Binary multiplication works just like normal multiplication. There are four main rules that are quite simple to understand:

$$0 \times 0 = 0$$

$$0 \times 1 = 0$$

$$1 \times 0 = 0$$

$$1 \times 1 = 1$$

Suppose you have two binary digits A1A0 and B1B0, here's how that multiplication would take place

	A1	A0
	B1	B0
	A1B0	A0B0
A1B1	A0B1	X
A1B1+C	A0B1+A1B0	A0B0

In the above calculation, A1A0 is the multiplicand. B1B0 is the multiplier. The first product obtained from multiplying B0 with the multiplicand is called as partial product 1. And the second product obtained from multiplying B1 with the multiplicand is known as the partial product 2.

As the number of bits increases, we keep shifting each successive partial product to the left by 1 bit. In the end, we add the digits while keeping in mind the carry that might generate.

Based on the above equation, we can see that we need four AND gates and two half adders to design the combinational circuit for the multiplier. The AND gates will perform the multiplication, and the half adders will add the partial product terms. Hence the circuit obtained is as follows.

2-bit multiplier