SOLUTION BRIEF

Enterprise Data Center Infrastructure
February 2019

Intel® Reference Solution for IBM Cloud Private*

Accelerate your path to an enterprise-grade container solution with an optimized, verified solution for VMware vSAN*.

Digital transformation isn't a buzzword, it's a fact of life for organizations today. Businesses simply can't compete the way they used to and remain competitive. For example:

- Since 2000, 52 percent of Fortune 500* companies have been acquired or ceased to exist because of digital disruption.[1]
- Half of S&P 500* companies will be replaced over the next 10 years.[2]

But how do IT organizations transform their businesses? Digital transformation requires businesses to modernize apps, infrastructure, and processes in order to compete and survive—and IT needs to execute these changes while keeping the lights on and without breaking the budget or adding management or deployment complexity.

Using a container-based microservices architecture is a compelling way to meet these needs with a modern application and technology infrastructure. Microservices-based architectures provide benefits to both IT and the business. Building apps using microservices simplifies app development and maintenance while enabling a business to respond to changing needs with greater agility. For IT, containers provide a lightweight means of hosting apps that is not only portable and runs the same anywhere, but that is also fast and easy to deploy, and that supports both traditional apps and microservices. For business, containers can work with virtual machines (VMs) to reduce hardware, licensing, and maintenance costs; they can also help reduce time to market, increase productivity, and enable hybrid clouds. But how do you deploy a microservices-based architecture cost effectively, incrementally, and without adding complexity? The combination of IBM Cloud Private*, VMware vSphere*, and VMware vSAN* on Intel® hardware can provide an economical, enterprise-grade way forward for digital transformation. The Intel® Reference Solution for IBM Cloud Private combines Intel® Xeon® Scalable processors, Intel® 3D NAND Solid State Drives (SSDs), Intel® Optane™ DC SSDs, and the Intel® Ethernet 700 Series with the multi-cloud capabilities of IBM Cloud Private and the hyperconverged storage offered by VMware vSAN to enable businesses to quickly deploy an enterprise-ready, extensible private and hybrid cloud solution.

IBM Cloud Private

IBM Cloud Private is a scalable cloud platform that is built on a container architecture based on Kubernetes* and that harnesses the power of Intel hardware and technologies. In addition to a core platform, you can discover and deploy new services to use in your application from the IBM Cloud Private catalog. IBM Cloud Private includes management services like logging, monitoring, access control, and event management, and it brings cloud-native container capabilities to enterprise IT for all container use cases.

Rapid Innovation

IBM Cloud Private provides an open container platform based on Kubernetes for orchestration. This platform provides for automated deployment, scaling, and management of containerized applications. Moreover, IBM Cloud Private integrates with the IBM* DevOps toolchain to streamline the entire development process for continuous integration and delivery of containerized applications.

Hybrid Cloud Integration

IBM Cloud Private integrates capabilities to unlock and connect applications with a variety of clouds, both public and private. The tools provided in IBM Cloud Private can seamlessly manage multi-cloud environments and also help apps secure access to public cloud services like artificial intelligence (AI) and blockchain. All of these capabilities provide for a consistent experience across private and public clouds with IBM Cloud Private, in addition to helping prevent vendor lock-in to specific clouds.

VM and Container Management

Managing VMs and containers through different solutions can be challenging for administrators. IBM Cloud Automation Manager* provides a single solution for provisioning and managing both traditional VMs and containers. With IBM Cloud Automation Manager, you can manage your existing VM-based workloads, like SAP* solutions, while also embracing containers—and you can manage the infrastructure prerequisites for your VMs and containers.

Investment Improvement

IBM Cloud Private provides containerized versions of IBM Middleware* to connect containerized apps to your existing systems. You can thus make the move to modern, containerized apps without having to rework legacy workloads all at once. Prescriptive guidance from IBM can also help you optimize workloads and work with the existing apps, data, skills, and infrastructure already in your IT organization, even as you move to transform your infrastructure.

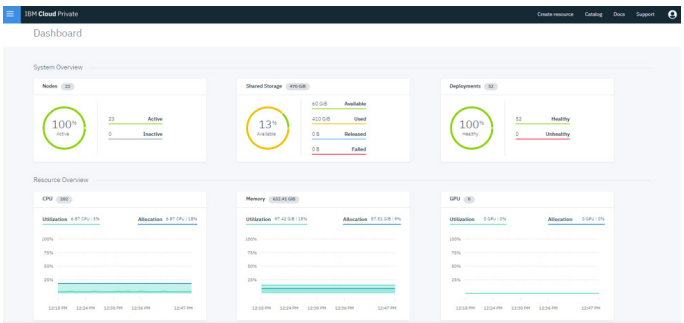

Figure 1. An example of management tools for the Intel® Reference Solution for IBM Cloud Private*: the IBM Cloud Private dashboard

VMware vSAN ReadyNodes*

The Intel Reference Solution for IBM Cloud Private uses VMware vSAN ReadyNodes* to deliver hyper-converged infrastructure and serve as the foundation for a transformed, software-defined data center. The VMware vSAN ReadyNode certification program provides assurance to data center buyers that their VMware vSAN provider of choice has undergone VMware's rigorous certification process. Verified Intel solutions—such as the Intel Reference Solution for IBM Cloud Private—are certified for vSAN ReadyNodes and are tightly specified by Intel and VMware to deliver out-of-the-box high performance. With the Intel Reference Solution for IBM Cloud Private, IT organizations can rest assured that their solutions are already verified for balanced and optimized performance, from the hardware up through the firmware stack to the VMware vSAN software. IT teams can get right to work providing VMware vSAN services to IBM Cloud Private rather than wading through multiple component options or conducting extensive, system-level testing.

Intel Reference Solution for IBM Cloud Private

The Intel Reference Solution for IBM Cloud Private helps optimize price and performance and can reduce infrastructure evaluation time compared to building an IBM Cloud Private solution from scratch. Specifically, the Intel Reference Solution for IBM Cloud Private combines the Intel Xeon Scalable processor platform, Intel 3D NAND SSDs, Intel Optane DC SSDs, and Intel® Ethernet Network Adapters to empower enterprises to quickly harness a reliable, comprehensive solution that allows organizations to:

- **Prepare** infrastructure investments for the future with scalable storage and compute
- **Generate excellent total cost of ownership (TCO)** with general-purpose hardware that IT organizations are used to managing
- **Accelerate time to market** by using a solution with a rich development toolset that is optimized for crucial software libraries

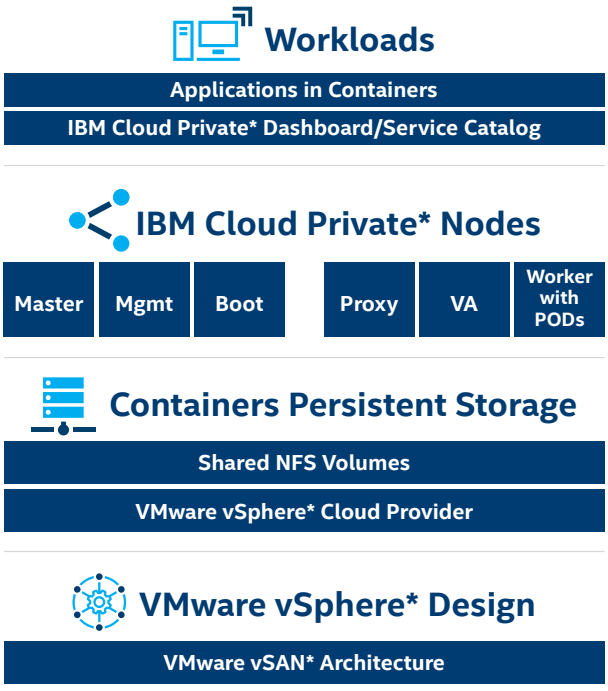

Figure 2. Software design for IBM Cloud Private* on VMware vSAN*

Solution Components

The Intel Reference Solution for IBM Cloud Private combines Intel Xeon Scalable processors, Intel 3D NAND SSDs, Intel Optane DC SSDs, and the Intel® Ethernet 700 Series, all of which enable businesses to quickly deploy IBM Cloud Private on VMware vSAN on a performance-optimized infrastructure.

Intel® Xeon® Scalable Processors

Intel Xeon Scalable processors provide the Intel Reference Solution for IBM Cloud Private with an excellent performance-to-cost ratio. Intel Xeon Platinum processors are also available for the Intel Reference Solution for IBM Cloud Private, and can provide extra performance when required.

Intel® SSD Data Center Family

Storage latency can be a bottleneck for container and VM performance. For this reason, the Intel Reference Solution for IBM Cloud Private uses Intel Optane SSD DC P4800X and Intel SSD DC P4510 drives. Based on Intel Optane technology and Intel 3D NAND technology, these enterprise data center SSDs can provide 13x better performance than hard-disk drives (HDDs).[3]

Intel® Ethernet Connections and Intel® Ethernet Adapters

The Intel Ethernet 700 Series accelerates the performance of the Intel Reference Solution for IBM Cloud Private. The solution features the Intel Ethernet 700 Series with 10 gigabit Ethernet (GbE) for validated performance ready to meet high quality thresholds for data resiliency and service reliability for most media types and port speeds, and it's backed by extensive testing, validation, and worldwide product support.[4,5,6,7]

Dev/Test, Base, and Plus Configurations

The Intel Reference Solution for IBM Cloud Private is available in three configurations: "Dev/Test," "Base," and "Plus," as shown in Appendix B. The Dev/Test configuration specifies the minimum required performance capability for the Intel Reference Solution for IBM Cloud Private. The Base configuration offers an optimized balance of price and performance for a typical deployment. The Plus configuration provides one example of how system builders, system integrators, and solution and service providers can further optimize the solution to achieve higher performance and capabilities.

Transform Your Infrastructure Faster with the Intel Reference Solution for IBM Cloud Private

IBM and Intel modernize the data center for digital transformation. The combination of IBM Cloud Private and VMware vSAN provides an open, agile, and scalable platform for building modern multi-cloud workloads. Coupled with Intel hardware and technologies, this provides enterprise-grade security and performance for multi-cloud workloads—on the broadest software platform—to give you choice with consistency in building consistent multi-cloud environments. When organizations choose the Intel Reference Solution for IBM Cloud Private, they get pre-tuned and tested configurations that are workload-optimized and that let organizations deploy data center infrastructure quickly and efficiently with less tuning.

Intel® Xeon® Scalable Processors

Intel Xeon Scalable processors:

- Offer high scalability for enterprise data centers
- Deliver performance gains for virtualized infrastructure compared to previous-generation processors
- Achieve exceptional resource utilization and agility
- Enable improved data and workload integrity and regulatory compliance for data center solutions

The Intel® Reference Solution for IBM Cloud Private* features Intel Xeon Silver processors and Intel Xeon Gold processors.

Learn More

1. IBM Cloud Private: **ibm.com/cloud/private**
2. Intel and IBM: **ibm.com/cloud/private/partners**
3. Intel Xeon Scalable processors: **intel.com/xeonscale**
4. Intel SSD Data Center Family: **intel.com/content/www/us/en/products/memory-storage/solid-state-drives/data-center-ssds.html**
5. Intel Ethernet 700 Series: **intel.com/ethernet**

Appendix A: Quantity of Physical Nodes for the Intel Reference Solution for IBM Cloud Private

The IBM Cloud Private cluster at the heart of the Intel Reference Solution for IBM Cloud Private has four main classes of nodes: boot, master, worker, and proxy. In addition, it has two optional classes of nodes—management and vulnerability advisor. The chart below lists the number of physical nodes by hardware configuration of the Intel Reference Solution for IBM Cloud Private that are required to support a given range of VM-based workloads.

CONFIGURATION	**SMALL** IBM CLOUD PRIVATE*	**MEDIUM** IBM CLOUD PRIVATE		**LARGE** IBM CLOUD PRIVATE	
NODE HARDWARE CONFIGURATION	MAXIMUM 20 WORKER-NODE VMs	MINIMUM 5 WORKER-NODE VMs	MAXIMUM 70 WORKER-NODE VMs	MINIMUM 7 WORKER-NODE VMs	MAXIMUM 150 WORKER-NODE VMs
DEV/TEST SKU	4	5	17	N/A	N/A
BASE SKU	4	4	9	4	17
PLUS SKU	4	4	6	4	12

Appendix B: Dev/Test, Base, and Plus Configurations for the Intel Reference Solution for IBM Cloud Private

Server vendor or data center solution providers providing this solution must meet or exceed the defined minimum configuration ingredients and reference minimum benchmark-performance thresholds listed below for this solution.

INGREDIENT	INTEL® REFERENCE SOLUTION FOR IBM CLOUD PRIVATE* **DEV/TEST CONFIGURATION**	INTEL REFERENCE SOLUTION FOR IBM CLOUD PRIVATE **BASE CONFIGURATION**	INTEL REFERENCE SOLUTION FOR IBM CLOUD PRIVATE **PLUS CONFIGURATION**
HARDWARE			
PROCESSOR	2 x Intel® Xeon® Silver 4114 processor (2.20 GHz, 10 cores, 20 threads) or a higher number Intel Xeon Scalable processor	2 x Intel Xeon Gold 5120 processor (2.20 GHz, 14 cores, 28 threads) or a higher number Intel Xeon Scalable processor	2 x Intel Xeon Gold 6148 processor (2.40 GHz, 20 cores, 40 threads) or a higher number Intel Xeon Scalable processor
MEMORY	192 GB or higher (12 x 16 GB DDR4-2,400 MHz or 2,666 MHz)	384 GB or higher (12 x 32 GB DDR4-2,666 MHz)	768 GB** or higher (24 x 32 GB DDR4-2,666 MHz)
BOOT DRIVE	1 x 480 GB Intel® SSD DC S3520 (M.2 Serial ATA [SATA])	2 x 480 GB Intel SSD DC S3520 (M.2 SATA)	2 x 480 GB Intel SSD DC S3520 (M.2 SATA)
CACHE TIER	1 x 375 GB Intel® Optane™ SSD DC P4800X (2.5-in. PCIe*)	2 x 375 GB Intel Optane SSD DC P4800X (2.5-in. PCIe)	2 x 375 GB Intel Optane SSD DC P4800X (2.5-in. PCIe)
CAPACITY TIER	3 x 2 TB Intel SSD DC P4510 (2.5-in. PCIe 3.1)	6 x 2 TB Intel SSD DC P4510 (2.5-in. PCIe 3.1)	6 x 2 TB Intel SSD DC P4510 (2.5-in. PCIe 3.1)
DATA NETWORK	1 x Intel® Ethernet Converged Network Adapter X710-DA2	1 x Intel Ethernet Converged Network Adapter X710-DA4	1 x Intel Ethernet Converged Network Adapter X710-DA4 OR 2 x 25 gigabit (Gb) Intel® Ethernet Controller XXV710
MANAGEMENT NETWORK PER NODE	Integrated 1 gigabit Ethernet (GbE)	Integrated 1 GbE	Integrated 1 GbE
ADDITIONAL COMPONENTS		2 x Intel® 8-Port PCIe Gen3 x8 Switch AIC (AXXP3SWX08080)	2 x Intel 8-Port PCIe Gen3 x8 Switch AIC (AXXP3SWX08080)
SOFTWARE			
IBM CLOUD PRIVATE	Enterprise Edition 3.1.1		
LINUX* OS	Red Hat* Enterprise Linux (RHEL*) 7.5		
VMWARE VSPHERE*	6.7 U1		

VMWARE VCENTER* APPLIANCE	6.7 U1
VMWARE VSAN*	6.7 U1
APPLIES TO ALL NODES	
TRUSTED PLATFORM MODULE (TPM)	TPM 2.0 discrete or firmware TPM (Intel® Platform Trust Technology [Intel® PTT])
FIRMWARE AND SOFTWARE OPTIMIZATIONS	Intel® Trusted Execution Technology (Intel® TXT) enabled Intel® Hyper-Threading Technology (Intel® HT Technology) enabled Intel® Turbo Boost Technology enabled Intel® Speed Shift Technology, hardware P-states (HWP) native Intel® Volume Management Device (Intel® VMD) disabled Power-management settings set to performance, workload input/output (I/O) intensive LLC prefetch enabled Uncore frequency scaling enabled PCIe and Single-Root I/O Virtualization (SR-IOV) support enabled Integrated I/O with Intel® Virtualization Technology for Directed I/O (Intel® VT for Directed I/O) enabled

**A cost-optimized configuration can use 512 GB RAM (2 x CPU, 16 x 32 GB 2,666 MHz DDR4). However, this is an unbalanced configuration and will decrease memory-access performance.

[1] Constellation Research. "Research Summary: Sneak Peeks From Constellation's Futurist Framework And 2014 Outlook On Digital Disruption." February 2014. constellationr.com/blog-news/research-summary-sneak-peeks-constellations-futurist-framework-and-2014-outlook-digital.

[2] Innosight. "2018 Corporate Longevity Forecast: Creative Destruction is Accelerating." innosight.com/insight/creative-destruction/.

[3] Evaluator Group. "Latest Intel Technologies Power New Performance Levels on VMware vSAN – 2018 Update." August 20, 2018. evaluatorgroup.com/document/lab-insight-latest-intel-technologies-power-new-performance-levels-vmware-vsan-2018-update/. 13x performance claim based on IOmark-VM* benchmark. Prior generation: 2 x Intel® Xeon® processor E5-2699 v4 (22 cores at 2.20 GHz with Intel® Hyper-Threading Technology [Intel® HT Technology] enabled) running VMware ESXi 6.0* with VMware vSAN 6.2*, 1 x Intel® SSD DC S3700 + 4 x 1 TB Seagate 10K HDD*; 88 IOmark-VM score. Current generation: 2 x Intel Xeon Gold 6154 processor (24 cores at 2.70 GHz with Intel HT Technology enabled) running VMware ESXi 6.7 with vSAN 6.7, 2 x Intel® Optane™ SSD DC P4800X + 4 x Intel SSD DC P4500, no deduplication; 1,152 IOmark-VM score.

[4] The Intel® Ethernet 700 Series includes extensively tested network adapters, accessories (optics and cables), hardware, and software, in addition to broad operating system support. A full list of the product portfolio's solutions is available at intel.com/ethernet. Hardware and software is thoroughly validated across Intel® Xeon® Scalable processors and the networking ecosystem. The products are optimized for Intel® architecture and a broad operating system ecosystem: Windows*, Linux* kernel, FreeBSD*, Red Hat* Enterprise Linux (RHEL*), SUSE*, Ubuntu*, Oracle Solaris*, and VMware ESXi*.

[5] The Intel® Ethernet 700 Series is backed with global support infrastructure for customers pre- and post-sales.

[6] Supported connections and media types for the Intel® Ethernet 700 Series are: direct-attach copper and fiber SR/LR (QSFP+, SFP+, SFP28, XLPPI/CR4, 25G-CA/25G-SR/25G-LR), twisted-pair copper (1000BASE-T/10GBASE-T), backplane (XLAUI/XAUI/SFI/KR/KR4/KX/SGMII). Note that Intel is the only vendor offering the QSFP+ media type.

[7] The Intel® Ethernet 700 Series supported speeds include 10 GbE, 25 GbE, 40 GbE, and 100 GbE.

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 intel.com/benchmarks.

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.

Cost reduction scenarios described are intended as examples of how a given Intel- 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.

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