# Previously

- Error Correction
  - Forward Error Correction
- Error Detection
  - Cyclic Redundancy Check



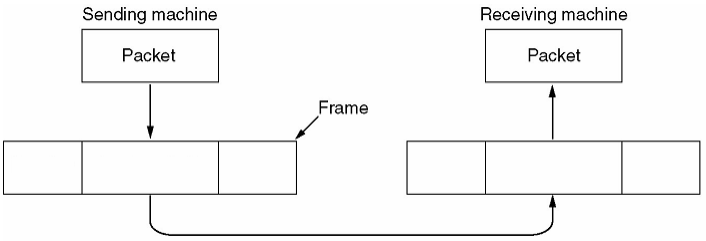
# Design Issues

**Introduction**
Framing
Error Control
Flow Control

- Introduction
  - Functionality
  - Services
- Framing
  - Stuffing
- Error Control
- Flow Control

# Functionality

- Provide a well defined _____
- Deal with transmission _____
- Regulate the flow _____
- Manage frames – _____



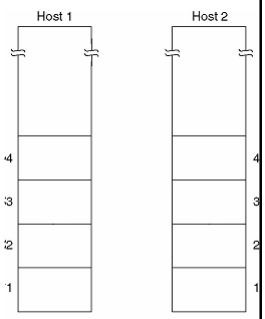







# Services

- Virtual communication
  - To the network layer it seems _____
  - However the actual path goes _____
- The data link layer provided different service levels as follows:
  - Connectionless
    - Unacknowledged
    - Acknowledged
  - Connection-oriented



# 1. Unacknowledged connectionless service



- All frames are _____
- No frames are _____
- No logical connection _____
- In the case of a lost frame…
  - Detection: _____
  - Recovery: _____
- This type of service is appropriate where _____
  _____

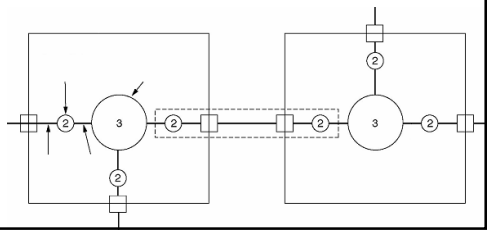




# 2. Acknowledged connectionless service



- All frames are _____
- No logical connection _____
- In the case of a lost frame…
  - Detection: _____
  - Recovery: _____
- This type of service is appropriate when _____
  _____



## 3. Acknowledged connection–oriented service



- All frames are _____
- A logical connection _____
- Frames are guaranteed to arrive only _____
- Frames are guaranteed to arrive in _____
- Three phases
  - Connection: _____
  - Transmission: _____
  - Release: _____
- This type of service is appropriate where _____ _____





## Transmitting Frames

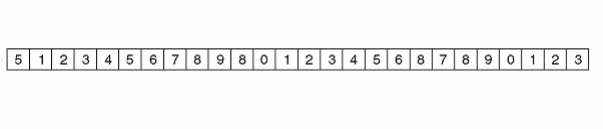


- To transmit frames the data link layer must use _____.
  - This provide an _____ where _____
- The data link layer takes packets and breaks them into _____
- Framing the data is done using various methods:
  1. Character count
  2. Byte stuffing
  3. Bit stuffing
  4. Coding violations

# 1. Character Count



- Use a header field to specify _____
  _____
- However if the header is corrupted how can we find _____




- This is a common mechanism _____
  _____





# 2. Flag bytes, byte stuffing




- Use a FLAG byte at the _____
  - If the FLAG FLAG appears _____
    _____
  - If FLAG occurs in the data _____
  - If ESC appears in the data _____
- Efficiency – Assuming Header (8), Payload (80) Trailer (4)
  - Average: _____
  - Worst Case: _____

# 3. Flags, bit stuffing

- It is more efficient to work with bits rather than _____
- So instead transmit Frames of bits
  - Flag specified as 01111110: _____
  - If _____ occur in the data then _____ _____
  - If _____ 0110111111111111111110010 data stream then strip
- Efficiency – Assuming Header (64), Payload (640) Trailer (32)
  - Average: _____
  - Worst Case: _____







# 4. Coding violations

- Some physical layer coding scheme use more than _____
- It is possible to use _____ _____

# Error Control



- To identify errors in a received from
  - Use a _____
  - Then send a _____
  - The sender should _____
- If a frame goes missing, what then?
  - Data frame
    - Sender needs _____
  - ACK frame
    - Receiver needs to be able to cope with _____
  - NAK
    - Sender needs _____





# Flow Control



- Swamping
  - It is possible that a receiver may not be able to cope _____
  - E.g. _____
- To overcome this:
  - Use Feedback based flow control where _____ _____
  - Use Rate based flow control but _____ _____