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Systems

IBM 3704 and 3705 Communications Controllers Emulation Program Storage and Performance Reference Manual

IBM

Preface

This manual is intended to be used in determining storage requirements and line priority assignments necessary for efficient operation of the communications controller operating in emulation mode.

The manual is directed to systems analysts, systems programmers, systems engineers, and IBM salesmen.

The major subjects are calculating storage requirements, determining line speed and line priorities, and assigning subchannel priorities. The Emulation Program can handle a variety of line speeds. The emphasis is in helping you to determine which combinations are acceptable and how to assign internal priorities in the 3704 and 3705 for optimal performance.

The prerequisite publication is the *IBM 3704 and 3705 Communications Controllers Emulation Program Generation and Utilities Guide and Reference Manual,* GC30-3002.

Sixth Edition (June 1975)

This is a major revision of, and makes obsolete, GC30-3005-4. Changes or additions to the text and illustrations are indicated by a vertical line to the left of the change. Refer to the Summary of Amendments page for a complete summary of the changes to this edition.

This edition applies to the following 3704 and 3705 Emulation Programs:

OS	Version 2 Modification 3
DOS	Version 2 Modification 3
OS/VS	Version 2 Modification 3
DOS/VS	Version 2 Modification 3

This edition also applies to all subsequent versions and modifications with their associated temporary fixes (PTF) until otherwise indicated in new editions or Technical Newsletters. Changes are continually made to the information herein; before using this publication in connection with the operation of IBM equipment, consult the latest *IBM System/370 Bibliography* (Order No. GC20-0001) and associated technical newsletters, for the editions that are current and applicable.

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Contents

Figures

Summary of Amendments for GC30-3005-5

This revision updates the publication with information regarding the increased performance effects of the dynamic dump utility resulting from the use of eight byte trace entries.

Summary of Amendments for GC30-3005-4

This update is a reprint of GC30-3005-3, incorporating changes to the cover and edition notice of this publication.
These changes were issued in Technical Newsletter GN30-3002.

Summary of Amendments for GC30-3005-3

Storage Changes

Chapter 2 contains updated sotrage figures to reflect the latest version of the program.

Performance Changes

Chapter 3 describes a method for calculating the performance effects of the dynamic dump utility.

Miscellaneous Changes

Chapter 3 clarifies how priority schemes affect the number of lines that can be attached.

Chapter 1: Introduction

The purpose of this publication is to assist you in planning for Emulation Program storage requirements and performance.

Storage

The amount of storage required depends on the configuration of your teleprocessing subsystem—the number of terminals, the types of terminals used, and the type of communication scanner used.

Determine the total storage required by adding the individual storage requirements for:

1. Base code
2. Code required to support specific configurations
3. Control blocks and tables.

Chapter 2 lists the procedures for calculating storage requirements.

Performance

Performance is one of the major factors on which the total productivity of a system depends. Performance is largely determined by your combination of line speeds, interrupt priorities, and the proper placement of the communications controller on the channel.

The communications controller can support a variety of line speeds and interrupt priorities. Chapter 3 describes the procedures for determining valid configurations for each type of communication scanner.

Chapter 2: Emulation Program Storage Requirements

The Emulation Program requires storage in the IBM 3704 and 3705 Communications Controllers and in the host processor system. The amount of storage required depends on the configuration of the teleprocessing subsystem—the number and types of terminals, the type of communication scanner, and the type of communication lines that are used.

Determine the total amount of storage required for the Emulation Program by adding the individual storage requirements for:

1. Base code (5,560 bytes) including the Loader
2. Code needed to support specific configuration and options
3. Emulation Program control blocks and tables

The total storage requirement for your Emulation Program load module is also the storage requirement for the object library data set (OBJLIB—BUILD macro) and the load library data set (LOADLIB—BUILD macro) used in the OS generation procedure.

Base Code Requirements

The Emulation Program needs 5,560 bytes to support base code plus the loader code. Determine the additional storage requirements by selecting the options that pertain to your configuration:

Communication Scanner Code Requirements

	Bytes
Type 1 communication scanner support for: (select one)	
Binary synchronous lines	960
Start-stop lines	1,024
Binary synchronous and start-stop lines	1,224

Type 2 communication scanner support: No code requirement

Start-Stop Terminal Support

The following represents code required to support the operation of start-stop terminal types, allowing the Emulation Program to operate lines and communicate with terminals that fall within that type.

Choose the applicable option:

IBM type III	2,128
TTY type I and II	2,408
IBM type I and II	2,032
IBM type I, II and III	2,128
IBM and TTY type I and II	2,632
TTY I and II and IBM type III	2,128
TTY I and II and IBM type I, II, and III	2,128

Note: IBM type I and II - IBM 1030, 1050, 1060, 2740, 2741 terminals
IBM type III - IBM 2260/2848, 2265/2845 terminals
TTY type I - AT&T 83B2 and 83B3, WU 115A line control
TTY type II - TWX 33/35 line control

Binary Synchronous Terminal Support

The following represents code required to support binary synchronous line control.
Choose the applicable option:

	Bytes
EBCDIC	2,672
USASCII	2,320
Both	2,928

Line Trace Option (LINETRC)

Choose the applicable option:

type 1 communication scanner without dynamic dump:	1,464
type 1 communication scanner with dynamic dump:	2,472
type 2 communication scanner without dynamic dump:	1,448
type 2 communication scanner with dynamic dump:	2,456

If you include LINETRC, it is recommended that you provide enough additional storage to trace one line entry for every line being traced. An entry is either a level 1, level 2, or level 3 interrupt, and each entry requires 8 through 16 bytes.

Test Panel Option (TEST)

Choose the applicable option:

type 1 communication scanner without auto call:	1,184
type 1 communication scanner with auto call:	1,488
type 2 communication scanner without auto call:	1,128
type 2 communication scanner with auto call:	1,416

See *Performance Effects of the Trace Option* in Chapter 3 for more detail.

Character Control Block

The Emulation Program uses a character control block for each line in your configuration. (Storage for the character control block is required regardless of the communication scanner type used.) The character control block contains current information, primarily on the physical operation of the line. Figure 1 shows the character control block's storage requirements for each line and its possible options. Select the size applicable for each line.

	BSC Bytes	S/S Bytes
Line only	42	38
Line with auto call (AUTO)	42	38
Line with dual communications (DUALCOM) interface with or without auto call	44	n/a
Line with station select [1] with or without auto call or dual communications interface	46	n/a

[1]Station select is indicated if TADDR is specified

Figure 1. Character Control Block Storage Values

Every character control block is associated with a particular subchannel address; however every subchannel address within the range of the high and low subchannel addresses configured does not necessarily apply to a line within that specified range. Any subchannel address within the range of the high and the low subchannel address not associated with a line is a *skipped subchannel address.* Skipped subchannel addresses require dummy character control blocks, each of which occupy 10 bytes of storage. See the ADDRESS operand of the LINE macro instruction in the *IBM Emulation Program Generation* manual for more information.

Example 1:
During the generation of the Emulation Program, you will define the subchannel address and the line address for each LINE macro. You will also define the high (HICHAN) and low (LOCHAN) range of subchannel addresses in the BUILD macro.

Assume LINE macros such that the ADDRESS operands had the following subchannel and line addresses specified:

Subchannel Address	*Line Address*
01	04
02	05
03	06
06	07
07	08

The high subchannel address is X'07'. The low subchannel address is X'01'. Within the range, the skipped subchannel addresses are X'04' and X'05'. Each of these skipped subchannels requires a dummy character control block 10 bytes in length.

For more information on LINE and BUILD macros, see the *IBM Emulation Program Generation* manual. The procedure for calculating storage requirements for the character control blocks is as follows:

1. Determine the storage requirement for each line from Figure 1.
2. Add all line requirements.
3. Multiply the number of skipped subchannels by 10 bytes.
4. Add the sum from Step 2 to the product of Step 3.

Example 2:
A communications controller with a grouping of channel addresses falling within address X'00' and address X'3F' has 64 channel addresses. Assume these lines are start-stop with auto call, and ten of these lines are not associated with any channels. The storage for the character control blocks is calculated as follows:

1. The storage requirement for start-stop lines with auto call is 38 bytes.
2. Since all lines are the same, 54 subchannels x 38 bytes = 2,052.
3. There are 10 skipped subchannels. 10 subchannels x 10 bytes = 100.
4. Adding 2,052 from step 2 to 100 from step 3 yields 2,152 bytes.

Tables

The Emulation Program uses three tables: the channel vector table, the line vector table and the line group table.

Channel Vector Table

The Emulation Program uses the channel vector table to translate the multiplexer subchannel address to the corresponding communication scanner interface line address.

The channel vector table is a variable length table. Its size depends on the highest subchannel address assigned to the Emulation Program.

To determine the storage requirements for the channel vector table, use the following formula (where all values must be in decimal):

10 bytes + (high - low channel address x 2 bytes) + (number of scanners x 2 bytes) = number of bytes of storage required.

Example:
Assume the high subchannel address is X'54' and the low subchannel address is X'22' and that you have 2 communication scanners installed. (Converting to decimal: X'54' = 84; X'22' = 34.)

Using the formula:

10 bytes + ((84 - 34) x 2 bytes) + (2 x 2 bytes) = 114 bytes.

Line Vector Table

The Emulation Program uses the line vector table to index to the corresponding character control block once a line interface address is known. When a type 1 communication scanner is installed, the line vector table also contains the fields and pointers required by the type 1 communication scanner control program. The length of the line vector table depends on the highest line interface address specified. The amount of storage required for the line vector table is calculated as follows:

For type 1 communication scanners: (highest line address in decimal + 1) x 16 bytes = number of bytes of storage.

For type 2 communication scanners: (highest line address in decimal + 1) x 2 bytes = number of bytes required.

Assume you are using the highest possible address on a type 2 communication scanner base module—X'05F' (95 in decimal notation).

Using the formula:

(95 + 1) x 2 = 192 bytes of storage required.

Assume you are using the highest possible address on a type 1 communication scanner—X'03F' (63 in decimal notation).

Using the formula:

(63 + 1) x 16 = 1,024 bytes of storage required.

Line Group Table

The line group table contains parameters that a group of lines has in common. The line group tables are formed by GROUP macros at Emulation Program generation time and are eight bytes in length.

Allow eight bytes for every GROUP macro in your Emulation Program generation procedure.

Barswap Table

The barswap table contains parameters to provide linkage between a line and the trace facilities.

Allow four bytes for each line that will be traced simultaneously. A default of four bytes for each line defined at Emulation Program generation time is assumed.

To determine the storage requirements for the barswap table, use the following formula:

6 bytes + (number of lines to be traced simultaneously x 4 bytes) = number of bytes of storage required.

Example:

Assume that the maximum number of lines that you would want to trace simultaneously is three.

Using the formula:

6 bytes + (3 x 4 bytes) = 18 bytes.

Example of Calculating Total Storage Requirements

Assume the following configuration:

- A type 1 communication scanner with binary synchronous lines (base module only).
- Only EBCDIC code is used.
- Line trace with dynamic dump option is used.
- LOCHAN address is X'00'
- HICHAN address is X'3F'
- There are ten skipped subchannel addresses
- The highest line address is X'03F'

- Three GROUP macros are in the system generation object deck.

Storage Calculation:		Bytes
Base code		5,560
Type 1 scanner with BSC lines		960
Binary synchronous terminal support (EBCDIC)		2,728
Line trace option with dynamic dump		2,472
Trace table area		836
Character control block (BSC lines only)		
(42 x 54) + (10 x 10)	=	2,368
Channel vector table		
10 + (63 x 2) +2	=	138
Line vector table		
63 + 1 x 16	=	1,024
Line group table		
3 x 8	=	24
Barswap Table		
6 + (3 x 4)	=	18
Total bytes required:		16,128

Chapter 3: Performance

Performance in the communications controller depends on:

- The communications controller being used—3704 or 3705.
- The various combinations of lines, line speeds, and the priorities assigned to them.
- The type of communication scanner being used.
- The load created by the operation of the teleprocessing network.
- The subchannel priority arrangement.
- The number of lines being traced by the line trace option.

Type 1 Communication Scanner

Performance in the communications controller depends on the various combinations of lines, line speeds, and the priorities assigned to them. Lines attached to a type 1 communication scanner can be assigned to either of two interrupt priorities, 0 or 1. (See the *IBM Emulation Program Generation* manual for a description of the INTPRI operand on the LINE macro.) Priorities are assigned according to line speeds, with the highest speeds assigned to the highest priorities.

Figures 2 and 3 show the maximum simultaneous line operation capability for acceptable performance of a communications controller with a type 1 communication scanner operating in emulation mode. Figure 2 shows the maximum line counts, assuming all lines are assigned to priority 1 (which can be the case when all lines are the same or nearly the same speed). For example, 2,400 bps and 2,000 bps lines can be assigned the same interrupt priority.

Figure 3 shows the maximum number of lines allowed when using a two priority arrangement. The use of two priorities permits a higher total number of bits per second throughput than a single priority scheme does.

IBM 3704		IBM 3705	
Highest Speed (bps)	Number of Lines	Highest Speed (bps)	Number of Lines
4800	1	7200	1
3600	2	4800	2
2400	4	2400	5
2000	6	2000	7
1200	11	1200	12
600 (S/S)	30	600	36
600	32	up to 300	64
up to 300	32		

Figure 2. Type 1 Communication Scanner Line Counts for Single Priority Configurations

For IBM 3704 :

Highest Priority 1 Speed	Total Priority 1 Lines	Total Priority 0 Lines Allowed (Select Highest Speed Priority 0 Lines)											
		2400	2000	1200	600	300	150	134.5	110	75	74.2	56.9	45.5
3600	1	2	3	6	10	20	26	26	28	28	28	30	30
2400	3		2	4	9	22	29	29	29	29	29	29	29
	2		3	6	12	28	30	30	30	30	30	30	30
	1		3	7	16	31	31	31	31	31	31	31	31
2000	5			3	6	13	27	27	27	27	27	27	27
	4			3	8	17	28	28	28	28	28	28	28
	3			4	9	22	29	29	29	29	29	29	29
	2			6	12	26	30	30	30	30	30	30	30
	1			7	16	31	31	31	31	31	31	31	31
1200	10				5	7	15	15	22	22	22	22	22
	9				5	12	23	23	23	23	23	23	23
	8				6	12	24	24	24	24	24	24	24
	7				6	13	25	25	25	25	25	25	25
	6				6	14	26	26	26	26	26	26	26
	5				7	15	27	27	27	27	27	27	27
	4				8	18	28	28	28	28	28	28	28
	3				10	22	29	29	29	29	29	29	29
	2				12	28	30	30	30	30	30	30	30
	1				16	31	31	31	31	31	31	31	31
600	30					2	2	2	2	2	2	2	2

For IBM 3705 :

Highest Priority 1 Speed	Total Priority 1 Lines	Total Priority 0 Lines Allowed (Select Highest Speed Priority 0 Lines)											
		2400	2000	1200	600	300	150	134.5	110	75	74.2	56.9	45.5
4800	1	3	3	6	10	15	19	19	19	20	19	21	22
2400	4			4	8	20	33	33	36	37	36	40	40
	3			5	10	24	43	43	46	49	47	49	50
	2			6	12	30	52	52	56	60	59	60	62
	1			8	16	38	60	62	63	63	63	63	63
2000	6			3	6	14	30	30	35	36	36	38	40
	5			3	7	17	37	41	44	48	47	49	50
	4			4	8	20	44	49	54	57	56	60	60
	3			5	10	24	52	59	61	61	61	61	61
	2			6	12	29	62	62	62	62	62	62	62
	1			8	16	38	63	63	63	63	63	63	63
1200	11				5	12	29	33	41	53	53	53	53
	10				6	13	31	34	44	54	54	54	54
	9				6	14	32	36	46	55	55	55	55
	8				6	15	34	38	48	56	56	56	56
	7				7	15	36	40	50	57	57	57	57
	6				7	16	37	42	52	58	58	58	58
	5				8	17	38	43	54	59	59	59	59
	4				8	20	45	50	60	60	60	60	60
	3				10	24	53	59	61	61	61	61	61
	2				12	30	62	62	62	62	62	62	62
	1				16	38	63	63	63	63	63	63	63

Figure 3. Maximum Line Count for a Type 1 Scanner When Assigning Lines to Two Priorities (Part 1 of 2)

For IBM 3705 (Continued)

Highest Priority 1 Speed	Total Priority 1 Lines	Total Priority 0 Lines Allowed (Select Highest Speed Priority 0 Lines)											
		2400	2000	1200	600	300	150	134.5	110	75	74.2	56.9	45.5
600	35					5	11	11	16	18	17	28	29
	34					7	14	15	21	24	23	30	30
	33					7	18	17	22	30	29	31	31
	32					8	19	18	24	32	32	32	32
	31					8	19	19	24	33	33	33	33
	30					8	20	20	26	34	34	34	34
	29					9	21	20	27	35	35	35	35
	28					9	22	22	28	36	36	36	36
	27					9	22	23	29	37	37	37	37
	26					10	24	24	31	38	38	38	38
	25					10	24	25	32	39	39	39	39
	24					10	25	26	33	40	40	40	40
	23					11	26	27	34	41	41	41	41
	22					11	27	28	36	42	42	42	42
	21					11	27	28	37	43	43	43	43
	20					12	28	30	38	44	44	44	44
	19					12	29	31	39	45	45	45	45
	18					12	30	32	40	46	46	46	46
	17					13	30	33	41	47	47	47	47
	16					13	32	34	43	48	48	48	48
	15					14	32	35	44	49	49	49	49
	14					14	33	36	45	50	50	50	50
	13					14	34	36	46	51	51	51	51
	12					15	35	38	48	52	52	52	52
	11					15	35	39	48	53	53	53	53
	10					16	36	40	50	54	54	54	54
	9					16	37	41	51	55	55	55	55
	8					16	38	42	52	56	56	56	56
	7					17	38	43	53	57	57	57	57
	6					17	39	44	55	58	58	58	58
	5					17	40	44	56	59	59	59	59
	4					19	44	49	60	60	60	60	60
	3					24	52	59	61	61	61	61	61
	2					29	62	62	62	62	62	62	62
	1					38	63	63	63	63	63	63	63

Figure 3. Maximum Line Count for a Type 1 Scanner When Assigning Line to Two Priorities (Part 2 of 2)

Sixty-four lines can be physically attached to the 3705 type 1 communication scanner. However, certain combinations of line interface bases and line sets can lower this limit.

When more than two speeds are involved, use the highest speeds assigned to each priority to determine the line mix and priority assignment from Figure 3.

To use Figure 3:

1. Select your highest priority 1 line speed from the first column, "Highest Priority 1 Speed."
2. Select your total number of priority 1 lines used at that line speed and at lower speeds from the second column, "Total Priority 1 Lines."
3. In the column beneath the speed of your highest-speed priority 0 lines, find the number that intersects the number selected in Step 2.
4. The number selected in Step 3 is the maximum number of priority 0 lines—of all speeds—allowed in your configuration.

Example 1:
Assume that you have a 3705 with five priority 1 lines, and the highest line speed is 2,000 bps. If your highest priority 0 line speed is 134.5 bps, a maximum of 41 priority 0 lines can be used.

Example 2:
Assume that you have a 3705 with 49 priority 0 lines, and the highest line speed is 134.5 bps. If your highest priority 1 line speed is 2,000 bps, a maximum of 4 priority 1 lines can be used.

Example 3:
Assume that you have the following line configuration on a 3705.

Speed in bps	Line Count	
2,400	2	priority 1
1,200	2	priority 0
134.5	10	
75	10	
45.5	13	

If you assigned the 2,400 bps lines to priority 1 and the remaining 35 lines to priority 0, the highest speed line on priority 0 is 1,200 bps. This arrangement is not valid because Figure 3 indicates that only six priority 0 lines are allowed.

By changing the priority arrangement for the same configuration, you can accommodate the 37 lines as follows:

Speed in bps	Line Count	
2,400	2	priority 1
1,200	2	
134.5	10	priority 0
75	10	
45.5	13	

With the new boundary between priorities 1 and 0, four priority 1 lines have a high speed of 2,400 bps; 33 priority 0 lines have a high speed of 134.5 bps. Figure 3 shows that this arrangement is valid.

Note: You may sometimes need to assign different priorities to lines of the same speed. For example, eight 1,200 bps lines combined with eight 600 bps lines is valid. The eight 1,200 bps lines and two of the 600 bps lines are assigned to priority 1, and the remaining six 600 bps lines are assigned to priority 0.

Type 2 Communication Scanner

The following procedure can be used for determining whether the communications controller with type 2 communication scanners can handle a given collection of communication lines.

Calculation of Test Value (T)

When attaching lines of varying speeds, determine the ability to perform at those speeds, and then establish a suitable priority arrangement as stated below under

Assigning Priorities to Lines. To determine whether your configuration will provide acceptable performance, calculate a test value T.

If the resulting T value is less than or equal to 1, the line mix is adequate. Configurations resulting in a T value greater than 1 will probably have frequent overruns.

Calculate a test value T, given by

$$T = (N \times 0.0002) + EBSC + ABSC + SS$$

Where: N = total number of lines.

EBSC= 0.000084 (for 3704) or 0.000070 (for 3705) multiplied by the sum of the products of the number of lines of each speed using EBCDIC code times the speed in characters per second.

Restated in mathematical notation:

$$\left\{\begin{matrix} 0.000080 \text{ (for 3704)} \\ \text{or} \\ 0.000070 \text{ (for 3705)} \end{matrix}\right\} \quad x \ \Sigma \ (N_i) \ x \ (S_i)$$

where:

N_i= number of lines of speed I

S_i= line speed in characters per second for speed I

ABSC= USASCII equivalent of EBSC; for the IBM 3704, substitute 0.000084 for 0.000080; for the IBM 3705, substitute 0.000074 for 0.000070.

SS= 0.000092 (for 3704) or 0.000083 (for 3705) multiplied by the sum of the products of the total number of start-stop lines times the speed in characters per second of these lines.

Example:

Configuration on a 3705:

(N)	(bits per sec)	(line control)		(characters per second)
Ten	4,800	BSC	EBCDIC	600
Ten	2,400	BSC	USASCII	300
Twenty	134.5	SS	1050	14.8
Five	1,200	SS	2848	120

N = 45 x 0.0002 = 0.009
EBSC = 600 x 10 x 0.000070 = 0.420
ABSC = 300 x 10 x 0.000074 = 0.222
SS = ((14.8x20) + (120x5)) x 0.000083 = 0.069

T = 0.009 + 0.384 + 0.204 + 0.069 = 0.744

0.744 is less than 1.0; the system passes the test for validity.

Restrictions for 3704

Consider the following restrictions when using the above formula.

1. Only one 50,000 bps or 48,000 bps or 40,800 bps line may be mixed with other speeds; start-stop lines may not be mixed with either a 50,000 bps or a 48,000 bps line.
2. A suitable priority arrangement must also be found, as described below in *Assigning Priorities to Lines.*

Restrictions for 3705

Consider the following restrictions when using the above formula.

1. Only one 50,000 bps or 48,000 bps line may be mixed with other speeds.
2. Two 40,800 bps lines may be mixed with other speeds less than 9,600 bps up to a T value of 0.9.
3. Only five 19,200 bps or 20,400 bps lines may be mixed with lower speeds.
4. Only three 19,200 bps or 20,400 bps lines may be mixed with a 50,000 bps or 48,000 bps line. If lower speeds are also present, only two 19,200 bps or 20,400 bps lines may be mixed with a 50,000 bps or 48,000 bps line.
5. Only four 19,200 bps or 20,400 bps lines may be mixed with a 40,800 bps line. If lower speeds are also present, only three 19,200 bps or 20,400 bps lines may be mixed with a 40,800 bps line.
6. A suitable priority arrangement must also be found, as described below in *Assigning Priorities to Lines.*

Assigning Priorities to Lines

Lines attached to a type 2 communication scanner can be assigned to one of four interrupt priorities (0-3). (See the *IBM Emulation Program Generation* manual for a description of the INTPRI operand on the LINE macro.) Lines on each of the four possible communication scanners may be assigned to the same priority. For example, you may have a 2,400 bps line on each scanner with a priority of 2.

The *Priority Share Limits* given in Figures 4 and 5 must be used as a limit in filling priorities. Priorities are filled starting with the highest priority (3) and continuing to the lowest (0). Lines are assigned to priorities starting with the highest speed unassigned line and continuing downward.

Use the following four steps to assign priorities. Begin with priority 3.

Step 1: Assign the following values:

L_h = highest line speed remaining to be assigned
C_h = line speed in characters per second, from Figures 4 and 5
S_i = character speed for *each* line already assigned a priority.

Step 2: Assign the following values:

BSC lines only: (Round quotient to highest whole number.)
$R_i = S_i/C_h$ (load from higher priority line)

SS lines only: (Do not round quotient)

$R_i = S_i/C_h \times 1.2$ = new R1

Calculate R where,
R (combined load from higher priority lines) = $R_i + R_i + \ldots R_i$
(Round R to the next whole number.)

Note: Omit Step 2 when assigning lines to priority 3. Assign R = 0.)

Step 3: Determine priority share limit of line from Figures 4 and 5.

Priority Share Limit minus R = number of unassigned lines that may be assigned to this priority (0-3). Assign higher speeds first.

Step 4: If only *one* line remains to be assigned, it may be assigned to this priority. Otherwise, assign lines to the next lower priority by repeating Steps 1-4.

Example 1:
Configuration: Two 50,000 bps lines on a 3705

Assigning priority 3:

Step 1: L_h = 50,000 bps; C_h = 6,250 cps
Step 2: skip;
R = 0
Step 3: Priority Share Limit = 1;
one line can be
assigned to priority 3.
Step 4: Only one line remaining; also assigned to
priority 3.

Example 2:

Configuration: a 3705 communications controller
one 50,000 bps line (BSC)
one 19,200 bps line (BSC)
one 4,800 bps lines (BSC)
ten 2,400 bps lines (BSC)
twenty 74.2 bps lines (S-S)
thirty-three lines in total
one type 2 communication scanner
scan limit = 96; address substitution used

Assigning priority 3:

Step 1: L_h = 50,000 bps line; C_h = 6,250
Step 2: Skip;
R = 0
Step 3: Priority Share Limit = 1;
one line can be
assigned to priority 3.
Thirty-two lines remain to be assigned.

Assigning priority 2:

Step 1: L_h = 19,200 bps line; c_h = 2,400; CS1 = 6,250;
Step 2: R1 = 6250/2400
R1 = 3
R = 3
Step 3: Priority Share Limit = 7;
7 - 3 = 4;
four lines can be assigned to priority 2:
one 19,200 bps and one 4,800 bps line
and two 2,400 bps lines.
Twenty-eight lines remain to be assigned.

Assigning priority 1:

Step 1: L_h = 2,400 bps line;
S1 = 6,250 cps
S2 = 2,400 cps
S3 = 600 cps
C_h = 300 cps
R1 = 6250/300

Step 2: R1 = 21
R2 = 2400/300
R2 = 8
R3 = 600/300
R3 = 2
R4 = 300/300
R4 = 1
R5 = 300/300
R5 = 1
R = 33

Step 3: Priority Share Limit = 66;
66 - 33 = 33, the number of lines that can be assigned to this priority.
the remaining 28 lines (eight 2400 bps and twenty 74.2 bps) can be assigned to priority 1.

Step 4: No lines remain to be assigned.

Note: If four priorities have been assigned by this formula and lines are left, then re-evaluate your line speeds and alter your configuration such that all lines can be assigned a priority.

In general, use all four available priorities for best communications controller performance. If four priorities have not been assigned after using the procedure described above, take the following additional steps.

Step a. Perform the following test for *each* priority (K) on which the highest speed line assigned is in the 600 bps to 4800 bps range.
If none exist, proceed to step b below.

The following symbols are used:

S = number of scanners on which lines of priority K reside
N = total number of lines on priority K
A = the average number of lines of priority K per scanner (N / S)
C = highest character speed of this priority
L = highest scan limit set on any of the S scanners on which lines of priority K reside.

The test for a priority K involves evaluating one of the following expressions:

If $A \leq 24$:
Evaluate (N x L x C) / 1,000,000

If $A > 24$:
Evaluate (S x L x C) / 1,000,000 x (12 + (A / 2))

If the evaluated expression is less than or equal to 1, go to Step b Otherwise split the failing priority (there will be at most one), using the procedure below on splitting priorities. After the priority is split, go to Step b.

Step b. If all four priorities are still not assigned after performing Step a, use the procedure below to split the most heavily loaded priorities, if possible, until you have assigned lines to all four priorities.

Reassigning Lines to Priorities

Use the following procedure to split a given priority K.

1. Reassign all lines on any priority lower than K to the next lower priority; for example, if priority 2 is to be split, reassign any lines on priority 1 to priority 0. (Priority 0 previously had to be open because priorities are assigned highest to lowest. This procedure should be used only when all priorities are not used.)
2. Reassign the bottom half of the lines on priority K to the next lower priority. Assume priority 1 in the example above has eight 2400 bps lines and twenty 74.2 bps lines assigned. To reassign the bottom half of the lines means fourteen of the 74.2 bps lines must be moved to priority 0.

Refer to the preceding Example 2 under *Assigning Priorities to Lines.*

Step a. Priority 1 has eight 2400 bps lines and twenty 74.2 bps lines assigned.

S = 1
N = 28
A = 30
C = 300
L = 96

S x L x C / 1,000,000 x (12 + (28 / 2) = 0.749

From Step b, assume all line utilizations are equal. Priority 1 is the most heavily loaded. Therefore, move the fourteen lines of speed 74.2 bps to priority 0.

Example 1:

Consider the following configuration:

Controller: 3705
lines: 48 - 2400 bps
number of scanners: type 2
scan limits on scanners: 96

The procedure described in Steps 1 through 4 would assign all lines to the highest priority. The other 3 priorities are open.

From Step a:

S = 2
N = 48
A = 24
C = 300
L = 96

Evaluating N x L x C / 1,000,000 = 48 x 96 x 300 /1,000,000 = 1.3824

The result is greater than 1, so the priority must be split. Assign one-half of the lines to the second highest priority.

For IBM 3704 :

Line Speed (bps)	Character Speed	Priority Share Limit	Max Number of Lines	
			EBCDIC	USASCII
50000	6250	1	2	2
48000	6000	1	2	2
40800	5100	1	2	2
20400	2550	4	2	2
19200	2400	4	4	4
9600	1200	10	10	10
7200	900	15	14	14
4800	600	25	21	21
2400	300	56	24	24
2000	250	68	24	24
1200	150	116	24	24
600	75	237	24	24

For IBM 3705 :

Line Speed (bps)	Character Speed	Priority Share Limit	Max Number of Lines	
			EBCDIC	USASCII
50000	6250	1	2	2
48000	6000	1	2	2
40800	5100	2	2	2
20400	2550	7	6	6
19200	2400	7	6	6
9600	1200	13	12	12
7200	900	20	17	16
4800	600	31	25	24
2400	300	66	51	48
2000	250	80	61	58
1200	150	136	102	96
600	75	275	200	188

Figure 4. Priority Assignment for BSC Lines for Type 2 Scanners

From Step b:

Assuming the two highest priorities each have approximately the same load, they should now each be split so that all four priorities are used. The resulting priority assignment is 12 lines on each priority.

Subchannel Service Priorities

Subchannel service priorities, which the communications controller services internally, are assigned at Emulation Program generation time by coding CHNPRI=NORMAL or HIGH on the LINE macro. See the *IBM Emulation Program Generation* manual for a description of the CHNPRI operand.

For IBM 3704 :

Line Speed (bps)	Character Speed	Priority Share Limit	Max Number of Lines
2400	240	71	24
1200	120	131	24
600	66.7	267	24
300	30	600	24
150	15	1206	24
134.5	14.8	1210	24
110	10	1811	24
74.2	10	1811	24
75	8.3	2174	24
56.9	7.7	2363	24
45.5	6.1	2956	24

For IBM 3705:

Line Speed (bps)	Character Speed	Priority Share Limit	Max Number of Lines
2400	240	83	53
1200	120	170	105
600	66.7	310	187
300	30	694	255
150	15	1392	255
134.5	14.8	1397	255
110	10	2090	255
74.2	10	2090	255
75	8.3	2509	255
56.9	7.7	2719	255
45.5	6.1	3401	255

Figure 5. Priority Assignment for Start-Stop Lines for Type 2 Scanners

Communications Controller Subchannel Priorities

When the highest speed line in a configuration is less than 9,600 bps, all lines may be assigned to the same priority. Performance is about 1% better if lines are all assigned to the HIGH priority.

When the highest speed line is greater than 9,600 bps, assign all lines of speeds less than or equal to 9,600 bps to the NORMAL priority, and all lines greater than 9,600 bps to the HIGH priority, with the following exception. When the highest speed line is greater than 19,200 bps (or 20,400 bps for WTC line speed), assign the 19,200 bps or 20,400 bps line and lower speed lines to the NORMAL priority and the higher speed lines to the HIGH priority.

Device Priority on The Byte Multiplexer Channel

The communications controller is an "overrunnable" device. It should have the highest priority on the byte multiplexer channel; that is, it should be the first device to secure the *Select Out* signal.

When multiple communications controllers are on the same channel, position the controllers with the highest speed lines and the most heavily used lines first on the channel.

Line Trace Option

The line trace option is a diagnostic tool that builds a trace table dynamically in all unused storage beyond the Emulation Program load module. For information on how to specify this option, see the LINETRC operand on the BUILD macro in the *Emulation Program Generation* manual.

Performance Effects of the Trace Option

When the trace (with or without the dynamic dump) is not activated, the trace code resident in the communications controller has no effect on performance. Tracing lines imposes an additional load on the communications controller, depending on the number of lines being traced.

Line trace (with or without the dynamic dump) cannot be activated for any lines on a heavily loaded system without shutting down part of the teleprocessing system.

To determine if you have to shut down any lines to avoid overrun, use the following procedures to calculate the effects of trace on your system for the type of communication scanner installed.

Performance Effects of Trace on a Type 1 Communication Scanner

Using the procedure below, calculate a "larger system" (to show the effects of the increased load created by the trace function) with hypothetical line counts greater than your present system. Determine the validity of the "larger system" according to the method established in the preceding text. If it is not valid, the difference in the line count of the "larger system" and the present system is the number of lines you will have to shut down when tracing the intended lines. See the *Performance Effects of the Dynamic Dump Utility* in this chapter to determine whether trace table entries will be overlaid.

1. For each line (grouped by speed in bps) to be traced, increase the line count by 50% (when necessary, round up to the next whole number).
2. If the highest speed line is among those to be traced, the increased value for the number of highest speed lines must be a minimum value of 2.
3. If the highest speed line is not to be traced, then add 2 to the number of lines of the highest speed.
4. Use Figures 2 and 3 to determine whether the "larger system" with the hypothetical lines is still valid.

In general, trace cannot be activated when 7,200 bps and 4,800 bps lines are active on a type 1 scanner for the 3705 and 3704 respectively.

Example:
A 3705 Communications Controller
A type 1 scanner
Two 2,400 bps lines
Ten 134.5 bps lines
Trace five 134.5 bps lines

Add the hypothetical lines to measure the effect of trace:

1. 10 priority 0 lines + (5 x 0.50) = 10 + 2.5 = 12.5 (round up to 13) priority 0 lines.

2. Not applicable
3. 2 + 2 (2400 bps lines) = 4 priority 1 lines
4. Use Figure 3, and consider the "larger system" after Step 4. Find 2400 bps under the "Highest Priority 1 Speed" column; find four lines (the new value) at that speed under the "Total Priority 1 Lines" column. Now find 134.5 bps under the "Total Priority 0 Lines Allowed" column; at the intersection, the number of possible lines is 33. Because 33>13, the requirement is met. Therefore, the configuration with trace is valid.

Performance Effects of Trace on a Type 2 Communication Scanner

Using the procedure below, calculate a "larger system" with a hypothetical lin count greater than your present system. Determine if the "larger system" is valid according to the method established in the preceding text. If it is not valid, the difference in the line count of the "larger system" and the present system is the number of lines you will have to shut down when tracing the intended lines.

1. Multiply the number of highest speed lines by 1.25; round the total upwards.
2. Multiply the number of lines of the speed being traced by 2.5; add the product to the total number of lines for that speed. If lines of the highest speed are being traced, add the product of step 1 also.
3. Use Figures 4 and 5, and the formula for T (see *Type 2 Communication Scanner* above) to determine whether the system with the hypothetical lines is still valid.

In general, trace cannot be activated when 40,800 bps, 48,000 bps, and 50,000 bps lines are active on a type 2 scanner.

To illustrate the effects of trace, assume the following configuration on a 3705.

Example 1:
A type 2 scanner
48 lines of speed 2400 bps (EBCDIC)
Trace 2 lines

Add the hypothetical lines to measure the effects of trace.

1. 48 (2,400 bps lines) x 1.25 = 60
2. 2 x 2.5 = 5
   5 + 60 = 65
3. Using Figure 4:
   65 - 51 = 14 lines that need to be shut down.

The "larger system" with hypothetical lines is invalid. Therefore, a reduction must be made in either the number of lines being traced or the number of lines currently in use. Possible solutions are to:

(1) Reduce the number of lines by 34(48-14) Then the total number of lines including hypothetical lines is:

34 x 1.25 = 42.5, round up to 43
2 x 2.5 = 5
43 + 5 = 48 lines

(2) Reduce the number of lines being traced simultaneously to 1 and the number of lines in use to 38. Then the total number of lines including hypothetical lines to be added is:

38 x 1.25 = 48
48 + 2.5 = 50.5
round up to 51 lines.

Example 2:
A type 2 scanner
Ten 4800 bps lines (EBCDIC)
Six 1200 bps lines (ASCII)
Twenty 134.5 bps lines (start-stop)
Trace two 1200 bps lines and two 134.5 bps lines

Add the hypothetical lines to quantify the effects of trace.

1. 10 (4800 bps lines) x 1.25 = 13 — 4800 bps
2. 6 + (2 x 2.5) = 11 — 1200 bps
   20 + (2 x 2.5) = 25 — 134.5 bps
3. Calculate a test value (T) for the system with hypothetical lines:

13 x 600 x 0.000070	=	0.5460
11 x 150 x 0.000074	=	0.1221
25 x 14.8 x 0.000083	=	0.0307
T	=	0.6988

0.6998 is less than 1.0, therefore the system passes the test; this is a valid system.

Performance Effects of the Dynamic Dump Utility

The dynamic dump utility is an optional utility that is useful in debugging. This utility can be used to:

- Obtain, without terminating the execution of the Emulation Program, (1) a storage dump (from locations 0 through the end of storage) of the communications controller, or (2) a display on the operator's console at the host processor of portions of controller storage (up to 144 bytes) starting at any location, or (3) a dump of the Emulation Program trace table only.
- Activate or deactivate the Emulation Program line trace function.
- Perform a dynamic dump of Emulation Program trace table entries as they are entered into the trace table.

Refer to the *Emulation Program Generation and Utilities Manual* for more information about the dynamic dump utility.

Certain precautions are required when dynamically dumping trace table entries. You must ensure that enough storage is available for your trace table and that there is sufficient idle line time to prevent the overlaying of trace entries. In some situations, the dynamic dump utility is not able to keep pace with the generation of trace data. This situation occurs because more time is needed to dump the trace table than to build it; as a result, with a high data rate, the entries will be overlaid. If you suspect that your data will be overlaid, you can (1) increase the amount of storage allocated to your trace table, (2) reduce the number of lines being traced, and/or (3) reduce the number of lines that are active.

To determine the characters per second for traced and non-traced lines, plot the coordinate of the point (cps_n, cps_t) on the graph that matches your machine configuration (Figures 8 through 11). cps_n represents the throughput in characters per second for non-traced lines and is plotted along the X axis. cps_t represents the throughput in characters per second for traced lines and is plotted along the Y axis. The point determined by these coordinates will indicate if further calculations are required for determining the size of the trace table and the amount of idle line time required between transmissions.

The following steps describe this process:

1. Determine cps_n and cps_t and plot this point on the appropriate graph (Figures 8 through 11). Use Figure 4 for binary synchronous (BSC) lines and Figure 5 for start-stop lines to determine the character speed.
2. If the point is below the line for the level(s) to be traced, proceed with the trace.
3. If the point is above the line for the level(s) to be traced, perform the calculations described in the following section to determine the size of the trace table required and the amount of idle line time required between transmissions to prevent trace table entries from possibly being overlayed.

The following two examples illustrate the use of the Figure 8 through 11. The first example gives a value in Figure 9 *below* the line for the level to be traced. This indicates that trace entries can be dumped without the possibility of overlaying trace table entries.

Machine type: 3705
Communication scanner: type 2
Level to be traced: level 2 only
Traced line: 1 at 2,400 bps (BSC)
Non-traced lines: 17 at 2,400 bps (BSC)

Throughput of traced line: 2,400 bps = 300 cps (CPS_T)
Throughput of non-traced lines: 17 x 300 cps = 5,100 cps (CPS_n)

Figure 9 shows that the point of intersection is below the line for tracing level 2.

The second example gives a value in figure 10 *above* the line for the levels to be traced. You will need to perform the calculations for trace table size and line idle period between transmissions before you can determine whether trace entries can be dumped without the possibility of overlaying the trace table.

Machine type: 3704	
Communication scanner: type 1	
Level to be traced:	levels 2 and 3
Traced line:	1 at 2,400 bps (BSC)
	2 at 600 bps (BSC)
Non-traced lines:	5 at 600 bps (BSC)
	4 at 134.5 bps (S-S)

Throughput of traced line: 3,600 bps = 450 cps (CPS_T)
Throughput of non-traced lines: (5 x 75) + (4 x 14.8) = 434 cps (CPS_n)

Figure 10 shows the point of intersection to be above the line for tracing levels 2 and 3; however, it is below the line for tracing level 2 only. You can trace level 2, or you can perform the calculations necessary for tracing levels 2 and 3. If you can not meet the conditions required, as shown by the calculation, you must systematically close down part of your network until the load imposed by the trace function has been compensated for by less line traffic.

Determining Trace Table Storage and Idle Line Time Requirements

Overlaying of trace table entries can be prevented if the following criteria are met:

- The trace table is large enough to hold pending trace entries until the idle condition necessary to dump them is reached.
- The duration of the idle line time is sufficient for the dump to empty the pending trace entries.

Calculation of Trace Table Storage Requirements

To determine if the trace table is large enough for the 3705 trace entries to be dumped (the method is identical for a 3704, only the values from the figures change), determine the following:

Step 1: Calculate the rate (K_1) in which data is stored in the trace table.

$K_1 = cps_t \times L$

Where cps_t is the throughput of traced lines in characters per second.

L is 16 if only level 2 is traced, 2 if only level 3 is traced, or 18 if both level 2 and 3 are traced.

Step 2: Calculate the rate (K_2) in which data is dumped from the trace table.

$K_2 = (1 - [(C \times cps_t) + (D \times cps_n)])/M$

Where C is the value from Figure 6 (3705) or Figure 7 (3704).

D is the value from Figure 6 (3705) or Figure 7 (3704).

cps_n is the throughput of non-traced lines in characters per seconds.

cps_t is the throughput of traced lines in characters per second.

M is 0.000062 (3705), or 0.000070

Step 3: Calculate the rate (B) in which the dump falls behind the building of the table.

$B = K_1 - K_2$

Step 4: Calculate the period (T_a) in which the traced lines are active.

$T_a = L_r/cps_t$

Where L_r is the number of characters in the transmission during the active period, and cps_T is the throughput of traced lines in characters per second.

Step 5: Using the values from Steps 4 and 5 calculate the size of the trace table (P) needed to prevent data from being overlaid. This value should be less than the controller's storage minus the size of the Emulation program load module. If it is greater, less lines will have to be traced. This value also assumes that the accumulated trace data is dumped during the idle line time.

$P = T_a \times B$

	Trace Level 2 only		Trace Level 3 only		Trace Levels 2 and 3	
	C	D	C	D	C	D
3705 TYPE 1 SCANNER	.000391	.000303	.000326	.000311	.000414	.000311
3705 TYPE 2 SCANNER	.000146	.000065	.000087	.000072	.000170	.000073

Figure 6. 3705 Processing Time (in microseconds) per Character

	Trace Level 2		Trace Level 3		Trace Levels 2 and 3	
	C	D	C	D	C	D
3704 TYPE 1 SCANNER	.000444	.000348	.000373	.000356	.000470	.000357
3704 TYPE 2 SCANNER	.000161	.000072	.000097	.000080	.000187	.000081

Figure 7. 3704 Processing Time per Character

Sample Trace Table Size Calculation

The following example illustrates the steps necessary to determine trace table size.

Machine type: 3705
Communication scanner: type 2
Traced line: 7200 bps = 900 cps
Non-traced lines: 2400 x 6 = 1800 cps
Number of characters in transmission during active period: 200
Level to be traced: 2

Step 1: Calculate the rate (K_1) in which data is stored in the trace table.

$K_1 = cps_t \times L$

$K_1 = 900 \times 16$

$K_1 = 14{,}400$ characters per second

Step 2: Calculate the rate (K_2) in which data is dumped from the trace table.

$K_2 = (1 - [(C \times cps_T) + (D \times cps_n)])/M$

$K_2 = (1 - [(0.000146 \times 900) + (0.000065 \times 1800)])/0.000062$

$K_2 = (1 - [0.1314 + 0.117])/0.000062$

$K_2 = (1 - [0.1314 + 0.117])/0.000062$

$K_2 = 12{,}123$ characters per second

Step 3: Calculate the rate (B) in which the dynamic dump falls behind the building of the table.

$B = K_1 - K_2$

$B = 14{,}400 - 12{,}123$

$B = 2{,}277$ characters per second

Step 4: Calculate the period (T_a) in which the traced line is active.

$T_a = L_r/cps_t$

$T_a = 200/900$

$T_a = 0.22$ seconds (220 milliseconds)

Step 5: Calculate the size of the trace table (P) needed to prevent data from being overlaid.

$P = T_a \times B$

$P = 0.22 \times 2277$

$P = 501$ bytes

The trace table must have 501 bytes of storage to hold non-dumped trace entries until the idle line condition is reached assuming that the accumulated entries are dumped during periods of idle line time.

Calculation of the Idle Line Period Required between Transmissions

If your configuration has enough storage to accommodate the non-dumped trace entries, calculate the length of idle line time required between transmissions for the dump to "catch up" or keep pace with the storing of the data entries. To determine the length of idle line time, calculate the following:

Step 1: Assume that the traced line (or lines) is idle. Set cps_t equal to zero. If $cps_t=0$, then K_1, B, and T_a are also equal to zero.

Step 2: Calculate the characters per second transmitted for all lines not being traced.

Step 3: Calculate the "catch up" rate (K_3) in which previously stored data is being dumped from the trace table while processing continues for non-traced lines.

$K_3 = (1 - (D + cps_n))/M$

Where D is the value from Figure 6 (3705) or Figure 7 (3704).

cps_N is the throughput of non-traced lines in characters per second.

M is .000062 (3705) or .000070 (3704).

Step 4: Calculate the idle time (T_i) required between transmissions to dump the table entries.

$T_i = P/K_3$

Where P is the trace table size needed to prevent data from being overlaid.

Sample Calculation of Line Idle Time Requirement

The following example illustrates the steps necessary to determine the line idle time required to empty the trace table whose size was determined in the above example.

Step 1: Assume cps_T equal to 0.

Step 2: Calculate the characters per second transmitted for all lines not being traced. The sample configuration has six lines at 2400 bps.

$(2400 \times 6)/8 = 1800$ cps

Step 3: Calculate the "catch up" rate in which previously stored data is dumped from the trace table while processing continues for non-traced lines.

$K_3 = (1 - (D + cps_N))/M$

$K_3 = (1 - (0.000065 \times 1800))/0.000062$

$K_3 = (1 - 0.117/0.000062$

$K_3 = 0.883/0.000062$

$K_3 = 14{,}242$ characters per second

Step 4: Calculate the idle line time required to dump the trace table entries.

$T_i = P/K_3$

$T_i = 501/14{,}242$

$T_i = 0.035$ seconds (35 milliseconds)

The trace table size has a direct effect on the amount of time required for the dumping of trace entries to keep pace with the storing of entries. For example, assume that P is 1,424 bytes and K_3 is the same (14,242), T_i would be 0.100 seconds.

The smaller the trace table required, the less time needed between transmissions to dump it; the larger the table required, the more time needed to dump it.

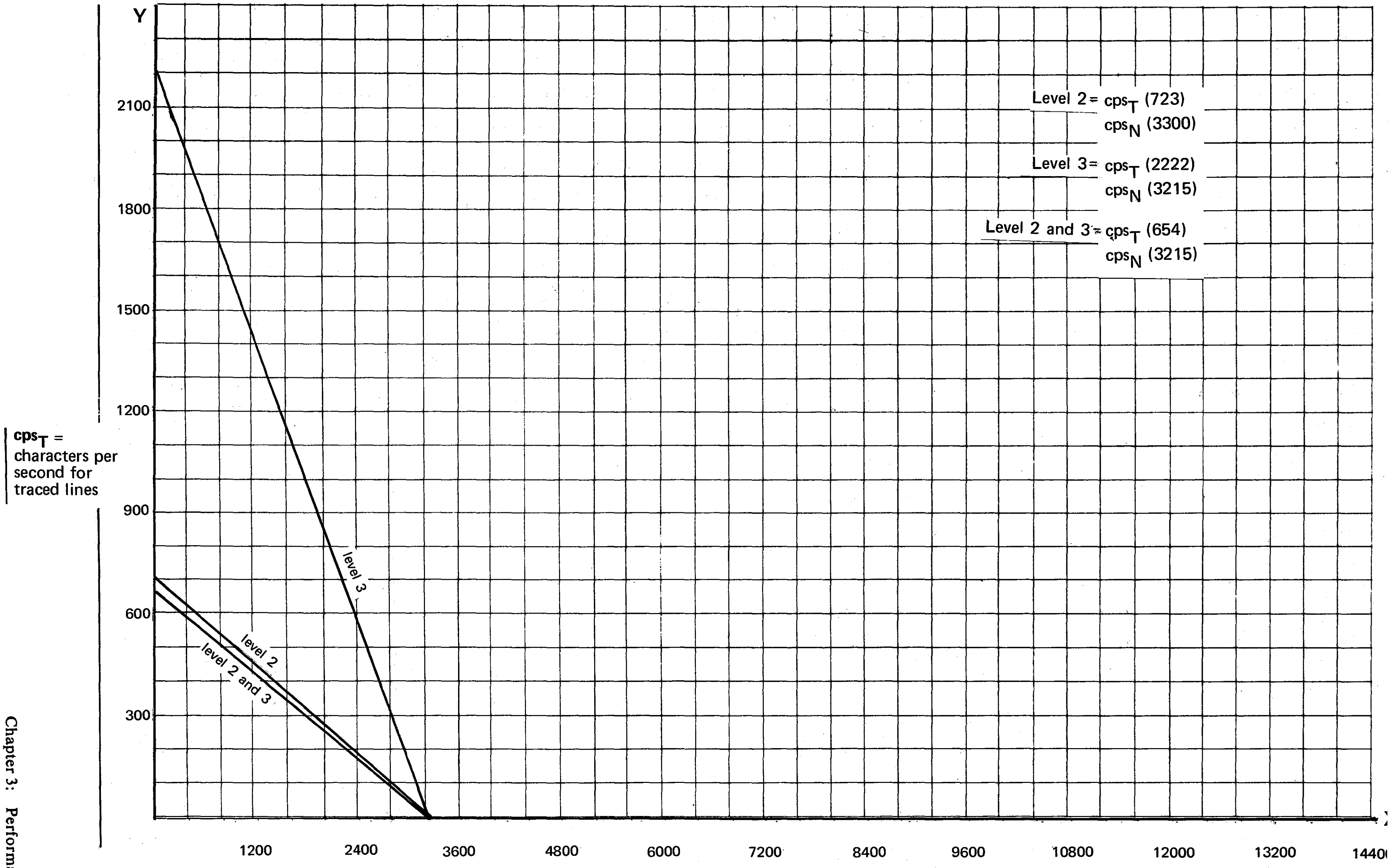

Figure 8. 3705 with a Type 1 Communication Scanner

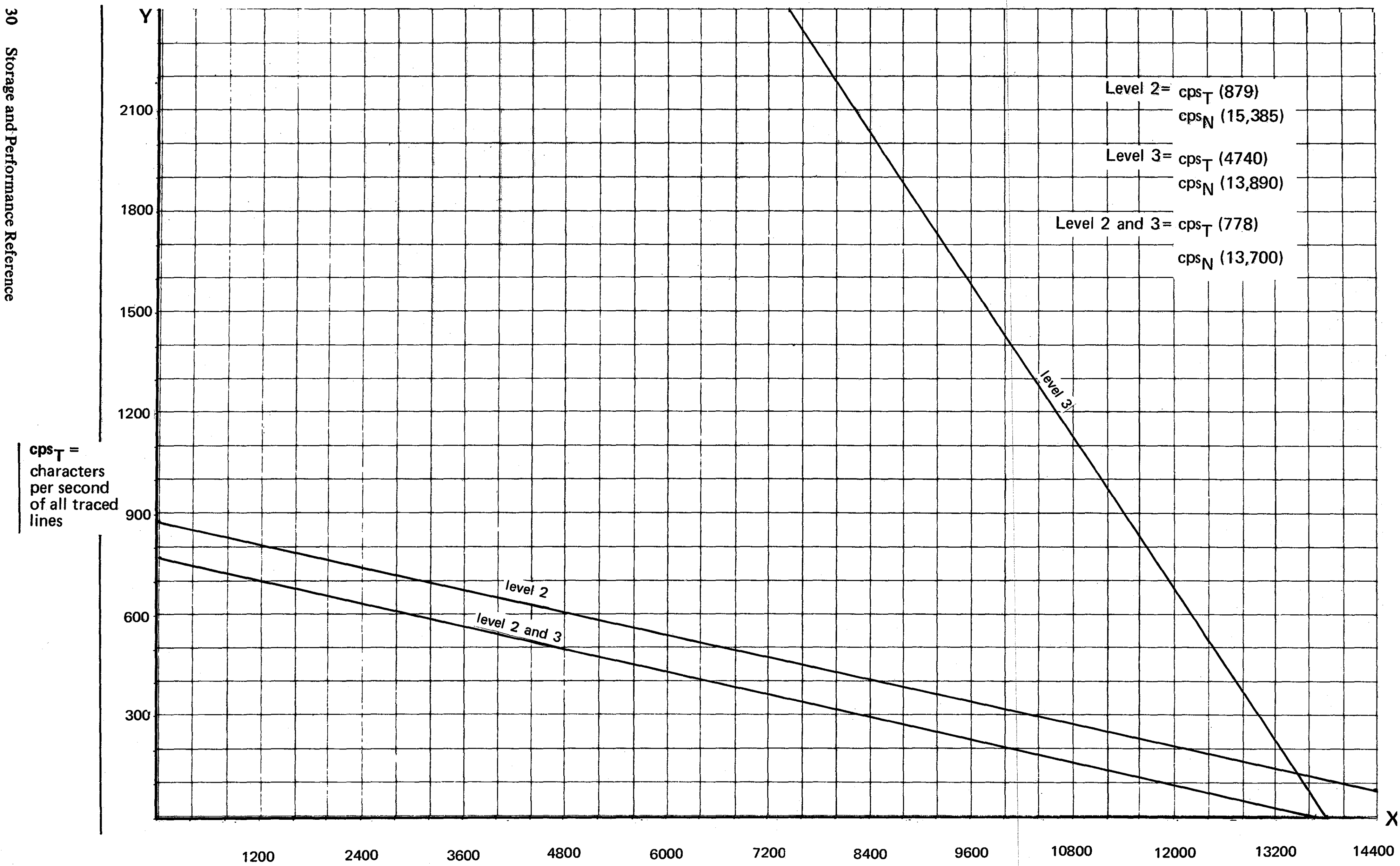

Figure 9. 3705 with a Type 2 Communication Scanner

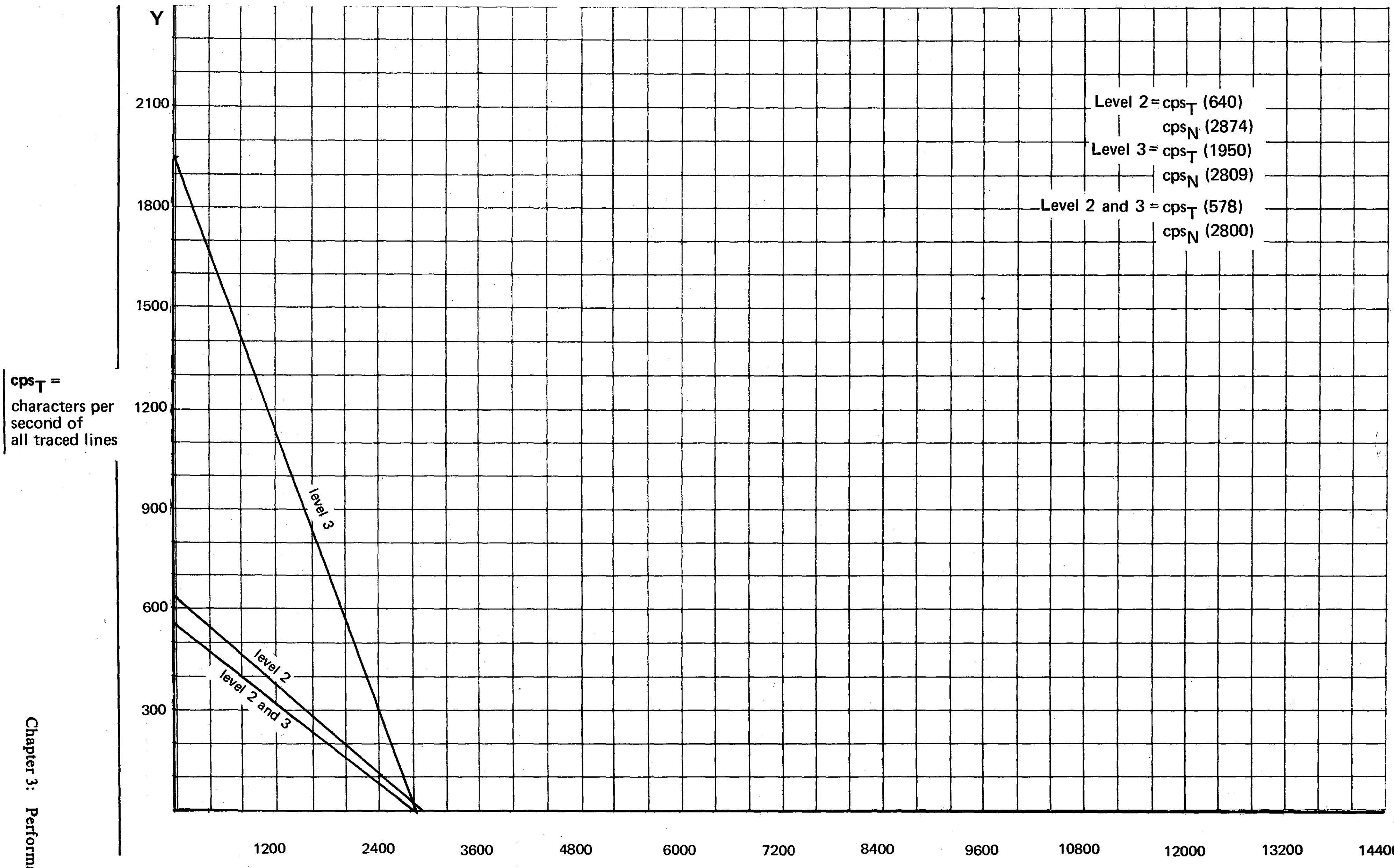

Figure 10. 3704 with a Type 1 Communication Scanner

cps_N = characters per second of all non-traced lines

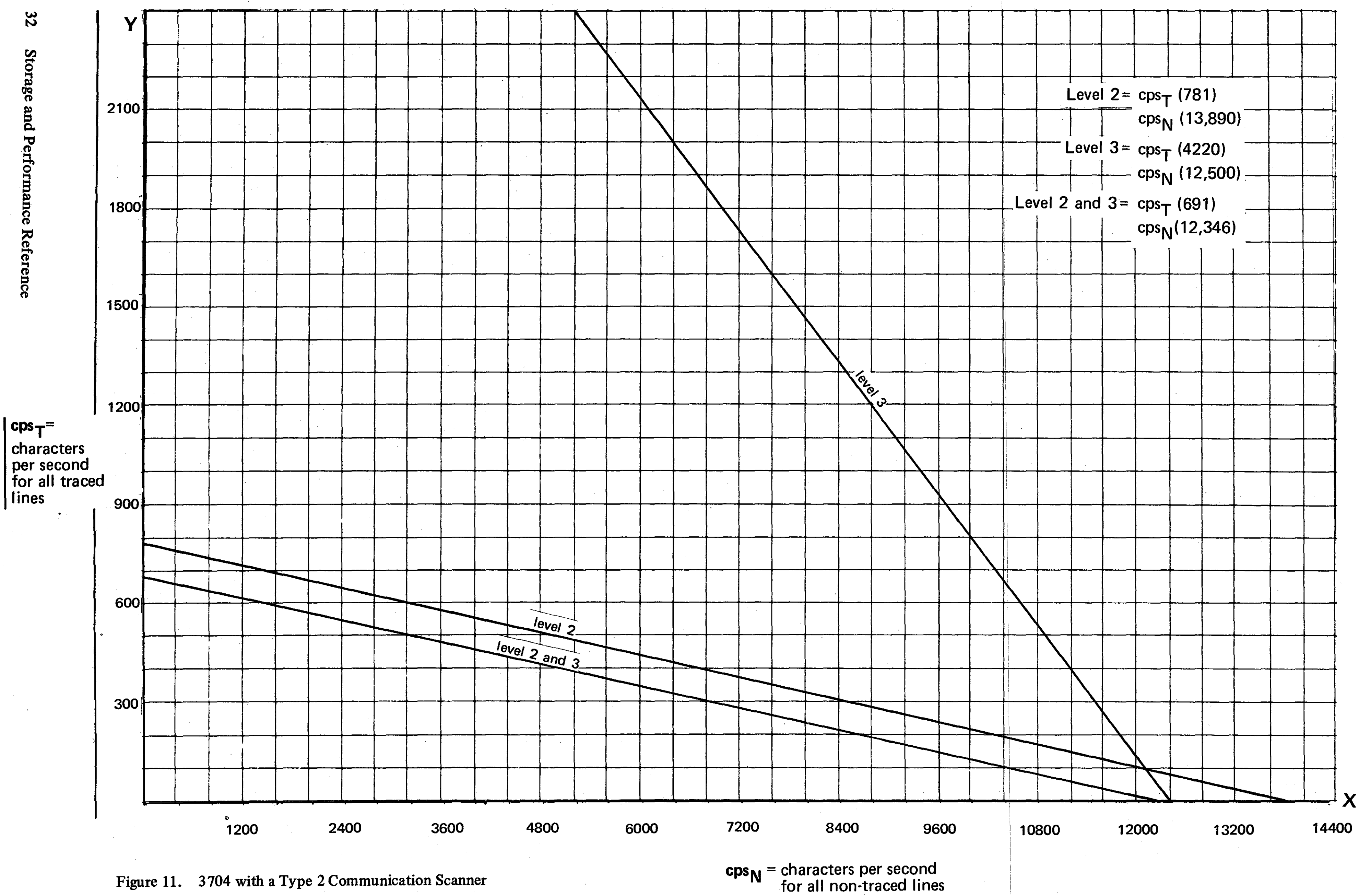

Figure 11. 3704 with a Type 2 Communication Scanner

Glossary

availability: is the degree to which a system is ready when needed to process data.

block: The smallest data unit recognized by the communications controller. For start-stop devices, a unit of data between two EOB characters; for BSC devices, a unit between two ETB or ETX characters.

central control unit: The communications controller hardware unit that contains the circuits and data flow paths needed to execute the controller's instruction set and to control storage and the attached adapters.

channel adapter: A communications controller hardware unit that provides attachment of the communications controller to a System/360 or System/370 channel.

communication scanner: A communications controller hardware unit that provides the interface between line interface bases and the central control unit. The communication scanner monitors the communication lines for service requests.

Dynamic Dump Utility: A utility operating partly in the Emulation Program and partly in the host processor that (1) transfers the entire contents of the controller to the host, or (2) transfers the entire contents of the trace table to the host process, or (3) transfers the trace table entries, as they are made, to the host processor. The controller continues to operate under the control of the Emulation Program during and after the dumping process.

Emulation Program: An IBM-supplied control program for the communications controller.

interrupt priority: The order in which Emulation Program processes interrupts received simultaneously from two or more communication lines.

line interface base (LIB): A communications controller hardware unit that provides for the attachment of up to 16 communication lines to the communications controller.

performance: is one of the major factors on which the total productivity of a system depends. Performance is largely determined by a combination of three factors: throughput, response time, and availability.

response time: is the time between the submission of work to the system and the return of results. (Turnaround time)

subchannel: The channel facility required for sustaining a single I/O operation.

teleprocessing device: A unit of teleprocessing equipment connected to the communications controller via a communication line and identified as a cluster, terminal, or component at Emulation Program generation time.

terminal: A teleprocessing device capable of transmitting or receiving data (or both) over a communications line.

throughput: is the total volume of work performed by a computing system over a given period of time.

trace table: An area within the network control program into which line trace information is placed.

Index

IBM 3704 and 3705
Communications Controllers
Emulation Program
Storage and Performance
Reference Manual

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