



UNLOCKING THE MOBILE PRIVATE NETWORKS OPPORTUNITY: AMDOCS' SOLUTIONS FOR COMMUNICATION SERVICE PROVIDERS

*Jake Leo Gergs, Principal Analyst
Dimitris Mavrakis, Senior Research Director*

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CONTENTS

- INTRODUCTION: THE STATUS QUO OF THE TELCO INDUSTRY** 1
- MOBILE PRIVATE NETWORKS FOR ENTERPRISES**..... 3
 - A LOOK AT THE NUMBERS—WHAT IS AT STAKE FOR CSPS?..... 3
 - DIFFERENT DEPLOYMENT MODELS FOR DIFFERENT USE CASES 4
- MAIN CHALLENGES IN BRINGING CELLULAR CONNECTIVITY TO ENTERPRISES** 5
 - TECHNOLOGY CHALLENGES 5
 - BUSINESS CHALLENGES..... 6
- THE ROLE OF AMDOCS IN PROVIDING PRIVATE 5G NETWORKS**..... 7
 - INTEGRATING & MANAGING MULTI-VENDOR NETWORKS..... 8
 - BRIDGING THE GAP BETWEEN TELCO AND ENTERPRISE 9
 - AMDOCS' AUTOMATION PRODUCT PORTFOLIO FOR PRIVATE CELLULAR NETWORKS 9
- CONCLUDING REMARKS** 12

INTRODUCTION: THE STATUS QUO OF THE TELCO INDUSTRY

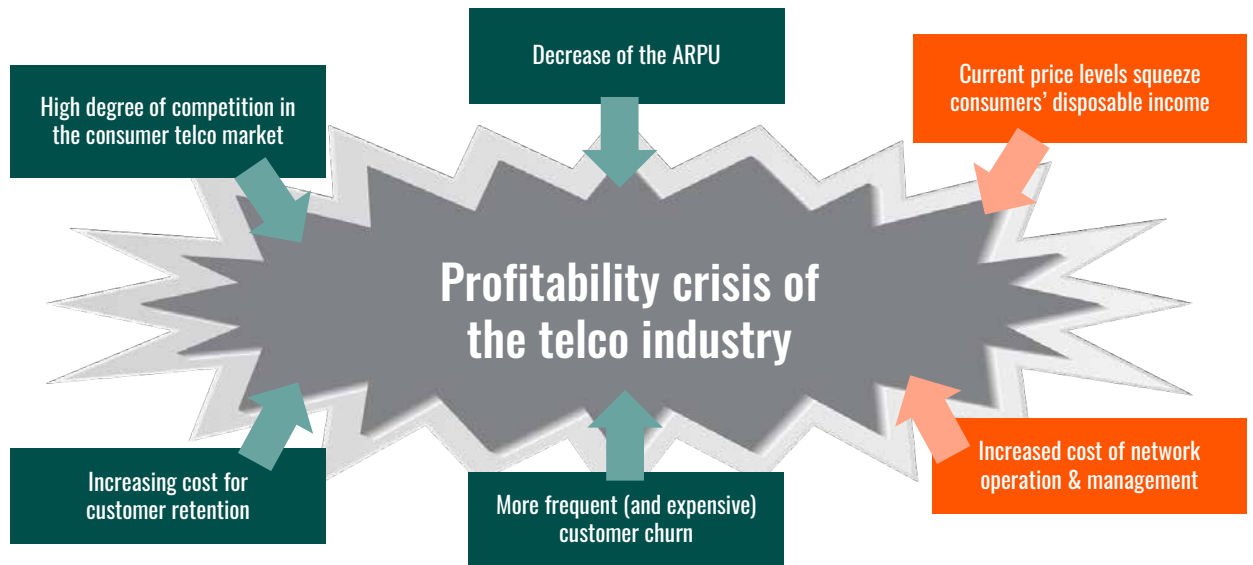
The world has experienced significant turmoil over the past few years, with the COVID-19 pandemic, the Ukraine-Russia war, geopolitical tensions, and rising inflation challenging consumers and enterprises alike. Many companies are reassessing their future financial guidance to be more moderate and in-line with these ongoing challenges. Regardless of these challenges, a stable foundation for the operation of both consumer and enterprise markets has been telco networks, which operated flawlessly throughout the pandemic, when most employees had to work from home. Since then, there has been renewed national interest in maintaining high-quality telco networks, while ensuring that wired and wireless communications continue creating opportunities in consumer and enterprise domains.

At the same time, the telco industry faces a revenue crisis. Because of the degree of competitiveness in the consumer market, it is nearly impossible to generate new revenue or increase the Average Revenue per User (ARPU)—even through introducing new services. This becomes even more important as current macroeconomic conditions squeeze consumers' disposable incomes. Consequently,

their willingness to pay higher prices for telco services will decrease further. While Communication Service Providers (CSPs) have had to experience this for some years already, the effect is now also trickling through to telco network infrastructure vendors—as they realize that CSP investments in consumer macro network deployments are decreasing everywhere but in India.

Figure 1: The Crisis of the Telco Industry

(Source: ABI Research)



As a way out of this revenue crisis, CSPs and telco infrastructure vendors will need to move outside of their comfort zone and embrace the immense opportunity that providing 5G connectivity for enterprises will bring.

Considering enterprise verticals, 5G is much more than just another G. The distinct features of 5G allow for completely new applications for connectivity on the factory floor: Supporting the connectivity of between 1,000 and 1 million devices per square kilometer will enable setting up highly-dense wireless sensor networks, enabling the permanent monitoring of production processes and production machine conditions. The Enhanced Mobile Broadband (eMBB) capabilities (both in the uplink and downlink) furthermore enable automating particularly data-intensive processes (e.g., Virtual Reality (VR) or Augmented Reality (AR) for predictive and preventative maintenance). In addition, the low latency (below 10 Milliseconds (ms)) and the high reliability, as well as the support for Time-Sensitive Networking (TSN) and deterministic networking, make 5G particularly interesting for use on the factory floor.

Even though revenue opportunities are high, the different enterprise verticals are highly fragmented and, therefore, hard to address with a traditional telco approach, and will need a new process of consultative selling and co-development.

MOBILE PRIVATE NETWORKS FOR ENTERPRISES

Mobile private networks are not a recent market development. The concept of combining the carrier-grade nature of cellular networks with the localized deployment that wireless Local Area Networks (LANs) offer has been around for several decades. In the wake of rapidly advancing enterprise digitalization and automation of processes and workflows, cellular connectivity has become more interesting for enterprise use cases. Furthermore, 5G connectivity brings important features such as eMBB, Massive Machine-Type Communication (mMTC), and Ultra-reliable Low Latency Communication (URLLC), which will make cellular connectivity even more relevant for enterprises—particularly for highly critical use cases.

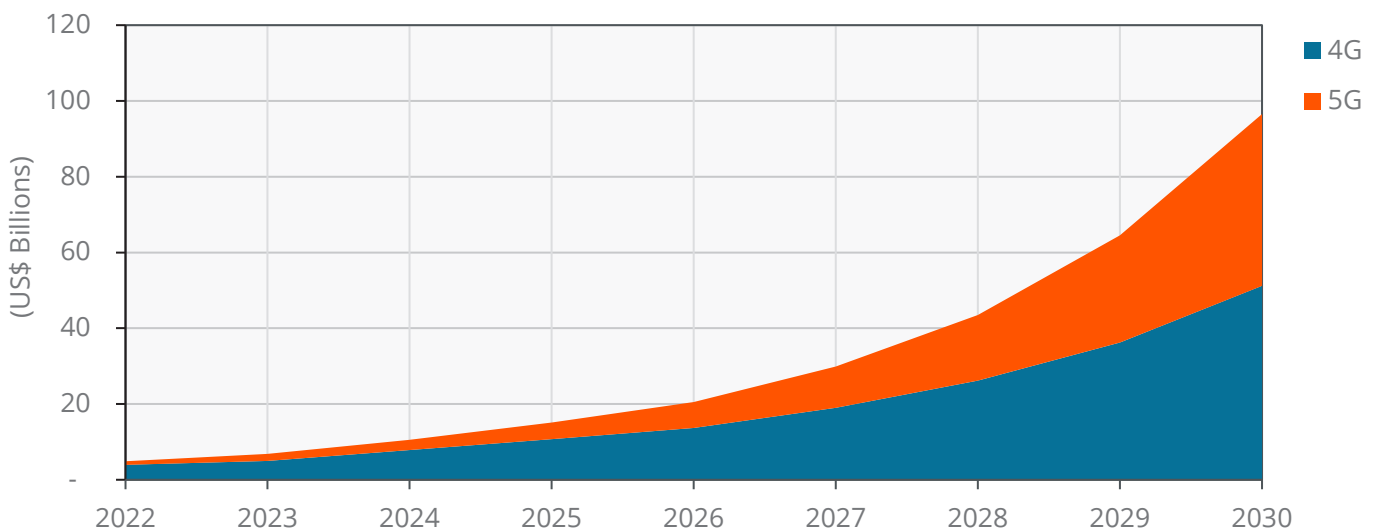
Moreover, the access point and device ecosystem for cellular is currently maturing, allowing enterprise users to take advantage of these economies of scale and reduce the cost of deployment and operation. Several shared spectrum initiatives worldwide give enterprises access to cellular-grade spectrum. However, the majority of licensed spectrum globally is held by CSPs, which gives them an opportunity to play into this domain.

A LOOK AT THE NUMBERS—WHAT IS AT STAKE FOR CSPS?

The mobile private networks opportunity for the telco industry is sizable. As data from ABI Research highlight, the Total Addressable Market (TAM) for private cellular networks will grow to more than US\$100 billion by 2030. As Chart 1 shows, this is primarily driven by 4G Long Term Evolution (LTE) deployments in the short- and medium term, while 5G deployments will take longer to pick up pace.

Chart 1: *Private Cellular Network TAM by Technology
World Markets: 2022 to 2030*

(Source: ABI Research)



The timid uptake of 5G connectivity within enterprises can be primarily explained with the ecosystem of enterprise-grade cellular devices that still needs to mature. Important enterprise-

related 5G capabilities, such as TSN, or the URLLC features—guaranteeing network availability up to 99.999% of the time with data transmission reliability of 99.999%—will require new chipsets and devices that have yet to emerge.



At the same time, 4G LTE connectivity is good enough technology for most present-day enterprise use cases. Within industrial environments, for example, ABI Research assumes that roughly three-quarters of current use cases for connectivity can be served by 4G LTE. As the demand for enterprise connectivity—fueled in part by recent geopolitical events and macroeconomic conditions—is particularly high and enterprises are ready to invest as we speak, it will, therefore, be important to target this opportunity now and offer a smooth upgrade path throughout the deployment process.

DIFFERENT DEPLOYMENT MODELS FOR DIFFERENT USE CASES

From an architectural point of view, there are different ways in which private connectivity can be provided to enterprises. There are three main ways to provide private connectivity to enterprise verticals. First, the enterprise private network could be completely isolated from any public networking infrastructure, which means that all network infrastructure (for core, transport, and Radio Access Network (RAN)) would need to be deployed on the implementers' premises. Second, a private network could be deployed in conjunction with a public network, whereby the private enterprise network shares some of the network infrastructure with the public network. A third option to provide enterprise connectivity is to use 5G network slicing capabilities to dedicate one slice of a public network to enterprise connectivity exclusively. As Table 1 shows, each of these deployment models has different advantages and disadvantages, which need to be carefully assessed against the exact requirements of the respective enterprise toward cellular connectivity.

Table 1: Advantages and Disadvantages of Different Mobile Private Network Deployment Models

(Source: ABI Research)

| |  |  |
|--|---|---|
| Dedicated Private Network | <ul style="list-style-type: none"> ▪ Full control over network functions & performance ▪ Full ability for network customization ▪ Maximum degree of data integrity ▪ Full guarantee of non-interference | <ul style="list-style-type: none"> ▪ Cost & resource-intensive deployment ▪ Solid partnership strategy needs to be in place ▪ No guaranteed connectivity beyond enterprise sites |
| Hybrid Network | <ul style="list-style-type: none"> ▪ Data integrity can be guaranteed through local breakouts ▪ Connectivity beyond enterprise sites ▪ Public network resources drive down cost and increase network efficiencies | <ul style="list-style-type: none"> ▪ Roaming arrangements between private and public network providers ▪ Devices need to support two networks ▪ Growingly complex management and customization |
| Renting a Slice of the Public Network | <ul style="list-style-type: none"> ▪ Competitive price point, as no additional infrastructure needs to be deployed. | <ul style="list-style-type: none"> ▪ End-to-end slicing for maximum control over network functions, integrity, and interference can be challenging to implement. |

Targeting the enterprise verticals certainly brings a sizable new revenue opportunity for the telco industry.

The optimal deployment architecture depends on respective enterprise requirements and investment opportunities. For particularly large enterprises with high investment capabilities, for example, a fully dedicated private network could be best suited to serve for highly critical use cases. In addition, large enterprises have the staffing capabilities to integrate different connectivity infrastructure and operate the mobile private network.

At the same time, Small and Medium Businesses (SMBs) often have to work with tight budgetary controls that prevent large Capital Expenditure (CAPEX) investments. Using some public network resources can provide more cost-efficient deployments. In addition, these hybrid network deployments can—with the right arrangements in place—provide seamless connectivity for enterprise devices even beyond the enterprise premises. This can enable important use cases such as supply chain monitoring or goods tracking and will, therefore, provide additional incentives for enterprises to deploy cellular connectivity. This is why—over time—a hybrid network deployment that combines both public macro network assets and dedicated enterprise equipment will be the most prominent deployment model.

MAIN CHALLENGES IN BRINGING CELLULAR CONNECTIVITY TO ENTERPRISES

Targeting the enterprise verticals certainly brings a sizable new revenue opportunity for the telco industry. At the same time, however, the enterprise landscape is a lot more fragmented than the consumer domain. Not only do the requirements differ between enterprise verticals, but even within the same verticals, enterprises will have varying surrounding conditions that shape their individual requirements toward cellular connectivity. Consequently, successfully targeting the enterprise verticals business requires a consultative sales/deployment approach in which telco connectivity suppliers should aim to design and plan the final offering together with enterprises to be able to tweak to meet their exact requirements.

TECHNOLOGY CHALLENGES

As the discussion in Section 2 highlighted, deployment options for private cellular connectivity for enterprise verticals will be somewhat more complex than providing a cellular macro network for consumer use cases. This will result in additional challenges when it comes to the complexity of deployments. This will not only mean choosing the right deployment model for each enterprise installation, but also—and arguably more importantly—what network functions shall remain on enterprise premises and what can move off-premises into public/private cloud or telco network assets.

Fundamentally, enterprises approach 5G deployment projects from a pain-point focused perspective. Industrial digitization projects will likely be driven by a desire to increase Overall Equipment Efficiency (OEE) and the quality and output of workflow processes. From a technology perspective, this observation carries two important implications. First, enterprise implementers typically approach digitization projects with a technology-agnostic perspective. They will deploy a multitude of different connectivity technologies based on what is best suited for different use

cases. Consequently, this will lead to a multitude of different connectivity technologies present on-premises, which an enterprise 5G system will need to be able to integrate to be appealing to enterprises.

Second, the pain point-focused approach means that enterprises are looking for full End-to-End (E2E) digitization solutions, rather than just a private cellular network. Most importantly, this requires integrating the connectivity element with other infrastructure assets (e.g., the edge and cloud), as well as enterprise-grade applications. This requires opening the private cellular network to the developer community for enterprise-grade applications. At the same time, this requires successful providers of private cellular networking solutions to be able to integrate these enterprise applications into a fully-fledged solution.

Finally, enterprises are looking for easily deployable and manageable connectivity solutions, rather than building up traditional telco knowledge themselves. In addition, enterprises require one company as their central interface to introduce connectivity solutions. Especially with the regard to hybrid—or public network integrated non-public network—deployments, this means that a supplier of private 5G solutions to enterprises requires extensive technology skills in translating enterprise use cases and requirements into the most efficient deployment model, and skills in designing dedicated enterprise infrastructure (e.g., edge or private cloud assets) that can be integrated into public network assets (e.g., macro core network or telco/public cloud assets). As such, successfully bringing cellular connectivity to enterprises requires a much larger technology skillset than pure cellular connectivity expertise.

An enterprise point of view, a monetizing model for private network deployments should be built around OPEX, rather than CAPEX.

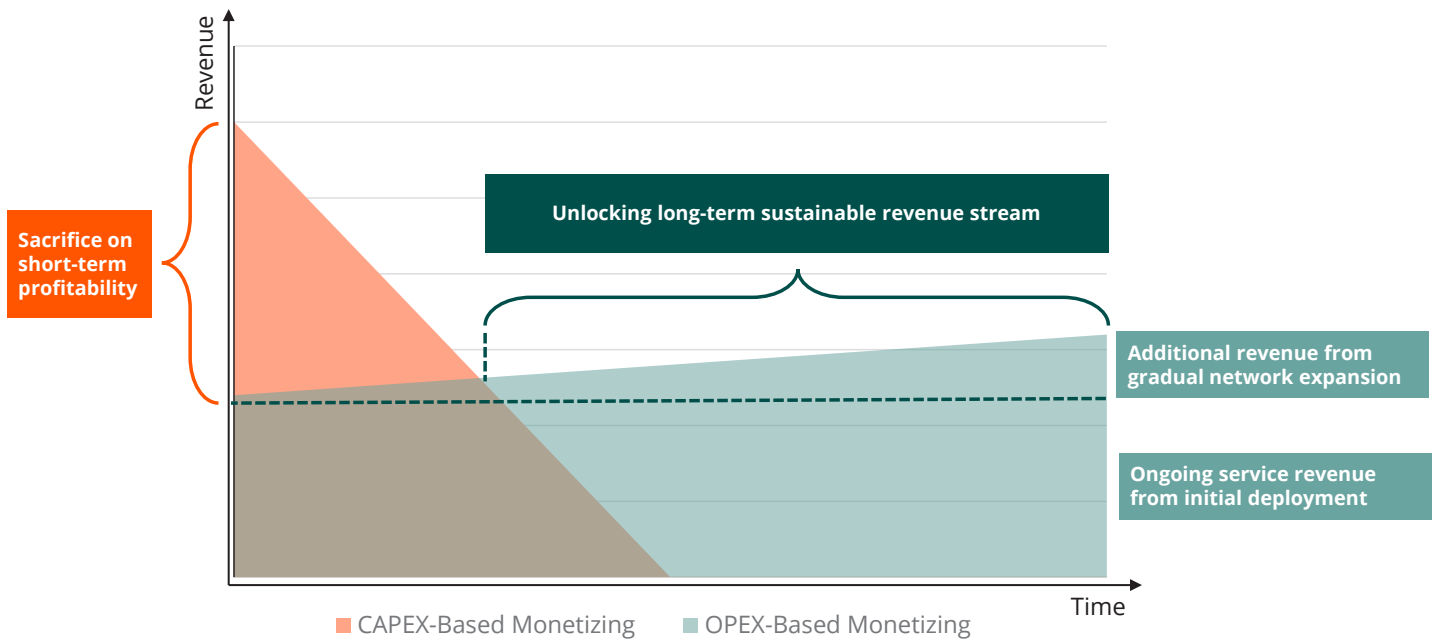
BUSINESS CHALLENGES

In addition to technology aspects, enterprise verticals also require a different business model and monetizing strategy from what is well known in the consumer domain: Enterprises are governed by tight budgetary controls and their opportunities to invest large amounts of money into deploying connectivity infrastructure are very limited. Therefore, from an enterprise point of view, a monetizing model for private network deployments should be built around Operational Expenditure (OPEX), rather than CAPEX. This allows enterprises to ensure that they are paying for exactly what they are using, minimizing enterprises' risks for bad investments.

A shift in monetizing strategies has important implications for the telco industry and the supply side of private networks, as it shifts the profitability horizon and increases the time frame to reach a Return on Investment (ROI). While in a CAPEX-based monetizing strategy, the largest revenue stream would come in at the beginning of a deployment, an OPEX-based strategy would even out this development. Therefore, private network providers should revisit their Profit & Loss (P&L) culture, as an OPEX-based monetization could unlock a long-term sustainable revenue stream at the expense of short-term profitability. Furthermore, enterprises will look to deploy a private network that will gradually expand, so OPEX-based monetization will enable additional revenue generation from upselling. Figure 2 highlights the key differences between an OPEX- and a CAPEX-based strategy.

Figure 2: OPEX-Based versus CAPEX-Based Monetizing Strategies

(Source: ABI Research)



In addition to challenges regarding the business model, delivering and managing mobile private networks can also be difficult for CSPs from a business infrastructure point of view. Due to their highly fragmented organizational structure, deploying and managing a mobile private network often spans multiple different CSP teams, increasing the cost and time of private network delivery.

THE ROLE OF AMDOCS IN PROVIDING PRIVATE 5G NETWORKS

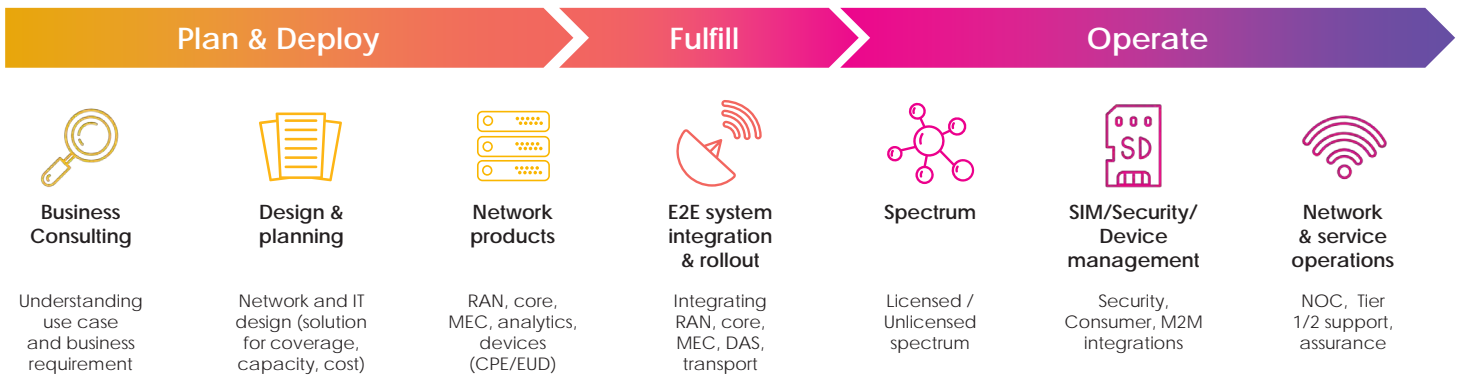
Against this backdrop, both Mobile Network Operators (MNOs) and telco infrastructure vendors can benefit from potent partners with profound experience in integrating different networking components and automation capabilities for CSPs. Amdocs can be an important partner to help them target the private cellular network opportunities with different enterprise verticals.

Its experience in automating, easing, and streamlining Operations Support System (OSS)/Business Support System (BSS) processes for CSPs equips Amdocs with valuable tools to support the very same telco actors in deploying mobile private networks as well.

Furthermore, its experience in working across different telco domains for successful RAN and core deployments, operation, and optimization equips Amdocs with the necessary toolset to bridge different silos within CSPs to offer full E2E support for private networks deployments, as depicted in Figure 4. The offering extends from planning and deploying, through fulfilling/commissioning to operating the enterprise private cellular network.

Figure 4: Amdocs' Private Networks Offering

(Source: Amdocs)



INTEGRATING & MANAGING MULTI-VENDOR NETWORKS

As a result of enterprises' technology-agnostic approach—and the fact that enterprises will leave any currently existing connectivity solution in place—there will be multitude of different connectivity technologies present on an enterprise site. This will require extensive integration and network management skills, which Amdocs can provide as part of its private networks offering. Specifically, Amdocs offers a range of network and system integration services that will ease private cellular networks deployments for both the implementing enterprise and the suppliers of private networking solutions.

- **Industry Vertical Consultation and Business Planning:** As a starting point, Amdocs will look at different enterprises' pain points and desired outcomes. Leveraging its profound expertise in specific industry verticals, this will then determine the appropriate private network solution and technical requirements.
- **Network Planning and Design:** As part of the conceptual stage, Amdocs can provide an in-depth analysis of use cases and translate that into technology requirements. Based on this analysis, Amdocs will select the appropriate wireless connectivity solution.
- **Network Deployment:** Amdocs can provide E2E engineering services. These include planning, design, integration, and optimizing components across the RAN and core domains, as well as software-powered automation for faster and more efficient rollouts.
- **Solution Management:** Amdocs can offer the full portfolio of network management solutions. This includes network assurance, Network Operations Center (NOC) management, triage, and Service-Level Agreement (SLA) management—all based on advanced network monitoring and analytics tools.
- **Spectrum Management:** Amdocs' management solution also helps navigate spectrum options (dedicated, shared, rented) and choose the right RAN vendor to support specific bands. In the United States, Amdocs is also a Federal Communications Commission (FCC)-approved vendor for the Citizens Broadband Radio Service (CBRS) Spectrum Access Systems (SAS), providing capabilities such as Radio Frequency (RF) channel allocation and interference protection.

In addition, Amdocs implemented all these considerations into its multi-vendor Single Pane of Glass (SPOG) solution, which is discussed in more detail in Section 4.3.

BRIDGING THE GAP BETWEEN TELCO AND ENTERPRISE

Early market observations and extensive discussions with implementing enterprises highlight an important gap between the traditional telco industry (especially MNOs) and these enterprises—especially in the industrial environment. This gap shows itself in several ways: First, network operators often do not speak the same language as enterprise implementers. Ultimately, this results in a value proposition that is either too telco-specific for enterprises to digest or does not touch upon the relevant aspects and, therefore, appears irrelevant to enterprises.

Second, enterprises do not perceive network operators as trustworthy—particularly when it comes to highly critical Operational Technology (OT) data. At the same time, there is growing demand for partnerships around network management and operation, as most enterprises currently do not hold any expertise in managing and operating telco network infrastructure. They are also willing to acquire this expertise and invest in hiring people around it. By providing the implementing enterprise with an offering that speaks their language—addressing their pain points, requirements, and their key concerns around Quality of Service (QoS) and SLAs—Amdocs can provide the network operator community with the ties toward implementing enterprises. At the same time, the ability to translate enterprise use cases and pain points into technology requirements will help drive network operators closer toward the enterprise opportunity and will, therefore, be of utmost importance.

At the same time, enterprises require partners with specific telco knowledge when it comes to operating and managing their private network. In particular, mid-sized enterprises (even the size of multinational chemical manufacturers or airport operators) are neither willing, nor do they have the capability to acquire this telco expertise for their own enterprise structures. Key capabilities of network operators are, therefore, highly sought after by the enterprises. They just need to be packaged into a full E2E digitization solution. This is where Amdocs with its large partnership network across different industries and its deep roots in supporting network operators with their RAN and core deployments, operations, and optimization can help enterprises bring these capabilities together.

AMDOCS' AUTOMATION PRODUCT PORTFOLIO FOR PRIVATE CELLULAR NETWORKS

Wireless connectivity presents significant challenges for optimizing IT and OT processes. This is especially true in private networks, with their abundance of devices and diverse technologies. As enterprises do not possess telco-specific networking knowledge, any connectivity solution needs to be easy to deploy and manage. Increasing network automation can, therefore, become an important building block to ease the complexity of private cellular networks for enterprises.

In this context, a simplified user interface is particularly important to enable enterprises to retain maximum control over their private cellular network without having to invest too much time and

The ability to translate enterprise use cases and pain points into technology requirements will help drive network operators closer toward the enterprise opportunity and will, therefore, be of utmost importance.

financial resources to acquire telco-specific knowledge and networking expertise. This is where Amdocs can support network operators to address enterprises with appealing private cellular networks offerings.

First, Amdocs' existing OSS product portfolio, especially its Intelligent Network Suite (INS), could be relevant for CSPs to manage at scale if they consider providing private cellular in the same way they treat providing Ethernet Lines (E-LINES), Secure Digital Wide Area Networks (SD-WANs), and Virtual Private Networks (VPNs) for enterprises—as pure connectivity element. Furthermore, Amdocs' OSS capabilities will become interesting for CSPs offering and monetizing network slicing. Offering services and applications such as network orchestration, network exposure, and network monetization, the INS can assist CSPs with streamlining their own mechanisms.

To help CSPs harness the mobile private networks opportunity, Amdocs developed its Network Platform for Operations (NPO) with a SPOG solution. The SPOG aims to ease the complexity of bringing wireless connectivity to enterprises with agile monitoring and unified visibility across hybrid networks, LTE/5G, transport, Wi-Fi, and IoT devices. The solution (which is driven by Application Programming Interfaces (APIs)) supports the entire spectrum from planning and deployment to operations, which enables managing complex multi-tenant environments and empowering enterprise customers to enhance network efficiency. More specifically, Amdocs' SPOG offering includes the following elements:

- **Mediation:** Bi-directional integration with the Network Management System (NMS)/Element Management System (EMS), aggregating data from diverse sources, including Performance Management (PM) counters, alarms, and trouble tickets.
- **Multi-Domain, Multi-Technology, Multi-Vendor Performance and Fault Monitoring:** Real-time tracking of network Key Performance Indicators (KPIs), offering trend analysis and insights at the network element level; comprehensive monitoring of network and service faults, enabling intelligent threshold application for fault detection and analysis.
- **Device Management:** Network configuration and comprehensive monitoring.
- **Configuration Oversight:** Audits network data, highlights inconsistencies, supports multiple vendors, and facilitates corrective actions to rectify misconfigurations.
- **Dashboard & Visualization:** User-friendly portal for network overview, KPI-based grouping, failure analysis, and trouble ticket correlation.
- **User Control:** Enables comprehensive management of authentication, user rights, configuration, and network performance settings.

As any successful mobile private network solution should have, the Amdocs SPOG offering carries some distinctive features that will allow CSPs to configure mobile private networks tailored to different enterprise requirements.

- **Open APIs:** Northbound for external systems; southbound for element management.
- **Modular Framework:** Based on International Organization for Standardization (ISO) models for network management considering the fault, configuration, accounting, performance, security (FCAPS) domains. In addition, there are extensions for device, subscriber, and Embedded Subscriber Identity Module (eSIM)/Integrated Subscriber Identity Module (iSIM) card management.
- **Multi-Vendor Support:** Correlates events, providing intelligent support across vendors.
- **Comprehensive Insights:** Full stack views, service availability, and performance monitoring.
- **SLA Management:** Monitors and manages SLAs.
- **Optimization Recommendations:** Provides suggestions for network operators to optimize the mobile private network deployment.

Figure 5: The Benefits of a Single Pane of Glass Solution for Mobile Private Networks

(Source: Amdocs)



CONCLUDING REMARKS

As the revenue crisis of the telco industry in the consumer sector will, if anything, become more severe, the need to identify new revenue streams will grow more important. In particular, CSPs, which will be affected by revenue slumps from the consumer domain as the most immediate party, need a way out of this revenue crisis—sooner rather than later. Providing mobile private networks for enterprises can be an escape route and CSPs should be prepared to take it. To be successful in this new enterprise domain, CSPs need to bear in mind two general aspects.

ENTERPRISES DEMAND APPLICATIONS INSTEAD OF CONNECTIVITY AS SUCH

Enterprises are not networking experts and have their own pain points to solve. Consequently, they are interested in applications, and not so much in the underlying connectivity technology. To be successful in the enterprise domain, a private networking solution needs to be focused on business outcomes and applications. Not only does this require CSPs to adjust their value proposition considerably (from a traditional “connectivity first” to an “outcome first” approach), but more importantly, it requires partnering with different application developers and software vendors.

THE ENTERPRISE BUSINESS VERTICALS ARE EXTREMELY FRAGMENTED

Different enterprise verticals have different requirements for mobile private networking solutions based on their specific pain points and use cases. In addition, individual enterprise verticals have their own well-established supply chains for enterprise digitalization solutions. In this context, CSPs need to be careful not to diversify too thinly into separate verticals, but to provide the mobile private networks as a platform, so that sales scale easily—even across different verticals. Applications can then be provided in a modularized approach on top of that.

To deliver mobile private networking solutions to enterprises, CSPs need assistance and broad ecosystem support. As this whitepaper has laid out, Amdocs’ legacy and product portfolio can provide CSPs with the necessary tools to deploy mobile private networks, managing and operating them for respective enterprises in the most cost-efficient way.



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157 Columbus Avenue 4th Floor

New York, NY 10023

United States

Tel: +1 516-624-2500

www.abiresearch.com

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