CLAIMS

What is claimed is:

1. A system (100) for satellite communications, comprising:

a transmitter (200) configured to transmit a composite signal and comprising:

a plurality of component spreaders (265, 270, 275), wherein each component spreader of the plurality of component spreaders (265, 270, 275) is configured to apply a respective spreading code of a plurality of spreading codes to a common data symbol of a modulated signal, wherein a plurality of spread data symbols are output by the plurality of component spreaders based at least in part on the common data symbol, and

a plurality of antenna elements (240, 245, 250) coupled with the plurality of component spreaders (265, 270, 275), wherein each antenna element of the plurality of antenna elements (240, 245, 250) is configured to obtain one or more spread data symbols of the plurality of spread data symbols and emit an element signal comprising the one or more spread data symbols, the composite signal comprising the element signals emitted from the plurality of antenna elements (240, 245, 250); and

a receiver (300) configured to receive the composite signal and comprising:

a plurality of component despreaders (320, 335), wherein each component despreader of the plurality of component despreaders (320, 335) is configured to apply a despreading code of a plurality of despreading codes to the composite signal, wherein a plurality of despread data symbols are output by the plurality of component despreaders based at least in part on the composite signal,

a plurality of header estimators (355, 365) coupled with the plurality of component despreaders (320, 335), wherein each header estimator of the plurality of header estimators (355, 365) is configured to estimate one or more coefficients for respective despread data symbols of the plurality of despread data symbols, and

a summing circuit (350) coupled with the plurality of header estimators (355, 365), wherein the summing circuit (350) is configured to combine the plurality of despread data symbols based at least in part on the one or more coefficients estimated for the plurality of despread data symbols to obtain a combined data symbol corresponding to the common data symbol.

2. The system (100) of claim 1, wherein the receiver (300) further comprises:

a plurality of decimators (315, 330) coupled with the plurality of component despreaders (320, 335) and the plurality of header estimators (355, 365) and configured to obtain a plurality of decimated data symbols, wherein each decimator of the plurality of decimators (315, 330) is configured to configured to filter and downsample a respective despread data symbol of the plurality of despread data symbols to obtain a decimated data symbol.

3. The system (100) of claim 2, wherein each header estimator of the plurality of header estimators (355, 365) is configured to estimate the one or more coefficients for the respective despread data symbols based at least in part on respective decimated data symbols of the plurality of decimated data symbols.

4. The system (100) of any one of claims 1 through 3, wherein the receiver (300) further comprises:

a demodulator (370) that is coupled with the summing circuit (350), wherein the demodulator (370) is configured to demodulate the combined data symbol to obtain a demodulated data symbol; and

a decoder (370) that is configured to decode a plurality of demodulated data symbols comprising the demodulated data symbol.

5. The system (100) of any one of claims 1 through 4, wherein each antenna element of the plurality of antenna elements (240, 245, 250) is configured to obtain a respective spread data symbol of the one or more spread data symbols.

6. The system (100) of any one of claims 1 through 4, wherein an antenna element of the plurality of antenna elements (240, 245, 250) is configured to obtain a two or more of the plurality of spread data symbols.

7. The system (100) of any one of claims 1 through 4, wherein two or more of the plurality of antenna elements (240, 245, 250) are configured to obtain a spread data symbol from one of the plurality of component spreaders (265, 270, 275).

8. The system (100) of any one of claims 1 through 7, wherein the plurality of despreading codes is the same as the plurality of spreading codes.

9. The system (100) of any one of claims 1 through 8, wherein the one or more coefficients comprises magnitude, phase, timing, frequency, or any combination thereof.

10. The system (100) of any one of claims 1 through 9, wherein the modulated signal is a first modulated signal, and wherein the transmitter (200) further comprises:

a beamformer (205) configured to apply beamforming coefficients to a second modulated signal to obtain a plurality of beamformed data symbols; and

a communications manager (253) that is configured to switch between a first mode for transmitting the plurality of beamformed data symbols via the plurality of antenna elements (240, 245, 250) for communication via beamformed spot beams and a second mode that causes the first modulated signal to bypass the beamformer (205).

11. The system (100) of claim 10, wherein the communications manager (253) is further configured to:

activate the first mode for a first interval of a period and the second mode for a second interval of the period that is smaller than the first interval.

12. The system (100) of any one of claims 1 through 11, wherein the transmitter (200) further comprises:

a modulator (255) coupled with the plurality of component spreaders (265, 270, 275), the modulator (255) configured to generate a plurality of data symbols comprising the common data symbol.

13. The system (100) of any one of claims 1 through 12, further comprising:

a satellite (120) comprising the plurality of antenna elements (240, 245, 250), and

a gateway (130) communicatively coupled with the satellite (120), wherein the gateway (130) comprises the plurality of component spreaders (265, 270, 275).

14. The system (100) of any one of claims 1 through 12, further comprising:

a satellite (120) that comprises the plurality of component spreaders (265, 270, 275) and the plurality of antenna elements (240, 245, 250) of the transmitter (200).

15. The system (100) of any one of claims 1 through 12, further comprising:

a plurality of gateways (130), wherein the transmitter (200) comprises the plurality of gateways, each gateway of the plurality of gateways (130) comprising a respective component spreader of the plurality of component spreaders (265, 270, 275) and a respective antenna element of the plurality of antenna elements (240, 245, 250); and

a satellite (120) comprising a plurality of transponders configured to relay the composite signal.

16. A method for satellite communications, comprising:

receiving a composite signal from a transmission system (200), wherein the composite signal comprises a plurality of element signals, each element signal of the plurality of element signals comprising one or more spread data symbols associated with a common data symbol;

applying a plurality of despreading codes to the composite signal, wherein a plurality of despread data symbols are obtained based at least in part on the applying;

estimating one or more coefficients for respective despread data symbols of the plurality of despread data symbols; and

combining the plurality of despread data symbols based at least in part on the one or more coefficients estimated for the plurality of despread data symbols to obtain a combined data symbol corresponding to the common data symbol.

17. The method of claim 16, further comprising:

using the one or more coefficients to adjust the plurality of despread data symbols, wherein a plurality of adjusted data symbols are obtained based at least in part on using the one or more coefficients, wherein the combining comprises:

combining the plurality of adjusted data symbols to obtain the combined data symbol.

18. The method of claim 16 or 17, further comprising:

decimating the plurality of despread data symbols, wherein the decimating comprises, for each despread data symbol, filtering a set of frequencies from a respective despread data symbol and downsampling the respective despread data symbol after the filtering.

19. The method of any one of claims 16, 17, or 18, wherein estimating the one or more coefficients for the plurality of despread data symbols comprises:

estimating a magnitude, phase, timing, frequency, or any combination thereof for the plurality of despread data symbols.

20. The method of any one of claims 16, 17, 18, or 19, further comprising:

demodulating the combined data symbol to obtain a demodulated data symbol; and

decoding the demodulated data symbol.

21. An apparatus for satellite communications, comprising:

a plurality of component despreaders (320, 335), wherein each component despreader of the plurality of component despreaders (320, 335) is configured to apply a despreading code of a plurality of despreading codes to a composite signal received from a transmission system (200), wherein the composite signal comprises a plurality of element signals, each element signal of the plurality of element signals comprising one or more spread data symbols associated with a common data symbol, and wherein a plurality of despread

data symbols are output by the plurality of component despreaders based at least in part on the composite signal;

a plurality of header estimators (355, 365) coupled with the plurality of component despreaders (320, 335), wherein each header estimator of the plurality of header estimators (355, 365) is configured to estimate one or more coefficients for respective despread data symbols of the plurality of despread data symbols; and

a summing circuit (350) coupled with the plurality of header estimators (355, 365), wherein the summing circuit (350) is configured to combine the plurality of despread data symbols based at least in part on the one or more coefficients estimated for the plurality of despread data symbols to obtain a combined data symbol corresponding to the common data symbol.

22. The apparatus of claim 21, further comprising:

a plurality of decimators (315, 330) configured to apply a low-pass filter to and downsample the plurality of despread data symbols.

23. The apparatus of any one of claims 21 or 22, further comprising:

a demodulator (370) configured to demodulate the combined data symbol to obtain a demodulated data symbol; and

a decoder (370) configured to decode the demodulated data symbol.

24. The system (100) of any one of claims 1 through 15, wherein each component spreader of the plurality of component spreaders (265, 2670, 275) is configured to output the one or more spread data symbols to a respective subset of the plurality of antenna elements (240, 245, 250).