SYSTEM ANALYSIS

For The

Huntsville Operation Support Center
Distributed Computer System

CONTRACT FINAL REPORT

June 1986

Submitted By:

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Submitted To:

NASA MSFC, Alabama
Technical Monitor: Frank Emmens, EB32
(205)453-4629

NAS8-34906

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LIST OF FIGURES

LIST OF TABLES

TABLE OF CONTENTS

1.0 INTRODUCTION

During this contract a simulation model of the NASA Huntsville Operational Support Center (HOSC) was developed. This simulation model emulates the HYPERchannel Local Area Network (LAN) that ties together the various computers of HOSC. The HOSC system is a large installation of mainframe computers such as the Perkin Elmer 3200 series and the Dec VAX series. These computers and a UNIVAC computer are physically located in three buildings separated by hundreds of feet.

In the original concept HOSC was not envisioned to be as large and complex a system as it has become. Lack of existence of a diagnostic tool for the the HYPERchannel such as the EXCELAN Nutcracker for ETHERNET, precludes an actual LAN network simulation prior to missions. Thus the existence of a simulation model with which to make system analysis of various configurations of the computers with varying Input/Output (I/O) requirements is very desirable if not an actual necessity when heavy loading of the systems is projected.

Other work performed during this contract has been the inclusions of dual trunk simulation and additional A400 interfaces to provide CSO, IGDS and other additional system interfaces such as the CREY or DSTP in the simulation model. Additionally an analytical analysis of a projected ETHERNET LAN (to be used to connect a series of Video Terminals (VTs) for addition to the HOSC system) was performed.

Section 2 of this report describes a series of six simulation exercises of the HOSC model using data sets provided by NASA. A

comprehensive report detailing the HOSC simulation model computer code has been submitted as an annual report (reference 1) in July 1985. Section 3.0 of this report contains the analytical analysis of the ETHERNET LAN (see also the December 1984 monthly report) and the VT distribution system which was projected at the time the analysis was requested. This section provides an interface analysis of the smart terminal network model which allows the data flow requirements due to the VTs on the ETHERNET LAN to be estimated.

2.0 HYPERCHANNEL TRAFFIC ANALYSIS

2.1 INTRODUCTION

This section describes the results of six simulation model exercises conducted for six different HOSC configurations. These configurations vary from typical system connections and I/O traffic requirements to projected systems connections and I/O traffic requirements. The six simulation exercises are enumerated as:

1. A Typical HOSC Activity Configuration
2. A Current HOSC Activity Under Heavy Loading
3. A Rerun of Run 2 with Reconfiguration of Destinations
4. Anticipated HOSC/CREY Configuration Under Extreme Loading
5. A Rerun of Run 4 with Reduced Loading on One Device
6. Suggested HOSC/CREY Configuration for Extreme Loading

Each of the simulation runs is discussed in the following sections.

2.2 A TYPICAL HOSC ACTIVITY UNDER HEAVY LOADING

This simulation run was conducted for a typical HOSC configuration with what is considered a heavy I/O data load requirement for the various devices. Figure 2.1 illustrates the system configuration and documents the specific HOSC computers involved in the system.

Inspection of figure 2.1 also reveals the source/destinations connections, the relative probabilities of the source/destination connections, the data generation rates, the data buffer sizes and the device/adapter I/O rates.

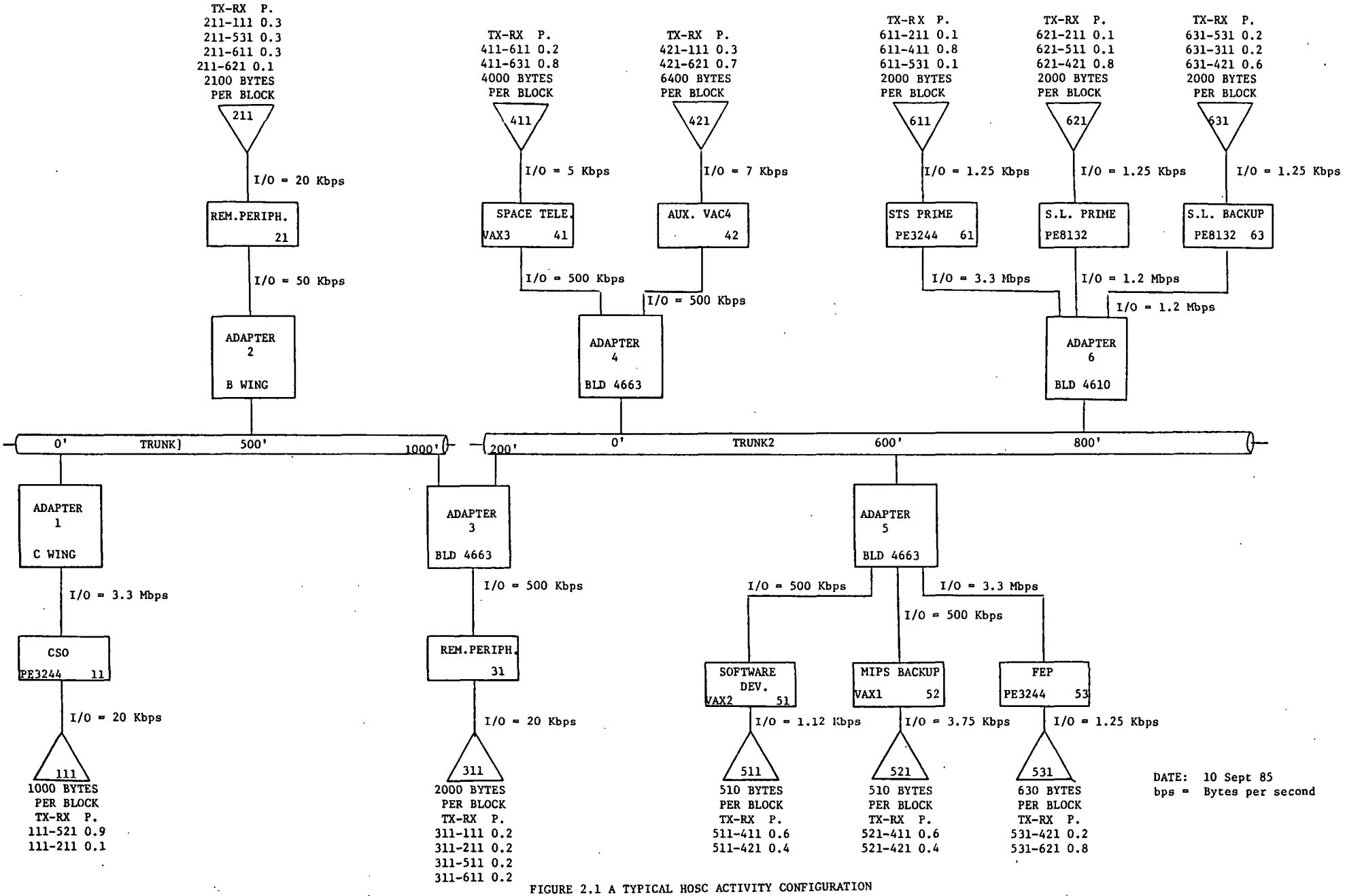


FIGURE 2.1 A TYPICAL HOSC ACTIVITY CONFIGURATION

The backup simulation data in Appendix I details the adapter priorities which are assigned each adapter on the trunk, the distances between adapters (noted as fixed delay) and in the case of an adapter common to two trunks lists the trunk priorities on each trunk.

Table 2.1 and 2.2 present the results of the simulation exercise. Table 2.1 presents the overall statistics of the system including the parameters of perhaps greatest interest: total aborts, percent trunk active time and total offered load. Table 2.2 presents the individual device statistics of the network including individual device aborts, collisions, waiting time and average message delay. These device statistics are important in assessing how to reassign devices to the various adapters or trunks in the event that anticipated network performance is not satisfactory in the event that the anticipated network performance is not satisfactory. The network statistics are important in assessing the anticipated network performance.

The results in Table 2.1 indicate that the system is lightly loaded. This may be observed from the trunk active times of 1.848 percent for trunk 1, 1.69 percent for trunk 2. When a trunk activity time of 30 percent or more is incurred the trunk tends to start saturating with regards new data transmissions. Furthermore the collision frequency is low, amounting to 65 collisions out of 638 transmissions for approximately 10 percent collision frequency. Only 110 frames were placed in queue waiting for an opportunity to transmit and only 1 abort was incurred (this by source 411, see Table 2.2). The trunk to trunk transmissions incurred only 24

TABLE 2.1 NETWORK STATISTICS FOR FIGURE 2.1

ADP #	DEV #	SOURCE #	TIME ACTIVE	TIME WAITING	TIME IN COLLISIONS	AVG MESSAGE DELAY	ABORT COUNT	TRANSMISSION COUNT	RECEPTION COUNT	WAIT COUNT	COLLISION COUNT
1 111	1	1	0.1795	0.0008	1.3E-06	6.8E-04	0	197	98	18	1
2 211	1	1	0.0924	0.0000	1.3E-06	1.3E-03	0	94	0	0	1
3 311	1	1	0.1734	0.0006	0.0E+00	7.0E-04	0	201	202	15	0
4 411	1	1	0.0408	0.0000	1.3E-04	3.6E-03	1	11	54	0	43
4 421	2	1	0.0333	0.0000	0.0E+00	2.3E-03	0	10	25	0	0
5 511	1	1	0.0072	0.0003	0.0E+00	5.8E-04	0	24	0	5	0
5 521	2	1	0.0861	0.0009	0.0E+00	5.8E-04	0	24	197	21	0
5 531	3	1	0.0196	0.0000	5.3E-07	6.0E-04	0	59	2	0	1
6 611	1	1	0.0086	0.0000	0.0E+00	8.3E-04	0	6	4	0	0
6 621	2	1	0.0277	0.0008	5.3E-07	8.5E-04	0	6	49	16	1
6 631	3	1	0.0235	0.0016	1.3E-04	4.4E-03	0	6	7	32	63

TABLE 2.2 DEVICE STATISTICS FOR FIGURE 2.1

```
*** END OF RUN NETWORK STATISTICS ***

CURRENT TIME :       10.0273 SECS

SUCCESSFUL SEQUENCE TRANSMISSIONS              :    638
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 1      :    295
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 2      :    343
COLLISIONS    (FRAMES)                         :     65
WAITS         (FRAMES)                         :  1.1E+02


TOTAL ATTEMPTS (SEQUENCES)                     :    640
TOTAL ABORTS                                   :      1
ATTEMPTED TRUNK-TRUNK TRANSMISSIONS            :    225
SUCCESSFUL TRUNK-TRUNK TRANSMISSIONS           :    201

TRUNK 1 ACTIVE TIME                            :  0.1852660 SECS
TRUNK 2 ACTIVE TIME                            :  0.1694709 SECS
TOTAL TRUNK ACTIVE TIME                        :  0.3547369 SECS
% TRUNK 1 ACTIVE TIME                          :  1.848 %
% TRUNK 2 ACTIVE TIME                          :  1.690 %
% TOTAL ACTIVE TIME                            :  3.538 %

CONTROL BYTES TRANSMITTED - TRUNK 1            :  4.68994E-01 MBYTES
DATA BYTES TRANSMITTED    - TRUNK 1            :  6.39584E-01 MBYTES
CONTROL BYTES TRANSMITTED - TRUNK 2            :  5.52063E-01 MBYTES
DATA BYTES TRANSMITTED    - TRUNK 2            :  4.67610E-01 MBYTES
TOTAL BYTES TRANSMITTED                        :  2.12825E+00 MBYTES

TOTAL OFFERED LOAD                             :  8.22242E-01 MBYTES
```

collisions for roughly a 10 percent collision rate. Thus the system is operating in a mode in which new offered data will be handled virtually on a one for one basis.

The highest average message delay is 4.4ms (source 631 see Table 2.1) and this is not a significant increase in delay over the system's normal delay of about .6 ms.

The total offered load is approximately 822K Bytes for about 10 seconds or .6576 Mbps.* This is one tenth the recommended maximum of approximately 6 Mbps offered load for dual trunk systems which was documented in the 1985 Annual Report for this contract (Reference 1, page 109). Note that a load of 16.5 Mbps would correspond to 33% of the 50 Mbps trunk capacity and is the usual upper limit for these types of systems. Note also that a 16.5 Mbps load includes data and control bytes which amount to roughly the same total bytes as data bytes. Thus an offered data load of one half of 16.5 Mbps or 8.25 Mbps would result in a total offered load of 16.5 Mbps.

For the system configuration of Figure 2.1 with the loading shown the offered data loads per trunk are:

Offered data load Trunk 1 is 60KBps = 240 Kbps

Offered data load Trunk 2 is 20.75KBps = 166 Kbps

TOTAL OFFERED DATA LOAD = 406 Kbps.

This amounts to approximately 62% of the total offered load from the simulation exercise. Thus we see that the total offered data loading (406 Kbps) for figure 2.1 is well beneath the recommended upper limit (8.25 Mbps).

---

*Bps = Bytes Per Second, bps = Bits Per Second.

2.3 A CURRENT HOSC ACTIVITY UNDER HEAVY LOADING

Figure 2.2 depicts a current HOSC system configuration under heavy offered data load configurations. Tables 2.3 and 2.4 contain the network statistics and device statistics for the currently operating HOSC system configurations of Figure 2.2.

Inspection of the results in the tables reveal a high number of collisions for a bus with no more activity time than indicated. (18.6% trunk 1, 7.8% trunk 2, 26.5% for both trunks and a total offered load of 640 Kbps.) This collision frequency can be further investigated by inspecting the device statistics in Table 2.4. These indicate that data sources 341 and 441 are the most heavily involved in collisions. From Figure 2.2 the receivers for data sources 341 and 441 are seen to be 441 and 421 respectively.

The data source 341 is tied to device adapter three which is the busiest device on trunk 1. However communications to adapter three's devices is certainly occurring, witness the 924 receptions by source 331 of data from 211. Also 341 does transmit one packet to 441 although 27 aborts are initiated. This indicates that the 341 to 441 link cannot be established. That this is the case may be observed from noting that adapter 4, the cross trunk adapter is heavily loaded as an adapter on trunk 2. In fact adapter 4 receives data from six external data sources and one internal data source as well as being a transmitter of data to six external data sources. Obviously adapter 4 is going to be busy much of the time.

It is also apparent that since source 341 only sends data to 441 it might be sensible to put source 341 on adapter 4 except for the fact that then source 211 would have a very difficult time sending

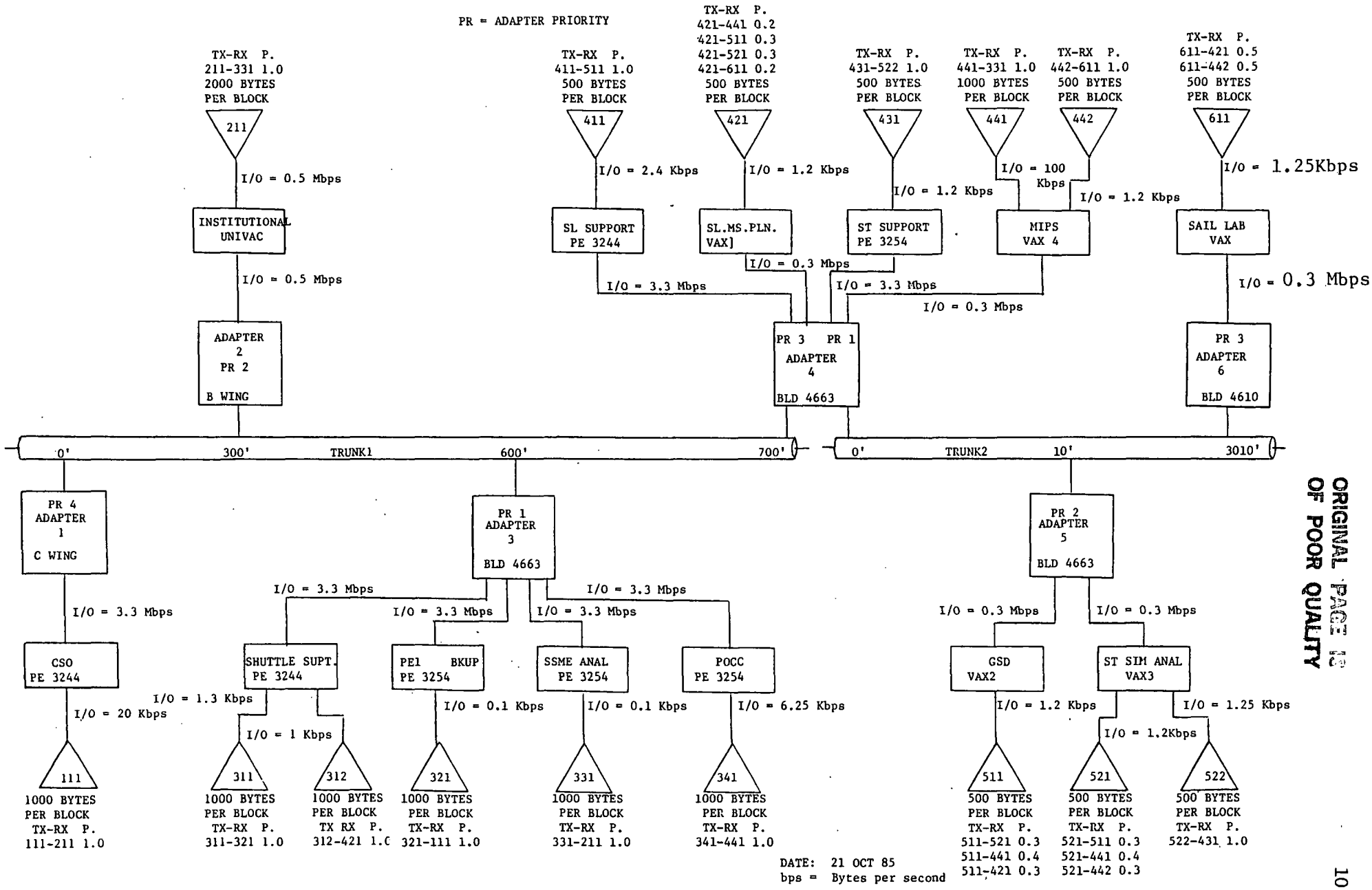


FIGURE 2.2 A CURRENT HOSC ACTIVITY UNDER HEAVY LOADING

TABLE 2.3 NETWORK STATISTICS FOR FIGURE 2.3

```
*** END OF RUN NETWORK STATISTICS ***

CURRENT TIME :        5.0000 SECS

SUCCESSFUL SEQUENCE TRANSMISSIONS              :  1026
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 1      :  1022
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 2      :     4
COLLISIONS    (FRAMES)                         :  1499
WAITS         (FRAMES)                         :  4.4E+05
TOTAL ATTEMPTS (SEQUENCES)                     :  1121
TOTAL ABORTS                                   :    94
ATTEMPTED TRUNK-TRUNK TRANSMISSIONS            :     0
SUCCESSFUL TRUNK-TRUNK TRANSMISSIONS           :     0

TRUNK 1 ACTIVE TIME                            :  0.9310461 SECS
TRUNK 2 ACTIVE TIME                            :  0.3944174 SECS
TOTAL TRUNK ACTIVE TIME                        :  1.3254635 SECS
% TRUNK 1 ACTIVE TIME                          :  18.621 %
% TRUNK 2 ACTIVE TIME                          :  7.888 %
% TOTAL ACTIVE TIME                            :  26.509 %


 CONTROL BYTES TRANSMITTED - TRUNK 1           :  3.67055E+00 MBYTES
 DATA BYTES TRANSMITTED    - TRUNK 1           :  2.01141E+00 MBYTES
 CONTROL BYTES TRANSMITTED - TRUNK 2           :  2.20184E+00 MBYTES
 DATA BYTES TRANSMITTED    - TRUNK 2           :  2.25600E-03 MBYTES
 TOTAL BYTES TRANSMITTED                       :  7.88606E+00 MBYTES

 TOTAL OFFERED LOAD                          :  3.19825E+00 MBYTES
```

TABLE 2.4 DEVICE STATISTICS FOR FIGURE 2.2

ADP #	DEV #	SOURCE #	TIME ACTIVE	TIME WAITING	TIME IN COLLISIONS	AVG MESSAGE DELAY	ABORT COUNT	TRANSMISSION COUNT	RECEPTION COUNT	WAIT COUNT	COLLISION COUNT
111	1	1	0.0393	0.0000	9.0E-05	1.1E-03	0	97	0	0	66
211	2	1	0.6719	0.0040	1.6E-04	1.4E-03	1	924	97	91	279
311	3	1	0.0374	0.0002	1.9E-05	0.0E+00	6	0	0	2	38
312	3	2	0.0255	0.0000	1.2E-05	0.0E+00	4	0	0	0	21
321	3	2	0.0374	0.0000	0.0E+00	0.0E+00	0	0	0	0	0
331	3	3	0.6537	0.0000	0.0E+00	0.0E+00	0	0	924	0	0
341	3	4	0.1726	0.0129	4.8E-05	4.9E-01	27	1	0	255	108
411	4	1	0.0003	4.5838	0.0E+00	6.3E-04	0	1	0	91554	0
421	4	2	0.2125	4.5834	0.0E+00	0.0E+00	0	0	1	91702	0
431	4	3	0.0694	4.1336	1.7E-06	0.0E+00	1	0	1	82675	65
441	4	4	0.2929	4.5665	7.1E-03	0.0E+00	13	0	1	91327	1190
442	4	4	0.0004	4.1658	0.0E+00	9.3E-04	0	1	0	83539	0
511	5	1	0.1252	0.0000	1.7E-06	0.0E+00	11	0	1	0	65
521	5	2	0.1123	0.0340	7.9E-06	0.0E+00	11	0	0	705	3
522	5	2	0.0644	0.0000	1.1E-03	2.0E-01	10	1	0	0	146
611	6	1	0.1046	0.0000	9.0E-03	3.4E-01	10	1	1	0	1006

data to source 341. Rather it would appear logical to make the cross trunk adapter (Number 4) one which is not so heavily utilized.

The simulation program does not model the dual trunk system in an exact manner. The program allows only one adapter to be a dual trunk adapter. Although this models the usual case for HOSC it is possible to connect several of the HOSC adapters to two trunks. Another difference is the transfer mechanism. In the real system intra trunk data transfers are accomplished by the transfer of the data to a cross trunk adapter's device for holding. This device then finishes the data transfer when the link between it and the destination is available. The simulation model requires the total link to be available which is a more severe requirement. The simulation results are thus more pessimistic than the real case but is an excellant predictor of system tendencies toward overload.

In this case the decision to make a slight reconfiguration resulted in the system simulation of sections 2.4. As will be noted in section 2.4 the collision rate and abort rate were significantly reduced by a very minor reconfiguration.

2.4 A RERUN OF FIGURE 2.2 RECONFIGURED

In Figure 2.3 a reconfiguration of Figure 2.2 is illustrated. The differences are fairly minor but the results are significant and indicate the dramatic differences of systems performance that can occur with seemingly minor system changes or loading additions. The difference of the configuration of Figure 2.3 from Figure 2.2 are as follows:

Source 331 sends its data to 441 rather than 321

Source 312 sends its data to 611 rather than 421

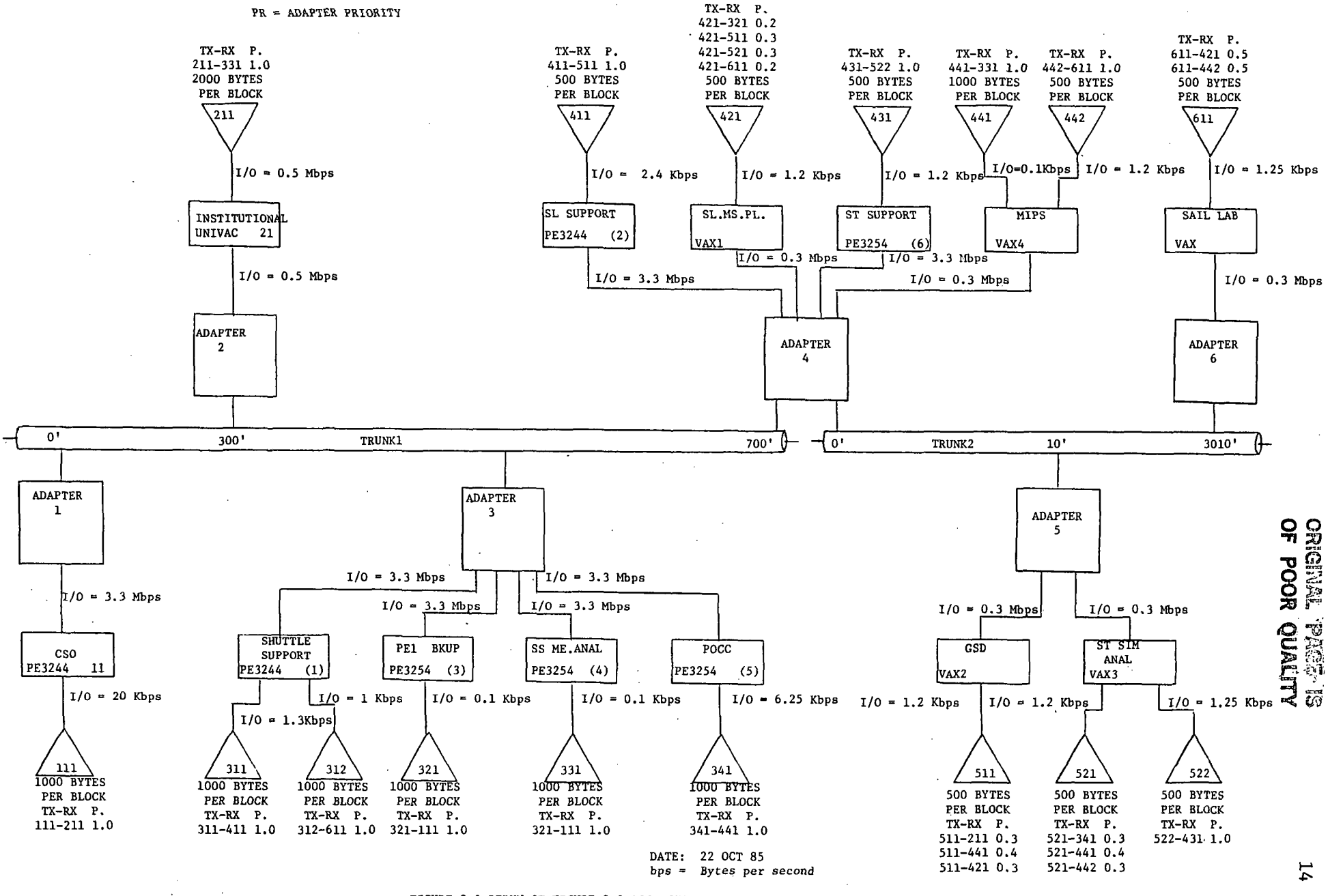


FIGURE 2.3 RERUN OF FIGURE 2.2 RECONFIGURED

Source 421 sends its data to 321 rather than 441

Source 441 sends its data to 311 rather than 421

Source 511 sends its data to 211 rather than 521

Source 521 sends its data to 341 rather than 511

Device 61 has I/O rate 1250 Bps rather than .3 Mbps.

The statistical results of (tabulated in Tables 2.5 and Table 2.6) indicate a much lower number of collisions and a much lower number of aborts than the configuration of Figure 2.2. A comparison of the results is given below:

Configuration	Figure 2.2	Figure 2.3
Collisions	1499	55
Aborts	94	2
%Trunk Active Time (Both Trunks)	26.5%	17.6%
TOTAL OFFERED LOAD	638 KBps	639 KBps
Successful Transmissions	1026	1751
Transmissions Trunk 1	1022	1663
Transmissions Trunk 2	4	88

This illustrates how small reconfigurations of a system can make a significant difference in system performance. For the same total offered data loads there is a significant reduction in the trunk activity time and the number of successful transmissions rises sharply. The maximum coverage message delay time (Table 2.4, source 341) of .49 seconds was reduced to .24 milliseconds (Table 2.6, source 522) and the trunk-to-trunk transmissions were significantly increased.

TABLE 2.5 NETWORK STATISTICS FOR FIGURE 2.3

```
*** END OF RUN NETWORK STATISTICS ***

CURRENT TIME :        5.0025 SECS

SUCCESSFUL SEQUENCE TRANSMISSIONS              :   1751
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 1      :   1663
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 2      :     88
COLLISIONS    (FRAMES)                         :     55
WAITS         (FRAMES)                         :   1.2E+03
TOTAL ATTEMPTS (SEQUENCES)                     :   1754
TOTAL ABORTS                                   :      2
ATTEMPTED TRUNK-TRUNK TRANSMISSIONS            :    492
SUCCESSFUL TRUNK-TRUNK TRANSMISSIONS           :     19

TRUNK 1 ACTIVE TIME                            :   0.8343533 SECS
TRUNK 2 ACTIVE TIME                            :   0.0375456 SECS
TOTAL TRUNK ACTIVE TIME                        :   0.8718989 SECS
% TRUNK 1 ACTIVE TIME                          :   16.679 %
% TRUNK 2 ACTIVE TIME                          :   0.751 %
% TOTAL ACTIVE TIME                            :   17.429 %


CONTROL BYTES TRANSMITTED - TRUNK 1            :   2.34199E+00 MBYTES
DATA BYTES TRANSMITTED    - TRUNK 1            :   2.79893E+00 MBYTES
CONTROL BYTES TRANSMITTED - TRUNK 2            :   1.71519E-01 MBYTES
DATA BYTES TRANSMITTED    - TRUNK 2            :   5.16320E-02 MBYTES
TOTAL BYTES TRANSMITTED                        :   5.36407E+00 MBYTES

TOTAL OFFERED LOAD                             :   3.19960E+00 MBYTES
```

TABLE 2.6 DEVICE STATISTICS FOR FIGURE 2.3

ADP #	DEV #	SOURCE #	TIME ACTIVE	TIME WAITING	TIME IN COLLISIONS	AVG MESSAGE DELAY	ABORT COUNT	TRANSMISSION COUNT	RECEPTION COUNT	WAIT COUNT	COLLISION COUNT
1 111	1	1	0.0371	0.0000	4.0E-06	7.4E-04	0	98	0	0	5
2 211	1	1	0.5966	0.0077	2.9E-05	8.3E-04	0	1040	104	161	50
3 311	1	1	0.1922	0.0004	7.9E-07	6.5E-04	0	6	463	8	1
3 312	1	2	0.0015	0.0000	7.9E-07	6.6E-04	0	4	0	0	1
5 521	2	1	0.0020	0.0000	0.0E+00	0.0E+00	0	0	6	0	0
3 331	3	1	0.5816	0.0000	0.0E+00	0.0E+00	0	0	1040	0	0
3 341	4	1	0.0144	0.0033	7.9E-07	6.7E-04	0	31	9	72	1
4 411	1	1	0.0065	0.0028	2.6E-08	1.3E-03	0	23	0	57	1
4 421	2	1	0.0087	0.0004	2.6E-08	7.1E-04	0	11	12	7	1
4 431	3	1	0.0078	0.0206	0.0E+00	6.3E-04	0	11	10	435	0
4 441	4	1	0.1955	0.0197	4.5E-05	7.9E-04	0	463	43	363	44
4 442	4	2	0.0190	0.0013	5.3E-07	7.2E-04	0	21	19	27	1
5 511	1	1	0.0124	0.0000	2.6E-08	8.7E-04	0	11	28	0	1
5 521	2	1	0.0085	0.0022	0.0E+00	2.2E-03	1	10	0	42	0
5 522	2	2	0.0073	0.0028	2.6E-08	2.4E-03	1	10	11	61	1
6 611	1	1	0.0076	0.0000	2.4E-05	8.2E-04	0	12	6	0	3

This type of study can be used to determine in advance the probable worst case system performance limitations and gives one an opportunity to try ''in the laboratory'' various reconfigurations in a search for an optimum system performance configuration.

2.5 ANTICIPATED HOSC/CREY CONFIGURATION UNDER EXTREME LOADING

The system configuration illustrated in Figure 2.4 is an anticipated configuration including an outside computer link called the CREY. The CREY link is anticipated to feed data to HOSC and to require some communications from HOSC to the CREY facility. The configuration of Figure 2.4 is a suggested manner in which to tie together the CREY facility and the HOSC facility and yet provide a means for isolating HOSC from unwarranted demands by the CREY facility during missions support by HOSC.

It should be noted that this configuration has added an extra adapter in relation to the configurations of Figure 2.3. This extra adapter has a twofold purpose, one is to help relieve adapter 3 loading by moving SSME to adapter 4 and to provide an adapter as a tie link through which CREY interfaces to HOSC.

Tables 2.7 and 2.8 contain the simulation results. It may be observed that there a significant number of aborts (48) and a high number of collisions (3901) in a 10 second simulation period. Also the offered load is 1.958MBps (15.664Mbps) which is quite high compared to the recommended limit of 1.031MBps (8.25Mbps) and the trunk active times are over 50%. This indicates that the system is not performing satisfactorily under this configuration. One data source is running with a 1.3 MBps data operation rate which is extreme. This was an arbitrarily chosen figure which evolved during discussions with NASA personnel. A rerun of this configuration with a reduced data generation rate is contained in the next section.

Because this system performance is not judged satisfactory a suggested reconfiguration for the HOSC/CREY system is presented in Section 2.7.

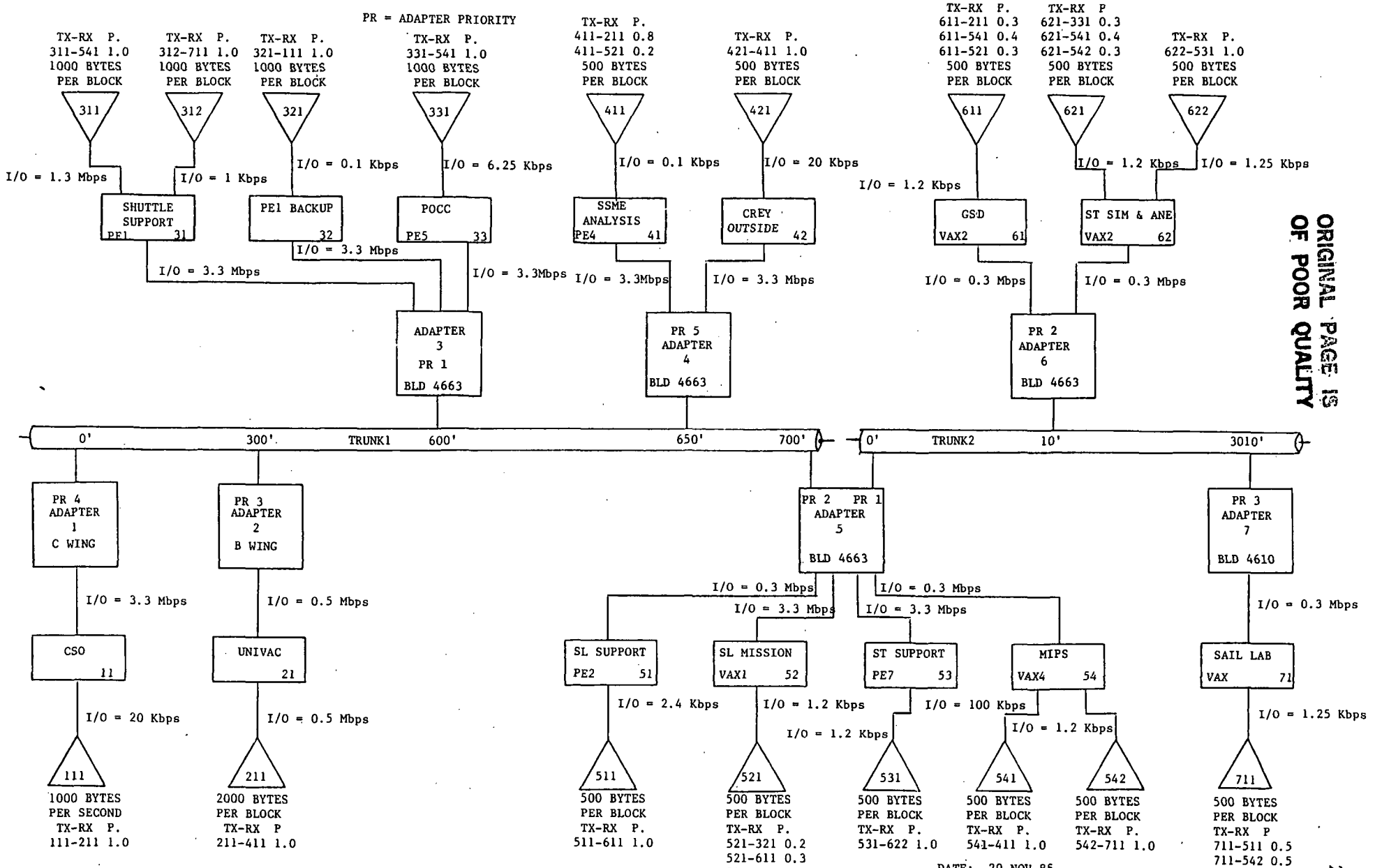


FIGURE 2.4 ANTICIPATED HOSC/CREY CONFIGURATION UNDER EXTREME LOADING

TABLE 2.7 NETWORK STATISTICS FOR FIGURE 2.4

```
*** END OF RUN NETWORK STATISTICS ***

CURRENT TIME :      10.0000 SECS

SUCCESSFUL SEQUENCE TRANSMISSIONS           :  4940
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 1   :  4771
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 2   :   169
COLLISIONS    (FRAMES)                      :  3901
WAITS         (FRAMES)                      :  3.6E+04
TOTAL ATTEMPTS (SEQUENCES)                  :  5424
TOTAL ABORTS                                :   480
ATTEMPTED TRUNK-TRUNK TRANSMISSIONS         :  4404
SUCCESSFUL TRUNK-TRUNK TRANSMISSIONS        :    32

TRUNK 1 ACTIVE TIME                         :  5.6689979 SECS
TRUNK 2 ACTIVE TIME                         :  0.2184609 SECS
TOTAL TRUNK ACTIVE TIME                     :  5.8873588 SECS
% TRUNK 1 ACTIVE TIME                       :  56.689 %
% TRUNK 2 ACTIVE TIME                       :  2.185 %
% TOTAL ACTIVE TIME                         :  58.874 %

CONTROL BYTES TRANSMITTED - TRUNK 1         :  2.90019E+01 MBYTES
DATA BYTES TRANSMITTED    - TRUNK 1         :  5.76584E+00 MBYTES
CONTROL BYTES TRANSMITTED - TRUNK 2         :  1.13755E+00 MBYTES
DATA BYTES TRANSMITTED    - TRUNK 2         :  9.83160E-02 MBYTES
TOTAL BYTES TRANSMITTED                     :  3.60036E+01 MBYTES

TOTAL OFFERED LOAD                          :  1.95835E+01 MBYTES
```

TABLE 2.8 DEVICE STATISTICS FOR FIGURE 2.4

ADP #	DEV #	SOURCE #	TIME ACTIVE	TIME WAITING	TIME IN COLLISIONS	AVG MESSAGE DELAY	ABORT COUNT	TRANSMISSION COUNT	RECEPTION COUNT	WAIT COUNT	COLLISION COUNT
1 111	1	1	0.1104	0.0000	5.3E-04	1.1E-02	0	165	0	0	374
2 211	1	1	1.2541	0.0062	2.7E-04	9.5E-03	100	709	174	136	365
	1	1	2.7786	0.2420	1.4E-04	2.0E-03	160	3468	0	4868	319
3 312	1	2	0.0072	0.0000	5.3E-07	6.2E-03	3	6	0	0	2
3 321	2	1	0.0259	0.0000	0.0E+00	0.0E+00	0	0	14	1	0
3 331	3	1	0.1118	0.2333	1.5E-05	5.1E-03	6	53	16	4725	46
4 411	1	1	2.5191	0.0000	0.0E+00	0.0E+00	0	0	1040	0	0
4 421	2	1	0.2170	0.0047	1.5E-05	0.0E+00	34	0	0	92	37
5 511	1	1	0.0154	0.4432	5.0E-05	9.4E-04	0	45	0	8807	46
5 521	2	1	0.0775	0.3414	2.5E-04	5.7E-03	2	20	23	6887	73
5 531	3	1	0.0675	0.2289	5.1E-04	2.0E-03	0	23	19	4605	86
5 541	4	1	4.1397	0.2117	1.5E-02	1.5E-02	154	331	3528	4233	2117
5 542	4	2	0.1122	0.0313	5.4E-03	1.0E-02	10	37	40	611	735
6 611	1	1	0.0562	0.0154	1.6E-03	6.4E-03	2	21	51	309	205
6 621	2	1	0.0353	0.0004	2.5E-04	5.2E-03	3	20	0	6	34
6 622	2	2	0.0676	0.0380	1.9E-03	1.2E-02	5	19	23	778	275
7 711	1	1	0.0570	0.0000	2.1E-02	1.3E-02	1	23	12	0	2650

2.6 A RERUN OF FIGURE 2.4 WITH REDUCED LOADING ON ONE DEVICE

Figure 2.5 illustrates the configuration of Figure 2.4 but with the data generation rate of source 311 reduced from 1.3 MBps to a more reasonable 1.3 KBps. The results as indicated in Tables 2.9 and 2.10 show a reduction in trunk activity from over 50% to 33% which is judged to be an upper operating limit (see reference 1, pages 93-97 for discussion), the collision rate is down from 3901 to 1804 and the aborts are down from 480 to 320. The new offered load is 659 KBps and is reasonable.

This configuration could still be improved, however. The device statistics (Table 2.10) show that adapter 5 is responsible for most of the congestion. Since 5 is loaded with two devices talking to adapter 6 only, it seems prudent to remove those devices from adapter 5 and connect them to adapter 7 to balance the load and to free adapter 5 for trunk to trunk transmission. Section 2.7 contains the results of this reconfiguration.

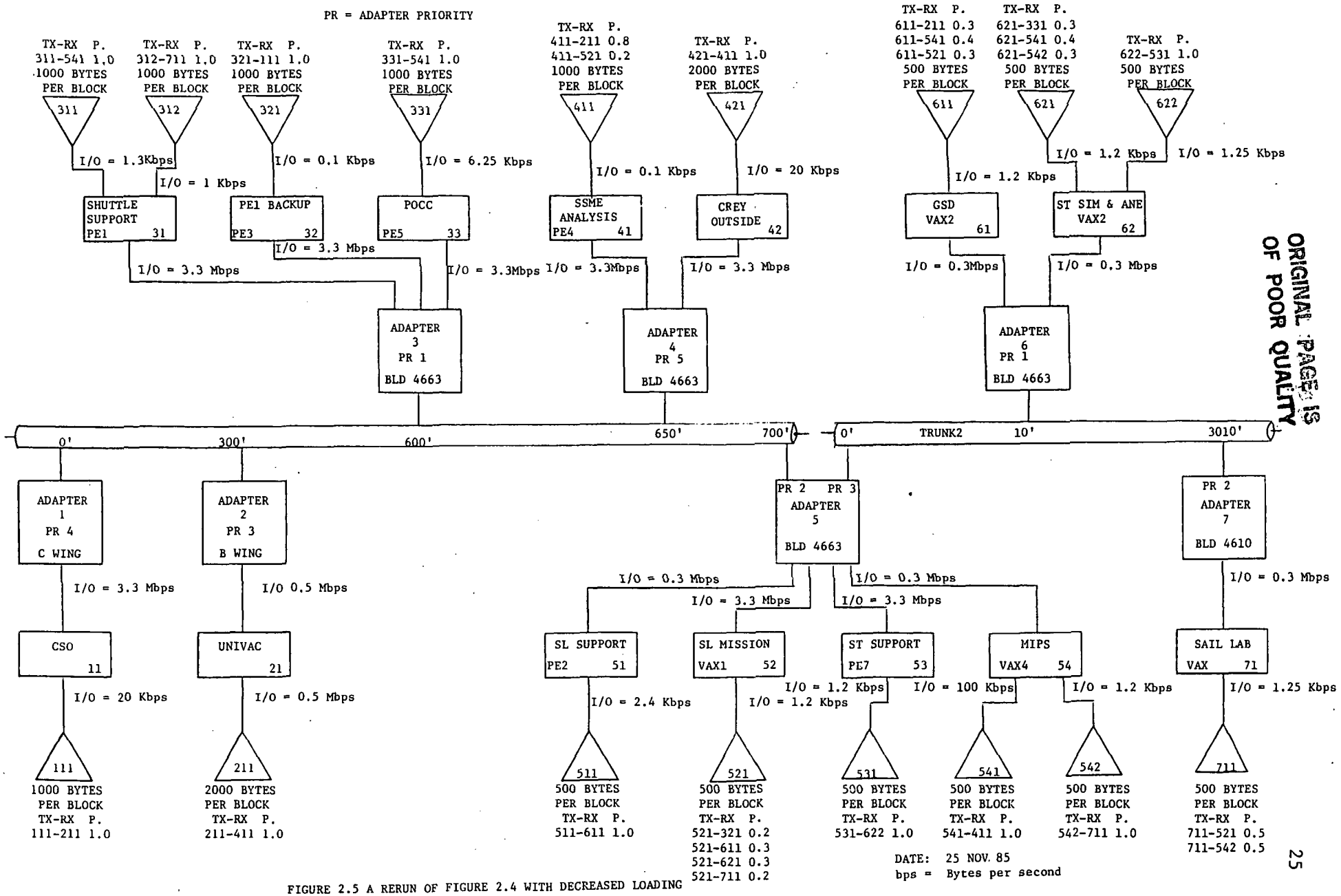


FIGURE 2.5 A RERUN OF FIGURE 2.4 WITH DECREASED LOADING

TABLE 2.9 NETWORK STATISTICS FOR FIGURE 2.5

```
*** END OF RUN NETWORK STATISTICS ***

CURRENT TIME :      10.0000 SECS

SUCCESSFUL SEQUENCE TRANSMISSIONS            :  2298
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 1    :  2129
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 2    :   169
COLLISIONS   (FRAMES)                        :  1804
WAITS        (FRAMES)                        :  1.1E+04
TOTAL ATTEMPTS (SEQUENCES)                   :  2612
TOTAL ABORTS                                 :   310
ATTEMPTED TRUNK-TRUNK TRANSMISSIONS          :  4334
SUCCESSFUL TRUNK-TRUNK TRANSMISSIONS         :    37

TRUNK 1 ACTIVE TIME                          :  3.1655554 SECS
TRUNK 2 ACTIVE TIME                          :  0.1895149 SECS
TOTAL TRUNK ACTIVE TIME                      :  3.3550703 SECS
% TRUNK 1 ACTIVE TIME                        :  31.656 %
% TRUNK 2 ACTIVE TIME                        :  1.895 %
% TOTAL ACTIVE TIME                          :  33.551 %

CONTROL BYTES TRANSMITTED - TRUNK 1      :  1.58485E+01 MBYTES
DATA BYTES TRANSMITTED    - TRUNK 1      :  3.50226E+00 MBYTES
CONTROL BYTES TRANSMITTED - TRUNK 2      :  1.03773E+00 MBYTES
DATA BYTES TRANSMITTED    - TRUNK 2      :  9.93160E-02 MBYTES
TOTAL BYTES TRANSMITTED                  :  2.04883E+01 MBYTES

TOTAL OFFERED LOAD                       :  6.59650E+00 MBYTES

                DEVICE ACTIVITY SUMMARIES
```

TABLE 2.10 DEVICE STATISTICS FOR FIGURE 2.5

ADP #	DEV #	SOURCE #	TIME ACTIVE	TIME WAITING	TIME IN COLLISIONS	AVG MESSAGE DELAY	ABORT COUNT	TRANSMISSION COUNT	RECEPTION COUNT	WAIT COUNT	COLLISION COUNT
111	1	1	0.1397	0.0000	9.3E-04	5.6E-03	0	179	0	0	595
211	2	1	1.6373	0.0021	3.6E-04	3.6E-03	118	1260	194	46	493
311	3	1	0.0141	0.0000	0.0E+00	3.5E-03	1	11	0	0	0
312	3	2	0.0062	0.0000	0.0E+00	2.4E-03	0	9	0	0	0
321	3	2	1	0.0056	0.0000	0.0E+00	0.0E+00	0	0	18	0	0
331	3	3	1	0.0944	0.0000	1.3E-06	4.2E-03	1	59	13	0	5
411	4	1	1	2.8857	0.0000	0.0E+00	0.0E+00	0	0	1825	0	0
421	4	2	1	0.3700	0.0033	7.3E-04	0.0E+00	59	0	0	45	15
511	5	1	1	0.0209	0.1857	5.1E-04	1.6E-03	1	45	0	3733	109
521	5	2	1	0.0322	0.0591	1.4E-05	3.3E-03	1	22	24	1163	124
531	5	3	1	0.0487	0.0824	9.0E-06	2.6E-03	1	22	23	1645	95
541	5	4	1	1.1183	0.1148	1.7E-03	5.4E-03	119	565	80	2273	464
542	5	4	2	0.0891	0.0710	1.4E-04	1.9E-03	1	40	38	1412	28
611	6	1	1	0.3709	0.0000	3.6E-06	7.3E-03	4	19	49	0	137
621	6	2	1	0.0434	0.0335	2.2E-06	7.3E-03	3	20	0	670	93
622	6	2	2	0.0486	0.0000	4.7E-03	6.4E-03	1	23	22	0	594
711	7	1	1	0.0242	0.0000	6.3E-03	6.3E-03	0	24	12	0	797

2.7 SUGGESTED HOSC/CREY CONFIGURATION FOR EXTREME LOADING

Figure 2.6 illustates a suggested reconfiguration of the HOSC/CREY system for operation under heavy loading. The two devices formerly attached to adapter 5 which conversed with adapter 6 have been moved to adapter 7. This may be ackward if adapter 7 is in a different building but one could reconfigure the two devices from adapter 5 to adapter 6 itself since adapter 6 is in the same building as adapter 5. Another approach would be to add another adapter to the system. Any of these approaches would relieve the cross trunk adapter of some of its congestion.

The results of the simulation run for figure 2.6 shows a marked improvement due to the reconfiguration. The numbered collisions are down from 1804 to 195, the number of frames which had to wait for a 'transmission time has dropped by an order of magnitude and the number of aborts has dropped from 310 to 1. Further inspection and comparisons of Table 2.11 and Table 2.9 reveals that the trunk busy time has been reduced from a total of 33.55% to 19.935% while the number of data bytes transmitted has actually increased on trunk 1 by 67% and by 7% increase on trunk 2.

THIS SIMULATION RUN ILLUSTRATES THE BENEFITS THAT CAN BE ACHIEVED BY SIMULATION OF A PROPOSED CONFIGURATION, INSPECTION OF THE RESULTS AND PERFORMING A RECONFIGURATION IF DESIRABLE.

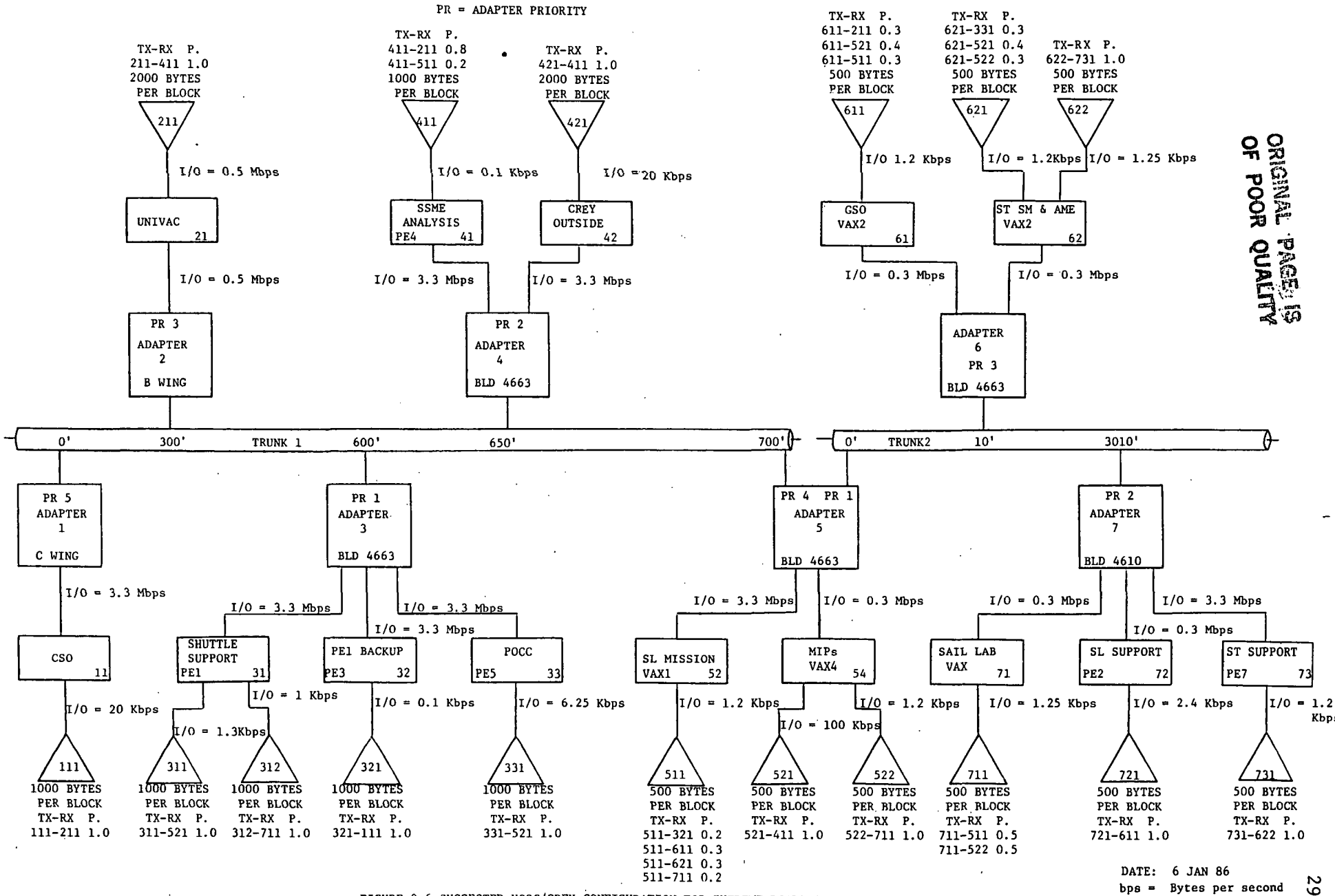


FIGURE 2.6 SUGGESTED HOSC/CREY CONFIGURATION FOR EXTREME LOADING

TABLE 2.11 NETWORK STATISTICS FOR FIGURE 2.6

*** END OF RUN NETWORK STATISTICS ***

CURRENT TIME : 10.0000 SECS

SUCCESSFUL SEQUENCE TRANSMISSIONS	:	4446
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 1	:	4265
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 2	:	181
COLLISIONS (FRAMES)	:	195
WAITS (FRAMES)	:	3.2E+03
TOTAL ATTEMPTS (SEQUENCES)	:	4449
TOTAL ABORTS	:	1
ATTEMPTED TRUNK-TRUNK TRANSMISSIONS	:	181
SUCCESSFUL TRUNK-TRUNK TRANSMISSIONS	:	45
TRUNK 1 ACTIVE TIME	:	1.9128248 SECS
TRUNK 2 ACTIVE TIME	:	0.0306966 SECS
TOTAL TRUNK ACTIVE TIME	:	1.9935214 SECS
% TRUNK 1 ACTIVE TIME	:	19.128 %
% TRUNK 2 ACTIVE TIME	:	0.307 %
% TOTAL ACTIVE TIME	:	19.935 %
CONTROL BYTES TRANSMITTED - TRUNK 1	:	6.02326E+00 MBYTES
DATA BYTES TRANSMITTED - TRUNK 1	:	5.79952E+00 MBYTES
CONTROL BYTES TRANSMITTED - TRUNK 2	:	3.14394E-01 MBYTES
DATA BYTES TRANSMITTED - TRUNK 2	:	1.06554E-01 MBYTES
TOTAL BYTES TRANSMITTED	:	1.22438E+01 MBYTES
TOTAL OFFERED LOAD	:	6.59650E+00 MBYTES

DEVICE ACTIVITY SUMMARIES
(SECONDS)

TABLE 2.12 DEVICE STATISTICS FOR FIGURE 2.6

DF #	DEV #	SOURCE #	TIME ACTIVE	TIME WAITING	TIME IN COLLISIONS	AVG MESSAGE DELAY	ABORT COUNT	TRANSMISSION COUNT	RECEPTION COUNT	WAIT COUNT	COLLISION COUNT
111	1	1	0.0740	0.0000	6.9E-06	7.3E-04	0	197	0	0	6
211	2	1	1.2047	0.0048	8.1E-06	8.6E-04	0	2069	214	90	13
311	3	1	0.0045	0.0003	0.0E+00	7.7E-04	0	12	0	6	0
	7	1	0.0034	0.0000	2.6E-07	7.3E-04	0	9	0	0	1
21		2	0.0593	0.0000	0.0E+00	0.0E+00	0	0	114	0	0
331	3	1	0.0234	0.0000	1.3E-07	7.9E-04	0	62	19	0	1
411	4	1	1.7296	0.0000	0.0E+00	0.0E+00	0	0	3835	0	0
421	4	2	0.0521	0.0189	3.6E-06	5.2E-04	0	99	0	390	11
511	5	1	0.0222	0.0035	1.0E-03	2.0E-03	1	22	24	65	132
521	5	2	0.5466	0.0356	3.4E-05	6.7E-04	0	1766	82	729	22
422	5	2	0.0321	0.0322	1.5E-04	8.4E-04	0	46	47	639	22
611	6	1	0.0345	0.0009	2.4E-05	2.0E-03	0	23	54	19	4
621	6	2	0.0069	0.0316	2.4E-05	7.7E-04	0	23	0	616	3
622	6	2	0.0225	0.0000	3.2E-05	7.7E-04	0	24	23	0	4
711	7	1	0.0133	0.0000	4.0E-05	7.4E-04	0	24	10	0	5
721	7	2	0.0167	0.0334	6.4E-05	7.2E-04	0	47	0	679	8
731	7	3	0.0225	0.0000	1.2E-03	2.2E-03	0	23	24	0	157

2.8 CONCLUSIONS

The dual trunk HOSC simulation model which has been developed for NASA has been exercised for six scenarios ranging from a typical but lightly loaded HSOC configuration to a severly loaded HOSC/CREY configuration. Analysis of the network and device statistics have shown where potential problems may develop.

The simulation results of the HOSC/CREY configuration which has been proposed by NASA indicates a bottle neck in the trunk-to-trunk data flow and a suggested reconfiguration has been run. These results indicate that a much smoother operation is possible with reconfiguration while still allowing isolation from the CREY input through use of an adapter for controlling the CREY data inputs.

The simulation model has been shown to be a very valuable tool for predicting possible problems with envisioned HOSC configurations, additions, etc. It is recommended that every newly envisioned HOSC configuration with added data flow requirements be simulated to the best ability with this model and potential trouble spots identified before planning has progressed to the purchase and installation of equipment or software.

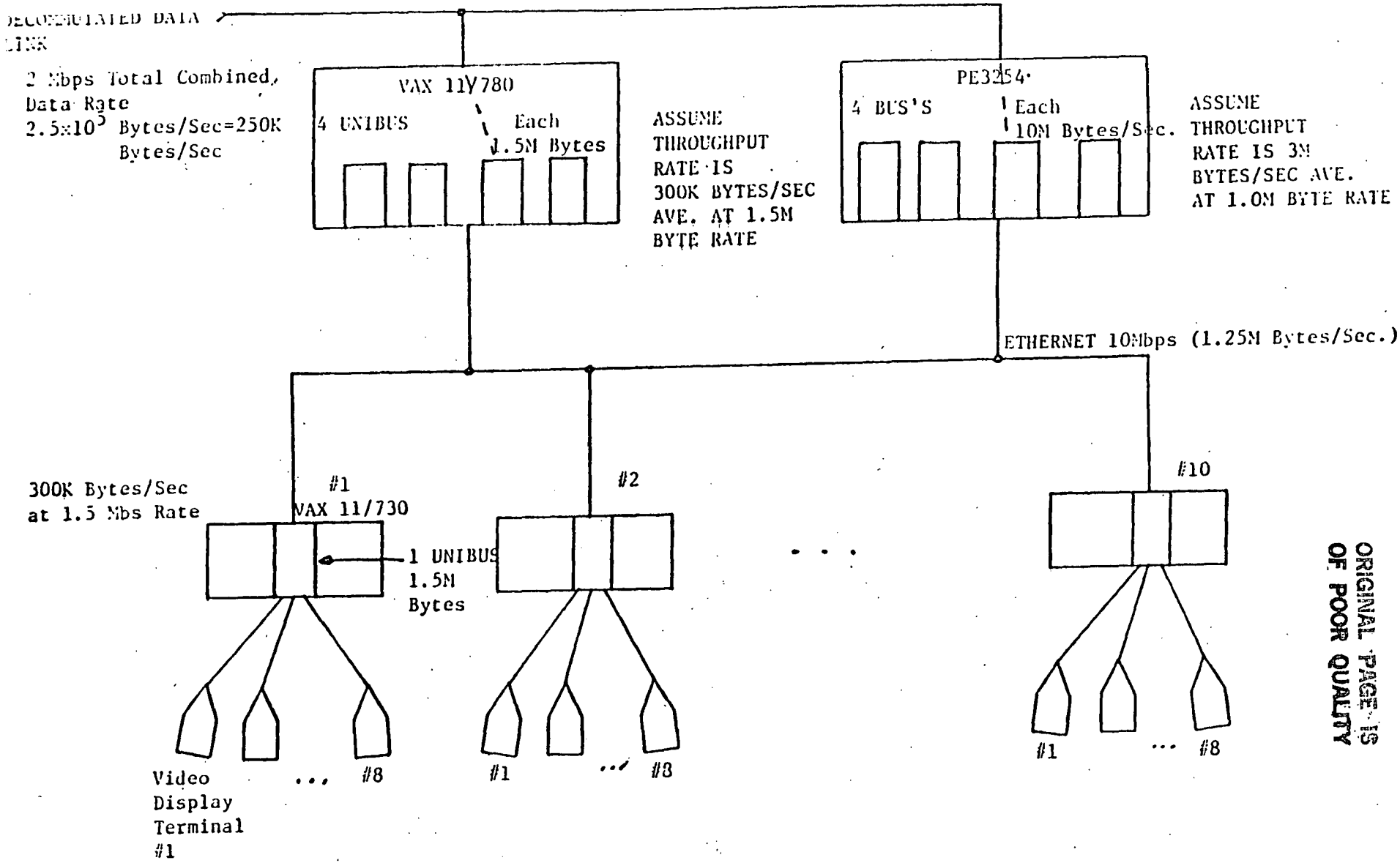
3.0 ANALYSIS OF VIDEO TERMINAL NETWORK INTERCONNECT NETWORK

3.1 INTRODUCTION

The system depicted in Figure 3.1 is a proposed Video Terminal interconnect network. The Space Telescope data link which is received at HOSC is decommutated and an ensemble of decommutated channels with an aggregate of 2 Mbps (250KBps) is delivered to the combination of a VAX 11/780 and a PE3254 computer set as envisioned by NASA HOSC personnel in 1984. These two computers accept the Space Telescope data, perform changes to place the data in proper format for the Video Terminals, perform data calculations to compute new parameters, perform data unit conversions and extrapolate data tendencies. The PE3254 is the main computational tool for data calculations while the VAX 11/780 is the main computational tool for data format changes.

These two computers serve as data sources for the 80 video Terminals which are connected by a Local Area Network (LAN) to the VAX 11/780 and PE3254 by 10 VAX 11/730 computers each of which can handle up to 8 Video Terminals each.

Data I/O rates are constrained to a large extent by the internal data buses of the computers which must serve as I/O buses as well as data buses for internal disk and file transfers. Thus, the VAX 11/730, for instance, which has 1 UNIBUS with 1.5MBps data transfer rate is required to handle input data flow, output data flow as well as disk and file and DMA data transfers. The effective data transfer rate for the I/O functions is estimated to be approximately 300KBps due to this multifunction requirement placed on the UNIBUS (Reference 2).



1. 1920 Bytes (24 Linesx80 Bytes/Line) To Fill Screen
2. 11/730 Refreshes the screen every 5 seconds (comes from 11/780 + PE3254) Sequentially through the 8.
3. When terminal requests screen format change, the request is relayed to 11/730, Then to 11/780 or PE3254 which then finds/calculates and sends down data to terminal.
4. Assume packet lengths 128 or 256 or 512 Bytes/Packets.
5. Assume terminal requests update or format change every 3 minutes.

Figure 3.1 Video Terminal Distribution System

Thus, although the data is actually transferred over the UNIBUS at 1.5MBps, the waiting to gain access for UNIBUS use yields a data throughput analogous to a slower speed bus of 300KBps rate which is instantly available.

The VAX 11/780 has 4 UNIBUS's each with 1.5MBps speed, but only 1 of these is assigned to provide I/O for the Space Telescope/Video Terminal usage. Hence, the equivalent I/O rate is once again estimated to be 300KBps.

The PE3254 has four 10MBps buses, but only one is assigned to Space Telescope I/O and hence after degrading due to other required functions for the bus, the equivalent data transfer rate is estimated to be 3MBps (Reference 2).

To determine a worst case waiting time for a screen change request, the system may be assumed to be in the following condition:

1. Assume all screens are currently in use with 1920 Bytes of refresh data every 5 seconds being transmitted from VAX 11/780 and PE3254 to the screens via ETHERNET and the VAX 11/730 computers.
2. Assume all screen operators simultaneously request a screen change which requires a new set of 1920 Bytes to be sent for each screen.

The data requirements for the ETHERNET channel will be two complete sets of 1920 Bytes per Video Terminal, or a total of 37,200 bytes plus the number of bytes required to request the screen change. Assuming that a screen change can be accomplished in 50 bytes of information, that increases the total channel requirement by 4000 bytes for a total of 311,200 bytes.

The ETHERNET channel can transmit data at a 10Mbps rate or 1.25MBps rate. Hence, the channel itself with no collisions would require .249 seconds to transmit this data set. Assuming 10% collisions which require another 20% more data to be sent the total time could easily approach .324 seconds to effect the total data transfer. However, the host computers cannot accomplish this data rate.

The VAX 11/730 sequentially services the Video Terminals and the I/O rate is essentially 1/2 the effective rate of 300K Bytes per second of the UNIBUS in a one way direction. The actual data flow, however, is two way with the screen change request bytes flowing outward. The interchange is effectively 1920 bytes in, 50 bytes out 1920 bytes in again, interspersed with the other Host requirements on the UNIBUS.

If the VAX 11/780 is assumed to transfer all the data for screen update (which is a worst case situation since the PE3254 is faster), then the fastest transfer of the total data which can be achieved is 311,200 bytes at 300KBps byte rate or a 1.04 second time period. Because the ETHERNET channel is idle during much of the time waiting for the VAX 11/780 to output data, the ETHERNET channel will not be a factor in the total time to transfer the data. Furthermore, the VAX 11/730 hosts are only trying to transfer 31,120 total bytes each. Thus, they are waiting for their time to communicate with the VAX 11/780 as the VAX 11/780 can get to them.

The upshot of the above discussion is the illustration of the fact that the VAX 11/780 will be the major limiting factor in the

data transfer. Assuming 10% collisions on the ETHERNET channel, the total time to transfer the data would be approximately 1.352 seconds.

3.1.1 WORST CASE ANALYSIS

The above assumes 1920 Bytes/packet and that all screen change requests occur after the next screen refresh. In actuality, some screen change requests will be received at the VAX 11/780 before the screen refresh and eliminate the need for the transfer of the 1920 bytes of screen refresh data for the old screen; then the total number of bytes required is only 234,400 and the time for total screen change including 10% collisions would be 1.016 seconds.

Now assuming the data is packaged in 512 Bytes per packet, it will require 4 packets for each 1920 Bytes and 1 packet for screen change request. Thus, the total packet count to be transmitted is 4x2x80+80=720 packets. Each packet requires 1.71ms to be transmitted. (Assuming each packet is transmitted at an average of 300,000 bytes per second). This means the VAX 11/780 and VAX 11/730's need to gain the channel access 720 times. The VAX 11/780 will need 720 times 1.71ms or 1.23 seconds to send the data (no collisions) (remembering one full packet is now used for only 50 bytes of screen change request data) as opposed to the previous no collision time of .249 seconds.

3.2 STATISTICAL ANALYSIS

The article of Reference 3 presesnts a ''slotted'' ETHERNET Model which is useful for an analysis of waiting time, bus efficiency

and acquisition probability since the ETHERNET listens before talking and in essence waits one slot time before trying to transmit.

Let P = the number of bits in an ETHERNET packet.

Let C = the peak capacity in bits per second carried on the ETHERNET.

Let T = the time in seconds of a slot duration.

Let Q = the number of stations continuously queued to transmit a packet. Q is, therefore, the total offered load on the network ($\geq$ 1).

It is assumed that a queued station attempts to transmit in the currently available slot with probability 1/Q and delays the attempt with probability (1 - 1/Q).

The probability, A, that exactly one station attempts a transmission in a slot and, therefore, acquires the ETHERNET channel is

$$A = Q(1/Q)(1 - 1/Q)^{Q-1} \quad ,$$

since there are Q stations that can try for the channel access with probability 1/Q and the remaining 1-Q channels choose to wait with probability (1-Q) each.

The waiting time, W, is the average (mean) number of channel slots of waiting in a contention interval before a successful acquisition of the channel by a station.

The probability of no waiting is A. The probability of waiting one slot is A(1-A). The probability of waiting i slots is $A(1-A)^i$. The mean of this geometric distribution is:

$$W = (1-A)/A.$$

For 10 users on a channel (10 VAX 11/730's).

$$A = (1-1/Q)^{Q-1} = (.9)^{9} = .3874$$

or 38.74% of the time a station's attempt to gain channel access is successful on the first try.

The mean waiting time is

$$W = (1-A)/A = (1- .3874)/(.3874) = 1.58,$$

or a station waits an average of 1.58 attempts before gaining a channel when it is trying to transmit.

The efficiency e is the fraction of time the ETHERNET channel is carrying good packets. The ETHERNET channel's time is divided between transmission intervals and contention intervals.

For most operations, including the HOSC application, this is a worst case analysis by far. Most applications do not utilize the bus continuously which is the assumption here. Furthermore when the bus is idle, the first station to request the channel gains the channel with no waiting.

To continue the analysis a packet transmission takes P/C seconds and the mean time to acquisition is WT. Hence, this simple worst case analysis yields an estimate of the efficiency as

$$E = (P/C)/((P/C) + WT)) \quad ,$$

where P is the packet size in bits, C is the channel data transmission rate in bits per second and T is the time slot duration which must either be long enough to allow a collision to be detected or at least twice the ETHERNET Channel's round trip time. There should be a limit in software of the maximum length of the packets to be near 4,000 bits (500 Bytes plus overhead) to keep the latency of the network access down and to permit efficient use of station packet buffer storage.

Assuming a packet size of 512 Bytes total, a 10 Mbps (1.25MBps) ETHERNET channel transfer rate and a slot duration of 16 microseconds (8000 feet of cable) the efficiency is:

$$E = \left(\frac{512}{1.25\times10^{6}}\right) \Big/ \left(\frac{512}{1.25\times10^{6}} + 1.58\times16\times10^{-6}\right)$$

$$= 4.09\times10^{-4} \quad (4.09\times10^{-4} + 2.528\times10^{-5})$$

$$= .94178$$

or 94.178% of the packets are good packets

or for a fully loaded bus 94.178% of the time good packets are transmitted.

Table 3.1 summarizes this comparison of worst case possibilities and statistical performance parameters.

TO IMPROVE PERFORMANCE, THE VAX 11/780 SHOULD HAVE ONE UNIBUS DEDICATED TO THE I/O OF THE SPACE TELESCOPE DATA INPUT AND THE ETHERNET CHANNEL DATA REQUESTS.

TABLE 3.1

WORST CASE AND STATISTICAL AVERAGE PERFORMANCE ESTIMATES FOR ETHERNET INTERCONNECTION OF VIDEO TERMINAL/VAX 11/730.

Assumptions: All 80 Terminals Request Screen Data Change Simultaneously. (1920 Bytes/Screen refresh or change). 8 Terminals Per VAX 11/730; 5 Second Screen Refresh Period; 3 Minute Screen Change Request on the Average. 10 VAX 11/730's, 1 VAX 11/780; 1 PE3254 Linked Together.

	LONGEST WAITING TIME (NO COLLISIONS) FOR SCREEN CHANGE	LONGEST WAITING TIME 10% COLLISIONS	LONGEST WAITING TIME (NO COLLISIONS) FOR SCREEN CHANGE, 50% SCREEN REFRESH ELIMINATED	LONGEST WAITING TIME 10% COLLISIONS, 50% SCREEN REFRESH ELIMINATED
WORST CASE: I Assuming 1920 Bytes Per packet	1.04 Seconds	1.352 Seconds	0.78 Seconds	1.016 Seconds
WORST CASE: II Assuming 512 Bytes per Packet	1.23 Seconds	1.6 Seconds	0.95 Seconds	1.25 Seconds

	AVERAGE WAITING TIME	AVERAGE TIME TO REFRESH SCREEN WITH 1920 BYTES ASSUMING SEQUENTIAL SERVICING OF VAX 11/730's BY VAX 11/780, (WITH COLLISIONS)	PROBABILITY OF NO WAITING	PERCENTAGE GOOD PACKETS ON BUS (EFFICIENCY)	AVERAGE COLLISION PERCENTAGE
AVERAGE STATISTICAL PARAMETERS:	(16μsec per Slot)				
512 Bytes/Packet	1.58 Slots = 25.3μsec.	9.6 ms	.3874	94%	6%
256 Bytes/Packet	1.58 Slots = 25.3μsec.	20.2 ms	.3874	89%	11%
128 Bytes/Packet	1.58 Slots = 25.3μsec.	48.6 ms	.3874	80.2%	19.8%

3.3 CONCLUSIONS

Under the assumptions of the system architecture as envisioned at the time this analysis was performed, the system had 80 video terminals in a configuration of 8 video terminals per a VAX 11/730, with the 10 VAX 11/730's connected to two host computers (VAX 11/780 and a PE 3254) by the ETHERNET network. (November-December 1983 monthly report for this contract).

The analysis illustrates a worst case time of 1.6 seconds to change all 80 screen contents to new displays if 512 bytes were used per packet (in the ETHERNET protocol a packet is the transmission frame). There is a dependency between waiting time and packet length with the worst case waiting time projected to be 1.252 seconds for a packet length of 1920 bytes. Statistical parameters indicate a 48 MS screen change time for 128 bytes per packet and 10 MS for 512 bytes packet.

The most important point that is illustrated with the analysis is the fact that the major limiting factor in the data transfer was felt to be the VAX 11/780 rather than the ETHERNET network. This is felt to be due to the VAX 11/780 throughput time and it was recommended that the VAX 11/780 should have one UNIBUS dedicated to the I/O of the Space Telescope data input and the ETHERNET channel data requests.

A review of the November/December 1983 report containing this analysis is recommended for those involved in the consideration of adding 2 POCC requirements to the 160 terminals that are now in consideration.

3.4 DISCUSSION OF SIMULATION ANALYSIS RESULTS

A simulation program for the general ETHERNET system has been developed by General Dynamics, Inc., Fort Worth, Texas. (GDFW). This program was exercised for the proposed 80 terminal (10 VAX 11/730 host) video terminal system as a courtesy to NASA/MSFC by DFGW via a request by this investigator. The data in Tables 3.2 and 3.3 of this section are results of the equivalent of 15 seconds of run time of the video terminal system.

The simulation was run for a 70%/30% relative loading between the VAX 11/780 and the PE 3254 (reference Figure 3.1) and also for a 50%/50% relation loading between the VAX 11/780 and the PE 3254. Data packet sizes were varied from 960 bytes per packet to as little as 120 bytes per packet and a constant total data block of 1920 bytes was assumed (worst case screen change).

OBSERVATIONS OF THE SIMULATIONS ARE:

(1) The smaller packet sizes (120 bytes per packet) are to be avoided due to adverse effects on collision rate and delay times.

(2) Video change requests are troublesome if they happen to occur during a 1920 byte data dump by the VAX 11/780/PE3254 units.

(3) It is suggested (as was also demonstrated by analysis) that the larger packet sizes be used and that video change requests not be transmitted during video screen dumps or, as an alternate, space the video dumps by the VAX 11/780/PE 3254 units by 1 or 2 milliseconds to allow VAX 11/730 video change requests to be transmitted.

Thee was good agreement between the analysis (Table 3.4) and the simulation results.

The simulation results are contained in the section 3.5. The writing in this section defines the terms used in the Tables 3.2 and 3.3. Table 3.2 presents the system parameters as they developed during a simulation of 15 seconds of Video terminal ETHERNET data flow which assumed that all 80 terminals are receiving a full screen refresh of 1920 bytes every 5 seconds. Table 3.3 presents the system parameters as they developed during a simulation of 15 seconds of VIDEO Terminal ETHERNET data flow which assumed that all 80 terminals are receiving a full screen refresh of 1920 bytes every 5 seconds and that video requests are being received so as to result in a complete screen change for every terminal every three minutes. The worst case scenario for Table 3.3 was used. This assumed that the VAX 11/780 and the PE 3254 were assumed to be synchronized and would begin their dumps on the ETHERNET at exactly the same time.

The parameters of most interest are the collision frequency and the process times.

The worst case analysis and the statistical average analysis were calculated assuming a 10% collision frequency. Inspection of Table 3.2 and Table 3.3 illustrates a collision frequency of approximately 10% for the short length data packets (120 bytes per packet) for the light load simulations (Table 3.2) and 10% collision frequency for virtually all the packet lengths simulated for the heavy load simulation (Table 3.3). Thus the simulation results in so far as collision frequency are in very good agreement with the analysis assumptions.

The analysis for absolute worst case predicts a worst case longest waiting time of 1.6 seconds (512 byte packets) to complete a

video screen change request assuming a heavy load situation (all video screen operators are assumed to request a screen change) with 10% collisions. The statistical average analysis predicts a longest waiting time of 9.6 MS (with 512 byte packets) and 48.6 MS for 128 byte packets). The simulation run for the heavy load situation (Table 3.3) illustrates a maximum individual packet waiting time of 117 MS for 480 byte packets and 61 MS with 120 byte packets for the 70%/30% VAX 11/780 to PE 3254 load balance. For a 50%/50% VAX 11/780 to PE 3254 load balance the simulation results indicate a 500 MS waiting time for 480 byte packets and a 61 MS waiting time for 120 byte packets.

To compare these results it is necessary to calculate the total waiting time anticipated for a video screen change. Table 3.4 compares these results in the best manner possible. It may be observed that the worst case analysis and the worst case simulation agree quite well, considering the asumptions made, while the average parameters under simulation seem to be a better estimate than the average analysis. The statistical analysis average assumed true Poission distribution of screen change requests and no synchronization between data dumps of the VAX 11/780 and the PE 3254. Thus the most optimistic performance is estimated by the statistical analysis.

THE LESSONS TO BE LEARNED ARE QUITE CLEAR:

(1) TO REDUCE COLLISIONS USE LONG DATA PACKETS (1960 BYTES)

(2) PROVIDE A MINIMUM SPACE TIME (1MS PERHAPS) BETWEEN NORMAL SCREEN REFRESH DATA DUMPS FROM THE VAX 11/780 AND THE PE 3254. THIS

WILL ALLOW VIDEO SCREEN CHANGE REQUESTS TO MOVE FROM THE TERMINAL TO THE VAX 11/780 AND THE PE 3254.

(3) THE VAX 11/780 IS THE MAJOR LIMITING FACTOR UNDER FULL LOAD. ONE UNIBUS IN THE VAX 11/780 SHOULD BE DEDICATED TO THE I/O FOR THE SPACE TELESCOPE DECOMMUTATED DATA LINK AND THE ETHERNET LINK TO THE VIDEO TERMINALS.

3.5 SIMULATION ANALYSIS

These statistics were compiled by GDFW for Frank Ingels of Mississippi State in connection with a proposed satellite data retrieval and processing network. The hardware configuration consists of the raw data receptors, the conditioned data receptors, the user terminals, and the communications link between the two data receptors.

The raw data receptors take the satellite information and modify it. These modifications are performed by a VAX 11/780 and a PE 3254. These two in turn place the conditioned data (which are video terminal updates) on one ethernet line and send it to 10 VAX 11/730'S. These VAX'S act as flow managers for the ETHERNET. Each VAX 11/730 handles 8 video terminals and channels updates and screen change requests to/from these terminals through one ETHERNET tap.

There are 3 message types that come across the ETHERNET. The first type is video update. The message type is sent by the data conditioners to the VAX 11/730'S. Data length is 1920 bytes. The second type is video request, and is initiated by the video terminals. It is sent through the VAX 11/730's to either the VAX 11/780 or the PE 3254. It is 512 bytes long. This video request generates the third message type, called video response. Video response is similar to video update in length and origin.

The simulation modeled the I/O ports of the VAX 11/780, the PE 3254, and the 10 VAX 11/730's. It simulated the traffic flow along an ETHERNET bus, given maximum expected loads. These loads included 80 active video terminals, each of which received an update every 5

seconds. Approximately every 2.25 seconds (+/- 2.25 seconds) a video terminal will request a screen change. This request generates a response at the data conditioners. The response is sent back to the terminal.

Note that delay times internal to the data conditioners or the flow manager-terminal pair are not included in delay-measurement of video response. THIS DELAY MEASUREMENT MERELY REFLECTS DELAY INDUCED BY THE ETHERNET NETWORK CONFIGURAITON.

The video updates are released as a queued dump from the VAX 11/780 and the PE 3254 every 5 seconds. Worst case was taken; that is, the VAX 11/780 and the PE 3254 were assumed to be exactly synchronized and would begin their dumps at the same time. The video requests were released so as to simulate a complete screen change for all 80 terminals every three minutes.

Timing for the simulation occured on the 1 step per microsecond level. Simulation language limits on the size of variables restricted runs to 15 seconds of simulated time, or three dump cycles. These 3-cycle runs were executed for two different parameters. They were also run for only video updates, and then for all three message types.

The parametric variables were

(1) Relative loading of the VAX 11/780 and the PE 3254, and

(2) The frame size of the video updates.

Variation of relative loading came about as the result of uncertainty as to how much of the total load each data conditioner would in fact have.

Frame size was varied in order to determine whether message length (and of course the number of messages) has an effect on throughput and bus utilization.

EXPLANATION OF CHARTS: (TABLES 3.2 AND 3.3)

(1) MSSG Delay: Every 5 seconds the data conditioner dumps a new MSSG. MSSG delay is the time that it takes a message to reach its destination (A VAX 11/730) minus the time of the beginning of the slice.

(2) Slice Times: The time of the last video update message to be executed in the current slice determines slice time.

(3) Bus Times:

(a) Entries denote # of times that information was pushed onto the bus.

(b) Total time = total time of the three cycles, 15 second interval, that the bus was active.

(c) % util(active) is the bus utilization rate during the time that messages were waiting to be processed.

% UTIL(ACTIVE)=(TOTAL TIME)/(SLICE TIME)

(d) % UTIL(TOTAL)=(TOTALTIME)/15 SECONDS

(4) Collisions:

Collisions can occur during the first 45 μs of frame transmission.

(a) Ave # of attempts (>=1) is the average # of times any message is pushed onto the bus during the simulation.

(5) Process Time: The process time a message incurs is the time interval from the moment it is loaded into the

ETHERNET I/O port to the time it is received at the target I/O port.

(a) Video request/response time is the max process time of the video request and the process time of the video response frames.

TABLE 3.2
SIMULATION RESULTS, NO VIDEO CHANGE REQUESTS

X/Y = VAX x %; PE+E y% ETHERNET INGELS - STEADY - STATE - NO VID. REQ.

	70/30	70/30	70/30	70/30	50/50	50/50	50/50	50/50
TYPE OF STAT	2 x 960	4 x 480	8 x 240	16 x 120	2 x 960	4 x 480	8 x 240	16 x 120
SLICE MSSG DELAY								
MAX DELAY	142.5 ms	169.5 ms	162 ms	238.5 ms	163.5 ms	156 ms	156 ms	256.5 ms
AVE DELAY	66.7 ms	79.5 ms	73.4 ms	102 ms	74.0 ms	76.3 ms	77.9 ms	114.2 ms
STD. DEV = DELAY	39.3 ms	48.74 ms	44.3 ms	62.9 ms	45.5 ms	46.8 ms	46.8 ms	66.0 ms
SLICE TIMES								
MAX =	1425 ms	170.0 ms	162.5 ms	240 ms	165 ms	157.5 ms	157.5 ms	257.5 ms
AVE =	134.9 ms	156.7 ms	149.7 ms	211 ms	145 ms	151.2 ms	154.3 ms	239 ms
LOW =	132.5 ms	142.5 ms	142.0 ms	170 ms	134 ms	145.0 ms	152.4 ms	203 ms
BUS TIMES								
ENTRIES	550	1032	1988	4418	546	1028	1988	4464
AVE BUS TIMES	693.2 µs	378.8 µs	206.16 µs	106.2 µs	698 µs	380 µs	206.2 µs	105.4 µs
STD. DEV	2484 µs	91.9 µs	31.1 µs	25.6 µs	242 µs	89.9 µs	30.8 µs	26.6 µs
TOTAL TIME	.381257 s	.390922 s	.409848 s	.468992 s	.381106 s	.39072 s	.409925 s	.470705 s
%UTIL(ACTIVE SLICE)	94%	83%	91%	74.1%	87.6%	86%	88.6%	65.6%
%UTIL(TOTAL SLICE)	2.54%	2.6%	2.73%	3.13%	2.54%	2.6%	2.73%	3.14%
COLLISIONS								
# COLLISIONS	35	36	34	289	33	34	34	312
AVE COLLISION #(≥1)	3.54	3.89	3.75	2.79	3.62	3.735	3.75	2.89
MAX # OF ATTEMPTS	12	13	13	19	12	12	12	11
PROCESS TIME	VAX 11/780 AND PE+E VIDEO UPDATE							
MAX	107 ms	120 ms	119 ms	48 ms	93 ms	103 ms	99 ms	52 ms
AVE	1.42 ms	716 µs	352 µs	2488 µs	1.29 ms	6728 µs	346 µs	282.8 µs
STD. DEV.	7.81 ms	5.6 ms	3.77 ms	1.675 ms	6.42 ms	4.78 ms	3.36 ms	2 ms
# OF ENTRIES	480	960	1920	3840	480	960	1920	3840

TABLE 3.3
SIMULATION RESULTS WITH VIDEO CHANGE REQUESTS

X/Y = VAX x %; PE+E y% INGELS SATELLITE ETHERNET - FULL DRESS (With Video Req.)

	70/30	70/30	70/30	70/30	50/50	50/50	50/50	50/50
STATISTIC TYPE	2x960	4x480	8x240	16x120	2x960	4x480	8x240	16x120
SLICE MSSG DELAY								
AVE VAX/PE+E	68.5 ms	79.8 ms	98.9 ms	109.9 ms	796 ms	92.6 ms	94.8 ms	122.7 ms
AVE VIDEO REQ	51.2 ms	430 µs	430 µs	430 µs	430 ms	501 ms	500 ms	430 µs
MAX VIDEO/REQ	4.1 ms	3 ms	3 ms	3 ms	960 ms	503 ms	560 ms	3 ms
SLICE TIMES*								
MAX	142.5 ms	172.5 ms	231 ms	238 ms	180 ms	206 ms	198 ms	262.5 ms
AVE (APPROX)	138 ms	152 ms	208 ms	215 ms	167 ms	198 ms	176 ms	251 ms
LOW	732.5 ms	142.5 ms	203 ms	210 ms	163 ms	190 ms	171 ms	240 ms
BUS TIMES								
ENTRIES	595	1207	2352	4491	613	1294	2481	4544
AVE BUS TIMES	672.4 µs	337.6 µs	184.1 µs	106.8 µs	641.4 µs	319 µs	177.6 µs	105.7 µs
STD DEV. FR. AVE	266 µs	140.3 µs	64.6 µs	27~5 µs	294 µs	153 µs	69.9 µs	28.5 µs
TOTAL TIME	.40008 s	.407438 s	.433881 s	.47984 s	.39323 s	.412916 s	.440765 s	.48025 s
%UTIL(ACTIVE)	~ 96.6%	~99.3%	~70%	~74.4%	~78.5%	~69.6%	~83.4%	~64.4%
%UTIL(TOTAL)	~2.65%	~2.75%	2.89%	3.2%	2.62%	2.75%	2.94%	3.2%
COLLISIONS								
# COLLISIONS	44	111	196	283	59	152	254	318
AVE # COLLISION (≥1)	3.94	3.022	3.012	2.87	3.31	3.11	2.96	2.90
MAX # OF ATTEMPTS	12	14	11	14	12	12	OVER	10
PROCESS TIME	-VAX	,730	VIDEO REQ.					
MAX	1 s	117 ms	63 ms	61 ms	1 s	500 ms	500 ms	61 ms
AVE	21.1 ms	793.9 µs	485 µs	256 µs	21.6 ms	5.92 ms	3.01 ms	285 µs
STD DEV.	444 ms	5.1 ms	3.16 ms	1.98 ms	44.9 ms	159 ms	112 ms	2.07 ms

*SLICE TIMES TAKEN FROM VAX/PE+E MSSG DELAY TABLES

TABLE 3.4
COMPARISON OF STATISTICAL AND SIMULATION RESULTS

COMPARISON OF WAITING TIMES FOR VIDEO SCREEN CHANGE
ASSUMPTIONS ARE AS FOR TABLE II: MAX LOAD ON BUS AND
ALL 80 TERMINALS REQUEST VIDEO SCREEN CHANGE AT 2.25
SECOND INTERVALS WHILE FULL SCREEN REFRESH DATA (1920 BYTES PER SCREEN)
IS BEING TRANSMITTED FROM VAX 11/780/PE 3254 TO EACH TERMINAL

MAX WAITING TIME FOR COMPLETE VIDEO SCREEN CHANGE	ABSOLUTE WORSE CASE (10% COLLISIONS) ANALYSIS	REFRESH AVG WAITING TIME FOR SCREEN STATISTICAL AVERAGE (10% COLLISIONS) (ASSUMES NO SYNCHRONIZATION BETWEEN REQUESTS AND DATA DUMP	SIMULATION WORST CASE WAITING TIME FOR SCREEN REFRESH. (ASSUME SYNCHRONIZATION BETWEEN DATA DUMPS FROM VAX 11/780 AND PE 3254)		SIMULATION AVG WAITING TIME FOR SCREEN SCREEN REFRESH	
			70%/30%	50%/50%	70%/30%	50%/50%
128 byte/packet	_____	48.6 ms	976 ms	976 ms	217 ms	186 ms
512 byte/packet	1.6 seconds	9.6 ms	468 ms	2.0 sec	480 ms	412 ms
1960 byte/packet	1.352 seconds	_____	2.0 sec	2.0 sec	768 ms	832 ms

5.0 REFERENCES

1. System for the Huntsville Operational Support Center Distributed Computing System, D. Massey and F. Ingels, Annual Report 1985, NAS8-34906.

2. Verbal Conversation with Mr. Sherman Jobe, NASA/MSFC, 205+453-4629

3. Ethernet: Distributed Packet Switching for Local Computer Networks, R. M. Metcalfe and D R Boggs, ACM Communications, July 1976, Vol. 19, No. 7, page 395-404.

APPENDIX I

BACKUP SIMULATION DATA

SECTION 1.1

A TYPICAL HOSC ACTIVITY CONFIGURATION

```
**********************************************************
          **********************************************

                    NETWORK DESCRIPTION
                      ADAPTER #  1

          **********************************************
**********************************************************

ADAPTER # 1:

   PRIORITY DELAY ON TRUNK 1 :  0.0000077 SEC
   FIXED DELAY:  0.0000061SEC
   TOTALDELAY ON TRUNK 1 :  0.0000194SECS
   ADAPTER RETRY COUNT : 64

   DEVICE  1   STATUS: CLOSED--11
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:     0.0000000 SEC
                              NUMBER OF DATA SOURCES:  1
                              111
                               DEVICE NUMBER  111
                               BUFFER SIZE:  1.0E+03 BYTES
                               SOURCE # 1 DATA GENERATION RATE:  20000.00 BYTES
                               TRUNK TRANSMISSION INTERVAL:  0.0500 SEC
                               DATA BLOCK COUNT :  4.882812500E-01
 POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:111
 RECEIVER ID: 521                PROBABILITY:  9.0E-01
 RECEIVER ID: 211                PROBABILITY:  1.0E-01

   DEVICE  2   STATUS: OPEN

   DEVICE  3   STATUS: OPEN

   DEVICE  4   STATUS: OPEN

**********************************************************
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                    NETWORK DESCRIPTION
                      ADAPTER #  2

          **********************************************
**********************************************************

ADAPTER # 2:
```

```
      PRIORITY DELAY ON TRUNK 1 :  0.0000041 SEC
      FIXED DELAY:  0.0000061SEC
      TOTALDELAY ON TRUNK 1 :  0.0000194SECS
      ADAPTER RETRY COUNT : 64

      DEVICE  1   STATUS: CLOSED--21
                              I/O BUS TRANSFER RATE:     50000.00 BYTES/SEC
                              LOAD TIME:     0.0000025 SEC
                              NUMBER OF DATA SOURCES:  1
                              211
                               DEVICE NUMBER  211
                               BUFFER SIZE:  2.1E+03 BYTES
                               SOURCE # 1 DATA GENERATION RATE:  20000.00 BYTES
                               TRUNK TRANSMISSION INTERVAL:  0.1050 SEC
                               DATA BLOCK COUNT :  1.025390625E+00
 POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:211
  RECEIVER ID: 111                    PROBABILITY:  3.0E-01
  RECEIVER ID: 531                    PROBABILITY:  3.0E-01
  RECEIVER ID: 611                    PROBABILITY:  3.0E-01
  RECEIVER ID: 621                    PROBABILITY:  1.0E-01

      DEVICE  2   STATUS: OPEN

      DEVICE  3   STATUS: OPEN

      DEVICE  4   STATUS: OPEN


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                    ***************************************

                              NETWORK DESCRIPTION
                                ADAPTER #  3

                         ****************************************
                    **********************************************************


 ADAPTER # 3:

      PRIORITY DELAY ON TRUNK 1 :  0.0000005 SEC
      FIXED DELAY:  0.0000061SEC
      TOTALDELAY ON TRUNK 1 :  0.0000194SECS
      ADAPTER RETRY COUNT : 64

      PRIORITY DELAY ON TRUNK 2 :  0.0000077SEC
      FIXED DELAY:  0.0000061SEC
      TOTAL DELAY ON TRUNK 2 :  0.0000226SEC

      DEVICE  1   STATUS: CLOSED--31
                              I/O BUS TRANSFER RATE:     50000.00 BYTES/SEC
```

```
                                LOAD TIME:    0.0000025 SEC
                                NUMBER OF DATA SOURCES:  1
                                311
                                  DEVICE NUMBER  311
                                  BUFFER SIZE:  2.0E+03 BYTES
                                  SOURCE # 1 DATA GENERATION RATE:  20000.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.1000 SEC
                                  DATA BLOCK COUNT :  9.765625000E-01
  POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:311
  RECEIVER ID: 111                  PROBABILITY:  2.0E-01
  RECEIVER ID: 211                  PROBABILITY:  2.0E-01
  RECEIVER ID: 411                  PROBABILITY:  2.0E-01
  RECEIVER ID: 511                  PROBABILITY:  2.0E-01
  RECEIVER ID: 611                  PROBABILITY:  2.0E-01

    DEVICE  2   STATUS: OPEN

    DEVICE  3   STATUS: OPEN

    DEVICE  4   STATUS: OPEN



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                        NETWORK DESCRIPTION
                          ADAPTER #  4

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        ************************************************************


  ADAPTER #  4:

    PRIORITY DELAY ON TRUNK 2 :  0.0000005SECS
    FIXED DELAY ON TRUNK 2:  0.0000051SECS
    TOTAL DELAY ON TRUNK 2:  0.0000225SECS
    ADAPTER RETRY COUNT :  64

    DEVICE  1  STATUS : CLOSED--41
                                I/O BUS TRANSFER RATE:   500000.00 BYTES/SEC
                                LOAD TIME:    0.0000002 SEC
                                NUMBER OF DATA SOURCES:  1
                                411
                                  DEVICE NUMBER  411
                                  BUFFER SIZE:  4.0E+03BYTES
                                  SOURCE # 1DATA GENERATION RATE:   5000.00BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.8000SECS
  POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 411
  RECEIVER ID: 611                  PROBABILITY:  2.0E-01
  RECEIVER ID: 631                  PROBABILITY:  8.0E-01
```

```
    DEVICE  2  STATUS : CLOSED--42
                              I/O BUS TRANSFER RATE:   500000.00 BYTES/SEC
                              LOAD TIME:    0.0000002 SEC
                              NUMBER OF DATA SOURCES:  1
                              421
                                DEVICE NUMBER  421
                                BUFFER SIZE:  6.4E+03BYTES
                                SOURCE # 1DATA GENERATION RATE:   7000.00BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.9143SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 421
RECEIVER ID: 111                  PROBABILITY:  3.0E-01
RECEIVER ID: 621                  PROBABILITY:  7.0E-01

    DEVICE  3  STATUS : OPEN

    DEVICE  4  STATUS : OPEN

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                          NETWORK DESCRIPTION
                            ADAPTER #   5

         ***********************************************
        ************************************************************

ADAPTER #  5:

    PRIORITY DELAY ON TRUNK 2 :  0.0000045SECS
    FIXED DELAY ON TRUNK 2:  0.0000061SECS
    TOTAL DELAY ON TRUNK 2:  0.0000226SECS
    ADAPTER RETRY COUNT :  64

    DEVICE  1  STATUS : CLOSED--51
                              I/O BUS TRANSFER RATE:   500000.00 BYTES/SEC
                              LOAD TIME:    0.0000002 SEC
                              NUMBER OF DATA SOURCES:  1
                              511
                                DEVICE NUMBER  511
                                BUFFER SIZE:  5.1E+02BYTES
                                SOURCE # 1DATA GENERATION RATE:   1250.00BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4080SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 511
RECEIVER ID: 411                  PROBABILITY:  6.0E-01
RECEIVER ID: 421                  PROBABILITY:  4.0E-01

    DEVICE  2  STATUS : CLOSED--52
                              I/O BUS TRANSFER RATE:   500000.00 BYTES/SEC
                              LOAD TIME:    0.0000002 SEC
                              NUMBER OF DATA SOURCES:  1
                              521
                                DEVICE NUMBER  521
                                BUFFER SIZE:  5.1E+02BYTES
```

```
                                SOURCE # 1DATA GENERATION RATE:   1250.00BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4080SECS
  POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 521
  RECEIVER ID: 411                PROBABILITY:  6.0E-01
  RECEIVER ID: 421                PROBABILITY:  4.0E-01

      DEVICE  3  STATUS : CLOSED--53
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  1
                              531
                                DEVICE NUMBER  531
                                BUFFER SIZE:  6.3E+02BYTES
                                SOURCE # 1DATA GENERATION RATE:   3750.00BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.1680SECS
  POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 531
  RECEIVER ID: 421                PROBABILITY:  2.0E-01
  RECEIVER ID: 621                PROBABILITY:  8.0E-01

      DEVICE  4  STATUS : OPEN

          ************************************************************
            ********************************************

                          NETWORK DESCRIPTION
                            ADAPTER #  6

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          ************************************************************


  ADAPTER #  6:

      PRIORITY DELAY ON TRUNK 2 :  0.0000117SECS
      FIXED DELAY ON TRUNK 2:  0.0000051SECS
      TOTAL DELAY ON TRUNK 2:  0.0000226SECS
      ADAPTER RETRY COUNT :  64

      DEVICE  1  STATUS : CLOSED--61
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  1
                              511
                                DEVICE NUMBER  611
                                BUFFER SIZE:  2.0E+03BYTES
                                SOURCE # 1DATA GENERATION RATE:   1250.00BYTES
                                TRUNK TRANSMISSION INTERVAL:  1.6000SECS
    POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 611
    RECEIVER ID: 111                PROBABILITY:  1.0E-01
    RECEIVER ID: 411                PROBABILITY:  8.0E-01
    RECEIVER ID: 551                PROBABILITY:  1.0E-01

      DEVICE  2  STATUS : CLOSED--62
                              I/O BUS TRANSFER RATE:  1200000.00 BYTES/SEC
                              LOAD TIME:    0.0000001 SEC
```

```
                                NUMBER OF DATA SOURCES:  1
                                621
                                  DEVICE NUMBER  621
                                  BUFFER SIZE:  2.0E+03BYTES
                                  SOURCE # 1DATA GENERATION RATE:  1250.00BYTES
                                  TRUNK TRANSMISSION INTERVAL:  1.6000SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 621
RECEIVER ID: 211                    PROBABILITY:  1.0E-01
RECEIVER ID: 511                    PROBABILITY:  1.0E-01
RECEIVER ID: 421                    PROBABILITY:  8.0E-01

    DEVICE  3  STATUS : CLOSED--63
                                I/O BUS TRANSFER RATE:  1200000.00 BYTES/SEC
                                LOAD TIME:  0.0000001 SEC
                                NUMBER OF DATA SOURCES:  1
                                631
                                  DEVICE NUMBER  631
                                  BUFFER SIZE:  2.0E+03BYTES
                                  SOURCE # 1DATA GENERATION RATE:  1250.00BYTES
                                  TRUNK TRANSMISSION INTERVAL:  1.6000SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 631
RECEIVER ID: 531                    PROBABILITY:  2.0E-01
RECEIVER ID: 311                    PROBABILITY:  2.0E-01
RECEIVER ID: 421                    PROBABILITY:  6.0E-01

    DEVICE  4  STATUS : OPEN
```

SECTION 1.2

A CURRENT HOSC ACTIVITY UNDER HEAVY LOADING

```
**********************************************************
          ******************************************

                    NETWORK DESCRIPTION
                      ADAPTER #  1

          ******************************************
**********************************************************


ADAPTER # 1:

    PRIORITY DELAY ON TRUNK 1 :  0.0000093 SEC
    FIXED DELAY:  0.0000049SEC
    TOTALDELAY ON TRUNK 1 :  0.0000182SECS
    ADAPTER RETRY COUNT : 64

    DEVICE  1   STATUS: CLOSED--11
                          I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                          LOAD TIME:  0.0000000 SEC
                          NUMBER OF DATA SOURCES:  1
                          111
                            DEVICE NUMBER  111
                            BUFFER SIZE:  1.0E+03 BYTES
                            SOURCE # 1 DATA GENERATION RATE:  20000.00 BYTES
                            TRUNK TRANSMISSION INTERVAL:  0.0500 SEC
                            DATA BLOCK COUNT :  4.8828125000E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:111
RECEIVER ID: 211                  PROBABILITY:  1.0E+00

    DEVICE  2   STATUS: OPEN

    DEVICE  3   STATUS: OPEN

    DEVICE  4   STATUS: OPEN


**********************************************************
          ******************************************

                    NETWORK DESCRIPTION
                      ADAPTER #  2

          ******************************************
**********************************************************


ADAPTER # 2:

    PRIORITY DELAY ON TRUNK 1 :  0.0000093 SEC
```

```
    FIXED DELAY:  0.0000049SEC
    TOTALDELAY ON TRUNK 1 :  0.0000182SECS
    ADAPTER RETRY COUNT : 64

    DEVICE  1   STATUS: CLOSED--21
                              I/O BUS TRANSFER RATE:   500000.00 BYTES/SEC
                              LOAD TIME:    0.0000002 SEC
                              NUMBER OF DATA SOURCES:  1
                              211
                                DEVICE NUMBER  211
                                BUFFER SIZE:  2.0E+03 BYTES
                                SOURCE # 1 DATA GENERATION RATE:  500000.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.0040 SEC
                                DATA BLOCK COUNT :  9.765625000E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:211
RECEIVER ID: 331                  PROBABILITY:  1.0E+00

    DEVICE  2   STATUS: OPEN

    DEVICE  3   STATUS: OPEN

    DEVICE  4   STATUS: OPEN


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                        NETWORK DESCRIPTION
                          ADAPTER # 3

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ADAPTER # 3:

    PRIORITY DELAY ON TRUNK 1 :  0.0000005 SEC
    FIXED DELAY:  0.0000049SEC
    TOTALDELAY ON TRUNK 1 :  0.0000182SECS
    ADAPTER RETRY COUNT : 64

    DEVICE  1   STATUS: CLOSED--31
                              I/O BUS TRANSFER RATE:  3000000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  2
                              311
                                DEVICE NUMBER  311
                                BUFFER SIZE:  1.0E+03 BYTES
                                SOURCE # 1 DATA GENERATION RATE:  1300.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.7692 SEC
                                DATA BLOCK COUNT :  4.882812500E-01
```

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POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:311
RECEIVER ID: 321                    PROBABILITY:  1.0E+00
                                312
                                  DEVICE NUMBER  312
                                  BUFFER SIZE:  1.0E+03 BYTES
                                  SOURCE # 2 DATA GENERATION RATE:   1000.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  1.0000 SEC
                                  DATA BLOCK COUNT :  4.382812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:312
RECEIVER ID: 421                    PROBABILITY:  1.0E+00

    DEVICE  2   STATUS: CLOSED--32
                                I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                LOAD TIME:    0.0000000 SEC
                                NUMBER OF DATA SOURCES:  1
                                321
                                  DEVICE NUMBER  321
                                  BUFFER SIZE:  1.0E+03 BYTES
                                  SOURCE # 1 DATA GENERATION RATE:    100.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  10.0000 SEC
                                  DATA BLOCK COUNT :  4.382812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:321
RECEIVER ID: 111                    PROBABILITY:  1.0E+00

    DEVICE  3   STATUS: CLOSED--33
                                I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                LOAD TIME:    0.0000000 SEC
                                NUMBER OF DATA SOURCES:  1
                                331
                                  DEVICE NUMBER  331
                                  BUFFER SIZE:  1.0E+03 BYTES
                                  SOURCE # 1 DATA GENERATION RATE:    100.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  10.0000 SEC
                                  DATA BLOCK COUNT :  4.382812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:331
RECEIVER ID: 211                    PROBABILITY:  1.0E+00

    DEVICE  4   STATUS: CLOSED--34
                                I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                LOAD TIME:    0.0000000 SEC
                                NUMBER OF DATA SOURCES:  1
                                341
                                  DEVICE NUMBER  341
                                  BUFFER SIZE:  1.0E+03 BYTES
                                  SOURCE # 1 DATA GENERATION RATE:   6250.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.1600 SEC
                                  DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:341
RECEIVER ID: 441                    PROBABILITY:  1.0E+00
```

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NETWORK DESCRIPTION
ADAPTER # 4

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ADAPTER # 4:

   PRIORITY DELAY ON TRUNK 1 :  0.0000057 SEC
   FIXED DELAY:  0.0000049SEC
   TOTALDELAY ON TRUNK 1 :  0.0000182SECS
   ADAPTER RETRY COUNT : 04

   PRIORITY DELAY ON TRUNK 2 :  0.0000005SEC
   FIXED DELAY:  0.0000141SEC
   TOTAL DELAY ON TRUNK 2 :  0.0000435SEC

   DEVICE  1   STATUS: CLOSED--41
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  1
                              411
                                DEVICE NUMBER  411
                                BUFFER SIZE:  5.0E+02 BYTES
                                SOURCE # 1 DATA GENERATION RATE:  2400.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.2083 SEC
                                DATA BLOCK COUNT :  2.4414062500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:411
RECEIVER ID: 511                  PROBABILITY:  1.0E+00

   DEVICE  2   STATUS: CLOSED--42
                              I/O BUS TRANSFER RATE:  300000.00 BYTES/SEC
                              LOAD TIME:    0.0000004 SEC
                              NUMBER OF DATA SOURCES:  1
                              421
                                DEVICE NUMBER  421
                                BUFFER SIZE:  5.0E+02 BYTES
                                SOURCE # 1 DATA GENERATION RATE:  1200.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4167 SEC
                                DATA BLOCK COUNT :  2.4414062500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:421
RECEIVER ID: 441                  PROBABILITY:  2.0E-01
RECEIVER ID: 511                  PROBABILITY:  3.0E-01
RECEIVER ID: 521                  PROBABILITY:  3.0E-01
RECEIVER ID: 411                  PROBABILITY:  2.0E-01

   DEVICE  3   STATUS: CLOSED--43
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  1
                              431
```

```
                              DEVICE NUMBER  431
                              BUFFER SIZE:  5.0E+02 BYTES
                              SOURCE # 1 DATA GENERATION RATE:   1200.00 BYTES
                              TRUNK TRANSMISSION INTERVAL:  0.4167 SEC
                              DATA BLOCK COUNT :  2.441406250E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:431
RECEIVER ID: 522                PROBABILITY:  1.0E+00

    DEVICE  4   STATUS: CLOSED--44
                            I/O BUS TRANSFER RATE:   300000.00 BYTES/SEC
                            LOAD TIME:    0.0000004 SEC
                            NUMBER OF DATA SOURCES:  2
                            441
                              DEVICE NUMBER  441
                              BUFFER SIZE:  1.0E+03 BYTES
                              SOURCE # 1 DATA GENERATION RATE:  100000.00 BYTES
                              TRUNK TRANSMISSION INTERVAL:  0.0100 SEC
                              DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:441
RECEIVER ID: 421                PROBABILITY:  1.0E+00
                            442
                              DEVICE NUMBER  442
                              BUFFER SIZE:  5.0E+02 BYTES
                              SOURCE # 2 DATA GENERATION RATE:   1200.00 BYTES
                              TRUNK TRANSMISSION INTERVAL:  0.4167 SEC
                              DATA BLOCK COUNT :  2.441406250E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:442
RECEIVER ID: 411                PROBABILITY:  1.0E+00
```

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                        NETWORK DESCRIPTION
                          ADAPTER #   5

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ADAPTER #  5:

    PRIORITY DELAY ON TRUNK 2 :  0.000001 SECS
    FIXED DELAY ON TRUNK 2:  0.000014 SECS
    TOTAL DELAY ON TRUNK 2:  0.000043 SECS
    ADAPTER RETRY COUNT :  44

    DEVICE  1  STATUS : CLOSED--31
                            I/O BUS TRANSFER RATE:   300000.00 BYTES/SEC
                            LOAD TIME:    0.0000004 SEC
                            NUMBER OF DATA SOURCES:  1
```

```
                                511
                                  DEVICE NUMBER  511
                                  BUFFER SIZE:  5.0E+02BYTES
                                  SOURCE # 1DATA GENERATION RATE:  1200.00BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.4167SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 511
RECEIVER ID: 521                    PROBABILITY:  3.0E-01
RECEIVER ID: 441                    PROBABILITY:  4.0E-01
RECEIVER ID: 421                    PROBABILITY:  3.0E-01

    DEVICE  2  STATUS : CLOSED--52
                                I/O BUS TRANSFER RATE:  300000.00 BYTES/SEC
                                LOAD TIME:  0.0000004 SEC
                                NUMBER OF DATA SOURCES:  2
                                521
                                  DEVICE NUMBER  521
                                  BUFFER SIZE:  5.0E+02BYTES
                                  SOURCE # 1DATA GENERATION RATE:  1200.00BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.4167SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 521
RECEIVER ID: 511                    PROBABILITY:  3.0E-01
RECEIVER ID: 441                    PROBABILITY:  4.0E-01
RECEIVER ID: 442                    PROBABILITY:  3.0E-01
                                522
                                  DEVICE NUMBER  522
                                  BUFFER SIZE:  5.0E+02BYTES
                                  SOURCE # 2DATA GENERATION RATE:  1250.00BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.4000SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 522
RECEIVER ID: 431                    PROBABILITY:  1.0E+00

    DEVICE  3  STATUS : OPEN

    DEVICE  4  STATUS : OPEN

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                        NETWORK DESCRIPTION
                          ADAPTER #  5

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ADAPTER #  5:

    PRIORITY DELAY ON TRUNK 2 :  0.0000167SECS
    FIXED DELAY ON TRUNK 2:  0.0000141SECS
    TOTAL DELAY ON TRUNK 2:  0.0000435SECS
    ADAPTER RETRY COUNT :  64

    DEVICE  1  STATUS : CLOSED--51
                                I/O BUS TRANSFER RATE:  300000.00 BYTES/SEC
                                LOAD TIME:  0.0000004 SEC
```

```
                              NUMBER OF DATA SOURCES:  1
                              611
                                DEVICE NUMBER  611
                                BUFFER SIZE:  5.0E+02BYTES
                                SOURCE # 1DATA GENERATION RATE:   1250.00BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4000SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 611
RECEIVER ID: 421                  PROBABILITY:  5.0E-01
RECEIVER ID: 442                  PROBABILITY:  5.0E-01

    DEVICE  3  STATUS : OPEN

    DEVICE  2  STATUS : OPEN

    DEVICE  4  STATUS : OPEN
```

SECTION 1.3

A RERUN OF FIGURE 2.3 RECONFIGURED

*** END OF RUN NETWORK STATISTICS ***

CURRENT TIME : 10.0000 SECS

SUCCESSFUL SEQUENCE TRANSMISSIONS	:	3505
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 1	:	3325
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 2	:	180
COLLISIONS (FRAMES)	:	192
WAITS (FRAMES)	:	2.6E+03
TOTAL ATTEMPTS (SEQUENCES)	:	3510
TOTAL ABORTS	:	4
ATTEMPTED TRUNK-TRUNK TRANSMISSIONS	:	551
SUCCESSFUL TRUNK-TRUNK TRANSMISSIONS	:	39
TRUNK 1 ACTIVE TIME	:	1.6803061 SECS
TRUNK 2 ACTIVE TIME	:	0.0803471 SECS
TOTAL TRUNK ACTIVE TIME	:	1.7611532 SECS
% TRUNK 1 ACTIVE TIME	:	16.803 %
% TRUNK 2 ACTIVE TIME	:	0.808 %
% TOTAL ACTIVE TIME	:	17.612 %

CONTROL BYTES TRANSMITTED - TRUNK 1	:	4.75957E+00 MBYTES
DATA BYTES TRANSMITTED - TRUNK 1	:	5.59280E+00 MBYTES
CONTROL BYTES TRANSMITTED - TRUNK 2	:	3.77078E-01 MBYTES
DATA BYTES TRANSMITTED - TRUNK 2	:	1.06020E-01 MBYTES
TOTAL BYTES TRANSMITTED	:	1.08355E+01 MBYTES
TOTAL OFFERED LOAD	:	6.39600E+00 MBYTES

DEVICE ACTIVITY SUMMARIES
(PROCESSOR)

DEV	SOURCE	ACTIVE	TIME	TIME WAITING	TIME IN COLLISIONS	AVG MESSAGE DELAY	ABORT COUNT	COUNT
1	1		0.0799	0.0000	1.5E-05	7.5E-04	0	197
1	1				4.5E-05	8.4E-04	0	2078
1	1		0.0115	0.0115		6.5E-04	0	9
1	1		1.1943		7.9E-07		0	0
1	1			0.0004		6.6E-04		0
1	1		0.3979		7.9E-07		0	0
1	1			0.0000		0.0E+00		0
2	1		0.0033		0.0E+00		0	0
2	1			0.0000		0.0E+00		61
3	1	2	0.0054		0.0E+00		1	0
3	2	1		0.0000		9.7E-04		47
3	2	1	1.1629		1.5E-06		0	0
3	3	1		0.0065		9.5E-04		23
3	3	1	0.0342		5.5E-07		0	0
3	4	1		0.0246		7.2E-04		23
3	4	1	0.0135		2.6E-08		0	0
4	1	1		0.0003		2.0E-03		922
4	1	1	0.0171		1.5E-06		0	0
4	2	1		0.0216		8.1E-04		43
4	3	1	0.0289		7.5E-03		0	0
4	3	1		0.0548		6.8E-04		23
4	4	1	0.4017		1.1E-06		0	0
4	4	1		0.0022		3.2E-04		0
4	4		0.0323		2.5E-03			
4	4			0.0000				
4	4	2	0.0245					
4	5	1						
4	5	1						
5	1							
5	2	1		0.0022		1.1E-03		1
5	2	1	0.0113					
5	2			0.0000		0.0E+00		2
5	2	1		0.0023		7.3E-04		0
5	2	1	0.0269					
5	2	2		0.0000		3.1E-03		
5	2	2				7.2E-04		
5	2	2				6.5E-05		

DEV	SOURCE	ACTIVE	TIME	TIME WAITING	TIME IN COLLISIONS	AVG MESSAGE DELAY	ABORT COUNT	COUNT
1	1		0.0799	0.0000	1.5E-05	7.5E-04	0	197
1	1				4.5E-05	8.4E-04	0	2078
1	1		0.0115	0.0115		6.5E-04	0	9
1	1		1.1943		7.9E-07		0	0
1	1			0.0004		6.6E-04		0
1	1		0.3979		7.9E-07		0	0
1	1			0.0000		0.0E+00		0
2	1		0.0033		0.0E+00		0	0
2	1			0.0000		0.0E+00		61
3	1	2	0.0054		0.0E+00		1	0
3	2	1		0.0000		9.7E-04		47
3	2	1	1.1629		1.5E-06		0	0
3	3	1		0.0065		9.5E-04		23
3	3	1	0.0342		5.5E-07		0	0
3	4	1		0.0246		7.2E-04		23
3	4	1	0.0135		2.6E-08		0	0
4	1	1		0.0003		2.0E-03		922
4	1	1	0.0171		1.5E-06		0	0
4	2	1		0.0216		8.1E-04		43
4	3	1	0.0289		7.5E-03		0	0
4	3	1		0.0548		6.8E-04		23
4	4	1	0.4017		1.1E-06		0	0
4	4	1		0.0022		3.2E-04		0
4	4		0.0323		2.5E-03			
4	4			0.0000				
4	4	2	0.0245					
4	5	1						
4	5	1						
5	1							
5	2	1		0.0022		1.1E-03		1
5	2	1	0.0113					
5	2			0.0000		0.0E+00		2
5	2	1		0.0023		7.3E-04		0
5	2	1	0.0269					
5	2	2		0.0000		3.1E-03		
5	2	2				7.2E-04		
5	2	2				6.5E-05		

*** END OF RUN NETWORK STATISTICS ***

CURRENT TIME : 1.0000 SECS

SUCCESSFUL SEQUENCE TRANSMISSIONS	:	343
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 1	:	329
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 2	:	14
COLLISIONS (FRAMES)	:	14
WAITS (FRAMES)	:	9.3E+02
TOTAL ATTEMPTS (SEQUENCES)	:	346
TOTAL ABORTS	:	2
ATTEMPTED TRUNK-TRUNK TRANSMISSIONS	:	461
SUCCESSFUL TRUNK-TRUNK TRANSMISSIONS	:	2
TRUNK 1 ACTIVE TIME	:	0.1654959 SECS
TRUNK 2 ACTIVE TIME	:	0.0119461 SECS
TOTAL TRUNK ACTIVE TIME	:	0.1774421 SECS
% TRUNK 1 ACTIVE TIME	:	16.550 %
% TRUNK 2 ACTIVE TIME	:	1.195 %
% TOTAL ACTIVE TIME	:	17.744 %

CONTROL BYTES TRANSMITTED - TRUNK 1	:	4.63630E-01 MBYTES
DATA BYTES TRANSMITTED - TRUNK 1	:	5.50036E-01 MBYTES
CONTROL BYTES TRANSMITTED - TRUNK 2	:	6.35253E-02 MBYTES
DATA BYTES TRANSMITTED - TRUNK 2	:	7.89500E-03 MBYTES
TOTAL BYTES TRANSMITTED	:	1.09111E+00 MBYTES
TOTAL OFFERED LOAD	:	6.39600E-01 MBYTES

DEVICE ACTIVITY SUMMARIES
(SECONDS)

ADP #	DEV #	SOURCE	TIME ACTIVE	TIME WAITING	TIME IN COLLISIONS	AVG MESSAGE DELAY	ABORT COUNT	TRANSMISSION CODE	TRANSMISSION RECEPTION	WAIT	COLLISION

ADP #	DEV #	SOURCE #	TIME ACTIVE (SECONDS)	TIME WAITING (SECONDS)	TIME IN COLLISIONS (SECONDS)	AVG MESSAGE DELAY (SECONDS)	ABORT COUNT	TRANSMISSION COUNT	RECEPTION COUNT	WAIT COUNT	COLLISION COUNT
111	1	1	0.0073	0.0000	1.6E-06	8.1E-04	0	19	0	0	2
211	2	1	0.1190	0.0003	5.3E-06	8.3E-04	0	208	20	7	9
311	3	1	0.0377	0.0002	0.0E+00	6.5E-04	0	1	91	2	0
312	3	2	0.0000	0.0000	0.0E+00	0.0E+00	0	0	0	0	0
321	3	1	0.0007	0.0000	0.0E+00	0.0E+00	0	0	2	0	0
331	3	3	0.1162	0.0000	0.0E+00	0.0E+00	0	0	208	0	0
341	3	4	0.0025	0.0013	0.0E+00	6.8E-04	0	6	1	28	0
411	4	1	0.0012	0.0021	2.6E-08	4.3E-03	0	4	0	42	1
421	4	2	0.0019	0.0000	2.6E-08	9.8E-04	0	2	2	0	1
431	4	3	0.0018	0.0198	0.0E+00	6.4E-04	0	2	1	399	0
441	4	4	0.0336	0.0164	2.8E-05	7.9E-04	0	91	8	322	10
442	4	4	0.0074	0.0013	0.0E+00	6.5E-04	0	4	2	27	0
511	5	1	0.0023	0.0000	2.6E-08	1.6E-03	0	2	4	0	1
521	5	2	0.0059	0.0022	0.0E+00	1.5E-02	1	1	0	42	0
522	5	2	0.0019	0.0023	2.5E-03	1.7E-02	1	1	2	61	1
6	1	1	0.0019	0.0000	2.4E-03	1.6E-03					

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                NETWORK DESCRIPTION
                  ADAPTER #  1

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ADAPTER # 1:

   PRIORITY DELAY ON TRUNK 1 :  0.0000077 SEC
   FIXED DELAY:  0.0000049SEC
   TOTALDELAY ON TRUNK 1 : 0.0000166SECS
   ADAPTER RETRY COUNT : 64

   DEVICE  1   STATUS: CLOSED--11
                        I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                        LOAD TIME:    0.0000000 SEC
                        NUMBER OF DATA SOURCES:  1
                        111
                          DEVICE NUMBER  111
                          BUFFER SIZE:  1.0E+03 BYTES
                          SOURCE # 1 DATA GENERATION RATE:  20000.00 BYTES
                          TRUNK TRANSMISSION INTERVAL:  0.0500 SEC
                          DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:111
RECEIVER ID: 211              PROBABILITY:  1.0E+00

   DEVICE  2   STATUS: OPEN

   DEVICE  3   STATUS: OPEN

   DEVICE  4   STATUS: OPEN

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                NETWORK DESCRIPTION
                  ADAPTER #  2

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ADAPTER # 2:

   PRIORITY DELAY ON TRUNK 1 :  0.0000049 SEC
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    FIXED DELAY:  0.0000049SEC
    TOTALDELAY ON TRUNK 1 :  0.00001666SECS
    ADAPTER RETRY COUNT : 64

    DEVICE  1   STATUS: CLOSED--21
                          I/O BUS TRANSFER RATE:   500000.00 BYTES/SEC
                          LOAD TIME:    0.0000002 SEC
                          NUMBER OF DATA SOURCES:  1
                          211
                            DEVICE NUMBER  211
                            BUFFER SIZE:  2.0E+03 BYTES
                            SOURCE # 1 DATA GENERATION RATE:  500000.00 BYTES
                            TRUNK TRANSMISSION INTERVAL:  0.0040 SEC
                            DATA BLOCK COUNT :  9.7656250005-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:211
RECEIVER ID: 331                  PROBABILITY:  1.0E+00

    DEVICE  2   STATUS: OPEN

    DEVICE  3   STATUS: OPEN

    DEVICE  4   STATUS: OPEN



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                        NETWORK DESCRIPTION
                          ADAPTER #  3

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ADAPTER # 3:

    PRIORITY DELAY ON TRUNK 1 :  0.0000005 SEC
    FIXED DELAY:  0.0000049SEC
    TOTALDELAY ON TRUNK 1 :  0.00001666SECS
    ADAPTER RETRY COUNT : 64

    DEVICE  1   STATUS: CLOSED--31
                          I/O BUS TRANSFER RATE:  3500000.00 BYTES/SEC
                          LOAD TIME:    0.0000000 SEC
                          NUMBER OF DATA SOURCES: 42
                          311
                            DEVICE NUMBER  311
                            BUFFER SIZE:  1.0E+03 BYTES
                            SOURCE # 1 DATA GENERATION RATE:   1300.00 BYTES
                            TRUNK TRANSMISSION INTERVAL:  0.7692 SEC
                            DATA BLOCK COUNT :  4.8828125005-01
```

```
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:311
RECEIVER ID: 441                PROBABILITY:  1.0E+00
                              312
                                DEVICE NUMBER  312
                                BUFFER SIZE:  1.0E+03 BYTES
                                SOURCE # 2 DATA GENERATION RATE:  1000.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  1.0000 SEC
                                DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:312
RECEIVER ID: 311                PROBABILITY:  1.0E+00

    DEVICE  2   STATUS: CLOSED--32
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  1
                              321
                                DEVICE NUMBER  321
                                BUFFER SIZE:  1.0E+03 BYTES
                                SOURCE # 1 DATA GENERATION RATE:  100.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  10.0000 SEC
                                DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:321
RECEIVER ID: 111                PROBABILITY:  1.0E+00

    DEVICE  3   STATUS: CLOSED--33
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  1
                              331
                                DEVICE NUMBER  331
                                BUFFER SIZE:  1.0E+03 BYTES
                                SOURCE # 1 DATA GENERATION RATE:  100.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  10.0000 SEC
                                DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:331
RECEIVER ID: 211                PROBABILITY:  1.0E+00

    DEVICE  4   STATUS: CLOSED--34
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  1
                              341
                                DEVICE NUMBER  341
                                BUFFER SIZE:  1.0E+03 BYTES
                                SOURCE # 1 DATA GENERATION RATE:  6250.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.1600 SEC
                                DATA BLOCK COUNT :  3.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:341
RECEIVER ID: 441                PROBABILITY:  1.0E+00
```

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NETWORK DESCRIPTION
ADAPTER # 4

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ADAPTER # 4:

PRIORITY DELAY ON TRUNK 1 : 0.0000025 SEC
FIXED DELAY: 0.0000049SEC
TOTALDELAY ON TRUNK 1 : 0.0000166SECS
ADAPTER RETRY COUNT : 64

PRIORITY DELAY ON TRUNK 2 : 0.0000005SEC
FIXED DELAY: 0.0000141SEC
TOTAL DELAY ON TRUNK 2 : 0.0000435SEC

DEVICE 1 STATUS: CLOSED--41
I/O BUS TRANSFER RATE: 3300000.00 BYTES/SEC
LOAD TIME: 0.0000000 SEC
NUMBER OF DATA SOURCES: 1
411
DEVICE NUMBER 411
BUFFER SIZE: 5.0E+02 BYTES
SOURCE # 1 DATA GENERATION RATE: 2400.00 BYTES
TRUNK TRANSMISSION INTERVAL: 0.2083 SEC
DATA BLOCK COUNT : 2.441406250E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:411
RECEIVER ID: 511 PROBABILITY: 1.0E+00

DEVICE 2 STATUS: CLOSED--42
I/O BUS TRANSFER RATE: 300000.00 BYTES/SEC
LOAD TIME: 0.0000004 SEC
NUMBER OF DATA SOURCES: 1
421
DEVICE NUMBER 421
BUFFER SIZE: 5.0E+02 BYTES
SOURCE # 1 DATA GENERATION RATE: 1200.00 BYTES
TRUNK TRANSMISSION INTERVAL: 0.4167 SEC
DATA BLOCK COUNT : 2.441406250E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:421
RECEIVER ID: 521 PROBABILITY: 2.0E-01
RECEIVER ID: 511 PROBABILITY: 3.0E-01
RECEIVER ID: 521 PROBABILITY: 3.0E-01
RECEIVER ID: 411 PROBABILITY: 2.0E-01

DEVICE 3 STATUS: CLOSED--43
I/O BUS TRANSFER RATE: 3300000.00 BYTES/SEC
LOAD TIME: 0.0000000 SEC
NUMBER OF DATA SOURCES: 1
421

```
                    DEVICE NUMBER  431
                    BUFFER SIZE:  5.0E+02 BYTES
                    SOURCE # 1 DATA GENERATION RATE:  1200.00 BYTES
                    TRUNK TRANSMISSION INTERVAL:  0.4167 SEC
                    DATA BLOCK COUNT :  2.441406250E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:431
RECEIVER ID: 522                PROBABILITY:  1.0E+00

    DEVICE  4   STATUS: CLOSED--44
                    I/O BUS TRANSFER RATE:  300000.00 BYTES/SEC
                   LOAD TIME:  0.0000004 SEC
                   NUMBER OF DATA SOURCES:  2
                   441
                    DEVICE NUMBER  441
                    BUFFER SIZE:  1.0E+03 BYTES
                    SOURCE # 1 DATA GENERATION RATE:  100000.00 BYTES
                    TRUNK TRANSMISSION INTERVAL:  0.0100 SEC
                    DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:441
RECEIVER ID: 511                PROBABILITY:  1.0E+00
                   442
                    DEVICE NUMBER  442
                    BUFFER SIZE:  5.0E+02 BYTES
                    SOURCE # 2 DATA GENERATION RATE:  1200.00 BYTES
                    TRUNK TRANSMISSION INTERVAL:  0.4167 SEC
                    DATA BLOCK COUNT :  2.441406250E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:442
RECEIVER ID: 611                PROBABILITY:  1.0E+00
```

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                        NETWORK DESCRIPTION
                          ADAPTER #   5

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ADAPTER #  5:

    PRIORITY DELAY ON TRUNK 2 :  0.000002185ECS
    FIXED DELAY ON TRUNK 2:  0.000014166CS
    TOTAL DELAY ON TRUNK 2:  0.000043555ECS
    ADAPTER RETRY COUNT :  44

    DEVICE  1  STATUS : CLOSED--51
                    I/O BUS TRANSFER RATE:  300000.00 BYTES/SEC
                    LOAD TIME:  0.0000004 SEC
                    NUMBER OF DATA SOURCES:  1
```

```
                                511
                                  DEVICE NUMBER  511
                                  BUFFER SIZE:  5.0E+02BYTES
                                  SOURCE # 1DATA GENERATION RATE:  1200.00BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.4167SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 511
RECEIVER ID: 211                    PROBABILITY:  3.0E-01
RECEIVER ID: 441                    PROBABILITY:  4.0E-01
RECEIVER ID: 421                    PROBABILITY:  3.0E-01

    DEVICE  2  STATUS : CLOSED--52
                                I/O BUS TRANSFER RATE:  300000.00 BYTES/SEC
                                LOAD TIME:  0.0000004 SEC
                                NUMBER OF DATA SOURCES:  2
                                521
                                  DEVICE NUMBER  521
                                  BUFFER SIZE:  5.0E+02BYTES
                                  SOURCE # 1DATA GENERATION RATE:  1200.00BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.4167SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 521
RECEIVER ID: 341                    PROBABILITY:  3.0E-01
RECEIVER ID: 441                    PROBABILITY:  4.0E-01
RECEIVER ID: 442                    PROBABILITY:  3.0E-01
                                522
                                  DEVICE NUMBER  522
                                  BUFFER SIZE:  5.0E+02BYTES
                                  SOURCE # 2DATA GENERATION RATE:  1200.00BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.4167SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 522
RECEIVER ID: 431                    PROBABILITY:  1.0E+00

    DEVICE  3  STATUS : OPEN

    DEVICE  4  STATUS : OPEN

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                        NETWORK DESCRIPTION
                          ADAPTER #  5

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ADAPTER #  5:

    PRIORITY DELAY ON TRUNK 2 :  0.0000157SECS
    FIXED DELAY ON TRUNK 2:  0.0000141SECS
    TOTAL DELAY ON TRUNK 2:  0.0000435SECS
    ADAPTER RETRY COUNT :  44

    DEVICE  1  STATUS : CLOSED--51
                                I/O BUS TRANSFER RATE:  1200.00 BYTES/SEC
                                LOAD TIME:  0.0001000 SEC
```

NUMBER OF DATA SOURCES: 1
611
DEVICE NUMBER 611
BUFFER SIZE: 5.0E+02BYTES
SOURCE # 1DATA GENERATION RATE: 1250.00BYTES
TRUNK TRANSMISSION INTERVAL: 0.4000SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 611
RECEIVER ID: 421 PROBABILITY: 5.0E-01
RECEIVER ID: 442 PROBABILITY: 5.0E-01

DEVICE 2 STATUS : OPEN

DEVICE 3 STATUS : OPEN

DEVICE 4 STATUS : OPEN

*** END OF RUN NETWORK STATISTICS ***

SECTION 1.4

ANTICIPATED HOSC/CREY CONFIGURATION

UNDER EXTREME LOADING

DEVICE 4 STATUS : OPEN

*** END OF RUN NETWORK STATISTICS ***

CURRENT TIME : 5.0000 SECS

SUCCESSFUL SEQUENCE TRANSMISSIONS	:	2494
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 1	:	2412
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 2	:	82
COLLISIONS (FRAMES)	:	2591
WAITS (FRAMES)	:	1.8E+04
TOTAL ATTEMPTS (SEQUENCES)	:	2736
TOTAL ABORTS	:	238
ATTEMPTED TRUNK-TRUNK TRANSMISSIONS	:	2024
SUCCESSFUL TRUNK-TRUNK TRANSMISSIONS	:	15
TRUNK 1 ACTIVE TIME	:	2.8190647 SECS
TRUNK 2 ACTIVE TIME	:	0.1112463 SECS
TOTAL TRUNK ACTIVE TIME	:	2.9303110 SECS
% TRUNK 1 ACTIVE TIME	:	56.381 %
% TRUNK 2 ACTIVE TIME	:	2.225 %
% TOTAL ACTIVE TIME	:	58.606 %
CONTROL BYTES TRANSMITTED - TRUNK 1	:	1.43685E+01 MBYTES
DATA BYTES TRANSMITTED - TRUNK 1	:	2.92337E+00 MBYTES
CONTROL BYTES TRANSMITTED - TRUNK 2	:	5.74847E-01 MBYTES
DATA BYTES TRANSMITTED - TRUNK 2	:	4.77480E-02 MBYTES
TOTAL BYTES TRANSMITTED	:	1.79144E+01 MBYTES
TOTAL OFFERED LOAD	:	9.79176E+00 MBYTES

DEVICE ACTIVITY SUMMARIES

(SECONDS)

ADP #	DEV #	SOURCE #	TIME ACTIVE	TIME WAITING	TIME IN COLLISIONS	AVG MESSAGE DELAY	ABORT COUNT	TRANSMISSION COUNT	RECEPTION COUNT	WAIT COUNT	COLLISION COUNT
111 1	1	1	0.0526	0.0000	2.4E-04	1.0E-02	0	83	0	0	171
211 2	1	1	0.6264	0.0016	1.3E-04	9.1E-03	50	365	87	33	173
311 3	1	1	1.3934	0.1027	7.7E-05	2.0E-03	78	1747	0	2078	170
312 3	1	2	0.0028	0.0000	2.6E-07	4.4E-03	1	3	0	0	1
321 3	2	1	0.0076	0.0000	0.0E+00	0.0E+00	0	0	4	0	0
331 3	3	1	0.0498	0.0861	4.5E-06	4.3E-03	2	27	8	1752	13
411 4	1	1	1.2493	0.0000	0.0E+00	0.0E+00	0	0	536	0	0
421 4	2	1	0.1092	0.0026	6.5E-06	0.0E+00	17	0	0	52	19
511 5	1	1	0.0063	0.2412	4.2E-05	6.4E-04	0	22	0	4757	8
521 5	2	1	0.0363	0.1020	2.4E-04	3.7E-03	1	10	10	3285	33
531 5	3	1	0.0350	0.1224	5.1E-04	3.4E-03	0	11	9	2466	35
541 5	4	1	2.0597	0.0948	7.7E-03	1.4E-02	76	171	1776	1905	1092
542 5	4	2	0.0603	0.0306	5.4E-03	1.5E-02	6	17	20	600	729
611 6	1	1	0.0277	0.0154	1.6E-03	7.6E-03	1	10	28	309	201
621 6	2	1	0.0161	0.0000	2.5E-04	5.2E-03	2	9	0	0	33
622 6	2	2	0.0351	0.0380	1.9E-03	1.5E-02	3	9	11	778	246
711 7	1	1	0.0313	0.0000	1.4E-02	2.1E-02	1	10	5	0	1791

DEVICE 4 STATUS : OPEN

*** END OF RUN NETWORK STATISTICS ***

CURRENT TIME : 1.0000 SECS

SUCCESSFUL SEQUENCE TRANSMISSIONS	:	531
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 1	:	518
SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 2	:	13
COLLISIONS (FRAMES)	:	549
WAITS (FRAMES)	:	5.7E+03
TOTAL ATTEMPTS (SEQUENCES)	:	581
TOTAL ABORTS	:	44
ATTEMPTED TRUNK-TRUNK TRANSMISSIONS	:	974
SUCCESSFUL TRUNK-TRUNK TRANSMISSIONS	:	1
TRUNK 1 ACTIVE TIME	:	0.5513506 SECS
TRUNK 2 ACTIVE TIME	:	0.0308024 SECS
TOTAL TRUNK ACTIVE TIME	:	0.5821530 SECS
% TRUNK 1 ACTIVE TIME	:	55.135 %
% TRUNK 2 ACTIVE TIME	:	3.080 %
% TOTAL ACTIVE TIME	:	58.215 %
CONTROL BYTES TRANSMITTED - TRUNK 1	:	2.75305E+00 MBYTES
DATA BYTES TRANSMITTED - TRUNK 1	:	6.30152E-01 MBYTES
CONTROL BYTES TRANSMITTED - TRUNK 2	:	1.73235E-01 MBYTES
DATA BYTES TRANSMITTED - TRUNK 2	:	7.33200E-03 MBYTES
TOTAL BYTES TRANSMITTED	:	3.56377E+00 MBYTES
TOTAL OFFERED LOAD	:	1.95835E+00 MBYTES

DEVICE ACTIVITY SUMMARIES

(SECONDS)

ADP #	DEV #	SOURCE #	TIME ACTIVE	TIME WAITING	TIME IN COLLISIONS	AVG MESSAGE DELAY	ABORT COUNT	TRANSMISSION COUNT	RECEPTION COUNT	WAIT COUNT	COLLISION COUNT
1	1	1	0.0104	0.0000	4.8E-05	8.4E-03	0	16	0	0	34
111											
2	1	1	0.1259	0.0000	3.0E-05	7.8E-03	10	80	17	0	46
211											
3	1	1	0.2765	0.0160	2.9E-05	1.8E-03	15	378	0	325	68
311											
3	1	2	0.0000	0.0000	0.0E+00	0.0E+00	0	0	0	0	0
312											
3	2	1	0.0003	0.0000	0.0E+00	0.0E+00	0	0	1	0	0
321											
3	3	1	0.0067	0.0215	5.3E-07	3.7E-03	0	5	0	440	2
331											
4	1	1	0.2473	0.0000	0.0E+00	0.0E+00	0	0	117	0	0
411											
4	2	1	0.0216	0.0002	2.2E-06	0.0E+00	3	0	0	5	7
421											
5	1	1	0.0011	0.0586	4.0E-05	6.8E-04	0	4	0	1160	6
511											
5	2	1	0.0030	0.0546	0.0E+00	6.3E-04	0	2	2	1109	0
521											
5	3	1	0.0117	0.0236	4.9E-04	1.6E-02	0	2	1	480	82
531											
5	4	1	0.4009	0.0537	5.6E-04	1.3E-02	12	37	384	1076	109
541											
5	4	2	0.0151	0.0000	1.4E-04	1.2E-02	1	2	1	0	23
542											
6	1	1	0.0081	0.0154	1.3E-03	3.8E-02	1	1	5	309	158
611											
6	2	1	0.0057	0.0000	0.0E+00	1.6E-02	1	1	0	0	0
621											
6	2	2	0.0117	0.0380	1.0E-03	7.1E-02	1	1	2	778	128
622											
7	1	1	0.0051	0.0000	3.1E-03	3.7E-02	0	2	1	0	386
711											

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                NETWORK DESCRIPTION
                  ADAPTER #  1

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ADAPTER # 1:

    PRICRITY DELAY ON TRUNK 1 :  0.0000077 SEC
    FIXED DELAY:  0.0000049SEC
    TOTALDELAY ON TRUNK 1 :  0.0000204SECS
    ADAPTER RETRY COUNT : 64

    DEVICE  1   STATUS: CLOSED--11
                          I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                          LOAD TIME:    0.0000000 SEC
                          NUMBER OF DATA SOURCES:  1
                          111
                            DEVICE NUMBER  111
                            BUFFER SIZE:  1.0E+03 BYTES
                            SOURCE # 1 DATA GENERATION RATE:  20000.00 BYTES
                            TRUNK TRANSMISSION INTERVAL:  0.0500 SEC
                            DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:111
RECEIVER ID: 211                  PROBABILITY:  1.0E+00

    DEVICE  2   STATUS: OPEN

    DEVICE  3   STATUS: OPEN

    DEVICE  4   STATUS: OPEN

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                NETWORK DESCRIPTION
                  ADAPTER #  2

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ADAPTER # 2:

    PRIORITY DELAY ON TRUNK 1 :  0.0000049 SEC
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    FIXED DELAY:  0.0000049SEC
    TOTALDELAY ON TRUNK 1 :  0.0000204SECS
    ADAPTER RETRY COUNT : 64

    DEVICE  1   STATUS: CLOSED--21
                              I/O BUS TRANSFER RATE:   500000.00 BYTES/SEC
                              LOAD TIME:    0.0000002 SEC
                              NUMBER OF DATA SOURCES:  1
                              211
                                DEVICE NUMBER  211
                                BUFFER SIZE:  2.0E+03 BYTES
                                SOURCE # 1 DATA GENERATION RATE:  500000.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.0040 SEC
                                DATA BLOCK COUNT :  9.765625000E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:211
RECEIVER ID:  411                   PROBABILITY:  1.0E+00

    DEVICE  2   STATUS: OPEN

    DEVICE  3   STATUS: OPEN

    DEVICE  4   STATUS: OPEN



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                      NETWORK DESCRIPTION
                        ADAPTER #  3

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ADAPTER # 3:

    PRIORITY DELAY ON TRUNK 1 :  0.0000005 SEC
    FIXED DELAY:  0.0000049SEC
    TOTALDELAY ON TRUNK 1 :  0.0000204SECS
    ADAPTER RETRY COUNT : 64

    DEVICE  1   STATUS: CLOSED--31
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  2
                              311
                                DEVICE NUMBER  311
                                BUFFER SIZE:  1.0E+03 BYTES
                                SOURCE # 1 DATA GENERATION RATE:  1300000.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.0008 SEC
                                DATA BLOCK COUNT :  4.882812500E-01
```

```
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:311
RECEIVER ID: 541                    PROBABILITY:  1.0E+00
                                312
                                  DEVICE NUMBER  312
                                  BUFFER SIZE:  1.0E+03 BYTES
                                  SOURCE # 2 DATA GENERATION RATE:   1000.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  1.0000 SEC
                                  DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:312
RECEIVER ID: 711                    PROBABILITY:  1.0E+00

    DEVICE  2   STATUS: CLOSED--32
                                I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                LOAD TIME:    0.0000000 SEC
                                NUMBER OF DATA SOURCES:  1
                                321
                                  DEVICE NUMBER  321
                                  BUFFER SIZE:  1.0E+03 BYTES
                                  SOURCE # 1 DATA GENERATION RATE:    100.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  10.0000 SEC
                                  DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:321
RECEIVER ID: 111                    PROBABILITY:  1.0E+00

    DEVICE  3   STATUS: CLOSED--33
                                I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                LOAD TIME:    0.0000000 SEC
                                NUMBER OF DATA SOURCES:  1
                                331
                                  DEVICE NUMBER  331
                                  BUFFER SIZE:  1.0E+03 BYTES
                                  SOURCE # 1 DATA GENERATION RATE:   6250.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.1600 SEC
                                  DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:331
RECEIVER ID: 541                    PROBABILITY:  1.0E+00

    DEVICE  4   STATUS: OPEN



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                      NETWORK DESCRIPTION
                        ADAPTER #  4

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ADAPTER # 4:
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```
    PRIORITY DELAY ON TRUNK 1 :  0.0000115 SEC
    FIXED DELAY:  0.0000049SEC
    TOTALDELAY ON TRUNK 1 :  0.0000204SECS
    ADAPTER RETRY COUNT : 64

    DEVICE  1   STATUS: CLOSED--41
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  1
                              411
                                DEVICE NUMBER  411
                                BUFFER SIZE:  1.0E+03 BYTES
                                SOURCE # 1 DATA GENERATION RATE:    100.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  10.0000 SEC
                                DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:411
RECEIVER ID: 211                  PROBABILITY:  8.0E-01
RECEIVER ID: 521                  PROBABILITY:  2.0E-01

    DEVICE  2   STATUS: CLOSED--42
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  1
                              421
                                DEVICE NUMBER  421
                                BUFFER SIZE:  2.0E+03 BYTES
                                SOURCE # 1 DATA GENERATION RATE:  20000.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.1000 SEC
                                DATA BLOCK COUNT :  9.765625000E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:421
RECEIVER ID: 411                  PROBABILITY:  1.0E+00

    DEVICE  3   STATUS: OPEN

    DEVICE  4   STATUS: OPEN



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                        NETWORK DESCRIPTION
                          ADAPTER #  5

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ADAPTER # 5:

    PRIORITY DELAY ON TRUNK 1 :  0.0000025 SEC
```

```
    FIXED DELAY:  0.0000049SEC
    TOTALDELAY ON TRUNK 1 :  0.0000204SECS
    ADAPTER RETRY COUNT : 64

    PRIORITY DELAY ON TRUNK 2 :  0.0000005SEC
    FIXED DELAY:  0.0000141SEC
    TOTAL DELAY ON TRUNK 2 :  0.0000435SEC

    DEVICE  1   STATUS: CLOSED--51
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  1
                              511
                                DEVICE NUMBER  511
                                BUFFER SIZE:  5.0E+02 BYTES
                                SOURCE # 1 DATA GENERATION RATE:   2400.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.2083 SEC
                                DATA BLOCK COUNT :  2.441406250E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:511
RECEIVER ID: 511                  PROBABILITY:  1.0E+00

    DEVICE  2   STATUS: CLOSED--52
                              I/O BUS TRANSFER RATE:   300000.00 BYTES/SEC
                              LOAD TIME:    0.0000004 SEC
                              NUMBER OF DATA SOURCES:  1
                              521
                                DEVICE NUMBER  521
                                BUFFER SIZE:  5.0E+02 BYTES
                                SOURCE # 1 DATA GENERATION RATE:   1200.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4167 SEC
                                DATA BLOCK COUNT :  2.441406250E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:521
RECEIVER ID: 321                  PROBABILITY:  2.0E-01
RECEIVER ID: 611                  PROBABILITY:  3.0E-01
RECEIVER ID: 621                  PROBABILITY:  3.0E-01
RECEIVER ID: 711                  PROBABILITY:  2.0E-01

    DEVICE  3   STATUS: CLOSED--53
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  1
                              531
                                DEVICE NUMBER  531
                                BUFFER SIZE:  5.0E+02 BYTES
                                SOURCE # 1 DATA GENERATION RATE:   1200.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4167 SEC
                                DATA BLOCK COUNT :  2.441406250E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:531
RECEIVER ID: 622                  PROBABILITY:  1.0E+00

    DEVICE  4   STATUS: CLOSED--54
                              I/O BUS TRANSFER RATE:   300000.00 BYTES/SEC
                              LOAD TIME:    0.0000004 SEC
                              NUMBER OF DATA SOURCES:  2
                              541
```

```
                                DEVICE NUMBER  541
                                BUFFER SIZE:  1.0E+03 BYTES
                                SOURCE # 1 DATA GENERATION RATE:  100000.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.0100 SEC
                                DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:541
RECEIVER ID: 411                  PROBABILITY:  1.0E+00
                              542
                                DEVICE NUMBER  542
                                BUFFER SIZE:  5.0E+02 BYTES
                                SOURCE # 2 DATA GENERATION RATE:  1200.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4167 SEC
                                DATA BLOCK COUNT :  2.441406250E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:542
RECEIVER ID: 711                  PROBABILITY:  1.0E+00
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                        NETWORK DESCRIPTION
                          ADAPTER #   6

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ADAPTER #  6:

    PRIORITY DELAY ON TRUNK 2 :  0.0000021SECS
    FIXED DELAY ON TRUNK 2:  0.0000141SECS
    TOTAL DELAY ON TRUNK 2:  0.0000435SECS
    ADAPTER RETRY COUNT :  64

    DEVICE  1  STATUS : CLOSED--61
                              I/O BUS TRANSFER RATE:  300000.00 BYTES/SEC
                              LOAD TIME:  0.0000004 SEC
                              NUMBER OF DATA SOURCES:  1
                              611
                                DEVICE NUMBER  611
                                BUFFER SIZE:  5.0E+02BYTES
                                SOURCE # 1DATA GENERATION RATE:  1200.00BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4167SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 611
RECEIVER ID: 211                  PROBABILITY:  3.0E-01
RECEIVER ID: 541                  PROBABILITY:  4.0E-01
RECEIVER ID: 521                  PROBABILITY:  3.0E-01

    DEVICE  2  STATUS : CLOSED--62
                              I/O BUS TRANSFER RATE:  300000.00 BYTES/SEC
                              LOAD TIME:  0.0000004 SEC
```

```
                              NUMBER OF DATA SOURCES:  2
                              621
                                DEVICE NUMBER  621
                                BUFFER SIZE:  5.0E+02BYTES
                                SOURCE # 1DATA GENERATION RATE:   1200.00BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4167SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 621
RECEIVER ID: 331.                 PROBABILITY:  3.0E-01
RECEIVER ID: 541                  PROBABILITY:  4.0E-01
RECEIVER ID: 542                  PROBABILITY:  3.0E-01
                              622
                                DEVICE NUMBER  622
                                BUFFER SIZE:  5.0E+02BYTES
                                SOURCE # 2DATA GENERATION RATE:   1250.00BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4000SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 622
RECEIVER ID: 531                  PROBABILITY:  1.0E+00

    DEVICE  3  STATUS : OPEN

    DEVICE  4  STATUS : OPEN

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                          NETWORK DESCRIPTION
                             ADAPTER #  7

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ADAPTER #  7:

    PRIORITY DELAY ON TRUNK 2 :  0.0000157SECS
    FIXED DELAY ON TRUNK 2:  0.0000141SECS
    TOTAL DELAY ON TRUNK 2:  0.0000435SECS
    ADAPTER RETRY COUNT :  64

    DEVICE  1  STATUS : CLOSED--71
                              I/O BUS TRANSFER RATE:   300000.00 BYTES/SEC
                              LOAD TIME:    0.0000004 SEC
                              NUMBER OF DATA SOURCES:  1
                              711
                                DEVICE NUMBER  711
                                BUFFER SIZE:  5.0E+02BYTES
                                SOURCE # 1DATA GENERATION RATE:   1250.00BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4000SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 711
RECEIVER ID: 521                  PROBABILITY:  5.0E-01
RECEIVER ID: 542                  PROBABILITY:  5.0E-01

    DEVICE  2  STATUS : OPEN

    DEVICE  3  STATUS : OPEN
```

SECTION 1.5

A RERUN OF FIGURE 2.4 WITH REDUCED LOADING

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                    NETWORK DESCRIPTION
                      ADAPTER # 1

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ADAPTER # 1:

     PRIORITY DELAY ON TRUNK 1 :  0.0000077 SEC
     FIXED DELAY:  0.0000049SEC
     TOTALDELAY ON TRUNK 1 :  0.0000204SECS
     ADAPTER RETRY COUNT : 64

     DEVICE  1   STATUS: CLOSED--11
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  1
                              111
                                DEVICE NUMBER  111
                                BUFFER SIZE:  1.0E+03 BYTES
                                SOURCE # 1 DATA GENERATION RATE:  20000.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.0500 SEC
                                DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:111
RECEIVER ID: 211                  PROBABILITY:  1.0E+00

     DEVICE  2   STATUS: OPEN

     DEVICE  3   STATUS: OPEN

     DEVICE  4   STATUS: OPEN


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                    NETWORK DESCRIPTION
                      ADAPTER #  2

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ADAPTER # 2:

     PRIORITY DELAY ON TRUNK 1 :  0.0000049 SEC
```

```
     FIXED DELAY:  0.0000049SEC
     TOTALDELAY ON TRUNK 1 :  0.0000204SECS
     ADAPTER RETRY COUNT : 64

     DEVICE  1   STATUS: CLOSED--21
                                 I/O BUS TRANSFER RATE:  500000.00 BYTES/SEC
                                 LOAD TIME:    0.0000002 SEC
                                 NUMBER OF DATA SOURCES:  1
                                 211
                                   DEVICE NUMBER  211
                                   BUFFER SIZE:  2.0E+03 BYTES
                                   SOURCE # 1 DATA GENERATION RATE:  500000.00 BYTES
                                   TRUNK TRANSMISSION INTERVAL:  0.0040 SEC
                                   DATA BLOCK COUNT :  9.765625000E-01
  POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:211
  RECEIVER ID: 411                    PROBABILITY:  1.0E+00

     DEVICE  2   STATUS: OPEN

     DEVICE  3   STATUS: OPEN

     DEVICE  4   STATUS: OPEN



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                              NETWORK DESCRIPTION
                                 ADAPTER #  3

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  ADAPTER # 3:

     PRIORITY DELAY ON TRUNK 1 :  0.0000005 SEC
     FIXED DELAY:  0.0000049SEC
     TOTALDELAY ON TRUNK 1 :  0.0000204SECS
     ADAPTER RETRY COUNT : 64

     DEVICE  1   STATUS: CLOSED--31
                                 I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                 LOAD TIME:    0.0000000 SEC
                                 NUMBER OF DATA SOURCES:  2
                                 311
                                   DEVICE NUMBER  311
                                   BUFFER SIZE:  1.0E+03 BYTES
                                   SOURCE # 1 DATA GENERATION RATE:  1300.00 BYTES
                                   TRUNK TRANSMISSION INTERVAL:  0.7692 SEC
                                   DATA BLOCK COUNT :  4.882812500E-01
```

```
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:311
RECEIVER ID: 541                    PROBABILITY:  1.0E+00
                                  312
                                   DEVICE NUMBER  312
                                   BUFFER SIZE:  1.0E+03 BYTES
                                   SOURCE # 2 DATA GENERATION RATE:   1000.00 BYTES
                                   TRUNK TRANSMISSION INTERVAL:  1.0000 SEC
                                   DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:312
RECEIVER ID: 711                    PROBABILITY:  1.0E+00

   DEVICE  2   STATUS: CLOSED--32
                                  I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                  LOAD TIME:     0.0000000 SEC
                                  NUMBER OF DATA SOURCES:  1
                                  321
                                   DEVICE NUMBER  321
                                   BUFFER SIZE:  1.0E+03 BYTES
                                   SOURCE # 1 DATA GENERATION RATE:    100.00 BYTES
                                   TRUNK TRANSMISSION INTERVAL:  10.0000 SEC
                                   DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:321
RECEIVER ID: 111                    PROBABILITY:  1.0E+00

   DEVICE  3   STATUS: CLOSED--33
                                  I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                  LOAD TIME:     0.0000000 SEC
                                  NUMBER OF DATA SOURCES:  1
                                  331
                                   DEVICE NUMBER  331
                                   BUFFER SIZE:  1.0E+03 BYTES
                                   SOURCE # 1 DATA GENERATION RATE:   6250.00 BYTES
                                   TRUNK TRANSMISSION INTERVAL:  0.1600 SEC
                                   DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:331
RECEIVER ID: 541                    PROBABILITY:  1.0E+00

   DEVICE  4   STATUS: OPEN



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                        NETWORK DESCRIPTION
                          ADAPTER #  4

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ADAPTER # 4:
```

```
    PRIORITY DELAY ON TRUNK 1 :  0.0000115 SEC
    FIXED DELAY:  0.0000049SEC
    TOTALDELAY ON TRUNK 1 :  0.0000204SECS
    ADAPTER RETRY COUNT : 64

    DEVICE  1   STATUS: CLOSED--41
                                I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                LOAD TIME:    0.0000000 SEC
                                NUMBER OF DATA SOURCES:  1
                                411
                                  DEVICE NUMBER  411
                                  BUFFER SIZE:  1.0E+03 BYTES
                                  SOURCE # 1 DATA GENERATION RATE:    100.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  10.0000 SEC
                                  DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:411
RECEIVER ID: 211                    PROBABILITY:  8.0E-01
RECEIVER ID: 521                    PROBABILITY:  2.0E-01

    DEVICE  2   STATUS: CLOSED--42
                                I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                LOAD TIME:    0.0000000 SEC
                                NUMBER OF DATA SOURCES:  1
                                421
                                  DEVICE NUMBER  421
                                  BUFFER SIZE:  2.0E+03 BYTES
                                  SOURCE # 1 DATA GENERATION RATE:  20000.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.1000 SEC
                                  DATA BLOCK COUNT :  9.765625000E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:421
RECEIVER ID: 411                    PROBABILITY:  1.0E+00

    DEVICE  3   STATUS: OPEN

    DEVICE  4   STATUS: OPEN



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                          NETWORK DESCRIPTION
                            ADAPTER #  5

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ADAPTER # 5:

    PRIORITY DELAY ON TRUNK 1 :  0.0000025 SEC
```

```
    FIXED DELAY:  0.0000049SEC
    TOTALDELAY ON TRUNK 1 :  0.0000204SECS
    ADAPTER RETRY COUNT : 64

    PRIORITY DELAY ON TRUNK 2 :  0.0000005SEC
    FIXED DELAY:  0.0000141SEC
    TOTAL DELAY ON TRUNK 2 :  0.0000435SEC

    DEVICE  1   STATUS: CLOSED--51
                                I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                LOAD TIME:    0.0000000 SEC
                                NUMBER OF DATA SOURCES:  1
                                511
                                  DEVICE NUMBER  511
                                  BUFFER SIZE:  5.0E+02 BYTES
                                  SOURCE # 1 DATA GENERATION RATE:   2400.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.2083 SEC
                                  DATA BLOCK COUNT :  2.441406250E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:511
RECEIVER ID: 611                    PROBABILITY:  1.0E+00

    DEVICE  2   STATUS: CLOSED--52
                                I/O BUS TRANSFER RATE:   300000.00 BYTES/SEC
                                LOAD TIME:    0.0000004 SEC
                                NUMBER OF DATA SOURCES:  1
                                521
                                  DEVICE NUMBER  521
                                  BUFFER SIZE:  5.0E+02 BYTES
                                  SOURCE # 1 DATA GENERATION RATE:   1200.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.4167 SEC
                                  DATA BLOCK COUNT :  2.441406250E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:521
RECEIVER ID: 321                    PROBABILITY:  2.0E-01
RECEIVER ID: 611                    PROBABILITY:  3.0E-01
RECEIVER ID: 621                    PROBABILITY:  3.0E-01
RECEIVER ID: 711                    PROBABILITY:  2.0E-01

    DEVICE  3   STATUS: CLOSED--53
                                I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                LOAD TIME:    0.0000000 SEC
                                NUMBER OF DATA SOURCES:  1
                                531
                                  DEVICE NUMBER  531
                                  BUFFER SIZE:  5.0E+02 BYTES
                                  SOURCE # 1 DATA GENERATION RATE:   1200.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.4167 SEC
                                  DATA BLOCK COUNT :  2.441406250E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:531
RECEIVER ID: 622                    PROBABILITY:  1.0E+00

    DEVICE  4   STATUS: CLOSED--54
                                I/O BUS TRANSFER RATE:   300000.00 BYTES/SEC
                                LOAD TIME:    0.0000004 SEC
                                NUMBER OF DATA SOURCES:  2
                                541
```

```
                                DEVICE NUMBER  541
                                BUFFER SIZE:  1.0E+03 BYTES
                                SOURCE # 1 DATA GENERATION RATE:  100000.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.0100 SEC
                                DATA BLOCK COUNT :  4.882812500E-01
 POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:541
 RECEIVER ID: 411                PROBABILITY:  1.0E+00
                                542
                                DEVICE NUMBER  542
                                BUFFER SIZE:  5.0E+02 BYTES
                                SOURCE # 2 DATA GENERATION RATE:  1200.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4167 SEC
                                DATA BLOCK COUNT :  2.441406250E-01
 POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:542
 RECEIVER ID: 711                PROBABILITY:  1.0E+00


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                              NETWORK DESCRIPTION
                                ADAPTER #   6

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 ADAPTER #  6:

     PRIORITY DELAY ON TRUNK 2 :  0.0000021SECS
     FIXED DELAY ON TRUNK 2:  0.0000141SECS
     TOTAL DELAY ON TRUNK 2:  0.0000435SECS
     ADAPTER RETRY COUNT :  64

     DEVICE  1  STATUS : CLOSED--61
                                I/O BUS TRANSFER RATE:  300000.00 BYTES/SEC
                                LOAD TIME:  0.0000004 SEC
                                NUMBER OF DATA SOURCES:  1
                                611
                                  DEVICE NUMBER  611
                                  BUFFER SIZE:  5.0E+02BYTES
                                  SOURCE # 1DATA GENERATION RATE:  1200.00BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.4167SECS
 POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 611
 RECEIVER ID: 211                  PROBABILITY:  3.0E-01
 RECEIVER ID: 541                  PROBABILITY:  4.0E-01
 RECEIVER ID: 521                  PROBABILITY:  3.0E-01

     DEVICE  2  STATUS : CLOSED--62
                                I/O BUS TRANSFER RATE:  300000.00 BYTES/SEC
                                LOAD TIME:  0.0000004 SEC
```

```
                                NUMBER OF DATA SOURCES:  2
                               621
                                DEVICE NUMBER  621
                                BUFFER SIZE:  5.0E+02BYTES
                                SOURCE # 1DATA GENERATION RATE:  1200.00BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4167SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 621
RECEIVER ID: 331                 PROBABILITY:  3.0E-01
RECEIVER ID: 541                 PROBABILITY:  4.0E-01
RECEIVER ID: 542                 PROBABILITY:  3.0E-01
                              622
                                DEVICE NUMBER  622
                                BUFFER SIZE:  5.0E+02BYTES
                                SOURCE # 2DATA GENERATION RATE:  1250.00BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4000SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 622
RECEIVER ID: 531                 PROBABILITY:  1.0E+00

    DEVICE  3  STATUS : OPEN

    DEVICE  4  STATUS : OPEN

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                          NETWORK DESCRIPTION
                            ADAPTER #   7

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ADAPTER #  7:

    PRIORITY DELAY ON TRUNK 2 :  0.0000157SECS
    FIXED DELAY ON TRUNK 2:  0.0000141SECS
    TOTAL DELAY ON TRUNK 2:  0.0000435SECS
    ADAPTER RETRY COUNT :  64

    DEVICE  1  STATUS : CLOSED--71
                              I/O BUS TRANSFER RATE:  300000.00 BYTES/SEC
                              LOAD TIME:  0.0000004 SEC
                              NUMBER OF DATA SOURCES:  1
                              711
                                DEVICE NUMBER  711
                                BUFFER SIZE:  5.0E+02BYTES
                                SOURCE # 1DATA GENERATION RATE:  1250.00BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.4000SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 711
RECEIVER ID: 521                 PROBABILITY:  5.0E-01
RECEIVER ID: 542                 PROBABILITY:  5.0E-01

    DEVICE  2  STATUS : OPEN

    DEVICE  3  STATUS : OPEN
```

SECTION 1.6

SUGGESTED HOSC/CREY CONFIGURATION FOR EXTREME LOADING

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                    NETWORK DESCRIPTION
                      ADAPTER #  1

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ADAPTER # 1:

     PRIORITY DELAY ON TRUNK 1 :  0.0000109 SEC
     FIXED DELAY:  0.0000049SEC
     TOTALDELAY ON TRUNK 1 :  0.0000192SECS
     ADAPTER RETRY COUNT : 64

     DEVICE  1    STATUS: CLOSED--CSD
                          I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                          LOAD TIME:    0.0000000 SEC
                          NUMBER OF DATA SOURCES:  1
                          111
                            DEVICE NUMBER  111
                            BUFFER SIZE:  1.0E+03 BYTES
                            SOURCE # 1 DATA GENERATION RATE:  20000.00 BYTES
                            TRUNK TRANSMISSION INTERVAL:  0.0500 SEC
                            DATA BLOCK COUNT :  4.8828125000E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:111
RECEIVER ID: 211                    PROBABILITY:  1.0E+00

     DEVICE  2    STATUS: OPEN

     DEVICE  3    STATUS: OPEN

     DEVICE  4    STATUS: OPEN




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                    NETWORK DESCRIPTION
                      ADAPTER #  2

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ADAPTER # 2:

     PRIORITY DELAY ON TRUNK 1 :  0.0000049 SEC
```

```
     TOTALDELAY ON TRUNK 1 :  0.000019395ECS
     ADAPTER RETRY COUNT : 64

     DEVICE  1   STATUS: CLOSED--UNIVAC
                              I/O BUS TRANSFER RATE:   500000.00 BYTES/SEC
                              LOAD TIME:    0.0030002 SEC
                              NUMBER OF DATA SOURCES:  1
                              211
                                DEVICE NUMBER  211
                                BUFFER SIZE:  2.0E+03 BYTES
                                SOURCE # 1 DATA GENERATION RATE:  500000.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.0040 SEC
                                DATA BLOCK COUNT :  9.765625000E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:211
RECEIVER ID: 411                  PROBABILITY:  1.0E+00

     DEVICE  2   STATUS: OPEN

     DEVICE  3   STATUS: OPEN

     DEVICE  4   STATUS: OPEN




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                          NETWORK DESCRIPTION
                            ADAPTER #  3

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ADAPTER # 3:

     PRIORITY DELAY ON TRUNK 1 :  0.0000005 SEC
     FIXED DELAY:  0.000004995EC
     TOTALDELAY ON TRUNK 1 :  0.000019395ECS
     ADAPTER RETRY COUNT : 64

     DEVICE  1   STATUS: CLOSED--SHUTTLE SUPPORT
                              I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                              LOAD TIME:    0.0000000 SEC
                              NUMBER OF DATA SOURCES:  2
                              311
                                DEVICE NUMBER  311
                                BUFFER SIZE:  1.0E+03 BYTES
                                SOURCE # 1 DATA GENERATION RATE:   1300.00 BYTES
                                TRUNK TRANSMISSION INTERVAL:  0.7692 SEC
                                DATA BLOCK COUNT :  4.882812500E-01
```

```
                                    PROBABILITY:  1.0E+00
                                312
                                  DEVICE NUMBER  312
                                  BUFFER SIZE:  1.0E+03 BYTES
                                  SOURCE # 2 DATA GENERATION RATE:    1000.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  1.0000 SEC
                                  DATA BLOCK COUNT :  4.6828125000E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:312
RECEIVER ID: 711                    PROBABILITY:  1.0E+00

    DEVICE  2   STATUS: CLOSED--PE1 BACKUP
                                I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                LOAD TIME:    0.0000000 SEC
                                NUMBER OF DATA SOURCES:  1
                                321
                                  DEVICE NUMBER  321
                                  BUFFER SIZE:  1.0E+03 BYTES
                                  SOURCE # 1 DATA GENERATION RATE:     100.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  10.0000 SEC
                                  DATA BLOCK COUNT :  4.6828125000E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:321
RECEIVER ID: 111                    PROBABILITY:  1.0E+00

    DEVICE  3   STATUS: CLOSED--PDCC
                                I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                LOAD TIME:    0.0000000 SEC
                                NUMBER OF DATA SOURCES:  1
                                331
                                  DEVICE NUMBER  331
                                  BUFFER SIZE:  1.0E+03 BYTES
                                  SOURCE # 1 DATA GENERATION RATE:    6250.00 BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.1600 SEC
                                  DATA BLOCK COUNT :  4.6828125000E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:331
RECEIVER ID: 521                    PROBABILITY:  1.0E+00

    DEVICE  4   STATUS: OPEN


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                            NETWORK DESCRIPTION
                               ADAPTER #  4

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ADAPTER # 4:
```

```
      PRIORITY DELAY ON TRUNK 1 :  0.0000023 SEC
      FIXED DELAY:  0.0000049SEC
      TOTALDELAY ON TRUNK 1 :  0.0000192SECS
      ADAPTER RETRY COUNT : 64

      DEVICE  1   STATUS: CLOSED--SSME ANALYSIS
                                 I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                 LOAD TIME:    0.0000000 SEC
                                 NUMBER OF DATA SOURCES:  1
                                 411
                                   DEVICE NUMBER  411
                                   BUFFER SIZE:  1.0E+03 BYTES
                                   SOURCE # 1 DATA GENERATION RATE:    100.00 BYTES
                                   TRUNK TRANSMISSION INTERVAL:  10.0000 SEC
                                   DATA BLOCK COUNT :  4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:411
RECEIVER ID: 211                     PROBABILITY:  5.0E-01
RECEIVER ID: 511                     PROBABILITY:  2.0E-01

      DEVICE  2   STATUS: CLOSED--CRAY OUTSIDE
                                 I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                 LOAD TIME:    0.0000000 SEC
                                 NUMBER OF DATA SOURCES:  1
                                 421
                                   DEVICE NUMBER  421
                                   BUFFER SIZE:  2.0E+03 BYTES
                                   SOURCE # 1 DATA GENERATION RATE:  20000.00 BYTES
                                   TRUNK TRANSMISSION INTERVAL:  0.1000 SEC
                                   DATA BLOCK COUNT :  9.765625000E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:421
RECEIVER ID: 321                     PROBABILITY:  1.0E+00

      DEVICE  3   STATUS: OPEN

      DEVICE  4   STATUS: OPEN



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                        NETWORK DESCRIPTION
                          ADAPTER #  5

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ADAPTER # 5:

      PRIORITY DELAY ON TRUNK 1 :  0.0000073 SEC
```

```
     TOTALDELAY ON TRUNK 1 :  0.0000199SECS
     ADAPTER RETRY COUNT : 64

     PRIORITY DELAY ON TRUNK 2 :  0.0000005SEC
     FIXED DELAY:  0.0000141SEC
     TOTAL DELAY ON TRUNK 2 :  0.0000555SEC

     DEVICE  1   STATUS: CLOSED--SL MISSION
                                 I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                 LOAD TIME:    0.0000000 SEC
                                 NUMBER OF DATA SOURCES:  1
                                 511
                                   DEVICE NUMBER  511
                                   BUFFER SIZE:  5.0E+02 BYTES
                                   SOURCE # 1 DATA GENERATION RATE:   1200.00 BYTES
                                   TRUNK TRANSMISSION INTERVAL:  0.4167 SEC
                                   DATA BLOCK COUNT :  2.4414062500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:511
RECEIVER ID: 321                     PROBABILITY:  2.0E-01
RECEIVER ID: 611                     PROBABILITY:  3.0E-01
RECEIVER ID: 621                     PROBABILITY:  3.0E-01
RECEIVER ID: 711                     PROBABILITY:  2.0E-01

     DEVICE  2   STATUS: CLOSED--MIPS
                                 I/O BUS TRANSFER RATE:   300000.00 BYTES/SEC
                                 LOAD TIME:    0.0000004 SEC
                                 NUMBER OF DATA SOURCES:  2
                                 521
                                   DEVICE NUMBER  521
                                   BUFFER SIZE:  5.0E+02 BYTES
                                   SOURCE # 1 DATA GENERATION RATE:  100000.00 BYTES
                                   TRUNK TRANSMISSION INTERVAL:  0.0050 SEC
                                   DATA BLOCK COUNT :  2.4414062500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:521
RECEIVER ID: 411                     PROBABILITY:  1.0E+00
                                 422
                                   DEVICE NUMBER  522
                                   BUFFER SIZE:  5.0E+02 BYTES
                                   SOURCE # 2 DATA GENERATION RATE:   1200.00 BYTES
                                   TRUNK TRANSMISSION INTERVAL:  0.4167 SEC
                                   DATA BLOCK COUNT :  2.4414062500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:522
RECEIVER ID: 711                     PROBABILITY:  1.0E+00

     DEVICE  3   STATUS: OPEN

     DEVICE  4   STATUS: OPEN
```

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ADAPTER # 5:

PRIORITY DELAY ON TRUNK 2 : 0.0000277SECS
FIXED DELAY ON TRUNK 2: 0.0000141SECS
TOTAL DELAY ON TRUNK 2: 0.0000555SECS
ADAPTER RETRY COUNT : 64

DEVICE 1 STATUS : CLOSED--SSO
I/O BUS TRANSFER RATE: 300000.00 BYTES/SEC
LOAD TIME: 0.0000004 SEC
NUMBER OF DATA SOURCES: 1
611
DEVICE NUMBER 611
BUFFER SIZE: 5.0E+02BYTES
SOURCE # 1DATA GENERATION RATE: 1200.00BYTES
TRUNK TRANSMISSION INTERVAL: 0.4167SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 611
RECEIVER ID: 211 PROBABILITY: 3.0E-01
RECEIVER ID: 521 PROBABILITY: 4.0E-01
RECEIVER ID: 511 PROBABILITY: 3.0E-01

DEVICE 2 STATUS : CLOSED--ST STMBANE
I/O BUS TRANSFER RATE: 300000.00 BYTES/SEC
LOAD TIME: 0.0000004 SEC
NUMBER OF DATA SOURCES: 2
621
DEVICE NUMBER 621
BUFFER SIZE: 5.0E+02BYTES
SOURCE # 1DATA GENERATION RATE: 1200.00BYTES
TRUNK TRANSMISSION INTERVAL: 0.4167SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 621
RECEIVER ID: 331 PROBABILITY: 3.0E-01
RECEIVER ID: 521 PROBABILITY: 4.0E-01
RECEIVER ID: 522 PROBABILITY: 3.0E-01
622
DEVICE NUMBER 622
BUFFER SIZE: 5.0E+02BYTES
SOURCE # 2DATA GENERATION RATE: 1250.00BYTES
TRUNK TRANSMISSION INTERVAL: 0.4000SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 622
RECEIVER ID: 731 PROBABILITY: 1.0E+00

DEVICE 3 STATUS : OPEN

DEVICE 4 STATUS : OPEN

```
**********

NETWORK DESCRIPTION
ADAPTER #  7

**********
**********

ADAPTER #  7:

    PRIORITY DELAY ON TRUNK 2 :  0.0000141SECS
    FIXED DELAY ON TRUNK 2:  0.0000141SECS
    TOTAL DELAY ON TRUNK 2:  0.0000565SECS
    ADAPTER RETRY COUNT :  64

    DEVICE  1  STATUS : CLOSED--111
                                I/O BUS TRANSFER RATE:   300000.00 BYTES/SEC
                                LOAD TIME:    0.0000004 SEC
                                NUMBER OF DATA SOURCES:  1
                                711
                                  DEVICE NUMBER  711
                                  BUFFER SIZE:  5.0E+02BYTES
                                  SOURCE # 1DATA GENERATION RATE:   1250.00BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.4000SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 711
RECEIVER ID: 511                    PROBABILITY:  5.0E-01
RECEIVER ID: 522                    PROBABILITY:  5.0E-01

    DEVICE  2  STATUS : CLOSED--SL SUPPORT
                                I/O BUS TRANSFER RATE:   300000.00 BYTES/SEC
                                LOAD TIME:    0.0000004 SEC
                                NUMBER OF DATA SOURCES:  1
                                721
                                  DEVICE NUMBER  721
                                  BUFFER SIZE:  5.0E+02BYTES
                                  SOURCE # 1DATA GENERATION RATE:   2400.00BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.2083SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 721
RECEIVER ID: 611                    PROBABILITY:  1.0E+00

    DEVICE  3  STATUS : CLOSED--ST SUPPORT
                                I/O BUS TRANSFER RATE:  3300000.00 BYTES/SEC
                                LOAD TIME:    0.0000000 SEC
                                NUMBER OF DATA SOURCES:  1
                                731
                                  DEVICE NUMBER  731
                                  BUFFER SIZE:  5.0E+02BYTES
                                  SOURCE # 1DATA GENERATION RATE:   1200.00BYTES
                                  TRUNK TRANSMISSION INTERVAL:  0.4167SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 731
RECEIVER ID: 622                    PROBABILITY:  1.0E+00

    DEVICE  4  STATUS : OPEN
```