For Approval 10/30/07

An Introduction To Sony's Next Generation Digital Audio Wireless Transmission Technology

Exclusive to Broadcast Engineering

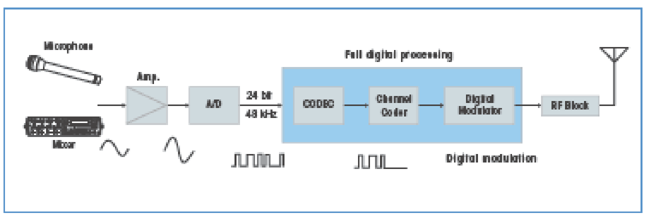
Analog vs. Digital Wireless Microphone Systems

In a conventional analog wireless system, a compander (compressor/expander) system has been the key element in allowing wide dynamic range transmission. A compander system is composed of complex analog circuits that provide sound quality and response characteristics. However, this analog system requires use of advanced techniques to keep performance levels constant, because analog circuits are, by nature, subject to the variable performance.

In contrast, the digital audio wireless transmission system is free from such fluctuations as it doesn't use a compander system. In short, digital audio wireless transmission is an optimum system to transmit high-quality audio signals without deterioration.

New Digital Wireless Transmitter

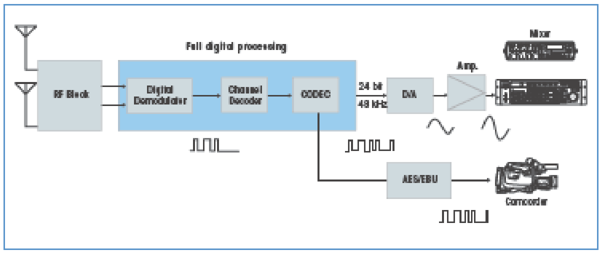
An analog audio signal is first amplified in the amplifier and digitized in the A/D converter. In the DSP, three types of processing are performed: digital encoding in the CODEC, channel coding in the channel coder, and modulated signal generation in the digital modulator. In the CODEC, the digital audio signal input from the A/D converter has data reduction applied, and it is converted into a low transfer rate digital stream. Subsequently, the channel coder adds the synchronization and error-handling data necessary for the wireless transmission, and then encrypts the data. After that, the digital modulator generates a PI/4 QPSK modulation signal for digital wireless transmission from the channel-coded digital stream. The modulation signal is then converted to analog through the D/A converter, and carried to the RF block. Finally, in the RF block, the modulated carrier wave is amplified to the adequate transmission power level and transmitted to the receiver.



New Digital Wireless Receiver

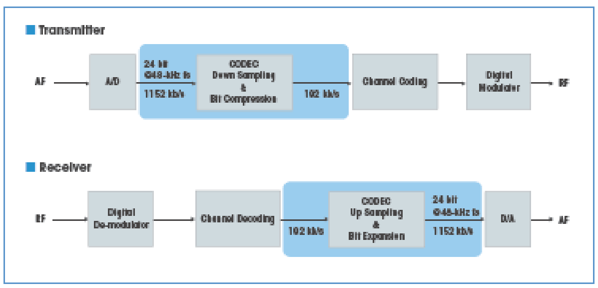
In the RF block, the received signal is digitized through the A/D converter. Similar to the transmitter, three main processes are then performed in the DSP: digital demodulation in the digital demodulator, channel decoding in the channel decoder, and digital decoding in the CODEC. After receiving the A/D-converted RF signal, the digital demodulator reproduces the digital stream that was channel coded at the transmitter. Then the channel decoder performs synchronization, decryption, and audio data abstraction processes.

Consequently, the CODEC decompresses the low transfer rate audio signal that has data reduced in the transmitter, and regenerates the digital audio signal. Finally, the digital audio signal is output to the audio equipment, either as an analog or digital audio signal. Should the audio equipment have a digital interface such as AES/EBU, the receiver can output the digital audio signal directly. Conversely, if the audio equipment is only equipped with an analog interface, the digital audio signal is D/A converted, amplified, and output by the audio equipment as an analog audio signal.



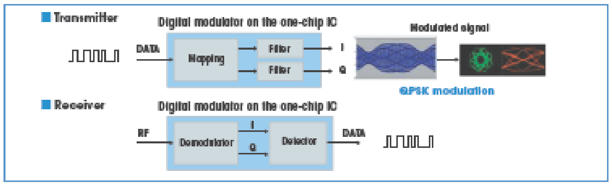
Sony Audio Codec Overview
In the wireless system, audio signals have to be transmitted within a limited wireless bandwidth. Transmitting the highest possible quality audio in this limited bandwidth is the major issue for wireless microphone development. In addition, low-latency audio transmission is another requirement of microphone applications. Sony is committed to designing audio codec technology that provides outstanding sound quality. To transmit the best quality audio within limited bandwidth, we decided to develop a digital wireless transmission system that employs the Sony digital audio CODEC, which realizes both outstanding sound quality and low latency.

The Sony digital audio CODEC has three main features; outstanding sound quality in 24-bit/48-kHz sampling, low latency and secure transmission. The Sony digital audio CODEC achieves an optimum balance between sound quality, bit-rate, and latency, while having the redundant bit assignment necessary for wireless transmission.

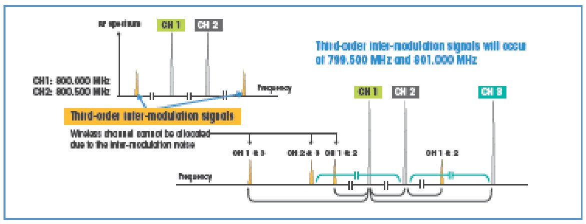


Low Latency Audio Transmission
The second key factor of the audio CODEC is its low latency. In a digital device, signal delays can often occur due to the sampling, synchronization, and calculation process. However, low latency is the mission-critical feature
especially in vocal and speech wireless microphone applications. In a commonly used CODEC, for example MPEG AAC, more than 20 ms is required just for decoding. In contrast, the Sony digital audio CODEC realizes an extremely low latency of 1.5 ms for both encoding and decoding by optimizing the balance between the redundant data assignment that is necessary for wireless transmission, synchronization processing, and codec processing. As a result, an extremely low latency of 3.6 ms – from the A/D converter of the transmitter to the D/A converter of the receiver – is achieved. In terms of spatial distance, latency becomes only 1.2 m.

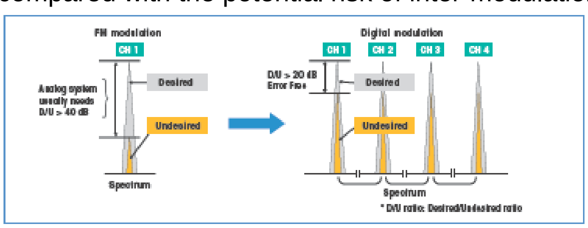
Digital Modulator and Demodulator Overview
In addition to the long experience of RF technology in the analog wireless transmission system, the digital audio wireless transmission system incorporates a digital modulation system that is less subject to wave interference. These technologies allow highly stable wireless transmission even for a large number of simultaneous multi-channel operations. The newly developed Sony one-chip digital modulator and demodulator enables up to 12 channels of simultaneous multi-channel operation in a bandwidth of just 6 MHz. Using a unique algorithm optimized for wireless microphone applications, this one-chip IC device is small enough to be integrated into a relatively small-sized general DSP for portable devices.



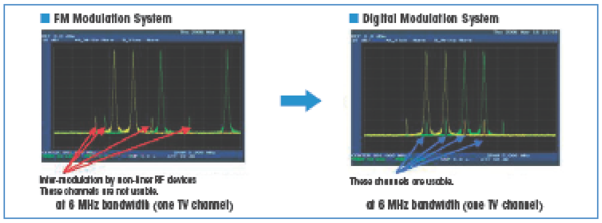
<u>Increasing the Number of Simultaneous Wireless Systems</u>
The RF design is an important technique to realize multi-channel operations. In wireless systems with multiple channels, the inter-modulation that is generated in the RF amplifier of the transmitter/receiver often causes interference between the wireless channels. The RF block of the analog wireless system is designed with careful considerations to eliminate such inter-modulation. However, the inter-modulation cannot be constrained either in the analog or digital system if the RF part is composed of analog circuits.



<u>Advantages of New Technologies</u>
Then why are digital systems advantageous to simultaneous multi-channel operation? As shown in the chart below, the D/U (Desired/Undesired) signal ratio will be the S/N ratio of demodulated audio signal in the analog system. The
higher the undesired signal level, the higher the noise will be in the modulated signal. Typically, the analog system requires a 40-dB D/U signal ratio.
On the other hand, the audio signal in the digital system does not deteriorate when an error does not occur. In the Sony digital wireless system, an error does not occur when it provides a D/U signal ratio of more than 20 dB. More specifically in the digital system, no audio signal degradation occurs as long as the D/U signal ratio reaches 20 dB, even if the undesired signal level is strong. For this reason, the digital system is far more tolerant to the undesired
signal of the analog transmission system (more than 20 dB), and thus has an advantage compared with the potential risk of inter-modulation interference.



<u>Increasing the Number of Simultaneous Wireless Systems</u>
The advantage of undesired signal tolerability brings about a great improvement in simultaneous multi-channel operation. The figure below (left) shows channel allocations in a conventional analog system. Here, it is necessary to assign channels by skipping unusable channels where inter-modulation occurs. In contrast, the below figure (right) shows the channel allocation in a digital modulation system. The effect of undesired signal is reduced to approximately less than 20 dB compared to the analog system. By combining the digital modulation system with an excellent RF circuit, even the inter-modulated channels can be allocated as usable channels. In other words, an equally spaced channel allocation is realized, without having to worry about inter-modulation. In the USA, for example, this allows 1.5 times more channels to be simultaneously operated compared to an analog system.



Conclusion
As described above, the technology used in the Sony digital audio wireless transmission system delivers outstanding sound quality and large-scale,multi-channel operation. This technological innovation can be applied not only for wireless microphone applications, but also for wireless audio transmission between a broad range of professional audio equipment.

This technology also has the potential to leverage any future improvements in DSP processing power or reductions in component size and power consumption – thereby enhancing system performance. What's more, its audio and data multiplexing capability allows for the wireless transmission of not only audio signal, but various other types of useful information too, offering further operational convenience. By incorporating these advanced technologies, Sony will continue to enhance the digital audio wireless transmission system, thereby opening up a whole new world of audio applications.

1363 words