

SMU Course #: EETS 7315

DATA COMMUNICATIONS

Week #5 -- Dr. Baker

Formats of the Control Field

Control field format for	Control field bits							
	1	2	3	4	5	6	7	8
Information transfer command/response (I format)	0	N(S)			P F	N(R)		
Supervisory commands/responses (S format)	1	0	S	S	P F	N(R)		
Unnumbered commands/responses (U format)	1	1	M	M	P F	M	M	M

The Common Unnumbered Commands & Responses

Command/ Response	M Values (Bits 3-8)	Command/ Response	M Values (Bits 3-8)
SNRM/	0 0 0 0 1	UI/UI	0 0 0 0 0
SABM/	1 1 1 0 0	XID/XID	1 1 1 0 1
DISC/	0 0 0 1 0	TEST/TEST	0 0 1 1 1
SNRME/	1 1 0 1 1	SIM/RIM	1 0 0 0 0
SABME/	1 1 1 1 0	/UP	0 0 1 0 0
/UA	0 0 1 1 0	/DM	1 1 0 0 0
/FRMR	1 0 0 0 1	/RD	0 0 0 1 0

The Connection Classes

1. Meanings of U & B

- Unbalanced - There is one command TE and one or more response TEs. The two types do not have equal authority.
- Balanced - There are two and only two TEs in the link. They have equal authority. They can each send commands and responses.

The Connection Classes

2. Meanings of N & A

- Normal - A response TE cannot initiate response to a command unless polled. Last frame of response contains F=1.
- Asynchronous* - A response TE may respond to any command. If polled, it responds with F=1 at its earliest convenience.

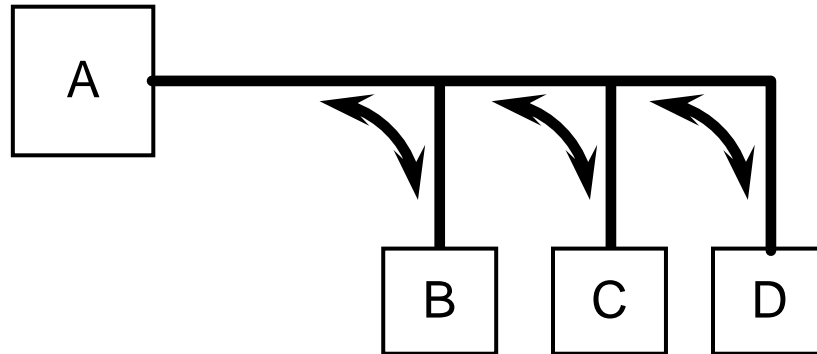
*Note that this use of the word "asynchronous" has nothing to do with bit timing.

Review: UN Class of HDLC* (a.k.a. Normal Response Mode)

- Unbalanced -- There is one command TE on the link (called the Primary Station), and one or more response TEs (called Secondary Stations).
- Normal -- A response TE can only initiate a transmission after receiving a poll.

*Remember, we are talking connection-oriented.

Example Configuration for UN Class of HDLC



In this case, "A" would be the primary station; the other TEs would be secondaries.

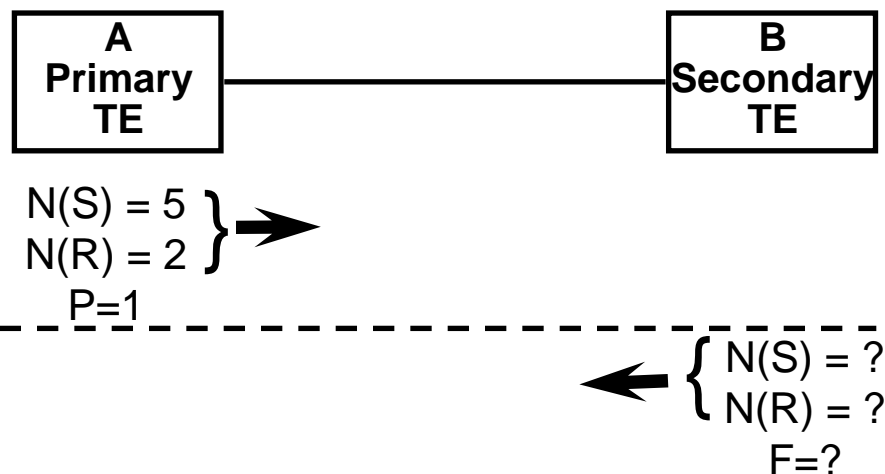
Frame Accountability

- Almost all connection-oriented HDLC systems use a technique called "continuous ARQ with pullback." (a.k.a. "Go back N")
- Each station sends frames in order.
- If a missing frame is detected, the sender "pulls back" to the errored frame and transmits in order from that point.

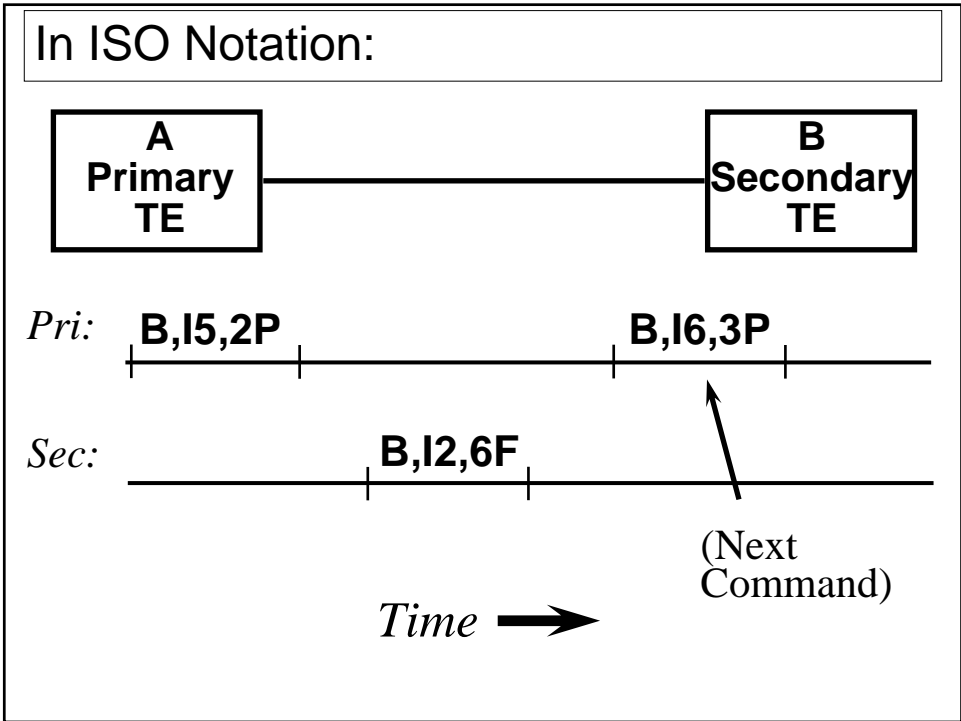
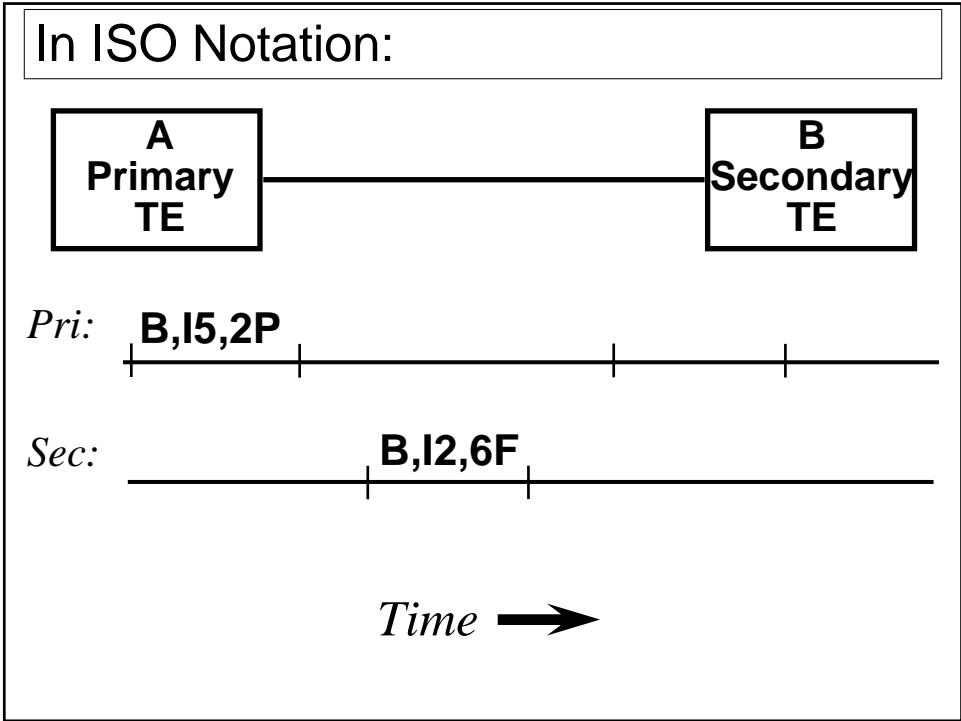
The "N" Counters

- Both the N(S) and N(R) counters are modulo 8 counters that can hold the values 0-7. The counters keep advancing until reset to 0 by a SNRM command.
- Only "I" frames have an N(S) counter.
- The value of N(S) in a frame is the count of "I" frames sent as of that particular frame.
- The value of N(R) is the N(S) value that the TE sending it expects to receive in the next "I" frame.

Simple TWA* Example



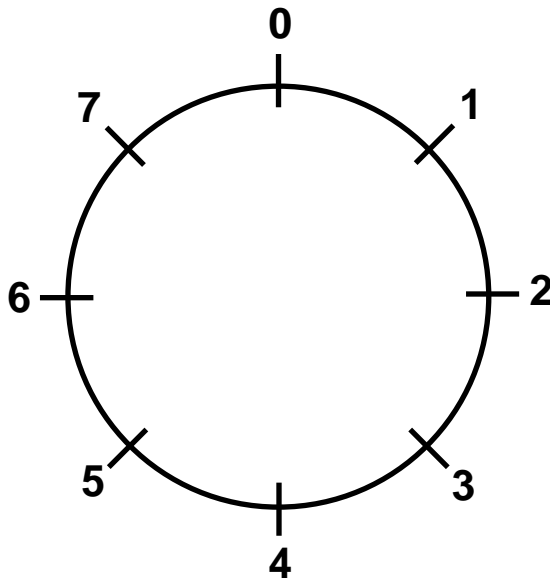
*Two-Way Alternate



The "Window" Concept

- The "Window" is defined as the maximum number of frames that can be outstanding (unacknowledged) in a system.
- In the previous example, $W = 1$.
- In any case, $W < \text{modulus of the frame counter}$.

The "Sliding Window"



Summary of UNC Operation

- The Primary is in control. It determines when the Secondary can send.
- Once the Secondary is polled, it can send one or more frames.
- The last frame sent by the Secondary has the "F" bit turned on.

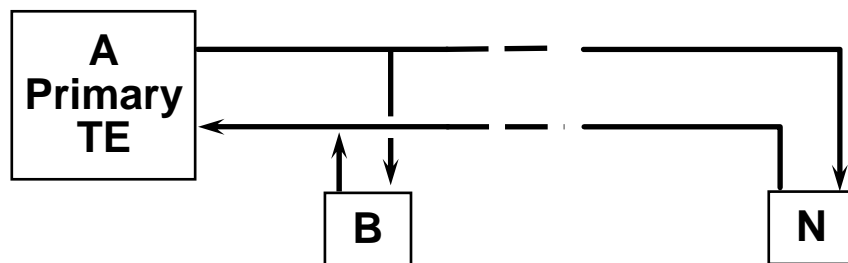
Formats of the Control Field

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The Supervisory Format

- The supervisory format of the C field can be used for:
- polling when there is no data to send
- responding to poll when there is no data to send
- exercising flow control
- forcing a retransmission
- checkpointing

Multipoint TWS* Example (UN Class)



- N sends 4 "I" frames to Primary while Primary sends 2 "I" frames to B.

*Two-way simultaneous

Note that:

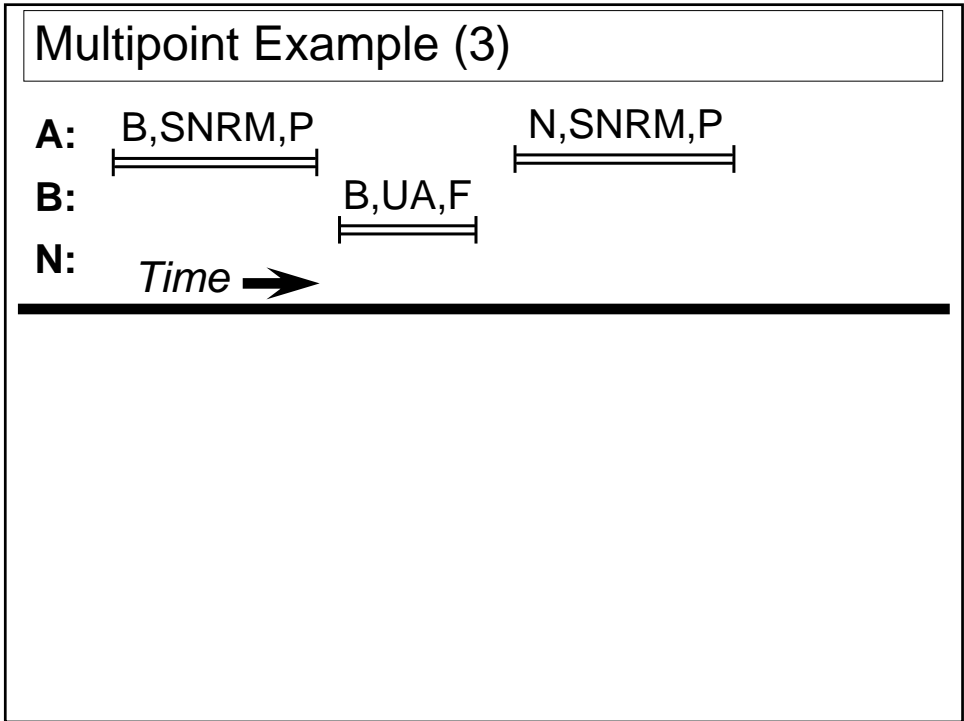
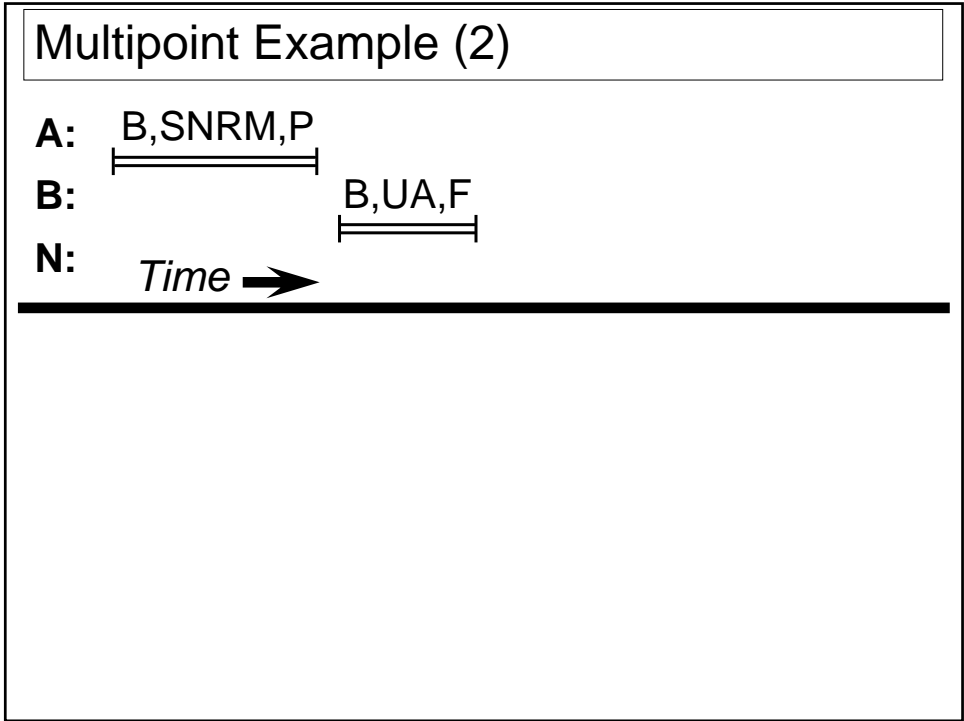
- Assuming sufficient window size, once polled, "N" can send all of its frames to "A" without pausing.
- Assuming sufficient window size, "A" can send all of its frames to "B" without pausing.
- "A" must prevent collisions between transmissions of secondaries by allowing only one to transmit at a time. (This is the Line Control function.)

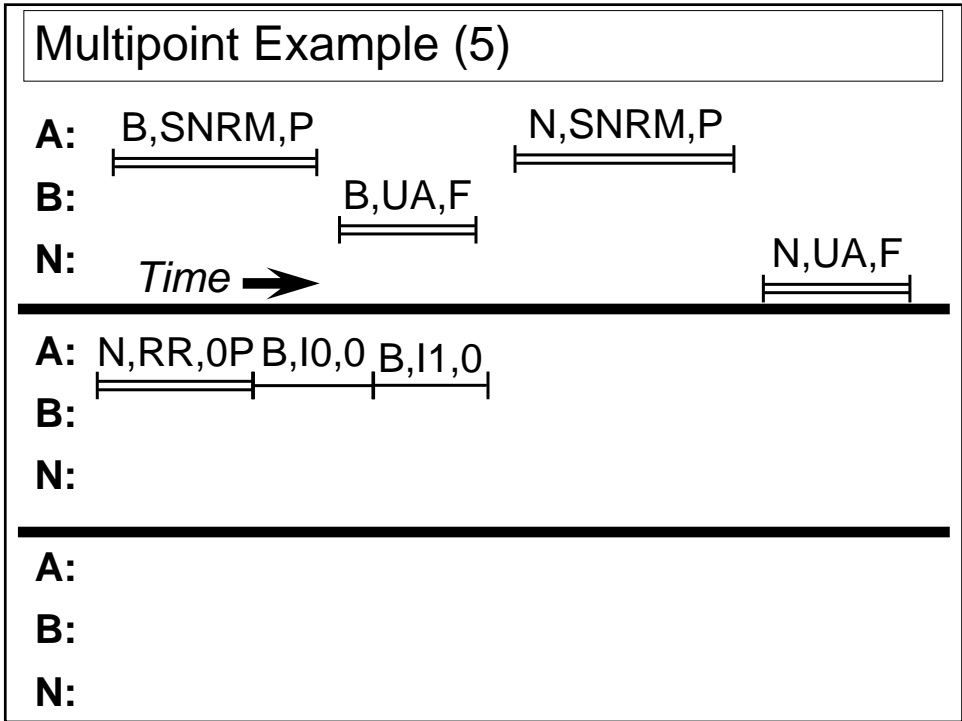
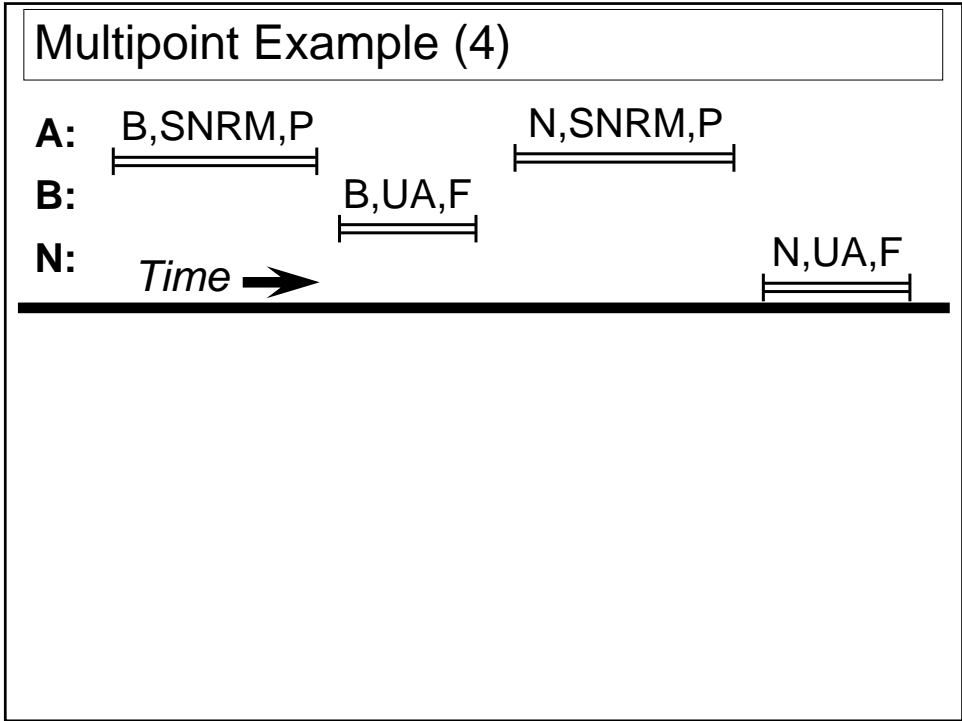
Multipoint Example (1)

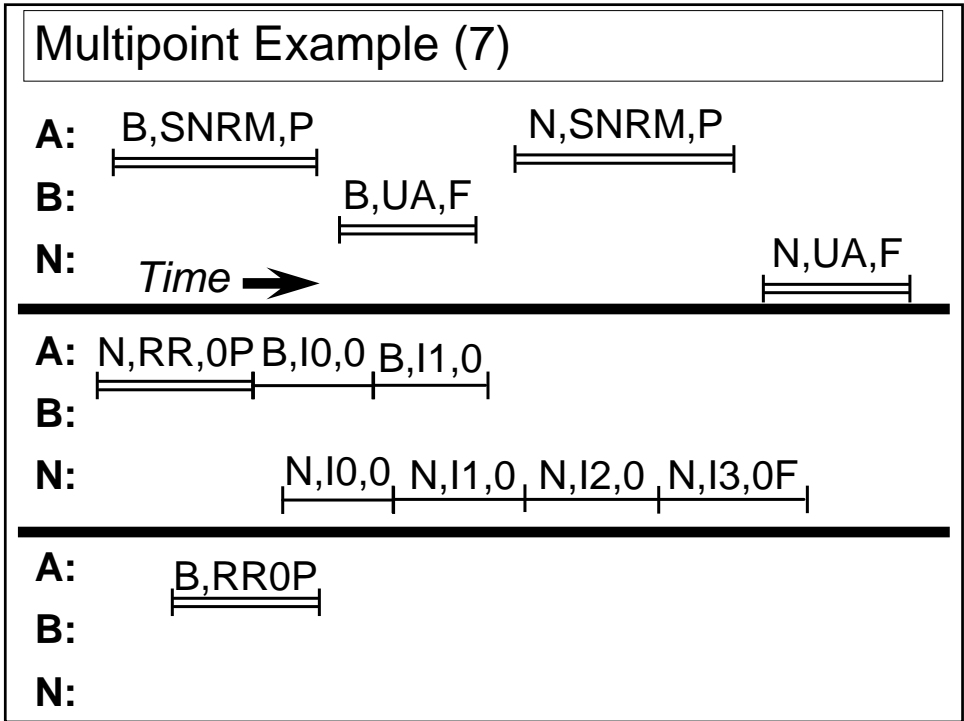
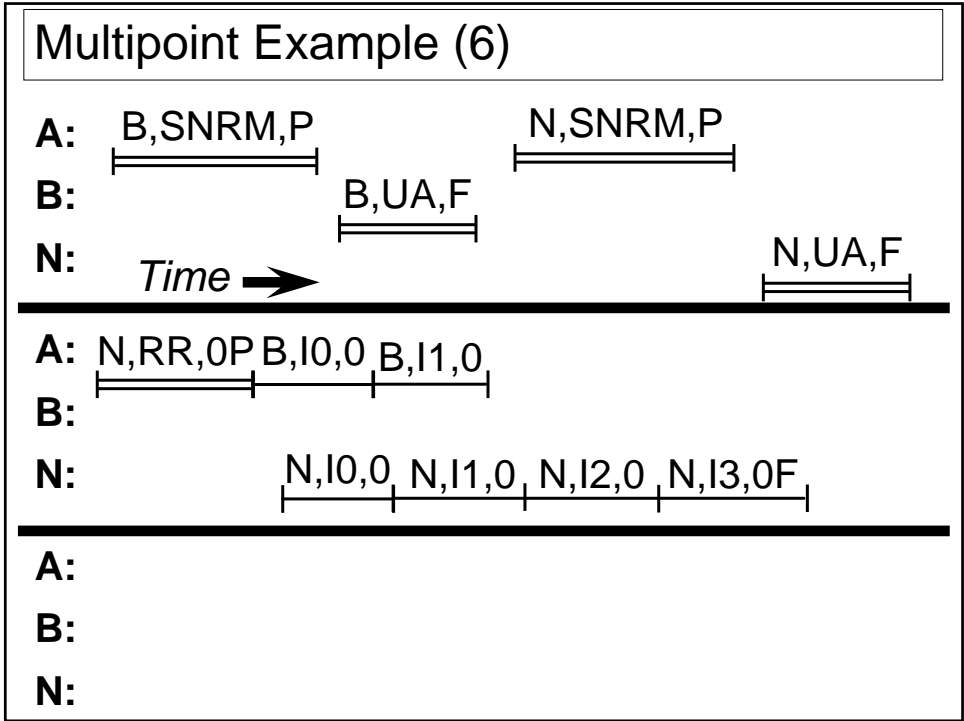
A: B,SNRM,P

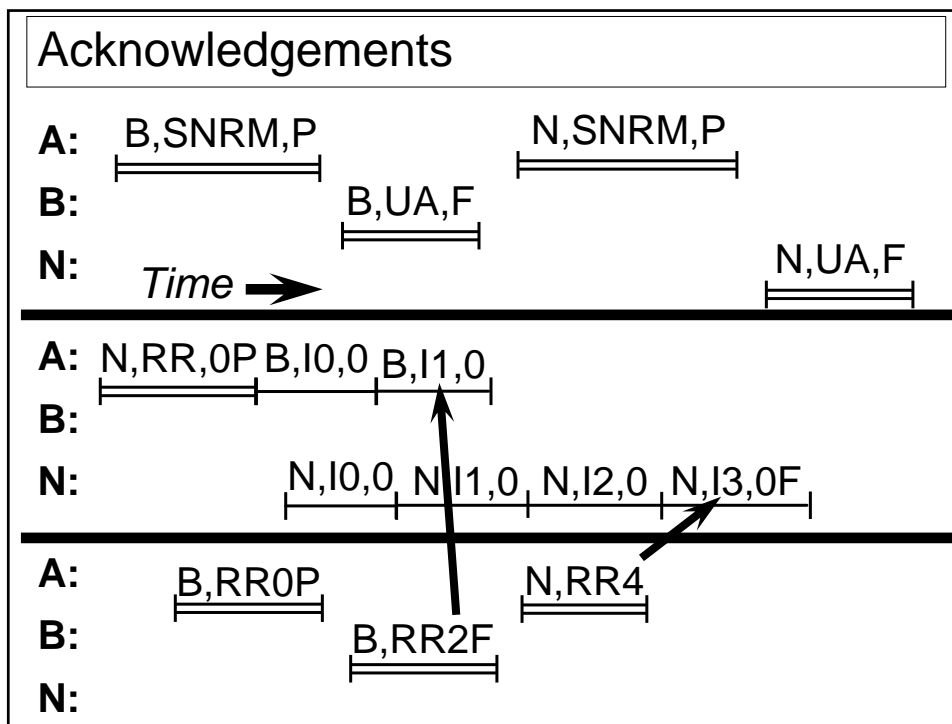
B:

N: *Time* →









- ### Control Field Format Review
- The I (Information) format of the C field is only used for connection-oriented operation, and then it is only used to send or receive the PDU of the upper layer.

Review: BA Class

- Balanced - There are two and only two TEs in the link. They have equal authority. They can each send commands and responses.
- Asynchronous - A response terminal may respond to any command. A poll compels a response with the F bit turned on in the response.

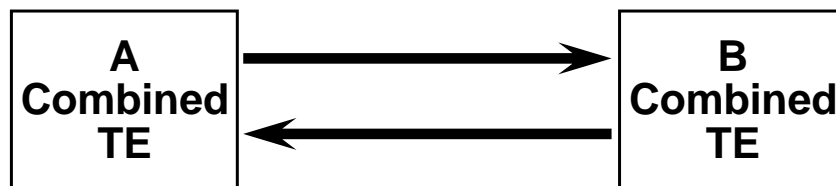
Notes on BA Systems

- Many (but not all) important BA systems adopt HDLC Option 8, which deletes "I" from the response repertoire.
- This technique can save both memory and complexity of software.
- For such systems, information frames can only be sent in commands.

More Notes on BA Systems

- In any case, when a TE receives a poll, it must respond "at its earliest convenience."
- If a TE is transmitting when the poll is received, it may complete that frame before responding; then ...
- The response (with $F = 1$) must be sent before it begins sending any other new frame.

Example



- Write out the international notation for the following session:
 - B sends 4 frames to A while
 - A sends 2 frames to B

Items for Discussion:

- When should UN Class be used?
- What if there are errors?
- Other commands/responses

The Unnumbered Format Review

- The U (Unnumbered) format is used for
- Setting (connecting) up and disconnecting any of the connection-oriented classes of operation
- Any of several connectionless operations, some of which use the I field for passing connectionless information

Just because the U format may make use of the I field does not make it I format.

Extended Addressing (HDLC Option 7)

- Option 7 can be software-invoked.
- If Option 7 is used, bit 1 of the A field is called the EA bit; otherwise, bit 1 is just part of the address field.
- For bit 1 = 0, this is not the last octet of the address field.
- For bit 1 = 1, this is the last octet of the address field.

Extended Sequence Numbering

- Depending on several factors to be illustrated in specific scenarios, a window of 7 is sometimes inadequate
- In such cases, the extended form of the mode-setting command is used (SNRM becomes SNRME; SABM becomes SAMBE)

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Formats of the <u>Extended</u> Control Field																	
Control field format for	Control field bits																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
I format	0	N(S)							P F	N(R)							
S format	1	0	S	S	0	0	0	0	P F	N(R)							
U format	1	1	M	M	P F	M											