ACI Active/Active Software on Stratus ftServer Systems

Protect your payments processing environment against the full spectrum of planned and unplanned downtime

Abstract

The ACI active/active payments architecture and fault-tolerant Stratus® ftServer® systems each provide superior availability compared with competitive offerings. Used together, the ACI and Stratus solutions protect your payments processing environment against the full spectrum of downtime threats: hardware failure, software and operating system failure, network failure, and site failure, and also enable uptime during planned maintenance procedures. This paper explores these issues in depth and explains the many advantages this powerful complementary product combination offers.

Deploying active/active with fault-tolerant servers

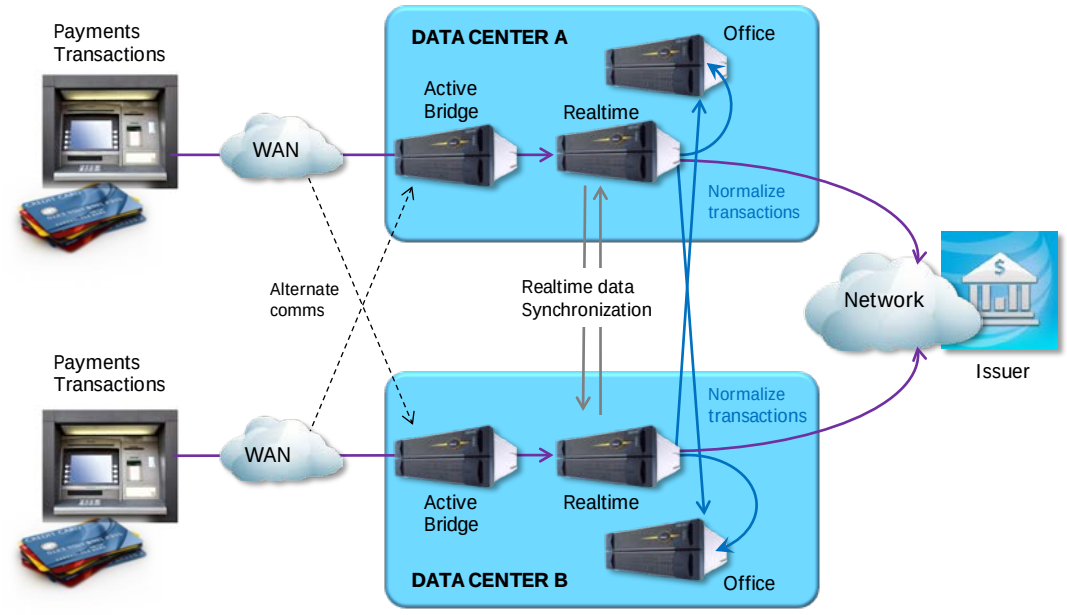
The ACI active/active payments solution deploys active production servers at two separate sites (Figure 1). While this is a relatively new enhancement that is being adopted widely by new customers, existing customers are also interested in the architecture for future migrations.

Terminal connections are normally split across the two sites, which lets the ACI Realtime servers at each site share the transaction load. Both Realtime servers are configured to handle 100% of the load, which continues to provide uptime if a failure occurs at one of the sites.

If a hardware or site failure prevents one of the Realtime servers from processing transactions, the Active Bridge server automatically routes transactions to the secondary system. If a software component failure prevents a Realtime server from processing transactions, current transactions will be aborted and future transactions will be routed to the secondary server. During a planned downtime scenario, the Active Bridge server allows existing transactions to complete while routing new transactions to the secondary payments system.

Each ACI Office server receives transaction data from both Realtime servers, providing a consolidated view of transactions across both systems. Back office operations are designed to continue without disruption, as well.

Figure 1: Active/active deployment with ftServer systems



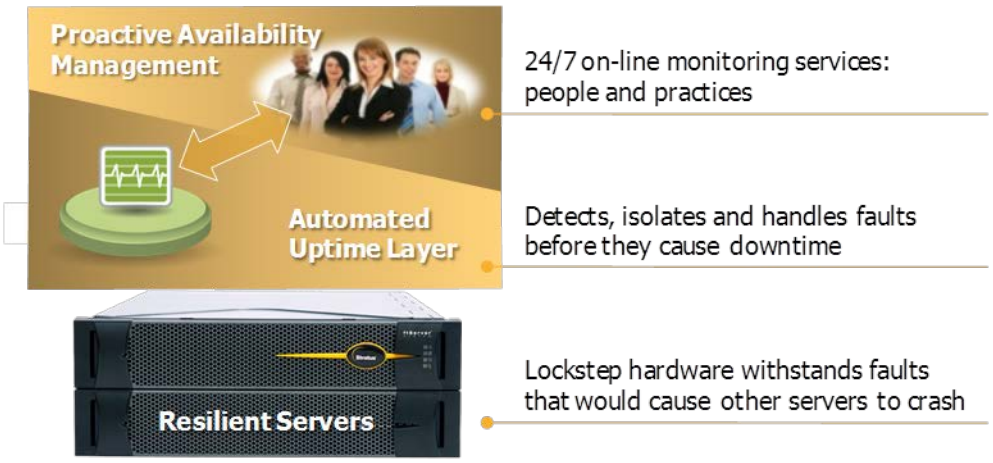
ACI recommends Stratus fault-tolerant ftServer systems, especially for the critical Realtime function. In addition to the many advantages the ACI active/active solution offers, Stratus servers provide the highest levels of uptime in the industry, operational simplicity, and 24/7 online support and remediation capabilities. These features also make Stratus ftServer systems the optimal platform for the Active Bridge and Office functions. The added value in using ftServer systems to address both unplanned and planned downtime is explained in the following sections of this whitepaper.

Stratus ftServer systems: layers of uptime protection

Proven in the field since 2001, the industry-standard Stratus ftServer family automatically prevents downtime and data loss. Their fault-tolerant architecture extracts the full power and performance of the latest Intel® multi-core processors to deliver uptime and performance for flawless payments processing.

Stratus ftServer systems running Microsoft® Windows Server® operating systems provide 99.999+% uptime for both the server and Windows® operating environment. Average unscheduled downtime for Stratus-serviced servers for the year 2011 was 81 seconds — saving Stratus customers more than $3 billion in downtime costs.

Figure 2: Core elements of Stratus uptime assurance



Stratus builds total uptime assurance into every ftServer system through a set of tightly integrated technologies:

- **Resilient servers:** The ftServer architecture includes fully replicated hardware components that virtually eliminate any single point of failure and safeguard data integrity. If a component fails, its partner simply continues processing. The replicated components perform the same instructions at the same time, so there is no interruption in processing, no loss of performance, and no data loss.

- **Automated Uptime Layer:** Predictive features constantly monitor more than 500 system components, operating conditions, and sensors to automatically identify, isolate, resolve, and report issues before they cause downtime or data loss.

- **Proactive availability monitoring and management:** Stratus uptime experts remotely monitor the system over the secure global ActiveService™ network. Leveraging

information provided by the Automated Uptime™ Layer, these experts are available 24/7 to diagnose and remediate more complex issues remotely. This proactive, remote serviceability does away with delays and costs associated with onsite service calls.

Protection from unplanned downtime

Payments processors understand that unplanned downtime comes from many sources, some with obvious consequences—like an interruption in payments processing. Other effects of unplanned failures are not as visible, yet may still affect your service levels and leave your IT department spending many hours on recovery.

Maintaining business continuity during site failures and disasters

Site disasters include problems such as power failures and network connectivity loss as well as natural disasters such as fires, floods, and earthquakes.

Other disaster recovery solutions require organizations to integrate complex technologies, such as data replication and geographic failover, with additional operational procedures and extensive testing. Site failover typically requires manual intervention by the IT operations staff and can take several minutes to hours before applications are up and running at the backup site. Any mistakes in planning, configuration, or failover can result in unsuccessful recovery, extended downtime, and even data loss.

In contrast, ACI integrates fully automated, fully tested disaster tolerance into the active/active payments application. This approach eliminates the need for additional software, special testing or new operational procedures along with failover delays and risks of human error. And, unlike typical active/standby disaster recovery solutions, the ACI solution allows both the primary and secondary data centers to operate simultaneously under normal operating conditions and share the transaction load. If one data center becomes unavailable, the second data center automatically takes over the network load of the failed data center.

Avoiding multiple hardware failures

Multiple hardware failures can bring payments processing to a complete stop. Standard servers can fail due to problems in many different components including internal disks, disk controllers, network controllers, I/O channels, power supplies, cooling, memory, and processors.

Many standard servers offer the option to duplicate some of these components, but none has the full redundancy of an ftServer system. Due to the criticality of payments processing, and the high costs associated with even brief periods of downtime, fault-tolerant servers are your best protection against the risk of multiple failures.

It is important to realize that exposure to a second hardware failure may not be limited to a short time window. A problem on a system motherboard could cause several hours of downtime while your organization waits for a system technician to arrive on site. And there are no guarantees the technician will correctly diagnose the problem on the first try, or have the correct spare part available on the initial service call. While the failed server is out of operation, there is a risk of the entire payments application being brought down by any one of many possible failures within the secondary server.

This single-point-of-failure scenario should be the last resort for unplanned outages. It not only increases the stress on the remaining infrastructure but can also lead to abnormal processing conditions that are not as well tested.

Comparing server hardware choices

Some organizations install **cold standby servers** to minimize the possibility of extended downtime caused by more than one failure. Maintaining a cold standby is not as simple as it may seem.

To ensure successful operation, IT staff must keep the cold standby hardware and software configuration up to date. They have to perform ongoing maintenance and testing, including properly applying hardware or software upgrades and patches to keep the standby server synchronized with the production system. The application is exposed to error when administrators plan and perform these tasks. Human error is also a risk when the standby server needs to be activated at a crucial time with no advance warning. Procedural errors can occur throughout the entire process of connecting and configuring the replacement system.

Exposure to multiple failures can be most easily eliminated by deploying **fault-tolerant ftServer systems** at the primary and secondary processing sites. Stratus ftServer systems continue to operate in the event of a component failure. The system automatically diagnoses and reports ACIthe failure; Stratus automatically dispatches the correct replacement part for next-day delivery. The server stays online while the failed component is replaced, maintaining full operational capacity throughout the repair.

And because your IT staff manages each ftServer system as a single system, there is no risk of operational error associated with trying to synchronize the administration of a cold standby system with its operating partner.

Dr. Bill Highleyman, an expert on active/active architectures, has noted that a two-site active/active implementation using standard servers (each rated at three 9s availability) can achieve almost six 9s of availability.[1] Based on this methodology, fault-tolerant Stratus ftServer systems (each rated at five 9s of availability) used within the ACI active/active architecture can be expected to achieve almost 10 nines of availability.

Who uses ACI and Stratus in payments processing?

Globally, the seven largest ACI active/active payments customers have deployed ftServer systems. The vast majority of the larger ACI customers that have not yet deployed an active/active implementation (as it is a relatively new technology) also use fault-tolerant ftServer hardware. ACI recommends the ftServer system as the underlying payments platform of choice for ensuring continuous uptime assurance.

The world's leading payments processors, banks and other financial institutions have used Stratus servers to host critical applications for more than 30 years. Today, you'll find Stratus fault-tolerant servers deployed in 98 of the top 200 Fortune 500 companies.

[1] The Availability Corner: Achieving Century Uptimes, Part 6 – Active/Active Versus Clusters, The Connection (HP Tandem magazine), September/October 2007, Dr. Bill Highleyman, Dr. Bruce Holenstein, Paul J. Holenstein

Preventing data corruption

Data corruption caused by a transient error at the processor, memory, I/O bus, I/O controller, or disk level is still a risk exposure with standard servers. If data corruption does occur, it can be very difficult to detect and requires manual intervention to correct.
The Stratus ftServer design includes constant checking across its duplicated processing modules, fully replicated I/O buses, I/O cards and disks, and performs extended error checking along the full I/O path. The server immediately detects and isolates errors, removes faulty components from service, and completes I/O operations using alternate paths and devices. As a result, ftServer systems prevent the possibility of data corruption from transient errors.

Eliminating causes of non-responsive systems

Sometimes systems become non-responsive, a condition called a “hung state.” A server in this state continues to run but the system or application stops responding to service requests. While there are many possible causes, two of the most common are intermittent hardware errors and misbehaving or incompatible device drivers. Recovery from a non-responsive condition can sometimes be triggered by external timeouts, but often requires that a person notices the problem and intervenes. Failover to the secondary system can be significantly delayed in either case.

Shutdown of the TCP/IP sockets on the failing server triggers the ACI active/active recovery mechanism. When the Active Bridge server detects the loss of TCP/IP connections, it routes all transactions to the healthy server. However, if the server fails in such a way that the TCP/IP sockets are kept open, the recovery mechanism will not activate as expected.

Stratus fault-tolerant ftServer hardware and Automated Uptime Layer work together to eliminate the causes of non-responsive systems. Lockstep technology and added error detection technology isolate hardware and software errors and remove faulty components from service before errors cause crashes or hangs.

Stratus extensively tests driver software for all supported devices, including unique fault-insertion testing. Work with technology partners corrects any issues that testing uncovers. The outcome is that device drivers work as expected, even under failure conditions.

In addition, Stratus ftServer software includes a change control agent. This agent checks for compatibility of all hardware or system software upgrades to detect incompatibilities that would cause system hangs or crashes.

Managing side effects of unplanned failures

The ACI active/active architecture protects against application downtime due to an unplanned hardware, software, or network failure. The payments application continues to operate because the active/active architecture automatically transfers production processing (or fails over) from the affected site to the healthy site.

Of course, it is impossible to control the timing of unplanned failures. There is always the risk of failure during periods of peak activity. While these unplanned failures should not cause a payments processing outage, they can still trigger undesirable side effects that are better avoided.

Incomplete transactions bring reversals and delays

During an unplanned server failure, incomplete transactions will generate reversals. At a transaction rate of 100 tps (transactions per second) and a response time of 2 seconds, around 100 transactions will require manual investigation. (Note that at a transaction rate of 100 tps,

each of the two Realtime servers handles 50 tps in normal load-share operation). These transactions will not be recovered until the failed server is repaired or replaced and the reversals are processed.

The ACI payments application normalizes completed transaction data from each Realtime server to the Office servers by transferring data at one minute intervals. If a Realtime server fails, up to one minute of transaction data will be trapped on the failed server and will not be transferred until the failed server is repaired. At a transaction rate of 100 tps, data for up to 3,000 transactions would be affected. Delays in getting the failed server back online will delay end-of-day processing. The end-of-day extraction, reconciliation, and settlement process cannot run until the normalization is complete.

With near-perfect reliability, Stratus ftServer systems virtually put an end to unplanned failures and the associated side effects that cause extra work and delays for payments processors.

Minimizing planned downtime

Software patches or upgrades to the operating system, database management system, payments application, or other software components often require taking the server offline for an hour or more. Even if scheduled for periods of low activity, these planned maintenance operations will still incur downtime for typical payments implementations and will result in some customer inconvenience. Hardware upgrades can also involve extended downtime and may be harder to schedule outside of normal business hours if vendor service personnel are required.

With the ACI active/active payments architecture, you can take the primary and secondary site servers offline one at a time to apply patches or upgrades without disrupting normal operations. The Active Bridge server, a critical component of this process, reroutes the transactions to the secondary site while planned maintenance is being performed at the primary site. This allows all payments transactions to be handled seamlessly without interruption.

Stratus ftServer systems support online hardware maintenance, including upgrades such as adding disk or I/O cards. These features reduce the amount of planned downtime and simplify the overall hardware maintenance process.

ftServer systems offer a unique Active Upgrade feature. The Active Upgrade capability lets IT administrators split a single lockstepped system into two independent halves to perform software maintenance. The administrator applies patches to one half of the server while the other half continues running the production application. The upgraded half is then rebooted and merged with the production half, requiring only a brief application restart. This greatly reduces your organization’s downtime for software maintenance and the chance of possible problems at the second active/active site.

Achieving fast and permanent problem resolution

Diagnosing the cause is often difficult when a conventional server fails. In a typical scenario, a server crashes with no clear error indication. When restarted, the server appears to run normally. Then hours or days later the same incident will reoccur. Hardware diagnostics may not point to any problems.

Periodic crashes can continue unless the root cause of the incident can be identified and corrected. But the problem could lie almost anywhere—an intermittent issue in any of dozens of

hardware components or a software error in the operating system, other system software, or the application. Even worse, the problem may manifest itself only in a specific combination of hardware and software not seen in vendor testing.

These types of issues are more likely to appear at the time of initial application deployment, or after hardware or software changes are made to the environment. Although the ACI active/active architecture will automatically fail over and continue processing when server failures occur, it is important to root cause and correct these problems to achieve a stable environment.

The Stratus fault-tolerant hardware and Automated Uptime Layer work together to automatically isolate hardware and software failures, capture key diagnostic data, and report problems to the Stratus customer service organization. Stratus service engineers are able to analyze and perform root cause analysis on problems at the hardware, Windows operating system, or system software layers.

Stratus service relationships with both ACI and Microsoft enable the three companies to work together to jointly diagnose problems when necessary. Quick issue isolation, timely analysis, and permanent correction stop difficult problems from causing repeat failures.

Integrating service and support across the whole solution

Support for each of the individual hardware and software products is important for reliable payments processing. Even more important is support that addresses integration issues across products. New versions of the ACI application or Stratus hardware are integration-tested under stress to ensure flawless operation as well as accurate sizing. Recent ACI testing of the latest ftServer models demonstrates sustained throughput of more than 1,200 tps.

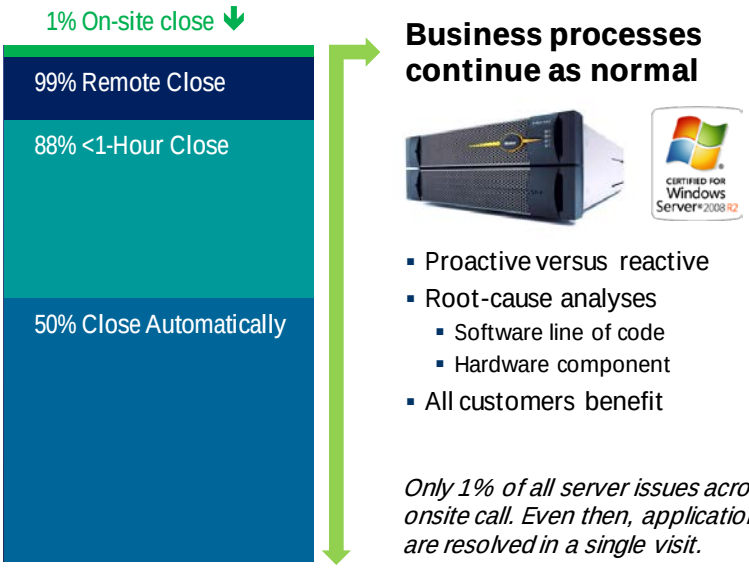
ACI takes the lead role in supporting the complete payments solution. And compared with other server vendors, Stratus provides significant added value in the areas of root cause analysis, remote monitoring, and premier 24/7 support that extends to integration issues beyond the server hardware.

The Stratus support organization focuses solely on mission-critical, 24/7 support, unlike hardware vendors that deliver premium support to only a small percentage of their customers. Stratus also has 30 years of experience in the payments industry and a successful 10-year partnership with ACI.

Application understanding and partnerships with ACI as well as Microsoft enable Stratus to provide broader and more effective support with a total-solution focus. Stratus support engineers help troubleshoot and isolate integration issues that cross product boundaries, including the application and Windows operating system.

Key performance metrics show how fast and effective the Stratus service organization and support model are (Figure 3). Stratus uses proactive monitoring and technology-enabled service to resolve 50% of all service issues automatically. What's more, 88% are resolved in less than one hour, and 99% are resolved online without the need to send a technician onsite.

Figure 3: Stratus resolves service issues online 99% of the time



ACI and Stratus: more protection, faster recovery, less work

The integrated ACI/Stratus payments processing solution provides the most comprehensive approach to managing both unplanned and planned downtime. At the same time, your organization benefits from simpler integration and operation, proactive service and support, and reduced cost throughout the entire application life cycle. The comparison chart (Figure 4) summarizes the major categories of risk and explains how ACI and Stratus address them.

Figure 4: Improving uptime with ACI and Stratus—comparison chart

	Downtime Risk	ACI Advantage	Stratus Advantage
Unplanned	• Server hardware failure	• Automatic site failover*	• Automated fault and error handling ensures uninterrupted server operation
	• Data corruption		• Self-checking hardware, dual storage I/O paths and enhanced internal error checking eliminate data corruption risks
	• Operating system failure	• Automatic site failover*	• Hardened driver, integration and failure testing, and root cause analysis reduce OS failures
	• Database or application software failure	• Automatic site failover*	• Problem isolation and root cause analysis provide faster resolution for software errors
	• Site failure	• Automatic site failover*	
Planned	• Software patches and upgrades	• Planned site failover	• Active Upgrade™ technology
	• Hardware repair and maintenance	• Planned site failover	• Online repair and maintenance • Captures data and preserves state information, enabling root-cause analysis to component or line of code • Orders correct replacement part 100% of the time
	• Hardware upgrade	• Planned site failover	• Online disk and I/O upgrades

*Unplanned failover can cause undesirable side effects

Saving money and time on mitigation

Any comprehensive approach to managing application downtime involves the cost of setting up a second data center with backup systems. Beyond this necessary step, the ACI-Stratus solution is extremely cost-effective compared with other payments processing alternatives while offering superior availability, simplified deployment and operation, and comprehensive support.

Data replication across data centers is built in to the ACI solution, while other solutions require a separate data replication product to provide this key function. Software and hardware data replication products can be costly, and also require additional staff experience and training.

The ACI active/active solution is also fully integrated, unlike those that require custom integration plus initial and ongoing testing to ensure proper failover. The ACI architecture provides immediate failover with no transaction loss. In contrast, alternative active/passive solutions incur at least minutes of downtime that can lead to lost transactions, higher costs for operational recovery and reconciliation, and customer inconvenience.

Similarly, Stratus ftServer systems are built to preempt downtime and data loss without requiring human intervention or complicated system administration.

Conclusion

An ACI active/active payments implementation running on fault-tolerant Stratus ftServer systems provides several significant advantages compared to alternative solutions:

- Prevents payments processing disruptions due to unplanned failures of hardware, software, networks or site infrastructure
- Enables planned maintenance of hardware and software with no disruption to processing or degraded performance
- Mitigates the risk of multiple failures, data corruption or the negative side effects of unplanned failures
- Eliminates the need for complex disaster-recovery software, custom integration and testing, and additional operational procedures, including specialized staff expertise and training. Ensures immediate access to expert assistance for inter-related platform, system software, and operating system (OS) issues. Leveraging a multi-vendor knowledgebase built on more than three decades of availability expertise, Stratus services team is available 24/7 to remotely diagnose and remediate complex issues.

  Drawing on the depth and frequency of diagnostic information provided by Stratus' Automated Uptime Layer they are also able to determine the root cause of hardware and software issues to provide permanent resolution.
- Lowers costs significantly: simplifies installation, reduces operational costs, and eliminates the high cost of downtime and recovery.

With a decade of supporting customers together, ACI and Stratus Technologies have the technology, the experience and the team you can rely on.

About Stratus Technologies

Stratus delivers the world's only proactive "uptime assurance" guarantee for the platforms that run the most vital functions of business, healthcare, manufacturing, and government. Combining its resilient software and hardware technologies with 30 years of unparalleled remote monitoring and management expertise for availability, Stratus helps save lives and protect the business and reputations of companies, institutions, and governments the world over.

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