Term	Definition
Bit serial	One bit is transmitted per unit time.
Bit parallel	Multiple bits are transmitted per unit time

7.5.1 Parallel Data Transmission

- One conductor is required for each bit transmitted. For example, a bus designed to transmit a byte of data must have eight (8) data lines, one for each bit in a byte. Other lines are required also.
- One line is required for synchronization, sometimes called a **strobe**.
- Parallel connections are effective over short distances – usually less than 30 feet – depending on the strength of signal, frequency of the signal, and quality of the cable. At longer distances, signals in the cable begin to weaken, because of the internal resistance of the conductors. Electrical signal loss over time or distance is called **attenuation**.

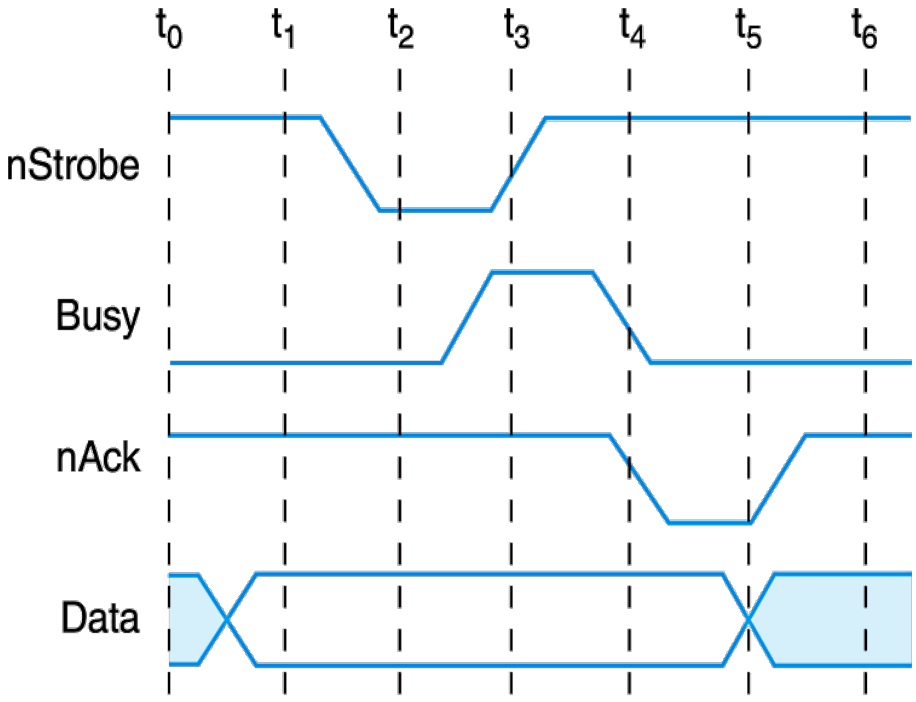

Figure 7.12 A Simplified Timing Diagram for a Parallel Printer

- `nStrobe`, `nAck` are asserted low.
- `Busy`, `Data` are asserted high.
- The Data signal represents eight different lines. Each of these lines can be either high or low (singl 1 or 0). The signals on these lines are meaningless (shaded in the diagram) before the `nStrobe` signal is asserted and after the `nAck` is asserted.
- Arbitrary reference times are listed across the top of the diagram, t_0 through t_6. The difference between two consecutive times, Δt, determines the speed of transmission. Typically Δt will range between 1ms and 5ms.

Sending a byte from the CPU to the printer:

1. The CPU places a byte, one bit per data line, on the bus.
2. The CPU checks the busy line. Wait until the busy line is low.
3. The CPU asserts the nStrobe signal so that the printer will know that there are data on the data lines.
4. The Printer waits for the nStobe line to be asserted (low).
5. When the nStobe line is asserted, the Printer reads the data lines.
6. After the data lines are read the Printer asserts the nAck line (low) telling the CPU that data have been received.

- In the foregoing system, there is no guarantee that data sent are the same data received. Over short distances, data can be transmitted reliably. Over longer distances data cannot be transmitted reliably.

7.5.2 Serial Data Transmission

- Only one bit is transmitted per unit time.
- One conductor is used to transmit data in the RS-232-C protocol. Additional lines carry control signals.
- For USB (Universal Serial Bus) data transmission, two conductors are used and the voltage difference is employed to determine whether a one or a zero has be transmitted.
- Serial data transmission is more reliable that parallel transmission and can be used over longer distances than parallel transmission.
- Serial transfer methods can also be used for time-sensitive **isochronous** data transfers, including real-time voice and video.