

WHAT IS CLAIMED IS:

1. A method for enhancing an uplink phase tracking reference signal (PT-RS), performed by~~applied to~~ a network device, the method comprising:

sending an indication message to a user equipment (UE), wherein the indication message comprises a plurality of pieces of PT-RS indication information corresponding to a plurality of transmission reception points (TRPs), and the PT-RS indication information ~~represents transmission sent~~ towards a corresponding TRP ~~and~~ indicates a demodulation reference signal (DMRS) port associated with a corresponding PT-RS port.

2. The method of claim 1, wherein sending the indication message to the UE comprises: sending the indication message to the UE through downlink control information (DCI).

3. The method of claim 2, wherein the indication message is determined based on a maximum number of uplink transmission layers supported by the UE in a current bandwidth part (BWP) configured by the network device and a number of PT-RS ports corresponding to uplink transmission of the UE configured by the network device.

4. The method of claim 3, wherein,

in response to the maximum number of uplink transmission layers configured by the network device being two and the number of uplink PT-RS ports being one, the DCI comprises one ~~corresponding~~ PT-RS indication field;

in response to the maximum number of uplink transmission layers configured by the network device being two and the number of uplink PT-RS ports being two, the indication message is not added to the DCI;

in response to the maximum number of uplink transmission layers configured by the network device being one, the indication message is not added to the DCI;

in response to the maximum number of uplink transmission layers configured by the network device being greater than two, the DCI comprises two ~~corresponding~~ independent PT-RS indication fields.

5. The method of claim 3, further comprising:

sending respective independent PT-RSs towards the plurality of TRPs, wherein each port of the PT-RSs is associated with a DMRS port in a same TRP transmission direction.

6. The method of claim 4, wherein in response to the maximum number of uplink transmission layers configured by the network device being two and the number of uplink PT-RS ports being one, the indication message comprises a first PT-RS indication field, and the first PT-RS indication field comprises respective PT-RS indication information corresponding

to PT-RSs sent in a plurality of TRP transmission directions.

7. The method of claim 6, further comprising:

in all transmission occasions (TOs) for transmission towards the plurality of TRPs, mapping the PT-RS port in the PT-RS indication information to send the PT-RS by using a DMRS port indicated by the PT-RS indication information, wherein a set of DMRS ports associated with each PT-RS port in the plurality of TRP transmission directions is preconfigured, wherein the set of DMRS ports comprises a DMRS port for sending the PT-RS.

8. The method of claim 6, further comprising:

when the UE reports that a PT-RS cyclic mapping mode is supported and the network device configures the UE to perform mapping based on the cyclic mapping mode, cyclically mapping each PT-RS port onto different DMRS ports associated with the PT-RS port, among all ports consisting of a set of DMRS ports associated with each PT-RS port configured by the network device, to send the PT-RS, and sending the PT-RS by using a DMRS port associated with the PT-RS port at different transmission occasions (TOs) in a corresponding TRP transmission direction, wherein the DMRS port indicated by the PT-RS indication information is mapped to a first start TO in the corresponding TRP transmission direction.

9. The method of claim 4, wherein in response to the maximum number of uplink transmission layers configured by the network device being greater than two and the number of uplink PT-RS ports being one, the indication message comprises a plurality of second PT-RS indication fields, wherein each of the second PT-RS indication fields corresponds to one TRP, and the second PT-RS indication field represents transmissions sent towards a corresponding TRP ~~and~~ indicates a DMRS port associated with a corresponding PT-RS port.

10. The method of claim 9, further comprising:

in all transmission occasions (TOs) for transmission towards the plurality of TRPs, mapping the PT-RS port in the second PT-RS indication field to send the PT-RS by using ~~onto~~ the DMRS port indicated by the second PT-RS indication field ~~to send the PT-RS~~, wherein a set of DMRS ports associated with the PT-RS port in a plurality of TRP transmission directions is preconfigured, and the set of DMRS ports comprises a DMRS port for sending the PT-RS.

11. The method of claim 9, further comprising:

when the UE reports that a PT-RS cyclic mapping mode is supported and the network device configures the UE to perform mapping based on the cyclic mapping mode, cyclically carrying the PT-RS port in sequence in the PT-RS indication information indicating ~~on~~ different DMRS ports, among all ports corresponding to a set of associated DMRS ports configured by

the network device, ~~to send the PT-RS,~~ and mapping the different DMRS ports to corresponding different TOs for transmission towards a corresponding TRP, wherein the DMRS port indicated by the second PT-RS indication field is mapped to a first start TO in the corresponding TRP transmission direction.

12. The method of claim 4, wherein in response to the maximum number of uplink transmission layers configured by the network device being greater than two and the number of uplink PT-RS ports being two, the indication message comprises a plurality of third PT-RS indication fields, wherein each of the third PT-RS indication fields corresponds to one TRP, and the third PT-RS indication field represents transmission sent towards a corresponding TRP ~~and~~ indicates two DMRS ports associated with the two PT-RS ports.

13. The method of claim 12, further comprising:

in all transmission occasions (TOs) for transmission towards the plurality of TRPs, mapping the PT-RS ports in the third PT-RS indication fields to send the PT-RS by using ~~onto~~ the two DMRS ports indicated by the third PT-RS indication fields ~~to send the PT-RS,~~ wherein a set of DMRS ports associated with each port of the PT-RS in a plurality of TRP transmission directions is preconfigured, and the set of DMRS ports comprises a DMRS port for sending the PT-RS.

14. The method of claim 12, further comprising:

when the UE reports that a PT-RS cyclic mapping mode is supported and the network device configures the UE to perform mapping based on the cyclic mapping mode, cyclically mapping the PT-RSs in sequence in the PT-RS indication information indicating ~~onto~~ different DMRS ports, among all ports corresponding to a set of associated DMRS ports configured by the network device, ~~to send the PT-RS,~~ and mapping the different DMRS ports to corresponding different TOs for transmission towards a corresponding TRP, wherein the DMRS port indicated by the third PT-RS indication field is mapped to a first start TO in the corresponding TRP transmission direction.

15. The method according to any one of claims 4 to 14, further comprising:

receiving a supported number of cyclic mapping DMRS ports reported by the UE and ~~the~~ a number of DMRS ports configured by the network device, wherein the supported number of cyclic mapping DMRS ports reported by the UE maps the PT-RS port at TOs corresponding to different TRP transmission directions.

16. A method for enhancing an uplink phase tracking reference signal (PT-RS), ~~applied~~ to be performed by a user equipment, the method comprising:

receiving an indication message sent by a network device, wherein the indication message comprises a plurality of pieces of PT-RS indication information corresponding to a plurality of transmission reception points (TRPs), and the PT-RS indication information sent ~~represents transmission~~ towards a corresponding TRP ~~and~~ indicates a demodulation reference signal (DMRS) port associated with a corresponding PT-RS port.

17. The method of claim 16, wherein receiving the indication message sent by the network device comprises:

receiving the indication message sent by the network device through downlink control information (DCI).

~~18. An apparatus for enhancing an uplink phase tracking reference signal (PT-RS), applied to a network device, the apparatus comprising:~~

~~a sending module, configured to send an indication message to a user equipment (UE), wherein the indication message comprises a plurality of pieces of PT-RS indication information corresponding to a plurality of transmission reception points (TRPs), the PT-RS indication information represents transmission towards a corresponding TRP and indicates a demodulation reference signal (DMRS) port associated with a corresponding PT-RS port.~~

~~19. An apparatus for enhancing an uplink phase tracking reference signal (PT-RS), applied to a user equipment, the apparatus comprising:~~

~~a receiving module, configured to receive an indication message sent by a network device, wherein the indication message comprises a plurality of pieces of PT-RS indication information corresponding to a plurality of transmission reception points (TRPs), the PT-RS indication information represents transmission towards a corresponding TRP and indicates a demodulation reference signal (DMRS) port associated with a corresponding PT-RS port.~~

~~20~~18. A communication device, comprising: a transceiver; a memory; and a processor, respectively connected to the transceiver and the memory;

the processor is configured to control a wireless signal transceiving of the transceiver and implement the method for enhancing an uplink PT-RS of any one of claims 1 to 15 or claims 16 to 17 by executing computer-executable instructions on the memory.

~~21~~19. A non-transitory computer-readable ~~computer~~ storage medium having computer-executable instructions stored thereon which, when executed by a processor, causes the method for enhancing an uplink PT-RS of any one of claims 1 to 15 or claims 16 to 17 to be implemented.