CLAIMS

1. A bent-pipe satellite having flexible intra-satellite communications between a plurality of fixed spot beams, the satellite comprising:

a fixed spot beam antenna subsystem having a plurality of uplink antenna ports and a plurality of downlink antenna ports, the uplink antenna ports comprising gateway uplink antenna ports and user uplink antenna ports, and the downlink antenna ports comprising gateway downlink antenna ports and user downlink antenna ports; and

a pathway selection subsystem responsive to control signals to activate a plurality of non-processed forward signal pathways that couple the plurality of gateway uplink antenna ports with at least some of the plurality of user downlink antenna ports via a plurality of gateway uplink pathway selectors (GUPSs) and a plurality of user downlink pathway selectors (UDPSs),

the pathway selection subsystem comprising a forward simulcast mode which, when active, couples one of the gateway uplink antenna ports with multiple of the user downlink antenna ports such that one of the plurality of non-processed forward signal pathways is a forward simulcast signal pathway;

a pathway scheduling controller that provides the control signals to the pathway selection subsystem to activate the plurality of non-processed forward signal pathways according to a pathway selection schedule; and

a memory (240), having stored thereon, the pathway selection schedule and a set of instructions, which, when executed, cause the pathway scheduling controller to provide the control signals to the pathway selection subsystem to activate the plurality of non-processed forward signal pathways according to a pathway selection schedule.

2. The bent-pipe satellite of claim 1, wherein:

each GUPS comprises a GUPS input coupled with a respective one of the gateway uplink antenna ports, and a plurality of GUPS outputs;

each UDPS comprises a UDPS output coupled with a respective one of the user downlink antenna ports, and a plurality of UDPS inputs; and

each of at least some of the UDPS inputs is coupled with one of the GUPS outputs.

3. The bent-pipe satellite of claim 2, wherein:

at least one of the non-processed forward signal pathways is formed by selecting one of the UDPS inputs of one of the UDPSs.

4. The bent-pipe satellite of claim 2 or 3, wherein:

at least one of the non-processed forward signal pathways is formed by selecting one of the GUPS outputs of one of the GUPSs.

5. The bent-pipe satellite of any one of claims 1– 3 wherein:

at least one of the GUPSs is a power divider that operates to couple one of the gateway uplink antenna ports with any one or more of the UDPSs at a time.

6. The bent-pipe satellite of any one of claims 1, 2, 4, or 5, wherein:

at least one of the UDPSs is a power combiner that operates to couple multiple of the GUPSs with a respective at least one of the user downlink antenna ports at a time.

7. The bent-pipe satellite of any one of claims 1– 5 wherein:

each UDPS is a selector switch that operates to couple one of the user downlink antenna ports with any single one of the GUPSs at a time.

8. The bent-pipe satellite of any one of claims 1 – 7, wherein:

the pathway selection subsystem further comprises a plurality of non-processed return signal pathways that couple at least some of the plurality of user uplink antenna ports with the plurality of gateway downlink antenna ports via a plurality of user uplink pathway selectors (UUPSs) and a plurality of gateway downlink pathway selectors (GDPSs).

9. The bent-pipe satellite of claim 8, wherein:

the pathway selection subsystem further comprises a return simulcast mode which, when active, couples multiple of the user uplink antenna ports with one of the gateway downlink antenna ports, such that one of the plurality of non-processed return signal pathways is a return simulcast signal pathway.

10. The bent-pipe satellite of claim 8 or 9, wherein:

each GDPS comprises a GDPS output coupled with a respective one of the gateway downlink antenna ports, and a plurality of GDPS inputs;

each UUPS comprises a UUPS input coupled with a respective one of the user uplink antenna ports, and a plurality of UUPS outputs; and

each of at least some of the UUPS outputs is coupled with one of the GDPS inputs.

11. The bent-pipe satellite of claim 10, wherein:

at least one of the non-processed return signal pathways is formed by selecting one of the UUPS outputs of one of the UUPSs.

12. The bent-pipe satellite of claim 10 or 11, wherein:

at least one of the non-processed return signal pathways is formed by selecting one of the GDPS inputs of one of the GDPSs.

13. The bent-pipe satellite of any one of claims 8 – 12, wherein:

at least one of the non-processed return signal pathways couples one of the user uplink ports with a corresponding one of the user downlink ports via one of the UUPSs and one of the UDPSs.

14. The bent-pipe satellite of any one of claims 8 – 11 or 13 wherein:

at least one of the GDPSs is a power combiner that operates to couple one of the gateway downlink antenna ports with any one or more of the UUPSs at a time.

15. The bent-pipe satellite of any one of claims 8 – 10, 12 or 13, wherein:

at least one of the UUPSs is a power divider that operates to couple multiple of the GDPSs with a respective at least one of the user uplink antenna ports at a time.

16. The bent-pipe satellite of any one of claims 8 – 11, 13, or 14, wherein:

each UUPS is a switch that operates to couple one of the user uplink antenna ports with any single one of the GDPSs at a time.

17. The bent-pipe satellite of any one of claims 1 – 16, wherein the pathway selection subsystem further comprises:

a divider-combiner network (DCN) having a plurality of DCN inputs and a plurality of DCN outputs,

wherein each GUPS comprises a GUPS simulcast output coupled with a respective one of the plurality of DCN inputs, and

wherein each UDPS comprises a UDPS simulcast input coupled with a respective one of the plurality of DCN outputs.

18. The bent-pipe satellite of claim 17, wherein:

each GUPS comprises N+1 GUPS outputs comprising N monocast outputs and the GUPS simulcast output;

each UDPS comprises N+1 UDPS inputs comprising N monocast inputs and the UDPS simulcast input;

the divider-combiner network comprises N DCN inputs and N DCN outputs; and

each monocast output of each GUPS is coupled with a respective monocast input of one of the UDPSs.

19. The bent-pipe satellite of any one of claims 1 – 18, wherein the pathway selection subsystem further comprises:

a plurality of channel filters, each coupled between a respective one of the GUPSs and a respective one of the gateway uplink antenna ports.

20. The bent-pipe satellite of any one of claims 1 – 19, wherein the pathway selection subsystem further comprises:

a plurality of frequency converters, each coupled between a respective one of the UDPSs and a respective one of the user downlink antenna ports.

21. The bent-pipe satellite of any one of claims 1 – 20, wherein the pathway selection subsystem further comprises:

a plurality of frequency converters, each coupled between a respective one of the GUPSs and a respective one of the gateway uplink antenna ports.

22. The bent-pipe satellite of any one of claims 1 – 21 further comprising:

a plurality of input subsystems, each comprising a low-noise amplifier coupled between a respective one of the GUPSs and a respective one of the gateway uplink antenna ports.

23. The bent-pipe satellite of any one of claims 1– 22, further comprising:

a plurality of output subsystems, each comprising a respective portion of a multiport amplifier coupled between a respective one of the UDPSs and a respective one of the user downlink antenna ports.

24. The bent-pipe satellite of claim 23, wherein the multiport amplifier comprises a plurality of power amplifiers coupled between a first butler matrix and a second butler matrix.

25. The bent-pipe satellite of claim 1, wherein the pathway selection schedule is updatable according to control information received from a ground terminal while the satellite is in orbit.

26. A method of flexible intra-satellite routing of communications between a plurality of fixed spot beams, the method comprising:

first switching a pathway selector system at a first time to a first one of a plurality of configurations, so as to couple one of a plurality of uplink antenna ports with one of a plurality of downlink antenna ports to form a monocast non-processed signal pathway;

first transmitting first traffic over one of a plurality of fixed spot beams via the monocast non-processed signal pathway and the one downlink antenna port, the first traffic received at the one uplink antenna port while the pathway selector system is in the first configuration;

second switching the pathway selector system at a second time to a second one of the plurality of configurations, so as to couple the one uplink antenna port with multiple of the plurality of downlink antenna ports to form a simulcast non-processed signal pathway;

second transmitting second traffic concurrently over multiple of the plurality of fixed spot beams via the simulcast non-processed signal pathway and the multiple downlink antenna ports, the second traffic received at the one uplink antenna port while the pathway selector system is in the second configuration; and

wherein the first switching to the first configuration and the second switching to the second configuration are according to a pathway selection schedule stored in a memory of the pathway selector system.

27. The method of claim 26, wherein:

the plurality of uplink antenna ports are gateway uplink antenna ports; the

plurality of downlink antenna ports are user downlink antenna ports; and

the first and second traffic are forward-link traffic.

28. The method of claim 26, wherein:

the plurality of uplink antenna ports are user uplink antenna ports; the

plurality of downlink antenna ports are gateway downlink antenna ports; and

the first and second traffic are return-link traffic.

29. The method of any of claims 26 – 28, wherein:

one of a plurality of uplink pathway selectors (UPSs) comprises:

a UPS input coupled with the one uplink antenna port; and

a plurality of UPS outputs, each coupled with a respective one of a plurality of downlink pathway selectors (DPSs), each DPS further coupled with a respective one of the plurality of downlink antenna ports; and

the first switching comprises selecting one of the plurality of UPS outputs of the one UPS at the first time, such that the selecting couples the one uplink antenna port with the one downlink antenna port via the one UPS and one of the DPSs to form the monocast non-processed signal pathway.

30. The method of claim 29, wherein:

the plurality of UPS outputs are UPS monocast outputs;

the one UPS further comprises a simulcast output coupled with a divider-combiner network, the divider-combiner network further coupled with a simulcast input of each DPS; and

the second switching comprises selecting the simulcast output of the one UPS at the second time, such that the selecting couples the one uplink antenna port with the multiple of the plurality of downlink antenna ports via the simulcast output of the one UPS, the divider-combiner network, and the simulcast inputs of multiple of the DPSs to form the simulcast non-processed signal pathway.

31. The method of any of claims 26 – 28, wherein:

each of a plurality of DPSs comprises:

a DPS output coupled with the one downlink antenna port; and

a plurality of DPS inputs, each coupled with a respective one of a plurality of UPSs, each UPS further coupled with a respective one of the plurality of uplink antenna ports; and

the first switching comprises selecting one of the plurality of DPS inputs of the one DPS at the first time, such that the selecting couples the one uplink antenna port with the one downlink antenna port via one of the UPSs and the one DPS to form the monocast non-processed signal pathway.

32. The method of claim 31, wherein:

the second switching comprises selecting one of the DPS inputs of each of at least two of the DPSs at the second time to couple the at least two DPSs with the one UPS, such that the selecting couples the one uplink antenna port with the multiple downlink antenna ports via the one UPS and the at least two DPSs to form the simulcast non-processed signal pathway.

33. The method of claim 31 or 32, wherein:

each of the plurality of UPSs comprises:

a UPS input coupled with a respective one of the plurality of uplink antenna ports; and

a plurality of UPS outputs, each coupled with a respective one of the plurality of DPSs; and

the first switching comprises selecting, at the first time, both the one of the plurality of DPS inputs of the one DPS and one of the plurality of UPS outputs of one of the plurality of UPSs, such that the selecting couples the one uplink antenna port with the one downlink antenna port via the one of the UPSs and the one DPSs to form the monocast non-processed signal pathway.

34. The method of claim 33, wherein:

the plurality of DPS inputs are DPS monocast inputs;

each of the plurality of DPSs further comprises a simulcast input coupled with a respective output of a divider-combiner network; and

the plurality of UPS outputs are UPS monocast outputs;

the one UPS further comprises a simulcast output coupled with an input of the divider-combiner network; and

the second switching comprises selecting the simulcast output of the one UPS and selecting the simulcast input of each of multiple of the DPSs at the second time, such that the selecting couples the one uplink antenna port with the multiple of the plurality of downlink antenna ports via the simulcast output of the one UPS, the divider-combiner network, and the simulcast inputs of the multiple DPSs to form the simulcast non-processed signal pathway.

35. The method of any of claims 26 – 34, wherein the plurality of uplink antenna ports is coupled with the pathway selector system via a plurality of input subsystems, each input subsystem comprising a low-noise amplifier.

36. The method of any of claims 26 – 35, wherein the plurality of downlink antenna ports is coupled with the pathway selector system via a plurality of output subsystems, each output subsystem comprising a respective portion of a multiport amplifier.

37. The method of any of claims 26-36, wherein the pathway selector system is disposed in a satellite, and further comprising:

receiving control information by the satellite from a ground terminal while the satellite is in orbit; and

updating the pathway selection schedule in the memory according to the control information.