RS1xx LoRa Protocol

Sentrius™ RS1xx Sensor

Application Note *v1.0*

Introduction

The goal of this document is to detail the messages sent between the RS1xx sensor and a LoRa network server.

Sensor-To-Server Messages

Message Name: Send BackLog Message

Method Name: SendBackLogMessage

Notes

Message Length = 10 bytes.

The "Timestamp" is the time the sensor data was sampled.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x03	0x03	0x03	0x03
HumidityDecimal	Integer value of humidity measurement in %.	uint8_t	0x00	0x1E	0x00	0xFF
HumidityInteger	Decimal value of humidity measurement in %.	uint8_t	0x00	0x01	0x00	0x64
Options	Options Bitmask: 0 = Server response is LoRa acknowledgement. 1 = Server to send UTC to sensor. Since LoRa messages are initiated by the sensor this will happen on the next time the sensor talks to the server. 2 = Sensor configuration error. 4 = Sensor has alarm condition.	uint8_t	0x00	0x00	0x00	0x0F
TempDecimal	Decimal value of temperature measurement in C.	uint8_t	0x00	0x41	0x00	0xFF

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Name	Description	Type	Default Value	Example Value	Min Value	Max Value
TempInteger	Integer value of temperature measurement in C.	int8_t	0x00	0x19	0xD8	0x55
Timestamp	Seconds since Jan 1 2015.	uint32_t	0x00000000	0x00000064	0x00000000	0xFFFFFFFF

Example Message

```
Sent MSB First.

03 1E 01 00 41 19 00 00 00 64
```

Message Name: Send BackLog Messages

Method Name: SendBackLogMessages

Notes

The length of this message is variable.

The MsgType, NumberReadings, and Options are 3 bytes.

The Timestamp, Temperature, and Humidity are 8 bytes.

Message Length is NumReading * 8 + 3. Since NumReadings max is 6: 6 x 8 = 48. 48 + 3 = 51.

It is important that this packet be 51 bytes or less, since the max EU packet across data rates is 51 bytes in length.

A "Sensor Configuration Error" in the Options byte means that the sensor is operating in North America at DR0, where the maximum LoRa payload is 11 bytes, but it is configured with an aggregate count > 1, which results in a payload greater than 11 bytes. In this case the sensor will store the data it can't send to FLASH. The server should change the sensor configuration.

The "Timestamp" is the time the sensor data was sampled.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x04	0x04	0x04	0x04
HumidityDecimal	Integer value of humidity measurement in %.	uint8_t	0x00	0x1E	0x00	0xFF
HumidityInteger	Decimal value of humidity measurement in %.	uint8_t	0x00	0x01	0x00	0x64
NumReading	Number of sensor reading backlogs in packet.	uint8_t	0x00	0x01	0x01	0x06
Options	Options Bitmask: 0 = Server response is LoRa ack. 1 = Server to send UTC to sensor. Since LoRa messages are initiated by the sensor this will happen on the next time the sensor talks to the server. 2 = Sensor configuration error. 4 = Sensor has alarm condition.	uint8_t	0x00	0x00	0x00	0x0F
TempDecimal	Decimal value of temp measurement in C.	uint8_t	0x00	0x41	0x00	0xFF
TempInteger	Integer value of temp measurement in C.	int8_t	0x00	0x19	0xD8	0x55

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
Timestamp	Seconds since Jan 1 2015.	uint32_t	0x00000000	0x00000064	0x00000000	0xFFFFFFFF

Example Message

```
Sent MSB First.

04 1E 01 01 00 41 19 00 00 00 64
```

Message Name: Send FW Version

Method Name: SendFWVersion

Notes

Message Length = 11 bytes.

A "Sensor Configuration Error" in the Options byte means that the sensor is operating in North America at DR0, where the maximum LoRa payload is 11-bytes, but it is configured with an aggregate count > 1, which results in a payload greater than 11-bytes. In this case the sensor will store the data it can't send to FLASH. The server should change the sensor configuration.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x07	0x07	0x07	0x07
Day	Version day.	uint8_t	0x00	0x01	0x01	0x1F
Month	Version month.	uint8_t	0x00	0x01	0x01	0x0C
Options	Options Bitmask: 0 = Server response is LoRa ack. 1 = Server to send UTC to sensor. Since LoRa messages are initiated by the sensor this will happen on the next time the sensor talks to the server. 2 = Sensor configuration error. 4 = Sensor has alarm condition.	uint8_t	0x00	0x00	0x00	0x0F
PartNumber	Part number of firmware.	uint32_t	0x00000000	0x00493E6F	0x00000000	0xFFFFFFFF
VersionMajor	Version major.	uint8_t	0x00	0x01	0x00	0xFF
VersionMinor	Version minor.	uint8_t	0x00	0x00	0x00	0xFF
Year	Version year.	uint8_t	0x00	0x11	0x00	0xFF

Example Message

```
Sent MSB First.

07 01 01 00 00 49 3E 6F 01 00 11
```

Message Name: Send Sensor Config Advanced

Method Name: SendSensorConfigAdvanced

Notes

Message Length is 16 bytes.

A "Sensor Configuration Error" in the Options byte means that the sensor is operating in North America at DR0, where the maximum LoRa payload is 11 bytes, but it is configured with an aggregate count > 1, which results in a payload greater than 11 bytes. In this case the sensor will store the data it can't send to FLASH. The server should change the sensor configuration.

The "SensorAggregate" setting will aggregate or collect sensor data every "ReadSensorPeriod" and only send them over LoRa when the "SensorAggregate" number is reached. For example, if the "SensorAggregate" is set to 2, and the "ReadSensorPeriod" is set to 60 seconds, the data will be sent over LoRa 2 x 60 seconds or every 120 seconds. This has a very positive affect on battery life.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x06	0x06	0x06	0x06
BatteryType	1 = Zinc-Manganese Dioxide (Alkaline). 2 = Lithium/Iron Disulfide (Primary Lithium).	uint8_t	0x00	0x01	0x01	0x02
HumidityAlarmLimitHigh	Humidity alarm limit - high in %.	uint8_t	0x00	0x50	0x00	0x64
HumidityAlarmLimitLow	Humidity alarm limit - low in %.	uint8_t	0x00	0x0A	0x00	0x64
HumidityAlarmsEnabled	True = Humidity alarms enabled. False = Humidity alarms disabled.	bool		False	0	1
LED_BLE	Flash period in seconds when in BLE connection. 0 = No flash	uint16_t	0x0000	0x0000	0x0000	0xFFFF
LED_Heartbeat	Flash period in seconds. 0 = No flash 65535 = LED in LoRa Tx/Rx mode, Green = Tx, Orange = Rx.	uint16_t	0x0000	0x0000	0x0000	0xFFFF
Options	Options Bitmask: 0 = Server response is LoRa ack. 1 = Server to send UTC to sensor. Since LoRa messages are initiated by the sensor this will happen on the next time the sensor talks to the server. 2 = Sensor configuration error. 4 = Sensor has alarm condition.	uint8_t	0x00	0x00	0x00	0x0F
ReadSensorPeriod	Period in seconds to read the sensor. 0 = Disabled, sensor will not be read.	uint16_t	0x0000	0x0000	0x0000	0xFFFF
SensorAggregate	Number of readings to aggregate before sending on LoRa.	uint8_t	0x00	0x01	0x01	0x0B
TempAlarmLimitHigh	Temperature alarm limit - high in C.	int8_t	0x00	0x32	0xD8	0x55
TempAlarmLimitLow	Temperature alarm limit - low in C.	int8_t	0x00	0x00	0xD8	0x55
TempAlarmsEnabled	True = Temperature alarms enabled. False = Temperature alarms disabled.	bool		False	0	1

Example Message

```
Sent MSB First.

06 01 50 0A 00 00 00 00 00 00 00 00 01 32 00 00
```

Message Name: Send Sensor Config Simple

Method Name: SendSensorConfigSimple

Notes

Message Length is 10 bytes.

A "Sensor Configuration Error" in the Options byte means that the sensor is operating in North America at DR0, where the maximum LoRa payload is 11 bytes, but it is configured with an aggregate count > 1, which results in a payload greater than 11 bytes. In this case the sensor will store the data it can't send to FLASH. The server should change the sensor configuration.

The "SensorAggregate" setting will aggregate or collect sensor data every "ReadSensorPeriod" and only send them over LoRa when the "SensorAggregate" number is reached. For example, if the "SensorAggregate" is set to 2, and the "ReadSensorPeriod" is set to 60 seconds, the data will be sent over LoRa 2 x 60 seconds or every 120 seconds. This has a very positive effect on battery life.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x05	0x05	0x05	0x05
BatteryType	1 = Zinc-Manganese Dioxide (Alkaline). 2 = Lithium/Iron Disulfide (Primary Lithium).	uint8_t	0x00	0x01	0x01	0x02
HumidityAlarmEnabled	False = Disabled. True = Enabled.	bool		False	0	1
Options	Options Bitmask: 0 = Server response is LoRa ack. 1 = Server to send UTC to sensor. Since LoRa messages are initiated by the sensor this will happen on the next time the sensor talks to the server. 2 = Sensor configuration error. 4 = Sensor has alarm condition.	uint8_t	0x00	0x00	0x00	0x0F
ReadSensorPeriod	Period in seconds to read the sensor. 0 = Disabled	uint16_t	0x0000	0x0000	0x0000	0xFFFF
SensorAggregate	Number of readings to aggregate before sending on LoRa.	uint8_t	0x00	0x01	0x01	0x0B
TempAlarmEnabled	False = Disabled. True = Enabled.	bool		False	0	1

Example Message

```
Sent MSB First.

05 01 00 00 00 00 01 00
```

Message Name: Send Temp and RH Aggregated Data

Method Name: SendTempRHAggregatedData

Notes

The length of this message is variable.

The MsgType, NumberReadings, Timestamp, and Options are 11 bytes.

The Temperature and Humidity are 4 bytes.

Message Length = NumReading * 4 + 11. Since NumReadings max is 10: 10 x 4 = 40. 40 + 11 = 51.

It is important that this packet be 51 bytes or less since the max EU packet across datarates is 51 bytes in length.

A "Sensor Configuration Error" in the Options byte means that the sensor is operating in North America at DR0, where the maximum LoRa payload is 11 bytes, but it is configured with an aggregate count > 1, which results in a payload greater than 11 bytes. In this case the sensor will store the data it can't send to FLASH. The server should change the sensor configuration.

The timestamp is the time of the last sensor reading. The server will have to use the sensor read period parameter (part of the device configuration) to calculate the timestamps of the remaining data.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x02	0x02	0x02	0x02
AlarmMsgCount	Number of backlog alarm messages in sensor FLASH. A value of 255 means there are 255 or more alarm messages on the device.	uint8_t	0x00	0x00	0x00	0xFF
BacklogMsgCount	Number of backlog non-alarm messages in sensor FLASH.	uint16_t	0x0000	0x0000	0x0000	0x0FF0
BatteryCapacity	% of battery capacity remaining.	uint8_t	0x00	0x5A	0x00	0x64
HumidityDecimal	Decimal value of humidity measurement in %.	uint8_t	0x00	0x1E	0x00	0x64
HumidityInteger	Decimal value of humidity measurement in %.	uint8_t	0x00	0x01	0x00	0xFF
NumberReadings	Number of sensor readings in packet.	uint8_t	0x00	0x01	0x00	0x0A
Options	Options Bitmask: 0 = Server response is LoRa ack. 1 = Server to send UTC to sensor. Since LoRa messages are initiated by the sensor this will happen on the next time the sensor talks to the server. 2 = Sensor configuration error. 4 = Sensor has alarm condition.	uint8_t	0x00	0x00	0x00	0x0F
TempDecimal	Decimal value of temperature measurement in C.	uint8_t	0x00	0x19	0x00	0xFF
TempInteger	Integer value of temperature measurement in C.	int8_t	0x00	0x41	0xD8	0x55
Timestamp	Seconds since Jan 1 2015.	uint32_t	0x0000 0000	0x00000 064	0x0000 0000	0xFFFF FFFF

Example Message

```
Sent MSB First.

02 00 00 00 5A 1E 01 01 00 19 41 00 00 00 64
```

Message Name: Send Temp RH Data

Method Name: SendTempRHData

Notes

Message Length is 11 bytes.

Note there is no timestamp in this message. The server will have to assume the time it receives this message is the timestamp, and this should almost always be within a few seconds of the actual time.

A "Sensor Configuration Error" in the Options byte means that the sensor is operating in North America at DR0, where the maximum LoRa payload is 11 bytes, but it is configured with an aggregate count > 1, which results in a payload greater than 11 bytes. In this case the sensor will store the data it can't send to FLASH. The server should change the sensor aggregate count in this case.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x01	0x01	0x01	0x01
AlarmMsgCount	Number of backlog alarm messages in sensor FLASH.	uint16_t	0x0000	0x0000	0x0000	0x0FF0
BacklogMsgCount	Number of backlog non-alarm messages in sensor FLASH.	uint16_t	0x0000	0x0000	0x0000	0x0FF0
BatteryCapacity	% of battery capacity remaining.	uint8_t	0x00	0x5A	0x00	0x64
HumidityDecimal	Decimal value of humidity measurement in %.	uint8_t	0x00	0x1E	0x00	0x64
HumidityInteger	Decimal value of humidity measurement in %.	uint8_t	0x00	0x01	0x00	0xFF
Options	Options Bitmask: 0 = Server response is LoRa ack. 1 = Server to send UTC to sensor. Since LoRa messages are initiated by the sensor this will happen on the next time the sensor talks to the server. 2 = Sensor configuration error. 4 = Sensor has alarm condition.	uint8_t	0x00	0x00	0x00	0x0F
TempDecimal	Decimal value of temperature measurement in C.	uint8_t	0x00	0x41	0x00	0xFF
TempInteger	Integer value of temperature measurement in C.	int8_t	0x00	0x19	0xD8	0x55

Example Message

```
Sent MSB First.

01 00 00 00 00 5A 1E 01 00 41 19
```

SERVER-TO-SENSOR MESSAGES

Message Name: Backlog Retrieval

Method Name: BacklogRetrieval

Notes

Message Length is 6 bytes.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x06	0x06	0x06	0x06
Backlog_PullReqNum	Number of records to send. Note: Alarm messages will be sent first. 0 = Cancel pull request.	uint16_t	0x0000	0x0001	0x0000	0xFFFF
Backlog_PullReqPeriod	How often to send a backlog LoRa packet (seconds).	uint16_t	0x0000	0x000A	0x0000	0xFFFF
Options	Mote Response Options: 0 = None 1 = Send simple config next uplink. 2 = Send advanced config next uplink. 3 = Send firmware version next uplink.	uint8_t	0x00	0x00	0x00	0x03

Example Message

```
Sent MSB First.

06 00 01 00 0A 00
```

Message Name: Backoff

Method Name: Backoff

Notes

Message Length is 4 bytes.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x05	0x05	0x05	0x05
BackoffPeriod	Amount of time in seconds to backoff the sensor.	uint16_t	0x0000	0x003C	0x0000	0xFFFF
Options	Mote Response Options: 0 = None 1 = Send simple config next uplink. 2 = Send advanced config next uplink. 3 = Send firmware version next uplink.	uint8_t	0x00	0x00	0x00	0x03

Example Message

```
Sent MSB First.

05 00 3C 00
```

Message Name: Config

Method Name: Config

Notes

Message Length is 16 bytes.

The "SensorAggregate" setting will aggregate or collect sensor data every "ReadSensorPeriod" and only send them over LoRa when the "SensorAggregate" number is reached. For example if the "SensorAggregate" is set to 2, and the "ReadSensorPeriod" is set to 60 seconds, the data will be sent over LoRa 2 x 60 seconds or every 120 seconds. This has a very positive affect on battery life.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x03	0x03	0x03	0x03
Config_BatteryType	1 = Zinc-Manganese Dioxide (Alkaline). 2 = Lithium/Iron Disulfide (Primary Lithium).	uint8_t	0x00	0x01	0x01	0x02
Config_HumidityAlarmEnable	Enable humidity alarm.	bool		false	0	1
Config_LED_BLE	Flash period in seconds when in BLE connection. 0 = No flash.	uint16_t	0x0000	0x0000	0x0000	0xFFFF
Config_LED_LoRa	Flash period in seconds. 0 = No flash. 65535 = Tx/Rx debug mode (green = Tx, orange = Rx).	uint16_t	0x0000	0x0000	0x0000	0xFFFF
Config_ReadSensorPeriod	Period in seconds to read the sensor. 0 = Disabled	uint16_t	0x0000	0x000A	0x0000	0xFFFF
Config_RHAlarmLimitHigh	Humidity alarm limit - high.	uint8_t	0x00	0x50	0x00	0x64
Config_RHAlarmLimitLow	Humidity alarm limit - low.	uint8_t	0x00	0x0A	0x00	0x64
Config_SensorAggregate	Number of readings to aggregate before sending on LoRa.	uint8_t	0x00	0x01	0x01	0x0B
Config_TempAlarmEnable	Enable temperature alarm.	bool		false	0	1
Config_TempAlarmLimitHigh	Temperature alarm limit - high.	int8_t	0x00	0x32	0xD8	0x55
Config_TempAlarmLimitLow	Temperature alarm limit - low.	int8_t	0x00	0x00	0xD8	0x55
Options	Mote Response Options: 0 = None	uint8_t	0x00	0x00	0x00	0x03

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
	1 = Send simple configuration next uplink. 2 = Send advanced configuration next uplink. 3 = Send firmware version next uplink.					

Example Message

```
Sent MSB First.

03 01 00 00 00 00 00 00 0A 50 0A 01 00 32 00 00
```

Message Name: Format Log Flash

Method Name: FormatLogFlash

Notes

Message Length is 2 bytes.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x07	0x07	0x07	0x07
Options	Mote Response Options: 0 = None 1 = Send simple configuration next uplink. 2 = Send advanced configuration next uplink. 3 = Send firmware version next uplink.	uint8_t	0x00	0x00	0x00	0x03

Example Message

```
Sent MSB First.

07 00
```

Message Name: Generic Data Retrieval

Method Name: GenericDataRetrieval

Notes

Message Length is two bytes.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x01	0x01	0x01	0x01
Options	Mote Response Options: 0 = None 1 = Send simple config next uplink. 2 = Send advanced config next uplink. 3 = Send firmware version next uplink.	uint8_t	0x00	0x00	0x00	0x03

Example Message

```
Sent MSB First.

01 00
```

Message Name: Heater Control

Method Name: HeaterControl

Notes

Message Length is five bytes.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x04	0x04	0x04	0x04
Options	Mote Response Options: 0 = None 1 = Send simple configuration next uplink. 2 = Send advanced configuration next uplink. 3 = Send firmware version next uplink.	uint8_t	0x00	0x00	0x00	0x03
Options_Si702x_Heater_Setting	Setting that controls the power sent to the heating element. See si7021 datasheet for more details.	uint8_t	0x00	0x00	0x00	0x0F
Options_Si702x_Heater_Time	Time in seconds for the unit to turn on the heating element. 0 = Heater disabled.	uint16_t	0x0000	0x0000	0x0000	0xFFFF

Example Message

```
Sent MSB First.

04 00 00 00 00
```

Message Name: Set Alkaline Thresholds

Method Name: SetAlkalineThresholds

Notes

Message Length is 14 bytes.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x08	0x08	0x08	0x08
EightyPercent	80% threshold in mV.	uint16_t	0x0A96	0x0A96	0x0000	0xFFFF
FivePercent	5% threshold in mV.	uint16_t	0x076C	0x076C	0x0000	0xFFFF

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
FortyPercent	40% threshold in mV.	uint16_t	0x099C	0x099C	0x0000	0xFFFF
Offset	Offset from 20 degrees C in mV.	uint16_t	0x0064	0x0064	0x0000	0xFFFF
Options	Mote Response Options: 0 = None 1 = Send simple configuration next uplink. 2 = Send advanced configuration next uplink. 3 = Send firmware version next uplink.	uint8_t	0x00	0x00	0x00	0x03
SixtyPercent	60% threshold in mV.	uint16_t	0x0A14	0x0A14	0x0000	0xFFFF
TwentyPercent	20% threshold in mV.	uint16_t	0x0898	0x0898	0x0000	0xFFFF

Example Message

```
Sent MSB First.

08 0A 96 07 6C 09 9C 00 64 00 0A 14 08 98
```

Message Name: Set Lithium Thresholds

Method Name: SetLithiumThresholds

Notes

Message Length is 14 bytes.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x09	0x09	0x09	0x09
EightyPercent	80% threshold in mV.	uint16_t	0x0B86	0x0B86	0x0000	0xFFFF
FivePercent	5% threshold in mV.	uint16_t	0x0834	0x0834	0x0000	0xFFFF
FortyPercent	40% threshold in mV.	uint16_t	0x0AF0	0x0AF0	0x0000	0xFFFF
Offset	Offset from 20 degrees C in mV.	uint16_t	0x0096	0x0096	0x0000	0xFFFF
Options	Mote Response Options: 0 = None 1 = Send simple config next uplink. 2 = Send advanced config next uplink. 3 = Send firmware version next uplink.	uint8_t	0x00	0x00	0x00	0x03
SixtyPercent	60% threshold in mV.	uint16_t	0x0B40	0x0B40	0x0000	0xFFFF
TwentyPercent	20% threshold in mV.	uint16_t	0x0A5A	0x0A5A	0x0000	0xFFFF

Example Message

```
Sent MSB First.

09 0B 86 08 34 0A F0 00 96 00 0B 40 0A 5A
```

Message Name: Set UTC

Method Name: SetUTC

Notes

Message Length is 8 bytes.

Name	Description	Type	Default Value	Example Value	Min Value	Max Value
MsgType	Message type.	uint8_t	0x02	0x02	0x02	0x02
Options	Mote Response Options: 0 = None 1 = Send simple config next uplink. 2 = Send advanced config next uplink. 3 = Send firmware version next uplink.	uint8_t	0x00	0x00	0x00	0x03
RTC_Day	Day	uint8_t	0x00	0x01	0x00	0x1F
RTC_Hours	Hours (24-hour format)	uint8_t	0x00	0x05	0x00	0x17
RTC_Minutes	Minutes	uint8_t	0x00	0x0F	0x00	0x3B
RTC_Month	Month	uint8_t	0x00	0x01	0x00	0x0C
RTC_Seconds	Seconds	uint8_t	0x00	0x1E	0x00	0x3B
RTC_Year	Year	uint8_t	0x00	0x11	0x00	0xFF

Example Message

```
Sent MSB First.

02 00 01 05 0F 01 1E 11
```

REVISION HISTORY

Version	Date	Notes	Approver
1.0	17 Dec 2018	Initial Release	Jonathan Kaye