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This research project is being conducted by Ivy Biomedical in Branford CT to determine if a wireless patient monitoring device can be used to replace a wired patient monitoring device during a magnetic resonance imaging (MRI) scan in a hospital environment.

Ivy biomedical currently manufactures and sells cardiac gating modules which collect patient electrocardiogram (ECG) data. The ECG data is used to synchronize scanning on a MRI scanner with the patient's cardiac cycle. This improves image quality and diagnostic utility. With the current wired approach, the patient is tethered to the MRI gantry by a set of lead wires which transfer the ECG data from the patient to the MRI gantry. There would be several advantages if this cardiac gating data could be transmitted wirelessly so that the patient was not directly connected to the MRI gantry. These advantages include improved patient comfort, less risk of patient entanglement in the lead wires, and increased patient throughput from the ability to connect the ECG leads to the patient before entry to the MRI exam room.

After a survey of existing wireless standards (among them: Bluetooth, ZigBee, and 802.11) we were unable to find a standard protocol which could meet our requirements. The ECG data must be processed and a trigger signal delivered to the MRI scanner with minimal delay and variability (dither). The current Ivy Biomedical wired solution provides approximately 10ms of delay from the peak of the patient's ECG signal to the gating signal delivered to the MRI scanner. The dither in the delivery time of the trigger is on the order of 100us. None of the available wireless standards appeared capable of delivering small packets of data with latency and dither that met our requirements and we have started design on a custom wireless solution.

To accomplish this wireless data transmission, we have chosen a Nordic Semiconductor NRF24LE1 Ultra-low power wireless system on a chip. This RF transceiver operates in the world wide ISM frequency band between 2.400 and 2.4835 GHz. The maximum power output of the chip is 0dBm. We will be using a chip antenna, external antenna, or an antenna fabricated in the circuit board with a gain of less than one and no power amplifiers. In addition, we expect the on-air duty cycle will be less than 50%. Given the properties of the Nordic radio and our anticipated antenna, we expect the radiated emissions of our transmitter to be below the 0dBm limit for unlicensed devices.