

# Eureka Oil & Gas

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### Problem 1:

Traffic Matrix for Eureka Oil & Gas. Peak Average Data Rate in bps

	Edm	4	5	6	8	Calgary	1	2	3	Regina	7	Sask	9	10	11	Total
Edm		24000	22400	9400	10000	132000	8000	24000	20000	124000	24000	86000	8000	24000	22400	538200
4	24000		1500	2400	2000	3200	1500	5000	3200	1500	3200	1500	1500	2400	4800	57700
5	22400	1500		3200	2100	15000	2000	2000	2400	1500	2400	6000	2000	4800	3200	70500
6	9400	2400	3200		2400	3200	3200	3200	1700	3000	3200	2300	3200	11500	3200	55100
8	10000	2000	2100	2400		2400	3400	4800	3200	4800	3200	2500	3400	3200	10000	57400
Calgary	132000	3200	15000	3200	2400		3600	15000	2500	70000	3200	32000	3600	2400	3200	291300
1	8000	1500	2000	3200	3400	3600		1500	1500	2400	2400	1500	1500	3200	2400	38100
2	24000	5000	2000	3200	4800	15000	1500		2400	20000	1500	1500	1500	2400	6000	90800
3	20000	3200	2400	1700	3200	2500	1500	2400		1500	3000	3000	1500	2800	3200	51900
Regina	124000	1500	1500	3000	4800	70000	2400	20000	1500		2400	15000	2400	3200	2400	254100
7	24000	3200	2400	3200	3200	3200	2400	1500	3000	2400		1800	2400	3200	2400	58300
Sask	86000	1500	6000	2300	2500	32000	1500	1500	3000	15000	1800		1500	1500	1500	157600
9	8000	1500	2000	3200	3400	3600	1500	1500	1500	2400	2400	1500		3200	2400	38100
10	24000	2400	4800	11500	3200	2400	3200	2400	2800	3200	3200	1500	3200		4000	71800
11	22400	4800	3200	3200	10000	3200	2400	6000	3200	2400	2400	1500	2400	4000		71100
Total	538200	57700	70500	55100	57400	291300	38100	90800	51900	254100	58300	157600	38100	71800	71100	

Average packet size = 552 bytes (includes 40 bytes layer 3/4 overhead)

Average Data Rate in Kbps

1KB=

1000 Bytes

	Edm	4	5	6	8	Calgary	1	2	3	Regina	7	Sask	9	10	11	Total
Edm	0	192	179.2	75.2	80	1056	64	192	160	992	192	688	64	192	179.2	4305.6
4	192	0	12	19.2	16	25.6	12	40	25.6	12	25.6	12	12	19.2	38.4	461.6
5	179.2	12	0	25.6	16.8	120	16	16	19.2	12	19.2	48	16	38.4	25.6	564
6	75.2	19.2	25.6	0	19.2	25.6	25.6	25.6	13.6	24	25.6	18.4	25.6	92	25.6	440.8
8	80	16	16.8	19.2	0	19.2	27.2	38.4	25.6	38.4	25.6	20	27.2	25.6	80	459.2
Calgary	1056	25.6	120	25.6	19.2	0	28.8	120	20	560	25.6	256	28.8	19.2	25.6	2330.4
1	64	12	16	25.6	27.2	28.8	0	12	12	19.2	19.2	12	12	25.6	19.2	304.8
2	192	40	16	25.6	38.4	120	12	0	19.2	160	12	12	12	19.2	48	726.4
3	160	25.6	19.2	13.6	25.6	20	12	19.2	0	12	24	24	12	22.4	25.6	415.2
Regina	992	12	12	24	38.4	560	19.2	160	12	0	19.2	120	19.2	25.6	19.2	2032.8
7	192	25.6	19.2	25.6	25.6	25.6	19.2	12	24	19.2	0	14.4	19.2	25.6	19.2	466.4
Sask	688	12	48	18.4	20	256	12	12	24	120	14.4	0	12	12	12	1260.8
9	64	12	16	25.6	27.2	28.8	12	12	12	19.2	19.2	12	0	25.6	19.2	304.8
10	192	19.2	38.4	92	25.6	19.2	25.6	19.2	22.4	25.6	25.6	12	25.6	0	32	574.4
11	179.2	38.4	25.6	25.6	80	25.6	19.2	48	25.6	19.2	19.2	12	19.2	32	0	568.8
Total	4305.6	461.6	564	440.8	459.2	2330.4	304.8	726.4	415.2	2032.8	466.4	1260.8	304.8	574.4	568.8	

Average Utilization in %

T1 in Kbps =

1024

	Edm	Calgary	Regina	Sask
Edm		59.69	133.44	160.86
Calgary	190.16		81.25	56.02
Regina	133.44	81.25		104.61
Sask	160.86	56.02	104.61	

Optimal Size of Branch Office Trunks in multiples of 64 Kbps

	% Util	Size
Edm		
4	360.63	2
5	440.63	2
6	344.38	2
8	358.75	2
Calgary		
1	476.25	1
2	567.5	2
3	324.38	2
Regina		
7	364.38	2
Sask		
9	476.25	1
10	448.75	2
11	444.38	2

Fractional T1 in Kbps =

64

Arrival rate in Packets per Second

Average Frame Size in Kb: 0.55

Edm	7800
4	836.23
5	1021.74
6	798.55
8	831.88
Calgary	4221.74
1	552.17
2	1315.94
3	752.17
Regina	3682.61
7	844.93
Sask	2284.06
9	552.17
10	1040.58
11	1030.43

Mean Service Rate in Packets per Second

Edm	1855.07
4	115.94
5	115.94
6	115.94
8	115.94
Calgary	1855.07
1	115.94
2	115.94
3	115.94
Regina	1855.07
7	115.94
Sask	1855.07
9	115.94
10	115.94
11	115.94

In-System Delay

Edm	0
4	0
5	0
6	0
8	0
Calgary	0
1	0
2	0
3	0
Regina	0
7	0
Sask	0
9	0
10	0
11	0

## Problem 2:

$$700 \times 570 \times 11 = 4389000 \text{ octets}$$

$$20 \times 570 \times 1000 = 11400000 \text{ octets}$$

$$40 \times 570 \times 100 = 2280000 \text{ octets}$$

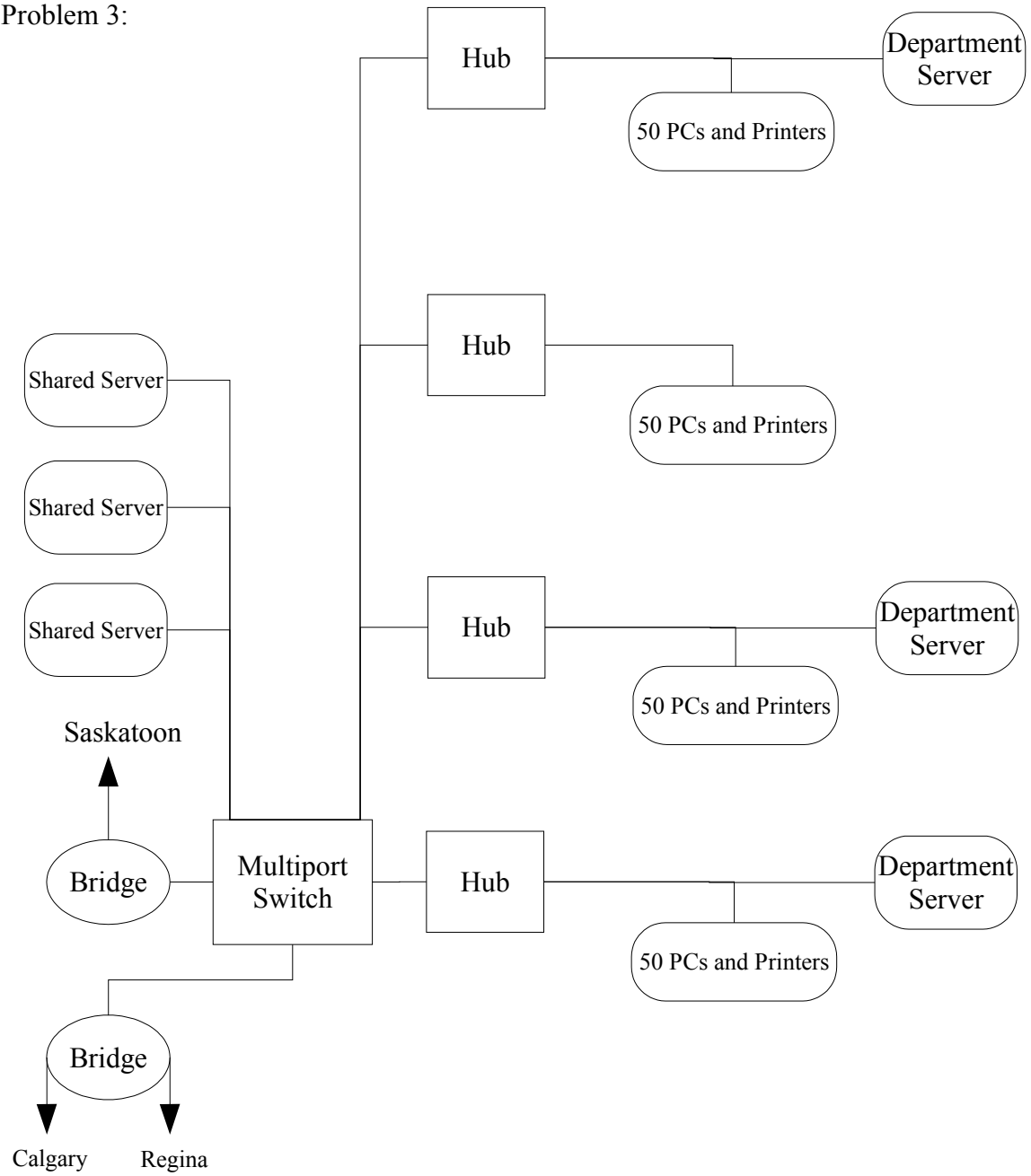
$$4389000 + 11400000 + 2280000 = 18069000 \text{ octets, or } 144.552000 \text{ Mb per 7 hour day.}$$

$$144552000 / 7 \times 60 \times 60 = 5.736 \text{ Kbps average load during the work day.}$$

Average data rate between Edmonton and Saskatoon is 688 Kbps prior to this move. This is 67.1% utilization.

An additional load of 5.736 Kbps will increase utilization to 67.7%. This will not greatly impact user delay experience.

Problem 3:



Problem 4:

<i>Site</i>	<i># of Hosts</i>	<i>Address Block</i>	<i>Mask</i>	<i># of Addresses</i>
Edmonton	200	193.45.160.0 - 193.45.160.255	/24	256
4	40	193.45.161.0 - 193.45.161.63	/26	64
5	35	193.45.161.64 - 193.45.161.127	/26	64
6	20	193.45.161.128 - 193.45.161.191	/26	64
8	30	193.45.161.192 - 193.45.161.255	/26	64
Calgary	280	193.45.162.0 - 193.45.163.127	/25	384
1	20	193.45.163.128 - 193.45.163.159	/27	32
2	40	193.45.163.160 - 193.45.163.223	/27	64
3	30	193.45.163.224 - 193.45.163.255	/27	32
Regina	340	193.45.164.0 - 193.45.165.127	/25	384
7	40	193.45.165.128 - 193.45.165.255	/25	128
Saskatoon	200	193.45.166.0 - 193.45.166.255	/24	256
9	20	193.45.167.0 - 193.45.167.63	/26	64
10	40	193.45.167.64 - 193.45.167.127	/26	64
11	40	193.45.167.128 - 193.45.167.191	/26	64

Problem 5:

The additional links need not be full T1s, as they are only used in case of a failure.

