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**REGIONAL
SEMINARS** 2012
The **Power** of **Data**



Architecture and Best Practices for PI Systems

Presented by **Joshua Bivins**, Field Service Engineer

Topics

Upgrading to PI System 2012

- Why Upgrade
- How to Upgrade

Architecture

- Hardware and System Sizing
- Virtualization

Best Practices

- PI Server
- Interfaces
- AF



Upgrading to PI Server 2012

What's New in PI Server 2012?

Performance & Scalability

- More efficient use of RAM
- More efficient use of archive space
- Better management of connections

Manageability

- Auto recovery of corrupted queues
- Streamlined backfilling process (hours, not weeks)

PI Server 2012 Performance



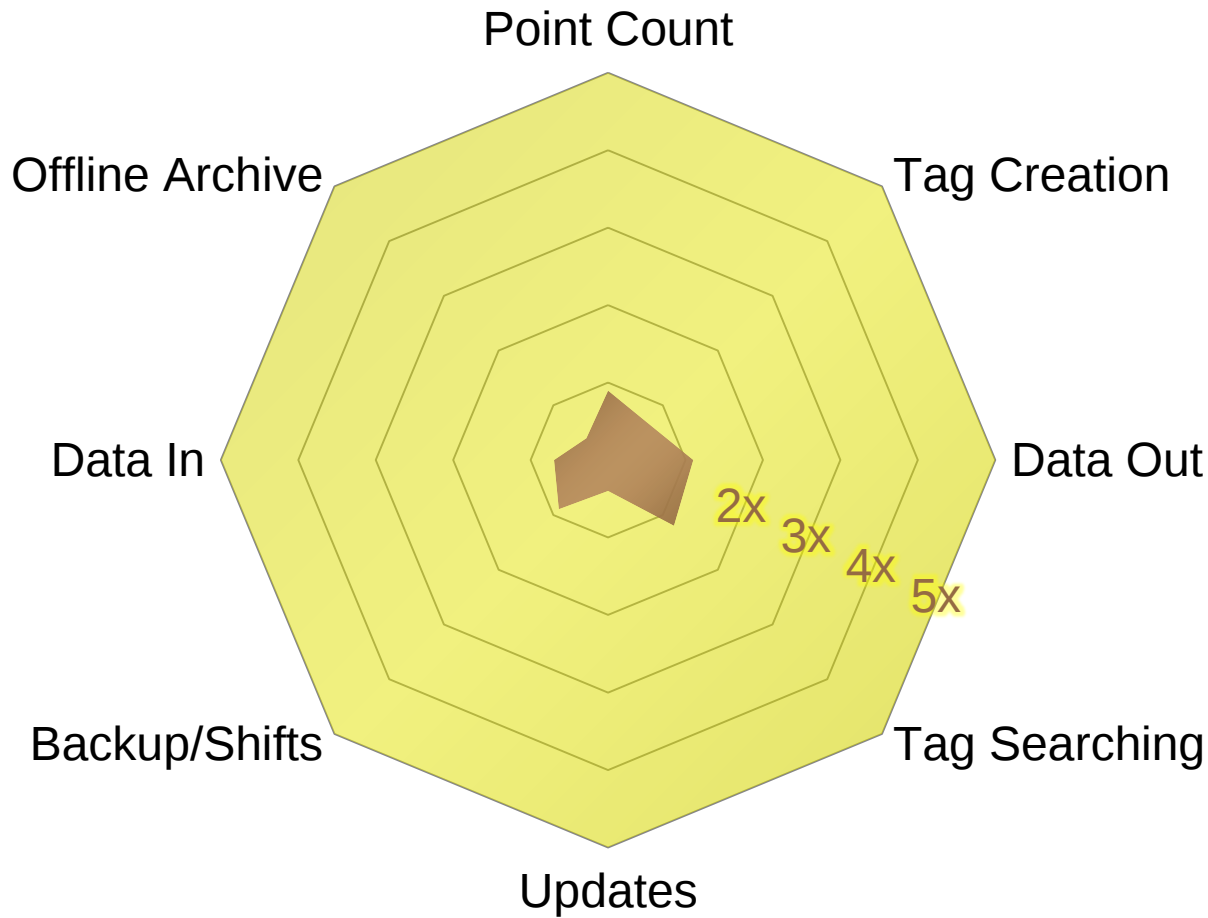
2010 R3

■	Max Point Count	2M+ tags
■	Max Data In Rate	<100K ev/sec
■	Max Data Out Rate	<5M ev/sec
■	Online Archives	2-5K files
■	Real-time Updates	200K signups
■	Point Changes	<10 pt/sec
■	Startup Time	>20 minutes



2012

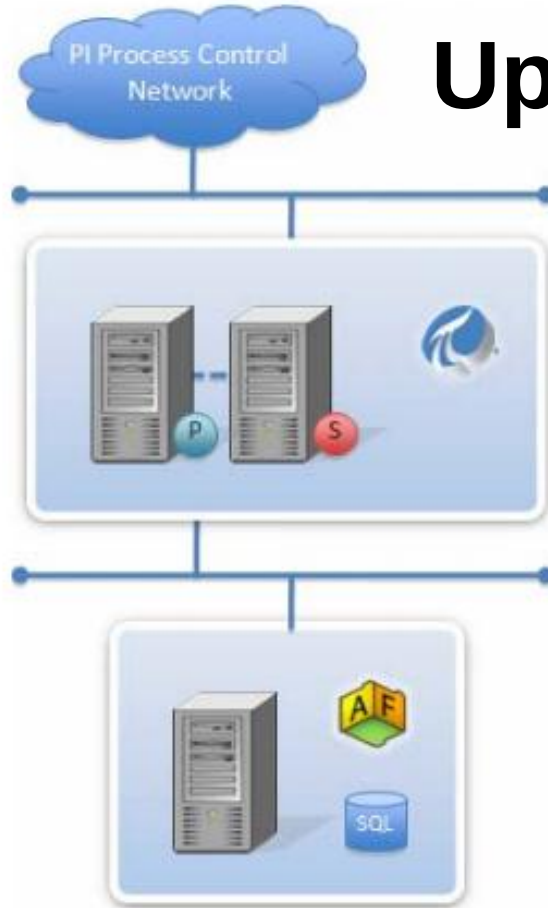
■	Max Point Count	5M tags
■	Max Data In Rate	500K ev/sec
■	Max Data Out Rate	5M ev/sec
■	Online Archives	>10K files
■	Real-time Updates	>3M signups
■	Point Changes	>500 pt/sec
■	Startup Time	<2 minutes



5x

- PI Server 2012
- PI Server 2010

Upgrading to PI System 2012



- PI Asset Framework is a required component since PI Server 2010

 Primary server of a collective

 Secondary server

SQL Server License:	 Express
	 Standard
	 Enterprise

I want to upgrade to PI System 2012
but...

...my current PI
Server is 32-bit

...I don't have
AF

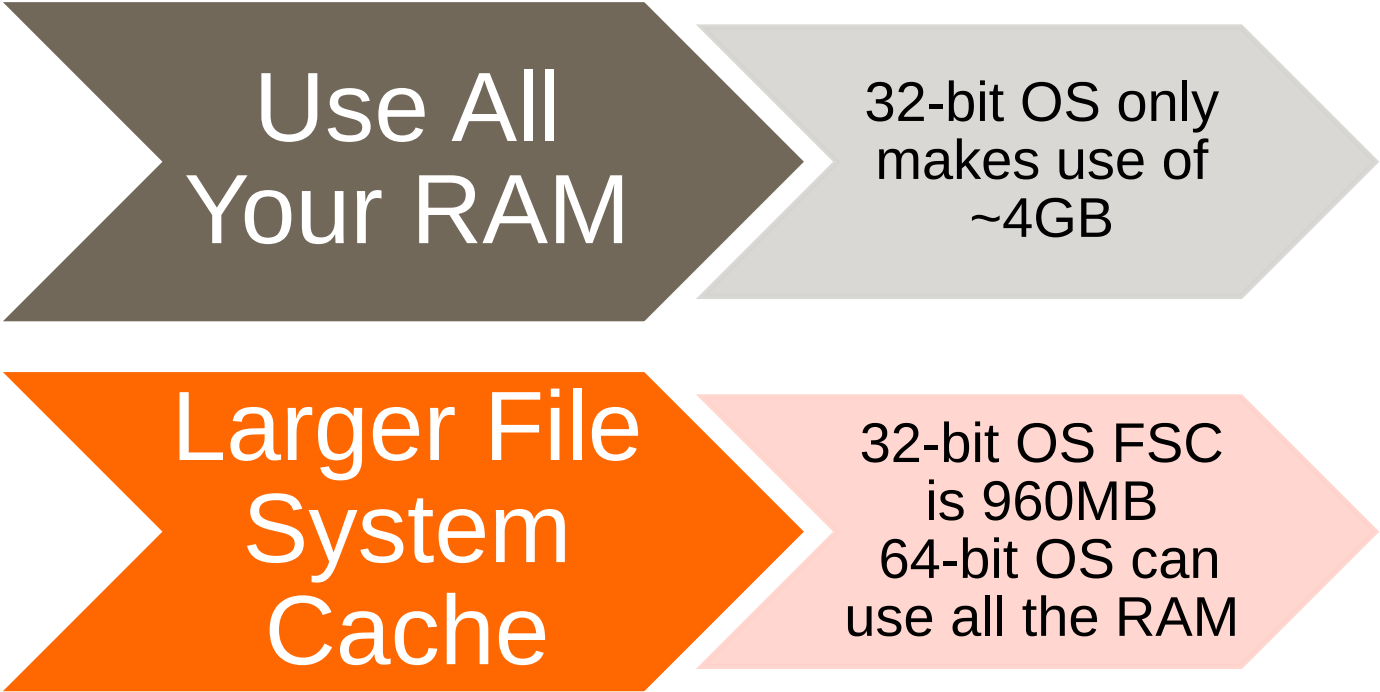
...on 64-bit
OS

...on 32-bit
OS

...for a
small PI
System

...for a
large PI
System

Why 64-bit?



Use All
Your RAM

32-bit OS only
makes use of
~4GB

Larger File
System
Cache

32-bit OS FSC
is 960MB
64-bit OS can
use all the RAM

...My Current PI Server is 32-bit

KB Article # KB00530

Upgrading to 64-bit PI Server while moving to 64-bit hardware

Product: PI Server

Version(s): 32-bit to 64-bit PI Server 2010 and later

Platform: Windows All

Issue

You currently have an old, 32-bit version of the PI Server installed. You then upgrade to the latest PI Server version. This procedure assumes the 32-bit version on the old hardware. Upgrades will be isolated to the new hardware to the old version in case something unexpected goes wrong with the move.

Review the following factors prior to upgrading:

- Except as noted in the table below, when moving a PI Server, you must install the same version of the PI Server that was on the original hardware before moving the databases. For example, if you installed on the original hardware, you must install PI Server 3.4.375.80 32-bit on the new hardware.
- Because you will need to install an old PI Server version on the new hardware, you must get the old installation kits. Some older PI Server versions are not available on the PI Server Center; however, most older installation kits require a manual or CD-ROM.
- Upgrading to PI Server 2010 or later may require a number of updates to the PI Asset Framework (PI AF) 2010 and later; synchronization of security settings on the PI AF and PI Server computers.
- Before upgrading to PI Server 2010 or later, the PI MDB to AF Migration tool must be installed on the PI Server.
- If you are moving a PI Server collective, the current PI Server database must be moved to the new hardware. Refer to known issue [236340S18](#) for a discussion of the differences between the two versions.

Solution

Upgrade Table for Moving from 32-bit Hardware to 64-bit Hardware

Source 32-bit server	Actions on target 64-bit machine
Any 32-bit PI Server version between 3.2.357.8 and 3.4.375.38.	• Install PI Server 3.4.375.99 64-bit on target machine • Move PI Server. • Upgrade to latest PI Server version Note: Moving from an old PI Server version (between 3.2.357.8 and 3.4.375.38) directly to 3.4.375.99 is the exception to the rule. Under other circumstances, you should move PI Server database files only between exact same versions of the PI Server.
PI Server 3.4.375.80 32-bit or 3.4.375.99 32-bit	• Install PI Server 3.4.375 64-bit on target machine. Use the exact same version of the PI Server that was installed on the 32-bit PI Server machine. (For example, if 3.4.375.80 32-bit was installed on the source PI Server, you should install 3.4.375.80 64-bit on the target PI Server. If 3.4.375.99 32-bit was installed on the 32-bit PI Server machine, you should install 3.4.375.99 64-bit on the target PI Server.) • Move PI Server

...I don't have AF

...small
system

Install SQL
Server
Express on
the PI Server
machine

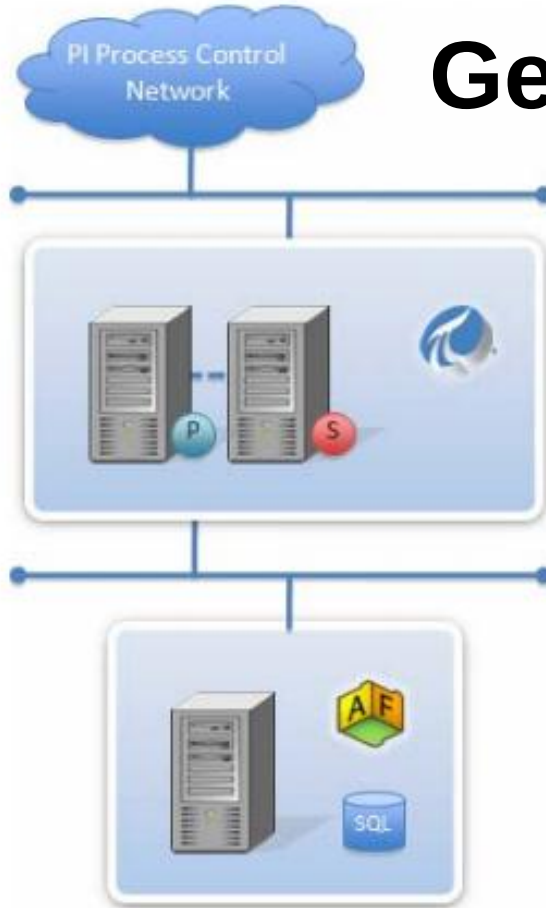
Install PI AF
on the same
machine

...large
system

Enterprise
grade SQL
Server
installation

Devote a
machine (or
several) to AF

Get AF



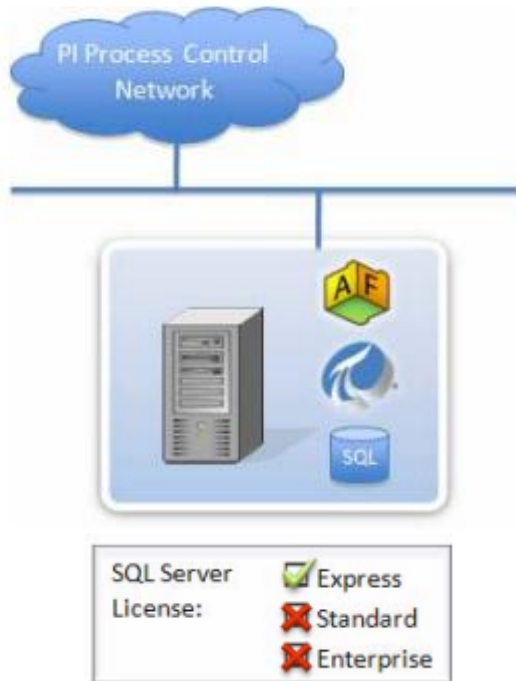
- PI AF has two components
 - AF Server
 - SQL Server Database

 Primary server of a collective

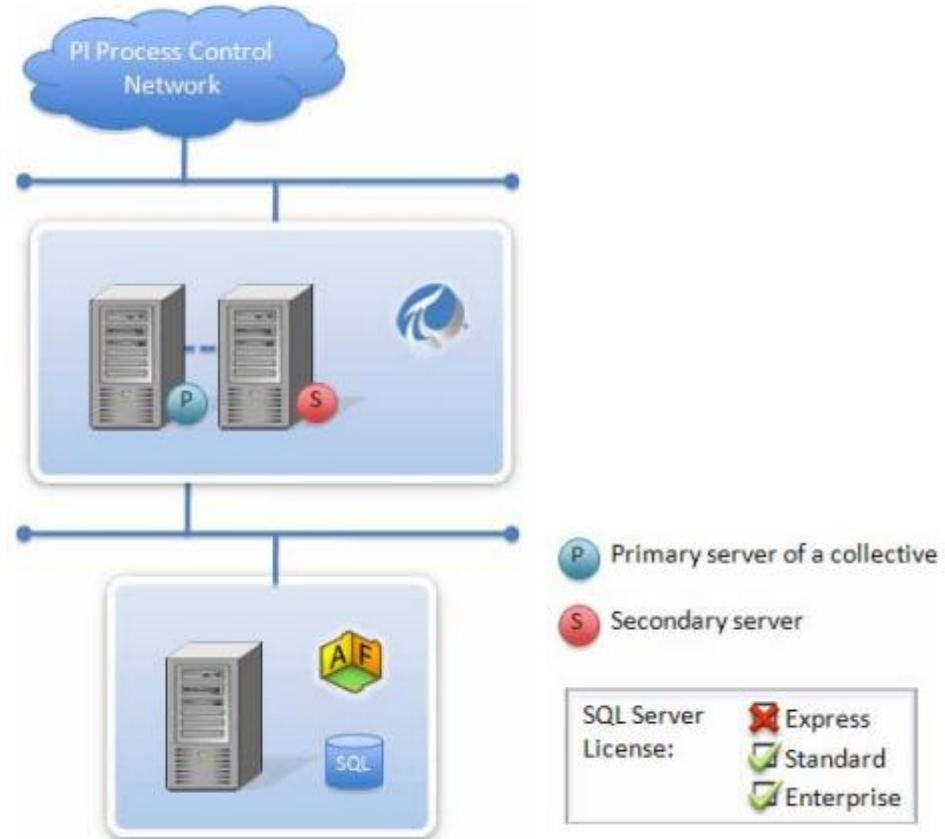
 Secondary server

SQL Server License:	 Express
	 Standard
	 Enterprise

Small AF (<10k Assets)



Larger AF (>10k Assets)



Help!!!

OSIsoft Field Service

- On-site or remote service. Typically a 4 day job.

Public Classes

- Practice with the product in a controlled environment.

YouTube Walkthroughs

- Step-by-step walkthrough. (Not a substitute for documentation)

OSIsoft Technical Support

- If there are problems during the upgrade.

Instructions.txt - Notepad

File Edit Format View Help

Hello! Today we are going to do a PI Server upgrade. We have a 32-bit PI Server, running version 3.4.380 SP1. We want to upgrade to the latest PI Server, PI 2012. We also want to use the 64-bit version. That means we need to move the PI Server to a new machine, because the current machine is a 32-bit windows 2003 machine.

I

32-bit Server

Pre-2012 PI Server

Step 1 (This Video):
PI Server Move

64-bit Server

PI Server 2012

Step 2 (Next Video):
PI Server Upgrade

Pre-2012 PI Server

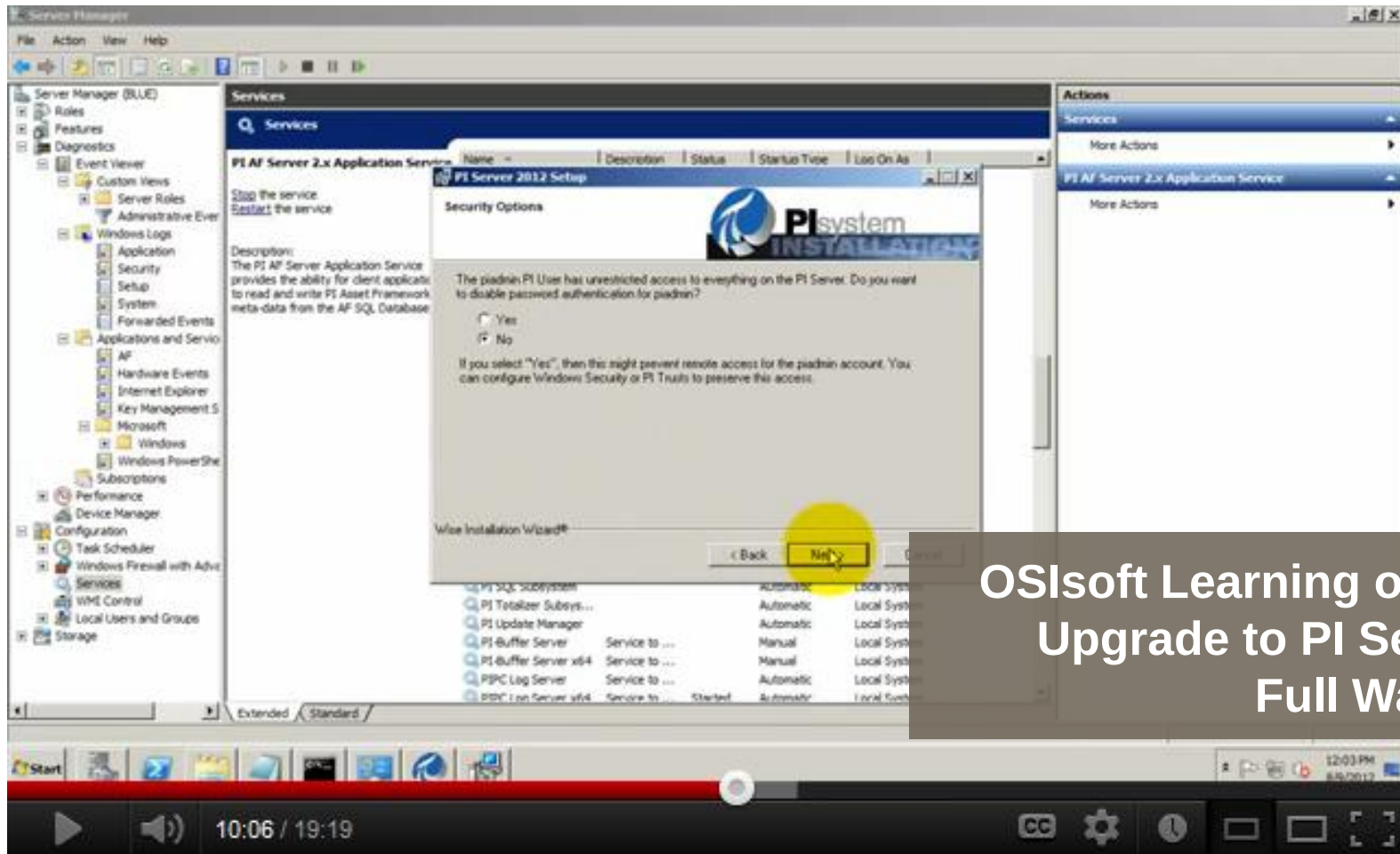
OSIsoft Learning on YouTube
Moving a PI Server:
Full Walkthrough

00:28 / 29:22

CC

Settings

Fullscreen



OSIsoft Learning on YouTube Upgrade to PI Server 2012: Full Walkthrough

A large graphic of the map of Africa, composed of numerous small icons. The icons represent various sectors: energy (solar panels, wind turbines, oil rigs, light bulbs, batteries), agriculture (wheat stalks, DNA helixes, water droplets), industry (factories, gears, trucks), and general technology (microchips, documents, speech bubbles). The map is colored in shades of grey, with some icons in yellow and green.

Basic Hardware Guidelines

- 0. Windows ⇒ Latest OS (64 bits)
- 1. Memory ⇒ most bang/\$
- 2. Storage ⇒ latency (IOPS)
- 3. Network ⇒ latency (RTT)
- 4. Computing ⇒ client workload

	RAM	Disk IO/s	Network	CPU Cores
Minimum	15KB per PI Point	Rate of Archived Events/50	100Mbps LAN	4 + Active Client Connections/5
Recommended	Enough to fit 2 full archives in RAM (file system cache)	Rate of Archived Events/10 + Read Workload (based on desired client response time)	1-10Gbps LAN (end-to-end latency is most critical)	4 + Active Client Connections/2 (more with multi-threaded clients)

PI Data Archive Hardware Sizing

 **PI Server** *PI Data Archive Hardware Sizing*

Last Update: 9-Oct-2012
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Please review and adjust values in the first 6 rows. Recommendations are shown in the white-text cells underneath.
Note: using lower numbers may affect performance and reliability, please contact OSIsoft Customer Services for help.

Expected Point Count	50,000 points
PI Interface Nodes	2 nodes
PI Interface Scan Rate	5.00000 sec (0.2 Hz)
Measurement Data Type	float32 (6-digit precision)
Average Data Compression	50 % (2:1)
Online Data Time Range	120 months
Estimated Snapshot Rate	10,000 events/sec
Estimated Event Size (on Disk)	6 bytes
Estimated Archiving Rate	5,000 events/sec

STORAGE

Minimum Archive Size	100 MB
Recommended Archive Size	256 MB
Required Online Disk Space	8,813 GB
Estimated Archive Count	3,525 files/year
Estimated Archive Volume (per server node)	103 MB/hour 73 GB/month

DISK I/O

Minimum Disk Bandwidth	1 MB/sec
Minimum Disk Throughput	100 IO/sec*
Recommended Disk Bandwidth	10 MB/sec
Recommended Disk Throughput	200 IO/sec*

(*) See "KB Article #xxxxx" for details on how to evaluate IO operations/sec

PI Collective Nodes	1 node (no HA)
Estimated Bandwidth per Interface Node	146 KB/sec
Active Client Applications	10 applications
Average Query Interval	
Average Query Rate	
Average Points per Second	

PROCESSOR

Recommended Processor	
------------------------------	--

(+) Physical, not virtual

MEMORY

Recommended RAM	
Estimated RAM	
Estimated Non-Cacheable Memory	

NETWORK

Recommended Bandwidth	100 Mbps
------------------------------	-----------------

(#) See "Buffer and Bandwidth Calculation" spreadsheet for latency considerations

Expected Point Count	50,000	points
PI Interface Nodes	2	nodes
PI Interface Scan Rate	5.00000	sec (0.2 Hz)
Measurement Data Type	float32	(6-digit precision)
Average Data Compression	50	% (2:1)
Online Data Time Range	120	months
Estimated Snapshot Rate		
Estimated Event Size (on Disk)		
Estimated Archiving Rate		

Enter the desired number of months to keep historical data available online. Typical ranges are 7 years (84 months), 10 years (120 months).

Better Performance on Old Hardware



2012

■	Max Point Count	10K+ tags
■	Max Data In Rate	>40K ev/sec
■	Max Data Out Rate	>100K ev/sec
■	Online Archives	>1K files
■	Real-time Updates	>5K signups
■	Point Changes	>50 pt/sec
■	Startup Time	<1 minutes

Dell OptiPlex
SX-260

- 32-bit Architecture
- Pentium 4 3GHz
(1 CPU Core)
- 1GB 266MHz DDR RAM
- 40GB 5.4K IDE HDD

eBay ~ \$30





2012

Max Point Count	20M+ tags
Max Data In Rate	1M ev/sec
Max Data Out Rate	>10M ev/sec
Online Archives	>50K files
Real-time Updates	10M+ signups
Point Changes	2,000 pt/sec
Startup Time	<10 minutes



2012

Max Point Count	5M tags
Max Data In Rate	500K ev/sec
Max Data Out Rate	5M ev/sec
Online Archives	>10K files
Real-time Updates	>3M signups
Point Changes	>500 pt/sec
Startup Time	<2 minutes



2012

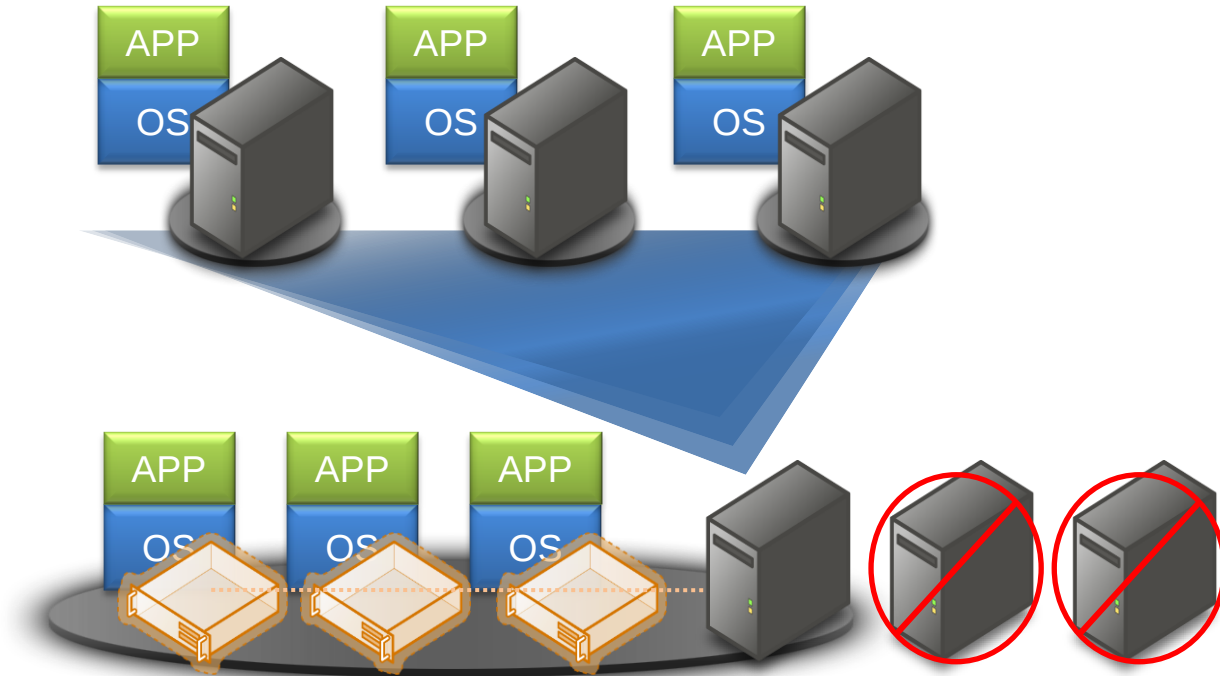
Points	10K+ tags
Data In	>40K ev/sec
Data Out	>100K ev/sec
Online	>1K files
Updates	>5K signups
Points	>50 pt/sec
Startup	<1 minutes





Virtualization

Hardware Virtualization



Operating System Virtualization

Why are OS/soft customers using virtualization?

- Server consolidation
- Improved availability and provisioning

OS/soft supports virtualization

- OS/soft Knowledge Base article 3062OSI8
- Consider shared resources implications

Operating System Virtualization*

Treat virtual machines as if they were physical machines

Invest in enterprise-level hardware and software

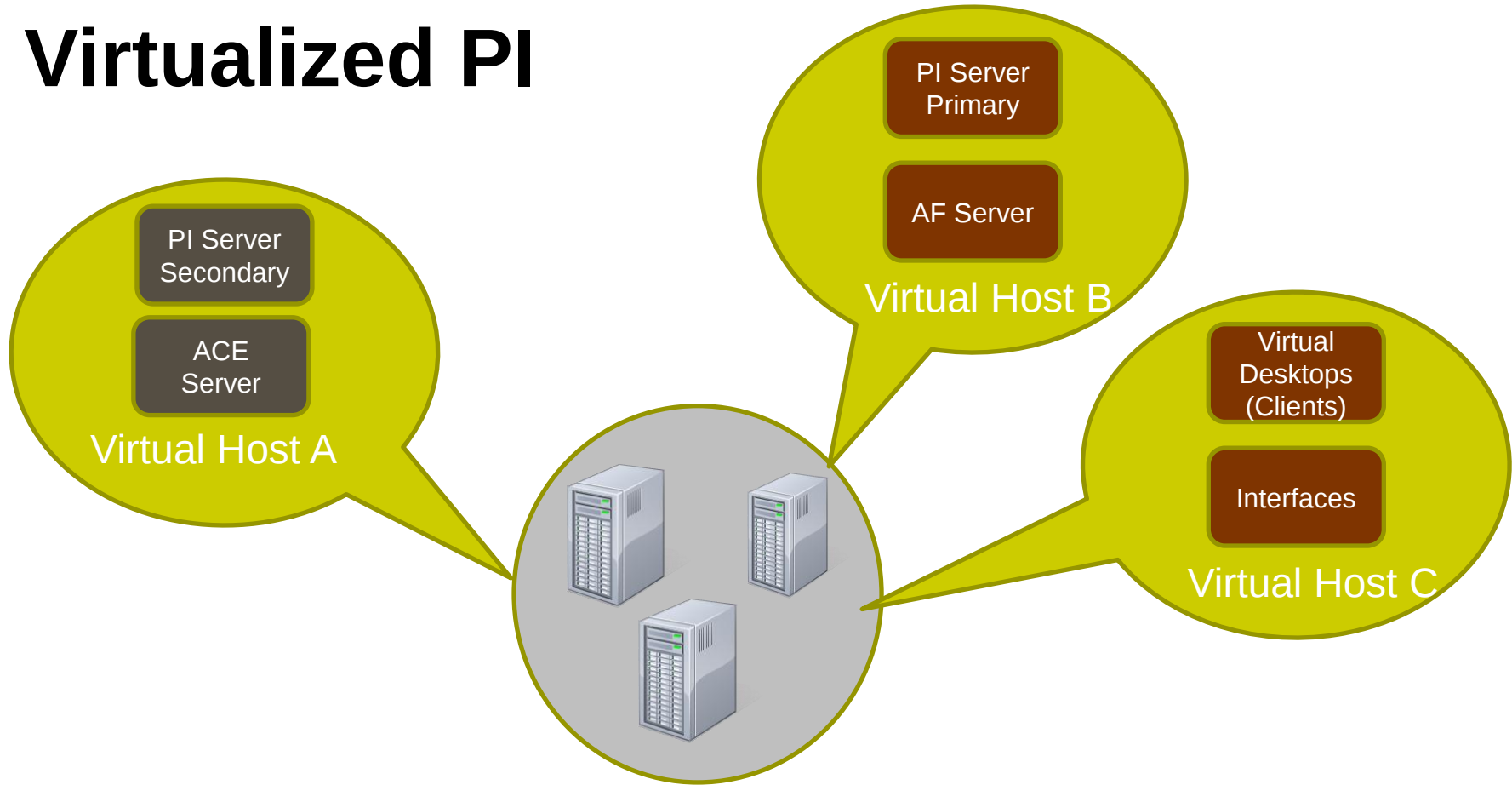
Do not mix virtual and physical on the same host

Use qualified virtualization support personnel

Test on the target platform

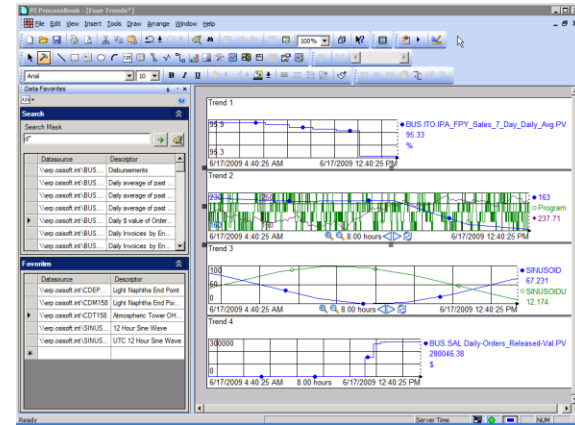
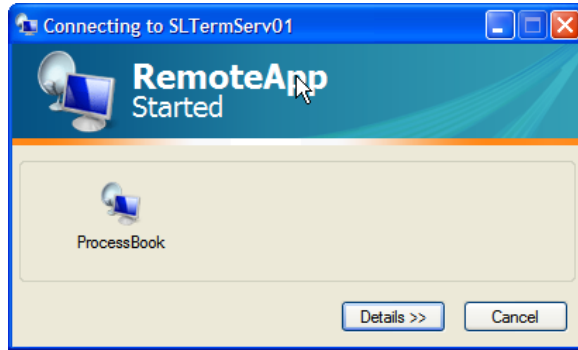
* OSIssoft Center of Excellence

Virtualized PI



Application Virtualization

- Applications centrally installed and managed
- Users are remote
- OS/soft customers are successfully using Microsoft and Citrix virtualization products





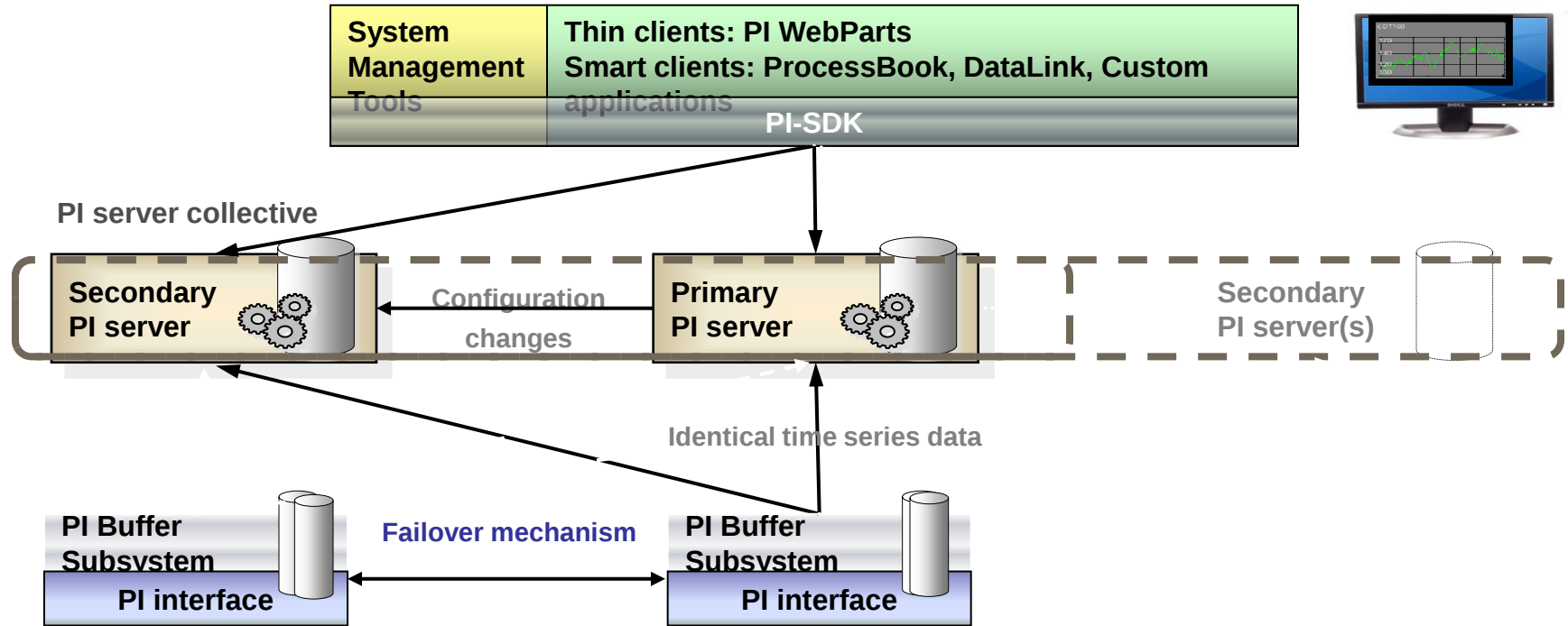
PI Server Best Practices

PI Server High Availability

Create a PI Server Collective

- Maximize data access for clients. Maintain availability during outages.
- Load balance by connecting clients to closest Collective member
- MS Clusters no longer supported in 2012

High Availability Architecture



Windows Integrated Security (WIS)

PI Server 3.4.380.36 (2009) introduced support for WIS



Use Microsoft Active Directory (AD) for PI Server Authentication



Map AD Principles to PI Identities



PI Identities are roles on the PI Server
e.g. PIAdmins, PIReaders, PIInterfaces

What Does WIS Do for Me?

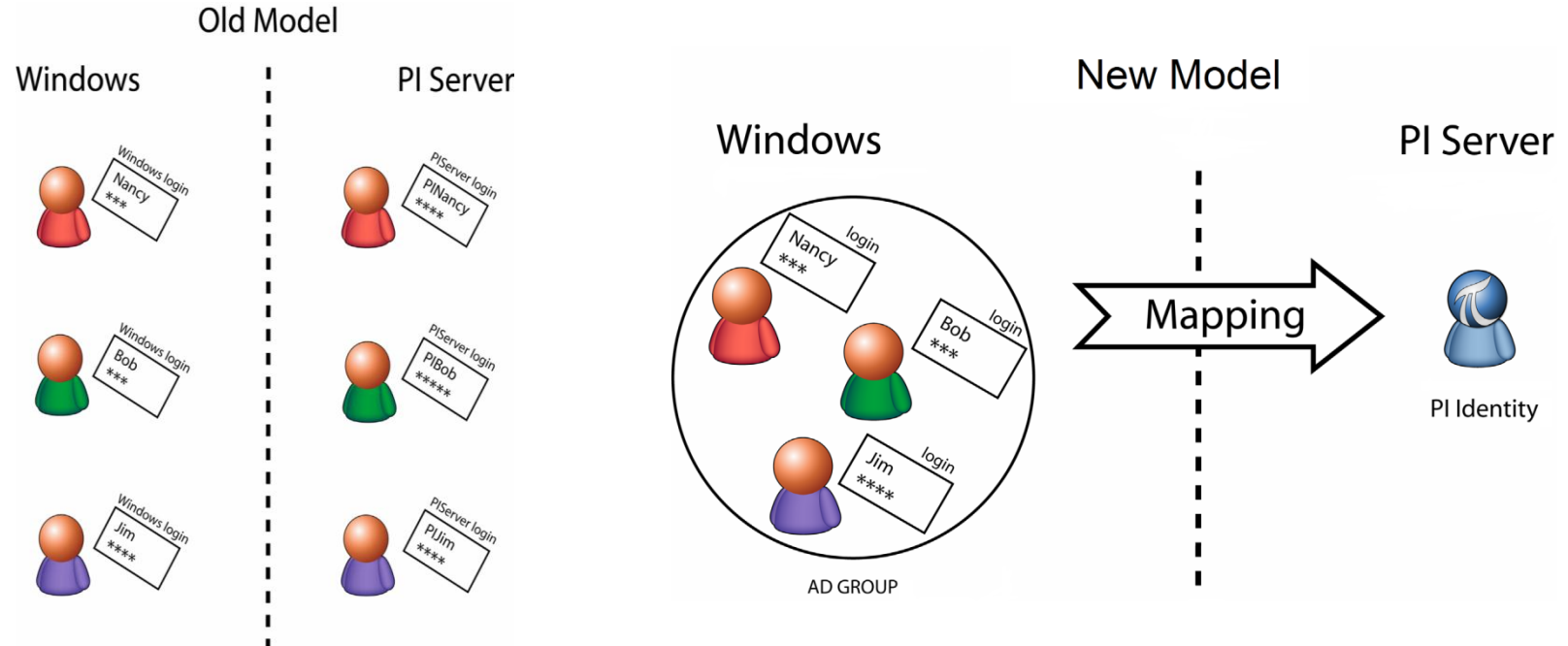
More
secure than
trusts and
explicit
login

Seamless
user login
experience.
No login
box.

No more PI
Users to
maintain

No more
piadmin
password
on sticky-
note

Comparing PI Users and PI Identities



Active Directory Integration

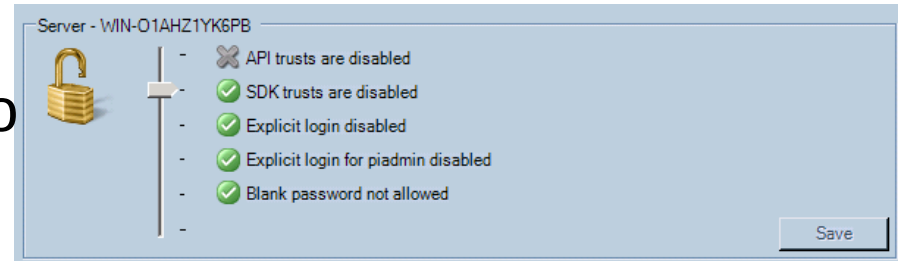
- PI Server must be a member of a domain to leverage Kerberos authentication
- Multiple AD domains must have trusts established
 - One-way trusts are supported: the server domain must trust the client domain

PI Identity Planning with AD

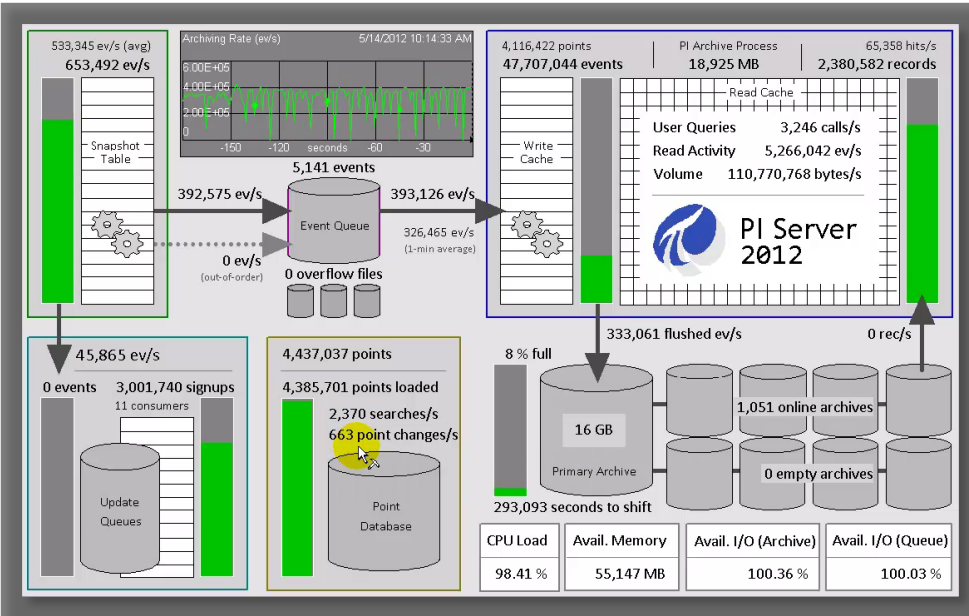
- Develop a PI Identity Scheme for your Organization
 - Who uses PI data?
 - Who writes to PI data?
 - Who needs Admin access?
- Managing Mappings
 - Map users and or groups directly
 - Add AD users to local groups that are mapped

How to Tighten Security

1. Physical and OS security are the first line of defense
2. Do not use the PIADMIN Pluser in trusts or mappings
3. Disable PI password authentication (explicit logins) (see KB00304)
4. Retire PI SDK-based Trusts
5. Use Windows Integrated Security
6. Use the new Security Tool to help secure your PI Server



PI Server Best Practices



Look at the Logs

Use the Security Features

Monitor PI System Health with PI PerfMon

Automatic Archive Creation

Check Your Backups and Know How to Use Them



PI Interface Best Practices

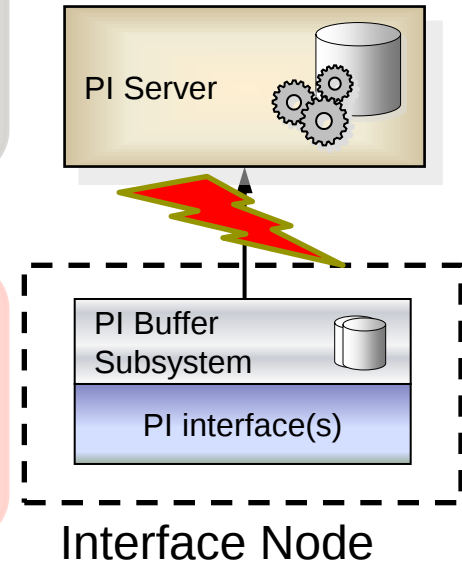
Enable Interface Buffering

Prevent
Data
Loss

- Stores data in the event of disconnection from PI Server(s)

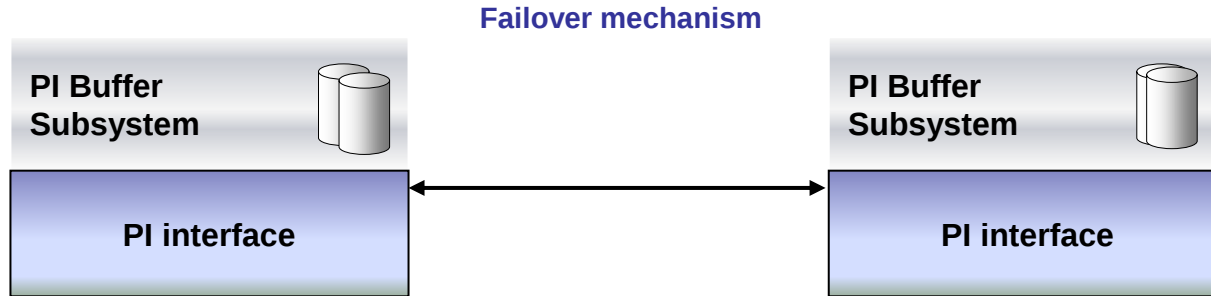
Two
Flavors

- **PI Buffer Subsystem (pibufss)**
- PI Buffer Server (bufserv)

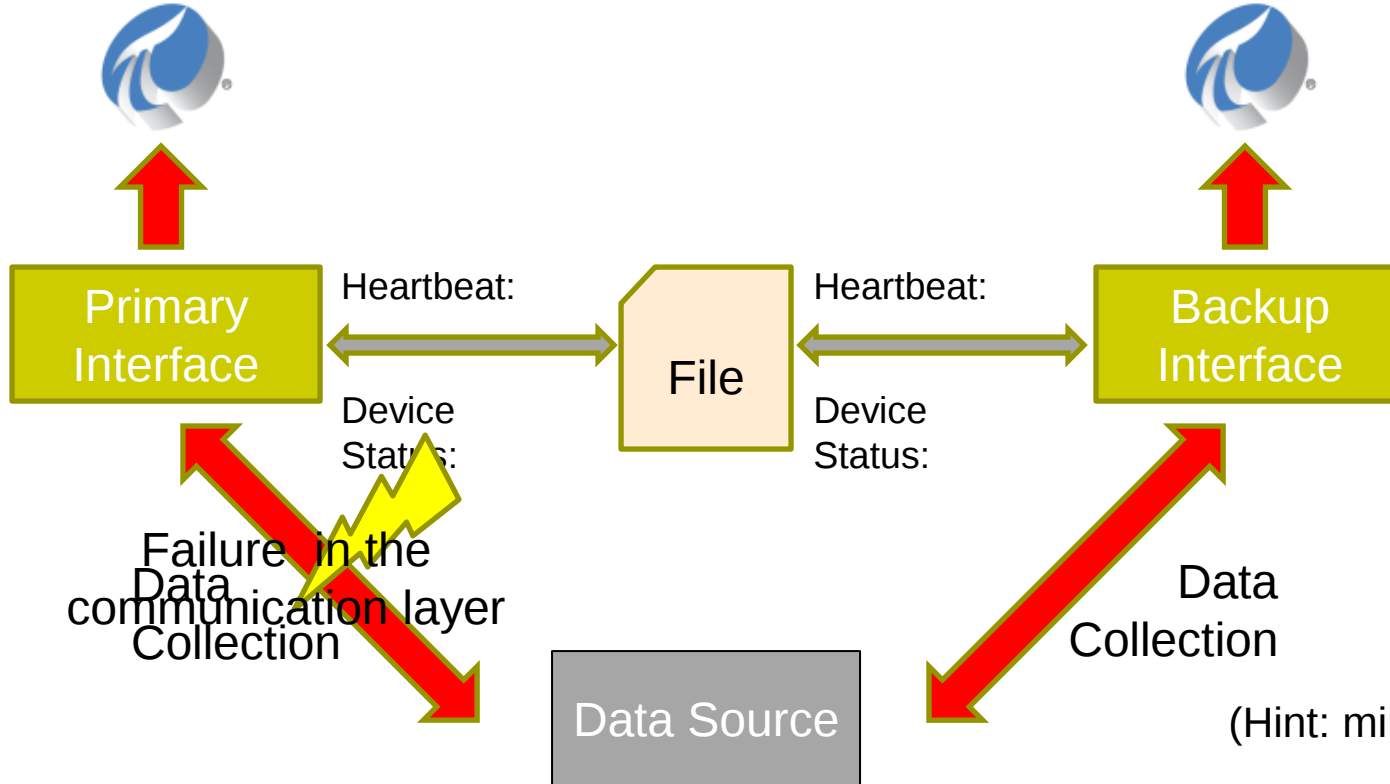


Enable Interface Level Failover

- Prevents (or minimizes) data loss if one of the interface machines fails.
- Each interface monitors the other's status and takes over if there is a problem.
- Unilnt Phase 2 Failover uses a shared file.



How does interface failover work?



Hot = No data loss

Warm = Maybe data loss

Cold = Some data lost

(Hint: minimize data loss by using disconnected startup)

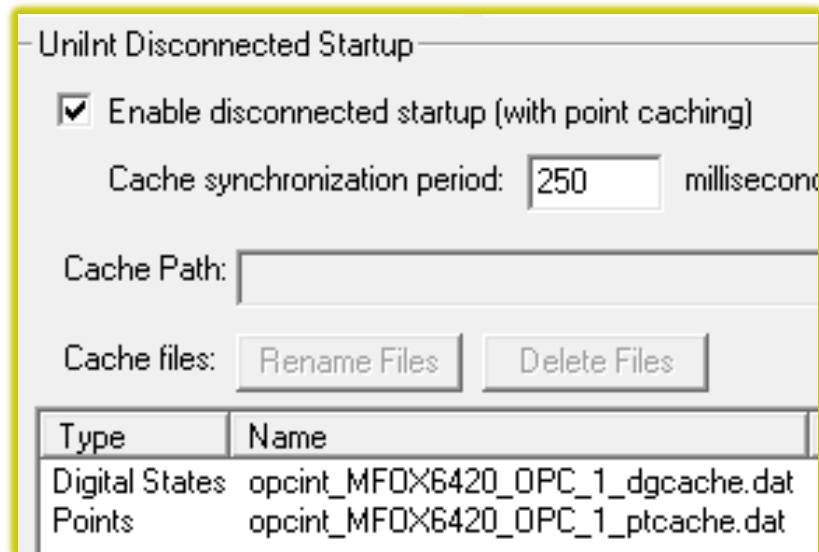
Enable Disconnected Startup

- Previously, if the PI Server was not available, it was not possible to start the interface
- Creates a local cache of all of the tags. Now the interface can start without connecting to the PI Server

Along with buffering, you now have an interface that can operate (almost) indefinitely without the PI Server!

Bonus: We have seen impressive decreases in interface startup time when this feature is enabled

Hint: If you make a lot of changes to this interface's tags consider shutting down the interface and deleting the cache files.



Unlnt Disconnected Startup

☒ Enable disconnected startup (with point caching)

Cache synchronization period: milliseconds

Cache Path:

Cache files:

Type	Name
Digital States	opcint_MFOX6420_OPC_1_dgcache.dat
Points	opcint_MFOX6420_OPC_1_ptcache.dat

PI Interfaces – In Summary

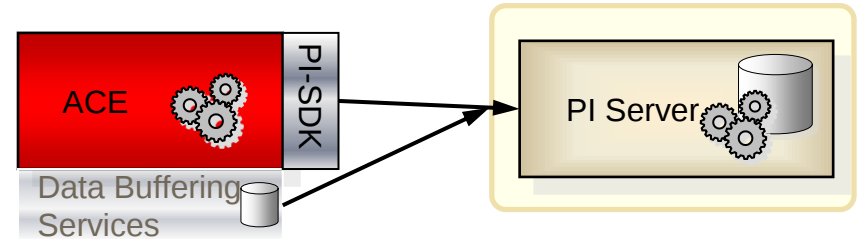
- Configure buffering with PI Buffer Subsystem
- Consider implementing UniInt Failover
- Disconnected start-up
- Create interface health points
- Configure 2+ trusts using a limited account (not piadmin)
- Don't forget to test!



PI ACE Best Practices

PI Advanced Computing Engine

- Best Practices
 - Configure buffering
 - Error handling
 - *Try...catch*
 - Performance Counters
 - Backup Code





PI Asset Framework and PI Notifications

PI Asset Framework Overview



- Adds context to PI data
 - Define relationships
 - Build hierarchy
 - Relate to non-PI data
- Usable
 - Provides context to end users
 - Integrated calculations and search tools
- Scalable
 - 10s of 1,000s of assets
 - Connect to multiple PI Servers & data sources
- Extensible
 - Access with PI OLEDB & PI Webservices
 - Customizable data references and plug-ins



PI AF Server - Components

- Two key components
 - AF Server
 - SQL Server database
- SQL Server
 - Express, Standard
 - Cluster or Mirror
- AF Server
 - Behind a load balancer
 - AFSDK Collective

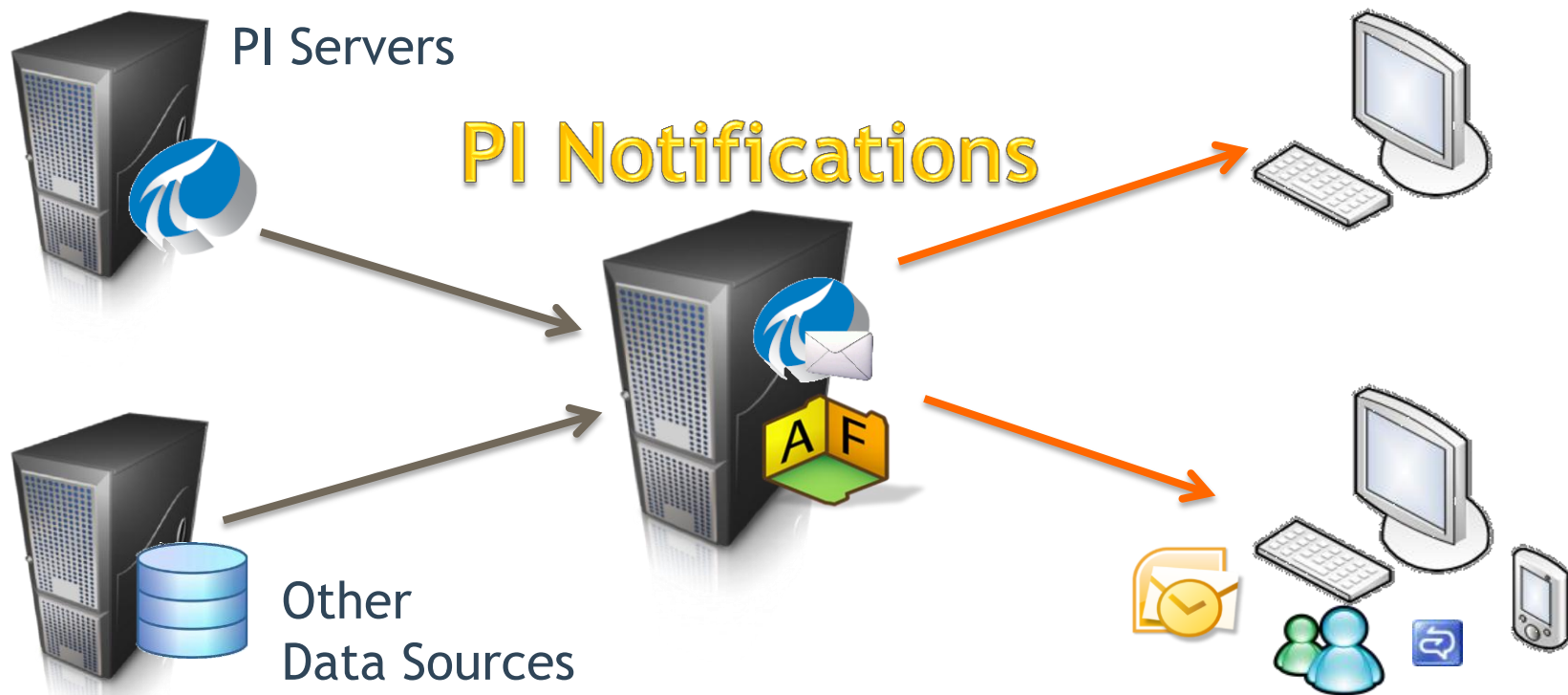


PI AF Server – Best Practices

- Configure AF backups – Backup PIFD and/or run afbackup.bat
- Monitor SQL Server health
- Do not run the SQL Server database engine as LOCALSYSTEM, admin, or domain admin.
- DO NOT RUN the AF Server with SysAdmin privilege (don't use SA account, LOCALSYSTEM, or admin)
 - Use a domain account

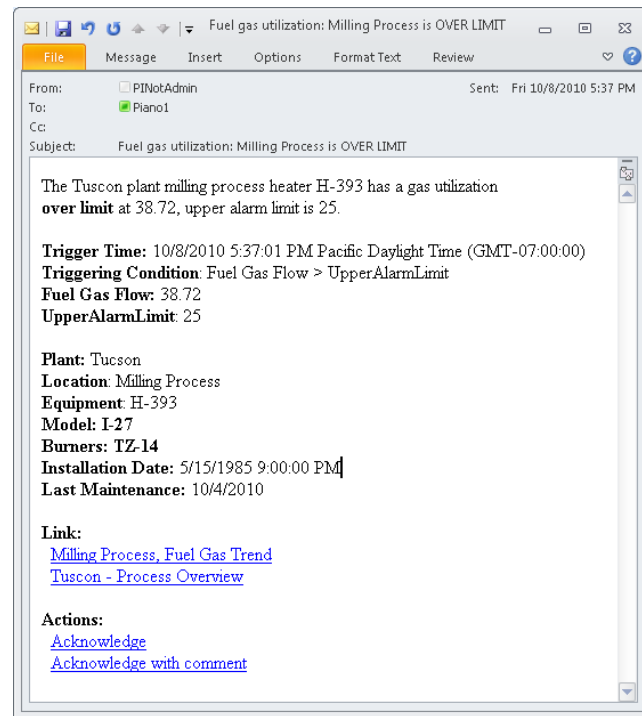
PI Notifications - Overview

PI ProcessBook
PI DataLink



PI Notifications – Best Practices

- Run PI Notifications as a domain account
- Configure PI Buffering
- Create redundant schedulers
- Monitor health with PI PerfMon tags



More Information

- Whitepapers and Tech Support bulletins on OSIssoft web site
- User Manuals
 - PI Server 2010 Configuring Security
 - Asset Framework 2010 User's Guide
- OSIssoft vCampus – Online community
 - Forums, Whitepapers, Webinars



THANK YOU

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