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Managing the inevitable move to SDN (Software Defined Networks) and NFV (Network Function Virtualization)

White Paper

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Introduction

Contemplating the differences between a transformation and a metamorphosis can lead to quite the debate. Consider the simple example of a caterpillar: It spends much of its early life cruising (albeit, slowly) along tree limbs, until after a few months it surrounds itself with a cocoon, only to emerge later as an entirely different, agile butterfly. A simple transformation would have really just been a "make-over" … perhaps to a bigger, faster caterpillar. But a metamorphosis changes the entire dynamic of its life. Instead of a few dozen legs, they have wings. Rather than spend a full day just crawling to a nearby tree, the agile butterfly can now visit dozens of trees in an hour. Instead of a bland, unimaginative appearance, they are now full of color. But what didn't change was how easily they can be consumed by predators.

Imagine telecommunication operators today in much the same way. Over the years they have transformed. In fact, they've transformed almost continuously since acquiring their first customers. Their networks have expanded and become faster. The technologies they provide and support are constantly changing (TDM to IP, 2.5G to LTE, Wired broadband to Wi-Max, etc.). The products they offer and the methods in which they package and bill those products change with some regularity. But these are all transformations; it can be argued that a true metamorphosis hasn't yet occurred in their businesses. That's all about to change, however.

The Metamorphosis in the Business: Adopting SDN/NFV

During the better part of the last 5 years the telecom market has been watching and in many cases, planning for the move to Software Defined Networks (SDN) and Network Function Virtualization (NFV). Many operators viewed this in the early days as just an optional set of technologies to consider adopting at some point in the future. However as more vendors, analysts and operators begun to fully explore what these moves could mean, suddenly the playing field has changed dramatically; the move is no longer optional for any operator.

But why isn't this just a transformation? Why does this rate as a full metamorphosis in operator businesses? The answer is in the scope: The adoption of SDN/NFV doesn't just impact networks and it doesn't just impact services. It actually has major implications in almost every corner of the operators' business and has the ability to completely alter their standard, traditional, aged business model.

Here are some examples of changes operators will need to manage when Software-defining and Virtualizing their networks:

> This has a direct implication on CAPEX costs, OPEX costs and time to market. By moving these functions to virtualized environments, operators can now deploy these functions faster than ever, which will limit (or eliminate) needs to incur OPEX costs and the allow operators to focus CAPEX costs far more precisely.

Managing the inevitable move to SDN-NFV

Network equipment. No longer will specialized, purpose-built hardware platforms be necessary. Commodity equipment may now be procured and installed, which greatly simplifies hardware management, hardware costs, equipment availability, rapid extensibility, etc

> As NFV gains momentum, it stands to reason that older legacy platforms will become more difficult to procure and costs will increase, making the move to NFV even more necessary.

Specialized services. Specific network functions including firewalls, routers, broadband remote access servers, etc., will now move into software and away from the group of specialized platforms operators previously needed to purchase.

Focus on licensing. In today's networks, a growth in demand results in either an increase in deployed (hardware) CAPEX to manage the increased traffic and services, or (in a more tactical scenario) a stricter enforcement of policies that limit services to some consumers in favor of higher-value enterprises. This landscape changes dramatically with the advent of SDN/NFV: A growth (or even an unexpected spike) in network and services demand can be managed almost instantaneously and automatically by the intelligence layers in these new networks. In many cases, real time policy controls and dynamic license allocations can seamlessly shift virtual resources to the network sector in need and then rebalance licensing as and when needed. No truck has rolled, no engineer has needed to install more equipment and no provisioning process has been manually executed. This practice alone offers operators a significant opportunity to optimize licensed assets and produce a significantly stronger ROI than previously possible.

Change in policy management. Common Policy controls deployments based on the 3GPP Policy and Charging Controls (PCC) are established to manage resource allocations to services (and customers) based on preset prioritization rules. They typically consist of policy servers and policy enforcement platforms (e.g., DPI). While several aspects of policy management will change in SDN/NFV networks, one of the complex changes will revolve around real-time shifting of licensed, logical resources between completely disparate sectors of the network. In practice, this means extending software defined network policy controls beyond network oriented and application oriented flow controls, to now also support individual subscriber preferences and their subsequent profiles. These controls enhancements will be dynamic and quite fluid in nature and may also have planning and billing implications that must be tracked also in real-time.

Changes in how products and services are bundled and sold. In today's environment, customers buy products and services that often are based on the bundle, not on the volume. While there are often consumption variables in those bundles (e.g., "burst rates"), generally speaking a customer pays monthly for the contents of that bundle, regardless of how much they use it. In SDN/NFV networks, operators can offer packages that scale up and down in price based on how much a product or service is used and even when (and where) it is used. This new approach is made possible by real-time network management and now provides operators an opportunity to sell far more products and services, as cost exposure is totally controlled by the customers themselves.

Adoption of new logical wholesale capabilities, including network slicing. With SDN/NFV networks, operators can now more easily create products including end-to-end logical networks ('slices"), which can be quickly deployed as a wholesale service to customers.

Customer self-fulfillment support. The industry has seen movement toward immediate customer fulfillment for several years. This first happened in both video and wireless environments, where a customer would request a product or service and within minutes that request would be delivered. More recently customers have been able to bypass phone queues completely, making and receiving service change requests completely online. What changes dramatically in SDN/NFV networks is the notion of a dynamic catalog. Now operators may provide almost their entire spectrum of available products and services to customers to "pick and choose" what they would like, without bundle limitations. Imagine an enterprise customer now being able to select virtual products for multiple site locations, with varying parameters (e.g., upload capacity, PBXs, etc.) all from online, with provisioning happening as soon as the order is committed. Imagine that same customer being able to login to their account online and change those parameters with immediate billing impact at any time during the billing cycle.

Potentially incompatible billing platforms. With the dramatic changes in the way products and services are not only sold, but also provisioned and billed, there is a very good chance that upgrades to operator billing platforms will be required. While most billing platforms deployed today have no problems managing intra-cycle pro-rata situations, many (if not all) of these platforms may not be equipped to "throttle" billing. Billing variables based on consumption are not the issue, but when the consumption is now based on the provisioned product itself actually changing the supporting environment around it – this can cause quite a mess in most billing platforms today. For example: if a customer selects products that result in creating a series of virtual network containers serving their multiple sites, each container may consist of a series of applications and other VNFs (virtual network functions). Now imagine an application within any particular container that suddenly extends beyond the bounds of the virtual server(s) has been allocated. This may result in billing platforms not only needing to recognize this change, but to now also create pro-rata billing to account for the increase in logical servers, application parameters and application licensing. But the change was only for six hours…and then a return to normal (expected) service operations resumed.

Evolution in network planning tactics. Network planning teams will need to factor additional dimensions into their modeling going forward. Planning for growth, expected acquisitions and network consolidations, network retirements and technology upgrades will now need to factor in new layers for virtualized assets, virtualized licensing, capacity based on consumption and allocation of virtualized assets and other factors. But the most difficult period for network planning and the primary focus for the balance of this paper, is the hybrid state, lasting years in most cases, where operators will need to balance legacy and target networks.

Creating a Pathway to SDN/NFV isn't to be taken lightly…

Ultimately the measured success of an operator moving across the plane of legacy networks and into SDN/NFV networks will consist of many factors, including customer retention, customer growth, corresponding revenue growth, CAPEX and OPEX preservation (and decline) and sustained network optimisation. But while the industry is very focused on the eventual target state SDN/NFV architecture (and its many benefits), the actual pathway to get there will lead operators through a veritable minefield that is the hybrid network they must operate during the migration.

Why is this hybrid state such a dangerous area for operators? If managed improperly, the cash drain to the business could effectively drive an operator into bankruptcy. They must keep in mind that this state will not only require OSS and BSS systems to manage the duality of products and services being offered, but it will also require network operations to provide at least the same level of quality it had prior to the hybrid architecture. Perceived and prolonged "slips" in quality will result in customer and revenue losses. Additionally, network planning will need access to fluid and continual analytics data to ensure appropriate levels of procurement to meet current and near-term growth characteristics of the products, services and customers currently riding on the legacy architecture.

The Migration: Careful Preparation and Detailed Execution

The anatomy of any successful migration starts with a comprehensive and documented set of outcomes the business needs to achieve. These will include factors such as target timeframes, budgets and desired network capabilities (products, services, capacities, etc.) available at the completion of the migration. Once that is completed, operators must be able to create and effectively navigate through a complex choreography of activities that will span the life of the migration project, ultimately terminating at those desired outcomes.

Understanding the Current State

For migrations into an SDN/NFV realm, that choreography begins with a strong grasp of the operator's current state of operations. Operators must absolutely have firm, controlled and continually updated views into many factors which all relate to their networks and delivery of services to their customers. Without this understanding, any migration launch will immediately begin to cause integrity issues that ultimately will result in customer and revenue losses. Factors (and their associated KPIs) should include:

- Discovered views into all physical and logical resources currently operating on the network. These views must be refreshed (at least) weekly across all assets and should include capture of service topology mappings.

- Independent synchronization of inventory and FAR (fixed asset registers). Based on discovered data, these systems must be brought into (and kept in) alignment with networks, to ensure all assets are both known and available for use.

- Continually updated Capacity analytics. Current consumption metrics are important, however predictive analytics are also crucial in understanding growth at regional and service levels. Factors including time to exhaustion, "What-If" modeling and other analytics must be well-defined and plans for translating those analytics to support hybrid network modeling must be developed.

- Mapping customers and revenues to services. Finance professionals often look at the ability to map customers to services and assets and then to costs, as the "Holy Grail" of ROI for networks. Realistically, however only limited amounts of this data have been reliably and repeatedly produced by some operators. The capabilities to achieve this with the assistance of technology tools are actually readily available today; having this discipline established in networks today is important not only in understanding ROI, but also in prioritizing migration and policy strategies and in justifying CAPEX expenditures to support those migrations.

- Ensuring accounts within billing and CRM align with the reality of service delivery and service parameters on the network. Many operators focus on either cost or revenue alignments in this realm, but in reality they should strive to focus on both, so accurate views into margins may be achieved. Margins have **customer, product** and **cost** dimensions that must be collectively understood; prior to SDN/NFV migrations, performance across all three of these dimensions should factor directly into migration prioritization planning.

- Views into growth and retirement planning. Strategic views exist today in most operators that provide details into where budgets for growth will be applied, as well as what (and when) technology will be retired. While there are ongoing, associated analytics used to assist planning teams for current networks (e.g., predicted growth budgetary needs, decommission planning and vendor performance, etc.), modeling must be expanded to now determine which projects move forward, versus which projects are re-purposed to move to the new network architecture. Depending on timeline and market pressures, many projects may be moved into the new SDN/NFV architecture, thus re-allocating that CAPEX as opposed to discarding it by buying more legacy equipment.

A firm grasp on these factors will position network planning to render the most cost-effective, capex-preserving decisions for the business as the migration activities commence. The inability to understand what customers are associated with which services, how those services are provisioned on the network, what assets are actually in operation and which are actually provisioned, how much of the network is actually generating revenue, whether billing accounts actually match what is being supplied on the network, etc., are only a few of the questions that must be readily understood before the first service or platform is migrated.

Supporting the migration: The hybrid state

With a firm grasp on current state, network migrations to SDN/NFV are best positioned to commence. Over the timeline of the migration, the network architecture scales will tip from initially favoring legacy networks, to ultimately favoring the new SDN/NFV networks, until eventually no legacy assets remain in service. The factors previously mentioned in the current state actually still apply – and having these disciplines in place will prove vital during the architectural transitions.

By definition, the period of network hybrid state implies that both network architectures will remain operational, until every last service and customer has been re-homed to the target architecture and every legacy piece of equipment has been decommissioned, retired and removed. Operators should expect this stage to take years to complete; while some operators will accomplish this in approximately 2-3 years, other (typically larger) operators can expect timelines to exceed 3-4 years.

Managing this stage involves developing a plan or even a choreography of what will be migrated, when it will be migrated, how services will transition, how customers will be transitioned, etc. Using the factors implemented to monitor the current state, operators will need to extend those views to include SDN/NFV variables:

- **Resource discovery**: The resource model expands to now include not only additional soft assets (virtual assets) but also their supporting licenses (that now also appear as assets). Additionally, hard assets (e.g., physical platforms) will begin to transition to less specialized and more commoditized platforms. Operators should anticipate complexities in mapping hard asset utilizations against the soft assets they support. For example, it is possible that a single commodity server could conceivably support every product and service available within the product catalog. Additionally, those products and the resources they consume on that server are dynamic and even transient in nature; therefore a utilization mapping of hard asset to soft asset will become less feasible. Instead higher level trended consumption modeling may be the most effective utilization model (also impacting capacity analytics discussed below).

- **Inventory and FAR alignment**: As the discovered resource model evolves to account for the expanded footprint of SDN/NFV architectural additions, inventory and FAR platforms must also be extended in similar fashion. Consideration must also be given to variable licensing however. With products and services that were previously not virtualized (e.g., vDNS, vFW, vADC), through virtualization the quantity deployed is now based on licensed instances. In cases where more licenses are needed to meet short term needs, temporary increases in licensed deployments may be invoked only to be removed once the need is no longer present. These transient changes must be kept updated in inventory, FAR and upstream accounting and ledger platforms.

- **Capacity analytics**: In legacy networks the capacity has most commonly been modeled as traffic volumes against platform specifications. In more sophisticated capacity analytics, models have expanded to include service parameters and device performance data (including available memory, processor utilization, connected users and devices, etc.). Moving to SDN/NFV, capacity models must expand again to consider the dynamic nature of virtual functions and services, while also paying close attention to device performance characteristics as those vNFs become more and less active on those devices. Capacity analytics must also look at license consumption and provide predictive insights on license procurement needs.

- **Mapping customers, revenues and services**: Determining ROI and overall profitability of assets (and customers) becomes a bit more complex in SDN/NFV environments, due to the fluid nature of the virtual assets themselves, not to mention the customers that consume services that are "spun up" and "spun down" to meet demand. Extending the foundational view created in the Current State is a major advantage that operators can leverage and build upon, as these mappings must now be further segmented by network sectors, time of day, types of services, customer demographics, revenue metrics, cost metrics and overall margin metrics. Planning teams will find this granularity of data extremely valuable for ongoing planning, while Finance teams will find significant budget justification data within the period aggregations and trended financial performance data.

- **Aligning billing, CRM and network**: Legacy product and service billing has historically focused on the provisioned product or service itself, the quantity or volume consumed by the customer and any associated mid-cycle pro-rata charges or credits. In SDN/NFV environments, additional dimensions must be added to account for the wide variety of virtual services that will now be available to the customers. What makes this a very significant challenge is in cases where customers appear (and access the same services) in both legacy and SDN/NFV sectors of the network. Accessing a service provided by legacy architectures may have entirely different revenue and cost drivers than if the service is accessed from within the virtualized architecture. It therefore becomes crucial that billing understands how (and from where within the network) services have been accessed.

- **Incorporating growth and retirement planning:** Earlier we discussed the potential (and preference) to shift growth and retirement activities away from legacy planning and into SDN/NFV architecture planning. During the migration activities there will be cases where growth and retirement must be completed in legacy networks, due to urgency of need. In those cases it becomes even more important to maintain analytics that essentially predict these needs and subsequently recommend spare and warehouse levels needed to meet these needs as they arise. During migration activities the processes associated with decommissioning and removing equipment culminates with potential resale of that equipment to other operators. While this is a good practice to raise free cash within the business, if appropriate levels of that equipment are not retained, that free cash is quickly depleted when it becomes necessary to re-procure that same equipment.

As operators work through the iterative migrations within the hybrid state, the risk of impeded quality of service and even service disruptions remains high. Not having an accurate, validated and updated view of the network, services and customers prior to embarking on a migration is frankly, dangerous for operators and examples of migrations in peril are beginning to appear around the world. Understandably, when this view is augmented and used to carefully and efficiently chart a course for migration activities, the resulting network can position an operator with a significant advantage in their market.

Moving into target state operations

As migration activities wind down and the last pieces of legacy networks and services are retired and removed, operators can also begin to decommission hybrid state analytics that no longer are necessary. It is important, however, that final integrity checks are performed to ensure:

- All services are migrated, or upgraded
- All customers are accounted for and services are intact or improved
- All customer account billing is successfully migrated away from legacy product codes
- New products are successfully "stress-tested" for network-to-billing integrity
- Remaining spare and warehouse inventories have removed unnecessary legacy components
- Customer care processes, including online self-service portals, etc., are properly tested and continuously monitored against service orchestration and network layers for continued accuracy

As network and business operations in the target state emerge from their "break-in" periods and stabilize, the analytics tools used during the migration will have ongoing value for network planning, network operations and finance functions. These tools should remain active, providing that familiar (and now evolved) Current State view of their networks and the delivery of services to their customers.

Conclusion: Managing the metamorphosis

A common denominator in every operator is the perpetual state of change in their networks, their technologies, their business and even their customers. The move to Software Defined Networks and Network Function Virtualization is unlike any transformation operators have undertaken in the past. Accordingly, care must be taken to minimize the risk and ensure success. Diligent preparations that include a solid understanding of the business before the migration begins, coupled with an ongoing view into migration performance analytics, minimizes their risk of a failed migration.

Thought leadership, technology tools and supporting analytics for SDN/NFV migrations are all available within the industry today. Programs that employ these components inevitably provide the lowest risk, the best use of budgets and ultimately a solid path to success.

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About Subex

Subex Ltd. is a leading telecom analytics solutions provider, enabling a digital future for global telcos. Founded in 1992, Subex has spent over 25 years in enabling 3/4th of the largest 50 CSPs globally achieve competitive advantage. By leveraging data which is gathered across networks, customers, and systems coupled with its domain knowledge and the capabilities of its core solutions, Subex helps CSPs to drive new business models, enhance customer experience and optimise enterprises.

Subex leverages its award-winning analytics solutions in areas such as Revenue Assurance, Fraud Management, Asset Assurance and Partner Management, and complements them through its newer solutions such as IoT Security. Subex also offers scalable Managed Services and Business Consulting services.

Subex has more than 300 installations across 90+ countries.

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