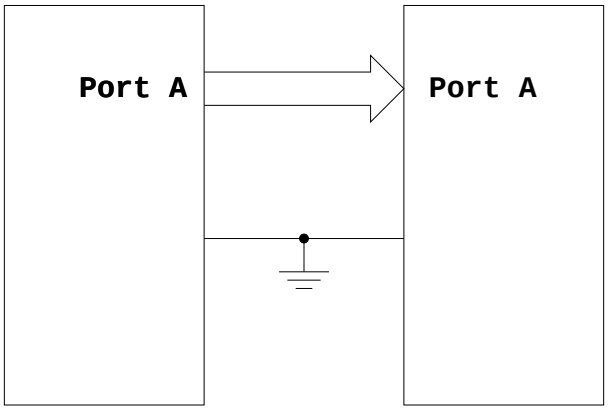
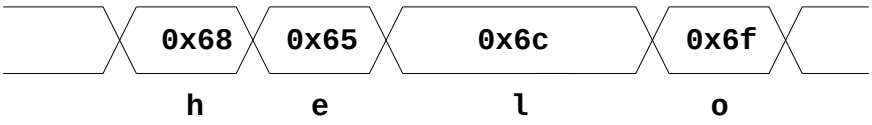
Parallel Data Transfer

- Suppose you need to transfer data from one HC12 to another. How can you do this?
- You could connect PORTA of the sending computer (set up as an output port) to PORTA of the receiving computer (set up as an input port).
- The sending computer puts the data on its PORTA, one byte at a time.
- The receiving computer reads the data on its PORTA.
- For example, want to sent the five bytes corresponding to the five characters ”hello”:

PARALLEL COMMUNICATIONS



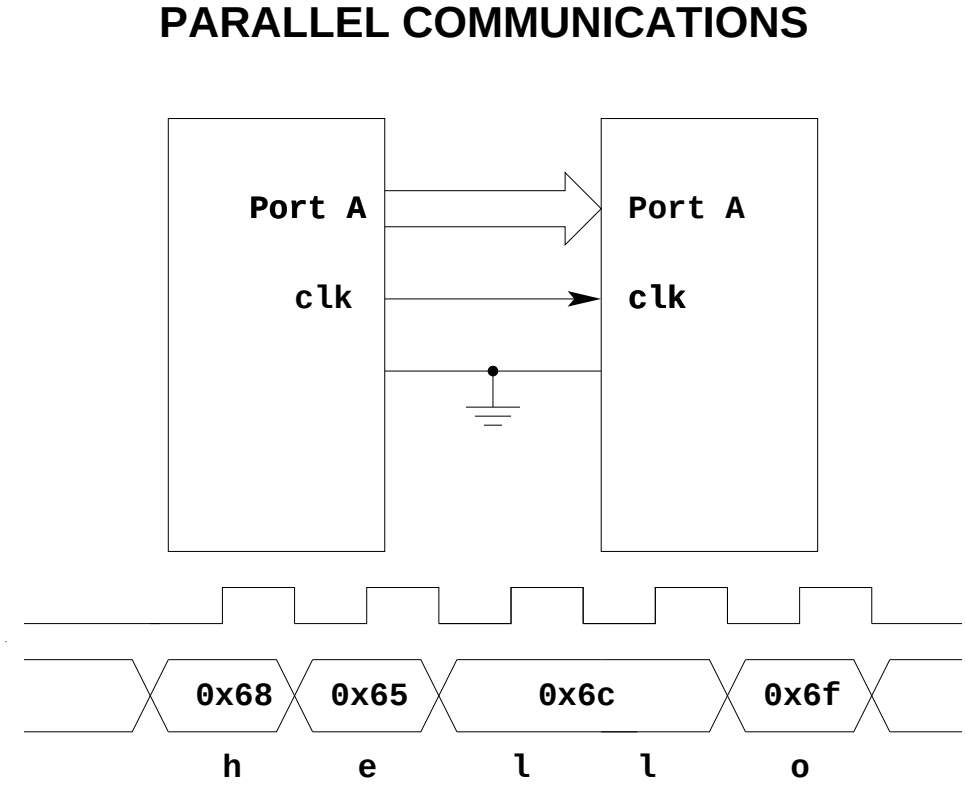


Need 9 wires to transmit 8 bits of data

How can receiver tell when it should read the data?

Parallel Data Transfer

- The sending computer needs to tell the receiving computer when to read the data.
- It can do this with another line used as a clock line.
- On the rising edge of the clock line, the receiving computer should read the data:



Need 10 wires to transmit 8 bits of data

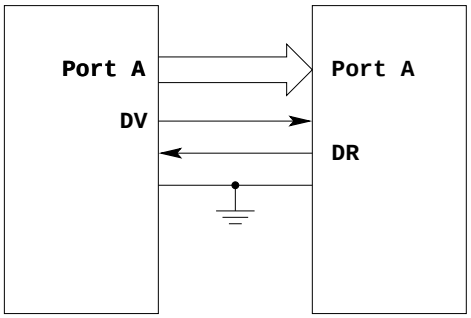
Parallel Data Transfer

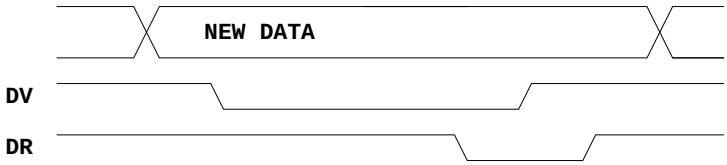
– How can the sending computer know that the receiving computer has received the data?

– Can use a method called handshaking.

  * The sending computer uses a Data Valid line to tell the receiving computer that the data on the data lines is valid.
  * The receiving computer uses a Data Received line to tell the sending computer that it has read the current data byte.

PARALLEL COMMUNICATIONS





Use two lines -- Handshake -- sender knows when receiver is ready for new data.

Need 11 wires to transmit 8 bits of data

– In the above figure, the sending computer puts the data on the data lines and brings DV low to indicate new data is available.

– When the receiving computer sees the new data is available it reads the data on the data lines, then brings DR low to say that it has read the data.

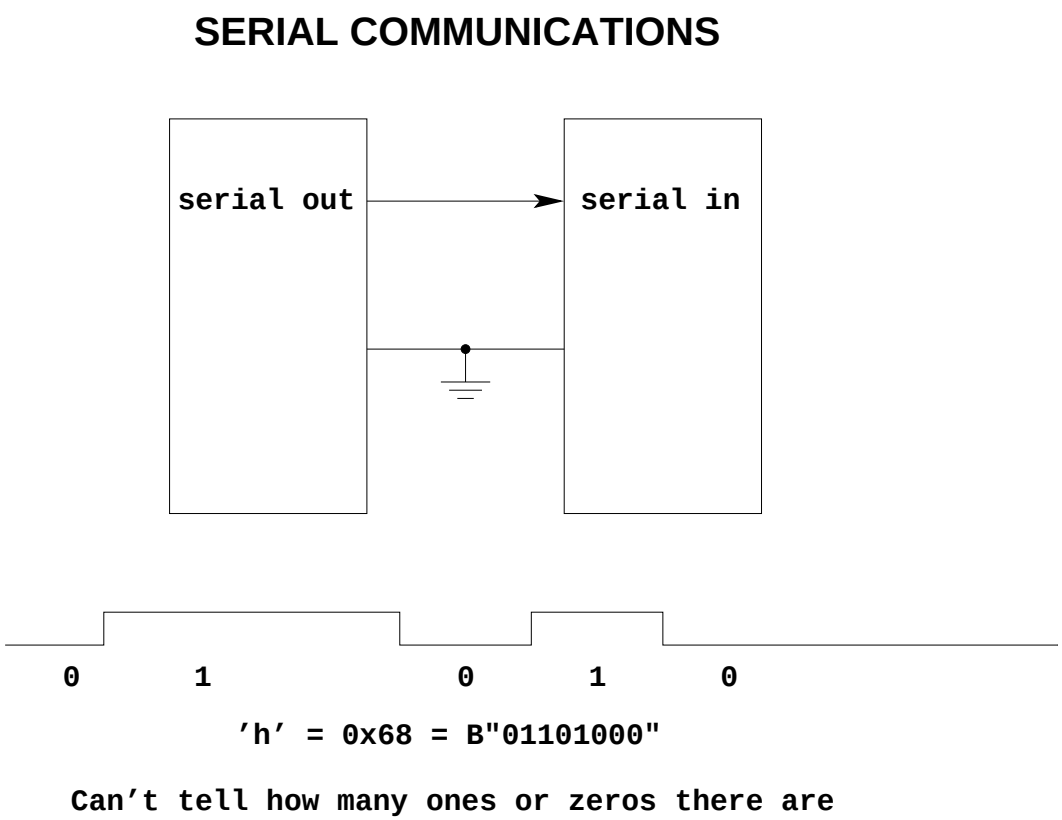
– When the sending computer sees DR go low, it brings DV high.

– When the receiving computer sees DV go high, it brings DR high.

– Both computers are now ready for the next data transfer.

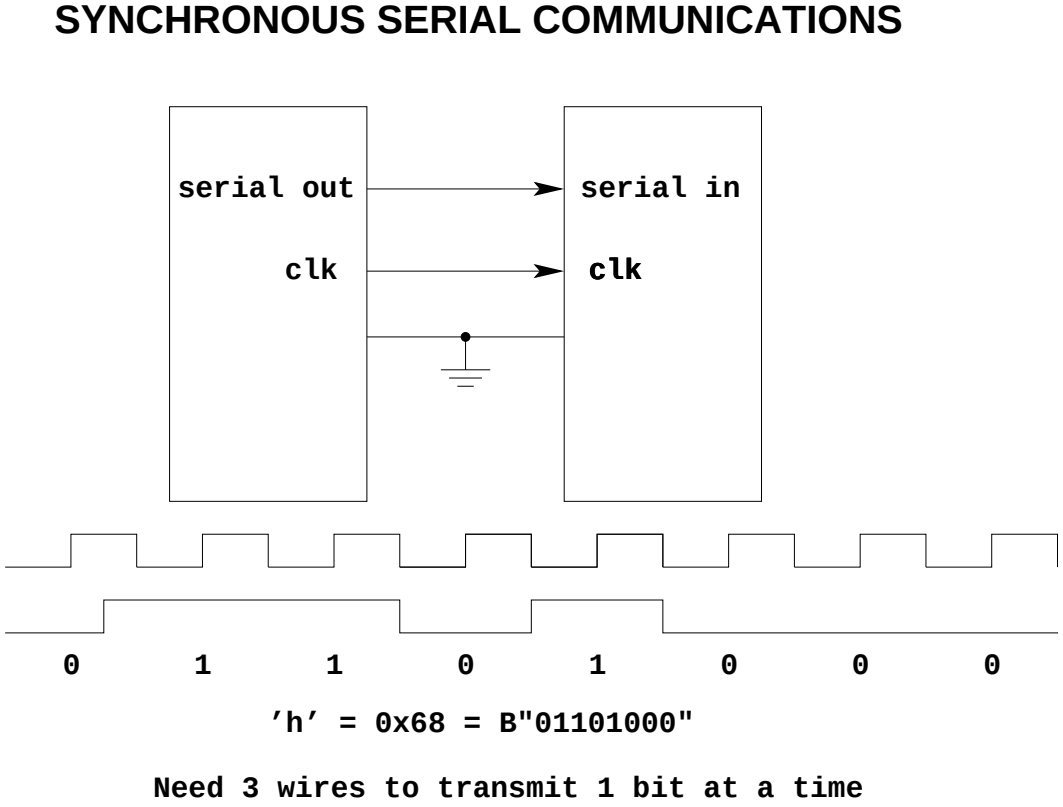
Serial Data Transfer

- Using parallel data transfer you can use 10 wires to transfer one byte at a time from one computer to another.
- Using 18 wires, you can transfer two bytes (16 bits) at a time.
- Parallel data transfer is a very fast way to transfer data between two computers.
- There are two problems with parallel data transfer:
  - It takes a lot of wires between the computers.
  - It uses lots of I/O pins on the computers.
- Serial data transfer is a slower transfer mechanism, but it uses fewer wires and fewer I/O pins.
- Serial data transfer sends one bit at a time between two computers:



Synchronous Serial Data Transfer

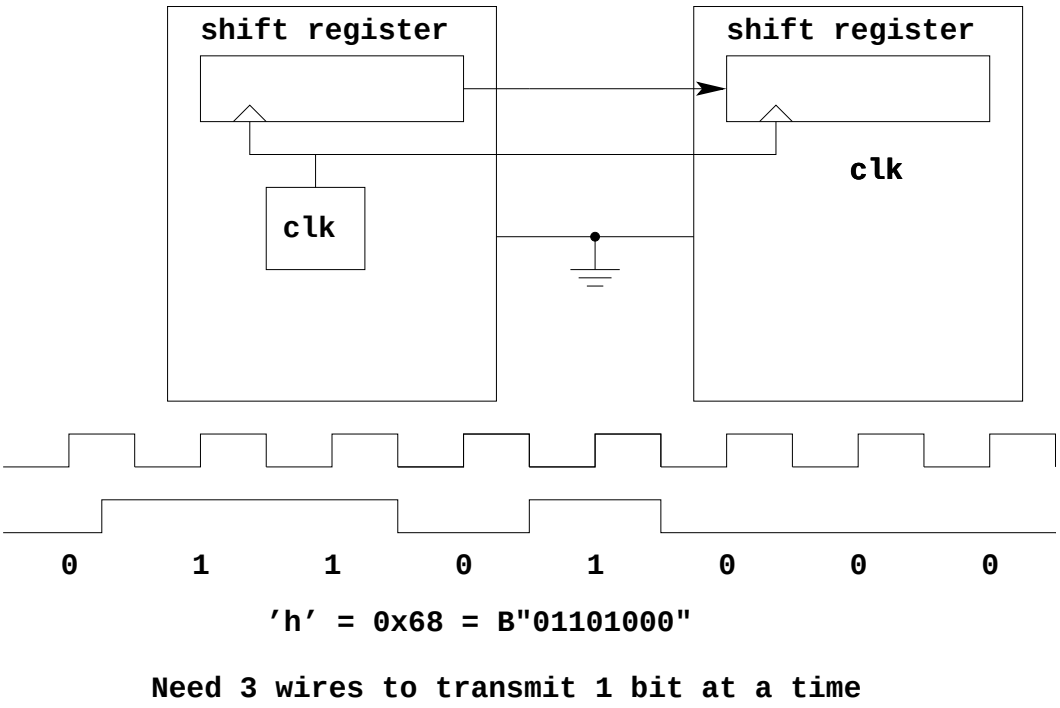
- To use serial data transfer, you need to have a way for the receiving computer to know when the data bit is valid.
- There are two ways to do this:
  - Synchronous Serial Data Transfers (SPI on the HC12)
  - Asynchronous Serial Data Transfers (SCI on the HC12)
- Synchronous Seraial Data Transfer uses a clock line between the two computers for the sending computer to tell the receiving computer when each data bit is valid:



Synchronous Serial Data Transfer

- In synchronous serial data transfer, the sending computer puts the data byte it wants to send into an internal shift register.
- The sending computer uses a clock to shift the 8 data bits out of the shift register onto an external data pin.
- The receiving computer puts the data from the sending computer on the input of an internal shift register.
- The receiving computer uses the clock from the sending computer to shift the data into its shift register.
- After 8 clock ticks, the data has been transfered from the sending computer to the recieving computer.

SYNCHRONOUS SERIAL COMMUNICATIONS



'h' = 0x68 = B"01101000"

Need 3 wires to transmit 1 bit at a time

The HC12 Serial Peripheral Interface (SPI)

- The HC12 has a Synchronous Serial Interface
- On the HC12 it is called the Serial Peripheral Interface (SPI)
- If an HC12 generates the clock used for the synchronous data transfer it is operating in Master Mode.
- If an HC12 uses and external clockused for the synchronous data transfer it is operating in Slave Mode.
- If two HC12's talk to each other using their SPI's one must be set up as the Master and the other as the Slave.
- The output of the Master SPI shift register is connected to the input of the Slave SPI shift register over the Master Out Slave In (MOSI) line.
- The input of the Master SPI shift register is connected to the output of the Slave SPI shift register over the Master In Slave Out (MISO) line.
- After 8 clock ticks, the data originally in the Master shift register has been transfered to the slave, and the data in the Slave shift register has been transfered to the Master.

Synchronous Serial Communications