CAPACITY ANALYSIS
NETWORK ADMINISTRATION
DMS 100/200® SWITCHES

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1. GENERAL

1.01 This practice provides a general description of the capacity analysis procedure for the DMS 100/200 switch. The responsibilities of the Network Administrator for capacity administration are covered as well as the capacities of the machine. Capacity analysis worksheets are provided for each of the traffic sensitive components in the switch.

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

1.03 The process of determining capacities for the DMS-100 switches is an important part of the traffic engineering and network administration responsibility. The capacities of the various components in the DMS-100 switch will vary because of equipment "breaks". Equipment breaks are associated with the equipment design, i.e., lines per switch, circuits per unit in service in service circuits, etc. One particular component will usually limit the office capability. This component is known as the limiting item. All other components will have the ability to satisfy demand plus some additional load. The maximum load carrying capability of each component and the most limiting hardware and/or software item of the office can be determined by reversing the component requirement calculation process used by the traffic engineer.

1.04 The capacity analysis worksheets provide a means of determining and summarizing the capacity of each switch component and stating this capacity in terms of a common denominator. A comparison of these capacity statements will readily indicate the limiting capacity component for the office. These capacities should be stated in terms of main stations and percent utilization.

1.05 The traffic engineer must know the capability of working DMS-100 switches to intelligently plan future relief. The network administrator must know the total office capacity and the capacity for handling individual custom calling services to maintain loading plans. The traffic engineer and the network administrator must work together in order to use the switch most efficiently.

2. CAPACITY DETERMINATION

A. General

2.01 The capacity analysis worksheets and the accompanying summary of equipment capacities are generally completed by the network administrator. Local option may involve other groups, such as, traffic engineering or planning in the preparation of these worksheets. The capacity analysis worksheets serve three functions.

(1) They serve as a major part of the annual busy season review of office performance.

(2) They provide a statement of office and component capacity used by the traffic engineer or the network administrator to analyze tentative proposals.

(3) They establish capacity statements used by the traffic engineer or the network administrator to analyze loading plans.

2.02 Prior to each capacity analysis study, the traffic engineer and the network administrator should jointly:

- validate the past busy season reports
- review the need for a busy hour determination study and the requirements for component busy hour data collection
- agree to a base data selection
- discuss loading plans, and
- agree to projection methods.

2.03 Loading plans are a joint effort of the network administrator and the traffic engineer. Projection methods are the responsibility of the traffic engineer. The data that is required for projection (i.e., growth factors) is supplied by the traffic engineer.

B. Busy Season Review

2.04 At the end of each busy season, a capacity review should be performed on all working DMS-100 switches. This review is based on the actual current busy season data. There are two purposes for this review.

(1) To reevaluate the capacity of the office and the individual components based on actual loads experienced in the last busy season. A comparison of the latest busy season results to the previously projected capacities may indicate a need for action.

(2) To update projections of load for future periods by incorporating the latest actual data into the historical data base. These revised data bases can be used by the traffic engineer to project and update capacity statements for future busy seasons.

2.05 The network administrator usually fills out the capacity analysis worksheets for a busy season review. The network administrator and the traffic engineer should then jointly review the worksheets. When completed, the capacity analysis worksheets serve as a statement of capacities jointly arrived at and agreed to by the traffic engineer and the network administrator. The completed worksheets from this busy season review serve the following purposes:

- provide support for office capacity statements on the Demand and Facility (D&F) chart and for the construction program
- provide support for any office capacity adjustments indicated as a result of the busy reason review
- provide an in depth review of equipment utilization or component weak spots
- provide a basis to develop and track loading plans
- provide a means to analyze capacity before and after cutover of a new office
- provide an aid in setting service monitoring thresholds
- provide a means to analyze capacity before, during, and after an office addition or transition
- provide a means to highlight capacity problems to permit corrective action.

2.06 The busy season review provides the traffic engineer and the network administrator with an efficient means for analyzing tentative planning and/or loading changes. This review may result in proposals to change the capacity administration plans of the switch. The traffic engineer may be called on to answer "what if" questions that may arise from this review. Tentative proposals may include such things as:

- forecast revisions
- fundamental planning changes
- sales promotions, etc.

2.07 Following adjustment of the traffic and station data to reflect the proposed plans, the capacity of the switch may be recalculated. This will indicate to the traffic engineer whether any additional equipment or software items are required to meet the demands of the proposal.

C. Loading Plans

2.08 The purchase, installation, and maintenance of central office switching systems are very costly matters. Considering this and the switching systems already in place and working, the need for proper loading of this equipment is vital.

2.09 The traffic engineer and the network administrator have the most significant responsibility in the efficient use of equipment already working and the proper provisioning of future installations. The capacity analysis procedure provides the engineer and the administrator with a means for monitoring equipment loading and maintaining it at an acceptable level.

D. Responsibilities

2.10 The determination of switching system capacities is required for several purposes. At the time of traffic order preparation, the traffic engineer calculates all planned equipment capacities and determines the exhaust date. A copy of the traffic order and the planned capacities are

provided to the network administrator for review and comment. The traffic engineer is responsible for and determines the capacity which is input to the D&F data base for future relief planning.

2.11 The network administrator monitors the use of traffic sensitive and physically limiting components throughout the life of the job and notifies the traffic engineer when recalculation of capacities differ from the engineered capacities. The traffic engineer in turn apprises the network administrator of any changes affecting the engineered capacities.

2.12 Following each busy season, the network administrator and the traffic engineer jointly review the past busy season for any capacity changes and plan for future busy seasons. The network administrator calculates the past busy season main station capacity of critical components and documents load service relationships. The traffic engineer is responsible for determining capacity for future periods in order to validate or reestablish equipment exhaust dates. The traffic engineer establishes attempt and usage forecasts based on a combination of historical data, the performance in past busy seasons, and significant traffic affecting changes planned for introduction during the life of the job. The traffic engineer is responsible for making any changes in the D&F data base.

3. CAPACITY ANALYSIS WORKSHEETS

A. General

3.01 The capacity analysis procedure is the reverse of the provisioning procedure. The capacity analysis worksheets provide a means of determining the current switch capacity and use. The data compiled on these worksheets is compared to that of previous busy hours. By doing this, the trends and exhaust dates of the switch can be predicted.

3.02 If data from the last busy season review is used in calculating capacity, then those capacity figures are for the most recent busy season. The capacity figures that are required though are those for the upcoming busy season. The network administrator uses these figures for developing loading plans and the designer uses them for central office relief planning. In order to project these capacity figures the office busy season data can be trended. A linear trend program can be used, ideally using five data points, each representing one busy seasons data. If five years of busy season data is not available, the trends can be based on the trends of another local machine with the same type of traffic mix. For example, if the CCS/MS of a similar local switch is increasing by a certain percentage then that same percentage may apply to the DMS switch. This estimate of MS traffic load is usually a mutual agreement of the network administrator and the central office designer.

3.03 The capacity analysis procedure is performed on one functional segment of central office equipment at a time, (e.g., interface modules, networks, or MF receivers). When all of the items are evaluated, the item with the lowest MS capacity is said to be limiting the office. This item may be either a major or minor item. A major item is a component such as a LM or NM. A minor item is a component such as a MF receiver. The limiting item should be a major item of equipment. To have a minor piece of equipment limiting an office's capacity is both undesirable and a poor engineering practice.

3.04 In order to calculate the capacity of an office, a data base with certain items of summarized data must be available. The data that must be used for capacity analysis must be summarized and processed on an ongoing basis. It is too big an undertaking to accomplish at the end of a busy season.

3.05 The capacity analysis worksheets provide a uniform, organized, step-by-step approach to accomplishing capacity analysis. The worksheet format is based on data that is available from the machine.

B. Numbers Capacity Worksheet

3.06 This worksheet (FIG. 1) is used to determine the directory number capacity of an office and its associated sites. This is especially important in areas where the office codes are running out.

3.07 The following header fields should be filled out for each worksheet.

Building - This is the wire center or entity.

Entity - The office designation. The data entered in this field will depend on local procedure (i.e., 3 digit office code, control group, or entity designation).

Page - The worksheet page number.

Study Period - The time period for which the capacity is being measured.

GPF Date - The General Planning Forecast date used for this capacity analysis.

3.08 This paragraph describes the data that should be entered in this worksheet. All data should be entered in the column under the appropriate heading.

Office NXX - This is the office code for each office working in the entity. This code should be entered once for each class of main station working within the code (e.g., MR, coin, and IBN) where the percent administrative spares would normally differ. The office codes for each remote site should also be entered in this column.

If an office serves two or more rate zones, a separate line will be required for each rate zone to accommodate the number series assigned to it.

Host or Remote - This column will contain either an H or an R. This designates whether the code or number is assigned to, or reserved for, the host or remote location.

Zone - This column indicates the calling rate zone to which the office code or number series is assigned.

Class of Service - The main station class of service associated with each office code.

Percent Administrative Spare - It develops an administrative number based on empirical data, and is largely generic in application. For more information see BR 231-070-620.

Numbers Installed - Directory numbers should be allocated to all classes of service, based on expected growth, by consulting the loading plans and the General Planning Forecast (GPF).

MS Capacity - To achieve this percent figure multiply numbers installed X (100% minus the Administrative spare %).

Remarks - This column is reserved for remarks about the number or code capacity.

C. Networks Capacity Worksheet Based on Network Ports

3.09 This worksheet (FIG. 2) deals mainly with network port utilization. It is also a convenient form on which to record certain office inventory.

3.10 The following header fields should be filled out for each worksheet.

Building - This is the wire center or entity.

Entity - The office designation. The data entered in this field will depend on local procedure (i.e., 3 digit office code, control group or entity designation).

Page - The worksheet page number.

Study Period - The time period for which the capacity is being determined.

GPF Date - The general planning forecast date that is being used for this capacity analysis.

Peripheral Modules - Lists all the types of peripheral modules that terminate on the NMs for both generations of peripheral units.

Number of Peripheral Modules - Enter the number of peripheral modules of each type. The TMINV, LMINV, and DCMINV Tables list each module.

Ports per Module - This indicates the number of network ports used by the respective peripheral modules. Values may be obtained from the office inventory tables.

Ports Required - These values are obtained by multiplying the number of peripheral modules X ports per module.

Total Ports Required - This is the sum of all ports required, and will be the total number of

assigned network peripheral ports in the office.

Networks Installed - The number of network modules (NMs) installed in the office. This information may be obtained from the Office Busy Hour (OBH) report.

Ports per Network - There are 64 ports per Network Module (NM).

Ports Installed - This is determined by multiplying the number of networks installed by the number of ports per network.

Number of Spare Ports - To determine this, subtract the number of ports used from the number of ports installed.

Percent Utilization - Divide the total ports assigned by the number of ports installed.

D. Networks Capacity Worksheet Based on CCS

3.11 This worksheet (FIG. 3) will help determine the percent utilization of "two way CCS". The following header fields should be filled out for each worksheet.

Building - This is the wire center or entity.

Entity - The office designation. The data entered in this field will depend on local procedure (i.e., 3 digit office code, control group or entity designation).

Page - The worksheet page number.

Study Period - The time period for which the capacity is being measured.

GPF Date - The date of the general planning forecast that is being used for this capacity analysis.

Engineering Criteria - NTI standards provide for network capacity on an ABS and HD basis. In order to extract the HD you may have to set up procedures for determining TS CCS/MS on a daily basis.

Networks Installed - The number of network modules (NMs) installed in the office. This information may be obtained from the Office Busy Hour (OBH) report.

Engineered CCS per Network - This is the DMS-100 switch local network capacities of two way CCS per netowrk module. This information is located in NTP-297-1001-450/2, Table E. For a DMS 200 switch use Table F.

CCS Capacity - To achieve this figure multiply the NMs installed by the CCS per NM.

Tandem CCS Demand - This is the DMS-200 switch toll network capacities of two way CCS per network module. This information may be found in NTP 297-1001-450/2, Table F.

CCS Capacity for MS - The General Planning Forecast or Loading Plan will give you this information.

Main Station Demand - The maximum number of MS's working in the entity for the "Study Period".

Time Switch 2 Way Network CCS/MS - This value is an estimation or "pick" of the total CCS/MS that is expected to materialize in the "Study Period". This data is the TS usage divided by the MS's that generated it.

MS CCS Demand - This is obtained by multiplying MS demand by (TS 2W CCS/MS).

MS Capacity - This represents the maximum number of MSs that can operate on the network at objective service levels and can be obtained by dividing the installed network capacity by the CCS/MS.

Percent Utilization - To obtain this divide MS demand by the MS capacity. The lower the MS capacity the higher the percent utilization.

E. Host Switch - LM & LCM Worksheet Line Terminations

3.12 These units should render objective service in a fully loaded office which is properly load balanced. The loading division for a DMS 100 switch is the LM or LCM. The following headers should be filled out on each worksheet (FIG. 4).

Building - This is the wire center or entity.

Entity - The office designation. The data entered in this field will depend on local procedure (i.e., 3

digit office code, control group or entity designation).

Page - The worksheet page number.

Study Period - The time period in which the capacity is being measured.

GPF Date - The date of the general planning forecast that is being used for this capacity analysis.

Office NXX - List each office code working in the entity for each major class such as MS, MR, Coin and IBN.

Line Modules or Line Concentrating Modules - Enter LM, LCM or both, but on separate lines. This will identify the type and indicate the proper capacity table.

Number of Speech Links - Enter the number of speech links that are associated with each line unit.

Host Main Station Demand - Enter the MS demand for the study period as indicated on the general planning forecast or loading plan.

Number of Lines Equipped - This number is determined by multiplying the number of LMs or LCMs by the number of lines each module can support.

Percent Administrative Spare - It develops an administrative number based on empirical data, and is largely generic in application. For more information see BR 231-070-620.

Number of Lines Operative - To obtain this number take the maximum number of lines the office can run with and subtract the administrative spares.

Main Station per Line Ratio - To obtain this ratio divide the number of working MS's by the number of working line equipment. This information may be obtained from the Line Assignment group.

Main Station Capacity - Multiply the Line Capacity by the MS/Line Ratio. This is the MS capacity based on LEN's only.

Percent Utilization - This is the maximum percent of the LEN Capacity expected to be used in the study period. Divide the MS demand by the MS capacity.

F. Host Switch - LM & LCM Worksheet CCS Capacity

3.13 This worksheet (FIG. 5) helps to provide for LM/LCM capacity on an ABS and HD basis. The information may be found in NTP 297-1001-450/2 Table G in the columns marked "Full Load Balancing Scheme". The following headers should be filled out on each worksheet.

Building - This is the wire center or entity.

Entity - The office designation. The data entered in this field will depend on local procedure (i.e., 3 digit office code, control group or entity designation).

Page - The worksheet page number.

Study Period - The time period in which the capacity is being measured.

GPF Date - The date of the general planning forecast that is being used for this capacity analysis.

Office NXX - List each office code working in the entity for each major class such as MS, MR, Coin and IBN.

Line Modules or Line Concentrating Modules - Enter LM, LCM or both, but on separate lines. This will identify the line module by type and indicates the proper capacity table.

Number of Speech Links - This is the number of speech links associated with each line unit.

Host Main Station Demand - Enter the MS demand for the study period as indicated on the general planning forecast or loading plan.

Number of Line Modules or Line Concentrating Modules - This is the total number of LM's or LCM's in an entity or office.

Engineering Criteria - NTI standards provide for LM/LCM capacity on an ABS and HD basis.

Engineering CCS per Line Module - This is the Line Module Traffic capacity (CCS) on a matching loss basis. This value is obtained from NTP 297-1001-450/2 Table G.

Blocking or Non Blocking of Line Group Controller (LGC) - This column is used in entities that have LCM's installed, and is used to determine if the LGC's that serve them are a blocking type.

Engineered CCS/LCM - This is LCM capacities (CCS) for LGC with blocking and non blocking time switch. If a non blocking type LGC is used refer to Table S (NTP-297-1001-450/2) and if a blocking type is used refer to Table T.

CCS Capacity for LM - Multiply the number of LM's by the Engineered CCS/LM. This represents the total installed LM capacity in the office.

CCS Capacity for LCM - Multiply the number of LCM's by the Engineered CCS/LCM. This represents the total installed LCM capacity in the office.

CCS Capacity for Host Office - This is the sum of the LM and LCM CCS capacities installed in the host office.

Originating Plus Terminating CCS/MS - This is the total LM or LCM CCS/MS that is expected to materialize in the study period. It is derived from the dial office data base and projected into the study period.

Main Station Capacity for the Host Office - This is the total installed line unit capacity (LM + LCM) divided by the projected O+TCCS/MS. This represents the maximum number of main stations that can operate in the line units at objective service levels.

Percent Utilization - This is the host MS demand divided by the host MS capacity and represents the maximum percent of installed line unit capacity (LM + LCM).

G. Remote Line Modules Worksheet Line Terminating

3.14 RLMs are used to interface with MSs and to concentrate their calls onto DS-1 link channels. The concentration function, like the LM and LCM, may cause blocking in a fully loaded site and will contribute to the office IML. The following headers should be filled out on each worksheet (FIG. 6).

Building - This is the wire center or entity.

Entity - The office designation. The data entered in this field will depend on local procedure (i.e., 3 digit office code, control group or entity designation).

Page - The worksheet page number.

Study Period - The time frame in which the capacity is being measured.

GPF Date - The date of the general planning forecast that is being used.

Site - If a site has its own NXX, it may be entered here, otherwise a letter (A, B, etc.) or other site identification should be used.

Number of RLM Bays - This column should be used to indicate the number of bays for which a capacity is being determined. This number can be verified on the RLM inventory table.

Number of DS-1 Links per Bay - This figure will be between 1 and 4, and can also be found on the RLM inventory table.

Number of Intra-Links per Bay - An intra link is comprised of 12 channels, each providing a talking path between 2 lines located in the same bay. An "Intra RLM" entry on the OFCINV table will verify if this option is provided.

Number of Inter Links per Bay - This option can only be provided if less than the maximum of 4 DS-1 host links are provided because the DS-1 link terminations are required. If less than 4 DS-1 links are provided then this option can be used for 24 inter bay link channels, one end of the link terminating on each bay.

Percent Intra Traffic - This is the percent of the total traffic usage that is within a site. A ratio of intra site calls to total calls can be applied to the O and T usage to develop a percent intra site usage, assuming the holding time (HT) for intra site calls is the same as the HT average for total calls (O + I).

Remote Line Module Main Station Demand - This is the maximum number of MS's expected to be working in this site during the study period. Refer to: the general planning forecast or loading plan. *This information is obtained from the Equipment and Traffic Engineers.

Number of Lines Equipped - This is the number of RLM bays times the number of lines each module can support.

Percent Administrative Spare - This item may be determined by following the recommendation on the Number Capacity Worksheet found in practice 231-070-620.

Number of Line Operative - This is the number of remote line equipments installed at this site minus the administrative spare. It represents the maximum number of lines the site can serve.

Main Station per Line Ratio - This ratio is obtained by dividing the number of working MS's by the number of working lines equipments at this site.

Main Station Capacity - This is equal to the line capacity multiplied by the MS/Line Ratio. This is the MS capacity based on Remote LENs only.

Percent Utilization - This is the percent of usable remote LEN capacity expected to be used in the study period.

H. Remote Line Modules Worksheet CCS Capacity

3.15 Capacity determination for remote line modules is more complex than other types of units. A high degree of accuracy is difficult to obtain because operational measurements cannot provide the necessary data. The following headers should be filled out on each worksheet (FIG. 7).

Building - This is the wire center or entity.

Entity - The office designation. The data entered in this field will depend on local procedure (i.e., 3 digit office code, control group or entity designation).

Page - The worksheet page number.

Study Period - The time frame in which the capacity is being measured.

GPF Date - The date of the general planning forecast that is being used.

Site -If a site has its own NXX, it may be entered here, otherwise a letter (A, B, etc.) or other site identification should be used.

Number of RLM Bays - This column should be used to indicate the number of bays for which a capacity is being determined. This number can be verified on the LM inventory table.

Number of DS-1 Links per Bay - This figure will be between 1 and 4 and can also be found on the LM inventory table.

Number of Intra Links per Bay - An intra bay link is comprised of 12 channels, each providing a talking path between 2 line locations in the same bay. An "Intra RLM" entry on the OFCINV table will verify if this option is provided.

Number of Inter Links per Bay - This option can only be provided if less than the maximum of 4 DS-1 host links are provided because the DS-1 link terminations are required. If less than 4 DS-1 links are provided then this option can be used for 24 inter bay link channels, one end of the link terminating on each bay.

Percent Intra Traffic - This is the percent of the total traffic usage that is intra site. A ratio of intra site calls to total calls can be applied to the O and T usage to develop a percent intra site usage, assuming the hold time (HT) for intra site calls is the same as the HT average for total calls (O+T)

Remote Line Module Main Station Demand - This is the maximum number of MS's expected to be

working in this site during the study period. Refer to: the general planning forecast or loading plan. This is obtained from the equipment and traffic engineers.

Engineering Criteria - Both ABS and HD may be used. See NTP 297-1001-450/312, Table G.

Engineered CCS per Bay - These values are obtained from Table 1. See NTP 297-1001-450/312.

CCS Capacity - Multiply the CCS per bay by the number of RLM bays.

Originating Plus Terminating CCS/MS - This is the total RLM O+T COS/MS for this site that is expected to materialize in the study period.

Main Station Capacity - The installed CCS capacity at this site divided by the site O+T. CCS/MS represents the maximum number of MS's that can operate at this site.

Percent Utilization - This is the percent of the MS CCS capacity that is expected to be used in the study period. The lowest capacity will yield the highest percent utilization.

I. Service Circuits and Miscellaneous Worksheet

3.16 This worksheet (FIG. 8) will help provide an inventory on the capacity of service and miscellaneous circuits within an entity or building site. The following headers should be filled out on each worksheet.

Building - This is the wire center or entity.

Entity - The office designation. The data entered in this field will depend on local procedure (i.e., 3 digit office code, control group or entity designation).

Page - The worksheet page number.

Study Period - The time frame in which the capacity is being measured.

GPF Date - The date of the general planning forecast that is being used.

MF Receivers - This is to indicate the type of service circuit.

(a) Circuits per pack - Indicates the number of circuits in one circuit pack.

(b) Circuits Provided - total - Enter the total number of circuits installed. This information can be found on the OBH operational measurement report.

(c) Circuits Provided - Traffic - This should be equal to the total circuits provided minus those required for service protection.

(d) Engineering Criteria - This indicates the engineering criteria for this item, which is ABS unless an appreciable amount of tandem or any toll traffic exists.

(e) Table - This indicates which table to use for determining circuit group capacity. It will either be a Northern Telecom or a Poisson table.

(f) Peak Factor (PF) - This will contain the PF (HD to ABS ratio or HD to 10 HD ratio) which is required only for circuit groups that use the poisson criteria are not Engineered on high day data.

(g) CCS Capacity Provided - This value is obtained from the poisson table and represents the traffic capacity of the service circuits.

(h) Component Main Station Demand - This value is the maximum number of MS's/MF incoming trunks expected to use this circuit group in the study period. Source: MS's = GPF or loading plan, trunks = network operations, general trunk estimate. This is obtained from the equipment and traffic engineers.

(i) Busy Hour Factor - This factor is used to provide a correction for data that was not generated during this components busiest hour. Source: Dial Office Busy Hour Study.

(j) Holding Time - The holding time is calculated by dividing MF receiver group usage by the corresponding call peg

count.

(k) Busy Hour calls per Main Station - This is the number of BH call peg counts for this component, divided by the number of main stations or trunks for the same time period in the study period.

(l) Busy Hour CCS per Main Station - This is an estimation, or "Pick", of the CCS per MS or trunk that is expected to materialize in this components BH during the study period. The base used to provide this data is the circuit group usage divided by the MSs or trunks that generate it.

(m) Main Station Capacity - Divide the CCS capacity by the CCS per MS or trunk for MF receivers, this represents the maximum number of MSs or trunks this service circuit group can render objective service.

(n) Percent Utilization - This is the percent of the MF receivers MS or trunk capacity that is expected to be used in the study period.

Digitone™ Receivers - This is to indicate the type of service circuit.

(a) Circuits per Pack - This is to indicate the number of circuits in one circuit pack.

(b) Circuits Provided - Total - The number of circuits installed. This number can be found on the OBH Operational Measurement report.

(c) Circuits Provided - Traffic - This number should be equal to that of circuits provided total minus those required for service protection.

(d) Engineering Criteria - This will be preprinted indicating that both HD and ABS calculations are required.

(e) Table - This indicates which table to use for determining circuit group capacity. It will either be a Northern Telecom or poisson table.

(f) Peak Factor - This will contain the PF (HD to ABS ratio or HD to 10 HD ratio) which is required only for circuit groups that use poisson criteria.

(g) CCS Capacity Provided - This value is obtained from the poisson table and represents the traffic capacity of the service circuits.

(h) Component Main Station Demand - For the digitone receiver group enter the maximum number of MS's expected to use this circuit group in the study period.

(i) Busy Hour Factor - This factor is used to provide a correction for data that was not generated during this component's busiest hour. Source: Dial Office Busy Hour Study.

(j) Holding Time - The holding time is calculated by dividing digitone receiver group usage by the corresponding call peg counts (excluding dial tone speed tests)

(k) Busy Hour Calls per Main Station - Divide the number of BH call peg counts for this component by the main stations for the same time period.

(l) Busy Hour CCS per Main Station - This value is an estimation, or "Pick" of the CCS per MS that is expected to materialize in component's BH during the study period.

(m) Main Station Capacity - Dividing the CCS capacity provided by the CCS per MS for digitone receivers represents the maximum number of MS's this service circuit group can render objective service to during the study period.

(n) Percent Utilization - This is the percent of the digitone receiver MS capacity that

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is expected to be used in the study period.

Three Port Conference Circuits -

(a) Circuits per Pack - This is to indicate the number of circuits in one circuit pack.

(b) Circuits Provided - Total - The total number of circuits installed. Source: Busy Hour Printout.

(c) Circuits Provided - Traffic - This number should equal the total circuits provided minus those required for service protection.

(d) Engineering Criteria - Engineering criteria indicates that only ABS calculations are required.

(e) Table - This indicates which table to use for determining circuit group capacity. It will be either a Northern Telecom or a poisson table.

(f) Peak Factor - This will contain the PF (HD to ABS ratio).

(g) CCS Capacity Provided - This value is obtained from the poisson table and represents the traffic capacity of the service circuits.

(h) Component Main Stations Demand - For three port conference circuits the maximum number of MSs expected to use this circuit group in the study period, is the preferred entry. This may be difficult to do because of the many applications of this circuit.

(i) Busy Hour Factor - This is used to provide a correction for data that was not generated during this component's busiest hour.

(j) Holding Time - The holding time is calculated by dividing 3 port conference circuit usage by the corresponding call peg counts.

(k) Busy Hour Calls per Main Station - Divide the number of BH call peg counts for this component by the main stations for the same time period.

(l) Busy Hour CCS per Main Station - This is an estimation, or "Pick", of the CCS per MS that is expected to materialize in this component's BH study period.

(m) Main Station Capacity - Divide the CCS capacity provided by the CCS per MS and this represents the maximum number of MS's this service circuit group can render objective service to in the study period.

(n) Percent Utilization - This is the percent of the 3 port circuit MS capacity that is expected to be used in the study period.

Receiver Off Hook Tone (ROH) - This indicates what type of service circuit.

(a) Circuits per Pack - This indicates the number of circuits in one circuit pack.

(b) Circuits Provided - Total - The number of circuits installed. Source: Table STN (NTP Form 2652 A-B).

(c) Circuits Provided - Traffic - This should equal the total circuits provided minus those required for service protection.

(d) Engineering Criteria - Only ABS calculations are required for this service circuit.

(e) Broadcast Connections - This is the number of simulatneous calls this circuit group can broadcast to, excluding circuits required for service protection. It is shown on Table STN, column MAX-CONN and is calculated by multiplying the number of channels by the number of traffic circuits.

(f) Table - This indicates which table to use for determining circuit group capacity. Source: NTP 297-1001-450/2 Table M.

(g) Peak Factor - This is not used with NTI tables.

(h) CCS Capacity Provided - This is obtained from the NTP 297-1001-450/2 Table M

and represents the traffic capacity of the circuits based on the number of broadcast connections.

(i) Component Main Station Demand - Enter the maximum number of office MS's expected to use this circuit group during the study period.

(j) Busy Hour Factor - This is used to provide a correction for data that was not generated during this component's busiest hour.

(k) Holding Time - The holding time is calculated by dividing circuit group usage by the corresponding call peg counts.

(l) Busy Hour Calls per Main Station - This is the number of BH call peg counts for the component, divided by the main stations for the same time period.

(m) Busy Hour CCS per Main Station - This is an estimation, or "Pick" of the CCS per MS that is expected to materialize in this component's BH.

(n) Main Station Capacity - Divide the CCS capacity provided by the CCS per MS, this will give the maximum number of MS's the ROH tone group can render objective service to during the study period.

(o) Percent Utilization - Divide component main station demand by main station capacity and this will give the percent of the ROH tone group MS capacity that is expected to be used in the study period.

Announcements - This column indicates an announcement but does not specify which one. The announcements with the highest projected usage should be used.

(a) Circuits per Pack - This does not apply because digital recording announcement machine (DRAM) channels are being evaluated and the quantity of channels is determined by the setting of switches on the DRAM control card.

(b) Circuits Provided - Total - Enter "1" because only one channel is being evaluated, the one with the highest projected usage.

(c) Circuits Provided - Traffic - Enter "1" because only one channel is being evaluated.

(d) Engineering Criteria - The engineering criteria indicates that only ABS calculations are required.

(e) Broadcast Connections - This is the number of simultaneous calls this circuit group can broadcast to. Source: Table ANNS. Max. Connections.

(f) Table - This indicates which table to use for determining circuit group capacity. See NTP 297-1001-450/2, Table M.

(g) Peak Factor - This is not used with NTI tables.

(h) CCS Capacity Provided - This value is obtained from the NTI table and represents the traffic CCS capacity of one channel, based on the number of broadcast connections.

(i) Component Main Station Demand - For this circuit group, enter the maximum number of office MS's expected to use this circuit group. For this group it will equate to the total office MS's.

(j) Busy Hour Factor - This is used to provide a correction for data that was not generated during this component's busiest hour.

(k) Holding Time - The holding time is calculated by dividing circuit group usage by the corresponding call peg counts.

(l) Busy Hour Calls per Main Station - Divide the number of BH call peg counts for the same time period. This item is not required for determining when empirical usage data is used.

(m) Busy Hour CCS per Main Station - This is an estimation, or "Pick" of the CCS per

MS that is expected to materialize in this component's BH. This item is not required for determining capacity when empirical usage data is used.

(n) Main Station Capacity - Divide the CCS capacity provided by the CCS per MS to get the maximum number of MS's this announcement channel can render objective service to during the study period.

(o) Percent Utilization - This is the percent of the announcement channel MS capacity that is expected to be used during the study period.

J. Main Station Capacity DRAMS Worksheet

3.17 This worksheet (FIG. 9) deals with the DRAM. The Bell Telephone standard is that a minimum of two DRAMS be installed in every switch.

Building - This is the wire center or entity.

Entity - The office designation. The data entered in this field will depend on local procedure (i.e., 3 digit office code, control group or entity designation).

Page - The worksheet page number.

Study Period - The time frame in which the capacity is being measured.

GPF Date - The date of the general planning forecast that is being used for this capacity analysis.

Digital Recorded Announcement Machine (DRAM) - Enter which DRAM is being evaluated in an office with more than one machine, excluding back ups. Source: Table ANNMENS.

Ports Deloaded - Enter the number of network ports that have been deloaded (are to remain unused) in the DRAM's sub group. If the assignments are laid out on a matrix showing every network time switch (TS) and their associated peripheral ports (16 per time switch), unassigned or spare TS peripheral ports will become apparent.

Maximum Channels - The capacity of the DRAM will vary depending on the maximum number of circuits or channels that are enabled on it. To determine which value to use it is recommended the number of channels working be determined from Table ANNS and rounded up to the next highest standard setting (8, 16, 24 or 30).

Engineering Criteria - The engineering criteria is preprinted indicating that only ABS calculations are required.

Table - This indicates which NTI table to use for determining circuit group capacity. Source: NTP 297-1001-450, Sec. 450/2, Tables Q and R.

Engineered CCS Capacity - This value is obtained from the NTI table and represents the traffic capacity of this DRAM.

Component Main Station Demand - Enter the maximum number or total office MS's expected to use the DRAM in the study period. Source: GPF or loading plan.

Busy Hour Factor - This factor is used to provide a correction for data that was not generated during this component's busiest hour.

Hold Time - The HT is calculated by dividing the total usage of all DRAM channels by the corresponding call peg count.

Busy Hour Calls per Main Station - Total Channels - This value is an estimation or "Pick" of the total calls per MS for all channels that is expected to materialize in the BH for the study period.

Busy Hour CCS per Main Station Total Channels - This value is an estimation, or "Pick" of the total CCS per MS for all channels that is expected to materialize in this component's BH.

Main Station Capacity - This is the CCS capacity provided divided by the CCS per MS. This is the maximum number of MS's the DRAM can render objective service to in the study period.

Percent Utilization - This is the percent of the DRAM MS capacity that is expected to be

used during the study period.

DMS - 100/200 SWITCH MAIN STATION CAPACITY

NUMBERS CAPACITY WORKSHEET

BUILDING:

ENTITY: PAGE:

STUDY PERIOD: GPF DATE:

OFFICE NXX	HOST OR REMOTE	ZONE	CLASS OF SERVICE	NUMBERS			REMARKS
				%ADM SPARE	INSTALLED	MS CAPACITY*	
TOTAL							

* MS Capacity = Installed(100% - % ADM Spare)

PREPARED BY

NAME:_____ DATE: __/__/__ TELEPHONE No.: ____-_____

Figure 1. Numbers Capacity Worksheet

DMS - 100/200 SWITCH MAIN STATION CAPACITY
NETWORKS CAPACITY WORKSHEET
BASED ON NETWORK PORTS

BUILDING:
ENTITY:
STUDY PERIOD:

PAGE:
GPF DATE:

PERIPH MOD	# OF PERIPH MODS	PORTS PER MOD	PORTS (1) REQUIRED	TOTAL(2) PORTS REQUIRED	NTWKS INST.	PORTS PER NTWK	(3) PORTS INST.	* OF(4) SPARE PORTS	(5) %UTIL
TM									
MTM									
DAU									
DES									
DRA									
LM(6)									
LM									
DCM									
DTC(7)									
DTC									
DTC									
LBC(7) LGC									
LGC									
LTC(7)									
LTC									
LTC									
SCM(7)									
SCM									
SCM									
TOTAL									

(1) Ports Required = Number of Peripheral Modules X Ports per Module
(2) Total Ports Required = Total Ports Required per Module
(3) Ports Installed = Networks Installed X Ports per Network
(4) Number of Spare Ports = Ports Installed - Total Ports Required
(5) % Utilization = Total Ports Required / Ports Installed
(6) LM Ports/Module m- Value Between 2 and 4 inclusive. Input Ports/Module and the number of peripheral modules with that configuration.
(7) DTC, LGC, LTC, SCM Ports/Module - Value Between 3 and 16 inclusive. Input Ports/Module and the Number of Peripheral Modules with that configuration

Figure 2. Networks Capacity Worksheet Based on Network Ports

DMS - 100/200 SWITCH MAIN STATION CAPACITY
NETWORKS CAPACITY WORKSHEET
BASED ON CCS

BUILDING:
ENTITY:
STUDY PERIOD:

PAGE:
GPF DATE:

ENG CRITERIA	NTWKS INST.	ENG (1) CCS PER NTWK	(2) CCS CAP	(3) TANDEM CCS DEMAND	CCS (4) CAPACITY FOR MS	(5) MS DEMAND	(5) TS 2W CCS/MS	MS (6) CCS DEMAND	(7) MS CAP	(8) %UTIL
ABS										
HD										

(1) Refer to NTP 297-1001-450, Section 450/2 Tables E(DMS-100) and F(DMS-200)
(2) CCS Capacity = Networks Installed X Eng. CCS per Network
(3) Include DID
(4) CCS Capacity for MS = CCS Capacity - Tandem CCS Demand
(5) Include Remotes
(6) MS CCS Demand = MS Demand X (TS 2W CCS/MS)
(7) MS Capacity = CCS Capacity for MS / TS 2W CCS/MS
(8) % Utilization = (Tandem CCS Demand + MS CCS Demand) / CCS Capacity

Figure 3. Networks Capacity Worksheet Based on CCS

DMS - 100/200 SWITCH MAIN STATION CAPACITY
HOST SWITCH - LM & LCM WORKSHEET
LINE TERMINATIONS

BUILDING:
ENTITY:
STUDY PERIOD:

PAGE: OF
GPF DATE:

OFC NXX	LM OR LCM	# SPEECH LINKS	HOST MS DEMAND	# LM OR LCM	(1) # LINES EQUIPPED	% ADM. SPARE	(2) # LINES OPERATIVE	MS PER LINE RATIO	(3) MS CAPACITY	(4) % UTIL.

(1) Each LM and LCM has a physical capacity of 640 main stations. The number of lines equipped equal 640 X the number of LM(LCM). Due to line card deferral, the full 640 lines may not be equipped at once; therefore, the number of lines equipped value may be less.
(2) Number of lines Operative = Number of lines Equipped(100% - % Adm Spare)
(3) MS Capacity = Number of Lines Operative X MS per Line Ratio
(4) % Utilization = Host MS Demand / MS Capacity

Figure 4. Host Switch-LM & LCM Worksheet-Line Terminations

DMS - 100/200 SWITCH MAIN STATION CAPACITY
HOST SWITCH - LM & LCM WORKSHEET
CCS CAPACITY

BUILDING:
ENTITY:
STUDY PERIOD:

PAGE: OF
GPF DATE:

OFC NXX	LM OR LCM	# SPEECH LINKS	HOST MS DEMAND	# LM OR LCM	ENG CRITERIA	(1) ENG CCS/LM	(2)BLKNG OR NON BLKNG LGC	(3) ENG CCS/LCM	CCS (4) CAPACITY FOR LM	CCS(5) CAPACITY FOR LCM	CCS(6)(7) CAPACITY FOR HOST	0 + T CCS/MS	MS (8) CAPACITY FOR HOST	(9) % UTIL

(1) Refer to NTP 297-1001-450, Section 450/2, Table G
(2) A blocking LGC has a greater number of peripheral channels than network channels
(3) Refer to NTP 297-1001-450, Section 450/2, Table S for non-blocking LGC, Table T for blocking LGC
(4) CCS Capacity for LM = Number of LM X Engineered CCS/LM
(5) CCS Capacity for LCM = Number of LCM X Engineered CCS/LCM
(6) Add CCS Capacity for all LMs and LCMs in Host.
(7) CCS Capacity for Host = CCS Capacity for LM + CCS Capacity for LCM.
(8) MS Capacity for Host = (CCS Capacity for Host) / (0 + T CCS/MS)
(9) % Utilization = (Host MS Demand) / (MS Capacity for Host).

Figure 5. Host Switch-LM & LCM Worksheet-CCS Capacity

DMS - 100/200 SWITCH MAIN STATION CAPACITY
REMOTE LINE MODULES WORKSHEET
LINE TERMINATIONS

BUILDING:
ENTITY: PAGE: OF
STUDY PERIOD: GPF DATE:

SITE	# RLM BAYS	# DS-1 LINKS PER BAY	#INTRA LINKS PER BAY	#INTER LINKS PER BAY	% INTRA TRAFFIC	RLM MS DEMAND	# LINES EQUIPPED	% ADM SPARE	#LINES(1) OPERATIVE	MS/LINE RATIO	MS(2) CAPACITY	%(3) UTIL

(1) Number of Lines Operative = Number of Lines Equipped(100% - % Adm. Spare)
(2) MS Capacity = Number of Lines Operative X (MS / Line Ratio)
(3) % Utilization = RLM MS Demand / MS Capacity. Use the MS capacity that was figured in Note 2.

Figure 6. Remote Line Modules Worksheet-Line Terminations

DMS - 100/200 SWITCH MAIN STATION CAPACITY
REMOTE LINE MODULES WORKSHEET
CCS CAPACITY

BUILDING:
ENTITY:
STUDY PERIOD:

PAGE: OF
GPF DATE:

SITE	# RLM BAYS	# DS-1 LINKS PER BAY	#INTRA LINKS PER BAY	#INTER LINKS PER BAY	% INTRA TRAFFIC	RLM MS DEMAND	ENG CRIT	ENG (1) CCS/BAY	CCS (2) CAPACITY	0 + T CCS/MS	MS (3) CAPACITY	% (4) UTIL

(1) Refer to NTP 297-1001-450, Section 450/312, Tables 1, 2, and 3.
(2) CCS Capacity = Number of RLM Bays / Engineered CCS / Bay
(3) MS Capacity = CCS Capacity / (0 + T CCS / MS)
(4) % Utilization = RLM MS Demand / MS Capacity. Use the MS capacity that was figured in Note 6.

Figure 7. Remote Line Modules Worksheet-CCS Capacity

DMS - 100/200 SWITCH MAIN STATION CAPACITY
SERVICE CIRCUITS AND MISCELLANEOUS

BUILDING:
ENTITY: PAGE:
STUDY PERIOD: GPF DATE:

		SERVICE CIRCUIT				
		MF RECEIVERS	DIGITONE RECEIVERS	3 PORT CONFERENCE	RECEIVER OFF-HOOK TONE	ANNOUNCEMENTS
CIRCUITS PER PACK		4	4	2	2	
CIRCUITS PROVIDED	TOTAL					
	TRAFFIC					
ENGINEERING CRIT.						
BROADCAST CONNECT.						
TABLE		POISSON TABLE			M	M
PEAK FACTOR						
CCS CAPACITY PROV.						
COMPONENT MAIN STATION DEMAND	MS					
	TRK					
BUSY HOUR FACTOR						
HOLDING TIME						
BUSY HOUR CALLS/MS						
BUSY HOUR CCS/MS						
MAIN STA. CAP.(1)						
% UTILIZATION (2)						

(1) Main Station Capacity = CCS Capacity Provided/CCS/MS Busy Hour
(2) % Utilization = Component Main Station Demand/MS Capacity

Figure 8. Service Circuits and Miscellaneous

DMS - 100/200 SWITCH MAIN STATION CAPACITY
DRAMS

BUILDING:
ENTITY:
STUDY PERIOD:

PAGE: OF
GPF DATE:

DRAM	PORTS(1) DELOADED IN TIME SWITCH	(2) MAXIMUM CHANNELS	ENGR CRITERIA	(3) TABLE	ENGR CCS CAPACITY	COMPONENT MS DEMAND	BUSY HOUR FACTOR	HOLDING TIME	BUSY HOUR		(4) MS CAPACITY	(5) UTIL
									CALLS/MS TOT.CHAN	CCS/MS TOT.CHAN		

(1) Deloading Ports in a Time Switch that serves a DRAM will Increase the DRAM capacity. Refer to NTP 297-1001-450, Section 450/2. Tables Q and R.
(2) Maximum Channels = The number of digital broadcast announcement channels. This value will be 8, 16, 24, or 30 channels depending on the number of announcements per DRAM(one channel per announcement).
(3) This column will contain either a Q or an R depending on which table is used.
(4) MS Capacity = Engineered CCS Capacity / (CCS/MS total channels)
(5) % Utilization = Component MS Demand / MS Capacity

Figure 9. Main Station Capacity DRAMS Worksheet