Previously

- Finite State Machine Models
- Petri Nets Models

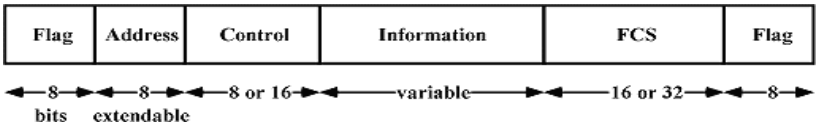
Example Data Link Protocols

- HDLC: _____
- PPP: _____

HDLC

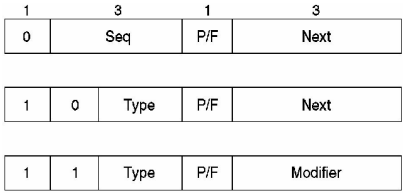
- Widely used to this day: e.g. in
  - X25 (LAPB) _____
  - IEEE 802 *LLC* _____
  - ISDN (LAP-D) _____
- All of these protocols are based on the same principles:
  - _____
  - _____
- They only differ in minor ways

Frame Format



- Flag Fields
  - Used to delimit the frame _____
  - Stations continually hunt _____
  - Bit Stuffing is used _____
- Address Field
  - Important when _____
    - Used to identify one of the termination
  - On point-to-point lines this _____
    - Can be used to distinguish _____

Protocol & Control Field



- 3 Frame Types:
  - *Information*
  - *Supervisory*
  - *Unnumbered*
- Protocol
  - Sliding window with a _____
    - *Seq* _____
    - *Next* _____
  - There can be up to 7 _____
- *P/F* bit is used when
  - _____

1. Information Frames

- Purpose:
  - To carry _____
  - To do _____
- Data Field
  - Contains _____
- FCS Field
  - Checksum field
  - Uses _____

2. Supervisory Frames

1	0	Type	P/F	Next

- Type = 00 (*RR*) _____
  - Used to indicate that _____
- Type = 01 (*REJ*) _____
  - Used to indicate that _____
  - *Next* specifies _____
  - Retransmission is done using a _____
- Type = 10 (*RNR*) _____
  - Used to indicate that _____
  - Also acknowledges _____
- Type = 11 (*SREJ*) _____
  - Used to indicate that _____
  - *Next* specifies _____
  - Retransmission is done using a _____

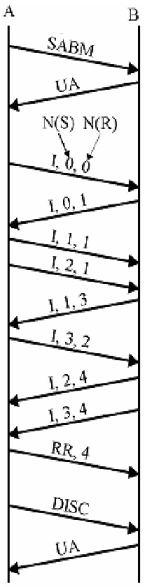
3. Unnumbered Frames

1	1	Type	P/F	Modifier

- Can be used to carry User Data
  - For unreliable _____
- Also provides up to 32 control functions:
  - DISC _____
  - SNRM _____
  - SABM _____
  - FRMR _____
  - UA _____

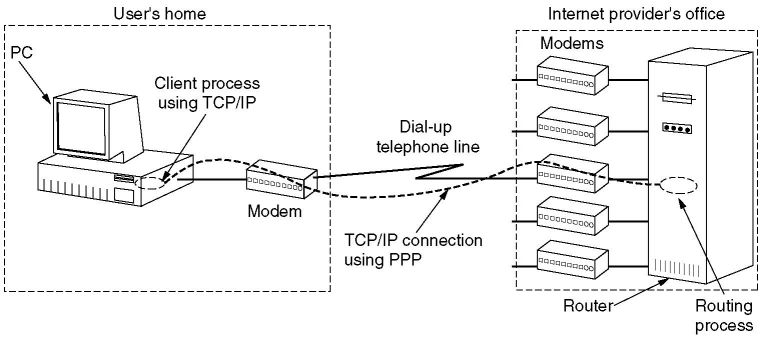
Basic HDLC Operation

- Phase 1
  - Initialises _____
  - Agree on _____
    - e.g. length of _____
- Phase 2
  - Exchange of _____
- Phase 3
  - DISC _____
  - UA _____



PPP

- Mainly used in two situations:
  - Between _____
  - Between a home user and _____
- Used in the _____



PPP Features

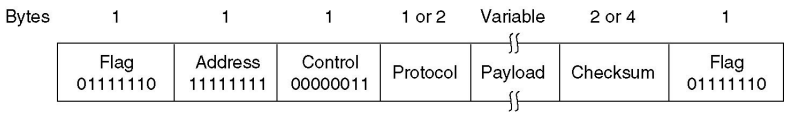
- Provides a framing method which
  - Unambiguously _____
    _____
  - Handles _____
- LCP _____
  - Used to _____
    _____
- NCP _____
  - A way of negotiating _____
    _____

Connection
↓
LCP
↓
NCP
↓
Frames
↓
NCP
↓
LCP
↓
Disconnection

LCP frame types

Name	Direction	Description
Configure-request	I → R	List of proposed options and values
Configure-ack	I ← R	All options are accepted
Configure-nak	I ← R	Some options are not accepted
Configure-reject	I ← R	Some options are not negotiable
Terminate-request	I → R	Request to shut the line down
Terminate-ack	I ← R	OK, line shut down
Code-reject	I ← R	Unknown request received
Protocol-reject	I ← R	Unknown protocol requested
Echo-request	I → R	Please send this frame back
Echo-reply	I ← R	Here is the frame back
Discard-request	I → R	Just discard this frame (for testing)

Frame Format



- Format is very like HDLC…
- However it is _____
- The address is fixed _____
- Control field defaults to _____
  - Can be _____
  - Can negotiate dropping _____
- Protocol fields allow us to specify _____
  - IP, IPX, OSI CLNP, XNS _____
  - LCP, NCP _____
- Payload length _____