

WHAT IS CLAIM IS :

1. A radio communications system comprising multiple satellites orbiting the earth in random orbits for providing a radio route for data communications between transceivers at two ground station locations, each satellite and ground station comprising a node of the system, wherein each of a plurality of the satellites includes:

a plurality of satellite antennas for receiving radio signals from a plurality of other nodes and for transmitting radio signals;

antenna pairing circuitry for storing address information identifying another node from which the satellite received a routing signal and identifying the satellite antenna on which the satellite received the routing signal; and

route creation circuitry for transmitting routing signals from a plurality of the satellite antennas, wherein the routing signals include (i) linking information identifying the satellite, and (ii) a quality of the received routing signal indicating a suitability of the satellite and the other node as a radio link in the radio route between the two ground station locations.

2. A system as in claim 1, wherein the satellite antennas are directional antennas.

3. A system as in claim 2, wherein the satellite antennas are arranged to transmit and receive radio signals over substantially the entire spherical space surrounding each of the satellites.

4. A system as in claim 2, wherein the satellite antennas are arranged to transmit and receive radio signals over less than the entire spherical space surrounding each of the satellites.

5. A system as in claim 1, wherein the satellite nodes are designated as a first type and the ground station nodes are designated as a second type, and nodes of the same type do not communicate with each other.

6. A system as in claim 1, wherein the routing signals comprise packets of digital data transmitted from the nodes, each packet including;
a header containing the linking information and the quality of the received routing signal;
and
a payload including a sample data stream used by another node receiving a routing signal to determine the quality of the routing signal received from the satellite.
7. A system as in claim 6, wherein the quality of the receiving routing signal is expressed as a quantitative figure of merit based at least in part on an error rate of the sample data stream.
8. A system as in claim 1, wherein each of the plurality of the satellites further includes a plurality of solar panels, wherein at least one solar panel is oriented to generate electricity regardless of satellite orientation when the satellite is exposed to solar radiation during its orbit.
9. A system as in claim 8, wherein each of the plurality of the satellites further includes a battery module for providing electrical power to the satellite antennas, the battery module being charged by the at least one solar panel when the satellite is exposed to solar radiation during its orbit.
10. A system as in claim 8, wherein the solar panels are constructed to cause the satellites to rotate in orbit.
11. A method for creating a radio communication route for data communications from a receiving ground station to a sending ground station, wherein the ground stations include a plurality of ground station directional antennas for transmitting and receiving radio signals, the method comprising:

- (a) providing multiple satellites orbiting the earth in random orbits ~~without attitude control~~, wherein each of a plurality of the satellites includes a plurality of satellite directional antennas for transmitting and receiving radio signals;
- (b) receiving at a satellite antenna of at least one satellite an initial information signal transmitted from an antenna at a sending ground station;
- (c) storing at any satellite receiving the initial information signal at least (i) address information identifying the ground station from which the initial information signal was received, and (ii) the satellite antenna on which the initial information signal was received;
- (d) transmitting linking information signals from a plurality of the antennas of at least one satellite receiving the initial information signal, wherein the linking information signals include (i) linking information identifying the satellite, and (ii) a quality of the received initial information signal indicating a suitability of the satellite and the sending ground station as a radio link in a radio route between the ground stations; and
- (e) storing at a receiving ground station receiving at least one linking information signal (i) address information identifying the satellite transmitting the linking information signal, (ii) the receiving ground station antenna on which the linking information signal was received, and (iii) a quality of the initial information signal received at the satellite transmitting the linking information signal; and
- (f) determining a quality of a radio route for data communications from the receiving ground station to the sending ground station via a particular satellite based on (i) a quality of the received linking information signal indicating a suitability of the receiving ground station and the particular satellite as a radio link in a radio route between the ground stations, and (ii) the quality of the initial information signal.

12. A method as in claim 11, wherein the satellites are designated as a first type of node and the ground stations are designated as a second type of node, and ~~the two types of nodes~~ of the same type do not communicate with each other.

13. A method as in claim 12 further including sending a data transmission from the originating ground station to the destination ground station, wherein the first type of node only transmits radio signals in a first mode and only receives radio signals in a second mode that substantially eliminates interference with transmissions in the first mode, and the second type of node only receives radio signals in the first mode and only transmits radio signals in the second mode.

14. A method as in claim 11, wherein:

the initial information signal comprises packets of digital data including a header containing at least the sending ground station address information and a payload including a sample data stream used by the satellite to determine the quality of the received initial information signal; and

the linking information signal comprises packets of digital data including a header containing at least the linking information and the quality of the received initial information signal and a payload including a sample data stream used by the receiving ground station to determine the quality of the received linking information signal.

15. A method as in claim 14, wherein the qualities of the initial information signal received by the satellite and the linking information signal received by the receiving ground station are expressed as quantitative figures of merit based at least in part on an error rate of the respective sample data streams.

16. A method as in claim 15 further including communicating a data transmission comprising packets of digital data from an origin comprising a receiving ground station to a

destination comprising a sending ground station, each data transmission packet including a header including the address information of the destination and a payload including a data stream representing the content of the transmission, wherein:

the origin transmits the packet of digital data to the particular satellite using the receiving ground station antenna on which the linking information signal was received; and

the particular satellite transmits the packet of digital data transmission to the destination using the antenna of the particular satellite on which the initial information signal was received.

17. A method as in claim 16, wherein the data transmission includes a plurality of packets and the header includes sequence information indicating the original order of the packets comprising the content of the transmission, the radio route from the origin to the destination uses different satellites during the data transmission, and the destination uses the sequence information to place the packets in the original order.

18. A method as in claim 11, wherein the satellite antennas are arranged to transmit and receive radio signals over substantially the entire spherical space surrounding the satellites and the ground station antennas are arranged to transmit and receive radio signals over substantially the entire spherical space above the surface of the earth surrounding the ground stations.

19. A method as in claim 11, wherein the satellite antennas are arranged to transmit and receive radio signals over less than the entire spherical space surrounding each of the satellites.

20. A method as in claim 11, wherein the determining step is performed by the receiving ground station without a central computer communicating with the satellites or other ground stations.

21. A method as in claim 11, further comprising deploying the satellites with a rotational velocity about an axis of rotation.

22. A radio communication route for data communication from an originating ground station to a destination ground station, the route comprising at least one of multiple satellites orbiting the earth in random orbits that communicate with the ground stations, each including a plurality of directional antennas for receiving radio signals from multiple directions and transmitting radio signals in multiple directions, wherein the satellite includes:

antenna pairing circuitry for storing address information identifying a destination ground station from which an initial information signal was transmitted and antenna information identifying the satellite antenna on which the initial information signal was received; and

route creation circuitry for transmitting linking information signals from a plurality of the satellite antennas, the linking information signals including linking information identifying the satellite to an originating ground station receiving the linking information signal on one of the ground station antennas, whereby data transmissions received at the originating ground station and designating a particular destination ground station are transmitted by the originating ground station using the ground station antenna on which the linking information was received and the satellite transmits the data transmission using the satellite antenna identified by the stored antenna information.

23. A radio communication route as in claim 22 including plural satellites, wherein:

the antenna pairing circuitry in a first satellite stores address information identifying a destination ground station from which it received an initial information signal and first satellite antenna information identifying the antenna of the first satellite on which the initial information signal was received;

the route creation circuitry in the first satellite transmits intermediate linking information signals from a plurality of the antennas of the first satellite, the first linking information signals including first linking information identifying the first satellite to an n^{th} satellite receiving the first linking information signal;

the antenna pairing circuitry in the n^{th} satellite stores (i) address information identifying the first satellite, and (ii) n^{th} satellite antenna information identifying the antenna of the n^{th} satellite on which the first linking information signal was received; and

the route creation circuitry in the n^{th} satellite transmits n^{th} linking information signals from a plurality of the antennas of the n^{th} satellite, the n^{th} linking information signals including n^{th} linking information identifying the n^{th} satellite, whereby data transmissions received at the originating ground station and designating a particular destination ground station are transmitted by the originating ground station using the antenna on which the linking information was received, the n^{th} satellite transmits the data transmission data using the antenna identified by the stored antenna information, and the first satellite transmits the data transmission data using the antenna identified by the stored first satellite antenna information.

24. A radio communication route as in claim 22, wherein:

a first predetermined number of the satellites are designated as a first type of node and the ground stations are designated as a second type of node, and nodes of the same type do not communicate with each other; and

at least one satellite is designated as the second type of node.

25. A method using the radio route of claim 22 to transmit data communications from the originating ground station to a destination ground station, the method comprising:

providing to the originating ground node a data transmission designating the address of the destination station in encrypted form and a payload including a data stream representing the content of the transmission; and

only destination ground stations in the geographic area include decryption keys enabling access to the data stream.

26. A radio communication route as in claim 22, comprising a first intermediate radio route between the destination ground station and an intermediate ground station via a first satellite and a second intermediate radio route between the intermediate ground station and the originating ground station via a second satellite.

27. A radio communication route as in claim 22, wherein:

the satellites rotate about a rotational axis; and

each of the plurality of the satellites further includes a plurality of solar panels constructed to impart a moment on the satellite about the rotational axis.

28. A method using the radio route of claim 27 to transmit communications from the originating ground station to a destination ground station, the method comprising:

providing a data transmission comprising packets of digital data to the originating ground node, each data transmission packet including a header designating the address of the destination station in encrypted form and a payload including a data stream representing the content of the transmission; and

only destination ground stations in the geographic area include decryption keys enabling access to the data stream.

29. A radio communication route as in claim 22, wherein the satellite antennas are arranged to transmit and receive radio signals over substantially the entire spherical space surrounding each satellite.

30. A radio communication route as in claim 22, wherein the satellite antennas are arranged to transmit and receive radio signals over less than the entire spherical space surrounding each satellite.

31. A method of communicating data via a radio route including at least one radio link between two satellites orbiting the earth, wherein at least one of the satellites is rotating and includes at least two directional antennas for data communications with another satellite.

32. A method as in claim 31 used in a system comprising more than two satellites orbiting the earth, wherein a predetermined plurality of the orbiting satellites rotate in a first direction about a rotational axis and a second predetermined plurality rotate in a second direction about a rotational axis.

33. A method as in claim 32, wherein predetermined pluralities of the satellites rotate at different angular velocities.

34. A radio communications system comprising multiple satellites orbiting the earth for providing a radio route for data communications between transceivers at two ground station locations, each satellite and ground station comprising a node of the system, wherein each of a plurality of the satellites includes:

a plurality of satellite antennas for receiving radio signals from a plurality of other nodes and for transmitting radio signals;

antenna pairing circuitry for storing address information identifying another node from which the satellite received a routing signal and identifying the satellite antenna on which the satellite received the routing signal; and

route creation circuitry for transmitting routing signals from a plurality of the satellite antennas, wherein the routing signals include (i) linking information identifying the satellite, and (ii) a quality of the received routing signal indicating a suitability of the satellite and the other node as a radio link in the radio route between the two ground station locations.

35. A system as in claim 34, wherein the satellite antennas are directional antennas.

36. A system as in claim 35, wherein the satellite antennas are arranged to transmit and receive radio signals over substantially the entire spherical space surrounding each of the satellites.

37. A system as in claim 35, wherein the satellite antennas are arranged to transmit and receive radio signals over less than the entire spherical space surrounding each of the satellites.

38. A method for creating a radio communication route for data communications from a receiving ground station to a sending ground station, wherein the ground stations include a plurality of ground station directional antennas for transmitting and receiving radio signals, the method comprising:

(a) providing multiple satellites orbiting the earth, wherein each of a plurality of the satellites includes a plurality of satellite directional antennas for transmitting and receiving radio signals;

(b) receiving at a satellite antenna of at least one satellite an initial information signal transmitted from an antenna at a sending ground station;

(c) storing at any satellite receiving the initial information signal at least (i) address information identifying the ground station from which the initial information signal was received, and (ii) the satellite antenna on which the initial information signal was received;

(d) transmitting linking information signals from a plurality of the antennas of at least one satellite receiving the initial information signal, wherein the linking information signals include (i) linking information identifying the satellite, and (ii) a quality of the received initial information signal indicating a suitability of the satellite and the sending ground station as a radio link in a radio route between the ground stations; and

(e) storing at a receiving ground station receiving at least one linking information signal (i) address information identifying the satellite transmitting the linking information signal, (ii) the receiving ground station antenna on which the linking information signal was received, and (iii) a quality of the initial information signal received at the satellite transmitting the linking information signal; and

(f) determining a quality of a radio route for data communications from the receiving ground station to the sending ground station via a particular satellite based on (i) a quality of the received linking information signal indicating a suitability of the receiving ground station and the particular satellite as a radio link in a radio route between the ground stations, and (ii) the quality of the initial information signal.

39. A radio communication route for data communication from an originating ground station to a destination ground station, the route comprising at least one of multiple satellites orbiting the earth that communicate with the ground stations, each including a plurality of directional antennas for receiving radio signals from multiple directions and transmitting radio signals in multiple directions, wherein the satellite includes:

antenna pairing circuitry for storing address information identifying a destination ground station from which an initial information signal was transmitted and antenna information identifying the satellite antenna on which the initial information signal was received; and

route creation circuitry for transmitting linking information signals from a plurality of the satellite antennas, the linking information signals including linking information identifying the satellite to an originating ground station receiving the linking information signal on one of the ground station antennas, whereby data transmissions received at the originating ground station and designating a particular destination ground station are transmitted by the originating ground station using the ground station antenna on which the linking information was received and the satellite transmits the data transmission using the satellite antenna identified by the stored antenna information.

40. A radio communication route as in claim 39, wherein the linking information includes a quality of the received linking information signal indicating the suitability of the satellite as a node in the radio communication route.

41. A radio communication route as in claim 40, wherein the originating ground station receives linking information signals from more than one satellite and selects a satellite as the node for data transmission based on the qualities of the linking information signals.