Distributed Systems, Lab 8
Clock Synchronization

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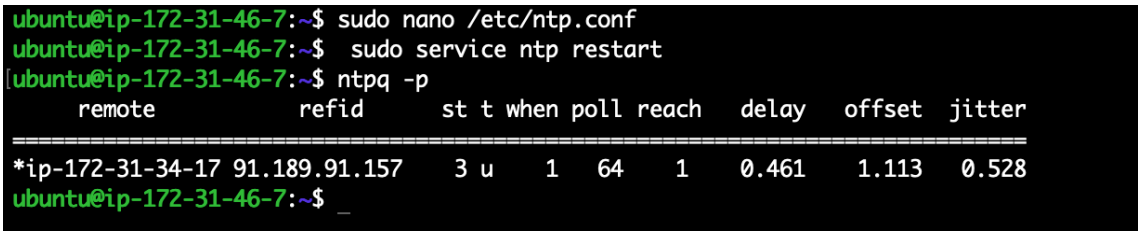
1 Questions

1.1 What is a stratum in terms of Network Time Protocol?

NTP is a protocol that is split into layers (stratums), which determine the device's distance from the reference clock. So that, a stratum is one layer in a hierarchical network of layers that distribute accurate time across a network of devices.

1.2 Provide the output of ntpq -p command from the client.



the screenshot was taken on the client, that I configured on the ec2 as well as server.

Describe the meaning of the fields:
remote, refid, st, t, when, poll, reach, delay, offset, and jitter.

- **remote** - is the address of the time server, and the asterisk (before the record) indicates the prefered update node (where first to try to get the time).
- **refid** - indicates the type of the time server, shows the current source of synchronization - the server DNS name or, if not found, the IP address.
- **st** - is the Stratum, which indicates the accuracy to be expected, thus, stratum level indicates the device's distance to the reference clock. its range is 0-15. More info about levels can be found here.
- **t** - indicates the type that the server is using, the type can be: unicast, broadcast, multicast, or manycast.
- **when** - is how long ago it was since the last time the server was polled.
- **poll** - indicates how often the server will be polled.
- **reach** - an octal number that is left-shifted on each update. On a successful update an 1 is shifted in, 0 otherwise.
- **delay** - is the RTT(round trip-time) to the time server.
- **offset** - is the difference between the remote and the local clock.
- **jitter** - the network latency between the hosts.

1.3 What are the lacks of using the Lamport's algorithm?

One of the drawbacks of Lamport's algorithm is in the fact that timestamp are only partially order events. Partial order indicates that not every pair of events need be comparable. And, if two events can't be compared, we call these events concurrent. Thus, the problem with Lamport's algo is that they can't tell if events are concurrent or not. But it can be solved by Vector Clocks.

2 Implementation of logical vector clock algorithm using Process and Pipe approaches

The final vector state of each process:
Process a - [7, 6, 1]
Process b - [2, 8, 1]
Process c - [2, 8, 4]

The source code is stored in this github private gist.