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National Security Agency

Fort George G. Meade, Maryland

TECHNICAL DEVELOPMENT PLAN

for

PROJECT DART GAME

(July 1971)

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HANDLE VIA COMINT CHANNELS ONLY

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I. INTRODUCTION

The purpose of this Technical Development Plan is to propose a solution to the proliferation of remote terminal types; to allow multiple host CPU addressing from a single terminal; and to provide relief to the central C Group computers of the communications overhead associated with handling multiple terminals.

The approach offered allows gradual implementation, minimal initial cost, simplicity in design, and a total family of remote batch terminals and on-site controller systems. This approach will enable us to reach the desired goal, years ahead of other approaches considered.

II. STATEMENT OF PROBLEM

There are currently some 450 remote terminals on-line to six major computer systems in C Group. At the present growth rate this number will be 650 terminals by FY73, with each terminal capable of addressing only one specific host computer. If C Group is to effectively support the predominant trend to remote access stations for batch and interactive applications with centralized computers, standardization of terminals, communications methods, and front-end processors must be accomplished. With this approach a greater variety of user functions will be available for problem solution such as multiple host computer addressing, greater data base accessibility and enhanced local pre-processing and post-processing functions. Figure 1 is a sample of the multiple computer utilization within the Production element.

With the accumulation of additional remote terminals, there must also come a means of handling the data communications between the host system and the remote terminal. Because of the nature of data communications, and the design of both computer hardware and software, the handling of data communications usually takes place at the highest priority. There are many time critical, communications oriented tasks that impair processing productivity: error detection and correction, message formatting, message addressing and routing, terminal polling, terminal control, message assembly and data concentration, etc. With each interrupt, several operating system commands must be executed and the applications processing interrupted and stored. As greater communications requirements are levied against a computer system, less and less time will be available for data processing.

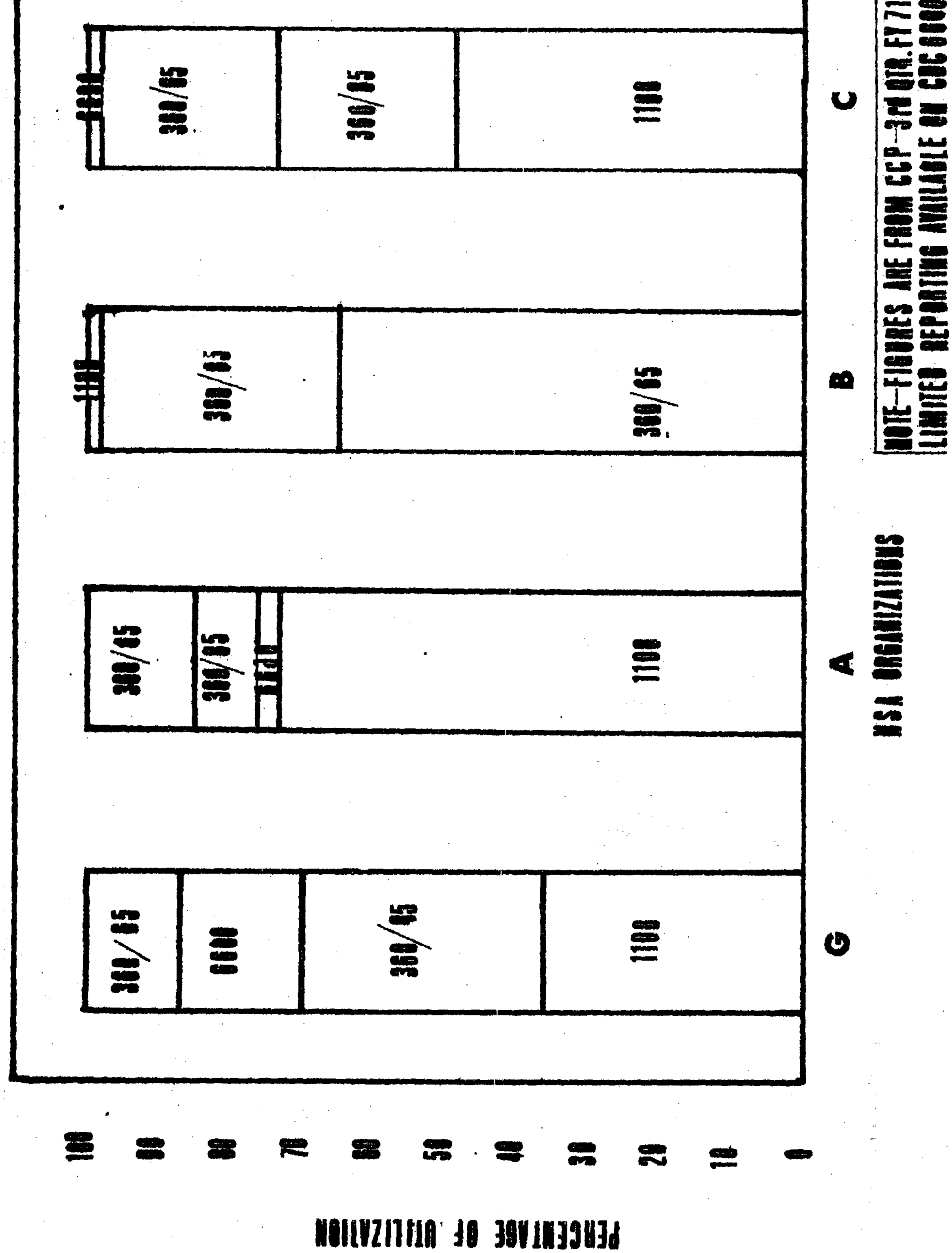

Fig 1

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It is this proliferation of terminal types and the need to relieve the computers of communications processing overhead that DART GAME is addressing.

BACKGROUND

Today each general purpose computer system in C Group has its own set of dedicated terminals. Generally, there are several different types of terminals required, depending upon the specific application.

Some of the different batch terminals currently in use at NSA are as follows:

1. IBM 2780 Data Transmission Terminal

A remote batch terminal designed primarily to enter card data into a central computer, with either punched card or printer output. The system is comprised of a 240 lpm printer, 400 CPM card reader/355 CPM punch, a line buffer, with the requisite communications interfaces.

2. IBM 360/MODEL 25

This system constitutes the upper limit of the IBM Remote Job Entry (RJE) terminal systems. The 25 series provides a full line of peripherals that allows the user a variety of input and output media. With the associated communications interface (2701) Data Adapter the terminal can receive or transmit data (in half duplex mode) at speeds up to 50 KBS.

3. CDC 217 Station Entry/Display

This system is capable of displaying data entered from keyboard or data received from the computer. The keyboard includes features for display control, edit functions, and message transmission. The 217 is equipped with a Line Printer which provides printed copy of display data at 300 lines/minute. Also attached is a card reader which reads punched card data to be displayed or printed, and/or transmitted to the computer at 330 cards/minute.

4. UNIVAC 1004 III System

The UNIVAC 1004 III System consists of a processor, printer, and card reader in a central unit, and a separate magnetic tape unit. Optional input/output units available include: card read/punch, auxiliary card reader, paper tape reader and paper tape punch. The 1004 is a plugboard - programmed computer which can function as a communications terminal.

5. UNIVAC 9300

The UNIVAC 9300 is a high speed card and magnetic tape processing system with high speed printer output. It can produce input of up to 2,000 cards per minute, up to 1,200 lines per minute output, and constant speed punching of 200 cards per minute.

Each of the terminals mentioned above are connected to a specific host computer. If a terminal user requires access to multiple computers of different makes, he must acquire a different terminal for each unique host he wishes to communicate with. (See Figure 2).

III. PROBLEM SOLUTION

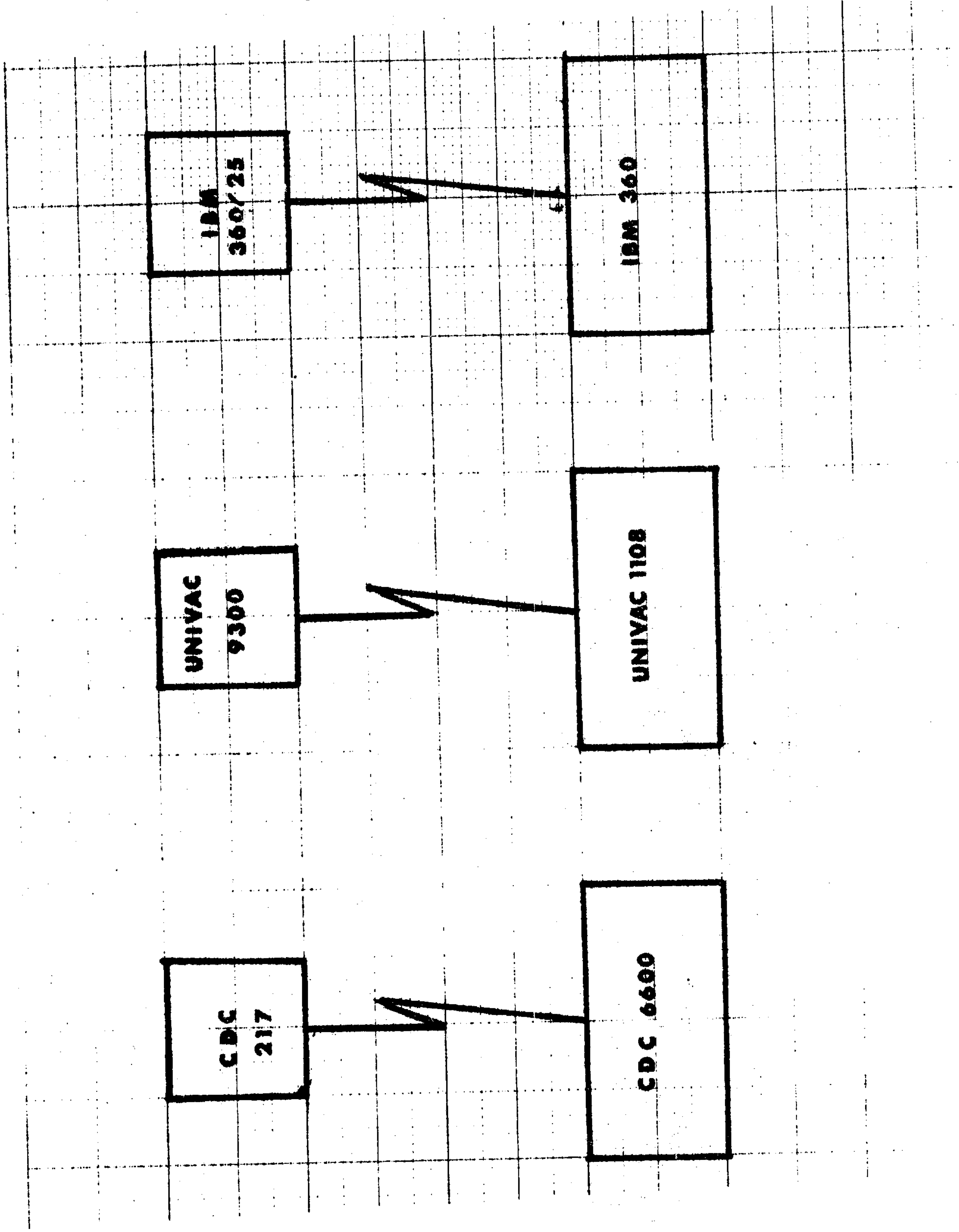
Figure 3 depicts the proposed DART GAME solution. The terminal provided can be tailored to many different requirements and is not predicated upon the characteristics of any central computer. (A feasibility study is underway to determine the best method of providing the communications link between the terminals and the Interface Control Processor, i.e., multiple, dedicated lines to the various computers or a single line to a dial-up Network Controller).

The Interface Control Processor (ICP) is fundamental to the problem solution since it provides a common communications interface to a large number and variety of remote terminals.

An interim solution to network control will be the inter-connection of ICP's. (See Figure 4). This would allow all terminals to have access to all the host processors. The ICP's are assigned one per host processor and the interconnection is provided by 50 KB communications lines.

Data received in the controller will be in a common communication code. The ICP EXEC would examine the common code header and upon detecting a routing indicator would submit the data to a background program. The background routine would schedule the data to be transmitted to the indicated ICP in a common code. The indicated controller would receive the data and process it as though it had received it from the terminal originally. Output data would take the reverse course back to the originating terminal.

Fig. 2



HANDLE VIA COMINT CHANNELS ONLY

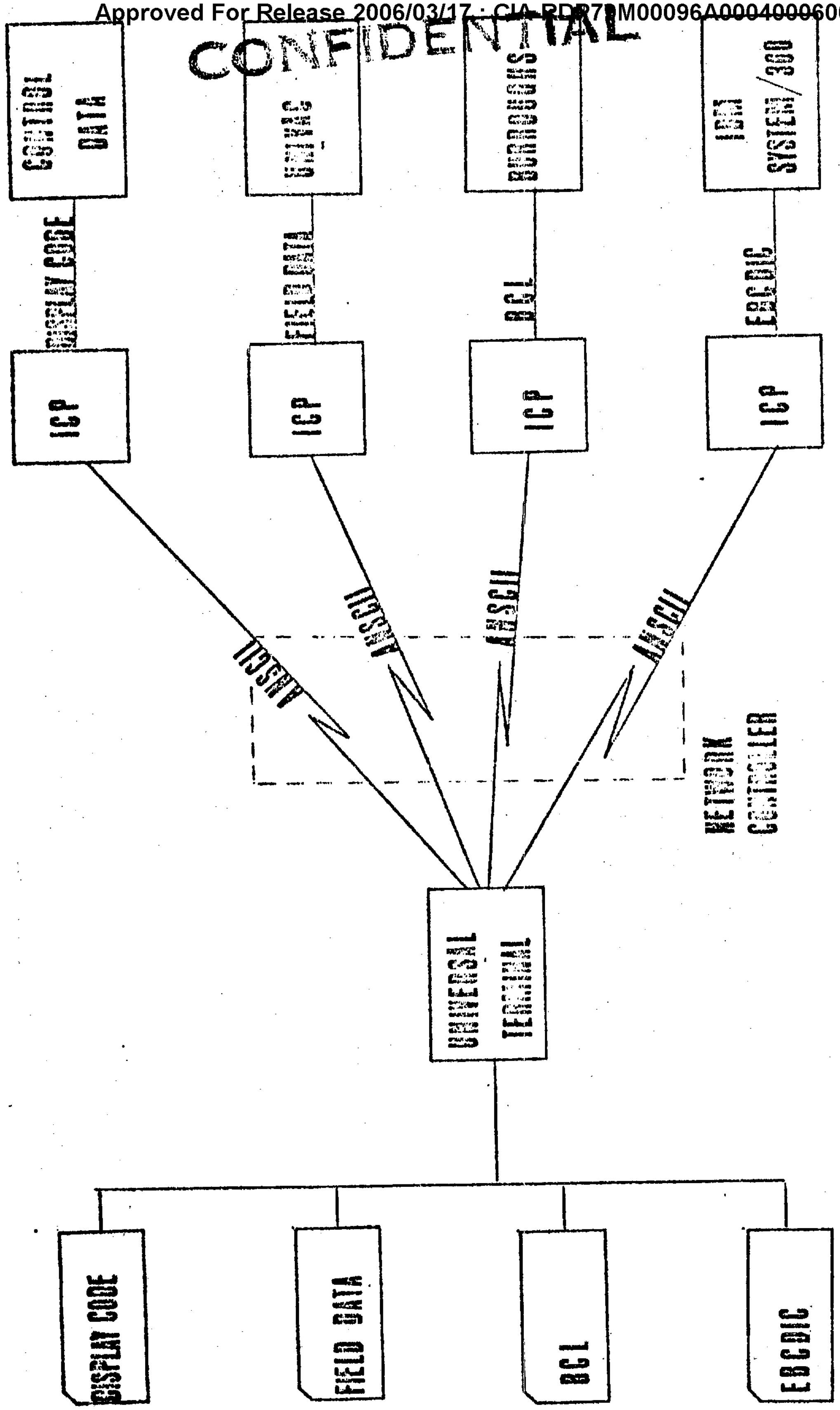

CONTROL DATA
UNIVAC
BURROUGHS
IBM SYSTEM/360
DISPLAY CODE
FIELD DATA
BCL
EBCDIC
ICP
ICP
ICP
ICP
ANSCII
ANSCII
ANSCII
ANSCII
NETWORK CONTROLLER
UNIVERSAL TERMINAL
DISPLAY CODE
FIELD DATA
BCL
EBCDIC

FIG. 3

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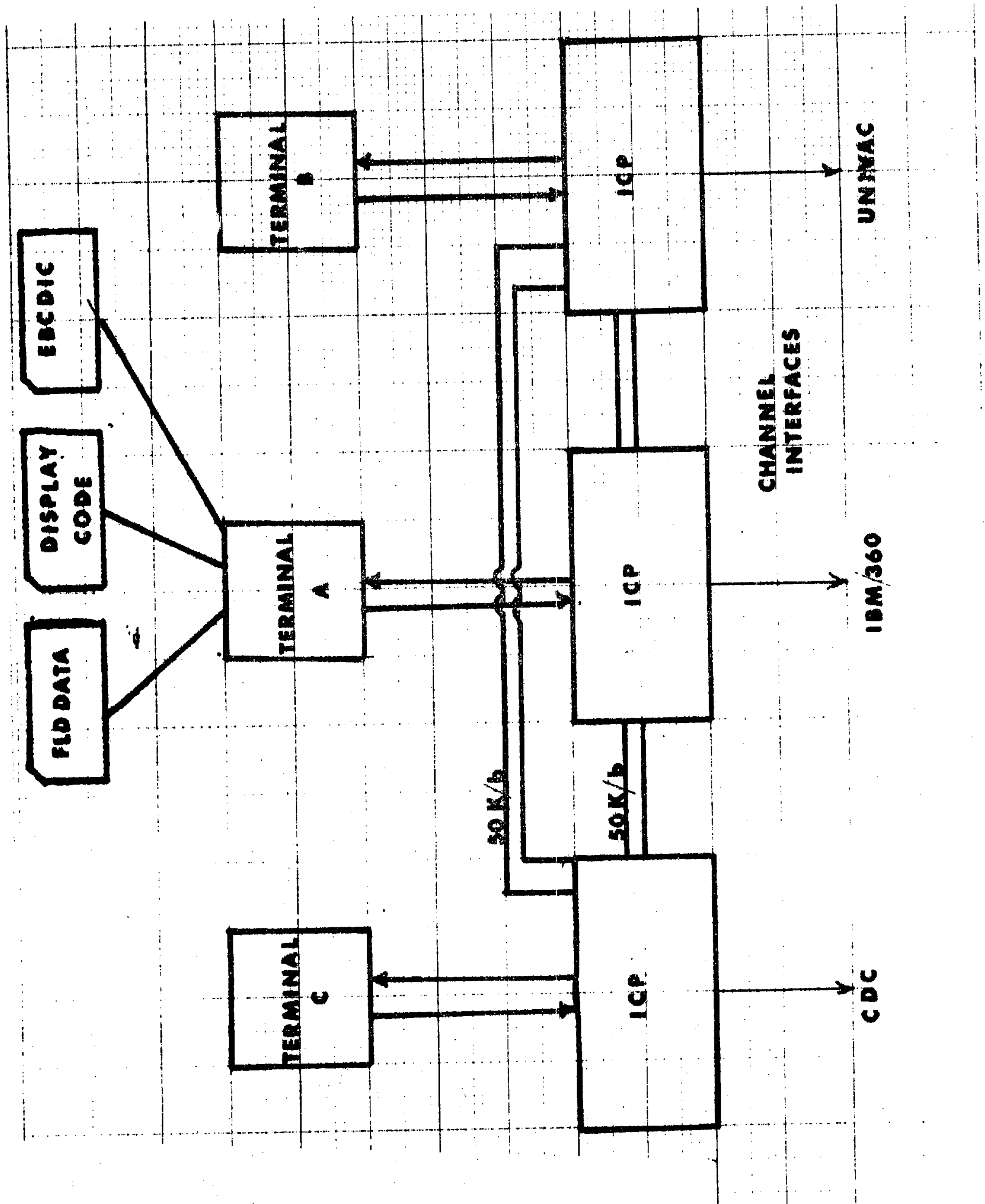

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FIG. 4

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A. UNIVERSAL TERMINAL

With acceptance of the Universal Terminal concept, an immediate benefit will be realized from the savings in logistic support, training, maintenance, and software support requirements, as well as, a reduction in the number of terminals required. By deploying a terminal with the hardware architecture, unique communications interface, and software, a multi-machine task may be initiated from a single analyst position. A significant decrease in problem solution time and overall improvement in resource utilization would result.

Ideally, DART GAME would provide one terminal configuration which would be applicable to all terminal requirements, whether it be conversational or batch or some combination thereof. In a survey of equipment offered today, we can find no such terminal. Therefore, for the DART GAME study, the UNIVERSAL Terminal evaluation is divided into batch and conversational/batch categories.

1. The UNIVERSAL Batch Terminal being proposed is a computer based communications oriented system, with a full complement of peripherals, that provides the full range of processing capability, from the basic batch terminal with card reader/punch and a printer (IBM 2780 magnitude) to a full satellite terminal (360/25 magnitude).

2. UNIVERSAL Conversational/Batch Terminal, although communications oriented, will most likely not be a computer based system. Like the UNIVERSAL Batch Terminal, a full complement of slow speed peripherals, keyboards, CRT's, printers, etc., would be available to tailor a system to a variety of applications.

B. INTERFACE CONTROL PROCESSOR (ICP)

Several approaches were considered regarding the communications controller associated with the CPU's, and the relative advantages and disadvantages of each weighed. Those considered were:

1. Use of one large ICP (494 magnitude) interfacing the variety of C Group computers. On the surface, there are many advantages to using a 494. It is a communications controller, with proven hardware and some applicable software and experience in handling multiple terminals. With a system of this magnitude and capability, it is felt that the network switching function would be incorporated. The disadvantages of this approach are:

a. Cost - a minimal system without mass storage devices would cost approximately $1.3 million.

b. Geographically it cannot be located close enough to the various CPU's to replace the existing 'hardwire' communications interfaces, i.e., IBM 2701 or UNIVAC CTMC. In addition, a system outage would stop the input/output for the entire network. Therefore, some means of backup must be provided, further increasing costs.

2. A second approach would be the use of large UNIVERSAL (programmable remote) terminals. The existing hardwired communication controllers would be retained, i.e., no Interface Control Processor provided.

The following was taken into consideration in this approach:

a. When communicating with System/360, only half-duplex operation is possible, prohibiting simultaneous terminal transmit and receive modes.

b. To perform the tasks of communication with various types of computers and simultaneously do background utility work, it would be necessary to have a fairly sophisticated executive, which would require large amounts of core and auxiliary disk storage for emulation packages and translation tables. Each terminal now becomes a relatively expensive device.

c. Because of the cost, it would not be feasible to place terminals in individual areas as we do now. The only practical way of using these large terminals would be to place them in central locations. The concept of centralizing the remote outstations adds many additional problems. The current IBM 360/25's at FANX are a good example. Personnel must be assigned to operate the machines and control the work flow.

d. The major disadvantage of this approach is that in no way does the large expensive terminal decrease the amount of data communications required of the host computer. Using this approach we still must use the expensive controllers, (IBM 270X, UNIVAC CTMC, etc.).

3. The third approach and the one offering the greatest advantage, provides individual programmable Interface Control Processors (ICP) for each CPU. The advantages are:

a. The ICP's can be gradually implemented to each type of host processor.

b. Initial implementation costs are kept at a minimum. The cost rises only as the system grows and can be utilized.

c. A form of backup is provided with ICP's front ending each host processor.

d. The ICP will relieve the CPU of some of the communications burden. To quote an article in DATAMATION, (September 1, 1970, pp49), "published figures have indicated that a large scale computer can be impaired by up to 40% of its throughput capacity if it is required to handle its own communications 'housekeeping'." "Typically, a large computer is designed to work best when it can function continuously, executing a full set of program instructions on a given application before branching to another." By the use of a 'hardwired' communications controller (IBM 2703), total reliance is placed on the central processor, i.e., interrupting on a demand basis every time a character or message segment is received.

The ICP on the other hand is configured and designed for interrupt responsiveness. Its full capacity would be directed toward:

(1) responding to each communication signal.

(2) sensing message conditions

(3) interacting with the host CPU under a priority scheme which greatly reduces main frame interrupt requirements.

(4) providing 'fail soft' protection between the communications network and the CPU. Should the latter go down, it can complete receipt of 'in-process' messages up to the limits of its own memory and then interrupt the terminals with status messages. It can keep going if it has access to its own mass storage devices.

e. There are disadvantages to this approach.

Mixed equipment at the host computer, a 'foreign' device interfacing the computer requires mixed maintenance and the associated problem of diagnosing and resolving problem areas. But this has been done successfully in several of the Agencies' systems, e.g., RYE, HOLDER, DAYS END, etc.

IV. RECOMMENDED SYSTEMS

From the preceding problem definition and the recommended solution, criteria was established for the DART GAME system selection process. The selection was based on the following considerations:

1. Implementable with the least possible disturbance to currently operating software and applications.

2. Implementable in phases.

3. A high degree of flexibility and expandability.

4. Available with a minimum of hardware or software development. It should be 'off-the-shelf' proven equipment.

Inclosure 2 is the detailed evaluation of the UNIVERSAL BATCH Terminal, including the criteria, vendors, and an analysis of those evaluated. Inclosure 2 details the evaluation of the Interface Control Processor (ICP). In both cases, emphasis was placed on manufacturers whose marketing approach and hardware architecture were oriented directly to the communications processing and control functions.

A. SELECTED UNIVERSAL TERMINAL SYSTEM

1. The University Computing Company (UCC) COPE series of programmable remote terminals was selected as the DART GAME universal batch terminal. Their primary function will be for remote transmission of batch jobs to central host computers and receipt of the processed data for the terminal printer. Data transmission is synchronous, ranging in speed from 2KBS to 50KBS in half or full duplex mode.

2. The COPE terminals range in capability from a basic 200 CPM reader, 240 LPM printer station to a full satellite (360/25 class), consisting of dual 1250 LPM printers 1500 CPM reader, magnetic tape, paper tape devices, etc. Inclosure 1 details the full COPE line of terminals. The basic low-speed terminal leases for $970 per month including maintenance up to the full satellite terminal at $7000. Programs are provided to simulate the terminals referenced in the criteria. The 360/25 handler program will require modifications to conform with in-house changes. Simulation software is included in the price of the terminal. Utilities

are provided to drive all peripherals and a RPG (Report Program Generator), is available when required for local background data preparation/editing functions. With the exception of the printer noise level, UCC met all requirements for selection. Future terminals will be encased to provide sufficient (noise) quieting for operating in an office environment.

3. The COPE terminals are based on a UCC 12 Computer using the 3 cycle data break feature, direct memory access, multilevel interrupt system and a 4K, 12 bit, 1.0 microsecond core memory. Memory can be expanded to 12K to support additional peripherals and background processing. A UCC designed synchronous multiplexor connected to the UCC-12 I/O bus can handle up to 10 peripheral devices with their respective interfaces. A program controlled communications unit (PCCU) permits the COPE terminals to communicate with the various synchronous adapters on the host CPU's. Parameters such as byte size, sync pattern, minimum sync character count, data inversion and byte time interrupts are sent to the PCCU under program control for the adapter being addressed.

4. A COPE.34 interfaced to the 360/85 has been in successful operation in C95 since September 1970. The terminal was in operation within two days of delivery.

B. SELECTED ICP SYSTEM

1. General

The COPE Controller is a programmable computer capable of accommodating up to 30 high speed terminals. The controller will support local high performance unit record and other peripherals such as, magnetic tape, paper/mylar tape and plotter devices.

All of the mundane communications tasks such as (1) multiplexing high and low speed devices, (2) error detection and correction, (3) code conversion for foreign devices/terminals, and (4) most of the buffering necessary to maintain maximum I/O speeds, are accomplished in the controller.

COPE mode terminals communicate with the controller in a manner which utilizes the capabilities of the full-duplex lines. Input and output operate independently of each other whenever there are commands, data, or acknowledgements to be sent.

2. COPE Processor

The processor is a 12 bit word, fixed address, parallel computer using 2's compliment arithmetic.

The basic system consists of a magnetic core memory of 4096 words expandable in 4096 word increments to 65K words, and has a 1.0 microsecond cycle time per word. Standard features include indirect addressing, instruction skipping, program interrupt for I/O conditions and a cycle stealing direct memory access method for transferring information to and from peripheral equipment. The COPE processor also contains a character converter that is designed to perform packing and unpacking, intermediate buffering and code conversion, all via hardware.

3. COPE Full Duplex

The full duplex communications scheme used by COPE is a combination of software and hardware and is a major factor in obtaining high input/output speeds.

Full duplex means the ability to perform input and output of data simultaneously. In the COPE system, a completely asynchronous scheme is used allowing both sides of the line to operate at their own rate. The COPE system uses a combination of long and short buffers. The long buffer contains data and a command portion which may also contain status replies. The short buffer contains only command or status information. Thus, when there is no data to be sent the short buffer is used and communications in an idle condition consists entirely of short buffers.

Figure 5 is a diagram of COPE's full duplex transmission scheme.

Additional communications efficiency is obtained by employing a code compression technique for deleting redundant characters in the text prior to transmission. Each character is masked against the next consecutive character; when five or more repeats are found (including blanks) a "ditto" word is generated indicating where the repeats begin and how many. When compressed data is received, decompression occurs based on the "ditto" word contents.

Further increase in peripheral speeds is obtained by reducing the printer data stream from eight bit characters to six bit characters.

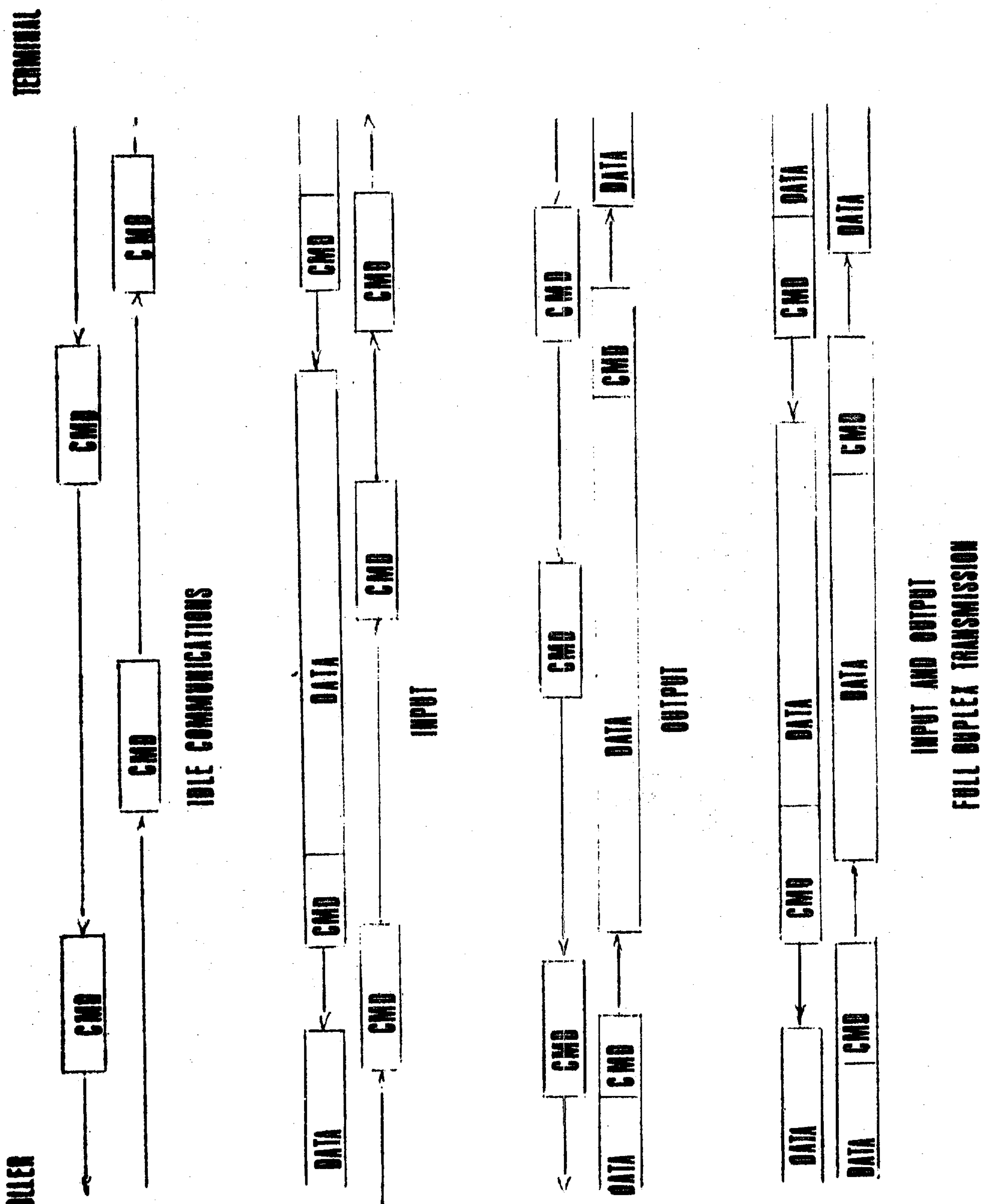

TERMINAL
CONTROLLER
CMD
DATA
IDLE COMMUNICATIONS
INPUT
OUTPUT
INPUT AND OUTPUT
FULL DUPLEX TRANSMISSION

FIG. 5

4. COPE Controller Executive

Initially UCC is supporting three unique executive systems. Although all three systems employ the same basic architecture, each is tailored to a specific host computer. Controller executives are available for the CDC 6600, UNIVAC 1108, and the IBM 360/370.

In the executive there are, in general, two levels of code; input/output code, which is generally interrupt level to provide maximum speed and response time for the devices, and what is called processor level code, which may be performed somewhat at leisure. In addition to the various processors, there are common input and output formatting routines which take the data from the processors one word at a time and format central computer buffers from this data.

In the fall of 1971 UCC will release EXECM, or the Multicomputer EXEC. A major objective of EXECM is to allow central computers of different types to be combined in a single communications network. Instead of using individual controller EXEC's tailored for a specific host computer, it will only be necessary to use one executive for all controllers.

5. Interface to UNIVAC 1108

The interface between the UNIVAC 1108 and the COPE Controller uses one I/O channel of the 1108 and plugs into the standard I/O cable output. Either a normal or compatible channel can be used with no change to the interface.

The interface handles 36-bit parallel transfers of data between the Controller and the UNIVAC 1108. The data buffers are 256 words in size (36 bits) and in format are identical to the buffers placed on the intermediate storage drums. Since the Controller's data word is 12 bits in length, three Controller words are required to make up one UNIVAC 1108 word. This would normally require the buffers in the Controller to be 768 words long however, special scheme has been devised, which interrupts the Controller after 256 12-bit Controller words are transferred. This facilitates software handling of buffers in the Controller by allowing use of a 556 word buffer from the buffer pool. A UCC designed 1108 resident symbiont is provided to handle the Controller.

The quiescient state of this symbiont and the I/O channel is to be prepared to receive input from the Controller. To perform input to the UNIVAC 1108 the Controller sends a command to the interface after first conditioning the access control words. The interface then obtains 3 12-bit data words from the Controller memory and assembles them into a 36-bit word which is then transferred to the 1108.

After each group of 256 12-bit words have been handled the Controller is interrupted to set up the control words for the next third of the buffer. Meanwhile, the UNIVAC 1108 is awaiting more data. This process continues until 256 36-bit words have been transferred. At this time the UNIVAC 1108 expires its word count and sends an EF to the Interface. The Interface then interrupts the Controller and sends an output data request to the UNIVAC 1108 at which point the data transfer control is complete.

6. CDC 6600 Interface

The COPE Controller interface attaches directly to the 6600 channel; no converter or additional controller is required. Standard CDC cables and logics are used to simplify the interface with the CDC logic providing the complete electrical isolation at the controller. From the peripheral processor the interface looks just like any other standard peripheral. In operation, the interface looks at the commands from either the controller or a peripheral processor. I/O operations being when the controller sends a command to the interface to initiate either input or output. No data transfer takes place at this time, however, the interface simply records the appropriate status. When the peripheral processor queries the interface for this status, it can determine what the controller is prepared to do next. The peripheral processor then has the option of initiating input or output whenever it is ready and only at this point does the actual data transfer begin. This puts the I/O operation completely under the control of the peripheral processor. Data is transferred across the channel in blocks of up to 256 12-bit words. This means that the peripheral processor simply hangs, during the transfer, waiting for all the data to cross. Error conditions, a difference between the length of message sent and expected, are detected in the peripheral processor by an early disconnect from the channel or in the controller by an error status interrupt which also indicates an early disconnect of the channel from the other end. To provide protection against possible hang-ups, the interface includes an automatic timeout function which disconnects the channel in case of error.

7. IBM 360 Interface

The interface attaches directly to the IBM 360 multiplexor channel and no converter or additional controller is required. The hardware interface is capable of being switched between off-line and on-line modes both manually and by software. In the off-line mode, all channel actions will be passed on to the next device down the channel, thus allowing the COPE Controller to be powered up or down without affecting other devices attached to the 360 channel.

From the System 360 the interface looks just like any other standard peripheral. In operation, the interface takes commands from either the System 360 or the COPE Controller. Operations begin when the Controller sends a command to the interface to initiate either input or output. There is no actual transfer of data at this time, however, the interface records the appropriate status. When the 360 queries the interface, it can determine what the Controller is prepared to do next by interpreting the status. This allows the System 360 the option of initiating input or output whenever it is ready and at this point data transfer takes place. This technique puts the I/O operation under control of the System 360.

The interface handles a 24-bit parallel transfer of data between the Controller and the 360. The data buffers can be up to 1224 bytes. This means the 360 simply waits for the entire transfer to complete. The interface passes the data at high speeds in order to minimize the amount of time required for I/O.

Error conditions, a difference between the length of messages sent and expected, are detected in the System 360 by an early disconnect from the channel or in the controller by an error status interrupt which also indicates an early disconnect of the channel from the other end. To provide protection against possible hang-ups, the interface includes an automatic time out function which disconnects the channel in case of error.

C. MAINTENANCE

Since the equipment will be leased, University Computing Co. will perform all maintenance. During the prime shift a field service engineer will be cleared and in residence. Maintenance during "non-prime" hours will be on an "on-call" basis. C8 will monitor the maintenance contract and provide space for the UCC engineer.

V. IMPLEMENTATION

DART GAME implementation is planned for three phases to allow the System to evolve with a minimal interruption to current activities, to permit adequate testing, and to allow for next phase planning.

Phase I is projected for the first six months, with Phases II and III scheduled for six month periods thereafter.

A. PHASE I

1. Implementation Schedule

a. The initial COPE configuration as shown in Figure 6 will be installed on one of the IBM 360/85's. Only COPE terminals will be connected to the COPE Controller. The IBM RJE software system will be replaced with UCC's RJES. It will be possible to operate both RJE and RJES simultaneously in the same processor if desired. Initially EXEC 5 will be used in the COPE Controller.

b. Resolve any software differences if any, between NSA's 1108 EXEC 8 software system and UCC's required modifications. The same coordination will be performed between NSA's CDC 6600 Scope System and UCC's required modifications.

c. Design and implement a line status monitor package which will provide a historical log of the communications activity. The on-going monitor records would be used for evaluating such factors as line outage, error rate, traffic utilization, etc., such historical records are vital for continued improvement of network configurations.

d. C96 will continue the replacement of remote batch terminals with COPES.

e. Evaluate UCC's EXECM for implementation.

2. Planning

a. Initiate study for possible implementation of a COPE Controller to Burroughs and RYE Systems.

b. Initiate study on methods of utilizing the UCC asynchronous multiplexor. Study the software modifications required to interface asynchronous devices to IBM, UNIVAC, and Control Data Computers.

c. Begin preliminary study of the Network Controller.

d. Design software required for Controller to Controller communications.

B. PHASE II

1. Implementation

a. Checkout and replace EXEC 5 with EXECM on the COPE Controller.

b. Test dual IBM 360/85 Interface.

c. Lease A COPE Controller for the UNIVAC 1108.

d. Lease A COPE Controller for the CDC 6600.

e. Complete study and begin implementation of the "non-batch" Universal Terminals.

f. Test interconnection of COPE Controllers/ software and hardware.

g. Begin coding software required for supporting asynchronous devices.

h. If feasible, (based on study in Phase I), contract for interfaces to RYE and Burrough systems.

i. Complete the replacement of lease batch terminals with Universal Terminals.

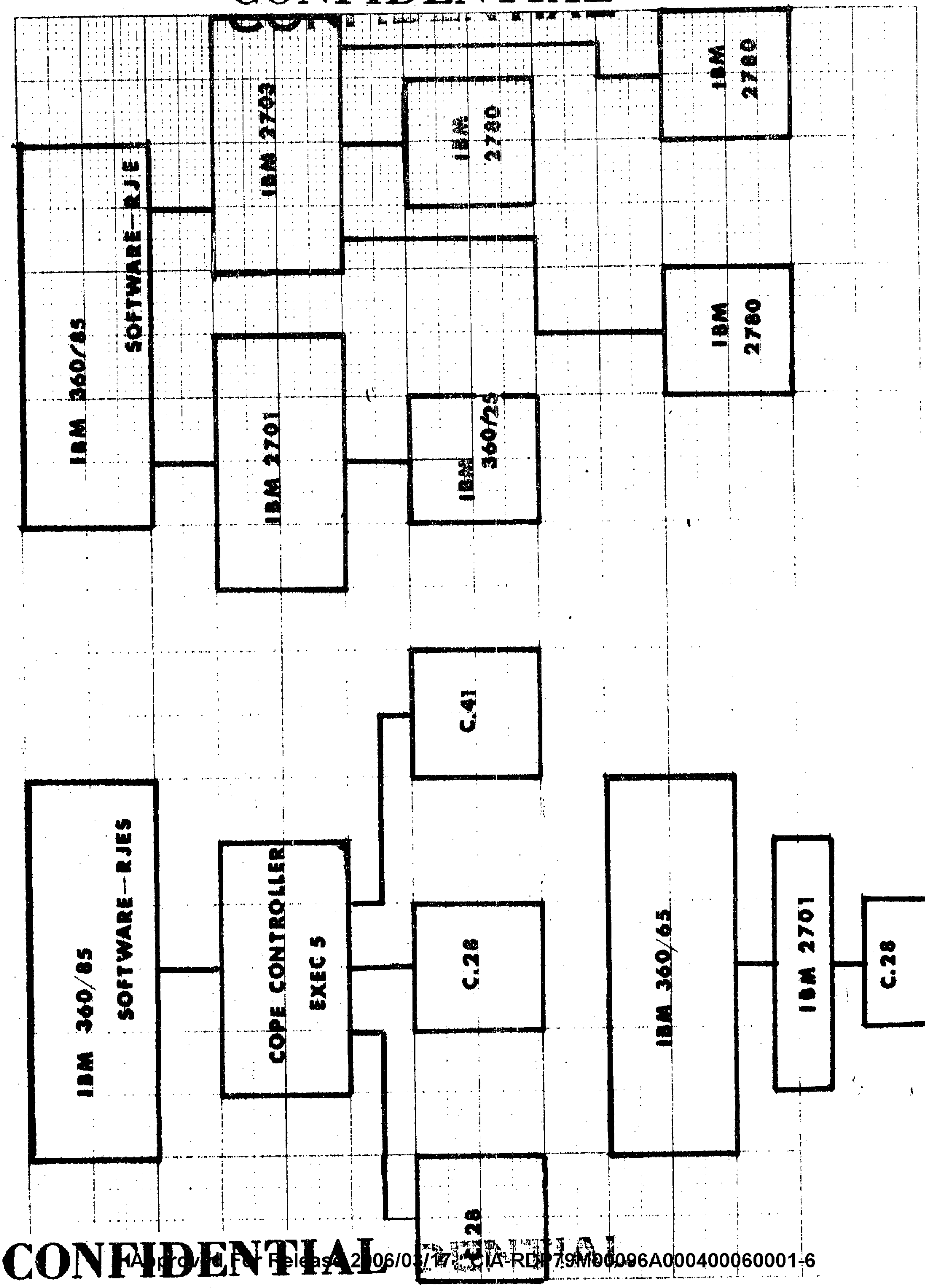
j. Test single terminal talking to multiple computers.

2. Planning

a. With C93 and C7, design a 'load-sharing' system for the dual IBM 360/85 system.

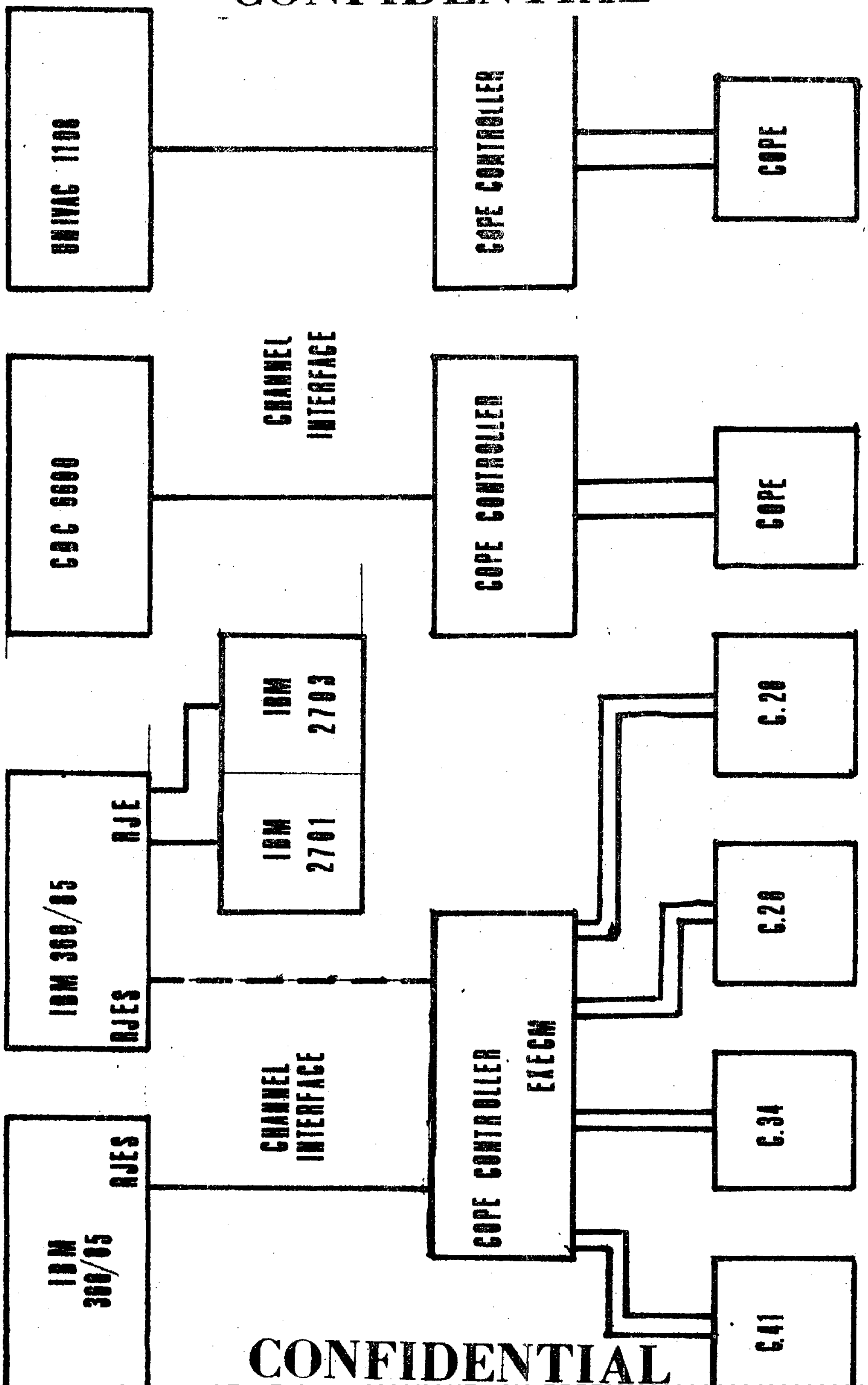
b. Begin design specifications for the Network Controller.

(SEE FIGURE 7)


IBM 360/85
SOFTWARE—RJE
IBM 2703
IBM 2701
IBM 2780
IBM 2780
IBM 2780
IBM 360/25
IBM 360/85
SOFTWARE—RJES
COPE CONTROLLER
EXEC 5
C.41
C.28
C.28
IBM 360/65
IBM 2701
C.28

PHASE I

FIG. 6


UNIVAC 1108
COPE CONTROLLER
COPE
CHANNEL INTERFACE
CDC 6600
COPE CONTROLLER
COPE
IBM 2703
IBM 2701
C.28
C.28
RJE
IBM 360/85
RJES
COPE CONTROLLER
EXECM
C.34
C.41
IBM 360/85
RJES
CHANNEL INTERFACE

PHASE 2

FIG 7

C. PHASE III

1. Implementation

a. Add 2nd COPE Controller to IBM 360/85's.

b. Connect all remote batch terminals to COPE Controllers on the IBM, UNIVAC and Control Data Computers.

c. Install COPE Controllers on the IBM 360/65's.

d. Release 'Remote Batch' 270X Systems.

e. Implement COPE Controllers on RYE and Burroughs Computers.

f. Complete specifications on the Network Controller.

g. Implement 'Load Sharing' software.

h. Connect to the COPE Controller asynchronous devices attached to the IBM 360, UNIVAC 1108, and CDC 6600.

i. Continue replacement of remote terminals with Universal Terminals.

j. Complete design specifications and contract for the Network Controller.

2. Planning

Continue study of the ICP functions to determine other means of relieving the CPU's of more menial functions. Also, how can the ICP be used in non-prime hours.

(SEE FIGURE 8)

D. PHASE IV.

Implement the Network Controller.

(SEE FIGURE 9)

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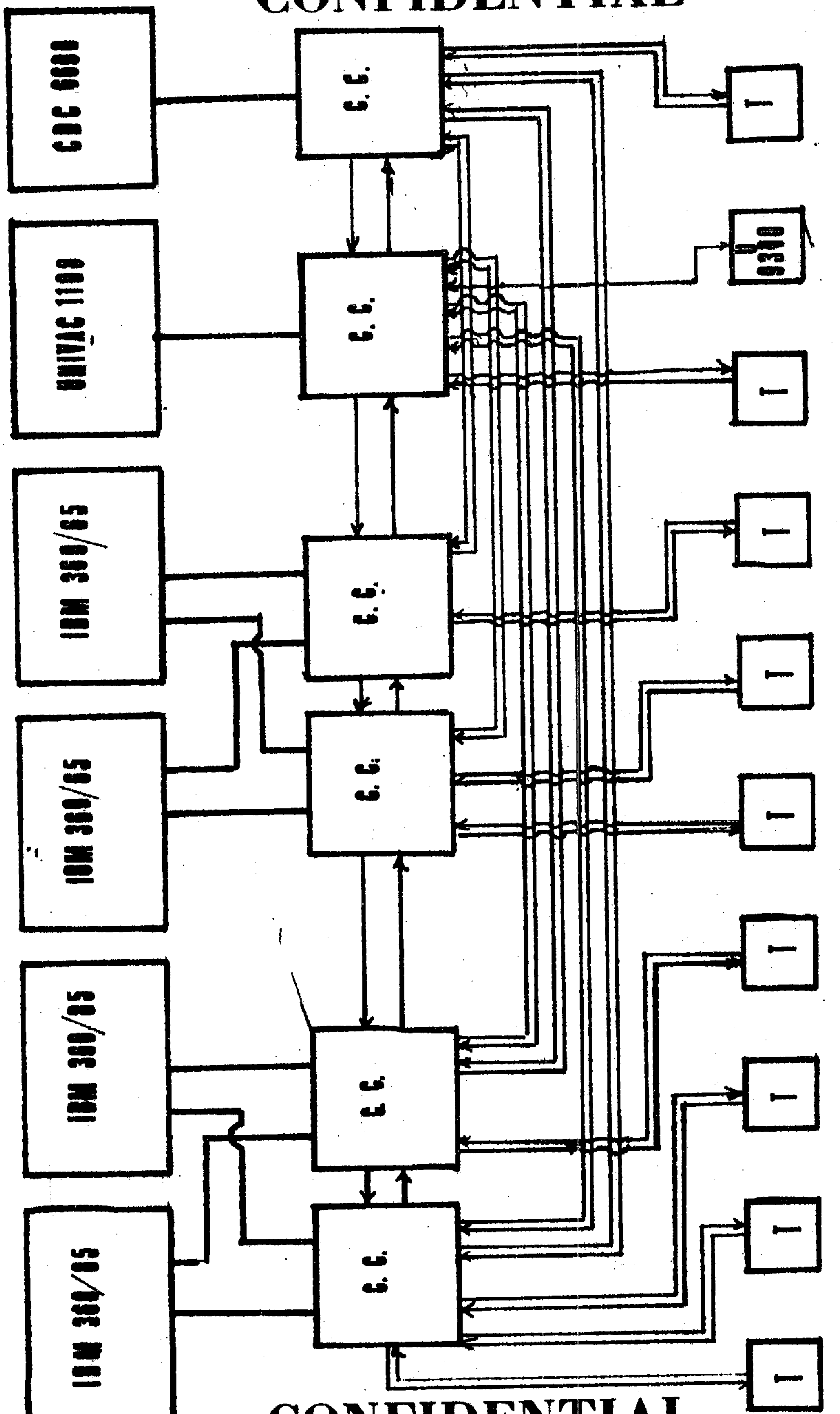

CC — COPE CONTROLLER
T — COPE TERMINAL

PHASE 3

FIG. 8

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HANDLE VIA COMINT CHANNELS ONLY

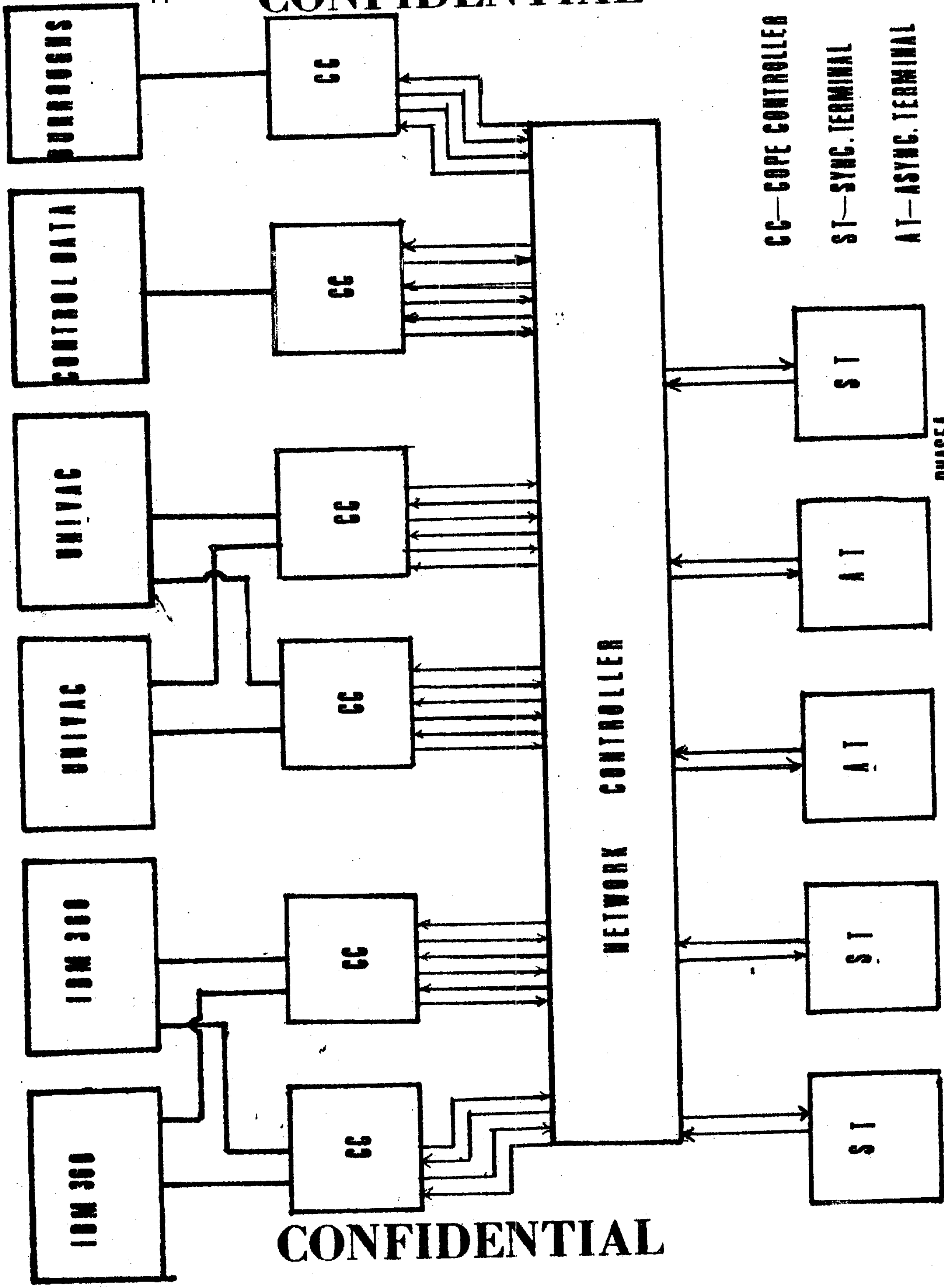
BURROUGHS
CONTROL DATA
UNIVAC
UNIVAC
IBM 360
IBM 360
CC
CC
CC
CC
CC
CC
NETWORK CONTROLLER
ST
AT
AT
ST
ST
CC—COPE CONTROLLER
ST—SYNC. TERMINAL
AT—ASYNC. TERMINAL
PHASE4

FIG. 9

INCLOSURES

OVERVIEW OF UCC COPE TERMINAL CAPABILITIES

TYPE	READER (CPM)	PRINTER (LPM)	MAX. MEMORY	** CARD PUNCH	** MAG. TAPE	** PAPER TAPE	MO. RENTAL
* 1225	300	300	8K	✓			$ 900
C.28	300	360	8K	✓			970
C.34	300	360	12K	✓	✓	✓	1,340
C.36	300	480	12K	✓	✓	✓	1,475
C.38	600	480	12K	✓	✓	✓	1,615
C.41	600	1250	12K	✓	✓	✓	2,265
C.45	1500	1250	12K	✓	✓	✓	3,015

* No TTY Console, Switched Operation

** Extra Cost Option

Inclosure 1

I. TERMINAL

A. CONSIDERATIONS

Primary consideration in the UNIVERSAL Batch Terminal selection was a device which could satisfy the widest spectrum of on-line and local processing applications at reasonable costs while interfaced to any of the major C Group host computers. For this reason, a programmable terminal (controller) was selected that could initially simulate the major terminals (IBM 2780, 360/25, 1004, 9300 and UT200), operate over a wide range of communication line speeds and offer a complete set of peripherals with support software. Also considered was the ease of hardware and software expansion to facilitate a common universal terminal to ICP, full duplex ANSCII based communications method.

B. CRITERIA

1. Simulation - For those systems not initially equipped with the DART GAME ICP, terminal operation would be in the simulation mode. A demonstrated simulation capability of the most commonly used terminals was required. This approach would require no hardware or software modifications to existing C Group host CPUs.

2. Programmable

a. To accommodate changing terminal requirements.

b. Allow conversion to the DART GAME common universal terminal to ICP full duplex ANSCII based communications method (DART GAME mode).

c. To accommodate non-standard handler packages.

3. General Purpose Handler - Availability of a basic interrupt handling executive common to all classes of terminals, and capable of handling the requisite data communications and other terminal applications.

4. Expansion Capability - Sufficient hardware channels, memory, and software routines to support a full set of low to high speed printers, card readers, magnetic tapes, card punch, etc.

5. Off-Line Support - Availability of basic data processing routines such as RPG, pre and post processing, editing, file search, language syntax scan, etc.

6. Full Duplex - The hardware interface and software necessary to allow simultaneous on-line transmission to and from another device.

7. Keyboard Entry -- This will permit local selection of basic utility routines and queries to the host CPU as to job status,operator messages, and other control functions.

8. EBCDIC, ANSCII, SBT, etc. - Capability of conforming to the internal codes of the various host computers to be addressed.

9. Dial Capability - To allow a single terminal to address selected CPU's through a central network controller.

10. Multifunction - Existence of a multi-programming technique to facilitate concurrent local operation and on-line data communications.

11. Adaptability to Local Environment - That the terminal noise levels, power and signal, temperature, humidity and space requirements conform as close as possible to the local situation.

12. Solvency - That the vendor is in as stable a financial position as possible to assure continued Agency support.

C. SYSTEMS EVALUATED

Offerings from a large number of vendors were examined against the selection criteria. Only a few offered the variety of peripheral speeds, software supported high speed (50KB) full duplex communications support and operational terminal simulators.

1. Atron Corporation - The Atron Datamanager met most of the criterion and was competitively priced. Their first intelligent terminal was only recently demonstrated and they did not have the complete emulation capability desired. The company based in St. Paul, Minnesota, offered no local support.

2. Data 100 Corporation - The Data 100 78 series terminals were considered quite good but was limited in communications speed and application. Terminal emulation capability was limited.

3. IBM 2780 - The 2780 is totally unsuited for the universal terminal application. The 2780 is hardwired, has no keyboard entry, is limited to a 400 byte buffer and does not support mag. tape. Since it is not programmable, adherence to the future DART GAME mode, ICP to terminal communications conventions would be impossible. No interface for other host CPUs is offered.

4. IBM 360/25 - A wide gap in performance and cost exists between the 2780 and the 360/25. The 360/25 cost begins at about 5K per month and offers very limited capability. The company supplied software in BPS, a card oriented system. BPS does not support on-line mag tape input/output, on-line background utility functions or off-line paper tape utilities. The 360/25 has a limited interrupt handling system, is code sensitive, and its architecture was not designed for control functions.

II. ICP SELECTION

A. CONSIDERATIONS

In developing criteria for selecting an Interface Control Processor, prime consideration was given to the ultimate role of the ICP as the common denominator between the UNIVERSAL terminal and the CPU and the ease of implementing the system without disturbing existing operating systems. The criteria used are a direct reflection of these considerations.

B. ICP SELECTION CRITERIA

1. 360 Interface - Since the first host computer to use an ICP would be the IBM 360/85, it was mandatory that the manufacturers considered, be able to interface directly with a 360 multiplexor channel.

2. Interface for other hosts (U1108, CDC6600) - In the subsequent phases of DART GAME the ICP front ending other Agency systems, (i.e., UNIVAC 1108, CDC 6600; Burroughs 6500; etc.), will be considered. Therefore, the companies' plans and capability of interfacing with other CPUs were evaluated.

3. Support a throughput of 15,000 CPS - The ability to support a throughput rate of 15,000 CPS.

4. Support asynchronous devices - The 360/85 supports many and various asynchronous devices (i.e., 2741, 1050) as do other CPU systems (CDC211, UNISCOPE 100).

5. Vendor to supply line handlers - The prospective vendor must supply the requisite interrupt handling executive for the synchronous and asynchronous, variable speed, communication lines.

6. Expansion Capabilities - By design, the ICP will expand, both by the number and speed of the lines and by the communications handling functions it will perform for the host CPU.

7. Software supplied - As with any computer system operating software is a very necessary item. Greatest emphasis was placed on the host processors interface package, executive system, and assembler. Also, various utility and diagnostic packages were desired.

8. Dual CPU Interface - Controller must be capable of interfacing more than one host computer either via a manual switch or dual channel interfaces.

9. Delivery - Although implementation of DART GAME will not be for a few months, the availability of the hardware and software provided an indication as to which stage of development the system was in.

10. Solvency - This was a very important criterion and solvency of the companies investigated ranged from excellent to out-of-business. Since this project will take a few years for full development, the financial stability and continued support of the manufacturer is vital.

C. SYSTEMS EVALUATED

Proposals from the major manufacturers of communications processing equipment were solicited for evaluation against the desired criteria. The vendors were briefed on the technical requirements of the project and invited to respond.

Several vendors (IBM, UNIVAC, XDS) proposed large and expensive systems. However, none has an operable system nor would one be available in the near future. The software to be supplied was limited and backup would be very expensive.

Other manufacturers (TEMPO, CCI) are gearing their approach towards 270X emulation which does not require host computer software modifications. Although this is a desirable approach, extensive software development would be required by NSA. This development effort would increase the DART GAME implementation by at least a year or two. Still others did not respond (Data General) or went out-of-business (Kettell, Devonshire).

1. COMCET 60 - (COMCET CORP.)

COMCET was established for the IBM 360 front end (ICP) replacement market. They proposed a COMCET 60 to meet the ICP requirement. This machine is a programmable processor designed to perform the entire 360 communications function.

The COMCET 60 was comparatively expensive and required replacement of (BTAM) and modification to the Remote Job Entry (RJE) software. Software modifications that would be necessary were on a contract basis. COMCET was having software problems with this system at other government agencies. There was also some doubt as to their financial stability.

2. SANDAC 200 (Sanders Associates, Inc.)

The SANDERS 200 is a programmable processor designed specifically for message switching, concentrating, and processing, either as a system component or as a communication controller. Two of the major problems with the SANDERS 200 are (1) the 200 does not support peripherials, and (2) SANDERS does not have and is not planning an IBM Channel Interface.

3. IBM Programmable Terminal Interchange (2969)

The IBM 2969, a stored program control unit, performs the function of a communications CPU, using a subset of the system/360 instruction set. The IBM 2969 operates in full or half-duplex mode. The IBM 2969 would interface with other manufacturers computers via the IBM 2701 equipped with a parallel data adapter.

This system is extremely expensive. However, if we were to use two PTI's (one as backup) for all the systems in DART GAME (including using the PTI as the Network Controller) the IBM 2969 may be justifiable. We do not feel that this is the most efficient or the most flexible approach.

4. TEMPO I (GTE)

TEMPO proposed a system called the TEMPO 270T Terminal Control Processor, which is a programmable front end communications control subsystem. This system is based on TEMPO's general purpose 16-bit 900-NSEC digital computer. Combined with an assortment of specialized communication hardware and software, the 270T acts as a direct, plug-to-plug compatible replacement for the 2703 transmission control unit.

5. PDP-11 - DIGITAL Equipment Corporation

Digital Equipment Corporation is in the designing stages of a direct interface with S/360. They are planning to emulate a 270X. We felt that it would be sometime before this package would be ready.

6. XEROX Data Systems

XDS suggested that we use the Sigma 5 computer in conjunction with their CC50 communication input/output processor. The system that was outlined by XDS is extremely powerful; much too powerful. Their interface to S/360 is only in the design phase. They are planning on interfacing with S/360 directly using the software replacement method, not an emulation of an IBM 2701. They are not, however, planning on providing the S/360 software replacement package. The purchase price of the recommended system is $759,050 or $26,068/month on a 1-year lease. This system could be considered on the same scale or larger than the IBM 2969.

7. CCI - Computer Communications Inc.

Computer Communications proposed a front end communications system which would emulate the IBM 270X equipment. The CC-70 Computer Communicator was specifically designed for front end, communications control applications. Although the CC-70 system looks promising, the 270X emulation software package and the hardware package that CCI proposed is in the very early stages, for example:

(a) The CC70 computer is a new product line for CCI and the first system was installed in January 1971.

(b) The CC70 Input/Output Processor which is a high speed byte oriented I/O command processor used for high speed data transfers is being modified specifically for binary synchronous communications. This modification is in the design phase.

8. INTERDATA Inc.

INTERDATA submitted a 'talking paper' defining two possible approaches to solving the ICP problem. It was INTERDATA's intention that NSA join them in arriving at the final method of attack for the DART GAME problem. At no point in their paper was the IBM/360 interface discussed. INTERDATA states that their primary goal in the design of their CCU Communication Control Unit software is to relieve the system/360 of the tasks associated with control of the communication network. They do not discuss how they intend to do this.

It is clear from this paper that INTERDATA is only examining possible approaches to enter the 'front end' market.

9. PCC - UNIVAC PROGRAMMED COMMUNICATIONS CONTROL

The Programmed Communications Controller will be an internally programmed communications concentrator/ multiplexor. The hardware is in the prototype stage. The software is in the design phase. UNIVAC is estimating November or December 1971 as a first release date. UNIVAC declined to submit a proposal using the PCC as an ICP for the DART GAME project.

OVERVIEW OF COPE CONTROLLER COSTS.

MEMORY	TERMINAL INTERFACES	HOST INTERFACES	LEASE	PURCHASE	MAINT.
32K	4	1	$4,395	$152,000	$625
40K	4	2	$5,025	$174,000	$730
40K	11	2	$6,345	$217,000	$975
65K	21	2	$8,255	$311,000	$1,505

Inclosure 3

HANDLE VIA COMINT CHANNELS ONLY

Inclosure 4

CONFIDENTIAL

VENDOR	360 Interface	Other Interfaces		15,000 CPS Sustained Thruput	Support Asynchronous Devices	Supply Line Handlers	Able To Change Line Speed/ Code Characteristics	Expansion Capabilities	Software Supplied	Dual CPU Interface	Delivery		Solvency	COSTS Purchase/Lease
		UNIVAC 1108	CDC 6600								H'ware	S'ware		
TEMPO	yes	u/d	yes	yes	yes	yes	yes	To 65K wds; 2 CPU's on memory Bus; 256 lines/ processor	360 assembler; oper sys; 270T test pug.	U/D	Now	Jun 71	Excell.	$118.4K + maint. $3894 + maint.
CCI	yes	u/d	yes	yes	yes	yes	yes	To 65K bytes; 2 CPU's on memory bus; 120 lines/ processor	360 assembler; oper. sys.	U/D	Now	Mar 71	Good	$125.4K purchase + maint. $4483 lease incl. maint.
COMCET	yes	yes	no	yes	yes	no	N/A	262K bytes	360 assembler; oper sys.	no	N/A	N/A	Fair	$341.8K + maint. $13,672 lease incl. maint.
INTERDATA	yes	yes	yes	yes	yes	N/A	N/A	64K bytes	N/A	N/A	N/A	N/A	Good	Price not incl.
UCC	yes	yes	yes	yes	u/d	no	u/d	65K words	Controller EXEC Host Computer, Replacement pkg. 360,1108,6600	U/D	now	now	Good	$3915 lease incl. maintenance
SANDERS	no	no	no	yes	yes	no	yes	65K words, 256 I/O chans.	360 assembler; no assembler	no	N/A	N/A	Good	Not Applicable
XDS	u/d	N/A	N/A	yes	yes	yes	N/A	256K 32 bit words	Oper. Sys.	no	N/A	N/A	Excell.	$760K purchase + maint. $26,068 incl. maint
UNIVAC	yes	yes	no	yes	yes	no	yes	N/A	Oper. Sys.	yes	Late 71	Late 71	Excell.	No response
IBM	yes	no	no	yes	yes	no	no	N/A	None	yes	Mid 71	N/A	Excell.	$350K purchase
GE DATANET	no	no	no	yes	yes	yes	N/A	N/A	Oper. Sys.,	no	N/A	N/A	Good	Not Applicable
DEVONSHIRE	yes	yes	yes	yes	yes	yes	yes	N/A	Operating Sys., Assembler	no	OUT OF BUSINESS			
HONEYWELL	no	no	no	yes	yes	yes	N/A	65K 16 bit wds	Oper. System, Assembler	no	now	N/A	Excell.	$140K + maint.

N/A = Figures not available. U/D = Under Development

CONFIDENTIAL HANDLE VIA COMINT CHANNELS ONLY

Approved For Release 2006/03/17 : CIA-RDP79M00096A000400060001-6

OVERVIEW OF REMOTE TERMINAL TYPES

HOST CPU	REMOTE TERMINALS	
	TYPES	DESCRIPTION
IBM 360/85	IBM 2741	Selectric Typewriter used for APL
3-2701's	1050	KB/Printer used for CAI
1-2703	2265	KB/CRT
	2780	Printer, Card Reader for RJE
	360/25	Printer, Card Reader, Mag tape for RJE
	UCC Cope.34	Printer, Card Reader, KB/Printer for RJE
	Cope.41 (Proposed)	Printer, Card Reader,KB/Printer for RJE
	Cope.28 (Proposed)	Printer, Card Reader, KB/Printer for RJE
	TABLON	
360/65	IBM 2260	KB/CRT
	360/25	Printer, Card Reader
5-2701's	UNIVAC 9300	Printer, Card Reader/Punch for HOLDER
	TABLON	

Inclosure 5

OVERVIEW OF REMOTE TERMINAL TYPES

HOST CPU	REMOTE TERMINALS	
	TYPES	DESCRIPTION
CDC 6600*	CDC 211	Entry Display (hardwired to machine - have cable length limitation)
	217	KB/CRT, Card reader/punch, Printer
	217	KB/CRT
	AGT 30	Display Processor
UNIVAC 1108	UNIVAC U300	KB/CRT
	U9300	Printer, Card reader/punch, Mag. Tape
	TTY MOD 35 ASR	KB/PTR, Paper Tape Reader/Punch
BURROUGHS B5500	TTY MOD 35 ASR	KB/Printer, Paper Tape Reader/Punch
	BURROUGHS B300	Card Reader/Punch, Paper Tape Reader/Punch, Mag. Tape, Printer
	B500	Card reader/punch, paper tape reader/punch Mag. tape, Disk, Printer.
	TC500	KB/Printer, Paper Tape reader/punch.
	BURROUGHS CRT	KB/CRT

*Have remote mag tape, printer, and card reader; remote from CPU but hardwired with length limitation.

Enclosure 5

OVERVIEW OF REMOTE TERMINAL TYPES

HOST CPU	REMOTE TERMINAL	
	TYPES	DESCRIPTION
UNIVAC U494 RYE	TTY MOD 35 ASR	KB/Printer, Paper Tape Read/Punch
	MOD 38 REC	Page Printer
	BOSTIC I	Paper tape Reader/Punch
	BOSTIC II	Paper Tape Reader/Punch
	UNIVAC U1004	Printer, Card Reader
	ZITO	KB/CRT, Paper Tape, Mag. Tape
	RAYTHEON CRT	KB/CRT
	CDC	Printer
	OMNITEC	Printer, Card reader
	SOROBAN	Card Reader

Inclosure 5

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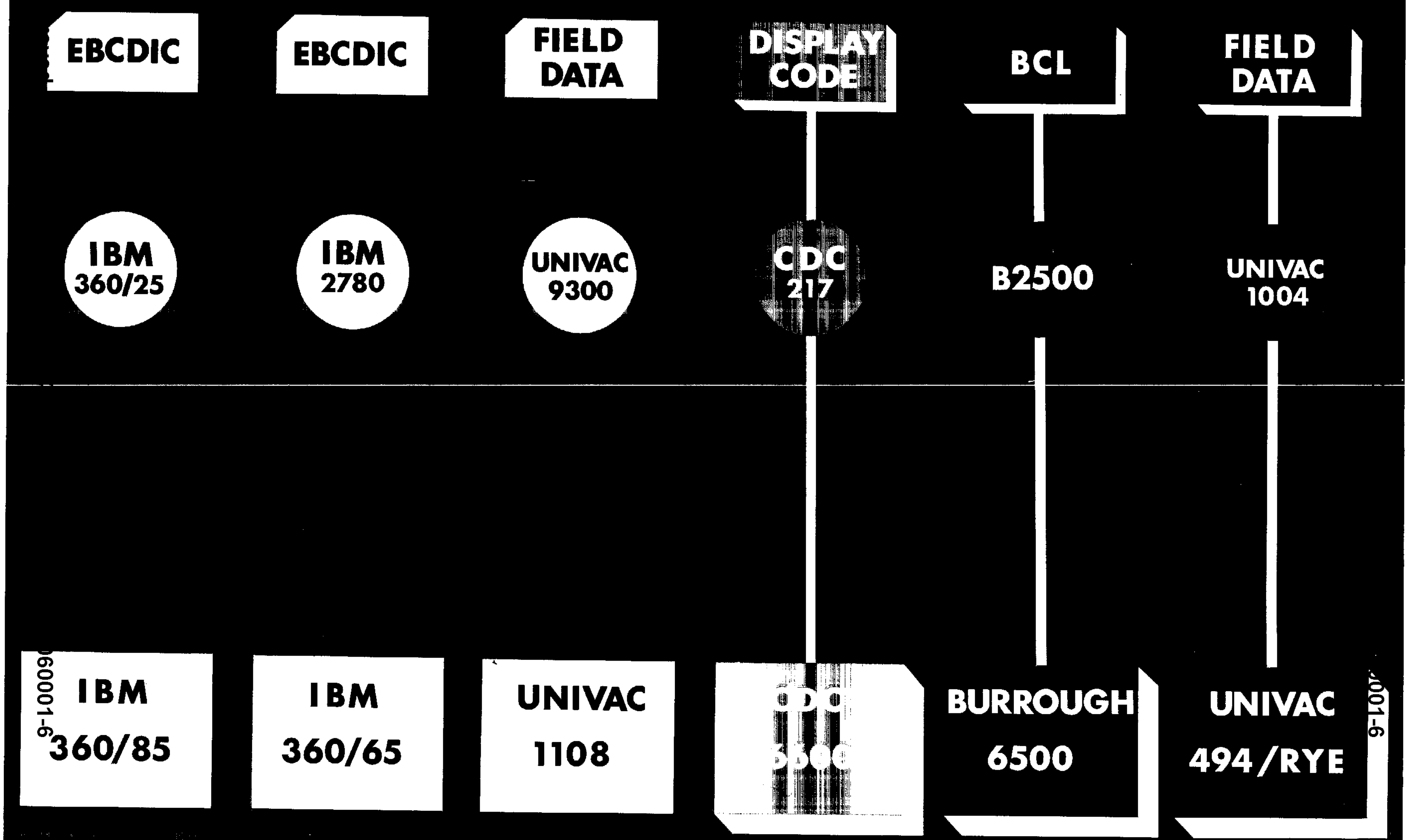
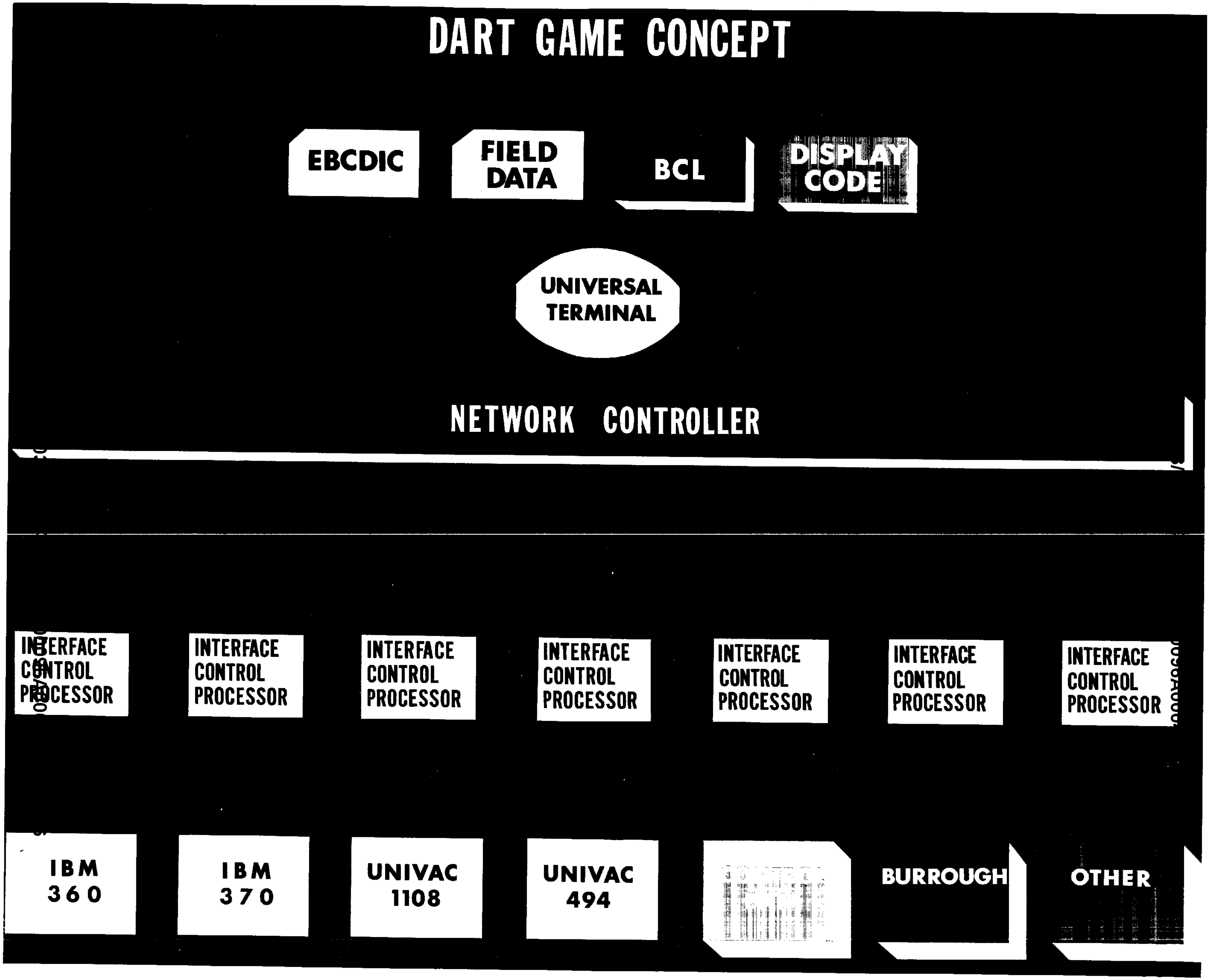
CURRENT TERMINAL ORGANIZATION




DART GAME CONCEPT
EBCDIC
FIELD DATA
BCL
DISPLAY CODE
UNIVERSAL TERMINAL
NETWORK CONTROLLER
INTERFACE CONTROL PROCESSOR
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INTERFACE CONTROL PROCESSOR
INTERFACE CONTROL PROCESSOR
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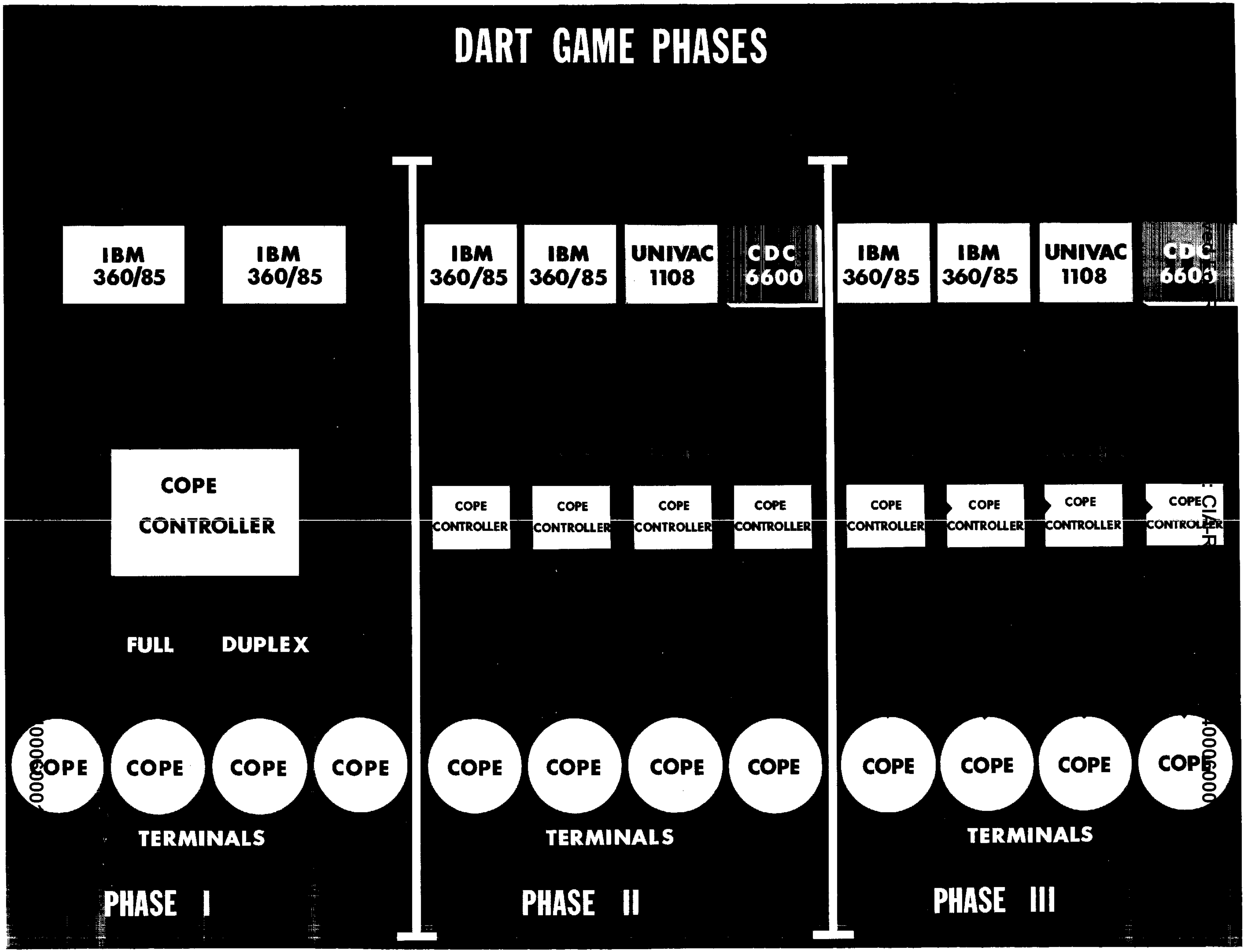
INTERFACE CONTROL PROCESSOR
INTERFACE CONTROL PROCESSOR
IBM 360
IBM 370
UNIVAC 1108
UNIVAC 494
BURROUGH
OTHER


DART GAME PHASES
IBM 360/85
IBM 360/85
COPE CONTROLLER
FULL DUPLEX
COPE
COPE
COPE
COPE
TERMINALS
PHASE I
IBM 360/85
IBM 360/85
UNIVAC 1108
CDC 6600
COPE CONTROLLER
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PHASE II
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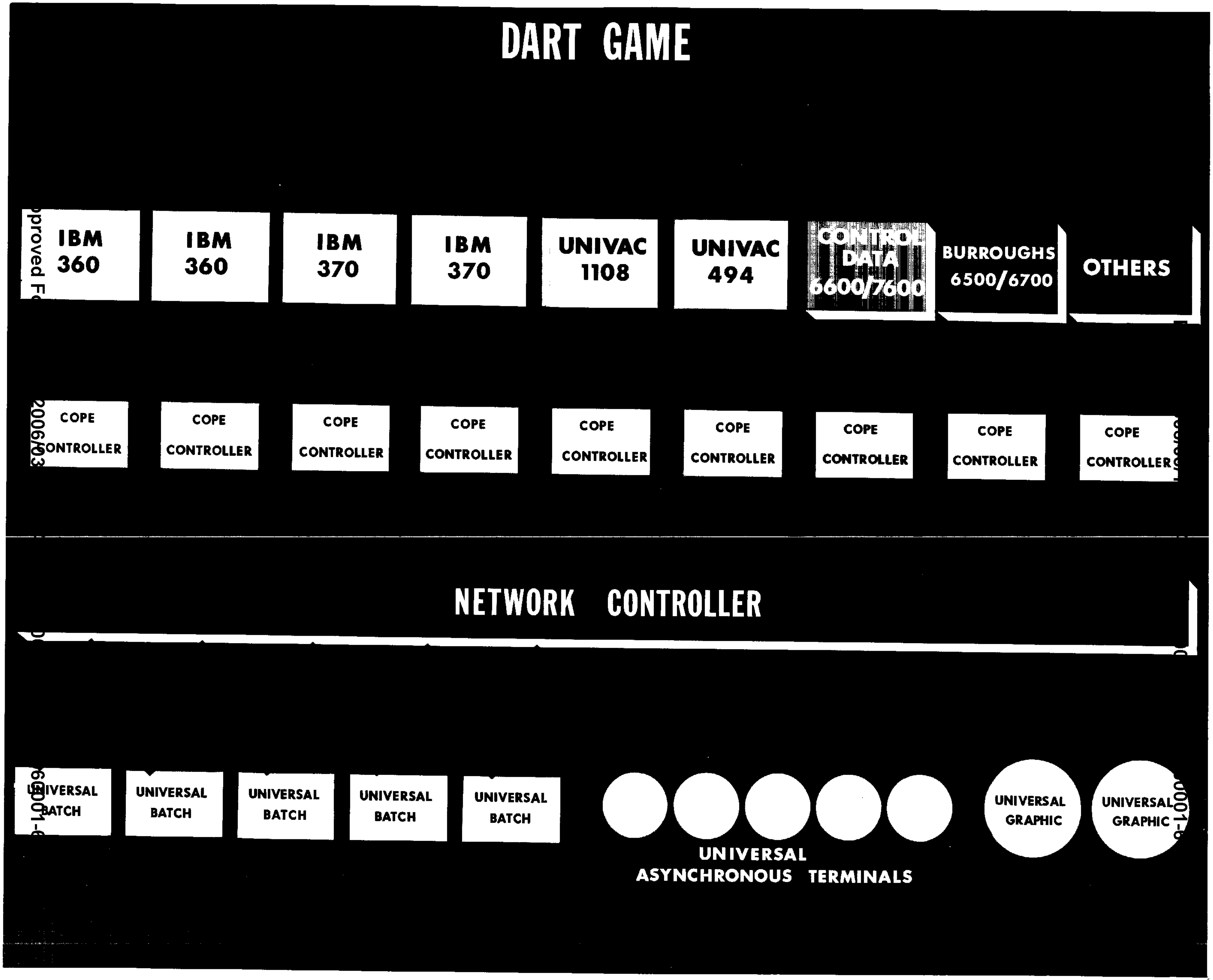
TERMINALS
PHASE III


DART GAME
IBM 360
IBM 360
IBM 370
IBM 370
UNIVAC 1108
UNIVAC 494
CONTROL DATA 6600/7600
BURROUGHS 6500/6700
OTHERS
COPE CONTROLLER
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COPE CONTROLLER
NETWORK CONTROLLER
UNIVERSAL BATCH
UNIVERSAL BATCH
UNIVERSAL BATCH
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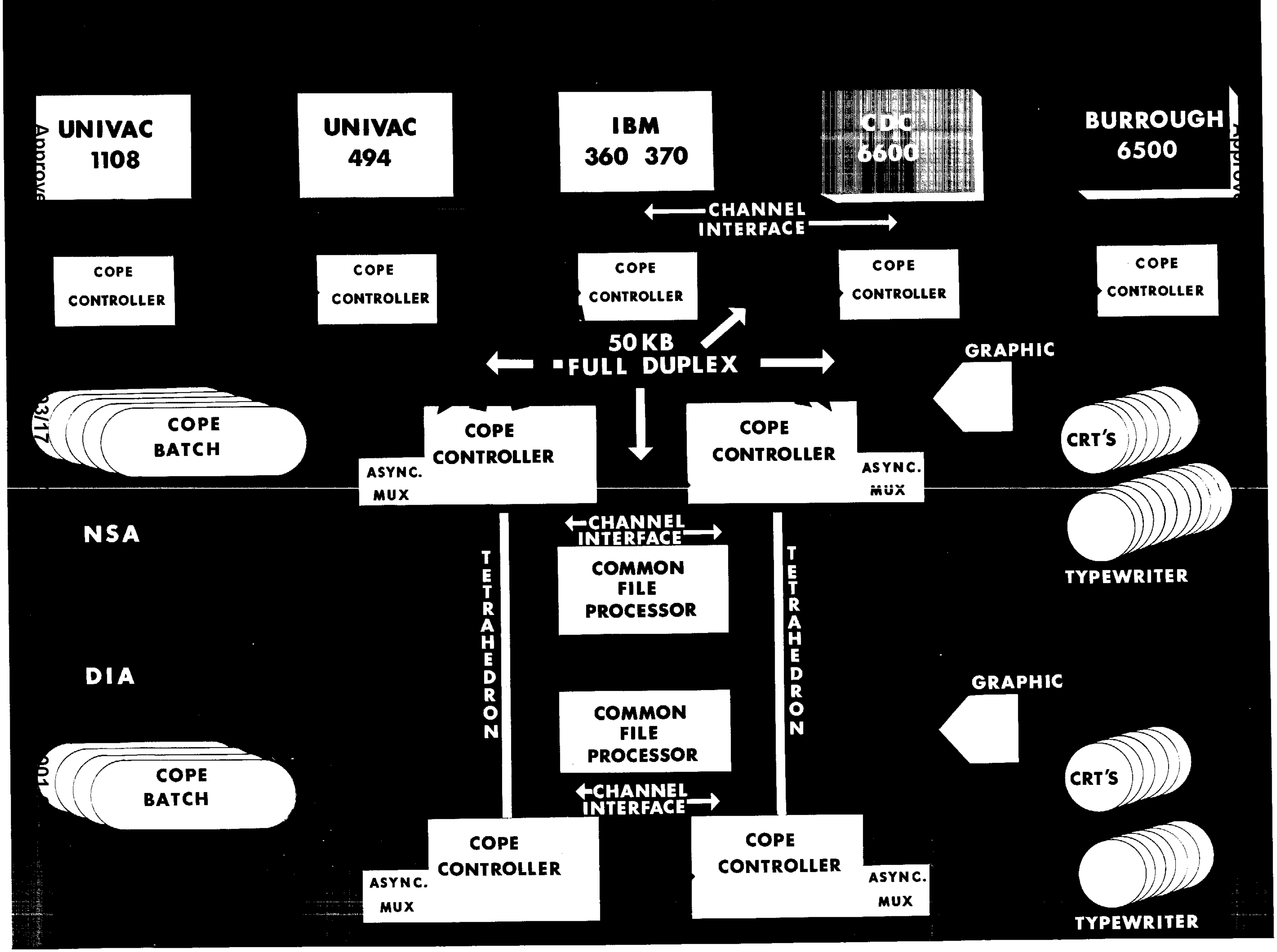
UNIVERSAL ASYNCHRONOUS TERMINALS
UNIVERSAL GRAPHIC
UNIVERSAL GRAPHIC

COINS II NETWORK



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