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OPEN-SOURCE – PAVING THE WAY FOR DIGITAL TRANSFORMATION

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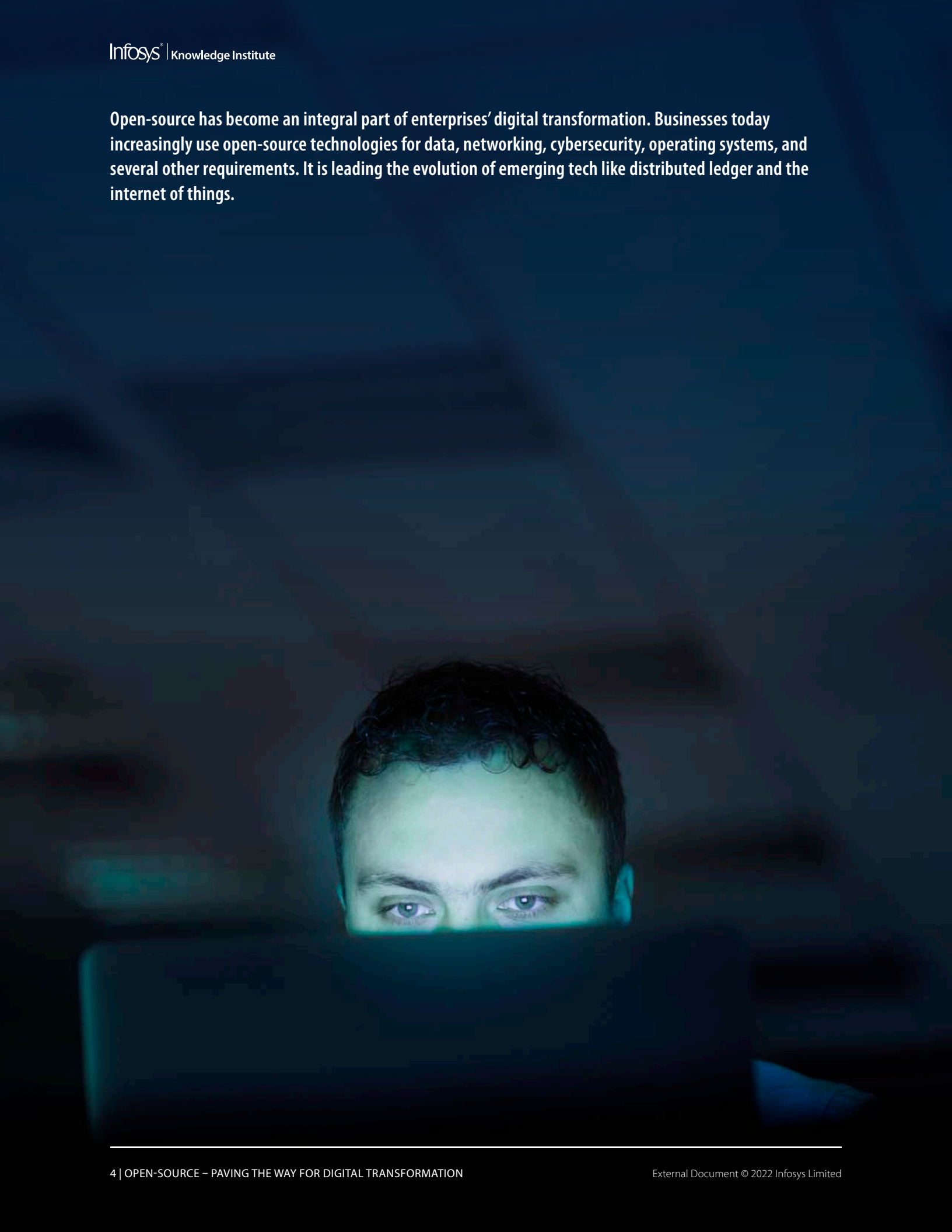
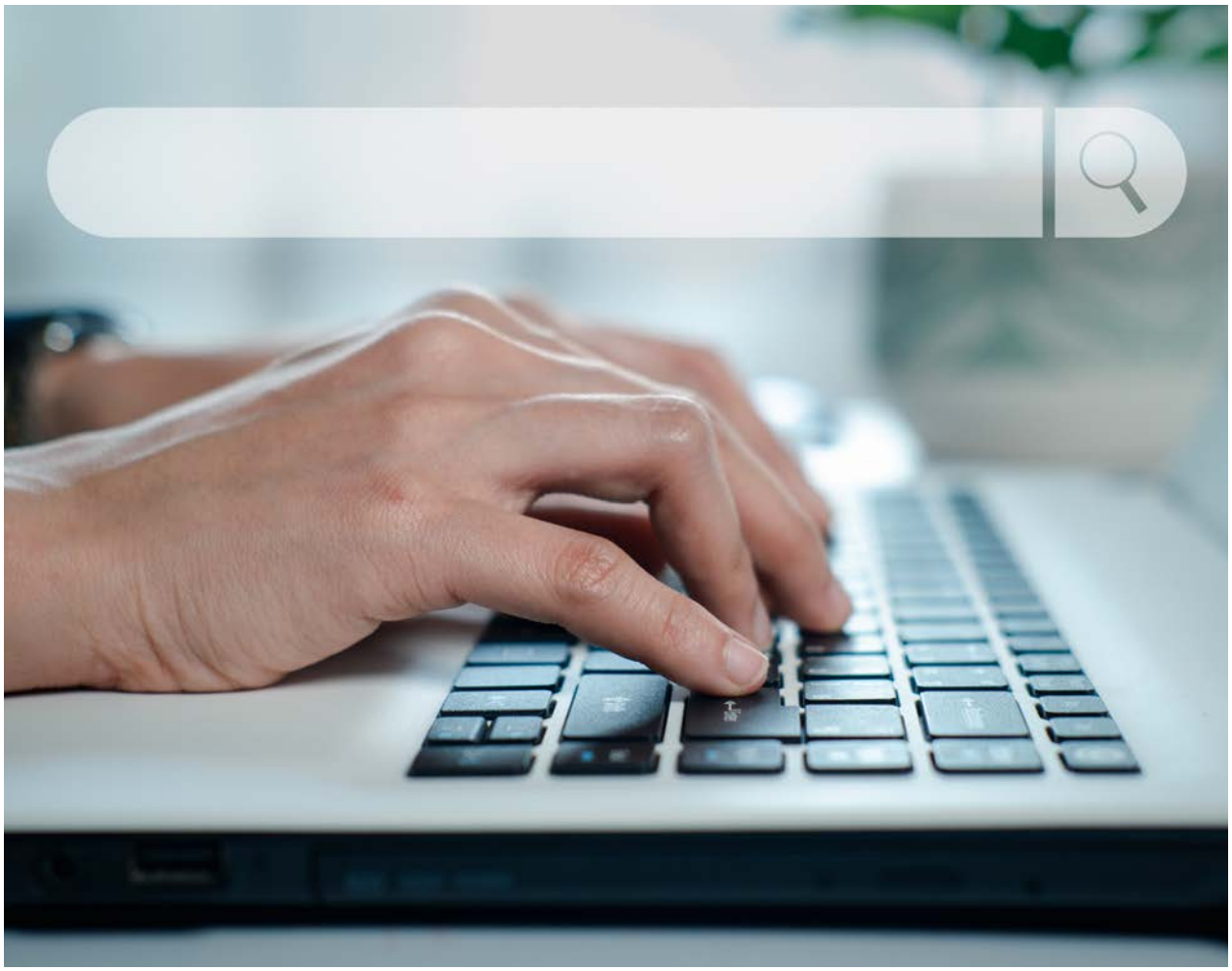
Contents

Open-source has become an integral part of enterprises' digital transformation. Businesses today increasingly use open-source technologies for data, networking, cybersecurity, operating systems, and several other requirements. It is leading the evolution of emerging tech like distributed ledger and the internet of things.





Digital transformation is critical for the survival and future growth of organizations. Artificial intelligence (AI) and automation-powered innovative solutions are the key to new business possibilities. However, associated cybersecurity risks have intensified amid increased remote/hybrid work models and the volatile geopolitical situation. The ongoing uncertainties have also limited the capacity of organizations to spend on transformation.

Data needs to be reimagined while consumers demand a responsive, rich user experience for digital interactions. Organizations must find new ways to continue their modernization journey despite stagnant or even shrinking budgets. All this must happen while enterprises gradually move to the cloud and as a service model.

The evolving technology landscape is not making it any simpler. The average lifecycle of technology has come down from 20-25 years earlier to 8-10 years now. Enterprises must prepare their IT systems, processes, and workforces to absorb the shock of constantly changing technology landscapes.

Open-source technologies offer cutting-edge innovation without any vendor lock-in and give enterprises the power to contribute and steer the direction of technology, rather than becoming hostage to selective vendors' visions. How do enterprises figure out which technologies to invest in? How do they ensure compliance and consistency?

Enterprises should use the principles of resiliency, cost optimization, and security to build a vision based on open-source, cloud, and innovation-driven organizational culture. Infosys' Live Enterprise Suite prescribes a modular, flexible approach to modernize and simplify IT processes by adopting open-source and adding intelligence to the enterprise core.

Evolution of open-source across the three horizons (H1 to H3)

Figure 1: Market dynamics across the three horizons

H3
Driver of digital transformation

Network operations and interoperability
Transformer architecture, self-supervised — AI
AI/ML-based intelligent validation
Decentralized, resilient operations
Intelligent data, new databases
UX-driven, responsive, citizen-developed functions and Application programming interfaces (APIs)
Digital-first, remote-first infra, hyperautomation, data-at-core

KEY PATTERNS

- Deploy anywhere, on-premises, cloud, edge
- Enterprise-scale, integrated and interoperable technologies
- Full-scale, integrated functionality
- Leading future, innovative solutions
- Industry-backed umbrella foundations

H2
Production, planned usage

Transfer learning, explainable systems AI
Full-scale functional and nonfunctional validation
Integrated security for apps, cloud, network, edge
Agile, AI-driven ops
Unstructured data (NoSQL), Cloud DBaaS, and ELT
Distributed, cloud-native microservices
New compute paradigms, collaboration

- Hybrid cloud deployments
- As a service, backed by cloud service providers (CSPs)
- Broad, enterprise grade functionality
- AI-driven efficiency gain
- At par with proprietary solutions
- Large, interconnected foundations

H1
Nonproduction, citizen usage

Data Lite – conventional AI
Siloed, functional validation
App security
Traditional ops
Relational data
Monolithic, on-premises apps
Virtual infrastructure

- Desktop-based open-source tools
- Siloed functionality
- Nonproduction, on-premises deployment
- Catching up on proprietary solutions
- Small, isolated foundations

Source: Infosys

Until recently (H1), most open-source technologies were adopted by developers for experimentation and other nonproduction tasks, while production ran on proprietary solutions. Now (H2), many enterprises have started adopting open-source in a planned manner for production tasks, mainly in operating systems and application technologies.

In H3, open-source is set to become a key to cost-effective digital transformation and innovation. Future open-source solutions will offer unparalleled flexibility in deploying them anywhere, on-premises, cloud, or edge. The variety of open-source solutions conforms to industry standards, paving the way for interoperable and vendor-agnostic solutions. The emergence of several prominent foundations and consortiums is leading to the development of fully integrated solutions. And lastly, the leadership assumed by open-source communities in driving innovation in various emerging technologies and industries will make H3 the era of unparalleled transformation.

We have explored the key trends in open-source across the following seven technology subdomains:

Modern apps

Data

Cloud continuum

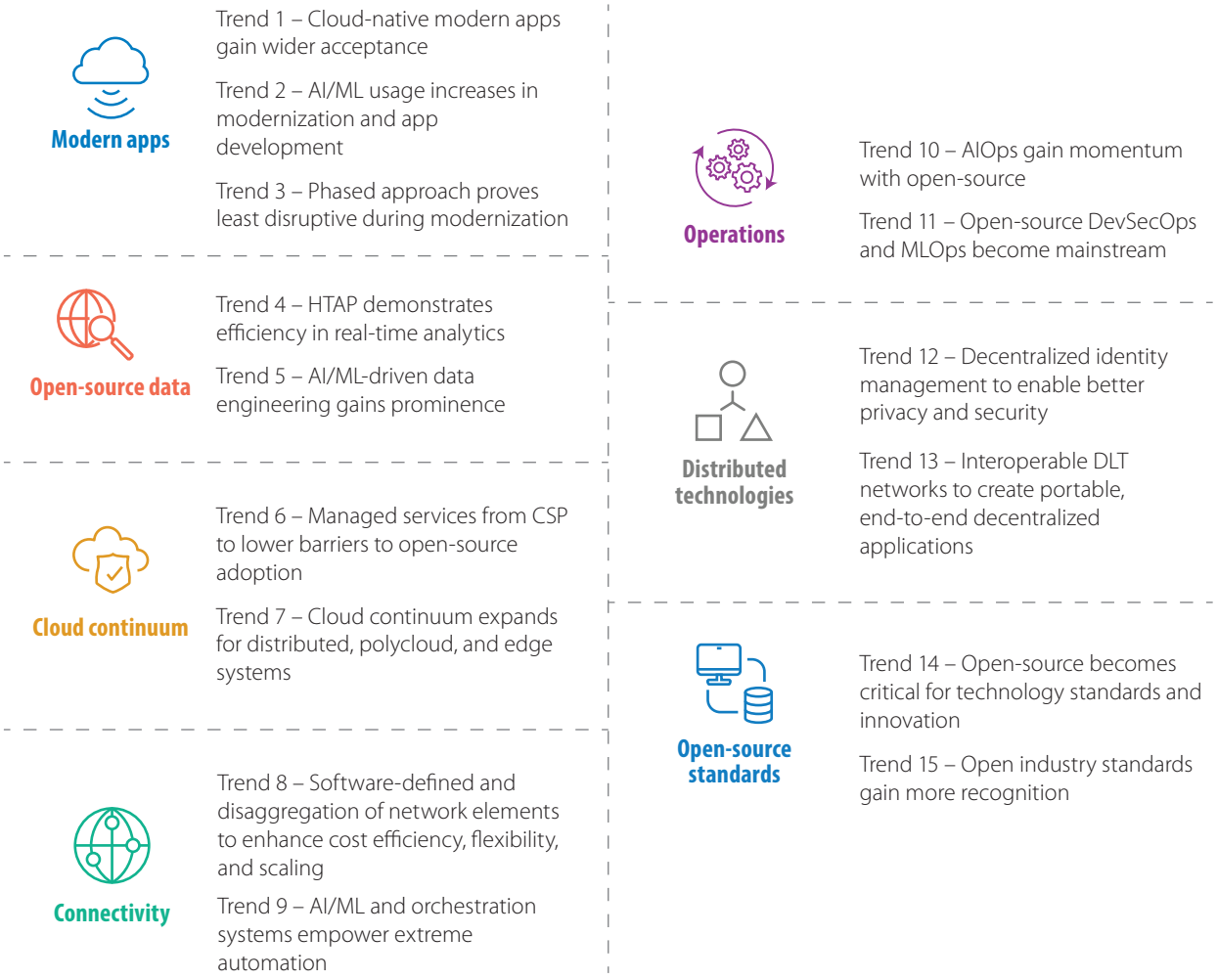
Connectivity

Operations

Distributed technologies

Standards

Figure 2: Key trends across open-source subdomains



Source: Infosys

MODERN APPS

Modern apps have become the agent of more accessible, meaningful, and quicker tech and operational changes. Enterprises use them to boost employee productivity, serve customers efficiently, and speed-up software releases. These apps work independently or in conjunction with other apps to deliver faster business value.

Modern apps are cloud-native and built following SaaS and PaaS concepts. These apps are user-centric with the ability to scale up or down based on user requirements, providing flexibility to decision makers, and helping optimize operations and costs.

A significant degree of modern apps' flexibility and ease comes from open-source tools and practices. It allows developers to share best-in-class tools, applications, practices, and platforms with the broader community. They can also collectively approve or reject code based on its value and usage.

Trend 1: Cloud-native modern apps gain wider acceptance

Cloud-native apps drive digital transformations across enterprises. This fuels the growth of open-source technologies across all layers of the IT stack, including infrastructure, platform, middleware, application, data, and operations. Backed by the cloud, the concept of microservices gained traction with containers and docker. Infosys Cloud Radar 2021 highlighted that companies that moved 60% of their workload to the cloud achieved significantly better performance than peers. It has become the foundation of the entire cloud-native architecture, with Kubernetes further pushing this trend. Modern API design and implementation are based on open-source protocols such as REST and gRPC. Enterprises are further exploring microgateways and other concepts powered by open-source.

An Australian retailer wanted to improve its customer connects across channels. It partnered with Infosys to modernize its mainframe systems and migrate workloads to the cloud. This was achieved using Infosys' accelerate-renew-translate framework for mainframe modernization. With the migration to the cloud and the modernization of native apps, the company achieved faster business growth and unlocked potential from its data.

Trend 2 – AI/ML usage increases in modernization and app development

AI and ML enhance reliability, automation, and efficiency across data analytics, LCNC, quality assurance, and digital experience (speech, vision, gestures, etc). Infosys Modernization Radar 2022 highlighted AI and ML as the third most popular investment area by enterprises, with 96% of businesses leveraging these technologies for their modernization goals. Both technologies have already made their mark on avenues like churning massive volumes of customer data to identify opportunities. Now, they also help businesses accelerate backend applications and development processes. Developers can leverage this opportunity to identify patterns of issues from a complex set of code much earlier in the development process. Combining these patterns with open-source tools like GitHub can help developers use someone else's experience with similar issues to solve their problems. Further, open-source communities for ML have also become instrumental in automating coding tasks.

Subsidiary of a European financial services giant, worked with Infosys to improve its customer experience. The bank wanted to translate documents into data points and usable information. The bank modernized its traditional data management system using Infosys Mortgage Solutions, which provides business process automation for the mortgage industry. Built on open-source, the technologies and tools employ state-of-art computer vision and natural language processing. They also include data correlation, predictive analytics, and classification.

Trend 3 – Phased approach proves least disruptive during modernization

Businesses typically modernize their applications using three approaches: big-bang, phased, and coexistent. Big-bang can be a cheaper option, but it can cause serious risks of rewriting legacy systems and disrupting ongoing services. This approach is more viable for small and easy-to-replace applications. For large-scale modernizations, phased or coexistent methods are better options, as they offer minimal disruption to existing services. However, enterprises need to shell out extra money for additional cloud storage and manage two processes parallelly for the coexistent method. Our Modernization Radar research highlights that the phased approach causes least disruption. It helps gradually migrate to new systems with substantially lower risks than big-bang.

A property and casualty insurance company wanted to modernize its legacy system with zero disruptions for 23,000 agents. The existing system had over 50,000 business rules and over 10 million lines of code. To meet service level agreements (SLAs), the company used microchange management to drive the project with customer-centricity. Legacy workloads were migrated to the cloud in a phased manner, which shortened the implementation cycle by ~30%. The project resulted in ~70% reduced ticket inventory and ~10% productivity improvement for maintenance teams. It also improved agent productivity by 20%.

OPEN-SOURCE DATA

Businesses are increasingly moving to open-source databases away from proprietary counterparts owned by large corporations. Some of the most engaged and productive open-source communities such as PostgreSQL are found in the database space. Distributed RDBMS is an upcoming area with promising open-source technologies, including Yugabyte, VoltDB, Gemfire, etc.

Open-source technologies have heavily dominated the NoSQL space with databases such as MongoDB, Cassandra, and Couchbase. They have become a de facto choice for new application development. Similarly, in the big data space, cloud databases such as Snowflake and AWS Redshift are gaining popularity.

Data engineering space has seen a steady shift in the adoption of open-source technologies (Apache NIFI, Strom, Spark, Kafka), including a shift in automated data engineering with DBT leading the way. The future data consumption space with AI and ML is also heavily dominated by open-source technologies (e.g., TensorFlow, sci-kit-learn).

Trend 4 – HTAP demonstrates efficiency in real-time analytics

Hybrid transaction/analytics processing (HTAP) can reduce the time lag between a business event and its visibility in analytics. By combining the capabilities of a transactional database that provides high speed, atomicity-consistency-isolation-durability compliance, and SQL friendly interface with the broad analytical capabilities of an OLAP/data warehouse, HTAP reduces complexity and enables faster decision making.

HTAP databases use memory structures to allow rapid ingestion of business events that reliably get stored as a system of record. By horizontally scaling out data storage and processing, HTAP databases provide sufficient room to carry out complex analytical queries without any additional ETL process. Further reduction in costs and complexity can be achieved by leveraging a cloud HTAP in an as a service model. Some databases that support this model are SingleStore, GridGain, MongoDB Atlas, and Couchbase.

A large North American bank leveraged SingleStore to create an HTAP database to store master data currently stored on a mainframe DB2 database. By using the in-memory capabilities of SingleStore, the bank could offload over 11TB of data from the mainframe with over 1,000 transactions per second. In the first month of operations, the new database achieved over 27 million read requests, including analytics workloads.

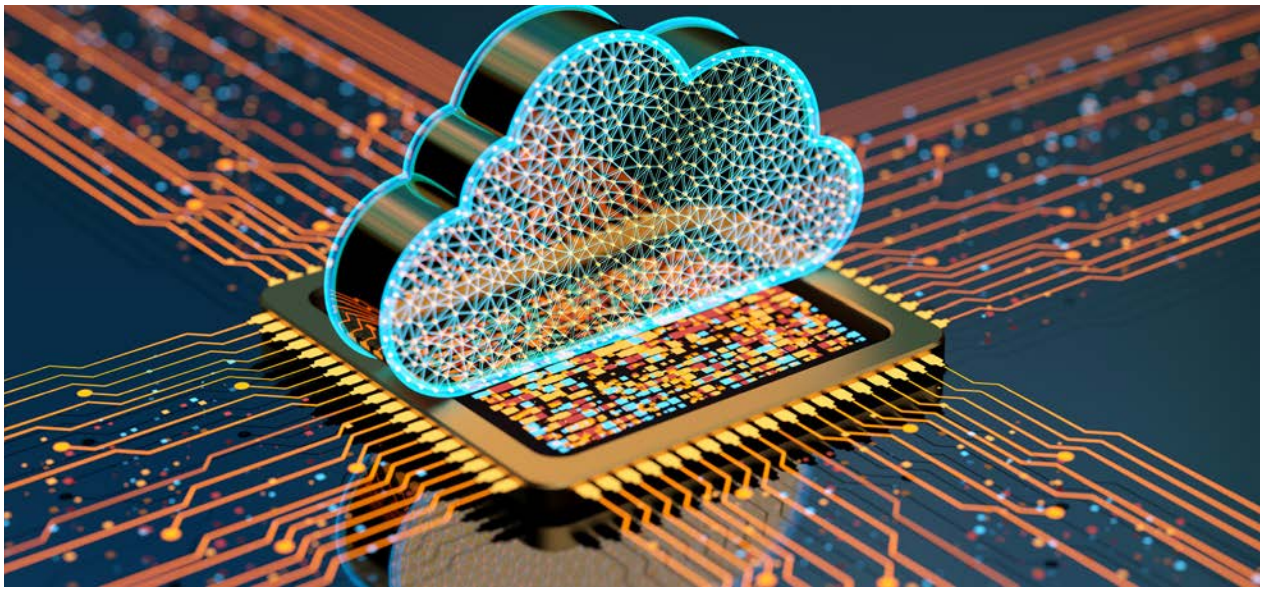
Trend 5 – AI/ML-driven data engineering gains prominence

Businesses today rely on an ecosystem of enterprises to deliver customer value. Each partner in this symbiotic ecosystem is a node that depends on internal information and shared intelligence from other partners. This forces these organizations to be data and intelligence-driven and be agile to respond. While the organizations have adopted agile ways of working, they still rely on traditional hand cranked data pipelines that are requirements-driven and limit the pace at which businesses can respond.

To overcome these limitations, enterprises are shifting toward AI and ML-driven data engineering combined with industry semantics. AI/ML are used for 'source to target mapping', 'auto data curation', 'smart and contextual data quality management', 'data rights management', and 'collaborative data management and governance'. The goal here is to enable engineered systems to process data from disparate systems, learn from experience, and work with humans and machines in a symbiotic relationship.

A leading global CPG company built a retail data intelligence cloud to listen, collate, curate, and drive shopper and category intelligence from retailers. This was a time- and effort-intensive task, involving multiple stakeholders. Infosys implemented an AI-powered data engineering framework that uses ontology-driven services to organize, process POS data signals across retailers, and apply ML-driven data quality. The solution made it a machine-run, human-assisted process. This reduced retailer onboarding time by 50% and time to insight by 30%.

CLOUD CONTINUUM



Open-source offers a series of innovation opportunities for internet companies and cloud-native organizations. However, organizations did not have the required engineering capabilities earlier to manage such opportunities. To help manage open-source technologies from the upstream distribution, new companies emerged to provide enterprise distribution like RedHat and SUSE for Linux, Hortonworks, and Cloudera for Hadoop. Another variation is enterprise subscription and support from the core open-source committers themselves like Confluent for Kafka and Elastic for Elastic Search. While these enterprise subscriptions alleviated support-related issues, the complexity of adoption increased with a rising number of vendors.

Trend 6 – Managed services from CSP to lower barriers to open-source adoption

CSPs are strengthening their PaaS portfolios by providing managed services for a wide range of open-source technologies, complemented by PaaS/marketplace solutions from the core committers organization on the CSP of choice. This opens the opportunity to explore a vast collection of open-source technologies, experiment with them with low entry barriers, and bring open-source technologies into single consumption process on scaling up the adoption.

A leading technology product company, which delivers its services as SaaS, could not meet business SLAs due to the complexity of managing a multitude of open-source technologies used in building products. The company's platform was not scalable to meet its business growth and stability requirements. Infosys helped the company transform with Google Cloud by adopting managed PaaS like GKE, DataProc, Cassandra from Marketplace, and Kafka from Confluent. The company improved the platform availability to 99.97%.

Trend 7 – Cloud continuum expands for distributed, polycloud, and edge systems

Cloud continuum has expanded seamlessly for distributed, polycloud, and edge systems. New architectures and topologies shape the cloud's evolution of new possibilities across private/public/hybrid/multicloud patterns and tap into a chain of distributed resources to the edge.

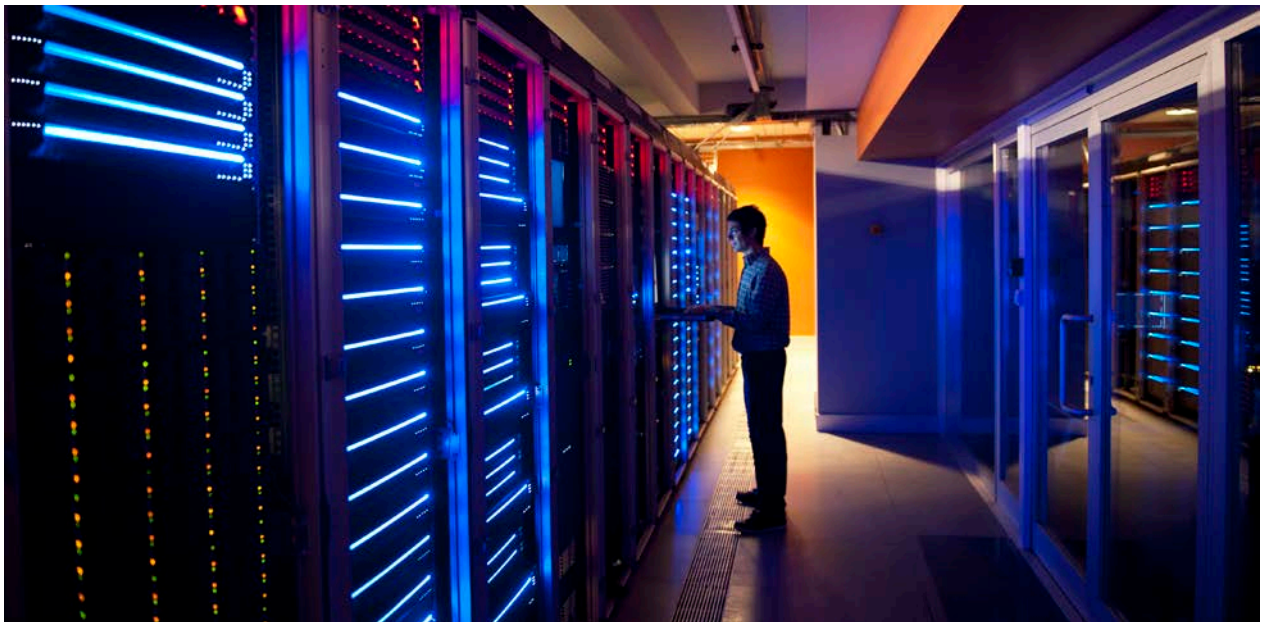
Enterprises that started their cloud journey with chosen hyperscalers are evolving into multicloud, hybrid cloud, and/or distributed edges incrementally. This is improving their resiliency maturity levels, portability, and cloud neutrality. While many intra-POD capabilities have developed, distributed architectures for inter-POD/cloud-native modern app needs have begun unfolding multicluster, multicloud, multikubernetes federations for service-mesh discovery/visibility and overlays.

Shifting data boundary, movement of security defenses into the cloud, and modern hybrid ecosystems collaboration drivers have led to the deperimeterization phenomenon, pushing borderless access transforms at the edges. A lot is happening at the edges – zero-trust architectures, multicloud exchanges, and unified CPEs/NFV-edges. All of these will have to transform in tandem as the patterns shift. Clients urgently need to onboard, accelerate, and provide quicker access to rapidly evolving partner ecosystems, mergers and acquisitions, subsidiaries, and gig workers. This would imply connecting enterprises' service edge access securely from machines outside one's administrative domain(s).

Hyperautomation around the cloud is going to deliver self-healing/self-defending orchestrations. Cloud compliance, governance, and cybersecurity practices are an integral part of the continuum in an increasingly risky world, and defense shields need to keep pace ahead of emerging threats.

> Infosys' deperimeterization is a zero-trust platform infra solution, which enables secure hybrid EDGE access for extended ecosystems and accelerates onboarding-cocreation-collaboration for subsidiaries, mergers and acquisitions, trainees, partners, gig workers, and client projects. Secure zero-trust fine-grained platform authorizes access from nondomain connected machines, enabling enterprises to safely enroll external ecosystems.

CONNECTIVITY



Over the past few years, the network industry has undergone multiple transformations and is slated to evolve further. Modern day network is software-defined (SDN), and many of the network elements are architected and developed as cloud-native. The advent of open architecture in wireline (CORD), wireless (O-RAN), and orchestration (ONAP) has brought open-source into the mainstream of networking. Most of core, edge, and access networks are moving toward container and virtual network functions. Their controllers such as RIC and orchestration are available in open-source. The container as a service for network loads is powered by open-source like Kubernetes, but it requires heavy hardening and change. The adoption of 5G, multiaccess edge computing, and, in future, 6G will further amplify the importance and use of open elements.

Trend 8 – Software-defined and disaggregation of network elements to enhance cost efficiency, flexibility, and scaling

Telecom service providers and enterprises are increasingly looking at options to reduce CAPEX and OPEX on networks while reducing dependence on select vendors. Disaggregation and software defined abstraction enable them to have a choice of hardware and software. Open networking and open-source components play a major role in creating this disruption.

Two important standard forums and architecture pushing this forward are CORD architecture (by ONF) and O-RAN (by O-RAN alliance). CORD architecture essentially proposes to break the embedded network elements to open hardware and open-source software. ONF has come up with multiple reference implementations like Trellis, software enabled broadband access and converged multiaccess and core, which accelerates the adoption. While O-RAN is standardizing the open wireless radio access network.

The role of system integrators is evident in this journey, as they need to harden the components, integrate them, and provide a single accountable interface to the customer. Infosys has hardened ONF components available as Infosys Network Edge Controller and Infosys Software Defined Access to accelerate the adoption.

A leading North American cable multi-system operator achieved cost efficiency, edge scalability, and operational efficiency by using ONF Trellis as software and white-box as hardware for disaggregating the network fabric. Infosys helped the company integrate this solution and build the cloud service and management layer using open-source components. In the process, Infosys had closely worked and contributed to multiple open-source projects in ONF and K8s.

Trend 9 – AI/ML and orchestration systems empower extreme automation

Enterprises find it challenging to orchestrate multidomain end-to-end observability. Open-source libraries provide ML/AI algorithms (such as Spark) to create network-specific assurance use cases. Data management and dashboarding are increasingly using Kibana and Grafana as underlying components. Open-source-based orchestration for slice management and vendor-agnostic automation frameworks are getting renewed focus. ONAP from LFN is one such example.

The business value of the above can be completely derived only by taking these available open-source and converting them into the right solutions which address business problems like multidomain orchestration, enabling zero touch provisioning, network assurance for operational cost reduction, etc. Infosys has used open-source AI/ML libraries in developing an AI/ML-based predictive closed loop assurance solution called Infosys Smart Network Assurance.

A European energy and utility company partnered with Infosys to transform some components of its operations. It used Infosys' open-source-based AI/ML network assurance solution - Infosys Smart Network Assurance for AI Ops. The solution brought end-to-end visibility, improved predictive fault management, device metric analysis, and proactive alerting and automation. The company reduced operational costs by 30-40% and improve cycle time by up to 80%.

OPERATIONS

Operations have evolved from being IT- to business-focused. This transition has also boosted autonomous solutions with a focus on observability, resiliency, AIOps for the app, IT support, and cognitive automation for business and IT tasks with zero touch. It is supported by a thriving Agile ecosystem and rapid innovation culture, collaborative value generation, and business citizen developer enablement.

This space is dominated by open-source software and it competes with established vendors like Dynatrace, Datadog, AppDynamics, SolarWinds, uDeploy, Crucible, etc.

Trend 10 – AIOps gain momentum with open-source

AIOps comprise seamless monitoring, data gathering from various apps, devices (sense), intelligent correlations, insightful analytics, and zero touch automation as the primary solution pillars. It is leveraging low-code, configuration-driven, cloud-native, open-source solutions to take enterprise Ops intelligence and productivity to the next level.

It is augmenting the decision makers with the right problem management insights (think), eliminating humans in the value chain where it could be automated (act). With AIOps, enterprises can devote more resources to business issues than IT issues. It is also helping move enterprises from reactive to proactive to predictive and pre-empt the disruptions and execute possible resolutions. To further enhance innovation speed, enterprises embrace Agile innovative practices, including Living Labs, Hackathons, etc. and rapidly interweaving the output with the IT processes. IT provisioning is evolving into the cloud and serverless, as a service-based appliance than the traditional hosting, making it faster, cheaper, secure, and more resilient. To support AIOps, platforms and tools are becoming more integrated and self-sufficient. All these result in lower OpenX for support and increased opportunity space due to avoidance of disruptions. As this space matures, we see it evolving into AIOps as a service through cloud subscriptions, and would integrate with newer forays like AR/VR, IoT, 5G to take Ops to the next level.

A global CPG player wanted to revamp its operations into intelligent AIOps. Infosys helped it deploy self-service through intelligent chatbots, intelligent ticket routing, and auto resolution using robotic process automation. Real-time monitoring and dashboards helped the company to get a live pulse of apps, infra, and associated disruptions. Beyond the traditional incidents-based measures of change initiative impact, the self-service system also measured net promoter score for the end users to assess net impact. This helped transform the traditional support system into an intelligent, resilient, Agile, and efficient system.

Trend 11 – Open-source DevSecOps and MLOps become mainstream

While AIOps is bringing efficiency in operations, DevSecOps is helping development teams build and deploy apps faster and make them secure. It ensures on-demand infra, near real-time vulnerability detection, app lifecycle automation, automate mundane tasks, and ensures standards compliance. This space is dominated by open-source tools and frameworks that allow low-code approach, easy customizability for power users and visibility into app tech debt. From mere developer-oriented tooling, DevSecOps is evolving into a strategic, gold standard for enterprise app dev processes. Beyond traditional apps as well as soon-to-be-mainstream containers, MLOps modules are helping embrace DevOps for ML apps. The deployment targets are moving from on-premises to hybrid cloud, even serverless as the infra matures. Due to gated activities, DevSecOps allows controlled review, check-ins, and deployments at a rapid pace, across environments and in production. There are multiple reference implementations available for an enterprise to leverage and adopt. While the current maturity of AI-driven DevSecOps is low, this is the space to watch and grow in the medium to long term.

An industry-leading semiconductor manufacturer was facing issues due to frequently changing business requirements, long deployment times, long test cycles, lack of standards, security pitfalls, and inconsistent and slow deployment processes. Infosys helped the company in digital transformation by assessing the current maturity, implementing DevOps automation, and JIT infra provisioning. It also included security testing, and continuous monitoring and reporting throughout the transformation journey. The company achieved reduced build, release cycle time, multifold increased deployment success rate, optimized infra costs, more secure app delivery, and permanently embedded compliance standards.

DISTRIBUTED TECHNOLOGIES

The early application of distributed ledger technologies (DLTs) was for cryptocurrency to enable the transfer of value represented by the cryptocurrency coins or tokens over a decentralized network. These transactions were immutably recorded on a distributed ledger after being validated through a proof of work consensus algorithm. The next milestone in DLT was the introduction of Smart Contracts, which allowed implementation of transaction processing and validation rules programmatically. This made it possible to develop decentralized applications on DLT that implemented business workflows. These applications lacked features such as privacy and scalability, limiting their enterprise adoption.

Several DLT platforms have evolved over the years. Private-permissioned DLTs specifically cater to enterprises by focusing on privacy, scalability, network operations, and governance. These have seen adoption across the industry for several use cases such as supply chain traceability, contract management, etc. On the other hand, public DLTs provide open access and have created worldwide networks of publicly available nodes. These are widely used to implement novel use-cases such as nonfungible tokens and decentralized finance.

DLTs are expected to become interoperable and enable trusted ecosystems that run decentralized applications. These interconnected ecosystems will enable the end-to-end implementation of existing and new use cases. Further advances in user experience along with deployment, management, and governance of DLT networks will boost enterprise adoption. These developments will pave the way for web 3.0 — the next generation of digital services and business models built on decentralized applications.

Trend 12 – Decentralized identity management to enable better privacy and security

Traditionally, personal identity information is managed by centralized organizations that could be public authorities or large private corporations. Third parties can authenticate the identity of individuals by verifying these credentials with the issuer. This centralized approach leads to privacy risks and makes these organizations potential targets for cyberattacks and identity theft.

Decentralized identity management solutions use DLT to address privacy and security issues. It follows the self-sovereign identity model, where individuals are the custodians of their identity information with full control over how their data is accessed and used. This is implemented using encrypted and verifiable

digital identity credentials that the issuer directly sends to individual's identity wallet. The individual can present these credentials to others, who can then verify them on the DLT without contacting the issuer. The credentials themselves are not stored on the blockchain and they cannot be forged, duplicated, or reused. Using zero-knowledge proofs, selective disclosure is also possible. Individuals can share only a subset of attributes from their identity credentials, thus providing only the minimum necessary information to others.

DLT frameworks such as Hyperledger Indy and Aries have been custom-built for supporting decentralized identity management solutions. Soon, it would be possible to provide decentralized credentials to everyone and integrate them into enterprise workflows for user authentication and authorization. Through decentralized identity management, organizations can mitigate privacy risks and comply with personal data protection laws enacted across several jurisdictions.

> A U.S. state regulator was facing difficulty due to the manual process of issuing business licenses, which was inefficient and time consuming. Infosys helped the government entity implement a DLT solution to issue and verify licenses. The system uses decentralized identity management, and has streamlined the licensing process and simultaneously strengthened citizen privacy and data security.

Trend 13 – Interoperable DLT networks to create portable, end-to-end decentralized applications

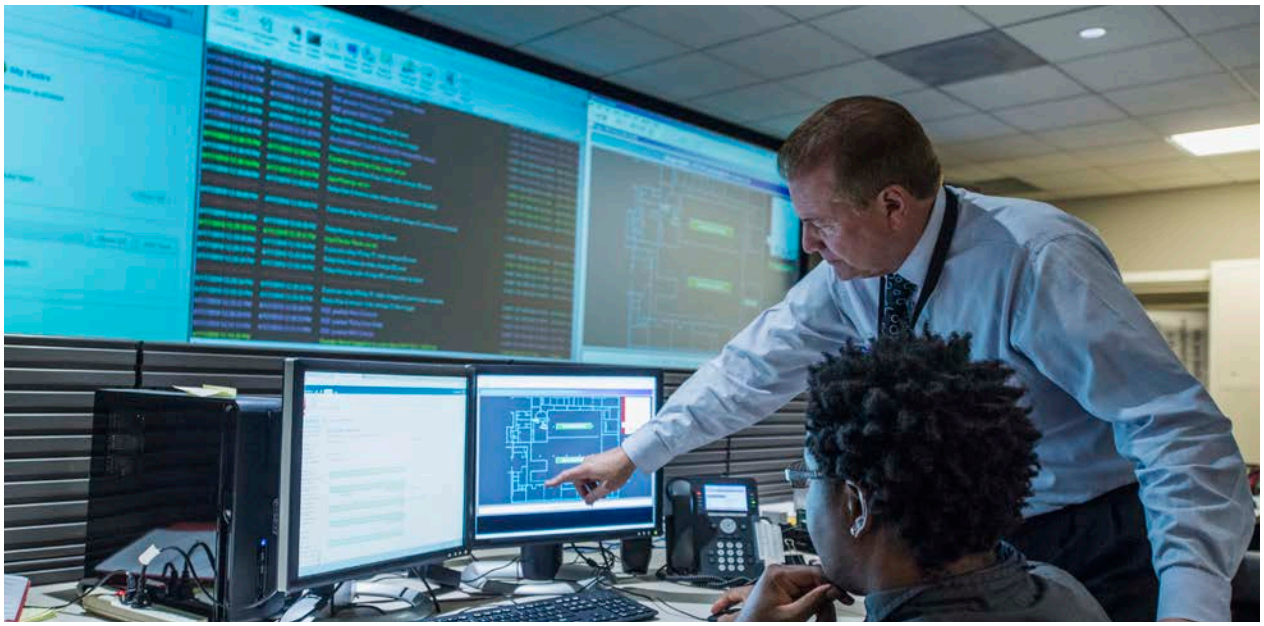
Currently, most DLT platforms and networks are not compatible with each other. This makes it difficult to develop portable solutions that can span across multiple networks while maintaining trust and security guarantees associated with DLT. For enterprises working with DLTs, it creates platform/vendor lock-in and requires them to maintain multiple versions of the same application.

Bridging solutions (called blockchain bridges) partly solve the problem. These can transfer data from one DLT network to another along with proof of correctness. For the transfer of value, crypto tokens are used, then they are locked or burned in the source network, and then an equivalent number of tokens are minted in the destination network. They, however, do not address application portability or provide any means of direct interaction between applications deployed on different DLT networks.

At various maturity stages, other solutions provide frameworks and tools to address limitations. The digital asset modeling language is a smart contract language and development platform that enables to develop portable applications that can run on top of many available DLT platforms and databases. It also provides for cross-platform application deployment. Similarly, Hyperledger Cactus is developing the tooling designed to securely integrate different DLTs and making them interoperable.

> A connectivity solutions provider partnered with Infosys to create a DLT-based solution for reconciling billing records. The solution uses a blockchain abstraction layer to make it work across different DLTs in a unified and consistent manner. This enables communication service providers who use the solution on one DLT platform to seamlessly reconcile their billing records with other providers using other DLT platforms.

OPEN-SOURCE STANDARDS



Standards and interoperability help with the commoditization of technologies. These help enterprises optimize costs, avoid vendor lock-ins, and manage skills requirements. However, standardized implementations are not always easily available. Vendors often create proprietary standards to lock in customers. Open-source is changing that, slowly but surely.

Several foundations and industry consortiums are developing and evangelizing open standards for technologies and specific use cases. These include pure technical standards such as AI, data, cloud, and industry standards such as 5G and open banking.

Initially, technology vendors collaboratively started these foundations. They saw immense value in open standards as they allowed them to easily integrate with other technologies and quickly build wide support ecosystems.

Enterprises, typically consumers of technologies, have become active participants and contribute to such efforts. Open-source empowers them to influence the direction and roadmap of standards that directly impact their capability to create flexible and agile solutions. The main enterprise participants include large digital savvy enterprises like large banks, telcos to digital natives, and startups.

Trend 14 – Open-source becomes critical for technology standards and innovation

Open technology standards have become critical in resolving complexity stemming from ever-expanding technology sprawl. Several open-source foundations are leading the development of standards and aggressively pushing their adoption.

Several new foundations have led the evolution of open-source, vendor-neutral standards and technologies. Internet Architecture Board, earlier known as Internet Configuration Control Board, is one of the initial bodies to provide architecture oversight and manage internet standards. Then emerged other bodies such as Cloud Native Computing Foundation, Business Process Modeling Notation, Center for Internet Security, and Open Web Application Security Project. Even the emerging technologies standards are evolving in open-source foundations. For example, Sovrin is establishing a governance framework for self-sovereign identity on the internet, a hyper ledger-based identity management solution. Similarly, Open Networking Foundation promotes open-networking and software-defined programmable networks.

By creating interoperable, vendor-neutral ecosystems, open standards help prolong technologies' lifecycle,

reduce wastage, and save the planet. They encourage healthy competition and reduce the overall costs of an enterprise solution.

A leading multinational automotive manufacturer faced several challenges with a decades-old legacy application. The system suffered frequent business disruptions, nonintuitive user experience, and high costs. In association with Infosys, the company modernized the system using open-source, cloud-native technologies (Node.JS, Kubernetes, Kafka, Elastic, etc.). As a result, the company could deliver 10% effort saving for end users, less than 0.5% downtime, and saved US$50,000 in annual costs.

Trend 15 – Open industry standards gain more recognition

Industry-specific standards have emerged recently. Industry players are building open standards and joint solutions to accelerate the innovation for specific industry use cases. Foundations and consortiums in all major industries are trying to evolve the next generation of solutions in their respective fields. The most wide-ranging industry initiatives are happening in the financial sector, with multiple consortiums contributing to several areas. The banking architecture network is leading the charge in digital banking; open banking projects are pioneering open banking standards and concepts; and the fintech open-source foundation is focusing on open-source software and standards. Similarly, in the energy sector, LF Energy is transitioning to robust, secure open-source solutions that help reduce carbon footprint. Open Group Open Subsurface Data Universe is developing open standards and common data architecture to transition to a lower carbon future.

In the telecom domain, TMForum enables service providers, technology vendors, and system integrators to develop open APIs and frameworks and drive innovation to accelerate digital transformation. Anuket is another project concentrating on developing reference architectures, conformance programs, and tools to transform network services.

Health Level 7 (HL7)/Fast Healthcare Interoperability Resources develop and maintain HL7 open specifications for interoperability in healthcare. Similarly, the open manufacturing platform drives innovation across the manufacturing community and value chain to build platform-agnostic solutions, open standards, and technologies to enable smart manufacturing.

A FinTech startup in the working capital space partnered with Infosys to build a highly scalable and reliable account aggregator platform to disburse loans faster. Infosys' Banking API Platform helped accelerate the development of the solution, which implemented RBI AA open banking specification using an open-source technology stack to deliver 50% faster time-to-market.

Glossary

Abbreviation/Acronym	Full Form
AI	Artificial intelligence
AIOps	Artificial intelligence for IT operations
API	Application programming interface
CORD	Central office re-architected as a datacenter
CSP	Cloud service providers
DBaaS	Database as a service
DLT	Distributed ledger technology
ELT	Extract, load, and transform
HTAP	Hybrid transaction/analytics processing
LCNC	Low-code, no-code
ML	Machine language
MLOps	Machine learning operations
OLAP	Online analytical processing
ONAP	Open network automation platform
O-RAN	Open radio access network
PaaS	Platform as a service
RDBMS	Relational database management system
SaaS	Software as a service
SDN	Software defined networking
UX	User experience

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