CLAIMS

1. A device, comprising:

a first qubit;

a second qubit; and

a multi-resonant architecture comprising a first resonator that capacitively couples the first qubit to the second qubit and a second resonator that capacitively couples the first qubit to the second qubit.

2. The device of claim 1, wherein the first qubit has a first operational frequency, wherein the second qubit has a second operational frequency, wherein the first resonator has a first resonant frequency that is less than the first operational frequency and the second operational frequency, and wherein the second resonator has a second resonant frequency that is greater than the first operational frequency and the second operational frequency.

3. The device of claim 2, wherein the first resonator and the second resonator are $\lambda/2$ resonators, and wherein the first resonator and the second resonator are in parallel.

4. The device of claim 3, wherein the first resonant frequency is about 3 gigahertz, wherein the second resonant frequency is about 6 gigahertz, and wherein the first operational frequency and the second operational frequency are between 4.5 gigahertz and 5.5 gigahertz.

5. The device of claim 2, wherein the first resonant frequency, the second resonant frequency, the first operational frequency, and the second operational frequency are fixed.

6. A device, comprising:

a first qubit;

a second qubit; and

a multi-resonant architecture comprising a resonator, wherein a first end of the resonator is capacitively coupled to the first qubit and to the second qubit, and wherein a second end of the resonator is coupled to ground.

7. The device of claim 6, wherein the first qubit has a first operational frequency, wherein

the second qubit has a second operational frequency, wherein the resonator has a first harmonic frequency that is less than the first operational frequency and the second operational frequency, and wherein the resonator has a second harmonic frequency that is greater than the first operational frequency and the second operational frequency.

8. The device of claim 7, wherein the resonator is a λ/4 resonator.

9. The device of claim 8, wherein the first harmonic frequency is about 2 gigahertz, wherein the second harmonic frequency is about 6 gigahertz, and wherein the first operational frequency and the second operational frequency are between 4.5 gigahertz and 5.5 gigahertz.

10. The device of claim 7, wherein the first harmonic frequency, the second harmonic frequency, the first operational frequency, and the second operational frequency are fixed.

11. A device, comprising:

a first qubit;

a second qubit; and

a multi-resonant architecture comprising a resonator that capacitively couples the first qubit to the second qubit and a differential direct coupler that capacitively couples the first qubit to the second qubit, wherein the differential direct coupler capacitively couples opposite pads of the first qubit and the second qubit.

12. The device of claim 11, wherein the first qubit has a first operational frequency, wherein the second qubit has a second operational frequency, and wherein the resonator has a resonant frequency that is greater than the first operational frequency and the second operational frequency.

13. The device of claim 12, wherein the resonator is a λ/2 resonator, and wherein the resonator and the differential direct coupler are in parallel.

14. The device of claim 13, wherein the resonant frequency is about 6 gigahertz, and wherein the first operational frequency and the second operational frequency are between 4.5 gigahertz and 5.5 gigahertz.

15. The device of claim 12, wherein the resonant frequency, the first operational frequency, and the second operational frequency are fixed.

16. A device, comprising:

a first qubit;

a second qubit; and

a multi-resonant architecture comprising a resonator and a direct coupler, wherein a first end of the resonator is capacitively coupled to the first qubit and to the second qubit, wherein a second end of the resonator is coupled to ground, wherein the direct coupler capacitively couples the first qubit to the second qubit, and wherein the direct coupler capacitively couples common pads of the first qubit and the second qubit.

17. The device of claim 16, wherein the first qubit has a first operational frequency, wherein the second qubit has a second operational frequency, and wherein the resonator has a resonant frequency that is greater than the first operational frequency and the second operational frequency.

18. The device of claim 17, wherein the resonator is a $\lambda/4$ resonator.

19. The device of claim 18, wherein the resonant frequency is about 6 gigahertz, and wherein the first operational frequency and the second operational frequency are between 4.5 gigahertz and 5.5 gigahertz.

20. The device of claim 17, wherein the resonant frequency, the first operational frequency, and the second operational frequency are fixed.

21. An apparatus, comprising:

a first transmon qubit having a first operational frequency;

a second transmon qubit having a second operational frequency; and

a multi-resonant architecture that capacitively couples the first transmon qubit to the second transmon qubit, wherein the multi-resonant architecture has a first resonant frequency less than the first operational frequency and the second operational frequency and has a second resonant frequency greater than the first operational frequency and the second operational

frequency.

22. The apparatus of claim 21, wherein the multi-resonant architecture comprises a first λ/2 resonator capacitively coupled to the first transmon qubit and to the second transmon qubit and comprises a second λ/2 resonator capacitively coupled to the first transmon qubit and to the second transmon qubit, wherein the first λ/2 resonator and the second λ/2 resonator are in parallel, wherein the first λ/2 resonator exhibits the first resonant frequency, and wherein the second λ/2 resonator exhibits the second resonant frequency.

23. The apparatus of claim 22, wherein the first resonant frequency is about 3 gigahertz, and wherein the second resonant frequency is about 6 gigahertz.

24. The apparatus of claim 21, wherein the multi-resonant architecture comprises a λ/4 resonator, wherein a first end of the λ/4 resonator is coupled between coupling capacitors of the first transmon qubit and the second transmon qubit, wherein a second end of the λ/4 resonator is shorted to ground, wherein a first harmonic of the λ/4 resonator is the first resonant frequency, and wherein a second harmonic of the λ/4 resonator is the second resonant frequency.

25. The apparatus of claim 24, wherein the first harmonic is about 2 gigahertz, and wherein the second harmonic is about 6 gigahertz.