White Paper

Oracle Private Cloud Solutions — Strong Foundation for Modernizing Enterprise Applications

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IDC OPINION

Enterprise applications that can take advantage of the growing volumes of data are a key aspect of building and sustaining competitive differentiation and critical to the business success of organizations of all sizes. This requires a mindset of continuous innovation and has led to an increase in the adoption of modern infrastructure paradigms and Agile development processes.

Leveraging cloud-native concepts such as containers and API-driven automation enables applications to be more scalable, more fault tolerant, and interoperable. This allows organizations to deploy the applications on any suitable infrastructure platform on premises or in the cloud. Agile processes empower application developers to build and release software faster. Together, these are essential tenets of digital transformation, leading to autonomous operations, rich customer experiences, and the rapid introduction of new products and services.

IDC recommends that organizations leverage a platform that facilitates the development and operation of modern applications while integrating with existing technology investments. To help organizations modernize enterprise applications, Oracle Private Cloud Appliance (PCA) provides the following benefits:

- Supports necessary environments, tools, and capabilities to modernize legacy applications.
- Provides turnkey on-premises cloud infrastructure with automated installation, configuration, and management capabilities.
- Allows customers to run cloud-native applications through Oracle PCA's curated stack of software, tools, and capabilities including support for Kubernetes, an open source container orchestration platform, and multiple container runtimes including Docker and CRI-O.
- Provides flexible consumption options and complete management by Oracle with Oracle Private Cloud@Customer (PCC), eliminating infrastructure management overhead and enabling a public cloud experience with self-service provisioning and pay-as-you-go subscription models.

Demonstrating that Oracle is establishing itself as a strong player in cloud solutions, interviews with Oracle customers confirmed up to a 5 times increase in application responsiveness and a 30% reduction in TCO. Solutions such as Oracle Private Cloud Appliance and Oracle Private Cloud@Customer provide a technology stack that supports heterogeneous workloads and integrates with Oracle Exadata Database Machine, Oracle Exadata Cloud@Customer, and Oracle SaaS offerings, making it easier for organizations to achieve their desired business outcomes.

This white paper discusses how new infrastructure paradigms provide the foundation for application modernization (AM) and best practices for enterprises to build upon private cloud platforms to create hybrid cloud environments as a part of a successful application migration journey to the cloud.

SITUATION OVERVIEW

Modern Infrastructure — Foundation for Application Modernization

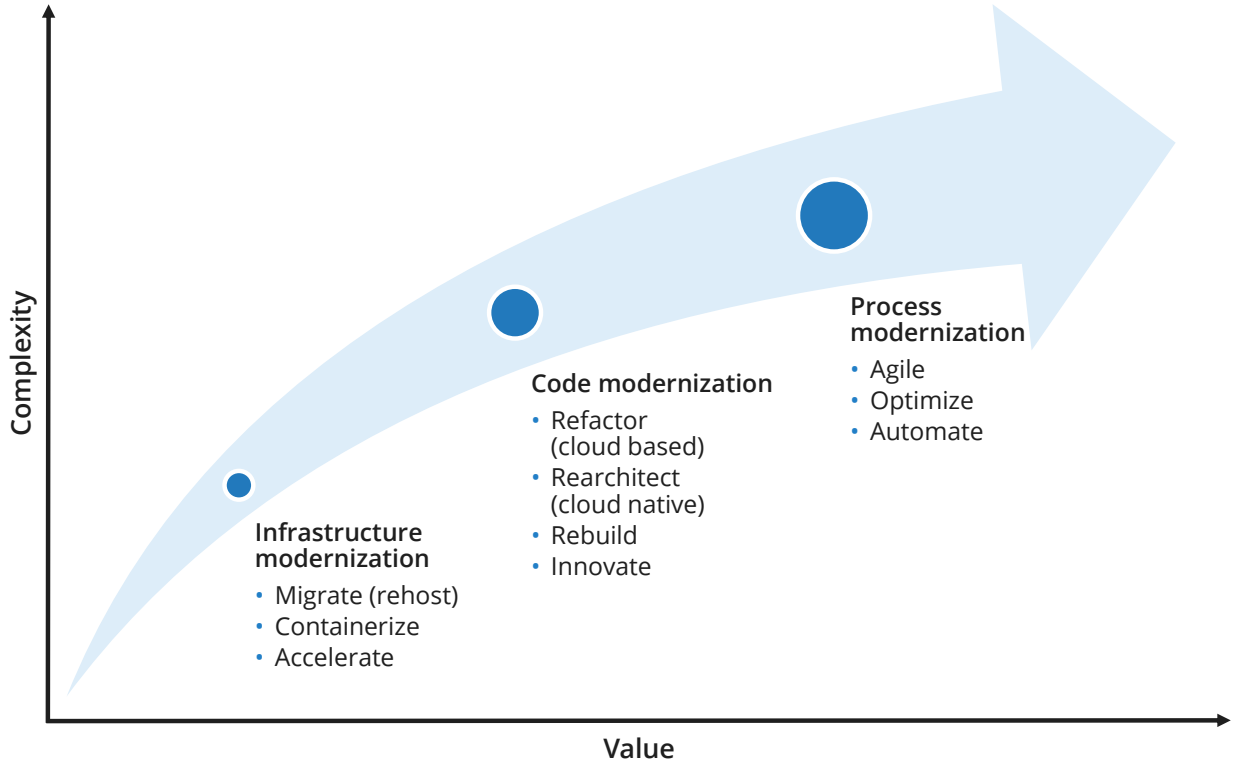
Application modernization refers to updating older software to newer computing paradigms, including languages, frameworks, and Agile development practices to gain increased developer productivity and faster time to market. This involves three layers of the technology stack — infrastructure, code, and process (see Figure 1):

- **Infrastructure modernization** refers to implementing software-defined compute, storage, and networking resources that can scale on demand.
- **Code modernization** consists of refactoring legacy workloads using cloud-native concepts such as containers, microservices, and API-driven automation.
- **Process modernization** is the introduction of DevOps methodologies, including continuous integration (CI) and continuous delivery (CD) of new software.

Cloud services provide an ideal platform for AM. For example, organizations can standardize cloud-native applications on containers running on Kubernetes clusters, database capabilities consumed as services, end user–facing capabilities implemented as functions, and certain stateful legacy applications rehosted to virtual machines (VMs) on cloud platforms.

FIGURE 1

Foundation for Application Modernization



Source: IDC, 2021

Growth of Heterogeneous Applications

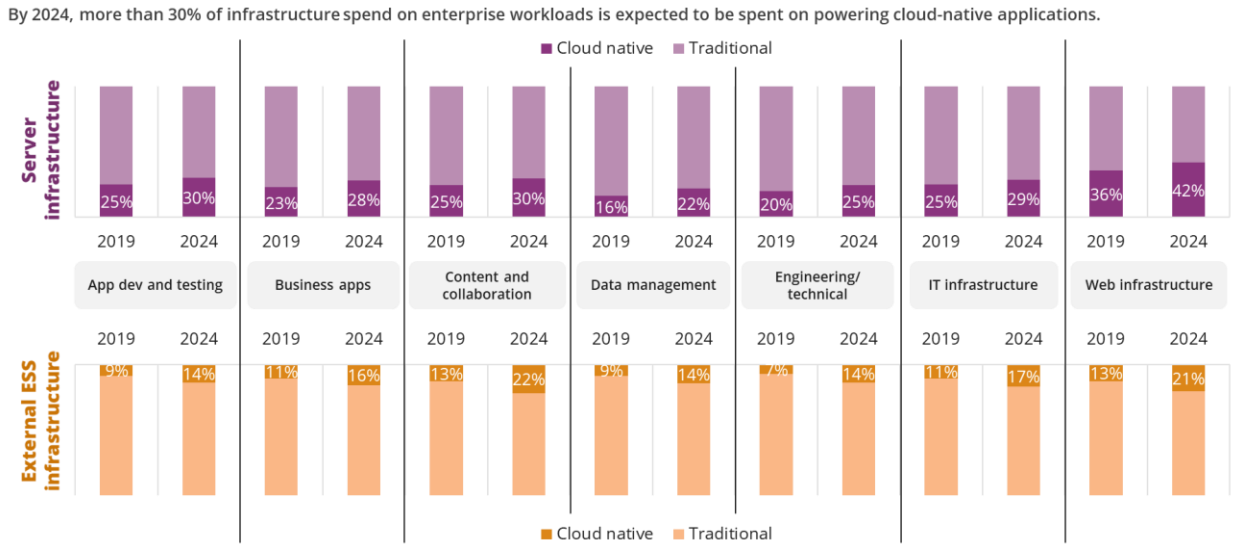
Traditional enterprise workloads running on premises, so-called legacy applications, tend to be monolithic. They are usually deployed on either bare metal servers or virtual machines. With the increased adoption of containers and serverless compute, enterprise workloads are becoming heterogeneous, requiring infrastructure that can support multiple architectures. IDC estimates that by 2024, more than 30% of infrastructure spend on enterprise workloads is expected to power cloud-native applications (see Figure 2).

Enterprises are also increasingly leveraging containers and cloud-native technologies for applications that need massive scale and are less stateful. They are also embracing AI/ML technologies for new business use cases deployed across cloud, core, and edge locations. A recent IDC study predicts that by 2024, 55% of enterprises will rely on embedded AI functions in their business-critical workloads to make real-time business decisions and drive business process outcomes directly.

With such growth in cloud-native applications and infrastructure abstractions, it is more important than ever for enterprises to leverage the right infrastructure at the right location for the right workload.

FIGURE 2

Spending on Heterogeneous Applications, 2019 and 2024



Source: IDC, 2021

Flexible Consumption of IT Infrastructure

Enterprise procurement of IT infrastructure has traditionally been capital intensive, following the capex model. With the advent of cloud computing and as-a-service provisioning models, enterprises are showing a preference toward flexible models of consuming IT infrastructure on premises:

- Flexible consumption of IT infrastructure enables a partial shift to an opex model, where the enterprise owns the equipment but has variable usage costs that are charged over the life span of the contract.
- As-a-service consumption of IT infrastructure enables a full shift to opex, where the equipment is owned by the service provider – installation, management, maintenance, and upgrades are included as part of the solution.

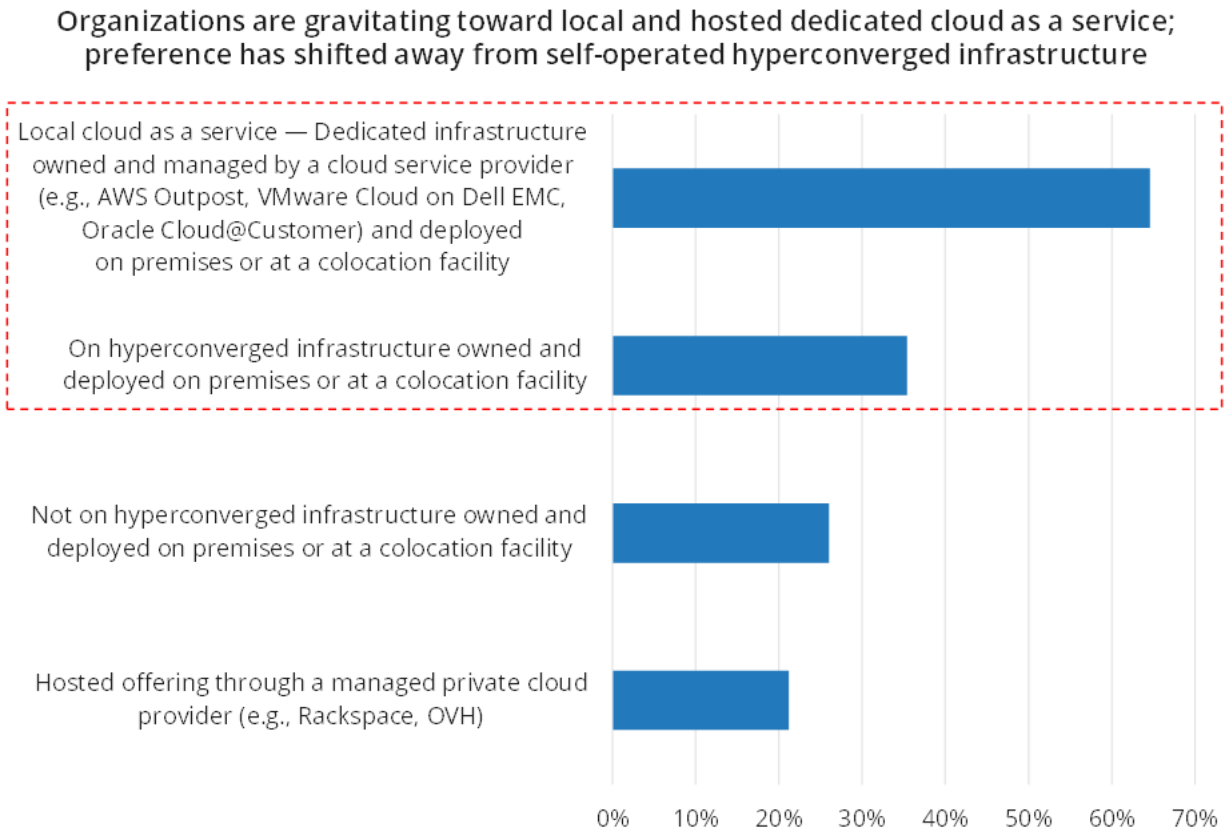
In a recent IDC study (see *Dedicated and Hybrid Cloud Infrastructure Adoption Trends,* IDC #US47570021, March 2021), more than 60% of the respondents indicated a preference toward consuming dedicated cloud infrastructure owned/managed by the cloud service provider and deployed on premises (see Figure 3).

Despite these trends, enterprises cite a lack of skill set, inconsistent management across multiple environments, and operational complexity as primary challenges with application modernization. Faced with the reality of supporting heterogeneous applications, enterprises require a common platform that provides support for cloud-native workloads across on-premises and public cloud environments while protecting legacy investments.

FIGURE 3

Growth of As-a-Service Consumption: Today and in the Next 12 Months

Q. What private cloud platforms and deployments does your organization have or plan to have in the next 12 months?



Source: IDC, 2021

ORACLE PRIVATE CLOUD SOLUTIONS

Oracle provides the following offerings on premises that enable infrastructure abstractions that support application modernization with technology and an experience consistent with that of its public cloud platform – Oracle Cloud Infrastructure (OCI).

Oracle Private Cloud Appliance

Oracle Private Cloud Appliance is a dedicated cloud infrastructure solution that enables rapid deployment of converged compute, network, and storage technologies. Oracle PCA is a turnkey solution with automated installation, configuration, and management capabilities. It also supports the high availability of underlying infrastructure, expansion, and upgrades.

Technology Stack

Oracle PCA consists of the following hardware components (see Figure 4):

- **Management –** Infrastructure management/life-cycle management capabilities
- **Compute –** Up to 1,408 cores for x86 server virtualization
- **Storage –** Up to 4.4PB, using high-capacity or high-performance all-flash storage trays
- **Network –** 100Gbps Ethernet-based physical network layer that enables SDN capabilities

The Oracle PCA software stack consists of the following:

- **Oracle PCA Dashboard** is an Oracle JET application that provides a web-based graphical interface to perform administrative tasks. Oracle PCA also provides a command-line interface (CLI) to perform administrative tasks.
- **Password Manager (Wallet)** is a global encrypted store for system configuration components, which can be managed through the dashboard or the CLI.
- **VM Lifecycle Management Software** is a WebLogic application that provides life-cycle management capabilities for virtual machines.
- **Oracle PCA Management Software** provides for provisioning, management, and maintenance of all Oracle PCA-managed components.
- **Oracle PCA Diagnostics Tool** is a diagnostic tool to monitor and collect diagnostic data across management components and compute, storage, and networking resources.

Oracle PCA software stack also includes guest operating system images and databases used for internal purposes.

FIGURE 4

The Oracle PCA Technology Stack

Source: Oracle, 2021

Support for Cloud-Native Environment

In addition to supporting server virtualization, Oracle PCA also supports cloud-native applications through its curated stack of software, tools, and capabilities. Oracle PCA's cloud-native environment includes:

- **Kubernetes:** is an open source container orchestration platform to build, deploy, and manage containerized applications on resource nodes pooled into clusters.
- **Container runtimes** are self-sufficient runtime environments that enable running complete applications in a system process called "container" on the host operating system. Oracle PCA supports CRI-O (an open source container runtime environment) and Docker (the most popular container runtime environment).
- **Management tools** are based on popular infrastructure-as-code (IaC) frameworks such as Ansible and Terraform for easy management of Kubernetes clusters.
- **Storage** enables a cloud-native storage back end to support highly available (by default) persistent volumes on top of Oracle ZFS Storage Appliance for file, block, and object storage access.

Middleware Modernization

Oracle PCA enables organizations to modernize legacy applications that use middleware through the support for cloud-native environments and the ability to run popular databases (including MySQL, Oracle NoSQL Database, and Oracle Database) and application middleware (including Oracle Business Intelligence, Oracle Coherence, Oracle Fusion Middleware Infrastructure, and Oracle WebLogic Server).

Oracle PCA provides automatic conversion of popular middleware such as Oracle WebLogic Server into cloud-native applications through commonly used cloud-native tools/constructs such as Kubernetes Operator and Helm charts. Oracle PCA also includes templates/cookbooks for modernizing popular enterprise applications such as Oracle E-Business Suite and n-Tier applications.

Finally, Oracle PCA integrates easily with Oracle Exadata Database Machine and Exadata Cloud@Customer, providing the high performance, scalability, availability, and security that modern, data-driven application environments require.

Oracle Private Cloud@Customer

Flexible Consumption Option

Oracle Private Cloud@Customer supports the same capabilities as Oracle PCA but is offered with flexible consumption options that allow customers to convert up-front capex into recurring opex. Since Oracle PCC is completely managed by Oracle, it not only offers financial benefits but also alleviates enterprise users from the overhead of having to manage infrastructure. Enterprise users can consume capabilities and features enabled by Oracle PCA through a minimal commitment for four years, at the same prices as Oracle Cloud Infrastructure.

Application Modernization Using Oracle PCA and Oracle PCC

Embracing modern infrastructure paradigms such as cloud-based services, containers, and serverless abstractions is the first step toward application modernization. Oracle PCA supports Kubernetes, an open source container orchestration platform, and multiple container runtimes including Docker and CRI-O. This enables the development of containerized applications. Through its support for

infrastructure abstractions including bare metal, virtual machines, and containers, Oracle PCA provides a solid foundation for infrastructure modernization for the deployment of cloud-based and cloud-native applications.

Application modernization also involves agile application development processes, which need the right set of tools and frameworks. Oracle PCA supports popular application development environments and infrastructure-as-code frameworks including Ansible and Terraform. By supporting infrastructure, code, and process modernization, Oracle PCA enables enterprises to modernize their applications.

Modern applications provide an opportunity to optimize resource allocation through better resource utilization, efficient scaling, and on-demand resource consumption. This in turn helps enterprises save on IT infrastructure costs, staffing, and other operational costs, thereby achieving better TCO. A large oil distributor cited saving about 30% on TCO over five years, with about 10% savings in infrastructure-related costs using Oracle PCA. 40% of this improvement was attributed to reduced licensing costs. In Latin America, a real estate company experienced 30% savings over prior infrastructure through consolidated licensing and efficient resource utilization.

In addition to cost savings, Oracle customers are realizing performance gains. Depending on the workload, customers are reporting a three to five times improvement in application responsiveness. In a specific example, a company was able to reduce the time to process employee payroll from 4 hours to 30 minutes. Similarly, the time to restore from backup was five times faster than the previously installed solution. Together, this improves customer satisfaction and user productivity, allowing the business to increase sales as well as to make better use of its human resources.

FUTURE OUTLOOK

Public Cloud Experience On Premises

While enterprise adoption of public cloud infrastructure is increasing, enterprises are finding that not all workloads can be migrated to public cloud infrastructure. Low-latency needs, regulatory compliance requirements, data gravity, and geopolitical limitations constrain the mobility of workloads. As a result, enterprises are faced with the dilemma of enabling the agility that the public cloud provides but being unable to migrate certain workloads off premises.

Solutions such as Oracle Private Cloud@Customer enable customers to experience public cloud in terms of self-service provisioning and pay-as-you-go models while maintaining workloads on premises. With many vendors providing similar offerings in this market, IDC expects this trend to continue and forecasts this market to grow at a CAGR of more than 150%, reaching more than $24 billion by 2024.

Growth of Cloud-Native Applications

More enterprises are adopting the right infrastructure abstraction for the right workload paradigm. For example, enterprises leverage containers and cloud-native technologies for applications that need massive scale and are less stateful. They are also embracing AI/ML technologies for new business use cases deployed across cloud, core, and edge locations. A recent IDC study forecasts that by 2024, 55% of enterprises will rely on embedded AI functions in their business-critical workloads to make real-time business decisions and drive business process outcomes directly.

As organizations move to modern architectural paradigms, enterprises are also introducing modern application life-cycle management practices. The adoption of DevOps processes such as CI/CD is

increasing. An IDC survey (see *Application Services, 2019,* IDC #US45005516, April 2019) among enterprises shows that nearly 75% of the respondents rated application modernization as a high or top priority. Another IDC survey (see *U.S. DevOps Survey of Large Enterprise Organizations, 2019,* IDC #US45688619, December 2019) reveals that more than 75% of the respondents have already adopted DevOps practices.

With such growth in cloud-native applications and many infrastructure abstractions, it is more important than ever for the underlying infrastructure to support heterogeneous workloads. Oracle PCA and Oracle PCC are well positioned to be the foundation upon which enterprises can leverage heterogeneous workloads.

CHALLENGES/OPPORTUNITIES

Opportunities

Support for Legacy and Modern Applications

Those willing to take the necessary steps to adopt the open hybrid cloud model can create value faster, increase business resilience, and reduce operating costs. Cloud-native approaches have accelerated the pace of innovation by reducing the time it takes to launch new product offerings. Developers spend less time managing the underlying resources and can instead focus on creating new functionality and user experiences.

More than ever, businesses are under pressure to react quickly to changing customer needs to build and maintain a competitive advantage. By abstracting the application logic from the underlying infrastructure with Kubernetes, it is possible to automate platform changes to address variations in usage patterns and to increase the overall availability of services. It is also easier to build and deploy new features incrementally without waiting for the next major release.

With the complexity introduced by heterogeneous applications and environments, single-vendor support for the entire stack of infrastructure, middleware, and applications across deployment locations would mitigate integration and management challenges. Oracle is uniquely poised to help enterprises through its portfolio of offerings across the infrastructure continuum of cloud, core, and edge.

Flexible Consumption, Deterministic Pricing

Lack of clarity in costs and predictability in TCO is one of the challenges cited by enterprise respondents when adopting public cloud platforms. With pay-as-you-go models and unpredictable resource utilization typical of cloud-based applications, such unpredictability leads to unpleasant billing surprises. Public cloud service providers provide methods such as Reserved Instances, Spot Instances, and multiyear ELAs to alleviate such unpredictability in TCO.

Though flexible consumption pricing enables the opex model of consumption on premises, it tends to introduce similar unpredictability. Solutions such as Oracle Private Cloud@Customer, through approaches such as minimal commit, make flexible consumption models more deterministic.

Challenges

Mindshare

Oracle has established its mindshare among enterprises around business-critical/mission-critical databases. While Oracle is increasing its market share among cloud services revenue, Oracle, through

offerings such as Oracle Private Cloud Appliance and Oracle Private Cloud@Customer (as well as Exadata Cloud@Customer and Dedicated Region Cloud@Customer), is also establishing itself as a strong player in the private cloud solutions and cloud management solutions market. With a technology stack that supports heterogeneous workloads and has the ability to integrate with Oracle Exadata Database Machine, Oracle Exadata Cloud@Customer, Oracle Cloud Infrastructure, and Oracle SaaS offerings, Oracle has a significant role to play in this market.

ESSENTIAL GUIDANCE

Leverage Hybrid Cloud Building on Private Cloud

IDC recommends that enterprises leverage hybrid cloud to protect and future proof their current investments, avoid vendor lock-in, and innovate faster by selecting solutions such as Oracle Private Cloud Appliance and Oracle Private Cloud@Customer to modernize their applications.

Infrastructure and application development paradigms go through mutually influencing cycles of innovations. When modernizing applications, no single infrastructure platform can satisfy the application needs of an organization. It is also typical for organizations to grow through various acquisitions that bring in multiple technology stacks and platforms, thus making hybrid cloud infrastructure even more inevitable. A hybrid cloud platform built on a private cloud that standardizes infrastructure abstractions and that provides consistent operational experience across locations positions enterprises exactly so.

Be Flexible

IDC recommends enterprise organizations be flexible while modernizing their IT infrastructure. Enterprise IT organizations are increasingly leveraging heterogeneous workloads running on bare metal servers, virtual machines, or containers. Hybrid environments consisting of on-premises and public cloud infrastructure are also fast becoming a reality for enterprise IT organizations.

A hybrid cloud platform built on a private cloud enables migrating/modernizing workloads strategically across different infrastructure abstractions (such as VMs, containers, or bare metal) and across multiple locations (edge, core, or cloud) and provides enterprises with maximum flexibility and choice. This flexibility and choice in infrastructure optimizes resource utilization and hence better overall TCO.

Plan for Modern Applications with an Eye to Future Innovations

Enterprises also tend to focus on requirements posed by the workloads currently in use, such as databases or productivity workloads. In doing so, they tend to prioritize immediate technology drivers and business drivers while selecting infrastructure platforms. Technology drivers include support for diverse hardware, a flexible open source ecosystem, and improved day 2 operations. Business drivers include lower TCO, lower support costs, and support capabilities.

IDC recommends that enterprises look further than their current needs and consider the types of workloads they may be using in the future. With more enterprises adopting heterogeneous workloads across heterogeneous platforms, the vendor must understand the nuances of supporting business-critical workloads across such environments.

IDC recommends selecting a vendor that has demonstrated a deep understanding of supporting business-critical workloads across such diverse environments and solutions such as Oracle Private Cloud Appliance/Oracle Private Cloud@Customer to modernize applications.

CONCLUSION

Application modernization enables enterprises to modernize their infrastructure, code, and application life-cycle management processes. This combination of flexibility in infrastructure platforms and development agility enables developers to build faster, spurring innovation and bring products to market faster.

IDC recommends leveraging the appropriate infrastructure paradigm to modernize legacy applications. Offerings such as the Oracle Private Cloud Appliance provide the necessary environments, tools, and capabilities to not only modernize legacy applications but also develop cloud-native applications. IDC also recommends considering flexible ways to consume IT infrastructure, such as Oracle Private Cloud@Customer, to lower overall TCO on hybrid infrastructures.

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