## Microcode Components

## Supervisor

*"Operating System" for the adapter microcode.*

## Ring Task

*Handles 802.5 MAC Protocol.*

## System Interface Task
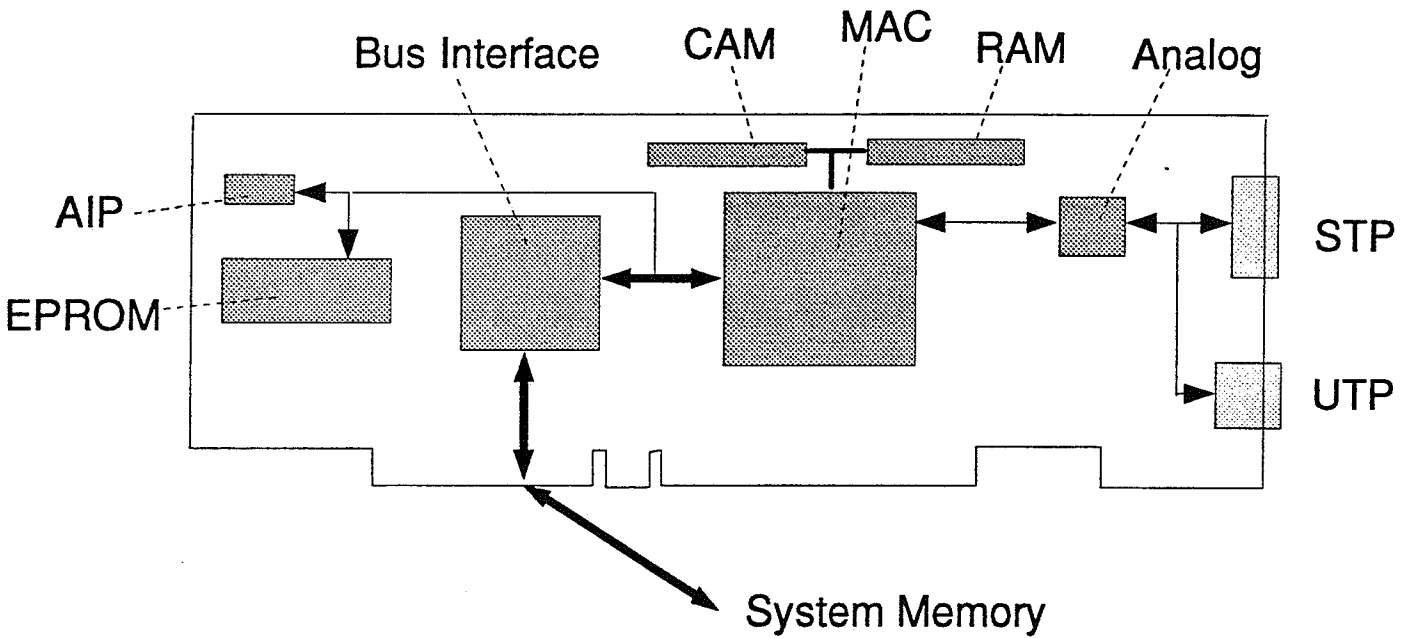
*Handles all commands from the device driver.*

## On-Card Diagnostics

*Check card operation at initialization time.*

# Adapter Data Flows

Frames are moved from system memory to the ring in one copy.

Microcode only intervenes on MAC frames and adapter commands.
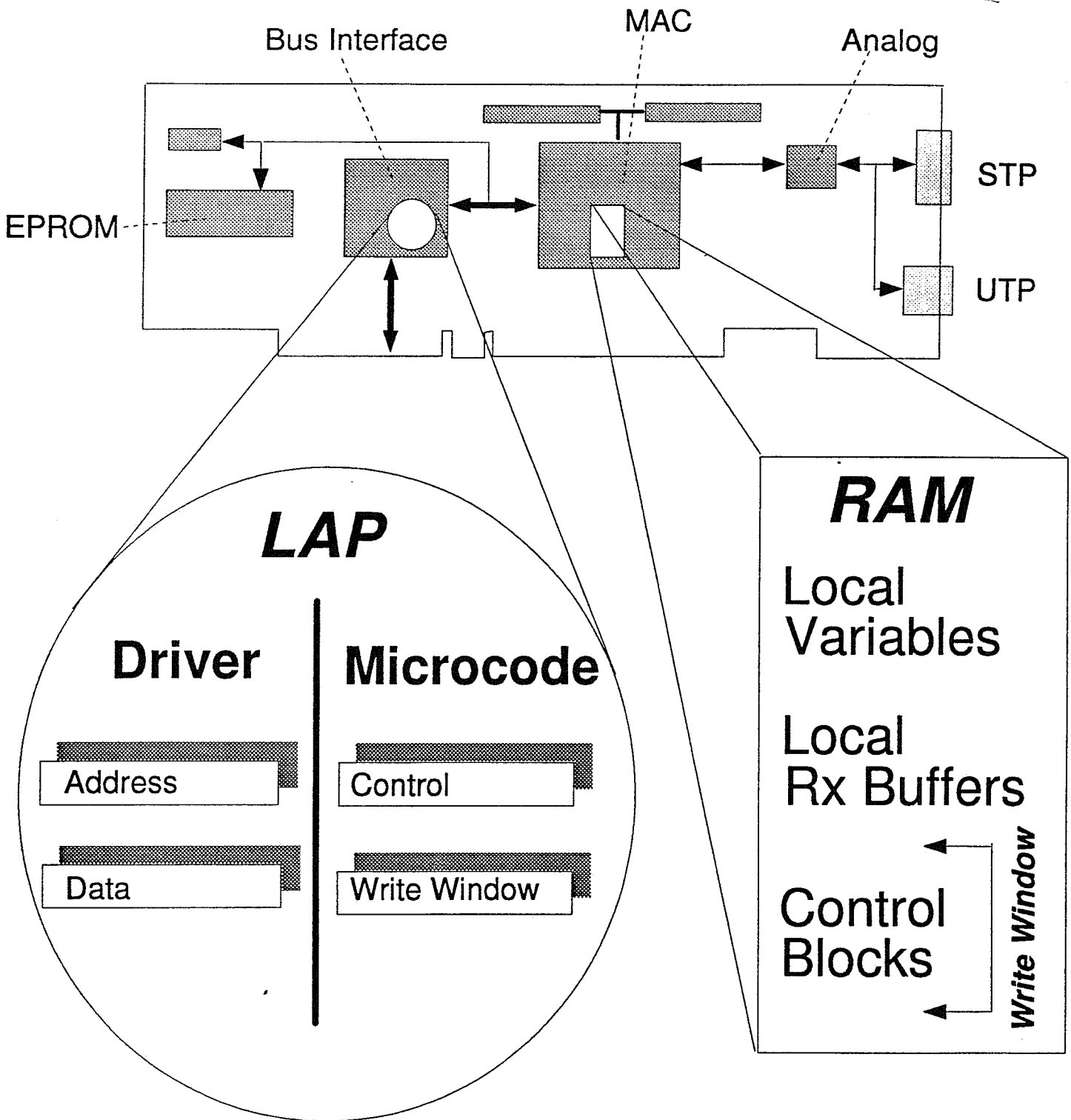
# System/Adapter Communication

Device Drivers talk to adapter microcode via Common RAM and Interrupts.

Access to the Common RAM is provided via the Local Access Port.

Interrupts are passed to the adapter via the Local Interrupt Status Register.

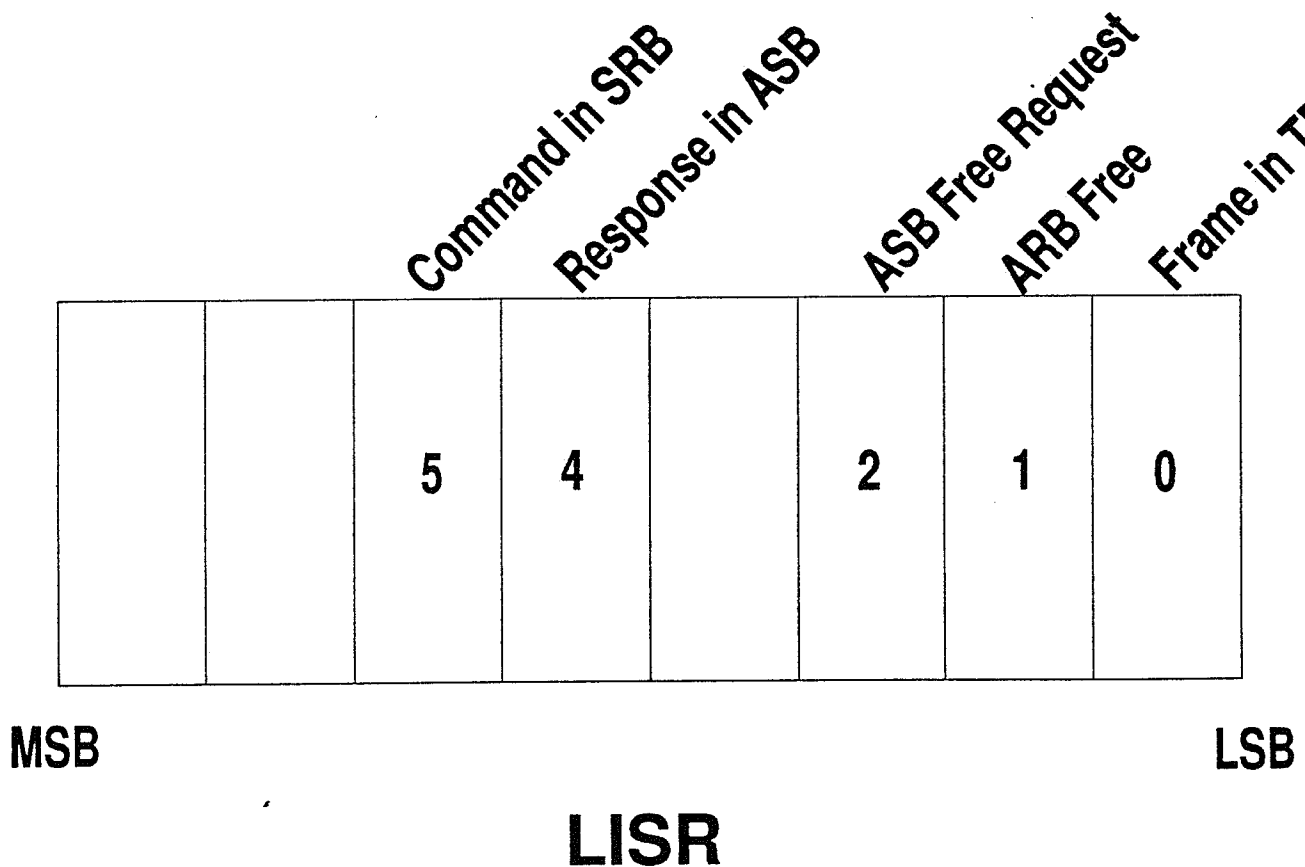Interrupts are passed to the system via the System Interrupt Status Register.

LLC traffic is passed from the ring to the system memory via DMA channels.

# Local Access Port

Bus Interface

MAC

Analog

EPROM

STP

UTP

## *LAP*

**Driver** | **Microcode**

Address

Control

Data

Write Window

## *RAM*

Local
Variables

Local
Rx Buffers

Control
Blocks

*Write Window*

# Local Interrupt Status Register

Used by Device Driver to interrupt adapter microcode.

Each bit in the LISR is assigned a particular meaning.

| | | Command in SRB | Response in ASB | | ASB Free Request | ARB Free | Frame in TRB |
|---|---|---|---|---|---|---|---|
| | | 5 | 4 | | 2 | 1 | 0 |

MSB                                                                    LSB
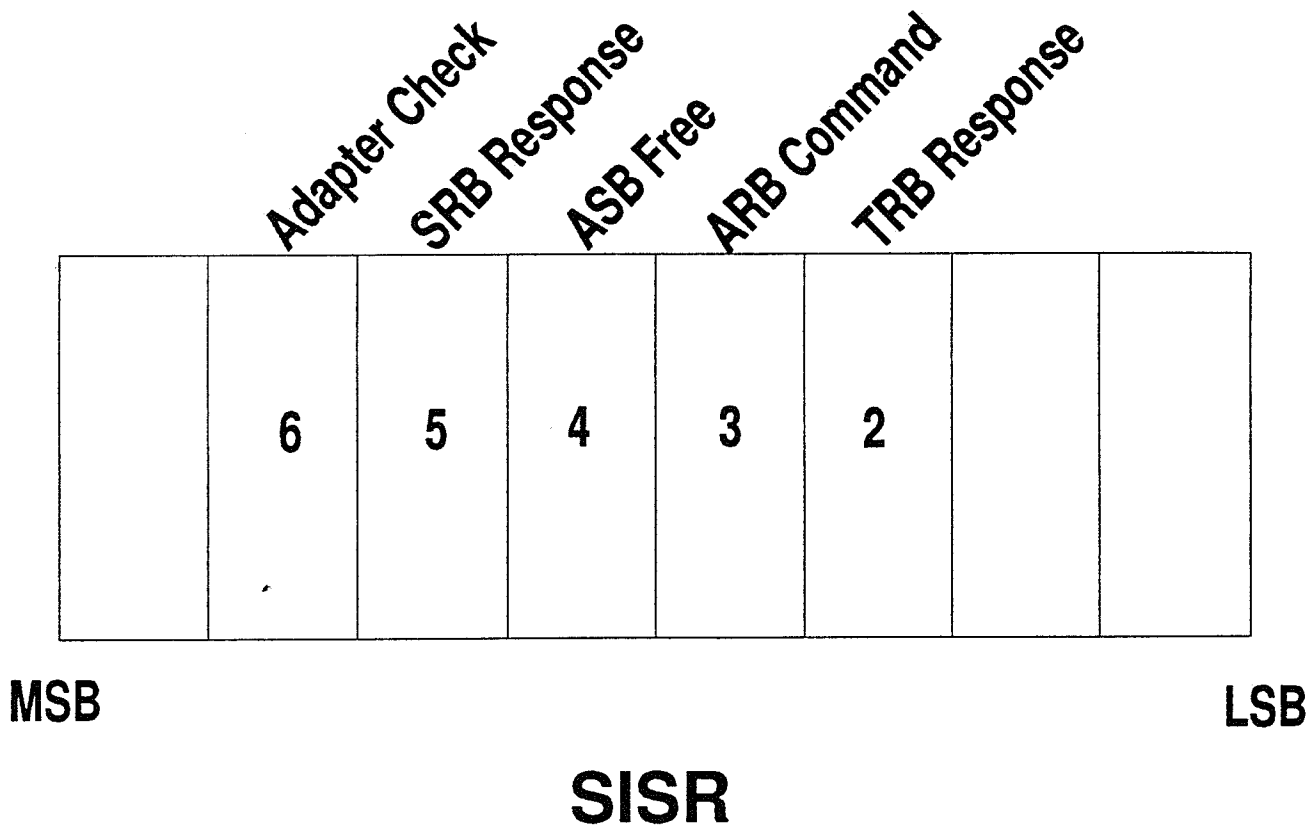
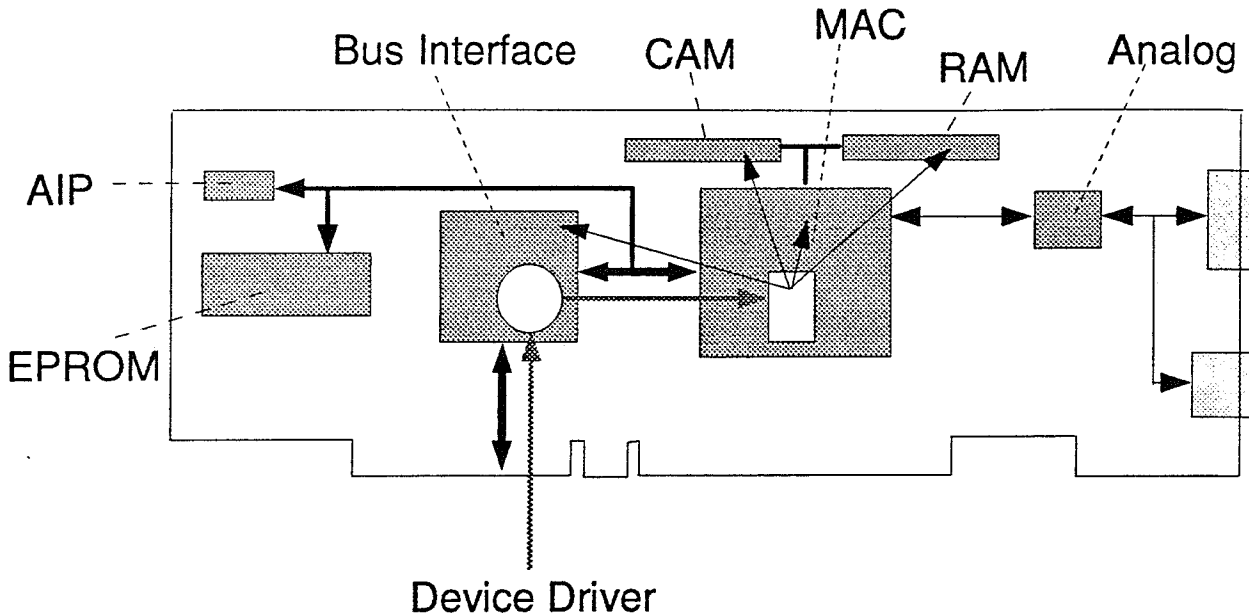## LISR

# System Interrupt Status Register

Used by microcode to interrupt the system.

Each bit in the SISR is assigned a particular meaning.

Each bit may be masked via the SISR Mask.

High byte of SISR is used by hardware to indicate Busmaster,
Timer, LAP Data Parity, LAP Access and Microchannel Parity Interrupts.

| | Adapter Check | SRB Response | ASB Free | ARB Command | TRB Response | | |
|---|---|---|---|---|---|---|---|
| | 6 | 5 | 4 | 3 | 2 | | |

MSB          LSB

**SISR**

# System Request Block



**Device Driver places SRB in Common RAM via LAP Interface.**

**Device Driver sets LISR bit 5.**

**Microcode handles the request.**

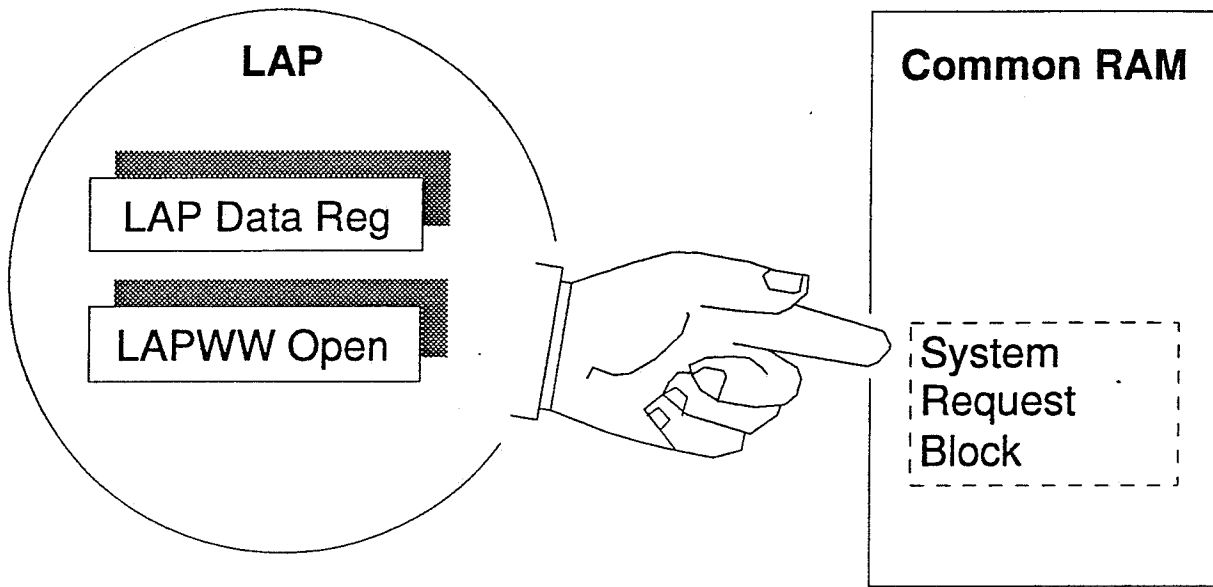**SRB Response is updated by microcode.**

**Microcode sets SISR bit 5.**

**Device Driver checks SRB Response.**

## Before adapter is Open:

LAP Write Window Open points to the SRB in Common RAM.
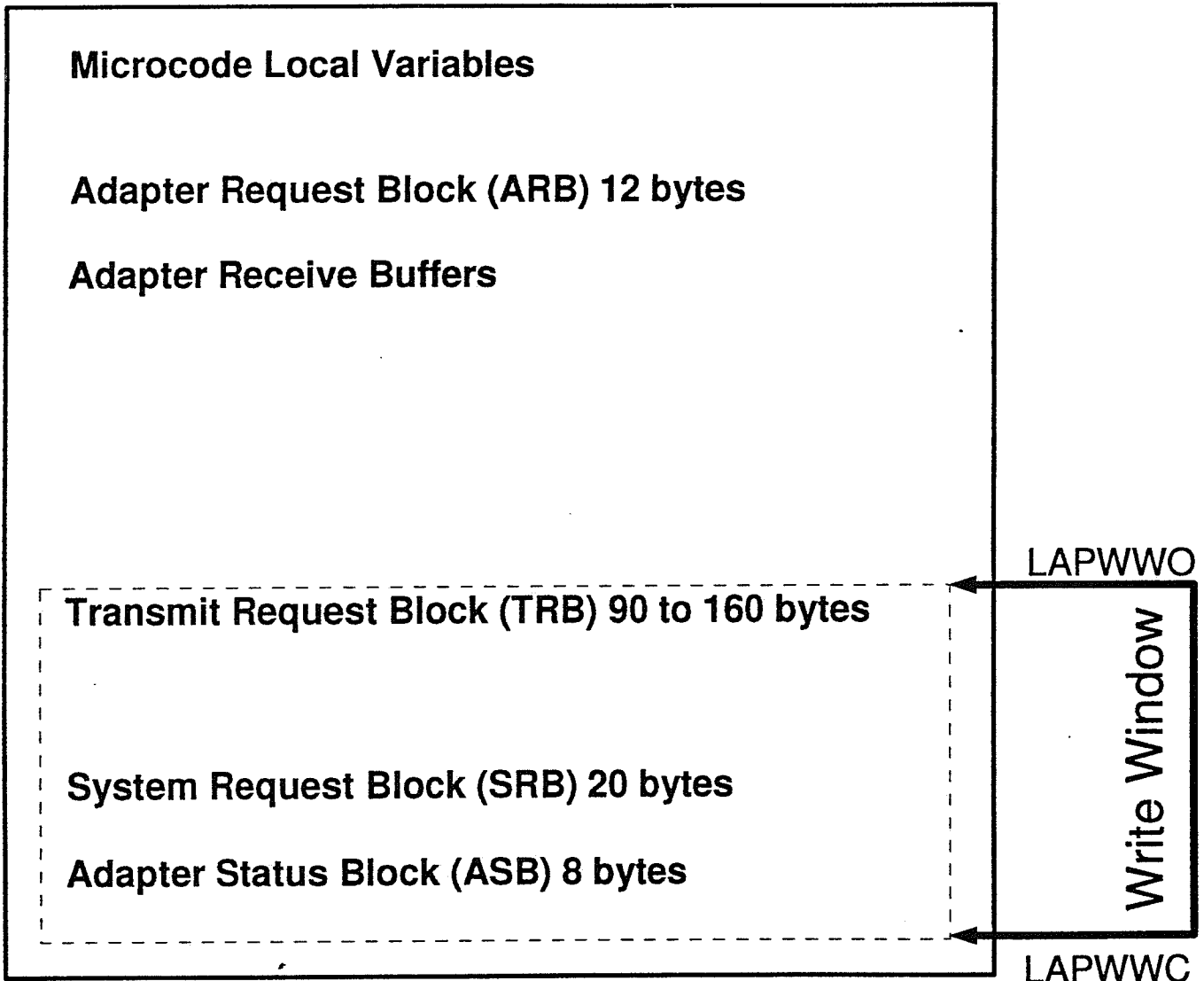


## After adapter is Open:

**Open SRB Response returns a pointer to the new location of the SRB.**

**LAPWWO does not point to the SRB after the adapter is Open.**

# Common RAM Layout

## Common RAM while adapter is Open:

Begining of Adapter RAM

**Microcode Local Variables**

**Adapter Request Block (ARB) 12 bytes**

**Adapter Receive Buffers**

LAPWWO

**Transmit Request Block (TRB) 90 to 160 bytes**

**System Request Block (SRB) 20 bytes**

**Adapter Status Block (ASB) 8 bytes**

Write Window

LAPWWC

End of Adapter RAM

DBSP0067.CDF

# LAP Access Violation

Occurs when the device driver attemps to access a location which has
been protected by the microcode.

Protection is acomplished via the LAP Control register and
LAP Write Window registers.

LAP Write Window registers are for RAM Addresses only.

LAP Control register allows/disallows reads and writes to:
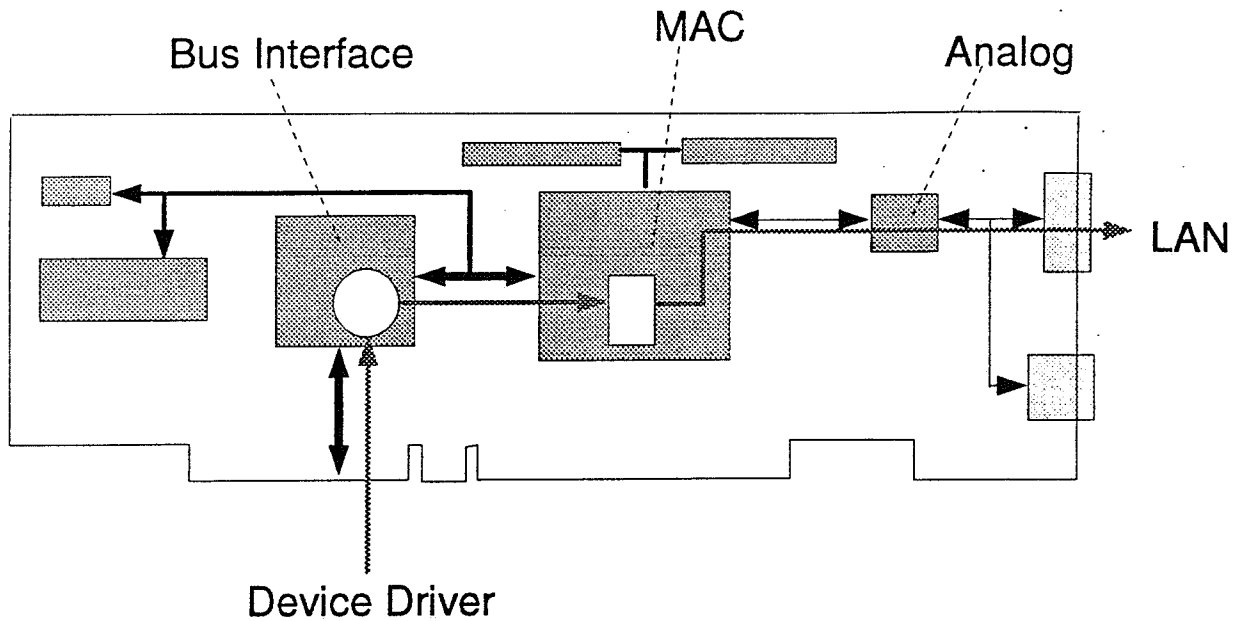
Protocol Handler Registers

ROM

RAM (can always be read)

# Examples:

Device Driver attempts to read a PH Register.

Device Driver attempts to write to ROM.

Device Driver attempts to write a RAM location outside the Write Window.

# Transmit Request Block



**Device Driver places TRB in Common RAM via LAP Interface.**

**Device Driver sets LISR bit 0.**
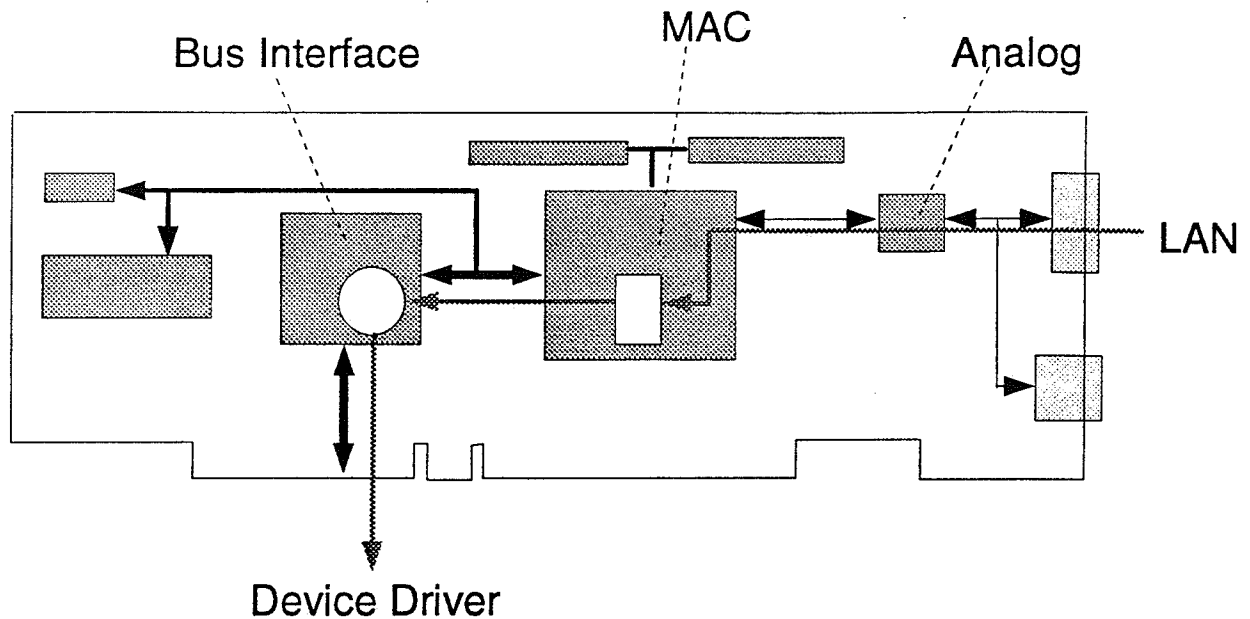
**Microcode checks the frame.**

**Microcode queues frame.**

**Frame is transmitted.**

**TRB Response is updated by microcode.**

**Microcode sets SISR bit 2.**

**Device Driver checks TRB Response.**

# Receive MAC Frame (ARB)

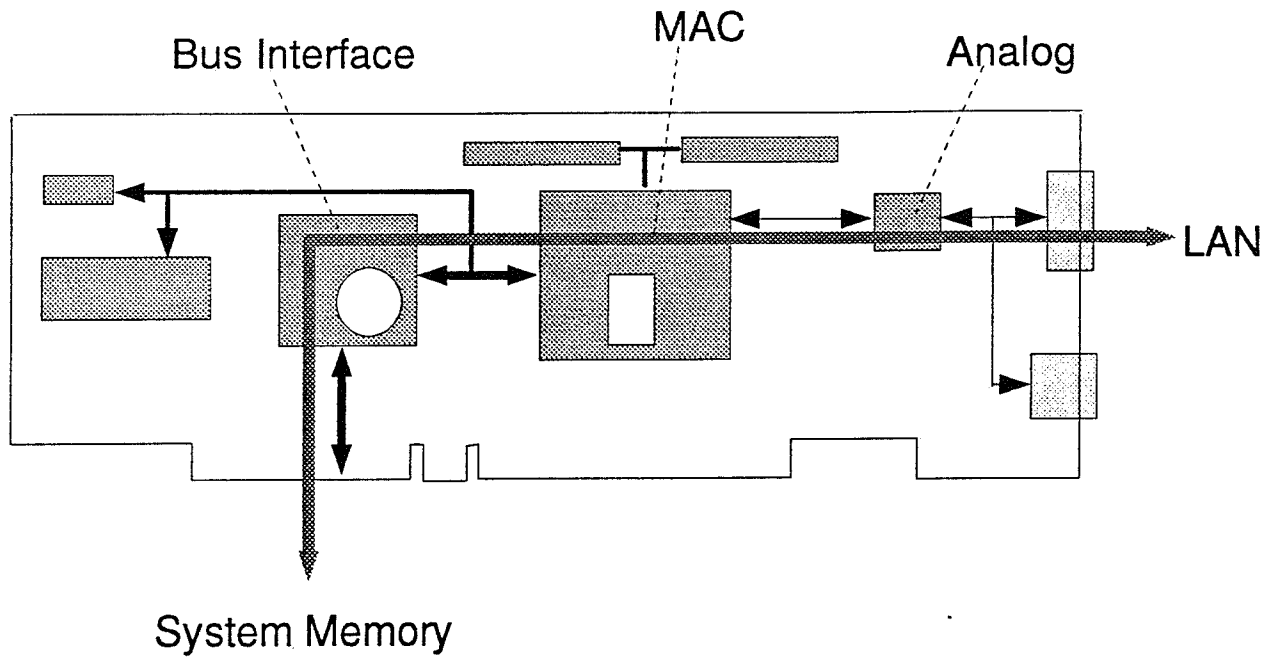Bus Interface          MAC          Analog

LAN

Device Driver

**Microcode receives a MAC frame.**

**Microcode determines that the system needs to see this MAC frame.**

**Microcode builds an ARB.**

**Device Driver reads the MAC frame via the LAP Interface.**

# LLC Frame Data Path

Bus Interface  MAC  Analog

LAN

System Memory

LLC Frames are Transmitted and Received via DMA Channel.

MAC Frames placed on LLC Busmaster Queue will be rejected.

**Places adapter into a known state.**

**Must be done before any other operation.**

**Causes On-Card Diagnostics to be performed.**

>  *Checks EPROM and AIP checksums.*

>  *Tests On-Card RAM used by MAC.*

>  *Checks MAC Protocol Handler for correct operation.*

>  *Checks adapter's microprocessor for correct operation.*

>  *Tests Address Match RAM and CAM.*

>  *Checks Busmaster operation of system bus.*

**Initialization Response provides pointers to adapter's Universal Address, Microcode Level, Node Address, Functional Address, Parms Table MAC Transmit Buffer and Ring Utilization Counter.**

# Initialization Procedure

Device Driver Resets the adapter.

Device Driver builds a 512 byte Receive Buffer in System Memory.

Device Driver writes address of Receive Buffer to RxBDA.

Device Driver sets SISRMask bit 15.

Microcode executes On-Card Diagnostics.

Microcode builds Initialization Response.

Microcode sets SISR bit 5.

Device Driver reads LAP Write Window Open to find location of Response.

Device Driver inspects Bring Up Code.

If Bring Up Code is not zero, then adapter is defective.
 Adapter will not respond to other commands.

Device Driver may issue other commands to the adapter.

LAPWWO will remain at the same location until an Open SRB is issued.

# Parameters Table

## Parameters Table contains these fields of interest:

| Offset | Description |
|--------|-------------|
| 4 | Node Address of Upstream Neighbor |
| 34 | Last Received Beacon Type |
| 38 | Ring Status |
| 44 | Local Ring Number |
| 48 | Last Beacon Transmit Type |
| 54 | NAUN of Beaconing Station |

## Ring Utilization

Pointer to Utilization is returned in Initialization Response.

Utilization is updated every 40 seconds by microcode.

Utilization is a number between 0 and 1000 (decimal).

Utilization / 1000 = Average Ring Utilization % over last 40 seconds.

**Inserts the adpater into the network and enables transmit and receive.**

**Parameters for the Open Adapter SRB:**

Node Address

Group Address

Functional Address

Number of Local Addresses

TRB Buffer Length

Product ID

Receive Options (See Part 2)

Open Options (See Part 2)

## Multiple Locally Administered Addresses

The adapter may have up to 32 MAC Addresses open at one time.

Duplicate Address Test is performed for each address.

Addresses are sequentially numbered starting with "Node Address".

All 32 Addresses must have identical values for the upper 36 bits.

## Values Returned from the Open Adapter SRB:

Return Code

Open Error Code (valid if Return Code is X'07' only)

Address for all future SRBs

Address of Transmit Request Block (TRB)

Address of Adapter Status Block (ASB)

Address of Adapter Request Block (ARB)

## Common Open Error Codes:

| | |
|---|---|
| Lobe Media Test Failed | *Lobe Cable is bad or not present* |
| Ring Beaconing | *Ring is Beaconing* |
| Duplicate Address Check | *Another station on ring has same address* |
| Request Parameters Failed | *Request Init was copied, but never responded to* |
| No Monitor for RPL | *Cannot RPL if no other stations are on the ring* |
| Removed Received | *Remove Station MAC frame was received* |

# Open Options:

**Wrap**   *Adapter will be opened, but not inserted into the ring.*
*Adapter is on a ring with exactly one station.*

**Disable Hard Error Ring Status**

*Hard Error Ring Status will not be passed to the system via an ARB.*

**Disable Soft Error Ring Status**

*When this station transmits a Soft Error, no ARB will be passed.*

**Pass Adapter Class MAC Frames**

*Unsuported Adapter Class MAC frames will be passed to the system.*

**Pass Attention MAC Frames**

*Express MAC frames will be passed, except when Express MAC Mode.*

**Contender**

*This adapter will always participate Monitor Contention.*

**Pass Beacon MAC Frames**   *Beacon frames will be passed to the*
*system everytime the Source Address or Beacon Type changes.*

**Open for RPL**

*Open will fail if no other stations are on the ring.*

**Inhibit Early Token Release**

*Tokens will not be released until the Source Address is stripped.*

# Receive Options:

## Disable Transmit LLC Copy (16 Mpbs only)

*Non-RI LLC frames transmitted by this station will not be copied.*

## Disable Transmit RI Copy

*LLC frames with RI, transmitted by this station will not be copied.*

## Disable Destination Address Match LLC Copy

*LLC frames with this station's Destination Address will not be copied.*

## Enable Destination MAC Copy (via LLC Channel)

*MAC frames with this station's Destination Address*
*will be copied via the LLC Channel.*

## Enable Broadcast MAC Copy (via LLC Channel)

*MAC frames with a Destination Address of x'C000FFFFFFFF'*
*will be copied via the LLC Channel.*

# Close Adapter SRB

Deinserts the adpater from the network.

Moves the SRB to the location pointed to by the LAPWWO.

Reset all adapter addresses  (Node, Group and Functional).

Reset all Receive and Open options.

Does not reset the Bridge Channel configuration.

# Set Functional Address SRB

**Sets the adapter's Functional Address after open.**

## Parameters:

Functional Address (lower 4 bytes only)

## Restrictions:

Active Monitor Functional Address may not be set via this SRB.

Bridge Functional Address is not affected by this SRB.

Ring Paramter Server Functional Address may only be set if the adapter
    is configured for bridge operation.

# Set Group Address SRB

Enable adapter to copy frames destined to a group address.

Set multiple group addresses.  (Up to (6 x 4096) + 256)

## Parameters:

Group Address    *All 6 bytes must be provided*

Group Type       *Selects Indexed or General*

Number of Addresses to Set
                 *For Indexed Type only*

## Restrictions:

May be issued anytime while adapter is Open.

Group Addresses must have the Group/Individual bit set.

Group Addresses with the Local/Universal bit set must have the not-F bit set.

Several restrictions apply to Indexed type group addresses.

**A Location Identifier will be returned for this SRB.**

# General Group Addresses

**Up to 256 unique, unassociated group addresses may be set in the General Address Registers.**

**Addresses are not hashed.**

**Restrictions for General Group Addresses:**

Functional Addresses may not be set.
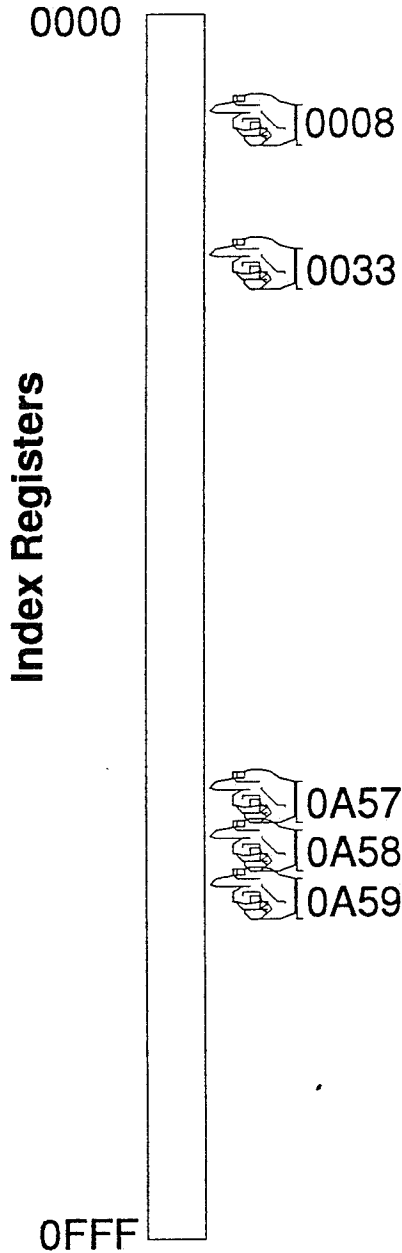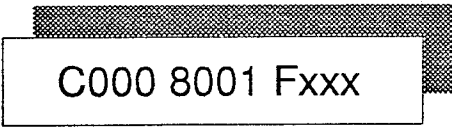
Group/Individual bit must be set.

Multiple sequential addresses may not be set via the Number of Addresses field.

(Sequential addresses should be placed in Indexed registers for optimization.)

# Indexed Group Addresses

## Base Register

```
C000 8001 Fxxx
```

**0000**

**Index Registers**

☞ 0008

☞ 0033

☞ 0A57
☞ 0A58
☞ 0A59

**0FFF**

**There are six Base/Index Register pairs.**

**The Set Group Address SRB will return a Location Identifier.**

**When setting multiple indexed addresses in a single SRB, all addresses must have the upper 36 bits identical.**

# Reset Group Address SRB

---

## "Turns Off" one or more Group Addresses.

## Parameters:

Group Address      *All 6 bytes must be provided*

Group Type         *Selects Indexed or General*

Number of Addresses to Set
                   *For Indexed Type only*

Reset All          *Resets all Group Addresses of "Group Type"*

## Restrictions:

May be issued anytime after adapter is Open.

---

# Configure Bridge Channel SRB

**Causes the Bridge Channel to be enabled when the adapter is Opened.**

**Allows the Ring Parameter Server functional address to be set.**

**Forces the Bridge functional address to be set.**

## Parameters:

Access Priority for Bridge Channel

## Restrictions:

Must be issued while adapter is closed.
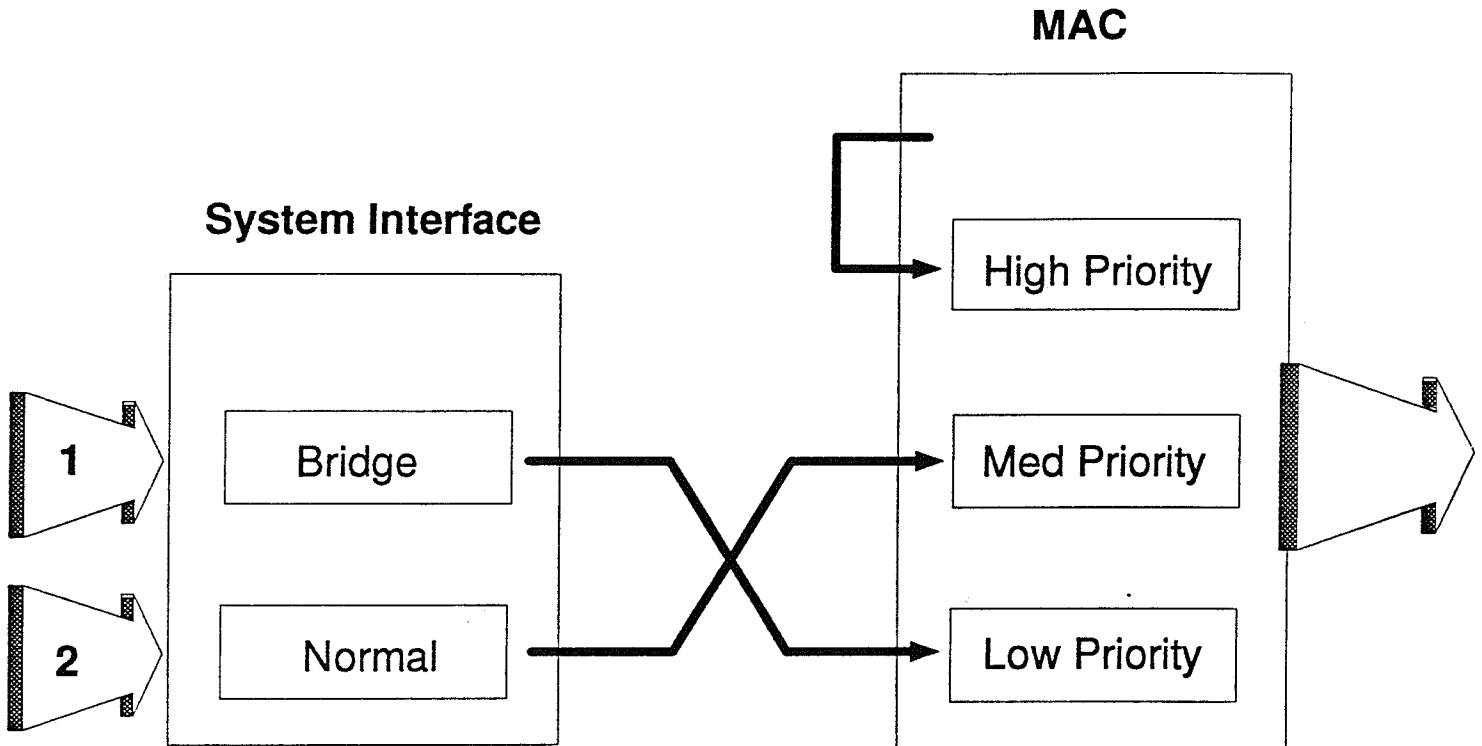
To disable the bridge channel:
    Initialize the adapter  OR
    Issue Configure Bridge Channel with Access Priority of x'FF'.

Access Priority must be between 0 and 4.

All frames queued for the Bridge Channel will be forced to the prioirty
    set by the Access Priority parameter.

This SRB does not affect the Normal Transmit Channel.

# Transmit Channels

**MAC**

## System Interface

```
  1 >         Bridge  ──────┐   ┌──────>  High Priority

                            │   │

                             ╲ ╱
                              ╳
                             ╱ ╲

  2 >         Normal  ──────┘   └──────>  Med Priority

                                          Low Priority
```

**System Interface Channel 1 is used for bridge forwarding traffic.**

**System Interface Channel 2 is used for normal LLC trafic.**

**If Configure Bridge Channel has not been issued, then System Interface Transmit Channel 2 is piped to the Low Priority MAC Channel.**

# Set Bridge Parameters SRB

## Activates bridge address match functions.

## Parameters:

Source Ring Number, Target Ring Number and Bridge Number

Multi-port Bridge Enable

Limited Broadcast Copy
*Enable or disable the copying of Single Route Broadcast frames.*

Inhibit Bridge Copy
*Allows bridge copy to be suspended for short periods of time.*

## Restrictions:

May only be issed after Configure Bridge Channel and Open Adapter SRBs.

# Modify Bridge Parameters SRB

**Allows state of Limited Broadcast Copy to be changed.**

**Start/Stop Bridge Copy functions.**

## Parameters:

Limited Broadcast Copy
> *Enable or disable the copying of Single Route Broadcast frames.*

Inhibit Bridge Copy
> *Allows bridge copy to be suspended for short periods of time.*

## Restrictions:

May only be issed after Set Bridge Parameters SRB.

# Set Target Segment SRB

**Set a target segment for Multi-port Bridge address match logic.**

## Parameters:

Target Ring Number

All Routes Explorer
   *If non-zero, RI Broadcast frames with this target will not be copied.*

Spanning Tree Explorer
   *If non-zero, RI Limited-Broadcast frames with this target will not be copied.*

## Restrictions:

May only be issued if Multi-port Bridge is enabled.

**Use Reset Target Segment SRB to remove a target segment.**

# Read Adapter Log SRB

Returns ten Token Ring related counters, including:
     Burst Errors, Lost Frames, Congestion, and Token Errors

May be issued anytime the adapter is Open.

Should be issued when Ring Status ARB indicates Counter Overflow.

Counters are all reset after this SRB is issued.

All counters are one byte long.

---

# Read Source Routing Bridge Counters SRB

Returns three Source Routing related counters, including:
     Number of SR frames <u>repeated</u> by this adapter.

     Number of <u>valid</u> SR frames missed by this adapter.

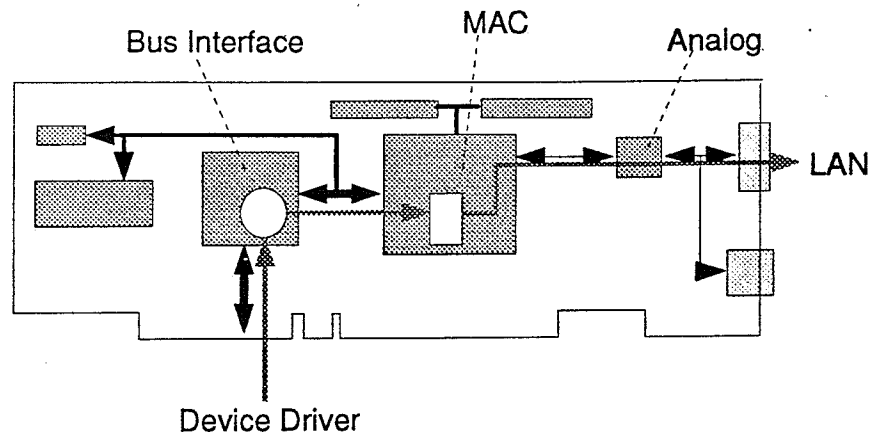     Number of <u>invalid</u> SR frames discarded by this adapter.

May be issued anytime the adapter is Open, but intended for bridge mode.

Should be issued when Ring Status ARB indicates SR Counter Overflow.

Counters are all reset after this SRB is issued.

All counters are two bytes long.

---

# Transmitting MAC Frames: TRBs



Bus Interface    MAC    Analog

LAN

Device Driver

**Microcode checks validity of frame:**

    **Checks for valid Access Priority**

    **Allows only MAC frames**

    **Checks for valid Source Address**

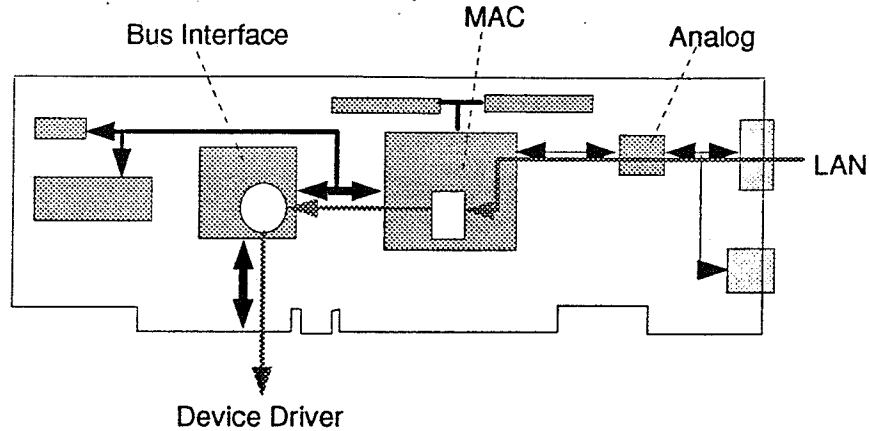    **Checks for valid RI field (if present)**

    **Checks MAC frame syntax**

    **Rejects Adapter Class MAC frames**

**If frame is not transmitted, a x'23' Return Code will be posted.**

**If frame is not copied, a x'22' Return Code will be posted.**

**TRBs cannot be longer than the length reserved at Open time.**

Bus Interface      MAC      Analog

LAN

Device Driver

**Provides a way for the microcode to deliver MAC frames and Ring Status to the system.**
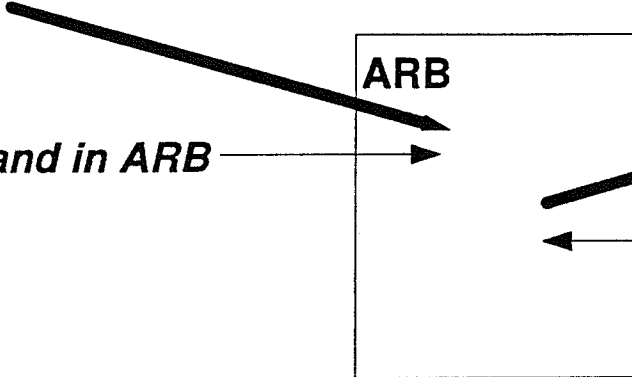
**Ring Status ARBs do not require responses to the adapter.**

**Receive Frame ARBs require the Adapter Status Block (ASB) to be used to convey status to the adapter.**

Microcode builds ARB

**ARB**

Device Driver reads ARB

*Command in ARB*

*ARB Free*

**The ARB will contain the current Ring Status.**

**No action is required by the Device Driver.**

# Receive Frame ARB

Microcode builds ARB

**ARB**

Device Driver reads ARB

*Command in ARB*

*ARB Free*

Device Driver builds ASB

Microcode writes Return Code

**ASB**

*Response in ASB*

*ASB Free Request*

*ASB Free*

Device Driver reads Return Code

*Note: If an error is detected by the microcode, the ASB Return Code will be updated and an ASB Free Interrupt will be posted regardless of the state of the ASB Free Request.*

# Adapter Check

**When microcode detects a catastrophic error, an Adapter Check will result.**

**LAPWWC points to Adapter Check data.**

**LAP**

LAP Data Reg

LAPWW Close

**Common RAM**

Reason Code
Parm 1
Parm 2
Parm 3

**Reason Code and following six bytes of Parameters should be recorded.**

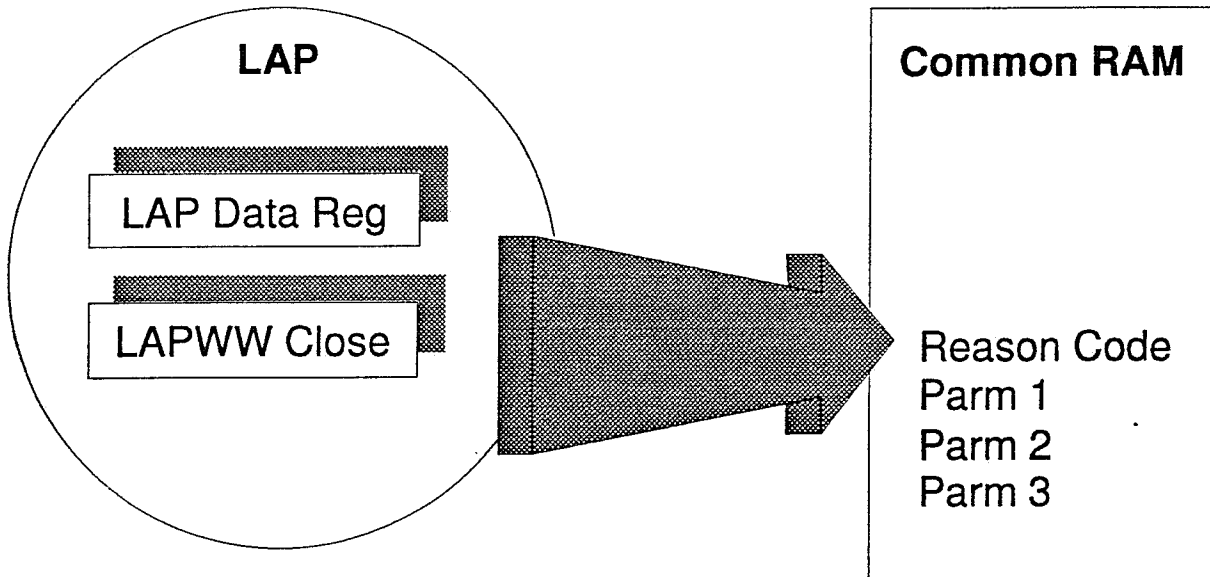**Adapter Checks <u>should</u> never occur on a good adapter.**

**If the adapter was open, it will be closed for any adapter check.**

# Reasons for Adapter Check:

On-Card microprocessor executes an illegal instruction.

ICD Bus Parity Error.

Parity Error in PH on Transmit, Receive, or AMF Bus.

PH DMA Overrun or Underrun.

# Adapter Identification PROM

**Contains the Burned In Address and its complement.**

**Contains configuration data used by the microcode.**

**The PROM is 4 bits wide.**

| Table I. Adapter Identification PROM | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Offset Addr | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
| FF00 | -- | -- | -e | -- | -w | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FF10 | -r | -r | -r | -r | -r | -r | -r | -r | -- | -- | -- | -- | -- | -- | -- | -- |
| FF20 | -m | -m | -m | -m | -m | -m | -m | -m | -m | -m | -m | -m | -m | -m | -m | -m |
| FF30 | -i | -i | -i | -i | -i | -i | -i | -i | -i | -i | -i | -i | -i | -i | -i | -i |
| FF40 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FF50 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FF60 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FF70 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FF80 | -a | -a | -a | -a | -a | -a | -a | -a | -a | -a | -a | -a | -α | -α | -α | -α |
| FF90 | -α | -α | -α | -α | -α | -α | -α | -α | -4 | -D | -4 | -1 | -5 | -2 | -5 | -3 |
| FFA0 | -3 | -6 | -3 | -3 | -5 | -8 | -3 | -4 | -3 | -5 | -3 | -1 | -3 | -8 | -2 | -0 |
| FFB0 | -B | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FFC0 | -1 | -3 | -5 | -7 | -9 | -B | -D | -F | -E | -C | -8 | -A | -6 | -4 | -0 | -2 |
| FFD0 | -B | -D | -D | -9 | -F | -C | -A | -F | -E | -C | -F | -- | -- | -- | -- | -- |
| FFE0 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| FFF0 | -D | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |