Material to cover

- VHDL Reference Items
- Board I/O

VHDL - IF statement

The general form of an IF statement.

IF expression THEN
   statement ;
   [statement ;]
ELSIF expression THEN
   statement ;
   [statement ;]
ELSE
   statement ;
   [statement ;]
END IF ;

Example:
IF Sel = '0' THEN
   f <= x1 ;
ELSIF Sel = '1' THEN
   f <= x2 ;
ELSE
   f <= x2 ;
END IF ;

VHDL - CASE statement

The general form of an CASE statement.

CASE expression IS
   WHEN constant value>
   statement ;
   [statement ;]
   WHEN constant value>
   statement ;
   [statement ;]
   WHEN OTHERS>
   statement ;
   [statement ;]
END CASE ;

Example:
CASE Sel IS
   WHEN '0' =>
   f <= x1 ;
   WHEN OTHERS =>
   f <= x2 ;
END CASE ;

VHDL - FOR loop

The general forms of FOR-LOOP

[loop label:]
FOR variable name IN range LOOP
   statement ;
   [statement ;]
END LOOP [loop label] ;

Example:
process (A) begin
   Z <= "0000";
   for I in 0 to 3 loop
      if (A = I) then
         Z(I) <= '1';
         end if;
      end loop;
end process;

VHDL - WHILE loop

The general forms of WHILE-LOOP

[loop label:]
WHILE boolean expression LOOP
   statement ;
   [statement ;]
END LOOP [loop label] ;

Example:
process (A) variable I : integer range 0 to 4;
begin
   Z <= "0000";
   I := 0;
   while (I <= 3) loop
      if (A = I) then
         Z(I) <= '1';
         end if;
      end loop;
end if;
I := I + 1;
end loop;
end process;
Interfaces

Parallel Port
- Primarily a printer port on the PC (obsolete)
  - goes by name LPTx: line printer
  - usually LPT1
- 8 data bits
  - with strobe to signal valid data
  - can be fast (1 Mbit/sec)
- Other control and status bits for (printer) communication
- Some CNC Machines use this port for motor control

Parallel Port - Pin out

The Serial Port
- Most PCs have a DB9 male plug for RS-232 serial asynchronous communications
  - often COM1 on a PC
- In most cases, it is sufficient to use a 2- or 3-wire connection
  - ground (pin 5) and either or both receive and transmit (pins 2 and 3)
- Other controls available, but seldom used
- Data transmitted one bit at a time, with protocols establishing how one represents data
  - Slow-ish (most common is 9600 bits/sec)

Common Implementations of Computer Interfaces
- Parallel port (8 bits per shot)
- Serial (RS-232, RS-485, USB)
  - usually asynchronous
- GPIB (IEEE-488) parallel
  - General Purpose Interface (or Instrument) Bus
  - originally HPIB; Hewlett Packard
- DAQ card (data acquisition)
  - like national instruments A/D, D/A, digital I/O
- CAMAC
  - Computer Automated Measurement And Control
- Ethernet
  - Widely implemented LAN protocol

Serial Port cont.
- With separate clock and data, the transmitter gives the receiver timing on one signal, and data on another
- Requires two signals (clock and data): can be expensive
- Data values are arbitrary (no restrictions)
- Used by local interfaces: V.35, (synchronous) EIA-232, HSSI, etc.
- As distance and/or speed increase, clock/data skew destroys timing
Serial-Timing

- Most long-distance, high speed, or cheap signaling is **self timed**: it has no separate clock; the receiver recovers timing from the signal itself.
- Receiver knows the nominal data rate, but requires **transitions** in the signal to locate the bits, and interpolate to the sample points.
- Two General Methods:
  - Asynchronous: data sent in short blocks called **frames**
  - Symmetric: continuous stream of bits
- Receiver tracks the timing continuously, to stay in sync.
- Tracking requires sufficient **transition density** throughout the data stream.
- Used in all DSLs, DS1 (T1), DS3, SONET, all Ethernets, etc.

Serial - Asynchronous

- **Asynchronous**
  - technical term meaning "whenever I feel like it"
- Start bit is always 0. Stop bit is always 1.
- The line “idles” between bytes in the “1” state.
- This guarantees a 1→0 transition at the start of every byte.
- After the leading edge of the start bit, if you know the data rate, you can find all the bits in the byte.

The Serial Port

- **RS-232** is an electrical (physical) specification for communication:
  - idle, or "mark" state is logic 1;
  - 0 to -15 V (usually about -12 V) on transmit
  - -3 to -25 V on receive
  - "space" state is logic 0;
  - 0 to +15 V (usually about +12 V) on transmit
  - +3 to +25 V on receive
  - the dead zone is from -3 V to +3 V (indeterminate state)
- Usually used in asynchronous mode:
  - so idles at ~12; start jumps to +12; stop bit at -12
  - since each packet is framed by start/stop bits, you are guaranteed a transition at start
- parity (if used) works as follows:
  - even parity guarantees an even number of ones
  - odd parity guarantees an odd number of ones in the train

Other Serial Devices - Ethernet

- **Ethernet**:
  - IEEE Standard 802: Has many subparts for different components (ie 802.11 for wireless)
  - Communicates in data packets transporting frames –blocks of data sent and delivered individually
  - Cabling can be twisted-pairs or fiber (co-ax sometimes)
  - Speeds from 1Mb/s to 100Gb/s

Ethernet Components

- **MAU**: Medium Attachment Unit
- **MDI**: Medium Dependent Interface: Rj45 jack
- **PMA**: Physical Medium Attachment: contains functions for transmission and reception
- **PLS**: Physical Layer Signaling: signal characteristics, connectors, cable lengths
- **MAC**: Medium Access Control: initiates the transmission of data
Other Serial - USB

- Universal Serial Bus (USB)
  - Communicates on pipes (logic channel / connection between the host and device)
  - 2 types of pipes
    - Message: bi-directional, used for short messages
    - Stream: unidirectional transferring data in isochronous or bulk transfers
  - Different connectors on each side A & B
  - Speeds of 1.5Mbits/s (USB 1) up to 10Gbits/s (USB 3.1)
  - Host device controls the transfers

References and Links