FILE MEMO

SUBJECT: Card-to-Tape* Operations--STRETCH

This memo supports the thesis that it is economically undesirable to do a
card-to-5X tape operation directly, let alone card-to-10X tape.

Assumptions:

   1.   No loss due to operator handling.
   2.   100% utilization of equipment.
   3.   Fictional prices of equipment.

The card-reader stipulated operates at 1000 cpm, but as a matter of interest
computations are given below also for the 250 cpm reader.

Figure 1 is indecisive. The direct costs in "1B" and "1D" are so close that
the user would be tempted to use other criterion than direct cost in making
his choice. Figure 3 shows, however, that "B" becomes a better choice as
price of tape equipment increases.

Figure 2 is more conclusive. "2D" shows that 421,875 units could have been
processed by 5X tape in the 22.5 minutes involved, whereas it did process
only 22,500 units--a waste of 399,375 units. (It is interesting to note that
such inefficiency is not new to IBM. "2A" shows that in 705 card-to-tape
operations waste amounts to 315,000 units). "2B" shows, however, a waste
of only 61,875 units on 1X tape and 90,000 units on 5X tape.

Another way to observe the same facts is to recognize that in "2D" the 5X
tape operates at only 5% efficiency whereas in "2B" it operates at 20% efficiency.
The totals indicate that overall the "2B" operation is nearly twice as efficient
as the "2D".

Figure 4 shows that efficiency is even lower for 10X tapes.

*This does not refer to off line (independent) operations.

FIGURE 1

		Min	USER 'S DIRECT COST					
			250 cpm	1000 cpm	1X	5X	Total	
A	250 cpm to 1X tape	90	8.10		6.75		14.85	
	1X tape to 5X tape	6			.45	.90	1.35	
							16.20	16.20
B	1000 cpm to 1X tape	22.5		4.05	1.69		5.74	
	1X tape to 5X tape	6			.45	.90	1.35	
							7.09	7.09
C	250 cpm to 5X tape	90	8.10			13.50	21.60	
							21.60	21.60
D	1000 cpm to 5X tape	22.5		4.05		3.38	7.43	
							7.43	7.43

22, 500 cards
250 cpm at $900/mo--$09/min
1000 cpm at 1800/mo--$.18/min
1X tape at 750/mo--$.075/min
5X tape at 1500/mo--$.15/min

FIGURE 2

		min	250 cpm	1000 cpm	1X	5X	Total	
A	250 cpm to 1X tape	90	22,500		337,500		360,000	
	1X tape to 5X tape	6			22,500	112,500	135,000	
							495,000	495,000
B	1000 cpm to 1X tape	22.5		22,500	84,375		106,875	
	1X tape to 5X tape	6			22,500	112,500	135,000	
					106,875		241,875	241,875
C	250 cpm to 5X tape	90	22,500			1,687,500	1,710,000	
							1,710,000	1,710,000
D	1000 cpm to 5X tape	22.5		22,500		421,875	444,275	
							444,275	444,275

Number of "units" that could have been passed

1X tape ---3,750 units/min
5X tape---18,750 units/min
1 unit--- 80 characters of data

FIGURE 3

		min	User's	Direct Cost				
			250 cpm	1000 cpm	1X	10X	Total	
A	250 cpm to 1X tape	90	8.10		6.75		14,85	
	1X tape to 10X tape	6			.45	1.80	2.25	
							17.10	17.10
B	1000 cpm to 1X tape	22.5		4.05	1.69		5.74	
	1X tape to 10X tape	6			.45	1.80	2.25	
							7.99	7.99
C	250 cpm to 10X tape	90	8.10			27.00	35.10	
							35.10	35.10
D	1000 cpm to 10X tape	22.5		4.05		6.76	10.81	
							10.81	10.81

10X tape at $3000/mo---$30/min

FIGURE 4

		min	250 cpm	1000 cpm	1X	10X	Total	
							Number of units that could have been passed	
A	250 cpm to 1X tape	90	22,500		337,500		360,000	
	1X tape to 10X tape	6			22,500	225,000	247,500	
							607,500	607,500
B	1000 cpm to 1X tape	22.5		22,500	84,375		106,875	
	1X tape to 10X tape	6			22,500	225,000	247,500	
							354,375	354,375
C	250 cpm to 10X tape	90	22,500			3,375,000	3,397,500	
							3,397,500	3,397,500
D	1000 cpm to 10X tape	22.5		22,500		843,750	866,250	
							866,250	866,250

10X tape---37,500 units/min

The numbers in figures 1 and 3 do not reflect the effect of the cost of memory. Those in figures 5 and 6 do.

Here it is assumed that--

1. It is desired to form 1000 word blocks on the 5X tape.

2. 100% memory utilization by multiprogramming.

3. Price of memory for 32,768 words is $20,000; i.e. price is $.16 per 1000 words per min.

4. There is only one 1000 word area used; it is for both input and output.

5. Memory for the program is nearly the same for both approaches and need not be considered here.

FIGURE 5

	If the 1X tape is blocked--1000							
		min	cpm	1X	5X	memory	Total	
B	1000 cpm to 1X tape	22.5	4.05	1.69		3.60	9.34	
	1X tape to 5X tape	2.0		.15	.30	.32	.77	
							10.11	10.11
D	1000 cpm to 5X tape	22.5	4.05		3.38	3.60	11.03	
							11.03	11.03

FIGURE 6

	If the 1X tape is not blocked--							
		min	1000 cpm	1X	5X	memory	Total	
B	1000 cpm to 1X tape	22.5	4.05	1.69		0.00	5.74	
	1X tape to 5X tape	6.0		.45	.90	.96	2.31	
							8.05	8.05
D	1000 cpm to 5X tape	22.5	4.05		3.38	3.60	11.03	
							11.03	11.03

Doubling the block size in 6B increases cost by $.96; doubling it in 6D increases cost by $3.60.

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