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 -( 1 of 1 )

United States Patent -10,305,567

Maamari ,   et al. -May 28, 2019

System and method for hierarchal beamforming and rank adaptation for hybrid antenna architecture

What is claimed is:

1. A method comprising: receiving, by a user equipment (UE), first beamformed reference signals; transmitting, by the UE, a first report that indicates at least one reference signal index and a transmission rank based on the first beamformed reference signals; receiving, by the UE, at least a second beamformed reference signal after transmitting the first report; transmitting, by the UE, a second report that includes a channel quality indicator and a precoding matrix indicator derived from the second beamformed reference signal; and receiving, by the UE, a beamformed data signal after transmitting the second report.

2. The method of claim 1, wherein a digital precoder of the beamformed data signal is selected according to the channel quality indicator and the precoding matrix indicator included in the second report, and wherein an analog beam used to transmit the beamformed data signal is selected according to the at least one reference signal index and the transmission rank included in the first report.

3. A device comprising: a non-transitory memory storage comprising instructions; and one or more processors in communication with the non-transitory memory storage, wherein the one or more processors execute the instructions to: receive first beamformed reference signals; transmit a first report that indicates at least one reference signal index and a transmission rank based on the first beamformed reference signals; receive at least a second beamformed reference signal after transmitting the first report; and transmit a second report that includes a channel quality indicator and a precoding matrix indicator derived from the second beamformed reference signal; and receive a beamformed data signal after transmitting the second report.

4. The device of claim 3, wherein a digital precoder of the beamformed data signal is selected according to the channel quality indicator and the precoding matrix indicator included in the second report, and wherein an analog beam used to transmit the beamformed data signal is selected according to the at least one reference signal index and the transmission rank included in the first report.

5. A method for beam-related information and channel state information feedback, the method comprising: transmitting, by a first beamformed reference signals; receiving a first report that indicates at least one reference signal index and a transmission rank based on the first beamformed reference signals; transmitting at least a second beamformed reference signal in accordance with the at least one reference signal index and the transmission rank after receiving the first report; receiving a second report that includes a channel quality indicator and a precoding matrix indicator derived from the second beamformed reference signal; and transmitting a beamformed data signal in accordance with the channel quality indicator and the precoding matrix indicator after transmitting the second report.

6. The method of claim 5, wherein the first report includes a plurality of transmission ranks and a plurality of reference signal indices, and wherein the method further includes selection one of the plurality of transmission ranks and one or more of the plurality of reference signal indices for use in transmitting the second beamformed reference signal.

7. The method of claim 5, wherein a digital precoder of the beamformed data signal is selected according to the channel quality indicator and the precoding matrix indicator included in the second report, and wherein an analog beam used to transmit the beamformed data signal is selected according to the at least one reference signal index and the transmission rank included in the first report.

8. A device comprising: a non-transitory memory storage comprising instructions; and one or more processors in communication with the non-transitory memory storage, wherein the one or more processors execute the instructions to: transmit first beamformed reference signals; receive a first report that indicates at least one reference signal index and a transmission rank; transmit at least a second beamformed reference signal in accordance with the at least one reference signal index and the transmission rank after receiving the first report; receive a second report that includes a channel quality indicator and a precoding matrix indicator derived from the second beamformed reference signal; and transmit a beamformed data signal in accordance with the channel quality indicator and the precoding matrix indicator after transmitting the second report.

9. The device of claim 8, wherein the first report includes a plurality of transmission ranks and a plurality of reference signal indices, and wherein the programming further includes instructions to select one of the plurality of transmission ranks and one or more of the plurality of reference signal indices for use in transmitting the second analog beamformed reference signal.

10. The device of claim 8, wherein a digital precoder of the beamformed data signal is selected according to the channel quality indicator and the precoding matrix indicator included in the second report, and wherein an analog beam used to transmit the beamformed data signal is selected according to the at least one reference signal index and the transmission rank included in the first report.

11. A method for beam-related information and channel state information feedback, the method comprising: receiving first beamformed reference signals; transmitting a first report that indicates at least one reference signal index; receiving at least a second beamformed reference signal after transmitting the first report; transmitting a second report that includes a transmission rank, as well as a channel quality indicator and a precoding matrix derived from at least the second beamformed reference signal, after receiving the second beamformed reference signal; and receiving a beamformed data signal in accordance with the channel quality indicator and the precoding matrix indicator after transmitting the second report.

12. The method of claim 11, wherein a digital precoder of the beamformed data signal is selected according to the channel quality indicator and the precoding matrix indicator included in the second report, and wherein an analog beam used to transmit the beamformed data signal is selected according to the at least one reference signal index included in the first report and the transmission rank included in the second report.