CONNECTING
THE WORLD

Cyber Security and Application Hardening

James Johnson

Objectives

- Why should you care about security?
- What can you do?
- Where can you find information and updates?
- Best practices for hardening a Niagara application
- PKI overview
- How to deploy PKI certificates in a Niagara application
- Code signing program objects

Read the News Lately?

Yahoo says 500 million accounts stolen

by Seth Fiegerman @sfiegerman

September 23, 2016: 10:39 AM ET

INTERNATIONAL

Ransomware Attacks Ravage Computer Networks In Dozens Of Countries

Recommend 20K

TECHNOLOGY

Nearly 200 million IoT devices are 'vulnerable to hacking'

VOTE 2016

FBI investigates cyberattack of Democratic National Committee

Up to 400 million accounts in Adult Friend Finder breach

14 November 2016 | Technology

Here Are 4 Vulnerabilities Ransomware Attacks Are Exploiting Now

A zero-day exploit exposed ... breach is amon...

Another Day, Another New Threat to Privacy on the Internet

...ON HIGGINS Executive Editor ... reading, 3/22/2016

Bought a car recently? Millions of dealership customer details found online

Customers for more than a hundred car dealerships across the US were put at risk because of shoddy database security.

US Banks Targeted with Trickbot Trojan

Nearly 1 million new malware threats released every day

LinkedIn Lost 167 Million Account Credentials in Data Breach

IoT Security Incidents Rampant and Costly

TECH

FBI Says Threat From 'Ransomware' Is Expected to Grow

Law-enforcement agency sees problem of extortion by hackers worsening in 2016

How 1.5 Million Connected Cameras Were Hijacked to Make an Unprecedented Botnet

DEFCON 2.0: Expert warns cyber warfare has reached critical turning point

Updated 11 Oct 2015, 10:15pm

More than 65m Tumblr emails for sale on the darknet

An Army of Million Hacked IoT Devices Almost Broke the Internet Today

Friday, October 21, 2016 Mohit Kumar

RISK ASSESSMENT —

Double-dip Internet-of-Things botnet attack felt across the Internet

Massive attack combining compromised IoT devices, other bots cripples many sites.

SEAN GALLAGHER - 10/21/2016, 5:17 PM

Big Data privacy risks

Not in front of the telly: Warning over 'listening' TV

WANNACRY II? Britain, Europe and Chernobyl hit by 'Petya' ransomware in cyber-attack with chilling echoes of the 'WannaCry' assault which crippled the NHS

Oil firms, government systems and a major shipping firm also come under attack as virus sweeps across the Continent

DDoS Attack Takes Down Central Heating System Amidst Winter In Finland

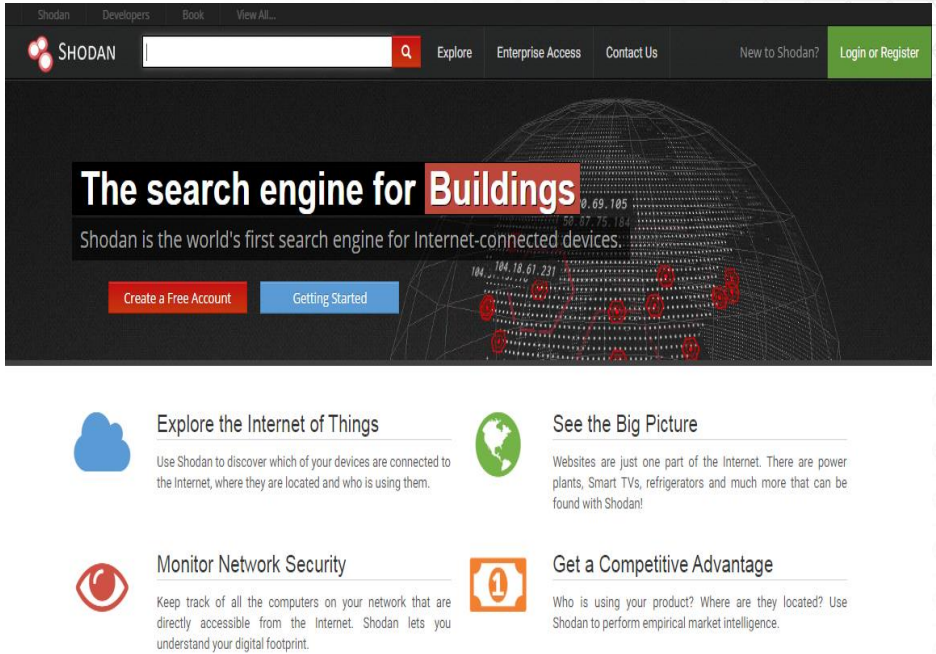
Wednesday, November 09, 2016 Mohit Kumar

REPORT

FBI: An Account on Clinton's Private Email Server Was Hacked

IoT Search Engines

- https://www.shodan.io
- https://censys.io
- https://www.punkspider.org
- https://www.zoomeye.org
- https://ivre.rocks



People Forget Physical Security

- Even if you have secure products and great network security, it really doesn't matter if someone can gain physical access to your control system and edge devices.
- Many successful cyber-attacks also begin with a physical attack.
- Malware can be introduced through USB drives.

Protect Against Ransomware

- Educate your people on the safe use of IT assets and the dangers of ransomware.
- Use anti-virus software
- Perform periodic scheduled backups of your systems.
- Treat systems as mission-critical infrastructure, which means it shouldn't be used for surfing the web or checking email.

Patch Management is Critical

- Organizations such as US-CERT and ICS-CERT provide a great service internationally, reporting vulnerabilities in hardware and software.
- Many advisories affect millions of devices.
- Vendors release security patches and updates, and these organizations point you to where to get them.
- Any unpatched system on your network can be an attackers avenue into your organization.

US-CERT
UNITED STATES COMPUTER EMERGENCY READINESS TEAM

https://www.us-cert.gov

ICS-CERT
INDUSTRIAL CONTROL SYSTEMS CYBER EMERGENCY RESPONSE TEAM

https://ics-cert.us-cert.gov

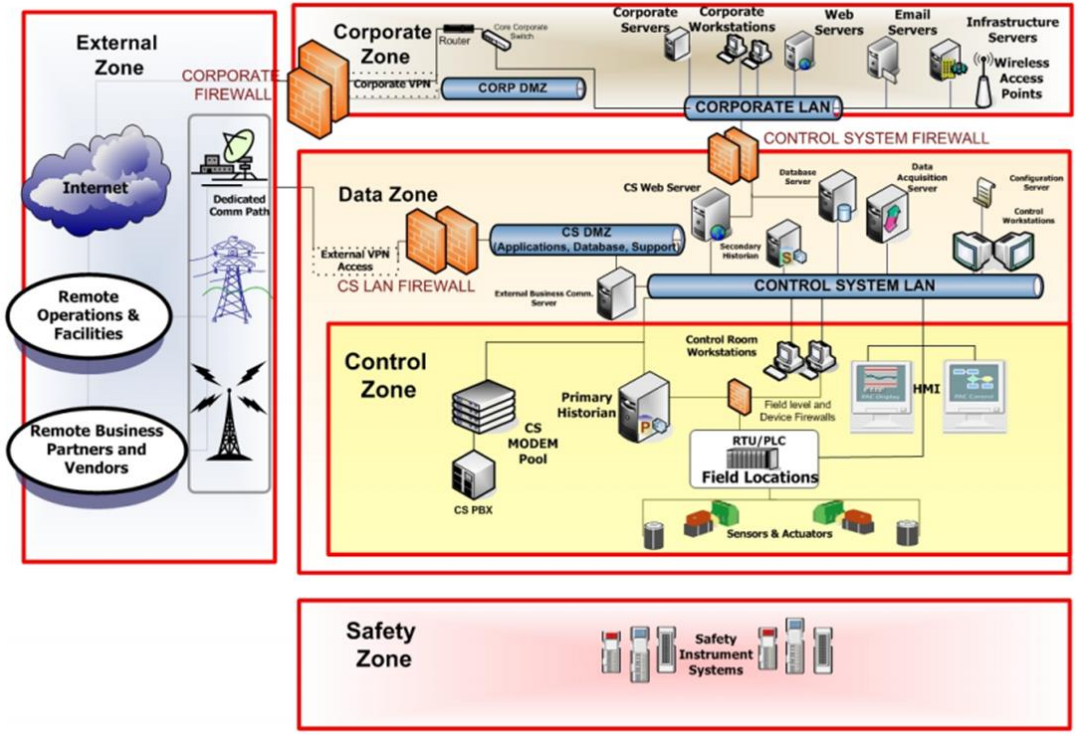
Assessments – what are you assets and risks?

- Understand your organization's appetite for risk and determine a risk threshold using a CVSS score.
- Identify electronic assets you wish to protect and document security requirements.
- Engage an independent security team to assess threats and potential vulnerabilities for your network and assets.
- Follow up with action items.
- Perform on a periodic basis because assets and requirements change over time.

Networking – Defense-In-Depth

From “Recommended Practice: Improving Industrial Control Cybersecurity With Defense-In-Depth Strategies”

DHS, ICS-CERT, 2009



Helpful Resources

Resources	Where to Find
NIST SP 800-50: Building and Information Technology Security Awareness and Training Program	www.nist.gov
NIST SP 800-82: Guide to Industrial Control System (ICS) Security	www.nist.gov
NIST SP 800-61: Computer Incident Security Handling Guide	www.nist.gov
ICS-CERT – “Improving Industrial Control Systems Cybersecurity with Defense-In-Depth Strategies”	https://ics-cert.us-cert.gov

Helpful Resources

Resources	Where to Find
ICS-CERT – “Developing an Industrial Control Systems Cybersecurity Incident Response Plan	https://ics-cert.us-cert.gov
ICS-CERT – “Remote Access for Industrial Control Systems.”	https://ics-cert.us-cert.gov
Niagara 4 & AX Hardening Guides	www.tridium.com/en/resources/library
Tridium Security Bulletins	www.tridium.com/en/resources/library
Niagara Smart Building Guide Specification	www.tridium.com/en/resources/library

Niagara – Good Behavior Through Technology

- **Secure by Default**
  - Forcing default credential changes upon commissioning
  - Strongest authentication mechanisms by default
  - Enforcement of strong passwords
  - Encrypted communications (FOXS and HTTPS)
- **Role-based Access Control** – Make user management easier with role-based abstractions.
- **Encryption** of sensitive information at rest
- **Digitally-signed code**, validated for integrity and source at run time.
- **Secure Boot**

Flexible Authentication Schemes

- **Lightweight Directory Access Protocol (LDAP) / Active Directory (AD)**
  - Integrates to existing directory information services.
  - Supports using Kerberos for SSO.
- **Security Assertion Markup Language (SAML)**
  - Provides SSO functionality.
  - Works with popular on premise and cloud based SAML Identity Providers (IdP) such as OpenAM, Salesforce, Active Directory, etc.
- **Google**
  - Provides two factor authentication using Google Authenticator app.
  - Available for Android, BlackBerry and iOS devices.

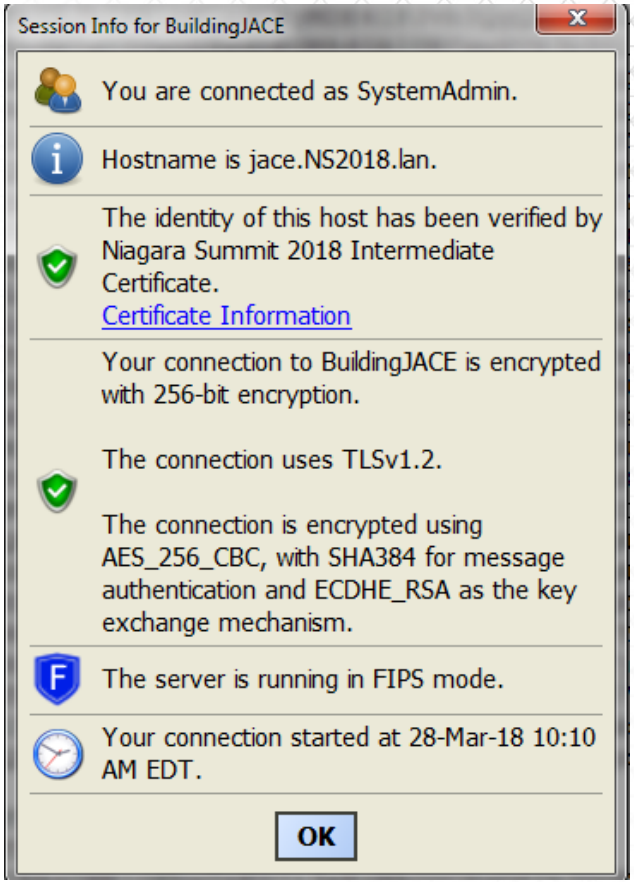
LDAP and Kerberos and SAML, Oh My!

Another session to come focusing on these features

- 10:30 AM Tomorrow – Active Directory and SAML Integration

FIPS 140-2

- Federal Information Processing Standard (FIPS) is a government security standard used to accredit cryptographic modules.
- Cryptographic modules undergo a thorough certification process to ensure that all cryptographic algorithms adhere to the government security guidelines.
- Workbench clients and stations running in FIPS mode are restricted to using FIPS certified algorithms.



Public Key Infrastructure (PKI)

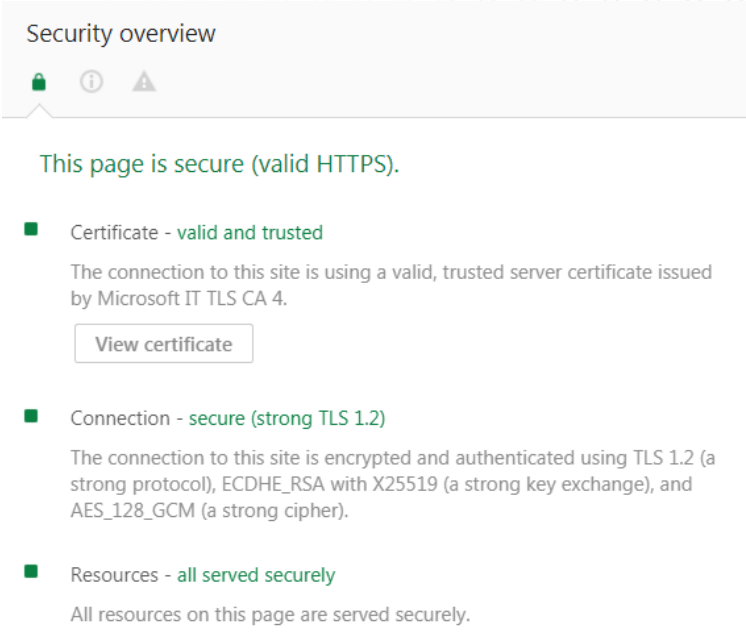
- An infrastructure that supports the distribution of certificates containing public identification keys that are used to both securely identify entities and also provide confidentiality in transmissions.
- A **Certificate Authority** (CA) is an organization which stores, issues and signs digital certificates.
- A **digital certificate** is an electronic document used to identify an entity, digitally signed by a trusted third party (the CA).
- Certificates for a web server also binds together the organization's identity with the web server's identity using the server's domain name, server's name, host name or IP address.

Public Key Cryptography

- Uses a **private** and **public key pair**, used together for encrypting and signing.
- Keys are asymmetric, meaning each key is unique but only two specific keys work together.
  - Each participant has a private and public key. The public key is not a secret and is available to everyone, while each participant keeps its private key a secret.
  - A sender **encrypts data** with a **recipient's public key**, and only someone who holds the private key (the recipient) can decrypt the data.
  - A sender can **sign data** with **their own private key**, and everyone who has access to the signer's public key can validate the sender signed it.
- TLS uses an asymmetric public key pair (2048 to 4096 bit) to establish a TLS connection, and then a symmetric session key (128 to 256 bit) for encryption of data for performance reasons.

What Does a TLS Certificate Provide

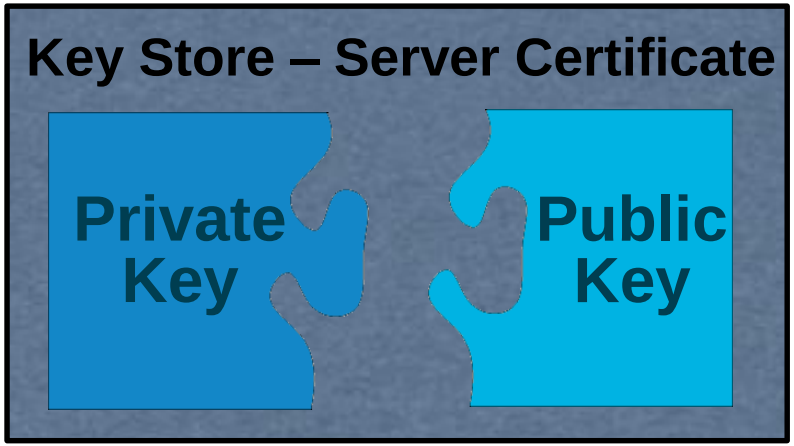
- Through a handshake process, the client establishes an encrypted connection with the server.
- **Verifies the identity** of the server.
- **Validate the authenticity** of the server's certificate.
- Session info displays details regarding the server's identity, cipher strength, protocol, and key exchange mechanism.
- A connection can be encrypted without verifying the server's identity or validating the certificate authenticity.

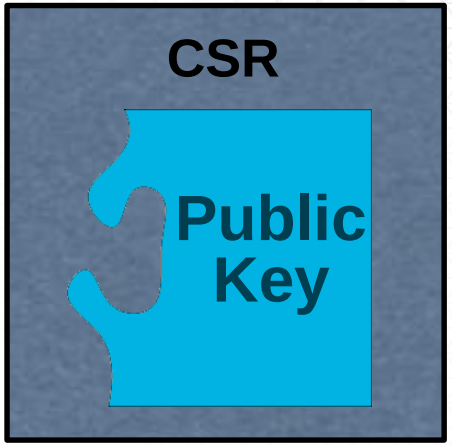


Certificate Authority (CA)

- In cryptography, an **organization that issues digital certificates**.
- A trusted third party organization who vets the organization seeking to have their certificate signed.
- The vetting process varies depending on the specific type of certificate.
- The CA typically charges a fee for the process.
- Certificates are typically **only valid for a period of 1 year**.
- Could be well known public organizations such as Thawte, GoDaddy or Verisign, or could be a local authority.

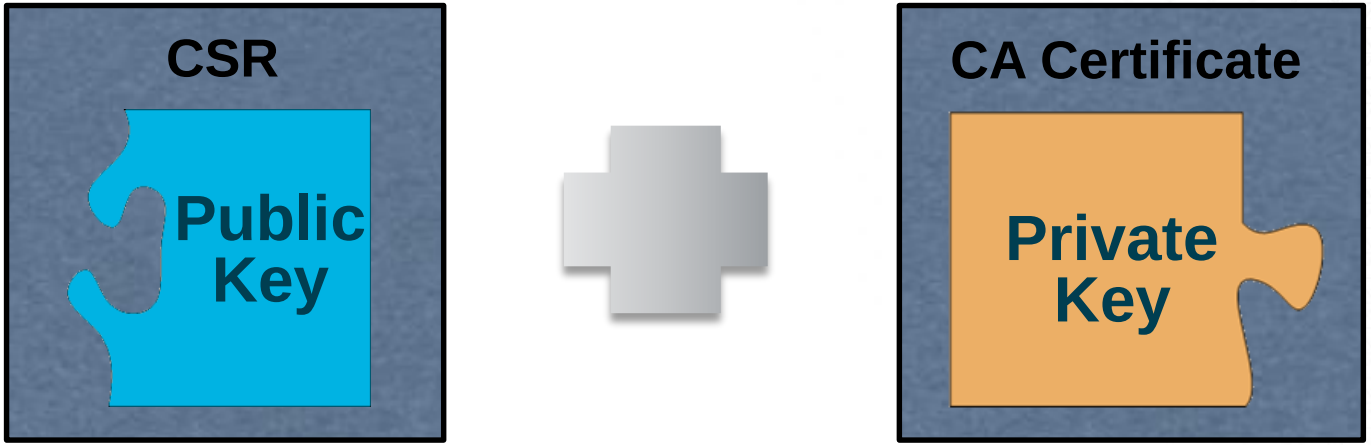
Creating a Certificate Signing Request (CSR)





- Only includes the **public key** from the server's certificate.
- The original private key must remain in the server's key store.

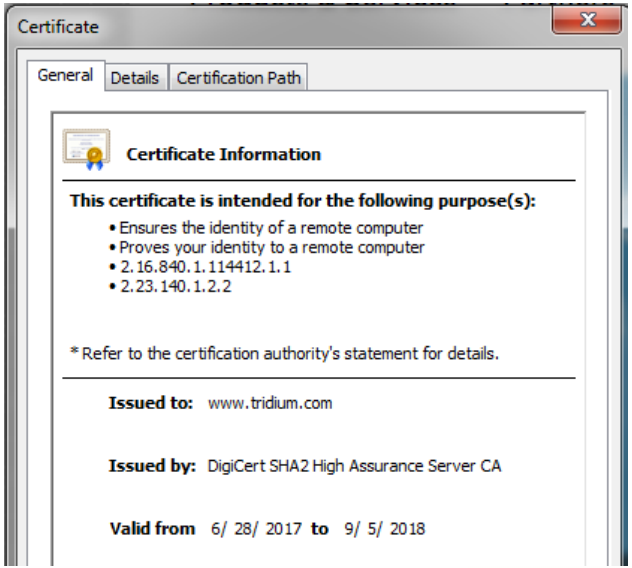
Signing a Certificate Signing Request (CSR)

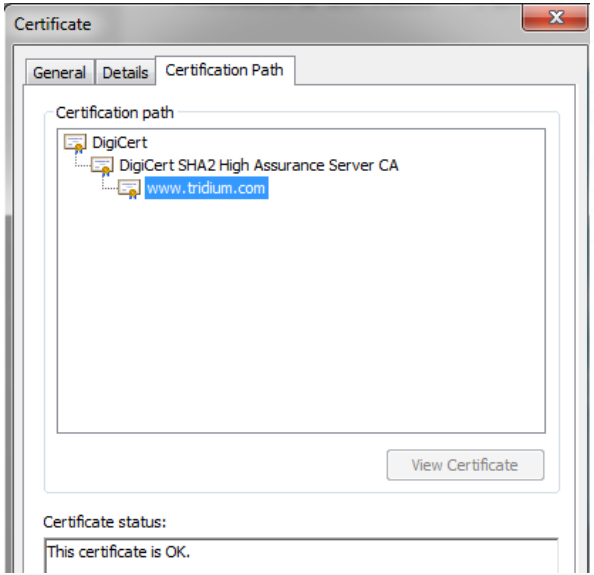


- After validating the request, the certificate authority signs the CSR using their private key.
- The certificate authority sends the signed certificate and other information to the applicant.

Certificate Chain of Trust

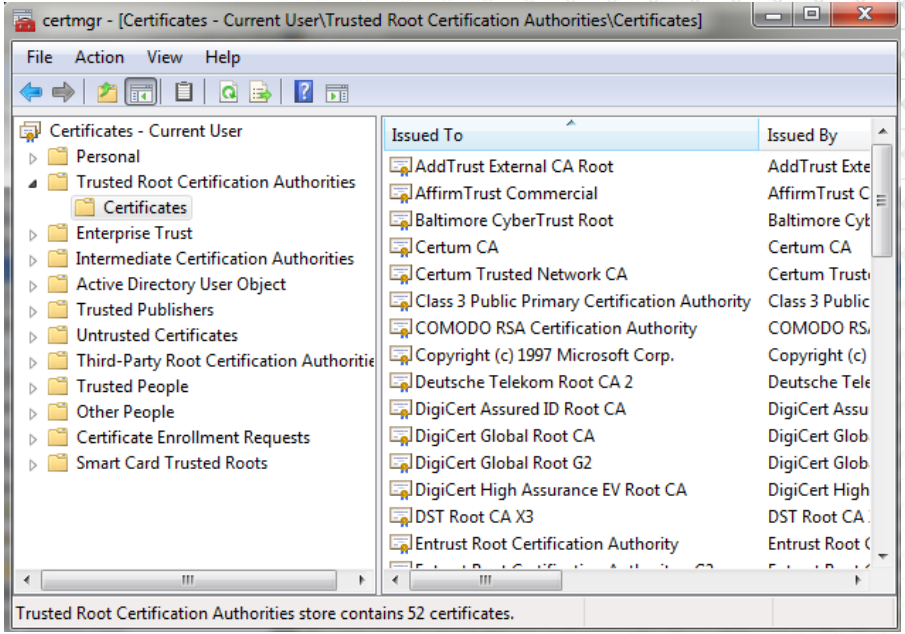
- Shows the **chain of certificates** used to digitally sign the certificate.
- Typically includes at least an intermediate and root certificate.





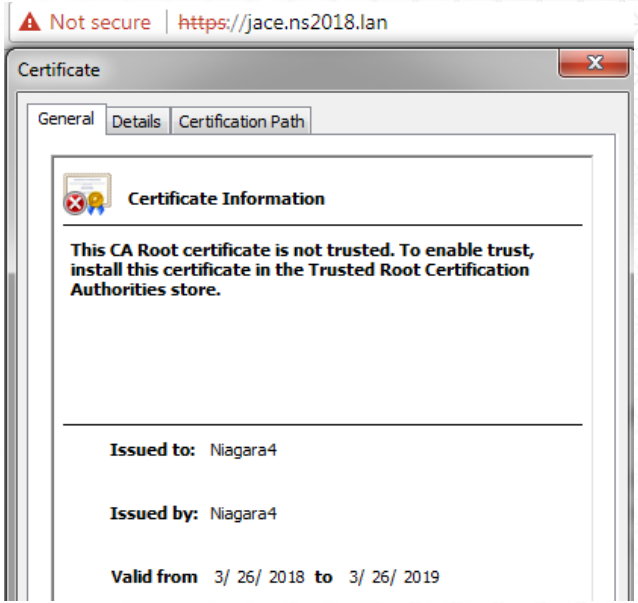
Certificate Trust Store

- A **collection of root and intermediate certificates** including their public encryption keys.
- Typically populated by the operating system or application provider with well known public certificate authorities.
- Can import additional certificates from other certificate authorities.
- Use by the client to **validate the digital signatures** used in a certificate's chain of trust.



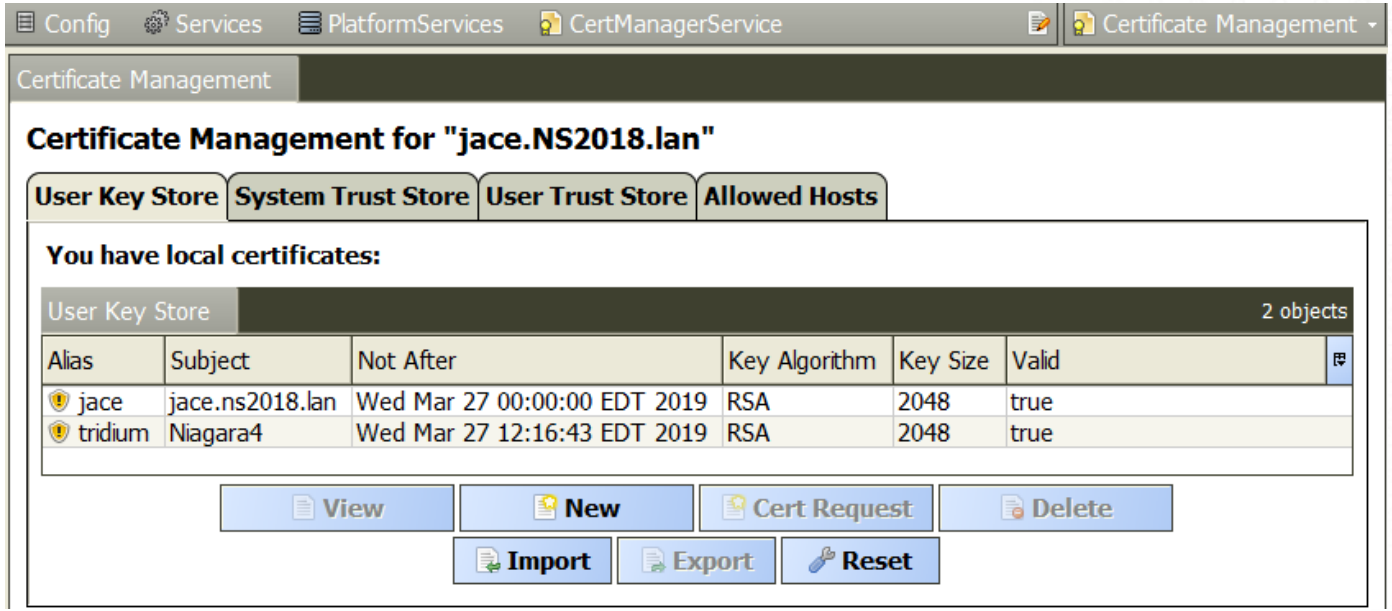
Default Self-Signed Certificate

- The **issuer and subject properties match**.
- Can only be used to **encrypt** the connection and data being transferred.
- **Cannot** be used to **verify the identity** of the server or to establish trust.



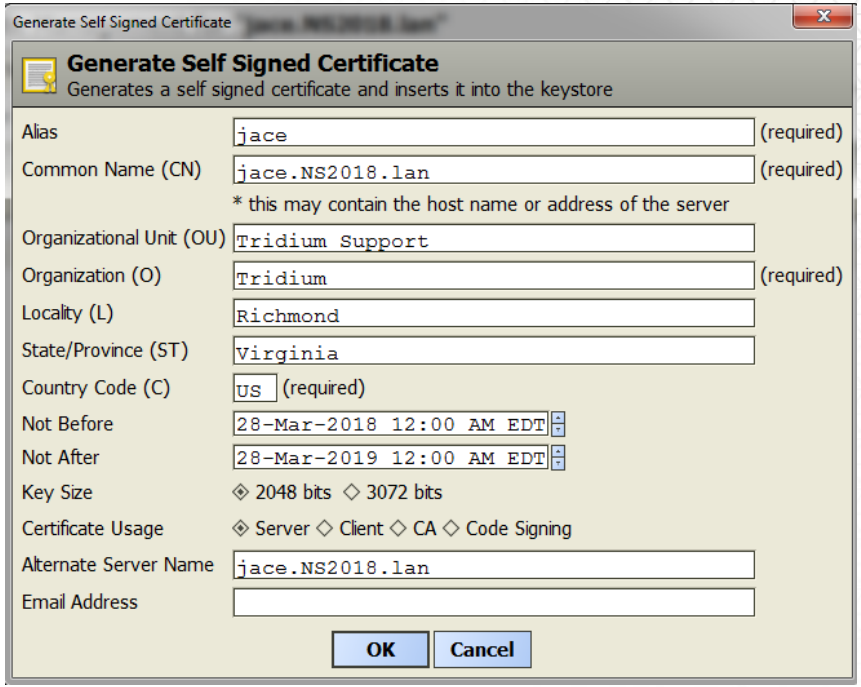
Workbench Certificate Management Tools

- Used to manage the server's key store, trust store and host exceptions.



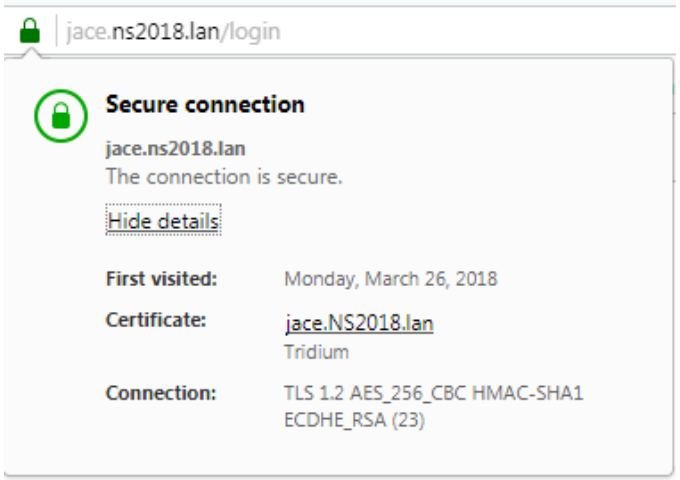
Workbench – Create a Self-Signed Certificate

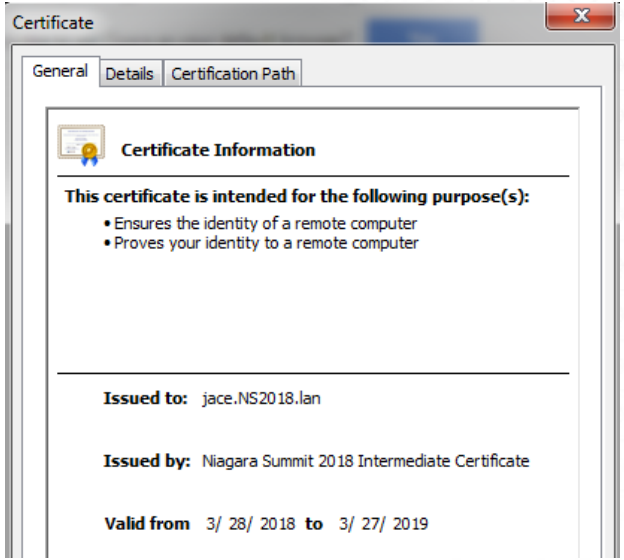
- Common Name (CN) should be the domain name which the server will be accessed using.
- Alternative Server Name should contain CN and possibly other DNS aliases.
- Not all fields are required, verify with your CA which fields they require.
- Typically only valid for 1 year.
- Verify supported key size.



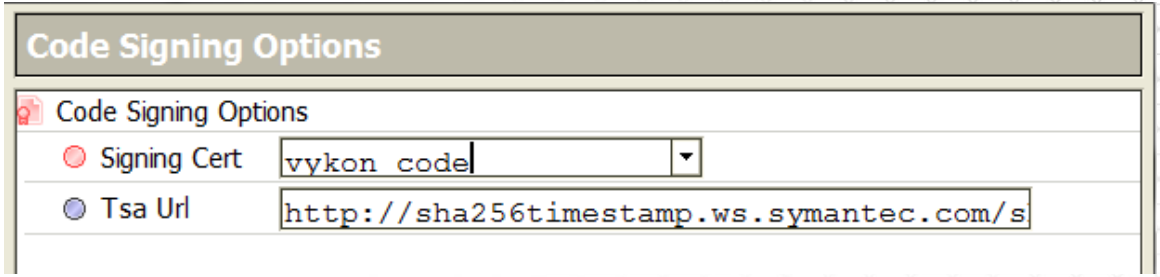
Using a Signed Certificate

- Issued to and issued by are different.
- Provides **encryption, verifies the identity** of the server and **establishes trust** between the client and server.





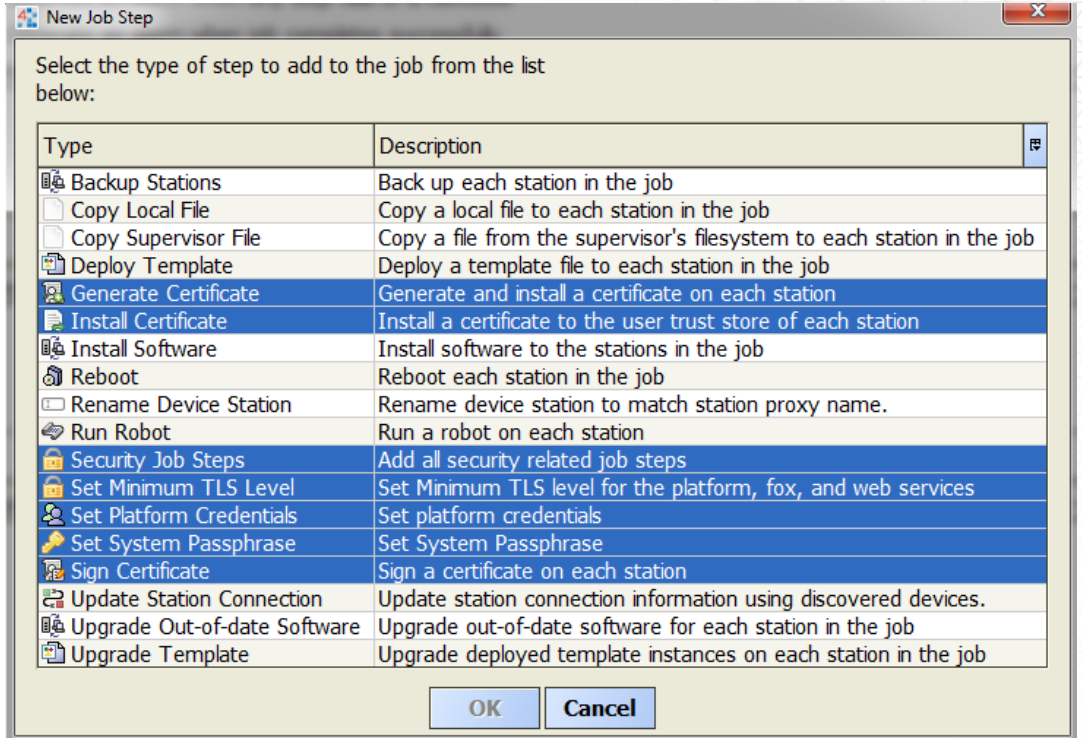
Code Signing



- The process of digitally signing executables and scripts to confirm the software author and guarantee the code has not been altered or corrupted since it was signed.
- Trusted timestamping is the process of securely keeping track of the creation and modification times of a document.
- Timestamping Authority (TSA) URL – Server which timestamps the code signature so client can verify when the code was digitally signed.
- All core modules from Tridium are code signed.
- Third party developers may optionally code sign their modules.
- Program objects may optionally be code signed.

Provisioning Tools

- Batch tools for managing security related features on JACEs under a supervisor.
- Certificate steps for creating and installing signed server certificates to the key store or installing CA certificates to the trust store.
- Steps for setting the system passphrase, platform credentials and TLS levels.



Type	Description
Backup Stations	Back up each station in the job
Copy Local File	Copy a local file to each station in the job
Copy Supervisor File	Copy a file from the supervisor's filesystem to each station in the job
Deploy Template	Deploy a template file to each station in the job
Generate Certificate	Generate and install a certificate on each station
Install Certificate	Install a certificate to the user trust store of each station
Install Software	Install software to the stations in the job
Reboot	Reboot each station in the job
Rename Device Station	Rename device station to match station proxy name.
Run Robot	Run a robot on each station
Security Job Steps	Add all security related job steps
Set Minimum TLS Level	Set Minimum TLS level for the platform, fox, and web services
Set Platform Credentials	Set platform credentials
Set System Passphrase	Set System Passphrase
Sign Certificate	Sign a certificate on each station
Update Station Connection	Update station connection information using discovered devices.
Upgrade Out-of-date Software	Upgrade out-of-date software for each station in the job
Upgrade Template	Upgrade deployed template instances on each station in the job

Summary

- Everyone must **care and be aware** of cybersecurity.
- Multiple layers of security provide **defense in depth**.
- Secure systems **require active management** including but not limited to managing certificates, installing software patches and performing periodic security audits.
- PKI certificates are used to **establish trust** between a client and server by verifying the identities and **encrypting data exchanged over the network**.

Questions