Preliminary APPLENET Interface Specification

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This specification is a first-cut at describing how the Lisa Host interfaces with the APPLENET card to execute the basic network services provided by the Z8. Many details are left out, such as exact sizes of host queue elements, etc. since these are dynamiclly defined. This document should give the reader a basic sense of the "style" of interaction to be provided.

The host sees the APPLENET card as a shared-memory device. All commands are initiated by setting parameters into a single Task Command Block (TCB) within this shared memory. Periodically, the Z8 performs a scan of this TCB and will execute the command when it discovers it. After a command has been completed, the Z8 will generate an interrupt to the Host. At this time, the host is responsible to examine the results of the command.

In addition, the APPLENET card is normally always armed to receive packets over the net. Data from received packets are placed within buffers in the shared memory. Several such buffers (called Host Queue Elements - HQE) are maintained by the Z8 after Initailization. As in the case of a completed command, the Z8 will interrupt the Host after each packet is successfully received.

The term "queue" is somewhat misleading, since no explicit queuing mechanisms are provided. Instead, by mutual agreement between the Host and the Z8, these Host Queue Elements are scanned in a cyclic fashion. Thus, the Z8 will guarantee to fill the Host Queue in sequence (chronological order). Likewise, the Host should maintain such a cyclic sequencing when examining the queue. The only time when this "queue" will become full is when the Host does not free a HQE. The Z8 will consider the buffer overrun and Jam directed packets and increment the buffer overrun status on bradcast packets until the next HQE is free.

In order to properly synchronize the shared usage of thes TCB, and HQEs (and long buffers), each such object contains a semaphore. The value of the semaphore always indicates the current state of the object. The interpretation of the semaphores is as follows:

0 A value of zero for any semaphore means that the object is currently free; eg. neither the Z8 nor Host is using the object.

\+ Any (strictly) positive value indicates that the object is being processed by the Z8. For the TCB, the value is set by the Host with a unique value indicating the desired command. For HQEs and long buffers, the value is set by the Z8 when the object is first allocated to begin reception of a new packet.

\- A negative value indicates that the object has been "completed" by the Z8 and should thus be processed by the Host. For the TCB, this indicates that the command is done. For HQEs, this indicates that a packet has been successfully received and should be processed by the Host.

The following scenarios describe the sequence of semaphore values for two cases: the first shows a command execution sequence while the second

describes the order of processing of a received packet.

Command Execution

The Host initiates a command by setting up the necessary parameters in the TCB. The very last byte to be set is the command itself (which is also the semaphore). This will be a positive value. When the Z8 next polls the TCB, it will see the command and begin processing it. After the command is complete, it will set the upper bit of the semaphore, thus making it -, and interrupt the Host. The host can then examine the Status data, etc. When the Host has determined the status of the command it then zeros the command/semaphore, indicating that the command cycle is now complete.

Packet Reception

When the Z8 determines that a new packet is being received, it allocates the next HQE and sets the semaphore value (from 0) to +1. If the packet contains data (thus requiring a long buffer, it will allocate a long buffer and set its semaphore to the HQE number. The Z8 will then finish receiving the packet. Assuming that the packet is valid, the Z8 will change the values of the semaphore(s) to - and interrupt the Host. The Host will then examine the Host Queue, looking at each HQE whose semaphore is -. After copying the data from shared RAM into itself, the Host will clear the semaphore(s) to 0, indicating tha the HQE and long buffer are again free.

If a packet is not valid, the Z8 will clear the semaphores itself (and, of course, not interrupt the Host).

Memory Organization

Since all communication between the Host and the Z8 is done via shared memory, it is important that each understand the organization of the data structures contained therein. This section describes this layout; as certain parameters become better understood (such as HQE size, etc.) this information will become more detailed.

The memory is divided into several distinct areas. The order of these areas and their basic purpose are defined as:

HQ pointer. This two-byte value (set by the Z8 at Initialization time) points to the first HQE.

Task Command Block (TCB). This area contains the command/semaphore and parameter areas for Host initiated commands. It is at a fixed location ($002,$003) to ease the interactions between Host and Z8 (especially for executing the Initialize command).

Status Data. This area (contained in a fixed location) is used by the Z8 to maintain the current status of the card. It includes the following data:

Completed Task Status.
Error #
# of bad packets received
# of jams sent
# of jams received
# of queue overruns

Note: the number of queue overruns indicates only when broadcast packets could not be received due to inadequate buffer space. Directed packets will be jammed if buffer space is not available (thus, showing up in the # of jams sent).

Buffer Allocation Table. This table contains one word for each HQE and long buffer in the system. It is setup by the Z8 at Initialization time and is used by the Z8 to locate HQEs and long buffers during execution. All reference to HQEs and long buffers is via a single byte index (thru this table). The host may choose to use this table directly or (more likely) copy the table after completion of the Initialization command into its own memory area for faster reference.

Host Queue Elements. These objects are the HQEs themselves. Note that the HQE pointer will point to the first of these Indirectly via the Buffer Allocation Table. HQEs contain the data from packet headers plus the HQE semaphore and a byte index for any associated long buffer for this packet. The number of HQEs is specified during Initialization time.

Long Buffers. The last area of memory contain the long (data) packet buffers. Note that network control packets are always short and thus are totally contained withing the HQEs. Only data packets require the use of long buffers.

APPLENET Commands

Having described the shared memory interface, here we describe the six functions which are implemented by the Z8 card.

At system power-up time, the Z8 will automatically perform a self-diagnostic function and return status; it will interrupt the Host to indicate the completion of this testing. After generating the interrupt, the Z8 will enter its normal polling operation, awaiting the Initialization command, which should always be the first command. During this time, the netword card does not appear to be on the net. I.e., no packets will be received (or jammed).

Initialize command

This command is used to specify allocation of HQEs and long buffers. After initialization, the Z8 will begin accepting packets and will thus be "online" to the network.

The parameters of the Initialize command are:

six byte receiver addr.
size of short packets (HQE)
size of long buffers (data packet)
transmit buffer allocation flags (indicating short/long allocation)
number of short packets (HQEs)
number of long packets

The Z8 will check to make sure that sufficient space is available for the total space implied. It will also initialize the Buffer Allocation Table. After a valid initialization, packet reception is armed.

Send

This command is used to initiate a packet transmission over the net. The Host must fill in all associated packed header data via the transmit short addr. index located at the HQ pointer -4 , plus any data in the long buffer via HQ pointer -2 (if any). It then places the Send command value into the TCB semaphore. After the Z8 has successfully sent the packet, or the packet was not sent because of collision retry exhaustion, it will set the semaphore - and interrupt the Host.

In addition to the command/semiphore , the TCB contains several additional fields which must be set up by the Host for proper packet transmission. These are:

Coin-Flip value. This 32 bit number is generated by the Host for each transmission. It is used by the Z8 whenever a collision retry backoff must be performed. When this value is all 0, the Z8 will abort the transmission attempt.

Inter-packet gap.This is a one byte field to allow for the time to transmit after idle detection.This is useful for packet priorities and the resolution of the byte is given as 6us per bit binary.

Jam retry count.This is used by the Z8 to determine the number times to resend a packet when the packet has been jammed.

Monitor command

This command is used to set the Z8 into "monitor mode". While in monitor mode, all packets seen on the net will be received (subject to buffer availability). Only the packet headers are received, data is ignored, thus preserving a modicum of privacy. There is no Un-Monitor command; instead, the Host can re-Initialize the card.

Note that when in monitor mode, it may be desirable to initialize no long buffers and instead allocate as many shorts as will fit.

Wait command

This command is used to inhibit any further reception of packets while allowing all currently received packets to be processed by the Host. Normally, this command is used to "cycle down" the Z8 card before Resetting or Re-Initializing. Durning this wait period all directed packets are jammed and all broadcast packets are flaged as buffer overruns.

This command is marked done when no more HQEs remain unprocessed by the Host.

Reset command

The Reset command is used to turn off the Z8 card after having been Initialized. The response to this command is identical to the power on reset sequence.

Clear Status command

This command is provided to allow the Host to signal the Z8 to reset all accumulated status information. This would normally be done periodically when the Host sees that any of the Status data is approaching overflow. While the Host could clear this data itself, a command is provided so that any internally maintained data (within the Z8 registers, for example) are appropriately cleared also.

Shared Memory Allocation

```
Host Queque Pointer .....word  -
Semiphore/command........byte  - TCB
Inter-packet gap.........byte  -
Random #.............2.words  -
Task status..............byte  - Status Regs
Bad packets..............word  -
Jams sent................word  -
Jams rcvr................word  -
Buffer overruns..........word  -
Short packet Lng.........byte  - Buffer alloc. blk
Long packet Lng..........byte  -
Tx buffer alloc..........byte  -
# of Shorts..............byte  -
#of longs................byte  -
Rcrv. Addr............3.words  -
Tx. short addr...........word  - Tx. Table
Tx. long addr............word  -
0 Queue addr.............word  - queue table
1 Queue addr.............word  -
        .
        .
N Queue addr.............word -
0 Long addr..............word - long table
        .
        .
N long addr..............word -
Queue response/semi......byte - Queue Element
Long index...............byte -
SHORT..................BUFFER -
        .                          .
        .                        N Queue Elements
Long semiphore...........byte - Long storage
Long ..................Buffer -
        .                          .
        .                        N long storage
```

Recommended Command Codes

Reset : 1h Initialize : 2h Wait : 3h Clear
Status: 4h Monitor : 5h Send : 6h

Recommended Receive Code

Valid read : 8h