



HRG Assessment: Stratus everRun® Enterprise

Today IT executive decision makers and their technology recommenders are faced with escalating demands for more effective technology based solutions while at the same time having to deal with increasing budgetary constraints. IT professionals need to understand how a service outage, degradation in QoS (quality of service), or missing SLA (service level agreement) targets will negatively impact their business, business partners, customers, and other key stake holders.

As the cost of downtime continues to increase every year many conventional unmanaged servers continue to experience unacceptable levels of service outages and downtime. This exposure to outages is not appropriate for today's always on web-centric and cloud based businesses where any downtime results in lost productivity, revenue, and customer good will.

With the growth of always-on business requirements demand is increasing for continuous-availability of business-critical applications with no tolerance for service disruptions or lost revenue. Stratus Technologies meets these requirements with Stratus everRun® Enterprise which provides AEC 4 level availability for business critical workloads running on x86 IA (Intel architecture) systems. For HRG's Availability Environment Configuration (AEC) definitions - <http://www.hrgresearch.com/High%20Availability.html#>.

Stratus everRun Enterprise provides true fault tolerant levels of availability for x86 IA servers. The software solution comes with Kernel-Based Virtual Machine (KVM) and the CentOS Linux operating system embedded. KVM is a Linux module used to create bare-metal Linux Hypervisors and VMs (virtual Machines). CentOS is essentially the free version of Red Hat enterprise Linux. CentOS is a popular Linux distribution for web servers with roughly 30% of all Linux web servers and a large and active user community. CentOS supports 64-bit processors and up to 8 TB of physical memory.

everRun Enterprise works on x86 IA servers and will also run on AMD x86 IA systems. However, at this time Stratus is not supporting everRun Enterprise for AMD x86 IA based servers.

everRun Enterprise

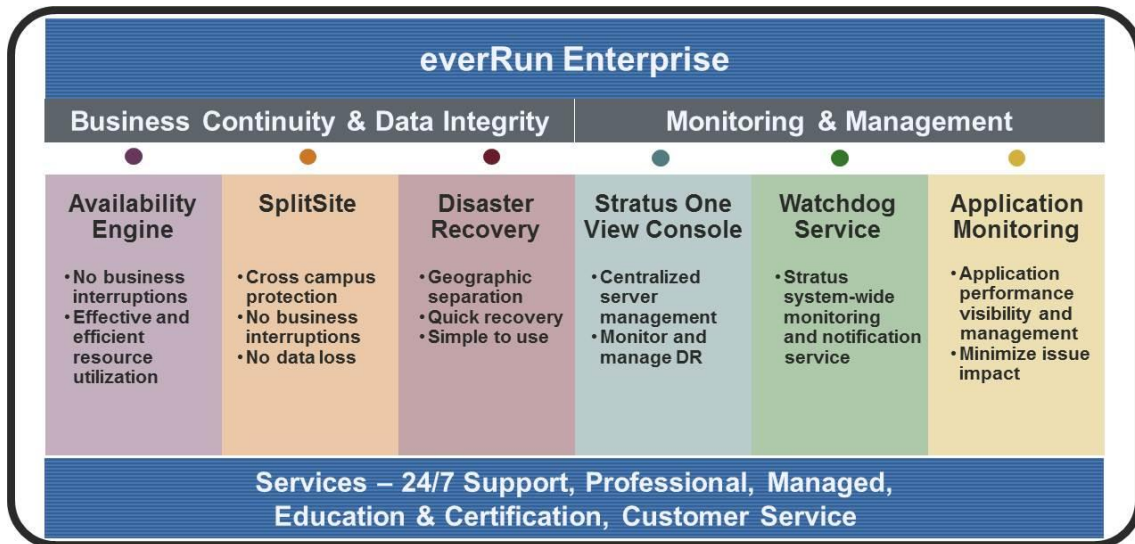
everRun Enterprise keeps Windows and Linux applications up and running continuously without changes to applications or in-flight data loss and it runs on industry-standard Intel-based x86 IA servers requiring no specialized IT skills. If one server fails, the application continues to run on the other server with no data loss, and no machine restarts. Customers can set application availability profiles for individual VMs and servers by specifying fault tolerance for applications that need it and high availability for less critical applications that don't require full fault tolerance.

With everRun Enterprise when there is a component or system failure the failing or failed workload and the VM that contains that work load resume processing on the standby server with no apparent outage of service and no loss of in-flight data. I/O is automatically rerouted to the standby system and end users are not aware that a failover has taken place.

everRun Enterprise continuously monitors systems, system components, software, and VMs keeping data and system states synchronized between the active or primary system and the standby or secondary system.

everRun Enterprise Solution Architecture

The following diagram shows the key elements of the everRun Enterprise solution.



Disaster recovery, SplitSite and Application Monitoring are sold separately.

Stratus everRun Enterprise: HA and FT (AEC 4) Availability

The Stratus everRun Enterprise software is embedded, packaged and delivered by Stratus Technologies with the CentOS Linux operating system and KVM, which is a loadable Linux module. It is installed on two x86 servers IA and administered on one of the two – the active or primary server. Stratus software leverages the functionality of KVM and CentOS to create, configure, manage, move, and administer

protected KVM VMs. Once the KVM VMs have been set up these protected VMs (PVMs) are then copied or replicated to the secondary or standby server.

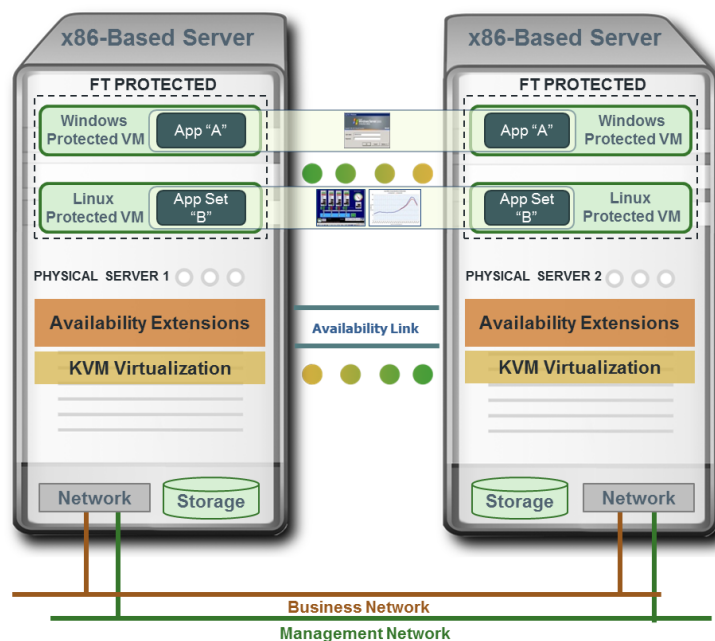
FT (AEC 4) Mode

When an everRun Enterprise VM is set up to run in fault tolerant mode and a work stopping software error, server failure, component failure, or virtual machine failure occurs, the affected application will automatically fail over to the secondary or backup server and continue working with no interruption of service and no data loss.

HA Mode

When everRun Enterprise creates and designates a VM to run in HA mode the computing resources of both x86 IA servers can be used during normal operation. In the event of a failure or planned outage for maintenance or upgrades, the VMs running on the affected node are automatically migrated to the healthy node, and continue running without interruption. everRun Enterprise can automatically stage and reboot underlying system resources during upgrades while the virtual machines are unaffected and experience no downtime.

The following is a diagram of the Stratus Availability Engine.



Availability Engine

everRun Enterprise uses KVM and QEMU based virtualization techniques to mirror and synchronize virtual machines between two x86 IA servers in order to manage and maintain synchronous operations between these servers. The solution automatically identifies failed components and logically removes them from

service until repairs or replacements have been made. It then brings those components back into service. There is no loss of data, transactions or application state, and there is no application downtime.

The Availability Engine, which is the core of the everRun Enterprise solution, includes the redirectors, fault handlers and recorders, memory synchronizers and the logic for maintaining synchronous operations between two identical VM images and their associated data. When there is an I/O fault or failure the I/O is automatically mirrored or switched to the secondary or standby server. In the case of I/O and memory failover, everRun Enterprise's memory check-pointing ensures that all in-flight transactions, transactions in memory and transactions in cache, are captured and preserved with no need for a machine restart.

If a device fails, the everRun Enterprise system detects it, removes it from service, and takes appropriate recovery action transparently. In the case of a Network Adapter failure, network traffic will be routed through the other server. In the case of a disk failure, the workload will automatically run on the server without the failed disk. Check pointing ensures that consistency in application and data states across both servers is persisted and in the event that any device or server should fail, transactions and data are never lost. Check pointing is performed constantly in real time as memory changes, ensuring that the memory is in the same state on both systems.

everRun Enterprise automatically determines when it needs to do a full mirror copy or just a delta copy. If it determines that the storage on the side requiring synchronization or updating can be trusted, it will 'delta' copy the data that was missed while that side was off-line. If everRun Enterprise determines that data could have been corrupted, for example with a server, disk or RAID controller failure, it will initiate a full copy of all data from the known good source.

everRun Enterprise senses when a device (or server) has failed and then removes the failed component logically, logs the failure and sends warnings through the communication interfaces. It is also responsible for bringing components back into synchronous operation once repaired. The process of resynchronizing repaired or replaced components and bringing them back into operation with no downtime is initiated once a component is rediscovered and verified as being good.

SplitSite

The everRun Enterprise SplitSite feature provides support for application fault tolerance through synchronous replication across geographically separated sites. SplitSite availability prevents downtime from occurring at locations up to three miles apart and provides fault tolerance at two different locations. Separation distance between the two sites is currently limited to a maximum of three miles with an aggregated ping rate or data transmission latency of less than 10 ms round trip.

The SplitSite feature uses Quorum or voting services installed on a physically separate server to protect against the occurrence of split brain or divergent application execution /data execution when a site connection fails. In the event of such a failure the Quorum service will determine which is the "healthy" system and then switch processing to the healthy system such that it becomes the primary system until such time as the initial fault or failure condition has been remediated.

Disaster Recovery

everRun Enterprise's Disaster Recovery (DR) feature, available Q3 2014, mitigates the impact of a disaster or catastrophic site failure. DR, the cornerstone of any business continuity and regulatory compliance plan, is setup, managed, and administered through the Stratus One View Console and

supports Windows and Linux applications. The everRun Enterprise DR recovery feature replicates data asynchronously over a wide area network for regulatory compliant DR regardless of geographic location.

With everRun Enterprise DR the primary location runs in fault tolerant mode while the secondary or remote location runs in disaster recovery mode. Using the Stratus One View Management Console graphical user interface the user decides which servers will run in DR mode and then designates them accordingly.

Stratus One View Console

The browser based Stratus One View Console lets users build, designate, deploy, monitor and manage everRun Enterprise instances and KVM VMs from a single centralized location in order to build, designate VMs as HA or FT, and deploy servers and VMs and designate systems for Disaster Recovery. Using the console VMs can be created, protected, exported and imported and elements such as network connections, virtual CPU allocation, memory and storage sizes can be modified and hardware can be monitored and managed.

System Watchdog and Alerting Service

The Stratus Watchdog service constantly monitors everRun Enterprise systems and automatically sends a system-level notification to Stratus support professionals who monitor these protected systems twenty four hours a day seven days a week and notify customers immediately if a fault occurs.

Application Monitoring

everRun Enterprise Application Monitoring provides visibility across IT environments and delivers automatic fault diagnosis. Application monitoring provides performance monitoring and automates the correlation of all performance dependencies from the end user to the application virtualization layer and underlying infrastructure. With Application Monitoring customers can quickly and precisely diagnose performance bottlenecks, restore user experience, and right-size their IT infrastructure.

Kernel-Based Virtual Machine (KVM)

The benefits gained by providing everRun Enterprise with embedded KVM on CentOS are significant due to participation of the open source community in KVM's ongoing development and enhancement. KVM benefits from ongoing Linux development as improvements and enhancements made to the Linux kernel become available to KVM and CentOS once they have been incorporated into Linux.

KVM, part of current Linux distributions, can be run on a broad range of architectures and hardware platforms. KVM leverages the hardware-assisted virtualization features provided by Intel VT-X / VTd or AMD-V-enabled CPUs. KVM (Kernel-based Virtual Kernel) is a loadable Linux module that essentially converts the Linux operating system into a bare-metal hypervisor capable of creating, running, and managing virtual machines. KVM is supported by most leading software and systems vendors.

KVM virtual machines can run a wide range of applications and operating systems as guests without modification. As a result, with everRun Enterprise customers can run current Linux and Windows applications in either HA or FT mode based on their business requirements for availability.

KVM inherits the ongoing improvements made to Linux and everRun Enterprise takes advantage of these improvements through KVM and CentOS. VMware and other previous generation legacy hypervisors can make no such claim and because KVM is part of the Linux Operating system it runs on bare metal x86 IA servers without incurring the overhead and performance degradation that previous generation x86 IA hypervisors have to contend with. The migration from VMware to KVM is straightforward with users reporting a significant improvement in disk performance and memory usage as compared to VMware.

KVM supports the live migration of a virtual machine between physical hosts without interruption of service, as well as, preserving a virtual machine's current state on disk, allowing that VM to be stored and resumed at a later time. With KVM the enhancements made to the Linux kernel are inherited into the virtual environment. In the past, companies providing hypervisors had to create functionality that was redundant between the hypervisor and the OS kernel. This resulted in overhead and inefficiencies, and slowed the adoption of virtualization. KVM delivers a much more efficient means for Linux on x86 IA servers to deliver virtualization and painlessly take advantage of future Linux improvements without incurring the overhead of redundant functionality.

Migration to KVM

Traditional stand-alone applications and workloads on x86 IA platforms can now be migrated to a KVM virtualized computing infrastructure with no apparent impact on performance, improved manageability, and reduced cost.

Conclusion

As IT professionals are continually forced to do more with less and to stretch capital budgets to the breaking point in order to wring out every last penny's worth of value, these same IT professionals are finding relief from the squeeze with Stratus everRun Enterprise. everRun Enterprise delivers fault tolerant level outage protection at or below the price of less capable High Availability solutions.

Stratus everRun Enterprise is an excellent solution for process manufacturers, mid to large size retailers, facilities management and building security companies, financial services companies, hospitals and other healthcare provider organizations. In addition, everRun Enterprise is a good fit for many energy, water, and other SCADA infrastructure applications.

With server virtualization and workload consolidation and the new generation of Linux on x86 IA platforms IT professionals require fewer physical resources to support the same levels of functionality, throughput, performance, and security. Hypervisor technologies such as the Kernel-based Virtual Machine (KVM) have greatly reduced virtualization related overhead and latency.

Now when always-on availability is considered normal by many consumers and businesses why would you trust your mission critical workloads and data to a less robust solution? HRG gives Stratus very high marks for their everRun Enterprise software and we recommend that you take a closer look at this solution.

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