uts-server - RFC 3161 Timestamp Server

Release 0.2.1

Apr 07, 2021

Contents

CHAPTER 1

Dependencies

1.1 Runtime dependencies

List of dependencies uts-server relies on to run:

- OpenSSL.
- civetweb.
- on none GNU LibC, argp-standalone

1.2 Build dependencies

List of dependencies needed to build uts-server:

- CMake
- either gcc or clang

CHAPTER 2

Compilation

uts-server is compiled using cmake:

```
# If civetweb is already present on the system
$ cmake .
$ make

# If civetweb is not present.
# this will get the master branch of civetweb from upstream and compile it.
# Only for developpment/testing purposes
$ cmake . -DBUNDLE_CIVETWEB=ON
$ make

# Compile with debug flags
# Only for developpment/testing purposes
$ cmake . -DDEBUG=ON
$ make

# Compile statically
# (in some cases, it might be necessary to still
# link some libraries like dl or gcc_s or pthread, if necessary,
# add -DLINK_DL=ON and/or -DLINK_GCC_S=ON and/or -DLINK_PTHREAD=ON)
$ cmake . -DSTATIC=ON  # -DLINK_DL=ON -DLINK_GCC_S=ON -DLINK_PTHREAD=ON
$ make
```

Warning: The BUNDLE_CIVETWEB exists only for developpment/testing purposes.

Please compile civetweb externally for building a production binary.

Using this option outside of developpment/testing is a bad idea for the following reasons:

- having an external download in a build process is a bad idea
- recovering the master branch ensures that the build may break randomly
- a build proccess should be reproductible which is not the case with this option

CHAPTER 3

OS specific tips

3.1 Debian

The installation requires installing the following packages:

```
# build dependencies
$ apt-get install libssl-dev cmake clang
```

3.2 CentOS/RHEL

The installation requires installing the following packages:

```
# build dependencies
$ yum insall cmake gcc gcc-c++ openssl-devel
```

3.3 FreeBSD

The installation requires installing the following packages:

```
# build dependencies
$ pkg add argp-standalone cmake
```

3.4 OpenBSD

The installation requires installing the following packages:

```
# build dependencies
$ pkg_add gcc g++ argp-standalone cmake

# for the test scripts
$ pkg_add python curl
```

To build you must egcc and eg++ (not the old 4.2 gcc in the base system)

```
# set compilers
$ export CC=/usr/local/bin/egcc
$ export CXX=/usr/local/bin/ec++

# then build normally
$ cmake . -DBUNDLE_CIVETWEB=ON && make
```

CHAPTER 4

Configuration Parameters

4.1 Section [main]

Main configuration section (mostly http configuration).

Parameter	Description	Example Value
access_control_allow_origin	Comma separated list of IP subnets to accept/deny Ex: -0.0.0.0/0,+192.168.0.0/16 (deny all accesses, only allow 192.168.0.0/16 subnet)	-0.0.0.0/0,+192.168/16
enable_keep_alive	Allows clients to reuse TCP connection for subsequent HTTP requests, which improves performance.	no
listening_ports	Comma-separated list of IP:port tuples to listen on. If the port is SSL, a letter s must be appended. Ex: listening_ports = 80,443s	127.0.0.1:2020
log_level	Loglevel (debug, info, notice, warn, err, emerg, crit)	info
log_to_stdout	Enable logging to stdout (default: no)	no
log_to_syslog	Enable logging to syslog (default: yes)	yes
num_threads	Number of worker threads.	50
request_timeout_ms	Timeout for network read and network write operations. In milliseconds.	30000
run_as_user	Switch to given user credentials after startup. Required to run on privileged ports as non root user.	uts-server
ssl_ca_file	Path to a .pem file containing trusted certificates. The file may contain more than one certificate.	/etc/uts-server/ca.pem
ssl_ca_path	Name of a directory containing trusted CA certificates.	/etc/ssl/ca/
ssl_certificate	Path to the SSL certificate file . PEM format must contain private key and certificate.	/etc/uts-server/cert.pem
ssl_cipher_list	List of enabled ciphers for ssl. See https://www.openssl.org/docs/manmaster/apps/ciphers.html or 'man ciphers' for more detailed.	ALL:!eNULL:!SSLv3
ssl_default_verify_paths	Loads default trusted certificates locations set at OpenSSL compile time.	yes
ssl_protocol_version	Sets the minimal accepted version of SSL/TLS protocol according to the table: • SSL2+SSL3+TLS1.0+TLS1.1+TLS1.2 -> 0 • SSL3+TLS1.0+TLS1.1+TLS1.2 -> 1 • TLS1.0+TLS1.1+TLS1.2 -> 2 • TLS1.1+TLS1.2 -> 3 • TLS1.2 -> 4	3
ssl_short_trust	Enables the use of short lived certificates	no
ssl_verify_depth	Sets maximum depth of certificate chain. If client's certificate chain is	9

4.2 Section [oids]

Section for declaring OID mapping. Just add <name> = <OID> pairs.

Parameter	Description	Example Value
tsa_policy1		1.2.3.4.1
tsa_policy2		1.2.3.4.5.6
tsa_policy3		1.2.3.4.5.7

4.3 Section [tsa]

TSA configuration parameters.

Parameter	Description	Example Value
accuracy	Time-Stamp accuracy. (optional)	secs:1, millisecs:500, microsecs:100
certs	Certificate chain to include in reply. (optional)	$dir/cacert.pem
clock_precision_digits	Number of decimals for Time-Stamp. (optional)	0
crypto_device	OpenSSL engine to use for signing.	builtin
default_policy	Policy if request did not specify it. (optional)	tsa_policy1
digests	Acceptable message digests. (mandatory) See https://www.openssl.org/docs/manmaster/apps/dgst.html or 'man dgst' to get the list of available digests	md5, sha1, sha224, sha256, sha384, sha512
dir	TSA root directory.	/etc/uts-server/pki
ess_cert_id_chain	Must the ESS cert id chain be included? (optional, default: no)	no
ordering	Is ordering defined for timestamps? (optional, default: no)	yes
other_policies	Acceptable policies. (optional)	tsa_policy2, tsa_policy3
signer_cert	The TSA signing certificat. (optional)	$dir/tsacert.pem
signer_key	The TSA private key. (optional)	$dir/private/tsakey.pem
tsa_name	Must the TSA name be included in the reply? (optional, default: no)	yes

Warning: The TSA signing certificate must have exactly one extended key usage assigned to it: **timeStamping**.

The extended key usage must also be **critical**, otherwise the certificate is going to be refused.

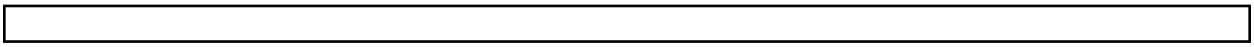
Here is a sample openssl.cfg configuration for creating such certificate:

```
[ tsa_cert ]

# TSA server cert is not a CA cert, disabling CA role
basicConstraints=CA:FALSE

# The following key usage flags are mandatory for TSA server certificates.
# This parameters set the main specificities of a TSA certificate
keyUsage = nonRepudiation, digitalSignature
extendedKeyUsage = critical,timeStamping

# PKIX recommendations harmless if included in all certificates.
subjectKeyIdentifier=hash
authorityKeyIdentifier=keyid,issuer:always
```



CHAPTER 5

Full Configuration File

```
# Section for declaring OID mapping. Just add <name> = <OID> pairs.
[ oids ]

tsa_policy1 = 1.2.3.4.1
tsa_policy2 = 1.2.3.4.5.6
tsa_policy3 = 1.2.3.4.5.7

# Main configuration section (mostly http configuration).
[ main ]

# Comma-separated list of IP:port tuples to listen on.
# If the port is SSL, a letter s must be appended.
#
# Ex: listening_ports = 80,443s
listening_ports = 127.0.0.1:2020

# Allows clients to reuse TCP connection for subsequent
# HTTP requests, which improves performance.
enable_keep_alive = no

# Number of worker threads.
num_threads = 50

# Switch to given user credentials after startup.
# Required to run on privileged ports as non root user.
#run_as_user = uts-server

# Limit download speed for clients.
#
# Throttle is a comma-separated list of key=value pairs:
#
# - *            -> limit speed for all connections
#
# - x.x.x.x/mask ->  limit speed for specified subnet
```

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```
#
# The value is a floating-point number of bytes per second,
# optionally followed by a k or m character
# meaning kilobytes and megabytes respectively.
#
# A limit of 0 means unlimited rate.
#
# Ex: throttle = *=1k,10.10.0.0/16=10m,10.20.0.0/16=0
throttle = *=0

# Timeout for network read and network write operations.
# In milliseconds.
request_timeout_ms = 30000

# Path to the SSL certificate file .
# PEM format must contain private key and certificate.
#ssl_certificate = /etc/uts-server/cert.pem

# Enable client's certificate verification by the server.
#ssl_verify_peer = yes

# Name of a directory containing trusted CA certificates.
#ssl_ca_path = /etc/ssl/ca/

# Path to a .pem file containing trusted certificates.
# The file may contain more than one certificate.
#ssl_ca_file = /etc/uts-server/ca.pem

# Sets maximum depth of certificate chain.
# If client's certificate chain is longer
# than the depth set here connection is refused.
#ssl_verify_depth = 9

# Loads default trusted certificates
# locations set at OpenSSL compile time.
#ssl_default_verify_paths = yes

# List of enabled ciphers for ssl.
# See https://www.openssl.org/docs/manmaster/apps/ciphers.html
# or 'man ciphers' for more detailed.
#ssl_cipher_list = ALL:!eNULL:!SSLv3

# Sets the minimal accepted version of SSL/TLS protocol
# according to the table:
#
# - SSL2+SSL3+TLS1.0+TLS1.1+TLS1.2 -> 0
#
# - SSL3+TLS1.0+TLS1.1+TLS1.2      -> 1
#
# - TLS1.0+TLS1.1+TLS1.2           -> 2
#
# - TLS1.1+TLS1.2                  -> 3
#
# - TLS1.2                         -> 4
#ssl_protocol_version = 3

# Enables the use of short lived certificates
```

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```
#ssl_short_trust = no

# Comma separated list of IP subnets to accept/deny
#
# Ex: -0.0.0.0/0,+192.168.0.0/16
# (deny all accesses, only allow 192.168.0.0/16 subnet)
#access_control_allow_origin = -0.0.0.0/0,+192.168/16

# Enable TCP_NODELAY socket option on client connections.
tcp_nodelay = 0

# Loglevel (debug, info, notice, warn, err, emerg, crit)
log_level = info

# Enable logging to syslog (default: yes)
log_to_syslog = yes

# Enable logging to stdout (default: no)
#log_to_stdout = no

# TSA configuration parameters.
[ tsa ]

# TSA root directory.
dir = /etc/uts-server/pki

# OpenSSL engine to use for signing.
#crypto_device        = builtin

# The TSA signing certificat. (optional)
signer_cert = $dir/tsacert.pem

# Certificate chain to include in reply. (optional)
certs = $dir/cacert.pem

# The TSA private key. (optional)
signer_key = $dir/private/tsakey.pem

# Policy if request did not specify it. (optional)
default_policy = tsa_policy1

# Acceptable policies. (optional)
other_policies = tsa_policy2, tsa_policy3

# Acceptable message digests. (mandatory)
# See https://www.openssl.org/docs/manmaster/apps/dgst.html
# or 'man dgst' to get the list of available digests
digests = md5, sha1, sha224, sha256, sha384, sha512

# Time-Stamp accuracy. (optional)
accuracy = secs:1, millisecs:500, microsecs:100

# Number of decimals for Time-Stamp. (optional)
clock_precision_digits = 0

# Is ordering defined for timestamps? (optional, default: no)
ordering = yes
```

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```
# Must the TSA name be included in the reply? (optional, default: no)
tsa_name = yes

# Must the ESS cert id chain be included? (optional, default: no)
ess_cert_id_chain = no
```

CHAPTER 6

Deploy

6.1 Usage

```
$ ./uts-server --help
Usage: uts-server [OPTION...] -c CONFFILE [-d] [-D] [-p <pidfile>]

UTS micro timestamp server (RFC 3161)

  -c, --conffile=CONFFILE    Path to configuration file
  -d, --daemonize            Launch as a daemon
  -D, --debug                STDOUT debugging
  -p, --pidfile=PIDFILE      Path to pid file
  -?, --help                 Give this help list
      --usage                Give a short usage message
  -V, --version              Print program version

Mandatory or optional arguments to long options are also mandatory or optional
for any corresponding short options.

Report bugs to Pierre-Francois Carpentier <carpentier.pf@gmail.com>.
```

6.2 Running uts-sever

To debug problems with uts-server, run it in the foreground in debug mode:

```
# In debug mode with verbose debugging on stdout
$ ./uts-server -c <path/to/conf> -D
```

To run it as a daemon:

```
# In daemon mode
$ ./uts-server -c <path/to/conf> -d -p <path/to/pidfile>
```

CHAPTER 7

Changelogs

7.1 0.2.1

- [fix] fix compilation for newer GCC (>10.2) (global variable definition issue

7.2 0.2.0

- [fix] disable buffering when logging to stdout (it was causing issues when running in docker)
- [impr] make the stdout logger an official logger (previously, it was only for debugging)
- [impr] the 'log_to_syslog' and 'log_to_stdout' parameters to enable/disable logging to syslog/stdout
- [impr] serve the CA and the signer certificate
- [impr] better landing page with download links for the previous 2 files and some instructions

7.3 0.1.10

- [fix] point to upstream civetweb (forked civetweb now removed)
- [fix] using dynamic openssl loading for civetweb when bundling
- [impr] add possibility to specify which tag used for civetweb bundling
- [impr] use same compiler for uts-server and civetweb when bundling

7.4 0.1.9

- [fix] add explicit C standard (C99), fixes compilation with olders gcc/cmake

7.5 0.1.8

- [impr] add OpenBSD support
- [impr] add LibreSSL support

7.6 0.1.7

- [doc] add warnings to explicitely state the BUNDLE_CIVETWEB option as test/dev only
- [impr] add option for easily linking lib pthread (mainly for static linking)

7.7 0.1.6

- [fix] option declaration for LINK_GCC_S

7.8 0.1.5

- [impr] add support for a static build

7.9 0.1.4

- [impr] more portable code

7.10 0.1.3

- [impr] add support for FreeBSD

7.11 0.1.2

- [fix] adding support for OpenSSL 1.1 (with compatibility with 1.0)

7.12 0.1.1

- [fix] correct compilation issues in older gcc/clang caused by missing -D_XOPEN_SOURCE, missing -std and missing headers
- [impr] exit at the first TS_RESP_CTX (OpenSSL TS response context) initialization failed.

7.13 0.1.0

- [impr] adding various goodies (init scripts)
- [impr] safer crypto algorithm in configuration file
- [impr] removing useless default_tsa parameter in configuration file

7.14 0.0.3

- [fix] memleak on configuration parameters loading

7.15 0.0.2

- [fix] Fix loading of certificate in case of relative path

7.16 0.0.1

- First version

CHAPTER 8

Some Goodies

8.1 Time-Stamp script combining curl and openssl

```
#!/bin/sh

RCol='\33[0m'    # Text Reset

# Regular           Bold                Underline           High Intensity
↪BoldHigh Intens
Bla='\33[0;30m';     BBla='\33[1;30m';    UBla='\33[4;30m';    IBla='\33[0;90m';
↪BIBla='\33[1;90m';
Red='\33[0;31m';     BRed='\33[1;31m';    URed='\33[4;31m';    IRed='\33[0;91m';
↪BIRed='\33[1;91m';
Gre='\33[0;32m';     BGre='\33[1;32m';    UGre='\33[4;32m';    IGre='\33[0;92m';
↪BIGre='\33[1;92m';
Yel='\33[0;33m';     BYel='\33[1;33m';    UYel='\33[4;33m';    IYel='\33[0;93m';
↪BIYel='\33[1;93m';
Blu='\33[0;34m';     BBlu='\33[1;34m';    UBlu='\33[4;34m';    IBlu='\33[0;94m';
↪BIBlu='\33[1;94m';
Pur='\33[0;35m';     BPur='\33[1;35m';    UPur='\33[4;35m';    IPur='\33[0;95m';
↪BIPur='\33[1;95m';
Cya='\33[0;36m';     BCya='\33[1;36m';    UCya='\33[4;36m';    ICya='\33[0;96m';
↪BICya='\33[1;96m';
Whi='\33[0;37m';     BWhi='\33[1;37m';    UWhi='\33[4;37m';    IWhi='\33[0;97m';
↪BIWhi='\33[1;97m';

SYSLOG=1

help(){
  cat <<EOF

usage: `basename $0` -i <input file> -u <ts server url> \\
    -o <output ts file> -O <openssl options> -C <curl options>
```

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```
HTTP timestamping client using openssl and curl (RFC 3161)

arguments:

 * mandatory:
   -i <input file>:     the input file to timestamp
   -u <ts server url>:  the timestamp server url

 * optionnal:
   -l                 :  enable logging to syslog
   -o <output ts file>:  output timestamp file name (default: <input file>.ts)
   -O <openssl options>: openssl additionnal options (man ts for more details)
   -C <curl options>:    curl additionnal options (man curl for more details)

EOF
  exit 1
}

simple_logger(){
    [ $SYSLOG -eq 0 ] && logger -t `basename $0` -p  user.$1 $2
}

clean(){
    rm -f -- "$TMPREQ"
}

clean_exit(){
    clean
    exit 1
}

exit_error(){
    msg=$1
    simple_logger err "error, $msg"
    printf "${BIRed}[ERROR]   ${IYel}%s${RCol}\n" "$msg"
    clean_exit
}

info(){
    msg=$1
    simple_logger debug "$msg"
    printf "${BIBlu}[INFO]    ${RCol}%s${RCol}\n" "$msg"
}

success(){
    msg=$1
    simple_logger info "$msg"
    printf "${BIGre}[SUCCESS] ${RCol}%s${RCol}\n" "$msg"
}

trap clean_exit HUP INT TERM
TMPREQ=`mktemp`

REMOVE_TS=0

while getopts ":lhru:i:o:O:C:" opt; do
  case $opt in
```

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```
    h)  help;;
    l)  SYSLOG=0;;
    u)  TS_URL="$OPTARG";;
    i)  INPUT_FILE="`readlink -f $OPTARG`";;
    o)  OUTPUT_FILE="`readlink -f $OPTARG`";;
    O)  OPENSSL_OPTS="$OPTARG";;
    C)  CURL_OPTS="$OPTARG";;
    r)  REMOVE_TS=1;;
    \?) echo "Invalid option: -$OPTARG" >&2; help; exit 1;;
    :)  echo "Option -$OPTARG requires an argument." >&2; help; exit 1;;
  esac
done

# If no output file specified, output to <input file>.ts
[ -z "$OUTPUT_FILE" ]   && OUTPUT_FILE="${INPUT_FILE}.tsr"

# Check that input file exists
[ -f "$INPUT_FILE" ]    || exit_error "Input file '$INPUT_FILE' doesn't exist"
# Check that output file doesn't exit
if [ $REMOVE_TS -eq 1 ]
then
        [ -f "$OUTPUT_FILE" ] && rm -f "$OUTPUT_FILE"
else
        ! [ -f "$OUTPUT_FILE" ] || exit_error "Output timestamp file '$OUTPUT_FILE'␣
↪already exists"
fi
# Check that url is not empty
! [ -z "$TS_URL" ]      || exit_error "Missing timestamp server url"

info "Generating timestamp on file '$INPUT_FILE', to '$OUTPUT_FILE', using server '
↪$TS_URL'"

# Building the timestamp request with openssl
openssl ts $OPENSSL_OPTS \
    -query -data "$INPUT_FILE" \
    -out "$TMPREQ" || exit_error "Request generation failed"

# Submitting the timestamp request to the RFC 3161 server with curl
curl "$TS_URL" $CURL_OPTS \
    -H "Content-Type: application/timestamp-query" \
    -f -g \
    --data-binary @$TMPREQ \
    -o "$OUTPUT_FILE" 2>/dev/null || exit_error "Timestamp query failed"

openssl ts -verify -data "$INPUT_FILE" -in "$OUTPUT_FILE" 2>&1 | grep -q "asn1␣
↪encoding routines" && exit_error \
        "Reponse doesn't appear to be a timestamp response"

success "Timestamp of file '$INPUT_FILE' using server '$TS_URL' succeed, ts written␣
↪to '$OUTPUT_FILE'"

clean
```

CHAPTER 9

uts-server

Micro RFC 3161 Time-Stamp server written in C.

Doc Uts-Server documentation on ReadTheDoc

Dev Uts-Server source code on GitHub

License MIT

Author Pierre-Francois Carpentier - copyright © 2019

9.1 Demo

A demo is accessible here: https://uts-server.kakwalab.ovh/

9.2 License

Released under the MIT Public License

9.3 What is RFC 3161?

An RFC 3161 time-stamp is basically a cryptographic signature with a date attached.

Roughly, it works as follow:

1. A client application sends an hash of the data it wants to time-stamp to a Time-Stamp authority server.
2. The Time-Stamp authority server retrieves the current date, concatenates it with the hash and uses its private key to create the time-stamp (kind of like a signature).
3. The Time-Stamp authority server returns the generated time-stamp to the client application.

Then a client can verify the piece of data with the time-stamp using the Certificate Authority of the time-stamp key pair (X509 certificates).

It gives a cryptographic proof of a piece of data content, for example a file, at a given time.

Some use cases:

- time-stamp log files at rotation time.
- time-stamp file at upload to prove it was delivered in due time or not.

9.4 Quick (and dirty) Testing

Here a few steps to quickly try out uts-server, for production setup, please compile civetweb externally and create proper CA and certificates:

```
# Building with civetweb embedded (will recover civetweb from github).
# Note: the BUNDLE_CIVETWEB option is only here for fast testing purpose
# The recommended way to deploy uts-server in production is to build civetweb
# separatly and to link against it.
$ cmake . -DBUNDLE_CIVETWEB=ON
$ make

# Create some test certificates.
$ ./tests/cfg/pki/create_tsa_certs

# Launching the time-stamp server with test configuration in debug mode.
$ ./uts-server -c tests/cfg/uts-server.cnf -D

# In another shell, launching a time-stamp script on the README.md file.
$ ./goodies/timestamp-file.sh -i README.rst -u http://localhost:2020 -r -O "-cert";

# Verify the time-stamp.
$ openssl ts -verify -in README.rst.tsr -data README.rst -CAfile ./tests/cfg/pki/
↪tsaca.pem

# Display the time-stamp content.
$ openssl ts -reply -in README.rst.tsr -text
```

9.5 Powered by

OpenSSL