Perspective

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Software-defined access networks: creating value with open, cloud-native automation

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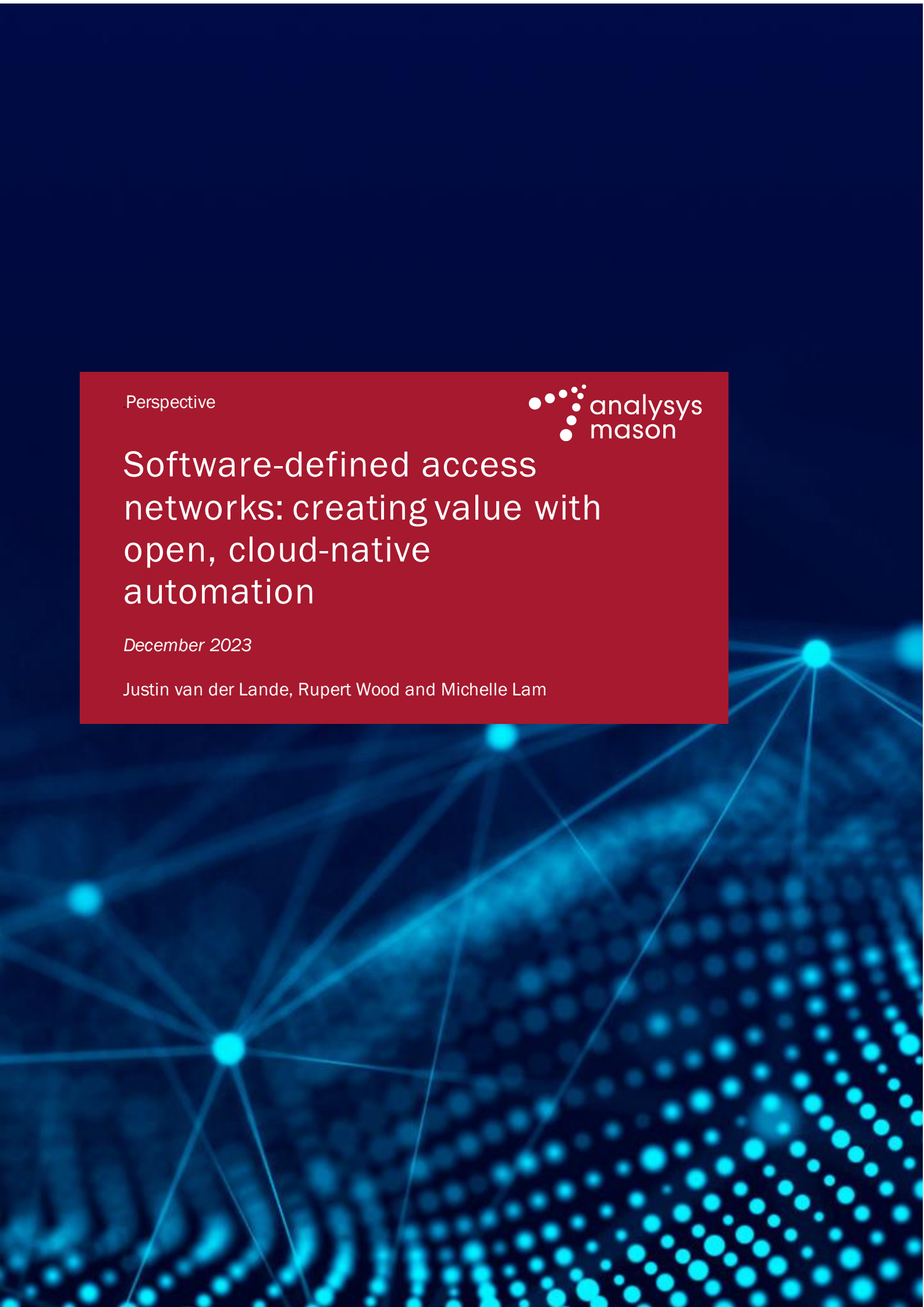

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1. Executive summary

As the digital landscape continues to expand with data-intensive applications, such as cloud gaming, ultra-high-definition video streaming content and augmented and virtual reality, operators are evolving their networks to meet consumers' demand for high-bandwidth, low-latency connectivity. Fibre-to-the-home (FTTH) provides the physical underpinning for a set of access technologies that are uniquely well-positioned to service this evolving demand. Such is its combination of future-proofed infrastructure and low operating costs, FTTH has appeared as an attractive investment option to new entrants and existing operators alike. Investment has burgeoned over the past decade as operators seek to monetise FTTH deployments via new business models such as open access fibre networks.

Investor and operator enthusiasm has a flip side. FTTH roll-out across national geographies has been uncoordinated, thus causing a high degree of overbuild and fragmentation of networks often with siloed systems. This has resulted in national broadband landscapes with two salient characteristics:

- Areas with several overbuilt gigabit fixed access infrastructures all competing for a finite set of end-users and/or a small number of wholesale service-provider customers.
- A geographically fragmented patchwork of many small FTTH infrastructure providers that enjoy few of the efficiencies of scale of larger players.

Competitive pricing strategies among FTTH infrastructure providers in attempts to increase their market share in terms of revenue has also led to falling margins. This has reinforced the need for swift and efficient ways in streamlining the automation of network operations and service delivery to lower operating costs. Software-defined access networks (SDAN) presents a solution for FTTH network operators to simplify and automate network and service provisioning, increase ARPU by offering high-bandwidth, on-demand differentiated services and improve customer experience with intent-based automation across network lifecycle management, service fulfilment and assurance processes. SDAN also provides an open platform with highly configurable APIs which enables flexible integrations with existing OSS/BSS systems and faster software upgrades. This will help operators lower the total cost of ownership (TCO), speed up service innovation and generate new revenue streams as networks evolve to become more autonomous to improve margins and differentiate themselves in a highly competitive business environment.

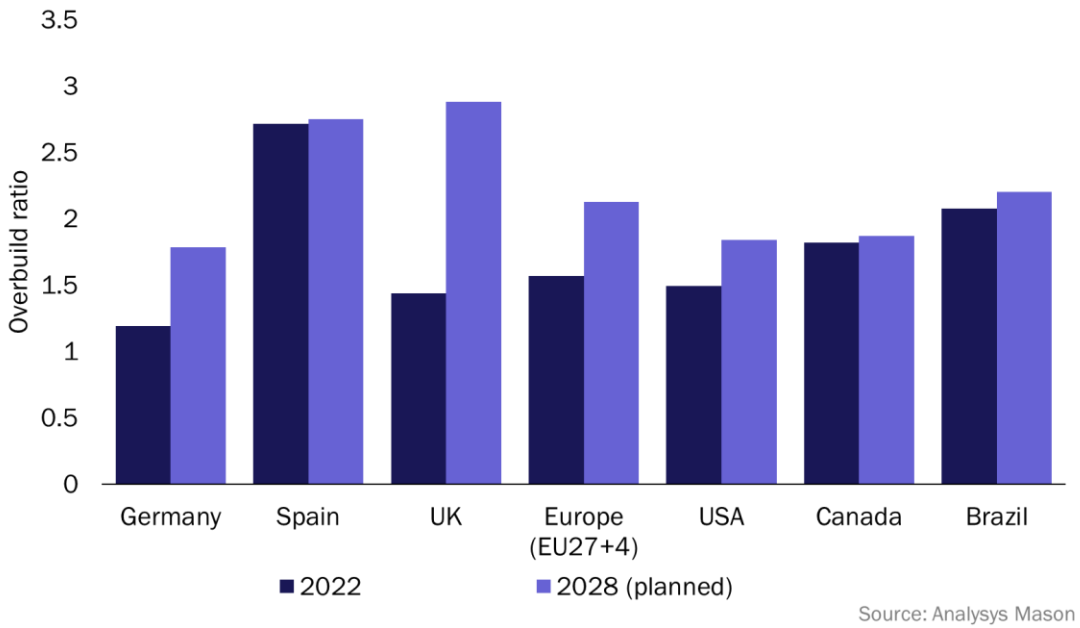
2. FTTH network providers are facing increasing commercial pressures

2.1 Competition between FTTH infrastructures has led to falling margins

The upgrade of legacy copper and hybrid fibre coaxial (HFC) networks to FTTH has been the largest single investment in telecoms infrastructure since the roll-out of telephony. With a few exceptions, the bulk of roll-out has been left to market forces and has hence been rather uncoordinated, resulting in a higher degree of overbuild in some areas than original business plans had accounted for, as well as a high degree of fragmentation of networks with siloed systems.

Capital expenditure (capex) on FTTH infrastructure continues to grow apace: in Europe, FTTH is the single-largest component of all telecoms capex; and in North America there has been a major uptick in investment in the past 3 years. A plethora of fibre alternative networks (altnets) operators have entered the market, often focusing investment on specific geographical areas and offering faster and more reliable services than incumbent operators. These new players are frequently the first to offer FTTH availability in the regions they focus on. Many cable operators (most of those in Europe and Latin America) are also planning to upgrade from HFC to FTTH, adding to the already-crowded market. This has resulted in high actual or planned FTTH overbuild ratios in many markets. Figure 2.1 shows the aggregate planned coverage of FTTH and HFC operators in key markets.

Figure 2.1: Overbuild ratios, in 2022 and 2028 (planned), selected countries[1] [2]



[1] Aggregate of actual and planned FTTH and HFC premises passed divided by total unique premises passed by at least one FTTH or HFC infrastructure. HFC networks that are self-overbuilt with FTTH are counted only once.

[2] EU (27+4) represents the 27 EU member states plus Iceland, Norway, Switzerland and UK.

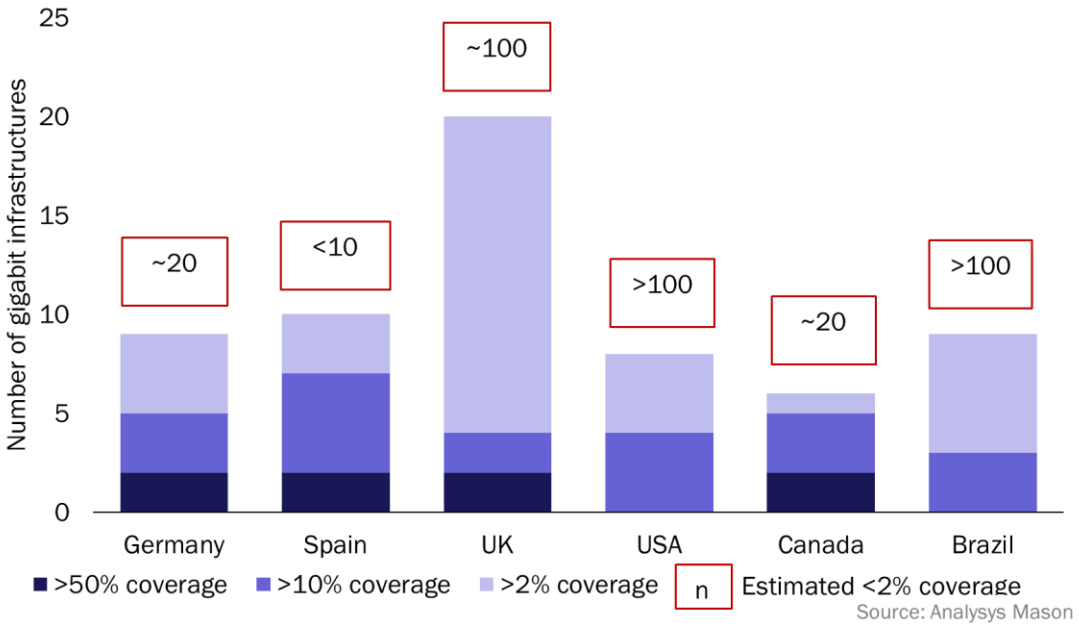
This coverage will not, of course, be evenly spread: many areas will end up with three or more gigabit-access infrastructures, and some will end up with fewer.[3]

Fierce competition for a finite number of premises (homes and business sites) means that the conversion of premises passed to the number of active subscribers or wholesale customers (usage of assets) becomes the most important key performance indicator (KPI) for FTTH investors. Furthermore, competitive pricing strategies, and increased marketing efforts to attract subscribers, coupled with recent inflationary pressures on deployment costs, puts extra pressure on margins. In this context, FTTH infrastructure providers need be better able than their competitors to deliver effectively on the new demands made of their networks. They need to be able to conduct their operations more efficiently to secure the conversion of homes passed, prevent churn and enable the flexible creation and provisioning of differentiated services to generate new revenue.

2.2 FTTH infrastructure providers need to find swift and efficient ways to run their services to remain competitive

The roll-out of FTTH infrastructure is, in many countries, geographically fragmented, a condition that stands in marked contrast to mobile networks. In the UK, for example, there are over 100 active altnets, most of which have ambitions to pass 2% or less of total national premises. Though few markets are as fragmented as the UK, it remains that very few altnets have plans to cover as much as 20% of premises, and the vast majority substantially less.

Figure 2.2: The number of FTTH and HFC infrastructure plays, by coverage ambition, selected countries, 2023



Because there is a disconnect between this fragmented infrastructure and the long-standing retail service provider market structure (mainly large national brands often with a mobile network), a competitive wholesale

[3] These projections are not forecasts, because it would be assumed that some form of rationalisation will take place. Of larger European markets, France is omitted because of an effective national plan that pre-empts overbuild in the last sections of FTTH access lines, and Italy is omitted because of political and regulatory uncertainties over the proposed consolidation of the two largest fixed networks.

market has started to emerge. Most of the larger retail service providers (RSPs) will not be in the business of building extensive FTTH networks, and therefore securing these larger RSPs as wholesale customers will be a commercially critical part of FTTH infrastructure providers' success.

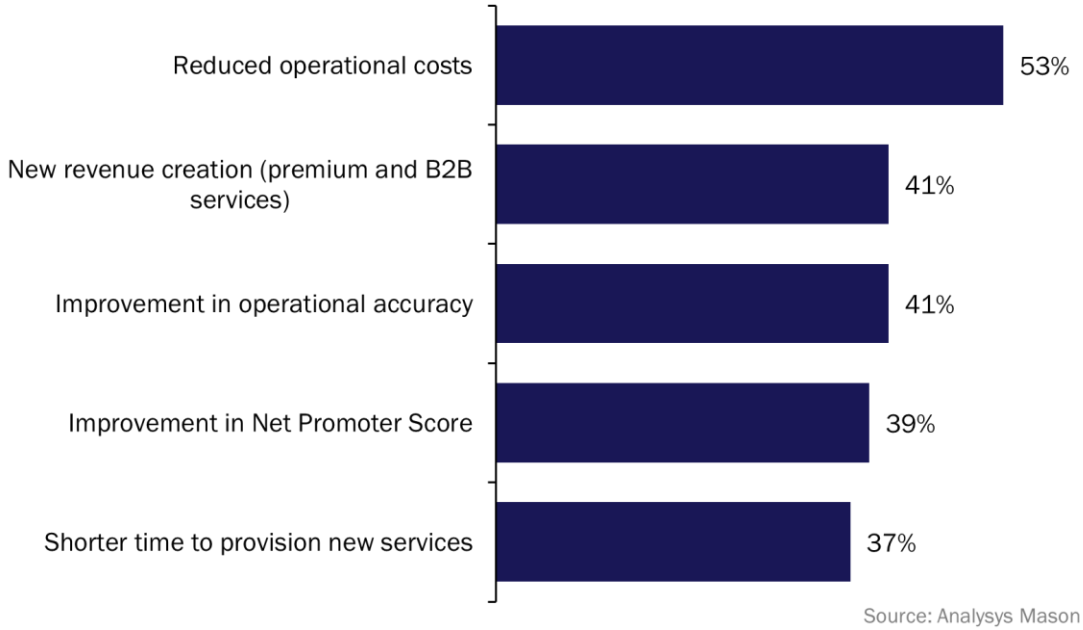
Wholesaling is likely to be competitive, and FTTH infrastructure providers need to overcome two main obstacles. Firstly, to provide a better and more digitalised service than legacy wholesaling, which often has its roots in the grudging provision of services mandated by regulators, and secondly, to have sufficient scale for national providers to feel it is worthwhile to contract with them.

FTTH infrastructure provision is entering a phase of rationalisation and consolidation of existing physical assets. Stakeholders from across the FTTH value chain will be looking for efficient solutions to integrate diverse and geographically isolated active and passive fibre/optical assets prior to, or even instead of, full financial and operational mergers and acquisitions (M&A). This has led to a demand for open access fibre networks in which a single FTTH network infrastructure is shared across multiple retail service providers. The integration and standardisation of technologies across different wholesale networks will become a critical factor in this business model.

3. Technological drivers for automation

FTTH infrastructure requires much lower network opex than copper or HFC access. Much of the business case for upgrades to FTTH derives from these efficiencies. But in the new competitive environment of multiple FTTH networks, attention must shift from the case for upgrade to how to improve efficiency as an FTTH operator. Automation is key. There remain cost pools that stand to benefit from improved automation, and improved automation can tie in customers and unlock new revenue opportunities.

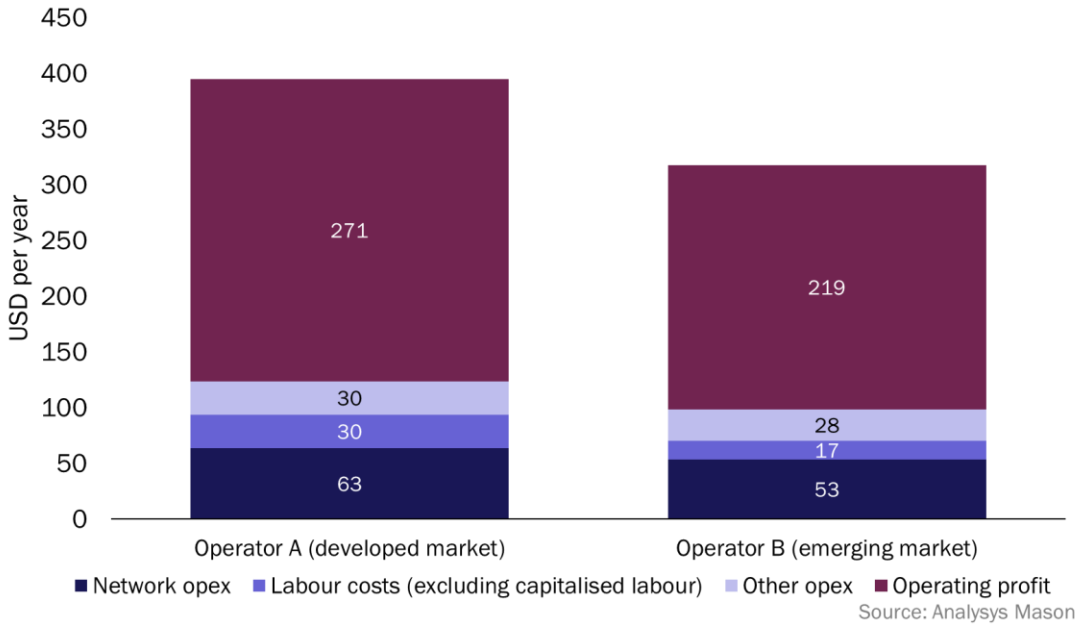
Figure 3.1: Factors driving CSPs' automation initiatives, 2023



3.1 Automation to reduce opex

Typical opex per active line for a mature FTTH operator is about USD90–USD120 per year and this figure typically represents about 30%–35% of ARPU. Looking across FTTH operations in different types of markets (for example, a developed market operator with a high penetration of homes passed versus an emerging market operator with much lower penetration achieved or expected), these broad figures for opex per active line closely align with each other. Figure 3.2 shows an estimated isolation of FTTH revenue and costs per line from other revenue and costs for an operator in the developed market and an operator in the developing market. The data demonstrates an unexpected degree of similarity in the figures.

Figure 3.2: Breakdown of average revenue per line in opex by category and profit for Operator A (the developed market) and Operator B (the developing market), per active line, 2023



While much of the cost of connecting properties for the first time is largely manual and requires the presence of an engineer, customer installations and first-time activations of lines frequently involve multiple end-user touchpoints and more than one truck-roll. The need for automation to enable efficient network provisioning is critical in reducing opex in a highly competitive business environment. Opex per active line falls as penetration rates rise, making each customer more profitable. Hence, automation that can reduce costs for each existing subscriber while, at the same time, drive take-up creates a dual impact on opex per active line.

3.2 New revenue creation (premium and B2B services)

There is an increasing demand for bandwidth-intensive and latency-sensitive applications as consumers are embracing a greater variety of services, such as 4K/8K TV and cloud gaming. Consumer xR is embryonic but could potentially impose unprecedented requirements for bursts of speed or ensured low latency. There are also new demands that enterprise users have which require the sporadic use of high bandwidth and differentiated classes of service. High-quality business- and enterprise-class FTTH connections, positioned as alternatives to direct Ethernet access, are increasingly common. These all place an increasing burden on the performance of the access network, not only in terms of best-efforts bandwidth, but in terms of guaranteed/committed bandwidth, of application-sensitive bandwidth and of low-latency values. Depending on the service-level agreements (SLAs),

operators need to be able to demonstrate that committed bandwidth is always available and goes further than just the front door; premium and B2B services need to be controlled end-to-end, all the way into the home as a substantial and critical network part for the end-user experience.

3.3 Improving operational accuracy through real-time network visibility

FTTH operators encounter significant challenges in gaining comprehensive visibility into network performance within traditional access network setups as they often lack advanced monitoring tools and access to granular network performance data. Administration and control of broadband access services also tends to be restricted in the subscriber's household. The rapid proliferation of internet-connected devices within homes through Wi-Fi has made it necessary for operators to effectively oversee and monitor the in-home network and monitor factors such as data usage, traffic patterns and device connectivity in real-time to ensure a superior broadband service quality.

3.4 Improving Net Promoter Score (NPS) to increase usage and reduce churn

As consumer demands diversify and demanding cloud applications become increasingly prevalent, FTTH networks are placed under pressure to cater for the diverse array of services with varying bandwidth and quality of service (QoS) requirements. If service providers fail to offer a diverse range of high-bandwidth services, this could lead to subscriber churn and excess network capacity that has not been fully used, therefore resulting in slower returns on investment (ROI). The optimisation of network resources is one of the main challenges for operators to achieve optimal usage of network assets to meet the varying demands of differentiated services and personalise services based on user preferences.

3.5 Shorter time to provision a new service instance

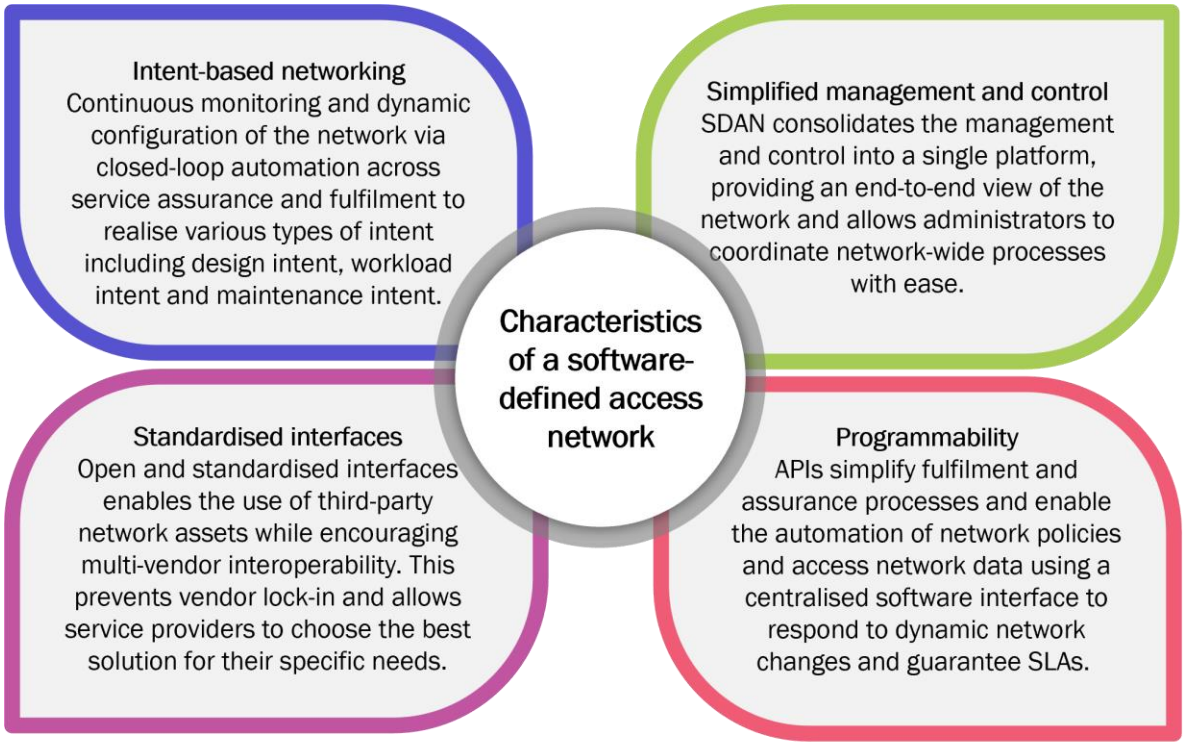
FTTH operators encounter significant challenges to deliver timely service provisioning which involve network configuration, resource allocation and validation. This becomes time consuming when these processes are manual, leading to a slow response to customer needs and increases the likelihood of inaccuracies, causing operational inefficiencies and potential customer dissatisfaction. To stay competitive and meet the ever-increasing demand for quick, flexible services, CSPs must embrace automation to streamline service provisioning, reduce lead times, and enhance overall operational agility.

4. Benefits of SDAN through process automation

4.1 SDAN overview

Software-defined access networks (SDAN) extend the principles of software-defined networking (SDN) and network functions virtualisation (NFV) to access networks and to enable an intent-based network which can autonomously configure and optimise itself to achieve closed-loop automation service fulfilment and assurance.

Figure 4.1: Defining features of SDAN

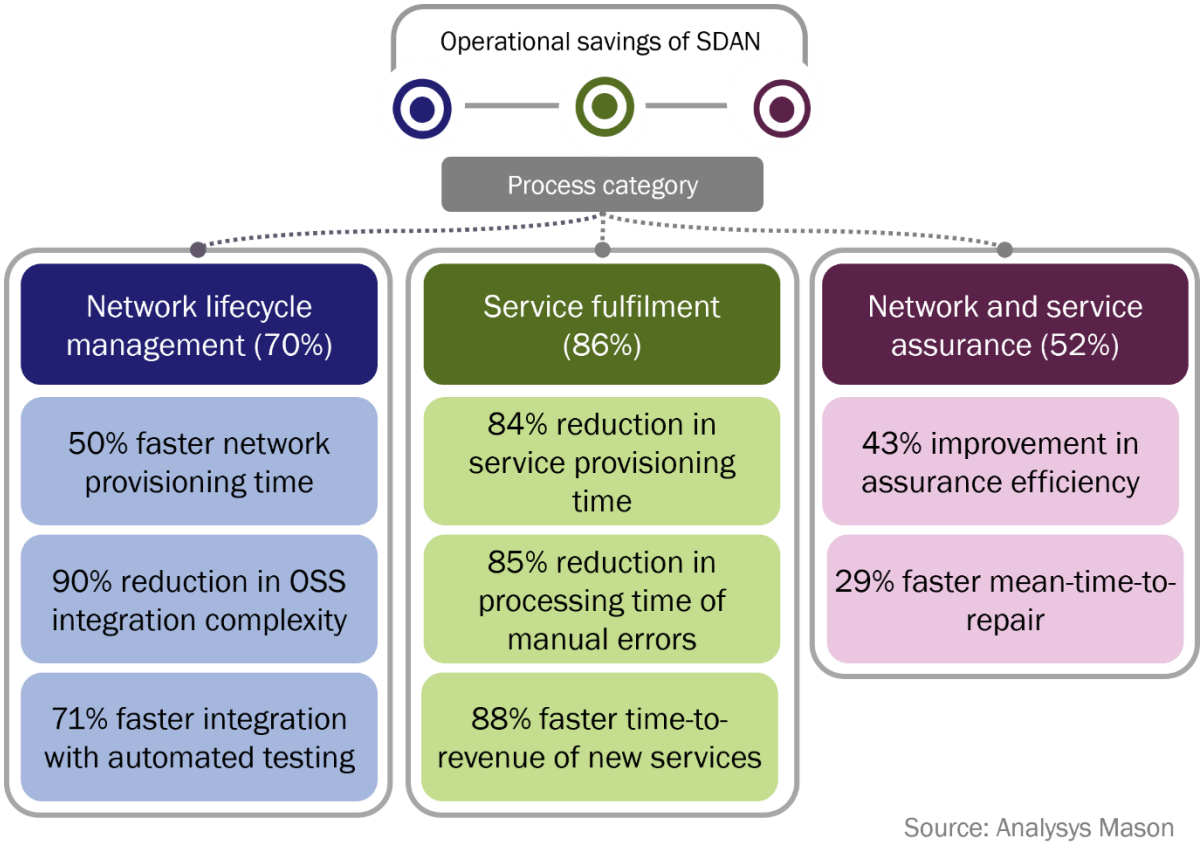


Source: Analysys Mason

This enables FTTH network operators to improve opex and capital expenditure (capex) efficiencies with more efficient resource usage and streamlined operations, consequently reducing the network TCO and improving overall network performance. SDAN also enables service providers and FTTH operators to generate new revenue streams by better supporting wholesale, B2B and premium differentiated services.

Analysys Mason estimates that SDAN will improve opex for network lifecycle management (70%), service fulfilment (86%) and network and service assurance (52%) processes.

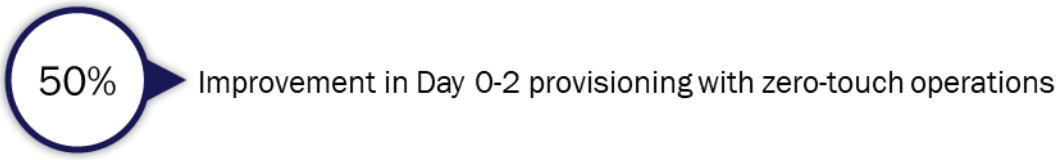
Figure 4.2: Operational benefits of SDAN by process category



4.2 Network lifecycle management

Automated network design and roll-out with zero-touch provisioning

Network operators can achieve faster network design and roll-out by virtually simulating and modelling different network configurations and optimising network architectures to meet specific requirements. This accelerated design process allows for quicker roll-out of new network infrastructures, enabling service providers to meet the growing demand for FTTH access. The closed-loop automation capabilities of SDAN will allow CSPs to automate the network planning, configuration, management and optimisation processes and enable zero-touch provisioning. This is an effective way of reducing the number of end-user touchpoints and field engineers required in the installation and first-time provisioning of a line, and, importantly, in the number of costly truck-rolls.

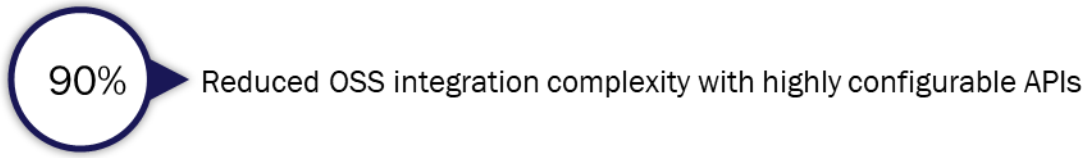


A shift to open platforms will enable faster and more flexible OSS integration

Traditional network management systems rely on manual configurations where each network device, such as optical line terminations (OLTs), switches and access points, is managed separately using its proprietary management interface. There is also a risk of vendor lock-in when a single vendor is used to control the entire network infrastructure, making it challenging for retail operators to transition to different suppliers or adopt new

technologies, limiting their ability to adapt to changing market dynamics and differentiate their service offerings.

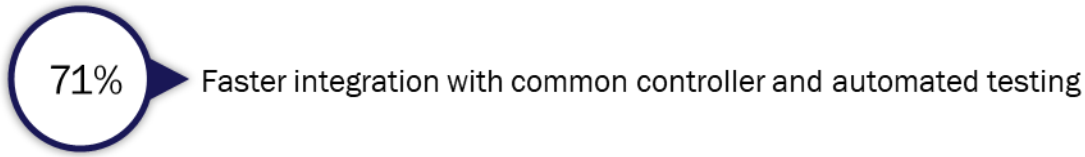
SDAN enables flexible integration of highly configurable and open APIs with existing OSS systems by shifting network control functions to the cloud. The capex associated with computation and storage resources on physical network elements is mitigated, and opex is reduced through streamlined network management and fewer required touch-points. Moreover, SDAN offers a programmable, open interface between wholesale and retail providers that enables shared management and control, bringing benefits to both parties in terms of cost savings and revenue generation.



Multi-vendor, multi-technology networking without additional operation overhead

FTTH networks that interoperate across different infrastructure providers' systems and components brings complexity in designing, configuring and maintaining the infrastructure. The complexity increases when dealing with multi-vendor equipment and coordinating with different parties involved in the deployment process.

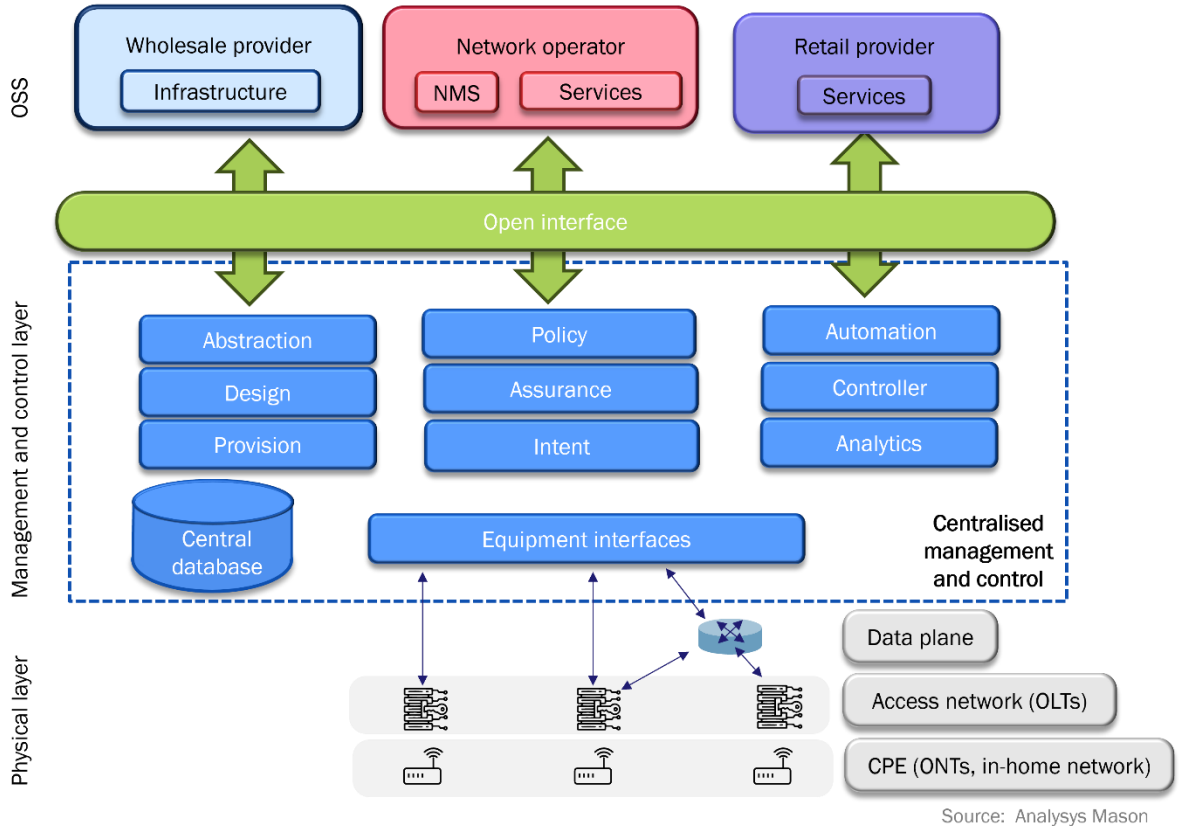
An SDAN architecture consolidates the abstracted network functions into a single point of management and control across multiple vendors. This provides a global view of the network conditions, simplifies the management and configuration of resources, as well as ensures consistent policy enforcement across the entire network.



Modular software upgrades and agile CI/CD pipelines

The ability to repurpose hardware through software updates helps mitigate the high initial capex barrier. For example, when an OLT requires a new software upgrade, SDAN simplifies this process with remote software upgrades that enhance the longevity of network components by not having to purchase new hardware. The decoupling of OLT management transforms the network into a programmable flexible infrastructure so that changes to one software module will have minimal impact to others, and decoupled components can be upgraded individually. Using DevOps and CI/CD approaches can further accelerate the deployment of FTTH thanks to the systematic and automated process of code changes integration, testing and deployment into the network environment with up to four times faster feature delivery. This, in turn, leads to reduction in costs associated with integrating new physical network elements and makes fibre infrastructure investment more feasible and cost-effective in the long run.

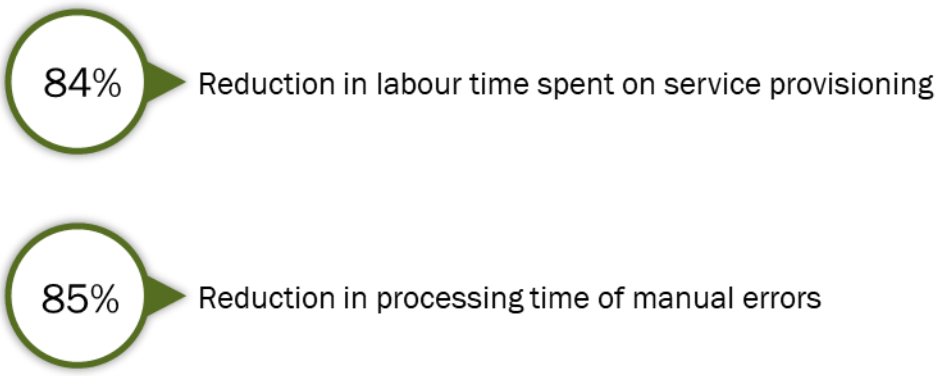
Figure 4.3: Centralised management and control for SDAN



4.3 Service fulfilment

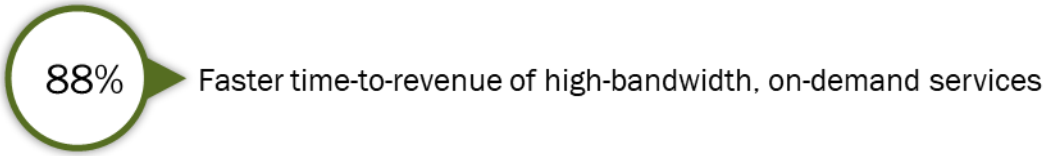
Automated service provisioning to speed up service fulfilment

SDAN's intent-based networking capabilities enhances service agility by allowing operators to automate the service fulfilment process by translating user intent into actionable functions and protocols to enable automated service provisioning. This results in quicker service provisioning speed, smoother roll-out of high-bandwidth services and creates a more responsive approach to customer needs. According to previous survey results, operators reported automation may reduce order fallout by up to 80% by using standardised templates, scenarios or customer journeys. Most operators expected a large reduction in labour time on the service provisioning processes of 84% or higher.



Dynamic network configuration to ensure deterministic subscriber-specific experiences

The ability to dynamically configure parameters such as latency, data rates or Ethernet VLAN class of service (CoS) allows operators to introduce premium services with guaranteed performance levels such as guaranteed low-latency and prioritised bandwidth to customers who are willing to pay more, which leads to increased revenue streams from upgraded service packages. This can enable service providers to offer modular and flexible pricing models where customers pay for the on-demand bandwidth they consume and provision slices for differentiated services with distinct application performance requirements.

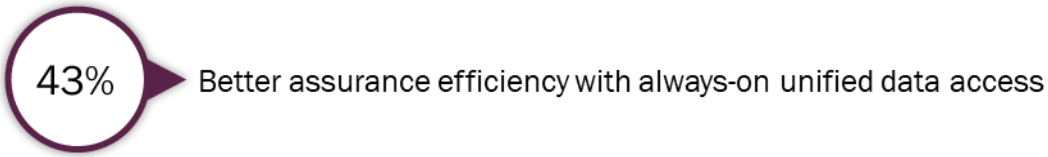


4.4 Network and service assurance

Real-time data monitoring to deliver more precise SLA management

For a growing number of service providers, the quality (performance and reach) of in-home networks has supplanted last-mile bandwidth as the main factor in price-tiering. This means that the in-home Wi-Fi network is a substantial and critical part of operators' recurrent revenue. Being able to support more deterministic and more intent-based networks genuinely from end-to-end rather than just from end-to-the-front-door (that is, to the optical network terminals (ONT)) will become more critical. An intent-based assurance system is able to continuously monitor the network, automatically detect intent drift and dynamically reconfigure the network. The goal is to achieve unified management and visibility across both broadband access and home networks and to incorporate end-user customer experience with third-party digital services, allowing operators to identify customers in need of service upgrades.

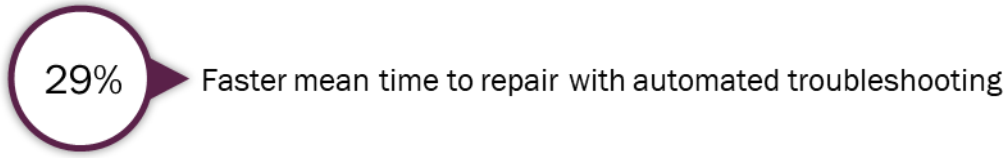
SDAN enables a unified analytics platform which collects data from multiple open sources in a multi-vendor environment, resulting in more fine-grained telemetry data, wire data and active test data for advanced network monitoring. This allows for near real-time, data-driven, continuous network and service monitoring with the ability to channel information into artificial intelligence/machine learning (AI/ML) models which then generate various outputs such as historical KPI trends, anomalies, insights and predictions for detailed analytics and reporting capabilities. Operators can access information about individual devices, user behaviour and application performance. This level of granularity helps in understanding usage patterns and optimising network resources. SDAN further enhances the accuracy of network and service inventory and facilitates smoother network operations.



Faster diagnostics and remediation with high-precision telemetry

SDAN facilitates enhanced diagnostics and remediation through improved telemetry. It expedites mean time to repair (MTTR) by swiftly detecting faults and streamlining diagnostics. This results in minimised downtime, ensuring seamless network availability and uninterrupted user experience. Extending performance monitoring to in-home networks enables operations team to remotely diagnose and address issues pertaining at any point in the

home network, and therefore reduce trouble tickets and minimise the number of faults and performance issues. This leads to improved customer satisfaction and reduction in churn.



5. New revenue generation

The scale of revenue gains that could be achieved with SDAN enablement is difficult to assess. Nevertheless, some sense of the upper bounds of the value of SDAN can be estimated based on the kind of more expensive options that exist for carrying these classes of traffic. There are three main types of revenue streams: B2B, B2C and wholesale.

5.1 B2B (Business to Business)

B2B connections account for about 6% of FTTH lines. Ethernet emulation is an obvious candidate service for SDAN, but this will generally be more attractive to new hitherto consumer broadband focused players than those that already have a revenue stream from Ethernet point to point (PTP). It is nevertheless of note that New Zealand national wholesale operator Chorus, which does have an existing line in wholesale Ethernet circuits, has introduced an Ethernet-emulation service (High Priority Access) that is based on XGS-PON. If available bandwidth has to be managed and if stringent SLAs demand clear bandwidth at all times, software-defined control is a critical tool. Internet access based on Ethernet PTP typically commands a retail price 4x-7x higher than the equivalent headline downstream speed based on best-efforts. If, say, one in ten of all B2B broadband subscribers took a competitively priced Ethernet emulation service that commanded three times the price of a high-end best-efforts service then a 3% uplift in overall revenue would be possible, going forward perhaps more.

Some B2B applications might already demand more; these could include certain types of industrial fibre-to-the machine, and video type surveillance applications that demand ultra-low latency (for example, uncompressed video for 'public safety'). SDAN will also allow providers to generate new revenue from future innovative offerings based on edge clouds.

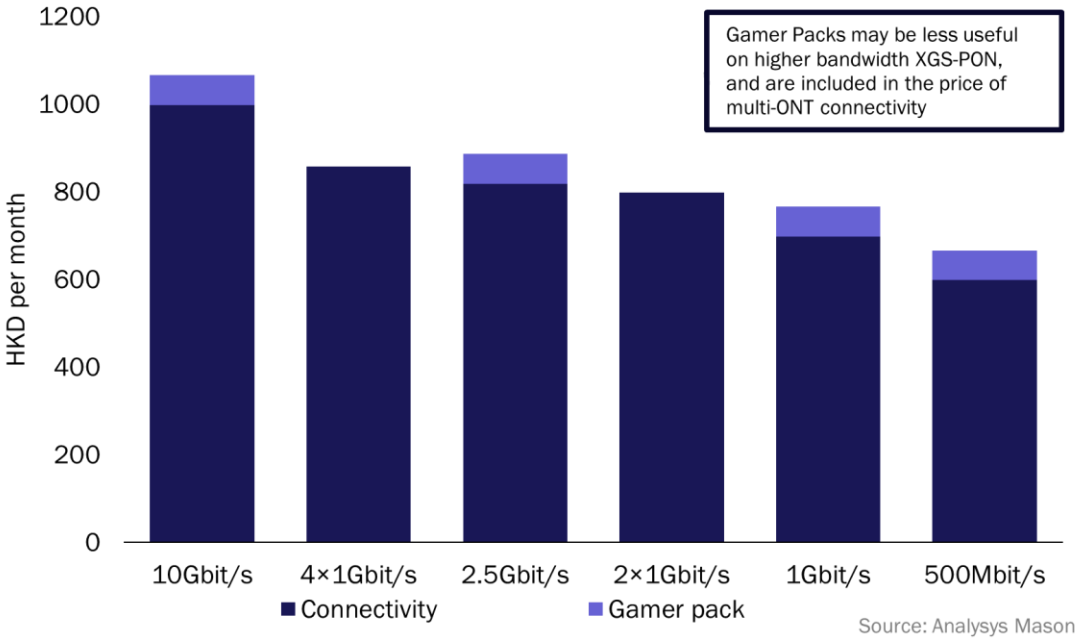
5.3 B2C (Business to Consumer)

Operator revenue from consumer type applications could be generated in two ways: direct from end-user, or indirectly from end-use via a content or applications provider (CAP). The first is more compatible with net neutrality. The second model is more complex.

Consumer pays directly: A few operators currently already provide higher-spec services for specific applications (usually games) with guaranteed low latency and with dedicated connectivity to game servers. One

such is HKT Netvigator. Its 'Gamer Pack' service, which costs HKD68/month (USD9) represents a 10% uplift on basic 1Gbit/s and 6% on 10Gbit/s connectivity. It is not available on-demand in real time. So, if 10% take it and there is a 10% uplift then the operator sees a 1% rise in revenue. It is unclear whether the Gamer Pack is being targeted as an option for 'low-bandwidth' subscribers (options start at 500Mbit/s), or as an option for any subscriber. But this shows that boosted connectivity options in the B2C space will always be in commercial competition against improvements in basic connectivity. One might imagine several such services (ultra-high quality immersive metaverse-type VR is the most obvious), but it is difficult to see more than single digit percentage uplift in revenue overall.

Figure 5.1: HKT Netvigator service pricing, 2023



Consumer pays indirectly: The B2B2C approach, where the consumer pays the CAP, which in turn pays for a slice or participation in a slice is one that CAPs have not hitherto shown great interest in. If a consumer buys a gaming subscription with superior network connectivity built in, they would need to have a connection with a compliant (that is, SDAN-enabled) service provider: this could be a business rationale as much as a problem.

We understand that CAPs generally make forward-looking assumptions about what the state of general best-efforts consumer connectivity will be, and tailor their R&D to those assumptions: so they might reasonably assume that by the end of the decade most households in their target markets will have FTTH, be able affordably to get multi-gigabit FTTH, and that Wi-Fi7 will also be available and affordable, allowing single bursty symmetrical gigabit streams to individual devices within the home.

What might change these assumptions is cloud-based rendering of XR services. Current rendering of video for XR type applications generally happens on-device, making devices expensive. Shifting rendering to the cloud might involve a lower overall cost, but it would make great demands on both the last-mile and the in-home networks, not simply in terms of bandwidth, but in terms of latency and jitter. We would not expect much movement until the end of the decade, but there is a reasonable chance that an operator could tap earlier into some revenue streams.

- Fibre operators face a similar challenge to mobile operators: demand for higher bandwidths is likely to saturate. Few subscribers need (or are willing to pay a premium for) more than 1Gbit/s. Operators must therefore differentiate on more than speed if they wish to avoid competing purely on price; offering bundles of content and other services is one potential option.

- Offer additional services such as technician connecting end-user devices to the Wi-Fi network or giving advice on optimal locations to install Wi-Fi hardware.

5.4. Wholesale service provisioning (network sharing)

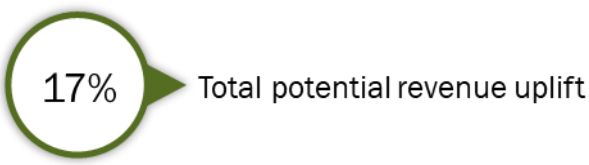
FTTH infrastructure operators will be aware that they need to differentiate themselves from increasing competition, and hence must explore new ways cost-effectively to enable services beyond consumer-grade best-efforts Internet access. The virtualisation of access network functions through SDAN will enable service providers to partition network resources into discrete slices and offer services tailored for distinct applications with specific requirements, or for distinct customer-types with specific requirements.

SDAN has an important function in the development of open-access wholesale because these partitioned network resources can be provided for wholesale-buying virtual network operators (VNOs) as well as for particular applications or particular retail customer types. For the VNO, these SDAN-based models offer a higher degree of operational autonomy and agility than familiar VULA/bitstream services typically offer, while at the same time reducing capex entry-barriers. Ultimately, SDAN-based network sharing should allow smaller fibre infrastructure providers to integrate their resources on a common software-based platform, allowing them to scale up rapidly as to appeal to service providers large and small. SDAN also extends NaaS into the realm of fixed broadband access. Innovative business models can emerge in which retail providers can operate at different levels of scope, such as providing subscriber management alone or also providing network diagnostics, optimisation or nearly full control over virtually segmented network resources. These new business models allow retail operators potentially to create new service offerings and improve upsell and cross-sell opportunities.

Sharing of this kind (VNOs) would in all probability account for no more than 20% of utilised lines, and if wholesale ARPU is 60% of retail ARPU, this represents a 12% uplift. However, wholesale is a double-edged sword for a service provider because some of this uplift will likely be cannibalising existing or future retail revenue, so a true uplift of about 7% looks realistic. Much could be provided via non-SDAN means (traditional VULA/bitstream), but SDAN capability can be an attractive incentive for an access-seeker to use that wholesaler.

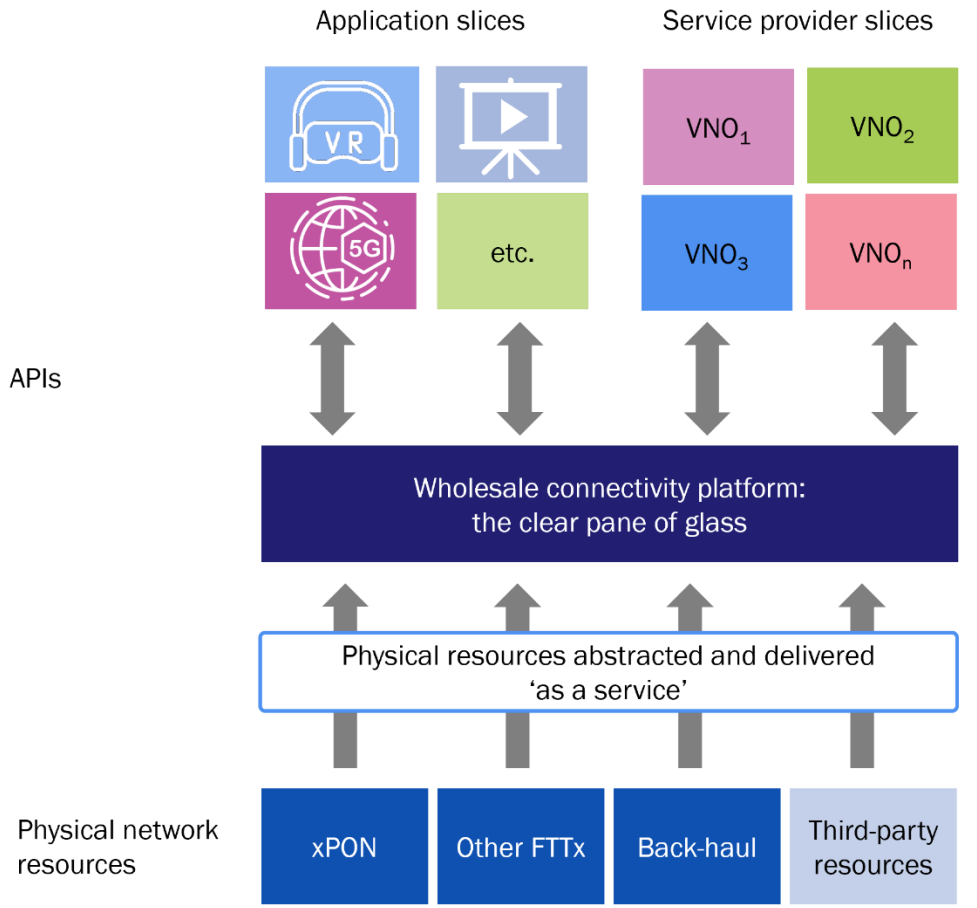
5.2 Total potential revenue uplift

Added these streams together, and assuming a further 30% uplift for unqualified B2B and vertical market use-cases, a fibre infrastructure provider that hitherto offered only broadband might see, on top of existing or foreseen revenues, a best-case 17% uplift.



- 3% uplift through B2C
- 3% uplift through B2B
- 7% uplift through wholesale

Figure 5.2: NaaS model for fibre wholesale operators



Source: Analysys Mason

6. Recommendations

- **Operators must identify specific use cases that will improve their margins and help them differentiate in a highly competitive business environment.**

  SDAN brings numerous benefits by simplifying network management and control of access networks by enabling intent-based networking, closed-loop automation, zero-touch provisioning and enhanced telemetry to achieve a higher level of automation. The need for automation to enable efficient network provisioning is critical in reducing opex in a highly competitive business environment. In order to improve margins, operators must identify specific use cases that will generate savings, carefully assess their return on investment for deploying SDAN and operators should focus on meeting the demands of high-priority subscriber services to generate new revenue streams on top of reducing operational costs.

- **Operators should collaborate with vendors to ensure compliance with industry standards and open interfaces.**

The open, cloud-native platform capabilities of SDAN allows operators to flexibly integrate across multi-vendor, multi-technology environments and enable faster software upgrades and device replacements, making fibre infrastructure investment more feasible and cost-effective in the long run. Ensuring interoperability across multi-vendor environments, however, can be challenging, and operators should carefully evaluate compatibility and standardisation efforts when introducing new vendors into the network.

- **FTTH players that face high capex to overbuild existing fibre operators should adopt SDAN to enable a flexible wholesale platform for monetising new services.**

  Wholesale fibre providers that face costly overbuilding capex should consider investigating the potential advantages offered by SDAN to build an innovative wholesale platform. The adoption of NaaS for FTTH reduces entry barriers and foster a retail market competitive landscape that relies less on driving prices downward and more on offering differentiated services for new revenue generation.

7. About Nokia's SDAN solution

This SDAN example was provided by our sponsor Nokia. Analysys Mason does not endorse any of the vendor's products or services.

Nokia's SDAN solution is the Altiplano Access Controller. Altiplano enhances FCAPS processes by providing an open software framework, programmable interface and unified management across different systems, technologies, and deployment models. This is achieved through intent-based networking, established blueprints, proven workflows, and assured pre-integration with commonly used IT and cloud platforms. Nokia's Altiplano Access Controller aims to address three main challenges in SDN/NFV adoption:

1. **Avoid closed ecosystems**

   Altiplano prevents software silo restrictions by employing an open software framework that works alongside various SDN controllers, orchestration systems and automation platforms to enable multi-vendor interoperability and innovation at all layers. Multivendor networks can be easily managed as blueprints can be created for different access device implementations and vendor-specific APIs.

2. **Deploy carrier-grade cloud solutions**

   Altiplano offers carrier-grade network functions optimised for the cloud and leverages validated best practices and real-world use cases to facilitate the transition to cloud-native environment and optimise operational performance.

3. **Interoperability between physical and virtual networks**

   Altiplano provides unified management across hybrid, physical and virtual networks. It also provides workflows and tools to visualise, optimise and automate the network across different operational deployment models and between legacy and SDN environments.

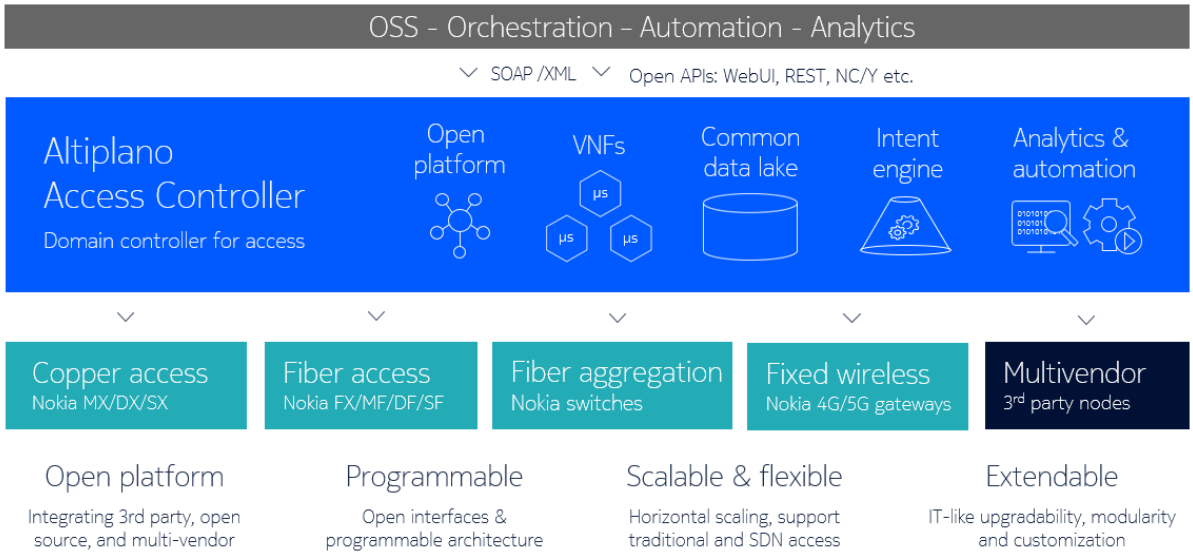
Altiplano leverages intent-based networking by decoupling the operator systems from underlying network such that the service layer can be scaled and developed independently from the device layer. This enables, for

example, a service for a FTTH subscriber to be configured without needing to know the OLT and ONU hardware designs, or even the specific xPON technology deployed. Altiplano has a built-in catalogue of infrastructure and service intents that allows plug-and-play provisioning. This enables operators to break down network element configuration into multiple micro-intents, split into infrastructure and service intents or use a single macro-level intent. The service intents can be technology agnostic (for example, GPON, XGS-PON, NG-PON2).

The solution also brings a standardised set of tool chains, breaking down barriers between networking and IT operations, thereby driving network transformation and allowing operators to access skilled IT professionals globally, reducing learning curves and enhancing employees' career prospects by cultivating valuable and transferable software skills, therefore lowering lower integration costs and simplifying the complexity of OSS/BSS system.

Nokia's Altiplano Access Controller enables operators to achieve **increased business agility** through streamlined operations and ability to introduce and make changes to new services rapidly and consistently, **optimise operational expenditure** through automated network operations and minimise the need for labour-intensive manual interventions, **enhance service assurance** by enabling network administrators to assess and manage service availability efficiently and **improve programmability** by simplifying intricate network configurations through a modular and customisable framework.

Figure 7.1: Overview of Nokia's Altiplano Access Controller



Source: Nokia

8. About the authors

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Rupert Wood (Research Director) is the lead analyst for our *Fibre Infrastructure Strategies* and *Wireless Infrastructure Strategies* research programmes. His research covers the following areas: the evolution of operators' investment priorities; operator business structures; business models for FTTH and convergence; fixed broadband technologies; the economic impact of digital transformation; capex forecasting; and network traffic forecasting. He has extensive experience of advising senior management on strategic issues. Rupert has a PhD from the University of Cambridge, where he was a Lecturer before joining Analysys Mason.

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