DEVICE-TO-DEVICE COMMUNICATION

FIELD

[0001] The invention relates generally to mobile communication networks. More particularly, the invention relates to device-to-device communication in a communication network.

BACKGROUND

[0002] Generally, in a mobile communication network, such as the Long Term Evolution (LTE) or the LTE-Advanced (LTE-A) of the 3rd Generation Partnership Project (3GPP), two user terminals communicate with each other via a base station (evolved Node B (eNB) in the LTE). However, the requirements for efficient use of network resources and the needs for new services or service models may lead to applying direct device-to-device (D2D) communication. The D2D communication, or mobile-to-mobile, terminal-to-terminal, or peer-to-peer communication may be employed within the mobile communication network.

[0003] The direct D2D communication comprises at least two relatively closely located devices communicating with each other directly instead of a conventional communication link for end-to-end (E2E) communication, in which the source device transmits data to the destination device via the eNB. The two devices in the D2D communication may apply radio resources of the mobile communication network, thus sharing the resources with devices that are communicating with the eNB in the conventional link. This may lead to challenges in the radio resource allocation performed by the eNB. Further, the quality of service (QoS) of the E2E communication may suffer from the decisions related the radio resource allocation, a data transport method (the D2D communication link versus the conventional link), and the like, governed by the eNB.

[0004] Consequently, for the sake of performing reliable D2D communication, reducing transmitter power, increasing the capacity and coverage of the network, and creating and supporting services for the users, it is important to provide a solution for more efficient use of the D2D communication in a mobile communication network.

BRIEF DESCRIPTION OF THE INVENTION

[0005] An object of the invention is to provide a solution for more efficient use of direct device-to-device communication.

[0006] According to an aspect of the invention, there is provided a method as specified in claim **1**.

[0007] According to an aspect of the invention, there are provided apparatuses as specified in claims **15** and **29**.

[0008] According to an aspect of the invention, there is provided a computer program product as specified in claim **30**.

[0009] Embodiments of the invention are defined in the dependent claims.

LIST OF DRAWINGS

[0010] In the following, the invention will be described in greater detail with reference to the embodiments and the accompanying drawings, in which

[0011] FIG. **1** presents a communication network according to an embodiment;

[0012] FIG. **2** presents a communication network employing a direct communication link according to an embodiment;

[0013] FIG. **3** shows a communication network employing a direct communication link according to an embodiment;

[0014] FIG. **4** illustrates a communication network employing a direct communication link according to an embodiment;

[0015] FIG. **5** illustrates use of sequence numbers according to an embodiment;

[0016] FIG. **6** shows a block diagram of an apparatus according to an embodiment;

[0017] FIG. **7** illustrates a method for applying uplink signaling according to an embodiment;

[0018] FIG. **8** presents a method for controlling the quality of service of the communication, according to an embodiment; and

[0019] FIG. **9** presents a method for transmitting the uplink signaling according to an embodiment.

DESCRIPTION OF EMBODIMENTS

[0020] The following embodiments are exemplary. Although the specification may refer to "an", "one", or "some" embodiment(s) in several locations of the text, this does not necessarily mean that each reference is made to the same embodiment(s), or that a particular feature only applies to a single embodiment. Single features of different embodiments may also be combined to provide other embodiments. Although this invention is described using LTE (or Evolved universal mobile telecommunications system (UMTS) terrestrial radio access network (UTRAN) as a basis, it could be applicable to any other wireless mobile communication systems as well. For example, the embodiments may be applied under the UMTS or the Global system for mobile communications (GSM), etc. The telecommunication system may have a fixed infrastructure providing wireless services to subscriber terminals:

[0021] FIG. **1** illustrates possible methods for communication in a mobile communication network. The communication network may comprise a base station **100**. The base station **100** may provide radio coverage to a cell **102**, control radio resource allocation within the cell **102**, perform data and control signaling, etc. The cell **102** may be a macro cell, a micro cell, or any other type of cell where radio coverage is present. Further, the cell **102** may be of any size or form depending on the antenna aperture. That is, it may not be of oval or circular form, but any other form is applicable to embodiments. The cell **102** controlled by the base station **100** may be divided into sectors, but such a scenario is not illustrated in greater detail in order to keep the focus on the invention.

[0022] The base station **100** may be used by multiple network operators in order to provide radio coverage from multiple operators to the cell **100**. The base station **100** may be a node B, an evolved node B (eNB) as in LTE-A, a radio network controller (RNC), or any other apparatus capable of controlling radio communication within the cell **102**. In the case of multiple base stations in the communication network, the base stations may be connected to each other with an X2 interface and via S1 interface to an evolved packet core (EPC), more specifically to a mobility management entity (MME) and to a serving gateway (S-GW). The MME controls the functions of non-access stratum signaling, roaming, authentication, tracking area list management, etc.,