subject: Customer Telephone Facilities - 770 PBX - Traffic Business Services Facilities Engineering Information

File Code:

date: June 1, 1971 JUNE 2 1971

file no. gl: 71-06-009
other: 3B4.5

MR. DIAL
MR. MORSE

AT&T
American Telephone & Telegraph Company
195 Broadway
New York, N. Y. 10007
Phone (212) 393-9800

to: General Traffic Managers (Copies to Chief Engineers)

from: Traffic Operations Director - Business Services

synopsis: Transmits preliminary traffic facilities information on new 770 PBX.

* * *

The 770 PBX is a crossbar customer telephone system designed to be competitive with non-Bell manufacturers' systems in the 40 to 400 line size. It is designed to provide Series 100, 200 and 300 service as well as Hotel/Motel features.

A field trial of the system will be conducted during the 2nd Quarter of 1971 with the 1st production systems available in the 3rd Quarter of 1971.

The attached Notes are preliminary and are subject to changes resulting from the field trial. However, the features and traffic information described are adequate to meet Traffic Business Services responsibilities in the vehicle selection process where a customer's size and calling characteristics warrant. These Notes also contain sufficient information for the preparation of traffic orders on the initial systems.

The Notes fulfill the Traffic Business Services Facilities Committee request that preliminary information, on new developments, be sent to the Associated Companies as soon as possible even though updating may be required before the system is offered as a standard serving vehicle.

A complete Traffic Business Services Facilities Engineering Practice will be issued in the 3rd Quarter of 1971.

Questions regarding this PBX may be referred to R. W. Brooks on Area Code 212 393-2442.

Traffic Operations Director

Attachment

GENERAL

The 770 PBX is a common control switching system using a 3-stage crossbar network composed of line switches, mid-switches and trunk switches. A single marker is used to establish connections, and registers are used to provide dial tone, store dialed or keyed information, and pass on to the marker the necessary information for establishing the connection.

It is designed to provide PBX Series 100, 200 and 300 service as well as Hotel/Motel features in the 40 to 400 line range and is packaged in from one to five cabinets depending upon size.

Cordless 1- and 2-type telephone consoles and the 1-type selector console (for DSS feature) are used as attendant positions. Up to 3 consoles may be used for installations on a switched loop basis with up to 10 loops shared by all three positions. One or two consoles may be provided on a direct trunk basis. With this arrangement, when two consoles are used, all trunks are multiplied between the positions.

The consoles and station equipment may be equipped with either rotary dial or TOUCH-TONE®. With TOUCH-TONE, one TOUCH-TONE Receiver is required for each Register provided.

Additional information on the 770 PBX may be found in GL 71-01-023 and in BSP 981-680-100 - General Description 770A PBX.

FEATURES

Will provide Series 100, 200 and 300 service with the following optional features:

1. TOUCH-TONE Calling
2. Tie Trunks - Dial repeating type only
3. 2, 3 or 4-digit dialing with 1, 2 or 3-digit access codes
4. Toll restriction
5. Lockout and Secrecy
6. Attendant DSS for 200 stations - DSS for an additional 200 stations might be available later with a special assembly arrangement.

The following Hotel/Motel features may also be provided:

1. Single digit access for Room Service, Valet, etc.
2. Mixed 3 and 4-digit station dialing with provision to associated room numbers with station numbers.
3. Message registers

4. Message waiting indicators
5. Room-to-Room Dialing Restriction - Attendant controlled
6. Direct Single Digit Access - Station to Toll operator on a permissive basis.

CAPACITY

The capacity of the 770 PBX is determined by four factors:

1. Terminations:

   A line switch has 40 line ports. Each extension line, each position circuit and each incoming termination of a tie trunk requires one line port. The Conference circuit also requires one line port.

   A trunk switch has 20 trunk ports which are used for the various types of trunks, the registers, dial transfer circuits, and the conference circuit. Each circuit requires one trunk port, except intercom circuits and dial transfer circuits which require two trunk ports each, and the conference circuit which requires six trunk ports.

   The system may be equipped with a minimum of one line switch and one trunk switch, up to a maximum of 10 line switches (400 ports) and at least 8 trunk switches (160 ports). The final design may provide for a maximum of 12 trunk swtiches (240 ports).

2. CCS: The system will handle 7.75 CCS per line at slightly better than P.01. If the CCS per line requirement exceeds this limit, it may be necessary to provide more line switches than would otherwise be required for line circuit terminations alone.

3. Calls: The number of calls that can be processed per hour depends upon two items -

   Number of registers, of which a minimum of two and a maximum of eight may be provided. The register capacities are discussed elsewhere.

   The capacity of the one marker is expected to handle as many calls as can be processed by eight registers. Further analysis may indicate a slightly lower capacity; for systems with high call rates and low holding time.

4. Attendant Positions (Consoles only): A minimum of one and maximum of three may be provided.

LINE SWITCH

Each line switch is a 10 x 20, 6-wire crossbar switch which provides 40 line ports and 20 paths (links) to the mid-switch. The horizontals serve as line ports, and since each line requires only 3 wires, each horizontal serves two line ports. Furthermore, since the horizontals are split down the middle, each "half-switch" serves 20 line ports with access to 10 of the links to the mid-switch.

For systems requiring more than 40 line ports, one or more additional line switches (up to a maximum of 10) must be provided.

MID-SWITCH

The mid-switch is a 10 x 20, 3-wire crossbar switch serving as the second switch in the three-stage network. Each link from a given line switch appears as a horizontal cross-point on a single horizontal level of the mid-switch; i.e., each cross-point on horizontal 0 of the mid-switch serves the 20 links from line switch 0, etc. Where more than one mid-switch is provided, each link from a line switch is multiplied to the same horizontal cross-point of every mid-switch.

The 20 verticals of the mid-switch act as the links to the trunk switch. Since the linkage between the mid-switch and the trunk switch is on a one for one basis, one mid-switch is required for each trunk switch provided.

TRUNK SWITCH

The trunk switch is a 10 x 20, 6-wire crossbar switch and provides 20 trunk ports which are used for the various types of trunks required. The 20 links from the mid-switch appear as the 20 verticals on the trunk switch. Each 6-wire horizontal is arranged to provide two trunk port paths. Considerable flexibility is possible since most trunks may be randomly located on any available trunk port. The trunk switch units are provided in increments of 20 trunk ports each, but individual trunk circuits may be ordered in actual quantities required.

For systems requiring more than 20 trunk ports, one or more additional trunk switches must be provided.

MARKER

The single marker provided with each 770 PBX is the basic control element of the system and is used in the completion of each call. The marker connects a register to a line upon request for dial tone and sets up connections between lines and trunks by using the information it receives from the register. Appropriate marker cross-connections establish the desired class of service options, line hunting, trunk hunting and intercept assignments. It is possible that systems in the larger line sizes (over 300 lines)

with a high percent intercom traffic will be marker limiting. Marker holding time will be about .52 seconds per seizure and an average of two seizures will be required per call. Preliminary studies indicate that marker holding time will be approximately 1.0 seconds per call with 10% intercom; 1.1 seconds per call with 20% intercom and 1.2 seconds per call with 40% intercom traffic. If the marker fails, calls in progress will continue but no further connections can be made.

REGISTER

The register provides dial tone, functions as a dial pulse counter and digit call class and group information store on all calls originated within PBX or incoming through the attendant. The register provides information to the marker on call completion and indicates to the marker the calling and called party identity and class of service when required. Average Register Holding Time is about 5 seconds with rotary dial and about 2.5 seconds with TOUCH-TONE. When engineering a system, this holding time should be increased if mixed access digit dialing is required or if a high percent toll restriction is expected. With mixed access digit codes the register waits 3 seconds after each digit to see if another digit is required. With Toll Restriction the register remains bridged to the connection on dial "9" calls from restricted lines to check code dialed for the first 4 digits.

DIAL TRANSFER UNIT

A station dial transfer unit is required to provide the dial transfer feature. One station dial transfer unit provides two transfer ports for each group of 8 C.O. trunks. This ratio may be reduced by assigning fewer trunks to each dial transfer unit provided; i.e., a 300 series system with 10 incoming C.O. trunks should have 2 Station Dial Transfer units with 5 incoming C.O. trunks in each unit. The dial transfer circuit remains busy for the duration of a transferred call. Additional dial transfer units may be ordered if required but each such unit requires two additional trunk ports. If all dial transfer circuits are busy, calls overflow to attendant. The C.O. trunks associated with a dial transfer unit must be assigned in the same trunk switch as the dial transfer circuits for that unit.

ATTENDANT TRUNKS

Attendant trunk circuits are used in completing dial "0" calls, conference calls, and vacant line or access code intercept calls from station users to the attendant. Tie line calls to vacant lines, vacant access codes, or the attendant are routed via the attendant trunks. These trunks are also used to route permanent signals to the attendant.

CENTRAL OFFICE TRUNKS

Trunks used as central office trunks may be one-way incoming, one-way outgoing to two-way combination. Complete flexibility is achieved

since any C.O. trunk circuit is physically interchangeable with any other C.O. trunk circuit on a plug-in basis. The C.O. trunks may be divided into one or more trunk groups with mixed single or two-digit access codes if required. With mixed digit access, on a single digit call, the Register waits 3 seconds for a possible second digit before calling in the Marker for connection.

INTERCOM TRUNKS

Intercom trunk circuits are used in completing direct dialed station-to-station calls. These trunks are double ended and therefore require two trunk ports per circuit. Both ends must be assigned in the same trunk switch and on the same horizontal. The originating end should be assigned on one half of the split cross-point (of the 6-wire horizontal) and the terminating end assigned to the other half of the split cross-point.

ATTENDANT CONTROLLED CONFERENCE CIRCUIT

The attendant controlled conference circuit permits the PBX attendant to set up a conference with a maximum of five conferees. The conference may involve any combination of tie lines or PBX stations but only one C.O. trunk. Only one tie line can be connected when the conference includes a central office trunk. All six trunks of the conference circuit must be assigned in the same trunk switch.

TOLL RESTRICTION

The 770 PBX provides the capability of restricting designated NPA and/or central office codes from selected stations or tie lines. On calls from restricted lines, the register remains bridged to the connection to provide code detection. There may be up to 4 different codes restricted depending upon the strapping. A Toll Control Unit is required for each central office trunk that may be used for outgoing calls. When dial tone is returned and the calling party dials, the register detects and stores the digits (up to four). If a non-allowed code is dialed, the register signals the toll controller to drop the central office trunk. The register then signals the marker to connect the call to the attendant.

STATION LINES

Station lines and incoming tie lines may be Unrestricted, Semi-Restricted or Fully Restricted on an individual basis. Up to 16 different classes of service may be recognized by the Marker.

Station lines may be arranged for one- or two-way consecutive or non-consecutive hunting as desired.

POWER FAILURE TRANSFER

In the event of commercial power failure, the emergency transfer of up to four stations in each line switch (group of 40 stations) to central office trunks is permitted. The station number locations in each line switch for this feature are 00, 10, 20, 30. The stations arranged for power failure transfer must be equipped with a non-locking dial tone start key.

TRAFFIC REGISTERS

Registers for traffic-sensitive circuits and trunks will be provided and arrangements will be made to have essential traffic usage leads brought out to a cross-connect panel for connection to the TMS 1-A.

TRAFFIC CONSIDERATIONS

Numbering Plan: Station numbering is based on a three-digit numbering plan. A four-digit numbering plan is available with the Hotel/Motel PBX to permit the stations to be matched with room numbers and a two-digit numbering plan may be used for systems of less than 80 lines. A typical three-digit numbering plan might be:

Dialing Code	Destination
0	Attendant Calls
1	Unassigned
2	Stations 200-299
3	Stations 300-399
4	Stations 400-499
5	Stations 500-599
6	Unassigned
7	Miscellaneous Trunks (WATS, FX)
8	Miscellaneous Trunks (CCSA)
9	Central Office Trunks

A station-to-station call requires two links. When a station-to-station call is completed within one subgroup of 20 lines, two of the ten available links are required. Assignments should be made so that stations likely to generate any consistent amount of intercom traffic be assigned to different "20-line groups".

In general, heavy station users should be spread throughout the line groups to equalize the load as much as possible.

Each group of central office trunks, tie trunks and miscellaneous special service trunks may be assigned a separate single digit code. However, where the number of trunk groups exceeds the number of available single digit codes, two- or even three-digit codes may be used. If necessary, mixed one, two or three-digit access codes may be used. However,

this method is not recommended for general use because of the delay factor introduced while the register waits to determine if a second or third digit is to be dialed.

TRAFFIC ENGINEERING

The 770 PBX is growable by nature of its plug-in switch design and may be engineered to provide a wide range of traffic capacities. At its full 400 line size the 770 may be engineered to provide a maximum traffic capacity of 7.75 CCS/line. Lower traffic capacities may be engineered over the full line range. Heavier traffic usage will limit the number of working lines to a level below 400 due to network limitations.

To determine the proper size PBX for a particular customer, a preliminary judgement can be made on the basis of estimated stations, central office trunks, miscellaneous trunks and call rates in cooperation with Marketing.

After selecting a tentative package, the traffic engineer must determine the adequacy of the traffic handling capacity of that package for the particular installation as follows:

Step 1: To determine the number of line switches required add the number of stations, tie trunks, CCSA trunks and position circuits required (include one port for conference line if required) and divide by 40. The answer rounded off to the next whole number represents the number of line switches to be ordered. Spare line ports in the line switches as determine above are available for future growth. When these spares are used up additional line switches will be required.

Step 2(a): Estimate the total Busy Hour calls and holding time for direct dialed station-to-station calls and compute the B.H. CCS requirements. Using Poisson Capacity Table 10 (P.01) determine the number of intercom trunks required. This figure multiplied by 2 represents the number of trunk ports required for intercom trunks.

(b): Total the BH CCS requirements for central office trunk by trunk groups (P.01). These trunks may be one-way, combination or two-way.

(c): Determine the number of FX lines, WATS lines and tie lines required by the customer, either on a CCS basis (use Table 10 (P.01)) or on the basis of trunks ordered by the customer.

(d): Total the BH usage for all attendant trunk calls, including calls from stations and tie lines to and through the attendant,

calls originated by the attendant, intercepted calls and recalls. The F.E.P. for the 770 PBX when it comes out will have a table for attendant trunk capacity but until the F.E.P. is issued, Table 10 may be used to determine attendant trunk requirements.

(e): Determine the number of registers required by multiplying the BH calls by estimated register holding time to determine CCS requirement. Calls handled by the attendant involve two register seizures per call, all other calls require only one seizure per call. Register capacity tables will be contained in the 770 F.E.P. when it is issued. Until then, information contained in the T.F.P., Division D, Sec. 8-e, Figures 6 and 7 can be used to estimate number of registers required.

Step 3: Total the number of trunk ports required as determined in Step 2. Add to this total the Dial Transfer requirement of 2 trunk circuits for every 8 one-way incoming or two-way CO trunks provided. An additional 6 ports must be provided if a Conference Circuit is required. One trunk port is required for the Busy Tone Trunk. The total of all the above port requirements divided by 20 and raised to the next whole number represents the number of trunk switches required. Spare trunk ports in the trunk switches provided, as determined above, are available for future growth. Individual trunk circuits may be ordered as required and plugged in. When these spares are used up, additional trunk switches will be required.

Step 4: The number of positions required (maximum of 3) is determined as for any other PBX's.

ADDITIONAL CONSIDERATIONS

1. No test number assignments are required.

2. Trunk circuits can be assigned indiscriminately to any trunk port location subject to the restrictions noted above. Therefore, when more than one trunk switch is required, trunks of each type provided should be assigned in each trunk switch. In this way, if a trunk switch fails, all the trunks of one type will not be lost.

3. With Series 300 service, a dial transfer unit of 2 circuits is provided for every 8 CO trunks of portion thereof. These units should be assigned as evenly as possible within the CO trunk group. For example:

   - With 10 CO trunks, one dial transfer unit should be connected to each 5 trunks.

   - With 18 CO trunks, the 3 dial transfer units should be connected to the trunks in groups of 6.

4. A recommended traffic order form will be included in the TBS-FEP when it is issued in the 3rd Quarter. Until then your 757 traffic order form can be adapted for issuing traffic orders on the 770 PBX.

Use as Pac. Cv. standard?