Telecommunication Standardisation Sector
Study Group 15
Experts Group for Video Coding and Systems in
ATM and Other Network Environments

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SOURCE : Stuart Dunstan, Siemens Ltd
TITLE : Review of H.245 master slave determination procedures
PURPOSE : Proposal

1. Introduction

This document illustrates 'wo problems with the current master slave determination procedure in H.245 and presents modified procedures as solutions.

In addition, on October 5 Mile Nilsson proposed that the Master Slave Determination Signalling Entity (MSDSE) should initiate another determination procedure if the current result is indeterminate. The modifications to this document incorporate these procedures. These modifications are shown with change bars.

This document does not address the proposal from Mike Nilsson regarding the procedure for determining the master/slave/indeterminate result. The procedure is addressed in the subroutine "Determine status" on the final page of the MSDSE SDL, which can be modified as required.

On August 18 Hardish Singh wrote the following;

> Here's a scenario: Let's say the far-end H.245 terminal receives an MSD PDU, decides that it is the master, and attempts to send an MSDACK PDU (slave) to the near end. But suppose the far-end MSDACK never makes it to the far-end SRP layer (for whatever reason). The near end terminal's timer expires, and it *wrongly* generates a new statusDeterminationNumber, and sends a new MSD PDU to the far-end. Suppose this MSD PDU now makes the far end the slave and the near end the master. During the time that the far-end terminal flip flopped from master to slave, it may have issued a bi-directional open channel request as a master, which is wrong.

The above scenario is illustrated in Figure 1 where the remote end becomes the master. In Figure 1 states IDLE and AWAITING RESPONSE are labelled as "0" and "1" respectively.

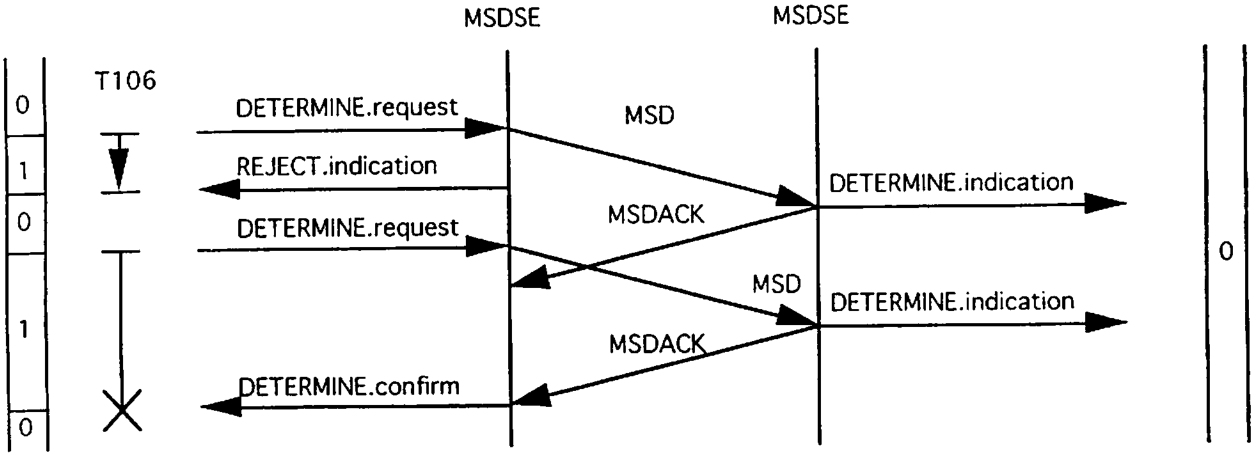

Figure 1

Master-slave determination procedure, with expiry of timer T106, followed by a second determination procedure.

The comments and Figure 1 highlight the following;

a) the remote terminal does not know if and when the near end terminal is ready
b) it is necessary to distinguish old MSDACK PDUs from a current one. This is illustrated in Figure 1 by the fact that the first MSDACK arrives at the near end during the second determination phase. It should be ignored.

One of the aims of H.245 procedures is to allow terminals to co ordinate call signalling phases. The current MSDSE fails to do this satisfactorily. With respect to a) the rule should be;

- a terminal should not initiate bi directional signalling procedures until it has received notification that the remote terminal is ready to accept them.

With respect to b) sequence numbers should be added to MSD and MSDACK PDUs.

2. Modified master slave determination procedures

2.1. Introduction

Examples of modified MSDSE procedures are first presented in the following figures, while Annex 1 gives a modified section 8.2/H.245 on MSDSE procedures, which formally defines these new procedures.

An important concept is the meaning given to the DETERMINE.indication and the DETERMINE.confirm primitives. This is summarised in the following table.

Table 2-1

Master slave determination - DETERMINE primitive meaning

	bi directional signalling procedure capability	
primitive	receive	initiate
DETERMINE.indication	allowed	not allowed
DETERMINE.confirm	allowed	allowed

As shown in the following figures, while the status result is known at the time of the DETERMINE.indication primitive, the terminal may not initiate any procedures relevant to the status determination result, until the DETERMINE.confirm primitive has been issued. The terminal may however accept procedures relevant to the status determination result, any time following the DETERMINE.indication primitive.

The feature of these procedures are that each terminal knows when the other terminal is ready to receive commands.

2.2. Examples

Figures 2-1 and 2-2 show normal determination procedures. Figure 2-3 shows the case of equal statusDeterminationNumbers. Figure 2-4 shows the case of determination procedures initiated simultaneously from both ends. Figures 2-5 to 2-9 show exception conditions, with expiry of timer T106.

In the following Figures IDLE, OUTGOING AWAITING RESPONSE, and INCOMING AWAITING RESPONSE states are labelled as "0", "1", and "2" respectively.

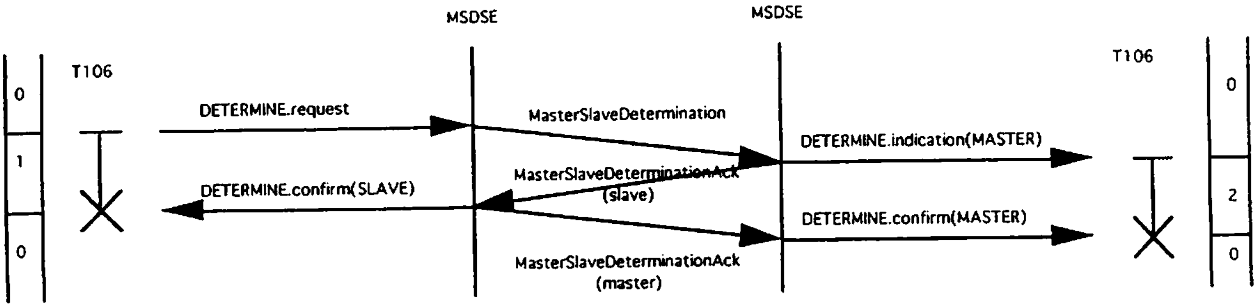
MSDSE
MSDSE
T106
T106
0
1
0
0
2
0
DETERMINE.request
MasterSlaveDetermination
DETERMINE.indication(MASTER)
MasterSlaveDeterminationAck (slave)
DETERMINE.confirm(SLAVE)
DETERMINE.confirm(MASTER)
MasterSlaveDeterminationAck (master)

Figure 2-1

Master slave determination - master at remote MSDSE

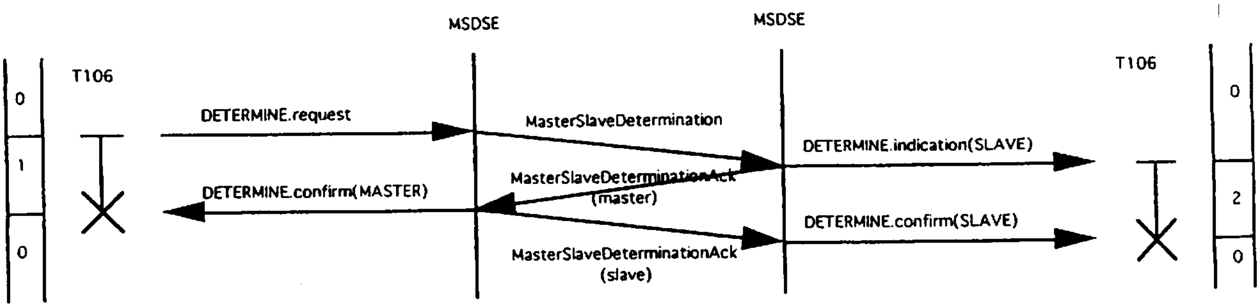
MSDSE
MSDSE
T106
T106
0
1
0
0
2
0
DETERMINE.request
MasterSlaveDetermination
DETERMINE.indication(SLAVE)
MasterSlaveDeterminationAck (master)
DETERMINE.confirm(MASTER)
DETERMINE.confirm(SLAVE)
MasterSlaveDeterminationAck (slave)

Figure 2-2

Master slave determination - slave at remote MSDSE

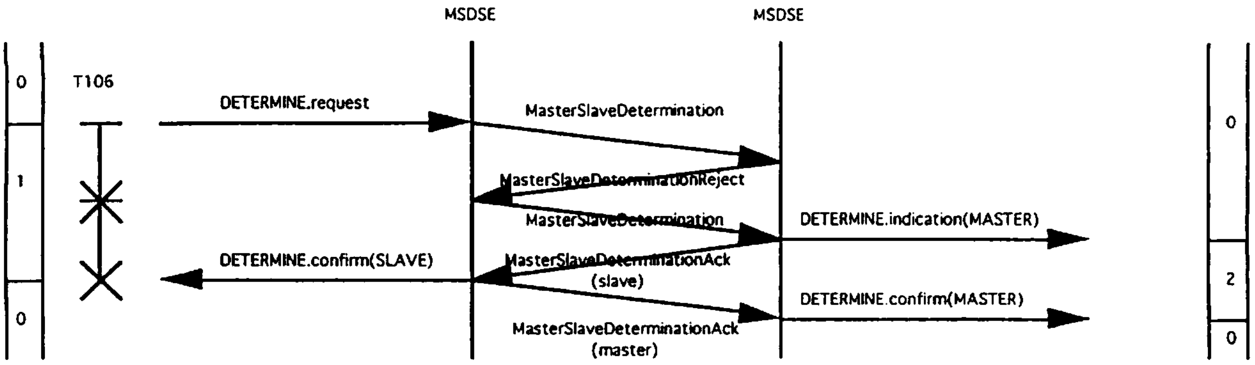
MSDSE
MSDSE
0
T106
DETERMINE.request
MasterSlaveDetermination
0
1
MasterSlaveDeterminationReject
MasterSlaveDetermination
DETERMINE.indication(MASTER)
DETERMINE.confirm(SLAVE)
MasterSlaveDeterminationAck
(slave)
2
0
DETERMINE.confirm(MASTER)
MasterSlaveDeterminationAck
(master)
0

Figure 2-3

Master slave determination - first attempt produced an indeterminate result. The second test was successful.

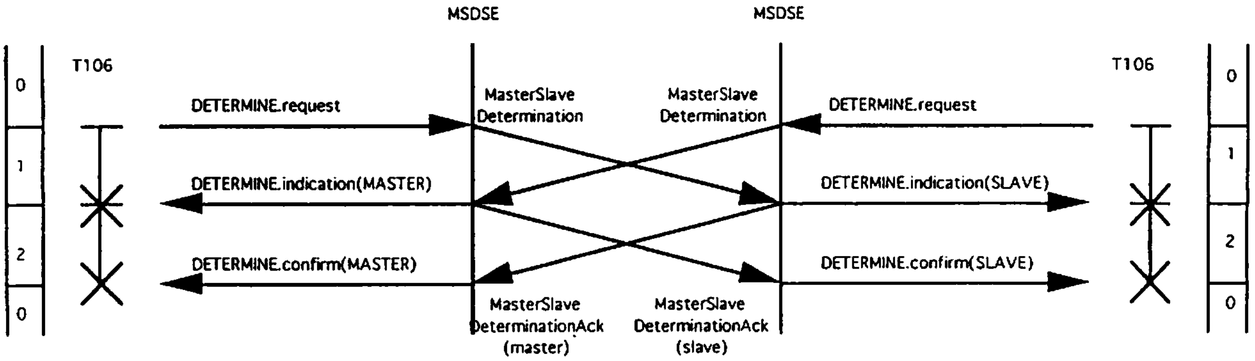

Figure 2-4

Master slave determination - simultaneous determination

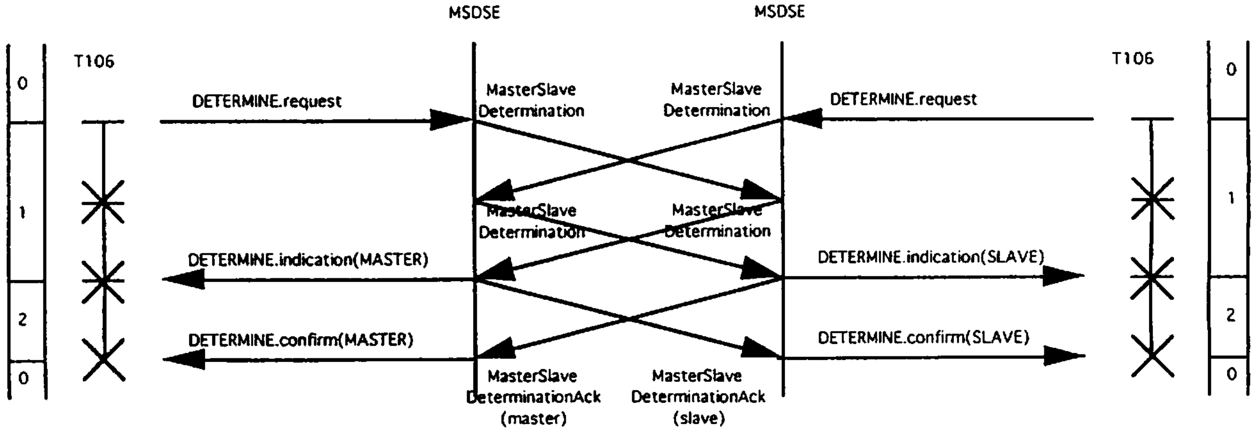

Figure 2-5

Master slave determination - simultaneous determination but with the first attempt returning an indeterminate result.

In Figure 2-6 local timer T106 has expired. Only the terminal on the right knows its status. The terminal on the right is able to receive new commands e.g openLogicalChannel (bi-directional), but may not request anything of the master terminal e.g open bi directional logical channel. The terminal on the left can neither accept nor initiate new procedures. A second status determination procedure should be initiated.

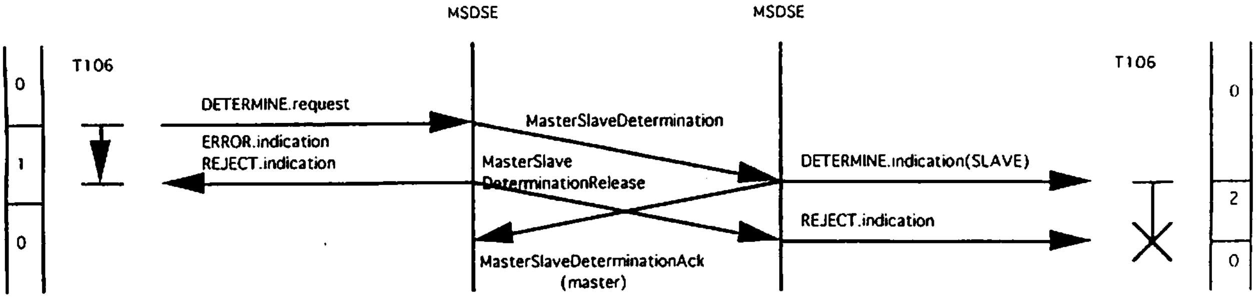

Figure 2-6

Master slave determination - local timer T106 expiry with slave at remote end.

In Figure 2-7 remote timer T106 has expired during INCOMING AWAITING ACKNOWLEDGEMENT. Both terminals know their status. The terminal on the left may receive and issue commands. However the remote terminal does not know if the local terminal is ready to receive, and can not issue commands. A second status determination procedure should be initiated.

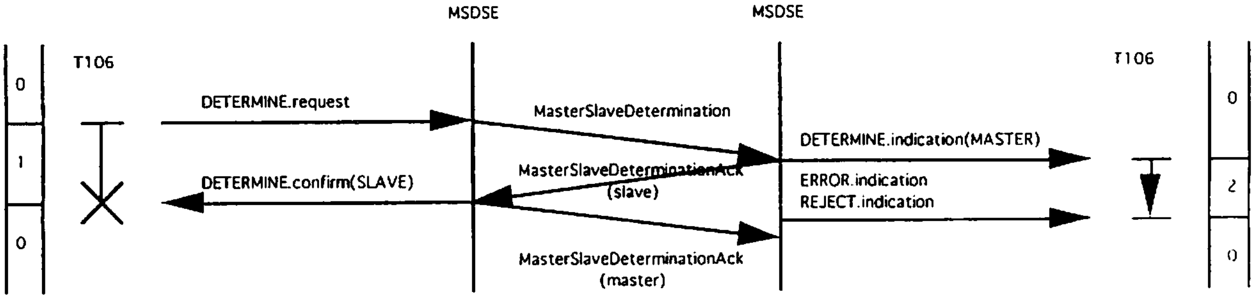

Figure 2-7

Master slave determination - remote timer T106 expiry with master at remote end.

In Figure 2-8 remote timer T106 has expired during OUTGOING AWAITING ACKNOWLEDGEMENT during a simultaneous determination procedure. Both terminals know their status. The terminal on the right can receive and issue commands. However the terminal on the left does not know if the other terminal is ready to receive, and can not issue commands. It may receive commands. A second status determination procedure should be initiated.

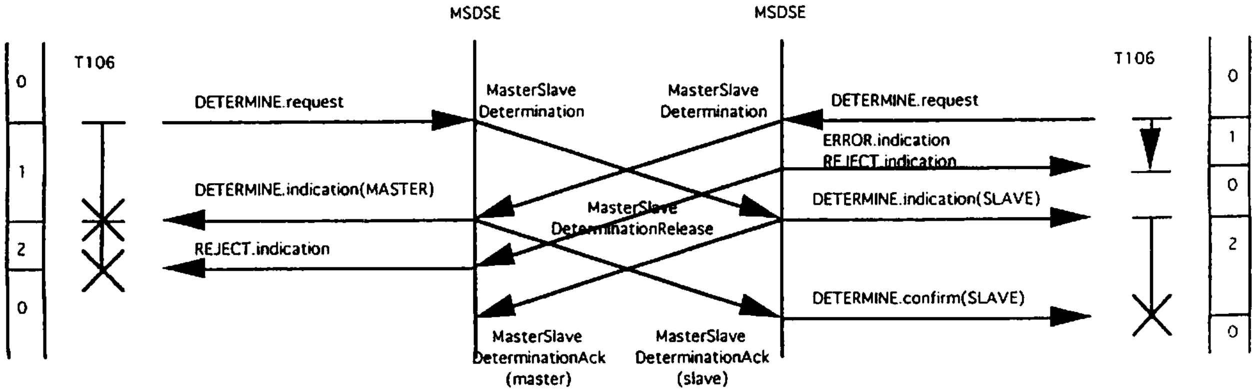

Figure 2-8

Master slave determination - simultaneous determination procedures with timer T106 expiry at slave.

In Figure 2-9 remote timer T106 has expired during INCOMING AWAITING ACKNOWLEDGEMENT, during a simultaneous determination procedure. Both terminals know their status. The terminal on the left can receive and issue commands. However the terminal on the right does not know if the other terminal is ready to receive, and can not issue commands. It may receive commands. A second status determination procedure should be initiated.

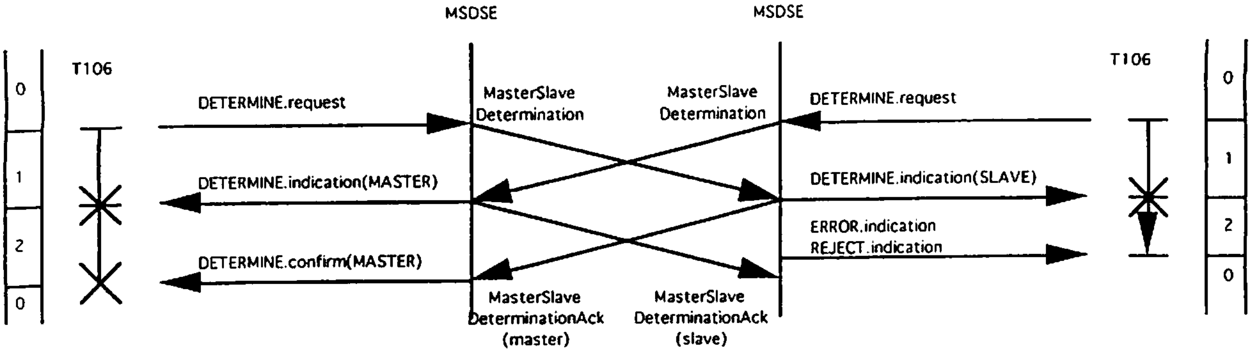
MSDSE
MSDSE
T106
0
1
2
0
DETERMINE.request
DETERMINE.indication(MASTER)
DETERMINE.confirm(MASTER)
MasterSlave Determination
MasterSlave Determination
MasterSlave DeterminationAck (master)
MasterSlave DeterminationAck (slave)
DETERMINE.request
DETERMINE.indication(SLAVE)
ERROR.indication
REJECT.indication
T106
0
1
2
0

Figure 2-9

Master slave determination - simultaneous determination procedures with timer T106 expiry during INCOMING AWAITING ACKNOWLEDGMENT.

In Figure 2-10 an indeterminate result was obtained N100 times. In this case N100 = 3.

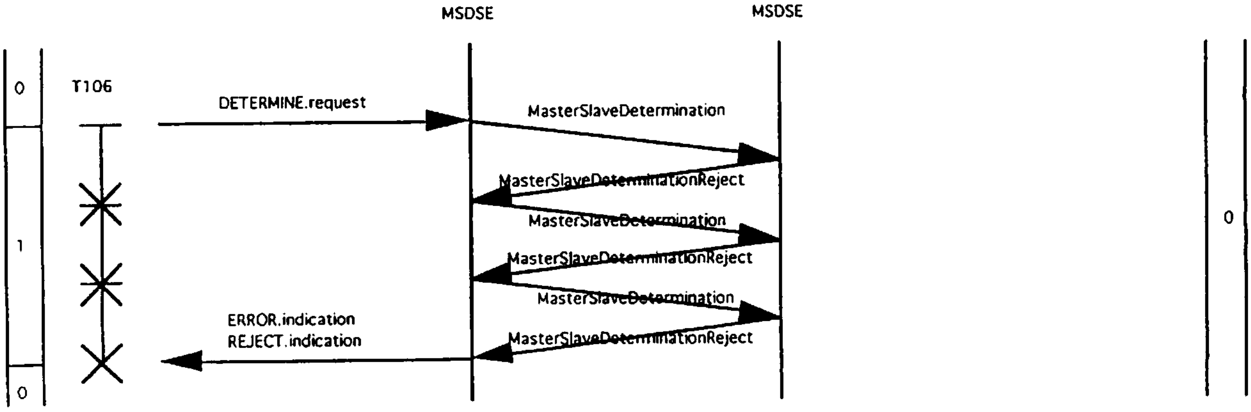

Figure 2-10

Master slave determination - indeterminate result with N100 = 3.

- end -

Annex 1

8.2 Master slave determination procedures

8.2.1 Introduction

Some procedures, such as bi-directional logical channel signalling, require one of the terminals involved in a communications call to act as a master terminal and the other terminal(s) involved in the call to act as slave terminals. The protocol defined here allows terminals in the call to determine which is the master terminal and which is the slave terminal.

The protocol described here is referred to as the Master Slave Determination Signalling Entity (MSDSE). There is one instance of the MSDSE in each terminal involved in a call.

Either terminal may initiate the master slave determination process by issuing the DETERMINE.request primitive to its MSDSE. The result of the procedure is returned by the DETERMINE.indication and DETERMINE.confirm primitives. While the DETERMINE.indication primitive indicates the result, it does not indicate that the result is known at the remote terminal. The DETERMINE.confirm primitive indicates the result and confirms that it is also known at the remote terminal.

A terminal shall not initiate procedures that require knowledge of the result until it has received confirmation that the remote terminal also has knowledge of the result. It shall, however, respond to procedures initiated at the remote terminal before it has confirmation that the remote terminal also has knowledge of the result.

The following text provides an overview of the operation of the protocol. In the case of any discrepancy with the formal specification of the protocol that follows, the formal specification will supersede.

Either terminal may initiate the master slave determination process by transmitting a random number, called statusDeterminationNumber. When a terminal receives such a number, it compares it with its own number, and the terminal with the larger number is determined as the master. The terminal that receives the statusDeterminationNumber acknowledges by sending the decision, that is, the status of the terminal that sent the statusDeterminationNumber. The initiating terminal, unless it has already sent an acknowledgment, responds to the receipt of an acknowledgment by sending one itself, to confirm to that remote terminal that it knows the result.

If both terminals have equal statusDeterminationNumbers, the terminal that receives the other's number responds with the rejection message indicating that the numbers were identical. In this case, the initiating terminal(s) shall transmit a new statusDeterminationNumber. This process shall be repeated until the two numbers are different or one or other terminal ends the connection.

8.2.2 Communication between the MSDSE and the MSDSE user

8.2.2.1 Primitives between the MSDSE and the MSDSE user

Communication between the MSDSE, and MSDSE user, is performed using the primitives shown in Table 17.

TABLE 17/H.245

Primitives and parameters

generic name	type			
	request	indication	response	confirm
DETERMINE	- [1]	TYPE	not defined [2]	TYPE
REJECT	not defined	CAUSE	not defined	not defined
ERROR	not defined	ERRCODE	not defined	not defined

Notes:

1. "-" means no parameters
2. "not defined" means that this primitive is not defined.

8.2.2.2 Primitive definition

The definition of these primitives is as follows:

a) The DETERMINE primitive is used to initiate, and to return the result from, the master slave determination procedure.

The DETERMINE.request primitive is used to initiate the master slave determination procedure.

The DETERMINE.indication primitive is used to indicate the result of the master slave determination procedure. As the result of the procedure may not be known at the remote terminal, the terminal shall not initiate any procedures that rely on knowledge of the result, although it shall respond to any procedures that rely on knowledge of the result.

The DETERMINE.confirm primitive is used to indicate the result of the master slave determination procedure and that the result of the procedure is known at both terminals. The terminal may initiate, and shall respond to, any procedures that rely on knowledge of the result.

b) The REJECT primitive indicates that the master slave determination procedure was unsuccessful.

{SD: Mike - I propose not to change the REJECT primitive from the current definition. I suggest that a REJECT.indication primitive is not generated upon an indeterminate result.}

c) The ERROR primitive reports MSDSE errors to a management entity.

8.2.2.3 Parameter definition

The definition of the primitive parameters shown in Table 17 are as follows:

a) The TYPE primitive indicates the terminal type. It has the value of "MASTER" or "SLAVE".

b) The CAUSE parameter indicates the reason for failure of the master slave determination procedure. It has the value of "PROTOCOL", which indicates a protocol error.

{SD: Can remove CAUSE parameter completely if desired.}

c) The ERRCODE value indicates the type of MSDSE error. Table xx indicates the values that the ERRCODE parameter may take.

8.2.2.4 MSDSE states

The following states are used to specify the allowed sequence of primitives between the MSDSE and the MSDSE user.

State 0: IDLE

No master slave determination procedure has been initiated.

State 1: OUTGOING AWAITING RESPONSE

The local MSDSE user has requested a master slave determination procedure. A response from the peer MSDSE is awaited.

State 2: INCOMING AWAITING RESPONSE

A master slave determination procedure has been initiated in the local MSDSE by the remote MSDSE. A response from the peer MSDSE is awaited.

8.2.2.5 State transition diagram

The allowed sequence of primitives between the MSDSE and the MSDSE is shown in Figure 2.

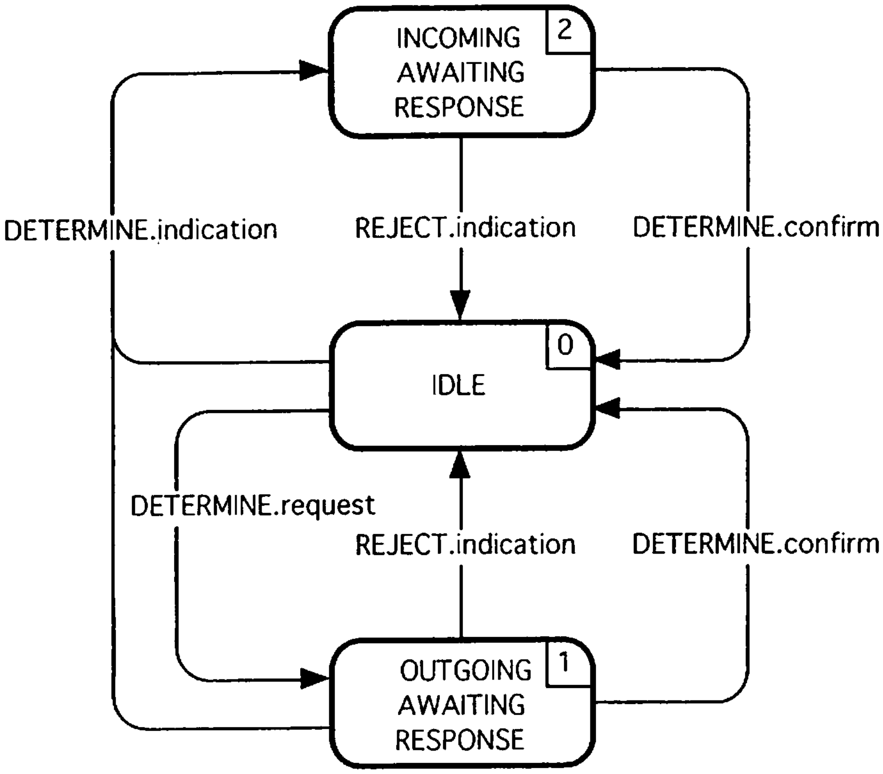

FIGURE 2/H.245

State transition diagram for sequence of primitives at MSDSE

8.2.3 Peer to peer MSDSE communication

8.2.3.1 MSDSE messages

Table 18 shows the MSDSE messages and fields, defined in section 6, which are relevant to the MSDSE protocol.

TABLE 18/H.245

MSDSE message names and fields

function	message	field
determination	MasterSlaveDetermination	sequenceNumber statusDeterminationNumber
	MasterSlaveDeterminationAck	sequenceNumber decision
	MasterSlaveDeterminationReject	sequenceNumber cause
error recovery	MasterSlaveDeterminationRelease	-

{SD: Shorthand PDU name has been removed in above table and from SDLs. In addition message transmission direction has been removed, since the MSDSE works in both directions}.

8.2.3.2 MSDSE state variables

The following MSDSE state variables are defined:

sv_SDNUM

This state variable holds the status determination number for this terminal.

sv_SQ

This state variable is used to indicate the most recent MasterSlaveDetermination message. It is incremented by one and mapped to the MasterSlaveDetermination message sequenceNumber field before transmission of an MasterSlaveDetermination message. Arithmetic performed on sv_SQ is modulo 256.

sv_STATUS

This state variable is used to store the result of the latest master slave determination procedure. It has values of "master", "slave", and "indeterminate".

sv_NCOUNT

This state variable is used to count the number of MasterSlaveDetermination messages that have been sent during the OUTGOING AWAITING RESPONSE state.

8.2.3.3 MSDSE timers

The following timer is specified for the MSDSE:

[SD: Removed word "outgoing" from the above sentence]

T106

This timer is used during the OUTGOING AWAITING RESPONSE and during the AWAITING RESPONSE states. It specifies the maximum allowed time in which no acknowledgment message may be received.

8.2.3.4 MSDSE parameters

The following parameter is specified for the MSDSE:

N100

This parameter specifies the maximum value of sv_NCOUNT.

8.2.4 MSDSE procedures

8.2.4.1 Introduction

Figure 3 summarises the MSDSE primitives and their parameters, and messages.

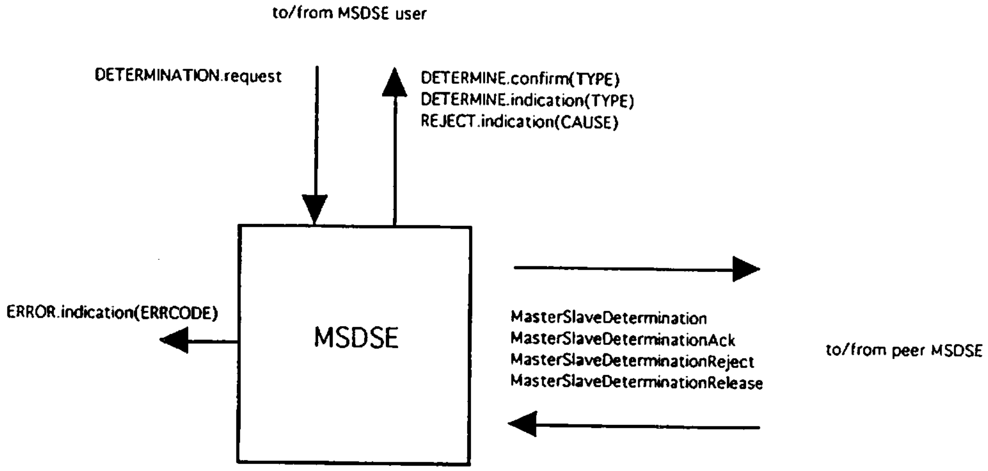
to/from MSDSE user
DETERMINATION.request
DETERMINE.confirm(TYPE)
DETERMINE.indication(TYPE)
REJECT.indication(CAUSE)
ERROR.indication(ERRCODE)
MSDSE
MasterSlaveDetermination
MasterSlaveDeterminationAck
MasterSlaveDeterminationReject
MasterSlaveDeterminationRelease
to/from peer MSDSE

FIGURE 3/H.245

Primitives and messages in the MSDSE.

8.2.4.2 Primitive parameter default values

Where not explicitly stated in the SDL diagrams the parameters of the indication and confirm primitives assume values as shown in Table 19.

TABLE 19/H.245

Default primitive parameter values

primitive	parameter	default value
DETERMINE.confirm	TYPE	MasterSlaveDeterminationAck.decision
DETERMINE.indication	TYPE	sv_STATUS
REJECT.indication	CAUSE	PROTOCOL

8.2.4.3 Message field default values

Where not explicitly stated in the SDL diagrams the message fields assume values as shown in Table 20.

TABLE 20/H.245

Default message field values

message	field	default value
MasterSlaveDetermination	sequenceNumber statusDeterminationNumber	sv_SQ sv_SDNUM

MasterSlaveDeterminationAck	sequenceNumber
	decision
		MasterSlaveDetermination.sequenceNumber
		Opposite of sv_STATUS i.e
		if(sv_STATUS == master) decision = slave
		if(sv_STATUS == slave) decision = master

MasterSlaveDeterminationReject	sequenceNumber cause	MasterSlaveDetermination.sequenceNumber identicalNumbers

{SD: PDU names removed in above table}

8.2.4.4 ERRCODE parameter values

Table xx shows the values that the ERRCODE parameter of the ERROR.indication primitive may take for the MSDSE.

TABLE xx/H.245

ERRCODE parameter values at MSDSE

error type	error code	error condition	state
no response from peer MSDSE	A	local timer T106 expiry	OUTGOING AWAITING RESPONSE INCOMING AWAITING RESPONSE
remote sees no response from local MSDSE	B	remote timer T106 expiry	OUTGOING AWAITING RESPONSE INCOMING AWAITING RESPONSE
inappropriate PDU	C	MasterSlaveDetermination	INCOMING AWAITING RESPONSE
	D	MasterSlaveDeterminationReject	INCOMING AWAITING RESPONSE
inconsistent field value	E	MasterSlaveDeterminationAck.decision != sv_STATUS	INCOMING AWAITING RESPONSE
maximum number of retries	F	sv_NCOUNT == N100	OUTGOING AWAITING RESPONSE

{SD: PDU names removed in above table}

8.2.4.5 SDLs

The MSDSE procedures are expressed in SDL form in Figure 4.

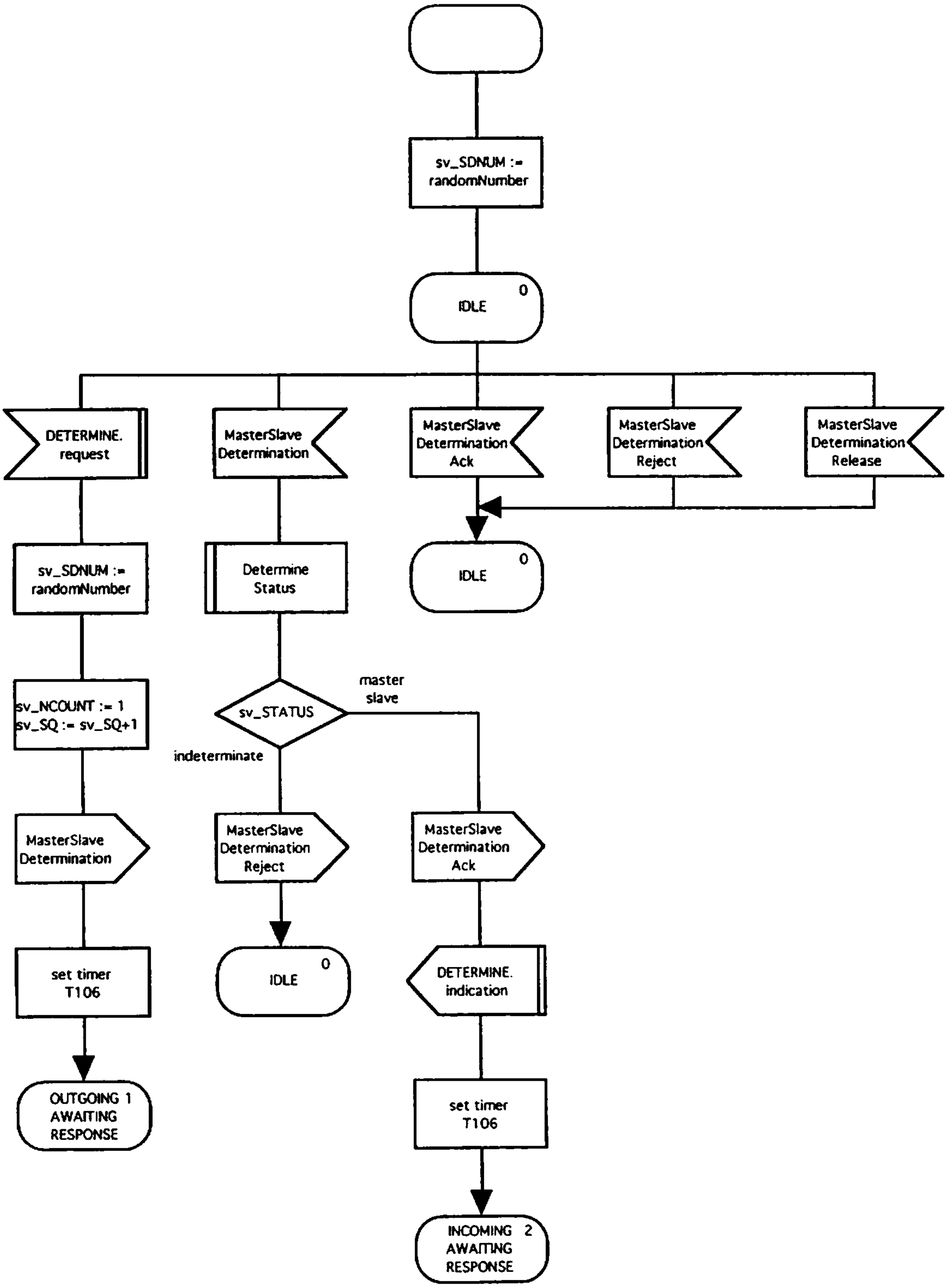
sv_SDNUM := randomNumber
IDLE 0
DETERMINE. request
MasterSlave Determination
MasterSlave Determination Ack
MasterSlave Determination Reject
MasterSlave Determination Release
sv_SDNUM := randomNumber
Determine Status
IDLE 0
sv_NCOUNT := 1
sv_SQ := sv_SQ+1
sv_STATUS
master
slave
indeterminate
MasterSlave Determination
MasterSlave Determination Reject
MasterSlave Determination Ack
set timer T106
IDLE 0
DETERMINE. indication
OUTGOING 1 AWAITING RESPONSE
set timer T106
INCOMING 2 AWAITING RESPONSE

FIGURE 4/H.245
MSDSE SDL

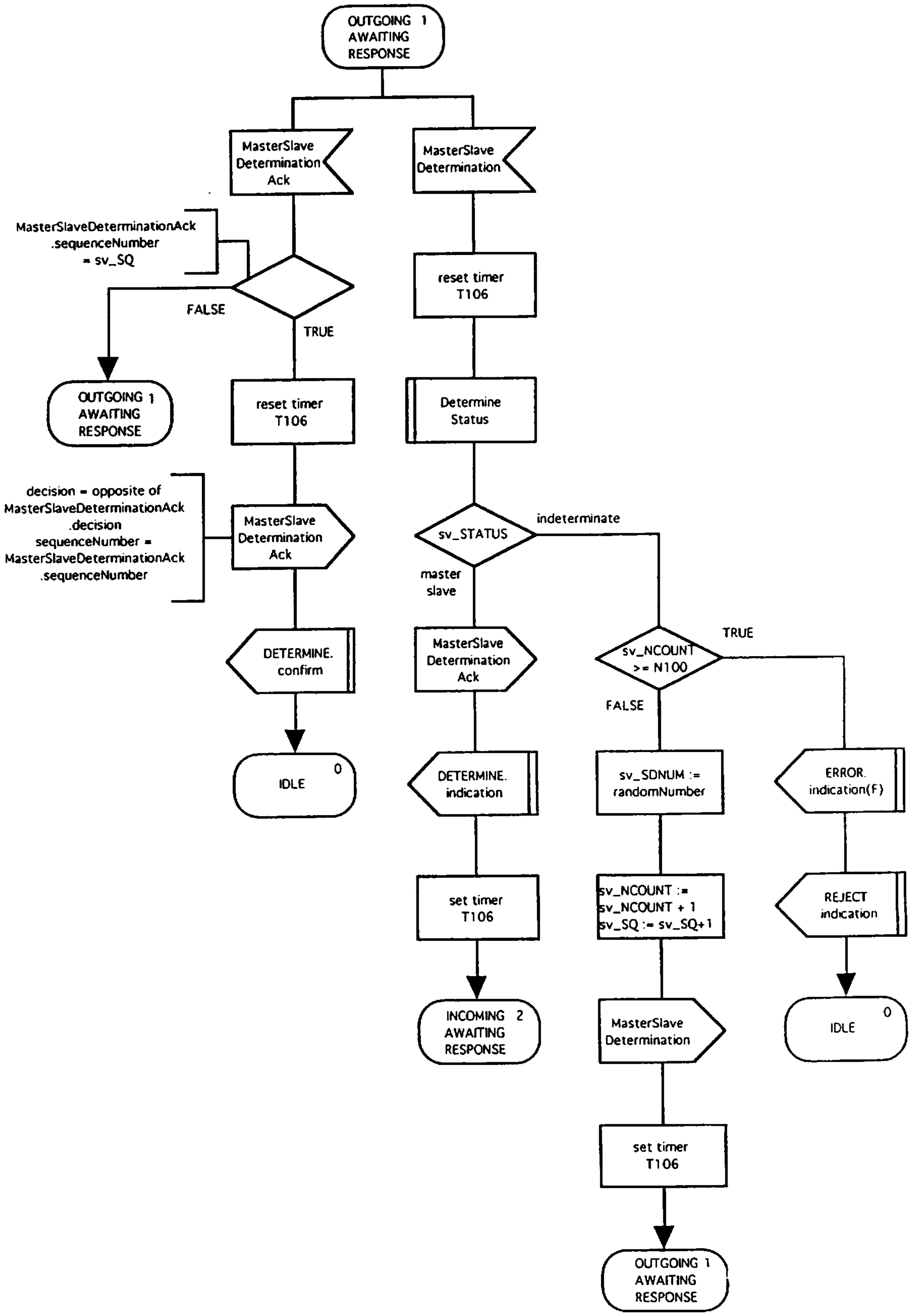

FIGURE 4/H.245

MSDSE SDL (continued)

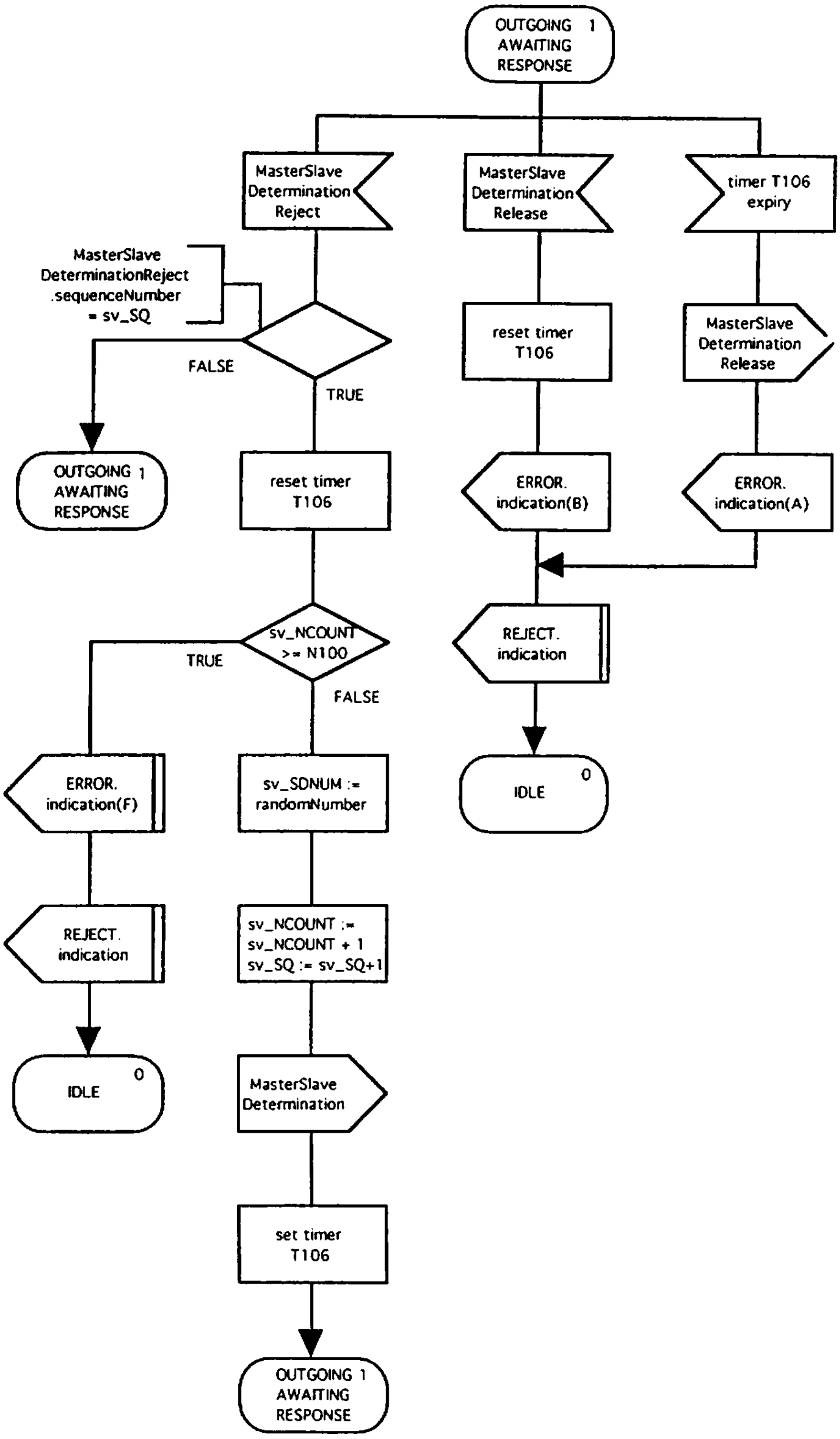

FIGURE 4/H.245

MSDSE SDL (continued)

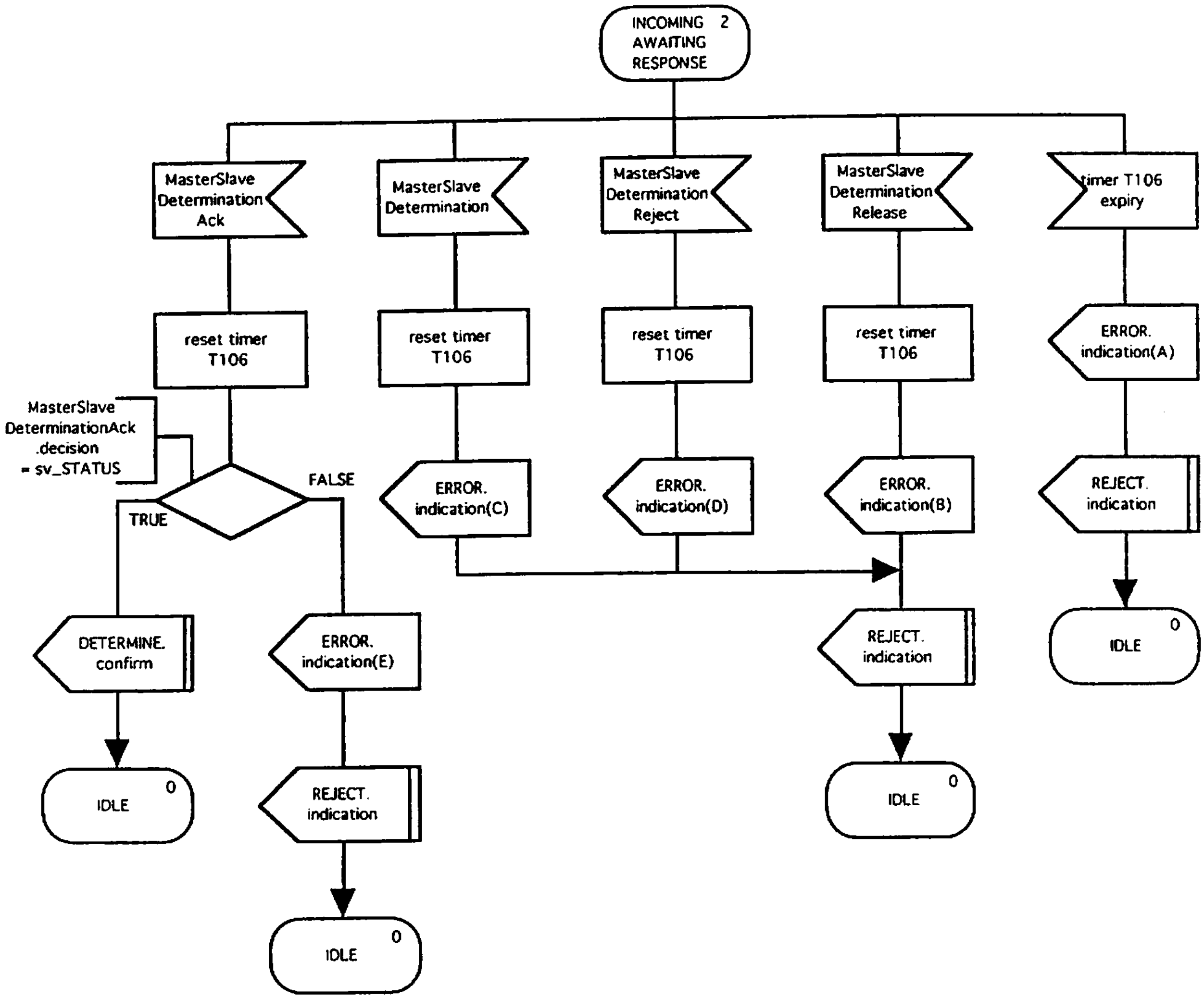

FIGURE 4/H.245

MSDSE SDL (continued)

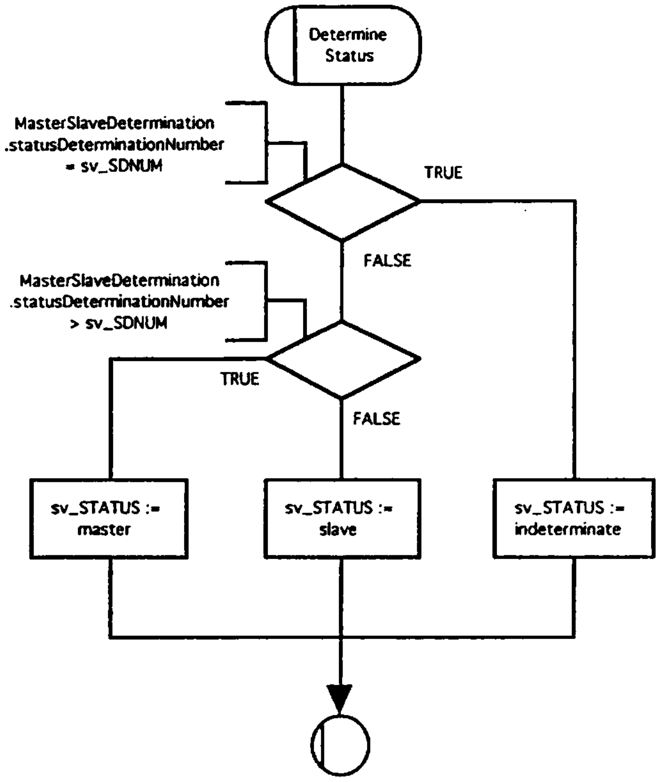
Determine Status
MasterSlaveDetermination .statusDeterminationNumber = sv_SDNUM
TRUE
FALSE
MasterSlaveDetermination .statusDeterminationNumber > sv_SDNUM
TRUE
FALSE
sv_STATUS := master
sv_STATUS := slave
sv_STATUS := indeterminate

FIGURE 4/H.245

MSDSE SDL (concluded)

{SD: Above subroutine can be modified for any new status determination strategy.}