Automated Testing of Storage Arrays

Part A - Drive Control Module:

Quarch Drive Control Modules are part of the Torridon storage array test system. They are placed between a disk drive and its host controller to allow full automation of insertion / removal from a storage enclosure.

With total control over every power and control pin, many common manual tests such as hot-swapping and creating bugged hardware can be done automatically and with full repeatability.

Drives can be plugged and pulled automatically

- Tests that require a plug/pull can be automated.

  Groups of tests often have points where they halt until a manual action (pulling or plugging a drive) is required. By automating this action, a much larger block of tests can be run without a user being present. This allows full overnight utilisation of a test system and reduces the chanced of a test idling for some time because the user is not available.

  "A customer had a regression test that took 2 weeks to complete. This required 2 engineers for significant blocks of manual drive pulls and generally idled overnight. Using the Torridon System, the full regression test now takes around 36 hours and requires no manual intervention"

- Tests can be created that pull and plug drives at precise times and in groups. This allows easy testing of scenarios such as multiple drive removal.

  "After starting to run the Torridon system on a new product, one customer quickly found critical faults when certain combinations of drives were pulled in close succession. These combinations had not been tested manually before due to limited time."

Changes to the system are precisely timed and repeatable

- Removing the human from the test ensures that the correct drive is pulled, and at the correct time. This removes human error that could either delay a test or give the wrong outcome.

  "An error made towards the end of a set of manual tests could lead to hours of wasted time. If the mistake was not noticed then the incorrect result could waste days..."

- Plugging a drive manually will give a different effect every time. It is totally impossible to get the same pin mating sequence and pin bounce twice in a row. With the Torridon system, timings are accurate to within 1uS and 100% repeatable.

  "Most drives have a longer pre-charge pin avoid the drive pulling too much current when powering up. Finding any failure conditions of the system can now be done in a matter of minutes. This would be hard enough with manual testing that it is often ignored, leading to potential field failures"

Capital costs are reduced

- Fewer test systems and drives are required due to the higher utilisation of equipment and the increased testing speed.

  "When implementing the Torridon system on a new project, it was found that the reduction in test times allowed several storage arrays to be allocated to other purposes as they were no longer required for manual testing"

Drive depreciation is reduced

- Wear and tear on drive connectors is reduced.
- The 'on time' for a group of drives to complete a test cycle is greatly reduced.

  "A storage provider could easily write off $1,000,000 a year in disk drives. This is due to depreciation of drives in test and losses in drives due to worn connectors or passing their maximum 'on time'."

Part B - SBB Canister Control Module

Quarch Canister Control Modules are part of the Torridon storage array test system. They are placed between an SBB canister and the mid-plane to allow full automation of insertion / removal from a storage enclosure.

As well as Hot-Swap, the SBB module is ideally suited for bugged hardware and fault injection tests due to the large number of pins that can be switched.

Canisters can be plugged and pulled automatically

- Tests that require a plug/pull can be automated.

  As with drives, SBB canisters can be hot-swapped. With far more pin connections an SBB canister is even more complicated to test than a drive. The Torridon system allows the huge number of hot-swap combinations to be methodically tested, without user intervention.

Bugged hardware and error injection

- Faults during power up.

  A faulty pin that fails to connect when the canister is plugged. This can be simulated without cutting the pin from a test canister

  "With a simple script, every possible broken pin can be tried to ensure the system recovers correctly. The entire test could be run in a matter of hours and without modifying any hardware"

- Failures while running.

  "Bugging hardware is a slow and limited process. Adding extra wires and switches to a card can make for an unrealistic test, can damage the test canister and each switch added only tests one faulty pin (SBB 2.0 has almost 200 pins). The Torridon system can test every combination without any physical changes to the device under test."

- Temporary failures.

  Pins can be temporarily disconnected while the canister is in use. This tests how the system responds to glitches and short term failures.

- Driving lines.

  The newest SBB 2.0 LD module is capable of driving pins high and low as well as simply breaking them. This massively increases the number of failures that can be injected into the system

  "A damaged pin or loose component could cause a pin to be shorted to ground or pulled high. Too many of these combinations exist to test them effectively by any manual means. With the SBB Module, these possible faults can be tested quickly and easily."

Part C - Confidence in test results

It is critical to have confidence in the results of tests, whether faults are discovered or not. The Torridon system is specifically designed to increase your confidence and repeat any unusual failures quickly and easily.

Increased test coverage reduces field returns

By trying out far more combinations of test and repeating them more often, a larger number of errors will be found. Field can be extremely costly and damaging to reputation, the Torridon system allows critical bugs to be found earlier in the test process.

Reduced human error

The single most common reason for a failed test is human error. This could be due to a mistake during setup or an incorrect action or measurement during the test procedure.

By removing the human element from the testing, there is a much higher chance that a failure corresponds to a genuine problem.

Increased repeatability

As the test is automated and hot-swap event are 100% repeatable, failed tests can be re-run *exactly* as they were before. As an engineer can repeat the result more quickly and understand exactly what happened, it is much easier to find the root cause