Radiometrix

Hartcran House, 231 Kenton Lane, Harrow, HA3 8RP, England

Tel: +44 (0) 20 8909 9595, Fax: +44 (0) 20 8909 2233

29January 2008

Application note 011

Not all radios are created equal

By Myk Dormer - Senior RF design engineer, Radiometrix

(First published in Electronics World magazine. Jan 2007 issue)

- "ISM band: that's all garage door openers and door bells ?"
- "You need a licence to do that ?"
- "10 milliwatts? That won't reach the next room"
- "BlueFiBee will fulfil all possible wireless connectivity requirements"

There are an awful lot of misconceptions to be found when looking into the subject of 'low power' or 'ISM' radio. Partly this stems from this being a very broad categorisation indeed, and partly from the (all too human) attempts by suppliers in this area to push 'their' solution as the only one. In this article I will attempt to un tangle a few of the confusions. I hope.

The terms 'low power radio', 'ISM' (industrial, scientific and medical) and 'SRD' (short range device) has come to refer to a wide class of data communication radios with transmitter output powers of less than 1 watt (although many are below 10mW), operating at ranges of less than 500m (...but some can reach over 10km) and a wide variety of data rates (below 100bit/sec, to over 1Mbit/sec). They are used in general data communication, remote control, monitoring and alarm applications. The term 'telemetry' radio is also applied to these devices (but incorrectly, as 'telemetry' means 'remote measuring' which covers only some of these applications)

Fig 1: A NBFM ISM band transceiver

Most radios in this class operate in 'unlicensed' areas of spectrum, where regulatory authorities allow suitably approved and tested radios to be used without the need for individual user licenses. Some parts of this spectrum is assigned to 'general' usage, while other bands may be limited to (for instance) alarms, or remote meter reading. Unfortunately, despite attempts to harmonise usage within the EU and beyond, the permissible bands and approval standards can vary from country to country. Most of Europe, Africa and Australia have fairly similar regulations (look for the "EN300-220-3" standard approval), but America and Canada are totally different (FCC 'chapter 15, part 247'). Great care is needed in selecting radios for a globally marketed product.

So what is available ? Assigning any absolute categories is fraught with difficulty, so instead we will consider them in terms of usable range. (In all these cases the 'range' quoted is in a typical in-building or urban environment. Much longer ranges are seen across valleys, over sea, or air to ground. In fact, any range quoted by a manufacturer must be taken with a large pinch of salt)

- **Up to 10 meters**: Two very different types of radio provide very short range coverage.Simple remote control tasks (toys and gadgets, controls for domestic goods) are typically handled by primitive 27 and 40MHz designs, while high data throughput links (digital wireless audio, computer peripherals, point of sale terminals) use complex integrated circuit solutions, frequently using protocol standards such as Bluetooth in the 2.4GHz band. (Although in car control and monitoring applications use simpler, low data rate conventional wireless)

- **Up to 50 meters:** Wireless LAN and other high throughput systems use WiFi or similar in the 2.4 or 5.8GHz bands. Complex mesh-network systems (data gathering, home automation networks) use ZigBee, or one of it's imitators. Simpler one to one, or polled network, data systems, and higher end remote control tasks use lower cost, lower power conventional wideband radios in the 433 or 868MHz (915MHz in USA) allocations (either simple modules, or single chip radios)

- **Up to 200 meters**: Alarm systems, vehicle data download systems. As range increases, the 2.4GHz high speed units reach their limit. Conventional wideband modules begin to show superior RF performance to single chip solutions and simpler narrow band radios are used for critical industrial and alarm tasks. High data rate links using 2.4GHz require more sophisticated, fixed aerials. In USA/Canada this market segment is addressed by high power 915MHz spread spectrum radios.

- **Up to 500 meters**: Industrial control and monitoring, large site alarm systems. More complex narrow band radios dominate, frequently multichannel to improve adaptability and allow multiple co-sited systems. Data rates rarely exceed 10kbit/sec. Low power VHF equipment is used (lower path loss, giving more range for given power)

- **Over 1km**: Long range telemetry and command, remote operated vehicles, high value asset tagging. Only VHF band and higher powered (500mW) UHF radios offer sufficient link reliability. National regulations become more of an issue, as not all countries have suitable bands. GPRS infrastructure modems begin to compete where good network coverage is available

Fig 2: A 500mW multi channel VHF transceiver

- **Over 5km:** Marine data telemetry, agricultural control. Of all the unlicensed ISM band radios, only VHF units can offer this range, and even then good aerials will be needed. At these ranges licensed operation (UHF, with much higher allowable transmitter power) starts to become economic, as does GPRS (assuming coverage) and admittedly high cost satellite based systems (ARGOS for instance)

Any more range than that, and we're in a very different area indeed.

Radiometrix Ltd

Hartcran House
231 Kenton Lane
Harrow,
Middlesex
HA3 8RP
ENGLAND
Tel: +44 (0) 20 8909 9595
Fax: +44 (0) 20 8909 2233
sales@radiometrix.com
www.radiometrix.com

Limitation of liability

The information furnished by Radiometrix Ltd is believed to be accurate and reliable. Radiometrix Ltd reserves the right to make changes or improvements in the design, specification or manufacture of its subassembly products without notice. Radiometrix Ltd does not assume any liability arising from the application or use of any product or circuit described herein, nor for any infringements of patents or other rights of third parties which may result from the use of its products. This data sheet neither states nor implies warranty of any kind, including fitness for any particular application. These radio devices may be subject to radio interference and may not function as intended if interference is present. We do NOT recommend their use for life critical applications.

The Intrastat commodity code for all our modules is: 8542 6000