

## FC / FCoE Protocol Package

### Industry's premiere validation system for SAN technologies

#### Overview

The FC and FCoE initiator protocols are specifically designed to work with the WorkloadWisdom 16GFC Series Workload Generators. The combined protocol and generator solution can seamlessly run the same exact workload over either FC and FCoE, ideal for comparing workloads across the two technologies. WorkloadWisdom 16GFC and 32GFC Series generators support FC functionality at 4G, 8G, 16G and 32G speeds and FCoE functionality at 10GE speed. The powerful system delivers the industry's highest throughput and IOPS on every port at all supported speeds. The FC / FCoE protocol support includes connectivity directly to FC targets and to the FC / FCoE SAN switches. Targets and LUN sizes are automatically discovered.

The WorkloadWisdom 32GFC generator is the newest offering adding improved FC and FCoE suites to its existing powerful portfolio of file, block and object-based workload generation solutions. Fibre Channel / Fibre Channel over Ethernet workloads include full-featured initiator with multipath I/O (MPIO) support, which is essential for performance and system level validation of storage products and storage networking environments.

A rich suite of SCSI commands is presented for detailed system level testing. The suite covers a thorough set of SCSI commands for disk, tape and virtual tape. Commands specified to the user are injected directly at the SCSI layer, ensuring unparalleled performance, repeatability and scalability. Tests can be executed either through WorkloadWisdom's powerful GUI, or from scripts using the automation API.

The initiator can connect directly to storage arrays and create huge amounts of realistic I/O load patterns to test the storage under worst case conditions.

#### Highlights

- Attain fine grain control over data traffic at the SCSI level
- Ensure exact SCSI workload replication
- Validate advanced functions including caching, backup, and virtual server storage offloads
- Seamless comparison of FC vs. FCoE workloads
- Generate FC and FCoE workloads from the same generator

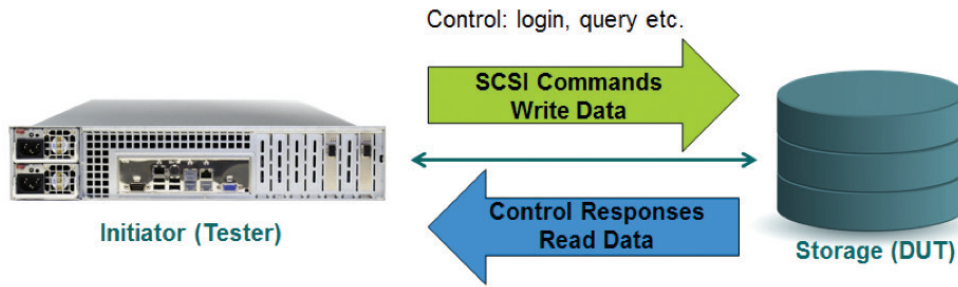


Figure 1: Validating FC / FCoE targets with realistic workloads and storage functions.

It can also connect to storage via a SAN and thus be used for SAN testing. Both the storage device and the SAN switch can be independently subjected to varying types of load, and the performance characterized easily. The amount and variety of load created can accelerate discovering and resolving bugs.

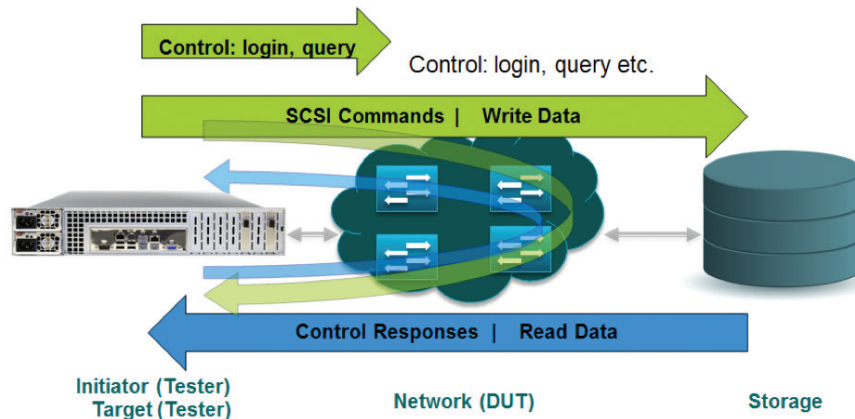


Figure 2: Validating converged data center Top-of-Rack switches featuring FCoE / FC interconnects

## Key Features

### Initiator Emulation Realism

- Realistic emulation of FC / FCoE initiators with the ability to emulate multiple scenarios from a single interface
- FC / FCoE initiator Queue Depth control provides the ability to assess the optimized Queue Depth configuration for the array under test
- N\_Port ID Virtualization (NPIV) support simulates virtualized Fibre Channel hosts in data center networks with customized WWPN settings
- Multipath I/O (MPIO) support for load balancing validations, three algorithms, and failover verifications (failover and fallback)
- ALUA support with ability to trigger dynamic MPIO failover / fallback based on ALUA port states
- Support for direct access block devices (e.g. SSDs, disks) and stream devices (e.g. tapes, VTLs)
- Validate advance storage features such as virtual server storage offloads (e.g. VAAI)
- Direct SCSI layer control without OS interventions allows for realistic simulation of application unique workloads
- Vary the ratio of sequential disk access and random disk access
- DCB / FIP Support for FCoE

## Key Features Continued

|   |  |
|---|--|
| <b>Test Modeling</b>                        | <ul style="list-style-type: none"><li>• Flexible scenario modeling with looping constructs, user parameter files, and functions for unique parameter usage such as creating complex disk access patterns</li><li>• Set independent, iterative load profile objectives for each parallel scenario to assess scalability including: concurrent scenarios, new scenarios per second, concurrent actions, new actions per second, concurrent connections, new connections per second, and throughput</li></ul>   |
| <b>Content Creation / Data Verification</b> | <ul style="list-style-type: none"><li>• Create complex read / write characteristics with varying IO chunk sizes and IO transfer sizes for block storage</li><li>• Support for reading and writing large files with diverse data patterns: sequential, random, seeded random, and user supplied files</li><li>• Data verification options to ensure the integrity of data written to target storage</li><li>• Innovative Data Compressibility and Deduplicability algorithm</li></ul>   |
| <b>Commands</b>                             | <ul style="list-style-type: none"><li>• SCSI command sequencing control within scenarios to emulate any complex workload that represents initiator, application and device behaviors. Supported commands include:<ul style="list-style-type: none"><li>- <b>SCSI Primary Commands (SPC):</b> commands that apply to all SCSI devices such as INQUIRY, MODE SENSE, and TEST UNIT READY</li><li>- <b>SCSI Block Commands (SBC):</b> commands that apply to Block devices (e.g. SSDs, disks) such as VERIFY, WRITE SAME, and the direct access READ and WRITE operations</li><li>- <b>SCSI Stream Commands (SSC):</b> commands that apply to Stream devices (e.g. tapes, VTL) such as REWIND, SPACE, and the stream access READ and WRITE operations</li><li>- <b>SCSI Media Changer Commands (SMC):</b> commands that manage independent media changer devices and attached media changer functions</li><li>- <b>Custom CDB Builder:</b> Create custom SCSI commands for advanced functionality testing, compliance testing, and negative testing. Integrates with Scenario Editor to create highly customized test scenarios and workloads, with per command statistics support</li></ul></li></ul> |
| <b>Automation</b>                           | <ul style="list-style-type: none"><li>• Automate any task needed with the protocol commands supported using scripting languages: Perl, Python and C#</li></ul>   |

## Statistics

|                            |   |
|----------------------------|---|
| Actions / IOPS             | <ul style="list-style-type: none"><li>FC SCSI Action counts or Actions/sec (average for all or individual Actions)</li></ul>  |
| FC SCSI Details            | <ul style="list-style-type: none"><li>FC SCSI command transmission/receipt OK/Fail/Drop in packets/sec or bytes/sec</li></ul> |
| FC SCSI Completion Time    | <ul style="list-style-type: none"><li>FC SCSI command completion time (average, minimum, maximum)</li></ul>                   |
| FC SCSI IO Throughput      | <ul style="list-style-type: none"><li>FC SCSI IOs packet or byte throughput on per command or All basis</li></ul>             |
| FC MPIO SCSI IO Throughput | <ul style="list-style-type: none"><li>FC SCSI IOs packet or byte throughput on per path or All paths basis</li></ul>          |
| FC Sessions                | <ul style="list-style-type: none"><li>Attempts, Opened, Closed, Failed, Reset, Timeout</li></ul>                              |
| FC Session Time            | <ul style="list-style-type: none"><li>FC SCSI session time (average, minimum, maximum)</li></ul>                              |
| FC Network Bandwidth       | <ul style="list-style-type: none"><li>FC packet or byte throughput</li></ul>  |
| FCoE Network Bandwidth     | <ul style="list-style-type: none"><li>FCoE packet or byte throughput</li></ul>  |
| Data Verification          | <ul style="list-style-type: none"><li>FC SCSI data verification operations attempts, successes, failures</li></ul>            |

## Supported Platforms

- WorkloadWisdom 16FC Series Generator
- WorkloadWisdom 32GFC Generator
- WorkloadWisdom Series Generators
- WorkloadWisdom Unified Series Generators



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