in the above-mentioned LTE network, the E-UTRAN connects cellular IoT (CIoT) UEs to a CN and ultimately to services available through a PDN or other data network. However, in currently proposed implementations, there are security concerns for CIoT UEs in NB-IoT networks, for example, during operations such as radio link recovery.

**Summary**

Illustrative embodiments provide techniques for providing secure radio link recovery for user equipment in a communication system.

In a first aspect, the present disclosure provides a method comprising: in a communication system, in response to a radio link failure between a user equipment and a source access node of the communication system during a data transfer operation over a control plane; recovering the radio link for the user equipment through a target access node of the communication system, wherein the radio link recovery is enabled via a mobility management node of the communication system using a non-access stratum security context previously established between the user equipment and the mobility management node.

In a second aspect, the present disclosure provides an apparatus comprising: in a communication system, in response to a radio link failure between a user equipment and a source access node of the communication system during a data transfer operation over a control plane; a network node in the communication system configured to function as a mobility management entity, and further configured to enable recovering the radio link for the user equipment through a target access node of the communication system, wherein the radio link recovery is enabled via the mobility management entity using a non-access stratum security context previously established between the user equipment and the mobility management entity.

In a third aspect, the present disclosure provides a method comprising: in a communication system, in response to a radio link failure between a user equipment and a source access node of the communication system during a data transfer operation over a control plane; recovering the radio link for the user equipment through a target access node of the communication system, wherein the radio link recovery is initiated by the user equipment by sending a message to a mobility management node of the communication

system through the target access node using a non-access stratum security context previously established between the user equipment and the mobility management node.

In a fourth aspect, the present disclosure provides an apparatus comprising: in a communication system, in response to a radio link failure between a user equipment and a source access node of the communication system during a data transfer operation over a control plane; the user equipment configured to enable recovery of the radio link for the user equipment through a target access node of the communication system, wherein the radio link recovery is initiated by the user equipment by sending a message to a mobility management node of the communication system through the target access node using a non-access stratum security context previously established between the user equipment and the mobility management node.

In a fifth aspect, the present disclosure provides an article of manufacture comprising a non-transitory computer-readable storage medium having embodied therein executable program code that when executed by a processor causes the processor to perform the method according to the first aspect or the third aspect.

In one embodiment, a method comprises, in response to a radio link failure between given user equipment and a source access node of a communication system during a data transfer operation over a control plane, recovering the radio link for the given user equipment through a target access node of the communication system. The radio link recovery is enabled via a mobility management node of the communication system using a non-access stratum security context previously established between the given user equipment and the mobility management node.

In another embodiment, a method comprises, in response to a radio link failure between given user equipment and a source access node of a communication system during a data transfer operation over a control plane, recovering the radio link for the given user equipment through a target access node of the communication system. The radio link recovery is initiated by the given user equipment by sending a message to a mobility management node of the communication system through the target access node using a non-access stratum security context previously established between the given user equipment and the mobility management node.

Advantageously, in illustrative embodiments, secure radio link recovery is achieved with no new context set up to protect the link between the given user equipment and the target access node, only the non-access stratum security context between the given user equipment and the mobility management node and its related cryptographic keys are used. For the sake of key separation, new keys may be computed using existing non-access stratum security parameters or non-access stratum message counts either in the uplink or in the downlink.