Demultiplexor (DeMux)

Takes 1 input, n select lines, and has 2^n outputs. Used to select which output the input is routed to.

challenge: Draw the circuit diagram for a 1-4 demux

Multiplexors and demultiplexors can work together to transmit information over a single data line and n control lines.

So 2^n inputs are transmitted over n+1 long distance lines instead of 2^n. This number can be reduced to ≈1 line under certain circumstances, regardless of the size of n.

(Note long distance may mean just a metre, or some distance on a circuit board.)

USB

A USB keyboard, for example, will have five wires connecting to the computer. Two for data, one for ground, one for power, and one for a clock.

Here, the select lines of the mux and demux change together. By changing the combination of inputs on the select lines from 0…0 to 1…1, each input of the mux will in turn be sent to the corresponding output of the demux.

Terminology

Black Box

A black box is a device whose output depends only on its inputs. You don't need to know how it works or what is inside.

With a black box, we abstract away detail and consider only functionality. We've seen this already when building a multibit adder from many full adders.

We can take it further by representing the multibit (4-bit in this case) adder as a black box itself, with 8 inputs, 4 outputs, a carry-in, and a carry-out.

Carry-In in Multibit Adders

For just addition of two numbers you don't actually need a carry-in (you'll be setting it to 0), but it's useful for other things (e.g. you can subtract numbers using adders by manipulating the carry-ins).

Limitations

Let's look at the limitations of using a fixed number of bits to represent information (numbers in this example).
With 32 bits, we can represent 2^{32} different 32-bit patterns, where each pattern can represent a unique thing:

000.....000	0
000.....001	1
...	
111.....111	4,294,967,295

If we add 1 to this last number, since we don't have a 33rd bit, we get 0 again.
Typically there is a 33rd bit, which is used to tell if we have overflown the limit of the 32-bit number. If it's 1, there is overflow, if it's 0, there isn't.