

CLAIMS

What is claimed is:

1. A method for combining a plurality of downlink signals representative of a communication signal, the method comprising:
 - receiving the plurality of downlink signals from a plurality of antenna feeds;
 - in a first one or more processing blocks in a one or more processors,
 - performing a first blind detection operation on first data packets of a first signal of the plurality of downlink signals, and
 - performing a first doppler compensation operation on the first data packets of the first signal of the plurality of downlink signals;
 - in a second one or more processing blocks in the one or more processors in parallel with the first one or more processing blocks,
 - performing a second blind detection operation on second data packets of a second signal of the plurality of downlink signals, and
 - performing a second doppler compensation operation on the second data packets of the second signal of the plurality of downlink signals; and
 - combining the first signal and the second signal based on (i) aligning timing and phase of the first data packets with the second data packets and (ii) performing a weighted combiner operation that applies scaling to each of the first and second data packets based on corresponding signal quality.
2. The method of claim 1, wherein the first one or more processing blocks comprises a first one or more central processing unit (CPU) cores and the second one or more processing blocks comprises a second one or more CPU cores.
3. The method of claims 1 or 2, wherein the one or more processors comprises a plurality of processors, wherein in the first one or more processing blocks are comprised in a first processor of the plurality and the second one or more processing blocks are comprised in a second processor of the plurality of processors.
4. The method of claims 1 or 2, wherein the one or more processors comprises a single processor comprising the first one or more processing blocks and the second one or more processing blocks.
5. The method of one of claims 1-4, wherein the first one or more processing blocks comprises a first processing block and a second processing block, wherein the first

blind detection operation is performed in the first processing block and the first doppler compensation is performed in the second processing block.

6. The method of claim 5, wherein the second one or more processing blocks comprises a third processing block and a fourth processing block, wherein the second blind detection operation is performed in the third processing block and the second doppler compensation is performed in the fourth processing block.

7. The method of claim 6, wherein the third processing block performs the second blind detection operation in parallel with the first processing block performing the first blind detection operation.

8. The method of claim 6, wherein the fourth processing block performs the second doppler compensation operation in parallel with the second processing block performing the first doppler compensation operation.

9. The method of any one of claims 1-8, wherein at least one of the first and second blind detection operations comprises estimating one or more of symbol rate, modulation type, and center frequency of the first signal or the second signal, respectively, without input from the user.

10. The method of any one of claims 1-9, wherein the first blind detection operations comprises a first plurality functions including:

- receiving the first data packets as samples of the first signal, the samples having an unknown symbol rate, modulation type, and frequency;
- estimating a symbol rate based on a detected maximum peak frequency;
- determining a timing error of the samples based on the estimated symbol rate;
- synchronizing samples of the first signal by performing a timing recovery operation based on the determined timing error;
- detecting a modulation type and estimating carrier frequency based on the synchronized samples; and
- estimating an energy per symbol to noise power spectral density.

11. The method of claim 10, wherein the first one or more processing blocks comprises a first plurality of processing blocks, wherein at least two of the first plurality of functions are performed by the separate processing blocks of the first plurality of processing blocks in parallel.

12. The method of claim 10, wherein the second blind detection operations comprises a second plurality of functions including:

- receiving the second data packets as samples of the second signal, the samples having an unknown symbol rate, modulation type, and frequency;
- estimating a symbol rate based on a detected maximum peak frequency;
- determining a timing error of the samples based on the estimated symbol rate;
- synchronizing samples of the second signal by performing a timing recovery operation based on the determined timing error;
- detecting a modulation type and estimating carrier frequency based on the synchronized samples; and
- estimating an energy per symbol to noise power spectral density.

13. The method of claim 12, wherein the second one or more processing blocks comprises a second plurality of processing blocks, wherein at least two of the second plurality of functions are performed by the separate processing blocks of the second plurality of processing blocks in parallel.

14. The method of claim 12, wherein one or more of the second plurality of functions are performed in the second one or more processing blocks in parallel with one or more of the first plurality of functions performed in the first one or more processing blocks.

15. The method of any one of claims 1-14, wherein the first doppler compensation operations comprises a third plurality of functions comprising:

- receiving the first data packets as samples of the first signal;
- receiving an estimate of carrier frequency of samples;
- calculate phase correction information for the samples based on the estimated carrier frequency; and
- removing at least a portion of Doppler from the samples based on the calculated phase correction information.

16. The method of claim 15, wherein the first one or more processing blocks comprises a first plurality of processing blocks, wherein at least two of the third plurality of functions are performed by the separate processing blocks of the first plurality of processing blocks in parallel.

17. The method of claims 15, wherein the second doppler compensation operations comprise a fourth plurality of functions comprising:

receiving the second data packets as samples of the second signal;

receiving an estimate of carrier frequency of samples;

calculate phase correction information for the samples based on the estimated carrier frequency; and

removing at least a portion of Doppler from the samples based on the calculated phase correction information.

18. The method of claim 17, wherein the second one or more processing blocks comprises a second plurality of processing blocks, wherein at least two of the fourth plurality of functions are performed by the separate processing blocks of the second plurality of processing blocks in parallel.

19. The method of claim 17, wherein one or more of the fourth plurality of functions are performed in the second one or more processing blocks in parallel with one or more of the third plurality of functions performed in the first one or more processing blocks.

20. The method of any one of claims 1-17, wherein combining the first plurality of data packets and the second plurality of data packets comprises a fifth plurality of functions comprising:

calculating an Early, Prompt and Late (EPL) terms between the first data packets and the second data packets;

determining timing and phase error between the first data packets and the second data packets based on the EPL terms; and

adjusting the timing and phase of the first data packets relative to the second data packets.

21. The method of claim 20, further comprising:

in a third one or more processing blocks, adjusting the timing and phase of the samples for the first portion of the plurality of data packets; and

in a third one or more processing blocks, in parallel with the third one or more processing blocks, adjusting the timing and phase of the samples for the second portion of the plurality of data packets.

22. The method of any one of claims 1-21, further comprising dividing, at one or more processors, the digital bit stream into a plurality of data packets, each of the data

packets of the plurality of data packets including an overlap of data from an adjacent packet.

23. The method of claim 22, wherein the adjacent packets overlap in time by one percent of the length of the packets.

24. The method of claims 22 or 23, wherein the plurality of data packets have varying lengths.

25. The method of any one of claims 1-24, wherein the one or more processors are one or more general-purpose central processing units (CPU).

26. The method of any one of claim 1-24, wherein the one or more processors employ single instructions, multiple data (SIMD) techniques to achieve high throughput.

27. A system for combining a plurality of downlink signals representative of a communication signal, the system comprising:

a plurality of antennas configured to receive the plurality of downlink signals; and
one or more processors communicatively coupled to the plurality of antennas, the one or more processors having a plurality of processing blocks and operable to perform the method of any one of claims 1-26.