Org: Serial Communication

Alex Chi

Update: April 21, 2020

Contents

1 Data Communication

- transfer of data as electromagnetic signal over physical communication channel

2 Parallel & Serial

- parallel data transfer, use a separate wire for each bit, often 8 or more lines
- fast, expensive, short-distance communication
- serial data transfer, over single data line
- bits sent one by one
- no dedicated lines for signal controls
- cheap, slow, long-distance communication

3 Whole Picture

- DTE, DCE, channel, DCE, DTE
- t: terminal
- c: communication
- e: equipment
- DCE: usally MODEM

4 Serial Communication

4.1 Data Transfer Rate

- (S) symbol rate, (baud, or baud rate)
  - number of distinct symbol or pulse changes
  - each symbol can represent one or more bits of data
- bit rate
  - $B = S \times \log_2 N$

4.2 Synchronization Methods

4.2.1 Asynchronous serial communication

- crystals may not be exactly the same
- phase may not be the same
- start each byte with start bit
- end with one or more stop bits

- e.g. idle and stop = high, start = low, parity bit
- starting of each byte is async
- what if clock not aligned?
  - amplitude / phase distortion
- bit synchronization
  - receiver clock N times faster
  - first 1-0 transition is start bit
  - each bit sampled at the center
  - signal sampled after N/2 cycles, then N*bits, therefore finding center value
- character synchronization
  - after start bit detected, receiver counts programmed number of bits

4.2.2 Synchronous serial communication

- transfer a block of data at a time
- find synchronous character
- bit synchronization
  - clock encoding and extraction
  - manchester encoded signal
    - rising edge = 1, falling edge = 0
    - bit stream - transmitter clock - encoded data
    - extracted clock - received data
  - bit oriented synchronous transmission
    - opening flag + frame contents + closing flag
    - insert 0 after five consecutive 1s (bit stuffing)

4.3 Communication Modes

- simplex
- half-duplex
- full-duplex
- refer to figures on slides

4.4 Error Detection

- parity bit
- CRC calculation

4.5 Modulation and Demodulation

- long distance
  - signal distortion
- FM, AM, PSK

5 8251 USART Chip

- full duplex, double buffered
- error checking
- async + sync
- signals: refer to slides
  - TxRDY, TxEMPTY, RxRDY