World Academy of Science, Engineering and Technology
International Journal of Computer and Information Engineering
Vol:8, No:2, 2014

Big Data Strategy for Telco: Network Transformation

F. Amin, S. Feizi

***Abstract*—**Big data has the potential to improve the quality of services; enable infrastructure that businesses depend on to adapt continually and efficiently; improve the performance of employees; help organizations better understand customers; and reduce liability risks. Analytics and marketing models of fixed and mobile operators are falling short in combating churn and declining revenue per user. Big Data presents new method to reverse the way and improve profitability. The benefits of Big Data and next-generation network, however, are more exorbitant than improved customer relationship management. Next generation of networks are in a prime position to monetize rich supplies of customer information—while being mindful of legal and privacy issues. As data assets are transformed into new revenue streams will become integral to high performance.

***Keywords*—**Big Data, Next Generation Networks, Network Transformation.

I. Introduction

THE proliferation of smart devices and popularity of social networking is generating unprecedented amounts of data, both structured and unstructured, whether it be text, audio or video. More data means more opportunities for operators to gain insight about customers, and hence new ways to serve customers, and to offer well-tailored products and services.

An operator can now know within 15 minutes that a subscriber has downloaded a specific application such as Skype, and that the subscriber's usage pattern will likely change. Telco operators possess information on close to 100 percent of mobile users in a region and can know which searches subscribers are making on Yahoo, Google, MSN and other services.

Operators hold a treasure trove of customer-behavior data, and there is gold in Big Data. Next-generation analytics can help mobile operators mine and refine the value of this new economic asset. The race is on to collect as many details as possible and mobile network operators are in a prime position to know the most.

Mobile carriers have vast resources of data, essentially everything that passes through their pipes. The assets are considerably larger than what tablet manufacturers, retailers or content providers possess. New data-collection technologies are able to extract virtually 100 percent of mobile network data from a copy of traffic across an industry standard interface.

As Google and Facebook have proven, shareholders place a high value on information companies. Rather than remaining as infrastructure companies or utilities, a mobile operator's strategic plan might include ways to monetize information assets. Leading operators will be thinking broadly about new products and services they might provide.

F. Amin is Advisor at TCI Co., Tehran, Iran (corresponding author to provide e-mail: f.amin@tci.ir).
S. Feizi is Senior Advisor at TCI Co., Tehran, Iran (e-mail: feizi@tci.ir).

Operators have an opportunity to dominate the ecosystem, but they must act quickly or lose out to aggressive competitors, whether they are familiar industry players or innovative companies from other industries. Manufacturers, retailers, media and other companies will be battling with mobile network operators to win the hearts and minds of customers.

Analytics is likely to become a differentiator, and eventually a core capability, for telecommunications companies to achieve high performance. It will move away from siloed capabilities in engineering, customer service and IT to become an integrated and holistic capability.

Making this shift will require changes to organization design, and changes in roles and responsibilities, to nurture an analytics culture. To achieve next-generation results, operators will require an agile operating model, along with technology building blocks such as data management, data mining and real-time decision solutions.

Depending on internal capabilities, business leaders will make decisions on whether to develop next-generation capabilities in-house, whether to collaborate with other organizations, or whether to outsource the function for greater speed and results.

II. Big Data

Big data is a relative term describing a situation where the volume, velocity and variety of data exceed an organization's storage or compute capacity for accurate and timely decision-making.

Some of this data is held in transactional data stores – the byproduct of fast-growing online activity. Machine-to-machine interactions, such as metering, call detail records, environmental sensing and RFID systems; generate their own tidal waves of data. All these forms of data are expanding, and that is coupled with fast-growing streams of unstructured and semi structured data from social media.

Big data refers to enormity in five dimensions [1]:

- Volume: from terabytes to petabytes and up.
- Variety: an expanding universe of data types and sources.
- Velocity: accelerated data flow in all directions.
- Variability: inconsistent data flows with periodic peaks.
- Complexity: the need to correlate and share data across entities.

Up to 85 percent of an organization's data is unstructured– not numeric – but it still must be folded into quantitative analysis and decision-making. Text, video, audio and other unstructured data require different architecture and technologies for analysis. When the volume, velocity, variability and variety of data exceed an organization's storage or compute capacity for accurate and timely decision-making.

In addition to the speed at which data comes your way, the data flows can be highly variable – with daily, seasonal and event-triggered peak loads that can be challenging to manage.

Difficulties dealing with data increase with the expanding universe of data sources and are compounded by the need to link, match and transform data across business entities and systems. Organizations need to understand relationships, such as complex hierarchies and data linkages, among all data.

According to a survey conducted by Gartner [2], some 64% of companies planned to invest in big data technology in 2013, if they had not already done so.

This leaves 36% of those surveyed who did not plan to invest in 2013. Meanwhile at the end of 2012, 42% of surveyed organizations had adopted big data technologies, yet just 15% of this figure had employed an enterprise strategy.

A separate Gartner [3] survey of 398 government CIOs based around the world revealed that big data analytics is viewed as a top two priority, the other being replacing legacy systems. A total of 720 business leaders from around the world were surveyed by Gartner, with findings suggesting that media and communications (39%), banking (34%) and services (32%) businesses are prioritizing big data investments in 2013. Half of the business leaders who work in transportation, 41% of those in healthcare and 40% in insurance said they were planning to invest in big data. There is no disputing that big data should now be a top business priority, with IDC [4] also forecasting that the big data market will have grown from $3.2 billion in 2010 to $16.9 billion in 2015. By 2020, business transactions on the internet for example business to business and business to consumer will reach $450 billion per day.

IT department need to ensure a network department can handle the greater demands that big data can create.

Many IT systems will be ill-equipped to handle the volume and variety of data that needs to be managed and analyzed. This will likely be the case with antiquated IT systems, but even if a network department has recently been updated, it may still not be able to withstand the challenge.

Underlining the significance of the perception by business leaders that IT is no longer a back office function and instead core to a Telco's strategy, the majority of organizations now think that businesses' big data projects would lead to an increase in IT budgets.

III. Network Transformation

A. Network Function Virtualization

To implementation of big data strategy, operators need IT and infrastructure to ensure they can handle the greater demands.

One of main concern is network infrastructures that the operator must be run transformation network project.

To launch a new network service often requires yet another variety and finding the space and power to accommodate these boxes is becoming increasingly difficult; compounded by the increasing costs of energy, capital investment challenges and the rarity of skills necessary to design, integrate and operate increasingly complex hardware-based appliances.

Network Functions Virtualization (NFV) [5] aims to address these problems by leveraging standard IT virtualization technology to consolidate many network equipment types onto industry standard high volume servers, switches and storage, which could be located in Datacenters, Network Nodes and in the end user premises. We believe Network Functions Virtualization is applicable to any data plane packet processing and control plane function in fixed and mobile network infrastructures.

We would like to emphasize that we see Network Functions Virtualization as highly complementary to Software Defined Networking (SDN). These topics are mutually beneficial but are not dependent on each other. Network Functions can be virtualized and deployed without an SDN being required and vice-versa.

Vitalizing Network Functions could potentially offer many benefits including, but not limited to [5]:

- Reduced equipment costs and reduced power consumption through consolidating equipment and exploiting the economies of scale of the IT industry.
- Increased speed of Time to Market by minimizing the typical network operator cycle of innovation. Economies of scale required to cover investments in hardware-based functionalities are no longer applicable for software-based development, making feasible other modes of feature evolution. Network Functions Virtualization should enable network operators to significantly reduce the maturation cycle.
- Availability of network appliance multi-version and multi-tenancy, which allows use of a single platform for different applications, users and tenants. This allows network operators to share resources across services and across different customer bases.
- Targeted service introduction based on geography or customer sets is possible. Services can be rapidly scaled up/down as required.
- Enables a wide variety of eco-systems and encourages openness. It opens the virtual appliance market to pure software entrants, small players and academia, encouraging more innovation to bring new services and new revenue streams quickly at much lower risk.
- To leverage these benefits, there are a number of technical challenges which need to be addressed[5]:
- Achieving high performance virtualized network appliances which are portable between different hardware vendors, and with different hypervisors.
- Achieving co-existence with bespoke hardware based network platforms whilst enabling an efficient migration path to fully virtualized network platforms which re-use network operator OSS/BSS. OSS/BSS development needs to move to a model in-line with Network Functions Virtualization and this is where SDN can play a role.
- Managing and orchestrating many virtual network appliances (particularly alongside legacy management

systems) while ensuring security from attack and miss configuration.

- Network Functions Virtualization will only scale if all of the functions can be automated.
- Ensuring the appropriate level of resilience to hardware and software failures.
- Integrating multiple virtual appliances from different vendors. Network operators need to be able to “mix & match” hardware from different vendors, hypervisors from different vendors and virtual appliances from different vendors without incurring significant integration costs and avoiding lock-in.

Network Functions Virtualization aims to transform the way that network operators architect networks by evolving standard IT virtualization technology to consolidate many network equipment types onto industry standard high volume servers, switches and storage, which could be located in Datacenters, Network Nodes and in the end user premises, as illustrated in Fig. 1. It involves the implementation of network functions in software that can run on a range of industry standard server hardware, and that can be moved to, or instantiated in, various locations in the network as required, without the need for installation of new equipment.

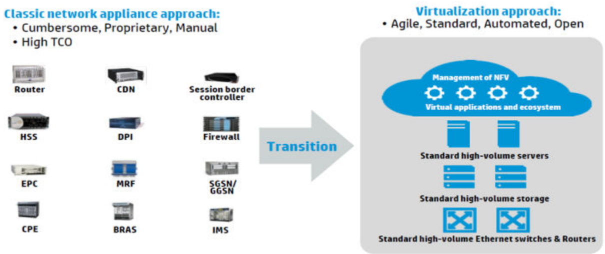

Fig. 1 Network functions virtualization concept

B. Software defined Networking

Network Functions Virtualization is highly complementary to Software Defined Networking (SDN), but not dependent on it (or vice-versa). Network Functions Virtualization can be implemented without a SDN being required, although the two concepts and solutions can be combined and potentially greater value accrued.

Network Functions Virtualization goals can be achieved using non-SDN mechanisms, relying on the techniques currently in use in many datacenters. However, approaches relying on the separation of the control and data forwarding planes as proposed by SDN can enhance performance, simplify compatibility with existing deployments, and facilitate operation and maintenance procedures [5].

Network Functions Virtualization is able to support SDN by providing the infrastructure upon which the SDN software can be run. Furthermore, Network Functions Virtualization aligns closely with the SDN objectives to use commodity servers and switches.

C. Cloud Computing

Network Functions Virtualization will leverage modern technologies such as those developed for cloud computing. At the core of these cloud technologies are virtualization mechanisms: hardware virtualization by means of hypervisors, as well as the usage of virtual Ethernet switches (e.g. vswitch) for connecting traffic between virtual machines and physical interfaces. For communication-oriented functions, high-performance packet processing is available through high-speed multi-core CPUs with high I/O bandwidth, the use of smart Ethernet NICs for load sharing and TCP Offloading, and routing packets directly to Virtual Machine memory, and poll-mode Ethernet drivers (rather than interrupt driven, for example Linux NAPI and Intel’s DPDK).

Cloud infrastructures provide methods to enhance resource availability and usage by means of orchestration and management mechanisms, applicable to the automatic instantiation of virtual appliances in the network, to the management of resources by assigning virtual appliances to the correct CPU core, memory and interfaces, to the re-initialization of failed VMs, to snapshot VM states and the migration of VMs.

Finally, the availability of open APIs for management and data plane control, like OpenFlow, OpenStack, OpenNaaS or OGF’s NSI, provide an additional degree of integration of Network Functions Virtualization and cloud infrastructure.

D. Network Service in NFV

A network service can be viewed architecturally as a forwarding graph of Network Functions (NFs) interconnected by supporting network infrastructure. These network functions can be implemented in a single operator network or interwork between different operator networks. The underlying network function behavior contributes to the behavior of the higher-level service. Hence, the network service behavior is a combination of the behavior of its constituent functional blocks, which can include individual NFs, NF Sets, NF Forwarding Graphs, and/or the infrastructure network.

The ends and the network functions of the network service are represented as nodes and correspond to devices, applications, and/or physical server applications. An NF Forwarding Graph can have network function nodes connected by logical links that can be unidirectional, bidirectional, multicast and/or broadcast. A simple example of a forwarding graph is a chain of network functions. An example of such an end-to-end network service can include a smart phone, a wireless network, a firewall, a load balancer and a set of CDN servers. The NFV area of activity is within the operator-owned resources. Therefore, a customer-owned device, e.g. a mobile phone is outside the scope as an operator cannot exercise its authority on it. However, virtualization and network-hosting of customer functions is possible and is in the scope of NFV.

IV. Conclusion

Big data presents an opportunity for operators to deliver radical changes to existing business processes. It affords operators the ability to utilize the latest technology and data analytics techniques to capture insights from the information they collect. This could prove to be that elusive differentiating factor that separates them from their competition.

Any big data strategy should consider issues such as controls and monitoring, particularly the need to classify data along legal and regulatory lines. Handling a volume of data of such magnitude also increases the risk of negative brand impact.

The key to a successful big data strategy is securing leadership buy in. One of approach that is very important is merging CTO and CIO with together. Embracing big data requires cultural change within an organization of operators. Business leaders need to be closely involved in laying out the organization's strategy, but CITOs need to lead the approach and be clear as to how the organization can maximize and capitalize on the benefits.

Big data is a boardroom issue, yet business leaders can be reticent about using data to inform business strategies. This underlines the importance of CITOs, and in some cases marketing departments, working alongside business leaders to ensure all sides understand the benefits of employing big data technologies.

REFERENCES

[1] Martin Hilbert and Priscila Lopez, "The World's Technological Capacity to Store, Communicate, and Compute Information", Science, Vol. 332, No. 6025, 1 April 2011.
[2] S. Sicular, "Information Governance in the Age of Big Data", Gartner, ID: G00251071, 30 May 2013.
[3] S. Sicular, "The Road Map for Successful Big Data Adoption", Gartner, ID: G00254965, 19 August 2013.
[4] Available at: http://www.idc.com/prodserv/FourPillars/bigData/index.jsp
[5] "Network Functions Virtualization (NFV); Architectural Framework", ETSI GS NFV 002 V1.1.1, 2013.