Data and Computer Communications

Chapter 11 – Asynchronous Transfer Mode

Eighth Edition

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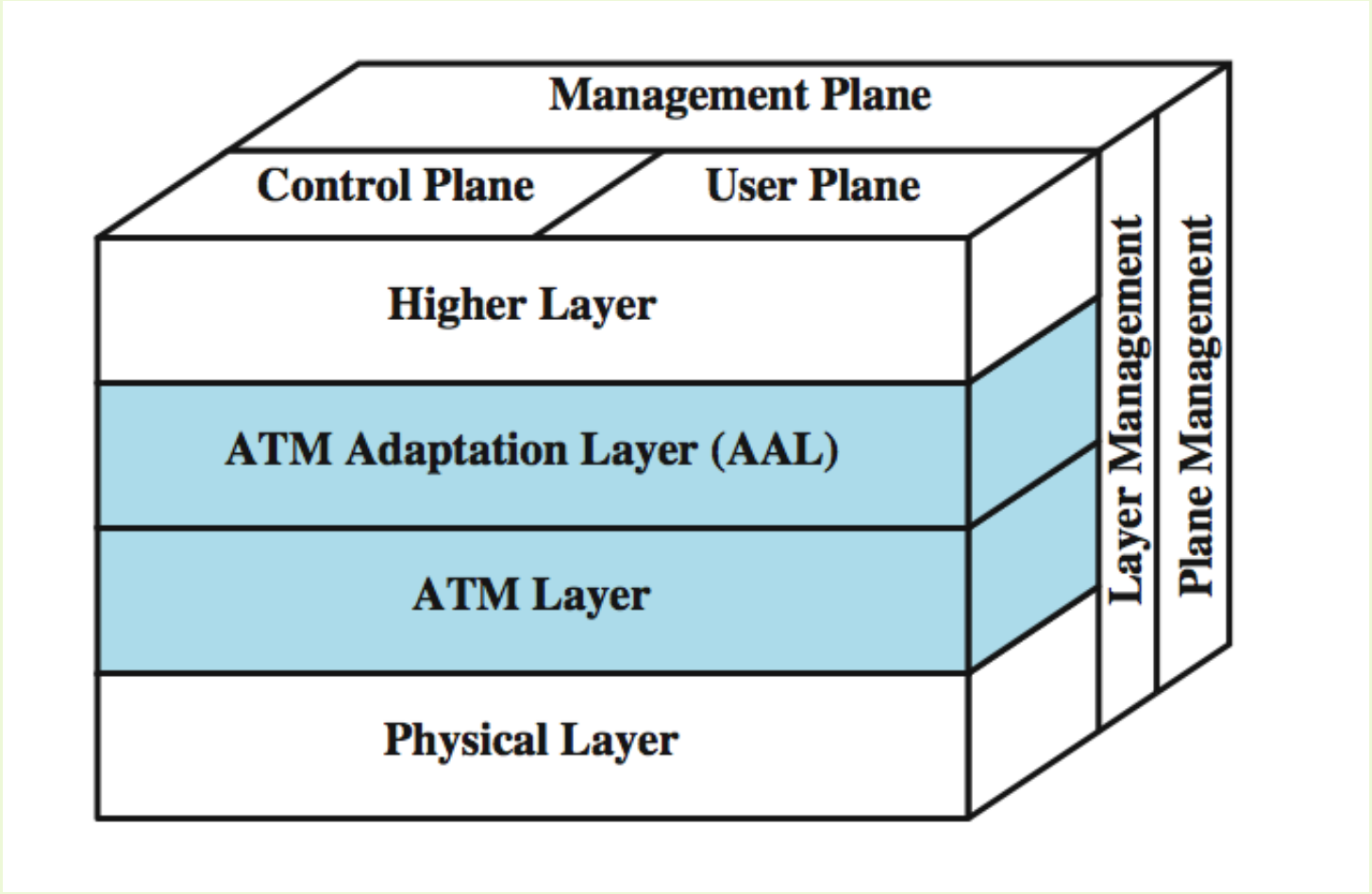
ATM

- a streamlined packet transfer interface
- similarities to packet switching
  - transfers data in discrete chunks(离散数据块)
  - supports multiple logical connections over a single physical interface
- ATM uses fixed sized packets called cells
- with minimal error and flow control
- data rates of 25.6Mbps to 622.08Mbps

Protocol Architecture



Reference Model Planes

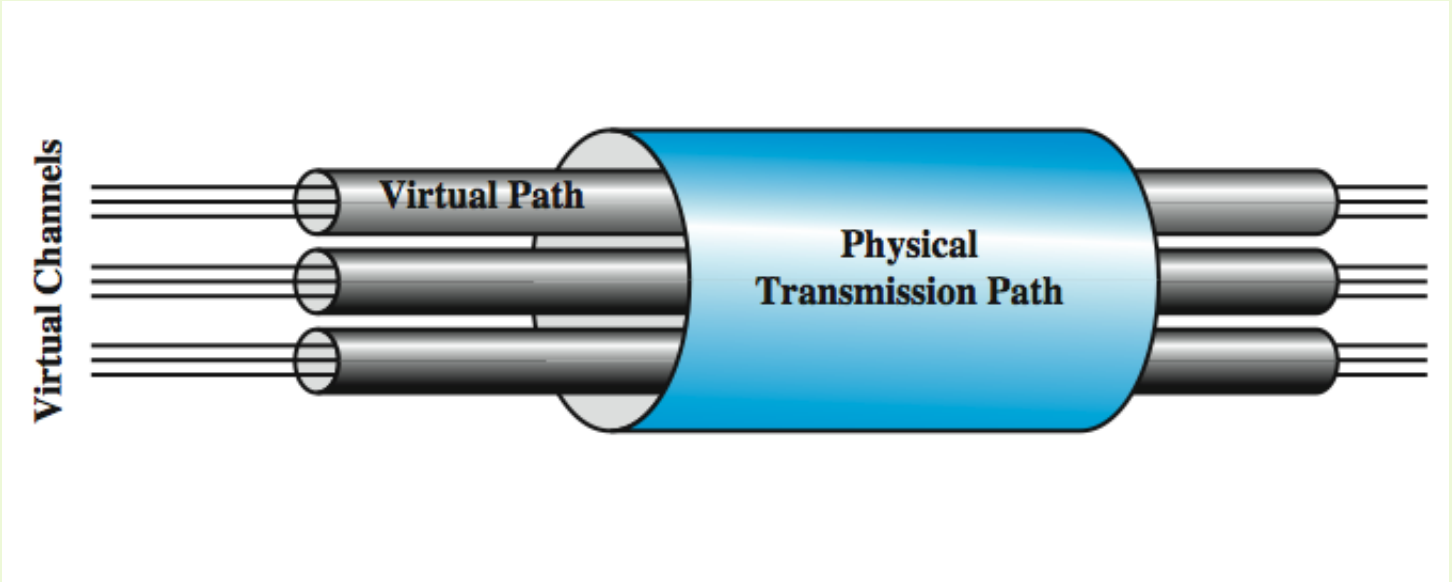
- user plane
  - provides for user information transfer
- control plane
  - call and connection control
- management plane
  - plane management
    - whole system functions
  - layer management
    - Resources and parameters in protocol entities

ATM Logical Connections

- virtual channel connections (VCC)
  - analogous to virtual circuit in X.25
- basic unit of switching between two end users
  - full duplex
  - fixed size cells
- also for
  - user-network exchange (control)
  - network-network exchange (network mgmt & routing)

ATM Virtual Path Connection

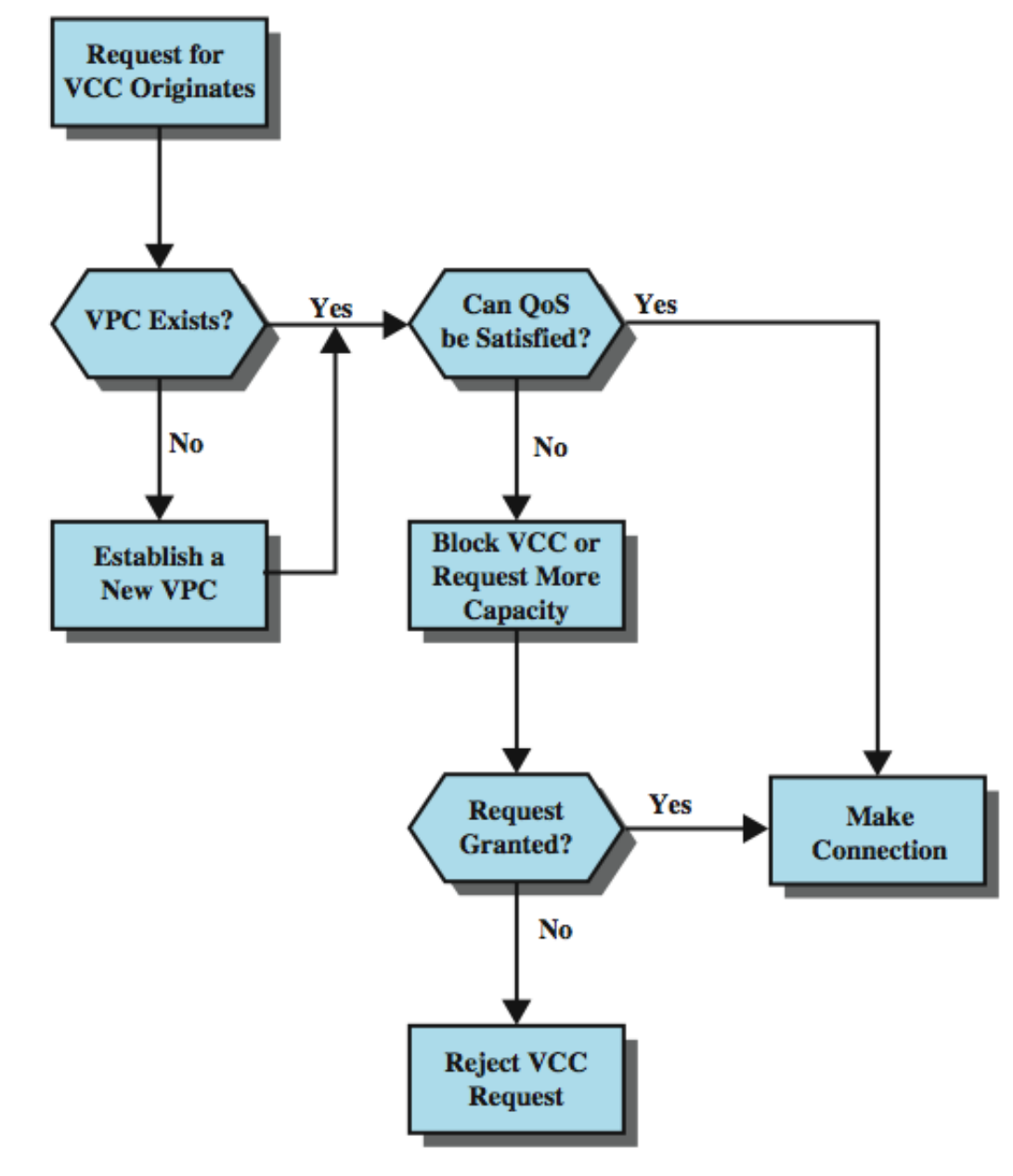
- virtual path connection (VPC)
  - bundle of VCC with same end points



Advantages of Virtual Paths

- simplified network architecture
- increased network performance and reliability
- reduced processing
- short connection setup time
- enhanced network services

Call Establishment Using VPs



Virtual Channel Connection Uses

- between end users
  - end to end user data
  - control signals
  - VPC provides overall capacity
    - VCC organization done by users
- between end user and network
  - control signaling
- between network entities
  - network traffic management
  - routing

VP/VC Characteristics

- quality of service
- switched and semi-permanent channel connections
- cell sequence integrity
- traffic parameter negotiation and usage monitoring

- VPC only
  - virtual channel identifier restriction within VPC

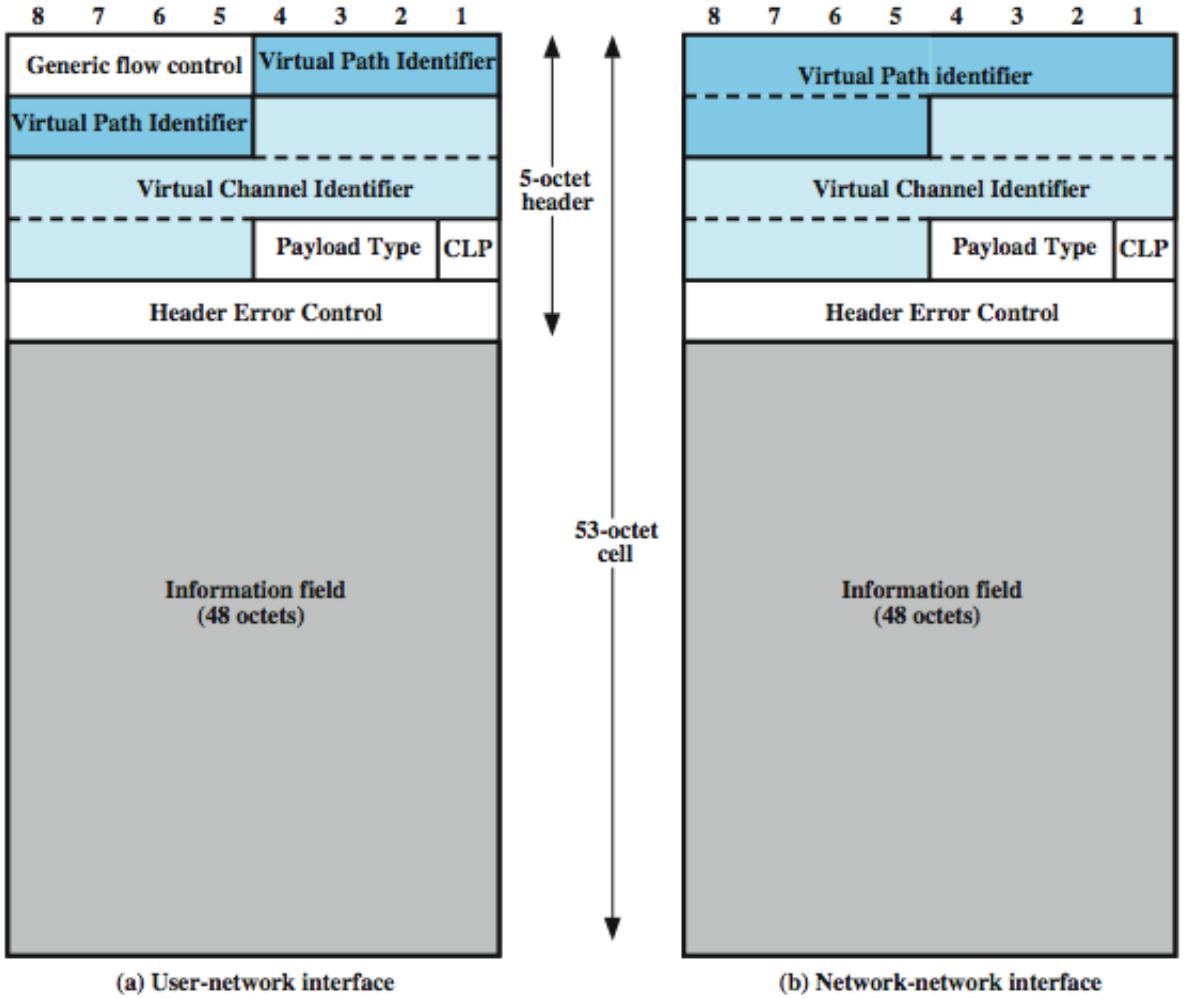
Control Signaling - VCC

- to establish or release VCCs & VPCs
- uses a separate connection
- methods are:
  1. semi-permanent VCC
  2. meta-signaling channel
  3. user to network signaling virtual channel
  4. user to user signaling virtual channel

Control Signaling - VPC

- methods for control signaling for VPCs:
  1. Semi-permanent
  2. Customer controlled
  3. Network controlled

ATM Cells


8 7 6 5 4 3 2 1
Generic flow control
Virtual Path Identifier
Virtual Path Identifier
Virtual Channel Identifier
Payload Type
CLP
Header Error Control
Information field
(48 octets)
5-octet
header
53-octet
cell
8 7 6 5 4 3 2 1
Virtual Path identifier
Virtual Channel Identifier
Payload Type
CLP
Header Error Control
Information field
(48 octets)
(a) User-network interface
(b) Network-network interface

ATM Header Fields

- generic flow control
- Virtual path identifier
- Virtual channel identifier
- payload type
- cell loss priority
- header error control

Generic Flow Control (GFC)

- control traffic flow at user to network interface (UNI) to alleviate(减轻) short term overload
- two sets of procedures
  - uncontrolled transmission
  - controlled transmission
- every connection subject to flow control or not
- if subject to flow control
  - may be one group (A) default
  - may be two groups (A and B)
- flow control is from subscriber to network

GFC - Single Group of Connections

1. If TRANSMIT=1 send uncontrolled cells any time. If TRANSMIT=0 no cells may be sent
2. If HALT received, TRANSMIT=0 until NO_HALT
3. If TRANSMIT=1 & no uncontrolled cell to send:
    1. If GO_CNTR>0, TE may send controlled cell and decrement GO_CNTR
    2. If GO_CNTR=0, TE may not send controlled cells
4. TE sets GO_CNTR to GO_VALUE upon receiving SET signal

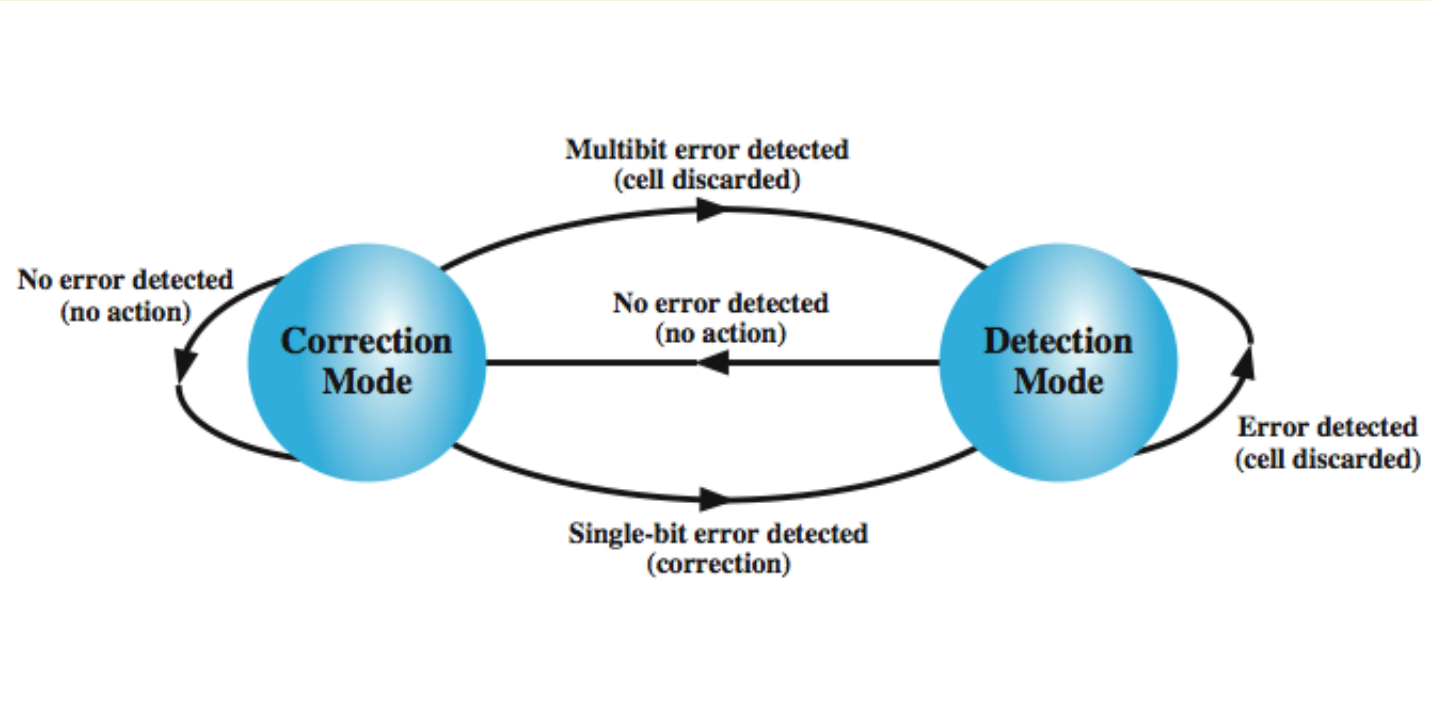
Use of HALT

- to limit effective data rate on ATM
- should be cyclic
- to reduce data rate by half, HALT issued to be in effect 50% of time
- done on regular pattern over lifetime of connection

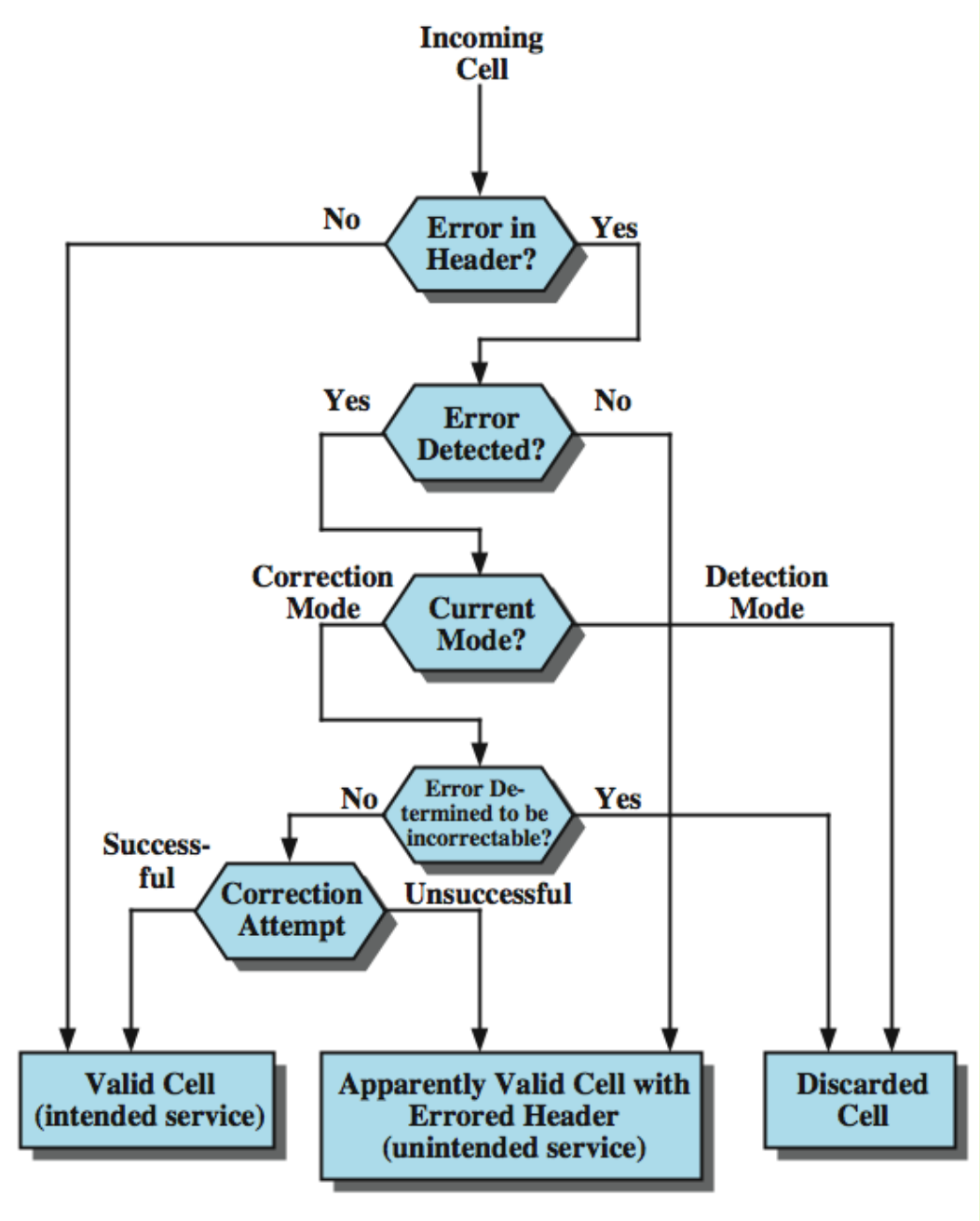
Two Queue Model

- uses two counters each with current & initial values:
  - GO_CNTR_A
  - GO_VALUE_A
  - GO_CNTR_B
  - GO_VALUE_B

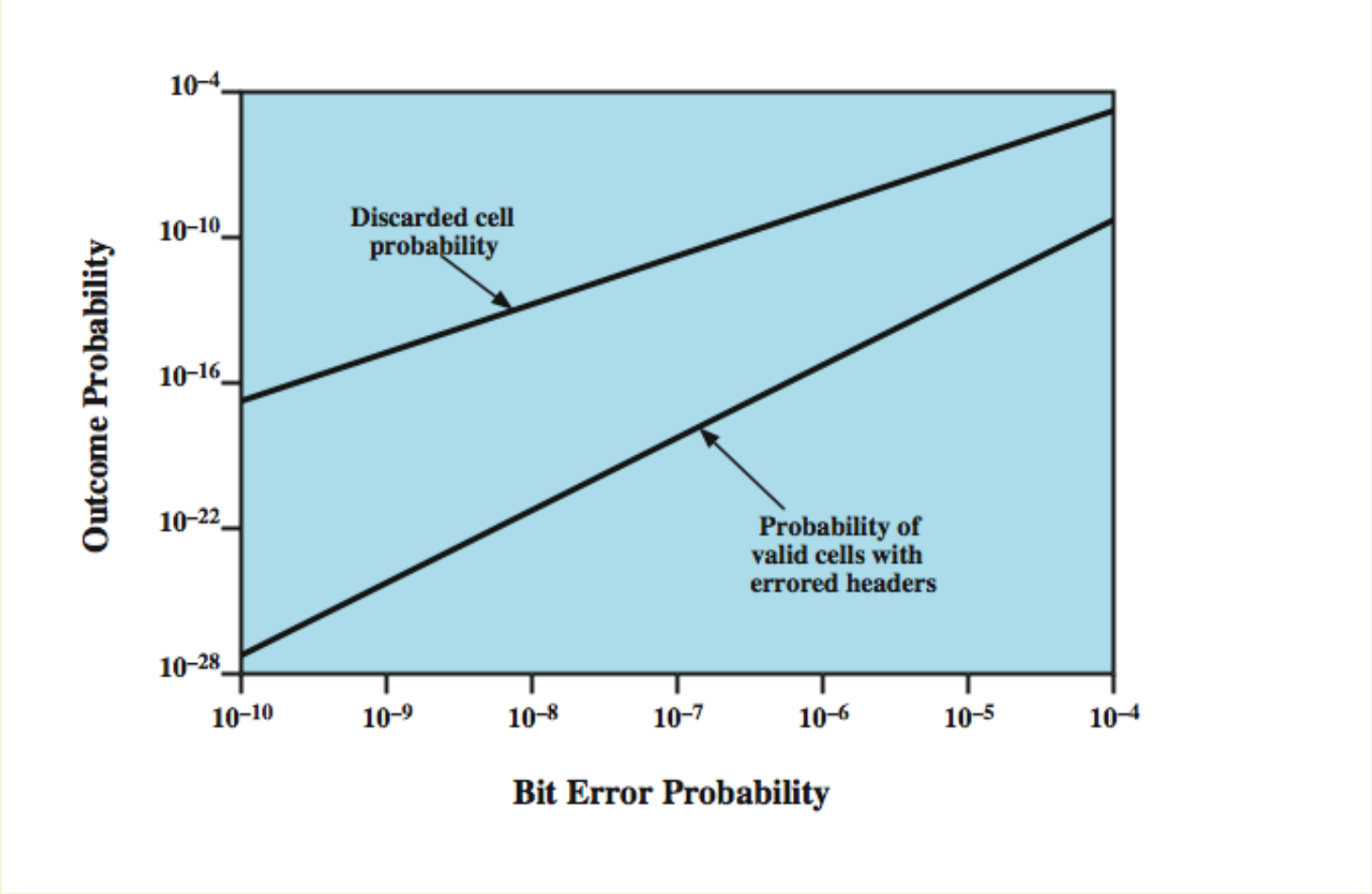
Header Error Control



Effect of Error in Cell Header



Impact of Random Bit Errors on HEC Performance



Transmission of ATM Cells

- I.432 specifies several data rates:
  - 622.08Mbps
  - 155.52Mbps
  - 51.84Mbps
  - 25.6Mbps
- two choices of transmission structure:
  - Cell based physical layer
  - SDH based physical layer

Cell Based Physical Layer

- no framing imposed
- continuous stream of 53 octet cells
- cell delineation based on header error control field

Cell Delineation State Diagram