The State Criminal Justice Telecommunications (STACOM) project has developed techniques for the identification and analysis of user requirements and designs for networks for the dissemination of criminal justice information on a state-wide basis. Techniques developed for user requirements analysis include methods for determining data required, data collection, data organization, and forecasting the volume of network traffic. Network design techniques center around a computerized program that enables the user to generate least cost network topologies that satisfy network requirements for traffic, response time, and other specified functions. Results of the application of these techniques in Texas and Ohio are reported. (Author/CMV)
State Criminal Justice Telecommunications (STACOM) Final Report

Volume I: Executive Summary

J. E. Fielding
H. K. Frewing
Jun-Ji Lee
W. G. Leflang
N. B. Reilly

October 31, 1977

Law Enforcement Assistance Administration
U. S. Department of Justice
U. S. DEPARTMENT OF JUSTICE
Law Enforcement Assistance Administration

James M. H. Gregg, Acting Administrator
Harry Bratt, Assistant Administrator
National Criminal Justice Information and Statistics Service

Wayne P. Holtzman, Director
Systems Development Division

This report was prepared by the Jet Propulsion Laboratory, California Institute of Technology for the Law Enforcement Assistance Administration, Department of Justice by agreement with the National Aeronautics and Space Administration.
FOREWORD

The State Criminal Justice Telecommunications, (STACOM), Project consists of two major study tasks. The first entails a study of criminal justice telecommunication system user requirements and system traffic requirements through the year 1985. The second investigates least cost network alternatives to meet these specified traffic requirements.

Major documentation of the STACOM Project is organized in four volumes as follows:

<table>
<thead>
<tr>
<th>Title</th>
<th>Document No.</th>
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</thead>
</table>

The above material is also organized in an additional four volumes which provide a slightly different reader orientation as follows:

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<td>State Criminal Justice Telecommunications (STACOM) Network Design and Performance Analysis Techniques</td>
<td>5030-99*</td>
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*Jet Propulsion Laboratory internal document
This document, No. 77-53, Volume I, entitled "Executive Summary," describes, in summary form, the methodologies and results of the user requirements analysis and state criminal justice communications network design tasks of the STACOM project. It summarizes the more detailed descriptions and results found in volumes II (Ohio results), III (Texas results), and IV (network design software users' guide) of this final report.

It presents the results of one phase of research carried out jointly by the Jet Propulsion Laboratory, California Institute of Technology, and the States of Ohio and Texas. The work at the Jet Propulsion Laboratory was performed by the Systems Division, Telecommunications Science and Engineering Division, and Information Systems Division under the cognizance of the STACOM Project. The project is sponsored by the Law Enforcement Assistance Administration, Department of Justice, through the National Aeronautics and Space Administration (Contract NAS7-100).
ACKNOWLEDGMENT

It is a pleasure to acknowledge the help received from the entire STACOM team. Special thanks for their many contributions go to the following state and federal officials.

**Washington D.C.**

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Major T. G. Gentry Ohio State Patrol
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Lt. Gene Howell Ohio State Patrol
Herman Slonecker Bureau of Criminal Investigation
James Wogaman Administration of Justice

**Ohio**

Jim Jones Criminal Justice Division
Jack Martine Department of Public Safety
Chief H. W. McFarling Department of Public Safety
Chief Glen H. McLaughlin Department of Public Safety
Vernon Strey Department of Public Safety
GLOSSARY OF ABBREVIATIONS AND ACRONYMS

<table>
<thead>
<tr>
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<td>All-points bulletin</td>
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<tr>
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</tr>
<tr>
<td>BMV</td>
<td>Ohio Bureau of Motor Vehicles</td>
</tr>
<tr>
<td>BPP</td>
<td>Texas Boards of Pardons and Paroles</td>
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<td>bps</td>
<td>Bits per second</td>
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<tr>
<td>CCH</td>
<td>Computerized Criminal Histories</td>
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<td>CDS</td>
<td>Comprehensive Data System</td>
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<td>CJIS</td>
<td>Criminal Justice Information System</td>
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<td>CLEAR</td>
<td>Hamilton County, Ohio (Cincinnati) County Law Enforcement Applied Regionally</td>
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<td>CRT</td>
<td>Cathode ray tube</td>
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<td>DPS</td>
<td>Texas Department of Public Safety</td>
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<td>FINDER</td>
<td>Calspan Technology Products, Inc., registered trademark for Fingerprint Detector Readers</td>
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<td>NORIS</td>
<td>Lucas County, Ohio (Toledo) Northwest Ohio Regional Information System</td>
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<td>OBSCIS</td>
<td>Offender Based State Corrections Information System</td>
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<td>Ohio State Patrol</td>
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<tr>
<td>PD</td>
<td>Police Department</td>
</tr>
<tr>
<td>RCC</td>
<td>Regional Computing Center</td>
</tr>
<tr>
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<td>Regional Crime Information Center</td>
</tr>
<tr>
<td>RSC</td>
<td>Regional Switching Center</td>
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<td>SEARCH</td>
<td>System for Electronic Analysis and Retrieval of Criminal Histories</td>
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<tr>
<td>SIFTER</td>
<td>System for Identification of Fingerprints by Technical Search of Encoded Records</td>
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<td>Texas Judicial Council</td>
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<td>TLETS</td>
<td>Texas Law Enforcement Telecommunications System</td>
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TYC  Texas Youth Council
UCR  Uniform Crime Reports
ABSTRACT

An executive overview is provided in Volume I of the Final Report for the major study components and a summary of a State Criminal Justice Telecommunications (STACOM) project sponsored by the Law Enforcement Assistance Administration (LEAA).

The project has developed techniques for identifying user requirements analysis and network designs for criminal justice networks on a statewide basis. Techniques developed for user requirements analysis involve methods for determining data required, data collection, (surveys), and data organization procedures, and methods for forecasting network traffic volumes. Developed network design techniques center around a computerized topology program which enables the user to generate least cost network topologies that satisfy network traffic requirements, response time requirements, and other specified functional requirements.

The developed techniques were applied in the states of Ohio and Texas and results of these studies are presented.
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SECTION 1

INTRODUCTION

State Criminal Justice Telecommunications (STACOM), developed techniques for identifying user requirements and designs for criminal justice networks on a statewide level. These requirements were developed for user requirements analysis involving data required, data collection, (surveys), and procedures, and methods for forecasting network needs. Developed network design techniques center around a topology program which enables the user to generate topologies that satisfy network traffic requirements, and other specified functional requirements. In this project, these techniques were applied in two model cases. This document provides an executive overview of objectives, a brief description of the analytic techniques, and a summary of application results in the two model cases.

JUSTICE NETWORK COMPONENTS

A detailed statewide digital criminal justice telecommunications network, depicted in Figure 1-1. Network system terminations through regional switching centers (RSC), to data base facilities, in the general case, RSCs service the system terminations in forward and receive messages to and from central base facilities. The use of a single RSC in the network is determined by cost and performance factors. Depending on the number of terminals on a common transmission path or as shown in the Figure 1-1, is a typical line costs when applicable.

JUSTICE NETWORK FUNCTIONS

The function of statewide digital criminal justice networks is to process inquiry/response messages between agencies to and from centralized state and national law enforcement agencies. Compatibility for point-to-point transmission of messages is also provided. In law enforcement applications, data base inquiries initiated by field officers is of major concern. Work carried out in Ohio and Texas suggests that a digital criminal justice network by law enforcement agencies is a viable technology for accessing vehicle related files. This emphasis on the emerging vehicle file previously envisioned, does not have knowingly, (or unknowingly), as traffic growth in this direction. In either case, inquiry traffic into vehicle related files of criminal justice networks merits further analysis by law enforcement administrators as it may provide a focal point for network cost effectiveness. Other law enforcement agencies...
Figure 1-1. A General Communications Network
uses include inquiries into files containing data on drivers licenses, stolen property, warrants/warrants and computerized criminal histories. Criminal justice agencies other than law enforcement agencies use statewide criminal justice communication networks primarily for access to CCH, SJIS, OBSCIS, and OBTS functions.

1.3 STACOM PROJECT OBJECTIVES

The STACOM Project objectives are:

(1) To develop and document techniques for intrastate traffic measurement, analysis of measured data, and prediction of traffic growth.

(2) To develop and document techniques for intrastate network design, performance analysis, modeling and simulation.

(3) To illustrate applications of network design and analysis techniques on typical existing network configurations and new or improved configurations.

(4) To develop and illustrate a methodology for establishing priorities for cost effective expenditures to improve capabilities in deficient areas.

To support these overall project goals, an exercise was undertaken to develop and apply procedures for predicting future criminal justice communications traffic. These procedures include techniques of statistical analysis for extrapolating past trends into future traffic predictions, and survey and interviewing techniques for estimating future traffic in data types that do not yet exist. The effort was therefore divided into two phases: a study of past trends in existing data types to project future trends in communications traffic for these data types; and a study of new data types that do not yet exist, but which are anticipated, to estimate their future traffic volume.

In addition, a Network Functional Requirements document was developed which specifies in detail what the network must do to meet user requirements. These specifications include traffic levels which must be handled, desired response times, system availability goals and other performance requirements.

Network designers then used the developed functional requirements to study future intrastate network optional designs that minimize cost and still satisfy performance requirements. Knowing estimated traffic volumes over a decade, network designers can also suggest the best times to upgrade computers or communication lines to maintain performance within required limits and assure minimum costs.

The developed analysis and design techniques have been applied in the States of Ohio and Texas leading to new or improved network designs.
Finally, a major STACOM objective has been to document the developed analysis and design techniques with the goal of providing a guide for other states to carry out similar studies.

1.4 STACOM RESULTS

Traffic predictions and major network design findings resulting from the STACOM Project are as follows.

1.4.1 Traffic Forecasts

Statewide criminal justice information system traffic projections in average messages per day for the states of Ohio and Texas are presented in Figures 1-2 and 1-3.

The major contributors to traffic totals are the existing law enforcement data types and law enforcement use of CCH/OBTS data.

1.4.2 Network Design

In both the States of Ohio and Texas, the least-cost statewide network, among options considered, consists of a single switcher database facility located at the state capitol serving system terminations throughout the state over multidropped communication lines. In both cases, line savings due to the use of distributed regional switchers are not sufficient to offset additional costs incurred for regional switcher hardware, sites, personnel, interregion lines and increased engineering costs.
Figure 1-2. Ohio Statewide Criminal Justice Information System Traffic Projection in Average Messages per Day
Figure 1-3. Texas Statewide Criminal Justice Information System
Traffic Projection in Average Messages per Day
SECTION 2

USER REQUIREMENTS

In order to design communications and computer facilities that will satisfy stated needs over a number of years, it is necessary to project future user needs. User needs are meaningful to system designers in two forms. The first expresses the demand on the system and is given in terms of the amount of communication traffic to be transmitted over the state criminal justice telecommunication system. The second is the level of performance required of the system which includes measures such as required response times, and required system availability. Given these two forms of user requirements, designers can devise systems that handle the communications traffic while operating at required performance levels.

Paragraph 2.1 of this report describes the methods used to determine current communication message volumes and the methods used in predicting future message volumes. Basic steps of these methods are:

1. Determination of required data
2. Data collection
3. Data organization
4. Development of forecasting techniques
5. Application of forecasting techniques

Since there are always uncertainties contained in forecasts it becomes necessary for the analyst to make assumptions about future events. The major assumptions required for each of the above steps will be emphasized.

Paragraph 2.2 discusses required performance levels of the state criminal justice telecommunications system. The steps required to establish these functional requirements as well as a statement of the requirements in the two model states will be presented.

Two categories of future communication traffic were defined. The first was future traffic into existing data bases and the second was future traffic into new data bases. Because of differences in the availability of operations information, two distinct methods were used to predict future message volumes of these message categories. Subsequent discussions will thus separate into existing data types and new data type sections.
2.1 MESSAGE VOLUME DETERMINATION

2.1.1 Existing Data Types

2.1.1.1 Determination of Required Data

To determine current message volumes and to forecast future message volumes, the following categories of information are required.

(1) A historical description of the state criminal justice telecommunications system.

(2) Statistics on past and current message volumes and message characteristics.

(3) Operational policies that impact traffic levels.

(4) Planned upgrades or changes to the communication system that may impact traffic levels.

The historical system description should cover the last five years and include information on types of records maintained, a list of system users, topology of the communication network, and the location of major system components. Changes to the system configuration having major impacts on traffic volume should be carefully documented.

Past traffic statistics should also be obtained for the previous five years. Both the number of communication messages and the number of computer transactions are required. It is necessary to break out messages by type, and the distribution of messages to system users is also needed. Message length by message type is required.

Any operational policies that impact traffic volume should be identified. Examples are automatic generation of messages by computer or restrictions to entry of data bases.

Finally, any planned improvements to the system or changes to the operating procedures that would increase traffic must be known. Possible examples are replacement of low-speed communication lines with high-speed lines, addition of new system users, or addition of new record types.

2.1.1.2 Data Collection

Data collection was accomplished by the use of surveys. Surveys were directed to the state agency responsible for operating the state criminal justice telecommunications system, to the state criminal justice planning agency and to system users. The operating agency provided information on system description, traffic statistics, message characteristics, and operational policies. State planning agencies have traditionally provided funding for system upgrades and thus provided information on planned future improvements. Finally
user agencies verified the traffic statistics and provided a qualitative statement of the effectiveness of the state system in meeting their needs.

2.1.1.3 Data Organization

Data collected from the above sources were organized to provide the following products:

(1) An historical traffic growth curve which shows traffic levels each month for the last five years

(2) Descriptions of the communication system over the last five years. Complete system descriptions are given for quarterly periods over the past 5 years including information on data base contents and sites, switcher sites, communication line topology, and lists of system users

(3) Overall system message lengths

(4) Distributions of traffic by message type for each month over the last five years

(5) Distributions of traffic by user agency for the last 3 months of available traffic statistics

The experiences with the model states in data organization suggest that extreme care must be taken in the analysis of traffic data. Problems encountered included inconsistencies in definitions, changes over time in methods of collecting traffic statistics and errors in computer statistics gathering packages. Because of these problems it is important for the analyst to work closely with state agency personnel responsible for using and maintaining the traffic statistics. It is also advisable to validate traffic levels by using independent data sources. Unfortunately this is not always possible. An example of a case where validation is possible concerns national traffic where the amount of traffic recorded by the state as being sent to national systems should equal the amount of traffic recorded by the national system as coming from the state.

2.1.1.4 Forecasting Techniques

The basic forecasting framework postulates that past traffic growth is caused by two factors. The first is an increased demand by users and the second is communication system improvements. We assume that growth in traffic due to the first factor will continue in the future as it has in the past. However, growth in traffic due to communication system improvements will depend on the rate of future system improvements. The estimates of these two components of traffic are combined to form the prediction of total future communication traffic levels into existing data types.
The historic traffic growth curve is analyzed to determine the fraction of growth caused by increased utilization, called baseline growth, and the fraction of growth caused by system improvements. The impacts of system improvements are assessed by measuring sudden increases in traffic immediately following the improvement. Future traffic forecasts are obtained by projecting forward the baseline growth curve and by surveying state planners regarding future system improvements. It is assumed that traffic increases in the future due to a specific improvement will be proportional to traffic increases in the past when that improvement was made.

Once total traffic is forecast, the analyst must distribute this traffic to the many system users. It is assumed that all traffic flows between user agencies and data bases. Relevant characteristics were collected for all criminal justice agencies and relationships were developed between traffic volumes and user characteristics. These experiences were then used to distribute future traffic as a function of future user characteristics.

2.1.1.5 Application of Forecasting Techniques

Figure 2-1 shows the historic growth patterns of communication messages in the modal states of Ohio and Texas. Over the last five years both states have experienced continual and substantial traffic growth. Figure 2-2 displays the causes of the substantial growth in traffic in Ohio and Texas. Baseline growth in both states accounts for approximately half the traffic increase. System improvements included the conversion to high speed communication lines and terminals, the addition of new users, the addition of new data bases, the implementation of mobile digital terminals, the automatic generation of messages to the National Crime Information Center and the implementation of regional information systems.

Baseline growth curves were projected forward as shown in Figure 2-3. Straight line approximations were used with two different growth rates. The higher growth rate was projected to occur when growth is not constrained by system capacity with the slower growth rate occurring when actual traffic is close to system capacity. It is assumed that there will only be short periods of time in the future where growth is constrained by system capacity.

Surveys of state planners identified the following future system improvements: addition of new users, conversion to high speed communication lines and terminals, implementation of regional information systems, implementation of mobile digital terminals, and message handling changes. Table 2-1 shows the effects of these system improvements on future traffic in Ohio and Texas.

Baseline traffic growth is combined with growth due to system improvements and growth in new data type messages to predict total system traffic. System capacity acts as a constraining factor on total system growth.
Figure 2-1. Ohio and Texas Past Communication Traffic Growth
Figure 2-2. Causes of Ohio and Texas Past Traffic Growth
Figure 2-3. Projected Ohio and Texas Baseline Traffic Growth (Average Messages/Day, thousands)
Table 2-1. Future Traffic Increases due to Communication System Improvements
(Units are Average Communication Messages per day.)

<table>
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<th>High-Speed Lines</th>
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Vol. I

I. Selection and Organization

Traffic, there are no historic traffic volumes. Data on current new data types

Justice agencies for information databases

Of potential user agencies that could distribute traffic

Uncertainty, and predicting future similarly difficult. However, an attempt made by examining the need for the obtaining the required funding to begin implementing the required information for each function.

Accomplished by the use of written surveys system planners from law enforcement, id paroled and parole agencies were contacted in their areas. Personnel were asked to provide insight on possible barriers to implementation.

To estimate the statewide traffic volume

Criminal Justice Functions

For Each Function

Copy of Functions

Data Traffic Volume

And the frequency of occurrence of a potential traffic level. This system is fully operational. During the traffic is only a fraction of what for this reason a factor is introduced, factor, which ranges between 0 and 1 for implementation.
2.1.2.3 Application of Forecasting Techniques

Key criminal justice statistics were used to determine the frequency of criminal justice functions which when combined with data requirements per function lead to the calculation of traffic volume. Arrest statistics were used to forecast CCH and fingerprint traffic, number of inmates was used to forecast OBSCIS traffic and number of court dispositions was used to forecast SJIS traffic.

For predicting CCH traffic in Ohio and Texas, criminal justice flow diagrams were developed which described an offenders' progress through the criminal justice system. Functions along this path requiring interaction with the CCH file were identified and their frequency was determined using arrest statistics. Predictions were made of future arrest rates so that forecasts could be made of CCH traffic levels. Law enforcement, courts, corrections, and identification bureaus will all be users of the CCH data files.

Classified fingerprint traffic projections were also based on arrest statistics. It was assumed that the equipment for fingerprint encoding, classification and transmission will be available only in the largest cities since it is expensive and requires a large fingerprint volume to justify it. The number of fingerprint transactions per arrest is based on past statistics maintained by the FBI. In Texas, transmission of fingerprints will begin in Dallas-Fort Worth in 1981 and by 1985 Houston, San Antonio and El Paso will also transmit fingerprints. In Ohio, Cleveland will begin transmission by 1981 and Columbus, Cincinnati, Toledo, Dayton and Akron will be on line in 1985.

The OBSCIS data file serves the management needs of correctional institutions. Traffic is forecast based on the number of transactions with the system per inmate-day. An estimate of the frequency of inquiry or update for each inmate was provided by state correctional institutions. In Ohio OBSCIS traffic is assumed to begin in 1981 and all correctional institutions are assumed to be on line by 1983. In Texas, OBSCIS implementation will also begin in 1981 however, it is assumed that not until 1985 will all correctional institutions be on line.

The SJIS data file serves the management needs of the courts. SJIS traffic is estimated based on the number of transactions per court disposition including both criminal and civil cases in the courts that handle felonies and non-traffic misdemeanors. The majority of court management traffic will be confined to the local level, and the state level traffic will be confined to statistical reporting. Thus the number of SJIS transactions per disposition has been taken as 1.0 in both states. In Ohio, implementation of SJIS begins in 1979 and is completed in 1981. Texas SJIS is forecast to begin implementation by 1983 and to be complete by 1985.

Figure 2-4 shows new data traffic growth forecasts for Ohio and Texas. The largest component of new data type traffic will be law enforcement use of criminal history files.
Figure 2-4. Ohio and Texas New Data Traffic Growth
2.2 FUNCTIONAL REQUIREMENTS

At the completion of state system surveys, and after sufficient interaction with state planning personnel, and prior to any specific network design activity, a document was produced specifying Network Functional Design Requirements. This document provides network performance criteria which are to be met in subsequent designs. The Functional Requirements specify what the network must do, and do not address at this level the specifics of how requirements are to be met.

The Functional Requirements document specifies characteristics and performance for the following network parameters:

- Message types
- Message content
- Message length
- Message routing
- Line protocols
- Message coding
- Error detection
- Status messages
- System terminations
- Regional switcher operation and control
- Security and privacy constraints
- Message response time
- Network availability
- Network traffic volumes

Table 2-2 lists two functional requirements of major importance for Ohio and Texas; mean response time and network availability.

Table 2-3 lists traffic requirements for Ohio and Texas for the years 1977, 1981 and 1985.

Table 2-2. Functional Requirements for Ohio and Texas Response Time and Network Availability

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Ohio</th>
<th>Texas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Response Time (seconds)</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Network Availability</td>
<td>0.9790</td>
<td>0.9722</td>
</tr>
</tbody>
</table>
Table 2-3. Functional Requirements for Ohio and Texas Traffic (Average Msg/Day in 1000s)

<table>
<thead>
<tr>
<th>Year</th>
<th>Ohio Leads</th>
<th>OHV</th>
<th>New Data</th>
<th>Texas Leads</th>
<th>TLETS</th>
<th>New Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977</td>
<td>147</td>
<td>9</td>
<td>14</td>
<td>138</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>1981</td>
<td>214</td>
<td>85</td>
<td>142</td>
<td>247</td>
<td>24</td>
<td>86</td>
</tr>
<tr>
<td>1985</td>
<td>284</td>
<td>98</td>
<td>170</td>
<td>311</td>
<td>86</td>
<td>86</td>
</tr>
</tbody>
</table>
SECTION 3
NETWORK ANALYSIS AND DESIGN

The principal goals of the network analysis and design tasks carried out in the STACOM project are:

(1) To develop and document techniques for intrastate network design, performance analysis, modeling and simulation.

(2) Illustrate applications of network design and analysis techniques on typical existing network configurations and on new or improved configurations that meet the specified functional requirements for the States of Ohio and Texas.

Major tasks carried out in the network analysis and design phase, and the results of these activities are summarized in the following paragraphs.

3.1 DEFINITION OF ANALYSIS AND MODELING TECHNIQUES

A task was undertaken to define and develop specific analysis and modeling tools for general use in intrastate systems. The principal tool developed is the STACOM Communications Network Topology Program. This program, written in FORTRAN V and implemented on a UNIVAC 1108 computer under the EXEC-8 operating system, enables a user to find least cost multidropped statewide networks as a function of traffic level demands and other functional performance requirements.

The major inputs to the program are:

(1) Traffic levels at each system termination on the network,
(2) Desired response time at network system terminations,
(3) Line tariff structures.
(4) Locations of system terminations using Bell System Vertical Horizontal (V-H), coordinates.
(5) The number of desired regional switching center, (RSC), facilities. RSCs serve system terminations in their defined regions and are interconnected to form total networks.

Principal outputs of the topology program are:

(1) Line capacities and layouts servicing system terminations,
(2) Fixed and annual recurring costs for lines, modems, and service terminals. RSCs are priced separately.
(3) Line performance characteristics such as average line utilizations and mean response times.

A second major analysis technique enables network designers to determine the reliability and availability of network configurations produced by the topology program.

Finally, a network response time model, used in the topology program, is also useful in understanding present and future performance requirements for switching and/or data base computers in the network. This is true because the response time model involves a queueing analysis which includes queueing times encountered at computer facilities.

3.2 ANALYSIS OF EXISTING NETWORKS

This task developed and applied design and analysis tools to determine the extent to which existing statewide networks conform to state functional requirements. Areas of discrepancy are noted as follows:

3.2.1 Existing Ohio LEADS Network

The LEADS Network presently consists of ten, 2400 Baud line configurations serving 102 Ohio State Patrol Offices and twenty, 150 Baud, multidropped lines serving 287 Sheriff and Police Departments. The network also provides lines for the Lucas County (Toledo), NORIS System, the Cleveland P.D., the Hamilton County (Cincinnati), CLEAR System, NLETS and the NCIC.

The present network meets all Functional Requirements for the State of Ohio with the exception of response times on the low speed lines and on the high speed lines during peak traffic loading hours. Figure 3-1 shows present mean response time performance for the 2400 Baud lines. Figure 3-2 shows present mean response time performance for the 150 Baud lines. The STACOM functional requirement goal for mean response time is 9 seconds.

3.2.2 Existing Texas TLETS Network

The present TLETS system serves 431 law enforcement agencies consisting of police departments, sheriff offices, and State Department of Public Safety offices. The TLETS network is topologically distributed from three regional switching centers located in Garland, Austin, and San Antonio. Terminals on the network are served from these switchers by 75, 110 or 1200 Baud multidropped lines. Network users have access through the Austin Switcher to data bases located in Austin consisting of the TCIC, LIDR and MVD data bases.

The present network meets all functional requirements for the State of Texas with the exception of response times on the 75 and 110 Baud lines, response times on 1200 Baud lines during peak traffic loading, and the TCIC/LIDR data base availability.
Figure 3-1. Existing LEADS Network Response Time vs Throughput—2400 Baud Lines
Figure 3-2. Existing LEADS Network Response Time vs Throughput—150 Baud Lines
Figures 3-3, 3-4 and 3-5 show present mean response time performance for the 1200, 150 and 75 Baud lines respectively. The STACOM functional requirement goal for mean response time is 9 seconds.

The present system availability is calculated at 0.915 which corresponds to 122.5 minutes of outage per day. Improvements in the TCIC/LIDR data base such as an MTTF of 145 hrs and an MTTR of 1.7 hrs would result in a system availability of 0.974 which meets the functional requirement goal.

3.3 GENERATION OF NEW OR IMPROVED NETWORKS

After specific studies of interest were identified with state personnel, STACOM design and analysis techniques were employed to study statewide network configuration alternatives, (options), and additional tradeoff studies of interest.

3.3.1 Ohio Network Studies

In the State of Ohio, four basic network options were considered for the LEADS system. These involved determining cost and performance measures under the Multi-Schedule Private Line, (MPL), tariff for LEADS configurations employing from zero to three RSCs in addition to the switcher and database facility in Columbus. The four options were:

Option 1 - switcher and database located in Columbus (one region).

Option 2 - switcher and database located in Columbus plus an RSC in Cleveland (two regions).

Option 3 - switcher and database located in Columbus plus RSCs located in Cleveland and Cincinnati, (three regions).

Option 4 - switcher and database located in Columbus plus RSCs located in Cleveland, Cincinnati and Toledo, (four regions).

Four more network options were studied in Ohio involving the possible integration of BMV and New Data Networks with the LEADS Network. These options were:

Option 5 - costs for maintaining separate LEADS and BMV networks.

Option 6 - costs for integrating the LEADS and BMV networks into a single network.

Option 7 - costs for maintaining separate LEADS and New Data networks.
Figure 3-3. Texas 1200 Baud Network Mean Response Time to TCIC.
Figure 3-4. TLETS Mean Response Time 110 Baud Lines
Figure 3-5. TLEPS Mean Response Time 75 Baud Lines
Option 8 - costs for integrating the LEADS and New Data networks into a single network.

Two additional network performance studies carried out in Ohio included consideration of LEADS network cost increases as terminal response times are reduced, and an inquiry into the impact on network cost and performance due to adding digitized classified fingerprints as a traffic type to the LEADS system.

3.3.2 Ohio Study Results

Figure 3-6 summarizes total eight-year costs for options 1 through 4 and shows an eight-year cost estimate for continuation of the present LEADS system. The least cost LEADS Network is a single region configuration with a switcher/data base facility located in Columbus. This network is depicted in Figure 3-7. The single through four region STACOM Networks all meet Ohio Functional Requirements.

Eight-year cost tradeoffs between integrated and separate BMV and LEADS networks are shown in Figure 3-8. There are no meaningful cost savings to be realized through the integration of LEADS and BMV systems if the integrated network is priced with the MPL tariff. If the integrated network could be priced as an intrastate network, an eight-year cost of approximately $7 million would result. Figure 3-9 shows the STACOM optimized BMV network under an intrastate tariff and Figure 3-10 shows the integrated BMV and LEADS network under the interstate MPL tariff. Results are very dependent on the definition of intrastate and interstate networks. Change in these definitions would necessitate additional analysis.

Figure 3-11 presents initial and annual cost estimates for separate versus integrated LEADS and New Data Type networks. There are no significant cost savings to be realized through the integration of New Data Types into the LEADS system over maintaining separate networks for an eight-year period.

Figure 3-12 presents results of the response time cost sensitivity study. LEADS network response times for the STACOM/OHIO single region case can be reduced from 9 to 7 seconds before additional costs are incurred. Reduction to 6 seconds increases annual line costs approximately 2%. Reduction to 5 seconds increases annual line costs approximately 13%.

Finally, digitized classified fingerprint data can be added to the LEADS network as specified in this report without compromising performance of the STACOM/OHIO LEADS System.

These results assume that the mean service time per transaction in the Columbus switcher/data base computer is immediately reduced to 470 ms. In 1981 the required mean service time per transaction is 425 ms and in 1985 340 ms is required in order to meet functional requirements for traffic growth. A 4 X 4 processor (4 central processing units) configuration is called for in 1981.
TOTAL 8 YEAR RECURRING COSTS

ONE TIME INSTALLATION COSTS

1st -- 1978 Through 1985 Options

4th and Present System

Ohio
Figure 3-8. Separate vs Integrated BMV and LEADS Network Ohio

- **Total 8 Year Cost:** $9,658,000
- **BMV = 0.19**
- **LEADS = 0.80**
Figure 3-10. Integrated LEADS and BMV Network
Figure 3-11. Separate vs Integrated New Data and LEADS Network for Ohio
Figure 3-12. Recurring Line Costs vs Mean Response Time
3.3.3 Texas Network Studies

In the State of Texas, three basic network options were considered for the TLETS network. These involved the study of cost and performance measures for one, two and three region networks as follows:

**Option 1** - a single switcher located in Austin (one region).

**Option 2** - a switcher located in Austin and a second RSC located either in Dallas, or Midland, or Lubbock, or Amarillo (two regions).

**Option 3** - a switcher located in Austin, and a second RSC located in Dallas with a third RSC located either in Houston, or San Antonio, or Midland, or Lubbock, or Amarillo.

Two additional options were studied involving the possible integration of New Data types in Texas with the TLETS as follows:

**Option 4** - costs of maintaining separate TLETS and New Data networks.

**Option 5** - costs of integrating the TLETS and New Data networks into a single network.

Three additional network studies were considered, (1) network cost increases as terminal mean response times were reduced, (2) the impact of network cost and performance due to adding digitized classified fingerprints as a data type to the TLETS system, and (3) the relative difference in network costs between maintaining and abandoning TLETS Network line service oriented towards the existing regional Councils of Government (C.O.G.s).

3.3.4 Texas Study Results

Figure 3-13 summarizes the least total eight-year costs for options 1 through 3. The two region case has switchers in Dallas and Austin. The best three region case employs switchers in Dallas, Austin and San Antonio, and thus represents an eight-year cost estimate for continuation of the present system. All networks meet Texas' functional requirements. The single region, least cost network, is shown in Figure 3-14.

Eight-year cost tradeoffs between integrated and separate New Data Type and TLETS networks are shown in Figure 3-15. The eight-year cost savings for integrating is approximately $900,000.

Figure 3-16 presents results of the response time versus cost sensitivity study. TLETS network response time for the STACOM/TEXAS single region case can be reduced from 9 to 7 seconds before additional costs are incurred. Reduction to 6 seconds increases annual line costs.
Figure 3-13: Total Comparative Cost 1978 Through 1985 Options 1 Through 3

<table>
<thead>
<tr>
<th>CASE</th>
<th>SWITCHER LOCATION(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 REGION</td>
<td>AUSTIN</td>
</tr>
<tr>
<td>2 REGION</td>
<td>AUSTIN, DALLAS</td>
</tr>
<tr>
<td>3 REGION</td>
<td>AUSTIN, DALLAS, SAN ANTONIO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REGION</th>
<th>TOTAL 8 YEAR RECURRING COST</th>
<th>ONE TIME INSTALLATION COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15.8</td>
<td>15.8</td>
</tr>
<tr>
<td>2</td>
<td>17.0</td>
<td>17.0</td>
</tr>
<tr>
<td>3</td>
<td>18.2</td>
<td>18.2</td>
</tr>
</tbody>
</table>
Figure 3-14. Single Region TLETS Network
Figure 3-15. Eight Year Comparative Costs Separate and Integrated TLETS/New Data Networks.
Figure 3-16. Recurring Annual Line Costs vs Mean Response Time — TLETS Single Region
No 5 seconds increases annual line costs

Fied fingerprint data can be added to the
this report without compromising performance

line cost savings due to the abandonment
Texas is estimated at $48,000. Consequently,
or in the management decision to continue

assume the following system upgrades

IDR Data Base computer is immediately
exhibit an availability of 0.9814.
1 switchers are used, their availability
upgraded to 0.997.

ines to the TCIC/LIDR Data Base from the
cher are immediately upgraded to 4800

tes to the MVD Data Base from the Austin
re immediately upgraded to 4800 Baud:

service time per transaction in the Austin
immediately reduced to 130 ms. In 1981,
service time per transaction should be
his will be sufficient through 1985.

service time per transaction in the Austin
Data Base computer is immediately reduced
From 1981 to 1985 the mean service time
option required is 200 ms.