

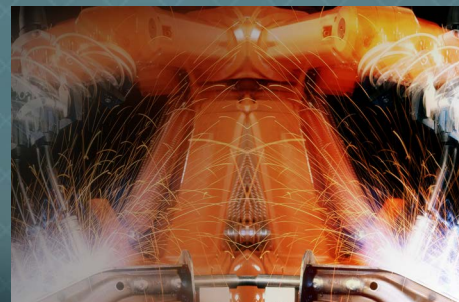


VIRTUALIZATION IN INDUSTRIAL PLANTS

Better Application Management to Increase Control
and Decrease Complexity

modernize
AUTOMATION

Eliminate Unplanned Downtime





The priority for companies in the industrial sector is increased efficiencies

75%

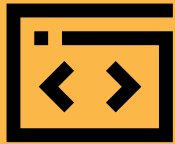
Of companies in the industrial space will have adopted virtual server platforms by 2020

MODERN OPERATIONAL TECHNOLOGY

One of the main priorities for companies in the industrial sector—from water authorities and oil and gas pipelines, to manufacturing plants—is increasing efficiencies. Operating equipment effectiveness, process efficiency, and improved return on assets (RoA) with less investment are all top of mind for industrial managers. To achieve these efficiencies, leaders in the industrial sector need new technologies that ensure visibility and availability of Industrial Control Systems (ICS) and eliminate unplanned downtime altogether.

Traditional systems are no longer sufficient for handling downtime. Modern technology, specifically virtualization coupled with fault tolerance, mitigates downtime—both planned and unplanned—to allow plants to operate smarter, faster and safer, and simplify overall system management.

Just a few years ago, virtualization was a relatively unknown concept in the industrial sector. However, Stratus Technologies estimates that, by the end of 2020, 75% of companies in the space will have adopted virtual server platforms for running SCADA, HMI, Historian and MES. With virtualization comes the promise of cost savings, ease of management and increased efficiency. But in the industrial sector, the technology also carries a high risk factor—outages can be disastrous and expensive. The key to succeeding with virtualization in the industrial sector is guaranteeing uptime with systems that offer fault tolerance, comprehensive monitoring and simplified management.



With virtualization many applications can run on a single physical server



Traditional systems are no longer sufficient for handling downtime

WHAT IS VIRTUALIZATION?

Prior to the advent of virtualization, a single server or PC ran a single application, which often meant the hardware was vastly underutilized. Virtualization essentially allows one physical server to do the work of many servers, thereby maximizing the use of capacity.

In a virtualized environment, each virtual machine (VM) on a physical server exists within its own container or partition. Each partition contains an application (or applications) and an instance of an operating system known as a guest operating system. A number of these partitions sit on a software layer called a hypervisor. The hypervisor is the thin, low-overhead layer that manages the basic services necessary to host the applications and their guest operating systems. So, virtualization makes it possible to run multiple VMs, and therefore many different applications and operating systems, on a single physical server.



Save on both capex and opex with virtualization



Easier to run new applications or software upgrades



Upgrade the hardware without affecting the software



Fewer servers means less space, electricity and cooling

WHY VIRTUALIZE?

Cost savings: Using one server to do the work of many enables companies to buy fewer servers and increase efficiency in maintaining servers. It also puts less pressure on scarce OT and IT resources.

More efficient use of physical resources: Since space can be tight in industrial plants, facilities may or may not have dedicated computer rooms, so automation systems sometimes have to compete for space with other kinds of equipment. Consolidating applications onto fewer servers makes space less of a concern. Moreover, cooling and powering servers becomes less expensive and less of a potential problem.

Hardware platform upgrades with ease: Virtualization allows plants to abstract the application and OS away from the server hardware. They can effectively extend the lifecycle of applications as a result. The ability of a hypervisor to support older guest operating systems allows plants to upgrade the hardware platform without affecting applications or their operating systems. Easily upgrading server hardware eliminates the need to source hard-to-obtain components required to maintain older servers.

Easier provisioning of capacity: Provisioning virtual machines - assigning them tasks - is far simpler than provisioning physical servers. In a virtualized environment, that eases the process of testing updated versions of applications. Automation engineers can try out the upgraded versions without having to bring in a new physical server to run each application. If an updated application doesn't work on one virtual machine, the engineer can go back to using a previous version on another VM residing on the same server.



With virtualization a server crash can negatively affect multiple processes



Virtualization makes downtime even more damaging and expensive



A fault-tolerant platform is critical when deploying a virtualized environment

THE LITTLE-KNOWN VIRTUALIZATION RISK

The benefits virtualization offers provide clear examples of why companies in the industrial sector space are adopting the technology. But with the cost savings and efficiency of virtualization comes significant risk, namely that of unplanned downtime.

Plant operators know that when ICS such as HMI and SCADA go down, technicians “go blind” and lose visibility into plant operations. When this occurs, they have to revert to manually operating critical processes, with the ensuing negative impact on efficiency and potential for catastrophic failure. For instance, if a valve that’s supposed to close doesn’t and a technician is unable to see what’s happening because a system has crashed, toxic gas could escape into the plant. Aside from serious safety issues and blindness to plant operations, unplanned downtime leads to a number of other problems: process interruptions, data loss, regulatory and quality compliance challenges, increased exposure to fines—all of which can lead to loss of revenue and customer confidence, as well as irreparable damage to corporate reputation.

Unfortunately, virtualization makes downtime even more damaging and costly. Before virtualization, when one server hosted one application, only one process stopped if that server went down. But with virtualized servers running multiple applications, a crash can negatively affect multiple processes.

The potential damage caused when multiple applications stop working simultaneously underscores the criticality of a fault-tolerant platform when deploying a virtualized environment. While there are numerous high availability alternatives available to help protect a virtualized environment, only a fault-tolerant solution can ensure uptime and mitigate the risk involved with bringing virtualization into a plant. Fault-tolerance is the most important of the three pillars of virtualization in a plant environment, although the other two—simplicity of management and ease of servicing—are also important for increasing efficiency while keeping costs in check.

THE PILLARS OF ALWAYS-ON VIRTUALIZATION IN A PLANT ENVIRONMENT

Fault tolerance: Minimizing the impact of downtime

Minimizing planned downtime and avoiding unplanned downtime are key objectives for plant operators. Since server downtime is especially dangerous in a virtualized environment, servers need to be “dressed to the nines”; that is, they need to provide as many nines of uptime as possible. A growing list of vendors offer virtualization solutions, but few focus specifically on plant technology. Stratus servers built to host solutions specifically for plants offer fault tolerance, which delivers industry-leading levels of application availability. Fault tolerance translates into “five nines,” or 99.999 percent, uptime – or approximately 5 minutes of downtime per year.

Stratus achieves fault tolerance by effectively engineering the functionality of two servers into a single unit so that one server constantly checks on the other’s availability. That system enables one server to immediately pick up operations if the other encounters any type of glitch. Since both are contained in a single physical footprint and function as a single system, users need only to license a single copy of the operating system, hypervisor and application software. In addition to the cost savings associated with licensing a single copy of the software, system management and administration is simplified as well.

Alternative ways to achieve high availability involve clusters, or groups, of servers, which IT professionals have to integrate themselves and then diligently maintain. Not only is this option more complex to implement and expensive and difficult to maintain, the fact that clustered servers are a reactive, not proactive, form of availability means they deliver an inferior level of availability compared to a fault-tolerant solution.

WHAT A DIFFERENCE A DECIMAL POINT MAKES

While the difference between 99%, or 99.9%, versus 99.999% might seem negligible, the difference in potential downtime is actually enormous. For example, while Stratus’s ftServer® is likely to experience only a little over 5 minutes of downtime in a year, typical clustered servers, on average, are potentially exposed to the risk of 4 hours and 38 minutes of downtime per year, and a standard availability server is exposed to 88 hours of downtime.

Thus, the added protection of 99.999% availability versus 99.9% or 99%, results in tens of thousands of dollars of savings, regardless of whether a plant’s cost of hour of downtime is \$10,000 or \$100,000.

To see the cost impact of the different levels of availability, check out: [The Total Cost of Downtime in Industrial Automation](#)

Fault tolerance vs. failover

Even though most virtualization solutions have ways to handle server failures, they usually involve failing over and recovering or restarting on another host. Failover routines and restarting VMs require downtime, precious time business-critical applications can't afford to lose. It's better to prevent downtime from happening in the first place.

Failover techniques — typically using clustering — get plants to a level of three to four nines. But they're not fault tolerant. A failure still occurs. To recover from a failure, applications must be restarted on a healthy system. In addition to the time it takes for the applications to restart, any data being processed that hasn't been written to disk when the failure occurs (otherwise known as in-flight data) is lost.

None of this is an issue in true fault-tolerant solutions. No additional configuration work or system modifications are necessary. Plant operators simply get downtime prevention and data protection right out of the box. (See: [Virtualization for Dummies: 3rd Special Stratus Edition](#))

Monitoring your OT systems

Monitoring is another critical element of keeping virtualized servers running in a plant environment. With everRun® Monitor powered by Sightline Assure®, Stratus offers a fault-tolerant solution that automatically monitors and maintains the entire server stack and issues alerts before problems can arise. Unlike other similar solutions, Sightline Assure monitors not just the health of the server itself but also that of the virtualized applications running on the server. That extra layer of visibility enables plant operators to have yet another safeguard against downtime.

MINIMIZING THE IMPACT OF DOWNTIME

Pinellas County Utilities, provider of water to a county in Florida, chose to implement Stratus ftServers running virtual applications rather than go with server clusters. Ken Osborne, SCADA supervisor for Pinellas County Utilities, estimates that had his organization used clusters, the cost of its virtualization project would have doubled, and the project would have taken weeks longer to implement.

“When you compare the total cost of a fault-tolerant server solution to building a cluster, the investment is really a wash,” Osborne said. “The fault-tolerant server is also more flexible and much simpler than buying many individual x86 servers. For me, the big benefit is support. Having Stratus engineers monitor and protect my server 24/7/365 costs less and is better than hiring a full-time technician. The server always runs and we never lose a thing. That’s peace of mind.”

Simplicity of management: Controlling costs and minimizing risk

One of the cornerstones of the value of virtualization is simplicity, so a virtualized system for running ICS should be simple to both implement and maintain. For that reason, choosing solutions that are built for the industrial sector is critical. When servers and software in a virtualized environment are built specifically for plants with the requirements of the sector in mind, implementation and maintenance go smoothly. Force-fitting other solutions into a plant environment can introduce complexity, increase costs and expose a plant to risk.

Ease of serviceability: Minimizing the number of components

The decision to virtualize involves more than just considering the effects of downtime. One of the barriers to entry for many plants is the number of external components that can complicate maintaining a virtualized system. Virtual environments that don't use fault-tolerant solutions, for instance, often need costly external storage in order to achieve high availability—and even then, availability isn't as high as it is with a fault-tolerant system.

Investment in a Storage Area Network (SAN) complicates the management of a virtualized plant system and can be expensive. However, Stratus does not require a SAN for data storage since storage is built into Stratus solutions. As a result, plant operators can more easily maintain virtualized systems and also save the cost of having to invest in an extra storage component.

SIMPLICITY OF MANAGEMENT

Concord Riesemobile, a German manufacturer of motorhomes, migrated from a physical to a virtual environment in just two hours with the Stratus everRun high-availability solution. The Stratus solution was so non-disruptive that users hardly noticed the change.

“The reason for the fast project turnaround was predominantly the pre-installation and preparation that Stratus built into the software,” said Roland Eichkorn, IT manager Concorde Riesemobile. “We simply migrated our existing physical environment into a virtual server environment. This saves time and effort.”

COST-EFFECTIVE STORAGE

For the integration partner that worked with Concord Riesemobile on its Stratus implementation, ease of serviceability has made a major difference: “Before this, we used to integrate virtualization software with a dedicated SAN [storage area network],” said Bernhard Schlögel, CEO of SIT Solutions.

“We'd been looking for a long time for a solution that is redundant, easy to manage, and economical. We found it in Stratus software. We've seen that Stratus software improves availability, takes less effort to maintain, and saves money. Before we used to integrate other high-availability solutions for our customers. Now we prefer Stratus.”

FUTURE-PROOFING THE PLANT

Whereas virtualization was a concept for the future in the industrial sector just a few years ago, it's now very much the technology of the present. The future comes fast, and the next milestone on the horizon is the Industrial Internet of Things (IIoT). In the coming era of constant, automatic communications between devices within and outside a plant, companies in the industrial sector will need virtualized systems that can handle massive amounts of data and minimize downtime.

With fault tolerant servers and software solutions that guarantee uptime, Stratus is positioned as the technology provider to carry plants into the IIoT era. It is already moving plants in the right direction by providing fault-tolerance, simple

management and ease of serviceability, all of which are critical to maintaining maximum efficiency and driving effectiveness from equipment in a plant.

“Our operation has relied on Stratus systems for about ten years with no unscheduled downtime caused by a server failure,” Ken Osborne, SCADA supervisor for Pinellas County Utilities, a provider of water to a county in Florida, said. “I can foresee a time when the SCADA operation runs entirely on virtual machines and three fault-tolerant servers. That option didn't exist a decade ago. Our decisions then proved to be the right ones in every regard and today we're smarter about our virtualization strategy because of it.”



Stratus Technologies is the leading provider of infrastructure-based solutions that keep applications running continuously in today's always-on world. Stratus enables rapid deployment of always-on infrastructures, from enterprise servers to clouds, without any changes to applications. Stratus' flexible solutions – software, platform and services – prevent downtime before it occurs and ensure uninterrupted performance of essential business operations.

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