Introducing LoRa™ !

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LoRa™ = ***Long Range wireless data telemetry*** and relates to a radical VHF/UHF 2-way wireless **spread spectrum** data modulation approach that has recently been developed & trademarked (™) by Semtech - a long established (1960) US multinational electronics firm. Refer [1]=> http://www.semtech.com/ (http://www.semtech.com/)

The technology behind LoRa™ was developed by Cycleo, a French company acquired by Semtech in 2012. LoRa™ is proprietary, but it appears to use some sort of "simpler" CSS (Chirp Spread Spectrum) pulsed FM "sweeping frequency" modulation rather than DSSS (Direct Sequence SS) or FHSS (Frequency Hopping SS).

Semtech's web site mentions that ***"LoRa™ technology offers a 20dB link budget advantage compared to existing solutions, which significantly extends the range of any application while delivering the lowest current consumption to maximize battery life."***

Claimed ranges are typically x10 that of regular UHF wireless data systems. Yes -compared with regular narrow band data setups LoRa™ gives 100s of metres rather than 10s, several 1000m rather than mere 100s. Magic !

LoRa™ is somewhat complicated,as it uses terms and requires settings likely unfamiliar to many "normal" users. **Pleasingly however it's been found possible to verify claims with simple setups - here using paired UK sourced US$3 PICAXE micros as the controllers.** PICAXEs are near ideal for such trials as they're programmed in high level interpreted BASIC & any execution speed overheads are incidental for the s-l-o-w LORA™ data !Refer [2] => **(http://www.picaxe.com)**www.picaxe.com (http://www.picaxe.com) **(http://www.picaxe.com)**

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Step 1: Semtech's SX127x

In recent decades, & aided by cheap PC processing,diverse smart digital modes have been developed (especially by radio hams) for lower frequency HF (3-30MHz) work where bandwidth is precious. (Bandwidth hungry spread spectrum modulation is usually illegal on these lower frequencies). Some modes can span oceans with low power (a few Watts) but are slow & need sophisticated PC software for encoding/decoding, along with very sensitive comms. receivers and significant antenna. Refer [3] => http://hfradio.org.uk/html/digital_modes.html (http://hfradio.org.uk/html/digital_modes.html)

Semtech's VHF/UHF SX127x LoRa™ RF ICs however house almost everything within a smart thumb nail sized ~US$4 chip!

**** Early 2019 update: Semtech have recently upgraded the SX127x series, with their new SX126x based modules looking VERY worthwhile. Refer further comments at Instructable end.***

Semtech makes several RF IC variations, with the SX1278 being lower UHF frequency slanted to suit 433 MHz ISM band users. Higher freq. 800-900 MHz offerings appeal for more professional work, although at these near 1GHz frequencies reduced RF punch and signal path absorption may be an issue. Sub GHz frequencies however have lower noise, legally higher transmit power & more compact high gain antenna that may offset this.

As well as LoRa™.modulation (shown pictured), SX127x transceiver modules can also produce FSK, GFSK, MSK, GMSK, ASK/OOK and even FM tone signals (Morse Code !) to suit legacy systems. Refer Semtech datasheets (131 pages!) [4] => www.semtech.com/images/datasheet/sx1276.pdf (http://www.semtech.com/images/datasheet/sx1276.pdf)

Note: HOPERF, a long established Chinese wireless data firm, offer LoRa™ modules with a "'7 a side" RF96/97/98 IC that seems akin to Semtech's SX127x. It's unknown however if these are just an Asian LoRa™ 2nd sourcing...

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Step 2: LoRa™spread Spectrum Benefits !

SS (Spread Spectrum) systems are not new, but their sophistication meant they were far too costly for many users until modern microelectronic approaches evolved. As SS techniques offer significant interference and fading immunity, security & "undetectable" transmissions they've long the domain of the military - even as far back as WW2. Check the amazing 1940s work of bombshell actress Hedy Lamarr ! [5] => http://en.wikipedia.org/wiki/Hedy_Lamarr (http://en.wikipedia.org/wiki/Hedy_Lamarr)

LoRa™'s likely Chirp SS modulation, as well as enjoying other SS benefits,may offer Doppler effect "shifting frequency" immunity too - perhaps significant in fast moving LEO (Low Earth Orbital) satellite radio applications. See [6] => https://en.wikipedia.org/wiki/Chirp_spread_spectrum (https://en.wikipedia.org/wiki/Chirp_spread_spectrum)

But -here on earth- most attention arises from claims made by Semtech (& the 2014-2015 promotion of many others -IBM & MicroChip included!), that low UHF spread spectrum LoRa™ devices boost ranges by at least an order of magnitude (x 10) over traditional NBFM (Narrow Band FM) data modules under similar conditions and setups.

Much of this amazing range boost seems to come from LoRa's ability to work BELOW the noise level. The basis of this may relate to noise being random (& hence self cancelling over a period), while a signal is ordered (with multiple samples thus "building it up"). Refer the concept at the attached surf picture !

Although very low powered "smell of an oily electron" mW level transmitters may hence be feasible (& battery powered setups may have a near shelf life of perhaps years), LoRa™'s downside however is that weak signal long range links may be associated with very low data rates (<1kbps). This may be incidental for occasional IoT (Internet of Things) monitoring in applications involving temperatures, meter reading, status & security etc.

Step 3: SIGFOX - Network Based IoT Rival ?

Perhaps LoRa™'s closest IoT long range LPWA (Low Power Wide Area) wireless rival is French company **SIGFOX** [7] => http://www.sigfox.com/en/ (http://www.sigfox.com/en/)

Unlike Semtech's proprietary LoRa™, SigFox's devices are pleasingly open sourced, BUT they demand a specialized linking network. They hence become useless, much as do cell phones, when out of SigFox network coverage - a particularly telling factor in remote regions (**or for the many countries not yet served**!). Ongoing service charges or surging technical progress may become an issue too - Metricom's late '90s ill-fated 900 MHz "Ricochet" wireless Internet service springs to mind [8] => http://en.wikipedia.org/wiki/Ricochet_%28Internet... (http://en.wikipedia.org/wiki/Ricochet_%28Internet_service%29)

SigFox devices differ from LoRa™ in using UNB (ultra-narrowband) 100Hz radio “channels”, with BPSK (Binary Phase Shift Keying) modulation at 100bps. Transmitters are similar battery friendly 10-25 mW, but in the license free 868-902 MHz bands. Rooftop base stations, which connect to the Internet via fibre etc, have ultra sensitive -142dBm receivers. Ranges of 10’s of km may result (hence similar to LoRa™) - data links have been reported from high flying aircraft and offshore vessels when near SigFox base stations.

But just 12 byte messages, limited to 6 messages per hour, are allowed. Information arrives in a few seconds, but the SigFox network cannot support such real-time communications as credit card authorizations, and the system best suits data “snippets” transmitted a few times a day. Typically these may include remote utility meter reading, flow & level monitoring, asset tracking, emergency alerts or car parking spaces - the latter a real asset!

SigFox networks are quite simple and can be deployed at a fraction of the cost of a traditional cellular system. Spain & France are already covered with ~1000 base stations (vs 15,000 for standard cellular service), with Belgium, Germany, the Netherlands, UK (via Arqiva) and Russia soon to follow. Trials are also underway in San Francisco,

Sigfox doesn't directly build these networks however, but contracts with local companies to handle the relatively simple deployment of rooftop base stations and antennas. . Roll out can be rapid and cost effective- their deployment partner in Spain spent $5 million to deploy a network across the country in just 7 months. These local partners then resell IoT services, at end user charges around ~US$8 a year per device.

Uptake of the SigFox approach has been dramatic, with an early 2015 funding drive raising > US$100 million. Wireless rivals TI/CC (Texas Instruments/ChipCon), who recently joined SigFox, in fact indicate that Lora™ may have weaknesses - see [9] => https://e2e.ti.com/support/wireless_connectivity/f... (https://e2e.ti.com/support/wireless_connectivity/f/156/p/343273/1476432)

Hands on SigFox investigations have been difficult to locate, but see "Instructable" level insights [10] => http://www.disk91.com/2014/technology/internet-of-... (http://www.disk91.com/2014/technology/internet-of-things-technology/lets-start-playing-with-sigfox-technology/)

It could be that both approaches eventually coexist, much as do 2 way radios (= LoRa™) and cell phones (= SigFox) for voice level comms. At present (May 2015) LoRa™ is certainly THE way to explore long range IoT wireless possibilities- **read on**!

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Step 4: Chinese LoRa™ Modules -1

Although an EU invention, Semtech's SX127x LoRa™ engines have been very eagerly taken up by Chinese manufacturers. LoRa's ability to punch thru' obstructing buildings in crowded Asian cities has no doubt been been appealing.

Makers in China's mega e-city of Shenzhen (near Hong Kong) have been especially enthusiastic, with offerings noted from such "makers" as **Dorji**, **Appcon**, **Ulike**, **Rion**/**Ron**, **HopeRF**, **VoRice**, **HK CCD**, **Shenzhen Taida**, **SF**, **NiceRF, YHTech** & **GBan**. Although their interface pinouts differ somewhat, the 2 chip "micro moderated" modules fromDorji, Appcon, VoRice & NiceRFseem almost badge engineered.

Extensive Googling is hence recommended for those after bulk purchase, samples, free shipping, more lucid technical insights, better access to SX127x features/pins, easier control, lighter weight, rugged packaging (YTech'sE32-TTL-100 style) etc. Browse the likes of EBay, Alibaba or Aliexpress [11]=> http://www.aliexpress.com/premium/sx1278.html (http://www.aliexpress.com/premium/sx1278.html)

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Step 5: Chinese LoRa™ Modules - 2

Be alert that cheaper (< $US10) single chip modules control the SX1278 via tedious clock linked SPI (Serial Peripheral Interface). Although they're larger & more costly (~US$20), two chip LoRa™ modules use a 2nd on board MCU (microcontroller) for the SX1278 linkage, and are usually much easier to configure & work with on the fly. Most offer friendly industry standard TTL (Transistor Transistor Logic) transparent data handling via simple RXD & TXD pins. Tiny red & blue LEDs are usually fitted onboard the TTL modules - handy for TX/RX insights.

NOTE: 8 pin offerings may use 2mm pin spacing rather than the standard 2.54 mm (1/10th inch), which could limit solderless breadboard evaluation.

Although the near price doubling of TTL LoRa™ devices may be daunting, skinflints could consider cheaper (both to purchase & ship) boards without the SMA socket & matching "rubber ducky" aerial. It'll not be as professional of course, but a simple ¼ wave (~165mm long) whip can readily be made from scrap wire. This may even out perform the "rubber ducky" antenna too- especially if elevated !

Overall (and -sigh- likely rapidly influenced by the increasingly numerous offerings), at the time of writing (mid April 2015) Dorji's433 MHz **DRF1278DM** seems the easiest way to get started with LoRa™. However this module's limited pinout access,HEX level tweaking & need for higher supply voltages (3.4 -5.5V) may be a limitation.

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Step 6: Dorji DRF1278DM

Chinese maker Shenzhen Dorji sells these micro commanded DRF1278DM modules for ~US$20 each from Tindie [12] => https://www.tindie.com/products/DORJI_COM/long-ra... (https://www.tindie.com/products/DORJI_COM/long-range-semtech-lora-sx1276-sx1278-data-radio-modem-drf1278dm/)

The 7 pins are spaced the usual breadboard friendly 2.54 mm (= 1/10th inch). A supply between 3.4 - 5.5V is needed. The module electronics however work at lower voltages - there's an on board 3.2V voltage regulator. This higher supply need is irksome in todays "3V" era, as although this suits USB 5V (or even bulky 3 x AA 1.5V cells), it prevents use of single 3V Li coin cells etc. The regulator could perhaps be bypassed?

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Step 7: DAC02 USB Adapter

A cheap USB - TTL adapter (here Dorji's DAC02) can be used for module configuration via "RF Tools" PC software. Modules are mechanically rather unsupported when inserted however, and repeated use may stress the pins...

Similar adapters abound at very low prices, BUT pre use **it's essential to first ensure pin functions on the adapter match those on the wireless module** ! If they don't (with VCC/GND swaps common) then flying lead approaches may have to be used. Although a tad tedious these can also be more versatile as they suit config. of other modules (refer the HC-12 transceiver setup) and even direct terminal program display on a PC.

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Step 8: USB Config Tools + SF, BW and CR Insights

Herewith screens typical of the user friendly USB configuring "RF Tools". Dorji modules worked out of the box, but the frequency and power settings should at least be altered for local regulations. Many countries limit 433 MHz transmitter power to 25 mW (~14 dBm) or even 10mW (10dBm) - these are Dorji power settings 5 & 3 respectively.

The licence free ISM band, which covers a ~1.7 MHz slice between 433.050 - 434.790 MHz, does NOT allow transmissions on exactly 433.000 MHz either !

Transparent data handling looks thankfully to occur,meaning whatever serial data is fed in is eventually itransparently dentically fed out after "on air" transmission. However the rumoured 256 byte buffer looked more like 176 bytes (CRC overhead?), some settings with the Dorji tool were difficult to interpret, and changes "written" were not always shown to have been accepted either...

Download Dorji's **DRF_Tool_DRF1278D.rar** config tool (listed near bottom RHS "Resources" column) via => http://www.dorji.com/pro/RF-module/Medium_power_tranceiver.html (http://www.dorji.com/pro/RF-module/Medium_power_tranceiver.html)
Check diverse insights (especially P. 9 -10) into it's use and USB adapters etc => http://www.dorji.com/docs/app/ADW1014_Testing_Data_Radio_Modem_With_Serial_Port_Tool.pdf (http://www.dorji.com/docs/app/ADW1014_Testing_Data_Radio_Modem_With_Serial_Port_Tool.pdf)

Explanation of LoRa™ spread spectrum terms: (N.B. Data rate relates to BW & SF)

BW (Band Width in kHz): Although mere 10s of kHz BW may appeal, it's important to appreciate that cheap 32 MHz crystals used by many LoRa™ modules (Dorji & HOPERF etc) may not quite exactly match in frequency. Temperature related drifts and aging may also arise too. Selection of narrower bandwidths may hence prevent module synching unless tedious crystal tweaking &

thermal regulation is employed. Although Chinese LoRa™ module makers like Dorji recommend a BW minimum of 125 kHz, for most purposes a narrower BW of 62.5 kHz should be quite OK. Refer shaded table column shown in Step 10.

SF (Spreading Factor "chips" as a base-2 log): In SS systems each bit in the pseudo-random binary sequence is known as a "chip". Incrementing from 7 (2^7 = 128 chip pulses per symbol) up to the limit of 12 improves sensitivity by 3dB each step, but approx. halves the data rate. Although hence a SF of 11 (2^11 = 2048) is 12dB more sensitive than SF7, the data rate drops (at 62.5 kHz BW) from ~2700 bps to just 268 bps. Slow data rate transmitters stay on longer too & thus may also consume more energy overall than transmitters sending faster data.

However very low data rates may be tolerable for occasional IoT (Internet of Things) monitoring of course (& the increased battery energy drain near incidental), while the x 4 range boost could be extremely worthwhile!

CR (error Coding Rate): Initial UK tests used a CR of 4/5. (This denotes that every 4 useful bits are encoded by 5 transmission bits). Increasing CR to 4/8 lengthens transmit time by ~27%, but improves reception by 1 to 1.5dBm, representing a potential range improvement of some 12 to 18%. This CR tweak probably will not give as beneficial a range gain as incrementing the SF.

Most NZ trials were at 434.000 MHz, 2400 bps serial data, SF7, 62.5kHz BW and CR 4/5.

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Step 9: Direct DRF1278DM Configuration.

The DRF1278DM can also be configured from an external microcontroller- even a humble 8 pin PICAXE-08. Although involving cryptic base 16 HEX coding, this allows on board/on the fly tweaking rather than continual module removal & USB adapter configuration. Refer full details P.7-8 at the Dorji . pdf. [13] => http://www.dorji.com/docs/data/DRF1278DM.pdf (http://www.dorji.com/docs/data/DRF1278DM.pdf)

Although it offers diverse sleep features, HEX level tweaking insights may be also gained via Appcon's (near lookalike) APC-340 data sheets [14] => http://www.propox.com/download/docs/APC340_Datasheet.pdf (http://www.propox.com/download/docs/APC340_Datashe...)

Thanks to fellow Kiwi *Andrew "Brightspark" HORNBLOW* herewith a PICAXE-08M2 code fragment to modulate the DRF1278DM TX power into a staircased ramp of transmission blips. (For easier range/power insights these could readily be associated with receiver end PICAXE generated tones too). Note however that TX levels 6 & 7 exceed the NZ/Australia allowance of 25mW (~14dBm or setting 5). Andrew's insights arose from monitoring / copying and pasting the raw hex serial data from***terminal.exe*** (a superb engineering tool [15] => http://hw-server.com/terminal-terminal-emulation-... (http://hw-server.com/terminal-terminal-emulation-program-rs-232)) while viewing the serial data chatter to and from the modules when the RF power level is changed.

The Dorji power level step = 4th byte from the RH end (**$01**, $02 etc) plus the following CS byte (CheckSum **$AB**,$AC etc) just need to be tweaked. Sample PICAXE code sentences to modify the power level on the fly are as follows:

```
wait 2
```

```
 serout 4,T2400,($AF,$AF,$00,$00,$AF,$80,$01,$0C,$02,$00,$6C,$80,$12,$09,$00,$07,$00,$00,$00,$01,$AB,$0D,$0A)
```

```
serout 4,T2400,($AF,$AF,$00,$00,$AF,$80,$01,$0C,$02,$00,$6C,$80,$12,$09,$00,$07,$00,$00,$00,$02,$AC,$0D,$0A)
```

```
serout 4,T2400,($AF,$AF,$00,$00,$AF,$80,$01,$0C,$02,$00,$6C,$80,$12,$09,$00,$07,$00,$00,$00,$03,$AD,$0D,$0A)
```

```
 serout 4,T2400,($AF,$AF,$00,$00,$AF,$80,$01,$0C,$02,$00,$6C,$80,$12,$09,$00,$07,$00,$00,$00,$04,$AE,$0D,$0A)
```

```
serout 4,T2400,($AF,$AF,$00,$00,$AF,$80,$01,$0C,$02,$00,$6C,$80,$12,$09,$00,$07,$00,$00,$00,$05,$AF,$0D,$0A)
```

```
 serout 4,T2400,($AF,$AF,$00,$00,$AF,$80,$01,$0C,$02,$00,$6C,$80,$12,$09,$00,$07,$00,$00,$00,$06,$B0,$0D,$0A)
```

```
 serout 4,T2400,($AF,$AF,$00,$00,$AF,$80,$01,$0C,$02,$00,$6C,$80,$12,$09,$00,$07,$00,$00,$00,$07,$B1,$0D,$0A)
```

```
 wait 2
```

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Step 10: Performance Estimations & Results !

PICAXE 28X2 driven HOPERF 434 MHz Semtech LoRa™ based RFM98 data modules were used in trials conducted over a 750m link in a typical UK urban environment. The transmitter antenna was elevated ~2½ m on a low mast, with the receiver on a short pole ~1½ m – both above ground. With a confirmed 750m dense urban environment range at UK's 10mW TX (using 500kHz BW & thus giving ~22kbps), then at 10.4kHz BW (or 455 bps) some 6 km look feasible with sub mW power !

Confirming field tests (with settings SF7 & only BW 62.5 kHz) were made in Wellington (NZ) with 3 x AA battery powered PICAXE-08M driven Dorji DRF1278DM modules & similar antenna, but at Aus/NZ's "paint blistering" higher 25mW (14dBm) TX power. Suburban signal links, perhaps aided by a more open environment and wooden buildings, were consistently made over 3 - 10 km. (As 6dB gain doubles LoS range, then 4dB extra power ~x 1½. & hence ranges may improve over implied UK ones by >1½ times).

Step 11: Breadboard Layout

A breadboarded layout (used previously for Dorji's "7020" GFSK modules) suits simple swap over to the LoRa device. GFSK (Gaussian Freq. Shift Keying) modulation has previously been considered the best 433 MHz approach, so it was beneficial to compare results of the "7020" offerings with the new LoRa modules.

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Step 12: PICAXE Schematic

(https://content.instructables.com/ORIG/FOD/A1QM/I8H69T5A/FODA1QMI8H69T5A.jpg?auto=webp&frame=1&fit=bounds&md=f7d11f7889d20e6e23290c4ef8d7bab4)

Both the RX & TX use a near identical layout, although their code somewhat differs. Although naturally appealing and readily achieved with PICAXEs, no attempt was made at this stage to enter energy saving sleep modes. Current draw from 3 xAA batteries was ~15mA, pulsing to ~50mA when transmitting.

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Step 13: PICAXE Transmitter Code

Naturally this code can be extensively enhanced and modified, perhaps with settling delays and preambles. Presently it's essentially just spitting out an advancing 0-100 number. As the trial was merely intended to verify reliable range claims, no attempt was made (with either transmitter or receiver) to enable power saving modes.

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Step 14: PICAXE Receiver Code & Display

(https://content.instructables.com/ORIG/F0J/FRMU/I8FR3JH0/F0JFRMUI8FR3JH0.jpg?auto=webp&frame=1&fit=bounds&md=882775001576b58effa25e5500eb10b7)

Here's the associated PICAXE receiver code, with numeric values displayed via the editor's inbuilt "F8" terminal. The beauty of a simple count is that sequences can quickly be visually scanned & missing or swampy values readily spotted.

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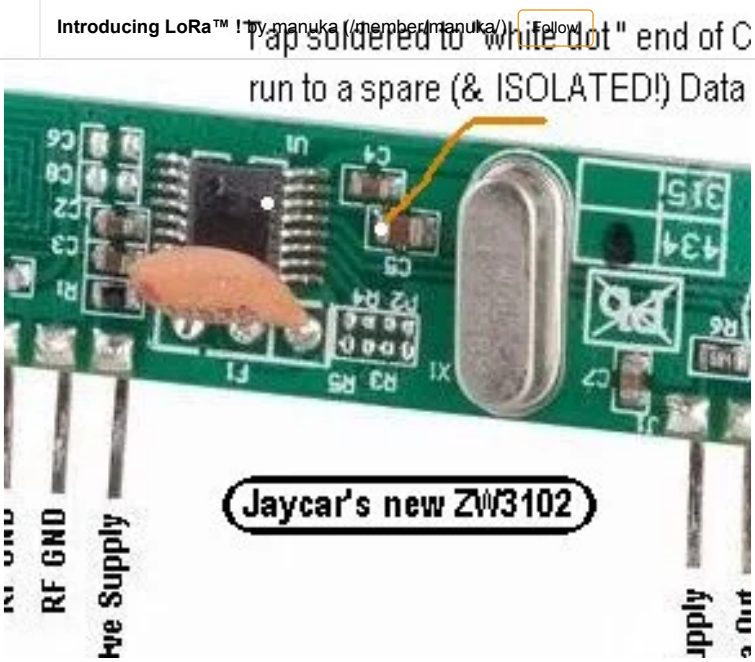
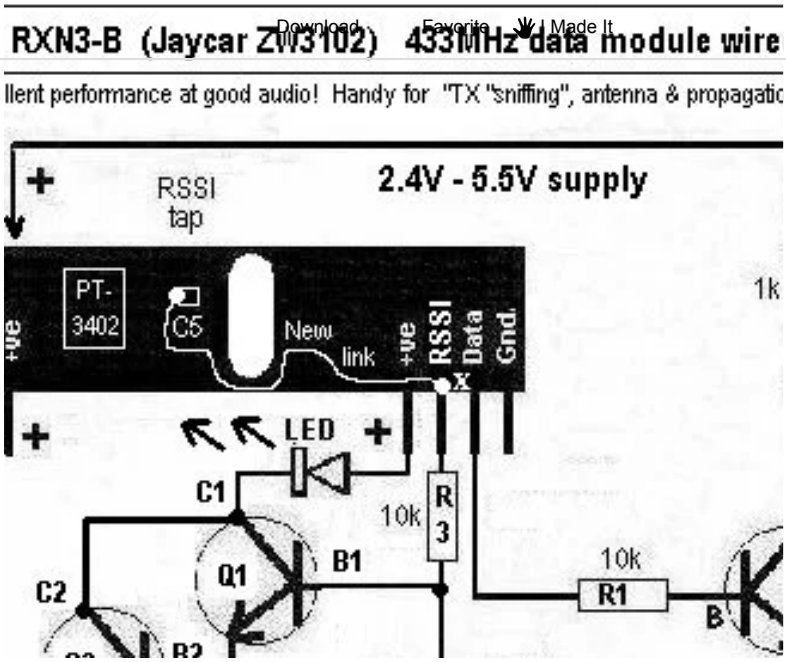
Step 15: User Friendly LoRa™RF Tuneup Aids?





As LoRa™ module settings can be difficult to comprehend and verify, it's pleasingly been found possible to use cheap (& relatively broadband) ASK 433 MHz receiver modules as simple tune up aids.

NZ/Aus outlet Jaycar offer a ZW3102 module that can readily be persuaded into "sniffer duties" to suit audible signal monitoring. When near (< 5 metres) to LoRa™ transmissions the outgoing signal will readily be heard as "scratches",while the brightness of an attached LED relates to RSSI (Received Signal Strength Indication).

A similar (& cheaper) module made by Dorji is featured in Instructable [16] => https://www.instructables.com/id/433-MHz-tape-meas... (https://www.instructables.com/id/433-MHz-tape-measure-antenna-suits-UHF-transmitte/)

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Step 16: Field Tests- Wellington, New Zealand

This beach setup shows the earlier testing with Dorji's "7020" GFSK (Gaussian Frequency Shift Keying) modules. Ranges then maxed at ~1km in such conditions, and at best were ~300m thru' light vegetation & the localities wooden framed buildings. Cross harbour links were only found possible when the transmitter was significantly elevated some 100m up at an eagle's nest view spot on a hillside behind.

In contrast Dorji's LoRa modules at the same 25mW power "flooded" the suburb, with arm high (~2.4m) transmissions reliably detected to ~3km close in, 6km at headland "sweet spots" and even 10km surface LOS across harbour. Reception only ceased when in bays behind the rocky headlands (visible in the background). LoRa settings were, BW 62.5kHz, SR 7, CR 4/5 and 25mW (14dBm) TX power into a ¼ wave omnidirectional vertical antenna.

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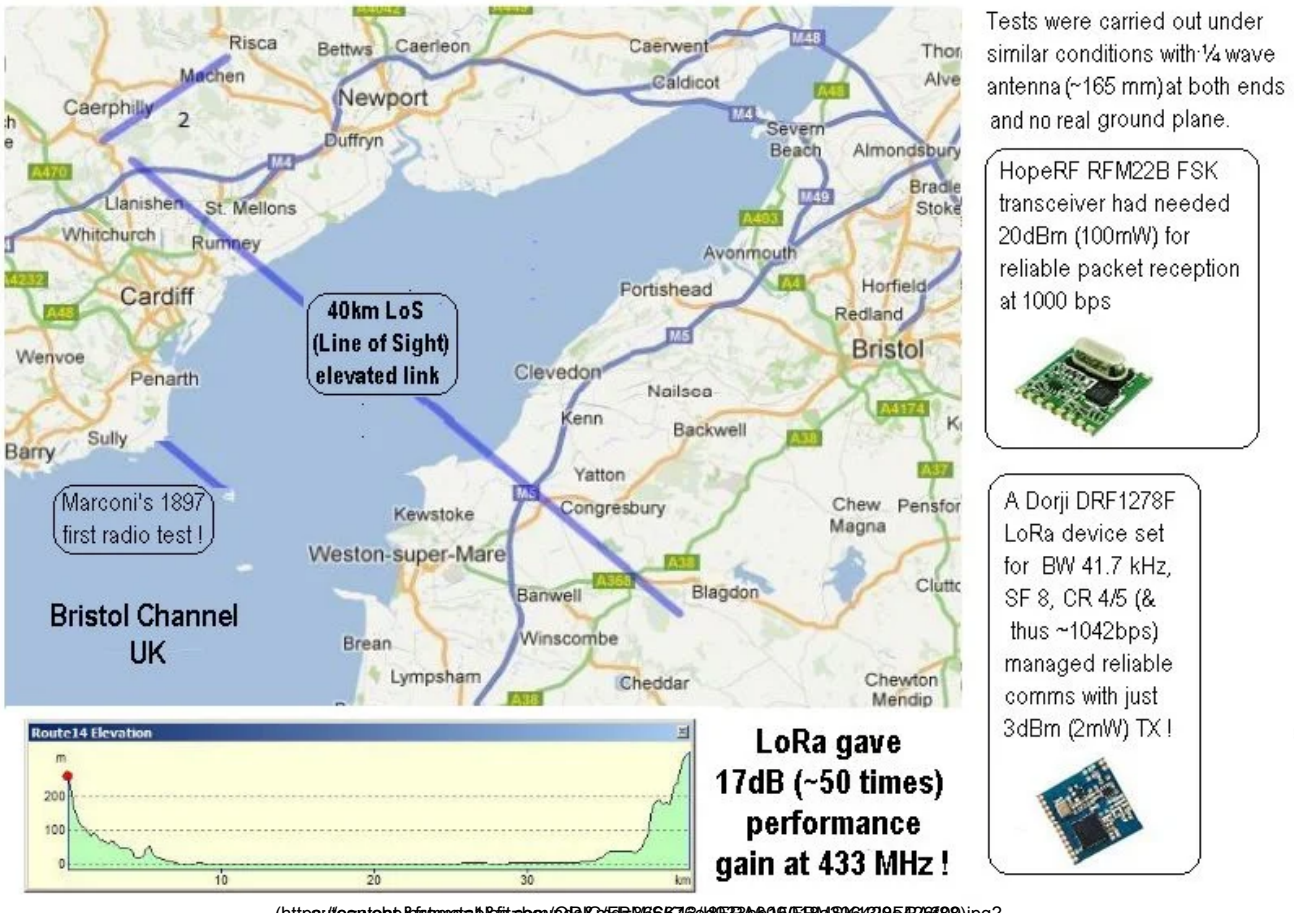
Step 17: UK LoRa Versus FSK - 40km LoS (Line of Sight) Test !



Thanks to Cardiff based Stuart Robinson (radio ham GW7HPW), FSK (Frequency shift keying) versus LoRa™ comparison tests were carried out over an elevated 40km distance across the UK's Bristol Channel. Refer picture.

The region is rather wireless historic as in 1897 Marconi carried out his first "long range" (6 - 9km using power hungry spark transmitters!) tests nearby [17] => http://en.wikipedia.org/wiki/Lavernock (http://en.wikipedia.org/wiki/Lavernock)

Stuart's results speak for themselves - LoRa™ data links were amazingly possible in 2014 at a fraction of the power needed for his previously well respected Hope RFM22BFSK modules!

A PICAXE-40X2 controlled RFM22B in fact is still up orbiting in the esteemed **$50sat**, with weak ground signals detectable as it passes in LEO (Low Earth Orbital) many 100s of km above. (LoRa™ modules were not available at it's 2013 launch time) [18] => http://www.50dollarsat.info/ (http://www.50dollarsat.info/)

)

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Step 18: Other Region Tests

Successful links were made over 22km LoS (Line of Sight) in Spain & several km in urban Hungary.

Check the Libelium promotion that shows the technology's ~900MHz benefits[19] =>http://www.libelium.com/extreme-range-wireless-sen... (http://www.libelium.com/extreme-range-wireless-sensors-connectivity-through-buildings-in-city-lora-868mhz-915mhz/)

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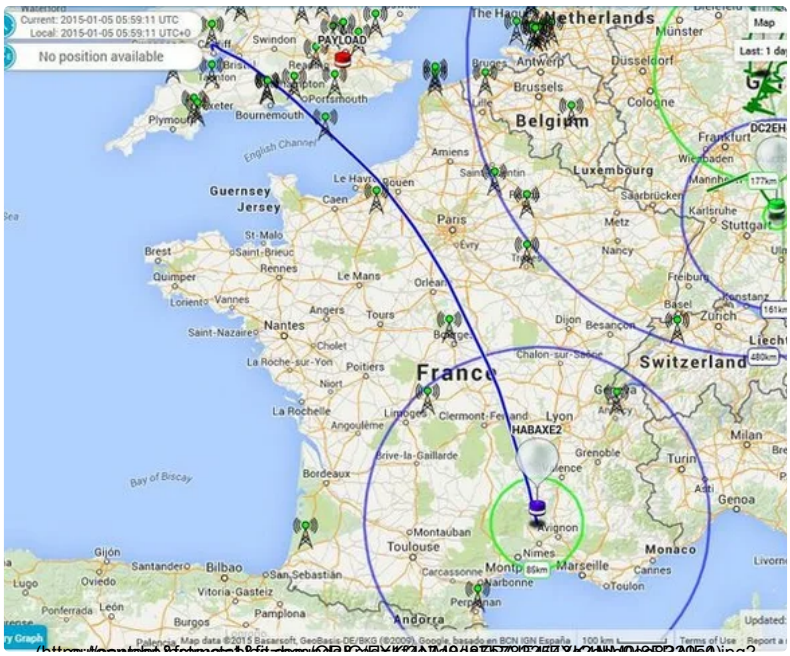
Step 19: LoRa Receiver & Links



UK HAB (High Altitude Ballooning) trials gave 2 way LoRa™ coverage at up to 240 km. Lowering the data rate from 1000bps to 100bps should allow coverage all the way to the radio horizon, which is perhaps 600 km at the typical 6000-8000m soaring altitude of these balloons. Balloon tracking can be made via ther on board GPS - check the extensive HAB & LoRa™ documentation at [20] => https://goo.gl/t4UkoN (https://goo.gl/t4UkoN)

A LoRa receiver for both HAB & future LEO satellite work is under development - details to follow.

Summary: LoRa™ is shaping up as disruptive technology, especially for emerging - and much hyped- **IoT** (Internet of Things) wireless networked applications. Stay informed via the LoRa Alliance site [21] => http://lora-alliance.org/ (http://lora-alliance.org/)

Disclaimer & appreciation: This account is essentially intended as a heads up/hands on investigation & compilation of -what seems- a game changing UHF wireless data technology. Although welcoming free samples (!), I have no commercial links with any of the LoRa™ makers mentioned. Feel free to "copy left" this material - especially for educational use- but site credit naturally appreciated.

Note: Some images have been web sourced, for which (if not referenced) appreciative credit is hereby extended.

Stan. SWAN => stan.swan@gmail.com Wellington, New Zealand. (ZL2APS -since 1967).

Links: (As at 15th May 2015)

[1] http://www.semtech.com/ (http://www.semtech.com/)

[2] http://www.picaxe.com (http://www.picaxe.com)

[3] http://hfradio.org.uk/html/digital_modes.html (http://hfradio.org.uk/html/digital_modes.html)

[4] http://www.semtech.com/images/datasheet/sx1276.pdf (http://www.semtech.com/images/datasheet/sx1276.pdf)

[5] http://en.wikipedia.org/wiki/Hedy_Lamarr (http://en.wikipedia.org/wiki/Hedy_Lamarr)

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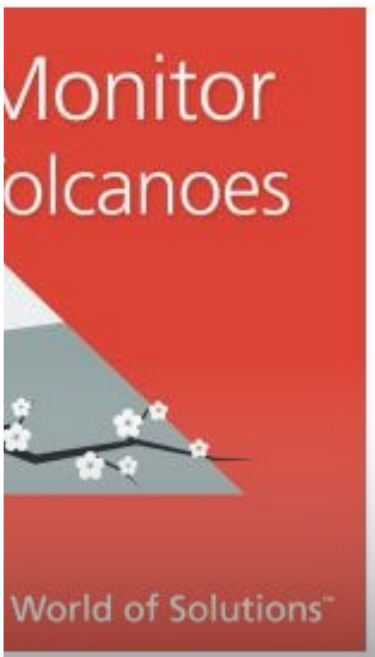

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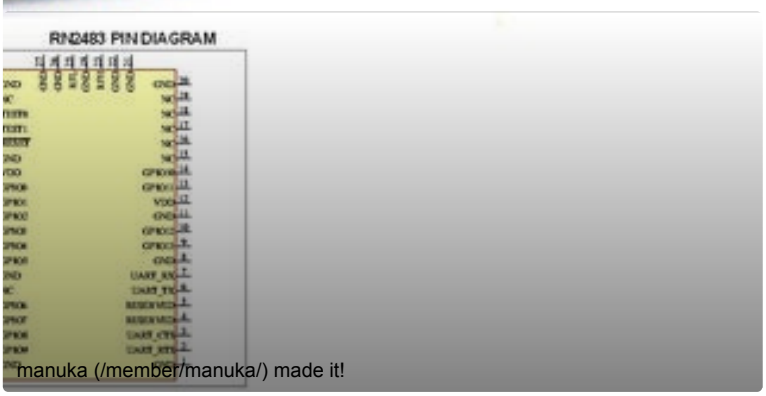

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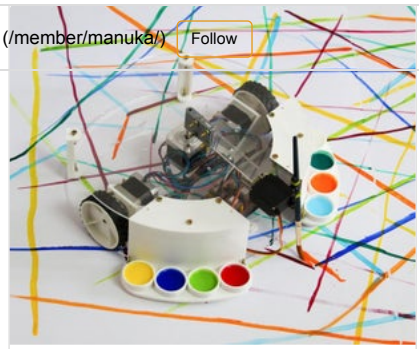

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50 Discussions

(/member/manuka/) manuka (author) 1 year ago

Reply Upvote

The RSSI reporting feature on DORJI's new SX126x based modules has shown great promise - numerous IoT & ranging applications look feasible!

(https://content.instructables.com/ORIG/F1Y/VQQK/K2CGDPYJ/F1YVQQKK2CGDPYJ.jpg?fit=bounds&frame=1&height=1024&width=1024)

1 reply

(/member/AliS49/) AliS49 (/member/AliS49/) Question 7 months ago on Step 19

Answer Upvote

Hello...
I need arduino library for lora sx1278 UART interface DRF1278DM
How to Get RSSI value for this module
How to read RSSI value using arduino

(/member/manuka/) manuka (author) Tip 1 year ago on Step 19

Reply Upvote

A Feb. 2019 heads up for Semtech's updated SX126x based LoRa ! Semtech announced these new "RF engines" in 2018 and complete setups are now arriving. See DORJI's SPI => https://www.tindie.com/products/DORJI_COM/433mhz-sx1268-tcxo-module-drf1268t/ (https://www.tindie.com/products/DORJI_COM/433mhz-sx1268-tcxo-module-drf1268t/).

Enhanced features abound when compared with existing SX127x based LoRa modules - check the likes of **Chengdu EBYTE's SX126x E22 range** -
* cheaper (< US$10 for UART), smaller, lighter
* wide supply range
* allow remote config.
* RSSI
* channel "listen before talk" carrier sense
* WOR (Wake On Radio -greatly enhances battery life !)
* relay feature - could ENORMOUSLY boost range.
* low RX current drain (~half that of SX127x)
* config. over a wider freq. range. "400" apparently 410-493MHz @1MHz spaced
* simple UART or SPI
* GUI setup
* AT command friendly
* work with SX127x

Several of these features look "smell of an oily electron" goldmines for energy sniffing IoT applications!

EBYTE'S E22 pinouts however are 1.27mm spaced (half the normal 0.1" = 2.54mm) which means breadboard issues. However at least pins are not cussed 2mm, & only a handful are needed anyway. Pitch changing adapters are of course available too.

I've ordered some E22-400T22S 433MHz UART versions,but factory delivery influenced by the present CNY (Chinese New Year) shut down.
Stay tuned -Stan.

(https://www.instructables.com/id/Introducing-LoRa-/)

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2 replies

(/member/manuka/) manuka (author) 1 year ago

Reply Upvote

Chinese firm Dorji now also offer SX126x based LoRa modules, breadboard friendly adapters & software configuration tools.

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1

(/member/JaimeZ14/) JaimeZ14 (/member/JaimeZ14/) 2 years ago

Reply Upvote

manuka - have you had any experience configuring one device as a transceiver? I am also wondering if you have tried to detect two transmitters at once?
I am hoping to make a simple game where three people are racing to find each other with these.

(/member/moebius.lutching/) moebius.lutching (/member/moebius.lutching/) 3 years ago

Reply Upvote

Thanks for the article! I just decided use LoRa on my next project... I pick a pair of the Whisper Node LoRa (http://wisen.com.au/store/products/whisper-node-lora/), as apparently they are designed to run on Battery and that's exactly what I'm after.

(https://content.instructables.com/ORIG/FH8/L055/J5CQ1DA0/FH8L055J5CQ1DA0.jpg?fit=bounds&frame=1)

(/member/manuka/) manuka (author) 3 years ago

Reply Upvote

Scios: OK on your "8000 hectare" cattle farming cousin, & glad he's looking at commercial options ! You never did specify either his "farm's location " or it's terrain- such apscts are CRUCIAL for comms. insights...

At your UHF starter level perhaps the best INITIAL way is with some simple handheld UHF PRS CBs used to explore coverage. Their power is typically a few Watts, giving a range maybe a few km in built areas, but MUCH more if Line of Sight (LoS).

LoRa offers 10 times the range for the same power, BUT you are legally only allowed 25milliWatts ! As every 6dB gain doubles range (thus 100mW gives twice the range of 25 mW) then by chance 25 mW LoRa will cover about the same as 1 Watt PRS.

As fair as UHF data starters go, these days I suggest the extremely versatile US$5 Chinese HC-12 transceiver modules. I import these directly from Satisfy Electronics in China (freight free too), & all my work with them has been PICAXE related (& GUI config).

HC-12 now have significant Arduino/Instructable exposure, so suggest checking the likes of this => https://www.instructables.com/id/Long-Range-18km-Arduino-to-Arduino-Wireless-Commun/

Regards- Stan.

1 reply

(/member/manuka/) manuka (author) 3 years ago

Reply Upvote

Kiwi firm Gallagher's approach is essentially water TANK level monitoring, which is probably less prone to stock mischief.& vegetation etc than open ponds/dams. A quick Google shows an Australian firm seemingly offering similar, with the 2 way radio gear off the shelf UHF CB PRS handhelds! See => http://www.electrosense.com.au/uhf-telemetry.htm

But you can't beat "management by walking around" on a farm! There may be the likes of sick/dead cattle polluting the pond that a sensor would not register. Here in NZ some farmers are already using agricultural drones to check crops, stock, gates & dams etc - ranges of the on board video camera can be several km ! See a recent ag. drone review => https://bestdroneforthejob.com/drone-buying-guides/agriculture-drone-buyers-guide/ Stan.

3 replies

(/member/manuka/) manuka (author) 3 years ago

Reply Upvote

Scois: MATE - an 8000 acres "farm" & 20 km links (LoS ?) , along with seemingly a mission critical stock watering need ! We are NOT talking hobby farm/kids stuff here, & I suspect the application is also VERY commercial.

Thought for the future - specify the setup RIGHT at the beginning of a technical request so helpers can better get an handle on things.

At least in outback Queensland you should have plenty of sun for solar charging, but the implications of something falling over are pretty profound... I was raised on a NZ farm & well know how even simple things (stock hi jinks etc) can cause mischief...

25 mW LoRa at 433 MHz may just do but I'd say that UHF CB "PRS" channels 21 & 22 are best suited. These legally allow 5 Watts TX power & are specifically assigned for just such telemetry & telecommand applications. Regards- Stan.

3 replies

(/member/Scois/) Scois (/member/Scois/) 3 years ago

Reply Upvote

Hi,
At the time of writing this article, you seemed quite fond of the Dorji DRF1278DM module. Is this still the case? Later on you mention HopeRF as well?
I am playing around with a Modtronix SX1278 module. I uses SPI connections which I found a bit complicated. I hope something like the Dorji, with its TTL connection will make my life a bit easier.

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