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CONTENTS

TECHNOLOGY TRANSFER

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TCT 3720: NEW HUNGARIAN DATA TRANSFER CONTROL

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[Article by Oszkar Kovacs and Balazs Martos: "New Domestically Manufactured Data Transfer Control: The TCT 3720 Teleprocessing Processor"]

[Text] For a long time the Telephone Factory and MTA SZTAKI [Computer Technology and Automation Research Institute of the Hungarian Academy of Sciences] have cooperated successfully in research, development and manufacture of teleprocessing equipment. Research connected with teleprocessing has been conducted for a long time at MTA SZTAKI in the areas of microprogrammed computer architectures, the technology of microprogramming and computer networks. A practical result connected to this work is the TCT 3720 (EC 8372) teleprocessing processor developed on a commission from the Telephone Factory. The equipment has successfully passed international tests within the framework of the ESZR [Uniform Computer Technology System] and a number of domestic and Soviet state authority tests.

Introduction

The remote and collective accessing of computer resources became necessary in an early stage of computer development. The teleprocessing technique thus developed.

Teleprocessing systems became increasingly complicated in the course of use and the number of remote users increased. As a result the control of more complicated large computer systems put more and more administrative burden on the central computer, and less and less power was available for data processing.

In the course of the development of computer technology they succeeded in solving this contradiction in several ways:

--by increasing the central processing capacity;

--by decentralizing data processing in such a way that data were processed by individually installed micro and minicomputers; and

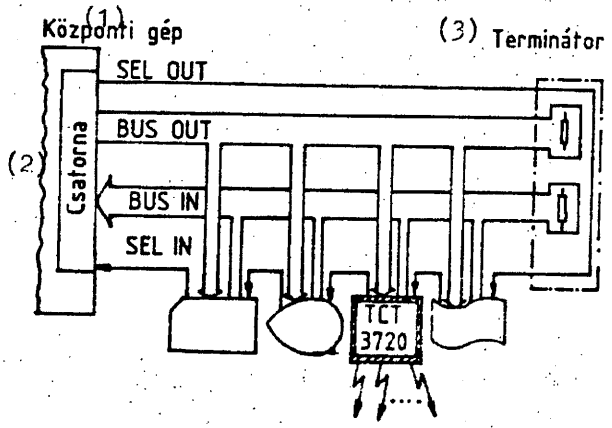
--by increasing the intelligence of the elements of the system, maintaining the teleprocessing structure, in such a way that only data processing tasks accounted for the great bulk of the resources of the central processing unit.

Of the above the first solution soon ran into technical limits and because of its high cost it was not widespread. In certain cases the second version provides a satisfactory solution, if it is not necessary to have an information link between the several processing tasks. In practice, however, data exchange between decentralized processing sites is necessary in most cases, so we come to the third solution, which is the presently most favorable solution for larger information teleprocessing systems. With the spread of the ISDN principle the transmission of digital material causes fewer and fewer problems.

The Place of the TCT 3720 in a Large Computer Environment

In ESZR and compatible large computer systems control units connect data transmission to the I/O interface of the channel. The TCT 3720 also can be connected into a system in this standard way (Figure 1).

Figure 1.



Key:

1. Central Computer
2. Channel
3. Terminator

The TCT 3720 equipment is a programmable data transfer control device, which means that at the beginning of operation its control program must be loaded from the central computer through the I/O interface.

Programmability has the following advantages:

--The system can be flexibly reorganized at any time if we load it with a control program prepared according to new considerations.

--Thanks to the higher degree of intelligence of programmed equipment the link between the computer and the data transfer control is less administrative;

that is, the data transfer control equipment can take over a number of tasks which the computer performed earlier. Relieving the burden on the central machine increases the power of the entire system.

Independent of the loaded control program we use the TCT 3720 equipment in two modes, emulation and network modes. Table 1 compares the two modes.

Table 1.

Parameter	Emulation Mode	Network Mode
Interrupt request in central computer	by character	by message
Insert and delete and character management:		
Directly from central machine:	data tranfer control	terminal
Data transfer control:	access mode	data transfer control
Error correction	access mode	data transfer control
Code transformation	access mode	data transfer control
Managing timing	access mode	data transfer control
Polling terminals	access mode	data transfer control

Internal Structure of the Equipment

The internal structure of the TCT 3720 can be seen in Figure 2. In the following we describe the several components and their functions.

CCU (Central Control Unit)

Provides total control of device. Control of the several interface units (channel interface scanner) takes place through hardware registers connected to the I/O bus. The CCU executes a program located in main memory; the instruction set for it consists of 51 macro instructions.

MEM (Main Memory)

Provides intermediate storage for the control program for the equipment and for data. The control program administers the memory.

CA (Channel Adapter)

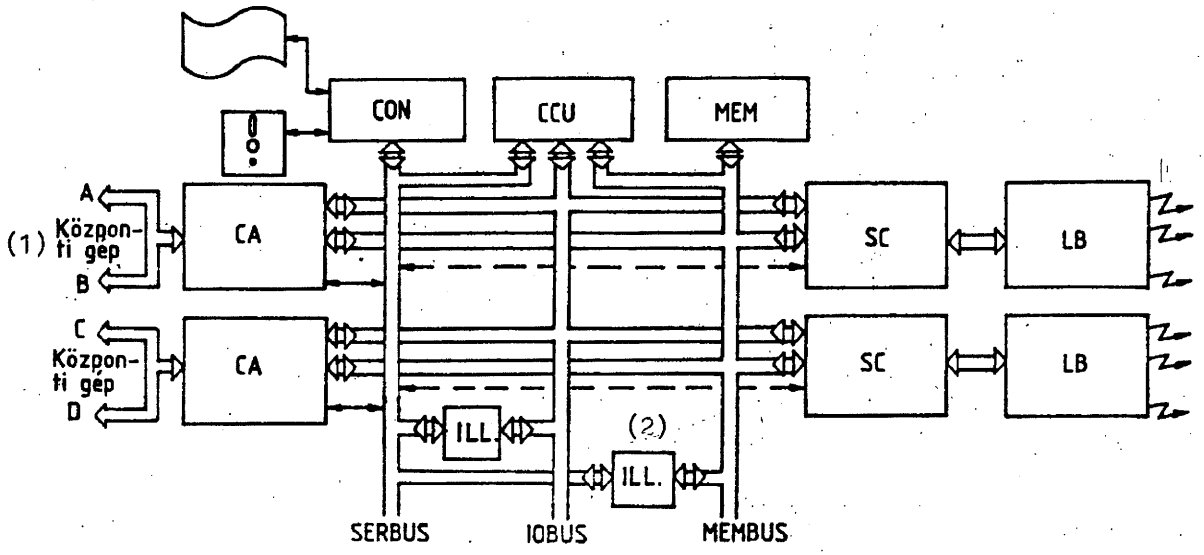
The channel adapters connect the equipment to the central computer. The TCT 3720 can be supplied with two types of channel adapter:

--The type 1 channel adapter (CA1) can operate in both emulation and network mode. It requests interrupts from the central control unit (CCU) of the

equipment by byte. It communicates with the central computer in the form of packets with a maximum of 4 bytes.

--The type 4 channel adapter (CA4) can also operate in both emulation and network mode. It communicates with the central computer in packets with a maximum of 256 bytes without program intervention. Data are transferred between Main Memory and the I/O interfaces by direct memory access in packets of at most 255 characters (bytes).

Figure 2.



Key:

1. Central computer 2. Interface

SC (Scanner)

The equipment handles the data transmission lines with the aid of scanning coupling units. Each such unit can handle a maximum of 32 lines. The TCT 3720 can be supplied with two types of coupler:

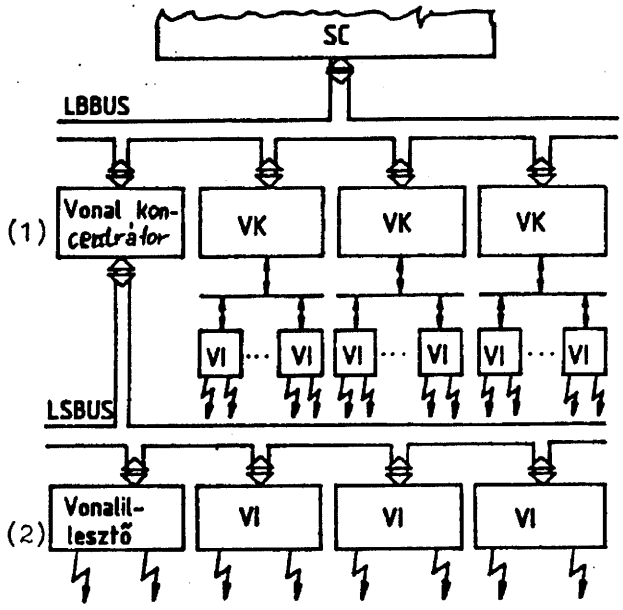
--The type 2 scanner can handle lines working according to any data transmission protocol interpreted to the equipment. The control program regards the data as instructions. The scanner then processes these on the line by bit.

--The type 3 scanner handles lines working according to the SDLC/HDLC protocol. The data are transferred between main memory and the data transmission lines by direct memory access, in packets of at most 255 characters (bytes).

LB (Line Interface)

Figure 3 shows the hardware structure between the scanners and the data transmission lines.

Figure 3.



Key:

1. Line concentrator 2. Line interface

Each line concentrator can handle four line interfaces. Each line interface serves two data transmission lines. The line interfaces can be located as one likes in the available spaces.

Four types of line interfaces can be used in the TCT 3720 equipment:

--a line interface working according to the Start-Stop and BSC protocols,
--a line interface working according to the SDLC/HDLC protocol,
--a line interface working according to CCITT proposals V.25 or S.16, controlling automatic caller; or
--a line interface controlling automatic call according to CCITT proposals X.20 or X.21.

CON (Console)

The console is an intelligent component of the TCT 3720 based on an 8 bit personal computer. The program running in its operational memory works independently of the TCT 3720. Information exchange between the TCT 3720 and the console is handled over a special hardware and software interface.

The several components of the equipment can be accessed with the aid of the hardware interface (SERBUS). This makes possible the testing of microprograms running in the several adapters.

Two each input and output registers support data transfer between the central control unit (CCU) and the console. Through these the operating status of the TCT 3720 can be monitored from the console during operation. There is also a possibility for control of the TCT 3720.

The link between the console and the main memory of the TCT 3720 offers numerous diagnostic possibilities with the aid of which one can even intervene in the control program of the equipment. This could be the listing of a given memory area or writing to a given memory area.

The peripherals of the console (disk and printer) offer the possibility of automating diagnosis of the equipment (program loading, journal, etc.).

The Unique Feature of the TCT: Microprogrammed Structure

In general the speed and power needs of equipment handling serial data transmission lines are not so great that control of it could not be handled by the somewhat slower microprogrammed method instead of a purely logic circuit solution. In regard to their functions purely task oriented logic circuits for the most part become rather complicated so the advantages offered by microprogramming appear in an obvious way.

Among the advantages one might stress the smaller need for parts. A microprogrammed version is favorable not only from the viewpoint of price and the size of the equipment but also because it increases reliability, so it is important to consider jointly the needs of the user and the reliability of the available parts.

In addition to all this it is of great significance for practice that microprogrammed equipment is reviewable and testable so that repairs--in case of failure--are substantially simpler. The economic advantage of this appears in less expenditure for the manufacturer and in shorter downtime for the user.

We would like to believe that in developing the TCT 3720 (EC 8372) teleprocessing processor we took good advantage of the theoretical considerations and practical possibilities connected with microprogramming.

Additional Technical Data on the TCT 3720

Software support:

The equipment can be controlled by the DOS, OS, VM, DOS/EC, OS6 and OS7 operating systems. In addition it is supported by BTAM, TCAM and VTAM access modes, by EP, NCP and PEP control programs and by OLTEP and OLTSEP diagnostic programs. The number of macro instructions interpreted is 51.

Table 2 shows the computer-side surface:

Item	ESZR	IBM
Central computers which can be connected	R 20, RYAD-2, RYAD-3	Systems 360, 370, 3400, 3030 and 4300
Channel types which can be connected	mpx, selector	mpx, selector
Number of central computers or channels which can be connected	a maximum of 4	
Transmission speed in the channel	max. 20 K bytes/s	

The characteristics of the line-side surface are given below.

Interface types:

--CCITT V.24/V.28 (ISO 2110; RS-232-C)
--CCITT V.25 (ISO 2110; RS-366)
--CCITT X.20/X.24 (ISO 4903)
--CCITT X.21/X.24 (ISO 4903; RS-422)
--CCITT V.35 (ISO 2593)

Types of telecommunications lines which can be connected:

--switched or leased 2/4 wire telephone connection;
--leased 2/4 wire galvanic connection;
--public postal line switched data network;
--broad band connection.

Data transmission speeds:

--with internal clock signal, 50 - 19,200 bps;
--with external clock signal, max. 64 K bps.

The maximum number of data transmission lines which can be connected is 64.

Types of Terminals Which Can Be Connected

ESZR Code No	ESZR Model	IBM Model	Protocol	Code
EC 8591 EC 8592	T 51 T 63 T 100 F 1000		Start-Stop	MTK 2 CCITT No 2
EC 8570 EC 8575M	TAP 70	2740/41	"	CCITT No 5; ASCII; KOI-7

(continued next page)

Types of Terminals Which Can Be Connected (continued)

ESZR Code No	Model	IBM Model	Protocol	Code
EC 8564	AP-64	2260	Start-Stop	CCITT No 5; ASCII; KOI-7
EC 8534.01	TAP 34	2780	BSC	"
EC 8534.02	"	"	"	"
EC 8534.03	TAP 34VER	"	"	"
EC 8534.75	TAP 34EDT	3275	"	"
EC 7290	TAP 34GDT	3276	"	"
EC 7920	"	"	SDLC/HDLC	"
EC 8566			"	"
		3767	"	ASCII

Autobiographic Notes

Oszkar Kovacs: I graduated from the Electrical Engineering School of the Budapest Technical University in 1971. Since then I have worked in the computer technology development main department of the Telephone Factory. I have participated in or led the development of a number of data transmission devices (modem, telegraph line coupler, error protection equipment). I won my doctorate in 1985 at the Budapest Technical University, on the theme of operations monitoring questions with computer networks. At present I am leading work connected with development and manufacture of the TCT 3720 processor. My interests are computer networks, technical history and choral singing.

Balazs Martos: I graduated from the Electrical Engineering School of the Budapest Technical University in 1977. Since then I have worked at the Computer Technology and Automation Research Institute of the MTA. During the past 10 years I have done or guided microprocessor hardware-firmware work on various research and development themes. I am especially interested in questions of microprogrammed control. I and my colleagues received the Institute Prize for development of the TCT 3720 processor.

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