Software-Defined and Intent-Based Networking

CMIT 495: Current Trends and Projects in Computer Networks and Security

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By:

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Executive Summary

By implementing virtualization along with software-defined and intent-based networking, our company will be able to lower the costs associated with hardware and upkeep of our network. Software-defined networking refers to a network architecture that uses applications and a central controller to control the data flow within the network. The central controller will act as a load balancer, reducing latency and improving efficiency, and provide control over security features by determining access control through workload or network types. Intent-based networking is often considered an extension of software-defined networking. An intent-based network uses artificial intelligence and machine learning to optimize network configurations and provide solutions to any issues that occur on a network. This optimization allows network administrators to tailor networks quickly for various business intents. During the upcoming refreshment of our network infrastructure, we must consider implementing these technologies instead of continuing to use an aging infrastructure and reliance on local hardware.

Introduction

Network technology is improving by the day, and as we begin to plan the refreshment of our infrastructure, we should consider implementing more advanced network architectures. In conjunction with virtualization, software-defined and intent-based networks will allow us to lower the hardware costs of replacing our desktops, decrease the upkeep required for the software and servers currently in use, and manage our network more efficiently. The following is a brief introduction to software-defined and intent-based networks and some of the benefits they will bring to our company.

Software-Defined Networking

Software-Defined Networking (SDN) is an approach to networking that focuses on using software-based controllers or application programming interfaces (APIs) to communicate with hardware, like routers, to control network traffic (IBM Cloud Education, 2021; VMWare, 2022). Traditional networks differ in that they rely on hardware, such as routers and switches to control network traffic (VMWare, 2022). Figure 1 shows how an example of how a traditional network differs from an SDN.

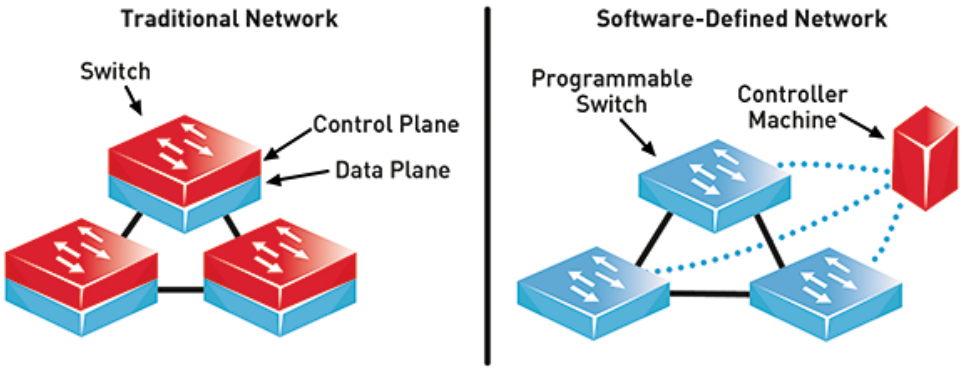

Figure 1: Difference between traditional and software-defined networks (Dungay, 2016)

There are three main components to SDNs: applications, controllers, and network devices (IBM Cloud Education, 2021; VMWare, 2022). Applications send requests for resource allocation or information about the network. Controllers are responsible for communicating with the applications to decide how to route data packets; controllers also act as load balancers for the network. The network devices then use the instructions obtained from the controllers to route data. These interactions can be seen in Figure 2.

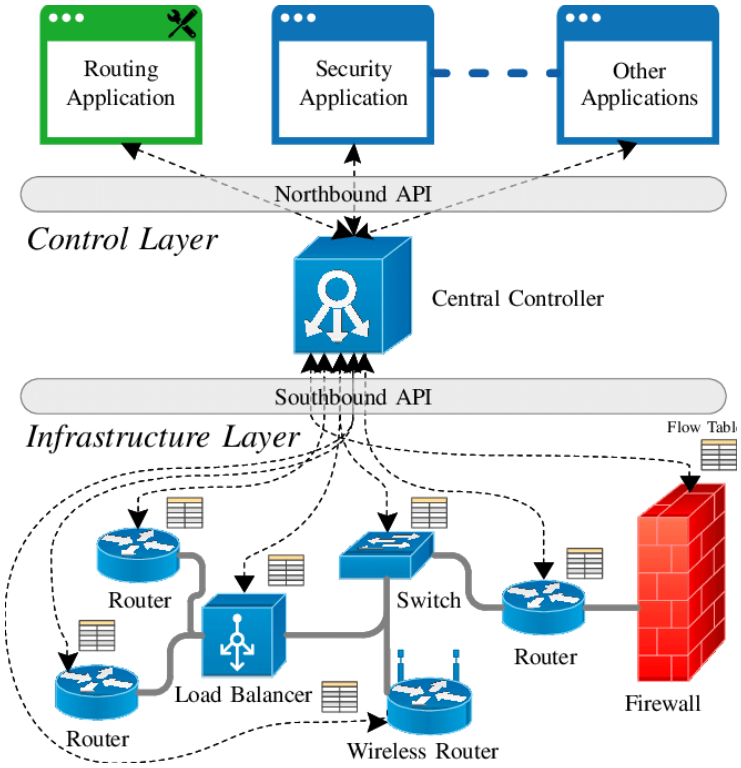

Figure 2: Basic SDN Architecture (Awad, 2017)

There are benefits of implementing an SDN, including load balancing when traffic fluctuates, which reduces latency and improves network efficiency. In addition, SDNs allow for more significant control over security by setting policies from a central location that can determine access control and other security measures based on workload or network type; and a simplified network design by using a controller instead of vendor-specific devices and protocols (IBM Cloud Education, 2021). However, by using an SDN and centralizing the controller, you create a single point of failure. This vulnerability can be remedied by creating a redundant controller with an automatic fail-over.

Intent-Based Networking

Intent-Based Networking (IBN) is a concept that aims to use artificial intelligence (AI) and machine learning (ML) to automate configuring networks and addressing any issues on the networks (Wigmore, 2019). This automation is intended to decrease the complexity of creating, managing, and enforcing network policies to make the network faster while reducing errors (VMWare, 2022).

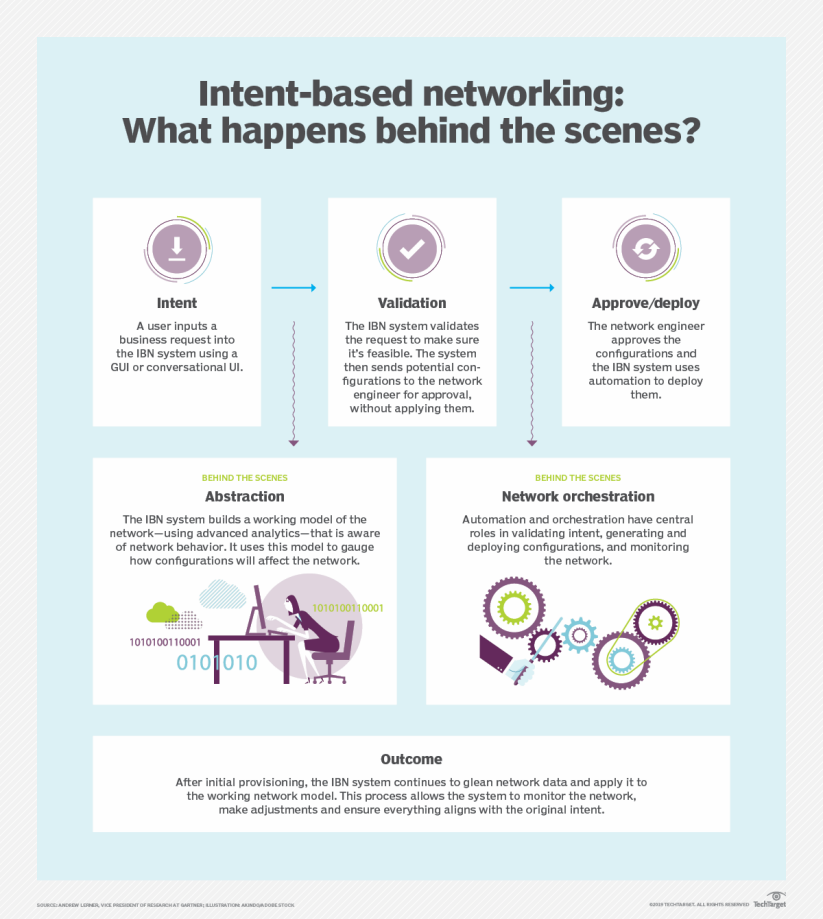

Figure 3: Intent-Based Networking process (Wigmore, 2019)

An IBN will usually incorporate four characteristics: translation and validation, automated implementation, state awareness, and dynamic optimization/remediation (Wigmore, 2019).

Translation and validation translate commands and business intent into actions while verifying that these actions' intent can be accomplished. After the AI understands the intent, it uses automated implementation to allocate resources and enforce applicable policies. As the AI conducts all of these changes, the system will constantly gather data and monitor the system's state (state awareness). The AI will then use ML to maintain the desired state of the network through automated corrections if necessary, which allows the AI to analyze, extract, and learn from gathered data dynamically.

How SDN and IBN Interact

SDNs and IBNs can be very similar. However, SDNs are focused on moving infrastructure from hardware to software and policies, while IBNs focus on taking that idea and using AI and ML to create predictability (Wigmore, 2019). SDNs allow network administrators to automate network configurations and quickly reconfigure a network for a specific task while providing an overview of the entire network. IBNs take the idea of SDNs further; IBNs allow network administrators to

tailor the network to a business intent instead of individual tasks (VMWare, 2022). An ideal implementation of an IBN would be to incorporate and build upon an existing SDN architecture.

Virtualization of the Desktop and Back-End Infrastructure

Virtualizing the desktop and back-end infrastructure will bring us many benefits. Desktops, once virtualized, will be centralized in a data center with resources pooled for efficiency (VMWare, 2022). We can even virtualize applications, like Microsoft Office, that are used on our computers. This process involves installing the software on a server and allowing our devices to use that software through virtualization (VMWare, 2022). This centralization means that updating or installing operating systems (OS) and applications can be done only once at the data center instead of pushing these updates to every device. Another benefit of virtualizing our desktops is that we can implement less powerful and less expensive devices since these devices will be used mainly for input and output (VMWare, 2022). In addition, with our computers undergoing refreshing soon, we will have more, less expensive, options to consider than the Dell Optiplex series. Finally, our employees will essentially be able to access their desktops from anywhere with an internet connection.

Virtualizing our back-end infrastructure will allow us to reduce upkeep on hardware and software. Similar to the desktops, virtualization will centralize all 30 of our Dell Poweredge servers and optimize resources for our Oracle Databases and other services. Our security suite will also become easier to manage. Firewalls, intrusion detection and prevention systems, and even the security software can be virtualized, further reducing upkeep. In addition to virtualization, using an SDN and IBN will further simplify network and security management.

Conclusion

As technology improves, software-defined and intent-based network architectures become more refined and cost-effective. When used in conjunction with virtualization, both architectures will cut hardware costs while allowing for efficient, centralized management of our network and security suite. As we begin to plan for the refreshment of our network infrastructure, we must consider implementing virtualization and software-defined and intent-based networking to reduce upkeep while increasing the effectiveness of our systems.

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