Technical Article

Leveraging the 60-GHz RF Band for Intelligent Industrial mmWave Sensing

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Industrial designers are eager to use millimeter-wave (mmWave) sensors, given their ability to accurately sense the range, velocity and angle of objects in a scene. As cities, buildings and factories have become more intelligent, they need to have more accurate and intelligent sensing capabilities. The open 60-GHz radio-frequency (RF) band enables more uses of mmWave technology while delivering the high resolution needed for industrial environments.

Historically, mmWave sensors have used the 24- and 77-GHz radio bands. The 77-GHz band is common in automotive applications but has restrictions in most global regions for industrial factory, building and city infrastructure applications, including those that require human/machine interaction.

In addition, spectrum regulations and standards developed by the European Telecommunications Standards Institute and Federal Communications Commission prohibit new products from using the 24-GHz ultrawide band as of September 2018. All existing products using the 24-GHz ultrawide band must be phased out by the year 2022. These regulatory changes directly impact a sensor's range resolution, robustness and accuracy, as the available bandwidth on the 24-GHz band is reduced to only 250 MHz. Figure 1 compares the bandwidth available in the 24-GHz narrowband and 60-GHz band.

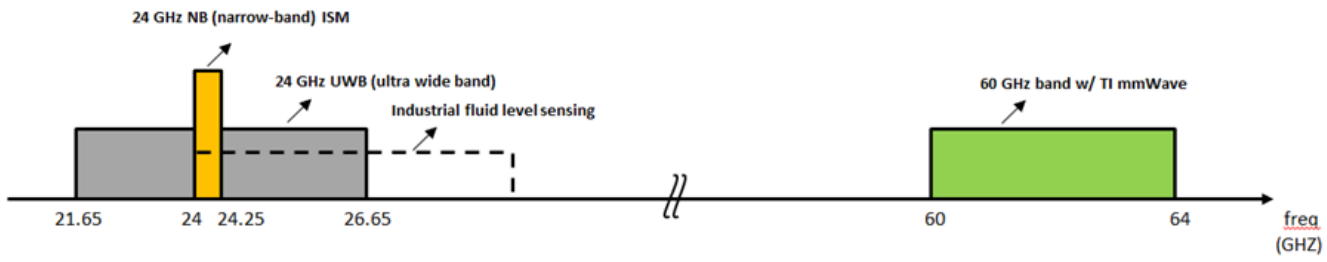

Figure 1. Comparison between the 24-GHz Narrowband and 60-GHz Ultrawide Frequency Bands

The 60-GHz band can be openly used for a wide variety of industrial applications in all markets worldwide. Sensors using this band are capable of gathering rich point-cloud data with high accuracy; TI 60-GHz mmWave sensors provide 4 GHz of ultrawide bandwidth, resulting in 16 times more available bandwidth than the 24-GHz band once the regulations take effect.

Sensor Accuracy and Edge Intelligence

Sensing objects accurately is a key requirement for mmWave sensors, but many applications need more than just simple object detection. TI mmWave sensors integrate a microcontroller, digital signal processor and fast Fourier transform acceleration, so they not only acquire data but also perform advanced applications such as object classification, providing intelligence at the edge.

By gathering rich point-cloud data and combining it with intelligent processing, mmWave technology can identify the number of objects in the sensor's field of view, indicate their location, and classify them. An example of classification is the ability to distinguish human movement from mechanical movement coming from ceiling fans, shutters or other objects in a building, as shown in Figure 2. For applications requiring precise detection of people, the detection of non-human movement would be considered false detection.

Figure 2. Using 60-GHz mmWave Sensors for People Classification (Red and Blue) and False Detection Mitigation (Gray)

Conclusion

As the upcoming regulation changes begin affecting industrial designs, you will need to reassess any systems leveraging the 24-GHz ultrawide band to determine their future viability before they are completely phased out.

Industrial sensing solution designers should consider the benefits of TI's 60-GHz integrated single-chip sensors for their ability to acquire rich point-cloud data in a compact form factor. Between having a higher center frequency and offering an integrated single-chip solution, TI mmWave sensors are capable of not just sensing and extracting the range, velocity and angle of objects, but also leveraging that information to count people, navigate rooms and classify objects. This processing capability enables the sensor to make decisions on the spot, while still communicating with the bigger network.

Additional Resources

- Read the white paper, "Choosing 60-GHz mmWave sensors over 24-GHz to enable smarter industrial applications".
- Get started with our modular development platform.
- Learn more about industrial mmWave on our website.

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