COMP202-08B
Computer Communications

Lecture 5 – Communicating

Matthew Luckie
mluckie@cs.waikato.ac.nz

THE UNIVERSITY OF WAIKATO

Lecture Outline

- Asynchronous I/O
- OSI

Asynchronous I/O

- Asynchronous means each system having an independent clock
  - A separate clock signal is not provided
  - This will become clearer in the lecture
- The fundamental unit in computer communications is a bit having a value of one or zero.
- Data is usually sent in units of 8-bit bytes.

Experiment

- Receive a binary number
- Using hand signals to denote 0 or 1
  - A computer often uses voltage on a wire
- In class: what number did I send?

Experiment

- What did I send?
  - Was it 10101100 (172)
  - Or was it 01010011 (32)
- Need to define how data bits are sent!
  - We'll define one as raised hand, zero as lowered hand
  - We'll define each bit as occupying one second in time
- Could have also defined the opposite
  - One as lowered hand, zero as raised hand.

Asynchronous I/O

- Need to define when we're going to start transmitting
- Which means we also have to define an idle state (i.e. what we should do when we have nothing to transmit)
- Idle state: assert 1 continuously (hand in air)
- To start a message: send a '0' bit

Asynchronous I/O

- Need some way to distinguish one byte from another
- It isn't practical to send a large number of bits as a single stream as clocks run at different rates to each other
  - That is, they *drift*
- Class demo:

Asynchronous I/O

- I sent: 10101100 00000001
  - A stretch of nine continuous zeros.
  - Or was it ten continuous zeros and a stop bit?
- Need to define a maximum number of bits to send
  - i.e., when the transmitter should stop sending
  - i.e., the minimum requirement for clock accuracy
  - Computers often deal in 8-bit bytes, so 8 is a natural boundary
- Send 8 bits, then one stop bit (value of 1)
- Transmitter must use start bit to send next sequence

Issues

- Noise immunity
  - Can distinguish 0 and 1 fairly easily (most of the time)
  - Advantage of binary is clearer signalling than (say) ternary
- Timing immunity
  - Look at middle of each interval when signal is settled rather than at the start of each bit
  - Restart timing on every character
- Can add extra error checking
  - Parity, Hamming, etc. (to be discussed later in course)

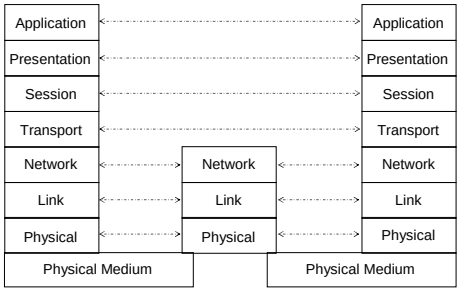
Asynchronous serial

- Used on serial port of computers
  - For communication with dial-up modem
  - Serial mouse (before PS/2 and USB mice)
  - For REX board used in COMP200
- Standard agreed speeds (baud rate)
  - 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
- Precisely (1/1000th) crystal measured

Asynchronous I/O

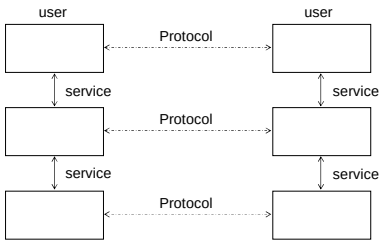
- Key questions of asynchronous serial I/O communications systems:
  - How and when are data bits sent?
  - When do we start and stop?
  - What if there are timing errors?
  - What if there are errors on the line?

Open Systems Interconnection (OSI)



OSI layers

- Each OSI layer provides a service



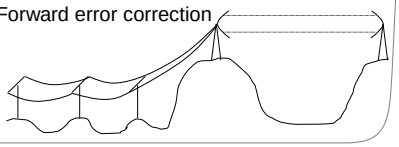
OSI Layers

- Mostly of historical note these days
- Perhaps a good place to begin thinking about communications protocols

OSI Layer: Physical

Application
Presentation
Session
Transport
Network
Link
Physical

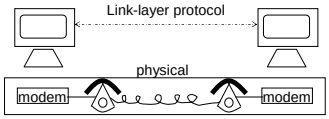
- Bits
- What the cables look like
  - Serial, parallel, USB, RJ45 Cat5 Ethernet etc.
  - And wireless!
- Best effort
- Point-to-point or multipoint
- Forward error correction



OSI Layer: Link

Application
Presentation
Session
Transport
Network
Link
Physical

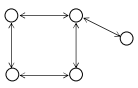
- Delimiting messages
  - start and stop sequence
- Error detection (and sometimes correction)
- Flow control: how fast something should go
- Addressing
- Examples: dial-up modems, Ethernet

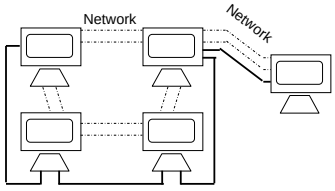


OSI Layer: Network

Application
Presentation
Session
Transport
Network
Link
Physical

- Relay (end-to-end)
- Addressing
- Routing
- Flow control

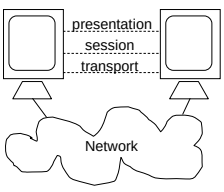




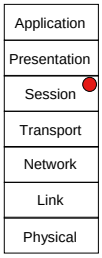
OSI Layer: Transport

Application
Presentation
Session
Transport
Network
Link
Physical

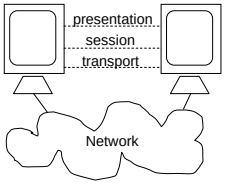
- High quality end-to-end
- Error detection and correction
- Multiplexing/concatenation
- Segmenting
- Flow control



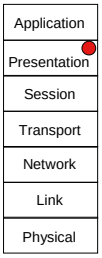
OSI Layer: Session



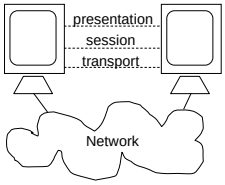
- Dialogue
- Session structure
- Interruption and recovery



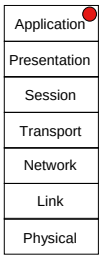
OSI Layer: Presentation



- Byte order
- Encoding of
  - Real numbers
  - Character codes
  - Structures



OSI Layer: Application



- Application interfaces with presentation layer to send and receive messages

OSI

- Reality turned out quite different
  - How many layers had error detection?
  - How many layers had flow control?
- The Internet protocols use what is known as an *End-to-end principle*
  - Communications protocol operations should be defined to occur at the endpoints of a communications system

Summary

- Asynchronous I/O as example of physical layer
- OSI protocol model has seven layers