

## Virtualization Technology Enables a Common Automation Platform

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### Keywords

Virtualization, Servers, Consolidation, PC, Real-Time, Security, Manufacturing, Operations, Automation, Platform, PAC, RTOS

### Summary

Virtualization has proven to be an effective method for enabling information systems to support new business needs in an increasingly complex IT environment. Server consolidation, increased security and increased reliability are just a few of the strong benefits already demonstrated by corporate IT.

Virtualization software has proven valuable in corporate IT and it is receiving increasing attention with well known supporters such as Intel and Microsoft. Recent innovations from Intel improve the robustness of virtualization and promise to broaden its applicability.

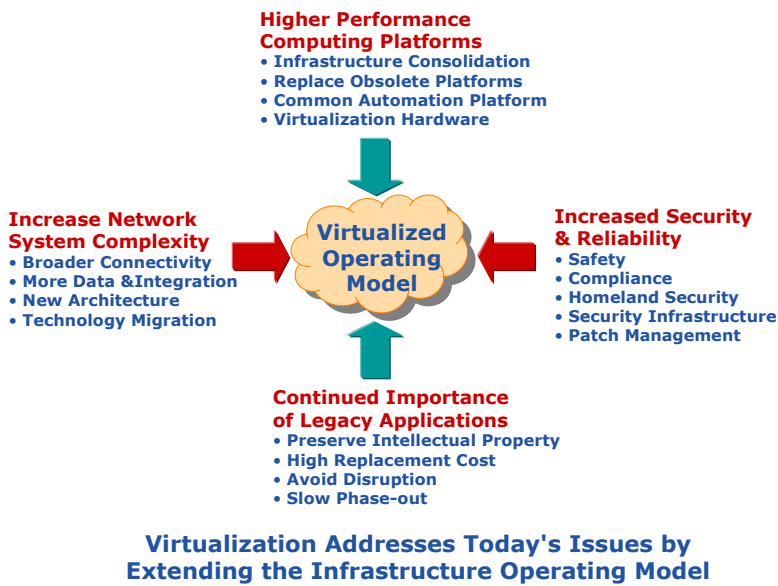
The manufacturing community should consider a virtualized operating model and technology to reduce costs, improve security and reliability, and advance the state of common automation platforms.

A virtualized operating model within manufacturing IT can utilize most of the same techniques and achieve similar results when addressing the unique needs of operations. Virtualization should also be considered for other manufacturing applications such as a strategy for building a common technology platform for a Programmable Automation Controllers (PAC) which can support all automation applications, including various types of real-time control systems and operator interfaces in a variety of architectures.

### Why Virtualization Now?

Virtualization concepts have been around for many years. They are being applied to several important challenges and are becoming essential to meeting business objectives in increasingly complex information systems. Consequently, virtualization has attracted industry wide attention from software and hardware suppliers, end users, the open source community and others. Well known companies such as Intel, Microsoft, Oracle, IBM, HP and many others are collaborating on its evolution and use in both commercial and open source products.

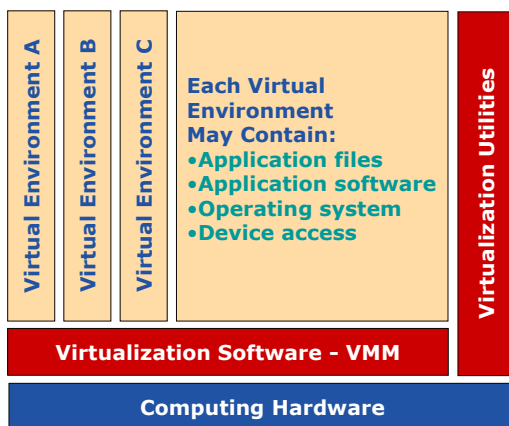




This industry buzz around virtualization did not happen over night. It has been building for several years from multiple directions. Grid computing depends on virtualization to provide high performance distributed storage, computing and application services. Virtual server technology has enabled server consolidation, on-demand computing efficiencies and enhanced system level security and reliability. These and other benefits will change the infrastructure operating model.

### Common Approaches to Virtualization

Several useful commercial products provide virtualization using architecture similar to the figure below. A layer of software - a Virtual Machine Monitor (VMM) - is installed in standard hardware such as Intel®-based servers or desktops. The VMM is then used to create and manage multiple isolated computing environments. Each environment is then configured as if it were a standalone computer on a network by installing an operating system and application software along with configuration information; different operating systems and applications may be installed in each environment.



**A Virtualized Server appears to be Multiple Networked Servers**

Typically virtualization software includes tools to set up and manage virtual environments, including functions such as backing up, copying and moving a virtual environment from one physical computer to another. Once configured, the VMM manages the execution of each virtual environment, allocating resources, execution time and device access according to configurable policies. Each environment runs independent of other environments.

The magic is in how a VMM manages hardware access needed by hosted operating systems. Two

approaches have been used. One approach is to modify the operating systems to be supported, and the other is to steal control on-the-fly. In both cases, updates to hosted operating systems can become a problem.

Interest in virtualization has been fueled by advances in hardware support that enables better performance and reliability. Direct "chip level" support eliminates most of the magic needed from virtualization software suppliers in hosting multiple operating systems on one computer with better support for legacy operating systems.

Interestingly, these techniques are similar to those used to provide real-time extensions to Windows operating systems for automation applications. It is important to remember that not all VMMs are the same and most do not support deterministic real-time behavior.

## Intel Technology Advances Virtualization

Realizing the general value of the virtualized operating model, Intel addressed virtualization at the foundation - the chip level - where they could simultaneously eliminate the need for modifications to the hosted operating systems and provide better performance. The resulting Intel® Virtualization Technology (Intel® VT) not only provides a consistent approach, but also opens the door for wider use of virtualization concepts such as real-time systems.

In simple terms, Intel VT adds new instructions, registers and interrupt management that can be used by VMM software to manage virtual environments. These new capabilities can be used to create a VMM that requires no changes to the hosted operating systems. Consequently, legacy systems are well supported and the VMM is not dependent on operating system version, update or patches.

With Intel® Virtualization Technology, the VMM can also allow the hosted operating system to have capabilities it could not have in previous virtualization approaches while at the same time enabling better security.

End users begin to realize the benefits from Intel VT after the suppliers of virtualization software modify their products to use the new capabilities. Intel has involved the virtualization community in the specification and development process and work is underway to utilize Intel VT in commercial products. For example,

Microsoft has committed to ongoing support of Intel VT in Windows Servers, and the open source VMM, Xen 3.0, supports Intel VT. In the real-time and embedded markets, operating system suppliers such as TenAsys and Jaluna have also committed to supporting Intel VT.

Intel VT becomes especially attractive when considered in concert with Intel's Dual-Core technology to provide enhanced performance and concurrency of multiple environments to enhance real-time capabilities. Further advances such as Quad-Core will provide additional capabilities.

## Benefits of Virtualization within Manufacturing IT

Because of the growing diversity and complexity of manufacturing systems, many of the corporate IT benefits of virtualization can also be achieved in manufacturing operations IT (factory and plant systems). The unique needs of manufacturing systems such as testing and patch management further justify the consideration of a virtualized operations model.

| Benefit                                                       | Explanation                                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Decrease Cost by Consolidating Computers                      | <p>Replace obsolete legacy hardware with fewer, high performance computers. Enable "on demand" load leveling and save on data acquisition adapters.</p> <p>Run multiple versions of legacy operating systems. Use Virtualization tools to move environments between physical machines.</p>                                               |
| Increase Reliability by Isolating Mission Critical Components | <p>When in different virtual environments on the same computer, mission critical parts continue to run when non-mission critical parts are re-booted.</p> <p>Optimize security policies separately.</p>                                                                                                                                  |
| Improve Testing Using Virtualization Management Tools         | <p>Use virtualization tools to quickly set up test environments, discard corrupted environments and restart tests at consistent points. Quickly re-purpose limited test hardware.</p> <p>Apply security patches to a duplicate virtual environment, move to production after testing and remove quickly if problems are encountered.</p> |

### Virtualization Operating Model Benefits for Manufacturing Operations IT

#### Virtualization Provides "On Demand" Benefits to Operations

The "on demand" computing model reduces costs by consolidating applications into higher performance computers. This avoids the excesses of designing multiple systems for peak performance and adding new hardware for each application. Virtualization offers the same benefits for manufacturing IT when multiple obsolete legacy computers are replaced. In effect, virtualization breaks the coupling of one operating system with one computer and allows the utilization of under-used computing resources.

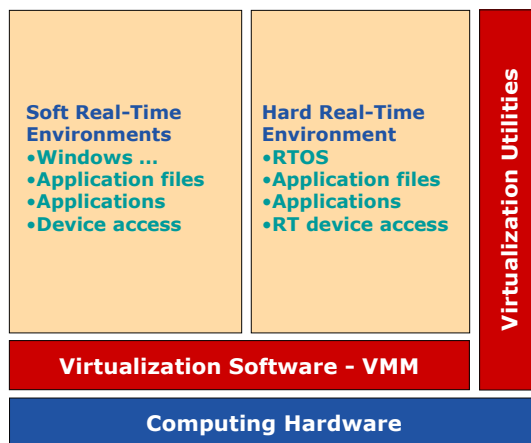
### Virtualization Provide Secure and Reliable Environments

Successful consolidation depends on the high degree of isolation provided by virtualization hardware and software to provide secure and reliable separation of applications and associated information. Manufacturing IT can utilize this same capability to increase the reliability of mission critical application by separating them from less reliable application components without adding hardware.

### Virtualization Improves Security Patch Management

One of the biggest IT problems faced by manufacturing operations is security patch management and virtualization can help. Patches can be applied to virtual test environments for testing and if successful quickly moved into production. If the production environment is also virtualized, troublesome systems can be easily restored, minimizing the impact on operations. This clearly reduces staff loading and more importantly minimizes production losses.

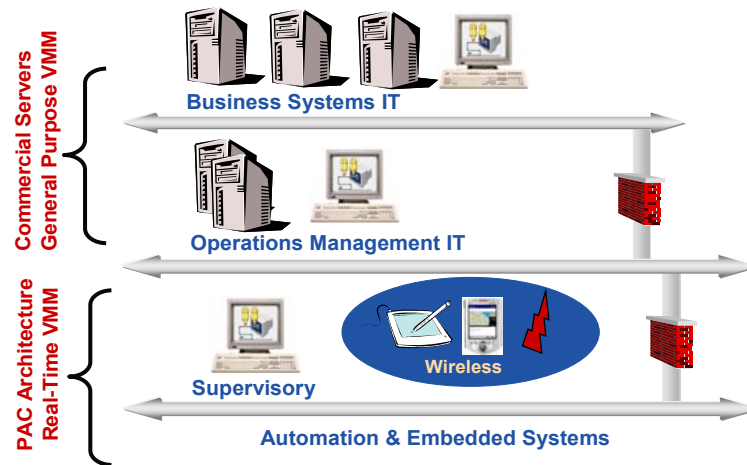
### Virtualization Enables a Common Automation Platform



**Opportunity for Standardized Real-time Control Approaches**

A few years ago, ARC introduced the concept of a common Programmable Automation Platform (PAC) that supports multiple industries and diverse needs. Since then, several automation suppliers have been working toward this PAC vision. The basic idea is to create a single platform to implement automation of discrete and process systems, motion control, information management, operator interface (HMI) and others. PAC does not specify automation system architecture, allowing applications whereby all functions are implemented in one computer, as well as distributed across several.

The implication of PAC is that we need an operating system that supports familiar user interface functions - such as those in Windows - as well as hard real-time control in one computer. Intel VT enables the development of a real-time aware VMM that can host a hard real-time operating system (RTOS) in the same box as standard Windows, Linux or other operating system. Importantly, with hardware virtualization the real-time control environment will not be affected by Windows updates and patches.



### Virtualization Enhances Operations IT Management and Real-time Computing Models

A more subtle benefit to a real-time VMM is that it opens the door for more re-use through application portability by allowing the same operating system to be used for embedded and PC-based real-time applications.

## Conclusions

Virtualization software is available and is being used for consolidation, improved patch management, better system management and others. Direct hardware support enables better support for legacy systems and more manageable installations. It is clear that virtualization technology will change the information system operating model.

- Manufacturing, utilities and other industries should examine the benefits of a virtualized operating model in light of current and projected computing needs. Some areas, such as the use of virtualization technologies in creating a common PAC may offer more flexibility in network and automation system architecture with accompanying increases in security, reliability and cost.
- Virtualization software suppliers, manufacturing software suppliers and embedded device suppliers should examine Intel VT enabled VMMs for ways to improve their solutions and architectures.

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