The communication system and associated devices typically operate in accordance with a given standard or specification which sets out what the various entities associated with the system are permitted to do and how that should be achieved. Communication protocols and/or parameters which shall be used for the connection are also typically defined. One example of a communications system is UTRAN (3G radio). Another example is the long-term evolution (LTE) of the Universal Mobile Telecommunications System (UMTS) radio-access technology. LTE is being standardized by the 3rd Generation Partnership Project (3GPP). A further example is the so-called 5G or New Radio (the term used by 3GPP) networks. Standardization of 5G or New Radio networks is currently under discussion.

Summary

In a first embodiment there is provided a method comprising causing transmission of a first uplink transmission from a first user device, the first uplink transmission having a transmission time interval comprising a plurality of subframes, receiving information from a base station, the information comprising an indication to pause transmission of the first uplink transmission for N subframes, pausing transmission of the first uplink transmission for N subframes and causing, after N subframes, continued transmission of the first uplink transmission.

At least one of a second uplink transmission and a downlink transmission may be scheduled during at least a portion of the N subframes.

The at least one second uplink transmission may be scheduled for the first user device or a second user device.

The first uplink transmission may be associated with at least one of a mobile broadband service and a massive machine communication service. The at least one of the second uplink transmission and downlink transmission may be associated with a mission critical communication service.

The method may comprise pausing the first uplink transmission during the transmission time interval.

N may be preconfigured.

N may be equal to 1.

The information may comprise an indication of N.

The information may comprise an indication to pause the first uplink transmission, and subsequently, after N subframes, an indication to continue the first uplink transmission

The method may comprise receiving the information on a physical layer control channel.

The method may comprise receiving a scheduling grant for the first uplink transmission on the physical layer control channel.

Receiving the information may comprise determining at each subframe of the first uplink transmission whether the information has been received.

In a second embodiment, there is provided a method comprising receiving a first uplink transmission from a first user device, the first uplink transmission having a transmission time interval comprising a plurality of subframes, providing information to the user device, the information comprising an indication to pause transmission of the first uplink transmission for N subframes and receiving, after N subframes, continued transmission of the first uplink transmission.

The first uplink transmission may be paused during the transmission time interval.

The method may comprise scheduling at least one of a second uplink transmission and downlink transmission during at least a portion of the N subframes.

The method may comprise scheduling the second uplink transmission during the N subframes and receiving the second uplink transmission during at least a portion of N subframes.

The first uplink transmission may be associated with at least one of a mobile broadband service and a massive machine communication service. The at least one of the second uplink transmission and downlink transmission may be associated with a mission critical communication service.

N may be preconfigured.

N may be equal to 1.

The information may comprise an indication of N.

The information may comprise an indication to pause the first uplink transmission, and subsequently, after N subframes, an indication to continue the first uplink transmission

The method may comprise providing the information on a physical layer control channel.

The method may comprise providing a scheduling grant for the first uplink transmission on the physical layer control channel.

In a third embodiment, there is provided an apparatus comprising means for causing transmission of a first uplink transmission from a first user device, the first uplink transmission having a transmission time interval comprising a plurality of subframes, means for receiving information from a base station, the information comprising an indication to pause transmission of the first uplink transmission for N subframes, means for pausing transmission of the first uplink transmission for N subframes and means for causing, after N subframes, continued transmission of the first uplink transmission.

At least one of a second uplink transmission and a downlink transmission may be scheduled during at least a portion of the N subframes.

The at least one second uplink transmission may be scheduled for the first user device or a second user device.

The first uplink transmission may be associated with at least one of a mobile broadband service and a massive machine communication service. The at least one of the second uplink transmission and downlink transmission may be associated with a mission critical communication service.

The apparatus may comprise means for pausing the first uplink transmission during the transmission time interval.

N may be preconfigured.

N may be equal to 1.

The information may comprise an indication of N.

The information may comprise an indication to pause the first uplink transmission, and subsequently, after N subframes, an indication to continue the first uplink transmission

The apparatus may comprise means for receiving the information on a physical layer control channel.

The apparatus may comprise means for receiving a scheduling grant for the first uplink transmission on the physical layer control channel.

Receiving the information may comprise determining at each subframe of the first uplink transmission whether the information has been received.

In a fourth embodiment, there is provided an apparatus comprising means for receiving a first uplink transmission from a first user device, the first uplink transmission having a transmission time interval comprising a plurality of subframes, means for providing information to the user device, the information comprising an indication to pause transmission of the first uplink transmission for N subframes and means for receiving, after N subframes, continued transmission of the first uplink transmission.

The first uplink transmission may be paused during the transmission time interval.

The apparatus may comprise means for scheduling at least one of a second uplink transmission and downlink transmission during at least a portion of the N subframes.

The apparatus may comprise means for scheduling the second uplink transmission during the N subframes and means for receiving the second uplink transmission during at least a portion of N subframes.

The first uplink transmission may be associated with at least one of a mobile broadband service and a massive machine communication service. The at least one of the second uplink transmission and downlink transmission may be associated with a mission critical communication service.

N may be preconfigured.

N may be equal to 1.

The information may comprise an indication of N.

The information may comprise an indication to pause the first uplink transmission, and subsequently, after N subframes, an indication to continue the first uplink transmission

The apparatus may comprise means for providing the information on a physical layer control channel.

The apparatus may comprise means for providing a scheduling grant for the first uplink transmission on the physical layer control channel.

In a fifth embodiment there is provided an apparatus comprising at least one processor and at least one memory including a computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to cause transmission of a first uplink transmission from a first user device, the first uplink transmission having a transmission time interval comprising a plurality of subframes, receive information from a base station, the information comprising an indication to pause transmission of the first uplink transmission for N subframes, pause transmission of the first uplink transmission for N subframes and cause, after N subframes, continued transmission of the first uplink transmission.

At least one of a second uplink transmission and a downlink transmission may be scheduled during at least a portion of the N subframes.

The at least one second uplink transmission may be scheduled for the first user device or a second user device.

The first uplink transmission may be associated with at least one of a mobile broadband service and a massive machine communication service. The at least one of the second uplink transmission and downlink transmission may be associated with a mission critical communication service.

The apparatus may be configured to pause the first uplink transmission during the transmission time interval.

N may be preconfigured.

N may be equal to 1.

The information may comprise an indication of N.

The information may comprise an indication to pause the first uplink transmission, and subsequently, after N subframes, an indication to continue the first uplink transmission

The apparatus may be configured to receive the information on a physical layer control channel.

The apparatus may be configured to receive a scheduling grant for the first uplink transmission on the physical layer control channel.

The apparatus may be configured to determine at each subframe of the first uplink transmission whether the information has been received.

In a sixth embodiment, there is provided an apparatus at least one processor and at least one memory including a computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to receive a first uplink transmission from a first user device, the first uplink transmission having a transmission time interval comprising a plurality of subframes, provide information to the user device, the information comprising an indication to pause transmission of the first uplink transmission for N subframes and receive, after N subframes, a continued transmission of the first uplink transmission.

The first uplink transmission may be paused during the transmission time interval.

The apparatus may be configured to schedule at least one of a second uplink transmission and downlink transmission during at least a portion of the N subframes.

The apparatus may comprise be configured to schedule the second uplink transmission during the N subframes and receive the second uplink transmission during at least a portion of N subframes.

The first uplink transmission may be associated with at least one of a mobile broadband service and a massive machine communication service. The at least one of the second uplink

transmission and downlink transmission may be associated with a mission critical communication service.

N may be preconfigured.

N may be equal to 1.

The information may comprise an indication of N.

The information may comprise an indication to pause the first uplink transmission, and subsequently, after N subframes, an indication to continue the first uplink transmission

The apparatus may be configured to provide the information on a physical layer control channel.

The apparatus may be configured to provide a scheduling grant for the first uplink transmission on the physical layer control channel.

In a seventh embodiment, there is provided a computer program embodied on a non-transitory computer-readable storage medium, the computer program comprising program code for controlling a process to execute a process, the process comprising causing transmission of a first uplink transmission from a first user device, the first uplink transmission having a transmission time interval comprising a plurality of subframes, receiving information from a base station, the information comprising an indication to pause transmission of the first uplink transmission for N subframes, pausing transmission of the first uplink transmission for N subframes and causing, after N subframes, continued transmission of the first uplink transmission.

At least one of a second uplink transmission and a downlink transmission may be scheduled during at least a portion of the N subframes.

The at least one second uplink transmission may be scheduled for the first user device or a second user device.

The first uplink transmission may be associated with at least one of a mobile broadband service and a massive machine communication service. The at least one of the second uplink

transmission and downlink transmission may be associated with a mission critical communication service.

The process may comprise pausing the first uplink transmission during the transmission time interval.

N may be preconfigured.

N may be equal to 1.

The information may comprise an indication of N.

The information may comprise an indication to pause the first uplink transmission, and subsequently, after N subframes, an indication to continue the first uplink transmission

The process may comprise receiving the information on a physical layer control channel.

The process may comprise receiving a scheduling grant for the first uplink transmission on the physical layer control channel.

Receiving the information may comprise determining at each subframe of the first uplink transmission whether the information has been received.

In an eighth embodiment, there is provided a computer program embodied on a non-transitory computer-readable storage medium, the computer program comprising program code for controlling a process to execute a process, the process comprising receiving a first uplink transmission from a first user device, the first uplink transmission having a transmission time interval comprising a plurality of subframes, providing information to the user device, the information comprising an indication to pause transmission of the first uplink transmission for N subframes and receiving, after N subframes, continued transmission of the first uplink transmission.

The first uplink transmission may be paused during the transmission time interval.

The process may comprise scheduling at least one of a second uplink transmission and downlink transmission during at least a portion of the N subframes.

The process may comprise scheduling the second uplink transmission during the N subframes and receiving the second uplink transmission during at least a portion of N subframes.

The first uplink transmission may be associated with at least one of a mobile broadband service and a massive machine communication service. The at least one of the second uplink transmission and downlink transmission may be associated with a mission critical communication service.

N may be preconfigured.

N may be equal to 1.

The information may comprise an indication of N.

The information may comprise an indication to pause the first uplink transmission, and subsequently, after N subframes, an indication to continue the first uplink transmission

The process may comprise providing the information on a physical layer control channel.

The process may comprise providing a scheduling grant for the first uplink transmission on the physical layer control channel.

In an embodiment there is provided a computer program product for a computer, comprising software code portions for performing the steps the method of the first and second embodiment when said product is run on the computer.

A device for a communication system may comprise the apparatus according to the above embodiments.

In view of the above, according to a first aspect, there is provided a method comprising: causing transmission of a first uplink transmission for mobile broadband communication from a first user device, the first uplink transmission having a first transmission time interval comprising a plurality of subframes; receiving, during the first transmission time interval, information from a base station, the information comprising an indication to pause transmission of the first uplink transmission for N subframes; pausing transmission of the first uplink transmission during the first transmission time interval for the N subframes, wherein a transmission of a mission critical communication is scheduled by the base station to take place

during the pause for a second transmission time interval that is shorter than the first transmission time interval; and causing, after the N subframes, continued transmission of the remainder of the first uplink transmission for mobile broadband communication.

According to a second aspect, there is provided a method comprising: receiving a first uplink transmission for mobile broadband communication from a first user device, the first uplink transmission having a first transmission time interval comprising a plurality of subframes; providing, during the first transmission time interval, information to the first user device, the information comprising an indication to pause transmission of the first uplink transmission during the first transmission time interval for N subframes; scheduling a transmission of a mission critical communication to take place during the pause for a second transmission time interval that is shorter than the first transmission time interval; and receiving, after the N subframes, continued transmission of the remainder of the first uplink transmission for mobile broadband communication.

In accordance with a third aspect, there is provided an apparatus comprising means for performing a method according to any one of the above aspects and embodiments.

In accordance with a fourth aspect, there is provided a computer program product for a computer, comprising software code portions for performing the steps of any of the above aspects and embodiments when the product is run on the computer.

In accordance with a fifth aspect, there is provided an apparatus comprising: at least one processor and at least one memory including a computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to: cause transmission of a first uplink transmission for mobile broadband communication from a first user device, the first uplink transmission having a first transmission time interval comprising a plurality of subframes; receive, during the first transmission time interval, information from a base station, the information comprising an indication to pause transmission of the first uplink transmission for N subframes; pause transmission of the first uplink transmission during the first transmission time interval for the N subframes, wherein a transmission of a mission critical communication is scheduled by the base station to take place during the pause for a second transmission time interval that is shorter than the first transmission time interval; and cause, after the N subframes, continued transmission of the remainder of the first uplink transmission for mobile broadband communication.

In accordance with a sixth aspect, there is provided an apparatus comprising: at least one processor and at least one memory including a computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to: receive a first uplink transmission for mobile broadband communication from a first user device, the first uplink transmission having a first transmission time interval comprising a plurality of subframes; provide, during the first transmission time interval, information to the first user device, the information comprising an indication to pause transmission of the first uplink transmission during the first transmission time interval for N subframes; scheduling a transmission of a mission critical communication to take place during the pause for a second transmission time interval that is shorter than the first transmission time interval; and receive, after the N subframes, a continued transmission of the remainder of the first uplink transmission for mobile broadband communication.

In the above, many different embodiments have been described. It should be appreciated that further embodiments may be provided by the combination of any two or more of the embodiments described above.

Description of Figures

Embodiments will now be described, by way of example only, with reference to the accompanying Figures in which:

Claims

1. A method comprising:

causing transmission of a first uplink transmission for mobile broadband communication from a first user device, the first uplink transmission having a first transmission time interval comprising a plurality of subframes;

receiving, during the first transmission time interval, information from a base station, the information comprising an indication to pause transmission of the first uplink transmission for N subframes;

pausing transmission of the first uplink transmission during the first transmission time interval for the N subframes, wherein a transmission of a mission critical communication is scheduled by the base station to take place during the pause for a second transmission time interval that is shorter than the first transmission time interval; and

causing, after the N subframes, continued transmission of the remainder of the first uplink transmission for mobile broadband communication.

2. A method according to claim 1, wherein the transmission of a mission critical communication includes at least one of a second uplink transmission and a downlink transmission, and wherein the second transmission time interval includes at least a portion of the N subframes.

3. A method according to claim 2, wherein the at least one second uplink transmission is scheduled for the first user device or a second user device.

4. A method according to claim 2 or claim 3, wherein the first uplink transmission is associated with at least one of a mobile broadband service and a massive machine communication service and the at least one of the second uplink transmission and downlink transmission is associated with a mission critical communication service.

5. A method according to any preceding claim, wherein N is preconfigured.

6. A method according to claim 5, wherein N=1.

7. A method according to any one of claims 1 to 4, wherein the information comprises an indication of N.

8. A method according to any preceding claim, comprising receiving the information on a physical layer control channel.

9. A method according to any preceding claim, comprising receiving a scheduling grant for the first uplink transmission on the physical layer control channel.

10. A method according to any preceding claim, wherein receiving the information comprises determining at each subframe of the first uplink transmission whether the information has been received.

11. A method comprising:

receiving a first uplink transmission for mobile broadband communication from a first user device, the first uplink transmission having a first transmission time interval comprising a plurality of subframes;

providing, during the first transmission time interval, information to the first user device, the information comprising an indication to pause transmission of the first uplink transmission during the first transmission time interval for N subframes;

scheduling a transmission of a mission critical communication to take place during the pause for a second transmission time interval that is shorter than the first transmission time interval; and

receiving, after the N subframes, continued transmission of the remainder of the first uplink transmission for mobile broadband communication.

12. A method of claim 11, wherein the transmission of a mission critical communication includes at least one of a second uplink transmission and downlink transmission, and wherein the second transmission time interval includes at least a portion of the N subframes.

13. A method according to claim 12, comprising scheduling the second uplink transmission during the N subframes; and

receiving the second uplink transmission during at least a portion of N subframes.

14. A method according to any one of claims 12 and 13, wherein the first uplink transmission is associated with at least one of a mobile broadband service and a massive machine communication service and the at least one of the second uplink transmission and downlink transmission is associated with a mission critical communication service.

15. A method according to any one of claims 11 to 14, wherein N is preconfigured.

16. A method according to claim 16, wherein N=1.

17. A method according to any one of claims 11 to 16, wherein the information comprises an indication of N.

18. A method according to any one of claims 11 to 17, comprising providing the information on a physical layer control channel.

19. A method according to any one of claims 11 to 18, comprising providing a scheduling grant for the first uplink transmission on the physical layer control channel.

20. An apparatus comprising means for performing a method according to any one of claims 1 to 19.

21. A computer program product for a computer, comprising software code portions for performing the steps of any of claims 1 to 19 when the product is run on the computer.

22. An apparatus comprising:

at least one processor and at least one memory including a computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to:

cause transmission of a first uplink transmission for mobile broadband communication from a first user device, the first uplink transmission having a first transmission time interval comprising a plurality of subframes;

receive, during the first transmission time interval, information from a base station, the information comprising an indication to pause transmission of the first uplink transmission for N subframes;

pause transmission of the first uplink transmission during the first transmission time interval for the N subframes, wherein a transmission of a mission critical communication is

scheduled by the base station to take place during the pause for a second transmission time interval that is shorter than the first transmission time interval; and

cause, after the N subframes, continued transmission of the remainder of the first uplink transmission for mobile broadband communication.

23. An apparatus comprising:

at least one processor and at least one memory including a computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to:

receive a first uplink transmission for mobile broadband communication from a first user device, the first uplink transmission having a first transmission time interval comprising a plurality of subframes;

provide, during the first transmission time interval, information to the first user device, the information comprising an indication to pause transmission of the first uplink transmission during the first transmission time interval for N subframes;

scheduling a transmission of a mission critical communication to take place during the pause for a second transmission time interval that is shorter than the first transmission time interval; and

receive, after the N subframes, a continued transmission of the remainder of the first uplink transmission for mobile broadband communication.