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SERVICE ASSURANCE IN A NFV AND SDN WORLD: Assuring the virtualized networks of the future

By Dan Meyer

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Whether ready or not, the mobile telecommunications industry is moving towards a world of fewer parts and more code. This move is being conducted under the guise of virtualization technologies, led in the telecom space by software-defined networking, network functions virtualization and cloud platforms.

This move is seeing telecom operators steering away from the deployment of hardware-based platforms to support the launch of new services and towards software-based solutions designed to run over common off-the-shelf hardware. Telecom operators are going through a complete re-think of how they architect their networks in an attempt to get a handle on the explosive demand for data services, while also preparing to handle expected demand from the “internet of things” and the eventual migration to “5G” technologies.

This is not an easy transition, or is it expected to become easier the deeper carriers move. Most operators have for decades refined their operations around hardware-based infrastructure and are now looking to completely upend that model through the use of software for as

many functions as possible.

While complex, the market has made significant progress in this move, with some operators already rolling out new services running on these virtualized platforms. Most of these deployments have been somewhat siloed in terms of their reach across the network or in serving specific market segments, but these operators are already seeing the financial fruits of that labor.

AT&T Business Solutions CEO Ralph de la Vega recently noted the carrier’s aggressive SDN and NFV plans have allowed it to reduce the capital expense and operating expense needed to run its operations.

“When you put something in our

network as we’re moving forward on it, we’re virtualizing it, but we’re significantly reducing the opex and the capex that it takes to run that network,” de la Vega said during an investor conference earlier this year. “But the beautiful thing about it, from a marketing point of view, is the services that ride on top of this new architecture. Not only do they cost less capex and less opex, but they generate more revenue. Because now the software cycles to turn up the services are almost instantaneous. ... We made good profit on the old services, but that’s on old technology. The new technology gives us a chance to operate our network better to make better margins and at

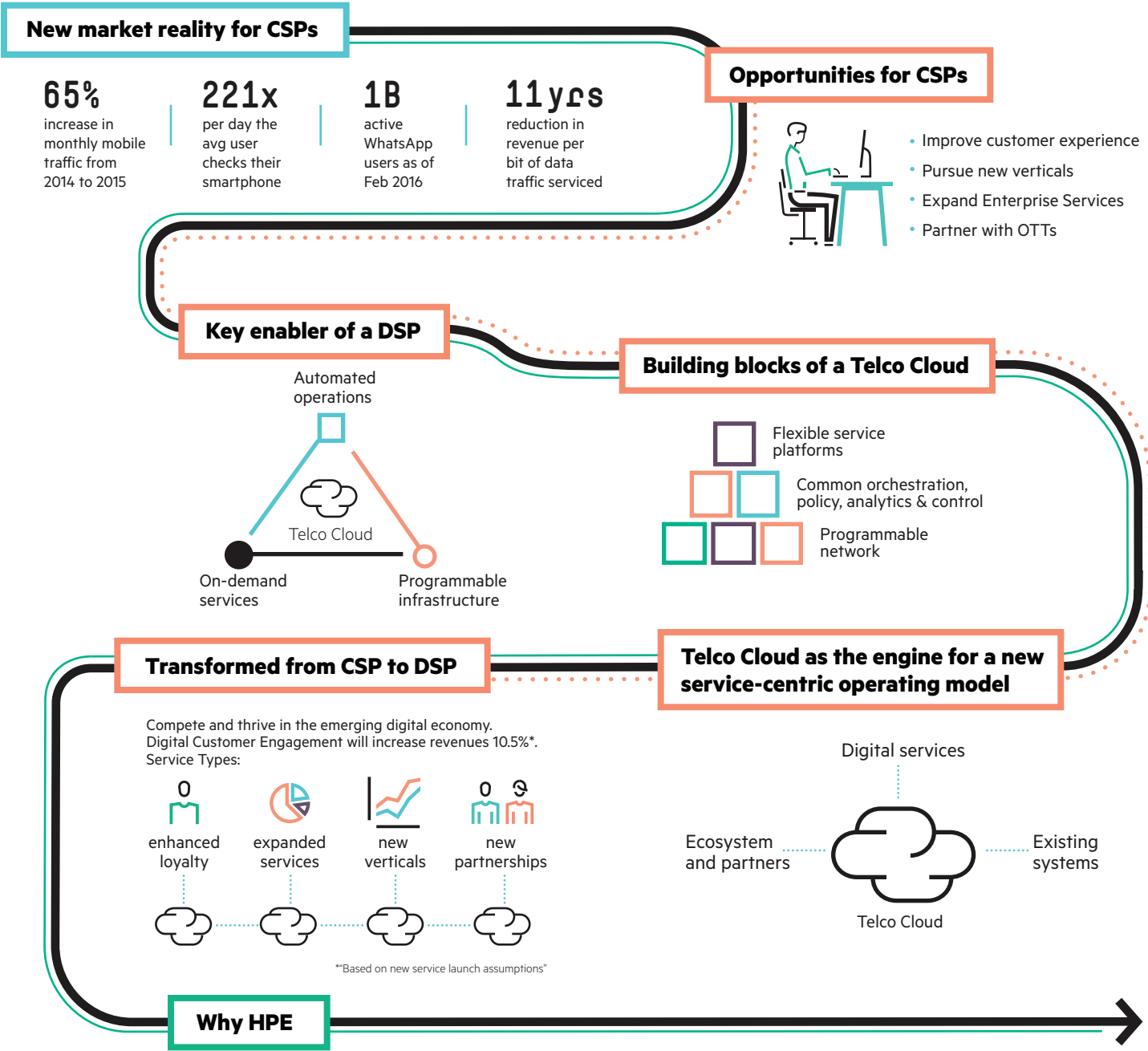


Ralph de la Vega, Business Solutions CEO, AT&T.

Source: AT&T

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the same time give our customers a better deal, because everybody's costs are lower, when you implement the new architecture.”

Through all of this, network service assurance remains a top priority for telecom operators, though views on what those assurance levels need to be in a virtualized environment remain in flux. Wireless carriers are likely to avoid virtualizing aspects of their network and services - like voice-over-LTE and voice over Wi-Fi services expected to match performance of legacy systems - if they are not confident their virtualized versions are up to snuff.

This report will look at some of the challenges telecom operators and vendors are facing in terms of updating their assurance platforms in virtualized environments to support telecom-specific services; how the view on what is needed in terms of assurance is changing due to virtualization; and provide an update on the development of assurance strategies from carriers and vendors.

The investment is huge

A recent report from IHS Markit predicts the service provider NFV

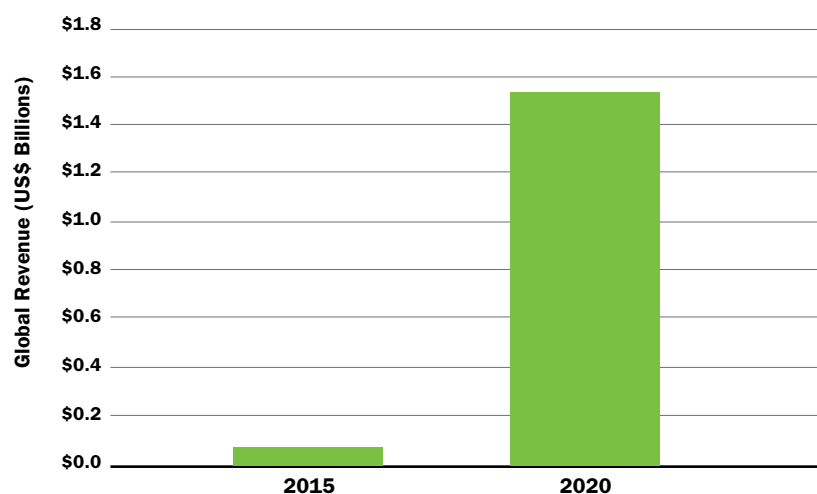
market, including hardware, software and services, will surge from \$2.7 billion in 2015, to \$15.5 billion by 2020. The prediction noted NFV software would comprise 80% of the \$15.5 billion total, “or around \$4 out of every \$5 spent on NFV.”

In addition, the firm claims 11% of NFV revenue would come from new software and services; 16% from NFV infrastructure, which includes servers, storage and switches purchased in place of purpose-built network hardware; and 73% from existing marketing segments, primarily from virtualization network functions.

A more bold, and perhaps more encompassing, report came from Technology Business Research, which predicts the NFV and SDN markets are expected to hit \$158 billion by 2021, boosted by early adopters such as AT&T beginning to ramp investments into the NFV and SDN ecosystems.

“A growing group of tier-one operators is leading the charge in implementing NFV and SDN. This group is driving a significant amount of development in the NFV and SDN ecosystem and is pushing the vendor community to rapidly adapt to this new architectural approach to

Service providers globally will spend over \$1.5B in 2020 to deploy vCPE use case services



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networks,” explained Chris Antlitz, telecom senior analyst at TBR. “NFV- and SDN-related spend volume is forecast to ramp up in 2017, at which time use cases will be more defined and the cost benefits of using NFV and SDN will be more apparent. This will prompt holdout operators to jump on the bandwagon and aggressively pursue transformation with these technologies to avoid being left behind.”

A recent survey released by the Linux Foundation’s Open Platform for NFV Project, found an increasingly small percentage of telecom operators have not yet planned for

network functions virtualization. The survey, which was conducted for OPNFV by Heavy Reading and released at the recent OPNFV Summit, noted 6% of the more than 90 telecom operators questioned did not have an NFV strategy planned at all, down from 14% last September.

However, these investment and deployment predictions can be stymied if operators are unable to tackle issues surrounding service assurance.

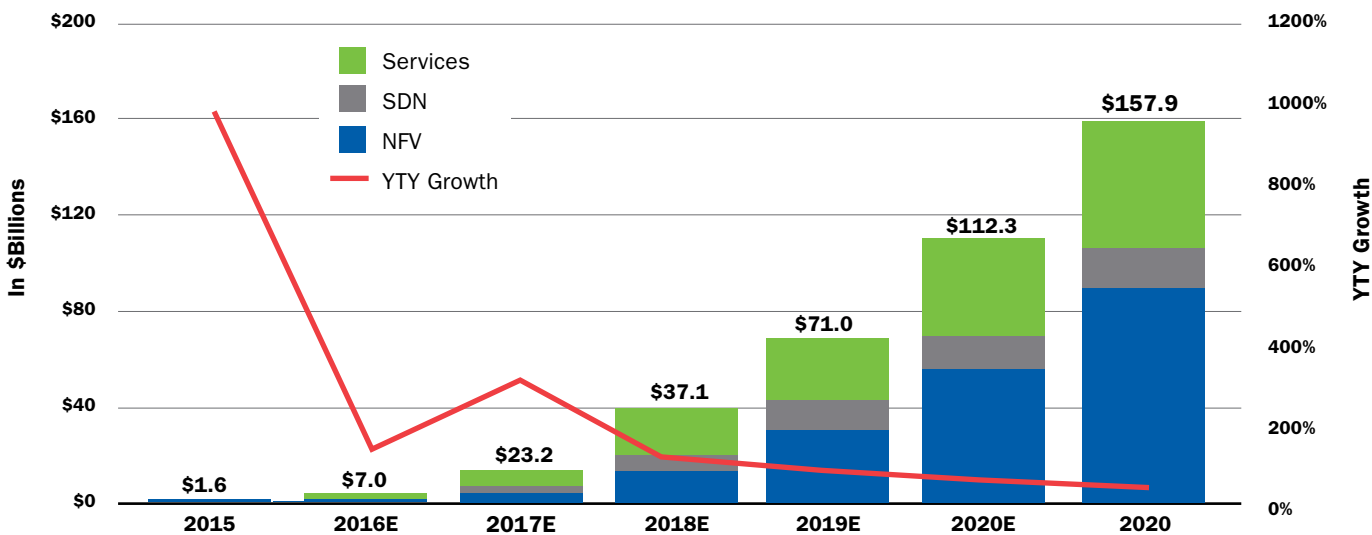
“Without sufficient NFV validation the significant investment being made by operators will be at risk and the evolution to virtualized

network functions will not deliver the quality of service available from existing hardware-centric networks,” said Ultan Kelly, product director at Cobham Wireless.

Obviously, expectations are high in terms of the telecom and mobile telecom space moving into the software-centric world using NFV and SDN technology. But, that doesn’t mean there aren’t significant challenges still needing to be tackled, with service assurance seen as one of those hurdles.

“Nobody really has the same approach at this point,” explained Bala Thekkedath, director of NFV

Total NFV/SDN spend by segment



Source: TBR Data



If You Can't Assure It in Agile Way, You Can't Virtualize It

So how can services that are created in a dynamic environment can be assured on delivery?



By proper **integration of service assurance** tools with **network and service orchestration**



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marketing at Hewlett-Packard Enterprise. “Some are leading and others are following.”

Carrier concerns

While far from perfect, mobile operators have come to an understanding on how service assurance worked in the real world of hardware-based network operations. Sure, some of the processes in place would seem a bit arcane for platforms designed to transport high-tech services, but at least carriers - and more importantly their engineers - have had a lot of time to work through kinks and understand those processes.

But, as operators begin moving network control over to virtualized platforms, the game changes as “real” tools are set to be replaced with virtual code. Of even more concern for operators is the near-term need to support both real and virtualized hybrid deployments that many think will be around for up to a decade.

“The good news is that service quality management direction works just as well in the new world as the old world,” said Chris Rice, VP of advanced technology

at AT&T Labs. “From a black box point of view, you are just looking at black boxes.”

AT&T is seen by many as one of the telecom leaders in terms of its migration to a software-controlled future. AT&T in late 2014 announced plans to control 75% of its network resources using virtualization technologies by 2020, and that at the end of 2015 the carrier had reached 5.7% control, which was ahead of its 5% target.

Krish Prabhu, CTO and president of AT&T Labs, recently explained the carrier’s network “typically has about 250 distinct network functions. So when we say 5% or 6% of the network has been virtualized, we’re essentially saying that any new network function that’s deployed in the network in that cluster of virtualized network functions is deployed as a software element running on cloud infrastructure as opposed to buying up the shelf hardware.”

In making the adjustment of dealing with service assurance in a hardware world as compared with dealing with service assurance in a virtualized world, Rice noted the difference was not cut and dry.

“There are a couple of differences

in a cloud world, however,” Rice said. “No. 1 is that there is no such thing as a pure cloud world. Everything is old and new world. It’s all brownfield and that brings some challenges. ... Reliability is an example. In the old world you would have special gear and boxes you would buy and implement. There was a lot of proprietary elements, but allowed for what I would call an atomic level of resiliency. In the virtual world you can get the same or better level of resiliency with a combination of things.”

In looking to help bridge those worlds, Rice explained AT&T’s recently launched enhanced control, orchestration, management and policy project as a move in that direction. AT&T said it launched the ECOMP project due to a lack of guidance for NFV and SDN deployments in a wide area network environment. ECOMP is said to provide automation support for service delivery, service assurance, performance management, fault management and SDN tasks. The platform is also designed to work with OpenStack, though the company has noted it was extensible to other cloud and compute environments.

That lack of guidance from vendors was a common theme among telecom operators, who are in the position of driving the virtualization movement instead of legacy models where vendors were always moving to roll out new technologies.

Verizon Communications, which as of late has become more vocal in terms of the progress it's making with virtualized platforms, noted it's definitely a different position in terms of comfort level for the carrier, but said the carrier was becoming more confident in the transition.

"No one is completely comfortable yet with virtualization, but it's OK that it's an uncomfortable world," said Victoria Lonker, director of product management for MPLS, SDN and Mobile Private Network at Verizon Communications. "We have made sure we could service chain multiple vendor deployments together so they could work, which took some work because some vendors said their design would work in an open environment, but they didn't work as planned once deployed. ... We also have that challenge today with physical devices, but have been able to leverage that

with managed services. The move towards virtualization is really not that much different today."

Analysts are also cognizant of the challenges facing carriers, especially as it concerns service assurance issues in what those operators are looking to deploy in a multivendor environment. Much of this is looking to be surmounted using the open source community, but even that has its issues.

"If you look at a basic OpenStack software model, there needs to be some hardening to support carriers in terms of service assurance, and that seems to be pretty clear," said Greg Collins, founder of Exact Ventures. "Just getting the scripts

in place to tackle the issues are still a challenge."

As an example of operators recognizing the importance of the open source community, AT&T recently said it was set to move its ECOMP program to developers interested in building upon the already established software code. AT&T said it is working with the Linux Foundation on the structure of the open source release.

"This is a big decision and getting it right is crucial," said John Donovan, chief strategy officer and group president for technology and operations at AT&T. "We want to build a community - where people contribute to the code base



Source: AT&T

AT&T is seen as a market leader in terms of its move towards virtualizing network resources.

and advance the platform. And, we want this to help align the global industry. We've engaged a third-party company to be the integrator and provide support in the industry for the ECOMP platform. And we've received positive feedback from major global telecom companies."

In touting the platform, AT&T said ECOMP is "mature, feature-complete and tested in real-world deployments. And, we believe it will mature SDN and become the industry standard. Releasing this software into open source levels the worldwide playing field for everyone. Most importantly, we believe this will rapidly accelerate innovation across the cloud and networking ecosystems."

"Thekkedath noted AT&T's ECOMP model is likely to help some operators that will look at the outline and want to follow the carrier's lead.

"AT&T has a complete view of how they want to overhaul their systems," Thekkedath said.

Vendors to the rescue?

Telecom operators are not alone in trying to find balance in the

new world of virtualization. Vendors that deal in service assurance are also having to come to grips with new business models and collaboration efforts that many with a history in the telecom space have never had to deal with.

"I think initially there was some reluctance, some skepticism about what can be done in this new architecture," noted Prabhu. "Also part of the challenge for the vendors was, it certainly upset their business model because since they're buying boxes, we're now going to buy just software and we would buy it in small chunks rather than big chunks. And we've also been very vocal about having open source to play a key role in the ecosystem. ... So, I think we're all learning. I think it's best to say we're all learning how the new ecosystem evolved and how we settle into business models that we're comfortable with."

Among the vendor community, Prabhu highlighted a distinct difference between legacy vendors and new companies that have come into the space from the data center and web-centric worlds, with many using AT&T's Domain 2.0 program as the gateway.

"The historical providers and suppliers know our network best," Prabhu said. "They know how we use their products. So from a functionality standpoint or usage standpoint, they certainly have more information than a new vendor coming in, but if they decide to stick to their existing business and they don't move fast, then you run the risk of losing the business to a new vendor because the new vendor would be motivated, has lower entry barriers to get us the software we're looking for and we've seen that. ... So we call them disrupters and we have several disrupters that have shown up in our network and over 12, 18 months, they've caught up with some of the network specific knowledge. So, today they provide us network functions that actually are pretty good. We can run our network on their network functions and traditional vendors have seen this and they've also stepped up."

Vendors are well aware of this challenge, but also know that when it comes to service assurance issues, telecom carriers are in need of their help.

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new can of worms, especially for mobile,” said Scott Sumner, VP of strategic marketing for Accedian. “The basic problem is that there is a much larger multiplicity of end points that need to be monitored. Whether it’s device aggregation points or small cells, everything is multiplying in terms of density.”

That multiplication is leading to a significant increase in the amount of data flowing across networks, which in turn is leading to the need for more robust service assurance platforms to track that flow. This need is easily outpacing the capabilities of legacy service assurance platforms.

“In the physical world, the

visibility to traffic through the service layer was available by placing taps into physical wires,” said Vikram Saksena, office of the CTO and Cable Markets at NetScout. “We would put probes and tap physical connections to get traffic data and then run through our system to get information to carriers. With virtualization, there are still physical wires, but there is traffic that stays inside the core running on a VNF or service chain that does not show up in a physical wire. To gain visibility you need to extend your technology.”

Saksena also noted the need to have processes in place to actually do something with this ability to

tap into a vastly greater amount of data coming across the network, especially as telecom operators look to compete against web-based OTT players.

“There is also now a greater emphasis on real-time analysis of service flow,” Saksena explained. “Operators want to be more agile and elastic. They want to be able to react more quickly to changes in the network. But, this requires the need to access more information. In the old world, the changes were not that dynamic. It’s extremely critical to have as real-time access as possible.”

Some help for carriers could come by way of work being conducted by the vendor community into network slicing initiatives, which could help carriers get a better handle on service level agreements tied to services deployed over virtualized platforms. Ihab Mahna, solutions architect at EXFO, noted recent work in network slicing could come into play as SLAs can be more specifically sliced into different service needs depending on the required service assurance.

“SLAs are not for fun,” Mahna said. “They are necessary and are



Source: I23RF

Automation is expected to play a big role in supporting service assurance in a virtualized environment.

NFV and its implications on network assurance

By Abhinav Anand, consulting partner in the OSS-BSS practice team of Global Media & Telecom, WiPro

Network functions virtualization has brought the capability of the telco networks on commodity hardware and software. Never before was the pace of change so fast and so disruptive. The question being asked today is whether the disruptions brought on by these technologies will create a paradigm shift in the way networks are being operated. Another question is how NFV will actually result in significant savings for service providers on capital expense and operating expense. This column focuses on the network fault management area and how it is impacted for providing assurance for virtualized and hybrid networks.

Impact on operations and systems

Telecom networks today are operated and managed by network operations team, consisting of monitoring teams, field engineers and level two and three experts, which are organized around types of network, services and so on. Both IT and network operations are handled in silos, with duplicate setups and teams created for managing the same. We shall see that NFV will have both qualitative and quantitative impact on these teams. These teams, smaller in size in the future, may need to get familiar with both IT and network operations.

With NFV, the physical network will start getting augmented with virtual networks. There will be co-existence of these hybrid networks for some time with new virtual networks before the physical networks see a trend of getting completely marginalized. In the context of network assurance, one would require additional

instrumentation for visibility on the whole new virtual setup that gets created for delivering the virtual network functions, which is limited with existing legacy tools.

NFV and network assurance

As per the European Telecommunications Standards Institute's ISG Management and Network Operations framework, the virtual infrastructure manager that manages NFVI resources within a domain and the VNF Manager that performs orchestration and management function of various VNFs, will both support complete fault, configuration, accounting, performance and security capabilities. The framework also has a NFV orchestrator that performs orchestration and management of NFVI resources across multiple VIMs and interacts with operating support and business support systems or provisioning, activation, capacity management and so on.

In the initial phases, the strategy or toolsets for monitoring of NFV will not be significantly different from what is currently available for the physical networks. The NFV infrastructure (compute, storage and network), VM and VNF related faults will be collected through following means:

- Direct SNMP-based monitoring of the underlying physical infrastructure (e.g. Esxi hosts).
- VIMs may be an alternate source of respective fault and performance alarms to OSS systems.
- Both element managers and VNF managers will be the source of alarms. They have overlapping capabilities today, however one significant difference between the two is that while element managers implement proprietary interfaces for managing their

respective VNFs, VNF managers will do the same with industry standard interfaces.

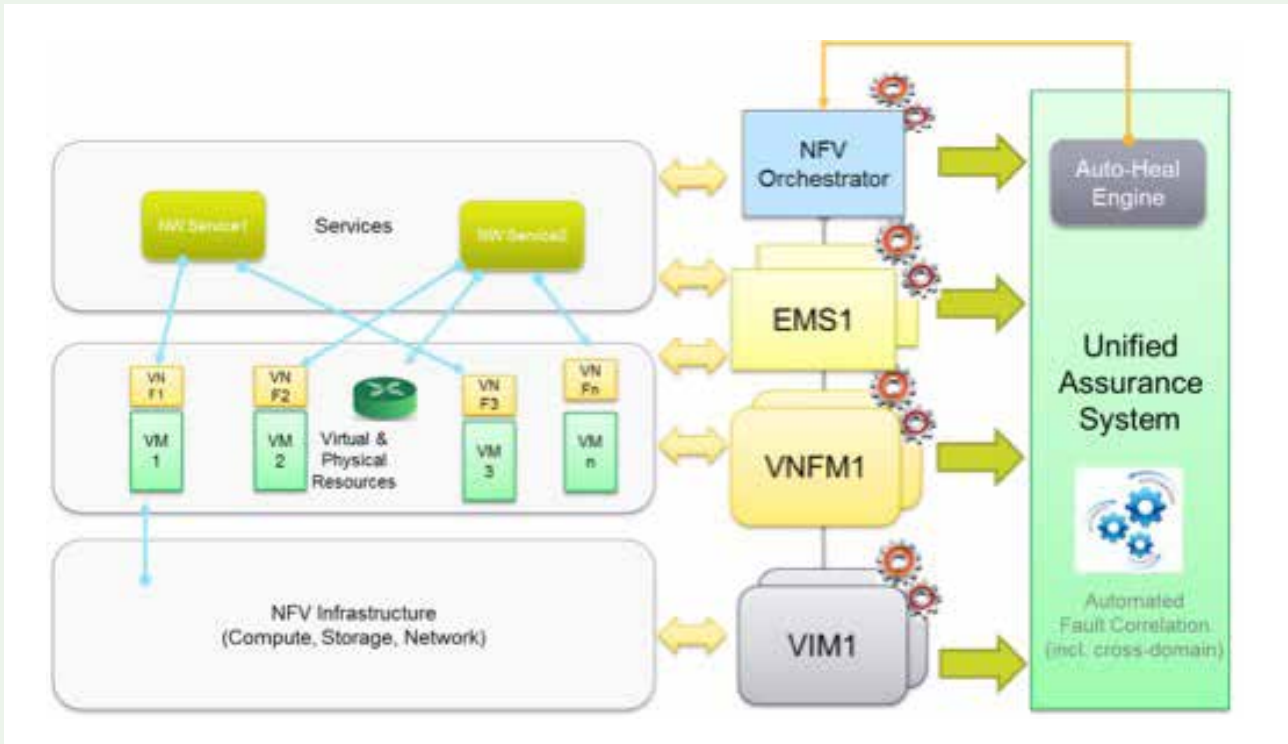
- Other sources would be system logs, process and services monitoring through URL and port monitoring.
- Native management APIs of the leading cloud or virtual environment will provide further insights into the internal working of these environments. Many of the commercial and open-source tools have already announced availability of these monitoring packs in their respective solution.
- New analyzers and agents are being developed that would be located in strategic locations in the virtualized environment and be able to capture the packets flowing across the network to provide insights into working of complex use cases involving multitenant services and applications.

Fault management evolution and implications for network availability

The faults that emanate in the physical world typically require a lot of manual intervention. The capacity issue or hardware related faults in the physical environment are the ones that require manual trouble-shooting, visits by field engineers, etc.

However, in the virtual environment, due to in-built resiliency in the environment, these manual activities can be completely done away with. Further, VIMs and VNF managers are designed to have comprehensive configuration management capabilities of their respective domain, which can be leveraged to fix the Infrastructure issues dynamically in real time, remotely and even without manual intervention.

One can foresee each of these VIMs and VNF managers will be enhanced to have a separate



Source: Global Media & Telecom, WiPro

Figure 1: Future unified fault assurance system.

in-built resolution modules that would trigger a corrective action based on alarms generated at the NFVI layer and VM/VNF layer. Over a period of time with advance analytics capabilities further augmented in these systems, these will be able to identify not only the issues proactively but also will be able to trigger a series of actions to avoid a larger system impact. This system will also get further enhanced with an auto-healing engine that would trigger certain corrective actions through the NFV orchestrator resulting in a truly “self-healing” network.

Doing fault correlation in a virtual environment will be a complex task as there exist many-to-many relations between VNFs to VMs

to underlying physical resources. Secondly, network services get orchestrated through complex service function chaining or VNF forwarding graphs across both VNFs/PNFs. In this scenario, a network service being provided through multiple service providers deployed in multiple data centers will add to the complexity, but due to above self-healing engine the noise will get drastically reduced enabling faster or auto resolution.

Conclusion

It is a matter of time until inherent resilience of virtual environment, automated workflows and corrective actions within the VIMs or VNF

managers or OSS assurance systems as described above will be able to solve significant number of the problems dynamically. This will result in major effort reduction in the network assurance operations.

Therefore, NFV as a technology is not only going to impact the capex for acquisition of new networks and services, but is also going to have a far reaching implication of reducing opex for the network organizations.

The current industry collaboration is bringing these changes at breakneck speed. It is important for operators and service providers to align their focus for achieving the benefits of this technology.

often tied to regulatory issues.”

Virtualized voice a harbinger

Outside of specific market segments, service assurance is being stretched in terms of dealing with some carrier service offerings. One service noted by many is voice, which with the push towards voice-over-LTE solutions remains a service assurance challenge for carriers.

The ability to run voice traffic over a data network has led many carriers to take the next step in running those VoLTE platforms as something like an over-the-top

application, except bolstered with the ability to embed the service deeper into the network operations. However, unlike legacy voice services that ran over circuit-switch networks and non-voice data services running as either part of a IP-based data network or an OTT application, any imperfection in a VoLTE transmission results directly in a poor service experience for customers.

Some operators in moving their voice traffic to data have gone with the approach of using a virtualized platform to support the new service. This in one way allows carriers to drive even more efficiencies from

the migration as voice services can now be deployed as an application.

However, unlike data services, voice traffic is extremely sensitive to disruptions as instead of a customer dealing with some buffering when confronted with a poor data session, they are immediately aware when there are issues with an IP-based voice call.

“With VoLTE, voice traffic contends for network resources against data traffic,” explained Monica Paolini, founder and president of Senza Fili Consulting, in a recent report. “Sharing the same transmission channel with data brings performance and quality benefits, but at the cost of simplicity. Operators have to work harder to manage and optimize voice traffic, but in doing so they can improve the [quality of experience] for both data and voice, because they can use the capacity in their networks more efficiently.”

Verizon Wireless, for instance began working on VoLTE services more than five years ago as the carrier viewed the eventual turn down of its legacy CDMA-based 2G and 3G services in favor of its LTE-based “4G” network. However,



Source: I23RF

IP-based voice services like VoLTE and VoWi-Fi are expected to tax virtualized deployments.

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the carrier noted difficulties in tuning the voice experience to match that of its legacy service, before finally launching a commercial VoLTE service in 2014. The time involved in fine-tuning the service opened the door for rivals to launch their own VoLTE platforms, though some of those were on a limited geographic scale.

More telling has been the near lack of any promotional efforts thrown behind VoLTE services from carriers, with informal surveys showing customers reporting degraded voice service quality when using VoLTE in the real world.

“A lot of networks need to be vetted and tested with VoLTE in terms of integration and other data services,” Sumner said. “It’s hard to simulate this stuff. VoLTE worked great in the lab for years, but in commercial deployments it has been a different story.”

By moving VoLTE platforms into a virtualized environment, carriers can further free up network resources as well as garner greater control over the quality of the voice service though the use of automation designed to monitor quality levels in real- or near-real time.

“VoLTE is very difficult to handle in a physical world, and really can’t be done with humans,” explained Sumner. “Automation and virtualized instrumentation makes it much easier to see where there are issues in the billions of lines of code being acquired each day. ... Loss and throughput used to not be connected, but now networks are very sensitive to throughput for retransmission. Even a less than 1% loss results in a dramatic customer experience issue. Taken separately, there is not much of an issue, but together you have a train wreck.”

Conclusion

Despite the challenges brought on by the move towards a greater reliance on software, there is too much at stake for telecom operators to deviate from the path. Most operators admit that while they are able to deal with current traffic demands on their network, the oncoming deluge expected from IoT and 5G mean they need to act fast in order to avoid network meltdowns.

Unlike previous technology revolutions, the virtualization movement is being driven by those carriers, with in many cases the leading

edge providers taking matters in their own hands in an attempt to drag the vendor community along. This pressure is causing many vendors to alter their business models in order to compete in this new world, though most acknowledge it’s an alteration they must move on.

“I don’t think carriers have a choice in moving towards virtualization,” Mahna added, noting the challenge at this point is around 30% in terms of technology and 70% in terms of retraining operations.”

In terms of the ability for service assurance platforms to handle the needs of these new deployment models, the journey continues and expectations are that advances will allow for this evolution of service assurance to meet the challenge. The market might not be ready for large-scale rollouts today, but it appears to be only a matter of time.

“We are getting closer,” admitted Sumner. “In another two or three years there will be a greater level of stability in the market in terms of performance and interoperability, and for carriers that means there will be more choices available.” (☺)



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