Indicating a Transmission Configuration Indicator State

Field

The following exemplary embodiments relate to wireless communication and to indicating resources associated with transmission of data.

Background

Wireless networks, such as cellular communication networks, use control channels to for example indicate control information. Such control information may allow resources to be allocated such that data transmissions are enabled. It is also desirable to have as optimal usage of resources as possible.

Brief Description

The scope of protection sought for various embodiments of the invention is set out by the independent claims. The exemplary embodiments and features, if any, described in this specification that do not fall under the scope of the independent claims are to be interpreted as examples useful for understanding various embodiments of the invention.

Summary

According to an aspect, the present disclosure refers to an apparatus comprising at least one processor, and at least one memory including a computer program code, wherein the at least one memory and the computer program code are configured, with the at least one processor, to cause the apparatus to:

receive a pre-configuration;

receive, in a downlink control information, a first information element , wherein the first information element indicates two transmission configuration indicator states; and

determine, in accordance with the pre-configuration, which of the following associations is an association between the two transmission

configuration indicator states and a physical uplink control channel resource group:

both of the two transmission configuration indicator states are applicable to the physical uplink control channel resource group;

a first transmission configuration indicator state of the two transmission configuration indicator states is applicable to the physical uplink control channel resource group; or

a second transmission configuration indicator state of the two transmission configuration indicator states is applicable to the physical uplink control channel resource group.

According to an aspect, the present disclosure refers to an apparatus comprising at least one processor, and at least one memory including a computer program code, wherein the at least one memory and the computer program code are configured, with the at least one processor, to cause the apparatus to:

transmit, to a terminal device, a pre-configuration; and

transmit, to the terminal device, in a downlink control information, a first information element, wherein the first information element indicates two transmission configuration indicator states;

wherein the pre-configuration is for causing the terminal device to determine which of the following associations is an association between the two transmission configuration indicator states and a physical uplink control channel resource group:

both of the two transmission configuration indicator states are applicable to the physical uplink control channel resource group;

a first transmission configuration indicator state of the two transmission configuration indicator states is applicable to the physical uplink control channel resource group; or

a second transmission configuration indicator state of the two transmission configuration indicator states is applicable to the physical uplink control channel resource group.

According to an aspect, the present disclosure refers to a method comprising, by a terminal device:

receiving a pre-configuration;

receiving, in a downlink control information, a first information element, wherein the first information element indicates indicating two transmission configuration indicator states; and

determining, in accordance with the pre-configuration, which of the following associations is an association between the two transmission configuration indicator states and a physical uplink control channel resource group:

both of the two transmission configuration indicator states are applicable to the physical uplink control channel resource group;

a first transmission configuration indicator state of the two transmission configuration indicator states is applicable to the physical uplink control channel resource group; or

a second transmission configuration indicator state of the two transmission configuration indicator states is applicable to the physical uplink control channel resource group.

According to an aspect, the present disclosure refers to a method comprising:

transmitting, to a terminal device, a pre-configuration; and

transmitting, to the terminal device in a downlink control information, a first information element, wherein the first information element indicates two transmission configuration indicator states; wherein the pre-configuration is for causing the terminal device to determine which of the following associations is an association between the two transmission configuration indicator states and a physical uplink control channel resource group:

both of the two transmission configuration indicator states are applicable to the physical uplink control channel resource group;

a first transmission configuration indicator state of the two transmission configuration indicator states is applicable to the physical uplink control channel resource group; or

a second transmission configuration indicator state of the two transmission configuration indicator states is applicable to the physical uplink control channel resource group.

According to an aspect, the present disclosure refers to a computer program comprising instructions for causing an apparatus to perform the methods of the above aspects.

According to an example, the present disclosure refers to a computer program comprising instructions for causing an apparatus to perform at least the following:

transmit, to a terminal device, a first information element indicating two transmission configuration indicator states; and

transmit, to the terminal device, a configuration for determining an association between the two indicated transmission configuration indicator states and at least one physical uplink control channel resource group.,

wherein the configuration causes the terminal device to determine the association between the two indicated transmission configuration indicator states and the at least one physical uplink control channel resource group to be one of the following:

both of the two indicated transmission configuration indicator states are applicable to the at least one physical uplink control channel resource group;

a first indicated transmission configuration indicator state of the two indicated transmission configuration indicator states is applicable to the at least one physical uplink control channel resource group; or

a second indicated transmission configuration indicator state of the two indicated transmission configuration indicator states is applicable to the at least one physical uplink control channel resource group.

According to a first example there is provided an apparatus comprising means for: receiving a first information element, wherein the first information element indicates at least one transmission configuration indicator state, receiving a second information element, and determining, based on the second information element, an

association between the at least one transmission configuration indicator state and at least one physical uplink control channel resource group.

In some examples according to the first example, the means comprises at least one processor, and at least one memory, including a computer program code, wherein the at least one memory and the computer program code are configured, with the at least one processor, to cause the performance of the apparatus.

Claims

1. An apparatus comprising:

at least one processor (410), and

at least one memory (420) including a computer program code, wherein the at least one memory (420) and the computer program code are configured, with the at least one processor (410), to cause the apparatus (400) to:

receive a pre-configuration;

receive, in a downlink control information (340), a first information element, wherein the first information element indicates two transmission configuration indicator states (372, 374); and

determine, in accordance with the pre-configuration, which of the following associations is an association between the two transmission configuration indicator states (372, 374) and a physical uplink control channel resource group:

both of the two transmission configuration indicator states (372, 374) are applicable to the physical uplink control channel resource group;

a first transmission configuration indicator state of the two transmission configuration indicator states (372, 374) is applicable to the physical uplink control channel resource group;

a second transmission configuration indicator state of the two transmission configuration indicator states (372, 374) is applicable to the physical uplink control channel resource group.

2. An apparatus (400) according to claim 1, wherein the apparatus (400) is further caused to transmit a physical uplink control channel transmission according to the determined association between the two transmission configuration indicator states (372, 374) and the physical uplink control channel resource group.

3. An apparatus according to any preceding claim wherein the pre-configuration is received via RRC.

4. An apparatus (500) comprising

at least one processor (510), and

at least one memory (520) including a computer program code, wherein the at least one memory (520) and the computer program code are configured, with the at least one processor (510), to cause the apparatus (500) to:

transmit, to a terminal device (100, 102), a pre-configuration; and

transmit, to the terminal device (100, 102) in a downlink control information (340), a first information element, wherein the first information element indicates two transmission configuration indicator states (372, 374);

wherein, the pre-configuration is for causing the terminal device (100, 102) to determine which of the following associations is an association between the two transmission configuration indicator states (372, 374) and a physical uplink control channel resource group:

both of the two transmission configuration indicator states (372, 374) are applicable to the physical uplink control channel resource group;

a first transmission configuration indicator state of the two transmission configuration indicator states (372, 374) is applicable to the physical uplink control channel resource group;

a second transmission configuration indicator state of the two transmission configuration indicator states (372, 374) is applicable to the physical uplink control channel resource group.

5. An apparatus (500) according to claim 4 wherein the pre-configuration is transmitted via RRC.

6. A method comprising:

receiving a pre-configuration;

receiving, in a downlink control information (340), a first information element, wherein the first information element indicates two transmission configuration indicator states (372, 374); and

determining, in accordance with the pre-configuration, which of the following associations is an association between the two transmission configuration indicator states (372, 374) and a physical uplink control channel resource group:

both of the two transmission configuration indicator states (372, 374) are applicable to the physical uplink control channel resource group;

a first transmission configuration indicator state of the two transmission configuration indicator states (372, 374) is applicable to the physical uplink control channel resource group;

a second transmission configuration indicator state of the two transmission configuration indicator states (372, 374) is applicable to the physical uplink control channel resource group.

7. A method comprising:

transmitting, to a terminal device (100, 102), a pre-configuration; and

transmitting, to the terminal device (100, 102) in a downlink control information (340), a first information element, wherein the first information element indicates two transmission configuration indicator states (372, 374);

wherein, the pre-configuration is for causing the terminal device (100, 102) to determine which of the following associations is an association between the two

transmission configuration indicator states (372, 374) and a physical uplink control channel resource group:

both of the two transmission configuration indicator states (372, 374) are applicable to the physical uplink control channel resource group;

a first transmission configuration indicator state of the two transmission configuration indicator states (372, 374) is applicable to the physical uplink control channel resource group;

a second transmission configuration indicator state of the two transmission configuration indicator states (372, 374) is applicable to the physical uplink control channel resource group.

8. A computer program comprising instructions for causing an apparatus to perform the method of claim 6.

9. A computer program comprising instructions for causing an apparatus to perform the method of claim 7.