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A Functional View of Hybrid-Cloud Environment – Use Cases and Best Practices

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Abstract Hybrid-Cloud Environment is a promising area of research, considering the greater flexibility and agility that it provides to businesses for moving their workloads and applications onto the cloud environment, as business requirements and budgets fluctuate. Governments, nonprofits, educational institutions, Product and Service Oriented Companies are all leveraging a hybrid-cloud deployment model to modernize their Information Technology (IT) platform, improve service availability, expand IT capacity, build highly reliable, resilient fault tolerant applications, systems and infrastructure on cloud and innovate faster. This paper discusses best practices on how organizations can seamlessly integrate their on-premises infrastructure with cloud native solutions from various cloud vendors for extending and optimizing their hybrid-cloud environments. In response to the complexities involved in the hybrid-cloud deployment, the work in this paper also discusses some of the popular use cases and how organizations can leverage cloud analytics, artificial intelligence tools and scalability of the cloud whilst also maintaining greater control and operational flexibility over their data for compliance purposes.

Keywords Hybrid Cloud, Deployment, Integration, On-Premises, Native Cloud, Artificial Intelligence, Architecture, Data, Modern Data Platform, Data Lake, Data Warehouse, Applications, Legacy Systems, Infrastructure, Resilient, Reliable, Operationally Excellent, Performance Efficient, High Availability, Fault Tolerance, Scalable, Environments, Infrastructure, Systems, Applications AWS, Azure, Google, VMware, IBM, API, WAN, LAN

1. Introduction

The hybrid-cloud platform refers to a cloud environment which is a combination of on-premises or private cloud resources integrated with third-party public cloud resources that use orchestration between them [1]. It is simply a coalescence of on-premises private cloud (private cloud can be on-premises as shown in Fig. 1 or a dedicated off-premises facility as shown in Fig. 2) resources combined with third-party public cloud resources that use automated configuration management software to manage the workflow and co-ordination between them. Many organizations, either as part of their digital transformation initiatives or with the vision of modernizing their existing legacy infrastructure and applications embrace the ever changing and evolving cloud capabilities to transform their existing IT landscape. For some of their use cases a hybrid cloud approach becomes more feasible path to IT modernization and cloud adoption. For instance, some organizations have applications that require the lowest network latency possible, or they are already achieving the required consistency and predictability in their performance in a on-premise setup, but want to encapsulate on the new cloud tools to improve their application's overall availability and make it more fault tolerant and reliable. Some organizations may be facing unique challenges like federal and regulatory compliance requirements associated with data residency or restrictions on their use of the cloud. One of the greatest benefits of hybrid-cloud deployment model is that it allows workloads and data to move between private and public clouds in a flexible way as demands, needs and costs change, offering businesses greater flexibility and more options for data deployment and use. Hybrid-Cloud solutions maximizes the value delivered across all IT environments, by offering a common tool set to manage the resources deployed in both the environments, ensuring seamless communications between environments, and leveraging the innovative managed or native cloud services that enhance and modernize legacy on-premises systems. A hybrid-cloud (the use of both on-premises and cloud resources), allows Information Technology (IT) organizations to optimize the performance and costs of every application, project and system in either the cloud, on-premises datacenters, or a combination of both [2]. In other words, if companies already have some IT resources that they are replicating, supplementing or augmenting with an external third-party cloud service provider or vendor then they are dealing with a

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hybrid-cloud environment. This paper gives an overview of the various motivating factors which are the drivers for organizations to move towards the path of hybrid-cloud adoption strategy, the popular hybrid-cloud use cases, and hybrid-cloud best practices. This paper also highlights the benefits of a hybrid-cloud deployment model and gives an understanding to the readers as how this deployment model can be used to optimize current or future state/planned hybrid architectures.

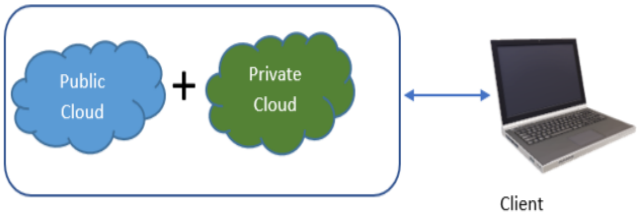

Figure 1. A Hybrid-Cloud Deployment Model showing combination of on-premises infrastructure with public cloud

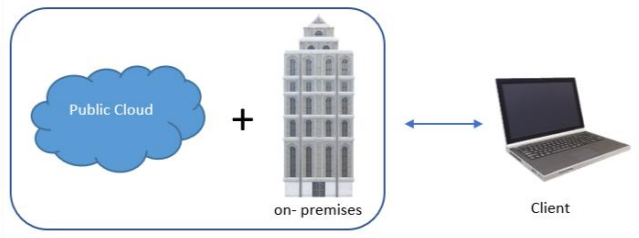

Figure 2. A Hybrid-Cloud Deployment Model showing combination of public cloud with private cloud

2. Hybrid-Cloud Solutions Provided by Cloud Vendors

The hybrid-cloud solutions offered by different cloud service providers maximize the value delivered across all IT environments, by offering a common toolset to manage both the environments, enabling seamless communications between them, that enhance and modernize legacy on-premise systems. There are various cloud service providers but the top five that are driving the market currently are Amazon Web Services (AWS) – AWS Outposts, Microsoft Azure, Google's Google Cloud Platform (GCP), Rackspace's RackConnect and IBM's Bluemix [4]. The hybrid-cloud approach provided by these vendors are ideal for organizations that want the latest cloud analytics, machine learning [5], artificial intelligence tools and need the scalability of the cloud infrastructure. It is also ideal for organizations that demand greater operational flexibility. Data that needs to stay on-premises because of compliance and regulatory requirement reasons can remain in the data center, while the application development, testing, deployment, high performance computing and scalable capacity can take place in the cloud.

Also, Intelligent data is a pivotal force enabling businesses to create a unique competitive advantage for themselves and to discover new revenue streams. When leaders and management are presented with useful information and key actionable data insights, it can help them take some game changing business decisions. The availability of this vast scalable data is possible by connecting on-premises, cloud environments and hybrid-cloud platforms across business units and silos. The inherent characteristic of public clouds is that because of their numerous data centers spread worldwide it gives organizations the ability to scale quickly without having to think about and account for provisioning of the resources upfront which otherwise the companies would have had to account for in an on-premise infrastructure expansion. The three main motivational factors that have driven organization's decisions to adopt a hybrid-cloud strategy are scalability, performance and better/faster access to resources. Hybrid-cloud solutions help companies accelerate their data-driven digital transformation initiatives like ingesting of new IoT data generated from tablet devices, mobile devices, Artificial Intelligence (AI) powered chatbots to answer simple customer questions and direct them to the correct resources, AI enabled marketing techniques for targeted pricing and promotion strategies [5] and product/service industry transformations for providing greater agility and self-servicing capabilities to the customers and employees [5].

3. Connectivity Between On-Premise and Hybrid-Cloud

For a hybrid-cloud environment, the network connections between various components of on-premise/private and public clouds is very important to ensure seamless integration and flow of information between them. If these components are not connected, then an organization is not running a truly hybrid-cloud infrastructure, but they would be running several cloud silos in tandem. There are several methods by means of which we can connect public clouds, private clouds and on-premises infrastructure.

3.1. VPN

A VPN or a virtual private network enables secure, encrypted connections over the internet or public Wi-Fi. With VPN, clouds and on-premise infrastructure can connect safely over the public internet [3]. Other than the most common benefits that VPN can offer which is privacy and security, VPN's can hide your private information behind an encrypted network connection, escape/avoid data and bandwidth throttling and reduce support costs for you. While the benefits outweigh the cons exhibited by VPN's, since VPN's reroutes and encrypts your internet connection, which makes it to compete with other internet connections out there, thus reducing the speed slightly.

3.2. WAN

Wide Area Network connects computers over a distance

as opposed to a local area network (LAN) that connects computers locally [3]. A WAN is a network that uses various links - private lines, virtual private networks (VPNs), wireless (cellular), the Internet - to connect smaller metropolitan and campus networks in diverse locations into a single, distributed network[6]. At least a part of WAN relies on the physical connections provided by telecommunications carriers.

3.3. API's

Application program Interface (API's) are an important component for making the hybrid-cloud work, by connecting databases, platforms, applications, systems and so on. API calls are sent from cloud to on-premise as HTTP requests and they can be sent via VPN, or a private direct connect link (offered by some cloud service providers like AWS).

4. Hybrid-Cloud Drivers: New Paradigms Powering the Shift and Their Short Comings

Many organizations and businesses migrate to cloud or adopt a hybrid-cloud deployment model to help them take advantage of generational market disruption driven by data. Below we will discuss few of the high-level most common cloud drivers:

4.1. Increased Data Sources and Growing Data Volumes

As businesses expand and grow their operations, through joint ventures, mergers and acquisitions and venturing into new markets the amount of data generated by business also grows undoubtedly. Enterprises will then need to have a platform to manage the data coming from these varied disparate data sources, in many different formats, in different sizes and structures to store, access and transform the data to be able to gain quick business insights out of them in order to empower them to take transformative business decisions to maintain their competitive advantage in the market. It also becomes an increasingly daunting and an expensive avenue for companies to pursue and manage the complexities involved in maintaining the monolithic architecture-based applications on-premises. The increased variety of data sources brings a new set of complexities to this task [7].

4.2. Increased Data Silos/Data Pockets within the Organization's On-Premise Environment

Over a period of time many organizations have seen the need to solve immediate challenges facing their business which have caused them to create numerous data silos residing in various databases in on-premise platforms which require different dialects of programming languages for accessing and transforming that data to feed into reports for gaining useful actionable insights out of them. Having said that, data silos can also exist in the form of various SaaS (Software as a Service) in the cloud. Hence an enterprise wide data integration strategy is very critical when it comes to supporting on-premise and cloud environments that helps organizations deliver trusted single version of truth of their data into various business groups for transformative insights.

4.3. Following the Competitor in Business

Market disruptions requires Information Technology (IT) departments in organizations to respond faster to the ever-changing climate needs of their businesses to be able to maintain their strategic position and competitive edge in the market. With new data being collected by applications daily, the analysis needs of the businesses also evolve rapidly. IT, in that case must develop suitable processes and provide those necessary enterprise wide capabilities to house that data and make it readily available to the business for their analysis and insights, even if it is totally a new area that IT will be venturing into.

4.4. More Focused Analytics Use Cases

Many organizations want to reduce their contact centre calls by trying out speech to text analytics, virtual assistants, virtual bots to understand the customer's sentiments and provide them with an enriching customer experience across all channels and points of contacts. Companies are striving hard to provide that increasing self-servicing capabilities and greater agility to the customers to help them have their issues and concerned addressed and resolved faster and in a most-efficient manner. Insurance Companies and Financial service institutions for instance can leverage the unthinkable possibilities offered by Advanced Machine learning models and algorithms to detect fraudulent claims and transactions. E-commerce companies can provide expedited services to senior citizen and shoppers with disabilities. The hybrid-cloud platform with its necessary data management capabilities can offer seamless flow of information, maintaining integrity, efficiency, and governed data across cloud and hybrid environments. "Garbage-In, Garbage-Out" has never been truer [7]. Maintaining data quality, data assurance, data governance, data integrity and integration are critical factors in IT especially when it comes to deeper structured analytics.

4.5. Scalability and Increased Agility

Scaling traditional infrastructure can be expensive and time-consuming, inefficient and requires accurate forecasting in many organizations. Hybrid-cloud environment can provide organizations the opportunity to scale out quickly and dynamically for specific workloads. Also, by implementing automation rules in the cloud, resources can be provisioned dynamically based on demand-driven usage taking advantage of the pay-as-you-go pricing model.

4.6. The Need for Processing Millions of Data Records

Organizations with complex use cases which requires accessing millions of data records from various data sources

and processing them parallelly on on-premise infrastructure, it becomes challenging in terms of the large processing times (in hours and sometimes even days) to fetch the data from the database and to cache the data for performing in-memory cache analytics. Hybrid-cloud on the other hand, because of its massive scalability and dynamic capability of autoscaling of instances based on resource utilization provides the required responsiveness to help organizations improve their applications performance, reduce their upfront investment of infrastructure (CapEx), increase their operating efficiency, make their applications highly available, fault tolerant and deliver faster results.

5. Hybrid-Cloud Use Cases

The hybrid-cloud data model started gaining a lot of traction due to ever changing business needs of enterprises which includes keeping certain data and legacy systems on-premises while also leveraging the benefits cloud computing has to offer. Below are some of the most common use cases for which organizations have adopted a hybrid-cloud strategy:

5.1. Keeping Data and Applications On-Premise for Compliance Reasons

Many organizations for regulatory and compliance purposes need to keep assets (data and applications) on–premises. Other reasons one can think of, as to why organizations may need to keep their data on - premise could be low latency requirements, local data processing needs, securing Personal Identifiable Information (PII) or legacy architectures. Such use cases we most commonly encounter in public sector organizations, healthcare sector companies and financial services institutions. But, for greater agility, flexibility in their operations and ability to scale most organizations in that case find the optimal solution in extending their existing enterprise on-premises data warehouse solution into the cloud and connect to Massive Parallel Processing (MPP) cloud data warehousing solution like Aws Redshift or Azure Synapse [5]. In such a kind of set up organizations have resources on-premises, partnering in multi-year journeys of cloud adoption. With continuous innovation some cloud service providers even offer solutions that brings the same cloud experience like the cloud infrastructure, services, API's, service management tools, support and operating models that customers are familiar with, to virtually any data centre, co-location space or on-premises facility like AWS outposts [8].

5.2. Cloud as Data Centre Extension

Organizations want the ability to seamlessly integrate their on-premises and cloud storage, their networking components, identity access management, databases, virtualization tools and security policies to enable use cases such as data centre extension to the cloud, ability to take backup, store less frequently used data onto the cloud, restoration capabilities, disaster recovery and hybrid data processing. When organizations often experience the frequent and growing need to provision more resources to handle sudden changes in workload and increase the compute capacity, then they may need to deploy new resources quickly and effectively. Cloud as a data centre provides organizations with the huge savings in time which otherwise the companies would have had to spend on maintaining, provisioning, updating and scaling their existing on-premises solution. Adding a server to your virtual infrastructure or on to your cloud environment no more take half a day or longer but can be done in less than thirty minutes and if configured behind a load balancer can also scale and shrink dynamically to handle varying amounts of workloads and network traffic [5]. Organizations may also in this case, use cloud data centre on a project-by-project basis, to accommodate those anticipated spikes in network traffic, deploying dynamically new virtual servers by autoscaling of resources as and when they are needed. Hybrid-Cloud model for a data centre extension use case will also enable organizations to easily incorporate high-performance dedicated servers(like general, compute optimized, storage optimized and memory optimized compute instances for advanced machine learning use cases and workloads), equipped with the latest technology into your infrastructure [8]. This kind of an infrastructure also shits the internal costs from a Capex (Capital Expenditure) model to an OpEx (Operating Expenditure) which means companies will no longer need to pay for licenses for network and hardware, or end up with either under-utilized capacity or have unmet demand (Over - utilized capacity) in hand, instead they can rent and resize resources as they are required in cloud.

5.3. Legacy Applications and Systems Modernization

As organizations are forced to update the legacy and traditional hardware and software systems on their on-premise environment, a continuous transition to Hybrid-Cloud can eliminate risk of obsolescence. That way, companies can be rest assured that they have the ability and flexibility to pick and choose the latest off the shelf hardware and software PaaS solutions (Platform As a Service) provided by cloud service providers whilst also being able to retain full control over their infrastructure and data.

5.4. Migrating Workloads to and from Cloud

The organizations which are concerned over the migration pain points can leverage hybrid-cloud model. Migrations of applications and existing workloads onto the cloud environment is not a one-day task and can take days, weeks and even up to a few months to complete the same along with several planned phases of migration, testing and validation. Enterprises with heavy workloads need the kind of flexibility where they can roll back a change should an issue occur [10]. This way, companies will also be able to implement a disaster recovery plan, that would be fully in alignment with their preferred Recovery Point Objective (RPO) / Recovery Time Objective (RTO) strategy, based on clear budgets,

costs and business objectives [9]. This use case will also give the companies the ability to leverage hybrid-cloud to start their cloud adoption journey without having the need to adapt and change all at once. It perfectly lays the ground for companies to test and check out the optimal resources and their capabilities which could be a best fit or the kind of challenges their business is facing for workloads by migrating applications to and fro from cloud and comparing the operating efficiency and performance of on-premises v/s cloud deployments.

5.5. For Building a Modern Data Architecture Platform

It is never easy and never too late for companies to come out and sunset their existing traditional legacy systems and infrastructure on which they are running some of their most critical business operations. Having a total new and updated set of technology stack will enable organizations to explore plethora of use cases and do so much more analytics (like Diagnostic, Descriptive, Predictive and Prescriptive Analytics) [5] to be able to gain those new quick actionable business insights and critical business information to make new game-changing business decisions. There have been several scenarios where new businesses have outpaced already set-up well established organizations just with an advance stack of new technologies. Modern Data architecture also provides the ability to ingest new streaming data, IoT Data into a data lake foundation setup. From there, the newly ingested/introduced data can be accessed and transformed to be stored in or a massive parallel processing cloud data warehousing solution from where data can be accessed via any Business Intelligence tool (like Tableau, PowerBI, Qlik Sense, Looker) or consumption methodology for more deeper structured analysis to cater to various analytic use cases. This type of a modern data platform mushrooms unthinkable possibilities for organizations to handle some of the complex challenges in the field of rising cost pressure, market shifts, gaining operational efficiency and maintaining competitive advantage in the market.

5.6. Hybrid-Cloud Provides Development and Testing Ground for the Developers

Most organizations have different products and projects, Proof of Concepts (POC's) which are at various stages of development and testing. Hence, the developers need an environment to do the code tweaks and do testing mimicking the real production like workloads in order to develop a thorough well-tested product. Developers need to have this kind of an environment set up without incurring a huge bill to the finance teams. Hybrid-Cloud environment in such cases works as a best fit solution where development and necessary testing can be done to develop an unblemished product. Development and Testing environments in cloud are primarily popular for three reasons. First one, being that they are cost-effective as it embraces a pay-as-you-go cost model and companies will have to pay only for the resources used. Secondly, developers can provision resources almost dynamically within just a few clicks as opposed to the procurement processes of necessary hardware and software which they would have to go through in an on-premise infrastructure situation which can take months. Thirdly, hybrid-cloud environment also allows for "bursting" capacity or temporary allocation of cloud capacity for short periods, at a lower cost than using physically and owned IT resources. This helps prevent over-provisioning and resource abandonment when the instances (virtual servers in the cloud) are no longer needed [11].

5.7. For High-Availability (HA) and Disaster-Recovery (DR) Capability

Organizations want their entire solutions to be running in an expected manner despite the issues that may occur. This is called High-Availability. In a hybrid-cloud deployment model, enterprises need to use load balancers to distribute traffic between on-premises and cloud environments during peak hours and as and when needed. Organizations also want their systems and infrastructure to be highly reliable and resilient. Resiliency is how quickly systems and applications can bounce back from failures. Reliability is being able to recover your systems and applications from failures and disruptions. It is when you know that you can trust your systems and that recovery was not just by luck. For disaster recovery, there are various deployment patterns that organizations adopt. Although mirroring of the entire on-premises environment onto the cloud can be a very expensive option, certain choices that enterprises are faced with are, Pilot-Light, Warm Standby and Active-Active or Multi-Site / Multi-Region kind of a deployment. Pilot-Light kind of an architecture is where all resources in the cloud are set up, functioning and running but are not scaled fully and can be scaled quickly usually within few minutes to a few hours to handle the actual full production workloads in the case of a DR event. For the Warm-Standby kind of an architecture there could be a Primary Database on-premises and a secondary-database, replica of the primary could be on cloud. Should there be a disruption in the on-premise data centre, all the applications can then be failed over to the cloud and operations can continue to run without minimal disruption to the users. Lastly is the Active-Active or the Multi-Site/Multi-Region deployment pattern where in both on-premise and on-cloud are handling equal workloads or a canary release kind of a pattern (70-30) or a blue-green kind of a deployment (Master-Slave).

5.8. Backup to the Cloud

The exponential growth of data has made backups and storage of data more difficult than ever before. Traditional on-premises backup appliances and tape libraries can be challenged to scale as data volumes do, maintenance of these storage devices by encrypting them properly is a daunting task and maintaining a secondary standby site could be an expensive option to pursue for many companies. Enterprises then, usually in this case see cloud as a backup device to

store, archive their home directory data as they can leverage the advantages of cloud storage scalability and high availability capabilities offered by the cloud with simple changes, for instance switching the backup target to an endpoint storage in cloud or a local cloud gateway appliance. Moving backups to the cloud can help companies reduce their costs significantly on storage, securing and managing that data in an on-premise platform. IT does not need to worry about database management tasks such as over provisioning, patching, applying upgrades and hotfixes, setup, configuration, backups, restoration and recovery services.

Also, as organizations are embracing 'Digital Transformation initiates' and providing enhanced customer experience by improving their customer interfaces, point of contact experiences, enterprises need to be able to build platforms that can support this kind of unstructured and semi-structured data generated from these various customer activities and data growth. Customers have traditionally stored data on Network Area Storage NAS) arrays, or even file server Virtual Machine's (VM's), but the cost and operational burden of buying, managing and replacing storage infrastructure on-premises is a distraction for the IT-team's priorities of increasing agility and innovation, strengthening security, and reducing costs for the companies [12]. Reducing these administrative tasks helps IT focus on higher value projects such as application fine-tuning for increasing performance or enabling newer technologies such as big data or artificial intelligence and machine learning deployments.

5.9. Data Layering and Storage Expansion

Adding extra additional capacity to the traditional Network Area Storage, Storage Area Network Arrays and data blocks, provisioning new ones on regular basis to meet the growing needs of the business consumes a lot of manhours, budgets and rack space. Sometimes it becomes impossible to get the new capacity as quickly as applications and business groups need it because of the long procurement cycles within organizations, hardware scalability limitations or physical infrastructure and power limits. In that case, embracing a hybrid-cloud kind of a platform give organizations the buffer for application's file data, persistent block volumes, snapshots or tape backup pools that can grow and scale as and when needed, providing long term benefits for the company by extending the life of company's investments on the cloud, reducing the need of future infrastructure purchases and helping companies gracefully manage capacity fluctuations [12].

5.10. VMware Solution for On-Premises and Cloud

Most of the companies that run their existing on-premise workloads on VMware virtualization software want to leverage their investment in VMware skills and tools as they start their cloud journey. VMware has partnered with many of the prominent cloud solution providers in the market where they provide a jointly engineered service offering which is directly managed by VMware. Companies can use the same VMware skills and tools to manage and run their VMware vSphere infrastructure on the cloud service provider's cloud infrastructure platform [13].

5.11. Independent Software Vendor (ISV) Lock in's and Software Compatibility Use Cases

Most of the companies who have purchased an ISV are faced with the vendor lock-in problem where they are dependent on a single technology solution provider's implementation to satisfy the unique business challenges they are facing. They cannot easily switch software vendors without incurring substantial costs, legal restrictions or software/technological incompatibilities. To cater to this particular kind of a use case, most of the cloud service providers like AWS and Azure have the most complete and proven approach for rapidly migrating tens of thousands of applications to the cloud(lift and shift/plug and play kind of a solution) so that companies can start leveraging their existing on-premises ISV's be it Windows-based applications like Active Directory, .NET, System Centre, Microsoft SQL Server, Visual Studio, Windows File Server, SAP applications, platforms, databases for all types of SAP HANA workloads, Oracle databases, Oracle PeopleSoft applications, Oracle E-Business Suite, Oracle Seibel CRM to name a few which most organizations commonly use for managing their operations. Most cloud service providers also offer curated digital catalogue containing third-party products which makes it easy for organizations to explore, find and buy, deploy and manage third-party software on cloud service provider's cloud platform.

5.12. Edge Computing Use Cases

There are certain industries in sectors like mining, shipping (marine), alternate sources of energy(Power Turbines/Windmills) where they may store data but do not have the network capacity and processing power in those remote and disconnected areas to process and take actions on that data in a timely manner. Such use cases could also be a driving factor for companies to adopt a hybrid-cloud strategy to support and enhance the operating efficiency for these sectors as cloud service providers in such cases connect the users through their widely spread Points of Presence (POP's) which enhances the user's internet and connectivity experience by about 60% [13]. The edge and global accelerator services provided by the cloud service providers basically use two any cast IPv4 (Internet Protocol Version Four) addresses which are not tied to any single region to increase the availability and performance of the applications deployed on the cloud infrastructure of the cloud service providers (CSP).

6. Hybrid-Cloud Best Practices

In this section, we will outline a few of the imperatives and best practices for the hybrid-cloud adoption strategy:

6.1. Data Security – Data Encryption at Rest and In-Transit

It is very critical to incorporate and build the right level of security at every level both at the technology level and at the processes level. It is a best practice to encrypt the data at rest and in motion when data is in-transit between applications and in between on-premises and cloud environments [12]. Encrypting at client side and server side offers double layers of protection for the data. Implementing Identity Access and management control best practices like Multi-Factor authentication (MFA) and setting up complex password policies can add that additional layer of protection from unauthorized access and use of resources. Also, by implementing least access privilege, resources and services are granted only the required levels of permissions to access accounts and applications. Regular patch maintenance, upgrading of the applications and penetration testing can keep organizations ahead of their competitors. Also, security, should not be bolted-on rather it should be incorporated and integrated throughout the platform and the environment.

6.2. Intelligent Data Management Solution

Leveraging a metadata driven microservices based or loosely coupled architecture enable continuous delivery and deployment of data, providing for greater visibility, enhanced performance, improved productivity, reduced risk and superior data governance and security. This way organizations can also achieve increased operational confidence of managing the data from a single point of control for end to end data flows and not having to configure and maintain change management catalogues for tracking changes at multiple places [7].

6.3. Effective Communication Between IT and Business

Close collaboration between IT and business is the key to success for any IT project or cloud adoption initiatives of organizations. If the collaboration and communication between IT and the business is ineffective or is insufficient, communication is weak, or expectations and goals are not managed, then even a great IT project can struggle to be successful. Teamwork, Communication, Collaboration and sound project management principles are often the difference between success and failures of projects in organizations. In such cases organizations often use 'Agile Framework' to ensure early and continuous delivery of valuable and workable solutions and software to gain confidence, effective buy-in and participation of the business.

6.4. Data Governance and Automation

Implementing strong data governance procedures becomes even more critical when data is being moved from on-premises into a cloud environment or in between them. While cloud computing brings a new set of concerns for data governance, they are entirely manageable with careful planning, forethought and by choosing the right technology stack [7]. Cloud Automation refers to the use of software to reduce manual intervention and infrastructure engineering and simplify the cloud operations [14]. Automation can help organizations gain agility and scalability, simply the business processes, minimize and mitigate risks and manual errors, faster deployment of resources and cloud management, reduce IT infrastructure costs, streamline IT focus, and make systems, applications and infrastructure more resilient and reliable.

6.5. Understanding the Workloads Properly

It is very critical to have a good understanding of the workloads that are currently running in the on-premise infrastructure and their essential characteristics in order to determine if hybrid-cloud is the best fit or not. Each application needs to be examined for the right mix of public cloud, private cloud resources and traditional IT resources that best fit the workload in order to make the most from a hybrid-cloud architectural deployment [1].

7. Why Hybrid-Cloud Might not be Always the Right Fit

Smaller organizations operating on a tighter IT budget might best be served by a purely public cloud solution. The initial upfront cost of setting and operational expenses of running and managing those private servers is substantial. An application that requires the highest possible speed may not be suitable for Hybrid-Cloud deployment model depending on the specific cloud implementation [1]. While latency does play a factor in data storage, it plays less of a prominence in cases, where users only use the application for uploading and downloading data, than for organizations using hybrid cloud computing environment for advanced computing use cases requiring highly compute, memory optimized virtual servers and instances.

8. Conclusions

Many organizations are moving their workloads, applications and infrastructure to public clouds to simplify infrastructure management, innovate faster at a lower cost, modernize applications, increase agility, collaborate and communicate effectively, build highly available and fault tolerant applications in the cloud. In doing so, many customers are finding a hybrid-cloud solution approach provides the responsiveness and cost savings needed to support critical applications and systems [13]. Additionally, hybrid cloud transforms IT departments into a strategic function tied to an organization's mission, rather than being a support function since IT professionals are freed from the daunting, heavy undifferentiated task of scaling out/building out and maintaining, provisioning on-premise infrastructure.

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