

REFERENCES

- [1] NIST, “Final Version of NIST Cloud Computing Definition Published,” National Institute of Standards and Technology, 25 October 2011. [Online]. Available: <https://www.nist.gov/news-events/news/2011/10/final-version-nist-cloud-computing-definition-published>. [Accessed 11 April 2021].
- [2] G. Novkovic, “Five characteristics of cloud computing,” Control Engineering, 11 August 2017. [Online]. Available: <https://www.controleng.com/articles/five-characteristics-of-cloud-computing/>. [Accessed 25 April 2021].
- [3] DWBIMASTER, “Deployment Models In Cloud Computing,” DW BI Master, 10 June 2018. [Online]. Available: <https://dwbimaster.com/deployment-models-in-cloud-computing>. [Accessed 24 April 2021].
- [4] S. Hossain, “Cloud Delivery Model (SaaS vs PaaS vs IaaS),” 16 October 2014. [Online]. Available: <https://learnwithshahriar.wordpress.com/2014/10/16/cloud-delivery-model-saas-vs-paas-vs-iaas/>. [Accessed 28 April 2021].
- [5] IBM Cloud Education, “Multicloud,” IBM Cloud Education, 5 September 2019. [Online]. Available: <https://www.ibm.com/cloud/learn/multicloud>. [Accessed 10 April 2021].
- [6] HashiCorp, “Unlocking the Cloud Operating Model,” HashiCorp, 2021. [Online]. Available: <https://www.hashicorp.com/cloud-operating-model>. [Accessed 10 April 2021].
- [7] Afolaranmi, O. Samuel, Ferrer, R. Borja, Lastra and L. M. Jose, “A Framework for Evaluating Security in Multi-Cloud Environments,” in *IECON 2018 - 44th Annual Conference of the IEEE Industrial Electronics Society*, 2018.
- [8] RedHat, “What is multicloud?,” RedHat, 2021. [Online]. Available: <https://www.redhat.com/en/topics/cloud-computing/what-is-multicloud>. [Accessed 10 April 2021].
- [9] M. Suh, S. H. Park, B. Lee and S. Yang, “Building firewall over the software-defined network controller,” in *16th International Conference on Advanced Communication Technology*, Pyeongchang, Korea (South), 2014.
- [10] J. Cropper, J. Ullrich, P. Fruhwirt and E. Weippl, “The Role and Security of Firewalls in IaaS Cloud Computing,” in *10th International Conference on Availability, Reliability and Security*, Vienna, Austria, 2015.
- [11] H. Sheng, L. Wei, C. Zhang and X. Zhang, “Privacy-Preserving Cloud-Based Firewall for IaaS-Based Enterprise,” in *International Conference on Networking and Network Applications*, Wuhan, China, 2016.
- [12] C. Diekmann, J. Michaelis, M. Haslbeck and G. Carle, “Verified iptables firewall analysis,” in *Proceedings of The IFIP Networking Conference*, Vienna, Austria, 2016.

- [13] S. Dowell, A. Barreto III, J. B. Michael and M.-T. Shing, "Cloud to Cloud Interoperability," in *6th International Conference on System of Systems Engineering, Albuquerque, New Mexico, USA, New Mexico, USA, 2011*.
- [14] R. Ranjan, "The Cloud Interoperability Challenge," *IEEE Cloud Computing*, vol. 1, no. 2, pp. 20 - 24, 2014.
- [15] B. D. Martino and A. Esposito, "Semantic Techniques for Multi-Cloud Applications Portability and Interoperability," in *Distributed to Complete Computing, CF2016, 18-20 October 2016, Madrid, Spain, 2016*.
- [16] F. Kordon, T. Meriem and M. Boufaïda, "An approach for developing an interoperability mechanism between cloud providers," *Int. J. Space-Based and Situated Computing*, vol. 4, no. 2, 2014.
- [17] B. D. Martino, G. Cretella and A. Esposito, "Advances in Applications Portability and Services Interoperability among Multiple Clouds," *IEEE Cloud Computing*, vol. 2, no. 2, pp. 22 - 28, 2015.
- [18] B. Parak and Z. Sustr, "Challenges in Achieving IaaS Cloud Interoperability across Multiple Cloud Management Frameworks," in *2014 IEEE/ACM 7th International Conference on Utility and Cloud Computing*, London, United Kingdom, 2014.
- [19] D. Petcu, C. Crăciun, M. Neagul, I. Lazcanotegui and M. Rak, "Building an Interoperability API for Sky Computing," in *2011 International Conference on High Performance Computing & Simulation*, Istanbul, Turkey, 2011.
- [20] A. Levin, K. Barabash, Y. Ben-Itzhak, S. Guenender and L. Schour, "Networking Architecture for Seamless Cloud Interoperability," in *2015 IEEE 8th International Conference on Cloud Computing*, New York City, NY, USA, 2015.
- [21] R. Pellegrini, P. Rottmann and G. Strieder, "Preventing vendor lock-ins via an interoperable multi-cloud deployment approach," in *The 12th International Conference for Internet Technology and Secured Transactions (ICITST-2017)*, Cambridge, United Kingdom, 2017.
- [22] N. Gray, C. Lorenz, A. Müssig, S. Gebert, T. Zinner and P. Tran-Gia, "A priori state synchronization for fast failover of stateful firewall VNFs," in *Proceedings of 2017 International Conference on Networked Systems (NetSys)*, United States, 2017.
- [23] X. Bao, L. Liu, N. Xiao, Y. Zhou and Q. Zhang, "Policy-driven Configuration Management for NoSQL," in *2015 IEEE 8th International Conference on Cloud Computing*, New York City, NY, USA, 2015.
- [24] B. Vanbrabant and W. Joosen, "Configuration management as a multi-cloud enabler," in *the 2nd International Workshop*, Chengdu, China, 2014.
- [25] S. Knittl and M. Brenner, "Towards a Configuration Management System for Hybrid Cloud Deployments," in *6th IFIP/IEEE International Workshop on Business Driven IT Management*, Vancouver, Bc, Canada, 2006.

- [26] Duplyakin, Dmitry, Haney, Matthew, Tufo and Henry, “Architecting a Persistent and Reliable Configuration Management System,” in *Proceedings of the 6th Workshop on Scientific Cloud Computing*, New York, United States, 2015.
- [27] J. Schroeter, P. Mucha, Marcel and M. Lochau, “Dynamic Configuration Management of Cloud-based Applications,” in *Proceedings of the 16th International Software Product Line Conference*, Beijing China, 2012.
- [28] J. S. De and A. K. Pal, “A Policy-based Security Framework for Storage and Computation on Enterprise Data in the Cloud,” in *2014 47th Hawaii International Conference on System Science*, Waikoloa, HI, USA, 2014.
- [29] Y. Matharu and T. Coulter, “Introduction to policy as code with automation,” Red Hat, 16 December 2022. [Online]. Available: <https://www.redhat.com/sysadmin/policy-as-code-automation>. [Accessed 01 February 2024].
- [30] The Linux Foundation, “Policy-based control for cloud native environments,” Cloud Native Computing Foundation, 2024. [Online]. Available: <https://www.openpolicyagent.org/>. [Accessed 12 June 2023].
- [31] Hashicorp, “Sentinel,” Hashi Corp, 2024. [Online]. Available: <https://www.hashicorp.com/sentinel>. [Accessed 02 11 2023].
- [32] The Linux Foundation, “Kyverno, Kubernetes Native Policy Management,” The Linux Foundation, 2024. [Online]. Available: <https://kyverno.io/>. [Accessed 10 November 2023].
- [33] C. Dimoulas, S. Moore, A. Askarov and S. Chong, “Declarative Policies for Capability Control,” in *2014 IEEE 27th Computer Security Foundations Symposium*, Vienna, Austria, 2014.
- [34] R. Echahed and F. Prost, “Security Policy in a Declarative Style,” in *PPDP '05: Proceedings of the 7th ACM SIGPLAN international conference on Principles and practice of declarative programming*, NY, United States, 2005.
- [35] G. Gebel, “Rethinking Policy Enforcement For Multicloud Environments,” Forbes, 22 February 2022. [Online]. Available: <https://www.forbes.com/sites/forbestechcouncil/2022/02/22/rethinking-policy-enforcement-for-multicloud-environments/?sh=b649a671450f>. [Accessed 02 September 2023].
- [36] A. Huang, “Cloud Multi-Account Policy Enforcement,” *GIAC (GSNA) Gold Certification.*, 2021.
- [37] OpenText, “What is Policy Orchestration?,” OpenText, 2023. [Online]. Available: <https://www.opentext.com/what-is/policy-orchestration>. [Accessed 09 October 2023].
- [38] C. Sheridan, P. Massonet and A. Phee, “Deployment-Time Multi-Cloud Application Security,” in *IEEE International Conference on Smart Computing (SMARTCOMP)*, Hong Kong, 2017.
- [39] O. Tomarchio, D. Calcaterra and G. D. Modica, “Cloud resource orchestration in the multi-cloud landscape: a systematic review of existing frameworks,” *Journal of Cloud Computing: Advances*,

Systems, vol. 9, p. 49, 2020.

- [40] P. Raj and A. Raman, "Automated Multi-cloud Operations and Container Orchestration," in *Software-Defined Cloud Centers, Computer Communications and Networks*, Noida, India, 2018, pp. 185-218.
- [41] J. Klein and D. Reynolds, "INFRASTRUCTURE AS CODE—FINAL REPORT," *IEEE Software*, vol. 40, no. 6, 2018.
- [42] T. Ijlal, "Securing and Embracing Infrastructure as Code," *ISACA Journal*, vol. 4, 2020.
- [43] L. Popa, M. Yu, S. Y. Ko, S. Ratnasamy and I. Stoica, "CloudPolice," in *Ninth ACM SIGCOMM Workshop on Hot Topics in Networks*, 2010.
- [44] W. P. de-Jesus, D. A. da-Silva, R. T. de-Sousa and F. V. L. da-Sousa, "Analysis of SDN Contributions for Cloud Computing Security," in *IEEE/ACM 7th International Conference on Utility and Cloud Computing*, London, UK, 2014.
- [45] J. Cropper, J. Ullrich, P. Fruhwirt and E. Weippl, "The Role and Security of Firewalls in IaaS Cloud Computing," in *10th International Conference on Availability, Reliability and Security*, 2015.
- [46] R. Li, D. Abendroth, X. Lin, Y. Guo, H.-W. Baek, E. Eide, R. Ricci and J. V. der-Merwe, "Potassium: penetration testing as a service," in *Proceedings of the Sixth ACM Symposium on Cloud Computing SoCC*, 2015.
- [47] G. Liyanage and S. Fernando, "Firewall model for cloud computing," in *IEEE 8th International Conference on Industrial and Information Systems*, 2013.
- [48] M. Moshref, M. Yu, A. Sharma and R. Govindan, "vCRIB: Virtualized Rule Management in the Cloud | USENIX," 2014. [Online]. Available: <https://www.usenix.org/conference/hotcloud12/workshopprogram/presentation/moshref>. [Accessed 10 March 2021].
- [49] H. Hu, G. J. Ahn and K. Kulkarni, "Detecting and Resolving Firewall Policy Anomalies," *IEEE Trans. Dependable Secur. Comput.*, vol. 9, no. 3, pp. 318-331, 2012.
- [50] F. B. Ftima, K. Karoui and H. B. Ghzela, "A secure mobile agents approach for anomalies detection on firewalls," in *10th International Conference on Information Integration and Webbased Applications & Services*, 2008.
- [51] H. Li, P. Liang, J. Yang and S. Chen, "Analysis on Cloud-Based Security Vulnerability Assessment," in *IEEE 7th International Conference on E-Business Engineering*, 2010.
- [52] X. He, T. Chomsiri, P. Nanda and Z. Tan, "Improving cloud network security using the Tree-Rule firewall," *Futur. Gener. Comput. Syst.*, vol. 30, pp. 116-126, 2014.
- [53] D. A. B. Fernandes, L. F. B. Soares, J. V. Gomes, M. M. Freire and P. M. Inácio, "Security issues in cloud environments: a survey," *Int. J. Inf. Secur.*, vol. 13, no. 2, pp. 113-170, 2013.

- [54] M. Wiebelitz, C. Brenner, C. Kunz and M. Smith, "Early defense," in *Proceedings of the 19th ACM International Symposium on High Performance Distributed Computing - HPDC*, 2010.
- [55] C. N. Modi, D. R. Patel, A. Patel and M. Rajarajan, "Integrating Signature Apriori based Network Intrusion Detection System (NIDS) in Cloud Computing," *Procedia Technol.*, vol. 6, pp. 905-912, 2012.
- [56] S. Yu, R. Doss, W. Zhou and S. Guo, "A general cloud firewall framework with dynamic resource allocation," in *IEEE International Conference on Communications (ICC)*, 2013.
- [57] F. Guenane, H. Boujezza, M. Nogueira and G. Pujolle, "An architecture to manage performance and reliability on hybrid cloud-based firewalling," in *IEEE Network Operations and Management Symposium (NOMS)*, 2014.
- [58] R. Harrison, "Reducing complexity in securing heterogeneous networks," *Netw. Secur.*, vol. 2015, no. 10, pp. 11-13, 2015.
- [59] H. Hu, W. Han, G. Ahn and Z. Zhao, "FLOWGUARD," in *Proceedings of the third workshop on Hot topics in software defined networking - HotSDN*, 2014.
- [60] R. Knights and E. Morris, "Move to intelligence-driven security," *Netw. Secur.*, vol. 2015, no. 8, pp. 15-18, 2015.
- [61] S. Cates, "The evolution of security intelligence," *Netw. Secur.*, vol. 2015, no. 3, pp. 8-10, 2015.
- [62] Y. Yang, H. Yu, Y. Che and Y. Kang, "Design of distributed firewall based on KeyNote in campus network," in *International Conference on Test and Measurement*, Hong Kong, China, 2009.
- [63] Y. Fei and Y. Bo, "The Research and Application of Firewall Based on Netfilter/Iptables Under Linux," *J.. Journal of Qiqihar University (Natural Science Edition)*, vol. 3, pp. 53-58, 2015.
- [64] Q.-X. Wu, "The Research and Application of Firewall based on Netfilter," *Physics Procedia*, vol. 25, pp. 1231-1235, 2012.
- [65] J. Gang, Y. Yan and T. Huaïou, "Firewall Establishment Based on Netfilter/Iptables in Linux Kernel," *J.. Computer Knowledge and Technology*, vol. 19, pp. 4550-4552, 2011.
- [66] A. Atrey, H. Moens, G. Van Seghbroeck, B. Volckaert and F. De Turck, "An overview of the OASIS TOSCA standard: Topology and Orchestration Specification for Cloud Applications," 2015/09/17.
- [67] A. Sampaio, T. Rolim, N. C. Mendonça and M. Cunha, "An Approach for Evaluating Cloud Application Topologies Based on TOSCA," in *2016 IEEE 9th International Conference on Cloud Computing (CLOUD)*, San Francisco, CA, USA, 2016.
- [68] R. Qasha, J. Cala and P. Watson, "Towards Automated Workflow Deployment in the Cloud Using TOSCA," in *2015 IEEE 8th International Conference on Cloud Computing*, New York, NY, USA, 2015.

- [69] Barracuda, “Barracuda CloudGen Firewall,” Barracuda, 2022. [Online]. Available: <https://www.barracuda.com/products/network-security/cloudgen-firewall>. [Accessed 19 06 2023].
- [70] Check Point, “Check Point CloudGuard,” CHECK POINT, 2019. [Online]. Available: https://sc1.checkpoint.com/documents/CloudGuard_Dome9/Documentation/Overview/CloudGuard-CSPM-Introduction.htm. [Accessed 24 06 2013].
- [71] Tufin, “Network security orchestration with Tufin Orchestration Suite,” Tufin, 11 2019. [Online]. Available: <https://www.tufin.com/tufin-orchestration-suite>. [Accessed 24 06 2023].
- [72] Cloud Custodian, “Cloud Custodian,” Capital oOne, 2000. [Online]. Available: <https://cloudcustodian.io/>. [Accessed 24 06 2023].
- [73] Palo Alto Network, “Panorama Firewall Management,” Palo Alto Network, 2020. [Online]. Available: <https://www.paloaltonetworks.com/network-security/panorama>. [Accessed 24 06 2023].
- [74] A. Brogi, A. Ibrahim, J. Soldani, J. Carrasco, J. Cubo, E. Pimentel and F. D’Andria, “SeaClouds: a European project on seamless management of multi-cloud applications,” *ACM SIGSOFT Software Engineering Notes*, vol. 39, 2014/02/11.
- [75] Hashicorp, “What is Infrastructure as Code with Terraform?,” Hashicorp, 2022. [Online]. Available: <https://developer.hashicorp.com/terraform/tutorials/aws-get-started/infrastructure-as-code>. [Accessed 30 May 2023].
- [76] Hashicorp, “CDK for Terraform,” Hashicorp, 2024. [Online]. Available: <https://developer.hashicorp.com/terraform/cdktf>. [Accessed 20 02 2024].
- [77] K. Kushala M V and D. B. S. Shylaja., “Recent Trends on Security Issues in Multi-Cloud:A Survey,” in *2020 International Conference on Smart Electronics and Communication (ICOSEC)*, Trichy, India, 2020.