LPRS

Europe's leading supplier of short range radio modules and solutions.

Sub-1GHz Radio

The Best Solution for the Internet of Things?

Over the past few years there have been endless discussions around the complexities facing the evolution of IoT (Internet of Things) technology. In a recent webinar led by Rick Winscot, a Pennsylvanian State University Professor specialising in Information Systems and Technology, three common issues engineers face when designing products for the IoT were highlighted; cost, features and security. More recently a fourth issue has arisen - range.

$$\text{Path Loss} = 20 * \log_{10}\left[\frac{4 * \pi * d}{\lambda}\right] \{dB\}$$

Freiss Frequency Formula

To simplify: for the same transmitter power, receiver sensitivity and other conditions, the lower the radio frequency (lambda) the greater the range. As an interesting aside and demonstration of this phenomena submarine communications operating at VLF (Very Low Frequency) can cover the Globe!

Whilst wired Ethernet will be almost certainly used for the 'backbone' network communications, the use of wireless provides much greater convenience for the 'end nodes' (edge devices) such as sensors and actuators. The physical wiring of such nodes within a building or infrastructure can be difficult, time consuming and very inflexible to change of location. 'Wireless' is therefore the obvious choice for these nodes but not so obvious is the particular wireless technology that is best suited for this application.

Wi-Fi (802.11 at 2.4GHz) would at first seem to be the best contender for this connectivity as users are now very familiar with this ubiquitous technology. However the practical range (distance) limitations are well known throughout the industry and perhaps through personal experience within even a domestic environment. In the real world of: a high density saturated radio spectrum, multiple devices within proximity to each other, brick walls and steel reinforced buildings, Wi-Fi can be rendered grossly inadequate for this task. It is of course possible to use 'repeaters' or range extenders but these are really intended as quick 'workarounds' to fix what is the basic problem, that Wi-Fi has inadequate practical range!

Looking at the theoretical formula (right) we see that radio path loss (effective range) is inversely related to frequency. The question is what other (lower) frequencies could be used? The answer is the sub-1GHz frequencies made available for licence free operation in the Industrial, Scientific and Medical (ISM) bands of 433MHz and 868MHz (Europe) and 915MHz (US).

"So both from a theoretical and practical perspective sub-1GHz radios offer better range than Wi-Fi radios."

The use of this sub-1GHz radio is therefore growing ever more popular as Design Engineers strive for longer range combined with the need for lower power consumption. On the topic of power consumption it should be noted that whilst Wi-Fi radio transceivers often consume hundreds of milliwatts (mW), sub-1GHz radio modules typically consume an order of magnitude less. There is yet another important issue to be taken into account if the 'node' is to be battery powered. A Wi-Fi device in sleep mode may take considerable time to wake up and make or re-establish connection to the Wi-Fi router as it exchanges network credentials. Whereas a sub-1GHz device can wake and be exchanging data with the host in milliseconds.

In Professor Winscot's webinar he states that lower frequencies also benefit from less interference.

Will you be brave enough to delve into a sub-1GHz world and explore it's long range, low interference benefits, or will you follow the crowd and continue on the high power consumption, unreliable, shorter range Wi-Fi bus?

"Freiss tells us that higher frequencies are more susceptible to interference and that signal range and coverage is reduced proportional to the amount of interference. So more 2.4GHz devices in proximity equals more 'noise' resulting in less coverage. You are not going to get the distance on the datasheet with all that interference. On the other hand, sub-1GHz radios do not react to the interference in the same way and they are much more forgiving, meaning you will more easily achieve the advertised distances. They are much less susceptible to the 'interference factor'."

So both from a theoretical and practical perspective sub-1GHz radios offer better range than Wi-Fi radios.

A slight objection to using the sub-1GHz bands is there is not one frequency band that can be used throughout the world. The new eRIC9 (915MHz or 868MHz) module from LPRS (Low Power Radio Solutions Ltd) solves this issue by offering frequency band selection (by pin state) to meet both North American and European market requirements and approvals in one module. The eRIC4 (433MHz) version covers all of Europe and Asia-Pacific.

So the question is – will you be brave enough to delve into a sub-1GHz world and explore it's long range, low interference benefits, or will you follow the crowd and continue on the high power consumption, unreliable, shorter range Wi-Fi bus?