Lecture (07)
ATM II

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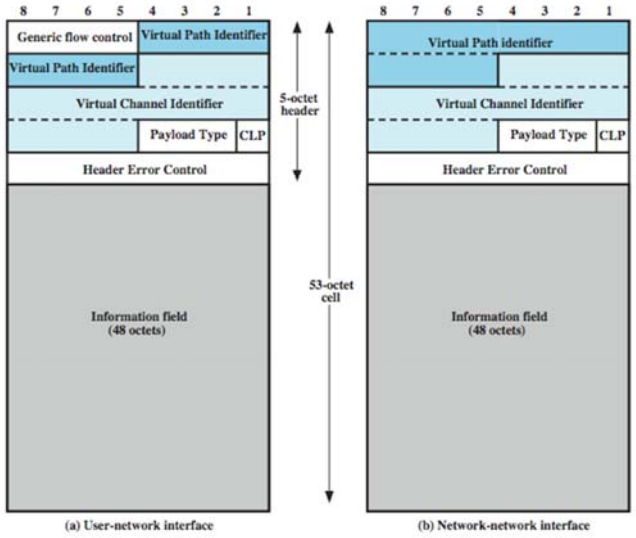
Agenda

- Introduction
- ATM protocol architecture

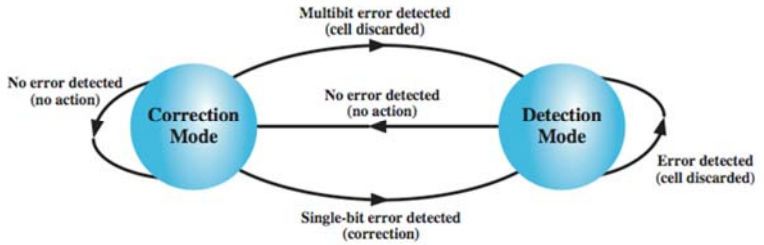
Header error control

- ATM cell includes an 8-bit HEC field that is calculated based on the remaining 32 bits of the header.



Header error control (cont,..)

- The polynomial used to generate the code is $X^8 + X^2 + X + 1$.
- The input is relatively short (32 bits) compared to HEC (8 bits) allows the code to be used for actual error correction.
- The sufficient redundancy in the code is used to recover from certain error patterns.



Header error control (cont,..)

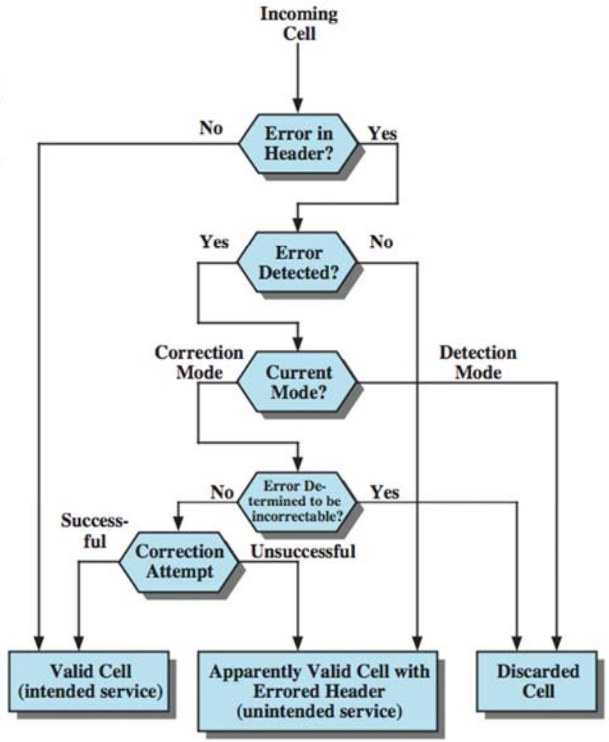
- At initialization, the receiver's error correction algorithm is in the default mode for single-bit error correction.
- As each cell is received, the HEC calculation and comparison is performed.
- As long as no errors are detected, the receiver remains in error correction mode.
- When an error is detected, the receiver will correct the error if it is a single-bit error or will detect that a multi bit error has occurred.
- In either case, the receiver now moves to detection mode.

Header error control (cont,..)

- In detection mode, no attempt is made to correct errors.
- The reason for this change is a recognition that a noise burst or other event might cause a sequence of errors, a condition for which the HEC is insufficient for error correction.
- The receiver remains in detection mode as long as errored cells are received.
- When a header is examined and found not to be in error, the receiver switches back to correction mode.

Header error cor

The whole story



Header error control (cont,..)

- The main function of Header Error Control is to provide
  - recovery from single-bit header errors
  - a low probability of the delivery of cells with errored headers under bursty error conditions.

Why?

- The error characteristics of fiber-based transmission systems are a mix of
  - single-bit errors
  - And a relatively large burst errors.

Header error control (cont,..)

Supported Data rate

- 622.08Mbps
- 155.52Mbps
- 51.84Mbps
- 25.6Mbps

Data format based on physical layer approaches

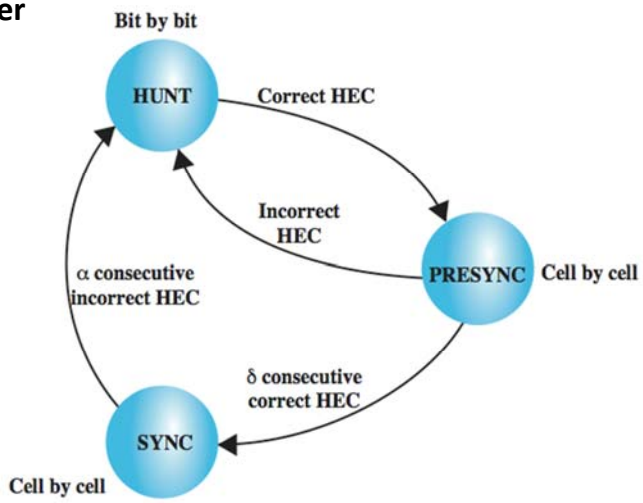
- **Cell based physical layer**
- **SDH (**Synchronous Digital Hierarchy**) based physical layer**

Cell based physical layer

- no framing is imposed.
- The interface structure consists of a continuous stream of 53-octet cells.
- Because there is no external frame some form of synchronization is needed.
- Synchronization is achieved on the basis of the HEC field in the cell header.

Cell based physical layer (cot,..)

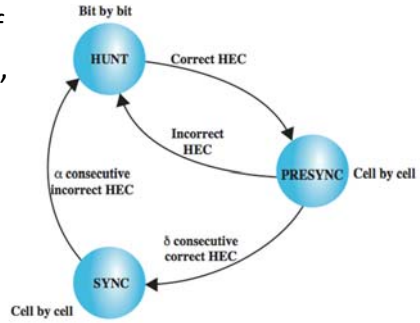
Synchronization mechanism (cell delineation algorithm**) in cell based physical layer**



Cell based physical layer (cot,..)

1. In the HUNT state,

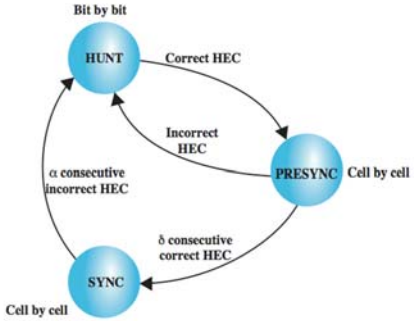
- a cell delineation algorithm is performed bit by bit to determine if the HEC coding law is observed (i.e., match between received HEC and calculated HEC).
- Once a match is achieved, it is assumed that one header has been found, and the method enters the PRESYNC state.



Cell based physical layer (cot,..)

2. In the PRESYNC state,

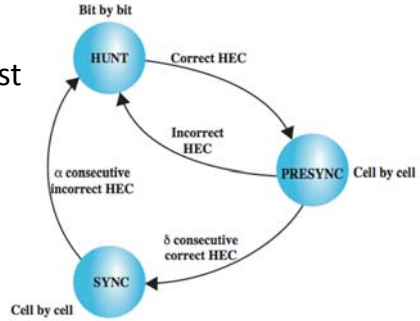
- a cell structure is now assumed.
- The cell delineation algorithm is performed cell by cell until the encoding law has been confirmed consecutively δ (delta) times.



Cell based physical layer (cot,..)

3. In the SYNC state,

- The HEC is used for error detection and correction .
- Cell delineation is assumed to be lost if the HEC coding law is recognized consecutively as incorrect α (Alpha) times.



Cell based physical layer (cot,..)

What is α and δ ?

- The values of α and δ are design parameters.
- Greater values of δ result in longer delays in establishing synchronization but in greater robustness against false delineation.
- Greater values of α result in longer delays in recognizing a misalignment but in greater robustness against false misalignment.

Cell based physical layer (cot,..)

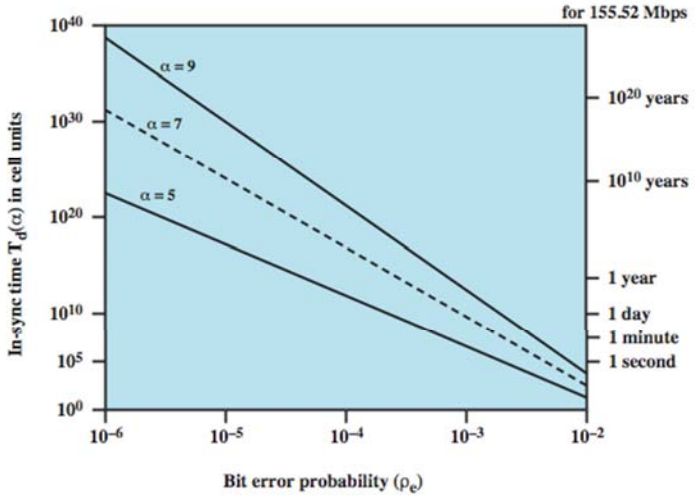
advantage

The advantage of using a cell-based transmission scheme is the

- simplified interface
- that results when both transmission and transfer mode functions are based on a common structure.

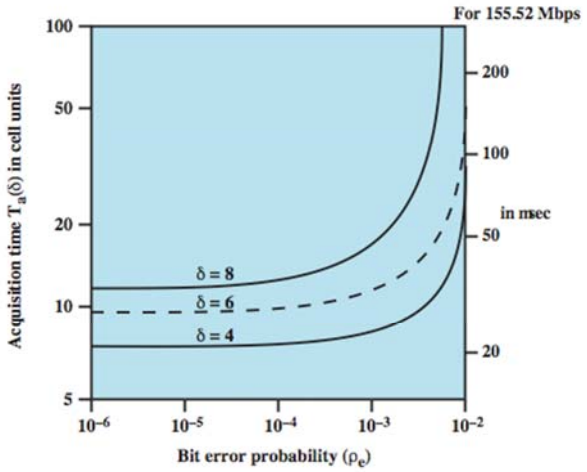
Cell based physical layer (cot,..)

- figure shows the average amount of time that the receiver will maintain synchronization in the face of errors, with α as a parameter.



Cell based physical layer (cot,..)

- figure shows the average amount of time to acquire synchronization as a function of error rate, with δ as a parameter



SDH (Synchronous Digital Hierarchy) Based Physical Layer

2.1. several ATM streams can be combined to build interfaces with higher bit rates than those supported by the ATM layer at a particular site.

- For example, four separate ATM streams, each with a bit rate of 155 Mbps (STM-1) (Synchronous Transport Module level-1), can be combined to build a 622-Mbps (STM-4) (Synchronous Transport Module level-4) interface.
- This arrangement may be more cost effective than one using a single 622-Mbps ATM stream

SDH Based Physical Layer (cont,..)

2.2. Some specific connections can be circuit switched using an SDH channel.

- For example, a connection carrying constant-bit-rate video traffic can be mapped into its own exclusive payload envelope of the STM-1 signal, which can be circuit switched.
- This may be more efficient than ATM switching.

SDH Based Physical Layer (cont,..)

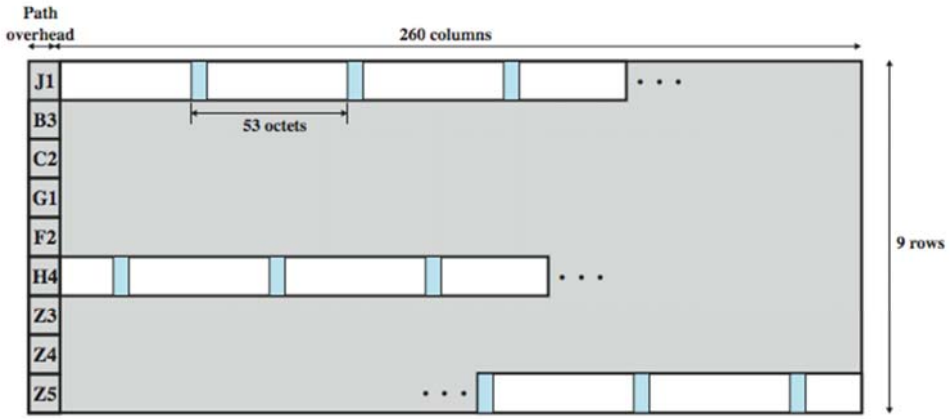
2.3. It can be used to carry either ATM-based or STM-based (synchronous transfer mode) payloads,

- Making it possible to initially deploy a high-capacity fiber-based transmission infrastructure for a variety of circuit-switched and dedicated applications and then readily migrate to the support of ATM.

SDH Based Physical Layer (cont,..)

SDH frame format

STM-1 Payload (frame) for SDH-Based ATM Cell Transmission



SDH Based Physical Layer (cont,..)

- the payload consists of a 9-octet path overhead portion and the remainder, which contains ATM cells.
- Because the payload capacity (2340 octets) is not an integer multiple of the cell length (53 octets), a cell may cross a payload boundary.
- So payload may be offset from the beginning of the frame, as indicated by the pointer in the section overhead of the frame.
- The H4 octet in the path overhead is set at the sending side to indicate the next occurrence of a cell boundary.
- That is, the value in the H4 field indicates the number of octets to the first cell boundary following the H4 octet.
- The permissible range of values is 0 to 52.

ATM services categories

- An ATM network is designed to be able to transfer many different types of traffic simultaneously, including
  - real-time flows
  - voice,
  - video,
  - bursty TCP flows
- There are two types of services
  - Real time -
  - Non-real time –

ATM services categories (cont,..)

1. Real-Time Service:

- The most important distinction among applications concerns
  - the amount of delay
  - the variability of delay, referred to as jitter, that the application can tolerate.
- Real-time applications typically involve a flow of information to a user that is intended to reproduce that flow at a source.
- Variants include
  - Constant bit rate (CBR)
  - Real-time variable bit rate (rt-VBR)

ATM services categories (cont,..)

2. Non-Real-Time Service: are

- intended for applications that have bursty traffic characteristics and do not have tight constraints on delay and delay variation.
- Accordingly, the network has greater flexibility in handling such traffic flows and can make greater use of statistical multiplexing to increase network efficiency.
- Variants include:
  1. Non-real-time variable bit rate (nrt-VBR),
  2. Available bit rate (ABR),
  3. Unspecified bit rate (UBR), &
  4. Guaranteed frame rate (GFR)

1. Constant Bit Rate (CBR)

- Real-time applications like audio or video information

or any applications that involve interaction between people

  - have tight constraints on delay.
  - any delay above a few hundred milliseconds becomes noticeable and annoying.
  - need to be presented in a continuous, smooth fashion.
  - A lack of continuity or excessive loss results in significant loss of quality.

ATM services categories (cont,..)

- CBR is used for applications that require a
  - fixed data rate during the connection lifetime
  - relatively tight upper bound on transfer delay.
- CBR is commonly used for uncompressed audio and video information.
- Example of CBR applications include:
  - Videoconferencing
  - Interactive audio (e.g., telephony)
  - Audio/video distribution (e.g., television, distance learning, pay-per-view)
  - Audio/video retrieval (e.g., video-on-demand, audio library)

ATM services categories (cont,..)

2. Real-Time Variable Bit Rate (rt-VBR)

- Used for time-sensitive applications, that has tightly constrained delay and delay variation
- Main difference between CBR & rt-VBR, that rt-VBR applications transmit at a rate that varies with time, can be characterized as somewhat bursty streams
- Examples: an approach of video compression results in a sequence of image frames of varying sizes.
- Because real-time video requires a uniform frame transmission rate, the actual data rate varies.

ATM services categories (cont,..)

- The rt-VBR service allows the network more flexibility than CBR.
- The network is able to statistically multiplex a number of connections over the same dedicated capacity and still provide the required service to each connection.

ATM services categories (cont,..)

3. Non-Real-Time Variable Bit Rate (nrt-VBR)

- intended for applications that have bursty traffic characteristics and do not have tight constraints on delay and delay variation.
- nrt-VBR service can be used for data transfers that have critical response-time requirements.
- Examples include
  - airline reservations,
  - banking transactions, and
  - process monitoring.

ATM services categories (cont,..)

- With this service, the end system specifies
  - a peak cell rate,
  - a sustainable or average cell rate, and
  - a measure of how bursty or clumped the cells may be.
- With this information, the network can allocate resources to provide relatively low delay and minimal cell loss.
- the network has greater flexibility in handling such traffic flows and can make greater use of statistical multiplexing to increase network efficiency.

ATM services categories (cont,..)

4. Unspecified Bit Rate (UBR)

- This service is suitable for applications that can tolerate variable delays and some cell losses, which is typically true of TCP-based traffic.
- Cells are forwarded on a first-in-first-out (FIFO) basis using the capacity not consumed by other services; both delays and variable losses are possible.

best-effort service

- No initial commitment is made to a UBR source and no feedback concerning congestion is provided;

Applications :

Text/data/image transfer, messaging, distribution, retrieval; or Remote terminal (e.g., telecommuting).

ATM services categories (cont,..)

- At any given time, ATM network capacity is shared between:-
  - CBR services
  - Plus two types of VBR services (real time& non real time).
- Additional capacity is available for one or both of the following reasons:
  1. Not all of the total resources have been committed to CBR and VBR traffic,
  2. the bursty nature of VBR traffic means that at some times less than the committed capacity is being used.
- The rest capacity can be assigned for UBR

ATM services categories (cont,..)

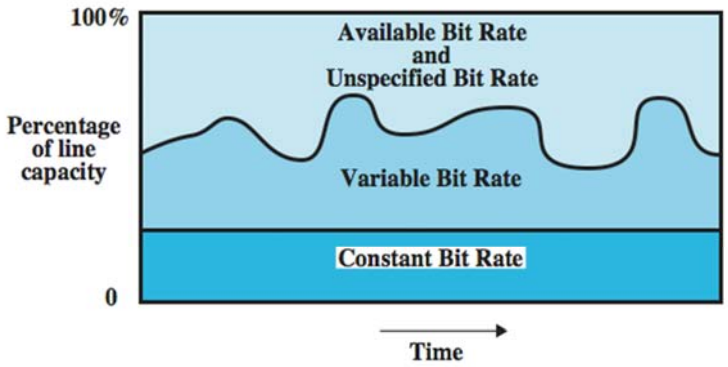
5. Available Bit Rate (ABR)

- Bursty applications that use a reliable end-to-end protocol such as TCP can detect congestion in a network by means of increased round-trip delays and packet discarding.
- TCP has no mechanism for fairly sharing of network resources among various TCP connections.
- Further, TCP does not minimize congestion as efficiently as is possible using explicit information from congested nodes within the network.
- To improve the service provided to bursty sources that would otherwise use UBR, the ABR service has been defined.

ATM services categories (cont,..)

- application specifies
  - peak cell rate (PCR)
  - minimum cell rate (MCR)
- resources allocated to give at least MCR
- spare capacity fairly shared among all ARB sources
- The ABR mechanism uses explicit feedback to sources to assure that capacity is fairly allocated.
- Any capacity not used by ABR sources remains available for UBR traffic.
- example of an application using ABR is LAN interconnection.
- In this case, the end systems attached to the ATM network are routers.

ATM Bit Rate Services



Thanks,…