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Measured Performance of the Network Time Protocol in the DARPA/NSF Internet System

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Abstract

This paper describes a series of experiments involving over 100,000 hosts of the DARPA/NSF Internet system and located in the U.S., Europe and the Pacific. The experiments are designed to evaluate the availability, accuracy and reliability of international standard time distribution using the DARPA/NSF Internet and the Network Time Protocol (NTP), which is designed specifically for use in a large, diverse internet system operating at speeds from mundane to lightwave. In NTP a distributed subnet of time servers operating in a self-organizing, hierarchical, master-slave configuration exchange precision timestamps in order to synchronize subnet clocks to each other and national time standards via wire or radio.

The experiments are designed to locate Internet hosts and gateways that provide time by one of three time distribution protocols and evaluate the accuracy of their indications. For those hosts that support NTP, the experiments determine the distribution of errors and other statistics over paths spanning major portions of the globe. Finally, the experiments evaluate the accuracy and reliability of precision timekeeping using NTP and typical Internet paths involving DARPA, NSFNET and other agency networks. The experiments demonstrate that timekeeping accuracy throughout most portions of the Internet can be ordinarily maintained to within a few tens of milliseconds, even in cases of failure or disruption of clocks, time servers or networks.

Keywords: internet clock synchronization, standard time distribution, Internet protocol, timekeeping experiments.

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Table of Contents

1. Introduction 1
1.1. Standard Time and Frequency Dissemination 2
1.2. The Network Time Protocol 2
1.3. Determining Time and Frequency 3
2. Discovering Internet Timetellers 4
2.1. Evaluation of Timekeeping Quality 6
2.2. Discussion 7
3. Survey of NTP Hosts 8
3.1. Errors Due to Statistical Delays 9
3.2. Errors due to Radio Propagation Effects 11
3.3. Errors due to Radio Clock Phase Noise 13
4. Conclusions 15
5. References 15

List of Figures

Figure 1. Calculating Delay and Offset 4
Figure 2. Error Distribution by Protocol 6
Figure 3. Offset vs Delay 9
Figure 4. Raw Offsets 10
Figure 5. Filtered Offsets 10
Figure 6. Error Distribution for NTP hosts 11
Figure 7. Radio Clock Frequency Error 13
Figure 8. Radio Clock Offset Error 14

List of Tables

Table 1. Time Responses by Protocol 5
Table 2. Time Responses by Category 8
Table 3. Radio Propagation Delay 12