RcPAX Network System

X.25 DCE and X.75 STE

Installation and Operating Guide

Keywords:
RcPAX, RC5000 MegaSwitch, RC5000 Network Switch, NMC8000, DCE, STE.
TESTABN.

Abstract:
This document describes the installation and operation of X.25 DCE and X.75 STE Software Entities of the RcPAX Network System.

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1. Introduction

1. 1. Purpose

This guide enables the NMC operator to install the DCE/STE components and to define, configure and operate the DCE/STE Software Entities in RC5000 Network Switch or RC5000 MegaSwitch nodes.

This guide is intended for RcPAX NMC8000 Operators. Knowledge of the RcPAX Data Transmission System, the RC5000 Network Switch and the RC5000 MegaSwitch at least to the extent of refs. 1, 2 and 3 is assumed. Furthermore it is assumed that the reader is familiar with the recommendations refs. 4 and 5.

The EM operations and events for the DCE and the STE Software Entities are described in refs. 6 and 7.

1. 2. Scope

The scope of this guide is the NMC operations (database definitions, on-line activities, EM operations etc.), required to install the DCE/STE Software Component and to configure, install and operate the DCE/STE Software Entities.

This guide does not consider:

- the generation of appropriate load files containing DCE/STE Software Components
- How the DES-file for the DCE/STE Software Components is made available

However, both are prerequisites for the activities described in this document.

This guide does not give a description of the DCE database.

1. 3. History

Date	Change Description
1991-01-12	First version

All changes and updates to this guide result in a new version of the guide.

1. 4. Structure

Chapter 2: General Description
Contains a general description of the functions of the DCE/STE Software Entities, and how it interacts with other Software Entities.

Chapter 3: Requirements
Describes the soft- and hardware requirements for a DCE/STE Software Component.

Chapter 4: Definition in NMC8000
Describes all NMC-operations, which must be performed in order to define the DCE/STE Software Entities at a general NMC-level.

Chapter 5: Definition in LSM groups
Specifies the definitions needed in the NMC8000 for DCE/STE Software Entities at the LSM group level.

Chapter 6: Definition in a Node
Describes all NMC operations, which must be performed in order to define the DCE/STE Entities in a specific Node.

Chapter 7: Configuration
Contains a number of guidelines for the configuration of a DCE/STE entity.

Chapter 8: Normal Operation
Describes how the DCE/STE Entities could be operated in normal situations.

Chapter 9: Error Operation
Describes how the DCE/STE Entities should be operated in error situations.

Chapter 10: Guidelines for Error Reporting
Describes what shall be considered, when an error is reported.

Chapter 11: References

Chapter 12: Exception codes

Chapter 13: Trace codes

Chapter 14: DCE/STE EM-Summary

1. 5. Using this Guide

1. 5. 1. Installation in NMC8000

Prepare the loadfile(s) and the file containing the DES for the DCE/STE EM.

Check that the loadfile(s) fulfils the software requirements in section 3.1 and the load sequence requirements in section 7.6

Follow the instructions in section 4.

Follow the instructions in section 5.

1. 5. 2. Installation of DCE/STE entity in a Node

Check that the installation as described in section 1.5.1 is carried out.

Create suitable configuration request-sets following the guidelines in section 7.

Follow the instructions in section 6.

1. 5. 3. Operation of the DCE/STE entity

Follow the instructions in section 8.

In case of troubles use section 9 together with appendix B and C to solve the problem.

If no solution is found follow the instructions in section 10 to report the error.

1. 6. Conventions

Reference to an EM operation is stated as:

(XXX,Y,ZZ):
where XXX is the EM name, Y is the operation type (a = answer, e = event, r = request) and ZZ is the operation number.

Reference to the EM-request number 40 for the DCE component will have the format (DCE,r,40).

2. General Description

The main task of the DCE and the STE software entity is to implement an access interface to RcPAX in accordance with the CCITT X.25 and X.75 level 3 recommendations as described in ref. 6 and 7.

RcPAX contains 2 versions of the DCE/STE components:

1. The DCE/STE component for the RC5000 Network Switch or the RC5000 CPU of the RC5000 MegaSwitch.

2. The DCE/STE component for the RC5000 MegaSwitch.

The DCE component 1) is delivered in the SW50322 RcPAX X.25 Access, the STE component 1) is delivered in the SW50324 RcPAX X.75 Access while the DCE component 2) and the STE component 2) are delivered in SW50512 64 kbps X.25 Access for MegaSwitch.

This document covers all DCE/STE components. There exists some differences which are stated explicitly when required.

The DCE/STE builds upon the services offered by the LIC software entity, see ref. 2 and 8. There exists one LIC entity per each DCE/STE entity. The actual end-user for a DCE is an external DTE. The actual end-user for a STE is an external STE. In both cases the communication is performed via an HDLC-driver. There exists one HDLC-driver entity per each DCE/STE entity.

Furthermore the DCE/STE uses the services from the following entities: Timer,ATS,DIS and NCP. There exists only one of each of these entities to service all DCE/STE's in the node.

In the RC5000 MegaSwitch the ATS and DIS services are made available by the MegaLink, Mopsys and Mbxlink entities constituting a link to the ATS and DIS entities on the RC5000 CPU. And the Entity Management part of DCE/STE entity communicates with the Mopsys which again communicates with the LSM entity on the RC5000 CPU of the RC5000 MegaSwitch.

The DCE/STE also uses the service of a Poolmanager entity. One Poolmanager entity can service more than one DCE/STE entity.
The DCE/STE entity is implemented as a single RTP process. A sketch of a DCE/STE entity together with its immediate communication partners is presented below.

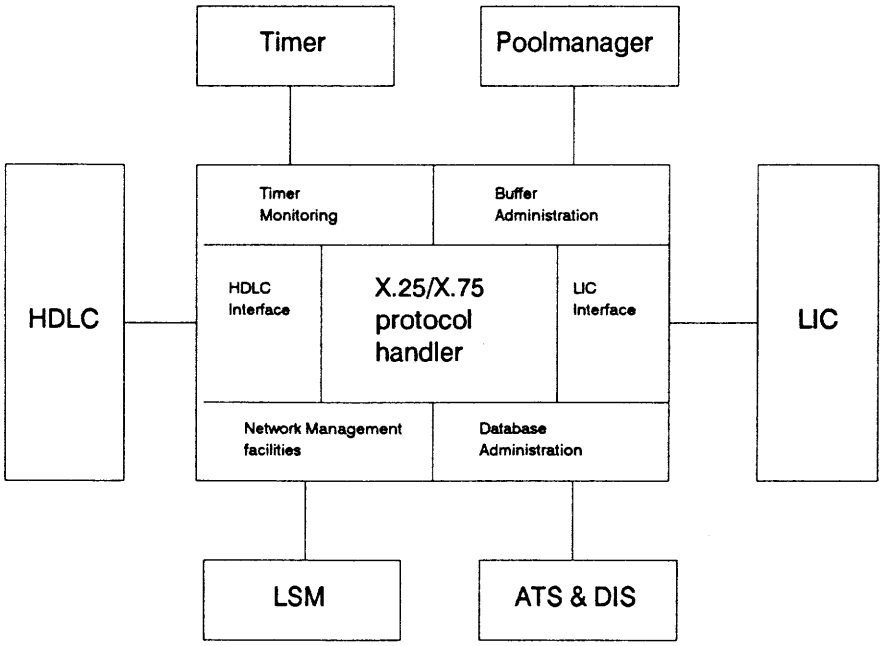


Figure 1, Structure and Interfaces of a DCE/STE entity

3. Requirements

This section summarizes the soft- and hardware requirements for the DCE and the STE entities.

3. 1. Software Requirements

Software packages

The following SW packages are required for the DCE/STE component depending on where the DCE/STE entity is running:

RC5000 Network Switch
- SW50020 RC5000 Operating System
- SW51010 RcPAX Operating System
- SW51012 RcPAX Router System
- SW51013 RcPAX Basic Switching System
- SW51016 RcPAX Name Server

RC5000 CPU of RC5000 MegaSwitch
- SW50020 RC5000 Operating System
- SW51010 RcPAX Operating System
- SW51013 RcPAX Basic Switching System
- SW51016 RcPAX Name Server
- SW50050 MegaSwitch Basic Software
- SW51100 MegaSwitch Interworking

RC5000 MegaSwitch
- SW50050 MegaSwitch Basic Software
- SW51100 MegaSwitch Interworking
- SW51016 RcPAX Name Server
- In addition requirements derived from the above SW-packages

The Package Descriptions for the software packages containing a DCE or a STE component will contain the exact versions of the above required software packages.

Software Configuration
With reference to fig. 2.1:

- The timer functionality is part of the operating system and is therefore always considered available.

- The Entity Management part of the DCE/STE entity requires that the LSM exists before a DCE/STE entity can be started.

- The LIC entity is activated by the DCE/STE entity. But a LocalConnector of the ROUTER entity must be accessible before this can be done.

- The DIS entity is always necessary, and a ATS entity is necessary when address translation is wanted.

3. 2. Hardware Requirements

The DCE/STE is running in a RC5000 Network Switch or in a RC5000 CPU of a RC5000 MeagSwitch.

3. 3. Storage Requirements

The storage requirements for a DCE/STE entity consist of requirements for object code, runtime stack, heap and buffers. The storage requiement for object code is per node, the storage requirement for runtime stack, heap and buffers is per entity:

3. 3. 1. Code size

The DCE/STE Software Components require the following amount of memory for the object code

	DCE	STE
RC5000 Network Switch	99.7 Kbytes	84.7 Kbytes
RC5000 MegaSwitch	134.4Kbytes	115.1 Kbytes

3. 3. 2. Stack size

The runtime stack size requirement is divided into a basic stack size and the configuration dependent stack size.

The basic stack size is as follows:

	DCE	STE
RC5000 Network Switch	3.5 Kbytes	3.3 Kbytes
RC5000 MegaSwitch	6.1 Kbytes	5.3 Kbytes

The configuration dependent stack size requirements can be calculated as follows:

	DCE	STE
RC5000 Network Switch	no_of_lc * 32 bytes	no_of_lc * 34 bytes
RC5000 MegaSwitch	no_of_lc * 48 bytes	no_of_lc * 52 bytes

3. 3. 3. Heap size

The heap size requirement is less than:

DCE RC50000 Network Switch	2k + ((no_of_lc + 4) DIV 5) * kbytes
DCE RC5000 MegaSwitch	2k + ((no_of_lc + 3) DIV 4) * kbytes
STE RC5000 Network Switch	1k + ((no_of_lc + 3) DIV 4) * kbytes
STE RC5000 MegaSwitch	1k + no_of_lc * 264 bytes

3. 3. 4. Buffers

For an in depth description of storage requirement for buffers see section 7.3.

3. 4. Network Requirements

The DCE/STE component has no requirements to other network nodes. If the DIS service is used it may be required that a "master" DIS is available.

4. Definition in NMC8000

This chapter describes all NMC operations, which must be performed in order to define a DCE/STE entity in NMC8000, at a general NMC level. These definitions should only be performed once for an NMC8000.

4. 1. EM Identity

4. 1. 1. Class

The DCE/STE component has been defined with Class: PAXNET.

4. 1. 2. Type

This section defines the EM Type Name and Number of the DCE/STE component to be defined in the NMC database by means of the NMC "typ" on-line activity.

Software component	EM Name	EM Number
DCE	DCE	13
DCE	X.25 account	64
X.75	X.75	39
X.75	X.75 account	65

4. 1. 3. Classification

The DCE and STE software components are classified as "public".

4. 2. Creator Process Name

The creator-process (father) of the DCE and STE component is PAXOP-SYS on the RC5000 Network Switch and on the RC5000 CPU of the RC5000 MegaSwitch. On the RC5000 MegaSwitch the creator-process is Mopsys.

4. 3. Event Mask Definition

This section defines which events are connected to which bits in the (old) event mask of the DCE and the STE components.

The correspondence between single bits in the event mask and the events they control is defined using "eve" NMC8000 on-line activity.

The bits are counted from 1 (the rightmost bit) to 16 (the leftmost bit). The numbers are refering to events, i.e. (71) is (DCE,e,71) or (STE,e,71).

Bit	Event	
1	lic establishment	(71),(31)
2	restart	(203),(219),(235)
4	vc clear	(27),(211),(227)
5	vc establishment request	(23),(297)
6	vc reset	(215),(223),(231)
7	vc establishment indication	(63),(67)
8	ats respons	(59)
9	diagnostic	(199)
11	b account	(167)
12	a account	(163)
13	dis respons	(47)
14	hdlc disconnect	(43),(51)
15	hdlc connect	(39)
16	delay measuring	(55)

Because the diagnostic packet does not exist in the X.75 recommendation the diagnostic event (STE,e,199) is not relevant.

For the X25account and the X75account only 2 event are connected to bits, the A account event is connected to bit 12 and the B account event is connected to bit 11.

4. 4. Initial Event Mask

The recommended value for the initial event mask for DCE/STE entities at the NMC level is defined as the default value in the DES-File for operation (DCE,r,4) and respectively (STE,r,4) and is as follows:

Update mask:	11111111 11111111
Value mask:	01100000 00000010

This corresponds to the following events:

restart	(203),(219),(235)
hdlc disconnect	(43),(51)
hdlc connect	(39)

These events are initially ordered at DCE/STE entity activation. An on-line explanation of the correspondence between single bits in the event mask and the events they control is given in the explanation text for the operation (DCE/STE,r,4) in the DES-Files.

The recommended value for the initial event bit mask for X25account and X75account is:

Update mask:	11111111 11111111
Value mask:	00001000 00000000

This corresponds to the A account event.

4. 5. DES-File

The description of the EM Operations for a DCE/STE entity is included in the NMC8000 database by installing the DES-File for the DCE/STE component using the desload RC8000 program.

The DES-Files for NMC8000 is included in the SW50322 and SW50324 Software Packages and for the appropriate RC5000 MegaSwitch Software Packages.

The EM Operations for DCE and STE entities are described in ref 6 respectively ref 7.

The installed DES-Files may be displayed by the NMC8000 using the "des" on-line activity.

5. Definition in LSM Group

This section describes all NMC operations, which must be performed in order to define the DCE/STE entities at the LSM group level. These operations must be performed once for each LSM/NCP group. It is assumed that the definitions described in section 4 has been carried out.

5. 1. Initial Event Mask

This section specifies the recommended value for the initial event bit mask for the DCE/STE entities at the LSM group level.

These event bit masks are defined in the database using the NMC8000 "mas" on-line activity.

The same initial event mask as for the NMC level is recommended for the LSM group level, i.e. the initial event mask for the DCE/STE is as specified in section 4.4:

Initial Event Mask
00110000 00000010

5. 2. Treatment Category

For each LSM group containing DCE/STE entities the treatment category and log handling shall be defined for each EM event using the NMC8000 "not" on-line activities.

The INITIAL LOG and ACTUAL LOG are identical and shall be set such that the following events are handled as alarm notifications:

restart	(203),(219),(235)
hdlc connect	(39)
hdlc disconnect	(43)
exception	(254)
events-lost	(255)

Using the PAXNET convention the following treatment categories shall be defined:

23	call accepted	00000000 00000000 00000001
27	clear confirm	00000000 00000000 00000001
31	indication establish	00000000 00000000 00000001
39	hdlc connect	00000000 10000000 00000000
43	hdlc disconnect	00000000 10000000 00000000

47	dis respons	00000000 00000000 00000001
51	hdlc warning	00000000 01000000 00000000
56	measure delay	00000000 00000000 00000001
59	ats respons	00000000 00000000 00000001
63	incoming call	00000000 00000000 00000001
67	call connect	00000000 00000000 00000001
71	establish lic	00000000 00000000 00000001
199	diagnostic	00000000 00000000 00000001
203	restart request	00000000 10000000 00000000
207	call request	00000000 00000000 00000001
211	clear request	00000000 00000000 00000001
215	reset confirmation	00000000 01000000 00000000
219	restart confirmation	00000000 10000000 00000000
223	reset request	00000000 01000000 00000000
227	dce clear request	00000000 00000000 00000001
231	dce reset request	00000000 01000000 00000000
235	dce restart request	00000000 10000000 00000000
253	trace	00000000 00000000 00000001
254	exception	00000000 10000000 00000000
255	events lost	00000000 10000000 00000000

The account events from X25account and X75account are only logged.

6. Definition in a Node

This section describes the NMC operations required when defining DCE/STE entities in the NMC8000 at the node level. The NMC operations should be carried out once for each node. It is assumed that the definitions described in section 4 and 5 already have been carried out.

Before a DCE/STE entity can be activated in a node, the software for the corresponding DCE/STE software component have to be loaded into the node in question. The load of the node is done using the "inco" NMC8000 on-line activity.

6. 1. EM Incarnation Definition

The recommended use of incarnation-numbers and the associated extension numbers is described in reference 12.

6. 2. Initial Event Mask

The recommended value of the event mask at node and module level is the standard value of the operation (DCE,r,4).

6. 3. Load File Description

The load file description for a node is manipulated using the "lfd" NMC8000 on-line activity.

The load file description defines which load files (and their sequence) shall be loaded into the node whenever:

- the node is down-line loaded from the NMC8000 automatically or using the "inco" NMC8000 on-line activity, or
- the winchester disc connected to the node is filled using the "wd-fill" function of the "inco" NMC8000 on-line activity

The DCE/STE software components from SW50322 and SW50324 are contained in the nsixiplib load file.

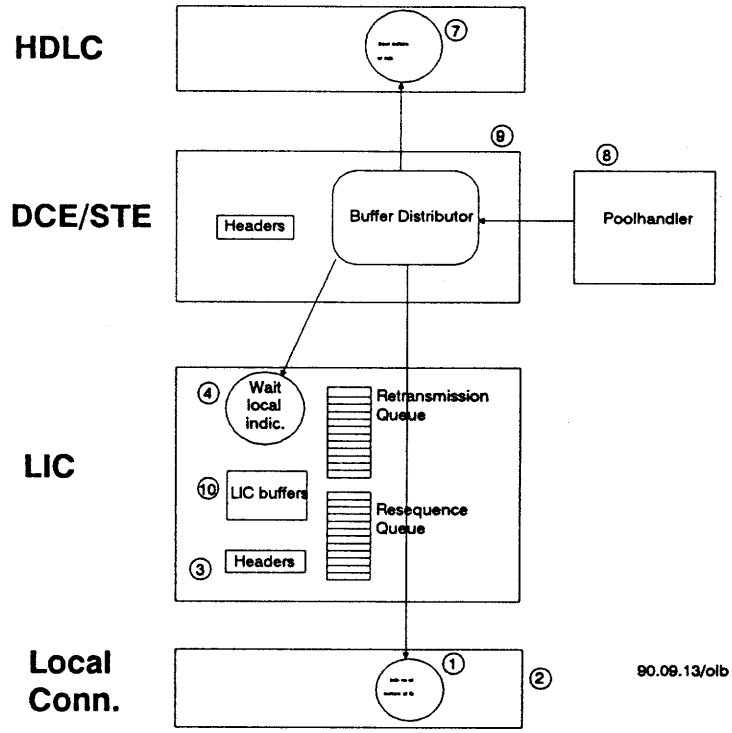
For the DCE/STE software components from SW50512, see the Installation and and Operation Guide for the RC5000 MegaSwitch, ref. 9.

7. Configuration

This section contains information to the configuration of an DCE/STE entity. Specially the buffer strategy is described in depth.

The "dce" NMC-8000 on-line activity may be used for configuration of DCE entities, see ref 11. Apart from Bilateral Closed User Groups, all 84-facility subscriptions can be entered into the NMC-database.

Subscriptions for X.75 utilities must still be configured by separate requests.



1. Min. no. of rec bufs at lic
2. Pref. no. of rec bufs at lic
3. No of headers in lic
4. Wait local indic bufs to lic
7. Input buffers at hdlc
8. Buffers at poolhandler
9. Max no of bufs dce/ste can use
10. No of buffers in lic

Figure 2, Buffer Strategy in DCE/STE

7. 1. General Overview of Buffer Strategy in DCE/STE

Fig. 2 shows how buffers are distributed between HDLC and LIC. The encircled numbers refer to the parameters in "Set buf configuration" (dce/ste,r,156).

In the following discussion the parameter names are denoted P1-P10 as shown below:

P1 Min no of rec-bufs at LIC
P2 Pref. no of rec-bufs at LIC
P3 No of headers in LIC
P4 Wait local indic bufs to LIC
P7 Input-buffers at HDLC
P8 Buffers at Poolmanager
P9 Max no of bufs DCE/STE can use
P10 No of buffers in LIC

The DCE/STE is responsible for the buffer strategy, and it will as far as possible satisfy the requirements of HDLC and LIC.

When recognizing that data come in from 2 sources, namely HDLC access and trunk lines, it is evident that the DCE/STE must supply input buffers to HDLC and Local Connector. As can be seen from the figure, the DCE/STE Buffer Distributor requests buffers from the Poolmanager, and supplies the buffers to (1) the Local Connector, (7) the HDLC and (4) the LIC as "Wait loc ind buffers".

7. 1. 1. Buffer allocation at startup

When requested to initialize, the DCE/STE will ask the Poolmanager to allocate P8 buffers. From these buffers the DCE/STE will send P2 + P4 buffers to LIC and P7 buffers to the HDLC (actually the buffers to the HDLC are not sent until an "open hdlc" request is issued). The constraint is clearly that

(P2 + P4 + P7) < P8

7. 1. 2. Buffer strategy after startup

After initialization, the DCE/STE will try to maintain a situation, where P2 input buffers are at the LIC, P4 buffers are at the LIC as "Wait loc ind bufs" and P7 buffers are at the HDLC. In case of buffer shortage, the buffers available are distributed evenly between the HDLC and the LIC.

The LIC will supervise the number of buffers outstanding at the Local Connector. If this number falls below P1, the LIC will ask the DCE/STE for more buffers. If these buffers are not granted, the LIC will eventually cancel the resequence queue in order to obtain buffers. Whenever this happens, the LIC vil send event 39 to the NMC to indicate that the resequence queue has been canceled.

If the resequence queue is empty, the LIC cannot provide buffers to the Local Connector, and input will be dropped. This will cause the remote LIC to retransmit.

7. 1. 3. LIC-owned buffers

The lic maintains two types of buffers:

LIC buffers (P10).
These buffers are not taken from the poolmanager, but allocated by the LIC itself. They are used when handshaking with the remote LIC, and they are never seen by the DCE/STE. A LIC buffer contains a router header and a LIC header.

Wait loc ind buffers (P4).
These buffers are used mainly to indicate to the DCE/STE that the LIC by itself initiates an action to DCE/STE. For example, if the LIC times out because of a missing answer from the remote LIC, the local LIC will use a "wait loc ind buffer" to indicate this event to the DCE/STE.

It is the Buffer Distributor's responsibility to maintain P4 "wait loc ind bufs" at the lic.

P4 must be equal to the number of ats buffers set in "Init address translation" (ATS,r,252).

Apart from buffers, the LIC allocates P3 headers for its own use. The headers are pushed onto buffers sent to the Local Connector, thereby limiting the maximum number of buffers pending at the Local Connector.

7. 2. Description of the Fields in Op. 156

Through the operation "Set buf-configuration" (DCE/X75,r,156) the DCE/STE buffers can be configured. The operation must occur before the initialize operation.

In the following the term "standard value" (std-value) is used meaning the recommended value. This is not necessarily the value in the DES-fields. In some cases there is no "standard value", e.g. because it depends on the buffer size.

7. 3. Calculation of actual values

For the fields P1, P2 and P10 the following rule applies:

actual value = (standard value) * (lcn div 10 + 1)

Applying this rule for the field P1, "Min no of rec-bufs at LIC" having a standard value of 2 and assuming 60 logical channels, results in:

"Min no of rec-bufs at LIC" = 2 * (60 div 10 + 1) = 14

Special care must be taken when defining P8, "Buffers at poolhandler". The following formula is recommended :

P8 = P2 + P4 + P7 + (average * number of lcn's configured)

The factor "average" is the average number of buffers used on one logical channel, and depends on:

1) The traffic pattern. How many packets per second are send on this logical channel ? Is it in both directions ? etc.

2) The X.25/X.75 Window. The window size can be negotiated within limits, and can therefore vary for the different logical channels.

3) The free_queue set in (DCE/STE,r,24)

The possibilities for buffer usage on one logical channel can be separated in the 2 data directions and consists of:

Possible buffer usage on the direction from the External User to the LIC:

a) In a queue to the LIC: Maximum = X.25/X.75 Window - 1

b) In Retransmission queue: Maximum = free_queue (In fact it is the free_queue from the remote end, but in most cases the free_queue is set to the same value in the whole net)

Possible buffer usage on the direction from the LIC to the External User:

c) In a queue to the External User: Maximum = free_queue

d) In Resequence queue: Maximum = free_queue -1

Total maximum = 3 * free_queue + X.25/X.75 Window - 2

The calculation of "average" should be based on an empirical study in the actual node. The configuration of window size, free_queue and number of logical channels and thereby the value of P8 and the buffer size set in field 11 must match the actual memory size in the node, or the MAC241 memory size for the MegaSwitch.

The DCE/STE contains a configurable limit concerning the max no of buffers it will fetch at the poolhandler (P9). The following is recommended:

"max no of bufs DCE/STE can use" = "buffers_at_poolhandler" + 50 %

The extra 50% means that the DCE's and STE's are allowed to share buffer resources. This applies of course only, if there are more than one DCE or STE in a node using a common poolmanager. Further, the following constraint must be fulfilled in this case:

$$\text{Max}(P9-(P2+P4+P7)) <= \text{Sum of all}(P8-(P2+P4+P7))$$

This means that the maximum value of the extra amount of buffers any DCE/STE can use, must be less than the sum of the individual contributions.

In other words: Each DCE/STE gives a contribution, which is P8-(P2+P4+P7), to a common pool shared by all DCE's and STE's using the same Poolmanager. The sum on the right-hand side of the inequality give that combined contribution. The left-hand side is the maximum possible extra (dynamic) value used by any DCE/STE.

The inequality ensures that no single DCE/STE can completely starve the other DCE's and STE's using the same Poolmanager.

If there is only one DCE/STE using the Poolmanager, the inequality becomes:

$$P9-(P2+P4+P7) <= P8-(P2+P4+P7)$$
$$P9 <= P8$$

As P9 can never be less than P8, equality must hold. This states clearly that there can be no "overbooking" in this case.

Note that sharing of buffers is not usual in the MegaSwitch, there is normally one Poolmanager for each DCE/STE.

In the following the meaning of each field in operation 156 is described.

P1: Min no of rec-bufs at LIC

The minimum number of buffers outstanding at LIC (Local Connector) for receiving input from Router. As already mentioned, this is an absolute minimum, and the LIC will cancel it's resequence queue, if it cannot get at least P1 buffers.

std-value: 2*(lcn div 10 + 1)
min-value: 10
max-value: 2*lcn

P2: Pref. no of rec-bufs at LIC

Preferred number of buffers outstanding at LIC (Local Connecter) for receiving input from Router. As already mentioned, the Buffer Distributor in the DCE/STE will do it's best to assure that there are always P2 input buffers at the Local Connector.

std-value: 5*(lcn div 10 + 1)
min-value: 15
max-value: 5*lcn

P3: No of headers in LIC

The number of headers in LIC must be greater than the number of buffers in LIC. The LIC allocates the headers itself.

std-value: 3*P2

P4: Wait local indic bufs to lic

This number must be the same as "number of ats-messages" in "init address translation" (ATS,r,252).

std-value: 1

Field 5: Max net credit

std-value: 16

Field 6: No of HDLC event buffers

Number of buffers used for receiving HDLC-events. The standard value should always be used.

std-value: 6

P7: Input-buffers at HDLC

Number of buffers outstanding at the HDLC for receiving data. Maintained by the DCE/STE Buffer Distributor.

std-value: 14
min-value: 10

P8: Buffers at poolhandler

The total numbers of buffers ordered at the Poolhandler. As described earlier, the recommended formula is:
P8 = P2 + P4 + P7 + (average * No. of lcn's configured)

std-value: None
min-value: None

P9: Max no of bufs DCE/STE can use

As described earlier, the recommended value is:
P9 = P8 + 50%

std-value: None
min-value: None

P10: No of buffers in LIC

These buffers are used when handshaking with the remote LIC. If many requests from the remote LIC occur within a short time, the value of this variable must be increased.

std-value: 5*(lcn div 10 + 1)
min-value: 10
max-value: 2*lcn

Field 11: Buffer size / Max. pac in buf

The size of the buffers used in communication with LIC and Router. The value must be set to the code for the maximum packet size that the buffer shall contain: 8..12, where 8 means 256 bytes user data, and 12 means 4K bytes user data.

The value is defined in page 8 in the dce-database.

std-value: None

Field 12: DTE version (1: 80, 0: 84)

This field is unused. Instead DTE version is set in (DCE,r,204) or (X75,r,228).

std-value: None

Field 13: rec N1

The maximum size of frames that may be received. The value is given in bits, and must include level 3 header and level 2 header and CRC. For packet size = 256, rec N1 is 2104 bits.

std-value: None

Field 14: receive buffers

The number of receive buffers allocated on the COM20x controller. The recommended value is for COM206.

std-value: 14

Field 15: transmit buffers

The number of transmit buffers allocated on the COM20x controller.

std-value: 7

Field 16: rec test elem pr buf

Used only in COM204.

std-value: 16

Field 17: xmit test elem pr buf

DCE-database page 6. Used only in COM204.

std-value: 16

Field 18: cntrl test elem pr buf

Used only in COM204.

std-value: 16

Field 19: test bufs

Used only in COM204.

std-value: 6

Field 20: protocol

The value is a bit pattern, and the standard value selects the 84-version and allows that I-frames with zero length information field are sent to the packet layer. See ref. 10 section 3.1.2 for a description of the bits.

std-value: 01000010

Field 21: xmit N1

The maximum size of frames that may be transmitted. The value is given in bits, and includes level3 header and level 2 header and CRC. Should be set equal to "rec N1" (field 13).

std-value: None

Field 22: T3

The idle channel detect time. Measured in units of 0.1 sec. T3 > > N2*T1. This value is crucial for the MegaSwitch.

std-value: None

Timers.

In this chapter the level 2 timers T1 and T3, and a number of level 3 timers are described.

7. 4. Level 2 Timers

The level 2 timers T1 and T3 must be defined. T1 is set in "Open HDLC line" (DCE/X75,r,36), while T3 is set in "Set buffer configuration" (DCE/X75,r,156).

T1-timer.

The T1-timer is the retransmission timer, i.e. a frame is retransmitted if a positive acknowledge is not received within T1 milliseconds. The timer is defined in the dce-database page 2. In order to determine the value of T1, the following things must be taken into account:

- line speed
- frame size
- the frame-processing time at the remote end

T1 must be set at least so high that 3 packets can be transmitted on the line, before the timer runs out. If the value of the T2 timer at the remote end is large, the value of T1 must be increased.

The value N2 * T1, where N2 is the maximum number of attempts to complete a transmission, determines the time which will elapse, until a line of poor quality (many transmission errors) is set to be "down".

It should be noted that T1 is only significant for the last frame in the window, because otherwise the DCE will detect that the frame was not received correctly in the remote end from the sequence counts in the answer.

Standard value: 1600 mS

T3-timer.

The T3-timer is used to detect an excessively long idle channel state, i.e. a state where steady ONES are received. When T3 expires, an event is sent to the packet layer indicating that a link setup is needed before normal link operation can resume.

T3 is defined in the dce-database page 6.

Standard value: 300 (in units of 0.1 sec)

7. 5. Level 3 Timers

In the following each of the 15 level 3 timers are documented. The first 4 timers are defined in table D-1/X.25/X.75 in the recommendations.

Timer T10/T30 - Restart Indication.
Started when DCE/STE issues a restart indication/request.
Normally terminated when DCE/STE leaves r3.
The timer is restarted after 1st timeout.
After 2nd timeout the DCE/STE enters r1. Further, the DCE issues a diagnostic packet.

Standard value: 60/180 seconds

Timer T11/T31 - Incoming Call.
Started when DCE/STE issues an incoming call / call request.
Normally terminated when DCE/STE leaves the p3 state.
If the timer runs out, the DCE/STE enters the p7 state and issues a clear indication/request.

Standard value: 180/200 seconds

Timer T12/T32 - Reset Indication.
Started when DCE/STE issues a reset indication/request.
Normally terminated when DCE/STE leaves the d3 state.
The timer is restarted after 1st timeout.
After 2nd timeout the DCE/STE enters the p7 state and issues a clear indication/request.

Standard value: 60/180 seconds

Timer T13/T33 - Clear Indication.
Started when DCE/STE issues a clear indication.
Normally terminated when DCE/STE leaves the p7 state.
The timer is restarted after 1st timeout.
After 2nd timeout the DCE/STE enters p1. Further, the DCE issues a diagnostic packet.

Standard value: 60/180 seconds

Timer: RR-Timeout
When the DCE/STE has no data to send to the DTE/STE it will send an RR packet at certain intervals. The RR-Timer sets this interval. The value may be zero, in which case this mechanism will be disabled.

Standard value: 20 seconds

Timer: Call Request Timeout
This and the following 6 timers are maintained by the LIC. They are started when the DCE/STE asks the LIC to execute an operation, and if the timer runs out without the LIC having received a valid response from the remote LIC, the local LIC will indicate this condition to the DCE/STE, which will subsequently clear the call.

Started when receiving a call request from DTE/STE.

Standard value: 60 seconds.

Timer: Clear Request Timeout
Started when receiving a clear request from DTE/STE, or if DCE/STE by itself decides to clear the call.

Standard value: 45 seconds.

Timer: Reset Request Timeout
Started when receiving a reset request from DTE/STE, or if DCE/STE by itself decides to reset the call.

Standard value: 45 seconds.

Timer: Accept Incoming Call
Started when a call accepted packet is received and a Confirm Establish message is sent to the LIC.

Standard value: 60 seconds.

Timer: Interrupt Timeout
Started when an interrupt packet is received from DTE/STE. Cleared when the remote LIC acknowledges.

Standard value: 120 seconds.

Timer: Data Timeout
In normal operation, the LIC has a number of outstanding packets (up to the LIC window). An internal LIC timer will be retriggered each time the remote LIC acknowledges a data packet. If this internal LIC timer runs out, the LIC will enter a mode, where only one outstanding packet at a time is allowed. The packet is retransmitted a number of times, which is the ratio between the Data Timeout timer from DCE/STE and the LIC internal timer. If the packet is still not confirmed by the remote LIC, the local LIC will indicate this condition to the local LIC, which will eventually clear the call.

Standard value: 120 seconds.

7. 6. How to sequence requests

When configuring a dce/ste, the ordering of the requests in the request set is important. The following layout must be followed:

1. Change HDLC line user (PAXOPSYS,r,40), (not for MegaSwitch)

2. Start DCE/STE (DCE,r,1), (X75,r,1). The dce-database uses operation 50 for the RC3502.

3. Delay (SRS,r,8), unnecessary for MegaSwitch.

4. Set extended packet sequence numbering (DCE,r,216)

5. Set dce/ste buf-configuration (DCE,r,156), (X75,r,156)

6. Initialize address translation (DCE,r,252), (X75,r,252)

7. Initialize dce/ste (DCE,r,52), (X75,r,52)

8. X.25/X.75 subscriptions

9. Set 80/84 vars (DCE,r,204), (X75,r,228)

10. Set default credit (DCE,r,24), (X75,r,24)

11. Set receive limit (DCE,r,220), (X75,r,220)

12. Create PVC (DCE,r,28), (X75,r,28)

13. Set event bit mask (DCE,r,4),(X75,r,4),(X25ACCOUNT,r,4)(X75ACCOUNT,r,4),(LIC,r,4)

14. Open hdlc line (DCE,r,36), (X75,r,36)

In 9. the following variables can be set:

- D-bit modification
- 80/84 selection
- Local dte version
- M-bit procedure on/off
- Packet retransmission on/off
- Dummy

For the STE, the 1st and 5th variable are not implemented. The last parameter (Max. net credit) is dummy, it is set in (STE,r,156).

The X.25/X.75 subscriptions in 8. may be issued at any time after 5., but it is recommended that they are set after 7.

7. 7. Optional User Facilities

The DCE/STE entity can be additionally configured to satisfy the needs/wishes of the user or the operator see ref. 6 and 7.

8. Normal Operation

This chapter describes how the DCE/STE entity should be operated in normal situations after installation and configuration.

The normal way of operating a DCE/STE entity - that is surveying it and/or actively operating on a specific channel or the module itself - is done by means of NMC-activities.

The main NMC-activities for surveying and manipulating a DCE/STE entity are:

XOV, XMAN and VCO

8. 1. Operating the DCE/STE entity

Excluding create, start and configuration of the DCE/STE module the fol lowing EM-operations can be used explicitly when actively operating the DCE/STE entity :

- restart DCE/STE	(DCE/STE,r,8)
- clear logical channel	(DCE/STE,r,12)
- reset logical channel	(DCE/STE,r,16)
- open HDLC-line	(DCE/STE,r,36)
- close HDLC-line	(DCE/STE,r,40)
- create account record	(DCE/STE,r,148)
- measure transit delay	(DCE/STE,r,152)

8. 2. Survey of DCE/STE sense operations

A number of sense-operations can fetch some of the parameters from the actual configuration as described in ref. 6 and 7.

8. 3. Statistical information

Statistical information from a DCE/STE entity is available through the following operations :

- get logical channel statistics	(DCE/STE,r,6)
- get HDLC line statistics	(DCE/STE,r,14)

8. 4. Cause and Diagnostic Codes

8. 4. 1. Cause and diagnostic codes in the DCE

8. 4. 1. 1. Clear Indication packet

If the cause code from the DTE in a Clear Request packet is between 1 and 127, it is set to 0 in the Clear Indication packet. If set by the network, the cause code can assume the following values:

0 DTE originated
1 Number busy
3 Invalid facility request
5 Network congestion
9 Out of order
10 Access barred
13 Not obtainable
17 Remote procedure error
19 Local procedure error
25 Reverse charging acceptance not subscribed
33 Incompatible destination
41 Fast select acceptance not subscribed

If the cause code from the DTE is zero or 127, it is parsed unchanged.

8. 4. 1. 2. Reset Indication packet
If the cause code from the DTE in a Reset Request packet is between 1 and 127, it is set to 0 in the Reset Indication packet. If set by the network, the cause code can assume the following values:

0 DTE originated
1 Out of order
3 Remote procedure error
5 Local procedure error
7 Network congestion
9 Remote DTE operational
15 Network operational
17 Incompatible destination

If the cause code from the DTE is zero or 127, it is parsed unchanged.

8. 4. 1. 3. Restart Indication packet
If the cause code from the DTE in a Restart Request packet is between 1 and 127, it is set to 0 in the Restart Indication packet. If set by the network, the cause code can assume the following values:

0 DTE originated
1 Local procedure error
3 Network congestion
7 Network operational
If the cause code from the DTE is zero or 127, it is parsed unchanged.

8. 4. 1. 4. Diagnostic codes from DCE
Diagnostic codes for clear-, reset- and restart-packets.

0 No additional information
1 Invalid P(S)
2 Invalid P(R)
17 Packet type invalid for state r1
18 Packet type invalid for state r2
20 Packet type invalid for state p1
21 Packet type invalid for state p2
22 Packet type invalid for state p3

23 Packet type invalid for state p4
24 Packet type invalid for state p5
25 Packet type invalid for state p6
26 Packet type invalid for state p7
27 Packet type invalid for state d1
28 Packet type invalid for state d2
29 Packet type invalid for state d3

33 Unidentifiable packet
34 Call on one-way logical channel
35 Invalid packet type on a permanent virtual circuit
36 Packet un unassigned logical channel
37 Reject not subscribed to
38 Packet too short
39 Packet too long
40 Invalid general format identifier
41 Restart or registration packet with nonzero in bits 1-4 of octet 1, or bits 1-8 of octet 2
42 Packet type not compatible with facility
43 Unauthorized interrupt confirmation
44 Unauthorized interrupt
45 Unauthorized reject

49 Time expired for incoming call
50 Time expired for clear indication
51 Time expired for reset indication
52 Time expired for restart indication

64 Call set up, call clearing or registration problem
65 Facility/registration code not allowed
66 Facility parameter not allowed
67 Invalid called address
68 Invalid calling address
69 Invalid facility/registration length
70 Incoming call barred
71 No logical channel available
72 Call collision
73 Duplicate facility requested
74 Non zero address length
76 Facility not provided when expected
77 Invalid CCITT-specified DTE facility

121 Unknown called DNIC
128 Network management center originated
129 Internal lack of resources

140 Not enough buffers in poolhandler to handle more calls. Is also used in case of buffer shortage when resetting.
142 Trunk line failure or remote port down

8. 4. 2. Cause and diagnostic codes in the STE

8. 4. 2. 1. Clear Indication packet

If the cause code from the STE in a Clear Request packet is between 1 and 127, it is set to 0 in the Clear Indication packet. If set by the network, the cause code can assume the following values:

0 DTE originated
1 Number busy
5 Network congestion
9 Out of order
11 Access barred
13 Not obtainable
17 Remote procedure error
25 Reverse charging acceptance not subscribed
41 Fast select acceptance not subscribed
If the cause code from the DTE is zero or 127, it is parsed unchanged.

8. 4. 2. 2. Reset Indication packet
If the cause code from the STE in a Reset Request packet is between 1 and 127, it is set to 0 in the Reset Indication packet. If set by the network, the cause code can assume the following values:

0 DTE originated
1 Out of order
3 Remote procedure error
7 Network congestion
9 Remote DTE operational
15 Network operational
17 Incompatible destination
If the cause code from the DTE is zero or 127, it is parsed unchanged.

8. 4. 2. 3. Restart Indication packet
The cause code can assume the following values:

3 Network congestion
7 Network operational
If the cause code from the DTE is zero or 127, it is parsed unchanged.

8. 4. 2. 4. Diagnostic codes from STE
Diagnostic codes for clear-, reset- and restart-packets.

0 No additional information
1 Invalid P(S)
2 Invalid P(R)

17 Packet type invalid for state r1
18 Packet type invalid for state r2
20 Packet type invalid for state p1
21 Packet type invalid for state p2
22 Packet type invalid for state p3
23 Packet type invalid for state p4
25 Packet type invalid for state p6
26 Packet type invalid for state p7
28 Packet type invalid for state d2

33 Unidentifiable packet
35 Invalid packet type on a permanent virtual circuit
38 Packet too short
39 Packet too long
41 Restart with nonzero in bits 1-4, 9-16
43 Unauthorized interrupt confirmation
44 Unauthorized interrupt

49 Time expired for incoming call/call request
51 Time expired for reset indication/request
52 Time expired for restart indication/request

64 Call set up or clearing problem
65 Facility/utility code not allowed
66 Facility/utility parameter not allowed
67 Invalid called address
68 Invalid calling address
69 Invalid facility length
73 Duplicate facility/utility requested

101 Invalid utility length
103 M bit violation
113 Remote network problem
114 International protocol problem
121 Unknown called DNIC
128 Network management center originated
129 Internal lack of resources

140 Not enough buffers in poolmanager to handle more calls.
142 Trunk line failure or remote port down

9. Error Operation

This chapter describes how the DCE/STE entity should be operated in error situations after installation and configuration.

9. 1. Handling of Exceptions

Concerning the DCE/STE entity exceptions can be of two kinds:

a) Exceptions explicitly generated by the DCE/STE entity. These exceptions and the advised action to take are described in appendix B.

b) Exceptions occurring in the DCE/STE entity by situations not fore seen by the component.

In these situations an error-report must be filed together with the part of the logfile for this node corresponding to the last 5 minutes before the exception.

9. 2. Handling of Traces

The trace mechanism is only used by the DCE/STE entity in connection with the exception routine. Handling as above.

9. 3. Handling of Serious Events

All events are described and explained in the DES-file.

9. 3. 1. HDLC Line Up

Identification: (DCE/STE,e,39)

Action

No action is to be taken immediately, but the event should not be generated repeatedly with short intervals without notice. In this case a customer error report should be awaited as the error could be in the customer's equipment.

9. 3. 2. HDLC Line Down

Identification: (DCE/STE,e,43)

This event is generated when the HDLC driver returns a "line down" event.

Action

The action to be taken depends on the first parameter in the event data (HDLC Event Data).

2: Line reset. The line has been down for a short time but is coming up again. The event should always be followed by an HDLC Line Up event.

3: The line is disconnected. Start the line with the NMC activity XMAN.

4: Disconnected by the other end. The node has stopped the line.

5-
10: Different forms of error packets received. The line will normally come up within a few seconds. If the error occurs often the customer must be advised and a hardware error finding procedure must be started.

11: Timeout. The customer's equipment is powered off or disconnected in another way.

12: Timeout. This timeout should never occur, as it indicates a serious system error.

14: Line Error. This event occurs normally in connection with the HDLC Line Warning Event (with Event Data = 13). The cause is no modem clock.

9. 3. 3. HDLC Line Warning

Identification: (DCE/STE,e,51)

This event is generated when an HDLC-event categorized as a warning is received from the HDLC-driver.

There has been a line error, which has not changed the line state.

The cause can be found in the first field of the event data (HDLC event data).

Action
The action depends on the HDLC Event Data code:

1: RNR timeout. The customer's equipment cannot receive the packets sent. The timeout is given after the packets have been retransmitted a number (n2) times.
Try to stop and start the line with the NMC activity XMAN.

13: Temporary line error due to a disconnected modem or to a bad line. Check for disconnected modem or if connected, for a bad line.

15: Parity error in controller RAM. If the error occurs, the line controller should be tested.

9. 3. 4. Diagnostic Packet

Identification: (DCE,e,199) , this packet does not exist for the STE.

The DCE has sent a diagnostic packet to the DTE. The contents of this packet is stated in the event data. The diagnostic packet is sent to the DTE after the DCE has received an error packet from the DTE.

Action
In the event data the error can be found in the diagnostic code, which follows the X.25 recommendation. The next 3 fields are a copy of the packet received with errors.

Diagnostic Code
X.25 packet byte 1 (Q,M,M128/M8,LCGN(4)),
X.25 packet byte 2 (logical channel number)
X.25 packet byte 3 (packet type identifier)

The action could be to check the configuration with the customer.

9. 3. 5. Trace event

Identification: (DCE/STE,e,253)

Action
These events should not come as they normally indicate a coding error. If a trace event occurs an error report has to be made as stated in chapter 10: Error Reporting.

The first field of the event data is a trace code. This code states the error type.

The following table lists an explanation of the trace codes.

Code	Info.	Explanation
1	event_type	Illegal event_type in call of procedure 'create_event'
4		Buffer length error when buffer is received from LIC
5	U2	Unknown U2 when buffer is received from LIC
12	lc_index	Unknown u3 at return of input-buffer from LIC.
13	log_chan	U2 = rejected at return of output buffer from LIC.
14	log_chan	U2 = format error at return of output buffer from LIC.
15	DIS_reason	Unexpected reason in DIS-indication when waiting for DNIC answer.
16	DIS_reason	Unexpected reason in DIS-indication when waiting for NUI answer.
17	0	u2 < > ok at return of output buffer from DIS, state = r1.
18	0	Unknown u4 at return of buffer, u2 < > 7.
19	cur_action	Illegal action in state r1.
20	lc_incarn	Unexpected success in DIS-indication when channel is waiting for DNIC answer.
21	0	Object type not DNIC object-type as expected in DIS-indication.
22	lc_incarn	Unexpected success in DIS-indication when channel is waitanswer.
23	0	Object type not NUI object-type as expected in DIS-indication.
24	wait_cause	Unexpected success in DIS-indication when channel is not expecting an DIS-answer.
25	lc_incarn	Unexpected failure in DIS-indication when channel is waiting for DNIC answer.
26	lc_incarn	Unexpected failure in DIS-indication when channel is waiting for NUI answer.
27	wait_cause	Unexpected failure in DIS-indication when channel is not expecting an DIS-answer.
28	sev	Unexpected severity in DIS-indication.
29	lc_index	Bad ucid in DIS-indication.
30	indic	Unknown indic in DIS-indication.

31	org_ext	Warning. The extension used is greater than 69. The user will see the extension as org_ext mod 100.
32	0	u2 < > ok at return of output-buffer from DIS, state < > r1.
33	cur_action	Msg < > nil after this buffer has been handled.
34	lc_index	Lc_index > Max_lc at return of an output-buffer from LIC.
35	8	Called address modified notification not inserted properly when redirecting (in clear-ind.)
36	8	Called address modified notification not inserted properly when redirecting (in call-acc).
37	265	Transit delay facility not inserted properly in incoming call packet.
38	265	Transit delay facility not inserted properly (in call-acc).
39	8	Called address modified notification facility not inserted properly when hunting.
40	195	Redirection notification not inserted properly in call-packet when redirecting.
45	lc_index	Charging info not inserted properly.
52	lc_index	Illegal state when answer received from ATS.
53	state	State P2, then ATS calling address query is illegal.
70	Event_lost	The HDLC has lost events.
71	0	No free memory to measure line speed.
72	dce_state	Link reset timeout outside of R1
73	0	U2 value not ok at link reset timeout
80	0	Lc_index = 0 when it was expected to be greater than 0
200	-	It is not possible to allocate enough buffers to DIS.
201	-	Initialization of DIS does not succeed.

When the event ATS respons is turned on the following Trace events can be generated:

51	lc_index	Lc_index max_index
52	lc_index	I.e. Illegal state
55	result	Unexpected result received from ATS.

When the event DIS respons and the event Delay Measure are turned on the following Trace event can be generated.

61	0	DIS Query A end.

9. 3. 6. Events Lost

Identification: (DCE/STE,e,255)

Action

Normally no action. If the event occurs often, a new configuration for the node has to be prepared.

9. 4. Handling of Other Error Situations

No information available - initially.

10. Guidelines for Error Reporting

When reporting an error that involves the DCE/STE entity the following information is required :

1. Version number of the DCE/STE entity involved.
2. Clarify whether it is an RC5000 Network Switch or RC5000 MegaSwitch DCE/STE Software Component that is involved.
3. The stack trace in case of an exception.
4. The configuration parameters of the DCE/STE entity if relevant.
5. The NMC event log, if relevant.
6. Additional information of how the error is experienced, the circumstances, the failure pattern if any etc.

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12. Exception Codes

The codes explained here are those that the DCE/STE entity generates on purpose in certain situations.

A number of exceptions are similar in the sense that it is an allocation of buffers that fails probably because of lack of storage.

During initialization the following exceptions can occur:

Excode (hex)	Explanation
250	Buffers to the Exception routine can not be allocated.
300	Header buffer can not be allocated.
400	The DCE/STE entity cannot include itself at the DIS.
500	Poolhandler initialisation problem.
500 + x	x buffers cannot be allocated in the Poolhandler.
600 + x	The LIC cannot be started. x denotes the result-value returned by the routine start.
700 + x	The LIC cannot be linked. x denotes the result-value returned by the routine link.
750	Impossible to allocate one buffer for the hunting facility.
751	Impossible to find the LIC semafore.
800 + u2	u2 denotes the result-value returned by the LIC on a "set receive buffers" request. Should not occur ! - make an error-report.
801	Buffer received from Poolhandler is not correct.
900	Buffer was not received from Poolhandler in time.
900 + minimum(x,99)	Buffer was not received from Poolhandler in time. x input buffers have been sent to LIC, but more have to be sent.
1100 + x	x headers have successfully been allocated to the header-pool - but more headers were ordered. Same as for excode 300 but occurs at a different place in the initialization.
1150 + x	x buffers have successfully been allocated to the HDLC-event buffer pool - but more were ordered.
1200 + x	x is one or two link reset buffers that cannot be allocated.
1300 + minimum (x, 99)	x = The number of Internal Poolhandler buffers that can not be allocated.

The only exceptions that can occur outside initialization are:

136 Em break exception. The DCE/STE entity has been ordered into exception by the LSM.

800 Buffer received from Poolhandler is not correct.

13. Trace Codes

The trace mechanism is only used by the DCE/STE entity in connection with the exception routine, i.e. should be explained by the above.
The trace procedure is called by the DCE/STE exception procedure except for excodes 80 and 81 (pax_break_code,pax_break_code + 1).

14. DCE/STE EM-Summary

This appendix contains a summary print of the request/answer EM operations and the EM events for the DCE/STE component. The prints are generated from the DES-FILES.

DCE EM Operations

1. **Survey of all EM Operations. (0)**

2. **Control Operations.**
   restart DCE (8)
   clear logical channel (12)
   reset logical channel (16)
   set timeout value (20)
   set default credit (24)
   create PVC (28)
   open HDLC line (36)
   close HDLC line (40)
   initialize dce (52)
   set default window size (56)
   set default packet size (60)
   set flow control negotiation (64)
   cancel flow cntr negotiation (68)
   set throughput class neg. (72)
   cancel throughput class neg (76)
   set default throughput class (80)
   set access barred (84)
   set closed user group facil. (88)
   initialize closed user group (92)
   remove closed user group (96)
   set fast select (100)
   cancel fast select (104)
   set fast select acceptance (108)
   cancel fast select acceptance (112)
   set reverse charging (116)
   cancel reverse charging (120)
   set default destination addr. (124)
   set reverse charge acceptance (128)
   cancel reverse charge acc. (132)
   set nui validation (136)

cancel nui validation (140)
change current tariff (144)
create account record event (148)
measure transit delay (152)
Set DCE buf-configuration (156)
Set redirection (160)
Cancel redirection (164)
Define huntgroup (168)
Cancel huntgroup (172)
Set transit delay (176)
Set called adr modified notif (180)
Cancel called adr mod notif (184)
Set redirection notification (188)
Cancel redirection notific (192)
set local charging prevention (196)
cancel local charging prevent (200)
Set 80/84 vars (D-bit - 8084) (204)
Charging information subscr (208)
Cancel charging information (212)
set extended packet seq. num (216)
set receive limit (220)
Set default calling address (236)
set bcug facility subscript (240)
Initialize bcug membership (244)
Remove bcug membership (248)
init address translation (252)
ats pnic activate (253)

3. **Sense Operations.**
get dce survey (9)
sense timeout values (17)
sense logical channel range (25)
sense flow control neg. (29)
sense closed user group (33)
get default destination addr (37)
get current tariff (41)
sense HDLC state (45)
Get DCE buf-configuration (49)
Get huntgroup description (53)
Get redirection description (57)
get local charging prevention (61)
sense ats zone (65)
sense buffers (69)
sense logical channel (113)
get lc survey from index (149)
Sense bcug (161)
Get 80/84 vars (D-bit - 8084) (205)
sense poolhandler zone (209)

4. **Statistics Operations.**
get logical channel statistic (6)
get HDLC line statistics (14)
Get buffer statistics (18)

5. **Old Event Ordering Operations.**
set event bit mask (4)
get event bit mask (5)

6. **Supervisory Events.**
   HDLC line up (39)
   HDLC line down (43)
   HDLC line warning (51)

7. **Transmission Events.**
   call accepted from DTE (23)
   clear confirmation from DTE (27)
   indication establish lic (31)
   SCC indication answer (47)
   measured transit delay (55)
   address translation respond (59)
   incoming call to DTE (63)
   call connected to DTE (67)
   establish lic request (71)
   PVC_removal_xcep (159)
   A-end Account record (163)
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