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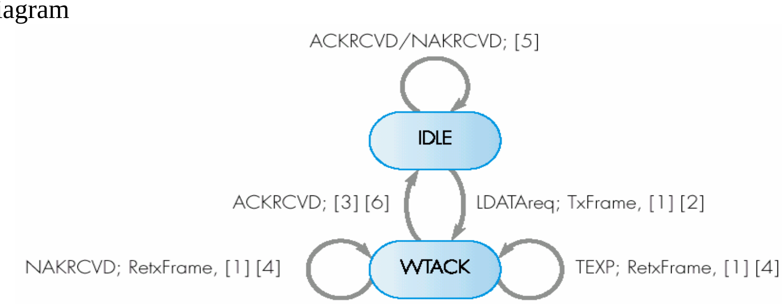
CS455 Data Communications
Homework #5
March 23, 2005

1. (6.37) Using the abbreviated names listed in Figure 6.32, show how the idle RQ primary can be specified in the form of:

i. a state transition diagram



The state transition diagram shows the possible states of the idle RQ protocol. The directional arrows show the possible state transitions. The incoming event causing the transition is noted first, with the resulting event and specific actions written next. There are two states in this diagram, the IDLE state, where no message transfer is in progress and the WTACK state, where we are waiting for an acknowledgement. An example of idle RQ follows, starting in the IDLE state. We receive an LDATAreq from the LS_user. This causes a TxFrame with a Start_timer using TIM_user queue and Increment Vs. We are now in the WTACK state waiting for an acknowledgement of the transferred frame. From here we either have a TEXP, NAKRCVD, or ACKRCVD event. The TEXP event and the NAKRCVD event both cause a RetxFrame with the timer restarted, Start_timer using TIM_user queue and an Increment RetxCount while remaining in the WTACK state. A ACKRCVD event will move us back into the IDLE state while Stop_timer using TIM_user queue and Reset RetxCount to zero are implemented. From the IDLE state, we can either receive a ACKRCVD or NAKRCVD event that will cause an Increment ErrorCount, or a LDATAreq that will bring us back to the beginning of this example.

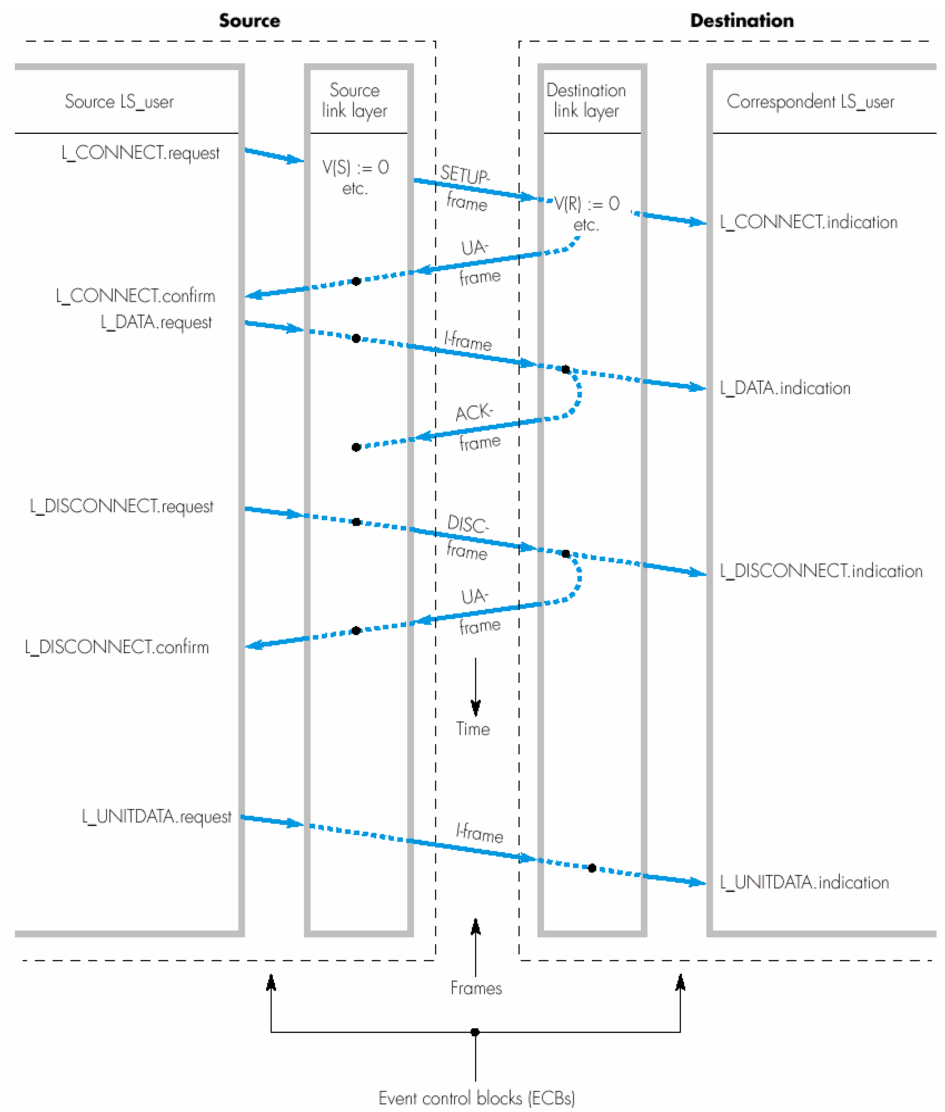
ii. an extended event-state table

Present state \ Incoming event	LDATAreq	ACKRCVD	TEXP	NAKRCVD
IDLE	1	0	0	0
WTACK	4	2	3	3

0 = [5], IDLE (error condition)
1 = TxFrame, [1] [2], WTACK
2 = P0 and P1: [3] [6], IDLE
P0 and NOT P1: RetxFrame, [1] [4], WTACK
NOT P0 and NOT P1: [5], IDLE
3 = RetxFrame, [1] [4], WTACK
4 = NoAction, WTACK

In the extended event-state table, we can represent all of the possible incoming events and protocol states in the form of a table. The columns in the table represent the different incoming events and the rows represent the different protocol states. The extended event-state table allows for all possible incoming-event, present-state combinations. The cell informs us of the actions that need to be executed for each event-state combination and the example above can be followed in the table here as well.

2. (6.38) with the aid of a time sequence diagram, show a typical set of link layer service primitives assuming the link layer provides



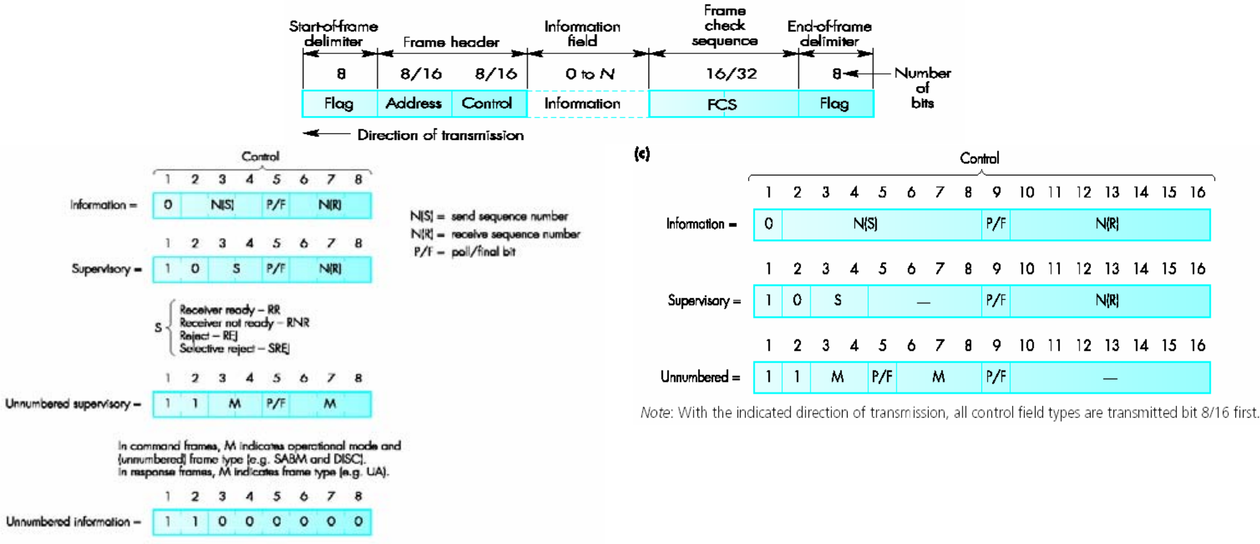
i. A reliable service and

With a reliable service, we ensure connections and disconnects as well as acknowledgements of I-frames. Communication begins with the link setup phase where a connection request is made, and a confirmation is sent back. From here we enter the link management phase where data requests are made with acknowledgements sent back. When all of the data is successfully exchanged, a disconnect request is sent with a confirmation replied. The use of requests and acknowledgements makes this a reliable, or connection-oriented, service.

ii. A best-effort service.

The connectionless, or best-effort, service is shown in the bottom of the diagram above. Since it is not necessary to set up a logical connection before sending blocks of information, best-effort service is known as connectionless. In this mode of operation, we discard any and all frames received with errors, unlike the reliable service, and therefore called a best-effort service.

3. (6.39) In relation to the HDLC frame format shown in Figure 6.36, explain the meaning and use of the following terms:



i. Supervisory Frames

Supervisory Frames are all frames in which error and flow control is performed.

ii. Unnumbered Frames

Unnumbered Frames are the various frames that are used to set up and disconnect a logical link.

iii. Poll/final bit

The P/F or Poll/Final bit is called a poll bit when used in a command frame and indicates that the receiver must acknowledge the frame. It is called a final bit in the response frame when the receiver acknowledges the frame.

iv. Command and response frames

Command frames are sent by the primary station, while the Response frames are sent by the secondary station.

v. Extended control field bit definitions

There are used for applications involving very long links, such as satellites, or for links that involve very high bit rates. These links require a larger send window if a high link utilization is to be achieved. Then the extended format used 7 bits (0 through 127) thereby increasing the maximum send window to 127.

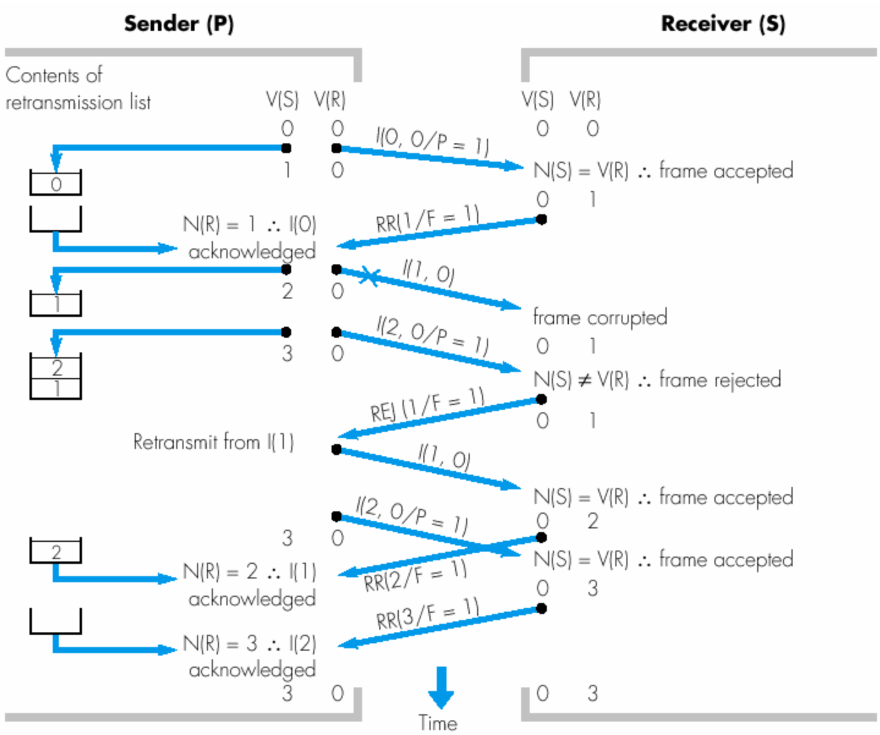
vi. Piggyback acknowledgment

In the Piggyback acknowledgment, since each I-frame contains an N(s), or send sequence number, and an N(R), or receive sequence number, when the N(R) is acknowledging frames flowing in the reserve direction.

vii. Unnumbered information frame

The unnumbered information frames are used in the set up of a logical link between the primary and the secondary, and also as a means of informing the secondary of the mode of operation to be used.

4. (6.40) with the aid of the frame sequence diagram shown in Figure 6.37, explain how a corrupted I-frame is overcome in the normal response mode. Include in your explanation the use of the P/F bit.



When the receiver (S) detects that I-frame I(2,0/P = 1) is out of sequence, it returns an REJ (1/F = 1) frame. This means that the sender (P) has sent the I-frame with a P bit indicating that an acknowledgment of the frame is needed. Since the frame was out of sequence, S sends a negative acknowledgment (REJ) frame with the F bit set indicating the (negative) acknowledgment. P picks up on the negative acknowledgment and retransmits the needed frame (without the P bit) and continues to send the remaining frames with the P bit set.