Hardware Remains Critical In A Software-Defined World

Roadmap: The Infrastructure Transformation Playbook

by Naveen Chhabra and Chris Gardner
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Why Read This Report

Infrastructure and operations (I&O) leaders live in a world of constant change. Their challenge is to embrace the latest technologies while continuing to maintain the tech they already have. I&O pros need to serve requirements within the data center as well as in the cloud and at the edge. In addition to operational and manageability requirements, current challenges include meeting organizational security guidelines. This report shows why I&O pros should focus on certain technologies from their infrastructure roadmap perspective.

Key Takeaways

Your Infrastructure Roadmap Is Now Multidimensional
Infrastructure isn't confined to the data center; firms are evaluating the possibilities of taking it out into the wild, including the harshest environments. They are also developing artificial intelligence capabilities that are at times tangential to existing investments. I&O leaders need to keep a multidimensional view of business requirements before developing a comprehensive roadmap.

Evaluate Future Technologies Based On Forrester's "Design For Dependability" Model
It's easy to be swayed by the specific promises of future technologies. However, I&O leaders need to maintain a fine balance between gains and risks by gaining a comprehensive view of the situation. Use Forrester's design for dependability model to develop this view.

Data And Application Security Considerations Must Be Built In
Infrastructure advancements and roadmaps must consider various dimensions of the overall security posture. A pragmatic roadmap promises Zero Trust security that's baked in, not bolted on. Zero Trust should be a native capability, not an afterthought.

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Table Of Contents

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Hardware Architecture Remains Key To Building Dependable Services

Firms invest in innovative technology solutions to improve business operations or develop new ways to engage ecosystem players. Software is essential to delivering great experiences to internal and external stakeholders. While the growth of software has caused hardware to fall out of favor as a cool tech subject, every piece of software needs to run on some form of hardware platform. That's why infrastructure technology decision makers say that their firms, on average, spend 37% of their IT budget on hardware infrastructure.[1] Business and tech decision makers are increasingly adopting public cloud services to develop and host their applications, taking advantage of the flexibility, agility, and scalability of the underlying hardware. Infrastructure demands are growing rapidly in the face of scalability and performance requirements, especially for applications in the realm of AI, machine learning (ML), edge computing, and the internet of things. Tech leaders must create infrastructure roadmaps that not only cater to increasing performance and capacity requirements, but also align with macro industry trends.

Technology Change Is A Megaforce Pushing Your Roadmap Forward . . .

Organizations are experiencing two major transformational forces: technology change and enterprise innovation. I&O leaders must address the unique — and often competing — requirements of each of these forces. On the technology side, I&O pros need to define a pragmatic roadmap, because:

› **Aging, fragile infrastructure demands immediate refreshes.** Many Forrester clients ask us how they can identify the next best fit-for-purpose tech solution in a variety of situations. One telco needed to transform its batch processing system by replacing its archaic 7-year-old storage box with spinning disks that had hit its capacity and performance limits with all-flash storage. As vendors reduce their investment in sustaining existing products, some systems break so often that they have a significant impact on business. This infrastructure urgently requires immediate upgrades if IT is to continue to deliver to business requirements.

› **Tech obsolescence poses a threat.** Technology is advancing rapidly, and every new version promises improved speed, efficiency, and cost economics.[2] The increased speed of new tech rollouts has reduced the average lifespan of technology.[3] Vendors declare end of life or end of support for their existing technologies, rendering them obsolete. For example, the lifespans of proprietary Unix platforms — once known for their reliability, availability, and security — have shrunk significantly. Standalone storage is a thing of the past; software-defined and cloud-connected storage are paving the way to a successful future.[4]

› **Resource availability significantly affects your tech choices.** The legion of engineers who embraced, deployed, maintained, and operated mainframes in their heyday is on the verge of retirement. Today's engineering and IT workforce is developing microservices-based applications running in Kubernetes orchestration. Finding, attracting, and retaining talent — especially engineers with aspirations for mainframe development and management — is a challenge.[5] This situation is pushing organizations to develop a comprehensive migration plan that includes infrastructure migration.

› **Tech leaders strive to improve the economies of technology.** Tech leaders are familiar with the phrase "Do more with less." Shrinking budgets shift technology spending to newer-generation products and services that promise better outcomes with better economics. The need to reduce cost and time-to-market have pushed innovation projects to the public cloud, as cloud economics often proves more reasonable. Vendors of on-premises technology are also rolling out opex options — not financial leasing — for large enterprise tech buyers.[6]

. . . As Enterprise Innovation Pulls You Forward Just As Hard

Technology is at the heart of every business. During the years of shadow IT and public cloud growth, tech leaders lagged in the adoption of new technologies. Today, these leaders don't want to miss another opportunity, and they want to be trusted advisors to their business peers on tech decisions. Businesses aim to drive innovative tech solutions that promise a competitive edge. For example, service integration and automation can reduce service delivery time and significantly improve time-to-market. Technology leaders must be mindful in driving the enterprise innovation roadmap, as:

› **Businesses demand more automation in infrastructure delivery.** Public cloud providers are automating infrastructure so it's invisible to application developers. Developers focus on application logic and don't want to worry about infrastructure intricacies. Cloud providers abstracted the infrastructure layer via innovative services like serverless compute.[7] On-premises infrastructure remains relevant in tomorrow's business model, but only if technology leaders automate and abstract the infrastructure services across silos and lifecycle stages and take care of all interdependencies.

› **Container ecosystems require a focused strategy.** Application developers are shifting to newer platforms like containers that promise benefits such as flexibility, scalability, and application portability.[8] Currently deployed data center infrastructure — dedicated systems or shared virtual infrastructure — cannot serve containers in a flexible and agile manner. Every infrastructure vendor is at a different stage of building compatibility into evolving container ecosystem standards.[9] I&O pros must rethink their infrastructure strategy and roadmap to remain relevant in the age of containers.

› **AI and deep learning use cases need specialized infrastructure.** Globally, business leaders are excited by the potential of AI and ML.[10] Algorithms for training and inferencing AI application models have an insatiable appetite for silicon and therefore require specialized compute infrastructure.[11] Their storage needs are orders of magnitude more than that of any transactional system. If an insurance company uses video to train its AI models, a 1-hour video stored in 4K format consumes about 478 gigabytes of storage.[12] Such video training data can easily run into hundreds of petabytes, an astounding figure for most enterprises. Next-generation storage must be performant and have ultra-high capacity.

› **Edge infrastructure characteristics differ from those of data center infrastructure.** Along with cloud computing, edge computing has been one of the most important trends, as it enables a multitude of use cases for I&O pros. As industry needs and use cases evolve, so do the

infrastructure needs. Forrester predicts that vendors will customize the fit, form, and function of edge infrastructure to match specific use cases. Tech giants are scrambling to grab a share of this expanding market. Some are using bold tactics: Hewlett Packard Enterprise (HPE) led a Series C investment of up to $145 million into former Cisco CEO John Chambers' startup Pensando Systems, which is bringing a custom programmable processor optimized for edge computing to market.[13]

› **Security holes in hardware are as risky as those in software.** Businesses are being attacked from all sides and must guard against all attack vectors to stay afloat. It's not just software that has security vulnerabilities; they also exist at the hardware layer. Spectre and Meltdown demonstrated how failing to consider security results in insecure hardware.[14] Infrastructure — especially when heavily distributed to support edge use cases — can increase the attack surface by orders of magnitude. Tech leaders face considerable pressure to embrace infrastructure innovation and serve business requests without compromise — even as they need to maintain or improve the overall security posture.

A Multidimensional Infrastructure Roadmap Is The New Normal

To be competitive, firms must embrace technologies that serve capacity and performance needs and simplify operations, yet are secure.[15] Business expectations of infrastructure platforms are changing as applications and use cases evolve. I&O pros look after not only data center infrastructure, but also innovation and infrastructure for edge computing, AI, public cloud, and automation — all of which serve the needs of different stakeholders. While software-defined offerings made on-premises hardware a commodity, purpose-built hardware will deliver significant benefits in a growing number of scenarios. In addition to technical benefits, it improves customer experience, boosts product revenue, and lowers time-to-market. Your multidimensional infrastructure roadmap should include:

› **Infrastructure for edge use cases.** Edge infrastructure is not a product or offering, but a family of technologies that distribute application data and services where they can best drive outcomes in a growing set of connected assets. Edge technologies include infrastructure, network optimization, data localization, analytics, transient storage, sensors, and communication. Limitations like network bandwidth, application latency, data volume, and transfer costs play a role in developing hyperlocal applications and hardware.[16] Examples include hardened devices meant to perform analytics in harsh environments such as on oil rigs. Twenty-six percent of global mobility decision makers say their firms have already implemented edge computing or plan to do so in the next 12 months.[17]

› **Infrastructure for AI deployments.** AI workloads are deep learning algorithms that are implemented as mathematical models but process data objects like images, speech, and language. When a major US-based insurer sends drones to capture video of a flood-hit area, its system must identify when to zoom in and capture minute details depending on characteristics that it learned during training and make these decisions in real time. AI needs purpose-built compute for

operations on vectors, matrices, and tensors. AI workloads benefit greatly from specialized chips, specially crafted systems, and a hybrid cloud roadmap, as they need capacity to store big data and perform compute operations on it.[18]

› **Hyperconverged infrastructure (HCI).** HCI simplifies operations while saving money. For on-premises hosted workloads, HCI packages server, storage, and network functions into a modular unit and adds a software layer to discover, pool, and reconfigure assets across multiple units quickly and easily. Traditionally, HCI focused on specific application use cases like virtual desktops and Microsoft SharePoint.[19] But HCI vendors are now expanding their base by partnering with ecosystem players to deliver more holistic solutions. HPE partners with Ctera to deliver file services based on SimpliVity; Nutanix partners with Commvault, HYCU, Unitrends, Veeam, and Veritas to serve secondary storage use cases.

› **Write once, read many (WORM) storage.** The security of both production and backup data worries every infrastructure and security leader. WORM storage was developed to fulfill the need that regulated data, once written, cannot be changed.[20] Thankfully, WORM capabilities can also address contemporary data security challenges. Ransomware can encrypt data, but WORM storage products like those from IBM and NetApp are an antidote, as the data can't be deleted or modified.

› **Scale-out storage.** Firms are grappling with unprecedented growth in the volume, variety, and velocity of data. Today's scale-up architectures can't handle this growth efficiently and cost-effectively. Business applications require instant insights to serve customers in real time. For example, analytics for fraud detection must occur in real time and apply to a variety of data, not just transactions. Scale-out architectures solve the problems of storing huge volumes of unstructured data, serving the business in its time of need while avoiding new storage silos. However, to fully leverage the capabilities of this architecture, organizations must also make infrastructure and application changes. Some applications, like transactional databases, are less amenable to a scale-out deployment.

› **Composable infrastructure.** Composable infrastructure enables dynamic reconfiguration of disaggregated hardware through a unified API, connected via a software-defined network. In real-world terms, it allows the treatment of infrastructure-as-code down to the bare metal. While there is no unifying architectural standard, vendors like HPE and Intel make it easier to configure and manage composable systems. Investing in composability allows enterprise architects to tie application releases to hardware in a holistic, modeled system stack.

› **High-performance computing (HPC).** HPC consists of large clusters of computational nodes conjoined with high volumes of storage and bandwidth that enable fast computing and complex problem-solving. These nodes are often augmented with hardware specific to AI and ML tasks, such as graphics processing units and tensor processing units. HPC adoption is no longer limited to academic and scientific institutions due to wider hardware availability. Verticals that see the most benefit include finance, retail, energy, and pharmaceuticals.

Boost Hardware Security Through A Zero Trust eXtended Ecosystem

The Zero Trust model of information security is a conceptual and architectural security model for how to set up microperimeters on networks, strengthen data security using obfuscation techniques, limit the risks of excessive user privileges, and improve threat detection.[21] True success with Zero Trust demands that I&O pros carry its principles through down to the bare metal with:

› **Security within software-defined infrastructure.** In a software-defined world, everything has APIs — not just the cloud, but also your servers and even hardware at the edge. You can, and likely will, give more control to application developers to configure bare metal infrastructure. Don't assume they know what they're doing, but don't put obstacles in their path. Instead of giving them access directly to hardware APIs, rely on automation to carry out policy as code.[22] Leverage infrastructure automation tools that can configure systems en masse and keep it aligned to consistent configuration states.[23]

› **Pervasive systemwide encryption.** To fully execute Zero Trust on bare metal, you need to deploy encryption up and down the entire system stack. IBM Z mainframes pervasively encrypt application and system data in hardware.[24] Trusted platform modules provide a secure cryptoprocessor that locks up disk encryption and password protection keys. More recently, vendors like HPE have built a "silicon root of trust" directly into the hardware. This ensures platform integrity from the firmware to the BIOS to the operating system.[25]

Recommendations

Maintain A Nimble, Flexible, And Agile Infrastructure Roadmap

Technology services form the bedrock of flexibility and agility that help define what any business can achieve in the marketplace. Rapid advancements in infrastructure technology will force the roadmap to be a living asset. It's imperative to embrace new developments to deliver better customer insights — but also improve your operations by using hosting and managing hardware that delivers better performance and higher capacity. Every new technology promises to deliver better results than its predecessor at a lower cost. This does not mean that you need to upgrade your technology at every new milestone — or, conversely, to wait for technology stability. You must develop and maintain a flexible, nimble, and agile roadmap that adapts to changes in business direction, needs, and imperatives. I&O leaders must:

› **Employ Forrester's dependability model.** Forrester's "design for dependability" model highlights the important elements that I&O leaders must consider. Infrastructure leaders have focused on availability, performance, capacity, and cost as the prime factors that define system reliability; while these capabilities and characteristics are still relevant, give due consideration to others, like manageability and security.

› **Partner with security peers.** Involve and partner with your security peers before freezing the roadmap. Motivate I&O and security teams to collaborate on how the infrastructure roadmap complies with your organization's security requirements; these discussions will prevent crisis situations later. Be aware of security and dependability risks like hacking, crashes, privacy violations, and weaponization that can come as a side effect of new technologies. Give these due consideration before onboarding new tech.[26]

› **Use the right tool for the job.** One size does not fit all. Commodity compute in the public cloud is the right approach for many enterprise workloads. Barring regulatory, economic, or other pertinent restrictions, send those applications to the public cloud. Invest in specialized on-premises hardware for workloads that will benefit from it. The oft-neglected mainframe may even play in this tech ecosystem long into the future. Use objective criteria to determine where you execute work; treat the entire mix as one rich, diverse family of technologies. Business leaders will appreciate the power and flexibility you deliver — and customers will be happy.

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Endnotes

[1] Base: 454 infrastructure technology decision makers at a director or VP level or who report to the CIO. Source: Forrester Analytics Global Business Technographics® Infrastructure Survey, 2019.

[2] 5G networking is a common subject of discussion at tech conferences. While it has yet to see production deployments, the buzz about its potential benefits is certainly in the air. Ecosystem players across the industry have also started building applications that will use the 5G as its base.

[3] The total time that 2G, 3G, and 4G technologies have stayed in production has declined with each technology upgrade. While 4G is not even a reality in major economies globally, vendors and the market are talking about the usage and potential of 5G networking infrastructure.

[4] See the Forrester report "The Forrester Tech Tide™: Storage Technologies For Business Data, Q4 2019."

[5] See the Forrester report "Tackling The Unsexy Challenge Of Mainframe Modernization."

[6] See the Forrester report "The New Economics Of On-Premises Infrastructure."

[7] AWS Lambda, Azure serverless, and Google Cloud Functions are examples of serverless computing. Source: Microsoft Azure (https://azure.microsoft.com/en-us/solutions/serverless/), Amazon Web Services (https://aws.amazon.com/lambda/), and Google (https://cloud.google.com/serverless-options/).

[8] In 2019, 53% of infrastructure decision makers say that their firms have implemented, are implementing, or are expanding or upgrading their implementation of microservices/container architecture. Source: Forrester Analytics Global Business Technographics Infrastructure Survey, 2019.

[9] Each of the major public cloud providers — AWS, Microsoft Azure, and Google Cloud — offers a robust container development and deployment platform. The on-premises infrastructure vendors are developing a roadmap for their offerings compatible with the container standards.

VMware announced Project Tanzu at its flagship VMworld 2019 conference. Source: Paul Fazzone, "Vmware Tanzu Completes the Modern Applications Picture," Cloud Native Apps Blog, August 26, 2019 (https://blogs.vmware.com/cloudnative/2019/08/26/vmware-completes-approach-to-modern-applications/).

NetApp project Trident was commissioned few months back and is in progress. Source: NetApp (https://www.netapp.com/us/media/ds-netapp-project-trident.pdf).

Portworx is in advanced stages with a container focused storage offering. Source: Portworx (https://portworx.com/).

[10] In 2019, 53% of global data and analytics decision makers say their firms have implemented, are in the process of implementing, or are expanding or upgrading their implementation of some form of AI for analytics. Source: Forrester Analytics Global Business Technographics Data And Analytics Survey, 2019.

[11] See the Forrester report "AI Deep Learning Workloads Demand A New Approach To Infrastructure."

[12] For a file size calculator, check out the following website. Source: Frogsoft (http://frogsoft.com/filecalc/).

[13] Source: "Pensando Emerges From Stealth With Up To $145 Million Series C Funding To Drive Democratization Of The Cloud," PR Newswire, October 16, 2019 (https://www.prnewswire.com/news-releases/pensando-emerges-from-stealth-with-up-to-145-million-series-c-funding-to-drive-democratization-of-the-cloud-300939734.html).

[14] Vulnerabilities exist at every layer in the infrastructure stack, including hardware. See the Forrester report "Quick Take: Fatal Chip Flaws Set Security Back Decades."

[15] Technology services need to be built on seven fundamental capabilities that are availability, capacity, performance, simplicity, consolidation, security, and cost. See the Forrester report "Design For Dependability By Embracing A Future Of Trusted Technology."

[16] More details are outlined in the following Forrester report. See the Forrester report "Edge Computing Will Radically Alter Your Infrastructure Strategy."

[17] Source: Forrester Analytics Global Business Technographics Mobility Survey, 2019.

[18] See the Forrester report "AI Deep Learning Workloads Demand A New Approach To Infrastructure."

[19] See the Forrester report "The Forrester Wave™: Hyperconverged Infrastructure, Q3 2018" and see the Forrester report "Now Tech: Hyperconverged Infrastructure, Q3 2018."

[20] See the Forrester report "Four Technologies Combine To Protect You From Ransomware Attacks."

[21] For more information on the ZTX ecosystem, see the Forrester report "The Zero Trust eXtended (ZTX) Ecosystem."

[22] To learn how infrastructure automation affects security and risk, see the Forrester report "Reduce Risk And Improve Security Through Infrastructure Automation."

[23] To determine what infrastructure automation products are right for you, see the Forrester report "The Forrester Wave™: Infrastructure Automation Platforms, Q3 2019."

[24] Source: IBM (https://www.ibm.com/it-infrastructure/z/technologies/pervasive-encryption).

[25] Source: Willa Anderson, "Protect from attacks with HPE Gen10's Silicon Root of Trust, Secure Compute Lifecycle, and iLO5," Hewlett Packard Enterprise, January 12, 2018 (https://community.hpe.com/t5/Alliances/Protect-from-attacks-with-HPE-Gen10-s-Silicon-Root-of-Trust/ba-p/6993347).

[26] See the Forrester report "Protect Your Firm From Drones."

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