CLAIMS

1. A universal integrated circuit card (UICC) for controlling radio communications via a radio communications network (312, 320, 412) to and from a host device (402) in which the UICC is installed in use, the UICC comprising:

a microprocessor (434) provided within the UICC for controlling the operation of the UICC;

a data store (436) provided within the UICC for storing data relating to the operation of the UICC, the data store (436) comprising:

a plurality of mobile operator network profiles including:

an operational profile (440) comprising radio communications network settings for connecting the host device (402) to a first radio communications network (312, 412); and

a bootstrap profile (442) comprising radio communications network settings for connecting the host device (402) to a second radio communications network (320, 412); and

a program operating on the microprocessor (434), the program comprising a plurality of instructions for configuring operation of the UICC;

wherein, in use, the microprocessor (434) is configured by the program to:

use the operational profile (440) to connect the host device (402) to the first radio communications network (312, 412);

perform a first radio communications network connectivity test to test the radio communications network connectivity between the host device (402) and the first radio communications network (312, 412) established by the program using the operational profile (440) and return a first connectivity test result based on the radio communications network connectivity test;

determine (704, 706), 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 network (312, 412); and

if such a loss of connection has been determined, deselect (900) the operational profile (440) and select the bootstrap profile (442) and use the bootstrap profile (442) to connect to the second radio communications network (320, 412) based on the network settings of the bootstrap profile (442) in order to re-establish radio communications network connectivity to and from the host device (402).

2. The UICC of Claim 1, wherein the UICC is an embedded UICC (eUICC) (410) which enables the program and profiles to be configured and/or updated remotely.

3. The UICC of Claim 1 or 2, wherein the program comprises an applet (438) having a relatively small size and dedicated functionality.

4. The UICC of any preceding claim, wherein the data store (436) is provided in a secure transversal domain (436) of the UICC and the operational profile (440) or the bootstrap profile (442) is able to securely provide access to the secure transversal domain (436) of the UICC to allow an external server (414) 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 (436) for configuring the operational (440) and bootstrap profiles (443) and their use in controlling radio communications via the radio communications network to and from the host device (402).

6. The UICC of any preceding claim, wherein the program comprises instructions for configuring the microprocessor (434) in use to:

start a cancellation timer, for a predetermined time period when a loss of connection on the first network has been detected;

deselect the bootstrap profile (440) and re-select the operational profile (440) once the cancellation timer is completed and use the operational profile (440) to re-connect to the first radio communications network in order to re-establish radio communications network connectivity between the host device (402) and the first radio communications network.

7. The UICC of any preceding claim, wherein the program comprises instructions for configuring the microprocessor (434) in use to:

perform, following use of the bootstrap profile (442) to connect the host device (402) to the second radio communications network, a second radio communications network connectivity test to test the radio communications network connectivity between the host device (402) 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 (442) 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 (402).

8. The UICC of Claim 6 or 7, wherein the program comprises instructions for configuring the microprocessor (434) in use to:

determine a time slot for using the re-selected operational profile (440); and

delay the disconnection from the second radio communications network and use of the re-selected operational profile (440) to connect to the first radio communications network until the time slot is reached.

9. The UICC of Claim 8, 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 (402).

10. The UICC of any of Claims 7 to 9, wherein the program comprises instructions for configuring the microprocessor (434), 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 (402) and one or more test servers within the radio communications network being tested.

11. The UICC of Claim 10, wherein the program comprises instructions for configuring the microprocessor (434) 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.

12. The UICC of Claim 10, wherein the program comprises instructions for configuring the microprocessor (434) 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 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.

13. The UICC of Claim 12, wherein the program comprises instructions for configuring the microprocessor (434) 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.

14. The UICC of Claim 10, wherein the program comprises instructions for configuring the microprocessor (434) 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.

15. The UICC of Claim 10, wherein the program comprises instructions for configuring the microprocessor (434) 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.

16. The UICC of any preceding claim, wherein

the data store (436) comprises a roaming profile comprising radio communications network settings for connecting the host device (402) to a roaming radio communications network; and

the program comprises instructions for configuring the microprocessor (434) in use, after detecting the loss of operational connectivity with the first communications network, to use the roaming profile to connect the host device (402) 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.

17. The UICC of any preceding claim, wherein

the data store (436) 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 (440) and the bootstrap profile (442) from the plurality of profiles.

18. The UICC of any of Claim 1 to 16, wherein

the data store (436) comprises a plurality of radio network profiles, each comprising radio communications network settings for connecting the host device (402) to a respective radio communications network; and

the UICC is configured to enable local user selection of the operational profile (440) and the bootstrap profile (442) from the plurality of profiles.

19. The UICC of Claim 17 or 18, wherein each radio network profile (440, 442) in the plurality of radio network profiles is associated with a different independent radio communications network.

20. The UICC of Claim 17 or 18, wherein each network profile (440, 442) 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.

21. The UICC of any preceding claim, wherein the UICC comprises an eUICC (410), a Mini SIM, a Micro SIM, a Nano SIM or a Solderable SIM.

22. A host device (402) comprising a processor having a memory, a radio module (406) for connecting the host device to a radio communications network, and the universal integrated circuit device of any of Claims 1 to 20.

23. The host device (402) of Claim 22, wherein the host device (402) comprises an alarm device (402), 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.

24. 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 (402) 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 (436) within the UICC, the data including a plurality of mobile operator network profiles including:

an operational profile (440) comprising radio communications network settings for connecting the host device (402) to a first radio communications network; and

a bootstrap profile (442) comprising radio communications network settings for connecting the host device (402) to a second radio communications network; and

controlling the operation of the UICC using a microprocessor (434) within the UICC and a program operating on the microprocessor (434), the program comprising a plurality of instructions for configuring operation of the UICC; the controlling step comprising:

connecting the host device (402) to the first radio communications network using the operational profile (440),

performing a first radio communications network connectivity test to test the radio communications network connectivity between the host device (402) and the first radio communications network (312, 412) established by the program using the operational profile (440) and returning a first connectivity test result based on the radio communications network connectivity test;

determining (704, 706), 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 network (312, 412); and

if such a loss of connection has been determined, deselecting (900) the operational profile (440) and selecting the bootstrap profile (442) and using the bootstrap profile (442) to connect to the second radio communications network (320, 412) based on the network settings of the bootstrap profile (442) in order to re-establish radio communications network connectivity to and from the host device (402).

25. 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 24.