AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A satellite computer system for a satellite, the satellite including at least one antenna configured to send and receive signals to terrestrial user equipment (UE) on a radio access network (RAN) via a plurality of directional beams, each of the beams having a beam footprint that defines a cell of the RAN, the satellite computer system comprising at least one processor in communication with a memory, the memory storing computer-readable instructions that are executable to cause the at least one processor to perform steps including:

receiving, via the at least one antenna, a data stream on a first beam of the plurality of beams, the data stream including an uplink signal from a first UE, wherein the received uplink signal includes a Doppler shift due to one or more of an orbital motion of the satellite relative to the Earth and a motion of the first UE relative to the Earth;

compensating the received data stream for a reference Doppler shift based on a trajectory of the satellite relative to a cell reference location within the beam footprint of the first beam, including converting the received uplink signal to a reference-location-compensated uplink signal, wherein the reference-location-compensated uplink signal retains a residual Doppler shift due to a difference in one or more of a location of the UE relative to the cell reference location and a velocity of the UE relative to the cell reference location;

estimating a coarse portion of the residual Doppler shift;

estimating a fine portion of the residual Doppler shift; and

de-shifting the reference-location-compensated uplink signal by a shift frequency comprising the coarse portion and the fine portion.

2. (Original) The satellite computer system according to claim 1, wherein the step of estimating the fine portion comprises correlating a reference signal in two slots of a subframe of the uplink signal.

3. (Original) The satellite computer system according to claim 2, wherein the step of correlating the reference signal comprises correlating a Demodulation Reference Signal (DMRS) in the two slots of the subframe.

4. (Original) The satellite computer system according to claim 1, wherein the step of estimating the coarse portion comprises correlating a cyclic prefix (CP) in one or more symbols of one or more slots of a subframe of the uplink signal.

5. (Original) The satellite computer system according to claim 1, wherein the steps further include:

estimating a geographic location of the first UE; and

assigning the first UE to a smaller geographic region within the beam footprint based on the estimated geographic location, wherein the shift frequency further comprises a region-based portion based on the trajectory of the satellite relative to a region reference location within the smaller geographic region.

6. (Original) The satellite computer system according to claim 5, wherein the step of estimating the geographic location comprises:

accumulating a series of signal propagation delay values for the first UE; and

applying a Gaussian-Newton position-estimation algorithm to the series of signal propagation delay values.

7. (Original) The satellite computer system according to claim 6, wherein the step of accumulating the series of signal propagation delay values comprises generating one of the signal propagation delay values in the series by, for a time corresponding to the signal propagation delay value:

summing an initial timing adjustment command for the first UE, additional timing adjustment commands for the first UE, and the signal propagation delay from the cell reference location at the time, wherein the initial timing adjustment command is associated with an initial access request by the first UE to the RAN and the additional timing adjustment commands are associated with further communications from the first UE to the RAN between the initial access and the time.

8. (Original) The satellite computer system according to claim 1, wherein the step of estimating the fine portion is performed before the step of estimating the coarse portion, and the estimated fine portion is incorporated into the step of estimating the coarse portion.

9. (Original) The satellite computer system according to claim 1, wherein the step of estimating the coarse portion comprises selecting the coarse portion from among a set of hypothesized coarse portions, wherein the set divides a potential range of the residual Doppler shift into intervals and each interval is no larger than an accuracy of the estimated fine portion.

10. (Original) The satellite computer system according to claim 9, wherein the step of estimating the coarse portion further comprises:

generating, for each hypothesized coarse portion in the set, filter coefficients that produce a frequency shift comprising the hypothesized coarse portion plus the estimated fine portion;

applying the filter coefficients for each hypothesized coarse portion in the set to an unshifted reference version of the received uplink signal to generate a reference Doppler-distorted uplink signal for each hypothesized coarse portion in the set;

correlating, for each hypothesized coarse portion in the set, the reference Doppler-distorted uplink signal and the received uplink signal; and

selecting one of the hypothesized coarse portions as the estimated coarse portion by comparing a result of the correlation for each hypothesized coarse portion in the set.

11. (Original) The satellite computer system according to claim 10, wherein the step of de-shifting the reference-location-compensated uplink signal comprises applying a complex conjugate of the filter coefficients associated with the estimated coarse portion to the reference-location-compensated uplink signal.

12. (Currently Amended) The satellite computer system according to claim 11, wherein the steps further include:

error-checking the de-shifted reference-location-compensated uplink signal;

in response to the error-checking detecting an error, selecting an other of the hypothesized coarse portions as a replacement estimated coarse portion; and

re-executing the step of de-shifting the reference-location-compensated uplink signal by applying a complex conjugate of the filter coefficients associated with the replacement estimated coarse portion to the reference-location-compensated uplink signal.

13. (Original) The satellite computer system according to claim 10, wherein the step of selecting the one of the hypothesized coarse portions as the estimated coarse portion comprises:

determining that a difference between a best result of the correlation, associated with a first hypothesized coarse portion, and a second-best result of the correlation, associated with a second hypothesized coarse portion, is less than a predetermined threshold;

in response to the determination, comparing a previous residual Doppler shift value determined for a previous uplink signal from the first UE to a first potential residual Doppler shift, corresponding to the first hypothesized coarse portion, and to a second potential residual Doppler shift, corresponding to the second hypothesized coarse portion; and

selecting the estimated coarse portion as the one of the first and second hypothesized coarse portions for which the comparison to the previous residual Doppler shift value is closest.

14. (Original) The satellite computer system according to claim 9, wherein the step of selecting the coarse portion comprises selecting the coarse portion from among the set based on one or more previous residual Doppler estimates by the satellite computer system.

15. (Currently Amended) The satellite computer system according to claim 14, wherein the steps further include:

error-checking the de-shifted reference-location-compensated uplink signal;

in response to the error-checking detecting an error,

generating, for two or more of the hypothesized coarse portions in the set, filter coefficients that produce a frequency shift comprising the hypothesized coarse portion plus the estimated fine portion;

applying the filter coefficients for each of the two or more hypothesized coarse portions to an unshifted reference version of the received uplink signal to generate a reference Doppler-distorted uplink signal for each of the two or more hypothesized coarse portions;

correlating, for each of the two or more hypothesized coarse portions, the reference Doppler-distorted uplink signal and the received uplink signal; and

selecting one of the two or more hypothesized coarse portions as a replacement estimated coarse portion by comparing a result of the correlation for each of the two or more hypothesized coarse portions; and

re-executing the step of de-shifting the reference-location-compensated uplink signal by applying a complex conjugate of the filter coefficients associated with the replacement estimated coarse portion to the reference-location-compensated uplink signal.

16. (Original) The satellite computer system according to claim 14, wherein a previous estimated coarse portion is associated with the one or more previous residual Doppler estimates, and wherein the step of selecting the coarse portion further comprises:

tracking a trend in the fine portion over two or more uplink signals from the first UE; and

selecting the coarse portion to be one of the hypothesized coarse portions different from the previous estimated coarse portion in response to the trend indicating that a change in a value of the coarse portion is imminent.

17. (Currently Amended) A method of operating a satellite computer system for a satellite, the satellite including at least one antenna configured to send and receive signals to terrestrial user equipment (UE) on a radio access network (RAN) via a plurality of directional beams, each of the beams having a beam footprint that defines a cell of the RAN, the satellite computer system including at least one processor in communication with a memory, the method comprising steps performed by the at least one processor including:

receiving, via the at least one antenna, a data stream on a first beam of the plurality of beams, the data stream including an uplink signal from a first UE, wherein the received uplink signal includes a Doppler shift due to one or more of an orbital motion of the satellite relative to the Earth and a motion of the first UE relative to the Earth;

compensating the received data stream for a reference Doppler shift based on a trajectory of the satellite relative to a cell reference location within the beam footprint of the first beam, including converting the received uplink signal to a reference-location-compensated uplink signal, wherein the reference-location-compensated uplink signal retains a residual Doppler shift due to a difference in one or more of a location of the UE relative to the cell reference location and a velocity of the UE relative to the cell reference location;

estimating a coarse portion of the residual Doppler shift;

estimating a fine portion of the residual Doppler shift; and

de-shifting the reference-location-compensated uplink signal by a shift frequency comprising the coarse portion and the fine portion.

18. (Original) The method according to claim 17, wherein the step of estimating the fine portion comprises correlating a reference signal in two slots of a subframe of the uplink signal.

19. (Original) The method according to claim 18, wherein the step of correlating the reference signal comprises correlating a Demodulation Reference Signal (DMRS) in the two slots of the subframe.

20. (Original) The method according to claim 17, wherein the step of estimating the coarse portion comprises correlating a cyclic prefix (CP) in one or more symbols of one or more slots of a subframe of the uplink signal.

21-46. (Cancelled)