Technical Validation

Maximizing Performance and Security of IBM Z Replication Solutions

Leveraging IBM Storage with Transparent Cloud Tiering and IBM b-type Networking for Mainframe Backup

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Contents

ESG Technical Validations

The goal of ESG Technical Validations is to educate IT professionals about information technology solutions for companies of all types and sizes. ESG Technical Validations are not meant to replace the evaluation process that should be conducted before making purchasing decisions, but rather to provide insight into these emerging technologies. Our objectives are to explore some of the more valuable features and functions of IT solutions, show how they can be used to solve real customer problems, and identify any areas needing improvement. The ESG Validation Team's expert third-party perspective is based on our own hands-on testing as well as on interviews with customers who use these products in production environments.

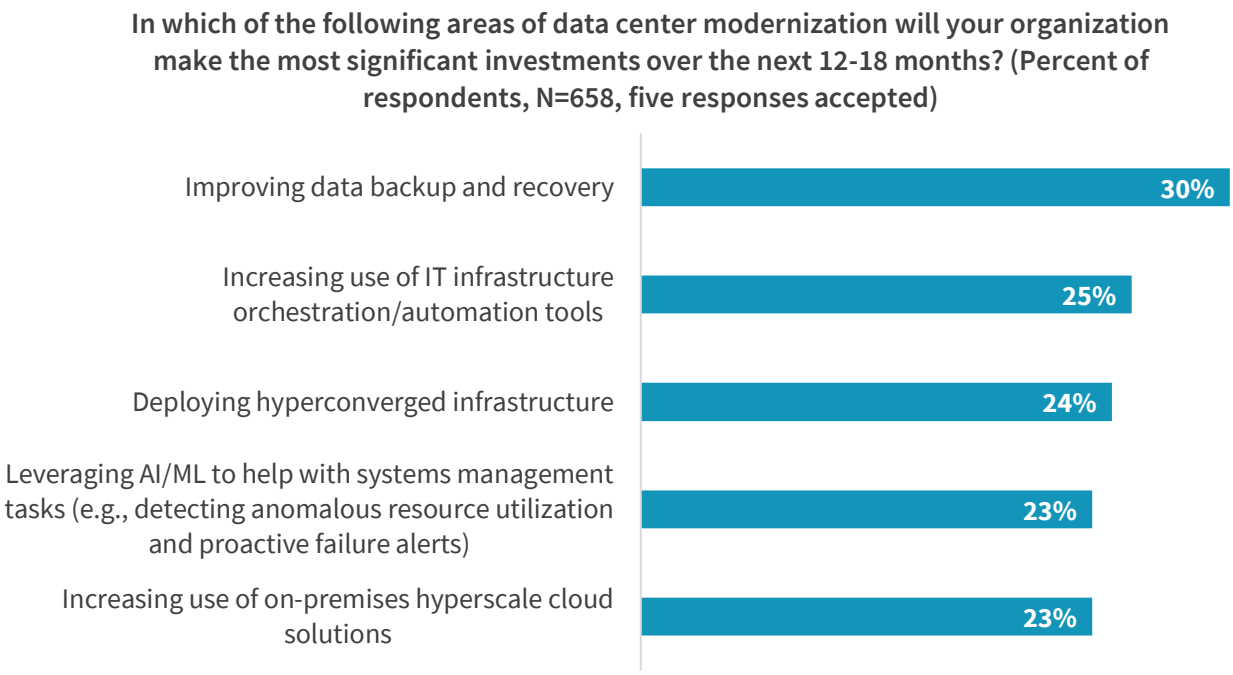
Introduction

This ESG Technical Validation documents testing of the combination of IBM Z Mainframe storage, the IBM DS8000[1] and TS7700 families, and IBM b-type networking, with a goal of verifying how the Transparent Cloud Tiering solution can maintain the high data transfer performance required for backup and restore operations. We also explore how the IBM solution secures the data in flight and at rest through its encryption capabilities.

Background

ESG research has uncovered that IT professionals identified improving data backup and recovery as one of the areas in which they will make their most significant investments over the next 12-18 months as they modernize their data centers (see Figure 1).[2] At the same time, 36% of organizations indicated that improving security/risk management is one of the considerations that they believe will be most important in justifying IT investments to their organization's business management team in 2020, making it the most cited response. While cybersecurity encompasses many areas, 31% of IT professionals stated that data security is one of the areas of cybersecurity in which their organizations would make the most significant investments over the next 12-18 months, and 30% indicated that network security would be one of those areas, making them the second and third most cited responses.

Figure 1. Top Five Areas of Investment for Data Center Modernization



Source: Enterprise Strategy Group

Organizations continue to rely on mainframe environments to support select mission-critical applications, such as airline reservations and financial transaction processing. They need to design their storage area networks (SAN) and enterprise IP wide area networks (WAN) to maximize storage traffic performance, especially when conducting operations related to ensuring disaster recovery and maintaining business continuity. Specifically, IP switching devices are not designed for the high and predictable levels of storage data transfer performance expected.

[1] The IBM DS8000 family includes both the DS8800 (for hybrid storage) and DS8900F (all-flash array).
[2] Source: ESG Master Survey Results, *2020 Technology Spending Intentions Survey*, January 2020. All ESG research references and charts in this technical validation have been taken from this master survey results set, unless otherwise indicated.

With these mission-critical applications, organizations must also consider how to secure their data both at rest and in flight without impacting performance. Typically, large enterprises have relied on a patchwork of tools and processes to encrypt data flowing through their mainframe environments. Alternatively, organizations can deploy storage and network infrastructure developed with security in mind without sacrificing performance. By adopting this perspective of "cyber-resiliency," organizations ensure that their mainframe IT environments—SAN, WAN, and private cloud—are built to encrypt data at rest and in motion from Day 1 as opposed to implementing security solutions onto existing IT infrastructure.

IBM Z Mainframe Storage with IBM b-type Networking

The combination of IBM z15 Mainframe storage and IBM Storage Networking b-type family of switches helps organizations to implement a cyber-resilient storage infrastructure. These "integrated by design solutions" can maintain high data transfer performance when backing up and restoring data of IBM z15 supported applications while securing the data both at rest and in flight.

IBM's solution, the IBM DS8900F all-flash array (AFA) and IBM TS7700 virtual tape solution and the IBM b-type (Brocade) series of FICON (FC) SAN switches, addresses four key areas:

- Performance: Both the IBM mainframe storage arrays and IBM b-type switches have been designed with enhancements to improve performance and increase throughput. The IBM DS8900F currently supports 32Gbps host adapters, which doubles the throughput of the previous generation. IBM's b-type switches and directors, based on Brocade technology, also doubled its FICON and FC port speeds up to 32Gbps. In addition, the IBM b-type family supports IP Extension (IPEX) technology, which can minimize the effects that longer distances and packet loss within an IP-native WAN can have on performance.

- Security: Designed with security in mind, both the IBM DS8900F and TS7700 support the IBM Z suite of data protection technologies to encrypt data at the host level, in flight across the network over Ethernet, and at rest in storage. Additionally, other capabilities help to secure application data, such as cloud and tape air gaps and safeguarded copies for instilling cyber-resiliency into the mainframe environment.

- Scalability: Both IBM Z mainframe storage and IBM b-type networking equipment enable organizations to scale their IBM mainframe environments. The IBM z15 can support up to 320 FICON and FC ports. IBM b-type directors and switches can support virtually any size storage network required.

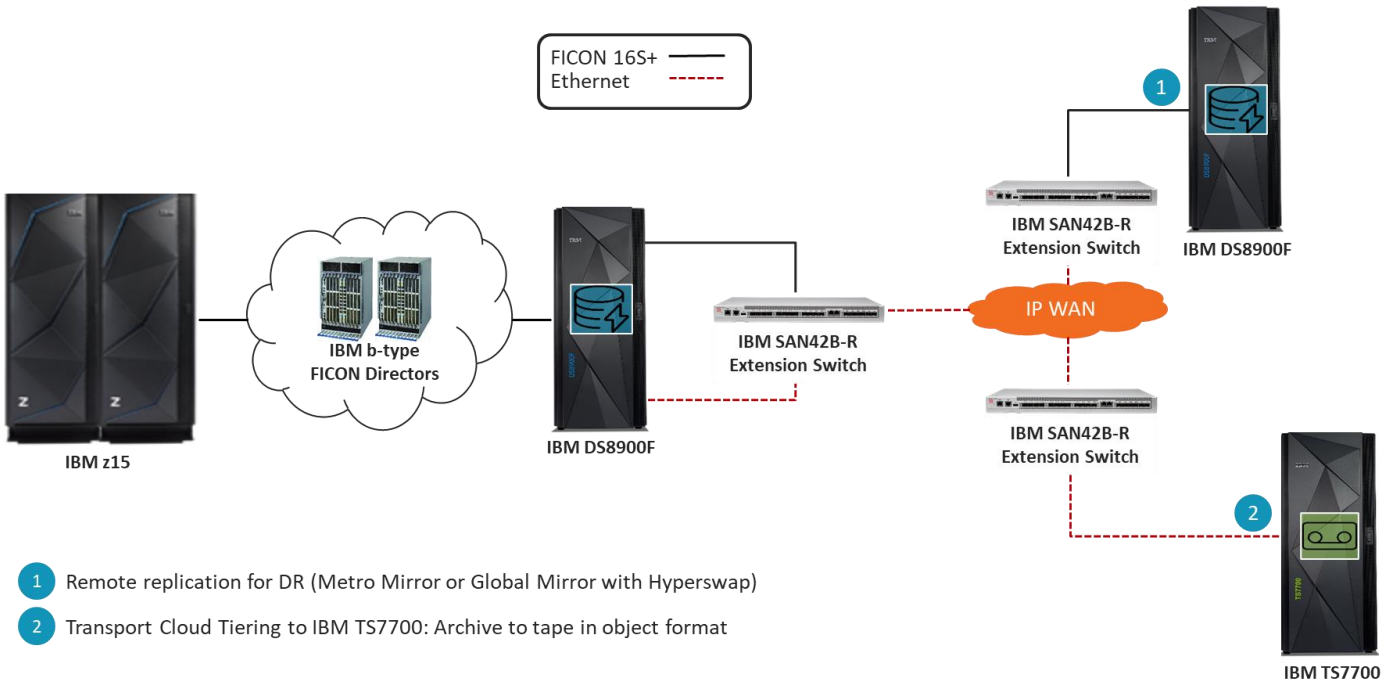
- Reliability: IBM builds off its history of supporting mainframe applications for large enterprises prevalent in finance, banking, and airline operations. With this IBM solution, organizations can continue to expect minimal overall downtime, thus increasing business continuity.

Integration with Transparent Cloud Tiering

This joint solution leverages IBM Transparent Cloud Tiering (TCT) to back up IBM z15 mainframe data without sacrificing performance. IBM TCT has been designed to offload data movement processing-related workloads from IBM Z/OS, potentially reducing mainframe CPU utilization up to 50%. Organizations can use IBM TCT to convert their block storage to object storage without additional hardware or software infrastructure. This is especially helpful for backing up large data sets, as organizations can leverage the IBM TS7700 or IBM Cloud Storage as large capacity object stores offsite.

Figure 2 illustrates how organizations can support backup and restore functions using a combination of IBM DS8900F, IBM TS7700, IBM b-type SAN/extension platforms, and IBM TCT.

Figure 2. Backing Up Data Using IBM Z Mainframe Storage and IBM b-type Networking Switches



Source: Enterprise Strategy Group

1. For remote replication between two DS8900F, organizations can use IBM Metro Mirror or Global Mirror with Hyperswap. Both AFAs are connected via FICON to an IBM b-type switch for the host to storage transport. For the mirroring function, data is transmitted via FCIP over 10GE network links between the AFAs.

2. TCT allows for archiving data from the IBM DS8900F to the IBM TS7700. Data is transmitted directly between the IBM DS8900F to the IBM TS7700 via IP over 10GE links. The IBM b-type IPEX platforms provide additional stability of the IP transport and help maintain consistent performance independent of distance or network packet loss.

ESG Technical Validation

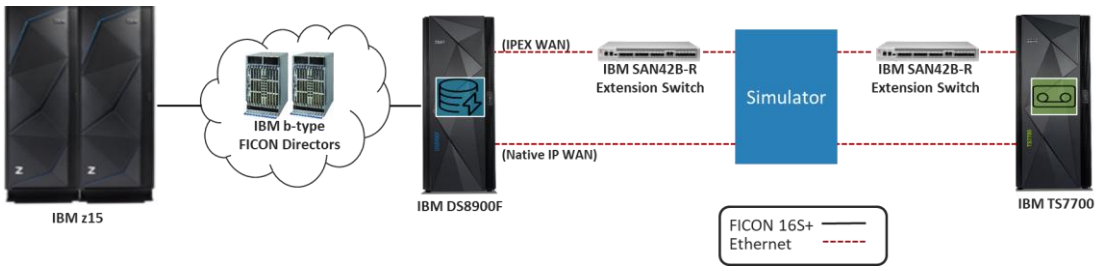
ESG performed evaluation and testing of IBM's TCT solution at remote facilities in Tucson, AZ. Testing was designed to demonstrate how the TCT solution combined with the IBM b-type IPEX platforms can improve performance of backing up and restoring data when faced with the challenges of long distances and packet loss encountered in an IP-based WAN.

Reducing Impact of Distance on Performance

Organizations require that data of mission-critical workloads can be read and written to storage with low and predictable times. This is especially true for business continuity and disaster recovery purposes. However, transmitting data packets over long distances in an IP-based WAN can be delayed due to latency issues. Random times that data packets are read or written from remote storage—due to possible data re-transmissions—will subsequently increase the overall time for a read or write request to complete. Using IBM TCT to back up and restore data between the IBM DS8900F (at the host data center) to the IBM TS7700 (at a secondary data center) connected via a b-type IPEX-enabled WAN can minimize the effects of latency, especially as the distance between storage systems increases.

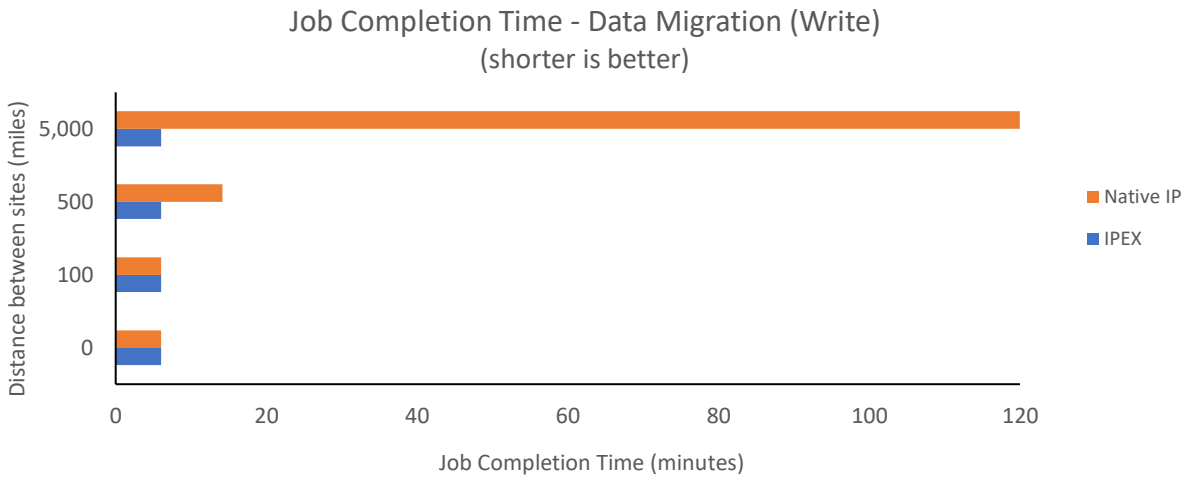
ESG Testing

To observe the effects of latency on reads and writes between an IBM DS8900F and IBM TS7700 using IBM TCT, ESG used a test bed similar to the setup shown in Figure 2, #2. Each storage system connected with an IBM SAN42B-R (Brocade 7840) switch. ESG performed data migrations ("writes") and recalls ("reads") of an uncompressed 20GB data set while simulating an increase in distance from 0 to 5,000 miles over a 10GE IPEX WAN and a 10GE native IP WAN.



We first measured job completion times for writing the 20GB data set from the IBM DS8900F to the IBM TS7700 as we increased the distance. The goal was to observe how the IBM solution can mitigate the effects of increasing distance on write performance. Measured time includes an acknowledgement from the IBM TS7700 that the data has been successfully received and copied onto the IBM TS7700. We compared job completion times of writing the data set using the IPEX WAN with those obtained using the native IP WAN. Figure 3 and Table 1 show our results.

Figure 3. Effect of Distance on Job Completion Time for Data Migration (Write) – IPEX WAN versus Native IP



Source: Enterprise Strategy Group

Table 1. Job Completion Times for Data Migration with Increasing Distance – IPEX versus Native IP

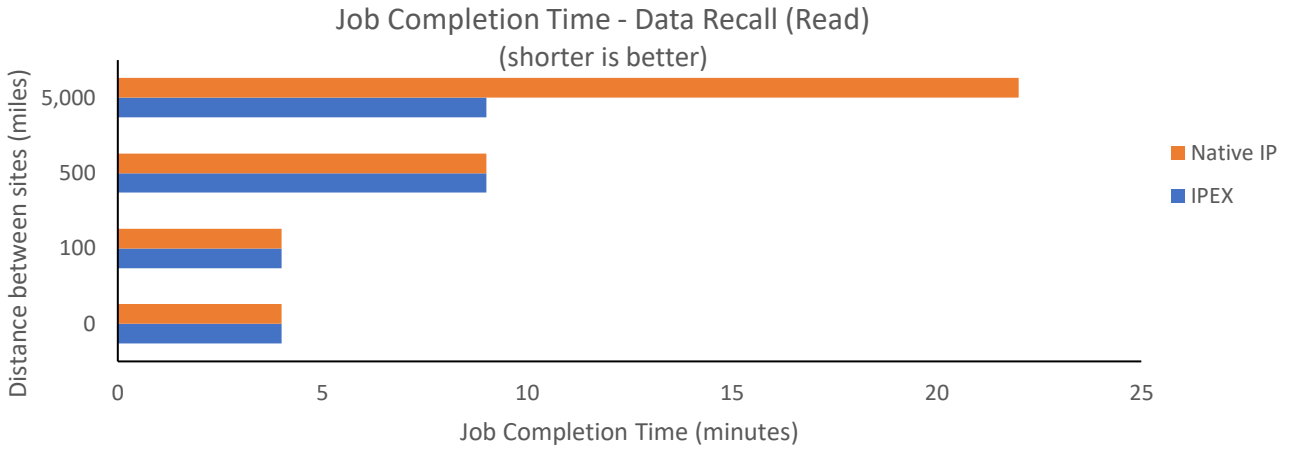
Distance between Sites (miles)	Job Completion Time with IPEX (min)	Job Completion Time with Native IP (min)
0	6	6
100	6	6
500	6	14.2
5,000	6	120

Source: Enterprise Strategy Group

ESG observed that job completion times for "writes" to the IBM TS7700 remained consistent at six minutes when using IPEX and TCT over all distances. On the other hand, job completion times for writes over the native IP WAN without IPEX increased from six to 14.2 minutes when reaching 500 miles. At 5,000 miles, job completion time with the native IP WAN reached 120 minutes, an increase of 2,000% over the job completion time using the IPEX WAN.

ESG then measured job completion times for reading the 20GB data set from the IBM TS7700 and loading the data set back onto the IBM DS8900F. Again, distances between sites ranged from 0 to 5,000 miles. The goal was to observe how the IBM solution can mitigate the effects of increasing distance between the IBM DS8900F and IBM TS7700 on read performance. Measured time includes submitting the data request. Results are shown in Figure 4 and Table 2.

Figure 4. Effects of Distance on Job Completion Times for Data Recall (Read) – IPEX WAN versus Native IP



Source: Enterprise Strategy Group

Table 2. Job Completion Times for Data Recall with Increasing Distance – IPEX versus Native IP

Distance between Sites (miles)	Job Completion Time with IPEX (min)	Job Completion Time with Native IP (min)
0	4	4
100	4	4
500	9	9
5,000	9	22

Source: Enterprise Strategy Group

ESG observed that job completion times for data recalls ("reads") on the IPEX and native IP WAN remained consistent at four minutes for distances of 0 and 100 miles, then nine minutes at a distance of 500 miles.

However, at a distance of 5,000 miles, data recall times diverged significantly. While job completion time for reads over the IPEX WAN remained at nine minutes, job completion time over the native IP WAN reached 22 minutes, an increase of 244%.

Based on our testing, ESG found that the combination of IBM TCT and IPEX helps the IBM solution to achieve low job completion times for both reads and writes as distance increased. Since IBM TCT offloads data movement workloads from the host z/OS, MIPS utilization decreases, subsequently increasing data transfer performance. Coupled with an IPEX-enabled WAN that maintains consistent throughput over network links, the IBM solution can help in delivering fast and consistent reads and writes for backup and recovery purposes.

Why This Matters

When designing a storage network infrastructure for backup and disaster recovery purposes, it is critical to consider the impact of increasing distance between the local and remote data center sites. In a mainframe environment in which mission-critical applications are run, the ability to quickly and securely recover from a service-disrupting event becomes paramount.

ESG validated that an IBM z15 mainframe storage environment, consisting of the DS8900F, TS7700, and b-type switches, can help organizations to architect a highly performant SAN. With IBM TCT and an IPEX-enabled WAN, organizations can experience consistent, low data backup and recovery times, even when geographic distance increases between local and remote sites.

Reducing Impact of Packet Loss on Performance

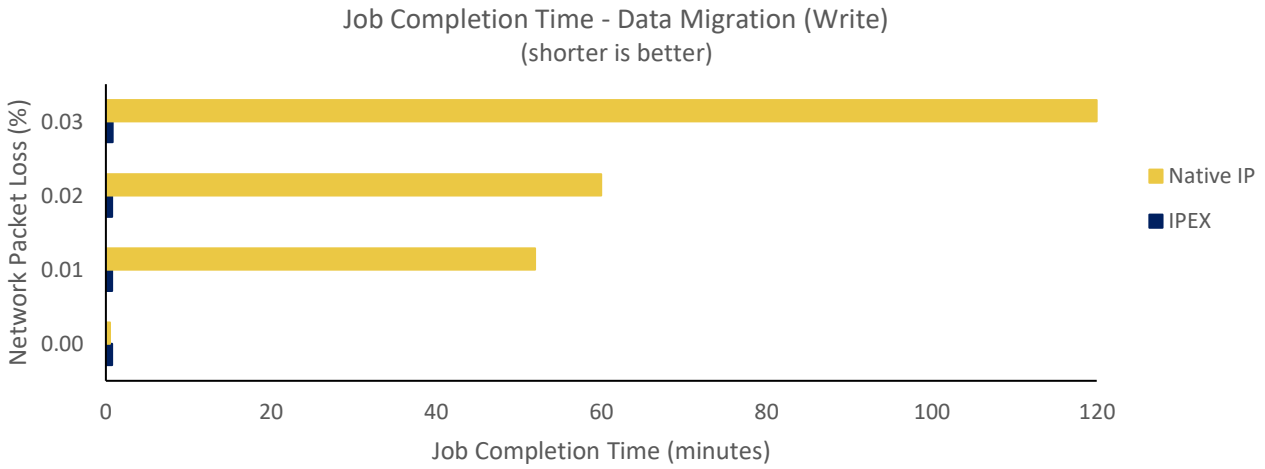
When organizations backup and restore data over a native IP WAN, data transfers can be subject to network packet loss. The effects of network packet loss can affect read and write throughput due to an increase in packet re-transmission and transmission failures. With IBM TCT to back up and restore data between the IBM DS8900F and IBM TS7700 connected via an IPEX WAN, network packet loss effects on read and write performance can be minimized.

ESG Testing

To observe the effects of network packet loss on reads and writes between an IBM DS8900F and IBM TS7700 using IBM TCT, ESG used the same test bed for observing distance impacts on data transfer performance. Distance between the IBM DS8900F and IBM TS7700 was kept constant at 100 miles. ESG performed data migrations ("writes") and data recalls ("reads") of an uncompressed 7.6GB data set while simulating network packet loss at 0.01%, 0.02%, and 0.03% on both the IPEX and native IP WAN.

ESG first measured the job completion time for copying of the 7.6GB data set from the IBM DS8900F to the IBM TS7700 as we simulated an increase in packet loss from 0 to 0.03% in 0.01% increments. The goal was to observe how the IBM solution can minimize the potential effects of network packet loss on write performance. Measured time includes an acknowledgement from the IBM TS7700 that the data has been successfully received and copied. We compared job completion times of backing up the data set using both the IPEX WAN and native IP WAN. Results are displayed in Figure 5 and Table 3.

Figure 5. Effect of Packet Loss on Job Completion Times for Data Migration (Write) – IPEX versus Native IP



Source: Enterprise Strategy Group

Table 3. Job Completion Times for Data Migration with Increasing Packet Loss – IPEX versus Native IP

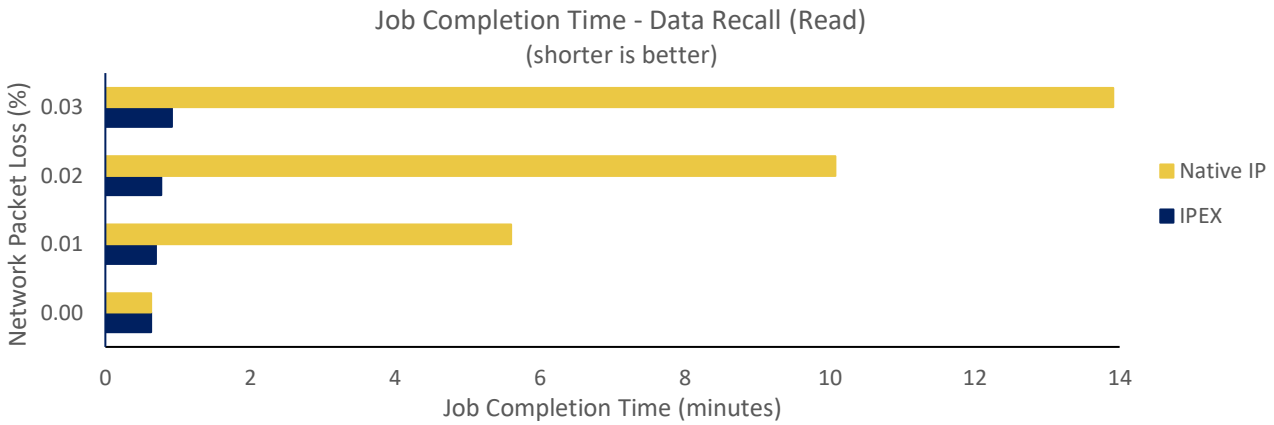
Network Packet Loss (%)	Job Completion Time with IPEX (min)	Job Completion Time with Native IP (min)
0.00	0.78	0.52
0.01	0.78	52
0.02	0.78	60
0.03	0.83	120

Source: Enterprise Strategy Group

ESG observed that the times for data migration ("writes") between the IBM DS8900F and the IBM TS7700 remained consistent at 0.78 minutes using IPEX and TCT for packet loss up to 0.02%. (At 0.03% packet loss, job completion time increased slightly to 0.83 minutes.) On the other hand, job completion times for writes over the native IP WAN without TCT increased as packet loss reached 0.03%, from 0.52 minutes to 120 minutes.

ESG then measured job completion times for recovering a copy of the 7.6GB data set from the IBM TS7700 and loading it back onto the IBM DS8900F. The goal was to observe how the IBM solution can minimize the impact of increasing network packet loss on read performance. Measured time includes submitting the request for the data. Results are shown in Figure 6 and Table 4.

Figure 6. Effect of Packet Loss on Job Completion Times for Data Recall (Read) – IPEX versus Native IP



Source: Enterprise Strategy Group

Table 4. Job Completion Times for Data Recall with Increasing Packet Loss – IPEX versus Native IP

Network Packet Loss (%)	Job Completion Time with IPEX (min)	Job Completion Time with Native IP (min)
0.00	0.63	0.63
0.01	0.70	5.60
0.02	0.77	10.08
0.03	0.92	13.91

Source: Enterprise Strategy Group

ESG observed that the times for data recall ("read") on the IPEX WAN increased slightly—from 0.63 to 0.92 minutes—using IPEX and TCT when packet loss increased from 0 to 0.03%. However, job completion times for reads over the native IP WAN without TCT increased as the packet loss increased from 0% to 0.03%, from 0.63 minutes (37.8 seconds) to 13.91 minutes, a 95% increase. While packet loss is expected as transmissions occur to handle the resulting errors, we observed that increases in job completion time are significantly less overall compared with those obtained on the native IP WAN.

ESG's review of the test results showed that organizations using this IBM solution for backup and restore operations, in combination with IBM TCT and IPEX, can achieve high and consistent performance in light of network packet loss up to 0.03%. While IBM TCT works to reduce MIPS spent on moving data between locations, IPEX maintains consistent throughput.

Why This Matters

Any storage network infrastructure will experience network packet loss. For mainframe environments running mission-critical applications, packet loss can negatively affect performance when backing up and restoring data. ESG testing concluded that using IBM TCT over an IPEX-enabled WAN on IBM's combination of the DS8900F, TS7700, and b-type switches can help organizations to achieve low and predictable backup and recovery times, even when packet loss is present.

The Bigger Truth

The importance of data backup and recovery operations cannot be ignored when running and securing mission-critical applications, especially those found in mainframe environments. Any service-disrupting event, due to either network limitations or security breaches, can negatively impact an organization's ability to maintain business continuity or recover from physical disaster. To continue normal operations, data backup and recovery scenarios must be supported by a storage environment that delivers high and consistent data transfer performance.

IBM's solution for business continuity and disaster recovery scenarios in mainframe environments can help organizations to achieve high data transfer performance. With an infrastructure that combines the IBM DS8900F, TS7700, and b-type switches, organizations can employ IBM TCT over an IPEX-enabled WAN to minimize times for completing backup and recovery jobs. The IBM solution also ensures the security of these data transfers without impacting performance, employing features that secure both data at rest and data in flight.

ESG validated that the IBM solution can achieve low and predictable job completion times for backing up and recovering data using the IBM DS8900F and TS7700. When the two storage systems are located in a primary and secondary data center, the combination of IBM TCT and an IPEX-enabled WAN compensates for increases in physical distance between the sites and network packet loss.

The IBM brand has been synonymous with the word "mainframe" for many years, due to its ongoing ability to support an organization's mission-critical applications with a highly performant and secure storage and network infrastructure. As with any other solution, ESG urges organizations to perform their own due diligence when assessing if the IBM solution is appropriate for supporting their stringent requirements for backup and recovery operations.

ESG has validated that the IBM solution (the DS8900F, TS7700, and b-type switches), combined with IBM TCT and IPEX, can help organizations to ensure high and predictable performance for data backups and recoveries supporting mission-critical applications. We suggest that your organization looks closely at this solution when architecting a multi-site data center strategy for business continuity and disaster recovery purposes.

Appendix

Table 5.Validation Test Bed

Components Tested	Component Release Information
IBM z15	IBM zOS 2.3
IBM DS8900F	R9.0SP2.1 (89.2.40.0)
IBM TS7770	R5.0 (8.50.0.134)
IBM SAN42B-R	FOS 8.2.x

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