IDC Analyze the Future

IDC FutureScape

IDC FutureScape: Worldwide Enterprise Infrastructure 2018 Predictions

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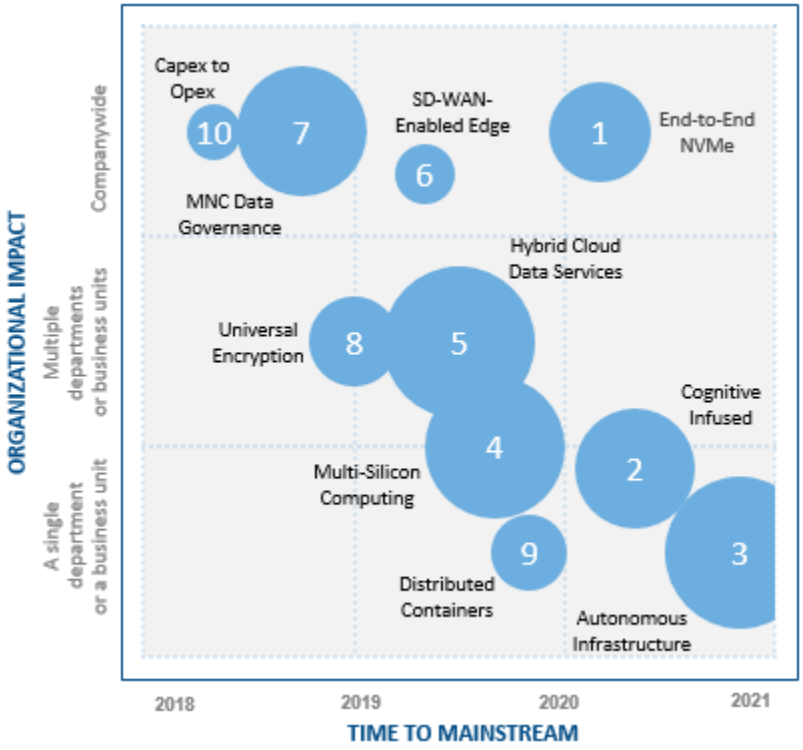
IDC FUTURESCAPE FIGURE

FIGURE 1

IDC FutureScape: Worldwide Enterprise Infrastructure 2018 Top 10 Predictions



Note: The size of the bubble indicates complexity/cost to address.

Source: IDC, 2017

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Figure 1 presents IDC's enterprise infrastructure top 10 predictions in terms of their likely impact across the enterprise and the time it will take for the predictions to reach mainstream. By mainstream, IDC means the broad middle of the bell curve of adoption (i.e., the 40–60% of enterprises that are neither the first movers and early adopters nor the last to act). Each bubble's size provides a rough indicator of the complexity and/or cost an enterprise will incur in acting on the prediction.

EXECUTIVE SUMMARY

IT leaders have never had so much choice in their infrastructure strategies, both on-premises and in a hybrid or off-premises world. With this choice comes the potential to positively impact budgets, staffing, operational effectiveness, and business outcomes.

This IDC study presents IDC's enterprise infrastructure top 10 predictions for 2018. Highlights include that by 2021, the following will be true:

- NVMe will replace SCSI as the protocol of choice in enterprise-class arrays; more than 25% of spending on AFAs in 2021 will derive from end-to-end NVMe-based systems.
- 50% of enterprise infrastructure will employ cognitive and artificial intelligence (AI) to improve enterprise productivity, manage risks, and drive overall cost reduction.
- Spending on hybrid cloud data services for data protection, integration and orchestration, security and compliance, and location optimization will total more than $60 billion.
- 65% of enterprises will be deploying universal encryption on server infrastructure to comply with data privacy, integrity, and confidentiality.

This IDC study presents IDC's enterprise infrastructure top 10 predictions for 2018.

"Digital transformation has given rise to new IT imperatives, which span modernizing enterprise infrastructure, developing data-centric strategies and organizations, and providing the most agile, IT services in response to real-time business demands," said Laura DuBois, group vice president at IDC's Enterprise Storage, Server, and System Infrastructure Software.

IDC FUTURESCAPE PREDICTIONS

IDC has identified four technology forces and seven innovation accelerators that are at once both enabling digital transformation (DX) and creating disruption with established IT segments. It is these technologies that successful CIOs will embrace as they embark on three imperatives: modernizing the IT foundation, enabling new products and services, and developing future-looking, data-driven organizations. In this IDC FutureScape, we identify the technologies that CIOs and IT organizations must begin to evaluate and implement to not only remain competitive but to outperform their industry peers. Increasingly, the CIOs of the future must craft a path to both refresh and support existing systems with greater efficiency and economies while pioneering an organization that has the skills, processes, and technology that serve as a launchpad for greater levels of both operational and business innovation, doing so while often transforming cultural norms, practices, and work patterns.

This IDC FutureScape serves as a blueprint for enterprises that will thrive in the modern, digital economy by leveraging technology to forge new business models, customer experiences, and products with data serving as the foundation of the new opportunities. Increasingly, the CIO alone cannot enable this transformation. Instead, it is the CIO in concert with new leadership roles – from

data officers to innovation officers to data scientists and technology officers that together can bridge the path to the data-centric organization. CIOs must reinvent their organizations or else risk becoming ineffective or obsolete.

Summary of External Drivers

- **Accelerating DX:** Technology-centric transformation altering business and society
- **Human versus machine:** The impact of AI and automation
- **Innovation impasse:** Legacy systems constraining transformation
- **Cyberthreats:** Theft, ransom, and cyberattack on the rise
- **DX delta:** Leaders and disruptors widen performance gap
- **Pace of change:** Technology capabilities enable sustainable change at the speed of digital business
- **Platform disruption:** Unleashing digital innovation's power for scale

Predictions: Impact on Technology Buyers

The predictions in the sections that follow will have an impact on CIOs and IT organizations over the next decade. As a consequence, innovative and forward-looking IT leadership will begin to evaluate where, how, and when the infrastructure technologies included in these predictions will be evaluated, tested, and deployed in their organizations and based on what business outcomes sought.

Prediction 1: Through 2021, NVMe Will Replace SCSI as the Protocol of Choice in Enterprise-Class Arrays; More Than 25% of Spending on AFAs in 2021 Will Derive from End-to-End NVMe-Based Systems

The use of big data is changing the way businesses evolve, and while today there are few companies that are highly dependent on real-time big data analytics to drive business results, the use of real-time big data analytics will spread across the Fortune 2000 and become increasingly mission critical in its orientation. The penetration of real-time big data analytics will be part of the digital transformation that business undergo. Leveraging real-time data capture from mobile, social media, and cloud computing environments will provide an unprecedented ability to spot new market opportunities and draw correlations that will drive a deeper understanding of how to take advantage of them. It will also provide better security capabilities by leveraging machine learning to detect and defend against increasingly sophisticated threats (fraud analytics and related areas). With the speed of business proceeding at a rapid pace, real-time analysis and response will become a necessary capability in many IT infrastructures.

By 2020, 60–70% of Fortune 2000 companies will have at least one mission-critical workload that leverages real-time big data analytics versus batch analytics. For real-time big data analytics, the amount of data that will need to be captured and processed in real time will drive the need for the performance of NVMe technology. Rack-scale flash systems – storage solutions that feature end-to-end NVMe technology – are needed to address these requirements. These systems first emerged in 2016 and are distinct from primary and big data flash arrays in that they feature NVMe rather than SCSI technology end to end (NVMe devices, array backplanes and controllers, and NVMe over Fabric host connections). Today, they lack enterprise features (in particular, a rich set of data services), but given the workloads they're being sold for (primarily unstructured data sets), that is not yet an issue. They feature blazing performance, however, delivering tens of millions of IOPS from centralized

storage that can be shared across literally hundreds of application servers with basically the same latencies that customers are today getting from local PCIe SSDs.

While real-time big data analytics is an early workload driver of NVMe penetration, as enterprise NVMe technology matures, comes down in price, and is readily available from multiple sources, an increasing number of enterprise customers will want to buy NVMe storage appliances (rather than just purchase NVMe devices). As rack-scale flash systems mature into more general-purpose enterprise storage platforms with the data services capabilities necessary to manage multitenant workloads, customers that were originally only using them for real-time workloads will look to move other more mainstream workloads to them as part of consolidation efforts to simplify their infrastructures.

Associated Drivers

- **Accelerating DX:** Technology-centric transformation altering business and society
- **Innovation impasse:** Legacy systems constraining transformation

IT Impact

- IT organizations can use NVMe performance to achieve security and compliance, supporting use cases such as fraud detection, anti-money laundering, and surveillance.
- Infrastructure teams will need to plan for migration of legacy systems to new architectures. This includes an assessment of the network used to implement NVMe. The result will be improved business outcomes from faster time to market for new/improved products.
- Application owners and line-of-business customer satisfaction can be improved with consistently low-latency, high-bandwidth I/O for mission-critical real-time analytics workloads.

Guidance

- Request NVMe road maps from incumbent storage suppliers.
- Evaluate network connectivity for use with NVMe.
- Work with business units and analytics teams to identify use cases and workloads requiring microsecond latency and tens of millions of IOPS.

Prediction 2: By 2021, 50% of Enterprise Infrastructure Will Employ Some Form of Cognitive and Artificial Intelligence to Improve Enterprise Productivity, Manage Risks, and Drive Overall Cost Reduction

Artificial intelligence and machine learning (ML), a subset of the larger discipline of AI, are poised to transform enterprise infrastructure and business processes. Machine learning involves the design and creation of systems that are able to learn based on the data they collect. AI algorithms will be able to review and understand log files throughout the IT infrastructure in ways that are impossible to do with traditional collection and analysis methods today. AI will be able to predict a system crash or component failure minutes or hours before a human might notice anything was wrong. In this regard, AI holds great promise with its ability to learn patterns in networks, devices, and systems and decode deviations that could reveal problems before an event occurs or detect in-progress cyberattacks. AI will allow for smart security features to detect data and packet loss during transit and within the payload — all leading to improved security and reduction in compliance risk.

AI will become integrated into public and private cloud architectures where machine learning is used to transition data seamlessly between infrastructure tiers and cloud environments without human intervention. Automated data movement across heterogenous infrastructure, effective utilization of their current assets in conjunction with public cloud adoption, and automation of provisioning and

repetitive tasks will all lead to reduction in infrastructure capex and opex. Data will be analyzed, and logic engines will automate the data movement. Organizations will also be able to make more effective utilization of infrastructure resources, from processors to memory and persistence. Further, as IoT progresses, the amount of unstructured machine data created will far exceed our ability to make sense of it with current analytical methods. Organizations will use AI to mine billions of data points for actionable insights, valuable for incremental revenue streams, and competitive differentiation.

AI will drive self-configurable and self-healing infrastructure, improving productivity and eliminating processes prone to human errors. An example is intelligent network automation using network virtualization platforms such as Cisco's ACI and VMware's NSX. Often, customers do not know what policies they should implement because they do not have enough insight into what is happening on their network. By leveraging machine learning, customers will benefit by the system making recommendations on optimal policies to implement. Analytics is the first step in the journey, while automation will be the next step to enhance overall productivity and accuracy. In the near term, AI will be used to safely automate repetitive infrastructure tasks, while AI algorithms integrated into physical robots will handle maintenance tasks such as swapping out server racks and keeping track of datacenter environments. With self-configurable, self-healing enterprise infrastructure and automation of repetitive tasks, IT will be able to eliminate hours used to monitor and tune infrastructure and spend more time on strategic tasks. This will lead to retooling of IT staff and redeployment toward strategic IT initiatives.

Associated Drivers

- **Human versus machine:** The impact of AI and automation

IT Impact

- IT organizations evaluating new infrastructure systems (and public cloud services) should evaluate the capabilities based on the level of intelligence within the system. Cognitive will improve productivity and redeployment of staff through greater levels of automation.
- Security teams and line-of-business owners can achieve improved security and compliance by the ability of infrastructure to predict and ultimately prevent security events.
- CIOs with constrained IT budgets should look for ways to increase efficiency and reduce lower utilization rates; cognitive infused systems can help identify these opportunities for overall cost reduction through improved use of resources.

Guidance

- Establish a change management organization chartered to proactively address human concerns with the use of AI.
- Look for ways to retool IT staff to support more strategic initiatives and fill skills gaps.
- Develop a staged approach to adopt AI-enabled infrastructure. As a first step, leverage it for predictive analytics, and then phase in automation of tasks once confidence in outcomes is achieved.

Prediction 3: By 2021, in Value Terms, Over 25% of Infrastructure Services Will Have Some Autonomous Self-Managing Capabilities, Expediting Business Outcomes and Mitigating the Risk of Human Error Resulting from Manual Intervention

Real-time, autonomous, and self-managing infrastructure delivers resources to applications based on AI and machine-learning algorithms. This results in enormous operational cost savings and much

greater IT efficiency. To achieve this objective, systems and software will be designed to support infrastructure abstraction, pooling, and management across disparate and heterogenous resources. Applications will be abstracted, and the infrastructure composed dynamically. The infrastructure will make use of new and emerging computing and persistence mechanisms including accelerated computing, heterogeneous silicon technologies, storage-class memory, and self-driving networks. The need for autonomous infrastructure will be to deliver on business-driven time-to-market outcomes.

The self-management attributes of autonomous infrastructure are made feasible by predictive analytics and AI to automate configuration, provisioning, optimization, QoS management, and troubleshooting in order to accelerate workload access to pools of resources such as persistence, processor, and network. To bring this vision to fruition, "autonomous infrastructure" will require composer and orchestration software, APIs and disaggregated systems, and the embedding of ML into APIs that support and manage the infrastructure. With these steps in place, the first fully end-to-end autonomous infrastructure designs will become commercially available by 2027.

The adoption of autonomous infrastructure will be seen first in larger hyperscale datacenter environments and cloud environments with the skill and expertise to build autonomous infrastructure themselves. Over time, the skill set shortages among enterprises datacenter operators will bring access to commercial solutions downmarket. To meet the needs of the business and support DX initiatives, technical needs are shifting from infrastructure operations to developers and infrastructure coders. In some environments, there is a focus on decreasing capital infrastructure costs to add more developers, analytics, and cloud skill sets. It will be these environments that embrace autonomous infrastructure first.

In the longer run, the skill set gap will be filled by a combination of both machines and software. Constructs such as teaching systems to code and the use of robotics for both physical and logical operations will be standard in datacenters. The model used by hyperscale cloud operators whereby 1 administrator is used to manage over 10,000 servers will become more feasible as IT organizations become comfortable with the decisions that machines are making. This will drive IT staff to develop business and analytics skills in lieu of systems and operations skills.

Associated Drivers

- **Human versus machine:** The impact of AI and automation
- **Innovation impasse:** Legacy systems constraining transformation

IT Impact

- Infrastructure leaders are challenged to provide faster response to new applications and provisioning requests. Teams can accelerate business innovation through faster access to infrastructure, enabled through automation.
- Skill set challenges can be, in part, addressed by reallocating operations to higher-value tasks. This will require retraining. The manual administrative tasks are eliminated by automating provisioning and enabling self-remediation.
- CIOs with constrained capital budgets gain IT efficiency because infrastructure resource allocation is optimized. Infrastructure becomes intent based, policy driven, and increasingly intelligent.

Guidance

- Ask strategic suppliers to provide their vision for how cognitive computing, AI, and machine learning will be incorporated into their architectures.

- Begin to assess applications and workloads facing the highest degree of fluctuation in resource demand and user access as candidates for autonomous infrastructure.

Prediction 4: In 2020, Spending on Multi-Silicon Computing Will Total More Than $6 Billion, with the Technology Becoming Ubiquitous in Most Computing Environments

Computing platforms (e.g., servers in the datacenter, in the cloud and at the edge) are poised to gain a level of heterogeneity from a silicon point of view — which IDC collectively refers to as multi-silicon or heterogeneous computing. This includes systems based on x86 and non-x86-based silicon architectures such as ARM and OpenPOWER (from vendors like Intel, AMD, Qualcomm, Cavium, and IBM), as well as systems with accelerator cards such as GPUs, FPGAs, and coprocessors (from vendors like NVIDIA, AMD, and Intel).

Much of multi-silicon computing will be born out of a need to overcome the limitation posed by current-generation computers to analyze the increasing size and complexity of data sets before the expiry of their shelf-life. When the "silicon" is matched to the appropriate application or workload, the system will seek to provide faster "time to value," that monolithic or homogeneous architectures struggle to provide today. Similarly, hardware accelerators when added to such systems would "turbocharge" cognitively enabled applications, enabling them to quickly and efficiently analyze and learn from data generated by connected and autonomous devices. When placed at the appropriate location (i.e., at the core or edge, depending on the use case), the locality of data analytics becomes crucial.

Pursuing the simulation of real-life scenarios and computation of complex outcomes will lead to the adoption of multi-silicon computing-based composable infrastructure. Such systems will be largely API driven (software defined) and based on a shared pool of dynamically allocated computing and data persistence resources connected via high-speed low-latency interconnects (e.g., Gen Z). Such systems will initially break away from processor-centric computing and eventually incorporate quantum computing into the mold.

Much of multi-silicon computing, especially where the initial capex costs are large, will follow a "born in the cloud" model wherein such resources are consumed on a pay-as-you-go basis. This will also mean that many of the investments in technologies such as composable infrastructure, memory-driven computing, and quantum computing will be made by hyperscalers and public cloud service providers.

Associated Drivers

- **Pace of change:** Technology capabilities enable sustainable change at the speed of digital business
- **Platform disruption:** Unleashing digital innovation's power for scale

IT Impact

- Infrastructure leaders asked to deliver solutions that accelerate "time to value" from data via newer workloads and applications ability to respond faster to their stakeholders.
- IT administrators operate in a dual mode where they support current-generation applications and workloads along with next-gen applications.
- IT teams embrace a new automatic application-centric selection computing paradigm where a common software-defined operating environment supports a heterogeneous infrastructure.

Guidance

- Embrace an open software-defined computing model, in which the dependency of applications slowly shifts from "silicon dependent" to "silicon adapted" and eventually to "silicon agnostic."
- Examine server platforms from various vendors with a focus on matching the platform to the workload — especially as such workloads shift to cloud native.
- Explore investments in composable software and disaggregated systems as a step in moving toward an elastic software-defined infrastructure.

Prediction 5: In 2021, Spending on Hybrid Cloud Data Services for Data Protection, Integration and Orchestration, Security and Compliance, and Location Optimization Will Total More Than $60 Billion

As data grows in amount, variety, and importance, business leaders must focus their attention on the data that matters the most. Not all data is equally important to businesses or consumers. The enterprises that thrive during this data transformation will be those that can identify and take advantage of the critical subset of data that will drive meaningful positive impact for user experience, solving complex problems, and creating new economies of scale. Business leaders should focus on identifying and servicing that unique, critical slice of data to realize the vast potential it holds. Data identification — both onsite and in public cloud locations — will require human data specialists in combination with cognitive systems.

The proliferation of application deployment models, including newer, cloud-native software as a service (SaaS), IoT, mobile, and hybrid cloud, plus traditional on-premises applications has resulted in organizational data being widely and unpredictably spread across multiple repositories. This proliferation of data types and repositories creates numerous and increasing challenges for IT staff, ranging from knowing what data is to changes in fundamental data protection, security, governance, and infrastructure management. In many cases, organizations must purchase and manage numerous overlapping tools simply to address unique environments. Integrating the information from these similar, yet disparate, tools may be either time consuming or impossible. As a result, these organizations are not able to harness the value and the totality of the information within their organization, an issue that is even more important than the inherent inefficiency of this scenario.

Moreover, the lines between previously discrete IT activities are being erased. Data protection is a clear case in point, where backup, disaster recovery, and high availability are evolving from disciplines to points on a continuum. Similarly, security is a requirement that pervades nearly every element of the IT stack. This situation challenges product development requirements for vendors to provide needed functionality without succumbing to product creep. It also challenges end-user organizations to develop a coherent hybrid cloud data strategy of complementary, integrated, and cloud-enabled products and solutions that optimizes the value of organizational data.

Data services for hybrid cloud is location and infrastructure-independent software that understands and performs various protection, security, integration, and optimization functions on data for the purposes of business control or SLAs. These functions can be performed in place or following data movement. Data services for hybrid cloud covers data services (including protection, security, compliance, integration, orchestration, and data location optimization using SLA profiles or machine-learning-based cognitive/AI capabilities) that operate on structured, semistructured, and/or unstructured data and work across location (on-premises and public cloud stacks) and infrastructure.

Further, a central tenet of these solutions is their operation on data, specifically files, objects, or application instances, rather than physical or logical storage constructs such as LUNs, volumes, or devices. Data services for hybrid cloud solutions do not provide the persistence capabilities themselves nor do they provide the schema, structure, or repository in which the data is stored. Data service functions operate on data that can reside in structured, semistructured, or unstructured repositories. For more information, refer to *IDC's Worldwide Data Services for Hybrid Cloud Taxonomy, 2017* (IDC #US42598817, June 2017).

Associated Drivers

- **Accelerating DX:** Technology-centric transformation altering business and society
- **DX delta:** Leaders and disruptors widen performance gap
- **Pace of change:** Technology capabilities enable sustainable change at the speed of digital business

IT Impact

- IT leaders that partner with other data focused stakeholders will be able to offer better business outcomes through faster access to the right data.
- Data governance committed and teams should evaluate how a holistic data services program can improve security and compliance through greater data insight, visibility, control, and governance.
- Application owners and IT have excessive amounts of redundant data. This redundant data presents risk and cost that can be reduced.

Guidance

- Create a data map identifying the sources and formats of data.
- Map these data sources to the value of the data within them, including data custodians and data integration into other systems.
- Form a data management function or office spanning infrastructure, analytics, line-of-business and data architects/engineering to develop a data-centric vision and strategy.

Prediction 6: By Mid-2020, SD-WAN, as an Enabler of Edge Computing, Will Be the Mainstream Foundation Technology — One That Represents More Than $6 Billion in Spending on Infrastructure and Managed Services in 2020

DX remains an urgent imperative for enterprises worldwide, and IT infrastructure investments increasingly are made for strategic rather than tactical reasons. Furthermore, IDC has found that organizations with digital-ready networks are realizing two to three times the revenue growth of organizations without such networks. DX clearly demands — and benefits from — network transformation.

To a large extent, the focus on network transformation has shifted to the wide area network (WAN), which provides essential connectivity and valuable network services for branch and remote offices as well as other edge sites. On the WAN, however, operational complexity has become an acute problem, driven by factors such as increased bandwidth usage, diverse requirements in WAN connectivity, and the need to support a growing number of cloud-based applications. Enterprises are seeking cost efficiencies amid rapidly evolving application delivery requirements, especially as they continue to embrace SaaS and IaaS/PaaS cloud offerings.

SD-WAN has emerged as a solution for modern enterprises dependent on the cloud and on a workforce and edge resources that require "anytime, anywhere" access to applications and cloud services. IDC research indicates that the need for SD-WAN is acute for a growing number of enterprises, especially as they migrate to public cloud services and seek to enhance customer engagement.

SD-WAN business benefits include providing cost-effective delivery of business applications, satisfying the requirements of the modern branch/remote site, accommodating SaaS- and cloud-based applications and services, and improving branch and edge IT efficiency through automated provisioning of edge infrastructure, applications, and services.

Associated Drivers

- **Accelerating DX:** Technology-centric transformation altering business and society
- **Pace of change:** Technology capabilities enable sustainable change at the speed of digital business

IT Impact

- Networking teams can offer the faster time to market in provisioning branch and edge sites and realize improved IT efficiency and staff productivity.
- CIOs will be able to enable efficient use of WAN bandwidth, resulting in cost savings while delivering availability, reliability, and security and performance of cloud applications.

Guidance

- Get started by defining POCs and trials at a limited number of sites.
- Carefully evaluate SD-WAN offerings from vendors and service providers, taking into account breadth and depth of features, ease of deployment/use, and ability to support use cases.
- Determine whether your organization prefers (or is better suited to) a DIY option from a vendor or a turnkey SD-WAN service from a commercial or managed service provider; choice will often depend upon availability of skill sets and resources.
- Measure technology and business benefits (including ROI), and expand SD-WAN coverage as needed.

Prediction 7: By 2019, 50% of Multinational Organizations Will Have Revisited Their Cloud, IT Infrastructure, and Data Governance Setups to Ensure Compliance with New Data Regulations Being Introduced Around the World, Especially the EU's GDPR and Revised Payment Service Directive (PSD2)

Compliance and security demands will drive greater cloud maturity as only mature cloud users will be able to incorporate cloud services in a secure way and be able to pass audits. A rise in security incidents will drive organizations to build out proper hybrid cloud strategies and improve their data governance guidelines. Regulatory compliance impact will vary by region. While European users might withdraw from the cloud initially for compliance reasons, users in the Middle East and Africa will turn to cloud services to actually address on-premises security and compliance challenges.

General Data Protection Regulation (GDPR) enforcement will begin in May 25, 2018. The EU-wide regulation streamlines many of the complex local and regional regulations already in place and updates the laws around data collection and security to be more applicable and relevant to modern businesses using a range of cloud, mobile, and social technologies. From all the GDPR articles, IDC

has distilled four major implications for organizations processing the personal data of EU-located data subjects including larger noncompliance fines and mandatory breach notification.

For large multinationals with operations outside of the United States, the GDPR contains an extra-territoriality clause, which extends its applicability to any data processor dealing with the personal data of EU citizens. This means that, for example, this regulation is applicable to a United States-based cloud service provider with no physical footprint in the EU if it processes EU citizen data. Social networks, ecommerce sites, and other internet-based companies are therefore included in the GDPR, making the regulations enforceable far beyond EU borders. Furthermore, in extreme cases, a regulator can suspend the right of companies to process personal data. This is effectively an order to cease trading since the processing of orders or the payment of employees typically involves processing personal data. Although it is unlikely that this sanction would be wielded often, it exists within the written law. This sanction will act as a backstop should all others fail and must be given serious consideration during any risk assessment associated with GDPR, since it has the potential to halt business operations entirely.

This level of visibility and scrutiny from the boardroom to the project room will drive the need for greater levels of insight, visibility, and control into data practices. These data practices will drive changes in infrastructure strategies, cloud use, and overall data governance.

Associated Drivers

- **Accelerating DX:** Technology-centric transformation altering business and society
- **Innovation impasse:** Legacy systems constraining transformation
- **Cyberthreats:** Theft, ransom, and cyberattack on the rise

IT Impact

- Security, infrastructure, and application teams will be impacted by data regulations that mandate prescriptive actions. This will accelerate storage, compliance, and security modernization.
- CISO and C-level executives need a bulletproof response to cybersecurity events. The increasing importance of data oversight will drive organizations to invest in holistic hybrid cloud services for data protection, data security, and data insight and control.
- Data oversight programs covering people, process, and technology changes, continuous education and improvement, will need to adapt to changing data management requirements.

Guidance

- CIOs should use GDPR and other data-related regulations as the launchpad to drive holistic data management controls, which serve as the foundation for greater data insights.
- IT and business leaders must define roles such as a data controller, processor, and subprocessor and establish guidelines on how data will be managed between the organization and third parties.

Prediction 8: By 2021, 65% of Enterprises Will Be Deploying Universal Encryption on Server Infrastructure to Comply with Data Privacy, Integrity, and Confidentiality

With the release of the IBM z14, which features built-in, automated "pervasive encryption," a security approach has been introduced that will inspire other server vendors to design similar capabilities into their offerings. Universal encryption, similar to IBM's notion of pervasive encryption, means that all

data, at rest or in flight, within the entire envelope of a platform as well as its network with the rest of the on-premises infrastructure and the cloud (via APIs) is completely and automatically encrypted. Administrators need not make choices as to what to encrypt and what not. The encryption is performed (in IBM's case) by silicon, firmware, and the operating system (OS). A server ships with the encryption feature installed and capable. As a response to the mounting security threats, server vendors and their customers will find a comprehensive solution like pervasive encryption more compelling than continuing with a patchwork of solutions and manual choices as to what to encrypt.

With universal encryption, the administrative overhead associated with selecting what data to encrypt is eliminated as is the consideration of the processor overhead associated with encryption and the implications on system performance. The use of accelerated computing, dedicated FPGAs, and the like may help mitigate any potential resource burdening. In addition to IBM, other chip manufacturers such as Intel and AMD are incorporating features to make data encryption ubiquitous across the infrastructure. Further, cloud providers such as Google see the value in universal security features. Google has made public it designs custom chips, including a hardware security chip that is currently being deployed on both servers and peripherals. These chips allow Google to "securely identify and authenticate legitimate Google devices at the hardware level. That silicon works alongside cryptographic signatures employed over low-level components like the BIOS, bootloader, kernel, and base operating system image."

Associated Drivers

- **Innovation impasse:** Legacy systems constraining transformation
- **Cyberthreats:** Theft, ransom, and cyberattack on the rise

IT Impact

- CEOs and C-level executives will mitigate the risk of data compromise or breach by taking a holistic, universal approach to data security.
- Architects and engineers will see time relief by eliminating administrative overhead and policy-focused decision making.

Guidance

- Operations teams should run POCs and test universal encryption from their server platform provider.
- Benchmark processor consumption and performance impact with and without the use of universal encryption.
- Analyze the results and make intelligent decisions, balancing the performance impact versus the potential risk of data compromise.

Prediction 9: By 2021, Installed and In-Use Container Instances Will Amount to More Than 3.5 Billion, with Over 20% of Them Running in Distributed Locations Serving Edge and IoT Workloads

While container adoption is nascent among most commercial organizations today, the level of interest, experimentation, and prototype usage across most verticals is high and growing quickly as more leadership teams become more comfortable and aware of the maturing technology. Adoption is expected to continue to rise rapidly as more successful experimentation occurs, and business pressures force CIOs and their teams to respond more quickly to customer demands. Containers today are used in concert with cloud-native applications built using microservices and running on

scale-out distributed compute and storage services. These applications commonly run in a private or public cloud within an enterprise or a service provider datacenter.

However, containers will be used to abstract applications not only in the datacenter but also in distributed computing and edge locations. Containers will be used to run applications in cars, in kiosks, cruise ships, airport terminals, and in IoT gateways. However, to satisfy both distributed (i.e., campus, ROBO) and edge/fog computing will mean differences in pricing and packaging and product services. For example, edge/fog computing will require lightweight container services, fewer memory and CPU resources, and minimal persistence. Containers are a core component of a workflow-driven infrastructure. The developer does not care how it's done, but containers become the vehicle for the distribution of the service, the application, and the access point to customers and data.

Associated Drivers

- **Pace of change:** Technology capabilities enable sustainable change at the speed of digital business
- **Platform disruption:** Unleashing digital innovation's power for scale

IT Impact

- Application developers and operations teams will need to develop effective container management strategies. Doing so will allow for business innovation through application and workload portability.
- IT and operations teams will need to tackle short-term container management hurdles around storage, security, and orchestration and invest in operations team retraining.

Guidance

- In the immediate term, operations teams should evaluate running containers within virtual machines (VMs) to streamline management.
- As the container ecosystem continues to evolve, IT organizations need to continue to evaluate broader management solutions spanning containers, bare metal, and virtual environments.

Prediction 10: In 2021, Spending on Infrastructure as a Service Will Be 15% More Than Spending on On-Premises Compute, Storage, and Networking Infrastructure, Reflecting the Ongoing Shift from Capex to Opex Among Enterprises

In 2015, companies were about 3.4 times more likely to buy IT infrastructure hardware than to rent infrastructure via IaaS or hosted private cloud services. However, in the DX era, most corporate datacenters are seeking new ways to procure and use IT services. This often means a desire to use infrastructure on demand and realize the expense in an operating budget rather than a capital budget. Rather than dealing with capital allocation, capacity planning, and infrastructure maintenance, newer 3rd Platform application companies as well as enterprises will increasingly rent IT resources from cloud service providers. This transfers the task of building and running elastic IT infrastructure to a shrinking group of experts.

The macroeconomic climate has an additional impact. While demand for IT resources to support new DX projects continues, demands to reduce large and long-term capital commitments are forcing many enterprises to look to service providers, including traditional IT OEMs, for any means to achieve a transition in IT infrastructure costs from a capital expense to an operating expense. This has resulted in a growing demand for and availability of IT infrastructure, sold on a subscription or on-demand basis.

Legacy infrastructure that remains on-premises will get modernized in response to innovation demands. The infrastructure will become cloud like, with on-premises scale-up and scale-out characteristics, agility, service catalogs, flash, and cognitive enabled with application and infrastructure abstraction. For example, customers using legacy infrastructure to run Oracle will replace this infrastructure with Oracle Cloud on-premises, which is a cloud service from Oracle. The on-premises infrastructure will become IaaS like in the same manner that public cloud IaaS is, with mandatory simplification of the infrastructure deployment and operations — because of the skills gap and the rising need for developers. However, most enterprises will shift to public cloud services infrastructure consumption. The percentage of infrastructure which is rented will increase, while the percentage of the infrastructure that is owned will decrease. Companies such as Oracle, Dell EMC, and HPE will continue to roll out pay-as-you-go and utility model options as more infrastructure becomes rented and ultimately moves to a complete utility model.

Associated Drivers

- **Pace of change:** Technology capabilities enable sustainable change at the speed of digital business
- **Platform disruption:** Unleashing digital innovation's power for scale

IT Impact

- CIOs should plan for a mix of public and private cloud use over the next decade. The use of IaaS offers improved productivity and redeployment of staff by reducing the infrastructure management burden.
- Finance and IT budget owners will get greater predictability into costs and cost fluctuations, although should be careful about planning for increasing IaaS costs. Implementing a hybrid cloud costing solution is recommended.
- CIOs can reallocate capital budgets to data-centric DX projects or application development projects.

Guidance

- In the immediate term, compare costs associated with rent versus own models. Discuss trade-offs in capital and operating budget controls with corporate finance.
- Ask incumbent IT suppliers for options in renting, subscription, or utility-based pricing.

ADVICE FOR TECHNOLOGY BUYERS

IT professionals are facing a business climate that is demanding change, and it is coming to every region. Data-driven, future-looking IT leaders must take the following actions, in concert with new stakeholders, to continue to stay relevant over the next 10 years:

- **Private and public cloud use:**
  - Invest in a software-defined private cloud infrastructure for workload and data-sensitive environments or where compliance/security policies mandate data processing remain local.
  - Migrate legacy infrastructure to flash-based architectures for increased performance, improved customer satisfaction, faster time to market, and lower cost.

    - Use public cloud infrastructure for test/dev, analytics, and workloads with higher degrees of variability in resource requirements, or where adjacent public cloud service, such as analytics, can be leveraged effectively.
    - Public cloud is not going to be cheaper. It is the use of the public cloud ecosystem of services combined with internal staffing and skill rebalancing that allows IT organizations to be more responsive to business user requirements.
- **Applications and application development:**
    - Develop an application development strategy with an eye toward agility, new methodologies, new programming languages, and frameworks and an open mind about leveraging open source components.
    - Develop a data-centric vision for the services IT will offer to the line of business. This should start with a holistic data map of data sources, data stewards, data insights, and so forth.
    - Rationalize application portfolios and sunset and rightsize legacy systems. Engage with third parties for application refactoring assessments as part of workload migration to the cloud.
- **Organizational structure, skill sets, and staffing:**
    - Access operations teams and train/rehire for programming, architecture, DevOps, container, and cloud architecture skills.
    - Invest in data-centric innovation teams with staffing spanning analytics, data stewards, line of business, application owners, and digital/innovation executives.
    - Develop strategies for how innovation accelerators such as IoT, AR/VR, robotics, and blockchain will be leveraged within the organization. Research and engage with third-party specialists in these areas as you embark on new initiatives.

EXTERNAL DRIVERS: DETAIL

Accelerating DX: Technology-Centric Transformation Altering Business and Society

- **Description:** Digital transformation refers to the continuous process by which enterprises adapt to or drive disruptive changes in their customers and markets (internal and external ecosystems) by leveraging digital competencies to innovate new business models, products, and services that seamlessly blend digital and physical and business and customer experiences while improving operational efficiency and organizational performance.
- **Context:** In the past few years, we have witnessed the rise of digital transformation and the disruptions and opportunities it poses for traditional businesses and society. Organizations of every size and industry risk fundamental disruption because of new technologies, new players, new ecosystems, and new ways of doing business. Early success is met by the subsequent challenge of achieving digital business at scale. Business disruptions cascade into societal disruptions. IDC predicts worldwide spending on digital transformation technologies will expand at a compound annual growth rate (CAGR) of 17.9% through 2021 to more than $2.1 trillion.

Pace of Change: Technology Capabilities Enable Sustainable Change at the Speed of Digital Business

- **Description:** Today, survival of the fittest is not linked to size or strength, but the ability to change. While digital transformation accelerates globally, the half-life of companies shrinks, disrupted by new business models and 3rd Platform technologies. The imperative is not just keeping pace with business change but also increasing the speed of business operations. In an attempt to go faster, organizations struggle under a forest of siloes and business innovations stagnate with redundancy and inconsistency. Companies that don't adapt will become part of the carnage, while leaders get farther ahead by rationalizing and integrating their data and applications and leveraging DX capabilities to move faster and deliver better products and services.
- **Context:** Over the past 50 years, the average lifespan of S&P 500 companies has shrunk from around 60 years to closer to 18 years. The rate of change is accelerating dramatically. Time to decide and act requires near frictionless, fact-based decision-making processes. To survive, companies not only have to be digital transformers, but they must do so while improving adaptability and adopting changes. Digital capabilities provide modular, plug-and-play technology, business, and industry platforms, allowing businesses to quickly adapt and compete in digital transformation.

DX Delta: Leaders and Disruptors Widen Performance Gap

- **Description:** The best-performing companies, armed with digital native culture, tools, and process, are pulling away from the rest, creating a bifurcated and unequal landscape where a few firms exhibit high productivity and profits. Digitalized sectors are the most profitable as firms adopt new technologies and deliver winning products and services more efficiently. Having disrupted one sector, firms attack adjacencies to expand their markets and then protect their status through mergers, acquisitions, and R&D.
- **Context:** The gap is widening more and more quickly between the thriving companies — the best performers — and the survivors — those companies just hanging on. Thrivers, undergoing continuous self-disruption and innovation, are leveraging their capabilities to create new digital products and services, expand digital ecosystems, and foster digitally savvy workforces. While they experience double-digit growth in productivity, market share, and revenue, others are flat or declining. Technology-literate leadership, vision, and organizational and culture change are key to any digital business at scale.

Human Versus Machine: The Impact of AI and Automation

- **Description:** Cognitive advances, combined with robotics and AR/VR, are now actively impacting experiential engagement, business and manufacturing processes, and strategies. Personal privacy is increasingly at risk as big data, facial recognition, and other technologies create deeper personal profiles. Automation is enhancing and, in some cases, replacing human decisions yet is less transparent and more difficult to understand or challenge. Many tasks can be automated, but tough management decisions must be made about if, how, or when. Automation can empower humans to be more intelligent and productive but may also redefine or eliminate job categories.
- **Context:** Intelligent applications based on cognitive computing, artificial intelligence, and continual deep learning are the next wave of technology transforming how consumers and enterprises work, learn, and play. IDC forecasts worldwide revenue for cognitive and artificial intelligence systems will reach $12.5 billion in 2017, an increase of 59.3% over 2016. Cognitive and AI solutions will continue to see significant corporate investment over the next

several years, achieving a CAGR of 54.4% through 2020 when revenue will be more than $46 billion.

Platform Disruption: Unleashing Digital Innovation's Power for Scale

- **Description:** The "platform" is the new battleground for innovation, developers, and marketplaces. "Going it alone" is obsolete. Powerful network effects continue to entrench leaders and extend reach. Industry platforms layer on digital business platforms built on technology platforms. Market consolidation limits choices but increases the power to consumers as a critical mass of partners, customers, and solutions converge. Mega platforms – fueling innovation – demand a widening cloud-based ecosystem, network, and business platform of connected things, channels, technology, data, and talent.
- **Context**: Platforms have long played a key role in the IT industry. We are in a platform economy – one in which tools, capabilities, and frameworks based upon the power of information, cognitive computing, and ubiquitous access will frame and channel our economic, business, and social lives. The platform concept expands from microservices, technology stacks, and software bundles to PaaS to entirely new digital business-specific and industry-specific platforms, ecosystems, and operating models.

Cyberthreats: Theft, Ransom, and Cyberattack on the Rise

- **Description:** The dark net and hacker networks continue to grow and get more organized. Cybercrime hits a massive scale as illustrated by the WannaCry debacle, highlighting inadequate attention to basic security practices. Comparatively, the cloud looks pretty secure. While vigilant security practices can protect against most threats, governments and private institutions are actively using their digital power and weapons to affect outcomes. Bots and misinformation drive political and social change and divisiveness. The digital arms race expands as 3rd Platform technologies become tools or countermeasures to extend or resist coercion.
- **Context**: Data breaches and cybercrime are in the news every day, followed only by state sponsored cyberactions. IDC forecasts that global spending on security solutions will reach almost $105 billion in 2020, with a CAGR of 8.7%. "Contain and control" approaches, augmented with cognitive computing, replace outdated "protect and defend" models. Security initiatives need to employ new technologies and approaches to evaluate and mitigate the new array of risks while ensuring privacy, confidentiality, integrity, and availability.

Innovation Impasse: Legacy Systems Constraining Transformation

- **Description:** Technology has been enabling business for decades, and refreshing deployed systems has always been problematic. American businessman Dee Hock said, "The problem is never how to get new, innovative thoughts into your mind, but how to get old ones out." This is true about digital transformation as well. Organizations are burdened with old systems that "run the business." Most cannot be retrofitted to the new digital ecosystem, leaving organizations with the unpleasant choice of either constraining their DX initiatives and environments or embarking on an expensive and disruptive upgrade of critical systems.
- **Context:** Many organizations today are facing the challenge of maintaining or modernizing their trusted operational systems of record (SOR). Yet decades of changes have built up technical debt, making those systems fragile and expensive. Systems of engagement (SOE) don't go far enough to meet new customer expectations, but add to the debt, complexity of upgrading and the challenge of integrating existing systems with new digital transformation services. Legacy constraints and incremental fixes won't cut it any longer. Upgrades to intelligent, cloud-based systems offer the opportunity to leapfrog ahead. Doing so is

problematic and expensive. Not doing so may be suicidal. Leading organizations are prepared to leave legacy behind where it is no longer relevant.

LEARN MORE

Related Research

- *Market Analysis Perspective: Worldwide Enterprise Storage Systems, 2017* (IDC #US42287817, September 2017)
- *Market Analysis Perspective: Worldwide Enterprise Servers and Computing Platforms, 2017* (IDC #US42917217, July 2017)
- *Market Analysis Perspective: Worldwide Datacenter Networking, 2016* (IDC #US40774516, September 2016)

About IDC

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