INTERNATIONAL TELECOMMUNICATION UNION

ITU-T E.492

TELECOMMUNICATION
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OF ITU

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TELEPHONE NETWORK AND ISDN

QUALITY OF SERVICE, NETWORK MANAGEMENT AND TRAFFIC ENGINEERING

TRAFFIC REFERENCE PERIOD

ITU-T Recommendation E.492

(Previously “CCITT Recommendation”)

FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (ITU). The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation E.492 was prepared by ITU-T Study Group 2 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 19th of February 1996.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

CONTENTS

SUMMARY

Traffic reference period is a time period, relevant in traffic observations for quality control or dimensioning. The traffic reference periods are defined to detect periods of loads appropriate for monitoring Grade of Service (GOS). Normally these are not predictable. This Recommendation discusses aspects related to determining these periods. Definitions are provided, also, for normal and high load.

Recommendation E.492

TRAFFIC REFERENCE PERIOD

(Geneva, 1996)

1 Scope

This Recommendation provides the definition of traffic reference periods, normal load and high load for the purpose of collecting measurements for monitoring Grade of Service (GOS) for networks and network components (e.g. exchanges and circuit-groups).

2 References

Related Recommendations are E.490, E.491, E.500 and E.502 about traffic measurements and dimensioning and E.721, E.723, E.771 and E.776 about specifying target service quality parameters.

3 Terms and definitions

Terms and definitions follow Recommendations E.600 and E.800.

4 Introduction

Switched or packet networks are now being used, and will be used even more in the future, for different services. The traffic management of a network provided by a single operator is described in Recommendation E.490; but many actual network structures involve multiple network operators. A given service can make use of the networks of several operators in several countries. In order to guarantee the service level in the networks, a number of operations are necessary, like augmentations, restructuring and reroutings. Many of these operations are based on known and forecasted changes in the traffic intensity. Therefore, relevant measured information on traffic intensities and qualities is needed.

Different measurement periods and principles for collecting traffic data may have been used in different networks and services, depending on the operator. This solution leads, however, to overlapping data collecting and processing, and increases the possibility of inconsistencies. This Recommendation presents some principles which facilitate collecting and handling of data for different purposes, in different networks and services, run by several operators.

This Recommendation addresses traffic reference period for monitoring GOS. Because dimensioning methods should be consistent with GOS monitoring, traffic reference periods defined here should also be used for dimensioning purposes. In the event that the definitions in this Recommendation conflict with previous Recommendations, this one shall prevail.

5 Principles

Measurements can be alternatively continuous, scheduled, activated manually, or depend on observed values automatically. Values collected in continuous measurements are prehandled at an early stage. Scheduled measurements are motivated if the traffic variations are regular and predictable. Many rare measurements are started manually. Automatic measurements save from collecting unnecessary data and from continuous observations by operations people. Reporting can be started when the measured data exceeds a preset value.

In order to avoid separate measurement operations for each network, each service and each action taken, the measurement principles and data should be applied consistently and one common database used for all purposes in a given network, the data processing only varying case by case.

Data collecting should be minimized, so that this administrative work does not unnecessarily load the control processors, data handling and reporting systems of the network.

There are three basic types of traffic load that are considered in network dimensioning and monitoring GOS. For control devices, (e.g. exchanges) call attempts are considered, for traffic carrying devices, (e.g. circuit-groups) carried traffic intensity is considered, and for other aspects, (e.g. billing) the completed call attempts and their durations are considered. Traffic volume periods are defined separately for each of these types of traffic load.

6 Operations

From the point of view of different operations, various traffic properties are relevant. Operations affecting the quality of service, like planning, dimensioning, forecasting, or fault detection, need peak values of the traffic measured even during short lengths of time. For optimizing, but especially for invoicing, accumulated values over longer periods are needed. The long-term prognoses form the basis for planning, the short-term prognoses for network management.

7 Measurement seasons and days

Traffic intensity varies irregularly during a year and it is not common for the highest loads to occur in the same weeks from one year to another. The lowest load season can be easier to predict. What is said about seasonal variations is valid also for individual days. Even if the weekdays can have repeated similarities from week to week, the predictability of the highest intensities per day is often poor. The low intensities are mostly found at weekends or other holidays but, due to many special reasons, some of these days can be the most loaded ones, too. Therefore, the highest loads can be found only by measuring the traffic continuously, interrupting the work only for very good reasons. Such reasons can be network operations in order to clear a network overload, reprogramming of the processor, augmentation procedures, or similar actions. Except for the first one, it is preferable to carry out these operations during a predicted period with low load.

8 Combination of measured data

Of all measurable traffic data, as described in Recommendation E.502, only those are recorded which are needed for further operations. Nevertheless, they may form an immense data quantity, not to be gathered unnecessarily, neither stored in its entirety.

9 Measurement hours

In many cases the day's peak hour can be found among the common office hours, but seldom during a fixed hour from day to day. Peak hours in the evening are usually caused by domestic calls, but sometimes by data traffic, too. Low evening or night tariffs encourage calling during those hours. Traffic measurements have to be continuous during the whole day so that the peak intensities can be found.

10 Read-out periods

An important means to condense data is to summarize the phenomena over a certain length of time. Thus, data from several calls are given as sum or average, integrated over this read-out period. The length of the read-out period has a decisive effect on the apparent size of traffic peaks, and to what extent they are damped by averaging with their neighbouring values.

The read-out period has traditionally been one hour in manual telephony, corresponding from 10 to 20 times occupation time. For the purpose of discovering the relevant peak values, in actual automatic telephone traffic, but especially in signalling and data traffic with short occupation times, the read-out period has to be much shorter. The read-out period should be suitably chosen so that traffic variations and peaks within the read-out period can be determined using mathematical models and its measured average intensity. The recommended read-out periods for different networks and services are given in clause 13.

11 Reference periods for quality factors during the normal and high load

The quality values indicate the service from the user's point of view. These values, like congestion, waiting time and fault factors, normally grow with increasing load. Therefore, the quality factor measurements are concentrated on the peak-load periods, in cases when this period can be foreseen. Since this is often not possible, the quality factors too, are measured continuously or automatically.

For certain purposes, the quality factors per circuit-group and individual components (e.g. exchanges) are defined for a normal and high load.

The normal load is determined over a monthly time interval by the following steps:

1) determine the maximum read-out period load of each day;
2) order the days in a month from the lowest to highest daily high read-out period load;
3) select the day having the fourth highest daily high read-out period load. This load is defined as the normal load for the monthly interval being considered[1)].

The high load is determined by following steps 1) and 2) above and then selecting the day having the second highest daily peak read-out period. This load is defined as the high load for the monthly interval being considered. The first highest monthly load is not used here, since it can be caused by extreme traffic circumstances or fault conditions.

The purpose of identifying the normal and high load as defined above is to select which day and read-out period to use, save and analyse monitored GOS performance and compare the monitored values to the GOS target values specified for normal and high load. The GOS measurements used are those collected for the day and read-out period in which the network normal and high load occur. It should be noted that different types of network components could have different time periods at which normal and high load occur.

12 Reference periods for network-wide quality factors

A circuit-switched network consists of several circuit-groups and other interconnected network components for service control and signal transfer. Quality factors, relevant for the network, are monitored during normal and high load of the network, defined in the following way.

The load is defined commonly for the whole network. In order to avoid influence of the network structure, the load is seen from outside: traffic incoming to and originated by the network are summarized in each read-out period. The periods for normal and high load are defined by this total traffic, as in clause 8.

The normal and high load above serve to define the monthly reference periods for quality factors.

13 Different networks and services

13.1 PSTN

The recommended read-out periods are 60 minutes and/or 15 minutes.

13.2 N-ISDN and the IN-based services

The reference periods for traffic caused by narrow-band ISDN and the IN services, like freephone, UPT and televoting, are for further study.

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1) If there is more information available on the distribution of the peak daily traffic load, a day other than the fourth highest might be determined to be more appropriate.

13.3 Signalling System No. 7 (SS No. 7)

The traffic measurements for SS No. 7 loads should be collected continuously for read-out periods of between 5 and 15 minutes. The exact value depends on measured traffic variability, as discussed in 2.4/E.733. The peak value of this measurement should be recorded each day for each load set (e.g. a load set could be a link-set load, a point-to-point load, an aggregate STP load, etc.).

For network dimensioning, a sliding window of M days is considered and the reference traffic load over a window is defined as the average of the N highest daily peak measurements over those M days. This definition of reference traffic is based on the philosophy of the ADPH (Average of Days' Peak Hours) method recommended in Recommendation E.500 (Rev.1). Recommended values for M and N are provided in 2.3/E.733.

Special measurement studies must be done periodically to determine a factor K to multiply the measured peak load to determine the peak value to be used for dimensioning. The factor K reflects burstiness and short-term load variations that are not captured by the load data from the continuous measurement periods. The methods of determining K are given in 2.4/E.733.

13.4 B-ISDN

The traffic measurements for B-ISDN loads should be handled as mentioned in 13.3 concerning SS No. 7.

However, for B-ISDN there may be services having traffic with the self-similar property. The self-similarity property is seen when the traffic statistical properties remain the same when the time-scale is changed. For self-similar traffic, the length of the periods over which average traffic levels are measured can be chosen over a wide range and similar results will be obtained. Therefore, the length of a reference period is not critical. The measurements needed to identify and characterize self-similar traffic are for further study.

13.5 Other networks and services

The definition of the traffic reference periods for networks and services not covered in 13.1 to 13.5 (e.g. maritime and aeronautical services) is for further study, because of the possible differences in traffic characteristics.

14 History

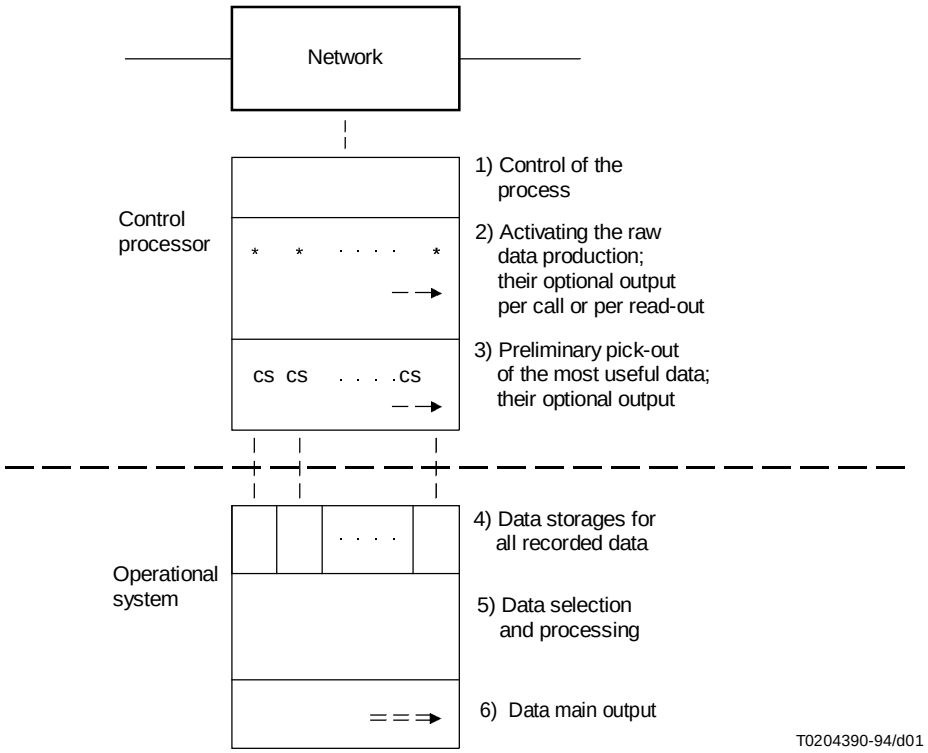
Recommendation E.492 will be published for the first time in 1996.

Annex A

Traffic measurements process chart

(This annex forms an integral part of this Recommendation)

An example:



1) One or several processors control the trafffic handing network.
2) The raw traffic data production can be activated:
   a) all the time;
   b) scheduled by day, week, month and/or year; or
   c) manually.

   These data can have direct output.
3) Raw data values can be compared in a primitive gate, which allows a direct output only for data having values above:
   a) preset value; or
   b) the highest of the earlier values.
4) Raw data are mainly stored in a container for further needs.
5) Container collects data from several sources and over a longer time. The data are processed by given logical rules:
   a) as scheduled; or
   b) by demand.
6) The data are usable for:
   a) reporting; or
   b) further processing in a control system or a commercial computer.

Annex B

Examples of traffic measurements

(This annex forms an integral part of this Recommendation)

Traffic intensity measurements in conventional telephony, as presented in Recommendation E.500 (Rev.1), can be handled according to the traffic measurement process chart as follows:

– *Fixed Daily Measurement Hour (FDMH)*

  Raw data are produced during one preselected daily hour only, with an immediate output 2).

– *Fixed Daily Measurement Period (FDMP)*

  Raw data are produced during some preselected daily hours 2) in quarter-hours, stored in the container 4), processed and reported later [5), 6)].

– *Time Consistent Busy Hour (TCBH), in fact peak hour of the average day*

  Raw data are produced continuously 2) in quarter-hours, stored in the container 4) and processed and reported later [5), 6)].

– *Average of Days' Peak Hours (ADPH)*

  Raw data are produced continuously 2) at full hours, day's highest value is picked out with immediate reporting 3).