

NPL 1: IEEE P802.11n (D3.00) Draft STANDARD for Information Technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications, 2007.

Summary

[0007]

However, this does not take into consideration that there are a plurality of reception apparatuses that are communication partners of the transmission apparatus described above. Further, a transmission method of reference signals for estimating phase noise with good precision at each of the a plurality of reception apparatuses to has not been studied.

[0008] An aspect of the present disclosure provides a base station apparatus, comprising:

a downlink signal generation circuit, which, in operation, generates a downlink signal including a first data signal for a first reception apparatus mapped on a first set of subcarriers and a second data signal for a second reception apparatus mapped on a second set of subcarriers,

determines whether to map a first Reference Signal for Phase Tracking (PT-RS) to the first data signal based on a first Modulation and Coding Scheme (MCS) configured for the first data signal, wherein in a case where Phase Shift Keying (PSK) is used as a modulation scheme of the first MCS, the downlink signal generation circuit determines to not map the first PT-RS,

determines whether to map a second PT-RS to the second data signal based on a second MCS configured for the second data signal, wherein in a case where PSK is used as a modulation scheme of the second MCS, the downlink signal generation circuit determines to not map the second PT-RS,

responsive to determining to map the first PT-RS, maps the first PT-RS to the first data signal for the first reception apparatus, and

responsive to determining to map the second PT-RS, maps the second PT-RS to the second data signal for the second reception apparatus; and

a transmitter, which is coupled to the downlink signal generation circuit and which, in operation, transmits the downlink signal. An aspect of the present disclosure provides a transmission method performed by a base station, comprising:

generating a downlink signal including a first data signal for a first reception apparatus mapped on a first set of subcarriers and a second data signal for a second reception apparatus mapped on a second set of subcarriers;

determining whether to map a first Reference Signal for Phase Tracking (PT-RS) to the first data signal based on a first Modulation and Coding Scheme (MCS) configured for the first data signal, wherein in a case where Phase Shift Keying (PSK) is used as a modulation scheme of the first MCS, the determining includes determining to not map the first PT-RS;

determining whether to map a second PT-RS to the second data signal based on a second MCS configured for the second data signal, wherein in a case where PSK is used as a modulation scheme of the second MCS, the determining includes determining to not map the second PT-RS;

responsive to determining to map the first PT-RS, mapping the first PT-RS to the first data signal for the first reception apparatus;

responsive to determining to map the second PT-RS, mapping the second PT-RS to the second data signal for the second reception apparatus; and

transmitting the downlink signal.

An aspect of the present disclosure provides a transmission apparatus, reception apparatus, transmission method, and reception method, where a plurality of communication partners can estimate phase noise with good precision.

[0009]

A transmission apparatus according to the aspect of the present disclosure includes: a circuit that generates a modulated signal including reference signals for phase noise estimation, for a plurality of reception apparatuses, where a correction coefficient of transmission power for the reference signals is associated with a pattern of a sequence used as the reference signals, on a one-to-one basis; and a transmitter that transmits the modulated signal.

[0010]

A reception apparatus according to the aspect of the present disclosure includes: a receiver that receives a modulated signal including reference signals for phase noise estimation, for a plurality of reception apparatuses, where a correction coefficient of transmission power for the reference signals is associated with a pattern of a sequence used as the reference signals, on a one-to-one basis; and a circuit that estimates phase noise using the reference signals for the plurality of reception apparatuses included in the modulated signal.

[0011]

It should be noted that these general or specific embodiments may be implemented as a system, an apparatus, a method, an integrated circuit, a

Claims

1. A base station apparatus, comprising:
a downlink signal generation circuit, which, in operation,
generates a downlink signal including a first data signal for a first reception apparatus mapped on a first set of subcarriers and a second data signal for a second reception apparatus mapped on a second set of subcarriers,
determines whether to map a first Reference Signal for Phase Tracking (PT-RS) to the first data signal based on a first Modulation and Coding Scheme (MCS) configured for the first data signal, wherein in a case where Phase Shift Keying (PSK) is used as a modulation scheme of the first MCS, the downlink signal generation circuit determines to not map the first PT-RS,
determines whether to map a second PT-RS to the second data signal based on a second MCS configured for the second data signal, wherein in a case where PSK is used as a modulation scheme of the second MCS, the downlink signal generation circuit determines to not map the second PT-RS,
responsive to determining to map the first PT-RS, maps the first PT-RS to the first data signal for the first reception apparatus, and
responsive to determining to map the second PT-RS, maps the second PT-RS to the second data signal for the second reception apparatus; and
a transmitter, which is coupled to the downlink signal generation circuit and which, in operation, transmits the downlink signal.
2. The base station apparatus according to Claim 1,
wherein whether to map the first PT-RS is determined based on a modulation wherein whether to map the second PT-RS is determined based on a modulation order of the second MCS.
3. The base station apparatus according to Claim 1,
wherein, when the first PT-RS is to be mapped, frequency of insertion of the first PT-RS in a time axis, in a frequency axis, or in time and frequency domain depends on the first MCS, and
wherein, when the second PT-RS is to be mapped, frequency of insertion of the second PT-RS in the time axis, in the frequency axis, or in time and frequency domain depends on the second MCS.
4. The base station apparatus according to Claim 1,
wherein a correction coefficient of transmission power for the first PT-RS and a correction coefficient of transmission power for the first data signal are different from each other, and

wherein a correction coefficient of transmission power for the second PT-RS and a correction coefficient of transmission power for the second data signal are different from each other.

5. The base station apparatus according to Claim 1,

wherein, in a case where a first modulation order of the first MCS configured for the first data signal for the first reception apparatus is equal to or greater than a threshold value, the downlink signal generation circuit maps the first PT-RS to resources allocated to the first reception apparatus, and in a case where the first modulation order is smaller than the threshold value, the downlink signal generation circuit does not map the first PT-RS to the resources.

6. A transmission method performed by a base station, comprising:

generating a downlink signal including a first data signal for a first reception apparatus mapped on a first set of subcarriers and a second data signal for a second reception apparatus mapped on a second set of subcarriers;

determining whether to map a first Reference Signal for Phase Tracking (PT-RS) to the first data signal based on a first Modulation and Coding Scheme (MCS) configured for the first data signal, wherein in a case where Phase Shift Keying (PSK) is used as a modulation scheme of the first MCS, the determining includes determining to not map the first PT-RS;

determining whether to map a second PT-RS to the second data signal based on a second MCS configured for the second data signal, wherein in a case where PSK is used as a modulation scheme of the second MCS, the determining includes determining to not map the second PT-RS;

responsive to determining to map the first PT-RS, mapping the first PT-RS to the first data signal for the first reception apparatus;

responsive to determining to map the second PT-RS, mapping the second PT-RS to the second data signal for the second reception apparatus; and

transmitting the downlink signal.

7. The transmission method according to Claim 5,

wherein whether to map the first PT-RS, is determined based on a modulation order of the first MCS, and

wherein whether to map the second PT-RS is determined based on a modulation order of the second MCS.

8. The transmission method according to Claim 5,

wherein, when the first PT-RS is to be mapped, frequency of insertion of the first PT-RS in a time axis, in a frequency axis, or in time and frequency domain depends on the first MCS, and wherein, the second PT-RS is to be mapped, frequency of insertion of the second PT-RS in the time axis, in the frequency axis, or in time and frequency domain depends on the second MCS.

9. The transmission method according to Claim 5,

wherein a correction coefficient of transmission power for the first PT-RS and a correction coefficient of transmission power for the first data signal are different from each other, and wherein a correction coefficient of transmission power for the second PT-RS and a correction coefficient of transmission power for the second data signal are different from each other.

10. The transmission method according to Claim 5,

wherein, when a first modulation order of the first MCS configured for the first data signal for the first apparatus is equal to or greater than a threshold value, the first PT-RS is mapped to resources allocated to the first reception apparatus, and when the modulation order is smaller than the threshold value, the first PT-RS is not mapped to the resources.