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CLOUD MIGRATION:
ASSESSING STRATEGIES

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Cloud migration:
Assessing strategies

We hope you enjoy the report and, most importantly, will find ways to use the ideas, concepts and recommendations detailed within. You can send your feedback to the editorial team at TM Forum via editor@tmforum.org

The big picture

There has been an inexorable trend towards the use of cloud in telecoms IT for several years, but it is gathering pace as communications service providers (CSPs) embrace public and hybrid cloud configurations for their operational and business support systems (OSS/BSS). Vendors in these sectors are being driven to redesign their solutions from the ground up, in a cloud native form. The importance of this shift cannot be overstated as CSPs' requests for information and proposals (RFI/RFPs) often turn the searchlight on software companies' cloud native credentials.

CSPs' own business transformations mean they need to incorporate cloud's attributes into their operations to gain:

Competitive agility to respond to market opportunity. They must design, launch, and monetize new services quickly and effectively. They are no longer in competition with other telcos but with digital service providers and others too as CSPs seek to participate in B2B2x service ecosystems.

Automation, as orchestration-led ecosystems are the norm in the 5G era, the shift to cloud native software is step towards fully automated operations.

Scale because the elasticity of the cloud allows not only scaling up of successful service models but failing fast innately encourages a culture of innovation.

Economic advantage from setting up new software stacks in multi-cloud deployments which can save CSPs up to 50% on their initial CapEx outlay according to the CTO of one European mobile network operator.

5G monetization because this is where so many forecasts for the 2020s predict growth for CSPs, so monetizing 5G in an optimal way is critical. Non-standalone 5G solutions need mechanisms like dynamic revenue management in readiness for monetizing services using network slices when standalone 5G is deployed.

BSS leads the way to cloud native
Most CSPs still run most of their OSS/BSS on-premise and in their own data centers. Across the gamut of telecoms software functions, there is evidence that BSS segments are often the first to migrate to the cloud. Indeed, within BSS, there are some hot spots for CSPs that are addressing digital service models and value chains.

One US Tier 1 OSS/BSS specialist we spoke to during this research said: "BSS is where we are seeing the most bang for our buck in turning to cloud native software and multi-cloud configurations. It's also where we can most obviously show our customers our IT capabilities; so many cloud-based, front-line systems is a great message."

This report focuses on the drivers and trends within this industry migration towards cloud native software and what this means for operators and vendors, backed up with new opinion polls from TM Forum's latest *Digital Transformation Tracker* survey.

Cloud vs. cloud native
The terms "cloud" and "cloud native" are often used in an inconsistent way, but they mean very different things and it's important to understand the distinction as here cloud native represents much more than a different form of hosting.

Cloud native describes container-based environments: Cloud native technologies are used to develop applications built with services packaged in containers, deployed as microservices and managed on elastic infrastructure through Agile DevOps processes and continuous delivery workflows. Containers isolate an application and its dependencies in a self-contained unit that can run anywhere. In this environment, hardware and operating systems are virtualized, which means the same operating system is shared with other hosted applications.

Cloud deployments that are not cloud native are traditional IT applications which are hosted in a cloud but to all intents and purpose could be the same as legacy systems hosted in an on-premise server in a data center. In a traditional IT environment, operations teams manually allocate infrastructure resources to applications. In a cloud native environment, applications are deployed on infrastructure that abstracts the underlying compute, storage and networking primitives. Cloud native platforms automatically handle many tasks (scheduling, lifecycle management, scaling, load balancing, discovery, etc.) through the software tools that manage the containers.

The advantages of cloud native BSS

Available for multi-tenancy use	Does not need hardware	Can be implemented in day or weeks, not months	The CSP can try it before buying	Offers configuration not customization
Supports vendor-independent services	Regular software updates	Easy to import or export data	CSP only pays for what it uses	Supports multiple devices

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Read this report to understand:
- Where CSPs are with the migration to cloud native OSS/BSS
- What strategies CSPs are putting in place to build cloud native architectures
- Where the hotspots are for the first wave of truly cloud native BSS
- What the differences are between private, public and hybrid cloud deployments
- What CSPs see as the benefits of multi-cloud operations
- What it means to "lift and shift" applications to the cloud
- Why APIs are a crucial part of a cloud strategy
- What the biggest challenges are to moving OSS/BSS to the cloud and how to address them
- Why CSPs need an evolutionary cloud strategy and how TM Forum's Open Digital Architecture can help

Section 1

Reality check – Where are CSPs with cloud adoption?

Cloud native has been at the center of telecoms commentary for some time, and there is little doubt it is the future of most telecoms software. We asked some communications service providers (CSPs) how they are progressing with their cloudification efforts.

Many enterprise organizations are much further down the road than CSPs regarding the adoption of public cloud, but this is because CSPs are fundamentally different to all other types of technology-led companies. Also, there is a distinction to be made between CSPs' old and new motives for cloudification which is integral to the telecoms cloud story.

The traditional telco was not overly constrained by capital resources, and had a stable core business model and little need for radical innovation. Those revenues and margins are increasingly threatened to the point that fundamental change is necessary to diversify CSP businesses and generate new, large revenue streams from non-traditional services.

Cloud migration has a long way to go
In the decade after 2010, some CSPs experimented with the 'lift and shift' approach to migrating applications that were not designed for the cloud into private or hybrid cloud to save CapEx and OpEx. They quickly realized that the expected savings might not be realized. Another consideration in these early experiments was that little, if any, commercial-off-the-shelf software that could be considered cloud native, so CSPs began working more closely with technology providers to address this fundamental shift.

Today there is still much to do because of the scale of the task, and CSPs' need to get as good a return on investment as possible from their old infrastructure. In a recent survey for TM Forum's upcoming *Digital Transformation Tracker 5*, we asked several hundred CSPs about the migration of their

Percentage of IT workloads CSPs have migrated to public cloud

- ■ 0-10%
- ■ 10%-25%
- ■ 25%-50%
- ■ 50%-75%
- ■ More than 75%
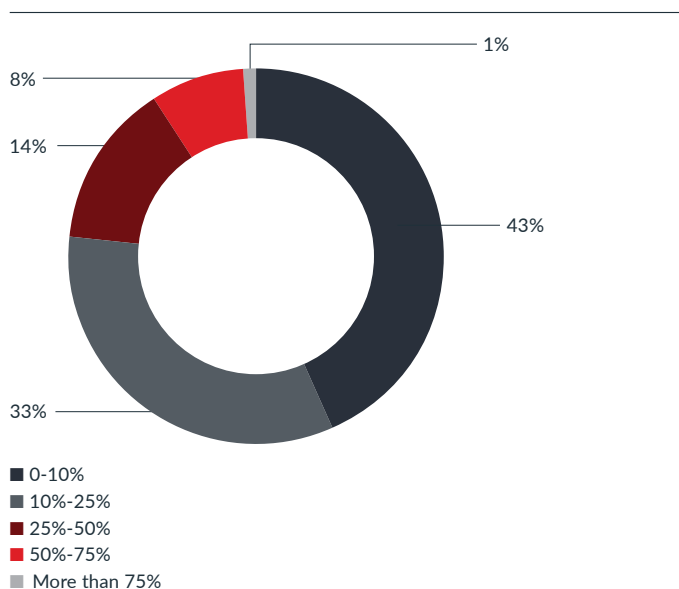
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business and operations to cloud. The graph above shows that the move is underway, but only a small percentage of IT workloads have been migrated to the public cloud (although public cloud does not cover all cloud deployment models, it is a good measure of overall cloud migration – see **Section 2**). The timeline for cloud to become the dominant installed model of telecoms software is long.

In most conversations we had with CSPs for this research, it became evident that the growth of cloud deployments will continue, but some IT workloads will never be migrated to a cloud model. CSPs are generally taking a pragmatic approach to this realization and are developing a hybrid long-term strategy, migrating functions that have obvious cloud native futures and building a solid interoperability plan for the rest.

However, in the same survey 20% of operator respondents state they do not have a clear preference for a cloud native approach which is more than expected. The group of participants was selected widely from many different sizes of operators, we often see Tier 3 and 4 CSPs letting early adopter Tier 1's establish best practice before making their own investments. This result could be symptomatic of that pause before smaller operators establish their own cloud strategy.

Are CSPs seeing total cost of ownership benefits?
The prospects of new revenue opportunities for CSPs in the 2020's are brighter than they have been for decades with investments in 5G and IoT lighting the path to new service models and use cases across previously untapped industry verticals.

The promising economics of 5G and IoT are driving the transformation of most CSPs and means they are not mirroring legacy data center deployments in the cloud but building something entirely new. This new build is not only for the CSPs' use because the new business and operational models are based on collaborative, multi-partner business models in a B2B2X setting that involves consumers, businesses, government agencies and other entities.

Level of commitment to taking a cloud native approach to cloud migration

20%

24%

58%
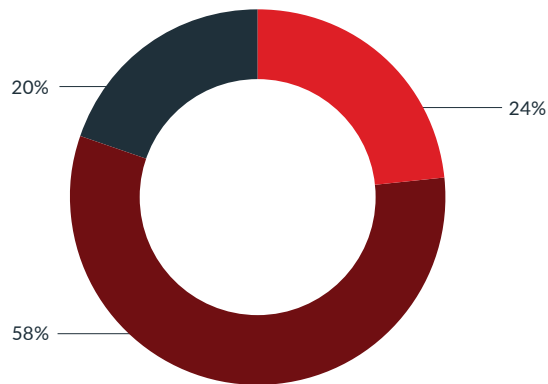
- ■ We are absolutely committed to taking a cloud native approach for all of our IT workloads
- ■ We want to take a cloud native approach but accept that this may not be possible for all our applications and workloads
- ■ We don't have a clear preference for a cloud native approach

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Now there is economic motivation for those CSPs investing in cloud native software because it can:

- ■ Use the software-as-a-service (SaaS) model and therefore has usage-based pricing models
- ■ Run in the public cloud (Amazon Web Services, Google Cloud, Microsoft Azure)
- ■ Empower them to create new business cases and experiment with new potential lines of business
- ■ Future-proof functional capabilities and their digital operations
- ■ Improve legacy operational systems and processes

- Ultimately lower their total cost of ownership
- Allow them to become more innovative and disruptive, facilitating access into new markets
- Guarantee carrier-grade quality and compliance with strict security and privacy requirements

The new customer experience focus

As many CSPs now see customer experience as the strongest way to differentiate themselves from competitors, there is a huge focus on new ways to engage and delight customers. Digital-first customer experiences are now worthy of investment, rather than lip service, and these investments are being made in the modernization of software ecosystems.

It is becoming more common that the cloud native story for OSS and BSS is talked about by CSPs in terms of their ability to deliver unparalleled customer experiences rather than the features of those software systems. This is a big shift for telcos and symptomatic of the thematic coming together of business drivers and operational challenges.

5G is big news, but not everything

5G is catalyzing the need for cloud native service operations but the move to cloud has much wider implications for CSPs' business. Enterprise digital services such as SD-WAN are primarily internet-based, non-mobile (although standalone 5G may also revolutionize the way SD-WAN is delivered in years to come) and are the proving to be a genuine current-day revenue opportunity for the CSPs. As this is a prime example of the way CSPs can use NFV/SDN to create a next-generation service for businesses, we are seeing CSPs stablishing multi-cloud strategies with SD-WAN to optimize costs, increase business agility and drive security as they scale out those services across their B2B customer base.

Cloud native is not a Tier 1, multi-region strategy

As shown in the graph on **page 8**, most CSPs are adopting a cloud native approach to new and future OSS/BSS procurements. Aligned with that, success stories are appearing across the industry from smaller, single-country CSPs and operators. In additional to this, service providers that are providing connectivity solutions to industry-specific customers (for example, private networks for airports) are realizing the benefit of cloud native deployment models for their custom networks, operational and even retail environments. As such it is important to see the migration to cloud as a much wider macro-trend than multinational mobile network operator groups experimenting with new technology.

We spoke to an African operator that has many hundreds of product categories and is planning to move a large number of its workloads to a public cloud set-up. The main driver for this is to increase competitive agility as the company adds subscribers and modernizes the product line, and most of all, to speed up operations for the full portfolio. The first workloads to be addressed are in revenue management for billing, rating, charging, and partner settlement.

The company has fewer than 10 million subscribers so it does not have the complex organizational structure of a large multi-country group where a category of products or line of business can be addressed at once based on strategic value perceived by its shareholders.

In the next section, we'll look at how CSPs feel about the different varieties of cloud.

Section 2

CSPs' attitudes about public, private & hybrid cloud

The terminology surrounding cloud migration can be impenetrable and has been cynically co-opted by certain groups in the industry seeking to exploit the confusion. Combined with the fact that some CSP have become cloud service platforms themselves, the nomenclature has become somewhat baffling. Here we look at the differences in these terms and the implications for telecoms.

Private cloud

Private clouds are cloud environments that support custom, bespoke services constructed for the specific needs of a CSP or large enterprise. The services are typically delivered by a private network or WAN. CSP private cloud (also known as telco cloud) is optimized for telco workloads, incorporating specific requirements such as performance acceleration and security. In a recent TM Forum survey, 37% of CSPs prefer a private cloud-only approach for their IT workloads, shown in the graph on the next page.

Private clouds no longer have to be sourced from on-premises IT infrastructure: In some places CSPs have built private clouds on third-party or vendor-owned data centers located off-premises. This has led to a number of private cloud subtypes, including managed private clouds and dedicated clouds.

CSPs are also at the early stages of building private edge clouds to accommodate the new uses cases that are made possible with 5G. The use of private cloud only for a customer's OSS/BSS solutions is still common, particularly if it is a government body or similar which is prohibited from using public internet systems to store and transport its data.
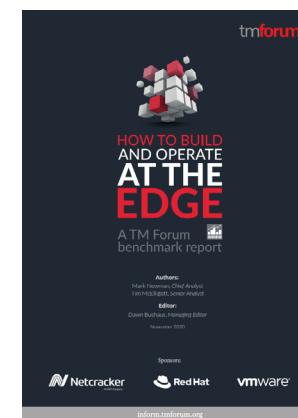
Public cloud

Public cloud services provide access to software, computing platforms, or compute and storage infrastructure hosted on servers in a data center typically via the public internet. All clouds become public clouds when the environments are partitioned and redistributed to multiple tenants. The total pool of cloud compute load is shared by numerous customers in a dynamic fashion based on demand. An online self-service portal is often the sole human interface with the cloud service provider which typically has a software-as-a-service (SaaS) pricing model based on usage.

As such, public cloud services are the typical choice for small- and medium-sized businesses and IT startups that need to control costs and have the flexibility to scale up or fail fast if required. The bare-metal IT infrastructure used by public cloud providers can also be abstracted and sold as infrastructure-as-a service (IaaS), or it can be developed into a cloud platform sold as platform-as-a-service (PaaS).

As CSPs build trust with public cloud providers, they will move applications to the public cloud, reducing the need to build and run data centers. They will embrace public cloud because it's much less expensive, more scalable and easier to manage. This is why the majority of CSPs' cloud migration strategies include public cloud.

Read this report to learn more about CSPs' cloud and edge strategies:

All of the major public cloud providers now have a global footprint of data centers interconnected with their own secure private network, providing edge locations in nearly every country in the world, which addresses the issue of proximity of the data center and the latency of response time to applications.
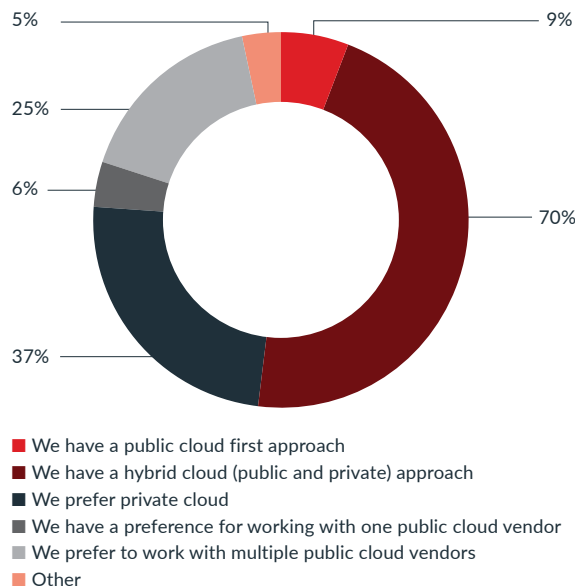
Hybrid cloud

Hybrid cloud is a combination of public and private clouds. Hybrid cloud services share many of the characteristics of private cloud services, but some data may be transported across the public internet and IT applications might be accessible via the internet. Hybrid cloud services can be significantly more complex than public cloud services and are generally seen as being more "carrier-grade" with a proprietary architecture.

The price tag for a hybrid cloud arrangement is not always somewhere between that of private and public cloud – it could be as expensive as a private cloud. CSPs often choose a hybrid cloud to meet business imperatives such as regulatory rules or data sovereignty requirements. The hybrid cloud is evolving to include edge workloads, bringing the compute power of the cloud to IoT devices, for instance, and closer to where data is stored.

As the graph opposite shows, hybrid cloud is the preferred cloud migration approach among CSPs to deploy operational and business support systems (OSS/BSS). This makes practical sense as it reduces operators' reliance on more expensive and labor-intensive private cloud deployments.

CSPs' preferred approaches to cloud migration

- 5%
- 9%
- 25%
- 70%
- 6%
- 37%

- ■ We have a public cloud first approach
- ■ We have a hybrid cloud (public and private) approach
- ■ We prefer private cloud
- ■ We have a preference for working with one public cloud vendor
- ■ We prefer to work with multiple public cloud vendors
- ■ Other

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Multi-cloud

CSPs realized they were often running multiple clouds, in a number of configurations to address a variety of requirements. In a multi-cloud solution, a CSP would typically use multiple different public cloud services, potentially from several cloud platform providers, in a best-of-breed fashion to match the cloud to the appropriate OSS/BSS function.

Sourcing clouds from different providers may increase the complexity of the overall deployment, but it lessens the CSP's exposure to a single point of failure. The main difference is that in a multi-cloud strategy several public clouds will be used in combination with physical on-premise, virtualized, and private cloud infrastructure. In a sense, multi-cloud is a hybrid cloud that interoperates with non-cloud aspects of the CSP's IT ecosystem.

CSPs are drawn to multi-cloud architectures
The nature of the multi-cloud architecture enables CSPs to drive a great deal of cost out of their IT ecosystems and gain flexibility, while remaining pragmatic about leaving legacy systems in place that do not need transformation. However, the transition to effective multi-cloud ecosystems is recognized as being complex, and a journey the CSP and its technology providers take together. The CTO of a European mobile operator told us that common phrases like "cloud-ready" and "lift and shift" are indicators that we talking about legacy system strategies, not cloud native architectures.

Following are key considerations for implementing a multi-cloud strategy:

Don't just replicate old processes
Multi-cloud is not simply old systems and processes hosted on a variety of clouds and servers: A great deal of effort is going into establishing these new processes in many CSPs. TM Forum's Open Digital Architecture (ODA), part of the Open Digital Framework (**see page 28**), is a component-based approach. It enables CSPs to evolve incrementally to a fully automated, cloud native operations environment that

ODA functional architecture
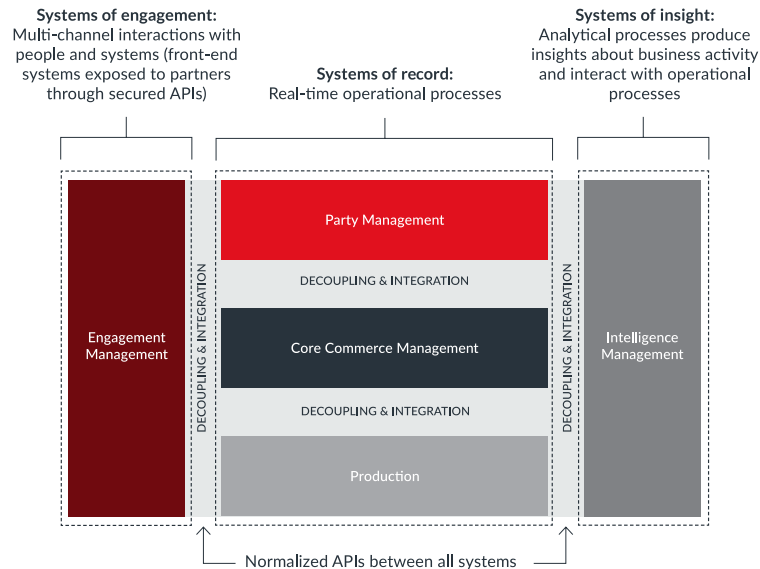
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relies on analytics and AI to deliver zero-touch services. The ODA defines standardized, interoperable software components organized into loosely coupled domains. These components expose business services through the Forum's suite of Open APIs, which are built on a common data model. Importantly, the ODA provides machine-readable assets and software code, including a reference implementation and test environment.

CSPs have led development of the architecture to reduce the time it takes to create new services from many months to just days or even hours. Today it typically takes about 18 months for CSPs to develop and monetize new services

Read this report to learn more about the ODA and Open APIs:
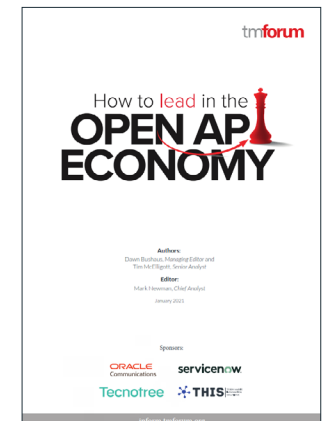
because of requirements to build connections many times over between customer management, service management, and ordering and billing systems across several lines of business. TM Forum members refer to these as systems of engagement, record and insight rather than OSS/BSS.

The ODA offers a blueprint for evolving from legacy support systems to applications that are cloud based and cloud native, but widespread agreement, collaboration and contribution among many CSPs and vendors is necessary to advance it. In addition to the ODA, leading vendors are focusing efforts on process design and optimization as a way to add value and differentiate their intellectual property from their competitors. As standards draw vendors' solutions into a more similar form, they are finding other ways to excel and prove their worth as partners, which is reflected in the growing regularity of pricing based on shared success.

Telco-specific services from hyperscale cloud platforms

Amazon Web Services, Microsoft Azure, Google Cloud Platform and others have realized the potential in offering telco-specific cloud services as opposed to generic cloud IT services they offer to enterprise customers. They are focusing on the volume of data that CSPs have to move around in real time, carrier-grade analytics, improved specific virtualization tools and more complex application support.

These refinements are combined with bare metal to integrate legacy applications, making them available to almost any cloud, hence migrations to the cloud are catalyzed by capability. In any multi-cloud strategy, the OSS/BSS vendor solution could manage the use of public cloud platforms with CSP operations, to give the optimal usage for specific services. Dynamically managing the multi-cloud is a theme that is becoming a hot topic in the CSP interviews we did for this research, reflecting their desire to have maximum flexibility and control in any cloud framework being built today.

5G-era communications platforms

A platform for all communication and IT-based requirements which blends the usual cellular connectivity capabilities with edge computing, internet-based services and IT services is altering how CSPs interact with their customers – and the nature of their potential customer base. The point of a platform concept is grounded in the fact that we know that new revenue opportunities will come from new technologies, but we still don't know exactly what they are. Instead of spending time and money guessing, or betting on a single horse, we should build a platform that could address any requirement. Cloud native methodology is at the heart of building any such entity.

In February, Japan's Rakuten Mobile announced what is thought to be the first commercial contract, with US satellite operator, Ligado Networks for its Rakuten Communications Platform (RCP). This is a virtualized, cloud native mobile communications platform and Ligado Networks plans to use the RCP to offer private 5G networks. The platform has become a point of great interest in the industry due to its greenfield build using only cloud native tech and the latest methodologies.

Read this report to learn more about Rakuten's strategy:
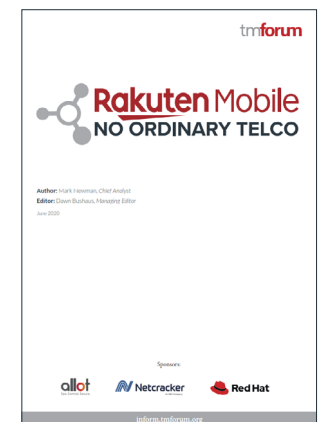
Also in February, Rakuten Mobile's CTO, Tareq Amin, told a roundtable that RCP services, "have already 15 global customers. A lot of people don't know that the sales already started. And these are not small customers. Some of them are very, very massive." That number is now thought to have passed 20.

Manage data end to end

The migration to cloud is also another opportunity for CSPs to address the longstanding problem of systems' proliferation. Every large telco has tens of billing systems, service fulfilment components, service assurance systems meshed together with adapters and custom interfaces, usually as the legacy of decades of M&A activity. As both internal consolidation and company mergers increase, it makes sense to further unify the data management of customers, products and services, orders and revenue.

In the past BSS systems were managed in separate locations but in end-to-end, service-centric operations, it increasingly makes sense to centralize data and strive for more joined-up thinking to be mirrored in the systems architecture. This can help make better sense of much more data and drive out cost. Throughout this process CSPs must work with their vendor partners to expose the correct amount of data at the interfaces within a multi-vendor environment.

Dissolving security concerns for public cloud

Despite the advantages that the public cloud can bring to CSPs' operations – the promise of lower costs, increased efficiency and more effective customer interactions – they are still concerned about its security. Hence public cloud platforms and telecoms software vendors have striven to make their security protocols more robust and fit for purpose, and to spread as much educational material through the industry as possible.

Static application security testing (SAST), dynamic application security testing (DAST) and penetration testing are giving CSPs confidence that vendors' security arrangements can deal with current cybersecurity threats. AWS, Microsoft Azure and Google Cloud Play have layers of advanced security that combine with vendors' security measures to make public and hybrid cloud extremely resilient.

All public cloud providers can expose where CSPs' data is located, based on the type of storage used and the geographical location of that storage. They will also allow operators to control the format, structure and security of the data, including whether it is masked, anonymized or encrypted and where that takes place. This transparency plays an important role is dissolving the security concerns that still surround public cloud.

In the next section we look at the migration patterns emerging around different kinds of applications and workloads.

Section 3

Cloud native today and tomorrow

Some definite patterns are emerging around the types of applications and workloads that are best suited for communications service providers (CSPs) to migrate to the cloud. Lightweight digital systems such as chatbots and web portals are proving a good place to start because the systems are new and much less complex or mission critical than other BSS solutions, but CSPs are now moving to the next phase, migrating core OSS/BSS functions.

Applications like chatbots and web portals are suited to public cloud deployment as they only need a small upfront investment to start with one geography or product line, and then build it out to all customers. These applications do, however, contain a great deal of sensitive customer data which means CSPs are placing their trust in public cloud providers and that they must fully understand the necessary data management and regulatory implications.

However, we are now seeing more substantial announcements around core OSS/BSS functions using cloud native software, many of which have a 5G flavor. Vivo, the Brazilian subsidiary of Telefónica Group, for example, has been working on a large-scale BSS transformation for e-commerce, to facilitate ordering and purchasing of products and services, and the building of new convergent offers and to deliver enhanced customer experience.

The e-commerce channel will be enabled through the deployment of product catalog and configure, price, quote (CPQ) and customer engagement solutions. As the BSS solution is cloud native, built on microservices architectures with DevOps methodologies, it allows Vivo to offer mobile, fixed and convergent products to its B2B customers via a digital channel. It also decreases time-to-market for new offers and lets Vivo use digital experience metrics accurately. This is a good example of a forward-looking CSP gaining agility in its IT ecosystem that was lacking before, so it can be more opportunistic and is setting a standard for future operations.

Cloud native revenue management
CSPs' progress towards standalone 5G and network slicing need a cloud native revenue management platform to handle rating, charging, billing and partner management in a more dynamic way. 5G network slicing requires fully automated, E2E service management, which makes the BSS as important as the OSS for ensuring SLA-compliant characteristics for each slice. The ephemeral nature of slice-based services means that a dynamic, real-time software stack is needed to manage services optimally.

Consequently, revenue management to address this emerging need is becoming a hot topic for CSPs as they work towards offering a range of new digital services, IoT deployments and next-gen connectivity and IT solutions. Established solutions are not up to the job: Revenue management systems need a radically different approach.

Cloud native customer interaction
Within cloud BSS, customer management and sales functions like CPQ, service order management and centralized product/service catalog have been highlighted as important candidates for cloud migration due to their role in the lead-to-cash process and the increased focus on customer experience. The cloudification of this process down into fulfillment is likely to put more focus on cloud OSS in the coming years as the process for end-to-end service operations is mostly migrated to the cloud.

Vendors need to be flexible

The graph opposite shows the considerations CSPs labeled as "major" in deciding which cloud approach to take. It is not surprising that security has a slight edge, but most are equally weighted. This is a reflection of the variety of considerations that depend on companies' individual needs – there is not a one-size-fits-all approach. As such, vendors would be foolhardy to gear their solutions only to cater to SaaS in a private cloud; rather true cloud native attributes must be verifiable today for CSPs to be confident that all iterations of cloud architecture are possible to meet future needs.

The mid-term future of cloud migration

CSPs' cloud native approach is building towards a future where applications are developed with services packaged in containers, deployed as microservices and managed on elastic infrastructure using Agile DevOps practices including continuous integration, delivery and testing (CI/CD/CT). This differs from what happens today in that as it becomes the dominant mode of deployment across the company, the IT estate will grow horizontally.

CSPs are moving away from clunky, proprietary applications – that to all intents and purposes are monoliths – towards an environment where they can make incremental changes and upgrades across the operational ecosystem. Feedback from the systems, with the aid of analytics powered by AI and machine learning, will help the CSPs build a library of microservices and process best practices that can be used to build complementary applications.

In the next section we examine the essential components of cloud native BSS.

Key considerations in deciding which cloud approach to take
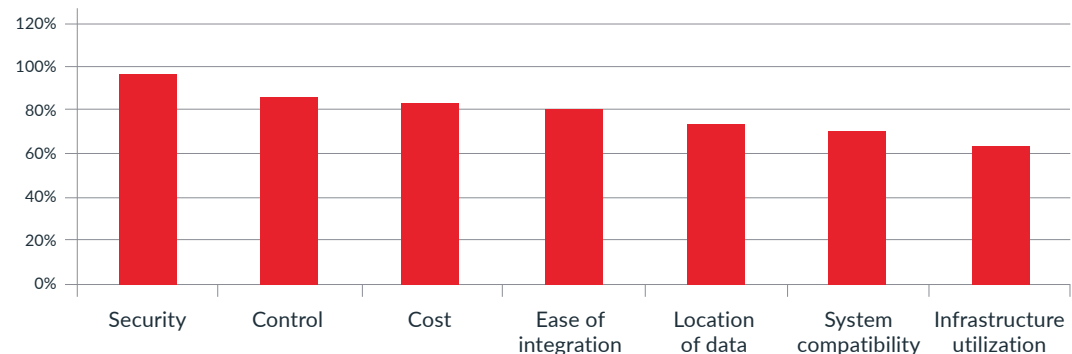
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" Feedback from the systems, with the aid of analytics powered by AI and machine learning, will help CSPs build a library of microservices and process best practices."

Section 4

Essential components of cloud native BSS

The move away from monolithic software systems has been underway for over a decade, but the last couple of years have seen real progress in the evolution towards modular architectures, microservices, DevOps methodologies, continuous integration and delivery (CI/CD), and standardized frameworks and interfaces. In the drive to simplify OSS and BSS, it has become obvious that modular architectures have massive advantages over the millions of lines of single-use custom code in monolithic systems and that constant self-improvement is superior methodology to mass upgrades at intervals. These fundamental characteristics have been born in the cloud era and have changed forever how software is developed and deployed within CSPs.

Microservices

Microservices are smaller units of code that represent a self-contained piece of software that can run specific tasks independently within the framework and context of a wider solutions architecture. This means that larger solutions can be constructed or altered quickly, at little cost, and will still contain pre-approved code modules that are ready to hit the ground running. Microservices also lend themselves to quicker, more efficient continuous upgrade cycles. Removing the need for large customization projects to establish a new software stack is big news for CSPs scoping new opportunities and designing appropriate services.

Microservices are the fabric of CSPs' software solutions for cloud native service operations, providing the agility and quick time-to-market responses that we hear in our research from CSPs in relation to the cloud. Any software that is considered cloud native must be built from microservices, and use Open APIs to expose services and interconnect with other components, and run on container-based cloud platforms. In OSS/BSS and network systems we are seeing vendors rebuilding their portfolios in this model.

DevOps methodologies

CSPs' software development methods have undergone vast change in the last decade with DevOps techniques becoming the norm within web-scale businesses and cloud native enterprise software. CSPs are striving to move to those standards to gain the obvious benefits in their own operations, such as:

Faster and more frequent deployment cycles – CSPs are moving from annual releases and waterfall processes to dynamic iteration cycles with CI/CD – a hallmark of digital operations characterized by speed and agility.

More accurate and flexible scalability – DevOps allow operators to scale the operational resources allocated to a project to match the opportunity, cutting out wasteful overhead. This also drives innovation on service design.

Culture change is fostered within CSPs and vendor partnerships – collaboration by and integration of internal and external IT personnel enables a non-hierarchical, decision-making process. The resulting best practices in IT can bring about changes in attitude to what is possible.

Shared risk, shared reward – partnerships between vendors and service providers are closer with commercial arrangements to match.

Swisscom as a good example: The company has been very open about the use of DevOps tools to build its new OSS/BSS ecosystem. CI/CD processes are used wherever possible on software for the company's 5G development program. This has made a 65% reduction in OpEx possible on Swisscom's 5G assets.

In the next section we look at practical steps to making cloud migration happen.

" CI/CD processes are used wherever possible on software for Swisscom's 5G development program. This has made a 65% reduction in OpEx possible on the company's 5G assets. "

Section 5

Make it happen – Strategies for cloud migration

The migration is under way but as our research shows, we are not far enough down the path yet for there to be an established, clear-cut process for the move to the cloud. Even so, we have identified some methodologies and decisions that are essential to ensure the cloud age is superior to what came before and will enable communications service providers (CSPs) to thrive in new markets:

Establish close technology partnerships
The old vendor model of selling software then disappearing is gone. DevOps ensure closer working relationships with CSPs' technology suppliers, and now the other players such as systems integrators and hyperscale cloud providers are moving closer the operators.

Adopt a digital-first mentality
Cultural change is one of the most challenging shifts for any industry to make and usually it cannot be forced through just by orders from management. Change has to be nurtured by the operational constructs which show what is possible and by using automation to remove some of the hard, repetitive work.

Pick the low-hanging fruit first
BSS hotspots have developed for CSPs' cloud migration with several vendors having garnered enough experience of this evolution to put a replicable transformation process in place. CSPs approaching a BSS transformation will be able to measure the benefits of cloud migration by using those systems, which will better inform their cloud strategy.

Don't replicate legacy problems in the cloud
The shift to cloud is an opportunity to fix process and systems issues, and these opportunities only come around every decade or so. Re-architecting should focus on using modern IT methodologies to drive out error-prone processes; this is the time for embattled operations staff to speak up.

Remain flexible
Different applications, workloads and customers need different blends of private and public cloud. CSPs and their vendor partners need a flexible framework in place to quickly establish a specific cloud environment based on requirements. Hybrid cloud is the configuration operators choose for most workloads currently, but the economics of those set-ups are still being fine-tuned.

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Concentrate on architectures & standards
There is a marked difference between hosting legacy systems in a cloud and procuring a cloud native solution. Microservice architectures are revolutionizing CSPs' ability to participate in new value chains as IT-centric digital service providers.

TM Forum's Open Digital Architecture can help by facilitating a cloud native marketplace for IT procurement. To learn more, contact CTO **George Glass.**

" Microservice architectures are revolutionizing CSPs' ability to participate in new value chains as IT-centric digital service providers.”

Netcracker Cloud BSS

5G technology demands an immediate change of course for CSPs to maximize long-term benefits. The leaders of tomorrow will be determined by the investments of today in 5G and IoT to create new use cases and business models. CSPs must create multi-partner business models to monetize 5G and IoT and match the rapid pace of innovation in the industry.

Monetizing 5G and IoT will require collaborative, multi-partner business models with rapid service innovation and dynamic settlements in a B2B2X setting for consumers, businesses, government agencies and other entities.

A growing number of CSPs are also looking for ways to empower customers with digital-first experiences to differentiate themselves and win market share. They require new levels of automation to dramatically reduce customer service costs and artificial intelligence (AI) to drive loyalty by anticipating customer behavior with personalized engagement through their preferred channel.

CSPs must modernize their BSS to meet these demands. Success in the digital economy requires the flexibility and scalability of cloud-native BSS systems to rapidly update service offerings and pricing, implement service innovation and decrease TCO.

Netcracker provides a digital portfolio of fully open and standards-compliant products and services for BSS.

It is built for the cloud and allows service providers to develop their own enhancements or co-develop functions through a low-code platform and blueprint delivery approach. With continuous short releases using Agile/DevOps processes, service providers gain faster access to innovative features without disrupting business operations.

Netcracker Cloud BSS is a SaaS-based, cloud-native solution that runs in the public cloud (AWS, Google Cloud, Microsoft Azure) and helps CSPs create new business cases with their BSS cloud migration strategy. CSPs can become innovative industry disruptors with future-proofed functional capabilities, digital operations and lower TCO to access new markets, guarantee carrier-grade quality and meet strict security and privacy requirements.

Netcracker Cloud BSS builds customer loyalty by using AI to monitor and analyze customer behavior to personalize multi-channel engagement and offer unparalleled convenience. Operators achieve precise control and enormous flexibility with the Netcracker software-as-a-service (SaaS) model of deployment to offload responsibility for software and infrastructure.

Netcracker Cloud BSS leverages cloud economics to increase revenue with E2E business processes and open new markets. It includes three cloud-based offerings: Marketing and Commerce Cloud, Sales and Customer Service Cloud and Revenue Management Cloud.

" CSPs must create multi-partner business models to monetize 5G and IoT and match the rapid pace of innovation in the industry. "

Netcracker Cloud BSS

Marketing and Commerce Cloud increases customer lifetime value by providing one-stop shopping for telco, retail and partner products to support customers on their unique digital journey. It connects customers with an omnichannel experience and uses AI to analyze customer behavior during their digital journey for personalized content and offerings. Marketing and Commerce Cloud implements real-time campaign visualization and ML-driven analysis to drive ROI and eliminate the uncertainty and frustration of blind marketing campaigns.

Sales and Customer Service Cloud inspires strong brand loyalty with a guided process from lead creation to contract generation and an intuitive quotation interface across every sales channel for rapid B2C rollouts and simplified B2B scenarios. Its streamlines and enhances lead conversion to create a large base of paying customers. It enables CSPs to expand into new verticals with rapid time-to-market for traditional, IoT and cloud products, and intelligent customer service builds strong brand loyalty through a customer-centric approach. Sales and Customer Service Cloud increases the level of automation to dramatically reduce operator costs for customer support.

Revenue Management Cloud unlocks new revenue streams with support for multi-partner business models, complex multi-partner B2B2X settlements and cost-effective IoT billing. It provides real-time charging for any service, partner or business model

Netcracker Cloud BSS
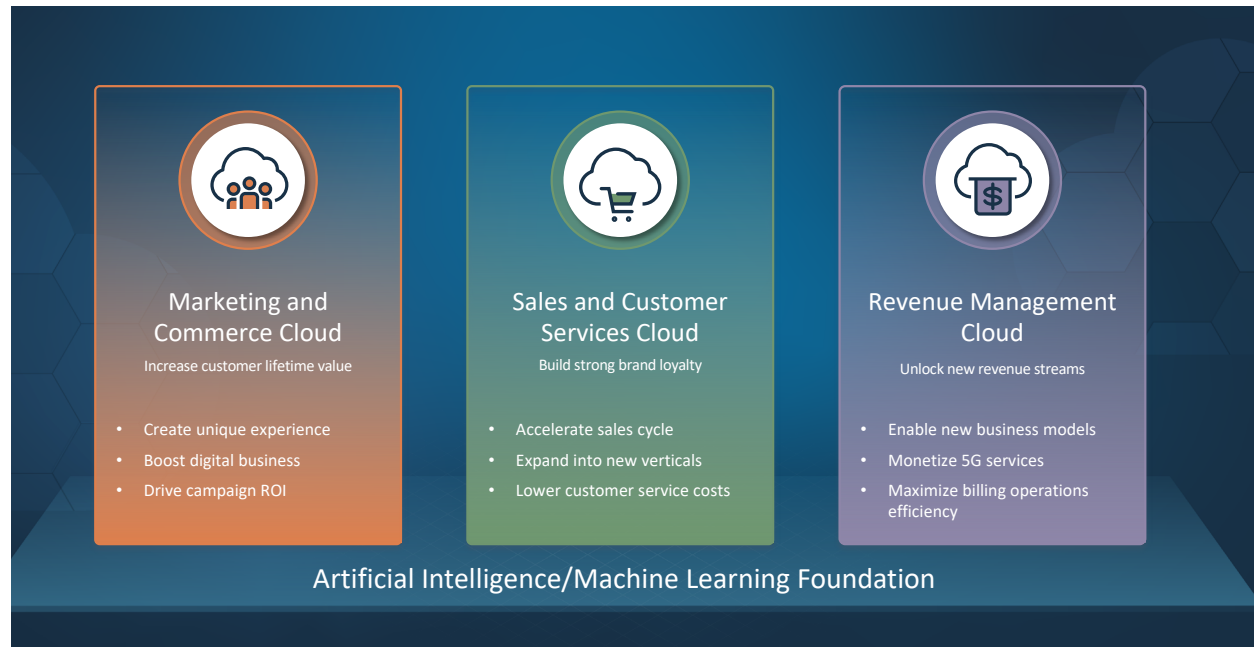
and flexible rating and discounting for B2B and B2C services. It implements dynamic network slicing as a service (SLaaS) to optimize usage of network resources and create new monetization scenarios. Revenue Management Cloud streamlines operations with E2E configurations, automated execution and real-time monitoring and troubleshooting.

> " Success in the digital economy requires the flexibility and scalability of cloud-native BSS systems to rapidly update service offerings and pricing, implement service innovation and decrease TCO. "

TM Forum Open Digital Framework

A blueprint for intelligent operations fit for the 5G era

The TM Forum Open Digital Framework provides a migration path from legacy IT systems and processes to modular, cloud native software orchestrated using AI. The framework comprises tools, code, knowledge and standards (machine-readable assets, not just documents). It is delivering business value for TM Forum members today, accelerating concept-to-cash, eliminating IT and network costs, and enhancing digital customer experience. Developed by TM Forum members through our Collaboration Community and Catalyst proofs of concept and building on TM Forum's established standards, the Open Digital Framework is being used by leading service providers and software companies worldwide.

Core elements of the Open Digital Framework
The framework comprises TM Forum's Open Digital Architecture (ODA), together with tools, models and data that guide the transformation to ODA from legacy IT systems and operations.
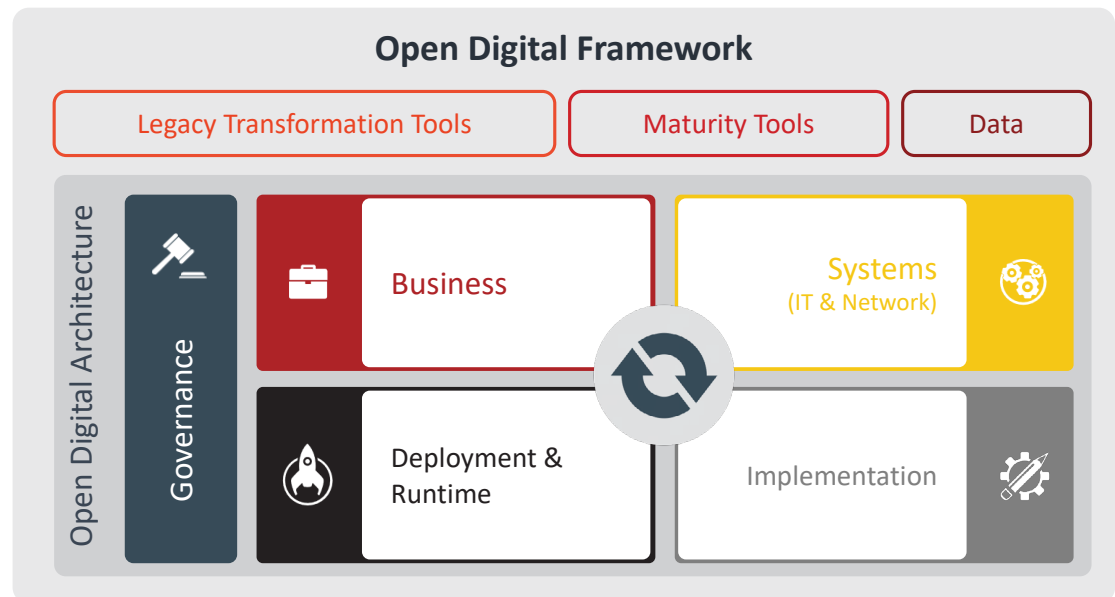
Open Digital Architecture
- Architecture framework, common language and design principles
- Open APIs exposing business services
- Standardized software components
- Reference implementation and test environment

Transformation tools
- Guides to navigate digital transformation
- Tools to support the migration from legacy architecture to ODA

Maturity tools & data
- Maturity models and readiness checks to baseline digital capabilities
- Data for benchmarking progress and training AI

Open Digital Framework

Legacy Transformation Tools · Maturity Tools · Data

Open Digital Architecture · Governance · Business · Systems (IT & Network) · Deployment & Runtime · Implementation

Goals of the Open Digital Framework
The Open Digital Framework aims to transform business agility (accelerating concept-to-cash from 18 months to 18 days), enable simpler IT solutions that are easier and cheaper to deploy, integrate and upgrade, and to establish a standardized software model and market which benefits all parties (service providers, vendors and systems integrators).

Learn more about collaboration
If you would like to learn more about the project or how to get involved in the TM Forum Collaboration Community, please contact George Glass.

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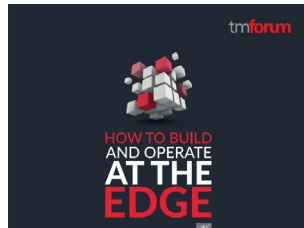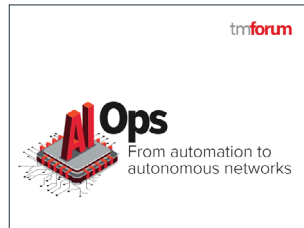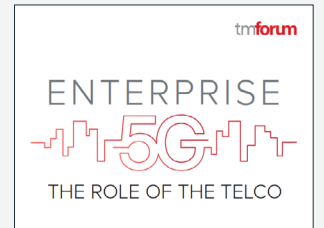
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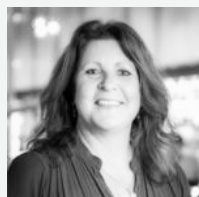
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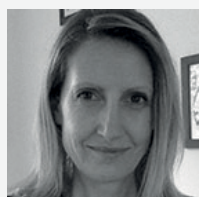
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