Embracing Microservices Architecture in Telecommunications

Adoption and measuring success of microservices
The telecommunications industry is in a transition phase. Physical networks are being replaced by digital ones. Moving beyond communications services, the sector is now providing industry-specific technology solutions. Sales, support, and delivery operations are transforming from a simple solo mode to a complex collaborative one.

The industry is exploring business, IT, and network strategies to manage the changing business environment. Focusing on improving the customer experience, telcos are revising their IT and network architectural capabilities to support extensibility and elasticity. A key mechanism for enabling these strategies is adoption of microservices architecture (MSA).

Adopting MSA architecture in telecommunications will not only be a technology transformation but also a major shift in people’s mindsets, the organizational culture, and team structures. While microservices architecture will ensure flexibility and scalability, its implementation needs to be meticulously planned and executed. Microservices development goes hand in hand with DevOps-based delivery model to deploy business capabilities which need agility and on-demand scalability.

Since implementation of the architecture will need expensive foundational blocks such as establishment of DevOps practices, automated delivery platform, and complex infrastructure operation management, it should be continuously monitored to ensure efficient and effective implementation of the MSA strategy. A well-designed MSA monitoring strategy will be required to keep its governing body informed about any deviation from the planned path.

This point of view outlines the rapidly changing telecommunications industry and how the microservices architecture strategy can help the industry respond to new challenges. It focuses on:

1. How communications service providers (CSPs) can adopt microservices architecture?
2. How CSPs can monitor the effectiveness of the MSA strategy?
The telecommunications industry is changing

The telecommunications industry will be transitioning from its business path to enter uncharted territory. It will explore collaborative business models by venturing into industry-specific offerings. It could be ‘uberising’ its network by moving it from the ground to the cloud. It should prepare to move into a service guarantee-based multi-partner delivery and support ecosystem. The customer will be the center of innovation and browse-first will become the norm.

The business change
The collision of telecom products and services with other industry domains is providing CSPs with the opportunity to explore new technology service offerings. The evolution of a new telecom service ecosystem is restructuring the organization e.g. new service lines; redefining the business process e.g. sales, support and revenue models; and more automation of business operations e.g. service fulfilment orchestration with multiple partners.

The delivery change
The adoption of software-as-a-service (SaaS), platform-as-a-service (PaaS) and cloud technologies is transforming the telecoms industry’s core assets - the physical networks - into digital e.g. software-defined networking (SDN) and virtual network function (VNF). It is supporting an emerging demand for every operation to be on-demand, intuitive and intelligent e.g. self-service, zero touch provisioning, self-healing and real-time analytics.

The operations change
The telecommunications industry, as a digital enabler of other industry offerings, needs a platform to support a service level agreement (SLA) based operational model. Signing SLA-based operational models with industry partners will compel CSPs to reorganize themselves with service-level objective (SLO) based internal operational functions e.g. service desk management shifting from reactive incident resolver to proactive problem finder and solver.

The imperative
The business, delivery, and operational changes need enabling applications to be responsive to these changes. Telcos will need IT and network systems that can be continuously augmented with new business and operational capabilities. They will need scalable applications for processing millions of events, requests, and transactions generated from automated provisioning and operational activities. They will require more business and operational process automation to ensure reliable time-to-deliver, time-to-support and time-to-invoice the services.

The challenge
In today’s ‘experiment-and-explore’ business model, the rate at which system requirements change is outpacing commercial off-the-shelf (COTS) product release cycles. Most COTS product vendors and bespoke application developers are experiencing technical and delivery constraints to deal with continuous change, processing spikes and assuring business process reliability. Other industries have successfully responded to these challenges by moving key business capabilities from COTS to SaaS packages, adopting continuous integration (CI) and continuous delivery (CD) release cycles and decomposing monolith applications into discrete microservices.
Microservices in telecommunications

The technology sector has successfully applied MSA to overcome challenges of elongated release cycles and inefficient horizontal hardware cloning-based system scaling. Now, this proven approach is gradually expanding to the telecoms industry.

Microservices are redesigning BSS

The critical components in the business support systems (BSS) domain such as sales order capture, commercial order management, product catalogue and offer management are good candidates to adopt microservices. Adoption of microservices architecture in BSS can protect expensive customization and major upgrades of COTS packages. The MSA allows you to decouple the ‘system of engagements’ from the ‘system of records’, and gives agility for differentiation in a hypercompetitive market. The missing capabilities in BSS can be implemented as microservices on a platform-as-a-service (PaaS). It will reduce time-to-market for new service launches, and will allow management of seasonal scalability requirements. There are different patterns of microservices that can be applied:

- **Discrete microservices** – They are developed to support unique business capabilities, and good candidates to implement discrete microservices are product / catalogue, offer / promotions, payment.

- **Pass-through microservices** – They are developed to support legacy system integrations, e.g., Tuxedo integration with mainframe systems.

- **Orchestration microservices** – They are developed to support workflows and calls of multiple discrete microservices. Good candidates for implementing orchestration microservices are cart and order orchestration.

Microservices are redesigning OSS

MSA provides capabilities for operations support system (OSS) components to manage frequent changes to individual network interfacing components. Discrete microservices are good candidates to decouple the OSS from constantly changing environments. Some of the processes where microservices pattern can be applied are network event monitoring, network fault alarms, technical order decomposition, inventory provisioning and resource activation. It can provide agility for OSS software upgrades and stability in dynamic interfaces with heterogeneous network element managers.

Microservices are redesigning the network

The relevance of MSA for telecommunications is not limited to BSS/OSS IT, instead it will be gradually moving deep down into network management, network elements, and functions.

Telecom network technology vendors have already started seeing the relevance and benefits of MSA alignment, and many have announced strategies to redesign their network orchestration and management platforms.

The virtual network function will eventually move from virtualized in-premise commodity hardware to the cloud, and the cloud-native VNFs can be deployed as microservices. The MSA-aligned VNFs will simplify feature upgrades and have virtually unlimited scalability. They will support dynamic provisioning.

Microservices-based building blocks are used in software-defined network platforms to create dynamic and on-demand ‘bandwidth’ services. The SDN control functions - designed and deployed as microservices - can continuously be augmented with new capabilities. It also provides scalability required by OSS systems and other third-party applications communicating with the SDN platform.

Microservices are moving (not removing) the complexities

MSA will move complexity from software ‘design-build-test’ implementation process to automated ‘service routing-messaging-monitoring’ operation management process.

Microservices will increase developer productivity by limiting their scope to a smaller set of cohesive features without being concerned about impact on other services. But CSPs must ensure meticulous design and also be ready to make significant investments in automation tools for operational support and maintenance.

CSPs should be aware that decomposing BSS/OSS and network services into microservices will offer greater flexibility, but communication complexities among them could bring performance challenges too.

Figure #2: Microservices in telecommunications
As microservices support quicker delivery and runtime flexibility, CSPs need to change their funding from fixed cost to continuous business benefit-based investments.

The biggest impact CSPs would need to manage is organizational change. They will have to reorganize their teams from technology to functional/feature domain. The feature teams should have skills to design, develop, test, deploy, operate and maintain.
Strategy to adopt microservices architecture

Introducing microservices architecture for telcos is a gradual and iterative process for which a long-term strategy has to be formulated. To make the most of the MSA pattern, CSPs must first build the foundation, then discover, design and develop relevant microservices use cases.

改变文化

主要问题在于，DevOps、自动化交付和MSA一起合作解决的是欢迎变化请求。这是一次文化转变，从反对变化到拥抱变化。DevOps文化支持持续变化，即持续开发、集成和交付。DevOps带来了所有权和协作意识，涉及变更使能者——运营商、设计师、开发者和测试者。

DevOps练习可以有助于说服CIO接受灵活变更管理，但可能不适用于复杂协作环境。一个自动化交付平台用于构建、测试和部署将需要移动用户故事的开发人员到消费者台式机的频繁发布周期。它将赋予开发社区执行其任务的灵活性和重复性，且无需人工干预。

微服务架构模式的特征使其非常适合敏捷和自动化交付。一个微服务代表了一个自我管理的企业操作。它使开发、测试和部署变得简单。它具有硬边界，几乎没有或没有依赖性。这鼓励了有限或无影响的频繁变化。它通过清晰的服务合同（即开放接口）暴露了其服务。它简化了服务的集成和组合。

选择PaaS

第二个重要的问题是微服务架构模式旨在解决的将是面对易变性。它需要一个弹性托管基础设施和平台来应对动态缩放需求。与硬件虚拟化基础设施相比，OS虚拟化容器技术提供了更大弹性，且虚拟化开销更低。微服务架构的半自主特征使其非常适合容器化。容器封装了一个微服务及其完整运行时依赖项，如库、二进制文件和配置文件。容器可以在几秒钟内被实例化和销毁，因为无需启动或关闭宿主OS。容器是资源消耗感知的。因此，部署在容器中的微服务最适合弹性可伸缩性。

当容器管理器看到微服务的需求增加时，它可以复制微服务，通过实例化更多容器来扩展。它使应用在Y轴上可垂直扩展。此外，它还跟踪资源使用情况并分布负载到服务器。这提供了X轴的可水平扩展性。

微服务架构简化了开发，因为其范围包括问题域（功能）内的最小或无依赖性。不同微服务的应用程序需要在给定的策略域（功能）内进行开发。微服务架构简化了开发，因为其范围包括问题域（功能）内的最小或无依赖性。不同微服务的应用程序需要在给定的策略域（功能）内进行开发。
eventually managed as one application. A multi-container-based application requires a container management layer over the infrastructure.

Building a custom environment for containers’ auto-scaling and load balancing will be a mammoth task. It is more feasible to rent a PaaS emulating container-as-a-service that can manage orchestration, scheduling and clustering of containers distributed across nodes.

Discover the microservices
Once the CSPs successfully institutionalize the DevOps culture and arrive at a consensus to move capabilities from static infrastructure to dynamic PaaS, they should be ready to scan their application capabilities landscape and discover opportunities for microservices application.

There are many methods to discover and design microservices, including the most practiced domain-driven design using noun (entity) based and verb (activity) based decomposition. Whatever method is used, a microservice should represent a discrete business operational activity. A well-choreographed microservice will form a business operational function. When these functions are orchestrated through a workflow, it will eventually reflect the end-to-end business process.

The microservice could be the base unit of the CSP’s business process. The following diagram illustrates an approach to identify the candidates for microservices in the order-to-cash process.

To summarize, microservice adoption is an iterative (not big bang) journey. The CSPs need to define and follow their multi-year iterative microservice transformation road map. The journey begins with establishing the foundation with DevOps and PaaS preference, and then continues with a dynamic iterative approach for adding new and shifting existing business capabilities. The TM Forum’s eTOM Level 3 business processes could be a good reference point to discover microservices based business capabilities across sub-domains of the telecom service value chain i.e. concept to market, prospect to order, order to activate, trouble to resolve and usage to cash.

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### What is Microservices Domain?

<table>
<thead>
<tr>
<th>Domain – Order to Cash</th>
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<tbody>
<tr>
<td>Sub Domain – Lead to Order</td>
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<tr>
<td>Features – Get or Post – Quote</td>
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<tr>
<td>Business Capabilities</td>
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**Definition** – A Microservices domain is a service around a specific business logic and the associated data. The systems of record derived through Domain-Driven Design

![Diagram of discover microservices in telecommunications domain](image-url)

To align EToM processes with business objects:

- Align Microservices Asset with eToM L3 Business processes
- Provides a framework for organizing, assigning, managing, delivering, and maintaining Microservices
- Drives feature and function based Microservices asset management
- Enables a Business Product – management style lifecycle management of IT capabilities and services
- Drives agility, flexibility and responsiveness throughout IT operations
- Promotes and advances reuse of IT services – eliminating redundancy, reducing costs, and increasing agility

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Once the microservices business and operational capabilities deployments begin in production, a governance body driving MSA programs will need a microservice navigation compass. It is critical to ensure alignment of IT programs with expected business outcomes. CSPs should design a navigation compass with three-dimensional measurement metrics that can continuously monitor their microservices strategy effectiveness across business stakeholders, operational staff and most important - the customer.

Figure#5 – Microservices navigation compass – Business measurement metrics
Response time (Rt) represents time taken by a service to accept a request, process a request and provide a response.

Request (Rq) is an operation that a consumer service wants the provider service to perform.

Rt = F (∑Rq)

Response time is a direct function of number of requests.

Elasticity Index = F (1/Rt)

Elasticity is inverse function of response time.

Extension index = ‘n’ Million Request per second

Extensibility Index = ‘n’ User Stories per Day

How to interpret extensibility reading

Higher extensibility means a shorter time for a business user story to be available in a production application, keeping the application relevant for business stakeholders at all times. It indicates the degree of application relevance with reference to business stakeholders’ demand.

Elasticity meter

The elasticity meter measures response time. It offers information about the number of requests that a system can process in a given time period i.e. acceptable response time.

Extension index = ‘n’ User Stories per Day

How to interpret elasticity reading

More elasticity means that a system design is highly capable to scale in a very short time to meet any surge in requests without impacting the response time. It involves maintaining a resilient business operation in an ultra-high data volume band with fluctuating demand scenarios. It predicts the probability of meeting or missing SLA/SLO by business operations.
Experience meter
The experience meter measures business process ‘cycle-time variance.’ It indicates business process reliability to complete a customer transaction within a given time period i.e. committed customer time.

How to interpret experience reading
A high experience reliability reading shows business processes are automated to an extent where the cycle time is consistently repeatable and reproducible in different scenarios (various combinations of customer segment, products, transaction volume). It is the degree of consistency in offering a standardized customer experience.

- Process variance time \( P_t \) indicates time variance of a process to execute the same process with different variables
- Use cases \( U \) represent a scenarios with different input variables

\[ P_t = f(\sum U) \]
Process variance time is direct function of number of use cases.

Experience Index = \( f\left(\frac{1}{P_t}\right) \)
Experience reliability is the inverse function of process variance time.
Role of CSP’s IT Partner

A microservices architecture strategy can be a catalyst for a business transformation.

CSPs must partner with an IT services company for their microservices adoption road map. It can help discover relevant business capabilities (benefits) and manage increased operational complexity.

DevOps, as an enabler of microservices adoption, is more about bringing cultural change than technology change. The CSP’s IT service partner can support in establishing process, people and platform change management required for institutionalizing DevOps culture.

Microservices are relevant for business alignment and business ownership of IT. The IT service provider can help bring IT and business alignment by monitoring, measuring and guiding the CSP’s microservices implementation success.

A CSP should partners with an IT services company for return on investment and risk mitigation in MSA.
About the author

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Sanjay is a Business Solution Consultant, with over 18 years of experience in Telecommunication Industry across BSS and OSS applications. In his recent engagements, he has played advisory roles at CxO level for drafting IT Architecture roadmap, technology evaluations and solution definitions. He is passionate about analysing relevance of trending technologies for Telecom industry and how it can be leveraged to realize his client’s business strategies. He has published thought papers on – SDN/NFV, APIs and Microservices.
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