

Multi-Cloud Automation with Ansible

*Automate, orchestrate, and
scale in a multi-cloud world*

Pankaj Sabharwal



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First published: 2024

Published by BPB Online

WeWork

119 Marylebone Road

London NW1 5PU

UK | UAE | INDIA | SINGAPORE

ISBN 978-93-55517-746

www.bpbonline.com

Dedicated to

My wife Dr. Geetika Sabharwal

My sons Ayaan and Anay

My beloved Parents:

Naresh Sabharwal

Reeta Sabharwal

About the Author

Pankaj Sabharwal stands as an embodiment of deep technological prowess and visionary leadership. With an illustrious tenure of over 11 years at IBM, Pankaj currently holds the esteemed position of Principal Solution Architect, primarily catering to the Financial and Federal sectors. His adeptness is best reflected in his monumental achievements, having modernized and migrated a staggering 200+ legacy applications to renowned cloud platforms, including AWS and IBM. His expertise is not confined to just cloud platforms; he's also reshaped numerous legacy systems, steering them towards a modern era encapsulated by containers and microservices.

Hailing from the historic city of New Delhi, India, Pankaj's academic pursuits led him across shores. He made his journey to the United States in 2006, where he earned his Master's in Computer Science from the **New Jersey Institute of Technology (NJIT)**. This was a progressive leap from his robust foundation in engineering, which he acquired from the esteemed Pune University in India.

In Pankaj, one sees not just an executive architect but a luminary, who seamlessly melds his rich heritage with a forward-looking, global perspective on technology's transformative powers.

About the Reviewers

- ❖ **Anil Murmu** is a solution architect with over a decade of IT enterprise expertise. Anil specializes in AI and Machine Learning, automation, and Infrastructure as Code (IaC), leveraging Python and Ansible to design, implement and automate independently operated multifaceted cloud-based (AWS, Azure, and GCP) solutions for clients across the globe. He loves exploring new technologies and helps enable people through appropriate knowledge bases to match and support IT requirements.

He is currently working in HCL Technologies Ltd. and is part of the Automation Implementation program, encouraging clients from all over the globe to build, implement, adopt and adapt AI and ML enriched independently operated automation systems within their environment.

- ❖ **Amit Bhanushali** is a highly accomplished software quality assurance professional with over 22 years of experience in the IT industry. He earned his Master's in Business Data Analytics from West Virginia University in 2017. Based in West Virginia, USA, Mr. Bhanushali is a Senior IEEE Member and has significantly contributed to software testing research and practice.

His expertise spans automation testing, performance testing, DevOps, and CI/CD implementation. He has also led testing efforts in complex cloud environments. In addition to testing, Mr. Bhanushali has authored several articles exploring cutting-edge topics like artificial intelligence and machine learning. His published research demonstrates his thought leadership and impact on software quality engineering.

Mr. Bhanushali's accomplishments have been recognized through prestigious appointments. He serves as a technical reviewer for the Elsevier journal, Books, and has served as a judge for hackathons and the Globee Awards. His contributions were further honored in 2023 when he received the International Achievers' Award. With his sustained record of excellence in software development, testing, and research, Mr. Bhanushali continues to be an influential leader in his field.

Acknowledgement

First and foremost, I want to express my profound gratitude to my parents, Naresh and Reeta Sabharwal. A special mention goes to my mother, whose constant prayers and relentless support have been my guiding light. Every word in this book is a testament to the values and strength she instilled in me.

To my wife, Dr. Geetika Sabharwal, who, amidst her bustling schedule, has been my pillar of strength. Her encouragement, faith, and belief in me have made this journey smoother. Even when her plate was already overflowing, she gave me the space and time I needed to immerse myself in this project, a sacrifice I deeply appreciate.

My sons, Ayaan and Anay, have been the heartbeats behind this book. Their innocent inquiries about the book's progress, their unending love, and their cheerful encouragement gave me the motivation to push through even the most challenging phases of writing. Their excitement has been infectious and rejuvenating.

I also wish to extend my heartfelt gratitude to BPB Publications. The professionalism, patience, and support provided by BPB have been instrumental in bringing this book to fruition. Collaborating with BPB has truly been a rewarding experience.

To all mentioned above and many others who have been part of this journey, either directly or indirectly, I thank you. Every page of this book is imbued with the positive energies you have all shared with me.

Preface

In the dynamic landscape of IT, the need to ensure scalability, repeatability, and consistency across infrastructures has driven the surge in automation tools. Ansible, with its declarative nature and agent-less architecture, emerges as a favorite. This book, structured meticulously over eleven chapters, offers an in-depth dive into leveraging Ansible for modern IT needs.

The book commences by grounding the reader in Ansible's core principles, laying a foundation upon which more intricate subjects are built. Our exploration is not restricted to a single environment; instead, we delve into Ansible's prowess in a multi-cloud world. Be it AWS's expansive service offerings, GCP's data analytics capabilities, or Azure's enterprise solutions, Ansible seamlessly weaves these platforms together, ensuring interoperability without compromising on security or efficiency.

Infrastructure automation is at the heart of Ansible. Through dedicated chapters, we dissect how Ansible interacts with servers, network devices, and even storage solutions. This ensures that from the physical layer up to the virtual, everything remains orchestrated and in harmony.

However, Ansible's magic is not just confined to infrastructures. We expand our horizon into application and platform automation, allowing developers and operations teams alike to ensure that applications are consistently deployed, scaled, and managed. In synergy with platforms like OpenShift and Kubernetes, Ansible takes container orchestration to new heights, ensuring microservices and applications run smoothly, irrespective of the underlying complexities.

As computing transcends beyond centralized data centers, our discussion ventures into the realm of Edge computing. Here, we unearth how Ansible, with its lightweight footprint, becomes invaluable in managing and automating tasks closer to data sources, be it IoT devices or regional servers.

For organizations striving for centralized control, role-based access, and a visual dashboard, our chapters on Ansible Tower illuminate its pivotal role in enterprise-scale automation. From job scheduling to real-time job status monitoring, Tower's capabilities are dissected and illustrated.

In the later sections, the book takes a futuristic turn. We delve into the realm of AI and Machine Learning, exploring Ansible's potential role in managing AI infrastructures, orchestrating ML workflows, and even its interplay in generating AI. As machine learning

models and AI applications become mainstream, ensuring their consistent deployment and scalability becomes paramount – a challenge Ansible is poised to address.

This book is not just theoretical; it is a blend of concepts, hands-on examples, and real-world use cases. It is crafted for both the novice trying to understand automation's basics and the expert aiming to push Ansible's boundaries.

To every reader picking up this book, you are about to embark on a journey that intertwines automation, cloud, containers, edge computing, and the frontier of AI. It is a journey I'm excited to guide you through. Let us begin.

Chapter 1: Ansible in Multi-Cloud Environment – This chapter navigates the challenges of a multi-cloud landscape, showcasing Ansible's strengths in addressing manual deployments, environment inconsistencies, and other complexities. We will delve into the myriad benefits that Red Hat Ansible offers, from increased operational efficiency to its cloud-agnostic capabilities, emphasizing its transformative role in the future of cloud automation.

Chapter 2: Ansible Setup Across OS and Cloud – This chapter takes a hands-on approach, guiding readers through the installation of Ansible across diverse environments—from major cloud platforms like AWS, Google Cloud, and Azure to diverse operating systems such as MacOS and Windows. Whether you are setting up on a VM, a Docker container, or a desktop, this chapter ensures you are adeptly equipped to get Ansible up and running seamlessly.

Chapter 3: Writing Tasks, Plays, and Playbooks – This chapter delves deep into the foundational elements of Ansible. From understanding basic concepts such as control nodes, managed nodes, and inventories to crafting intricate playbooks and plays, we elucidate the importance of each component. We explore the organization and configuration of playbooks, the dynamism of Ansible's inventories, and offer hands-on guidance with a real-life example—crafting a playbook to deploy an NGINX server. By the chapter's end, readers will have a robust grasp of Ansible's structure and operational anatomy.

Chapter 4: Infrastructure Automation Using Red Hat Ansible – In this chapter, we embark on a journey of infrastructure automation using Ansible across the three major cloud giants: AWS, GCP, and Azure. We will showcase the power and adaptability of Ansible as we automate infrastructure provisioning and management, demonstrating its capabilities in diverse cloud ecosystems and ensuring readers are well-prepared to harness Ansible's full potential, regardless of their cloud platform of choice.

Chapter 5: Network Automation Using Ansible – This chapter delves into the world of network automation with Ansible. From gathering critical network data and viewing system configurations to ensuring the safety of your settings through backups, we will guide you step by step. We also touch upon specific configuration tasks, such as setting host names and adjusting system settings, underscoring Ansible’s prowess in streamlining and bolstering network management tasks..

Chapter 6: App Automation Using Ansible – Chapter six zooms in on Ansible’s capabilities in the realm of application automation. We take a practical approach, walking you through the deployment processes on major platforms: from AWS, GCP, and Azure to the container-centric world of RedHat OpenShift. By the end, you will appreciate the versatility and power of Ansible in seamlessly deploying and managing applications across diverse infrastructures, culminating in a comprehensive conclusion that ties together the chapter’s key insights.

Chapter 7: Security Automation Using Red Hat Ansible – In this pivotal chapter, we delve deep into the realm of security automation with Ansible, emphasizing its transformative impact on security operations. Ansible offers unparalleled efficiency, allowing swift implementation of security protocols across diverse cloud environments. The chapter illustrates its prowess in crucial security tasks—from patch management to intrusion detection. We also spotlight how Ansible fosters synergies with leading security tools, including CyberArk and QRadar. In essence, Ansible not only streamlines but elevates security automation, arming organizations against evolving threats with agility and finesse.

Chapter 8: Red Hat Ansible Automation for Edge Computing – This chapter spotlights Ansible’s role in the emerging domain of Edge Computing. We begin by exploring the broader spectrum of enterprise automation, segueing into the potent capabilities of the Ansible Automation Platform and the revolutionary concept of the Automation Mesh. The heart of the chapter showcases diverse industry use cases, highlighting Ansible’s transformative impact in sectors like transportation, retail, telecommunications, and health care, among others. By the chapter’s end, readers will have a panoramic view of Ansible’s expansive reach and relevance in the dynamic world of Edge Computing.

Chapter 9: Red Hat Ansible for Kubernetes and OpenShift Clusters – Chapter nine delves into the synergistic relationship between Ansible and the container orchestration giants, Kubernetes and OpenShift. From utilizing Ansible for Kubernetes Operators to exploring its dedicated modules for the platform, the chapter showcases the efficiency of deploying Kubernetes objects using Ansible. Furthermore, it details the intricacies of

managing Kubernetes/OpenShift clusters, emphasizing Day2Ops operations. The chapter culminates with a deep dive into deploying a DevSecOps pipeline, epitomizing the combined power of Ansible, Kubernetes, and OpenShift in today's cloud-native landscape.

Chapter 10: Using Ansible Automation Platform in Multi-Cloud – In this chapter, we venture into the multifaceted world of the Ansible Automation Platform, especially in multi-cloud environments. We commence by breaking down the core components of AAP, with a deep dive into the Automation Controller and its architecture. The journey continues with a hands-on guide to installing AAP via the OpenShift Operator on an OpenShift 4 cluster. The integration of AAP with essential tools such as GIT repositories and **Red Hat Advance Cluster Management (RHACM)** is explored, setting the stage for real-world use cases. Highlighting GitOps implementation and efficient policy management, the chapter reveals the holistic power and potential of AAP in a multi-cloud landscape.

Chapter 11: Red Hat Ansible for Deep Learning – This chapter illuminates Ansible's pivotal role in the realm of deep learning. Deep learning frameworks, such as TensorFlow, PyTorch, and Keras, come with intricate software dependencies, making them daunting to set up manually. Enter Ansible: a solution to automate these configurations seamlessly. Readers will grasp how Ansible's playbooks, with their modular and customizable nature, simplify and expedite the setup of deep learning environments. We further emphasize Ansible's strength in fostering reproducibility across different machines, a critical factor in large-scale research and collaborative ventures. In essence, Ansible emerges not just as a tool but as a game-changer, empowering deep learning enthusiasts to channel their efforts into model development and research without the overhead of setup hassles.

Code Bundle and Coloured Images

Please follow the link to download the *Code Bundle* and the *Coloured Images* of the book:

<https://rebrand.ly/255a8c>

The code bundle for the book is also hosted on GitHub at

<https://github.com/bpbpublications/Multi-Cloud-Automation-with-Ansible>

In case there's an update to the code, it will be updated on the existing GitHub repository.

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CHAPTER 1

Ansible in Multi-Cloud Environment

Introduction

In the fast-paced realm of today's IT world, the landscape has shifted dramatically towards a multi-cloud approach. Organizations are no longer tethered to a single cloud provider. Instead, they operate enterprise applications across multiple cloud environments to leverage the unique benefits each one offers, be it cost-effectiveness, advanced features, or regional availability.

Modern-day mission-critical enterprise applications have truly transformed how businesses operate. These applications are characterized by their complexity, distributed nature, and scalability. Such qualities make them powerful tools, capable of driving efficiency and innovation. Yet, with great power comes an inherent set of challenges. Their intricate architecture and wide distribution can often make them challenging to manage and maintain.

These challenges manifest in various ways. For instance, when setting up a network across different clouds, one must consider the nuances and specific protocols of each provider. Security policies, which are paramount in ensuring the safety of data and applications, might differ vastly from one cloud environment to another, necessitating careful crafting and regular updates. Furthermore, managing compute engines across different cloud platforms requires a deep understanding of each environment's strengths and limitations. Moreover, when issues arise, the clock starts ticking. The ability to swiftly detect and

rectify problems becomes a crucial competency, as prolonged downtimes or data breaches can have dire consequences for businesses.

This is where Ansible steps in as the hero of the story. Ansible is not just a tool; it is a solution designed to address the multifaceted challenges posed by a multi-cloud ecosystem. With its automation capabilities, Ansible streamlines processes, ensuring that networks are set up efficiently, security policies are uniformly applied, and compute engines are optimally managed. Most importantly, when issues emerge, Ansible facilitates rapid detection and rectification, minimizing potential damages.

As we delve deeper into this chapter, we will unravel how Ansible seamlessly integrates into the multi-cloud paradigm, acting as a linchpin that holds together the diverse and dynamic components of modern enterprise applications. Through real-world examples and expert insights, readers will gain a profound understanding of Ansible's pivotal role in navigating the challenges and opportunities of the multi-cloud era.

Structure

In this chapter, we will go through the following topics:

- Challenges in multi-cloud
 - Manual and error-prone deployments
 - Complex deployments
 - Environment inconsistencies
- Business value Red Hat Ansible brings
 - Faster business agility
 - Increased efficiency of IT operations
 - Same technology across the board
 - Simple and agentless
 - Step by step reporting
 - Cloud agnostic
- Why Red Hat Ansible is the future for cloud automation
 - Provisioning
 - Configuration management
 - Application deployment
 - Continuous delivery
 - Security automation
 - Cloud automation
 - Orchestration
 - End point protection

Objectives

In this chapter, we aim to delve deep into the multi-faceted challenges of a multi-cloud environment, such as the hurdles posed by manual and error-prone deployments, the intricacies of handling complex deployments, and grappling with environmental inconsistencies. As we navigate these challenges, we will also uncover the substantial business value that Red Hat Ansible brings to the table. Through our exploration, readers will gain insights into how Ansible fosters faster business agility, amplifies the efficiency of IT operations, and offers the consistency of a single technology across diverse platforms. Its simplicity, combined with an agentless architecture, detailed step-by-step reporting, and cloud-agnostic features, truly accentuates its significance in the IT landscape. Finally, we will extrapolate why Ansible is not just a current solution but the future of cloud automation. We will touch upon its prowess in provisioning, configuration management, application deployment, and continuous delivery. Additionally, we will highlight its capabilities in ensuring security, orchestrating cloud processes, and safeguarding endpoint protection. By the end of this chapter, readers will be well-equipped with a comprehensive understanding of Ansible's role in shaping the future of multi-cloud operations.

Challenges in multi-cloud

Let us discuss the common problems that exist in managing enterprise applications in multi-cloud.

Manual and error-prone deployments

Deployments are done manually every other month and if everything goes as planned, it can take about eight hours to complete:

- Deployments are done by multiple global teams who follow the written instructions in cookbooks to perform different tasks.
- Different parts and bits of deployments are managed by different people based on his/her area of expertise using his/her custom scripts.
- Each deployment exercise is unique and brings its own complexity and challenges.

Complex deployments

As mentioned above, each deployment is unique. Some deployments become complex as you are required to follow a particular sequence in order to make deployment successful. A common example is database change, where you need to shut down the application before making a database update and before all that, you need to deploy a front-page, informing users that the site is under maintenance:

- If you deploy the database to change without shutting down the application, then the deployment will fail.

- Human interaction is also another factor which makes some deployments more complex. In some deployments, human interaction is required due to the lack of the right automation tools.
- Traditional manual script-based deployments procedures are not able to cope with applications like microservices, which are more distributed and scalable.

Environment inconsistencies

It is very rare that you will find an organization where non-prod environments are running with exact hardware and network configurations as prod environments. Normally, they will be in different network zones or will have different compute power assigned to them. In some cases, you will find inconsistencies in software as well due to reasons like different versions of software running or the way software was deployed and configured on each environment. These inconsistencies will create issues in prod, which can potentially lead to significant expenses and discomfort.

Business values Red Hat Ansible brings

Ansible can be the core of the solution you will build to solve all the problems described above in multi-cloud architecture and it is very human readable.

Faster business agility

There are a lot of tedious, manual and repeatable tasks which can be automated using Ansible, hence improving the productivity of teams. This way, businesses are able to meet and exceed their goals.

Increased efficiency of IT operations

Deployments and operational tasks which used to take multiple days to complete can be done in minutes with much higher success rates and less downtime. Since the same Ansible code can be used in all environments without change, it brings a lot more consistency between non-prod and prod environments and fewer errors.

Same technology across the board

Ansible can be used in deploying infrastructure, platform, and software. This means, you do not need a different software or need to learn new skills to manage each domain. Hence, with Ansible, you can install cloud infrastructure like **VPCs** and **EC2** on **AWS** and deploy any platform like **OpenShift** or **Kubernetes** and in the same fashion you can deploy any software like **Apache** or **Nginx** or even a database like **Oracle** or **Db2**.

Simple and agentless

Ansible is very human-readable, you do not need to have prior skills to learn Ansible. There is no special agent that needs to be deployed on each node, but Ansible just uses simple **OpenSSH** and **WinRM** to access the target node and deploy changes.

Step-by-step reporting

Ansible encourages administrator to name every step in their script, which helps in determining what each task is doing. It makes troubleshooting easier if any step fails, so administrator have a pinpoint view of where to look to fix the issue.

Cloud agnostic

Mostly, the same Ansible code can be used on any cloud provider of your choice. There are cloud-specific modules in Ansible for sure, but there is a very thin abstraction layer. Switching from one cloud provider to another can be done with very minimum effort.

Ansible is the future for cloud automation

When we talk about cloud automation, there are multiple use cases we are talking about. We are talking cloud provisioning, platform provisioning and management, configuration management, security and compliance management and much more. We are living in an age of microservices and cloud-native, where automation is not good to have but is a basic necessity. Ansible is a tool which can automate anything, as we have mentioned before.

In a traditional non-cloud environment, infrastructure provisioning is a separate exercise for configuration management. There is a dedicated team who owns infrastructure provisioning. But with Ansible, you can automate infrastructure provisioning too and since Ansible can be used for configuration management exercises, day one and day two operations can be performed in a more simplified way using a common tool.

The following are some common cloud-related use cases that Ansible can support easily and make the process much more efficient.

Provisioning

Whether you are on traditional bare metal hardware or modern serverless or function as a service model, you need the underlying infrastructure and hence, it is the first step if you want to automate your application's operational life cycle. Ansible can be used to provision infrastructure on any cloud service provider, hypervisors, network devices and bare metals. Provisioning infrastructure can be easily followed by the next steps, which can be configuration management, or even setting up a new modern platform layer like Kubernetes or OpenShift Container Platform if you plan to run containerized workloads.