CLAIMS

What is claimed is:

1. A method, comprising:

transmitting, from a first satellite (120), a first plurality of forward downlink signals (170) via an antenna (121) illuminating a geographical region (625), wherein each of a first plurality of forward downlink beams (125) within the geographical region (625) is formed from at least a subset of the first plurality of forward downlink signals (170);

receiving, by a plurality of second satellites (122), respective first signals (128) comprising reflections of the first plurality of forward downlink beams (125);

processing, with a multi-static synthetic aperture radar (SAR) processor and based at least in part on a first beamforming matrix (823) used to form the first plurality of forward downlink beams (125), the respective first signals (128) received by the plurality of second satellites (122) to obtain an image (850) of the geographical region (625).

2. The method of claim 1, wherein the first plurality of forward downlink beams (125) comprises a plurality of forward downlink beams (125) having a first combination of polarization and frequency range, and wherein at least a subset of the respective first signals (128) comprise respective composite reflections from the plurality of forward downlink beams (125) having the first combination of polarization and frequency range, and wherein the processing comprises:

determining components of the at least the subset of the respective first signals (128) associated with each of the plurality of forward downlink beams (125) based at least in part on signal data of the each of the plurality of forward downlink beams (125).

3. The method of any one of claims 1 or 2, wherein the first plurality of forward downlink signals (170) correspond to a first time duration, the method further comprising:

transmitting, from the first satellite, a second plurality of forward downlink signals (170) corresponding to a second time duration, wherein the second plurality of forward downlink signals (170) form a second plurality of forward downlink beams (125) over the geographical region (625);

receiving, by the plurality of second satellites (122), respective second signals (128) comprising reflections of the second plurality of forward downlink beams (125);

processing, based at least in part on a second beamforming matrix (823) used to form the second plurality of forward downlink beams (125), the respective second signals (128) received by the plurality of second satellites (122) to obtain the image (850) of the geographical region (625).

4. The method of claim 3, wherein the first plurality of forward downlink beams (125) are associated with a first beam coverage pattern comprising a first plurality of beam coverage areas (126) associated with a first polarization and a first frequency range, and wherein the second plurality of forward downlink beams (125) are associated with a second beam coverage pattern comprising a second plurality of beam coverage areas (126) associated with the first polarization and the first frequency range, and wherein the second plurality of beam coverage areas (126) are offset from the first plurality of beam coverage areas (126).

5. The method of claim 3, wherein the first plurality of forward downlink beams (125) are associated with a first beam coverage pattern comprising a first beam coverage area (126) associated with a first combination of polarization and frequency range, and wherein the second plurality of forward downlink beams (125) are associated with a second beam coverage pattern comprising a second beam coverage area (126) associated with a second combination of polarization and frequency range, and wherein the second beam coverage area (126) is substantially overlapping with the first beam coverage area (126).

6. The method of any one of claims 1 through 5, wherein transmitting the first plurality of forward downlink signals (170) from the first satellite (120) comprises:

applying, at the first satellite (120), the first beamforming matrix (823) to a plurality of forward uplink signals (175) received from a satellite access node (130) to obtain the first plurality of forward downlink signals (170).

7. The method of any one of claims 1 through 5, wherein transmitting the first plurality of forward downlink signals (170) from the first satellite (120) comprises:

transmitting, from a plurality of satellite access nodes (130), respective forward uplink signals (175); and

relaying, by a plurality of transmit/receive signal paths of the first satellite (120), the respective forward uplink signals (175), wherein each of the first plurality of

forward downlink signals (170) comprises a composite of at least a subset of the respective forward uplink signals (175).

8. The method of any one of claims 1 through 7, wherein the first plurality of forward downlink signals (170) comprises a plurality of forward user data streams for transmission to a plurality of user terminals (150) within the geographical region (625).

9. The method of any one of claims 1 through 8, wherein the first satellite (120) is a geostationary (GEO) satellite and the plurality of second satellites (122) are low earth orbit (LEO) satellites.

10. An imaging system, comprising:

a first satellite (120) configured to transmit a first plurality of forward downlink signals (170) via an antenna (121) illuminating a geographical region (625), wherein each of a first plurality of forward downlink beams (125) within the geographical region (625) is formed from at least a subset of the first plurality of forward downlink signals (170);

a plurality of second satellites (122) configured to receive respective first signals (128) comprising reflections of the first plurality of forward downlink beams (125); and

at least one multi-static synthetic aperture radar (SAR) processor configured to process, based at least in part on a first beamforming matrix (823) used to form the first plurality of forward downlink beams (125), the respective first signals (128) received by the plurality of second satellites (122) to obtain an image (850) of the geographical region (625).

11. The imaging system of claim 10, wherein the first plurality of forward downlink beams (125) comprises a plurality of forward downlink beams (125) having a first combination of polarization and frequency range, and wherein at least a subset of the respective first signals (128) comprise respective composite reflections from the plurality of forward downlink beams (125) having the first combination of polarization and frequency range, and wherein the at least one processor is configured to determine components of the at least the subset of the respective first signals (128) associated with each of the plurality of forward downlink beams (125) based at least in part on signal data of the each of the plurality of forward downlink beams (125).

12. The imaging system of any one of claims 10 or 11, wherein the first plurality of forward downlink signals (170) correspond to a first time duration, and wherein:

the first satellite (120) is configured to transmit a second plurality of forward downlink signals (170) corresponding to a second time duration, wherein the second plurality of forward downlink signals (170) form a second plurality of forward downlink beams (125) over the geographical region (625);

the plurality of second satellites (122) are configured to receive respective second signals (128) comprising reflections of the second plurality of forward downlink beams (125); and

the at least one processor is configured to process, based at least in part on a second beamforming matrix (823) used to form the second plurality of forward downlink beams (125), the respective second signals (128) received by the plurality of second satellites (122) to obtain the image (850) of the geographical region (625).

13. The imaging system of claim 12, wherein the first plurality of forward downlink beams (125) are associated with a first beam coverage pattern comprising a first plurality of beam coverage areas (126) associated with a first polarization and a first frequency range, and wherein the second plurality of forward downlink beams (125) are associated with a second beam coverage pattern comprising a second plurality of beam coverage areas (126) associated with the first polarization and the first frequency range, and wherein the second plurality of beam coverage areas (126) are offset from the first plurality of beam coverage areas (126).

14. The imaging system of claim 12, wherein the first plurality of forward downlink beams (125) are associated with a first beam coverage pattern comprising a first beam coverage area (126) associated with a first combination of polarization and frequency range, and wherein the second plurality of forward downlink beams (125) are associated with a second beam coverage pattern comprising a second beam coverage area (126) associated with a second combination of polarization and frequency range, and wherein the second beam coverage area (126) is substantially overlapping with the first beam coverage area (126).

15. The imaging system of any one of claims 10 through 14, wherein the first satellite (120) is configured to apply the first beamforming matrix (823) to a plurality of forward uplink signals (175) received from a satellite access node (130) to obtain the first plurality of forward downlink signals (170).

16. The imaging system of any one of claims 10 through 14, further comprising:

a plurality of satellite access nodes (130) configured to transmit respective forward uplink signals (175),

wherein the first satellite (120) comprises a plurality of transmit/receive signal paths configured to relay the respective forward uplink signals (175), wherein each of the first plurality of forward downlink signals (170) comprises a composite of at least a subset of the respective forward uplink signals (175).

17. The imaging system of any one of claims 10 through 16, wherein the first plurality of forward downlink signals (170) comprises a plurality of forward user data streams for transmission to a plurality of user terminals (150) within the geographical region (625).

18. The imaging system of any one of claims 10 through 17, wherein the first satellite (120) is a geostationary (GEO) satellite and the plurality of second satellites (122) are low earth orbit (LEO) satellites.