CLAIMS

What is claimed as new and desired to be protected by Letters Patent of the United States is:

1. An optical communications system comprising

at least one optical signal source providing a plurality of spaced optical carrier wavelengths forming a plurality of optical communication channels, each optical communications channel having at least two carrier wavelengths which can be modulated with data; and

a respective optical modulator for each optical communications channel, each optical modulator comprising at least a first and second resonant modulator circuit, each for selectively modulating one of the carrier wavelengths associated with the optical communications channel with data, the first resonant modulator circuit having a resonant frequency at a first of the carrier wavelengths of the associated optical communications channel and the second resonant modulator circuit having a resonant frequency shifted from and out of resonance with a second of the carrier wavelengths of the associated optical communications channel.

2. A system as in claim 1, wherein for each optical communications channel the resonant frequency of the first and second resonant modulator circuits can shift with a temperature increase and the shift in resonant frequency with a temperature increase of the second modulation circuit is towards obtaining resonance with the second of the carrier wavelengths.

3. A system as in claim 2, further comprising a first switch circuit for switching from the first to the second modulator circuit of each optical communications channel in response to a switch command.

4. A system as in claim 3, further comprising a detector circuit for issuing the switch command when a particular temperature is detected.

5. A system as in claim 3, further comprising a detector circuit for issuing the switch command when a predetermined amount of shift in the resonance frequency of a first modulator circuit is detected relative to the first carrier wavelength in at least one of the optical communications.

6. A system as in claim 5, wherein the detector circuit detects a drop in a modulation index of the first modulator circuit.

7. A system as in claim 4, wherein the detector circuit detects the temperature of a die on which the optical modulators are located.

8. A system as in claim 4, wherein the detector circuit comprises a temperature sensor which provides an output to a hysteresis circuit.

9. A system as in claim 8, wherein the hysteresis circuit comprises a Schmitt Trigger.

10. A system as in claim 6, wherein the detector circuit further comprises a hysteresis circuit.

11. A system as in claim 10, wherein the hysteresis circuit comprises a Schmitt Trigger.

12. A system as in claim 3, further comprising an optical multiplexer for multiplexing the plurality of optical communications channels onto a waveguide.

13. A system as in claim 12, further comprising an optical demultiplexer for receiving the optical communications channels from the waveguide and demultiplexing them into respective received optical communications channels.

14. A system as in claim 13, further comprising an optical demodulator respectively associated with each demultiplexed optical communication channel, each optical demodulator comprising at least two optical demodulator circuits, a first for demodulating data signals on the first carrier wavelength associated with the respective optical communication channel and a second for demodulating optical signals on the second carrier wavelength associated with the respective optical communications channel.

15. A system as in claim 14, further comprising a second switch circuit associated with each optical demodulator for selecting one of the first and second optical demodulator circuits for providing demodulated output data.

16. A system as in claim 15, wherein the second switch circuit is responsive to a received switch command.

17. A system as in claim 16, wherein the received switch command is received over one of the demultiplexed optical communications channels.

18. A system as in claim 16, wherein the switch command is received over an electrical communications channel.

19. A system as in claim 14, wherein each optical demodulator circuit has an associated optical tap for providing an optical output signal to a respective photo detector.

20. A system as in claim 14, wherein each of the said first and second optical demodulator circuits of an optical demodulator comprises a pair of optical demodulator circuits having optical resonant frequencies which are shifted from each other.

21. A system as in claim 1, wherein for each optical communications channel the resonant frequency of the first and second resonant modulator circuits can shift such that as the resonant frequency of the first resonant modulator circuit shifts away from the first of the carrier wavelengths of the associated communications channel, the resonant frequency of the second resonant modulator circuit shifts towards the second of the carrier wavelengths of the associated optical communications channel.

22. An optical communications method comprising:

establishing a plurality of carrier wavelengths for at least one optical communication channel;

modulating data on a first one of the carrier wavelengths of the at least one optical communications channels using a first resonant modulator;

determining if the first resonant modulator is losing resonance with the first carrier wavelength and, if so, turning off the first resonant modulator and turning on a second resonant modulator which modulates data on a second one of the carrier wavelengths of the at least one optical communications channel.

23. An optical communications method as in claim 22, wherein a plurality of optical communications channels are provided, each having a first and second carrier wavelength and a first resonant modulator circuit for modulating data on the first carrier wavelength and a second resonant modulator circuit for modulating data on the second carrier wavelength, the method further comprising turning off the first resonant modulator circuit and turning on the second resonant modulator circuit of each optical communications channel at substantially the same time.

24. A method as in claim 23, wherein the first resonant modulator circuit of each associated optical communications channel has a resonant frequency at the wavelength of the first carrier wavelength of the associated optical communications channel and the second resonant modulator circuit of each associated optical communications channel has a

resonant frequency displaced from the second carrier wavelength of the associated communications channel such that as the first resonant modulator moves out of resonance with the first carrier wavelength the second resonant modulator moves into resonance with the second carrier wavelength.

25. A method as in claim 22, wherein the determination is made based on sensing a temperature which affects the first and second resonant modulator circuits.

26. A method as in claim 22, wherein the determination is made based on sensing the quality of the modulation performed by the first resonant modulator.

27. A method as in claim 24, further comprising wave division multiplexing the plurality of optical communications channels onto a multiplexed communications channel on a multiplexing side of the system.

28. A method as in claim 27, further comprising demultiplexing the plurality of optical communications channels from the multiplexed communications channel on a demultiplexing side of the system, and demodulating data off the one of the first and second carrier wavelengths of each optical communications channel which has been modulated with data.

29. A method as in claim 28, further comprising sending a signal from the multiplexing side to the demultiplexing side indicating when the first modulator is being turned off and when the second modulator is being turned on.

20. A method as in claim 29, wherein the demodulation of data is performed by a selected one of at least a first demodulator circuit associated with the first carrier wavelength of an optical communications channel and a second demodulator circuit associated with the second carrier wavelength of an optical communications channel, the selection being based on the signal from the multiplexing side.

31. A method as in claim 29, further comprising sending the signal on one of the optical channels.

32. A method as in claim 29, further comprising sending the signal on an electrical communication channel.

CLAIMS

1. An optical communications system comprising

at least one optical signal source providing a plurality of spaced optical carrier wavelengths forming a plurality of optical communication channels, each optical communications channel having at least two carrier wavelengths which can be modulated with data; and

a respective optical modulator for each optical communications channel, each optical modulator comprising at least a first and second resonant modulator circuit, each for selectively modulating one of the carrier wavelengths associated with the optical communications channel with data, the first resonant modulator circuit having a resonant frequency at a first of the carrier wavelengths of the associated optical communications channel and the second resonant modulator circuit having a resonant frequency shifted from and out of resonance with a second of the carrier wavelengths of the associated optical communications channel.

2. A system as in claim 1, wherein for each optical communications channel the resonant frequency of the first and second resonant modulator circuits can shift with a temperature increase and the shift in resonant frequency with a temperature increase of the second modulation circuit is towards obtaining resonance with the second of the carrier wavelengths.

3. A system as in claim 2, further comprising a first switch circuit for switching from the first to the second modulator circuit of each optical communications channel in response to a switch command.

4. A system as in claim 3, further comprising a detector circuit for issuing the switch command when a particular temperature is detected.

5. A system as in claim 4, wherein the detector circuit detects the temperature of a die on which the optical modulators are located.

6. A system as in claim 4, wherein the detector circuit comprises a temperature

sensor which provides an output to a hysteresis circuit.

7. A system as in claim 6, wherein the hysteresis circuit comprises a Schmitt Trigger.

8. A system as in claim 3, further comprising a detector circuit for issuing the switch command when a predetermined amount of shift in the resonance frequency of a first modulator circuit is detected relative to the first carrier wavelength in at least one of the optical communications.

9. A system as in claim 8, wherein the detector circuit detects a drop in a modulation index of the first modulator circuit.

10. A system as in claim 9, wherein the detector circuit further comprises a hysteresis circuit.

11. A system as in claim 10, wherein the hysteresis circuit comprises a Schmitt Trigger.

12. A system as in claim 3, further comprising an optical multiplexer for multiplexing the plurality of optical communications channels onto a waveguide.

13. A system as in claim 12, further comprising an optical demultiplexer for receiving the optical communications channels from the waveguide and demultiplexing them into respective received optical communications channels.

14. A system as in claim 13, further comprising an optical demodulator respectively associated with each demultiplexed optical communication channel, each optical demodulator comprising at least two optical demodulator circuits, a first for demodulating data signals on the first carrier wavelength associated with the respective optical communication channel and a second for demodulating optical signals on the second carrier wavelength associated with the respective optical communications channel.

15. A system as in claim 14, further comprising a second switch circuit associated with each optical demodulator for selecting one of the first and second optical demodulator circuits for providing demodulated output data.

16. A system as in claim 15, wherein the second switch circuit is responsive to a received switch command.

17. A system as in claim 16, wherein the received switch command is received over one of the demultiplexed optical communications channels.

18. A system as in claim 16, wherein the switch command is received over an electrical communications channel.

19. A system as in claim 14, wherein each optical demodulator circuit has an associated optical tap for providing an optical output signal to a respective photo detector.

20. A system as in claim 14, wherein each of the said first and second optical demodulator circuits of an optical demodulator comprises a pair of optical demodulator circuits having optical resonant frequencies which are shifted from each other.

21. A system as in claim 1, wherein for each optical communications channel the resonant frequency of the first and second resonant modulator circuits can shift such that as the resonant frequency of the first resonant modulator circuit shifts away from the first of the carrier wavelengths of the associated communications channel, the resonant frequency of the second resonant modulator circuit shifts towards the second of the carrier wavelengths of the associated optical communications channel.

22. An optical communications method comprising:

establishing a plurality of carrier wavelengths for at least one optical communication channel;

modulating data on a first one of the carrier wavelengths of the at least one optical communications channels using a first resonant modulator;

determining if the first resonant modulator is losing resonance with the first carrier wavelength and, if so, turning off the first resonant modulator and turning on a second resonant modulator which modulates data on a second one of the carrier wavelengths of the at least one optical communications channel.

23. An optical communications method as in claim 22, wherein a plurality of optical communications channels are provided, each having a first and second carrier wavelength and a first resonant modulator circuit for modulating data on the first carrier wavelength and a second resonant modulator circuit for modulating data on the second carrier wavelength, the method further comprising turning off the first resonant modulator circuit and turning on the second resonant modulator circuit of each optical communications channel at substantially the same time.

24. A method as in claim 23, wherein the first resonant modulator circuit of each associated optical communications channel has a resonant frequency at the wavelength of the first carrier wavelength of the associated optical communications channel and the second resonant modulator circuit of each associated optical communications channel has a resonant frequency displaced from the second carrier wavelength of the associated communications channel such that as the first resonant modulator moves out of resonance with the first carrier wavelength the second resonant modulator moves into resonance with the second carrier wavelength.

25. A method as in claim 24, further comprising wave division multiplexing the plurality of optical communications channels onto a multiplexed communications channel on a multiplexing side of the system.

26. A method as in claim 25, further comprising demultiplexing the plurality of optical communications channels from the multiplexed communications channel on a demultiplexing side of the system, and demodulating data off the one of the first and second carrier wavelengths of each optical communications channel which has been

modulated with data.

27. A method as in claim 26, further comprising sending a signal from the multiplexing side to the demultiplexing side indicating when the first modulator is being turned off and when the second modulator is being turned on.

28. A method as in claim 27, wherein the demodulation of data is performed by a selected one of at least a first demodulator circuit associated with the first carrier wavelength of an optical communications channel and a second demodulator circuit associated with the second carrier wavelength of an optical communications channel, the selection being based on the signal from the multiplexing side.

29. A method as in claim 27, further comprising sending the signal on one of the optical channels.

30. A method as in claim 27, further comprising sending the signal on an electrical communication channel.

31. A method as in claim 22, wherein the determination is made based on sensing a temperature which affects the first and second resonant modulator circuits.

32. A method as in claim 22, wherein the determination is made based on sensing the quality of the modulation performed by the first resonant modulator.

33. An optical communications system comprising

a communications channel having at least two carrier wavelengths which can be modulated with data; and

an optical modulator for the communications channel, the optical modulator comprising at least a first and second resonant modulator circuit, each for selectively modulating one of the carrier wavelengths associated with the optical communications channel with data, the first resonant modulator circuit having a resonant frequency at a first of the carrier wavelengths of the optical communications channel and the second resonant modulator circuit having a resonant frequency

shifted from and out of resonance with a second of the carrier wavelengths of the optical communications channel.

34. A system as in claim 33, wherein the resonant frequency of the first and second resonant modulator circuits can shift with a temperature change and the shift in resonant frequency with a temperature change causes the first resonant modulator circuit to move in a direction away from resonance with the first carrier wavelength and the second resonant modulator in a direction towards obtaining resonance with the second of the carrier wavelengths.

35. A system as in claim 34, further comprising a first switch circuit for switching from the first to the second modulator circuit in response to a switch command.

36. A system as in claim 35, further comprising an optical demodulator associated with the optical communication channel, the optical demodulator comprising at least two optical demodulator circuits, a first for demodulating data signals on the first carrier wavelength associated with the optical communication channel and a second for demodulating optical signals on the second carrier wavelength associated with the optical communication channel.

37. A system as in claim 36, wherein the optical demodulator circuits are capable of resonating with and demodulating a respective carrier wavelength over respective changes which otherwise adversely affect a resonant modulator circuit.

38. A system as in claim 36, further comprising a second switch circuit associated with each optical demodulator for selecting one of the first and second optical demodulator circuits for providing demodulated output data.

39. A system as in claim 38, wherein the second switch circuit is responsive to a received switch command.

40. A system as in claim 39, wherein the received switch command is received over an optical communication channel.

41. A system as in claim 39, wherein the switch command is received over an electrical communication channel.

42. A system as in claim 36, wherein each optical demodulator circuit has an associated optical tap for providing an optical output signal to a respective photo detector.

43. A system as in claim 36, wherein each of the said first and second optical demodulator circuits have optical resonant frequencies which are shifted from each other.

44. A system as in claim 33, wherein each resonant modulator circuit receives the same input data.

45. A system as in claim 44, further comprising a detector circuit for issuing the switch command when a particular temperature is detected.

46. A system as in claim 45, wherein the detector circuit detects the temperature of a die on which the optical modulator is located.

47. A system as in claim 45, wherein the detector circuit comprises a temperature sensor which provides an output to a hysteresis circuit.

48. A system as in claim 47, wherein the hysteresis circuit comprises a Schmitt Trigger.

49. A system as in claim 44, further comprising a detector circuit for issuing the switch command when a predetermined amount of shift in the resonance frequency of a first modulator circuit is detected relative to the first carrier wavelength.

50. A system as in claim 49, wherein the detector circuit detects a drop in a modulation index of the first modulator circuit.

51. A system as in claim 50, wherein the detector circuit further comprises a hysteresis circuit.

52. A system as in claim 51, wherein the hysteresis circuit comprises a Schmitt Trigger.

53. An optical communications system, comprising:

an optical communications channel having at least two associated carrier wavelengths, at least one of which is transmitting data;

an optical demodulator coupled to the optical communications channel, the optical demodulator comprising at least two optical demodulator circuits, a first for demodulating data signals on a first carrier wavelength associated with the optical communication channel and a second for demodulating optical signals on a second carrier wavelength associated with the optical communication channel; and

a switch circuit associated with the optical demodulator for selecting one of the first and second optical demodulator circuits corresponding to the carrier wavelength transmitting data for providing demodulated output data.

54. An optical communication system as in claim 53, wherein the switch circuit is responsive to a received switch command.

55. An optical communication system as in claim 54, wherein the received switch command is received over one of an optical and electrical communications channel.

56. An optical communication system as in claim 54, wherein the received switch command is received from a circuit which controls which of the carrier wavelengths contains modulated data.

57. An optical communication method comprising:

receiving an optical signal over an optical communications channel comprising at least two carrier wavelengths, one of which contains data;

demodulating the data using one of at least two demodulator circuits each of which is capable of resonating with and demodulating data from a respective one of the carrier wavelengths; and

selecting which of the demodulator circuits will be used to demodulate the data in accordance with which of the at least two carrier wavelengths contains data.

58. An optical communications system as in claim 57, further comprising receiving a command to select one of the demodulator circuits.

59. An optical communications system as in claim 58, further comprising receiving the select command from a circuit which controls which of the carrier wavelengths contains data.