1. Preface
This whitepaper describes how it is possible to easily upgrade legacy RS-232 designs to USB compatible designs using the nRF24E1 and nRF9E5 devices together with the Cygnal CP2102 RS-232 to USB converter device.

2. Introduction
Historically RS-232 has been the mainstay for industrial and commercial data-acquisition systems. Over the past 5 years or more there has been a growing necessity for these systems to interface to USB. This has become all the more important as serial ports are starting to disappear on many portable PC’s and are become less common also on some stand-alone units also.

Engineers have become very familiar with the venerable COM port and most embedded designers are fully comfortable with communicating across USART’s at whatever is their chosen speed of data transfer. It is not all plain sailing however familiarity with the intricacies of USB communications is not trivial and is certainly more demanding than those across serial data links.

3. The USB design-time problem
As mentioned, for many small to medium volume applications, especially in the arena of data-acquisition, control and monitoring there is a legacy of products that interface to standard serial RS-232 communications via a COM port. In addition design centers may not currently have the requisite skill-set in-house to comfortably develop USB-based applications. Coupled to this is the difficulty in finding, or worse still, writing drivers for PC-based applications in order to obtain data via the USB port and handle it in an application, be it a 3rd party application such as LabView or a proprietary solution.

For many such applications the full speed of USB is not a requirement, it is purely to address the issue of COM port availability, and also the need for products to appear up-to-date and modern by way of USB port usage.

4. Data capacity requirements over ISM RF links
It is important to bear in mind that typical ISM radio speeds are in the region of 20 to 70kbs for ISM radio devices running in the 433/868/915 MHz bands. This means that a device that can handle the maximum datarates available here will be quite sufficient for any application. Full USB speed is not necessary for such applications.
5. The solution – nRF9E5 & CP2102

The Nordic Semiconductor nRF9E5 is a fully-integrated system-on-chip available as a standard component. It has the following feature set:

- Tri-band receiver architecture for 433/868/915 MHz ISM frequencies
- Nordic ShockBurst auto-protocol engine
- Enhanced 8052 architecture capable of greater than 1Mips
- 10-bit 100ksps ADC
- PWM
- USART
- On-chip power regulation for 1.9v operation

This device allows almost any application to be carried out on a single chip with the bare minimum of external components required for operation. Data operations, frequency hopping and networking functionality can be implemented in the RAM space available on the device.

5.1. SiLabs Cygnal CP2102 RS-232 to USB converter

Cygnal have developed a very useful device that, in a single chip, with no external crystal requirements can negotiate the transfer and conversion of data between USB and RS-232 in both directions. Serial data speeds are catered for from 300 to 921600 baud, it is fully compatible with the both USB1 and USB2 standards.

The use of the device also enables the application developer to use and distribute the necessary PC drivers for functionality over Microsoft Windows 2000/XP/98/CE, Linux and also MAC OS. The design approach using the nRF9E5 and the Cygnal CP2102 is illustrated in fig. 5.1

![Fig. 5.1 Interface scheme between nRF9E5 and CP2102](image-url)
6. **In operation**

When this system is implemented correctly the communications link is effectively a serial one between the nRF9E5 and the PC. Both PC and the nRF9E5 will regard communication as serial RS-232. The PC will allocate the next available COM port to the CP2102 automatically. The nRF9E5 will communicate with the CP2102 as if it were dealing directly with the COM port, there is no further protocol handling to be implemented in software.

7. **Conclusion**

This whitepaper has hopefully served up a quick and expedient alternative to full USB development for some applications. It is fully understood that there there are some very low-cost USB microcontrollers available today, and for high volume applicatons this solution with the inclusion of the CP2102 may not be competitive enough. It is however a useful alternative for small to medium scale development works that have legacy software in the field and where time to market is a dominant factor.

For more information about nRF products see: [http://www.nordicsemi.no](http://www.nordicsemi.no)

For more information about CP2102 see: [http://www.silabs.com](http://www.silabs.com)
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