Analysis of Time Measurements in Network Systems Using Decomposition on Subprocesses

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Abstract. The article discusses a simple case of the statistical interpretation of measurement data representing the response time of the wireless network, when during one measuring two phenomena were observed. The measurement data were separated and the two cases of network behavior were distinguished. One case can be used to analyze the quantitative measurement of a best-effort system. The second one can be used for the worst case analysis. The problem of stationarity of the process is also discussed. A measurement series was modeled statistically.

Keywords: distribution, convolution, time measurements, ping, decomposition, network, subprocess, stationarity, non-stationarity.

1 Introduction

In examining the computer system, the time sequence of its answers to some of stimuli can be observed. However, this system may consist of several subsystems. These subsystems may have different time characteristics. It is possible that different subsystems determine the different characteristics of the system, for example, the maximum value of response time or the average value. In some cases, one can attempt to extract the time characteristics of the subprocesses from time characteristics of the main processes. One of the objectives of the study is the interpretation of the measurements obtained from the computer systems using the probability mass function. The interpretation is based on a statistical qualification of the phenomena, which result in obtaining a characteristic response of the system.

This analysis may be helpful in determining the influence of the various subsystems on the operation of the system and its parameters. It may also be helpful in determining compliance with the requirements of the system’s response time, especially for the time constraints systems.

In computer systems measuring practice, it appears that even results of the simple measurements are statistically complex. One of the reasons is non-stationarity of processes describing response times. The stationarity of these processes must be also examined. If the process is not stationary, which happens often in real systems, one of the approaches is an attempt to separate stationary
and non-stationary subprocesses from the main processes. These subprocesses can then be analyzed separately as stationary processes.

In each analysis it is important to skillfully simplify a real case observed and ignore the insignificant details from the perspective of the goal of analysis. In some cases, response time characteristics of these subsystems can be modeled, using statistical operations, even without knowing the mechanisms of action of the subsystems or tasks they carry.

Time analysis based on the analysis of probability distributions may be interesting for cases where analysis is done on a working system, especially when changes are to be set to its independent components. The ability to qualify new characteristics of the system is valuable for the proper selection of the time parameters of considered tasks.

2 Time Response Measurement

While measuring even a simple process [6,7], it appears that typically a number of different processes are measured. For example, in a network transmission using the cache, it appears that the observed times are complex and can not be described by a simple statistical relationship, because the process of writing is composed of two different mechanisms.

To show such a phenomenon, the case was chosen in which the ping RTT (Round Trip Time) was measured during debugging of the problems encountered in wireless network operation. The ping command is a common tool used for network testing. The question arises, how to analyze obtained measurement data. Time responses for the ping command realized in wireless network with the access point set in infrastructure mode, are presented in Fig. 1. The network was placed in the high-urban area and worked in the environment of the other wireless networks. There was a low traffic in the network with a few stations. The suspected reasons of high response times are interferences with other networks.

![Figure 1](image_url)

**Fig. 1.** Time responses for ping command realized in certain wireless network. Both graphs (a) and (b) represent the same data in the various ranges.