

NTP-like time synchronization

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NTP is an Internet protocol used to synchronize the clocks of computers to some-time reference. The NTP system consists of a network of primary and secondary time servers, clients and interconnecting transmission paths.

Features of the system

- System should create a hierarchy of servers, which are self-organizing in nature. E.g. there are servers which comes under a class *Stratum 1*, *Stratum 2*... etc. *Stratum 0* is the reference clock i.e. our primary source for synchronization. Here *Stratum n+1* server synchronizes its time with *stratum n*. If any server synchronizes with another server with *stratum x* then it becomes *stratum x+1*.
- NTP client sends request to NTP server to query the time after some designated interval. The NTP server should reply to this request with its own timestamp.
- Synchronization between two servers should give some timing guarantees, meaning the system should bound to some duration of time. If you take any two pair of nodes in the system than they must be in some max allowed time drift with respect to each other.
- System should be scalable. System should handle dynamic addition of new nodes.
- System should be fault tolerant. It should tolerate removal or crash of nodes. It should handle spurious clocks, drop of packets, duplication of packets etc.
- When receiving reply from the server, NTP client shall do some corrections on time to be applied based on statistical metrics e.g. Round trip time *rtt*, server processing time.
- To ensure reliability, client should negotiate with the server multiple times before actually accepting its clock. The server time is applied only if the server is found to be reliable after the negotiations.
- Client shall reject highly deviated values or outliers if received from server. Client assumes that deviations beyond some bound can't happen if the NTP is working correctly in the first place.
- After calculating the correct time, client should decide how to apply the time, client does not directly apply the time to itself, rather it sees the difference and according to that it fastens or slows its clock till some time.
- System shall accept some parameters from the users e.g. maximum drift allowed or re-synchronization time.
- Server can negotiate time with its neighbours (server at the same stratum level) to ensure servers reliability or in case of temporary failure of server.