

SD-WAN, NFV, HYBRID

THE FUTURE OF CORPORATE NETWORKS IS HERE

NEXT GEN IT REQUIRES A DISRUPTION IN NETWORK PROVISIONNING

Today, we observe a major move towards Next Gen IT in large companies. But current networks fail to keep up the pace of such transformation.

Next Gen IT is a 3-pillar structure (organization, application & infrastructure) based on a security foundation allowing companies to innovate efficiently. It must be able to increase business added value and the productivity of autonomous and agile teams.

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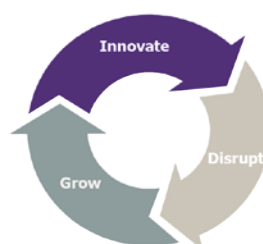
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Next Gen IT to support Next Gen Business

NEXT GEN BUSINESS

- ✓ Capture customer **attention**, generate the best **customer experience** at a **global scale**
- ✓ Retain customer with **fast time to value** and **fast evolution of value** proposal
- ✓ Adapt organization towards **learnability** and **innovation**, leveraging **cutting edge technology**

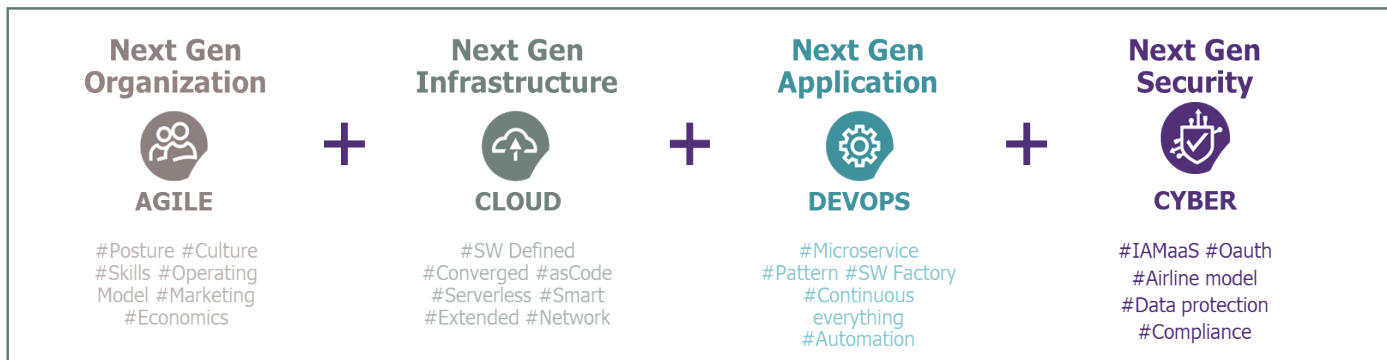


NEXT GEN IT

- ✓ **Close to business** & customer needs, expectations and **satisfaction**
- ✓ **Fast release/update** of **high quality** products and services
- ✓ **Increased business added value** and **productivity** of autonomous and **agile teams**

To build a consistent Next Gen IT platform, large companies must redefine infrastructures, applications, security and organization.

Next Gen IT components



Increased **mobility** and **autonomy** of today's workforce drive the demand for networks which are flexible and always available.

the network in a cost-effective and flexible manner, we observed a movement towards hybrid networks in the last few years. Hybrid Networks maximize the effectiveness of

In this context, one of the major challenges is to be able to provide network connectivity that underpins the delivery of Next Gen IT with the same flexibility and reactivity as software is delivered today.

Agile Software Development allows new software products to be released within weeks, Datacenter and Cloud automation enable the delivery of compute resources within hours, but connectivity services delivery is still a matter of months.

To maintain the increasing pace of IT delivery, companies must improve WAN connectivity services in terms of time-to-connect, agility and footprint. Software Defined WAN (SD-WAN) is designed to be the solution that will best address these requirements.

The Internet of Things and **real-time analytics** will require high bandwidth and reliable network capabilities to transport increasing amounts of data from edge to Cloud.

In the meantime, a shifting business model centered on the use of data and digital services makes **cyber security** one of the biggest concerns of the future. Furthermore, as technology continues to advance, it demands an **Operating Model** that can continuously adapt to these changes.

Moving from hybrid WAN to SD-WAN to gain agility

With the development of Cloud services and to support the growing demand on

the WAN by load-balancing the traffic over multiple links, typically by using:

- / Higher cost MPLS link(s) for mission critical, throughput/latency sensitive applications (Voice, Video, Virtual Desktop);
- / Lower cost, internet link(s) for non-critical, non-real-time applications (mail, FTP, desktop updates etc.);
- / The closest SaaS provider's Point of Presence to avoid the backhauling of SaaS traffic to central Internet access points.

Hybrid Networks are now the **mature and proven technical solution** being completed by SD-WAN services.

SD-WAN PRINCIPLES AND FUNCTIONS

Business challenges put high pressure on the WAN

Businesses and business applications require WAN services to provide more agility, capacities and performances:

- / Businesses increasingly rely on **digital tools and Cloud services**. This requires a greater reliability and capacity of the IT network.
- / Businesses need to **deliver Applications** and **deploy new branches** worldwide simply, quickly and securely to increase their time-to-service and time-to-market.



Software Defined Networks (SDN) is a technology that allows the management of network infrastructures in accordance with business needs. It is an abstraction of the physical network that enables easy provisioning of network resources to endpoints. Delivery is achieved using both:

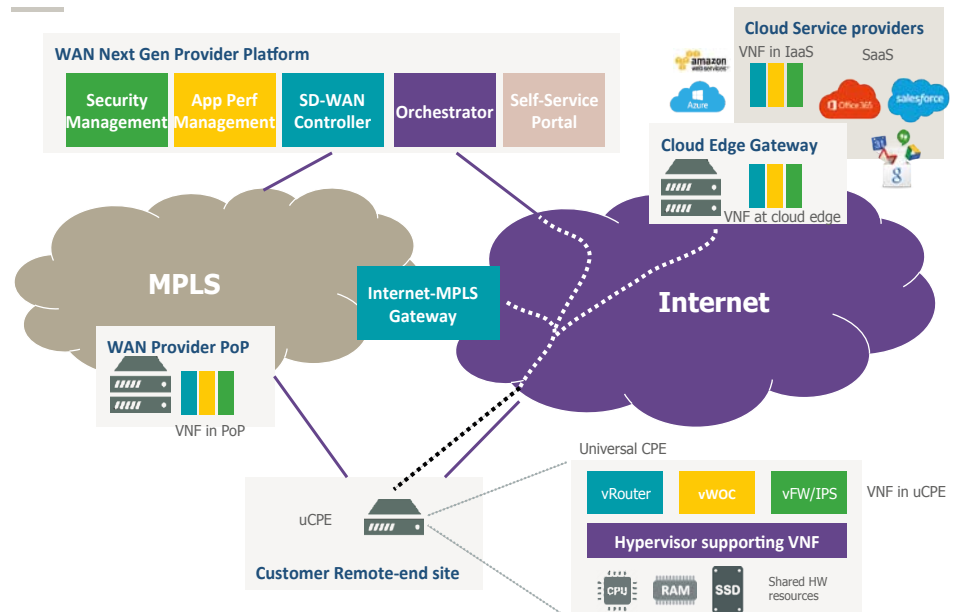
- / a centralized management console and API to automate the provisioning.
- / and automatic reactions to events such as congestion, new quality of service needs etc. (works effectively in conjunction with Network Functions Virtualization - NFV of VNF - environments).

SD-WAN is the adaptation of SDN to WAN which uses software to **dynamically route traffic** based on global QoS policies and real-time performances of the network links. Unlike legacy networks that rely on static and non-flexible routing protocols, SD-WAN adjusts the network behavior for each application and minimizes the impact of congestion or incidents on the network.

Key differentiators of SD-WAN technologies

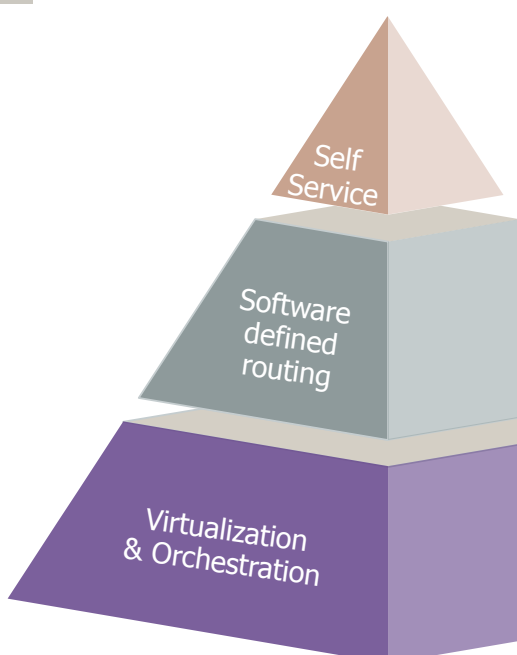
SD-WAN is a transformational technology within the networking area. It offers a whole new level of network agility:

Typical SD-WAN architecture



- / **Smart routing functionalities:** multipath, dynamic routing, based on network performances and application awareness;
- / **Increased visibility of network traffic and applications:** operations leverage native performance monitoring to improve the diagnosis and response to applications performance issues;
- / **Cloud on-ramp:** SaaS applications performances are enhanced by the implementation of local or smart internet breakout as well as the extension of WAN optimization features up to the Cloud Service Provider edges;
- / **Zero touch provisioning:** simplify network roll-out with the automation of the initial configuration tasks;
- / **Network add-on capabilities:** activate additional network functionalities (firewall, WAN optimization, WiFi controllers...) without any additional hardware.

Building blocks for a SD-WAN design



Self-service Portal: a portal where a customer network admin can directly manage the SD-WAN service: register newly installed and autodiscovered uCPE, remotely deploy VNF, apply new application policies (routing, performance)... The Portal leverages the Orchestrator northbound APIs to execute changes in the network configuration.

On-demand bandwidth: provided that access rate of last-mile technology is sufficient (often the case with fiber), the customer can himself upgrade the bandwidth.

SD-WAN Controller: the central intelligence (software-defined) managing routing policies to teach the end routers to select the best path based on applications policies and performance measurement on possible paths

Overlay & Tunnels: to connect locations and gateways over the Internet whatever the technology and ISP

Gateways: to seamlessly interconnect MPLS and Internet + to access cloud providers

CPE and vCPE: routing function on the end-site (on a dedicated HW or as a virtual network function)

Virtual Network Function (VNF): a network service (routing, optimization, security...) packed as a virtual component to be executed on a virtualized environment whatever the hardware and the location (uCPE, servers in PoP or cloud, cloud provider edge)

Universal CPE (uCPE): Hardware (usually bare metal x86 server) in customer premises (replacing branch routers) and hosting VNF functions running as virtual machines

Orchestrator: central management service to enroll managed HW/Hypervisor and remotely deploy VNF with predefined packages (service chaining)



A MARKET IN COMPLETE RENEWAL

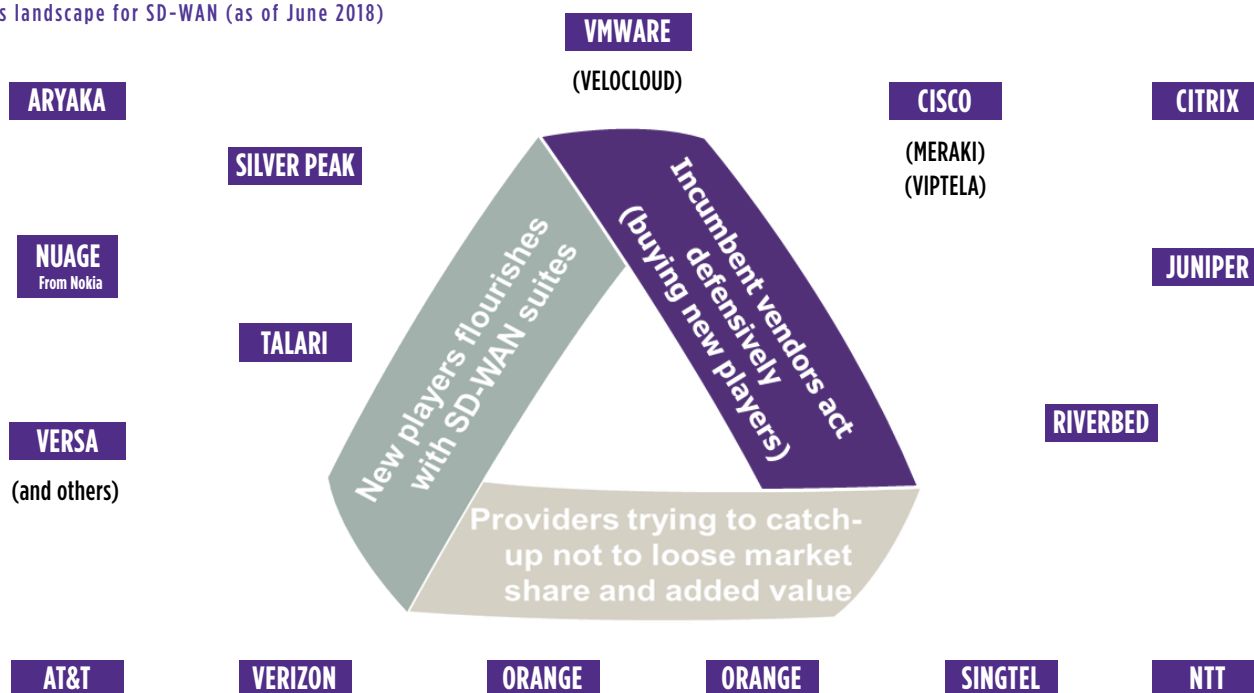
SD-WAN is disrupting the Telco market

There is much hype in the WAN market and our experience has demonstrated

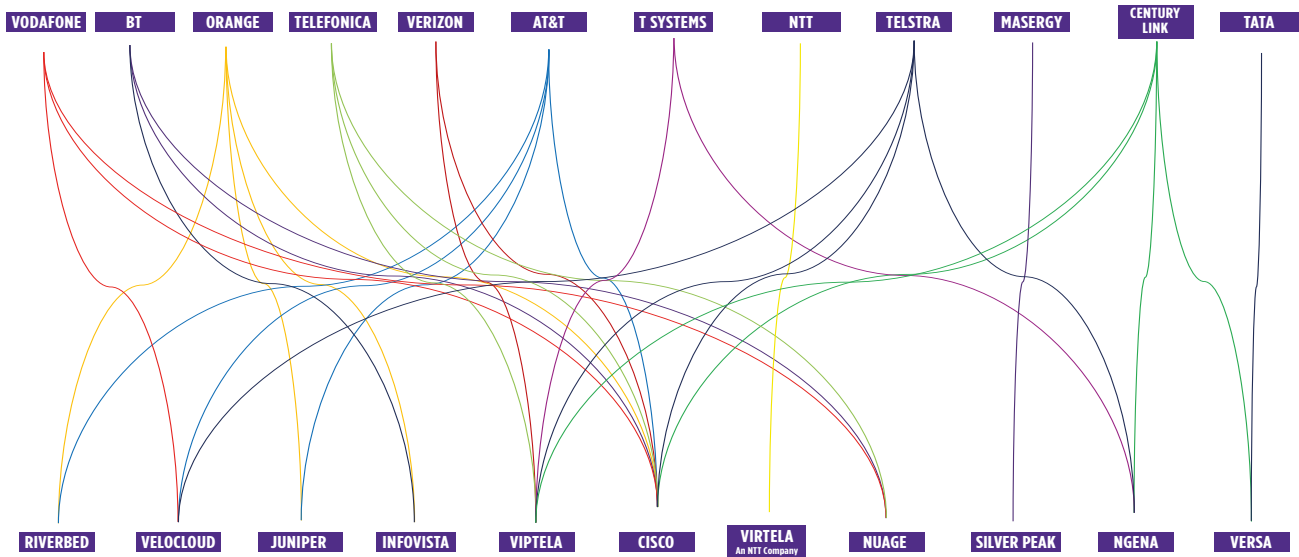
that there is a **broad spread of capability and plenty of roadmaps** across both the **traditional global carriers** and the **major hardware/software suppliers**. Nevertheless, this technology has opened opportunities for **new players** to enter and has created

challenges for traditional carriers and equipment manufacturers. Over the last 5 years, many new players flourished in the WAN market introducing diversity in a market that was locked for decades by giants like Cisco or Juniper.

Suppliers landscape for SD-WAN (as of June 2018)



SD-WAN everchanging partnership landscape (as of early 2018)



Many of the traditional telecom providers are partnering up with the vendors to quickly gain access to market and product engineering intelligence. Some of these relationships can be detailed in the diagram above, but this is an everchanging landscape. The market is not yet consolidated, and operators prefer to multiply the partnerships to reduce uncertainty.

Caution is still required as market consolidation is not over

There is an acceleration in the SD-WAN market, but the **ongoing market consolidation should keep enterprise customers cautious.**

From technology vendors' perspective: many of the new tech players have already been acquired by the larger manufacturers. This confirms that there is demand for SD-WAN products and services, but it also means that the product roadmaps are ever-changing. Investing in one manufacturer solution is a difficult decision to make over the longer term.

From network providers' perspective: the technical strategies for the network providers are not final. For Telco providers, investing in a new vendor specific technology remain at

risk: additional market consolidation may happen and there is no standard to secure interoperability. Also, there are many questions regarding the evolution of the managed WAN model of the global providers. Wrong decisions on their Target Operating Model or lack of development in their products could result in a loss of revenue as customers move to competitors or they decide to do more in-house.

Acceleration of an everchanging SD-WAN market

- Cisco launches its IWAN offering
- Nuage Networks (Alcatel-Lucent) launches its SDN for datacenters
- Citrix develops the Virtual WAN product and adds it to its CloudBridge portfolio
- NTT acquires Virela
- Nokia acquires Alcatel-Lucent, now owns Nuage Networks
- Singtel launches SD-WAN offering, partnership with Viptela
- Verizon initial MS SD-WAN offer
- Riverbed updates steelconnect, AT&T partners with CISCO IWAN
- Orange Business Services (OBS) partnership with Riverbed
- Telefonica partnership with Nuage Networks
- Talari partners with Tech Data
- Verizon uses Cisco Virtual Managed Services NTT partnership with Virela
- Level 3 rolls out its SD-WAN offer
- Cisco buys Viptela
- BT launches BT Agile Connect, partnership with Nuage Networks
- Singtel launches Singtel SD Branch
- Vmware acquires VeloCloud

2013	2014	2015	2016	2017	
	<ul style="list-style-type: none"> • Nuage Networks launches its SD-WAN solution VNS • VeloCloud markets its SD-WAN solution 		<ul style="list-style-type: none"> • Citrix rebrands Cloudbridge to Netscaler • Riverbed launches Steelconnect • Juniper launches its Cloud Enabled Branch SD-WAN, Century Link partnership with Versa Networks Technologies • Fatpipe and Avaya partnership • AT&T partnership with VeloCloud 		<p>Offer launch Partnership Buyout</p>

SHOULD WE BELIEVE IN MARKET PROMISES?

Vendors have published whitepapers full of promises about SD-WAN and Network Function Virtualization. Our experience shows that SD-WAN benefits can vary significantly depending on customer context, implemented design, and geographical coverage.

- / **Agility of deployment:** with plug-and-play features, SD-WAN offers faster provisioning. Automation of policy configurations enables global changes to be deployed faster and more reliably. Also, the virtualization of physical appliances can simplify the deployment of new network features. On the other hand, field operations are still required to deal with initial setup or cabling issues.
- / **Service flexibility:** SD-WAN allows for a more agile way of managing the network and improves site availability through simplified and faster failover and relocation of traffic. However, attention must be focused on any-to-any VPN architecture complexity and related scalability constraints.
- / **A smarter WAN to improve end user experience:** SD-WAN provides an intelligent flexible overlay that can leverage the benefits of a hybrid WAN connectivity. Traffic is routed based on the needs of each application and



real-time performances of the underlying links. However, making the most of these features requires a good knowledge of the application requirements and the ability to design a detailed QoS strategy.

- / **Cost savings:** SD-WAN cost benefits are currently less visible than the announced savings.
 - SD-WAN can certainly bring savings on operations management (automation, zero touch provisioning), but investments required for setup and deployment are significant. Moreover, customers should deal with developing new skills within their teams.
 - Virtualization allows to add or remove network functions (VNF) without on-site intervention. However, the market of uCPE hardware (hosting such VNF) is not yet fully mature. The standard x86 hardware currently fails to match performances of traditional

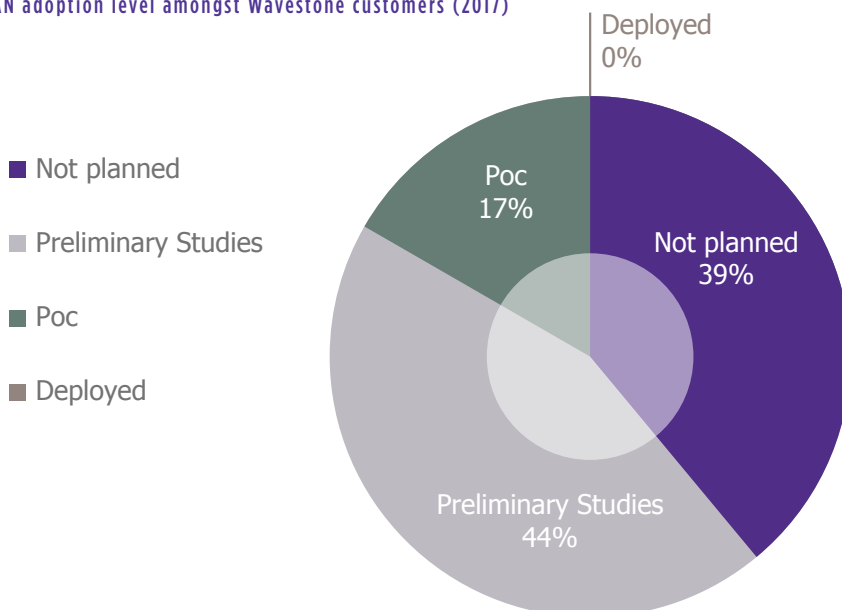
network appliances packed with dedicated optimized circuits (ASIC). Additionally, it remains difficult to have the same guarantees in terms of delivery and maintenance SLA with these new uCPE hardwares.

- Total or partial substitution of Internet over MPLS can generate savings. But such savings are subject to high variation depending on geographical coverage and local market pricing.
- Finally, improved lead-time-to-connect brings business value but related costs savings are difficult to estimate.

AN EMERGING ADOPTION OF SD-WAN

In 2017, most large companies considered the topic of SD-WAN, with an increase in Proof of Concept studies. However, we don't observe any large deployments at this stage.

SD-WAN adoption level amongst Wavestone customers (2017)



20 accounts benchmarked

- 11 from Industry
- 2 from Transports
- 3 from Insurance & Banking
- 4 other accounts

We predict that the very first large deployments should occur in 2019.

SHOULD YOU NOW CONSIDER MOVING TO SD-WAN?

Assess the value of SD-WAN based on use-cases

Discussions with customers raise several questions with respect to the deployment opportunities. The main issue is the uncertainty of when the best time to move to SD-WAN is, due to the fact that the market is quite new and is evolving rapidly.

Initial customer feedback from SD-WAN roll-outs has highlighted some use-cases where SD-WAN is improving the network delivery experience. Therefore, SD-WAN is particularly suited to:

- / **Quickly connect new international branches:** extensions to new markets, business carve-in or carve-out lead to strong expectations for reduced lead-time-to-connect. In addition, in some regions the SD-WAN could provide substantial savings by using internet lines instead of MPLS.
- / **Support cloud-oriented usages:** sites with usages mainly based on public Cloud (versus in-house applications) can directly benefit from SD-WAN added value: flexibility, enhanced performance and cost effectiveness.
- / **Ease hybrid or full Internet transition:** SD-WAN could offer a relevant solution to move from full MPLS to an Internet-based network, helping to maintain a good level of QoS and resiliency.

Migration is not straightforward

Migration to SD-WAN is not an easy move. Therefore, the following topics should be addressed carefully in each SDWAN project:

- / **Technical design:** the design should be done considering future needs (cloud-based applications) but also legacy networks and applications.
- / **Sourcing strategy and operating model:** The SD-WAN opens up the possibility of different operating models from the traditional managed WAN service, such as
 - Assigning a **global provider to directly operate the SD-WAN solution**. The major advantage is



to keep a clear responsibility on a single actor.

- Deciding to **manage the WAN** internally via SD-WAN tools, and to shop for bandwidth (Internet, MPLS) in a “best of breed” approach. This requires strong internal capabilities (technical skills, people on the field, and ability to operate worldwide on a 24x7 basis).
- Delegating the **SD-WAN management to a third party** (integrator model). This model adds flexibility, differentiating the sourcing of WAN management and bandwidth delivery. But this model also adds complexity in the operations organization and governance model.

In most cases, a **hybrid strategy** (a combination of several of the above models depending on the country or region) is the best way to get the best business case while securing performance and availability of the network.

How to get ready for SD-WAN disruptions?

If you think it's a good time to start, you should probably begin with:

- / **Testing technologies:** make the most of Proof of Concepts and Proof of Value to seize SD-WAN capabilities

and opportunities for your specific business.

- / **Adapting your strategy to regional contexts:** SD-WAN benefits can highly vary depending on local MPLS and Internet markets (bandwidth, quality of service, performance, costs). The strategy should be adapted accordingly (eg. no clear ROI in Western Europe to move from MPLS to Internet).
- / **Targeting quick wins:** a limited number of sites can represent a significant share of the global invoice - target these sites to highlight SD-WAN benefits and get business support.
- / **Challenging the target operating model:** as SD-WAN technologies are now becoming quite mature, the key challenge is now regarding the target operating model, in order to:
 - Ensure clear accountability of the actors (MPLS and Internet carriers, SD-WAN operator...)
 - Secure sourcing at scale (which providers where?)
 - Get a relevant business case (decrease costs or at least get more for the same price).



FUTURE NETWORKS WILL BE EVEN MORE INTELLIGENT

SD-WAN experimentation opens a whole new perspective in the networking industry. While SD-WAN leverages

software and virtualization to be smarter and more agile, Intent-Based Networking (IBN) will make use of metrology data and machine learning, to improve the automation of networks provisioning and operations. Networks won't be configured using

command lines or lines of code anymore, but by a natural business language. Like SD-WAN a few years ago, IBN is just emerging today, but it will likely become the future of the networking industry.

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