
Meridian 1

Meridian Link / Customer Controlled Routing

Engineering Guide

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About this guide

This guide is intended for the person who plans or supervises the engineering of the system. If you are this person, the guide provides information and procedures so that you can plan for the engineering and can understand what is required.

The term “Meridian 1” is used throughout this document, and refers to Meridian 1 and “Meridian 1-ready” systems (such as Meridian SL-1 style cabinets that have been upgraded). See the *Meridian Link /Customer Controlled Routing Installation and Upgrade Guide (553-3202-210)* for further information on application requirements.

The name “Meridian Link” applies to two objects in this guide. For easier reading:

- Meridian Link, the application, is referred to as “the Meridian Link application”. Applications based on, or designed to work with, the Meridian Link application are referred to as “Meridian Link-based applications”.
- Meridian Link, the data link, is referred to as “the Meridian Link”.

What is engineering?

The term “engineering” applies to the procedures needed to be performed to answer the following types of questions:

- If I install a call center, what size Meridian 1 do I need?
- How many additional calls can I add to my Meridian 1 before it needs to be upgraded?
- Can I add CCR to my Meridian Link system without upgrading it?

- When I install the Meridian Link application, what speed should I set the host link to?
- I want to add a complicated call script. Will my system be able to handle it?

This guide provides procedures to enable you to find answers to these and similar questions.

Determining the skills required to engineer the system

In planning to engineer a Meridian 1 system for the Meridian Link application or the Customer Controlled Routing (CCR) application, or both, you should ensure that you have the following skills and experience:

- a basic knowledge of call center functionality
- an understanding of the Meridian Link or CCR application, or both, as required for your operation
- an understanding of traffic engineering
- a knowledge of Meridian Configurator and how to use it

In addition, you should have completed the 275 Meridian 1 System Engineering course (in the United States, or the equivalent in other countries).

References

The following Northern Telecom Publications (NTPs) may be of assistance when using this document.

- *Application Equipment Module Installation Guide* (553-3201-200)
- *Meridian Link /Customer Controlled Routing Installation and Upgrade Guide* (553-3202-210)
- *Customer Controlled Routing User Guide* (P0747008)
- *Meridian Configurator User's Guide* (004-0021-315)
- *Meridian 1 System Planning and Engineering Guide* (P0744197)

Determining the performance requirements of the customer

If you are planning to add Meridian Link to your Meridian 1 system, you must consider some of the ramifications, such as the following:

- Can the Meridian 1 handle the extra traffic load?
- You will (presumably) be increasing the load on your Meridian 1. Can it handle the added load? If not, what size of Meridian 1 should you upgrade to?
- If you are adding features such as Host Enhanced Routing, how will this affect the load on the Meridian 1?
- If you are adding voice processing, how many Meridian Mail ports do you need?
- If you already have CCR, can the Meridian Link application co-reside with CCR? Do you need to add an Intelligent Peripheral Equipment (IPE) Module or an Application Module?
- You will be adding a link to a host computer. What data rate should the host link be set to?

If you are planning to add CCR to your Meridian 1 system, some of the things you must consider are:

- Can the Meridian 1 handle the extra traffic load?
- Will using complicated scripts affect the ability of the Meridian 1 system to handle the load?
- If you already have Meridian Link, can CCR co-reside with the Meridian Link application?

2 Determining the performance requirements of the customer

To help you focus on these considerations, and to enable you to prepare for engineering, this chapter provides lists of basic information about your system as it is and as you intend it to be.

In planning for the engineering, you should answer the questions on the blank lines provided in the checklist and use the checklist to engineer the system.

Type of call-center or call-processing operation

Describe what type of call-center or call-processing operations are to be performed using your Meridian 1 system (for example, incoming calls using Host Enhanced Routing and predictive dialing).

Applications

List the applications currently available on your system and the applications you plan to add (for example, MAX, Meridian Link, CCR, third-party VRU).

Current applications in use

- _____
- _____
- _____
- _____

Applications to be added

- _____
- _____
- _____

Equipment

List the equipment currently installed on the premises and the equipment you plan to add (for example, Meridian Link, CCR, third-party autodialers).

Equipment currently installed

- _____
- _____
- _____

Equipment to be added

- _____
- _____
- _____

Capacity of the equipment

List the calling rates (calls per hour) of the equipment currently installed on your system and the capacity you expect when the planned applications and equipment have been installed. Refer to the “Engineering Meridian Link and CCR applications” chapter for more information.

Current calling rates (calls per hour)

- _____

Proposed calling rates

- _____

Specific requirements

List the objectives you intend to achieve by adding Meridian Link or CCR or both to your system.

- _____
- _____
- _____

Engineering Meridian Link and CCR applications

In engineering a Meridian 1 system for the Meridian Link or CCR application, you are basically finding the answers to four questions:

- Does the Meridian 1 system have enough capacity to be able to handle the traffic added by the new application or which Meridian 1 option best meets the requirements?

To be able to answer this question you must know or calculate the current spare capacity and the capacity required to handle the added traffic.

- How many additional music and recorded announcement (RAN) ports are required?

Both CCR and the Meridian Link application require music ports but only CCR requires RAN ports.

- How many additional Meridian Mail ports are required to handle related Interactive Voice Response (IVR) or Host Enhanced Voice Processing (HEVP) applications?

Meridian Mail ports may be required for the Hold-in-Queue-for-IVR feature of CCR or for the HEVP feature of the Meridian Link application.

- What data rate is required for the data link between the Meridian Link module and the host computer (the Host Link or Meridian Link)? (Note that the AML is set to 19.2 kbps for both Meridian Link and CCR.)

This chapter provides procedures to enable you to answer these questions. For more information about engineering a Meridian 1 system, refer to *Meridian 1 System Planning and Engineering Guide* (P0744197).

Engineering the Meridian 1 capacity

The *call capacity* of a Meridian 1 system is the maximum number of calls that the system can handle in one hour. The *rated capacity* is the number of calls the system can handle in 0.7 hours (2520 seconds). The rated capacity leaves a reserve of 30% to accommodate peaks in the traffic during the busiest hour (so that the service will not deteriorate during these peaks).

The rated capacity depends on the type of CPU (NT, XT, Option 11, Option 81, and so on), and the types and numbers of features installed. However, if you know the rated capacity for one type of system, you can easily find the rated capacity of another type of system with the same configuration of features. This is useful, for example, if the Meridian Configurator does not compute the capacity for your CPU type.

For the same configuration of features, and with an Option 81 CPU having a relative rated capacity of 1, Table 1 shows the relative rated capacities of other CPUs. (Note that Table 1 assumes that all CPUs are using the same release of software.)

Table 1
Relative real-time capacity

| Meridian 1 system | Relative real-time capacity |
|-----------------------------|-----------------------------|
| Option 81 | 1 |
| Option 71 (Omega CPU) | .47 |
| Option 61c | 1 |
| Option 51/61/81 (Omega CPU) | .47 |
| Option 21E (Storme CPU) | .38 |
| Option 21 (Gemini CPU) | .12 |
| XT/NT (Omega CPU) | .47 |
| ST (Gemini CPU) | .12 |
| Option 11E | .18 |

So, for example, if you know that the rated capacity of an Option 81 system with a certain configuration of features is 30,000 calls per hour, you can calculate that the rated capacity of an NT system with the same configuration is $(30,000 \times 0.47)$ or 14,100 calls per hour.

The capacity is usually expressed in terms of *Equivalent Basic Calls* (EBC) per busy hour. An EBC is an internal, unfeatured call from one 2500 telephone set to another, and represents the simplest type of call in regard to call set-up and tear-down.

Determining the Meridian 1 capacity

The following procedure describes how to use the Meridian Configurator to calculate the real-time capacity of your Meridian 1 system. If the Meridian Configurator does not handle your processor type (for example, if you have an NT or XT processor), calculate the capacity of an Option 81 system with the same configuration as yours, and then use the relative real-time capacity from Table 1 to calculate the capacity of your system.

If you cannot use the Meridian Configurator, or if it is not supported in your market, refer to Appendix A, which contains a Quick Guide, or Appendix B, which contains manual procedures for calculating the Meridian 1 real-time capacity. You should be aware that Appendix A is the least accurate method for determining Meridian 1 capacity, and that the formulas used in Appendix B are simpler than those used by the Meridian Configurator and consequently provide results that are not as accurate as the results provided by the Meridian Configurator.

This procedure assumes that you know how to use the Meridian Configurator. Refer to the Meridian Configurator User Guide for the identity of each input field.

- 1 Enter the type and number of lines, the expected holding times, and the traffic in centicall-seconds (CCS).
- 2 To account for real-time impact, enter the type and number of trunks, the expected holding times and the CCS.
- 3 Enter all software options to be configured, including Meridian Mail.

- 4** Enter:

 - the numbers of ACD agents and trunks.
 - the number of RAN trunks and music ports
 - the number of local ACD agents receiving inbound calls that are queued to local ACD DNs
 - CCS
 - holding times
 - average seconds to answer
- 5** Enter the number of ACD and non-ACD lines to be assigned as associate sets (AST). This number includes:

 - Any ACD agent lines for which the Meridian Link application will report call information (such as ANI/CLID or DNIS information on incoming calls).
 - Any lines connected to IVR, Voice Response Unit (VRU), or autodialer ports.
 - Any non-ACD set to be controlled or monitored by the Meridian Link application
- 6** Enter the percentage of lines to be assigned as AST that will be configured for Meridian Link status messages. This includes non-ACD sets to be controlled by the Meridian Link application.
- 7** Enter the percentage of incoming calls to be routed by an application using CCR or Host Enhanced Routing on the Meridian Link application. This includes any ACD or non-ACD calls to receive routing treatment. It does not include incoming traffic terminated normally.
- 8** Enter the number of ACD agents placing outbound calls by previewing customer telephone numbers using a Meridian Link-based application. Enter CCS and holding times.
- 9** Enter the number of ACD agents placing outbound calls using a Meridian Link-based application with third-party autodialers. Enter CCS and holding times.

- 10** Enter the number of autodialing ports associated with a Meridian Link-based predictive-dialing application. A predictive-dialing application predicts when an agent will become available and makes a call based on that prediction. Enter also the CCS, holding time, and the percentage of calls that will be transferred.
- 11** Enter the number of third-party voice-response ports that will receive inbound ACD calls. Enter the CCS, holding time, and percentage of calls to be transferred to a live agent. These numbers should be entered even if the voice ports will not be controlled by a CCR-based or Meridian Link-based application.
- 12** Enter the number of Meridian Mail ports required to support a Meridian Link-based application using HEVP. HEVP allows a host-computer application to answer a call and prompt the caller to enter information.

Table 2
Meridian 1 capacity worksheet

| | | |
|---|---|--|
| 1 | Number of lines | |
| | Type of line | |
| | Expected holding time | |
| | Traffic (CCS) | |
| 2 | Number of trunks | |
| | Type of trunk | |
| | Traffic (CCS) | |
| 3 | Software options to be configured <ul style="list-style-type: none"> • _____ • _____ • _____ • _____ | |
| 4 | Number of ACD agents | |
| | Number of trunks | |
| | Number of RAN trunks | |
| | Number of music ports | |
| | Number of local ACD agents receiving inbound calls queued to local ACD DN | |
| | Traffic (CCS) | |
| | Holding time | |
| | Average time to answer (seconds) | |
| 5 | Lines to be assigned as AST | |
| 6 | Percentage of AST lines (item 5) to be configured for Meridian Link status messages | |

Table 2
Meridian 1 capacity worksheet, continued

| | | |
|----|---|--|
| 7 | Percentage of incoming calls to be routed by an application using CCR or HER on Meridian Link (does not include incoming traffic terminated normally) | |
| 8 | Number of ACD agents placing outbound calls by previewing customer telephone numbers using a Meridian Link-based application | |
| | Traffic (CCS) | |
| | Holding time | |
| 9 | Number of ACD agents placing outbound calls using a Meridian Link-based application with third party autodialers | |
| | Traffic (CCS) | |
| | Holding time | |
| 10 | Number of autodialing ports associated with a Meridian Link-based predictive-dialing application | |
| | Traffic (CCS) | |
| | Holding time | |
| | Percentage of calls that will be transferred | |
| 11 | Number of third party voice-response ports that will receive inbound calls | |
| | Traffic (CCS) | |
| | Holding time | |
| | Percentage of calls that will be transferred to a live agent | |
| 12 | Number of Meridian Mail ports required for a Meridian Link-based application using HEVP | |

Engineering Meridian Mail and IVR ports

CCR and the Meridian Link application both provide access to voice prompting and processing. CCR has a Hold-In-Queue-for-IVR feature that enables calls to be held in a queue for subsequent access to interactive voice processing. The Meridian Link application has a Host Enhanced Voice Processing (HEVP) option that allows a host-computer application to use voice prompting and processing.

Determining Meridian Mail port requirements for Hold in Queue for IVR

- 1 Using the number of calls for the busiest hour of the year, estimate the number that will receive voice processing. For example, if a call center receives 5000 calls, half of which require voice processing, this number will be 2500.
- 2 Estimate the average holding time for the calls that will receive voice processing for the busiest hour of the year.
- 3 Calculate the total traffic in CCS.
$$\text{CCS} = \text{calls receiving voice processing} \times \text{holding time}/100$$

For example, if a call center receives 2500 calls requiring voice processing, and the average holding time before the call transfers to an agent is 40 seconds, the $\text{CCS} = (2500 \times 40)/100 = 1000$.
- 4 Determine the maximum traffic already on the Meridian Mail system during the busiest hour. (Use Meridian MAX reports on traffic through Meridian Mail agents or the Meridian Mail Voice Service Summary Report).
- 5 Determine the traffic from both voice messaging and call center at the call center busiest hour.
- 6 If the busiest hour for the call center differs from that for Meridian Mail, estimate the traffic from the call center for Meridian Mail's busiest hour. Then estimate the combined traffic on Meridian Mail.
- 7 Using the greater of the results from steps 5 and 6, use Table 4 to estimate the number of ports required. Subtract the number of ports already installed to obtain the number of additional ports required.

Table 3
Worksheet for determining Meridian Mail ports for Hold in Queue for IVR

| | | |
|---|---|-----|
| 1 | Number of calls receiving voice processing in the call center's busiest hour | (a) |
| 2 | Average holding time for calls in step 1 | (b) |
| 3 | Traffic (CCS) = (a) x (b) / 100 | (c) |
| 4 | Existing Meridian Mail traffic during call center busiest hour | (d) |
| 5 | Total traffic = (c) + (d) | (e) |
| 6 | If the busiest hour for the call center is different from the busiest hour for Meridian Mail, repeat steps 1–5 for the Meridian Mail busiest hour. Total traffic | (f) |
| 7 | Using the greater of (e) and (f), find the number of ports in Table 4. Required ports | (g) |
| 8 | Existing ports Additional ports = (g) - (h) | (h) |

Table 4
Calculating number of ports

| Traffic in CCS | Number of ports |
|----------------|-----------------|
| 54-156 | 4 |
| 157-272 | 8 |
| 273-521 | 12 |
| 522-650 | 20 |
| 651-781 | 24 |
| 782-914 | 28 |
| 915-1048 | 32 |
| 1049-1182 | 36 |
| 1183-1317 | 40 |
| 1318-1454 | 44 |
| 1455-1592 | 48 |
| 1593-1730 | 52 |
| 1731-1868 | 56 |
| 1869-2007 | 60 |
| 2008 | 64 |

For example, if the CCS for calls requiring voice processing in a call center is 1000, the number of ports required (from Table 4) is 32.

You can use this number when engineering the Meridian 1 real-time capacity. Refer to “Engineering the Meridian 1 capacity” earlier in this chapter.

N Meridian Link HEVP processing is currently limited to a maximum of 48 voice ports, so traffic CCS figures for more than 48 ports implies a mix of voice port usage (probably including normal

16 Engineering Meridian Link and CCR applications

Meridian Mail mailbox use and IVR sessions in addition to Meridian Link HEVP).

Determining Meridian Mail port requirements for HEVP

- 1 Using the number of calls for the busiest hour of the year, estimate the number that will receive HEVP treatment. For example, if a call center receives 5000 calls, half of which require HEVP treatment, this number will be 2500.
- 2 Estimate the average holding time for the calls that will receive HEVP treatment for the busiest hour of the year.
- 3 Calculate the total traffic in CCS.

$$\text{CCS} = \text{calls receiving HEVP treatment} \times \text{holding time} / 100$$

For example, if a call center receives 2500 calls requiring HEVP treatment and the average holding time before the call transfers to an agent is 40 seconds, the $\text{CCS} = (2500 \times 40) / 100 = 1000$.
- 4 If your system intends to use Meridian Mail or the Meridian IVR feature, use Table 4 (earlier in this chapter) to determine the number of ports required.

Table 5
Worksheet for determining Meridian Mail ports for HEVP

| | | |
|---|--|-----|
| 1 | Number of calls receiving HEVP treatment in the busiest hour | (a) |
| 2 | Average holding time | (b) |
| 3 | Traffic (CCS) = (a) x (b) / 100 | (c) |
| 4 | From Table 4, find the number of ports required | |
| | Ports required | (d) |
| | Existing ports | (e) |
| | Additional ports = (d) - (e) | |

Engineering the Meridian Link and the AML

Using the Meridian Link application, the Meridian 1 system exchanges messages with the host computer. These messages travel across the Meridian Link (link 1, between the host computer and the IPE Module or the Application Module and the AML (link 0, between the Application Module or IPE Module and the Meridian 1 system). In relation to the Meridian Link application, for every message on the AML there is a corresponding message on the Meridian Link (which has additional messages if HEVP is used).

Determining the link data rate

CCR systems use only one link, the AML (link 0). Set the data rate of the AML to the default value of 19,200 bps.

In Meridian Link systems, both links should be set to the same baud rate. You should set the data rate for the Meridian Link (link 1) to the default value of 19,200 bps unless the default value cannot be used (for example, if the host computer or LAN server cannot operate at that rate). In that case, use the following procedure to estimate the lowest acceptable data rate for the link. Then set the data rate of the AML to the same value.

The following procedure involves making estimates for the busiest hour of the year. You may find unusual results. For example, during the busiest hour, agents may be exceptionally busy handling incoming calls and so the number of predictive or preview calls may be much lower than during non-busy hours.

N The following procedure assumes that the effect of status change messages is negligible. You can eliminate unnecessary status change messages by setting up IAPGs.

e

:

For the busiest hour of the year:

- 1 Estimate the number of incoming calls terminating directly on ACD and non-ACD lines that will be assigned the AST attribute.

For example, in a Meridian 1 with 500 ACD agents and 100 Voice Response ports arranged as ACD associated sets, 11,000 calls might directly reach AST-configured ACD agents and sets during the busiest hour of the year.

- 2** Estimate the number of the above incoming calls that will be subsequently transferred to another agent under the control of the Meridian Link-based application.

For example, in the above example, 1500 out of 3,000 calls terminating on the above 100 voice ports may be subsequently transferred to live agents.
- 3** Estimate the number of outbound calls originated by ACD agents using a preview dialing application based on Meridian Link.

For example, a 20-agent group might generate 400 calls in the busiest hour.
- 4** Estimate the number of inbound calls to be routed to Meridian Mail ports for treatment by an application based on Meridian Link HEVP.

For example, if one third of all incoming calls received in a system handling 1,200 busy hour incoming calls were routed for host-enhanced voice response, this number would be 400 calls.
- 5** Estimate the number of inbound calls to receive routing treatment by means of an application based on Meridian Link HER.

For example, if in a large Call Center 50% of the 7,000 incoming calls in the busiest hour receive host routing, this number would be 3,500 calls.
- 6** Estimate the number of predictive dial calls to be originated on behalf of ACD or non-ACD agents using a predictive dialing application based on Meridian Link.

For example, 20 Autodialers might generate 1,000 calls in the busiest hour.
- 7** Estimate the number of calls to be transferred for a large HEVP application. For example, a 20-port HEVP application might result in 2,000 transfers in the busiest hour. (Normally, other activities such as conference initiation or agent ready/not-ready activation can be ignored.)

N You are trying to estimate the busiest anticipated hour. In some instances, all agents might be handling just incoming calls during the busiest hour and thus the number of preview or predictive dial calls in

the busiest hour would be smaller than expected in non-busy hours.
:

- 8 Add up the numbers calculated in steps 1 through 7 above and select a data rate that handles at least that number of calls in the busy hour from Table 7.

Table 6
Worksheet for determining the link data rate

| | | |
|---|---|-----|
| 1 | Number of incoming calls terminating on AST lines | (a) |
| 2 | Number of incoming calls from step 1 that will be transferred to another agent by the Meridian Link-based application | (b) |
| 3 | Number of outgoing calls from ACD agents using preview dialing | (c) |
| 4 | Number of incoming calls to be routed to Meridian Mail calls for HEVP treatment | (d) |
| 5 | Number of incoming calls to receive HER treatment | (e) |
| 6 | Number of predictive dial calls | (f) |
| 7 | Number of calls to be transferred for a large HEVP application | (g) |
| 8 | Add (a) through (g). Use Table 7 to select the appropriate link data rate | (h) |

N Use this procedure *only* if the default data rate cannot be used because, for example, the modems cannot support that speed).

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Table 7
Link data rates and capacity

| Maximum call load (calls/hour) | Link data rate |
|--------------------------------|----------------|
| 12,331–24,660 | 19,200 |
| 6,116–12,330 | 9,600 |

| | |
|-------------|-------|
| 3,058–6,115 | 4,800 |
| 1,542–3,057 | 2,400 |
| 1,528 | 1,200 |

22 Engineering Meridian Link and CCR applications

For example, if a system handles the following busy hour calls:

| | |
|--------------------------------|-------------|
| Incoming ACD calls | 3500 |
| Subsequently transferred calls | 500 |
| Preview-dialed calls | 1000 |
| Transferred calls | 2000 |
| HER calls | 2000 |
| Predictive-dialed calls | 200 |
| HEVP calls | <u>1000</u> |
| TOTAL | 10200 |

The total number of busy hour calls is 10,200, which requires a 9600 bps connection to the host, as indicated in Table 7.

Engineering the IPE Module and the Application Module

N For detailed information on engineering CCR, refer to Appendix C.

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In engineering the IPE Module and Application Module for Meridian Link and CCR, you are finding the answer to one or more of the following:

- For an existing IPE Module or Application Module with Meridian Link, can I add CCR? Or do I need to upgrade the module or add another IPE Module or Application Module?
- For an existing IPE Module or Application Module with CCR, can I add Meridian Link? Or do I need to upgrade the IPE Module or Application Module or add another IPE Module or Application Module?
- If I want to add Meridian Link or CCR or both to my Meridian 1 system, do I need an Application Module or an IPE Module? Do I need one, or more than one?

Calculating modules required

The following procedure describes how you can use the Meridian Configurator to calculate the capacity you require and determine the type and number of the modules needed to handle that capacity. Refer to the Meridian Configurator User Guide for the identity of each input field.

If you cannot use the Meridian Configurator, or if it is not supported in your market, use the manual procedure that follows this procedure.

N New Application Modules are shipped with the MVME167

•ard. Co-residency is supported only on an IPE Module or an MVME167-equipped Application Module. Customers cannot order MVME147-equipped Application Modules.

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For the busiest hour of the year:

- 1** Enter the estimated number of inbound calls terminating directly at ACD agents or non-ACD sets at which Meridian Link alerts computer applications of such calls. Such calls should include calls terminating directly at third-party voice-response ports controlled by a Meridian Link application.

Enter the estimated number of such inbound calls that are subsequently transferred to another agent under the control of a Meridian Link-based application. A scenario might involve calls terminating at third-party voice-response ports controlled by the application and subsequently transferred to live agents.
- 2** Enter the estimated number of outbound calls originated by ACD agents using a preview dialing application based on Meridian Link.
- 3** Enter the estimated number of predictive dial calls to be originated on behalf of ACD or non-ACD agents using a predictive dialing application based on Meridian Link.
- 4** Estimate the number of calls to be transferred for a large HEVP application.
- 5** Enter the estimated number of inbound calls to receive routing treatment by means of an application based on Meridian Link HER.
- 6** Enter the estimated number of inbound calls to be routed to Meridian Mail ports for treatment by an application based on Meridian Link HEVP.
- 7** Enter the estimated number of calls that will receive basic CCR treatment (that is, they will require less than five messages per call—to find out how to calculate the number of messages per call, see the description later in this chapter). Examples of this type of call are provided in the following sections.
- 8** Enter the estimated number of calls that will receive typical CCR treatment (that is, they will require less than ten messages per call—to find out how to calculate the number of messages per call, see the description later in this chapter). Examples of this type of call are provided in the following sections.

- 9 Enter the estimated number of calls that will receive complex CCR treatment (that is, they will require about twenty messages per call—to find out how to calculate the number of messages per call, see the description later in this chapter). Examples of this type of call are provided in the following sections.
- 10 Enter the total number of ACD DN's for which the Meridian 1 system will provide statistics to CCR.

Table 8
Worksheet for engineering the IPE Module and Application Module

| | | |
|----|--|--|
| 1 | Number of incoming calls terminating directly at ACD agents or non-ACD sets at which Meridian Link alerts applications | |
| | Number of such calls that are transferred to another agent by a Meridian Link-based application | |
| 2 | Number of outgoing calls originated by ACD agents using preview dialing | |
| 3 | Number of predictive dial calls originated by ACD or non-ACD agents | |
| 4 | Number of calls transferred for a large HEVP application | |
| 5 | Number of incoming calls to receive HER treatment | |
| 6 | Number of incoming calls to receive HEVP treatment | |
| 7* | Number of calls that will receive basic CCR treatment (10 or fewer messages per call) | |
| 8* | Number of calls that will receive typical CCR treatment (about 20 messages per call) | |
| 9* | Number of calls that will receive complex CCR treatment (30 or more messages per call) | |
| 10 | Number of ACD DN's providing statistics | |

* If you have a combination of scripts and have difficulty determining the type, you can make the assumption that they are typical scripts.

The Meridian Configurator will automatically determine how many modules will be required.

To manually determine what type and how many modules will be needed, follow the same steps as above but enter the information in the following worksheets.

Table 9
Meridian Link/CCR load worksheet

| Call Types | Calls | Load Factor | Weighted Load |
|--|-------|--|---------------|
| Inbound calls | | Calls x 1.0 | = |
| Subsequently transferred calls | | Calls x 1.0 | = |
| Outbound calls | | Calls x 1.0 | = |
| Preview dialed calls | | Calls x 1.0 | = |
| Predictive dialed calls | | Calls x 1.1 (successful call) Calls x 1.0 (unsuccessful call) | = |
| HER calls | | Calls x 1.1 | = |
| HEVP calls | | Calls x 1.4 | = |
| Meridian Link total | | | |
| Basic CCR calls* (10 messages/call) | | Calls x 1.0 + (90 x ACD DNs)** | = |
| Typical CCR calls* (20 messages/call) | | Calls x 2.0 + (45 x ACD DNs)** | = |
| Complex CCR calls* (30 messages/call) | | Calls x 3.0 + (30 x ACD DNs)** | = |
| Meridian CCR total | | | |
| Grand total (Meridian Link total plus Meridian CCR total) | | | |

* Refer to “Determining the complexity of CCR calls” later in this chapter.

30 Engineering the IPE Module and the Application Module

** “ACD DN’s” means the number of ACD DN’s with statistics.

Calculating modules required for co-residency

If the Grand Total is less than 10,000, Meridian Link and CCR can co-reside on an IPE Module or an MVME167-equipped Application Module.

If the Grand Total is less than 16,500, Meridian Link and CCR can co-reside on an IPE Module or an MVME167-equipped Application Module.

If the Grand Total is larger than 16,500 and the Meridian 1 can handle the call volumes, more than one module will be needed, and you will need separate modules for Meridian Link and CCR.

Calculating modules required for Meridian Link alone

If the Meridian Link total is less than 10,000, Meridian Link can operate on any dedicated IPE Module or Application Module.

If the Meridian Link total is less than 16,500, Meridian Link can operate on an IPE Module or a dedicated MVME167-equipped Application Module.

Calculating modules required for CCR alone

If the CCR total is less than 10,000, CCR can operate on a dedicated MVME147-equipped Application Module.

If the CCR total is less than 16,500, CCR can operate on an IPE Module or a dedicated MVME167-equipped Application Module.

Example calculation

Following is an example of filled-in worksheets for an inbound-outbound Meridian 1 call center with Meridian Link and CCR enabled:

Table 10
Meridian Link/CCR load worksheet (example)

| Call Types | Calls | Load Factor | Weighted Load |
|--|-------|------------------------------|---------------|
| Inbound calls | 2,700 | 2700 x 1.0 | = 2700 |
| Subsequently transferred calls | 300 | 300 x 1.0 | = 300 |
| Outbound calls | 500 | 500 x 1.0 | = 500 |
| Preview dialed calls | | x 1.0 | = |
| Predictive dialed calls | | x 1.1 | = |
| HER calls | | x 1.1 | = |
| HEVP calls | | x 1.4 | = |
| Meridian Link total | | | = 3500 |
| Basic CCR calls | | Calls x 1.0 + (90 x ACD DNs) | = |
| Typical CCR calls | 300 | 300 x 2.0 + (45 x 5) | = 825 |
| Complex CCR calls | | Calls x 3.0 + (30 x ACD DNs) | = |
| Meridian CCR total | | | = 825 |
| Grand total (Meridian Link total plus Meridian CCR total) | | | 4325 |

In this case, Meridian Link and CCR can be expected to comfortably co-reside on an IPE Module or an MVME167-equipped Application Module.

Determining the complexity of CCR scripts

The number of messages generated per call greatly affects the capacity of a CCR system. The number of messages can vary from as few as three to as many as 35.

Factors that influence the number of messages are:

- the number of paths through the script, and what happens on each path
- the length and structure of the script
- the way that the call ends

Procedure for systems not yet installed

In determining the complexity of a CCR call, use the following for systems not yet installed:

1. Use the most likely path to be taken by the average call handled by the script.
2. Analyze the path and calculate the number of messages generated by the commands, based on Table 11.
3. If the average call is answered or abandoned, add two messages for overhead. Alternatively, if the calls end in a Force Busy, Force Disconnect, or Route To command, add one message for overhead.

Basic calls have 10 messages or fewer. Typical calls have 11–25 messages. Complex calls have 26 messages or more.

Table 11
CCR commands and messages generated

| CCR Command | Number of Messages |
|-------------------------------|--------------------|
| GO TO <i>section</i> | 0 |
| WAIT <i>seconds</i> | 0 |
| SECTION <i>label</i> | 0 |
| QUIT | 0 |
| QUEUE TO <i>acd_dn</i> | 2 |
| REMOVE FROM <i>acd_dn</i> | 2 |
| ROUTE TO <i>dn</i> | 2 |
| FORCE BUSY | 2 |
| FORCE DISCONNECT | 2 |
| GIVE RINGBACK | 2 |
| GIVE SILENCE | 2 |
| GIVE MUSIC <i>music_route</i> | 2 |
| GIVE RAN <i>ran_route</i> | 3 |
| GIVE IVR <i>ivr_dn</i> | 3 |

N For answered and abandoned calls, add two messages for
 overhead.

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Basic CCR call script example

| Command | Messages |
|--------------------|----------|
| Queue to 8900 | 2 |
| Wait 20 | 0 |
| Give RAN RAN_Route | 3 |

| | |
|---------------------------|------------------|
| Give Music Easy_listening | <u>2</u> |
| | 7 + 2 (Overhead) |
| Total | 9 |

Typical script example

| Command | Messages |
|--|-------------------|
| Queue to Main_ACD with Priority 2 | 2 |
| Queue to Cust_svc with Priority 2 | 2 |
| Wait 10 | |
| | |
| Give RAN RAN_Rte | 3 |
| Give Music Music_Rte | 2 |
| | |
| Section Regular_Loop | |
| Wait 2 | |
| Goto Change_Priority If Age Of Call > 60 | |
| Goto Regular_Loop | |
| | |
| Section Change_Priority | |
| Give RAN Agents_Busy | 3 |
| Queue to Main_ACD with Priority 1 | 2 |
| Queue to Cust_ACD with Priority 1 | 2 |
| Queue to Supv_ACD with Priority 2 | 2 |
| Quit | |
| | 18 + 2 (Overhead) |
| | |
| Total | 20 |

Complex script example

| Command | Messages |
|---|-----------------|
| /* Check to see if the groups that can answer calls are in Night Service and disconnect the caller if they are */ | |
| | |
| Goto Night_Treatment If Night Service Main_ACD | |
| | |
| /* Check to see if there are already more than twice as many calls queued as there are agents logged in and force the caller to busy if this is true */ | |

— continued —

Complex script example, continued

| Command | Messages |
|---|-------------------|
| Force Busy if Total Queued Calls Main_ACD > (2 * Logged Agents Main_ACD) | |
| Give RAN announce | 3 |
| /* get account number */ | |
| Give IVR 2780 with Treatment 2653 | 3 |
| Give RAN second_msg | 3 |
| Give Music Music_Rte | 2 |
| Queue to Main_ACD with Priority 3 | 2 |
| Queue to Second_ACD with Priority 3 | 2 |
| Wait 10 | |
| Give RAN Agents_busy | 3 |
| Section Check_age | |
| Queue to Main_ACD with Priority 1 If Age Of Call > 120 | 2 |
| Queue to Second_ACD with Priority 1 If Age Of Call > 120 | 2 |
| Queue to Backup_group with Priority 1 If Age Of Call > 120 | 2 |
| Wait 20 | |
| Give RAN agents_still_busy | 3 |
| Goto Check_age | |
| /* This section is not added to the message count because this is a different call path */ | |
| Section Night_Treatment | |
| Give RAN closed | |
| Force Disconnect | |
| | 27 + 2 (Overhead) |
| Total | 29 |

Procedure for installed systems

Use the following for systems that have been installed (from which you have access to traffic reporting information).

- 1 From CCR traffic reports, determine the total number of calls and the number of calls that received particular treatments.

Following is an example of a traffic report for a script named SUPPORT.

Table 12
Traffic report example

| Script Name | No. of Calls | Treatment | Number Attempted |
|-------------|--------------|-----------|------------------|
| SUPPORT | 1202 | QUEUE TO | 1194 |
| | | QUIT | 1194 |
| | | WAIT | 1194 |
| | | ABANDONED | 1185 |
| | | RINGBACK | 1202 |

In this example:

- The total number of calls is 1202.
- 1194 calls received QUEUE TO, QUIT, and WAIT treatments.
- 1185 calls were abandoned.
- 1202 calls received ringback.

- 2 Using Table 11, calculate the number of messages generated by each treatment.

In the example:

1194 QUEUE TO treatments x 2 = 2388 messages

1194 QUIT treatments x 0 = 0 messages

1194 WAIT treatments x 0 = 0 messages

1184 ABANDONED overhead x 2 = 2368 messages

1202 RINGBACK treatments x 2 = 2404 messages

Total = 7160 messages

- 3 Calculate the total number of messages and divide by the total number of calls to obtain the number of messages per call. Then, using Table 13, determine whether the script is basic, typical, or complex.

Table 13
Determining the complexity of a script

| Messages per call | Type of script |
|-------------------|----------------|
| 10 | Basic |
| 11–29 | Typical |
| 30 | Complex |

In the example:

• Total number of messages = 7160

• Total number of calls = 1202

So messages per call = 7160 / 1202

= 5.96

Therefore, the script is basic.

Tips to assist CCR engineering

This section provides tips that can help you to reduce the demand at peak periods and can help you to improve the efficiency of scripts.

Tips to reduce the demand at peak periods

- Schedule maintenance activities for periods of low traffic.
- Schedule midnight routines (for example, backups) to periods of low traffic.
- Perform manual backups during periods of low traffic.
- Perform modem activity during periods of low traffic.
- Schedule CCR module midnight activities at different times from the Meridian 1 midnight activities.
- Schedule CCR module midnight activities (including scheduled backups) at least one hour before or after midnight. During midnight activities, the CCR module processor is synchronized to the Meridian 1 system. If the Meridian 1 clock is slow, and the clock synchronization is done when the CCR module clock is just past midnight, the CCR module clock may be set back to the previous day, causing midnight routines to be executed twice.
- When the clock needs to be changed backwards (for example, when changing from Daylight Savings Time to Standard Time), schedule this activity so that the day remains the same. In other words, do not around midnight.

Script writing tips

- You can improve the capacity of the CCR system by limiting the number of ACD DN's for which the Meridian 1 system sends statistics to CCR. Check all ACD variables in the Variable Table and discard any that are not used by any script.
- Delete all WAIT commands that directly precede a QUIT command. For example, by deleting the WAIT statement in the following command sequence, you reduce the waiting time while maintaining the effect.

```
GIVE RAN ran_route
WAIT 20
QUIT
```

- Avoid starting scripts with a sequence of commands that have no waiting time. Such a command sequence causes a burst of messages for every new call. For example, a script starting with the following command sequence

```
QUEUE TO 8900
QUEUE TO 8901
QUEUE TO 8902
QUEUE TO 8903
GIVE RAN ran_route
```

can be very inefficient if calls find an idle agent at ACD 8900. The QUEUE TO commands for 8901, 8902, and 8903 may execute and generate unneeded messages before the Meridian 1 system can indicate that the call has been presented to ACD 8900.

Breaking up the sequence of QUEUE TO commands by adding WAIT commands makes the sequence more efficient.

```
QUEUE TO 8900
WAIT 2
QUEUE TO 8901
WAIT 2
QUEUE TO 8902
WAIT 2
QUEUE TO 8903
GIVE RAN ran_route
```

However, this solution increases the execution time of the script, and may not be acceptable in some circumstances. An alternative solution may be to make the second QUEUE TO command conditional.

```
QUEUE TO 8900
QUEUE TO 8901 IF (Idle Agents 8900 = 0)
.
.
.
GIVE RAN ran_route
```

Summary

The method you should use to analyze a script is as follows:

- 1 Identify the call types of the script.
- 2 Analyze the call types and create a table showing the execution time and messages created by each command, and the overhead messages created by the call type. Refer to Tables 15 and 16 for examples.
- 3 Create a spreadsheet for the script using average times and percentages of the total calls for each call type, and use the spreadsheet to calculate the average number of messages per call for the script. Refer to Tables 18, 19 and 20 for examples.
- 4 Use the average number of messages per call to estimate the capacity of the CCR module from Figure 2 or 3, depending on the type of SBC card.

Detecting and resolving performance problems

CPU capacity

The majority of switch performance problems can be traced back to an overloaded CPU or to a data link speed that is insufficient to handle the Meridian Link or CCR connection. Use the available standard traffic reports to:

- help determine whether the switch CPU is operating within its rated capacity. If the switch is being operated above its rated capacity, it should either be upgraded with a faster CPU or some of the traffic or features should be off-loaded to another switch.
- help determine whether the AML or Meridian Link data rate is adequate for the number of messages sent over the AML to the module. There are also similar reports on the module.

Use LD 2 or Overlay 2 to schedule traffic report 8. Report 8 can be printed periodically, typically every half hour or every hour. The report contains a count of the number of messages sent and received. Use the TFS traffic reports to get information on system counters and the TFC reports for customer-specific data. NTP 553-2001-450 contains a detailed description of each traffic report.

Assuming an average message size of 30 bytes, you can estimate the occupancy of the link. For example, suppose the traffic report indicates that the Meridian 1 sent 1000 messages and received 1500 messages during a particular busy half hour period. Because the link is 19,200 bps full duplex, use the larger number, which in this case is 1500 messages per half-hour. Dividing 1500 messages per half-hour by 30 minutes indicates that 50 messages were transmitted on average in each minute. Dividing 50 messages

per minute by 60 seconds per minute indicates that 0.83 messages were transmitted on average per second. Multiplying 0.83 by 30 bytes per message and by 8 bits per byte indicates that 200 bits per second are being transferred. If the link is operating at 19,200 bits/second, its occupancy is very low (1.042%). When the occupancy is 75%, the link is operating at its rated capacity. Similar calculations can be done for the Meridian Link (link 1).

N Using the monitor and trace commands can slow down the system significantly. These facilities should only be used for debug purposes. The record and traffic facilities will slow the system down too, but to a much lesser degree.

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When to use traffic reports

The recommended times to use traffic reports are as follows:

- immediately after an application has been turned into operation
- when performance problems are reported
- annually, to determine if adjustments are needed to the link speed

Resolving problems with an overloaded link

If the traffic reports reveals that the link is overloaded during the busy hour, resolve the problem using the following methods:

- Adjust the link speed, if possible.
- If unable to adjust the link speed, off-load the application to another switch.

Appendix A: Determining the Meridian 1 call center capacity (Quick Guide)

This chapter lets you quickly and simply determine whether a particular Meridian 1 system will have sufficient capacity for typical call center applications.

You can use this section when you want to:

- determine the feasibility of using a particular Meridian 1 system for typical call-center configurations
- understand possible limits and impacts of using particular Meridian 1 call-center services
- plan potential expansions of call-center applications
- illustrate the kind of flexibility the Meridian 1 call-center solutions provide

Do not use this section when traffic or usage assumptions vary dramatically from those listed in the following assumptions. If these assumptions do not apply to your situation, use the Meridian Configurator for engineering.

Assumptions

- CPU real time is the only limiting resource considered in attached charts for both Meridian 1 and application (physical or other constraints are not considered).
- For small systems (Option 11E, 21E or 51), the capacity limitation may be physical, not real time. Refer to the detailed engineering guide if in doubt.
- An adequate and balanced number of trunks will be provided. The number of trunks provided for call center agent use will be

approximately 120% of the number of agents and the number of trunks provided for non-call-center use will be approximately 10% of the number of non-call-center sets.

- 50% of non-call-center calls are intra-office calls, and 50% are incoming or outgoing calls.
- CCR calls use a basic script, including one cycle of RAN and music. No statistic messages on ACD DNs are turned on.
- Every feature call is assumed to invoke all features under consideration (CCR plus MAX plus incoming CDR)
- The average holding time is
 - 60 seconds per agent call
 - 150 seconds per non-agent call
- The average usage is 30 CCS per agent (= 50 calls/agent/hour), and 6 CCS per set (= 4 calls/set/hour)
- The average holding time per Meridian Mail port is 60 seconds.
- The capacity of each Meridian Mail system is 64 ports. If more capacity is required, multiple Meridian Mail systems will be used with some capability limitations between Meridian Mail systems.

Before you start

In combined call centers, Meridian 1 must provide sufficient call-processing capacity for call-center users and for non-call-center users. The amount of call-processing capacity required for call-center applications also depends on which Meridian 1 call-center services (such as CCR, MAX, Meridian Link) are to be used.

You must estimate one of the following:

- the number of call-center calls and the number of non-call-center calls that will be expected during the busiest hour of the busiest season
- the number of call-center (ACD) agents and non-call-center users (sets) that will be using the system simultaneously in the busiest hour of the busiest season.

Using the busy-hour busy-season calling rates is more accurate than using agents and sets.

Call centers using CCR only

Use Figure 4 or 5 to determine the Meridian 1 required for call centers that use Meridian CCR for call routing but which are not equipped with MAX or Meridian Link.

If you have estimated the busy-season busy-hour calling rates, draw on Figure 4 a horizontal line depicting the (incoming) calling rates required for the call-center operation and a vertical line depicting the calling rates required for non-call-center users.

If you have estimated only the number of agents and the number of non-call-center users, draw on Figure 5 a horizontal line depicting the number of call center agents and a vertical line depicting the number of non-call-center users.

Find that point on the chart where the horizontal and vertical lines intersect. The label for the area where the points intersect indicates the Meridian 1 option required.

If the lines intersect in the area labelled “Multiple Meridian 1 systems”, a single Meridian 1 cannot handle the capacity. Consult a Northern Telecom representative for alternatives. If the lines intersect above the line labelled “Capacity of an SMM167 or MVME167 Card”, a Meridian 1 can handle the capacity, but a single IPE Module or MVME167-equipped Application Module may not. If the lines intersect above a line labelled “Capacity of an MVME147 card”, the Meridian 1 can handle the capacity but an MVME147-equipped Application Module may not. You should refer to the chapter on “Engineering the IPE Module and the Application Module”.

The lines labelled “Basic CCR Script”, “Typical CCR Script”, and “Complex CCR Script” indicate the typical capacity of a Meridian 1 handling that type of CCR script.

Example 1

A call center using the CCR application is expected to handle 5000 call-center calls and 7500 non-call-center calls. What Meridian 1 option is required?

Draw (Figure 4) a horizontal line through the point on the vertical axis indicating 5000 call-center calls. Draw a vertical line through the point on the horizontal axis indicating 7500 non-call-center calls. Figure 4 shows that the lines intersect in the area labeled “81” indicating that an Option 81 is required to handle this configuration.

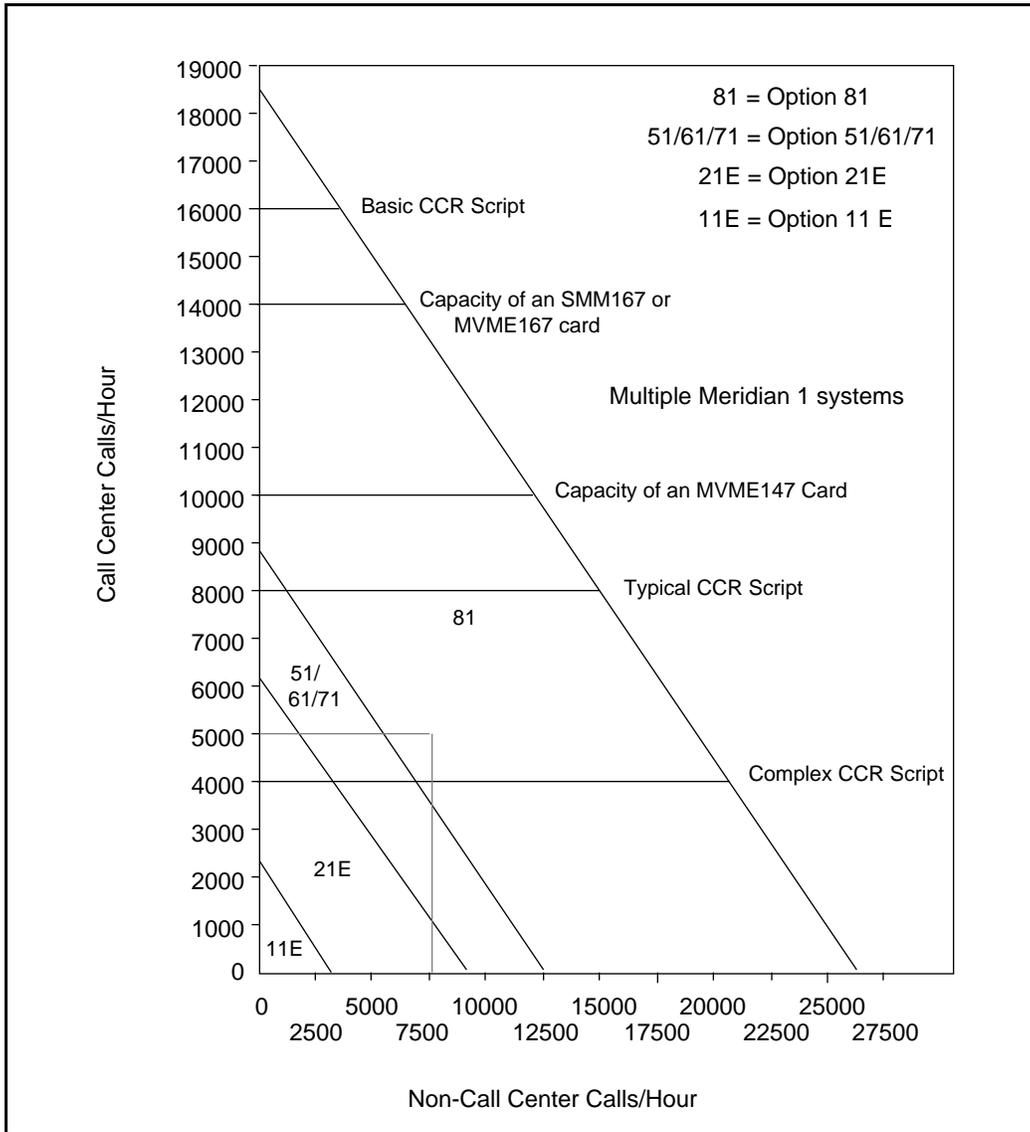
The lines intersect above the line marked “Complex CCR script”. This indicates that the Meridian 1 will handle basic or typical CCR scripts. However, the Meridian 1 will not be able to handle the capacity if all CCR scripts are complex.

Example 2

A call center has 160 ACD agents and 3000 non-call-center telephone sets. What Meridian 1 option is required to service it?

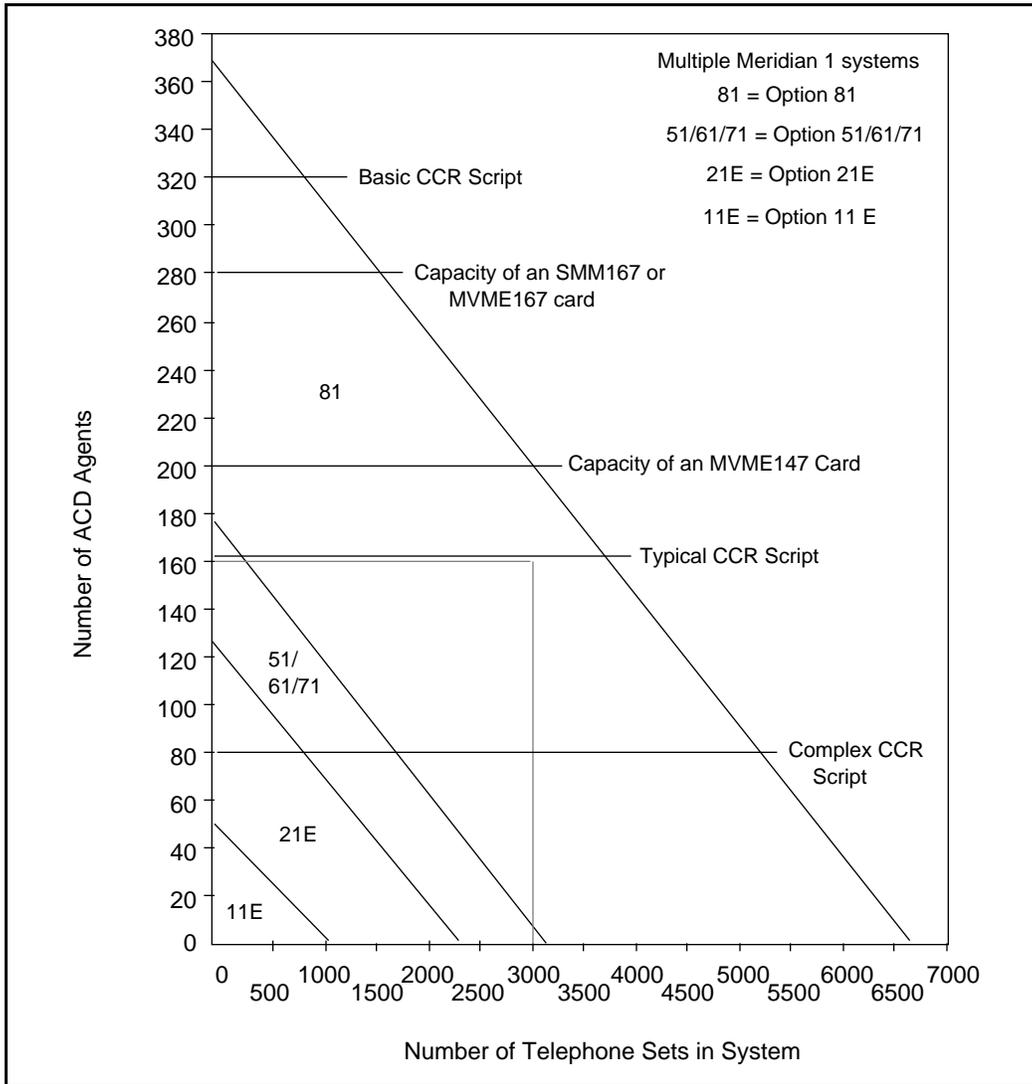
On Figure 5, draw a horizontal line through the point on the vertical axis representing 160 ACD agents. Draw a vertical line through a point on the horizontal axis representing 3000 non-call-center calls. The lines intersect in the area labelled “81”, indicating that an Option 81 is required.

Figure 4
Meridian 1 quick capacity guide for call centers that use CCR only (1)



* Refer to the “Engineering the IPE Module and the Application Module” chapter for more information.

Figure 5
Meridian 1 quick capacity guide for call centers that use CCR only (2)



Call centers using CCR, MAX and incoming CDR

Use Figure 6 or 7 to determine the Meridian 1 Option required for call centers that use CCR for call routing, MAX for call center reporting, and incoming CDR call detail reporting.

If you have estimated the busy-season busy-hour calling rates, draw on Figure 6 a horizontal line depicting the (incoming) calling rates required for the call-center operation and a vertical line depicting the calling rates required for non-call-center users.

If you have estimated only the number of agents and the number of non-call-center users, draw on Figure 7 a horizontal line depicting the number of call-center agents and a vertical line depicting the number of non-call-center users.

Find that point on the chart where the horizontal and vertical lines intersect. The label for the area where the points intersect indicates the Meridian 1 option required.

If the lines intersect in the area labelled “Multiple Meridian 1 systems”, a single Meridian 1 cannot handle the capacity. Consult a distributor or Northern Telecom support personnel for alternatives. If the lines intersect above the line labelled “Capacity of an SMM167 or MVME167 Card”, a Meridian 1 can handle the capacity, but a single IPE Module or MVME167-equipped Application Module may not. If the lines intersect above a line labelled “Capacity of an MVME147 card”, the Meridian 1 can handle the capacity but an MVME147-equipped Application Module may not. You should refer to the chapter on “Engineering the IPE Module and the Application Module”.

The lines labelled “Typical CCR Script” and “Complex CCR Script” indicate the typical capacity of a Meridian 1 handling that type of script.

Example 3

A call center using CCR, MAX, and incoming CDR is expected to process 7,000 call-center calls and 6,000 non-call-center calls during the busy hour. What Option of Meridian 1 is required?

On Figure 6, draw a vertical line through 6,000 non-call-center calls point on the horizontal axis. Draw a horizontal line through 9,000 call-center calls point on the vertical axis. The point of intersection is in the area labelled “81” indicating that an Option 81 is required to handle this configuration.

The lines intersect above the line marked “Complex CCR script”. This indicates that the Meridian 1 will handle basic or typical CCR scripts. However, the Meridian 1 will not be able to handle the capacity if all CCR scripts are complex.

Example 4

Another application is expected to generate 2,000 call-center calls and 600 non-call-center calls during busy hour. What Meridian 1 option is required?

Draw two lines through points of interest as in the previous example. The intersection point indicates that an Option 21E is required to handle this application.

Example 5

A call center houses 80 ACD agents and 2,000 non-call-center sets. What Meridian 1 option is required to serve it?

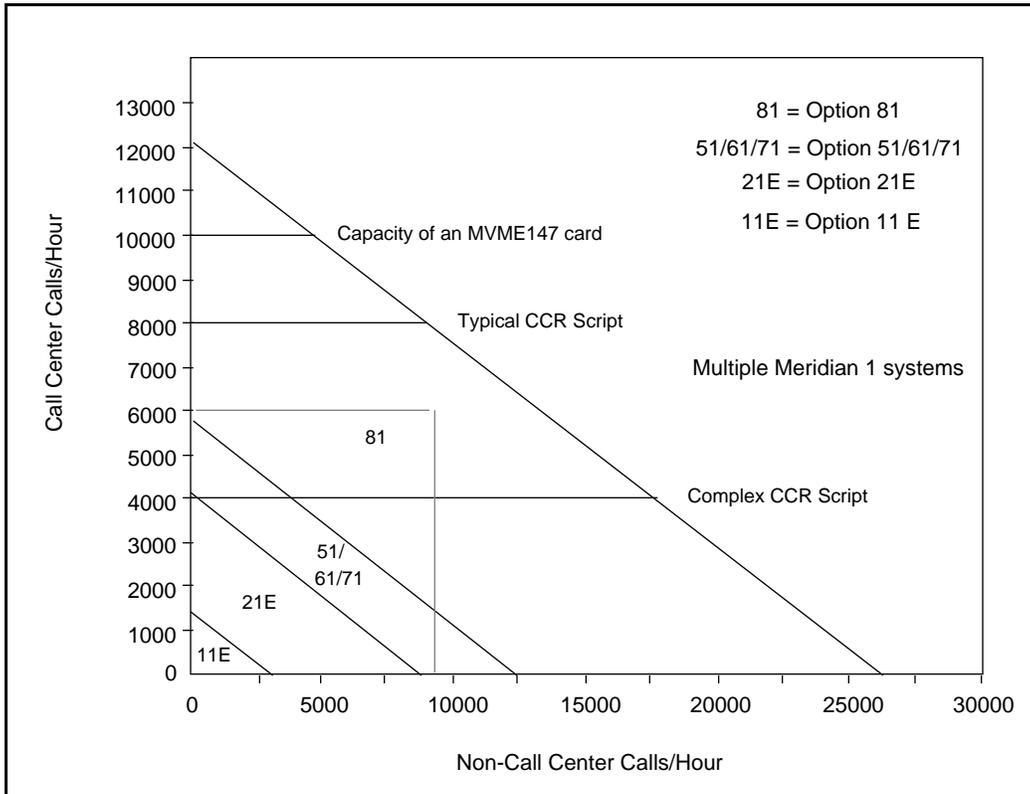
On Figure 7, draw a vertical line through 2,000 telephone sets point on the horizontal axis. Draw a horizontal line through 80 ACD agents point on the vertical axis. The point of intersection indicates that an Option 81 is required to handle this configuration.

Example 6

Can an Option 71 switch serve a call-center application (CCR/MAX/CDR) with 90 ACD agents and 500 administrative sets?

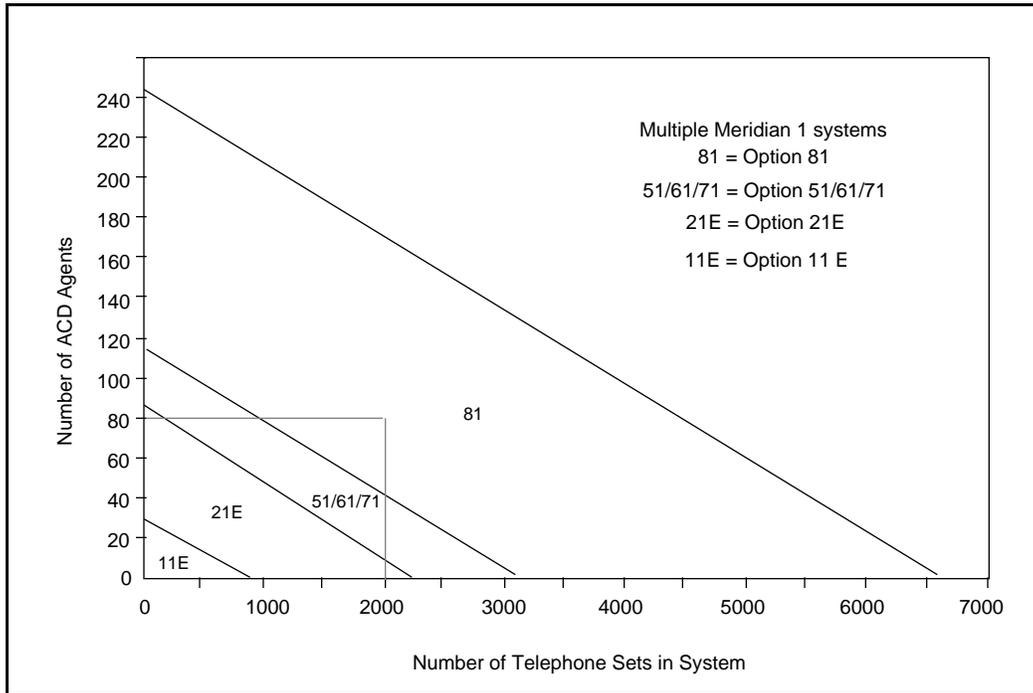
Draw two lines through these two points of interest on axes. The point of intersection indicates that an Option 71 is adequate to handle this application.

Figure 6
Meridian 1 quick guide for call centers using CCR/MAX/incoming CDR (1)



* Refer to the “Engineering the IPE Module and Application Module” chapter for more information.

Figure 7
Meridian 1 quick guide for call centers using CCR/MAX/incoming CDR (2)



Call centers using Meridian Link only

Use Figure 8 or 9 to determine the Meridian 1 Option required for call centers that use Meridian Link to enable Computer Telephony Integration for inbound calls.

If you have estimated the busy-season busy-hour calling rates, draw on Figure 8 a horizontal line depicting the (incoming) calling rates required for the call-center operation and a vertical line depicting the calling rates required for non-call-center users.

If you have estimated only the number of agents and the number of non-call-center users, draw on Figure 9 a horizontal line depicting the number of call-center agents and a vertical line depicting the number of non-call-center users.

Find that point on the chart where the horizontal and vertical lines intersect. The label for the area where the points intersect indicates the Meridian 1 option required.

If the lines intersect in the area labelled “Multiple Meridian 1 systems”, a single Meridian 1 cannot handle the capacity. Consult a Northern Telecom representative for alternatives. If the lines intersect above the line labelled “Capacity of an SMM167 or MVME167 Card”, a Meridian 1 can handle the capacity, but a single IPE Module or MVME167-equipped Application Module may not. If the lines intersect above a line labelled “Capacity of an MVME147 card”, the Meridian 1 can handle the capacity but an MVME147-equipped Application Module may not. You should refer to the chapter on “Engineering the IPE Module and the Application Module”.

Example 7

A call center is expected to handle 6,000 incoming ACD trunk calls per hour and 2000 non-call-center calls per hour. What Meridian 1 option is required?

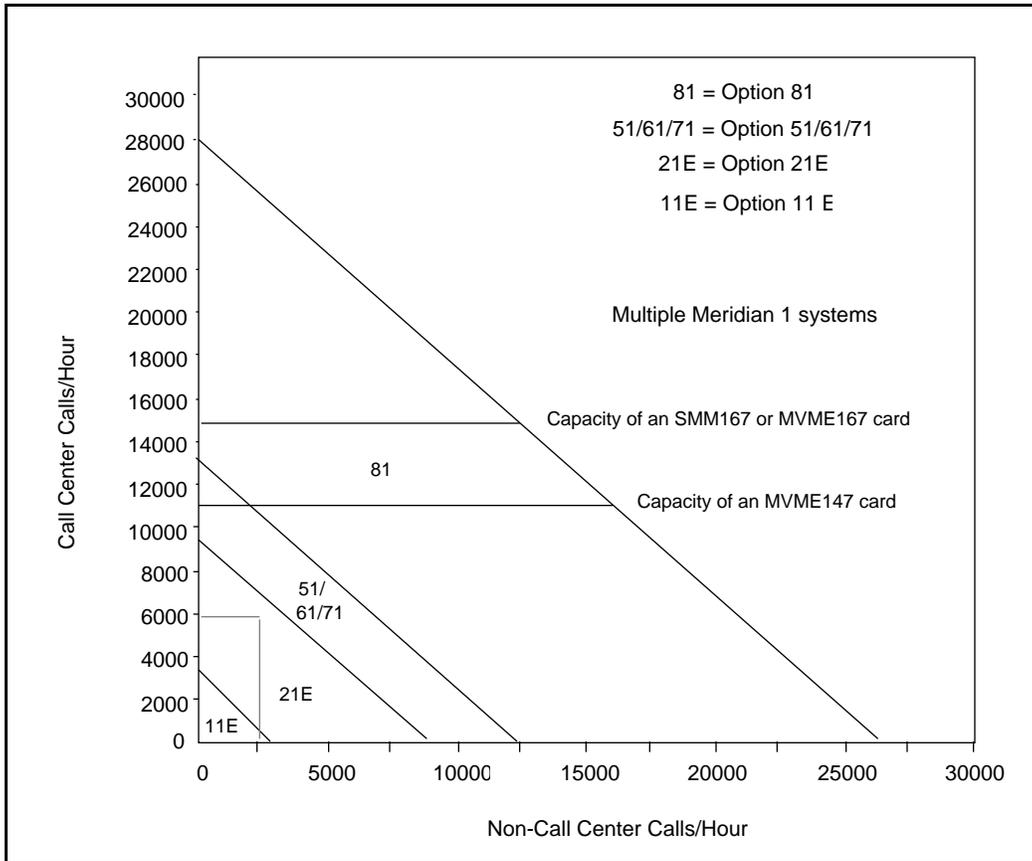
On Figure 8, draw a horizontal line through the point on the vertical axis representing 6,000 AML associated calls. Draw a vertical line through the point representing 2,000 non-call-center calls. The lines intersect in the area labelled “21E”, indicating that an Option 21E is required.

Example 8

A call center has 50 ACD agents with associated sets and 1200 non-call-center telephone sets. What Meridian 1 option is required to service it?

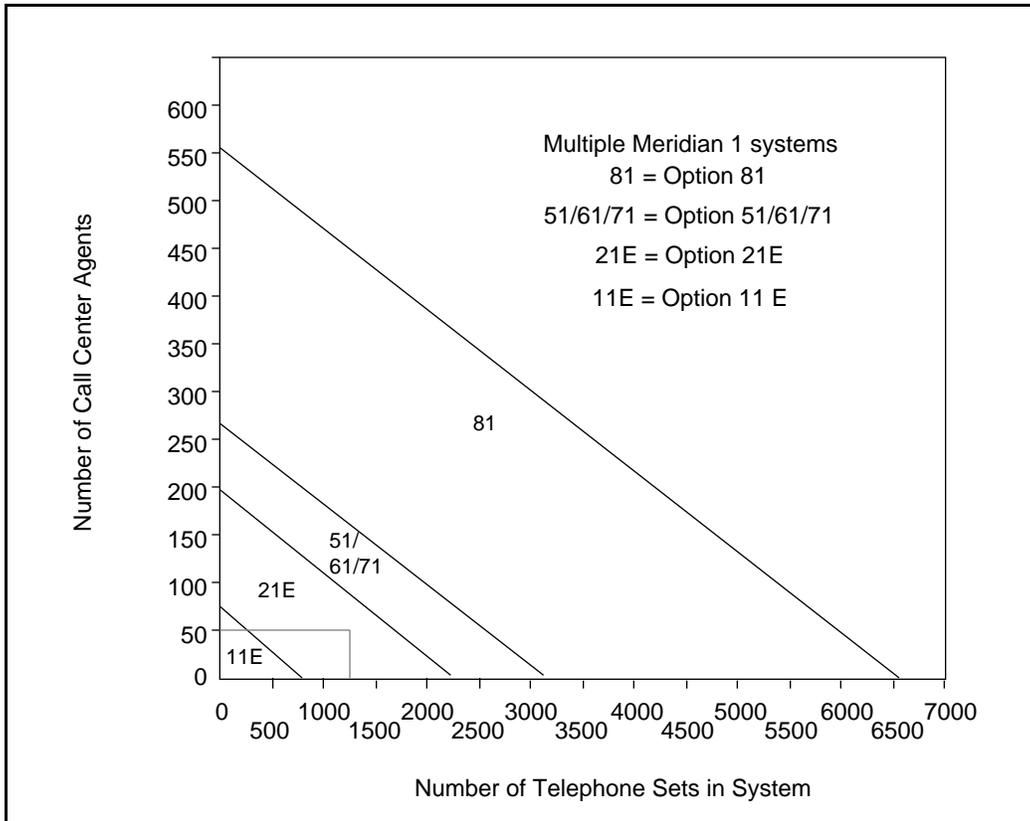
On Figure 9, draw a horizontal line through the point on the vertical axis representing 50 ACD agents. Draw a vertical line through a point on the horizontal axis representing 1200 non-call-center calls. The lines intersect in the area labelled “21E”, indicating that an Option 21E is required.

Figure 8
Meridian 1 quick capacity guide for call centers using Meridian Link only (1)



* Refer to the "Engineering the IPE Module and Application Module" chapter for more information.

Figure 9
Meridian 1 quick capacity guide for call centers using Meridian Link only (2)



Call centers using Meridian Link for Host Enhanced Routing and Voice Processing

Use Figure 10 or 11 to determine the Meridian 1 Option required for call centers that use Meridian Link to perform host enhanced routing and host enhanced voice processing in addition to host notification on inbound calls.

If you have estimated the busy season busy hour calling rates, draw on Figure 10 a horizontal line depicting the (incoming) calling rates required for the call-center operation and a vertical line depicting the calling rates required for non-call-center users.

If you have estimated only the number of agents and the number of non-call-center users, draw on Figure 11 a horizontal line depicting the number of call-center agents and a vertical line depicting the number of non-call-center users.

Find that point on the chart where the horizontal and vertical lines intersect. The label for the area where the points intersect indicates the Meridian 1 option required.

If the lines intersect in the area labelled “Multiple Meridian 1 systems”, a single Meridian 1 cannot handle the capacity. Consult a distributor or Northern Telecom support personnel for alternatives. If the lines intersect above the line labelled “Capacity of an SMM167 or MVME167 Card”, a Meridian 1 can handle the capacity, but a single IPE Module or MVME167-equipped Application Module may not. If the lines intersect above a line labelled “Capacity of an MVME147 card”, the Meridian 1 can handle the capacity but an MVME147-equipped Application Module may not. You should refer to the chapter on “Engineering the IPE Module and the Application Module”.

Example 9

A call center is expected to handle 3000 call-center calls per hour and 2500 non-call-center calls per hour. What Meridian 1 option is required?

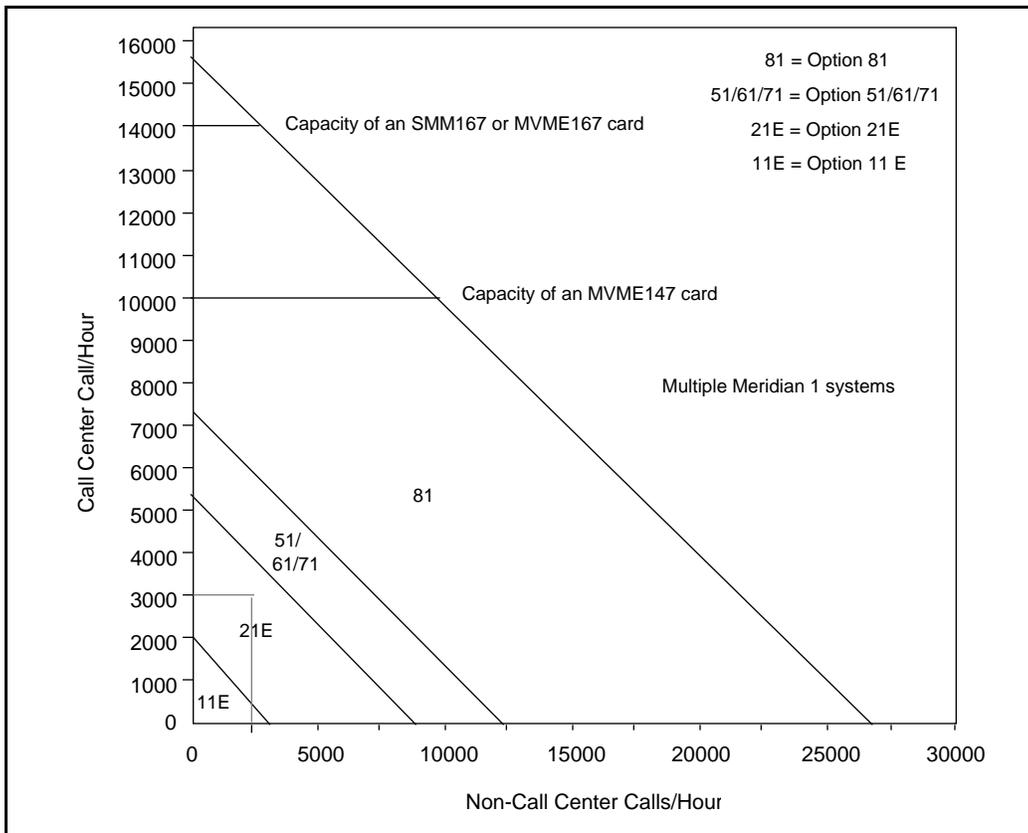
On Figure 10, draw a horizontal line through the point on the vertical axis representing 3000 call-center calls. Draw a vertical line through the point on the horizontal axis representing 2500 non-call-center calls. The points intersect in the area labelled “21E”, indicating that an Option 21E is required.

Example 10

A call center has 70 ACD agents and 1000 non-call-center telephone sets. What Meridian 1 option is required to service it?

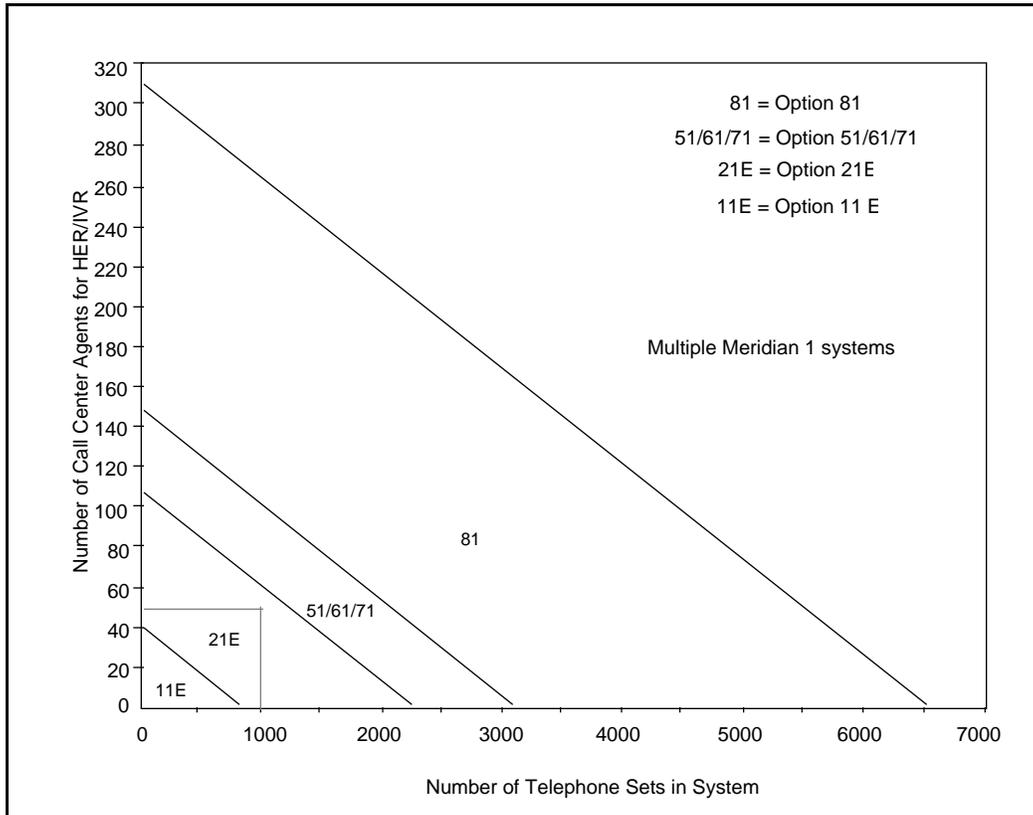
On Figure 11, draw a horizontal line through the point on the vertical axis representing 70 ACD agents. Draw a vertical line through a point on the horizontal axis representing 1000 non-call-center calls. The lines intersect in the area labelled “21E”, indicating that an Option 21E is required.

Figure 10
Meridian 1 quick capacity guide for call centers using HER and HEVP (1)



* Refer to the “Engineering the IPE Module and Application Module” chapter for more information.

Figure 11
Meridian 1 quick capacity guide for call centers using HER and HEVP (2)



Appendix B: Meridian 1 CPU capacity engineering

The preferred way to perform Meridian 1 CPU capacity engineering is to use the Meridian Configurator. If for some reason you are unable to use the Meridian Configurator, this appendix provides procedures, scenarios, and examples to enable you to perform engineering calculations.

This appendix refers to two terms used in engineering calculations: load and call capacity.

For an IPE Module or Application Module, the *load* is the total number of calls handled by the IPE Module or Application Module. The load includes all inbound and outbound calls for all applications, as well as all calls transferred or conferenced through the IPE Module or Application Module.

The *call capacity* of an IPE Module or Application Module is the maximum number of calls that the IPE Module or Application Module can handle per hour. The call capacity is limited by the data rates set for link 0 and link 1. Link 0 is the data link between the ESDI card and the Meridian 1 system, and is usually known as the Application Module Link or AML. Link 1 is the data link between the IPE Module or Application Module and the host computer, and is usually known as the Meridian Link. The data rates for the AML and the Meridian Link should be set at the same value.

Table 22 shows the maximum call capacity of the AML and the Meridian Link for different data rates. Table 22 applies only to Option 71 systems and assumes that the AML and the Meridian Link have the same data rate. For more information about Table 22, refer to “Meridian Link and AML engineering” section later in this appendix.

Table 22
Link data rates and capacity

| Maximum call load (calls/hour) | Link data rate |
|--------------------------------|----------------|
| 12,331–24,660 | 19,200 |
| 6,116–12,330 | 9,600 |
| 3,058–6,115 | 4,800 |
| 1,542–3,057 | 2,400 |
| 1,528 | 1,200 |

A fully loaded link at 19,200 bps carries more messages than the Option 71 CPU can process.

Data rate settings for AML and the Meridian Link should be identical. The default data rate for both is 19,200 bps. If you need to set a data rate that is different from the default, ensure that the data rate you choose is within the CPU capacity of the Meridian 1 system and corresponds to a call capacity that is larger than a Meridian 1 is expected to handle. In other words, choose a value that will not limit the call capacity of the Application Module.

To determine whether the number of calls is within the CPU capacity of the Meridian 1 system, add the number of calls for each application together.

You should engineer the Meridian 1 system to the *rated real-time capacity* of the CPU, which corresponds to the CPU being used 2520 seconds out of a busy hour. (The value of 2520 seconds represents 70% of the maximum value and makes allowance for peaks in traffic during busy hours. For more information, refer to “Peak load adjustment” later in this appendix.) At this level of traffic, the system can meet requirements for all grades of service.

An *Equivalent Basic Call* (EBC) is an internal, non-featured, 2500-set-to-2500-set call, and represents the simplest call set-up and tear-down functions performed by the CPU. An EBC is used as the unit to represent the constant, maximum call capacity of a CPU. For Release 18, an EBC is 79 milliseconds for an Omega CPU (Option 51, 61, and 71 switches). The CPU rated call capacity with the maximum absolute value is 31,898 EBC per busy hour (that is, 2520 seconds divided by 79 milliseconds). For any application

with features, the rated call capacity is actually a smaller number of calls per hour, the extent depending upon the number and the combination of features.

Your main objective in performing real-time capacity engineering on the Meridian 1 system is to calculate the real-time call capacity and usage of a given switch, expressed in EBC. Then you can estimate the expected use and spare capacity.

For a Gemini processor (ST or Option 11), you must divide the value 31,898 EBC per hour by a factor of 5 to obtain the rated call capacity of 6379 EBC per hour. For a STORME processor (Option 21E), you must divide 31,898 EBC per hour by a factor of 1.35 to obtain the rated call capacity of 23, 628 EBC per hour.

CPU capacity engineering

You can use the following procedures to estimate the load of a new installation and to calculate the spare capacity of an existing switch. You can also use these procedures to estimate how many additional application calls the system can accommodate, and to get a high-level estimate of CPU loading.

The procedures have been simplified from Meridian Configurator and the real-time spreadsheet program, and you should not use these procedures as substitutes for the Meridian Configurator. The Meridian Configurator result should prevail if there are any discrepancies between results produced by these procedures and the Meridian Configurator.

There are two different procedures, one for new installation, and one for existing installations. In using either procedure, you should be aware that the term “real-time factor” used in this document is not the same as the term “real-time ratio” used in the Meridian Configurator and the real-time document.

The *real-time factor* is the additional real time required by a featured call compared with the real time required by a basic (non-featured) call, and is expressed as a fraction of the basic call. That is:

$$\text{Real-time factor} = (r_a - r)/r$$

in which r_a is the real time for a featured call and r is the real time for a basic call (79 milliseconds for an Omega CPU). The real-time factor is available in the real-time document for each new release.

The *real-time ratio* of a complicated featured call is the ratio of the real time for that featured call to the real time for a basic call. That is:

$$\text{Real-time ratio} = r_a/r$$

in which r_a is the real time for a featured call and r is the real time for a basic call (79 milliseconds).

The real-time ratio is also the sum of all increments in real-time factors associated with the feature. For example: an incoming trunk call at 100 milliseconds per call has a real-time factor of 0.26 over an EBC, as shown below.

$$\text{Real-time factor} = (100 - 79)/79 = 0.26$$

An incoming ACD call at 147 milliseconds per call has a real-time factor of 0.59 over an incoming trunk calls, as shown below.

$$\text{Real-time factor} = (147 - 100)/79 = 0.59$$

A Meridian Link call at 153 milliseconds per call has a real-time factor of 0.08 over an incoming ACD call, as shown below.

$$\text{Real-time factor} = (153 - 147)/79 = 0.08$$

A CCR call at 253 milliseconds has a real-time factor of 1.27 over a Meridian Link call, as shown below.

$$\text{Real-time factor} = (253 - 153)/79 = 1.27$$

The real-time ratio as calculated as the sum of the real-time factors of a CCR call is 3.20, as shown below.

$$\text{Real-time ratio} = 1 + 0.26 + 0.59 + 0.08 + 1.27 = 3.20$$

The real-time ratio as the ratio of the real time of the CCR call to the real time of a basic call is also 3.20, as shown below.

$$\text{Real-time ratio} = 253/79 = 3.20$$

Although the examples described above compare a featured call to a basic call, you can use the difference in real-time ratios between any two features to calculate the incremental real-time impact of adding one feature to a system that already has the other feature installed.

Spare CPU capacity at a new installation

When you make this calculation, the results of the traffic engineering of your site should be available to you, and you should be able to find out the numbers and types of calls to be handled by the Meridian 1.

$$\begin{aligned} &\text{Spare CPU capacity in EBC per busy hour} \\ &= 31,898 - (\text{call}_1 \times r_1 + \text{call}_2 \times r_2 + \dots + \text{call}_n \times r_n) \end{aligned}$$

where r_i is the real-time ratio for featured call type i (call_i). r_i and call_i are defined in the following way:

$$\begin{aligned} r_i &= (\text{real time of featured call type } i \text{ in milliseconds})/79 \\ \text{call}_i &= \text{number of calls of featured call type } i \end{aligned}$$

If, instead of the number of calls, you have the number of ACD agents and the number of centicall-seconds (CCS), you can use the following method to find the number of calls:

$$\text{Number of calls} = n \times a \times 100/H_t$$

where n = number of ACD agents

a = CCS per agent

H_t = average holding time per agent (for more information and a default value, refer to “*Real-time engineering*” later in this appendix)

Note that all calls must be of the disjoint type to apply the spare capacity equation correctly. The incremental real-time impact of features can be calculated only for those features listed in Table 23 later in this appendix.

Spare CPU capacity at an existing installation

If you are doing an estimate to calculate the effect of adding new features to an existing system, you should find the spare capacity of the CPU first. If the system has Release 18 or later software, its traffic report (TFS004) provides a value for the CPU utilization. You should use this value to calculate the spare CPU capacity.

If the software is of an older vintage and does not have the utilization estimate in the traffic report, you should calculate the average real time per call of the system and use that in the following to calculate spare capacity.

Method 1

If you know the system CCS

$$\begin{aligned} \text{Spare CPU capacity in EBC per busy hour} \\ = 31,898 \times (1 - (0.5 \times \text{system CCS} \times 100 \times T/H_t/2520)) \end{aligned}$$

where

- 0.5 accounts for originating or incoming calls only obtained by adding all terminal loop CCS from TFS001
- T is the real time per call in seconds (this time can be measured or calculated and is normally in the range 0.15-0.25 for an Option 71 system)
- H_t is the average holding time per call in seconds (normally in the range 150-250)

Method 2

From TFS004, choose two points (one for a busy hour, and one for a quiet hour) on the curve relating call attempts (CA) and idle cycle counts (ICC).

If the two points are:

for the busy hour, P1 = ICC1, CA1

for the quiet hour, P2 = ICC2, CA2

then:

Rated capacity (C_r)

$$= 0.7 \times (CA1 - ICC1 \times (CA1 - CA2)/(ICC1 - ICC2))$$

$$\text{Spare capacity (S)} = 31,898 \times (1 - CA1/C_r)$$

There are risks involved in picking only two points for curve fitting. The more reliable approach is to use regression analysis on many hours of traffic data and come up with a least-square line with a confidence interval on the fitness of the data. The simplified form presented above is useful for high-level estimation only.

Method 3

From Table 23, choose a call type.

Table 23 is a simplified real-time capacity table for AML calls. It can be used to estimate the additional load to a CPU if a given number of AML calls is added to the system. Interpolation between two columns to find a finer increment is permitted.

Table 23
Real-time capacity

| Extra load to CPU as % Rated Capacity | 100 | 80 | 60 | 40 | 20 | 10 |
|---|--------|--------|--------|--------|-------|-------|
| EBC/Hr | 31,898 | 25,518 | 19,138 | 12,759 | 6,379 | 3,189 |
| AST Calls (inbound) | 16,442 | 13,153 | 9,864 | 6,576 | 3,288 | 1,644 |
| HER/CCR (inbound) | 9,968 | 7,974 | 5,980 | 3,987 | 1,993 | 996 |
| Direct autodialer (outbound) | 22,948 | 18,358 | 13,768 | 9,179 | 2,589 | 2,294 |
| Predictive Dialing with Transfer (20%) (outbound) | 14,975 | 11,980 | 8,985 | 5,990 | 2,995 | 1,497 |

- For AST calls,
Spare capacity (S) = 31,898 x (1 - AST calls/16,442)
- For HER calls,
Spare capacity (S) = 31,898 x (1 - HER calls/9,968)
- For autodialer calls,
Spare capacity (S) = 31,898 x (1 - autodialer calls/22,948)

- For predictive dialer calls,
Spare capacity (S) = 31,898 x (1 - predictive dialer calls/14,975)

In the third scenario, the real time per call of the specific type required is used in the calculation, therefore no average real time per call (T) is needed. This method is the easiest to use if the real-time characteristics of a switch are not known or available.

Calculation of the allowance for new features

If the spare capacity is zero or is negative, the CPU loading at 100% or more of the rated capacity and there is no room for new features. If the system is new, it is over-engineered for the configuration.

For any new type of featured call to be added to the system, you should use the following formula to estimate the number of calls of the new type that the CPU can support:

$$\text{Number of calls of new type } i = S/r_i$$

where S is the spare capacity in EBC per busy hour, and r_i is the real-time ratio of the new type of featured call i.

Examples of data-link and real-time calculations

This section describes examples of signaling the AML and/or Meridian Link for types of featured calls. The resources involved in the engineering are the data rate of the Meridian Link or AML and the utilization of the CPU.

The AML and the Meridian Link should be engineered identically. So any results shown for the Meridian Link also apply to the AML. Not all calculations for AML apply to the Meridian Link because CCR does not use the Meridian Link.

The examples are designed to evaluate the CPU loading of a system or the available capacity for adding new features. The approach is different from that of the Meridian Configurator, which uses the incremental impact method. However, the final real-time factor and impact of a feature should be the same. In the following examples, the first five examples are associated with one configuration, and are designated as Examples 1.1 to 1.5. Similarly, the next four problems are related and designated as Examples 2.1 to 2.4. The last scenario is independent of others.

Scenario 1

Example 1.1: AML engineering

A Meridian 1 with 600 ACD agents is expected to serve 11,000 calls per hour. If every agent set is an AST paired with a terminal controlled by a host, what is the data rate required of the AML to serve this configuration?

From Table 22, the link data rate and capacity table, a data link with 9,600 bps can serve 6,186 to 12,330 AML calls per hour. So 9600 bps should be the data rate to handle 11,000 calls per hour.

Example 1.2: CPU spare capacity estimation

**Does the system have any spare capacity to handle additional calls?
What is the spare?**

From Table 23, on the row for AST calls, loading for 11,000 calls is calculated as follows (based on 100% rated capacity):

$$\text{CPU loading} = 11,000/16,442 = 0.669 = 66.9\%$$

$$\text{Spare capacity (S)} = 31,898 \times (1 - 0.669) = 10,558$$

The CPU has a spare capacity equal to 10,558 EBC (or 33.1%) to handle additional calls.

Example 1.3: Additional CCR calls calculation

How many CCR calls can the system spare capacity handle?

From Table 23 (real-time capacity), the extra load on the CPU due to inbound CCR calls is 9,968 calls per hour (assuming 100% rated capacity).

From example 1.2, spare capacity for EBC calls = 10,558 EBC.

The 10,558 EBC can be converted to CCR calls simply by dividing by 3.20 (that is, 31,898/9,968).

Example 1.4: Recheck signaling link requirements

With an additional 3,298 CCR calls offered to the system, is the original estimate of data rate at 9600 bps for the Meridian Link adequate?

The total calls = 11,000 + 3,298 = 14,298

Table 22 (link data rates and capacity) shows that a 9,600 bps link can serve only 12,330 calls per hour.

The next higher rate of 19,200 bps is required to serve 14,298 ML calls per hour. As shown in the table, a 19,200 bps link can actually serve up to 24,660 calls per hour.

Example 1.5: ACD agents calculation

How many additional ACD agents are required to handle these CCR calls?

Each agent is assumed to handle 33 CCS with an average holding time of 180 seconds. The average calling rate per agent is 18.3 calls/hour (= 33 x 100/180).

The additional Meridian Link call capacity can be converted to additional ACD agents to the system by the following formula:

$$\begin{aligned}\text{ACD Agents} &= \text{spare capacity/calling rate per agent} \\ &= 3,298/18.3 \\ &= 180\end{aligned}$$

The total number of ACD agents the CPU is capable of serving is 780 (= 600 + 180).

Scenario 2

Example 2.1: Autodialer with call transfer (predictive dialing) application

A Meridian 1 call center consists of 65 ports controlled by autodialers (or a host) making outgoing calls for sales agents. If each port generates calls at 40-second intervals, how many agents are needed to handle this traffic load? How much is the CPU of this system loaded?

Assuming 33 CCS per agent and 120 seconds holding time (outgoing calls usually have shorter holding times), each agent can handle 27.5 calls per hour ($33 \times 100/120$). In a hour of 3,600 seconds, each autodialer port generates 90 calls ($= 3,600/40$).

$$\begin{aligned}\text{The total calls by autodialers} &= \text{ports} \times \text{calls per port} \\ &= 65 \times 90 \\ &= 5,850 \text{ calls per hour}\end{aligned}$$

Assuming that 20% of calls are answered and transferring to agents,

$$\begin{aligned}\text{Number of agents required} &= \text{calls} \times 20\% / \text{calls per agent} \\ &= 5,850 \times 0.2 / 27.5 \\ &= 43\end{aligned}$$

$$\begin{aligned}\text{CPU loading} &= 5,850 \times 2.13 / 31,898 = 0.39, \\ &\text{because the real-time factor is 2.13 for autodialer calls with transfer.}\end{aligned}$$

From **Table 23** (real-time capacity), CPU loading = $(5,850/14,975) = 0.39$

Either calculation shows that autodialer calls make up 39% of the CPU rated capacity.

Example 2.2: Host Enhanced Routing or similar incoming application

In addition, 300 ACD agents are relocated from another site to the above switch to take sales orders. The incoming calls are routed by the Host Enhanced Routing feature based on the DNIS numbers of arriving calls. How much additional load will be offered to the CPU?

To serve incoming calls, an agent typically handles 18.3 calls per hour (see Example 1.5). The system must process an additional 5,490 (= 300 x 18.3) calls per hour.

Based on the real-time ratio of 3.20 for HER calls (see Example 1.3), the estimated real-time is as follows:

$$\begin{aligned}\text{CPU loading for HER calls} &= \text{HER calls} \times \text{real-time ratio} / 31,898 \\ &= 5,490 \times 3.20 / 31,898 \\ &= 0.55\end{aligned}$$

Or, based on **Table 23** (real-time capacity),

$$\text{CPU loading for HER calls} = 5,490 / 9,968 = 0.55$$

The HER calls make up 55% of the CPU rated capacity.

Example 2.3: Direct autodialer application

The management decides to use the system to its rated capacity by adding a number of autodialer ports to monitor and collect transaction data for a client. What is the maximum number of autodialer ports that can be equipped, if the data monitoring takes place every minute?

When each autodialer call lasts less than 60 seconds (as is usually the case for direct autodialer calling), a port can make 60 calls per hour. So, considering the loading for predictive dialing (0.39) and HER calls (0.55):

$$\text{Spare CPU capacity} = 1 - 0.39 - 0.55 = 0.06 = 6\%$$

The real-time ratio for direct autodialer calls is 1.39. The spare capacity can be converted to calls as follows:

$$\begin{aligned}\text{Spare capacity} &= 31,898 \times 6\% / \text{real-time ratio} \\ &= 31,898 \times 0.06 / 1.39 \\ &= 1,376 \text{ calls}\end{aligned}$$

or from **Table 23** (real-time capacity), multiplying the fraction of spare with the number of calls denoting 100% CPU loading (22,948 calls):

$$\text{Spare capacity} = 0.06 \times 22,948 = 1,376 \text{ calls}$$

$$\text{Autodialer ports} = \text{calls/calls per port} = 1,376 / 60 = 22$$

The system can add 22 autodialer ports (rounded-down so traffic is less than the limit) for monitoring purposes and still operate within the rated capacity of the Meridian 1 CPU.

Example 2.4: AML requirement

What is the AML data rate required for this system if all of the above three applications are deployed?

From earlier calculations, the number of autodialer calls with transfer is 5,850 per hour, the number of inbound calls is 5,490 per hour, and the number of Direct autodialer calls is 1,376. Therefore, the total number of calls that could generate messages to ML is 12,716 calls per hour.

According to Table 22, a 19,200 bps link can serve 12,716 calls per hour. The required signaling link data rate for this configuration is therefore 19,200 bps.

Scenario 3

Example 3: System upgrade from a mixed application

A system with a mixed ACD application (tandem, incoming, outgoing, and so on) is considering adding some new applications. From its traffic reports, the busiest hour has 8,500 call attempts and 9,500,000 in idle cycle counts. Its most quiet hour has 200 call attempts and 16,800,000 idle cycles. How much spare capacity does the system have?

In this case, the busy hour point $P1 = (9,500,000; 8,500)$ and the quiet hour point $P2 = (16,800,000; 200)$

Based on method 3 under the heading “Spare CPU capacity at an existing installation” in Appendix A, the rated CPU capacity (Cr) can be estimated as follows:

$$Cr = 0.7 \times [8,500 - 9,500,000 \times (8,500 - 200) / (9,500,000 - 16,800,000)] \\ = 13,510$$

The spare capacity can be estimated as follows:

$$S = 31,898 \times (1 - 8,500 / 13,510) = 11,814 \text{ EBC}$$

Expressed as a percentage of the total capacity,

$$S = 11,814 / 31,898 = 0.37 \text{ or } 37\%$$

Rationale and assumptions

This section describes the rationale and assumptions used in deriving the tables and formulas for AML and real-time engineering.

Meridian Link and AML

The link data rate and capacity table (Table 22) is based on

- using an average of 38.5 bytes per message
- leaving a reserve of 30% of capacity to accommodate traffic peaks during the busy hour
- using an average of 10 messages per AML call
- engineering the AML for 70% of combined inbound and outbound messages to take into account duplex operation of the link

A link with a data rate of 19,200 bps will handle any application currently envisioned for the AML and the Meridian Link on the Meridian 1, because the system CPU will exhaust its capacity before a 19,200 bps link is fully utilized.

Estimating AML and Meridian Link capacity consists of calculating the number of calls and using a table lookup to find the data rate corresponding to the calculated number of AML or Meridian Link calls.

CCS, and holding time per line and per agent can vary significantly from site to site, and from application to application. You should use the formulas provided to recalculate the calling rate if the holding time of an application is significantly different from the underlying assumptions.

Relationship between AML and Meridian Link

One of the real time functions of an Application Module is to convert AML protocol to X.25 protocol and vice versa. Other than local maintenance on the server, each message arriving from the Application Module will be converted and sent to the host. Similarly, each X.25 message from the host is translated to AML protocol and sent to the Meridian 1. There is a one-to-one correspondence between the input message and the output message of an Application Module. It is recommended that the data rate at both AML and Meridian Link should be the same. One calculation should yield the result for both links.

X.25 layer 3 and layer 2 overhead

Each network layer (layer 3) message communicated between a host and the Application Module needs to be supported by layer 2 overhead such as adding a header, a CRC error checking field, and a flag or flags to form a layer 2 frame. In addition, an RR (Receive Ready) message needs to be sent from one processor to the other communicating processor to ask whether previous messages have been received. RR frames can be sent at a varying rate from once every two messages to none, where an information frame may be sent instead of an RR frame after receiving a message.

When an average message length of 28 bytes is ready to be transmitted through the signaling link, the packet becomes 38.5 bytes long including the above mentioned overhead and an allocated RR message per message sent.

Peak load adjustment

The Meridian 1 CPU requires a margin of 30% over rated capacity to allow for traffic peaks in the busy hour. The AML and Meridian Link should have the same allowance because the extra processing power in the CPU needs to be matched by increased link capacity in order to accommodate peaks in the traffic. At a 19,200 bps data rate, for example, the recommended engineering load for the AML is 14.7 Kbps ($= 19.2/1.3$). This is the actual data rate used to calculate the message capacity of the link.

Uneven distribution of duplex link traffic

A full-duplex data link at 19,200 bps can carry traffic in one direction at 19,200 bps and traffic in the opposite direction also at 19,200 bps. The total message count obtained from Meridian Link is two-way traffic. By assuming a 70%-30% split on the direction of the traffic, the data link can be expected to handle 70% of the total two-way message traffic.

Real-time engineering

The real-time ratio is the ratio of the real-time of a featured call to that of the 2500-to-2500-set call. It is not an incremental real-time factor as defined in the real-time document or the Meridian Configurator. Be aware of the difference in using the engineering procedures.

Incoming AST calls

The directory number (DN) of an associated set (AST) is assigned to be controlled by a host. The AST is associated with a computer terminal through a data base stored in the host. A host, alerted by message of an incoming call from the Meridian 1, can bring up customer or sales information on the terminal screen while a connection is made to the AST. This type of arrangement is typical for ACD agents.

Use the following to calculate the CCS and calls:

$$\text{AST Agent CCS} = n \times a$$

$$\text{AST Agent calls} = n \times a \times 100/H_t$$

where:

n = number of AST agents

a = CCS per AST agent (the default value is 33 CCS)

H_t = average holding time per AST agent (the default value is 180 seconds)

A typical incoming call involving Meridian Link consumes 153 milliseconds of Omega CPU time. A basic 2500-to-2500-set call requires 79 milliseconds of the same processor.

The real-time ratio of an incoming call over a basic call = $153/79 = 1.94$

Direct autodialer calls or outgoing ACD calls (preview dialing)

An autodialer connected to a 2500-type line card is controlled by a host through Meridian Link to make calls according to a data base in the host. This type of call does not involve an ACD agent. The autodialer either monitors control points by dialing these numbers periodically (as used in factory automation and sales updates) or is connected to a recording machine to perform customer surveys or market research.

Preview dialing works differently from autodialing (the agent selects the number to be dialed by a single keystroke) but the real-time impact to a CPU is about the same. All Meridian Link outgoing calls without transfer use the same formula.

(1) Direct autodialer

Use the following to calculate the CCS and calls:

$$\text{Autodialer CCS} = n \times a$$

$$\text{Autodialer calls} = n \times a \times 100/H_{t1}$$

where:

n = number of autodialer ports

a = CCS per autodialer port (the default value is 30 CCS)

H_{t1} = average holding time per autodialer port (the default value is 60 seconds)

(2) Preview dialing

Use the following to calculate the CCS and calls:

$$\text{Agent CCS} = n \times a$$

$$\text{Agent calls} = n \times a \times 100/H_{t2}$$

where:

n = number of ACD agents

a = CCS per ACD agent (the default value is 30 CCS)

H_{t2} = average holding time per ACD agent (the default value is 120 seconds)

The real-time ratio of an outgoing call over a basic call
 $= 100/79 = 1.39$

Autodialer calls with transfer (predictive dialing)

This category includes the scenario known as predictive dialing. An autodialer or host directs the Meridian 1 to make a central office (CO) trunk call. When a potential customer answers, the autodialer (or host) transfers the call to an agent to answer.

The average holding time of this type of call is relatively short for the autodialer compared to a conventional call, thus the frequency of calls can be very high.

Use the following to calculate the CCS and calls:

$$\text{Autodialer CCS} = n \times a$$

$$\text{Autodialer calls} = n \times a \times 100/H_{t3}$$

where:

n = number of autodialer ports

a = CCS per autodialer port (the default value is 30 CCS)

f = fraction of calls being transferred (the default value is 0.2)

H_{t3} = average holding time per autodialer (the default value is 20 seconds)

An autodialer call is equivalent to a Meridian Link outgoing call plus the overhead of a call transfer. Usually, calls generated by an autodialer or a host are answered and then transferred to agents for conversation.

To calculate the weighted average real time per call with a 20% built-in transfer rate, use the following:

$$\text{Real time} = 110 + 289 \times 0.2 = 168 \text{ milliseconds}$$

$$\text{Real-time ratio of an autodialer call over a basic call} = 168/79 = 2.13$$

A transfer call consumes 289 milliseconds of Omega CPU time. The impact of a call transfer is included in the real-time factor; however, it should not be counted as an extra call, because it is accounted for by the number of agents provided.

Host Enhanced Routing

The Host Enhanced Routing (HER) feature does not itself generate calls. It allows an application to treat an incoming call, based on DNIS, CLID, and so on.

Based on lab measurements, an HER call requires 253 milliseconds of Omega CPU time to process, assuming an average call waiting on two queues.

The real-time ratio of an HER call over a basic call = $253/79 = 3.20$

If HER calls are upgraded from ACD calls:

the incremental impact in real time = $253 - 153 = 100$ milliseconds.

The real-time ratio = $100/79 = 1.26$

Appendix C: Engineering the CCR system

For easier reading throughout this chapter, the combination of

- a Meridian 1 system within its appropriate software
- the AML
- the IPE Module or Application Module with its appropriate software (including CCR)

is referred to as the CCR system.

In engineering a CCR system, you are really finding the capacity of the system. The capacity of a CCR system depends on:

- the capacity of the Meridian 1 system. Has the Meridian 1 system enough spare capacity to add CCR? Or, if CCR is already installed, will CCR's portion of the total capacity be large enough to handle your requirements?
- the capacity of the AML. Can the AML handle the messages that will be generated by CCR?
- the capacity of the IPE Module or Application Module. Will the module be able to handle the requirements of CCR?

The capacity of the CCR system is the smallest of these three capacities.

An earlier chapter in this guide, "Engineering Meridian Link and CCR applications", describes how you can estimate the capacity of the Meridian 1 system.

This chapter describes how you can estimate the capacity of the CCR system. The accuracy of your estimate depends on how accurately you

estimate the number of messages generated by your scripts. This chapter describes how you can optimize a script

Engineering the capacity of a CCR system

The following factors influence the capacity of a CCR system:

- the Meridian 1 system option (Option 11-81)
- the Meridian 1 system software release
- the portion of Meridian 1 system real time allotted to CCR
- the baud rate of the AML
- the CCR release
- the number of ACD DN's for which statistics are provided by the Meridian 1 system to CCR (see the note below for more information)
- the average number of messages generated per call by active scripts
- the average length of time a call is controlled by CCR (includes the queuing time for QUEUE TO commands and waiting time for WAIT commands)

The following factors *do not* influence the capacity of a CCR system:

- the number of active scripts
- the number of CDNs

N The Meridian 1 system provides ACD DN statistics to CCR for all ACD DN's used:

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e
: as parameters in intrinsics. For example, the command IDLE AGENTS 8900 causes the Meridian 1 system to send ACD DN statistics on ACD DN 8900 so that CCR can evaluate the command (true or false)

- as ACD variables in the Variable Table

Calculating the CCR system capacity using the IPE Module or Application Module capacity rating

The IPE Module or Application Module capacity rating is based on the type of processor used in the Single Board Computer (SBC) card.

The assumptions used are:

- the AML baud rate is 19,200 bps (for more information, refer to the chapter on “Engineering Meridian Link and CCR applications”)
 - traffic arrives at a steady rate
 - each call generates ten messages on average
- 1 Calculate the portion of the capacity of the Meridian 1 system allotted to CCR.
Refer to the chapter on “Engineering Meridian Link and CCR applications” for information on calculating the capacity of a Meridian 1 system.
 - 2 Compare the CCR portion of the capacity of the Meridian 1 system with the following rating:
 - If the Application Module contains an MVME147 card, the rating is 10,000 calls per hour
 - If the IPE Module or Application Module contains an SMM167 or MVME167 card, the rating is 16,500 calls per hour.
 - 3 Use the lower value of the IPE Module or Application Module rating (step 2) and the portion of the Meridian 1 capacity (step 1) as the capacity of the CCR system.

Calculating the CCR system capacity using the IPE Module or Application Module performance chart

The IPE Module or Application Module performance chart (shown in Figure 1) is based on the type of processor used in the SBC card. Use this method if your scripts generate more than or less than ten messages per call on average. Refer to the section “Analyzing execution time and messages per call” later in this chapter for information on how to analyze your scripts to obtain this value. (If you are not sure, use a value of ten messages per call.)

The assumptions used are:

- the AML baud rate is 19,200 bps (for more information, refer to the chapter on “Engineering Meridian Link and CCR applications”)
- traffic arrives at a steady rate
- 10 messages per call
- no ACD statistics are used

- 1 Calculate the portion of the capacity (calls per hour) of the Meridian 1 system allotted to CCR.

Refer to the chapter on “Engineering Meridian Link and CCR applications” for information on calculating the capacity of a Meridian 1 system.

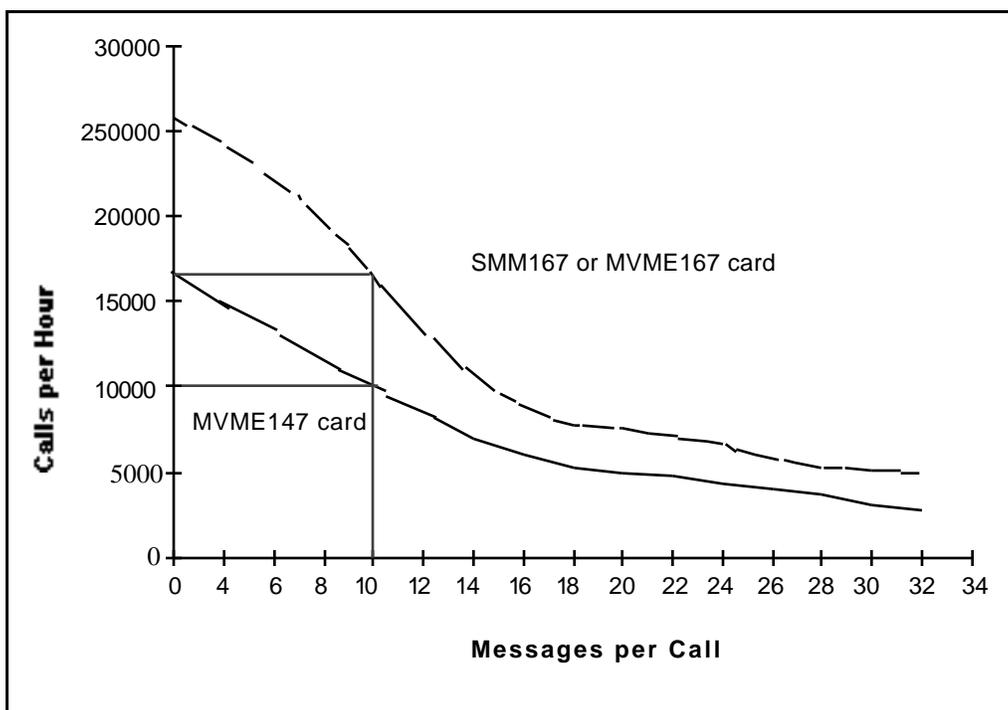
- 2 Using the chart shown in Figure 1, read along the horizontal axis to the point that represents the number of messages per call for your system. Draw a vertical line to the curve that represents the type of SBC card in your IPE Module or Application Module. From the point where the vertical line intersects with the curve, draw a horizontal line to the vertical axis to obtain a value for the capacity of the IPE Module or Application Module:

- If the Application Module contains an MVME147 card, obtain the rating from the solid line (the capacity for 10 messages per call is approximately 10,000 calls per hour)
- If the IPE Module or Application Module contains an SMM167 or MVME167 card, obtain the rating from the dashed line (the

capacity for 10 messages per call is approximately 16,500 calls per hour)

- 3 Use the lower value of the IPE Module or Application Module performance rating (step 2) and the portion of the Meridian 1 capacity (step 1) as the capacity of the CCR system.

Figure 1
CCR performance chart without ACD DN statistics



Calculating the CCR system capacity using ACD DN statistics

This method provides a value for the CCR system capacity that is more accurate than the previous two methods but requires an analysis of the scripts to be used.

The assumptions used are:

- the AML baud rate is 19,200 bps (for more information, refer to the chapter on “Engineering Meridian Link and CCR applications”)
- traffic arrives at a steady rate

- 1 Calculate the portion of the capacity of the Meridian 1 system allotted to CCR.

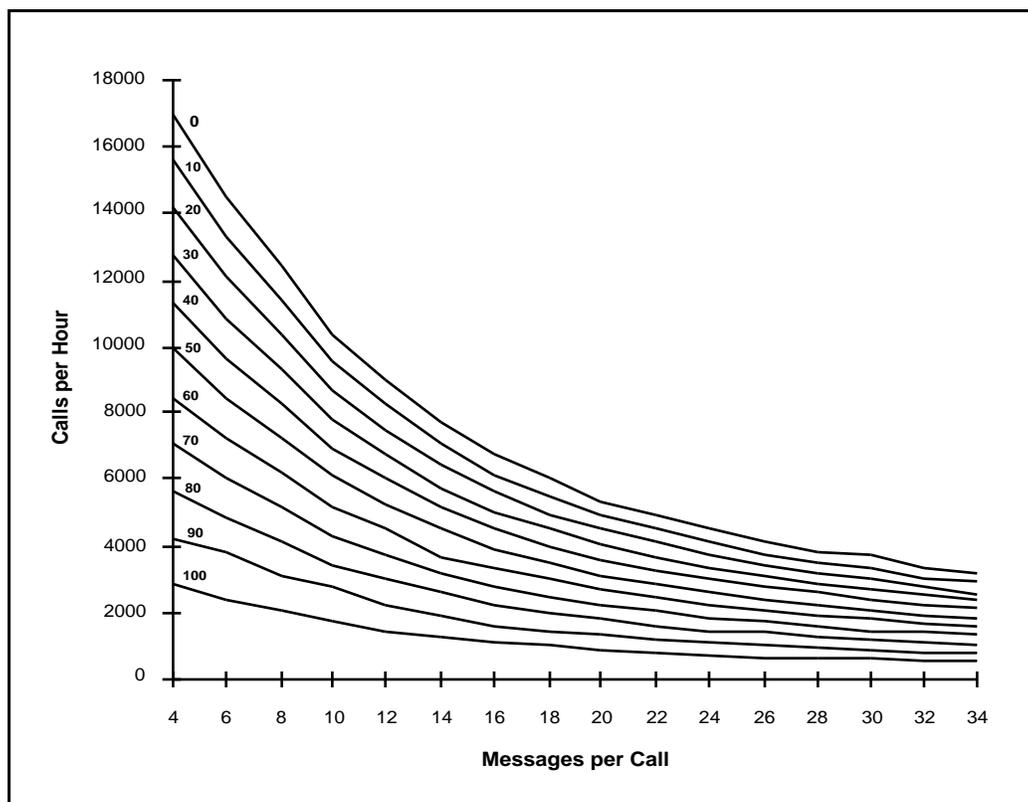
Refer to the chapter on “Engineering Meridian Link and CCR applications” for information on calculating the capacity of a Meridian 1 system.

- 2 Calculate the number of ACD DNs for which the Meridian 1 system will provide statistics to CCR. Use the following steps:

- list all ACD DNs used as a parameter in an intrinsic in any script (for example, ACD DN 8900 in “IDLE AGENTS 8900”)
- list all ACD DNs in the Variable Table
- delete any ACD DNs from the second list that appear in the first list
- count the resulting ACD DNs from the two lists

- 3 If your SBC card is an SMM167 or MVME167 card, go to step 4. If your SBC card is an MVME147 card, perform this step. On Figure 2, find the curve that represents the number of ACD DNs closest to the value obtained in step 2. Read along the horizontal axis to find the value that represents the average number of messages per call for your CCR system. Draw a vertical line from the point on the horizontal axis representing the average number of messages per call to the curve. From the point where the vertical line intersects the curve, draw a horizontal line to the vertical axis to obtain the capacity in calls per hour.

Figure 2
CCR performance chart with ACD DN statistics (MVME147)



N The points to the right of the vertical axis represent lines with θ -100 ACD DNs.

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e

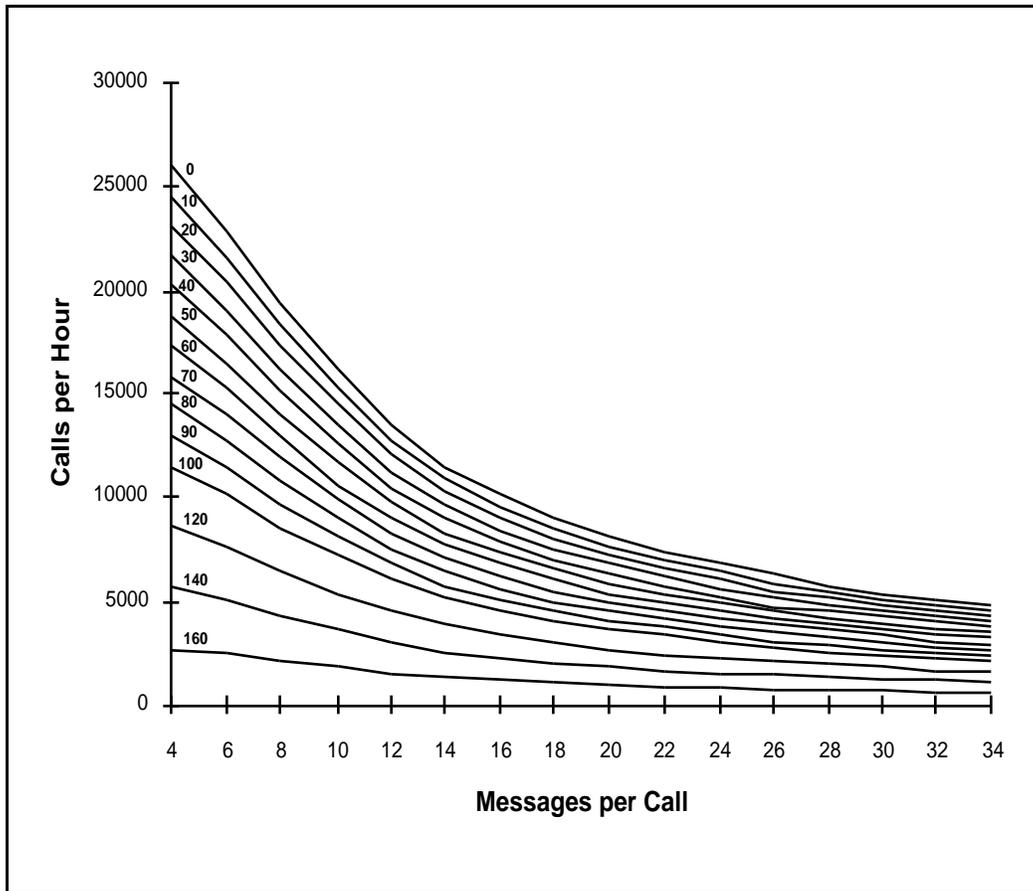
:

For example, assume that, in step 2, you listed 60 ACD DNs. Assume also that your CCR system generates ten messages per call. Figure 2 shows that the capacity is 5100 calls per hour.

- 4 If you have an MVME147 card, go to step 5. If you have an SMM167 or MVME167 card, perform this step. On Figure 3, find the curve that represents the number of ACD DNs closest to the value obtained in

step 2. Read along the horizontal axis to find the value that represents the average number of messages per call for your CCR system. Draw a vertical line from the point on the horizontal axis representing the average number of messages per call to the chosen curve. From the point where the vertical line intersects the curve, draw a horizontal line to the vertical axis to obtain the capacity in calls per hour.

Figure 3
CCR performance chart with ACD DN statistics (MVME167)



N The points to the right of the vertical axis represent lines with

0-100 ACD DNs.
t
e
:

For example, assume that, in step 2, you listed 60 ACD DN's. Assume also that your CCR system generates ten messages per call. Figure 3 shows that the capacity is approximately 11,000 calls per hour.

- 5 Use the lower value of the CCR module call capacity (step 3 or 4) and the portion of the Meridian 1 capacity (step 1) as the capacity of the CCR system.

Analyzing scripts

The number of messages generated per call has a major effect upon the capacity of a CCR system. For example, from Figure 3, the capacity of a CCR system with 60 ACD DN's providing statistics and with an average of 10 messages per call is 11,000 calls per hour. The capacity of the same system but with an average of 12 messages per call is 9000 calls per hour. The number of messages per call can vary from as few as three to as many as 35.

The factors that influence how many messages a script will generate are:

- the call type — how many paths through the script are there, and what happens on each path?
- the execution time — how long does a call take to complete or how long does the call wait before it is answered or abandoned?
- the length and structure of the script — how many commands are there per call, and how long a delay between commands?

This section describes how you can analyze a script to determine the types of call it creates and the number of messages that will be generated by that call. This section also describes how you can change the structure to make the script more efficient.

Analyzing call types

The number of paths a call can take through a script identifies the number of *call types* that the script has. Scripts can be simple, with one or two paths that a call can take, or complicated, with several paths that a call can take. Yet, even with very complicated scripts, most calls will use only a few call types, and these call types are usually apparent. You should analyze your scripts to find out how many call types each script has, and what happens to each type. You may want to analyze all call types for simple scripts but only the most-used call types for very complicated scripts. The following examples show the method.

Example 1

```
QUEUE TO 8900
WAIT 20
GIVE RAN ran_route
GIVE MUSIC music_route
```

The script in Example 1 has only a single path. All calls (if they wait for 20 seconds or more) execute all commands. This example has one call type.

Example 2

```
FORCE BUSY IF (Total Queued Calls 8900 > 100)
QUEUE TO 8900
WAIT 20
GIVE RAN ran_route
GIVE MUSIC music_route
```

The script in Example 2 has two paths:

- path 1, in which calls receive a busy signal and drop from CCR control
- path 2, in which calls execute the remaining commands

The script in Example 2 has two call types. If this is a new script in an existing system, you may be able to use historical reports to find out how many calls receive busy signals. If this is a new script in a new system, you must estimate how many calls you expect to receive busy signals.

Example 3

```
GOTO Platinum_Callers IF DNIS = platinum_dnis
GOTO Gold_Callers IF DNIS = gold_dnis
GOTO Regular_Callers
SECTION Platinum_Callers
    QUEUE TO cust_svc WITH PRIORITY 1
    QUEUE TO special_svc WITH PRIORITY 1
    GIVE RAN platinum_ran
    GIVE MUSIC soft_music
    QUIT
SECTION Gold_Callers
    QUEUE TO cust_svc WITH PRIORITY 2
    GIVE RAN gold_ran
    GIVE MUSIC soft_music
SECTION Loop
    WAIT 2
    GOTO Queue_Secondary IF Age Of Call > 30
    GOTO Loop
SECTION Queue_Secondary
    QUEUE TO special_svc WITH PRIORITY 2
    QUIT
SECTION Regular_Callers
    FORCE BUSY IF (Day Of Year = Holiday OR
                  Day Of Week = Weekend) AND
                  (Total Queued Calls cust_svc >
                   (2*Logged Agents cust_svc))
    QUEUE TO cust_svc WITH PRIORITY 3
    GIVE RAN regular_ran
SECTION Regular_Loop
    WAIT 2
    GOTO Change_Priority IF Age Of Call > 60
    GOTO Regular_Loop
SECTION Change_Priority
    QUEUE TO cust_svc WITH PRIORITY 2
    QUIT
```

On first glance at Example 3, you may see three call types; one each for the Platinum, Gold, and Regular Callers. However, if you analyze the script carefully, you will see an additional call type, making a total of four call types.

Call type 1

```
GOTO Platinum_Callers IF DNIS = platinum_dnis
.
.
SECTION Platinum_Callers
    QUEUE TO cust_svc WITH PRIORITY 1
    QUEUE TO special_svc WITH PRIORITY 1
    GIVE RAN platinum_ran
    GIVE MUSIC soft_music
    QUIT
```

Call type 2

```
GOTO Gold_Callers IF DNIS = gold_dnis
.
.
SECTION Gold_Callers
    QUEUE TO cust_svc WITH PRIORITY 2
    GIVE RAN gold_ran
    GIVE MUSIC soft_music
SECTION Loop
    WAIT 2
    GOTO Queue_Secondary IF Age Of Call > 30
    GOTO Loop
SECTION Queue_Secondary
    QUEUE TO special_svc WITH PRIORITY 2
    QUIT
```

If you examine the script, you will see that some regular callers will receive busy signals, and others will not.

Following is the path for the call type for regular callers who do not receive busy signals.

Call type 3

```
GOTO Regular_Callers
.
.
SECTION Regular_Callers
.
.
    QUEUE TO cust_svc WITH PRIORITY 3
    GIVE RAN regular_ran
SECTION Regular_Loop
    WAIT 2
    GOTO Change_Priority IF Age Of Call > 60
    GOTO Regular_Loop
SECTION Change_Priority
    QUEUE TO cust_svc WITH PRIORITY 2
    QUIT
```

Following is the path for the call type for regular callers who receive busy signals.

Call type 4

```
GOTO Regular_Callers
.
.
SECTION Regular_Callers
    FORCE BUSY IF (Day_Of_Year = Holiday OR
                 Day_Of_Week = Weekend) AND
                 (Total_Queued_Calls cust_svc >
                  (2*Logged_Agents cust_svc))
```

Analyzing execution time

After having analyzed your script in the previous section to find the number of call types, you should examine each call type to find out how long the call type will take to execute and how many messages the call type will generate while executing. This section describes how you can do this. This section also describes how you can create a spreadsheet and use the spreadsheet to create charts similar to those shown earlier in this chapter.

CCR commands may be *executed* or *unexecuted*. An executed command can be either an unconditional command (such as QUEUE TO 8900) or a conditional command whose condition evaluates to true (such as QUEUE TO 8900 IF Time of Day = 08:00..17:00 if evaluated during normal working hours).

An unexecuted command is a conditional command whose condition evaluates to false (such as QUEUE TO 8900 IF Time of Day = 08:00..17:00 if evaluated after normal working hours). Each executed CCR command generates a specific number of messages, and many CCR commands have a specific execution time. Table 14 shows the time to execute and the number of messages generated by executed CCR commands.

Table 14
CCR command execution times and messages generated

| CCR command | Execution time | Number of messages |
|-------------------------------|-----------------------|--------------------|
| GOTO <i>section</i> | 0 | 0 |
| WAIT <i>seconds</i> | number of seconds | 0 |
| SECTION <i>label</i> | 0 | 0 |
| QUIT | terminates | 0 |
| QUEUE TO <i>acd_dn</i> | 0 | 2 |
| REMOVE FROM <i>acd_dn</i> | 0 | 2 |
| ROUTE TO <i>dn</i> | terminates | 2 |
| FORCE BUSY | terminates | 2 |
| FORCE DISCONNECT | terminates | 2 |
| GIVE RINGBACK | 0 | 2 |
| GIVE SILENCE | 0 | 2 |
| GIVE MUSIC <i>music_route</i> | 0 | 2 |
| GIVE RAN <i>ran_route</i> | length of RAN | 3 |
| GIVE IVR <i>ivr_dn</i> | length of IVR session | 3 |

Some commands (such as GOTO and WAIT) do not generate any messages and you can disregard them when you are calculating the message traffic.

In addition to the messages generated per executed command (the command messages), overhead messages may be generated by a call depending on how the call ends. If the call is answered or abandoned, the call generates two overhead messages in addition to the command messages. If a call terminates in a FORCE BUSY, FORCE DISCONNECT, or ROUTE TO command, the call generates one overhead message in addition to the command messages.

The total number of messages generated per call = $m_0 + (m_1 + m_2 + \dots + m_n)$

in which m_0 represents the overhead messages and m_1 through m_n represent the messages for each executed command in the script.

Example 4

```
QUEUE TO 8900
WAIT 20
GIVE RAN ran_route
GIVE MUSIC music_route
```

The script in Example 4 generates 9 messages as follows:

- QUEUE TO 8900 generates 2 messages
- WAIT 20 generates 0 messages
- GIVE RAN ran_route generates 3 messages
- GIVE MUSIC music_route generates 2 messages
- the script generates 2 overhead messages because all calls will be either answered or abandoned

Example 5

```
FORCE BUSY IF (Total Queued Calls > 100)
QUEUE TO 8900
WAIT 20
GIVE RAN ran_route
GIVE MUSIC music_route
```

The script in Example 5 has two call types as shown by Table 15.

Table 15
Messages generated by Example 5

| | | Execution Time | Cumulative Script Execution Time | Messages per Command | Cumulative Script Messages |
|--------------------|------------|----------------|----------------------------------|----------------------|----------------------------|
| Call Type 1 | FORCE BUSY | 0 | 0 | 2 | 2 |
| Call Type 2 | QUEUE TO | 0 | 0 | 2 | 2 |
| | WAIT | 10 | 10 | 0 | 2 |
| | GIVE RAN | 30 | 40 | 3 | 5 |
| | GIVE MUSIC | 0 | 40 | 2 | 7 |

Call type 1 (calls receiving busy signals) generates 3 messages as follows:

- FORCE BUSY IF (Total Queued Calls > 100) generates 2 messages
- the call type generates one overhead message because it ends in a FORCE BUSY command

Call type 2 (calls queued) generates 9 messages as follows:

- QUEUE TO 8900 generates 2 messages
- WAIT 20 generates 0 messages
- GIVE RAN ran_route generates 3 messages
- GIVE MUSIC music_route generates 2 messages
- the call type generates 2 overhead messages because all calls will be either answered or abandoned

Example 6

```
GOTO Platinum_Callers IF DNIS = platinum_dnis
GOTO Gold_Callers IF DNIS = gold_dnis
GOTO Regular_Callers
SECTION Platinum_Callers
    QUEUE TO cust_svc WITH PRIORITY 1
    QUEUE TO special_svc WITH PRIORITY 1
    GIVE RAN platinum_ran
    GIVE MUSIC soft_music
    QUIT
SECTION Gold_Callers
    QUEUE TO cust_svc WITH PRIORITY 2
    GIVE RAN gold_ran
    GIVE MUSIC soft_music
SECTION Loop
    WAIT 2
    GOTO Queue_Secondary IF Age Of Call > 30
    GOTO Loop
SECTION Queue_Secondary
    QUEUE TO special_svc WITH PRIORITY 2
    QUIT
SECTION Regular_Callers
    FORCE BUSY IF (Day Of Year = Holiday OR
                  Day Of Week = Weekend) AND
                  (Total Queued Calls cust_svc >
                   (2*Logged Agents cust_svc))
    QUEUE TO cust_svc WITH PRIORITY 3
    GIVE RAN regular_ran
SECTION Regular_Loop
    WAIT 2
    GOTO Change_Priority IF Age Of Call > 60
    GOTO Regular_Loop
SECTION Change_Priority
    QUEUE TO cust_svc WITH PRIORITY 2
    QUIT
```

As described in Example 3, the script in Example 6 has four call types. Table 16 shows the messages generated by each call type.

Table 16
Messages generated by Example 6

| | | Delay per Command | Cumulative Script Execution Time | Messages per Command | Cumulative Script Messages |
|---------------------------|------------|----------------------------------|---|-------------------------------------|---|
| Platinum | QUEUE TO | 0 | 0 | 2 | 2 |
| | QUEUE TO | 0 | 0 | 2 | 4 |
| | GIVE RAN | 20 | 20 | 3 | 7 |
| | GIVE MUSIC | 0 | 20 | 2 | 9 |
| Gold | QUEUE TO | 0 | 0 | 2 | 2 |
| | GIVE RAN | 25 | 25 | 3 | 5 |
| | GIVE MUSIC | 0 | 25 | 2 | 7 |
| | WAIT 2 | 2 | 27 | 0 | 7 |
| | WAIT 2 | 2 | 29 | 0 | 7 |
| | WAIT 2 | 2 | 31 | 0 | 7 |
| | QUEUE TO | 0 | 31 | 2 | 9 |
| Regular- busy | FORCE BUSY | 0 | 0 | 2 | 2 |
| | QUEUE TO | 0 | 0 | 2 | 2 |
| Regular- queue | GIVE RAN | 15 | 15 | 3 | 5 |
| | WAIT 2 | 2 | 17 | 0 | 5 |
| | WAIT 2 | 2 | 19 | 0 | 5 |
| | WAIT 2 | 2 | 21 | 0 | 5 |
| | WAIT 2 | 2 | 23 | 0 | 5 |

| | | | | | |
|---------------|--------|---|----|---|---|
| | WAIT 2 | 2 | 25 | 0 | 5 |
| — continued — | | | | | |

Table 16
Messages generated by Example 6, continued

| | | Delay per Command | Cumulative Script Execution Time | Messages per Command | Cumulative Script Messages |
|----------------------------------|--------|-------------------|----------------------------------|----------------------|----------------------------|
| Regular-queue (continued) | WAIT 2 | 2 | 27 | 0 | 5 |
| | WAIT 2 | 2 | 29 | 0 | 5 |
| | WAIT 2 | 2 | 31 | 0 | 5 |
| | WAIT 2 | 2 | 33 | 0 | 5 |
| | WAIT 2 | 2 | 35 | 0 | 5 |
| | WAIT 2 | 2 | 37 | 0 | 5 |
| | WAIT 2 | 2 | 39 | 0 | 5 |
| | WAIT 2 | 2 | 41 | 0 | 5 |
| | WAIT 2 | 2 | 43 | 0 | 5 |
| | WAIT 2 | 2 | 45 | 0 | 5 |
| | WAIT 2 | 2 | 47 | 0 | 5 |
| | WAIT 2 | 2 | 49 | 0 | 5 |
| | WAIT 2 | 2 | 51 | 0 | 5 |
| | WAIT 2 | 2 | 53 | 0 | 5 |
| | WAIT 2 | 2 | 55 | 0 | 5 |
| WAIT 2 | 2 | 57 | 0 | 5 | |

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| | | | | | |
|--|----------|---|----|---|---|
| | WAIT 2 | 2 | 59 | 0 | 5 |
| | WAIT 2 | 2 | 61 | 0 | 5 |
| | QUEUE TO | 0 | 61 | 2 | 7 |

Table 16 shows that call type 4 (shown in the following series of commands) executes inefficiently. The WAIT 2 statement repeats approximately 23 times in the Regular Loop until the call has aged beyond 60 seconds. During that time, the WAIT 2 statement does no useful work.

```
SECTION Regular_Callers
.
.
  QUEUE TO cust_svc WITH PRIORITY 3
  GIVE RAN regular_ran
SECTION Regular_Loop
  WAIT 2
  GOTO Change_Priority IF Age_Of_Call > 60
  GOTO Regular_Loop
SECTION Change_Priority
  QUEUE TO cust_svc WITH PRIORITY 2
  QUIT
```

The following series of commands shows a more efficient way to achieve the same effect:

```
SECTION Regular_Callers
.
.
  QUEUE TO cust_svc WITH PRIORITY 3
  GIVE RAN regular_ran
  WAIT 40
SECTION Regular_Loop
  WAIT 2
  GOTO Change_Priority IF Age_Of_Call > 60
  GOTO Regular_Loop
SECTION Change_Priority
  QUEUE TO cust_svc WITH PRIORITY 2
  QUIT
```

By adding the WAIT 40 command, the call will have aged to approximately 55 seconds before it enters the Regular Loop and hence the number of executions of the inefficient WAIT 2 command has been reduced dramatically.

Analyzing messages per call

After having analyzed your script to find the number of call types, examined each call type to find out how long the call type will take to execute, you should analyze how many messages the call type will generate while executing. A factor affecting the number of messages generated by a call is the time required by the script to execute. In most cases, commands take very little time to execute and for the purposes of these calculations can be considered to take no time to execute. However, commands such as WAIT, GIVE RAN, and GIVE IVR impose a waiting time on the script. The WAIT command has a waiting time indicated by the command's parameter; the GIVE RAN command has a waiting time equal to the length of the RAN; the GIVE IVR command has a waiting time equal to the length of the IVR session.

Example 7

```
QUEUE TO 8900
WAIT 20
GIVE RAN ran_route
GIVE MUSIC music_route
```

If the RAN is 30 seconds long:

- QUEUE TO 8900 generates 2 messages and has 0 execution time
- WAIT 20 generates 0 messages and has 20 seconds execution time
- GIVE RAN ran_route generates 3 messages and has 30 seconds execution time
- GIVE MUSIC music_route generates 2 messages and has 0 execution time

The script in Example 7 can only complete if the call's execution time is longer than 50 seconds. If a call is answered or abandoned after less than 20 seconds, only the QUEUE TO and WAIT commands execute, generating four messages (two command messages for the QUEUE TO command and two overhead messages because the call is answered or abandoned). If a call is answered or abandoned after 20 to 50 seconds, the QUEUE TO, WAIT, and GIVE RAN commands execute, generating seven messages (five command messages and two overhead messages). If a call waits for more than 50 seconds, the complete script executes, generating nine messages (seven command messages, two overhead messages).

Example 8

```

FORCE BUSY IF (Total Queued Calls > 100)
QUEUE TO 8900
WAIT 20
GIVE RAN ran_route
GIVE MUSIC music_route

```

Table 17 is a spreadsheet showing the execution time and number of messages generated during the execution of the script, assuming the RAN is 30 seconds long.

Table 17
Execution time and messages generated by Example 8

| | | Execution Time | Cumulative Script Execution Time | Messages per Command | Cumulative Script Messages |
|--------------------|------------|----------------|----------------------------------|----------------------|----------------------------|
| Call Type 1 | FORCE BUSY | 0 | 0 | 2 | 2 |
| Call Type 2 | QUEUE TO | 0 | 0 | 2 | 2 |
| | WAIT | 10 | 10 | 0 | 2 |
| | GIVE RAN | 30 | 40 | 3 | 5 |
| | GIVE MUSIC | 0 | 40 | 2 | 7 |

Scenario 1

If 20% of calls receive busy signals, and 80% of calls wait for 50 seconds and complete the script, Table 18 is a spreadsheet showing that the average execution time per call is 7.8 seconds.

Table 18
Average execution time for Example 8 (1)

| | | Number messages/call | % of Call Type |
|------------------|----------|----------------------|----------------|
| Busy Tone | Script | 2 | |
| | Overhead | 1 | |
| | Total | 3 | 20% |
| Queue | Script | 7 | |
| | Overhead | 2 | |
| | Total | 9 | 80% |
| | | 7.8 | |

You can use this value on the horizontal axis of Figure 1, 2 or 3 to find the capacity (number of calls per hour) of the CCR module, assuming that all calls use the script shown in Example 8.

Scenario 2

If, however, 20% of calls receive busy signals, 40% are answered or abandoned in less than 25 seconds, and 40% are complete, Table 19 is a spreadsheet showing that the average execution time is 7 seconds.

Like Scenario 1, you can use this value on the horizontal axis of Figure 1, 2 or 3.

Table 19
Average execution time for Example 8 (2)

| | | Length (seconds) and % of Calls | | | | Average msgs/call | % of Call Type |
|------------------|----------|---------------------------------|-----|----------|-----|-------------------|----------------|
| | | <25 seconds | | Complete | | | |
| | | #msgs | % | #msgs | % | | |
| Busy Tone | Script | 2 | | 2 | | | |
| | Overhead | 1 | | 1 | | | |
| | Total | 3 | 50% | 3 | 50% | 3.0 | 20% |
| Queue | Script | 5 | | 7 | | | |
| | Overhead | 5 | | 2 | | | |
| | Total | 7 | 50% | 9 | 50% | 8.0 | 80% |
| | | | | | | 7.0 | |

Example 9

```
GOTO Platinum_Callers IF DNIS = platinum_dnis
GOTO Gold_Callers IF DNIS = gold_dnis
GOTO Regular_Callers
SECTION Platinum_Callers
    QUEUE TO cust_svc WITH PRIORITY 1
    QUEUE TO special_svc WITH PRIORITY 1
    GIVE RAN platinum_ran
    GIVE MUSIC soft_music
    QUIT
SECTION Gold_Callers
    QUEUE TO cust_svc WITH PRIORITY 2
    GIVE RAN gold_ran
    GIVE MUSIC soft_music
SECTION Loop
    WAIT 2
    GOTO Queue_Secondary IF Age_Of_Call > 30
    GOTO Loop
SECTION Queue_Secondary
    QUEUE TO special_svc WITH PRIORITY 2
    QUIT
SECTION Regular_Callers
    FORCE BUSY IF (Day_Of_Year = Holiday OR
                 Day_Of_Week = Weekend) AND
                 (Total_Queued_Calls cust_svc >
                  (2*Logged_Agents cust_svc))
    QUEUE TO cust_svc WITH PRIORITY 3
    GIVE RAN regular_ran
SECTION Regular_Loop
    WAIT 2
    GOTO Change_Priority IF Age_Of_Call > 60
    GOTO Regular_Loop
SECTION Change_Priority
    QUEUE TO cust_svc WITH PRIORITY 2
    QUIT
```

Scenario 3

Of all calls:

- 20% are from Platinum Card holders and, of these, 90% are answered within 10 seconds
- 30% are from Gold Card holders and, of these, 70% are answered within 30 seconds
- 5% are from Regular Card holders and receive busy signals
- 45% are from Regular Card holders and, of these, 60% are answered within 60 seconds

Table 20 is a spreadsheet showing that the average execution time for this scenario is 7.5 seconds. Like Scenario 1, you can use this value on the horizontal axis of Figure 1, 2 or 3.

Table 20
Average execution time for Example 9

| | | Length (seconds) and % of Calls | | | | | | | | | | | Average msgs/call | % of Call Type | |
|----------------------|----------|---------------------------------|------|-------------|-----|-------------|----|-------------|---|-------------|-----|-------------|-------------------|----------------|-----|
| | | <10 seconds | | >10 seconds | | <30 seconds | | >30 seconds | | <60 seconds | | >60 seconds | | | |
| | | #msgs | % | #msgs | % | #msgs | % | #msgs | % | #msgs | % | #msgs | | | % |
| Regular-busy | Script | 2 | | | | | | | | | | | | | |
| | Overhead | 1 | | | | | | | | | | | | | |
| | Total | 3 | 100% | | | | | | | | | | 0% | 3.0 | 5% |
| Regular-queue | Script | | | | | | | | | 5 | | 7 | | | |
| | Overhead | | | | | | | | | 2 | 60% | 2 | | | |
| | Total | | | | | | | | | 7 | | 9 | 40% | 7.8 | 45% |
| Gold | Script | | | | 7 | | 9 | | | | | | | | |
| | Overhead | | | | 2 | | 2 | | | | | | | | |
| | Total | | | | 9 | 70% | 11 | 30% | | | | | | 9.5 | 30% |
| Platinum | Script | 2 | | 9 | | | | | | | | | | | |
| | Overhead | 2 | | 2 | | | | | | | | | | | |
| | Total | 4 | 90% | 11 | 10% | | | | | | | | | 4.7 | 20% |
| | | | | | | | | | | | | 7.5 | | | |

Other characteristics that affect traffic calculations

The calculations in this chapter make some assumptions. This section describes characteristics that could affect these assumptions and hence the calculations.

Steady arrival rate traffic

The calculations in this chapter assume that the traffic arrives at a steady rate; that is, the time between the arrival of successive calls is approximately equal. For example, a steady arrival rate of 10,800 calls per hour means three calls arrive at equal intervals per second.

Burst rate traffic

An average hourly call rate of 10,800 calls can also be the result of 800 calls arriving in a burst over the first 30 seconds and the remaining 10,000 calls arriving over the rest of the hour. This type of traffic is called burst rate traffic. The more uneven the rate of arrival, the more the traffic resembles burst rate traffic rather than steady arrival rate traffic.

Effect of burst rate traffic on capacity

All calculations in this chapter assume that traffic arrives at a steady rate. The CCR system can sustain the calculated steady rate traffic indefinitely. The CCR system can also sustain bursts of higher call rates but only for a limited time.

An Application Module containing an MVME147 SBC card can handle a burst of traffic arriving at 5 to 6 calls per second (18,000 to 21,600 calls per hour) for no longer than 30 seconds. The same module can handle a burst of traffic arriving at about 8 calls per second (28,800 calls per hour) for 5 to 6 seconds. A burst of traffic arriving at a rate of 10 calls per second (36,000 calls per hour) or greater overloads the module almost immediately.

An IPE Module or an Application Module containing an SMM167 or MVME167 SBC card can handle a burst of traffic arriving at 10 to 12 calls per second (36,000 to 43,200 calls per hour) for no longer than 30 seconds. The same module can handle a burst of traffic arriving at about 20 calls per second (72,000 calls per hour) for 5 to 6 seconds. A burst of traffic arriving at a rate of 25 calls per second (90,000 calls per hour) or greater overloads the module almost immediately.

Controlling Overload

Overload occurs when a burst of traffic has exceeded the capacity of the system. The system handles overload conditions in different ways, depending on the type of overload.

Congestion control

When a call arrives, CCR must respond to the Meridian 1 system within four seconds with a valid treatment for that call. If CCR does not respond in time or with a valid treatment, the call defaults. That is, the call is removed from CCR control, is routed to the ACD DN of the CDN where the call arrived, and is treated as if it entered the ACD DN directly.

If ten successive calls default, the Meridian 1 assumes that the system is congested and prints a CCR001 message followed by a CSA105 message on the maintenance console. From this point, the Meridian 1 system gives all CCR calls (that is, calls arriving at CDNs controlled by CCR) default treatment until the congestion clears. CCR and the Meridian 1 system clear the congestion with a handshake, printing a CCR002 message followed by a CSA104 message on the Meridian 1 maintenance console.

Congestion usually clears within 10 to 20 seconds. No calls are lost, because Meridian 1 handles them during congestion. After congestion clears, CCR call processing resumes without manual intervention. Infrequent congestion due to an unusual high burst of traffic is normal operation.

CCR flow control

When the AML becomes overloaded (for example, by a burst of traffic), the Meridian 1 system sends overload messages to CCR to control the execution of calls. Depending on the arrival rate of calls, the number of calls waiting, and the configuration of the AML, the Meridian system assigns a flow control level to the overload messages. Table 21 shows the flow control levels, what they mean, and how CCR responds to them.

Table 21
CCR flow control levels

| Level | Meaning | CCR action |
|--------------|---|--|
| 0 | No flow control needed | Continue or resume normal call processing execution |
| 1 | Warning. Inbound traffic was too high during the last time period | Slow down call execution by waiting between calls |
| 2 | Some messages were lost. Inbound traffic was too high for two successive time periods | Reject all new calls back to the Meridian 1 system where they will receive default treatment. No new calls will be accepted until level 0 is restored or the link fails |
| 3 | All inbound traffic is lost. If inbound traffic continues, the link will fail. Inbound traffic can resume when level 0 is restored. | New calls will either time out or receive default treatment. CCR cannot communicate with the Meridian 1 system and responds to a level 3 event in a similar way to a link-down event by cleaning up its call database and doing nothing until it receives a level 0 message. |

CCR activities that do not relate to call execution (such as script installation and removal) are not affected by flow control as long as they do not require communication with the Meridian 1 system.

If the link fails, or if CCR is stopped and restarted, or if CCR receives a Meridian 1 initialization signal, CCR assumes a level 0 condition until the Meridian 1 system sends an overload message with a different level.

List of terms

Application Module (AM)

Northern Telecom's Motorola-based Application Processor that is packaged within an AEM in a Meridian 1.

Application Module Link (AML)

A Northern Telecom internal and proprietary link that connects the Meridian 1 (via ESDI or MSDL) to the Application Module or IPE Module.

Automatic Call Distribution (ACD)

This is a feature offered by the Meridian 1 that queues and distributes incoming calls to a number of answering positions. Calls are queued until an agent is available. If multiple agents are available, calls are serviced in the order they arrive and distributed so that the workload at each answering position is approximately equal. ACD has many additional features, including recorded announcement (RAN), music while queued, night treatment, overflows, statistics/reports, and networking with ISDN.

associated set (AST)

AST is an attribute applied to a telephone set that tags it as controllable by a host application over Meridian Link. A set must be configured as AST (Overlay 10 or 11) before a host application can issue call processing requests (such as, MakeCall, Transfer, Conference, Answer, Release) on behalf of the set, or receive event reports (such as, Status Change or CallOffered messages) on behalf of a set. AST is configured for 500/2500 sets (also known as PBX sets) in Overlay 10, and for proprietary sets (known as BCS, or Business Communications System) in Overlay 11. In the case of BCS sets, up to two DNs can be configured as AST in Overlay 10/11 and will be identified as the AST set: the administrator will not be permitted to configure additional sets with that DN as AST.

central office (CO)

A public network telephone exchange. Local subscribers are connected to the CO via local loops; PBXs are connected to the CO via trunks. Northern Telecom's DMS-100 is an example of a CO.

Customer Controlled Routing (CCR)

CCR is a product that enables you to control and route Automatic Call Distribution (ACD) calls entering your Meridian 1 system. You can provide a specific recorded announcements, music, etc. before assigning a call to an agent.

Enhanced Serial Data Interface (ESDI)

A Northern Telecom Meridian 1 pack, numbered QPC513. This card supports internal communications between the Meridian 1 CPU and other components within the Meridian 1 system.

Equivalent Basic Call

An internal, non-features, 2500-set-to-2500-set call. Used in representing the call capacity of a CPU.

Intelligent Peripheral Equipment (IPE) Module

Northern Telecom's more compact type of Application Module designed to offer customers a low-cost system which may be housed in a Meridian Option 11 cabinet or IPE shelf.

Interactive Voice Response (IVR)

A system/facility that plays voice menus to callers, and acts upon user input (typically DTMF digits from a touch tone phone).

IPE Module

See Intelligent Peripheral Equipment (IPE) Module.

link 0

Link 0 is the link between the Meridian Link module or the CCR module and Meridian I.

link 1

Link 1 is the link between the Meridian Link module and host computer.

Meridian 1

Meridian 1 is the private branch exchange (PBX) that handles the calls to and from an organization's ACD system. It routes calls to the various queues and provides the framework for all the ACD features available through various applications.

Meridian Link

Meridian Link is an application that allows a Meridian 1 system to exchange information with a host computer so that users can integrate the capabilities of both into a business application.

Multi-use Serial Data Link (MSDL)

This card supports internal communications between the Meridian 1 CPU and other components within the Meridian 1 system.

Private Branch Exchange (PBX)

A CPE telephone switch, typically used by a business to service their internal telephone needs. A PBX typically offers many more advanced features that are generally available on the public network. A PBX interfaces with the public network central office via circuits known as trunks. PBX is also used as a name for a family of telephone sets: 500 (rotary) and 2500 (touch tone) sets.

real-time factor

The additional real time required for a featured call over a basic call. Expressed as a fraction of a basic call.

real-time ratio

The ratio of the real time of a featured call to a basic call.

route

Route usually refers to a trunk route. This is a collection of trunks which share many common characteristics, such as trunk type (for example, DID). On the Meridian 1, trunks must be associated with (belong to) a trunk route. Routes are configured in Overlay 16 on the Meridian 1.

trunk

A communications link between a PBX and the public central office (CO), or between PBXs, or between COs.

variable

This is a user-defined name that represents a value or set of values. Scripts use variables so that changes made in the Variable Table will be reflected in all scripts using that particular variable.

X.25

A standard interface protocol to a public switched data network. X.25 has been implemented by every major computer vendor, and is frequently used as the preferred communication mechanism between dissimilar systems. Meridian Link supports X.25 for communications between a host computer and the Meridian 1.

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Meridian 1

Meridian Link / Customer Controlled Routing

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