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GAO

Briefing Report to the Chairman, Subcommittee on Oversight, Committee on Ways and Means, House of Representatives

October 1986

DATA COMMUNICATIONS

Thorough Testing and Workload Analyses Needed for IRS Processors

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GAO

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Information Management and
Technology Division

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The Honorable J. J. Pickle
Chairman, Subcommittee on Oversight
Committee on Ways and Means
House of Representatives

Dear Mr. Chairman:

In your March 7, 1986, letter, you requested that we assist the Subcommittee in its oversight and evaluation of the Internal Revenue Service (IRS). Among other things, you requested that we investigate the performance of IRS' existing communications processors and evaluate the soundness of the planned replacement of those processors with a system proposed by Sysorex Information Systems, Inc. (Sysorex). This report addresses the results of our review of these issues and documents a June 27, 1986, oral briefing we provided members of your Subcommittee staff. You also requested that we make an independent analysis of IRS' plans to upgrade its large mainframe computer. The results of that analysis are being forwarded to you in a separate report.

IRS' communications processors are the computers through which all on-line inquiries via computer terminals must pass to get access to key IRS data bases on the mainframe computers. The existing communications processors, which are old, have experienced reliability and capacity problems. As a result, IRS has contracted with Sysorex to replace these processors with a new system, the Communications Replacement System (CRS); initial plans called for installation and testing to begin on July 24, 1986, and for installation to be completed at all centers by October 1987.

Since our briefings, we have learned that IRS has altered its planned installation schedule. Due to problems in the development of CRS software, IRS now expects to begin testing at its National Computer Center in October 1986. Installation at all centers is currently scheduled to be completed in December 1987. In addition, the Service now plans to pilot test the system at the Fresno Service Center rather than at the Atlanta Service Center. This change was made to reduce any interference that the pilot tests could have on Atlanta's plans to reduce its large backlogs in the adjustments/correspondence caseload.

Our findings are summarized below; details on these findings and on our objectives, scope, and methodology are included in the attached appendixes. Although our detailed audit work was completed on June 15, 1986, this report provides updated information obtained through September 25, 1986, on IRS' CRS installation schedule delays.

Overall, we found that the performance of the existing processors had no significant adverse effect on IRS' 1986 tax filing season. There were some processor reliability problems, but IRS was generally able to meet its goals for overall computer system availability. Although the processors were approaching their capacity limitation during peak processing periods at the larger service centers, this had no significant adverse effect on the processing of tax returns and related data. While we and IRS believe that the processors should be able to meet IRS' needs until their scheduled replacement, a significant delay in the replacement processor installation schedule or a significant increase in workload will increase the chances that the existing processors will experience reliability and capacity problems. IRS has alternative actions that could be taken in the event that the processors experience capacity or reliability problems prior to their replacement, but has not developed formal contingency plans addressing specific actions that would be taken at each service center.

With respect to the new processors, the configuration of the system should provide IRS with a reliable system (i.e., the processors should meet IRS' minimum availability requirements). The replacement processors selected by IRS have a history of being highly reliable and should be able to process IRS' short-term workload requirements. We are less certain, however, about the processors' ability to meet IRS' longer-term needs. The contractor is experiencing problems and significant delays in developing some complex security software. While the software is not fully developed, it already requires more of the processors' computing capacity than originally estimated. In addition, IRS' projections of future workload, or transaction volumes, used by the contractor when sizing the processors are outdated and cannot be relied upon. Several events have taken place since the May 1983 projections were made that reduce their overall reliability and that could affect the useful life of not only the communications processors but also IRS' mainframe computers.

IRS has not updated its projections because it believes that the contract specifications allowed for a considerable growth in processing needs and that a reconsideration of specifications would cause a significant delay in obtaining

replacement processors. We agree that the specifications provide for a significant increase in computing power; however, as recognized in federal information processing guidance, and as agreed to by IRS, an on-going forecasting effort is needed to help ensure that an agency's computing resource (system capacity) needs are effectively estimated and planned.

We have also learned that IRS intends to install the new system at its larger service centers during the 1987 tax filing season. We believe that installation of any critical automatic data processing equipment during a fast-paced tax filing season increases the risk of serious disruption of processing tax returns and refunds to taxpayers if problems occur with the new equipment or its software. To reduce the risk to an acceptable level, IRS has designed safeguards, which include thorough tests of the new system at the National Computer Center and then at the Fresno Service Center prior to any nationwide installation. A 100-percent fallback capability will also be provided at each of its service centers during system testing--that is, if significant problems occur with the new processors, service centers can switch back to the old processors until the problems with the new system are corrected. This testing plan is particularly important because successful operation of the system depends heavily on the development of new hardware and software by two different subcontractors to make the new processors operate properly with the main computers and the terminals.

As stated earlier, delays in the development of new software have caused IRS' testing schedule to slip and have increased the chances that the existing processors will experience reliability and capacity problems. We have also learned that the software necessary for the Service's fallback capability is not expected to be developed and available for testing at the National Computer Center until near the end of the scheduled testing period and may not be available until the test at the Fresno Service Center. We believe, and IRS concurs, that it is essential for all hardware and software to be thoroughly tested at the National Computer Center and then at Fresno prior to any nationwide service center installations. Furthermore, a formalized contingency plan is needed in the event that the existing processors experience reliability or capacity problems prior to replacement.

Accordingly, because of the importance of computers to IRS' operations and the impact that the planned installation of processors could have on 1987's tax return and related processing, we recommend that the Commissioner of Internal Revenue:

--Report to the Subcommittee on Oversight, House Committee on Ways and Means, any significant deviations or delays in the installation testing plans that could alter the implementation of planned testing safeguards or reduce the chances of all processors being operational by December 1987. The report should also include actions that IRS plans to take to alleviate the situation.

--Establish formal contingency plans at each IRS service center to provide reasonable continuity of data processing support should events occur that prohibit the timely installation of replacement processors or cause the existing processors to experience capacity or reliability problems.

--Update existing and future workload projections and monitor the performance of the communications processors and supporting mainframes to ensure that these computing resources can fulfill IRS' mission. Such updates and performance monitoring should be conducted regularly throughout the life of the systems.

On September 25, 1986, we obtained oral comments from IRS. IRS agreed with the report's findings, conclusions, and recommendations. Because of the Service's interest in keeping the Subcommittee informed and because of the likelihood of further installation schedule changes, IRS anticipates meeting with your Subcommittee in the near future, thus implementing our first recommendation.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of the document. At that time, we will send copies to the Commissioner of IRS; the Director, Office of Management and Budget; the Secretary of Treasury; and other interested congressional committees and subcommittees. We will also make copies available to others upon request.

If you have any questions, please call James Watts, Associate Director, on 275-3455.

Sincerely yours,

Warren G. Reed
Director

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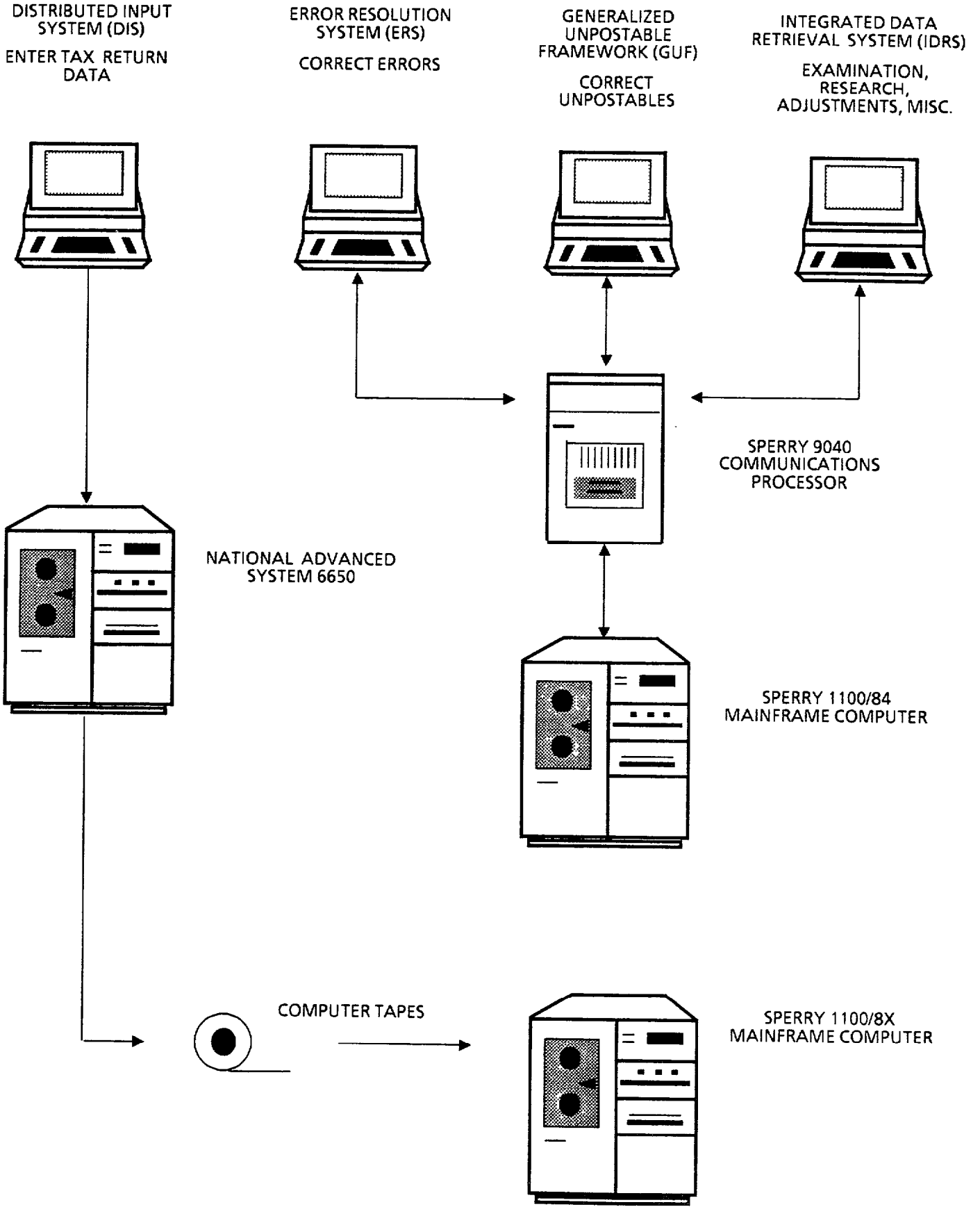
ABBREVIATIONS

ADP	automatic data processing
CDC	Control Data Corporation
CIU	Channel Interface Unit
CRS	Communications Replacement System
DIS	Distributed Input System
DTC	Display Terminal Controller
ERS	Error Resolution System
FIRMR	Federal Information Resources Management Regulation
GUF	Generalized Unpostable Framework
IBM	International Business Machines Corporation
IDRS	Integrated Data Retrieval System
NCC	National Computer Center
PC	Personal Computer

APPENDIX I

INTRODUCTION

TAX PROCESSING SYSTEM OVERVIEW



TAX PROCESSING SYSTEM OVERVIEW

The Internal Revenue Service (IRS) is one of the largest users of computers in the federal government. The annual processing of millions of tax returns is highly dependent on automatic data processing (ADP). In addition, the proper management of IRS' ADP resources is crucial for ensuring that the nation's tax laws are administered in an efficient and effective manner. IRS' tax processing system is comprised of independently operated computer networks at its National Computer Center (NCC) in Martinsburg, West Virginia, and ten service centers nationwide.

As shown on the adjacent chart, the communications processor is a critical component of IRS' tax processing system. IRS' communications processor is the computer through which all on-line inquiries via computer terminals must pass to get access to key data bases on one of IRS' mainframe computers, a Sperry Univac (herein after referred to as Sperry) 1100/84. The terminals and communications processor support (1) the Integrated Data Retrieval System (IDRS), which is used to handle active taxpayer accounts, such as collection and examination cases, and taxpayers' inquiries on these accounts; (2) the Error Resolution System (ERS), which is used to correct errors found on tax returns during returns processing and errors made by IRS in transcribing information off of the returns; and (3) the Generalized Unpostable Framework (GUF), which is used to correct conditions that prevent service center processed data from being matched with taxpayer accounts maintained at NCC.

If tax returns have no errors, they are not processed through the communications processor. Tax return and payment data is entered into a Sperry mainframe computer initially through the Distributed Input System (DIS). The DIS consists of a series of terminals connected to a National Advance System 6650 computer, which processes and formats the data so that it can be processed by either a Sperry 1100/84, 1100/83, or 1100/82 computer. (The last number in the Sperry series depicts the number of central processing units in the computer. For example, the 1100/84 has four central processing units and can process nearly twice as fast as an 1100/82 which has two central processing units.) The output from the National Advance System are computer tapes, which are then input to the Sperry computer.

IRS officials estimate that approximately 70 percent of all individual returns are processed without error. However, the other 30 percent need to interact with IRS' error correction systems. The ERS is used to correct errors on the returns that are made by taxpayers and IRS while processing a tax return, such as missing taxpayer identifiers, incomplete tax information, and math and data transcription errors. The GUF is used to correct

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problems with taxpayers' names and social security numbers, etc., which cause mismatches between the service centers' records and the NCC taxpayer accounts. Without support from the communications processor, these error corrections could not be accomplished.

Each center has only one communications processor. When that processor fails, no on-line activity can occur until it is repaired. Lengthy failures can result in significant productivity losses because service center personnel are unable to complete their work. This can affect the timeliness of processing tax returns with errors and can result in unmanageable backlogs in IRS' taxpayer correspondence activities.

CONGRESSIONAL CONCERNS

CONGRESSIONAL CONCERNS ABOUT IRS' EXISTING AND REPLACEMENT COMMUNICATIONS PROCESSORS:

- WHETHER EXISTING PROCESSORS WILL MEET IRS' NEEDS UNTIL REPLACEMENT PROCESSORS ARE FUNCTIONING.

- WHETHER REPLACEMENT PROCESSORS WILL MEET IRS' NEEDS THROUGHOUT THE LIFE OF THE SYSTEM

CONGRESSIONAL CONCERNS

On March 7, 1986, the Chairman, Subcommittee on Oversight, House Committee on Ways and Means, requested that we assist the Subcommittee in reviewing the performance of IRS' computers during the 1986 tax filing season. This briefing report addresses the Subcommittee's request for us to investigate the performance of IRS' existing communications processors and to evaluate the soundness of IRS' decision to replace them with a system proposed by Sysorex Information Systems, Inc. (hereinafter referred to as Sysorex). In addition, this report provides information and comments on IRS' schedule for installing the processors.

The request to investigate the performance of the existing communications processors stemmed from concerns about the processors' reliability, capacity, and ability to serve IRS until their planned replacement. These concerns were initially discussed on December 16, 1985, and March 4, 1986, during GAO testimonies before the Subcommittee. The processors' reliability was questioned because of intermittent breakdowns. For example, on one occasion a service center processor was down for about 30 hours during which access to IRS' mainframe computer was not possible, and critical service center functions could not be conducted. The capacity concerns stemmed from results of an internal study conducted by IRS in February 1984, which concluded that by December 1985, IRS' workload demands at larger service centers could exceed the capacity limits of the existing communications processors. This concern was heightened by the potential for a higher than anticipated increase in workload to be processed by the communications processor during 1986 due to existing IRS backlogs in its correspondence with taxpayers and its intent to emphasize taxpayer service during the 1986 filing season.

The Subcommittee's concerns about reliability and capacity were further intensified by IRS' lengthy implementation schedule for replacing the processors. According to IRS' planned installation schedule, all replacement processors will not be available for service center use until December 1987. As a result, there is some concern about the ability of the existing processors to meet IRS' needs until the replacement processors are functional.

The request to review the soundness of IRS' decision to replace its communications processors with the Sysorex system stemmed from the Subcommittee's awareness of problems experienced by IRS in the management of its Service Center Replacement System acquisition. This acquisition involved the replacement of IRS' mainframe computers at its 10 service centers and the National Computer Center and an associated in-house computer software

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conversion. These computers, installed between March 1982 and April 1983, were intended to support IRS' processing requirements through 1988. However, at the start of the 1985 tax filing season, a combination of insufficient computer capacity, inefficient computer software, and increased demand to use the system adversely affected the service centers and played a major role in creating returns processing backlogs, document control problems, and excessive correspondence inventory levels. In an attempt to correct these problems, IRS by January 1986 had among other things accelerated its planned procurement of additional computer resources and had to procure still more computing resources beyond what was initially envisioned. Because of the problems with the Service Center Replacement System acquisition, the Subcommittee requested that we address the question of whether or not the replacement processors will meet IRS' needs throughout the life of the system.

OBJECTIVES, SCOPE, AND METHODOLOGY

OBJECTIVES

- ANALYZE PERFORMANCE OF EXISTING PROCESSORS
- EVALUATE RELIABILITY AND CAPACITY OF REPLACEMENT PROCESSORS

SCOPE

- 5 IRS SERVICE CENTERS AND THE NATIONAL OFFICE
- SYSOREX INFORMATION SYSTEMS, INC.; THE IBM CORPORATION; ARTHUR ANDERSEN & CO.; POTOMAC SCHEDULING COMPANY; AND CORPORATE DATA PROCESSING CENTERS

METHODOLOGY

- ASSESS EXISTING PROCESSORS' RELIABILITY AND CAPACITY DURING IRS' 1986 TAX FILING SEASON
- EVALUATE REPLACEMENT PROCESSORS' ABILITY TO MEET SERVICE'S STATED NEEDS

OBJECTIVES, SCOPE, AND METHODOLOGY

The objectives of this assignment were 1) to assess the performance of IRS' existing communications processors during the 1986 tax filing season (January thru May 1986) and 2) to analyze the soundness of IRS' decision to replace its existing processors with a system proposed by Sysorex.

This report is based mainly on interviews with IRS officials and a review of existing and replacement processor documentation at five IRS service centers and its National Office. The centers included within this review were located in Andover, Massachusetts; Austin, Texas; Fresno, California; Ogden, Utah; and Philadelphia, Pennsylvania. In addition, we gathered and analyzed performance and procurement related documentation and interviewed the following IRS contractors who are developing and installing the replacement system: Sysorex, the IBM Corporation, Arthur Andersen & Co., and Potomac Scheduling Company. We also interviewed other private sector officials who currently use computers similar to IRS' replacement processors to obtain their opinions on the computer's performance and overall reliability.

In assessing the performance of the existing communications processors, we reviewed their overall reliability and capacity to process IRS' transaction volumes during the 1986 tax filing season. In doing so, we analyzed IRS' ability to meet its daily system availability goal of 16 or more hours of real-time processing and categorized all system downtime associated with the communications processors. In addition, from reports generated by the communications processors, we calculated the number of transactions per second that each processor executed during its monthly peak processing hour and compared this transaction processing rate to IRS' estimated capacity limit for the existing processors. We also analyzed system response times associated with these processing rates against IRS' response time goals.

We relied on computer generated and manually prepared IRS reports. In some cases, our audit work uncovered inconsistencies in the accuracy of such reports. For example, at times the service center and National Office reported figures differed on overall system availability and communications processors' downtime. Inconsistencies such as these generally resulted from differences in the procedures followed at selected centers and the National Office to categorize this information. When this occurred, our analysis was based on the reports that we and IRS considered to be the most reliable.

In assessing the soundness of IRS' decision to procure the replacement processors proposed by Sysorex, this report focuses on the probable performance of the main component of the

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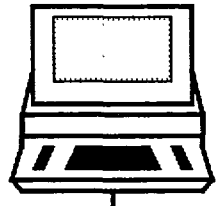
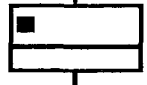
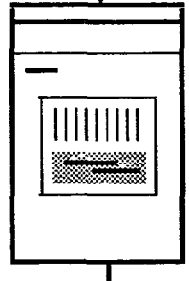
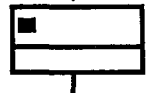
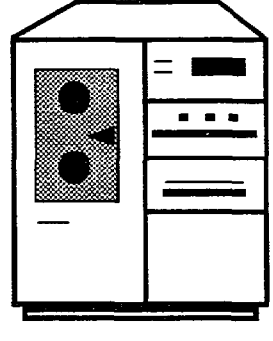
Communications Replacement System--the communications processor. We evaluated the processor's capability to meet IRS' stated reliability and capacity needs. This evaluation was primarily conducted using IRS specifications and vendor-supplied documentation. We compared IRS' reliability requirement, as stated in the CRS procurement documentation, against the new system's configuration and reports of the processor's overall reliability as experienced by various private sector users. Using vendor-supplied documentation, we evaluated IRS' processor capacity requirements against an estimated transaction processing rate for the replacement processor. In addition, the Service's contractor provided comments on the probable transaction rates expected from the replacement processors.

At the completion of this review, significant development and testing of the communications replacement system had not yet begun. For example, the software required to operate the communications processor and the associated hardware components had not been fully developed, and no testing had taken place. As a result, we can comment on neither the adequacy of the CRS computer software nor the ability of each CRS hardware component to interface successfully with the communications processor or IRS' mainframe computers.

Detailed audit work was conducted from March 1986 through June 15, 1986. In addition, we updated our work with information received through September 25, 1986, on IRS' CRS installation delays. Our work was done in accordance with generally accepted government auditing standards.

EXISTING COMMUNICATIONS PROCESSORS

DESCRIPTION OF EXISTING SYSTEM

ITEM		FUNCTION
SPERRY/CDC TERMINALS		USED TO ENTER AND RECEIVE DATA FROM THE PROCESSING SYSTEM
DISPLAY TERMINAL CONTROLLER		INTERFACES THE LOCAL AND REMOTE TERMINALS TO THE COMMUNICATIONS PROCESSOR
SPERRY 9040 COMMUNICATIONS PROCESSOR		SUPPORTS THE IDRS COMMUNICATIONS NETWORK AND SUPPLIES STATISTICAL DATA
CHANNEL INTERFACE UNIT		PERFORMS THE CONVERSION PROCESS NECESSARY FOR THE TRANSFER OF DATA BETWEEN THE COMMUNICATONS PROCESSOR AND MAINFRAME
SPERRY 1100/84 MAINFRAME		USED IN THE PROCESSING AND RESEARCH OF TAX RETURN AND RELATED DATA

DESCRIPTION OF EXISTING SYSTEM

Each of IRS' ten service centers and a test computer facility at the IRS National Computer Center use an independent network of terminals, a communications processor, and a mainframe computer to support critical on-line applications, such as the Integrated Data Retrieval System which accesses tax account files on the mainframe computer for the purposes of data retrieval and account modification.

As shown on the adjacent chart, computer terminals access the mainframe computer primarily through the following three components:

-- the Display Terminal Controller, a specially built microprocessor that interfaces all the terminals to the communications processor;

-- the Sperry 9040 Communications Processor, which controls message traffic to the mainframe computer, performs security and validation functions, and collects network statistics; and

-- the Channel Interface Unit, which performs the conversion process necessary for the transfer of data between the communications processor and the mainframe.

In a typical transaction, the process begins at the terminal where the transaction is initiated to request or to enter data into the system. The user may have requested, for example, information to research a taxpayer's account. The transaction is sent from the terminal to the Display Terminal Controller (DTC), which performs all the necessary error checking and transmission control between the terminal and the communications processor. For example, the DTC informs the communications processor of line or terminal problems and temporarily stores data input and output to the terminals. After the message passes through the DTC, it is sent to the communications processor. The Sperry 9040 controls the message traffic to the mainframe Sperry 1100/84 computer and performs the necessary security and validation functions. For example, one of the security and validation functions of the communications processor is to ensure that users supply proper passwords and that they perform only those functions that they are authorized to perform. The communications processor also keeps system performance statistics, such as transaction volumes, and routes the message to the Sperry 1100/84 mainframe computer through the Channel Interface Unit (CIU). The CIU provides the physical connection between the Sperry 9040 and the Sperry 1100/84 and performs the necessary code conversion to permit compatible data transfer between the terminals and the Sperry mainframe computer.

Upon receipt of the message, the Sperry 1100/84 mainframe computer processes the request. The requested data is sent through the CIU, the Sperry 9040, the DTC, and finally back to the terminal.

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RELIABILITY OF EXISTING PROCESSORS

OVERALL SYSTEM AVAILABILITY AND DOWNTIME

- IMPORTANCE

  --SYSTEM MUST BE AVAILABLE FOR THE PROCESSING AND RESEARCH OF TAX RETURN AND RELATED DATA

- IRS CRITERIA

  --OVERALL AVAILABILITY OF 16 OR MORE HOURS PER DAY

- 1986 PERFORMANCE

  --FROM JANUARY THRU MAY IRS ACHIEVED ITS DAILY GOAL 93 PERCENT OF THE TIME

RELIABILITY OF EXISTING PROCESSORS: OVERALL SYSTEM AVAILABILITY AND DOWNTIME

In order for IRS to achieve its mission, its entire real-time system (including the terminals, the communications processor, and the Sperry mainframe computer) must be available for the processing and research of tax return and related data. IRS has an established goal of providing 16 or more hours of real-time computer system availability per day at each service center. IRS officials believe that this timeframe provides sufficient time for those service center personnel who need to use the computer to complete their work.

Our review focused on IRS' ability to achieve this real-time computer system availability goal. In addition, we compared, for the five service centers included in our review, the number of hours the real-time system was scheduled to be available during January through May 1985 and 1986 with the number of hours the real-time system was actually available to system users. We also specifically focused on the reliability of IRS' communications processors by documenting the number of instances and total hours during which the communications processors and associated supporting devices (i.e., Display Terminal Controller, disk drives, or tape drives) were unavailable to system users during the 1985/1986 tax filing seasons.

We found that during 1986 IRS was generally able to meet its real-time computer system availability goal. From January through May 1986, the real-time system at the five centers included in our review combined to achieve or exceed 16 hours of daily availability an average of 93 percent of the time. Additionally, when the systems at the centers didn't achieve this goal, it was usually only by a small margin. For example, in about half the cases where the 16 hour goal was not met, it was missed by one hour or less. This compares favorably to the 1985 tax filing season when most service centers could not provide 12 hours of daily real-time system availability.

Our analysis of the number of scheduled and actual hours achieved by the real-time computer system during January through May 1985 and 1986 shows that significantly more real-time computer system hours were scheduled and actually achieved in 1986. For example, the Austin Service Center scheduled 1407 hours of real-time system availability in 1985 but was only able to achieve 1182 hours or 84 percent of its goal (see appendix VI, table VI.1). However, in 1986 the Center scheduled 1932 hours during the same time period and achieved 1889 hours or 98 percent of its goal.

Our analysis during 1985 and 1986 of the number of instances and total hours during which the communications processor was

unavailable to system users also shows improvements in 1986. For example, two of three centers in our review with comparable 1985 and 1986 processor unavailability statistics showed a reduction in both the number of instances that the processor was unavailable and the number of total hours of processor unavailability (see appendix VI, table VI.2). Although the centers did experience continual minor periods of processor downtime in 1986, the highest total number of hours that a processor was unavailable at a center throughout the 1986 tax filing season was only 16 hours, compared to a reported high of about 54 hours in 1985.

Information on the real-time systems availability and communications processor downtime is shown more fully in appendix VI.

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CAPACITY OF EXISTING PROCESSORS

TRANSACTION PROCESSING RATES AND RESPONSE TIME

- IMPORTANCE

  --PROCESSORS MUST HAVE CAPACITY TO PROCESS TRANSACTIONS ON A TIMELY BASIS

- IRS CRITERIA

  --PROCESSORS' ESTIMATED CAPACITY LIMIT IS ABOUT 18 TRANSACTIONS PER SECOND WITH A 1-SECOND RESPONSE TIME

- 1986 PERFORMANCE

  --DURING PEAK HOURS AT LARGE SERVICE CENTERS, PROCESSORS WERE APPROACHING ESTIMATED CAPACITY LIMIT

CAPACITY OF EXISTING PROCESSORS

IRS' communications processors must have the computer capacity to process transactions from system users on a timely basis. The speed with which on-line inquiries are processed by IRS' computers depends, in part, on the number of transactions per second that a given communications processor is able to execute. If more inquiries are sent via computer terminals to the communications processor than it can handle, the processor's "throttling mechanisms" are activated, and system users are temporarily unable to access key IRS data bases to conduct their work until the momentary processor input backlog is eliminated. IRS officials believe that the loss of operational productivity caused by unacceptable communications processor availability and poor response times hampered the Service's compliance efforts and ability to respond to taxpayer inquiries during 1985.

An internal study conducted by IRS in February 1984 concluded that the existing processors have an estimated capacity limit of about 18 transactions per second. This estimate is based on a processor transaction response time of no more than 1 second, a certain expected transaction message length, and an 85-percent utilization of each processor.

Using daily communications processor transaction rate and response time reports from January through May 1986, we calculated the average number of transactions per second being executed by the processors at the five centers in our review during each center's peak monthly processing hour. In addition, we documented the "internally measured" transaction response time during each center's peak monthly processing hour. This response time generally measured the elapsed time required by the communications processor and mainframe computer to process one transaction. We also interviewed system users to obtain their level of satisfaction with the overall computer system's response time and any negative effects that the processors' capacity limits had on their ability to complete their work during the 1986 tax filing season.

We found that during peak processing hours, the communications processors at IRS' larger service centers (Austin, Fresno, and Ogden) were approaching their estimated capacity limit. For example, at the Fresno Service Center in April 1986, the processor's transaction processing rate during the peak monthly processing hour averaged 17 transactions per second. This represented a range from about 12 to 19 transactions per second. For more information on the processors' transaction processing rates at other centers in our review see appendix VI.

We also found that transaction response times were generally within IRS' stated requirements. The average "internally

measured" response time during each center's monthly peak processing hour was about 1 second. This represented a response time range of about 0.6 a second to about 2 seconds. In addition, the system users at each center reported general satisfaction with the system response times during the 1986 tax filing season, and the capacity limitation of the processors was reported to have no significant negative effects on the processing of tax returns and related data.

It should be noted, however, that the scope of our review did not encompass the typical annual peak processing period for the communications processors--which usually occurs from May through August. At that time, IRS' correspondence with taxpayers and related adjustments typically reach their traditional peak.

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ANSWER TO CONGRESSIONAL CONCERN

WILL EXISTING PROCESSORS MEET SERVICE'S NEEDS
UNTIL REPLACEMENT PROCESSORS ARE FUNCTIONAL?

- NO EVIDENCE THAT EXISTING PROCESSORS WILL NOT MEET SERVICE NEEDS UNTIL REPLACEMENTS ARE FUNCTIONAL

- PROCESSORS PERFORMED WITHIN STATED CRITERIA. REASONS FOR OVERALL PERFORMANCE INCLUDED:

  --A LEVELING OF SYSTEM WORKLOAD

  --SOFTWARE OPTIMIZATION

  --ATTENTION TO SYSTEM MAINTENANCE AND PROBLEM RESOLUTION

  --INCREASED STAFF TRAINING AND EXPERIENCE WITH SYSTEM

- IRS BELIEVES PROCESSORS WILL PERFORM ADEQUATELY UNTIL REPLACED. HOWEVER, FURTHER ACTIONS CAN BE TAKEN, IF NEEDED, TO MAINTAIN PERFORMANCE LEVELS

- IMPLEMENTATION SCHEDULE FOR REPLACEMENT PROCESSORS
  --NOVEMBER 1986 - FRESNO SERVICE CENTER
  --FEBRUARY 1987 - REMAINING CENTERS, ONE PER MONTH

WILL EXISTING PROCESSORS MEET SERVICE'S NEEDS UNTIL REPLACEMENT PROCESSORS ARE FUNCTIONAL?

In the 1986 tax filing season, IRS' computers generally provided adequate service to support its tax processing and administrative requirements. This represented a significant improvement in computer performance compared to IRS' 1985 tax filing season. As discussed below, the predominant reasons for the overall improvements in computer performance were 1) a leveling of the real-time system's transaction processing workload, 2) optimization of certain computer software programs, 3) an increase in attention to system maintenance and problem resolution, and 4) an increase in training and experience with the system.

In 1986, IRS was generally able to meet its real-time system availability goal of 16 or more hours per day. Compared to the 1985 tax filing season, when most service centers could not provide 12 hours of daily real-time system availability, this was a significant improvement. This 1986 extension in real-time availability leveled the daily transaction processing workload among more hours and thereby helped to reduce the number of transactions entering the system during peak periods. In this way, IRS was able to reduce the chances of the communications processor's capacity limitation and possible response time problems that could have occurred had the transaction processing workload not been extended over the additional hours.

Another factor that contributed to IRS' ability to achieve its real-time system availability goal and therefore to improve the communications processors' overall performance was the optimization of some of IRS' weekend processing software programs. Weekend processing involves updating the service center's data bases with transactions from the National Computer Center. During the 1985 tax filing season, this processing often extended into the weekday, which reduced the amount of time available for real-time processing. However, IRS has streamlined some of the weekend processing software programs. As a result, the weekend processing during 1986 has generally been completed on time, and the real-time system has usually been available to system users on Monday morning.

Also, in 1986 both IRS and the Sperry Corporation increased the attention given to overall system maintenance and problem resolution. For example, Sperry Corporation provided on-site as opposed to on-call maintenance for both the communications processors and the Sperry mainframe computers. In 1985, only the communications processing system had on-site maintenance. IRS also established a National Office Command Center to serve as a central point of contact for service centers to report processing problems. The command center was established to facilitate

communication of these problems within the Service and to elevate problems to a level where they could be resolved. In addition, the Sperry Corporation established its own command center in order to respond to IRS' computer processing problems. IRS officials believe that this attention to system maintenance and problem resolution has helped to increase the availability of the communications processor during 1986.

Increased staff training and experience with the system has also improved the performance of the communications processor in 1986. Last year, for example, IRS' Remote Terminal Technicians, the employees responsible for monitoring network performance and correcting communications problems, sometimes lacked the necessary training and experience to address communications-related problems. However, in 1986, the technicians have received valuable on-the-job training from a private sector corporation contracted for by IRS to provide additional support for its real-time system at each of the service centers.

Because of improvements such as those mentioned above, IRS officials believe that the existing processors will perform adequately until they are replaced. However, if problems do arise before the communications processors are replaced, IRS officials believe that further actions can be taken to maintain satisfactory performance levels. For example, IRS officials told us that if capacity related problems increase the system's response time to users, IRS can institute procedures such as staggering work hours of system users to distribute service center work more evenly throughout the day. This action would reduce the number of transactions entered during the peak processing hours and therefore reduce the impact of the communications processor capacity limitation. In addition, in the event of serious communications processor reliability problems at one or more service centers, IRS now has two spare communications processors that could replace a failed processor until it is repaired. This ability to replace a failed processor becomes increasingly important since the potential for computer hardware failures increases with age. Formalization of plans such as these into a detailed contingency plan would help to ensure that essential processing is accomplished without a serious disruption.

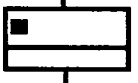
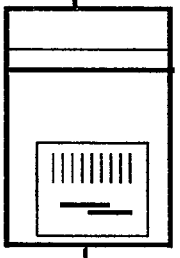
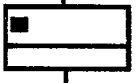
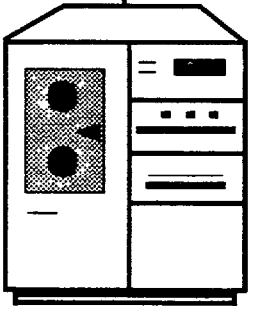
As a result of the actions IRS has taken and could take in the event of future communications processor performance problems, we found no evidence to conclude that the existing processors will not meet the Service's needs until their scheduled replacement. During the 1986 tax filing season, the Service had only minor problems with the unavailability of the communications processors. When problems did occur, IRS was able to quickly respond and to correct these problems, in most cases within an hour.

The implementation schedule for IRS replacement processors calls for the first communications processor to be installed and tested at the Fresno Service Center beginning in November 1986. The remaining processors are scheduled to be replaced, about one service center per month, beginning in February 1987. The three largest service centers should have replacement processors operational by April 1987, prior to the traditional peak processing period for these processors, which generally extends from May through August.

If this schedule is met, and assuming no large unexpected increase in workload occurs, we believe that the existing processors should meet the Service's needs until the replacement processors are functioning. However, either a significant delay in this schedule or a significant increase in workload will increase the chances that the existing processors will experience reliability and capacity problems. Therefore, IRS should closely monitor the performance of the existing processors to ensure that these computing resources continue to fulfill IRS' mission and formalize its contingency plans in the event that problems occur with the existing communications processors prior to their replacement.

REPLACEMENT COMMUNICATIONS PROCESSORS

DESCRIPTION OF REPLACEMENT SYSTEM

ITEM		SOURCE
SPERRY/IBM TERMINALS		EXISTING SPERRY TERMINALS AND NEW IBM PC TERMINALS
PROTOCOL MASTER PROCESSOR		NEW INTERFACE BEING BUILT BY POTOMAC SCHEDULING COMPANY
IBM 4381 COMMUNICATIONS PROCESSOR		NEW FRONT-END PROCESSOR SUPPLIED BY THE IBM CORPORATION
HOST CHANNEL ADAPTOR		NEW INTERFACE BEING BUILT BY POTOMAC SCHEDULING COMPANY
SPERRY 1100/84 MAINFRAME		EXISTING SPERRY HOST COMPUTER

DESCRIPTION OF REPLACEMENT SYSTEM

On February 11, 1986, IRS awarded a contract to Sysorex to replace its existing data communications processing system and old Control Data Corporation (CDC) computer terminals with a new system known as the Communications Replacement System (CRS). Under this procurement, IRS will replace its 11 communications processors and 4,100 CDC computer terminals at its service centers and the National Computer Center with IBM 4381 communications processors and IBM Personal Computer (PC) terminals. In addition, IRS' terminal network will be expanded. About 900 more terminals nationwide will be added to the system to support IRS' taxpayer service function. Also, this contract provides for the optional acquisition of 5,000 additional PC terminals to accomodate future system growth.

Sysorex is the prime contractor on the CRS contract and is acting as an integrator for the subcontractors who are actually supplying the new hardware and software for the system. The subcontractors and their roles are as follows:

-- International Business Machines (IBM) Corporation - supplying 1) the communications processor (an IBM 4381) and related systems software, 2) IBM personal computers serving as terminals for the network, and 3) terminal system software used to operate the IBM PC's.

-- Potomac Scheduling Company - supplying the two communications interfaces that allow the new communications processor to communicate with the terminals and the Sperry 1100/84 mainframe computer.

-- Arthur Andersen & Co. - supplying the security and validation software that will run on the IBM 4381 communications processor.

The CRS will consist basically of three hardware components: the main communications processor and two interface units, a Protocol Master Processor and a Host Channel Adapter. The heart of the CRS is the communications processor. As with the existing processor it will be responsible for all real-time transaction switching, security and validation processing, and performance statistics. The Protocol Master Processor will allow the IBM PC's and existing Sperry terminals to communicate with the IBM communications processor. The Host Channel Adapter will allow the communications processor to interface with the Sperry 1100/84 mainframe computer. Both devices are needed to control message traffic to and from the mainframe computer and the terminals.

Since the two interface devices, as well as the software that will run on the replacement communications processor, have yet to be completely developed and tested at IRS, our evaluation centered on the reported reliability and capacity of the CRS' main hardware component--the communications processor.

Appendix III

RELIABILITY OF REPLACEMENT PROCESSORS

- IRS REQUIRES 99.5 PERCENT SYSTEM AVAILABILITY DURING REAL-TIME OPERATING PERIODS.

- RELIABILITY INDICATORS

  --REPLACEMENT SYSTEM WILL HAVE TWO PROCESSORS, ONE FOR BACK-UP AND SUPPORT

  --AUGUST 1985 STUDY REPORTS HIGH RELIABILITY OF IBM 4381

  --MAJOR AIRLINE REPORTS 99.9 PERCENT AVAILABILITY FOR ITS IBM 4381

- PROCESSOR RELIABILITY SCHEDULED FOR IRS TESTING IN OCTOBER 1986

RELIABILITY OF REPLACEMENT PROCESSORS

IRS' solicitation document for its CRS calls for a highly reliable computer system that can provide a minimum availability level of 99.5 percent during real-time operating periods. Our review of the processor's ability to meet this requirement included a review of the CRS hardware configuration. In addition, since at the close of our review the processors had yet to be installed within IRS, we reviewed reports of the processor's historical reliability and interviewed several private sector users of the IBM 4381 processor and related software to document their overall experiences with the processor's reliability.

We found that the configuration of the CRS will provide IRS for the first time with dual communications processors at each of its service centers. In normal operation, one processor will be responsible for all real-time transaction processing, security and validation processing, logging, journaling, etc. The second processor will be available for back-up and support in the event that the main processor becomes unavailable. IRS' total expected exposure if the main processor malfunctions is estimated by its contractors to be restricted to a 3-4 minute period. This switchover is expected to be transparent to the terminal operators because the communications network will remain active and the operators will remain logged onto the system. The only sign of a failure will be the short lapse in CRS response time.

User experience with the reliability of the replacement processor has been reported to be favorable. For example, an August 1985 Data Pro Research Corporation report summarized the results of user experiences with over 900 mainframe systems. For all systems that received 20 or more evaluations, the IBM Model 4381 processor received the highest user rating for overall reliability. In addition, users that we interviewed during this review reported a high degree of satisfaction with the reliability of the processor. For example, a major airline reported that its IBM Model 4381 processor was achieving its targeted minimum availability level of 99.9 percent without the benefit of dual processors.

Testing of the processor's reliability within IRS' computer operations is scheduled to begin in October 1986 at the National Computer Center; service center testing is scheduled to begin at the Fresno Service Center in November 1986.

CAPACITY OF REPLACEMENT PROCESSORS

- IRS REQUIRES PROCESSING RATES OF 39 TRANSACTIONS PER SECOND IN 1988 AND 60 TRANSACTIONS PER SECOND BY 1991 WITH A PEAK PROCESSING RATE OF 90 TRANSACTIONS PER SECOND

- CAPACITY INDICATORS

  --SYSTEM THROUGHPUT = $\frac{\text{PROCESSOR EXECUTION CAPACITY}}{\text{PROGRAM INSTRUCTIONS PER MESSAGE}}$

  --WITH 85-PERCENT PROCESSOR UTILIZATION, THE PROCESSOR'S THROUGHPUT IS ESTIMATED TO RANGE FROM 86 TO 137 TRANSACTIONS PER SECOND

  --IRS' CONTRACTOR ESTIMATES 125 TRANSACTIONS PER SECOND WITH SOME DISCLAIMERS

- IRS PLANS TO BEGIN TESTING PROCESSOR CAPACITY TO MEET 1991 REQUIREMENTS BEGINNING IN OCTOBER 1986

CAPACITY OF REPLACEMENT PROCESSORS

IRS' CRS solicitation document requires a processor with the initial capacity to process an average peak hourly transaction rate of 39 transactions per second and an ability to expand to an average peak hourly transaction processing rate of 60 transactions per second. The latter is IRS' estimated average transaction rate required to process its expected workload for calendar year 1991 and represents a range of transaction processing rates with peaks as high as 90 transactions per second. This is a significant increase over the ability of IRS' existing communications processors, which have an estimated capacity limit of about 18 transactions per second.

To thoroughly assess the transaction processing ability of IRS' replacement communications processor, the processor and its software must be tested in IRS' processing environment using actual IRS transactions. The earliest an assessment such as this could take place is in December 1986, after the system is installed at Fresno Service Center. However, we did make a preliminary assessment of the replacement processor's ability to execute IRS' transaction processing requirements by using vendor-supplied data to calculate the estimated number of transactions capable of being processed by an IBM 4381. We also similarly obtained an estimate of the processing ability of the IBM 4381 from IRS' contractor. It should be noted that neither of these estimates includes an evaluation of the throughput ability of IRS' total computer system. For example, these estimates do not include processing limitations of IRS' mainframe computer or file subsystem devices, such as a communications channel, which are required to support the transaction processing rate. The estimates are based solely on the processing ability of the replacement communications processor.

When the IBM 4381 system software called for within Sysorex's CRS proposal documentation is used, the manufacturer's suggested procedure for estimating the expected throughput of an individual replacement processor is to take the average number of program instructions to process an average IRS message and divide that number into the processor's instruction execution capacity.

When information from Sysorex's CRS proposal documentation is used for this calculation, a replacement processor's estimated throughput ability, assuming 85-percent processor utilization, is about 137 transactions per second. However, using an updated June 1986 estimate by Sysorex of the average number of instructions required to process an average IRS message, a processor's throughput capability is estimated at about 86 transactions per second. This difference in expected transaction processing rates results from a possibility that the model 4381 application software programs currently being written may be less efficient

than anticipated by Sysorex at the time that it prepared its CRS proposal documentation.

At the close of our review, IRS' contractor was refining the IBM 4381 application software and believed with some disclaimers, that once the software was completed, the processor should be able to process up to 125 transactions per second. The disclaimers dealt with factors such as a need for planned processor memory increases and a potential for IRS' communications line speeds to adversely affect processing at this higher processing rate.

Testing at IRS of the processor's capacity to meet 1991 requirements is scheduled in October 1986, at the National Computer Center. Processor testing at an IRS service center is scheduled to begin at Fresno Service Center in December 1986.

Appendix III

ANSWER TO CONGRESSIONAL CONCERN

WILL REPLACEMENT PROCESSORS MEET
SERVICE'S NEEDS FOR THE LIFE OF THE SYSTEM?

- REPLACEMENT PROCESSORS SHOULD BE ABLE TO MEET CURRENT PROJECTED NEEDS, BUT THE ACCURACY OF THE PROJECTIONS IS UNCERTAIN

- ESTIMATES OF FUTURE WORKLOADS ARE OUTDATED

  --BASED ON 1980 THRU 1983 TRANSACTION VOLUMES

  --BASED PREDOMINANTLY ON WORKLOAD OF ONE APPLICATION

- PROJECTED WORKLOAD WILL MAKE MAINFRAME COMPUTERS BOTTLENECKS

- PLANNED EXPANSION OF TERMINAL NETWORK COULD INCREASE TRANSACTION VOLUMES

- TAX REFORM UNDER CONSIDERATION COULD ALTER FUTURE TRANSACTION VOLUMES

- TO FULLY ADDRESS THIS QUESTION, IRS NEEDS TO CONDUCT AN UPDATED AND MORE THOROUGH ANALYSIS OF FUTURE WORKLOAD REQUIREMENTS FOR ITS ENTIRE COMPUTER SYSTEM

WILL REPLACEMENT PROCESSORS MEET SERVICE'S NEEDS FOR THE LIFE OF THE SYSTEM?

In the early 1990s, IRS plans to begin to implement a redesign of its overall tax processing system, which may alter its requirements for a communications processor. However, this project is in its early planning stage, and no requirements have currently been established for communications processors. As previously discussed under the caption "Capacity of Replacement Processors," IRS has projected that its computer resource needs through 1991 will require processors capable of processing an average of 60 transactions per second during a service center's peak processing hour. Because information beyond 1991 was not available, we could only assess the processors' ability to meet IRS' 1991 requirements.

From a reliability standpoint, the replacement processors should be able to meet IRS' stated requirement for system availability. In addition, the processors should be able to handle IRS' near term workload requirements. However, we are less certain about the processors' ability to meet IRS' needs through 1991 because IRS' workload projections used by the contractor when sizing the processors are outdated. In addition, when the system's ability to execute IRS' projected workload is viewed from a total system perspective to include the processing ability of the mainframe computer as well as the communications processor, additional uncertainties are introduced. Finally, other IRS actions and tax reform legislation under consideration by the Congress could alter future transaction volume requirements. As a result, to fully address the question of whether the replacement processor will meet the Service's needs for the life of the system, IRS needs to more frequently update and thoroughly analyze its existing and future workload requirements for both its communications processors and supporting mainframes.

The purpose of workload forecasting is to provide information on future processing requirements in order to provide adequate computing resources to perform the expected workload and ultimately to fulfill the agency's mission. Requirements and guidance in this area are provided in the Federal Information Resources Management Regulation (FIRMR) and National Bureau of Standards guidance. For example, when acquiring information resources, FIRMR requires an agency to develop, at a minimum, a requirements analysis, which includes an analysis of the proposed system's present and projected workload requirements. In addition, National Bureau of Standards guidance provides techniques of various levels of sophistication to project an agency's future computing needs and recognizes a need for an on-going workload forecasting effort to help ensure that an agency's computing resources (system capacity) needs are effectively estimated and planned.

IRS could not provide any documentation on how it established its projected needs for a communications processor. However, the individual responsible for estimating IRS' future workload stated that the projections were made in May 1983 and were based on a number of assumptions including 1) a continuation of an historical daily and peak hour transaction growth increase experienced by IRS from about 1980 to 1983, 2) a 10-hour work day to complete all daily processing requirements, 3) the use of a communications processor primarily by IDRS, and 4) the replacement of the existing mainframe computers in 1988 with more powerful computers.

The results of this analysis yielded a projection of daily transaction volume increases of 10 percent per year and about a 24-percent average annual increase in the number of transactions processed during a service center's peak processing hour. The latter figure was used to calculate IRS' estimated future processing need of 60 transactions per second. However, several events have taken place that have reduced the reliability of these projections. Since calendar year 1983:

-- IRS' daily transaction volumes have increased faster than previously estimated. For example, at the Fresno Service Center, the daily transaction volume for April 1986 frequently exceeded the volumes predicted for 1987. Although IRS does not anticipate the higher transaction volumes to continue, a continuation of higher-than-expected transaction volumes will reduce the useful life of the communications processors.

-- IRS has increased its scheduled real-time computer processing work day from the 10-hour work day used in the May 1983 projections to a 16-or more hour work day. During the 1986 tax filing season the average computer processing work day was about 17 hours. With more hours of processing time per day, IRS is able to spread out the number of transactions being processed per hour, thereby reducing the number of transactions needed to be processed during the peak processing hours.

-- Other IRS functions are planning major compliance, tax processing, and taxpayer service projects, which may become either directly or indirectly reliant on the communications processor and the mainframe computer for information. Examples of planned projects under consideration include the Automated Examination System, the Automated Underreporter Program, Automated Taxpayer Service System, Integrated Collection System, and Service Center

Integrated Management System. Each of these projects could use the communications processor to access key IRS data bases on its main computers. An increased use of the communications processor by systems other than the Integrated Data Retrieval System could increase IRS' transaction processing needs above projected levels and saturate the communications processor sooner than expected.

-- IRS has decided not to procure more powerful mainframe computers in 1988 in favor of a phased solution to its future mainframe computer capacity needs. This phased solution includes numerous separate initiatives designed to stretch the usefulness of IRS' mainframe computers through 1991. Examples of the initiatives are a realigning and better balancing of IRS' tax processing workload among its 10 service centers and the off-loading of selected computer jobs from the real-time mainframe computers onto other computer systems. IRS currently has other main computers at each of its service centers that are primarily used for batch processing. These computers could be reconfigured if necessary to accept real-time transactions from a communications processor. Successful implementation of initiatives such as these is essential to IRS' mainframe computers continuing ability to meet IRS' computing needs. Currently, each service center's real-time mainframe computer is estimated to be able to process only about 30 transactions per second from the communications processor. If IRS' future transaction processing rates exceed this level and only one real-time mainframe computer is used, IRS runs the risks of saturating the processing power of its mainframe computer and making it a bottleneck in processing IRS' transactions. In addition, the faster processing speeds of the communications processor would be wasted.

-- As part of the CRS acquisition, IRS plans to immediately increase the number of computer terminals available to system users. However, no thorough impact studies or analyses have been conducted by IRS to determine the potential for an increase in transaction processing rates associated with this increase in network terminals access. In other installations where terminal access has been increased, there has traditionally been some offsetting increase in transactions being processed due to the increased availability of the computer

system. An increase in the transaction processing requirements, particularly during peak processing hours, would affect the useful life of the communications processor.

-- Recent Congressional actions to revamp the nation's tax laws could alter IRS' future transaction processing requirements. For example, proposed tax simplification measures could change the number of taxpayers required to file a tax return. In addition, less complicated reporting requirements could reduce the amount of information IRS is now required to maintain on taxpayers.

The replacement communications processors appear to be able to process IRS' projected near term needs. However, we believe that IRS' projections of future transaction volumes, which lead Sysorex to propose the replacement processors, are not reliable. These projections, made in May 1983, are outdated, and the more recent events discussed above could affect the useful life of not only the communications processors but also IRS' main computers.

IRS had an opportunity to update its specifications in January 1986 when the General Services Administration's Board of Contract Appeals ordered IRS to terminate its CRS contract, which had been previously awarded to another vendor. However, this was not done because IRS officials felt that the contract specifications allowed for a considerable growth in processing needs and IRS estimated that a reconsideration of its contract specifications could cause a significant delay in obtaining replacement processors. We agree that the specifications do provide for a significant increase in computing power; however, to fully address the question of whether the replacement processors will meet the Service's actual needs for the system's life, IRS needs to conduct more regular workload analyses and monitor the performance of the communications processors and supporting mainframes to ensure that these computing resources can fulfill IRS' mission.

REPLACEMENT SYSTEM INSTALLATION SCHEDULE

INSTALLATION SCHEDULE FOR REPLACEMENT SYSTEM

PLANNED SCHEDULE AT 6/27/86	PLANNED SCHEDULE AT 8/31/86	
07/01/86	07/01/86	INSTALL HARDWARE AT THE NATIONAL COMPUTER CENTER
07/24/86	09/22/86*	CONDUCT NCC ACCEPTANCE TESTS
08/14/86	09/29/86	CONDUCT COMPATIBILITY TESTS AT NCC
09/01/86	11/08/86	INSTALL COMMUNICATIONS REPLACEMENT SYSTEM AT FIRST SERVICE CENTER
09/12/86	11/24/86	CONDUCT COMPATIBILITY TESTS AT FIRST SERVICE CENTER
11/03/86	12/20/86	CONDUCT ACCEPTANCE TESTS FOR TERMINALS AND PROCESSORS AT FIRST SERVICE CENTER
12/03/86	01/02/87	SHIP TERMINALS AND PROCESSORS TO SECOND SERVICE CENTER
01/05/87	02/09/87	INSTALL ENTIRE SYSTEM AT SECOND CENTER; REMAINING SERVICE CENTERS ABOUT ONE PER MONTH
10/09/87	12/18/87	COMPLETION DATE FOR SYSTEM'S IMPLEMENTATION AT ALL SERVICE CENTERS

*As of September 25, 1986, IRS estimated that continuing problems in the development of CRS software will delay NCC acceptance testing for at least 3 weeks. Depending on the actual date for NCC acceptance testing, the remaining installation schedule dates will likely be changed.

INSTALLATION SCHEDULE FOR REPLACEMENT SYSTEM

IRS' installation schedule calls for the CRS to be installed and tested at the NCC in Martinsburg, West Virginia, before being installed at any of the service centers. The system must pass an acceptance test, which demonstrates the capability of the system to meet the requirements contained in IRS' solicitation documents and a compatibility test, which demonstrates the ability of the IBM terminals to interface with the existing communications processor. The acceptance test includes the following requirements:

1) a throughput and response time measurement that will validate the ability of the system to process the transaction volumes projected through 1991,

2) an operational demonstration that will validate numerous technical features required of the individual hardware and software products, and

3) a 30-consecutive-calendar-day test designed to determine whether the reliability of each component in the communications processing system is able to meet IRS' minimum availability requirements within its solicitation documents.

The compatibility test will validate IRS' fallback capability by testing the ability of the IBM terminals to work with an existing communications processor.

IRS met its planned date to install the communications processor at NCC; however, because of delays in the development and testing of CRS application software, the CRS testing at NCC has been delayed until October 1986. Once testing is successful at NCC, IRS intends to begin to install and pilot test the CRS at the Fresno Service Center in November 1986. The remaining service center systems will be installed at a rate of one service center every five weeks starting in March 1987 after acceptance of the Fresno Service Center system. The volume of IDRS transactions in a service center is the primary factor affecting the service center installation order. If IRS' installation schedule proceeds as planned, the completion date for system's implementation at all service centers is December 18, 1987.

INSTALLATION SCHEDULE RATIONALE, SAFEGUARDS, AND POTENTIAL PROBLEMS

RATIONALE BEHIND INSTALLATION OF REPLACEMENT SYSTEM DURING 1987 FILING SEASON

- EXPANDING TERMINAL NETWORKS AT LARGE SERVICE CENTERS
- INCREASING MAINTENANCE OF EXISTING TERMINALS

IRS SAFEGUARDS FOR INSTALLATION DURING FILING SEASON

- SYSTEM MUST HAVE 100-PERCENT FALLBACK CAPABILITY AT SERVICE CENTERS DURING SYSTEM TESTING
- SYSTEM MUST PASS ALL TESTS AT THE NATIONAL COMPUTER CENTER, ATLANTA, AUSTIN, ETC., BEFORE OTHER SERVICE CENTERS TEST SYSTEM

POTENTIAL PROBLEMS IN THE DEVELOPMENT OF THE COMMUNICATIONS REPLACEMENT SYSTEM COULD DELAY INSTALLATION

- PROCESSORS' LOW-LEVEL SOFTWARE DESIGNS IS UNACCEPTABLE (AS DETERMINED BY IRS)
- DELAYED DEVELOPMENT OF TERMINAL INTERFACE SOFTWARE NECESSARY FOR IRS' FALLBACK CAPABILITY

Appendix IV

RATIONALE BEHIND INSTALLATION OF REPLACEMENT SYSTEM DURING 1987 FILING SEASON

The original CRS installation schedule that we obtained from IRS did not call for nationwide installations of the CRS at IRS' service centers until after the close of the 1987 filing season. The reason for this delay was to avoid a possibility of the CRS installation's adversely affecting the processing of tax return and related data during a service center's busy tax filing season. However, IRS reversed this decision and decided to install the CRS as soon as feasible. Given what IRS considered adequate time to install and test the new system at NCC and to pilot test the CRS at the first service center, coupled with software development delays, IRS decided to begin CRS installations at the remaining centers starting in February 1987. As in the original schedule, those service centers with the largest workload would be the first to receive the new communications system.

IRS chose to install the CRS at its larger service centers during the 1987 filing season for two primary reasons. First, the schedule allows for an immediate expansion of the terminal network, which IRS feels is needed, particularly at its larger centers. Currently, the four largest service centers already have the maximum number of computer terminals that can be connected to the existing network. Installation of the CRS gives these centers the flexibility to expand their terminal network to accomodate their needs. As part of the CRS, IRS will add 900 terminals to its nationwide network to support the taxpayer service function. In addition, subject to budgetary constraints and adequate justifications, IRS intends to immediately exercise its option in the CRS contract to acquire some of its 5,000 additional terminals.

The second primary reason for installing the CRS during the 1987 filing season is to eliminate the increasing maintenance costs associated with the existing Control Data Corporation terminals. These 4,100 terminals, which were installed in the early 1970s, have become costly and difficult to maintain due to their age and the lack of spare parts; maintenance has been estimated by IRS to cost approximately $1.1 million per month. In addition, the loss of operational productivity caused by failing terminals has reportedly hampered the Service's compliance efforts and ability to respond to taxpayer inquiries.

IRS SAFEGUARDS FOR INSTALLATION DURING FILING SEASON

IRS recognizes that there are risks associated with installing a new computer system in its service centers during the tax filing season. However, it believes that its CRS implementation strategy includes adequate safeguards for reducing the risk of nationwide CRS installation problems that could affect the 1987 tax filing season.

During the system testing, IRS is requiring that each service center have the ability to completely revert back to its old communications system in the event that the new system fails. To accomplish this task, IRS, among other things, executed a contract modification with its CRS contractor to require the IBM terminals that will replace the old CDC terminals to have the capability to interface with the existing communications processor. Under the original contract terms, the replacement IBM terminals were only required to interface with the new IBM 4381 communications processor.

In addition, IRS has required that the CRS pass all the system testing at the NCC, Fresno Service Center, Austin Service Center, etc., before other service centers begin to install and test the system. By phasing installation IRS believes that it will minimize the possibility of system testing problems affecting multiple service centers.

POTENTIAL PROBLEMS IN THE DEVELOPMENT OF THE COMMUNICATIONS REPLACEMENT SYSTEM COULD DELAY INSTALLATION

Throughout our review, the replacement communications system was in its development phase. Although some of the CRS' hardware (e.g., IBM 4381 processors and computer terminals) is commercially available and proven technology, custom software must be written for the communications processors and related interface devices and then integrated with hardware components to form the overall CRS. Although the system components and software have yet to be integrated or tested within IRS' environment, we did find two problems with the development of certain CRS software that could affect the system's successful implementation and future maintenance and preclude IRS from installing the CRS according to its planned installation schedule. With a delay in the installation schedule, the replacement communications processors would not be operational at IRS' larger service centers prior to the peak processing period (typically May through August). An extension in the use of the existing processors could increase the chances of those processors experiencing some reliability and capacity problems, and may require IRS to institute other procedures to maintain satisfactory performance levels.

At periodic stages during the development of the application software for the CRS, IRS reviewed and commented on the adequacy of the software design being written by its contractor. IRS provided feedback to its contractor on the application software's functional and low-level design specifications. The functional design specifications provide a general description of how the software is intended to be developed and includes such things as data flow diagrams, data definitions, and processing specifications. The software's low-level design specifications

further describe the system's design and are used by programmers to develop the actual software programs to operate the system.

In each of its feedback sessions, IRS expressed concerns to its contractor about the adequacy and quality of the software's documentation. In addition, when IRS' communications software technicians reviewed the low-level design specifications, they found them unacceptable because discrepancies existed between the specifications and the requirements of the contract. Although the contractor assured IRS that all required software documentation would be provided, at the close of our detailed review the Service was withholding payment to its contractor until it provided documentation that met contractural requirements. Without adequate CRS application software, the system will not be able to function correctly. Without adequate documentation for the software, it will be more difficult to maintain.

Another potential software problem that could delay the CRS installation schedule involves the development of terminal system software required by IRS' contract modification. This terminal software permits IRS to fall back to the existing communications system in the event of problems with the CRS during service center testing. The contractor completed some preliminary work to include this capability in the overall design of the CRS, but deferred development of the required software until August 1986 when it received, in writing, IRS' contract modification. According to the contractor's rough estimates, this software probably will not be developed and ready for testing at NCC until well into the testing cycle and may not be available until the CRS is planned to be tested at Fresno Service Center. In accordance with IRS' testing plans, without the successful completion of this software test, as well as all other system tests at NCC, no service centers should begin to install and test the system.

Appendix IV

COMMENTS ON INSTALLATION SCHEDULE

GAO VIEWS

- NO RISK-FREE TIME TO INSTALL REPLACEMENT SYSTEM
- COMPLETE ADHERENCE TO 1) A FALLBACK CAPABILITY DURING TESTING AND 2) DEMONSTRATIONS OF SYSTEM'S ACCEPTANCE PRIOR TO FURTHER INSTALLATIONS IS ESSENTIAL TO REDUCING IRS' RISKS
- THE REPLACEMENT SYSTEM AND FALLBACK CAPABILITY MUST BE THOROUGHLY TESTED AT THE NATIONAL COMPUTER CENTER AND FRESNO SERVICE CENTER, PRIOR TO BEGINNING NATIONWIDE IMPLEMENTATION
- IRS' INTERNAL AUDIT FUNCTION PLANS TO REVIEW THE NATIONAL COMPUTER CENTER AND FRESNO SERVICE CENTER ACCEPTANCE TESTING PROCESS

COMMENTS ON INSTALLATION SCHEDULE

Ideally, new hardware should be installed at computer centers during times that are least disruptive to production processing. However, due to the nature of IRS' current workload, there appears to be no risk-free time to install the CRS. IRS' tax filing season complicates service center computer processing from January through May. Afterwards, from May through August, the IDRS real-time transaction volumes reach their peak. The IDRS provides information on taxpayer accounts and status to the Taxpayer Service, Collection, Examinations, and Criminal Investigation units. In addition, if IRS waits until after these peak-processing periods and installs the replacement system beginning in September 1987, most service centers would have to depend on the existing communications processing system for the entire 1987 filing season and the peak IDRS processing period, and probably would not have a full complement of new computer processors available at the beginning of the 1988 tax filing season. This alternative would also not provide early relief of the high Control Data Corporation computer terminal maintenance costs nor any computer terminal network expansion during most of 1987.

Given that there is no risk-free time in which to install the CRS, we believe that it is essential that IRS strictly adhere to the safeguards provided within the Service's implementation strategy. Complete adherence to 1) a fallback capability during testing and 2) demonstrations of system's acceptance prior to further installations is essential to reducing IRS' risks. The ability to revert back to the existing communications system during CRS service center testing is important because of the large number of IRS functions that rely on the real-time system to complete their work. Also, IRS' requirement for the CRS to pass all tests prior to successive center installations is important to protecting against the possibility of perpetuating installation problems throughout the Service.

We are also aware that despite careful use of preventative measures, there is always some likelihood that events will occur that could prevent the normal installations or operations of IRS' replacement communications processors. Currently, IRS' contractor is experiencing problems in the development of software critical to the successful operation of the replacement communications processors. A well-defined contingency plan documenting actions that can be taken by each service center in the event that problems such as these disrupt processing would help to ensure a smooth and rapid restoration of normal processing. IRS' internal audit function plans to review the NCC and Fresno Service Center testing process. This review will include an assessment of the adequacy and thoroughness of the testing process and IRS' ability to provide for a 100-percent fallback capability during system testing.

CONCLUSIONS & RECOMMENDATIONS

CONCLUSIONS

EXISTING COMMUNICATIONS PROCESSORS

- OVERALL PERFORMANCE OF EXISTING PROCESSORS DID NOT NEGATIVELY AFFECT THE 1986 TAX FILING SEASON

- NO EVIDENCE TO SUGGEST THAT EXISTING PROCESSORS WILL HAVE A SIGNIFICANT NEGATIVE EFFECT ON PROCESSING BEFORE REPLACEMENT

REPLACEMENT COMMUNICATIONS PROCESSORS

- REPLACEMENT PROCESSORS APPEAR TO BE HIGHLY RELIABLE AND TO PROVIDE A SIGNIFICANT INCREASE IN COMPUTING POWER

- IRS' MAINFRAME COMPUTERS WILL BECOME SATURATED LONG BEFORE THE REPLACEMENT COMMUNICATION PROCESSORS

- THE ACCURACY OF IRS' FUTURE WORKLOAD PROJECTIONS IS UNCERTAIN; PROJECTIONS NEED TO BE UPDATED FOR THE ENTIRE COMPUTER SYSTEM TO ENSURE THAT ADEQUATE COMPUTING RESOURCES ARE AVAILABLE TO FULFILL ITS MISSION

INSTALLATION SCHEDULE FOR REPLACEMENT SYSTEM

- PLANNED INSTALLATION SCHEDULE IS NOT WITHOUT RISK

- STRICT ADHERENCE TO A 100-PERCENT FALLBACK CAPABILITY DURING SYSTEM TESTING AND A PHASED INSTALLATION SCHEDULE BASED ON SUCCESSFUL COMPLETION OF ACCEPTANCE TESTING ARE ESSENTIAL TO REDUCE IRS' RISKS

- IRS INTERNAL AUDIT PLANS TO REVIEW THE THOROUGHNESS OF THE SYSTEM'S TESTING PROCESS PRIOR TO NATIONWIDE IMPLEMENTATION

CONCLUSIONS

IRS' communications processors are an important component of its overall tax processing system. Each IRS service center currently has only one processor. If that unit fails, no access can be provided to key IRS data bases until that unit is repaired or one of IRS' two spare processors are installed. The data bases are used by numerous personnel to respond to taxpayer inquiries, process tax refunds, investigate tax crimes, etc. IRS has experienced some reliability problems with their existing communications processors. In addition, IRS' current and projected workload demands, particularly at larger service centers, approach or exceed IRS' estimated processor capacity limit. IRS is replacing these processors with a new communications processing system. It plans to install this new system at some service centers during the 1987 tax filing season and expects to have all processors available for use by the beginning of its 1988 tax filing season.

Our review of the overall reliability and capacity of the existing communications processors during January through May 1986 shows that their performance did not have a significant adverse effect on IRS' 1986 tax filing season. IRS was generally able to meet its goals for overall system availability. In addition, although IRS' processors were approaching their capacity limitations at the larger service centers during peak processing periods, this had no significant adverse effect on the processing of tax returns and related data. The processors' 1986 performance can be attributed to a combination of actions taken by IRS to improve their overall computer-related tax processing, including a leveling of the system's overall workload and an increased attention to system maintenance and problem resolution. IRS officials believe that the existing processors will meet their needs until the replacement processors are functional.

IRS' most recent installation schedule for the new communications replacement system would complete the installation of processors at three high volume service centers prior to IRS' peak IDRS processing period. This should reduce the chances of the existing processor capacity limitations affecting these centers. IRS' schedule calls for installation and testing at all 10 centers to be completed in December 1987. If this schedule is met, and assuming no large unexpected increase in workload occurs, the existing processors should be able to meet IRS' needs until the replacement processors are functional. However, since either a significant delay in this schedule or a significant increase in workload will increase the chances that the existing processors will experience reliability and capacity problems, IRS should closely monitor the performance of the existing processors to ensure that these computing resources continue to fulfill IRS'

mission. IRS has alternative actions that could be taken in the event that the processors experience capacity and reliability problems prior to their replacement, but has not developed formal contingency plans addressing specific actions which would be taken at each IRS service center.

Our review of the reported reliability and capacity of the replacement processors shows that the processors appear to be highly reliable and to provide for a significant increase in computing power over IRS' existing processors. Private sector user reports on the reliability of the replacement processor have been favorable, and for the first time IRS will have a back-up processor at each center in the event that the primary processor encounters reliability problems. The replacement processor itself has also been reported by IRS' contractors to be able to process IRS' stated workload demands through 1991. We believe that the processors should be able to handle IRS' near term workload requirements; however, we are less certain about the processors ability to meet IRS' needs through 1991.

Two critical factors could materially affect the useful life of these processors. First, IRS' contractor is beginning to experience problems and delays in developing software essential for operating the processors. How much of the processor's capacity will be actually required by this software will not be known until it is fully developed and tested. The more capacity required by the software, the less that will be available to process IRS' workload. Second, the accuracy of IRS' future workload projection is uncertain. Several events that have taken place since the May 1983 projections were made reduce their overall reliability. Most importantly, IRS has decided to implement a number of initiatives designed to extend the usefulness of IRS' mainframe computers through 1991. Given IRS' projected needs in 1991 of a communications processor capable of processing an average of 60 transactions per second and an estimated capacity limit of IRS' real-time mainframe computer of about only 30 transactions per second, IRS' mainframe computers will become saturated long before the replacement communications processors.

If IRS' projections are accurate, without successful implementation of IRS' initiatives, its mainframe computers will be unable to process IRS' workload, not only wasting the resources of the more powerful communications processor but also potentially impairing IRS' ability to achieve its mission. To fully address the question of whether the replacement processors will meet the Service's actual needs for the system's life, IRS' projections need to be more regularly updated for its communications processors and supporting mainframe computers. In addition, the performance of these computers should be continually monitored.

We also believe that IRS' planned installation schedule for the replacement processor is not without risks. Any equipment installation during a service center's fast-paced tax filing season could have a disruptive effect on service center computer processing. To reduce its installation schedule risks, IRS has established safeguards in its CRS installation testing plan. Most importantly, IRS will provide for a 100-percent fallback capability at each of its service centers during system testing and will implement a phased service center installation schedule based on the successful completion of system testing at its National Computer Center, at Fresno Service Center, and at successive service center installations.

However, IRS' contractor is experiencing problems in the development of the communications replacement system's software that has affected the system's timely installation. Although efforts are underway to correct these problems, the processor's low-level software design has been determined by IRS to be unacceptable. Without adequate CRS software, the system will not be able to function correctly. Without adequate documentation for the software, it will be more difficult to maintain.

In addition, there is a question as to whether terminal interface software necessary for IRS' fallback capability will be developed and ready for testing at NCC. This could further delay testing at IRS' first service center. With delays in the installation schedule, the existing processors will have to be used longer than planned. This increases the chances of these processors experiencing some reliability and capacity problems and may require IRS to institute other procedures to maintain satisfactory performance levels. IRS' internal audit function plans to review the thoroughness of IRS' system testing process at the NCC and Fresno Service Center. Internal Audit intends, among other things, to review the adequacy of the system's security software documentation and IRS' ability to provide for a fallback capability at each service center during system testing.

RECOMMENDATIONS

In view of the Subcommittee's longstanding interest in this area and because of the importance of IRS' computers to its operations and the impact that its planned installation of communications processors could have on the 1987 tax filing season and related processing, we recommend that the Commissioner of Internal Revenue:

-- Report to the Subcommittee on Oversight, House Committee on Ways and Means, any significant deviations or delays in the CRS installation testing plans that could alter the implementation of planned testing safeguards or reduce the chances of all processors being operational by

Appendix V

December 1987. The report should also include actions that IRS plans to take to alleviate the situation.

-- Establish formal contingency plans at each IRS service center to provide reasonable continuity of data processing support should events occur that prohibit the timely installation of replacement processors or cause the existing processors to experience capacity or reliability problems.

-- Update existing and future workload projections and monitor the performance of the communications processors and supporting mainframes to ensure that these computing resources can fulfill IRS' mission. Such updates and performance monitoring should be conducted regularly throughout the life of the systems.

Appendix VI

Tables and Figures

RELIABILITY OF EXISTING PROCESSORS

Table VI.1: REAL-TIME SYSTEM AVAILABILITY
JANUARY-MAY 1985, JANUARY-MAY 1986

SERVICE CENTER	SCHEDULED HOURS		AVAILABLE HOURS		PERCENTAGE OF SCHEDULED HOURS ACHIEVED	
	1985	1986	1985	1986	1985	1986
ANDOVER	1553	1911	1449	1867	93	98
AUSTIN	1407	1932	1182	1889	84	98
FRESNO*	982	1900	785	1854	80	98
OGDEN	1347	1834	1231	1786	91	97
PHILADELPHIA	1328	1848	1207	1794	91	97

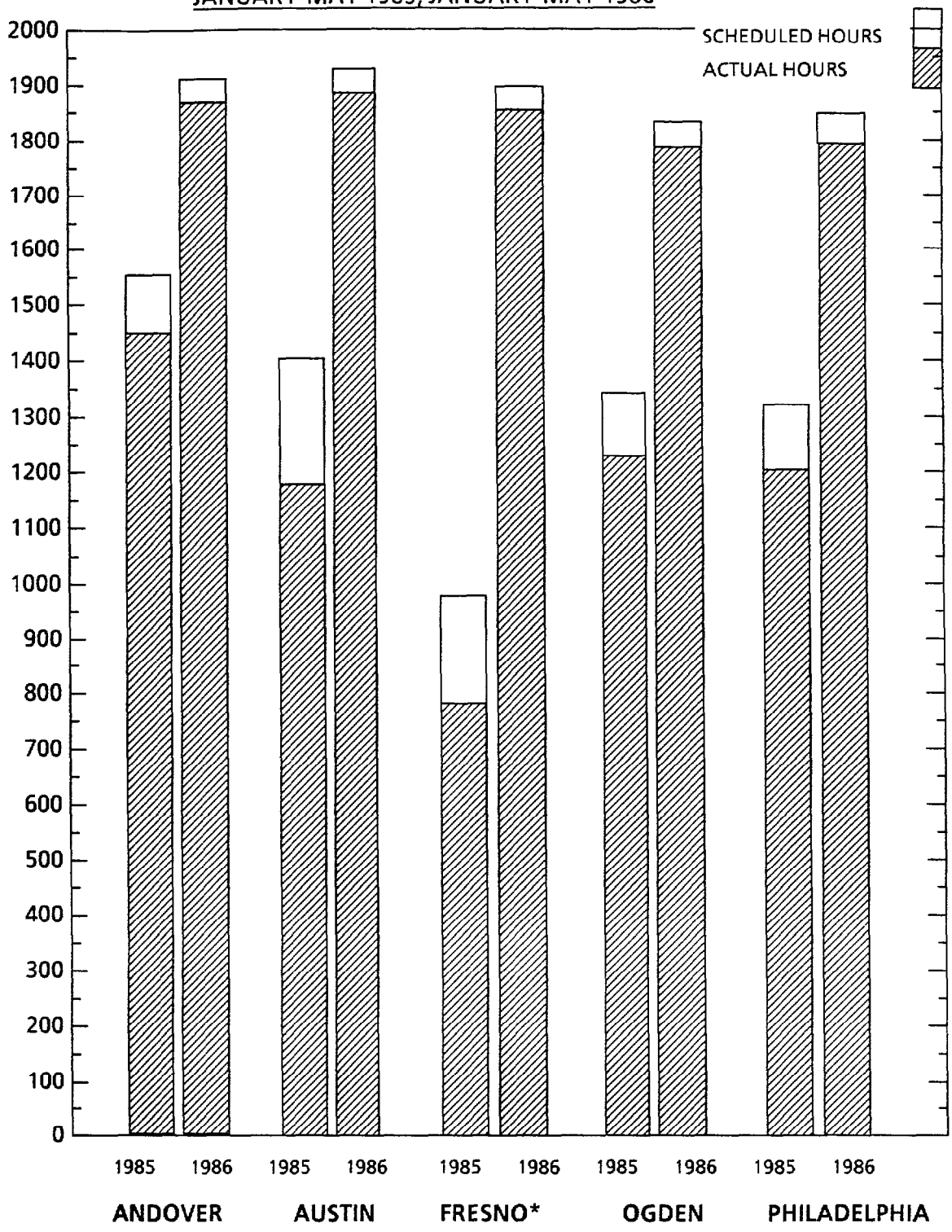
*ON MONDAYS IN 1985 FRESNO FREQUENTLY DID NOT SCHEDULE ANY REAL-TIME SYSTEM AVAILABILITY

COMMENTS ON REAL-TIME SYSTEM AVAILABILITY

- MORE HOURS SCHEDULED IN 1986
- MORE HOURS AVAILABLE IN 1986
- HIGHER PERCENTAGE OF HOURS ACHIEVED IN 1986

Appendix VI

FIGURE VI.1: REAL-TIME SYSTEM AVAILABILITY
SCHEDULED AND ACTUAL HOURS
JANUARY-MAY 1985, JANUARY-MAY 1986



*ON MONDAYS IN 1985 FRESNO FREQUENTLY DID NOT SCHEDULE ANY REAL-TIME SYSTEM AVAILABILITY

Appendix VI

RELIABILITY OF EXISTING PROCESSORS

TABLE VI.2: COMMUNICATIONS PROCESSOR DOWNTIME
JANUARY-MAY 1985, JANUARY-MAY 1986

SERVICE CENTER	NUMBER OF INSTANCES		TOTAL HOURS		INSTANCES >1 HOUR	
	1985	1986	1985	1986	1985	1986
ANDOVER	65	43	30	12	6	0
AUSTIN	184	39	54	9	8	1
FRESNO	N/A	23	N/A	13	N/A	3
OGDEN	N/A	22	N/A	9	N/A	2
PHILADELPHIA	18	32	16	16	5	2

N/A - INFORMATION NOT AVAILABLE

COMMENTS ON COMMUNICATIONS PROCESSOR DOWNTIME

- TWO OUT OF THREE CENTERS SHOWED REDUCTION IN DOWNTIME INSTANCES FROM 1985 TO 1986

- IN 1986, EACH CENTER'S COMMUNICATIONS PROCESSOR DOWNTIME TOTALED 16 HOURS OR LESS

Appendix VI

CAPACITY OF EXISTING PROCESSORS

TABLE VI.3: COMMUNICATIONS PROCESSOR
TRANSACTION RATES PER SECOND DURING
THE PEAK MONTHLY AVERAGE PROCESSING HOUR
JANUARY-MAY 1986

	JANUARY	FEBRUARY	MARCH	APRIL	MAY
ANDOVER	9.9	N/A	N/A	11.6	11.4
AUSTIN	13.6	16.0	15.7	**16.8**	**15.9**
FRESNO	15.8	16.2	16.4	**17.0**	**16.2**
OGDEN	12.9	14.7	15.3	**15.5**	**15.1**
PHILADELPHIA	11.5	12.8	14.7	14.4	14.3

N/A - INFORMATON NOT AVAILABLE

COMMENTS ON TRANSACTION RATES

- AT LARGE SERVICE CENTERS (AUSTIN, FRESNO, OGDEN), COMMUNICATIONS PROCESSORS WERE APPROACHING IRS' ESTIMATED CAPACITY LIMIT OF 18 TRANSACTIONS PER SECOND

- PEAK PROCESSING PERIOD NOT EXPECTED UNTIL JULY/AUGUST TIMEFRAME

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