Serial Communication

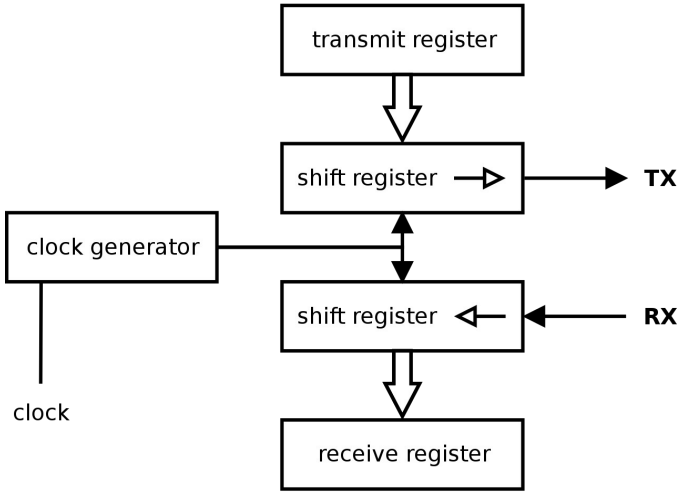
For micro-{controller,processor} systems

Serial Communications

- Why?
  - Quicker interfacing
  - Less wire(s) → less cost!
- Where?
  - Classic: teletypewriters (operator consoles), hardware for early internet
  - Current: microcontroller interfacing and/or console
- How?
  - UART (hardware)
  - RS232 (signal protocol)

Asynchronous Serial Communication

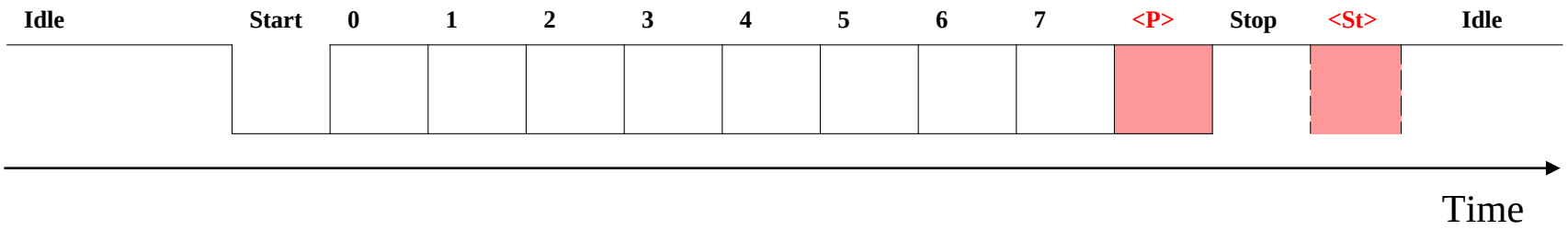
- Universal Asynchronous Receiver-Transmitter (UART)
  - generic hardware design consensus
  - parallel ↔ serial logic conversion
  - configurable clock generator
  - dual lines: transmit (TX) and receive (RX)



UART: Data Framing

- 2 issues in asynchronous serial transmission
  - keep device clock in-phase
  - know when data begins/ends
- needs meta-signal → frame!
  - Idle [1] (logic high @mark)
  - Start [1] (logic low @space)
  - Data [5-9], Parity [0-1]
  - Stop [1-2] (logic high)

Note: Logic high can be most +ve (e.g. 5V) OR most -ve (e.g. 0V)



Note: **mark** and **space** are terms used in telecommunications. Sometimes, still used to explain serial communication.

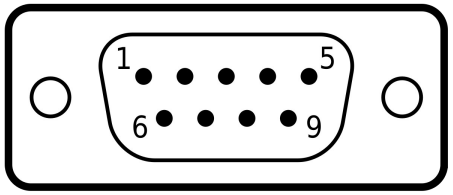
UART: Signal Protocol and Timing

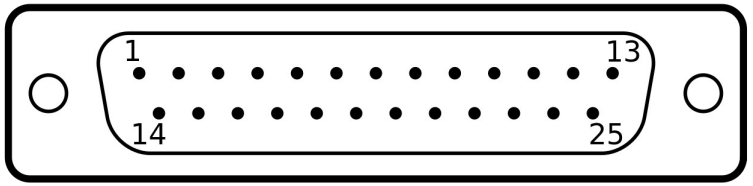
- RS232 – Recommended Standard 232
  - in telecommunications, for serial communications
  - defines signals between DCE and DTE
  - commonly used protocol in microcontroller systems
- RS232 specifies (among others):
  - electrical signal characteristics (logic level, timing, etc.)
  - mechanical characteristics (connectors, pin id, etc.)

Note: **DCE** is **D**ata **C**ommunication (@Circuit-terminating) **E**quipment (like a modem) and **DTE** is Data Terminal Equipment (like a computer).

RS232 Interface

- Physical Port
  - DB9 (most common) or DB25
  - no longer a ‘standard’ port on modern PC





- Virtual Port
  - USB virtualization → USB-to-serial converters
  - Utilizes 0V – 5V range instead

RS232 Signals

- Line count:
  - defines many signals (using up to 25-pin connector)
  - only 3 core signals: TX (Data Transmit), RX (Data Receive), GND (Voltage reference)
- Voltage level:
  - logic 1 (@mark) at -15V to -3V range
  - logic 0 (@space) at 3V to 15V range
  - not TTL → require line driver like MAX232

That's all!