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A Programmer's Guide to Secure Connections

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BARCLAYS

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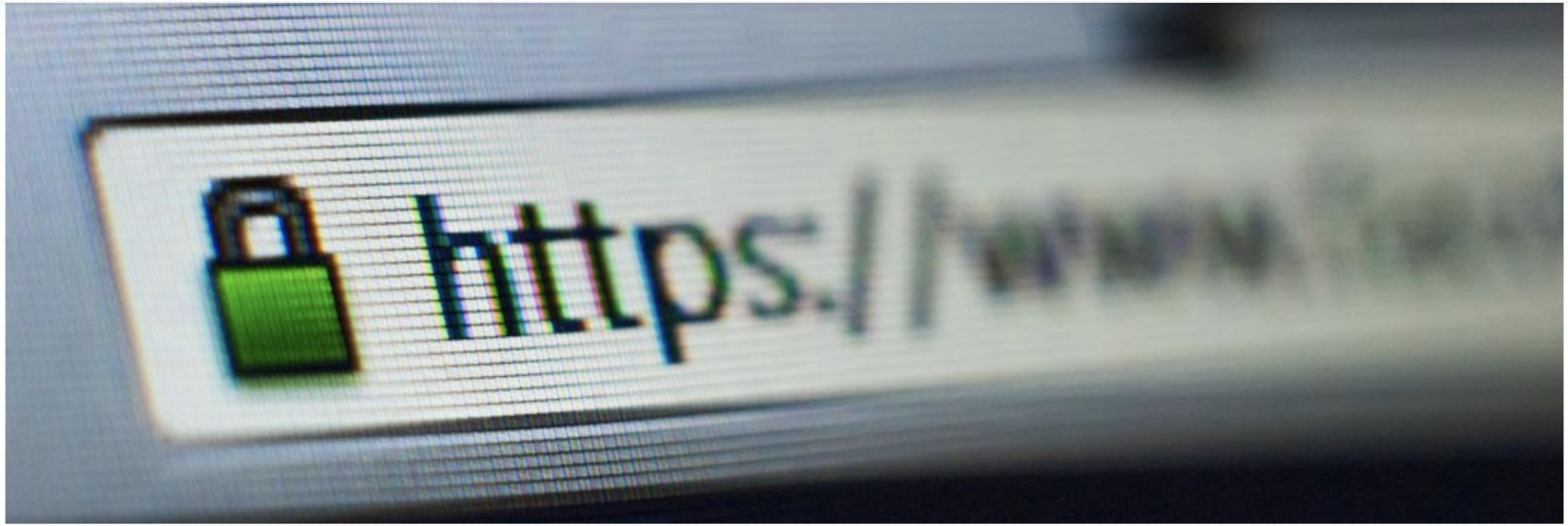


Cyber and online shopping security tips

How a green padlock can help

Cybercrime is a constant threat, but you can help make your site safer for customers by providing a secure online connection.

Branch: master ▾ kubernetes-the-hard-way / docs / 04-certificate-authority.md Find file Copy path

kelseyhightower Update to Kubernetes 1.10.2 and add gVisor support b974042 on 14 May

1 contributor

411 lines (327 sloc) 8.18 KB Raw Blame History

Provisioning a CA and Generating TLS Certificates

In this lab you will provision a PKI Infrastructure using CloudFlare's PKI toolkit, cfssl, then use it to bootstrap a Certificate Authority, and generate TLS certificates for the following components: etcd, kube-apiserver, kube-controller-manager, kube-scheduler, kubelet, and kube-proxy.

Certificate Authority

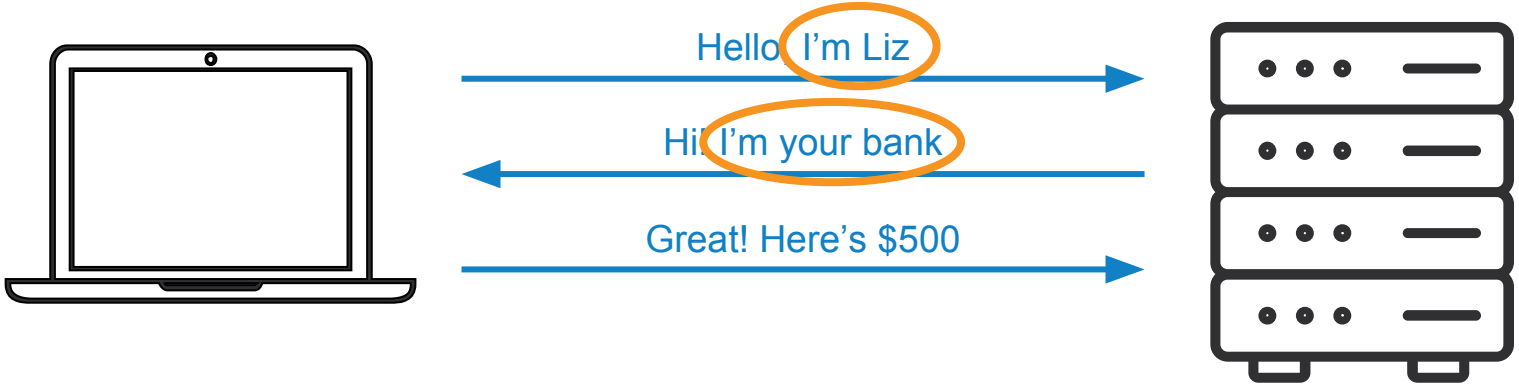
In this section you will provision a Certificate Authority that can be used to generate additional TLS certificates.

Generate the CA configuration file, certificate, and private key:

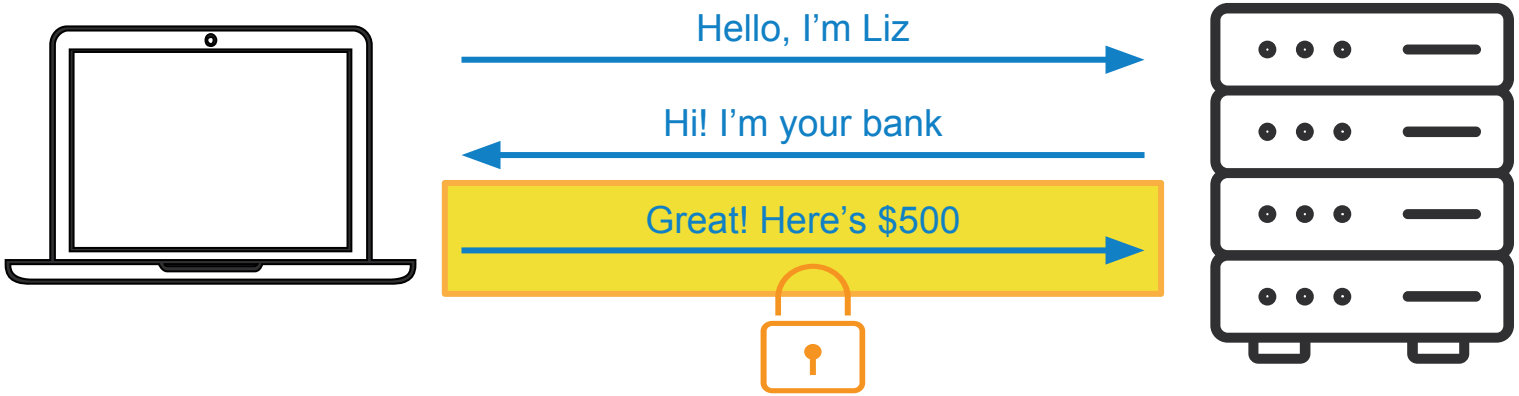
```
{

cat > ca-config.json <<EOF
```

A guide to TLS connections

- As a Go programmer, how do I secure my connections?
- What do these error messages mean?
- What the hell are all these .crt, .key, .csr and .pem files?



Establishing identity is critical



Encrypted traffic prevents interception

HTTPS

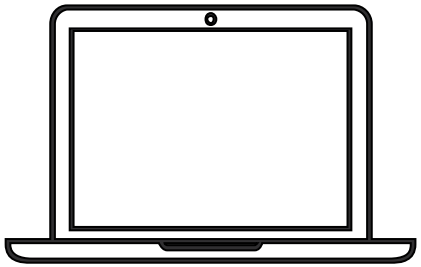
From Wikipedia, the free encyclopedia

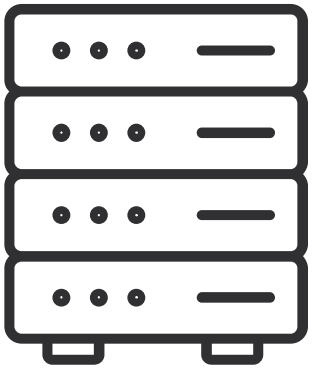
HTTP Secure (**HTTPS**) is an extension of the Hypertext Transfer Protocol (HTTP) for secure communication over a computer network, and is widely used on the Internet.[1][2] In HTTPS, the communication protocol is encrypted using Transport Layer Security (TLS), or formerly, its predecessor, Secure Sockets Layer (SSL). The protocol is therefore also often referred to as **HTTP over TLS**,[3] or **HTTP over SSL**.

HTTP(S) runs over TCP

- Create TCP connection
- TLS - encrypt TCP connection
  - Skip if regular HTTP
- Send HTTP packets on connection

TCP connection

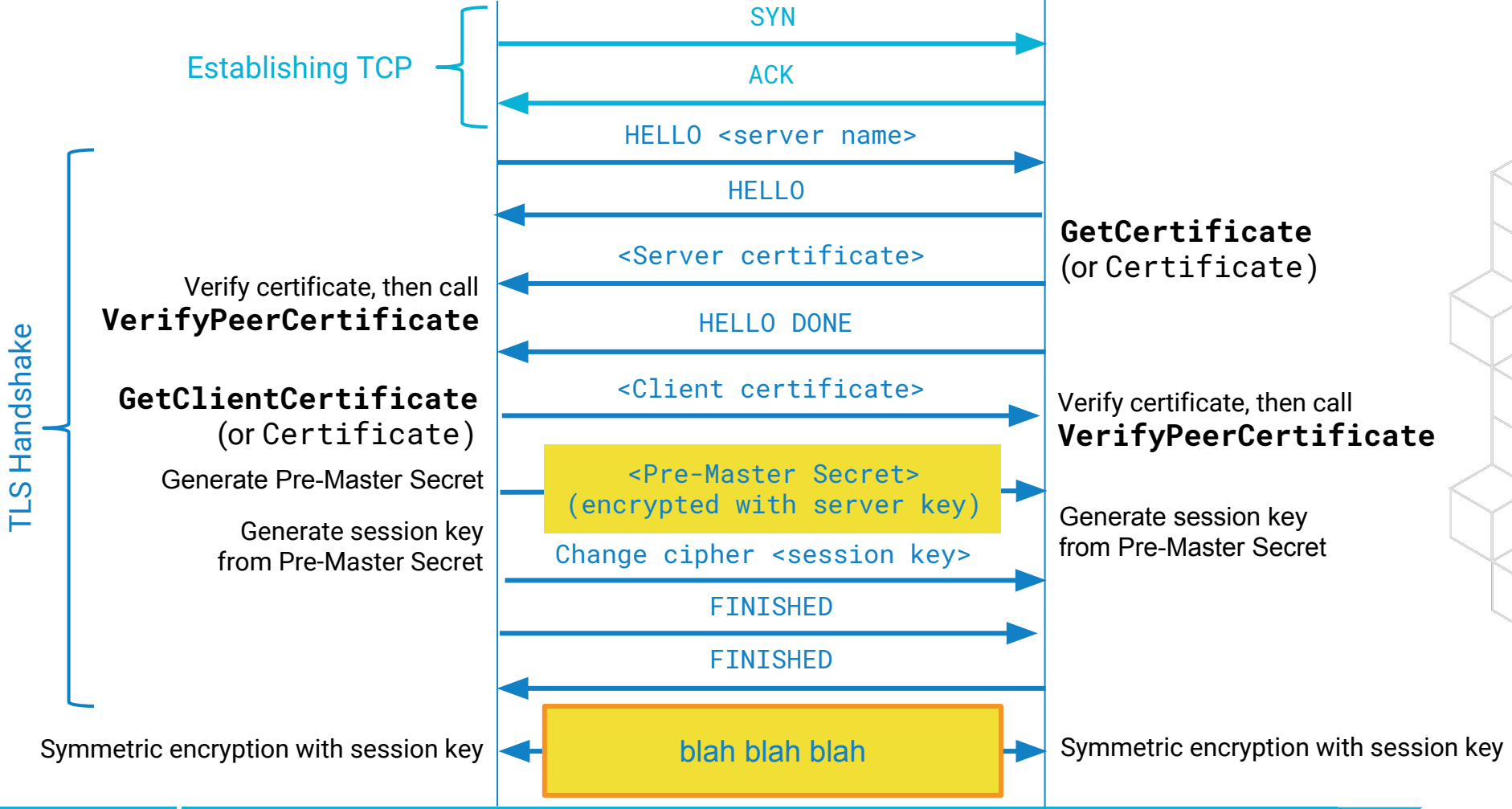




59.97.3.25:60401 ⟷ 27.193.43.2:8080

“Connection refused” = wrong port

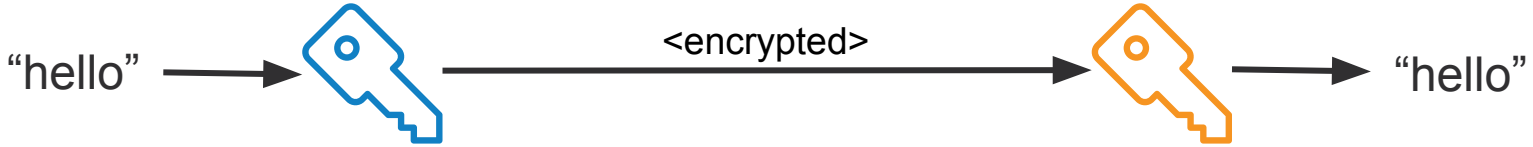
(nearly always)


Establishing TCP
SYN
ACK
HELLO <server name>
HELLO
GetCertificate
(or Certificate)
<Server certificate>
Verify certificate, then call
VerifyPeerCertificate
HELLO DONE
TLS Handshake
GetClientCertificate
(or Certificate)
<Client certificate>
Verify certificate, then call
VerifyPeerCertificate
Generate Pre-Master Secret
<Pre-Master Secret>
(encrypted with server key)
Generate session key
from Pre-Master Secret
Generate session key
from Pre-Master Secret
Change cipher <session key>
FINISHED
FINISHED
Symmetric encryption with session key
blah blah blah
Symmetric encryption with session key

Keys & certificates

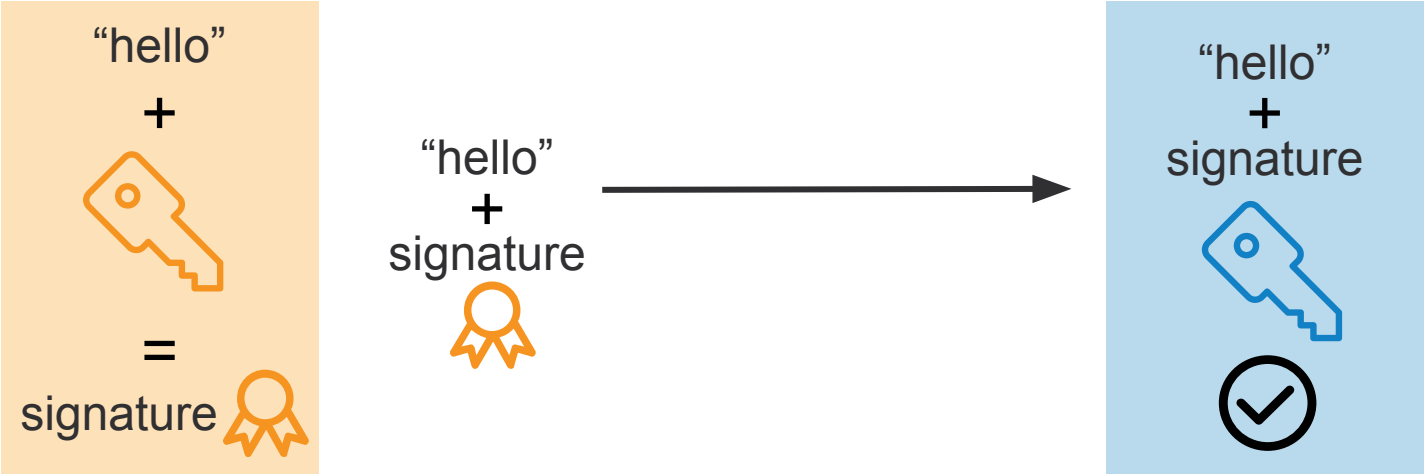
Public / private key encryption

- **Public key** can be freely distributed and is used to encrypt
- **Private key** must be kept private and is used to decrypt

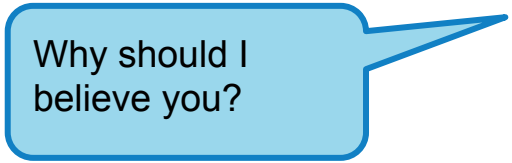


Public / private key signatures

- **Private key** must be kept private and is used to sign message
- **Public key** is used to verify signature



Sharing a public key

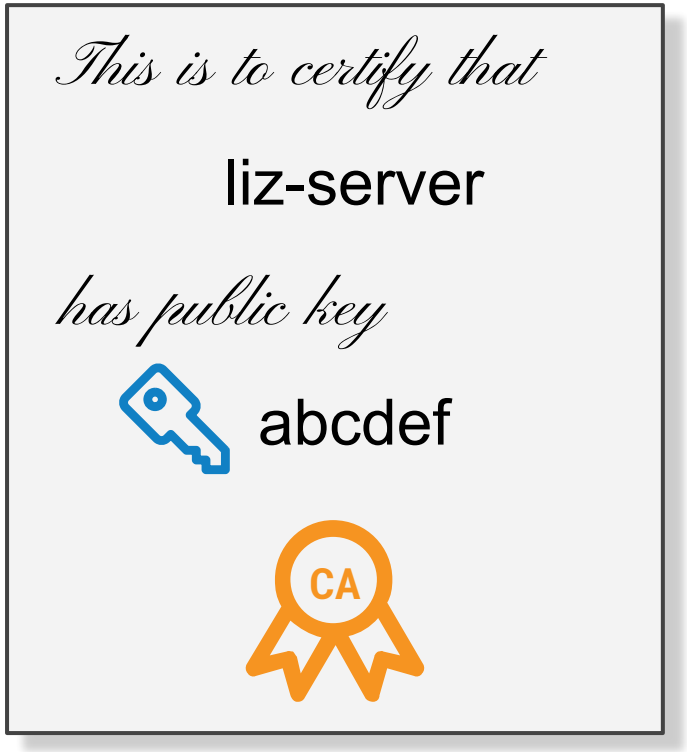


Need a trusted authority in common
"Certificate Authority"

X.509 certificate

- Subject name
- Subject's public key
- Issuer (CA) name
- Validity

Certificate **signed** by issuer (CA)



Subject Name

- Your certs should use Subject alternative names (SAN)
- Common Name deprecated in 2000
  - Chrome browser stopped supporting CN in April 2017
  - SAN supports multiple DNS names in one certificate

Creating keys & certificates

Trusted Certificate Authorities

- Like Let's Encrypt
- Known in system certificate pools
- Create a Certificate Signing Request
  - `openssl req -key private-key -new -out csr`
- For public-facing domains
- Not for internal components in a distributed system

CLI tools

- openssl
  - See contents of certificate: `openssl x509 -text`
  - Doesn't easily support SANs (Subject Alternative Names)
- cfssl
  - Comprehensive toolkit
- mkcert
  - Local development
  - Installs CA into your system & browsers
- minica
  - Easy generation of key & certs

There are several commonly used filename extensions for X.509 certificates. Unfortunately, some of these extensions are also used for other data such as private keys.

- `.pem` – (Privacy-enhanced Electronic Mail) Base64 encoded DER certificate, enclosed between "-----BEGIN CERTIFICATE-----" and "-----END CERTIFICATE-----"
- `.cer`, `.crt`, `.der` – usually in binary DER form, but Base64-encoded certificates are common too (see `.pem` above)

Mutually-authenticated TLS (mTLS)

Takeaways

To establish your identity

You will need:

- A private key
- A certificate for your identity

The other end needs to trust the Certificate Authority that signed your certificate. This may require appending the CA's certificate.

File extensions

Inconsistently used

- Information type : `.crt` for certificate, `.key` for private key...
- Or file format: `.pem`

PEM files are base64-encoded and tell you what they contain

- `openssl` can tell you about the contents

Common error messages

- Connection refused
  - Check you're connecting to the right port
- Certificate signed by unknown authority
  - Received a certificate, but it's not trusted
  - Examine CA in certificate to see if it should be known to receiver
- Remote error
  - It's the other end that's complaining

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github.com/lizrice/secure-connections

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