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Network Transformation

2012 Belonged to SDN & NFV. But Will They Deliver in 2013? That's the question posed in the opening article in this special report and there's no doubt that, during the first four months of 2013, software-defined networking (SDN) and network functions virtualization (NFV) have been the hottest topics in the telecom sector. The adoption of NFV concepts in particular is moving at a pace that has taken much of the industry by surprise, with proof of concept trials underway at multiple Tier 1 operators worldwide.

This is shaping up to be a dramatic year, with operators of all sizes considering their network, service and business strategies, with network transformation decisions set to shape the future of the communications sector for the remainder of this decade and beyond.

Ray Le Maistre, Editor-in-Chief, Light Reading

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Ray Le Maistre has been in technology publishing for 25 years and focused on the telecom sector since 1996. He has been at Light Reading since 2002, holding a number of editorial positions covering all aspects of the global communications market, but is particularly focused on Service Provider IT developments, including SDN and NFV. Le Maistre, who is based in the U.K., was appointed Editor-in-Chief in April 2013.

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Graham Finnie has been researching telecommunications for more than 20 years, formerly as a journalist and latterly as an analyst and consultant. Since joining Heavy Reading in September 2004, following a ten-year tenure at the Yankee Group, Finnie has been responsible for a wide range of research, focusing primarily on next-generation broadband services and IMS. He became Chief Analyst of Heavy Reading in February 2007. He has also hosted numerous Webinars and Live events for Light Reading, and is a regular speaker at other major industry events. As a journalist, Finnie was formerly editor-in-chief of the award-winning industry paper Communications Week International and has edited several other leading trade publications. He is based in the U.K.

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Craig Matsumoto is the North America managing editor for Light Reading, the ultimate source for technology and financial analysis for the telecom industry. His coverage areas include software-defined networking; routers and switches; and optical components and semiconductors. Craig joined Light Reading in 2002 after seven years covering electronics and networking for EE Times. He splits his time between Silicon Valley and the UBM Tech office in San Francisco.

2012 Belonged to SDN & NFV. But Will They Deliver in 2013?

INTRO

There's no question (at least in my mind) that software defined network (SDN) and its close cousin, network functions virtualization (NFV), were the big stories of 2012 in telecommunications technology – and not much doubt, either, that they will continue to be the big stories of 2013. But before we can predict they will also be the big success story, an awful lot of detail must be sorted out: We are far from being able to declare definitively that SDN and NFV represent the future of networking technology.

Here are ten challenges that must be resolved if SDN and NFV are to fully realize their huge promise:

How will SDN be integrated with, OSS and BSS systems?

Presently, this is a big black hole with nothing much in it, but given the legacy that exists in every major telco, it's the biggest unanswered question in the SDN story.

How will the new environment be orchestrated?

There's a general recognition that an orchestration layer of some kind is required, but will this be accomplished by operators themselves, by vendor proprietary schemes, on the back of open source schemes such as OpenStack or through a new set of standards?

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What's the relationship between NFV and SDN?

Some operators believe that NFV can bring benefits without using SDN (or at least Openflow) – others believe that they are joined at the hip. In 2013, we will see the first fruits of NFV, and with it the beginnings of an answer to this question.

What's the relationship between SDN, NFV and the various telco cloud programs?

Again, some telcos are trying to ensure that the three developments are coordinated, but though there clearly is a relationship, there's no defined roadmap for how it's constructed.

How far will the ONF be the prime location for SDN development?

Other initiatives already underway include the IETF's ForCES work, but such is the significance of SDN that we can expect other major industry organizations to get involved too.

Will operators really take the plunge and replace proprietary hardware with generic Ethernet switches and generic industry-standard servers?

Some already say yes, but when push comes to shove, will the famously conservative network engineering teams agree?

Equally, how will major suppliers respond?

Despite bold statements from some telcos, few will likely bet the network on start-up vendors, and will likely be dependent on their major suppliers for some time yet. But will those suppliers respond boldly to the new requirements or drag their feet?

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How hybrid is hybrid, and for how long?

The ONF is working on a standard hybrid switch solution, but it's not yet clear what it will look like and whether big established vendors (some of whom already are touting their own hybrid solutions) will play along.

Where will telcos start with NFV and SDN?

Few, if any, expect a big bang – instead they will likely replace or augment existing networks and functions piece by piece. In its white paper, the NFV group sets out a long list of functions that might lend themselves to virtualization. But where will telcos start, and will they all start in the same place?

Can telcos resolve the many rivalries and tensions among their departments and divisions in a way that enables them to fully realize the benefits?

This brings us full circle, since the OSS question is right at the heart of this dilemma. Can the gap between IT and networks be bridged in an environment where some functions and divisions may disappear altogether? It's a long list that raises legitimate questions about the timing of the transition, and it's in the nature of these developments that this list is far from definitive; there are many others.

Making things worse, these questions must be answered in a rapidly evolving environment that may soon include some highly disruptive network service providers using all the principles of SDN to usurp the major telcos and their businesses.

Despite the uncertainties, we should not doubt that the underlying principles of SDN and developments

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associated are truly revolutionary, and represent perhaps the most exciting potential change in telecommunications technology since IP hit telcos big-time in the mid-1990s. If SDN really delivers, we may find ourselves reversing John Gage's famous 1984 aphorism that the network is the computer; instead, we may see the computer (aka the server, aka the data center ...) becoming the network. As one SDN revolutionary put it in conversation, "Our aim is to make the network disappear."

The stakes could hardly be higher, and we will likely see big fortunes made and big companies lost in the coming transition. *Heavy Reading* has been following all the key developments closely, and has already published its initial thinking in **Multicore Processors Drive the Software-Defined Network: A *Heavy Reading* Competitive Analysis**. And to kick off 2013, we plan a **special webinar in early January** in which the team will further elaborate its views on SDN, NFV and their potential impact. Look out for that invitation, and in the mean time, a happy New Year from all at *Heavy Reading*!

— **Graham Finnie**, Chief Analyst, *Heavy Reading*

What's NFV All About?

Ray Le Maistre

International Managing Editor

Light Reading

It has become abundantly clear during the past week at Mobile World Congress that the topic of network functions virtualization (NFV) is going to be a key focus for network operators and their partners and suppliers in the coming years. (See MWC: The Network Blinked.)

So it's important at this point to pin down what NFV is/means if it's going to be important.

Why the term NFV? Because it is the term used by the network operator members of the Industry Specifications Group formed in late 2012 under the auspices of European Telecommunications Standards Institute (ETSI). When the group was announced it had already put together a white paper on NFV, which included the following definition:

Network Functions Virtualisation aims to transform the way that network operators architect networks by evolving standard IT virtualisation technology to consolidate many network equipment types onto industry standard high volume servers, switches and storage, which could be located in Datacentres, Network Nodes and in the end user premises... 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.

The white paper usefully explains the relationship with software-defined networking (SDN): "Network Functions Virtualisation aligns closely with the SDN objectives to use commodity servers and switches," but importantly notes that NFV "goals can be achieved using non-SDN mechanisms."

The group met in January this year and is meeting again in April in California to coincide with the Open Networking Summit and

What's NFV All About? *(continued)*

an Open Networking Foundation meeting (so that the NFV and SDN communities can find common ground while drinking the Napa Valley's finest -- and why not!).

The January meeting appears to have generated multiple working groups and expert groups -- check out this blog, Report from the ETSI NFV Meeting, to find out more.

What's encouraging currently is that the operator members of the NFV Industry Specifications Group are very keen to figure out whether this is a red herring or the start of a new era in wide area network topography. No doubt they will be helped and hindered along the way by "messaging" from the industry.

What the team at Light Reading wants to do is help keep the debate focused by identifying productive technology and strategic advances and flag up those that don't.

Despite our best efforts and intentions, I have no doubt that, at times, we'll get it wrong. And that's why the message boards here on Light Reading and this LinkedIn group are important -- informed input (including constructive criticism) is needed and encouraged.

So please weigh in.

In the meantime, here are some recent NFV-related articles:

- Alcatel-Lucent Preps 'TiMetra Mark II'
- V Is for Virtualization
- Juniper Puts a Virtual Spin on MobileNext
- Ericsson Claims SDN Advantage
- Huawei Unfolds SDN Roadmap
- F5 Gets Into Policy Enforcement
- Is Acme a Virtual Gain for Oracle? ■

Carriers Peer Into Virtual World

Ray Le Maistre

International Managing Editor

Light Reading

Interest in the potential offered by software-defined networking (SDN) is growing rapidly among major telcos, if the membership of the recently formed Industry Specifications Group focused on Network Functions Virtualization (NFV), which has just held its first official meeting, is anything to go by.

The group was formed late last year by a core group of major carriers -- see Carriers Collaborate on Network of the Future -- but has now grown to include 18 operators (NTT is represented by two separate units). A handful of those operators are "participants," as they are not full members of European Telecommunications Standards Institute (ETSI), which has created and hosts the Industry Specifications Group. (ETSI stresses, though, that any company can join the group.)

Those members and participants are exploring the potential gains that virtualization of multiple network functions might be able to deliver: In theory, reduced capex and opex, quicker time to market, greater flexibility and a more competitive supplier ecosystem are all potential advantages, but the operators want to figure whether these can be realized, or if they're just wishful thinking.

That concern was clearly explored during the group's first meeting, held near ETSI's headquarters in the south of France from Jan. 15-17 and attended by more than 140 executives, when the topic of "reliability of network functional virtualization" was discussed. (See Telcos Turn Spotlight on Virtualization.)

Other areas of focus included the extension of OSS data models to support virtual network appliances, the provision of network service using NFV service APIs (application programming interfaces) and the nature of common hardware network elements for virtualized nodes (among many more).

Carriers Peer Into Virtual World *(continued)*

During that meeting, the group elected Dr. Prodip Sen of Verizon Communications Inc. as its chairman (for two years), Uwe Michel of Deutsche Telekom AGas vice chair, and Don Clarke of BT Group plc as technical manager.

The carriers currently involved are (full member status unless noted otherwise):

- AT&T Inc.
- BT Group
- CenturyLink Inc. (participant)
- Colt Technology Services (participant)
- Deutsche Telekom
- DOCOMO Communications Laboratorie Europe GmbH (a subsidiary of NTT Docomo)
- Everything Everywhere Ltd. (EE) (participant)
- France Télécom – Orange
- KDDI Corp. (participant)
- KT Corp.
- NTT Corp.
- Portugal Telecom SGPS SA
- Sprint Nextel Corp.
- Telecom Italia SpA
- Telefónica SA
- Telekom Austria AG
- Telstra Corp. (participant)
- Verizon Communications (represented by Verizon UK)
- Vodafone Group plc

In addition, China Mobile Ltd. was one of the operators involved at the group's inception and it is believed to still be involved, but is not currently named as a member or participant.

But while the operators are in the driving seat, they're not alone: Major hardware and software vendors and systems integrators, including Alcatel-Lucent, Ericsson AB, Huawei Technologies Co. Ltd. and Nokia Siemens Networks, but not ZTE Corp. currently, are also members of the group.

In a statement outlining the aims of the group, ETSI noted that the group will "develop requirements and architecture specifications for the hardware and software infrastructure required to support ... virtualized functions, as well as guidelines for developing network functions. This effort will incorporate existing virtualization technologies and existing standards as appropriate and will co-ordinate

Carriers Peer Into Virtual World *(continued)*

with ongoing work in other standards committees. The first specifications are expected before the end of 2013."

Making sense of NFV and figuring out how new technologies such as SDN protocol OpenFlow can exist in wide area networks is a key challenge for the industry this year, as Heavy Reading Chief Analyst Graham Finnie noted in the title of his recent note, 2012 Belonged to SDN & NFV. But Will They Deliver in 2013? ■

Users Want 'Open' SDN Done Right

Craig Matsumoto

Managing Editor

Light Reading

Isn't networking gear supposed to be interoperable? Shouldn't that interoperability prevent vendor lock-in?

The answer isn't always "yes," to put it politely. A users' group that convened Wednesday to discuss software-defined networking (SDN) seems determined to make things work in their favor this time.

The Open Networking User Group (ONUG) was a one-day conference organized in Boston by consultant Nick Lippis, head of Lippis Enterprises. "Users," in this case, refers mostly to large enterprises, representatives of which gathered to hear talks from SDN-vendor executives, among others.

I haven't gotten to talk to attendees yet. But the five-point recommendation they're issuing Thursday morning is rather telling. Here's what they want to see in an "open" network:

- **Interoperable networks.** When it comes to standards such as OpenFlow or common elements such as hypervisors, everyone has to play nice.
- **No vendor lock-in.** Everybody ought to support everybody else's switches, services, hypervisors, controllers, and so on.
- **Networks that are programmable via northbound application programming interfaces (APIs).** Part of the idea here is to speed up service creation by offering easy ways to link networks and applications. But it's also about replacing command-line interfaces with something more modern.

Increased network visibility. Monitoring needs to be pervasive and more thorough. Moreover, "Open networks should emit real time network statistics to various traffic analytic and Big Data engines to determine network operational state," the recommendation reads.

An open-networking business model. "ONUG believes that for open networking to acceler-

Users Want 'Open' SDN Done Right *(continued)*

ate, the industry needs a viable, altruistic, truly open networking business model to drive innovation, fuel research and development and deliver best of breed solutions without allowing individual vendor proprietary interests to derail SDN deployments. Who will be the Red Hat of Open Networking?"

Whether you believe in SDN or not, it seems clear that networking is at the start of some major changes.

It's the first two points and the last one -- the part about an "altruistic" model -- that stand out.

Whether you believe in SDN or not, it seems clear that networking is at the start of some major changes. I think the goal behind ONUG was to make sure it gets done "right," by making sure the path isn't led by vendors.

That mainly means Cisco Systems Inc. There's a concern Cisco will hijack SDN, either by redefining it into Cisco-friendly terms or by flooding the space with so many standards as to make SDN unusable. I've heard competitors fret about both possibilities.

This attitude, this caution about vendors' methods and motives, isn't unique to ONUG. The Open Networking Foundation (ONF), which curates the OpenFlow standard and promotes SDN in general, bars equipment vendors from its board of directors. And the Network Functions Virtualization (NFV) effort is being driven by carriers.

Every vendor (including Cisco) pledges its SDN architecture will be "open." This time, users will hold them to that.

For more

- Intel Invests in Big Switch
- Cisco Extends Its SDN & Cloud Plans
- Carriers Peer Into Virtual World
- Where SDN Is Going Next ■

Putting OpenFlow to the Test

Ray Le Maistre

International Managing Editor

Light Reading

Network operators keen for verifiable data about technology products that support software-defined networking (SDN) architectures should have a few more questions answered in 2013 as independent labs put various technologies to the test and OpenFlow conformance testing resources become available.

The Open Networking Foundation, the industry body set up to promote SDN and the OpenFlow protocol, has already held a couple of "plugfests," the most recent of which was held in October 2012.

But this year looks set to have a broader set of reference points for operators and systems integrators to get their teeth into.

German independent test lab European Advanced Networking Test Center AG (EANTC) is creating a test network that will include OpenFlow and Path Computation Element (PCE) solutions interfacing with non-SDN Carrier Ethernet and MPLS elements as part of its annual multivendor interoperability test, which takes place over a three-week period in February at the lab's facilities in Berlin. (See SDN Added to Interop Test.)

In addition, the ONF is in the process of developing a conformance testing program that will enable systems and software vendors to become certified against the ONF's OpenFlow specifications.

ONF executive director Dan Pitt tells Light Reading that the ONF is currently working with the Indiana Center for Network Translational Research and Education (InCNTRE) at Indiana University to develop test cases that can be developed and used for OpenFlow conformance testing and that those cases should be completed and the InCNTRE ready to begin conformance testing by the middle of this year.

Pitt says that the test cases will be avail-

Putting OpenFlow to the Test *(continued)*

able for other test labs to use and that the ONF will be working with other test facilities in order to run conformance programs, thereby avoiding a monopoly situation (and potential bottleneck) by only having one certification lab.

It's likely that by the time the test cases are ready there will be quite a few more OpenFlow products available for network planners to consider: Pitt says that, to date, more than 64 OpenFlow products have shipped and more than 30 million OpenFlow ports are in deployment (though not necessarily "live").

Another area of focus for Pitt is to get more insight into how telcos might consider deploying SDN capabilities. To that end he is in discussions with the carrier-led Network Functions Virtualization (NFV) group that recently met in France. (See Carriers Peer Into Virtual World.)

"We've talked about how the two organizations might be able to help each other -- our efforts are complementary," says Pitt. "We're keen to know about the carriers' goals. Which SDN elements matter the most to them? It'll be interesting to see what their priorities are."

Another industry body with which the ONF has engaged is the International Telecommunication Union, Standardization Sector (ITU-T) -- "we are creating a formal relationship ... we want to avoid duplication of efforts" -- but the Internet Engineering Task Force (IETF) is not a body that Pitt sees as a potential ally. "We think differently about the network," he states. ■

SDN: More Than Just a Tremor

Ray Le Maistre

International Managing Editor

Light Reading

For the past two days I've been in Darmstadt, Germany, along with more than 300 others -- many from Tier 1 operators -- at the SDN & OpenFlow World Congress. Darmstadt isn't the most obvious location for an industry event, but it's home to many Deutsche Telekom AG R&D staff and the German incumbent has been a major participant at the event.

And it's in western Germany in late October, so no-one is here for the beach or to spend a long weekend visiting the sights. No offense intended, but Darmstadt is no tourist trap.

The attendees are here because the topics of wide-area network virtualization and software-defined networking (SDN) are a couple of the hottest in the industry right now. The potential changes to the way that traditional telcos might be able to run their networks and introduce new services is exciting just about every carrier CTO/CIO office on the planet.

As Matt Finnie, CTO at pan-European network operator Interoute Communications Ltd. said here today, "This is possibly the biggest shift in telecoms in 30 years."

It's clear that others agree. That's why more than a dozen carriers (and the number is growing) have formed a new Industry Specifications Group to jointly decide what the potential of Network Functions Virtualization (NFV) could be. Look at the list of names involved -- this is serious stuff. (See Carriers Collaborate on Network of the Future.)

While there's a great deal of excitement, there's also healthy skepticism about what can really be done in carrier networks -- there are a lot of challenges to overcome. But there are also many projects in operator labs and even creeping into production networks that show there is great potential for a new way of building, configuring and abstracting net-

SDN: More Than Just a Tremor *(continued)*

working capabilities.

There's a lot more to come on this in the coming years -- this is just the beginning. But expect things to happen fast. Companies such as Google are already deploying SDN techniques in their live networks and that means there will be others doing the same thing. The telcos know that if they don't build the networks of the future, someone else will. (See Google: SDN Works for Us.)

Companies such as Google are already deploying SDN techniques in their live networks and that means there will be others doing the same thing.

And whoever builds the networks, don't expect them to turn to the traditional network vendors for the technology -- that's far from a given. The equipment suppliers will need to move just as fast as the operators and prove themselves capable of delivering on operator requirements -- historical relationships will count for little in the world of virtualized network services.

This isn't just another tremor in the telecom world -- this is a full-scale earthquake. Expect the networking earth to move. ■

Policy Train Still Rolling, But to Where?

Graham Finnie

Chief Analyst

Heavy Reading

It may not be moving quite as fast as it was in 2011, but the policy and DPI express train is still rolling along nicely, according to the latest edition of our **Policy Control & DPI Market Tracker** – and it's taking on new carriages as it does so. While 2010 and 2011 were the years of the land-grab as vendors fought to win the first contracts from network operators, 2012 and 2013 look like being years of consolidation when – if all goes to plan – operators enhance initial deployments with a range of new use cases, and policy proliferates through the network and beyond.

But will it all go to plan? And to extend our metaphor, what exactly is the destination of the policy express?

There are plenty of reasons to be optimistic. As we have reported here and elsewhere, operators say in *Heavy Reading* surveys that they intend to greatly increase the number of policy use cases, from typically three or four today to 20 or more within a few years. But the really good news is that this anticipated expansion is actually starting to happen among pioneering operators. Both vendors and their customers report that initial use cases such as fair use management, bill shock and tier management are now being augmented, mainly by use cases that extend service packages and use more policy triggers – for instance, by introducing packages based on application or URL, by adding turbo-boosts and other add-ons, and with services such as family plans that share an allowance among related members.

In sum, the destination of the policy express is a service creation environment that connects a whole range of ever-changing conditions, including customer location, application in use and real-time congestion, to create packages that best suit both supplier

Policy Train Still Rolling, But to Where? *(continued)*

and customer.

But to get to that destination, operators need to convince users that more complex granular data service offerings are in their interests, and their suppliers need to up their game across a range of key areas. For operators, it is becoming essential to foster close liaison between network planners, product marketing and IT, since policy control is no longer a mere network function handling traffic management. Equally, suppliers must improve policy creation environments, simplify interoperability through the policy and DPI value chain, and enable a massive, cost-efficient scaling-up on metrics such as transactions per second.

These challenges, formidable though they are, will be met by both operators and their suppliers; the prize is too great for them to fail.

Heavy Reading believes that these challenges, formidable though they are, will be met by both operators and their suppliers; the prize is too great for them to fail. We anticipate that policy use cases will multiply in most networks, driven by the increasingly pressing need to differentiate and enrich service offerings, and we project a market for policy servers, DPI gear and associated software of some $2.5 billion by 2016, up from an estimated $984 million at the end of 2012.

As we report in this month's edition of the Tracker, many vendors have invested heavily to improve their platforms in the areas that count. But like any market projection it could be derailed if operators lose their nerve or vendors ultimately fail to deliver. We'll continue to track the leading indicators, for good or ill, in future updates. ■

SDN: Start Making Sense

Jim Hodges

Senior Analyst

Heavy Reading

Very few – if any – days have gone by over the past few months in which the relative merits of software-defined networking (SDN) have not been publicly debated.

As we note in the latest *Heavy Reading* report, "SDN & the Future of the Telecom Ecosystem," the debate is likely to increase in the near future given the potential impact for both carriers and vendors.

Conceptually, SDN and the approach of separating the control plane from the data plane present a strong value proposition. And while this approach has long been adopted in other parts of the network (session border controllers and IMS core), it does hold the promise to revolutionize and break new ground on the way data transport networks function.

Here's a quick take on the factors and unanswered questions that ultimately will determine if SDN becomes a truly transformative force in telecom, or if it ends up being something that achieves reasonable facsimile status in that it effected change, but ultimately not within scope of the original vision.

On the transformative potential side, there are these two points:

Point 1: SDN-based initiatives such as OpenFlow are being driven by the carrier in response to real-world requirements. This is an important factor given that it highlights a view that the status quo approach of "pseudo" open tools and software applications is too costly, too inflexible and ultimately no longer sustainable.

Point 2: SDN brings some much-needed simplicity to an overly complex world. Given the impact of moving applications to the cloud and the requirement to introduce policy control for application access and security, networks are going to increase in complexity on many levels, and any approach

SDN: Start Making Sense *(continued)*

that has the potential to minimize or reduce that complexity is highly desirable. Support of a distributed control plane model is no longer a viable approach.

On the less-than-meets-the-eye side, we have:

Point 1: It's difficult to implement a concept. Despite all the recent activity in the various industry forums, SDN is still largely in the first phase of industry adoption. As a result, it's really difficult to assess where it will be in even the next few years once the real product development work starts to take place. Further complicating the process is that even though OpenFlow, an SDN protocol implementation, clearly has some early market momentum, other approaches exist and more could emerge. For example, in our report we analyze how the IETF's Path Computation Element (PCE) specification may be a more practical approach to take for carrier SDN optical deployments. The question then becomes whether SDN can achieve meaningful cost savings and programmability openness if a number of protocols/specifications that follow a similar methodology are adopted on a global basis.

Point 2: We still don't know what vendors really think about SDN. This is a difficult question and ultimately depends on vendor competitive standing and market momentum. Therefore, vendors will have to tread very carefully as they define their SDN strategies to protect market share while also appearing as aligned to the spirit of SDN and not simply integrating SDN associated buzzwords like programmability into marketing campaigns. This dilemma is further complicated by uncertainty of how licensing of control plane clients associated with approaches such as OpenFlow will be priced.

A lot remains to be sorted out regarding SDN, including potential for success as a game-changer for telecom networks. Over the next 12 months, a number of critical developments both at a vendor and forum level will provide a much better picture of SDN's ultimate impact on the telecom industry. ■