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A Bird's Eye View of Software-defined Networking

Most people working in IT today have heard of software-defined networking as the next step in the evolution of networks. The term appears in industry news publications, thought leadership articles, and IT-related websites and blogs all over the world. But whether the concept is fully understood yet – its technical meaning, as well as its wider implications for the industry – is another matter.

According to Gary Middleton, Business Development Manager – Networking, at Dimension Data, the general consensus is that **software-defined networking** will have a **major market-wide impact**.

> 'In fact, commentators to the left of the adoption scale – the progressive "movers and shakers" of the industry – don't shy away from using pressing terms such as "sea change" and "seismic shift" to describe the effect they expect to see in the next few years. On the far right, conservative players are reserving judgement, saying it's "early days" and that it's "better to wait and see".'

But given this broad range of responses, how are we to understand software-defined networking, and how much of it is hype?

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Over the technical humps

If software-defined networking is still a poorly understood term, it's often because the implications for the corporate network can't be articulated well without a thorough grasp of the technology. In short, **a software-defined network is intelligent, programmable, and automated**. To explore what this means, it's best to compare it to how traditional networks work.

Middleton explains that the way in which a LAN, WAN, or data centre network directs and manages the data that flows through it is controlled by how each networking device is configured.

> 'Collectively, these settings and rules determine where the data goes, how quickly the data flows, how the data is checked against security policies, which data is allowed, and which is blocked. The challenge is that the network manager needs to configure each device individually, often by physical adjustment.
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> 'In a large estate comprising several hundreds of routers, switches, and ports, configuring the network optimally is a labour-intensive, time-consuming, and complicated job,'

continues Middleton.

> 'Changes to accommodate, for example, new applications and their provisioning to a specific group of end users, take time to implement. As a result, network management is a discipline requiring highly specialised skills and several years of experience. Software-defined networking promises to offer a simpler, better way to manage networks.'

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'The result is that a **software-defined network is easier** to **implement**; **simpler to control and manage**, with less human interaction; and is far **more dynamic in accommodating the constantly changing requirements** of today's ICT environments, particularly in data centres.'

Central intelligence

The reason traditional networking devices need to be configured individually lies in the way they're constructed. Says Middleton:

> 'Each router and switch consists of a number of different layers or planes, including the data plane, through which the data packets are transferred; and the control plane, which controls how the data is handled and where network "applications" are embedded. Much of the network's "intelligence" – how it deals with data traffic – is therefore scattered among all the devices and distributed across the network. A traditional network lacks central intelligence and control... and this is where software-defined networking hopes to make a change.
>
> 'A software-defined network separates the data, control, and application planes of the devices,'

explains Middleton.

> 'This allows some of the intelligent elements of each device to be split from the packet-forwarding engine and moved centrally, and enables them to become programmable. This type of architecture therefore uses hardware networking devices that are configured and controlled by a central software program called a controller.'

Hence the term 'software-defined': the network is configured and controlled through software, and no longer at the hardware or device level.

A network that drives itself

An even more powerful function that software-defined networking makes possible is automation. Says Middleton:

> 'The network becomes a programmable entity with which applications can directly interface by communicating, through the controller, with each individual device, thereby instantly and automatically configuring the network to enable its own optimal provisioning.
>
> 'The result is that a software-defined network is easier to implement; simpler to control and manage, with less human interaction; and is far more dynamic in accommodating the constantly changing requirements of today's ICT environments, particularly in data centres.'

Already, these features translate to almost irresistible benefits for any large organisation that's trying to cut costs and do more with less. But exactly how it will play out in the market can't be fully predicted, as there are both antagonising and promotional forces at play.

Three ways towards software control

Sweeping technology change rarely comes without its fair share of market politics. Software-defined networking is no different. While the benefits are clear to most end-user organisations, the vast majority – if not all – of the networking devices installed in their networks can't be software controlled. Moving in this direction would require a rip-and-replace approach which is expensive, risky, and disruptive.

'Complicating the matter further,'

continues Middleton,

'is the fact that there are currently three different approaches to implementing a software-defined network, all of which involve how the controller communicates with the network devices.

'The first of these is to use an industry standard protocol, like OpenFlow, which was developed by the Open Network Foundation (ONF) – an organisation whose members include some of the largest organisations in the world, including Verizon, Deutsche Telecom, NTT, Google, Microsoft, Facebook, and Yahoo. OpenFlow is an open standard, so any OpenFlow-enabled controller can use it to communicate with any OpenFlow-enabled networking device, regardless of manufacturer. Smaller networking vendors, and particularly end-user organisations, support this open standard because it allows for greater flexibility and freedom in networking design.'

Vendors with a larger share of the market have created what they call an application programming interface (API), as a second option. Middleton explains that an API enables external tools, software, or applications to communicate with the infrastructure, but these are vendor-specific and proprietary. So, a particular manufacturer's API can communicate only with its own devices. The benefit of this method is that an API exposes the maximum functionality of the vendor's devices because of the stronger integration between them.

'It's a good route to take if you have a single-vendor or a vendor dominated environment.'

Then there's a third option called a virtual network overlay.

'A virtual network is software that functions "on top of" your physical network,'

says Middleton,

'while also providing programmability and central control. There are a number of ways to implement network virtualisation that are widely supported across vendors. Virtual network overlays may be particularly useful in data centre networks. Each network can have different configurations and can be moved anywhere within a data centre, or between data centres, while the virtual view remains the same. Virtual networks function in the same way as virtual server environments, providing maximum flexibility and instant scalability.'

With all of these choices, in which direction should organisations move?

Where to go from here

Owing to the dynamic nature of technology progress, end-user organisations are having a tough time understanding these developments and choosing the best way forward. Says Middleton:

'Every organisation is unique and, to a great extent, so is every network. An information superhighway for one business may be a cul-de-sac for another. It's best to first understand the technical implications of software-defined networking and the benefits it may hold for your business. You also need to gain a clear view of your network's current readiness state, to identify a desired "to-be" state, and then define a clear roadmap of how to get there over time. This is where the help and advice of a trusted expert with extensive experience in end-to-end network implementation, support, and management – not just technology – can be a tremendous help as a first step on your journey.'

Networks and the city: software-defined networking in layman's terms

Think of today's typical network as the road system of a large city. Data packets are the traffic that flows through it. Each intersection is controlled by a traffic officer – today's network devices – who directs traffic by recognising the turning signals, size, and shape of the vehicles passing through. These officers can direct only the traffic at their intersections; they can't gauge the overall traffic volume or see its movement across the city. This makes it difficult to control the city's traffic patterns, to ease peak-hour traffic, or host special parades. For such events, each officer needs to be briefed individually – in person or via radio – about how to control the traffic at his or her intersection. In spite of each officer's best efforts, gridlock is a regular occurrence.

A software-defined network is the equivalent of a futuristic city. Each traffic officer is replaced by a traffic light and a set of electronic vehicle counters, which are connected to a central monitoring and control board. The city's traffic can now be instantly and centrally controlled. In fact, it's even possible to programme the control board to direct the traffic differently at various times of the day or to accommodate special parades via a planned route. The programme monitors traffic flow and automatically changes the traffic lights during these events to help traffic pass through the city with minimal disruption and, afterwards, returns the city's traffic to normal.

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