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2019 Trends in Applied Infrastructure & DevOps

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Hyper-competition and digital initiatives are driving forces behind the need to evolve how enterprises build, manage, secure and consume IT infrastructure platforms powering their business. These forces drive the need to rethink IT strategy and architecture to deliver applications and information intelligently, and in context, while automating tasks across diverse systems, clouds, devices and things. As we look ahead to 2019, we outline the key trends that will drive the evolution of hybrid IT.

451 RESEARCH'S 2019 PREVIEW REPORTS

Analysis of the technologies and trends that will drive and reshape enterprise technology markets in the year to come

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Trends

Trend 1: Process Automation, Bots and Mining Will Become Essential Technologies for Digital Business

Implication: In the digital era, the need to quickly respond to customer expectations and aggressive actions of rivals demands a persistent transformative approach – one that uncovers and automates efficiencies, crafts engaging user experiences and readily adapts when needed. These will be the roles of the emerging generation of digital automation platforms, robotic process automation (RPA) tools and the process mining technology needed to discover and automate the delivery of customer value.

Trend 2: Hyper-Distributed Infrastructure Will Drive Demand for Unified Management Platforms

Implication: Enterprise workload migration, IoT initiatives and distributed databases represent architectures that perpetuate billions of users, endpoints and nodes. This will force enterprises, cloud service providers and vendors of cloud-enabling technologies to seek more efficient means to handle the hyper-distributed nature of evolving cloud computing architecture. Next-generation tooling and services needed to manage and optimize the operational and economic performance of diverse distributed systems, on-premises infrastructure, and multi-clouds as part of emerging and hybrid IT architecture will evolve to become unified infrastructure management (UIM) platforms.

Trend 3: Storage Will Get Faster and Smarter

Implication: Although the flash storage revolution delivered a major jolt to performance, the demand for faster storage continues, driven by the rise of data-intensive applications such as machine learning. In reverse, the availability of faster storage will help encourage take-up of those applications. At the same time, the challenges of managing unstructured data are starting to be met by the use of object storage and metadata to provide true storage ‘intelligence’.

Trend 4: Container Usage Will Expand Into More Complex Applications

Implication: Fueled by not only cloud-native application development, but increasingly traditional applications as well as hybrid cloud, containers and microservices will continue to expand as both vendor and end user participation grows along with production use. Our 451 Research Market Monitor analysis of the container market indicates a broad market involving many new startups as well as the largest players in the industry. We estimate the container market will be valued at about \$2.1bn in 2019, growing at a compound annual growth rate of 30% to top \$4.3bn by 2022. We believe this growth is driven largely by the fact that most modern, cloud-native application development and deployment patterns – including DevOps, microservices and serverless – involve containers at the core with varying levels of abstraction for customers. Regardless of how visible they are to developers, lines-of-business heads or consumers, containers will be a critical element of the Invisible Infrastructure that characterizes today's enterprise efforts toward automation and digital transformation.

Trend 5: DevSecOps Will Heighten Collaboration To Secure Software Iterations

Implication: DevOps adoption has been gaining ground with enterprises, but many are not incorporating security into their DevOps practices. At least half of continuous integration/continuous delivery (CI/CD) workflows in the enterprise do not include any security testing elements, according to a 451 Research survey of 350 enterprise IT decision-makers in North America and Europe fielded in May 2018. DevOps can lead to streamlined and more collaborative approaches to development, but organizations will need to ensure they are not compromising on security as the pace of development hastens. Helped along by high-profile security breaches and incidents, we expect to see the DevSecOps trend evolve and grow in 2019.

Trend 6: Compute Platforms Will Evolve on the Path to Composable Infrastructure

Implication: Mesh-like deployments of compute sources including CPUs and accelerators will become the norm for datacenter infrastructure. Efficient development of next-generation, highly differentiated applications will rest heavily on deployments that outfit IT with compute horsepower for any need, rather than infrastructure that's deployed on a workload-by-workload basis.

Trend 7: Hyperconverged Infrastructure Innovation Will Further Break IT Silos

Implication: The ultimate archetype of digital transformation will rely heavily on seamless software-defined IT. HCI is carrying this torch with success, but barriers remain that prevent effective consolidation of IT teams and full-scale, efficient modernization of IT infrastructure. Networking innovation in the coming year – including integration of SDN capabilities – will further weaken walls between internal IT teams that disrupt the productivity promised by the ongoing implementation of Invisible Infrastructure.

Trend 8: Use of Adaptive Networking Will Continue To Grow

Implication: As enterprise IT continues to automate application and service provisioning, companies will be prioritizing software features such as programmatic capabilities, integration APIs, and the breadth and depth of integrated products from technology and service partners. Networking infrastructure vendors will succeed by supporting external control, while orchestration platforms will succeed with automated workflows and a broad technology ecosystem.

Trend 9: The New Accelerators Will Accelerate

Implication: An emerging new generation of specialist accelerators is capable of boosting the performance of targeted workloads – particularly AI and machine learning – by a significant factor. Without them, current infrastructure won't be capable of delivering on the compute performance and power efficiency requirements demanded by tasks such as neural network training and inference.

Trend 10: Monitoring Vendors Will Begin To Refine Machine Learning Applications

Implication: Emerging sophisticated applications of machine learning in monitoring tools promise to distinguish vendors that can deliver powerful utility and hamper those that, without the technology, are unable to respond to evolving needs of businesses. The emerging availability of these new capabilities may empower businesses to better serve customers, resulting in material benefits.

Trend 11: The Edge Wars Will Heat Up, Driven by IoT

Implication: The term 'edge computing' refers to IT topologies that deliver computing resources closer to the applications, devices and users that rely on them. Edge computing architectures provide a necessary counterpoint to the trend in which IT resources swayed toward centralized public clouds and large corporate datacenters over the past 10 years. Many mature and emerging use cases, such as analytics applied to IoT data close to the source, can take advantage of edge platforms. While IoT leads the pack, we foresee demand for edge computing accelerating in 2019, driven by a variety of low-latency applications like augmented reality and gaming, streaming data analytics, video analytics and the beginning of widespread rollouts of 5G. The critical question remains around who will win as the edge takes off.



Executive Summary

Introduction

The pace and shape of the evolution of IT to support digital business initiatives have challenged 451 Research to rethink how we approach applied IT infrastructure and supporting developer and IT operational tools and processes. Starting in Q4 2018, we have merged our discrete IT technology practices including networking, storage, and IT systems and software with our DevOps and middleware practices. This new mindset and research methodology is inspired by and supportive of our concept of 'Invisible Infrastructure,' as described in our [451 4SIGHT report](#), which explores four overarching themes driving the future of IT. Invisible Infrastructure broadly encompasses the trend of IT platforms converging and becoming increasingly distributed, autonomic, intelligent, commodified, consumption-driven and software-defined.

"The accelerating journey of infrastructure becoming 'invisible' to drive and support emergent digital business outcomes and intelligent ops requires very visible changes in how modern IT infrastructure is deployed and managed and how applications are designed, deployed and secured. "

This new combined practice is called Applied Infrastructure & DevOps, and we're excited about the collective insights this new team will bring 451 Research clients on [the journey to Invisible](#). Modern IT infrastructure must be designed and equipped to rapidly adapt to changing workloads as enterprises adopt DevOps tools, culture and processes in support of their digital business goals. This new practice focuses on how IT infrastructure should be designed to rapidly adapt to changing workloads born from evolving DevOps environments and studies how enterprise infrastructure can be crafted as a set of building blocks that can be configured and composed in response to unforeseen needs. Our research will extend across tangential technologies in IT ops and DevOps, and other markets as needed, to interpret how they interoperate (converge) to enable 'applied infrastructure.'

Given the overall size and impact of this newly joined-up topic area, there are a number of trends we will be tracking into 2019, including the 11 trends called out in this Preview Report.

This inaugural version of the Applied Infrastructure & DevOps Preview provides guidance on the key trends fueling the disruptive change we expect to only accelerate in 2019. In aggregate, these trends are actually influencing each other to drive that change. The accelerating journey of infrastructure becoming 'invisible' to drive and support emergent digital business outcomes and intelligent ops requires very visible changes in how modern IT infrastructure is deployed and managed and how applications are designed, deployed and secured. Perhaps the most impactful of all the trends is growing demand for seamless automation within and between IT resources and business processes to drive greater overall efficiency and speed along with the uptime of critical infrastructure. Another common theme found throughout this research centers on convergence and integration. The convergence of digital infrastructure itself will drive efficiency and optimized support for emerging workloads, and we see a growing need for convergence across IT and developer tools and processes such as security ops (SecOps) and DevOps to drive agility and speed while also managing risk. Integration tools and processes allow support for workload consumption patterns spanning a growing array of hybrid execution venues, from public clouds to premises-based environments and every iteration in between.

451 Research's 2019 Applied Infrastructure and DevOps Trends

Source: 451 Research, 2018

	Winners	Losers
<i>Process Automation, Bots and Mining Will Become Essential Technologies for Digital Business</i>	Enterprises that view business processes as strategic assets and manage them using a continuous process improvement program; vendors that look more holistically across the various tangential technologies and markets that enterprises must now assemble on their own	Enterprises that remain oblivious to how their business processes execute and perform within and across business applications; vendors that fail to continuously automate and integrate the various technologies needed by their enterprise clients
<i>Hyper-Distributed Infrastructure Will Drive Demand for Unified Management Platforms</i>	Enterprises that periodically review and compare operational requirements and price performance characteristics; vendors that embrace the UIM platform challenge	Enterprises that are late to exploit the unique advantages of distributed infrastructure and execution venues; vendors that fail to proactively develop and offer tools to improve the economic performance of their customers' IT investments
<i>Storage Will Get Faster and Smarter</i>	Vendors that are prepared to introduce new, purpose-built NVMe storage systems to their portfolios	Vendors that sit on the sidelines with respect to new memories and NVMe
<i>Container Usage Will Expand Into More Complex Applications</i>	Vendors that embrace open source and providers with software that is supported across hybrid infrastructures	Container vendors that don't participate in open source communities; vendors that only support one type of infrastructure

DevSecOps Will Heighten Collaboration To Secure Software Iterations	Vendors that provide security tools that can be integrated and automated; enterprises that can augment their workflow and release processes	Vendors that can't offer technologies to facilitate DevSecOps at scale; organizations that are culturally too rigid or otherwise lagging in DevOps adoption
Compute Platforms Will Evolve on the Path to Composable Infrastructure	Traditional server manufacturers and accelerator vendors	Public cloud providers and pure-play hyperconverged vendors
Hyperconverged Infrastructure Innovation Will Further Break IT Silos	Full-stack providers and service providers	Partnership-weak vendors; service providers
Use of Adaptive Networking Will Continue To Grow	Vendors whose products echo Crawl, Walk and Run; those that simplify workflows and reduce operational overhead; those that enable end-to-end automated networking to improve connectivity	Vendors that embrace lock-in or inhibit integration; automation and orchestration vendors that can't maintain a broad set of multi-vendor technology integrations; vendors thinking, 'If we merely build a developer portal, they will come'
The New Accelerators Will Accelerate	Startups that have taken a more general-purpose approach to their architectures; challengers that successfully refocus their current offerings with a strong software stack and ecosystem	Inflexible incumbents and the majority of AI chip startups
Monitoring Vendors Will Begin To Refine Machine Learning Applications	Vendors that have invested in and continue to develop machine learning capabilities; businesses that embrace these emerging capabilities	Vendors that are sitting on the machine learning sidelines and those without SaaS offerings
The Edge Wars Will Heat Up, Driven by IoT	Telecom operators; IoT service providers that get in front of the edge	Vendors that try to go all in on either side of edge or cloud; enterprises that eschew edge computing due to cost or complexity

Methodology

Reports such as this one represent a holistic perspective on key emerging markets in the enterprise IT space. These markets evolve quickly, though, so 451 Research offers additional services that provide critical marketplace updates. These updated reports and perspectives are presented on a daily basis via the company's core intelligence service, 451 Research Market Insight. Forward-looking M&A analysis and perspectives on strategic acquisitions and the liquidity environment for technology companies are also updated regularly via Market Insight, which is backed by the industry-leading 451 Research M&A KnowledgeBase.

Emerging technologies and markets are covered in 451 Research channels including Applied Infrastructure & DevOps; Cloud Transformation; Customer Experience & Commerce; Data, AI & Analytics; Datacenter Services & Infrastructure; Information Security; Internet of Things; Managed Services & Hosting; and Workforce Productivity & Compliance.

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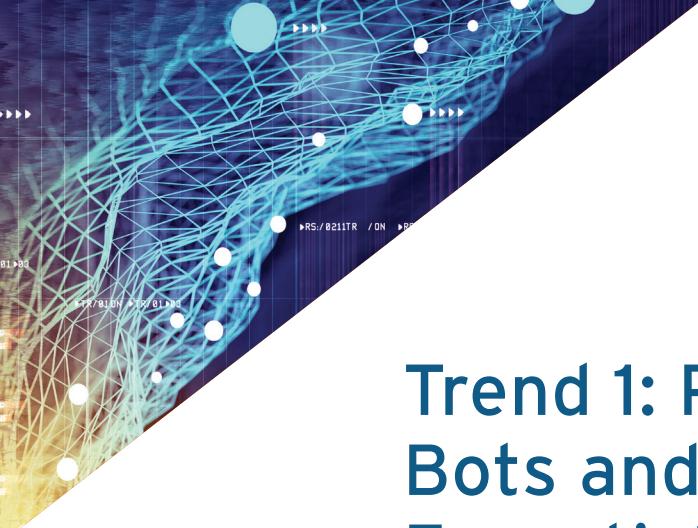
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451 Research's 4SIGHT: Empowering the Digital Revolution

Throughout this report, you will see the below graphic indicating which of our 451 4SIGHT themes each trend relates to. 4SIGHT is 451 Research's look into the future of information technology, organized around four main themes that we expect to shape the digital transformation agenda over the next 10 years and beyond. The 4SIGHT report is available to all clients via our research dashboard. For more information, [visit our website](#).





Trend 1: Process Automation, Bots and Mining Will Become Essential Technologies for Digital Business



Implication: In the digital era, the need to quickly respond to customer expectations and aggressive actions of rivals demands a persistent transformative approach – one that uncovers and automates efficiencies, crafts engaging user experiences and readily adapts when needed. These will be the roles of the emerging generation of digital automation platforms, robotic process automation (RPA) tools and the process mining technology needed to discover and automate the delivery of customer value.

Common to all attributes of digital business is the need to improve, transform and automate intelligent and adaptable business processes. The traditional vehicles to do so were business process management (BPM) suites, enterprise content management (ECM) software, and other specialized platforms designed to automate workflows, manage workgroups and document flow, or enable general-purpose application development. Each enabled considerable efficiency for their purposes but were less than intelligent and unwittingly also created a new, daunting and expensive business problem: manual repetition.

All these tools crafted new applications, many of which included a flood of forms for data capture and other information-rich documents that required manual retrieval, review, updates and actions. Similarly, the core business applications used by enterprises such as ERP, CRM and supply chain management systems all evolved, creating new user interface screens that required similar manual repetitive actions. Moreover, mobility accelerated the rapid growth of e-commerce that soon overran many customer service organizations, creating an immediate need to automate and scale.

As these trends played out, BPM suites, ECM software and other application development environments began to transform and converge into smarter process- and content-oriented application development and runtime platforms. They enabled a 'low-code/no-code' approach that uses graphical drag-and-drop tooling and preconfigured templates to compose, rather than code, applications. Some added analytic tools to interpret context and make recommendations. IT vendors in these markets are now positioning their new offerings as the means to enable digital transformation – creating next-generation development environments we refer to as digital automation platforms (DAPs).

DAPs include new efficiencies that allow business and IT teams to collaborate to rapidly automate business processes, improve developer productivity, and support enterprise DevOps strategies. They help enable intelligent process automation (IPA) – an application development discipline focused on intuitive user experiences, contextual awareness and transparent execution. IPA provides a new means to accelerate business operations and make them efficient, as well as extract knowledge from automated execution to meet the innovation and operational efficiency needs of enterprises. However, DAPs do little to resolve highly repetitive manual operations, and their abilities to automate many e-commerce tasks were incomplete. A new class of tools has entered the market to help resolve this issue.

RPA crafts software robots (bots) that can automate repetitive manual activities within business processes, helping reduce errors, cost and cycle times. In some use cases, they use machine learning technology to interpret context and make relevant recommendations to users, thus easing the burden on customer service organizations while enabling scale. But doing so is not a simple matter. Proper analysis of manual operations is required, without which RPA projects can just replace old inefficiencies with new ones, or worse – frustrate customers with bad recommendations.

A class of IT analytic tools has been under development for many years attempting to automate, with checkered success, the tasks needed to accurately visualize and understand how current business processes and manual tasks execute and perform. Process mining technology (PMT – also referred to as process discovery) has recently matured in response to the emergence of DAP and RPA platforms. It now makes practical the examination of process hierarchies, decisions, policies, rules and tasks to reveal how to improve and automate the quality and efficiency of process flows, manual operations and outcomes. DAPs, RPA and PMT today represent formidable tools needed by all enterprises as part of their transformation to digital businesses and to efficiently adjust to the age of aggressive digital rivals and empowered customers.

Recommendations

- **Manage business processes as strategic assets.** Today, most business processes are codified in and across multiple applications. Sadly, the processes are not treated as enterprise assets. Rather, the applications that run the processes are the assets. In such environments, process behavior and performance get lost, become invisible and consequently are difficult to visualize, analyze and improve.
- **Inventory and evaluate business processes for risk and value to the enterprise.** Categorize them by user groups such as customers, workforce and business partners. Select those processes core to customer value creation and assess their ability to do so. Correlate the applications that compose each business process (many processes transcend multiple applications). Determine those processes and applications that need modernization and begin redesign (digital transformation) efforts considering the use of PMT, DAP and RPA platforms.
- **Enterprises that have not already done so should examine the new crop of DAP, RPA and PMT vendors.** We recommend comparing their respective capabilities to how your organization currently approaches the analysis, design and development of process automation projects to enable digital business.

Winners

- **Enterprises that view business processes as strategic assets and manage them using a continuous process improvement program** designed to modernize user experiences by exploiting the current generation of PMT, DAP and RPA technology to enable intelligent process automation.
- **Vendors that look more holistically across the various tangential technologies and markets** that enterprises must now assemble on their own to design, develop and maintain their digital business strategies and intelligent process automation projects.

Losers

- **Enterprises that remain oblivious to how their business processes execute and perform within and across business applications**, and how the users exposed to or facilitating the processes perceive the quality of their design, navigation, contextual assistance and outcomes.
- **Vendors that fail to continuously automate and integrate the various technologies needed by their enterprise clients** (e.g., DAPS, RPA, PMT and other application development and integration technologies) to rapidly modernize and deploy intelligent process automation initiatives.



Trend 5: DevSecOps Will Heighten Collaboration To Secure Software Iterations



Implication: DevOps adoption has been gaining ground with enterprises, but many are not incorporating security into their DevOps practices. At least half of continuous integration/continuous delivery (CI/CD) workflows in the enterprise do not include any security testing elements, according to a 451 Research survey of 350 enterprise IT decision-makers in North America and Europe fielded in May 2018. DevOps can lead to streamlined and more collaborative approaches to development, but organizations will need to ensure they are not compromising on security as the pace of development hastens. Helped along by high-profile security breaches and incidents, we expect to see the DevSecOps trend evolve and grow in 2019.

DevOps is appealing to organizations because it can be a means to achieve faster software iteration and can pave the way to implementing agile development methodologies and CI/CD release processes. Organizations will need to be able to integrate security testing into development processes and adopt the right toolset and level of automation. This can enable them to maintain the speed of software releases without compromising on security and potentially even save time that would otherwise be required for patching and fixes post-release. Security testing is often perceived as a speed bump that can slow down release cycles, so there will naturally be some reticence to integrating it into the work of DevOps teams. However, security is growing as a priority for enterprises and is increasingly going hand in hand with the notion of quality in regard to the software being delivered. With CI/CD workflows, the pace at which an enterprise is producing code is rapid and the need to factor in security earlier in the process is essential.

Enterprises that are aiming to achieve a holistic DevSecOps approach will need to focus on two core areas: culture and tooling. Culturally, DevSecOps requires multiple different groups and stakeholders within an organization to work together. DevOps already works to collapse silos as it integrates developers and IT operations, and DevSecOps takes this one step further by pulling in security teams so that security can be integrated into the software development lifecycle as early as possible. On a technical level, security testing tools will need to be able to be integrated with existing development workflows and automated to maintain release velocity while limiting false positives, and this is the opportunity in the space for security vendors.

Recommendations

- **Enterprises need to foster collaboration between security and DevOps teams.** As is the case with DevOps, DevSecOps is a joint effort between multiple teams. While their specific jurisdictions and tasks may differ, organizations need to unite around the end goal of better-quality code and safer delivery.
- **Vendors must ensure that they can help enterprises achieve tangible risk prevention benefits without derailing release timelines.** Organizations need to include security tooling in their CI/CD deployments, yet will be hesitant to do so if it means compromising the cadence of their software development lifecycles. Vendors will need to provide security testing and assurance tools that are integrated, automated and as unobtrusive as possible.

Winners

- **Vendors that provide security tools that can be integrated and automated.** Security and testing tools will need to be tightly integrated into the processes and workflows of DevOps teams so as not to impede their ability to execute on CI/CD pipelines.
- **Enterprises that can augment their workflow and release processes.** Integrating security with DevOps to take on a more holistic DevSecOps approach won't be easy for some organizations, but those that can empower developers and augment their release processes, especially those implementing CI/CD, will achieve an enhanced level of quality and security without impacting release velocity.

Losers

- **Vendors that can't offer technologies to facilitate DevSecOps at scale.** Developer use of technologies such as containers and cloud-based infrastructure along with microservices-based application architectures means that any tooling offered by vendors will need to work at scale and in different environments.
- **Organizations that are culturally too rigid or otherwise lagging in DevOps adoption.** DevSecOps will be a collaborative effort and will necessitate some cultural change. Enterprises that are unwilling or unable to modify their culture or practices internally and pull in the right stakeholders will get left behind and leave their software development lifecycle and releases exposed to greater risk.

Trend 9: The New Accelerators Will Accelerate



Implication: An emerging new generation of specialist accelerators is capable of boosting the performance of targeted workloads – particularly AI and machine learning – by a significant factor. Without them, current infrastructure won't be capable of delivering on the compute performance and power efficiency requirements demanded by tasks such as neural network training and inference.

Workloads in the datacenter are changing rapidly, beyond traditional text, structured data and transaction processing toward web-native applications heavy with multimedia elements. In particular, emerging applications in AI (and its subsets machine intelligence and deep learning) require different characteristics from general-purpose processors, such as high data throughput, multi-core for parallelism, and variable or single-precision operations. Meanwhile, cloud datacenter infrastructure is evolving toward the use of many standard processor, storage and networking units in scale-out architectures. The intelligent edge is opening up a whole new layer of infrastructure and data management, where intelligence has to be applied in real time, close to the application front end.

Like AI, accelerator chips are not new. Specialist mainframe processors, vector processors in supercomputers, graphics cards for gamers and technical workstations are all commonplace and familiar. Outside the high-performance computing sector, however, these first-generation accelerators weren't easy to incorporate into datacenter servers, particularly at scale. But today, clusters of x86 boxes are now the standard compute building blocks for datacenters of all sizes. Inside them are powerful CPUs, NVMe storage and plenty of high-speed PCIe slots to house multiple adapters. This makes it far more practical to incorporate accelerators non-disruptively, enabling a whole new ecosystem of devices.

Existing CPUs, GPUs, FPGAs and embedded processors have the advantage of established ecosystems that help them penetrate the market. But they weren't built specifically to run AI. We are now tracking almost 50 brand new custom-designed chips that are claimed to offer 10 times the level of performance and efficiency of current architectures – including GPUs and FPGAs. How can they do that? By focusing on a set of fixed operations and narrow functionality and dedicating all the silicon logic to their execution at the fastest possible speed. The clue is in the name. Custom ASICs are 'application-specific' and the additional performance gained must be weighed against less flexibility. The ASIC model also pays off better when large-volume shipment numbers mean that volume economics kicks in.

The first of these new architectures will reach the market in 2019 – and they will drive other new developments in systems architectures better suited to support heterogeneous silicon, such as distributed system fabrics, composable infrastructure and memory-centric computing. High-performance computing and hyperscale architectures are gradually coming together. However, the new startups won't have it all their own way. All the major hyperscale companies now have their own internal silicon development efforts underway. It's also a certainty that only a handful of the new startups will be successful: The majority will fail, and others will be acquired for their technology or people. Vying for the rest of the business will be incumbents (Intel and ARM), challengers (NVIDIA, AMD and Xilinx) and the embedded processor establishment (including Broadcom, NXP, Renesas, Infineon Technologies and STMicroelectronics).

Recommendations

- **Remember that AI and deep learning are still evolving, particularly in regard to infrastructure.** New chip architectures are coming to market that address problems that are hardly defined yet. It's not likely that any of these have yet reached their final form. Even the exact role of the accelerator in relation to the CPU is still fluid. Engagements with startups at this stage should be made with that in mind.
- **Be aware of supplier control points and trade-offs.** The incumbents engineer their offerings around the technology they've already developed. GPUs are the most obvious example here: designed for graphics, now re-focused on analytics and AI. They each have their control points to maintain in order to create sticky business opportunities. The development of heterogeneous standards for AI processors and software is an important piece of the puzzle. No single architecture will dominate – there are a range of different problems with very different demands and power envelopes. As always, trade-offs will have to be made.

Winners

- **Startups that have taken a more general-purpose approach to their architectures.** If a chip is aimed at too narrow a problem, it's unlikely to have a long future. The most future-proof silicon offerings will be those that are adaptable to a wider range of the new workloads.
- **Challengers that successfully refocus their current offerings with a strong software stack and ecosystem.** It's already happened with GPUs, while momentum is growing for different use cases with FPGAs. But software – particularly programming tools and AI/deep learning frameworks – are crucial.

Losers

- **Inflexible incumbents.** Established offerings that aren't flexible enough to be adapted will lose significant market share as heterogeneous systems offering significant performance, density and efficiency benefits are adopted.
- **The majority of AI chip startups.** There are too many, and most of them won't last the course. Chip development is expensive, and while the barrier to entry has been lowered, it's establishing a roadmap with multiple generations of products that is the hardest (and costliest) part. And without that, customers won't take the risk.



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