the Availability Digest

Stratus Continues its $50,000 Uptime Guarantee
March 2015

In 2010, Stratus Technologies (www.stratus.com) bet $50,000 that its fault-tolerant ftServer would not go down in the first six months of operation. If you bought a system by the end of February, 2010, and if it failed in its first six months of operation, Stratus would pay you $50,000 in cash (or in product credit if you wanted).[1]

How did it do on this wager? It did so well that Stratus announced several extensions to the guarantee. Five years later, it is sticking to its guarantee. In the five years of the guarantee, Stratus has not paid out a cent, thus illustrating its claim that ftServers achieve over five 9s of availability.

Stratus' Expanded Guarantee Now Extends to Virtualization

The ftServer now supports Windows Server 2008 R2 and Windows Server 2012, as well as Red Hat Enterprise Linux (RHEL), versions 5 through 7. Its support has also been extended to virtualized environments with Microsoft's Hyper-V and VMware's vSphere hypervisors.

Critical virtualized applications depend upon an extremely reliable infrastructure on which to run. If a host server goes down, not just one application is lost. All applications running on that server are down until they can be failed over to another host server – a process that can take several minutes and even up to an hour or more for large, complex applications. The impact of a failed server is amplified manyfold in a virtualized environment.

Stratus ftServers provide fault tolerance for virtualized environments. Stratus has worked closely with Microsoft and VMware to harden their virtualized environments and to protect systems against both hardware (Stratus) and software (Windows, Hyper-V, Linux, and vSphere) failures. Stratus feels so confident in the results that it continues to bet $50,000 against a failure. But at this time, it is wagering not only on its ftServer. It is betting that the entire hardware/software virtualized environment will not fail.

The range of operating systems covered under its guarantee has now been extended from Windows Server to Linux and to virtualized systems running VMware's vSphere hypervisor and its guest operating systems.

---

[1] Stratus Bets $50,000 That You Won't Be Down, *Availability Digest*; January 2010.
http://www.availabilitydigest.com/public_articles/0501/stratus_guarantee.pdf

The Stratus ftServer

Achieving Five 9s Availability

Stratus ftServer Uptime Meter as of February 20, 2015

ftServer uses dual modular redundancy to provide plug-and-play fault tolerance to Windows, Linux, and virtualized applications. To measure the availability of its servers in the field, Stratus monitors its service incident reports and updates an Uptime Meter daily, which it displays on its ftServer web site.[2] The Uptime Meter covers all hardware, operating system, and hypervisor failure incidents and consistently shows an availability of five 9s or better (an average of five minutes of downtime per year or less).

## ftServer Architecture

The high availability of the Stratus ftServer product line is achieved by running all applications on dual

The Stratus ftServer

processors that are lockstepped at the memory-access level. Should there be a disagreement between the processors, one of the processors has suffered a fault. If the faulty processor has detected its own fault, that processor is taken out of service. Otherwise, each processor enters a self-test mode; and the processor in error is taken out of service.

Each processor contains its own I/O subsystem. In normal operation, peripheral devices are driven by both I/O subsystems via a multipath connection. However, if an I/O subsystem detects a malfunction, it will remove itself from service.
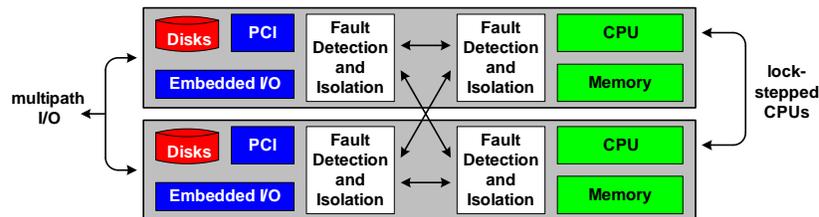
The ftServer Architecture

Each logical processor is connected to each of the I/O subsystems. In this way, any combination of one logical processor failure and one I/O subsystem failure will not render the system inoperable.

The ftServers use industry-standard multi-core Intel Xeon processor chips. Depending upon the model of the ftServer, each logical processor can support anywhere from six to twenty cores, letting it scale to meet very large processing demands. Furthermore, each processor chassis contains not only its logical microprocessor cores, memory, and I/O subsystem but also integrated disks, a portion of which can be solid state drives (SSDs). The internal storage is mirrored between the slices, providing fault-tolerant storage within the ftServer itself.

Stratus offers three models of ftServers to accommodate various user needs:

Model	Cores	Use
2710	6	Remote and Branch Office Locations
4710	10	Regional offices and Corporate Data Centers
6410	20	Corporate or Cloud Data Centers

---

[2] The Stratus Uptime Meter can be found at http://www.stratus.com/Products/Platforms/ftServerSystems.

Virtualization

Virtualization technology allows many virtual machines to run on a single server. Virtualization is an important technique for getting full utilization out of large server farms.

A problem faced with virtualization technology is that availability becomes far more important. One particular application may not have a high value and can suffer some downtime without serious consequence. However, run many of these as virtual machines on a single server, and a server failure becomes much more costly.

Stratus has integrated the ftServer with Microsoft's Hyper-V and VMware's vSphere hypervisors to allow an ftServer to host multiple virtual Windows and Linux machines in any combination. The hypervisor sits on top of the ftServer hardware and supports multiple instances of different guest operating systems running as if they were in their own physical servers.

As a result, it is very simple to add a fault-tolerant pool of servers to a virtualized server farm. It is this integration of ftServer with VMware's vSphere that Stratus is wagering will not fail.

Hardened Commodity Operating Systems

The Windows and Red Hat Linux operating systems that Stratus supports are those that are commercially available to anyone. The same is true of the Hyper-V and vSphere hypervisors. Therefore, the ftServers are application binary interface (ABI) compatible with Windows and Linux applications. Any application that can run under Windows or Red Hat Linux on an industry-standard server can run on an ftServer without modification, either directly or as a Windows or Linux virtual machine running on top of one of the supported hypervisors. The installation and administration procedures are identical. The user should see no difference except for downtime – and that is the big difference. There is no downtime.

When a new operating system version is about to be released, Stratus engineers do everything that they can to break it. Stratus engineers claim that they have not yet found a device driver that they could not break. Faults that involve the operating system are reported back to Microsoft and Red Hat, who make corrections to eliminate the sources of those failures. Everyone benefits from this effort because it is the hardened version that is released for public use. The Windows and Red Hat Linux operating systems that Stratus runs are the standard, commercially available versions.

The Three-Legged Stool

Dual modular redundancy is only one leg of the fault-tolerant capability of the ftServers. The other legs are the Automated Uptime Layer and Proactive Availability Management.

Automated Uptime Layer

Stratus ftServers use pairs of hardware components to eliminate any single point of failure. The Automated Uptime Layer provides a single-system view that keeps these redundant components running in perfect lockstep. The user

also sees a single-system image. Unlike clusters, management of the system is the same as if the applications were running on a single standard commodity server. Also, multiple licenses for software are not necessary.

A primary function of the Automated Uptime Layer is to detect potential faults before they cause an outage. More than 500 conditions in the ftServer hardware and software are monitored. This includes
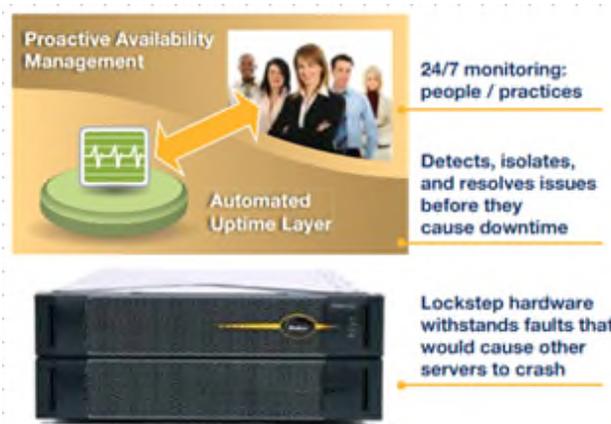
indicators of resource exhaustion and poor performance. The Automated Uptime Layer can decide to alarm the Stratus Customer Assistance Center, and action is immediately taken by Stratus technicians to diagnose the problem. This capability is dubbed "Stratus Call Home."

If a component needs to be replaced, Stratus will send the component to the customer's site via next day delivery. There are many cases in which the first sign of a problem to the customer is when it receives the replacement part in the mail. A failed processor is easily replaced by an untrained customer. No special tools or operational procedures are required. Simply remove the failed processor and slip the new processor into the ftServer chassis. The new processor will automatically synchronize itself and begin its lockstep processing.

Proactive Availability Management

If the user chooses to use Stratus's proactive availability management services, Stratus support technicians monitor the system over its secure ActiveService Network (ASN). Using information provided by the Automated Uptime Layer, these experts are ready 24/7 to remotely diagnose and remediate more complex issues than those that can be automatically resolved by the Automated Uptime Layer. There are no hours wasted for a repair technician to show up, hopefully with the correct parts.

Nearly everything a service technician can do onsite, Stratus's proactive availability management services can do remotely. 99% of all ftServer problems are resolved remotely.

The Fine Print

This guarantee is a bold offer from Stratus. But what about the fine print? The terms and conditions of the guarantee are straightforward. The terms include the following definitions and requirements:

- A Stratus ftServer must be purchased with Stratus' Total Assurance Service.

- The covered components include the Stratus hardware, Stratus system software, Windows and Linux operating systems, and VMware's vSphere hypervisor.

- The system must be installed within one year of delivery using Stratus' installation services.

- The system cannot be used for development within the guarantee period.

- The customer must maintain an active modem or Internet connection between the system and Stratus' ActiveService Network (referred to above as Stratus Call Home).

- The customer must replace customer-replaceable units within one business day of receipt of the unit.

- The determination of the failure cause is determined by Stratus' root-cause analysis.

- The failure of non-fault-tolerant components such as USB ports, keyboards, or monitors is not covered.

- The six-month guarantee period begins on the first day of production deployment by the customer.

Summary

Stratus' fault-tolerant systems change the focus of availability from hardware failures and operating-system faults to other factors. Application bugs, operator errors, and environmental faults such as power, cooling, and data-center destruction now become the things about which to most worry.

Continuous availability is no longer a technological problem. It is an exercise in balancing system cost with downtime cost. Stratus' ftServer is an affordable starting point to achieve extreme availabilities. Stratus says so – with its wallet.

More information on the ftServer architecture can be found in the Stratus documents "Stratus ftServer Architecture"[3] and "Stratus Uptime Assurance Architecture."[4]

---

[3] Stratus ftServer Architecture
http://www.stratus.com/~/media/Stratus/Files/Library/WhitePapers/StratusUptimeAssuranceArchitectureForWindows.pdf
[4] Stratus Uptime Assurance Architecture
http://www.stratus.com/~/media/Stratus/Files/Library/WhitePapers/Stratus-Uptime-Assurance-Architecture-For-Linux.pdf