DS_2020-2021_GRR_A2.1a

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Exercise 1

The concept of a *good time* nowadays is measured by how close It's the precision of the clock compared to the UTC, which uses highly precise atomic clocks combined with the Earth's rotation to estimate and approach the most precise time as possible. The smaller the deviation respect the physical time in an instant is, the more precise our clock is.
As our mobile phones and computers are connected to the internet they can receive UTC time from these atomic clocks, but they also receive even better updates from the Global Positioning System so their precision is as accurate as possible(the accuracy of GPS is 0,1 µs and not as subject to issues as internet connections).

Exercise 2

The concepts are clear, nothing to report.

Exercise 3

A possible answer could be that, in exemption of a reliable time source, the computers and systems of the net could use the time of a computer as the reference time. The chosen reference computer could send its time to the other components of the net, and then they synchronize their clock.

The objective is to select a reference time and determine the deviation of each clock at a given time with respect to the reference time (in order to adjust the clocks). ***Describe your strategy using a message passing protocol and try to quantify the accuracy it offers.***

Exercise 4

Nothing to present in this report.

Exercise 5

NTP is a time service that has become a standard on the Internet. It provides synchronization with UTC.

NTP's organization
NTP is structured in layers of time servers, known as Stratum N where N is the level number.
The primary servers maintain reliable UTC references, using very accurate atomic clocks and are known as Stratum 0 clocks. Normally these clocks are managed from important administrations like the US Naval Observatory.

The secondary servers are kept synchronized with respect to the primary ones and they provide the time normally all over the Internet, giving access to anyone to an accurate time easily, those are known as Stratus 1.
The lower layer servers are the ones that correspond to the clients. This layer can be extended as much as 15 layers, but against more hops are used, the smaller the accuracy is. Is not recommended to have many layers, because normally the devices that the users use do not have an accurate clock frequency.

NTP's protocols
NTP uses UDP protocol to make the communication to synchronize the clocks, through the port 123. It is designed to face the latency effects of the net taking into account different parameters as deviation, trying always to get the biggest accuracy applying different mechanisms.

NTP's Linux configuration
Chrony is installed by default in all the Red Hat distributions and It's available in the repositories of Ubuntu. Chrony is mostly oriented to the common computers; Computers that have intermittent connection to the internet or computers that enter the suspension state. Chrony is also oriented to virtual machines, which are even more unstable environments. It is characterized by it's low resource cost.
In Linux there is the command "ntpdate -u hora.roa.es" which is used to show the NTP using the server of the ROA (Real Instituto y Observatorio de la Armada). If not installed, you should use the command "apt install NTP", and It should be ready to run. It also gives you the ability to change the server from which we take the time. Ntpd is the daemon used by NTP.

Exercise 6

- Prepare a report describing **the simulated case,** the synchronization values obtained (**deviation** and **accuracy**), and **how** you have reached them. Include a discussion about the **advantages and disadvantages** of NTP with respect to other synchronization protocols, specifically that of **Cristian**.

The simulation case consists of two hosts communicating between them with the objective to synchronize the clocks. As seen before, the synchronization process carries some deviation on the communication process due to the latency on the net and the time that the system takes processing the package. To fix this deviation problem and with the objective of increasing the accuracy to the maximum, the system applies different mechanisms: negative and positive deviation adjustment.

We have tried both protocols to synchronize time: NTP and Cristian algorithm.

NTP

Using Iñigo's times

T1: 11:14:30
T2: 11:15:26
T3: 11:16:19
T4: 11:17:00

T2 = T1 + t + o ⇒ 11:15:26 = 11:14:30 + t + o
T4 = T3 + t' - o ⇒ 11:17:00 = 11:16:19 + t' - o

di = t + t' = T2 - T1 + T4 - T3 = (T4 - T1) - (T3 - T2) = (11:17:00 - 11:14:30) - (11:16:19 - 11:15:26) = 00:02:30 - 00:00:53 = 00:01:37
Then di = 00:01:37

o = oi + (t' - t)/2 ⇒ o = (T2 - T1 + T3 - T4)/2 + (t' - t)/2 ⇒
o = (00:00:56 - 00:00:41)/2 + (t' - t)/2 = (00:00:15 + (t' - t))/2
then o = (00:00:15 + (t' - t))/2
o = (00:00:54 - 00:00:51)/2 + (t' - t)/2 = (00:00:03 + (t' - t))/2
then o = (00:00:03 + (t' - t))/2

oi - (di / 2) <= o <= oi + (di / 2) ⇒
-(di / 2) <= o - oi <= (di / 2)

-00:00:48 <= o - oi <= 00:00:48

o - oi = (00:00:15/2) + (t' - t)/2 - (00:00:15/2) = (t' - t)/2

---
di = 00:01:37 = t + t' then
t' = 00:01:37 - t

T4 = T3 + t' - o ⇒ 11:17:00 = 11:16:19 + t' - o
00:00:41 = t' - o ⇒ t' = 00:01:37 - t ⇒ 00:00:41 = 00:01:37 - t - o

o = (00:00:15 + (t' - t))/2

then

00:00:41 = 00:01:37 - t - (00:00:15 + (t' - t))/2

00:01:22 = 00:03:14 - 2t - 00:00:15 + (t' - t)

-00:01:52 = -3t + t'

t' = 00:01:37 - t

-00:01:52 = -3t + 00:01:37 - t

-00:03:29 = -4t

t = 00:00:52

t' = 00:01:37 - t

then

t' = 00:01:37 - 00:00:52

---
t' = 00:00:45
t = 00:00:52

(t' + t)/2 = 49 s

deviation estimate 7.5s
precision 48.5s

Cristian Algorithm

time in which the mreq was sent: 11:22:00
mikel local time: 11:26:14
t1 = t: 11:26:35

t(mt) = time returned by the server in message: 11:25:14
D: time since sending mreq and receiving mt: mt-mreq = 11:26:35 - 11:22:00 = 00:04:35
min = minimum transmission time of a message

Deviation: O = t - t(mt) = t1 - D/2 - t(mt)

O = 11:26:35 - (00:04:35)/2 - 11:26:14 ⇒
⇒ 11:26:35 - 00:02:17 - 11:26:14 ⇒ converting to seconds
⇒ 41185 - 137 - 41174 = -126 ⇒ to hh/mm/ss ⇒ -00:02:06
Deviation: -00:02:06