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SDN, NFV and IP Optical Convergence: harness the power of your network

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Getting the industry thinking

SYNOPSIS

The way in which the telecoms network is being managed by service providers is changing. Evolution towards open, programmable and more flexible architectures is becoming increasingly prominent, as the network struggles to keep up with the demand generated by rapidly escalating mobile data consumption and machine to machine traffic.

Various innovative networking technologies and principles are emerging, which promise enhanced service delivery capabilities. By embracing technologies like software defined networking (SDN), network functions virtualisation (NFV) and IP optical convergence, operators can transform their network architecture, and innovate towards the future.

This paper will examine the role of next generation network technologies in delivering enhanced flexibility, scalability, service delivery capabilities, increased bandwidth, and perhaps most importantly, decreasing operating and capital expenditure.

INTRODUCTION

The telecommunications industry has been undergoing a transformation in recent years. As an "always-on" society consumes an ever increasing amount of data, the strain on service provider network infrastructure has become a perennial headache for network architects and engineers the world over. In the next 4 years, global IP traffic is expected to grow threefold at a compound annual growth rate (CAGR) of 21%, according to Cisco's Visual Networking Index.

The proliferation of LTE and 4G services has resulted in a boom in data usage on mobile devices, and subsequently an added amount of expectation on metro networks. In fact, Cisco suggests metro area traffic is likely to overtake long-haul traffic by 2015, and claims the growth is in part due to the increasing reliance on content delivery networks (CDN). The aforementioned research also indicates CDNs will be responsible for carrying over half of internet traffic in the next four years, as video on demand services, content streaming, app downloading and gaming become more prevalent for today's smartphone user.

Incidentally, mobile data traffic is projected to grow at a CAGR of 61% over the next 4 years. As a consequence of the mobile boom, pressure is mounting on SPs to guarantee they continue to keep ahead of demand. And it's not just mobile that's driving traffic growth. While consumers are spending more time streaming video on the move, the internet of things (IoT) is a rapidly developing industry which continues to add workloads onto the network.

After announcing plans for a dedicated research centre in Barcelona, Cisco claimed IoT brings with it a $19 trillion opportunity. While the revenue generation potential is something that's not to be missed, it once again illustrates the growing amount of traffic buzzing around an operator's network. Of course, such an increase in mobile internet and M2M increases the stress being placed on the service provider transport network.

But what can service providers do in order to simultaneously future-proof the network against the inevitable growth in bandwidth demand, while also reaching new levels of control, agility and flexibility?

Recently, the discussion surrounding higher capacity 100G optical network infrastructure as a feasible technology for increasing bandwidth has amplified. Previous advancements in optical, moving from 10G to 40G, appear to have stagnated somewhat due to convoluted interoperability and spectral efficiency issues. However, industry standards groups, such as the International Telecommunications Union (ITU), Optical Internetworking Forum (OIF) and the Institute of Electrical and Electronics Engineers (IEEE) have been developing standards to help make the move towards 100G as cost efficient and smooth as possible.

Advancements in 100G appear to be a very timely boost for service providers, especially when we consider the stress modern networks are under to deliver ever-increasing amounts of bandwidth for varying services at varying times.

Having more bandwidth is just one part of the problem, and evolving to more sophisticated and efficient network management techniques is equally integral to meeting and surpassing customer demands.

Convergence of the optical and IP layers is increasingly being viewed as a means for operators to gain more control, flexibility and scalability over the network. Technologies such as software defined networking (SDN) seem to offer opportunities for operators to gain an element of programmability and operational freedom over network infrastructure. By implementing a more configurable control plane between IP and optical, fewer points of human interaction with the network are required. Subsequently, a more agile and intelligent infrastructure has the potential to deliver flexibility gains which can lead to increased revenue generation, reduced capex and opex, and enhanced time-to-market.

This paper will investigate how a converged IP and optical infrastructure, coupled with open networking environments featuring SDN and network functions virtualisation (NFV), can help position operators more effectively against market forces threatening revenue generation.

> More than 20 billion devices are going to be connected to the internet, transmitting and receiving data, by 2020

Total Transformation

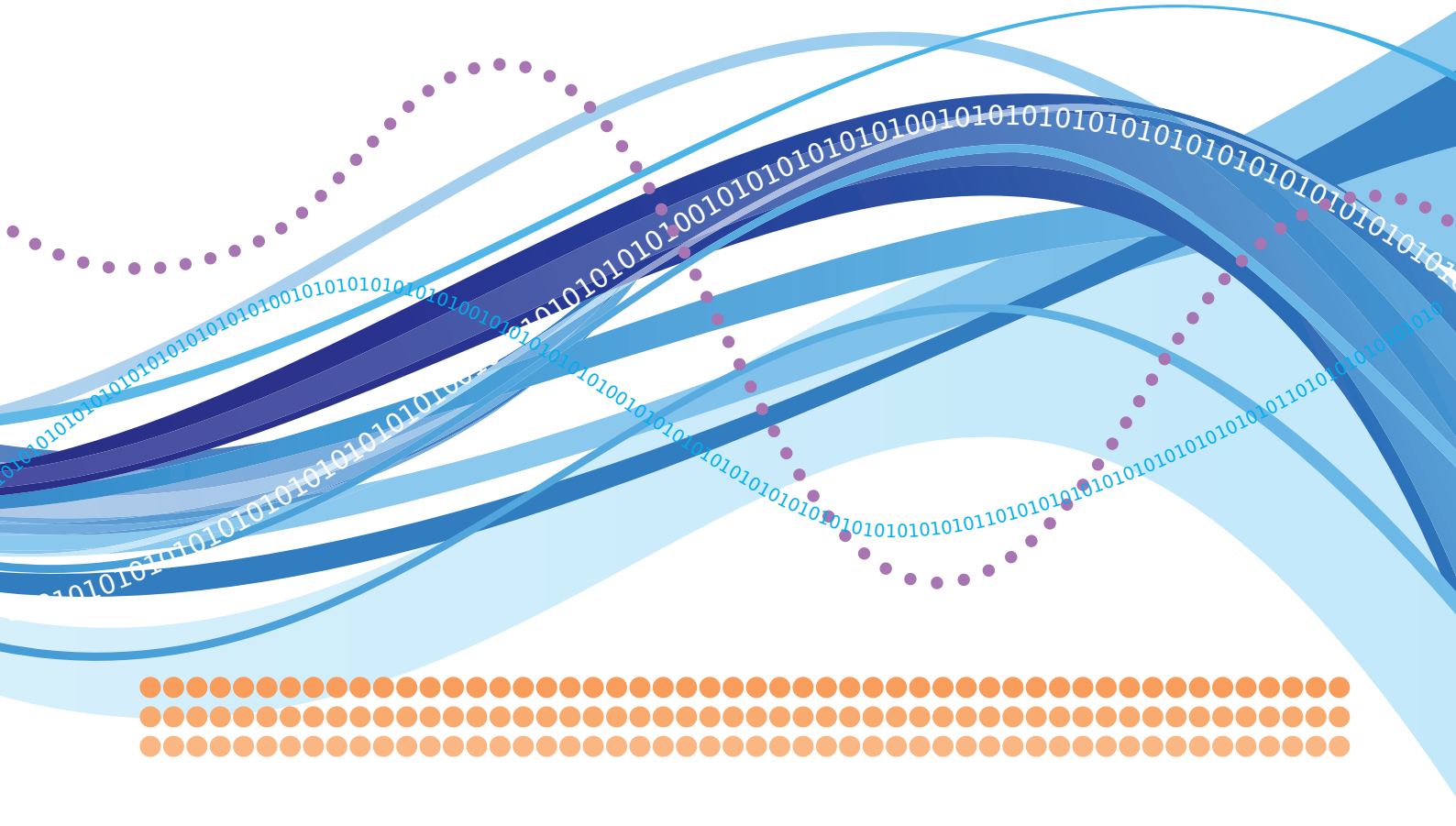
In order to understand how operators can innovate their way to a transformed network infrastructure, and subsequently to new revenue streams, we must first further explore some of the initial concepts we addressed at the beginning of this paper.

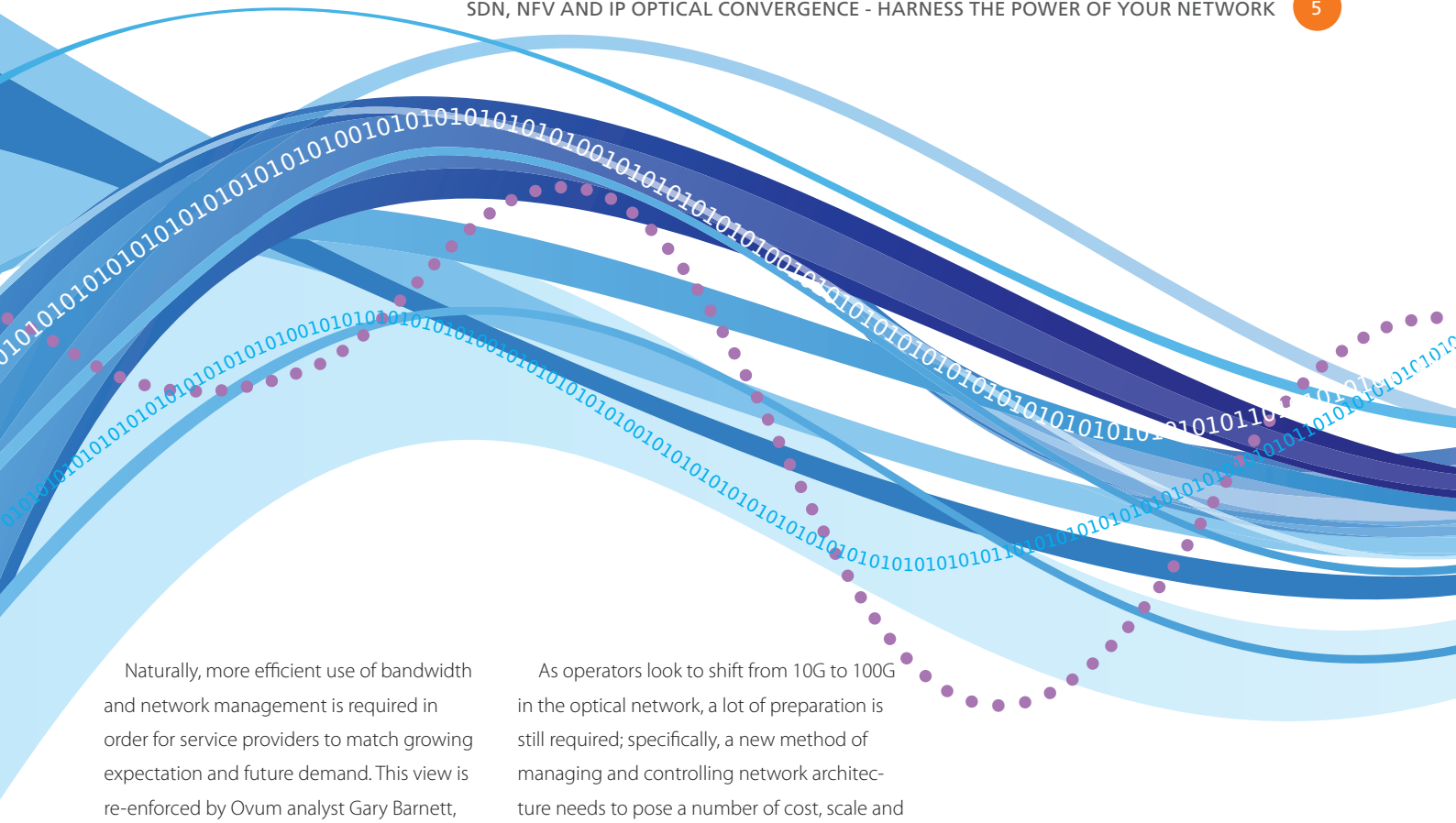
As we increasingly hear in today's industry, a truly open networking environment which embraces customisable and virtualised services has the potential to deliver three key areas of improvement and efficiency gains for service providers. Increased revenues, average revenue per user (ARPU) and reduced opex are promised as a consequence of having increased flexibility, agility, speed to market and operational simplicity.

But why is redefining a vastly convoluted and intricate network architecture so important to today's telco? Well, as we referred to at the start of this paper, IP traffic growth is set to boom in the next five years. While mobile data and video usage has been very much in the spotlight recently, an emerging trend we are yet to fully understand is that of the internet of things (IoT).

IoT generally refers to the transmission of data between, and the connection of, machines. Cisco forecasts that taking the principle of IoT further can present service providers with another $1.7 trillion opportunity over the next 10 years. The Internet of Everything is the concept of connecting people, processes and data, as well as other 'things'. This is where an ecosystem is formed around multiple services, such as personalised M2P services (i.e. home security and energy control), P2P services (i.e. remote presence or smart health) and M2M services as we know them today (i.e. connected cars).

Some recent research by Ovum has revealed that more than 20 billion devices are going to be connected to the internet, transmitting and receiving data, by 2020. Whether the flows themselves are as small as a kilobyte, or as large as a gigabyte, the sheer volume of data being moved across the service provider network is going to continue rocketing as more devices connect to it. »





Naturally, more efficient use of bandwidth and network management is required in order for service providers to match growing expectation and future demand. This view is re-enforced by Ovum analyst Gary Barnett, who recently wrote "The volume of data generated by the Internet of Things (IoT) will be immense, and organisations planning to implement IoT projects will have to radically rethink the way they transmit, store, manage, and exploit the data that is produced"

Dealing with increased network demand is the real nucleus of the discussion, and a fundamental rethink of innovation through the network, starting at the bottom, is required in order for operators to get ahead of the curve.

Seemingly one of the most feasible ways for operators to address the growth of data, IP optical convergence has the potential to enable more flexible control of the networking layers. Software defined networking (SDN) and network functions virtualisation (NFV) also allow operators to exploit the potential of existing hardware.

From the bottom up

Creating a sophisticated, evolved, programmable network presents a number of challenges and considerations. IP optical convergence helps provide an added element of control and automation between layers 2 and 3 of the network.

As operators look to shift from 10G to 100G in the optical network, a lot of preparation is still required; specifically, a new method of managing and controlling network architecture needs to pose a number of cost, scale and operational benefits to the business.

Such a transition must offer an open, virtualised, programmable and automated infrastructure. Converging IP and optical can certainly provide a compelling proposition in this regard, as one piece of the overall puzzle.

But why should operators consider IP and optical convergence as a suitable means for driving greater control and speed through the network?

Since the development of the internet, traditional IP and optical architectures have always acted and been managed independently from one another. As a consequence, the two network siloes are incapable of systematic and intelligent control based on common usage patterns and traffic flows of each.

The concept of tying together and integrating multiple network layers with a separated, centralised control plane is very much in keeping with the philosophy of SDN. By exploiting a software-based solution, it may be possible to harness network intelligence, orchestrate, manage and assess the impact of changes in and on the network. Consequently, it will be possible to configure the network in a manner which best compliments the constraints of any service. »

> By implementing an aggregation platform to bridge the IP and 100G-enabled optical layers, network engineers are able to develop a control plane which is capable of sharing information and adding real-time intelligence

In the optical network, an agile reconfigurable optical add/drop multiplexing platform (ROADM) allows for remote, touchless programmability of the layer, as well as massive DWDM scale through the use of 100G and super channels.

By implementing an aggregation platform to bridge the IP and 100G-enabled optical layers, network engineers are able to develop a control plane which is capable of sharing information and adding real-time intelligence. Subsequently, a framework for controlling layers 2 and 3 of the network could allow network engineers to process service requests into a converged network management system, whereby resources are appropriately allocated across both layers for optimal network operations.

And therein lays the value proposition of IP optical convergence: to maximise the efficiency of network operations while simplifying management and minimising operating and capital expenditure.

The same can also be said for creating a service platform based on open standards, and by utilising software defined networking and network functions virtualisation. Working up from the bottom, convergence injects layers 1-3 with an increase in agility, driving more efficiency and responsiveness to service requests. At a service platform level, SDN and NFV then accelerate the delivery of truly customisable and tailored services to customers, particularly in the enterprise space.

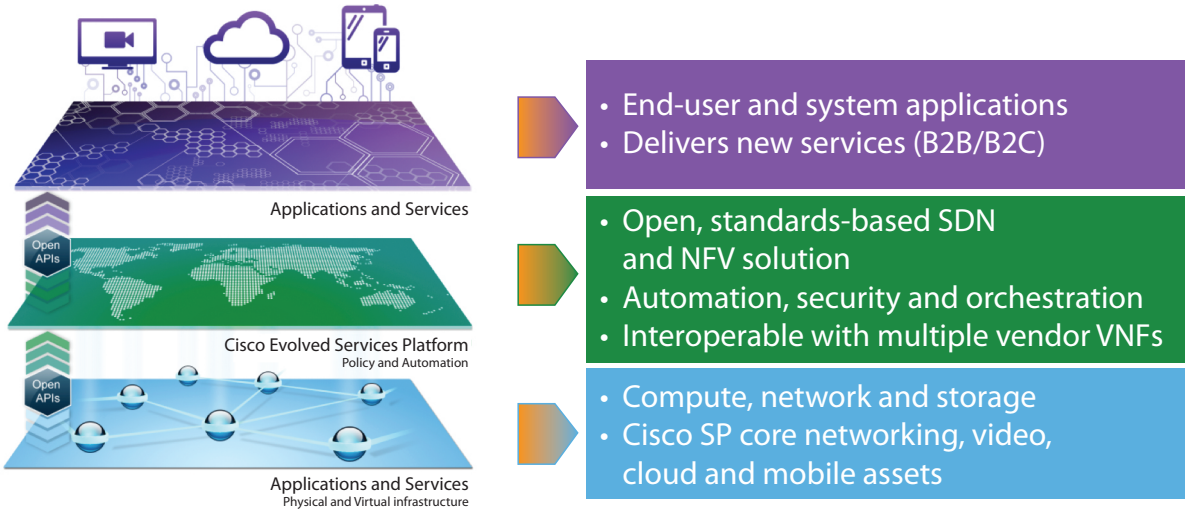
The IT industry has certainly provided the telco sector with an ideal template for maximising the use of available resources in the network. We are increasingly seeing the two worlds, telecoms and IT, moving towards each other, and the former could certainly benefit from adopting techniques and technologies being utilised by the latter.

Going soft

It's widely recognised that the telecoms industry, traditionally speaking, hasn't been quite as agile as its counterpart, the IT industry. Cumbersome service delivery platforms and mechanisms have made it difficult for service providers to quickly recognise the needs of its enterprise customers and suitably deliver the correct solutions. The whole process of ordering a new function, shipping, delivering and configuring it is known for taking more than days, and usually more than weeks. This, in itself, presents a couple of areas where service providers can innovate existing network architecture and processes to move towards a softer, more agile and flexible structure. Technologies and principals such as network functions virtualisation (NFV) are emerging, with the specific goal of enabling more agility and enhanced service delivery capabilities.

On the network's service and application delivery layer, there are emerging technologies and mechanisms which can be utilised to enhance the network's speed and flexibility capabilities. NFV is one such practise, utilising the power of cloud computing to consolidate hardware-based network functions onto high density, cloud-based servers in the data centre. »

The Cisco Open Network Architecture model, including IP optical convergence, SDN & NFV



The premise was devised in 2012 when a collection of Tier 1 operators identified the need to reduce network complexity and remove redundant hardware located in and around the network edge. Subsequently, the movement towards an NFV-enabled service delivery architecture gained an unprecedented level of traction through the wider industry.

In the two years since, the potential use cases of NFV has led to nearly 25 proof-of-concept trials (PoC), which focus on a plethora of network instruments, including the evolved packet core, firewall, customer premises equipment and much more. Each function is capable of being hosted in a virtualised instance and spun up on demand as and when necessary.

Having the ability to deliver services only when necessary is what's prompting the telecoms industry to examine NFV in such detail. Not only is a telco afforded the capability of giving service delivery speeds a shot in the arm, but removing redundancy and only utilising functions when necessary has the potential to deliver drastic reductions in operating and capital expenditure.

However, perhaps the primary motivator for telcos looking at NFV is for a substantial escalation in agility and service delivery capabilities. Implementing orchestration software with the ability to coordinate VNF services, while chaining them together, allows for a certain level of automation, and subsequently an element of self-service on behalf of the customer.

The premise of devising a truly open network architecture through the use of both NFV and SDN builds on a trend which has been moving through the industry over the past few years: interoperability.

Automation accelerated by a holistic and vendor-neutral orchestration platform is at the core of any virtualised architecture. In a multi-vendor environment, where different network elements may be supplied by different providers, an orchestration platform with the ability to unite multiple vendor offerings is of overwhelming significance. So much so that the ETSI NFV industry specification group has assigned a specific management and orchestration (MANO) task-force to design a reference architecture showing where the orchestration layer sits in the NFV topology, and how it dictates the variety of VNFs sat underneath it.

The orchestrator is able to assess the availability of physical resources required upon request, and appropriately maps out the optimal path for available resource locations. It then suitably determines where and when each VNF should be spun up, and how multiple VNFs are chained together, so that the customer request can be fulfilled and successfully delivered.

Without such orchestration capabilities, the ability to automate service chaining and deliver an on-demand experience for customers, both business and consumer, is all the more challenging.

CONCLUSION

So, where does that leave operators looking to embrace these technologies and harness the power of the network? Well, moving to a truly open network architecture is a journey all network operators and service providers will embark on sooner or later. As enabling technologies (such as 100G, IP optical convergence, software defined networking and network functions virtualisation) mature and develop, the transition will be made smoother and easier by vendors specialising in across the board technologies. Initiatives being driven by industry specification bodies are rapidly developing the maturation of IP optical convergence, SDN and NFV, which subsequently drives further innovation from the industry's go-to vendors.

At the moment, chunks of the network are being singled out and targeted for virtualisation. Work is being done by a number of the world's leading operators to identify and accelerate progress on virtualising specific network functions, which appears to be just one of the early stages in creating a virtualised network architecture.

Going all-in on a fully virtualised, converged network is a hefty undertaking. While the long-term benefits and promises are clear for all to see, a step-by-step approach is being taken at the moment.

The rise of both data demand and IP traffic globally will continue to put a heavy burden on to service provider networks. With the rate of technology innovation continuing to accelerate at ever-increasing speeds, there is a huge opportunity for telcos to get ahead of the curve, and transform network architecture through technological innovation.

Telcos that move to adopt technologies such as 100G, IP optical convergence and NFV will be well positioned for current and future network challenges.

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