Configure the resources to connect to a PI Server without sending explicit credentials

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History

First Draft – Nov 25, 2009
Base Document – Dec 7, 2009
Edit 1 – Dec 9, 2009
1. Put PI-SDK installation before PI-OleDb installation for more clarity. 2. Gave details about the PI System Management Tools. 3. Explained creation of PIIdentity. 4. Removed *Install Application* step from the *Using PI machine authentication for PI-API calls* section.
Edit 2 – Dec 14, 2009
Added Exception to the *Using PI windows authentication for PI-OleDb calls* section
Edit 3- Feb 23, 2010
Updated the *Appendix B: Run a Web Application as a particular user* for ASP.Net Framework 2.0. Updated the title of Appendix B to *Appendix B: Run a Web Application or a Web Service as a particular user*.
Edit 4 – Dec 21, 2011
Updated the *Encrypted Credentials on Registry* action of *Appendix B.*
Edit 5 – Aug 8, 2013
1. Updated the *Encrypted Credentials on Registry* action of *Appendix B.* 2. Updated the *Registry Permissions* action of *Appendix B.* 3. Updated the *Folder Permissions* action of *Appendix B.*
Edit 6 – Nov 26, 2013
1. Rectified the *Trust* step of the *Using PI machine authentication for PI-API calls* section. 2. Updated the *Encrypted Credentials on Registry* step of *Appendix B.* 3. Updated the *Registry Permissions* step of *Appendix B.* 4. Updated the *Impersonation* step of *Appendix B.*

Introduction

The motivation of this document came from the fact that System Operations forwarded a notification from NERC as follows:

> Recently NERC put out a "CIP: OSIsoft PI Enterprise Server Authentication" Industry advisory that stated the following (part of it):
>
> *"The ES-ISAC and ICS-CERT strongly encourage users of PI Enterprise Server configure authentication via PI Trust records, which is not affected by this vulnerability. All types of PI Trusts avoid the exchange of unsecure PI passwords. The newest PI Enterprise Server version (3.4.380) if configured with the default authentication settings is not affected by this vulnerability. It is recommended that these users verify server authentication policy is set to "explicit login disabled".*

Various options were tried to move the Development applications and tools from the explicit credentials to the machine or the Window ID trusts. Here is a table summarizing these efforts:

Application	Use	Authentication	Success	Details
Excel	Pi menu	Machine Trust	Yes	
		Auto Connect	Yes	
		Get data	Yes	
Excel	Pi menu	Windows Authentication	Yes	
		Auto Connect	Yes	
		Get data	Yes	
DIS Extract	PiApi	Machine Trust	Yes	
		Trust machine	Yes	IP trust, not machine trust, because "ping <machinename>" does not seem to work from the PI Server.
		Connect but no login	Yes	
DIS Extract	PiApi	Windows Authentication	No	Known issue - from OSI
DIS Extract	Odbc	Machine Trust	No	OSI Odbc component not updated - Logged PLI 21257OSI8
DIS Extract	Odbc	Windows Authentication	No	OSI Odbc component not updated - Logged PLI 21257OSI8
DIS Extract	OleDb	Machine Trust	No	Known issue - from OSI
DIS Extract	OleDb	Windows Authentication	Yes	
		Install SDK	Yes	PISDK_1.3.6.364
		Install OleDb	Yes	PIOLEDB_3.2.2.10
		Setup Windows Authentication	Yes	
		Test using Excel DataConnection Wizard	Yes	Try twice

The options which resulted in a failure were logged with the OSI Soft Inc. The options which succeeded were further refined to be used for Production. This document gives the details of these steps.

Terminology

Developer
Programmer working with the PI-API or PI-OleDb.
PI-API
A component which is used by the PIAPIWrapper to communicate with a PI server. It is possible that Pi-SDK is needed to make the PI-API to work. This hypothesis or its negation has not been tested yet. In case of any issue, please refer to the PI-SDK and PiSdkInstallationKit in this section.
PiApiInstallationKit
An installation kit containing the PI-API. At the time of writing of this document, the installation kit containing the latest API version is *PI Buffer Subsystem Install Kit, Version 3.4.375.84*, Release Date 21-Sep-09. It has the *PI-API version 1.6.1.15*.
PiApiSnap
The application used to quick test the connection of PI-API to the PI Server. Usually, it is *C:\Program Files\PIPC\bin\apisnap.exe*.
PI-OleDb
A universal OleDb data access provider component to access a Pi Server. Also note that PI-SDK is needed to use the Pi-OleDb.
PiOledbInstallationKit
An installation kit containing the PI-OleDb. At the time of writing of this document, the installation kit containing the latest PiOleDb provider version is *PI OLEDB Provider Install Kit, Version 3.3.0.1*, Release Date 13-Jul-09. It has the *PI-OleDb version 3.3.0.1*.
PiOledbTester
A windows application to test the connection from WinServer to PiServer using the Pi-OleDb provider. It is usually installed as a part of the PiOleDbInstallationKit. This application is usually opened by double clicking *C:\Program Files\PIPC\OLEDB\Tools\PI OLEDB Tester\PIOLEDBTester.exe*.
PI-SDK
A component required to make the PI-OleDb work. Although it is called an SDK, it also serves the PI-OleDb component. In other words, PI-OleDb will not work without PI-SDK being installed on the same machine.
PiSdkInstallationKit
An installation kit containing the PI-SDK. At the time of writing of this document, the installation kit containing the latest PiSdk version is *PI SDK Install Kit, Version 1.3.6.364*, Release Date 25-Mar-09. It has the *PI-*

SDK version 1.3.6.363.
PiServer
The PI Server, which is to be used, for example, eccpi.coned.com.
PiServerAdmin
The administrator of the PiServer.
PiTags
PI tags which will be accessed by using PI-API.
PiSMT
This is an application containing the PI System Management Tools. At the time of writing of this document, the latest PiSMT version is 3.3.1.3.
WAD
Windows Active Directory
WadAdmin
The administrator of the Windows Active Directory.
WinServer
The machine which will run the Windows service or application that will be sending the PI-API requests to the PiServer. WinServer is just the short form of the Windows Server. This term will also be used for the server that will host web applications.
WinServerAdmin
The administrator of WinServer.

Using PI machine authentication for PI-API calls

Install PI-API

Install the PI-API on the WinServer, using the PiApiInstallationKit. Please refer to the *Terminology* section for details about this kit.

Actor

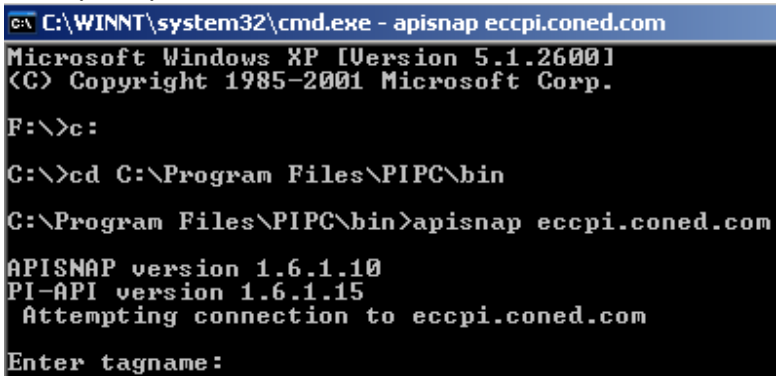
WinServerAdmin

Result

PI-API is installed on the WinServer

Test

1. Open a command window on the WinServer
2. Run **`apisnap <PiServer>`**, as shown:



Getting the message: **`Enter tagname:`** denotes success.

Please refer to the *Terminology* section for details of the PiApiSnap application.

PI Tags

Provide the PiTags to the PiServerAdmin. Also provide the access level required for each tag.

Actor

Developer

Result

The PiServerAdmin has the PiTags, along with the access level for each of them.

Application Name

Provide a 4-character string, uniquely identifying the application, to the PiServer.

Actor

Developer

Result

The PiServerAdmin has the application name.

IP Address

Provide the IP address of the WinServer, to the PiServerAdmin.

Actor

WinServerAdmin

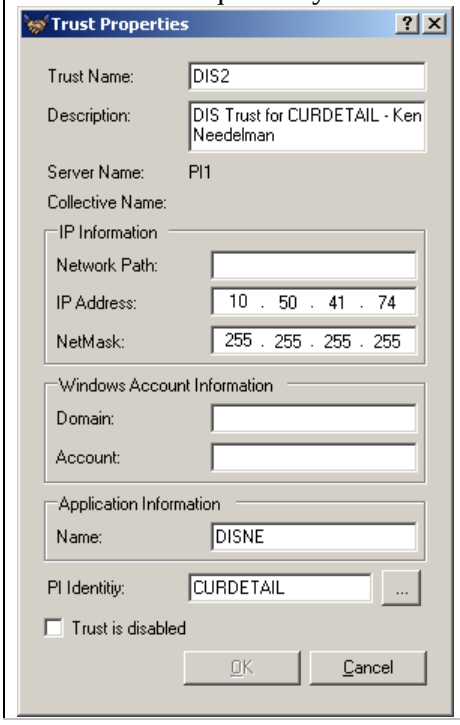
Result

The PiServerAdmin has the IP address of the WinServer.

Trust

Create Trust for the machine-application combination using

1. The IP address of the machine given by the WinServerAdmin.
2. The application name given by the Developer followed by the character "*E*". Say, the developer gave the application name as **`DISN`**. Then, the application name entered in the Trust should be **`DISNE`**.
3. A PI User or PI Identity having the access to the PiTags same or greater than those required by the developer.



Actor

PiServerAdmin

Result

Trust for this machine with the application is created. The application can now access the tags as required.

Connect from application

Use the following syntax to connect from the application:

```
PIAPI32.piut_connect( <string: application name> )
PIAPI32.piut_setservernode( <string: server name> )
```

For example:

```
PIAPI32.piut_connect("DISN")
PIAPI32.piut_setservernode("eccpi.coned.com")
```

Actor

Developer

Result

The application will connect to the server

Test

Check the Network Manager Statistics in the PiSMT. An entry with this application name, IP, the PI user to which the Trust was mapped and the Trust name will appear.

Name	PID	RegApp...	RegAppType	ProtocolVersion	PeerAddress	PeerPort	ConType	NetType	ConStatus	ConTime
DISNE	-1			1.8	10.105.9.15	3848	PI-API connection	TCP/IP	[0] Success	11/19/2009 6:02:56 AM
DISNE	-1			1.8	10.105.9.15	3851	PI-API connection	TCP/IP	[0] Success	11/19/2009 6:03:07 AM
DISNE	-1			1.8	10.105.9.15	3856	PI-API connection	TCP/IP	[0] Success	11/19/2009 6:03:25 AM
DISNE	-1			1.8	10.105.9.15	3858	PI-API connection	TCP/IP	[0] Success	11/19/2009 6:03:38 AM
DISNE	-1			1.8	10.105.9.15	3860	PI-API connection	TCP/IP	[0] Success	11/19/2009 6:03:51 AM
DISNE	-1			1.8	10.105.9.15	3863	PI-API connection	TCP/IP	[0] Success	11/19/2009 6:04:16 AM

ConTime	LastCall	E..	B	B	M	M	R.	S.	A	S	S	PINetMgr V...	OS...	O.	O..	Identity	OSUser	Trust
11/19/2009 6:02:56 AM	11/19/2009 3:47:50 PM	4...	2.	2.	3..	3.	0	0	0..	0.		PI 3.4.380.36	Wi...	5..	S...	CURDETAIL		DISDEVSQLSERV
11/19/2009 6:03:07 AM	11/19/2009 3:06:37 PM	4...	2.	2.	3..	3.	0	0	0..	0.		PI 3.4.380.36	Wi...	5..	S...	CURDETAIL		DISDEVSQLSERV
11/19/2009 6:03:25 AM	11/19/2009 11:15:20 AM	4...	1.	1.	2..	2.	0	0	0..	0.		PI 3.4.380.36	Wi...	5..	S...	CURDETAIL		DISDEVSQLSERV
11/19/2009 6:03:38 AM	11/19/2009 10:17:30 AM	4...	1.	1.	2..	2.	0	0	0..	0.		PI 3.4.380.36	Wi...	5..	S...	CURDETAIL		DISDEVSQLSERV
11/19/2009 6:03:51 AM	11/19/2009 10:33:06 AM	4...	1.	1.	2..	2.	0	0	0..	0.		PI 3.4.380.36	Wi...	5..	S...	CURDETAIL		DISDEVSQLSERV
11/19/2009 6:04:16 AM	11/19/2009 5:17:32 PM	4...	2.	2.	4..	4.	0	0	0..	0.		PI 3.4.380.36	Wi...	5..	S...	CURDETAIL		DISDEVSQLSERV

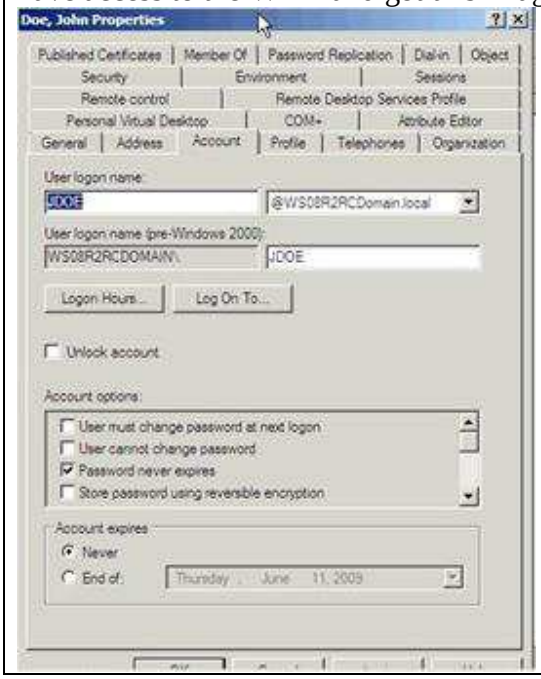
Using PI windows authentication for PI-OleDb calls

Establish a WAD account
Establish an account on the WAD, with the following settings: 1. `User must change password` at next logon is unchecked. 2. `Password never expires` is checked. 3. `Account is disabled` is unchecked (for WAD 2008, in the `Account Expires` section, the radiobutton `Never` should be chosen.). For reference in this handbook, let's call this user `CONED\IrPiElectric` and let its password be `DumPwd768`.
Actor
WadAdmin

Result

This is how it will look in WAD (just observe the options since the author does not have access to the WAD and got this image from the internet):

This is how it will look in WAD 2008 (just observe the options since the author does not have access to the WAD and got this image from the internet):



Share Credentials with WinServerAdmin
Provide the newly created username and its password to the WinServerAdmin
Actor
WADAdmin
Result
The WinServerAdmin has the newly created username and its password.

Share Credentials with PiServerAdmin
Provide the newly created username (but not its password) to the PiServerAdmin
Actor
WADAdmin
Result
The PiServerAdmin has the newly created username.

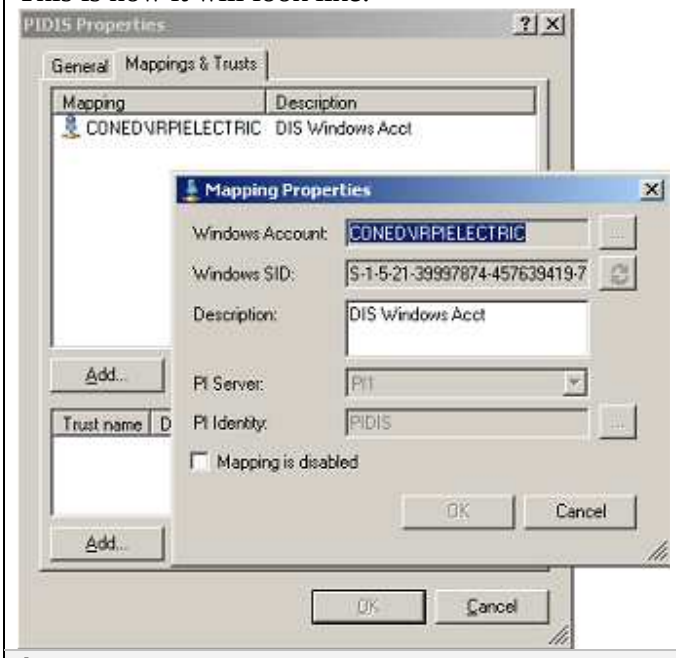
PI Tags
Provide the PiTags to the PiServerAdmin. Also provide the access level required for each tag.
Actor
Developer
Result
The PiServerAdmin has the PiTags, along with the access level for each of them.

PI Identity

Take the following steps to create a PIIdentity:

1. Open PiSMT.
2. Log onto the PiServer.
3. Go to the *Security* group of PiSMT.
4. Click on the *Identities, Users and Groups* section.
5. Click the *PiIdentities* tab. Create a new PI Identity. Map this identity to the WAD account, provided by the WadAdministrator.
6. Provide this PiIdentity the access to the PiTags same or greater than those required by the developer.

This is how it will look like:



Actor

PiServerAdmin

Result

Trust for this WAD Identity is created. The application can now access the tags as required.

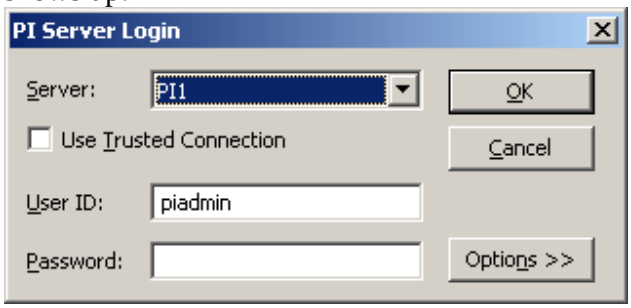
Dummy PI User
Provide the credentials of a dummy PI user to the WinServerAdmin to test the installation of the PI-OleDb. This user should be able to access the PiServer. Note: A PiUser is different from a PIIdentity.
Actor
PiServerAdmin
Result
WinServerAdmin has the credentials of a dummy PI user.

Install PI-SDK
Install the PI-SDK on the WinServer, using the PiSdkInstallationKit. Please refer to the *Terminology* section for details about this kit.
Actor
WinServerAdmin
Result
PI-SDK is installed on the WinServer.

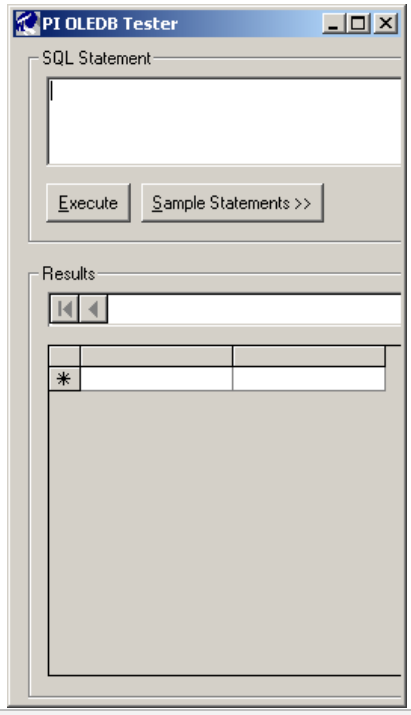
Install PI-OleDb
Install the PI-OleDb on the WinServer, using the PiOledbInstallationKit. Please refer to the *Terminology* section for details about this kit.
Actor
WinServerAdmin
Result
PI-OleDb is installed on the WinServer.

Test 1

1. Open the PiOledbTester application. Please refer to the Terminology section for details about this application.
2. In the login window that opens up, choose the server. To be sure that you are opening the correct server, go to the **`PiLogin.ini`** (usually in the *C:\Program Files\PIPC\dat* folder) and do the appropriate setup.
   A better alternative is to open the Connections in the PI menu in Microsoft Excel and check / setup the Connections appropriately. This is how the login window shows up:



3. Enter the credentials of the dummy PI user provided by the PIServerAdmin. Hit the **`OK`** button.
4. The PiOleDbTester application should open up. This denotes that the installation was successful. Any other window (error / warning / information window) means that the installation was not successful. This is how it looks like:



Test 2

1. Log on to the WinServer with the credentials of the newly created WAD account.
2. Carry out steps 1 and 2 from the last test.
3. Check the **`Use Trusted Connection`** box. Hit the **`OK`** button.

4. The PiOleDbTester application should open up. If the last test was successful, then opening up of this window denotes that the PiIdentity for the WAD account was established successfully. If the last test installation was successful, then opening up of any other error / warning / information window, at this point, means that the PiIdentity for the WAD account was not established properly. The PiOleDbTester application window is shown in the last test.

Note: If the last test was not successful, then carrying out this test is meaningless.

Connect from application

1. The application should be run with the credentials of the WAD account created earlier. This is done in different ways. This is shown in the *Appendix A: Run a Windows Service as a particular user* and in the *Appendix B: Run a Web Application as a particular user*.
2. Use the OleDb classes in the `System.Data.OleDb` namespace (`OleDbConnection, OleDbDataAdapter, OleDbDataReader`, etc.).
3. Use the following code to create a connection to the PiServer:

```
New OleDbConnection("Provider=PIOLEDB; Data Source=<Server>;
Integrated Security=SSPI;")
```

For example:

```
New OleDbConnection("Provider=PIOLEDB; Data
Source=eccpi.coned.com; Integrated Security=SSPI;")
```

Actor

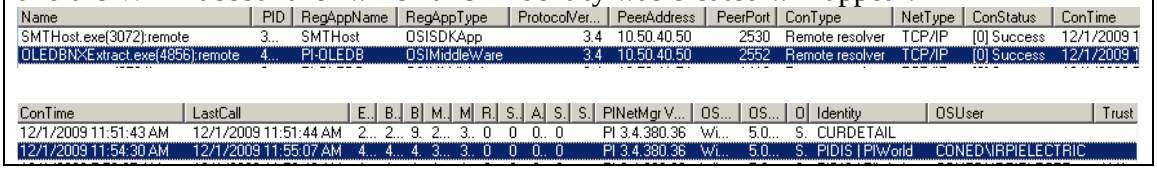
Developer

Result

The application will connect to the server

Test

Check the Network Manager Statistics in the PiSMT. An entry with the name of the application, IP from where the application is being run, the PiIdentity that was created and the WAD account for which this PiIdentity was created will appear.



Name	PID	RegAppName	RegAppType	ProtocolVer...	PeerAddress	PeerPort	ConType	NetType	ConStatus	ConTime
SMTHost.exe(3072):remote	3...	SMTHost	OSISDKApp	3.4	10.50.40.50	2530	Remote resolver	TCP/IP	[0] Success	12/1/2009 1
OLEDBNXExtract.exe(4856):remote	4...	PI-OLEDB	OSIMiddleWare	3.4	10.50.40.50	2552	Remote resolver	TCP/IP	[0] Success	12/1/2009 1

ConTime	LastCall	E..	B..	B	M..	M	R..	S..	A	S..	S..	PINetMgr V...	OS...	OS...	O	Identity	OSUser	Trust
12/1/2009 11:51:43 AM	12/1/2009 11:51:44 AM	2...	2...	9.	2...	3..	0	0	0..	0		PI 3.4.380.36	Wi...	5.0...	S.	CURDETAIL		
12/1/2009 11:54:30 AM	12/1/2009 11:55:07 AM	4...	4...	4.	3...	3..	0	0	0..	0		PI 3.4.380.36	Wi...	5.0...	S.	PIDIS IPIWorld	CONED\IRP\ELECTRIC	

Appendix A: Run a Windows Service as a particular user

Specify that a user will run this Windows Service

1. In the Project Installer, select the Service Process Installer.
2. In the Properties section, make sure that the **`Account`** property is selected as **`User`** (it is the default).

Actor

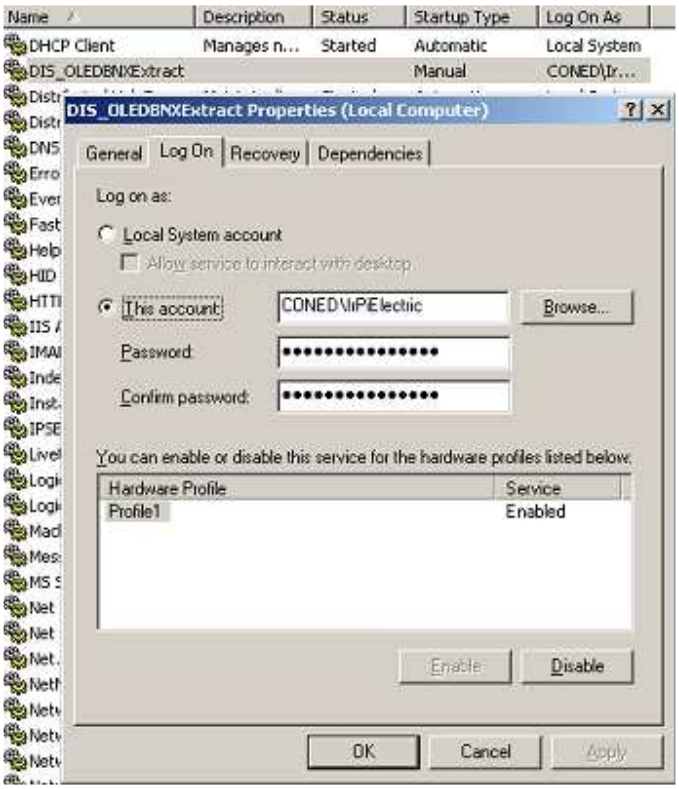
Developer

Result

This windows Service will now be run by a user. This user has to be specified at the time of installation. This specification can be changed later using the Services Snap-In in the Control Panel → Administrative Tools

Installation

At the time of installation of the Windows Service, provide the user, under whose account, the service should be run.
This can also be done from the Services Snap-In in the Control Panel → Administrative Tools.



Make sure that the domain name is prefixed to the username, as shown above.

Actor

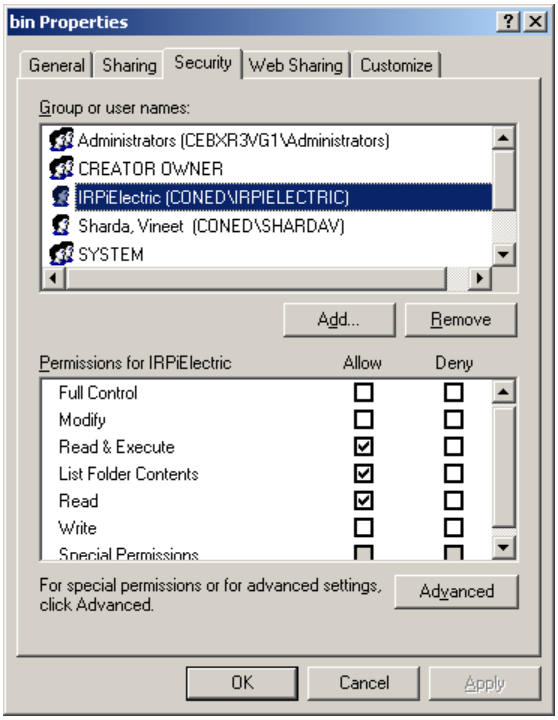
WinServerAdmin

Result

The service will run as the specified user.

Permissions

Allow **`Read & Execute`** permissions to this user to the folder and the files which contain the Windows Service. This is how it will look like:



On granting the **`Read & Execute`** permission, the **`List Folder Contents`** and **`Read`** permissions are granted automatically.

Note: The WAD account will have to be added to the **`Group or User names`** section. This is done by clicking the **`Add…`** button, entering the **`<WADDomain>\<WADUsername>`** (**`ConEd\IrPiElectric`** in our example) and clicking the **`OK`** button.

Actor

WinServerAdmin

Result

The specified user can now run the Windows Service.

Exception

A program using the PI-OleDb, when scheduled from SQL Server 2000 does not work.

The same program when ran from SQL Server 2005 worked. But in this case, a PI Trust was created for the machine and the user, rather than a PI Identity.

Appendix B: Run a Web Application or a Web Service as a particular user

Encrypted Credentials on Registry

The credentials that are needed by the web application should be stored at a safe location in an encrypted format. The following steps accomplish this task:

1. Download aspnet_setreg.exe from
   `http://download.microsoft.com/download/2/9/8/29829651-e0f0-412e-92d0-e79da46fd7a5/aspnet_setreg.exe`.
2. Run the file. It will ask for the folder where the files should be unzipped. Give the name of a folder different from the one into which the file was downloaded, say, `C:\Tools`.
3. Open the command prompt and navigate to the above folder.
4. Run the command to enter the username and password of the account under which we want to run the web application as:
   `aspnet_setreg -k:<Subkey> -u:<WadDomain>\<WadUsername> -p:<Password>`
   For example:

```
C:\Tools>aspnet_setreg -k:software\DIS\Identity -u:ConEd\IrPiElectric -p:DumPwd7
68

Please edit your configuration to contain the following:

        userName="registry:HKLM\software\DIS\Identity\ASPNET_SETREG,userName"
        password="registry:HKLM\software\DIS\Identity\ASPNET_SETREG,password"

The DACL on the registry key grants Full Control to System, Administrators, and
Creator Owner.
```

Actor

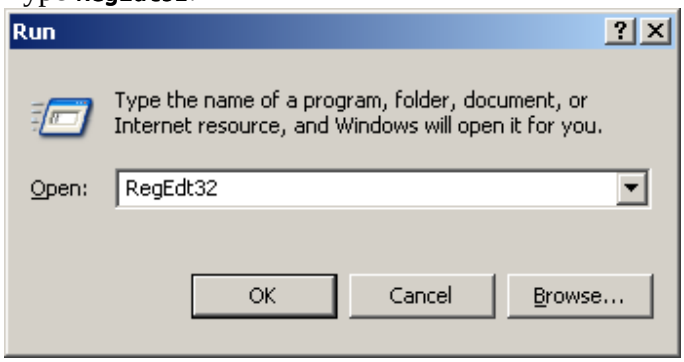
WinServerAdmin

Result

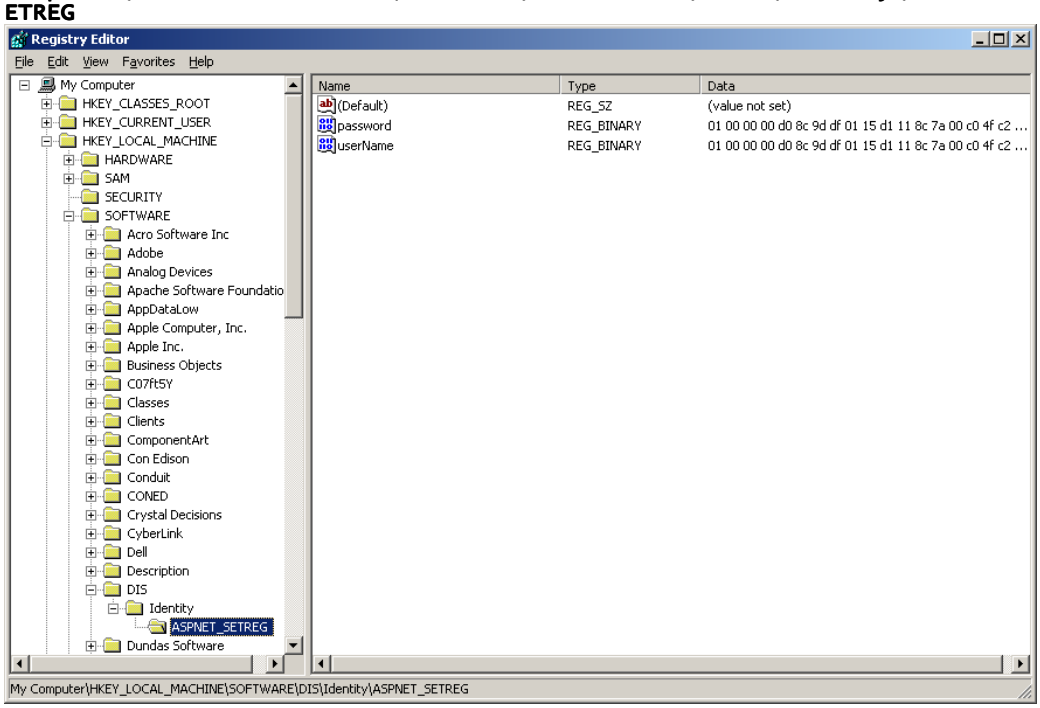
The credentials of the account are now in the registry, in an encrypted format.

Test

1. Click Start → Run
2. Type **`RegEdt32`**.



3. Press OK button. The machine registry should open up.
4. Navigate to the registry subkey that was specified earlier. In our example, we go to **`My Computer\HKEY_LOCAL_MACHINE\SOFTWARE\DIS\Identity\ASPNET_SETREG`**. In the Windows 7, 64 bit machine, the path is **`Computer\HKEY_LOCAL_MACHINE\SOFTWARE\Wow6432Node\DISNG\Identity\ASPNET_SETREG`**



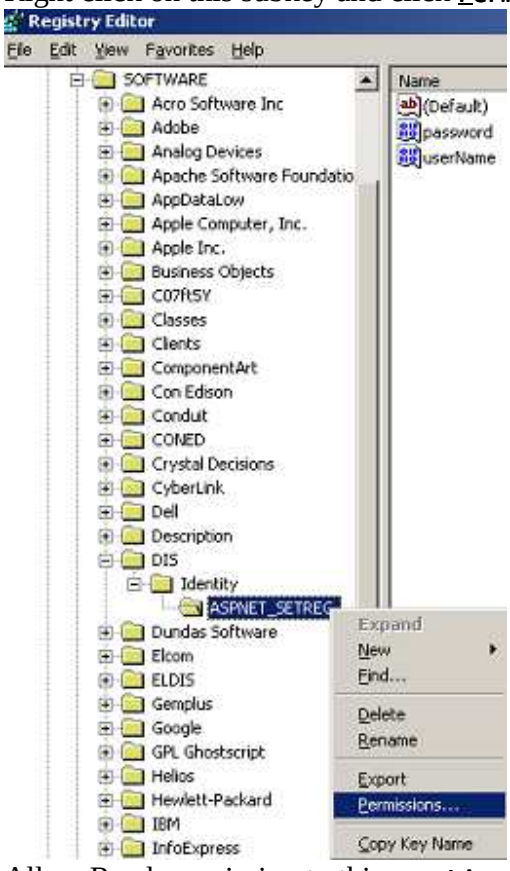
If you are able to navigate to your subkey and see the **`password`** and **`userName`** entries, then the entries have been made correctly, otherwise this step failed.

Registry Permissions

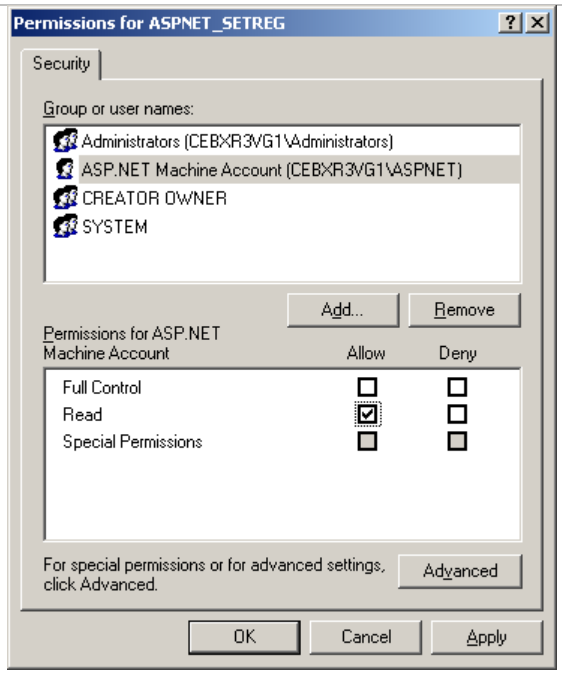
This action can be skipped for Windows 7.

The registry should be accessible to the AspNet process. This process uses the machine AspNet account till it is impersonated as the account that we want it to run as. So the registry entries made earlier should be made accessible to the AspNet. We accomplish this with the following steps:

1. Go to the subkey in the registry created in the last step, by opening up the Registry Editor and navigating to that subkey, as shown in the Test section of the last step.
2. Right click on this subkey and click **`Permissions`**….



3. Allow Read permission to this **`<MachineName>\AspNet`** account. This is how it will look like:



4. Click the Apply button.

Note: The **AspNet** machine account will have to be added to the **Group or User names** section. This is done by clicking the **Add…** button and then entering the **<MachineName>\AspNet** (**CeBxr3Vg1\AspNet** in our example) and clicking the **OK** button.

In Windows 7 machine, the access needs to be given to **<MachineName>\IIS_Usrs** user group (**CeBxr3Vg1\IIS_Usrs** in our example).

Actor

WinServerAdmin

Result

The machine AspNet account can now access the user credentials.

For the Windows 7 machine, the IIS_Usrs user group can now access the user credentials.

In other words, any web application can now access these credentials.

Folder Permissions

The following permissions should be given to the user that we want to run the web application as:

Folder for dynamically compiled files: *installroot*\ASP.NET Temporary Files	Full Control
Usual folder: C:\WINNT\Microsoft.NET\Framework\v1.1.4322\Temporary ASP.NET Files Or C:\WINNT\Microsoft.NET\Framework\v2.0.50727\Temporary ASP.NET Files	
Global Assembly Cache: *systemroot*\assembly	Read
Usual folder: C:\WINNT\system32	
Web Application Directory	Read & Execute
For the DISSln project: C:\Projects\DIS	
Full hierarchy of .Net Framework	Read & Execute
Usually all files and folders under: C:\WINNT\Microsoft.NET\Framework\v1.1.4322 Or If we are using .Net Framework 3.5 and ASP.Net Framework 2.0.50727, the easiest way to do this will be to grant the permission to C:\WINNT\Microsoft.NET\Framework\	
Any other folder which the web application accesses	As appropriate
For the DISSln project: Full control is required for the C:\Projects\Dundas folder	
Folder for supporting web services: *systemroot*\temp	Full Control
Usual folder: C:\WINNT\Temp	

In Windows 7, this can be done simply by adding the user to the IIS_IUSRS user group.

Actor

WinServerAdmin

Result

The user should have the appropriate access to the folders.

Impersonation

Specify that the web application will run with the impersonation credentials specified in the registry subkey that we have made. This is done by putting the following entry in the Web.config file of the web application:

```
<identity impersonate="true"
  userName="registry:<subkey>,userName"
  password="registry: <subkey>,password"
/>
```

This entry must be made under the `<system.web>` section. Here is an example:

```
<configuration>
  <system.web>
    <!--  AUTHENTICATION
      This section sets the authentication policies of the application.
Possible modes are "Windows", "Forms", "Passport" and "None"
    -->
    <authentication mode="Windows" />
    <identity impersonate="true"
      userName=
        "registry:HKLM\SOFTWARE\DIS\Identity\ASPNET_SETREG,userName"
      password=
        "registry:HKLM\SOFTWARE\DIS\Identity\ASPNET_SETREG,password"
    />
    <!--  OTHER system.web SETTINGS -->
  </system.web>
  <!--  OTHER configuration SETTINGS -->
</configuration>
```

As expected, the entry for a Windows 7, 64 bit machine with our example will be:

```
<configuration>
  <system.web>
    <!--  AUTHENTICATION
      This section sets the authentication policies of the application.
Possible modes are "Windows", "Forms", "Passport" and "None"
    -->
    <authentication mode="Windows" />
    <identity impersonate="true"
      userName=
       "registry:HKLM\SOFTWARE\Wow6432Node\DISNG\Identity\ASPNET_SETREG,userName"
      password=
       "registry:HKLM\SOFTWARE\Wow6432Node\DISNG\Identity\ASPNET_SETREG,password"
    />
    <!--  OTHER system.web SETTINGS -->
  </system.web>
  <!--  OTHER configuration SETTINGS -->
</configuration>
```

Actor

Developer

Result

The web application will now run under the credentials given at the specified machine registry subkey.