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A study of the accuracy of Network Time Protocol client synchronization in large computing clusters

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As computing systems become more distributed and as networks increase in throughput and resources become ever increasingly dispersed over multiple administrative domains, even continents, there is a greater need to know the performance limits of the underlying protocols which make the foundations of complex computing and networking architectures. One such protocol is the Network Time Protocol (NTP) which is often overlooked as an important part of any large scale computing system. With the adoption of new highly distributed technologies, such as those employed in grid computing, the increasing number of users and resources will test not only the synchronization of these resources but also the transaction logging and event correlation in any problem resolution/diagnostic systems. In essence, good quality and reliable time synchronization is a key component to the actual operation of any large scale production system incorporating many components. In this paper we present the CERN NTP server and client architecture and discuss the statistical quality of time synchronization of 4 computing clusters of increasing size from approximately 50 to 3000 nodes and inter-connected via a high-performance 10Gbit/s symmetrically routed network backbone infrastructure. Each cluster is dedicated to a specific task or application resulting in various IO load profiles, some more deterministic than others. The relationship between the reliability of time synchronization, system load and network IO is analysed and optimization suggestions are presented.

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