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Traditional IP-Based Segmentation vs. Application-Based Segmentation

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ABSTRACT

This comparative study on switching from a traditional IP-based network segmentation to an app-based dynamic segmentation has a strong emphasis on improving system security. To elucidate the benefits and drawbacks of each segmentation style, this article combines a review of the literature with an in-depth case study of Shahr Bank and Google. The main finding is that, although it is more difficult to design and maintain, application-based segmentation performs better in dynamic, contemporary network environments because it offers greater flexibility and data/information protection. Network administrators should be concerned about this abrupt change as it suggests a change in approach toward a better comprehension of network requirements for better segmentation.

INTRODUCTION

Segmenting the network into smaller, manageable parts that act individually is one of the most critical things in improving cybersecurity and overall network performance Chowdhury & Noll, 2010). Earlier, segmentation mainly used to be IP-based, as brought about by physical and logical divisions for traffic separation and control (Alimi &Mufutau, 2015)[1]. Last but not the least one, on the other hand, there comes cloud computing (Chica et al., 2020)[2] and virtualization rather than working on traditional L2 and L3 knowledge addition (Takamäki, 2018)[3] there is a clear change towards application-based segmentation.

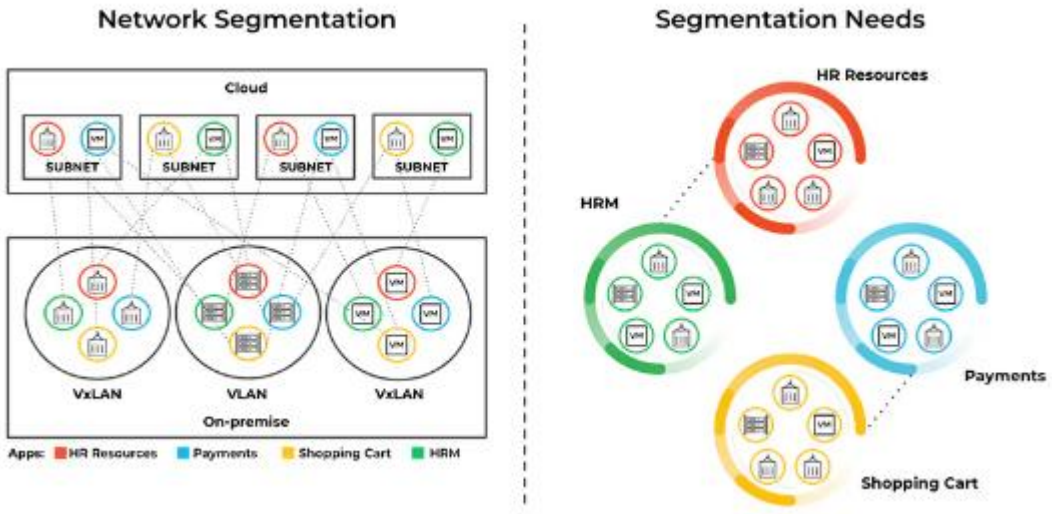

Figure: Network Segmentation (https://www.paloaltonetworks.com/cyberpedia/what-is-microsegmentation)

1. [1]Alimi, I. A., &Mufutau, A. O. (2015). Enhancement of network performance of an enterprises network with VLAN. American Journal of Mobile Systems, Applications and Services, 1(2), 82-93.

[2]Chica, J. C. C., Imbachi, J. C., & Vega, J. F. B. (2020). Security in SDN: A comprehensive survey. Journal of Network and Computer Applications, 159, 102595.

2. [3]Takamäki, M. (2018). Overlay Technologies and Microsegmentation in Data Centers.

This approach manifests the subtle nature of threat detection, and hence the issue is solved not only by the IP addresses but also by the application behavior (Gartner, 2016; Palo Alto Networks, n.d.)[4]. The paper will compare these segmentation techniques to examine how they affect network security, network's manageability, and suitability for else When network operational environments change. In this example, using the comparison we want to reach an understanding of changes in segmenting protocols and the effect it has on the future network design and security posture (Makeri et al., 2021)[5].

Method

The comparative analysis that was carried out was done through an approach that was systematic and involved a general literature review and an examination of case studies. By this methodology, a research result was obtained about application-based segmentation instead of IP-based network segmentation. The choice of key criteria to be analyzed was affected by several critical factors that had to do with effectiveness, scalability, and management issues. Through this criterion, selections were made which cover most aspects, including the advantages and drawbacks of each segmentation type.

Research

The research was built on data from different sources to get a credible outcome. These sources included scholarly journals, which provided theoretical and practical perspectives, industry reports, which provided insight into the practical handling of network security, and real-life case studies including the Shahr Bank case and Google. Target implementation in these case studies particularly helped as it showed vital applications and implications of each segmentation strategy in real-life situations. From these sources' findings, the distinctions and similarities that IP-based and application-based network segmentations could be drawn, whereby strengths and weaknesses would be described in different environments.

Results

A comparative analysis of different network segmentation techniques determines discrete benefits that characterize each technique. IP-based Segmentation which is a notable example from Shahr Bank where they use VLANs and ACLs resulted in convenient network organization and a virtually reduced number of data breaches (Alimi and Mufutau, 2015; Afaghie, 2021)[67]. The network had a hierarchical design where virtual local area networks (VLANs) were created where certain parts of the bank's network were segmented out based on the addresses of IPs, thus improving security through compartmentalization (Win et al., 2017)[8].

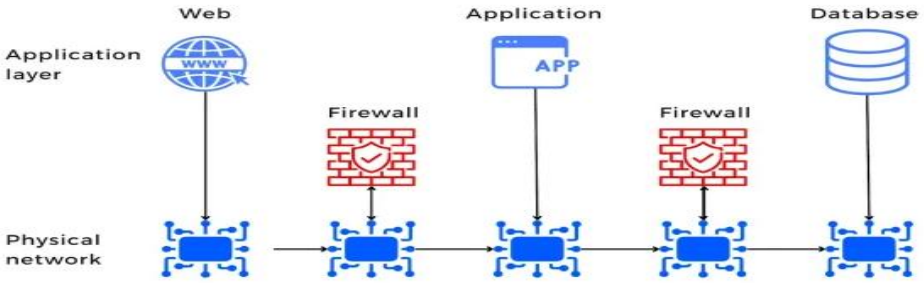

Figure: Traditional network segmentation (https://research.aimultiple.com/network-segmentation/)

3. [4]Palo Alto Networks. (n.d.). How to Segment Data Center Applications. Retrieved from https://docs.paloaltonetworks.com/best-practices/10-2/data-center-best-practices/data-center-best-practice-security-policy/create-a-data-center-segmentation-strategy/how-to-segment-data-center-applications

[5]Makeri, Y. A., Cirella, G. T., Galas, F. J., Jadah, H. M., & Adeniran, A. O. (2021).

4. [6]Alimi, I. A., &Mufutau, A. O. (2015). Enhancement of network performance of an enterprises network with VLAN. American Journal of Mobile Systems, Applications and Services, 1(2), 82-93.

5. [7]Aghaei, M. (2021). Market Segmentation in the Banking Industry Based on Customers' Expected Benefits: A Study of Shahr Bank. Iranian Journal of Management Studies, 14(3), 629-648.

6. [8]Win, M. T. Z., Maw, A. H., & Mya, K. T. (2017). Study on Segment Routing in Software Defined Networking (Doctoral dissertation, MERAL Portal).

Similarly, to the Application-Based Segmentation approach applied by Google, there were proven certain advantages of micro-segmentation and packet header inspection techniques (Fuad & Al-Yahya, 2021)[9]. This technique offered a more advanced and versatile way to secure networks by undertaking granular examinations of application-specific data traffic patterns, as well as the decomposition of workloads (Bahashwan, Anbar, & Abdullah, 2020)[10]. Google achieved a higher level of security, as a result, it focused on the behavior and identity of the applications as compared to the segregation of IPs. This approach was particularly successful in controlling the lateral movement of network traffic and only authorized network resources was granted access, significantly reducing the exposure to a potential network breach; hence, the risk of unauthorized access within the network (Takamäki, 2018), Wagner et al., 2016)[11][12] .

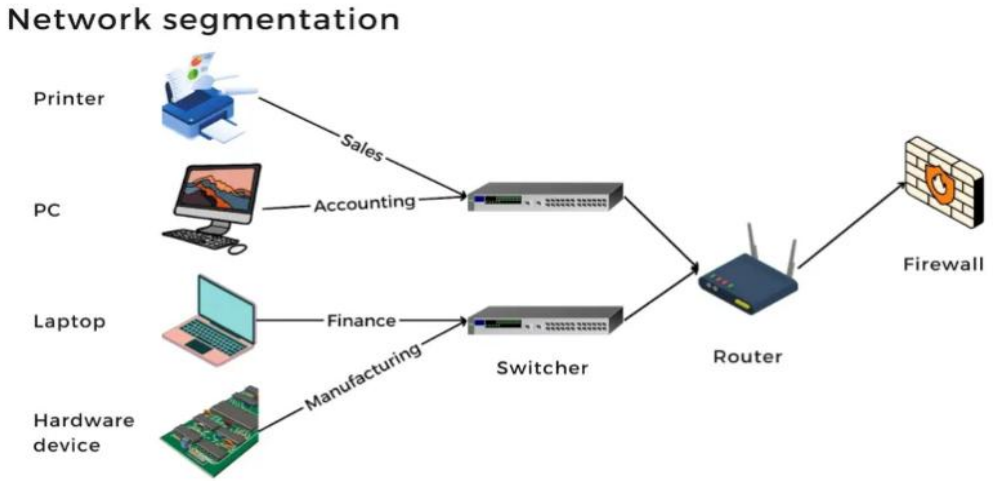

Figure: Network Based Segmentation (https://research.aimultiple.com/network-segmentation/)

DISCUSSION

The traditional versus application-based segmentation is either effective or not to assuage the current network security challenges, this is due to the ever-changing threat landscapes and the evolution of technologies. IP-Based segmentation, from the perspective of Shahr Bank, presents the initial security layer which is characterized by the structured approach to network division (Alimi &Mufutau, 2015)[13]. This initiative is the best mechanism for organizing networks and preventing some categories of breaches. Although this method proves effective for simple networks, it becomes limited when complexity and scale increase, building up on the issues of scalability and flexibility that are vital in cloud computing environments (Brosch et al., 2018)[14].

7. [9]Fuad, A., & Al-Yahya, M. (2021). Analysis and classification of mobile apps using topic modeling: A case study on Google Play Arabic apps. Complexity, 2021, 1-12.

8. [10]Bahashwan, A. A., Anbar, M., & Abdullah, N. (2020). New architecture design of cloud computing using software defined networking and network function virtualization technology. In Emerging Trends in Intelligent Computing and Informatics: Data Science, Intelligent Information Systems and Smart Computing 4 (pp. 705-713). Springer International Publishing.

9. [11]Takamäki, M. (2018). Overlay Technologies and Microsegmentation in Data Centers.

10. [12]Wagner, N., Şahin, C. Ş., Winterrose, M., Riordan, J., Pena, J., Hanson, D., & Streilein, W. W. (2016, December). Towards automated cyber decision support: A case study on network segmentation for security. In 2016 IEEE Symposium Series on Computational Intelligence (SSCI) (pp. 1-10). IEEE.

11. [13]Alimi, I. A., &Mufutau, A. O. (2015). Enhancement of network performance of an enterprises network with VLAN. American Journal of Mobile Systems, Applications and Services, 1(2), 82-93.

12. [14]Brosch, T., Peters, J., Groth, A., Stehle, T., & Weese, J. (2018). Deep learning-based boundary detection for model-based segmentation with application to MR prostate segmentation. In Medical Image Computing and

On the other side, Google's approach to application-specific segregation is more tightlyknit and dynamic, in line with the features of today's distributed systems, according to Fuad & Al-Yahya (2021). Through concentration to apply behavior and traffic patterns, this technique provides extra security parameters against the latest cyber threats (Chica, Imbachi, & Vega, 2020)[15], thus, allowing full control and monitoring of network resources. It should be mentioned that this advanced segmentation has some drawbacks, such as troubles with automation and continuous policy management, especially in the environment where there are many changes and updates made very often (Wagner et al., 2016; Hu et al., 2022)[1617] .

The examples of Shahr Bank and Google point to the more incorporated segmentation methodologies that focus on the complicated ecosystem of modern networks. Furthermore, there are pros and cons associated with each method; therefore, it is important to weigh every aspect in their context of use before any decision is made. The decision to go for just the traditional segmentation or the application-specific one should be based on the particular security features of the organizational network environment and its capacity to manage or adjust the segmentation solution as required.

CONCLUSION

This study demonstrates the gentle perks of old IP-based and network separation. Conventional segmentation is a valuable resource for securing not-so-sophisticated networks. Shahr Bank's advanced security is validated by the domain specific. However, the Google system which incorporates software segregation is superior in terms of detailed traffic analysis and personalized access controls in complex and dynamic environments. When it comes to the final selection of the best segmentation approach, the complexity of the network and security needs as well as the administration capabilities of the organization will be considered. (Palo Alto Networks, n.d.; Takamäki, 2018)[18]. As cyber threats exploit opportunities, being able to adapt with experience and intelligence in network segmentation becomes irreplaceable for vigilant network security (Smeriga&Jirsik, 2019)[19].

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