A Breakthrough in Wireless Audio: A White Paper on Zaxcom's Narrow Band Direct Conversion Technology

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Abstract

Professional wireless audio in the media and entertainment industry has evolved significantly over the last two decades. Today's productions require a greater number of wireless channels, while sound professionals work in RF environments that are more congested and less predictable than ever before.

To meet these demands, the receiver in a professional wireless audio system must reliably preserve a selected signal, even under weak or low reception conditions, while effectively rejecting interference from surrounding transmissions.

In 2023, Zaxcom initiated the development of Narrow Band Direct Conversion, an innovative receiver architecture aimed to respond to these requirements. The technology debuted in May 2026 with DCiRX, an audio device that integrates a receiver, recorder, automixer, and USB-C interface.

Our design approach to Narrow Band Direct Conversion has been found to achieve superior interference rejection, more robust near/far performance, improved power efficiency, and greater scalability for next-generation wireless systems.

Challenges of Modern Productions

Modern wireless audio productions operate in increasingly congested radio frequency (RF) environments populated with broadcast facilities, cellular networks, intercom systems, two-way radios, Wi-Fi access points, Bluetooth equipment, and other high-power RF sources, making reliable wireless audio transmission more challenging than ever.

At the same time, professional sound recordists are relying on more wireless channels while placing equipment in closer proximity. Simply locating an unoccupied frequency is no longer enough for professional wireless audio. A receiver must provide sufficient selectivity and interference rejection to protect the desired signal from nearby RF sources.

As wireless spectrum availability continues to decline, interference rejection is becoming an essential performance requirement for professional wireless audio systems.

Limits of Established Architectures

Professional wireless audio systems in the media and entertainment industry have traditionally relied on different types of receiver technology. Among them include Superheterodyne and Wideband Direct Conversion. Both approaches can work well but each carry limitations and compromises that become more significant as RF environments grow more complex.

Zaxcom designed its first Superheterodyne receiver in 2000. This architecture converts incoming RF to one or more intermediate frequencies (IF) where the signal can be filtered and

processed. The technology has provided reliable performance for professional wireless audio systems over several decades but the conversion process can introduce IF leakage, image-frequency sensitivity, crosstalk, and interference among multiple receivers placed close together. These limitations are inherent to the Superheterodyne architecture rather than signs of inadequate design.

Wideband Direct Conversion is well suited for applications such as cellular infrastructure, where power, antenna placement, and operating conditions can be managed. Applying the technology to wireless audio systems requires hardware that is less cost-effective, demands substantial power, and occupies more design space. Production sound recordists have different needs including the desire for equipment to be compact, lightweight, power efficient, dependable at ground level, often near other transmitters, and at a desirable price point.

Narrow Band Direct Conversion Architecture

Narrow Band Direct Conversion addresses interference before digitizing the wireless signal. A tunable tracking front-end filter selects the portion of the spectrum containing the desired signal. The signal is then down-converted and filtered through a 200 kHz window before being passed to the analog-to-digital (A/D) converter. Frequencies outside the 200 kHz window are rejected before they can degrade the performance of the A/D converter which is critical for filtering out interference and improving signal reception.

Compared with Narrow Band Direct Conversion, conventional wideband receiver architectures typically digitize 25 MHz or more of spectrum before using software to isolate the desired channel. This provides flexibility but exposes the A/D converter to signals the receiver does not need. If that unwanted RF energy overwhelms the A/D converter's dynamic range, the desired signal may be compromised before digital processing begins. Once information is lost during conversion, software cannot recover it. Processing a broad span of spectrum also requires faster conversion and more power.

> ***Example:*** *Imagine you are on a plane with rowdy passengers and a crying baby. Narrow Band Direct Conversion is the noise cancelling headphones that let in only what you want to hear.*

Since the A/D converter processes far less unwanted RF energy under Narrow Band Direction Conversion, it has a cleaner environment in which to resolve the intended signal. This is especially valuable in near/far situations or when a receiver is recovering a weak signal while a much stronger transmitter operates nearby. It also helps protect against reception from out-of-band sources such as walkie-talkies.

The architecture of Narrow Band Direct Conversion achieves more predictable and consistent performance under adverse RF conditions.

A Tracking Front-End That Adapts

Zaxcom's Narrow Band Direct Conversion operates across the 470–698 MHz UHF spectrum. Its tunable tracking front-end filter can be adjusted electronically in 1 MHz increments, allowing the receiver's 30 MHz front-end to follow the frequencies in a particular location.

Rather than remaining open to spectrum it does not need, the receiver focuses on the exact relevant operating window. The front-end filter can be tuned exactly to the frequencies of interest and is not limited by fixed frequency saw filters.

Efficiency by Design

Digitizing 200 kHz requires substantially less data handling than digitizing 25 MHz or more. The reduced processing burden supports lower power consumption, longer operating time, smaller devices, and less heat.

Independent Channels, Efficient Spectrum

With ZHD96 modulation, each wireless channel occupies 100 kHz, allowing up to 30 independent channels within a 6 MHz of spectrum. Each transmitter and receiver remains a complete wireless link.

This lets a wireless system grow one channel at a time and allows receivers to be placed where they are most useful. Productions can deploy only the spectrum and hardware they need, without making several audio channels dependent on a single shared RF transmission. Narrow Band Direct Conversion makes this independent channel approach more efficient and cost effective.

DCiRX, the First Product

DCiRX is the first UHF receiver built around Narrow Band Direct Conversion. It combines mono or stereo wireless reception with a direct input for a 5V lavalier or 48V phantom-powered microphone. Its four-track recorder captures up to three ISO tracks and one automix track with timecode in either 32-bit float or 24-bit fixed formats. A four-channel USB-C interface connects to compatible mobile devices, computers, and cameras and also carries timecode.

Together, these capabilities allow DCiRX to serve as wireless receiver, camera link, wired microphone and/or wireless audio, create isolated recordings, an automix track, or be integrated with a computer or mobile device. DCiRX expands capability while reducing the need for additional equipment.

Summary: Beyond a Single Receiver

Narrow Band Direct Conversion was designed as a scalable architecture rather than a feature of a single product. Zaxcom is now applying the technology to a new generation of multichannel wireless receivers using the same principles: prioritize the desired signal and reject unwanted RF interference before it can affect performance.