"DIMENSION ®" 600/2000/CUSTOM PBX

BUSINESS SERVICES DESIGN ENGINEERING

DISTRIBUTED COMMUNICATIONS SYSTEM ENGINEERING

CONTENTS PAGE

1. GENERAL

1.01 This section describes the method for estimating intercom traffic distribution within and between DIMENSION Private Branch Exchange (PBX) Feature Package (FP) 8 switches in a distributed communication system (DCS) cluster arrangement. This method is primarily used when an existing large centrex or 701 PBX is being replaced by a DCS cluster.

1.02 Whenever this section is reissued, the reason(s) for reissue will be listed in this paragraph.

1.03 Several factors affect the sizing of DCS-clustered PBXs. Issue 1 of this section only addresses the method for estimating intercom hundred call seconds (CCS) distribution. As other factors are identified, they will be included in subsequent reissues of this section.

1.04 References in this section to methods, planning, data requirements, service levels, and equipment quantities are based on American Telephone and Telegraph Company recommendations.

1.05 Recommendations for changes to this section should be submitted on Form E-3973 as specified in Section 000-010-015, How To Comment on Bell System Practices.

2. INTERCOM CCS DISTRIBUTION

2.01 Part 2 of this section determines the intercom traffic within a cluster of PBXs, which includes both intra- and inter-PBX intercom traffic.

Inter-PBX intercom traffic is typically completed via tie trunks.

2.02 A typical application that needs intercom traffic distribution to PBX clusters is a customer having a large centrex system which is being reconfigured into several DIMENSION PBXs. These arrangements will generate tie-line traffic between the switches for intercom call completion. The number of tie trunks required between switches can be minimized by identifying community of interests and assigning stations which have a high community of interest intercom calling rate to the same switch. Where communities of interest cannot be identified, it is necessary to assume that all stations generate an equal amount of intercom traffic with an equal probability of terminating at any station in the cluster.

2.03 Eight steps are used to determine intercom traffic and intercom traffic distribution between switches in the cluster. They are as follows:

(1) Determine total number of switches in the cluster.

(2) Determine number of stations in each switch (SW).

(3) Determine intercom CCS generated by each switch.

(4) Determine intra-PBX intercom CCS generated by each switch.

(5) Determine inter-PBX intercom CCS for each switch.

(6) Determine inter-PBX traffic distribution from each switch in the cluster to other switches in the cluster.

(7) Summarize data.

(8) Check calculations.

2.04 Two examples of the method of determining intercom CCS distribution are given. Example 1 is for a configuration without community of interests identified. Example 2 is for a configuration with communiy of interests identified. Both examples use the same basic eight steps.

EXAMPLE 1 — CONFIGURATION WITHOUT COMMUNITY OF INTERESTS IDENTIFIED

Step 1 — Determine the Total Number of Switches in the Cluster

Based on factors such as physical location, traffic capacity, processor occupancy, and memory contraints, the cluster in this example requires three DIMENSION 2000 FP8 PBXs and one DIMENSION 600 FP8 PBX for a total of four switches.

Step 2 — Determine the Number of Stations in Each Switch

For this example, each DIMENSION 2000 PBX has 1300 stations, and the DIMENSION 600 PBX has 400 stations. (See Fig. 1.)

Step 3 — Determine Intercom CCS Generated by Each Switch

Since no community of interests have been identified, it has been estimated from traffic studies that each station in the cluster generates an average of one CCS/station intercom traffic. By multiplying the average intercom CCS/station by the number of stations in the switch, the total intercom CCS/PBX is found. (See Table A.)

Step 4 — Determine Intra-PBX Intercom CCS Generated by Each Switch

The intra-PBX intercom CCS (without community of interests) is the ratio of stations in the switch to the total stations in the cluster multiplied by the intercom traffic generated by the switch.

Ratio of Station in Switches:

$$\text{Switch 1 Ratio} = \frac{\text{SW1 Stations}}{\text{Total Stations in Cluster}}$$

$$= \frac{1300}{1300+1300+1300+400}$$

$$= \frac{1300}{4300}$$

$$= 0.302$$

Switch 2 and Switch 3 Ratios Are the Same As Switch 1 Ratio, ie, 0.302.

$$\text{Switch 4 Ratio} = \frac{\text{SW4 Stations}}{\text{Total Stations in Cluster}}$$

$$= \frac{400}{4300}$$

$$= 0.093$$

Intra-Switch Intercom CCS:

Intra-Switch 1 Intercom CCS = SW1 Ratio × SW1 Intercom CCS

= 0.302 × 1300 CCS

= 393 CCS

Intra-Switch 2 and Intra-Switch 3 Intercom CCS are the Same as Intra-Switch 1, ie, 393 CCS.

Intra-Switch 4 Intercom CCS = SW4 Ratio × SW4 Intercom CCS

= 0.093 ×400

= 37 CCS

Step 5 — Determine Inter-PBX Intercom CCS for Each Switch

This value is calculated by subtracting the intercom CCS that stay within the switch from the total intercom CCS generated by the switch. (See Table B.)

Step 6 — Determine Inter-PBX Traffic Distribution From Each Switch in the Cluster to Other Switches in the Cluster

This value is calculated by determining the ratio of stations for each switch (other than the switch being analyzed) compared to the total stations for all switches (other than the switch being analyzed).

The ratio for each switch is then multiplied by the total outgoing intercom CCS leaving the switch being analyzed to get the CCS distribution to each switch.

The following equations use values obtained from Tables A and B.

Switch 1 Outgoing Intercom Distribution:

$$\text{Switch 2 Ratio} = \frac{\text{SW2 Stations}}{\text{SW2+SW3+SW4 Stations}}$$

$$= \frac{1300}{3000}$$

$$= 0.433$$

$$\text{Switch 3 Ratio} = \frac{\text{SW3 Stations}}{\text{SW2+SW3+SW4 Stations}}$$

$$= \frac{1300}{3000}$$

$$= 0.433$$

$$\text{Switch 4 Ratio} = \frac{\text{SW4 Stations}}{\text{SW2+SW3+SW4 Stations}}$$

$$= \frac{400}{3000}$$

$$= 0.133$$

Intercom CCS From SW1 to SW2 = SW2 Ratio × Outgoing CCS SW1

= 0.433 × 907 CCS

= 393 CCS

Intercom CCS From SW1 to SW3 = SW3 Ratio × Outgoing CCS SW1

= 0.433 × 907 CCS

= 393 CCS

Intercom CCS From SW1 to SW4 = SW4 Ratio × Outgoing CCS SW1

= 0.133 × 907 CCS

= 121 CCS

Switch 2 Outgoing Intercom Distribution:

$$\text{Switch 1 Ratio} = \frac{\text{SW1 Stations}}{\text{SW1+SW3+SW4 Stations}}$$

$$= \frac{1300}{3000}$$

$$= 0.433$$

$$\text{Switch 3 Ratio} = \frac{\text{SW3 Stations}}{\text{SW1+SW3+SW4 Stations}}$$

$$= \frac{1300}{3000}$$

$$= 0.433$$

Switch 4 Ratio = $\frac{\text{SW4 Stations}}{\text{SW1+SW3+SW4 Stations}}$

= $\frac{400}{3000}$

= 0.133

Intercom CCS From SW2 to SW1 = SW1 Ratio × Outgoing CCS SW2

= 0.433 × 907 CCS

= 393 CCS

Intercom CCS From SW2 to SW3 = SW3 Ratio × Outgoing CCS SW2

= 0.433 × 907 CCS

= 393 CCS

Intercom CCS From SW2 to SW4 = SW4 Ratio × Outgoing CCS SW2

= 0.133 × 907 CCS

= 121 CCS

Switch 3 Outgoing Intercom Distribution:

Switch 1 Ratio = $\frac{\text{SW1 Stations}}{\text{SW1+SW2+SW4 Stations}}$

$\frac{1300}{3000}$

= 0.433

Switch 2 Ratio = $\frac{\text{SW2 Stations}}{\text{SW1+SW2+SW4 Stations}}$

$\frac{1300}{3000}$

= 0.433

Switch 4 Ratio = $\frac{\text{SW4 Stations}}{\text{SW1+SW2+SW4 Stations}}$

$\frac{400}{3000}$

= 0.133

Intercom CCS From SW3 to SW1 = SW1 Ratio × Outgoing CCS SW3

= 0.433 × 907 CCS

= 393 CCS

Intercom CCS From SW3 to SW2 = SW2 Ratio × Outgoing CCS SW3

= 0.433 × 907 CCS

= 393 CCS

Intercom CCS From SW3 to SW4 = SW4 Ratio × Outgoing CCS SW3

= 0.133 × 907 CCS

= 121 CCS

Switch 4 Outgoing Intercom Distribution:

Switch 1 Ratio = $\frac{\text{SW1 Stations}}{\text{SW1+SW2+SW3 Stations}}$

= $\frac{1300}{3900}$

= 0.333

Switch 2 Ratio = $\frac{\text{SW2 Stations}}{\text{SW1+SW2+SW3 Stations}}$

= $\frac{1300}{3900}$

= 0.333

Switch 3 Ratio = $\frac{\text{SW3 Stations}}{\text{SW1+SW2+SW3 Stations}}$

= $\frac{1300}{3900}$

= 0.333

Intercom CCS From SW4 to SW1 = SW1 Ratio × Outgoing CCS SW4

= 0.333 × 363 CCS

= 121 CCS

Intercom CCS From SW4 to SW2 = SW2 Ratio × Outgoing CCS SW4

= 0.333 × 363 CCS

= 121 CCS

Intercom CCS From SW4 to SW3 = SW3 Ratio × Outgoing CCS SW4

= 0.333 × 363 CCS

= 121 CCS

Step 7 — Summarize Data

Using the results from Step 4 (intra-PBX intercom CCS) and Step 6 (inter-PBX intercom CCS), develop Table C and Fig. 2)

Step 8 — Check Calculations

The totals from Tables A and C should agree. For this example, the intra-PBX intercom CCS are 1216 CCS, and the inter-PBX intercom CCS are 3084, totaling 4300 CCS. This total intercom CCS agrees with Table A.

EXAMPLE 2 — CONFIGURATION WITH COMMUNITY OF INTERESTS IDENTIFIED

Step 1 — Determine the Total Number of Switches in the Cluster.

Based on factors such as physical location, traffic capacity, processor occupancy, and memory constraints, the cluster in this example requires three DIMENSION 2000 FP8 PBXs and one DIMENSION 600 FP8 PBX for a total of four switches.

Step 2 — Determine the Number of Stations in Each Switch.

For this example, each DIMENSION 2000 PBX has 1300 stations, and the DIMENSION 600 PBX has 400 stations. (See Fig. 1.)

Step 3 — Determine Intercom CCS Generated by Each Switch

It has been estimated from traffic studies and consultations with the customer that each of the four switches will have a different intercom calling characteristic as follows:

Switch 1 Will Generate CCS/STA	1.65
Switch 2 Will Generate CCS/STA	0.75
Switch 3 Will Generate CCS/STA	0.60
Switch 4 Will Generate CCS/STA	1.00

By multiplying the average intercom CCS/station by the number of stations in each switch, the total intercom CCS/PBX is found. (See Table D.)

Step 4 — Determine Intra-PBX Intercom CCS Generated by Each Switch

In consultation with the customer, it has been determined communities of interest exist in switches 1, 2, and 3. That is, it is known that a specified percentage of intercom traffic generated in these switches stays within the switch. These percentages are as follows:

Switch 1—75% Stays Within Switch
2—60% Stays Within Switch
3—50% Stays Within Switch
4—Equal Distribution to all Stations in the Cluster.

By multiplying these percentages by the total intercom CCS generated by each switch (Table D), the intra-PBX intercom CCS may be determined for switches 1, 2, and 3. Since switch 4 has no community of interest and calls are distributed equally among all stations in the cluster, the fraction that stays within switch 4 is developed by taking the ratio of stations on switch 4 to the total stations in the cluster. The results are recorded in Table E.

Intercom CCS Within Switch:

Intra-Switch CCS Intercom CCS × % CCS Within Switch

Intra-Switch 1 CCS = 2145 CCS × 0.75

= 1609 CCS

Intra-switch 2 CCS = 975 CCS × 0.60

= 585 CCS

Intra-switch 3 CCS = 780 CCS × 0.50

= 390 CCS

$$\text{Switch 4 Ratio} = \frac{\text{SW4 Stations}}{\text{Total Stations in Cluster}}$$

$$= \frac{400}{1300+1300+1300+400}$$

$$= \frac{400}{4300}$$

= 0.093

Intra-switch 4 CCS = 400 CCS × 0.093
= 37 CCS

Step 5 — Determine Inter-PBX Intercom CCS for Each Switch in the Cluster

This value is calculated by subtracting the intercom CCS that stays within the switch from the total intercom CCS generated by the switch. (See Table F.)

Step 6 — Determine Inter-PBX Traffic Distribution From Each Switch in the Cluster to Other Switches in the Cluster.

This value is calculated by determining the ratio of stations for each switch (other than the switch being analyzed compared to the total stations for all switches (other than the switch being analyzed).

The ratio for each switch is then multiplied by the total outgoing intercom CCS leaving the switch being analyzed to get the CCS distribution to each switch.

The following equations use values obtained from Tables D and F.

Switch 1 Outgoing Intercom Distribution:

$$\text{Switch 2 Ratio} = \frac{\text{SW2 Stations}}{\text{SW2+SW3+SW4 Stations}}$$

$$= \frac{1300}{3000}$$

= 0.433

$$\text{Switch 3 Ratio} = \frac{\text{SW3 Stations}}{\text{SW2+SW3+SW4 Stations}}$$

$$= \frac{1300}{3000}$$

= 0.433

$$\text{Switch 4 Ratio} = \frac{\text{SW4 Stations}}{\text{SW2+SW3+SW4 Stations}}$$

$$= \frac{400}{3000}$$

= 0.133

Intercom CCS From SW1 to SW2 = SW2 Ratio × Outgoing CCS SW1

= 0.433 × 536 CCS

= 232 CCS

Intercom CCS From SW1 to SW3 = SW3 Ratio × Outgoing CCS SW1

= 0.433 × 536 CCS

= 232 CCS

Intercom CCS From SW1 to SW4 = SW4 Ratio × Outgoing CCS SW1

= 0.133 × 536 CCS

= 71 CCS

Switch 2 Outgoing Intercom Distribution:

$$\text{Switch 1 Ratio} = \frac{\text{SW1 Stations}}{\text{SW1+SW3+SW4 Stations}}$$

$$= \frac{1300}{3000}$$

= 0.433

Switch 3 Ratio = $\frac{\text{SW3 Stations}}{\text{SW1+SW3+SW4 Stations}}$

= $\frac{1300}{3000}$

= 0.433

Switch 4 Ratio = $\frac{\text{SW4 Stations}}{\text{SW1+SW3+SW4 Stations}}$

= $\frac{400}{3000}$

= 0.133

Intercom CCS From SW2 to SW1 = SW1 Ratio × Outgoing CCS SW2

= 0.433 × 390 CCS

= 169 CCS

Intercom CCS From SW2 to SW3 = SW3 Ratio × Outgoing CCS SW2

= 0.433 × 390 CCS

= 169 CCS

Intercom CCS From SW2 to SW4 = SW4 Ratio × Outgoing CCS SW2

= 0.133 × 390 CCS

= 52 CCS

Switch 3 Outgoing Intercom Distribution:

Switch 1 Ratio = $\frac{\text{SW1 Stations}}{\text{SW1+SW2+SW4 Stations}}$

= $\frac{1300}{3000}$

= 0.433

Switch 2 Ratio = $\frac{\text{SW2 Stations}}{\text{SW1+SW2+SW4 Stations}}$

= $\frac{1300}{3000}$

= 0.433

Switch 4 Ratio = $\frac{\text{SW4 Stations}}{\text{SW1+SW3+SW4 Stations}}$

= $\frac{1300}{3000}$

= 0.433

Intercom CCS From SW3 to SW1 = SW1 Ratio × Outgoing CCS SW3

= 0.433 × 390 CCS

= 169 CCS

Intercom CCS From SW3 to SW2 = SW2 Ratio × Outgoing CCS SW3

= 0.433 × 390 CCS

= 169 CCS

Intercom CCS From SW3 to SW4 = SW4 Ratio × Outgoing CCS SW3

= 0.133 × 390 CCS

= 52 CCS

Switch 4 Outgoing Intercom Distribution:

Switch 1 Ratio = $\frac{\text{SW1 Stations}}{\text{SW1+SW2+SW3 Stations}}$

= $\frac{1300}{3900}$

= 0.333

Switch 2 Ratio = $\frac{\text{SW2 Stations}}{\text{SW1+SW2+SW3 Stations}}$

= $\frac{1300}{3900}$

= 0.333

Switch 3 Ratio = $\frac{\text{SW3 Stations}}{\text{SW1+SW3+SW3 Stations}}$

= $\frac{1300}{3900}$

= 0.333

Intercom CCS From SW4 to SW1 = SW1 Ratio × Outgoing CCS SW4

= 0.333 × 363 CCS

= 121 CCS

Intercom CCS From SW4 to SW2 = SW2 Ratio × Outgoing CCS SW4

= 0.333 × 363 CCS

= 121 CCS

Intercom CCS From SW4 to SW3 = SW2 Ratio × Outgoing CCS SW4

= 0.333 × 363 CCS

= 121 CCS

Step 7 — Summarize Data

Using results from Step 4 (intra-PBX intercom CCS) and Step 6 (inter-PBX intercom CCS), develop Table G and Fig. 3.

Step 8 — Check Calculations

The totals from Tables D and G should agree. For this example, the intra-PBX intercom CCS are 2621 CCS, and the inter-PBX intercom CCS are 1678 CCS for a total of 4299 CCS. The total intercom CCS from Table D is 4300. This 1 CCS difference is due to rounding.

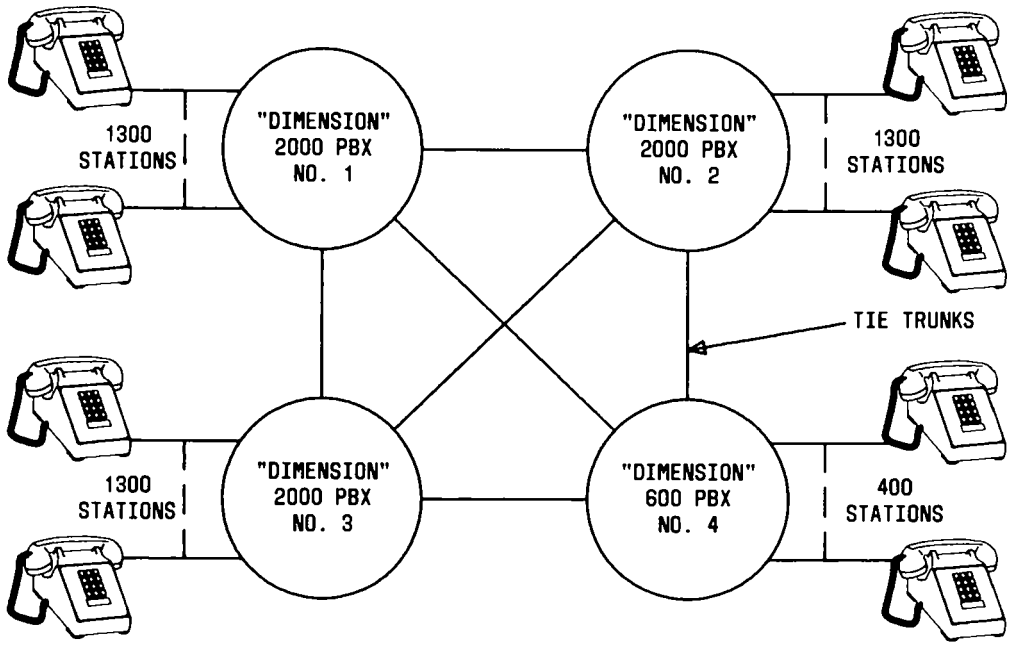

Fig. 1—DCS Clustered PBXs

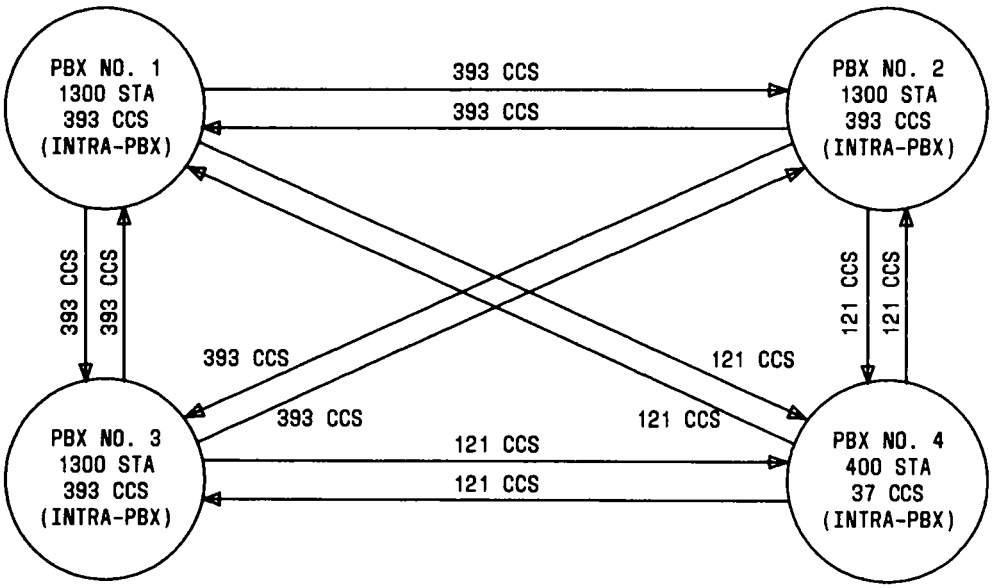

Fig. 2—Total Intercom Traffic Flow Within and Between PBXs—Example 1

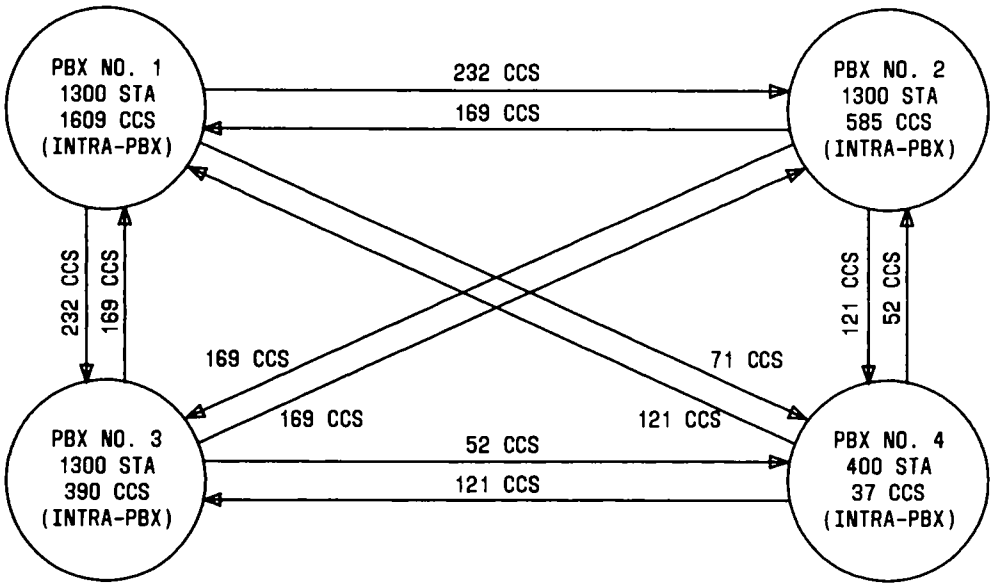

Fig. 3—Total Intercom Traffic Flow Within and Between PBXs—Example 2

TABLE A

TOTAL INTERCOM TRAFFIC—EXAMPLE 1

PBX NUMBER	STATIONS IN PBX	CCS/STATION	INTERCOM CCS
1	1,300	1	1,300
2	1,300	1	1,300
3	1,300	1	1,300
4	400	1	400
		TOTAL	4,300

TABLE B

INTERCOM TRAFFIC DISTRIBUTION—EXAMPLE 1

PBX NUMBER	INTERCOM CCS (NOTE 1)	INTRA-PBX INTERCOM CCS (NOTE 2)	INTER-PBX INTERCOM CCS (NOTE 3)
1	1,300	393 CCS	907 CCS
2	1,300	393 CCS	907 CCS
3	1,300	393 CCS	907 CCS
4	400	37 CCS	363 CCS
	TOTAL	1,216 CCS	3,084 CCS

Note 1: Obtain from Step 3.
Note 2: Obtain from Step 4.
Note 3: Intercom CCS minus intra-PBX intercom CCS.

TABLE C

INTERCOM TRAFFIC SUMMARY—EXAMPLE 1

FROM PBX NUMBER	TO PBX	INTRA-PBX INTERCOM CCS	INTER-PBX INTERCOM CCS
1	1	393	
1	2		393
1	3		393
1	4		121
2	1		393
2	2	393	
2	3		393
2	4		121
3	1		393
3	2		393
3	3	393	
3	4		121
4	1		121
4	2		121
4	3		121
4	4	37	
	TOTAL	1216	3084

TABLE D

TOTAL INTERCOM TRAFFIC—EXAMPLE 2

PBX NUMBER	STATIONS IN PBX	CCS/STATION	INTERCOM CCS
1	1,300	1.65	2,145
2	1,300	0.75	975
3	1,300	0.60	780
4	400	1.00	400
		TOTAL	4,300

TABLE E

INTRA-PBX TRAFFIC PER SWITCH—EXAMPLE 2

PBX NUMBER	INTERCOM CCS	PERCENT INTRASWITCH INTERCOM	INTRASWITCH INTERCOM CCS
1	2,145	.75	1,609
2	975	.60	585
3	780	.50	390
4	400	.093	37
		TOTAL	2,621

TABLE F

INTERCOM TRAFFIC DISTRIBUTION—EXAMPLE 2

PBX NUMBER	INTERCOM CCS (NOTE 1)	INTRA-PBX INTERCOM CCS (NOTE 2)	INTER-PBX INTERCOM CCS (NOTE 3)
1	2,145	1,609	536
2	975	585	390
3	780	390	390
4	400	37	363
	TOTAL	2,621 CCS	1,679 CCS

Note 1: Obtain from Step 3.
Note 2: Obtain from Step 4.
Note 3: Intercom CCS minus intra-PBX intercom CCS.

TABLE G

INTERCOM TRAFFIC SUMMARY—EXAMPLE 2

FROM PBX NUMBER	TO PBX	INTRA-PBX INTERCOM CCS	INTER-PBX INTERCOM CCS
1	1	1,609	
1	2		232
1	3		232
1	4		71
2	1		169
2	2	585	
2	3		169
2	4		52
3	1		169
3	2		169
3	3	390	
3	4		52
4	1		121
4	2		121
4	3		121
4	4	37	
	TOTAL	2,621	1,678