these priorities because they incorporate continuous development principles from the beginning, ensuring that operators are properly geared for constantly innovating and optimising their deployments. With this in mind, all operators should align with their vendors and partners on an open roadmap that best supports this long-term service innovation, and allows for integration with future partners.

Figure 6: Considerations for long-term BNG evolution

Cloud-native transformation

- Cloud-native BNG solutions will drive long-term network simplification, automation, and innovation
- Potential to realise TCO savings across BNG hardware and software
- Requires operators to invest in new skill sets and organisational change to maximise long-term benefits

Distributed architecture

- Reduces traffic costs by enabling earlier traffic offloading and optimising data flows
- Hosts services closer to the end user, facilitates new service revenue from latency-sensitive applications
- Supports distributed AI/ML applications across the network that can deliver improved outcomes and efficiencies

Source: Omdia

The steps operators take in their adoption of cnBNG solutions and architectural shifts to more distributed deployments are critical for the long-term scalability and monetisation of their broadband access networks. In context of NFV and SDN evolution, the control/user plane separation implemented in cnBNG solutions helps provide a more scalable and dynamic architecture for operators to distribute network resources. Transitioning to cnBNG deployments now will also help operators manage the network evolution to FMC business models, which aims to provide their customers the same quality of experience no matter the access network technology used.

Adopting cloud-native and distributed architectures are also key value creators for their customers. These transformations will drive improved quality and consistency of experience for end users for the content they consume today, and in speeding up operator innovation will ensure end users have new value creating services to consume tomorrow.

Appendix

Methodology

Omdia used a combination of primary research and secondary sources to complete this report. Primary research included relevant Omdia research supported by qualitative interviews with global providers of BNG solutions and those vendors that provide network software and virtualisation portfolios and services.

Further Reading

Communications Provider Revenue and Capex Tracker (August 2021)

Total Fixed Broadband Subscription and Revenue Forecast (August 2021)

Telecoms AI Contracts Tracker (June 2021)

2021 Trends to Watch: Carrier Network Software (November 2020)

Carrier SDN Adoption and Vendor Leadership Survey (October 2020)

The Intersection of NFV and Edge: NFV adoption and vendor leadership (September 2020)

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