



LAB: RPKI

Part-1: Installing RPKI-Client Validator

In Part 1, you will install an RPKI Validator. There are a few validators available, and in this section, there are steps for installing the RPKI-Client Validator. For more detail about installing other validators refer to the APNIC blog - <https://blog.apnic.net/2019/10/28/how-to-installing-an-rpki-validator/>

RPKI-Client is a routing security initiative by the OpenBSD Project, for more information refer to <https://www.rpki-client.org>

The steps to complete this section are:

- SSH to the server
- Update software
- Install required software
- Install libreTLS software
- Install RPKI-Client validator
- Update RPKI cache

Login Details

- Username `apnic` and password `training`.

Lab Setup

For this lab, we will use [RPKI-Client](#) from OpenBSD Project as the relying party or the RPKI validator.

1. Login to the server (SSH using the username and password given above), where **X** is your group number:

```
ssh apnic@192.168.30.X
```

NOTE: Type `yes` if asked about wanting to continue connecting

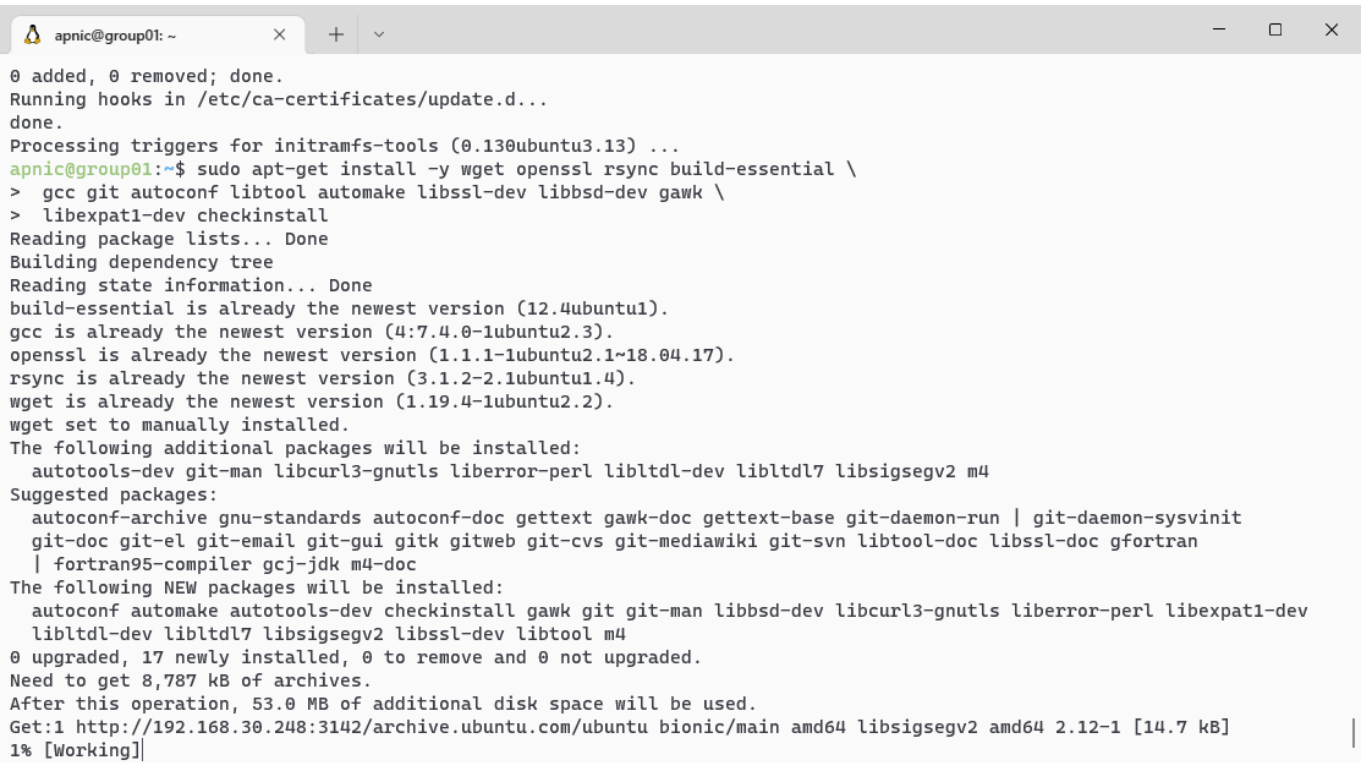
Password = `training`

2. Update the list of software from the repository and complete updates

```
sudo apt-get update && sudo apt-get -y dist-upgrade
```

3. Install the dependencies:

```
sudo apt-get install -y wget openssl rsync build-essential \
gcc git autoconf libtool automake libssl-dev libbsd-dev gawk \
libexpat1-dev libtclsh-dev
```

A terminal window titled 'apnic@group01: ~' showing the output of the command 'sudo apt-get install -y wget openssl rsync build-essential \ gcc git autoconf libtool automake libssl-dev libbsd-dev gawk \ libexpat1-dev checkinstall'. The output indicates that several packages are already at the newest version, while others like 'build-essential', 'gcc', 'openssl', 'rsync', and 'wget' are being installed. It also lists additional packages to be installed and suggested packages. The progress bar at the bottom shows '1% [Working]'.

```
0 added, 0 removed; done.
Running hooks in /etc/ca-certificates/update.d...
done.
Processing triggers for initramfs-tools (0.130ubuntu3.13) ...
apnic@group01:~$ sudo apt-get install -y wget openssl rsync build-essential \
> gcc git autoconf libtool automake libssl-dev libbsd-dev gawk \
> libexpat1-dev checkinstall
Reading package lists... Done
Building dependency tree
Reading state information... Done
build-essential is already the newest version (12.4ubuntu1).
gcc is already the newest version (4:7.4.0-1ubuntu2.3).
openssl is already the newest version (1.1.1-1ubuntu2.1~18.04.17).
rsync is already the newest version (3.1.2-2.1ubuntu1.4).
wget is already the newest version (1.19.4-1ubuntu2.2).
wget set to manually installed.
The following additional packages will be installed:
  autotools-dev git-man libcurl3-gnutls liberror-perl libltdl-dev libltdl7 libsigsegv2 m4
Suggested packages:
  autoconf-archive gnu-standards autoconf-doc gettext gawk-doc gettext-base git-daemon-run | git-daemon-sysvinit
  git-doc git-el git-email git-gui gitk gitweb git-cvs git-mediawiki git-svn libtool-doc libssl-doc gfortran
  | fortran95-compiler gcj-jdk m4-doc
The following NEW packages will be installed:
  autoconf automake autotools-dev checkinstall gawk git git-man libbsd-dev libcurl3-gnutls liberror-perl libexpat1-dev
  libltdl-dev libltdl7 libsigsegv2 libssl-dev libtool m4
0 upgraded, 17 newly installed, 0 to remove and 0 not upgraded.
Need to get 8,787 kB of archives.
After this operation, 53.0 MB of additional disk space will be used.
Get:1 http://192.168.30.248:3142/archive.ubuntu.com/ubuntu bionic/main amd64 libsigsegv2 amd64 2.12-1 [14.7 kB]
1% [Working]
```

4. Install LibreTLS

```
wget https://causal.agency/libretls/libretls-3.5.2.tar.gz
tar -xzvf libretls-3.5.2.tar.gz
cd libretls-3.5.2
./configure --libdir=/lib/x86_64-linux-gnu; make check; sudo make install
cd ..
```

5. Create a new group, user and add user to group

```
sudo groupadd _rpki-client
sudo useradd -g _rpki-client -s /sbin/nologin -d /nonexistent -c \
'rpki-client user' _rpki-client
```

6. Download RPKI-Client source and extract from archive

```
wget https://ftp.openbsd.org/pub/OpenBSD/rpki-client/rpki-client-7.8.tar.gz
tar xzvf rpki-client-7.8.tar.gz
```

```
apnic@group01: ~  
apnic@group01:~/libressl-3.4.3$ cd ..  
apnic@group01:~$ wget https://ftp.openbsd.org/pub/OpenBSD/rpki-client/rpki-client-7.8.tar.gz  
--2022-05-25 06:00:35-- https://ftp.openbsd.org/pub/OpenBSD/rpki-client/rpki-client-7.8.tar.gz  
Resolving ftp.openbsd.org (ftp.openbsd.org)... 199.185.178.81  
Connecting to ftp.openbsd.org (ftp.openbsd.org)|199.185.178.81|:443... connected.  
HTTP request sent, awaiting response... 200 OK  
Length: 451195 (441K) [text/plain]  
Saving to: 'rpki-client-7.8.tar.gz'  
  
rpki-client-7.8.tar.gz      100%[=====>] 440.62K  495KB/s   in 0.9s  
  
2022-05-25 06:00:37 (495 KB/s) - 'rpki-client-7.8.tar.gz' saved [451195/451195]  
  
apnic@group01:~$ tar zxvf rpki-client-7.8.tar.gz  
rpki-client-7.8/m4/libtool.m4  
rpki-client-7.8/m4/ltoptions.m4  
rpki-client-7.8/m4/ltsugar.m4  
rpki-client-7.8/m4/ltversion.m4  
rpki-client-7.8/m4/lt~obsolete.m4  
rpki-client-7.8/Makefile.am  
rpki-client-7.8/configure  
rpki-client-7.8/configure.ac  
rpki-client-7.8/aclocal.m4  
rpki-client-7.8/Makefile.in  
rpki-client-7.8/AUTHORS  
rpki-client-7.8/INSTALL  
rpki-client-7.8/TODO  
rpki-client-7.8/compile  
rpki-client-7.8/config.guess  
rpki-client-7.8/config.sub  
rpki-client-7.8/depcomp  
rpki-client-7.8/install-sh  
rpki-client-7.8/ltmain.sh  
rpki-client-7.8/missing
```

Note: To confirm the latest version of RPKI Client go to <https://ftp.openbsd.org/pub/OpenBSD/rpki-client/>

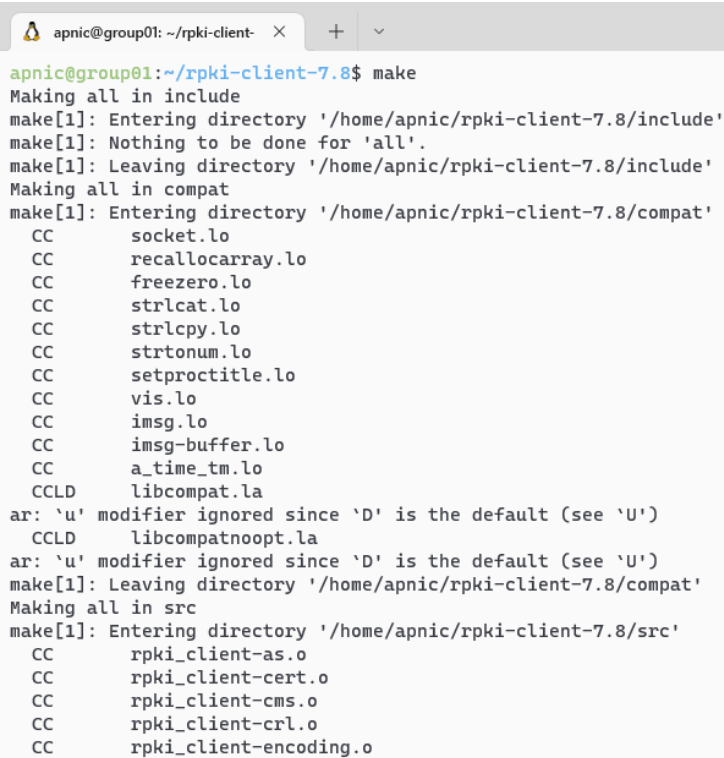
7. Run the configure script to get ready to install RPKI-Client

```
cd rpki-client-7.8  
./configure
```

```
apnic@group01:~$  
apnic@group01:~$ cd rpki-client-7.8  
apnic@group01:~/rpki-client-7.8$ ./configure  
checking build system type... x86_64-pc-linux-gnu  
checking host system type... x86_64-pc-linux-gnu  
checking for a BSD-compatible install... /usr/bin/install -c  
checking whether build environment is sane... yes  
checking for a thread-safe mkdir -p... /bin/mkdir -p  
checking for gawk... gawk  
checking whether make sets $(MAKE)... yes  
checking whether make supports nested variables... yes  
checking whether make supports nested variables... (cached) yes  
checking for cc... cc  
checking whether the C compiler works... yes  
checking for C compiler default output file name... a.out  
checking for suffix of executables...  
checking whether we are cross compiling... no  
checking for suffix of object files... o  
checking whether we are using the GNU C compiler... yes  
checking whether cc accepts -g... yes  
checking for cc option to accept ISO C89... none needed  
checking whether cc understands -c and -o together... yes  
checking whether make supports the include directive... yes (GNU style)  
checking dependency style of cc... |
```

8. Run the make script to get ready to install RPKI-Client

```
make
```



```
apnic@group01: ~/rpki-client-7.8$ make
Making all in include
make[1]: Entering directory '/home/apnic/rpki-client-7.8/include'
make[1]: Nothing to be done for 'all'.
make[1]: Leaving directory '/home/apnic/rpki-client-7.8/include'
Making all in compat
make[1]: Entering directory '/home/apnic/rpki-client-7.8/compat'
CC      socket.lo
CC      reallocarray.lo
CC      freezero.lo
CC      strlcat.lo
CC      strlcpy.lo
CC      strtonum.lo
CC      setproctitle.lo
CC      vis.lo
CC      imsg.lo
CC      imsg-buffer.lo
CC      a_time_tm.lo
CCLD    libcompat.la
ar: `u' modifier ignored since `D' is the default (see `U')
CCLD    libcompatnnoop.la
ar: `u' modifier ignored since `D' is the default (see `U')
make[1]: Leaving directory '/home/apnic/rpki-client-7.8/compat'
Making all in src
make[1]: Entering directory '/home/apnic/rpki-client-7.8/src'
CC      rpki_client-as.o
CC      rpki_client-cert.o
CC      rpki_client-cms.o
CC      rpki_client-crl.o
CC      rpki_client-encoding.o
```

9. Install RPKI-Client

```
sudo make install
```

```

apnic@group01: ~/rpki-client-7.8$ sudo make install
Making install in include
make[1]: Entering directory '/home/apnic/rpki-client-7.8/include'
make[2]: Entering directory '/home/apnic/rpki-client-7.8/include'
make[2]: Nothing to be done for 'install-exec-am'.
make[2]: Nothing to be done for 'install-data-am'.
make[2]: Leaving directory '/home/apnic/rpki-client-7.8/include'
make[1]: Leaving directory '/home/apnic/rpki-client-7.8/include'
Making install in compat
make[1]: Entering directory '/home/apnic/rpki-client-7.8/compat'
make[2]: Entering directory '/home/apnic/rpki-client-7.8/compat'
make[2]: Nothing to be done for 'install-exec-am'.
make[2]: Nothing to be done for 'install-data-am'.
make[2]: Leaving directory '/home/apnic/rpki-client-7.8/compat'
make[1]: Leaving directory '/home/apnic/rpki-client-7.8/compat'
Making install in src
make[1]: Entering directory '/home/apnic/rpki-client-7.8/src'
make[2]: Entering directory '/home/apnic/rpki-client-7.8/src'
/bin/mkdir -p '/usr/local/sbin'
/bin/bash ../libtool --mode=install /usr/bin/install -c rpki-client '/usr/local/sbin'
libtool: install: /usr/bin/install -c rpki-client /usr/local/sbin/rpki-client
/bin/mkdir -p '/usr/local/share/man/man8'
/usr/bin/install -c -m 644 rpki-client.8 '/usr/local/share/man/man8'
make[2]: Leaving directory '/home/apnic/rpki-client-7.8/src'
make[1]: Leaving directory '/home/apnic/rpki-client-7.8/src'
make[1]: Entering directory '/home/apnic/rpki-client-7.8'
make[2]: Entering directory '/home/apnic/rpki-client-7.8'
make[2]: Nothing to be done for 'install-exec-am'.
/bin/mkdir -p '/usr/local/etc/rpki'
/usr/bin/install -c -m 644 afrinic.tal apnic.tal lacnic.tal ripe.tal '/usr/local/etc/rpki'
make install-data-hook
make[3]: Entering directory '/home/apnic/rpki-client-7.8'
make[3]: Leaving directory '/home/apnic/rpki-client-7.8'
make[2]: Leaving directory '/home/apnic/rpki-client-7.8'
make[1]: Leaving directory '/home/apnic/rpki-client-7.8'
apnic@group01: ~/rpki-client-7.8$

```

10. Confirm the Trust Anchor Locator (TAL) files exist

```

ls -lash /usr/local/etc/rpki
ls -lash /usr/local/var/db/rpki-client/

```

11. Download the ARIN Trust Anchor Locator (TAL) file

```

sudo wget https://www.arin.net/resources/manage/rpki/arin.tal \
-O /usr/local/etc/rpki/arin.tal

```

Note: Make sure to read the ARIN Relying Party Agreement (RPA) at

<https://www.arin.net/resources/manage/rpki/rpa.pdf> before proceeding.

```
apnic@group01: ~/rpki-client- x + v
make[3]: Entering directory '/home/apnic/rpki-client-7.8'
make[3]: Leaving directory '/home/apnic/rpki-client-7.8'
make[2]: Leaving directory '/home/apnic/rpki-client-7.8'
make[1]: Leaving directory '/home/apnic/rpki-client-7.8'
apnic@group01:~/rpki-client-7.8$ ls -lash /usr/local/etc/rpki
total 24K
4.0K drwxr-xr-x 2 root root 4.0K May 26 00:00 .
4.0K drwxr-xr-x 3 root root 4.0K May 26 00:00 ..
4.0K -rw-r--r-- 1 root root 496 May 26 00:00 afrinic.tal
4.0K -rw-r--r-- 1 root root 532 May 26 00:00 apnic.tal
4.0K -rw-r--r-- 1 root root 509 May 26 00:00 lacnic.tal
4.0K -rw-r--r-- 1 root root 482 May 26 00:00 ripe.tal
apnic@group01:~/rpki-client-7.8$ ls -lash /usr/local/var/db/rpki-client/
total 8.0K
4.0K drwxr-xr-x 2 _rpki-client root 4.0K May 26 00:00 .
4.0K drwxr-xr-x 3 root root 4.0K May 26 00:00 ..
apnic@group01:~/rpki-client-7.8$ sudo wget https://www.arin.net/resources/manage/rpki/arin.tal \
> -O /usr/local/etc/rpki/arin.tal
--2022-05-26 00:03:45-- https://www.arin.net/resources/manage/rpki/arin.tal
Resolving www.arin.net (www.arin.net)... 192.136.136.47, 199.43.0.47, 2001:500:4:201::47, ...
Connecting to www.arin.net (www.arin.net)|192.136.136.47|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 487 [application/octet-stream]
Saving to: '/usr/local/etc/rpki/arin.tal'

/usr/local/etc/rpki/arin.tal 100%[=====>] 487 --.-KB/s in 0s

2022-05-26 00:03:46 (60.8 MB/s) - '/usr/local/etc/rpki/arin.tal' saved [487/487]

apnic@group01:~/rpki-client-7.8$
```

12. Start the RPKI Client and synchronise RPKI cache and save as a Comma Separated File (CSV)

```
whereis rpki-client
sudo rpki-client -c -v
```

Read the manual for more detail about rpki-client <https://man.openbsd.org/rpki-client>

```
apnic@group01: ~/rpki-client - x + v
2022-05-26 02:30:10 (46.3 MB/s) - '/usr/local/etc/rpki/arin.tal' saved [487/487]

apnic@group01:~/rpki-client-7.8$ whereis rpki-client
rpki-client: /usr/local/sbin/rpki-client
apnic@group01:~/rpki-client-7.8$ sudo rpki-client -v
rpki-client: ta/arin: pulling from https://rrdp.arin.net/arin-rpki-ta.cer
rpki-client: ta/apnic: pulling from https://rpki.apnic.net/repository/apnic-rpki-root-iana-origin.cer
rpki-client: ta/ripe: pulling from https://rpki.ripe.net/ta/ripe-ncc-ta.cer
rpki-client: ta/afrinic: pulling from https://rpki.afrinic.net/repository/AfriNIC.cer
rpki-client: ta/lacnic: pulling from https://rrdp.lacnic.net/ta/rta-lacnic-rpki.cer
rpki-client: ta/apnic: loaded from network
rpki-client: https://rrdp.apnic.net/notification.xml: pulling from network
rpki-client: https://rrdp.apnic.net/notification.xml: downloading snapshot
rpki-client: ta/arin: loaded from network
rpki-client: https://rrdp.arin.net/notification.xml: pulling from network
rpki-client: ta/ripe: loaded from network
rpki-client: https://rrdp.ripe.net/notification.xml: pulling from network
rpki-client: ta/lacnic: loaded from network
rpki-client: https://rrdp.lacnic.net/rrdp/notification.xml: pulling from network
rpki-client: ta/afrinic: loaded from network
rpki-client: https://rrdp.afrinic.net/notification.xml: pulling from network
rpki-client: https://rrdp.ripe.net/notification.xml: downloading snapshot
rpki-client: https://rrdp.lacnic.net/rrdp/notification.xml: downloading snapshot
rpki-client: https://rrdp.arin.net/notification.xml: downloading snapshot
rpki-client: https://rrdp.apnic.net/notification.xml: loaded from network
rpki-client: https://rpki.akrn.net/rrdp/notification.xml: pulling from network
rpki-client: https://rpki.admin.freerangecloud.com/rrdp/notification.xml: pulling from network
rpki-client: https://rpki.cnnic.cn/rrdp/notify.xml: pulling from network
rpki-client: https://rpki.lacnic.net/rrdp/notification.xml: pulling from network
rpki-client: https://rpki.lacnic.net/rrdp/notification.xml: pulling from network
99EBD2D.mft: no valid mft available
rpki-client: rpki-repo.registro.br/repo/5W7uSSxMN9HHSdKFLRZcf9QP7uP8o64aJkQyz7KkGbAp/0/66D1CF513762D93CCE6587E4C79051D23
3AA3F2B.mft: no valid mft available
rpki-client: rpki-repo.registro.br/repo/DYXq3CJk32GiXqGbYSMkme2FM2xf4FxVegn75oNBdkG/0/9F7BB81C7C6111731D1A97D3C8F3935E4
848C3E3.mft: no valid mft available
rpki-client: rpki-repo.registro.br/repo/HQRndEEbTgyd81Ao8UtKRrbs52GuKxr9gHaN8h1n2vm/0/92A98777C611343F735B4C3A1373D4DB3
CADB63F.mft: no valid mft available
rpki-client: rpki-repo.registro.br/repo/54jWfSUX4rs2Cxf53Gm95XLPVSpRcZAsPV1p2wQQhxnw/0/F19221B3666BF9827B7F3EADFBEB1B5058
50F2BA7.mft: no valid mft available
rpki-client: rpki-repo.registro.br/repo/Hh8LK8FZqkFMnwaTa9hgVFJQnCh8hQExPjebk4xeZCkg/0/FC209833BE7BF9197BBFFD6F17F51754C
27153ED.mft: no valid mft available
rpki-client: rpki.luys.cloud: timeout, connection closed
rpki-client: https://rpki.luys.cloud/rrdp/notification.xml: load from network failed, fallback to rsync
rpki-client: .rsync/rpki.luys.cloud/repo: pulling from rsync://rpki.luys.cloud/repo
rpki-client: .rsync/rpki.luys.cloud/repo: loaded from network
rpki-client: all files parsed: generating output
rpki-client: Processing time 212 seconds (169 seconds user, 26 seconds system)
rpki-client: Route Origin Authorizations: 118368 (4 failed parse, 0 invalid)
rpki-client: BGPsec Router Certificates: 2
rpki-client: Certificates: 31312 (0 invalid)
rpki-client: Trust Anchor Locators: 5 (0 invalid)
rpki-client: Manifests: 31310 (28 failed parse, 0 stale)
rpki-client: Certificate revocation lists: 31282
rpki-client: Ghostbuster records: 2
rpki-client: Repositories: 51
rpki-client: Cleanup: removed 4 files, 55595 directories, 5039 superfluous
rpki-client: VRP Entries: 355942 (347907 unique)
apnic@group01:~/rpki-client-7.8$
```

Note: There may be some messages about **validation failed** or other types of error messages. These can be ignored.

13. List the files created by rpki-client

```
ls -lash /usr/local/var/db/rpki-client/
```

14. View the first 10 validated ROA payloads and header information

```
head /usr/local/var/db/rpki-client/csv
```

A list of Autonomous System Numbers (ASN), IP Prefix, Max Length, Trust Anchor and Expiration will be displayed.

```
apnic@group01: ~/rpki-client-
rpki-client: Processing time 161 seconds (161 seconds user, 10 seconds system)
rpki-client: Route Origin Authorizations: 118370 (4 failed parse, 0 invalid)
rpki-client: BGPsec Router Certificates: 2
rpki-client: Certificates: 31312 (0 invalid)
rpki-client: Trust Anchor Locators: 5 (0 invalid)
rpki-client: Manifests: 31310 (28 failed parse, 0 stale)
rpki-client: Certificate revocation lists: 31282
rpki-client: Ghostbuster records: 2
rpki-client: Repositories: 51
rpki-client: Cleanup: removed 8 files, 2500 directories, 6377 superfluous
rpki-client: VRP Entries: 355969 (347934 unique)
apnic@group01: ~/rpki-client-7.8$ ls -lash /usr/local/var/db/rpki-client/
total 33M
4.0K drwxr-xr-x 2 _rpki-client root      4.0K May 26 03:24 .
4.0K drwxr-xr-x 3 root      root      4.0K May 26 02:29 ..
15M -rw-r--r-- 1 _rpki-client _rpki-client 15M May 26 03:24 csv
18M -rw-r--r-- 1 _rpki-client _rpki-client 18M May 26 02:34 openbgpd
apnic@group01: ~/rpki-client-7.8$ head /usr/local/var/db/rpki-client/csv
ASN,IP Prefix,Max Length,Trust Anchor,Expires
AS13335,1.0.0.0/24,24,apnic,1653704293
AS38803,1.0.4.0/24,24,apnic,1653694944
AS38803,1.0.4.0/22,22,apnic,1653694944
AS38803,1.0.5.0/24,24,apnic,1653694944
AS38803,1.0.6.0/24,24,apnic,1653694944
AS38803,1.0.7.0/24,24,apnic,1653694944
AS13335,1.1.1.0/24,24,apnic,1653704293
AS4134,1.1.4.0/22,22,apnic,1653671025
AS4134,1.1.16.0/20,20,apnic,1653671025
apnic@group01: ~/rpki-client-7.8$ |
```

15. **OPTIONAL** Python can be used to convert the expiration into a valid Date

```
python3
from datetime import datetime
timestamp = 1653704293
dt_object = datetime.fromtimestamp(timestamp)
print(dt_object)
exit()
```

16. To search for ROAs for APNIC Training's AS45192

```
grep -in AS45192 /usr/local/var/db/rpki-client/csv
```

```
apnic@group01: ~/rpki-client- x + v
15M -rw-r--r-- 1 _rpki-client _rpki-client 15M May 26 03:24 csv
18M -rw-r--r-- 1 _rpki-client _rpki-client 18M May 26 02:34 openbgpd
apnic@group01:~/rpki-client-7.8$ head /usr/local/var/db/rpki-client/csv
ASN,IP Prefix,Max Length,Trust Anchor,Expires
AS13335,1.0.0.0/24,24,apnic,1653704293
AS38803,1.0.4.0/24,24,apnic,1653694944
AS38803,1.0.4.0/22,22,apnic,1653694944
AS38803,1.0.5.0/24,24,apnic,1653694944
AS38803,1.0.6.0/24,24,apnic,1653694944
AS38803,1.0.7.0/24,24,apnic,1653694944
AS13335,1.1.1.0/24,24,apnic,1653704293
AS4134,1.1.4.0/22,22,apnic,1653671025
AS4134,1.1.16.0/20,20,apnic,1653671025
apnic@group01:~/rpki-client-7.8$ python3
Python 3.6.9 (default, Mar 15 2022, 13:55:28)
[GCC 8.4.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> from datetime import datetime
>>> timestamp = 1653704293
>>> dt_object = datetime.fromtimestamp(timestamp)
>>> print(dt_object)
2022-05-28 02:18:13
>>> exit()
apnic@group01:~/rpki-client-7.8$ grep -in AS45192 /usr/local/var/db/rpki-client/csv
255116:AS45192,202.125.96.0/24,24,apnic,1653704323
255117:AS45192,202.125.96.0/23,23,apnic,1653704323
255118:AS45192,202.125.97.0/24,24,apnic,1653704323
292716:AS45192,2001:df0:a::/48,48,apnic,1653704323
293247:AS45192,2001:df2:ee00::/48,48,apnic,1653704323
```

Use python to convert
back to date format

17. Optional - Export the RPKI Client's ROA payload outputs ready for comparison with another validator's output.

Remove the Trust Anchor and expiration columns

```
cd /usr/local/var/db/rpki-client
cut -d , -f 4,5 csv --complement > ~/rpki-client_trimmed.csv
cd ~
```

Sort the output

```
sort rpki-client_trimmed.csv > rpki-client_sorted.csv
```

To sort the file, and ignore the header row

```
grep -v Prefix rpki-client_trimmed.csv | sort > rpki-client_sorted.csv
```

18. Optional - Compare ROA output with another validator's output. Compare the output from Fort validator

```
diff -u fort_sorted.csv rpki-client_sorted.csv
```

NOTE: For RPKI Client to feed the validated cache to BGP speaking routers through the RTR (RPKI-to-Router) protocol a third-party RTR Server software such as GoRTR will be required or use BIRD or OpenBGP.

For more detail refer to:

- <https://rpki.readthedocs.io/en/latest/ops/tools.html>
- <http://rpki-client.org>

End of Lab