Summary

Embodiments described herein provide for updates to UE configuration parameters using Non-Access Stratum (NAS) messages. As an overview, mobile networks migrating to next generation networks may include a Unified Data Management (UDM) and an Access and Mobility Management Function (AMF). The UDM, which is in the home network of a UE, is configured to assemble a UE configuration parameter update for a UE with security protection (e.g., a secured packet, integrity protection, etc.). The UDM sends the UE configuration parameter update, with security protection, to the AMF. The AMF, in turn, is configured to transparently send the UE configuration parameter update to the UE using a NAS message. Again, the UE configuration parameter update is security protected in the NAS message. Upon receipt of the NAS message, the UE is configured to update its UE configuration parameters based on the update provided in the NAS message. One technical benefit of this procedure is that end-to-end security is provided for the UE configuration parameter update. Another technical benefit is that native control plane functionalities may be used to update UE configuration parameters. Thus, a dedicated network element does not need to be deployed to provide the updates for UEs.

One embodiment comprises an AMF element of a mobile network. The AMF element includes a processor(s), and memory including computer program code executable by the processor. The processor is configured to cause the AFM element to receive a control plane message from a UDM element including a UE configuration parameter update for a UE. The UE configuration parameter update is security protected according to a protection mechanism. The processor is further configured to cause the AFM element to insert the UE configuration parameter update that is security protected in a container of a first NAS message, where the container is designated for the UE configuration parameter update. The processor is further configured to cause the AFM element to send the first NAS message to the UE with the container including the UE configuration parameter update that is security protected.

In an aspect, there is a User Equipment (UE) comprising:

a Universal Subscriber Identity Module (USIM);

at least one processor; and

at least one memory including computer program code;

wherein the UICC stores UE configuration parameters for the UE, the at least one memory and the computer program code being configured to, with the at least one processor, cause the UE at least to:

receive, from an Access and Mobility Management Function (AMF) element, a first Non-Access Stratum (NAS) message having a container that includes a UE configuration parameter update for the UE, the UE configuration parameter update including a UE parameter being encapsulated in a secured packet according to a protection mechanism, the UE parameter encapsulated in the secured packet comprising a routing indicator parameter;

perform a first security check to verify the UE configuration parameter update; and

if the first security check is successful, forward the secured packet to the USIM, wherein the USIM is operable to perform a second security check to verify the secured packet, and if the second security check is successful, to update one or more of the UE configuration parameters in the USIM based on the UE parameter encapsulated in the security packet.

In an aspect, there is a method comprising:

receiving, at a user equipment (UE), from an Access and Mobility Management Function (AMF) element, a first Non-Access Stratum (NAS) message having a container that includes a UE configuration parameter update for the UE, the UE configuration parameter update including a UE parameter being encapsulated in a secured packet according to a protection mechanism, the UE parameter encapsulated in the secured packet comprising a routing indicator parameter;

performing a first security check to verify the UE configuration parameter update; and

if the first security check is successful, forwarding the secured packet to a Universal Subscriber Identify Module (USIM) in operable communication with the UE, wherein the USIM is operable to perform a second security check to verify the secured packet, and if the second security check is successful, to update one or more of the UE configuration parameters in the USIM based on the UE parameter encapsulated in the security packet.

In an aspect, there is Access and Mobility Management Function (AMF) element comprising:

at least one processor; and

at least one memory including computer program code, the at least one memory and the computer program code being configured, with the at least one processor, to cause the AMF element at least to:

generate a first Non-Access Stratum (NAS) message having a container that includes a UE configuration parameter update for the UE, the UE configuration parameter update including a UE parameter being encapsulated in a secured packet according to a protection mechanism, the UE parameter encapsulated in the secured packet comprising a routing indicator parameter; and

transmit the first NAS message towards a User Equipment (UE), wherein the first NAS message is operable to (i) cause the UE to perform a first security check to verify the UE configuration parameter update, (ii) if the first security check is successful, to cause the UE to forward the secured packet to a Universal Subscriber Identify Module (USIM) in operable communication with the UE, (iii) cause the USIM to perform a second security check to verify the secured packet, and (iv) if the second security check is successful, to update one or more of the UE configuration parameters in the USIM based on the UE parameter encapsulated in the security packet.

In an aspect, there is a method comprising:

generating a first Non-Access Stratum (NAS) message having a container that includes a UE configuration parameter update for the UE, the UE configuration parameter update including a UE parameter being encapsulated in a secured packet, the UE parameter encapsulated in the secured packet comprising a routing indicator parameter; and

transmitting the first NAS message towards a User Equipment (UE), wherein the first NAS message is operable to (i) cause the UE to perform a first security check to verify the UE configuration parameter update, (ii) if the first security check is successful, to cause the UE to forward the secured packet to a Universal Subscriber Identify Module (USIM) in operable communication with the UE, (iii) cause the USIM to perform a second security check to verify the secured packet, and (iv) if the second security check is successful, to update one or more of the UE configuration parameters in the USIM based on the UE parameter encapsulated in the security packet.

In another embodiment, the UE configuration parameter update is encapsulated in a secured packet according to the protection mechanism.

In another embodiment, the UE configuration parameter update is integrity protected using a NAS security context of the UE according to the protection mechanism.

~~In another embodiment, the UE configuration parameter update is encapsulated in a secured packet, and the secured packet is integrity protected using a NAS security context of the UE according to the protection mechanism.~~

~~In another embodiment, the first NAS message comprises a NAS registration accept message sent to the UE during a NAS registration procedure. The processor is further configured to cause the AMF element to receive a second NAS message from the UE during the NAS registration procedure with a container including a UE acknowledgement that the UE configuration parameter update was received, and send another control plane message to the UDM element with the UE acknowledgement. The second NAS message received from the UE may comprise a NAS registration complete message or an Uplink NAS Transport message.~~

~~In another embodiment, the first NAS message comprises a Downlink NAS Transport message of a NAS transport procedure performed after a NAS registration procedure. The processor is further configured to cause the AMF element to receive a second NAS message from the UE with a container including a UE acknowledgement from the UE that the UE configuration parameter update was received, and send another control~~

Claims

What is claimed is:

1. User Equipment (UE) comprising:

a Universal Subscriber Identity Module (USIM);

at least one processor; and

at least one memory including computer program code;

wherein the UICC stores UE configuration parameters for the UE, the at least one memory and the computer program code being configured to, with the at least one processor, cause the UE at least to:

receive, from an Access and Mobility Management Function (AMF) element, a first Non-Access Stratum (NAS) message having a container that includes a UE configuration parameter update for the UE, the UE configuration parameter update including a UE parameter being encapsulated in a secured packet according to a protection mechanism, the UE parameter encapsulated in the secured packet comprising a routing indicator parameter;

perform a first security check to verify the UE configuration parameter update; and

if the first security check is successful, forward the secured packet to the USIM, wherein the USIM is operable to perform a second security check to verify the secured packet, and if the second security check is successful, to update one or more of the UE configuration parameters in the USIM based on the UE parameter encapsulated in the security packet.

~~2. The UE of claim 1, wherein:~~

~~the UE parameter encapsulated in the secured packet is a routing indicator parameter.~~

~~3.~~2. The UE of claim 1, wherein:

the first security check verifies the integrity of the UE configuration parameter update using a NAS security context of the UE.

~~4.~~3. The UE of claim 1, wherein:

the USIM resides on a Universal Integrated Circuit Board (UICC) within the UE.

~~5.~~4. The UE of claim 1, wherein:

the first NAS message comprises a NAS registration accept message sent to the UE during a NAS registration procedure.

~~6.~~5. The UE of claim ~~5~~4, wherein:

when the NAS registration accept message includes a UE acknowledgement indicator, the processor is further configured to cause the UE to send a second NAS message to the AMP element with a container including a UE acknowledgement from the UE that the UE configuration parameter update was received;

wherein the second NAS message comprises a NAS registration complete message or an Uplink NAS Transport message.

~~7.~~6. The UE of claim 1, wherein:

the first NAS message comprises a Downlink NAS Transport message of a NAS transport procedure.

~~8.~~7. The UE of claim ~~7~~6, wherein:

when the Downlink NAS Transport message includes a UE acknowledgement indicator, the processor is further configured to cause the UE to send an Uplink NAS Transport message to the AMP element with a container including a UE acknowledgement from the UE that the UE configuration parameter update was received.

~~9.~~8. The UE of claim 1, wherein:

when the first NAS message includes a re-registration indicator, the processor is further configured to cause the UE to initiate a NAS registration procedure to re-register using the updated UE configuration parameters.

~~10.~~9. A method comprising:

receiving, at a user equipment (UE), from an Access and Mobility Management Function (AMF) element, a first Non-Access Stratum (NAS) message having a container that includes a UE configuration parameter update for the UE, the UE configuration parameter update including a UE parameter being encapsulated in a secured packet according to a protection mechanism, the UE parameter encapsulated in the secured packet comprising a routing indicator parameter;

performing a first security check to verify the UE configuration parameter update; and

if the first security check is successful, forwarding the secured packet to a Universal Subscriber Identify Module (USIM) in operable communication with the UE, wherein the USIM is operable to perform a second security check to verify the secured packet, and if the second security check is successful, to update one or more of the UE configuration parameters in the USIM based on the UE parameter encapsulated in the security packet.

~~11. The method of claim 10, wherein the UE parameter encapsulated in the secured packet is a routing indicator parameter.~~

~~12.~~10. The method of claim ~~10~~9, wherein the first security check verifies the integrity of the UE configuration parameter update using a NAS security context of the UE.

~~13.~~11. The method of claim ~~10~~9, wherein the USIM resides on a Universal Integrated Circuit Board (UICC) within the UE.

~~14.~~12. The method of claim ~~10~~9, wherein the first NAS message comprises a NAS registration accept message sent to the UE during a NAS registration procedure.

~~15.~~13. The method of claim ~~14~~12, wherein, when the NAS registration accept message includes a UE acknowledgement indicator, the method further comprises:

causing the UE to send a second NAS message to the AMF element with a container including a UE acknowledgement from the UE that the UE configuration parameter

update was received, wherein the second NAS message comprises a NAS registration complete message or an Uplink NAS Transport message.

~~16.~~14. The method of claim ~~10~~9, wherein the first NAS message comprises a Downlink NAS Transport message of a NAS transport procedure.

~~17.~~15. The method of claim ~~16~~14, wherein, when the Downlink NAS Transport message includes a UE acknowledgement indicator, the method further comprises:

causing the UE to send an Uplink NAS Transport message to the AMF element with a container including a UE acknowledgement from the UE that the UE configuration parameter update was received.

~~18.~~16. The method of claim ~~10~~9, wherein, when the first NAS message includes a re-registration indicator, the method further comprises:

causing the UE to initiate a NAS registration procedure to re-register using the updated UE configuration parameters.

~~19.~~17. An Access and Mobility Management Function (AMF) element

comprising: at least one processor; and

at least one memory including computer program code, the at least one memory and the computer program code being configured, with the at least one processor, to cause the AMF element at least to:

generate a first Non-Access Stratum (NAS) message having a container that includes a UE configuration parameter update for the UE, the UE configuration parameter update including a UE parameter being encapsulated in a secured packet according to a protection mechanism, the UE parameter encapsulated in the secured packet comprising a routing indicator parameter; and

transmit the first NAS message towards a User Equipment (UE), wherein the first NAS message is operable to (i) cause the UE to perform a first security check to verify the UE configuration parameter update, (ii) if the first security check is successful, to cause the UE to forward the secured packet to a Universal Subscriber Identify Module (USIM) in

operable communication with the UE, (iii) cause the USIM to perform a second security check to verify the secured packet, and (iv) if the second security check is successful, to update one or more of the UE configuration parameters in the USIM based on the UE parameter encapsulated in the security packet.

~~20.~~18. The AMF element of claim ~~19~~17, wherein the UE parameter encapsulated in the secured packet is a routing indicator parameter.

~~21.~~19. The AMF element of claim ~~19~~17, wherein the first security check is operable to verify the integrity of the UE configuration parameter update using a NAS security context of the UE.

~~22.~~20. The AMF element of claim ~~19~~17, wherein the first NAS message comprises a NAS registration accept message sent to the UE during a NAS registration procedure.

~~23.~~21. The AMF element of claim ~~22~~20, wherein, when the NAS registration accept message includes a UE acknowledgement indicator, the NAS registration accept message is further operable to cause the UE to send a second NAS message to the AMF element with a container including a UE acknowledgement from the UE that the UE configuration parameter update was received;

wherein the second NAS message comprises a NAS registration complete message or an Uplink NAS Transport message.

~~24.~~22. The AMF element of claim ~~19~~17, wherein the first NAS message comprises a Downlink NAS Transport message of a NAS transport procedure.

~~25.~~23. The AMF element of claim ~~24~~22, wherein, when the Downlink NAS Transport message includes a UE acknowledgement indicator, the first NAS message is further operable to cause the UE to send an Uplink NAS Transport message to the AMF element with a container including a UE acknowledgement from the UE that the UE configuration parameter update was received.

~~26.~~24. The AMF element of claim ~~19~~17, wherein, when the first NAS message includes a re-registration indicator, the first NAS message is further operable to cause the UE to initiate a NAS registration procedure to re-register using the updated UE configuration parameters.

~~27.~~25. The AMF element of claim ~~19~~17, wherein the at least one memory and the computer program code being configured, with the at least one processor, to cause the AMF element at least to:

receive a control plane message from a Unified Data Management (UDM) element including the UE configuration parameter update for the UE; and

insert the UE configuration parameter update into the container of the first NAS message.

~~28.~~26. The AMF element of claim ~~27~~25, wherein the at least one memory and the computer program code being configured, with the at least one processor, to cause the AMF element at least to:

receive the second NAS message from the UE during the NAS registration procedure with a container including a UE acknowledgement that the UE configuration parameter update was received; and

send another control plane message to the UDM element with the UE acknowledgement, wherein the second NAS message received from the UE comprises a NAS registration complete message or an Uplink NAS Transport message.

~~29.~~27. A method comprising:

generating a first Non-Access Stratum (NAS) message having a container that includes a UE configuration parameter update for the UE, the UE configuration parameter update including a UE parameter being encapsulated in a secured packet, the UE parameter encapsulated in the secured packet comprising a routing indicator parameter; and

transmitting the first NAS message towards a User Equipment (UE), wherein the first NAS message is operable to (i) cause the UE to perform a first security check to verify the UE configuration parameter update, (ii) if the first security check is successful, to cause

the UE to forward the secured packet to a Universal Subscriber Identify Module (USIM) in operable communication with the UE, (iii) cause the USIM to perform a second security check to verify the secured packet, and (iv) if the second security check is successful, to update one or more of the UE configuration parameters in the USIM based on the UE parameter encapsulated in the security packet.

~~30.~~28. The method of claim ~~29~~27, wherein the UE parameter encapsulated in the secured packet is a routing indicator parameter.

~~31.~~29. The method of claim ~~29~~27, wherein the first security check verifies the integrity of the UE configuration parameter update using a NAS security context of the UE.

~~32.~~30. The method of claim ~~29~~27, wherein the first NAS message comprises a NAS registration accept message sent to the UE during a NAS registration procedure.

~~33.~~31. The method of claim ~~32~~30, wherein, when the NAS registration accept message includes a UE acknowledgement indicator, the method further comprises:

causing the UE to send a second NAS message to the AMF element with a container including a UE acknowledgement from the UE that the UE configuration parameter update was received, wherein the second NAS message comprises a NAS registration complete message or an Uplink NAS Transport message.

~~34.~~32. The method of claim ~~29~~27, wherein the first NAS message comprises a Downlink NAS Transport message of a NAS transport procedure.

~~35.~~33. The method of claim ~~34~~32, wherein, when the Downlink NAS Transport message includes a UE acknowledgement indicator, the method further comprises:

causing the UE to send an Uplink NAS Transport message to the AMF element with a container including a UE acknowledgement from the UE that the UE configuration parameter update was received.

~~36.~~34. The method of claim ~~29~~27, wherein, when the first NAS message includes a re-registration indicator, the method further comprises:

causing the UE to initiate a NAS registration procedure to re-register using the updated UE configuration parameters.

~~37.~~35. The method of claim ~~29~~27, further comprising:

receiving a control plane message from a Unified Data Management (UDM) element including the UE configuration parameter update for the UE; and

inserting the UE configuration parameter update into the container of the first NAS message.

~~38.~~36. The method of claim ~~37~~35, further comprising:

receiving the second NAS message from the UE during the NAS registration procedure with a container including a UE acknowledgement that the UE configuration parameter update was received; and

sending another control plane message to the UDM element with the UE acknowledgement, wherein the second NAS message received from the UE comprises a NAS registration complete message or an Uplink NAS Transport message.