DIMENSION 4 BOOT PROCESS OVERVIEW (versions 1.0.2 and above)

LED	Boot Process Step	Failure Modes

BOOT (FIRMWARE)

1. Obtaining an IP address

(a) The sensor loads the firmware from non-volatile memory.

(b) The firmware reads the sensor's network configuration from non-volatile memory, and decides whether to obtain its IP using DHCP or to use statically-assigned IP settings.

(c) The firmware performs DHCP if required.

DHCP Error ● ● ● ●

(d) The firmware sends ARP probes and announcements in accordance with RFC-5227. If the firmware detects an IP address conflict at any point (e.g. by receiving a conflicting ARP probe) then it will reboot. If a CNC is set for the sensor, it will stay in Pending validation state.

IP address conflict ● ● ● ●

2. Firmware search for the Configuration Server

(a) The firmware reads the search order from non-volatile memory. If the search order has not been configured or has been marked as invalid then a default search order is used.

(b) For each search method, the firmware tries to contact the configuration server, performing needed DNS requests. If the firmware receives a valid response, it goes to the next step, marking the network configuration as valid.

Configuration server timeout ● ● ● ●

3. Obtaining boot configuration and software files

(a) The firmware reads the boot configuration server's address from the configuration server's response.

No boot configuration server registered ● ● ● ●

(b) The firmware sends a request to the boot configuration server, which replies with the version of the software to run, and the address of a boot file server to obtain the software from. If the boot configuration server has the **boot** trace enabled, it will report **Sensor <MAC> requested configuration...** Currently the boot configuration server will always send its own address in response to the configuration request, because the boot configuration server also serves as the single boot file server for the system.

Boot configuration server timeout ● ● ● ●
Boot configuration invalid ● ● ● ●

(c) If the correct version of the software is already "flashed" into non-volatile memory, the firmware loads it.

(d) Otherwise the firmware requests the software from the boot file server. If the boot file server has the **boot** trace enabled, it will report messages of the form **Sensor <MAC> requested …** and then **Sensor <MAC> completed request …** if the download is successful.

Kernel download timeout ● ● ● ●
File system download timeout ● ● ● ●

BOOT (SOFTWARE)

4. Starting the software and software networking

(a) The firmware runs the software, telling it whether to use DHCP or the existing static IP information.

(b) The software performs DHCP if requested and if so it also sends ARP probes and ARP announcements in accordance with RFC-5227. N.B. If the sensor is using static IP, then no ARP probes or announcements are needed because the IP settings have not changed.

LED	Boot Process Step	Failure Modes

5. Software configuration

(a) The software performs a search for the Configuration Server in the same way as the firmware does. It should not time out because it is repeating the task that succeeded when run from firmware

Configuration server timeout (no LED sequence)

(b) The software reads the address of the location system configuration server from the Core Server's response, and then registers its MAC address, IP address and the location system parameters it needs to run.

Various errors listed in software fatal errors section

(c) The appropriate cellular location system configuration distribution server responds to the sensor with the required location system parameters, including the IP address of the cellular location sink service to send status and location information to.

6. Firmware/software/network configuration

(a) The software checks if various diagnostic parameters have been written to the sensor's non-volatile memory. If not, then the sensor calculates these, writes them to the non-volatile memory and reboots.

(b) The software checks if there are any pending firmware upgrades. If so, the sensor requests its boot configuration from boot configuration server and verifies that the requested version of firmware is available. The sensor then downloads the firmware from the boot file server, writes it to the non-volatile memory and reboots.

(c) The sensor performs the same checks as above with the software.

(d) The software checks if there are any pending changes to the sensor's network configuration. If so, the sensor writes the updated network configuration to the non-volatile memory and reboots.

7. Sensor hardware and timing initialisation

(a) The software starts to send periodic status updates. At this stage its status appears as **Initializing**.

(b) The software initialises the rest of the hardware, and waits until it gets a stable timing signal, or until it is generating a stable timing signal if it is a timing source.

(c) The sensor's status is now **Running**. If the **sensor_init** trace is enabled, the sensor will report **Initialisation complete**.

(d) The sensor starts to send measurements to the relevant effective master sensor for each tag, and it sends calculated locations back to the appropriate cellular location sink server.

(e) If the sensor's timing signal subsequently becomes unstable or disappears then its status will be set to **No Timing Signal**, and the LED will go back to the green-orange flashing state.

INITIALISATION (NO TIMING SIGNAL)

RUNNING

FIRMWARE FATAL ERRORS

The firmware stage of the boot sequence can produce a number of fatal errors. When the firmware detects an error, it does not send any trace message, but it flashes its LED in an error sequence:

1. The red LED is lit for about three seconds
2. There is a pause with the LEDs off
3. An error code of four LED colours is emitted, repeated six times with pauses in between
4. The sensor reboots.

The following table lists the meaning of the codes:

Code	LEDs	Meaning
RORO	●●●●	**DHCP Error** There was an error performing DHCP.
RORG	●●●●	**Configuration server timeout** The sensor cannot find the Ubisense configuration server.
ROGR	●●●●	**No boot configuration server registered** There is no configuration parameter '_ls_boot_cfg_server' which is automatically added by the boot configuration server.
ROGO	●●●●	**Boot configuration server timeout** The sensor failed to retrieve its boot configuration from the boot configuration server.
RGRO	●●●●	**Boot configuration invalid** The sensor could not understand the response from the boot configuration server.
RGRG	●●●●	**Kernel download timeout** The sensor failed to retrieve the kernel from the boot server given in the boot configuration.
RGOR	●●●●	**File system download timeout** The sensor failed to retrieve the file system from the boot server given in the boot configuration.
RGOG	●●●●	**IP conflict** The sensor detected an IP address conflict and has rebooted.
OROR	●●●●	Internal error #1
OROG	●●●●	Internal error #2
ORGR	●●●●	Internal error #3
ORGO	●●●●	Internal error #4
OGRO	●●●●	Internal error #5
OGRG	●●●●	Internal error #6
OGOR	●●●●	Internal error #7
OGOG	●●●●	Internal error #8
GROR	●●●●	Internal error #9
GROG	●●●●	Internal error #10
GRGR	●●●●	Internal error #11
GRGO	●●●●	Internal error #12
GORO	●●●●	Internal error #13
GORG	●●●●	Internal error #14
GOGR	●●●●	Internal error #15
GOGO	●●●●	Internal error #16

If an internal error is seen, please report this to Ubisense engineering.

SOFTWARE FATAL ERRORS

The software can produce several fatal errors. These are indicated by sending a trace message using the standard Ubisense tracing support. These trace messages all start with "<MAC>: fatal:" followed by a descriptive section explaining the nature of the error.

The following errors might be seen if sensors are booting whilst services are being restarted. If the error appears transiently and the sensor recovers after rebooting then there is no cause for concern.

Possible sensor errors

- No Location System Configuration Server registered. Sensor will now reboot.
- Config registration request failed (server at <address>). Sensor will now reboot.
- Config registration request failed (server at <address>) response: MAC <mac> is not known. Sensor will now reboot.
- Config registration request failed (server at <address>) response: incompatible configuration request. Sensor will now reboot.
- Config establish timeout. Sensor will now reboot.
- Failed to retrieve boot configuration from <address> for <software/firmware> upgrade. Sensor will now reboot.
- Failed to download file "<file>" from <address> for <software/firmware> upgrade. Sensor will now reboot.
- Firmware version mismatch: intended version is <version>, but server at <address> reports available version is <version>. Sensor will now reboot.
- Software version mismatch: intended version is <version>, but server at <address> reports available version is <version>. Sensor will now reboot.
- Failed software upgrade: downloaded kernel size mismatch, expected <size> but file is <size>. Sensor will now reboot.
- Unable to perform <software/firmware> upgrade due to missing boot config server parameter in configuration. Sensor will now reboot.

If a fatal error is seen which is not listed above, please report this to Ubisense engineering.