Benchmarking a System Built from the Static Structural Test Reference Architecture

To create performance benchmarks for the Static Structural Test Reference Architecture design pattern, NI built a physical test system according to the pattern and tested the system for viability and reliability, using the following tests.

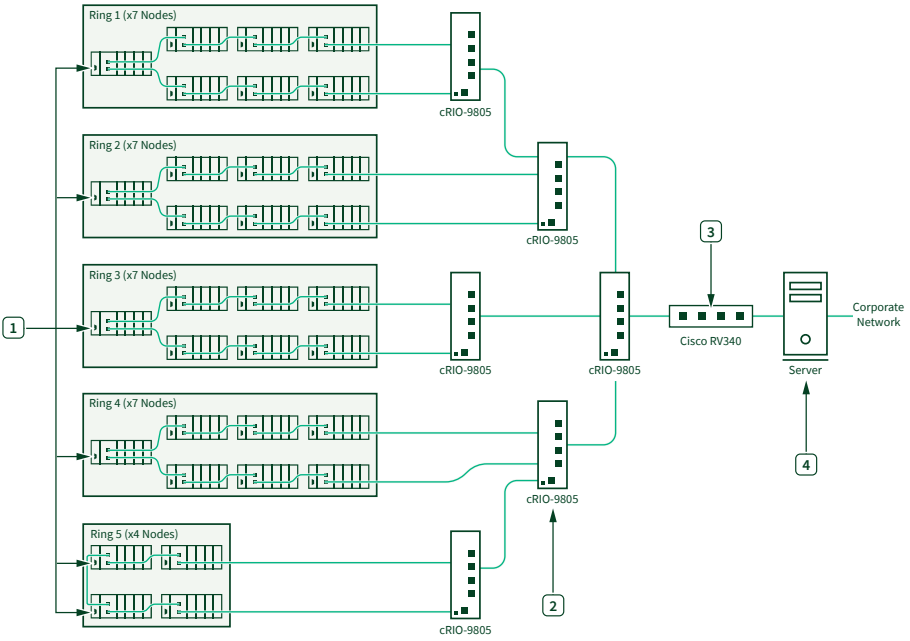
- Long-Term Test: assessed the performance of the benchmark system when continuously logging data without producing errors
- Channel Count Parametrized Test: found the highest sample rates the benchmark system could achieve at different channel counts.
- Shunt Calibration and Null Offset Tests: assessed the time to complete a shunt calibration and null offset.

Use the results of the benchmark system tests as reference when building your own system from the Static Structural Test Reference Architecture.

The Static Structural Test Benchmark System

The following figure and table depict the composition of the Static Structural Test benchmark system built by NI.

Figure 1. Diagram of Benchmark System Built by NI



1. cDAQ-9189: 8-Slot, TSN-Enabled Ethernet CompactDAQ Chassis
2. cRIO-9805: 4-Port, 802.1AS Ethernet Switch Expansion Module for CompactRIO
3. Cisco RV340: Router
4. Lenovo ThinkStation P330 Tower Gen 2: Server

Note To stress scalability and performance, NI configured the benchmark system with over 2,000 channels—the top-end channel count suggested in the Static Structural Test Reference Architecture.

The 32 cDAQ-9189 8-Slot chassis in the benchmark system are configured with a total of 256 modules and a channel composition that represents a common static structural test application.

Table 1. Channel Composition and Sample Rates for the Benchmark System Built by NI

Number and Type of Channels	Number of Modules	Module Model Numbers	Sample Rate (samples per second)
1,944 quarter bridge strain gauges	243	NI-9235 and NI-9236	100 S/s
32 voltage	8	NI-9215	100 S/s
64 temperature	4	NI-9213	1 S/s

Conditions

The benchmark test results were found under the following conditions unless otherwise noted.

- Static Test Software Suite 1.1 installed
- Windows 10 operating system
- Google Chrome browser
- System components connected according to the Static Structural Test Reference Architecture design pattern, as shown in the previous figure

Long-Term Test Results

The Long-Term Test assessed the performance of the benchmark system when continuously logging data without producing errors.

Conditions

- 2-week test time
- 2,048 channel count
- 100 S/s sample rate for strain and voltage channels
- 1 S/s sample rate for thermocouple channels

Performance	
CPU usage	20% to 70%
Memory usage	15% to 30%, 2,000 MB to 6,000 MB
Network utility	17% to 18%
Storage utilization	
Total utilization	2.15 TB
Utilization by file type	337 technical data management streaming (TDMS) files at ~5.91 GB each 337 TDMS index files at ~620 MB each

Channel Count Parametrized Test Results

The Channel Count Parametrized Test found the highest sample rates the benchmark system could achieve at different channel counts. The highest sample rates, reported in the following section, were achieved for 30 minutes without producing errors and within the following parameters:

- < 80% memory usage
- < 95% CPU usage
- < 80% network utility

Highest Sample Rates by Channel Count

2,048 channels	
Maximum sample rate	3 kS/s
CPU usage	36% to 50%
Memory usage	28% to 30%
Network utility	~22%
1,160 channels	
Maximum sample rate	10 kS/s (NI-9235 and NI-9236 have a maximum sample rate of 10 kS/s)
CPU usage	40% to 60%
Memory usage	34% to 40%
Network utility	~38%
448 channels	
Maximum sample rate	10 kS/s (NI-9235 and NI-9236 have a maximum sample rate of 10 kS/s)
CPU usage	15% to 25%
Memory usage	21% to 22%
Network utility	~15%

Shunt Calibration and Null Offset Test Results

Time to complete shunt calibration on 1,944 channels	3 minutes
Time to complete null offset on 1,944 channels	1 minute

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