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IT Modernization: A Foundational Requirement for IT Transformation

The ongoing pursuit of IT cost efficiency and an increasing need to support new data-intensive workloads in a hybrid cloud are powerful reasons to upgrade legacy infrastructure sooner than later

> 71% of IT decision makers consider IT transformation critical to remaining competitive[1]

Executive Summary

Companies that want to remain competitive are making IT modernization an urgent priority. A sprawling infrastructure consisting of legacy hardware and software slows business down and blocks innovation. In a global survey, seventy-one percent of IT decision makers cite legacy infrastructure as their biggest barrier to business transformation[1]. The business value of IT modernization is compelling:

- Reduce technical debt
- Improve IT efficiency and total cost of ownership (TCO)
- Deliver services at scale faster and support emerging data-intensive workloads
- Ease the path to hybrid cloud deployments
- Enhance application developer innovation
- Reduce business risk with improved regulatory compliance and enhanced data security from data center to cloud to edge

Realizing these benefits will take more than just an investment in compute power. It will take a holistic approach to infrastructure investment. Businesses across a variety of industries can take advantage of Intel's leadership and experience to assess their legacy debt that is constraining infrastructure and build a strategy for IT modernization that will help them meet the demands of the business in an era of digital transformation.

Business Challenge: Legacy Infrastructure Hinders Competitiveness

Historically, IT refreshed hardware and software on a predictable schedule. But it's not "business as usual" any more. The velocity of business change and disruptive technology trends require a more agile response from IT. This means constantly evaluating new infrastructure investments through the combined lens of diverse workload demands, TCO calculations, and new innovations across compute, storage and networking.

Another powerful driver of IT modernization is the business risk associated with aging software. Unsupported software poses several risks, including:

- Loss of OS security patches and lack of latest compliance and regulation capabilities

- Loss of innovative capabilities that come with modern software

- High maintenance costs associated with running older systems.

Modern software is designed for outstanding performance when running on modern hardware. Therefore, IT modernization strategies must address both the legacy hardware and software in the infrastructure. Intel has developed deep relationships and collaborative engagements across the technology ecosystem of hardware OEMs and ISVs (including open source). Working with Intel, enterprises can use these relationships to find optimized solutions that support the demands of the business.
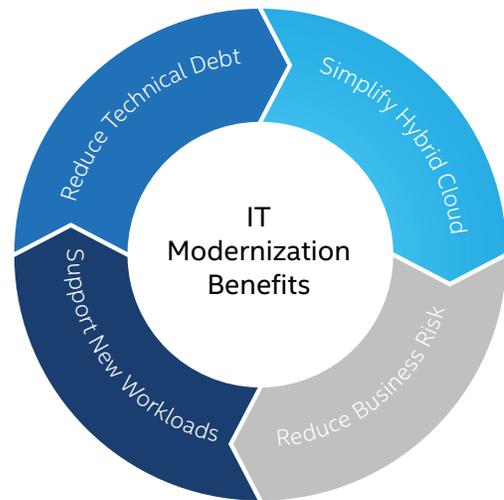

Figure 1. A holistic IT modernization strategy can provide a wide range of benefits.

Microsoft and Intel Work Together to Ease the Path to IT Modernization

Microsoft support for Windows Server* 2008 and SQL Server* 2008 is winding down, and many organizations are evaluating their plans for these aging systems. For companies looking to gain or maintain a competitive advantage, moving now to Microsoft Windows Server 2019 and SQL Server 2017 makes sense. Optimized for Intel® Xeon® Scalable processors, Windows Server 2019 and SQL Server 2017 deliver highly scalable performance, strengthened security, and faster insights from data—all while improving total cost of ownership (TCO). In addition, these hyperconverged infrastructure (HCI) solutions from Intel and Microsoft help organizations get future-ready by easing the path to hybrid cloud, for increased agility without giving up control. Updating both hardware and software at the same time delivers the maximum functionality, as the two are designed to work best together.

Building an infrastructure capable of meeting modern business challenges can seem overwhelming. Pre-configured, Intel-verified Intel® Select Solutions can help. Intel offers Intel Select Solutions for SQL Server* Business Operations, Microsoft SQL Server* Enterprise Data Warehouse and Windows Server* Software Defined Storage, as well as Intel Select Solutions for Microsoft Azure Stack*. Intel intends to refresh the Intel Select Solution for Windows Server Software Defined Storage to include Windows Server 2019, as well as support for Intel® Optane™ DC Persistent Memory.

Four Business Benefits of Modernizing Now

There are several reasons that now is the right time for enterprises to pursue IT modernization.

1. Pay Down Technical Debt

The technical debt that organizations incur through the sprawl of legacy infrastructure is significant. Ongoing costs, incurred long after the infrastructure has been amortized, can come in many forms:

- Increasing maintenance costs

- Unplanned outages resulting in employee downtime

- Sub-optimal developer productivity

- Business impact from online security threats that legacy hardware is not designed to address.

Investing in a modern architecture can boost IT efficiency and reduce IT spend, freeing more budget to allocate toward more innovative investments. For example, compared to four- to five-year old servers, the next-generation Intel® Xeon® Scalable processor family can provide up to 4X performance[2] and improve TCO by up to 60 percent, with fewer servers delivering similar performance levels[3]. A recent paper jointly produced by Intel, Dell and IDC studied IT organizations that have started aggressive modernization efforts in support of broader digital transformation initiatives. The paper calculates that these organizations have reduced or eliminated technical debt worth an average of almost USD 40 million per organization per year. That represents 32 percent of their annual IT budgets[4].

2. Simplify the Path to Hybrid Cloud with Hyperconverged Infrastructure (HCI)

To meet a growing demand for agile, scalable, and cost-efficient computing, enterprises are turning to the hybrid cloud—deploying workloads seamlessly across one or more private and public clouds. Legacy, siloed systems lack the interoperability that the hybrid cloud requires. Therefore, enterprises are migrating to hyperconverged systems built on industry-standard servers that virtualize large and shared pools of compute, storage and networking resources. HCI improves infrastructure efficiencies and interoperability, streamlines management of IT and delivers the scale-out performance across compute, storage and networking that today's data-intensive workloads demand. HCI can also lower total cost of ownership. A Wikibon business analysis found that a traditional white box system with external SAN is 47 percent more expensive with 600 percent higher people costs than the hyperconverged SAN approach[5]. HCI also sets the stage for software-defined storage and networking which are essential for large scale-out hybrid cloud deployments.

> Improve performance by 4x[2] and reduce TCO by 60%[3] with modern infrastructure

3. Support Expanding Workloads and DevOps Practices

A modern infrastructure helps data centers support the increasing business demand for compute- and data-intensive workloads, such as advanced analytics, artificial intelligence (AI) and blockchain transactions. Sixty percent of C-level executives surveyed in a recent study say their organizations plan to increase investment in AI by over 50 percent compared to last year[6]. These rapidly emerging workloads increase the demand for an agile, converged infrastructure. Without modern infrastructure, enterprises struggle to support diverse workloads, quickly deploy new cloud-first applications and improve resiliency and stability.

Additionally, the impact of modernization on developer productivity is far-reaching. In a recent IDC study, developers working with a modern infrastructure experienced a 39 percent improvement in development life cycle and a 64 percent improvement in their ability to develop new applications[7]. With prompt delivery of compute and storage resources, hyperconvergence and self-service capabilities deliver a friction-free environment for developers. These changes are helping IT departments transform how applications are developed. One recent report showed a steady increase in the number of people on DevOps teams, from 16 percent of respondents in 2014 to 29 percent in 2018[8].

> ## 95%
> of CIOs expect cybersecurity threats to increase over the next three years[13].

4. Reduce Business Risk and Improve Data Security

With the estimated cost of cybercrime climbing to USD 2.1 trillion by 2019[9], it is paramount that enterprises invest in infrastructure that can protect the business and meet increasingly stringent compliance regulations. Ninety-five percent of CIOs expect cybersecurity threats to increase over the next three years[10]. A multi-layered approach to security is required to improve the protection of critical business data and assets and deliver better stability and resiliency. There are several areas where IT modernization can help better secure infrastructure:

- **Regulatory compliance.** Compliance with the General Data Protection Regulation (GDPR) as well as additional regulations like HIPAA, PCI, SOX, US FISMA and FedRAMP is a challenge for IT. These regulations present an opportunity for organizations to evaluate the footprint of (and related risks from) their legacy IT systems. It is necessary to rethink data security at both the system and infrastructure level for improved data protection.

- **Hardware-based root-of-trust protection.** Infrastructure built on the latest generation of Intel® processors comes with hardware root-of-trust protections, enabling businesses to improve security and the protection of critical business data and assets. Deploying systems with silicon-enabled controls helps improve an organization's security posture.

- **Efficient encryption.** With modern infrastructure, businesses can efficiently encrypt everything everywhere to help protect data at rest, in flight and in use. An Intel® Xeon® processor-based infrastructure delivers integrated hardware cryptography resources, including robust algorithms, strong keys, and built-in encryption accelerators, along with software optimizations. This lays the foundation for strong data security while maintaining high performance throughout the data lifecycle.

- **Security analytics.** With cybercriminals becoming increasingly sophisticated, real-time detection and remediation of malicious network activity across the data center is critical. Advanced security analytics and machine learning powered by Intel® technology can transform information security—quickly detecting not only known threats but also unknown and insider threats.

Investing in these areas can help establish a multi-layered security strategy that protects from the platform up, helps provide data encryption at all stages of use and can proactively hunt the threats on the network through the use of analytics and machine learning.

Accelerate IT Modernization

Intel® Select Solutions are verified, workload-optimized, and ready-to-deploy infrastructure stacks. They are available from specific industry OEMs and ISVs. Intel Select Solutions are a great fit for enterprises that are on a fast track to IT modernization and want to minimize the complexity of new deployments. Intel Select Solutions offer:

- **Simplified evaluation.** Verified infrastructure configurations help reduce complexity and investment in hardware evaluation and software integration. As a result, IT managers spend less time exploring endless options and searching for the perfect solution.

- **Fast and easy deployment.** Tightly specified hardware and software components help eliminate guesswork and speed decision-making. With pre-defined settings and rigorous system-wide tuning, Intel Select Solutions are designed to increase efficiency in IT's testing process, speed time to service delivery and increase confidence in solution performance.

- **Workload-optimized performance**. Configurations are designed per workload and deliver a specific performance threshold. Each solution is built on the latest Intel® architecture foundation. Solution delivery partners must verify that they have matched the specified configuration and have met or exceeded specified performance benchmark thresholds. In addition to validating their results, solution delivery partners can also add unique features and variations to fit their customers' needs and are expected to publish detailed implementation guides that significantly reduce infrastructure evaluation and deployment time and expense.

Extensive Portfolio for Comprehensive IT Transformation

As a global leader in data center technologies, Intel continues to drive the platform innovation and next-generation capabilities needed for the data era. Architected with deep knowledge and expertise across every infrastructure domain—from compute to storage to network to memory and accelerator technologies—Intel platforms are the future of the digital, data-centric enterprise and form the foundation for modern infrastructure. Intel's leadership and experience can help organizations across a variety of industries optimize their current infrastructure:

- **Flexible, powerful compute.** The latest generation of Intel processors is the centerpiece of an expansive technology portfolio that is optimized to handle current data center demand as well as deliver future-ready capabilities. Amazing things happen when Intel processors combine with open source deep-learning libraries such as BigDL* for Apache Spark* and key optimizations for industry-leading AI frameworks. Compared to the previous generation of processor, deep-learning inference throughput increased by up to 277x[11] and training throughput increased by up to 241x[12].

- **Fast encryption and compression.** Intel® QuickAssist Technology (Intel® QAT) supports massive volumes of encrypt/decrypt/compression operations without bogging down the server, freeing the CPU to process other critical business workloads.

- **Enhanced privacy and security.** Intel® Software Guard Extensions (Intel® SGX) helps protect selected code and data from disclosure or modification. Intel SGX uses trusted execution environments that can help prevent direct attacks on executing code or data stored in memory.

- **Future-ready storage.** Enterprises seeking to replace legacy storage infrastructure with high-performance, high-reliability storage have a wide choice of Intel® Optane™ Solid State Drives (SSDs) and Intel® 3D NAND SSDs. These drives are excellent for data-intensive workloads such as advanced analytics, machine learning and deep learning.

- **Affordable, high-performance memory.** Intel® Optane™ DC Persistent Memory is a new class of memory and storage technology that offers an unprecedented combination of high-capacity, affordability and persistence. Customers can use this new class of memory to optimize their workloads by moving and maintaining larger amounts of data closer to the processor and minimizing the higher latency of fetching data from system storage.

- **High-performance enterprise networks.** Intel® Ethernet 700 Series is the foundation for server connectivity. It offers broad interoperability, critical performance optimizations and increased agility for enterprise networks. Building a virtualized, software-defined network architecture using Intel Xeon processor-based solutions provides the security and agility needed to quickly provision services. Virtualization and software-defined capabilities also provide a consistent user experience across a multi-cloud and edge environment with anywhere, anytime application access. IT modernization can increase the speed, efficiency and security of the network from the data center to the edge.

Across this entire portfolio of capabilities, Intel works with customers to extract high performance and utilization from their Intel® processor-based infrastructure.

Conclusion

It is increasingly apparent that businesses cannot successfully compete on legacy infrastructure, and the benefits of IT modernization are numerous. They include decreased technical debt, an easier path to hybrid cloud with HCI, support for expanding workloads, improved data security and compliance and enhanced application developer productivity and innovation.

CIOs and their IT teams face complex technology choices in an effort to transform IT and build a stable, scalable platform that supports business growth and innovation. In addition to navigating disruptive trends, IT must also continue to prioritize modernization initiatives that can help them shed the burdens of legacy infrastructure and boost operational efficiency.

Intel delivers an unmatched portfolio of world-class data center platform technologies that are the foundation for the industry's leading enterprise solutions. From high-performance processors and storage systems, to networking and memory technologies and accelerators, Intel innovation

delivers the critical capabilities to drive modernization benefits from the data center to the edge. To help accelerate modernization efforts and reduce complexity, Intel works closely with its ecosystem to provide optimized solutions that use the latest data center technology and provide amazing performance.

Learn More

You may find the following resources helpful:

- Business Transformation for the Digital Age
- IT Transformation for the Digital Age
- Accelerate IT Modernization
- Intel® Xeon® Scalable Processors
- Intel® Select Solutions
- Intel® Optane™ DC Persistent Memory
- Intel® Data Center Builders Program

Find the solution that is right for your organization. Contact your Intel representative or visit **intel.com/beready**.

Solution Provided By:

[1] The Enterprise Strategy Group, Inc. 2017. https://www.emc.com/collateral/analyst-reports/esg-dellemc-it-transformation-maturity-report.pdf

[2] Performance results are based on testing as of June 26, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No component or product can be absolutely secure.

Up to 60% TCO savings compared to 5-year old system. Example based on estimates as of June 26, 2018 of equivalent rack performance over 4-year operation on integer throughput workload (estimate based on SPECrate*2017_int_base on Intel internal platforms) running VMware vSphere Enterprise Plus* on Red Hat Enterprise Linux Server* and comparing 20 installed 2-socket servers with Intel® Xeon® processor E5-2690 at a total cost of $737,460 [Per server cost $36.8K: acquisition=12,5K, infrastructure and utility=4.5K, OS & software=10.2K, maintenance=9.7K] vs. 5 new Intel® Xeon® Platinum 8180 processors at a total cost of $294,540 [Per server cost $58.9K: acquisition=12,5K, infrastructure and utility=10.1K, OS & software=10.1K, maintenance=9.7K]. Assumptions based on https://xeonprocessoradvisor.intel.com/assumptions as of June 6, 2018. Per node 4X higher integer throughput performance: estimate based on SPECrate*2017_int_base on Intel internal platforms: 1x node, 2x Intel® Xeon® Processor E5-2690, 128 GB total memory, 16 slots / 8 GB/ 1600MT/s DDR3 RDIMM, Benchmark: SPEC CPU2017 V1.2, Compiler: Intel® Compiler IC17 update 2, Optimized libraries / versions: IC18.0_20170901, Other Software: MicroQuill SMART HEAP. uCode: 713, OS: Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.11.6.el7.x86_64 x86_64, Score 65.5 vs. 1x Node, 2x Intel® Xeon® Platinum 8180 processor, 384 GB total memory, 12 slots / 32 GB / 2666 MT/s DDR4, Benchmark software: SPEC CPU® 2017, Compiler: Intel® Compiler IC18 OEM, Optimized libraries: Intel® AVX-512, ucode:0x043, Red Hat Enterprise Linux* 7.4, 3.10.0-693.11.6.el7.x86_64, Score: 281. Cost reduction scenarios described are intended as examples of how a given Intel® architecture-based product, in the specified circumstances and configurations, may affect future costs and provide cost savings. Circumstances will vary. Intel does not guarantee any costs or cost reduction.

[3] Performance results are based on testing as of June 26, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No component or product can be absolutely secure.

Per node 4X higher integer throughput performance: estimate based on SPECrate*2017_int_base on Intel internal platforms as of June 2018: 1x node, 2x Intel® Xeon® processor E5-2690, 128 GB total memory, 16 slots / 8 GB/ 1600MT/s DDR3 RDIMM, Benchmark: SPEC CPU2017 V1.2, Compiler: Intel® Compiler IC17 update 2, Optimized libraries / versions: IC18.0_20170901, Other Software: MicroQuill SMART HEAP. uCode: 713, OS: Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.11.6.el7.x86_64 x86_64, Score 65.5 vs. 1x Node, 2x Intel® Xeon® Platinum 8180 processor, 384 GB total memory, 12 slots / 32 GB / 2666 MT/s DDR4, Benchmark software: SPEC CPU® 2017, Compiler: Intel® Compiler

IC18 OEM, Optimized libraries: Intel® AVX-512, ucode:0x043, Red Hat Enterprise Linux* 7.4, 3.10.0-693.11.6.el7.x86_64, Score: 281. Cost reduction scenarios described are intended as examples of how a given Intel® architecture-based product, in the specified circumstances and configurations, may affect future costs and provide cost savings. Circumstances will vary. Intel does not guarantee any costs or cost reduction.

[4] The Enterprise Strategy Group, Inc. 2017. https://www.emc.com/collateral/analyst-reports/esg-dellemc-it-transformation-maturity-report.pdf

[5] Wikibon 2017. https://www.emc.com/collateral/analyst-report/wikibon-hci-featuring-vxrack-flex.pdf

[6] Constellation Research 2018. https://www.constellationr.com/blog-news/ai-investment-rising-significantly-among-early-adopters

[7] IDC 2017. https://www.emc.com/collateral/analyst-reports/idc-the-technology-impact-of-it-transformation-report.pdf

[8] Puppet 2018. https://puppet.com/resources/whitepaper/state-of-devops-report

[9] Juniper Research, May 2015, "Cybercrime will Cost Businesses Over $2 Trillion by 2019." https://www.juniperresearch.com/press/press-releases/cybercrime-cost-businesses-over-2trillion

[10] Gartner, July 2018, "Gartner Survey Finds Only 65 Percent of Organizations Have a Cybersecurity Expert." https://www.gartner.com/newsroom/id/3882863

[11] Performance results are based on testing as of June 26, 2018 and may not reflect all publicly available security updates.

INFERENCE using FP32 Batch Size Caffe GoogleNet v1 128 AlexNet 256.

Configurations for Inference throughput

Baseline configuration: 2S Intel® Xeon® processor E5-2699 v3 @ 2.30GHz (18 cores), Intel® Hyper-Threading Technology enabled, Intel® Turbo Boost Technology disabled, scaling governor set to "performance" via intel_pstate driver, 64 GB DDR4-2133 ECC RAM. BIOS: SE5C610.8 6B.01.01.0024.021320181901, CentOS* Linux-7.5.1804(Core) kernel 3.10.0-862.3.2.el7.x86_64, SSD sdb INTEL SSDSC2BW24 SSD 223.6GB. Framework BVLC-Caffe: https://github.com/BVLC/caffe revision 2a1c552b66f026c7508d390b526f2495ed3be594, Inference & Training measured with "caffe time" command. For "ConvNet" topologies, dummy dataset was used. For other topologies, data was stored on local storage and cached in memory before training.

Test configuration: 2-socket Intel® Xeon® Platinum 8180 processor @ 2.50 GHz / 28 cores, Intel® Hyper-Threading Technology enabled, Intel® Turbo Boost Technology enabled, Total Memory 376.28 GB (12 slots / 32 GB / 2666 MHz), 4 instances of the framework, CentOS* Linux-7.3.1611-Core , SSD sda RS3WC080 HDD 744.1 GB, sdb RS3WC080 HDD 1.5 TB, sdc RS3WC080 HDD 5.5TB , Deep Learning Framework Caffe version: a3d5b022fe026e9092fc7abc7654b1162ab9940d Topology: GoogleNet v1 BIOS:SE5C620.86B.00.01.0004.071220170215, Intel® MKL-DNN: version: 464c268e544bae26f9b85a2acb9122c766a4c396 NoDataLayer. Measured: 1449.9 imgs/sec

[12] Performance results are based on testing as of June 26, 2018 and may not reflect all publicly available security updates.

TRAINING using FP32 Batch Size Caffe GoogleNet v1 128 AlexNet 256.

Configuration for Training throughput

Baseline configuration: 2-socket Intel® Xeon® processor E5-2699 v3 @ 2.30 GHz (18 cores), Intel® Hyper-Threading Technology enabled, Intel® Turbo Boost Technology disabled, scaling governor set to "performance" via intel_pstate driver, 64 GB DDR4-2133 ECC RAM. BIOS: SE5C610. 86B.01.01.0024.021320181901, CentOS* Linux-7.5.1804(Core) kernel 3.10.0-862.3.2.el7.x86_64, SSD sdb INTEL SSDSC2BW24 SSD 223.6GB. Framework BVLC-Caffe: https://github.com/BVLC/caffe revision 2a1c552b66f026c7508d390b526f2495ed3be594, Inference & Training measured with "caffe time" command. For "ConvNet" topologies, dummy dataset was used. For other topologies, data was stored on local storage and cached in memory before training.

Test Configuration:

2-socket Intel® Xeon® Platinum 8180 processor @ 2.50 GHz / 28 cores Intel® Hyper-Threading Technology enabled, Intel® Turbo Boost Technology enabled, Total Memory 376.28 GB (12 slots / 32 GB / 2666 MHz), 4 instances of the framework, CentOS* Linux-7.3.1611-Core , SSD sda RS3WC080 HDD 744.1 GB, sdb RS3WC080 HDD 1.5 TB, sdc RS3WC080 HDD 5.5 TB, Deep Learning Framework caffe version: a3d5b022fe026e9092fc7abc765b1162ab9940d Topology: Alexnet BIOS:SE5C620.86B.00.01.0004.071220170215, Intel® MKL-DNN: version: 464c268e544bae26f9b85a2acb9122c766a4c396 NoDataLayer. Measured: 1257 imgs/sec

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation.

Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your system manufacturer or retailer or learn more at intel.com

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information visit www.intel.com/benchmarks

Performance results are based on testing as of 26th June 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No component or product can be absolutely secure.

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