SYSTEM ANALYSIS

For The

Huntsville Operation Support Center
Distributed Computer System

CONTRACT FINAL REPORT

June 1986

Submitted By:

F. M. Ingels, Principal Investigator

Submitted To:

NASA MSFC, Alabama
Technical Monitor: Frank Emmens, EB32

Mississippi State University
Electrical Engineering Department
Mississippi State, MS 39762
(601)325-3912

(603)325-3912

NAS8-34905

https://ntrs.nasa.gov/search.jsp?R=19860022760 2019-06-07T03:00:36+00:00Z
SYSTEM ANALYSIS

For The

Huntsville Operation Support Center
Distributed Computer System

CONTRACT FINAL REPORT

June 1986

Submitted By:

F. M. Ingels, Principal Investigator

Mississippi State University
Electrical Engineering Department
Mississippi State, MS 39762
(601)325-3912

Submitted To:

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

NAS8-34906
<table>
<thead>
<tr>
<th>FIGURE</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>A Typical HOSC Activity Configuration</td>
<td>4</td>
</tr>
<tr>
<td>2.2</td>
<td>A Current HOSC Activity Under Heavy Loading</td>
<td>10</td>
</tr>
<tr>
<td>2.3</td>
<td>A Rerun of Figure 2.2 Reconfigured</td>
<td>14</td>
</tr>
<tr>
<td>2.4</td>
<td>Anticipated HOSC/CREY Configuration</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Under Extreme Loading</td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>A Rerun of Figure 2.4 with Reduced Loading on one Device</td>
<td>25</td>
</tr>
<tr>
<td>2.6</td>
<td>Suggested HOSC/CREY Configuration for Extreme Loading</td>
<td>29</td>
</tr>
<tr>
<td>3.1</td>
<td>Video Terminal Distribution System</td>
<td>34</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>NETWORK STATISTICS FOR FIGURE 2.1</td>
<td>6</td>
</tr>
<tr>
<td>2.2</td>
<td>DEVICE STATISTICS FOR FIGURE 2.1</td>
<td>7</td>
</tr>
<tr>
<td>2.3</td>
<td>NETWORK STATISTICS FOR FIGURE 2.2</td>
<td>11</td>
</tr>
<tr>
<td>2.4</td>
<td>DEVICE STATISTICS FOR FIGURE 2.2</td>
<td>12</td>
</tr>
<tr>
<td>2.5</td>
<td>NETWORK STATISTICS FOR FIGURE 2.3</td>
<td>16</td>
</tr>
<tr>
<td>2.6</td>
<td>DEVICE STATISTICS FOR FIGURE 2.3</td>
<td>17</td>
</tr>
<tr>
<td>2.7</td>
<td>NETWORK STATISTICS FOR FIGURE 2.4</td>
<td>22</td>
</tr>
<tr>
<td>2.8</td>
<td>DEVICE STATISTICS FOR FIGURE 2.4</td>
<td>23</td>
</tr>
<tr>
<td>2.9</td>
<td>NETWORK STATISTICS FOR FIGURE 2.4</td>
<td>26</td>
</tr>
<tr>
<td>2.10</td>
<td>DEVICE STATISTICS FOR FIGURE 2.5</td>
<td>27</td>
</tr>
<tr>
<td>2.11</td>
<td>NETWORK STATISTICS FOR FIGURE 2.6</td>
<td>30</td>
</tr>
<tr>
<td>2.12</td>
<td>DEVICE STATISTICS FOR FIGURE 2.6</td>
<td>31</td>
</tr>
<tr>
<td>3.1</td>
<td>WORST CASE AND STATISTICAL AVERAGE PERFORMANCE ESTIMATES FOR ETHERNET</td>
<td></td>
</tr>
<tr>
<td></td>
<td>INTERCONNECTION OF VIDEO TERMINAL/VAX 11/730</td>
<td>41</td>
</tr>
<tr>
<td>3.2</td>
<td>SIMULATION RESULTS, NO VIDEO CHANGE REQUESTS</td>
<td>51</td>
</tr>
<tr>
<td>3.3</td>
<td>SIMULATION RESULTS WITH VIDEO CHANGE REQUESTS</td>
<td>52</td>
</tr>
<tr>
<td>3.4</td>
<td>COMPARISON OF STATISTICAL AND SIMULATION RESULTS</td>
<td>53</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF FIGURES</td>
<td>i</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>ii</td>
</tr>
<tr>
<td>1.0 INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2.0 HYPERCHANNEL TRAFFIC ANALYSIS</td>
<td>3</td>
</tr>
<tr>
<td>2.1 INTRODUCTION</td>
<td>3</td>
</tr>
<tr>
<td>2.2 A TYPICAL HOSC ACTIVITY CONFIGURATION</td>
<td>3</td>
</tr>
<tr>
<td>2.3 A CURRENT HOSC ACTIVITY UNDER HEAVY LOADING</td>
<td>9</td>
</tr>
<tr>
<td>2.4 A RERUN OF FIGURE 2.2 RECONFIGURED</td>
<td>13</td>
</tr>
<tr>
<td>2.5 ANTICIPATED HOSC/CREY CONFIGURATION UNDER EXTREME LOADING</td>
<td>19</td>
</tr>
<tr>
<td>2.6 A RERUN OF FIGURE 2.4 WITH REDUCED LOADING ON ONE DEVICE</td>
<td>24</td>
</tr>
<tr>
<td>2.7 SUGGESTED HOSC/CREY CONFIGURATION FOR EXTREME LOADING</td>
<td>28</td>
</tr>
<tr>
<td>2.8 CONCLUSIONS</td>
<td>32</td>
</tr>
<tr>
<td>3.0 ANALYSIS OF VIDEO TERMINAL INTERCONNECT NETWORK</td>
<td>33</td>
</tr>
<tr>
<td>3.1 INTRODUCTION</td>
<td>33</td>
</tr>
<tr>
<td>3.1.1 WORST CASE ANALYSIS</td>
<td>37</td>
</tr>
<tr>
<td>3.2 STATISTICAL ANALYSIS</td>
<td>37</td>
</tr>
<tr>
<td>3.3 CONCLUSIONS</td>
<td>42</td>
</tr>
<tr>
<td>3.4 DISCUSSION OF SIMULATION ANALYSIS RESULTS</td>
<td>43</td>
</tr>
<tr>
<td>3.5 SIMULATION ANALYSIS</td>
<td>47</td>
</tr>
<tr>
<td>4.0 REFERENCES</td>
<td>54</td>
</tr>
<tr>
<td>APPENDIX I. BACKUP SIMULATION DATA</td>
<td>55</td>
</tr>
</tbody>
</table>
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 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
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>
<thead>
<tr>
<th>ADP #</th>
<th>DEV #</th>
<th>SOURCE #</th>
<th>TIME ACTIVE</th>
<th>TIME WAITING</th>
<th>TIME IN COLLISIONS</th>
<th>AVG MESSAGE DELAY</th>
<th>ABORT COUNT</th>
<th>TRANSMISSION COUNT</th>
<th>RECEPTION COUNT</th>
<th>WAIT COUNT</th>
<th>COLLISION COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0.1795</td>
<td>0.0008</td>
<td>1.3E-04</td>
<td>6.9E-04</td>
<td>0</td>
<td>197</td>
<td>98</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0.0924</td>
<td>0.0000</td>
<td>1.3E-06</td>
<td>1.3E-03</td>
<td>0</td>
<td>94</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0.1734</td>
<td>0.0000</td>
<td>3.0E+00</td>
<td>7.0E-04</td>
<td>0</td>
<td>201</td>
<td>202</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0.0409</td>
<td>0.0000</td>
<td>1.3E-04</td>
<td>3.5E-03</td>
<td>1</td>
<td>11</td>
<td>54</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1</td>
<td>0.0333</td>
<td>0.0000</td>
<td>4.9E+00</td>
<td>2.3E-03</td>
<td>0</td>
<td>10</td>
<td>25</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
<td>0.0072</td>
<td>0.0000</td>
<td>5.0E+00</td>
<td>5.6E-04</td>
<td>0</td>
<td>24</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>1</td>
<td>0.0861</td>
<td>0.0009</td>
<td>5.9E+00</td>
<td>5.8E-04</td>
<td>0</td>
<td>24</td>
<td>197</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>1</td>
<td>0.0195</td>
<td>0.0000</td>
<td>6.3E-07</td>
<td>6.0E-04</td>
<td>0</td>
<td>59</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>1</td>
<td>0.0066</td>
<td>0.0000</td>
<td>8.3E+00</td>
<td>8.3E-04</td>
<td>0</td>
<td>6</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>1</td>
<td>0.0277</td>
<td>0.0000</td>
<td>5.3E-07</td>
<td>8.5E-04</td>
<td>0</td>
<td>6</td>
<td>4</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>3</td>
<td>1</td>
<td>0.0235</td>
<td>0.0016</td>
<td>1.3E-04</td>
<td>4.4E-03</td>
<td>0</td>
<td>6</td>
<td>7</td>
<td>32</td>
<td>61</td>
</tr>
</tbody>
</table>
### Table 2.2 Device Statistics for Figure 2.1

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Attempts (Sequences)</strong></td>
<td>640</td>
</tr>
<tr>
<td><strong>Total Aports</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Attempted Trunk-Trunk Transmissions</strong></td>
<td>225</td>
</tr>
<tr>
<td><strong>Successful Trunk-Trunk Transmissions</strong></td>
<td>201</td>
</tr>
<tr>
<td><strong>Trunk 1 Active Time</strong></td>
<td>0.1852660 SECS</td>
</tr>
<tr>
<td><strong>Trunk 2 Active Time</strong></td>
<td>0.1694709 SECS</td>
</tr>
<tr>
<td><strong>Total Trunk Active Time</strong></td>
<td>0.3547369 SECS</td>
</tr>
<tr>
<td><strong>% Trunk 1 Active Time</strong></td>
<td>1.848 %</td>
</tr>
<tr>
<td><strong>% Trunk 2 Active Time</strong></td>
<td>1.690 %</td>
</tr>
<tr>
<td><strong>% Total Active Time</strong></td>
<td>3.538 %</td>
</tr>
<tr>
<td><strong>Control Bytes Transmitted - Trunk 1</strong></td>
<td>4.68994E-01 MBYTES</td>
</tr>
<tr>
<td><strong>Data Bytes Transmitted - Trunk 1</strong></td>
<td>6.39584E-01 MBYTES</td>
</tr>
<tr>
<td><strong>Control Bytes Transmitted - Trunk 2</strong></td>
<td>5.52063E-01 MBYTES</td>
</tr>
<tr>
<td><strong>Data Bytes Transmitted - Trunk 2</strong></td>
<td>4.67610E-01 MBYTES</td>
</tr>
<tr>
<td><strong>Total Bytes Transmitted</strong></td>
<td>2.12825E+00 MBYTES</td>
</tr>
<tr>
<td><strong>Total Offered Load</strong></td>
<td>6.22242E-01 MBYTES</td>
</tr>
</tbody>
</table>
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 HSOC ACTIVITY UNDER HEAVY LOADING
### Table 2.3 Network Statistics for Figure 2.3

---

**End of Run Network Statistics***

<table>
<thead>
<tr>
<th>Current Time</th>
<th>5.0000 secs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful Sequence Transmissions</td>
<td>1026</td>
</tr>
<tr>
<td>Successful Sequence Transmissions - Trunk 1</td>
<td>1022</td>
</tr>
<tr>
<td>Successful Sequence Transmissions - Trunk 2</td>
<td>6</td>
</tr>
<tr>
<td>Collisions (Frames)</td>
<td>1499</td>
</tr>
<tr>
<td>Waits (Frames)</td>
<td>4.45E+05</td>
</tr>
<tr>
<td>Total Attempts (SEQUENCES)</td>
<td>1121</td>
</tr>
<tr>
<td>Total Rejects</td>
<td>94</td>
</tr>
<tr>
<td>Attempted Trunk-Trunk Transmissions</td>
<td>0</td>
</tr>
<tr>
<td>Successful Trunk-Trunk Transmissions</td>
<td>0</td>
</tr>
</tbody>
</table>

**Trunk 1 Active Time**

- Total Trunk Active Time: 0.9310461 secs
- Total Trunk Active Time: 1.254635 secs
- % Trunk 1 Active Time: 17.421 %
- % Trunk 2 Active Time: 7.638 %
- % Total Active Time: 26.509 %

**Control Bytes Transmitted - Trunk 1**

- Total Bytes Transmitted: 3.57056E+00 MBYTES

**Data Bytes Transmitted - Trunk 1**

- Total Bytes Transmitted: 3.01141E+00 MBYTES

**Control Bytes Transmitted - Trunk 2**

- Total Bytes Transmitted: 2.20184E+00 MBYTES

**Data Bytes Transmitted - Trunk 2**

- Total Bytes Transmitted: 2.25693E-03 MBYTES

**Total Offered Load**

- Total Bytes Transmitted: 3.19025E+00 MBYTES
<table>
<thead>
<tr>
<th>AUP #</th>
<th>DEV SOURCE</th>
<th>TIME ACTIVE</th>
<th>TIME WAITING</th>
<th>TIME IN COLLISIONS</th>
<th>AVG MESSAGE DELAY</th>
<th>ADOPT COUNT</th>
<th>TRANSMISSION COUNT</th>
<th>RECEPTION COUNT</th>
<th>WAIT COUNT</th>
<th>COLLISION COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 1</td>
<td>0.0797</td>
<td>0.0000</td>
<td>5.2E-05</td>
<td>1.1E-03</td>
<td>0</td>
<td>97</td>
<td>0</td>
<td>0</td>
<td>55</td>
</tr>
<tr>
<td>2</td>
<td>1 1</td>
<td>0.6719</td>
<td>0.0040</td>
<td>1.6E-04</td>
<td>1.4E-03</td>
<td>1</td>
<td>924</td>
<td>97</td>
<td>91</td>
<td>279</td>
</tr>
<tr>
<td>3</td>
<td>1 1</td>
<td>0.0374</td>
<td>0.0002</td>
<td>1.9E-05</td>
<td>0.0E+00</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>98</td>
</tr>
<tr>
<td>3</td>
<td>1 2</td>
<td>0.0253</td>
<td>0.0000</td>
<td>1.2E-05</td>
<td>0.0E+00</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>1 1</td>
<td>0.0374</td>
<td>0.0000</td>
<td>0.2E+00</td>
<td>0.0E+00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>3 1</td>
<td>0.6537</td>
<td>0.0000</td>
<td>0.0E+00</td>
<td>0.0E+00</td>
<td>0</td>
<td>924</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>4 1</td>
<td>0.1726</td>
<td>0.0129</td>
<td>4.8E-05</td>
<td>4.9E-01</td>
<td>27</td>
<td>1</td>
<td>0</td>
<td>255</td>
<td>198</td>
</tr>
<tr>
<td>4</td>
<td>1 1</td>
<td>0.0003</td>
<td>4.5828</td>
<td>0.7E+00</td>
<td>6.3E-04</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>91554</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>2 1</td>
<td>0.2125</td>
<td>4.1334</td>
<td>0.5E+00</td>
<td>0.0E+00</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>91702</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3 1</td>
<td>0.0674</td>
<td>4.1376</td>
<td>1.7E-04</td>
<td>0.0E+00</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>32675</td>
<td>65</td>
</tr>
<tr>
<td>4</td>
<td>4 1</td>
<td>0.2929</td>
<td>4.5655</td>
<td>7.1E-03</td>
<td>0.0E+00</td>
<td>13</td>
<td>0</td>
<td>1</td>
<td>31327</td>
<td>1100</td>
</tr>
<tr>
<td>4</td>
<td>4 2</td>
<td>0.0004</td>
<td>4.1658</td>
<td>0.0E+00</td>
<td>9.3E-04</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>33538</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>1 1</td>
<td>0.1252</td>
<td>0.0000</td>
<td>1.7E-05</td>
<td>0.0E+00</td>
<td>11</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>55</td>
</tr>
<tr>
<td>6</td>
<td>2 1</td>
<td>0.1122</td>
<td>0.0140</td>
<td>7.9E-08</td>
<td>0.0E+00</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>7335</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>2 2</td>
<td>0.3644</td>
<td>0.0000</td>
<td>1.1E-03</td>
<td>2.0E-01</td>
<td>15</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>140</td>
</tr>
<tr>
<td>5</td>
<td>1 1</td>
<td>0.1043</td>
<td>0.0000</td>
<td>9.0E-03</td>
<td>3.4E-01</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1006</td>
</tr>
</tbody>
</table>
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 excellent 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
The diagram represents a network configuration with various adapters and connections. Each adapter is connected to different systems and has specific data transfer rates and block sizes.

Key components of the diagram include:
- **Adapters**: Various adapters labeled 1, 2, 3, 4, 5, 6, 7, and 8, each with different data transfer rates and block sizes.
- **Network Connections**: Connections labeled as 0', 10', 700', and 3010', indicating distances or trunk lines.
- **Data Rates**: Rates such as 0.5 Mbps, 1 Mbps, 1.25 Mbps, and 0.3 Mbps are indicated for different connections and adapters.
- **Block Sizes**: Block sizes ranging from 500 bytes to 1000 bytes per block are specified for different adapters.

The diagram is labeled as a rerun of figure 2.2, indicating it is a reconfigured version of a previous figure. The date of rerun is noted as 22 OCT 85.
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:

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Figure 2.2</th>
<th>Figure 2.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collisions</td>
<td>1499</td>
<td>55</td>
</tr>
<tr>
<td>Aborts</td>
<td>94</td>
<td>2</td>
</tr>
<tr>
<td>%Trunk Active Time</td>
<td>26.5%</td>
<td>17.6%</td>
</tr>
<tr>
<td>(Both Trunks)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL OFFERED LOAD</td>
<td>638 KBps</td>
<td>639 KBps</td>
</tr>
<tr>
<td>Successful Transmissions</td>
<td>1026</td>
<td>1751</td>
</tr>
<tr>
<td>Transmissions Trunk 1</td>
<td>1022</td>
<td>1663</td>
</tr>
<tr>
<td>Transmissions Trunk 2</td>
<td>4</td>
<td>88</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th><strong>End of Run Network Statistics</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Time:</strong> 5.3325 SECS</td>
</tr>
<tr>
<td><strong>Successful Sequence Transmissions</strong> : 1751</td>
</tr>
<tr>
<td><strong>Successful Sequence Transmissions-Trunk 1</strong> : 1563</td>
</tr>
<tr>
<td><strong>Successful Sequence Transmissions-Trunk 2</strong> : 28</td>
</tr>
<tr>
<td><strong>Collisions (Frames):</strong> 55</td>
</tr>
<tr>
<td><strong>Waits (Frames):</strong> 1.2E+03</td>
</tr>
<tr>
<td><strong>Total Attempts (Sequences):</strong> 1754</td>
</tr>
<tr>
<td><strong>Total Attempts:</strong> 2</td>
</tr>
<tr>
<td><strong>Attempted Trunk-Trunk Transmissions:</strong> 492</td>
</tr>
<tr>
<td><strong>Successful Trunk-Trunk Transmissions:</strong> 19</td>
</tr>
</tbody>
</table>

| **Trunk 1 Active Time:** 0.834355 SECS |
| **Trunk 2 Active Time:** 0.0375456 SECS |
| **Total Trunk Active Time:** 0.8718989 SECS |
| **Trunk 1 Active Time:** 15.879 % |
| **Trunk 2 Active Time:** 0.751 % |
| **Total Active Time:** 17.629 % |

<p>| <strong>Control Bytes Transmitted - Trunk 1:</strong> 2.34199E+00 MBYTES |
| <strong>Data Bytes Transmitted - Trunk 1:</strong> 2.79893E+00 MBYTES |
| <strong>Control Bytes Transmitted - Trunk 2:</strong> 1.71519E+01 MBYTES |
| <strong>Data Bytes Transmitted - Trunk 2:</strong> 5.16320E-02 MBYTES |
| <strong>Total Bytes Transmitted:</strong> 5.36407E+00 MBYTES |
| <strong>Total Offered Load:</strong> 3.19960E+00 MBYTES |</p>
<table>
<thead>
<tr>
<th>ALP</th>
<th>DEV</th>
<th>SOURCE</th>
<th>TIME ACTIVE</th>
<th>TIME WAITING</th>
<th>TIME IN COLLISIONS</th>
<th>AVG MESSAGE DELAY</th>
<th>ABORT COUNT</th>
<th>TRANSMISSION COUNT</th>
<th>RECEPTION COUNT</th>
<th>WAIT COUNT</th>
<th>COLLISION COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0.0371</td>
<td>0.0000</td>
<td>4.0E-05</td>
<td>7.4E-04</td>
<td>0</td>
<td>98</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0.5962</td>
<td>0.0077</td>
<td>2.9E-05</td>
<td>8.3E-04</td>
<td>0</td>
<td>1040</td>
<td>104</td>
<td>161</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0.1922</td>
<td>0.0004</td>
<td>7.9E-07</td>
<td>6.5E-04</td>
<td>0</td>
<td>6</td>
<td>463</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0.0020</td>
<td>0.0000</td>
<td>0.0E+09</td>
<td>0.0E+09</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>0.5816</td>
<td>0.0000</td>
<td>0.0E+09</td>
<td>0.0E+09</td>
<td>0</td>
<td>0</td>
<td>1040</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0.0144</td>
<td>0.0033</td>
<td>7.9E-07</td>
<td>6.7E-04</td>
<td>0</td>
<td>31</td>
<td>9</td>
<td>72</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0.0365</td>
<td>0.0028</td>
<td>2.6E-08</td>
<td>1.3E-03</td>
<td>0</td>
<td>23</td>
<td>0</td>
<td>57</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0.0007</td>
<td>0.0004</td>
<td>2.4E-08</td>
<td>7.1E-04</td>
<td>0</td>
<td>11</td>
<td>12</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0.4038</td>
<td>0.0206</td>
<td>0.0E+09</td>
<td>5.3E-04</td>
<td>0</td>
<td>11</td>
<td>10</td>
<td>435</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0.1955</td>
<td>0.0197</td>
<td>4.5E-05</td>
<td>7.9E-04</td>
<td>0</td>
<td>463</td>
<td>43</td>
<td>363</td>
<td>44</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2</td>
<td>0.0190</td>
<td>0.0013</td>
<td>5.3E-07</td>
<td>7.2E-04</td>
<td>0</td>
<td>21</td>
<td>19</td>
<td>27</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>0.0124</td>
<td>0.0000</td>
<td>2.6E-08</td>
<td>3.7E-04</td>
<td>0</td>
<td>11</td>
<td>28</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1</td>
<td>0.0095</td>
<td>0.0022</td>
<td>0.0E+09</td>
<td>2.2E-03</td>
<td>1</td>
<td>10</td>
<td>0</td>
<td>42</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
<td>0.0073</td>
<td>0.0023</td>
<td>2.3E-08</td>
<td>2.4E-03</td>
<td>1</td>
<td>10</td>
<td>11</td>
<td>61</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
<td>0.0076</td>
<td>0.0000</td>
<td>2.4E-05</td>
<td>8.2E-04</td>
<td>0</td>
<td>12</td>
<td>6</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>
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) : 3.66E+04
TOTAL ATTEMPTS (SEQUENCES) : 5424
TOTAL ABORTS : 480
ATTEMPTED TRUNK-TRUNK TRANSMISSIONS : 4404
SUCCESSFUL TRUNK-TRUNK TRANSMISSIONS : 32

TRUNK 1 ACTIVE TIME : 5.6685979 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>
<thead>
<tr>
<th>ADP #</th>
<th>DEV #</th>
<th>SOURCE #</th>
<th>TIME ACTIVE</th>
<th>TIME WAITING</th>
<th>TIME IN COLLISIONS</th>
<th>AVG MESSAGE DELAY</th>
<th>AVOID COUNT</th>
<th>TRANSMISSION COUNT</th>
<th>RECEPTION COUNT</th>
<th>WAIT COUNT</th>
<th>COLLISION COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>1</td>
<td>0.1104</td>
<td>0.0000</td>
<td>5.3E-04</td>
<td>1.1E-02</td>
<td>0</td>
<td>165</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>374</td>
</tr>
<tr>
<td>211</td>
<td>1</td>
<td>1.2541</td>
<td>0.0062</td>
<td>2.7E-04</td>
<td>9.5E-03</td>
<td>100</td>
<td>709</td>
<td>174</td>
<td>136</td>
<td>365</td>
<td></td>
</tr>
<tr>
<td>312</td>
<td>1</td>
<td>0.0072</td>
<td>0.0000</td>
<td>5.3E-07</td>
<td>6.2E-03</td>
<td>3</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>321</td>
<td>2</td>
<td>0.0259</td>
<td>0.0000</td>
<td>0.0E+00</td>
<td>0.0E+00</td>
<td>0</td>
<td>0</td>
<td>14</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>411</td>
<td>3</td>
<td>2.5191</td>
<td>0.0000</td>
<td>0.0E+00</td>
<td>0.0E+00</td>
<td>0</td>
<td>0</td>
<td>1040</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>421</td>
<td>4</td>
<td>0.2170</td>
<td>0.0047</td>
<td>1.5E-05</td>
<td>0.0E+00</td>
<td>34</td>
<td>0</td>
<td>92</td>
<td>37</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>511</td>
<td>5</td>
<td>0.0154</td>
<td>0.4432</td>
<td>5.0E-05</td>
<td>9.4E-04</td>
<td>0</td>
<td>45</td>
<td>0</td>
<td>8807</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>521</td>
<td>5</td>
<td>0.0775</td>
<td>0.3414</td>
<td>2.5E-04</td>
<td>5.7E-03</td>
<td>2</td>
<td>20</td>
<td>23</td>
<td>6887</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>531</td>
<td>5</td>
<td>0.0675</td>
<td>0.2289</td>
<td>5.1E-04</td>
<td>2.0E-03</td>
<td>0</td>
<td>23</td>
<td>19</td>
<td>4605</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>541</td>
<td>5</td>
<td>4.1397</td>
<td>0.2117</td>
<td>1.5E-02</td>
<td>1.5E-02</td>
<td>154</td>
<td>331</td>
<td>3528</td>
<td>4233</td>
<td>2117</td>
<td></td>
</tr>
<tr>
<td>542</td>
<td>5</td>
<td>0.1122</td>
<td>0.0313</td>
<td>5.4E-03</td>
<td>1.0E-02</td>
<td>10</td>
<td>37</td>
<td>40</td>
<td>611</td>
<td>735</td>
<td></td>
</tr>
<tr>
<td>611</td>
<td>6</td>
<td>0.0552</td>
<td>0.0154</td>
<td>1.6E-03</td>
<td>6.4E-03</td>
<td>2</td>
<td>21</td>
<td>51</td>
<td>309</td>
<td>205</td>
<td></td>
</tr>
<tr>
<td>621</td>
<td>6</td>
<td>0.0353</td>
<td>0.0004</td>
<td>2.5E-04</td>
<td>5.2E-03</td>
<td>3</td>
<td>20</td>
<td>0</td>
<td>6</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>622</td>
<td>6</td>
<td>0.0675</td>
<td>0.0380</td>
<td>1.9E-03</td>
<td>1.2E-02</td>
<td>5</td>
<td>19</td>
<td>23</td>
<td>779</td>
<td>275</td>
<td></td>
</tr>
<tr>
<td>711</td>
<td>7</td>
<td>0.0570</td>
<td>0.0000</td>
<td>2.1E-02</td>
<td>1.3E-02</td>
<td>1</td>
<td>23</td>
<td>12</td>
<td>0</td>
<td>2650</td>
<td></td>
</tr>
</tbody>
</table>
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.
### Table 2.9 Network Statistics for Figure 2.5

*** End of Run Network Statistics ***

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Time</td>
<td>10,000 secs</td>
</tr>
<tr>
<td>Successful sequence transmissions</td>
<td>2299</td>
</tr>
<tr>
<td>Successful sequence transmissions - trunk 1</td>
<td>2129</td>
</tr>
<tr>
<td>Successful sequence transmissions - trunk 2</td>
<td>169</td>
</tr>
<tr>
<td>Collisions (frames)</td>
<td>1504</td>
</tr>
<tr>
<td>Waits (frames)</td>
<td>1.1e+04</td>
</tr>
<tr>
<td>Total attempts (sequences)</td>
<td>2612</td>
</tr>
<tr>
<td>Total Attempts</td>
<td>310</td>
</tr>
<tr>
<td>Attempted trunk-trunk transmissions</td>
<td>4334</td>
</tr>
<tr>
<td>Successful trunk-trunk transmissions</td>
<td>37</td>
</tr>
<tr>
<td>Trunk 1 active time</td>
<td>3.1655554 secs</td>
</tr>
<tr>
<td>Trunk 2 active time</td>
<td>0.1893149 secs</td>
</tr>
<tr>
<td>Total trunk active time</td>
<td>3.3550703 secs</td>
</tr>
<tr>
<td>% Trunk 1 active time</td>
<td>31.634%</td>
</tr>
<tr>
<td>% Trunk 2 active time</td>
<td>1.875%</td>
</tr>
<tr>
<td>% Total active time</td>
<td>33.551%</td>
</tr>
<tr>
<td>Control bytes transmitted - trunk 1</td>
<td>1.56485E+01 MBYTES</td>
</tr>
<tr>
<td>Data bytes transmitted - trunk 1</td>
<td>3.50222E+00 MBYTES</td>
</tr>
<tr>
<td>Control bytes transmitted - trunk 2</td>
<td>1.23773E+02 MBYTES</td>
</tr>
<tr>
<td>Data bytes transmitted - trunk 2</td>
<td>7.92463E+02 MBYTES</td>
</tr>
<tr>
<td>Total bytes transmitted</td>
<td>2.04882E+03 MBYTES</td>
</tr>
<tr>
<td>Total offered load</td>
<td>6.39050E+06 MBYTES</td>
</tr>
</tbody>
</table>

Device Activity Summaries
<table>
<thead>
<tr>
<th>ADD G/E SOURCE ACTIVITY</th>
<th>TIME</th>
<th>W/D C/COllISIONS</th>
<th>A/V MESSAGE SECONDS</th>
<th>A/D COUNT</th>
<th>T/R COUNT</th>
<th>R/T COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>119</td>
<td>1</td>
<td>0.1377</td>
<td>1</td>
<td>1.1579</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>212</td>
<td>1</td>
<td>1.379</td>
<td>1.36 - 04</td>
<td>3.65 - 03</td>
<td>3.65 - 03</td>
<td>3.65 - 03</td>
</tr>
<tr>
<td>313</td>
<td>1</td>
<td>0.0164</td>
<td>0.02 + 00</td>
<td>0.02 + 00</td>
<td>0.02 + 00</td>
<td>0.02 + 00</td>
</tr>
<tr>
<td>323</td>
<td>2</td>
<td>0.056</td>
<td>0.06 + 00</td>
<td>0.06 + 00</td>
<td>0.06 + 00</td>
<td>0.06 + 00</td>
</tr>
<tr>
<td>333</td>
<td>3</td>
<td>0.0927</td>
<td>0.09 + 00</td>
<td>0.09 + 00</td>
<td>0.09 + 00</td>
<td>0.09 + 00</td>
</tr>
<tr>
<td>414</td>
<td>1</td>
<td>0.1883</td>
<td>0.19 + 00</td>
<td>0.19 + 00</td>
<td>0.19 + 00</td>
<td>0.19 + 00</td>
</tr>
<tr>
<td>515</td>
<td>1</td>
<td>0.029</td>
<td>0.03 + 00</td>
<td>0.03 + 00</td>
<td>0.03 + 00</td>
<td>0.03 + 00</td>
</tr>
<tr>
<td>625</td>
<td>2</td>
<td>0.0592</td>
<td>0.06 + 00</td>
<td>0.06 + 00</td>
<td>0.06 + 00</td>
<td>0.06 + 00</td>
</tr>
<tr>
<td>735</td>
<td>3</td>
<td>0.1592</td>
<td>0.16 + 00</td>
<td>0.16 + 00</td>
<td>0.16 + 00</td>
<td>0.16 + 00</td>
</tr>
<tr>
<td>845</td>
<td>4</td>
<td>0.2081</td>
<td>0.21 + 00</td>
<td>0.21 + 00</td>
<td>0.21 + 00</td>
<td>0.21 + 00</td>
</tr>
<tr>
<td>955</td>
<td>5</td>
<td>0.2581</td>
<td>0.26 + 00</td>
<td>0.26 + 00</td>
<td>0.26 + 00</td>
<td>0.26 + 00</td>
</tr>
<tr>
<td>1065</td>
<td>6</td>
<td>0.3081</td>
<td>0.31 + 00</td>
<td>0.31 + 00</td>
<td>0.31 + 00</td>
<td>0.31 + 00</td>
</tr>
<tr>
<td>1175</td>
<td>7</td>
<td>0.3581</td>
<td>0.36 + 00</td>
<td>0.36 + 00</td>
<td>0.36 + 00</td>
<td>0.36 + 00</td>
</tr>
<tr>
<td>1285</td>
<td>8</td>
<td>0.4081</td>
<td>0.41 + 00</td>
<td>0.41 + 00</td>
<td>0.41 + 00</td>
<td>0.41 + 00</td>
</tr>
<tr>
<td>1395</td>
<td>9</td>
<td>0.4581</td>
<td>0.46 + 00</td>
<td>0.46 + 00</td>
<td>0.46 + 00</td>
<td>0.46 + 00</td>
</tr>
<tr>
<td>1405</td>
<td>10</td>
<td>0.5081</td>
<td>0.51 + 00</td>
<td>0.51 + 00</td>
<td>0.51 + 00</td>
<td>0.51 + 00</td>
</tr>
<tr>
<td>1515</td>
<td>11</td>
<td>0.5581</td>
<td>0.56 + 00</td>
<td>0.56 + 00</td>
<td>0.56 + 00</td>
<td>0.56 + 00</td>
</tr>
<tr>
<td>1625</td>
<td>12</td>
<td>0.6081</td>
<td>0.62 + 00</td>
<td>0.62 + 00</td>
<td>0.62 + 00</td>
<td>0.62 + 00</td>
</tr>
<tr>
<td>1735</td>
<td>13</td>
<td>0.6581</td>
<td>0.67 + 00</td>
<td>0.67 + 00</td>
<td>0.67 + 00</td>
<td>0.67 + 00</td>
</tr>
<tr>
<td>1845</td>
<td>14</td>
<td>0.7081</td>
<td>0.72 + 00</td>
<td>0.72 + 00</td>
<td>0.72 + 00</td>
<td>0.72 + 00</td>
</tr>
<tr>
<td>1955</td>
<td>15</td>
<td>0.7581</td>
<td>0.77 + 00</td>
<td>0.77 + 00</td>
<td>0.77 + 00</td>
<td>0.77 + 00</td>
</tr>
<tr>
<td>2065</td>
<td>16</td>
<td>0.8081</td>
<td>0.82 + 00</td>
<td>0.82 + 00</td>
<td>0.82 + 00</td>
<td>0.82 + 00</td>
</tr>
<tr>
<td>2175</td>
<td>17</td>
<td>0.8581</td>
<td>0.87 + 00</td>
<td>0.87 + 00</td>
<td>0.87 + 00</td>
<td>0.87 + 00</td>
</tr>
<tr>
<td>2285</td>
<td>18</td>
<td>0.9081</td>
<td>0.92 + 00</td>
<td>0.92 + 00</td>
<td>0.92 + 00</td>
<td>0.92 + 00</td>
</tr>
<tr>
<td>2395</td>
<td>19</td>
<td>0.9581</td>
<td>0.97 + 00</td>
<td>0.97 + 00</td>
<td>0.97 + 00</td>
<td>0.97 + 00</td>
</tr>
<tr>
<td>2405</td>
<td>20</td>
<td>0.9981</td>
<td>0.99 + 00</td>
<td>0.99 + 00</td>
<td>0.99 + 00</td>
<td>0.99 + 00</td>
</tr>
</tbody>
</table>

**TABLE 2.10: DEVICE STATISTICS FOR FIGURE 2.5**
2.7 SUGGESTED HOSC/CREY CONFIGURATION FOR EXTREME LOADING

Figure 2.6 illustrates 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 awkward 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/CHEY CONFIGURATION FOR EXTREME LOADING
### TABLE 2.11 NETWORK STATISTICS FOR FIGURE 2.6

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current time</td>
<td>10,000 secs</td>
</tr>
<tr>
<td>Successful sequence transmissions</td>
<td>4444</td>
</tr>
<tr>
<td>Successful sequence transmissions - trunk 1</td>
<td>4765</td>
</tr>
<tr>
<td>Successful sequence transmissions - trunk 2</td>
<td>151</td>
</tr>
<tr>
<td>Collisions (frames)</td>
<td>195</td>
</tr>
<tr>
<td>Waits (frames)</td>
<td>3.2E+03</td>
</tr>
<tr>
<td>Total attempts (sequences)</td>
<td>4449</td>
</tr>
<tr>
<td>Total aborts</td>
<td>1</td>
</tr>
<tr>
<td>Attempted trunk-trunk transmissions</td>
<td>101</td>
</tr>
<tr>
<td>Successful trunk-trunk transmissions</td>
<td>45</td>
</tr>
<tr>
<td>Trunk 1 active time</td>
<td>1.9124268 E+6</td>
</tr>
<tr>
<td>Trunk 2 active time</td>
<td>0.1205956 E+6</td>
</tr>
<tr>
<td>Total trunk active time</td>
<td>1.9935214 E+6</td>
</tr>
<tr>
<td>% Trunk 1 active time</td>
<td>19.126 %</td>
</tr>
<tr>
<td>% Trunk 2 active time</td>
<td>0.607 %</td>
</tr>
<tr>
<td>% Total active time</td>
<td>19.935 %</td>
</tr>
<tr>
<td>Control bytes transmitted - trunk 1</td>
<td>6.023256 E+00 Mbytes</td>
</tr>
<tr>
<td>Data bytes transmitted - trunk 1</td>
<td>5.790526 E+00 Mbytes</td>
</tr>
<tr>
<td>Control bytes transmitted - trunk 2</td>
<td>3.143965 E+01 Mbytes</td>
</tr>
<tr>
<td>Data bytes transmitted - trunk 2</td>
<td>1.285546 E+01 Mbytes</td>
</tr>
<tr>
<td>Total bytes transmitted</td>
<td>1.224325 E+01 Mbytes</td>
</tr>
<tr>
<td>Total offered load</td>
<td>6.596505 E+00 Mbytes</td>
</tr>
</tbody>
</table>

**Device Activity Summaries (seconds)**
<table>
<thead>
<tr>
<th>DEV SOURCE</th>
<th>TIME ACTIVE</th>
<th>TIME WAITING</th>
<th>TIME IN COLLISIONS</th>
<th>AVG MESSAGE DELAY</th>
<th>ABDRT COUNT</th>
<th>TRANSMISSION COUNT</th>
<th>RECEIPTION COUNT</th>
<th>WAIT COUNT</th>
<th>COLLISION COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 3, 5</td>
<td>1, 1</td>
<td>0.0000</td>
<td>0.0000</td>
<td>5.9E-05</td>
<td>7.3E-04</td>
<td>0</td>
<td>197</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2, 3, 5</td>
<td>1, 1</td>
<td>0.0043</td>
<td>0.0000</td>
<td>3.1E-06</td>
<td>8.6E-04</td>
<td>0</td>
<td>2069</td>
<td>214</td>
<td>90</td>
</tr>
<tr>
<td>3, 5</td>
<td>1, 1</td>
<td>0.0013</td>
<td>0.0000</td>
<td>0.3E+00</td>
<td>7.7E-04</td>
<td>0</td>
<td>12</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>1, 1</td>
<td>0.0000</td>
<td>0.0000</td>
<td>2.6E-07</td>
<td>7.3E-04</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>3, 5</td>
<td>0.0000</td>
<td>0.0000</td>
<td>3.1E-07</td>
<td>7.9E-04</td>
<td>0</td>
<td>62</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>1, 1</td>
<td>0.0000</td>
<td>0.0000</td>
<td>1.4E-07</td>
<td>7.9E-04</td>
<td>0</td>
<td>0</td>
<td>335</td>
<td>0</td>
</tr>
<tr>
<td>2, 4, 5</td>
<td>1, 1</td>
<td>0.0000</td>
<td>0.0000</td>
<td>6.2E-04</td>
<td>5.2E-04</td>
<td>0</td>
<td>99</td>
<td>0</td>
<td>390</td>
</tr>
<tr>
<td>5</td>
<td>1, 1</td>
<td>0.0000</td>
<td>0.0000</td>
<td>1.0E-06</td>
<td>2.0E-04</td>
<td>1</td>
<td>22</td>
<td>24</td>
<td>65</td>
</tr>
<tr>
<td>5, 2, 4</td>
<td>1, 1</td>
<td>0.0000</td>
<td>0.0000</td>
<td>1.0E-03</td>
<td>2.0E-03</td>
<td>0</td>
<td>1766</td>
<td>82</td>
<td>22</td>
</tr>
<tr>
<td>5, 2, 4</td>
<td>2, 2</td>
<td>0.0022</td>
<td>0.0322</td>
<td>1.5E-04</td>
<td>8.4E-04</td>
<td>0</td>
<td>46</td>
<td>47</td>
<td>539</td>
</tr>
<tr>
<td>5</td>
<td>1, 1</td>
<td>0.0009</td>
<td>0.0000</td>
<td>2.4E-05</td>
<td>2.0E-03</td>
<td>0</td>
<td>23</td>
<td>19</td>
<td>4</td>
</tr>
<tr>
<td>5, 2, 4</td>
<td>2, 2</td>
<td>0.0000</td>
<td>0.0000</td>
<td>2.4E-05</td>
<td>7.7E-04</td>
<td>0</td>
<td>23</td>
<td>0</td>
<td>518</td>
</tr>
<tr>
<td>2, 4, 5</td>
<td>2, 2</td>
<td>0.0000</td>
<td>0.0000</td>
<td>3.2E-05</td>
<td>7.7E-04</td>
<td>0</td>
<td>24</td>
<td>23</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>1, 1</td>
<td>0.0000</td>
<td>0.0000</td>
<td>4.0E-05</td>
<td>7.4E-04</td>
<td>0</td>
<td>24</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>3, 1</td>
<td>0.0000</td>
<td>0.0000</td>
<td>5.4E-05</td>
<td>7.2E-04</td>
<td>0</td>
<td>47</td>
<td>0</td>
<td>679</td>
</tr>
<tr>
<td>7</td>
<td>7, 3</td>
<td>0.0000</td>
<td>0.0000</td>
<td>1.2E-03</td>
<td>2.2E-03</td>
<td>0</td>
<td>23</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>7, 3</td>
<td>7, 3</td>
<td>0.0000</td>
<td>0.0000</td>
<td>1.2E-03</td>
<td>2.2E-03</td>
<td>0</td>
<td>23</td>
<td>24</td>
<td>0</td>
</tr>
</tbody>
</table>
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 HOSC configuration to a severely 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 bottleneck 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 presents 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

\[
A = Q(1/Q)(1 - 1/Q)^{Q-1}
\]

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

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

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 (1.25 MBps) ETHERNET channel transfer rate and a slot duration of 16 microseconds (8000 feet of cable) the efficiency is:

\[
E = \frac{\frac{512}{1.25 \times 10^6}}{\frac{512}{1.25 \times 10^6} + 1.58 \times 16 \times 10^{-6}} \\
= 4.09 \times 10^{-4} (4.09 \times 10^{-4} + 2.52 \times 10^{-5}) \\
= .94178
\]

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.

<table>
<thead>
<tr>
<th>WORST CASE: I</th>
<th>LONGEST WAITING TIME (NO COLLISIONS) FOR SCREEN CHANGE</th>
<th>LONGEST WAITING TIME FOR SCREEN CHANGE, 50% SCREEN REFRESH ELIMINATED</th>
<th>LONGEST WAITING TIME 10% COLLISIONS, 50% SCREEN REFRESH ELIMINATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assuming 1920 Bytes Per packet</td>
<td>1.04 Seconds</td>
<td>0.78 Seconds</td>
<td>1.016 Seconds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WORST CASE: II</th>
<th>AVERAGE TIME TO REFRESH SCREEN WITH 1920 BYTES ASSUMING SEQUENTIAL SERVICING OF VAX 11/730's BY VAX 11/780, (WITH COLLISIONS)</th>
<th>PROBABILITY OF NO WAITING</th>
<th>PERCENTAGE GOOD PACKETS ON BUS (EFFICIENCY)</th>
<th>AVERAGE COLLISION PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assuming 512 Bytes per Packet</td>
<td>1.23 Seconds</td>
<td>0.95 Seconds</td>
<td>1.25 Seconds</td>
<td></td>
</tr>
</tbody>
</table>

**Average Statistical Parameters:** (16usec per Slot)

<table>
<thead>
<tr>
<th>512 Bytes/Packet</th>
<th>1.58 Slots = 25.3usec.</th>
<th>9.6 ms</th>
<th>.3874</th>
<th>94%</th>
<th>6%</th>
</tr>
</thead>
<tbody>
<tr>
<td>256 Bytes/Packet</td>
<td>1.58 Slots = 25.3usec.</td>
<td>20.2 ms</td>
<td>.3874</td>
<td>89%</td>
<td>11%</td>
</tr>
<tr>
<td>128 Bytes/Packet</td>
<td>1.58 Slots = 25.3usec.</td>
<td>48.6 ms</td>
<td>.3874</td>
<td>80.2%</td>
<td>19.8%</td>
</tr>
</tbody>
</table>
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.

There 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 assumptions made, while the average parameters under simulation seem to be a better estimate than the average analysis. The statistical analysis average assumed true Poisson 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 CONFIGURATION.

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 occurred 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.
\[
\% \text{UTIL}(*\text{ACTIVE}) = \frac{\text{TOTAL TIME}}{\text{SLICE TIME}}
\]
(d) % UTIL(TOTAL) = (TOTALTIME) / 15 SECONDS

(4) Collisions:
Collisions can occur during the first 45 μs of frame transmission.
(a) Ave # of attempts (\(\geq 1\)) 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>
<thead>
<tr>
<th>TYPE OF STAT</th>
<th>70/30</th>
<th>70/30</th>
<th>70/30</th>
<th>70/30</th>
<th>50/50</th>
<th>50/50</th>
<th>50/50</th>
<th>50/50</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLICE MSSG DELAY</td>
<td>2 x 960</td>
<td>4 x 480</td>
<td>8 x 240</td>
<td>16 x 120</td>
<td>4 x 480</td>
<td>8 x 240</td>
<td>16 x 120</td>
<td>16 x 120</td>
</tr>
<tr>
<td>MAX DELAY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVE DELAY</td>
<td>142.5 ms</td>
<td>169.5 ms</td>
<td>162 ms</td>
<td>238.5 ms</td>
<td>163.5 ms</td>
<td>156 ms</td>
<td>156 ms</td>
<td>256.5 ms</td>
</tr>
<tr>
<td>STD. DEV = DELAY</td>
<td>39.3 ms</td>
<td>48.7 ms</td>
<td>44.3 ms</td>
<td>62.9 ms</td>
<td>45.5 ms</td>
<td>46.5 ms</td>
<td>46.8 ms</td>
<td>66.0 ms</td>
</tr>
<tr>
<td>SLICE TIMES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAX =</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVE =</td>
<td>1425 ms</td>
<td>170.0 ms</td>
<td>162.5 ms</td>
<td>240 ms</td>
<td>165 ms</td>
<td>157.5 ms</td>
<td>157.5 ms</td>
<td>257.5 ms</td>
</tr>
<tr>
<td>LOW =</td>
<td>132.5 ms</td>
<td>142.5 ms</td>
<td>142.0 ms</td>
<td>170 ms</td>
<td>134 ms</td>
<td>145.0 ms</td>
<td>152.4 ms</td>
<td>203 ms</td>
</tr>
<tr>
<td>BUS TIMES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENTRIES</td>
<td>550</td>
<td>1032</td>
<td>1988</td>
<td>4418</td>
<td>546</td>
<td>1028</td>
<td>1988</td>
<td>4464</td>
</tr>
<tr>
<td>AVE BUS TIMES</td>
<td>693.2 µs</td>
<td>378.8 µs</td>
<td>206.16 µs</td>
<td>106.2 µs</td>
<td>698 µs</td>
<td>380 µs</td>
<td>206.2 µs</td>
<td>105.4 µs</td>
</tr>
<tr>
<td>STD. DEV</td>
<td>2484 µs</td>
<td>91.9 µs</td>
<td>31.1 µs</td>
<td>25.6 µs</td>
<td>242 µs</td>
<td>89.9 µs</td>
<td>30.8 µs</td>
<td>26.6 µs</td>
</tr>
<tr>
<td>TOTAL TIME</td>
<td>0.381257 s</td>
<td>0.390922 s</td>
<td>0.409848 s</td>
<td>0.468992 s</td>
<td>0.381106 s</td>
<td>0.39072 s</td>
<td>0.409925 s</td>
<td>0.470705 s</td>
</tr>
<tr>
<td>%UTIL(ACTIVE SLICE)</td>
<td>94%</td>
<td>83%</td>
<td>91%</td>
<td>74.1%</td>
<td>87.6%</td>
<td>86%</td>
<td>88.6%</td>
<td>65.6%</td>
</tr>
<tr>
<td>%UTIL(TOTAL SLICE)</td>
<td>2.54%</td>
<td>2.6%</td>
<td>2.73%</td>
<td>3.13%</td>
<td>2.54%</td>
<td>2.6%</td>
<td>2.73%</td>
<td>3.14%</td>
</tr>
<tr>
<td>COLLISIONS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># COLLISIONS</td>
<td>35</td>
<td>36</td>
<td>34</td>
<td>289</td>
<td>33</td>
<td>34</td>
<td>34</td>
<td>312</td>
</tr>
<tr>
<td>AVE COLLISION #(≤1)</td>
<td>3.54</td>
<td>3.89</td>
<td>3.75</td>
<td>2.79</td>
<td>3.62</td>
<td>3.735</td>
<td>3.75</td>
<td>2.89</td>
</tr>
<tr>
<td>MAX # OF ATTEMPTS</td>
<td>12</td>
<td>13</td>
<td>13</td>
<td>19</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>PROCESS TIME</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAX 11/780 AND PE+E VIDEO UPDATE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAX</td>
<td>107 ms</td>
<td>120 ms</td>
<td>119 ms</td>
<td>48 ms</td>
<td>93 ms</td>
<td>103 ms</td>
<td>99 ms</td>
<td>52 ms</td>
</tr>
<tr>
<td>AVE</td>
<td>1.42 ms</td>
<td>716 µs</td>
<td>352 µs</td>
<td>2488 µs</td>
<td>1.29 ms</td>
<td>6728 µs</td>
<td>346 µs</td>
<td>282.8 µs</td>
</tr>
<tr>
<td>STD. DEV</td>
<td>7.81 ms</td>
<td>5.6 ms</td>
<td>3.77 ms</td>
<td>1.675 ms</td>
<td>6.42 ms</td>
<td>4.78 ms</td>
<td>3.36 ms</td>
<td>2 ms</td>
</tr>
<tr>
<td># OF ENTRIES</td>
<td>480</td>
<td>960</td>
<td>1920</td>
<td>3840</td>
<td>480</td>
<td>960</td>
<td>1920</td>
<td>3840</td>
</tr>
</tbody>
</table>
### TABLE 3.3

**SIMULATION RESULTS WITH VIDEO CHANGE REQUESTS**

<table>
<thead>
<tr>
<th>X/Y = VAX x %; PE+E y%</th>
<th>INGELS SATELLITE ETHERNET - FULL DRESS (With Video Req.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70/30</td>
<td>70/30</td>
</tr>
<tr>
<td><strong>STATISTIC TYPE</strong></td>
<td></td>
</tr>
<tr>
<td>SLICE MSSG DELAY</td>
<td>2x960</td>
</tr>
<tr>
<td>AVE VAX/PE+E</td>
<td>68.5 ms</td>
</tr>
<tr>
<td>AVE VIDEO REQ</td>
<td>51.2 ms</td>
</tr>
<tr>
<td>MAX VIDEO/REQ</td>
<td>4.1 ms</td>
</tr>
<tr>
<td><strong>SLICE TIMES</strong></td>
<td></td>
</tr>
<tr>
<td>MAX</td>
<td>142.5 ms</td>
</tr>
<tr>
<td>AVE (APPROX)</td>
<td>138 ms</td>
</tr>
<tr>
<td>LOW</td>
<td>732.5 ms</td>
</tr>
<tr>
<td><strong>BUS TIMES</strong></td>
<td></td>
</tr>
<tr>
<td>ENTRIES</td>
<td>595</td>
</tr>
<tr>
<td>AVE BUS TIMES</td>
<td>672.4 µs</td>
</tr>
<tr>
<td>STD DEV. FR. AVE</td>
<td>266 µs</td>
</tr>
<tr>
<td>TOTAL TIME</td>
<td>.40008 s</td>
</tr>
<tr>
<td>%UTIL(ACTIVE)</td>
<td>~ 96.6%</td>
</tr>
<tr>
<td>%UTIL(TOTAL)</td>
<td>~2.65%</td>
</tr>
<tr>
<td><strong>COLLISIONS</strong></td>
<td></td>
</tr>
<tr>
<td># COLLISIONS</td>
<td>44</td>
</tr>
<tr>
<td>AVE # COLLISION (&gt;1)</td>
<td>3.94</td>
</tr>
<tr>
<td>MAX # OF ATTEMPTS</td>
<td>12</td>
</tr>
<tr>
<td><strong>PROCESS TIME</strong></td>
<td></td>
</tr>
<tr>
<td>VAX</td>
<td>1 s</td>
</tr>
<tr>
<td>AVE</td>
<td>21.1 ms</td>
</tr>
<tr>
<td>STD DEV.</td>
<td>444 ms</td>
</tr>
</tbody>
</table>

*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.

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

53
5.0 REFERENCES


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

### APPENDIX I

**BACKUP SIMULATION DATA**

<table>
<thead>
<tr>
<th>SECTION</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>A TYPICAL HOSC ACTIVITY CONFIGURATION</td>
</tr>
<tr>
<td>1.2</td>
<td>A CURRENT HOSC ACTIVITY UNDER HEAVY LOADING</td>
</tr>
<tr>
<td>1.3</td>
<td>A RERUN OF FIGURE 2.2 RECONFIGURED</td>
</tr>
<tr>
<td>1.4</td>
<td>ANTICIPATED HOSC/CREY CONFIGURATION UNDER EXTREME LOADING</td>
</tr>
<tr>
<td>1.5</td>
<td>A RERUN OF FIGURE 2.4 WITH REDUCED LOADING</td>
</tr>
<tr>
<td>1.6</td>
<td>SUGGESTED HOSC/CREY CONFIGURATION FOR EXTREME LOADING</td>
</tr>
</tbody>
</table>
SECTION 1.1

A TYPICAL HOSC ACTIVITY CONFIGURATION
**NETWORK DESCRIPTION**

**ADAPTER # 1**

- **Priority Delay on Trunk 1**: 0.0000077 SEC
- **Fixed Delay**: 0.0000061 SEC
- **Total Delay on Trunk 1**: 0.0001945 SEC
- **Adapter Retry Count**: 64

**Device 1 Status**: Closed

- **I/O Bus Transfer Rate**: 3300000.00 BYTES/SEC
- **Load Time**: 0.0000000 SEC
- **Number of Data Sources**: 1

**Device Number**: 111

- **Buffer Size**: 1.0E+03 BYTES
- **Source #1 Data Generation Rate**: 20000.00 BYTES
- **Trunk Transmission Interval**: 0.0000 SEC

**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
<table>
<thead>
<tr>
<th>Device 1</th>
<th>Status: Closed</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I/O Bus Transfer Rate: 50000.00 Bytes/Sec</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Load Time: 0.0000025 Sec</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number of Data Sources: 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Buffer Size: 2.1e+03 Bytes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Source #1: Data Generation Rate: 20000.00 Bytes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trunk Transmission Interval: 0.1050 Sec</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data Block Count: 1.025390625e+00</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Possible Receivers and Their Respective Probabilities For: 211</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiver ID: 111</td>
</tr>
<tr>
<td>Receiver ID: 531</td>
</tr>
<tr>
<td>Receiver ID: 611</td>
</tr>
<tr>
<td>Receiver ID: 621</td>
</tr>
</tbody>
</table>

Device 2 Status: Open

Device 3 Status: Open

Device 4 Status: Open

---

**Network Description**

**Adapter #3**

---

**Adapter #3:**

<table>
<thead>
<tr>
<th>Device 1</th>
<th>Status: Closed</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I/O Bus Transfer Rate: 50000.00 Bytes/Sec</td>
<td></td>
</tr>
</tbody>
</table>
LOAD TIME: 0.0000025 SEC
NUMBER OF DATA SOURCES: 1
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: 9.76562900E+01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 311
RECEIVER ID: 111 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

*******************************************************
NETWORK DESCRIPTION
ADAPTER # 4:
*******************************************************

ADAPTER # 4:

- PRIORITY DELAY ON TRUNK 2: 0.00000453 SECS
- FIXED DELAY ON TRUNK 2: 0.00000555 SECS
- TOTAL DELAY ON TRUNK 2: 0.00002249 SECS
- ADAPTER RETRY COUNT: 64

DEVICE 1 STATUS: CLOSED
I/O BUS TRANSFER RATE: 500000.00 BYTES/SEC
LOAD TIME: 0.0000022 SEC
NUMBER OF DATA SOURCES: 1

DEVICE NUMBER: 411
BUFFER SIZE: 4.0E+03 BYTES
SOURCE # 1 DATA GENERATION RATE: 5000.00 BYTES
TRUNK TRANSMISSION INTERVAL: 0.1000 SEC
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 411
RECEIVER ID: 611 PROBABILITY: 2.0E-01
RECEIVER ID: 511 PROBABILITY: 8.0E-01
**DEVICE 2** STATUS: CLOSED

I/O BUS TRANSFER RATE: 500000.00 BYTES/SEC
LOAD TIME: 0.0000002 SEC
NUMBER OF DATA SOURCES: 1

DEVICE NUMBER: 21
BUFFER SIZE: 5.1E+03 BYTES
SOURCE #1 DATA GENERATION RATE: 7000.000 BYTES
TRUNK TRANSMISSION INTERVAL: 0.9143 SECS

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 21
RECEIVER ID: 111
PROBABILITY: 3.0E-01
RECEIVER ID: 421
PROBABILITY: 7.0E-01

**DEVICE 3** STATUS: OPEN
**DEVICE 4** STATUS: OPEN

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

**NETWORK DESCRIPTION**
**ADAPTER # 5**

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

**ADAPTER # 5:**

PRIORITY DELAY ON TRUNK 2: 0.0000045 SECS
FIXED DELAY ON TRUNK 2: 0.0000035 SECS
TOTAL DELAY ON TRUNK 2: 0.0000225 SECS
ADAPTER RETRY COUNT: 44

**DEVICE 1** STATUS: CLOSED

I/O BUS TRANSFER RATE: 500000.00 BYTES/SEC
LOAD TIME: 0.0000002 SEC
NUMBER OF DATA SOURCES: 1

DEVICE NUMBER: 111
BUFFER SIZE: 5.1E+02 BYTES
SOURCE #1 DATA GENERATION RATE: 1250.000 BYTES
TRUNK TRANSMISSION INTERVAL: 0.4060 SECS

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 111
RECEIVER ID: 411
PROBABILITY: 6.0E-01
RECEIVER ID: 421
PROBABILITY: 4.0E-01

**DEVICE 2** STATUS: CLOSED

I/O BUS TRANSFER RATE: 500000.00 BYTES/SEC
LOAD TIME: 0.0000002 SEC
NUMBER OF DATA SOURCES: 1

DEVICE NUMBER: 21
BUFFER SIZE: 5.1E+02 BYTES
SOURCE # 1 DATA 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 1 STATUS : CLOSED--53
I/O BUS TRANSFER RATE: 3300000.00BYTES/SEC
LOAD TIME: 0.00000000 SEC
NUMBER OF DATA SOURCES: 1

531 DEVICE NUMBER 531
BUFFER SIZE: 6.3E+02BYTES
SOURCE # 1 DATA 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: 521
PROBABILITY: 8.0E-01

DEVICE 4 STATUS : OPEN...

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

NETWORK DESCRIPTION
ADAPTER # 6

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

ADAPTER # 6:

PRIORITY DELAY ON TRUNK 2: 0.0000117SECS
FIXED DELAY ON TRUNK 2: 0.0000061SECS
TOTAL DELAY ON TRUNK 2: 0.0000278SECS
ADAPTER RETRY COUNT : 54

DEVICE 1 STATUS : CLOSED--61
I/O BUS TRANSFER RATE: 3300000.00BYTES/SEC
LOAD TIME: 0.00000000 SEC
NUMBER OF DATA SOURCES: 1

611 DEVICE NUMBER 611
BUFFER SIZE: 2.0E+03BYTES
SOURCE # 1 DATA GENERATION RATE: 1250.00BYTES
TRUNK TRANSMISSION INTERVAL: 1.4000SECS

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 611
RECEIVER ID: 111
PROBABILITY: 1.0E-01
RECEIVER ID: 411
PROBABILITY: 5.0E-01
RECEIVER ID: 511
PROBABILITY: 1.0E-01

DEVICE 2 STATUS : CLOSED--62
I/O BUS TRANSFER RATE: 1250000.00BYTES/SEC
LOAD TIME: 0.0000001 SEC
<table>
<thead>
<tr>
<th>Device</th>
<th>Status</th>
<th>I/O Bus Transfer Rate</th>
<th>Load Time</th>
<th>No. of Data Sources</th>
<th>Device Number</th>
<th>Buffer Size</th>
<th>Source # 1 Data Generation Rate</th>
<th>Trunk Transmission Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Closed</td>
<td>1200000.00 Bytes/Sec</td>
<td>0.0000001</td>
<td>1</td>
<td>621</td>
<td>2.0E+03</td>
<td>1250.00 Bytes</td>
<td>1.600000 Secs</td>
</tr>
<tr>
<td>4</td>
<td>Open</td>
<td></td>
<td></td>
<td></td>
<td>631</td>
<td>2.0E+03</td>
<td>1250.00 Bytes</td>
<td>1.600000 Secs</td>
</tr>
</tbody>
</table>

Possible Receivers and Their Respective Probabilities:

- Device 2: Receiver ID: 111, Probability: 1.0E-01; Receiver ID: 211, Probability: 1.0E-01; Receiver ID: 421, Probability: 6.0E-01
- Device 4: Receiver ID: 111, Probability: 2.0E-01; Receiver ID: 421, Probability: 6.0E-01
SECTION 1.2

A CURRENT HOSC ACTIVITY UNDER HEAVY LOADING
ADAPTER # 1:

PRIORITY DELAY ON TRUNK 1: 0.0000023 SEC
FIXED DELAY: 0.0000049 SEC
TOTAL DELAY ON TRUNK 1: 0.0000121 SEC
ADAPTER RETRY COUNT: 34

DEVICE 1 STATUS: CLOSED
I/O BUS TRANSFER RATE: 330000.00 BYTES/SEC
LOAD TIME: 0.000000 SEC
NUMBER OF DATA SOURCES: 1

DEVICE NUMBER: 111
BUFFER SIZE: 1.0E+01 BYTES
SOURCE # 1 DATA GENERATION RATE: 20000.00 BYTES
TRUNK TRANSMISSION INTERVAL: 0.0500 SEC
DATA BLOCK COUNT: 4.662812500E+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

ADAPTER # 2:

PRIORITY DELAY ON TRUNK 1: 0.0000013 SEC
Device 1 Status: Closed

I/O Bus Transfer Rate: 50000.00 Bytes/sec
Load Time: 0.000002 sec
Number of Data Sources: 1

Device Number: 211
Buffer Size: 2.0e+03 bytes
Source #1: Data Generation Rate: 50000.00 Bytes/sec
Trunk Transmission Interval: 0.0040 sec
Data Block Count: 0.78625000-01

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

Network Description

Adaptr #: 3

Adaptr #: 5

Priority Delay on Trunk 1: 0.000025 sec
Fixed Delay: 0.000049 sec
Total Delay on Trunk 1: 0.000120 sec
Adaptr retry count: 64

Device 1 Status: Closed

I/O Bus Transfer Rate: 370000.00 Bytes/sec
Load Time: 3.6570670 sec
Number of Data Sources: 1

Device Number: 311
Buffer Size: 1.0e+02 bytes
Source #1: Data Generation Rate: 1300.00 Bytes/sec
Trunk Transmission Interval: 0.7692 sec
Data Block Count: 4.43712500e-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 311
RECEIVER ID: 311
PROBABILITY: 1.0E+00

DEVICE 2
STATUS: CLOSED
312
I/O BUS TRANSFER RATE: 3300000.00 BYTES/SEC
LOAD TIME: 0.00000000 SEC
NUMBER OF DATA SOURCES: 1

DEVICE 3
STATUS: CLOSED
331
I/O BUS TRANSFER RATE: 3300000.00 BYTES/SEC
LOAD TIME: 0.00000000 SEC
NUMBER OF DATA SOURCES: 1

DEVICE 4
STATUS: CLOSED
341
I/O BUS TRANSFER RATE: 3300000.00 BYTES/SEC
LOAD TIME: 0.00000000 SEC
NUMBER OF DATA SOURCES: 1
### Network Description

**Adapter # 4**

<table>
<thead>
<tr>
<th>Device</th>
<th>Status</th>
<th>I/O Bus Transfer Rate</th>
<th>Load Time</th>
<th>Number of Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device 1</td>
<td>Closed</td>
<td>1330000.00 Bytes/sec</td>
<td>0.00000057 Sec</td>
<td>1</td>
</tr>
<tr>
<td>Device 2</td>
<td>Closed</td>
<td>300000.00 Bytes/sec</td>
<td>0.00000057 Sec</td>
<td>1</td>
</tr>
<tr>
<td>Device 3</td>
<td>Closed</td>
<td>300000.00 Bytes/sec</td>
<td>0.00000057 Sec</td>
<td>1</td>
</tr>
</tbody>
</table>

**Possible Receivers and their respective probabilities for 111**

- Receiver ID: 111, Probability: 1.0E+00
- Receiver ID: 311, Probability: 0.000000001
- Receiver ID: 411, Probability: 6.0E-01
- Receiver ID: 511, Probability: 6.0E-01

**Possible Receivers and their respective probabilities for 411**

- Receiver ID: 311, Probability: 1.0E+00
- Receiver ID: 411, Probability: 6.0E-01
- Receiver ID: 511, Probability: 6.0E-01

**Possible Receivers and their respective probabilities for 421**

- Receiver ID: 311, Probability: 1.0E+00
- Receiver ID: 411, Probability: 6.0E-01
- Receiver ID: 511, Probability: 6.0E-01

**Possible Receivers and their respective probabilities for 431**

- Receiver ID: 311, Probability: 1.0E+00
- Receiver ID: 411, Probability: 6.0E-01
- Receiver ID: 511, Probability: 6.0E-01

**Possible Receivers and their respective probabilities for 511**

- Receiver ID: 311, Probability: 1.0E+00
- Receiver ID: 411, Probability: 6.0E-01
- Receiver ID: 511, Probability: 6.0E-01
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: 2.44140625E-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

DEVICE NUMBER 441
BUFFER SIZE: 1.0E+03 BYTES
SOURCE # 1 DATA GENERATION RATE: 10000.00 BYTES
TRUNK TRANSMISSION INTERVAL: 0.0100 SEC
DATA BLOCK COUNT: 4.92281250E-01

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 441
RECEIVER ID: 421
PROBABILITY: 1.0E+00

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: 2.44140625E-01

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 442
RECEIVER ID: 411
PROBABILITY: 1.0E+00

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

NETWORK DESCRIPTION
CHAPTER 4 5

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

CHAPTER 4 T:

PROPAGA DELAY ON TRUNK 2: 0.00004156250
FIXED DELAY ON TRUNK 2: 0.00004156250
TOTAL DELAY ON TRUNK 2: 0.00004156250
ADAPTER ENTRY COUNT: 4

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

68
### Device 511
- **Device Number**: 511
- **Buffer Size**: 5.0E+02 Bytes
- **Source #1 Data Generation Rate**: 1200.000Bytes
- **Trunk Transmission Interval**: 0.4167 Seconds

#### Possible Receivers and Their Respective Probabilities for: 511
<table>
<thead>
<tr>
<th>Receiver ID</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>521</td>
<td>3.0E-01</td>
</tr>
<tr>
<td>444</td>
<td>4.0E-01</td>
</tr>
<tr>
<td>442</td>
<td>3.0E-01</td>
</tr>
</tbody>
</table>

### Device 522
- **Device Number**: 522
- **Buffer Size**: 5.0E+02 Bytes
- **Source #1 Data Generation Rate**: 1200.000Bytes
- **Trunk Transmission Interval**: 0.4167 Seconds

#### Possible Receivers and Their Respective Probabilities for: 522
<table>
<thead>
<tr>
<th>Receiver ID</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>511</td>
<td>1.0E+00</td>
</tr>
</tbody>
</table>

### Device 3 Status: Open

### Device 4 Status: Open

---

**Network Description**

---

### Adaptor 54
- **Priority Delay on Trunk 2**: 0.0000365943
- **Fixed Delay on Trunk 2**: 0.0000419851
- **Total Delay on Trunk 2**: 0.0000481785

### Device 1 Status: Closed
- **I/O Bus Transfer Rate**: 300000.00 Bytes/Sec
- **Load Time**: 0.0000365943
NUMBER OF DATA SOURCES: 1

DEVICE NUMBER: 611
BUFFER SIZE: 8.000000BYTES
SOURCE ID: 1D10G DATA GENERATION RATE: 1250.000BYTES
TRUNK TRANSMISSION INTERVAL: 0.000000SEC

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 611
RECEIVER ID: 421
PROBABILITY: 5.00-01
RECEIVER ID: 223
PROBABILITY: 5.00-01

DEVICE 2 STATUS: OPEN
DEVICE 1 STATUS: OPEN
DEVICE 4 STATUS: OPEN
SECTION 1.3

A RERUN OF FIGURE 2.3 RECONFIGURED
### End Of Run Network Statistics###

**Current Time:** 10,000 SECS

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful Sequence Transmissions</td>
<td>3505</td>
</tr>
<tr>
<td>Successful Sequence Transmissions - Trunk 1</td>
<td>3325</td>
</tr>
<tr>
<td>Successful Sequence Transmissions - Trunk 2</td>
<td>160</td>
</tr>
<tr>
<td>Collisions (Frames)</td>
<td>192</td>
</tr>
<tr>
<td>Aborts (Frames)</td>
<td>2.65e+03</td>
</tr>
<tr>
<td>Total Attempts (Sequences)</td>
<td>3510</td>
</tr>
<tr>
<td>Total Aborts</td>
<td>4</td>
</tr>
<tr>
<td>Attempted Trunk-Trunk Transmissions</td>
<td>351</td>
</tr>
<tr>
<td>Successful Trunk-Trunk Transmissions</td>
<td>39</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trunk 1 Active Time</th>
<th>1.5503061 SECS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trunk 2 Active Time</td>
<td>0.003471 SECS</td>
</tr>
<tr>
<td>Total Trunk Active Time</td>
<td>1.7611532 SECS</td>
</tr>
<tr>
<td>% Trunk 1 Active Time</td>
<td>0.8038 %</td>
</tr>
<tr>
<td>% Trunk 2 Active Time</td>
<td>0.8038 %</td>
</tr>
<tr>
<td>% Total Active Time</td>
<td>17.612 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Bytes Transmitted - Trunk 1</th>
<th>4.75957e+00 BYTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Bytes Transmitted - Trunk 1</td>
<td>5.52503e+00 BYTES</td>
</tr>
<tr>
<td>Control Bytes Transmitted - Trunk 2</td>
<td>3.77075e+01 BYTES</td>
</tr>
<tr>
<td>Data Bytes Transmitted - Trunk 2</td>
<td>1.0022e+02 BYTES</td>
</tr>
<tr>
<td>Total Bytes Transmitted</td>
<td>1.58799e+02 BYTES</td>
</tr>
<tr>
<td>Total Offered Load</td>
<td>8.34607e+02 BYTES</td>
</tr>
</tbody>
</table>

**Device Activity Summary**

**Original Source**
<table>
<thead>
<tr>
<th>KEY SOURCE</th>
<th>TIME ACTIVE</th>
<th>TIME WAITING</th>
<th>TIME IN COLLISIONS</th>
<th>AVG MESSAGE DELAY</th>
<th>ABORT COUNT</th>
<th>ABORT COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>1.0750</td>
<td>0.0000</td>
<td>7.5E-05</td>
<td>0</td>
<td>2078</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>1.1043</td>
<td>0.0115</td>
<td>6.5E-05</td>
<td>0</td>
<td>211</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>0.6779</td>
<td>0.0004</td>
<td>7.9E-07</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>0.0031</td>
<td>0.0000</td>
<td>0.0E+00</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>1.1529</td>
<td>0.0000</td>
<td>6.5E-05</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>1.0345</td>
<td>0.0000</td>
<td>7.5E-05</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>0.0171</td>
<td>0.0000</td>
<td>2.6E-05</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0239</td>
<td>0.0088</td>
<td>2.0E-05</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0216</td>
<td>0.0000</td>
<td>2.0E-05</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0043</td>
<td>0.0000</td>
<td>8.1E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0543</td>
<td>0.0000</td>
<td>8.1E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0511</td>
<td>0.0000</td>
<td>8.1E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0333</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.0246</td>
<td>0.0000</td>
<td>6.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
*** 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
MUTES (FRAMES) : 9,35402
TOTAL ATTEMPTS (SEQUENCES) : 346
TOTAL AQUITS : 2

ATTEMPTED TRUNK-TRUNK TRANSMISSIONS : 461
SUCCESSFUL TRUNK-TRUNK TRANSMISSIONS : 2

TRUNK 1 ACTIVE TIME : 0.1554059 SECS
TRUNK 2 ACTIVE TIME : 0.0123015 SECS
TOTAL TRUNK ACTIVE TIME : 0.1677421 SECS
% TRUNK 1 ACTIVE TIME : 16.550 %
% TRUNK 2 ACTIVE TIME : 1.195 %
% TOTAL ACTIVE TIME : 17.744 %

CONTROL BYTES TRANSMITTED - TRUNK 1 : 4.535305-01 BYTES
DATA BYTES TRANSMITTED - TRUNK 1 : 5.480366-01 BYTES
CONTROL BYTES TRANSMITTED - TRUNK 2 : 6.392332-02 BYTES
DATA BYTES TRANSMITTED - TRUNK 2 : 7.675208-03 BYTES
TOTAL BYTES TRANSMITTED : 1.091118E+00 BYTES

TOTAL OFFERED LOAD : 6.396835-01 BYTES

DEVICE ACTIVITY SUMMARIES (SECONDS)

PER DEV SOURCE TIME ACTIVE WRITING COLLISIONS RELAY TRAFFIC TRANSMISSIONS RECEPTION DRIVER COLLISION...
<table>
<thead>
<tr>
<th>ADP</th>
<th>DEV</th>
<th>SOURCE</th>
<th>TIME ACTIVE</th>
<th>TIME WAITING</th>
<th>TIME IN COLLISIONS</th>
<th>AVG MESSAGE DELAY</th>
<th>ABDORT COUNT</th>
<th>TRANSMISSION COUNT</th>
<th>RECEIPTION COUNT</th>
<th>WAIT COUNT</th>
<th>COLLISION COUNT</th>
</tr>
</thead>
</table>
DEVICE 1 STATUS: CLOSED

I/O BUS TRANSFER RATE: 500000.00 BYTES/SEC
LOAD TIME: 0.0000002 SEC
NUMBER OF DATA SOURCES: 1

DEVICE NUMBER: 211
BUFFER SIZE: 2.00003 BYTES
SOURCE #1 DATA GENERATION RATE: 500000.00 BYTES
TRUNK TRANSMISSION INTERVAL: 0.0040 SEC
DATA BLOCK COUNT: 9.756625000E-01

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 211
RECEIVER ID: 331
PROBABILITY: 1.00*00

DEVICE 2 STATUS: OPEN

DEVICE 3 STATUS: OPEN

DEVICE 4 STATUS: OPEN

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

NETWORK DESCRIPTION

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

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

ADAPTER # 5:

PRIORITY DELAY ON TRUNK 1: 0.0000005 SEC
FIXED DELAY: 0.0000000 SEC
TOTAL DELAY ON TRUNK 1: 0.0000005 SEC
ADAPTER RETRY COUNT: 04

DEVICE 1 STATUS: CLOSED

I/O BUS TRANSFER RATE: 370000.00 BYTES/SEC
LOAD TIME: 0.0000000 SEC
NUMBER OF DATA SOURCES: 1

DEVICE NUMBER: 311
BUFFER SIZE: 1.00003 BYTES
SOURCE #1 DATA GENERATION RATE: 1300.20 Bytes
TRUNK TRANSMISSION INTERVAL: 0.7692 SEC
DATA BLOCK COUNT: 4.529171500E-01
<table>
<thead>
<tr>
<th>Device ID</th>
<th>Probability</th>
<th>Device Number</th>
<th>Buffer Size</th>
<th>Source #1 Data Generation Rate</th>
<th>I/O Bus Transfer Rate</th>
<th>Load Time</th>
<th>Number of Data Sources</th>
<th>Trunk Transmission Interval</th>
<th>Data Block Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>512</td>
<td>1.0E+00</td>
<td>512</td>
<td>1.0E+03 Bytes</td>
<td>100.00 Bytes</td>
<td>1300000.00 Bytes/sec</td>
<td>0.000000 SEC</td>
<td>1</td>
<td>1.000000 SEC</td>
<td>4.382912500E-01</td>
</tr>
<tr>
<td>321</td>
<td>1.0E-01</td>
<td>321</td>
<td>1.0E+03 Bytes</td>
<td>400.00 Bytes</td>
<td>1300000.00 Bytes/sec</td>
<td>0.000000 SEC</td>
<td>1</td>
<td>1.000000 SEC</td>
<td>4.382912500E-01</td>
</tr>
<tr>
<td>331</td>
<td>1.0E-01</td>
<td>331</td>
<td>1.0E+03 Bytes</td>
<td>100.00 Bytes</td>
<td>1300000.00 Bytes/sec</td>
<td>0.000000 SEC</td>
<td>1</td>
<td>1.000000 SEC</td>
<td>4.382912500E-01</td>
</tr>
<tr>
<td>341</td>
<td>1.0E-01</td>
<td>341</td>
<td>1.0E+03 Bytes</td>
<td>6250.00 Bytes</td>
<td>1300000.00 Bytes/sec</td>
<td>0.000000 SEC</td>
<td>1</td>
<td>1.000000 SEC</td>
<td>4.382912500E-01</td>
</tr>
</tbody>
</table>
**Network Description**

**Adapter # 4:**

<table>
<thead>
<tr>
<th>Priority Delay on Trunk 1</th>
<th>0.0000025 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Delay</td>
<td>0.0000034 sec</td>
</tr>
<tr>
<td>Total Delay on Trunk 1</td>
<td>0.000016663 sec</td>
</tr>
<tr>
<td>Adapter Retry Count</td>
<td>04</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Priority Delay on Trunk 2</th>
<th>0.00000055 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Delay</td>
<td>0.000001413 sec</td>
</tr>
<tr>
<td>Total Delay on Trunk 2</td>
<td>0.000043355 sec</td>
</tr>
</tbody>
</table>

**Device 1 Status: Closed**

- I/O Bus Transfer Rate: 3300000.00 Bytes/sec
- Load Time: 0.0000000 Sec
- Number of Data Sources: 1

**Device 2 Status: Closed**

- I/O Bus Transfer Rate: 3000000.00 Bytes/sec
- Load Time: 0.0000004 Sec
- Number of Data Sources: 1

---

**Possible Receivers and Their Respective Probabilities for 411**

- Receiver ID: 511
  - Probability: 1.00/00

---

**Possible Receivers and Their Respective Probabilities for 421**

- Receiver ID: 511
  - Probability: 2.06/01
- Receiver ID: 411
  - Probability: 1.02/01
- Receiver ID: 521
  - Probability: 1.02/04

---

**Possible Receivers and Their Respective Probabilities for 431**

- Receiver ID: 511
  - Probability: 1.00/00
DEVI CE 4  STATUS: CLOSED: 54
I/O BUS TRANSFER RATE: 300000.00 BYTES/SEC
LOAD TIME: 0.0000004 SEC
NUMBER OF DATA SOURCES: 2

DEVICE NUMBER 441
BUFFER SIZE: 1.0E+03 BYTES
SOURCE # 1 DATA GENERATION RATE: 100000.00 BYTES/SEC
TRUNK TRANSMISSION INTERVAL: 0.0100 SEC
DATA BLOCK COUNT: 2.441406250E-01

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR 441
RECEIVER ID: 511
PROBABILITY: 1.0E+00

DEVICE NUMBER 442
BUFFER SIZE: 1.0E+03 BYTES
SOURCE # 1 DATA GENERATION RATE: 1200.00 BYTES/SEC
TRUNK TRANSMISSION INTERVAL: 0.4167 SEC
DATA BLOCK COUNT: 2.441406250E-01

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR 442
RECEIVER ID: 511
PROBABILITY: 1.0E+00

-------------------------------
NETWORK DESCRIPTION
-------------------------------

ADAPTER # 5

-------------------------------
ADAPTER A 5:
PRIORITY DELAY ON TRUNK 1: 0.0000004125 SECS
FIXED DELAY ON TRUNK 2: 0.000000000 SECS
TOTAL DELAY ON TRUNK 2: 0.000000000 SECS
ADAPTER RERTY COUNT: 64

DEVICE 1 STATUS: CLOSED: 49
I/O BUS TRANSFER RATE: 300000.00 BYTES/SEC
LOAD TIME: 0.0000004 SEC
NUMBER OF DATA SOURCES: 1
SECTION 1.4

ANTICIPATED HOSC/CREY CONFIGURATION

UNDER EXTREME LOADING
### END OF RUN NETWORK STATISTICS ###

**CURRENT TIME :  5.0000 SECS**

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUCCESSFUL SEQUENCE TRANSMISSIONS</td>
<td>2494</td>
</tr>
<tr>
<td>SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 1</td>
<td>2412</td>
</tr>
<tr>
<td>SUCCESSFUL SEQUENCE TRANSMISSIONS-TRUNK 2</td>
<td>82</td>
</tr>
<tr>
<td>COLLISIONS (FRAMES)</td>
<td>2591</td>
</tr>
<tr>
<td>WAITS (FRAMES)</td>
<td>1.8E+04</td>
</tr>
<tr>
<td>TOTAL ATTEMPTS (SEQUENCES)</td>
<td>2736</td>
</tr>
<tr>
<td>TOTAL ADEPTS</td>
<td>239</td>
</tr>
<tr>
<td>ATTEMPTED TRUNK-TRUNK TRANSMISSIONS</td>
<td>2024</td>
</tr>
<tr>
<td>SUCCESSFUL TRUNK-TRUNK TRANSMISSIONS</td>
<td>15</td>
</tr>
<tr>
<td>TRUNK 1 ACTIVE TIME</td>
<td>2.8190647 SECS</td>
</tr>
<tr>
<td>TRUNK 2 ACTIVE TIME</td>
<td>0.1112463 SECS</td>
</tr>
<tr>
<td>TOTAL TRUNK ACTIVE TIME</td>
<td>2.9308110 SECS</td>
</tr>
<tr>
<td>% TRUNK 1 ACTIVE TIME</td>
<td>55.391 %</td>
</tr>
<tr>
<td>% TRUNK 2 ACTIVE TIME</td>
<td>2.225 %</td>
</tr>
<tr>
<td>% TOTAL ACTIVE TIME</td>
<td>58.606 %</td>
</tr>
<tr>
<td>CONTROL BYTES TRANMITTED - TRUNK 1</td>
<td>1.43685E+01 MBYTES</td>
</tr>
<tr>
<td>DATA BYTES TRANMITTED - TRUNK 1</td>
<td>2.92337E+00 MBYTES</td>
</tr>
<tr>
<td>CONTROL BYTES TRANMITTED - TRUNK 2</td>
<td>5.7487E-01 MBYTES</td>
</tr>
<tr>
<td>DATA BYTES TRANMITTED - TRUNK 2</td>
<td>4.77480E-02 MBYTES</td>
</tr>
<tr>
<td>TOTAL BYTES TRANSMITTED</td>
<td>1.79144E+01 MBYTES</td>
</tr>
<tr>
<td>TOTAL OFFERED LOAD</td>
<td>9.79176E+00 MBYTES</td>
</tr>
</tbody>
</table>

**DEVICE ACTIVITY SUMMARIES**
<table>
<thead>
<tr>
<th>ADP #</th>
<th>DEV SOURCE #</th>
<th>TIME ACTIVE</th>
<th>TIME WAITING</th>
<th>TIME IN COLLISIONS</th>
<th>AVG MESSAGE DELAY</th>
<th>ABORT COUNT</th>
<th>TRANSMISSION COUNT</th>
<th>RECEPTION COUNT</th>
<th>WAIT COUNT</th>
<th>COLLISION COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>111</td>
<td>0.0526</td>
<td>0.0000</td>
<td>2.4E-04</td>
<td>1.0E-02</td>
<td>0</td>
<td>83</td>
<td>0</td>
<td>0</td>
<td>171</td>
</tr>
<tr>
<td>2</td>
<td>211</td>
<td>0.6264</td>
<td>0.0016</td>
<td>1.3E-04</td>
<td>9.1E-03</td>
<td>50</td>
<td>365</td>
<td>87</td>
<td>33</td>
<td>173</td>
</tr>
<tr>
<td>3</td>
<td>311</td>
<td>1.3934</td>
<td>0.1027</td>
<td>7.7E-05</td>
<td>2.0E-03</td>
<td>78</td>
<td>1747</td>
<td>0</td>
<td>2078</td>
<td>170</td>
</tr>
<tr>
<td>3</td>
<td>312</td>
<td>0.0028</td>
<td>0.0000</td>
<td>2.6E-07</td>
<td>4.4E-03</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>321</td>
<td>0.0076</td>
<td>0.0000</td>
<td>0.0E+00</td>
<td>0.0E+00</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>331</td>
<td>0.0493</td>
<td>0.0861</td>
<td>4.5E-06</td>
<td>4.3E-03</td>
<td>2</td>
<td>27</td>
<td>8</td>
<td>1752</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td>411</td>
<td>1.2493</td>
<td>0.0000</td>
<td>0.0E+00</td>
<td>0.0E+00</td>
<td>0</td>
<td>0</td>
<td>536</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>421</td>
<td>0.1092</td>
<td>0.0026</td>
<td>6.5E-06</td>
<td>0.0E+00</td>
<td>17</td>
<td>0</td>
<td>0</td>
<td>52</td>
<td>19</td>
</tr>
<tr>
<td>5</td>
<td>511</td>
<td>0.0063</td>
<td>0.2412</td>
<td>4.2E-05</td>
<td>6.4E-04</td>
<td>0</td>
<td>22</td>
<td>0</td>
<td>4757</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>521</td>
<td>0.0353</td>
<td>0.1620</td>
<td>2.4E-04</td>
<td>3.7E-03</td>
<td>1</td>
<td>10</td>
<td>10</td>
<td>3285</td>
<td>33</td>
</tr>
<tr>
<td>5</td>
<td>531</td>
<td>0.0350</td>
<td>0.1224</td>
<td>5.1E-04</td>
<td>3.4E-03</td>
<td>0</td>
<td>11</td>
<td>9</td>
<td>2444</td>
<td>33</td>
</tr>
<tr>
<td>5</td>
<td>541</td>
<td>2.0577</td>
<td>0.0948</td>
<td>7.7E-03</td>
<td>1.4E-02</td>
<td>76</td>
<td>171</td>
<td>177</td>
<td>1905</td>
<td>1022</td>
</tr>
<tr>
<td>5</td>
<td>542</td>
<td>0.0693</td>
<td>0.0306</td>
<td>5.4E-03</td>
<td>1.5E-02</td>
<td>6</td>
<td>17</td>
<td>20</td>
<td>600</td>
<td>729</td>
</tr>
<tr>
<td>6</td>
<td>611</td>
<td>0.0277</td>
<td>0.0154</td>
<td>1.6E-03</td>
<td>7.6E-03</td>
<td>1</td>
<td>10</td>
<td>28</td>
<td>309</td>
<td>201</td>
</tr>
<tr>
<td>6</td>
<td>621</td>
<td>0.0151</td>
<td>0.0000</td>
<td>2.5E-04</td>
<td>5.2E-03</td>
<td>2</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>6</td>
<td>622</td>
<td>0.0351</td>
<td>0.0390</td>
<td>1.9E-03</td>
<td>1.5E-02</td>
<td>3</td>
<td>9</td>
<td>11</td>
<td>779</td>
<td>244</td>
</tr>
<tr>
<td>7</td>
<td>711</td>
<td>0.0313</td>
<td>0.0000</td>
<td>1.4E-02</td>
<td>2.1E-02</td>
<td>1</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>1791</td>
</tr>
</tbody>
</table>
### *** 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**: 0.551350 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**: 28.215 %

- **CONTROL BYTES TRANSMITTED - TRUNK 1**: 2.75305E+00 BYTES
- **DATA BYTES TRANSMITTED - TRUNK 1**: 6.30132E-01 BYTES
- **CONTROL BYTES TRANSMITTED - TRUNK 2**: 1.73235E-01 BYTES
- **DATA BYTES TRANSMITTED - TRUNK 2**: 7.33200E-03 BYTES
- **TOTAL BYTES TRANSMITTED**: 3.56377E+00 BYTES

- **TOTAL OFFERED LOAD**: 1.95835E+00 BYTES

---

**DEVICE ACTIVITY SUMMARIES**
<table>
<thead>
<tr>
<th>ADP #</th>
<th>DEV #</th>
<th>SOURCE #</th>
<th>TIME ACTIVE (SECONDS)</th>
<th>TIME WAITING (SECONDS)</th>
<th>TIME IN COLLISIONS</th>
<th>AVG MESSAGE DELAY</th>
<th>ABORT COUNT</th>
<th>TRANSMISSION COUNT</th>
<th>RECEPTION COUNT</th>
<th>WAIT COUNT</th>
<th>COLLISION COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0.0104</td>
<td>0.0000</td>
<td>4.8E-05</td>
<td>8.4E-03</td>
<td>0</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>34</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0.1259</td>
<td>0.0000</td>
<td>3.0E-05</td>
<td>7.8E-03</td>
<td>10</td>
<td>80</td>
<td>17</td>
<td>0</td>
<td>46</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0.2765</td>
<td>0.0160</td>
<td>2.9E-05</td>
<td>1.8E-03</td>
<td>15</td>
<td>378</td>
<td>0</td>
<td>325</td>
<td>63</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>2</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0E+00</td>
<td>0.0E+00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0.0003</td>
<td>0.0000</td>
<td>0.0E+00</td>
<td>0.0E+00</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>1</td>
<td>0.0067</td>
<td>0.0215</td>
<td>5.3E-07</td>
<td>3.7E-03</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>440</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0.2473</td>
<td>0.0000</td>
<td>0.0E+00</td>
<td>0.0E+00</td>
<td>0</td>
<td>0</td>
<td>117</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0.0215</td>
<td>0.0002</td>
<td>2.2E-06</td>
<td>0.0E+00</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>0.0011</td>
<td>0.0586</td>
<td>4.0E-05</td>
<td>6.6E-04</td>
<td>0</td>
<td>4</td>
<td>1160</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1</td>
<td>0.0030</td>
<td>0.0546</td>
<td>0.0E+00</td>
<td>6.3E-04</td>
<td>0</td>
<td>1</td>
<td>1109</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>1</td>
<td>0.0117</td>
<td>0.0236</td>
<td>4.7E-04</td>
<td>1.6E-02</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>480</td>
<td>92</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>1</td>
<td>0.4009</td>
<td>0.0537</td>
<td>5.6E-04</td>
<td>1.3E-02</td>
<td>12</td>
<td>37</td>
<td>384</td>
<td>1076</td>
<td>109</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>2</td>
<td>0.0151</td>
<td>0.0000</td>
<td>1.4E-04</td>
<td>1.2E-02</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
<td>0.0031</td>
<td>0.0154</td>
<td>1.3E-03</td>
<td>3.3E-02</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>309</td>
<td>158</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>1</td>
<td>0.0057</td>
<td>0.0000</td>
<td>0.0E+00</td>
<td>1.5E-02</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>2</td>
<td>0.0117</td>
<td>0.0380</td>
<td>1.0E-03</td>
<td>7.1E-02</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>773</td>
<td>128</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>1</td>
<td>0.0051</td>
<td>0.0000</td>
<td>3.1E-03</td>
<td>5.7E-02</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>326</td>
</tr>
</tbody>
</table>
**NETWORK DESCRIPTION**
**ADAPTER # 1**

**ADAPTER # 1:**
- **PRIORITY DELAY ON TRUNK 1:** 0.0000077 SEC
- **FIXED DELAY:** 0.0000049 SEC
- **TOTAL DELAY ON TRUNK 1:** 0.0000204 SEC
- **ADAPTER RETRY COUNT:** 64
- **DEVICE 1 STATUS:** CLOSED
- **I/O BUS TRANSFER RATE:** 330000.00 BYTES/SEC
- **LOAD TIME:** 0.0000000 SEC
- **NUMBER OF DATA SOURCES:** 1
- **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:** 4.682512300E-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:** 0.0000049 SEC
FIXED DELAY: 0.00010495 SEC
TOTAL DELAY ON TRUNK 1: 0.00020456 SEC
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

   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 : 9.765325000E-01

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:211
RECEIVER ID: 211
PROBABILITY: 1.0E+00

DEVICE 2 STATUS: OPEN
DEVICE 3 STATUS: OPEN
DEVICE 4 STATUS: OPEN

***********************
***************
NETWORK DESCRIPTION
ADAPTER # 3
***********************

ADAPTER # 3:

PRIORITY DELAY ON TRUNK 1: 0.0000005 SEC
FIXED DELAY: 0.00000495 SEC
TOTAL DELAY ON TRUNK 1: 0.00020495 SEC
ADAPTER RETRY COUNT : 64

DEVICE 1 STATUS: CLOSED--31
   I/O BUS TRANSFER RATE: 330000.00 BYTES/SEC
   LOAD TIME: 0.0000000 SEC
   NUMBER OF DATA SOURCES: 2

   DEVICE NUMBER 311
   BUFFER SIZE: 1.0E+03 BYTES
   SOURCE # 1 DATA GENERATION RATE: 330000.00 BYTES
   TRUNK TRANSMISSION INTERVAL: 0.0000 SEC
   DATA BLOCK COUNT : 4.882812500E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 311
RECEIVER ID: 541
PROBABILITY: 1.0E+00

DEVICE 2
STATUS: CLOSED
I/O BUS TRANSFER RATE: 3300000.00 BYTES/SEC
LOAD TIME: 0.0000000 SEC
NUMBER OF DATA SOURCES: 1

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

DEVICE 4
STATUS: OPEN

***************************************************************
******* NETWORK DESCRIPTION *******
ADAPTER # 4
***************************************************************
ADAPTER # 4:
DEVICE 1: STATUS: CLOSED

I/O BUS TRANSFER RATE: 3300000.00 BYTES/SEC
LOAD TIME: 0.0000000 SEC
NUMBER OF DATA SOURCES: 1

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: 4.88281250E-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

I/O BUS TRANSFER RATE: 3300000.00 BYTES/SEC
LOAD TIME: 0.0000000 SEC
NUMBER OF DATA SOURCES: 1

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: 9.76562500E-01

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR 421
RECEIVER ID: 411          PROBABILITY: 1.0E+00

DEVICE 3: STATUS: OPEN

DEVICE 4: STATUS: OPEN

***************
NETWORK DESCRIPTION
***************

ADAPTER # 5:

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

ADAPTER # 5:

PRIORITY DELAY ON TRUNK 1: 0.00000025 SEC
FIXED DELAY: 0.0000049SEC
TOTAL DELAY 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: 330000.00 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: 0.0203 SEC
DATA BLOCK COUNT: 2.441406250E-01

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR:511
RECEIVER ID: 511
PROBABILITY: 1.OE+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.OE-01
RECEIVER ID: 511
PROBABILITY: 3.OE-01
RECEIVER ID: 621
PROBABILITY: 3.OE-01
RECEIVER ID: 711
PROBABILITY: 2.OE-01

DEVICE 3 STATUS: CLOSED--53
I/O BUS TRANSFER RATE: 330000.00 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.OE+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: 10000.00 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

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

---------------------------------------------------------
NETWORK DESCRIPTION
ADAPTER # 6
---------------------------------------------------------

ADAPTER # 5:
PRIORITY DELAY ON TRUNK 2: 0.00000215SEC
FIXED DELAY ON TRUNK 2: 0.00001415SEC
TOTAL DELAY ON TRUNK 2: 0.00004355SEC
ADAPTER RETRY COUNT : 64

DEVICE 1 STATUS : CLOSED--61
I/O BUS TRANSFER RATE: 320000.00 BYTES/SEC
LOAD TIME: 0.0000004 SEC
NUMBER OF DATA SOURCES: 1
511
DEVICE NUMBER 611
BUFFER SIZE: 5.0E+02BYTES
SOURCE # 1 DATA GENERATION RATE: 1200.00BYTES
TRUNK TRANSMISSION INTERVAL: 0.4167SEC
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: 320000.00 BYTES/SEC
LOAD TIME: 0.0000004 SEC
NUMBER OF DATA SOURCES: 2

DEVICE NUMBER 621
BUFFER SIZE: 5.0E+02BYTES
SOURCE # 1 DATA GENERATION RATE: 1200.00BYTES
TRUNK TRANSMISSION INTERVAL: 0.4167SECS

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 621
RECEIVER ID: 531
PROBABILITY: 3.0E-01
RECEIVER ID: 541
PROBABILITY: 4.0E-01
RECEIVER ID: 542
PROBABILITY: 3.0E-01

DEVICE 1 STATUS: OPEN
DEVICE 4 STATUS: OPEN

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

NETWORK DESCRIPTION
ADAPTER #: 7

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

ADAPTER #: 7:
PRIORITY DELAY ON TRUNK 2: 0.0000157SECS
FIXED DELAY ON TRUNK 2: 0.0000141SECS
TOTAL DELAY ON TRUNK 2: 0.0000398SECS
ADAPTER RETRY COUNT: 44

DEVICE 1 STATUS: CLOSED--71
I/O BUS TRANSFER RATE: 30000.00 BYTES/SEC
LOAD TIME: 0.0000034 SEC
NUMBER OF DATA SOURCES: 1
711
DEVICE NUMBER 711
BUFFER SIZE: 5.0E+02BYTES
SOURCE # 1 DATA 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
NETWORK DESCRIPTION

ADAPTER # 1

ADAPTER # 1:

PRIORITY DELAY ON TRUNK 1: 0.0000077 SEC
FIXED DELAY: 0.0000049 SEC
TOTAL DELAY ON TRUNK 1: 0.0000126 SEC
ADAPTER RETRY COUNT: 64

DEVICE 1 STATUS: CLOSED—11
I/O BUS TRANSFER RATE: 330000.00 BYTES/SEC
LOAD TIME: 0.0000000 SEC
NUMBER OF DATA SOURCES: 1

DEVICE NUMBER 111
BUFFER SIZE: 1.00E+03 BYTES
SOURCE # 1 DATA GENERATION RATE: 20000.00 BYTES
TRUNK TRANSMISSION INTERVAL: 0.0500 SEC
DATA BLOCK COUNT: 6.882512500E-09

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 111
RECEIVER ID: 211
PROBABILITY: 1.00E+00

DEVICE 2 STATUS: OPEN
DEVICE 3 STATUS: OPEN
DEVICE 4 STATUS: OPEN

NETWORK DESCRIPTION

ADAPTER # 2

ADAPTER # 2:

PRIORITY DELAY ON TRUNK 1: 0.0000049 SEC
### FIXED DELAY: 0.0000049 SEC
### TOTAL DELAY ON TRUNK 1: 0.000002045 SEC
### 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
- DEVICE NUMBER: 211
- BUFFER SIZE: 2.0E+03 BYTES
- SOURCE # 1 DATA GENERATION RATE: 500000.00 BYTES
- TRUNK TRANSMISSION INTERVAL: 0.0000 SEC
- DATA BLOCK COUNT: 9.76562500E-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

---

### NETWORK DESCRIPTION
### ADAPTER # 3

---

### ADAPTER # 3:
- PRIORITY DELAY ON TRUNK 1: 0.0000005 SEC
- FIXED DELAY: 0.00000495 SEC
- TOTAL DELAY ON TRUNK 1: 0.00000204 SEC
- 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
- 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: 4.592812500E-01
**POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 311**

**RECEIVER ID: 541**

**PROBABILITY:** 1.0E+00

**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:** 4.882512500E-01

---

**POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 312**

**RECEIVER ID: 711**

**PROBABILITY:** 1.0E+00

**DEVICE 2 STATUS:** CLOSED

**I/O BUS TRANSFER RATE:** 3300000.00 BYTES/SEC

**LOAD TIME:** 0.0000000 SEC

**NUMBER OF DATA SOURCES:** 1

**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:** 4.882512500E-01

---

**POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 321**

**RECEIVER ID: 111**

**PROBABILITY:** 1.0E+00

**DEVICE 3 STATUS:** CLOSED

**I/O BUS TRANSFER RATE:** 3300000.00 BYTES/SEC

**LOAD TIME:** 0.0000000 SEC

**NUMBER OF DATA SOURCES:** 1

**DEVICE NUMBER:** 331

**BUFFER SIZE:** 1.0E+03 BYTES

**SOURCE # 1 DATA GENERATION RATE:** -6250.00 BYTES

**TRUNK TRANSMISSION INTERVAL:** 0.1400 SEC

**DATA BLOCK COUNT:** 4.882512500E-01

---

**POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 331**

**RECEIVER ID: 541**

**PROBABILITY:** 1.0E+00

**DEVICE 4 STATUS:** OPEN

---

**NETWORK DESCRIPTION**

**ADAPTER # 4**

---

**ADAPTER # 4:**
PRIORITY DELAY ON TRUNK 1: 0.0000115 SEC
FIXED DELAY: 0.0000049 SEC
TOTAL DELAY ON TRUNK 1: 0.0000264 SEC
ADAPTOR RETRY COUNT: 3

DEVICE 1 STATUS: CLOSED--41
I/O BUS TRANSFER RATE: 1333333.00 BYTES/SEC
LOAD TIME: 0.0000000 SEC
NUMBER OF DATA SOURCES: 1
41
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: 4.802012500E+01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR 411
RECEIVER ID: 211 PROBABILITY: 6.0E-01
RECEIVER ID: 521 PROBABILITY: 2.0E-01

DEVICE 2 STATUS: CLOSED--42
I/O BUS TRANSFER RATE: 1333333.00 BYTES/SEC
LOAD TIME: 0.0000000 SEC
NUMBER OF DATA SOURCES: 1
42
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: 9.76562500E+01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR 421
RECEIVER ID: 411 PROBABILITY: 1.0E+00

DEVICE 3 STATUS: OPEN

DEVICE 4 STATUS: OPEN

*****************************************
NETWORK DESCRIPTION
ADAPTER # 5
*****************************************

ADAPTER # 5:
PRIORITY DELAY ON TRUNK 1: 0.0000025 SEC
FIXED DELAY: 0.0000049SEC
TOTAL DELAY ON TRUNK 1: 0.0000204SEC
ADAPTER RETRY COUNT: 1.64

PRIORITY DELAY ON TRUNK 2: 0.0000005SEC
FIXED DELAYS: 0.0000014SEC
TOTAL DELAY ON TRUNK 2: 0.0000155SEC

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: 2.641406250E+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: 2.641406250E+01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 521
RECEIVER ID: 311
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: 2.641406250E+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: 7.0E+03 BYTES
SOURCE # 1 DATA GENERATION RATE: 90000.00 BYTES
TRUNK TRANSMISSION INTERVAL: 0.0100 SEC
DATA BLOCK COUNT: 4.88281250E-01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 541
RECEIVER ID: 411
PROBABILITY: 1.0E+00

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

********************************************************
NETWORK DESCRIPTION
ADAPTER # 5

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

ADAPTER # 6:
PRIORITY DELAY ON TRUNK 2: 0.00000215ECS
FIXED DELAY ON TRUNK 2: 0.00001412ECS
TOTAL DELAY ON TRUNK 2: 0.00003037ECS
ADAPTER RETRY COUNT: 64
DEVICE 1 STATUS: CLOSED--61
I/O BUS TRANSFER RATE: 30000.00 BYTES/SEC
LOAD TIME: 0.0000094 SEC
NUMBER OF DATA SOURCES: 1
611
DEVICE NUMBER 611
BUFFER SIZE: 5.0E+02 BYTES
SOURCE # 1 DATA GENERATION RATE: 1200.00 BYTES
TRUNK TRANSMISSION INTERVAL: 0.4167ECS
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: 30000.00 BYTES/SEC
LOAD TIME: 0.0000094 SEC
NUMBER OF DATA SOURCES: 2

DEVICE NUMBER 621
BUFFER SIZE: 5.00E+02BYTES
SOURCE #1 DATA GENERATION RATE: 1200.00BYTES
TRUNK TRANSMISSION INTERVAL: 0.4167SECS

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 621
RECEIVER ID: 331
PROBABILITY: 4.00E-01
RECEIVER ID: 341
PROBABILITY: 3.00E-01
RECEIVER ID: 352

DEVICE NUMBER 622
BUFFER SIZE: 5.00E+02BYTES
SOURCE #2 DATA GENERATION RATE: 1250.00BYTES
TRUNK TRANSMISSION INTERVAL: 0.4000SECS

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 622
RECEIVER ID: 531
PROBABILITY: 1.00E+00

DEVICE 1 STATUS : OPEN
DEVICE 2 STATUS : OPEN

********************
NETWORK DESCRIPTION
ADAPTER # 7
********************

ADAPTER # 7:
PRIORITY DELAY ON TRUNK 2: 0.0000157SECS
FIXED DELAY ON TRUNK 2: 0.0000415SECS
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: 0.000004 SEC
NUMBER OF DATA SOURCES: 1

DEVICE NUMBER 711
BUFFER SIZE: 5.00E+02BYTES
SOURCE #1 DATA GENERATION RATE: 1250.00BYTES
TRUNK TRANSMISSION INTERVAL: 0.4000SECS

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 711
RECEIVER ID: 521
PROBABILITY: 5.00E-01
RECEIVER ID: 542
PROBABILITY: 5.00E-01

DEVICE 2 STATUS : OPEN
DEVICE 3 STATUS : OPEN

OF POOR QUALITY
SECTION 1.6

SUGGESTED HOSC/CREY CONFIGURATION FOR EXTREME LOADING
**NETWORK DESCRIPTION**

**ADAPTER # 1:**

Priority Delay on Trunk 1: 0.0000009 sec

Fixed Delay: 0.0000049 sec

Total Delay on Trunk 1: 0.0000092 sec

Adapter Retry Count: 54

Device 1 Status: Closed

ISO Bus Transfer Rate: 330000.02 bytes/sec

Load Time: 0.0000002 sec

Number of Data Sources: 1

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: 4.83312500E-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:**

Priority Delay on Trunk 1: 0.0000049 sec
DEVICE 1

STATUS: CLOSED

I/O BUS TRANSFER RATE: 500000.00 BYTES/SEC
LOAD TIME: 3.000000 SEC
NUMBER OF DATA SOURCES: 1

DEVICE NUMBER: 211

BUFFER SIZE: 2.000000 BYTES
SOURCE # 1 DATA GENERATION RATE: 500000.00 BYTES
TRUNK TRANSMISSION INTERVAL: 0.0040 SEC
DATA BLOCK COUNT: 9.95435030E-01

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 211
RECEIVER ID: 211
PROBABILITY: 1.000000

DEVICE 2

STATUS: OPEN

DEVICE 3

STATUS: OPEN

DEVICE 4

STATUS: OPEN

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

NETWORK DESCRIPTION
ADAPTER # 3

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

ADAPTER # 3:

PRIORITY DELAY ON TRUNK 1: 0.0000000 SEC
FIXED DELAY: 0.000000000 SEC
TOTAL DELAY ON TRUNK 1: 0.000000000 SEC
ADAPTER RETRY COUNT: 64

DEVICE 1

STATUS: CLOSED

I/O BUS TRANSFER RATE: 330000.00 BYTES/SEC
LOAD TIME: 3.000000000 SEC
NUMBER OF DATA SOURCES: 2

DEVICE NUMBER: 311

BUFFER SIZE: 1.000000000 BYTES
SOURCE # 1 DATA GENERATION RATE: 1330.00 BYTES
TRUNK TRANSMISSION INTERVAL: 0.7692 SEC
DATA BLOCK COUNT: 4.855825000E-01
DEVICE 2 STATUS: CLOSED--PE1 BACKUP
I/O BUS TRANSFER RATE: 1000000.00 BYTES/SEC
LOAD TIME: 0.0000000 SEC
NUMBER OF DATA SOURCES: 1
SOURCE # 1 DATA GENERATION RATE: 100.00 BYTES
TRUNK TRANSMISSION INTERVAL: 10.0000 SEC
DATA BLOCK COUNT: 4.582712500E+01

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 312
RECEIVER ID: 711
PROBABILITY: 1.0E+00

DEVICE 3 STATUS: CLOSED--POCC
I/O BUS TRANSFER RATE: 3300000.00 BYTES/SEC
LOAD TIME: 0.0000000 SEC
NUMBER OF DATA SOURCES: 1
SOURCE # 1 DATA GENERATION RATE: 6250.00 BYTES
TRUNK TRANSMISSION INTERVAL: 0.1500 SEC
DATA BLOCK COUNT: 4.582712500E+01

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 331
RECEIVER ID: 521
PROBABILITY: 1.0E+00

DEVICE 4 STATUS: OPEN

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

NETWORK DESCRIPTION
ADAPTER # 4

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

ADAPTER # 4:
PRIORITY DELAY ON TRUNK 1: 0.0000073 SEC
FIXED DELAY: 0.0000049 SEC
TOTAL DELAY ON TRUNK 1: 0.0000122 SEC
ADAPTER STATUS COUNT: 24

DEVICE 1: STATUS: CLOSED--SENT ANALYSIS
I/O BUS TRANSFER RATE: 3300000.00 BYTES/SEC
LOAD TIME: 2.0000000 SEC
NUMBER OF DATA SOURCES: 1
DEVICE NUMBER: 411
BUFFER SIZE: 1.00+03 BYTES
SOURCE 1 DATA GENERATION RATE: 100.00 BYTES
TRUNK TRANSMISSION INTERVAL: 10.0000 SEC
DATA BLOCK COUNT: 4.0000000E+01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR 411
RECEIVER ID: 011
PROBABILITY: 2.00E-01
RECEIVER ID: 511
PROBABILITY: 2.00E-01

DEVICE 2: STATUS: CLOSED--SIT OUTSIDE
I/O BUS TRANSFER RATE: 3300000.00 BYTES/SEC
LOAD TIME: 2.0000000 SEC
NUMBER OF DATA SOURCES: 1
DEVICE NUMBER: 421
BUFFER SIZE: 2.00+03 BYTES
SOURCE 1 DATA GENERATION RATE: 200.00 BYTES
TRUNK TRANSMISSION INTERVAL: 20.0000 SEC
DATA BLOCK COUNT: 4.0000000E+01
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR 421
RECEIVER ID: 321
PROBABILITY: 1.00E+03

DEVICE 3: STATUS: OPEN
DEVICE 4: STATUS: OPEN

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

NETWORK DESCRIPTION
ADAPTER # 5

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

ADAPTER # 5:

PRIORITY DELAY ON TRUNK 1: 0.0000073 SEC
FIXED DELAY: 0.0000049 SEC
TOTAL DELAY ON TRUNK 1: 0.0000122 SEC
ADAPTER STATUS COUNT: 24
TOTAL DELAY ON TRUNK 1: 0.0000182065 SEC
ADAPTER RETRY COUNT: 64

PRIORITY DELAY ON TRUNK 1: 0.00000555 SEC
FLAT DELAY: 0.00001647 SEC
TOTAL DELAY ON TRUNK 1: 0.00003555 SEC

DEVICE 1 STATUS: CLOSED
DATA TRANSFER RATE: 300000.00 BYTES/SEC
LOAD TIME: 0.00000000 SEC
NUMBER OF DATA SOURCES: 1

DEVICE NUMBER 511
BUFFER SIZE: 5.000000 BYTES
SOURCE # 1 DATA GENERATION RATE: 1200.00 BYTES
TRUNK TRANSMISSION INTERVAL: 0.4167 SEC
DATA BLOCK COUNT: 2.44146250E-01

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 511
RECEIVER ID: 311
PROBABILITY: 2.0E-01
RECEIVER ID: 611
PROBABILITY: 3.0E-01
RECEIVER ID: 811
PROBABILITY: 3.0E-01
RECEIVER ID: 711
PROBABILITY: 2.0E-01

DEVICE 2 STATUS: CLOSED
DATA TRANSFER RATE: 300000.00 BYTES/SEC
LOAD TIME: 0.00000000 SEC
NUMBER OF DATA SOURCES: 2

DEVICE NUMBER 521
BUFFER SIZE: 5.000000 BYTES
SOURCE # 1 DATA GENERATION RATE: 100000.30 BYTES
TRUNK TRANSMISSION INTERVAL: 0.0050 SEC
DATA BLOCK COUNT: 2.44146250E-01

POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 521
RECEIVER ID: 411
PROBABILITY: 1.0E+00
RECEIVER ID: 422
PROBABILITY: 1.0E+00

DEVICE 3 STATUS: OPEN
DEVICE 4 STATUS: OPEN
ADAPTER 1

Prior to delay on trunk 1: 0.000027 SECS
Fixed delay on trunk 2: 0.000014 SECS
Total delay on trunk 1: 0.000041 SECS
Chapter retry count: 4

Device 1 Status: Closed

I/O bus transfer rate: 100000000 bytes/sec
Load time: 0.000004 sec
Number of data sources: 1
Device number 111
Buffer size: 5.0E+02 bytes
Source #1 data generation rate: 1200.00 bytes/sec
Trunk transmission interval: 0.416786 sec

Possible receivers and their respective probabilities for 111:
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

I/O bus transfer rate: 300000000 bytes/sec
Load time: 0.000004 sec
Number of data sources: 2
Device number 621
Buffer size: 5.0E+02 bytes
Source #1 data generation rate: 1200.00 bytes/sec
Trunk transmission interval: 0.416786 sec

Possible receivers and their respective probabilities for 621:
Receiver ID: 311
Probability: 3.0E-01
Receiver ID: 521
Probability: 4.0E-01
Receiver ID: 522
Probability: 3.0E-01

Device 3 Status: Open

Device 4 Status: Open
NET-WORK DESCRIPTION
APPEAER # 7

APPEAER # 7:
PRIORITY DELAY ON TRUNK 2: 0.00001141SEC
FIXED DELAY ON TRUNK 2: 0.0000141SEC
TOTAL DELAY ON TRUNK 2: 0.0000855SEC
APPEAER NETTY COUNT : 4

DEVICE 1 STATUS: CLOSED -- 111
I/O BUS TRANSFER RATE: 3000000.00 BYTES/SEC
LOAD TIME: 0.0000004 SEC
NUMBER OF DATA SOURCES: 1
711
DEVICE NUMBER: 711
BUFFER SIZE: 5.0E+02BYTES
SOURCE #1 DATA GENERATION RATE: 1250.00BYTES
TRUNK TRANSMISSION INTERVAL: 0.40005SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 711
RECEIVER #1: 611
PROBABILITY: 5.0E-01
RECEIVER #2: 522
PROBABILITY: 5.0E-01

DEVICE 2 STATUS: CLOSED -- 5L SUPPORT
I/O BUS TRANSFER RATE: 3000000.00 BYTES/SEC
LOAD TIME: 0.0000004 SEC
NUMBER OF DATA SOURCES: 1
721
DEVICE NUMBER: 721
BUFFER SIZE: 5.0E+02BYTES
SOURCE #1 DATA GENERATION RATE: 2400.00BYTES
TRUNK TRANSMISSION INTERVAL: 0.20021SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 721
RECEIVER #1: 611
PROBABILITY: 1.0E+00

DEVICE 3 STATUS: CLOSED -- 5T SUPPORT
I/O BUS TRANSFER RATE: 3000000.00 BYTES/SEC
LOAD TIME: 0.0000004 SEC
NUMBER OF DATA SOURCES: 1
731
DEVICE NUMBER: 731
BUFFER SIZE: 5.0E+02BYTES
SOURCE #1 DATA GENERATION RATE: 1200.00BYTES
TRUNK TRANSMISSION INTERVAL: 0.4167SECS
POSSIBLE RECEIVERS AND THEIR RESPECTIVE PROBABILITIES FOR: 731
RECEIVER #1: 622
PROBABILITY: 1.0E+00

DEVICE 4 STATUS: OPEN

ORIGINAL PAGE IS OF POOR QUALITY