

ENERGIZE  
THE LIVE  
ENTERPRISE  
WITH CLOUD





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Almost all enterprises today are using cloud as the foundation for their digital transformation journey. We are seeing that most of our clients are starting to operate across multiple public and private clouds and are accelerating their journey toward a hybrid cloud ecosystem. In this hybrid ecosystem, we see several consumption and adoption patterns emerging based on capability, speed, compatibility, cost and compliance. For leaders driving cloud initiatives, we provide a strategic view to help make right decisions across the five cloud subdomains – PaaS, Management and Operations, Migration, Integration and Security.





The COVID-19 pandemic has shown that the enterprises with advanced digital programs and cloud adoption were equipped better to cope with the current situation. Their responses included the enablement of remote working for employees with secure access to enterprise and collaboration applications, improved system resiliency to handle increased reliance on IT systems to reduce risk, optimize costs with enhanced service levels and better manage the ecosystem through digital-first interconnections with partners and customers.

Cloud infrastructure aids enterprises against volatile conditions more quickly, as it provides scalability and flexibility at optimal costs. A recent [Infosys study](#) on cloud initiatives in large organizations worldwide showed the cloud was expected to capitalize on advanced computing capabilities, meet evolving customer needs, leapfrog competition, reduce IT

costs and enhance the availability and resilience of systems. Those enterprises still invested in traditional on-premises infrastructure will need to move swiftly to a cloud environment if they want to weather the current situation and forge a path for a digital future. They need to consider a hybrid cloud approach to protect their current investment and evolve it into an enterprise for the future.

This evolution lies in transforming to operate like a digital native so that the company can be resilient and adjust to new ways of working with stakeholders. As businesses seek to establish a new normal, the demand for high performance while staying flexible and resilient will continue to increase. For this, enterprises need cloud as an enabler and must understand cloud technologies – from the initial stages, to where it is today, and where it will progress. This insight will help them make informed decisions.



# The journey to hybrid cloud and edge ecosystem



The public cloud gained traction in 2010, when its focus was on infrastructure. Infosys cloud experts consider this the starting point to define the three horizons in the enterprise cloud journey.

**Horizon1 (H1):** As virtualization technologies evolved, efficiencies increased by packaging denser workloads that were isolated on the same hardware. The public cloud made great strides to provide virtualized resources and afford complete programmatic access to resource life cycle management. The infrastructure was available on demand and teams could migrate workloads to the cloud for scalability and lower costs. In the software-as-a-service (SaaS) model, user productivity and collaboration spaces also experienced early transformation to the cloud. For all the workloads on the cloud, core enterprise concerns such as integration and security management were addressed through extended data center processes, methodologies and tools to the cloud.

**Horizon2 (H2):** Over the last few years, multiple cloud technology players established a hybrid landscape for IT, complemented by a strong portfolio of SaaS solutions to make a direct business impact. Management dimension has grown more dense as containerization and container management platforms deliver better efficiency, scalability and agility. To

derive increased value and a competitive edge, enterprises exploit technical innovation to be cloud-native. Access to complex open-source technologies is democratized through managed platform-as-a-service (PaaS) solutions from cloud service providers (CSP) or managed cloud services from organizations that back open-source projects. Cloud-native applications for the interconnected business now require integrations to be more API-centric with near real-time interactions.

Automation across the application engineering and operations life cycle has evolved significantly, to deliver the speed and agility demanded by enterprises. H2 provides a unified identity, with better security for containers and services, security service brokers, security orchestration and integrated governance.

**Horizon3 (H3):** Enterprises are changing their technology approach to keep pace with the needs of business to deliver value as part of their digital transformation initiatives. In this H3 stage, enterprises must now provide developers with a polycloud landscape where they can manage a multi-cloud environment with better technologies and simplified orchestration, operations and governance.

Here, use cases such as gaming, AR/VR, process automation and autonomous operations will require computing to move beyond the data center and

public cloud hosting locations to metro and edge locations to address latency and real-time processing needs. Security is not within perimeters anymore, as more workloads run beyond typical enterprise perimeters and with the evolution of a “zero trust” model. This model is context-aware, enforces policies consistently through code and is bolstered by AI-powered threat detection and security incident prevention capabilities.

Widespread adoption of containerization and serverless architecture is expected as IT teams focus on developing applications for business needs instead of merely managing the platform to run them.

**Figure 1. Adapting to market dynamics: the three horizons**

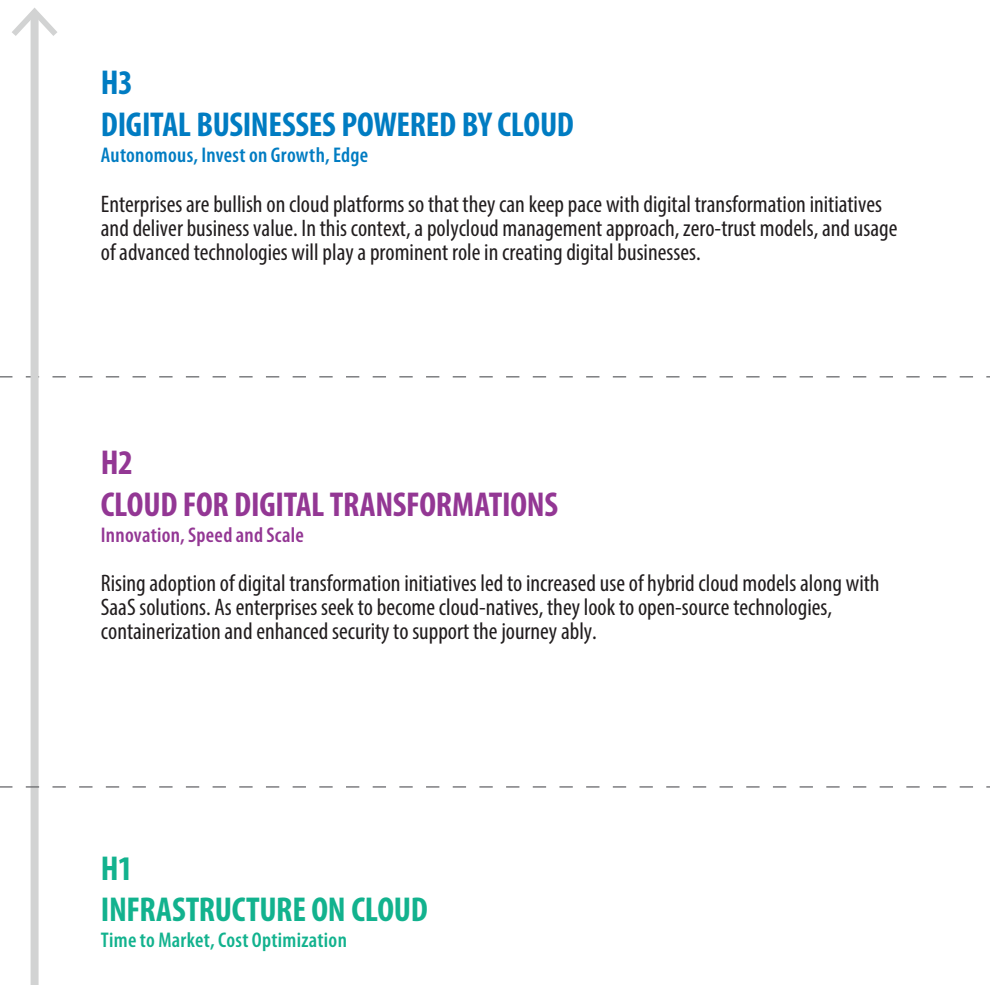
**KEY PATTERNS**

- Business-driven
- Digital-first integration
- API and micro SaaS
- AI-powered apps
- Edge and IoT
- Vertical flavors SaaS
- Zero trust security
- Polycloud

- Enterprise-driven
- Cloud-native applications
- Open-source technologies
- Migration and modernization
- Automation
- Containerization
- Unified security
- Hybrid cloud

- Infra-driven
- Collaboration
- As-is migration
- IaaS-focused public cloud
- Virtualization

Source: Infosys



The value of IT is measured on the delivery of business needs and not just managing the platform to run them. Hence, there will be more adoption of containerization and serverless architecture across the technology spectrum – including AI, data and process integration, analytics and the internet of things – to eliminate the complexity of platforms and provide seamless integration.

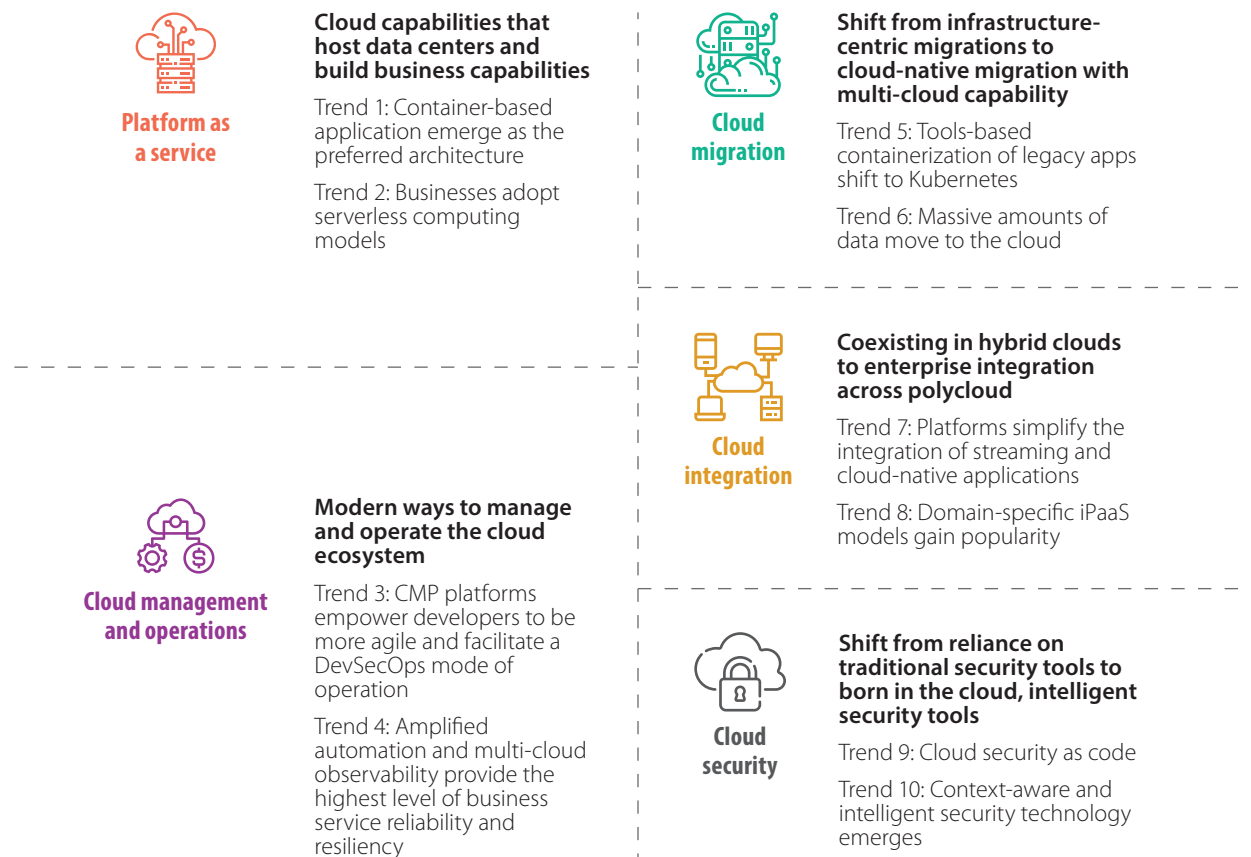
While technologies across all three horizons are relevant for enterprises, consider these cloud

subdomains in the cloud-led transformation roadmap:

1. **Platform as a service**
2. **Cloud management and operations**
3. **Cloud migration**
4. **Cloud integration**
5. **Cloud security**

Let us explore the capabilities and trends of each of these subdomains.

**Figure 2. Key trends across cloud subdomains**



Source: Infosys



# PLATFORM AS A SERVICE



## Cloud capabilities that host data centers and build business capabilities

With the expanded capabilities of managed PaaS, the focus has shifted from hosting compute or storage to providing wholly managed environments to host applications. The future indicates serverless platforms that remove the entire underlying infrastructure.

As PaaS adoption grows, businesses continue to streamline operational efforts, with an emphasis on application engineering and business capabilities. Cloud providers have recognized this need and offer managed containers, integration platforms and analytics in the cloud.

To further ease adoption, cloud platforms support access to their proprietary technologies with APIs of existing open-source components. For example, Azure Cosmos DB supports SQL API, MongoDB, Cassandra and Graph drivers, AWS does the same for DocumentDB with Mongo drivers, as does KeySpace with Cassandra drivers. Overall, we expect PaaS consumption to play a more prominent role in the cloud footprint of enterprises. With PaaS adoption comes a shift in operational responsibility in areas

such as performance and cost to the application team from platform teams.

### Trend 1 – Container-based applications emerge as the preferred architecture

Containers have emerged as the top choice for microservices-based architecture to build resilient and scalable applications for digital initiatives. Cloud providers started with proprietary services for container management, however, significant developments from the open-source community and industrywide adoption have seen Kubernetes emerge as a dominant platform. While cloud providers now offer fully managed Kubernetes environments, there are CSP-neutral managed distributions of Kubernetes like VMware Tanzu, Red Hat OpenShift and Rancher. Application portability is ensured through containerization, but the choice of management approach of Kubernetes also depends on portability required at the management plane.

Infosys partnered with a leading European carmaker to transform their massive legacy application onto Microsoft Azure. We implemented container clusters in a multi-region deployment to handle global transactions and, at the same time, meet stringent performance requirements.

## Trend 2 – Businesses adopt serverless computing models

Cloud services (infrastructure as a service (IaaS) and PaaS) and container management platforms help reduce the cost and complexity to set up, maintain and manage the stack for traditional three-tier applications. However, capacity planning and scalability management continue to haunt the operations teams. Serverless computing eliminates the need to maintain infrastructure and platforms so that

enterprises can focus on great business applications development using services or APIs across functions, stream processing, analytics, cognitive services and security. Foremost industry analysts and a recent Infosys study also validate this trend. Concerns around developer experience and runtime management are addressed through evolving maturity in frameworks and tools, yet there are a few operational changes that organizations need to undergo, including the move to consumption prediction models for better cost control.

Infosys sees the adoption of serverless computing for variable and intermittent workloads as well as atomic back-end processes. We transformed the e-commerce platform of a well-known retailer with fully serverless architecture, which provided a scalable and elastic solution adaptable to business volumes through the use of services such as AWS API Gateway, AWS Lambda and DynamoDB.





# CLOUD MANAGEMENT AND OPERATIONS



## Modern ways to manage and operate the cloud ecosystem

A single cloud service provider provides a wealth of services such as big data, event processing, AI and machine language (ML). Enterprises rely on multiple cloud service providers for their digital journey because their architecture is more complex and necessitates the integration of virtual machines, PaaS and serverless within a specific cloud model or across clouds to deliver highly resilient business applications. A powerful core built on hyperscaler infrastructure drives limitless innovation for these businesses.

The widespread adoption of these cloud services introduces complexities in governance, compliance, integration, security, portability and operations. Therefore, enterprises need a scalable cloud management and operations platform that addresses the complexities and delivers managed and optimized cloud services that can be consumed by businesses. Next-gen cloud management platforms provide native capabilities to support DevSecOps and SRE cultures that can be wrapped on a resource plane that comprises traditional and cloud-native container

ecosystems. These platforms support application deployments and real-time application porting across the cloud, cloud-native and cloud-neutral platforms. Utilizing the declarative scripting of Terraform and SaltStack, these platforms bring a low-code/no-code culture to the ecosystem. Further, they integrate with different point SaaS solutions that deliver billing, metering, security and ITSM capabilities.

### Trend 3 – CMP platforms empower developers to be more agile and facilitate a DevSecOps mode of operation

Enterprises on the digital journey are quick to embrace DevSecOps methodologies to accelerate the development and rollout of business solutions. The speed and innovation required to meet an enterprise's expectations can be delivered, for the most part, by hyperscale providers. While it is easy for developers to consume services through a hyperscaler's native interface, enterprises must ensure that services

delivered meet enterprise governance, compliance and regulatory requirements. Enterprise-grade cloud management platforms (CMPs) ensure that services subscribed through the platform adhere to enterprise requirements to allow developers to expand their solution confidently.

CMPs provide a wrapper of a smart catalog and identify cost-effective and optimized services from the right hyperscaler through the use of AI and ML capabilities. These platforms allow developers to tap into hyperscaler innovations, without any constraints, and act as a guardian rather than as a gatekeeper, which slows down innovation and delivery.

Infosys partnered with a top investment firm to deploy a cloud management and operations platform that provides flexibility to developers on the selection of services. It allows developers to consume services without depending on operate teams to track the compliance parameters. This approach helped increase the productivity of developers and freed the bandwidth of the cloud operate team.

#### **Trend 4 – Amplified automation and multi-cloud observability provide the highest level of business service reliability and resiliency**

Cloud operations are shifting to managed hybrid models that encompass services delivered on the public, private and edge cloud. CMPs enhance their observation capabilities to identify and resolve operational issues and help improve application

reliability. By utilizing AI and ML capabilities, the observability platforms can take preemptive actions to minimize incident occurrence. Furthermore, through continuous learning in ML models, the platform automatically resolves issues with higher accuracy which, in turn, creates a near-ideal self-healing system. Together, observability and AI-based amplified automation help cloud operations eliminate mundane level 1 and level 2 tasks so that teams can spend more time on delivering innovation and value-added services.

With the Infosys Polycloud Platform, we have automated up to 80% of level 1 and level 2 tasks and reduced the number of incidents by 50% in most cases.

To provide an intuitive and developer-friendly interface, CMPs expose services as APIs and provide command-line interfaces such as kubectl. These interfaces bring infrastructure as code features to

provide a full spectrum of services, from bare metal provisioning to Kubernetes cluster creation, along with infrastructure component configurations such as firewalls, switches and load balancers.



# CLOUD MIGRATION



## Shift from infrastructure-centric migrations to cloud-native migration with multi-cloud capability

A Gartner study confirms that a multi-cloud approach is expected to reduce vendor lock-in, with 81% of respondents saying they work with two or more cloud providers.<sup>1</sup>

Over the past few years, cloud adoption has evolved from IaaS to a more cloud-native with multi-cloud strategy, which involves the transformation of workloads into cloud-native or cloud-ready architectures. More recently, the containerization of legacy applications has helped bring scalability, agility, as well as multi-cloud capabilities without a complete re-architecture.

### Trend 5 – Tools-based containerization of legacy apps shift to Kubernetes

Containerization is emerging as a dominant strategy for cloud portability in a multi-cloud environment.

Industry analyst Forrester agrees that container services will become the preferred platform for application development in a multi-cloud environment.<sup>2</sup>

Containerization (with native Kubernetes) avoids cloud lock-in and allows vendor selection based on the best fit. While re-architecture to microservices has been the most prevalent way, it may not be feasible or always required. Alternate mechanisms to make the application ready to run and deploy in containers have become more reliable with tools-based containerization of legacy applications to Kubernetes. S2I, I2D tools and Google Anthos are looking at package applications with low touch to containers and tools like KubeVirt are aiming to run virtual machines (VM) in containers.

Infosys partnered with prominent financial institutions in the U.S. and Europe to move their workloads to Google Anthos-based environments using an automation-driven approach.

## Trend 6 – Massive amounts of data move to the cloud

Gartner expects that, by 2022, inadequate cloud skills will delay half of an enterprise IT organization's migration to the cloud by at least two years.<sup>3</sup> Despite the challenges, organizations must find a more efficient way to move data from their systems of

record to the cloud if they want to achieve better analytics and insights to help drive business decisions.

The portfolios of services from cloud service providers for data integration continue to expand. This space is dominated by niche data transfer products that move massive volumes of data across the hybrid cloud landscape, delivering reliability and performance at optimal cost.

Infosys partnered with a large financial institution in Europe to create a data marketplace and data distribution platform on Google Cloud using open-source technologies and to move data at petabyte .





# CLOUD INTEGRATION



## Coexisting in hybrid clouds to enterprise integration across多云

The global integration platform as a service (iPaaS) market is expected to grow to US\$10.2 billion, at almost 60% CAGR between 2018 and 2023, according to research firm Ovum.<sup>4</sup> The adoption is fueled by SaaS and cloud adoption among enterprises.

The move to the cloud has resulted in IT bottlenecks and process fragmentation due to the inability of legacy integration platforms to scale up and contribute when needed the most. Integration processes built over time carry significant customization issues as well as increased complexity and maintenance costs, creating more roadblocks to the cloud journey.

The application integration must move away from being an IT simplification tool to become a strategic differentiator that makes the cloud more agile. iPaaS platforms and cloud-native integration that use open-source and serverless technologies enable enterprises to integrate at scale, reduce risk and lower costs.

### Trend 7 – Platforms simplify the integration of streaming and cloud-native applications

The integration needs as part of application modernization can utilize the CSP integration platforms and API gateways or open-source and third-party party platforms. Cloud-native integration platforms cater to various enterprise integration patterns and act as a platform orchestrator with its out-of-the-box support for other cloud services. With SaaS solutions a key part of any enterprise landscape, the ability to integrate with them in real-time through API, streaming or batch is also a core capability delivered by cloud services. These platforms aim to reimagine the way the workflow, application integration and API management can help modernize their business processes using a low-code approach.

The low-code integration allows business users to implement the right integration aligned with continuously evolving business needs while retaining

proper organizational controls in the software development processes.

Infosys extended Azure native integration services for a leading food major in the U.S. to provide seamless integration from the business process in SAP with an ecosystem that also involved their partners.

## Trend 8 – Domain-specific iPaaS models gain popularity

The integration platform has moved from the EAI/ESB model to an API and iPaaS model with technologies from cloud service providers and standalone products such as Mulesoft, with over 200 rich connectors for all iPaaS platforms. These products are predominantly horizontal but, with faster application and service development expected, domain-specific iPaaS products will have an extreme focus on specific use cases to deliver better integration capabilities and accelerate time to market. Right now, products such as Greenbird for smart metering and Patchworks for e-commerce integrations lead the market.

For a primary CPG major, Infosys rolled out an iPaaS platform with CPG-specific integration templates to support the B2B market. We brought in operational efficiencies and process scalability in the complex supply chain process across ERP and CRM systems.



# CLOUD SECURITY



## Shift from reliance on traditional security tools to born in the cloud, intelligent security tools

It took time for the cloud to become prevalent, and a primary reason for the delay was a lack of confidence in the cloud's ability to provide security. This concern has been addressed through continuous innovative and dedicated efforts from cloud and security solution providers.

In the initial stages, the cloud environment employed few controls to address security risks. The approach was simplistic and included extending the controls and tools from the data center with legacy monitoring tools that were modified to monitor and manage for the cloud environment. Now, cloud-specific security tools are available that are more efficient and intelligent, enforcing policy and compliance-based deployment for resources to ensure "secure by design" adherence at the first stage.

### Trend 9 – Cloud security as code

A wide range of solutions for security are available from cloud service providers and cloud security-

focused providers that employ advanced technology. However, a dramatic change in implementation is needed if they want to empower developers to consume cloud services without compromising the implementation of security controls.

Today, it is mainstream practice to codify the security of cloud services and policies and embed them into DevSecOps and Rugged DevOps. These practices emphasize the "shift left" of cloud security to codify it in the software engineering and provisioning life cycle. Provisioning and configuration management tools from cloud service providers and open tools such as Ansible and Terraform, codify security controls such as firewall rules and subnet. Tools such as HashiCorp's Sentinel and Pulumi help in codifying organizational security policies. These codified security controls should be part of the CI/CD pipeline to ensure security misconfiguration is avoided early and validated with security-testing DAST solutions that ensure continuous compliance in production.



Infosys partnered with a leading American automotive company to automate the infrastructure setup and security configuration “as code” with pre-requisite software installation, necessary cloud security controls, SailPoint Identity IQ integrated into DevOps pipeline. This provision the fully compliant resources on AWS in under 30 minutes. SailPoint IIQ builds, validation and deployment on different environments is easy with full automation “as code” and upgrade of IIQ achieved in 20 mins.

## Trend 10 – Context-aware and intelligent security technology emerges

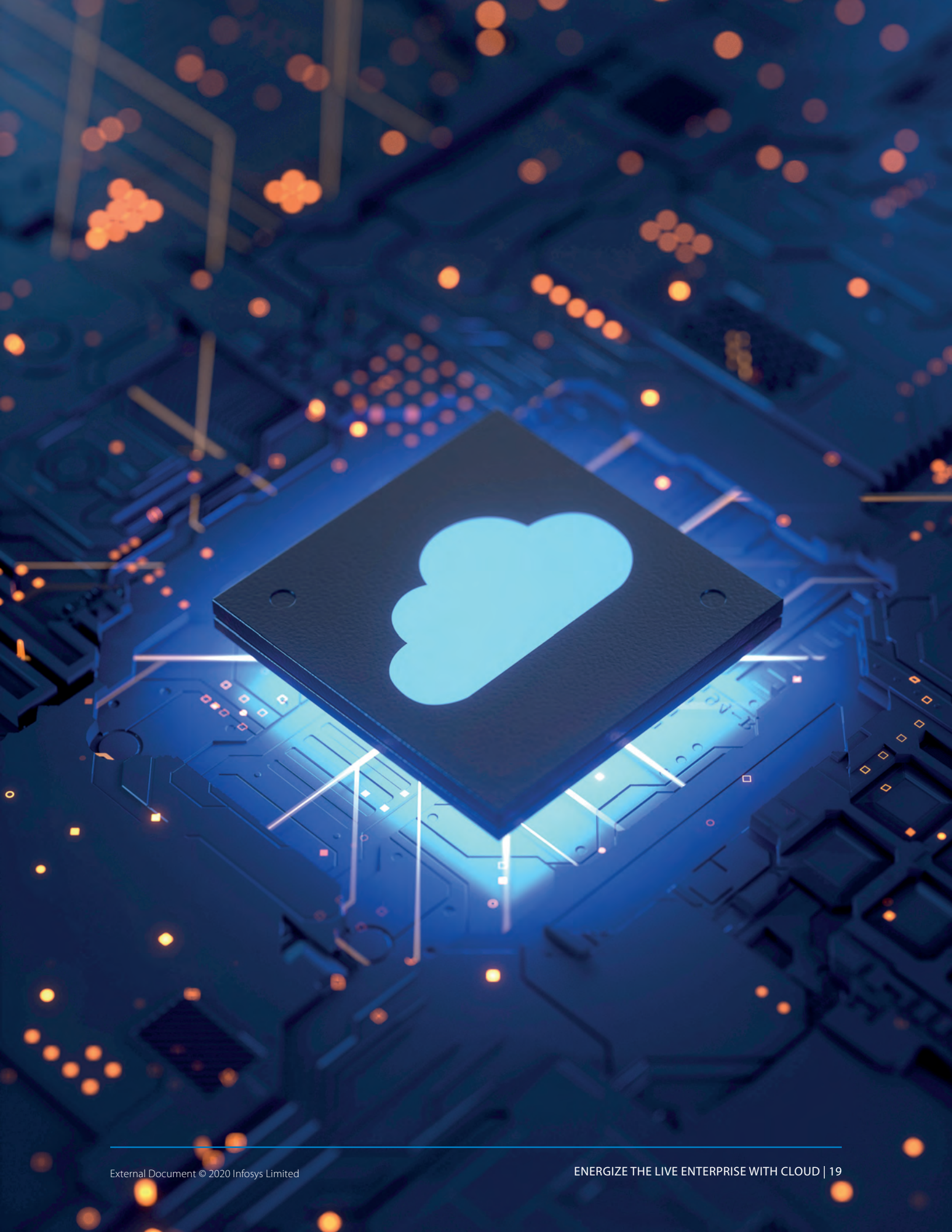
Compliance and regulatory requirements are a big challenge in hybrid clouds. Today, these requirements are addressed through advanced and intelligent platforms from CSPs and specialized third-parties like Prisma Cloud that provide ready-to-use templates and policies for almost all known frameworks. In addition, effective security operations, automation

and technologies such as EDR, next-gen firewall, SIEM and SOAR solutions provide effective security incident management and response handling.

With a lack of defined boundaries, a “context-aware zero trust” model will form the basis of identity and access management of cloud resources. As such, providers are rolling out monitoring solutions to provide AI- and ML-based threat detection and protection capability.

Infosys partnered with a major telecom company in the APAC region to launch new capabilities to its customers. The capabilities were built on Azure Cloud and the security operations were built on Azure Sentinel to monitor the security events from Azure Cloud and on-premised systems. Infosys ensured smooth security events monitoring and response with dashboards and AI and ML capabilities to address every use case.





## References

### Cloud Migration

- <sup>1</sup> [Why Organizations Choose a Multicloud Strategy](#)

### Trend 5

- <sup>2</sup> [5 cloud trends for 2020](#)

### Trend 6

- <sup>3</sup> [4 Trends Impacting Cloud Adoption in 2020](#)

### Cloud Integration

- <sup>4</sup> [Global IPaaS Market To Grow 60 Per Cent To US\\$10.2 Billion](#)



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