Claims

What is claimed is:

1. A user equipment comprising:

at least one processor;

at least one memory including executable program code;

the at least one memory and the executable program code being configured to, with the at least one processor, cause the user equipment at least to:

determine a size of user data to be transmitted over a control plane from the user equipment to at least one network entity of a communication system;

in response to determining that the size of the user data to be transmitted is below at least a threshold for small data transport, generate a control plane message comprising the user data to be transmitted in a small data container over the control plane ; and

transmit the generated control plane message from the user equipment to the at least one network entity of the communication system.

2. The user equipment of claim 1, wherein the at least one memory and the executable program code are further configured to, with the at least one processor, cause the user equipment to, in response to determining that the size of the user data is above the threshold for small data transport and below a threshold for large data transport, generate a control plane message comprising the user data to be transmitted and specifying a large data container dedicated to transport of large user data over the control plane from the user equipment to at least one network entity of a communication system.

3. The user equipment of claim 1, wherein the at least one memory and the executable program code are configured to transmit the generated control plane message from the user equipment to the at least one network entity of the communication system for transmission of the user data via the at least one network entity to a data network .

4. The user equipment of claim 1, wherein the user equipment is part of an Internet of Things (IoT) device.

5. The user equipment of claim 1, wherein the user equipment is in an idle mode and the generated control plane message comprises a control plane service request message with a control plane service type set to indicate a user equipment-originating request.

6. The user equipment of claim 5, further comprising applying transport protection to one or more non-cleartext information elements of the generated control plane message, the transport protection comprising providing one or more non-cleartext information elements including the user data content of the data container in a separate Non-Access Stratum (NAS) message container, and applying ciphering to the value part of separate NAS message container utilizing a NAS security context of the user equipment.

7. The user equipment of claim 6, wherein the one or more information elements provided in the separate NAS message container comprise at least one of a payload container type information element, a payload container information element, a Protocol Data Unit (PDU) session identifier information element, a PDU session status information element, an uplink status information element, and a release assistance indication information element.

8. The user equipment of claim 1, wherein the user equipment is in a connected mode and the generated control plane message comprises an uplink Non-Access Stratum (NAS) data transport message.

9. The user equipment of claim 1, wherein generating the control plane message comprises generating a payload container type information element comprising:

a payload container information element identifier associated with the small data container;

an indication of a length of the user data to be transmitted;

a Protocol Data Unit (PDU) session identifier;

a release assistance indication specifying when the at least one network entity of the communication system should release a Non-Access Stratum (NAS) signaling connection for

transmission of the user data between the at least one network entity and the user equipment; and

the user data to be transmitted.

10. The user equipment of claim 9, wherein the release assistance indication comprises one of:

an indication that the NAS signaling connection should be released subsequent to uplink transmission of the user data in the generated control plane message; and

an indication that the NAS signaling connection should be released subsequent to uplink transmission of the user data in the generated control plane message and subsequent to a next downlink transmission to the user equipment.

11. The user equipment of claim 2, wherein generating the control plane message comprises:

generating a payload container information element of a first format in response to determining that the size of the user data to be transmitted is below the threshold for large data transport and above the threshold for small data transport; and

generating a payload container information element of a second format in response to determining that the size of the user data to be transmitted is below the threshold for large data transport and below the threshold for small data transport.

12. The user equipment of claim 11, wherein the payload container information element of the first format is a “CIoT user data container”, and wherein the payload container information element of the second format is a “CIoT small data container” information element.

13. The user equipment of claim 11, wherein the threshold for large data transport and the threshold for small data transport are defined in a Non-Access Stratum (NAS) management object (MO).

14. The user equipment of claim 11, wherein the payload container information element of the first format comprises one or more of the following:

a first octet comprising a payload container information element identifier associated with the large data container;

second and third octets comprising an indication of a length of the user data to be transmitted;

a fourth octet comprising a Protocol Data Unit (PDU) session identifier and a release assistance indication; and

a plurality of additional octets comprising the user data to be transmitted.

15. The user equipment of claim 11, wherein the payload container information element of the second format comprises:

a first octet comprising a payload container information element identifier associated with the small data container;

a second octet comprising an indication of a length of the user data to be transmitted;

a third octet comprising a Protocol Data Unit (PDU) session identifier and a release assistance indication; and

one or more additional octets comprising the user data to be transmitted.

16. The user equipment of claim 1, wherein the communication system comprises a 5G communication system and the data network comprises a Packet Data Network (PDN).

17. The user equipment of claim 16, wherein the at least one network entity of the communication system comprises an Access and Mobility Management Function (AMF) of the 5G communication system.

18. The user equipment of claim 1, wherein the threshold for small data transport is configured to have a value of 254 octets.

19. The user equipment of claim 1, wherein the at least one memory and the executable program code are further configured to, with the at least one processor, cause the user equipment to, in response to determining that the size of the user data to be transmitted is up to 254 octets, determine that the size of the user data to be transmitted is below the threshold for small data transport.

20. A method comprising:

determining a size of user data to be transmitted over a control plane from user equipment to at least one network entity of a communication system ;

in response to determining that the size of the user data to be transmitted is below at least a threshold for small data transport, generating a control plane message comprising the user data to be transmitted in a small data container over the control plane ; and

transmitting the generated control plane message from the user equipment to the at least one network entity of the communication system.

21. A computer program product comprising a non-transitory computer-readable storage medium having embodied therein executable program code that when executed by a processor operatively coupled to the computer-readable storage medium cause the processor to perform steps of:

determining a size of user data to be transmitted over a control plane from user equipment to at least one network entity of a communication system ;

in response to determining that the size of the user data to be transmitted is below at least a threshold for small data transport, generating a control plane message comprising the user data to be transmitted in a small data container over the control plane ; and

transmitting the generated control plane message from the user equipment to the at least one network entity of the communication system.