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AEROSPACE STANDARD

SAE AS4075 REV. A

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Superseding AS4075

High Speed Ring Bus (HSRB) Standard

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE AS-1A Avionic Networks Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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1. SCOPE:

A fault tolerant, real time high speed data communication standard is defined based on a ring topology and the use of a Token passing access method with distributed control. The requirements for the HSRB standard have been driven predominantly, but not exclusively, by military applications. Particular attention has been given to the need for low message latency, deterministic message priority and comprehensive reconfiguration capabilities. This document contains a definition of the semantics and protocol including delimiters, tokens, message priority, addressing, error detection and recovery schemes; and is written to be independent of bit rate and media. Parameters related to particular media and bit rates are defined in separate documents, the AS4075 slash sheets.

2. APPLICABLE DOCUMENTS:

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AIR4289	Handbook for the SAE AS4075 High Speed Ring Bus
AS4075/1	Fiber Optic Implementation Slash Sheet
AIR4291	Test and Verification Plan for the SAE AS4075 High Speed Ring Bus (HSRB) Ring Interface Unit (RIU)
AIR4531	Test and Verification Plan for the SAE AS4075 High Speed Ring Bus (HSRB) Ring Interface Module (RIM)
AIR4271	Handbook of System Data Communications
ARD50007	Statement on Requirements for Real-Time Communication Protocols (RTCP)

2.2 Glossary:

2.2.1 Definitions:

4B5B ENCODING: An encoding method whereby four information data bits are encoded into five-bit symbols.

CON: The Control (CON) field follows the TSD in the Token Frame and Message Frame. It contains ring access control information, including token status, priority, priority reservation, and short message count.

DELIMITER: A symbol or sequence of symbols used to mark the boundary of a field. The HSRB standard specifies six types of delimiters: Token Starting, Token Ending, Message Frame Starting, Message Frame Ending, Beacon Frame Starting, and Beacon Frame Ending.

DETERMINISTIC: Property of an item to which the future behaviour can be predicted precisely.

FAULT TOLERANCE: Capability of the system to endure component errors and/or failures without causing total system failure. Actions range from ignoring it, to retrying action, to complex actions of fault isolation, and then taking positive action to continue operation without the failed component (i.e., invoking backup, reconfiguring, invoking degraded operation, etc.).

2.2.1 (Continued):

PR: The Priority (PR) subfield is part of the CON field. It indicates the priority level of a Token.

PROTOCOL: A set of related rules describing specific processes or activities.

RECONFIGURATION: Process by which the operation of the HSRB is initialized using Beacon frames following the application of power, the presence of failures, or the detection of certain errors.

RES: The Reservation (RES) subfield is part of the CON field. It indicates the highest reservation made by a station with a pending Message Frame.

SEMANTICS: The relationships between symbols and their meanings.

SMC: The Short Message Count (SMC) subfield is part of the CON field. It indicates the number of consecutive short messages, excluding the Message frame, that have been transmitted following the Claimed Token subfamily.

TED: The Token Ending Delimiter (TED) field indicates the ending boundary of the Token. It consists of a T symbol.

TOPOLOGY: The arrangement of elements comprising a system.

TS1 and TS2: The Token Status subfield(s) is part of the CON field and indicates the status of the Token (i.e., Claimed or Free). There are two TS subfields TS1 and TS2 with identical information. The redundancy in TS fields is intended for error detection.

TSD: Token Starting Delimiter (TSD) field indicates the beginning of a Token frame. It consists of a unique bit combination; a J symbol followed by a K symbol.

2.3 Acronyms:

AS: Avionic Systems (Division of SAE)

AS-2: Interconnect Networks Committee of AS Division

AC: Address Control Field

ACK: Acknowledgement (s.b. Acknowledgement)

ACK1: Message Acknowledged 1 Subfield

ACK2: Message Acknowledged 2 Subfield

ADJ: Adjustment Subfield

AW_o: Address Word Count Bit 0 (least significant)

AW_1: Address Word Count Bit 1 (most significant)

2.3 (Continued):

AWC: Address Word Count Subfield

AWC0: Address Word Count 0

AWC1: Address Word Count 1

BA: Bridge Access

BCON: Beacon Control

BFCS: Beacon Frame Check Sequence Field

$BFCS_0$: Beacon Frame Check Sequence Bit 0 (least significant)

$BFCS_{15}$: Beacon Frame Check Sequence Bit 15 (most significant)

BFED: Beacon Frame Ending Delimiter Field

BFSD: Beacon Frame Starting Delimiter Field

BLT: Beacon Loop Timer

BPI: Beacon Path Indicator Subfield

BT: Beacon Type Subfield

CON: Control Field

DA: Destination Address Field

DAL: Destination Address Logical Subfield

DAP: Destination Address Physical Subfield

DL: Destination Address Logical

DP_8: Sub Address Bit 8 (least significant)

DP_9: Physical Address Bit 0 (least significant)

DP_{15}: Physical Address Bit 15 (most significant)

4B5B: An encoding technique

FDDI: Fiber Distributed Data Interface

FS: Frame Status Field

FCS: Frame Check Sequence

GA: Global Address Field

GAL: Global Address logical Subfield

2.3 (Continued):

GAP: Global Address Physical Subfield

GL: Global Logical

GL_3: Global Address Logical Bit 3

GL_2: Global Address Logical Bit 2

GL_1: Global Address Logical Bit 1

GL_0: Global Address Logical Bit 0

GP : Global Address Physical

GP_0: Global Address Physical Bit 0 (least significant)

GP_1: Global Address Physical Bit 1 (most significant)

HART: High Speed Data Bus Applications and Requirements Task Group

HKA: Highest Known Address Field

HKA_0: Highest Known Address Bit 0 (least significant)

HKA_6: Highest Known Address Bit 6 (most significant)

HSRB: High Speed Ring Bus

IB: Information Bit

IB_0: Information Bit 0 (least significant)

IB_{15}: Information Bit 15 (most significant)

IED: Information Error Detected

IED1: Information Error Detected 1 Subfield

IED2: Information Error Detected 2 Subfield

IFA: Interframe Adjustment Field

IFCS: Information Frame Check Sequence Field

$IFCS_0$: Information Frame Check Sequence Bit 0 (least significant)

$IFCS_{15}$: Information Frame Check Sequence Bit 15 (most significant)

INFO: Information field

IW: Information Word

km: Kilometer (also Km)

2.3 (Continued):

LP: Logical Physical Subfield

LTC: Loop Timer Counter

MBd: Mega Baud

MCED: Message Control Error Detected

MCED1: Message Control Error Detected 1 Subfield

MCED2: Message Control Error Detected 2 Subfield

MCFCS: Message Control Frame Check Sequence Field

$MCFCS_0$: Message Control Frame Check Sequence Bit 0 (least significant)

$MCFCS_{15}$: Message Control Frame Check Sequence Bit 15 (most significant)

MFED: Message Frame Ending Delimiter Field

MFSD: Message Frame Starting Delimiter

MHz: Megahertz (10^6 hertz)

ms: Millisecond (10^{-3} second)

NRZ: Non Return to Zero

NRZI: Non Return to Zero Invert

P_0: Priority Bit 0 (least significant)

P_1: Priority Bit 1

P_2: Priority Bit 2 (most significant)

PDUS: Protocol Data Units (also PDUs)

PM_0: Priority Bit 0 (least significant)

PM_1: Priority Bit 1

PM_2: Priority Bit 2 (most significant)

PR: Priority Subfield

PRM: Message Priority Subfield

PRS: Priority and Retry Status

R_0: Reservation Bit 0 (least significant)

R_1: Reservation Bit 1

2.3 (Continued):

R_2: Reservation Bit 2 (most significant)

RCVD: Received

RCVD1: Message Received 1 Subfield

RCVD2: Message Received 2 Subfield

RCVST: Receiver Status (Table 3.5.15-3)

RES: Reservation (contents 3.4.4.2.5)

RIM: Ring Interface Module

RIU: Ring Interface Unit (3.5.15.1)

RIUC: Ring Interface Unit Controller

RSI: Retry Status Indicator Subfield

S_0: SMC Bit 0 (least significant)

S_1: SMC Bit 1

S_2: SMC Bit 2

S_3: SMC Bit 3 (most significant)

S1: Unconnected

S2: Reconfiguration

S3: Inactive Ring

S4: Repeater Ring

S5: Active Ring

S1.1: Unpowered

S1.2: Powered

S13: Quiescent

S1.4: Wait

S1.5: Synchronization

S1.6: listen

S2.1: Reconfiguration Initialization

2.3 (Continued):

S2.2: Vie

S2.3: Master Configuration

S2.4: Slave Configuration

S3.1: Inactive

S4.1: Repeater

S5.1: Await Token Starting Delimiter

S5.2: Check Token Priority

S5.3: Reserve Token

S5.4: Repeat Message

S5.5: Token Claim

S5.6: Originate Message

S5.7: Issue Token

S5.8: Strip Message

S5.9: Check Beacon

S5.10: Warm Start

SA_6: Sending Address Bit 6 (most significant)

SA_0: Sending Address Bit 0 (least significant)

SA: Sending Address Field

SAE: Society of Automotive Engineers

SC: Station Count Field

SC_0: Station Count Bit 0 (least significant)

SC_6: Station Count Bit 6 (most significant)

SMC: Short Message Count

T_1: Token Status 1 Bit (3.4.4.2.2)

T_2: Token Status 2 Bit (3.4.4.2.4)

TED: Token Ending Delimiter

2.3 (Continued):

TSD: Token Starting Delimiter field

TS1: Token Status 1 Subfield

TS2: Token Status 2 Subfield

TSDC: Token Starting Delimiter Counter

UTIT: Uncontrolled Transmit Inhibit Timer

WC_{11}: Word Count Bit 11 (most significant)

WC_0: Word Count Bit 0 (least significant)

WC: Word Count field

3. GENERAL REQUIREMENTS:

3.1 General Description:

The HSRB system is a physical token passing ring network that connects a set of stations in a closed loop topology with a serial transmission medium. To insure that the applicability of the standard is not restricted to current implementation technologies, the semantics and protocol described are independent of the data transmission rate. Parameters relating to the particular media and bit rates are defined in slash sheets Initial slash sheets specify 50 MBd and 100 MBd implementations. A single ring HSRB is shown in Figure 3.3-1. This configuration provides no redundancy and should not be used in applications that require a high degree of reliability or fault tolerance. Figure 3.1-2 shows a dual redundant ring HSRB, in which each station is connected by two rings that support message transmission in opposite directions. A HSRB can be configured with more than two rings if a further increase in reliability and fault tolerance is required. The dual ring configuration is the main subject of this document.

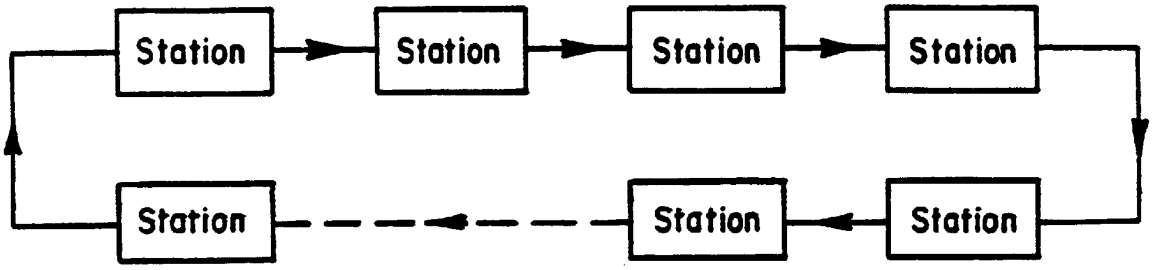


FIGURE 3.1-1 - Single Ring

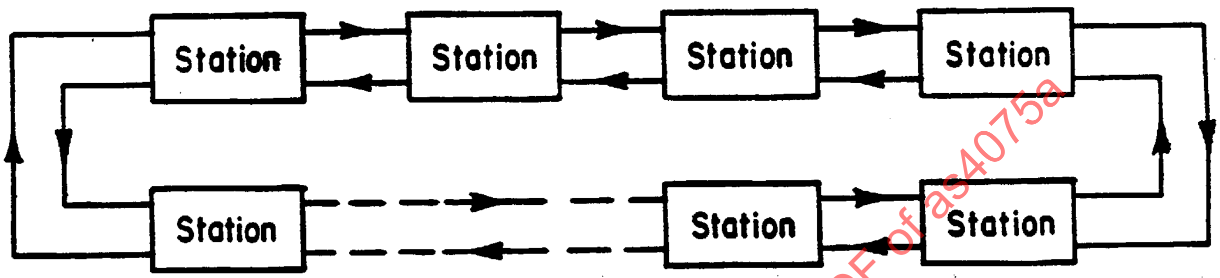


FIGURE 3.1-2 - Dual Ring

3.1.1 Ring Station: A station consists of a Host and one or more Ring Interface Units (RIU). The RIU interfaces with one or two rings through the Ring Interface Module (RIM) as shown in Figure 3.1.1-1. The RIU performs the following functions:

a. Interfaces with the Host
b. Receives serial transmission from each RIM
c. Decodes symbols from a received Message frames
d. Performs error checking on tokens, headers and data messages
e. Repeats received messages to the next station on the ring
f. Captures a Token when a transmission from the Host is queued
g. Removes messages from the ring which it originated
h. Transmits a Token at the completion of its transmissions

The station may contain more than one RIU to permit attachment of the Host to more than one HSRB, as shown in Figure 3.1.1-2.

3.1.2 Ring Interface Module: The function of the RIM is either to connect the RIU to the HSRB or to permit the HSRB to bypass the RIU. If the RIU is operational, the RIM shall connect the previous ring station to the RIU and the RIU to the next ring station. When a station is removed, or is nonoperational, a bypass mechanism is used to maintain the integrity of the ring by connecting the RIM output directly to its input. The two RIMs of a dual ring HSRB can be physically separated to reduce the risk of damage by a common cause.

3.1.3 Ring Control: The HSRB utilizes a Token passing protocol providing distributed control.

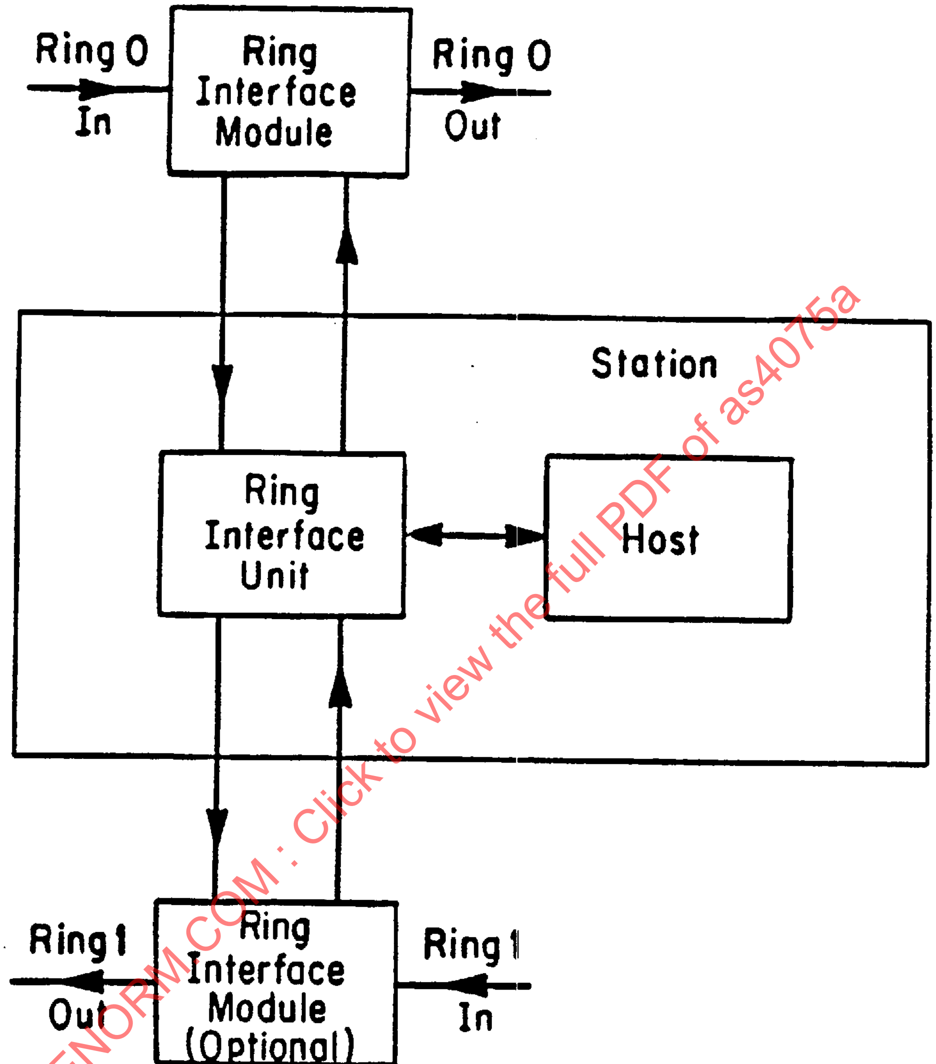


FIGURE 3.1.1-1 - Station Interface

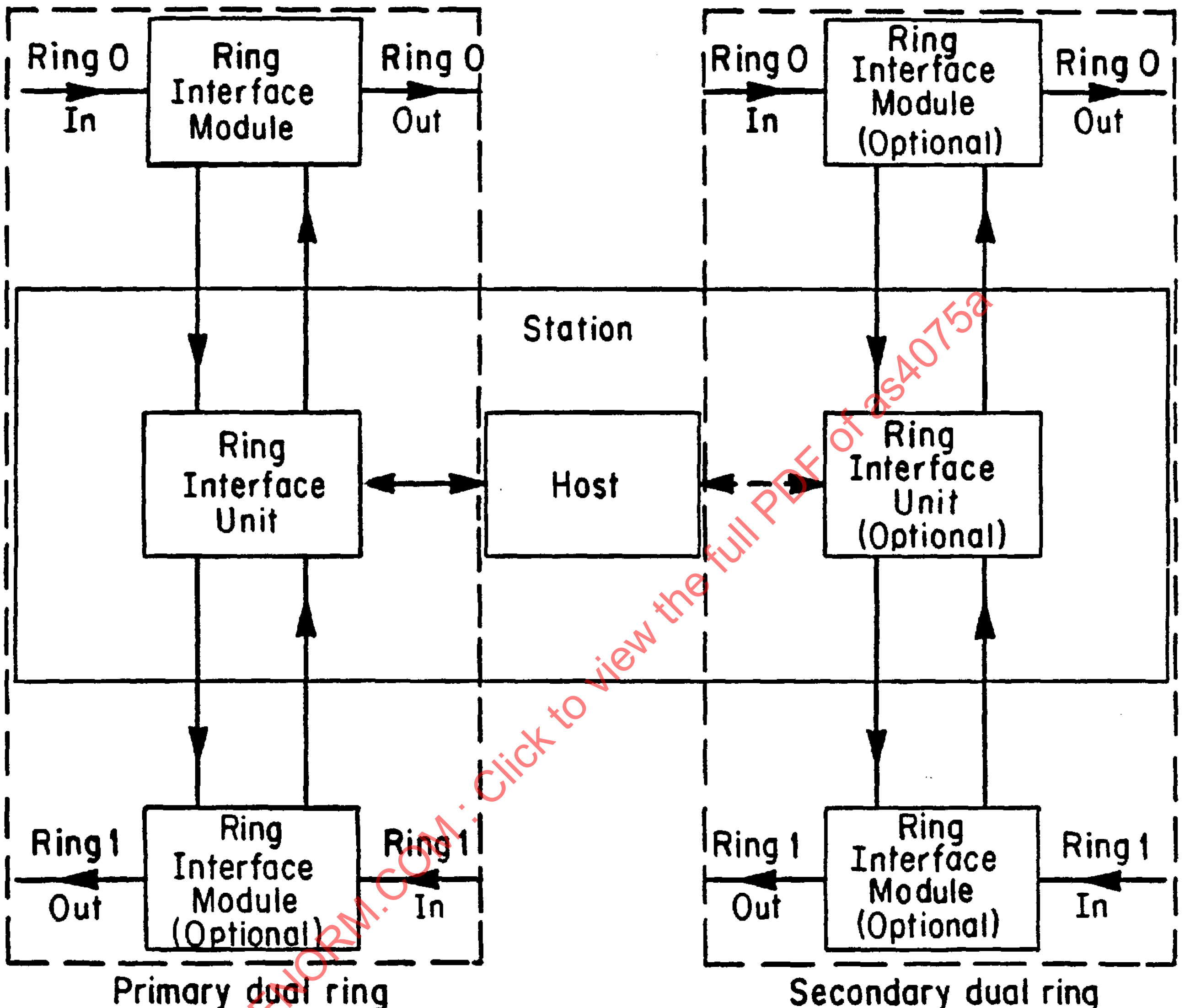


FIGURE 3.1.1-2 - Additional Redundancy

3.1.4 Ring Access: Ring access is achieved by means of a Token that passes from one station to the next to provide equitable access for any given priority of message. Data is transmitted in messages from one station to the next in a unidirectional manner, starting with the sending station, passing through the RIUs of the intermediate stations to the receiving-addressed station that copies the message for its Host. The message continues through the remaining stations until it reaches the sending station which removes it from the ring. The sending station must then transmit a Token following the end of the message. A station is permitted to transmit only one message before issuing a Token. Only a station that has claimed a valid Token is authorized to transmit a message for its Host. All other stations are constrained to repeat each message as received on the ring, with the exception of setting error-reporting and priority-reservation bits.

3.1.5 Data Coding: The HSRB utilizes a 16-bit word length with a variable message length of between 1 and 4096 words. Each word consists of four groups; each group consists of four data bits encoded into 5-bit symbols through 4B5B block encoding. The symbols are transmitted with a Non Return to Zero Invert (NRZI) format. A serial Non Return to Zero (NRZ) data stream is converted to the NRZI coding by using the following rules:

a. The bit duration time for NRZI is the same as in NU.
b. A NRZ logical '1' causes a transition in the NRZI signaling level.
c. A NRZ logical '0' does not cause a transition in the NRZI signaling level.

The 5 bit symbols and NRZI coding provide a self-clocking serial code with no more than four signal-bit times between signal transitions on the media, except for a Beacon frame which may have five. This encoding allows the extraction of a clock signal from the data stream.

3.1.6 Station Addressing: The HSRB has provision for physically addressing 128 stations on each of four single or redundant rings which are connected by bridges, that is up to 512 stations in all. The semantics support 512 subaddresses per station. The HSRB also supports logical addressing with up to 2^{64} addresses available. Logical addressing allows broadcasting (sending to all stations) and multicasting (sending to a logical group of stations) of messages to stations on the four connected rings.

3.1.7 Message Acknowledgement: Immediate acknowledgement of a message by the receiving RIU is implicit in the HSRB protocol. The protocol does not carry an overhead if immediate acknowledge is not required or possible, such as the case is in broadcast or multicast transmissions with a logical address.

3.1.8 Message Priority Levels: The HSRB supports eight priority levels for messages. Reservations are made in the Claimed Token so that the highest priority messages are serviced first. As an option, the system designer may allow multiple short messages to appear on the ring simultaneously. A short message, one in which a Token is issued by the sending station before the last Claimed Token is received, may result in the highest priority message not being serviced next. The HSRB protocol insures a minimum of

3.1.8 (Continued)

delay in servicing the highest priority message by providing that no more than 16 consecutive short messages can be issued before priority levels are re-established.

3.1.9 Types of Service: For physical addressing, an acknowledged datagram service with priorities is provided with Host selectable single retry in the event of a detected data error or nonreceipt of the message. For logical addressing, an unacknowledged datagram service is provided with Host selectable single retry in the event of a detected error. All other classes of service can be provided by the Host.

3.1.10 Adaptability: The HSRB protocol has no requirement for physical preordering of the stations on the rings. Insertion of additional stations or removal of current stations is easily accomplished. Growth to higher data rates and longer station separation is well supported by the HSRB since the ring efficiency is almost independent of these parameters. Increases in the media signaling rates are accompanied by an almost pro rata increase in throughput.

3.1.11 Media Requirements: The media requirements for the rings of the HSRB consist of a set of unidirectional point-to-point links. This document does not specify the media, the data signaling rate, or the station separation. The semantics and protocol of the HSRB are designed to be independent of the data signaling rate, which is limited only by the technologies employed.

3.1.12 Error and Fault Detection and Recovery: The HSRB provides error detection and recovery mechanisms to maintain or restore ring operation in the event of errors. Fault detection and recovery schemes allow station and media faults to be tolerated while maintaining ring operation. Redundant rings are provided on the dual HSRB so that a backup ring is available to overcome single media faults. Faults on both segments of media between adjacent stations can be tolerated without loss of station or system availability. A smaller ring, containing a subset of the stations, can be configured in the event of other multiple media faults.

3.1.13 Loop Back: The RIU has the ability to perform a loop back function. In the example shown in Figure 3.1.13-1, this function breaks the physical rings by receiving from ’Ring 0 In’ and retransmitting on ’Ring 1 Out’ instead of ’Ring 0 Out’. The capability is provided for isolating faults on Ring 0 and Ring 1 by having two stations perform the loop back function and forming a new ring that excludes the fault, as shown in Figure 3.1.13-2.

3.1.14 Reconfiguration: Reconfiguration is the process by which the operation of the HSRB is initialized using Beacon frames following the application of power, the presence of failures or the detection of certain errors. The Beacon frame is a control entity with a uniquely defined starting delimiter. The reconfiguration process accomplishes the following:

a. Determines the ring configuration that shall include the maximum number of participating stations consistent, where possible, with the maintenance of static redundancy

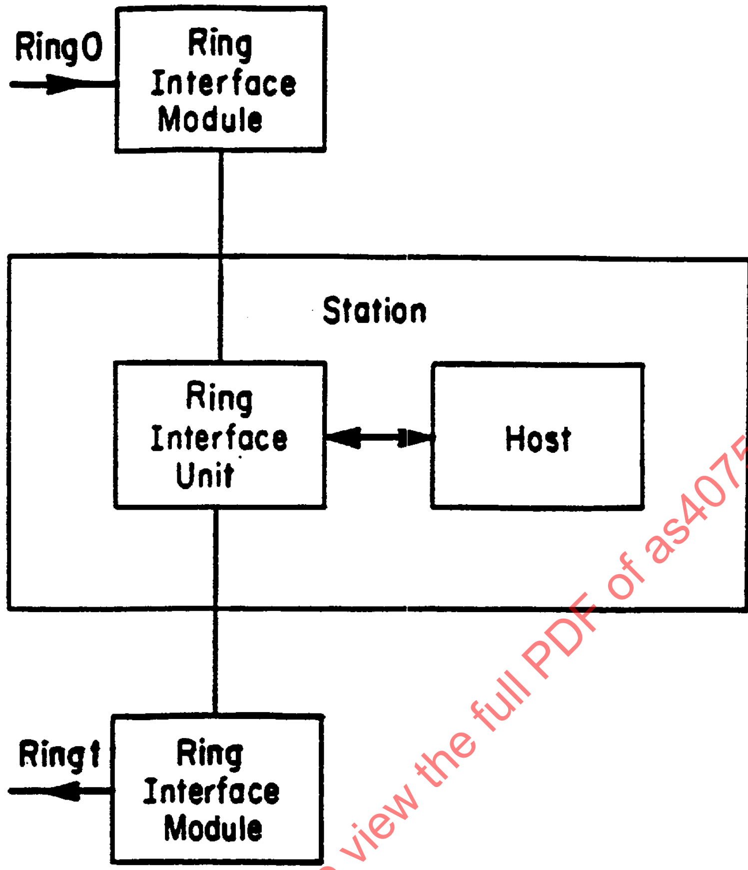


FIGURE 3.1.13-1 - Station With Loop Back

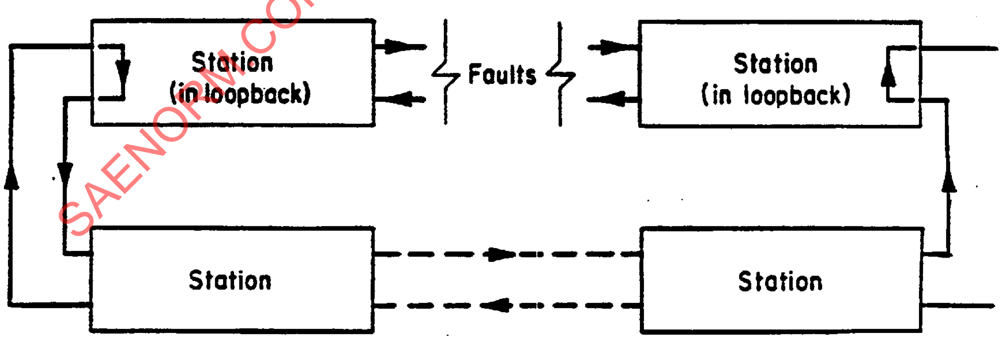


FIGURE 3.1.13-2 - Loop Back Excluding A Fault

3.1.14 (Continued)

b. Establishes the master station

The master station inserts a Token buffer to provide Token storage in systems consisting of a small number of stations. The master station transmits the initial Token after the ring is configured. All stations must be capable of performing the master function.

3.1.15 Synchronization: Each link on the ring is clocked using an independent clock in each transmitter. The receiver clock in each station is locked to transitions in its incoming waveform. An elastic buffer is placed between the receiver and the transmitter in each station to accommodate differences in receiver and transmitter clock frequencies.

3.1.16 Dual Ring HSRB: A dual ring HSRB, in a failure-free mode, consists of two complete rings. During reconfiguration the Master station selects one of the rings to be the Active ring. This is the ring over which all messages are transmitted. The other ring is the Inactive ring. A station initiating or repeating a message transmits the message on both the Active and Inactive ring. All messages on the Inactive ring other than Beacon frames are ignored.

A dual ring HSRB in a loop back mode shall form a ring consisting of two segments. The Active ring segment shall operate in the same manner as an Active ring in a failure-free HSRB. The Repeater ring segment is the counter rotating position. The RIMs which form the Repeater segment shall repeat any messages received, but shall not copy them.

3.2 Operational Requirements:

3.2.1 Serial Transmission: The HSRB is a serial data transfer system. All information (data, clock, addresses, etc.) shall be placed on a single transmission medium.

3.2.2 Word Length: The HSRB shall incorporate a word length of 16 information data bits.

3.2.3 Message Length: The HSRB shall allow for a message length from 1 to 4096 data words.

3.2.4 Electrical Isolation: Except for electrical wire shields, there shall not be a direct connection (that is one capable of carrying direct current) in the signal path between any physical stations on the HSRB.

3.2.5 Self-Test: A station shall guarantee its health, on a noninterrupting basis, before joining a ring. Having joined a ring, the station shall perform according to the protocols defined in 3.5.

3.3 Performance Requirements:

3.3.1 Station Delay: The delay of a slave station, not including transmitter and receiver delay, shall not exceed 6 bit times at the signalling bit rate as measured between a ring input and a corresponding ring output when its elastic buffer is in the initialized state. A station acting as the master station shall insert an additional delay of 40 bit times at the signaling bit rate.

3.4 Semantics:

3.4.1 Entities: The set of entities within the semantics shall consist of data bits, symbols, code bits, and signaling bits. The relationship between them is as shown in Figure 3.4.1-1.

Signaling bits shall be defined as NRZI bits. Signaling. bits shall be generated from 5-bit symbols or from code bits. Fields consisting of code bits shall include bits preassigned to logic 1 to ensure that the number of bit times between transitions is a maximum of three.

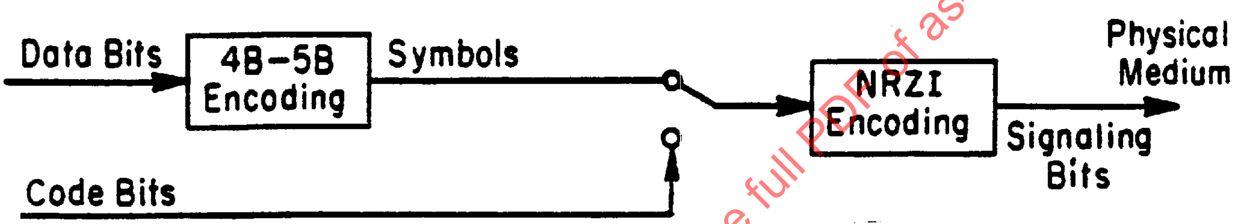


FIGURE 3.4.1-1 - Signaling And Code Bits

3.4.2 Symbols: A symbol shall be defined as an encoded group of four data bits and shall be the basic unit for data transfer. The symbol set shall be as defined in Table 3.4.2-1.

TABLE 6.4.2-1 - Symbol Coding

Symbol	Code Group	Assignment
0	11110	Data Symbol '0000' Binary
1	01001	Data Symbol '0001' Binary
2	10100	Data Symbol '0010' Binary
3	10101	Data Symbol '0011' Binary
4	01010	Data Symbol '0100' Binary
5	01011	Data Symbol '0101' Binary
6	01110	Data Symbol '0110' Binary
7	01111	Data Symbol '0111' Binary
8	10010	Data Symbol '1000' Binary
9	10011	Data Symbol '0001' Binary
A	10110	Data Symbol '1010' BinaryAlso used with a preceding 'J' symbol as the Message Frame Starting Delimiter.
B	10111	Data Symbol '1011' Binary

TABLE 3.4.2-1 (Continued)

Symbol	Code Group	Assignment
C	11010	Data Symbol '1100' Binary
D	11011	Data Symbol '1101' Binary
E	11100	Data Symbol '1110' Binary
F	11101	Data Symbol '1111' Binary
I	11111	IDLE: No information currently being transmitted
J	11000	Used for Token, Message Frame and Beacon Frame Starting Delimiters
K	10001	Used for Token and Beacon Frame Starting Delimiters
Q	00000	QUIET: No signal being transmitted
T	01101	TERMINATE: Ending Delimiter for Token, Message Frame and Beacon Frame
S	11001	Never transmitted as a symbol but may occur in a Token or Frame Status
V	00001	
V	00010	INVALID These symbols shall not be used as they
V	00100	violate consecutive code-bit zeros, duty cycle or
V	01000	prevent unique starting delimiter patterns
V	10000	
V	00011	
V	00101	
V	00110	
V	00111	
V	01100	

3.4.3 Protocol Data Units: Three Protocol Data Units (PDUs) shall be used: Token frames, Message frames and Beacon frames (Figure 3.4.3-1). The order of transmission on the medium shall be as shown in the corresponding diagram with the left-most field first.

3.4.3.1 Token Frame: The Token frame shall be the means by which the right to transmit (as opposed to the process of repeating) is transferred from one station to another. A Free Token frame (also referred to as a free Token) may be converted to a Claimed Token subframe (also referred to as a Claimed Token) by a station having a message to transmit, according to the protocol defined in 3.5. Conversion of a Free Token frame to a Claimed Token subframe is achieved by modification of the Control Field and deletion of the Token Ending Delimiter. The Claimed Token subframe becomes part of the Message frame. The Free Token frame shall consist of the Token Starting Delimiter field, the Control field, and the Token Ending Delimiter field.

TSD	CON	TED

TSD Token Starting Delimiter: 2 symbols
CON Control: 20 code bits
TED Token Ending Delimiter: 1 symbol
Note: TED is removed by the transmitting station in a Claimed Token

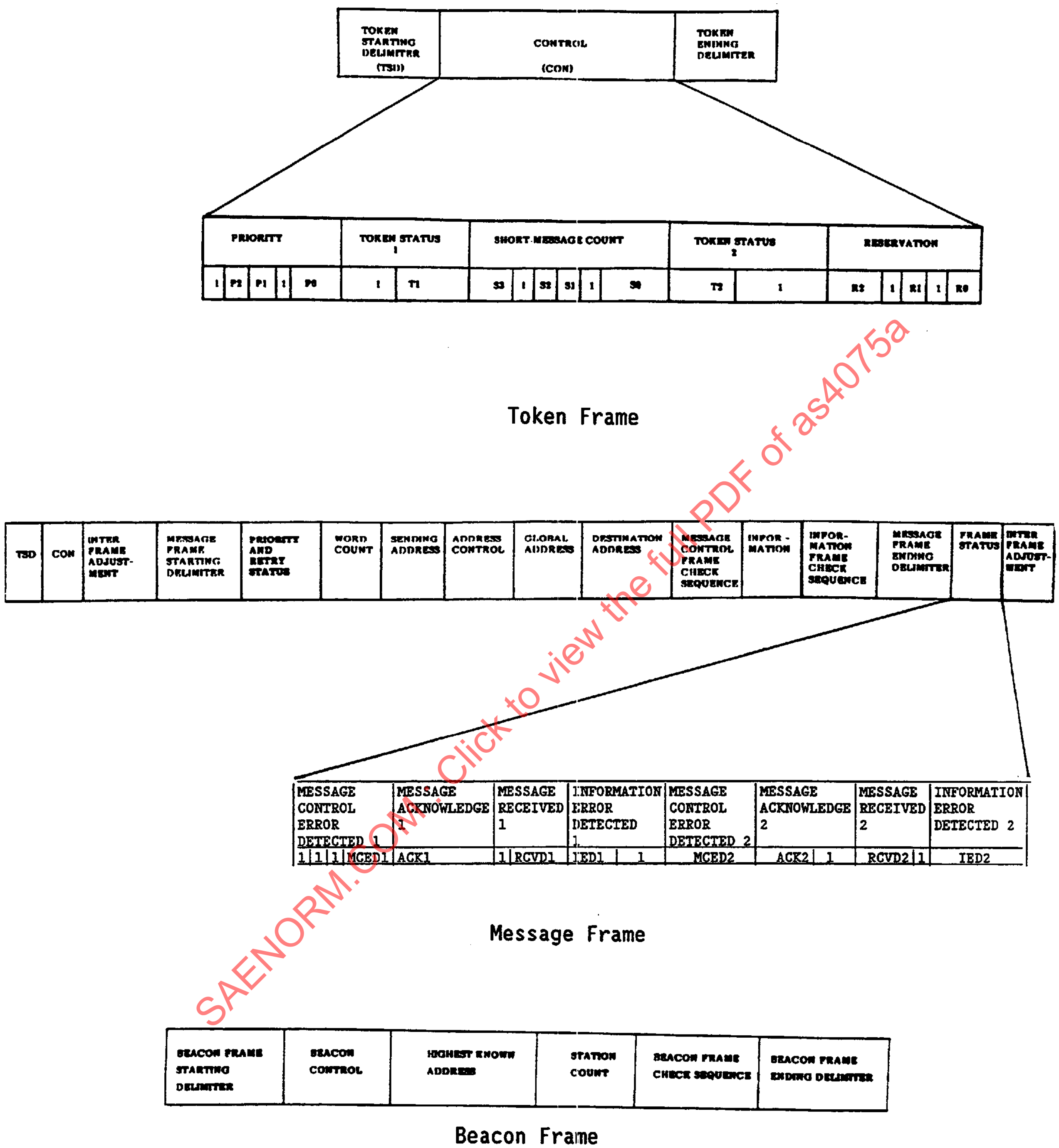


FIGURE 3.4.3-1 - Protocol Data Units

3.4.3.2 Message Frame: The Message frame shall be used to transmit data. The Message frame shall consist of the Token frame claimed by the station with its TED field removed followed by the Interframe Adjustment field, the Message Frame Starting Delimiter field, the Priority and Retry Status field, the Word Count field, the Sending Address field, the Address Control field, the Global Address field, the Destination Address field, the Message Control Frame Check Sequence field, the Information field, the Information Frame Check Sequence field, the Message Frame Ending Delimiter field, the Frame Status field, and the Adjustment field.

Claimed
|-------- Token----------| |-------------------------MCFCS Coverage-------------------------------|
sub-frame

TSD	CON	IFA	MFSD	PRS	WC	SA	AC	GA	DA	MCFCS

|---- IFCS Coverage --|

INFO	IFCS	MFED	FS	IFA

TSD	Token Starting Delimiter: 2 symbols	Claimed Token subframe
CON	Control: 20 code bits	
IFA	Interframe Adjustment	
MFSD	Message Frame Starting Delimiter: 2 symbols	
PRS	Priority and Retry Status: 1 symbol	
WC	Word Count: 3 symbols	
SA	Sending Address: 2 symbols	
AC	Address Control: 1 symbol	
GA	Global Address: 1 symbol	
DA	Destination Address: 4, 8, 12, or 16 symbols	
MCFCS	Message Control FCS: 4 symbols	
INFO	Information: 4-16384 symbols (exclusive of Adjustment sub-fields) in multiples of 4 symbols	
IFCS	Information FCS: 4 symbols	
MFED	Message Frame Ending Delimiter: 1 symbol	
FS	Frame Status: 15 code bits	
IFA	Interframe Adjustment	

3.4.3.3 Beacon Frame: The Beacon frame shall be used to transmit control information during system start up and reconfiguration. The Beacon frame shall consist of the Beacon Frame Starting Delimiter field, the Beacon Control field, the Highest Known Address field, the Station Count field, the Beacon Frame Check Sequence field, and the Beacon Frame Ending Delimiter field.

|--BFCS Coverage-------------------------------|

BFSD	BCON	HKA	SC	BFSC	BFED

BFSD Beacon Frame Starting Delimiter: 2 symbols
BCON Beacon Control: 1 symbol
HKA Highest Known Address: 2 symbols
SC Station Count: 2 symbols
BFCS Beacon Frame Check Sequence: 4 symbols
BFED Beacon Frame Ending Delimiter: 1 symbol

3.4.4 Fields: The fields contained within the PDUs shall be in accordance with the corresponding definitions in 3.4.4.1 to 3.4.4.22. The order of transmission on the medium shall be as shown in the corresponding diagram with the left-most symbol and the left-most code bit first.

3.4.4.1 Token Starting Delimiter (TSD) Field: The TSD field shall indicate the starting boundary of a Token. The TSD shall consist of a J symbol followed by a K symbol.

J	K

J: J symbol
K: K symbol

This sequence shall be recognized as the TSD regardless of any sequence of bits preceding it.

3.4.4.2 Control (CON) Field: The CON field shall consist of the Priority (PR) subfield, the Token Status 1 (TS1) subfield, the Short Message Count (SMC) subfield, the Token Status 2 (TS2) subfield, and the Reservation (RES) subfield.

PR	TS1	SMC	TS2	RES

PR Priority: 5 code bits
TS1 Token Status 1: 2 code bits
SMC Short Message Count: 6 code bits
TS2 Token Status 2: 2 code bits
RES Reservation: 5 code bits

3.4.4.2.1 PR Subfield: The PR subfield shall indicate the priority level of a Token. The PR subfield shall consist of code bits as follows:

1	P_2	P_1	1	P_0

P_2 Priority bit 2 (most significant)
P_1 Priority bit 1
P_0 Priority bit 0 (least significant)

The PR value 0 shall indicate the highest priority and the PR value 7 shall indicate the lowest priority.

3.4.4.2.2 TS1 Subfield: The TS1 subfield shall indicate the status of the Token. The TS1 subfield shall consist of code bits as follows:

1	T_1

T_1 = 0 shall indicate Claimed Token
T_1 = 1 shall indicate free Token

3.4.4.2.3 SMC Subfield: The SMC subfield shall indicate the number of consecutive short messages, excluding the Message frame following the Claimed Token subframe, that have been transmitted without an intervening Free Token frame. The SMC subfield shall consist of code bits as follows:

S_3	1	S_2	S_1	1	S_0

S_3 SMC bit 3 (most significant)
S_2 SMC bit 2
S_1 SMC bit 1
S_0 SMC bit 0 (least significant)

The SMC value 0 shall indicate the lowest count and the SMC value 15 shall indicate the highest count.

3.4.4.2.4 TS2 Subfield: The TS2 subfield shall indicate the Status of the Token. The TS2 subfield shall consist of code bits as follows:

T_2	1

T_2 = 0 shall indicate Claimed Token
T_2 = 1 shall indicate Free Token

3.4.4.2.5 RES Subfield: The RES subfield shall indicate the highest reservation made by a station with a pending Message Frame. The RES subfield shall consist of code bits as follows:

R_2	1	R_1	1	R_0

R2 Reservation bit 2 (most significant)
R1 Reservation bit 1
R0 Reservation bit 0 (least significant)

The RES value 0 shall indicate the highest priority and the RES value 7 shall indicate the lowest priority.

3.4.4.3 Token Ending Delimiter (TED) Field: The TED field shall indicate the ending boundary of a Token frame. The TED shall consist of a T symbol.

T

T: Terminate Symbol

3.4.4.4 Interframe Adjustment Field (IFA): The IFA field as transmitted shall consist of six IDLE symbols. The IFA field may be adjusted in length by any station to allow elastic buffer initialization.

I	I	I	I	I	I

I: I symbol

3.4.4.5 Message Frame Starting Delimiter (MFSD) Field: The MFSD field shall indicate the starting boundary of a Message frame. The MFSD shall consist of the J symbol followed by the A symbol.

J	A

J: J symbol
A: A symbol

3.4.4.6 Priority and Retry Status (PRS) Field: The PRS field shall consist of the Message Priority (PRM) subfield and the Retry Status Indicator (RSI) subfield.

PRM	RSI

PRM Message Priority: 3 data bits
RSI Retry Status Indicator: 1 data bit

3.4.4.6.1 PRM Subfield: The PRM subfield shall indicate the priority level of the message. The PRM subfield shall consist of data bits as follows:

PM_2	PM_1	PM_0

PM_2 Priority bit 2 (most significant)
PM_1 Priority bit 1
PM_0 Priority bit 0 (least significant)

The PRM value 0 shall indicate the highest priority, and the PRM value 7 shall indicate the lowest priority.

3.4.4.6.2 RSI Subfield: The RSI subfield shall indicate the Message frame retry status. The RSI subfield shall consist of data bits as follows:

RSI

RSI = 0 shall indicate that the Message Frame is not a retry
RSI = 1 shall indicate that the Message Frame is a retry

3.4.4.7 Word Count (WC) Field: The WC field shall indicate the number of words in the Information Field (INFO) of a Message frame (exclusive of Adjustment subfields). The number of words indicated by the WC field shall be not less than 1 and no more than 4096. The WC field shall consist of data bits as follows:

WC_{11}	--	WC_0

WC_{11} Word Count bit 11 (most significant)
WC_0 Word Count bit 0 (least significant)

WC = 1 shall indicate 1 word
WC = 4095 shall indicate 4095 words
WC = 0 shall indicate 4096 words

3.4.4.8 Sending Address (SA) Field: The SA field shall identify the station originating the Message frame. The SA field shall consist of data bits as follows:

0	SA_6	--	SA_0

SA_6 Sending Address bit 6 (most significant)
SA_0 Sending Address bit 0 (least significant)

3.4.4.9 Address Control (AC) Field: The AC field shall consist of the Logical-Physical (LP) subfield and the Address Word Count (AWC) subfield.

LP	AWC

3.4.4.9.1 LP Subfield: The LP subfield shall indicate the mode of addressing. The LP subfield shall consist of data bits as follows:

0	LP

LP = 0 shall indicate Physical Address Mode
LP = 1 shall indicate Logical Address Mode

3.4.4.9.2 AWC Subfield: The AWC subfield shall indicate the number of logical address words transmitted. The AWC subfield shall consist of data bits as follows:

AW_1	AW_0

3.4.4.9.2 (Continued):

AW_1 Address Word Count bit 1 (most significant bit)
AW_0 Address Word Count bit 0 (least significant bit)

AWC = 0 shall indicate 2^{16} logical address space
AWC = 1 shall indicate 2^{32} logical address space
AWC = 2 shall indicate 2^{48} logical address space
AWC = 3 shall indicate 2^{64} logical address space

In Physical Address Mode, the value AWC = 0 shall be transmitted.

3.4.4.10 Global Address (GA) Field: The GA field shall indicate the ring or rings for which the Message frame is intended. In the Physical Address Mode the GA field shall consist of the Global Address Physical (GAP) subfield and in the Logical Address Mode the GA field shall consist of the Global Address Logical (GAL) subfield.

3.4.4.10.1 GAP Subfield: The GAP subfield shall identify the ring number for which the Message frame is intended. The GAP subfield shall consist of data bits as follows:

BA	0	GP_1	GP_0

BA Bridge Access bit
GP_1 Global Address Physical Bit 1 (most significant)
GP_0 Global Address Physical Bit 0 (least significant)

BA = 0, GP = 0 shall indicate transmission on ring of originating station
BA = 1, GP = n shall indicate transmission on destination ring n
BA = 0, GP $\neq$ 0 is invalid and shall not be transmitted

3.4.4.10.2 GAL Subfield: The GAL subfield shall identify the ring or rings for which the Message frame is intended. The GAL subfield shall consist of data bits as follows:

GL_3	GL_2	GL_1	GL_0

3.4.4.10.2 (Continued)

GL_3 Global Address Logical Bit 3
GL_2 Global Address Logical Bit 2
GL_1 Global Address Logical Bit 1
GL_0 Global Address Logical Bit 0

GL_n = 1 shall indicate that the Message frame is intended for ring n
GL_n = 0 shall indicate that the Message frame is not intended for ring n

3.4.4.11 Destination Address (DA) Field: The DA field shall identify the ring station or stations for which the Message frame is intended. In the Physical Address Mode, the DA field shall consist of the Destination Address Physical (DAP) subfield and in the Logical Address Mode the DA field shall consist of the Destination Address Logical (DAL) subfield.

3.4.4.11.1 DAP Subfield: The DAP subfield shall identify the ring station for which the Message frame is intended. The DAP subfield shall consist of data bits as follows:

DP_{15}	--	DP_9	DP_8	--	DP_0

DP_{15} Physical Address Bit 6 (most significant)
DP_9 Physical Address Bit 0 (least significant)

DP_8 Sub-Address Bit 8 (most significant)
DP_0 Sub-Address Bit 0 (least significant)

3.4.4.11.2 DAL Subfield: The DAL subfield shall indicate the ring station or stations for which the Message frame is intended. The DAL subfield shall consist of data bits as follows:

$DL_{AWC_{15}}$	--	DL_{AWC_0}	$DL_{(AWC-1)_{15}}$	--	$DL_{(AWC-1)_0}$

$DL_{0_{15}}$	--	DL_{0_0}

3.4.4.11.2 (Continued)

$DL_{AWC_{15}}$	Destination Address logical (most significant word, most significant bit)
DL_{AWC_0}	Destination Address Logical (most significant word, least significant bit)
$DL_{(AWC-1)_{15}}$	Destination Address Logical (second most significant word, most significant bit)
$DL_{(AWC-1)_0}$	Destination Address Logical (second most significant word, least significant bit)
$DL_{0_{15}}$	Destination Address Logical (least significant word, most significant bit)
DL_{0_0}	Destination Address Logical (least significant word, least significant bit)

A station that is capable of receiving a logical address of no more than M words shall recognize addresses of M words or less but shall not recognize a logical address of more than M words. If a logical address of less than M words is received, the words received shall be treated as the least significant bits of the address.

The logical address zero is reserved and shall be used for broadcast.

3.4.4.12 Message Control Frame Check Sequence (MCFCS) Field: The MCFCS field shall cover the PRS field, the WC field, the SA field, the AC field, the GA field, the DA field and the MCFCS field in accordance with the following generator polynomial:

$$G(X) = X^{16} + X^{12} + X^5 + 1$$

The initial remainder shall be preset to FFFFH. The 1's complement of the remainder of the division of the fields covered by the generator polynomial G(X) shall be transmitted as the MCFCS.

The MCFCS field shall consist of data bits as follows:

$MCFCS_{15}$	--	$MCFCS_0$

$MCFCS_{15}$ Message Control Frame Check Sequence Bit 15 (most significant bit)
$MCFCS_0$ Message Control Frame Check Sequence Bit 0 (least significant bit)

3.4.4.13 Information (INFO) Field: The INFO field shall contain the data to be transmitted in the Message Frame. The INFO field shall consist of Information Word (IW) subfields and Adjustment (ADJ) subfields.

IW_N	---	IW_{N-256}	ADJ	---	IW_0

IW_N Information Word N
IW_{N-256} 256th Transmitted Information Word
IW_0 Information Word 0
N Number of Information Words Transmitted

3.4.4.13.1 IW Subfield: The IW subfield shall contain 16 Information Bits. The IW subfield shall consist of data bits as follows:

IB_{15}	---	IB_0

IB_{15} Information Bit 15 (most significant)
IB_0 Information Bit 0 (least significant)

3.4.4.13.2 ADJ Subfield: The ADJ subfield shall be transmitted within the Information (INFO) field at intervals of 256 IW subfields. An ADJ subfield shall not be inserted after a block of 256 words if no further Information words follow. The ADJ subfield may be adjusted in length by any station to allow elastic buffer initialization. The ADJ subfield as transmitted shall consist of six I symbols followed by the J symbol followed by the A symbol.

I	I	I	I	I	I	J	A

I: I symbol
J: J symbol
A: A symbol

3.4.4.14 Information Frame Check Sequence (IFCS) Field: The IFCS field shall cover the INFO field (excluding the adjustment subfields) and the IFCS field in accordance with the following generator polynomial:

$$G(X) = X^{16} + X^{12} + X^5 + 1$$

The initial remainder shall be preset to FFFFH. The 1’s complement of the remainder of the division of the fields covered by the generator polynomial G(X) shall be transmitted as the IFCS.

The IFCS field shall consist of data bits as follows:

$IFCS_{15}$	--	$IFCS_0$

$IFCS_{15}$ Information Frame Check Sequence Bit 15 (most significant bit)
$IFCS_0$ Information Frame Check Sequence Bit 0 (least significant bit)

3.4.4.15 Message Frame Ending Delimiter (MFED) Field: The MFED field shall indicate the ending boundary of the INFO field. The MFED shall consist of a T symbol

T

T: Terminate symbol

3.4.4.16 Frame Status (FS) Field: The FS field shall consist of the Message Control Error Detected 1 (MCED1) subfield, the Message Acknowledged 1 (ACK1) subfield, the Message Received 1 (RCVD1) subfield, the Information Error Detected 1 (IED1) subfield, the Message Control Error Detected 2 (MCED2) subfield, the Message Acknowledged 2 (ACK2) subfield, the Message Received 2 (RCVD2) subfield and the Information Error Detected 2 (IED2) subfield.

MCED1	ACK1	RCVD1	IED1	MCED1	ACK2	RCVD2	IED2

3.4.4.16 (Continued)

MCED1	Message Control Error Detected 1: 4 code bits
ACK1	Message Acknowledged 1: 1 code bit
RCVD1	Message Received 1: 2 code bits
IED1	Information Error Detected 1: 2 code bits
MCED2	Message Control Error Detected 2: 1 code bit
ACK2	Message Acknowledged 2: 2 code bits
RCVD2	Message Received 2: 2 code bits
IED2	Information Error Detected 2: 1 code bit

3.4.4.16.1 MCED1 Subfield: The MCED1 subfield shall indicate any disparity between the received and calculated values of the MCFCS. The MCED1 subfield shall consist of code bits as follows:

1	1	1	MCED

MCED = 0 shall indicate no error detected
MCED = 1 shall indicate error detected

3.4.4.16.2 ACK1 Subfield: The ACK1 subfield shall indicate that a message has been received without error and made available to the Host. The ACK1 subfield shall consist of code bits as follows:

ACK

ACK = 0 shall indicate negative acknowledgement
ACK = 1 shall indicate acknowledgement

3.4.4.16.3 RCVD1 Subfield: The RCVD1 subfield shall indicate that a station has received a message containing its address. The RCVD1 subfield shall consist of code bits as follows:

1	RCVD

RCVD = 0 shall indicate not received
RCVD = 1 shall indicate received

3.4.4.16.4 IED1 Subfield: The IED1 subfield shall indicate any disparity between the received and calculated values of the IFCS. The IED1 subfield shall consist of code bits as follows:

IED	1

IED = 0 shall indicate no error detected
IED = 1 shall indicate error detected

3.4.4.16.5 MCED2 Subfield: The MCED2 subfield shall indicate any disparity between the received and calculated values of the MCFCS. The MCED2 subfield shall consist of code bits as follows:

MCED

MCED = 0 shall indicate no error detected
MCED = 1 shall indicate error detected

3.4.4.16.6 ACK2 Subfield: The ACK2 subfield shall indicate that a message has been received without error and made available to the Host. The ACK2 subfield shall consist of code bits as follows:

ACK	1

ACK = 0 shall indicate negative acknowledgement
ACK = 1 shall indicate acknowledgement

3.4.4.16.7 RCVD2 Subfield: The RCVD2 subfield shall indicate that a station has received a message containing its address. The RCVD2 subfield shall consist of code bits as follows:

RCVD	1

RCVD = 0 shall indicate not received
RCVD = 1 shall indicate received

3.4.4.16.8 IED2 Subfield: The IED2 subfield shall indicate any disparity between the received and calculated values of the IFCS. The IED2 subfield shall consist of code bits as follows:

IED

IED = 0 shall indicate no error detected
IED = 1 shall indicate error detected

3.4.4.17 Beacon Frame Starting Delimiter (BFSD) Field: The BFSD field shall indicate the starting boundary of a Beacon frame. The BFSD shall consist of the K symbol followed by the J symbol:

K	J

K: K symbol
J: J symbol

3.4.4.18 Beacon Control (BCON) Field: The BCON field shall consist of the Beacon Type (BT) subfield and the Beacon Path Indicator (BPI) subfield:

BT	BPI

BT Beacon Type: 3 data bits
BPI Beacon Path Indicator: 1 data bit

3.4.4.18.1 BT Subfield: The BT subfield shall indicate the type of Beacon transmitted. The BT subfield shall consist of data bits as follows:

BT_2	BT_1	BT_0

BT = 0 shall indicate Warm Start
BT = 1 shall indicate Warm Recover
BT = 2 shall indicate Restart
BT = 3 shall indicate Vie
BT = 4 shall indicate Configure Ring 0
BT = 5 shall indicate Configure Ring 1
BT = 6 shall indicate Configure Loop Back
BT = 7 shall be reserved

3.4.4.18.2 BPI Subfield: The BPI subfield shall indicate the route by which the Highest Known Address (HKA) data has reached the receiving station. The BPI subfield shall consist of data bits as follows:

BPI

BPI = 0 shall indicate that the HKA data path has included both Ring 0 and Ring 1 links
BPI = 1 shall indicate that the HKA data path was exclusively on Ring 0 or exclusively on Ring 1

3.4.4.19 HKA Field: The HKA field shall indicate the highest station address known by the station transmitting the Beacon frame. The HKA field shall consist of data bits as follows:

0	HKA_6	--	HKA_0

HKA_6 Highest Known Address Bit 6 (most significant)
HKA_0 Highest Known Address Bit 0 (least significant)

3.4.4.20 Station Count (SC) Field: The SC field shall indicate the number of stations included in a complete ring. The SC field shall consist of data bits as follows:

0	SC_6	--	SC_0

SC_6 Station Count Bit 6 (most significant bit)
SC_0 Station Count Bit 0 (least significant bit)

3.4.4.21 Beacon Frame Check Sequence (BFCS) Field: The BFCS field shall cover the BCON field, the HKA field, the SC field and the BFCS field in accordance with the following generator polynomial:

$$G(X) = X^{16} + X^{12} + X^5 + 1$$

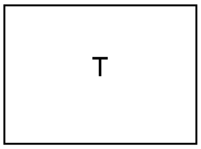
The initial remainder shall be preset to $FFFF_H$. The 1's complement of the division of the fields covered by the generator polynomial G(X) shall be transmitted as the BFCS.

The BFCS field shall consist of data bits as follows:

$BFCS_{15}$	--	$BFCS_0$

$BFCS_{15}$ Beacon Frame Check Sequence Bit 15 (most significant)
$BFCS_0$ Beacon Frame Check Sequence Bit 0 (least significant)

3.4.4.22 Beacon Frame Ending Delimiter (BFED) Field: The BFED field shall indicate the ending boundary of a Beacon frame. The BFED field shall consist of the T symbol:



T: Terminate symbol

3.5 Protocols:

The RIU shall operate in accordance with the state machine defined in 3.5.1. Paragraphs 3.5.2 to 3.5.15 are an operational description of the protocol. In cases of discrepancy, the state machine definition shall have precedence.

3.5.1 Protocol State Definitions: The portion of the RIU concerned with a single ring shall operate in accordance with 3.5.1.1 to 3.5.1.10 and the state diagram in Figure 3.5.1-1. The state machines for each pair of counter rotating rings shall operate in synchronism in states S1 and S2. Thereafter, one ring shall operate in accordance with state S5 while the other operates in accordance with either state S3 or S4.

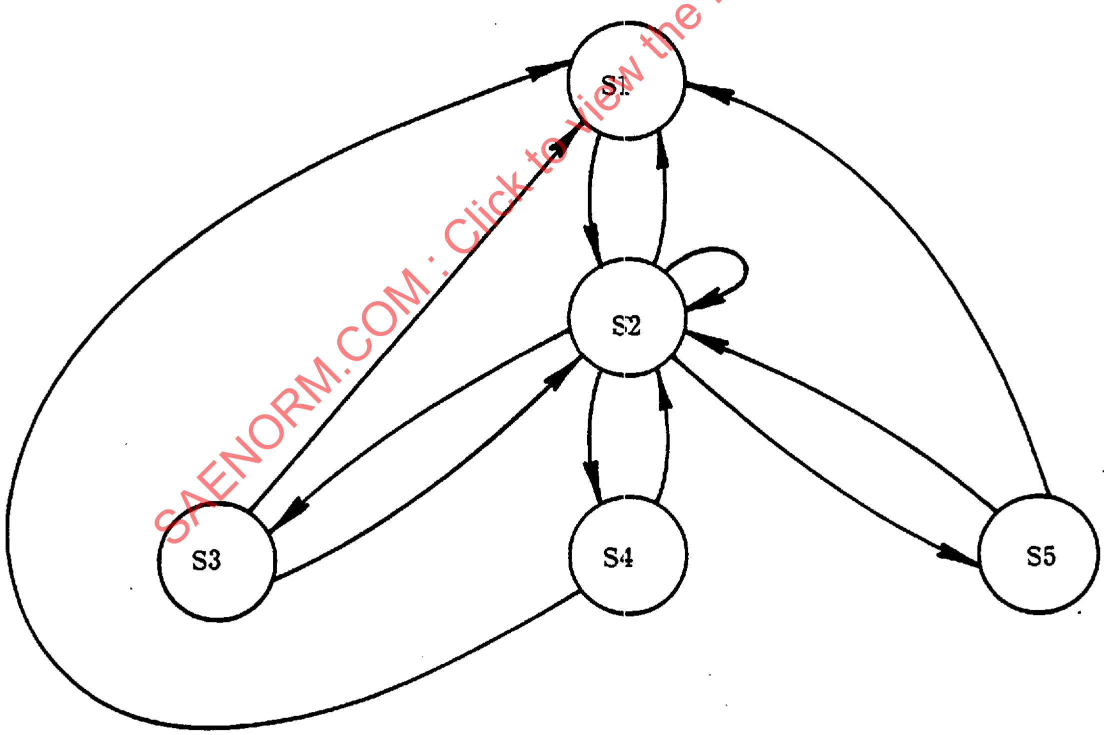


FIGURE 3.5.1-1 - Primary States

3.5.1.1 S1: Unconnected: The Unconnected state shall be entered upon power removal from the RIU or Reset command from the Host. Both state machines of the counter rotating ring pair (if present) shall enter and execute all actions in this state in synchronism. State transitions shall occur as follows:

S (1,2a): Operational Station Detected - A transition to state S2 shall occur if the presence of an operational station is detected. An indication of this transition shall be given to the state machine defining the operation of the counter rotating ring (if present).

S (1,2b): Operational Station, Other Side - A transition to state S2 shall occur if the state machine defining the operation of the counter rotating ring transitions to S2 due to detection of an operational station.

3.5.1.2 S2: Reconfiguration: The Reconfiguration state shall be entered to connect the stations on the ring to form the maximum ring configurable. Both state machines of the counter rotating ring pair (if present) shall enter and execute all actions in this state in synchronism. State transitions shall occur as follows:

S (2,1a): Loss Of Power - A transition to state S1 shall occur if the power is removed from the RIU.

S (2,1b): Reset By Host - A transition to state S1 shall occur if the Host resets the RIU.

S (2,2): Reconfigured Not Connected - A transition to state S2 shall occur at the end of reconfiguration if the RIU cannot configure as part of a ring system due to insufficient connectivity to operational stations. Both state machines of the counter rotating ring pair (if present) shall execute this transition in synchronism.

S (2,3): Reconfigured Inactive Ring - A transition to state S3 shall occur at the end of reconfiguration if the RIU configures as part of a ring system and this is the Inactive ring. The state machine defining the operation of the counter rotating ring shall execute one of the S (2,5) transitions.

S (2,4): Reconfigured Repeater Ring - A transition to state S4 shall occur at the end of reconfiguration if the RIU configures as part of a ring system and this is the Repeater ring. The state machine defining the operation of the counter rotating ring shall execute one of the S (2,5) transitions.

S (2,5a): Reconfigured Active Ring Master - A transition to state S5 shall occur after issuing a free Token if the RIU is determined to be the Master Station and this is the Active ring. This station shall remain as the Master Station until a subsequent reconfiguration takes place. The state machine defining the operation of the counter rotating ring (if present) shall execute either transition S(2,3) or transition S(2,4).

3.5.1.2 (Continued)

S (2,5b): Reconfigured Active Ring Slave - A transition to state S5 shall occur at the end of reconfiguration if the RIU is determined to be a Slave station and this is the Active ring. The state machine defining the operation of the counter rotating ring (if present) shall execute either transition S(2,3) or transition 5(2,4).

3.5.1.3 S3: Inactive Ring: The Inactive ring state shall be entered when the state machine defining the operation of the counter rotating ring is in the Active Ring state (S5) and the station is not in the middle of a looped back ring. State transitions shall occur as follows:

S (3,1a): Loss Of Power - A transition to state S1 shall occur if the power is removed from the RIU.

S (3,1b): Reset by Host - A transition to state S1 shall occur if the Host resets the RIU.

S (3,2a): Restart Reconfiguration - A transition to state S2 shall occur if the Host commands the ring system to reconfigure.

S (3,2b): Beacon Received - A transition to state S2 shall occur upon reception of a valid Restart Beacon on the Inactive ring input. This transition shall cause the state machine defining the operation of the Active ring to also enter S2.

S (3,2c): Line State Change - A transition to state S2 shall occur if the line state of the Inactive ring input changes. A line state change is defined as a change from a valid signal to an invalid signal or from an invalid signal to a valid signal. A valid signal is defined as an input signal of sufficient integrity (e.g., power level, signal to noise, clock tolerance, etc.) for which the RIU can become synchronized. This transition shall cause the state machine defining the operation of the Active ring to also enter S2.

S (3,2d): Active Ring Indication - A transition to state S2 shall occur if the state machine defining the operation of the Active ring indicates a transition to state S2.

3.5.1.4 S4: Repeater Ring: The Repeater ring state shall be entered when the state machine defining the operation on the counter rotating ring is in the Active ring state (S5) and the station is in the middle of a looped back ring. State transitions shall occur as follows:

S (4,1a): Loss Of Power - A transition to state S1 shall occur if the power is removed from the RIU.

S (4,1b): Reset By Host - A transition to state S1 shall occur if the Host resets the RIU.

S (4,2a): Restart Reconfiguration - A transition to state S2 shall occur if the Host commands the ring system to reconfigure.

3.5.1.4 (Continued):

S (4,2b): Beacon Received - A transition to state S2 shall occur upon reception of a valid Restart Beacon on the Repeater ring input. This transition shall cause the state machine defining the operation of the Active ring to also enter S2.

S (4,2c): Line State Change - A transition to state S2 shall occur if the line state of the Repeater ring input changes. This transition shall cause the state machine defining the operation of the Active ring to also enter S2.

S (4,2d): Active Ring Indication - A transition to state S2 shall occur if the state machine defining the operation of the counter rotating ring indicates a transition to state S2.

3.5.1.5 S5:Active Ring: The Active ring state shall be entered when the ring has been designated the ring on which data is to be received. The state machine defining the operation of the counter rotating ring (if present) shall be in state S3 or state S4, depending on the ring configuration. State transitions shall occur as follows:

S (5,1a): Loss Of Power - A transition to state S1 shall occur if the power is removed from the RIU.

S (5,1b): Reset By Host - A transition to state S1 shall occur if the Host resets the RIU.

S (5,2a): Restart Reconfiguration - A transition to state S2 shall occur if the Host commands the ring system to reconfigure.

S (5,2b): Beacon Received - A transition to state S2 shall occur upon reception of a valid Restart Beacon on the Active ring input. This transition shall cause the state machine defining the operation of the counter rotating ring (if present) to also enter S2.

S (5,2c): Line State Change - A transition to state S2 shall occur if the line state of the Active ring input changes. This transition shall cause the state machine defining the operation of the counter rotating ring (if present) to also enter S2.

S (5,2d): Counter Rotating Ring Indication - A transition to state S2 shall occur if the state machine defining the operation of the counter rotating ring indicates a transition to state S2.

S (5,2e): No Warm Recover Beacon - A transition to state S2 shall occur if the warm start protocol fails.

3.5.1.6 Unconnected State Substates: Operation in the Unconnected state shall be in accordance with Figure 3.5.1.6-1.

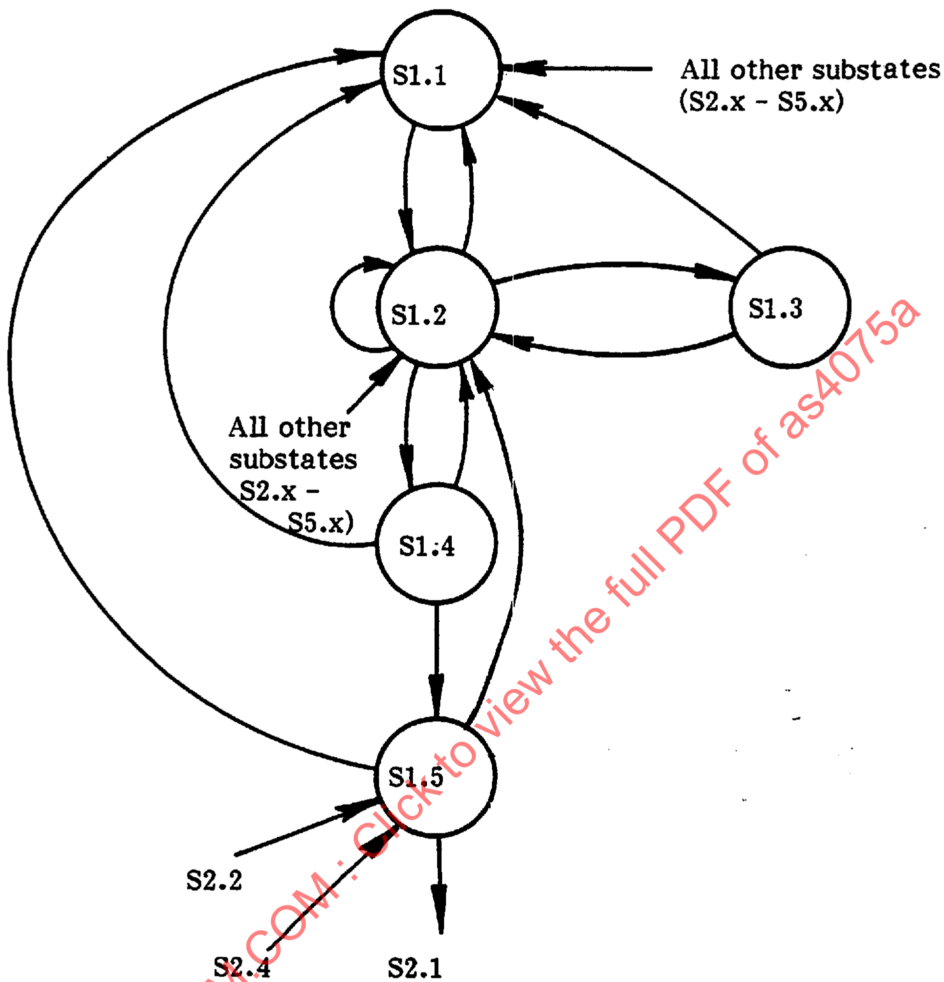


FIGURE 3.5.1.6-1 - Unconnected State Substates

3.5.1.6.1 S1.1: Unpowered: The Unpowered state shall be entered whenever power is not applied to the RIU. Both state machines for the counter rotating ring pair (if present) shall enter and execute all actions in this state in synchronism. The RIU shall be bypassed. State transitions shall occur as follows:

S (1.1,1.2): Power Applied - A transition to state S1.2 shall occur when power is applied to the RIU.

3.5.1.6.2 S1.2: Powered: The Powered state shall be entered upon application of power to the RIU or RIU reset by the Host. Both state machines for the counter rotating ring pair (if present) shall enter and execute all actions in this state in synchronism. The RIU shall be bypassed. Self-test of the RIU shall be carried out on entering this state and the self-test status made available to the Host. If the self-test detects no faults, a transition to S1.4 shall occur. If the self-test detects faults, which effects only one ring, that ring shall become Quiescent and the state machine defining operation of the fault free ring shall operate as if the second ring does not exist. State transitions shall occur as follows:

S (1.2,1.1): Loss Of Power - A transition to state S1.1 shall occur if the power is removed from the RIU. Both state machines of the counter rotating pair (if present) shall execute this transition in synchronism.

S (1.2,1.2): Reset By Host - A transition to state S1.2 shall occur if the Host resets the RIU. Both state machines of the counter rotating pair (if present) shall execute this transition in synchronism.

S (1.2,1.3): Self-Test Fail - A transition to state S1.3 shall occur if the RIU self-test detects a fault. One or both state machines of the counter rotating pair (if present) shall execute this transition depending on the self-test fault.

S (1.2,1.4): Self-Test Pass - A transition to state S1.4 shall occur if the RIU self-test completes without detecting a fault. Both state machines of the counter rotating pair (if present) shall execute this transition in synchronism if both are fault free. If a fault is detected in one of the pair, the state machine defining the operation of that one shall execute the transition S (1.2,1.3) in synchronism with this transition.

3.5.1.6.3 S1.3: Quiescent: The Quiescent state shall be entered upon failure of the RIU self-test to complete without finding a fault. If both state machines for the counter rotating ring pair enter this state, they shall execute all actions in this state in synchronism. The RIU shall be bypassed. State transitions shall occur as follows:

S (1.3,1.1): Loss Of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

3.5.1.6.3 (Continued)

S (1.3,1.2): Reset By Host - A transition to state S1.2 shall occur if the Host resets the RIU.

3.5.1.6.4 S1.4: Wait: The Wait state shall be entered upon completion of the RIU self-test with no faults detected. If both state machines for the counter rotating ring pair enter this state they shall execute all actions in this state in synchronism. The RIU shall apply power to the RIM (if required) and enable the transmitter. It shall then wait until it is able to transmit a signal to a neighboring station. The wait time is determined by the RIM employed. State transitions shall occur as follows:

S (1.4,1.1): Loss Of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S (1.4,1.2): Reset By Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S (1.4,1.5): Wait Finished - A transition to state S1.5 shall be made once the RIU has waited long enough to allow it to transmit a signal to the next station. The stations highest known address shall be set to the station address.

3.5.1.6.5 S1.5: Synchronization: The synchronization state shall be entered to transmit IDLE symbols to another station allowing it to synchronize and to attempt to synchronize to the signal transmitted by another station. Both state machines for the counter rotating ring pair (if present) shall enter and execute all actions in this state in synchronism. State transitions shall occur as follows:

S(1.5,1.1): Loss Of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(1.5,1.2): Reset By Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(1.5,2.1a): Valid Signal Received - A transition to state S2.1 shall occur if at least 1024 IDLE symbols have been sent and a valid signal is received. This transition shall cause the counter rotating state machine (if present) to also enter S2.1.

S(1.5,2.1b): Signal On Counter Rotating Ring - A transition to state S2.1 shall occur if the state machine defining the operation of the counter rotating ring indicates a transition to state S2.1.

3.5.1.7 Reconfiguration State Substates: Operation in the Reconfiguration state shall be in accordance with Figure 3.5.1.7-1.

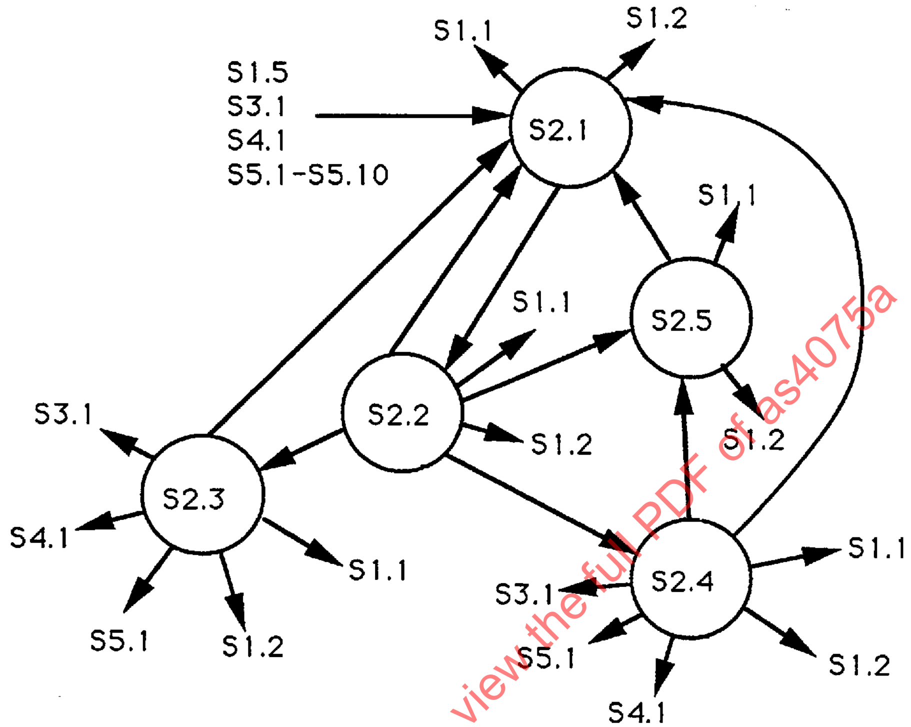


FIGURE 3.5.1.7-1 - Reconfiguration State Substates

3.5.1.7.1 S2.1: Reconfiguration Initialization: The Reconfiguration Initialization state shall be entered upon detection of a valid Restart Beacon, failure of the Warm Start protocol, change of input line state, Host command, or indication from the state machine defining the operation of the counter rotating ring that it has transitioned to this state. Both state machines for the counter rotating ring pair (if present) shall enter and execute actions in this state in synchronism. On entering this state, the HKA shall be set to the Station address.

The Beacon loop Timer (BLT) shall be reset and started. Two Restart Beacons, each followed by four IDLE symbols, shall be issued on each output. Received Restart Beacons shall be ignored for one Beacon Loop Time. State transitions shall occur as follows:

S(2.1,1.1): Loss Of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(2.1,1.2): Reset By Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(2.1,2.2): Restart Beacons Sent - A transition shall be made to state S2.2 after the Restart Beacons have been sent.

3.5.1.7.2 S2.2: Vie: The Vie state shall be entered after transmitting the Restart Beacon. It performs the passing of station addresses to allow the Master Station to be determined. Both state machines for the counter rotating ring pair (if present) shall enter and execute all actions in this state in synchronism. A Vie Beacon shall be transmitted every 16 symbol times separated by IDLE symbols. The fields of the Beacon shall take the current value of the HKA, BPI, and SC registers. On receiving valid Vie Beacons, the HKA, BPI, and SC registers shall be updated. State transitions shall occur as follows:

S(2.2,1.1): Loss Of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(2.2,1.2): Reset By Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(2.2,2.1a): Restart Beacon - A transition to state S2.1 shall occur if a Restart Beacon is received and one Beacon Loop Time has elapsed since starting Reconfiguration.

S(2.2,2.1b): No Master - A transition to state S2.1 shall occur if, after four Beacon Loop Times, no Configure Beacon has been received.

S(2.2,2.3a): Both Rings Intact - A transition to state S2.3 shall be made: if one Beacon Loop Time has elapsed, if a Vie Beacon is received with the HKA equal to this station address and the BPI field set to’1’, and the state machine defining the operation of the counter rotating ring (if present) indicates the same.

S(2.2,2.3b): This Ring Intact - A transition to state S2.3 shall occur if two Beacon Loop Times have elapsed, and a Vie Beacon has been received with HKA equal to this station address and the BPI field set to ’1’. An indication of this transition shall be sent to the state machine defining the operation of the counter rotating ring (if present).

S(2.2,2.3c): Other Ring Intact - A transition to state S2.3 shall occur if two Beacon Loop Times have elapsed, and the state machine defining the operation of the counter rotating ring has indicated that it has received a Vie Beacon with HKA equal to this station address and the BPI field set to ’1’.

S(2.2,2.3d): Neither Ring Intact - A transition to state S2.3 shall occur if two Beacon Loop Times have elapsed, Vie Beacons have been received with HKA equal to this station address and the BPI field set to ’0’ and the station HKA is equal to this station address immediately prior to the elapse of two Beacon Loop Times.

3.5.1.7.2 (Continued):

S(2.2,2.4): Configure Beacon - A transition to state S2.4 shall occur if a Configure Beacon is received: an indication of this transition shall be sent to the counter rotating ring (if present). A transition to S2.4 shall also occur if the state machine defining the operation of the counter rotating ring indicates it has received a Configure Beacon.

S(2.2,2.5): Bad Address - A transition to state S2.5 shall occur if no Vie Beacons have been received with HKA greater than or equal to this station address within one Beacon Loop Time.

3.5.1.7.3 S2.3: Master Configuration: The Master Configuration state shall be entered when this RIU is determined to be the Master. Both state machines for the counter rotating ring pair (if present) shall enter and execute all actions in this state in synchronism. The appropriate Configure Beacon shall be sent indicating the configuration of the ring. This Configure Beacon shall be followed by IDLE symbols for one Beacon Loop Time allowing all stations to switch to their repeater paths. State transitions shall occur as follows:

S(2.3,1.1): Loss Of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(2.3,1.2): Reset By Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(2.3,2.1a): Restart Beacon - A transition to state S2.1 shall occur if a Restart Beacon is received and one Beacon Loop Time has elapsed since the start of reconfiguration.

S(2.3,2.1b): Line State Change - A transition to state S2.1 shall occur if the line state changes from a valid signal to an invalid signal or from an invalid signal to a valid signal.

S(2.3,3.1): Reconfigured Inactive Ring - A transition to state S3.1 shall occur at the end of reconfiguration if the RIU configures as part of a ring system and this is the inactive ring or the inactive side at the end of a loop back ring. The state machine defining the operation of the counter rotating ring shall execute the S(2.3,5.1) transition.

S(2.3,4.1): Reconfigure Repeater Ring - A transition to state S4.1 shall occur at the end of reconfiguration if the RIU configures as part of a ring system and this is the Repeater ring. The state machine defining the operation of the counter rotating ring shall execute the S(2.3,5.1)transition.

3.5.1.7.3 (Continued):

S(2.3,5.1): Reconfigured Active Ring - A transition to state S5.1 shall occur after this station issues a free Token, if the RIU configures as part of a ring system and this is the Active ring. The state machine defining the operation of the counter rotating ring (if present) shall execute either transition S(2.3,3.1) or transition 5(2.3,4.1).

3.5.1.7.4 S2.4: Slave Configuration: The Slave Configuration state shall be entered upon receiving a Configure Beacon during the Vie process. Both state machines for the counter rotating ring pair shall enter and execute all actions in this state in synchronism. The Configure Beacon shall be retransmitted. State transitions shall occur as follows:

S(2.4,1.1): Loss Of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(2.4,1.2): Reset By Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(2.4,2.1a): Restart Beacon - A transition to state S2.1 shall occur if a Restart Beacon is received and one Beacon loop Time has elapsed since the start of reconfiguration.

S(2.4,2.1b): Line State Change - A transition to state S2.1 shall occur if the line state changes from a valid signal to an invalid signal or from an invalid signal to a valid signal.

S(2.4,2.5): Reconfigured Not Connected - A transition to state S2.5 shall occur after the first Token is received if the Configure Beacon indicates that the RIU is unable to connect to a ring system due to insufficient connectivity to operational neighbors. These conditions are noted in Table 3.5.15-2 as transitions to S2. Both state machines for the counter rotating ring pair (if present) shall execute this transition in synchronism.

S(2.4,3.1): Inactive Ring - A transition to state S3.1 shall occur if the Configure Beacon indicates that either a single ring is to be used or this station determines it is to loop back, and this is the Inactive ring. The state machine defining the operation of the counter rotating ring shall execute the S(2.4,5.1) transition.

S(2.4,4.1): Repeater Ring - A transition to state S4.1 shall occur if the Configure Beacon indicates that a looped ring is to be formed without loop back in the station and this is the Repeater ring. The state machine defining the operation of the counter rotating ring shall execute the S(2.4,5.1) transition.

3.5.1.7.4 (Continued):

S(2.4,5.1): Active Ring - A transition to state S5.1 shall occur if this is to be the Active ring. The state machine defining the operation of the counter rotating ring (if present) shall execute either the S(2.4,3.1) transition or the S(2.4,4.1) transition.

3.5.1.7.5 S2.5:Reconfiguration Idle: The Reconfiguration Idle state shall be entered upon detection of insufficient link connection. IDLE symbols shall be transmitted in order that the station should not continue to restart a ring which it cannot join. Both state machines for the counter rotating ring pair (if present) shall enter and execute all actions in the state in synchronism. State transitions shall occur as follows:

S(2.5,1.1): Loss of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(2.5,1.2): Reset By Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(2.5,2.1a): Line State Change - A transition to state S2.1 shall occur if the line state of the input changes from a valid signal to an invalid signal or from an invalid signal to a valid signal. This transition shall cause the counter rotating ring state machine (if present) to also enter S2.1.

S(2.5,2.1b): Restart Beacon - A transition to state S2.1 shall occur if a Restart Beacon is received.

3.5.1.8 Inactive Ring State Substates:

3.5.1.8.1 S3.1:Inactive: The Inactive state is entered when the state machine defining the operation of the counter rotating ring is in the Active ring state and the station is not in the middle of a looped back ring. Data received on the Active ring shall be retransmitted on the Inactive ring output. Data received on the Inactive ring input shall not be repeated but shall be monitored for Restart Beacons and changes in line state only, other received signals being ignored. State transitions shall occur as follows:

S(3.1,1.1): Loss of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(3.1,1.2): Reset by Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(3.1,2.1a): Restart Reconfiguration - A transition to state S2.1 shall occur if the Host commands the ring system to reconfigure.

3.5.1.8.1 (Continued):

S(3.1,2.1b): Beacon Received - A transition to state S2.1 shall occur upon reception of a valid Restart Beacon on the input. This transition shall cause the state machine defining the operation of the counter rotating ring to also enter S2.1.

S(3.1,2.1c): Line State Change - A transition to state S2.1 shall occur if the line state of the Inactive ring input changes from a valid signal to an invalid signal or from an invalid signal to a valid signal. This transition shall cause the counter rotating ring state machine (if present) to also enter S2.1.

S(3.1,2.1d): Active Ring Indication - A transition to state S2.1 shall occur if the state machine defining the operation of the Active ring indicates a transition to state S2.1.

3.5.1.9 Repeater Ring State Substates:

3.5.1.9.1 S4.1: Repeater: The Repeater state is entered when the state machine defining the operation of the counter rotating ring is in the Active ring state and the station is in the middle of a looped back ring. Data received on the repeater Ring input shall be retransmitted on the Repeater ring output and shall be monitored for Restart Beacons and changes in line state only, other received signals being ignored. State transitions shall occur as follows:

S(4.1,1.1): Loss of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(4.1,1.2): Reset by Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(4.1,2.1a): Restart Reconfiguration - A transition to state S2.1 shall occur if the Host commands the ring system to reconfigure.

S(4.1,2.1b): Beacon Received - A transition to state S2.1 shall occur upon reception of a valid Restart Beacon on the Repeater Ring input. The transition shall cause the state machine defining the operation of the Active ring to also enter S2.1.

S(4.1,2.1c): Line State Change - A transition to state S2.1 shall occur if the line state of the Repeater ring input changes from a valid signal to an invalid signal. This transition shall cause the state machine defining the operation of the Active ring to also enter S2.1.

S(4.1,2.1d): Active Ring Indication - A transition to state S2.1 shall occur if the state machine defining the operation of the Active ring indicates a transition to state S2.1.

3.5.1.10 Active Ring State Substates: Operation in the Active ring state shall be in accordance with Figure 3.5.1.10-1. The state machine defining the operation of the counter rotating ring (if present) shall be in either state S3.1 or S4.1, depending on the ring configuration. Data received on the Active ring input shall be retransmitted on the Active ring output. The data shall also be passed to the counter rotating ring (if present) for retransmission, if required. Expiration of the Loop Time Counter or Lost Token Starting Delimiter Counter while in States S5.1 through S5.8 shall cause a transition to state S5.10, Warm Start.

3.5.1.10.1 S5.1: Await Token Starting Delimiter: The Await Token Starting Delimiter state shall be entered when this ring is the Active ring and the station is waiting for a Token frame or Message frame. State transitions shall occur as follows:

S(5.1,1.1): Loss of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(5.1,1.2): Reset by Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(5.1,2.1a): Restart Reconfiguration - A transition to state S2.1 shall occur if the Host commands the ring system to reconfigure.

S(5.1,2.1b): Line State Change - A transition to state S2.1 shall occur if the line state of the Active ring input changes from a valid signal to an invalid signal. This transition shall cause the counter rotating ring state machine (if present) to also enter S2.1.

S(5.1,2.1c): Counter Rotating Ring Indication - A transition to state S2.1 shall occur if the state machine defining the operation of the counter rotating ring indicates a transition to state S2.1.

S(5.1,5.2): TSD Received - A transition to state S5.2 shall occur if a valid TSD is received.

S(5.1,5.9): Check Beacon - A transition to S5.9 shall occur upon detection of a BFSD on the Active ring.

3.5.1.10.2 S5.2: Check Token Priority: The Check Token Priority state shall be entered when a valid TSD is received on the Active ring input. The Lost Token Starting Delimiter Counter shall be restarted, the Lost Free Token Counter incremented and the Loop Time Counter disabled. The Token Priority field shall be received, the format checked and the priority contained compared to the highest message priority requested by the Host. The Token Status 1 field shall also be received and the format checked. State transitions shall occur as follows:

S(5.2,1.1): Loss of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

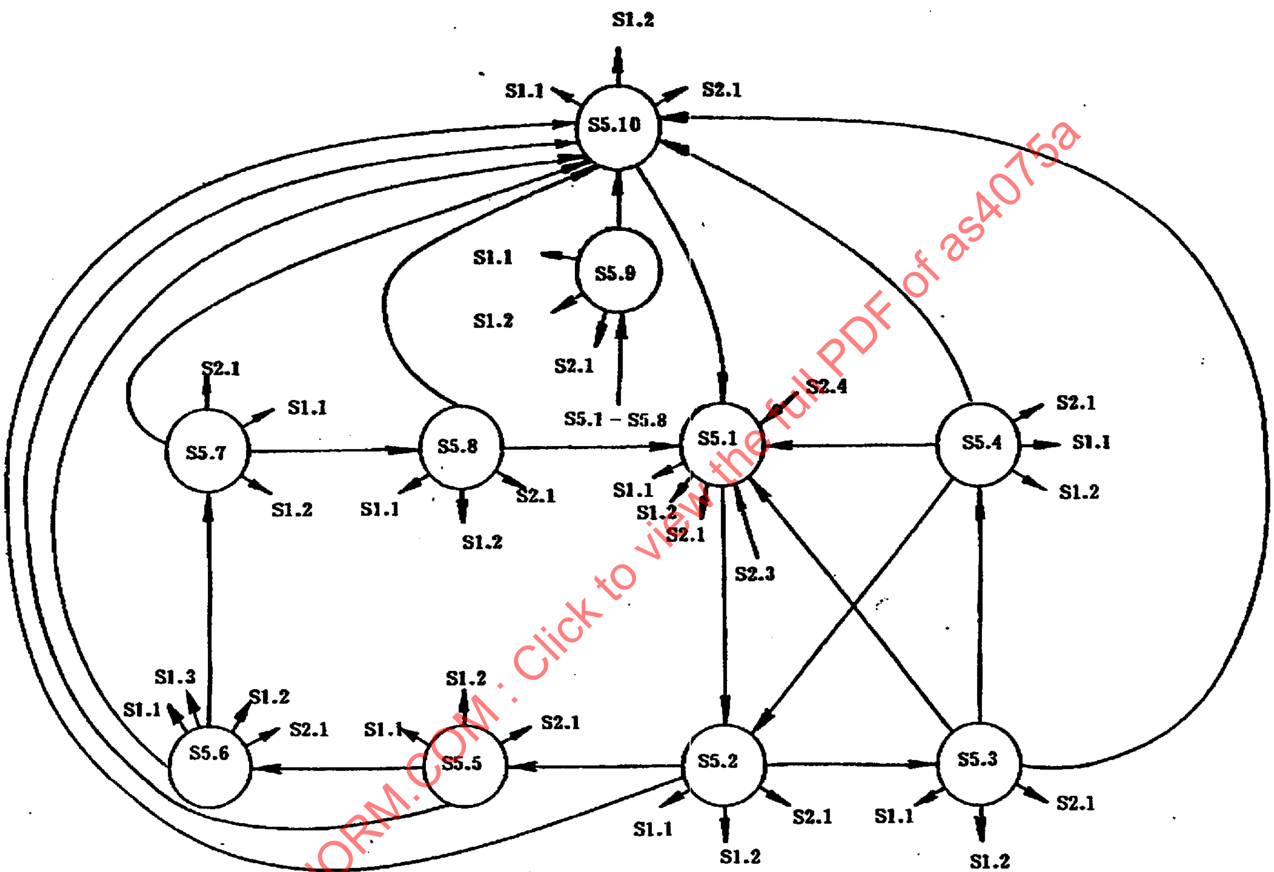


FIGURE 3.5.1.10-1 - Active Ring State Substates

3.5.1.10.2 (Continued):

S(5.2,1.2): Reset by Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(5.2,2.1a): Restart Reconfiguration - A transition to state S2.1 shall occur if the Host commands the ring system to reconfigure.

S(5.2,2.1b): Line State Change - A transition to state S2.1 shall occur if the line state of the Active ring input changes from a valid signal to an invalid signal. This transition shall cause the counter rotating ring state machine (if present) to also enter S2.1.

S(S.2,2.1c): Counter Rotating Ring Indication - A transition to state S2.1 shall occur if the state machine defining the operation of the counter rotating ring indicates a transition to state S2.1.

S(5.2,5.3a): No Message to Send - A transition to state S5.3 shall occur after receiving the Token Status 1 field if the RIU has no message to transmit.

S(5.2,5.3b): Message Priority lower than Token Priority - A transition to state S5.3 shall occur after receiving the Token Status 1 field if the RIU is unable to claim the Token because the Token Priority is greater than the highest priority requested by the Host.

S(5.2,5.3c): Claimed Token - A transition to state S5.3 shall occur after receiving the Token Status 1 field if the Token is already claimed.

S(5.2,5.5): Message Priority equal to or higher than Token Priority - A transition to state S5.5 shall occur after receiving the Token Status 1 field if the RIU has a message to send, the Token is free, and the priority of the message to be transmitted is greater than, or equal to, the priority of the Token.

S(5.2,5.9): Check Beacon - A transition to state S5.9 shall occur on detection of a BFSD on the Active Ring.

S(5.2,5.10a): Lost Free Token - A transition to state S5.10 shall occur immediately if the Lost Free Token Counter reaches two.

S(5.2,5.10b): Format Error - A transition to state S5.10 shall occur immediately if a Token format error is detected.

3.5.1.10.3 S5.3: Reserve Token Priority: The Reserve Token Priority state shall be entered after the RIU has determined it cannot claim a received Token. The Short Message Count field shall be received and the format checked. The Token Status 2 field shall be received, the format checked and the value compared to that of the Token Status 1 field. If the Token is claimed, the RIU shall insert the highest priority of a Message frame requested by the Host into the Reservation field if it is higher than that currently contained and the UTIT has not previously expired while transmitting a Message frame without being reset by the Host. No reservation shall be made in a free Token. If the Token is free, the RIU shall restart the Loop Time Counter and reset the Lost Free Token Counter. If the Token is already claimed, a period of IDLE symbols for adjustment may follow. State transitions shall occur as follows:

S(5.3,1.1): Loss of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(5.3,1.2): Reset by Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(5.3,2.1a): Restart Reconfiguration - A transition to state S2.1 shall occur if the Host commands the ring system to reconfigure.

S(5.3,2.1b): Line State Change - A transition to state S2.1 shall occur if the line state of the Active ring input changes from a valid signal to an invalid signal. This transition shall cause the counter rotating ring state machine (if present) to also enter S2.1.

S(5.3,2.1c): Counter Rotating Ring Indication - A transition to state S2.1 shall occur if the state machine defining the operation of the counter rotating ring indicates a transition to state S2.1.

S(5.3,5.1): Free Token - A transition to state S5.1 shall occur after receiving the Token Ending Delimiter if the Token is free.

S(5.3,5.4): Claimed Token - A transition to state S5.4 shall occur if the Token is claimed.

S(5.3,5.9): Check Beacon - A transition to S5.9 shall occur upon detection of a BFSD on the Active ring.

S(5.3,5.10a): Format Error - A transition to state S5.10 shall occur immediately if a Token format error is detected.

S(5.3,5.10b): Illegal Token Status - A transition to state S5.10 shall occur immediately if the values in the Token Status fields do not match.

3.5.1.10.3 (Continued):

S(5.3,5.10c): No Ending Delimiter - A transition to state S5.10 shall occur immediately if the Token Ending Delimiter is missing from a free Token.

S(5.3,5.10d): Two Free Tokens and Bidding - A transition to state S5.10 shall occur immediately if a bidding station receives two free Tokens it cannot claim without an intervening Claimed Token.

3.5.1.10.4 S5.4: Repeat Message: The Repeat Message state shall be entered after the RIU has determined that a Claimed Token has been received. The Message frame shall be received from the MFSD to the end of the Frame Status field. The RIU shall monitor that the protocol and error checks are correct and the Message frame valid. If the Message frame is valid and addressed to this station, the RIU shall copy the Information field to the Host, if possible. The RIU shall alter the Frame Status field in accordance with the action appropriate to the received Message frame. State transitions shall occur as follows:

S(5.4,1.1): Loss of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(5.4,1.2): Reset by Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(5.4,2.1a): Restart Reconfiguration - A transition to state S2.1 shall occur if the Host commands the ring system to reconfigure.

S(5.4,2.1b): Line State Change - A transition to state S2.1 shall occur if the line state of the Active Ring input changes from a valid signal to an invalid signal. This transition shall cause the counter rotating ring state machine (if present) to also enter S2.1.

S(5.4,2.1c): Counter Rotating Ring Indication - A transition to state S2.1 shall occur if the state machine defining the operation of the counter rotating ring indicates a transition to state S2.1.

S(5.4,5.1a): Invalid Symbols, Message Control - A transition to state S5.1 shall occur after setting the Message Control Error Detected bits to one and retransmitting the Frame Status field, as identified by the MFED, if any nondata symbols are received between the MFSD and the end of the Message Control FCS. No data from this Message Frame shall be used. If this error is detected, and MCED bits were not set, then this RIU shall indicate to the Host that it was the first to detect this error.

3.5.1.10.4 (Continued):

S(5.4,5.1b): Invalid Symbols, Information - A transition to state S5.1 shall occur after setting the Information Error Detected bits to one and retransmitting the Frame Status field if any nondata symbols are received between the Message Control FCS and the MFED, excluding adjustment fields. No data from this Message frame shall be used but the RIU shall set the RCVD bits to one and the ACK bits to zero, if the Message frame was correctly addressed to this station. If this error is detected, and the RCVD bits were not set to one, and the ACK bits were not set to zero, then this station shall indicate to the Host that it was the first to detect this error.

S(5.4,5.1c): MCFCS Incorrect - A transition to state S5.1 shall occur after setting the Message Control Error Detected bits to one and retransmitting the Frame Status field, as identified by the MFED, if the calculated Message Control FCS does not match that contained in the Message frame. No data from this Message frame shall be used. If this error occurs and the MCED bits were not previously set (by another station), then this station shall indicate to the Host that it was the first to detect this error.

S(5.4,5.1d): IFCS Incorrect - A transition to state S5.1 shall occur after setting the Information Error Detected bits to one and retransmitting the Frame Status field, if the calculated Information FCS does not match that contained in the Message frame. No data from this Message frame shall be used but the RIU shall set the Received bits to one and the Acknowledged bits to zero, if the Message frame was correctly addressed to this station. If this error occurs and the IED bits were not previously set (by another station), then this station shall indicate to the Host that it was the first to detect this error.

S(5.4,5.1e): Invalid Frame Status Field - A transition to state S5.1 shall occur after retransmitting the Frame Status field if the received Frame Status field is invalid. The Frame Status field is invalid if the redundant bits indicating either Message Control Error Detected, Information Error Detected, Message Received or Message Acknowledged do not agree, or if all these bits are zero or if there is an invalid frame format (as indicated by 1's in designated bit positions). No data from this Message frame shall be used. The RIU shall pass this status to the Host.

3.5.1.10.4 (Continued):

S(S.4,5.1f): Duplicate Address - A transition to state S5.1 shall occur if the Message frame contained a physical address, as indicated by the LP field, this station was addressed, and the RCVD bits received were one. The RIU shall indicate a Duplicate Address error to the Host.

S(5.4,5.1g): Not This Station - A transition to state S5.1 shall occur after retransmitting the Frame Status field if the valid Message frame was not addressed to this station. No data from this Message frame shall be used.

S(5.4,5.1h): Message Copied - A transition to state S5.1 shall occur after setting the Received bits to one and retransmitting the Frame Status field if the valid Message frame was addressed to this station and the RIU passed the Information field to the Host.

S(5.4,5.1i): Message Not Copied - A transition to state S5.1 shall occur after setting the Received bits to one, setting the Acknowledge bits to zero and retransmitting the Frame Status field if the valid Message frame was addressed to this station and the RIU was unable to pass the Information field to the Host.

S(5.4,5.2): TSD Received - A transition to state S5.2 shall occur immediately upon detecting a TSD.

S(5.4,5.9): Check Beacon - A transition to S5.9 shall occur upon detection of a BFSD on the Active ring.

S(5.4,5.10a): No MFSD Received - A transition to state S5.10 shall occur immediately upon detecting the loss of the MFSD.

S(5.4,5.10b): MFED in INFO Field - A transition to state S5.10 shall occur immediately upon detecting a MFED in the Information field. the length of which is determined by a valid Word Count field.

S(5.4,5.10c): No MFED After IFCS - A transition to state S5.10 shall occur immediately upon detecting the loss of the MFED after the Information FCS, the position of which is determined by a valid Word Count field.

3.5.1.10.5 S5.5: Token Claim: The Token Claim state shall be entered after receiving the Token Status 1 field when the RIU has a message to send, the Token is free, and the priority of the message is greater than, or equal to, the priority of the Token. The RIU shall set the Token Status 1 to zero. The Short Message Count field shall be received, the format checked, and the value saved. The Token Status 2 field shall be received, the format checked, and the value checked to be one. The Token Status 2 shall then be set to zero. The Loop Time

3.5.1.10.5 (Continued):

Counter and the Uncontrolled Transmit Inhibit Timer shall be restarted and the Lost Free Token Counter reset. The Reservation field shall be received, the format checked, and retransmitted with the value of all ones, the lowest priority. The Token Ending Delimiter shall be received, checked, and stripped while the IFA field is transmitted. Subsequent symbols shall be received, monitored, and stripped. State transitions shall occur as follows:

S(5.5,1.1): Loss of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(5.5,1.2): Reset by Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(S.5,2.1a): Restart Reconfiguration - A transition to state S2.1 shall occur if the Host commands the ring system to reconfigure.

S(5.5,2.1b): Line State Change - A transition to state S2.1 shall occur if the line state of the Active ring input changes from a valid signal to an invalid signal. This transition shall cause the counter rotating ring state machine (if present) to also enter S2.1.

S(5.5,2.1c): Counter Rotating Ring Indication - A transition to state S2.1 shall occur if the state machine defining the operation of the counter rotating ring indicates a transition to state S2.1.

S(5.5,5.6): Token Claimed - A transition to state S5.6 shall occur after transmitting the IFA field.

S(5.5,5.9): Check Beacon - A transition to S5.9 shall occur upon detection of a BFSD on the Active ring.

S(5.5,5.10a): Format Error - A transition to state S5.10 shall occur immediately upon detecting a Token Format error.

S(5.5,5.10b): Incorrect TS2 Field - A transition to state S5.10 shall occur immediately upon detecting the value of the Token Status 2 field to be zero.

S(S.5,5.10c): TED Not Received - A transition to state S5.10 shall occur immediately upon detecting that the Token Ending Delimiter is missing.

3.5.1.10.6 S5.6: Originate Message: The Originate Message state shall be entered after the RIU has claimed the Token. All received symbols shall be stripped from the ring. The MFSD shall be transmitted. The Priority, Retry Status Indicator, Word Count, Sending Address, and Destination Address shall be transmitted followed by the Message Control FCS calculated from them. The Information field shall be transmitted followed by the Information FCS calculated from it. The

3.5.1.10.6 (Continued)

MFED shall be transmitted followed by the Frame Status field. The Information Error Detected, Message Received, and Message Control Error Detected bits shall be transmitted as zeros while the Message Acknowledged bits shall be transmitted as ones. If a TSD is received, then the RIU shall be informed of the returning Token, the loop Time Counter disabled, and the lost Token Starting Delimiter Counter restarted. The format of the received Token shall be checked and must be a Claimed Token. The value in the returned Reservation field shall be saved and the RIU informed of the returned Reservation. The received Message frame shall be checked as if it were being repeated. The Sending Address shall also be compared with this station's address. The RIU shall be informed when the Message Control FCS has been received. State transitions shall occur as follows:

S(5.6,1.1): Loss of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(5.6,1.2): Reset by Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(5.6,1.3): UTIT Expires - A transition to state S1.3 shall occur immediately if the Uncontrolled Transmit Inhibit Timer expires. The status of the UTIT shall be made available to the Host.

S(5.6,2.1a): Restart Reconfiguration - A transition to state S2.1 shall occur if the Host commands the ring system to reconfigure.

S(5.6,2.1b): Line State Change - A transition to state S2.1 shall occur if the line state of the Active ring input changes from a valid signal to an invalid signal. This transition shall cause the counter rotating state machine (if present) to also enter S2.1.

S(5.6,2.1c): Counter Rotating Ring Indication - A transition to state S2.1shall occur if the state machine defining the operation of the counter rotating ring indicates a transition to state S2.1.

S(5.6,5.7): Message Transmission Complete - A transition to state S5.7 shall occur after the transmission of the IFA following the Frame Status field.

S(5.6,5.9): Check Beacon - A transition to S5.9 shall occur upon detection of a BFSD on the Active ring.

S(5.6,5.10a): Token Not Claimed - A transition to state S5.10 shall occur immediately if the received Token is free.

S(5.6,5.10b): Not This Station - A transition to state S5.10 shall occur if the received Sending Address is not the same as this station's address and the MCFCS is correct.

3.5.1.10.6 (Continued):

S(5.6,5.10c): Unexpected MFED - A transition to state S5.10 shall occur if a MFED is detected within the Information field and the MCFCS is correct.

3.5.1.10.7 S5.7: Issue Token: The Issue Token state shall be entered after the Message frame has been transmitted and shall control the issue of the free Token. All received symbols shall be tripped from the ring and, if a Token may not be issued immediately, IDLE symbols shall be transmitted. If the Multiple Message option is exercised, the Reservation has not been received in the returning Token, and the Short Message Count saved from the Token that was claimed is not equal to fifteen, the RIU shall increment the Short Message Count, restart the Loop Time Counter and Lost Token Starting Delimiter Counter, and issue a free Token with a Priority of seven, the new Short Message Count and a Reservation of seven. If the Multiple Message option is exercised and the Short Message Count saved from the Token claimed is equal to fifteen, then the RIU shall not issue a free Token until the RIU is informed of the returned Reservation. If the Multiple Message option is exercised and the Reservation has been received in the returning Token, the RIU shall restart the Loop Time Counter and the Lost Token Starting Delimiter Counter, and issue a free Token with a Priority equal to that returned in the Reservation field, a Short Message Count of Zero and a Reservation of seven. If the Multiple Message option is not exercised, the RIU shall not issue a free Token until the Reservation is received in the returning Token. At this time, the RIU shall restart the Loop Time Counter and Lost Token Starting Delimiter Counter and issue a free Token with a Priority equal to that returned in the Reservation field, a Short Message Count Field of fifteen, and a Reservation of seven. If a TSD is received, then the RIU shall be informed of the returning Token, the Loop Time Counter disabled, and the Lost Token Starting Delimiter Counter restarted. The format of the received Token shall be checked and must be a Claimed Token. The value in the returned Reservation field shall be saved and the RIU informed of the returned Reservation. The received Message frame shall be checked as if it were being repeated. The Sending Address shall also be compared with this station's address. The RIU shall be informed when the Message Control FCS has been received. If the Message Control FCS calculated is not the same as that contained in the Message frame, the end of the Message frame shall be determined by the MFED. If the Message Control FCS was received correctly then after the Information FCS is received, as determined by the Word Count, the MFED shall be received and checked. The Frame Status shall be received and the format checked. If the Message frame was transferred correctly, the status shall be made available to the Host. If the Message frame was not transferred correctly, it shall be retained for message retry, unless this was the retry or the message was not indicated to be retried. In this case, the status shall be made available to the Host and the message shall not be retried automatically. State transitions shall occur as follows:

3.5.1.10.7 (Continued):

S(5.7,1.1): Loss of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(5.7,1.2): Reset by Host - A transition to state SI.2 shall occur if the Host resets the RIU.

S(5.7,2.1a): Restart Reconfiguration - A transition to state S2.1 shall occur if the Host commands the ring system to reconfigure.

S(5.7,2.1b): Line State Change - A transition to state S2.1 shall occur if the line state of the Active ring input changes from a valid signal to an invalid signal. This transition shall cause the counter rotating ring state machine (if present) to also enter S2.1.

S(5.7,2.1c): Counter Rotating Ring Indication - A transition to state S2.1 shall occur if the state machine defining the operation of the counter rotating ring indicates a transition to state S2.1.

S(5.7,5.8): End of Token - A transition to state S5.8 shall occur after the Token Ending Delimiter of the free Token has been transmitted.

S(5.7,5.9): Check Beacon - A transition to S5.9 shall occur upon detection of a BFSD on the Active ring.

S(5.7,5.10a): Token Not Claimed - A transition to state S5.10 shall occur immediately if the received Token is free.

S(S.7,5.10b): Not This Station - A transition to state S5.10 shall occur if the received Sending Address is not the same as this station’s address and the MCFCS is correct.

S(5.7,5.10c): Unexpected MFED - A transition to state S5.10 shall occur if a MFED is detected within the Information field and the MCFCS is correct.

3.5.1.10.8 S5.8: Strip Message: The Strip Message state shall be entered after the free Token has been issued, shall control the completion of stripping the station’s message from the ring, and indicate to the Host the Message frame transfer success. IDLE symbols shall be transmitted and all received symbols shall be stripped from the ring. If a TO is received, then the RIU shall be informed of the returning Token, the Loop Time Counter disabled, and the Lost Token Starting Delimiter Counter restarted. The format of the received Token shall be checked and must be a Claimed Token. The received Message frame shall be checked as if it were being repeated. The Sending Address shall also be compared with this station’s address. The RIU shall be informed when the Message Control FCS has been received. If the Message Control FCS calculated is not the same as that contained in the Message frame, the end of the Message frame shall be determined by

3.5.1.10.8 (Continued)

the MFED. If the Message Control FCS was received correctly and after the Information FCS is received, as determined by the Word Count, the MFED shall be received and checked. The Frame Status shall be received and the format checked. If the Message frame was transferred correctly, the status shall be made available to the Host. If the Message frame was not transferred correctly, it shall be retried, unless this was the retry or the message was not indicated to be retried in which case the status shall be made available to the Host and the message shall not be retried automatically. State transitions shall occur as follows:

S(5.8,1.1): Loss of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(5.8,1.2): Reset by Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(5.8,2.1a): Restart Reconfiguration - A transition to state S2.1 shall occur if the Host commands the ring system to reconfigure.

S(5.8,2.1b): Line State Change - A transition to state S2.1 shall occur if the line state of the Active ring input changes from a valid signal to an invalid signal. This transition shall cause the counter rotating ring state machine (if present) to also enter S2.1.

S(5.8,2.1c): Counter Rotating Ring Indication - A transition to state S2.1 shall occur if the state machine defining the operation of the counter rotating ring indicates a transition to state S2.1.

S(5.8,5.1a): Valid Message Stripped - A transition to state S5.1 shall occur after the Frame Status field has been received if the Message was transferred correctly.

S(5.8,5.1b): Invalid Message Stripped - A transition to state S5.1 shall occur after the Frame Status field has been received if the Message was not transferred correctly.

S(5.8,5.9): Check Beacon - A transition to S5.9 shall occur upon detection of a BFSD on the Active ring.

S(5.8,5.10a): Token Not Claimed - A transition to state S5.10 shall occur immediately if the received Token is free.

S(5.8,5.10b): MFED Not Received - A transition to state S5.10 shall occur immediately if a MFED is not received.

S(5.8,5.10c): Unexpected MFED - A transition to state S5.10 shall occur if a MFED is detected within the Information field and the MCFCS is correct.

3.5.1.10.8 (Continued):

S(5.8,5.10d): Not This Station - A transition to state S5.10 shall occur if the received Sending Address is not the same as this station's address and the MCFCS is correct.

3.5.1.10.9 S5.9: Check Beacon: The Check Beacon state shall be entered when a Beacon Frame Starting Delimiter is received on the Active ring input. The RIU shall check that a valid Beacon frame is received.

S(5.9,1.1): Loss of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(5.9,2.1a): Reset by Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(5.9,2.1a): Restart Reconfiguration - A transition to state S2.1 shall occur if the Host commands the ring system to reconfigure.

S(5.9,2.1b): Restart Beacon - A transition to state S2.1 shall occur after receiving the BFED if the valid Beacon frame received is a Restart Beacon (Beacon Control = 2).

S(5.9,2.1c): Line State Change - A transition to state S2.1 shall occur if the line state of the Active ring input changes from a valid signal to an invalid signal. This transition shall cause the counter rotating ring state machine (if present) to also enter S2.1.

S(5.9,2.1d): Counter Rotating Ring Indication - A transition to state S2.1 shall occur if the state machine defining the operation of the counter rotating ring indicates a transition to state S2.1.

S(5.9,5.10a): Warm Start or Warm Recover Beacon - A transition to state S5.10 shall occur after receiving the BFED if the valid Beacon frame received is a Warm Start Beacon (Beacon Control I) or a Warm Recover Beacon (Beacon Control = 2).

S(5.9,5.10b): Invalid Beacon A transition to state S5.10 shall occur after receiving the BFED if the valid Beacon frame received is a Vie Beacon (Beacon Control = 3) or a Configure Beacon (Beacon Control = 4, 5 or 6) or an invalid Beacon frame is received.

3.5.1.10.10 S5.10: Warm Start: The Warm Start state shall be entered upon receiving a Warm Start or Warm Recover Beacon, or upon expiration of the Loop Time Counter, lost Token Starting Delimiter Counter, or Lost Free Token Counter. If a Warm Start Beacon was received, it shall be repeated; if this station is initiating Warm Start it shall issue a Warm Start Beacon. The Loop Time Counter shall be restarted and the lost Token Starting Delimiter Counter disabled. The data received at the Active ring input shall be retransmitted at the Active ring output and shall be monitored for a Warm Recover or Restart Beacon only. If this station is the Master Station, after retransmitting or issuing the Warm Start Beacon, the RIU shall transmit four IDLE symbols and issue a Warm Recover Beacon. Until the Warm Recover Beacon returns, it shall strip received symbols and transmit IDLE symbols. Upon return of the Warm Recover Beacon, the RIU shall strip the Beacon, restart the loop Time Counter, and issue a free Token with a Priority of seven, a Short Message Count of zero and a Reservation of seven.

S(5.10,1.1): Loss of Power - A transition to state S1.1 shall occur if the power is removed from the RIU.

S(5.10,1.2): Reset by Host - A transition to state S1.2 shall occur if the Host resets the RIU.

S(5.10,2.1a): Restart Reconfiguration - A transition to state S2.1 shall occur if the Host commands the ring system to reconfigure.

S(5.10,2.1b): Line State Change - A transition to state S2.1 shall occur if the line state of the Active ring input changes from a valid signal to an invalid signal. This transition shall cause the counter rotating ring state machine (if present) to also enter S2.1.

S(5.10,2.1c): Counter Rotating Ring Indication - A transition to state S2.1 shall occur if the state machine defining the operation of the counter rotating ring indicates a transition to state S2.1.

S(5.10,2.1d): Slave Station, No Warm Recover Beacon - A transition to state S2.1 shall occur if a Slave Station does not receive a valid Warm Recover Beacon within two Loop Times of repeating or transmitting the Warm Start Beacon. This transition shall cause the counter rotating ring state machine (if present) to also enter state S2.1.

S(5.10,2.1e): Master Station, No Warm Recover Beacon - A transition to state S2.1 shall occur if the Master Station does not receive a valid Warm Recover Beacon within a Loop Time of transmitting it. This transition shall cause the counter rotating ring state machine (if present) to also enter state S2.1.

3.5.1.10.10 (Continued):

S(5.10,2.1f): Restart Beacon - A transition to state S2.1 shall occur on detection of a valid Restart Beacon.

S(5.10,5.1a): Slave Station, Warm Recover Received - A transition to state S5.1 shall occur if a Slave Station receives a valid Warm Recover Beacon.

S(5.10,5.1b): Master Station, Warm Recover Received - A transition to state S5.1 shall occur after transmitting the Token Ending Delimiter if the Master Station receives a valid Warm Recover Beacon.

3.5.2 Priority Operation: A reservation priority mechanism shall be provided with eight levels of message priority. A station ready to transmit a Message frame (a bidding station) shall copy its Message frame priority level into the Reservation subfield of subsequent Claimed Tokens passing through, if its own Message frame priority is greater than the reservation already present. The transmitting station, upon return of its Claimed Token, shall compare the reservation subfield of the Claimed Token with the priority level of its next Message frame for transmission (if any). If this priority level is higher than the reserved priority, a free Token shall be issued with priority equal to that of the issuing station’s priority’. If the priority is lower, or the station has no further Message frames to transmit, then a free Token shall be issued with priority equal to the reservation level in the Claimed Token. Bidding stations that receive a free Token shall compare the priority level of the Token to that of their message priority level. A station may claim the free Token even if it has not set a reservation, if its Message frame priority is greater or equal to the free Token priority. A station that claims the free Token shall set the reservation field in the Claimed Token to the lowest value. The operation of the free Token originating station sending a reserved free Token to itself, rather than transmitting its next Message frame immediately when it has other Message frames of high priority to transmit, may slightly degrade throughput and latency. Allowing a station to retain the free Token, however, when it has many high priority messages to transmit, could create long periods during which a free Token is not issued. The operation described is therefore necessary in order to allow an equitable access to the medium.

3.5.3 Multiple Short Message Frame Option: A Short Message frame may occur when the length of the Message frame is such that transmission is complete before the Claimed Token returns to the originating station. Means may be provided for the simultaneous presence of more than one Short Message frame on the ring. This process allows one or more other stations to claim a free Token and transmit Message frames before stations that have previously originated Message frames begin to strip their Message frames. The option of allowing the presence of multiple short Message frames increases the throughput for Short Message frames, at the cost of priority order and increased Message frame latency, since during Multiple Short Message frame operation priorities are ignored. As a compromise between throughput and latency, a maximum of sixteen Short Message frames are allowed to occur in succession before a long Message frame is enforced and priority operation reestablished. The Multiple Short Message frame option may be disabled in

3.5.3 (continued)

the manner described in 3.5.3.3 should it be required by the system design to preserve priority operation for every Message frame. Use of the Multiple Short Message frame option does not effect priority operation for long Message frames.

3.5.3.1 Long Message: Since a free Token is not issued by the transmitting station before the Claimed Token returns, a free Token shall be issued at the reserved priority level. Thus, a long Message frame has the characteristic that the following free Token issued by the station contains a reserved priority. A long Message frame shall occur when the length of the Message frame is sufficiently long (as compared to the ring length) to fill the ring and thus allow the transmitting stations Claimed Token to return before transmission is complete. Specifically, a Message frame shall be considered long if the last bit of the Message frame is transmitted more than 40 bit times, plus maximum receiver, transmitter, elastic buffer, and token buffer (Master Station only) delays, after the first bit of the returning TSD is received.

3.5.3.2 Short Message: A short Message frame may occur when the length of the transmitted Message frame is such that transmission is complete before the Claimed Token returns to the originating station. Specifically, a Message frame transmission shall be considered short if the last bit of the Message frame is transmitted before the first bit of the returning TSD is received. In this case, a free Token of lowest priority shall be issued by the sending station on completion of transmission, provided that the Short Message Count had not reached fifteen in the free Token that was claimed prior to transmission. In the case of a Short Message Count of fifteen, a long Message frame shall be enforced. An enforced long Message frame shall be created by the transmitting station sending IDLE symbols after a short Message frame and not issuing a free Token until its Claimed Token has returned and priority levels set. A short Message frame has the characteristic that the free Token is issued, following the short Message frame, before its priority can be assigned.

3.5.3.3 Short Message Count: The Token format provides a four bit field to indicate a Short Message Count of zero to fifteen. In the case of a ring in which the Multiple Short Message frame option is not selected, the Short Message Count shall be set to fifteen by a station issuing a free Token. In the case of a ring in which the Multiple Short Message frame option is selected a station, upon transmission of a Short Message frame (which was not forced long) shall increment the Short Message Count in the free Token it issues and, upon transmission of a long Message frame, shall reset to zero the Short Message Count in the free Token it issues.

3.5.4 Ring Acquisition: A station having a Message frame ready for transmission (a bidding station) must claim the free Token in order to transmit its Message frame. This action proceeds as follows: a station, upon receipt of a Token, compares the priority field in the Token with the station's Message frame priority. A station with a Message frame of greater or equal priority and which sensed a free Token shall reset the Token Status bits, claiming the Token. This station shall then set the reservation field to the lowest priority and strip off the end delimiter of the Claimed Token.

3.5.4 (Continued)

A station which senses a Claimed Token shall not claim the Token. The Token format presents the Priority field first, followed by the Token Status bits, then the Reservation field. This placement allows the ring acquisition process to be implemented with minimal station delay. Attempting to claim a Claimed Token shall have no effect on the Token Status. The status of the Priority field must be evaluated in time to affect the Token Status bits. The Token Status bits must be evaluated in time to affect the Reservation field. The Short Message Count shall be copied and used in accordance with 3.5.3.3.

3.5.5 Message Frame Transmission: A station, after claiming a free Token, shall transmit its message. All error bit subfields following the Message End Delimiter shall be set inactive. The Message Received bits shall be set inactive and the Message Acknowledged bits shall be set active. A station, when transmitting, shall monitor but not repeat its input.

3.5.6 Message Frame Stripping: A station shall not repeat to its output the first Message frame received at its input following a Message frame transmission. This Message frame shall be its transmitted Message frame under error-free operation. The station shall check for message errors as described in 3.5.12.1 and shall evaluate the Frame Status field in its returning Message frame. Message error, receipt, and acknowledgement status shall be made available to the Host. A station, in following this procedure, shall begin stripping the Message frame on receipt of the TSD. The station shall check the Sending Address field and, if correct, shall continue stripping until the Message Frame Ending Delimiter is observed and the Frame Status field is removed. In the event that the Sending Address field is not correct, the station is the Master, has one nonoperational receiver input, the ring is in loop back, and this is the first attempt to transmit a message, an unviable configuration may be indicated. In this case, the station shall reset its effective beaconing address to zero and reenter reconfiguration. Otherwise the station shall indicate a Warm Start according to 3.5.12.12.

3.5.7 Token Issuance: A free Token shall be issued only by the station that currently holds the free Token, except under start-up and reconfiguration. Free Tokens shall be issued with the Priority field, and Short Message Count field set in accordance with appropriate priority, message, error recovery, or start-up protocols. A free Token shall be issued by the transmitting station immediately following its Message frame, unless-a long Message frame is to be enforced. If a short Message frame is transmitted that must be forced long, the free Token shall be issued as described in the short Message frame protocol. In all cases, after issuance of the Token, the station shall output IDLE symbols until Message frame stripping is complete, at which time it shall return to repeater operation and repeat its input.

3.5.8 Types of Service: An acknowledged datagram with Host selectable single automatic retry is the only type of service provided at this protocol layer in this document. All receiving stations shall execute Message frame receipt and acknowledge operations as specified in 3.5.11. The message originating station may be required to retransmit its Message frame as defined in 3.5.9.