IMPROVEMENT IN THE SERVICE QUALITY OF TELEPHONE EXCHANGE NETWORKS

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We certify that we have read this thesis and that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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ABSTRACT

In this project, the traffic engineering about telephone exchanges network which is the basic of the telecommunication mediums was studied. At the first stage of this project; the basics of telephone networks and traffic engineering, and the importance of traffic science were presented. At the second stage of this studying, the traffic and statistical measurements were taken from ALCATEL SYSTEM-12 JRACK (S-12) exchanges which are mostly used on network, and measurement result reports were transferred to a PC. These reports were evaluated according to traffic science using a computer program which was programmed in QBASIC language for this project. This program was named as EC7 ANALYZER (EC7 is the name of a software which runs on S-12 exchanges since the end of 1996). The aim of the project is to improve the service quality of telephone exchanges and networks using the EC7 ANALYZER. By use of the written software the performance of the telephone exchanges network has been improved. This improvement is given in detail in Chapter 5.

ÖZET

Bu tezde, telekomünikasyon ortamlarının temelini teşkil eden telefon santrallarından oluşan ağ üzerinde trafik mühendisliği ile ilgili çalışmalar yapılmıştır. Birinci aşama olarak, telefon ağı ile ilgili temel bilgiler,trafik mühendisliğinin temelleri ve trafik biliminin telefon ağındaki önemi verilmiştir. İkinci aşamada, oldukça yaygın sayıda kullanılmakta olan ALCATEL SİSTEM-12 JRACK (S-12) büyük tip telefon santrallarından trafik ve istatistiksel ölçüm raporları alınmış, text halindeki bu raporlar bilgisayar ortamına transfer edilmiştir. Tez çalışması aşamasında QBASIC dili ile yapılan, EC7 ANALYZER (EC7, S-12 santrallarının üzerinde çalışmakta olan yazılımın adı olup 1996 sonlarından itibaren santrallarda kullanılmaya başlamıştır) bilgisayar programı vasıtasıyla, trafik bilimi esas alınarak, raporlar değerlendirilmiş, telefon ağında en fazla sayıda telefon iletişiminin yapılabilmesine ve servis kalitesinin arttırılmasına yönelik incelemeler yapılmış, olumlu sonuçlar sergilenmiştir.

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CHAPTER ONE

INTRODUCTION

1.1 Importance of Traffic Engineering at Telephone Networks

In this project, it is aimed to study about telecommunication industry which has been developing recently and telephone networks which consist of telephone exchanges and transmission lines called trunks. And it is aimed to improve the service quality of telephone networks. It is studied about the teletraffic engineering and it's basic theories.

By means of teletraffic engineering PSTN (Public Switching Telephone Network) and GSM (Global System of Mobil Communication) telecommunication networks with exchanges and trunks are exploited most efficiently. The exchanges observe the traffic flowing on networks and operational statistical measurements, and issue traffic reports. From the traffic reports, it is decided to increase or decrease the number of trunks, to assign alternative routes, extend the hardware to exchanges, and etc. At the same time, operational measurements gathered from every exchanges are analyzed. The obtained results show the relationship between exchanges. Then, the networks and the amount of the trunks reorganized according to the results obtained above. By using a matrix form table (refer to Table 5.5) that includes counted values at rows and columns, the relationship about traffic flowing between exchanges can be evaluated. It would be able to obtain a SCADA (Supervisory Control And Data Acquisition) system for a dynamic trunk organization to concern the matrix form [1] [2]. The SCADA system can decide to traffic flowing on networks about to supervisory control. So, in "common channel signaling communication (NO:7 signaling)" [1], this tabulating method will be used for a basic routing reference on network.

1.2 Outline of the Thesis

In Chapter II, the concepts of telephone networks and their terminology are given.

Chapter III, explains essentials of traffic engineering.

Chapter IV, describes traffic measurement terminology and measurement basics of telephone traffic, and gives routing methods in telephone networks.

In Chapter V, the traffic measurements are gathered from Alcatel S-12 exchanges, these reports are evaluated by EC7 ANALYZER (developed for this thesis), and these results are considered.

The last chapter contains conclusions and recommendations for future work.

CHAPTER TWO
TELEPHONE NETWORKS

2.1 Introductory Terminology

Consider a very simplified example. Two towns are separated by, say, 20 km and each town has 100 telephone subscribers. Logically, most of the telephone activity (the traffic) will be among the subscribers of the first town and among those of the second town. There will be some traffic, but considerably less, from one town to the other. In this example let each town have its own switch. With the fairly low traffic volume from one town to the other, perhaps only six lines would be required to interconnect the switch of the first town to of that of the second. If no more than six people want to talk simultaneously between the two towns, a number as low as six can be selected. Economics has mandated that we install the minimum number of connecting telephone lines from the first town to the second to serve the calling needs between the two towns. The telephone lines connecting one *telephone switch* or *exchange* with another are called *trunks* in North America and *junctions* in Europe, and usually we calls trunks in Turkey. The telephone lines connecting a subscriber to the switch or exchange that serves the subscriber are called *lines, subscriber lines,* or *loops.* Concentration is a line-to-trunk ratio. In the simple case above it was 100 lines to six trunks, or about at 16:1 ratio.

A telephone subscriber looking into the network is served by a *local exchange.* This means that the subscriber's telephone line is connected to the network via the local exchange or central office, in North American parlance. A local exchange has a serving area, which is the geographical area in which the exchange is located; all subscribers in that area are served by that exchange.

The term *local area,* as opposed to *toll area,* is that geographical area containing a number of local exchanges and inside which any subscriber can call any other subscriber without incurring tolls (extra charges for a call). Toll calls and long-distance calls are synonymous. For instance, a local call in North America and Turkey, where telephones have detailed billing, shows up on the bill as a time-metered call or is covered by a flat monthly rate [3].

2.2. Bases of Network Configurations

2.2.1. Introductory Concepts

A network in telecommunications may be defined as a method of connecting exchanges so that any one subscriber in the network can communicate with any other subscriber. For this introductory discussion, let us assume that subscribers access the network by a nearby local exchange. There are three basic methods of connection of exchanges in conventional telephony: (1) *mesh,* (2) *star,* (3) *double and higher-order star.*

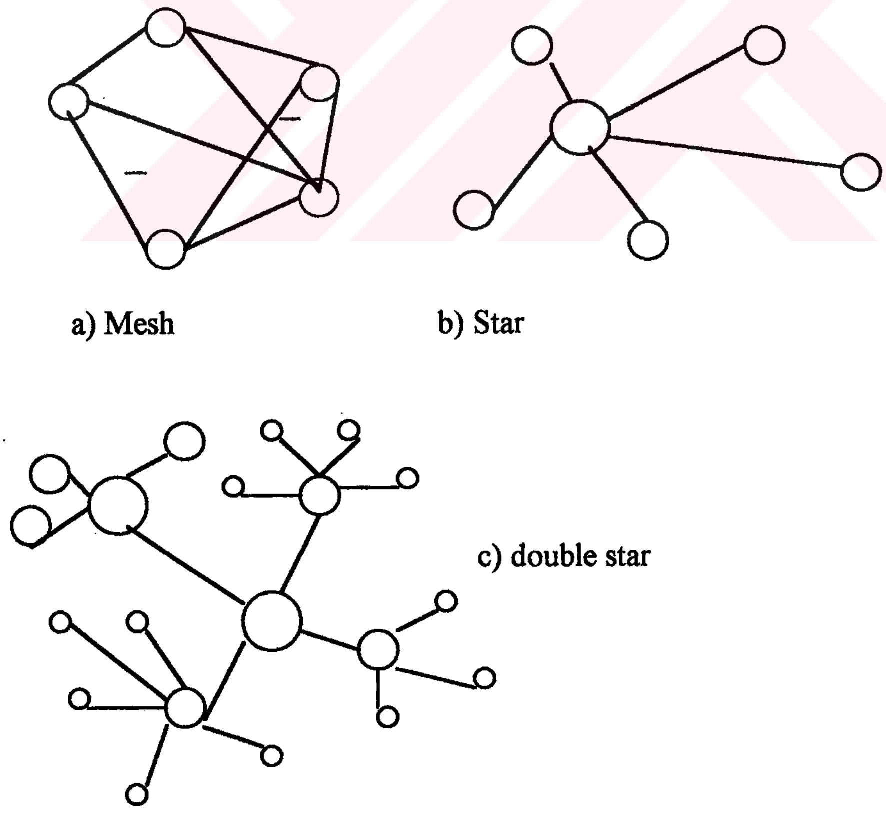


Figure 2.1 Examples of star, mesh, and double star configurations.

The mesh connection is one in which each and every exchange is connected by trunks to each and every other exchange as shown in Figure 2.1.a. A star connection utilizes an intervening exchange, called a *tandem exchange,* such that each and every exchange is interconnected via a *single* tandem exchange as shown in Figure 2.1.b. A double star configuration is one where sets of pure star subnetworks are connected via higher-order tandem exchanges, as shown in Figure 2.1.c.

As a general rule we can say that mesh connections are used when there are comparatively high traffic levels between exchanges, such as in metropolitan networks. On the other hand, a star network may be applied when traffic levels are comparatively low.

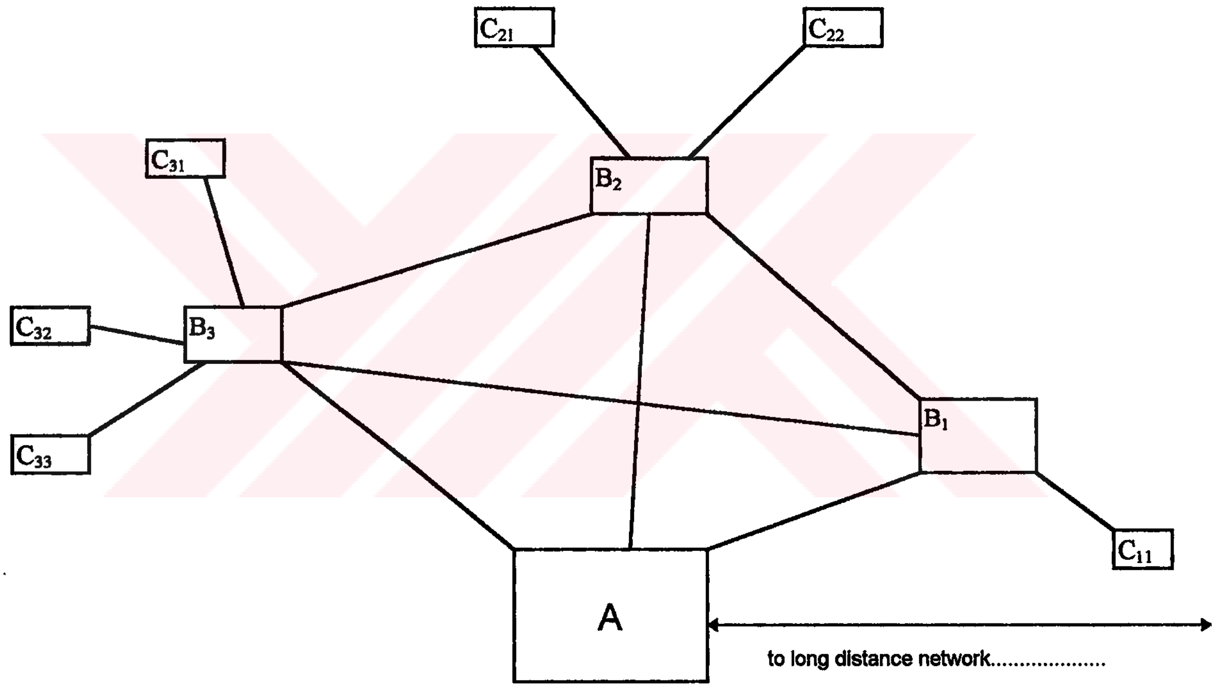


Figure 2.2 A typical telephone network serving a small city as an example of a compromise between mesh and star configuration.

A is a class 4(ATT), primary center(CCITT)

B is a class 3 exchange(ATT), a local exchange(CCITT)

C may be a satellite exchange or a concentrator.

Thus, in practice, most networks are compromises between mesh and star configurations. For instance, outlying suburban exchanges may be connected to a nearby major exchange in the central metropolitan area. This exchange may serve nearby subscribers and be connected in mesh to other large exchanges in the city proper. Another example is the city's long-distance exchange, which is a tandem exchange looking into the national long-distance network, whereas the major exchanges in the city are connected to it in mesh. An example of a real life compromise among mesh, star, and multiple-star configurations is shown Figure 2.2 [3].

2.2.2. Hierarchical Networks

Hierarchical network is a systematic network was developed that reduces the trunk group outlets (and inlets) of a switch to some reasonable amount, permits the handling of high traffic intensities on certain routes where necessary, and allows for overflow and a means of restoral in certain circumstances. Consider Figure 2.3, which is a simplified example of a higher-order star network. The term "order" here is a significant and leads to the discussion of hierarchical networks.

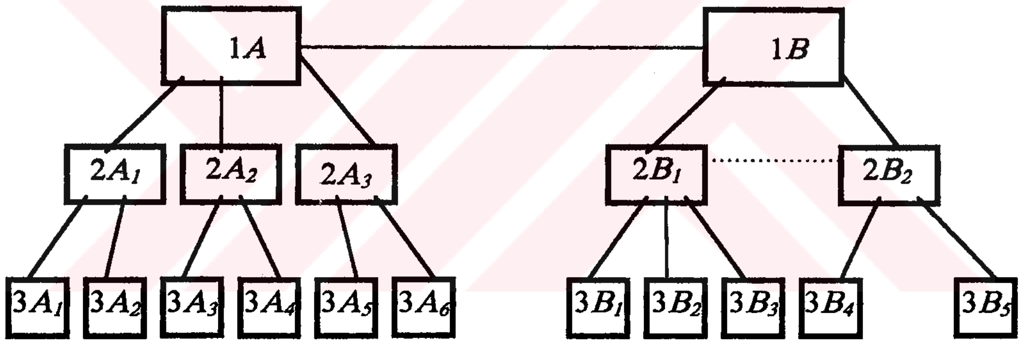


Figure 2.3 shows traffic routed between exchanges $2B_1$ and $2B_2$ via exchange $1B$ being routed on the final route.

A hierarchical network has levels giving orders of importance of the exchanges making up the network, and certain restrictions are placed on traffic flow. For instance, in Figure 2.2 there are three levels or ranks of exchange. The smallest boxes in the diagram are the lowest-ranked exchanges, which have been marked with a "3" to indicate the third level or rank. Note the restrictions(or rules) of traffic flow. As the figure is drawn, traffic from $3A_1$

bound for $3A_2$ would have to flow through exchange $2A_1$. Likewise, traffic from exchange $2A_2$ to $2A_3$ would have to flow through exchange 1A. Carrying the concept somewhat further, traffic from any A exchange to any B exchange would necessarily have to be routed through exchange 1A.

The next consideration is the high-usage route. For instance, if we found that there were high traffic intensities between $2B_1$ and $2B_2$, trunks and switch gear might well be saved by establishing a high-usage route between the two (shown in dashed line). Thus we might call the high-usage route a *highly traveled shortcut.* Of course, high-usage routes could be established between any pair of exchanges in the network if traffic intensities and distances involved proved this strategy economical. When high-usage routes are established, traffic between the exchanges involved will first be offered to the high-usage route and overflow would take place through hierarchical structure. Or as shown in our Figure 2.3, up to the next level and down. If routing is through the highest level in the hierarchy, we call this route the *final route.* Figure 2.3 shows traffic routed between exchanges $2B_1$ and $2B_2$ via exchange 1B being routed on the final route.

2.2.3. The ATT and CCITT Hierarchical Networks

Two types of hierarchical networks exist today, each serving about 50% of the world's telephones. These are the ATT network, generally used in North America, and the CCITT network, typically used in Europe or areas of the world under European influence. Frankly, there is really little difference from the routing viewpoint. Each has five levels or ranks in the hierarchy, although CCITT allows for a sixth level. The basic difference is in the nomenclature used. Figure 2.4 illustrates the ATT hierarchy and Figure 2.5, the CCITT hierarchy [4].

Particularly in Europe, the terminology distinguishes tandem exchanges from transit exchanges. Although both perform the same function, the switching of trunks, a tandem exchange serves the local area, as shown at the bottom of Figure 2.5, and figures in the lowest levels of hierarchy. A transit exchange switches trunks in the toll or long-distance area. Also, in older CCITT documents we should expect to see the term "CT", meaning "central transit" in French, in English the term is simply *transit exchange.*

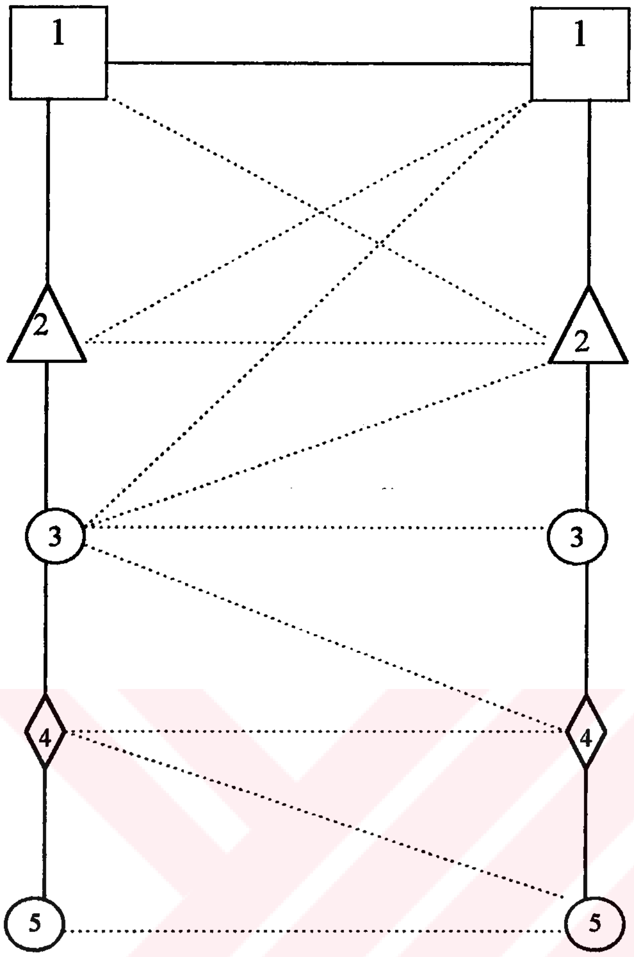


Figure 2.4 The North American (ATT) hierarchical network (dashed lines show high-usage trunks). Note how the two highest ranks are connected in mesh.

Figure 2.4 presents the ATT "routing pattern". The highest order or rank in the hierarchy is the class 1 center and the lowest, a class 5 office. It should be noted that a high-usage (HU) trunk group may be established between any two switching centers regardless of location or rank., whenever the traffic volume justifies it. The table that follows clarifies the comparative nomenclature of the two types of hierarchy, with the highest rank at the top.

Table 2.1 The terms of hierarchy in North America and Europe

	NORTH AMERICAN	CCITT
Class 1	Regional center	Quaternary center
Class 2	Sectional center	Tertiary center
Class 3	Primary center	Secondary center
Class 4	Toll center (toll point)	Primary center
Class 5	End office	Local exchange

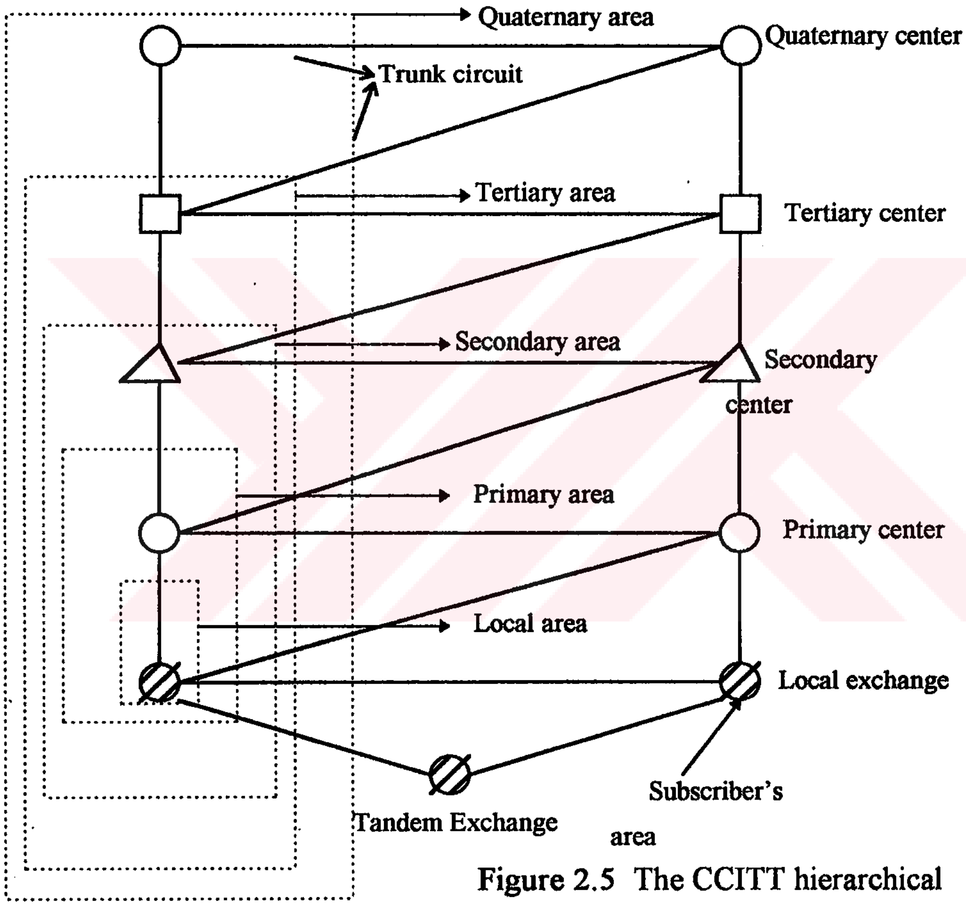


Figure 2.5 The CCITT hierarchical structure

2.2.4 Rules for Conventional Hierarchical Networks

A backbone structure to a hierarchical network is noted in Figures 2.4 and 2.5: from left to right or from right to left, the outside vertical lines connected by the top horizontal line, in either figure, which we refer to as "up, across, and down".

The CCITT terms these routes "theoretical final routes". For our argument, a final route is a route from which no overflow is permitted. A hierarchical network is characterized by a full set of final routes from source to sink. Any other routes are supplementary to the pure hierarchy, regardless of whether overflow is permitted on them.

A hierarchical system of routing leads to simplified switch design. A common expression is that lower-rank exchanges "home" on higher-rank exchanges. If a call is destined for an exchange of lower rank in its chain, the call proceeds down the chain. Likewise, if a call is destined for another exchange outside the chain, it proceeds up to chain. Or when such high-usage routes exist, a call may be routed on a route additional or supplementary to the pure hierarchy, proceeding to the distant transit center and then descending to the destination. Of course, at the highest level in a pure hierarchy the call crosses from one chain over to the other. In hierarchical networks only the order of each switch in the hierarchy and those additional links (high-usage routes) that provide access need to be known. In such networks administration is simplified, and storage or routing information is reduced when compared to the full-mesh type of network, for example.

2.3 Routing Methods

There are generally three methods of routing calls from source to sink through one, several, or many intermediate switching nodes. As we have seen, there may be many possible patterns through which a given call can traverse. The problem is to *decide* how the call should proceed through the many possible path combinations in the network. The three methods are (1) right-through routing, (2) own-exchange routing, and (3) computer-controlled routing (with common-channel signaling). In right-through routing the originating exchange determines the route from source to sink. Alternative routing is not allowed at intermediate switching points. However, the initial outgoing circuit group may be arranged so that one or more alternative routes are presented. Because of its inherent limitations in alternative routing and the requirement that a change in network configuration or the addition of new exchanges entail alteration in each existing complex switch (i.e., switches with translators), right-through routing is limited almost exclusively to the local area [3].

Own-exchange routing allows for changes in routing as the call proceeds to its destination. This routing system is particularly suited to networks with alternative routing and changes in routing patterns in response to changes in load configuration. Another advantage in own-exchange routing is that when new exchanges are added or the network is modified, minimal switch modifications are required in the network. One disadvantage is the possibility of establishing a closed routing loop where a call may be routed such that it is eventually routed back to its originating exchange or other exchange through which it has already been routed in attempting to reach its destination. However, a hierarchical routing system ensures that such loops cannot be generated. If routing loops are established in an operating network, there can be disastrous consequence.

Conventional telephone networks have signaling information for a particular call carried on the same path (pair of wires or their equivalent) that carries the speech, often called the conversation path. Signaling, is the generation and transmission of information that sets up a desired call and routes it through the network to its destination. New and more modern computer-controlled networks often use a separate path to carry the required signaling information. In this case the computer in the originating exchange or originating long-distance exchange can "optimally" route the call through the network on a separate signaling path. The originating computer would have a "map in memory" of the network with updated details of network conditions such as traffic load at the various nodes and trunks and outages. The necessary adaptive information is broadcast on the separate path that connects the various computers in the network. This is computer-controlled routing. Such routing is termed "routing with common-channel signaling" and with adaptive network management signals [2].

CHAPTER THREE

ESSENTIALS OF TRAFFIC ENGINEERING

3.1 Introduction and Terminology

Telephone exchanges are connected by trunks. The number of trunks connecting exchange X with exchange Y are the number of voice pairs or their equivalent used in the connection. One of the most important steps in telecommunication engineering practice is to determine the number of trunks required on a route or connection between exchanges. We could say we are *dimensioning* the route. To dimension a route correctly, we must have some idea of its usage, that is, how many people will wish to talk at once over the route. The usage of a transmission route or a switch brings us into the realm of traffic engineering, and the usage may be defined by two parameters: (1) *calling rate,* or the number of times a route or traffic path is used per unit period; and (2) *holding time,* or the duration of occupancy of a traffic path by a call, or sometimes the average duration of occupancy of one or more paths by calls. A *traffic path* is a channel, time slot, frequency band, line, trunk, switch, or circuit over which individual communications pass in sequence. *Carried traffic* is the volume of traffic actually carried by a switch, and *offered traffic* is the volume of traffic offered to a switch.

Busy hour definitions [5].

1. *Busy Hour:* The busy hour refers to the traffic volume or number of call attempts, and is that continuous 1-hour period lying wholly in the time interval concerned for which this quantity is greatest.

2. *Peak Busy Hour:* The busy hour each day; it usually is not the same over a number of days.

3. *Time Consistent Busy Hour:* The 1-hour period starting at the same time each day for which the average traffic volume or call-attempt count of the exchange or resource group concerned is greatest over the days under consideration.

3.2 What is Traffic Engineering

3.2..1 The Nature of the Traffic Engineering Job

Good traffic engineering can greatly contribute to attaining the objective of providing facilities of the right kind in the right place at the right time and in the right amounts to give high quality telephone services to all customers.

To estimate equipment requirements, the traffic engineers must predict the busy hour usage for each group of facilities in each dial office and for the related trunks at some future date; perhaps two to three years away, when these facilities will be installed and when the growth for which they were provided has been attained. Within an office, traffic is generally split into distinct channels to provide special switching features required by different classes of service and to conform to the specified routing pattern. Each segment of traffic may have its own busy hour, so that engineering data is required for each distinct class, as well as busy hour data for all office equipment used in common. Thus separate load estimated for many different groups in the dial system will be needed. Usually the traffic engineer makes an estimate based upon some knowledge of past usage, and then increases this estimate in proportion to the anticipated growth in telephone service. In the past, such usage data might be termed synthetic since it was calculated from independent measurements of call volumes and holding times.

3.2.2 Call and Holding Time Variation

Obtaining call volumes is one of the simplest means of measuring traffic. It is common practice to designate two days each week for making an hourly count of the calls handled by various portions of the equipment in each office by reading traffic registers connected to the equipment. These records are called "peg-counts", from the early method of keeping a count of calls handled at switchboards.

Equipment usage, however, depends not only on the number of the calls, but also average holding time per call. Holding time studies taken by exchanges measurement methods are therefore, usually too short and infrequent to be correlated with calling rate fluctuations.

Because the traffic load in CCS (in America and Canada)or ERLANG (in Europe) is of major interest in the engineering of dial offices, a logical step was to design a traffic measuring device for gathering usage data directly. Because of this purpose the exchanges have traffic and statistical measurement registers [6][7] [8].

3.2.3 Seasonal Variations

A significant characteristic of telephone traffic is the continual change of its magnitude. Traffic is generated by an assembly of individual subscribers apparently acting independently of each other. In most areas a higher traffic load occurs during one particular season of the year. Generally, for local offices this occurs during the winter months, although this is by no means universal [6][7] [8].

3.2.4 Daily Variations

The load also fluctuates from day to day. For example, in one particular office it might be observed that Mondays are systematically higher than Wednesdays and this phenomenon repeats itself week by week. In most offices Saturdays are lighter then weekdays, and Sunday generally the lightest day of all [6][7] [8].

3.2.5 Hourly Variations

Hourly variations in traffic loads are very pronounced and there is usually a large difference in the distributions for central offices serving a residential area compared with those serving a business area. Fig. 3.1 shows a characteristic residential weekday hourly load curve. From 11 PM to 7 AM the load is negligible; it builds up rapidly from 7 to 9.30 o'clock in the morning at which time a peak is reached. A recession occurred during the middle of the day. This is followed by an evening peak between 8 and 9 PM. A weekday hourly load curve for a typical business office for the same period is also shown in Fig 3.1. The morning peak occurred between 10 and 11. A lesser peak occurs in the afternoon. After 5 PM the load falls off very rapidly [6][7] [8].

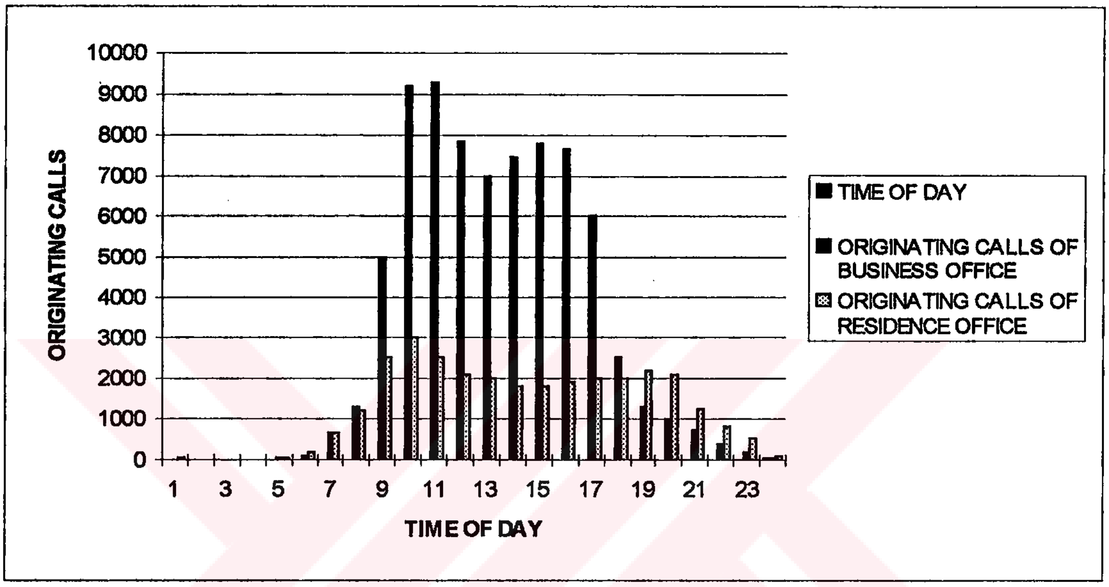


Figure 3.1 Hourly variations in residential and business calls.

The two preceding paragraphs contain examples of variation in traffic for business and residential offices. These are only two of other possible variations that may be noted for the different classes of service. Coin box traffic may peak up at noontime in business areas due to employees making telephone calls during their lunch hours. At airports, the peak may occur at any time, and for ferry, bus terminals, railroads and so forth coin box calls tend to peak up at the time employees are returning home from work. In residential areas coin box calls tend to increase during the evening hours. Therefore, the overall hourly variation in a particular central office depends upon the area being served and the classes of service involved.

3.2.6 "Odd Ball" Days

Perhaps once in several years, an "odd ball" day may be encountered due to a catastrophe, extremely severe weather or some other reason. To provide equipment to handle traffic on such days with normal service would be prohibitive from a cost standpoint. Furthermore, the magnitude and characteristics of such special traffic is often unpredictable. It may be necessary to use overload announcements or line load control under such extreme overload conditions [7] [8].

3.2.7 Sources of Variations in Load

Because of it is possible to maintain a detailed record of each subscribers calling records, it may be possible to know just when and where each call originates and depending on their destinations, which switches they use and for how long. It can be effectively analyzed by methods of mathematical statistics based on the theory of probability.

Randomness of Call Origination Times: The assumption that telephone subscribers originate calls at random during the busy hour and independently of the action of other subscribers is as realistic as can be made concerning telephone traffic. This is why the curve is so jagged, rather than a smooth curve , i.e. calling subscribers are unaware of the instance when other subscribers place their calls [6][7].

Variations in Calling Rates Among Subscribers: A second important source of call fluctuations lies in the fact that some subscribers make greater use of their telephones than others. In general, business subscribers make greater use of their telephones than residence subscribers.

Variations in Holding Times: Although the average length of holding times may vary considerably from office to office, from season to season, or from city to city, a summary of individual local call holding times from almost any locality will exhibit the characteristic shape of Fig. 3.2. Holding times of one to three minutes are relatively frequent, while long holding times of ten minutes or more occur much less often [7].

Variations in Subscriber Line Loads: A subscriber's line load in call seconds is the product of the calling rate in calls per hour and his average holding time in seconds. The variability of each was covered in the preceding two paragraphs. The resulting line loads should be expected to have a correspondingly wide variation.

3.2.8 Subscriber Behavior

Observations taken on the behavior of subscribers upon encountering busy signals indicate that about 90% of the subscribers redial their calls within a short period after encountering a busy signal. Also, if a particular trunk group handling subscriber dial calls encounters a serious shortage of trunks, subscribers with calls destined to that trunk group will encounter an unusual number of all trunks busy signals. These stuations have a bearing on the grade of service because a heavy load is being imposed on senders, markers, and so forth due to repetitious dialing. Moreover, these retrials are no longer random occurrences and as such cause wider traffic fluctuations than would otherwise occur [6][7] [8].

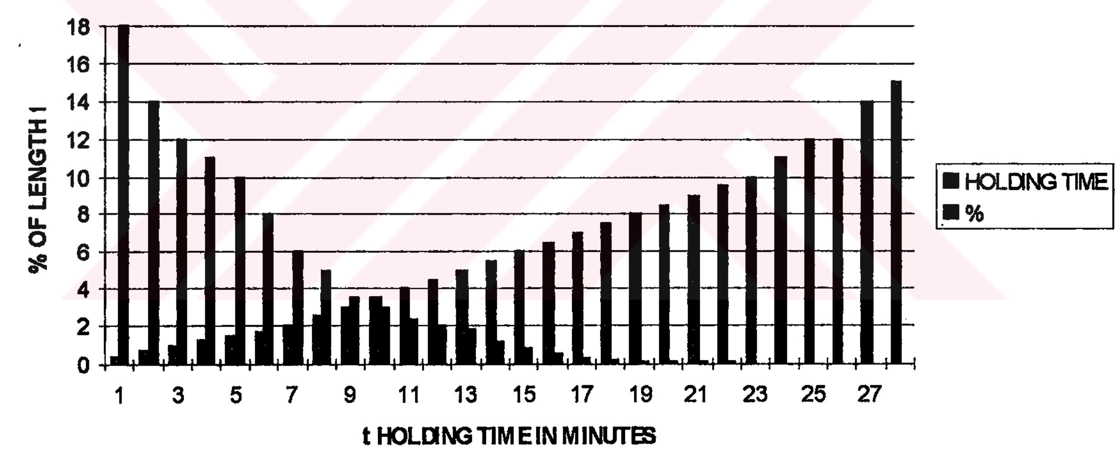


Figure 3.2 Holding time variations in local calls.

Studies show that as many as 25 or 30 per cent of customers dial attempts may for one reason or another result in no dial or partial dial calls. As the load in an office increases, these errors on the part of the subscribers are often observed to increase. Good engineering practice must attempt to take into account all of these factors.

CHAPTER FOUR

MEASUREMENT OF TELEPHONE TRAFFIC

4.1 Introduction

If we define *telephone traffic* as the aggregate of telephone calls over a group of circuits or trunks with regard to the duration of calls as well as their number, we can say that traffic flow (A)

$$A = C \times T \qquad (4.1)$$

where C is the calling rate per hour and T is the average holding time per call. From this formula it would appear that the traffic unit would be call-minutes or call-hours [9][10].

Suppose that the average holding time is 2.5 min. and the calling rate in the busy hour (BH) for a particular day is 237. The traffic flow would then be 237 x 2.5, or 592.5 call-minutes (CM), or about 9.87 call-hours.

The preferred unit of the traffic is the erlang, named after the Danish mathematician A.K. Erlang. The erlang is a dimensionless unit. One erlang of traffic intensity on one traffic circuit means a continuous occupancy of that circuit. Considering a group of circuits, traffic intensity in erlangs is the number of call-seconds per second or the number of call-hours per hour. If we knew that a group of 10 circuits had a call intensity of 5 erlangs, we would expect half of the circuits to be busy at the time of measurement.

Other traffic units are not dimensionless. For instance: *call-hour (CH)*, 1 CH is the quantity represented by one or more calls having an aggregate duration of 1 h; *call-second*

(CS), 1 CS is the quantity represented by one or more calls having an aggregate duration of 1 s; *"cent" call-second (CCS),* 1 CCS is the quantity represented by one 100-s call or by an aggregate of 100 CS of traffic; and the *equated busy hour call (EBHC)* is a European unit of traffic intensity (1 EBHC is the average intensity in one or more traffic paths occupied in the BH by one 2-min. call or for an aggregate duration of 2 min.) Thus we can relate our terms as follows:

$$1 \text{ erlang} = 30 \text{ EBHC} = 36 \text{ CCS} = 60 \text{ CM} \qquad (4.2)$$

assuming a 1-h time-unit interval.

4.2 Congestion, Lost Calls, and Grade of Service

Assume that an isolated telephone exchange serves 5000 subscribers and that no more than 10% of subscribers wish service simultaneously. Therefore, the exchange is dimensioned with sufficient equipment to complete 500 simultaneous connections. Each connection would be, of course, between any two of the 5000 subscribers. Now let subscriber 501 attempt to originate a call. He cannot because all the connecting equipment is busy, even though the line he wishes to reach may be idle. This call from subscriber 501 is termed a *lost call* or *blocked call.* He has met congestion. The probability of meeting congestion is an important parameter in traffic engineering of telecommunication systems. If congestion conditions are to be met in a telephone system, we can expect that those conditions will usually be met during the BH. A switch is engineered (dimensioned) to handle the BH load. But how well? We could, indeed, far overdimension the switch such that it could handle any sort of traffic peaks. However, that is uneconomical. So with a well-designed switch, during the busiest of BHs we may expect some moment of congestion such that additional call attempts will meet blockage. *Grade of service* expresses the probability of meeting congestion during the BH and is expressed by the letter p. A typical grade of service is $p = 0.01$. This means that an average of one call in 100 will be blocked or "lost" during the BH. Grade of service, a term in the Erlang formula, is more accurately defined as the *probability of congestion.* It is important to remember that lost calls (blocked calls) refer to calls that fail at *first* trial [10].

We exemplify grade of service by the following problem. If we know that there are 354 seizures (lines connected for service) and 6 blocked calls (lost calls) during the BH, what is the grade of service?

Call congestion = (Number of lost calls) / (Total number of offered calls)

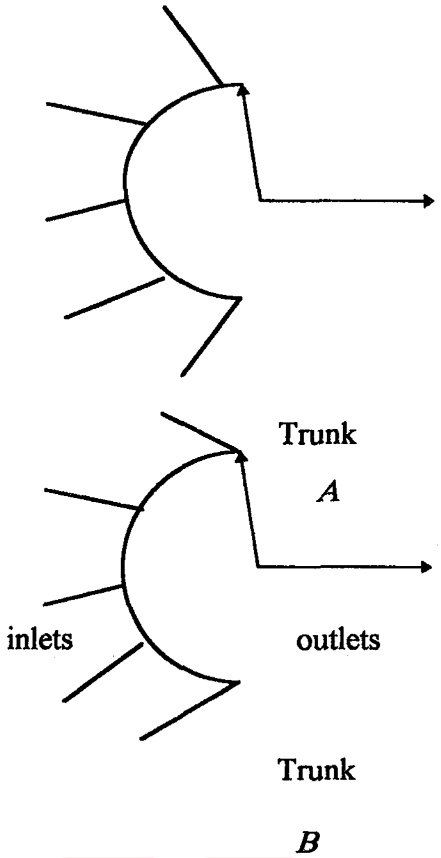
$$= 6/(354+6) = 6/360 = 0.017 = p$$

The average grade of service for a network may be obtained by adding the grade of service contributed by each constituent switch, switching network, or trunk group. The grade of service provided by a particular group of trunks or circuits of specified size and carrying a specified traffic intensity is the probability that a call offered to the group will find available trunks already occupied on first attempt. That probability depends on a number of factors, the most important of which are (1) the distribution in time and duration of offered traffic (e.g., random or periodic arrival and constant or exponentially distributed holding time), (2) the number of traffic sources (limited or infinite), (3) the availability of trunks in a group to traffic sources (full or restricted availability), and (4) the manner in which lost calls are "handled" [6][11] [12].

4.3 Availability

Switches were previously discussed as devices with lines and trunks, but better terms for describing a switch are "inlets" and "outlets." When a switch has full availability, each inlet has access to any outlet. When not all the free outlets in a switching system can be reached by inlets, the switching system is referred to as one with "limited availability." Examples of switches with limited and full availability are shown in Figures 4.1 and 4.2.

Of course, full availability switching is more desirable than limited availability but is more expensive for larger switches. Thus full availability switching is generally found only in small switching configurations and in many digital switches . *Grading* is one method of improving the traffic-handling capacities of switching configurations with limited availability [6]. Grading is a scheme for interconnecting switching subgroups to make the switching load more uniform.



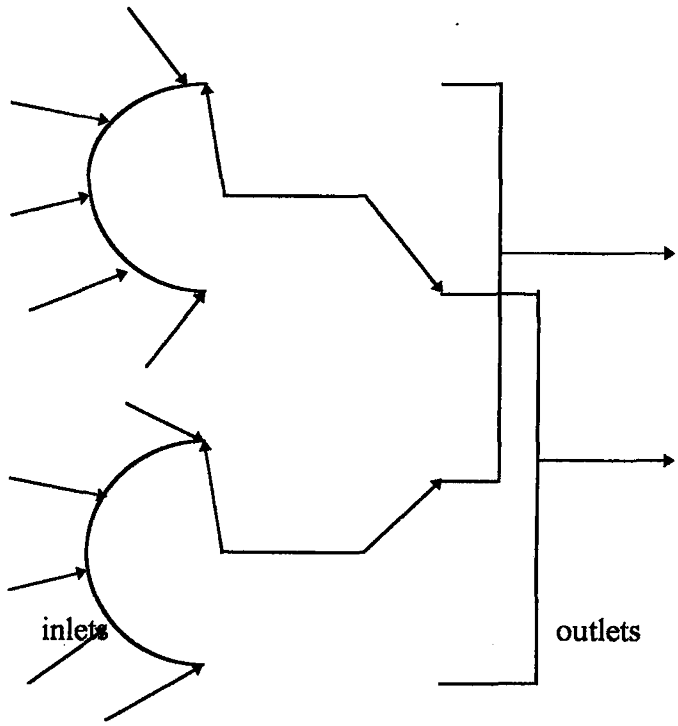


Figure 4.1 An example of a switch with limited availability

Figure 4.2 An example of a switch with full availability

4.4 Handling of Lost Calls

In conventional telephone traffic theory three methods are considered for the handling or dispensing of lost calls: (1) lost calls held (LCH), (2) lost calls cleared (LCC), and (3) lost calls delayed (LCD). The LCH concept assumes that the telephone user will immediately reattempt the call on receipt of a congestion signal and will continue to redial. The user hopes to seize connection equipment or a trunk as soon as switching equipment becomes available for the call to be handled. It is the assumption in the LCH concept that lost calls are held or waiting at the user's telephone. This concept further assumes that such lost calls extend the average holding time theoretically, and in this case the average holding time is zero, and all time is waiting time.

The LCC concept, which is used primarily in Europe or those countries accepting European practice, assumes that the user will hang up and wait some time interval before reattempting if the user hears the congestion signal on the first attempt. Such calls, it is assumed, disappear from the system. A reattempt (after the delay) is considered as initiating a new call. The Erlang formula is based on this criterion.

The LCD concept assumes that the user is automatically put in queue (a waiting line or pool). For example, this is done on computer-controlled switching systems, generally referred to under the blanket term *stored program control* (SPC). The LCD category may be broken down into three subcategorizes, depending on how the queue or pool of waiting calls is handled. The waiting calls may be handled last in first out , first in line first served, or at random [6].

4.5 Infinite and Finite Traffic Sources

We can assume that traffic sources are infinite or finite. For the infinite traffic-sources case the probability of call arrival is constant and does not depend on the state of occupancy of the system. It also implies an infinite number of call arrivals, each with an infinitely small holding time. An example of finite traffic sources is when the number of sources offering traffic to a group of trunks or circuits is comparatively small in comparison to the number of circuits. We can also say that with a finite number of sources the arrival rate is proportional to the number of sources that are not already engaged in sending a call [6][7].

4.6 Probability-Distribution Curves

Telephone-call originations in any particular area are random in nature. We find that originating calls or call arrivals at an exchange closely fit a family of probability-distribution curves following a Poisson distribution. The Poisson distribution is fundamental to traffic theory.

Most of the common probability distribution curves are two-parameter curves; that is, they may be described by two parameters, mean and variance. The mean is a point on the probability-distribution curve where an equal number of events occur to the right of the point as to the left of the point. "Mean" is synonymous with "average." We define mean as the *x*-coordinate of the center of the area under the probability-density curve for the population. μ is the traditional indication of the mean; $\bar{x}$ is also used.

The second parameter used to describe a distribution curve is the dispersion, which tells us how the values or population are dispersed about the center mean of the curve. There are several measures of dispersion [3][6][7]. One is the familiar *standard deviation*, where "the standard deviation *s* of a sample of *n* observations $x_1, x_2, x_3, \ldots\ldots, x_n$ *is*

$$s = \sqrt{\left(\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2\right)} \qquad (4.3)$$

The *variance V* of the sample values is the square of *s*. The parameters for dispersion *s* and s^2, the standard deviation and variance, respectively, are usually denoted σ and σ^2 and give us an idea of the squatness of a distribution curve. Mean and standard deviation of a normal distribution curve are shown in Figure 4.3, where we can see that σ^2 is another measure of dispersion, the variance, or essentially the average of the squares of the distances from mean aside the factor $n / (n - 1)$.

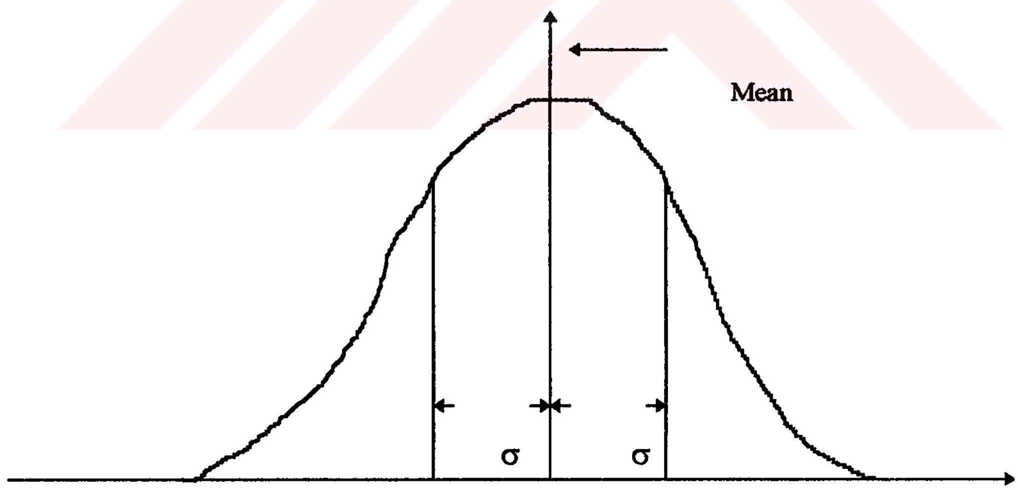


Figure 4.3 A normal distribution curve showing the mean and the standard deviation

We have introduced two distribution functions describing the probability of distribution, often called the *distribution* of or just *f(x)*. Both functions are used in traffic engineering.

But before proceeding, the variance-to-mean ratio (VMR) must also be introduced. Sometimes VMR is called the *coefficient of overdispersion.* The formula for VMR is

$$\alpha = \sigma^2 / \mu \qquad (4.4)$$

4.7 Smooth, Rough, and Random Traffic

Traffic probability distributions can be divided into three distinct categories: (1) smooth, (2) rough, and (3) random. Each may be defined by α, the VMR. For smooth traffic, α is less than 1. When α is equal to 1, the traffic distribution is called *random.* The Poisson distribution function is an example of random traffic where the VMR = 1. Rough traffic tends to be peakier than random or smooth traffic. For a given grade of service more circuits are required for rough traffic because of the greater spread of the distribution curve (greater dispersion) [3].

Smooth traffic behaves like random traffic that has been filtered. The filter is the local exchange. The local exchange looking out at its subscribers sees call arrivals as random traffic, assuming that the exchange has not been overdimensioned. The smooth traffic is the traffic on the local exchange outlets. The filtering or limiting of the peakiness is done by call blockage during the BH. Of course, the blocked traffic may actually overflow to alternative routes. Smooth traffic is characterized by a positive binomial distribution function, perhaps better known to traffic people as the *Bernoulli distribution.* An example of the Bernoulli distribution is as follows [6]. If we assume subscribers make calls independently of each other and that each has a probability p of being engaged in conversation, then if n subscribers are examined, the probability that x of them will be engaged is

$$B(x) = C_x^n p^x (1-p)^{n-x} \qquad (4.5)$$

$$\text{Its mean} = np \qquad (4.6)$$

$$\text{Its variance} = np(1-p) \qquad (4.7)$$

where the symbol C_x^n mean the number of ways that x entities can be taken at a time. Smooth traffic is assumed in dealing with small groups of subscribers. And as mentioned, smooth traffic is also used with carried traffic. In this case the rough or random traffic would be the offered traffic.

Let's consider the binomial distribution for rough traffic. This is characterized by a negative index. Therefore, if the distribution parameters are k and q, where k is a positive number representing a hypothetical number of traffic sources and q represents the occupancy per source and may vary between 0 and 1, then

$$R'(x,k,q) = \binom{X+K-1}{K-1} q^x (1-q)^k \tag{4.8}$$

where R' is the probability of finding x calls in progress for the parameters k and q [3]. Rough traffic is used in dimensioning toll trunks with alternative routing. The symbol B (Bernoulli) is used by traffic engineers for smooth traffic and R for rough traffic. Although P may designate probability, in traffic engineering it designates Poissonian, and hence we have "P"tables.

The Bernoulli formula is

$$B'(x,s,h) = C_s^x h^x (1-h)^{s-x} \tag{4.9}$$

where C_s^x indicates the number of combinations of s things taken x at a time, h is the probability of finding the first line busy of an exchange, $1-h$ is the probability of finding the first line idle, and s the number of subscribers. The probability of finding two line busy is h^2, the probability of finding s lines busy is h^s, and so on. We are interested in finding the probability of x of the s subscribers with busy lines.

The Poisson probability function can be derived from the binomial distribution, assuming that the number of subscribers s is very large and the calling rate per line h is low (for example, less than 50 milierlangs) such that the product $sh = m$ remains constant and letting s increase to infinity in the limit

$$P(x) = \frac{m^x}{x!} e^{-m} \tag{4.10}$$

$$x = 0,1,2,....$$

For most of our future discussion, we consider call-holding times to have a negative exponential distribution in the form

$$P = e^{-t/h} \tag{4.11}$$

where t/h is the average holding time and in this case P is the probability of a call lasting longer than t, some arbitrary time interval.

4.8 Erlang and Poisson Traffic Formulas

When dimensioning a route, we want to find the number of circuits that serve the route. There are several formulas at our disposal to determine that number of circuits based on the BH traffic load. In Section 4.2 four factors were discussed that will help us to determine which traffic formula to use given a particular set of circumstances. These factors primarily dealt with (1) call arrivals and holding-time distribution, (2) number of traffic sources, (3) availability, and (4) handling of lost calls [6][7].

The Erlang B loss formula is probably the most common one used today outside the United States. Loss here means the probability of blockage at the switch due to congestion or to "all trunks busy" (ATB). This is expressed as grade of service E_B or the probability of finding x channels busy. The other two factors in the Erlang B formula are the mean of the *offered* traffic and the number of trunks or servicing channels available. Thus

$$E_B = \frac{A^n / n!}{1 + A - A^2/2! + ...+ A^n/n!} \tag{4.12}$$

where n is the number of trunks or servicing channels. A is the mean of the offered traffic, and E_B is the grade of service using the Erlang B formula. This formula assumes that

- Traffic originates from an infinite number of sources.
- Lost calls are cleared assuming a zero holding time.
- The number of trunks or servicing channels are limited.
- Full availability exists.

At this point in our discussion of traffic, it must be learned to differentiate between time congestion and call congestion when dealing with grade of service [6][13]. *Time congestion,* of course, refers to the decimal fraction of an hour during which all trunks are busy simultaneously. *Call congestion,* on the other hand, refers to the number of calls that fail at first attempt, which we term *lost calls.* Keep in mind that the Erlang B formula deals with offered traffic, which differs from carried traffic by the number of lost calls.

Table 4.1 is based on the Erlang B formula and gives trunk-dimensioning information for some specific grades of service, from 0.001 to 0.05 and from 1 to 150 trunks. Table 4.1 uses traffic-intensity units UC (unit call) and TU (traffic unit), where TU is in erlangs assuming BH and UC is in ccs (100 call-seconds); 1 erlang = 36 ccs (based on a 1-h time interval). To exemplify the use of Table 4.1, suppose that a route carried 16.68 erlangs of traffic with a desired grade of service of 0.001; then 30 trunks would be required. If the grade of service were reduced to 0.05, the 30 trunks could carry 24.80 erlangs of traffic. When sizing a route for trunks or an exchange, we often come up with a fractional number of servicing channels or trunks. In this case we would opt for the next highest integer because we can not install a fraction of a trunk. For instance, if calculations show that a trunk route should have 31.4 trunks, it would be designed for 32 trunks.

The Erlang B formula, based on lost calls cleared, has been standardized by the CCITT [14] and has been generally accepted outside the United Stated. In the United States the Poisson formula [3] is favored. This formula often called the *Molina formula.* It is based on the LCH concept. Table 4..2 provides trunking sizes for various grades of service deriving from the *P* formula; such tables are sometimes called "*P*' tables, (Poisson) and assume full availability. We must remember that the Poisson equation also assumes that traffic originates

Table 4.1 Erlang Table, Loading Capacity, Full Availability

	Grade of Service 1 in 1000		Grade of Service 1 in 500		Grade of Service 1 in 200		Grade of Service 1 in 100		Grade of Service 1 in 50		Grade of Service 1 in 20	
	UC	TU	UC	TU	UC	TU	UC	TU	UC	TU	UC	TU
1	0.04	0.001	0.07	0.002	0.2	0.005	0.4	0.01	0.7	0.02	1.8	0.05
2	1.8	0.05	2.5	0.07	4	0.11	5.4	0.15	7.9	0.22	14	0.38
3	6.8	0.19	9	0.25	13	0.35	17	0.46	22	0.60	32	0.90
4	16	0.44	19	0.53	25	0.70	31	0.87	39	1.09	55	1.52
5	27	0.76	32	0.90	41	1.13	49	1.36	60	1.66	80	2.22
6	41	1.15	48	1.33	58	1.62	69	1.91	82	2.28	107	2.96
7	57	1.58	65	1.80	78	2.16	90	2.50	106	2.94	135	3.74
8	74	2.05	83	2.31	98	2.73	113	3.13	131	3.63	163	4.54
9	92	2.56	103	2.85	120	3.33	136	3.78	156	4.34	193	5.37
10	111	3.09	123	3.43	143	3.96	161	4.46	183	5.08	224	6.22
11	131	3.65	145	4.02	166	4.61	186	5.16	210	5.84	255	7.08
12	152	4.23	167	4.64	190	5.28	212	5.88	238	6.62	286	7.95
13	174	4.83	190	5.27	215	5.96	238	6.61	267	7.41	318	8.83
14	196	5.45	213	5.92	240	6.66	265	7.35	295	8.20	350	9.73
15	219	6.08	237	6.58	266	7.38	292	8.11	324	9.01	383	10.63
16	242	6.72	261	7.26	292	8.10	319	8.87	354	9.83	415	11.54
17	266	7.38	286	7.95	318	8.83	347	9.65	384	10.66	449	12.46
18	290	8.05	311	8.64	345	9.58	376	10.44	414	11.49	482	13.38
19	314	8.72	337	9.35	372	10.33	404	11.23	444	12.33	515	14.31
20	339	9.41	363	10.07	399	11.09	433	12.03	474	13.18	549	15.25
21	364	10.11	388	10.79	427	11.86	462	12.84	505	14.04	583	16.19
22	389	10.81	415	11.53	455	12.63	491	13.65	536	14.90	617	17.13
23	415	11.52	442	12.27	483	13.42	521	14.47	567	154.76	651	18.08
24	441	12.24	468	13.01	511	14.20	550	15.29	599	16.63	685	19.03
25	467	12.97	495	13.76	540	15.00	580	16.12	630	17.50	720	19.99
26	493	13.70	523	14.52	569	15.80	611	16.96	662	18.38	754	20.94
27	520	14.44	550	15.28	598	16.60	641	17.80	693	19.26	788	21.90
28	546	15.18	578	16.05	627	17.41	671	18.64	726	20.18	823	22.87
29	573	15.93	606	16.83	656	18.22	702	19.49	757	21.04	858	23.83
30	600	16.68	634	17.61	685	19.03	732	20.34	789	21.93	893	24.80
31	628	17.44	662	18.39	715	19.85	763	21.19	822	22.83	928	25.77
32	655	18.20	690	19.18	744	20.68	794	22.05	854	23.73	963	26.75
33	683	18.97	719	19.97	774	21.51	825	22.91	887	24.63	998	27.72
34	711	19.74	747	20.76	804	22.34	856	23.77	919	25.53	1033	28.70
35	739	20.52	776	21.56	834	23.17	887	24.64	951	26.43	1068	29.68
36	767	21.30	805	22.36	864	24.01	918	25.51	984	27.34	1104	30.66
37	795	22.03	834	23.17	895	24.85	950	26.38	1017	28.25	1139	31.64
38	823	22.86	863	23.97	925	25.69	981	27.25	1050	29.17	1175	32.63
39	851	23.65	892	24.78	955	26.53	1013	28.13	1083	30.08	1210	33.61
40	880	24.44	922	25.60	986	27.38	1044	29.01	1116	31.00	1246	34.60
41	909	25.24	951	26.42	1016	28.23	1076	29.89	1149	31.92	1281	35.59
42	937	26.04	981	27.24	1047	29.08	1108	30.77	1182	32.84	1317	36.58
43	966	26.84	1010	28.06	1078	29.94	1140	31.66	1215	33.76	1353	37.57
44	995	27.64	1040	28.88	1109	30.80	1171	32.54	1248	34.68	1388	38.56
45	1024	28.45	1070	29.71	1140	31.66	1203	33.43	1282	35.61	1424	39.55
46	1053	29.26	1099	30.54	1171	32.52	1236	34.32	1315	36.53	1459	40.54
47	1083	30.07	1129	31.37	1202	33.38	1268	35.21	1349	37.46	1495	41.54
48	1111	30.88	1159	32.20	1233	34.25	1300	36.11	1382	38.39	1531	42.54
49	1141	31.69	1189	33.04	1264	35.11	1332	37.00	1415	39.32	1567	43.54
50	1170	32.51	1220	33.88	1296	35.98	1364	37.90	1449	40.25	1603	44.53
51	1200	33.33	1250	34.72	1327	36.85	1397	38.80				
52	1229	34.15	1280	35.56	1358	37.72	1429	39.70				
53	1259	34.98	1310	36.40	1390	38.60	1462	40.60				
54	1289	35.80	1341	37.25	1421	39.47	1494	41.50				

Table 4.1 Erlang Table, Loading Capacity, Full Availability (Continued)

	Grade of Service 1 in 1000		Grade of Service 1 in 500		Grade of Service 1 in 200		Grade of Service 1 in 100	
	UC	TU	UC	TU	UC	TU	UC	TU
55	1319	36.63	1371	38.09	1453	40.35	1527	42.41
56	1349	37.46	1402	38.94	1484	41.23	1559	43.31
57	1378	38.29	1432	39.79	1516	42.11	1592	44.22
58	1408	39.12	1463	40.64	1548	42.99	1625	45.13
59	1439	39.96	1494	41.50	1579	43.87	1657	46.04
60	1468	40.79	1525	42.35	1611	44.76	1690	46.95
61	1499	41.63	1556	43.21	1643	45.64	1723	47.86
62	1529	42.47	1587	44.07	1675	46.53	1756	48.77
63	1559	43.31	1617	44.93	1707	47.42	1789	49.69
64	1590	44.16	1648	45.79	1739	48.31	1822	50.60
65	1620	45.00	1679	46.65	1771	49.20	1855	51.52
66	1650	45.84	1710	47.51	1803	50.09	1888	52.44
67	1681	46.69	1742	48.38	1835	50.98	1921	53.35
68	1711	47.54	1773	49.24	1867	51.87	1954	54.27
69	1742	48.39	1804	50.11	1900	52.77	1987	55.19
70	1773	49.24	1835	50.98	1932	53.66	2020	56.11
71	1803	50.09	1867	51.85	1964	54.56	2053	57.03
72	1834	50.94	1898	52.72	1996	55.45	2087	57.96
73	1865	51.80	1929	53.59	2029	56.35	2120	58.88
74	1895	52.65	1960	54.46	2061	57.25	2153	59.80
75	1926	53.51	1992	55.34	2093	58.15	2186	60.73
76	1957	54.37	2024	56.21	2126	59.05	2219	61.65
77	1988	55.23	2055	57.09	2159	59.96	2253	62.58
78	2019	56.09	2087	57.96	2191	60.86	2286	63.51
79	2050	56.95	2118	58.84	2223	61.76	2319	64.43
80	2081	57.81	2150	59.72	2256	62.67	2353	65.36
81	2112	58.67	2182	60.60	2289	63.57	2386	66.29
82	2143	59.54	2213	61.48	2321	64.48	2420	67.22
83	2174	60.40	2245	62.36	2354	65.38	2453	68.15
84	2206	61.27	2277	63.24	2386	66.29	2487	69.08
85	2237	62.14	2308	64.13	2419	67.20	2521	70.02
86	2268	63.00	2340	65.01	2452	68.11	2554	70.95
87	2299	63.87	2372	65.90	2485	69.02	2588	71.88
88	2330	64.74	2404	66.78	2517	69.93	2621	72.81
89	2362	65.61	2436	67.67	2550	70.84	2655	73.75
90	2393	66.48	2468	68.56	2583	71.76	2688	74.68
91	2425	67.36	2500	69.44	2616	72.67	2722	75.62
92	2456	68.23	2532	70.33	2650	73.58	2756	76.56
93	2488	69.10	2564	71.22	2682	74.49	2790	77.49
94	2519	69.98	2596	72.11	2715	75.41	2823	78.43
95	2551	70.85	2628	73.00	2748	76.32	2857	79.37
96	2582	71.73	2660	73.90	2781	77.24	2891	80.31
97	2614	72.61	2692	74.79	2814	78.16	2925	81.24
98	2645	73.48	2724	75.68	2847	79.07	2958	82.18
99	2677	74.36	2757	76.57	2880	79.99	2992	83.12
100	2709	75.24	2789	77.47	2913	80.91	3026	84.06
101	2740	76.12	2821	78.36	2946	81.83	3060	85.00
102	2772	77.00	2853	79.26	2979	82.75	3094	85.95
103	2804	77.88	2886	80.16	3012	83.67	3128	86.89
104	2836	78.77	2918	81.05	3045	84.59	3162	87.83
105	2867	79.65	2950	81.95	3078	85.51	3196	88.77
106	2899	80.53	2983	82.85	3111	86.43	3230	89.72
107	2931	81.42	3015	83.75	3145	87.35	3264	90.66
108	2963	82.30	3047	84.65	3178	88.27	3298	91.60
109	2995	83.19	3080	85.55	3211	89.20	3332	92.55
110	3027	84.07	3112	86.45	3244	90.12	3366	93.49
111	3059	84.96	3145	87.35	3277	91.04	3400	94.44
112	3091	85.85	3177	88.25	3311	91.97	3434	95.38

Table 4.1 Erlang Table, Loading Capacity, Full Availability (Continued)

	Grade of Service 1 in 1000		Grade of Service 1 in 500		Grade of Service 1 in 200		Grade of Service 1 in 100	
	UC	TU	UC	TU	UC	TU	UC	TU
113	3122	86.73	3209	89.15	3344	92.89	3468	96.33
114	3154	87.62	3242	90.06	3378	93.82	3502	97.28
115	3186	88.51	3275	90.96	3411	94.74	3536	98.22
116	3218	89.40	3307	91.86	3444	95.67	3570	99.17
117	3250	90.29	3340	92.77	3478	96.60	3604	100.12
118	3282	91.18	3372	93.67	3511	97.53	3639	101.07
119	3315	92.07	3405	94.58	3544	98.45	3673	102.02
120	3347	92.96	3437	95.48	3578	99.38	3707	102.96
121	3379	93.86	3470	96.39	3611	100.31	3741	103.91
122	3411	94.75	3503	97.30	3645	101.24	3775	104.86
123	3443	95.64	3535	98.20	3678	102.17	3809	105.81
124	3475	96.54	3568	99.11	3712	103.10	3843	106.76
125	3507	97.43	3601	100.02	3745	104.03	3878	107.71
126	3540	98.33	3633	100.93	3779	104.96	3912	108.66
127	3572	99.22	3666	101.84	3812	105.89	3946	109.62
128	3604	100.12	3699	102.75	3846	106.82	3981	110.57
129	3636	101.01	3732	103.66	3879	107.75	4015	111.52
130	3669	101.91	3765	104.57	3912	108.68	4049	112.47
131	3701	102.81	3797	105.48	3946	109.62	4083	113.42
132	3733	103.70	3830	106.39	3980	110.55	4118	114.38
133	3766	104.60	3863	107.30	4013	111.48	4152	115.33
134	3798	105.50	3896	108.22	4047	112.42	4186	116.28
135	3830	106.40	3929	109.13	4081	113.35	4221	117.24
136	3863	107.30	3961	110.04	4114	114.28	4255	118.19
137	3895	108.20	3994	110.95	4148	115.22	4289	119.14
138	3928	109.10	4027	111.87	4181	116.15	4324	120.10
139	3960	110.00	4060	112.78	4215	117.09	4358	121.05
140	3992	110.90	4093	113.70	4249	118.02	4392	122.01
141	4025	111.81	4126	114.61	4283	118.96	4427	122.96
142	4058	112.71	4159	115.53	4316	119.90	4461	123.92
143	4090	113.61	4192	116.44	4350	120.83	4496	124.88
144	4122	114.51	4225	117.36	4384	121.77	4530	125.83
145	4155	115.42	4258	118.28	4418	122.71	4564	126.79
146	4188	116.32	4291	119.19	4451	123.64	4599	127.74
147	4220	117.22	4324	120.11	4485	124.58	4633	128.70
148	4253	118.13	4357	121.03	4519	125.52	4668	129.66
149	4285	119.03	4390	121.95	4552	126.46	4702	130.62
150	4318	119.94	4423	122.86	4586	127.40	4737	131.58

Source: Courtesy of GTE Automatic Electric Company (Bulletin No. 485)

Table 4.2 Poisson Table, Loading Capacity, Full Availability

	Grade of Service 1 in 1000		Grade of Service 1 in 100		Grade of Service 1 in 50		Grade of Service 1 in 20		Grade of Service 1 in 10	
	UC	TU	UC	TU	UC	TU	UC	TU	UC	TU
1	0.1	0.003	0.4	0.01	0.7	0.02	1.9	0.05	3.8	0.10
2	1.6	0.05	5.4	0.15	7.9	0.20	12.9	0.35	19.1	0.55
3	6.9	0.20	16	0.45	20	0.55	29.4	0.80	39.6	1.10
4	15	0.40	30	0.85	37	1.05	49	1.35	63	1.75
5	27	0.75	46	1.30	56	1.55	71	1.95	88	2.45
6	40	1.10	64	1.80	76	2.10	94	2.60	113	3.15
7	55	1.55	84	2.35	97	2.70	118	3.25	140	3.90
8	71	1.95	105	2.90	119	3.30	143	3.95	168	4.65
9	88	2.45	126	3.50	142	3.95	169	4.70	195	5.40
10	107	2.95	149	4.15	166	4.60	195	5.40	224	6.20
11	126	3.50	172	4.80	191	5.30	222	6.15	253	7.05
12	145	4.05	195	5.40	216	6.00	249	6.90	282	7.85
13	166	4.60	220	6.10	241	6.70	277	7.70	311	8.65
14	187	5.20	244	6.80	267	7.40	305	8.45	341	9.45
15	208	5.80	269	7.45	293	8.15	333	9.25	370	10.30
16	231	6.40	294	8.15	320	8.90	362	10.05	401	11.15
17	253	7.05	320	8.90	347	9.65	390	10.85	431	11.95
18	276	7.65	346	9.60	374	10.40	419	11.65	462	12.85
19	299	8.30	373	10.35	401	11.15	448	12.45	492	13.65
20	323	8.95	399	11.10	429	11.90	477	13.25	523	14.55
21	346	9.60	426	11.85	458	12.70	507	14.10	554	15.40
22	370	10.30	453	12.60	486	13.50	536	14.90	585	16.25
23	395	10.95	480	13.35	514	14.30	566	15.70	616	17.10
24	419	11.65	507	14.10	542	15.05	596	16.55	647	17.95
25	444	12.35	535	14.85	572	15.90	626	17.40	678	18.85
26	469	13.05	562	15.60	599	16.65	656	18.20	710	19.70
27	495	13.75	590	16.40	627	17.40	686	19.05	741	20.60
28	520	14.45	618	17.15	656	18.20	717	19.90	773	21.45
29	545	15.15	647	17.95	685	19.05	747	20.75	805	22.35
30	571	15.85	675	18.75	715	19.85	778	21.60	836	23.20
31	597	16.60	703	19.55	744	20.65	809	22.45	868	24.10
32	624	17.35	732	20.35	773	21.45	840	23.35	900	25.00
33	650	18.05	760	21.10	803	22.30	871	24.20	932	25.90
34	676	18.80	789	21.90	832	23.10	902	25.05	964	26.80
35	703	19.55	818	22.70	862	23.95	933	25.90	996	27.65
36	729	20.25	847	23.55	892	24.80	964	26.80	1028	28.55
37	756	21.00	876	24.35	922	25.60	995	27.65	1060	29.45
38	783	21.75	905	25.15	951	26.40	1026	28.50	1092	30.35
39	810	22.50	935	25.95	982	27.30	1057	29.35	1125	31.25
40	837	23.25	964	26.80	1012	28.10	1088	30.20	1157	32.14
41	865	24.05	993	27.60	1042	28.95	1120	31.10	1190	33.05
42	892	24.80	1023	28.40	1072	29.80	1151	31.95	1222	33.95
43	919	25.55	1052	29.20	1103	30.65	1183	32.85	1255	34.85
44	947	26.30	1082	30.05	1133	31.45	1214	33.70	1287	35.75
45	975	27.10	1112	30.90	1164	32.35	1246	34.60	1320	36.65
46	1003	27.85	1142	31.70	1194	33.15	1277	35.45	1352	37.55
47	1030	28.60	1171	32.55	1225	34.05	1309	36.35	1385	38.45
48	1058	29.40	1201	33.35	1255	34.85	1340	37.20	1417	39.35
49	1086	30.15	1231	34.20	1286	35.70	1372	38.10	1450	40.30
50	1115	30.95	1261	35.05	1317	36.60	1403	38.95	1482	41.15

Table 4.2 Poisson Table, Loading Capacity, Full Availability (Continued)

	Grade of Service 1 in 1000		Grade of Service 1 in 100		Grade of Service 1 in 50	
Trunks	UC	TU	UC	TU	UC	TU
51	1143	31.75	1291	35.85	1349	37.45
52	1171	32.55	1322	36.70	1380	38.35
53	1200	33.35	1352	37.55	1410	39.15
54	1228	34.10	1382	38.40	1441	40.05
55	1256	34.90	1412	39.20	1472	40.90
56	1285	35.70	1443	40.10	1503	41.75
57	1313	36.45	1473	40.90	1534	42.60
58	1342	37.30	1504	41.80	1565	43.45
59	1371	38.10	1534	42.60	1596	44.35
60	1400	38.90	1565	43.45	1627	45.20
61	1428	39.65	1595	44.30	1659	46.10
62	1457	40.45	1626	45.15	1690	46.95
63	1486	41.30	1657	46.05	1722	47.85
64	1516	42.10	1687	46.85	1752	48.65
65	1544	42.90	1718	47.70	1784	49.55
66	1574	43.70	1749	48.60	1816	50.45
67	1603	44.55	1780	49.45	1847	51.30
68	1632	45.35	1811	50.30	1878	52.15
69	1661	46.15	1842	51.15	1910	53.05
70	1691	46.95	1873	52.05	1941	53.90
71	1720	47.80	1904	52.90	1973	54.80
72	1750	48.60	1935	53.75	2004	55.65
73	1779	49.40	1966	54.60	2036	56.55
74	1809	50.25	1997	55.45	2067	57.40
75	1838	51.05	2028	56.35	2099	58.30
76	1868	51.90	2059	57.20	2130	59.15
77	1898	52.70	2091	58.10	2162	60.05
78	1927	53.55	2122	58.95	2194	60.95
79	1957	54.35	2153	59.80	2226	61.85
80	1986	55.15	2184	60.65	2258	62.70
81	2016	56.00	2215	61.55	2290	63.60
82	2046	56.85	2247	62.40	2321	64.45
83	2076	57.65	2278	63.30	2354	65.40
84	2106	58.50	2310	64.15	2386	66.30
85	2136	59.35	2341	65.05	2418	67.15
86	2166	60.15	2373	65.90	2451	68.10
87	2196	61.00	2404	66.80	2483	68.95
88	2226	61.85	2436	67.65	2515	69.85
89	2256	62.65	2467	68.55	2547	70.75
90	2286	63.50	2499	69.40	2579	71.65
91	2317	64.35	2530	70.30	2611	72.55
92	2346	65.15	2562	71.15	2643	73.40
93	2377	66.05	2594	72.05	2674	74.30
94	2407	66.85	2625	72.90	2706	75.15
95	2437	67.70	2657	73.80	2739	76.10
96	2468	68.55	2689	74.70	2771	76.95
97	2498	69.40	2721	75.60	2803	77.85
98	2528	70.20	2752	76.45	28[illegible]6	78.80
99	2559	71.10	2784	77.35	2868	79.65
100	2589	71.90	2816	78.20	2900	80.55

Source: Courtesy of GTE Automatic Electric Company (Bulletin No. 485).

from a large (infinite) number of independent subscribers or sources (random traffic input), with a limited number of trunks or servicing channels and LCH.

It is not as straightforward as it may seem when comparing grades of service between Poisson and Erlang B formulas (or tables). The grade of service $p = 0.01$ for the Erlang B formula is equivalent to a grade of service of 0.005 when applying the Poisson (Molina) formula. Given these grades of service, assuming LCC with the Erlang B formula permits up to several tenths of erlangs of less traffic when dimensioning up to 22 trunks, where the two approaches equate (e.g., where each formula allows 12.6 erlangs over the 22 trunks). Above 22 trunks the Erlang B formula permits the trunks to carry somewhat more traffic and at 100 trunks, 2.7 erlangs more than for the Poisson formula under the LCH assumption.

4.8.1 Alternative Traffic Formula Conventions

The Poisson formula has the following assumptions: (1) infinite sources, (2) equal traffic density per source, (3) lost calls held (LCH). The formula is

$$P = e^{-A} \sum_{x=n}^{\infty} \frac{A^x}{x!} \tag{4.13}$$

The Erlang B formula assumes (1) infinite sources, (2) equal traffic density per source, and (3) lost calls to cleared (LCC). The formula is

$$P = \frac{\frac{A^n}{n!}}{\sum_{x=0}^{n} \frac{A^x}{x!}} \tag{4.14}$$

The Erlang C formula assumes (1) infinite sources, (2) lost calls delayed (LCD), (3) exponential holding times, and (4) calls served in order of arrival [7]. The formula is

$$P = \frac{\frac{A^n}{n!} \cdot \frac{n}{n-A}}{\sum_{x=0}^{n-1} \frac{A^x}{x!} + \frac{A^n}{n!} \cdot \frac{n}{n-A}} \tag{4.15}$$

The binomial formula assumes (1) finite sources, (2) lost calls held (LCH), and (3) equal traffic density per source. The formula is

$$P = \left(\frac{s-A}{s}\right)^{s-1} \sum_{x=n}^{s-1} \binom{s-1}{x} \left(\frac{A}{s-A}\right)^x \tag{4.16}$$

For all of these formulas:

A = The expected traffic density, expressed in busy hour erlangs.

P = The probability that calls will be lost (or delayed) because of insufficient channels.

n = The number of channels (trunks) in the group of channels.

s = The number of sources in the group of sources.

x = A variable representing a number of busy sources or busy channels.

e = 2.718

4.9 Waiting Systems (Queuing)

A short discussion follows regarding traffic in queuing systems [6]. Queuing or waiting systems, when dealing with traffic, are based on the third assumption, namely, lost calls delayed (LCD). Of course, a queue in this case is a pool of callers waiting to be served by a switch. The term *serving time* is the time a call takes to be served from the moment of arrival in the queue to the moment of being served by the switch. For traffic calculations in most telecommunications queuing systems, the mathematics is based on the assumption that call arrivals are random and Poisonnian. The traffic engineer is given the parameters of offered traffic, the size of the queue, and a specified grade of service and will determine the number of serving circuits or trunks required.

The method by which a waiting call is selected to be served from the pool of waiting calls is called *queue discipline*. The most common discipline is the first-come-first-served discipline [3][6], where the call waiting longest in the queue is served first. This can turn out to be costly because of the equipment required to keep order in the queue. Another type is random selection, where the time a call has waited is disregarded and those waiting are selected in random order. There is also the last-come-first-served discipline and bulk service discipline, where batches of waiting calls are admitted, and there are also priority service disciplines, which can be preemptive and nonpreemptive. In queuing systems the grade of service may be defined as the probability of delay. This is expressed as $P(t)$, the probability that a call is not being immediately served and has to wait a period of time greater than t.. The average delay on all calls is another parameter that can be used to express grade of service, and the length of queue is another.

The probability of delay, the most common index of grade of service for waiting systems when dealing with full availability and a Poisonnian call arrival process, is calculated by using the Erlang C formula, which assumes an infinitely long queue length.

4.10 Dimensioning and Efficiency

By definition, if we were to dimension a route or estimate the required number of servicing channels, where the number of trunks (or servicing channels) just equaled the erlang load, we would attain 100% efficiency. All trunks would be busy with calls all the time or at least for the entire BH. This would not even allow several moments for a trunk to be idle while the switch decided the next call to service. In practice, if we engineered our trunks, trunk routes, or switches this way, there would be many unhappy subscribers.

On the other hand, we do, indeed, want to size our routes (and switches) to have a high efficiency and still keep our customers relatively happy. The goal of our previous exercises in traffic engineering was just that. The grade of service is one measure of subscriber satisfaction. As an example, let us assume that between cities X and Y there are 100 trunks on the interconnecting telephone route. The tariffs, from which the telephone company derives revenue, are a function of the erlangs of carried traffic. Suppose we allow a dollar per erlang-hour. The very upper limit of service on the route is 100 erlangs. If the route carried 100 erlangs of traffic per day, the maximum return on investment would be $2400 a day for that trunk route and the portion of the switches and local plant involved with these calls. As we well know, many of the telephone company's subscribers would be unhappy because they would have to wait excessively to get calls through from X to Y. How, then, do we optimize a trunk route (or serving circuits) and keep the customers as happy as possible?

Remember from Table 4.1, with an excellent grade of service of 0.001, that we relate grade of service to subscriber satisfaction and that the 100 circuits could carry up to 75.24 erlangs during the BH. Assuming the route did carry 75.24 erlangs for the BH, it would earn $75.24 for that hour and something far less than $2400 per day. If the grade of service were reduced to 0.01, 100 trunks would bring in $84.06 for the busy hour. Note the improvement in revenue at the cost of reducing grade of service. Another approach to saving money is to hold the erlang load constant and decrease the number of trunks and switch facilities accordingly as the grade of service is reduced. For instance, 70 erlangs of traffic at $p = 0.001$ requires 96 trunks and at $p = 0.01$, only 86 trunks.

4.11 Alternative Routing

One method of improving efficiency is to use alternative routing (called *alternate routing* in North America, Turkey and etc.) [15]. Suppose that we have three serving areas, X, Y, and Z, served by three switches, X, Y, and Z, as shown in Figure 4.4.

Let the grade of service be 0.005 (1 in 200 in Table 3.1). We found that it would require 67 trunks to carry 50 erlangs of traffic during the BH to meet that grade of service between X and Y, still keeping the BH traffic intensity at 50 erlangs. We would thereby increase the efficiency on the X-Y route at the cost of reducing the grade of service. With a modification of the switch at X, we could route the traffic bound for Y that met congestion on the X-Y route via Z. Then Z would route this traffic on the Z-Y link. Essentially, this is alternative routing in its simplest form. Congestion probably would only occur during very short peaky periods in the BH, and chances are that these peaks would not occur simultaneously with peaks in traffic intensity on the Z-Y route. Further, the added load on the X-Y-Z route would be very small.

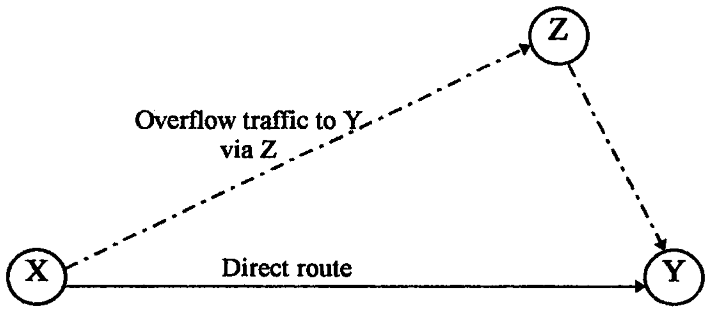


Figure 4.4 Simplified diagram of the alternative routing concept (solid line direct route, dashed line alternative route carrying the overflow from X to Y).

One of the most common accepted methods of dimensioning switches and trunks using alternative routing is the equivalent random group (ERG) method developed by Wilkinson [7][15]. The Wilkinson method uses the mean M and the variance V. Here the *overflow traffic* is the "lost" traffic in the Erlang B calculations, which were discussed earlier. Let M be the mean value of that overflow and A be the random traffic offered to a group of n circuits (trunks). Then

$$V = M\left(1 - M + \frac{A}{1 + n + M - A}\right) \qquad (4.17)$$

When the overflow traffic from several sources is combined and offered to a single second (or third, fourth, etc.) choice of a group of circuits, both the mean and the variance of the combined traffic are the arithmetical sums of the means and variances of the contributors.

The basic problem in alternative routing is to optimize circuit group efficiency (e.g., to dimension a route with an optimum number of trunks). Thus we are to find what circuit quantities result in minimum cost for a given grade of service, or to find the optimum number of circuits (trunks) to assign to a direct route allowing the remainder to overflow on alternative choices. There are two approaches to the optimization. The first method is to solve the problem by successive approximations, and this lends itself well to the application of the computer.

4.10.2 Efficiency versus Circuit Group Size

In the present context a *circuit group* refers to a group of circuits performing a specific function [3][11]. For instance, all the trunks (circuits) routed from X to Y in Figure 4.4 make up a circuit group, irrespective of size. The circuit group should not be confused with the "group" used in transmission-engineering carrier systems.

If we assume full loading, it can be stated that efficiency improves with circuit group size. From Table 4.1, given $p = 0.01$, 5 erlangs of traffic requires a group with 11 trunks, more than a 2:1 ratio of trunks to erlangs, and 20 erlangs requires 30 trunks, a 3:2 ratio. Note how the efficiency has improved. One hundred and twenty trunks will carry 100 erlangs, or 6 trunks for every 5 erlangs for a group of this size. Figure 4.5 shows how efficiency improves with group size.

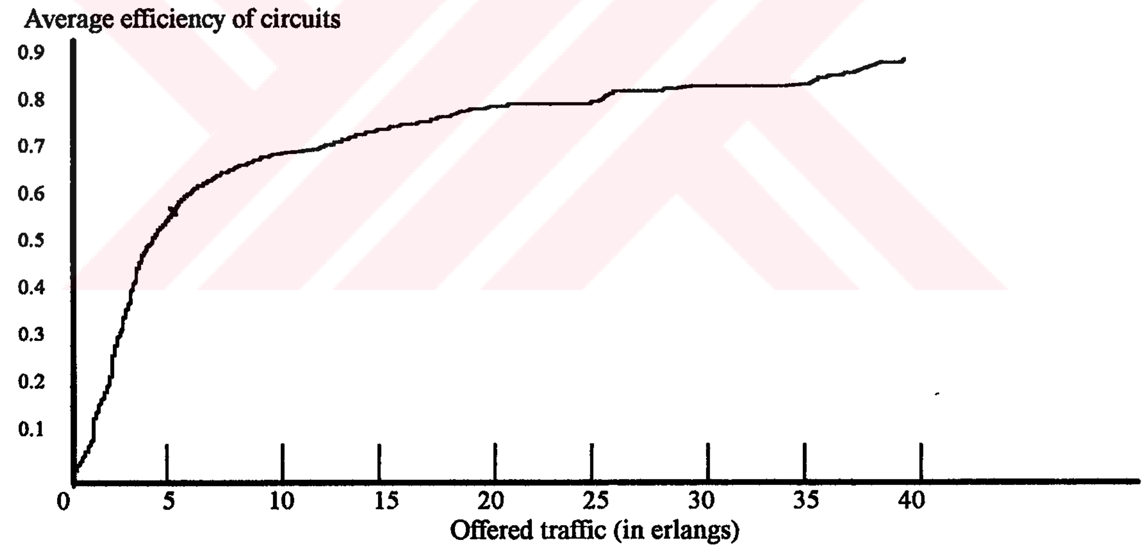


Figure 4.5 Group efficiency increases with size

CHAPTER FIVE
TRAFFIC ANALYZER PROGRAM

5.1 Traffic Structure of S-12 Exchanges

S-12 exchanges are built in modular structure. But other exchanges (produced by Siemens, Northern Electric, and etc.) are built in a compact structure. The module is a block which consists of circuit groups. Because of this modular structure of S-12 exchanges, the performance of these modules can be calculated in traffic loading individually. Some of these modules are *originating, internal, outgoing,* and *etc.* S-12 exchanges use separate modules for

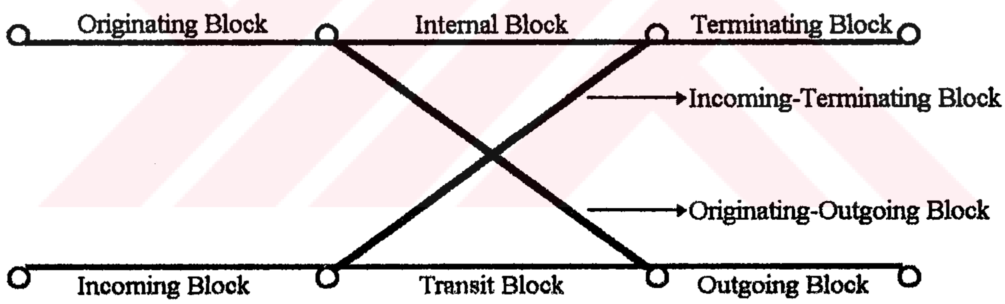


Figure 5.1 The modular structure of exchange for traffic flowing.

each call types because of the modular structure of them. The traffic evaluations of all exchanges can be considered about the same call types (*Originating, internal, outgoing* and *etc.*) (Call types are explained in Chapter 5.1.1). Thus, performance problems are located and the identified problems are solved at a modular base with specially methods. There are a lot of measurement types in EC7 software running on S-12 exchanges. These measurements are named as *counters.* A counter is a sub-program in EC7 software and observe different type of measurements on a S-12 exchange. If it is desired, these counters (all of or some of them) are observed by activating some of the sub-programs at certain time intervals. As a result of these observations, global performance of exchanges and performance per route can be calculated.

In addition, the number of necessary trunks per route, according to the traffic load, can be calculated or predicted using Erlang B formula. The traffic structure of S-12 (or other) exchanges is shown in Figure 5.1 [16].

5.1.1 Call Types

Originating Call (OR): Every exchanges have subscribers. If a subscriber calls to another subscriber belonging to the same or another exchange, this is *originating call.*

Internal Call (INT): If a subscriber calls to another subscriber belonging to the same exchange, this is *internal call.*

Originating Outgoing Call (OROG): If a subscriber calls to another subscriber belonging to another exchange, this is o*riginating outgoing call* .

Outgoing Call (OG): For tandem or local exchanges, the calls to another subscribers belonging to the another exchanges (the outgoing calls consist of originating and transit calls partially), are *outgoing calls.*

Incoming Call (INC): If the calls income from other exchanges, these are *incoming calls* (consist of incoming terminating and transit calls partially).

Terminating Call (TERM): Terminating calls, consist of incoming and originating calls partially. If a subscriber is called by another subscriber belonging to the same or different exchange, this is called as terminating call.

Transit Call (TRNS): For tandem exchanges, a call incomes from another exchange and outgoes to the other one. This is called as *transit call.*

Incoming Terminating Call (INCTERM): If a subscriber is called from another subscriber belonging to the another exchange, this is *incoming terminating call.*

5.1.2 Performances of Exchange

S-12 exchanges can observe a lot of different type of measurements about traffic load and performance of traffic loading. These measurement registers are named as "counters". Every counter has a numerical name like 135, 155, 161, and etc. The exchange can make measurements every 1 second [16]. These counters; for instance 135 measures *outgoing call attempts per route*, 155 measures *outgoing occupancy (carried traffic) per route*. And these are known as numerical names by EC7 software of S-12 exchanges. If the measurement sub-programs of EC7 software are activated by inputting the desired counters for desired time interval, the exchange issues the measurement results at a desired time. All of the digital exchanges can observe statistical and traffic measurements. But all of them have different softwares. Because of this reason, their measurement commands are different. These commands or activated methods can be learned by traffic engineers easily.

Because of the modular structure of S-12 exchanges, there are global counters for each module. In the same way, each call type can be observed using these global counters. Depending on the exchange type each call type are handled at a lot of different stages. These global counters can observe all of these stages of call handling on the modules. With Figure 5.1 and definitions of call types, modular performances of exchange can be formulated using some global counters as follows [16]:

$$OR\ (\%) = ((90 + 210 + 192 + 204 + 185) * 100) / 205 \qquad (5.1)$$

90 = Calls successful in preselection (Internal Global Counter).

210 = Calls with significant dialing received (successful or not) (Originating Global Counter).

192 = No dial tone received (Originating Global Counter).

204 = Partial dialing (Originating Global Counter).

185 = Invalid routing data or call (Originating Global Counter).

205 = Seizures (Originating Global Counter).

$$INT (\%) = ((92 + 101 + 89) * 100) / 88 \quad (5.2)$$

92 = Failed calls due to called subscriber busy (Internal Global Counter).

101 = In ringing phase but not answered (Internal Global Counter).

89 = Answered calls (Internal Global Counter).

88 = Complete number accepted (Internal Global Counter).

$$OROG (\%) = ((213 + 208) * 100) / (230 - 212) \quad (5.3)$$

213 = Not answered calls (Originating-outgoing Global Counter).

208 = Answered calls (Originating-outgoing Global Counter).

230 = Trunk seizures (Originating-outgoing Global Counter).

212 = Calls with failure in distant exchange (Originating-outgoing Global Counter).

$$INC (\%) = ((70 + 277 + 40 + 53 + 33) * 100) / 56 \quad (5.4)$$

70 = Calls successful in preselection (Incoming-terminating Global Counter).

277 = Calls with significant signaling information (successful or not) (Transit Global Counter).

40 = Calls with no signaling received (Incoming Global Counter).

53 = Incoming seizures with partial signaling information (Incoming Global Counter).

33 = Incoming calls with invalid routing data (Incoming Global Counter).

56 = Number of seizures (Incoming Global Counter).

$$INCTERM (\%) = ((72 + 81 + 69) * 100) / 68 \quad (5.5)$$

72 = Calls failed due to called subscriber busy (Incoming-terminating Global Counter).

81 = In ringing phase but not answered (Incoming-terminating Global Counter).

69 = Answered received (Incoming-terminating Global Counter).

68 = Complete number accepted (Incoming-terminating Global Counter).

$$TRNS (\%) = (301 * 100) / (277 - 281) \quad (5.6)$$

301 = Calls with through-switching (Transit Global Counter).

277 = Calls with significant signaling information (successful or not) (Transit Global Counter).

281 = Invalid routing data (Transit Global Counter).

$$TERM (\%) = ((260 + 253 + 256) * 100) / (88 + 68) \quad (5.7)$$

260 = Not answered calls (Terminating Global Counter).

253 = Answered calls (Terminating Global Counter).

256 = Calls with busy subscribers (Terminating Global Counter).

88 = Complete number accepted (Internal Global Counter).

68 = Complete number accepted (Incoming-terminating Global Counter).

$$OG (\%) = (178 * 100) / (134 - 146) \quad (5.8)$$

178 = Outgoing through-switching number (Outgoing Global Counter).

134 = Call attempts (Outgoing Global Counter).

146 = Call failures in distant exchange (Outgoing Global Counter).

In addition in S-12 exchanges, for general performance, there are service provider modules called "Dial Tone Multi Frequency service circuit module (DTMFSCM) and Multi Frequency R1 service circuit module (MFR1SCM)". With these modules, it is provided that other module structures are operated in a regular base, and in this way the general performance of exchange is increased. These modules are also considered for traffic flowing. These are formulated in [16]. If the number of these modules are not enough for traffic loading, the service quality of S-12 exchanges is decreased.

In EC7 ANALYZER program, all of these contributors are studied.

Table 5.1 The trunk and traffic load table of CINARLI_2 exchange for October 1996

ROUTES	ALT	OG DFF	IC DIFF	OG ASSN	OG AVI	OG NSSR	OG TRI	IC ASSN	IC AVL	IC NSSR	IC TRF
ALAYBEY1	ST	-10	-1	15	15	25	14	15	15	16	7
ALAYBEY2	ST	3	4	15	15	12	5	15	15	11	4
ALSANCAK1	ST	3	5	30	30	27	15	30	30	25	14
ALSANCAK2	KY2	-2	-1	30	30	32	19	30	30	31	19
AYKUSAN	ST	-1	-1	15	15	16	7	15	15	16	7
BAHCEVLER1	ST	2	4	15	15	13	5	15	15	11	4
BAHCEVLER2	ST	-2	2	15	15	17	8	15	15	13	5
BAHCEVLER3	MK5	0	0	0	0	0	0	0	0	0	0
BALCOVA	ST	0	-1	15	15	15	6	15	15	16	7
BAYRAKLI	ST	-6	-7	15	15	21	11	15	15	22	12
BORNOVA2	ST	-12	-9	45	30	42	28	45	30	39	26
BORNOVA3	ST	10	15	45	45	35	22	45	45	30	18
BOSTANLI	KY2	-3	-1	15	15	18	9	15	15	16	7
BUCA1	ST	7	3	30	30	23	12	30	30	27	15
BUCA2	BC1	0	0	0	0	0	0	0	0	0	0
BUCAEVKA	ST	13	16	30	30	17	8	30	30	14	6
BUYUKCIGLI1	ST	0	0	0	0	0	0	0	0	0	0
BUYUKCIGLI2	KY2	-7	-6	15	15	22	12	15	15	21	11
CINARLI1	ST	-16	6	45	45	61	44	45	45	39	26
GAZIEMIR	GY1	0	3	15	15	15	6	15	15	12	5
GAZİKENT	GY1	0	0								
GUZELBAHCE	BC1	0	0	0	0	0	0	0	0	0	0
GUZELYALI1	ST	-2	15	30	30	32	20	30	30	15	6
GUZELYALI2	GY1	0	0	0	0	0	0	0	0	0	0
HATAY1	ST	3	3	15	15	12	4	15	15	12	5
HATAY2	ST	-6	1	15	15	21	11	15	15	14	6
IZMIR2	ST	-11	7	30	30	41	27	30	30	23	12
IZMIR3		0	0								
IZMIR4	İZ2	-21	10	150	150	171	146	150	150	140	117
KARABAGLAR1	GY1	-5	-1	15	15	20	10	15	15	16	7
KARABAGLAR2	ST	4	4	15	15	11	4	15	15	11	4
KARSIYAKA1	MK5	0	0	0	0	0	0	0	0	0	0
KARSIYAKA2	ST	10	13	30	30	20	10	30	30	17	8
MAVİŞEHİR	ST	0	0								
MERKEZ1	ST	6	1	30	30	24	13	30	30	29	17
MERKEZ3	MK5	-7	-4	15	15	22	12	15	15	19	10
MERKEZ4	ST	3	10	30	30	27	14	30	30	20	10
MERKEZ5	ST	-6	8	60	60	66	49	60	60	52	37
NARLIDERE	GY1	0	0	0	0	0	0	0	0	0	0
STANDEM	IZ2	-9	10	90	90	99	78	90	90	80	62
YENISEHIR1	ST	-11	-4	45	45	56	40	45	45	49	34
YENISEHIR2	ST	-7	-3	30	30	37	24	30	30	33	21

Table 5.2 The trunk and traffic load table of CINARLI_2 exchange for November 1996

ROUTE	ALT	OG DFF	IC DFF	OG ASS	OG AVL	OG NSSR	OG TRF	IC ASS	IC AVL	IC NSSR	IC TRF
ALAYBEY1	ST	8	16	30	30	22	12	30	30	14	6
ALAYBEY2	ST	3	4	15	15	12	5	15	15	11	4
ALSANCAK1	ST	8	8	30	30	22	12	30	30	22	12
ALSANCAK2	KY2	12	10	45	45	33	21	45	45	35	25
AYKUSAN	ST	1	0	15	15	14	6	15	15	15	7
BAHCEVLER1	ST	0	0	15	15	15	7	15	15	15	7
BAHCEVLER2	ST	-4	0	15	15	19	10	15	15	15	7
BAHCEVLER3	MK5	0	0	0	0	0	0	0	0	0	0
BALCOVA	ST	-2	1	15	15	17	8	15	15	14	6
BAYRAKLI	ST	-8	-7	15	15	23	13	15	15	22	12
BORNOVA2	ST	5	-9	45	30	25	14	45	30	39	26
BORNOVA3	ST	8	7	45	45	37	24	45	45	38	25
BOSTANLI	KY2	-3	-1	15	15	18	9	15	15	16	7
BUCA1	ST	2	8	30	30	28	17	30	30	22	12
BUCA2	BC1	0	0	0	0	0	0	0	0	0	0
BUCAEVKA	ST	13	15	30	30	17	8	30	30	15	7
BUYUKCIGLI1	ST	0	0	0	0	0	0	0	0	0	0
BUYUKCIGLI2	KY2	-7	-7	15	15	22	12	15	15	22	12
CINARLI1	ST	-3	0	45	45	48	34	45	45	45	31
GAZIEMIR	GY1	0	0	15	15	15	7	15	15	15	7
GAZİKENT	GY1	0	0								
GUZELBAHCE	BC1	0	0	0	0	0	0	0	0	0	0
GUZELYALI1	ST	-1	12	30	30	31	19	30	30	18	9
GUZELYALI2	GY1	0	0	0	0	0	0	0	0	0	0
HATAY1	ST	3	3	15	15	12	4	15	15	12	5
HATAY2	ST	1	2	15	15	14	6	15	15	13	5
IZMIR2	ST	-4	1	30	30	34	23	30	30	29	19
IZMIR3											
IZMIR4	İZ2	-1	52	150	150	151	132	150	150	98	82
KARABAGLAR1	GY1	8	11	30	30	22	12	30	30	19	10
KARABAGLAR2	ST	4	4	15	15	11	4	15	15	11	4
KARSIYAKA1	MK5	0	0	0	0	0	0	0	0	0	0
KARSIYAKA2	ST	11	15	30	30	19	10	30	30	15	7
MAVİŞEHİR	ST	0	0								
MERKEZ1	ST	3	2	30	30	27	16	30	30	28	17
MERKEZ3	MK5	-7	-4	15	15	22	12	15	15	19	10
MERKEZ4	ST	7	12	30	30	23	13	30	30	18	9
MERKEZ5	ST	26	34	60	60	34	22	60	60	26	15
NARLIDERE	GY1	0	0	0	0	0	0	0	0	0	0
STANDEM	IZR2	-6	34	90	90	96	80	90	90	56	43
YENISEHIR1	ST	4	13	60	60	56	41	60	60	47	33
YENISEHIR2	ST	14	11	45	45	31	19	45	45	34	22

Table 5.3 The output of EC7 ANALYZER

ALCATEL S-12(JRACK) EXCHANGE EVAULATED TRAFFIC & PERFORMANCE VALUES by EC7 ANALYZER

EXCHANGE: CINARLI2_EK11 **DATE: 1996-12-06**

ROUTE	ICOCC	ICSZR	ICASS	ICAVL	ICNCSR	OGATT	OGOCC	OGSZR	OGOVF	OGREJN	OGASS	OGAVL	OGNCSR
ALAYBEY_1	7.67	235	30	30	16	154	6.11	154	0	0	30	30	14
ALSANCAK_1	2.45	87	30	30	8	74	1.68	74	0	0	30	28.99	7
BUCA_1	11.22	296	30	30	21	334	16.72	334	0	0	30	30	28
BEVLER_1	2.26	83	15	15	8	87	2.5	87	0	0	15	14	8
BEVLER_2	3.92	158	15	15	10	171	6.09	171	0	0	15	15	14
BALCOVA	3.21	171	15	15	9	127	4.09	126	1	0	15	14	11
BOSTANLI	4.63	149	15	15	12	155	5.13	155	0	0	15	15	12
BORNOVA_2	11.15	445	45	30	21	813	13.29	642	172	0	45	30	25
CINARLI_1	15.31	650	45	45	26	638	14.41	645	0	0	45	36.25	25
GAZIEMIR	2.6	96	15	15	8	213	4.02	213	0	0	15	15	11
GYALI_1	6.11	284	30	30	14	468	14.57.	471	0	0	30	30	25
HATAY_1	1.95	94	15	15	7	69	3.27	69	0	0	15	15	9
HATAY_2	2.69	128	15	15	8	116	3.61	116	0	0	15	16	10
KBAGLAR_1	4.46	198	30	30	11	199	6.45	199	0	0	30	30	14
KYAKA_2	2.76	172	30	30	9	119	5.42	119	0	0	30	29.04	13
MERKEZ_3	.53	25	15	15	4	48	1.41	48	0	0	15	15	6
MERKEZ_4	1.03	52	30	30	5	56	1.12	56	0	0	30	30	5
MERKEZ_5	.35	1271	30	29	4	0	1	0	0	0	28	26	1
TEPECIK_1	12.26	416	60	60	22	590	15.49	595	0	0	60	59.22	26
KBAGLAR_2	.93	51	15	15	5	53	1.77	53	0	0	15	15	7
IZR_TOLL_4	44.02	6186	118	118	6O	3586	80.58	3596	0	0	135	134.9	100
STANDEM	21.31	996	90	90	33	1250	29.01	1250	0	0	90	86.42	42
MERKEZ_5_N7	5.27	175	62	62	12	405	8.21	405	0	0	62	62	17
IZR_TOLL_3_N7	1.32	23	30	30	6	68	1.51	68	0	0	30	30	6
SPARE	0	0	15	0	1	0	0	0	0	0	15	0	1
AYKUSAN	.81	40	15	15	5	49	1.34	49	0	0	15	15	6
CIGLI_2	3.43	151	15	15	10	132	5.62	132	0	0	15	15	13
BAYRAKLI	7.96	401	15	15	16	393	9.9	367	26	0	15	15	19
ALSANCAK_2	2.56	109	45	45	8	107	1.85	107	0	0	45	44.02	7
EVKA_1	3.85	196	30	30	10	147	4.99	147	0	0	30	30	12
TEPECIK_2	7.19	312	45	45	15	366	11.75	366	0	0	45	45	21
BORNOVA_3	14.01	485	45	45	24	488	13.88	489	0	0	45	42.01	24
MERKEZ_1	1.27	86	30	30	6	98	3.17	98	0	0	30	30	9
ALAYBEY_2	2.95	101	15	15	9	178	3.23	178	0	0	15	15	9
IZR_TOLL_3	0	0	15	15	1	734	4.33	734	0	0	15	15	11
IZR_TOLL_4_	18.56	522	30	30	30	64	2.33	64	0	0	30	30	8
ADMI_DTG	0	0	10	10	1	0	0	0	0	0	10	10	1
ACS_DIR	0	0	4	4	1	0	0	0	0	0	4	4	1
MDMI_DTG	0	0	1	1	1	0	0	0	0	0	1	1	1
LER	0	0	0	0	1	0	0	0	0	0	1	1	1

PERFORMANCE VALUES :......................(%)

OCC_PER_SUBSCRBR(cErl) =1.56209
ORIGINATING =100.4891
INTERNAL =100.1864
ORIGINATING-OUTGOING =98.63493
INCOMING =100.0404
INCOMING-TERMINATING =93.3735
TRANSIT =0
TERMINATING =94.4795
OUTGOING =91.0084
DTMFSCM-NCSSR =4
MFR1SCM-NCSSRY =3

Table 5.4 The differences of trunk numbers for CINARLI_2 exchange in 1996

ROUTE	ALT	JAN		FEB		MARCH		APRIL		MAY		JUN	
		OG	IC	OG	IC	OG	IC	OG	IC	OG	IC	OG	IC
ALAYBEY1	ST	-3	-1	-5	-4	-3	-1	-4	-2	-4	-2	-4	-3
ALAYBEY2	ST	0	0	0	0	0	0	0	0	0	0	0	0
ALSNCK1	ST	2	7	-4	4	3	9	-1	7	-2	7	1	7
ALSNCK2	KY2	-3	-3	-9	-8	-8	-8	-8	-8	-10	-8	-8	-9
AYKUSAN	ST	1	6	1	4	3	3	2	2	2	4	3	3
BAHCVLR1	ST	6	6	6	6	0	4	1	2	1	4	1	3
BAHCVLR2	ST	-3	1	-1	-3	-3	-1	-3	1	-3	0	-2	-3
BAHCVLR3	MK5	0	0	0	0	0	0	0	0	0	0	0	0
BALCOVA	ST	1	3	-9	-7	-1	1	-2	1	-3	1	-3	0
BAYRAKLI	ST	-4	-3	-7	-6	-6	-4	-7	-6	-7	-8	-8	-7
BORNVA2	ST	-9	-5	-11	-8	-10	-8	-11	-8	-11	4	-11	-3
BORNVA3	ST	19	17	13	13	10	14	13	16	13	13	14	11
BOSTANLI	KY2	-3	3	-1	3	-1	3	2	2	0	-3	-3	0
BUCA1	ST	7	7	4	6	5	3	3	8	2	5	0	3
BUCA2	BC1	0	0	0	0	0	0	0	0	0	0	0	0
BUCEVKA	ST	18	19	16	16	16	16	16	17	15	17	15	16
BUYCIGLI1	ST	0	0	0	0	0	0	0	0	0	0	0	0
BUYCIGLI2	KY2	-3	-3	-3	-4	-6	-4	-6	-3	-7	-3	2	-5
CINARLI1	ST	1	7	6	4	-7	1	-2	4	-7	0	-2	1
GAZIEMIR	GY1	1	1	1	0	-1	1	-2	0	-2	0	-1	-1
GAZİKENT	GY1	0	0	0	0	0	0	0	0	0	0	0	0
GUZBAHC	BC1	0	0	0	0	0	0	0	0	0	0	0	0
GUZYALI1	ST	12	15	11	14	11	11	11	13	-7	8	11	13
GUZYALI2	GY1	0	0	0	0	0	0	0	0	0	0	0	0
HATAY1	ST	1	4	1	3	3	1	1	2	0	4	0	2
HATAY2	ST	3	4	1	3	3	3	1	2	1	1	1	4
IZMIR2	ST	15	15	-4	3	0	9	-4	11	-7	11	-11	13
IZMIR3	0	0	0	0	0	0	0	0	0	0	0	0	0
IZMIR4	İZ2	58	23	-13	17	-12	10	-27	15	-40	3	-21	8
KRBGLR1	GY1	-5	-1	-7	-6	-6	-4	-4	-6	-7	-4	-6	-5
KRBGLR2	ST	10	10	8	15	10	10	10	8	6	6	6	5
KRSIYKA1	MK5	0	0	0	0	0	0	0	0	0	0	0	0
KRSIYKA2	ST	15	16	12	12	12	14	13	15	13	16	13	3
MAVŞEHİR	ST	0	0	0	0	0	0	0	0	0	0	0	0
MERKEZ1	ST	10	6	4	3	5	3	8	3	5	4	8	3
MERKEZ3	MK5	-4	0	-5	-3	-4	-3	-2	-3	-2	-2	-2	-5
MERKEZ4	ST	4	12	3	12	3	11	4	12	4	13	5	9
MERKEZ5	ST	12	12	3	7	-6	11	10	13	5	12	11	11
NRLIDERE	GY1	0	0	0	0	0	0	0	0	0	0	0	0
STANDEM	IZR2	12	17	-13	-4	-8	7	-9	-3	-7	-7	-10	-13
YNSHIR1	ST	-4	1	-8	-4	-7	-2	-5	-1	-10	-3	3	-9
YNSHIR2	ST	-7	-1	-9	-8	-8	-7	-8	-8	-10	-9	-10	-10

Table 5.4 The differences of trunk numbers for CINARLI_2 exchange in 1996 (continued).

ROUTE	ALT	JULY		AUG		SEP		OCT		NOV		DEC	
		OG	IC	OG	IC	OG	IC	OG	IC	OG	IC	OG	IC
ALAYBEY1	ST	-6	-2	-6	-2	-2	-2	-10	-1	8	16	9	12
ALAYBEY2	ST	15	15	4	6	4	8	3	4	3	4	1	2
ALSNCK1	ST	2	11	2	9	-1	7	3	5	8	8	-2	9
ALSNCK2	KY2	7	7	-2	-3	-1	-1	-2	-1	12	10	11	8
AYKUSAN	ST	1	2	4	2	3	1	-1	-1	1	0	0	0
BAHCEVLR1	ST	1	2	0	4	0	3	2	4	0	0	1	1
BAHCEVLR2	ST	-3	0	-2	-2	-2	-1	-2	2	-4	0	-3	-2
BAHCEVLR3	MK5	0	0	0	0	0	0	0	0	0	0	0	0
BALCOVA	ST	-3	0	-4	1	-4	0	0	-1	-2	1	-3	-2
BAYRAKLI	ST	-8	-6	-8	-8	-6	-7	-6	-7	-8	-7	-7	-7
BORNV2	ST	-11	-8	-11	-8	-11	-6	-12	-9	5	-9	-11	-9
BORNV3	ST	13	13	18	14	14	11	10	15	8	7	8	10
BOSTANLI	KY2	-3	0	0	0	-2	-1	-3	-1	-3	-1	-4	-2
BUCA1	ST	3	4	8	5	3	3	7	3	2	8	1	3
BUCA2	BC1	0	0	0	0	0	0	0	0	0	0	0	0
BUCEVKA	ST	16	16	12	13	13	14	13	16	13	15	15	13
BUYCIGLI1	ST	0	0	0	0	0	0	0	0	0	0	0	0
BUYCIGLI2	KY2	-6	-4	-6	-6	-6	-6	-7	-6	-7	-7	-8	-7
CINARLI1	ST	-9	-5	-3	1	-7	1	-16	6	-3	0	-3	1
GAZIEMIR	GY1	0	0	0	-3	0	-1	0	3	0	0	-2	0
GAZİKENT	GY1	0	0	0	0	0	0	0	0	0	0	0	0
GUZBAHC	BC1	0	0	0	0	0	0	0	0	0	0	0	0
GUZYALI1	ST	7	13	2	15	-2	12	-2	15	-1	12	-1	9
GUZYALI2	GY1	0	0	0	0	0	0	0	0	0	0	0	0
HATAY1	ST	1	2	0	2	3	2	3	3	3	3	-3	1
HATAY2	ST	1	2	2	2	1	0	-6	1	1	2	1	0
IZMIR2	ST	-8	13	1	14	-3	6	-11	7	-4	1	0	0
IZMIR3	0	0	0	0	0	0	0	0	0	0	0	7	30
IZMIR4	İZ2	0	16	-15	8	11	-9	-21	10	-1	52	-4	38
KARBGLR1	GY1	-6	-6	-8	-6	-6	-6	-5	-1	8	11	7	7
KARBGLR2	ST	6	6	8	4	5	5	4	4	4	4	6	6
KARSYKA1	MK5	0	0	0	0	0	0	0	0	0	0	0	0
KARSYKA2	ST	15	15	13	13	13	15	10	13	11	15	8	12
MERKEZ1	ST	5	3	7	5	7	3	6	1	3	2	1	2
MERKEZ3	MK5	-7	-3	-4	-3	-7	-4	-7	-4	-7	-4	-7	-4
MERKEZ4	ST	4	11	5	11	3	7	3	10	7	12	-3	8
MERKEZ5	ST	6	12	-1	15	-8	6	-6	8	26	34	23	22
NARDERE	GY1	0	0	0	0	0	0	0	0	0	0	0	0
STANDEM	IZR2	-8	-3	1	10	-1	3	-9	10	-6	34	-12	20
YENSHIR1	ST	-8	-3	-9	-6	-9	-5	-11	-4	4	13	1	6
YENSHIR2	ST	5	7	-1	2	2	-5	0	0	14	11	12	8

Table 5.5 A matrix form of exchanges including available and necessary trunk numbers according to traffic load for May 1996

	ALAYBEY1				ALAYBEY2				ALSANCAK1			
	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC
AB1	******	******	******	******	60	56	60	58	30	18	30	15
AB2	60	57	60	58	******	******	******	******	0	0	0	0
AL1	0	0	0	0	30	0	30	0	******	******	******	******
AL2	15	17	15	9	15	10	15	8	60	67	60	60
AYK	0	0	0	0	0	0	0	0	0	0	0	0
BE1	15	0	15	0	0	0	0	0	44	0	48	0
BE2	15	12	15	14	0	0	0	0	30	16	30	15
BE3	0	0	0	0	0	0	0	0	0	0	0	0
BL	15	12	15	13	0	0	0	0	0	0	0	0
BY	0	0	0	0	0	0	0	0	0	0	0	0
BV2	30	21	30	19	15	0	15	0	41	13	45	15
BV3	15	15	15	13	15	9	15	9	0	0	0	0
BT	60	42	60	40	15	22	15	20	30	21	30	20
BC1	15	15	15	15	0	0	0	0	15	16	30	29
BC2	0	0	0	0	0	0	0	0	0	0	0	0
BCEVK	15	11	15	10	0	0	0	0	0	0	0	0
BYC1	0	0	0	0	0	0	0	0	0	0	0	0
BYC2	15	23	15	0	15	18	15	0	0	0	0	0
CN1	14	0	15	0	0	0	0	0	43	0	60	0
CN2	15	19	15	17	0	0	0	0	30	32	30	23
EML	0	0	0	0	0	0	0	0	0	0	0	0
GE	0	0	0	0	0	0	0	0	0	0	0	0
GB	0	0	0	0	0	0	0	0	0	0	0	0
GY1	30	19	30	29	0	0	0	0	75	55	75	27
GY2	0	0	0	0	0	0	0	0	0	0	0	0
HT1	15	0	15	0	0	0	0	0	48	0	70	0
HT2	15	14	15	16	0	0	0	0	30	16	30	16
IZR2	30	16	30	0	30	10	30	0	30	35	30	0
IZR3	0	0	0	0	0	0	0	0	0	0	0	0
IZR4	105	103	105	86	60	52	60	51	105	91	105	106
KB1	15	0	15	0	0	0	0	0	30	19	30	15
KB2	0	0	0	0	0	0	0	0	0	0	0	0
KY1	55	0	60	0	0	0	0	0	0	0	30	0
KY2	60	59	60	53	30	29	30	29	30	22	30	18
MVŞ	0	0	0	0	0	0	0	0	0	0	0	0
MK1	15	15	15	13	15	7	15	7	15	19	15	19
MK3	20	0	30	0	0	0	0	0	72	0	59	0
MK4	45	0	45	0	0	0	0	0	82	0	84	0
MK5	45	33	45	21	15	12	15	12	90	60	90	48
ND	0	0	0	0	0	0	0	0	0	0	0	0
ST	75	61	75	67	75	82	75	66	105	114	75	43
YS1	30	17	30	19	15	9	15	11	45	33	45	26
YS2	15	15	15	11	0	0	0	0	0	0	0	0

	ALSANCAK2				AYKUSAN				BAHCELIEVLER1			
	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC
AB1	15	8	15	19	0	0	0	0	15	12	15	10
AB2	15	9	15	10	0	0	0	0	0	0	0	0
AL1	0	0	0	0	60	0	60	0	0	0	0	0
AL2	******	******	******	******	15	5	15	5	15	16	15	11
AYK	15	31	15	23	******	******	******	******	0	0	0	0
BE1	15	0	15	0	0	0	0	0	******	******	******	******
BE2	15	0	15	0	0	0	0	0	75	62	75	58
BE3	15	7	15	10	0	0	0	0	30	25	30	24
BL	15	17	15	20	0	0	0	0	0	0	0	0
BY	0	0	0	0	0	0	0	0	0	0	0	0
BV2	30	11	30	15	15	5	15	6	27	14	27	16
BV3	30	18	30	18	15	9	15	9	0	0	0	0
BT	15	19	15	19	0	0	0	0	30	12	30	11
BC1	15	16	15	21	15	5	15	6	15	20	15	17
BC2	0	0	0	0	0	0	0	0	0	0	0	0
BCEVK	15	10	15	12	0	0	0	0	0	0	0	0
BYC1	0	0	0	0	0	0	0	0	0	0	0	0
BYC2	15	20	15	0	0	0	0	0	0	0	0	0
CN1	15	0	14	0	0	0	0	0	27	0	27	0
CN2	15	25	15	23	15	13	15	11	15	14	15	11
EML	0	0	0	0	0	0	0	0	0	0	0	0
GE	15	13	15	17	0	0	0	0	0	0	0	0
GB	0	0	0	0	0	0	0	0	0	0	0	0
GY1	30	22	60	67	30	9	30	13	75	54	75	43
GY2	15	13	15	14	0	0	0	0	0	0	0	0
HT1	15	0	15	0	0	0	0	0	70	0	80	0
HT2	15	15	15	17	15	5	15	5	30	31	30	23
IZR2	30	21	30	0	10	7	20	0	30	26	30	ST
IZR3	0	0	0	0	0	0	0	0	60	53	60	57
IZR4	135	136	165	174	30	31	30	32	0	0	0	0
KB1	15	14	15	21	0	0	0	0	45	22	45	28
KB2	0	0	0	0	0	0	0	0	0	0	0	0
KY1	15	0	15	0	0	0	0	0	0	0	0	0
KY2	30	20	30	21	15	7	15	8	15	13	15	11
MVŞ	0	0	0	0	0	0	0	0	0	0	0	0
MK1	30	36	30	30	15	10	15	9	0	0	0	0
MK3	15	0	15	0	0	0	0	0	57	0	36	0
MK4	22	0	30	0	0	0	0	0	49	0	88	0
MK5	75	61	75	61	15	35	15	14	60	31	60	26
ND	0	0	0	0	0	0	0	0	15	9	15	9
ST	120	117	75	37	45	39	75	36	60	60	60	47
YS1	30	26	30	31	15	13	15	13	30	15	30	19
YS2	15	22	15	18	15	9	15	9	0	0	0	0

	BAHCELIEVLER2				BAHCELIEVLER3				BALCOVA			
	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC
AB1	15	15	15	14	0	0	0	0	15	14	15	14
AB2	0	0	0	0	0	0	0	0	0	0	0	0
AL1	42	0	48	0	30	0	30	0	0	0	0	0
AL2	15	0	15	0	15	0	15	0	15	20	15	19
AYK	0	0	0	0	0	0	0	0	0	0	0	0
BE1	74	0	75	0	30	0	30	0	0	0	0	0
BE2	******	******	******	******	75	37	75	36	30	25	30	24
BE3	75	36	75	36	******	******	******	******	15	12	15	11
BL	30	24	30	24	15	13	15	12	******	******	******	******
BY	0	0	0	0	0	0	0	0	0	0	0	0
BV2	30	16	30	16	0	0	0	0	30	17	30	17
BV3	15	14	15	13	15	9	15	7	15	14	15	15
BT	15	14	15	12	0	0	0	0	15	15	15	16
BC1	30	35	30	38	15	13	15	12	30	18	30	33
BC2	15	0	15	0	0	0	0	0	15	7	15	7
BCEVK	15	0	15	0	0	0	0	0	15	11	15	12
BYC1	0	0	0	0	0	0	0	0	0	0	0	0
BYC2	15	12	15	0	0	0	0	0	15	16	15	0
CN1	15	0	15	0	0	0	0	0	0	0	0	0
CN2	15	18	15	15	0	0	0	0	15	18	15	14
EML	0	0	0	0	0	0	0	0	0	0	0	0
GE	15	17	15	17	0	0	0	0	0	0	0	0
GB	15	11	15	0	0	0	0	0	30	17	30	0
GY1	45	40	45	35	15	13	15	14	90	87	90	61
GY2	15	15	15	14	0	0	0	0	0	0	0	0
HT1	30	0	30	0	0	0	0	0	30	0	30	0
HT2	30	33	30	30	30	16	30	14	15	20	15	20
IZR2	30	18	30	ST	15	12	15	ST	30	22	30	ST
IZR3	75	79	75	78	45	39	45	39	105	95	90	86
IZR4	0	0	0	0	0	0	0	0	0	0	0	0
KB1	30	30	30	29	15	18	15	17	15	14	15	16
KB2	30	14	30	13	15	9	15	11	0	0	0	0
KY1	0	0	0	0	0	0	0	0	0	0	0	0
KY2	15	11	15	11	15	13	15	7	15	13	15	13
MVŞ	0	0	0	0	0	0	0	0	0	0	0	0
MK1	15	19	15	17	0	0	0	0	15	17	15	15
MK3	15	0	15	0	0	0	0	0	0	0	0	0
MK4	15	0	15	0	0	0	0	0	15	0	15	0
MK5	45	36	45	30	30	18	30	18	45	35	45	29
ND	15	14	15	13	0	0	0	0	15	22	15	23
ST	60	62	60	58	75	74	75	78	90	92	90	69
YS1	30	19	30	19	0	0	0	0	30	19	30	19
YS2	0	0	0	0	0	0	0	0	15	12	15	11

Table 5.5 A matrix form of exchanges including available and necessary trunk numbers according to traffic load for May 1996

	BAYRAKLI				BORNOVA2				BORNOVA3				BOSTANLI			
	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC
AB1	0	0	0	0	30	24	30	20	15	14	15	17	60	41	60	47
AB2	0	0	0	0	15	0	15	0	15	10	15	8	15	21	15	21
AL1	0	0	0	0	0	0	0	0	41	0	45	0	0	0	0	0
AL2	0	0	0	0	30	31	30	28	30	18	30	17	15	5	15	18
AYK	0	0	0	0	15	12	15	10	15	9	15	8	0	0	0	0
BE1	0	0	0	0	27	0	27	0	0	0	0	0	30	0	30	0
BE2	0	0	0	0	30	17	30	18	15	12	15	14	15	12	15	12
BE3	0	0	0	0	0	0	0	0	15	8	15	9	0	0	0	0
BL	0	0	0	0	30	13	30	17	15	13	15	15	15	15	15	15
BY	******	******	******	******	15	0	15	0	0	0	0	0	0	0	0	0
BV2	15	21	15	20	******	******	******	******	120	86	120	71	30	17	30	21
BV3	0	0	0	0	120	114	120	102	******	******	******	******	15	14	15	17
BT	0	0	0	0	30	18	30	20	15	16	15	16	******	******	******	******
BC1	0	0	0	0	30	20	30	18	15	16	15	15	15	13	15	15
BC2	0	0	0	0	15	10	15	9	15	8	15	7	0	0	0	0
BCEVK	0	0	0	0	15	12	15	12	0	0	0	0	0	0	0	0
BYC1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BYC2	0	0	0	0	0	0	0	0	15	14	15	0	30	24	30	0
CN1	0	0	0	0	45	0	44	0	0	0	0	0	15	0	11	0
CN2	15	22	15	23	30	41	30	26	45	32	45	32	15	15	15	18
EML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GE	0	0	0	0	30	13	30	13	0	0	0	0	0	0	0	0
GB	0	0	0	0	30	13	30	0	0	0	0	0	0	0	0	0
GY1	15	9	15	11	30	26	30	25	30	17	30	17	45	26	45	19
GY2	0	0	0	0	15	13	15	11	0	0	0	0	0	0	0	0
HT1	0	0	0	0	35	0	34	0	0	0	0	0	29	0	30	0
HT2	0	0	0	0	15	15	15	16	15	14	15	12	15	13	15	14
IZR2	15	14	15	0	30	18	30	0	30	14	30	0	30	12	30	0
IZR3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IZR4	45	64	45	64	120	133	120	129	75	88	75	84	105	103	105	114
KB1	0	0	0	0	30	15	30	16	0	0	0	0	15	14	15	11
KB2	0	0	0	0	0	0	0	0	15	5	15	5	0	0	0	0
KY1	0	0	0	0	27	0	26	0	0	0	0	0	50	0	60	0
KY2	0	0	0	0	30	24	30	23	30	13	30	14	60	57	60	53
MVŞ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MK1	0	0	0	0	30	22	30	19	30	14	30	11	15	15	15	13
MK3	0	0	0	0	45	0	45	0	0	0	0	0	45	0	30	0
MK4	0	0	0	0	45	0	45	0	0	0	0	0	30	0	30	0
MK5	30	18	30	26	75	43	75	38	30	25	30	23	45	22	45	20
ND	0	0	0	0	15	11	15	11	0	0	0	0	0	0	0	0
ST	105	118	105	115	90	86	90	61	75	88	105	81	90	69	90	58
YS1	0	0	0	0	60	35	60	32	15	19	15	20	15	15	15	15
YS2	0	0	0	0	15	20	15	19	15	16	15	14	0	0	0	0

	BUCA1				BUCA2				BUCAEVKA				BUYUKCIGLI1				BUYUKCIGLI2			
	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC
AB1	15	14	15	15	0	0	0	0	15	10	15	12	0	0	0	0	15	22	15	24
AB2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	17	15	18
AL1	30	0	30	0	14	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0
AL2	15	16	15	16	0	0	0	0	15	13	15	11	0	0	0	0	15	22	15	20
AYK	15	6	15	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BE1	15	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BE2	30	31	30	35	15	0	15	0	15	0	15	0	0	0	0	0	15	9	15	11
BE3	15	12	15	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BL	30	29	30	16	15	7	15	8	15	15	15	11	0	0	0	0	15	10	15	11
BY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BV2	30	18	30	20	15	8	15	5	15	12	15	14	0	0	0	0	0	0	0	0
BV3	15	15	15	15	15	7	15	9	0	0	0	0	0	0	0	0	15	11	15	14
BT	15	14	15	13	0	0	0	0	0	0	0	0	0	0	0	0	30	30	30	22
BC1	******	******	******	******	75	71	75	79	60	55	60	68	0	0	0	0	15	0	15	0
BC2	75	79	75	66	******	******	******	******	15	21	15	19	0	0	0	0	0	0	0	0
BCEVK	60	62	60	49	15	20	15	18	******	******	******	******	0	0	0	0	15	7	15	10
BYC1	0	0	0	0	0	0	0	0	0	0	0	0	******	******	******	******	60	0	60	0
BYC2	15	0	15	0	0	0	0	0	15	11	15	0	60	55	60	0	******	******	******	******
CN1	30	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CN2	30	28	30	25	0	0	0	0	30	15	30	13	0	0	0	0	15	22	15	18
EML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GE	15	15	15	15	15	5	15	9	15	0	15	0	0	0	0	0	0	0	0	0
GB	30	22	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GY1	105	25	105	27	15	11	15	11	15	15	15	11	30	13	30	9	15	9	15	7
GY2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HT1	30	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HT2	30	23	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IZR2	30	14	30	0	15	12	15	0	15	17	15	0	15	8	15	0	15	19	15	0
IZR3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IZR4	75	93	75	85	30	42	30	38	60	69	60	64	45	33	45	37	75	71	75	73
KB1	30	25	30	25	15	23	15	12	15	17	15	15	0	0	0	0	15	12	15	12
KB2	15	11	15	11	15	7	15	7	0	0	0	0	0	0	0	0	0	0	0	0
KY1	15	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KY2	15	13	15	12	15	7	15	6	15	11	15	8	30	32	30	34	45	31	45	31
MVŞ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MK1	15	18	15	16	15	9	15	10	15	12	15	10	0	0	0	0	15	0	15	0
MK3	27	0	30	0	0	0	0	0	0	0	0	0	20	0	19	0	0	0	0	0
MK4	30	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MK5	60	31	60	31	15	13	15	13	30	21	30	18	15	12	15	9	30	27	30	27
ND	15	17	15	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ST	60	73	60	61	60	56	60	45	75	86	75	70	60	41	60	42	105	94	105	81
YS1	60	43	60	46	0	0	0	0	15	19	15	18	0	0	0	0	15	18	15	19
YS2	30	25	30	22	15	0	15	0	15	9	15	5	0	0	0	0	15	16	15	11

Table 5.5 A matrix form of exchanges including available and necessary trunk numbers according to traffic load for May 1996

	CINARLI1				CINARLI2				EMLAK KON.				GAZIEMIR			
	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC
AB1	15	14	15	11	15	19	15	21	0	0	0	0	0	0	0	0
AB2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL1	0	0	0	0	43	0	60	0	30	0	30	0	0	0	0	0
AL2	15	18	14	13	15	25	15	24	0	0	0	0	15	18	15	16
AYK	0	0	0	0	15	13	15	13	0	0	0	0	0	0	0	0
BE1	27	0	27	0	15	0	15	0	0	0	0	0	0	0	0	0
BE2	15	10	15	11	15	19	15	16	0	0	0	0	15	16	15	18
BE3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BL	0	0	0	0	15	15	15	16	0	0	0	0	0	0	0	0
BY	0	0	0	0	15	0	15	0	0	0	0	0	0	0	0	0
BV2	45	14	45	13	30	25	30	33	0	0	0	0	30	14	30	10
BV3	0	0	0	0	45	35	45	32	0	0	0	0	0	0	0	0
BT	11	11	15	9	15	18	15	17	0	0	0	0	0	0	0	0
BC1	30	23	30	11	30	27	30	30	0	0	0	0	15	15	15	18
BC2	0	0	0	0	0	0	0	0	0	0	0	0	15	9	15	10
BCEVK	0	0	0	0	30	15	30	15	0	0	0	0	15	0	15	0
BYC1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BYC2	0	0	0	0	15	21	15	0	0	0	0	0	0	0	0	0
CN1	******	******	******	******	45	0	45	0	0	0	0	0	0	0	0	0
CN2	9	52	45	45	******	******	******	******	0	0	0	0	15	17	15	15
EML	0	0	0	0	0	0	0	0	******	******	******	******	0	0	0	0
GE	0	0	0	0	15	15	15	15	0	0	0	0	******	******	******	******
GB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GY1	30	14	30	11	30	18	30	19	0	0	0	0	45	19	45	17
GY2	0	0	0	0	0	0	0	0	0	0	0	0	15	7	15	7
HT1	22	0	17	0	15	0	15	0	0	0	0	0	56	0	60	0
HT2	0	0	0	0	15	15	15	14	0	0	0	0	15	11	15	14
IZR2	15	18	15	0	30	23	30	0	0	0	0	0	15	16	15	ST
IZR3	0	0	0	0	0	0	0	0	0	0	0	0	75	72	75	76
IZR4	60	51	60	59	135	131	135	146	0	0	0	0	0	0	0	0
KB1	14	12	15	10	15	19	15	21	0	0	0	0	30	27	30	27
KB2	0	0	0	0	15	14	15	13	0	0	0	0	0	0	0	0
KY1	26	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0
KY2	15	11	15	9	30	17	30	17	0	0	0	0	0	0	0	0
MVS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MK1	0	0	0	0	30	30	30	25	0	0	0	0	15	13	15	12
MK3	55	0	49	0	15	0	15	0	0	0	0	0	0	0	0	0
MK4	58	0	42	0	30	0	30	0	0	0	0	0	0	0	0	0
MK5	60	25	60	19	60	49	60	51	0	0	0	0	30	26	30	22
ND	15	5	15	5	0	0	0	0	0	0	0	0	0	0	0	0
ST	60	60	60	37	90	103	90	53	0	0	0	0	90	94	90	82
YS1	40	26	45	25	45	52	45	54	0	0	0	0	15	15	15	18
YS2	0	0	0	0	15	25	15	24	0	0	0	0	15	0	15	0

	GÜZELBAHÇE				GUZELYALI1				GUZELYALI2				HATAY1				HATAY2			
	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC
AB1	0	0	0	0	30	30	30	21	0	0	0	0	14	15	15	14	15	14	15	14
AB2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL1	0	0	0	0	0	0	0	0	75	0	75	0	0	0	0	0	48	0	74	0
AL2	0	0	0	0	60	68	30	21	15	10	15	12	15	20	15	17	15	16	15	14
AYK	0	0	0	0	30	13	30	6	0	0	0	0	0	0	0	0	15	6	15	5
BE1	0	0	0	0	75	0	75	0	0	0	0	0	60	0	70	0	30	0	30	0
BE2	15	6	15	9	45	32	45	36	15	15	15	16	30	28	30	31	30	33	30	29
BE3	0	0	0	0	15	16	15	14	0	0	0	0	0	0	0	0	30	16	30	15
BL	30	11	30	13	90	55	90	77	0	0	0	0	30	22	30	22	15	22	15	21
BY	0	0	0	0	15	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0
BV2	30	6	30	10	30	27	30	24	15	12	15	11	30	19	30	15	15	18	15	15
BV3	0	0	0	0	30	17	30	19	0	0	0	0	0	0	0	0	15	11	15	14
BT	0	0	0	0	45	21	45	27	0	0	0	0	30	16	30	16	15	14	15	15
BC1	30	16	30	22	105	27	105	21	0	0	0	0	30	25	30	16	30	25	30	24
BC2	0	0	0	0	15	11	15	11	0	0	0	0	0	0	0	0	0	0	0	0
BCEVK	0	0	0	0	15	12	15	10	0	0	0	0	0	0	0	0	0	0	0	0
BYC1	0	0	0	0	30	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0
BYC2	0	0	0	0	15	6	15	0	0	0	0	0	0	0	0	0	0	0	0	0
CN1	0	0	0	0	30	0	30	0	0	0	0	0	22	0	22	0			0	0
CN2	0	0	0	0	30	37	30	22	0	0	0	0	15	15	15	11	15	14	15	14
EML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GE	0	0	0	0	45	18	45	23	15	9	15	9	0	0	0	0	15	13	15	11
GB	******	******	******	******	45	16	45	0	15	6	15	0	0	0	0	0	0	0	0	0
GY1	45	17	45	14	******	******	******	******	105	86	135	100	60	52	60	59	45	32	45	34
GY2	15	5	15	7	135	121	105	60	******	******	******	******	0	0	0	0	15	18	15	15
HT1	0	0	0	0	0	0	0	0	0	0	0	0	******	******	******	******	45	0	45	0
HT2	0	0	0	0	45	36	45	31	15	17	15	18	45	52	45	50	******	******	******	******
IZR2	15	8	15	ST	45	16	15	ST	15	10	16	ST	15	12	15	ST	15	13	15	ST
IZR3	45	27	45	27	120	112	120	109	45	43	45	46	75	73	67	67	75	70	75	64
IZR4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KB1	0	0	0	0	45	17	45	28	0	0	0	0	30	15	30	21	15	16	15	15
KB2	0	0	0	0	15	7	15	13	0	0	0	0	0	0	0	0	15	7	15	7
KY1	0	0	0	0	45	0	45	0	0	0	0	0	30	0	30	0	0	0	0	0
KY2	0	0	0	0	30	21	30	18	15	10	15	10	15	15	15	15	15	11	15	12
MVS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MK1	0	0	0	0	30	21	30	16	15	10	15	12	0	0	0	0	15	17	15	14
MK3	0	0	0	0	39	0	45	0	0	0	0	0	40	0	39	0	15	0	15	0
MK4	0	0	0	0	60	0	60	0	0	0	0	0	46	0	47	0	15	0	15	0
MK5	15	9	15	9	60	41	60	35	15	17	15	16	45	32	45	31	30	26	30	23
ND	15	9	15	13	45	18	45	19	15	11	15	18	15	13	15	11	15	9	15	11
ST	45	31	45	24	60	67	60	50	75	88	75	72	60	69	60	57	60	47	60	45
YS1	0	0	0	0	45	19	45	22	0	0	0	0	25	17	30	15	15	15	15	15
YS2	0	0	0	0	30	33	30	23	0	0	0	0	0	0	0	0	15	12	15	9

Table 5.5 A matrix form of exchanges including available and necessary trunk numbers according to traffic load for May 1996

	IZMIR2				IZMIR3				IZMIR4			
	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC
AB1	30	24	30	15	0	0	0	0	105	101	103	107
AB2	30	18	30	8	0	0	0	0	60	54	58	54
AL1	30	0	30	0	30	0	30	0	0	0	0	0
AL2	30	38	30	22	0	0	0	0	165	172	135	135
AYK	20	13	10	8	0	0	0	0	30	41	30	36
BE1	30	0	30	0	59	0	60	0	0	0	0	0
BE2	30	24	30	19	75	83	75	60	0	0	0	0
BE3	15	10	15	11	45	44	45	43	0	0	0	0
BL	30	12	30	19	105	91	105	101	0	0	0	0
BY	15	0	15	0	0	0	0	0	45	0	45	0
BV2	30	30	30	18	0	0	0	0	120	136	120	123
BV3	30	23	30	12	0	0	0	0	75	84	75	79
BT	30	21	30	12	0	0	0	0	105	117	105	102
BC1	30	29	30	12	0	0	0	0	75	73	75	68
BC2	15	17	15	8	0	0	0	0	30	43	30	38
BCEVK	15	15	15	12	0	0	0	0	60	64	60	62
BYC1	15	0	15	0	0	0	0	0	45	0	43	0
BYC2	15	23	15	0	0	0	0	0	75	80	75	0
CN1	15	0	15	0	0	0	0	0	60	0	60	0
CN2	30	37	30	19	0	0	0	0	135	175	135	132
EML	0	0	0	0	0	0	0	0	0	0	0	0
GE	15	17	15	16	75	81	75	75	0	0	0	0
GB	15	6	15	0	45	19	45	0	0	0	0	0
GY1	15	10	45	45	120	107	120	91	0	0	0	0
GY2	15	8	15	8	45	47	45	43	0	0	0	0
HT1	15	0	15	0	67	0	75	0	0	0	0	0
HT2	15	11	15	15	75	72	75	79	0	0	0	0
IZR2	******	******	******	******	180	63	180	0	75	34	225	0
IZR3	180	139	180	78	******	******	******	******	165	26	255	63
IZR4	225	129	75	32	255	121	165	63	******	******	******	******
KB1	30	17	30	13	90	83	90	84	0	0	0	0
KB2	15	10	15	7	30	99	30	80	0	0	0	0
KY1	30	0	30	0	0	0	0	0	45	0	45	0
KY2	15	10	15	12	0	0	0	0	105	91	105	78
MVS	0	0	0	0	0	0	0	0	0	0	0	0
MK1	30	34	30	21	0	0	0	0	150	138	90	93
MK3	30	0	30	0	0	0	0	0	75	0	75	0
MK4	30	0	30	0	0	0	0	0	105	0	105	0
MK5	75	38	75	25	0	0	0	0	300	89	300	58
ND	15	12	15	16	75	56	75	62	0	0	0	0
ST	90	104	90	39	30	8	120	64	45	7	105	121
YS1	30	21	30	17	0	0	0	0	120	133	120	120
YS2	15	5	15	12	0	0	0	0	60	76	60	62

	KARABAGLAR1				KARABAGLAR2				KARSIYAKA1			
	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC
AB1	15	0	15	0	0	0	0	0	60	44	60	49
AB2	0	0	0	0	0	0	0	0	0	0	0	0
AL1	105	0	98	0	30	0	30	0	0	0	0	0
AL2	15	3	15	3	0	0	0	0	15	20	15	15
AYK	0	0	0	0	0	0	0	0	0	0	0	0
BE1	40	0	45	0	0	0	0	0	0	0	0	0
BE2	30	32	30	33	30	11	30	12	0	0	0	0
BE3	15	18	15	18	15	11	15	9	0	0	0	0
BL	15	16	15	17	0	0	0	0	0	0	0	0
BY	0	0	0	0	0	0	0	0	0	0	0	0
BV2	30	12	30	16	0	0	0	0	30	16	30	18
BV3	0	0	0	0	15	5	15	5	0	0	0	0
BT	15	12	15	8	0	0	0	0	60	50	60	36
BC1	30	28	30	28	15	10	15	10	15	17	15	10
BC2	15	16	15	13	15	13	15	11	0	0	0	0
BCEVK	15	17	15	17	0	0	0	0	0	0	0	0
BYC1	0	0	0	0	0	0	0	0	0	0	0	0
BYC2	15	12	15	0	0	0	0	0	0	0	0	0
CN1	15	0	14	0	0	0	0	0	30	0	26	0
CN2	15	22	15	19	15	9	15	9	0	0	0	0
EML	0	0	0	0	0	0	0	0	0	0	0	0
GE	30	29	30	26	0	0	0	0	0	0	0	0
GB	0	0	0	0	0	0	0	0	0	0	0	0
GY1	45	28	45	19	15	9	15	7	45	19	45	18
GY2	0	0	0	0	0	0	0	0	0	0	0	0
HT1	25	0	30	0	0	0	0	0	30	0	30	0
HT2	15	18	15	16	15	5	15	6	0	0	0	0
IZR2	30	13	30	ST	15	8	15	ST	30	14	30	0
IZR3	90	78	90	80	30	30	30	34	0	0	0	0
IZR4	0	0	0	0	0	0	0	0	45	55	45	56
KB1	******	******	******	******	60	36	60	40	15	8	15	9
KB2	60	69	60	56	******	******	******	******	0	0	0	0
KY1	15	0	15	0	0	0	0	0	******	******	******	******
KY2	15	11	15	8	15	5	15	5	90	90	90	71
MVS	0	0	0	0	0	0	0	0	0	0	0	0
MK1	30	21	30	19	15	9	15	7	0	0	0	0
MK3	45	0	45	0	0	0	0	0	23	0	15	0
MK4	45	0	47	0	0	0	0	0	30	0	41	0
MK5	45	39	45	34	15	12	15	13	45	27	45	21
ND	0	0	0	0	0	0	0	0	0	0	0	0
ST	75	70	75	58	45	42	45	45	105	90	105	74
YS1	30	26	30	26	15	9	15	9	30	13	30	13
YS2	15	18	15	16	15	9	15	8	0	0	0	0

	KARSIYAKA2				MAVISEHIR				MERKEZI			
	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC
AB1	60	56	60	60	15	5	15	7	15	14	16	16
AB2	30	27	30	28	15	0	15	0	15	8	15	9
AL1	0	0	30	0	30	0	30	0	0	0	0	0
AL2	30	20	30	16	0	0	0	0	30	33	30	35
AYK	15	7	15	6	0	0	0	0	15	8	15	8
BE1	15	0	15	0	0	0	0	0	0	0	0	0
BE2	15	12	15	11	0	0	0	0	15	15	15	20
BE3	15	7	15	12	0	0	0	0	0	0	0	0
BL	15	12	15	13	0	0	0	0	15	14	15	15
BY	0	0	0	0	0	0	0	0	0	0	0	0
BV2	30	19	30	24	0	0	0	0	30	6	30	10
BV3	30	14	30	13	0	0	0	0	30	13	30	13
BT	60	52	60	53	30	0	30	0	15	12	15	8
BC1	15	10	15	14	15	3	15	3	15	5	15	18
BC2	15	6	15	7	0	0	0	0	15	11	15	9
BCEVK	15	7	15	7	0	0	0	0	15	10	15	10
BYC1	30	0	30	0	0	0	0	0	0	0	0	0
BYC2	45	27	45	0	0	0	0	0	15	0	15	0
CN1	15	0	15	0	0	0	0	0	0	0	0	0
CN2	30	17	30	14	0	0	0	0	30	26	30	26
EML	0	0	0	0	0	0	0	0	0	0	0	0
GE	0	0	0	0	0	0	0	0	15	11	15	11
GB	0	0	0	0	0	0	0	0	0	0	0	0
GY1	30	18	30	22	15	0	15	0	30	15	30	19
GY2	15	9	15	11	0	0	0	0	15	9	15	9
HT1	15	0	15	0	0	0	0	0	0	0	0	0
HT2	15	15	15	12	0	0	0	0	15	15	15	16
IZR2	15	12	15	0	15	5	15	0	30	23	30	0
IZR3	0	0	0	0	0	0	0	0	0	0	0	0
IZR4	105	79	105	86	30	11	30	11	90	93	150	129
KB1	15	9	15	10	0	0	0	0	30	13	30	20
KB2	15	5	15	5	0	0	0	0	15	5	15	9
KY1	90	0	90	0	0	0	0	0	0	0	0	0
KY2	******	******	******	******	30	0	30	0	30	17	30	33
MVS	0	0	0	0	******	******	******	******	0	0	0	0
MK1	30	32	30	16	0	0	0	0	******	******	******	******
MK3	15	0	15	0	0	0	0	0	15	0	15	0
MK4	15	0	15	0	0	0	0	0	30	0	30	0
MK5	45	26	45	39	0	0	0	0	75	62	75	51
ND	0	0	0	0	0	0	0	0	15	7	15	9
ST	60	39	60	38	45	0	45	0	90	100	120	56
YS1	15	13	15	17	0	0	0	0	30	21	30	27
YS2	15	27	15	9	0	0	0	0	15	16	15	17

Table 5.5 A matrix form of exchanges including available and necessary trunk numbers according to traffic load for May 1996

	MERKEZ3				MERKEZ4				MERKEZ5			
	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC
AB1	25	12	20	15	45	15	45	16	45	24	45	33
AB2	0	0	0	0	0	0	0	0	15	12	15	13
AL1	0	0	0	0	72	0	60	0	82	0	84	0
AL2	15	21	15	18	30	35	22	24	70	65	75	59
AYK	0	0	0	0	0	0	0	0	15	17	15	14
BE1	36	0	57	0	87	0	52	0	60	0	60	0
BE2	15	15	15	15	15	17	15	18	45	33	45	37
BE3	0	0	0	0	0	0	0	0	30	18	30	19
BL	0	0	0	0	15	16	15	17	45	29	45	33
BY	0	0	0	0	0	0	0	0	30	0	30	0
BV2	45	8	45	7	45	10	45	8	75	15	75	14
BV3	0	0	0	0	0	0	0	0	30	28	30	26
BT	30	3	45	6	30	13	30	13	45	14	45	23
BC1	30	31	30	13	30	31	30	18	60	31	60	32
BC2	0	0	0	0	0	0	0	0	15	14	15	14
BCEVK	0	0	0	0	0	0	0	0	30	18	30	17
BYC1	19	0	20	0	0	0	0	0	15	0	15	0
BYC2	0	0	0	0	0	0	0	0	30	39	30	0
CN1	49	0	55	0	42	0	60	0	60	0	60	0
CN2	15	17	15	17	30	26	30	17	60	55	60	48
EML	0	0	0	0	0	0	0	0	0	0	0	0
GE	0	0	0	0	0	0	0	0	30	23	30	26
GB	0	0	0	0	0	0	0	0	15	11	15	0
GY1	45	27	45	19	60	37	60	32	60	39	60	44
GY2	0	0	0	0	0	0	0	0	15	18	15	18
HT1	39	0	40	0	47	0	46	0	45	0	45	0
HT2	15	13	15	12	15	15	15	15	30	26	30	17
IZR2	30	17	30	0	30	34	30	0	75	27	75	0
IZR3	0	0	0	0	0	0	0	0	0	0	0	0
IZR4	75	75	75	77	105	100	105	113	300	222	300	286
KB1	30	17	30	17	45	20	45	18	45	34	45	35
KB2	0	0	0	0	0	0	0	0	15	15	15	13
KY1	0	0	24	0	27	0	30	0	45	0	45	0
KY2	15	14	15	13	15	15	15	13	45	40	45	27
MVŞ	0	0	0	0	0	0	0	0	0	0	0	0
MK1	15	23	15	20	30	38	30	20	75	79	75	65
MK3	******	******	******	******	149	0	150	0	83	0	83	0
MK4	150	0	149	0	******	******	******	******	90	0	120	0
MK5	83	62	86	49	120	78	90	57	******	******	******	******
ND	15	11	15	9	15	11	15	9	30	17	30	17
ST	90	79	75	65	60	58	60	28	105	108	105	78
YS1	45	25	30	22	60	29	45	26	75	52	75	51
YS2	0	0	0	0	0	0	0	0	45	3	45	22

	NARLIDERE				SAYISALTANDEM				YENISEHIR1				YENISEHIR2			
	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC	OAVL	ONEC	IAVL	INEC
AB1	0	0	0	0	75	56	75	60	30	22	30	17	15	14	15	14
AB2	0	0	0	0	75	90	75	79	15	12	15	9	0	0	0	0
AL1	115	0	90	0	0	0	0	0	105	0	75	0	40	0	40	0
AL2	0	0	0	0	120	121	120	115	30	33	30	26	15	18	15	19
AYK	0	0	0	0	75	49	45	40	15	12	15	11	15	8	15	8
BE1	15	0	15	0	60	0	60	0	30	0	30	0	0	0	0	0
BE2	15	11	15	12	60	60	60	65	30	21	30	19	0	0	0	0
BE3	0	0	0	0	75	81	75	74	0	0	0	0	0	0	0	0
BL	15	29	15	22	90	74	90	83	30	16	30	10	15	10	15	10
BY	0	0	0	0	105	0	105	0	0	0	0	0	0	0	0	0
BV2	15	10	15	11	90	61	90	80	60	21	60	18	15	13	15	14
BV3	0	0	0	0	105	99	75	81	15	21	15	18	15	14	15	15
BT	0	0	0	0	90	61	90	54	15	16	15	14	0	0	0	0
BC1	15	14	15	17	60	54	60	69	60	45	60	45	30	23	30	25
BC2	0	0	0	0	60	60	60	62	0	0	0	0	15	0	15	0
BCEVK	0	0	0	0	75	62	75	81	15	20	15	19	15	0	15	0
BYC1	0	0	0	0	60	0	59	0	0	0	0	0	0	0	0	0
BYC2	0	0	0	0	105	108	105	0	15	21	15	0	15	11	15	0
CN1	11	0	11	0	60	0	60	0	15	0	15	0	0	0	0	0
CN2	0	0	0	0	90	97	90	97	45	55	45	48	15	25	15	24
EML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GE	0	0	0	0	90	87	90	87	15	11	15	17	15	0	15	0
GB	15	13	15	0	45	31	45	0	0	0	0	0	0	0	0	0
GY1	45	26	45	22	60	40	60	60	45	22	45	18	30	19	30	31
GY2	15	19	15	11	75	68	75	70	0	0	0	0	0	0	0	0
HT1	15	0	15	0	60	0	60	0	25	0	25	0	0	0	0	0
HT2	15	10	15	11	60	48	60	45	15	11	15	12	15	9	15	10
IZR2	15	12	15	ST	105	34	105	0	30	19	30	0	15	13	15	0
IZR3	75	60	75	55	135	37	45	7	0	0	0	0	0	0	0	0
IZR4	0	0	0	0	105	106	45	5	120	122	120	124	60	65	60	70
KB1	0	0	0	0	75	80	75	72	30	27	30	26	15	18	15	18
KB2	0	0	0	0	45	113	45	83	15	9	15	5	15	9	15	11
KY1	0	0	0	0	105	0	105	0	25	0	30	0	0	0	0	0
KY2	0	0	0	0	60	44	60	41	15	17	15	12	15	9	15	26
MVŞ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MK1	15	10	15	14	120	108	90	100	30	29	30	20	15	19	15	14
MK3	15	0	15	0	75	0	90	0	42	0	30	0	0	0	0	0
MK4	15	0	15	0	60	0	60	0	55	0	44	0	0	0	0	0
MK5	30	16	30	14	105	80	105	103	75	53	75	50	45	23	45	3
ND	******	******	******	******	45	54	45	50	15	9	15	11	0	0	0	0
ST	45	52	45	56	******	******	******	******	90	84	90	67	75	86	105	67
YS1	15	9	15	9	90	66	90	81	******	******	******	******	90	69	90	89
YS2	0	0	0	0	105	119	75	86	90	67	90	48	******	******	******	******

5.1.3 Performance per Route

S-12 exchanges can also observe every route individually. And it has a lot of measurement counters per route. If these observations are studied using Erlang B formula for occupancy counters, the amount of trunk numbers per route can be increased or decreased or not modified. Table 5.1 and Table 5.2 show the values per route for CINARLI_2 exchange at October 1996 and November 1996, respectively. Traffic reports gathered from CINARLI_2 exchange were processed using EC7 ANALYZER and it was decided to modify the amounts of trunk numbers per route. Table 5.3 shows the traffic report processed by EC7 ANALYZER. Table 5.3 is saved in a file in a PC and transferred to EXCEL-5 for WINDOWS 3.1. To organize these values, the file is linked to a destination file. For instance Table 5.4 is linked to Table 5.3 in the PC and shows the differences between the amount of available and necessary (according to traffic loading) trunk numbers at 1996 about CINARLI_2 exchange per route. If Table 5.4 is studied, the minus values per route are undesirable and therfore the number of trunks per route for minus values must be increased. Also Table 5.1 and Table 5.2 linked to Table 5.3, too. If Table 5.1 is studied, for instance ALAYBEY1 route, available (outgoing and incoming) trunk numbers are not enough in traffic loading for October 1996. But if Table 5.2 is studied, trunk numbers for ALAYBEY1 route were increased and positive result can also be seen from the Table 5.2. By use of Erlang B formula, the positive results were obtained and the service quality of very busy routes were improved.

EC7 ANALYZER can observe these counters per route:

44 = Incoming occupancy (Incoming counter per route).

57 = Incoming trunk seizures (Incoming counter per route).

360 = Incoming assigned trunk numbers (Incoming counter per route).

361 = Incoming available trunk numbers (Incoming counter per route).

135 = Outgoing call attempts (Outgoing counter per route).

155 = Outgoing occupancy ((1/ 100) Erl) (Outgoing counter per route).

161 = At the time while all trunks are busy, outgoing call attempts offered to an alternative route (Outgoing counter per route).

165 = Outgoing call attempts, no alternated, rejected (Outgoing counter per route).

167 = Outgoing trunk seizures (Outgoing counter per route).

363 = Outgoing assigned trunk numbers (Outgoing counter per route).

364 = Outgoing available trunk numbers (Outgoing counter per route) [16].

At the end of these measurements, it is shown that, whether the amount of trunk numbers per route is enough or not by means of 44 and 155 counters. It is also shown that whether the amount of trunk numbers of alternative routes is enough or not by means of 135, 155, 161, 165 and 167 counters values in the case of overflow. Since, every exchange consisting of network are observed at the same time interval, 167 counter value for other exchanges must be equal or approximately equal to 57 counter values of own exchanges for the same route. Also, transmission blockages on trunks or software faults for trunk assignments are located at the measurement time by means of 360, 361, 363, 364 counter values [16].

S-12 exchanges can observe many different type of measurements, but for the traffic engineering point of view, the most necessary counters as given above. If a problem is fixed, other counters related with the problem can be observed.

5.2 Importance of EC7 ANALYZER

Telephone network consists of a lot of different type and a lot of different brands of exchanges. But in Izmir, the majority of exchanges are S-12 (produced by Alcatel-Teletaş). The traffic evaluation of networks and organization are verified by the network-traffic engineering group of switching department. The digital exchanges are connected to a UNIX system, and transmit the different messages to the system disk. Traffic reports can be transferred from exchanges by means of a PC (via a modem) or UNIX system (leased-line operating). There are a lot of exchanges on the network and traffic reports have large values of data. In this case, by processing of EC7 ANALYZER, the traffic observations and performance measurements can be immediately evaluated. Thus, the efficiency of network-traffic engineering group can be increased.

By observing BORNOVA_2 and CINARLI_1 routes on Table 5.3, respectively, the followings are seen:

BORNOVA_2 route: There is 11.15 erlang occupancy (carried traffic) from BORNOVA_2 exchange to CINARLI_2 exchange (ICOCC-counter 44), there are 445 calls from BORNOVA_2 exchange to CINARLI_2 exchange (ICSZR-counter 57) (The call attempts to CINARLI_2 exchange from BORNOVA_2 exchange might be more than 445, but CINARLI_2 exchange could count only the amount of incoming trunk seizure numbers per route). There are 45 assigned (ICASS-counter 360), 30 available (ICAVL-counter 361) incoming trunks; ICASS means only assigned number of trunks in software, but in every time, whole assigned trunks aren't run (Some portion of assigned trunks can be turned off by the exchange personal, or some times if there are a lot of interferences in communications lines some trunks might be in an external blocked position). 21 trunks are been necessary according to 11.15 erlang occupancy in traffic loading by using Erlang B formula (ICNCSR) (diff = ICAVL - ICNCSR; if the difference between available and necessary trunk numbers is a positive value, trunk numbers are enough in traffic loading). To BORNOVA_2 exchange from CINARLI_2 exchange there are 813 call-attempts (OGATT-counter 135), 642 trunk-seizures (OGSZR-counter 167) and, for these seizures, 13.25 erlang occupancy in traffic loading (OGOCC- counter 155). 25 trunks are been necessary according to 13.25 erlang occupancy in traffic loading by using Erlang B formula (OGNCSR) (diff = OGAVL - OGNCSR; if the difference between available and necessary trunk numbers is a positive value, the available trunk numbers are enough). But there are 172 overflows to an alternative route (OGOVF-counter 161), and by means of the alternative route (for this exchange and for this route the alternative route is STANDEM route), these overflows seize idle trunks on STANDEM route (OGREJN-counter 165). If the difference between OGAVL and OGNCSR is a positive value, why are there 172 overflows? There may be a network maintenance or other reasons. But the calls are transmitted to other exchanges. The only problem is that, are these 172 overflows received from BORNOVA_2? By looking up to this report, it can't be determined. If there isn't any overflow at the same time period from STANDEM exchange to BORNOVA_2 exchange, these calls are successful.

CINARLI_1 route: ICOCC = 15.31 erlang, ICSZR = 650, ICASS = 45, ICAVL = 45, ICNCSR = 26, OGATT = 638, OGSZR = 645, OGOCC = 14.41 erlang, OGOVF = 0, OGREJN = 0 and OGNCSR = 25. As a result it can be said trunk numbers are enough. But OGSZR must be less than or equal to OGATT. Because of the trunk blockages at the measurement time interval (OGAVL=36.25), sometimes, counters may measure unreliably.

CINARLI_1 exchange is an analog type Xbar exchange. On analog exchange routes, the external blockage positions on trunks could often be encountered.

Consequently, the alternative routes for each route must be known by traffic engineers for a reliably evaluation. The alternative routes for each route and these results are input to a PC as shown in Table 5.1 and Table 5.2. These tables are linked to other files in PC as shown in Table 5.4 and Table 5.5. Table 5.4 and Table 5.5 obtain a healthy consideration for each exchange and the network, respectively.

5.3 Matrix Form Studying for Telephone Networks

In Izmir metropolitan area, there is a mesh structure network. An exchange has routes to the most of other exchanges. And the network structure can be accepted as static. By means of "common channel signaling communication" [2] an intelligent network can be established. In intelligent networks, there are dynamic routing methods according to the traffic flowe. Traffic evaluation results are linked to a matrix form table. The matrix form table consists of rows and columns including the amount of available and necessary trunk numbers according to traffic loading. In this way a SCADA(Supervisory Control And Data Acquisition) system can be obtained for a dynamic trunk organization concerning to the matrix form data base[1][2]. The SCADA system can decide on the traffic flowing on running networks. So, when the "common channel signaling (NO:7 signaling)" communication [1] system is established, this tabulating method would be used for a basic routing reference on networks. Table 5.5 shows a matrix table for metropolitan network of Izmir at May 1996. Unfortunately, there are a lot of analog type exchanges called Xbar on network and therefore statistical or traffic measurements can't be taken. On Table 5.5 the analog type exchanges are ALSANCAK_1, BAHCELIEVLER_1, BAYRAKLI, BUYUKCIGLI_1, KARSIYAKA_1, HATAY_1, MERKEZ_3, MERKEZ_4 and CINARLI_1. For this reason, the prediction and routing methods can't be reliably taken on network.

CHAPTER SIX

CONCLUSIONS

6.1 Results

On telephone exchange networks, to obtain the maximum efficiency of exchanges and network, the traffic flowing and statistical measurements must be taken at busy hours, and reports must be evaluated according to basics of traffic science. For healthy evaluation, the measurements must be taken at the same time interval on every exchanges and a traffic engineer must program a PC or other computer systems. According to measurement results the reorganizations must be obtained. As a result of the analysis the amount of trunk numbers can be increased, decreased or not modified, sometimes only alternative routes can be changed or not modified.

6.2 Future Work

Further improvements in performance of the traffic engineering on telephone networks could be carried out in the following areas;

1. Every type exchanges can be connected to a central system, and the measurements can be activated from this system. And the reports gathered from these exchanges must be evaluated by computer programs programmed by engineers at this system.

2. A dynamic routing system and communication medium can be established.

3. To provide compatibility between exchanges , all exchanges must be installed with software programs which run with NO:7 signaling and the analog type exchanges can be changed with digital types.

4. On network, an intelligent system can be run.

5. In spite of all of the explanations given above, a qualified traffic engineer should be able to research about every possible options of a network.

REFERENCES

(1) Bartleson, A. (1991, January). Introduction to Scada. Energy Environmental News. 8, 5-10.

(2) Alcatel-Bell-Teletaş. (1992). Yeni Şebekeler Tanıtım Programı. Ankara.

(3) L. Freeman, Roger. Telecommunication System Engineering. (2nd ed.). John Wiley & Sons. New York. 1989.

(4) CCITT. Red Books, VII Plenary, Q. Recommendations. (Recommendation Q. 40). Malaga-Torremolinos. 1984

(5) CCITT. Red Books, VII Plenary, E. Recommendations. (Recommendation E. 600). Malaga-Torremolinos. 1984.

(6) Durusoy, Günsel. Teletrafik I. ITU Electrical & Electronics Faculty. 1988.

(7) Northern Electric Company Limited. (1978). Theory of Telephone Traffic Engineering-Course 206E. Canada.

(8) Kurt, Sedat. (1996, June 28). (Personal interview). Izmir.

(9) Karafakioğlu, Bedri. Komütasyon Dersleri-Kısım I-Manuel Telefon Komütasyonu. (2.nd ed.). ITU Electrical Faculty. Istanbul. 1981.

(10) Karafakioğlu, Bedri. Santrallar Arası Trafik Hesaplamaları. ITU Electrical Faculty. Istanbul. 1981.

(11) Karafakioğlu, Bedri. Komütasyon: Alet Sayısı Hesabı Notları-Kısım II. ITU Electrical Faculty. Istanbul. 1976.

(12) Günsel, Durusoy. Telekomünikasyon Bağlaşma Sistemleri-Kısım I-Temel Prensipler. ITU Electrical & Electronics Faculty. Istanbul. 1990.

(13) Murray Hill, N.J. Engineering and Operations in the Bell System. (2nd ed.). AT&T Bell Laboraties. 1983.

(14) CCITT. Red Books, VII Plenary, Q. Recommendations. (Recommendation Q.87). Malaga-Torremolinos. 1984.

(15) Durusoy, Günsel. Teletrafik II. ITU Electrical & Electronics Faculty. 1988.

(16) Teletaş. (1991). Sistem-12 Santrallarında Trafik Analizleri. Istanbul.

APPENDICES

A. EC7 ANALYZER

B. S-12 EXCHANGE TRAFFIC & STATISTICAL REPORTS

APPENDIX A

EC7 TRAFFIC ANALYZER SOFTWARE IN QBASIC PRAGRAMMING LANGUAGE

```
DIM CONTR$(300)
   FOR I = 1 TO 300: CONTR$(I) = " ": NEXT I
   YONUZ = 0
   SATIR2$ = " "
   SATIR1$ = " "
SANTRAL$ = " "
TARIH$ = " "
OPEN "PARAVAN" FOR RANDOM AS #2 LEN = 28
OPEN "PARAVANT" FOR RANDOM AS #3 LEN = 28
OPEN "PRVNTRK" FOR RANDOM AS #4 LEN = 95
OPEN "PRVNGOS" FOR RANDOM AS #5 LEN = 262
OPEN "PRVNTEK" FOR RANDOM AS #6 LEN = 95
OPEN "PRVNTEK2" FOR RANDOM AS #7 LEN = 103
CLOSE

BAS: CLS
   LOCATE 13, 5

INPUT "INPUT TRAFFIC REPORTS FILE NAME ..............EXIT<ENTER>"; KA1$
IF KA1$ = "" THEN END
ON ERROR GOTO HATA
OPEN KA1$ FOR INPUT AS #1
KILL "PARAVAN"
KILL "PARAVANT"
KILL "PRVNTRK"
KILL "PRVNGOS"
KILL "PRVNTEK"
KILL "PRVNTEK2"
OPEN "PARAVAN" FOR RANDOM AS #2 LEN = 28
  TYPE YAPI
   CONTOR AS STRING * 3
   YON AS STRING * 18
   OLCUM AS STRING * 7
  END TYPE
 DIM SHARED SATIR AS YAPI

DO UNTIL EOF(1)
 LINE INPUT #1, SATIR1$
 BASTEST$ = LTRIM$(RTRIM$(MID$(SATIR1$, 23, 4)))
 SELECT CASE BASTEST$
 CASE "    "
 GOTO EX
 CASE "1996"
 SANTRAL$ = LTRIM$(RTRIM$(MID$(SATIR1$, 5, 18)))
 TARIH$ = LTRIM$(RTRIM$(MID$(SATIR1$, 23, 10)))
  GOTO EX1
 CASE "1997"
 SANTRAL$ = LTRIM$(RTRIM$(MID$(SATIR1$, 5, 18)))
 TARIH$ = LTRIM$(RTRIM$(MID$(SATIR1$, 23, 10)))
  GOTO EX1
 CASE "1998"
 SANTRAL$ = LTRIM$(RTRIM$(MID$(SATIR1$, 5, 18)))
```

```
 TARIH$ = LTRIM$(RTRIM$(MID$(SATIR1$, 23, 10)))
   GOTO EX1
 CASE "1999"
 SANTRAL$ = LTRIM$(RTRIM$(MID$(SATIR1$, 5, 18)))
 TARIH$ = LTRIM$(RTRIM$(MID$(SATIR1$, 23, 10)))
   GOTO EX1
 CASE "2000"
 SANTRAL$ = LTRIM$(RTRIM$(MID$(SATIR1$, 5, 18)))
 TARIH$ = LTRIM$(RTRIM$(MID$(SATIR1$, 23, 10)))
 GOTO EX1
EX: END SELECT
LOOP
EX1:
 I = 0
CLOSE #1
OPEN KA1$ FOR INPUT AS #1
DO UNTIL EOF(1)
  LINE INPUT #1, SATIR2$
  TEST$ = MID$(SATIR2$, 91, 3)
  IF TEST$ = ". ." THEN
   CONT$ = LTRIM$(RTRIM$(MID$(SATIR2$, 4, 4)))
   YONU$ = LTRIM$(RTRIM$(MID$(SATIR2$, 61, 18)))
   OLC$ = LTRIM$(RTRIM$(MID$(SATIR2$, 97, 8)))

   I = I + 1

   SATIR.CONTOR = CONT$
   SATIR.YON = YONU$
   SATIR.OLCUM = OLC$

   PUT #2, I, SATIR

   ELSE GOTO L
  END IF

L: LOOP

   KAYSAY = I
   CLOSE
DEN:   OPEN "PARAVANT" FOR RANDOM AS #2 LEN = 28
     TYPE YAPITT
     CONTORT AS STRING * 3
     YONT AS STRING * 18
     OLCUMT AS STRING * 7
    END TYPE
 DIM SHARED SATIRT AS YAPITT
 OPEN "PARAVAN" FOR RANDOM AS #1 LEN = 28
 CCC = 0
 FOR C = 1 TO KAYSAY
 GET #1, C, SATIR
   IF SATIR.YON = "........   " THEN
  SATIRT.YONT = SATIR.YON
  SATIRT.CONTORT = SATIR.CONTOR
  SATIRT.OLCUMT = SATIR.OLCUM
  CCC = CCC + 1
  PUT #2, CCC, SATIRT
  ELSE
  GOTO N
  END IF
N:  NEXT C

  FOR C = 1 TO KAYSAY
 GET #1, C, SATIR
   IF SATIR.YON <> "........   " THEN
  SATIRT.YONT = SATIR.YON
  SATIRT.CONTORT = SATIR.CONTOR
```

```
 SATIRT.OLCUMT = SATIR.OLCUM
 CCC = CCC + 1
 PUT #2, CCC, SATIRT
 ELSE
 GOTO NN
 END IF
NN:  NEXT C
 CLOSE

 CLS
 LOCATE 13, 5
 PRINT "EXCHANGE    :"; SANTRAL$
 PRINT "DATE        :"; TARIH$
 PRINT
 PRINT
 PRINT
 PRINT "THE PROCESSING IS BEING EXECUTED................"
 OPEN "PARAVANT" FOR RANDOM AS #1 LEN = 28
 OPEN "PRVNTRK" FOR RANDOM AS #2 LEN = 95
 TYPE YAPITRK
   YON AS STRING * 18
   T44 AS STRING * 7
   T57 AS STRING * 7
   T135 AS STRING * 7
   T155 AS STRING * 7
   T161 AS STRING * 7
   T165 AS STRING * 7
   T167 AS STRING * 7
   T360 AS STRING * 7
   T361 AS STRING * 7
   T363 AS STRING * 7
   T364 AS STRING * 7
 END TYPE

 DIM SHARED TRK AS YAPITRK
 OPEN "PRVNGOS" FOR RANDOM AS #3 LEN = 262

 TYPE YAPIGOS
  G33 AS STRING * 5
  G40 AS STRING * 5
  G43 AS STRING * 5
  G53 AS STRING * 5
  G56 AS STRING * 5
  G65 AS STRING * 5
  G67 AS STRING * 5
  G68 AS STRING * 5
  G69 AS STRING * 5
  G70 AS STRING * 5
  G72 AS STRING * 5
  G81 AS STRING * 5
  G85 AS STRING * 5
  G88 AS STRING * 5
  G89 AS STRING * 5
  G90 AS STRING * 5
  G92 AS STRING * 5
  G101 AS STRING * 5
  G104 AS STRING * 5
  G134 AS STRING * 5
  G139 AS STRING * 5
  G146 AS STRING * 5
  G154 AS STRING * 5
  G166 AS STRING * 5
  G175 AS STRING * 5
  G177 AS STRING * 5
  G178 AS STRING * 5
  G185 AS STRING * 5
```

```
  G192 AS STRING * 5
  G195 AS STRING * 5
  G199 AS STRING * 5
  G201 AS STRING * 5
  G204 AS STRING * 5
  G205 AS STRING * 5
  G208 AS STRING * 5
  G210 AS STRING * 5
  G212 AS STRING * 5
  G213 AS STRING * 5
  G229 AS STRING * 5
  G230 AS STRING * 5
  G247 AS STRING * 7
  G253 AS STRING * 5
  G256 AS STRING * 5
  G260 AS STRING * 5
  G264 AS STRING * 5
  G266 AS STRING * 5
  G277 AS STRING * 5
  G281 AS STRING * 5
  G301 AS STRING * 5
  G304 AS STRING * 5
  G305 AS STRING * 5
  G337 AS STRING * 5
END TYPE
 DIM SHARED GOS AS YAPIGOS

  T = 0
  TT = 1
  FOR J = 1 TO KAYSAY
  GET #1, J, SATIRT
  IF SATIRT.YONT = "........  " THEN

  SELECT CASE SATIRT.CONTORT

  CASE "33 "
  GOS.G33 = SATIRT.OLCUMT
  CASE "40 "
  GOS.G40 = SATIRT.OLCUMT
  CASE "43 "
  GOS.G43 = SATIRT.OLCUMT
  CASE "53 "
  GOS.G53 = SATIRT.OLCUMT
  CASE "56 "
  GOS.G56 = SATIRT.OLCUMT
  CASE "65 "
  GOS.G65 = SATIRT.OLCUMT
  CASE "67 "
  GOS.G67 = SATIRT.OLCUMT
  CASE "68 "
  GOS.G68 = SATIRT.OLCUMT
  CASE "69 "
  GOS.G69 = SATIRT.OLCUMT
  CASE "70 "
  GOS.G70 = SATIRT.OLCUMT
  CASE "72 "
  GOS.G72 = SATIRT.OLCUMT
  CASE "81 "
  GOS.G81 = SATIRT.OLCUMT
  CASE "85 "
  GOS.G85 = SATIRT.OLCUMT
  CASE "88 "
  GOS.G88 = SATIRT.OLCUMT
  CASE "89 "
  GOS.G89 = SATIRT.OLCUMT
  CASE "90 "
```

```
GOS.G90 = SATIRT.OLCUMT
CASE "92 "
GOS.G92 = SATIRT.OLCUMT
CASE "101"
GOS.G101 = SATIRT.OLCUMT
CASE "104"
GOS.G104 = SATIRT.OLCUMT
CASE "134"
GOS.G134 = SATIRT.OLCUMT
CASE "139"
GOS.G139 = SATIRT.OLCUMT
CASE "146"
GOS.G146 = SATIRT.OLCUMT
CASE "154"
GOS.G154 = SATIRT.OLCUMT
CASE "166"
GOS.G166 = SATIRT.OLCUMT
CASE "175"
GOS.G175 = SATIRT.OLCUMT
CASE "177"
GOS.G177 = SATIRT.OLCUMT
CASE "178"
GOS.G178 = SATIRT.OLCUMT
CASE "185"
GOS.G185 = SATIRT.OLCUMT
CASE "192"
GOS.G192 = SATIRT.OLCUMT
CASE "195"
GOS.G195 = SATIRT.OLCUMT
CASE "199"
GOS.G199 = SATIRT.OLCUMT
CASE "201"
GOS.G201 = SATIRT.OLCUMT
CASE "204"
GOS.G204 = SATIRT.OLCUMT
CASE "205"
GOS.G205 = SATIRT.OLCUMT
CASE "208"
GOS.G208 = SATIRT.OLCUMT
CASE "210"
GOS.G210 = SATIRT.OLCUMT
CASE "212"
GOS.G212 = SATIRT.OLCUMT
CASE "213"
GOS.G213 = SATIRT.OLCUMT
CASE "229"
GOS.G229 = SATIRT.OLCUMT
CASE "230"
GOS.G230 = SATIRT.OLCUMT
CASE "247"
GOS.G247 = SATIRT.OLCUMT
CASE "253"
GOS.G253 = SATIRT.OLCUMT
CASE "256"
GOS.G256 = SATIRT.OLCUMT
CASE "260"
GOS.G260 = SATIRT.OLCUMT
CASE "264"
GOS.G264 = SATIRT.OLCUMT
CASE "266"
GOS.G266 = SATIRT.OLCUMT
CASE "277"
GOS.G277 = SATIRT.OLCUMT
CASE "281"
GOS.G281 = SATIRT.OLCUMT
CASE "301"
```

```
   GOS.G301 = SATIRT.OLCUMT
   CASE "304"
   GOS.G304 = SATIRT.OLCUMT
   CASE "305"
   GOS.G305 = SATIRT.OLCUMT
   CASE "337"
   GOS.G337 = SATIRT.OLCUMT
   END SELECT
    ELSE GOTO YONANALIZ
    END IF
GET1: NEXT J

SON:
     PUT #3, 1, GOS
    CLOSE #1
    CLOSE #3
    TTT = T
  GOTO TRKDOSYA

YONANALIZ:

 IF TT = 1 THEN CONTR$(1) = SATIRT.CONTORT

 TT = TT + 1
  CONTR$(TT) = SATIRT.CONTORT

 IF CONTR$(TT) <> CONTR$(1) THEN
 GOTO SON
 END IF
 TRK.YON = SATIRT.YONT

 FOR K = J TO KAYSAY
 GET #1, K, SATIRT
 IF SATIRT.YONT = TRK.YON THEN

 SELECT CASE SATIRT.CONTORT
 CASE "44 "
 TRK.T44 = SATIRT.OLCUMT
 CASE "57 "
 TRK.T57 = SATIRT.OLCUMT
 CASE "135"
 TRK.T135 = SATIRT.OLCUMT
 CASE "155"
 TRK.T155 = SATIRT.OLCUMT
 CASE "161"
 TRK.T161 = SATIRT.OLCUMT
 CASE "165"
 TRK.T165 = SATIRT.OLCUMT
 CASE "167"
 TRK.T167 = SATIRT.OLCUMT
 CASE "360"
 TRK.T360 = SATIRT.OLCUMT
 CASE "361"
 TRK.T361 = SATIRT.OLCUMT
 CASE "363"
 TRK.T363 = SATIRT.OLCUMT
 CASE "364"
 TRK.T364 = SATIRT.OLCUMT
 END SELECT

 END IF
 NEXT K
 T = T + 1
 PUT #2, T, TRK
 GOTO GET1
```

```
HATA: CLS
    LOCATE 13, 5
    PRINT "CAN'T OPENED ......"
    PRINT
    PRINT
    PRINT "RETRY PLEASE.........."
    DO: LOOP WHILE INKEY$ = ""
    GOTO BAS

TRKDOSYA:
TYPE YAPITEK
ISTIKAMET AS STRING * 18
TT44 AS STRING * 7
TT57 AS STRING * 7
TT135 AS STRING * 7
TT155 AS STRING * 7
TT161 AS STRING * 7
TT165 AS STRING * 7
TT167 AS STRING * 7
TT360 AS STRING * 7
TT361 AS STRING * 7
TT363 AS STRING * 7
TT364 AS STRING * 7
END TYPE
DIM SHARED TEK AS YAPITEK
OPEN "PRVNTEK" FOR RANDOM AS #1 LEN = 95

DIM YONUZ(2), YONUM$(2), TRK44!(2), TRK57!(2)
DIM TRK135!(2), TRK155!(2), TRK161!(2), TRK165!(2)
DIM TRK167!(2), TRK360!(2), TRK361!(2)
DIM TRK363!(2), TRK364!(2), UZANTI$(2)
FOR I = 1 TO 2: YONUZ(I) = 0: UZANTI$(I) = " ": YONUM$(I) = " ": TRK44!(I) = 0:NEXT I
FOR I = 1 TO 2: TRK57!(I) = 0: TRK135!(I) = 0: TRK155!(I) = 0: UZANTI$(I) = " ":NEXT I
FOR I = 1 TO 2: TRK161!(I) = 0: TRK165!(I) = 0: TRK167!(I) = 0: TRK360!(I) = 0: NEXT I
FOR I = 1 TO 2: TRK361!(I) = 0: TRK363!(I) = 0: TRK364!(I) = 0: NEXT I
SY = 0
  TRKT44$ = "0"
  TRKT57$ = "0"
  TRKT135$ = "0"
  TRKT155$ = "0"
  TRKT161$ = "0"
  TRKT165$ = "0"
  TRKT167$ = "0"
  TRKT360$ = "0"
  TRKT361$ = "0"
  TRKT363$ = "0"
  TRKT364$ = "0"

FOR I = 1 TO TTT
GET #2, I, TRK
  YONUZ(1) = LEN(LTRIM$(RTRIM$(TRK.YON))) - 2
  UZANTI$(1) = MID$(LTRIM$(RTRIM$(TRK.YON)), (YONUZ(1) + 1), 2)
  IF UZANTI$(1) = "_O" OR UZANTI$(1) = "_I" THEN

  YONUM$(1) = MID$(LTRIM$(RTRIM$(TRK.YON)), 1, (YONUZ(1)))

  ELSE

  YONUM$(1) = LTRIM$(RTRIM$(TRK.YON))

  TRK44!(1) = VAL(LTRIM$(RTRIM$(TRK.T44)))
  TRK57!(1) = VAL(LTRIM$(RTRIM$(TRK.T57)))
  TRK135!(1) = VAL(LTRIM$(RTRIM$(TRK.T135)))
  TRK155!(1) = VAL(LTRIM$(RTRIM$(TRK.T155)))
  TRK161!(1) = VAL(LTRIM$(RTRIM$(TRK.T161)))
  TRK165!(1) = VAL(LTRIM$(RTRIM$(TRK.T165)))
```

```
TRK167!(1) = VAL(LTRIM$(RTRIM$(TRK.T167)))
TRK360!(1) = VAL(LTRIM$(RTRIM$(TRK.T360)))
TRK361!(1) = VAL(LTRIM$(RTRIM$(TRK.T361)))
TRK363!(1) = VAL(LTRIM$(RTRIM$(TRK.T363)))
TRK364!(1) = VAL(LTRIM$(RTRIM$(TRK.T364)))
TRKT44$ = " "
TRKT57$ = " "
TRKT135$ = " "
TRKT155$ = " "
TRKT161$ = " "
TRKT165$ = " "
TRKT167$ = " "
TRKT360$ = " "
TRKT361$ = " "
TRKT363$ = " "
TRKT364$ = " "

GOTO TEKIS
END IF

TRK44!(1) = VAL(LTRIM$(RTRIM$(TRK.T44)))
TRK57!(1) = VAL(LTRIM$(RTRIM$(TRK.T57)))
TRK135!(1) = VAL(LTRIM$(RTRIM$(TRK.T135)))
TRK155!(1) = VAL(LTRIM$(RTRIM$(TRK.T155)))
TRK161!(1) = VAL(LTRIM$(RTRIM$(TRK.T161)))
TRK165!(1) = VAL(LTRIM$(RTRIM$(TRK.T165)))
TRK167!(1) = VAL(LTRIM$(RTRIM$(TRK.T167)))
TRK360!(1) = VAL(LTRIM$(RTRIM$(TRK.T360)))
TRK361!(1) = VAL(LTRIM$(RTRIM$(TRK.T361)))
TRK363!(1) = VAL(LTRIM$(RTRIM$(TRK.T363)))
TRK364!(1) = VAL(LTRIM$(RTRIM$(TRK.T364)))
FOR J = (I + 1) TO TTT
GET #2, J, TRK
YONUZ(2) = LEN(LTRIM$(RTRIM$(TRK.YON))) - 2

UZANTI$(2) = MID$(LTRIM$(RTRIM$(TRK.YON)), (YONUZ(2) + 1), 2)
IF UZANTI$(2) = "_O" OR UZANTI$(2) = "_I" THEN

YONUM$(2) = MID$(LTRIM$(RTRIM$(TRK.YON)), 1, (YONUZ(2)))

ELSE

YONUM$(2) = LTRIM$(RTRIM$(TRK.YON))
END IF
IF YONUM$(2) = YONUM$(1) THEN
TRKT44$ = TRK.T44
TRKT57$ = TRK.T57
TRKT135$ = TRK.T135
TRKT155$ = TRK.T155
TRKT161$ = TRK.T161
TRKT165$ = TRK.T165
TRKT167$ = TRK.T167
TRKT360$ = TRK.T360
TRKT361$ = TRK.T361
TRKT363$ = TRK.T363
TRKT364$ = TRK.T364

TEKIS:
 SY = SY + 1
 TEK.ISTIKAMET = YONUM$(1)
 TEK.TT44 = MID$((LTRIM$(RTRIM$(STR$((TRK44!(1) + VAL(LTRIM$(RTRIM$(TRKT44$)))) / 100)))), 1, 5)
 TEK.TT57 = (LTRIM$(RTRIM$(STR$(TRK57!(1) + VAL(LTRIM$(RTRIM$(TRKT57$)))))))
 TEK.TT135 = (LTRIM$(RTRIM$(STR$(TRK135!(1) + VAL(LTRIM$(RTRIM$(TRKT135$)))))))
 TEK.TT155 = MID$((LTRIM$(RTRIM$(STR$((TRK155!(1) + VAL(LTRIM$(RTRIM$(TRKT155$)))) / 100)))), 1,
5)
 TEK.TT161 = (LTRIM$(RTRIM$(STR$(TRK161!(1) + VAL(LTRIM$(RTRIM$(TRKT161$)))))))
```

```
  TEK.TT165 = (LTRIM$(RTRIM$(STR$(TRK165!(1) + VAL(LTRIM$(RTRIM$(TRKT165$)))))))
  TEK.TT167 = (LTRIM$(RTRIM$(STR$(TRK167!(1) + VAL(LTRIM$(RTRIM$(TRKT167$)))))))
  TEK.TT360 = MID$((LTRIM$(RTRIM$(STR$((TRK360!(1) + VAL(LTRIM$(RTRIM$(TRKT360$))))   / 100)))), 1,
5)
  TEK.TT361 = MID$((LTRIM$(RTRIM$(STR$((TRK361!(1) + VAL(LTRIM$(RTRIM$(TRKT361$))))   / 100)))), 1,
5)
  TEK.TT363 = MID$((LTRIM$(RTRIM$(STR$((TRK363!(1) + VAL(LTRIM$(RTRIM$(TRKT363$))))   / 100)))), 1,
5)
  TEK.TT364 = MID$((LTRIM$(RTRIM$(STR$((TRK364!(1) + VAL(LTRIM$(RTRIM$(TRKT364$))))   / 100)))), 1,
5)
   PUT #1, SY, TEK
   END IF
  NEXT J
  NEXT I
  CLOSE

CLS
LOCATE 12, 5
PRINT "CALCULATING IS BEING EXECUTED USING ERLANG FORMULA..................."
TYPE YAPIT
TRUNK AS STRING * 3
TOLL AS STRING * 7
LOKAL AS STRING * 7
END TYPE
DIM SHARED ERLSATIR  AS YAPIT

OPEN "ERLANG.DAT" FOR RANDOM AS #2 LEN = 17

OPEN "PRVNTEK" FOR RANDOM AS #1 LEN = 95
OPEN "AYARFAK.DAT" FOR RANDOM AS #3 LEN = 8
TYPE AYARYAPI
 YUZDE AS STRING * 4
 AYAR AS STRING * 4
END TYPE
DIM SHARED AYAR AS AYARYAPI

TYPE YAPITEK2
ISTIKAMET2 AS STRING * 18
TT442 AS STRING * 7
TT44G AS STRING * 4
TT572 AS STRING * 7
TT1352 AS STRING * 7
TT1552 AS STRING * 7
TT155G AS STRING * 4
TT1612 AS STRING * 7
TT1652 AS STRING * 7
TT1672 AS STRING * 7
TT3602 AS STRING * 7
TT3612 AS STRING * 7
TT3632 AS STRING * 7
TT3642 AS STRING * 7
END TYPE
DIM SHARED TEK2 AS YAPITEK2
OPEN "PRVNTEK2" FOR RANDOM AS #4 LEN = 103
TEKTT155! = 0
TEKTT44! = 0
FOR I = 1 TO (LOF(1) / 95)

 GET #1, I, TEK
 IF VAL(LTRIM$(RTRIM$(TEK.TT135))) = 0 THEN
 TEK2.TT155G = "1  "
 GOTO TRK44
 END IF

 IF VAL(LTRIM$(RTRIM$(TEK.TT161))) >= 0 THEN
```

```
 AYR! = VAL(LTRIM$(RTRIM$(TEK.TT161))) / VAL(LTRIM$(RTRIM$(TEK.TT135)))
IF AYR! < .01 THEN

 TEKTT155! = (VAL(LTRIM$(RTRIM$(TEK.TT155))))
 FOR J = 1 TO (LOF(2) / 17)
 GET #2, J, ERLSATIR
IF VAL(LTRIM$(RTRIM$(ERLSATIR.LOKAL))) >= TEKTT155! THEN
 TEK2.TT155G = LTRIM$(RTRIM$(ERLSATIR.TRUNK))
 GOTO TRK44
END IF
 NEXT J

ELSEIF AYR! >= .01 AND AYR! <= .5 THEN
 FOR S = 1 TO 50
 GET #3, S, AYAR

IF VAL(LTRIM$(RTRIM$(AYAR.YUZDE))) >= AYR! THEN
 AYRKTS! = VAL(LTRIM$(RTRIM$(AYAR.AYAR)))
 TEKTT155! = AYRKTS! * VAL(LTRIM$(RTRIM$(TEK.TT155)))
 GOTO F:
END IF

 NEXT S
F:
 FOR J = 1 TO (LOF(2) / 17)
 GET #2, J, ERLSATIR
IF VAL(LTRIM$(RTRIM$(ERLSATIR.LOKAL))) >= TEKTT155! THEN
 TEK2.TT155G = LTRIM$(RTRIM$(ERLSATIR.TRUNK))
 GOTO TRK44
END IF
 NEXT J
ELSEIF AYR! > .5 THEN
 TEKTT155! = 1.35 * VAL(LTRIM$(RTRIM$(TEK.TT155)))
 FOR J = 1 TO (LOF(2) / 17)
 GET #2, J, ERLSATIR
IF VAL(LTRIM$(RTRIM$(ERLSATIR.LOKAL))) >= TEKTT155! THEN
 TEK2.TT155G = LTRIM$(RTRIM$(ERLSATIR.TRUNK))

 GOTO TRK44
END IF
 NEXT J
END IF
END IF
TRK44:
 TEKTT44! = VAL(LTRIM$(RTRIM$(TEK.TT44)))
 FOR J = 1 TO (LOF(2) / 17)
 GET #2, J, ERLSATIR
 IF VAL(LTRIM$(RTRIM$(ERLSATIR.LOKAL))) >= TEKTT44! THEN
 TEK2.TT44G = LTRIM$(RTRIM$(ERLSATIR.TRUNK))
 GOTO YER
 END IF
 NEXT J
YER:
 TEK2.ISTIKAMET2 = TEK.ISTIKAMET
 TEK2.TT442 = TEK.TT44
 TEK2.TT572 = TEK.TT57
 TEK2.TT1352 = TEK.TT135
 TEK2.TT1552 = TEK.TT155
 TEK2.TT1612 = TEK.TT161
 TEK2.TT1652 = TEK.TT165
 TEK2.TT1672 = TEK.TT167
 TEK2.TT3602 = TEK.TT360
 TEK2.TT3612 = TEK.TT361
 TEK2.TT3632 = TEK.TT363
 TEK2.TT3642 = TEK.TT364
 PUT #4, I, TEK2
```

```
NEXT I
CLOSE
CLS
LOCATE 10, 5
PRINT "GRADE OF SERVICE'S VALUES ARE BEING CALCULATED......................."
FOR F = 1 TO 12000: NEXT F
ABT! = 0: ORG! = 0: INTR! = 0: OROG! = 0: INC! = 0: INCTERM! = 0
 TRANS! = 0: TERM! = 0: OG! = 0
DTMFT! = 0: MFR1T! = 0: SCMDTMFT! = 0: SCMMFR1T! = 0: KK! = 0: KL! = 0: KM! = 0
 OPEN "PRVNGOS" FOR RANDOM AS #1 LEN = 262
 GET #1, 1, GOS
 IF VAL(LTRIM$(RTRIM$(GOS.G247))) <> 0 THEN
 ABT! = 100 * ((VAL(LTRIM$(RTRIM$(GOS.G195))) + VAL(LTRIM$(RTRIM$(GOS.G264))) -
VAL(LTRIM$(RTRIM$(GOS.G337)))) / VAL(LTRIM$(RTRIM$(GOS.G247))))
 ELSE
 ABT! = 0
 END IF
 IF VAL(LTRIM$(RTRIM$(GOS.G205))) <> 0 THEN
 ORG! = ((VAL(LTRIM$(RTRIM$(GOS.G90))) + VAL(LTRIM$(RTRIM$(GOS.G210)))
 + VAL(LTRIM$(RTRIM$(GOS.G192))) + VAL(LTRIM$(RTRIM$(GOS.G204))) + VAL(LTRIM$(
RTRIM$(GOS.G185)))) * 100) / VAL(LTRIM$(RTRIM$(GOS.G205)))
 ELSE
 ORG! = 0
 END IF
 IF VAL(LTRIM$(RTRIM$(GOS.G88))) <> 0 THEN
 INTR! = ((VAL(LTRIM$(RTRIM$(GOS.G92))) + VAL(LTRIM$(RTRIM$(GOS.G101))) + VAL(
LTRIM$(RTRIM$(GOS.G89)))) * 100) / VAL(LTRIM$(RTRIM$(GOS.G88)))
 ELSE
 INTR! = 0
 END IF
 IF (VAL(LTRIM$(RTRIM$(GOS.G230))) - VAL(LTRIM$(RTRIM$(GOS.G212)))) <> 0 THEN
 OROG! = ((VAL(LTRIM$(RTRIM$(GOS.G213))) + VAL(LTRIM$(RTRIM$(GOS.G208)))) * 100)  /
(VAL(LTRIM$(RTRIM$(GOS.G230))) - VAL(LTRIM$(RTRIM$(GOS.G212))))
 ELSE
 OROG! = 0
 END IF
 IF VAL(LTRIM$(RTRIM$(GOS.G56))) <> 0 THEN
 INC! = ((VAL(LTRIM$(RTRIM$(GOS.G70))) + VAL(LTRIM$(RTRIM$(GOS.G277))) + VAL(L
TRIM$(RTRIM$(GOS.G40))) + VAL(LTRIM$(RTRIM$(GOS.G53))) + VAL(LTRIM$(RTRIM$(GO S.G33)))) *
100) / VAL(LTRIM$(RTRIM$(GOS.G56)))
 ELSE
 INC! = 0
 END IF
 IF VAL(LTRIM$(RTRIM$(GOS.G68))) <> 0 THEN
 INCTERM! = ((VAL(LTRIM$(RTRIM$(GOS.G72))) + VAL(LTRIM$(RTRIM$(GOS.G81))) + VAL
(LTRIM$(RTRIM$(GOS.G69)))) * 100) / VAL(LTRIM$(RTRIM$(GOS.G68)))
 ELSE
 INCTERM! = 0
 END IF
 IF (VAL(LTRIM$(RTRIM$(GOS.G277))) - VAL(LTRIM$(RTRIM$(GOS.G281)))) <> 0 THEN
 TRANS! = ((VAL(LTRIM$(RTRIM$(GOS.G301))) * 100) / (VAL(LTRIM$(RTRIM$(GOS.G277)  )) -
VAL(LTRIM$(RTRIM$(GOS.G281)))))
 ELSE
 TRANS! = 0
 END IF
 IF (VAL(LTRIM$(RTRIM$(GOS.G88))) + VAL(LTRIM$(RTRIM$(GOS.G68)))) <> 0 THEN
 TERM! = ((VAL(LTRIM$(RTRIM$(GOS.G260))) + VAL(LTRIM$(RTRIM$(GOS.G253))) + VAL(
LTRIM$(RTRIM$(GOS.G256)))) * 100) / (VAL(LTRIM$(RTRIM$(GOS.G88))) + VAL(LTRIM$
(RTRIM$(GOS.G68))))
 ELSE
 TERM! = 0
 END IF
 IF (VAL(LTRIM$(RTRIM$(GOS.G134))) - VAL(LTRIM$(RTRIM$(GOS.G146)))) <> 0 THEN
 OG! = (VAL(LTRIM$(RTRIM$(GOS.G178))) * 100) / (VAL(LTRIM$(RTRIM$(GOS.G134))  -
VAL(LTRIM$(RTRIM$(GOS.G146))))
 ELSE
```

```
OG! = 0
END IF

T32! = 17.25
DTMFT! = (VAL(LTRIM$(RTRIM$(GOS.G199))) / 100)
MFR1T! = ((VAL(LTRIM$(RTRIM$(GOS.G175))) / 100) + (VAL(LTRIM$(RTRIM$(GOS.G65)))   / 100))

SCMDTMFT! = DTMFT! / T32!
SCMMFR1T! = MFR1T! / T32!
DTMFC! = 0: KK! = 0: KL! = 0: KM! = 0: MFR1C! = 0: SCMDTMFC! = 0: SCMMFR1C! = 0
DTMFSCM! = 0: MFR1SCM! = 0

IF VAL(LTRIM$(RTRIM$(GOS.G199))) <> 0 AND VAL(LTRIM$(RTRIM$(GOS.G201))) <> 0 THEN
DTMFC! = (DTMFT! / (VAL(LTRIM$(RTRIM$(GOS.G199))) / VAL(LTRIM$(RTRIM$(GOS.G201  ))) * 36))
ELSE
DTMFC! = 0
END IF

IF VAL(LTRIM$(RTRIM$(GOS.G67))) <> 0 THEN
KK! = ((VAL(LTRIM$(RTRIM$(GOS.G65))) / VAL(LTRIM$(RTRIM$(GOS.G67)))) * 36)
ELSE
KK! = 0
END IF

IF VAL(LTRIM$(RTRIM$(GOS.G177))) <> 0 THEN
KL! = ((VAL(LTRIM$(RTRIM$(GOS.G175))) / VAL(LTRIM$(RTRIM$(GOS.G177)))) * 36)
ELSE
KL! = 0
END IF

IF KK! < KL! THEN
KM! = KK!
ELSE
KM! = KL!
END IF
IF KM! <> 0 THEN
MFR1C! = MFR1T! / KM!
ELSE
MFR1C! = 0
END IF
SCMDTMFC! = DTMFC! / 8
SCMMFR1C! = MFR1C! / 8

IF (INT(SCMDTMFC!) + 1) > (INT(SCMDTMFT!) + 1) THEN

IF (INT(SCMDTMFC!) + 1) <= 5 THEN
DTMFSCM = (INT(SCMDTMFC!) + 2)
ELSE
DTMFSCM = (INT(SCMDTMFC!) + 1)
END IF

ELSE

IF (INT(SCMDTMFT!) + 1) <= 5 THEN
DTMFSCM = (INT(SCMDTMFT!) + 2)
ELSE
DTMFSCM = (INT(SCMDTMFT!) + 1)
END IF

END IF

IF (INT(SCMMFR1C!) + 1) > (INT(SCMMFR1T!) + 1) THEN

IF (INT(SCMMFR1C!) + 1) <= 5 THEN
MFR1SCM = (INT(SCMMFR1C!) + 2)
ELSE
```

```
MFR1SCM = (INT(SCMMFR1C!) + 1)
END IF

ELSE

IF (INT(SCMMFR1T!) + 1) <= 5 THEN
MFR1SCM = (INT(SCMMFR1T!) + 2)
ELSE
MFR1SCM = (INT(SCMMFR1T!) + 1)
END IF

END IF

CLOSE
CLS
PRINT "OCC_PER_SUBSCR="; ABT!; "*100ERLANG"
PRINT "ORG          ="; ORG!
PRINT "INTR         ="; INTR!
PRINT "OROG         ="; OROG!
PRINT "INC          ="; INC!
PRINT "INCTERM      ="; INCTERM!
PRINT "TRANS        ="; TRANS!
PRINT "TERM         ="; TERM!
PRINT "OG           ="; OG!
PRINT "DTMFSCM      ="; DTMFSCM
PRINT "MFR1SCM      ="; MFR1SCM
PRINT
PRINT
PRINT "HIT ANY KEY FOR CONTINUE......................"
DO: LOOP WHILE INKEY$ = ""

SATIR4$ = "                                          "
SATIR5$ = "ALCATEL S-12 EC7 SOFTWARE TRAFFIC PROGRAMME DEVELOPED FOR DOKUZ EYLUL
UNIVERSITY "
SATIR6$ = " SUBJECT:                                    NETWORK-TRAFFIC ENGINEERING"
SATIR8$ = "DRECTION        ICOCC  ICSZR  ICASS  ICAVL  ICNESS OGATT  OGOCC  OGSZR  OGOVF
OGREJN OGASS  OGAVL  OGNESS"

YAZDIRMA2:
CLS
LOCATE 13, 5
 PRINT "S.....SCREEN            P.....PRINTER"
 PRINT "         E........EXIT"
 PRINT
 PRINT
 PRINT
 PRINT
 PRINT "FOR SAVING A FILE            F........FILE"

 SECIM3$ = UCASE$(INPUT$(1))
IF SECIM3$ = "S" THEN
GOTO EKRAN
ELSEIF SECIM3$ = "P" THEN
GOTO YAZICI
ELSEIF SECIM3$ = "E" THEN
END
ELSEIF SECIM3$ = "F" THEN
GOTO FILE
END IF

YAZICI:
CLS
OPEN "LPT1:" FOR OUTPUT AS #2
LOCATE 13, 5
PRINT "REPORT IS BEING PRINTED ...................... ....."
WIDTH #2, 132
```

```
 PRINT #2, SATIR4$
 PRINT #2, SATIR5$
 PRINT #2, SATIR6$

 PRINT #2, "EXCHANGE: "; SANTRAL$; "                    DATE: "; TARIH$
 PRINT #2, SATIR8$
 OPEN "PRVNTEK2" FOR RANDOM AS #1 LEN = 103
 FOR K = 1 TO (LOF(1) / 103)
 GET #1, K, TEK2
 PRINT #2, TEK2.ISTIKAMET2; TEK2.TT442; TEK2.TT572; TEK2.TT3602; TEK2.TT3612; TEK2.TT44G; "   ";
TEK2.TT1352; EK2.TT1552;TEK2.TT1672; TEK2.TT1612; TEK2.TT1652; TEK2.TT3632; TEK2.TT3642;
TEK2.TT155G  NEXT K
 PRINT #2, SATIR4$
 PRINT #2, "  GRADE OF SERVICES VALUES:..............(% SUCCESS)"
 PRINT #2, "  "; SATIR4$
 PRINT #2, "OCC_PER_SUBSCR(Erlang) ="; ABT!; "*100ERL"

 PRINT #2, "  ORG        ="; ORG!
 PRINT #2, "  INTR       ="; INTR!
 PRINT #2, "  OROG       ="; OROG!
 PRINT #2, "  INC        ="; INC!
 PRINT #2, "  INCTERM    ="; INCTERM!
 PRINT #2, "  TRANS      ="; TRANS!
 PRINT #2, "  TERM       ="; TERM!
 PRINT #2, "  OG         ="; OG!
 PRINT #2, "  DTMFSCM    ="; DTMFSCM
 PRINT #2, "  MFR1SCM    ="; MFR1SCM

 CLOSE

END

EKRAN:
 CLS
 OPEN "CON" FOR OUTPUT AS #2
 WIDTH #2, 132
 PRINT #2, SATIR4$
 PRINT #2, SATIR5$
 PRINT #2, SATIR6$
 PRINT #2, "EXCHANGE: "; SANTRAL$; "                    DATE: "; TARIH$
 PRINT #2, SATIR8$
 OPEN "PRVNTEK2" FOR RANDOM AS #1 LEN = 103
 FOR K = 1 TO (LOF(1) / 103)
 GET #1, K, TEK2
 PRINT #2, TEK2.ISTIKAMET2; TEK2.TT442; TEK2.TT572; TEK2.TT3602; TEK2.TT3612; TEK2.TT44G; "   ";
TEK2.TT1352; TEK2.TT1552; EK2.TT1672; TEK2.TT1612; TEK2.TT1652; TEK2.TT3632; TEK2.TT3642;
TEK2.TT155G
 NEXT K
 PRINT #2, SATIR4$
 PRINT #2, "  GRADE OF SERVICES VALUES:..............(% SUCCESS)"
 PRINT #2, "  "; SATIR4$
 PRINT #2, "  OCC_PER_SUBSCRB(Erlang) ="; ABT!; "*100ERL"

 PRINT #2, "  ORG        ="; ORG!
 PRINT #2, "  INTR       ="; INTR!
 PRINT #2, "  OROG       ="; OROG!
 PRINT #2, "  INC        ="; INC!
 PRINT #2, "  INCTERM    ="; INCTERM!
 PRINT #2, "  TRANS      ="; TRANS!
 PRINT #2, "  TERM       ="; TERM!
 PRINT #2, "  OG         ="; OG!
 PRINT #2, "  DTMFSCM    ="; DTMFSCM
 PRINT #2, "  MFR1SCM    ="; MFR1SCM
 CLOSE
END
```

FILE:

```
INPUT "INPUT NAME OF OUT_FILE.........................."; FILE$
OPEN FILE$ FOR OUTPUT AS #2
 PRINT #2, SATIR4$
 PRINT #2, SATIR5$
 PRINT #2, SATIR6$
 PRINT #2, "EXCHANGE: "; SANTRAL$; "                    DATE: "; TARIH$
 PRINT #2, SATIR8$
 OPEN "PRVNTEK2" FOR RANDOM AS #1 LEN = 103
 FOR K = 1 TO (LOF(1) / 103)
 GET #1, K, TEK2
 PRINT #2, TEK2.ISTIKAMET2; TEK2.TT442; TEK2.TT572; TEK2.TT3602; TEK2.TT3612; TEK2.TT44G; "   ";
TEK2.TT1352; TEK2.TT1552; EK2.TT1672; TEK2.TT1612; TEK2.TT1652; TEK2.TT3632; TEK2.TT3642;
TEK2.TT155G
 NEXT K
 PRINT #2, SATIR4$
 PRINT #2, "  GRADE OF SERVICES VALUES :..............(% SUCCESS)"
 PRINT #2, "  OCC_PER_SUBSCRBR(Erlang) ="; ABT!; "*100ERL"

 PRINT #2, "  ORG        ="; ORG!
 PRINT #2, "  INTR       ="; INTR!
 PRINT #2, "  OROG       ="; OROG!
 PRINT #2, "  INC        ="; INC!
 PRINT #2, "  INCTERM    ="; INCTERM!
 PRINT #2, "  TRANS      ="; TRANS!
 PRINT #2, "  TERM       ="; TERM!
 PRINT #2, "  OG         ="; OG!
 PRINT #2, "  DTMFSCM    ="; DTMFSCM
 PRINT #2, "  MFR1SCM    ="; MFR1SCM

 CLOSE
 END
```

APPENDIX B

ALCATEL S-12(JRACK) EXCHANGE EC7 SOFTWARE TRAFFIC AND STATISTICAL MEASUREMENT REPORTS

M= 115875 DT=06/12/96 21:30:45
CINARLI2_EK11 1996-12-06 21:30:28 FR
000 0000/0000/0000
SEQ=6320+961127 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 6
RECORD PERIOD = 20H 30M - 21H 30M
OUTPUT PERIOD = 20H 30M - 21H 30M
OUTPUT NUMBER = 1

ENTITY	OBJECT	VALUE
33 INCCMIX INVC	....	36
40 INC NO SIG	....	1348
43 INC OCC	....	23213
53 INCCMIX PSIG	....	14
56 INC SEIZ	....	14844
65 INC RCVR OCC	....	393
67 INC RCVR SEIZ	....	14128
68 INCT ACC NBR	....	13929
69 INCT ANSW	....	4581
70 INCT CALLS	....	13452
72 INCT CD BSY	....	6839
81 INCT NO ANSW	....	1586
85 INCT OCC	....	22658
88 INT ACC NBR	....	2682
89 INT ANSW	....	1653
90 INT CALLS	....	2863
92 INT CD BSY	....	386
101 INT NO ANSW	....	648
104 INT OCC	....	5789
134 OG CALL ATT	....	13411
139 OG CALLS	....	13358
146 OG FAIL DIST	....	54
154 OG OCC	....	31001
166 OG SEIZ	....	12377
175 OG SNDR OCC	....	581
177 OG SNDR SEIZ	....	11844
178 OG THRSW	....	12156
185 ORCMIX INVC	....	1037
192 OR NO DIAL	....	8533
195 OR OCC	....	41320
199 OR PBR OCC	....	3655
201 OR PBR SEIZ	....	26775
204 ORCMIX PDIAL	....	1125

205 OR SEIZ	....	26785
208 OROG ANSW	....	5569
210 OROG CALLS	....	13358
212 OROG FAIL DIST	....	54
213 OROG NO ANSW	....	6570
229 OROG OCC	....	30974
230 OROG SEIZ	....	12361
247 SL AVLB OCC	....	3292000
253 TERM ANSW	....	6235
256 TERM CD BSY	....	7225

REPORT FOLLOWS NO = 00035

M= 115875 DT=06/12/96 21:30:45
CINARLI2_EK11 1996-12-06 21:30:28 FR
000 0000/0000/0000
SEQ=6320+961127 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 6
RECORD PERIOD = 20H 30M - 21H 30M
OUTPUT PERIOD = 20H 30M - 21H 30M
OUTPUT NUMBER = 2 = LAST REPORT OF THIS OUTPUT PERIOD

ENTITY	OBJECT	VALUE
260 TERM NO ANSW	....	2234
264 TERM OCC	....	28448
266 TERM SEIZ	....	8465
277 TRNS CALLS	....	0
301 TRNS THRSW	....	17
304 TRNS OCC	....	26
305 TRNS SEIZ	....	16
337 OR PARK OCC	....	18344

REPORT FOLLOWS NO = 00035

M= 115876 DT=06/12/96 21:31:42
CINARLI2_EK11 1996-12-06 21:30:30 FR
000 0000/0000/0000
SEQ=6322+961127 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 6
RECORD PERIOD = 20H 30M - 21H 30M
OUTPUT PERIOD = 20H 30M - 21H 30M
OUTPUT NUMBER = 1

ENTITY	OBJECT	VALUE
135 OG OFFD RTE	.........ALAYBEY_1_O	154
135 OG OFFD RTE	.........ALSANCAK_1_O	74
135 OG OFFD RTE	.........BUCA_1_O	334
135 OG OFFD RTE	.........BEVLER_1_O	87
135 OG OFFD RTE	.........BEVLER_2_O	171
135 OG OFFD RTE	.........BALCOVA_O	127
135 OG OFFD RTE	.........BOSTANLI_O	155
135 OG OFFD RTE	.........BORNOVA_2_O	813
135 OG OFFD RTE	.........CINARLI_1_O	638
135 OG OFFD RTE	.........GAZIEMIR_O	213
135 OG OFFD RTE	.........GYALI_1_O	468
135 OG OFFD RTE	.........HATAY_1_O	69
135 OG OFFD RTE	.........HATAY_2_O	116
135 OG OFFD RTE	.........KBAGLAR_1_O	199

135 OG OFFD RTE	.... KYAKA_2_O	119
135 OG OFFD RTE	.... MERKEZ_3_O	48
135 OG OFFD RTE	.... MERKEZ_4_O	56
135 OG OFFD RTE	.... MERKEZ_5_O	0
135 OG OFFD RTE	.... TEPECIK_1_O	590
135 OG OFFD RTE	.... KBAGLAR_2_O	53
135 OG OFFD RTE	.... IZR_TOLL_4_O	3586
135 OG OFFD RTE	.... STANDEM_O	1250
135 OG OFFD RTE	.... MERKEZ_5_N7	405
135 OG OFFD RTE	.... IZR_TOLL_3_N7	68
135 OG OFFD RTE	.... SPARE_O	0
135 OG OFFD RTE	.... MERKEZ_6_O	0
135 OG OFFD RTE	.... AYKUSAN_O	49
135 OG OFFD RTE	.... CIGLI_2_O	132
135 OG OFFD RTE	.... BAYRAKLI_O	393
135 OG OFFD RTE	.... ALSANCAK_2_O	107
135 OG OFFD RTE	.... EVKA_1_O	147
135 OG OFFD RTE	.... TEPECIK_2_O	366
135 OG OFFD RTE	.... BORNOVA_3_O	488
135 OG OFFD RTE	.... MERKEZ_1_O	98
135 OG OFFD RTE	.... ALAYBEY_2_O	178
135 OG OFFD RTE	.... IZR_TOLL_3_O	734
135 OG OFFD RTE	.... IZR_TOLL_4_N7	64
135 OG OFFD RTE	.... ADMI_DTG	0
135 OG OFFD RTE	.... ACS_DIR	0
135 OG OFFD RTE	.... MDMI_DTG	0
135 OG OFFD RTE	.... LER	0
155 OG OCC RTE	.... ALAYBEY_1_O	611
155 OG OCC RTE	.... ALSANCAK_1_O	168

REPORT FOLLOWS NO = 00035

REPORT FOLLOWS NO = 00035

M= 115878 DT=06/12/96 21:33:15
CINARLI2_EK11 1996-12-06 21:30:54 FR
000 0000/0000/0000
SEQ=6322+961127 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 6
RECORD PERIOD = 20H 30M - 21H 30M
OUTPUT PERIOD = 20H 30M - 21H 30M
OUTPUT NUMBER = 3

ENTITY	OBJECT	VALUE
155 OG OCC RTE	.... BUCA_1_O	1672
155 OG OCC RTE	.... BEVLER_1_O	250
155 OG OCC RTE	.... BEVLER_2_O	609
155 OG OCC RTE	.... BALCOVA_O	409
155 OG OCC RTE	.... BOSTANLI_O	513
155 OG OCC RTE	.... BORNOVA_2_O	1329
155 OG OCC RTE	.... CINARLI_1_O	1441
155 OG OCC RTE	.... GAZIEMIR_O	402
155 OG OCC RTE	.... GYALI_1_O	1457
155 OG OCC RTE	.... HATAY_1_O	327
155 OG OCC RTE	.... HATAY_2_O	361
155 OG OCC RTE	.... KBAGLAR_1_O	645
155 OG OCC RTE	.... KYAKA_2_O	542
155 OG OCC RTE	.... MERKEZ_3_O	141

155 OG OCC RTE	MERKEZ_4_O	112
155 OG OCC RTE	MERKEZ_5_O	100
155 OG OCC RTE	TEPECIK_1_O	1549
155 OG OCC RTE	KBAGLAR_2_O	177
155 OG OCC RTE	IZR_TOLL_4_O	8058
155 OG OCC RTE	STANDEM_O	2901
155 OG OCC RTE	MERKEZ_5_N7	821
155 OG OCC RTE	IZR_TOLL_3_N7	151
155 OG OCC RTE	SPARE_O	0
155 OG OCC RTE	MERKEZ_6_O	0
155 OG OCC RTE	AYKUSAN_O	134
155 OG OCC RTE	CIGLI_2_O	562
155 OG OCC RTE	BAYRAKLI_O	990
155 OG OCC RTE	ALSANCAK_2_O	185
155 OG OCC RTE	EVKA_1_O	499
155 OG OCC RTE	TEPECIK_2_O	1175
155 OG OCC RTE	BORNOVA_3_O	1388
155 OG OCC RTE	MERKEZ_1_O	317
155 OG OCC RTE	ALAYBEY_2_O	323
155 OG OCC RTE	IZR_TOLL_3_O	433
155 OG OCC RTE	IZR_TOLL_4_N7	233
155 OG OCC RTE	ADMI_DTG	0
155 OG OCC RTE	ACS_DIR	0
155 OG OCC RTE	MDMI_DTG	0
155 OG OCC RTE	LER	0
161 OG OFFD ART RTE	ALAYBEY_1_O	0
161 OG OFFD ART RTE	ALSANCAK_1_O	0
161 OG OFFD ART RTE	BUCA_1_O	0
161 OG OFFD ART RTE	BEVLER_1_O	0

REPORT FOLLOWS NO = 00035

M= 115879 DT=06/12/96 21:34:05
CINARLI2_EK11 1996-12-06 21:31:06 FR
000 0000/0000/0000
SEQ=6322+961127 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 6
RECORD PERIOD = 20H 30M - 21H 30M
OUTPUT PERIOD = 20H 30M - 21H 30M
OUTPUT NUMBER = 4

ENTITY	OBJECT	VALUE
161 OG OFFD ART RTE	BEVLER_2_O	0
161 OG OFFD ART RTE	BALCOVA_O	1
161 OG OFFD ART RTE	BOSTANLI_O	0
161 OG OFFD ART RTE	BORNOVA_2_O	172
161 OG OFFD ART RTE	CINARLI_1_O	0
161 OG OFFD ART RTE	GAZIEMIR_O	0
161 OG OFFD ART RTE	GYALI_1_O	0
161 OG OFFD ART RTE	HATAY_1_O	0
161 OG OFFD ART RTE	HATAY_2_O	0
161 OG OFFD ART RTE	KBAGLAR_1_O	0
161 OG OFFD ART RTE	KYAKA_2_O	0
161 OG OFFD ART RTE	MERKEZ_3_O	0
161 OG OFFD ART RTE	MERKEZ_4_O	0
161 OG OFFD ART RTE	MERKEZ_5_O	0
161 OG OFFD ART RTE	TEPECIK_1_O	0
161 OG OFFD ART RTE	KBAGLAR_2_O	0
161 OG OFFD ART RTE	IZR_TOLL_4_O	0

161 OG OFFD ART RTE	STANDEM_O	0
161 OG OFFD ART RTE	MERKEZ_5_N7	0
161 OG OFFD ART RTE	IZR_TOLL_3_N7	0
161 OG OFFD ART RTE	SPARE_O	0
161 OG OFFD ART RTE	MERKEZ_6_O	0
161 OG OFFD ART RTE	AYKUSAN_O	0
161 OG OFFD ART RTE	CIGLI_2_O	0
161 OG OFFD ART RTE	BAYRAKLI_O	26
161 OG OFFD ART RTE	ALSANCAK_2_O	0
161 OG OFFD ART RTE	EVKA_1_O	0
161 OG OFFD ART RTE	TEPECIK_2_O	0
161 OG OFFD ART RTE	BORNOVA_3_O	0
161 OG OFFD ART RTE	MERKEZ_1_O	0
161 OG OFFD ART RTE	ALAYBEY_2_O	0
161 OG OFFD ART RTE	IZR_TOLL_3_O	0
161 OG OFFD ART RTE	IZR_TOLL_4_N7	0
161 OG OFFD ART RTE	ADMI_DTG	0
161 OG OFFD ART RTE	ACS_DIR	0
161 OG OFFD ART RTE	MDMI_DTG	0
161 OG OFFD ART RTE	LER	0
165 OG REJ NART RTE	ALAYBEY_1_O	0
165 OG REJ NART RTE	ALSANCAK_1_O	0

REPORT FOLLOWS NO = 00035

M= 115881 DT=06/12/96 21:36:05
CINARLI2_EK11 1996-12-06 21:31:30 FR
000 0000/0000/0000
SEQ=6322+961127 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 6
RECORD PERIOD = 20H 30M - 21H 30M
OUTPUT PERIOD = 20H 30M - 21H 30M
OUTPUT NUMBER = 5

ENTITY	OBJECT	VALUE
165 OG REJ NART RTE	BUCA_1_O	0
165 OG REJ NART RTE	BEVLER_1_O	0
165 OG REJ NART RTE	BEVLER_2_O	0
165 OG REJ NART RTE	BALCOVA_O	0
165 OG REJ NART RTE	BOSTANLI_O	0
165 OG REJ NART RTE	BORNOVA_2_O	0
165 OG REJ NART RTE	CINARLI_1_O	0
165 OG REJ NART RTE	GAZIEMIR_O	0
165 OG REJ NART RTE	GYALI_1_O	0
165 OG REJ NART RTE	HATAY_1_O	0
165 OG REJ NART RTE	HATAY_2_O	0
165 OG REJ NART RTE	KBAGLAR_1_O	0
165 OG REJ NART RTE	KYAKA_2_O	0
165 OG REJ NART RTE	MERKEZ_3_O	0
165 OG REJ NART RTE	MERKEZ_4_O	0
165 OG REJ NART RTE	MERKEZ_5_O	0
165 OG REJ NART RTE	TEPECIK_1_O	0
165 OG REJ NART RTE	KBAGLAR_2_O	0
165 OG REJ NART RTE	IZR_TOLL_4_O	0
165 OG REJ NART RTE	STANDEM_O	0
165 OG REJ NART RTE	MERKEZ_5_N7	0
165 OG REJ NART RTE	IZR_TOLL_3_N7	0
165 OG REJ NART RTE	SPARE_O	0
165 OG REJ NART RTE	MERKEZ_6_O	0

165 OG REJ NART RTE ....AYKUSAN_O 0
165 OG REJ NART RTE ....CIGLI_2_O 0
165 OG REJ NART RTE ....BAYRAKLI_O 0
165 OG REJ NART RTE ....ALSANCAK_2_O 0
165 OG REJ NART RTE ....EVKA_1_O 0
165 OG REJ NART RTE ....TEPECIK_2_O 0
165 OG REJ NART RTE ....BORNOVA_3_O 0
REPORT FOLLOWS NO = 00035

M= 115882 DT=06/12/96 21:36:31
CINARLI2_EK11 1996-12-06 21:31:42 FR
000 0000/0000/0000
SEQ=6322+961127 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 6
RECORD PERIOD = 20H 30M - 21H 30M
OUTPUT PERIOD = 20H 30M - 21H 30M
OUTPUT NUMBER = 7

ENTITY	OBJECT	VALUE
165 OG REJ NART RTE	.........MERKEZ_1_O	0
165 OG REJ NART RTE	.........ALAYBEY_2_O	0
165 OG REJ NART RTE	.........IZR_TOLL_3_O	0
165 OG REJ NART RTE	.........IZR_TOLL_4_N7	0
165 OG REJ NART RTE	.........ADMI_DTG	0
165 OG REJ NART RTE	.........ACS_DIR	0
165 OG REJ NART RTE	.........MDMI_DTG	0
165 OG REJ NART RTE	.........LER	0
167 OG SEIZ RTE	.........ALAYBEY_1_O	154

REPORT FOLLOWS NO = 00035

M= 115883 DT=06/12/96 21:37:13
CINARLI2_EK11 1996-12-06 21:31:54 FR
000 0000/0000/0000
SEQ=6322+961127 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 6
RECORD PERIOD = 20H 30M - 21H 30M
OUTPUT PERIOD = 20H 30M - 21H 30M
OUTPUT NUMBER = 8

ENTITY	OBJECT	VALUE
167 OG SEIZ RTE	.........ALSANCAK_1_O	74
167 OG SEIZ RTE	.........BUCA_1_O	334
167 OG SEIZ RTE	.........BEVLER_1_O	87
167 OG SEIZ RTE	.........BEVLER_2_O	171
167 OG SEIZ RTE	.........BALCOVA_O	126
167 OG SEIZ RTE	.........BOSTANLI_O	155
167 OG SEIZ RTE	.........BORNOVA_2_O	642
167 OG SEIZ RTE	.........CINARLI_1_O	645
167 OG SEIZ RTE	.........GAZIEMIR_O	213
167 OG SEIZ RTE	.........GYALI_1_O	471
167 OG SEIZ RTE	.........HATAY_1_O	69
167 OG SEIZ RTE	.........HATAY_2_O	116
167 OG SEIZ RTE	.........KBAGLAR_1_O	199
167 OG SEIZ RTE	.........KYAKA_2_O	119
167 OG SEIZ RTE	.........MERKEZ_3_O	48
167 OG SEIZ RTE	.........MERKEZ_4_O	56

167 OG SEIZ RTE	.... MERKEZ_5_O	0
167 OG SEIZ RTE	.... TEPECIK_1_O	595
167 OG SEIZ RTE	.... KBAGLAR_2_O	53
167 OG SEIZ RTE	.... IZR_TOLL_4_O	3596
167 OG SEIZ RTE	.... STANDEM_O	1250
167 OG SEIZ RTE	.... MERKEZ_5_N7	405
167 OG SEIZ RTE	.... IZR_TOLL_3_N7	68
167 OG SEIZ RTE	.... SPARE_O	0
167 OG SEIZ RTE	.... MERKEZ_6_O	0
167 OG SEIZ RTE	.... AYKUSAN_O	49
167 OG SEIZ RTE	.... CIGLI_2_O	132
167 OG SEIZ RTE	.... BAYRAKLI_O	367
167 OG SEIZ RTE	.... ALSANCAK_2_O	107
167 OG SEIZ RTE	.... EVKA_1_O	147
167 OG SEIZ RTE	.... TEPECIK_2_O	366
167 OG SEIZ RTE	.... BORNOVA_3_O	489
167 OG SEIZ RTE	.... MERKEZ_1_O	98
167 OG SEIZ RTE	.... ALAYBEY_2_O	178
167 OG SEIZ RTE	.... IZR_TOLL_3_O	734
167 OG SEIZ RTE	.... IZR_TOLL_4_N7	64
167 OG SEIZ RTE	.... ADMI_DTG	0
167 OG SEIZ RTE	.... ACS_DIR	0
167 OG SEIZ RTE	.... MDMI_DTG	0
167 OG SEIZ RTE	.... LER	0

REPORT FOLLOWS NO = 00035

M= 115886 DT=06/12/96 21:39:27
CINARLI2_EK11 1996-12-06 21:32:32 FR
000 0000/0000/0000
SEQ=6322+961127 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 6
RECORD PERIOD = 20H 30M - 21H 30M
OUTPUT PERIOD = 20H 30M - 21H 30M
OUTPUT NUMBER = 11

ENTITY	OBJECT	VALUE
44 INC OCC RTE	.... ALAYBEY_1_I	767
44 INC OCC RTE	.... ALSANCAK_1_I	245
44 INC OCC RTE	.... BUCA_1_I	1122
44 INC OCC RTE	.... BEVLER_1_I	226
44 INC OCC RTE	.... BEVLER_2_I	392
44 INC OCC RTE	.... BALCOVA_I	321
44 INC OCC RTE	.... BOSTANLI_I	463
44 INC OCC RTE	.... BORNOVA_2_I	1115
44 INC OCC RTE	.... CINARLI_1_I	1531
44 INC OCC RTE	.... GAZIEMIR_I	260
44 INC OCC RTE	.... GYALI_1_I	611
44 INC OCC RTE	.... HATAY_1_I	195
44 INC OCC RTE	.... HATAY_2_I	269
44 INC OCC RTE	.... KBAGLAR_1_I	446
44 INC OCC RTE	.... KYAKA_2_I	276
44 INC OCC RTE	.... MERKEZ_3_I	53
44 INC OCC RTE	.... MERKEZ_4_I	103
44 INC OCC RTE	.... MERKEZ_5_I	35
44 INC OCC RTE	.... TEPECIK_1_I	1226
44 INC OCC RTE	.... KBAGLAR_2_I	93
44 INC OCC RTE	.... BAYRAKLI_I	796
44 INC OCC RTE	.... STANDEM_I	2131

44 INC OCC RTE	.... SPARE_I	0
44 INC OCC RTE	.... AYKUSAN_I	81
44 INC OCC RTE	.... CIGLI_2_I	343
44 INC OCC RTE	.... ALSANCAK_2_I	256
44 INC OCC RTE	.... EVKA_1_I	385
44 INC OCC RTE	.... TEPECIK_2_I	719
44 INC OCC RTE	.... BORNOVA_3_I	1401
44 INC OCC RTE	.... IZR_TOLL_4_I	4402
44 INC OCC RTE	.... MERKEZ_1_I	127
44 INC OCC RTE	.... IZMIR_4_OPR_I	0
44 INC OCC RTE	.... ALAYBEY_2_I	295
44 INC OCC RTE	.... IZR_TOLL_3_I	0
57 INC SEIZ RTE	.... MERKEZ_5_N7	175

REPORT FOLLOWS NO = 00035

M= 115887 DT=06/12/96 21:40:20
CINARLI2_EK11 1996-12-06 21:32:45 FR
000 0000/0000/0000
SEQ=6322+961127 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 6
RECORD PERIOD = 20H 30M - 21H 30M
OUTPUT PERIOD = 20H 30M - 21H 30M
OUTPUT NUMBER = 12

ENTITY	OBJECT	VALUE
57 INC SEIZ RTE	.... IZR_TOLL_3_N7	23
57 INC SEIZ RTE	.... IZR_TOLL_4_N7	522
57 INC SEIZ RTE	.... ADMI_DTG	0
57 INC SEIZ RTE	.... ACS_DIR	0
57 INC SEIZ RTE	.... MDMI_DTG	0
57 INC SEIZ RTE	.... LER	0
57 INC SEIZ RTE	.... ALAYBEY_1_I	235
57 INC SEIZ RTE	.... ALSANCAK_1_I	87
57 INC SEIZ RTE	.... BUCA_1_I	296
57 INC SEIZ RTE	.... BEVLER_1_I	83
57 INC SEIZ RTE	.... BEVLER_2_I	158
57 INC SEIZ RTE	.... BALCOVA_I	171
57 INC SEIZ RTE	.... BOSTANLI_I	149
57 INC SEIZ RTE	.... BORNOVA_2_I	445
57 INC SEIZ RTE	.... CINARLI_1_I	650
57 INC SEIZ RTE	.... GAZIEMIR_I	96
57 INC SEIZ RTE	.... GYALI_1_I	284
57 INC SEIZ RTE	.... HATAY_1_I	94
57 INC SEIZ RTE	.... HATAY_2_I	128
57 INC SEIZ RTE	.... KBAGLAR_1_I	198
57 INC SEIZ RTE	.... KYAKA_2_I	172
57 INC SEIZ RTE	.... MERKEZ_3_I	25
57 INC SEIZ RTE	.... MERKEZ_4_I	52
57 INC SEIZ RTE	.... MERKEZ_5_I	1271
57 INC SEIZ RTE	.... TEPECIK_1_I	416
57 INC SEIZ RTE	.... KBAGLAR_2_I	51
57 INC SEIZ RTE	.... BAYRAKLI_I	401
57 INC SEIZ RTE	.... STANDEM_I	996
57 INC SEIZ RTE	.... SPARE_I	0
57 INC SEIZ RTE	.... AYKUSAN_I	40
57 INC SEIZ RTE	.... CIGLI_2_I	151

REPORT FOLLOWS NO = 00035

M= 115888 DT=06/12/96 21:40:46
CINARLI2_EK11 1996-12-06 21:32:55 FR
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SEQ=6322+961127 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 6
RECORD PERIOD = 20H 30M - 21H 30M
OUTPUT PERIOD = 20H 30M - 21H 30M
OUTPUT NUMBER = 13 = LAST REPORT OF THIS OUTPUT PERIOD

ENTITY	OBJECT	VALUE
57 INC SEIZ RTE	.... ALSANCAK_2_I	109
57 INC SEIZ RTE	.... EVKA_1_I	196
57 INC SEIZ RTE	.... TEPECIK_2_I	312
57 INC SEIZ RTE	.... BORNOVA_3_I	485
57 INC SEIZ RTE	.... IZR_TOLL_4_I	6186
57 INC SEIZ RTE	.... MERKEZ_1_I	86
57 INC SEIZ RTE	.... IZMIR_4_OPR_I	0
57 INC SEIZ RTE	.... ALAYBEY_2_I	101
57 INC SEIZ RTE	.... IZR_TOLL_3_I	0

REPORT FOLLOWS NO = 00035

CINARLI2_EK11 1996-12-01 14:48:10 SU
001 0130/0006/0002
SEQ=7922+961201 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 1
RECORD PERIOD = 14H 15M - 14H 45M
OUTPUT PERIOD = 14H 15M - 14H 45M
OUTPUT NUMBER = 14

ENTITY	OBJECT	VALUE
360 INC ASSGD OCC RTE	.... IZR_TOLL_4_N7	3000
360 INC ASSGD OCC RTE	.... ADMI_DTG	1000
360 INC ASSGD OCC RTE	.... ACS_DIR	400
360 INC ASSGD OCC RTE	.... MDMI_DTG	100
360 INC ASSGD OCC RTE	.... LER	0
360 INC ASSGD OCC RTE	.... ALAYBEY_1_I	3000
360 INC ASSGD OCC RTE	.... ALSANCAK_1_I	3000
360 INC ASSGD OCC RTE	.... BUCA_1_I	3000
360 INC ASSGD OCC RTE	.... BEVLER_1_I	1500
360 INC ASSGD OCC RTE	.... BEVLER_2_I	1500
360 INC ASSGD OCC RTE	.... BALCOVA_I	1500
360 INC ASSGD OCC RTE	.... BOSTANLI_I	1500
360 INC ASSGD OCC RTE	.... BORNOVA_2_I	4500
360 INC ASSGD OCC RTE	.... CINARLI_1_I	4500
360 INC ASSGD OCC RTE	.... GAZIEMIR_I	1500
360 INC ASSGD OCC RTE	.... GYALI_1_I	3000
360 INC ASSGD OCC RTE	.... HATAY_1_I	1500
360 INC ASSGD OCC RTE	.... HATAY_2_I	1500
360 INC ASSGD OCC RTE	.... KBAGLAR_1_I	3000
360 INC ASSGD OCC RTE	.... KYAKA_2_I	3000
360 INC ASSGD OCC RTE	.... MERKEZ_3_I	1500
360 INC ASSGD OCC RTE	.... MERKEZ_4_I	3000
360 INC ASSGD OCC RTE	.... MERKEZ_5_I	3000
360 INC ASSGD OCC RTE	.... TEPECIK_1_I	6000

360 INC ASSGD OCC RTE	KBAGLAR_2_I	1500
360 INC ASSGD OCC RTE	BAYRAKLI_I	1500
360 INC ASSGD OCC RTE	STANDEM_I	9000
360 INC ASSGD OCC RTE	SPARE_I	1500
360 INC ASSGD OCC RTE	AYKUSAN_I	1500
360 INC ASSGD OCC RTE	CIGLI_2_I	1500
360 INC ASSGD OCC RTE	ALSANCAK_2_I	4500
360 INC ASSGD OCC RTE	EVKA_1_I	3000
360 INC ASSGD OCC RTE	TEPECIK_2_I	4500
360 INC ASSGD OCC RTE	BORNOVA_3_I	4500
360 INC ASSGD OCC RTE	IZR_TOLL_4_I	11800
360 INC ASSGD OCC RTE	MERKEZ_1_I	3000
360 INC ASSGD OCC RTE	IZMIR_4_OPR_I	200
360 INC ASSGD OCC RTE	ALAYBEY_2_I	1500
360 INC ASSGD OCC RTE	IZR_TOLL_3_I	1500

REPORT FOLLOWS NO = 00035

CINARLI2_EK11 1996-12-01 14:48:35 SU
001 0130/0006/0002
SEQ=7922+961201 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 1
RECORD PERIOD = 14H 15M - 14H 45M
OUTPUT PERIOD = 14H 15M - 14H 45M
OUTPUT NUMBER = 16

ENTITY	OBJECT	VALUE
361 INC AVLB OCC RTE	ALAYBEY_1_I	3000
361 INC AVLB OCC RTE	ALSANCAK_1_I	3000
361 INC AVLB OCC RTE	BUCA_1_I	3000
361 INC AVLB OCC RTE	BEVLER_1_I	1500
361 INC AVLB OCC RTE	BEVLER_2_I	1500
361 INC AVLB OCC RTE	BALCOVA_I	1500
361 INC AVLB OCC RTE	BOSTANLI_I	1500
361 INC AVLB OCC RTE	BORNOVA_2_I	3000
361 INC AVLB OCC RTE	CINARLI_1_I	4500
361 INC AVLB OCC RTE	GAZIEMIR_I	1500
361 INC AVLB OCC RTE	GYALI_1_I	3000
361 INC AVLB OCC RTE	HATAY_1_I	1500
361 INC AVLB OCC RTE	HATAY_2_I	1500
361 INC AVLB OCC RTE	KBAGLAR_1_I	3000
361 INC AVLB OCC RTE	KYAKA_2_I	3000
361 INC AVLB OCC RTE	MERKEZ_3_I	1500
361 INC AVLB OCC RTE	MERKEZ_4_I	3000
361 INC AVLB OCC RTE	MERKEZ_5_I	2900
361 INC AVLB OCC RTE	TEPECIK_1_I	6000
361 INC AVLB OCC RTE	KBAGLAR_2_I	1500
361 INC AVLB OCC RTE	BAYRAKLI_I	1500
361 INC AVLB OCC RTE	STANDEM_I	9000
361 INC AVLB OCC RTE	SPARE_I	0
361 INC AVLB OCC RTE	AYKUSAN_I	1500
361 INC AVLB OCC RTE	CIGLI_2_I	1500
361 INC AVLB OCC RTE	ALSANCAK_2_I	4500
361 INC AVLB OCC RTE	EVKA_1_I	3000
361 INC AVLB OCC RTE	TEPECIK_2_I	4500

361 INC AVLB OCC RTE	.... BORNOVA_3_I	4500
361 INC AVLB OCC RTE	.... IZR_TOLL_4_I	11800
361 INC AVLB OCC RTE	.... MERKEZ_1_I	3000
361 INC AVLB OCC RTE	.... IZMIR_4_OPR_I	200
361 INC AVLB OCC RTE	.... ALAYBEY_2_I	1500
361 INC AVLB OCC RTE	.... IZR_TOLL_3_I	1500

REPORT FOLLOWS NO = 00035

CINARLI2_EK11 1996-12-01 14:48:48 SU
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SEQ=7922+961201 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 1
RECORD PERIOD = 14H 15M - 14H 45M
OUTPUT PERIOD = 14H 15M - 14H 45M
OUTPUT NUMBER = 17

ENTITY	OBJECT	VALUE
363 OG ASSGD OCC RTE	.... KBAGLAR_1_O	3000
363 OG ASSGD OCC RTE	.... KYAKA_2_O	3000
363 OG ASSGD OCC RTE	.... MERKEZ_3_O	1500
363 OG ASSGD OCC RTE	.... MERKEZ_4_O	3000
363 OG ASSGD OCC RTE	.... MERKEZ_5_O	2800
363 OG ASSGD OCC RTE	.... TEPECIK_1_O	6000
363 OG ASSGD OCC RTE	.... KBAGLAR_2_O	1500
363 OG ASSGD OCC RTE	.... IZR_TOLL_4_O	13500
363 OG ASSGD OCC RTE	.... STANDEM_O	9000
363 OG ASSGD OCC RTE	.... MERKEZ_5_N7	6200
363 OG ASSGD OCC RTE	.... IZR_TOLL_3_N7	3000
363 OG ASSGD OCC RTE	.... SPARE_O	1500
363 OG ASSGD OCC RTE	.... MERKEZ_6_O	200
363 OG ASSGD OCC RTE	.... AYKUSAN_O	1500
363 OG ASSGD OCC RTE	.... CIGLI_2_O	1500
363 OG ASSGD OCC RTE	.... BAYRAKLI_O	1500
363 OG ASSGD OCC RTE	.... ALSANCAK_2_O	4500
363 OG ASSGD OCC RTE	.... EVKA_1_O	3000
363 OG ASSGD OCC RTE	.... TEPECIK_2_O	4500
363 OG ASSGD OCC RTE	.... BORNOVA_3_O	4500
363 OG ASSGD OCC RTE	.... MERKEZ_1_O	3000
363 OG ASSGD OCC RTE	.... ALAYBEY_2_O	1500
363 OG ASSGD OCC RTE	.... IZR_TOLL_3_O	1500
363 OG ASSGD OCC RTE	.... IZR_TOLL_4_N7	3000
363 OG ASSGD OCC RTE	.... ADMI_DTG	1000
363 OG ASSGD OCC RTE	.... ACS_DIR	400
363 OG ASSGD OCC RTE	.... MDMI_DTG	100
363 OG ASSGD OCC RTE	.... LER	100

REPORT FOLLOWS NO = 00035

CINARLI2_EK11 1996-12-01 14:49:01 SU
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SEQ=7922+961201 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 1
RECORD PERIOD = 14H 15M - 14H 45M
OUTPUT PERIOD = 14H 15M - 14H 45M
OUTPUT NUMBER = 18

ENTITY	OBJECT	VALUE
364 OG AVLB OCC RTE	.... ALAYBEY_1_O	3000
364 OG AVLB OCC RTE	.... ALSANCAK_1_O	2899
364 OG AVLB OCC RTE	.... BUCA_1_O	3000
364 OG AVLB OCC RTE	.... BEVLER_1_O	1400
364 OG AVLB OCC RTE	.... BEVLER_2_O	1500
364 OG AVLB OCC RTE	.... BALCOVA_O	1400
364 OG AVLB OCC RTE	.... BOSTANLI_O	1500
364 OG AVLB OCC RTE	.... BORNOVA_2_O	3000
364 OG AVLB OCC RTE	.... CINARLI_1_O	3625
364 OG AVLB OCC RTE	.... GAZIEMIR_O	1500
364 OG AVLB OCC RTE	.... GYALI_1_O	3000
364 OG AVLB OCC RTE	.... HATAY_1_O	1500
364 OG AVLB OCC RTE	.... HATAY_2_O	1500
364 OG AVLB OCC RTE	.... KBAGLAR_1_O	3000
364 OG AVLB OCC RTE	.... KYAKA_2_O	2904
364 OG AVLB OCC RTE	.... MERKEZ_3_O	1500
364 OG AVLB OCC RTE	.... MERKEZ_4_O	3000
364 OG AVLB OCC RTE	.... MERKEZ_5_O	2600
364 OG AVLB OCC RTE	.... TEPECIK_1_O	5922
364 OG AVLB OCC RTE	.... KBAGLAR_2_O	1500
364 OG AVLB OCC RTE	.... IZR_TOLL_4_O	13499
364 OG AVLB OCC RTE	.... STANDEM_O	8642
364 OG AVLB OCC RTE	.... MERKEZ_5_N7	6200
364 OG AVLB OCC RTE	.... IZR_TOLL_3_N7	3000

REPORT FOLLOWS NO = 00035

CINARLI2_EK11 1996-12-01 14:49:13 SU
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SEQ=7922+961201 00035
MEASUREMENT - STATISTICS
RESULTS OF GEN - STAT

DATE OF ISSUE = 1996 12 1
RECORD PERIOD = 14H 15M - 14H 45M
OUTPUT PERIOD = 14H 15M - 14H 45M
OUTPUT NUMBER = 19

ENTITY	OBJECT	VALUE
364 OG AVLB OCC RTE	.... SPARE_O	0
364 OG AVLB OCC RTE	.... MERKEZ_6_O	200
364 OG AVLB OCC RTE	.... AYKUSAN_O	1500
364 OG AVLB OCC RTE	.... CIGLI_2_O	1500
364 OG AVLB OCC RTE	.... BAYRAKLI_O	1500
364 OG AVLB OCC RTE	.... ALSANCAK_2_O	4402
364 OG AVLB OCC RTE	.... EVKA_1_O	3000
364 OG AVLB OCC RTE	.... TEPECIK_2_O	4500
364 OG AVLB OCC RTE	.... BORNOVA_3_O	4201
364 OG AVLB OCC RTE	.... MERKEZ_1_O	3000
364 OG AVLB OCC RTE	.... ALAYBEY_2_O	1500

364 OG AVLB OCC RTE	.... IZR_TOLL_3_O	1500
364 OG AVLB OCC RTE	.... IZR_TOLL_4_N7	3000
364 OG AVLB OCC RTE	.... ADMI_DTG	1000
364 OG AVLB OCC RTE	.... ACS_DIR	400
364 OG AVLB OCC RTE	.... MDMI_DTG	100
364 OG AVLB OCC RTE	.... LER	100

REPORT FOLLOWS NO = 00035