

Two-way Radio  
Wireless Communication  
Accessories

# Technology & Company

Abstract



**FREELINC**

## THE COMPANY

Founded in 2003, FreeLinc emerged on the emergency response scene with the industry's first and only wireless accessories for two-way radios. The Utah startup's innovative, patent-pending concepts answered users' needs for cord-free operation, reliable and secure communications, durability and comfort in headsets and speaker microphones for two-way radios.

FreeLinc's product line was developed to fit public safety, government/military, and select commercial applications. By focusing exclusively on these markets, the wireless-accessories pioneer has been able to provide technologically superior products and back them with reliable, knowledgeable service.

Its vigilant efforts to "untether" workers from their bulky two-ways have already earned it much growth and recognition. Hence FreeLinc is fast becoming known as a leading brand in mission-critical product design. FreeLinc will continue on this success track for years to come, refining existing products and introducing freedom-of-motion to vastly more customers across the country and around the globe.

## THE TECHNOLOGY

FreeLinc products are developed using cutting-edge wireless technology based on Near-Field Magnetic Communication (NFMC), which supplies the core of every FreeLinc product. NFMC supports mobility, freedom-of-motion, exceptional battery life, audio integrity, ease-of-use, durability, secure communications and comfort.

NFMC communicates wirelessly by coupling a low power, non-propagating, quasi-static magnetic field between devices. The carrier frequency of the field is nominally 13.56 MHz (other frequencies can be used) and is modulated with Gaussian minimum shift keying (GMSK), a minimal bandwidth digital frequency modulation technique. The range for NFMC – one to three meters – is both predictable and highly reliable due to a  $1/r^6$  attenuation in magnetic field energy and the lack of interferers in the frequency band.

While the concepts behind magnetic communication have been around for decades, FreeLinc's NFMC is the first technology of its kind to be implemented into practical voice and audio solutions for two-way radio communication. A thorough comparison of NFMC to competing wireless options clearly illustrates why the technology is the superior choice for FreeLinc's applications:

**Two wireless technologies** have promised to deliver an alternative to wires for personal audio applications: NFMC and Bluetooth wireless. Bluetooth is an industry standard that utilizes conventional radio frequency (RF) wireless communication whereby a modulated RF plane wave propagates through free space. Like NFMC, it is modulated using GMSK but at much higher and heavily populated carrier frequency. Its attenuation behavior is theoretically  $1/r^2$  in free space but in actuality is quite difficult to predict, especially in indoor situations.

As a result, Bluetooth's range (which is specified at ten meters) varies widely depending on the environment and channel quality. Range performance is also strongly affected by the presence of people and objects as well as by other occupants of the spectrum, including other Bluetooth users, 802.11 devices, cordless phones, and microwave ovens. However, perhaps the most significant factor impacting the achievable range is the type of transmitted information through the affected channel.

Many similar conventional RF communication systems are optimal for sending large amounts of information and communicating over long distances. Yet all consume power, create information security issues, and often result in interference, crowding, and limited reliability among devices. In the 2.4GHz and 900MHz ISM frequency bands, for example, simultaneous operation of a cordless phone, WiFi network and Zigbee handset is frequently not possible without severe degradation of transmission/reception quality. RF-only systems can fade, null, be blocked, or have multi-path signal degradation in the presence of either people or obstacles.

***In sharp contrast***, NFMC operates in a "bubble" that envelops one to three meters of each user's personal space, and is – by the laws of physics – fully private and secure. The result is an easier to use, lower cost system that makes far more efficient use of power and bandwidth than conventional RF systems. Additionally, the tight communication afforded by the  $1/r^6$  roll-off of the magnetic field energy allows for several users of NFMC systems to be co-located with guaranteed system fidelity. The only known potential interferers, 13.56MHz RFID readers (not tags), experience the same  $1/r^6$  roll-off—and thus interfere only when within a one-meter range.

An NFMC wireless link in an audio application has a raw channel bandwidth of 408 kbps, of which approximately 24 kbps is reserved for overhead and back channel communication. The net result is about 384 kbps reserved for the transmission of the audio content. Because of the bubble-like distribution of the magnetic signal, this synchronous bandwidth is guaranteed and is not shared with other users, even if they are in close proximity.

By limiting the range and bandwidth to only what the application requires, NFMC achieves a very substantial savings in power (10 mA at 2V). Signals are designed to propagate only within a two-meter range, enabling a huge power and battery advantage (up to six times) over competing RF solutions. Additional power saving is achieved through the much lower carrier frequency and the use of a lower complexity protocol stack.

More NFMC technological benefits include:

- Dedicated communication channels – unaffected by surroundings and largely interference free.
- No bandwidth sharing – bubble-like continuous signal minimizes latency, lost packets, bit errors.
- Worldwide regulatory flexibility – no additional FCC/IC/ETSI certification required.
- Reliable coexistence with WiFi, CDMA, TDMA, GSM –no noise, pops, static, dropouts or fading.
- Sufficient bit rates for quality voice – 384Kbps reserved for the transmission of audio content.

## THE CUSTOMER

Two-way radio users in military, security, law enforcement and public agencies have long had a real need for cord-free communications. Before FreeLinc however, the only wireless technologies available required the use of RF transceivers, which are prone to interference from other RF devices (microwaves, cordless phones, remote controls, etc.), making them unreliable. Such RF technologies have also been susceptible to interception and eavesdropping, and have proven power-hungry and difficult to power with current battery technology. Thus, the long-felt need for cord-free radio accessories was left unmet in these markets.

On top of that, agencies today are facing an increased demand for products that are more technically advanced and that meet military specifications. FreeLinc's cutting-edge technology provides the best solution currently available for reliable, secure, and private short-distance wireless communications. Every FreeLinc two-way radio accessory makes communication easier and safer:

***Law Enforcement.*** Officers in the field constantly struggle with bulky, cord-laden communication systems – from handheld portable radios to in-dash mobile radios. The need has never been greater for reliable, secure, private communications in law, while at the same time officers are increasingly faced with situations requiring freedom-of-motion, physical responsiveness, and rapid response. By tailoring NFMC technology to these needs, FreeLinc is finally able to eliminate the accessory cable for officers by avoiding the weaknesses inherent to RF-based wireless technologies. Officers that use FreeLinc products can have complete freedom-of-motion without the risks of interrupted or intercepted signals.

***Government/Military Operations.*** The most notable recent development in government/military has been increased precautions due to active homeland security initiatives. Customers in military, security and some public agency roles have a real need for protected communications. By utilizing the best medium currently available for secure and private short-distance wireless communications, FreeLinc helps forces maneuver more freely knowing they are free from both wires and eavesdroppers. In addition, eliminating the cable between the headset or speaker microphone and the radio allows individual users to equip faster, thus increasing readiness and mobility.

## THE PRODUCTS

For a majority of two-way radio users, wires are cumbersome and limiting. *Wired* accessory manufacturers have addressed these issues by employing advanced audio components and/or industrial-strength product designs. New to the industry, FreeLinc has been able to select and employ those features that have already proven useful in the field. Thus the company's current and future products benefit not only from its new, patented features and robust technology, but also from established public-domain technologies.

Moreover, FreeLinc knows that users of its products share one fundamental need: hands-free operation of two-way radios. The company's singular mission to "cut the cable" provides customers with a full freedom of motion that can only be met by wireless. FreeLinc's general product line includes the following two core components. Refer to FreeLinc's product brochure for physical specifications unique to each product design.

***FreeMic 200 Cordless Speaker-Microphone*** (speaker-microphone, adapter for two-way radio, and wall charger) was designed for use during everyday patrol duties, and so is constructed from industrial-strength plastic (withstanding temperatures between  $-40^{\circ}$  and  $+80^{\circ}$  C for all-weather, all-environment use). It attaches securely via a heavy-duty spring-clip, and communicates wirelessly with the two-way radio adapter via NFMC technology. The speaker-mic design includes a push-to-talk (PTT) button, a voice operated transmission (VOX) feature, a 2.5mm jack for attaching earphones for closed speaker operation, a jack for connecting to a battery charger, and an LED battery charging indicator. Weighing only 113 grams, each speaker-mic features:

- Rugged design for daily use – with convenient push-to-talk on the speaker-mic.
- Exceptional battery life – up to 20 hours total talk time.
- Unrivaled reliability – unaffected by signal degradation or obstacles.
- No spectrum contention - transmissions within communication bubble are unaffected by RF.
- Clear communication – uni-directional electret microphone for always-on audio fidelity.

***FreeMotion 200 Wireless Headset*** (earpiece with boom microphone, adapter for two-way radio, and wall charger) was designed for surveillance and tactical applications, as well as situations requiring closed-speaker operation. It is an extremely durable earpiece constructed of industrial-strength plastic (withstanding temperatures between  $-40^{\circ}$  and  $+80^{\circ}$  C for all-weather, all-environment use). It fits securely behind the ear, and communicates wirelessly with the two-way radio adapter exclusively via NFMC. Each headset design includes a variety of comfortable ear gels, a push-to-talk (PTT) button, a voice operated transmission (VOX) feature, a small boom microphone, a jack for connecting to a battery charger, and an LED battery charging indicator (this LED only illuminates when plugged into the charger).

Although the current design, tailored to the special operations and public safety markets, provides a steady fit out of the box, the product is also designed to work with custom-fit ear gels for applications involving physical encounters or extremely active use. Weighing only 30 grams, each headset features:

- Rugged design for daily use – with convenient push-to-talk on the headset.
- Exceptional battery life – 20 hours total talk time, four weeks standby time.
- Unrivaled reliability – unaffected by signal degradation or obstacles.
- No spectrum contention - transmissions within communication bubble are at 13.5MHz.
- Clear communication – uni-directional electret microphone for audio fidelity.