

CLAIMS

1. A universal integrated circuit card (UICC) for controlling radio communications via a radio communications network to and from a host device in which the UICC is installed in use, the UICC comprising:
 - 5 a microprocessor for controlling the operation of the UICC;
 - a data store for storing data relating to the operation of the UICC, the data store comprising:
 - a plurality of mobile operator network profiles including:
 - an operational profile comprising radio communications network settings for connecting the host device to a first radio communications network; and
 - 10 a bootstrap profile comprising radio communications network settings for connecting the host device to a second radio communications network; and
 - a program comprising a plurality of instructions for configuring operation of the UICC;
 - wherein, in use, the microprocessor is configured by the program to:
 - use the operational profile to connect the host device to the first radio
 - 15 communications network;
 - detect a loss of operational connectivity with the first radio communications network;
 - and
 - use the bootstrap profile to connect the host device to the second radio
 - communications network to re-establish radio communications to and from the host
 - 20 device.
2. The UICC of Claim 1, wherein the UICC is an embedded UICC (eUICC) which enables the program and profiles to be configured and/or updated remotely.
- 25 3. The UICC of Claim 1 or 2, wherein the program comprises an applet having a relatively small size and dedicated functionality.
4. The UICC of any preceding claim, wherein the data store is provided in a secure transversal domain of the UICC and the operational profile or the bootstrap profile is able to securely provide
 - 30 access to the secure transversal domain of the UICC to allow an external server to make changes to the program stored therein.
5. The UICC of any preceding claim, further comprising a set of variable parameters stored as files in the data store for configuring the operational and bootstrap profiles and their use in controlling
 - 35 radio communications via the radio communications network to and from the host device.
6. The UICC of any preceding claim, wherein the program comprises instructions for configuring the microprocessor in use to:
 - perform a first radio communications network connectivity test to test the radio
 - 40 communications network connectivity between the host device and the first radio communications network and return a first connectivity test result based on the radio communications network connectivity test;
 - determine, based on the first connectivity test result, if a loss of radio communications network connectivity has occurred between the host device and the first radio communications
 - 45 network; and
 - if such a loss of connection has been determined, deselect the operational profile and select the bootstrap profile and use the bootstrap profile to connect to the second radio communications network based on the network settings of the bootstrap profile in order to re-establish radio
 - communications network connectivity to the host device.
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7. The UICC of any preceding claim, wherein the program comprises instructions for configuring the microprocessor in use to:
 - start a cancellation timer, for a predetermined time period when a loss of connection on the
 - first network has been detected;
 - 55 deselect the bootstrap profile and re-select the operational profile once the cancellation timer is completed, and use the operational profile to re-connect to the first radio communications network in order to re-establish radio communications network connectivity between the host device and the first radio communications network.

8. The UICC of any preceding claim, wherein the program comprises instructions for configuring the microprocessor in use to:

perform, following use of the bootstrap profile to connect the host device to the second radio communications network, a second radio communications network connectivity test to test the radio communications network connectivity between the host device and the second radio communications network; and return a second connectivity test result based on the radio communications network connectivity test;

determine, based on the second connectivity test result, if a loss of radio communications network connectivity has occurred between the host device and the second radio communications network; and

if such a loss of connection has been determined, to deselect the bootstrap profile and re-select the operational profile and use the operational profile to connect to the first radio communications network based on the network settings of the operational profile in order to re-establish radio communications network connectivity to the host device.

9. The UICC of Claim 7 or 8, wherein the program comprises instructions for configuring the microprocessor in use to:

determine a time slot for using the re-selected operational profile; and

delay the disconnection from the second radio communications network and use of the re-selected operational profile to connect to the first radio communications network until the time slot is reached.

10. The UICC of Claim 9, wherein the time slot is determined using a random number or a digit taken from an ICCID, IMEI, or MISDIN associated with the UICC or host device.

11. The UICC of any of Claims 8 to 10, wherein the program comprises instructions for configuring the microprocessor, in use, to perform the first or the second radio communications network connectivity test by testing the radio communications network connectivity between the host device and one or more test servers within the radio communications network being tested.

12. The UICC of Claim 11, wherein the program comprises instructions for configuring the microprocessor in use to perform the first or second radio communications network connectivity test by performing a ping test, wherein the ping test comprises:

sending, to a test server of the one or more test servers, a forward data packet;

determining whether a response data packet is received from the test server; and

returning a negative first or second radio communications network connectivity test result if the response data packet is not received from the test server within a predetermined time period from sending the forward data packet.

13. The UICC of Claim 11, wherein the program comprises instructions for configuring the microprocessor in use to perform the first or second radio communications network connectivity test by performing a ping sequence test, wherein the ping sequence test comprises:

sending, to a first test server of the one or more test servers, a first forward data packet;

determining whether a first response data packet is received from the first test server within a first predetermined time period;

sending, to a second test server of the one or more test servers, a second forward data packet, if it is determined that the first response data packet is not received within the first predetermined time period;

determining whether a second response data packet is received from the second test server within a second predetermined time period;

sending, to a third test server of the one or more test servers, a third forward data packet, if it is determined that the second response data packet is not received within the second predetermined time period;

determining whether the third response data packet is received from the third test server within a third predetermined time period;

returning a negative ping sequence test result if it is determined that the third response data packet is not received within the third predetermined time period;

returning a negative first or second radio communications network connectivity test result if the negative sequence ping result is returned.

14. The UICC of Claim 13, wherein the program comprises instructions for configuring the microprocessor in use to perform the first or second radio communications network connectivity test by repeating the ping sequence test one or more times; and wherein the negative radio communications network connectivity test result is returned only if the number of consecutive negative ping sequence test results exceeds a predetermined threshold.
15. The UICC of Claim 11, wherein the program comprises instructions for configuring the microprocessor in use to perform the first or second radio communications network connectivity test by performing a data test, wherein the data test comprises:
 sending, to a test sever, a predetermined amount of data;
 determining whether the predetermined amount of data has been delivered to the test server;
 and
 returning a negative first or second radio communications network connectivity test result in the event that the predetermined amount of data has not been delivered to the test server.
16. The UICC of Claim 11, wherein the program comprises instructions for configuring the microprocessor in use to perform the first or second radio communications network connectivity test by performing a network layer test, wherein the network layer test comprises: testing different network layers of the first or second radio communications network.
17. The UICC of any preceding claim, wherein
 the data store comprises a roaming profile comprising radio communications network settings for connecting the host device to a roaming radio communications network; and
 the program comprises instructions for configuring the microprocessor in use, after detecting the loss of operational connectivity with the first communications network, to use the roaming profile to connect the host device to the roaming radio communications network based on the network settings of the roaming profile in order to re-establish radio communications to and from the host device.
18. The UICC of any preceding claim, wherein
 the data store comprises a plurality of radio network profiles, each comprising radio communications network settings for connecting the host device to a respective radio communications network; and
 the UICC is configured to enable remote selection of the operational profile and the bootstrap profile from the plurality of profiles.
19. The UICC of any of Claim 1 to 17, wherein
 the data store comprises a plurality of radio network profiles, each comprising radio communications network settings for connecting the host device to a respective radio communications network; and
 the UICC is configured to enable local user selection of the operational profile and the bootstrap profile from the plurality of profiles.
20. The UICC of Claim 18 or 19, wherein each radio network profile in the plurality of radio network profiles is associated with a different independent radio communications network.
21. The UICC of Claim 18 or 19, wherein each network profile in the plurality of network profiles is associated with an independent radio communications network platform or a different instance of the same radio communications network platform.
22. The UICC of any preceding claim, wherein the UICC comprises an eUICC, a Mini SIM, a Micro SIM, a Nano SIM or a Solderable SIM.
23. A host device comprising a processor having a memory, a radio module for connecting the host device to a radio communications network, and the universal integrated circuit device of any of Claims 1 to 21.

24. The host device of Claim 23, wherein the host device comprises an alarm device, a smart phone, a tablet computer, a dongle, a router, a GPS tracking device, an M2M device, an IoT device, a vehicle, a telehealth device or a telecare device.

25. A method of operating a universal integrated circuit card (UICC) for controlling radio communications via a radio communications network to and from a host device in which the UICC is installed in use, the method comprising:
- providing access to data relating to the operation of the UICC stored in a data store of the UICC, the data including a plurality of mobile operator network profiles including:
 - an operational profile comprising radio communications network settings for
 - connecting the host device to a first radio communications network; and
 - a bootstrap profile comprising radio communications network settings for connecting the host device to a second radio communications network; and
 - controlling the operation of the UICC using a microprocessor of the UICC and a program comprising a plurality of instructions for configuring operation of the UICC; the controlling step comprising:
 - connecting the host device to the first radio communications network using the operational profile,
 - detecting a loss of operational connectivity with the first radio communications network; and
 - connecting the host device to the second radio communications network using the bootstrap profile, to re-establish radio communications to and from the host device.

26. A computer program product or a computer-readable storage medium comprising instructions which, when executed by a computer, cause the computer to perform the method of Claim 25.

27. A computer-implemented method of re-establishing a radio communications network connection between a host device and a network platform providing the radio communications network connection, wherein the host device includes a universal integrated circuit card (UICC) having a mobile operator network profile for controlling the radio communications network connection, the method comprising:
- receiving, from the UICC via the radio communications network connection, a first data packet;
 - receiving, from the UICC via the radio communications network connection, a second data packet;
 - determining first time data indicative of the amount of time elapsed between receipt of the first data packet and receipt of the second data packet;
 - comparing the first time data to a predetermined time threshold;
 - transmitting a reset request from the radio communications network platform to reset the radio communications network connection to the host device, if the first time data is greater than the predetermined time threshold.
28. The computer-implemented method of Claim 27, further comprising:
- initiating a reset timer after the comparing step, if the first time data is greater than the predetermined time threshold; and
 - comparing a value of the reset timer to a predetermined reset timer threshold;
 - wherein the transmitting step is delayed until the value of the reset timer is greater than predetermined reset timer threshold.

29. The computer-implemented method of Claim 27 or 28, wherein the predetermined reset timer threshold is configurable to different time periods.