METHOD AND APPARATUS FOR PROVIDING RADIO RESOURCE INFORMATION FOR SIDELINK CONTROL

TECHNICAL FIELD

[0001] This disclosure is directed generally to digital wireless communications.

BACKGROUND

[0002] Mobile communication technologies are moving the world toward an increasingly connected and networked society. The rapid growth of mobile communications and advances in technology has led to greater demand for capacity and peak data rates. Other aspects, such as energy consumption, device cost, spectral efficiency, cost per delivered bit, throughput, proximity services, and latency are also important to meeting the needs of various applications based on mobile communications. In comparison with the existing wireless networks, next generation systems and wireless communication techniques may need to support a much wider range of use-case characteristics and provide a much more complex range of access requirements and flexibilities.

SUMMARY

[0003] This disclosure relates to methods, systems, and devices for improved sidelink communication resource utilization by transmitting from a base station to a mobile station supporting proximity services (ProSe) in connection with a mobile station with one or more other mobile or other wireless devices operating in network scheduled mode an indicator that designates the allowable resource pools and resources (e.g. the allowable sub-frames and resource blocks) within that resource pool that the mobile station is permitted to use in a sidelink channel to communicate with another wireless device. A sidelink is a generic wireless communication link between wireless communication devices such as described in the LTE wireless standards.

[0003a] In a first aspect, the present disclosure provides a wireless communication method, comprising transmitting, by a base station to a mobile station, a radio resource control (RRC) message which includes resource information corresponding to one or more resource pools, wherein the RRC message comprises, for each of the one or more resource pools, a corresponding resource pool index; and transmitting, to the mobile station, a resource pool index within a downlink control information (DCI) indicating at least one designated resource pool

from the one or more resource pools and designated resources from within the at least one designated resource pool such that the mobile station is permitted to communicate with a wireless device in communication with the mobile station via a wireless link using the at least one designated resource pool.

[0003b] In a second aspect, the present disclosure provides a device for wireless communication, comprising: a processor configured to: receive, by a mobile station, a radio resource control (RRC) message that includes resource information corresponding to one or more resource pools, wherein the RRC message comprises, for each of the one or more resource pools, a corresponding resource pool index; and receive, by the mobile station, a resource pool index within a downlink control information (DCI) indicating at least one designated resource pool from the one or more resource pools and designated resources from within the at least one designated resource pool such that communications between the mobile station and a wireless device is permitted via a wireless link between the mobile station and the wireless device using the at least one designated resource pool.

[0003c] In a third aspect, the present disclosure provides a device for wireless communication, comprising: a processor configured to: transmit, by a base station to a mobile station, a radio resource control (RRC) message which includes resource information corresponding to one or more resource pools, wherein the RRC message comprises, for each of the one or more resource pools, a corresponding resource pool index; and transmit, to the mobile station, a resource pool index within a downlink control information (DCI) indicating at least one designated resource pool from the one or more resource pools and designated resources from within the at least one designated resource pool such that the mobile station is permitted to communicate with a wireless device in communication with the mobile station via a wireless link using the at least one designated resource pool.

[0003d] In a fourth aspect, the present disclosure provides a wireless communication method, comprising: receiving, by a mobile station, a radio resource control (RRC) message that includes resource information corresponding to one or more resource pools, wherein the RRC message comprises, for each of the one or more resource pools, a corresponding resource pool index; and receiving, by the mobile station, a resource pool index within a downlink control information (DCI) indicating at least one designated resource pool from the one or more resource pools and designated resources from within the at least one designated resource pool such that communications between the mobile station and a wireless device is permitted via a wireless link

between the mobile station and the wireless device using the at least one designated resource pool.

[0004] In one ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises transmitting from a base station to a mobile station a first message which includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, transmitting to the mobile station an indicator of one or more designated resource

pools and designated resources from within the one or more designated resource pools such that the mobile station is permitted to communicate with a wireless device in communication with the mobile station via a sidelink using the one or more designated resources within the one or more designated resource pools.

[0005] In another ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises transmitting from a base station to a mobile station a first message which includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, transmitting to the mobile station an explicit indicator of one or more designated resource pools and designated resources from within the one or more designated resource pools such that the mobile station is permitted to communicate with a wireless device in communication with the mobile station via a sidelink using the one or more designated resources within the one or more designated resource pools.

[0006] In another ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises transmitting from a base station to a mobile station a first message which includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, transmitting to the mobile station an implicit indicator of one or more designated resource pools and designated resources from within the one or more designated resource pools such that the mobile station is permitted to communicate with a wireless device in communication with the mobile station via a sidelink using the one or more designated resources within the one or more designated resource pools.

[0007] In another ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises transmitting from a base station to a mobile station a first message which includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, transmitting to the mobile station an explicit indicator, in the form of an information data field in the downlink control information (DCI), of one or more designated resource pools and designated resources from within the one or more designated resource pools such that the mobile station is permitted to communicate with a wireless device in

communication with the mobile station via a sidelink using the one or more designated resources within the one or more designated resource pools.

[0008] In another ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises transmitting from a base station to a mobile station a first message which includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, transmitting to the mobile station an implicit indicator, in the form of a scrambling operation, of one or more designated resource pools and designated resources from within the one or more designated resource pools such that the mobile station is permitted to communicate with a wireless device in communication with the mobile station via a sidelink using the one or more designated resources within the one or more designated resource pools.

[0009] In another ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises transmitting from a base station to a mobile station a first message which includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, transmitting to the mobile station an implicit indicator, in the form of the downlink control information (DCI) location within the frame, of one or more designated resource pools and designated resources from within the one or more designated resource pools such that the mobile station is permitted to communicate with a wireless device in communication with the mobile station via a sidelink using the one or more designated resources within the one or more designated resource pools.

[0010] In another ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises transmitting from a base station to a mobile station a first message which includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, transmitting to the mobile station an implicit indicator of one or more designated resource pools and designated resources from within the one or more designated resource pools such that the mobile station is permitted to communicate with a wireless device in communication with the mobile station via a sidelink using the one or more designated resources within the one or more designated resource pools, wherein the mapping between the indicator and the resource pool is known.

[0011] In another ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises transmitting from a base station to a mobile station a first message which includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, transmitting to the mobile station an implicit indicator of one or more designated resource pools and designated resources from within the one or more designated resource pools such that the mobile station is permitted to communicate with a wireless device in communication with the mobile station via a sidelink using the one or more designated resources within the one or more designated resource pools, wherein the mapping between the indicator and the resource pool is signaled via a message.

[0012] In one ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises receiving, at a mobile station, a first message that includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, receiving, at the mobile station, an indicator of one or more designated resource pools and designated resources from within the one or more designated resource pools such that communications between the mobile station with a wireless device is permitted via a sidelink between the mobile station and the wireless device using the one or more designated resources within the one or more designated resource pools.

[0013] In another ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises receiving, at a mobile station, a first message that includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, receiving, at the mobile station, an explicit indicator of one or more designated resource pools and designated resources from within the one or more designated resource pools such that communications between the mobile station with a wireless device is permitted via a sidelink between the mobile station and the wireless device using the one or more designated resources within the one or more designated resource pools.

[0014] In another ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises receiving, at a mobile station, a first message that includes resource information corresponding to one or more resource pools, wherein the resource information

identifies at least one sub-frame and at least one resource block within the at least one sub-frame, receiving, at the mobile station, an implicit indicator of one or more designated resource pools and designated resources from within the one or more designated resource pools such that communications between the mobile station with a wireless device is permitted via a sidelink between the mobile station and the wireless device using the one or more designated resources within the one or more designated resource pools.

[0015] In another ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises receiving, at a mobile station, a first message that includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, receiving, at the mobile station, an explicit indicator, in the form of an information data field in the downlink control information (DCI), of one or more designated resource pools and designated resources from within the one or more designated resource pools such that communications between the mobile station with a wireless device is permitted via a sidelink between the mobile station and the wireless device using the one or more designated resources within the one or more designated resource pools.

[0016] In another ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises receiving, at a mobile station, a first message that includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, receiving, at the mobile station, an implicit indicator, in the form of a scrambling operation, of one or more designated resource pools and designated resources from within the one or more designated resource pools such that communications between the mobile station with a wireless device is permitted via a sidelink between the mobile station and the wireless device using the one or more designated resources within the one or more designated resource pools.

[0017] In another ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises receiving, at a mobile station, a first message that includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, receiving, at the mobile station, an implicit indicator, in the form of the downlink control information (DCI) location within the frame, of one or more designated resource pools and

designated resources from within the one or more designated resource pools such that communications between the mobile station with a wireless device is permitted via a sidelink between the mobile station and the wireless device using the one or more designated resources within the one or more designated resource pools.

[0018] In another ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises receiving, at a mobile station, a first message that includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, receiving, at the mobile station, an implicit indicator of one or more designated resource pools and designated resources from within the one or more designated resource pools such that communications between the mobile station with a wireless device is permitted via a sidelink between the mobile station and the wireless device using the one or more designated resources within the one or more designated resource pools, wherein the mapping between the indicator and the resource pool is known.

[0019] In another ~~exemplary aspect~~example, a wireless communication method is disclosed. The method comprises receiving, at a mobile station, a first message that includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, receiving, at the mobile station, an implicit indicator of one or more designated resource pools and designated resources from within the one or more designated resource pools such that communications between the mobile station with a wireless device is permitted via a sidelink between the mobile station and the wireless device using the one or more designated resources within the one or more designated resource pools, wherein the mapping between the indicator and the resource pool is signaled via a message.

[0020] In yet another ~~exemplary aspect~~example, a wireless communication base station is disclosed. The wireless communication base station comprises a memory that stores instructions for operations of the base station, and a processor in communication with the memory operable to execute instructions to cause the base station to: transmit in a transmission to a mobile station a first message which includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, transmit in a transmission to the mobile station an indicator of

one or more designated resource pools and designated resources from within the one or more designated resource pools such that the mobile station is permitted to communicate with a wireless device in communication with the mobile station via a sidelink using the one or more designated resources within the one or more designated resource pools.

[0021] In yet another ~~exemplary aspect~~example, a wireless communication mobile station is disclosed. The wireless communication mobile station comprises a memory that stores instructions for operations of the mobile station, and a processor in communication with the memory operable to execute instructions to cause the mobile station to: receive in a reception a first message that includes resource information corresponding to one or more resource pools, wherein the resource information identifies at least one sub-frame and at least one resource block within the at least one sub-frame, receive in a reception an indicator of one or more designated resource pools and designated resources from within the one or more designated resource pools such that communications between the mobile station with a wireless device is permitted via a sidelink between the mobile station and the wireless device using the one or more designated resources within the one or more designated resource pools.

[0022] In yet another ~~exemplary aspect~~example, the above-described methods are embodied in the form of processor-executable code and stored in a computer-readable program medium.

[0023] In yet another ~~exemplary embodiment~~example, a device that is configured or operable to perform the above-described methods is disclosed.

[0024] The above and other aspects and their implementations are described in greater detail in the drawings, the descriptions, and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] FIG. 1 shows an exemplary diagram of mobile stations (UEs) receiving coordination information from a base station (eNodeB) with the coordination information allowing the UEs to communicate with each other directly over a sidelink channel.

[0026] FIG. 2 shows an exemplary diagram of a mobile station (UE) in communication with a base station (eNodeB) with both downlink and uplink channels such that the UE may communicate with another UE directly over a sidelink channel or a fixed wireless infrastructure device such as a toll collection booth.

CLAIMS

1. A wireless communication method, comprising:

transmitting, by a base station to a mobile station, a radio resource control (RRC) message which includes resource information corresponding to one or more resource pools, wherein the RRC message comprises, ~~a resource pool index corresponding to~~ for each of the one or more resource pools, a corresponding resource pool index; and

transmitting, to the mobile station, a resource pool index within a downlink control information (DCI) indicating at least one designated resource pool from the one or more resource pools and designated resources from within the at least one designated resource pool such that the mobile station is permitted to communicate with a wireless device in communication with the mobile station via a wireless link using the at least one designated resource pool.

2. A device for wireless communication, comprising:

a processor configured to:

receive, by a mobile station, a radio resource control (RRC) message that includes resource information corresponding to one or more resource pools, wherein the RRC message comprises, ~~a resource pool index corresponding to~~ for each of the one or more resource pools, a corresponding resource pool index; and

receive, by the mobile station, a resource pool index within a downlink control information (DCI) indicating at least one designated resource pool from the one or more resource pools and designated resources from within the at least one designated resource pool such that communications between the mobile station and a wireless device is permitted via a wireless link between the mobile station and the wireless device using the at least one designated resource pool.

3. The method of claim 1, wherein a resource pool of the one or more resource pools corresponds to at least one sub-frame and at least one resource block within the at least one sub-frame.

4. The method of claim 1, wherein the DCI is carried on a physical downlink control channel (PDCCH).

5. The method of claim 1, wherein the ~~resource information further comprises a transmit power control (TPC) command, a resource block assignment and hopping allocation, or~~designated resources comprise a time resource pattern.

6. The method of claim 1, wherein the wireless link is configured to support a sidelink channel for proximity services.

7. The device of claim 2, wherein a resource pool of the one or more resource pools corresponds to at least one sub-frame and at least one resource block within the at least one sub-frame.

8. The device of claim 2, wherein the DCI is carried on a physical downlink control channel (PDCCH).

9. The device of claim 2, wherein the ~~resource information further comprises a transmit power control (TPC) command, a resource block assignment and hopping allocation, or~~designated resources comprise a time resource pattern.

10. The device of claim 2, wherein the wireless link is configured to support a sidelink channel for proximity services.

11. A device for wireless communication, comprising:

a processor configured to:

transmit, by a base station to a mobile station, a radio resource control (RRC) message which includes resource information corresponding to one or more resource pools, wherein the RRC message comprises, ~~a resource pool index corresponding to~~ for each of the one or more resource pools, a corresponding resource pool index; and

transmit, to the mobile station, a resource pool index within a downlink control information (DCI) indicating at least one designated resource pool from the one or more resource pools and designated resources from within the at least one designated resource pool such that the mobile station is permitted to communicate with a wireless device in communication with the mobile station via a wireless link using the at least one designated resource pool.

12. The device of claim 11, wherein a resource pool of the one or more resource pools corresponds to at least one sub-frame and at least one resource block within the at least one sub-frame.

13. The device of claim 11, wherein the DCI is carried on a physical downlink control channel (PDCCH).

14. The device of claim 11, wherein the ~~resource information further comprises a transmit power control (TPC) command, a resource block assignment and hopping allocation, or~~designated resources comprise a time resource pattern.

15. The device of claim 11, wherein the wireless link is configured to support a sidelink channel for proximity services.

16. A wireless communication method, comprising:

receiving, by a mobile station, a radio resource control (RRC) message that includes resource information corresponding to one or more resource pools, wherein the RRC message comprises, ~~a resource pool index corresponding to~~ for each of the one or more resource pools, a corresponding resource pool index; and

receiving, by the mobile station, a resource pool index within a downlink control information (DCI) indicating at least one designated resource pool from the one or more resource pools and designated resources from within the at least one designated resource pool such that communications between the mobile station and a wireless device is permitted via a wireless link between the mobile station and the wireless device using the at least one designated resource pool.

17. The method of claim 16, wherein a resource pool of the one or more resource pools corresponds to at least one sub-frame and at least one resource block within the at least one sub-frame.

18. The method of claim 16, wherein the DCI is carried on a physical downlink control channel (PDCCH).

19. The method of claim 16, wherein the ~~resource information further comprises a transmit power control (TPC) command, a resource block assignment and hopping allocation, or~~designated resources comprise a time resource pattern.

20. The method of claim 16, wherein the wireless link is configured to support a sidelink channel for proximity services.