

WHITEPAPER

Transform operations and enable new business models with E2ESO

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FOREWORD

Monetisation, APIs and orchestration – piecing together the puzzle

2024 marks the sixth anniversary of 5G services and, by all accounts, the growth story has been remarkable; 5G penetration has scaled faster than any previous mobile broadband technology. And yet, despite billions of dollars spent on 5G investment, the 5G monetisation story remains challenging. ARPU and profit growth are not following subscriber scale.

Against this backdrop, many strategies have been proposed and pursued to deliver on the industry's monetisation demands: Tariff innovation; private 5G targeting specific vertical market requirements; fixed wireless access

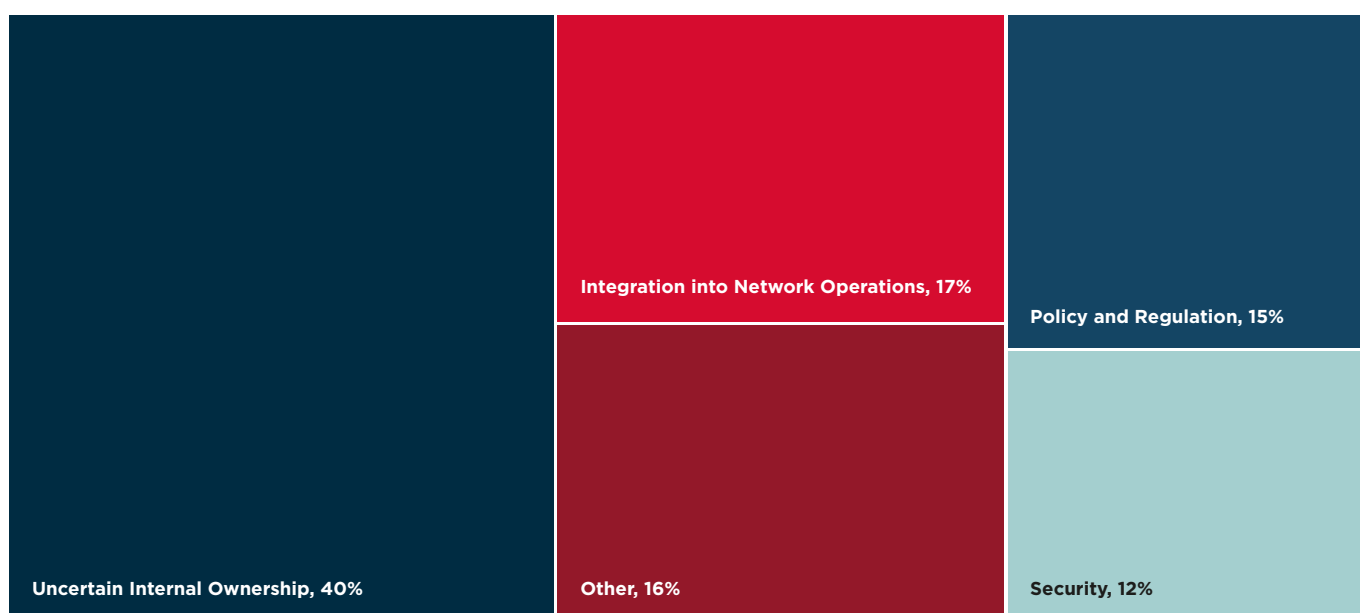
as a wireline broadband competitor or complement. Over the past year, however, one has received a lot of attention: Network API exposure.

Network API exposure involves giving developers access to mobile network capabilities which they can use to enhance their applications or deliver applications to bespoke needs. Building on this concept, the GSMA's Open Gateway initiative launched in 2023 to expose certain APIs in an open and consistent manner. With 17 APIs included and 48 operators signed (accounting for two-thirds of global mobile connections) progress has been impressive. Operators, however, still see clear barriers in putting Network APIs to use; GSMA Intelligence research finds that questions around which business units will drive API efforts and how

these will be securely integrated into an operator's network dominate current thinking. The fact that 70% of operators tell us they're already exposing network APIs only underscores how big of an issue these concerns are.

It also underscores the need for orchestration. Ensuring that new API-enabled services can be delivered in a secure manner which engages diverse network capabilities will require orchestration across multiple network and business domains, all alongside existing processes and services. To be sure, this isn't the only rationale for orchestration, but it is a reminder that as operators look to monetise 5G-era networks, end-to-end service orchestration must be part of the equation.

Figure 1: Network API Exposure: Top Deployment Obstacles



Source: GSMA Intelligence, Network Transformation 2023

INTRODUCTION

End-to-end service orchestration (E2ESO) describes the comprehensive, automated, intent-driven management of services across all operator technical domains. E2ESO encompasses all the systems, policies and processes from design, catalogue and distribution to on-boarding, composition and policies to network inventory, services, intent and resources. These all contribute to enabling network design that embraces the entire lifecycle of a service from instantiation to termination. The ultimate goal is to achieve fully automated transformation of business intent through the dynamic composition of workflows into seamless service execution.

That goal is complex to achieve and requires sustained investment as well as cultural, organisational and technological change and it is fundamental to the success of next generation services delivered by CSPs. E2ESO transforms and

accelerates the development of next generation services by creating a platform for business-driven service and network design, supported by agile catalogue onboarding, dynamic orchestration, real-time inventory and service assurance. This platform allows the rapid introduction of new services and streamlines how the network is dimensioned to support these.

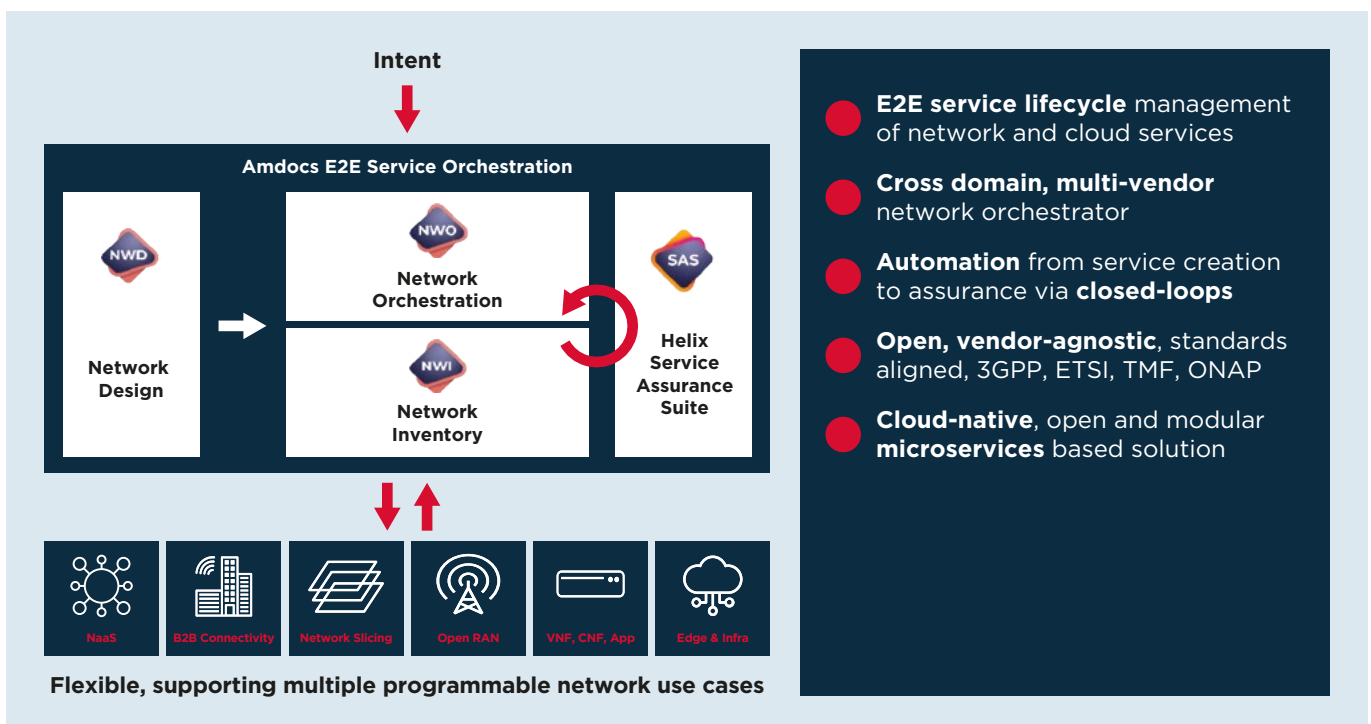
This is essential for CSPs as they seek to further monetise their networks and generate new revenues from advanced use cases such as edge services and exposure of their application programming interfaces (APIs). E2ESO is the enabling platform for the new services CSPs expect to deliver additional revenues such as quality-on-demand, network-as-a-service and many, many other new offerings enabled by flexibility and automation.

The E2ESO concept in itself is not new and CSPs have strived to create holistic, horizontal

approaches to enable greater operational efficiency and agility. Often these projects have proved to be extremely complex and slow to deliver rewards but the increasing reliance on software and the disaggregation of the networks means the end-to-end approach to service orchestration is needed more now than ever before.

That complete vision is still not reality because of the fragmented systems and processes landscape, constrained investment and the practical timetable of system-by-system, staged transformations. A staged but holistic transformation, if executed well, contributes to the overall E2ESO goal with the full advantages achieved once the completed, end-to-end capability is in place. That will deliver frictionless, automated service orchestration across cloud, CSP tools and systems, and into partners.

Figure 2: E2E service orchestration





WHY CAN'T WE GET THERE FROM HERE?

The main hold-up to CSPs accessing the full potential of E2ESO is the sheer scale of the challenge. As a result there are three principal approaches – holistic, incremental and staged. Few, if any, CSPs are able to invest, ingest and digest a holistic transformation of this size while also continuing to operate their networks and businesses profitably. Success therefore will more often come with incremental or staged transformation processes in which parts of the journey to E2ESO can be addressed in manageable projects that are affordable, demonstrate interim results and bring CSPs' people and processes along with the transformation.

The transformation itself occurs across three dimensions:

- **Cloud** - Adoption of cloud technologies is happening at the same time as CSPs embrace automation and artificial intelligence (AI). These are disruptive moves that often involve more than a single stage of transformation. The measured move to cloud will see some but not all systems utilise cloud resources and the adoption of AI for network and service operations is in its infancy.
- **Culture** - The time taken for these projects to go live can also be used to prepare for cultural and organisational

change, taking people along with the process rather than appearing to exclude them from it. It's a big change that is being prepared for and building familiarity with new technologies will help their readiness to operate in new ways.

- **OSS/BSS silos** - Current standalone, siloed OSS/BSS systems need to become more horizontal and allow for functional groups to be created with smoother integrations between each.

CSPs want to get to the ideal environment but are hampered in their efforts not only by the scale

of the transformation but also by limited proof points that the new environment will deliver substantial benefits. The weakness seen so far of new revenue streams from services, such as network slicing or API exposure today, do not breed confidence or strengthen the investment case for E2ESO yet these examples were brought to market early to demonstrate possibilities rather than to transform CSPs' balance sheets right now. Uncertain internal co-ordination and unclear ROI are key obstacles to the adoption of new technologies by telcos according to GSMA Intelligence.

The real benefits accrue as transformations mature and more gaps in the end-to-end service orchestration function are filled. That will see a far wider range of E2ESO use cases emerge that illuminate why CSPs need to invest in it in order to take up their place in the digital value chain.

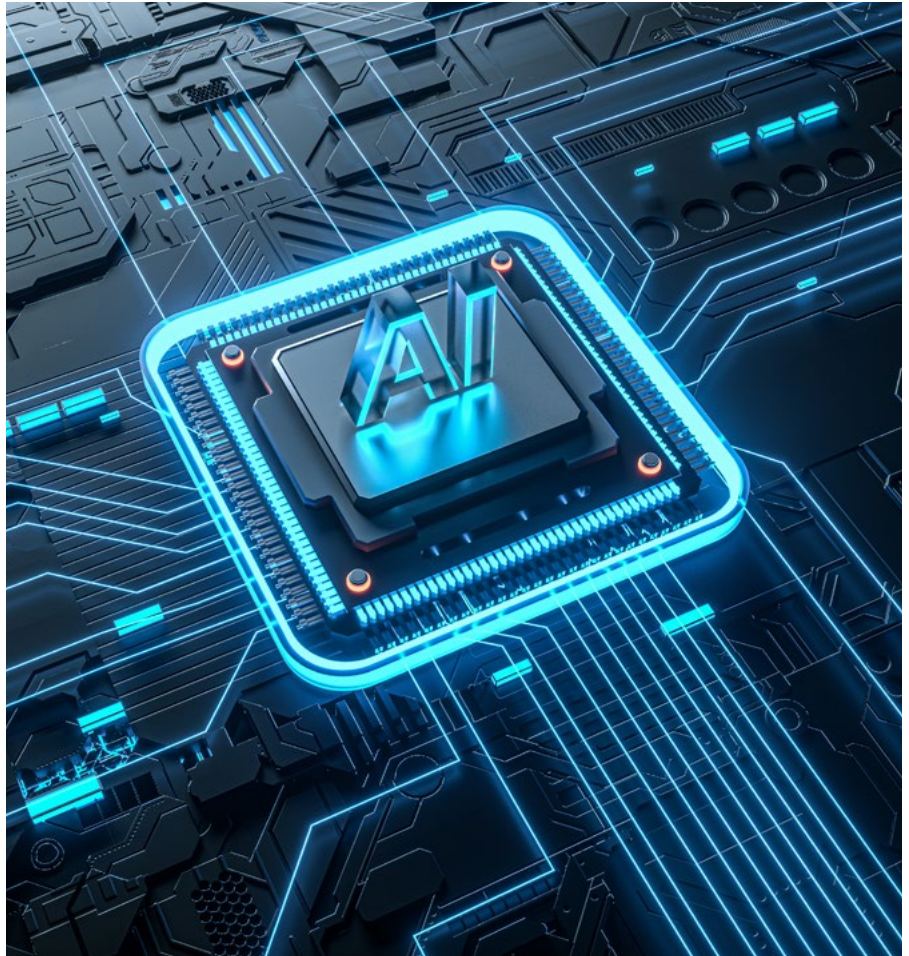
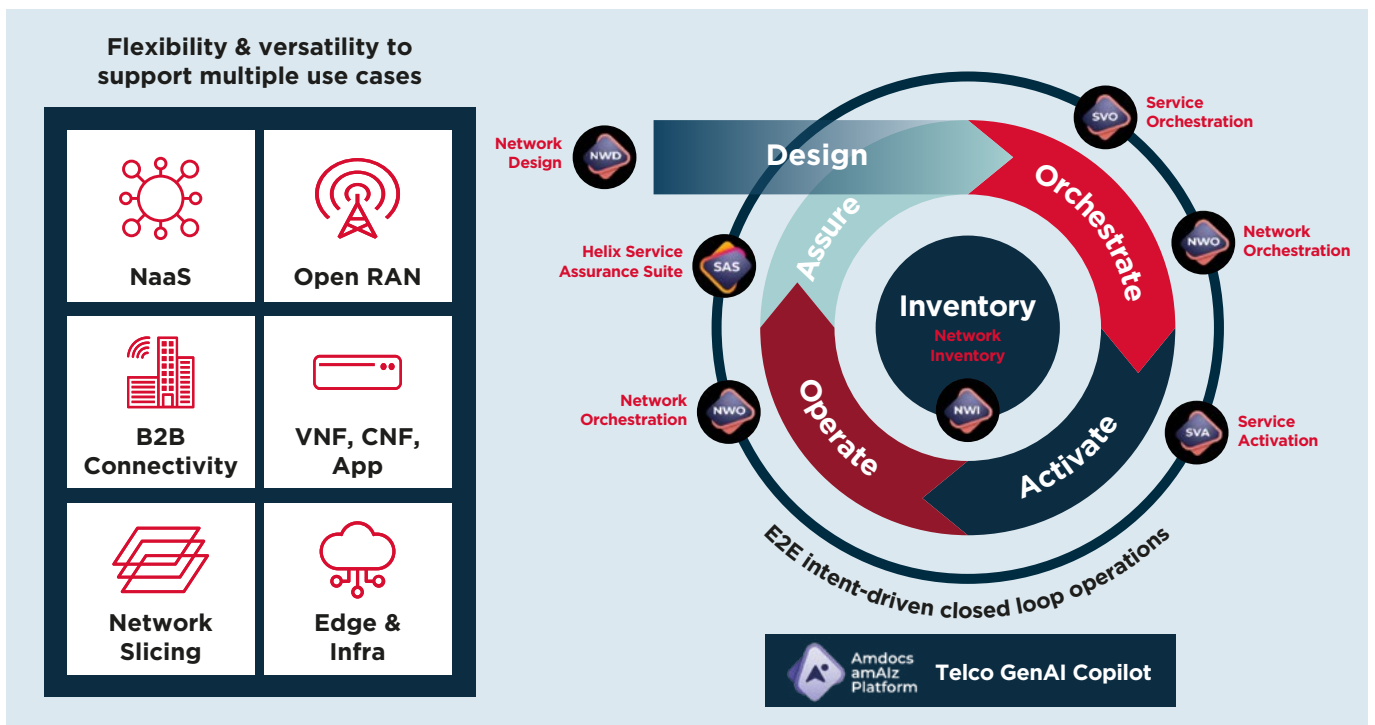


Figure 3: E2ESO supports network transformation and automation





COMPELLING E2ESO USE CASES EMERGE

API exposure

Although often cited as a means by which they will transform their revenue generating capabilities by opening up their APIs to third parties, CSPs remain cautious of giving away their most valuable assets in the form of access to network functions. That's understandable and tight control of access to exposed APIs in the form of rules and policies is needed. Significant work is being undertaken with the GSMA Open Gateway initiative which addresses how Network APIs can be developed. Further information can be viewed in a recent Amdocs whitepaper: [What's it all about - Network APIs & GSMA Open Gateway?](#)

With these policies in place, API exposure is an essential part of the journey towards programmable networks. The most immediate opportunities for exposure are focused on enabling simpler use cases such as SMS and SIM validation. The more advanced use cases will require E2ESO.

API exposure for high value services, such as quality on demand or edge selection and usage, is highly complex to achieve and the impacts on other systems should

not be overlooked. Simply exposing APIs is not enough, the knock-on effects of doing so on everything from inventory to charging and many other systems must also be assessed and controlled. Simplistic concepts such as opening up an API so a third party can manipulate quality on demand are suddenly not simple at all.

Why API exposure needs E2ESO

E2ESO needs to be in place to allow integration of all the systems and functions needed to orchestrate more complex services, such as quality on demand or edge intelligence offerings that exposed APIs allow.

SD-WAN

SD-WAN in particular is a service that is well-suited for delivery using E2ESO because it needs a platform that can support flexible, scalable and customised service offerings. E2ESO can help enhance network

performance and optimise costs by enabling efficient management of the WAN service, taking orchestration beyond the SD-WAN controller realm.

Why SD-WAN needs E2ESO

Simple SD-WAN services can be handled by SD-WAN controllers but the flexible, scalable offerings that enterprises expect in future as they expect to dynamically manage their WAN services.

Network-as-a-service (NaaS)

NaaS is a way for CSPs to offer enterprises dynamic services such as managed software-defined wide area networks (SD-WAN) or a virtual private network (VPN) with additional, value-added services, such as quality on demand. With NaaS, CSPs deliver these services in an advanced, on-demand and transparent manner to support specific use cases.

Familiarity with the propositions that NaaS can enable is growing within CSPs and investments in cross-domain orchestration are already underway. Customers meanwhile are increasingly ready to acquire telecoms services in this way, having seen the benefits of the cloud model for their own systems. It's not a straight replication of the cloud model for CSP services but the similarities reinforce confidence.

Why NaaS needs E2ESO

E2ESO is the enabler of the end-to-end automated, programmable networking capability that use cases such as security, bandwidth-on-demand and low latency edge applications need.

Edge

Edge adds further opportunities for CSPs to monetise their networks and broaden their service

portfolios. Edge computing enables the processing of data and workloads close to the use and therefore has advantages in supporting low latency services and providing secure processing for private wireless services.

Edge capabilities are assets that depend on a blend of cloud and network capabilities to operate effectively. With E2ESO, CSPs can abstract away network complexity and orchestrate multiple actions so edge services, such as data processing or the application of intelligence such as machine learning, can be operated efficiently and profitably. As CSPs' ability to support this is more widely recognised, edge offerings will proliferate.

E2ESO is needed for these sorts of use cases because of their dynamic requirements. To optimise edge use cases, efficient access to the network attributes they need are essential for the success of the service. Only by having the complete awareness across the CSP network systems can the required network services be delivered. Edge use cases, and therefore

revenues, depend on frictionless, real-time provisioning, access to the appropriate network resources and accurate charging.

Why edge needs E2ESO

E2ESO has an important role to play here because it can align the requirements of the edge service with the attributes of the network and make those available to the edge. E2ESO is needed to be able to locate the appropriate edge nodes to make this happen and orchestrate the relevant network domains, such as transport, UPF from core, vFW and others, to maintain the service needed. Edge is part of a larger whole which is connected with other assets including transport, core cloud and others. As part of that, edge capabilities need to be part of E2ESO.



Open RAN service management and orchestration

In the open radio access network (O-RAN), the service management and orchestration (SMO) capability is a transformative enabler to simplify network complexities and enhance the customer experience while minimising costs. Effective service management depends on the ability to handle various radio technologies, including 4G and 5G and the growing deployments of 5G standalone (SA). SMO within O-RAN therefore plays a fundamental role in lifecycle management and service provisioning.

The end-to-end capabilities of E2ESO are needed to reconcile the needs of multiple services to apportion network resources according to their needs and priorities. This optimises the services delivered and aligns the revenue generated with the resources provided by the CSP.

Why O-RAN needs E2ESO

E2ESO can provide underpinning functions that manage resource orchestration and optimised sharing of resources across multiple services. O-RAN relies on service assurance in relation to availability and reliability so users get the connectivity they expect and use cases can get the class of service or performance criteria that they need.

Sophisticated B2B and B2B2X service orchestration

Executing on B2B opportunities requires support for specific vertical demands such as low latency, security, guaranteed bandwidth and on-demand offerings. This support needs to be in line with business intent and enable seamless service instantiation based on enterprise ordering, which should be transparent to the organisation.

Why B2B and B2B2X service orchestration needs E2ESO

E2ESO allows CSPs to support innovative monetisation models such as marketplaces and B2B2X by bringing together the capabilities of virtualisation, cloud, 5G, slicing and edge technologies so CSPs make the types of offerings outlined above to enterprises. E2ESO is essential to enable the end-to-end view of resources these sophisticated services need and to allow multiple services and platforms to interact. B2B and B2B2X offerings simply won't work without E2ESO.



THE TELECOMS MARKETPLACE OF THE FUTURE

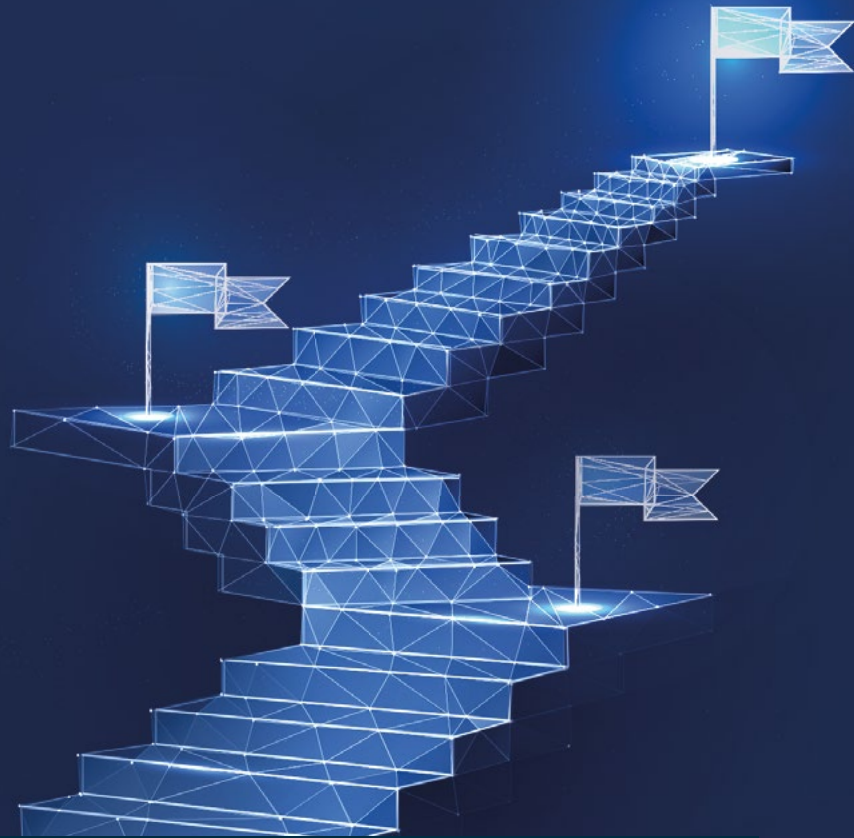
The new wave of CSP-provided services will not resemble the telecoms offerings of the past. Instead, CSPs will be in co-opetition with hyperscalers and sell their own offerings, while also exposing their network services for re-sale by partners. E2ESO will unlock valuable APIs such as real quality on demand, edge utilisation and other complex services might rely on multiple exposed APIs. Quality on demand based on location and validation, for example, might need access to several APIs.

There is a strong likelihood that service aggregators will play a significant role in this new market, reselling CSP capabilities. However, not all CSPs will engage and not all services will be offered via aggregators. CSPs have a unique advantage in that they can choose

what to expose directly and what to offer via aggregators based on their own specific business, regional and regulatory considerations.

Maximising their role will depend on CSPs engaging with standardisation as a means to encourage greater use of exposed APIs so marketplaces can mature to become revenue hubs and API usage is more widely understood and applied to a wider range of services and offerings.

Caution should be taken in engaging in multi-party business models as challenges exist for managing, assuring and charging for services provided by third parties. CSPs should assess the risks and carve out the role they take in each value chain with care and awareness of their role and responsibilities within it.



HOW TO SUCCEED TODAY

Success will not come by focusing on delivery of a single, specific service. The ultimate vision of a modern environment instead takes into account the entire service landscape, which involves services that have not been thought of today and technologies that are not fully-deployed. In time, these offerings will crystallise and the underpinning technologies will be more widely available.

The implementation of E2ESO is a considerable undertaking, a journey, and this should not be ignored. Instead, stages on the journey to E2ESO should be addressed in a step-by-step way, sharing quick wins in operational efficiency and providing the foundation for the next steps. Part of this evolutionary approach to transformation involves modernizing existing systems such as inventory, assurance, orchestration and charging being made ready to support E2ESO operation and monetisation which can result in further benefits becoming achievable during the journey.

The end-to-end approach is the core of E2ESO's transformational potential. Extending from business to network and bridging the gaps to support digital services better across different domains from access, such as RAN, to core bringing previously disjointed operations together. In addition, E2ESO can manage the end-to-end lifecycle for services from definition to maintenance and operation.

The ability to monetise a massive range of new services and features is the driver for CSPs to invest in E2ESO and transformation success can be achieved at the destination as well as during the journey.

HOW AMDOCS HELPS

Amdocs' E2ESO solution acts as a bridge between new desired business outcomes and the network resources and configurations that are required to achieve them. It abstracts away network complexity and enables the intelligent orchestration of multiple actions throughout the entire service

lifecycle. Amdocs E2ESO encapsulates orchestration (backed by inventory and assurance) for virtualisation, cloud, network slicing, edge technologies, NaaS and API exposure so CSPs can grow their businesses beyond connectivity.

With the experience to understand CSPs' current architectures and the ability to provide the link from network to monetisation via E2ESO, APIs and charging, Amdocs has the network to business knowledge to help customers build their businesses of the future, while continuing to operate effectively in the present.



CONCLUSION

While some examples of future CSP services will remain at the extreme edge of innovation with only limited uptake, there are numerous new services, such as edge, NaaS, network slices, quality-on-demand, API exposure and marketplace participation opportunities that are open to CSPs. Each must be carefully assessed so the complexity, costs, risks and rewards are fully understood but by automating, simplifying and enabling end-to-end orchestration, CSPs can enable their businesses to become indispensable in the new value chain.

E2ESO provides a framework upon which CSPs can build their transformed operations for the next era of telecoms. It provides a way to

ensure that projects stay on track and deliver value, even while the transformation is still ongoing. In addition, as part of E2ESO, operational benefits will be gained from having closed loop operations that see beyond a specific domain. This means early results can be achieved, some services can be launched now and the transformation can be managed in a controlled, step-by-step process. The rewards can come without the need for the final end state to be achieved.

All-embracing end-to-end service orchestration should be - and is - the ultimate destination for CSPs because it offers so much more capability than simply focusing on only the necessary solutions to

support a single offering. E2ESO capabilities can support all offerings but don't expect too much too soon. Instead, build up to E2ESO by targeting functions and capabilities to upgrade, amalgamate the advantages of each and continue on your transformation path. Assembling the complete E2ESO vision will transform operations and enable new opportunities beyond connectivity for CSPs.

IMPLICATIONS AND MARKET DYNAMICS

Considerations for operators

- **Take advantage of the 5G upgrade cycle.** Operators who are just beginning their 5G deployments, and those who are moving on 5G evolutions – including standalone 5G and 5G-Advanced – need to include E2ESO considerations in their roll-out plans. New network generations provide an opportunity to integrate new network innovations, and E2ESO will be important for executing on some of 5G's fundamental value propositions.
- **Orchestrate the B2B monetisation strategy.** For many operators, a focus on B2B sales and enterprise vertical demands is a core component of their revenue growth plans. 5G use cases, in particular, speak to vertical-specific requirements, but it will take much more than just 5G to meet those requirements. To deliver on demanding enterprise use cases involving secure, high bandwidth and low latency connectivity alongside cloud provisioning, for example, services will need to orchestrate network assets. If not

already part of B2B service strategies, any new B2B initiatives can be used as a trigger to investigate, and invest in, E2ESO capabilities.

- **Beware silos.** Where operators call out “uncertain internal ownership” as a top obstacle to the deployment of technologies such as Open RAN, Network API Exposure and Network Automation, the message is clear; domain-specific business priorities and “turf battles” represent a potential barrier to leveraging important innovations. To prevent siloed-thinking from holding back E2ESO, C-Suite buy-in and leadership is key.

For enterprises

- **E2ESO as buying criteria.** With B2B sales as a strategic objective for many operators, there is no shortage of options for enterprise verticals looking to leverage advanced connectivity technologies like 5G. In selecting an operator partner, enterprises need to look beyond connectivity technologies and include service orchestration capabilities as a deciding factor.

- **Orchestration vs. 5G.** From the outset, an ability to support diverse enterprise service requirements was one of 5G's key values, embodied in support for low-latency communications and massive IoT. Yet, despite 5G's ability to deliver impressive functionality, enterprises need to recognize the importance of orchestration. To this end, 4G combined with E2ESO with 4G may be a better solution for some use cases.
- **Orchestration vs. APIs.** As network API exposure matures and gains commercial momentum, enterprise verticals will naturally look to initiatives like Open Gateway to tap into network capabilities in support of specific service and application requirements. Working with API aggregators – including cloud players, CPaaS suppliers, and network infrastructure providers – may be a simple way to begin, benefitting from the extended reach and developer support these players offer. Ensuring that the aggregator selected can support E2ESO in order to support diverse functionalities and charging models is critical.



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