Guidelines to set up an I2P reseed server over Cloudflare

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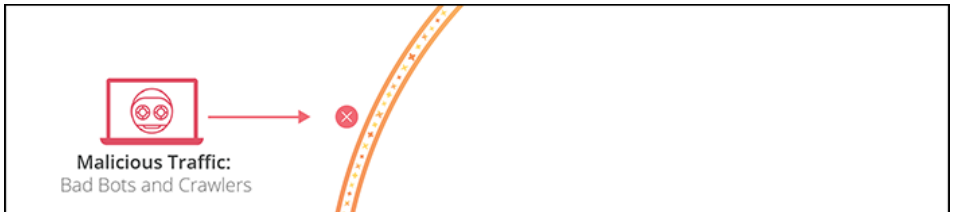
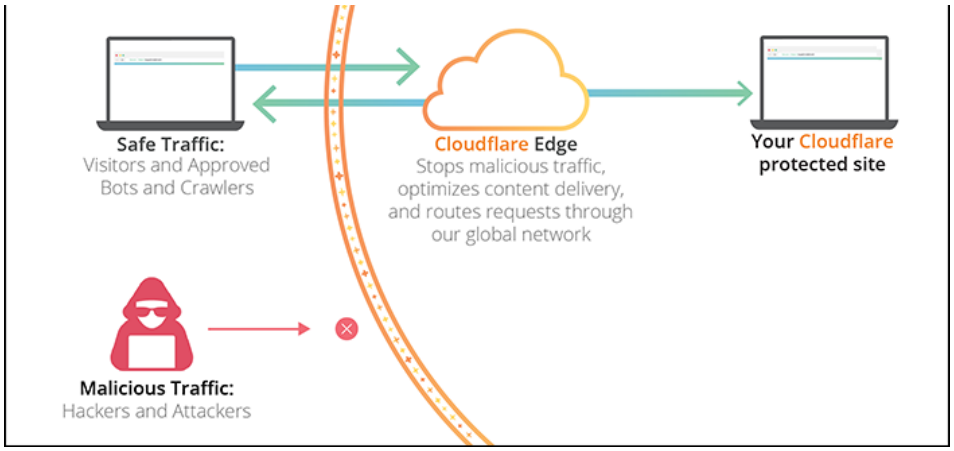
Based on the original definition from I2P homapage, a reseed server consists of a Java I2P router, an HTTPS web server, and some scripts that periodically gather router infos from the router, bundle and sign them into a custom file format, and deliver these files over HTTPS.

This tutorial will walk you through the process of setting up a reseed server and routing its traffic over Cloudflare. You may ask: *"But why Cloudflare?"*. In fact, you don't have to serve your reseed traffic over Cloudflare, and can just follow the original guidelines on I2P homapage to set up a reseed server running on your own server. However, Cloudflare manages a large Content Delivery Network (CDN) that can be used to improve several aspects of your reseed server. These are three primary reasons (opinions) why I choose to route my reseed traffic over Cloudflare.

- **Increased security.** Routing your reseed traffic over Cloudflare helps hiding the actual IP address(es) of your reseed server. So malicious traffic, including those from Denial-of-Service attacks, cannot directly affect your original server without bypassing Cloudflare.
- **Improved performance.** Cloudflare, with its large number of data centers distributed around the globe, can optimize the delivery of the reseed bundle (i.e., the su3 file) to I2P clients worldwide. The real latency from an I2P client to your reseed server will be reduced close to the latency from that client to her nearest Cloudflare data center.
- **Censorship resistance.** By putting your server on Cloudflare, in most cases, it will be sharing a pool of IP addresses with many other websites. Any censors that conduct IP-based blocking against your server would have to think twice about the collateral damage of also making thousands (or even tens of thousands) of co-hosted websites inaccessible. Furthermore, in our recent paper at USENIX FOCI '19, my co-authors and I show that several censors block access to I2P services based on the Server Name Indication (SNI), thus encrypting SNI would remedy this problem. Currently, Cloudflare is the only provider that supports Encrypted SNI (ESNI). Although ESNI has not been widely adopted while I2P router software has not been implemented to fully support ESNI in TLS1.3 yet, I believe that ESNI adoption is a necessary step to make the Internet more resistant to censorship. Therefore, I choose to proxy my reseed server over Cloudflare to prepare for a future when ESNI becomes standardized and widely adopted.

For demonstration purpose, I hereby borrow an image from Cloudflare to illustrate some points discussed above.





To follow this tutorial, you therefore need a Cloudflare account, in which your domain name is managed. For your reference, you can **add** your domain name to the Cloudflare account, or you can fully **transfer** it to Cloudflare Registrar.

0. Prerequisites

This section will walk you through the process of installing required software packages. My operating system for this tutorial is Ubuntu 18.04 LTS. According to the original guideline, it is ideal for your server to have:

- the capability to be continuously online 24/7
- at least 2 CPUs and 2GB of RAM
- a Unix environment to run the go-lang I2P reseed tools
- a sufficient amount of bandwidth

0.1 Install I2P router software

Run these commands to install the official I2P package:

```
sudo apt-add-repository -y ppa:i2p-maintainers/i2p;
sudo apt-get update;
sudo apt-get install -y i2p
```

Start I2P with this command: `i2prouter start` if it has not yet launched. At the time of composing this tutorial, the most current I2P version is `0.9.42`. If you already have I2P installed via Debian Package repository previously, it can be updated with:

```
sudo apt-get --only-upgrade install -y i2p
```

0.2 Install Go-lang

The Go project's official download page is at https://golang.org/dl/.

If you're using Ubuntu 16.04 LTS, 18.04 LTS or 19.04, then you can use the `longsleep/golang-backports` PPA and install Go 1.13.

```
sudo add-apt-repository -y ppa:longsleep/golang-backports;
sudo apt-get update;
sudo apt-get install -y golang-go
```

0.3 Install the I2P reseed tool

The official guidelines point to an all-in-one Go solution written by Matt. There are also some forked versions with more features, such as reseed over Tor and IPFS written by IDK or RTrade Technologies Ltd. For the purpose of this tutorial, all of them should function similarly so it's up to you to choose which one to install, depend on whether you want to add more features to your reseed server later.

```
export GOPATH=$HOME/go; mkdir $GOPATH; cd $GOPATH;
go get github.com/martin61/i2p-tools
```

You can confirm `i2p-tools` has been installed properly by changing to the directory where its binary is stored, and

run this command to show `help` function.

```
cd $GOPATH/bin; ./i2p-tools -h
```

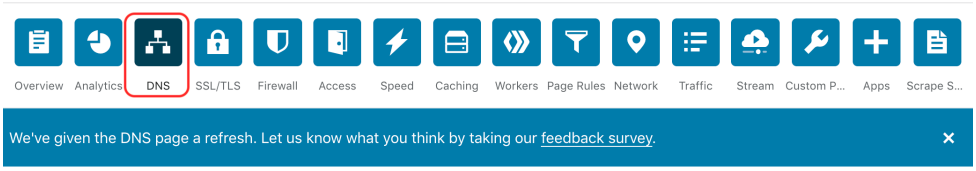
1. Cloudflare Setup

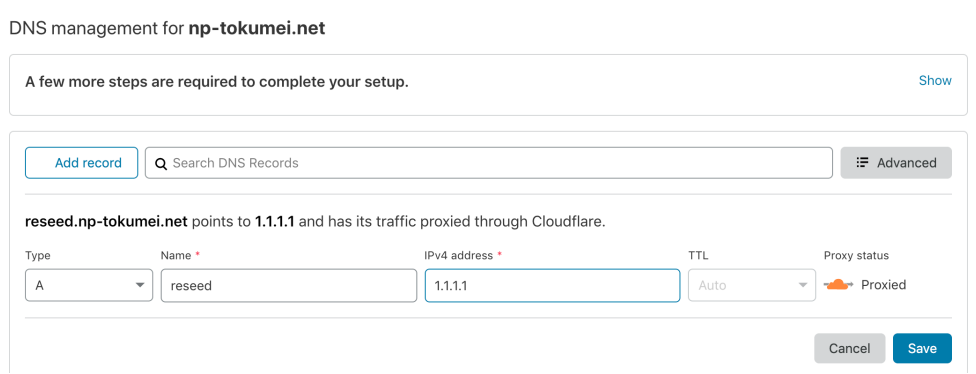
Next, assume that you have created and logged into your Cloudflare account, this section shows you how to configure a DNS record for the host name of your reseed server and obtain its TLS certificate and the private key.

1.0 DNS configuration

Under the `DNS` **Management** session, click **Add record**, and configure your record with:

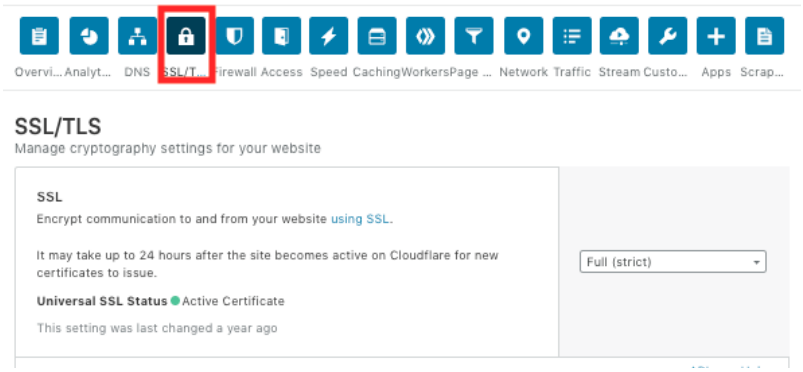
- **Type**: A
- **Name**: any string of your preference. However, this string should not contain any **dot(.)** so that the host name of your reseed server would be a third-level domain name to your own second-level domain. For example, if your domain is `np-tokumei.com`, then you should have your reseed server host name as `reseed.mp-tokumei.com`, but NOT `reseed.server.np-tokumei.com`. This is because Cloudflare's free TLS certificate only covers up to third-level domains currently.
- **IPv4 Address**: the IP address of your reseed server
- **TTL**: Auto
- **Proxy status**: make sure the cloud symbol is in `orange` to route your reseed traffic over Cloudflare CDN. This is very important to mask the real IP address of your server. If you leave the cloud grey for long enough, active DNS measurements may discover and store the real IP of your server.

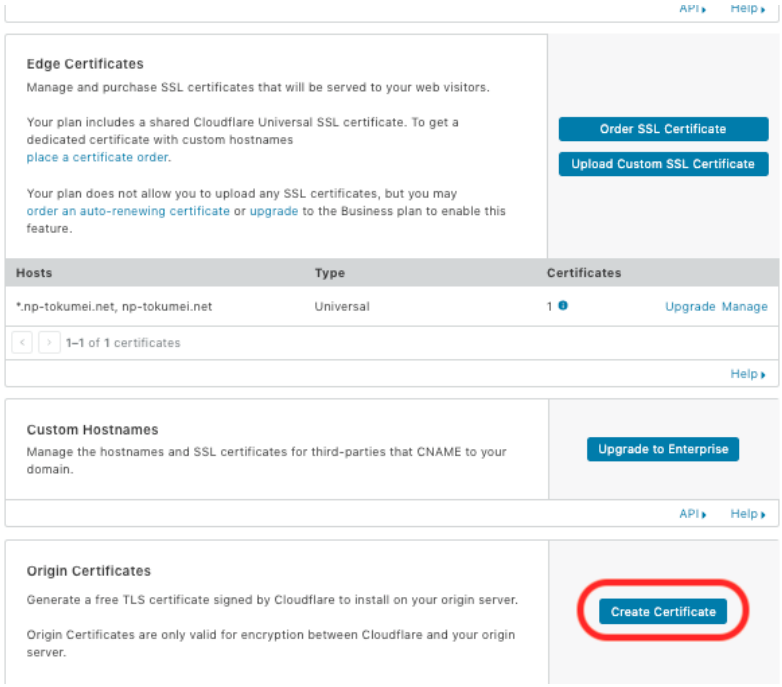




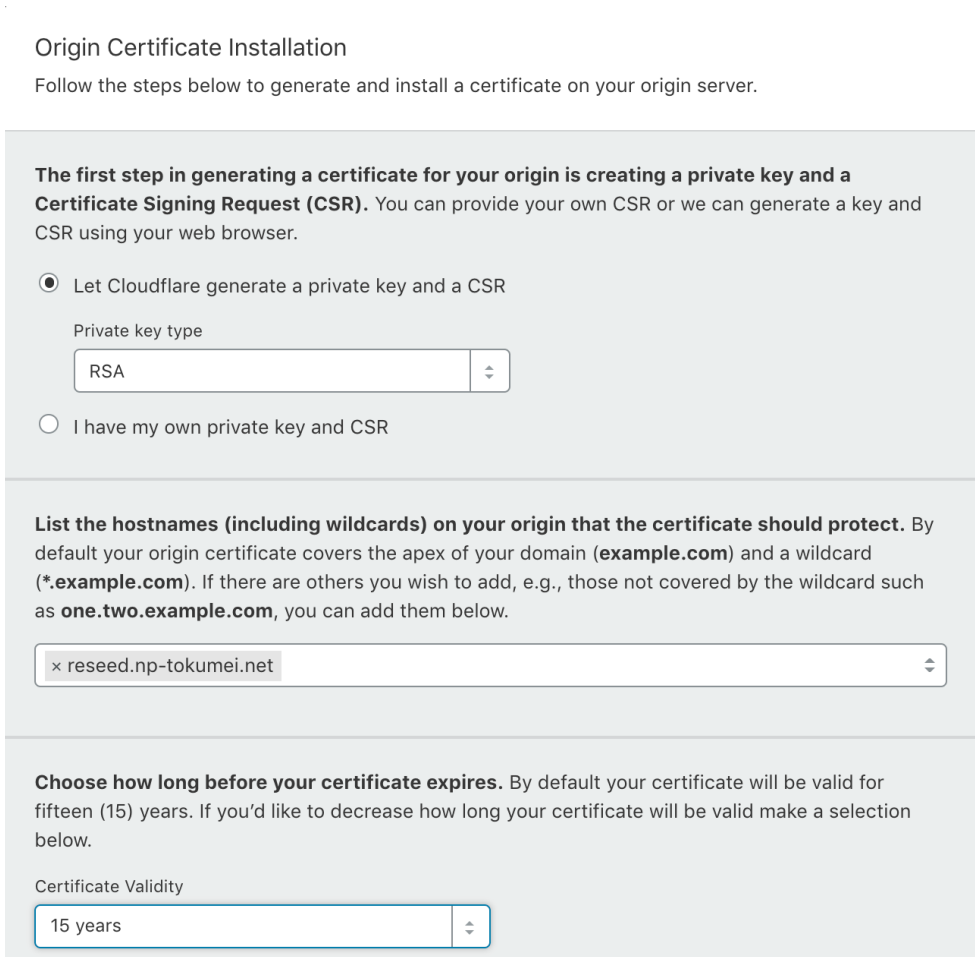
1.1 TLS Certificate

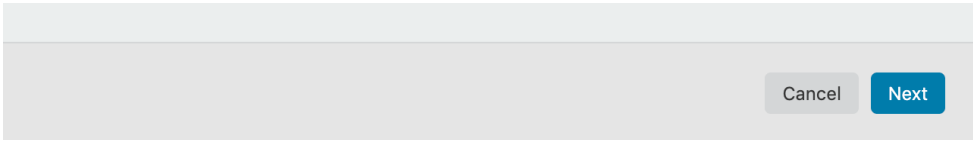
Next, under the `SSL/TLS` session, go to **Origin Certificates** and click **Create Certificate**.



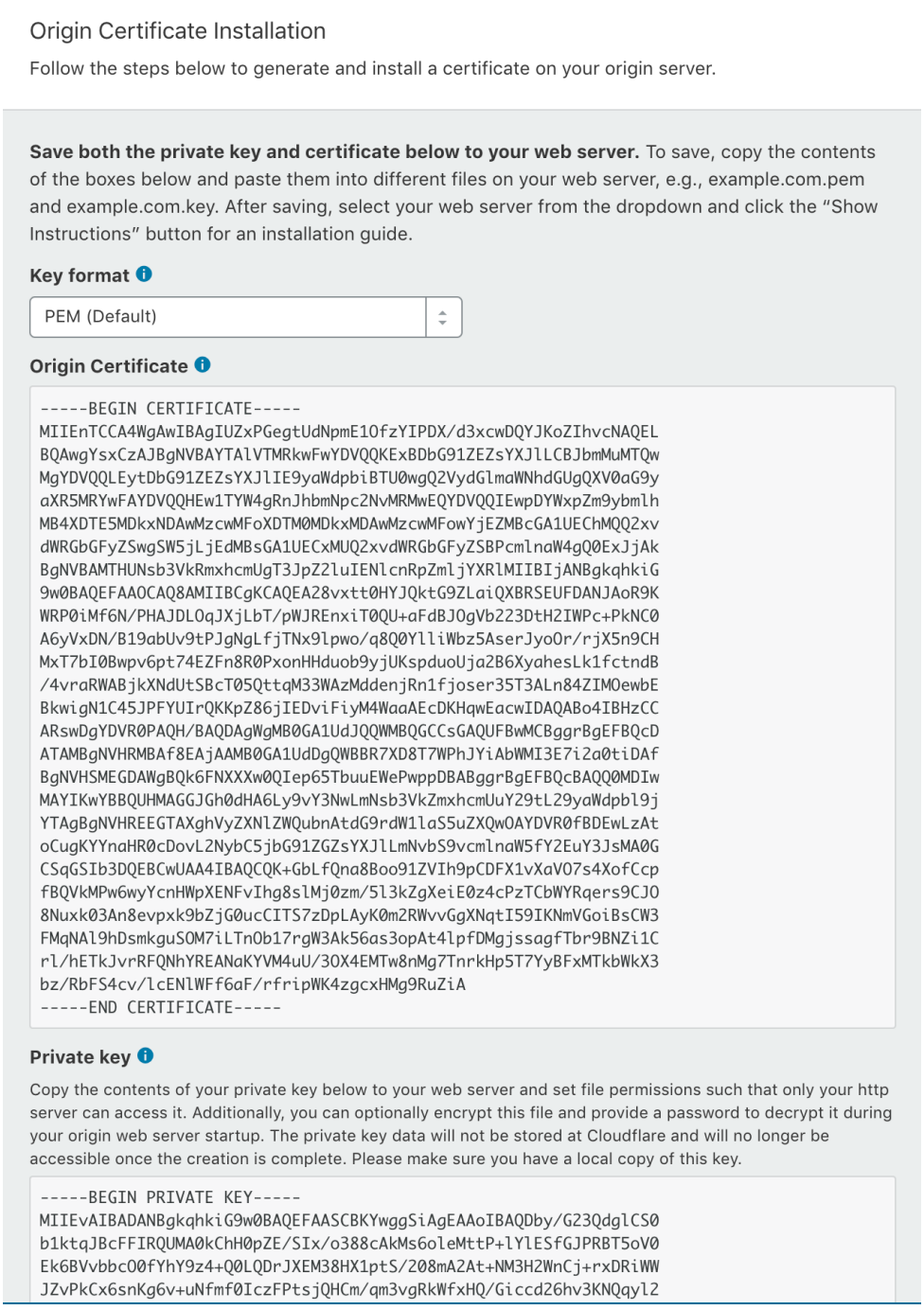


A window will pop up for you to choose the **Private key type** and the host name of your reseed server (e.g., `reseed.np-tokumei.net`).





You will then be provided with a private key and a certificate as shown in the picture below. Note that I put mine here for demonstration purpose, you should never leak your private key to anyone. As suggested, save them into two separate files named: `<your_reseed_host_name.tld>.pem` and `your_reseed_host_name.tld>.key`. Save them in a secure environment with password protection for later use. You can download the `.pem` file later from this dashboard, but NOT the key.



Origin Certificate Installation

Follow the steps below to generate and install a certificate on your origin server.

Save both the private key and certificate below to your web server. To save, copy the contents of the boxes below and paste them into different files on your web server, e.g., example.com.pem and example.com.key. After saving, select your web server from the dropdown and click the "Show Instructions" button for an installation guide.

Key format

PEM (Default)

Origin Certificate

```
-----BEGIN CERTIFICATE-----
MIIEnTCCA4WgAwIBAgIUZxPGegtUdNpmE1OfzYIPDX/d3xcwDQYJKoZIhvcNAQEL
BQAwgYsxCzAJBgNVBAYTAlVTMRkwFwYDVQQKExBDbG91ZEZsYXJlLCBJbmMuMTQw
MgYDVQQLEytDbG91ZEZsYXJlIE9yaWdpbiBTU0wgQ2VydGlmaWNhdGUgQXV0aG9y
aXR5MRYwFAYDVQQHEw1TYW4gRnJhbmNpc2NvMRMwEQYDVQQIEwpDYWxpZm9ybmlh
MB4XDTE5MDkxNDAwMzcwMFoXDTM0MDkxMDAwMzcwMFowYjEZMBcGA1UEChMQQ2xv
dWRGbGFyZSwgSW5jLjEdMBsGA1UECxMUQ2xvdWRGbGFyZSBPcmlnaW4gQ0ExJjAk
BgNVBAMTHUNsb3VkRmxhcmUgT3JpZ2luIENlcnRpZmljYXRlMIIBIjANBgkqhkiG
9w0BAQEFAAOCAQ8AMIIBCgKCAQEA28vxtt0HYJQktG9ZLaiQXBRSEUFDANJAoR9K
WRP0iMf6N/PHAJDLOqJXjLbT/pWJREnxiT0QU+aFdBJOgVb223DtH2IWPc+PkNC0
A6yVxDN/B19abUv9tPJgNgLfjTNx9lpwo/q8Q0YlliWbz5AserJyoOr/rjX5n9CH
MxT7bI0Bwpv6pt74EZFn8R0PxonHHduob9yjUKspduoUja2B6XyahesLk1fctndB
/4vraRWABjkXNdUtSBcT05QttqM33WAzMddenjRn1fjoser35T3ALn84ZIMOewbE
BkwigN1C45JPFYUIrQKKpZ86jIEDviFiyM4WaaAEcDKHqwEacwIDAQABo4IBHzCC
ARswDgYDVR0PAQH/BAQDAgWgMB0GA1UdJQQWMBQGCCsGAQUFBwMCBggrBgEFBQcD
ATAMBgNVHRMBAf8EAjAAMB0GA1UdDgQWBBR7XD8T7WPhJYiAbWMI3E7i2a0tiDAf
BgNVHSMEGDAWgBQk6FNXXXw0QIep65TbuuEWePwppDBABggrBgEFBQcBAQQ0MDIw
MAYIKwYBBQUHMAGGJGh0dHA6Ly9vY3NwLmNsb3VkZmxhcmUuY29tL29yaWdpbl9j
YTAgBgNVHREEGTAXghVyZXNlZWQubnAtdG9rdW1laS5uZXQwOAYDVR0fBDEwLzAt
oCugKYYnaHR0cDovL2NybC5jbG91ZGZsYXJlLmNvbS9vcmlnaW5fY2EuY3JsMA0G
CSqGSIb3DQEBCwUAA4IBAQCQK+GbLfQna8Boo91ZVIh9pCDFX1vXaVO7s4XofCcp
fBQVkMPw6wyYcnHWpXENFvIhg8slMj0zm/5l3kZgXeiE0z4cPzTCbWYRqers9CJO
8Nuxk03An8evpxk9bZjG0ucCITS7zDpLAyK0m2RWvvGgXNqtI59IKNmVGoiBsCW3
FMqNAl9hDsmkguSOM7iLTnOb17rgW3Ak56as3opAt4lpfDMgjssagfTbr9BNZi1C
rl/hETkJvrRFQNhYREANaKYVM4uU/3OX4EMTw8nMg7TnrkHp5T7YyBFxMTkbWkX3
bz/RbFS4cv/lcENlWFf6aF/rfripWK4zgcxHMg9RuZiA
-----END CERTIFICATE-----
```

Private key

Copy the contents of your private key below to your web server and set file permissions such that only your http server can access it. Additionally, you can optionally encrypt this file and provide a password to decrypt it during your origin web server startup. The private key data will not be stored at Cloudflare and will no longer be accessible once the creation is complete. Please make sure you have a local copy of this key.

```
-----BEGIN PRIVATE KEY-----
MIIEvAIBADANBgkqhkiG9w0BAQEFAASCBKYwggSiAgEAAoIBAQDby/G23QdglCS0
b1ktqJBcFFIRQUMA0kChH0pZE/SIx/o388cAkMs6oleMttP+lYlESfGJPRBT5oV0
Ek6BVvbbcO0fYhY9z4+Q0LQDrJXEM38HX1ptS/208mA2At+NM3H2WnCj+rxDRiWW
JZvPkCx6snKg6v+uNfmf0IczFPtsjQHCm/qm3vgRkWfxHQ/Giccd26hv3KNQqyl2
```

The `i2p-tools` require a TLS certificate file ended with `.crt` to work, so you will need to use this command to convert your `.pem` file to a `.crt` file.

```
openssl x509 -outform der -in <your_domain.tld>.pem -out temporary.crt
```

Now you will have a binary certificate named `temporary.crt`. DON'T try opening it with `cat` yet as it will mess up your terminal with non-printable characters. We then need to convert this binary `temporary.crt` to a base64-formated certificate, named `<your_reseed_host_name.tld>.crt`. In your terminal, replace `<your_reseed_host_name.tld>` of your reseed server and run this command:

```
echo "-----BEGIN CERTIFICATE-----" >> <your_reseed_host_name.tld>.crt;
cat temporary.crt | base64 >> <your_reseed_host_name.tld>.crt;
echo "-----END CERTIFICATE-----" >> <your_reseed_host_name.tld>.crt
```

Note the number of dashes `(-)` is exactly 5 on each side of the `BEGIN` and `END` tags. NO new line at the end of the file is allowed since it will cause syntax error. Finally, you can delete `temporary.crt` and put the `<your_reseed_host_name.tld>.crt` and `<your_reseed_host_name.tld>.key` in the same directory where you will be executing your `i2p-tools` binary.

2. Reseed server configuration

Now that we have all required software installed, lets navigate to your `i2p-tools` binary (normally stored under `$HOME/go/bin/`) and run the following command:

```
./i2p-tools reseed --signer=<your_email> \
                   --netdb=/home/ubuntu/.i2p/netDb \
                   --tlsHost=<your_reseed_host_name.tld> \
                   --tlsKey=<your_reseed_host_name.tld>.key \
                   --tlsCert=<your_reseed_host_name.tld>.crt \
                   --trustProxy
```

Note the `--trustProxy` flag! It is important for routing reseed traffic over Cloudflare since it will let our server to obtain the `X-Forwarded-For` header from client requests, which contain the actual IP addresses of newly joint I2P clients that send the reseed request instead of IP addresses of Cloudflare workers. As the guideline from the I2P official tutorial suggests that the reseed server should give the same `su3` file to the same client (IP) within a configurable time period. This helps to prevent bad clients from harvesting information of many I2P routers in the network.

Since we are running this command for the first time, you will be prompted:

```
Unable to read signing key your_email.pem
Would you like to generate a new signing key for your_email? (y or n):
```

Hit `y` and `Enter` to proceed and the tool will create three files for you in the current directory. They are named: `*.crl`, `*.crt`, and `*.pem`, where `*` is the email address you supplied for the flag `--singer=` above. **DO** keep these files in a secure environment with password protection, you will need them later for production mode!!

If the reseed server starts properly, you will see similar outputs to these in your console:

```
2019/08/20 05:52:18 Rebuilding su3 cache...
2019/08/20 05:52:18 Building 350 su3 files each containing 77 out of 2396 routerInfos.
2019/08/20 05:52:19 Done rebuilding.
2019/08/20 05:52:19 HTTPS server started on 0.0.0.0:8443
```

I2P reseed server by default runs on port `8443` so make sure this port is reachable from outside world. The `i2p-tools` also provides you with some flexibility to configure this port by using the flag `--port` in the above reseed command. However, you should choose a port that is supported by Cloudflare.

For more detail of how to run the reseed command in background, crontab it at reboot, please refer to the original guidelines.

2. Testing

These are two ways you might want to test whether your reseed server can successfully provide the reseed bundle `su3`. For this purpose, you will need a separate machine with I2P router software already installed.

2.1 Direct fetching

From the second machine, run this command to download an `su3` file from your reseed server. Note that the port

value should match with the port information you set up above. In the original guideline, you will see the command has `--no-check-certificate` flag. We don't need it in our tutorial because our TLS certificate is Cloudflare's one already validated by Certificate Authority. NOTE the user-agent flag as the server will only response to `--user-agent="Wget/1.11.4"`.

```
wget --user-agent="Wget/1.11.4" -O test.su3 https://<your_reseed_host_name.tld>:8443/i2pseeds.su3
```

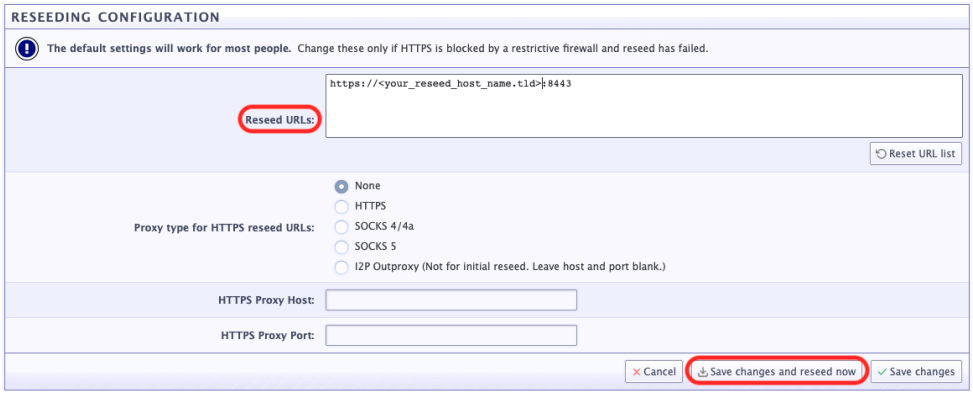
You should see a file named `test.su3` downloaded to your second machine. Examining the file with the command `zipinfo test.su3` should show you a list of files whose name is in the form of `routerInfo-*.dat`.

2.2 Reseeding from I2P router console

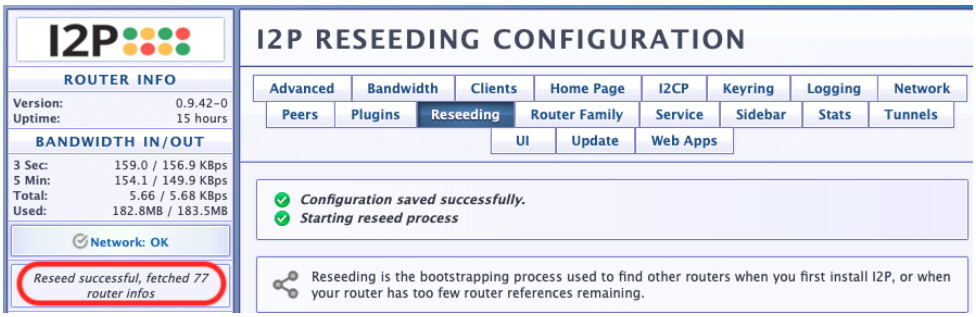
Next, we want to test if a real I2P client can successfully reseed from our server. First, you need to copy your reseed certificate (i.e., `your_singer_email.crt`) created by the reseed command above to the second machine. Note that this is **NOT** the TLS certificate since the TLS certificate in our case belongs to Cloudflare, which is already validated by Certificate Authorities. Only copy the reseed certificate to the location below:

- MacOS: `/Applications/i2p/certificates/reseed/`
- Ubuntu: `/usr/share/i2p/certificates/reseed/`

Now, on your second machine with I2P running, open a web browser and go to `http://127.0.0.1:7657/configreseed`. Under **Reseeding Configuration**, delete all current URLs of reseed servers, enter `https://<your_reseed_host_name.tld>:8443` and click **Save changes and reseed now** button at the bottom of the page. If you could successfully reseed as indicated in this photo, then your reseed server has been set up properly.



If you got an error, visit `http://127.0.0.1:7657/logs` to investigate further. After you could verify that your reseed server runs properly, you should **Reset URL list** to the list of default reseed servers.



3. Securing your reseed server with `iptables` and `ip6tables`

To secure your server from scanners (e.g, censys, shodan) and prevent its real IP address from being exposed, you will need to guard your server with firewall rules. More specifically, it should only response to requests coming from Cloudflare. You can create firewall rules to accept only requests originated from Cloudflare to your reseed server port (e.g., 8443 in this case), and drop all other connections from non-Cloudflare IPs. Note that the IP addresses used

below are updated on February 21st, 2019. Please get the most current ones at Cloudflare's IP Ranges.

```
sudo iptables -A INPUT -p tcp --dport 8443 -s 173.245.48.0/20 -j ACCEPT;
sudo iptables -A INPUT -p tcp --dport 8443 -s 103.21.244.0/22 -j ACCEPT;
sudo iptables -A INPUT -p tcp --dport 8443 -s 103.22.200.0/22 -j ACCEPT;
sudo iptables -A INPUT -p tcp --dport 8443 -s 103.31.4.0/22 -j ACCEPT;
sudo iptables -A INPUT -p tcp --dport 8443 -s 141.101.64.0/18 -j ACCEPT;
sudo iptables -A INPUT -p tcp --dport 8443 -s 108.162.192.0/18 -j ACCEPT;
sudo iptables -A INPUT -p tcp --dport 8443 -s 190.93.240.0/20 -j ACCEPT;
sudo iptables -A INPUT -p tcp --dport 8443 -s 188.114.96.0/20 -j ACCEPT;
sudo iptables -A INPUT -p tcp --dport 8443 -s 197.234.240.0/22 -j ACCEPT;
sudo iptables -A INPUT -p tcp --dport 8443 -s 198.41.128.0/17 -j ACCEPT;
sudo iptables -A INPUT -p tcp --dport 8443 -s 162.158.0.0/15 -j ACCEPT;
sudo iptables -A INPUT -p tcp --dport 8443 -s 104.16.0.0/12 -j ACCEPT;
sudo iptables -A INPUT -p tcp --dport 8443 -s 172.64.0.0/13 -j ACCEPT;
sudo iptables -A INPUT -p tcp --dport 8443 -s 131.0.72.0/22 -j ACCEPT;
sudo ip6tables -A INPUT -p tcp --dport 8443 -s 2400:cb00::/32 -j ACCEPT;
sudo ip6tables -A INPUT -p tcp --dport 8443 -s 2606:4700::/32 -j ACCEPT;
sudo ip6tables -A INPUT -p tcp --dport 8443 -s 2803:f800::/32 -j ACCEPT;
sudo ip6tables -A INPUT -p tcp --dport 8443 -s 2405:b500::/32 -j ACCEPT;
sudo ip6tables -A INPUT -p tcp --dport 8443 -s 2405:8100::/32 -j ACCEPT;
sudo ip6tables -A INPUT -p tcp --dport 8443 -s 2a06:98c0::/29 -j ACCEPT;
sudo ip6tables -A INPUT -p tcp --dport 8443 -s 2c0f:f248::/32 -j ACCEPT;
```

The above commands are to accept requests from all Cloudflare's IPv4 and IPv6 addresses. The following two commands need to be add **after** the above to drop all connections from non-Cloudflare IPs.

```
sudo iptables -A INPUT -p tcp --dport 8443 -j DROP;
sudo ip6tables -A INPUT -p tcp --dport 8443 -j DROP
```

Bonus: if you messed up and wanted to flush your iptables and ip6tables, use these command to delete all rules. NOTE: *be cautious when using these commands as they will remove all previous rules you might have had.*

```
sudo iptables -F INPUT; sudo ip6tables -F INPUT
```

4. Production

Now that you have a running reseed server secured behind Cloudflare, you can contact I2P's reseed coordinator at `backup@mail.i2p` or `backup@i2pmail.org`. Send `backup` information about your reseed server if you want it to be part of the default list of reseed servers. Or if you just want to help some friends who cannot bootstrap into the I2P network due to reseed server blocking, just give them this information:

- domain/url/port of your reseed server
- the su3-signing certificate, which is the `your_email_address.crt` file
- TLS certificate (**iff** self signed). Again, this information is not needed if you follow this tutorial because Cloudflare already takes care of certificate validation for us, read more.

5. Closing remarks

If you run into problems while following this tutorial, feel free to contact me at `hoang.nguyenphong@protonmail.com` or DM me on Twitter `@NP_tokumei`, I will try my best to help as much as possible. Or, you can also reach out to `backup` via the emails provided above, or ask questions on zzz's forum on I2P at http://zzz.i2p/topics/1893 or http://zzz.i2p/topics/1893.

I do plan to keep the reseed server (`https://reseed.np-tokumei.net:8443`) that I set up using this tutorial running as long as possible for those censored users who cannot access the default list to be able to join the network. So feel free to add the above URL to your reseed URLs, name my su3-signing certificate as `i2p.reseed_at_protonmail.com.crt`, save the following TEXT to the file and add it to `~/i2p/certificates/reseed/` directory.

```
-----BEGIN CERTIFICATE-----
MIIF4zCCA8ugAwIBAgIRAPojnWFToTIZZQ6prxKvyIswDQYJKoZIhvcNAQELBQAw
eTELMAkGA1UEBhMCWFgxCzAJBgNVBAcTAlhYMQswCQYDVQQJEwJYWDEeMBwGA1UE
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-----END CERTIFICATE-----
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PhD Candidate

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