Release Notes

LT1110

Version 5.8-0

This document provides release notes for version 5.8-0 of the LT1110 firmware as well as previously distributed release notes, if applicable.

Release notes are a summary of new and enhanced features, resolved issues, and known issues that are not resolved in this version. Consult the User's Guide for details on the features of this software release.

SOFTWARE VERSION 5.8-0

Released October 2016

Effectivity

Note: All production builds of PRM240-01 will be replaced by PRM240-02 from this point onwards and no further production of PRM240-01 will be made available. The DVK-PRM240 will still contain v2.9-0 firmware until inventory is depleted. The firmware can be simply and easily be upgraded in the field to that of v5.8-0.

Version 5.8-0 applies to the following LT1110 products:

PRM240-02	RAMP 900 MHz OEM transceiver, pluggable, 3.3V TTL serial, 200 mW, u.FL jack, firmware v5.8
DVK-PRM240	DVK, RAMP 900 MHz OEM transceiver, pluggable, 3.3V TTL serial, 200 mW, u.FL jack, firmware v5.8

New or Enhanced Features

No new features were implemented in this release.

Resolved Issues

The following issues were fixed in the **V5.8-0** release:

- **RF Packet Received but Not Sent Over Serial Interface –** Though rare, it was possible for a packet to be received over the RF in which an error in the packet existed but was not discovered until post-processing. By this time, an RF acknowledgement had already been queued to be sent over the RF to the sender. The packet was discarded because it was flawed, but the transmitter would not retry and would report successful reception (if Send Data Complete was enabled) because an Ack was received. The RF Ack

message is now modified in its queue when an error is discovered during post-process. The Ack is still sent but is ignored by the recipient, thus prompting transmit retries and maintaining the integrity of the Send Data Complete message (if enabled). This issue has been present since inception.

- **Duplicate Packets in Large Networks –** The radio maintains a database in RAM of the 32 most recent unique radios from which it has received packets. When the database is full and a packet is received from a radio not in the database, the radio with the largest timespan since its last transmitted packet is removed from the database and replaced by the new radio. A bug in the code caused the 32nd radio (located at the top of the RAM allocated to this database) to be dropped from the database whenever the database contained 32 radios and a packet is received from a radio already in the database. If this 32nd radio sends a broadcast packet (with multiple broadcast attempts) or sends a unicast (addressed) packet and misses the RF acknowledgement, a duplicate packet could be seen over the serial interface.
- **Hop Timing Change –** In v4.2 of the firmware, hop timing was changed slightly. The impact of this change did not show up under standard regression testing but was discovered when closely analyzing radio performance with a logic analyzer and while running test firmware. In v5.8, hop timing has been defaulted back to being identical with that of v2.9. This decision was made to keep production versions backward compatible. The result of this change is that v4.2 - v5.6 has hop timing that is slightly different than that of v2.9 and v5.8 (and all future versions). If a customer desires to run v5.8 firmware on an existing network that contains radios running v4.2 - v5.6, standard timing can be overridden in EEPROM and made compatible with the prevailing firmware version timing. Instructions for accomplishing the above have been documented in a whitepaper and is available on the website.
- **Missed Reception of Acknowledgement on Utility Packets –** To conserve power, the LT1110 does not enable the RF receiver after transmitting a broadcast packet as there is no expected RF acknowledgement being returned by the recipient(s). The logic utilized to track whether the previous packet sent was broadcast or unicast has always worked properly for data packets. However, when determining whether an acknowledgement is to be expected for utility packets, the logic looked at the last transmitted data packet rather than looking at the last transmitted utility packet. This issue is specific to usage of utility packets. Utility packets are only used for Remote IO and for Bin Analyzer mode. If these modes are not utilized, this bug has no impact on system performance. This bug has been present since v4.1-0.
  - Remote IO: If the previous data packet sent is unicast, this feature works properly. If the previous packet sent was broadcast, the IO is properly updated but the acknowledgment is missed, thus causing a retry the next utility slot.
  - Bin Analyzer: If the previous data packet sent was unicast, this feature works properly. If the previous packet sent was broadcast, the bin is reported as a failure as the acknowledgement containing the RSSI information is missed.
- **Client Losing Connectivity –** Sometimes, particularly in areas with a high level of RF interference, the Server beacon can get corrupted. The beacon is protected by a 16-bit CRC. In extremely rare situations, the beacon can be corrupted in a such a way that the 16-bit CRC calculation verifies the packet as being true. Odds of this happening are 1 in 65,535. There is one bit in the entire beacon packet that, when set, can cause the Client to fall of the network and be unable to rejoin the network until being reset. If this bit is set (corrupted) in a beacon in which the CRC still calculates as true and all the other authentications in the beacon are valid, the Client would process the bit, exit the network and require a reset before being able to rejoin the network. This bit is no longer processed in the beacon. This bit was first processed in the beacon in v4.4-0.

- **Random Backoff –** The random number generator utilized by the Random Backoff function was not generating much entropy. Entropy was improved in the random number generator used by Random Backoff. This has no effect if Random Backoff is left at default (1 packet time or 0x00).

Known Issues

No known issues at this time.

SOFTWARE VERSION 5.6-0

Released August 2016

Effectivity

Version 5.6-0 is available as an optional firmware upgrade via binaries posted to the website. Version 2.9-0 continues to ship on the following products:

PRM240-01	RAMP 900 MHz OEM transceiver, pluggable, 3.3V TTL serial, 200 mW, u.FL jack, firmware v2.9
DVK-PRM240	DVK, RAMP 900 MHz OEM transceiver, pluggable, 3.3V TTL serial, 200 mW, u.FL jack, firmware v2.9

New or Enhanced Features

- **Cyclic Sleep (0x61, bit 0) –** 0==disabled, 1==enabled. Default==0

  To assist products in maximizing battery life, cyclic sleep was developed. This causes the radio to sleep for a programmable period of time and wake for a programmer period of time. The radio can be awakened from sleep before its sleep cycle completes using the Force 9600 pin. Additionally, the wake time is, technically, an inactivity counter. Therefore, the device will stay awaI'm ke indefinitely so long as the device continues sending packets over the RF interface.

- **Forward Error Correction (FEC)** – FEC is enabled by selecting an RF profile that supports FEC mode. All profiles are listed below.

  RF Profiles:
  - 0x04: 230 kbps RF, 53 hops, 900 MHz
  - 0x11: 230 kbps RF + FEC, 53 hops, 900 MHz

  Enabling FEC mode affects the number of data slots per hop. The number of data slots is based on the RF packet size and whether FEC is enabled.

  FEC Mode Disabled

RF Data Rate	RF Packet Size	Number of Data Slots
230 kbps	0x01 – 0x10	3
230 kbps	0x11 – 0x3E	2

  FEC Mode Enabled

RF Data Rate	RF Packet Size	Number of Data Slots
230 kbps	0x01 – 0x26	1

Note: For RF packet sizes less than 0x07, the Enter AT Command String cannot be used, Force 9600 must be used to enter Command mode.

For RF packet sizes where there is only one data slot per hop, the client and server alternate use of the data slot in Full Duplex mode.

- **Reduced sleep currents**

  Current measurements in v2.9-0:

Server beaconing (average)	15.5 mA
Client inrange (average)	9.1 mA
125 mW TX 100% (200 mW)	238 mA
50 mW TX 100% (100 mW)	161.1 mA
RX 100%	31.4 mA
PM2 (sleep walk)	74 uA
PM3 (deep sleep)	82 uA

  Current consumption in v5.6-0:

Server beaconing (average)	15.5 mA
Client inrange (average)	9.5 mA
125 mW TX 100% (200 mW)	238 mA
50 mW TX 100% (100 mW)	161.1 mA
RX 100%	32.1 mA
PM2 (sleep walk)	34 uA
PM3 (deep sleep)	33 uA

- **Extend Command Timeout (0x61, bit 1)** – 0==disabled, 1==enabled. Default==0.
  This is primarily used during firmware upgrades. Causes interface timeout to be multiplied by 4 when in command mode. This is because some windows machines have random delays between bytes and can cause the RF upgrade procedure to fail.
- **Disable Utility (0xC1, bit 4)** – 0==disabled, 1==enabled. Default==0.
  Enabling this mode eliminates the utility (status) slot, reserved in each hop, to save ~1mA of current in idle mode. This has the side effect of disallowing modem modes (remote IO) and bin analyzer.

Resolved Issues

The following issues were fixed in the **V5.6-0** release:

- **Long Delays in Sending Packets –** Very rarely, the internal Random Backoff counter could get errantly set to zero (0). This was treated internally as a 256-slot delay. Thus, a queued packet would be delayed by roughly 1.5 to 3.5 seconds depending on configuration. This has been corrected.
- **Missed Reception on Large Packets -** Incorrect logic caused a timer event to be missed in rare situations. This is most prevalent when sending larger blocks of serial data than the maximum RF packet size based on the RF Profile selected. This timer triggers the start of the beacon. Due to the beacon getting delayed, the beacon would actually conflict with the immediate next transmit slot, thus conflicting with any packets sent during that slot. The end result is a missed RF packet in the rare instances that this timer event gets missed, thus, a higher incidence of retries.
- **Firmware Upgrades –** Firmware upgrades prior to v5.6-0were susceptible to being “bricked” when undergoing a firmware upgrade in the field, thus requiring the units to be returned to Laird for recovery.

This susceptibility has been addressed. Therefore, any firmware version can be upgraded to v5.4-0, however, any downgrade to a version prior to v5.6-0will have this susceptibility and be prone to lockup.

- **Sleep Wakeup –** The expectation when waking from sleep is that the Client has been able to maintain frequency/time synchronization with the Server and be able to send data very soon after a wakeup event. The timer was occasionally getting corrupted on the wakeup event, causing the Client to lose synchronization with the Server. This corruption has been addressed.
- **API Transmit Mode –** Previously, Auto Destination and Auto Destination on Beacons Only functioned when API Transmit mode was enabled. This operation doesn't make sense as destination is specified by the host on a packet-by-packet basis. Therefore, both of the Auto Destination settings are now ignored when API Transmit Mode is enabled.
- **9600 Boot Option –** When enabled, 9600 Boot Option causes the 9600 pin to be ignored on cold boot (power-up), command boot (0xCC 0xFF) and brown-out conditions. Therefore, the 9600 pin is only observed on warm boots (reset pin toggled). This can be helpful so that brown-out conditions don't cause the baud rate to change if the 9600 pin happens to be low at the time. It was determined that the "Interface Timeout" was not being set properly for 9600 baud rate when the 9600 Boot Option was enabled and the reset pin was toggled. Interface Timeout is now being set properly in that situation.
- **Packet Queueing –** Fixed issues in which packets were not being sent in the first available transmit slot and/or an extra retry was occasionally occurring. Systems experiencing these issues would take longer to transmit queued data (increased latency).
- **AT Command –** A command that was not intended to be released was included in the released code. When **^^^** or **!!!** were detected in the serial transmit stream sent to the radio, the radio would enter a test mode. A reset would exit this mode. This command has been removed and is not intended to be supported in the future.
- **TX Broadcast –** Present in all former versions of LT1110, if the radio was in TX Broadcast mode, the 0xCC 0x10 (Write Destination Address on-the-fly) was unable to shift the device out of broadcast and into addressed mode. This has been corrected and the command now has to ability to switch between broadcast and addressed modes.
- **Idle current reduction** – Reduced idle current by disabling receiver after receiving any packet. RF receiver chip was remaining enabled.
- **Receiver on immediately upon waking** – Turning receiver on immediately upon waking from sleep rather than waiting one hop. This permits packet transmission/reception up to 13.2 ms earlier.
- **Enter AT Command issue** – Enter AT Command sometimes was transmitted over RF. This has been corrected.
- **Sleep/9600 pin issue** – Radio will not go to sleep if 9600 pin is low. Formerly, the radio didn't look at 9600 pin (wake pin) to determine if it should go to sleep. It should not sleep when the pin is holding it awake. This issue has been fixed.
- **RTS mode** – Disabling RTS mode when in forced 9600. RTS pin is now disregarded when forced 9600 mode is active.
- **Receiver chip disabled** – Disabling receiver chip when in AT Command Mode. Formerly was drawing full receive current the entire time in AT Command Mode. Now, it draws same current as standard mode.

- **RS485 delay timer settings** – Properly setting RS485 delay timer when in forced 9600 baud mode. This timer is used to ensure RS485 driver pin control is released at the proper time and this timing was incorrect in forced 9600 baud mode.
- **Idle mode issue** – When in idle mode, serial data would not pull the micro out of idle and the incoming packet would not be processed until the conclusion of the idle period (on the order of a few ms). Now, idle is exited immediately upon seeing incoming serial data.

Known Issues

No known issues at this time.