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WHITE PAPER FOR AMDOCS

MARKET PULSE: DIGITAL TRANSFORMATION OF BSS/OSS TO THE CLOUD & DEVOPS

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1. Executive summary

"Software is moving to the cloud" is an oft-repeated phrase today. But just how fast are today's business support systems (BSS) and operations support systems (OSS) making that move? This white paper characterises that movement. It is based on surveys and in-depth discussions between Analysys Mason and mostly top-tier communications and media service providers (CSPs) in North America, Asia–Pacific and Europe. Although most top-tier CSPs are using new cloud technologies, we found that only a few are progressing rapidly, mostly due to their legacy software, people and processes. We expect that those few leaders which have emerged will become much more agile and cost effective in their operations, opening a gap between them and their competitors. Our assessment of BSS/OSS cloud maturity today, and how it is likely to evolve over the next five years can be seen in Figure 1.

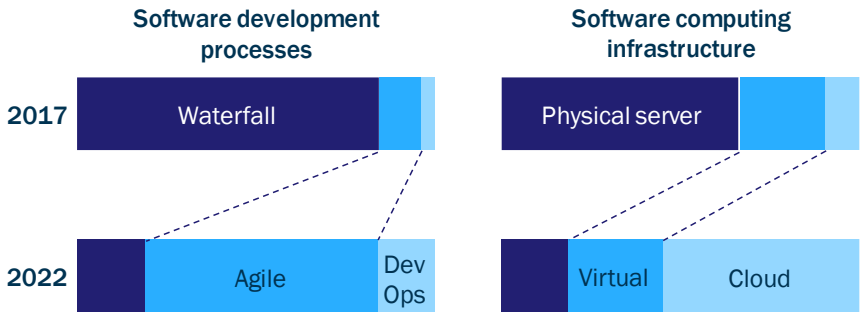

Figure 1: Estimation of BSS/OSS cloud maturity today and in five years' time [Source: Analysys Mason, 2017]

Our research indicates that movement to the cloud is best characterised by three major aspects:

- **Software development and implementation processes – DevOps:** moving from waterfall through agile to leading-edge DevOps processes. This includes the concept of continuous integration/continuous deployment (CI/CD). We found DevOps to be part of most CSPs' IT organisations, but not widely deployed. The transition to DevOps will put stress on IT organisations, which will have to live with bi-modal, or even tri-modal operations organisations.

- **Software technological infrastructure – cloud-native architecture & microservices:** transitioning from monolithic software architectures to a modern loosely coupled software architecture called "cloud native." This includes the concepts of automatic scaling in cloud environments, enhanced reliability and microservices. These characteristics are highly desired by CSPs, and CSPs are deploying them today in the new digital parts of their BSS/OSS architectures.

- **Software computing infrastructure – cloud computing:** the move from on-premises dedicated processors to virtualised private data centres is well underway, aimed at reducing data-centre costs. BSS is leading the movement to true cloud deployment (private, public or hybrid cloud), enabling CSPs to pick up further benefits. OSS is following, driven by network function virtualisation (NFV). But the movement of OSS to cloud deployment will happen slowly, due to the large legacy system infrastructure.

The need to "stretch" IT organisations to accommodate both legacy and leading-edge software will strain CSPs' resources. CSPs view both systems integrators and software vendors as key partners in making the transition to the cloud, which will require major changes to the IT organisational structure and to the skill sets of personnel.

The move to these new technologies will be accomplished through a combination of new systems and refactoring of legacy systems to introduce the new software technology.

Amdocs has developed a cloud maturity model for communications and media service providers. It provides a detailed framework for understanding the three major aspects of the move to cloud, while enabling service providers to assess where they are in the journey and the benefits they would gain from progressing further (see Appendix A). This white paper provides timescales for mainstream adoption of the various steps in the model, based on market data collected by Analysys Mason.

2. Competitive advantage through the cloud

2.1 Cloud is a key pillar of competitive advantages enjoyed by web-scale companies

Web-scale companies that have grown up in the cloud environment, over the last ten years, have evolved software development processes, software architecture and software deployment infrastructures. These elements have been applied to the business platforms that form an intrinsic part of their business – in fact, in many ways they *are* the business. It is impossible to imagine Uber without its ride-sharing software,[1] Netflix without its video streaming engine,[2] or Amazon without its recommendation system. These systems bring tremendous economies of scale through an integrated, highly automated software platform that incorporates all of the processes of the business. These companies, and others like them, have pioneered new ways of designing, developing and deploying software to give them great agility in their business, yet large economies of scale. There are three particular areas which characterise this new way of doing business: DevOps processes, cloud-native software architectures and cloud deployment, as discussed below.

Web-scale companies pioneered DevOps processes

Google operates some of the most reliable data centres in the world, which are key to ensuring that its services are 'always on'. The core principles of Google's operations are encapsulated in the company's site reliability engineering paradigm, which espouses the idea of building software products with an operations mindset. This philosophy, more popularly known as DevOps and widely adopted by other web-scale companies such as Amazon, brings the software development and operations functions together right from the start of the product lifecycle. Google's operations team basically consists of a group of software engineers who apply their programming skills to automate repetitive manual tasks, thus removing the business risk of manual errors during operations.

Web-scale companies have built software platforms with cloud-native technologies

Web-scale companies have launched services with a rapid iteration cycle with a high level of resilience for their customers (who outnumber the customer base of most CSPs). This has come from a way of architecting software from the next generation beyond three-tiered client/server technology, known as "cloud native."

Uber originally relied on a monolithic software architecture for its operations, which was designed for a single offering, UberBlack. But as Uber's business footprint expanded across the world, it migrated to a flexible and scalable cloud-native architecture. Key to that new architecture is the concept of microservices, which enable rapid, reliable and independent software releases across regions.

A microservices architecture (see Figure 2) enables the creation of small and highly granular functional software modules (e.g. performance analysis, log analysis, reporting) that can be used to compose applications (e.g. a service quality monitor, or an application for dispatching engineers). By its nature, a microservice is self-contained and highly available, enabling it to be configured, scaled, enhanced and replaced independently without affecting the availability and reliability of the cloud-native applications of which it forms a part.

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1 Uber, through its cab-hailing and car-sharing platform, provides 40 million rides per day across 633 cities in 78 countries without owning a single vehicle. Uber's valuation was over USD70 billion in June 2017.

2 Netflix has 120 million hours of video streaming across over 190 countries every day. While Netflix transformed from an online DVD rental business to a subscription-based OTT video business, its arch rival Blockbuster filed for bankruptcy in 2010 and millions of US households cut the cord on expensive cable-TV packages. Netflix's market capitalisation was just over USD600 billion in June 2017.

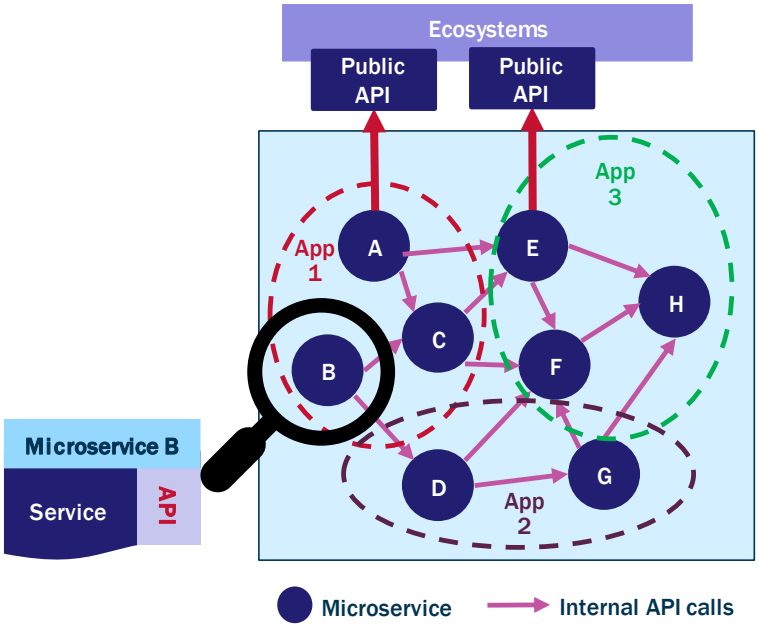


Figure 2: Microservices architecture [Source: Analysys Mason, 2017]

However, if such an architecture is to function effectively, the microservices must interlink and communicate with one another using application programming interfaces (APIs). APIs are one of the most powerful features of microservices, which enable them to be dynamically called by other microservices as part of a larger application. Security, quality of service, service call metering, transaction management and other functions are managed by smart API frameworks and gateways.

Web-scale companies deploy business platforms in the cloud

Web-scale companies all deploy their business platforms on virtualised data-centre infrastructures that have the advantage inherent lower cost and automatic scaling and reliability features. Some are using private clouds, while others use public clouds. For instance, Netflix migrated all aspects of its streaming services – ranging from customer-facing services to billing infrastructure – to Amazon Web Services between 2008 and 2016; in contrast, Alibaba, the Chinese e-commerce behemoth, started building its public cloud services in 2009 and now runs most of its core applications on Alibaba Cloud.

Without software that is *designed* for the cloud (not just "cloud ready"), it is difficult for web-scale companies to achieve the required reliability, however.

2.2 CSPs face special challenges in adopting cloud and DevOps

In the past, it was widely believed that non-telecoms software could not provide the reliability and scalability required for CSPs' operations. Today, however, web-scale companies operate at sizes and transaction rates that exceed those of CSPs in some areas, and the reliability of their operations has vastly improved. Nevertheless, there are still some critical differences between web-scale companies and CSPs, due to their heritage.

Legacy

While young web-scale companies have recruited mostly young people and implemented the latest software that they largely wrote themselves, CSPs have a substantial legacy of both. Their software systems are a patchwork of home-grown systems and systems bought from a large number of vendors over a long period of time (some more than 30 years ago). This puts a special burden on CSPs in terms of upgrading both these systems and the skills of their staff. CSP businesses have many 'moving parts' that require substantial planning, execution effort, as well as capex and opex.

Regulation

Web-scale companies are only lightly regulated, whereas CSPs face extensive regulatory oversight, much of it from decades ago. Regulations – especially those relating to consumer privacy – restrict storage methods and geographical data placement, while privacy concerns severely limit how CSPs can use customer information.

Organisational structure

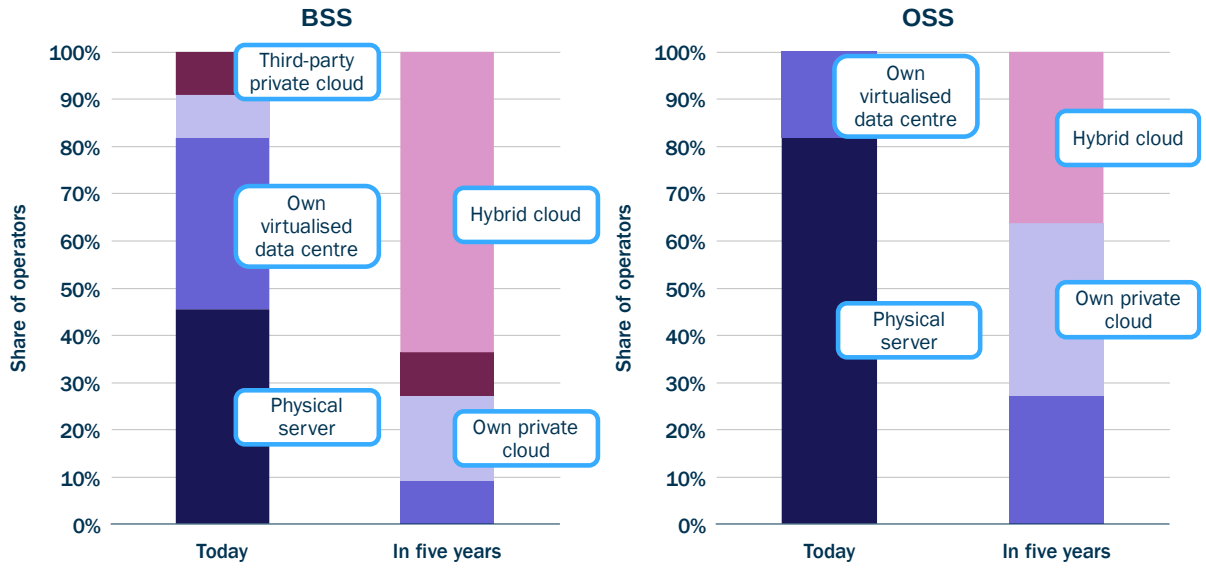
CSPs are organised in many silos, associated with function, customers served and technologies employed. Each of these different organisations within a CSP has been working for decades to automate its activities. As a result, it is difficult to fund and implement modern, automated processes that transcend the boundaries between the individual silos. In contrast, web-scale companies are organised around their software platforms, which follow business process flows, free from the silo effect.

3. Survey and interview results – transition to the cloud is inevitable, but will take time

3.1 CSPs will move their B/OSS stacks to hybrid and private clouds to reduce costs

Data centres are rapidly virtualising and automating the administrative processes which support BSS and OSS applications. Although both BSS[3] and OSS[4] are moving to the cloud, our research shows that BSS is further ahead than OSS. But network function virtualisation (NFV) will accelerate the movement of OSS to cloud computing, as shown in Figure 3.

Figure 3: Location of the majority of BSS and OSS stacks, today and in five years' time [Source: Analysys Mason, 2017]



CSPs expect very few BSS and OSS to run in a public cloud – hybrid cloud will dominate in BSS

CSPs stated that concerns over data privacy were a primary factor that will stop them from moving to public clouds, making the option of hybrid cloud popular. A CSP's applications can only be run in a public cloud if it is deployed as SaaS, or a managed service.

3.2 Most CSPs are implementing DevOps cloud processes and architectures in selected new areas

Almost all the CSPs that we contacted said they do have teams using DevOps and developing cloud-native architecture – but only in selected areas. Several expressed some scepticism that DevOps will establish itself as

3 BSS are those systems that support the business and customer operations. They are usually considered to include revenue-management and customer-care systems.

4 OSS are those systems that support the service and network operations. They usually include service fulfillment, service delivery platforms, element and network management systems (EMS and NMS), and a new generation of network orchestration systems.

best practice for all domains, citing traditional assumptions regarding the quality advantages of separating development from testing and deployment. This shows that there is still an ongoing mind shift among CSPs.

Many CSPs are still migrating from waterfall to agile, with DevOps trials limited to a small scale

Many IT organisations still use waterfall methodology, but they do wish to move to agile processes, which they feel have been proven. DevOps is mostly being used in new areas of software development, especially in digital experience areas such as portals, connecting both internal resources (such as catalogue or ordering) and external resources (such as suppliers and partners).

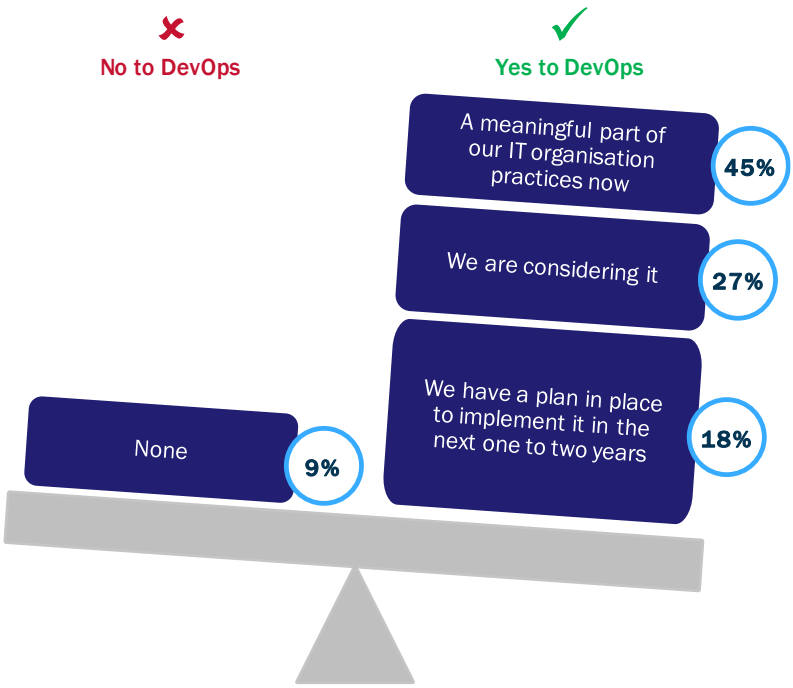
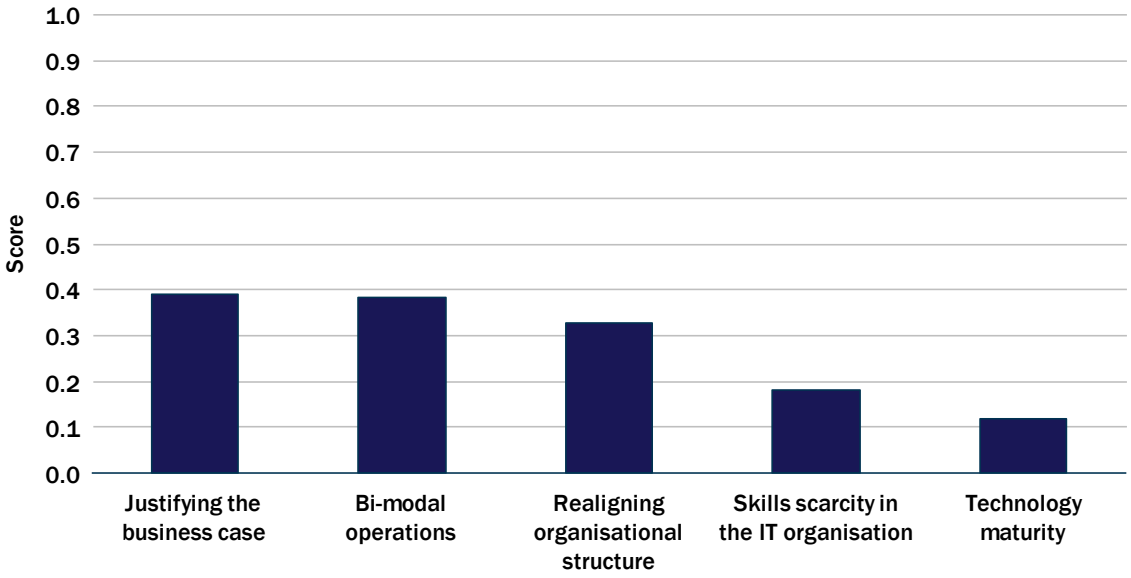


Figure 4: Level of adoption of DevOps by CSPs [Source: Analysys Mason, 2017]

The need to justify the business case and a lack of organisational readiness are inhibiting DevOps implementation

A number of factors are in play which inhibit the wider roll-out of cloud-native architecture and DevOps processes, as shown in Figure 5. The need to justify the business case for the move and the difficulty of running bi-modal operations are tied as the largest inhibitors. The need to reorganise the current siloed structure of IT organisation and improve skill sets are not far behind.

Figure 5: Pain scores[5] associated with the move to cloud-native architecture and DevOps processes [Source: Analysys Mason, 2017]



Despite their desire for greater business agility (see Figure 6), most CSPs are not yet ready for continuous software releases, which require them to receive new code from vendors and deploy it in their live operation environment every few weeks, over the next two to three years (see Figure 7).

Figure 6: Drivers for adopting cloud-native architecture and DevOps processes [Source: Analysys Mason, 2017]

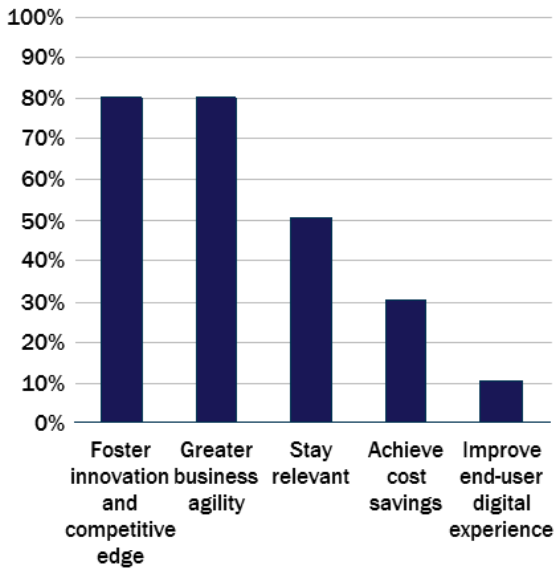
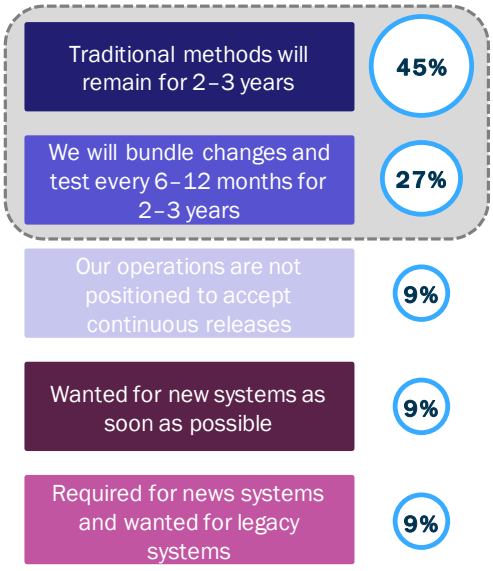


Figure 7: CSPs' view of CICD [Source: Analysys Mason, 2017]



Most CSPs plan to have new B/OSS stacks built on microservice architecture in five years, if not sooner

CSPs are quite aggressive about having new B/OSS stacks on microservice architecture, as illustrated by the survey results in Figure 8 and Figure 9 below. Software application development using microservices

5 CSPs were asked about the top-three 'pain points' they foresee in moving to cloud-native architecture and DevOps processes. The first, second and third pain points were given a score of 1, 0.3 and 0.1 respectively.

architecture is currently the fastest way to develop and deploy software applications, and has matured at the right time to coincide with the digital transformation of CSPs.

Using a microservices architecture in conjunction with DevOps software engineering principles, CSPs can significantly reduce the time needed to apply changes to the operations platform, as well as to develop new code. As a result, they can shorten the time it takes to launch new services to the market.

CSPs are aware of the challenges associated with the transformation to microservice architecture, particularly the integration costs, more-complex interoperability, and the training associated with new functionality.

Figure 8: Migration plan for B/OSS to microservices architecture [Source: Analysys Mason, 2017]

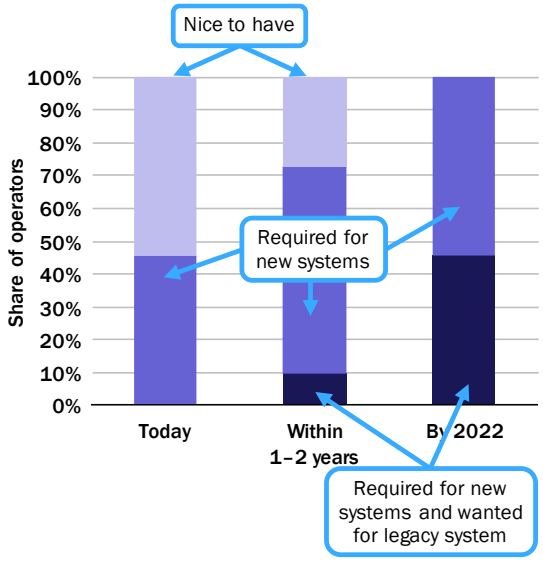
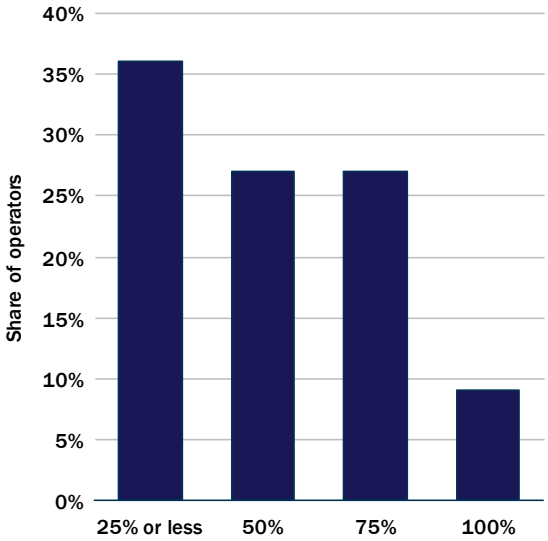


Figure 9: Percentage of CSPs' B/OSS stacks built on microservices by 2022 [Source: Analysys Mason, 2017]



CSPs will have a difficult time managing bi-modal or tri-modal operations

CSPs also realise that it will be challenging to operate traditional monolithic applications alongside new cloud-native applications, referred to as bi-modal operations (see Figure 10). Tri-modal operations, where CSPs simultaneously manage applications developed using waterfall, agile and DevOps methodologies, will also emerge as a major challenge: there will be a long period during which these approaches will co-exist, with a need to ensure that new capabilities offer backwards compatibility with the existing IT ecosystem.

Figure 10: CSP awareness of bi-modal operations [Source: Analysys Mason, 2017]

4. A model for BSS/OSS cloudification over the next five years

When conducting the surveys and interviews, we sought to research the full range of approaches and attitudes, rather than focusing on leading players in the move to the cloud. The primary research data was analysed 'through the lens' of the Amdocs cloud maturity model (see Appendix A). Here we present our findings regarding BSS and OSS cloud deployment in the telecoms market, following the structure of the model.

4.1 CSPs are adopting one of three main approaches to B/OSS cloud migration and digitalisation

Certain CSPs are moving very aggressively to the cloud, making major investments to move quickly and enlisting support from their software vendors. They believe that this transition can give them major competitive advantages, in the form of operational cost and business agility. These CSPs are typically also leading the shift from CSP to digital service provider (DSP), by following digital transformation strategies.

There is a major gap between these few companies and others in the industry. Most CSPs in the second group are currently taking a more gradual approach before making major commitments, and they foresee a graceful migration to the cloud. They are typically making faster progress on the move to cloud infrastructure than on the transition to DevOps. A third group, the sceptics, remain unconvinced of the rationale for moving to the cloud.

A select group of "true believers" are aggressively moving to cloud to compete with web-scale companies

Certain CSPs see themselves gaining competitive advantage from a fast movement to the cloud and cloud technologies. For example, AT&T has embarked on a set of very disruptive endeavours, including: its ONAP[6] programme for network virtualisation, its BSS evolution programme (which made AT&T one of the leaders in digitalisation of customer experience), and its Workforce 2020 project to upgrade the skills of its employees. Others CSPs that have announced major strides include Verizon,[7] Comcast[8] and Vodafone.[9] The approach taken by these leaders should enable them to compete on a host of new digital services, not only with other CSPs, but also with web-scale companies.

Most CSPs take a "hybrid" view, seeing themselves competing primarily with one another and therefore foreseeing a more graceful migration to the cloud

Many CSPs do not feel that the business case for cloud technologies is sufficiently proven to justify highly disruptive moves. They do plan to move to the new technologies, often with considerable help from their vendors, but they are adopting a more graceful path. This approach is not designed to equip them to compete with web-scale players on cost or agility, since they do not see web-scale players as major competitors. This

6 See http://about.att.com/innovationblog/onap

7 See https://www.slideshare.net/apigee/i-love-apis-2015-scaling-mobilefocused-microservices-at-verizon, https://www.google.co.il/url?sa=t&rct=j&q=&esrc=s&source=web&cd=7&cad=rja&uact=8&ved=0ahUKEwj194e8gKLWAhXFSRoKHcZUCyYQFghMMAY&url=https%3A%2F%2Fwww.cloudbees.com%2Fsites%2Fdefault%2Ffiles%2F2016-jenkins-world-verizons_journey_to_enterprise_grade_devops.pdf&usg=AFQjCNGE03o7RQyHS6I-ZD_42RAZzzzkyA and http://www.lightreading.com/nfv/nfv-elements/verizon-demands-better-nfv-answers-from-vendors/d/d-id/723228

8 See https://aws.amazon.com/solutions/case-studies/comcast/

9 See https://www.slideshare.net/OPNFV/summit-16-vodafone-ocean-updates-and-next-steps

group of CSPs tends to see their services as mostly circumscribed by communications services and minor extensions.

The sceptics are waiting and watching

Although all CSPs are studying and experimenting with the new technologies, a sizable minority remain in the sceptic category for now. They are adopting a 'wait-and-see' approach to DevOps, cloud native architecture and cloud deployment for their mission-critical BSS and OSS.

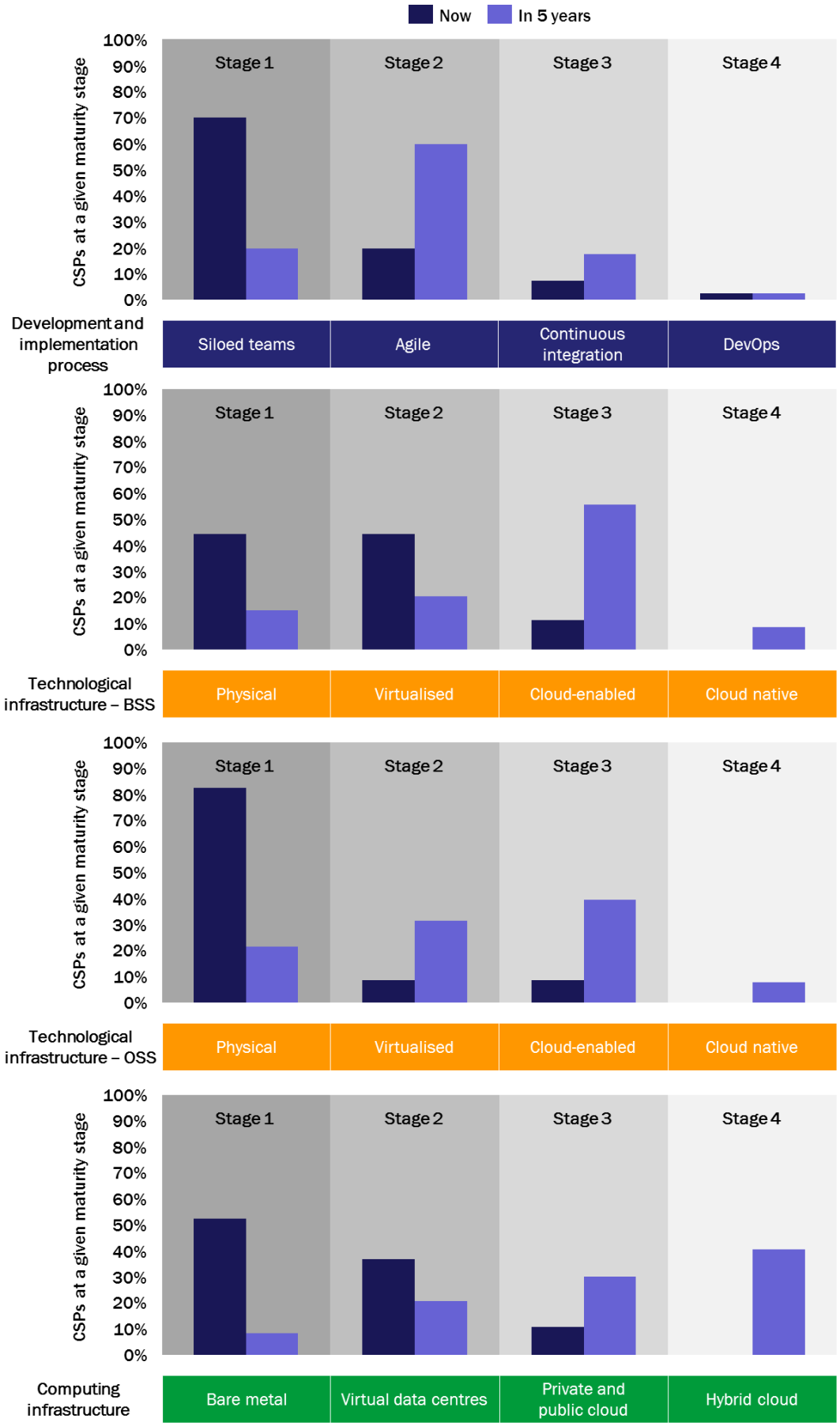
4.2 Analysys Mason's estimation of CSPs' B/OSS cloud maturity

Using data acquired through primary research and our own internal research, we have estimated the distribution of CSPs at various steps along the migration journey, showing the distribution today and our forecast of how it will evolve over the next five years.

The main points from our forecast (summarised in Figure 11 on the next page) are as follows:

- The **great majority of top-tier CSPs will adopt agile processes** over the next five years, while leading-edge CSPs will move the majority of their development to DevOps processes
- **Over half of top-tier CSPs will have cloud-enabled BSS applications** five years from now
- In five years, **the majority of OSS applications for virtualised networks will run in the cloud**
- **Hybrid cloud will have replaced bare metal** five years from now.

Figure 11: Estimation of BSS/OSS cloud maturity today and in five years' time [Source: Analysys Mason, 2017]



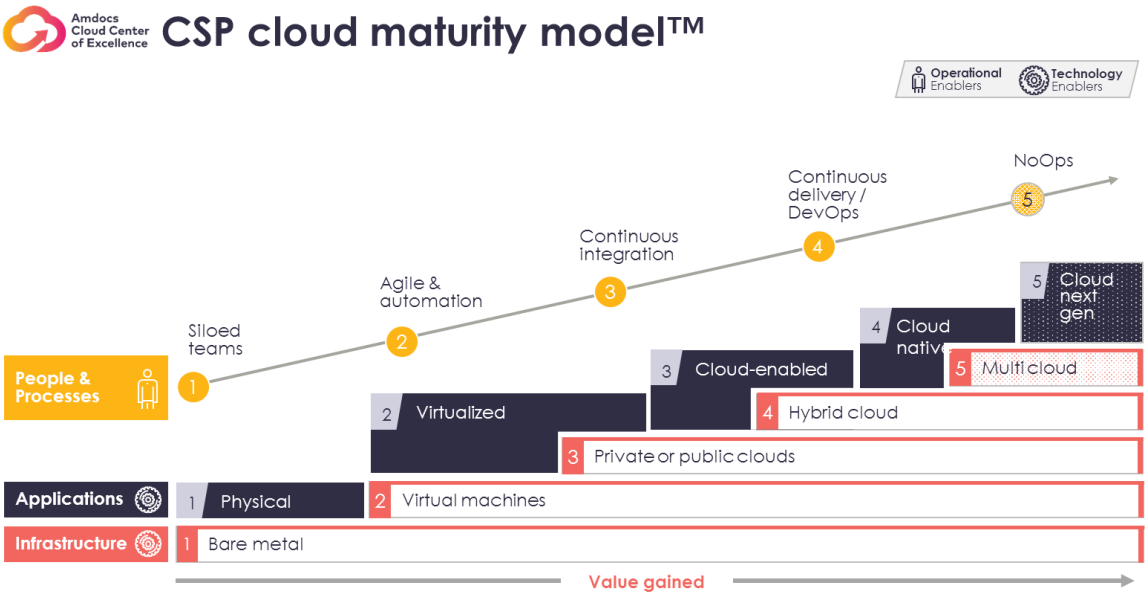
Annex A Amdocs CSP cloud maturity model

The model used in the surveys and interviews is based on the Amdocs cloud maturity model for communications and media service providers, a high-level version of which is provided in Figure 12 below.

The Amdocs cloud maturity model shows the three evolutions happening in parallel – i.e. adopting cloud infrastructure, evolving applications to cloud paradigms and transforming people and processes to DevOps practices. The model enables CSPs to assess their current stage of maturity, as well as plan what steps they need to take – and when – to progress further.

The Amdocs Cloud Centre of Excellence leverages deep communications industry and cloud expertise to help leading CSPs globally with roadmap definition and technology selection. When the Amdocs Cloud Centre of Excellence conducts advisory sessions with CSPs, it leverages the full cloud maturity model: this dives into the detailed definition of each step to assist CSPs in mapping their maturity, while at the same time highlighting the associated challenges and benefits to be gained from progressing to the next step.

Figure 12: Amdocs cloud maturity model [Source: Amdocs, 2017]



About the authors

Mark Mortensen (Research Director) is the Research Director and Practice Head for customer-facing systems in Analysys Mason's Telecoms Software and Networks Research stream. He is also the lead analyst for the Digital Experience research programme. His interest areas include the conversion of CSPs to modern DSP operations, the effect of network virtualisation on operations, and the evolution of software architectures in the cloud world.

The first 20 years of Mark's career were at Bell Laboratories, where he started software products for new markets and network technologies, and designed the interaction of BSS/OSS with the underlying network hardware. Mark was Chief Scientist of Management Systems at Bell Labs, and has also been president of his own OSS strategy consulting company, CMO at the inventory specialist Granite Systems, VP of Product Strategy at Telcordia Technologies, and SVP of Marketing at a network planning software vendor. Mark holds an MPhil and a PhD in Physics from Yale University and has received two AT&T Architecture awards for innovative software solutions. He is also an adjunct professor at UMass Lowell in the Manning School of Management, specialising in business strategy. Mark has also participated on the GSMA Global Mobile Awards judging panel.

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This white paper and the associated research were prepared on behalf of Amdocs.

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