T4 - Process Control: Virtualization for Manufacturing

Anthony Baker
PlantPAx Characterization & Lab Manager
Rockwell Automation

Rockwell Automation
Process Solutions User Group (PSUG)
November 14-15, 2011
Chicago, IL - McCormick Place West
Abstract

Using Virtualization in Manufacturing Industries to Improve Utilization and Availability of Resources and Applications

• Learn how the benefits of virtualized infrastructure are being used in manufacturing industries to improve system availability and hardware utilization.

• See and analyze an example of this technology applied to a production system using VMware vSphere Technologies.
Agenda:
1.) What is Virtualization?
2.) Why use Virtualization in Manufacturing?
3.) Considerations for Implementation
4.) Rockwell Automation Products & Services
5.) Questions & Answers (5-10 min.’s)
What is Virtualization?
What is Virtualization?

- Historically, computer hardware was designed to run a single instance of an operating system.

- Virtualization “breaks the link” between software from hardware
  - Allows a single computer to run multiple operating system instances.
  - Provides the ability to change hardware without replacing the OS or applications.
Types of Virtualization

Hosted or “Desktop”

- Application
- Hypervisor
- Host Operating System

Bare Metal or “Server”

- Hypervisor
- App
- OS

Copyright © 2011 Rockwell Automation, Inc. All rights reserved.
Why Use Virtualization in Manufacturing?
Issues Customers Face Everyday

- Age of servers
- Legacy operating systems
- Application upgrades / startup concerns
- Established disaster recovery plans
- Security concerns
- Limited capital for upgrades
Benefits of Virtualization

- Increased Application Longevity
- Extended Uptime
  - VMware High Availability
  - VMware Fault Tolerance
- Improved Utilization with Server Consolidation
- Lower Hardware Maintenance Costs
- Reduced Energy Costs
Increased application longevity

“..one of the primary issues that manufacturing end users continuously cite is the great disparity between the long product life cycle of their automation hardware vs. the short product life cycle of their automation software.”

-- Craig Resnick, ARC Advisory Group

- Typical computer refresh cycle is 3-5 Years
- Typical industrial control system refresh cycle is much longer.
- Computer replacements typically require software upgrades which are expensive and difficult
Increased application longevity

“Rather than upgrading software every two to three years or testing "old" Windows versions, virtualization technology helps enable end users to run the same software on a particular PC or operating system for more than 10 years”

--Rockwell Automation

- Virtualization abstracts the hardware from the application, allowing for hardware upgrades without software or application changes
VMware High Availability automatically restarts virtual machines when a physical server fails.
Improve system reliability: VMware Fault Tolerance (FT)

VMware Fault Tolerance provides a seamless switch-over in the event of a hardware failure.
The reliable, energy efficient, and scalable data center

**Dynamic Resource Scheduling**
- Balance workloads
- Right-size hardware
- Optimize real time

**High Availability**
- Restart immediately when H/W or OS fail
- Protect all apps

**On-demand Capacity**
- Scale without disruption
- Reconfigure on the fly
- Save time
Reduce physical server sprawl

- Many Server Machines
- Many Operating Systems
- Many Applications with Different CPU Usage
- High Maintenance of Server Infrastructure
- High Utility Cost (Electricity, Cooling)
Reduce physical server sprawl

- Consolidate applications with different OS requirements
- Maintain logical isolation between applications
- Improve hardware utilization
- Removes dependency on hardware
Value to Engineering

- Extends Lifecycle of Legacy Systems
  - Physical Hardware, Operating Systems and Applications
- Reduces Footprint, Capital, Maintenance and Utility costs
  - Server Consolidation
- Disaster Recovery
- High Availability
  - Increases reliability
- Simplifies Deployment of Configured Solutions
  - Ability to deploy from templates
  - Skip complex installation, configuration
- Centralizes Infrastructure Management
  - Tools to simplify provisioning
  - Scalable management of personas – engineer, supervisor, operator
  - Manage configuration data and master data centrally
Considerations for Implementation
Process System Today...

Plant Asset Management Information

Plant Enet

Batch Management

Engineering Workstation

Operator Workstations

Process Automation System Servers

Process Control Enet

Cisco 3750 L3 Stack

Stratix 8000

CLX 01 to CLX 07

Area 1

CLX 08 to CLX 13

Area 2
Now virtualized!

Process Automation System Server
Operator Workstations x 16
Engineering Workstation
Batch Server

VMware View / PCoIP / RDP

vCenter Server
(Management Console)

IT Resources:
Operations Allocation
• Memory – 200 GB
• CPU – 50 Cores
• Disk – 5 TB

Infrastructure Clients
Infrastructure Sizing

• “Infrastructure as a Service”
  – Memory
  – Disk Space
  – CPUs

• Getting started...
  – How many Virtual Machines will I need?
  – Are VMware HA and FT needed to meet my Uptime needs?
  – I don’t know where to start, how can RA help? We offer a Capacity Planner Service!

• Other Considerations
  – VMware and MS Licensing
Server Considerations

- **CPU**
  - Consolidation Ratios of 8 – 20 VM’s per Server

- **Memory**
  - Allocate by number of Virtual Machines
    - (4) OWS’s @ 2 GB
    - (1) EWS @ 4 GB
    - (1) PASS @ 4 GB
    - (1) Application Server @ 4 GB
  - Virtualizing this system would require a minimum of 20 GB Memory

- **Number of Servers**
  - With VMware Features such as vMotion, HA, and FT we recommend the use of 3 physical servers

Verify all of your hardware is compatible by using the [VMware Hardware Compatibility List](https://vmware.com) at VMware.com
Storage Considerations

- Storage Options
  - Fibre Channel
  - NAS
  - iSCSI
  - Direct Attached SAS

- Performance Factors
  - Capacity / Price
  - Disk types (SCSI, ATA, FC, SATA)
  - Access Time; IOPS; Sustained Transfer Rate
  - Reliability (MTBF)

VMware Performance is gated ultimately by IOPS density and storage Space
Virtualization requires additional networks to manage and isolate information traffic

- VM Network(s)
  - I.e. Assembly Line 1 VLAN, Assembly Line 2 VLAN
- Management / vMotion
- Storage Network (If applicable)
- Fault Tolerant Network

So how many NIC’s do I need on my server?

- In the scenario above, 4 Nic’s per server
- If Fault Tolerance was a requirement, 8 Nic’s…

Gigabit Switches are recommended

Networks should be isolated by VLAN’s

The NICs connected to the Servers act as Trunks into your vSwitches
Client Virtualization

Extend server virtualization benefits to clients:

- Software independence from hardware
- Lower maintenance and energy costs
- Leverage VM availability features
- Integrated secure remote access
- Time limited offline mode

VDI Protocols

- PCoIP
- RDP
Virtual System Management
Management Console View
Virtual Machines

The Infrastructure is all setup, so what about the Virtual Machines?

We have three options:

1.) Convert Old Machines to New Platforms
   • VMware Standalone an Converter
   • Free at www.vmware.com

2.) Create New VM's using our VMware Ready Software
   • Follow your PlantPax Selection Guide and PlantPAx Reference Manual for
     hardware sizing estimates and recommended software installations

3.) Utilize PlantPAx Virtual Appliances!
T4 – Process Control: Virtualization for Manufacturing:

Rockwell Automation Products & Services
“Rockwell Automation Supports Virtualization With VMware Ready Software”

“Support and certification will help companies take advantage of virtualization in the manufacturing environment”

--- Press Release dated Nov 10 2009
“Rockwell Automation will participate in the VMware Ready program with plans to validate its Rockwell Software configuration, human interface, and information products.”

Create a technical alliance with transparent mutual support

• Rockwell Automation joined the VMware Technical Alliance Program in September 2009.

• Rockwell will **support** customers using RA products in VMware virtualized environments.

• Formal support arrangements between Rockwell Technical Support and VMware Technical Support.

• Supported products include (Knowledge Base ID #42862)

<table>
<thead>
<tr>
<th>Product</th>
<th>FactoryTalk View SE</th>
<th>FactoryTalk AssetCentre</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSLinx 5000</td>
<td>FactoryTalk View SE</td>
<td>FactoryTalk AssetCentre</td>
</tr>
<tr>
<td>RSLinx 500</td>
<td>FactoryTalk View SE</td>
<td>FactoryTalk AssetCentre</td>
</tr>
<tr>
<td>RSLinx 5</td>
<td>FactoryTalk View ME</td>
<td>FactoryTalk VantagePoint</td>
</tr>
<tr>
<td>RSLinx Architect</td>
<td>RSView32</td>
<td>FactoryTalk Transaction Manager</td>
</tr>
<tr>
<td>RSLinx Classic</td>
<td>FactoryTalk Batch</td>
<td>FactoryTalk Metrics</td>
</tr>
<tr>
<td>RSLinx Enterprise</td>
<td>FactoryTalk Gateway</td>
<td>FactoryTalk ProductionCentre</td>
</tr>
</tbody>
</table>
ASSESS

• Assess the current state of the security program, design, policy
• Assess the current state of the network design, implementation
• Assess the current state of a manufacturing data center

DESIGN/PLAN

• Design and plan a network infrastructure
• Design and plan security program, policy, infrastructure, business continuity plan
• Design and plan a SANs infrastructure

IMPLEMENT

• Installation, procurement and configuration of a network
• Implementation of a security program, infrastructure design, policy training
• Installation, procurement and configurations of a SANs infrastructure

AUDIT

• Audit current architecture compared to governing body (ODVA, IEEE, ANSI/ TIA)
• Audit security program compared to governing body (NERC CIP, ISA -99, NIST 800-53, NIST 800-82

MANAGE/MONITOR

• Manage, maintain and monitor uptime and issues on the network and SANs environment
• Managed Security Services (Incident response, disaster recovery, monitoring)
Process System Characterization

- Provides Process System Guidelines
- System Element Definition and Configuration

... You get EXPECTED results!
PlantPAx Virtual Appliances

Process System Characterization
- Provides Process System Guidelines
- System Element Definition and Configuration

... You get EXPECTED results!

... with Virtual Appliances
- System Elements as standard products — Reduced validation Costs!
- Pre-installed & Pre-configured — Reduced Engineering Costs!
- Hardware Independent — Increased Product Lifecycle!
More Information...

- **Rockwell Automation Support Policy:**
  - RA Knowledgebase #42682

- **VMware Ready:**
  - News Release: Nov 2nd, 2010
    - "Rockwell Automation Expands PlantPAx Portfolio of VMware Ready Software,"
  - VMware Ready Product List Online:

- **Interested in a Solution and/or Services?**
  - Contact your local Sales Rep about engaging Network & Security Services (NSS)

- **At Automation Fair 2010:**
  - Process Booth Control Room: PlantPAx System Architecture
    - VMware vCenter with basic functionality
    - Virtual clients on Thin-client and iPad Hardware
Questions?