

Wideangle™ Issue 01. 05/2019

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SEDANS: SD-WAN AND *THE IMPORTANT* IN ENTERPRISE NETWORKING

The Important

- An Enterprise networking revolution is under way
- It is common to refer to this revolution as Software Defined X. Software is a means, not an end, so we prefer to focus less on the “software defined” piece, important as that maybe, and more on the Enterprise outcomes
- In the long run the current Enterprise Networking revolution will be remembered for three critical themes:
 - Security
 - Enterprise Driven
 - Application-centric
- This report captures these three themes in the acronym “SEDAN”
- This report focuses on the evolving nature of SEDANs through the lens of SD-WAN

- SEDANs will become manifest in SD-BRANCH/LANs as well, and possibly all of Enterprise networking
- SEDAN drivers include:
 - Competitive/customer experience needs for digital transformation, of which, cloud/multicloud computing/services, and increased bandwidth requirements, plays a significant role
 - Access link choice, including broadband & wireless
 - Agility & flexibility
 - Automation/Autonomy and policy/intent-based networking
 - Improved economics (MPLS alternatives, network optimizations, ease of management)
 - Addressing increasing security challenges / managed security

Call to Action

- While there is important narrative around cost savings relative to alternative approaches and the leverage of multiple access technologies, the emerging technological/product basis of competition in Enterprise Networking is Security, Enterprise Experience (with a focus on being Enterprise Driven), and Application-centric networking outcomes. Solution suppliers/resellers/managed service providers must compete effectively on these dimensions. Enterprise network managers should look to leverage these dimensions in digital transformation.

Summary

Frame Relay was often touted as “private line at half the price”. It was not of course, but the benefits of statistical multiplexing allowed it to be offered at a lower price than private line, while operators continued to maintain premiums on private line services. Important as this fundamental economic driver was, we remember Frame Relay for much more than this, including topology flexibility. Likewise, we remember IPVPNs for supporting multiple layer 3 / routed VPN services over a single network, and for some enterprises offering a better (managed) routed network experience. SEDANs will be no different, offering better economics with a better experience for Enterprises.

Online, real time application-aware optimizations, a single pane of glass, automated provisioning, and the ability to use many different access links, are just some of the qualities that make SEDANs a better experience for Enterprises. We refer in this report to “Enterprise Driven” to emphasize that software is not an end in itself, it needs a purpose/mission to add value. An important purpose is to put the definition and management of the enterprise network, into the hands of the Enterprise, even if delivered as a managed service. Overtime, as autonomy matures, Enterprise Driven will take on new meaning, for example cross-administrative boundary autonomy, either developed by the Enterprise (the most sophisticated) or installed by the Enterprise as a package from a third-party supplier (more likely).

With the rise of cloud, and the rise of applications / services being delivered out of locations / data centers not controlled by the Enterprise, application performance has risen as an important issue. A single

communications service provider may not be able to guarantee the end-to-end performance characteristics required, certainly not within a single VPN domain. Enter the cross-administrative boundary overlay network. This is an issue that will only increase as cloud traffic / share of Enterprise applications increases. It is at this intersection of time that SEDANs come to the forefront, and therefore are compelled to keep evolving in this direction.

Security is generically important everywhere. But when an Enterprise is connecting to cloud over the Internet and transferring traffic directly to a branch without going through a hub, then security is even more important. A SEDAN solution must address security in an effective way.

Security + Enterprise Driven + Application networks == SEDANs. By this we don't mean the opposite of exotic, we mean the approach to Enterprise Networks that will become used by many, if not most Enterprises, for all or some of their needs. Based on what we know today about the future, it will become the most popular choice by Enterprises over time. That said, in the auto world, there are in fact, some exotic sedans.

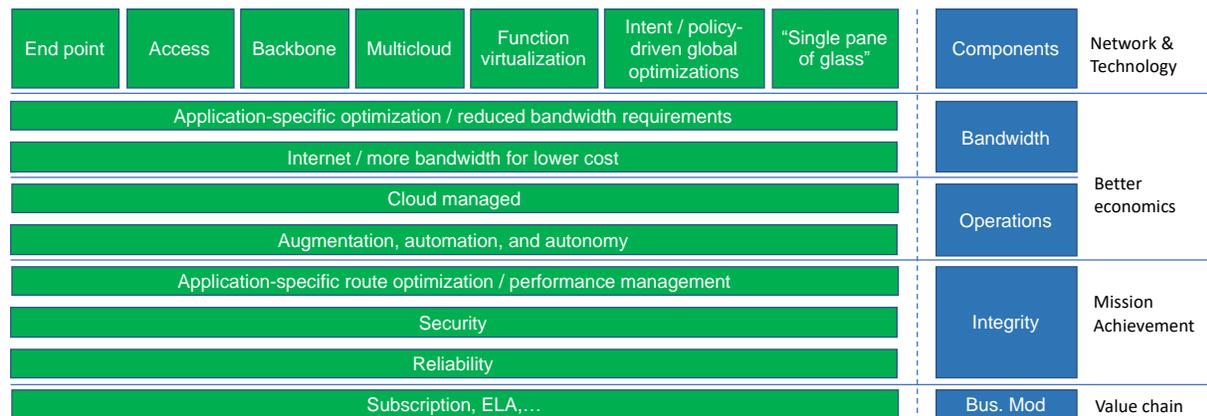


Figure 1. SEDAN Framework

In Figure 1., we introduce a framework for discussing pertinent SEDAN benefits, challenges, and decision points. The use of the term "SEDAN" in this report is synonymous with SD-WAN, SD-WAN aspirations, and SD-WAN directions. That said, as SD-Branch is emerging, with SD-LAN included, SEDANs take on a larger Enterprise role.

SEDAN components

End points

The end point of a SEDAN can be software on a general-purpose computer, software embedded in a traditional router design, or software embedded in an appliance designed for SEDAN. The latter is often referred to as uCPE (universal CPE). Reuse of existing router infrastructure has economic and operational benefits. The use of uCPEs can, if desired, lead to the placement of virtual network function (vNF) within the Enterprise.

WAN optimization is an approach to networking that has matured over multiple decades now. With the ability to understand application flows, WAN optimization can, for example, reduce the amount of traffic transferred, improving the performance of non-real time applications. Feedback from solution suppliers includes the perspective that going forward, the historical approach to achieving WAN optimization may not be the only approach. Indeed, bohca expects creativity and innovation in many aspects of network optimization. In addition, the move to high-speed broadband is another argument made about the diminishing importance of WAN optimization. On this issue, there are nuances WRT traditional telecom services which are widely available and still in service. The importance of WAN optimization may vary from Enterprise to Enterprise.

Access Networks

With the transition to cloud-based services, Enterprises need significantly greater bandwidth capacity than previously, and from more locations. This is an important business requirement today.

One of the most touted benefits of SEDANs is the ability to leverage a wide range of access networks, and specifically, non-MPLS based access networks, which makes SEDANs more flexible, in this sense, to pure MPLS/VPN services. In addition, some SEDAN solutions can provide active/active bonding of multiple links, which for some would mean new consideration of broadband as a primary link. In an age of digital transformation, the availability, reliability, and experience of the network is increasing in importance. This benefit can lead to SEDAN being either an adjunct complement to MPLS/VPNs or a complete replacement, with the former having garnered significant industry discussion already – an Enterprise may not be ready to rip and replace its existing VPN infrastructure, but it can still benefit from SEDAN solutions when expanding / supporting branches.

While SEDANs provide advantages for access network flexibility, that flexibility may come with some downsides. For example, while an access link is often managed for an MPLS/VPN service, it is not always for an Internet-focused access link. To this challenge, solution providers are responding with both technology and managed access services. This is a key decision issue when selecting an approach to SEDANs.

Backbone Networks

Backbone Networks, or the “middle mile”, are well-managed in MPLS/VPN services. For Internet services, there is sometimes a concern that QoS may not meet Enterprise requirements. There are many SEDAN responses to this, including path optimization. One response to this is to utilize a managed network provider that has points of presence in enough locations to curate good QoS experiences. Whether or not a managed backbone / middle mile provider is used is an important SEDAN solution consideration – does the backbone being used meet the Enterprise requirement. For some enterprises, an unmanaged backbone will not meet requirements.

Multicloud

With the shift towards cloud-based services, the ability to be able to optimize application experiences across multiple cloud platforms, public and private, has become important. SEDAN solutions are able to determine which cloud platform location is closest to the enterprise / traffic being transferred and then route that traffic on the best path to get to it. Significant latency reductions are reported from this approach. How this capability is achieved could become a point of competitive debate: cloud-proximate gateways vs rich edge, for example.

Function Virtualization

Function virtualization is the ability to instantiate / scale-out a function within a virtualized compute environment. In this report, we take a generic approach to the definition of function virtualization, we are not referring to a specific industry standard, and see “cloud-native” approaches as emerging. SEDAN implies function virtualization / parallelism and therefore is considered by many as perhaps the leading driver for function virtualization today. Function virtualization adds agility by allowing the definition and instantiation of a software function *faster* than a similar physical network appliance could be deployed, in historical models. Ultimately, how a SEDAN solution achieves support for multiple customers, multiple applications, and multiple services will vary depending on such things as cloud vs edge-centric approaches. There are likely multiple ways to achieve the same outcome, and there are nuances to each approach.

Intent / policy driven optimizations

Perhaps the aspect of SEDAN that has networkers most excited is the integration of an intent/policy engine. The now seen holy grail of the network is to preserve intent / policy, in the face of competing demands, across a variety of network conditions. The Intent / policy engine is seen as the way to achieve this aspiration. In addition, simply maintaining configuration/policy consistency across locations can be a clear and early win.

Automated provisioning in SEDANs is among its most powerful capabilities. One example is the automated provisioning of site-to-site tunnel meshes and topologies, which is a significant operations time and ease of management improvement. Other optimizations / automations include application-aware path selection.

Specifically, it is in this domain that we see the “Enterprise Defined” aspect of SEDANs being a large step forward in experience, on the road to “Enterprise Driven”, a future state, where enterprises integrate autonomy, and the network increases in the level of unassisted decision-making.

Better Economics

Application-specific optimizations

Two application-specific optimization approaches already mentioned are WAN optimization (historically good for non-real-time applications) and path optimization (good for real-time applications). The goal is to move from the network being only loosely aware of the needs of an application to the network being explicitly aware of users, flows/applications, and using policy/intent to deliver flow/application-specific experiences. This is an area of SEDAN that is not as mature as other areas but will likely see significant investment in the coming years, including the application of analytics and machine learning, feeding into real-time decision making.

Internet – more bandwidth for less cost

One of the reasons to use the Internet is to get more bandwidth for a lower price. The lower price points can also be used as leverage when (re)negotiating MPLS/VPN services if all an Enterprise wants to do is add some new SEDAN sites to an existing approach to VPNs.

Cloud-managed

Implied in software-based, cloud-delivered, single-pane of glass solutions is an approach to policy definition and network management that is easier, takes less time, and where every action is more powerful – in short, simplify management complexity. These benefits result in operations expense savings / increased productivity, increased agility, and more flexibility. These benefits also close the skills gaps that many enterprises have. Cloud-managed approaches could be either on-prem/private cloud or public cloud-based.

Arguments in favor of cloud-based approaches generally include lower cost of ownership, better control of network/security policies, and decreased expenditure on bandwidth (for example with hybrid networks).

Augmentation, automation, and autonomy

We subdivide the three aspects of increasing productivity and making better decisions into augmentation, automation, and autonomy. We define augmentation as a system that makes a recommendation to a network manager, who then implements the recommendation using a combination of the expertise from the recommendation system and the network manager. We define automation as a sequence or repeatable actions, that is often a repeated task (sometimes implemented as a “workflow”). We define autonomy as the ability of a network to make a real-time decision in the face of different network conditions, and in context of SEDANs, according to policy / intent. These three aspects of network operations transformation are not peculiar to SEDANs but are likely to be significant focal points within them. Solution providers have many avenues to pursue in adding value, including workflow management, analytics, and wireline/wireless network performance/reliability monitoring/mitigation.

Mission Achievement

Application-specific route optimization / performance management

While economic benefits are always welcome by Enterprises, they have to be achieved while still delivering the mission of the Enterprise. In other words, application-specific performance management is essential as cloud services become more dominant and as SEDAN becomes the dominant approach to Enterprise Networking. Whether this is a heavyweight approach to QoS (not for everyone), or simply intelligent application aware routing (likely), the measurement of performance and application of policy is important in a heterogeneous, multi-administration domain network consisting of different access technologies, backbone/access operators, the Internet, and diverse applications; an approach to performance that cannot be solved by a single communications service provider, and which will increasingly be in the hands of an overlay SEDAN, making decisions based on policy and the real-time and analyzed performance of different parts of a network.

Reliability

WAN connectivity diversity is a common concern for enterprises, as it can provide improved performance consistency when failures occur. Diversity can be achieved through use of multiple providers and/or multiple access/networking underlay technologies. Depending on corporate contracts, wireless can be a low-cost option for backup, also managed by a SEDAN. Some SEDAN solution providers are asserting they can deliver traffic over wireless connections with the same attributes as wireline connections.

As the dynamism of SEDANs increases, so does the need for visibility: degraded application performance, policy exceptions, a way to go back in time and see what and why something happened, and other analytics. Real-time and diagnostic historical visibility/analytics are increasingly important considerations for SEDANs.

Management Models

Different Enterprises will optimize around the management model that best suits their situation for delivery of Enterprise mission, including their own level of internal IT investment / expertise. Models that are emerging include self-management, shared/co-management, and provider/fully-managed.

Security

The efficacy of any IT resource is critical for Enterprise mission achievement. No less so for networks. As the Internet increases in usage as an Enterprise backbone, with split-out from remote / branch locations, security becomes an even more important issue. It is the direct connection to the Internet of branches / remote / satellite offices that is giving rise to an increased focus on security in SEDANs.

In addition, traditional approaches to site-to-site traffic have often led to a proliferation of VPN devices/firewalls. SEDAN solutions are attacking this problem with automatically provisioned IPSEC tunnels that provide the security fabric as well as greatly reducing the operational time/costs of adding new sites. Because all site-to-site traffic is encrypted, it may also mean less traffic has to pass through security devices.

SEDAN solutions have integrated security, for example firewalls, either in SEDAN devices, or as virtualized network functions in a cloud. This could lower the cost for an enterprise on specialized security devices. As security is both critical and highly specialized, some SEDAN solution providers may choose to partner with industry leaders for the overall security solution.

Another emerging aspect of SEDAN security is partnership between SEDAN solution vendors/providers and specialist cloud-based security providers. With these partnerships, traffic can be routed to the specialist cloud-based security provider to ensure needed security treatment. Some cloud-based security providers have tens to a hundred+ POPs around the world, in addition to being located in important data centers, providing good global coverage.

A complication arises in having a single security framework across SEDAN connections and other already deployed connections/security solutions. A security framework may include firewalls, VPNs, web filtering, sandboxing, network access control, next generation firewall (NGFW), and IPS. The security solution providers with broad portfolios are naturally highlighting this challenge, but it is something to be considered in any solution – how does the SEDAN security framework integrate with the existing security approach, and is the SEDAN solution provider working with the other security vendors an Enterprise is using, in addition to supporting the varying security controls in different security environments.

Business Model

Cloud service approaches, where value delivery / improvements are ongoing throughout the year, will shift business models from product / perpetual to service / subscription. While there are enterprises that will find the move from CAPEX to OPEX to be significant motivation to change from perpetual on-prem software licensing to subscription, we see the broader market trend towards a service offering, as opposed to a product offering – the business environment is dynamic, so the rate of change for offerings also has to be. An on-prem solution can still be a service offering, but the key is whether there is ongoing value delivery/improvement during the term of a subscription.

The discussion of business model is a nuanced and large topic area on its own, with discussion varying in scope from adding a few new SKUs to changing the end-to-end value chain of a company. We will write more on this important topic in the future, for now, please refer to:

- [Business model: a large range of meanings from SKUs to value.](#)
- [SW licensing in the age of cloud: measurement and reporting](#)
- [Networking Epochs from Mainframes to NaaS](#)
- [Open Source Software is not a Business Model – You have to create that](#)
- [Network as a Subscription – Opportunity to change the game](#)

Transition Considerations

The detailed/specific transition challenges may be somewhat unique to different enterprises, but some generic statements can be made. Considerations include which providers to use, sites to migrate, application response time, and whether to use physical or virtual appliances. A good practice for many will be to start with a small number of sites, a targeted network user base, measure performance before and after deployment, and assume some post-deployment tweaking will be required.

Enterprises have existing routers, security, and other networking solution equipment. Many will benefit from working with a knowledgeable/experienced channel partner to integrate the newer SEDAN solution with the existing equipment. In addition, using a managed service provider for the SEDAN solution will often be preferred, for example, to offload technology and bandwidth/network planning decisions.

If remote offices are not already using 4G/LTE services to branches, either as backup or primary*, transition to SEDAN may be a good opportunity to evaluate this option, especially with 5G being rolled out over the next few years. The industry has interest in whether 5G has the potential to replace wireline services for a number of use cases. Those sticking with wireline services will want to apply typical hygiene: are multiple providers giving you fiber diversity etc. The combination of SEDAN and Gigabit Ethernet may also be a compelling strategy for Enterprises, with both transitions occurring concurrently, if Gigabit Ethernet transition has not already occurred. The combination of wireline and wireless services also provides a diversity option.

There are some scenarios/solutions that allow for a mix of MPLS, fixed broadband, and wireless to be managed from a single SEDAN controller. This allows for the continuing use of MPLS for some traffic that

leverages the better “security” and real-time traffic characteristics of MPLS, where an Enterprise believes that value proposition / has that preference.

Futures

SEDAN, more specifically today’s SD-WAN solutions, vary in scope. The long-term aspiration is for end-to-end coverage of all aspects of security and application-aware networking, captured in this report in the concept coined as SEDANs. SEDANs will not just be about the WAN, with the aspiration including LAN. The term “SD-Branch” is already being used. Today there are gaps in end-to-end security, application-aware networking, and LAN. Whether data center will come together with WAN and LAN in a way that meets Enterprise needs, is a TBD, but there are a couple of suppliers that have a shot at pulling it off. How machine learning and artificial intelligence play out in this space could also determine which solutions thrive or not. Needless to say, most suppliers will claim some capability here. Perhaps one of the most interesting areas to watch is how intent, background analytics/ML, and real-time AI converge on a solution that is both what the Enterprise specifies, and at the same time optimized for that intent.

Conclusion

SEDAN, specifically in today’s context, SD-WAN, is one of the hottest conversations in networking, initially driven by economics, but over the long term, driven by a much better network experience for Enterprises. In this report, we coined the term “SEDAN” to emphasize a few key aspirations for Enterprise WAN networking, and, ultimately, for total Enterprise network experience: security, enterprise driven, application-aware networks.

*4G/LTE as a primary link may not always deliver the same characteristics as a wireline service. With a number of wireline substitution use cases being looked at for 5G, this may change. Some SD-WAN solution providers claim they can ensure broadband & 4G/LTE links perform as well as a private line.

Appendix

SEDAN checklist

- Compelling economic benefits vs other approaches
- Support for multiple access types: wireline broadband, wireless, Ethernet, MPLS and non-MPLS
- Application-aware identification and prioritization including partnership with multiple cloud providers to enable best performing paths to the cloud
- Support for Internet and automated provisioning of site-to-site VPNs
- Single security framework across all locations, including cloud destinations
- Consistent configuration / policies across all location
- Intent-based policy definition and enforcement
- WAN optimization
- SD-Branch (WAN and LAN)