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Broadband Outlook 2016

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Welcome

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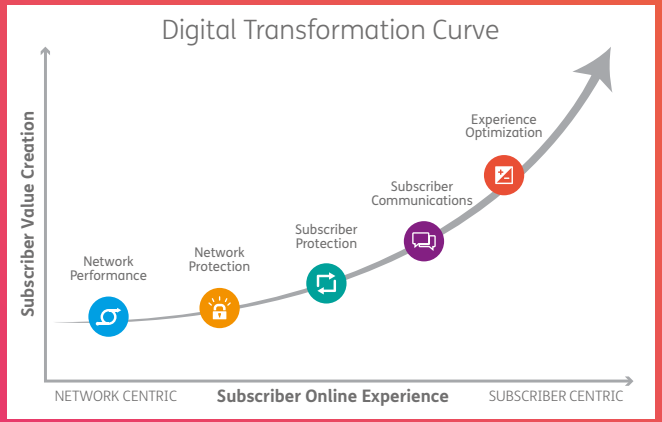
The Road to Digital Transformation is Paved with DNS

The dramatic growth in demand for online connectivity, fueled by the mobile internet boom, has created an overwhelming challenge for communications service providers (CSPs), resulting in a market situation we call the "digital transformation paradox." While the digital economy has flourished on the back of their networks, CSPs have been forced to keep pace by investing significant amounts of money in infrastructure. Such financial burdens have made it nearly impossible to commit innovation and development resources to creating higher-value digital services to thwart competition from over-the-top (OTT) players.

Herein lies the paradox: CSPs created the very infrastructure that enabled a thriving digital economy, but, through no fault of their own, have not reaped their fair share of the rewards. They are now turning the tide and moving up the digital transformation curve—a representation of the key steps to achieving digital transformation.

Now, the tables are turning and the infrastructure investments and cost efficiencies CSPs have made are paying off. As telecom providers undergo the transformation from CSP to DSP (digital service provider), they are shifting their focus from the network to the subscriber in order to deliver personalized, value-added services that create a compelling subscriber internet experience.

The Digital Transformation Curve represents the key steps needed for CSPs to become subscriber-centric DSPs



How are they undergoing this digital transformation effortlessly and without great expense? It's counter-intuitive but the answer is not to invest in new, overly complex subscriber-facing applications from multiple providers. This approach exacerbates the problem with respect to delayed time-to-value, lack of employee cohesion and increased subscriber confusion. The fastest, most cost-effective way to successfully end the paradox is to look for greater simplicity by finding the lowest common denominator to unify the systems, functions and people CSPs need to deliver an exceptional and personalized subscriber experience. The answer is found in an asset that already exists in every single CSP network today. The answer is DNS—the fundamental building block of the internet.

Because it is critical to virtually every online request and application, DNS is an ideal technology to power personalized services and give subscribers greater control over their online experience. Now, as CSPs are discovering the true value that DNS provides beyond simple internet look-up functionality, they are using it to secure the network; offer stronger subscriber protections; create high-value, premium offers like parental controls and content filtering; and enable interactive communications that reach 100% of subscribers in a timely and convenient manner.

With DNS—a high-performance, extensible and cost-effective service enabler—CSPs are creating greater customer value and speeding time-to-market of new product and service innovations, which puts them in a much stronger competitive position against OTT players, as outlined in the accompanying Telecoms.com Broadband Outlook Report. As you read the report and the survey responses highlighted within, I invite you to discover why we at Nominum say: "The road to digital transformation is paved with DNS."

Many thanks,

Brian Metzger

Brian Metzger
Vice President of Global Marketing
Nominum

Digital Transformation

Transformers, Identify Yourselves

Key takeaways:

More than half of respondents

are in the midst of a digital transformation.

Nearly two-thirds of the audience

say digital transformation is defined as an improvement of technology and processes to capture future market share.

40% say self-service portals using mobile applications

will be the most important customer engagement method in the future.

About Nominum:

Nominum® is the world's DNS innovation leader and the first company to create an integrated suite of DNS-based, subscriber-centric applications to digitally transform service providers and personalize the online subscriber experience.

Nominum N2™ solutions leverage the company's market-leading Vantio™ DNS software and expert team of data scientists to forge a clear path for service providers to move beyond a network-centric approach to a value proposition that is subscriber-centric and highly differentiated. N2 provides an extensible network services framework that synchronizes digital capabilities with people, processes and systems across the organization to deliver personalized solutions that enhance subscriber value and brand loyalty, fuel revenue growth and bolster competitive advantage.

Nominum is a global software company headquartered in Silicon Valley. More than 100 service providers in over 40 countries trust Nominum to enable a safer, more personalized Internet experience and promote greater value to subscribers. Nominum DNS software resolves 1.6 trillion queries around the globe each day—roughly 100 times more transactions than the combined daily volume of tweets, likes, and searches taking place on major web properties. For more information, please visit nominum.com.

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Transformers, Identify Yourselves

Welcome to the Broadband Outlook Report 2016, a comprehensive run through of the most current and pressing technologies affecting the broadband delivery industry today. This report, run by Telecoms.com Intelligence, will focus on three key areas of broadband delivery technology most important to operators in 2016.

First and foremost for this report is Digital Transformation, which is one of the telecoms industry's most nebulous and ill-defined terms, alongside 5G and IoT, of course. This section will be dedicated to understanding operator attitudes towards digital transformation, what it means, what it can mean, and where the industry is today in terms of harnessing the technology for what it can really do.

Secondly we will look at next generation access both today and as we begin looking towards the fifth generation of wireless networking – or 5G. We will understand the value proposition of fibre to the x (FTTx), whether 5G will act as the future access technology for consumer home broadband, and how IoT will play a role in the future of fixed networking across cities, countries, continents and the world.

Finally, we will examine how network functions virtualization (NFV) is having an impact on network management and service delivery for operators. As part of the future infrastructure of telecoms networks, NFV has a great role to play in converging traditional network hardware and management with cloud computing and its potential to deliver greater agility and sophisticated simplification of historically complex networks.

All of the findings you will gain from this report stem from an in-depth questionnaire we ran with the Telecoms.com audience in August and September 2016. More than 600 communications service providers (CSPs) and infrastructure professionals took part in the survey to share their thoughts on the wide array of questions we asked within each of these three broad topic areas. The results of the questionnaire have been analysed by the editorial team here at Telecoms.com and turned into the following report.

Since what feels like the dawn of time, the telecoms industry has been awash with clamour for the next big thing. Marketing managers are continually in search of the newest and greatest product line to keep customers returning year in, year out - whether it was when SMS revolutionised mobile more than 20 years ago, or when dial-up access turned into broadband, or when 3G arrived and mobile phones could actually do something vaguely resembling the capabilities of today's handsets. It didn't stop there either, 4G had plenty of hype despite nobody knowing which technology would dominate the generation. One of the most read stories on Telecoms.com every year, one of the top 3 even this year, is called "WiMAX vs. LTE vs. HSPA+: who cares who wins?" – showing some parts of the world still can't wait to find out what's going to happen in the 4G era. ›

> “Compared to those of 10 years ago, consumers today have an unprecedented amount of control in the operator/customer relationship.

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Indeed, the same can be said for digital transformation. The term may be confused by some to be nebulous or vague, but no one will dare underplay its importance as a part of today's telecom landscape. Operators the world over are assessing their options on how to arrive in the next generation of technology. Of course 5G will be a part of it, as will IoT, but as it stands today we're talking about a gamut of systems and practises which are significantly outdated.

Digital transformation means many things to many people, but to get things going for the Broadband Outlook 2016, we asked the audience where their organisation is with developing and implementing a digital transformation strategy.

A fairly honest 8% of the audience said they don't know, with a further 13% saying there are no digital transformation projects or plans ongoing at this stage. There's an additional 6% which is actively seeking third party assistance as well as 8% and 9% of the audience respectively planning on beginning the journey either this year or next.

As you can see in the graph See Fig. 1, however, the majority of the audience believes their organisation is in the midst of a digital transformation. But that doesn't help us understand exactly what digital transformation is, so we then asked the audience to explain to us what they think it means.

The answers to this question yielded a varied response, but a common trend was beginning to emerge. Digital transformation, from the responses we received, is about integrating and optimising technological and human processes behind the scenes so that the user is the ultimate beneficiary.

Respondents were asked to choose, from a range of statements, which ones they believed ticked the digital transformation boxes. In order from most-commonly identified to least:

61% Adapting business models, network architectures and technology platforms to increase subscriber value and capture the greatest share of opportunities arising within the digital economy.

50% Improving business processes and IT systems to enhance the customer experience through greater innovation, operational agility and efficiency.

37% Enabling the digital lifestyle by providing a more personalised internet experience for subscribers.

35% Focusing infrastructure investments on platforms that deliver greater customer experience to move service providers further up the value chain.

Incidentally, like the 6% in the previous question that was seeking external guidance on their strategy, another 6% chose the statement "I don't know what digital transformation means, there are too many conflicting definitions out there." It's not for us to say whether this was the same 6% for each question, but it is distinctly possible and would make perfect sense.

So with a common consensus on a definition beginning to emerge, we then asked the audience to select which facets of the subscriber experience are the most important for CSPs to optimise. Broadly speaking, they are terrified of declining ARPU, and even more so of churn; so it is interesting to understand what they consider to be the most important user-facing elements of a service to help keep customers satisfied and spending money.

Top of the list is an optimised network, with 58%, which makes a lot of sense since it is the primary service an operator delivers. Dead tied for first is service personalization, also on 58%, because there's nothing modern consumers hate more than being seen as just another number. That in itself is another driving factor for digital transformation.

Coming in just behind on 57% is subscriber behaviour analysis through the use of intelligent analytics, to help operators understand what customers want, when they want it and how they want it. Taking this to its logical conclusion, the utopia in this sense is the use of predictive analytics to give the customer what they want before they realise they want it. A tricky art to master considering the line between helpful operator and annoying operator is deceptively thin. ›

Figure 1

Does your organization have a digital transformation strategy?

- Yes 56%
- Not yet, but will begin this year 8%
- Not yet, but will begin in 2017 ..... 9%
- Currently seeking assistance with our digital transformation strategy 6%
- No plans at this time 13%
- Don't know 8%

> "Respondents were asked to choose, from a range of statements, which ones they believed ticked the digital transformation boxes.

Elsewhere, 49% of respondents want to see instantly responsive customer support and communications, while 41% and 25% voted for cyber security and premium service delivery respectively. See Fig. 2

Compared to those of 10 years ago, consumers today have an unprecedented amount of control in the operator/customer relationship. Enabled by a greater technological buffet from which to choose, empowerment from regulatory bodies for minimum SLAs and switching ease, as well as a more thorough technological education, today's consumer is a nightmare for operators. Therefore, operators have to protect their subscribers, give them continual service of a very high quality and satisfy nigh-on every whim, lest they be threatened with switching.

Unsurprisingly, when faced with a series of elements of a digital transformation strategy, the majority of operators put a very high importance rating on all of them. They are as follows:

- **96% importance rating -** Protect provider networks and subscribers from cyberattacks
- **94% importance rating -** Ensure subscribers receive the same user experience across all devices and networks
- **92% importance rating -** Simplify internet service provisioning, management and monitoring to optimize the subscriber lifecycle
- **88% importance rating -** Personalize internet access for every household member to keep children safe online

That message was reinforced once more in the following question. Please see the accompanying graph to understand how respondents chose to allocate proportions of their budget on specific customer-centric solutions.

Budget Allocation	0-25%	25-50%	50-75%	75-100%
Network performance and simplification to boost performance	19%	39%	32%	10%
Protect network and subscriber from security threats	36%	35%	19%	10%
Value-added services to boost subscriber experience	28%	42%	23%	8%
Effective subscriber communications	40%	37%	17%	7%

It is undeniable that the operator will always be at the centre of delivering rudimentary connectivity for users the world over. What is less certain perhaps, during this time of unilateral digital transformation, is the role the CSP will play beyond mere speeds and feeds.

There's an array of what could be defined as splinter groups—alternative service providers in more specific areas of communications, which could pose a substantial threat to operators. The term "OTT" was coined for digital service providers sitting on top of the operator network and providing subscribers with free or freemium services like Whatsapp, Skype, Facebook, Viber, Snapchat. These organisations are now worth billions, and have effectively spelt the death of SMS for operators in many global territories. Once considered to be a principal revenue stream, SMS is now a largely ignored "also included" feature in most tariffs.

IoT is another enormous opportunity but bespoke IoT service providers are already making a name for themselves with proprietary networks like Sigfox and LoRa.

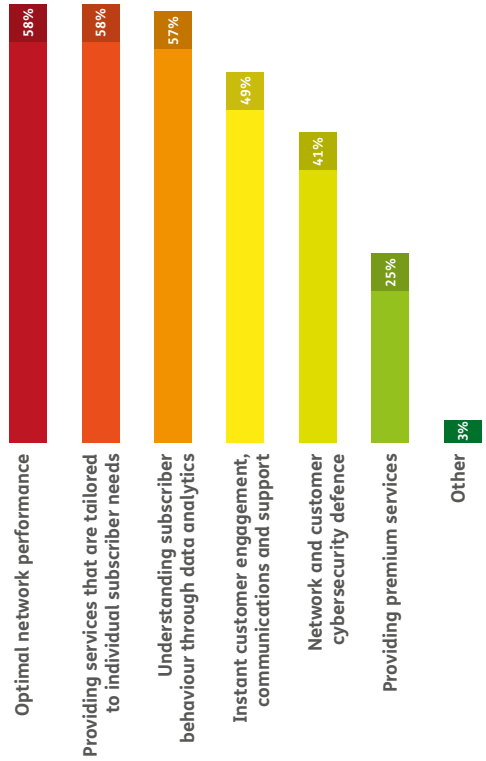
With an existential crisis potentially looming large on the horizon, our audience was asked how they see CSPs evolving to accommodate digital or IoT services in the home. Nearly half of the audience believes the operator will continue to be at the very epicentre of the digital revolution, and will become the one-stop-shop for the entire service experience – 46% said "CSPs will provide the entire digital service experience – from connectivity to service delivery and support."

Exactly one third of respondents believe being the provider of rudimentary connectivity is the best operators can hope for, with 33% saying "CSPs will provide basic internet connectivity, with other providers delivering digital or IoT services over the top."

Finally, just over one fifth of the audience reckon the CSP is under significant threat from aforementioned rival players. 21% said "CSPs' role in digital services is under threat from proprietary IoT networks (e.g. Sigfox), enabling consumer electronics firms to provide complete IoT bundles." ›

Figure 2

What are the most important aspects to improve the online experience for subscribers?



The final set of questions in this section of the report focused on the subscriber's internet experience within this overarching digital transformation theme. We've already established that customers are in a more powerful position than they perhaps ever have been, and so operators are under more pressure than they perhaps ever have been to ensure a premier customer experience every time.

The audience was asked to identify the primary customer engagement method they see being utilised by operators. Further reinforcing our previous assertion that SMS is dying a slow death, just 7% of respondents believe personalised application-to-person (A2P) SMS messaging will be the primary method of ensuring constant contact with customers in the digital era.

Conversely, the most popular method of customer contact identified by the audience is the deployment of self-service portals with the inclusion of instant assistance via mobile applications – with 40% of the votes. Elsewhere 19% of respondents each identified social media and in-browser communications, with 13% looking at interactive push notifications.

The concept of customer tactility is perpetually growing, with social media, particularly Twitter, putting pressure on operators to instantly give feedback and assistance to customers facing issues. With that in mind, the following graphic illustrates this change in expectations as respondents were asked to say what they consider to be an acceptable response time for customers requiring connectivity or service assistance. See Fig. 3

As the broadband industry anticipates overwhelming transformation in the years ahead, it is the transformation of digital practices that will likely take centre stage. We hope you find the remainder of this report useful. ■

> "The audience was asked to identify the primary customer engagement method they see being utilised by operators.

Figure 3

What do you consider to be an acceptable response time for customers requiring connectivity or service assistance?

- < 1 week 3%
- < 1 day 15%
- < 12 hours 8%
- < 6 hours 8%
- < 3 hours 10%
- < 1 hour 17%
- < 30 minutes 23%
- < 1 minute 16%

Sponsor's Comment

Digital transformation means putting the subscriber first. To evolve from CSP (communications service provider) to DSP (digital service provider) and effectively compete with OTT players, 61% of respondents said that adapting business models, network architectures and technology platforms to increase subscriber value and grow market share is key to digital transformation, while nearly 40% said that enabling the digital lifestyle through a more personalized internet experience is critical.

Optimized network performance and service personalization were identified as the two most important subscriber-centric services needed to strengthen customer loyalty. In both cases, Nominum's DNS technology is ideally suited to fill these needs.

Service provider capabilities that were viewed as the most essential to achieve digital transformation include: cyber protection of networks and subscribers (96%), seamless user experience across all devices and networks (94%), optimize the subscriber experience through simplified provisioning, management and monitoring (92%), and personalize internet access for all household members and keep children safe online (88%).

These results support the market drivers that Nominum® recognized early on, which prompted the development of the N2™ platform and integrated application suite. Leveraging our market-leading Vantio™ DNS software and expert team of data scientists, N2™ provides a unique ability for service providers to enrich the digital lifestyle for subscribers through a personalized internet experience.

The road to digital transformation is paved with DNS, and DSPs are discovering just how important this technology is to complete this journey.

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Fibre & Next Generation Access

A High Fibre Diet

Key takeaways:

90% of respondents

believe advanced fibre will be one of the most important technologies for enabling 5G.

85% reckon 5G will allow multiplay operators

to use one network for both home and mobile broadband

43% plan on

using existing infrastructure for both people and IoT devices

About CommScope:

CommScope (NASDAQ:COMM) helps companies around the world design, build and manage their wired and wireless networks. Our network infrastructure solutions help customers increase bandwidth; maximize existing capacity, improve network performance and availability, increase energy efficiency, and simplify technology migration. You will find our solutions in the largest buildings, venues and outdoor spaces of all shapes, sizes and complexity, at wireless cell sites and in cable headends; and in airports, trains and tunnels. Vital networks around the world run on CommScope solutions.

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A High Fibre Diet

The convergence of fixed and mobile network architectures is an inevitability. The level and scale of the technological revolution currently underway isn't exactly unprecedented, but it is unmatched in its nature by anything that has come before it.

As 5G continues to move from incremental R&D gains towards fully-blown real-world 5G-ness, expectations will eventually turn towards using it as a means of delivering wireless access to domestic broadband. The scope of 5G is yet to be fully defined, and as such its potential is almost limitless. What we do know right now is that with the right technologies behind it the capacity for radio-based broadband access in a 5G era sits in the region of Gbps, not Mbps like LTE and current access technology.

The anticipated arrival of 5G will be the end of this decade at the very earliest, probably the start of the next. 2020 is being heralded as the year when everything in the world will change for the better, and that may well turn out to be the case, but some operators are doing their utmost to drag that arrival date a little bit nearer.

To get things kicked off with this next-generation access-focussed section of the survey, we asked the audience what they believe is a realistic start date for 5G as a commercial proposition.

While a third of the audience, as expected, believe 2020 will see 5G kick off; nearly half of respondents (47%) believe it will be sooner. In fact, 24% reckon 5G will be here by 2018. In contrast, just 21% believe 5G will be a commercial reality later than 2021.

One of the biggest questions over 5G will be how it integrates with fixed broadband and what benefits it could bring to a hybrid fixed/fibre/wireless networking strategy.

With that in mind, we asked the audience to identify with a series of statements related to that very topic. Unsurprisingly, the vast majority of the audience either agreed or strongly agreed with the sentiment that fibre will be one of the great enablers for 5G. 90% agreed with: "the availability of a dense fibre network is very important in the development of 5G."

The specific role of fibre in this context though is yet to be fully defined. It is thought that to guarantee the capacity of the 5G radio network, fibre will play an integral role and its bandwidth capabilities will be the only means by which 5G access can be connected to the core successfully. Suitably, the statement "multiplay operators will merge their fibre networks to cover both FTTH and fibre backhaul for 5G" gained an 88% agreement rating among the audience.

Interestingly, the concept of developing one primary network for both home and mobile broadband is naturally being considered quite heavily by operators the world over. Another 85% of respondents agreed that "5G will allow us to develop one network for both home broadband and mobile".

> "Consensus suggests that copper broadband is slowly on the way out, and in the long term that is probably justified despite the promise shown by emerging technologies like G.fast. Fibre, meanwhile, is being viewed as the most promising home broadband delivery method, gathering a lot of support.

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That convergence may only take mobile operators so far, however, as the strongest disagreement of any statement in this question came to the statement "5G emergence will enable pure mobile operators to become a player in the fixed market by investing in their own fibre". See Fig. 1

As we alluded to in the opening phrases of this section, 5G as an enabler for fixed broadband access is entirely feasible proposition. The properties of millimetre wave spectrum suggest a low-range, high frequency wireless connection to fibre in the cabinet could be an ideal solution for 100m broadband. As such, the audience was canvassed on whether this is a feasible idea or fanciful marketing hype.

It turns out the overwhelming majority of respondents reckons the concept is at the very least feasible, with just 6% thinking it is not even remotely possible. More than half of the audience reckons 5G as a means of providing wireless access for domestic broadband will be feasible in the right scenarios – such as recently developed urban areas with the newest infrastructure. Nearly one in three respondents see it being possible for a large number of cases; while an ambitious 9% said 5G will be perfect for domestic broadband access for the vast majority of locations.

Moving on from using 5G exclusively for wireless access to the concept of doing away with domestic broadband altogether and just using 5G for everything. It's an ambitious idea and represents far-removed thinking, and drew a variety of responses by a divided audience.

Consensus suggests that copper broadband is slowly on the way out, and in the long term that is probably justified despite the promise shown by emerging technologies like G.fast. Fibre, meanwhile, is being viewed as the most promising home broadband delivery method, gathering a lot of support. Opinion is extremely divided on whether wireless networking is stable enough to replace traditional fixed networking; while some members of the audience believe 5G as the sole platform for wireless and wireline connectivity is the most promising opportunity for broadband there has ever been.

	Strongly Agree	Agree	Disagree	Strongly Disagree
It is the most promising opportunity for broadband access there's ever been	23%	53%	21%	3%
Fibre to the home will always produce the fastest network speeds for consumers	52%	38%	10%	0%
Copper will remain the primary access means for us for the foreseeable future, even after 5G has arrived	9%	37%	43%	11%
Wireless is too unreliable to replace traditional fixed network access	11%	32%	45%	11%

Focussing on fibre more specifically, our next set of questions sought to understand operator attitudes towards FTTH and whether it presents an attractive proposition for the domestic broadband consumer base.

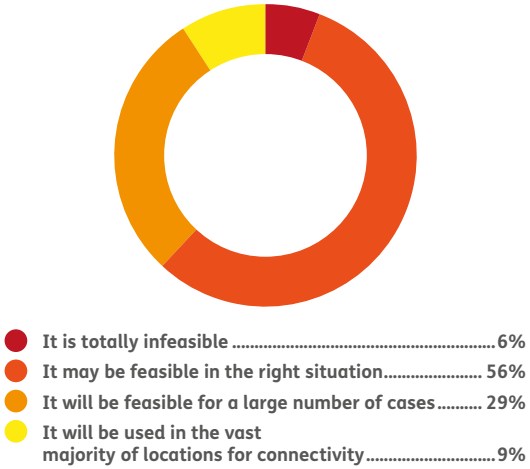
It would appear to be the case that the majority of respondents see fibre to the home as an attractive proposition for domestic broadband and one that boosts its consumer-facing branding. We asked the question "does fibre technology bring benefits in terms of branding/image to your service offering?", and it yielded a broadly positive response.

59% of the audience voted resolutely with a simple "yes", while a further 35% confirmed it will likely have some sort of positive impact on their product offering and subsequent marketing at some point in the future. Just 6% of respondents believe fibre technology does not currently present any marketing benefits, nor will it in the future.

With that in mind, we then asked when respondents expect to have transitioned the majority of their broadband users to FTTH. This is a tricky task form a civil engineering perspective, so isn't an overnight switch on and will likely take many years to rollout in densely populated urban areas with an entrenched existing infrastructure. ›

Figure 1

Do you consider it feasible to use wireless 5G access technology to connect the last 100m for domestic broadband customers?



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It would appear that the next three years will see a high number of global operators push towards an FTTH-first broadband delivery platform – with 35% of respondents saying they will transition the majority of network users to fibre to the home between 2017 and 2020. A further 26% expect to have done so by 2025. Ten years in telecoms is a lifetime, but the faith being put in fibre as network opportunity, and the speeds being demonstrated by raw fibre suggest it will be perfectly capable of accommodating the requirements of the next generation of broadband. See Fig. 2

In order for 5G to have any feasibility at all, one of the major challenges that requires addressing is the organisation of existing radio access network infrastructure. C-RAN, AKA centralised radio access network, is an approach to radio management started by China Mobile a few years ago and being deployed by a number of telcos the world over. The principle behind the premise is to centralise the number of base band units in one location and simplify the radio architecture, with fibre being used as a means of connecting the BBUs to the tower.

This concept helps pave the way for an NFV-driven radio management experience with resources being dynamically allocated to the radio as and when required to ensure maximum quality of service across the RAN.

The next question we asked the audience was to understand what the primary benefit of C-RAN would be, particularly with the 5G focus we've exhibited thus far in this questionnaire. The accompanying graph will help to illustrate the results here, but like NFV the primary benefit considered by the audience is reduced capex and simplified control; with greater bandwidth, coverage and efficiency of spectrum also yielding respectable results. See Fig. 3

The final set of questions in this section of the survey relate the impact the internet of things (IoT) will have on fixed network infrastructure, and particularly network access. IoT is expected to cause a boom in the amount of traffic hitting the service provider network, with a particular emphasis on latency for mission-critical machine-to-machine communications, such as smart cities.

The sheer number of sessions being generated from IoT devices hitting the network is expected to far outweigh the amount of bandwidth such sessions will suck up. That assumption is largely based on the explosive nature of IoT devices, sensors and gizmos being deployed in the next four or five years. By 2020, one in five respondents believe they will see a greater than 300% increase in IoT-related bandwidth consumption on the fixed network, primarily as a result of smart cities use-cases. 30% forecast a greater than 200% increase; an additional 30% see a greater than 100% increase; and one in five respondents thing a 50% increase is entirely feasible.

With IoT expected to have such an impact on the operator network, it isn't a major surprise that a number of proprietary networks are emerging from the likes of Sigfox and LoRa. These networks are beginning to present a relative level of threat to operators, as we briefly explored in the previous section of the report. The final question we asked in this section of the survey pondered whether alternative networks dedicated to IoT are being considered by operators. While just under half of respondents said they plan on using existing infrastructure for both people and IoT devices; the remaining 57% was fairly evenly split between a variety of network types.

17% of the audience each chose LTE as a dedicated network and a dedicated NB-IoT network respectively. 12% said they'll be using a dedicated wifi infrastructure for IoT support, with 11% saying they'll be looking at fibre for dedicated IoT.

What this section of the survey has taught us is that there is a broad array of issues the telecoms industry faces with regards to next generation access. It's touching upon wireless and fixed infrastructures and emergent technologies like IoT are increasing the pressure being placed on telcos to ensure their network infrastructure is capable of supporting the future digital world. The worlds of fixed and wireless networking appear to be colliding, and operators are ideally positioned to make sense of the chaos and exploit a once-in-a-generation opportunity. If they can make the most of the opportunity, that is. ■

Figure 2

By when do you expect to transition the majority of your network users to FTTH? (Pl

- Already have 10%
- 2017 – 2020 ..... 35%
- 2020 - 2025 ..... 26%
- Later 16%
- Never, it is not feasible for our user base 13%

Figure 3

What do you consider to be the biggest benefit of implementing a centralised RAN architecture (C-RAN)?

- Reduced network capex 56%
- More simplistic control of radio architectures 49%
- Improved bandwidth 32%
- More ubiquitous coverage 20%
- Spectral efficiency 26%

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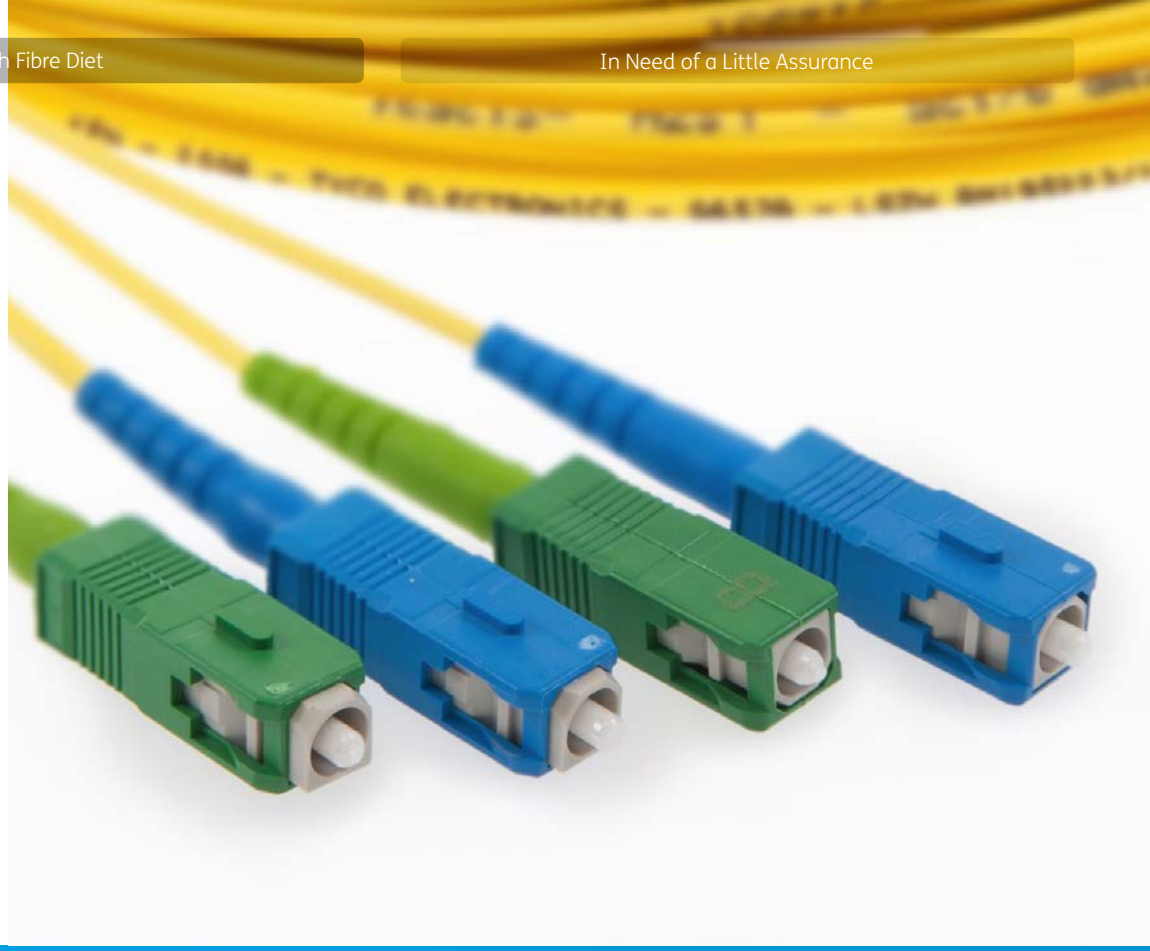

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Sponsor's Comment

COMMSCOPE®

NETWORK CONVERGENCE IS COMING FAST .... AND FIBER WILL BE AT THE HEART OF IT.

Fiber will play a crucial role in the development of 5G, which 79% of respondents see as a commercial reality in 2020. CommScope's vision of converging networks is clearly reflected in the results of this survey.

- 90% agree that Multiplay operators will merge their fiber networks to cover both FTTH and fiber backhaul for 5G
- 91% agree that the availability of a dense fiber network is very important in the development of 5G

How does wireless compare to traditional wireline access networks?

We see mixed answers to this question:

Wireless is seen as a promising opportunity by 76% of the respondents while many of them consider fiber as the most reliable technology and 90% agree that FTTH will always produce the fastest network speed for consumers.

In order to respond to the ever growing demand for bandwidth, fiber will inevitably be pushed further into the network. In areas where wireless is technically relevant, it can replace fiber and service providers will have to decide where fiber stops and where other technologies, like 5G, take over.

Whichever route you take, CommScope can help you. With the acquisition of TE Connectivity's Telecom, Enterprise and Wireless businesses last year, CommScope has become a global leader in fiber optic connectivity for wireless and wireline solutions.

Think Fiber, Think CommScope:
www.commscope.com/ThinkFiber/

NFV Orchestration and Assurance

In Need of a Little Assurance

Key takeaways:

63% of the audience

say NFV will be of most benefit to the development of 5G and IoT

Roughly half of respondents

say a virtualized content delivery network will be the most lucrative VNF

45% of the audience

is planning on deploying NFV orchestration capable of chaining together multiple VNF services within a single cloud domain.

About Netrounds:

Founded in 2007, Netrounds is an active network analytics solution provider for physical, hybrid and virtual networks. Netrounds' programmable, software-based test and service assurance capabilities enable telecom operators and service providers to enhance the end user experience of IP-based services such as Internet, TV, voice and other quality-demanding business services. Its extensive feature set covers all network and service layers for assurance and visibility of the full service lifecycle - service activation testing, ongoing quality monitoring and remote troubleshooting. Netrounds solutions are used by more than 270 network operators, service providers and enterprises worldwide and it is headquartered in Lulea, Sweden, with offices in Boston, Massachusetts and Stockholm, Sweden.

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In Need of a Little Assurance

One of the most notable technological success stories coming to the fore over the past four years is Network Functions Virtualization, otherwise known as NFV. NFV is essentially the virtualization of network functions and capabilities currently done in hardware.

In essence, NFV is the coming together of telecoms networking and enterprise-grade cloud computing functionality. The 'V' happens by consolidating hardware functionality onto general purpose, high-performance servers which are then scaled back to more convenient parts of the network, such as the data centre or network edge.

The theory behind NFV proposes several highly-touted benefits to the telco, the first of which is increased agility in delivering services owing to the flexibility of cloud computing and traditional ICT philosophies. Theoretically, an operator running an NFV-enabled infrastructure is able to roll out new network services to its enterprise customers on an ad-hoc, self-service, or even on demand basis. By chaining together, a number of virtualized network functions (such as firewalls, customer premises equipment, etc.), operators can implement a level of service automation, whereby services are selected and automatically rolled out when required.

NFV's well publicised perks seem to sell themselves, and it looks as though its potential is in the process of moving from conferences and working groups, to proof of concept testing, to real-world deployments. Those who jumped on the bandwagon early enough, AKA the early adopters, are already beginning to benefit from their virtualization transformations.

The majority of rollouts so far suggest customer premises equipment (vCPE) or evolved packet core (vEPC) have been the low-hanging-fruit. In a handful of implementations, tier 1 operators have gone all-in on virtualizing elements of their infrastructure and utilising complex multi-vendor architectures controlled by sophisticated management and orchestration platforms.

These early exploitations of virtualization technologies mean there's a core group of operators who are beginning to realise the gamut of benefits NFV possesses. This progress gives encouragement to the rest of the telcos that NFV is possible, it is here and that success is just business decision away.

This is most certainly the case when we consider NFV to be one of the few 'great enablers' for the telecoms networks of the future. Whether it's 5G, internet of things or next generation access, NFV will play a big role in providing the appropriate network conditions and allocating necessary resources for future services.

ORCHESTRATING THE VIRTUAL

Beyond the mere delivery of network functions via a cloud-centric infrastructure, the management, orchestration and assurance of the network is also stands to benefit greatly from NFV. NFV frequently falls under the broader term of OSS, and while it doesn't necessarily directly fall within that sub-section of network management, it certainly benefits the practice. ›

> "The telecoms community is taking this opportunity seriously, and the majority of those who participated in this year's Broadband Outlook 2016 seem to corroborate that conclusion.

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Indeed, many would consider an orchestrated network assurance policy to be one of its biggest benefits in terms of potential operational cost savings, improved operational efficiency, and the ability to deliver new, assured services to customers on-demand with agile service creation. With that in mind, this section of the survey sought to understand what the audience considers to be the next generation technology that NFV will benefit most, which facets of NFV will be most lucrative, and how NFV fits into a broader network management strategy. See Fig. 1

Unsurprisingly, at the top of the list of which technologies will be most enabled by NFV came IoT and 5G, almost identical in the level of responses from the audience – 32% and 31% respectively. These two technologies are receiving so much attention from the industry at the moment, and it can't be understated how important efficient network management practices will be to their future development.

Of the remaining 37%, multi-play services seemed the most favoured with 15%, while intelligent RAN, network slicing and real-time analytics also featured.

With multi-play gaining a relatively respectable amount of responses in this question, the next question we asked seemed to add further credibility to its importance. When asked which network functions seemed to potentially be the most lucrative, just over half the audience believes content delivery functionality will be the highest revenue-generating virtual network function (VNF) or service enabled by NFV. Of course this doesn't simply apply to multi-play services; 5G is also being widely considered as the required platform for next generation content, such as virtual reality gaming and 4K, or even 8K, video.

In addition, virtualized delivery of customer premises equipment will be significant opportunity for operators in the NFV space – 47% said it will bring the most value as a revenue stream. Additionally, one third of the audience vouched for VoIP (Voice over IP), so too for vRAN and vEPC for enhanced LTE rollout. Finally, vFirewall and vIMS gained 26% and 19% respectively. See Fig. 2

Somewhat related is a question asking the audience which network services they consider to be ripe for cloud deployment. XaaS, or "Something as a Service", has become a rather nebulous term for literally anything being deployed in the cloud. Appropriately, we threw out a few "as a Service" services to our users to find out what they thought was the most important.

Top of the list: software, with nearly two thirds of responses. Following up was infrastructure, backup and database; with 57%, 52% and 50% respectively. Just 3% of the audience surveyed does not believe in the cloud deployment methodology for network services.

As we touched upon earlier, having the flexibility to deliver virtualized services using cloud-based technology is one thing, but orchestrating it suitably to make sure that services are delivered as and when required is another thing altogether. ›

Figure 1

Which next generation technology do you think NFV will benefit most?

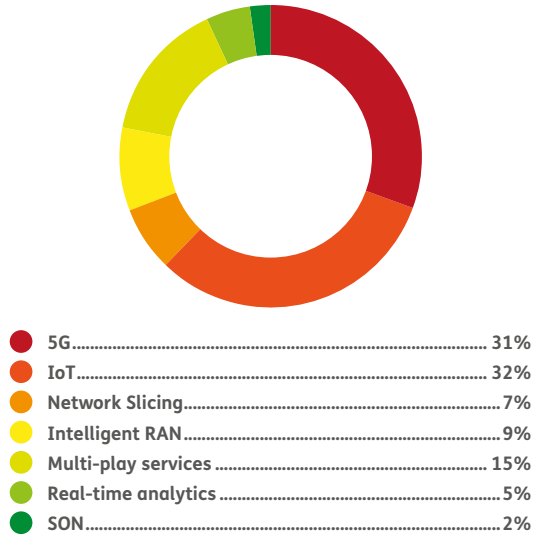
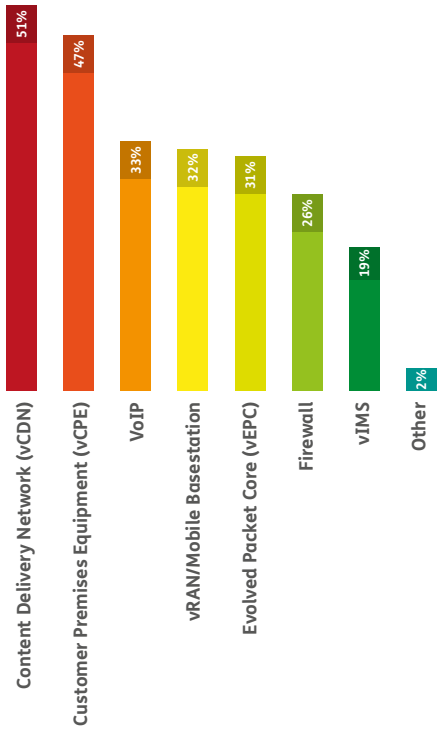


Figure 2

Which virtual network functions or services do you think will be the most lucrative in terms of revenues for operators?



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After the conceptual development of NFV back in 2012, management and orchestration (MANO) quickly became a top priority for the guys over at ETSI; so much so that it warranted its own working group. Orchestration of virtual functions comes in a few flavours depending on organisational requirements.

Ranging from small degrees of orchestration to full network orchestration, the audience was asked to determine which approach is most applicable to their organisation. The following graphic illustrates how voters responded.

45% Orchestration capable of chaining together multiple VNFs for complex service delivery within one individual cloud environment.

33% Sophisticated orchestration technologies capable of automatically spinning-up multiple VNFs, chaining them across multiple cloud domains including legacy networks, testing them end-to-end, and rolling out services for users on-demand.

23% Rudimentary management and orchestration capable of spinning-up and down individual VNFs on an ad-hoc basis.

Next, we wanted the audience to think about how NFV orchestration will fit into a wider technology strategy, and it appears that the audience is relatively mild-mannered in its attitude to using the MANO practise, with just under half saying that it will probably play some role in the delivery of future products and services. A similar proportion, however, were more enthusiastic about its potential – 42% said "Orchestration of virtual network functions will be fundamental to delivering new commercial communications offerings, like 5G". It is important to consider that 89% of the audience, in response to this question, consider NFV-based orchestration as important and relevant in the delivery of future products and services. See Fig. 3

Finally, there were just 12% of respondents who thought it wasn't that important at all. "It won't be too relevant, there are far more important areas of the network we need to focus on for the time being," they said.

ASSURE THING

One of the perhaps less publicized benefits of virtualization is that it enables active testing and assurance in a way that was neither financially viable or practical previously. NFV and the level of automation it enables, along with the ability to orchestrate and manage the network in a more assured and operationally efficient way that comes with it, brings significant benefits for the service and network assurance side of things. The ability to automate the management, quality monitoring, and maintenance through the software-defined natured of NFV means there's scope to fully optimise and expand the potential of existing telco infrastructure.

With that in mind, we sought to understand how assurance is viewed by respondents, and the results indicate the vast majority of the audience at least see potential in the technology going forward, if not right now.

While a quarter of respondents said they are currently in the process of using automated, active, software-defined assurance protocols for guaranteeing network service assurance; an additional 65% said they've seen the potential it possesses and are planning to implement active test and assurance to a greater degree.

25% We have automated, active software-defined assurance protocols in place to help guarantee network service assurance.

38% We have little by way of automated service assurance practices in place, but we believe that we can improve our solutions in this area.

27% We have realized the need for improved service assurance practices to prepare for 5G and the future network, but we have yet to implement these practices.

10% The services we deliver negate the need for sophisticated network assurance.

This discussion of active service assurance and the use of active network analytics solutions for network quality assurance generally falls under the OSS umbrella, a broad and vast concept with multiple facets. Cloud technologies, like NFV, are gradually pervading OSS methodologies, and one of the penultimate questions in this final section of the Broadband Outlook 2016 sought to understand how operators are approaching OSS as we progress through the decade and into the 2020s.

We wanted to know whether OSS is going to be a public, private or hybrid model for operators and posed that exact conundrum to the audience. It was a fairly even split, with the majority vouching a hybrid approach, with 23% and 20% of the audience respectively voting for private and public deployment models. ›

Figure 3

Where do you think 5G RAN will be most easily rolled out?

- **Orchestration of virtual network functions will be fundamental to delivering new commercial communications offerings, like 5G.** **42%**
- **NFV-based orchestration will play some role in the delivery of future products and services.** **47%**
- **It won't be too relevant, there are far more important areas of the network we need to focus on for the time being.** **12%**

"In essence, NFV is the coming together of telecoms networking and enterprise-grade cloud computing functionality.

23% Run all OSS components completely in my private environment.

57% Run selected OSS components in my private environment and deploy part of them in the public cloud using secure VPNs to interconnect them.

20% Run all OSS components in secure public cloud infrastructure.

All of this, of course, is to ultimately provide a superior end user experience in the current and future generations of broadband. To that end, we asked the audience what they consider to be the biggest challenge of ensuring exceptional end user experience. The following graphic demonstrates the audience's response.

53% Delivering new services faster and right the first time – i.e. agile service creation.

30% Detecting and correcting failed services before the customer notices.

16% Eliminating manual efforts that prevent full automation of fulfilment and assurance workflows.

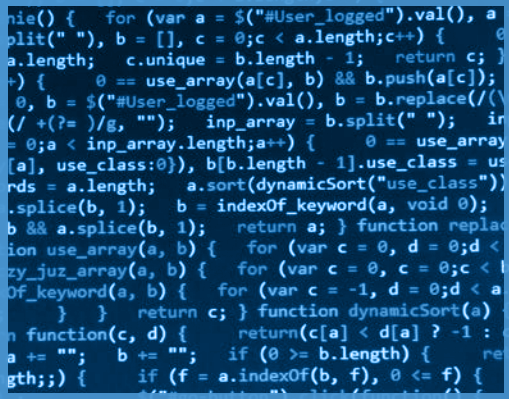
Ultimately what the results of this survey tell us is that NFV and cloud-based technologies enabling further development of complete network orchestration and the automation of active service assurance are certainly being eyed by the operator community as integral to the deployment of future technology trends. While its potential is vast, sophisticated management and orchestration, as well as network assurance, is of supreme necessity in order to realise said opportunity. The telecoms community is taking this opportunity seriously, and the majority of those who participated in this year's Broadband Outlook 2016 seem to corroborate that conclusion. ■

Sponsor's Comment

NFV will indeed be a 'great enabler' – it will allow Communications Service Providers (CSPs) to deploy dynamic services and take advantage of new market opportunities at a fraction of the time order to cash takes today. However, the industry's current transformation efforts to more virtualized and agile environments will create complexities that can only be addressed using automation and DevOps methods. Service assurance automation is crucial for ensuring that CSPs can achieve the agility in delivery and end-to-end service visibility that they require to maintain and improve their customer quality of experience with these added complexities.

Using active, software-based solutions, CSPs can assure the entire service lifecycle in an operationally efficient way. This eliminates manual efforts that prevent full automation of fulfillment and assurance workflows and helps CSPs to ensure that they are delivering new services faster and correctly the first time with automated activation testing. Completing the service lifecycle loop, active test and assurance solutions also assist CSPs to detect and correct network issues or failures before they are noticed by the customer, allowing proactive problem management and resolution to decrease support calls and increase customer quality of experience.

The use of open APIs for easy integration with OSS, NFV orchestration, Service Quality Management and other adjacent support systems will assist CSPs in their quest for zero-touch automation and greater degrees of flexibility and dynamic control. Read-write APIs, like those used in Netrounds' active analytics solution, enable further network intelligence like machine learning and self-healing to maintain service quality.

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