DECnet - RSX
Internals

| **Phase I** | Released 1975 | Supported operating systems: RSX–11M |
| | | RSX–11D |

Phase II	Released 1978	Supported operating systems: RSX–11M
		RSX–11D
		IAS
		RSTS/E
		RT–11
		VAX/VMS
		TOPS–20

Phase III	Released 1980	Supported operating systems: RSX–11M
		RSX–11M–Plus
		IAS
		RSTS/E
		RT–11
		VAX/VMS
		TOPS–20

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┌─────────────────────┐
│                     │              1982              VAX/VMS
│     PHASE IV        │                                RSX-11M/M+
│                     │                                ULTRIX
└─────────────────────┘                                MS-DOS
                                                        TOPS-20
                                                        RSTS/E




┌─────────────────────┐
│                     │              198?              VAX/VMS
│     PHASE V         │                                MS-DOS
│                     │                                ULTRIX
└─────────────────────┘                                DEC-ROUTER

                           OSI INTERGRATION
```

Communications Executive

Facilities provided by the Communications Executive:

- Simple scheduler
    - Processes execute to completion – no pre-emption
    - Minimal context setup required to enter a process
    - Driven by FIFO queue of pending requests

- Timer support
    - 1 second granularity repetitive timer
    - 100 msec granularity timer
    - Single shot
    - Repetitive

- Common Interrupt service routines
    - Fast interrupt service at priority 7
    - Co-routine to drop priority to device level

- Buffer management routines

- Common subroutines

RSX/Communications Executive Interfaces:

- Special polish routines for network I/O requests

- Scheduling activities required no executive changes

    - Scheduler entered from normal EXEC fork list processing
    - Timer service uses normal EXEC clock queue processing

- Special entry provided during powerfail recovery

    - New support in RSX-11M V4.0/RSX-11M-Plus V2.0
    - Provides general powerfail recovery for communications products

Processes

- An area of code (<4K words) loaded into a dynamic common partition

- Re-entrant code with multiple databases:

    - Channel database for LLC processes
    - Line/station database for DLC processes
    - Controller database for DDM processes

- Scheduled individually for each active database

Scheduler Features

- Entered from RSX executive fork processing

  - Single fork block used for all communications executive processing
  - Fork block contains listhead of pending requests

- All pending requests will be processed before returning to RSX

- Fast dispatch since no previous context to be saved

- General interprocess communications

  - Queued or direct subroutine interface
  - With or without CCB

Timer Support Features

- 1 second timer

    - Runs continuously
    - LLCs requesting timer service are entered every second
    - DLCs and DDMs use byte to control timing interval

- 100 msec timer

    - Elapsed time in multiples of 100 msec – up to 25 seconds
    - Single shot
    - Repetitive
    - Runs only when requests are pending

Interrupt Support

- Co-routine to drop processor priority

    Drops processor priority from 7 to device level
    Saves R4 and R5 for use by interrupt service code

- Exit from priority level 7 processing

    - Allows short interrupt service routine to execute at priority 7
    - Typically used for character interrupt devices
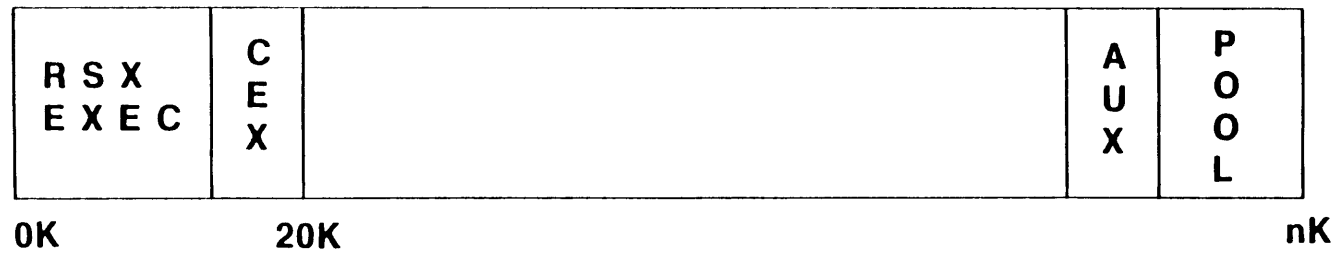
Buffer Management

- Allocation/Deallocation routines for:

  - Communication Control Blocks (CCBs)
  - Small Data Buffers (SDBs)
  - Large Data Buffers/Receive Data Buffers (LDBs/RDBs)

- Dynamic CCB allocation

  - Allocated from DSR when free list is almost exhausted
  - Non-interrupt level allocations only

- Allocation recovery mechanism

  - Available to device driver modules
  - Allows up to 7 outstanding buffer requests
  - Satisfied by next available buffer return

Common Subroutines

- Add/Remove entries from a queue

- Block move to/from an unmapped buffer

- Mapped subroutine call

- Event logging subroutine

Minimal Configuration

- Communications Executive (CEX)
- Auxiliary Process (AUX)
- Network Pool (POOL..)

```
+-------------+-----+----------------------------------+-----+-------+
|             |  C  |                                  |  A  |  P    |
|  R S X      |  E  |                                  |  U  |  O    |
|  E X E C    |  X  |                                  |  X  |  O    |
|             |     |                                  |     |  L    |
+-------------+-----+----------------------------------+-----+-------+
 0K            20K                                                 nK
```

Memory Layout

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AUX Components

- Scheduler entry from executive fork processing

- Timer entry from executive fork processing

- Modem control scanning routines

- DDM buffer allocation recovery routines

- Powerfail recovery routines

- Mapped pool allocation/deallocation routines

Process Layers

- LLC – Logical Link Control

    - Channel oriented
    - Provides virtual circuit management

- DLC – Data Link Control

    - Point-to-point or multipoint oriented
    - Provides error free path to adjacent nodes

- DDM – Device Driver Modules

    - Device controller/line oriented
    - Provides device specific control

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Control Flow Between Processes

LLC => DLC (Message transmission over virtual circuit)

- Direct subroutine call
- Completion will occur later

DLC => DDM (Message transmission over physical link)

- Direct subroutine call
- Immediate completion (C-bit clear)
- Delayed completion (C-bit set)

DDM => DLC (Message reception over physical link)

- Queued request
- DLC will execute under control of CEX scheduler

DLC => LLC (Message reception over virtual circuit)

- Queued request
- LLC will execute under control of CEX scheduler

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Process Databases

- Loaded in DSR or at the end of the process space

- Database per controlled entity:

  - Controller/Line for DDM modules
  - Station/Line for DLC modules
  - Database descriptor for LLC modules

- Created when process is loaded

  - NTL provides a "mini-assembler"
    - Allocate constant bytes and words
    - Reference global symbols from process symbol table file
    - Special database constructs (e.g. connect to interrupt vector)

DDM Specific Support

DLC

- ~~DDM~~ support is optional

    - Required to support software data link protocols

- Modem control

    - Samples modem signals once per second
    - Monitors Carrier or Dataset Ready signal
    - Recognizes line failure faster than data link protocol

- I/O requests processed for a specific line

    - Requests specify system line number (SLN) for I/O
    - May know about multipoint to manipulate modem control signals

DLC Specific Support

- DLC support is always present

- I/O requests processed for a specific line and logical station

  - Requests specify SLN and logical station number (tributary)

LLC Specific Support

- LLC support is always present

- I/O requests processed for a specific logical channel

    - Channel database is optional for LLCs
    - Each channel defines a physical path out of the machine
    - Channel 0 is reserved for internal loopback

NSP/NETACP Implementation

User Interface Functions

- Declare task as an active network user

- Declare AST address for network exception reporting

- Request connection to a partner on a remote system

- Accept/Reject an incoming request for connection

- Transmit/Receive data messages

- Transmit an interrupt message

- Retrieve network exception indication/interrupt message

- Disconnect/Abort a connection

- Remove declaration as an active network user

Device Driver Data Structures – NS:
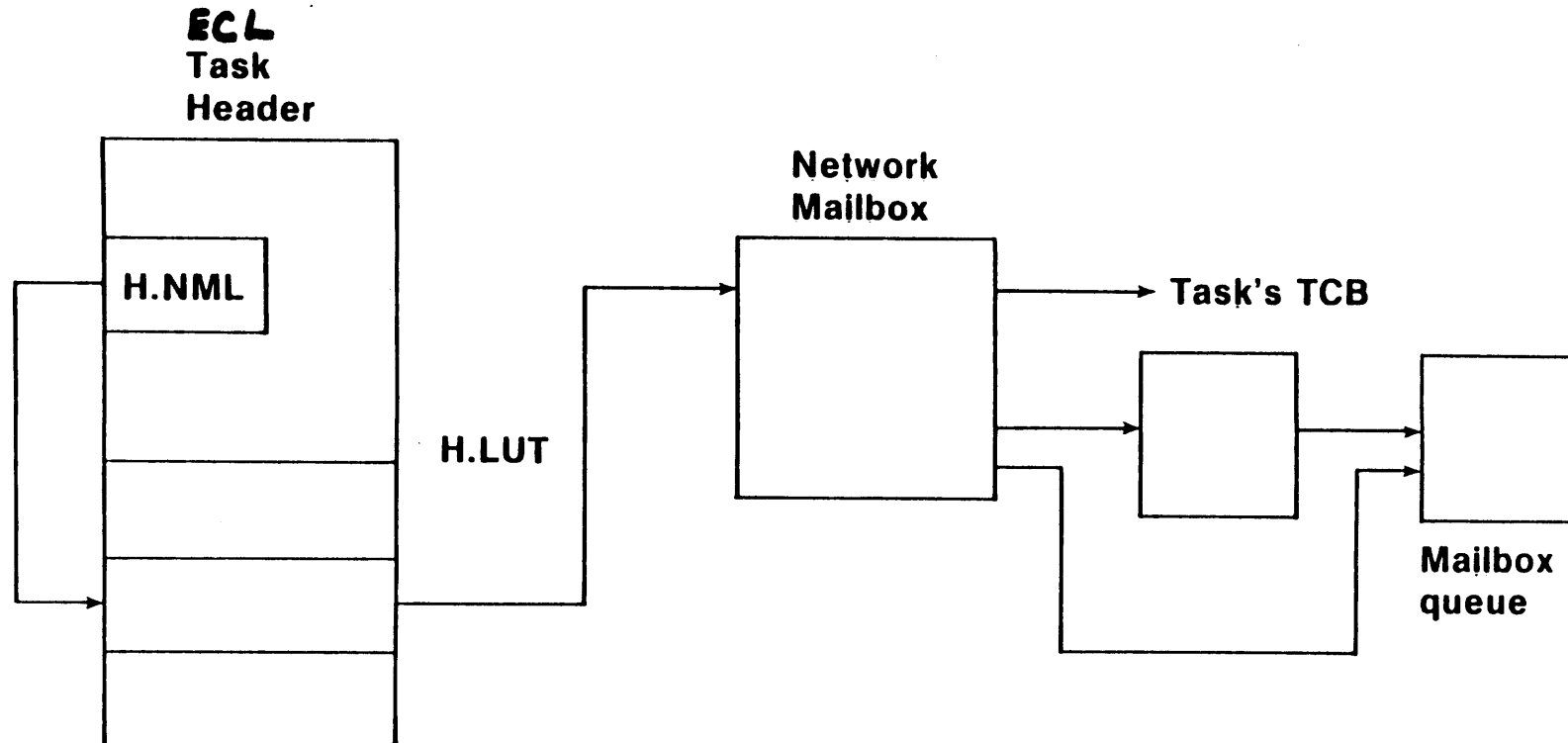
ECL
Task
Header

H.NML

H.LUT

Network
Mailbox

Task's TCB

Mailbox
queue

Device Driver Data Structures - NS :

ECL
Task
Header

Window
Block

Task's TCB
Mailbox

H.LUT

I/O packet
queues

I/O Packet Initiation

NSP Process

NETACP

Control
Functions

$DQPKT

I/O
request

NS:

UCB

UC.QUE
set

Transfer
Functions

Processed
locally

Receive I/O Packet Queue

Window Block

I/O packet

etc

Receive

queue

Active Ptr

User Task

Filled

I/O buffer
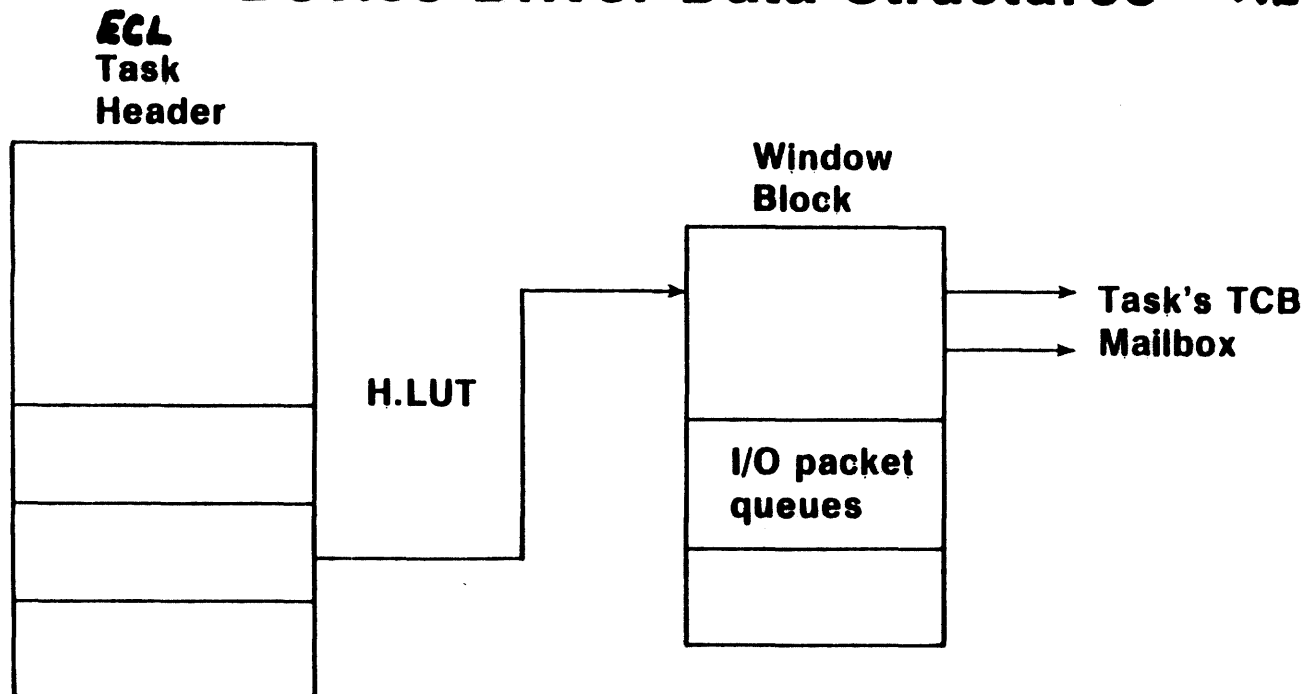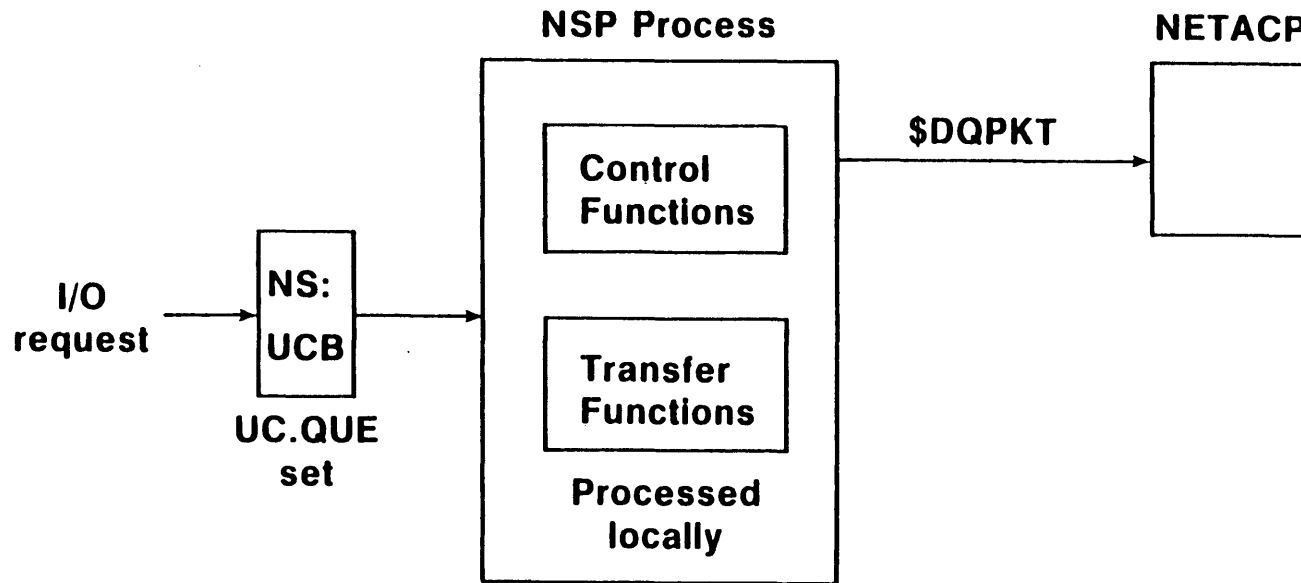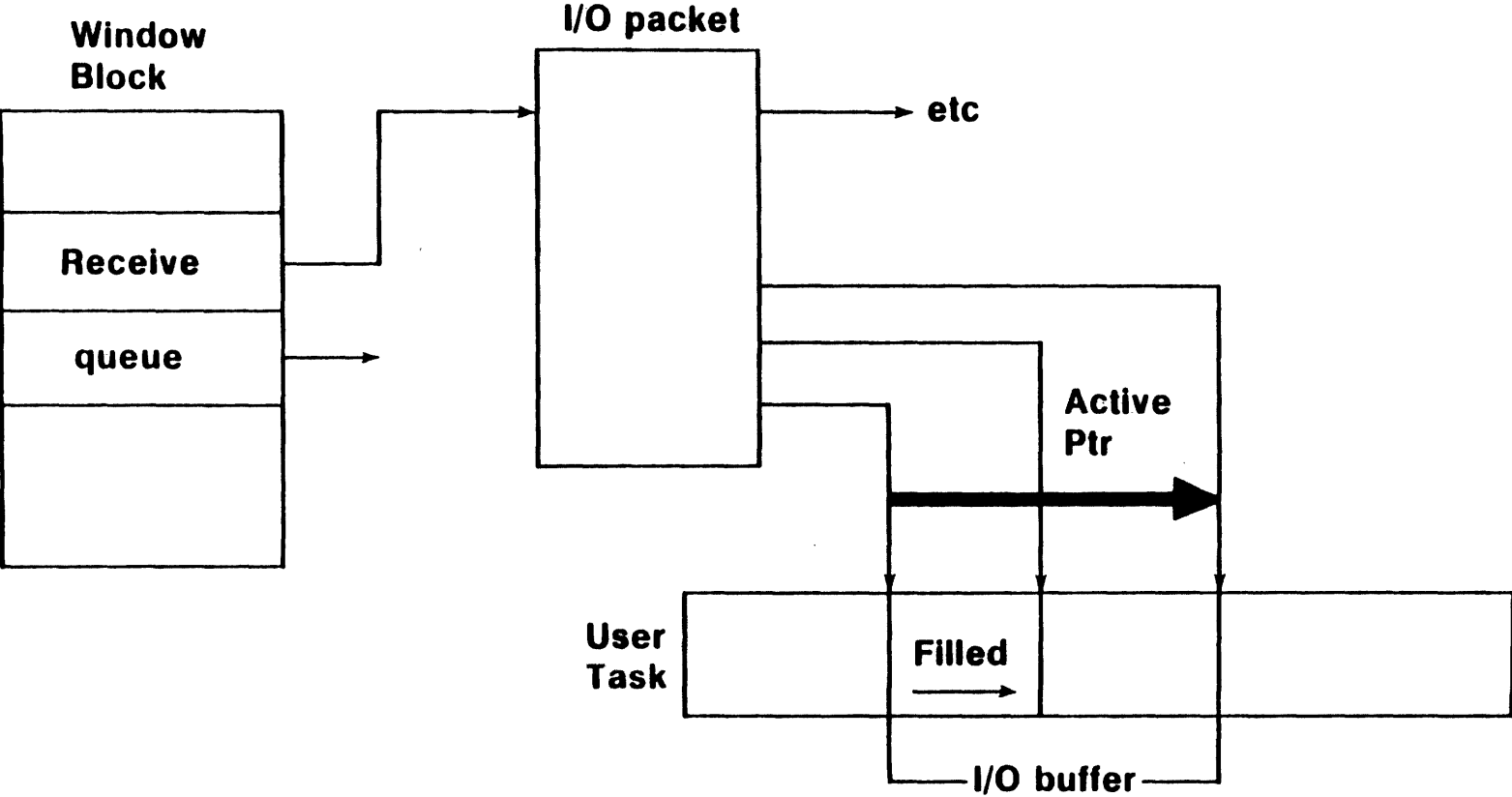
Transmit I/O Packet Queue

NSP Data Base Descriptor

PDV
Index
Table

PDV

Process bias

ECL

NSP Process (*ECL*)
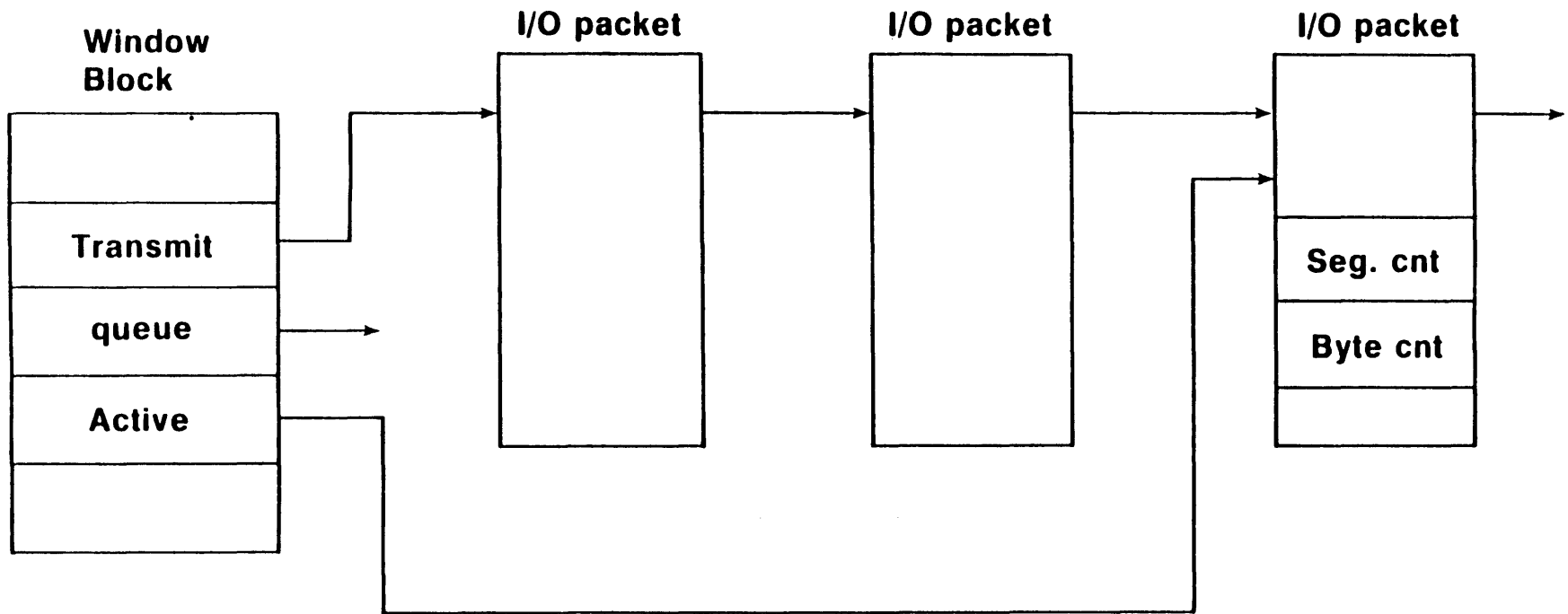
Database descriptor

Logical Link Table

NS:
UCB

Volume
Control
Block

Logical
Link
Address
Table
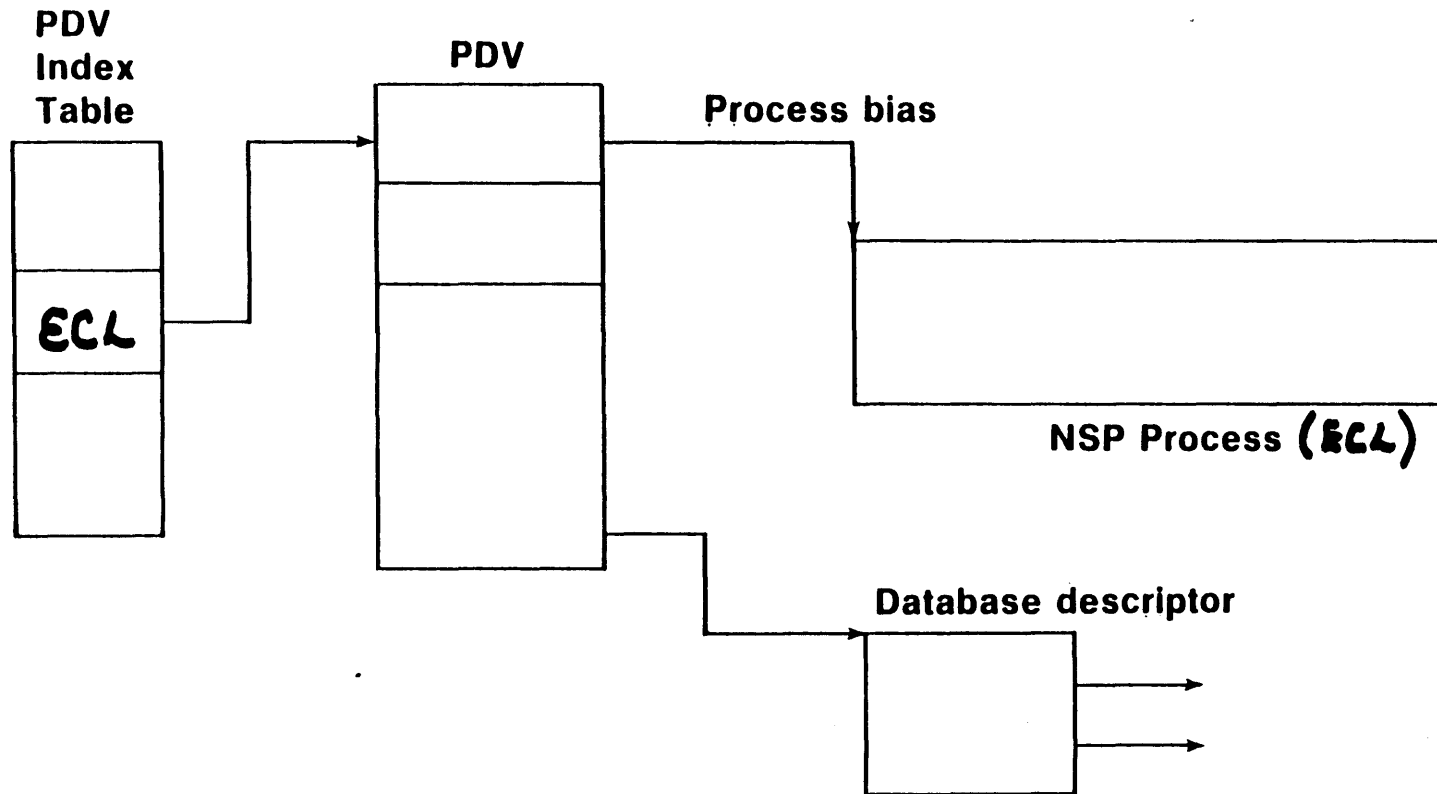
Logical
Link
Table

Message Reception

Flags	Source Address	Transport Control data

Transport Control message

Message dependent data

Except for transport initialization, must match expected value.
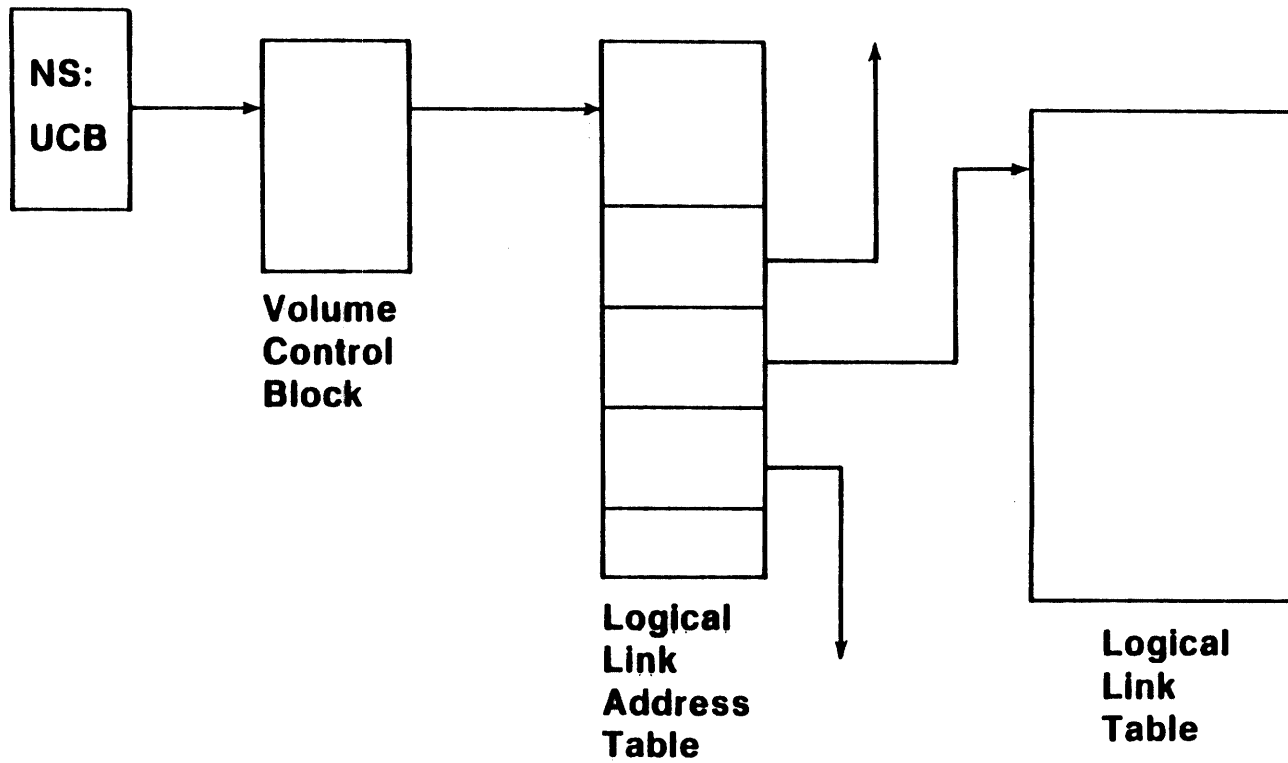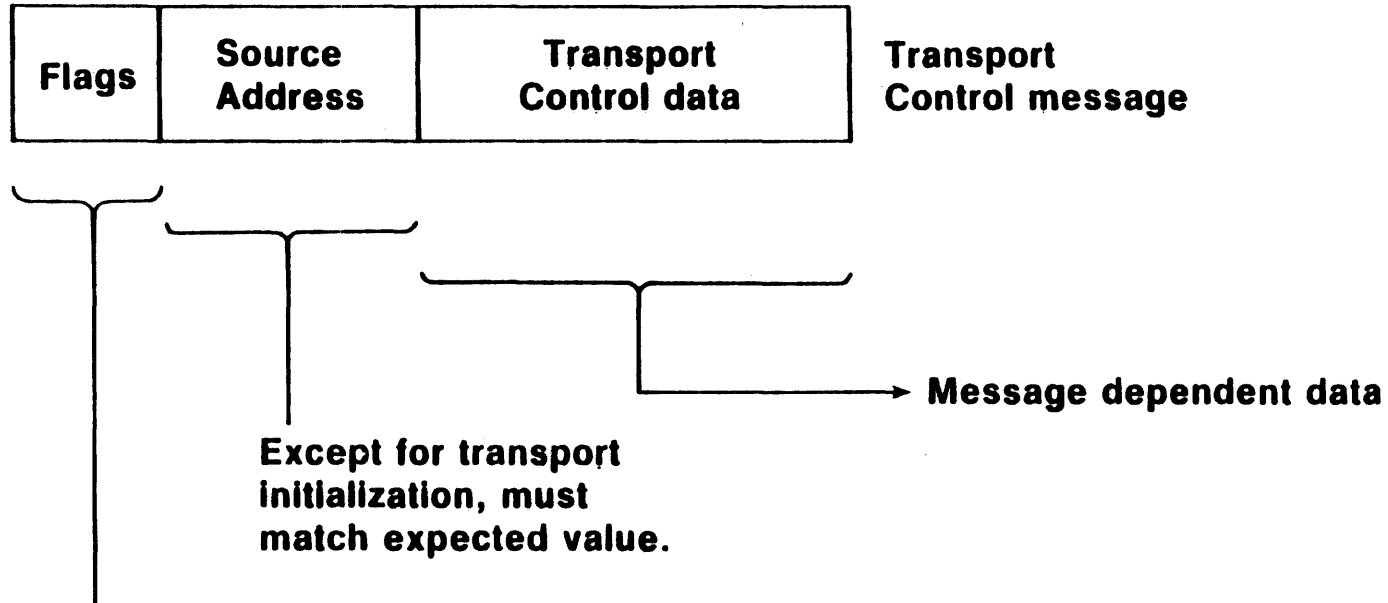
Message type:
0 = Transport Initialization
1 = Transport verification
2 = Transport hello and test
3 = Transport routing message

Message Reception

Flags	Destination Address	Source Address	Visit Count	Transported data

NSP message ← Transported data

Check validity of address ← Source Address

Process if equal to local node address else route forward ← Destination Address

Toss messages which have visited too many nodes to prevent looping ← Visit Count

NSP segment (Return to sender) ← Flags

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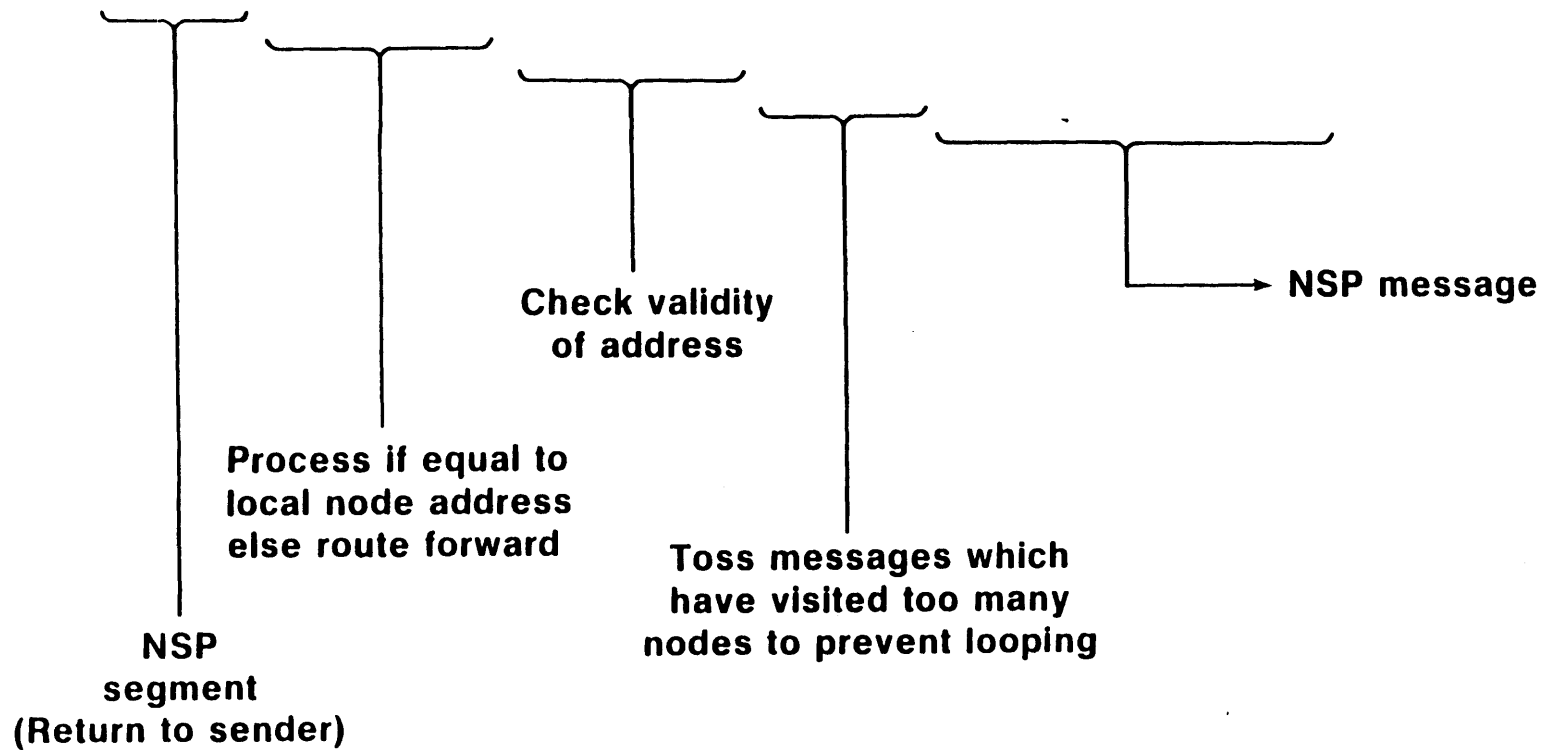
NSP Message Reception

```
┌─────────┬──────────────────────────────────────┐
│ MSGFLG  │                                      │
└─────────┴──────────────────────────────────────┘
     └────┬────┘
          │
          │
```
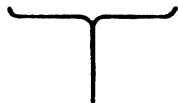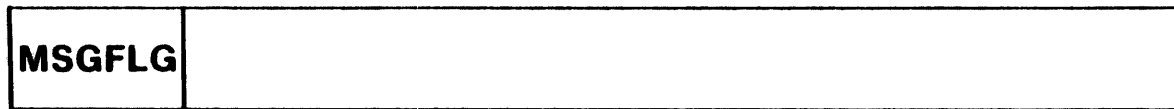
Message flags:

0 = Data message   1 = Acknowledgements   2 = Control message

(D) Data segment	(D) Data acknowledgement	(A) No operation
(A) Interrupt message	(D) I/LS acknowledgement	(A) Connect initiate
(D) Link service	(A) Connect acknowledgement	(A) Connect confirm
		(A) Disconnect initiate
(D) = Processed in the driver		(A) Disconnect confirm
(A) = Processed in NETACP		

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Data Messages

MSGFLG	DSTADR	SRCADR	[ACKNUM]	SEGNUM	Data

Optional ACK
number for
performance

Identify
logical
link

Data bytes to deliver
to the user

Segment number
for this message
modulo 4096

End of message
Beginning of message
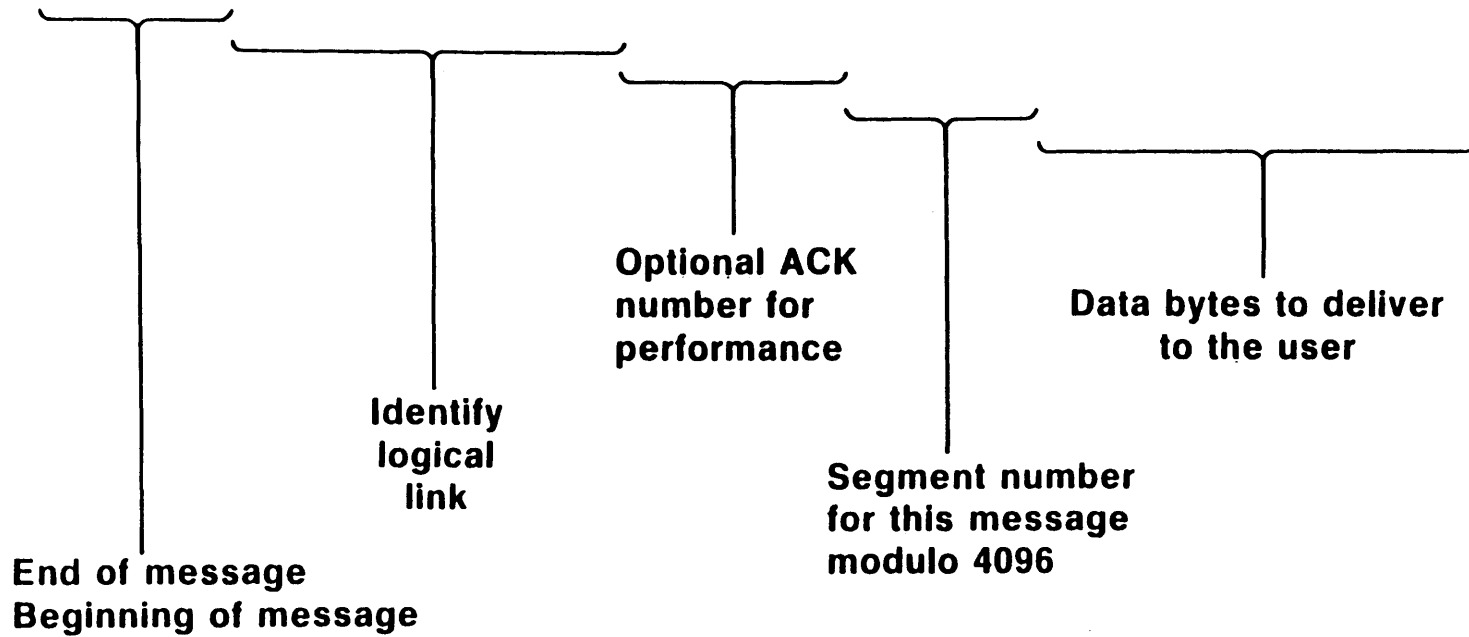
Acknowledgement Messages

MSGFLG	DSTADR	SRCADR	ACKNUM

Connect Acknowledgement

MSGFLG	DSTADR

Identify logical
link

Acknowledgement
segment number

Subchannel:
Data channel
I/LS channel

Identify logical
link

Indicates connect
acknowledgement

44
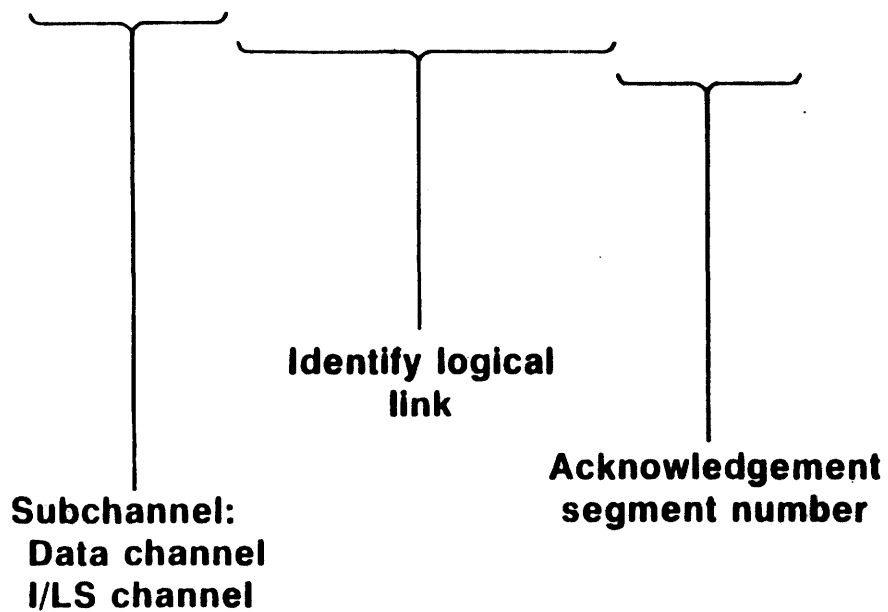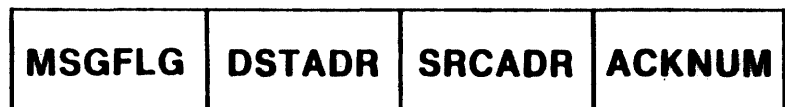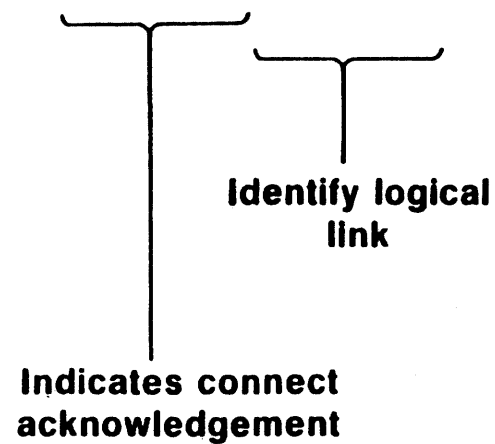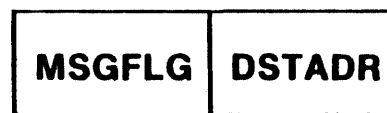
Control Messages

MSGFLG	TSTDATA	No operation

MSGFLG	DSTADR	SRCADR	SERVICES	INFO	SEGSIZE	DATA CTL

Connect initiate

Connect confirm

MSGFLG	DSTADR	SRCADR	REASON	DATA CTL

Disconnect initiate

MSGFLG	DSTADR	SRCADR	REASON

Disconnect confirm

Logical Link Creation

User task	NS: driver	NETACP	Messages sent/received
Issues OPN$	Creates mailbox	Links mailbox to global list	
Issues CON$	Creates window block	Creates logical link table entry	Sends connect initiate
		Stops connect timer	Receives connect acknowledgement
		Sets link into data state. Completes CON$ request to user.	Receives connect confirm
Link Established			Sends data acknowledgement

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Logical Link Creation

User task	NS: driver	NETACP	Messages sent/received
		Requests task to execute	Receives connect initiate
			Send connect acknowledgement
Issues OPN$	Creates mailbox	Links mailbox to global list	
Issues GND$		Returns connect request to user	
Issues ACC$	Creates window block	Creates logical link table	Sends connect confirm
		Complete ACC$ request to user	Receives data acknowledgement
Link established			

Logical Link Operation

User task	NS: driver	NETACP	Messages sent/received
Issues REC$	Queues I/O packet		Sends link service msg
			Receives link service acknowledgement
	Copies data segment to user's buffer. If end of message complete the receive request to user.		Receives data segment
			Sends data ACK

Repeated until
segment with
end of message
flag set is received

Logical Link Operation

User task	NS: driver	NETACP	Messages sent/received
Issues SND$	Queues I/O packet		
			Receives link service message
	Copies data segment from user's buffer to a large data buffer		Sends link service acknowledgement
			Sends data segment
			Receives data ACK
	Complete request to user.		

Repeated until
segment with
end of message
flag set is acknowledged

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Logical Link Disconnection

User task	NS: driver	NETACP	Messages sent/received
Issues ABT$	Marks link as aborting	Saves address of I/O packet. Completes outstanding transmits and receives with IE.ABO	Sends disconnect initiate
			Receives disconnect confirm
		Destroys logical link table. Destroys window block. Completes request to user.	

Logical Link Disconnection

User task	NS: driver	NETACP	Messages sent/received
		Completes outstanding transmits and receives with IE.ABO Queues disconnect notification to mailbox.	Receives disconnect initiate.
Issues GND$		Returns disconnect notice to user. Destroys logical link table. Desiroys window block.	Sends disconnect confirm

Transport Operation

┌─────────────────────────────┐
│ **NCP SET CIR XXX-0 STA ON** │   **Message Exchange**
└─────────────────────────────┘
                                        ────────────────────────────→ **Transport initialization**

          Transport initialization ◄────────────────────────────

                                        ────────────────────────────→ **Transport verification**
Optional {
          Transport verification ◄────────────────────────────

                                        ────────────────────────────→ **Routing message**
Full routing only {
          Routing message ◄────────────────────────────

                                        CIRCUIT declared 'UP'

                                        ────────────────────────────→ **Test message**
Repeated periodically {
          Test message ◄────────────────────────────

Message Segmentation

NSP message

CRC 16 checksum
prefixed to
message

All resources are
allocated before
data copy takes place

Buffer #1

Buffer #2

Buffer #3

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Message Reassembly

Buffer #3

Message buffers after the first are deallocated after copying the data

Buffer #2

M

Buffer #1

CRC 16 stripped and checked for completed message

C R C	M		

NSP message

Routing Message Reception

Flags	Source Address			Hops	Cost	Node
						1
						2
						3
						.
						.
						etc

Routing data

Source of
routing data

3   Routing message
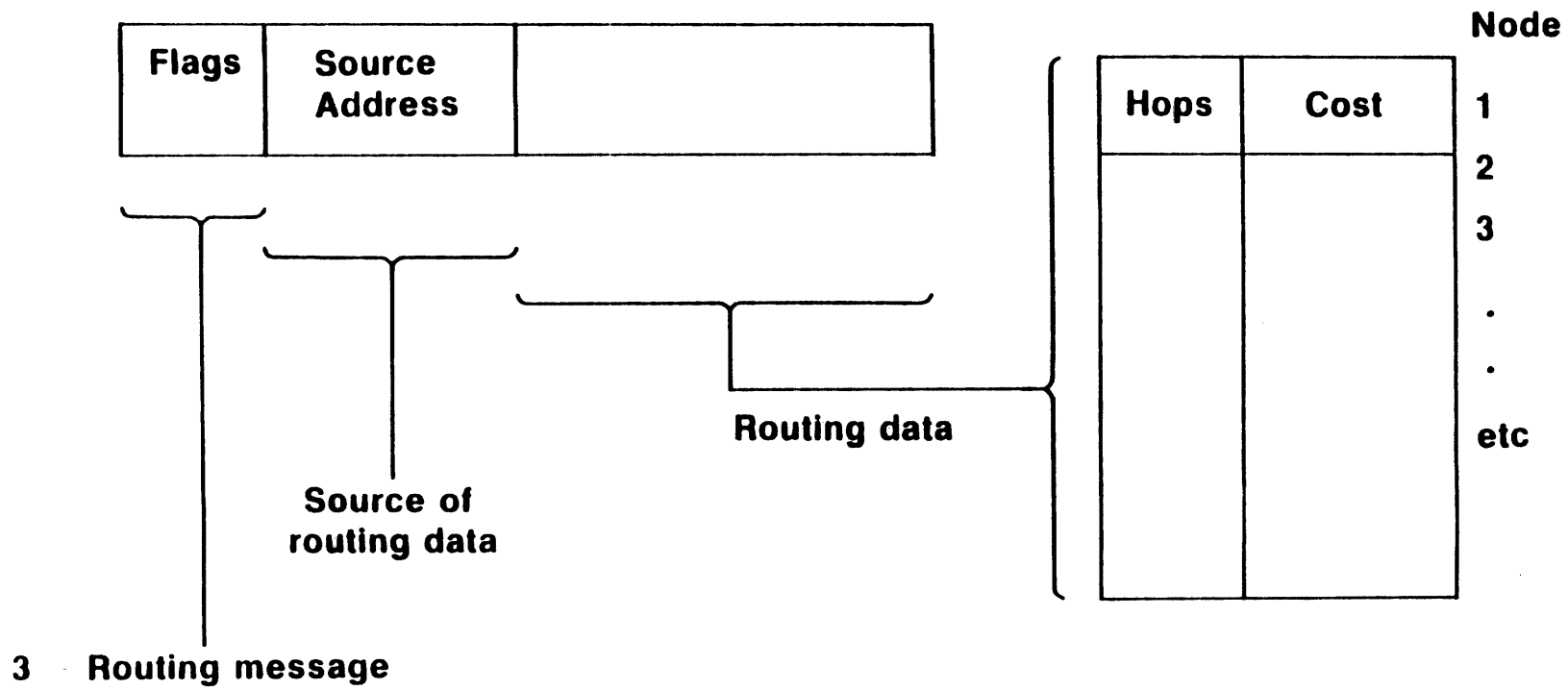
Routing Algorithm Operation

Routing message

Routing 'Event'

ROL vector

Channel 0 1 2 . . etc   Node

1 ⟶ "Routes" ⟶

2

.

.

etc

MinHop/MinCost vector

Hop/Cost Matrix

If Minhop/Mincost vector has
changed, send routing messages
on all channels controlled by
transport.
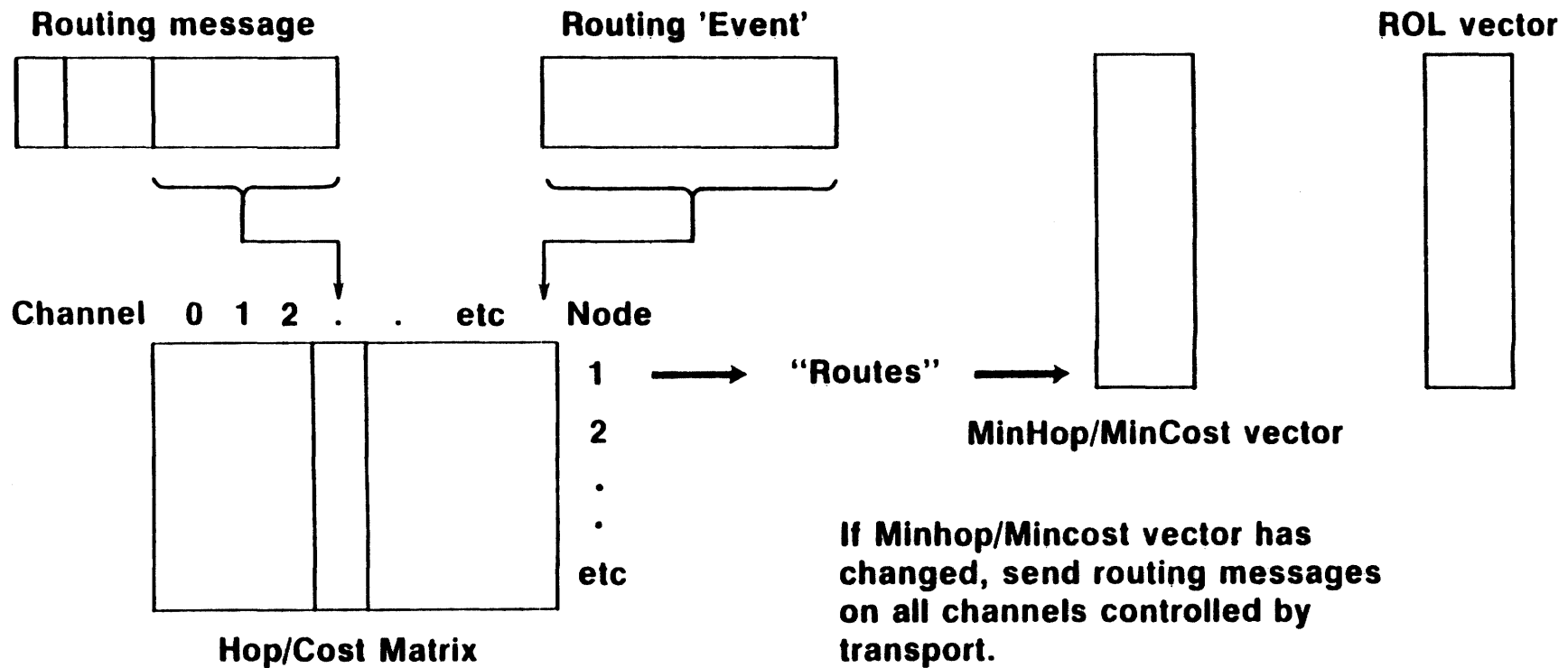
Loading the Network Software

NCP
NM:
NM VACP
NT INIT
NTL

Files

~~Components~~ processed during loading:

- CEX.TSK — only IIS / IIm

- CETAB.MAC

- CETAB.TSK

- Process task image files

- Process template files

CEX.TSK

- Created by NETGEN
- Contains communications executive

CETAB.MAC

- Macro file created by NETGEN
- Macros
  - Assembled by NETGEN
  - Scanned by NTL
- Modifiable by CFE

CETAB.TSK

- Created by NETGEN

- Contains:

    - PDV vector

    - PDVs

    - SLT vector

    - SLTs

    - Reverse mapping table

Process task image

- One per process
- Created by NETGEN

Process template files

- Labelled xxx.DAT (xxx = process name)
- Contain operators to create data base for process
- Allocated from end of process space or DSR
- Pointed to by PDV if LLC, SLT if DDM or DLC

Components involved in loading the network software

- NCP (Network Control Program)

- NM: (Network Management Driver)

- NMVACP (Network Management Volatile ACP)

- NTINIT (Network Initializer)

- NTL (Network Loader)

>NCP SET SYSTEM

Juse pass information along to NMVACP

NCP → **QIO** → NM: → **TCB queue** → NMVACP → **SDAT$** → NTINIT → **SDAT$** → NTL

$IOFIN

AST

SDAT$
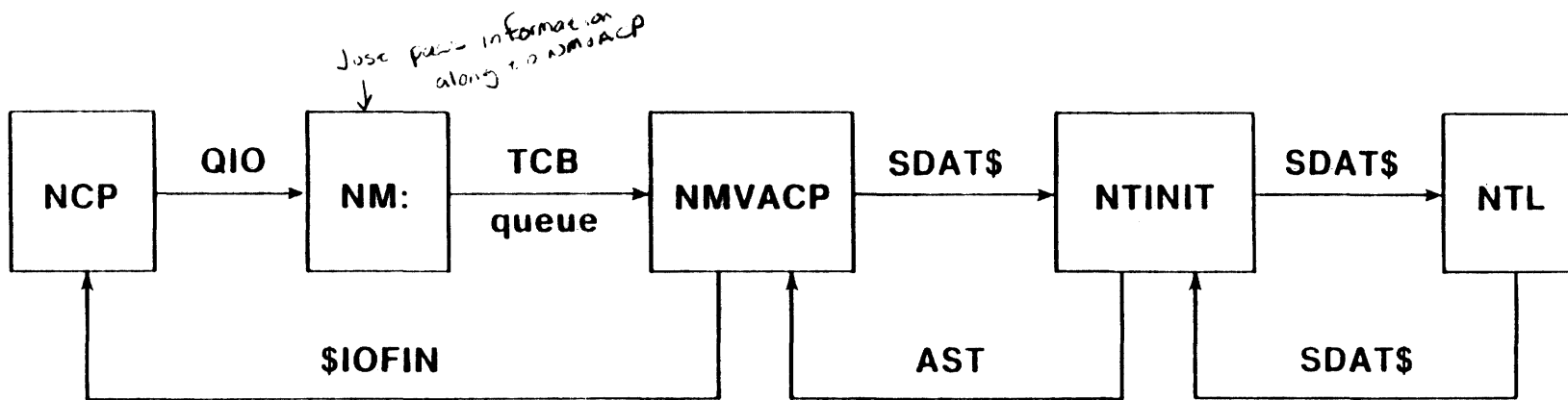
NTINIT

- Installed task name is NTINIT

- Send request to NTL to load Comm Exec

- Load's UMR's if necessary (Systems which have been VNP'ed)

- Start timers

- Send request to NTL to load processes marked-for-load

- Send request to NTL to load lines marked-for-load

NTL functions

- SET SYSTEM
- SET PROCESS
- SET LINE

NTL — SET SYSTEM

- Requested by NTINIT

- Scan CETAB.MAC for buffer, network pool and routing parameters

- Initialize network pool partition (POOL..)

  - NTL home block

  - Pool block area ($NBIAS,$QBIAS,$QSTRT)

    - Non-UMR mapped ($NBIAS)

    - UMR mapped ($QSTRT,$QBIAS)

  - Pool byte area ($XAVL,$XBIAS)

- Allocate RDB's, SDB's, CCB's

NTL — SET SYSTEM

- Load Comm Exec (CEX.TSK)

- Load Comm Exec Data Base (CETAB.TSK)

- Scan CETAB.MAC for

  - Processes/Lines marked-for-load

  - Object definitions

  - Remote node definitions

  - Event filter block definitions

  - Local node definitions

NTL — SET PROCESS

- Requested by NTINIT or NMVACP

- Load process into memory

- If process is an LLC build line table
  (Expand xxx.DAT)

- Build device data structures if necessary (NX: for DLX)

- NSP specific

NTL — SET LINE

- If DLC not in memory, load it
- Build DLC line table
- Load DDM if not in memory
- If KMC-11, load microcode
- Build DDM line table
- Build interrupt linkage

SET LINE — INTERRUPT LINKAGE

DDM line tables in process space:

Vector space

ICB
PS

DSR (ICB pool M+)

MOV @ # KISAR5,–(SP)
.
.
.
JMP Line Table

Line Table

.
.
.
JSR ISR
.
.
.
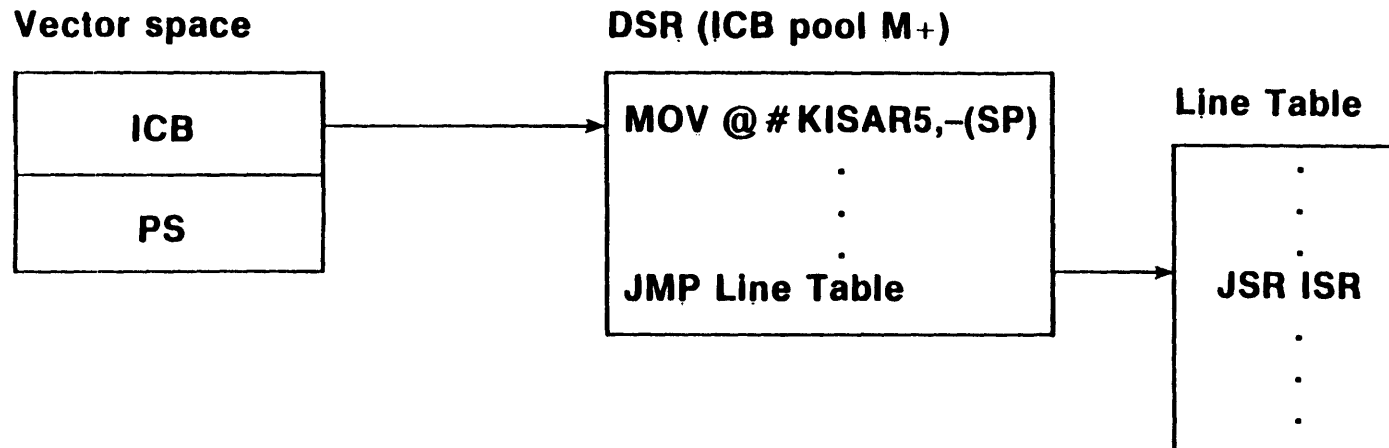
NTL data structures

- Accounting for allocations made by NTL
- Used by CLEAR PROCESS, CLEAR LINE, CLEAR SYSTEM
- Allocated from network pool area
- Pointers in NTL home block
- Unload blocks
- Library blocks

NTL Unload Blocks

- PDV index of process
- Line table allocation
- Additional allocations
- Library allocations

Library blocks

- Allocations from .LIBR
- RAD50 file name
- Bias of library
- Size of library
- Use count

NEW Features of DECnet-11M/M+ v4.3 and 4.0

Ethernet programming support for 802.3
DAP support for multi-block file transfers
LAT v5.1 application terminal support (M+ only)
PROXY network access (M+ only)
Extented access control (up to 39 chars)
Line and Circuit counter timer support
Device support for DELQA, DELUA, and DHQ11
Routing equal cost load splitting
Phase IV+ routing enchancements
DEC Standard 52 modem control for DHU/DHV

european modem control where
CD is switched during hdx

JULY

level 1/2
sep Multicast
address

U s e r

I S p a c e		D S p a c e	
PDR	PAR	PDR	PAR
077506	000000	000000	000000
077406	000200	000000	000000
077406	000400	000000	000000
077406	000600	000000	000000
077406	001000	000000	000000
067106	002074	000000	000000
024006	002614	000000	000000
077406	177600	000000	000000

S u p e r v i s o r

I S p a c e		D S p a c e	
PDR	PAR	PDR	PAR
000000	000000	000000	000000
000000	000000	000000	000000
000000	000000	000000	000000
000000	000000	000000	000000
000000	000000	000000	000000
000000	000000	000000	000000
000000	000000	000000	000000
000000	000000	000000	000000

K e r n e l

I S p a c e		D S p a c e	
PDR	PAR	PDR	PAR
077506	000000	000000	000000
077506	000200	000000	000000
077406	000400	000000	000000
077406	000600	000000	000000
077506	001000	000000	000000
077406	011246	000000	000000
077506	000013	000000	000000
077506	177600	000000	000000

U n i b u s M a p

1	00000000
2	00000000
3	00000000
4	00000000
5	00000000
6	00000000
7	00000000
8	00000000
9	00000000
10	00000000
11	00000000
12	00000000
13	00000000
14	00000000
15	00000000
16	00000000
17	00000000
18	00000000
19	00000000
20	00000000
21	00000000
22	00000000
23	00000000
24	00000000
25	00000000
26	00000000
27	00000000
28	00000000
29	00000000
30	00000000
31	00000000

INTEGRATION OF COMPONENTS
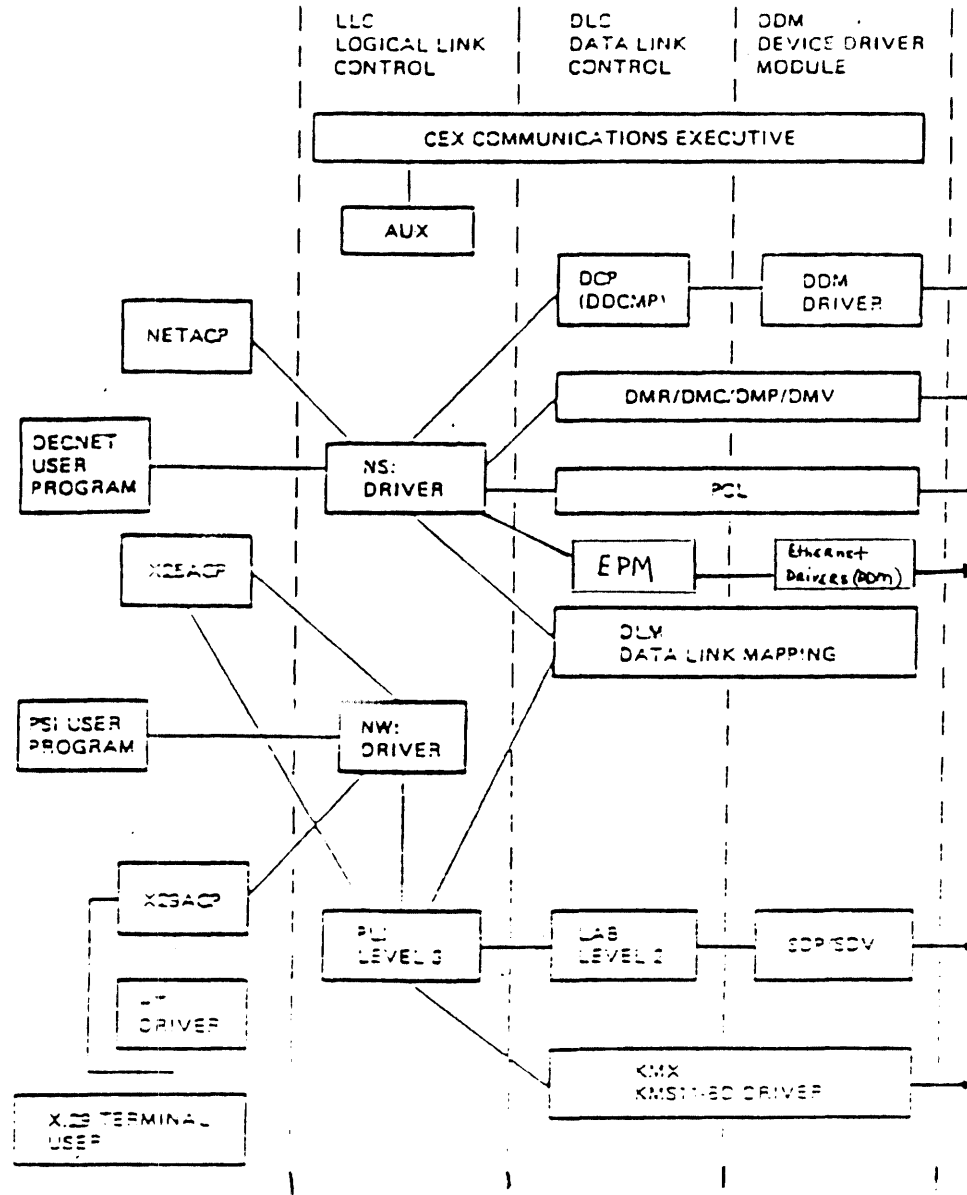
RSX-NETWORK INTERFACE

Network is implemented as a standard RSX QIO interface:

    tasks issue QIOs to network device drive by specifying the LUN for
    that network driver in the I/O call

    I/O packets created created by DRQIO exec routine are given to the
    driver or ACP based on the function mask in the driver's DCB

    Associated with each network driver are the standard RSX device
    structures DCBs, UCBs, and SCBs. These structures are created by
    NTL on loading of the network.

Network PSEUDO-DRIVERS

    NS: driver - provides I/O interface for logical link facility
                 implemented in the NSP process (ECL and NETACP)

    NW: drvier - provides I/O interface for the PSI facility

    NX: driver - provides I/O interface for the DLX facility

    NM: driver - provides I/O interface for network management facility
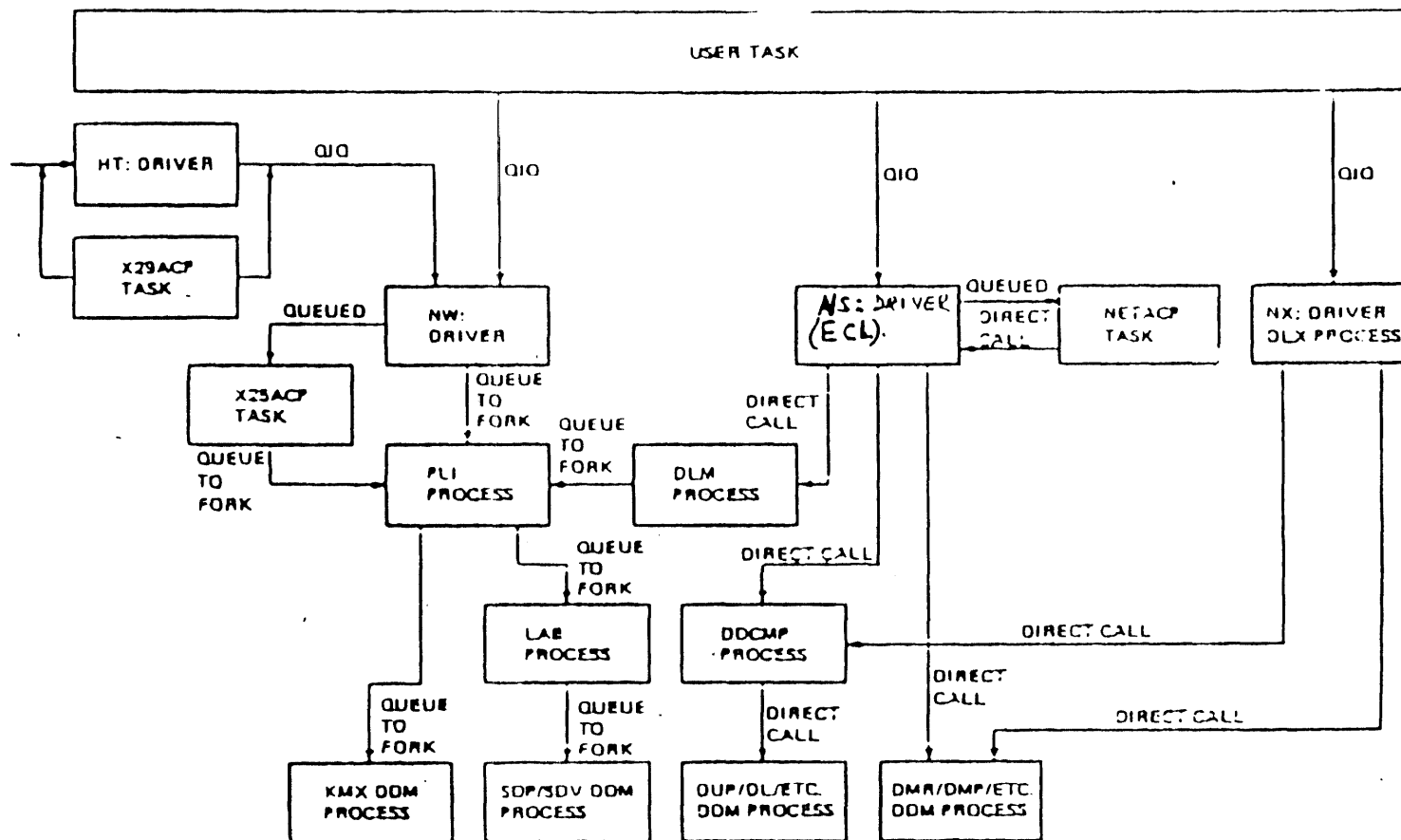
"Direct Calls" means that the current process gives a CCB to the next process to be run for that CCB and schedules that process for execution through the COMM EXEC.

"Queued" means that the I/O packet is given to the ACP via the ACP's receive queue in the task's header.   (ECL and NETACP)

"Queued to Fork" means that a CCB is queued by the current process to the end of the network fork queue and it will be dispatched to the next process by the COMM EXEC Fork processing routines (resident in AUX). The Network for processing routines will be activated by the RSX executive (SYSXT) the same way any standard for processing routines.

```
              .SBTTL      Process Dispatch Table
;+
;  **-$XPTTB-Process dispatch table
;
;           This dispatch table provides the interface between comm/exec
;           and the transport process.
;-
;
$XPTTB::.WORD          .XMENB                  ; Transmit enable - forward packet
        .WORD          .XMCHK                  ; Receive enable - check for packet limiting
        .WORD          .+1                     ; Kill enable - illegal
        .WORD          .CTENB                  ; Control enable - circuit control
        .WORD          .TMLIN                  ; Timeout - protocol timing
        .WORD          .XMCMP                  ; Transmit complete - packet forwarded
        .WORD          .RCCMP                  ; Receive complete - packet received
        .WORD          .+1                     ; Kill complete - illegal
        .WORD          .CTCMP                  ; Control complete - circuit control


;+
;  **-$DUPTB-DUP11 DEVICE DRIVER DISPATCH TABLE
;
;-
$DUPTB::.WORD          DPASX                   ; TRANSMIT ENABLE
        .WORD          DPASR                   ; RECEIVE ENABLE (ASSIGN BUFFER)
        .WORD          DPKIL                   ; KILL I/O
        .WORD          DPCTL                   ; CONTROL INITIATION
        .WORD          DPTIM                   ; TIME OUT
        .WORD          .+1                     ; TRANSMIT COMPLETE (VIA INTERRUPT)
        .WORD          .+1                     ; RECEIVE COMPLETE (VIA INTERRUPT)
        .WORD          .+1                     ; KILL COMPLETE
        .WORD          .+1                     ; CONTROL COMPLETE
        .WORD          PWRFL                   ; POWERFAIL RECOVERY


;+
;  **-$QNATB-QNA DEVICE DRIVER DISPATCH TABLE
;

$QNATB::
        .WORD          TXENB                             ; Transmit enable
        .WORD          RCENB                             ; Receive  enable
        .WORD          CRASH                             ; Kill I/O - not supported
        .WORD          CTENB                             ; Control dispatch
        .WORD          TIMER                             ; Timeout
        .WORD          CRASH                             ; Transmit complete - not supported
        .WORD          CRASH                             ; Receive complete - not supported
        .WORD          CRASH                             ; Kill complete - not supported
        .WORD          CRASH                             ; Control complete - not supported
        .WORD          PWRFL                             ; Powerfail recovery
        .WORD          NETMAN                            ; Network Management
        .WORD          CRASH                             ; Microcode load - not supported

CRASH:     IOT
```

NCP Set Circuit DUP-0 State On

Comm Exec

XPT

CE
CS

CEC

CSC

CE
CEC

DCP

AUX

DDCMP Start

CE
CS

CEC/CSC

DUP

CEC

Device init
Modem Signals
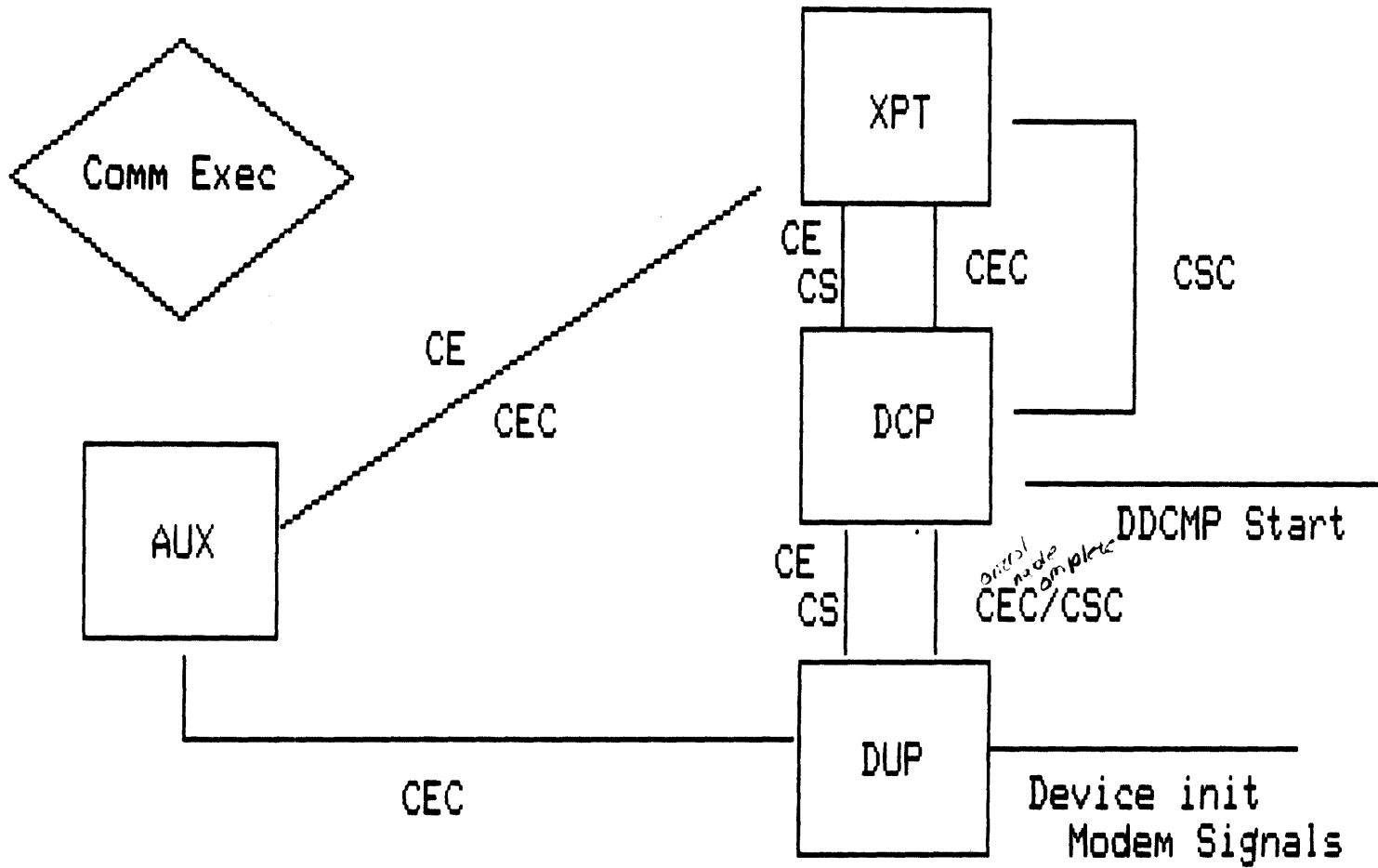
NTD (Network Demo Program)

Monitors:

- Local or remote system (RSX family only)

- Resource usage (CCB, SBD, RDB and active logical links)

- Tasks using the network and their outstanding I/O counts

- Reachable remote nodes and the output path to be used

- Fowarding database in NSP process and MinHop/MinCost
  vector

CEDUMP (Comm/Exec Dump)

Snapshots running system and dumps data to terminal:

- Comm/Exec resource usage (CCB, SDB and RDB)

- DSR and network pool usage

- Logical link related data structures:

    - Logical link table
    - Window block
    - Mailbox

- General delivery queue

- Physical link blocks

TRANSPORT AND ROUTING

ROUTING FEATURES

forwarding packets
adapting to changes in network topolo
adapting to different kinds of circuits
routing database updating
packet lifetime control
node level transport verification
maintaining counters and network event data
congestion control - input packet limiter
                     square route limiter

COMPONENTS

XPT – Transport Network process
        flavors – routing and end nodes

RCP – Routing Control task
        flavors – Level 1 (RCP1) and Level 2 (RCP2)
        RSX O.S./DECnet implementation limitation

RCP Database Calculation

space = (NN+(NN/2)+(NLN/2)+((NBRA+NLN+1)*(NN+1))+1400+117)

where:

NLN –   number of lines/tributaries on the node (loaded or not)
NN –   maximum address for the local node
NBRA–   maximum number of routing nodes on all Ethernets

```
                    .MACRO          XPDDB$,L,B,LST
                    .ASECT
        .=0
        N$RT1:'L'   .BLKW           1           ; TCB ADDRESS OF LEVEL 1 ROUTER
        N$LV1:'L'   .BLKW           2           ; LEVEL 1 MESSAGE LISTHEAD
        N$RT2:'L'   .BLKW           1           ; TCB ADDRESS OF LEVEL 2 ROUTER
        N$LV2:'L'   .BLKW           2           ; LEVEL 2 ROUTING MESSAGE LISTHEAD
        N$RTMX:'L'
        N$RTM1:'L'  .BLKB           1           ; LEVEL 1 ROUTING TIMER
        N$RTM2:'L'  .BLKB           1           ; LEVEL 2 ROUTING TIMER
        N$PLD:'L'   .BLKW           2           ; PHYSICAL LINK DESCRIPTOR (SIZE AND ADDRESS)
        N$ROA1:'L'  .BLKW           3           ; REACHABILITY VECTOR (SIZE AND ADDRESS)
        N$ROA2:'L'  .BLKW           3           ; AREA REACHABILITY VECTOR (SIZE AND ADDRESS)
        N$MHC1:'L'  .BLKW           3           ; MINHOP/MINCOST VECTOR (SIZE, BIAS, ADDRESS)
        N$MHC2:'L'  .BLKW           3           ; AREA MINHOP/MINCOST VECTOR (SIZE, BIAS, ADDR)
        N$HC1:'L'   .BLKW           2           ; HOPS/COST MATRIX IN RCP (BIAS, ADDR)
        N$HC2:'L'   .BLKW           2           ; AREA HOPS/COST MATRIX IN RCP (BIAS, ADDR)
        N$CACH:'L'  .BLKW           2           ; NI CACHE (COULD BE COND FOR ENDNODES)
        N$VER:'L'   .BLKW           2           ; PASSWORD DATABASE DESCRIPTOR (SIZE AND ADDRESS)
        N$ADJ1:'L'  .BLKW           1           ; BIAS OF FIRST PART OF ADJACENCY DATABASE
        N$ADJ2:'L'  .BLKW           1           ; BIAS OF SECOND PART OF ADJACENCY DATABASE
        N$PRI:'L'   .BLKW           1           ; ADDRESS OF BROADCAST ROUTERS' PRIORITY
        N$TLC:'L'   .BLKW           3           ; TRANSPORT LINE COUNTERS (SIZE AND ADDRESS)
        N$TRC:'L'   .BLKW           1           ; TRACE CONTROL WORD
        N$TTCB:'L'  .BLKW           1           ; TRACE COLLECTOR TCB ADDRESS
        N$TCTL:'L'  .BLKW           1           ; ADDRESS OF TRACE CONTROL BLOCK
        N$TNC:'L'   .BLKW           2           ; TRANSPORT NODE COUNTERS
        N$CRC:'L'   .BLKW           2           ; STCRC FOR DLM
        N$XLEN:'L'  .BLKW           0           ; LENGTH OF DATABASE
                    .PSECT
                    .IF NB          LST
                    .NLIST
                    .IFF
                    .MACRO          XPDDB$,X,Y,Z
                    .ENDM           XPDDB$
                    .ENDC
                    .ENDM           XPDDB$
```

```
              .MACRO      PLBDF$,L,B,LST
              .IIF NB     LST         .LIST
              .ASECT
.=0
P$LST:'L'    .BLKB      1               ; LINK STATE
P$TYP:'L'    .BLKB      1               ; ADJACENT NODE TYPE
P$LCD:'L'    .BLKB      1               ; RECOVERY FLAGS
P$RTIM:'L'   .BLKB      1               ; RECOVERY TIMER (MUST BE HIGH BYTE OF P$LCD)
P$CHN:'L'    .BLKB      1               ; LOGICAL LINE NUMBER
P$CNT:'L'    .BLKB      1               ; COUNT OF MESSAGES QUEUED TO LOWER LEVELS
P$PFQ:'L'    .BLKW      1               ; PENDING FUNCTION QUEUE
P$TIM:'L'    .BLKW      1               ; GENERAL PROTOCOL TIMER
P$FLG:'L'    .BLKW      1               ; FLAGS
P$IPL:'L'    .BLKB      1               ; INPUT PACKET LIMITER
P$DRCT:'L'   .BLKB      1               ; DESIGNATED ROUTER COUNT DOWN TIMER
P$RMX1:'L'   .BLKW      1               ; MAXIMUM DELAY BETWEEN ROUTING MESSAGES (LEVEL 1)
P$RMX2:'L'   .BLKW      1               ; MAXIMUM DELAY BETWEEN ROUTING MESSAGES (LEVEL 2)
P$STA1:'L'   .BLKB      1               ; LEVEL 1 ROUTING STATE
P$STA2:'L'   .BLKB      1               ; LEVEL 2 ROUTING STATE
P$TSIZ:'L'   .BLKW      1               ; TRANSPORT BLOCK SIZE
P$TSCT:'L'   .BLKW      1               ; COUNT OF ADJACENT NODES WITH SAME LOWEST TSIZ
P$FWD:'L'    .BLKW      2               ; STORE AND FORWARD QUEUE
P$CTR:'L'    .BLKW      1               ; POINTER TO TRANSPORT COUNTER BLOCK
P$DRTR:'L'   .BLKW      1               ; 16 BIT ADDRESS OF DESIGNATED ROUTER ON CHANNEL
P$NRNI:'L'   .BLKW      1               ; NUMBER OF ROUTERS ON NI
P$RPRI:'L'   .BLKW      1               ; CIRCUIT ROUTING PRIORITY
;
; PLB EXTENSION FOR DATA LINK MAPPING CIRCUITS
;
P$PKSZ:'L'   .BLKW      1               ; DATA LINK MAPPING PACKET SIZE
P$ICCB:'L'   .BLKW      1               ; INPUT RE-ASSEMBLY CCB
P$OCCB:'L'   .BLKW      1               ; OUTPUT SEGMENTATION QUEUE
P$LEN:'L'
;
; PHYSICAL LINK STATES
;
PS$OFF='B' 0                            ; OFF
PS$STR='B' 2                            ; STARTING
PS$WT='B'  4                            ; WAITING
PS$NTI='B' 6                            ; NOT INITIALISED
PS$VER='B' 10                           ; VERIFICATION WAIT
PS$UP='B'  12                           ; UP
PS$FAI='B' 14                           ; STARTUP FAILED FOR DLM CIRCUIT
PS$CHR='B' 16                           ; SET CHARACTERISTICS FAILED
;
; ADJACENT NODE TYPE FLAGS
;
PT$LV2='B' 1                            ; LEVEL 2 ROUTING NODE
PT$LV1='B' 2                            ; LEVEL 1 ROUTING NODE
PT$END='B' 4                            ; NON-ROUTING NODE
PT$PH3='B' 10                           ; PHASE 3 NODE
PT$XAR='B' 20                           ; ADJACENT NODE IS IN ANOTHER AREA
PT$DRT='B' 100                          ; WE ARE THE DESIGNATED ROUTER
PT$BRO='B' 200                          ; BROADCAST CHANNEL
;
; RECOVERY FLAGS
;
RF.CTL='B' 3                            ; COUNT OF OUTSTANDING CONTROL MESSAGES
RF.WTS='B' 10                           ; STOP FUNCTION MUST BE ISSUED
RF.WTD='B' 20                           ; DISABLE FUNCTION MUST BE ISSUED
RF.WTM='B' 30                           ; MASK FOR PENDING CONTROL FUNCTION REQUESTS
RF.LD1='B' 40                           ; SYNCHRONISATION WITH LEVEL 1 ROUTING
RF.LD2='B' 100                          ; SYNCHRONISATION WITH LEVEL 2 ROUTING
RF.WFC='B' 200                          ; WAITING FOR A COMPLETION FROM LOWER LAYERS
RF.TIM='B' 377*400                      ; TIMEOUT MASK
RF.TM0='B' 1*400                        ; 1 SECOND TIMER VALUE
```

```
;
; PHYSICAL LINK FLAGS
;
PF$ENB='B' 1                            ; LINK HAS BEEN ENABLED (NOTE: MUST BE 1)
PF$EIP='B' 2                            ; CONTROL ENABLE IN PROGRESS
PF$OFF='B' 0                            ; OFF STATE DESIRED
PF$UP='B' 4                             ; UP STATE DESIRED
PF$STA='B' 4                            ; MASK FOR DESIRED STATE
PF$RVR='B' 10                           ; VERIFICATION MESSAGE REQUESTED
PF$RM1='B' 20                           ; LEVEL 1 ROUTING MESSAGE REQUIRED
PF$RM2='B' 40                           ; LEVEL 2 ROUTING MESSAGE REQUIRED
PF$FM1='B' 100                          ; LEVEL 1 FULL ROUTING MESSAGE REQUIRED
PF$FM2='B' 200                          ; LEVEL 2 FULL ROUTING MESSAGE REQUIRED
PF$DLM='B' 100000                       ; THIS IS A DATA LINK MAPPING CIRCUIT
PF$SVC='B' 40000                        ; CIRCUIT IS AN SVC
PF$BLK='B' 20000                        ; BLOCKING SUPPORTED ON THIS CIRCUIT
PF$CLC='B' 10000                        ; CLEAR CONFIRMATION REQUIRED
PF$FAI='B' 4000                         ; LAST ATTEMPTED SVC CALL FAILED
PX$DLM='B' PF$DLM/400&377               ; TRANSPORT COUNTER BLOCK VERSION OF FLAGS
PX$SVC='B' PF$SVC/400&377
PX$BLK='B' PF$BLK/400&377
;
; ROUTING STATE VALUES
;
PR$UP='B'  1                            ; CIRCUIT IS UP
PR$DWN='B' 2                            ; CIRCUIT IS DOWN
PR$MOP='B' 4                            ; MAINTENANCE EVENT RECEIVED
PR$LCC='B' 10                           ; LINE COST CHANGE
PR$BRU='B' 20                           ; BROADCAST ROUTER ADJACENCY IS UP
PR$BRD='B' 40                           ; BROADCAST ROUTER ADJACENCY IS DOWN
PR$BEU='B' 100                          ; BROADCAST ENDNODE ADJACENCY IS UP
PR$BED='B' 200                          ; BROADCAST ENDNODE ADJACENCY IS DOWN
;
; PASSWORD DESCRIPTOR ENTRY DEFINITIONS
;
.=0
V$FLG:'L'  .BLKW     1                  ; PASSWORD VALIDITY FLAGS
V$RCV:'L'  .BLKB     8.                 ; RECEIVE PASSWORD
V$XMT:'L'  .BLKB     8.                 ; TRANSMIT PASSWORD
V$LEN:'L'
;
; VALIDITY FLAGS
;
VF$RCV='B' 100000                       ; RECEIVE PASSWORD IS VALID
VF$XMT='B'  40000                       ; TRANSMIT PASSWORD IS VALID
           .PSECT
           .IF NB    LST
           .NLIST
           .IFF
           .MACRO    PLBDF$,X,Y,Z
           .ENDM     PLBDF$
           .ENDC
           .ENDM     PLBDF$
```

```
                .MACRO      ADJDF$,L,B,LST
                .IIF NB     LST             .LIST
                .ASECT
.=0
;
; OFFSETS FOR ADJACENCY1 DATABASE
;
A$NID:'L'   .BLKW       1               ; NODE ID OF ADJACENCY
A$TYP:'L'   .BLKB       1               ; NODE TYPE
A$CIR:'L'   .BLKB       1               ; CHANNEL NUMBER
A$LEN:'L'   .BLKW       0               ; LENGTH
.=0
;
; OFFSETS FOR ADJACENCY2 DATABASE
;
A$TSZ:'L'   .BLKW       1               ; BLOCKSIZE
A$TMI:'L'   .BLKB       1               ; LISTEN TIMER RESET VALUE (MAGNITUDE 4 SEC)
A$TM:'L'    .BLKB       1               ; LISTEN TIMER (MAGNITUDE 4 SEC)
;
; ADJACENT NODE TYPE FLAGS
;
AT$LV2='B' 1                            ; LEVEL 2 ROUTING NODE <<NOTE-MUST BE = W/PLB>>
AT$LV1='B' 2                            ; LEVEL 1 ROUTING NODE <<NOTE-MUST BE = W/PLB>>
AT$CYC='B' 4                            ; ADJACENCY BEING RECYCLED
AT$UP='B'  10                           ; NODE "UP" ON BROADCAST CHANNEL
AT$AUP='B' 20                           ; ADJACENCY COMING UP BIT
AT$ADN='B' 40                           ; ADJACENCY GOING DOWN BIT
AT$ACL='B' 100                          ; ADJACENCY IS TO BE CLEARED BY RCP
AT$NEX='B' 200                          ; OTHER RCP IS TO CLEAR ADJACENCY
;
                .PSECT
                .IF NB      LST
                .NLIST
                .IFF
                .MACRO      ADJDF$,X,Y,Z
                .ENDM       ADJDF$
                .ENDC
                .ENDM       ADJDF$
```

ROUTING CONTROL MESSAGES

Ethernet router hello message
Ethernet end node message
Designated Router hello message
Routing Update message
Initialization message
Verification message
Hello/Test message

ROUTING Messages

Phase III – single complete routing message
Phase IV – segmented messages
            may contain only updated info (partial update)

PHASE IV+ Area Routing Improvements

Previously Level 1 and Level 2 routing update messages
were sent to ALL routers

Now Level 2 updates are sent only to Level 2 routers.
This unloads Level 1 routers from extra processing

Multicast address of routing update message

Level 1   —   AB-00-00-03-00-00
Level 2   —   09-00-2B-00-00-00

Legend:

(X)   = node
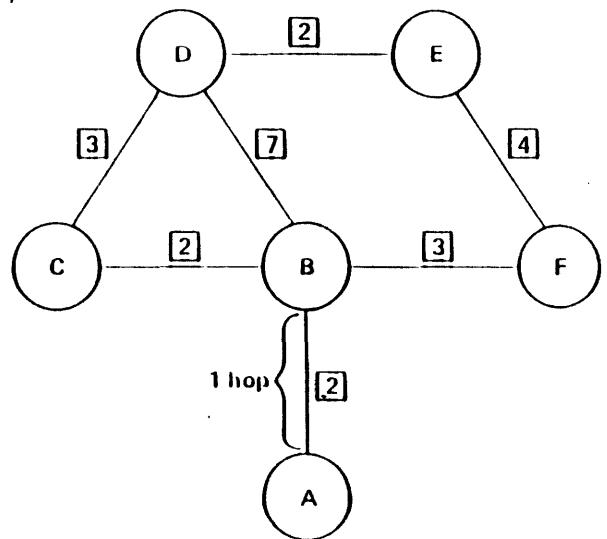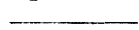
—————————   = circuit

[n]   = circuit cost

(X) — (X)   hop

Node A wants to send a packet to Node D. There are three possible paths.		
PATH	PATH COST	PATH LENGTH
(A) to (B), (B) to (C), (C) to (D)	[2] + [2] + [3] = 7*	3 hops
(A) to (B), (B) to (D)	[2] + [7] = 9	2 hops
(A) to (B), (B) to (F), (F) to (E), (E) to (D)	[2] + [3] + [4] + [2] = 11	4 hops

*7 is the lowest path cost; Node A therefore routes the packet to Node D via this path.

Example of Routing Update

A	ϕ			
B	∞			
C	∞			
D	∞			
E	∞			

ISO		DNA
APPLICATION		USER
PRESENTATION		NETWORK APPLICATION
SESSION		SESSION CONTROL
TRANSPORT		END COMMUNICATION
NETWORK		ROUTING
DATA LINK		DATA LINK
PHYSICAL LINK		PHYSICAL LINK

NETWORK MANAGEMENT

ROUTER
BRIDGE
REPEATER

ARCHITECTURE LAYERS
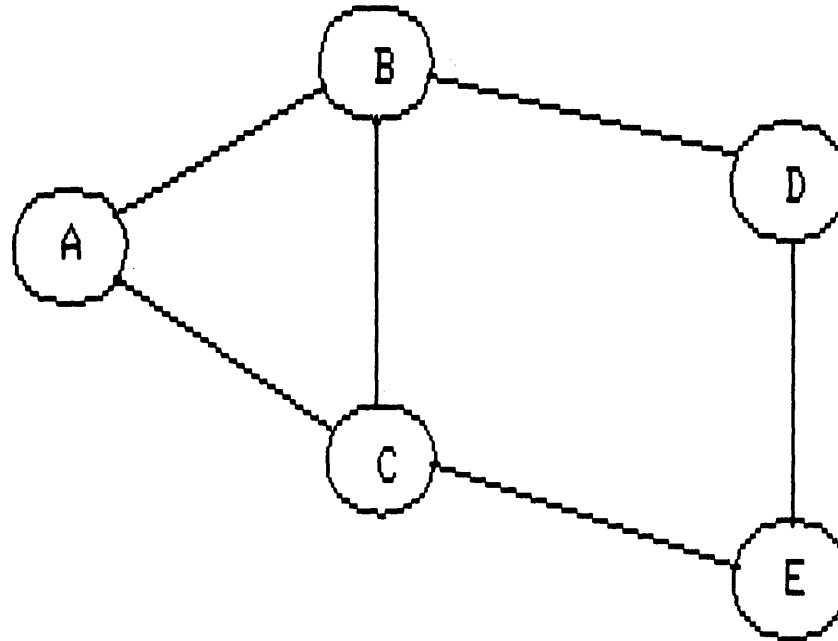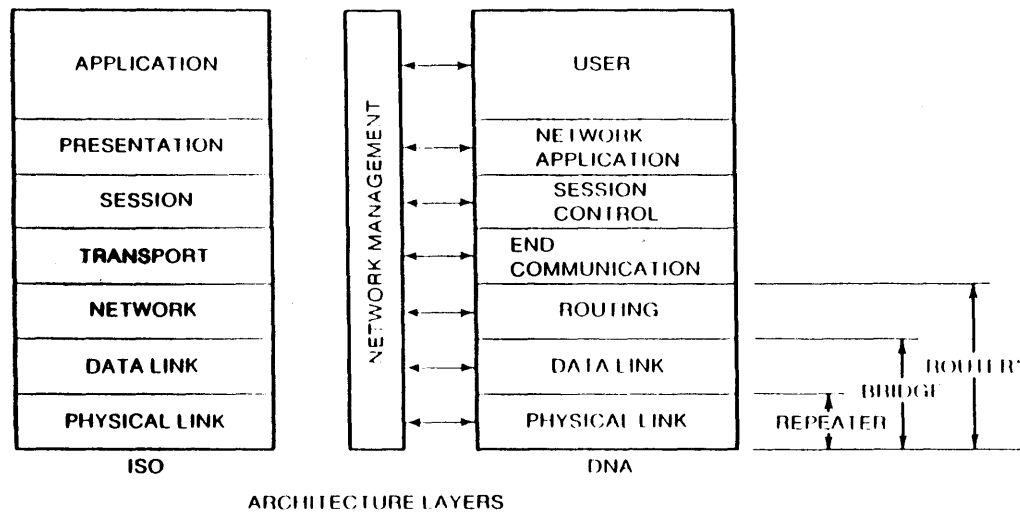
Table 3-1: Comparison of Routers and Bridges

Characteristic	Routers	Bridges
Network Environment	WANs or LANs	LANs
Multi-protocol	No	Yes
DNA Layer	Routing	Data Link
Terminal Communications		
LAT support	No	Yes
CTERM support	Yes	Yes
Network Management	High	Medium
Path Splitting	Yes	No
Area Routing	Yes	No
Reliable Data Service	Yes	No
Message Delay	High *	Low
Performance (Throughput)	Low *	High
Cost	Medium	Low to Medium

* Keep in mind that the ratings of router message delay and performance are "inferior" only in relation to bridges. Under normal conditions, the delay incurred by routers is minimal and imperceptible by network users and the throughput exceeds user requirements.
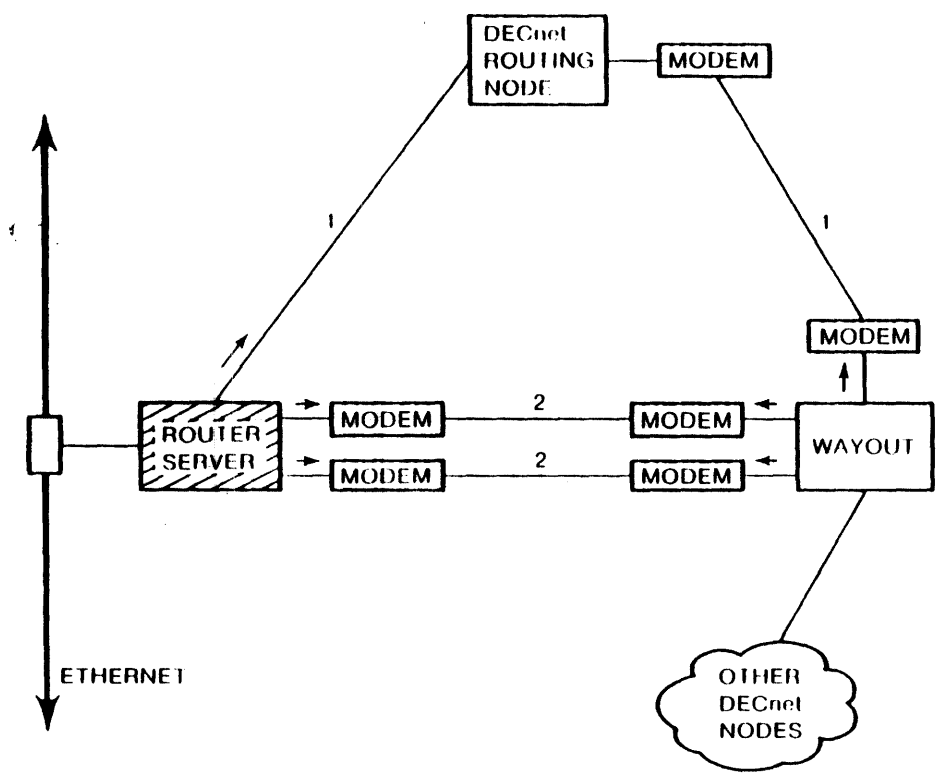
I KG 0561

Figure 2-5: Path Splitting

Path splitting can also connect modems to remote facilities. The transmission load can be split over several low-cost, low-speed switched circuits between the router and the remote facilities, with the combined throughput equaling that attained by an expensive high-speed line.

DEBUGGING AIDS

AND

HELPFUL HINTS

EXAMPLE OF A FAL TRACE

******** Connected Link #1 at 2-FEB-88 10:26:05
          UIC:[005,004] From Node:NAC   PID:MANEY
-> 1 CNF 001 000 074 020 007 003 007 000 000 005 000 367 373 331 377 256 254
         006
<- 1 CNF 001 000 046 004 014 001 007 000 000 002 000 367 373 331 376 256 274
         246 004
-> 1 ATT 002 002 011 257 040 001 000 002 002 000 000 000
-> 1 ACC 003 000 001 001 023 104 125 065 072 133 065 054 064 135 103 124 117
         123 056 104 101 124 073 061 002 002 265 002
         Filespec: "DU5:[5,4]CTOS.DAT;1"
<- 1 ATT 002 002 027 315 200 175 001 002 002 002 003 000 210 313 105 107 000
         002 003 000 002 004 000 000 000 000
<- 1 ALL 013 002 024 357 003 000 000 000 000 004 000 000 000 000 004 000 000
         000 000 000 001 000 000
<- 1 DTM 015 002 047 013 062 066 055 117 103 124 055 070 067 040 061 066 072
         062 062 072 060 062 060 062 055 106 105 102 055 070 070 040 061 060
         072 062 065 072 063 071 001 000
<- 1 PRO 016 002 014 037 005 133 065 054 064 135 000 000 000 212 002
<- 1 NAM 017 002 025 001 023 104 125 065 072 133 065 054 064 135 103 124 117
         123 056 104 101 124 073 061
<- 1 ACK 006 000
-> 1 CTL 004 000 002 010 000
<- 1 ACK 006 000
-> 1 CTL 004 000 001 011 003 000
<- 1 STA 011 000 147 120 000 000 002 004 005
-> 1 CMP 007 000 004
<- 1 CMP 007 000 002
-> 1 CMP 007 000 001 000
<- 1 CMP 007 000 002
** Mailbox item: 001 003 000 005
***** Disconnected Link #1 at 2-FEB-88 10:26:07

@[200,200]unsgen

```
========================================================================
UNSGEN - Unsupported Utility Generation
          Started at 12:13:09 on 24-SEP-87
========================================================================
01.00 Do you want to see the UNSGEN notes [D=N]
02.00 Target system device [dduu, D=SY:]du0:
03.00 Listing/Map device [dduu, D=SY:]du0:
04.00 UIC Group Code for UNSGEN output  101
05.00 Target operating system  mpl
06.00 Should tasks link to the Supervisor Mode FCS library [D=N]n
07.00 Do you want the RVT utility [D=N]
```

RVT provides RSX to VMS terminal communications. It provides functions
that are similar to those of RMT. RMT communicates between RSX
systems, RVT communicates between a RSX system and a VMS system. Note
that RVT requires the full duplex terminal driver.

```
08.00 Do you want the RRS utility [D=N]
```

RRS provides RSX to RSTS terminal communications. It provides
functions that are similair to those of RMT. RMT communicates between
RSX systems, RRS communicates between a RSX system and a RSTS system.
Note that RRS requires the full duplex terminal driver.

```
09.00 Do you want the HOST utility [D=N]
```

HOST provides RSX to TOPS-20 to terminal communications. It provides
functions that are similair to those of RMT. RMT communicates between
RSX systems, HOST communicates between a RSX system and a TOPS-20
system. Note that HOST requires the full duplex terminal driver.

```
10.00 Do you want the CEDUMP utility [D=N]
```

CEDUMP is the Communications Executive data structure dumper and
analyzer.

```
11.00 Do you want the PMR utility [D=N]
```

The Poor Mans Routing Task (PMR) , supports the passthrough protocol
that is compatible with the RSTS and VMS.

```
12.00 Do you want the RNT/ANT/CNT utilities [D=N]
```

RNT, ANT, and CNT are utilities to run (RNT), abort (ANT), and cancel
(CNT) tasks on remote nodes.

```
13.00 Do you want the TRC utility [D=N]
```

TRC is the Transport trace utility. It logs to a file or a terminal.
TRC logs all the messages that are sent or received by this node. It
is useful as a debug tool.

```
14.00 Do you want the virtual device server support [D=N]
```

This is the support that allows a user to set up a virtual device,
(disk, mag-tape, printer) on another system (host). This support
includes, the virtual device command processor (...VDV) the virtual
device front end (VDV$$$)

```
15.00 Do you want the RMD network pages [D=N]
```

If you answer this question YES, RMD will be built with the two

```
RUN [101,54]CEDUMP

CED>/HE

The following general switches may be used:

AL - Dump everything
HE - Dump the switch descriptions

The following Comm Exec switches may be used:

CM - Dump common data base
FR - Dump free resource list status
LT - Dump process line tables
NL - Dump Network Loader information
PD - Dump process descriptor vectors
PO - Dump pool statistics
RV - Dump reverse mapping table
SL - Dump system line table

The following DECnet switches may be used

DH - Dump DECnet home block
GE - Dump general delivery queue
IO - Dump NETACP I/O queues
LI - Dump active link counts
LL - Dump logical link vector
LN - Dump physical link data base
MB - Dump mailbox queue

CED>/ALL

77214     Address of PDV address table
17.       Number of PDV entries
4.        PDV index of current process
77256     Address of SLT address table
10.       Number of system lines
77712     Address Of LLC reverse mapping table
48.       Number of CCBs allocated
36.       Length of CCB (bytes)
32.       Number of CCBs available
0.        Number of CCB allocation failures
0.        Number of dynamic CCB allocations
48.       Number of RDBs allocated
576.      Length of RDBs (bytes)
35.       Number of RDBs available
0.        Number of RDB allocation failures
6.        LDB allocation threshold
0.        Number of LDB allocation failures
20.       Number of SDBs allocated
34.       Length of SDBs (bytes)
20.       Number of SDBs available
0.        Number of SDB allocation failures
25204     Address of DECnet Home Block
760600    Address of NTL Home Block
37        Comm Exec options
          - Modem control
          - DDM support
          - Dynamic CCB allocation
          - EIS support
          - Event logging support
761000    Address of free non-UMR mapped (block) network pool
764000    Original address of UMR mapped (block) network pool
764000    Address of free UMR mapped (block) network pool
```

Pool statistics (words):

```
                                Network  Extended
                 RSX:    CEX:   Pool:    Pool:
Free space:      4962.   0.     864.     376.
Largest segment:4802.   0.     864.     156.
Segment count:   27.    0.     1.       6.
```

Process descriptors:

PDV for process-AUX @ 077776 - Process loaded
006727 120000 004640 160000 000614 073650 000000 073614 011072
Bias-006727   Dispatch table-120000   PCB address-073650
Flag word-614   Process priority-0
  Flags set:
  LLC process
  Marked for load
  Requires timer service
  Requires timer entry on active CPU
No channels allocated

PDV for process-EVL @ 100016 - Process loaded
011072 120000 021274 160000 000214 073550 000000 025174 011123
Bias-011072   Dispatch table-120000   PCB address-073550
Flag word-214   Process priority-0
  Flags set:
  LLC process
  Marked for load
  Requires timer service
No channels allocated

PDV for process-ECL @ 100036 - Process loaded
011123 124700 017704 160000 001214 073504 000000 073430 011312
Bias-011123   Dispatch table-124700   PCB address-073504
Flag word-1214 Process priority-0
  Flags set:
  LLC process
  Marked for load
  Requires timer service
  Supports counters
No channels allocated

PDV for process-XPT @ 100056 - Process loaded
011312 122076 114224 160013 001214 073220 000000 073100 140000
Bias-011312   Dispatch table-122076   PCB address-073220
Flag word-1214 Process priority-0
  Flags set:
  LLC process
  Marked for load
  Requires timer service
  Supports counters
LLC channel table
140000
000000   UNA-0.0
000001   DMC-0
000002   DMC-1
000003   DUP-0
000004   DUP-1
000005   DZ -0-0
000006   DZ -0-1
000007   KDZ-0-0
```

```
System line table:

System line table for-UNA-0 @ 077304,   DLC process-EPM
131272  140450  012026  131222  007475  126700  000000  001420  035254
000000  001601  003000  000600  007000  000400  000001  000400  000001
000400  000001  000400  000001  000400  000001  000400  000001  000400
000001  000400  000001  000400  000001  000400  000001  000400  000001
000400  000001  000400  000001  000400  000001
DDM line table bias-017241,   DDM line table virtual address-131222
DDM characteristics virtual address-131272
DLC line table bias-007475,   DLC line table virtual address-126700
Number of portals-16.
Controller request block @ 035254
Flag word-140450          Buffer wait queue count-0
  Flags set:
  Requires timer service
  Circuit has service disabled
  Broadcast channel
  Ready
  Active
Portal #0.,   Owner-XPT
State=On                  ,   Substate=Closed
Flags-000201,   Cost-3.
  Flags set:
  Active
Portal #1.,   Owner-LAT
State=On                  ,   Substate=Closed
Flags-000200,   Cost-1.

DDM line table for - UNA-0        Physical address -1735300
013746  172372  012737  017241  172372  004537  123664  000100  174510  000401
060003  014001  000000  000000  000252  000004  010022  025710  035214  035230
074070  030254  036022  035314  000000  000000  000000  131264  000000  177470
000005  000006  035410  035462  035462  035462  140707  000000  131312  000007
035534  035624  035624  000000  160741  000000  131332  000000  131336  000000
000002  047125  046501  000103  052514  046501  000103  126546  000000  000000
000000  126742  000000  000000  000000  000026  000141  000002


DLC line table (and Station tables)
000401  006000  000401  000106  000000  000252  000004  010022  000010  001053
070604  002140  000000  126730  000000  000000  126736  000026  051063  000750
000252  000004  010022  000000  000000  125422  000000  000000  130511  127002
127704  127744  032750  127040  000000  000200  127760  127760  000136  066736
000001  164272  000736  115454  000000  142755  000034  000000  127076  000400
000200  000000  127046  000136  003721  000001  155232  000112  016743  000001
103460  000112  000000  127134  001000  000000  000000  127104  000136  000000
000000  000000  000000  000000  000000  000000  000000  000000  127172  001400
000000  000000  127142  000136  000000  000000  000000  000000  000000  000000
000000  000000  000000  127230  002000  000000  000000  127200  000136  000000
000000  000000  000000  000000  000000  000000  000000  000000  127266  002400
000000  000000  127236  000136  000000  000000  000000  000000  000000  000000
000000  000000  000000  127324  003000  000000  000000  127274  000136  000000
000000  000000  000000  000000  000000  000000  000000  000000  127362  003400
000000  000000  127332  000136  000000  000000  000000  000000  000000  000000
000000  000000  000000  127420  004000  000000  000000  127370  000136  000000
000000  000000  000000  000000  000000  000000  000000  000000  127456  004400
000000  000000  127426  000136  000000  000000  000000  000000  000000  000000
000000  000000  000000  127514  005000  000000  000000  127464  000136  000000
000000  000000  000000  000000  000000  000000  000000  000000  127552  005400
000000  000000  127522  000136  000000  000000  000000  000000  000000  000000
000000  000000  000000  127610  006000  000000  000000  127560  000136  000000
000000  000000  000000  000000  000000  000000  000000  000000  127646  006400
```

```
LLC data base for - LAT
000402  000000  000000  040540  000000  040544  000400  000007  131754
132310  000003  132454  000000  131610  131610  000000  040572  122262
006003  132674  100204  131406  012454  034742  000000  012510  000001
100674  000033  003772  000001  164404  000112  000000  000000  000001
000000  000000  000000  000000  017005  001500  003012  007777  026163
000000  040666  000000  040672  000000
```

Active link counts:

Current-3.   Maximum-5.

DECnet General delivery queue:

Empty

Logical link vector table:

LLT entry @ 1065224
Logical link state - DAT (Normal Data Transfer)
Link type-24
    Link type flags set:
    Logical link uses system level interface
    Supports cross channel acks
Local link address-136001   Remote link address-20120
Remote node address-4.6   Remote flow control count estimate-2.
Link flags-100   Remote NSP version-2.
    Link flags set:
    Local segment flow control

	DATA	I/LS
Transmits in progress-	0.	0.
Next segment to be assigned-	23.	63.
Next segment to be received-	63.	2.
Highest ack from user-	62.	1.
Highest ack from network-	22.	62.
Segments/msgs requested-	0.	1.
Flow control count-	0.	0.
Timer cell-	0.	0.
Retry cell-	5.	5.

Long term timer-0.   Periodic timer-6.
Counter block address-140500   Segment size-558.
Source channel number-1.   User link address-1
Control process PDV index-10.   Data process PDV index-10.
Current data transmit CCB address-0
Current interrupt transmit CCB address-0

DECnet Mailbox queue:

Mailbox @ 42650 for task-FAL.0   TI:=CO0
# of AST's needed-0.
# of active logical links-1.   Max # of links allowed-1.
Network data AST virtual address-61462
items on mailbox queue-0.
Logical link recovery timer-5.

Dump of DECnet home block for:

HALDIR(4.18) HALDIR - RSX DECnet maintaince

AA-00-04-00-12-10 Ethernet physical address
4.18   Host node address
1555   Alias node name listhead
25210   Remote node name listhead
17061   Service database listhead
17025   File name block listhead
11.   Number of routing channels
20.   Maximum visitation count
558.   ECL segment size
10.   Maximum number of logical links
25.   Maximum number of node counters
15.   Incoming logical link timer
30.   Outgoing logical link timer
30.   Logical link inactivity timer
32.   Round trip delay factor
2.   Round trip delay weight
6.   Input packet limiter
2.   Link service threshold
5.   Retransmit factor
100627   Features flags
          - Access verification support
          - Access verification enabled
          - Event logging support
          - Logical link integrity support
          - Multi-copy task support
          - Non-routing (end) node
          - System level interface support

EXAMPLE OF OUTPUT FROM TRC UTILITY

```
+--------------------------------------------------------------------------+
! Type !    Time     !Chan!FLGS! DSTADDR ! SRCADDR ! ACKNUM ! OTHACK ! SEGNUM !      !
+--------------------------------------------------------------------------+
+--------------------------------------------------------------------------+
! XDA  !11:42:27.1! 2  !  30!       0 !   65001 !        !        !        !      !
+-----------------------------------------------------------------+
!    Connect-initiate                                                            !
!           43.        5   2  56   2   0  52   1   0   3 116 103 124  43         !
!                            .            *           N   C   T   #             !
!                      0   0   0   0                                             !
!                                                                               !
+-----------------------------------------------------------------+
! RDA  !11:42:27.1! 2  !  44!   65001 !         !        !        !        !      !
+-----------------------------------------------------------------+
!    CI-ACK                                                                       !
+--------------------------------------------------------------------------+
! RDA  !11:42:27.3! 2  !  50!   65001 !       4 !        !        !        !      !
+-----------------------------------------------------------------+
!    Connect-confirm                                                              !
!           31.        1   2 266   5   0                                         !
!                          6                                                      !
+--------------------------------------------------------------------------+
! RDA  !11:42:27.3! 2  !  20!   65001 !       4 ! 100000 ! 120000 !      1 !      !
+-----------------------------------------------------------------+
!    Link-service    Data request       Send data        Request count =  11. !
+-----------------------------------------------------------------+
! XDA  !11:42:27.3! 2  ! 110!       4 !   65001 !        !        !        !      !
+-----------------------------------------------------------------+
!    Disconnect-confirm                                                           !
!           28.       51   0                                                     !
!                       )                                                         !
!                                                                               !
+--------------------------------------------------------------------------+
! XDA  !11:42:27.3! 2  !   4!       4 !   65001 ! 100000 !        !        !      !
+-----------------------------------------------------------------+
!    Data-ACK                                                                     !
+--------------------------------------------------------------------------+
! XDA  !11:42:27.3! 2  !  20!       4 !   65001 !        !        !      1 !      !
+-----------------------------------------------------------------+
!    Link-service    Data request                         Request count =   4. !
+-----------------------------------------------------------------+
! RDA  !11:42:27.8! 2  !  70!   65001 !       4 !        !        !        !      !
+-----------------------------------------------------------------+
!    Disconnect-initiate                                                          !
!           28.       41   0                                                     !
!                       !                                                         !
+--------------------------------------------------------------------------+
! XDA  !11:42:27.8! 2  ! 110!       4 !   65001 !        !        !        !      !
+-----------------------------------------------------------------+
!    Disconnect-confirm                                                           !
!           28.       52   0                                                     !
!                       *                                                         !
!                                                                               !
```

INTERNAL CTERM TRACE UTILITY

TRXCTL and TRXCOL in [netuic,54] ——— *INSTALL TRX/OL - collector task*

no documentation except help info

Need to assign trace file and install collector task

ASN device::[uic]filename.ext = process$trace

        ASN DU5:[1,4]TRX.LOG=NCT$TRACE   *Equivalence string*

                                    1) TRX RTH

>run [5,54]trxctl

TRC>help

CTERM Trace Control Task Syntax

   >TRX ENABLE <process> [/<ena_qual>[/<ena_qual>]]
   >TRX DISABLE <process>
   >TRX SHOW <process>
   >TRX HELP
           where
             <process>   is "NCT" | "RTH"
             <ena_qual> is "MESSAGE" = <msg_list> | "FORMAT" = <fmt_list>
               | "MAXIMUM = <number>
             <msg_list> is <msg_type> | "(" <msg_type> [,<msg_list>] ")"
             <msg_type> is "RFN" [rcvd FOUND messages] | "XFN" [xmtd FOUND messages]
               | "RCT" [rcvd CTERM messages] | "XCT" [xmtd CTERM messages]
             <fmt_list> is <trace_fmt> | "(" <trace_fmt> [,<fmt_list>] ")"
             <trace_fmt> is "BINARY" | "HEX" | "ASCII"

Each keyword can be abbreviated to three characters.
Defaults: /MESSAGE=(RCT,XCT) /FORMAT=BINARY

                        /MESSAGE = (XCT RCT RFN X FN)

TRX> enable nct/format=(hex,asscii)

EXAMPLE OF TRX OUTPUT FILE

CTERM trace (format = <2>) on "DEFRST" for process NCT   9-FEB-88 11:59:47

```
NCT (=10) 9-FEB-88 11:59:57.2 TTO: [5,54] 4.18 STA 150 ULA 2
   RESERVED: 000000       000000     000000     000000     000000     000000     000000     000000     000000     000000
   Common_Data <<-T (C=9.), len = 32.
   Embedded CTERM message(s) follow:
     Initiate (C=1.), len = 28.
     CTERM message dump (hex/ASCII):
               01 00 01 04 00 56 30 32 2E 30 30 20 20 01 02 2E     "_____V02.00 __."
               02 02 02 0D 02 03 02 FE 7F 04 01 0D               "_____"__"

NCT (=10) 9-FEB-88 11:59:57.3 TTO: [5,54] 4.18 STA 150 ULA 2
   RESERVED: 000000       000000     000000     000000     000000     000000     000000     000000     000000     000000
   Common_Data R->> (C=9.), len = 100.
   Embedded CTERM message(s) follow:
     Initiate (C=1.), len = 17.
     CTERM message dump (hex/ASCII):
               01 00 01 04 00 56 30 31 2E 30 31 20 20 01 02 2E     "_____V01.01 __."
               02                                               "_"
     Write (C=7.), len = 102.
     CTERM message dump (hex/ASCII):
               07 72 00 01 00 0D 43 6F 6E 6E 65 63 74 65 64 20     "_r____Connected "
               74 6F 20 22 48 41 4C 44 49 52 22 2C 20 53 79 73     "to "HALDIR", Sys"
               74 65 6D 20 74 79 70 65 20 3D 20 52 53 58 2D 31     "tem type = RSX-1"
               31 4D 2D 50 6C 75 73 0D 0A 53 79 73 74 65 6D 20     "1M-Plus_System "
               49 44 3A 20 48 41 4C 44 49 52 20 2D 20 02 00 90     "ID: HALDIR - __"
               2D 28 00 46 24 00 00 46 24 00 01 A0 42 01 00 61     "-(_F$_F$__B_a"
               00 00 00 6F 3B C5                                 "___o;_"
   *** message was truncated ***

NCT (=10) 9-FEB-88 11:59:58.1 TTO: [5,54] 4.18 STA 140 ULA 2
   RESERVED: 000000       000000     000000     000000     000000     000000     000000     000000     000000     000000
   Common_Data <<-T (C=9.), len = 6.
   Embedded CTERM message(s) follow:
     Input_State (C=14.), len = 2.
     CTERM message dump (hex/ASCII):
               0E 01

NCT (=10) 9-FEB-88 11:59:58.1 TTO: [5,54] 4.18 STA 140 ULA 2
   RESERVED: 000000       000000     000000     000000     000000     000000     000000     000000     000000     000000
   Common_Data R->> (C=9.), len = 25.
   Embedded CTERM message(s) follow:
     Start_Read (C=2.), len = 21.
     CTERM message dump (hex/ASCII):
               02 08 50 00 50 00 00 00 00 00 00 00 00 00 00 00     "__P_P_____"
               04 00 20 00 0C                                    "__ __"

NCT (=10) 9-FEB-88 11:59:59.5 TTO: [5,54] 4.18 STA 140 ULA 2
   RESERVED: 000000       000000     000000     000000     000000     000000     000000     000000     000000     000000
   Common_Data <<-T (C=9.), len = 22.
   Embedded CTERM message(s) follow:
     Read_Data (C=3.), len = 18.
     CTERM message dump (hex/ASCII):
               03 00 00 00 00 00 09 00 68 65 6C 20 6D 61 6E 65     "_____hel mane"
               79 0D                                             "y_"
```

(handwritten annotation) WHICH LAT SESSION "_" KEYS THEM ALL

```
NCT (=10) 9-FEB-88 11:59:59.7 TTO: [5,54] 4.18 STA 140 ULA 2
  RESERVED: 000000       000000      000000      000000      000000      000000      000000      000000      000000      000000
  Common_Data R->> (C=9.), len = 19.
  Embedded CTERM message(s) follow:
    Write (C=7.), len = 15.
    CTERM message dump (hex/ASCII):
                07 72 00 01 00 50 61 73 73 77 6F 72 64 3A 20      "_r___Password: "


NCT (=10) 9-FEB-88 11:59:59.7 TTO: [5,54] 4.18 STA 140 ULA 2
  RESERVED: 000000       000000      000000      000000      000000      000000      000000      000000      000000      000000
  Common_Data R->> (C=9.), len = 41.
  Embedded CTERM message(s) follow:
    Start_Read (C=2.), len = 37.
    CTERM message dump (hex/ASCII):
                02 08 4B 00 28 00 00 00 00 00 00 00 00 00 00 00      "__K_(_____"
                14 FF FF FF FF 00 00 00 00 00 00 00 00 00 00 00      "_____"
                80 FF FF FF FF                                       "_____"

NCT (=10) 9-FEB-88 12:00:02.0 TTO: [5,54] 4.18 STA 140 ULA 2
  RESERVED: 000000       000000      000000      000000      000000      000000      000000      000000      000000      000000
  Common_Data R->> (C=9.), len = 61.
  Embedded CTERM message(s) follow:
    Write (C=7.), len = 57.
    CTERM message dump (hex/ASCII):
                07 72 02 01 0D 0D 0A 52 53 58 2D 31 31 4D 2D 50      "_r_____RSX-11M-P"
                4C 55 53 20 56 33 2E 30 20 20 42 4C 32 34 45 20      "LUS V3.0  BL24E "
                20 5B 31 2C 35 34 5D 20 53 79 73 74 65 6D 20 20      " [1,54] System  "
                20 20 20 48 41 4C 44 49 52                           "   HALDIR"

NCT (=10) 9-FEB-88 12:00:02.0 TTO: [5,54] 4.18 STA 140 ULA 2
  RESERVED: 000000       000000      000000      000000      000000      000000      000000      000000      000000      000000
  Common_Data R->> (C=9.), len = 51.
  Embedded CTERM message(s) follow:
    Write (C=7.), len = 47.
    CTERM message dump (hex/ASCII):
                07 72 02 01 0D 31 39 2D 46 45 42 2D 38 38 20 31      "_r___19-FEB-88 1"
                32 3A 30 31 20 20 4C 6F 67 67 65 64 20 6F 6E 20      "2:01  Logged on "
                54 65 72 6D 69 6E 61 6C 20 52 54 30 3A 0D 0A         "Terminal RTO:__"

NCT (=10) 9-FEB-88 12:00:03.4 TTO: [5,54] 4.18 STA 140 ULA 2
  RESERVED: 000000       000000      000000      000000      000000      000000      000000      000000      000000      000000
  Common_Data R->> (C=9.), len = 35.
  Embedded CTERM message(s) follow:
    Clear_Input (C=6.), len = 2.
    CTERM message dump (hex/ASCII):
                06 00                                                "__"
    Clear_Input (C=6.), len = 2.
    CTERM message dump (hex/ASCII):
                06 00                                                "__"
    Start_Read (C=2.), len = 23.
    CTERM message dump (hex/ASCII):
                02 08 50 02 1C 00 02 00 00 00 02 00 00 00 02 00      "__P_____"
                04 00 20 00 04 1B 5A                                 "___ __Z"
```

The following 'magic' parameters can be tuned to allow DECnet-RSX to be used over a satellite link. The use of the phrase "'length' of the pipe" is a factor of the number of satellite hops involved. Keep in mind that these parameter changes may in fact reduce performance if the channel is not very clean . If there is a lot of noise, the majority of the traffic on the channel will simply be retransmission of data. If the number of packets in the pipe is increased, the number of packets requiring retransmission is increased.

ECL parameters:

Link Service Threshold

   This value is used to delay transmission of link service messages. The receiver side of a logical link maintains an estimate of the number of credits which have been sent to the remote system and have not been used yet. If more credits can be sent but the current value of the estimate is greater than LR$LST the link service message will be delayed unless it can be combined with an acknowledgement. For a satellite link this value should be increased to allow for the 'length' of the pipe.

Version 4.0/2.0:
        GBLDEF for LR$LST in ECLBLD.CMD (Default value = 2)
        Edit ECLBLD.CMD and task build ecl, netacp

Version 4.2/3.0:
        9th parameter on DEC$DF in CETAB.MAC (Default value = 2)
        Edit CETAB.MAC and reload the network

XPT parameters:

DLC Queue Threshold

   This value controls the maximum number of buffers which will be sent down to the data link layer. This parameter does not seem to have any real use since it just controls which queue the packets stay in and the data link layer can make better use of the information that more packets are available for transmission by piggybacking ACKs. For a satellite link this value should be increased to allow for the 'length' of the pipe.

Version 4.0/2.0:
        GBLDEF for PC$TH2 in XPTBLD (Default value = 4)
        Edit XPTBLD.CMD and task build xpt,rcp

Version 4.2/3.0:
        GBLDEF for PC$TH2 in XPTBLD (Default value = 4)
        Edit XPTBLD.CMD and task build xpt,rcp

Input Packet Limiter

   This value controls the maximum number of locally generated packets which the local node can queue on any individual circuit. This parameter is indended to limit the effect of locally generated packets on route-through traffic. It's effect on a non-routing node can be to reduce the overall performance of the node. For a satellite link this value should be increased to allow for the 'length' of the pipe.

Version 4.0/2.0:
        GBLDEF for PC$IPL in XPTBLD (Default value = 6)
        Edit XPTBLD.CMD and task build xpt,rcp

Version 4.2/3.0:
        8th parameter on DEC$DF in CETAB.MAC (Default value = 6)
        Edit CETAB.MAC and reload the network

```
        .MACRO  CCBDF$,L,B,LST
        .IIF NB LST     .LIST
;
; Communications Control Block Format
;
;       ---------------------------------
;       !              C.URM            !        -2 (Multi-processors only)
;       !-------------------------------!
;       !              C.LNK            !        000
;       !-------------------------------!
;       !   C.BID      !     C.RSV      !        002
;       !-------------------------------!
;       !              C.NSP            !        004
;       !-------------------------------!
;       !   C.STA      !     C.LIN      !        006
;       !-------------------------------!
;       !   C.MOD      !     C.FNC      !        010
;       !-------------------------------!
;       !              C.STS            !        012
;       !-------------------------------!
;       !                              !         014
;       !-             C.BUF1         -!
;       !                              !         016
;       !-------------------------------!
;       !              C.CNT1           !        020
;       !-------------------------------!
;       !              C.FLG1           !        022
;       !-------------------------------!
;       !                              !         024
;       !-             C.BUF2         -!
;       !                              !         026
;       !-------------------------------!
;       !              C.CNT2           !        030
;       !-------------------------------!
;       !              C.FLG2           !        032
;       !-------------------------------!
;       !                              !         034
;       !-             C.ADD          -!
;       !                              !         036
;       !-                            -!
;       !                              !         040
;       !-------------------------------!
;       !              C.PRO            !        042
;       !-------------------------------!
;
;       !-------------------------------!
;       !   C.XID      !     C.XPT      !        034
;       !-------------------------------!
;       !   C.XTC      !     C.X25      !        036
;       !-------------------------------!
;       !              C.XPLI           !        040
;       ---------------------------------
;
```

```
        .ASECT
.=-2
C.URM:'L'           .BLKW    1          ; Unibus run mask (Multi-processors only)
C.LNK:'L'           .BLKW    1          ; Forward link
C.RSV:'L'           .BLKB    1          ; Reserved cell for allocator of CCB
C.BID:'L'           .BLKB    1          ; Buffer ID
C.XACP:'L'                              ; Synonyn for C.NSP  (X25ACP)
C.NSP:'L'           .BLKW    1          ; NSP reserved cell
C.LIN:'L'           .BLKB    1          ; Line number
C.STA:'L'           .BLKB    1          ; Station number
C.FNC:'L'           .BLKB    1          ; Function code
C.MOD:'L'           .BLKB    1          ; Function code modifier
C.STS:'L'           .BLKW    1          ; Status word

                                        ; First buffer descriptor
C.BUF1:'L'
C.BUF:'L'           .BLKW    2          ; Buffer address doubleword
C.CNT1:'L'
C.CNT:'L'           .BLKW    1          ; Buffer count
C.FLG1:'L'
C.FLG:'L'           .BLKW    1          ; Buffer flags
                                        ; Second buffer descriptor
C.BUF2:'L'          .BLKW    2          ; Buffer address doubleword
C.CNT2:'L'          .BLKW    1          ; Buffer count
C.FLG2:'L'          .BLKW    1          ; Buffer flags

.$$$$.=.
C.ADD:'L'           .BLKW    3          ; Ethernet address
C.PRO:'L'           .BLKW    1          ; Ethernet protocol
.=.$$$$.
C.XPT:'L'           .BLKB    1          ; Level 3 port number
C.XID:'L'           .BLKB    1          ; Caller's ID field
C.X25:'L'           .BLKB    1          ; PLI user's reserved byte
C.XTC:'L'           .BLKB    1          ; Packet type code
C.XPLI:'L'          .BLKW    1          ; Scratch, for PLI and higher levels
C.XSVC:'L'          .BLKW    1          ; SVC descriptor - extended pool address
C.XLEN:'L'                              ; Size of a CCB, including X25 stuff
;
; CCB buffer ID definitons
;
CB.XLB='B'          000001             ; Extended pool buffer (PSI)
CB.CCB='B'          000002             ; Common pool CCB
CB.RDB='B'          000004             ; Large/receive data buffer CCB
CB.SDB='B'          000010             ; Combination CCB/SDB
CB.DLC='B'          000020             ; Reserved for DLC usage
CB.DDM='B'          000040             ; Reserved for DDM usage

CB.SLI='B'          000100             ; Received segment buffer from the SLI
;
; Flag to indicate CCB came from an LLC
;
CC.LLC='B'          000200             ; CCB came from an LLC process
;
; CCB status word bit definitions (C.STS) >LLC for line management.
;
; Startup Control Parameters:
;
CS.ENA='B'          000001             ; Channel is enabled
CS.CES='B'          000002             ; Change Enable State (as defined by bit 0)
CS.STR='B'          000004             ; Start the Channel
CS.CMP='B'          000200             ; Completion Status (if this bit is set,
                                       ;   bits 0->6 contain the error code).
```

```
;
; CCB status word bit definitions (C.STS) DDM > DLC
;

CS.HCR='B'        000001          ; Header CRC error
CS.DEV='B'        000002          ; Hard device error (I.E. NXM)
CS.ROV='B'        000004          ; Receiver overrun
CS.XUR='B'        CS.ROV          ; Transmit underrun
CS.RNG='B'        000010          ; Ring detect
CS.ENB='B'        000020          ; Connection established
CS.DIS='B'        000040          ; Disconnect detected
CS.ABO='B'        000100          ; Message aborted
CS.BUF='B'        000200          ; Previous buffer allocation failed & device res
CS.DCR='B'        000400          ; Data CRC error
CS.FTL='B'        001000          ; Fatal error for all stations on the line
CS.HFE='B'        002000          ; Header format error
CS.MTL='B'        004000          ; Message too long
CS.RSN='B'        010000          ; Receiver resynced before this message
CS.TMO='B'        020000          ; Timeout error (clock loss)
CS.LST='B'        040000          ; Last CCB in message chain (used by Comm Exec)
CS.ERR='B'        100000          ; Inclusive or of all errors
;
; CCB status word bit definitions (C.STS)
;       DDM (Ethernet) > DLC
;
CS.SID='B'        000002          ; Device supports system ID message
;
; CCB status word bit definitions (C.STS)
;       DLC   (DDCMP OR DMC11) > LLC   (NSP)
;
CE.RTE='B'        100376          ; Receive threshold exceeded
CE.TMO='B'        100374          ; REP threshold exceeded
CE.MOP='B'        100372          ; MOP message received
CE.ERR='B'        100370          ; General error
CE.DIS='B'        100366          ; Disconnect
CE.SRC='B'        100364          ; Start received
CE.ABO='B'        100362          ; Operation aborted
CE.NTE='B'        100361          ; NAK threshold exceeded
CE.LTO='B'        100356          ; Listener timeout
CE.TME='B'        100354          ; Test message error
CE.STP='B'        100352          ; Line stop requested
CE.ILN='B'        100350          ; Illegal station address (network management)
CE.DAO='B'        100346          ; Buffer overrun on network management function
CE.UNS='B'        100344          ; Unsupported network management subfunction
CS.SUC='B'        000001          ; Operation successful
;
; CCB status word bit definitions (C.STS)
;       DLC (Ethernet) > LLC
;
CS.BRO='B'        000002          ; Device is a broadcast channel
CS.DEF='B'        000004          ; Message is for default owner
CS.CHN='B'        000010          ; Device supports data chaining
                                  ; Above are or'd on completion of request
;
; Buffer flags word bit definitions (C.FLG)
;
CF.CHN='B'        000001          ; Device suuports buffer chaining
                                  ; (Only valid on start control function)
CF.LIN='B'        000002          ; Message to be output by line
CF.EOM='B'        000004          ; End of message
CF.SOM='B'        000010          ; Start of message
CF.HDR='B'        000020          ; Buffer is a header
CF.SYN='B'        000040          ; Preceed buffer by SYNCS
CF.TRN='B'        000100          ; List marker for turn around
CF.LB='B'         100000          ; Last buffer in this link
```

```
;
; PLI flags word definitions
;
CP.HDL='B'          000007              ; Length of header included in buffer
CP.2FR='B'          000030              ; 2 free bits
CP.DCF='B'          000040              ; Delivery confirmation needed
CP.XCF='B'          000100              ; This is a converted confirm
CP.PSI='B'          000200              ; Packet originated in PLI
CP.PS='B'           177400              ; P(S) saved in high byte
;
; Process operation function code definitions
;
FC.XME='B'          0                   ; Transmit enable
FC.RCE='B'          2                   ; Receive enable (buffer return)
FC.KIL='B'          4                   ; Kill I/O
FC.CTL='B'          6                   ; Control
FC.TIM='B'          10                  ; Timeout
FC.XCP='B'          12                  ; Transmit complete
FC.RCP='B'          14                  ; Receive complete
FC.KCP='B'          16                  ; Kill complete
FC.CCP='B'          20                  ; Control complete
FC.PWR='B'          22                  ; Powerfail recovery
FC.MAN='B'          24                  ; Network management request
FC.MLD='B'          26                  ; Microcode load
FC.PCT='B'          30                  ; Process control
;
; Receive enable subfunction codes
;
FS.RTN='B'          2*400               ; Buffer from buffer wait request
;
; Receive complete subfunction codes
;
FS.DVC='B'          2*400               ; Device checks CRC (Check C.STS for error indic
FS.CIB='B'          4*400               ; CRC is in receive buffer
;
; Kill subfunction codes
;
FS.KIL='B'          0*400               ; Receive & transmit kill
FS.CRA='B'          2*400               ; Receive kill
FS.XKL='B'          4*400               ; Transmit kill
;
; Control subfunction codes
;
FS.AST='B'          0*400               ; Asynchronous event (completion only)
FS.INI='B'          0*400               ; Initialize
FS.STR='B'          2*400               ; Start
FS.STP='B'          4*400               ; Stop
FS.TRM='B'          6*400               ; Terminate
FS.MNT='B'          10*400              ; Maintainance
FS.SET='B'          12*400              ; Set characteristics
FS.GET='B'          14*400              ; Get characteristics
FS.XON='B'          16*400              ; XON
FS.XOF='B'          20*400              ; XOFF
                                        ; Modem control: LLC > DLC > MDMCTL > DDM
FS.RNG='B'          22*400              ; Look for ring
                                        ; Modem control: DLC > MDMCTL > DDM
FS.ENB='B'          24*400              ; Enable line
FS.DIS='B'          26*400              ; Disable line
                                        ; Modem control: MDMCTL > DDM
FS.MSN='B'          30*400              ; Sense modem status
;
; Timeout subfunction codes
;
FS.STM='B'          0*400               ; Short timeout (50 msec)
FS.LTM='B'          2*400               ; Long timeout (1 sec)
```

```
;
; Network Management subfunction codes
;
FS.RET='B'        0*400              ; Return buffer to task
FS.REA='B'        2*400              ; Read counters
FS.ZER='B'        4*400              ; Zero counters
FS.REZ='B'        6*400              ; Read and zero counters
FS.SFS='B'        10*400             ; Set special function
FS.SFC='B'        12*400             ; Clear special function
FS.SFR='B'        14*400             ; Read special function
FS.SPW='B'        100*400            ; Spawn task
;
; Process dependent subfunction modifier
;
FS.LCL='B'        200*400            ; Subfunction code is locally defined
;
; Process control sub function codes
;
FS.RST='B'        0*400              ; Process restart
FS.EXI='B'        2*400              ; Process exit
;
;
; Network Management entity,return and special function codes
;
CM.LIN='B'        000000             ; Line
CM.CIR='B'        000002             ; Circuit
CM.FMT='B'        100000             ; Counters are formatted in returned data
CM.LOO='B'        000001             ; Controller loopback enabled (internal)
CM.HRD='B'        000002             ; Hardware address in returned data
CM.XLO='B'        000004             ; Controller loopback enabled (external)
;
; Microcode load subfunction codes
;
FS.HLT='B'        0*400              ; Halt load
FS.WLB='B'        2*400              ; Write load buffer
FS.RLB='B'        4*400              ; Read load buffer
            .PSECT
            .IF NB   LST
            .NLIST
            .IFF
            .MACRO   CCBDF$,X,Y
            .ENDM
            .ENDC
            .ENDM
```

```
          .MACRO  DHBDF$  L,B,LST
          .IIF NB LST      .LIST
          .SAVE
          .ASECT
.=0
D$ANN:'L'  .BLKW 1                    ; Alias node name listhead
D$RNN:'L'  .BLKW 1                    ; Remote node listhead (initialized to .+2)
           .BLKW 1                    ; Address of next remote node (after Executor)
D$LNAM:'L'.BLKB 6                     ; Local node name
D$LNUM:'L'.BLKW 2                     ; Local node number and unused flags word.
D$LID:'L'  .BLKW 1                    ; Address of node identification string (xpool)
D$HOST:'L'.BLKW 1                     ; Host node address
D$HIOR:'l'.BLKB 4                     ; Hi-order bytes of Ethernet address
D$NLN:'L'  .BLKW 1                    ; Number of routing channels
D$SER:'L'  .BLKW 1                    ; Service Database Address
D$FNB:'L'  .BLKW 1                    ; File Name Block Listhead Address
D$SEG:'L'  .BLKW 1                    ; ECL Segment Size
D$MLL:'L'  .BLKB 1                    ; Max number of logical links
D$MNOD:'L'.BLKB 1                     ; Max number of node counters
D$INCT:'L'.BLKB 1                     ; Incoming timer
D$OUTT:'L'.BLKB 1                     ; Outgoing timer
D$INAC:'L'.BLKB 1                     ; Inactivity timer
D$DELF:'L'.BLKB 1                     ; Delay factor
D$DELW:'L'.BLKB 1                     ; Delay weight
D$LST:'L'  .BLKB 1                    ; Link service threshold
D$RETF:'L'.BLKB 1                     ; Retransmit factor
D$IPL:'L'  .BLKB 1                    ; Input packet limiter
D$SQRL:'L'.BLKW 1                     ; Square root limiting factor
;
          .IF     DF R$$PRO           ; Start of PRO/DECnet specific cells
D$RNNA:'L'.BLKW 1                     ; Number of node blocks available
D$ALNA:'L'.BLKW 1                     ; Number of alias blocks available
D$OBNA:'L'.BLKW 1                     ; Number of object blocks available
D$STAT:'L'.BLKW 1                     ; PRO/DECnet specific status
;
; D$STAT bit definitions
;
DF.CFN='B'        1                   ; The DECNETCFG.BIN file needs updating
DF.UPD='B'        2                   ; The DECNETCFG.BIN data base is being updated
DF.AFN='B'        4                   ; The DECNETCFG.WAK file needs updating
DF.AUP='B'        10                  ; The DECNETCFG.WAK data base is being updated
;
          .ENDC   ; DF R$$PRO         ; End of PRO/DECnet cells
;
          .IF NB L
D$NEND==.                             ; Mark end of Non-Routing cells
          .IFF
D$NEND=.
          .ENDC
;
D$NBRA:'L'.BLKW 1                     ; Number of broadcast router adjacencies
D$NBEA:'L'.BLKW 1                     ; Number of broadcast endnode adjacencies
D$NN:'L'   .BLKW 1                    ; Number of nodes in network
D$NA:'L'   .BLKW 1                    ; Number of areas in network
D$MAXC:'L'.BLKW 1                     ; Maximum cost
D$MAXH:'L'.BLKW 1                     ; Maximum hops
D$MAXV:'L'.BLKW 1                     ; Maximum visitation count
D$AMXC:'L'.BLKW 1                     ; Area maximum cost
D$AMXH:'L'.BLKW 1                     ; Area maximum hops
D$RTMR:'L'.BLKW 1                     ; Routing timer (seconds)
D$BRTM:'L'.BLKW 1                     ; Broadcast routing timer (seconds)
D$BRPR:'L'.BLKW 1                     ; Broadcast router priority
;
          .IF NB L
D$END==.
          .IFF
```

```
        .MACRO  ECDDB$,L,B,LST
        .IIF NB LST     .LIST
        .ASECT
.=0
N$ACQ:'L'       .BLKW   2       ; ACP QUEUE LISTHEAD
N$TIM:'L'       .BLKB   1       ; TIMER COUNT
N$FLG:'L'       .BLKB   1       ; FLAGS BYTE
N$FNC:'L'       .BLKW   1       ; FUNCTION CODE
N$VCB:'L'       .BLKW   1       ; DUMMY VCB
N$SNOD:'L'      .BLKW   1       ; SOURCE NODE ADDRESS
N$DLY:'L'       .BLKB   1       ; ROUND TRIP DELAY TO ABOVE NODE
N$GTM:'L'       .BLKB   1       ; GENERAL DELIVERY QUEUE TIMER
N$SLA:'L'       .BLKW   1       ; SOURCE LINK ADDRESS
N$DLA:'L'       .BLKW   1       ; DESTINATION LINK ADDRESS
N$ERRC:'L'      .BLKW   1       ; ERROR CODE
N$LLTM:'L'      .BLKW   1       ; MAPPING OF CURRENT LLT
N$LLT:'L'       .BLKW   1       ; CURRENT LLT VIRTUAL ADDRESS
N$PLLT:'L'      .BLKW   1       ; CURRENT LLT PHYSICAL ADDRESS
N$ACTL:'L'      .BLKB   1       ; NUMBER OF ACTIVE LOGICAL LINKS
N$HIGH:'L'      .BLKB   1       ; HIGH WATER MARK OF LOGICAL LINKS
N$CIR:'L'       .BLKW   1       ; COUNT OF CI'S IGNORED DUE TO RESOURCE
N$LVC:'L'       .BLKW   2       ; LOGICAL LINK TABLE (LENGTH AND ADDRESS
N$ENC:'L'       .BLKW   3       ; ECL NODE COUNTERS (LISTHEAD + BIAS)
N$MBXQ:'L'      .BLKW   1       ; MAILBOX QUEUE LISTHEAD
N$GENQ:'L'      .BLKW   1       ; GENERAL DELIVERY QUEUE LISTHEAD
N$ELEN:'L'                      ; DATA BASE SIZE
;
; FLAG BYTE VALUES
;
NF$TIM  ='B'    200             ; ACP TIMER ACTIVE
NF$BLK  ='B'    100             ; I/O PACKET DE-QUEUING IS TEMPORARILY B
NF$MOU  ='B'    40              ; NETWORK IS MOUNTED
NF$SCN  ='B'    20              ; SCAN GENERAL DELIVERY QUEUE
NF$DMO  ='B'    10              ; NETWORK BEING DISMOUNTED
NF$SHU  ='B'    4               ; DISMOUNT VIA SHUT STATE
NF$RST  ='B'    2               ; NETWORK IS IN RESTRICTED STATE
        .PSECT
        .IF NB  LST
        .NLIST
        .IFF
        .MACRO  ECDDB$,X,Y,Z
        .ENDM   ECDDB$
        .ENDC
        .ENDM   ECDDB$
```

```
                .MACRO  LLTDF$,L,B,LST
                .IIF NB LST      .LIST
                .ASECT
        .=0
        L.STA:'L'       .BLKB   1               ; Logical link state
        L.TYP:'L'       .BLKB   1               ; Link type
        L.LLA:'L'       .BLKW   1               ; Local logical link address
        L.RLA:'L'       .BLKW   1               ; Remote logical link address
        L.REM:'L'       .BLKW   1               ; Remote node address
        L.NXTH:'L'      .BLKW   1               ; Node address of next hop (for loop node)
        L.TIPI:'L'      .BLKB   1               ; # of I/LS transmits in progress
        L.TIPD:'L'      .BLKB   1               ; # of data transmits in progress
        L.FLAG:'L'      .BLKB   1               ; Link flags
        L.VER:'L'       .BLKB   1               ; Remote NSP version
        L.NXN:'L'       .BLKW   1               ; Next data segment number to assign
        L.NIN:'L'       .BLKW   1               ; Next I/LS segment number to assign
                                                ; The following 4 words must remain together
        L.RNO:'L'       .BLKW   1               ; Next data segment number to receive
        L.USA:'L'       .BLKW   1               ; Highest data segment number ACK'D by user
        L.LNO:'L'       .BLKW   1               ; Next I/LS segment number to receive
        L.LSA:'L'       .BLKW   1               ; Highest I/LS segment number ACK'D by user
        L.LDA:'L'       .BLKW   1               ; Last data segment number acknowledged by netw
        L.LIA:'L'       .BLKW   1               ; Last I/LS segment number acknowledged by netw
        L.USTA:'L'      .BLKB   1               ; Disconnect substate for user
        L.CSTA:'L'      .BLKB   1               ; Disconnect substate for communications networ
        L.WIND:'L'      .BLKW   1               ; Pointer to user's window block
        L.TC:'L'        .BLKB   1               ; # of data segments or messages requested
        L.TIC:'L'       .BLKB   1               ; # of interrupt messages requested
        L.LSFI:'L'      .BLKW   1               ; Flow control request count (I/LS)
        L.LSFD:'L'      .BLKW   1               ; Flow control request count (data)
        L.RFC:'L'       .BLKW   1               ; Remote flow control count estimate
        L.ILSQ:'L'      .BLKW   1               ; I/LS pending ACK queue
                                                ; The following 4 bytes must remain together
        L.TMRD:'L'      .BLKB   1               ; Timer cell (data)
        L.RTYD:'L'      .BLKB   1               ; Retry cell (data)
        L.TMRI:'L'      .BLKB   1               ; Timer cell (I/LS)
        L.RTYI:'L'      .BLKB   1               ; Retry cell (I/LS)
        L.RTQ:'L'       .BLKW   1               ; Message awaiting retransmission
        L.LTT:'L'       .BLKW   1               ; Long term timer
        L.SEC:'L'       .BLKB   1               ; Seconds remaining in this minute
        L.LPT:'L'       .BLKB   1               ; Link periodic timer
        L.ILTT:'L'      .BLKW   1               ; Initial long term timer
        L.MASQ:'L'      .BLKW   1               ; Message re-assembly queue
        L.MASZ:'L'      .BLKB   1               ; Size of message re-assembly queue
        L.MAST:'L'      .BLKB   1               ; Message re-assembly queue timer
        L.CTR:'L'       .BLKW   1               ; Pointer to ECL counter block
        L.SEGZ:'L'      .BLKW   1               ; Segment size for this link
        L.DCR:'L'       .BLKW   1               ; Disconnect reason code
        L.OPDL:'L'      .BLKB   1               ; Length of optional data
        L.OPD:'L'       .BLKB   20              ; Optional data
                .EVEN
                .IF DF  N$$SLI
        L.CHN:'L'       .BLKB   1               ; Source channel #
        L.ULA:'L'       .BLKB   1               ; User link address
        L.PDVC:'L'      .BLKB   1               ; Control process PDV index
        L.PDVD:'L'      .BLKB   1               ; Data process PDV index
        L.XMTQ:'L'      .BLKW   2               ; Transmit message queue
        L.CXMT:'L'      .BLKW   1               ; Current transmit CCB
        L.INTQ:'L'      .BLKW   2               ; Interrupt message transmit queue
        L.CINT:'L'      .BLKW   1               ; Current interrupt transmit CCB
        L.PCTL:'L'      .BLKW   1               ; Pending disconnect/abort CCB
        L.ACC:'L'       .BLKW   1               ; Pending connect/accept CCB
                .ENDC
        L.LNG:
        ;
        ; Logical link state values
```

```
;
; DCP.DAT - DDCMP LINE TABLE
;
L.TIMR: .BYTE   0               ;LINE TIMER CELL
L.TIMI: .BYTE   0               ;LINE TIMER INITIALIZATION VALUE
L.STS:  .BYTE   0               ;LINE STATUS
L.ST2:  .BYTE   0               ;LINE STATE SECOND FLAGS BYTE
L.TBP:  .LSTHD                  ;TO BE POLLED TRIBUTARY STATION QUEUE
L.NIP:  .WORD   0               ;NEXT TRIBUTARY STATION TO IDLE POLL
L.PLL:  .MPLHD                  ;IDLE POLLING LIST
L.PAIR: .BYTE   5               ;RATIO OF NUMBER OF ACTIVE (XMITS OUTSTANDING)
                                ;TRIBUTARY STATIONS TO POLL BEFORE POLLING AN ID
L.PAIC: .BYTE   5               ;COUNT OF NUMBER OF CURRENT NUMBER LEFT IN
                                ;ACTIVE/IDLE POLLING RATIO
L.XSET: .LSTHD                  ;QUEUE OF XMITS READY TO BE GIVEN TO DRIVER
L.CNTL: .LSTHD                  ;QUEUE OF CONTROL REQUESTS
L.CRC:  .LIBR   STCRC           ;LIBRARY CALL TO CALCULATE CRC
L.CHA:  .DVCHA                  ;DEVICE CHARACTERISTICS
L.CRS:  .WORD   0               ;CURRENT TRIBUTARY STATION BEING POLLED
L.DISL: .WORD   0               ;LAST TRIBUTARY STATION TO BE DISCONNECTED
L.DISR: .WORD   0               ;REASON FOR DISCONNECT
L.LNUM: .SLNB                   ;SYSTEM LINE NUMBER
L.PLD:  .DPRB                   ;POLLING DELAY FOR DEAD DROPS
L.STRC: .BYTE   10              ;STREAMING TRIBUTARY INITIALIZATION COUNT
L.STRM: .BYTE   10              ;STREAMING TRIBUTARY COUNTER
L.BUFU: .BYTE   0               ;BUFFER UNAVAILABLE COUNTER
L.NRSE: .BYTE   0               ;REMOTE CONTROL STATION ERRORS
L.NLSE: .BYTE   0               ;LOCAL CONTROL STATION ERRORS
L.SCFW: .WORD   0               ;CONTROL STATION COUNTERS FLAG WORD
L.TIMC: .TIME                   ;TIME SINCE COUNTERS LAST ZEROED
L.BABL: .BYTE   0               ;BABBLING COUNT FOR SLAVES AND HDX LINES
L.STA:  .BYTE   0               ;LINE XMIT STATE
L.TOR:  .BYTE   0               ;TIMEOUT REASON
L.NAST: .BYTE   0               ;NUMBER OF ACTIVE TRIBUTARY STATIONS
L.ENA:  .BYTE   0               ;NUMBER OF TRIBUTARY STATIONS ENABLED
        .EVEN
        .VFY    L.STBL          ;CHECK BEGINNING TRIBUTARY STATION TABLES ADDRES
        .MPTAB  @DCPST          ;TRIBUTARY STATION TABLES
.END
```

```
NETCM.MAC
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For RSX-11M-PLUS V3.0 and greater.

NETCM.MAC and CEXBF.MAC are included with the RSX Operating System
distribution.  They can found in [11,10] directory.

Built into the RSX-11M+ Executive at SYSGEN.



;+
;         COMMUNICATION SYSTEM COMMON DATA BASE
;-

$PDVTA::.BLKW    1          ; ADDRESS OF PDV ADDRESS TABLE
$SLTMA::.BLKW    1          ; ADDRESS OF SLT ADDRESS TABLE
$LLCTA::.BLKW    1          ; ADDRESSS OF LLC REVERSE MAPPING TABLE
$PDVNM::.BLKW    1          ; NUMBER OF PDV ENTRIES
$SLTNM::.BLKW    1          ; NUMBER OF SYSTEM LINES
$CCBNM::.BLKW    1          ; # OF CCB'S ALLOCATED
$CCBSZ::.BLKW    1          ; # BYTES / CCB
$RDBNM::.BLKW    1          ; # OF RDB'S ALLOCATED
$RDBSZ::.BLKW    1          ; # BYTES / RDB
$SDBNM::.BLKW    1          ; # OF SDB'S ALLOCATED
$SDBSZ::.BLKW    1          ; # BYTES / SDB
$CCBCT::.BLKW    1          ; COUNTER OF CURRENT # OF CCBS IN POOL
$CCBAF::.BLKW    1          ; COUNTER OF # OF CCB ALLOCATION FAILURES
$LDBAF::.BLKW    1          ; COUNTER OF # OF LDB ALLOCATION FAILURES
$CCBAL::.BLKW    1          ; COUNTER OF # OF DYNAMIC CCB ALLOCATIONS
$RDBTH::.BLKW    1          ; POOL THRESHOLD FOR LDB ALLOCATON FAILURE
$CMPDV::.BLKW    1          ; PDV INDEX OF CURRENT DISPATCHED PROCESS
$ZTIME::.BLKW    1          ; TIME SINCE COUNTERS LAST ZEROED
$ZTIM2::.BLKW    1          ; TIME SINCE SYSTEM LAST ZEROED
   . . . . . . .
   . . . . . . .
   . . . . . . .

$CCBLH::.BLKW    1          ; POINTER TO FIRST FREE CCB
$SDBCT::.BLKW    1          ; COUNTER OF CURRENT SDB'S IN POOL
$SDBLH::.BLKW    1          ; POINTER TO FIRST FREE SMALL DATA BUFFER
        .BLKW    1          ; SECOND HALF OF ADDRESS DOUBLEWORD
$SDBAF::.BLKW    1          ; COUNTER OF # OF SDB ALLOCATION FAILURES
$RDBCT::.BLKW    1          ; COUNTER OF CURRENT RDB'S IN POOL
$RDBLH::.BLKW    1          ; POINTER TO FIRST FREE RECEIVE BUFFER
        .BLKW    1          ; SECOND HALF OF ADDRESS DOUBLEWORD
$RDBAF::.BLKW    1          ; COUNTER OF # OF RDB ALLOCATION FAILURES
$RDQSL::.BLKW    1          ; SYSTEM LINE # TO CHECK ON NEXT BUFFER RETURN
$RDQCT::.BLKW    1          ; NUMBER OF BUFFER WAIT REQUESTS AND FLAG
$NTLPT::.BLKW    1          ; NTL POINTER TO IMPURE AREA IN NTPOOL
$CXOPT::.BLKW    1          ; COMM/EXEC OPTIONS INCLUDED
   . . . . . . .
   . . . . . . .
   . . . . . . .
```

```
          .MACRO   PDVDF$  L,B,LST

          .RADIX 8
          .ASECT
.=0

.IIF NB LST      .LIST
;
;        PROCESS DESCRIPTOR VECTOR OFFSETS AND BIT DEFINITIONS
;

Z.DSP:'B'        .BLKW    1          ; RELOCATION BIAS OF DISPATCH TABLE
          .BLKW    1          ; VIRTUAL ADDRESS OF DISPATCH TABLE

          .IF DF  X$$MCB
Z.QUE:'B'        .BLKW    1          ; ADDRESS OF SCHEDULER LEVEL QUEUE
          .ENDC
Z.NAM:'B'        .BLKW    1          ; PROCESS NAME (RAD50)
Z.LLN:'B'        .BLKB    1          ; # OF LOGICAL LINES (LLC'S ONLY)
Z.SCH:'B'        .BLKB    1          ; PROCESS PRIORITY (COMPLEMENT)
Z.FLG:'B'        .BLKW    1          ; FLAGS WORD
          .IF DF  X$$MCB!R$$11M!R$$11S
Z.PCB:'B'        .BLKW    1          ; PCB OF LOADED PROCESS PARTITION
          .ENDC
          .IF DF  R$$11D!I$$AS
Z.GCD:'B'        .BLKW    1          ; ADDR GCD NODE(0=PROCESS NOT RESIDENT)
          .ENDC
Z.AVL:'B'        .BLKW    1          ; POINTER TO FIRST FREE BLOCK IN PROCESS
Z.LEN='L'        .-Z.DSP            ; LENGTH OF PDV
Z.DAT:'B'        .BLKW    1          ; BIAS OF LLC DATA BASE
Z.MAP:'B'                           ; DISPLACEMENT OF LLC MAPPING TABLE
          .NLIST
          .PSECT
          .LIST
;
; FLAGS WORD BIT DEFINTIONS
;
ZF.X3P='L'   0              ; PROCESS REQUIRES PARAMETERS FROM X3P$DF MACRO
ZF.DDM='L'   1              ; PROCESS IS A DDM
ZF.DLC='L'   2              ; PROCESS IS A DLC
ZF.LLC='L'   4              ; PROCESS IS A LLC
ZF.MFL='L'   10             ; PROCESS IS MARKED FOR LOAD ( WITH NS )
ZF.KMX='L'   20             ; PROCESS IS A DDM FOR A KMC DEVICE
ZF.MUX='L'   40             ; PROCESS IS A DDM FOR A MULTIPLEXER DEVICE
ZF.LMC='L'  100             ; PROCESS REQUIRES MICRO-CODE TO BE LOADED
ZF.TIM='L'  200             ; PROCESS REQUESTS TIMER SUPPORT
ZF.MTM='L'  400             ; PROCESS REQUIRES TIMER ENTRY ON EVERY ACTIVE
                            ; PROCESSOR (RSX-11M+ MULTI-PROCESSOR SYSTEMS)
ZF.COU='L'1000              ; LLC/DLC PROCESS SUPPORTS COUNTERS
ZF.PSE='L'2000              ; PROCESS IS A PSEUDO DDM/DLC
ZF.DIA='L'4000              ; PROCESS REQUIRES DIAGNOSTICS MICRO-CODE LOAD
ZF.SLI='L'10000             ; PROCESS SUPPORTS SYSTEM LEVEL INTERFACE
ZF.MAN='L'20000             ; PROCESS SUPPORTS NETWORK MANAGEMENT REQUESTS
ZF.INI='L'40000             ; PROCESS SUPPORTS INITIALIZATION AND TERMINATE
ZF.DVP='L'100000            ; PROCESS ALWAYS RUNS AT IT'S PRIORITY
;
; CHANNEL TABLE FLAGS
;
ZS.ASN='L'100000            ; CHANNEL IS FREE TO ASSIGN
ZS.BSY='L'140000            ; CHANNEL IS IN PROCESS OF ASSIGNMENT

.IIF NB LST      .NLIST
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        .MACRO  UNADF$  L,B,LST
        .IIF NB LST     .LIST
        .MCALL  TMPDF$
        TMPDF$
        .ASECT
        .=0
        .INT
        ..OFF.=-<.+6>
.=..OFF.
;
; LINE TABLE OFFSETS
;
L.VECT:'L'      .INT                            ;INTERRUPT TRANSFER VECTOR
L.PRI:'L'       .PRI                            ;DEVICE PRIORITY
L.CSR:'L'       .CSR                            ;ADDRESS OF UNA PCSR0 REGISTER
L.TIMR:'L'      .BLKB   1                       ;LINE TABLE TIMER CELL
L.TIMI:'L'      .BLKB   1                       ;TIMER RESET VALUE CELL
L.STA:'L'       .BLKB   1                       ;UNA STATE BYTE
L.FLAG:'L'      .BLKB   1                       ;UNA FLAGS BYTE
L.MODE:'L'      .BLKW   1                       ;UNA DEFAULT MODE
L.CMDE:'L'      .BLKW   1                       ;UNA CURRENT MODE
L.SPFC:'L'      .BLKW   1                       ;CURRENT SPECIAL FUNCTIONS SET
L.PADD:'L'      .BLKW   3                       ;NODE ADDRESS
L.PCB:'L'       .POOL   8.                      ;UNA PORT CONTROL BLOCK
L.CCB:'L'       .POOL   12.                     ;"BOGUS" CCB FOR POLL DEMAND
L.SCR:'L'       .POOL   12.                     ;UNA SCRATCH AREA (USED FOR COM
L.LOG:'L'       .BLKW   1                       ;CCB FOR INTERNAL FUNCTIONS
L.LBK:'L'       .POOL   40.                     ;EVENT LOGGING BLOCK (FOR $CELOG)
L.MLT:'L'       .BLKB   1                       ;NUMBER OF BYTES OF MULTICAST ADDRESS EN
L.MMLT:'L'      .BLKB   1                       ;MAXIMUM NUMBER OF MULTICAST ADDRESS BYT
L.MLST:'L'      .POOL   60.                     ;MASTER MULTICAST LIST BLOCK
L.CTMR:'L'      .BLKB   1                       ;CONTROL FUNCTION TIMER
L.TTMR:'L'      .BLKB   1                       ;TRANSMIT TIMER
L.CFNC:'L'      .BLKW   1                       ;CURRENT CONTROL FUNCTION
L.PFNC:'L'      .LSTHD                          ;PENDING CONTROL FUNCTION QUEUE
L.SLN:'L'       .SLNW                           ;SYSTEM LINE NUMBER(FOR RECEIVE BUFFERS)
L.CHA:'L'       .DVCHA                          ;DEVICE CHARACTERISTICS
L.RCVL:'L'      .BLKB   1                       ;RCV BUFFER LEVEL
L.RCVR:'L'      .BLKB   1                       ;       UNUSED
L.RCVB:'L'      .POOL   7*14.                   ;       RCV RING BASE ADDRESS
L.RCVS:'L'      .BLKW   1                       ;       RCV RING START CHAIN ADDRESS
L.RCVF:'L'      .BLKW   1                       ;       RCV RING NEXT FREE BUFFER ADDRES
L.RCVC:'L'      .BLKW   1                       ;       RCV RING CURRENT BUFFER ADDRESS
L.RCVQ:'L'      .BLKW   1                       ;       RCV SEQUENCE NUMBERS
L.RCVD:'L'      .LSTHD                          ;       RCV COMPLETE PENDING QUEUE
L.XMTL:'L'      .BLKB   1                       ;XMT BUFFER LEVEL
L.XMTN:'L'      .BLKB   1                       ;       XMT CURRENT LEVEL
L.XMTB:'L'      .POOL   7*14.                   ;       XMT RING BASE ADDRESS
L.XMTS:'L'      .BLKW   1                       ;       XMT RING START CHAIN ADDRESS
L.XMTF:'L'      .BLKW   1                       ;       XMT RING NEXT FREE BUFFER ADDRES
L.XMTC:'L'      .BLKW   1                       ;       XMT RING CURRENT BUFFER ADDRESS
L.XMTQ:'L'      .BLKW   1                       ;       XMT SEQUENCE NUMBERS
L.XMTD:'L'      .LSTHD                          ;       XMT PENDING COMPLETION QUEUE
L.XMTP:'L'      .LSTHD                          ;       XMT PENDING QUEUE
L.XMTA:'L'      .BLKW   1                       ;       XMT ACTIVE CHAIN CCB LISTHEAD
L.XMTM:'L'      .BLKW   1                       ;       XMT FLAGS WORD MASK
L.MNAM:'L'      .BLKB   6.                      ;       UNA MICROCODE ECO FILE NAME
L.LUNM:'L'      .BLKB   6.                      ;       LUA MICROCODE ECO FILE NAME
L.EXT:'L'       .BLKW   4                       ;       LINE TABLE EXTENSION FOR COUNTER
L.LUXT:'L'      .BLKW   4                       ;       LINE TABLE EXT FOR DELUA CTRS
L.PDV:'L'       .BLKW   1                       ;       LOCAL STORAGE OF PDV
L.TLZ:'L'       .TIME                           ;       TIME COUNTERS LAST ZEROED
L.LEN='B'.-..OFF.
$$LCNT='B'L.LEN
L.OFFS='B'-<..OFF.+2>
        .IIF NB LST     .NLIST
```