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# Deploying Cisco Industrial Network Director (IND) with Cisco ISE using pxGrid

#### About this document

This document is for Cisco Engineers and Customers deploying Cisco Industrial Network Director (IND) Release 1.3 or greater with Cisco Identity Services Engine (ISE) version 2.4 using pxGrid (Platform Exchange Grid). The reader should have some familiarity with ISE and IND and pxGrid.

Cisco IND is registered with pxGrid as a publisher and publishes information on endpoint attributes to ISE for IOTASSET Dictionary.

This document covers the registration process which involves importing a certificate from IND into ISE and also generating a self-signed certificate on ISE and then importing that certificate into IND. ISE features an Internal Certificate Authority(CA) for deploying pxGrid certificates.

#### **Technical Details**

Cisco IND is a Network Management tool for Industrial Networks which can detect Industrial endpoints such as PLC, HMI, I/O drives etc. IND also collects device attributes from these devices by communicating over Native protocols CIP, Profinet, Modbus etc.

Cisco IND can register with ISE and push the device attributes for these Industrial endpoints using pxGrid. IND will be acting as a pxGrid publisher and ISE as a pxGrid subscriber

Cisco IND pushes endpoint attributes such as assetID, assetDeviceType, assetMacAddress, assetIpAddress, assetProductID, assetProtocol, assetVendor, etc, and ISE subscribes to this information into "IOTASSET" Dictionary for the same attributes. ISE can use these attributes to Profile the Industrial endpoints based on Vendor, Type and location etc to apply Policies based on Organizational Security requirements.

#### Importing/Generating Certificate from ISE to import on IND

There are 2 methods to generate Certificate for ISE that needs to be imported into IND, first is using ISE Internal CA Authority and the second method is using External CA Authority, we will discuss both methods below.

#### Method 1: Generating Certificate using ISE Internal CA Authority

Note: The Instructions below shows generating Certificate using PKCS12 format, we can also generate certificate in .PEM or .CER format and import on IND

#### Generating Certificate for ISE that can be imported to pxGrid clients such as IND etc

## Step 1 Select Administration > pxGrid Services > Certificates and enter the relevant information as shown below



#### Step 2 Click Create

#### Step 3 Click **OK** to save the .zip file and extract the certificate onto the local drive



#### Method 2: Import Certificate from ISE using External CA Authority

Note: Only use this method if you are using External CA Authority.

Step 1.1 On ISE Navigate to the page Administration > System > Certificates > System Certificates and select the certificate from External CA and click Edit.

diale Identity Services Engine	Home   Context Visibility   Operations	Policy      Administration	Work Centers			0	License Warning 🔺 🔍
▼ System → Identity Management	Network Resources     Device Portal Management	pxGrid Services + Feed S	Service + Threat Centric NAC				
Deployment Licensing - Certificat	s → Logging → Maintenance Upgrade → Ba	ckup & Restore + Admin Acc	cess + Settings				
0							
- Certificate Management	System Certificates 🛕 For disaster recovery	it is recommended to export ce	ertificate and private key pairs of all system	certificates.			
System Certificates	📝 Edit 🕂 Generate Self Signed Certificate	🕂 Import 🕃 Export 🗙	Delete View				
Trusted Certificates	Friendly Name	Used By	Portal group tag	Issued To	Issued By	Valid From	Expiration Date
OCSP Client Profile	▼ ise-ind-demo						
Certificate Signing Requests	OU=Certificate Services System Certificat e,CN=ise-ind-demo.cisco.com#Certificat Services Endpoint Sub CA - ise-ind-dem	at e pxGrid p		ise-ind-demo.cisco.com	Certificate Services Endpoint Sub CA - ise -ind-demo	Sun, 10 Dec 2017	Sat, 11 Dec 2027
Certificate Authority	Default self-signed saml server certificate	3 SAML		SAML_ise-ind-demo.cisco.com	SAML_ise-ind-demo.cisco.com	Mon, 11 Dec 2017	Tue, 11 Dec 2018
	<ul> <li>Default self-signed server certificate</li> </ul>	EAP Authentication, Admin, Portal, RADIUS DTLS	Default Portal Certificate Group ()	ise-ind-demo.cisco.com	ise-ind-demo.cisco.com	Mon, 11 Dec 2017	Tue, 11 Dec 2018

Step 1.2 Enable pxGrid on this certificate to be used by pxGrid clients by selecting **pxGrid** option and then click **Save** as shown below.

dentity Services Engine	Home  → Context Visibility  → Operations  → Policy  → Administration  → Work Centers
✓ System → Identity Management	Network Resources     Device Portal Management     pxGrid Services     Feed Service     Threat Centric NAC
Deployment Licensing - Certific	ates → Logging → Maintenance Upgrade → Backup & Restore → Admin Access → Settings
	Valid From Mon. 11 Dec 2017 16:42:43 CST
<ul> <li>Certificate Management</li> </ul>	
System Certificates	Valid To (Expiration) Tue, 11 Dec 2018 16:42:43 CST
Trusted Certificates	
OCSP Client Profile	Serial Number 5A 2F 09 E3 00 00 00 00 1F A3 F9 2B 26 96 3E 17
Certificate Signing Requests	Signature Algorithm SHA1WITHRSA
Certificate Periodic Check Setti	
Certificate Authority	Key Length 2048
	Certificate Policies
	Usage
	Admin: Use certificate to authenticate the ISE Admin Portal
	EAP Authentication: Use certificate for EAP protocols that use SSL/TLS tunneling
	RADIUS DTLS: Use certificate for the RADSec server
	pxGrid: Use certificate for the pxGrid Controller
	SAML: Use ceruncate for SAML Signing
	* Portal group tag Default Portal Certificate Grouv
	Portal(s) using this tagon portal (default) Blacklist portal (default)
	Certificate Provisioning Portal (default) Client Provisioning Portal (default)
	Hotspot Guest Portal (default) MDM Portal (default)
	My Devices Portal (default) Self-Registered Guest Portal (default)
	Sponsor Portal (defadir.) Sponsored Guest Portal (defadir.)
	Renew Self Signed Certificate
	Renewal Period
	* Expiration TTL
	Sture
	Save Reser

Step 1.3 Export the certificate by selecting the certificate and click **Export**.

الدان، Identity Services Engine المعادية	Home )	Context Visibility	Policy  Administration	Work Centers	U		1	License Warning 🔺 🔍 🐵	
	Network Re	sources	pxGrid Services	Service + Threat Centric NAC					
Deployment Licensing - Certificates	▶ Loggir	ng + Maintenance Upgrade + Back	up & Restore + Admin Acc	cess > Settings					
0	0								
▼ Certificate Management	System	Certificates 🛕 For disaster recovery it	is recommended to export ce	rtificate and private key pairs of all system	pertificates.				
System Certificates	📝 Edit	🕂 Generate Self Signed Certificate	- Import 🕃 Export 🗙	Delete View					
Trusted Certificates		Friendly Name	Used By	Portal group tag	Issued To	Issued By	Valid From	Expiration Date	
OCSP Client Profile	▼ ise-inc	i-demo							
Certificate Signing Requests		OU=Certificate Services System Certificat e,CN=ise-ind-demo.cisco.com#Certificate Services Endpoint Sub CA - ise-ind-demo	Not in use		ise-ind-demo.cisco.com	Certificate Services Endpoint Sub CA - ise -ind-demo	Sun, 10 Dec 2017	Sat, 11 Dec 2027 🔽	
Certificate Periodic Check Setti		#00001							
Certificate Authority		- CN=SAML_ise-ind-demo.cisco.com	SAML		SAML_ise-ind-demo.cisco.com	SAML_ise-ind-demo.cisco.com	Mon, 11 Dec 2017	Tue, 11 Dec 2018 🛛 🗹	
		Default self-signed server certificate	Admin, Portal, EAP Authentication, pxGrid, RADIUS DTLS	Default Portal Certificate Group ()	ise-ind-demo.cisco.com	ise-ind-demo.cisco.com	Mon, 11 Dec 2017	Tue, 11 Dec 2018 🛛 🛃	

Step 1.4 Enter the **Private Key Password** and Click **Export** for the certificate and confirm as shown below.

Export Certificate 'Default self-signed server certificate' ×					
	O Export Certificate Only				
	Export Certificate and Private Key				
*Private Key Password					
*Confirm Password	••••••				
Warning: Exporting a private key is not a	secure operation. It could lead to possible exposure of the private key.				
	Export Cancel				

Step 1.5 Save the certificate to be used in later steps to import into IND.

#### Downloading Certificate from IND

- Step 4 On IND UI Navigate to the page Settings > pxGrid
- Step 5 Click on **Download .pem IND Certificate** as shown below



Step 6 Save ind.pem file to the local disk by clicking on Save File

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# Opening ind.pem You have chosen to open: ind.pem which is: Binary File (1.2 KB) from: https://10.31.96.157:8443 Would you like to save this file? Cancel Save File

**Technical Details** 

# Import IND Certificate into ISE, this certificate will allow ISE to bulk download asset information from IND

Step 7 On ISE, Navigate to Administration > System > Certificates > Certificate Management > Trusted Certificates and click Import as shown below

ululu Identity Services Engine	Home	Operations     Policy	<ul> <li>Administration</li> </ul>	N → Work Centers	
System Identity Management	Network Resources	Portal Management pxGrid	Services Feed	Service	ic NAC
Deployment Licensing - Certificate	s  Logging  Maintenance	Upgrade	estore      Admin A	ccess	
0					
✓ Certificate Management	Trusted Certificates				
System Certificates	🧨 Edit 🕂 Import	X Delete Delete			
Trusted Certificates	Friendly Name	•	Status 1	Trusted For	Serial Number
OCSP Client Profile	Baltimore CyberTrust Root		Z Enabled	Cisco Services	02 00 00 B9
Certificate Signing Requests	Cisco CA Manufacturing		Ø Disabled I	Endpoints Infrastructure	6A 69 67 B3 00 00
Certificate Periodic Check Setti	Cisco Manufacturing CA SH	IA2	Enabled	Endpoints nfrastructure	02
Certificate Authority	Cisco Root CA 2048		Disabled I	Endpoints Infrastructure	5F F8 7B 28 2B 54
	Cisco Root CA M2		Enabled E	Endpoints Infrastructure	01
	Default self-signed server of	certificate	Z Enabled	Endpoints Infrastructure	5A 2F 09 E3 00 00
	DigiCert root CA		Z Enabled	Endpoints Infrastructure	02 AC 5C 26 6A 0B
	DigiCert SHA2 High Assura	nce Server CA	Z Enabled	Endpoints Infrastructure	04 E1 E7 A4 DC 5C
	DST Root CA X3 Certificate	Authority	Z Enabled	Cisco Services	44 AF B0 80 D6 A3
	Thawte Primary Root CA		Enabled (	Cisco Services	34 4E D5 57 20 D5
	VeriSign Class 3 Public Prin	nary Certification Authority	Z Enabled	Cisco Services	18 DA D1 9E 26 7D
	VeriSign Class 3 Secure Se	rver CA - G3	Enabled 0	Cisco Services	6E CC 7A A5 A7 03

Step 8 ISE will prompt you to import the Certificate into Certificate store

#### Deploying Cisco Industrial Network Director (IND) with Cisco ISE using pxGrid

#### **Technical Details**

dentity Services Engine	Home  Context Visibility  Operations  Policy  Administration  Work Centers
✓ System → Identity Management	Network Resources     Device Portal Management     pxGrid Service     Feed Service     Threat Centric NAC
Deployment Licensing - Certificate	es → Logging → Maintenance Upgrade → Backup & Restore → Admin Access → Settings
✓ Certificate Management	Import a new Certificate into the Certificate Store
System Certificates	* Certificate File Browse No file selected.
Trusted Certificates	Friendly Name
OCSP Client Profile	
Certificate Signing Requests	Trusted For: 🥡
Certificate Periodic Check Setti	Trust for authentication within ISE
Certificate Authority	Trust for client authentication and Syslog
	Trust for authentication of Cisco Services
	Validate Certificate Extensions
	Description
	Submit Cancel

Step 9 Click **Browse** to select the ind.pem file on local disk from Step 6, give a name to the certificate and click **Submit** to complete the import of the certificate.

dentity Services Engine	Home  → Context Visibility  → Operations  → Policy  → Administration  → Work Centers	
✓ System → Identity Management	Network Resources     Device Portal Management     pxGrid Services     Feed Service     Threat Centric NAC	
Deployment Licensing	es → Logging → Maintenance Upgrade → Backup & Restore → Admin Access → Settings	
G		
- Certificate Management	Import a new Certificate into the Certificate Store	
System Certificates	* Certificate File ind(1).pem	
Trusted Certificates	Friendly Name IND PEM Certificate	Ð
OCSP Client Profile		
Certificate Signing Requests	Trusted For: 👔	
Certificate Periodic Check Setti	✓ Trust for authentication within ISE	
▶ Certificate Authority	Trust for client authentication and Syslog	
	Trust for authentication of Cisco Services	
	☐ Validate Certificate Extensions	
	Description	
	Submit Cancel	

Step 10 Import completed, see the list for certificate from IND on ISE as shown below

uludu Identity Services Engine	Home ► Context Visibility ► Operations ► P	olicy  → Administration  → Work Centers
	Network Resources	xGrid Service   Feed Service   Threat Centric NAC
Deployment Licensing - Certificates	► Logging ► Maintenance Upgrade ► Backup	o & Restore → Admin Access → Settings
G		
✓ Certificate Management	Trusted Certificates	
System Certificates	/ Edit 🔒 Import 🙃 Export 🗙 Delete 💭 View	
Trusted Certificates		Status     Trusted For     Serial Number
OCSP Client Profile	Baltimore CyberTrust Root	<ul> <li>✓ Enabled</li> <li>Cisco Services</li> <li>02 00 00 B9</li> </ul>
Certificate Signing Requests	Cisco CA Manufacturing	<ul> <li>Disabled</li> <li>Endpoints</li> <li>Infrastructure</li> <li>6A 69 67 B3 00 00</li> </ul>
Certificate Periodic Check Setti	Cisco Manufacturing CA SHA2	Enabled Endpoints 02
Certificate Authority	Cisco Root CA 2048	Disabled Endpoints 5F F8 7B 28 2B 54 Infrastructure
	Cisco Root CA M2	✓ Enabled Endpoints 01 Infrastructure
	Default self-signed server certificate	Enabled     Endpoints     Infrastructure     SA 2F 09 E3 00 00
	DigiCert root CA	✓ Enabled Endpoints 02 AC 5C 26 6A 0B Infrastructure
	DigiCert SHA2 High Assurance Server CA	✓ Enabled Endpoints 04 E1 E7 A4 DC 50 Infrastructure
	DST Root CA X3 Certificate Authority	Enabled Cisco Services 44 AF B0 80 D6 A3
	IND PEM Certificate	Enabled Infrastructure 3B 8A 16 AC
	Thawte Primary Root CA	Enabled Cisco Services 34 4E D5 57 20 D5
	VeriSign Class 3 Public Primary Certification Author	ity 🔽 Enabled Cisco Services 18 DA D1 9E 26 7E
-	VeriSign Class 3 Secure Server CA - G3	Enabled Cisco Services 6E CC 7A A5 A7 03

#### Complete IND Registration with pxGrid

#### Import Certificate from ISE to IND

Step 11 On IND UI, navigate to the page **Settings > pxGrid** and click/slide the toggle to enable pxGrid as highlighted below in red.

יוןייוןיי INDUSTRIAL cisco NETWORK DIRECTOR	Settings	>	pxGrid	
Cisco Platform Exchange Grid (pxG system with a Cisco Identity Service	irid) is an open, es Engine (ISE)	scalabl pxGrid	e data-sharing a controller. This ir	nd tr nforn
Download .pem IND certificate				

Step 12 IND will prompt to enter details of ISE server.

	, i i i i i i i i i i i i i i i i i i i				
				pxGrid	
able pxGrid- Settings					
Connect Using the Existing Noc	le				
negister a new node					
ISE Server					
ISE Server Server*			Node Name*		
ISE Server Server*		0	Node Name *		
ISE Server *		0	Node Name*		
ISE Server Server Certificate Password		•	Node Name *		
ISE Server Server* Certificate Password		0	Node Name*		

Step 13 If this is the first time you are registering IND with pxGrid, select **Register a New Node** and enter ISE server details and certificate password from Step 1 as shown below and click **Upload Certificate**.

	P				
				pxGrid	
3					
			Node Name*		_
		0	INDServer		6
			, ,	e Node Name* INDServer	pxGrid

Step 14 Window pops up to select the certificate.

cisco NETWORK DIRECTOR Settings > pxGrid							
				pxGrid			
Enable pxGrid- Settings	Upload Certifica	ne					×
	Certificate*		Browse				0
Connect Using the Existing Node Register a New Node							
ISE Server							
Server*	-	-	Node Name*				
ise-ind-demo.cisco.com		0	INDServer			0	
Certificate Password							
	۲	0					
				Cancel Upload Certif	icate		

Step 15 Click **Browse** and select the certificate from local disk saved in Step 3.

		_				_		
							pxGrid	
			Upload Certifica	ste				
inable pxGrid- Settings		Certificate*		Browse			0	
Connect Using the Existing Node Register a New Node			(<) [11]		🖩 🗸 🖿 Certificate	s	C 🛆 🖸 Q Search	1
ISE Server			tes Recents Desktop Downloads		Name ind(1).pem NDISE_Certificat	*_10.31.96.1 cert.zip	i1.p12	-
Server*		- Hit	de extension				Cancel	en in
ise-ind-demo.cisco.com				0	INDServer			0
Certificate Password								
			۲	θ				
						Cencel	Unioari Certificate	



Upload Certificate		×
Certificate *	Browse C:\fakepath\INDISE_Certificate_10.31.96.151.p12	
	Upload and Register Cancel	

Step 17	oxGrid certificate should be regi	stered successfully look f	for below message and click <b>OK</b> .
JCD 1/			

Upload Certificate	Message	×	×
Certificate*	pxGrid Certificate successfully registered	pxGrid Certificate successfully registered	
	ОК		

#### Approve IND Request on ISE

Step 18 On ISE Navigate to Administration > pxGrid Services > All Clients, you should see a request for Pending Approval as Total Pending Approval (1) as shown below, Click on Total Pending Approval (1) to see a drop down and click on Approve All to approve the request from IND.

Identity Services Engine         Home         Context Visibility         Operations	▶ Policy	→ Admini
System     Identity Management     Network Resources     Device Portal Management	nt pxGrid S	Services
All Clients Web Clients Capabilities Live Log Settings Certificates Pe	ermissions	
🖌 Enable 🧭 Disable 😪 Approve 🎯 Group 👎 Decline 😵 Delete 👻 🍪 Refresh 🛛 Total P	ending Approv	al(1)
Client Name Client Description Cap	ve All	
ise-pubsub-ise-ind-demo Capabilities	ie All S(U Pub, U Sut	))
□ ▶ ise-fanout-ise-ind-demo Capabilities	s(0 Pub, 0 Sub	o)
□ ▶ ise-mnt-ise-ind-demo Capabilities	s(2 Pub, 1 Sub	<b>)</b>
□ ▶ ise-bridge-ise-ind-demo Capabilities	s(0 Pub, 4 Sub	o)
□ ▶ ise-admin-ise-ind-demo Capabilities	s(5 Pub, 2 Sub	<b>)</b>
□ ▶ indserver Capabilities	s(0 Pub, 0 Sub	o)
□ ▶ ise-sxp-ise-ind-demo Capabilities	s(1 Pub, 1 Sul	<b>)</b>
Capabilities	s(0 Pub, 0 Sub	))

Step 19 Click on Approve All as shown.



#### Step 20 You should see IND on the list of clients as shown below

dentity Services Engine H	ome	Operations    Policy   Admin	istration Vork Centers			
System     Identity Management     N	letwork Resources	al Management pxGrid Services	Feed Service     Threat Centric N	AC		
All Clients Web Clients Capabilities	s Live Log Settings Cer	ificates Permissions				
🖋 Enable 🧭 Disable 😪 Approve 😝 Grou	ip 👎 Decline 🔞 Delete 👻 😵 Re	fresh Total Pending Approval(0) -				
Client Name	Client Description	Capabilities	Status	Client Group(s)	Auth Method	Log
ise-pubsub-ise-ind-demo		Capabilities(0 Pub, 0 Sub)	Online (XMPP)	Internal	Certificate	View
□ ▶ ise-fanout-ise-ind-demo		Capabilities(0 Pub, 0 Sub)	Online (XMPP)	Internal	Certificate	View
□ ▶ ise-mnt-ise-ind-demo		Capabilities(2 Pub, 1 Sub)	Online (XMPP)	Internal	Certificate	View
□ ▶ ise-bridge-ise-ind-demo		Capabilities(0 Pub, 4 Sub)	Online (XMPP)	Internal	Certificate	View
□ ▶ ise-admin-ise-ind-demo		Capabilities(5 Pub, 2 Sub)	Online (XMPP)	Internal	Certificate	View
□ ▶ ise-sxp-ise-ind-demo		Capabilities(1 Pub, 1 Sub)	Online (XMPP)	Internal	Certificate	View
□ ▶ smc		Capabilities(0 Pub, 0 Sub)	Offline (XMPP)		Certificate	View
indserver		Capabilities(0 Pub, 0 Sub)	Offline (XMPP)		Certificate	View

#### Activate pxGrid on IND

Step 21 Go back to IND and activate, Navigate to IND > Settings > pxGrid and click on Activate as shown below.

IIIIII INDUSTRIAL ISCO NETWORK DIRECTOR	Settings >	pxGrid	
			pxGrid
Enable pxGrid- Activate			
ISE Server			
Server*			Node Name*
ise-ind-demo.cisco.com			INDServer
Certificate*			Certificate Password
INDISE_Certificate_10.31.9	6.151		••••
			Disable Activate

Step 22 pxGrid becomes active as shown below.

V Message		×	
pxGrid Service is active			
	ОК		

Step 23 Completed pxGrid registration and activation on IND, pxGrid page on IND should look as shown below.

• NETWORK DIRECTOR	Settings	> р	xGrid		
					pxGrid
isco Platform Exchange Grid (px ystem with a Cisco Identity Servin	Grid) is an open, so ces Engine (ISE) px	calable da	ta-sharing and t troller. This infor	nreat control platform that a nation can then be leverag	slows seamless integration between multivendor identity, network, security and asset n ed by upstream security systems to monitor security, detect threats, and set network pr
ISE Server					
ISE Server				Ne	de Name*
ISE Server Server* ise-ind-demo.cisco.com				Ne	side Name* VDSorver
ISE Server Server* Ise-ind-domo.cisco.com Certificate*				No.	de Name * IDServer rtificate Password

#### Verify if IND is sending endpoint attributes to ISE

If IND send device attributes you should be able to find attributes on ISE endpoint attributes

Step 24 On ISE Navigate to **Context Visibility > Endpoints**, select and endpoint and look for attributes as shown below, these are the additional attributes supplied by IND for Industrial endpoints and can be used in ISE Profiling policies.

Identity Services Engine	
TotalFailedTime	5
UseCase	Host Lookup
User-Fetch-User-Name	00-1D-9C-CC-84-53
User-Name	001d9ccc8453
UserType	Host
allowEasvWiredSession	false
assetConnectedLinks.assetDeviceType	Switch
assetConnectedLinks.assetId	40109
assetConnectedLinks.assetIpAddress	192.168.119.116
assetConnectedLinks.assetName	IE4000-1
assetConnectedLinks.assetPortName	FastEthernet1/5
assetDeviceType	НМІ
assetGroup	Barcelona_Plant > Cell-1
assetId	40110
assetIpAddress	192.168.119.33
assetMacAddress	00:1d:9c:cc:84:53
assetName	192.168.119.33
assetProductId	PanelView Plus_6 100
assetProtocol	CIP
assetSerialNumber	12551566
assetVendor	Rockwell Automation/Allen-Bradley
e041a910-0085-11e8-9661-82afacd4c1d2	Barcelona_Plant > Cell-1
ip	192.168.119.33
operating-system	Microsoft Windows Mobile 5.0 - 6.1 or Zune audio player (firmware 2.2)
operating-system-result	Microsoft Windows Mobile 5.0 - 6.1 or Zune audio player (firmware 2.2)

#### References

#### Cisco ISE Configuration guides

https://www.cisco.com/c/en/us/support/security/identity-services-engine/products-installation-and-configuration-guides-list.html

#### Cisco IND Configuration guides

https://www.cisco.com/c/en/us/support/cloud-systems-management/industrial-network-director/tsd-products-support-series-home.html

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