

OSIsoft Self Paced Training Course

PI System Administration: Basics

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1. Introduction

1.1 Overview of the Course

 Video	<i>Before reading this section, please refer to the following course YouTube video: https://youtu.be/yJgPct6gAtg</i>
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This course will teach new PI System Administrators to install, configure, secure and manage the core components of a PI System, including:

- PI Data Archive installation and configuration
- PI Interface installation and configuration
- PI Point creation and administration
- User access configuration

During the class we'll cover best-practise configuration only, but will link out to documentation covering older practises and methods when necessary. No matter if you're about to administer a new PI System or are maintain an established one, you'll get a lot out of this class.

Throughout this class we will assume you have already completed the free [PI System Basics](#) class. We will not cover any background or content that has already been covered in this class.

The course consists of text-based lessons, and video lectures. You are encouraged to follow along with all video lectures using your Learning Cloud Environment. It is intended that you follow the video lectures in-order, as a lot of configuration depends on prior lessons. Text-based lessons contain background theory, documentation and other useful information.

Lessons are categorized using the following key words:

- Hands-On: These lessons contain hands-on walkthroughs on configuring your virtual environment. Skipping these videos is not recommended, you will find that you cannot complete some later lessons without first completing the earlier ones.
- Knowledge check: Exercises to complete using your virtual environment, or quizzes to keep your skills sharp. Lessons will assume you have completed prior knowledge checks. Some knowledge checks ask you to change the configuration of your virtual environment and skipping them may result in you being unable to complete later exercises.
- Background: Readings or videos containing useful background information to assist your understanding. These lessons are optional as they do not contain specific information regarding your virtual environment.

- Reference: Documentation or downloads you may find useful when applying this class to your own system. You are not expected to read through all references, and will not be examined on any content within them, but they are included for your convenience.

In the next lesson we'll cover the Learning Cloud Environment used in class, and what we'll accomplish in this class in detail.

1.2 PI System software

The VM (virtual machine) used for this course has the following PI System software installed:

Software	Version
PI Data Archive	2018 SP3
PI Asset Framework (PI AF) server	2018 SP3
PI Asset Framework (PI AF) client (PI System Explorer)	2018 SP3
PI Analysis & PI Notifications Services	2018 SP3
PI Interface Configuration Utility	1.5.0.7
PI Interface for OPC DA (Read Only)	2.7.1.41

For details on PI System software, please see <http://www.osisoft.com/pi-system/pi-capabilities/product-list/>



Video

After reading this section, please refer to the following course YouTube video: <https://youtu.be/WYPOsLvogkQ>

2. [Optional] Preparing for a PI System

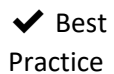
You can consider this chapter optional. If you will never plan for or install a PI System from scratch, the knowledge contained in this chapter is not strictly needed. If you will only ever maintain a PI System already in place, you can skip to the next chapter.

2.1 Background: What Preparation is Needed?

During this section we will cover prerequisites for a PI System Core installation. Even if your job description doesn't involve installing software in any way - preparing for and installing a system is the best way to learn how it all fits together. Preparing for a new PI System Installation consists of four parts:

1. Size up and Procure hardware
2. Install software prerequisites
3. Create service accounts and certificates
4. Obtain a PI Data Archive license file

Documentation for PI Server installation can be found on [PI Live Library](#)



Installation best practices are found in the PI Data Archive Install Field Service Technical Standard. This document can be downloaded from the [Reference: PI Data Archive Install Technical Standards] lesson online.

2.2 Background: Hardware Sizing

On OSIsoft's [Customer Portal](#) MS Excel spreadsheet "*Hardware and PI System Sizing Recommendation Spreadsheet*" can be found and downloaded ([link](#)). You can also find the spreadsheet attached to this lesson.

This spreadsheet gives recommendations for the following hardware resources based on current or anticipated load and data volume.

- Storage Capacity
- Disk Throughput (IOPS)
- CPU Count
- Memory (RAM)
- Network Bandwidth

The amount of disk space required depends primarily on the number of PI points that the PI system will collect. See below to calculate the necessary disk space.

PI Data Archive Component	Space Requirement	Notes
PI Data Archive and PI Software Development Kit (PI SDK)	160 MB 100 MB temporary disk space for installation	PI SDK includes the PI API.
PI Data Archive databases	11 MB per 1000 points + 1 MB	Located on the same computer as the PI Server.
Message log files	10 MB	Located on the same computer as PI Server, in the pi\log directory.
PI Archive files	10 MB per 1000 points	
PI event queue	5 MB per 1000 points	OSIsoft recommends that you place the event queue on a different physical drive from the PI archive files.
Rollback backup (upgrade only)	Size of PI Data Archive databases + primary archive	The PI Archive setup program performs a minimal backup during the upgrade.

For PI Data Archive, PI AF server, and Microsoft SQL Server, one or more Microsoft Windows compatible computers, with a 64-bit operating system is required.

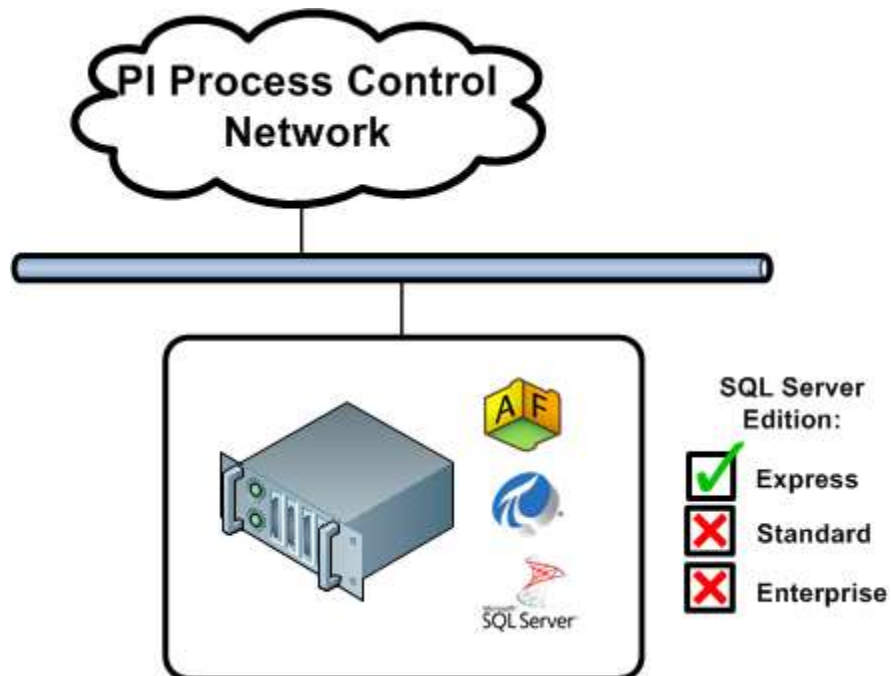
For best performance and improved security, OSIsoft recommends that you install MS SQL Server on a different computer from PI Server. If you plan to install MS SQL Server on the same node as the PI Data Archive, the SQL Express Edition should be installed so that the MS SQL Server does not compete with system resources of the PI Server. The MS SQL Express Edition is limited to using only a single physical CPU and 1 GB of RAM.

It is recommended that the PI AF server and PI Data Archive server be installed on *different computers* if:

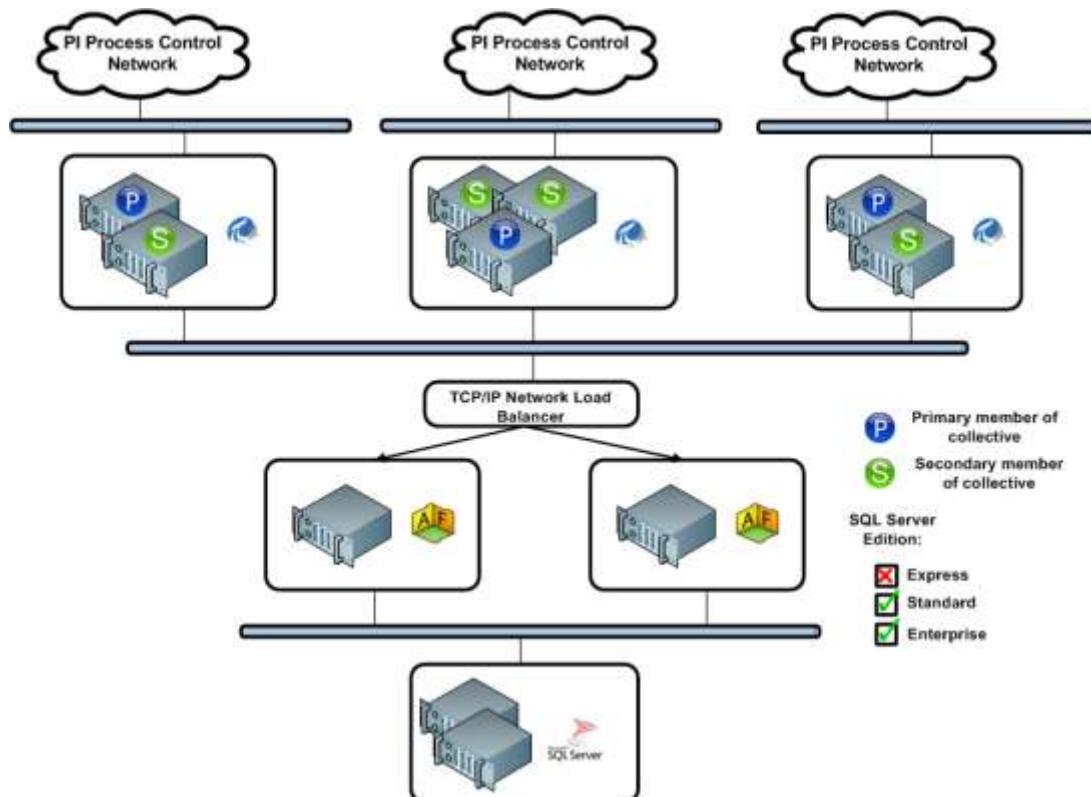
- PI AF server will use time-series data from multiple PI Servers
- PI AF server is configured for high availability (such as a load balanced PI AF server, PI AF servers connected to a mirrored MS SQL Server, or PI AF servers connected to clustered MS SQL Servers).

The number of required computers depends on the size and complexity of the PI System. The size of a PI System depends on the number of PI points and the number of units (elements) of equipment (such as mixers, tanks, or meters or whatever else you have added into the asset database).

A simple, small system will have the PI Data Archive, the PI AF Server and MS SQL Server (the free MS SQL Server Express may be used) installed on the same hardware (or virtualised) server, as shown below:



For distributed systems with large workloads and point counts, and with multiple PI Servers or PI Data Archive Server collectives that link to a central PI AF database, OSIsoft recommends that you install PI Data Archive Server collectives with two PI AF Servers with a Network Load Balancer over them, and Microsoft SQL Server on separate, redundant computers to achieve the best level of performance and scalability. This type of system is depicted below:



2.3 Background: Software Prerequisites

There are two major prerequisites for a PI System:

- Microsoft Windows
- Microsoft SQL Server
- A Data Source for Time Series Data

Except for select interfaces and adapters, all PI System software is Microsoft Windows-based. Any server where PI System software will be installed must have Microsoft Windows installed on it.

Microsoft SQL Server is required by both PI AF Server, and PI Vision. In this class we'll be focusing on PI AF Server - PI Vision installation is not covered in this class. To see which versions of Microsoft SQL Server are supported, see the [SQL Server Requirements](#) documentation.

Your time-series data source will be defined by your desired project outcome. Which pieces of equipment or data sources do you want to expose to your users? How do they expose their data now? These topics will be covered in depth during the upcoming lesson on PI Interface Installation and Configuration. For now, this course will assume you'll be using an OPC DA Server as your data source, as it is by far the most common. During the upcoming lesson on PI Interface installation and configuration, we will study this depth and cover non-OPC Server data sources. For more information on OPC DA, see the [OPC Foundation](#)'s page on the topic.

2.4 Background: Service Accounts and Certificates

Your IT Department will need to configure domain objects prior to installing the PI System, in the form of:

- Service accounts
- Certificates
- Service Principle Names

The information below should give you a better idea on what each of what to ask your IT department for regarding each of these topics.

2.4.1 Service Accounts

You can think of a service account similarly to a user account in a domain. It is an account that has been created for the purpose of running a specific service. Modern security best practises dictate that services that require different levels of access to different objects should run under different accounts. The permissions on these accounts should follow the principle of least privilege - each one should have the minimum privileges to perform its function and nothing more.

During this class, we will be using service accounts for the following services, and configuring least-privilege for each:

- PI AF Server
- PI Analysis Service
- PI Interface for OPC DA
- PI Buffer Subsystem

In this class we build a very simple system, but in a more complex production system, you may also need service accounts for:

- PI Notifications Service
- Any additional individual PI Interface instances
- PI Vision
- PI Web API
- PI Data Archive Network Manager
- PI Connectors, PI Connector Relay, PI Data Collection Manager
- Any PI Integrators
- Any additional standalone or legacy PI System services

2.4.2 Group Managed Service Accounts

In this class we will be using a special type of account for this job, called Group Managed Service Accounts (gMSAs). Most of the steps we work through in this class also work with other account types, and when there are configuration differences we'll make sure to mention them. We use gMSAs because their passwords are automatically managed by the domain, and they align much better with what we're trying to achieve than other account types. Once the initial setup is done, your job as an administrator is much simpler as password changes and maintenance is automatically performed. You can read more about using this type of account with PI System Services [here](#) and you can read about migrating to gMSAs [here](#) (both links require a validated OSIsoft customer portal account).

2.4.3 Certificates

You will need SSL Certificates generated for:

- PI AF Server
- PI Vision Server

There are many ways to generate these certificates, and the process you use will be decided by your IT department. You will need to ask your IT department for certificates for these two servers, generated by an authority that is trusted by all users that are going to be using the PI System at your organisation. For more information on these certificates, see the PI Vision documentation [here](#).

During this course we won't be installing PI Vision, but we will be installing PI AF Server, so we will need a certificate. We'll be using a certificate generated by our Domain's Certification Authority. The certificate we're using in this class have similar function to certificates generated by your IT department for use within your corporate domain, trusted by domain-joined computers and users. This is the most common type of certificate used for PI System Services the field.

2.4.4 Service Principle Names

This section relates specifically to the PI Vision and PI Web API components of the PI System. SPNs are used by Kerberos authentication to associate a service instance with a service logon account. If you'll be installing PI Vision and/or PI Web API, you'll need your IT department to set up SPNs for these services before users are able to connect to them. For more information start reading the PI Vision documentation from the chapter on Kerberos Delegation [here](#).

2.5 Background: Firewall Port Requirements

When connecting to any server with PI System software installed, the port for the service(s) installed on the server must be open. This is a task for your IT department to complete before an installation proceeds. All servers in your learning environment already have the required ports open.

A quick summary of inbound ports that must be open for each service:

Service/Product	Port
Data Archive	5450
Asset Framework Server	5457, 5459
PI Notifications	5468
PI Analysis Service	5463
PI Vision	80, 443

A full list of knowledge base articles on this topic can be found [here](#).

A simple way of checking if a port is open from one machine to another is to take advantage of the Test-NetConnection PowerShell cmdlet. Running the following command will attempt a connection to MACHINE on port 5450.

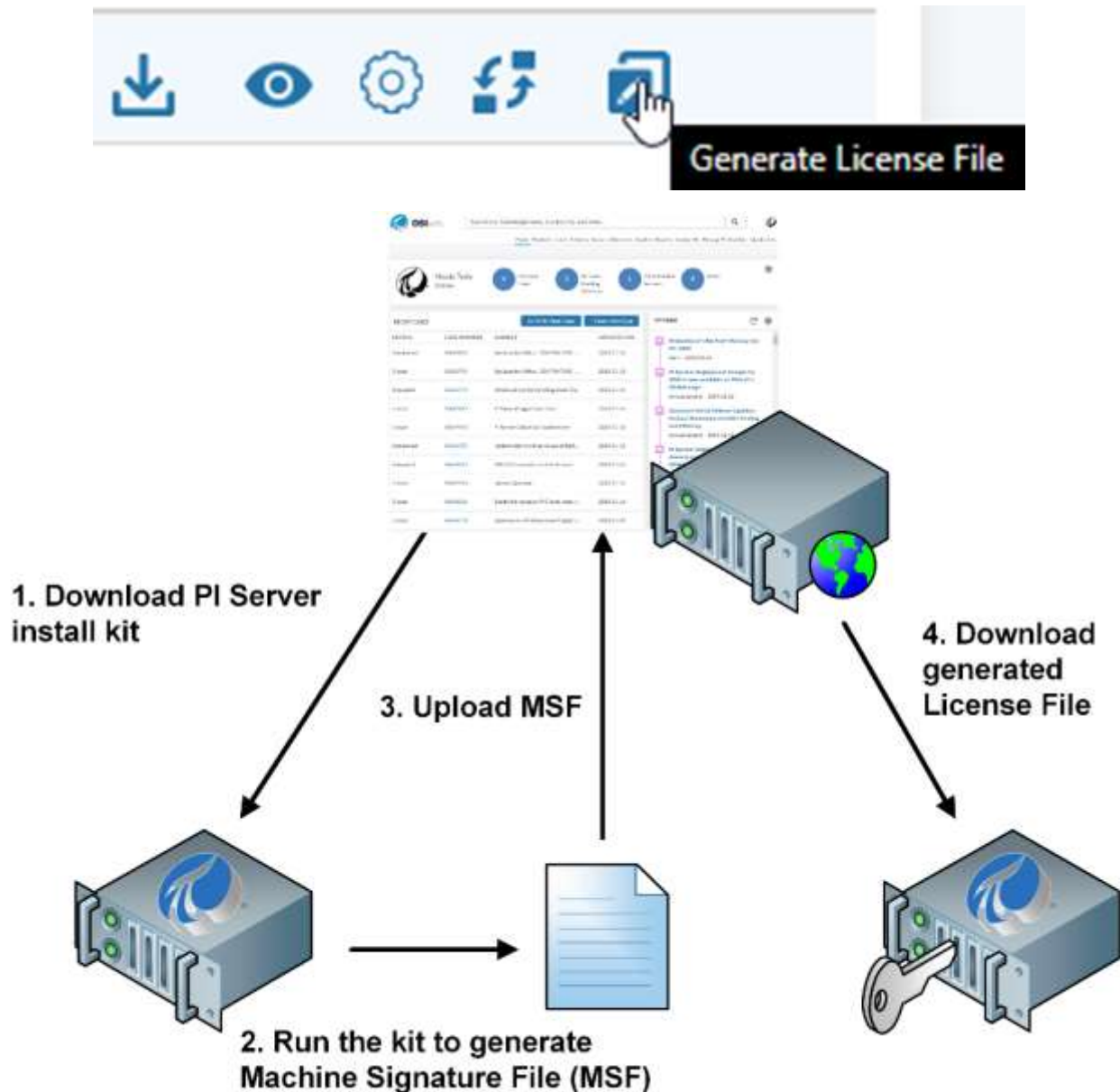
```
Test-NetConnection MACHINE -Port 5450
```

If you see an error, the port is blocked. If you don't see an error, the port is open.

2.6 Background: PI Data Archive License File Activation

A License File must be generated before the PI Data Archive server is installed. The [OSIsoft Customer Portal](#) allows you to generate your site-specific PI Server license file. This license file controls which

applications can run on the PI Data Archive Server and displays running parameters, such as the point count limit.



When the license file is generated, view the PI Server Manifest to verify the server details.

In order to generate license file, a **Machine Signature File (MSF)** is required. The PI Server install kit is capable to generate the MSF by itself, you must copy the install kit to a local disk on the PI Data Archive Server computer and then run the kit.

The kit will generate the MSF file to Documents folder of user running it.

i.e. C:\Users\<username>\Documents

If the PI Data Archive Server is on a virtual machine (VM), run the utility on the VM. If you generate the MSF on the wrong computer (on your laptop, for example) then the license activation file will match the

laptop computer. If you install PI Data Archive Server on a different computer or VM, the server will not run as expected. The license file must be present during the installation. It can be on a flash drive, CD, or any media that can be read by PI Data Archive Server during installation. The setup program copies the license file to the %PISERVER%\dat directory during installation; the original file will no longer be used.

License Generation


A machine signature file (MSF) is needed to generate a machine-specific license file from the [OSIsoft Tech Support](#) website. Setup has proactively created an MSF file in your Documents folder. Click [here](#) to show the MSF file in folder.

The MSF file created by this setup kit is guaranteed to generate a license file that is compatible with PI Server Installer. For this reason use the MSF file created by this setup kit instead of an MSF file created by other tools.

For more information, see the PI Data Archive Installation and Upgrade documentation [here](#).

3. PI Server Installation

3.1 Hands-On: PI Server Installation

 Video	<i>This is a hands-on chapter. It is recommend that you watch the video for this chapter and follow the steps using your own virtual environment: https://youtu.be/TcJ2Nw_R1Lk. Below are the configuration steps performed in the video.</i>
--	--

In this section we cover PI Server Installation. Documentation referenced in this video can be found [here](#).

Below is a step-by-step walkthrough on changes that are made to our virtual environment during this lesson:

Part 1: Data Archive Installation


1. Connect to **PISRV01**
2. Double click the **PI Install Kits** shortcut on the desktop
3. **Right click → Run as Administrator** on the PI Server install kit
4. Click **Next**
5. Select to install the **PI Data Archive** role
6. Change the three installation directories so they all point to **D:** instead of **C:**, keeping the rest of the installation paths the same as default
7. Click **Next**
8. Click the Ellipsis "... " button next to License directory
9. Select the file **D:\PI Install Kits\Training License\pilicense.dat**
10. Click **OK**
11. Change the **Historical** and **Future Archive** data directories to all point to **E:**, keeping the rest of the installation paths as default
12. Change the **Event Queues** directory to point to **D:**, keeping the rest of the installation path as default
13. Click **Next**
14. Click **Install**, and wait until it finishes.

Part 2: Asset Framework Installation

1. Connect to **PISRV02**
2. Double click the **PI Install Kits** shortcut on the desktop
3. **Right click → Run as Administrator** on the PI Server install kit
4. Click **Next**
5. Select to install the **AF Server** and **PI Analysis Service** roles

6. Click **Next**
7. Click **Next** on the **SQL Server Connection** page without making any changes
8. Click **Select** under the **HTTPS** section
9. Click **OK**
10. Click **Next**
11. Change the **PI AF Application Service** to run under **PISCHOOL\SVC-PIAF\$**
12. Change the **PI Analysis Service** to run under **PISCHOOL\SVC-PIANALYT\$**
13. Change the **PI SQL DAS** to run under **PISCHOOL\SVC-PIRTQP\$**
14. Click **Next**
15. Click **Install**, and wait until it finishes.

3.2 Hands-On: Post-Install - Backup

 Video	<i>This is a hands-on chapter. It is recommend that you watch the video for this chapter and follow the steps using your own virtual environment: https://youtu.be/3b7pLe22Nzs. Below are the configuration steps performed in the video.</i>
--	--


Below is a step-by-step walkthrough on changes that are made to our virtual environment during this lesson:

1. Connect to **PISRV01**
2. Open a **command prompt** with the shortcut on the taskbar
3. Type the following commands

```
D:
cd %piserver%\adm
pibackup E:\PIBackup -install
```

4. Click the Windows **Start** button
5. type **Task Scheduler** and press the enter key on your keyboard
6. Click **Task Scheduler Library**
7. Right click on **PI Server Backup** and click **Run**
8. After a few minutes, ensure the backed up files are created at **E:\PIBackup**

3.3 Hands-On: Post-Install - Security

 Video	<i>This is a hands-on chapter. It is recommend that you watch the video for this chapter and follow the steps using your own virtual environment: https://youtu.be/28OSQGrIPVk. Below are the configuration steps performed in the video.</i>
--	--

In this lesson we assume you will exclusively use the modern method to authenticate services and users that connect to the PI Data Archive; PI Mappings. We switch off PI Trusts completely as they're not being used by our system. If your organisation still uses legacy PI Trusts for authentication, we recommend reading the documentation for configuring [PI Interface connections using PI Trusts](#) to fully understand how these work. Even if your organisation has existing trusts, we do not recommend creating any new trusts for new interfaces or services in your system.

Below is a step-by-step walkthrough on changes that are made to our virtual environment during this lesson:

Part 1: Create a Mapping for your administrator user

1. Connect to **PISRV01**
2. Through the Start menu, open **PI System Management Tools**
3. Navigate to **Security → Mappings and Trusts**
4. Click **New Mapping** in the top left corner
5. Enter the following
 - Windows Account: **PISCHOOL\student01**
 - PI Identity: **piadmins**
6. Click **Create**
7. Close and reopen **PI System Management Tools**
8. Navigate back to **Security → Mappings and Trusts**
9. Ensure the account name in the bottom left hand corner says **"PISCHOOL\student01 | piadmins, PIWorld"**. If it still says **piadmin** (without the s on the end) go back and begin these steps again.

Part 2: Create an Identity and Mapping for the Analysis Service

1. Navigate to **Security → Identities, Users and Groups** inside **PI System Administration Tools** on **PISRV01**
2. Click the **New Identity** button in the top left of the window
3. Type the name **SVC-PIANALYT**
4. Click **Create**
5. Navigate to **Security → Database Security**
6. Double click on **PIPOINT**
7. Click **Add**
8. Select **SVC-PIANALYT**
9. Click **Add**
10. Check the box next to **Write**
11. Click **OK**

12. Navigate to **Security → Mappings & Trusts**
13. Click **New Mapping** in the top left corner
14. Enter the following
 - Windows Account: **PISCHOOL\SVC-PIANALYT\$**
 - PI Identity: **SVC-PIANALYT**
15. click **Create**

Part 3: Disable the Temporary Lookback Trust *[Note: This step should only be done for new PI Systems, or if you have already checked that you do not have any applications that require the loopback trusts to be in place to function]*

1. Navigate to **Security → Mappings & Trusts** inside **PI System Administration Tools** on **PISRV01**
2. Click the **Trusts** tab at the top of the screen, just below the row of buttons
3. Double click the only trust in the list: **!Proxy_127!**
4. Check **Trust is Disabled**
5. Click **OK**

Part 4: Raise the Security Slider to Maximum *[Note: This step should only be done for new PI Systems, or if you have already checked that you do not have any applications that require trusts to be in place to function]*

1. Navigate to **Security → Security Settings** inside **PI System Administration Tools** on **PISRV01**
2. Drag the Slider up to the top
3. Click **Save**

Part 5: Restart the Data Archive Services

1. On **PISRV01**, start a **command prompt** with the shortcut in the taskbar
2. run the following commands:
D:
cd %piserver%\adm
pisrvstop.bat
pisrvstart.bat

3.4 Knowledge Check: Final Post-Install Tasks

Great, so we've installed our server, let all the services in, and configured backups. Except... we forgot one service. During installation of the AF server, we were asked for a service account for the Real-Time Query Processing (RTQP) Engine Service to run under. The RTQP service requires read access to the PI Data Archive. If we have a service that needs access to the Data Archive - what do we need to create to let it in?

That's right - a **mapping**.

3.4.1 Exercise - Create a Mapping

Follow the steps below to create the mapping for our RTQP Engine service:

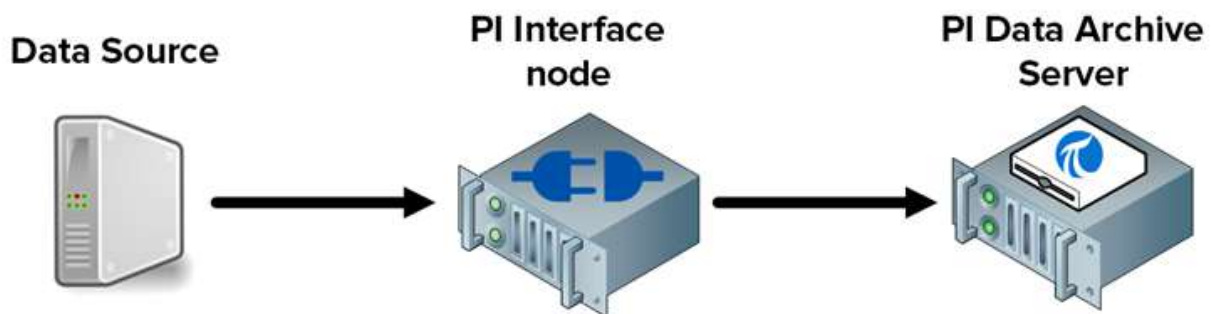
1. Connect to PISRV01
2. Open PI System Management Tools (SMT)
3. Use PI SMT to create an identity for the service, and a mapping for the account to the new identity. During installation of the AF Server we specified PISCHOOL\SVC-PIRTQP as the account to run the RTQP Engine Service.

4. PI Interface Installation

4.1 Background: How Does the PI System Connect to Data Sources?

There are a number of software components that can be used to extract data from a data source and store it in the Data Archive and/or the AF Server. If you have a data source that you'd like to read from, the easiest way to find the appropriate software component is to search our [Interface List](#). The search on this page finds any of the below components that can connect to your desired data source, and directs you to references where you can find out more.

4.1.1 PI Interfaces



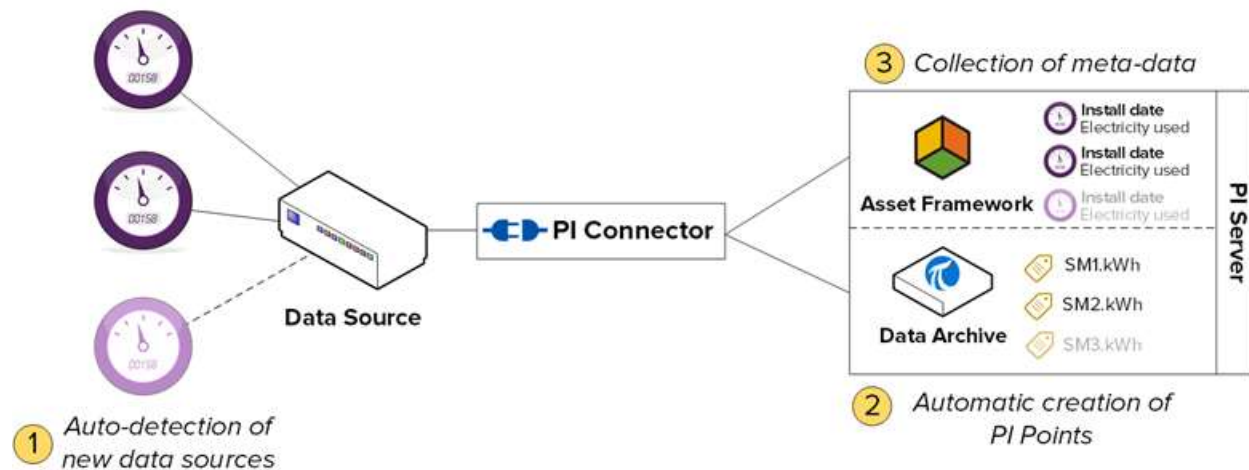
OSIsoft has over 450 different interfaces in its library of software, and their reliability and resiliency has made them an industry standard for decades. They do not automatically synchronise data streams or asset hierarchies from a data source to a PI System. Configuration and maintenance must be manually done by the administrator for the most part.

We will focus on interfaces in this class because:

- They are by far the most common method of connecting a PI System to a data source that you will find in the wild
- They require far more maintenance and setup by PI System Administrators than other connection technologies - if you are a PI System Administrator in the early 2020s in almost any organisation that uses the PI System, you **must** be familiar with interface configuration and maintenance

So even though they are the oldest technology we list on this page - and we recommend using any of the more modern methods below where possible, we'll still focus on Interfaces in this course.

4.1.2 PI Connectors



PI Connectors follow a much more modern design and architecture, and require considerably less maintenance and management than interfaces. Their features most notably include automatic point creation - normally a very time consuming task for PI System Administrators that manage interfaces. If you can find a PI Connector that supports your data source using the aforementioned interface list search, you should use it over an equivalent interface in almost every case. The technologies may not completely overlap and you may need to reconsider your architecture, but it will be a worthwhile exercise.

For example, you'd like to read from a data source that supports several different OPC standards. The source is capable of being both an OPC UA and OPC DA server. In this case you would most likely be much better off using the PI Connector for OPC UA over the PI Interface for OPC DA. Before making a choice between connection technologies, thoroughly read the documentation for each.

4.1.3 PI Adapters


PI Adapters are a newer technology, designed for fast deployment on low-power equipment. They are not managed through user interaction, but through programmatic service calls. Configuring PI Adapters are beyond the scope of this course, but if you have a scenario where there is highly distributed equipment and must extract that data using low-power consuming devices that must be managed in bulk, you may want to look into PI Adapters. You can find out more on [PI Live Library](#) under the "Edge" subheading.

4.1.4 Custom Applications

Many organizations develop their own applications to both read from and write to the PI System using technologies such as [PI AF SDK](#), [PI Web API](#), or [OMF](#). The use of these

technologies is beyond the scope of this course, but as a PI System Administrator, you should know that programmatically accessing or writing to the Data Archive and Asset Framework components is always an option if you can't find an out-of-the-box method of integrating systems together.

4.2 Hands-On: PI Interface Installation

 Video	<i>This is a hands-on chapter. It is recommend that you watch the video for this chapter and follow the steps using your own virtual environment: https://youtu.be/emNsxVcfHQE. Below are the configuration steps performed in the video.</i>
--	--

Below is a step-by-step walkthrough on changes that are made to our virtual environment during this lesson:

Part 1: Install the PI Interface Configuration Utility

1. Connect to **PIINT01**
2. Open the **PI Install Kits** folder on the desktop
3. On the installer for **PI ICU**, right click → **Run as Administrator**
4. Click **OK**
5. Click **OK**
6. For the **Default Data Server**, input: **PISRV01**
7. Click **Next**
8. Change the installation directories to install to **D:** instead of **C:**. Keep the rest of the paths the same as the default.
9. Click **next**, and continue through the rest of the installer

Part 2: Install the PI Interface for OPC DA (Read only)

1. On the installer for the **OPC Interface**, right click → **Run as Administrator**
2. Click **OK**
3. Click **OK**
4. Click **Next**
5. Continue through the rest of the installer until it is complete

Part 3: Install the PI API for Windows Integrated Security

1. On the installer for the **PI API for Windows Integrated Security**, right click → **Run as Administrator**
2. Click **OK**
3. Click **Install**
4. Continue through the rest of the installer until it is complete

4.3 Knowledge Check: Confirming Connectivity


This step should have been done during prerequisites, but it's usually a good idea to make sure the interface machine can connect to the correct port on the Data Archive machine before even getting started installing. This way, if the port is blocked you can contact your IT department and make sure the issue is resolved before you need to configure the system.

1. Open your connection to PIINT01
2. On PIINT01, open a Windows PowerShell console
3. Type and run the following command:

```
Test-NetConnection PISRV01 -Port 5450
```

This command will attempt to initiate a TCP connection on port 5450 to PISRV01, our Data Archive. If successful, it means that we should be able to proceed with our configuration of our interface. If the command gives an error, it means you need to talk to your IT department about allowing a connection from your interface machine through to your PI Data Archive on port 5450.

4.4 Hands-On: PI Interface Configuration

 Video	<i>This is a hands-on chapter. It is recommend that you watch the video for this chapter and follow the steps using your own virtual environment: https://youtu.be/7MyWwfbBVzI. Below are the configuration steps performed in the video.</i>
--	--

References in this Video:

- Find more information on the PI Interface for OPC DA [here](#)
- Find more information on the PI Buffer Subsystem [here](#)
- If configuring an interface instance to read from an OPC Server **not** on the same machine as the instance, you must go through DCOM configuration, explained [here](#).

NOTE: During this course we assume that the interface machine is a member of the same Windows Domain as the PI Data Archive, and set up authentication with this in mind. If policies within your organisation do not allow this, authentication can still be configured with the use of Windows Credential Manager. Read more about this in the knowledge base article [here](#) (requires a validated OSIsoft customer portal login account).

Below is a step-by-step walkthrough on changes that are made to our virtual environment during this lesson:

Part 1: Create the Identity and Mapping for the interface connection on the PI Data Archive

1. Connect to **PISRV01**
2. Open **PI System Management Tools** through the **Start** menu
3. Navigate to **Security → Identities, Users and Groups**

4. Click **New...** in the top left corner
5. Type the name **SVC-PIINT**
6. Click **Create**
7. Navigate to **Security → Mappings and Trusts**
8. Click **New...** in the top left corner
9. Type the following details
 - Windows Account: **PISCHOOL\SVC-PIINT\$**
 - PI Identity: **SVC-PIINT**

Part 2: Configure the Interface Instance

1. Connect to **PIINT01**
2. Open the **PI Interface Configuration Utility (ICU)** from the Start menu
3. Click the **Interface** menu at the top → **New Windows Interface Instance from BAT File...**
4. Select the file **D:\Program Files (x86)\PIPC\Interfaces\OPCInt_ReadOnly\OPCInt_ReadOnly.bat_new**
5. Select **PISRV01** from the drop down menu
6. Click **OK**
7. Click the **OPCInt** menu in the side-bar down the left hand side
8. Click the **List Available Servers** button
9. Open the drop-down menu under **OPC Server Name:** and select **OPCSample.OpcDa20Server.1**
10. Click **Apply** in the bottom right corner
11. Click the **Service** menu in the side-bar down the left hand side
12. Click the **Create** button

Part 3: Configure Buffering

1. On **PIINT01**, Inside the **ICU**, click the menu at the top of the window **Tools → Buffering**
2. Click **Yes**
3. Click **Continue with configuration**
4. Check the box next to **PISRV01**
5. Click **Next**
6. Click **Next**, then click **Yes**
7. Change the Buffer location to **D:\Buffer**
8. Click **Next**

9. Click **Exit new installation wizard**

Part 4: Configure Service Accounts

1. On **PIINT01**, open **Computer Management** with the shortcut in the taskbar
2. Navigate to **System Tools → Local Users and Groups → Groups**
3. Double Click on **PI Buffering Administrators**
4. Click **Add**
5. search for the account **svc-piint** and click **Check Names**, then **OK**
6. Click **OK**
7. Open the **Windows Services** applet with the shortcut in the taskbar
8. On the **PI Buffer Subsystem** service **right click → Properties**
9. Go to the **Log On** tab
10. Change it to run under **This account** and fill in **PISCHOOL\SVC-PIINT\$** as the name, and leave the passwords blank
11. Click **OK**, and **OK** again until you are brought back to the services console
12. Repeat steps 8 through 11 for the **PI-opcint_ReadOnly1** service, making it also run under the **PISCHOOL\SVC-PIINT\$** account
13. Right click and restart the **PI Buffer Subsystem** service
14. Close all **ICU** and **Buffer Manager** windows

Part 5: Configure Dependencies and Start the Interface Instance

1. On **PIINT01**, open the **ICU**
2. Select **opcint_ReadOnly1 -> PISRV01** from the large drop down select box at the top of the window
3. Click the **Service** menu in the side-bar down the left hand side
4. Click **Yes**
5. Click the **play ►** button at the top of the window to start the interface

4.5 Knowledge Check: The Bufferer, the Betterer

We have configured an interface, configured buffering for it, and confirmed that everything is working. But, there's another opportunity to configure buffering in our system.

The PI Analysis service, which we installed on PISRV02, also writes data to the PI Data Archive. The Analysis service is in charge of watching the Asset Framework server for calculations and analytics it should run, running the analytics, and writing the results to PI Points. Actual configuration of these calculations is done in other training classes and we won't configure them here, but it's our responsibility to make sure things work reliably once analytics start

running. Because the analysis service needs to write to PI Points, it also benefits from buffering being configured. Follow the below steps to configure buffering for this service.

Note: When performing most actions in this course in a production environment, you should **not** be logging directly into the server machines. This activity is an exception, however. You must configure buffering while being logged in to the machine itself.

1. Connect to **PISRV02**
2. The Interface Configuration Utility isn't installed on this machine - but that's ok. We can access the buffer manager from **PI System Explorer (PSE)** too. Open **PSE** by clicking **Start > PI System > PI System Explorer**.
3. Select **Tools > Buffering Manager**
4. Click **Yes** to the question asking if you'd like to configure buffering
5. Click **Continue with Configuration**
6. Change the Buffer location to **D:\Buffer**
7. Click **Next**
8. Exit the Wizard

Now we've configured buffering, we need to make sure it connects to the PI Data Archive using an account that can write to analysis points. In an earlier exercise, we configured the SVC-PIANALYT group managed service account to have these privileges.


9. Open the **Windows Services** panel by clicking on the icon for it in the taskbar
10. Modify the **PI Buffer Subsystem** service so it logs in as the **PISCHOOL\SVC-PIANALYT** account (hint: this account is a group-managed service account so you may need to do special things with dollar signs and passwords. If you don't know what to do, the configuration is very similar to the configuration we did in the interface buffering video, but with a different account this time).
11. Create a service dependency for **PI Analysis Service** on **PI Buffer Subsystem** to ensure that PI Buffer Subsystem starts first on machine start. To do this, run **Windows command prompt** with the icon in the taskbar and execute the following command:

```
SC CONFIG PIAalysisManager depend= pibufss
```

12. Open **Computer Management** from the Windows Start menu. Navigate to **System Tools → Local Users and Groups → Groups**
13. Double click on the **PI Buffering Administrators** group, and add the **SVC-PIANALYT** account to the group
14. Use the **Windows Services** panel to restart the **PI Buffer Subsystem service**. It should warn you that it will restart the PI Analysis service as well.
15. Close and reopen **Buffering Manager**. The status indicator should be green if you have configured buffering correctly.

5. PI Point Management

5.1 Hands-On: Creating Points for Interfaces

 Video	<i>This is a hands-on chapter. It is recommend that you watch the video for this chapter and follow the steps using your own virtual environment: https://youtu.be/n89Acel0Q40. Below are the configuration steps performed in the video.</i>
--	--

References for this video:

- In this video we cover creating our first point that will be loaded on our OPC Interface instance. All point attribute configuration for the OPC Interface is detailed [here](#).
- When using other interfaces, check the documentation for appropriate PI Point configuration. All interfaces have a similar point attribute configuration section in their documentation.

Below is a step-by-step walkthrough on changes that are made to our virtual environment during this lesson:

Part 1: Create a Point


1. Connect to **PISRV01**
2. Open **PI System Management Tools (SMT)** from the **Start** menu
3. Navigate to **Points → Point Builder**
4. Fill in the following attributes, on their corresponding tabs:
 - General
 - Name: **pump1.bearingtemp**
 - Descriptor: **Bearing Temperature of Pump 1**
 - Point Source: **OPC**
 - Eng Units: **degc**
 - Classic
 - Location 1: **1**
 - Location 2: **0**
 - Location 3: **1**
 - Location 4: **1**
 - Location 5: **0**
 - Instrument Tag: **Sample Process/Pump1/BearingTemp**

- Security
 - **Data Security → Add... → SVC-PIINT → Check both the Read and Write boxes**
- 5. Click **Save** in the top left
- 6. Wait for at least 2 minutes


Part 2: Confirm the new tag is receiving new data

1. On **PISRV01** inside **SMT**, navigate to **Data → Current Values**
2. Click the **Tag Search** in the top left corner
3. Enter a Point Source of **opc**
4. Click **Search**
5. Click **Select All**
6. Click **OK**
7. Click the **play ►** button at the top of the window to start updating values
8. Ensure your tag's value changes every few seconds

5.2 Background: Explore PI Points and Interfaces

 Video	<i>This is a background chapter with video content only. It is recommend that you watch the video for this chapter: https://youtu.be/Yleu86Y3SH4.</i>
--	--

5.3 Background: Compression and Exception

 Video	<i>This is a background chapter with video content only. It is recommend that you watch the video for this chapter: https://youtu.be/6-scv3oQ7Kk.</i>
--	--

Exception and Compression for points is controlled on a point-by-point basis. The Excdev, Excmax, Compdev and Compmax explained in the video are in the "archive" tab on Point Builder in PI System Management Tools. Go ahead and look at the settings on the points you already have set up.

For more details on how Exception and Compression works, see the [full details](#) video.

5.4 Reference: The Interface User Manual

Every PI System component, including Interfaces, has a corresponding User manual. Documentation for the most common interfaces and connectors can be found on [OSIsoft Live Library](#), under the "Interfaces and Connectors" subheading (you may need to click the "+ View

More" button below to see the whole list). In this class we're using the PI Interface for OPC DA, who's documentation can be found [here](#).

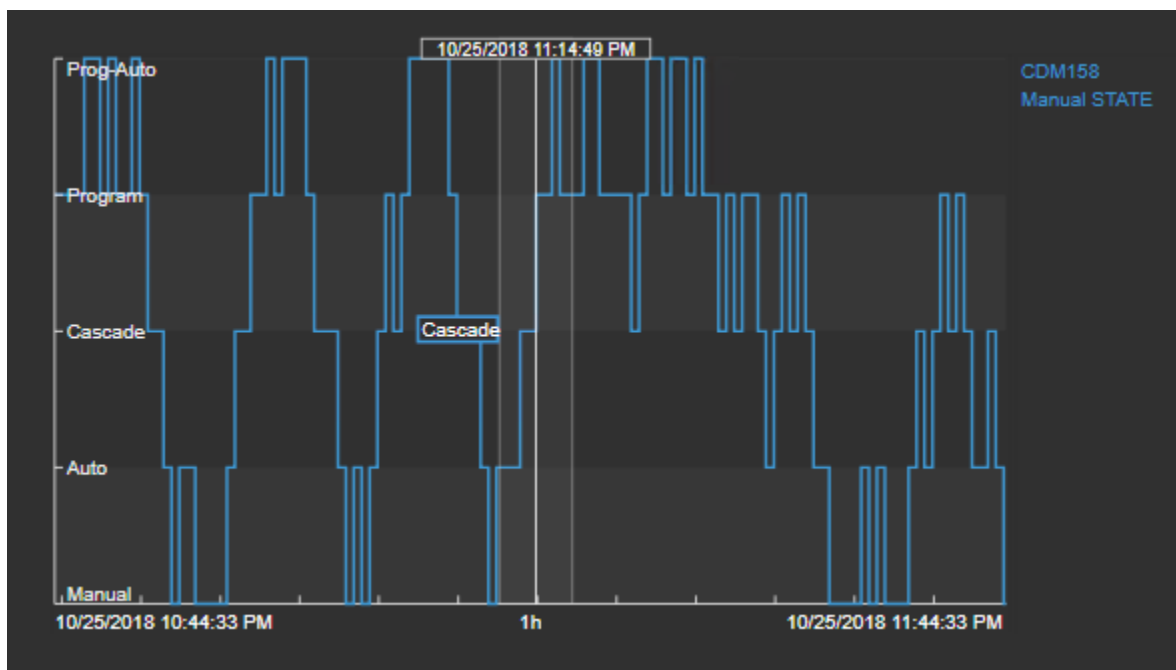
As a PI System Administrator, you'll become very familiar with the documentation for the interfaces your organisation uses. The most common places you'll refer to are the sections for [PI Point Configuration](#). We recommend reading through some of this section now and growing accustomed to it, now you know the basics of creating points in the PI Data Archive. Every interface has a similar section, and most interfaces have different requirements when it comes to point configuration - you'll need to read this section of the documentation each time you're configuring a new interface type.

5.5 Knowledge Check: Creating Digital Points

5.5.1 Introduction to Digital Points

When creating a PI Point, you must specify a **Point Type**. So far we've only used the default **float32** point type, which allows a point to store single-precision floating-point numbers. The PI Data Archive also allows you to store a few other types of data, most notably digital data.

5.5.2 Digital State Sets



PI Points of type **Digital** are used to store data values that have discrete states exemplified above. Example of typical states are Open/Closed for a valve or On/Off for a switch. While the user is interested in the actual state, PI Data Archive stores this information as an integer. This integer is then associated with a **Digital State Set**; a grouping of these states. Whenever the value is requested, PI Data Archive

retrieves the integer value, does a lookup in the Digital State Set, and then presents the associated text value.

Digital Sets are kept in a common table for all points of type Digital to access. The Digital State Set must exist prior to the creation of the digital point. When defining a point use the DigitalSet attribute to store the associated **Digital Set** name. The digital states are case preserving, but not case sensitive, so you can refer to them with upper and lower case, but any display will show the configured upper or lower case. There is a large default set called **System** that contains system error messages and other information. All points, including non-digital points, can receive and archive a state from the System digital states set (Shutdown, PtCreated, Over Range, Under Range, I/O Timeout, etc.).

Warning: Do not edit the SYSTEM set on your PI System!

5.5.3 Exercise: Create a Digital State Set and Point

One of the tags on our OPC Server is a digital tag. It has an itemID of **Sample Process/Pump1/Status**. The tag sends through integers 0 through 4, and you've asked the operations team what these numbers correspond with. You'd like your users to see the name of the state rather than just the number when they're looking at the tag's value in the system.

State Name	State Number
Off	0
Startup	1
Running	2
Warning	3
Error	5

We'd like to create a point to archive this controller's mode of operation. However, in order to build the point, you will first need a digital state set.

1. On PISRV01 open the PI SMT and navigate to Points → Digital States plug-in.
2. Create new Digital State Set called PumpStatus.
3. Fill the State Names according the table above.
4. Save it and restart PI SMT. We need to do this for the Point Builder to pick up the new state set.
5. Navigate to Points → Point Builder plug-in.
6. Create a new point with the following attributes:
 - **General Tab:** Name: pump1.status; Description: Status of Pump 1; Point Source: OPC; Point Type: Digital; Digital Set: PumpStatus

- **Classic Tab:** Location 1: 1; Location 3: 1; Location 4: 1; Instrument Tag: Sample Process/Pump1/Status
 - **Security Tab:** Add the SVC-PIINT identity to Data Security, and give it Read/Write permission
7. Save the configured PI Point.
 8. Wait for the PI Interface to start collecting data for the new point.
 9. Check the updates in Data → Current Values.

5.6 Knowledge Check: Confirming Interface Operation

You should now have a working interface. This exercise will guide you through some checks to confirm its operation.

5.6.1 Part 1: Check that you are receiving data for all points belonging to the interface in the PI Data Archive

You should now have a working interface. This exercise will guide you through some checks to confirm its operation.

Part 1: Check that you are receiving data for all points belonging to the interface in the PI Data Archive

1. Connect to **PISRV01**
2. Open **PI System Management Tools (SMT)**
3. Navigate to **Data > Current Values**
4. **Search** for all points that share a point source with your interface, and add them to the list of tags in the **Current Values** plugin
5. Ensure all points have recent timestamps (note that the virtual environment is in UTC, and may have a different timezone to your own), and click the **Start Updating** button. You should see new values come through every now and again.


5.6.2 Part 2: Check that data is flowing through the buffer

Note: It is possible for an interface to be sending data to the PI Data archive without it travelling through the buffer - but this is not what we want. Follow these steps to ensure that your data is being properly buffered by the PI Buffer Subsystem before being sent on to the PI Data Archive

1. Connect to **PIINT01**
2. Open the **PI Interface Configuration Utility (ICU)**
3. Navigate to **Tools > Buffering**

4. Ensure that the **X total events sent** is greater than zero, and you are getting a non-zero number of **events per second**. The number of **total events sent** should be increasing over time.
5. Ensure that the **X events in queue** settles at around zero events. Every now and again it may increase to a number greater than zero, then settle down again. You can use these numbers to diagnose issues. If the **X events in queue** number is going up, it means that the buffer is having trouble connecting to the PI Data Archive or does not have adequate bandwidth to send all the data it needs to. If the **X total events sent number** is not increasing, it means that the interfaces on this machine are not generating and/or sending data through - this is most likely a problem with the interface configuration and the interface message log should point you in the right direction.

5.7 Hands-On: Creating Points in Bulk

 Video	<p><i>This is a hands-on chapter. It is recommend that you watch the video for this chapter and follow the steps using your own virtual environment:</i></p> <p>https://youtu.be/XJwH_WZqob0. Below are the configuration steps performed in the video.</p>
--	--

Note: When opening Excel for the first time, you may be asked if you want to install the PI Builder Plugin. If you are, select **Install**. If you still *do not* see the **PI Builder** ribbon when you open a new workbook, you can enable it by doing the following:

1. Click the **File** ribbon in the top left corner of the window
2. Click **Options**
3. Select the **Add-Ins** option in the left sidebar
4. Change the drop-down select menu, Manage: **COM Add-ins**
5. Click **Go...**
6. Check the box next to **PIAFBuilder**
7. Click **OK**
8. You should now see the **PI Builder** ribbon at the top of the window

During this exercise, we connect to PISRV01 and modify the spreadsheet "C:\Class Documents\Exercise Files>tag export from DCS.xlsx". To skip the work done in this video and go straight to the solution, you can do the following:

1. Connect to **PISRV01**
2. Open **C:\Class Documents\Exercise Files\Solution\Pump Current Point Creation Solution.xlsx**
3. Select the **PI Builder** ribbon
4. Ensure the **Data Server** in the top left is **PISRV01**
5. Click the **Publish** button
6. Select **Create and Edit** in the select box

7. Click **OK**
8. If you receive any errors about digital state sets, see the previous lesson Creating Digital Points.

(In the video we specifically say **NOT** to use create and edit mode. This is specifically aimed at those modifying production systems. In this case, because we're applying a solution, it doesn't matter much and we do want to overwrite all current configuration)

5.8 Knowledge Check: The PI Data Archive Message Log

A very important part of troubleshooting and configuring a PI System is becoming familiar with the message logs on both the PI Data Archive and your Interface machines.

5.8.1 Exercise - Explore the PI Data Archive Message Log

1. Connect to **PISRV01**
2. Open **PI System Management Tools{ (SMT)}** and navigate to **Operation > Message Log**
3. Click the **Retrieve Messages** button in the top left. It is shaped like a magnifying glass. If no messages are returned, you may need to modify the "End:" entry and search for messages over a larger time range.



4. Scroll through the log, and modify the start and end times where needed. Try to find messages similar to the following:

```
[Server] PISRV01 [ID] 7082 [Time] 10/16/2020 2:59:19 AM [Program] pinetmgr [Priority] 10
[ProcessOSUser] pinetmgr [ProcessID] 3252 [Severity] Debug
Successful login ID: 16. Address: . Name: SMTHost.exe. Identity List: piadmins | PIWorld. Environment
Username : PISCHOOL\student01. Method: Windows Login (SSPI,NTLM,HMAC-MD5,RSADSI RC4,128)
```

This message indicates that a successful connection was made from SMTHost.exe (the name for the PI System Management Tools application), by PISCHOOL\student01 (the Windows account we are logged in with). This is the confirmation message that appeared in the log just now when we opened up SMT and connected. Every connection attempt is logged in the PI Server message log. This makes it an incredibly useful tool for

troubleshooting security problems. In the next few steps, we're going to create own security problem and see what the log files look like throughout.

5. In **SMT**, navigate to **Security > Mappings & Trusts**.
6. Double click on the mapping for **SVC-PIINT**, check the box next to **Mapping is disabled** and click ok.
7. On **PIINT01**, open the **PI ICU** and open a scrolling log with the **View current PI Message log continuously** button. [Note: The Message log on an interface machine can also be viewed and searched with an installed application called **PI SDK Utility**, available on the Windows Start menu]
8. Open **Windows Services**, and restart the **PI Buffer Subsystem** service. Select **Yes** to the prompt asking if you want to also restart your interface.
9. You should see an error message in your scrolling log similar to the following:

```
E 16-Oct-20 03:14:22 pibufss:pibufmgr<PISRV01> (2102)
>> Error connecting to server PISRV01:5450, [-10431] Authentication method is disabled by current
server policy
Attempt 1: [SSPI], [-10407] No Access - Secure Object, details: none
Attempt 2: [TRUST], [-10431] Authentication method is disabled by current server policy, details: none
```

This error indicates that the buffer attempted to connect to the Data Archive, but it was not allowed in. A good rule of thumb is that if you see any error in a log with an error code in the form 104XX - you should check your mappings and trusts, and make sure that the account has the required privileges.

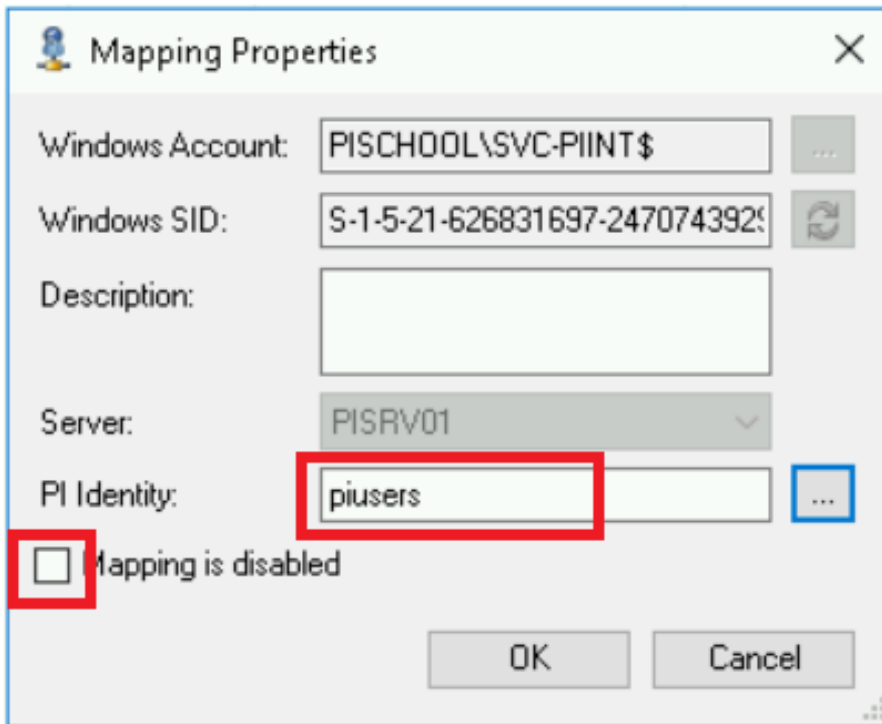
10. On **PISRV01**, in **SMT**, navigate back to the **Message Logs** and click **Retrieve Messages**. Try to find some messages like the following:

```
[Server] PISRV01 [ID] 7138 [Time] 10/16/2020 3:20:22 AM [Program] pinetmgr [Priority] 10
[ProcessOSUser] pinetmgr [ProcessID] 3252 [Severity] Information
Unsuccessful login ID: 28. Address: 192.168.0.22. Name: pibufss(5348):remote. Credentials used:
PISCHOOL\SVC-PIINT$. Method: Windows Login (SSPI,Kerberos,HMAC-SHA1-96,Kerberos AES256-CTS-
HMAC-SHA1-96,256). Error: [-10433] No identity mapping for this request
```

```
[Server] PISRV01 [ID] 7138 [Time] 10/16/2020 3:20:22 AM [Program] pinetmgr [Priority] 10
[ProcessOSUser] pinetmgr [ProcessID] 3252 [Severity] Information
Unsuccessful login ID: 28. Address: 192.168.0.22. Name: pibufss(5348):remote. Credentials used:
PISCHOOL\SVC-PIINT$. Method: Trust. Error: [-10431] Authentication method is disabled by current
server policy
```

These messages indicate that the buffer attempted to authenticate to the data archive using a Mapping, then a legacy Trust. Both have failed.

11. On **PISRV01**, in **SMT**, navigate back to **Mappings & Trusts** and re-enable your mapping. Before clicking OK, change its **PI Identity** to **piusers**. This will make your interface be given the piusers identity instead of the SVC-PIINT identity.



12. On PIINT01, restart the PI Buffer Subsystem service

13. Check your scrolling log. You should see a lot of errors similar to the following:

```
E 16-Oct-20 03:29:14 pibufss:pibufmgr<PISRV01> (2111)
>> Error -10401 encountered while posting to point ID 28.
event time: 16-Oct-20 03:28:55.24400, value: 103.08, mode: precomp_arc.
```

This error indicates that the buffer service cannot write to this point because it doesn't have permission to. By default the piusers identity doesn't have write access to tags, only read access. Note the 10401 error code. If we got this error in a production system, we'd go straight for the security tabs to check configuration to try to clear this error.

14. Check your **PI Server message log** again, and click **Retrieve messages**. You should see this message:

```
[Server] PISRV01 [ID] 7082 [Time] 10/16/2020 3:28:54 AM [Program] pinetmgr [Priority] 10
[ProcessOSUser] pinetmgr [ProcessID] 3252 [Severity] Debug
Successful login ID: 34. Address: 192.168.0.22. Name: pibufss(944):remote. Identity List: piusers |
PIWorld. Environment Username : PISCHOOL\SVC-PIINT$. Method: Windows Login (SSPI,Kerberos,HMAC-
SHA1-96,Kerberos AES256-CTS-HMAC-SHA1-96,256)
```

Our buffer subsystem has connected with the identity "piusers". When troubleshooting, we use both the logs on the Interface, and on the PI Data Archive to identify the problem here. We see that the interface is connecting as the identity "piusers", and it is

having trouble writing to the interface's points. We can conclude that the "piusers" identity doesn't have permission to write to the points.

15. On **PISRV01**, in **SMT**, navigate back to **Mappings & Trusts** and change the mapping's **PI Identity** back to **SVC-PIINT**.
16. On **PIINT01**, restart the **PI Buffer Subsystem** service.
17. Check message logs on both the interface and the Data Archive. All errors should now be cleared.

When going through the rest of this class, we recommend coming back to the PI Data Archive message log and taking a look at the messages every now and then. When newly installed and configured services connect, and when troubleshooting any issues you face, you'll find a wealth of information in this log.

5.9 Knowledge Check: Creating More Points

Right after we created our points in bulk - one of your engineers called you and ask you to also add another tag for pump input current. They've helpfully given you a DCS export for the current tags for your pumps, but it's in a different format to the last one they gave you!

5.9.1 Exercise - Create Points for Pump Current

1. Connect to **PISRV01**
2. Open the **Exercises** folder on the desktop, and navigate to the spreadsheet called "**currenttags.csv**".
3. Edit the file in **Microsoft Excel** so **PI Builder** can export the tags to the PI Data Archive, then export them.
4. Use the **Current Values** plugin in **PI SMT** to ensure you're seeing new data come in to the PI Data Archive for your new tags for pump current.

5.9.2 Exercise Solution


A solution spreadsheet can be found inside the Exercises folder on your virtual environment. To skip this exercise and simply apply the solution, do the following:

1. Connect to **PISRV01**
2. Open **C:\Class Documents\Exercise Files\Solution\Bulk Point Creation Solution.xlsx**
3. Select the **PI Builder** ribbon
4. Ensure the **Data Server** in the top left is **PISRV01**
5. Click the **Publish** button
6. Select **Create**

7. Click **OK**

6. Improving Interface Reliability

6.1 Background: Interface Redundancy

 Video	<i>This is a hands-on chapter. It is recommend that you watch the video for this chapter and follow the steps using your own virtual environment: https://youtu.be/atAFzUHx9jq. Below are the configuration steps performed in the video.</i>
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References used in this video:

- For different failover scenarios and how the interface reacts, see [this chapter in the documentation](#).

6.2 Knowledge Check: Preparing a Second PI Interface

We're about to set up two interfaces to be a redundant pair. But before we do that - we have to have a second interface machine, with exactly the same configuration as the first.


6.2.1 Exercise: Configure an OPC Interface on PIINT02

We'll need our PIINT02 configured in exactly the same way as our PIINT01. Follow the steps below. You may need to refer to earlier lessons in this course if you don't remember the exact steps. The "PI Interface Configuration" lesson earlier in the course covers steps 2 through 4 of this exercise.

1. To save time, the PI Interface for OPC DA, the Interface Configuration Utility (ICU) and the PI API for Windows Integrated Security are already installed on PIINT02 - there's no need to run the installers, and no need to juggle while you wait for the install to complete. Open the ICU and move to the next step.
2. Configure an OPC Interface Instance on PIINT02, using the same settings as on PIINT01. Do **not** start the interface yet.
3. Configure Buffering on PIINT02.
4. Configure the interface instance and the PI Buffer Subsystem to run under the SVC-PIINT account, and give the account appropriate permissions to run the buffer.
5. Connect to PIINT01 and turn off the interface with the stop button on the ICU.
6. Start the new interface instance on PIINT02. Ensure you are getting updated data by viewing the interface's points in PI System Management Tools.

Once you have data flowing, you're ready for the next lesson.

6.3 Hands-On: Configure UNIINT Failover

 Video	<i>This is a hands-on chapter. It is recommended that you watch the video for this chapter and follow the steps using your own virtual environment: https://youtu.be/hranir0BEM4. Below are the configuration steps performed in the video.</i>
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Below is a step-by-step walkthrough on changes that are made to our virtual environment during this lesson:

6.3.1 Part 1: Prepare the shared folder

1. Connect to **PIINT02**
2. Open **Windows File Explorer** using the shortcut on the taskbar
3. Navigate to **D:**
4. Right click in the white space and create a new folder called **Interface Failover**
5. On your new folder, **Right click → Properties**
6. Select the **Sharing** tab
7. Click **Advanced Sharing**
8. Check **Share this folder**
9. Click the **Permissions** button
10. Click the **Add...** button
11. Click the **Object Types** button
12. Check **Service Accounts**
13. Click **OK**
14. Enter the object name **SVC-PIINT\$** and click **Check Names**
15. Click **OK**
16. Check the **Full Control → Allow** checkbox
17. Click **OK**

6.3.2 Part 2: Configure failover on one interface

1. On **PIINT02**, Open the **PI Interface Configuration Utility (ICU)**
2. Select the interface instance **opcint_ReadOnly1** -> **PISRV01** from the Interface drop-down select box
3. Select the **UniInt → Failover** menu on the left side of the window
4. Check the **Enable UniInt Failover** checkbox
5. Enter the following numbers:
 - Failover ID# for this instance: **2**

- Failover ID# of the other instance: **1**
- 6. Click the **Browse** button next to **Failover ID# of the other instance**
- 7. Select **PIINT01 → opcint_ReadOnly1**
- 8. Click **OK**
- 9. Under **UFO Type**: select **HOT**
- 10. Right click on one of the tags in the table below and click **Create UFO_State Digital Set on Server PISRV01**
- 11. Click **OK**
- 12. Right click on one of the tags in the table below and click **Create all points (UFO Phase 2)**
- 13. Under **Synchronization File Path**: click the **Browse** button
- 14. In the address bar, enter **\\PIINT02\Interface Failover**
- 15. Click **Open**
- 16. Click **Apply** in the bottom right
- 17. Click **OK**
- 18. Restart the interface with the restart button at the top of the window

6.3.3 Part 3: Fix security for UFO status tags

1. On **PISRV01**, open a new blank workbook in **Microsoft Excel**
2. Select the **PI Builder** Ribbon
3. Ensure you have **PISRV01** selected as the **Data Server** in the top left
4. Click **PI Points → Find PI Points**
5. Enter a search of ***ufo*** and click **Search**
6. Click **OK**
7. Click **Clear All**
8. Select the checkbox **Security → datasecurity**
9. Add the string **" | SVC-PIINT: A(r,w)"** to each row in the datasecurity column
10. Click **Publish**
11. Select **Edit Only**
12. Click **OK**

6.3.4 Part 4: Configure failover on the second interface

1. On **PIINT01**, open the **ICU**

2. Select the interface instance **opcint_ReadOnly1** -> **PISRV01** from the Interface drop-down select box
3. Select the **Unlnt → Failover** menu on the left side of the window
4. Check the **Enable Unlnt Failover** checkbox
5. Enter the following numbers: *[NOTE: THESE ARE OPPOSITE TO THE NUMBERS IN PART 2]*
 - Failover ID# for this instance: **1**
 - Failover ID# of the other instance: **2**
6. Click the **Browse** button next to **Failover ID# of the other instance**
7. Select **PIINT02 → opcint_ReadOnly1**
8. Click **OK**
9. Under **UFO Type**: select **HOT**
10. Right click on one of the tags in the table below and click **Create UFO_State Digital Set on Server PISRV01**
11. Click **OK**
12. Right click on one of the tags in the table below and click **Create all points (UFO Phase 2)**
13. Under **Synchronization File Path**: click the **Browse** button
14. In the address bar, enter **\\PIINT02\Interface Failover** *[NOTE: THIS IS THE SAME LOCATION AS THAT CONFIGURED IN PART 2]*
15. Click **Open**
16. Click **Apply** in the bottom right
17. Click **OK**
18. Restart the interface with the restart button at the top of the window

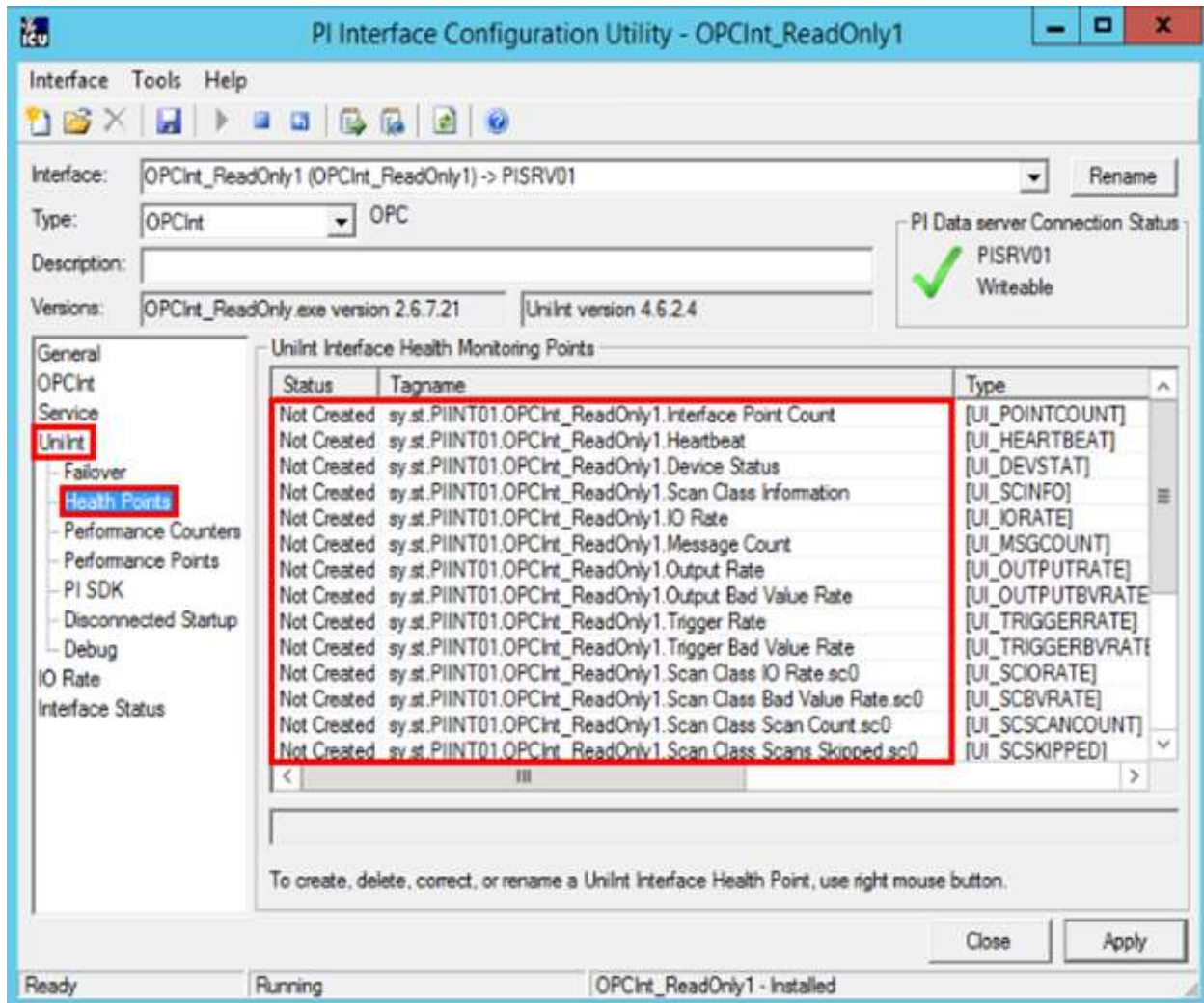
6.3.5 Part 5: Configure Disconnected Startup

1. On **PIINT02**, open the **ICU**
2. Select the **Unlnt → Disconnected Startup** menu on the left side of the window
3. Check the box for **Enable disconnected startup (with point caching)**
4. Next to **Cache Path**: click **Browse**
5. Click **OK**
6. Click **Apply**
7. Start or restart the interface with the buttons at the top of the window
8. Repeat steps 1 through 7 with **PIINT01**

6.4 Knowledge Check: Interface Health Points

6.4.1 Unlnt Health Points

Unlnt Health Points are PI Points that collect information about the health of the interface. They are created from the PI ICU, in the Unlnt > Health Points section:



OSisoft recommends that, at minimum, the following Unlnt Health Points be created:

1. **Heartbeat:** This PI Point indicates whether or not the interface is running. The heartbeat point is updated continuously unless the interface is shut down or in a deadlock situation. As long as the interface is running, the value of the point cycles incrementally from 1 to 15. The heartbeat point does not indicate whether the interface is connected to or collecting data from a data source.
2. **Device Status:** This PI Point contains information about communication between the interface and the data source. During normal operation, it contains the value GOOD, indicating that the interface is communicating properly with the data source. Otherwise, the point contains a string indicating status, formatted as follows:

Status code | Description | Interface-specific text.

Example:

95 | Device(s) in error

This device status means that the PI Interface cannot communicate with the data source.


3. **IO Rate:** This PI Point keeps a count of all point values (inputs, outputs, triggered inputs) being sent to the Data Archive. If the value stops updating, the interface has stopped collecting data.
4. **Scan Class Scans Skipped:** This PI Point counts, for a specific scan class, “skipped scans”, i.e the number of scans that were not performed before the scan time elapsed and the next scheduled scan was executed, for a defined reporting period (8 hours by default)

6.4.2 Exercise - Create Unlnt health points for both of your Interface instances

1. On **PIINT01**, run **PI ICU** and browse to **Unlnt → Health Points**
2. Right-click on the following Health Points and select **Create**:
 - **Heartbeat**
 - **Device Status**
 - **IORate**
 - **Scan Class Scans Skipped.sc0**
3. On **PISRV01**, using **SMT**, verify whether these Health Points are receiving data using the **Current Values** plugin. If they are not receiving data, correct the problem, then restart the interface. You may need to look in the interface message log for clues. If you can't find and correct the problem, see "**Health Points Solution.pdf**" attached to this lesson.
4. Repeat the above steps for the interface instance on **PIINT02**

7. Managing User Access

7.1 Hands-On: Data Archive Security

 Video	<i>This is a hands-on chapter. It is recommend that you watch the video for this chapter and follow the steps using your own virtual environment: https://youtu.be/0oMVa5NqjQY. Below are the configuration steps performed in the video.</i>
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References

- Full documentation on Data Archive security can be found [here](#).

Below is a step-by-step walkthrough on changes that are made to our virtual environment during this lesson:

Part 1: Configure security for PI Administrators

1. On **PISRV01**, open **PI System Management Tools (SMT)**
2. Navigate to **Security → Mappings & Trusts**
3. Click the **New...** button in the top left of the window
4. Enter **Windows Account: PISCHOOL\PI Administrators**
5. Enter **PI Identity: piadmins**
6. Click **Create**

Part 2: Configure security for PI Interfaces

1. On **PISRV01**, open **SMT** and navigate to **Security → Identities, Users & Groups**
2. Double click on **SVC-PIINT**
3. Change its name to **PI Interfaces**
4. Navigate to **Security → Mappings & Trusts**
5. Click the **New...** button in the top left of the window
6. Enter Windows Account: **PISCHOOL\PI Interfaces**
7. Enter **PI Identity: PI Interfaces**
8. Click **Create**

Part 3: Configure security for PI Users

1. On **PISRV01**, open **SMT** and navigate to **Security → Identities, Users & Groups**
2. Click the **New...** button in the top left of the window
3. Enter the **Name: PI Users**
4. Click **Create**
5. Navigate to **Security → Mappings & Trusts**

6. Click the **New...** button in the top left of the window
7. Enter **Windows Account: PISCHOOL\PI Users**
8. Enter **PI Identity: PI Users**
9. Click **Create**

Part 4: Configure security for PI Point and Analysis Creators

1. On **PISRV01**, open **SMT** and navigate to **Security → Identities, Users & Groups**
2. Click the **New...** button in the top left of the window
3. Enter the **Name: PI Point and Analysis Creators**
4. Click **Create**
5. Navigate to **Security → Mappings & Trusts**
6. Click the **New...** button in the top left of the window
7. Enter **Windows Account: PISCHOOL\PI Point and Analysis Creators**
8. Enter **PI Identity: PI Point and Analysis Creators**
9. Navigate to **Security → Database Security**
10. Double click on **PIPOINT**
11. Click **Add...**
12. Select **PI Point and Analysis Creators**
13. Click **Add**
14. Click **OK**
15. Check the **Write** checkbox
16. Click **OK**

Part 5: Clean up unneeded identities

1. On **PISRV01**, open **SMT** and navigate to **Security → Identities, Users & Groups**
2. **Right click → delete** the following identities:
 - **PIEngineers**
 - **PIOperators**
 - **PISupervisors**

7.2 Background: What is Asset Framework?




Video

This is a background chapter with video content only. It is recommend that you watch the video for this chapter: <https://youtu.be/VWrxS48PpjY>.

This video provides some background if you are not familiar with Asset Framework. The next lesson will go into how data flow works between Asset Framework and Data Archive, and security on Asset Framework objects.

7.3 Hands-On: Asset Framework Security

 Video	<p><i>This is a hands-on chapter. It is recommend that you watch the video for this chapter and follow the steps using your own virtual environment:</i></p> <p>https://youtu.be/oQHBhSzRIOE. Below are the configuration steps performed in the video.</p>
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References

- Full documentation for Asset Framework security can be found [here](#).

Note: This video assumes that all "Power Users" in your organisation belong to *both* the **PI Users** and **PI Power Users** active directory groups. If this is not the case, some extra configuration is needed to allow the Power Users to connect to the server at the top level. For directions on these steps, see the next exercise.

Below is a step-by-step walkthrough on changes that are made to our virtual environment during this lesson:

7.3.1 Part 1: Prepare Production and Development AF Databases

1. Connect to **PISRV01**
2. From the Windows Start Menu, open **PI System Explorer**

At this point, depending on what configuration you've done so far, you may be asked "There are no PI AF Servers defined. Do you want to define one?" If you are, click **Yes**, then enter **PISRV02** as the host, and click **OK**.

If you get an error popup saying "Could not connect to net.tcp://pisrv01:5457...", this indicates that your PISRV01 thinks that it has an AF server installed on it - which it doesn't. To fix this and instead point at the AF server installed on PISRV02, click **OK**, wait for the connection to time out, then click **Select**. Click the ... ellipsis next to the **PISRV01** dropdown menu, right click on **PISRV01**, select **Properties**, rename the **Host** to **PISRV02**, and click **OK**, then **OK**, then **Connect**.

3. Click the **Database** button in the top left of the window
4. Right click on **Database1** and rename it to **Production** (or if you don't have Database1, click New Database and create a new one called Production)
5. Click the **New Database** button in the top left of the window
6. Name the new database **Development**
7. Click OK

7.3.2 Part 2: Configure security for PI Administrators

1. Connect to **PISRV01**, open **PI System Explorer**, and click the **Database** button in the top left of the window
2. Click the small **Show Properties** button next to the greyed out Connect button
3. Select the **Mappings** tab
4. In the white space below the list of mappings **Right Click → New Mapping**
5. Type **Account: PISCHOOL\PI Administrators**
6. Select Identity: **Administrators**
7. Click **OK**
8. On the **BUILTIN\Administrators** mapping **Right Click → Delete**
9. Click **OK**

7.3.3 Part 3: Configure security for PI Users

1. Ensure you have the **Mappings** tab open in the **PI AF Server Properties** window
2. In the white space below the list of mappings **Right Click → New Mapping**
3. Type Account: **PISCHOOL\PI Users**
4. Select **Identity: World**
5. Click **OK**
6. On the **Everyone** mapping **Right Click → Delete**
7. Click **OK**

7.3.4 Part 4: Configure security for PI Power Users

1. Ensure you have the **Identities** tab open in the **PI AF Server Properties** window
2. In the white space below the list of identities **Right Click → New Identity**
3. Type Name: **Power Users**
4. Click the **Mappings** tab
5. Click **Add...**
6. Type Account: **PISCHOOL\PI Power Users**
7. Click **OK**
8. Click **OK** to leave the **PI AF Server Properties** window completely and return to the **Select Database** window
9. On the **Development** database, **Right Click → Security**
10. Click **Add...**
11. Select **Power Users**

12. Click **OK**
13. Click **OK** to return to the **Select Database** window

7.4 Knowledge Check: Contractor Access

A common scenario that requires a more complex security setup is when you have a group of contractors who need limited access to the system. where you may want to give employees and contractors different access to the PI System. In this exercise you will configure a model like this for your system, then test the configuration to make sure contractors don't have access to data that they shouldn't be able to see. For a full step-by-step solution to this exercise, see the attached "Contractor Security Solution.pdf" to the online version of this lesson.

7.4.1 Part 1: Prepare your Data Archive and Asset Framework

- Create an identity for **PI Contractors** on both the **Data Archive** using **System Management Tools (SMT)**, and **Contractors** on the **Asset Framework** server using **PI System Explorer (PSE)**. For a step-by-step on how to do this, see the respective lessons on Data Archive security and Asset Framework security.
- Create a mapping to the new identity for the group **PI Contractors** on both the Data Archive and Asset Framework.
- On the Asset Framework Server, there is one extra configuration step that needs to be completed to allow the contractors to connect to the server at the top level. Just because a user has permission to see a database, it doesn't mean they're allowed to connect to the server itself. The **Contractors** are not members of the **PI Users** active directory group and will not be allowed in under the World identity we set up in the previous lesson. Unlike the PI Data Archive, the World identity isn't given to all authenticated connections automatically.
 1. Connect to **PISRV01**, open **PI System Explorer**, and click the **Database** button in the top left of the window
 2. Click the **Edit Security** button at the top of the **Select Database** window. This allows you to edit permissions to the server at the top level.
 3. Click **Add...**
 4. Select **Contractors**
 5. Uncheck all **Allow** boxes except for **Read** and **Read Data**. This will modify all permissions on the server, allowing contractors to connect and see all objects. This is fine for now, don't worry - we're going to lock it down in the next part of this exercise.
 6. Click **OK**

7.4.2 Part 2: Satisfying a new management request

Management at our company has decided that the **Status** points for our pumps contain confidential business information. It is important that our contractors cannot see these points. In a previous exercise, we named these points with the convention **PumpX.Status**, where X is the number of the pump.

- Configure the security on the **Status** tags so that the contractors cannot read their data, or even see that they exist.

7.4.3 Part 3: Satisfying another management request

You've been asked to prepare a new database on Asset Framework, hosting data for Remote Assets. The contractors have been hired to manage these assets, but as they are not employees they are not permitted to see the Production or Development databases.


- Use **PSE** to create an additional database called **Remote Assets**, and allow your contractors to view it, but not write to it.
- Configure the security for each of your other databases to block access to your contractors completely.

7.4.4 Part 4: Check if your changes worked

1. Open extra copies of SMT and PSE *as a contractor* to check their access. To open them as a contractor, follow these steps:
 1. Right click on the application on your windows Taskbar
 2. Hold the **Shift** key and **right click** on the name of the application
 3. Select **Run as different user**
 4. We'll run these applications as student04, who is in the domain group "PI Contractors". For the credentials, enter:
 - User: PISCHOOL\student04
 - Password: **enter the password that was emailed to you after you originally created your virtual machines*
 5. Test searching for any status tag using SMT, or opening any database apart from the Contractor database in PSE
 6. Test again using PISCHOOL\student02, who is a member of the PI Users group. You should be able to connect to both the Data Archive and AF Servers, but not make any changes.

8. Managing Data

8.1 Background: What are Archive Files?



Video

This is a background chapter with video content only. It is recommend that you watch the video for this chapter: <https://youtu.be/zBN5m5JM2Es>.

This video was originally published in the playlist "Manage Archive Files & Check Archiving Health". You can find the full playlist [here](#).

8.2 Knowledge Check: PI Archives in Depth

In this lesson we'll take a look at the archives in our Data Archive. Take a look at the Archives in your system by doing the following:

1. Connect to **PISRV01** and open **PI System Management Tools (SMT)**
2. Navigate to Operation → **Archives**

You should see all archive files that are *registered* on your PI Data Archive. It's looking pretty sad right now - you only have a single file. The archive's start time is about the time you installed your Data Archive server, and the end time is "Current Time". Because the end time is the "Current Time", we call this archive the *Primary Archive* - it is being written to with data coming in live from your interface. You should also see a very small number in the %Full column. When the archive gets almost full, a new archive is automatically created, and we *shift* into it. When this happens, the end time of the previous archive is set to the time of the shift. Let's simulate this now.

3. Right click in the white space underneath your archive and click **Force shift**

After waiting a few seconds, you now see two archive files:

Historic: Future

Review and update parameters

#	Start Time	End Time	Duration	Size (MB)	% Full	Compu	Archive File	Last Modified Time	Backup Time
0	11/4/2020 9:50:09 AM	Current Time	00d 00:00:00	2048	0		E:\PI\arc\PISRV01_2020-11-04_09-48-49.arc	11/4/2020 9:50:08 AM	Never
1	10/5/2020 12:00:00 AM	11/4/2020 9:50:09 AM	30d 00:50:09	2048	0.1		E:\PI\arc\PISRV01_2020-10-05_00-00-00.arc	11/4/2020 8:49:27 AM	Never

One of them is your new primary archive. If data is written to the Data Archive server with a timestamp within the old archive's time range, it is written to the old one. If data comes in within the new time range, it is written to the new one.

A small warning - the action we performed - **Force shift** - isn't something you need to do often. In fact, you should never perform a **Force Shift** if you suspect something is wrong with your system. It hardly ever fixes any issues, and almost always causes more problems if your system is already in trouble.

Before the PI Data Archive to write to an archive file, it must be registered. Windows won't let us move an archive file while it's registered - if you try you'll get an error saying "This

action can't be completed because the file is open in PI Archive Subsystem". Let's say we'd like to move an archive file from one drive to another. We'd need to unregister the archive, move it with Windows File Manager, then register it again. This will only work if the PI Archive Subsystem is allowed to access the folder we move it into.

8.2.1 Exercise: Move old archives to a different drive

It is common to have two (or more) devices or drives hosting your archive files. You may want your recent archives on high performance storage, and your older archives on low performance storage as they are accessed much less frequently. We'll set up an alternate location to store archive files, then move an old archive into the folder. The new location we'd like to host our older archives will be **D:\PI\Archives**. Usually this would be a completely separate drive, one that doesn't have any other software installed on it - but we're starting to run out of drives to use in our learning environment.

Part 1: Prepare the new archive folder

Before an archive can be registered, the PI Archive Subsystem service must have full control permissions over that file location.

1. Open **Windows File Explorer**, and navigate to a new folder at the path **D:\PI**
2. Create a new folder called **Archives**
3. On your new Archives folder, **Right Click → Properties**
4. Go to the **Security** tab
5. Click **Edit...**
6. Click **Add...**
7. Click **Locations...**
8. Select **PISRV01**
9. Click **OK**
10. Enter the account name **NT Service\piarchss**
11. Click **OK**
12. Check the **Full Control** checkbox for **Allow**
13. Click **OK**
14. Click **OK**

Part 2: Move an old archive into the folder

1. Connect to **PISRV01** and open **PI System Management Tools (SMT)**
2. Navigate to **Operation → Archives**
3. Take a note of the name of your *old* archive (the archive that does not have "Current Time" as its End Time). You're going to move this file in a few steps, so try to remember the last few numbers in its name. Once you think you can tell your two archives apart, **Right Click → Unregister Archive**

4. Click **Yes**
5. Open **Windows File Explorer**
6. Navigate to **E:\PI\arc**
7. Select *both* the archive **.arc** file you unregistered, and its corresponding **.arc.ann** file. The **.ann** file is an annotation file, and contains annotations to data contained in the archive. whenever you move an archive file, you should always move both the archive, and its annotations.
8. Move both files to the new **D:\PI\Archives** folder
9. Go back to **SMT**, and in the white space below your list of archives **Right Click → Register archive**
10. Select the archive you moved to the **D:\PI\Archives** folder
11. Click **Open**
12. Your archive should appear back in the registry list, with the new path listed under the **Archive File** column

If you're looking into automating this job, all of the above steps can be scripted with the command line tool piartool. You can read about piartool [here](#).

9. Final Exam

The final exam for this course is taken online. Please check the course listing online for more details.

