

This document discusses the challenges that HCI vendors, system integrators and resellers face when their solutions are deployed into real-world networks. It also looks at a range of use cases to demonstrate the advantages of testing using a dedicated network emulator to ensure high performance and reliability.

# Hyperconverged Infrastructure (HCI)

## Ensuring successful HCI deployments



*In today's digital landscape, enterprise organizations increasingly rely on robust and reliable IT infrastructure solutions to support their business-critical operations and meet the ever-growing demand for data storage, processing, and availability. As such, Hyperconverged Infrastructure (HCI) solutions are playing a progressively crucial role in supporting businesses across various industry sectors with their ability to deliver high-performance, scalable, and resilient IT environments.*

*Many organizations leverage HCI solutions to enhance edge computing initiatives, enabling distributed data processing and analysis closer to data generation sources – often to comply with data sovereignty laws (e.g. GDPR). Other organizations such as those in the healthcare, finance, retail, and manufacturing sectors are adopting HCI solutions to support critical workloads and ensure data security, efficiency, compliance and accessibility.*



## The challenge of real-world network environments

While HCI solutions continue to gain traction across a diverse range of industries, HCI solution providers often face several challenges in meeting the stringent demands of enterprise customers in terms of both infrastructure performance and reliability. One of these challenges is optimizing the underlying network used to handle ever-increasing and demanding workloads.

HCI solutions operate in complex network environments with varying connectivity requirements, latency constraints, and unpredictable bandwidth demands. Ensuring optimal performance under these conditions is one of the key requirements of HCI customers, as is maintaining data resilience and integrity in the face of network failures, outages, and other adverse conditions. Safeguarding interoperability is also paramount. HCI deployments must frequently integrate with other systems and components such as cloud platforms, backup solutions, and monitoring tools, along with numerous technologies, including legacy. And all these challenges intensify as the IT infrastructure scales up.

Understanding and resolving network issues that can directly impact the performance, reliability, and overall effectiveness of HCI deployments is clearly vital. For instance:

- **Network latency:** HCI environments often involve data replication and synchronization across different sites or data centers. High latency in the network can lead to slow data transfers, impacting the performance of mission-critical applications and services.
- **Packet loss:** In distributed HCI environments, data integrity is fundamental. Packet loss can result in data corruption, incomplete transfers, and potential data loss.
- **Bandwidth constraints:** As HCI deployments scale and support more users and applications, bandwidth limitations can create bottlenecks leading to performance degradation, congestion, and potential service disruptions.
- **Network outages and failures:** HCI solutions must have disaster recovery capabilities that are resilient to network outages and failures to ensure data availability, service-level agreements (SLAs) for Recovery Time Objective (RTO) and Recovery Point Objective (RPO) and business continuity.

If network issues are not properly addressed, HCI providers may face significant consequences such as performance degradation and costly downtime. According to a study by Gartner, the average cost of downtime for a mission-critical application can range from \$300,000 to \$1 million per hour\*. Downtime and service interruptions can also result in lost productivity, revenue loss, and potential penalties or compensation due to violated SLAs.

## Network emulation is key to delivering robust, high-performing HCI solutions

To address these challenges, HCI providers need to implement best practice rigorous testing and validation strategies as a primary approach. By simulating real-world network conditions including dynamic traffic patterns, jitter, congestion, and failure scenarios, HCI providers can identify and address potential issues before deployment – crucial to ensuring their solutions meet customer expectations. Equally, as HCI solutions continue to innovate and expand, ongoing testing and validation strategies are required to make certain that product performance is not compromised. And one of the most practical and cost-effective methods for conducting these tests is using a dedicated network emulator.

While network emulators vary in scope and performance, for HCI providers, you'll need an emulator with the capability to create realistic network scenarios that provide deterministic and repeatable results. Typical requirements include the ability to impair hundreds of packet streams simultaneously, high line rates to emulate network conditions including 5G and 5.5G services, and flexible bandwidth control to test throughput-sensitive applications like real-time analytics and financial trading. Additionally, a wide range of impairments is mandatory to emulate, for example, dropped, mis-ordered and duplicate packets, as well as jitter to replicate traffic congestion. In short, all the essential tools to observe, test and validate HCI deployments under real-world dynamic network conditions.

Seven common use cases are summarized below to demonstrate the benefits of testing with a dedicated network emulator.

## Use cases – network emulation testing

USE CASE	PROBLEM	TEST SOLUTION	TEST BENEFITS
Cloud Object Storage solution testing	Many enterprises leverage cloud object storage solutions for disaster recovery, backup, and archiving purposes. HCI providers need to validate how their object storage solutions perform during failover scenarios, particularly when replicating data across data centers connected via wide-area networks (WANs).	Network emulation can emulate WAN conditions with latency, packet loss, and bandwidth constraints to accurately assess the performance and reliability of cloud object storage solutions during failover scenarios. By emulating real-world network conditions, HCI providers can identify potential issues and optimize their solutions for seamless disaster recovery and data availability.	<ul style="list-style-type: none"><li>Proves disaster recovery capabilities</li><li>Increases data availability and reliability</li><li>Optimizes performance during failover and failback scenarios</li><li>Enhances customer trust and satisfaction</li><li>Reduces the risk of data loss and business disruption</li><li>Provides a competitive advantage through robust and reliable solutions</li></ul>
Network file transfer testing	HCI solutions often involve transferring large files across network storage devices. Tests that can simulate various network conditions are essential to validate the performance and reliability of these file transfers.	Performing a network emulation test using various network conditions such as latency, packet loss, and bandwidth constraints will validate the performance and reliability of file transfers across network storage devices in HCI environments. This allows HCI providers to ensure data integrity and optimize transfer speeds, resulting in improved efficiency and reduced downtime.	<ul style="list-style-type: none"><li>Proves data integrity during file transfers</li><li>Optimizes transfer speeds and reduces downtime</li><li>Increases solution efficiency and productivity</li><li>Enhances user experience and satisfaction</li><li>Reduces the risk of data corruption and associated costs</li><li>Provides a competitive advantage through efficient and reliable file transfer capabilities</li></ul>
Data protection and disaster recovery testing	Data protection and disaster recovery are critical features of HCI solutions.	During a network emulation test, engineers can emulate network disruptions, outages, and other scenarios to thoroughly test and validate the resilience and failover capabilities of HCI systems. This ensures data availability and business continuity while minimizing the risk of data loss and downtime.	<ul style="list-style-type: none"><li>Proves data availability and business continuity</li><li>Reduces the risk of data loss and downtime</li><li>Optimizes failover mechanisms and disaster recovery procedures</li><li>Minimizes reputational and financial risks associated with data loss</li><li>Provides a competitive advantage through robust and reliable data protection solutions</li></ul>

## Use cases – network emulation testing (cont.)

USE CASE	PROBLEM	TEST SOLUTION	TEST BENEFITS
<p>Metro Availability testing</p>	<p>Metro Availability features in HCI solutions synchronously replicate data to another site, ensuring a real-time copy of the data exists at a different location.</p>	<p>Emulating a network in the lab environment can simulate various network conditions and scenarios to validate the performance and reliability of Metro Availability features in HCI solutions. By testing synchronous data replication under realistic network conditions, it helps HCI providers ensure real-time data availability and minimize the risk of data loss or corruption.</p>	<p>Proves real-time data availability and reliability</p> <p>Reduces the risk of data loss or corruption during replication</p> <p>Optimizes the performance of synchronous replication mechanisms</p> <p>Enhances customer trust and confidence in data availability</p> <p>Minimizes reputational and financial risks associated with data loss</p> <p>Provides a competitive advantage through robust and reliable Metro Availability solutions</p>
<p>Low-latency infrastructure testing for critical applications</p>	<p>HCI solutions are often used to support latency-sensitive applications such as real-time analytics, financial trading, and virtualized desktop infrastructure (VDI).</p>	<p>A network emulation test will accurately emulate low-latency network conditions, enabling HCI providers to validate the performance of their solutions for latency-sensitive applications. This helps ensure optimal performance and user experience for critical applications.</p>	<p>Proves performance for latency-sensitive applications</p> <p>Optimizes user experience and productivity</p> <p>Reduces the risk of service disruptions and downtime</p> <p>Enhances customer satisfaction and loyalty</p> <p>Minimizes reputational and financial risks associated with poor application performance</p> <p>Provides a competitive advantage through high-performing and reliable solutions for critical applications</p>
<p>Data reliability testing</p>	<p>HCI solutions must ensure data reliability and integrity, even in the face of network failures, packet loss, and other adverse conditions.</p>	<p>Network emulation allows HCI providers to validate the data protection mechanisms and resilience of their solutions under the most extreme conditions to ensure minimal risk of data corruption or loss.</p>	<p>Proves data reliability and integrity</p> <p>Reduces the risk of data corruption or loss</p> <p>Optimizes data protection mechanisms</p> <p>Enhances customer trust and confidence in data reliability</p> <p>Minimizes reputational and financial risks associated with data loss</p> <p>Provides a competitive advantage through robust and reliable data protection solutions</p>

## Use cases – network emulation testing (cont.)

USE CASE	PROBLEM	TEST SOLUTION	TEST BENEFITS
Scalability and performance testing	As HCI deployments grow and support more users and applications, scalability and performance become critical concerns.	By means of a network emulation test, HCI providers can simulate high-traffic loads, congestion, and other scalability scenarios in a lab environment, enabling them to validate the performance and capacity of their solutions under varying load conditions.	<p>Improves scalability and performance as deployments grow</p> <p>Optimizes resource utilization and capacity planning</p> <p>Reduces the risk of performance bottlenecks and service disruptions</p> <p>Enhances customer satisfaction and loyalty</p> <p>Minimizes reputational and financial risks associated with poor performance</p> <p>Provides a competitive advantage through scalable and high-performing solutions</p>

### Related Products: Calnex SNE-X



Trusted by leading HCI vendors/system integrators, enterprises and resellers worldwide, delivers the performance and flexibility essential for rigorous testing.

- **Massive scalability:** With up to 28 ports, simultaneously impair hundreds of packet streams, replicating the complex network environments of modern HCI deployments.
- **High-speed emulation:** Accurately simulate the demanding network conditions of 5G services and applications with 1 to 400GbE wire-rate performance.
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- **Flexible connectivity:** The high-performance backplane enables “Any Port to Any Port” testing, providing unmatched flexibility to simulate diverse network topologies and traffic patterns within HCI environments.

An example of how the Calnex SNE-X emulates data replication in an interconnect scenario across a distance of 2500 Km under realistic network conditions.



For more information on Calnex’s network emulation products, and to take advantage of our extensive experience in network emulation test, contact Calnex Solutions today:

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