DEVELOPMENT OF TRAFFIC DATA COLLECTION AND ANALYSIS
SYSTEM FOR VARIOUS ESS TYPES IN KOREA

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ABSTRACT

The traffic data in telecommunications network operation can be used for the following purposes:
- efficient use of existing facilities
- keeping up the grade of service level for subscribers
- planning and engineering of telecommunications network
Not only for the purposes described above, but for the automatic network management, the Centralized Traffic Management System (CTMS) has been developed.

In this article, we will introduce the CTMS architecture including the traffic data interface units of which primary functions are as follows;
- temporarily storing the traffic data from the ESS
- communication with the host computer to send the traffic data or receive messages.

1. INTRODUCTION

In general, the method of traffic measurement and data collection for the electromechanical switching systems is independent of the exchange type.

On the other hand, the electronic switching system (ESS) measures the traffic using the internal software in its own way, so an appropriate system for traffic data collection from the various types of ESS should be developed.

The Centralized Traffic Management System (CTMS) was developed to meet the needs described above in Korean situation, which could collect traffic data from the ESS and process it to control and manage the telephone network.

The CTMS performs the functions as follows;
- traffic data collection from the different types of ESS in Korea through the data line
- maintaining the central office equipment data
- storing the traffic data for further applications.

The CTMS consists of two basic parts; host computer system and traffic data interface units for each type of ESS. The data transfer interface processor (DTIP) was developed for the ESS which records the traffic measurement results on the magnetic tape.

On the other hand, the pollable data unit (PDU) was also developed for the ESS which produces the traffic measurement results on the local printer.

Both interface units, which were added to the relevant ESS, are under the control of the commands from the host computer system. Figure 1 illustrates the overall CTMS configuration.

![CTMS Configuration Diagram](image)

Fig. 1 The CTMS Configuration

2. INTERFACE UNITS

The interface units temporarily store the traffic data from the ESS and send it to the host computer after receiving the appropriate commands. As described above, two kinds of interface units (DTIP and PDU) were developed according to the traffic data collection method from the ESS.

2.1 Data Transfer Interface Processor (DTIP)

As shown in Figure 2, the DTIP catches the traffic data when it flows from the magnetic tape controller to magnetic tape unit in the ESS. The DTIP stores the traffic data until it receives the commands, "send", from the host computer.

The ESS (M10CN) has two CPUs (A and B) to operate in load sharing mode, and both CPUs measure the traffic and transmit it to MTU simultaneously. Accordingly, the DTIP was designed to use two processors to operate independently.

The DTIP hardware was configured using the Z80A microprocessor and its family.

The DTIP investigates the line status between MTC and MTU to catch the traffic data. Communications with the host computer is accomplished through the data set on the idle condition of the line after checking out the status between two processors in DTIP. As the interface units are connected to the host computer in multipoint mode,
each unit has its own site code (8 bits) to distinguish the messages from the host computer.

The software of DTIP was designed to operate in interrupt mode with its four main routines as follows:
- data collection routine: catches the traffic data between the MTC and MTU, and stores it in RAM
- communication routine: receives the commands from the host computer and performs its function after checking out the site code predefined
- system initialization routine: keeps up the system parameters and controls the printer for the special messages from DTIP or host computer
- self-diagnostic routine: investigates the PROM status.

Figure 3 shows the DTIP software structure.

2.2 Pollable Data Unit (PDU)

For the ESS (NO.1A) which has its own printer channel for the traffic data, the PDU collects the traffic data and transmits it to host computer.

The PDU hardware also used the Z80A microprocessor and its family as illustrated in Figure 4.

From the I/O channel A and B, the PDU receives the traffic data or other messages from the ESS. These two channels can be connected to the PDU through the data set or directly using EIA 25 pin connector. The PDU has two switches (8 bits), one for its site code and the other for its transmission speed control to the host computer.

The software of PDU was designed to operate in interrupt mode with its four main routines as follows:
- I/O control routine: receives the traffic data from the channel of the ESS and stores it in the buffer. When the messages are not for traffic data, this routine sends them to the printer-buffer for output on local printer.
- communication control routine: receives commands from the host computer and performs its function after checking out the site code. If the messages are for local printer, this routine just forwards them to the printer-buffer.
- printer control routine: investigates the three independent buffer areas (I/O A, I/O B and printer buffer) and prints out the contents of the buffer on local printer not-overlappingly.
- self-diagnostic routine: investigates the PROM every 25 minutes. If the error is detected after comparing the checksum of PROM, it generates a sound for warning.

Figure 5 illustrates the PDU software structure.
3. CTMS ARCHITECTURE

The computer system controls the interface units which were connected to the ESS through data lines in multipoint mode. VAX11/780 system has been used as the CPU with 64MB main memory, 900MB disk storage, 3 M.T units, 8 multiplexors and the other peripheral devices.

3.1 Interface Unit Control Technique

One I/O channel in CTMS computer has multi-connection to several sets of interface units which have their own inherent site codes.

When the command poll has been sent through the channel in CTMS computer, the interface unit detects it and compares the site code fields. If the site code in the command poll is consistent with that of the interface unit, it activates the request-to-send (RTS) signal "ON" to send response message.

One of the ASCII character A to Z can be used as a site code of interface units, and 0 to 9 for the command and response code.

The implemented command class is as follows;
- transmission request or cancellation of the traffic data stored in the interface units
- initialization of interface units
- timeout control of data line
- start or end of transmission
- status request for interface units, etc.

Data communications between the computer system and the interface units is achieved in handshaking mode. A command of CTMS computer is usually followed by a response from the interface units.

If the CTMS computer could not receive the response from the interface units, it retransmits the command every 1 second. The command is aborted after 3 times of retransmission.

3.2 Traffic Data Polling

On-line data polling is accomplished by the scheduling table in the CTMS computer. The invoked scheduling program analyzes the scheduling table every quarter hour and the format is as follow;

<table>
<thead>
<tr>
<th>device type</th>
<th>up/down</th>
<th>command-1</th>
<th>command-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>printer control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAM check</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROM check</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I/O A,B control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>data collection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>message collection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>status monitor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>data formatting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>command analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>message print</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>data transmit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>data buffering</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>data comm.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>diagnostic</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The number of tables which the computer system retains, is the number of sites multiplied by the number of quarter hours.

Device type field of the format displays classification of interface units, and up/down field indicates the status of the units. Command -1 and command-2 fields represent the contents of commands. Among these, the data polling commands are expressed in 100(oct) plus the number of traffic data classifications predefined.

On receiving the data polling command from the host computer, the interface unit transmits the traffic data which has been stored in its buffer area. If there is no traffic data stored, it transmits not-ready response frame to the host computer. Followings are the message frame formats in transmission sequence.

<table>
<thead>
<tr>
<th>SOH</th>
<th>&quot;A&quot;</th>
<th>101(oct)</th>
<th>ETX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>command poll frame</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SOH</th>
<th>&quot;A&quot;</th>
<th>101(oct)</th>
<th>ETX</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>response frame(ready)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SOH</th>
<th>&quot;A&quot;</th>
<th>EOT</th>
<th>ETX</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>text</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SOH</th>
<th>&quot;A&quot;</th>
<th>EOT</th>
<th>ETX</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>data end frame</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. DATA ANALYSIS SOFTWARES

This part describes the software systems, which uses the informations in the common data base to analyze the traffic data for the operations and maintenance of the exchanges.

The period of data analysis can be determined according to its operational purpose.
- 30sec. or 5min.; network control
- 15min. or hours; on-line reporting
- weeks or months; network administration
- weeks or months or years; network engineering/planning

In this paragraph, the following software systems will be described.
- on-line report generation and distributor
- detailed reporting system
- planning and engineering reporting system
- load balance analysis system
4.1 On-line Report Generation and Distributor

The traffic data collected by the data polling software is stored on addressed memory and then forwarded to mass storage (magnetic disk). The reporting software analyzes the traffic data using the exchange equipment informations in common data base (CDB), and generates the exception reports to be printed out on the interface unit's printer.

The items analyzed by this software are as follows:
- abnormal holding time (suspect usage)
- overflows on trunk group, junctor, signaling devices beyond the threshold.
- other informations needed to maintain the exchange facilities.

4.2 Detailed Reporting System

This software analyzes the traffic data collected weekly or monthly and the following reports can be produced.
- busy hour traffic calculation
- traffic flow diagram
- day to day traffic variation in a week
- number of required trunks
- traffic per subscriber in busy hour
- local and toll traffic
- traffic on common devices
- number of non-completed calls
- other informations

4.3 Planning and Engineering Reporting System

Using the annually accumulated data processed by the detailed reporting system, the traffic variation during a year can be produced to determine the busy season traffic. This system makes it possible for the engineer to calculate the seasonal or safety factors, so as to adjust the efficient number of the network operation facilities.

4.4 Load Balance Analysis System

The traffic congestion on the subscriber concentrator occurs occasionally upon the subscriber's behavior. This system analyzes the subscriber's line concentration circuit traffic of the specified period, and makes it possible to keep the traffic balance among the subscribers.

Figure 6 shows the overall software structure of CTMS.

5. CONCLUSION

The efficient administration and management of telephone network could be accomplished since the CTMS provides the sufficient informations for the short and long term study of traffic patterns in Korea.

For the automatic control of the toll telephone network, a specialized system with the graphical display capabilities of the network status, should be developed to collect and process the traffic data on shorter interval (at least less than 5 minutes).

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Fig. 6 CTMS Software Structure