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Why moving to new technology makes financial and technical sense

IBM z15 reduces IT costs and solves new business requirements

IBM **IT Economics Consulting & Research**

The cost of not staying current

Some organizations eagerly embrace the latest technology while others delay upgrades to their IT environments. For late adopters one of the prevailing reasons is cost. Upgrading to new technology is perceived as expensive and thought to be hard to justify with financial stakeholders in their company. Ironically these organizations may actually spend more by remaining on earlier technology. Over time, maintenance costs can increase, and the operational efficiencies of new features and technology advances are often missed since they may only be available with later releases. New technology can actually help reduce cost as a result of greater performance, increased capacity, advanced security, lower infrastructure costs and the availability of new hardware and software features.

IBM z15™ is designed to bring significant savings for enterprises using earlier IBM Z® technology. In this paper we examine cost cases with z15 versus IBM zEnterprise® EC12 (zEC12) and IBM z13® to illustrate how moving to z15 makes financial sense. We also highlight some of the technical features that z15 brings to organizations for 24x7 business availability, data encryption and protection across the enterprise, workload consolidation and hybrid cloud. Whether replacing zEC12, z13 or IBM z14®, the new z15 provides features that are intended to increase IT efficiencies, reduce cost and add business value.

Comparing z15 costs to earlier technology costs

To examine the cost benefits of z15 over earlier IBM Z platforms, a sampling of z/OS® workloads described below were compared on zEC12 and z13 systems versus z15 in terms of costs over five years and average annual operating expenses (OpEx) over five years.

Scenario 1 (zEC12 to z15): Scenario one is comprised of a two frame zEC12 system with CICS® v5.1, Db2® v11, and COBOL v5.1 on z/OS v2 using approximately 6,000 General Processor MIPS and 3 zIIPs versus a single frame z15 with CICS v5.4, Db2 v12 and COBOL v6.2 on z/OS v2.3. Both environments assumed *no workload growth* over the five-year period.

Scenario 2 (z13 to z15): Scenario two is comprised of a two frame z13 system with CICS v5.3, Db2 v12, and COBOL v6 on z/OS v2.2 using approximately 10,000 General Processor MIPS and 3 zIIPs versus a single frame z15 with CICS v5.4, Db2 v12 and COBOL v6.2 on z/OS v2.3. Both environments assumed *5% year to year workload growth.*

Using IBM pricing estimates and IT data from client environments in IBM IT Economics assessments, hardware, software, people, networking, space, and energy costs were calculated over a five-year period in a cost model. Cost analysis showed that z15 hardware and software upgrades can lower IT costs. In a modeled zEC12 to z15 replacement scenario, a software savings of 30% can be achieved as a result of hardware and software efficiencies of z15.[1] In a modeled z13 to z15 upgrade scenario, a software savings of 12% can be achieved as a result of hardware and software efficiencies with z15.[2]

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[1] An IBM IT Economics model was used to examine z15 hardware and software upgrade costs. The cost model compared total operating costs over five years for hardware, software, people, networking, floorspace, and energy costs. The zEC12 to z15 replacement scenario assumes no workload growth over a five-year time period. The cost model analyzed a sampling of z/OS workloads. For the zEC12 to z15 scenario the model used CICS v5.1, Db2 v11, and COBOL v5.1 on z/OS v2 for the zEC12 environment, and CICS v5.4, Db2 v12 and COBOL v6.2 on z/OS v2.3 for the z15 environment. Using findings from the IBM IT Economics Research Lab, the zEC12 to z15 upgrade scenario showed an effective 33.5% reduction in MIPS usage. For the zEC12 to z15 scenario, a configuration of 6,000 General Processor MIPS and 3 zIIPs for a two frame zEC12 system was used versus a single frame z15 using 3,987 General Processor MIPS (representing a 33.5% reduction) and 3 zIIPs. Labor costs were held constant across the compared environments. Annual OpEx cost is based on an average of the model costs over five years and includes hardware maintenance, software, people, energy, networking, and floorspace. Datacenter costs include energy, networking, and floorspace. For additional information on the use case model, contact the IBM IT Economics Team at IT.Economics@us.ibm.com

[2] An IBM IT Economics model was used to examine z15 hardware and software upgrade costs. The cost model compared total operating costs over five years for hardware, software, people, networking, floorspace, and energy costs. The z13 to z15 upgrade scenario assumes 5% year to year workload growth over a five-year time period. The cost model analyzed a sampling of z/OS workloads. For the z13 to z15 scenario the model used CICS v5.3, Db2 v12, and COBOL v6 on z/OS v2.2 for the z13 environment, and CICS v5.4, Db2 v12 and COBOL v6.2 on z/OS v2.3 for the z15 environment. Using findings from the IBM IT Economics Research Lab, the z13 to z15 upgrade scenario showed an effective 5.8% reduction in MIPS usage. For the z13 to z15 scenario, an initial configuration of 10,000 General Processor MIPS and 3 zIIPs for a two frame z13 system was used versus a single frame z15 using an initial 9,420 General Processor MIPS (representing a 5.8% reduction) and 3 zIIPs. Labor costs were held constant across the compared environments. Annual OpEx cost is based on an average of the model costs over five years and includes hardware maintenance, software, people, energy, networking, and floorspace. Datacenter costs include energy, networking, and floorspace. For additional information on the use case model, contact the IBM IT Economics Team at IT.Economics@us.ibm.com

Hardware maintenance

A significant cost driver can be hardware maintenance since older hardware generations like zEC12 have reached end of marketing and typically face higher-cost extended maintenance agreements to remain under support.

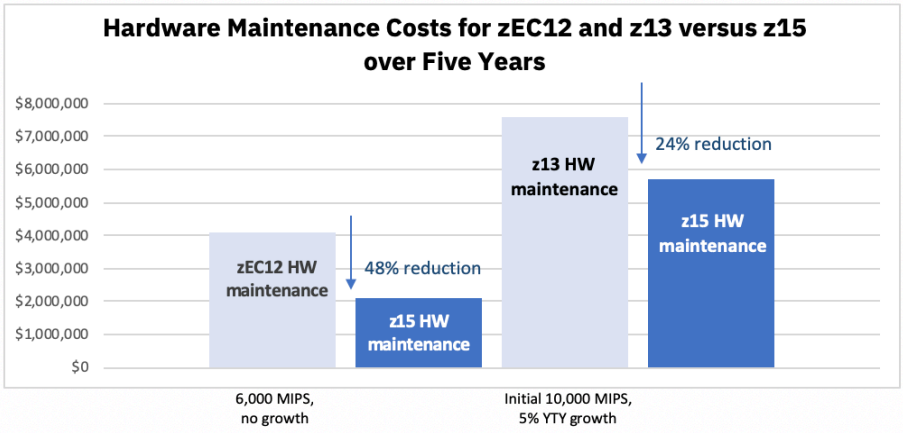

Figure 1: Total hardware maintenance costs over five years from zEC12 to z15 and z13 to z15

When using the model to compare the cost of hardware maintenance of the zEC12 to z15 and the z13 to z15 scenarios, both zEC12 and z13 were notably more expensive than z15. Older hardware may be less available for replacements or configuration updates resulting in higher maintenance costs. Even with a nominal maintenance increase of 2% between server generations, the five-year cost of extended hardware maintenance for the zEC12 was almost two times the cost of the maintenance for the z15 and the five-year cost of hardware maintenance for the z13 was almost a quarter more than the maintenance cost for the z15.[3]

Software costs

Software currency can also make a dramatic difference, not only in terms of feature/function availability but also in terms of cost. Newer software releases are designed to deliver performance efficiencies with improved resource requirements and better response times compared to earlier releases, for example compilers, new database functionality and operating system resource utilization. Programming changes designed to better exploit compute power, system I/O and memory coupled with the benefits of newer technology can enable workloads to run more productively using fewer MIPS and thus potentially lowering monthly license cost (MLC) charges.

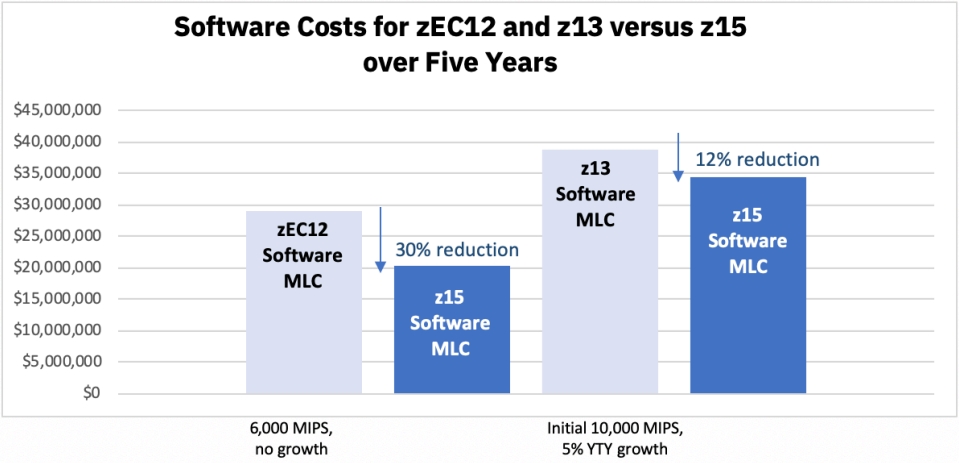

Figure 2: Total software costs over five years from zEC12 to z15 and z13 to z15

[3] Based on data from IBM IT Economics assessments with clients, hardware maintenance is based on a $120/MIPS annual cost for z15, on a $125/MIPS annual cost for z13 and on a $127/MIPS annual cost for zEC12

Due to technology advances with z15, systems are designed to process transactions faster and more efficiently, requiring less compute power for the same workloads of earlier generations. Analysis of the zEC12 and z15 and the z13 to z15 scenarios showed a software savings of 30% for the zEC12 to z15 scenario[1] and 12% for the z13 to z15 scenario[2] as a result of new hardware and software efficiencies designed into z15. By exploiting z15 compute power, design, memory and I/O and new software efficiencies for z/OS, COBOL, CICS and Db2, software costs can be reduced.

Energy consumption

Increasingly, lower energy consumption has become an important corporate objective to mitigate utility costs and achieve eligibility for energy efficiency incentive programs. Every generation of IBM Z strives to find increased energy efficiencies to provide financial savings. When using the model to compare energy costs between zEC12 and z13, z13 provided an energy savings of 8%. In the model for the z13 to z15 scenario, energy costs were reduced notably further with a 51% decrease in energy consumption.[4] Additionally, the new z15 provides the Intelligent Power Distribution Unit (iPDU) as an option for lower power consumption in radiator-cooled systems.[5]

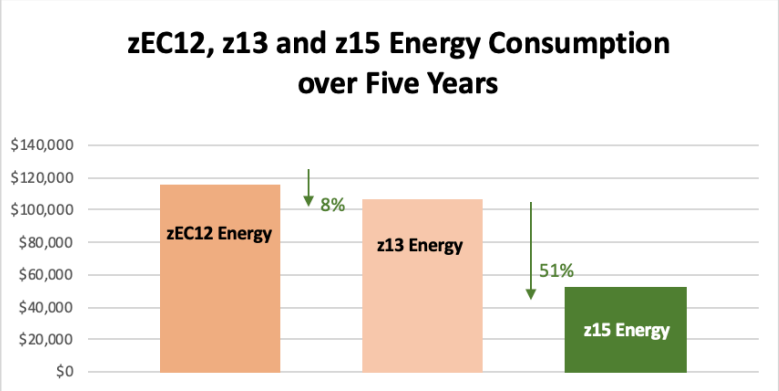

Figure 4: Total energy costs over five years for zEC12, z13 and z15

Floor space

Unlike earlier IBM Z generations such as the zEC12, z13 or z14, the new z15 provides a smaller, green physical footprint. Utilizing one to four standard 19-inch racks, the z15 fits into new and existing data centers similar to other servers. Datacenter planning and server deployment is simpler with more standardized cabling, power and cooling requirements. New features of IBM z15 enable maximum cable exit flexibility without requiring growth in system physical footprint. A single frame z15 can replace multiple frames of previous IBM Z generations, saving both space and energy.

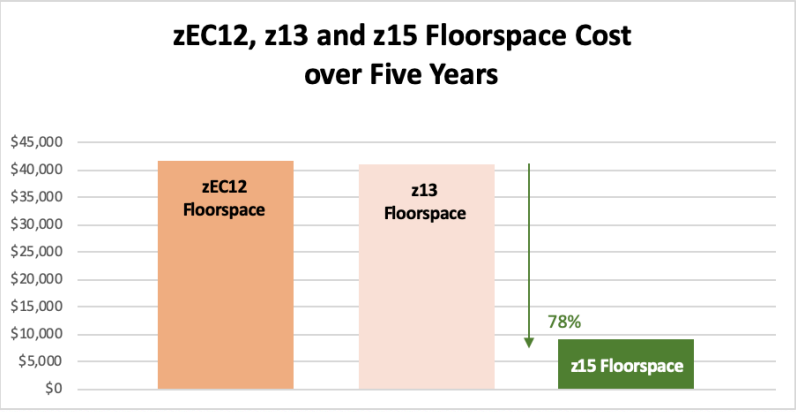

Figure 3: Total floorspace costs over five years for zEC12, z13 and z15

When using the model to compare floorspace costs between the zEC12 to z15 and z13 to z15 scenarios, z15 enabled a 78% savings in floorspace costs due to its smaller rack size. For IT operations in high-priced real

[4] Energy cost is based on 15.86 kW for the zEC12, 14.56 kW for the z13 and 7.2kW for the z15 at $0.10/kWh.
[5] On average, clients switching from a BPA System Z to an IBM z15 iPDU system can save over $10,000 on their data center energy costs over a 5-year period. Power consumption may vary depending on factors including configuration, workload, etc. Energy cost savings are based on the national average cost of electricity. Individual results may vary.

estate locations, the ability to reduce floorspace requirements can lower datacenter costs significantly by enabling organizations to grow their IT operations without necessarily needing to expand physical floor area.[6]

Workload consolidation

In addition to floorspace per server and energy savings, z15 continues to raise the standard for workload consolidation efficiencies. Whether off-prem and on-prem cloud, traditional z/OS, Linux®, AI or other state-of-the-art workloads, IT staff can consolidate and run many distributed workloads on a single z15 system, making server administration simpler, and more cost-effective. A z15 single frame can save an average of $21,726 in data center floor space and power consumption costs per year vs. compared to x86 2U servers running the same workloads and throughput.[7]

Dense consolidation of workloads is made possible by z15 workload management capabilities. z15 is designed to support 80% or higher sustained utilization rates. Based on IT Economics assessments of customer environments running a total of 13,800 x86 cores, average measured peak utilization is 16%.[8] Lower sustained x86 utilization rates require the use of more physical x86 servers and cores, associated software and datacenter costs. IBM internal tests show that when running mixed workloads consisting of both open source and IBM proprietary software, IBM z15 requires 23 times fewer cores than the compared x86 servers and delivers a 27% lower overall TCO over 5 years.[9] IBM Z sustained utilization rates can enable IT organizations to consolidate distributed workloads from many commodity servers to just a few servers, enabling IT efficiencies and lower datacenter costs. IBM z15 performance and server design are intended to help organizations run more workloads efficiently and securely with fewer resources.

Operating Expense

For some IT organizations, managing OpEx costs (hardware maintenance, software, people, and datacenter costs such as energy, networking, and floorspace) takes priority over total costs. These IT organizations are measured on their annual operating expenses without capital purchases (servers, adapters, cabling and other hardware parts).

When examining z15 in the model, from an OpEx perspective without capital expense, z15 provided average annual savings compared to earlier IBM Z platforms. Analysis found a cost reduction of approximately 23% with z15 over zEC12 and approximately 10% with z13.

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[6] Assuming annual data center floor space cost is $221.02 per square foot, a z15 single frame system can save up to $6,373 in data center floor space cost per year versus a z14 system. Actual floor space covered by the system includes doors and covers. The "Radiator-cooled with I/O top exit" version of z14 was used for all z14 models. All z14 models have standard front and rear covers. Floor space areas of all z14 models (M01-M05) are identical.

[7] The floor space covered by the systems includes doors and covers. The z15 system includes 3 CPC drawers with 108 configurable processor units and one I/O drawer. x86 systems ran at various utilizations according to 15 customer surveys, representing Development, Test, Quality Assurance, and Production levels of utilization and throughput. Workloads tested are a mix of leading databases and application servers, such as WebSphere, Node.js, MongoDB and Db2. Each consolidated workload ran at the same throughput and SLA response time on Z and x86. All x86 systems are 2U form factor, and 21 x86 systems fully populate a standard 42U rack. External storage floor space is not included. z15 performance data was projected from actual z14 performance data by assuming a 10% performance improvement on z15. Compared x86 models are all 2-socket systems containing a mix of the following x86 processor models: 8-core Xeon E5-2667 v4, 12-core Xeon E7-8857 v2, 12-core Xeon E5-2680 v3, 8-core Xeon E5-4650, 8-core Xeon E5-2650, and 14-core Xeon E5-2690 v4.
Average annual data center floor space cost is $221.02 per square foot; average US commercial power rate is $0.10 per kWh; and Average Power Usage Effectiveness ratio in Data Centers is 1.67 (67% additional power is required for cooling the data center), according to IBM IT Economics.

[8] Based on IT Economics assessments of customer environments running a total of 13,800 x86 cores, average measured peak utilization is 16%. Peak utilization of 16% is derived from a weighted average of x86 workloads in four large enterprise client IT environments using a total of the compared 13,861 x86 cores in production and test environments. For additional information on x86 workload analysis contact the IBM IT Economics team, IT.Economics@us.ibm.com.

[9] This is an IBM internal study designed to replicate a typical IBM customer workload usage in the marketplace. Results may vary. The workloads consisted of an airline flight reservation system (running MongoDB and node.js) and a transactional core banking application (running WAS and Db2). Four instances of the airline system were run, one instance simulating a Dev/QA environment, and three instances simulating a Production environment. Seven instances of the core banking application were run, one instance simulating a Dev/QA environment and six instances simulating a Production environment. Dev/Test and Production environments were differentiated by their CPU utilization levels. Intel servers are generally run at an average of 10-30% utilization per IT Economics data. For the x86 environment, the applications ran on a range of standard model, 2-processor x86 system, with speeds ranging from 2.4-3.2 GHz. The total number of cores needed to deliver the workloads on the x86 servers was 648. On z15, the airline system ran on Ubuntu 16.04 in an LPAR with z/VM 7.1, 4GB-8GB memory and 4 virtual CPs. The banking application ran on RHEL 7.6 in an LPAR with z/VM 7.1, with 4GB-16 GB memory and 4 virtual CPs. The total number of IBM Z cores needed to deliver the workloads was 28. Both the x86 and z15 environments had access to the same storage array. Total Cost of Ownership is defined here to include hardware, software, labor, networking, floor space and energy costs over a period of 5 years. IBM internal hardware list prices were used. x86 server prices were acquired from IDC. IBM software pricing was standard list prices with 20% discount applied.

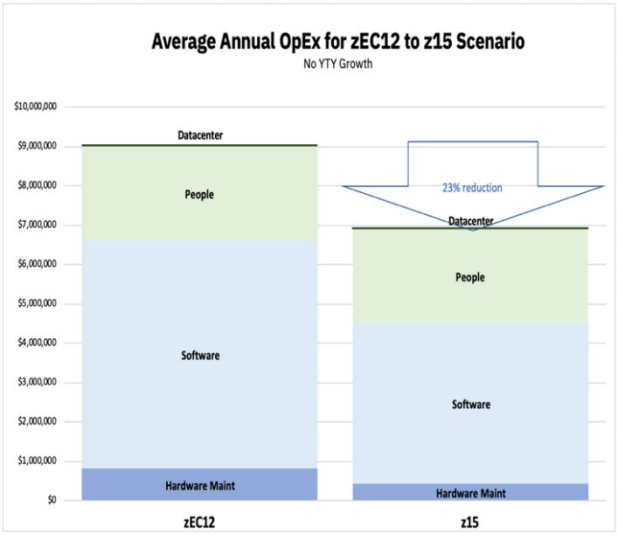

Figure 5: Average annual OpEx costs over five years from zEC12 to z15 (no growth). Datacenter category represents floorspace, energy and networking. OpEx excludes hardware OTC costs.

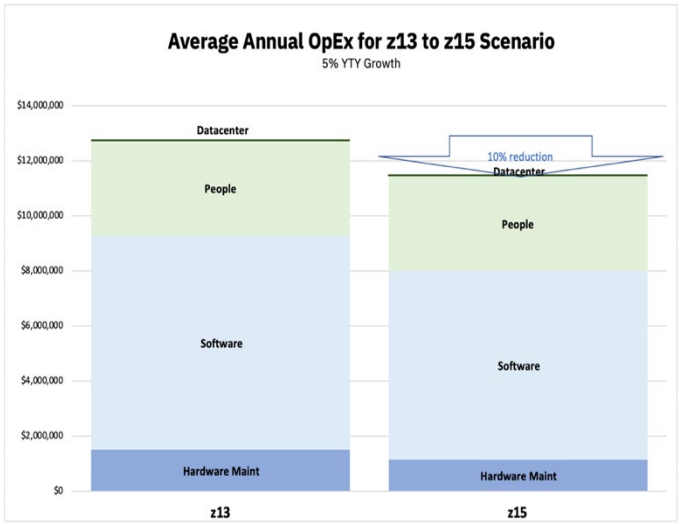

Figure 6: Average annual OpEx costs over five years from z13 to z15 (with 5% year to year growth). Datacenter category represents floorspace, energy and networking. OpEx excludes hardware OTC costs.

For IT organizations pressured by yearly budget targets, a z15 environment with the benefits of faster processing, more efficient power consumption and lower maintenance can offer lower operating costs to help achieve financial targets.

24x7 business availability

Mobile applications and online commerce require that organizations are open for business 24x7. Downtime, whether planned or unplanned, is costly. According to the Ponemon Institute, the average cost of a data breach is $3.92M.[10] For decades fault avoidance and fault tolerance capabilities have been designed into IBM Z. With each new generation of mainframe servers, IBM has implemented additional new functions and features designed for business continuity and resiliency. IBM z15 solutions are designed to deliver 99.99999%[11] (seven nines) availability, enabling enterprises to be able to provide almost non-stop commerce.

Even for IT environments in which the risk of an unplanned outage is minimized, planned outages are essential for software updates and system configuration changes. During a service outage, workload backlog grows during the time the system is unavailable. In order to maintain the organization's service level agreements (SLAs), the system needs to return to its steady state with all backlog processed as soon as possible.

IBM System Recovery Boost, a new capability introduced with z15, is designed to help enterprises recover from both planned and unplanned downtime quickly to deliver on their SLAs. IBM System Recovery Boost on z15 is designed to deliver increased processing capacity during both shutdown and

[10] https://www.ibm.com/security/data-breach

[11] IBM z15 solutions are designed to deliver 99.99999% availability. Internal data based on measurements and projections was used in calculating the expected value. The z15 servers must be configured in a parallel sysplex using z/OS 2.3 or above; GDPS management of data and middleware recovery across Metro distance systems and storage, including GDPS Metro Multi-site Workload and GDPS Continuous Availability; and DS888X with IBM HyperSwap. Necessary resiliency technology must be enabled, such as System Managed CF Structure Duplexing, Sysplex failure management and Capacity Provisioning Manager. Other configurations may provide different availability characteristics.

restart of a partition by boosting general processors to full speed on sub-capacity models and allowing zIIPs, when available, to perform general processor work for the boosted partition. An optional boost capability provides additional zIIP capacity during the boost period. IBM Lab testing found that organizations can restore service levels in half the time on z15 without additional IBM hardware or software costs with IBM System Recovery Boost enabled.[12]

Data encryption across the enterprise

Regardless of size, sector or geography, security is a priority for any organization. A data breach of unprotected data can cause devastating financial losses and affect an organization's reputation for years. z15 is designed for the highest level of HSM security (FIPS 140-2 Level 4, EAL 5+ certification) to help mitigate the risk of cyber-attacks and other data security threats by protecting your keys, and making breached data unreadable.

z15 has increased cost-efficiencies for IBM Z pervasive encryption by introducing on-chip compression and encryption capabilities for Central Processors for z/OS workloads and Integrated Facility for Linux workloads. Compression within the chip can help not only to reduce latency but also to eliminate the need and associated expense for encryption cards. z15 Integrated Accelerator for zEnterprise Data Compression can reduce transmission costs of daily back-ups for disaster recovery[13] and help reduce MIPS costs.[14]

Pervasive Encryption Productivity Savings

In addition to on-chip compression savings, z15 pervasive encryption can provide savings for security administration. Pervasive encryption relieves programmers from having to selectively implement encryption in their programs. Pervasive encryption on z/OS can result in approximate savings of 3-5% in administrative and programming labor costs, based on an IT Economics analysis. [15]

A sample of savings using an estimated of 5% effort reduction illustrates potential savings for server administrators and application programming FTEs when encryption is pervasive at a system level. For the zEC12 to z15 scenario with 6,000 MIPS, annual savings could be approximately $1.3 million per year. For the z13 to z15 scenario with an initial 10,000 MIPS, annual savings could be approximately $1.8 million per year (see figure 7).

[12] You can be back up and running to SLAs in up to ½ the time compared to z14, while catching up on your pending workloads, and with no increase to IBM software costs. Measurements were collected in a controlled environment running an IBM developed workload under z/OS 2.4 comprised of online transactions accessing WAS, CICS, MQ, IMS and Db2. Comparisons were made between z15 with System Recovery Boost and z14. Individual client results may vary.

[13] The z15 Integrated Accelerator for zEnterprise Data Compression can reduce transmission costs of daily back-ups for disaster recovery, by up to $720K annually in the analyzed scenario This claim is based on IBM internal analysis. Results may vary. Data is taken from IT Economics observations made during customer engagements. These are blended values and do not represent any particular circumstance. Data link costs vary geographically. Data compression reduces the volume of data transferred and can reduce transmission costs.
The scenario for this analysis is an enterprise with a requirement for a 250TB daily backup to a disaster recovery location within a seven-hour batch window using high speed dedicated 10Gb/sec direct links. Transmission costs between compressed and uncompressed data were compared. It is assumed that the data transferred is eligible for compression.
The $5K monthly cost for transmission of 10 Gb/sec is derived from https://cloud.ibm.com/docs/infrastructure/direct-link?topic=direct-link-pricing-for-ibm-cloud-direct-link#arranging-for-direct-link-conectivity.

[14] When modeling the costs of z15 using the Integrated Accelerator for zEnterprise Data Compression with z/OS data set encryption, MSU costs are expected to be reduced by at least 2.8X compared to encrypting uncompressed data. This claim is based on IBM internal analysis. In a tested scenario with a z14 and z/OS V2.3, the MSU cost is 2.8X less when the data is compressed before encryption versus using encryption without compression. Measurements were taken on z14 with and without a zEDC adapter. z15 MSU costs are designed to be less with compression built into the hardware compared to using a zEDC adapter on z14.
Results may vary.

[15] Pervasive Encryption relieves programmers and system administrators from having to selectively implement encryption for their data and programs. Cost benefits ranging from 3-5% are estimated based on a labor model of headcount derived from IT Economics assessments for client environments. Results may vary by customer.

Data Encryption Productivity Benefits for z15

Estimated Annual Cost per FTE: $150,000

zEC12 to z15 scenario

z13 to z15 scenario

z15 system Size by Installed MIPS	3,000	6,000	8,000	9,000	10,000
Administrator FTEs	11	16	19	20	22
Application Development FTEs	110	160	190	200	220
Total Administrate and Application Development FTEs without PE	121	176	209	220	242
Total z15 FTEs with PE	115	167	199	209	230
Estimated 5% FTE Savings with PE	6.05	8.8	10.45	11	12.1
Annual Productivity Benefits	$907,500	$1,320,000	$1,567,500	$1,650,000	$1,815,000

Model assumes a minimum of 6 FTEs and an additional FTE for every 650 MIPS for administrative labor. It also assumes an additional 10 Application Development FTEs for every administrator FTE.

Figure 7: Estimated data encryption benefits for z15 with pervasive encryption enabled based on an IT Economics model

IBM Data Privacy Passports

With IBM Data Privacy Passports[16], z15 can expand IBM Z pervasive encryption capabilities to not only protect data within the datacenter, but to also protect and enforce privacy and protection for data when shared and copied off-platform outside of the datacenter.

IBM Data Privacy Passports is engineered to encrypt data that leaves the platform (regardless of whether the data originates on IBM Z or comes from other systems in the cloud or on-prem) and manages individual access to data by policy at the field level without requiring application changes. Remote management of access to data and revocation of data access is enabled even after that data has left the platform. Access enforcement applies even to copies (authorized and unauthorized) so the privacy and protection can follow the data regardless of its travels. This is designed to help enterprises control their data governance for critical data; it can also help streamline compliance processes for security regulations.

Why moving to z15 makes sense

The new z15 platform enables organizations to address emerging new business demands. In today's consumer driven market, enterprises must run mission critical workloads securely within the data center and throughout the enterprise to all end users. Enterprises also require fast (low latency) and efficient delivery and need the ability to adapt to changing business requirements swiftly. z15 provides the latest technology to meet the business demands of large and small enterprises and offers significant advantages with datacenter green savings, workload consolidation efficiencies, reduced maintenance costs, lower OpEx, security with on-chip compression and encryption savings as well as resiliency for mission critical workloads with faster recovery time for planned service updates.

While actual savings will vary according to the types of workloads and IT environment in a specific organization, z15 can offer a significant decrease in IT cost over earlier IBM Z technologies. If your organization is interested in exploring IT efficiencies, or considering new workloads to address new business requirements, ask for an IT Economic assessment by the IBM IT Economics Consulting & Research team.

[16] For more information about IBM Z Data Privacy Passports V1.0 beta program, see Software Announcement JP19-0548, dated September 12, 2019 .

About the authors

David Anderson is the Chief IT Optimizer of the IBM IT Economics team. David's expertise includes optimizing IT environments for performance, qualities of service, encryption and especially cost. He has in depth knowledge of IBM's z/OS and IBM LinuxONE™ high end Systems, distributed systems, Cloud alternatives and software options.

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Roger Rogers is an IBM Executive IT Economics Consultant for the IBM IT Economics team and works with clients worldwide to optimize their IT operations. He has more than 35 years of experience in product development, management, and strategy. During his tenure at IBM Roger has received two IBM Outstanding Technical Achievement awards and has been recognized in IBM's Top 500 IBM Employees list. He is also a frequent speaker at IBM conferences and customer briefings to share technical and financial insights on the latest IT solutions. For more information contact the IBM IT Economics team.

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