Chapter 6

Evaluation of SNA based system

This chapter will evaluate the performance of the Thai airways International 's System under System Network Architecture environment. There are two major cases to be considered about the performance.

1. Response time.
2. System throughput

Inorder to evaluate the system performance and response time, we need to know the traffic predictions or the system load and the component service times. Message traffic has the following characteristics.

- Number and characteristics of input and output message per period of time.
- Frequency of message types
- Expected message rate
- Analysis of existing transaction load
- Knowledge of future growth pattern
- Knowledge of application design

Component service time can be divided in 4 categories.

1 CPU processing time per message
2 3705 processing time
3 3274 processing time
4 Data link characteristics, which are

- Transmission speed
- Half duplex or Full duplex
- Point to point or Multipoint
- Link protocol

For our example we will calculate the system response time and load by the using the following figure;

1. There are 2 message types, A and B

Message Type	Characters INPUT	Characters OUTPUT	Percentage of Message	Number of Disk accesses
A	10	150	80 %	3
B	60	800	20 %	2

2. Expected total system traffic rate is 2 messages per second.
3. There are four 3274 cluster controllers installed in 4 locations.
4. We will evaluate the effect of different traffic rates from 0 to n messages per second.

Service Times Components

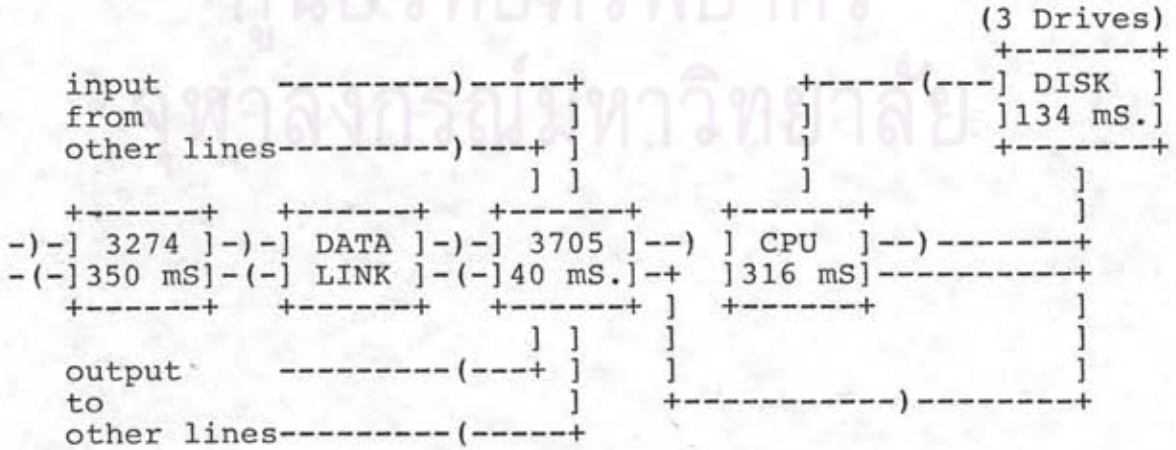
Information of Service times for each component can be got from:

-Basic product information
- Hardware specifications
- Software specifications
- Protocol manuals

- Some internal IBM aids available to System engineer.
- ANCICSVS
- SNAPSHOT

- Experience from installed systems
- Benchmarks

Service Time and transaction rate assumptions



Total system transaction rate = L messages per second

Component transaction rates (Lc) :

3274 = L/4 = 2/4 = 0.5 transaction per second
3705 = L/1 = 2.0 transaction per second
CPU = L/1 = 2.0 transaction per second
DISK A = L x 0.8 x 3 = 4.8 transaction per second
DISK B = L x 0.2 x 2 = 0.8 transaction per second
Both transaction access a single data base spread across 3 disk drives.

Data link will be evaluated in detail later,there are:

4 x 3274 cluster controllers
and 4 x Full duplex data links (point to point)

Total system load L = 2.0 Transaction / second
Component load = Lc Transaction / second
Service Time = Ts Transaction / second
Component saturation load Ls = L/(Lc*Ts)
Utilization R = Lc*Ts
Time waiting for service Tw = R*Ts/(1-R)
When R is greater than 1 the system throughput was limited
Number of times = n
Component response time Tr = (Ts+Tw)*n

Summary excluding link service -case 1

com-ponent	trans /sec Lc	service time Ts	max load Ls	util R	wait time Tw	no.of time n	response time Tr
3274	0.50	0.35	11.43	0.18	0.07	1.0	0.42
3705	2.00	0.04	25.00	0.08	0.00	1.0	0.04
CPU	2.00	0.32	3.16	0.63	0.54	1.0	0.86
DISK A	4.80	0.13			0.04	3.0	0.54
DISK B	0.80	0.13			0.04	2.0	0.36
A+B	5.60	0.13			0.04	2.8	0.50
Per Drive	1.87	0.13	8.00	0.25	0.04		

Evaluation of Link Service Time

In order to evaluate the data link service time using SDLC protocol the following characteristic are required:

- Number of characters. (Input and Output)

- Response protocol.
- Modem characteristics.
  - Propagation delay.
  - Clear to send delay.
- SDLC protocol.

The assumption made in this example are:
- NCP 'MAXDATA" parameter is 256
  - i.e. max PIU size is 256,
    + 9 bytes TH/RH (FID 2 Header)
- Data chaining is used for long messages

DATA LINK TRAFFIC ANALYSIS

	Primary Secondary	Sent	Received
POLL	----------→	6*	
MSG	<----------		L1+15
FME(DRx)	<----------	15*	
MSG 1	----------→	L2(1)+15	
(MSG2	----------→	L2(2)+15	
(MSG3	----------→	L2(3)+15	
(MSG4	----------→	L2(4)+15	
e.t.c.	----------→		
POLL	----------→	6*	
SDLC ACK	<----------		6*

* Indicates that the time must be included in the computation of link utilization, but need not be included in the response time. (Isolate pacing responses have been ignored for this example)

L1 = Number of Characters RECEIVED from the cluster.
L2 = Number of Characters TRANSMITTED to the cluster.
For each 256 Characters, a 15 character overhead is incurred i.e.:

6 SDLC frame characters.
6 SNA FID 2 Header characters (TH = 6, RH = 3)

L2 = L2(1) + L2(2) + L2(3) + ... in multiple of 256 characters

In our case MESSAGE TYPE

		A	B	
L1	=	10	60	
L2	=	150	800	(chained into 4 messages)

	Ts(R)	Ts(T)	T*s(R)	T*s(T)
A:	(10+15)8/2400 = 0.08	(150+15)8/2400 = 0.55	Ts(R)+12x8/2400 = 0.12	Ts(T)+6x8/2400 = 0.57
B:	(60+15)8/2400 = 0.25	(800+60)8/2400 = 2.87	Ts(R)+12x8/2400 = 0.29	Ts(T)+6x8/2400 = 2.89

- Link propagation delay can be ignored for short distances
- Link propagation delay will be significant for satellites link
- Ignore modem propagation
- No modem turn around delay (Point to point ,full duplex)
- Link speed is 2400 BPS.
- Ts(R) and Ts(T) are included in response time
- Ts*(R) and Ts*(T) required for link utilization
- The effect of link errors has been ignored
- Cluster implementation use Half duplex protocol
- Therefore link is only one logical service

Ts = Ts(T) + Ts(R)
Ts* = Ts*(T) + Ts*(R)

	Ts	Ts*
Message A	0.08+0.55 = 0.63	0.12+0.57 = 0.69
Message B	0.25+2.87 = 3.12	0.29+2.89 = 3.18
Average	(0.63x0.8)+(3.12x0.2) = 1.13	(0.69x0.8)+(3.18x0.2) = 1.19

summary case 1
- 4 x 3274 cluster controllers
- 4 x FDX Data links (point to point)

Summary including link service -case 1

com-ponent	trans /sec Lc	service time Ts	max load Ls	util R	wait time Tw	no.of time n	response time Tr
3274	0.50	0.35	11.43	0.18	0.07	1.0	0.42
3705	2.00	0.04	25.00	0.08	0.00	1.0	0.04
CPU	2.00	0.32	3.16	0.63	0.54	1.0	0.86
DISK A	4.80	0.13			0.04	3.0	0.54
DISK B	0.80	0.13			0.04	2.0	0.36
A+B	5.60	0.13			0.04	2.8	0.50
Per Drive	1.87	0.13	8.00	0.25			
DATA LINK	0.50	1.13	3.36	0.56	1.47	1.0	2.60
		1.19*		0.56	1.47		

Average response time = 0.42+0.04+0.86+0.50+2.60 = 4.42 sec.
Zero load time = 0.35+0.04+0.32+(2.8x.13)+1.19 = 2.27 sec.

Ts/Tr = 2.27/4.42 = 0.51

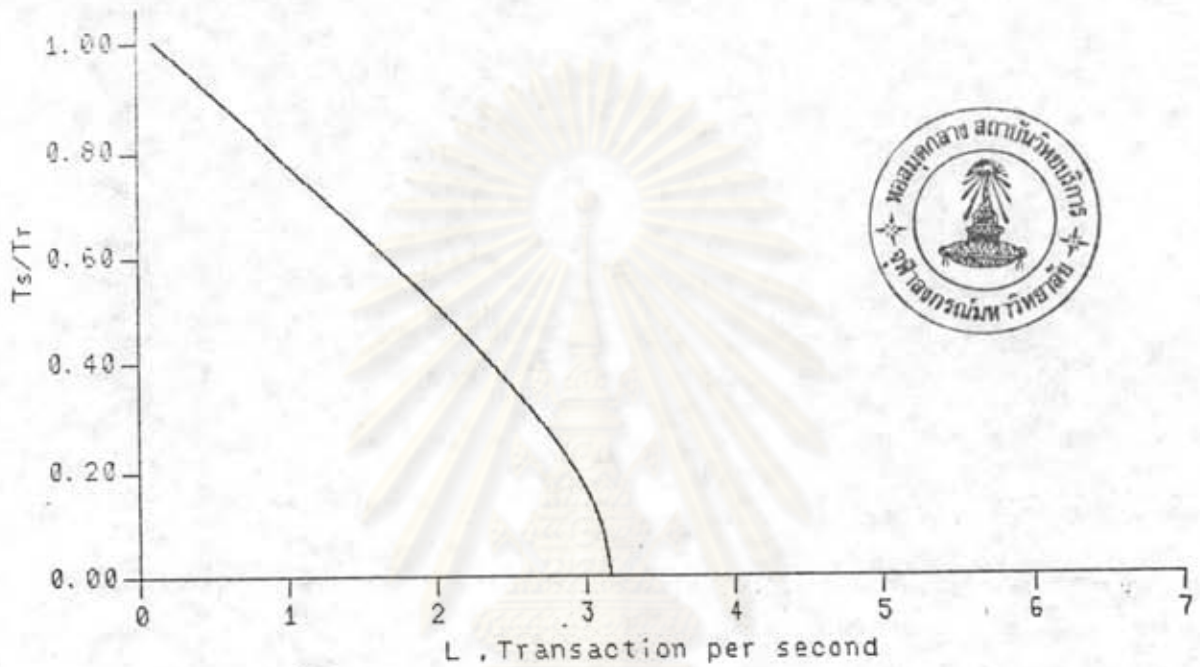


Figure 6-1 System performance map - case 1

System response chart in Figure 6-1 gives a pictorial view of ratio of wait time to service time.

- Tr= Ts + Tw = Response time
- At zero load, Tw = 0
  Tr = Ts

The calculation of the utilization shown that CPU have the longest delay and the value of R is greater than all component. From figure 6-1 we can summarize that:

- CPU limits system throughput
- Longest delay is waiting for CPU
- Data link has the longest service time.

In the next case, the calculation is based on the previous factor except:

- The line speed is double to 4800 BPS.

CASE 2

Point to point FDX* Speed = 4800 BPS
CPU Service time is the same as case 1

Link service time case 2, speed = 4800 BPS

	Ts(R)	Ts(T)	T*s(R)	T*s(T)
A:	(10+15)8/4800 = 0.04	(150+15)8/4800 = 0.27	Ts(R)+12x8/4800 = 0.06	Ts(T)+6x8/4800 = 0.28
B:	(60+15)8/4800 = 0.13	(800+60)8/4800 = 1.43	Ts(R)+12x8/4800 = 0.14	Ts(T)+6x8/4800 = 1.44

Ts = Ts(T) + Ts(R)
Ts* = Ts*(T) + Ts*(R)

	Ts	Ts*
Message A	0.04+0.27 = 0.31	0.06+0.28 = 0.34
Message B	0.13+1.43 = 1.55	0.14+1.44 = 1.58
Average	(0.31x0.8)+(1.55x0.2) = 0.56	(0.34x0.8)+(1.58x0.2) = 0.59

Summary including link service -case 2

com-ponent	trans /sec Lc	service time Ts	max load Ls	util R	wait time Tw	no.of time n	response time Tr
3274	0.50	0.35	11.43	0.18	0.07	1.0	0.42
3705	2.00	0.04	25.00	0.08	0.00	1.0	0.04
CPU	2.00	0.32	3.16	0.63	0.54	1.0	0.86
DISK-A	4.80	0.13			0.04	3.0	0.54
DISK B	0.80	0.13			0.04	2.0	0.36
A+B	5.60	0.13			0.04	2.8	0.50
Per Drive	1.87	0.13	8.00	0.25			
DATA LINK	0.50	0.56	6.72	0.28	0.22	1.0	0.79
		0.59*		0.28	0.22		

* See Glossary

Average response time = 0.42+0.04+0.86+0.50+0.79 = 2.61 sec.
Zero load time = 0.35+0.04+0.32+(2.8x.13)+0.59 = 1.68 sec.

Ts/Tr = 1.68/2.61 = 0.64

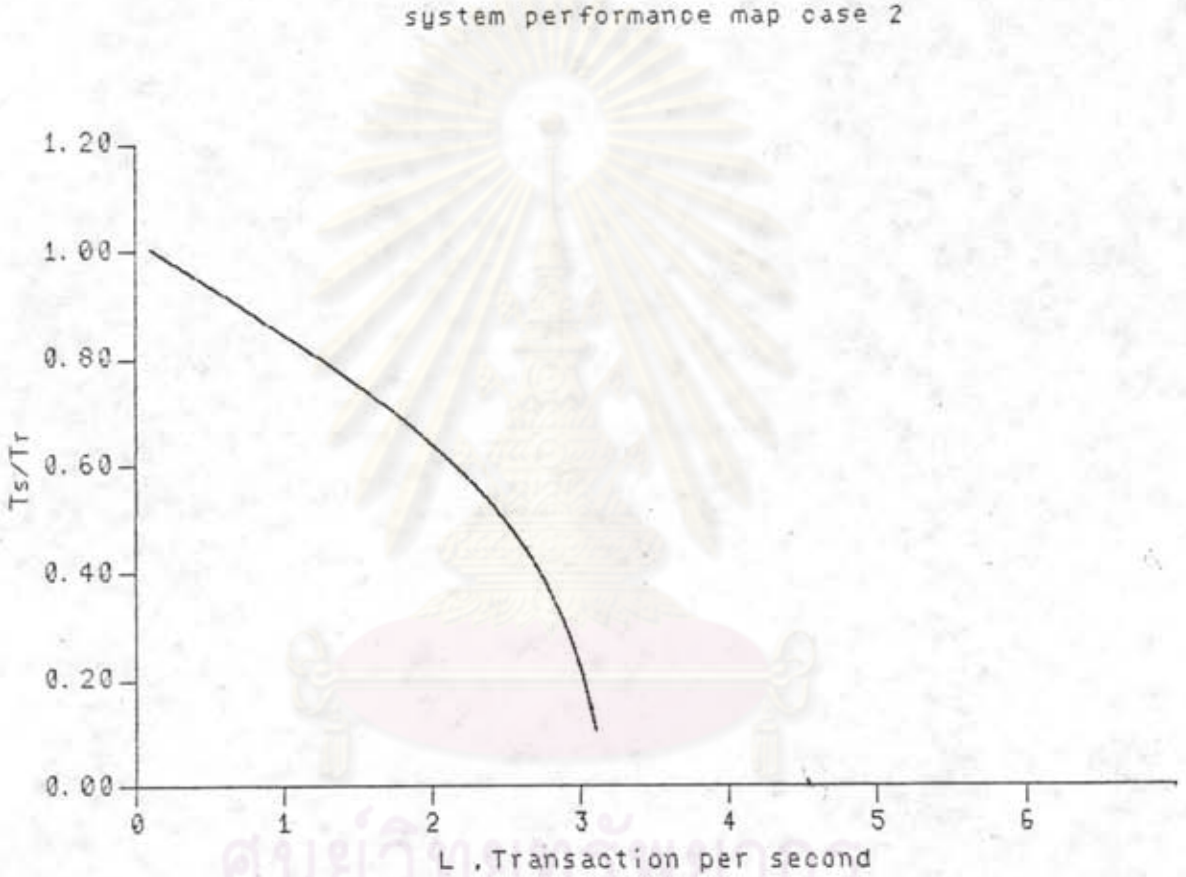


Figure 6-2 System performance map - case 2

- The chart shows that in this case CPU still limits the system throughput.
- Data link has the longest service time.
- But the response time is improved.
- Next two cases will evaluate the system throughput by reducing CPU service time, and in the final case, doubling the line speed with half CPU service times.

CASE 3

Point to point FDX Speed = 2400 BPS
Half CPU Service time (Ts = 0.158 Second)

Summary including link service -case 3

com-ponent	trans /sec Lc	service time Ts	max load Ls	util R	wait time Tw	no.of time n	response time Tr
3274	0.50	0.35	11.43	0.18	0.07	1.0	0.42
3705	2.00	0.04	25.00	0.08	0.00	1.0	0.04
CPU	2.00	0.16	6.33	0.32	0.07	1.0	0.23
DISK A	4.80	0.13			0.04	3.0	0.54
DISK B	0.80	0.13			0.04	2.0	0.36
A+B	5.60	0.13			0.04	2.8	0.50
Per Drive	1.87	0.13	8.00	0.25			
DATA LINK	0.50	1.13	3.36	0.56	1.47	1.0	2.60
		1.19*		0.56	1.47		

Average response time = 0.42+0.04+0.23+0.50+2.60 = 3.80 sec.
Zero load time = 0.35+0.04+0.16+(2.8x.13)+1.19 = 2.11 sec.

Ts/Tr = 2.11/3.80 = 0.56

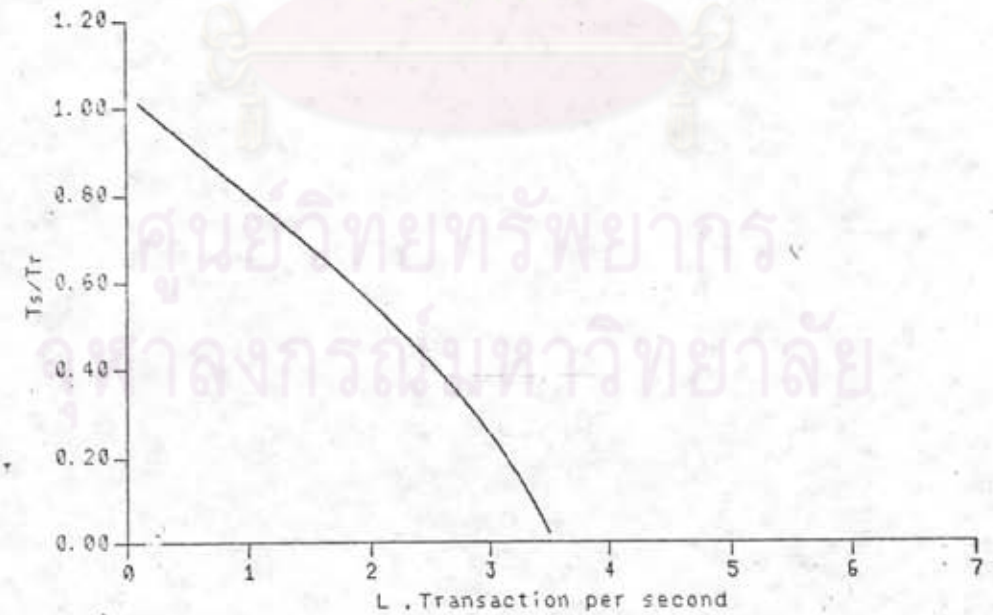


Figure 6-3 System performance map - case 3

- The chart in Figure 6-3 shows that in this case DATA LINK limits the system throughput.
- Data link has the longest service time.
- But the response time is almostly the same as case 1

CASE 4

Point to point FDX Speed = 4800 BPS
Half CPU Service time (TS = 0.158)

Summary including link service -case 4

com-ponent	trans /sec Lc	service time Ts	max load Ls	util R	wait time Tw	no.of time n	response time Tr
3274	0.50	0.35	11.43	0.18	0.07	1.0	0.42
3705	2.00	0.04	25.00	0.08	0.00	1.0	0.04
CPU	2.00	0.16	6.33	0.32	0.07	1.0	0.23
DISK A	4.80	0.13			0.04	3.0	0.54
DISK B	0.80	0.13			0.04	2.0	0.36
A+B	5.60	0.13			0.04	2.8	0.50
Per Drive	1.87	0.13	8.00	0.25			
DATA LINK	0.50	0.56	6.72	0.28	0.22	1.0	0.79
		0.59*		0.28	0.22		

Average response time = 0.42+0.04+0.23+0.50+0.79 = 1.99 sec.
Zero load time = 0.35+0.04+0.16+(2.8x.13)+0.59 = 1.52 sec.

Ts/Tr = 1.52/1.99 = 0.76

- The chart shows that in this case CPU, Data Link and disk drives limit the system throughput.
- Data link has the longest service time.
- The response time is improved.

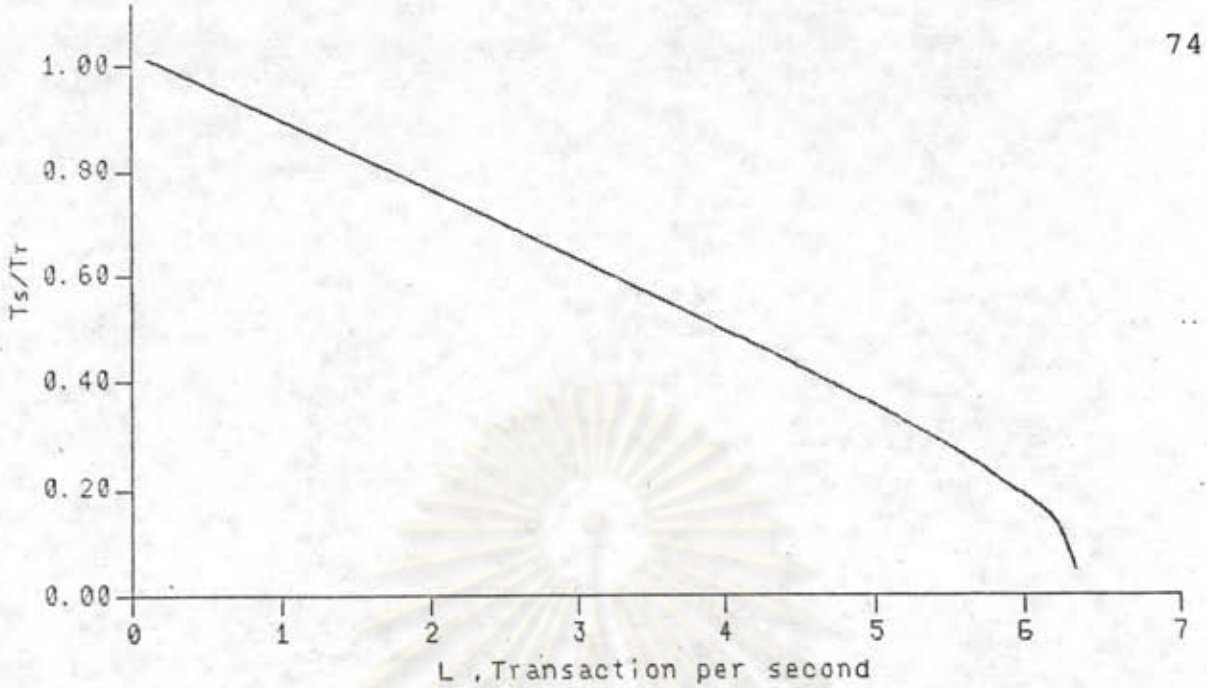


Figure 6-4 System performance map case 4

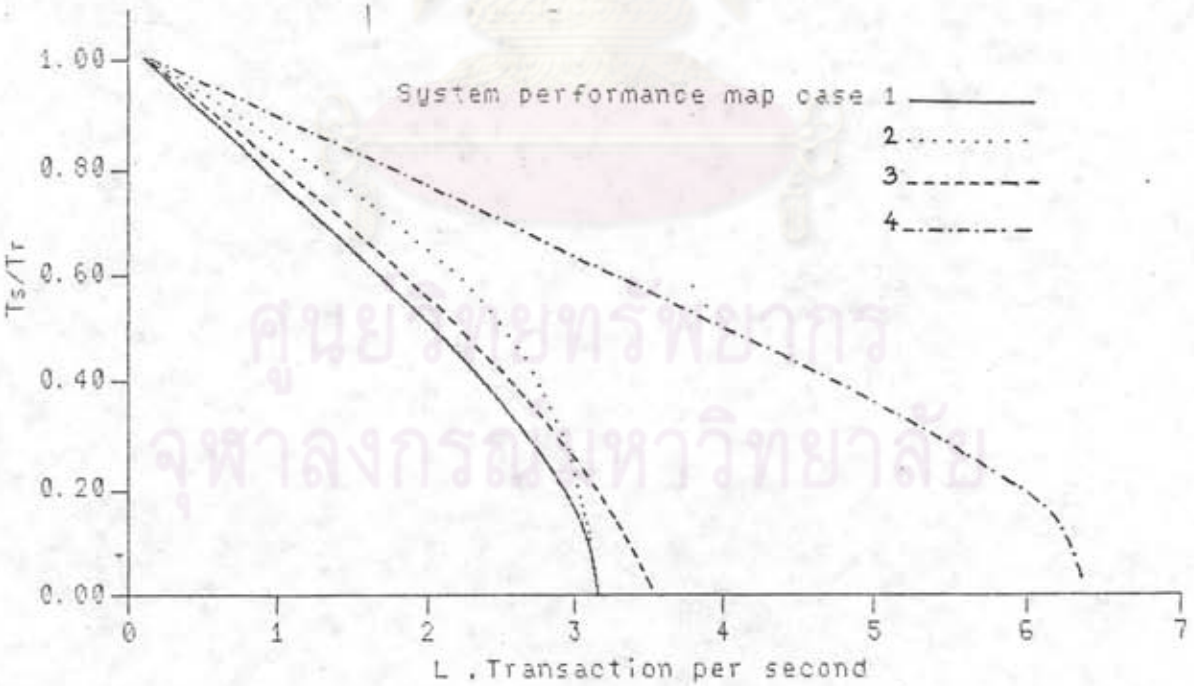


Figure 6-5 System performance map ,all cases

Summary of system performance case 1-4

The figures that used to determine the system performance is an approximation because real data are varied from times to times , however , result from this evaluation will be helpful in the system capacity planning.

Case 1 , transmission speed is 2400 BPS and CPU service time is 0.316 second. In this case, general response time is 4.42 seconds at 2 transactions per second. At zero load time, the response time will be 2.27 seconds. When the transaction rates is increased, the utilization of each components are increased too . Figures in case 1 show that the utilization of CPU is the highest (0.63) which limits the transaction rates at 3.16 transaction per second. Data link utilization (=0.56) is also higher than other component and could be one factor of the system throughput limitation.

Case 2, transmission speed is 4800 BPS, which is doubled from case 1, made the data link service time lower by half. The figures in case 2 shown the response times at nominal transaction rate is 2.61 seconds and at zero load time is 1.68 seconds. The response time is much improved, compared to case 1. However, CPU still limits the system throughput at 3.16 transaction per second.

Case 3, using transmission speed at 2400 BPS and lower CPU service time to 0.158 sec. In this case the response time is improved from case 1 (but very little) The utilization of data link is higher than other components and also limits the system throughput at 3.56 transaction per second.

Case 4, is the best case , using transmission speed 4800 BPS and CPU service times is 0.158 sec. Response time at 2 transaction per second is only 1.99 second and at zero load time is 1.52 second. The ration of zero load time and average response time is 0.76 which shown that the waiting time is lower than other cases. CPU utilization is 0.32 and will limits the system throughput at 6.35 transaction per second.