

FREQUENCIES FOR WIRELESS  
SENSOR NETWORKS:

# THE 900 MHz ADVANTAGE

*Why 900 MHz outperforms 2.4 GHz for IoT sensor networks in commercial buildings*

The rise of the Internet of Things (IoT) has transformed commercial buildings, enabling unprecedented levels of automation, efficiency, and data-driven decision-making. Wireless IoT sensors now play a critical role in optimizing energy consumption, enhancing occupant comfort, and streamlining facility management. By eliminating the need for extensive wiring, wireless sensor networks (WSNs) significantly reduce installation costs and complexity, making large-scale deployments more feasible and cost-effective.

However, the success of a wireless IoT deployment hinges on one fundamental choice: selecting the right communication frequency. This decision directly impacts network reliability, coverage, power consumption, and long-term operational stability. While 2.4 GHz has long been the default choice for many wireless applications due to its ubiquity, it is not

necessarily the optimal frequency for commercial IoT sensor networks.

In contrast, the 900 MHz band offers significant advantages, particularly in commercial buildings where interference, signal penetration, and power efficiency are critical factors. This whitepaper delves into the key performance differences between 900 MHz and 2.4 GHz, demonstrating why 900 MHz is the superior choice for robust, reliable, and efficient IoT communication in commercial environments. Through an in-depth examination of real-world performance metrics—ranging from signal penetration and interference mitigation to battery life and network security—this paper makes the case for adopting 900 MHz as the preferred frequency for modern smart buildings.

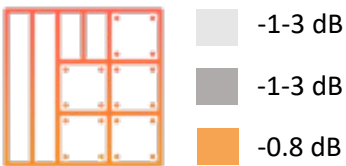
## SIGNAL PENETRATION & BUILDING MATERIALS

The effectiveness of a wireless sensor network depends greatly on the signal's ability to penetrate common structural materials found in commercial buildings. The 900 MHz frequency, characterized by its longer wavelengths, exhibits superior penetration capabilities through materials such as concrete, glass, drywall, steel, and wood. This ensures reliable signal coverage throughout entire buildings, minimizing dead zones and

significantly reducing instances of signal loss. In contrast, 2.4 GHz signals, with shorter wavelengths, experience much higher levels of attenuation, severely restricting their ability to traverse structural barriers effectively. Consequently, 900 MHz systems offer consistent connectivity and greatly enhanced performance in complex and large-scale commercial environments.

### COMMON BUILDING MATERIALS & AVERAGE ATTENUATIONS\*

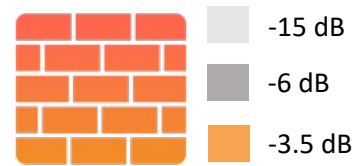
5 GHz      2.4 GHz      900 MHz



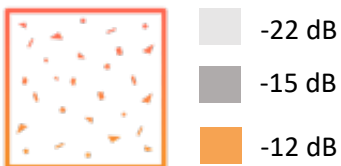
**DRYWALL**  
12.7 mm



**REINFORCED CONCRETE**  
203 mm



**BRICK**  
89 mm



**CONCRETE**  
102 mm



**BRICK-FACED CONCRETE**  
192 mm



**GLASS**  
6 mm

**\*SOURCES**

[Security Today](#) – Indoor Wireless Path Loss

[Digi](#) – Indoor Path Loss

[Wi-Fi Vitae / National Institute of Standards & Technology](#) – Wall Attenuation Measurements

## RANGE & COVERAGE

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The inherent advantages of the 900 MHz frequency extend to transmission range and overall network coverage. On average, the effective transmission distance for a 900 MHz signal is approximately twice that of a comparable 2.4 GHz system, enabling wireless sensors to maintain communication over significantly greater distances. This increased coverage capability

dramatically reduces the need for additional repeaters, extenders, or gateway nodes. As a result, installation is simpler, infrastructure complexity decreases, and total cost of ownership drops. Particularly in commercial environments where extensive sensor deployment is required, this improved range directly translates into substantial savings and simpler network maintenance.

### ATTENUATION DUE TO FREE SPACE PATH LOSS\*

DISTANCE	ATTENUATION	
	2.4 GHz	900 MHz
10 meters	81 dB	72.5 dB
100 meters	101 dB	92.5 dB
1000 meters	121 dB	112.5 dB

**\*SOURCE**

[Digi](#) – Indoor Path Loss

### REDUCED INTERFERENCE & ENHANCED RELIABILITY

Commercial buildings frequently experience high concentrations of wireless devices, notably Wi-Fi networks, Bluetooth peripherals, ZigBee controllers, and other consumer and professional-grade electronics. These devices predominantly operate on the crowded 2.4 GHz spectrum, increasing the potential for significant interference and signal degradation. Conversely, the 900 MHz frequency band is comparatively less congested and faces far fewer sources of interference. This reduced interference ensures a cleaner, more stable communication channel, directly contributing to higher data integrity, fewer packet losses, fewer retransmissions, and ultimately a more reliable and resilient sensor network.

### ENERGY EFFICIENCY & EXTENDED BATTERY LIFE

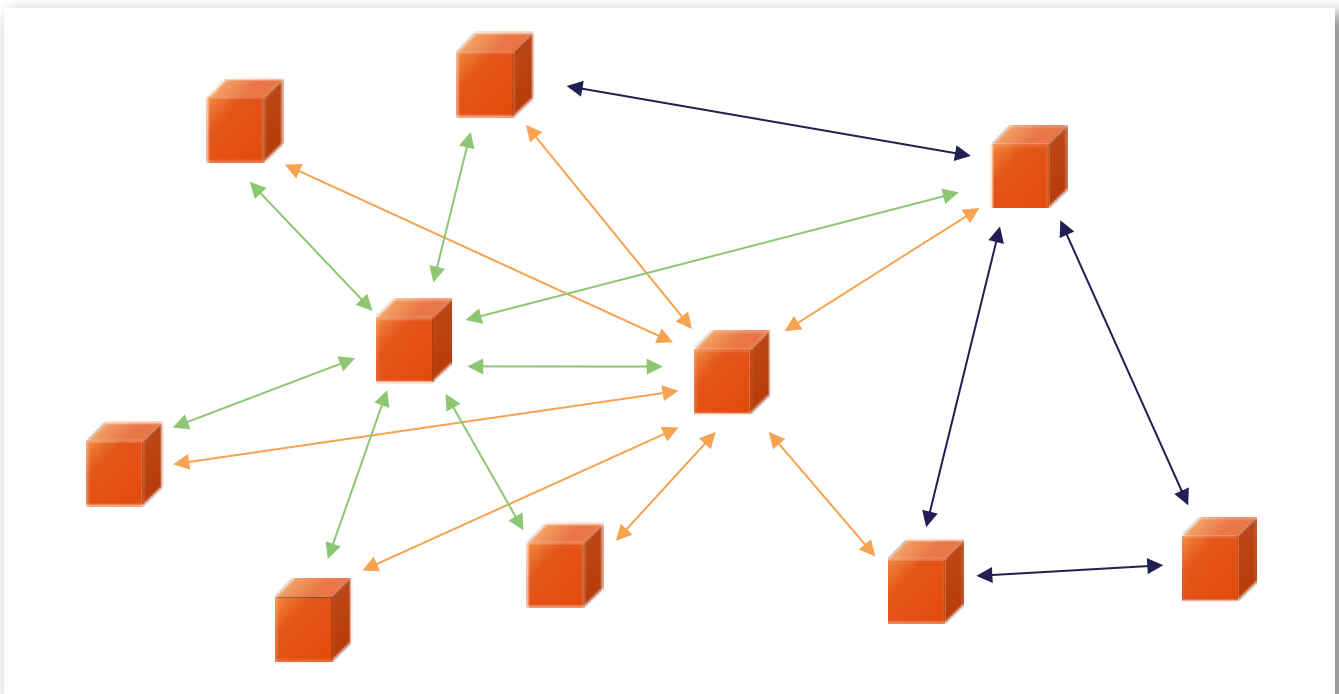
Power efficiency is a crucial factor for sensor networks, especially in commercial buildings, where frequent battery replacements would be both expensive and impractical. Sensors using 900 MHz communication benefit from reduced transmission power requirements due to the superior propagation characteristics of lower-frequency signals. In addition, the lower congestion and interference means there are fewer retransmissions. This results in lower overall energy consumption, significantly extending the operational lifespan of battery-powered sensors. The extended battery life not only reduces ongoing maintenance costs but also enhances network reliability and minimizes system downtime, thereby improving overall operational effectiveness.



## SECURITY & NETWORK STABILITY

Given that commercial buildings increasingly rely on secure, stable networks, the 900 MHz band provides an additional advantage in terms of security and interference management. The lower congestion levels and greater signal robustness simplify encryption and communication integrity management.

Networks based on 900 MHz frequencies are inherently more stable and less vulnerable to interference-based security threats, delivering enhanced protection for sensitive data transmitted within building automation and IoT ecosystems.



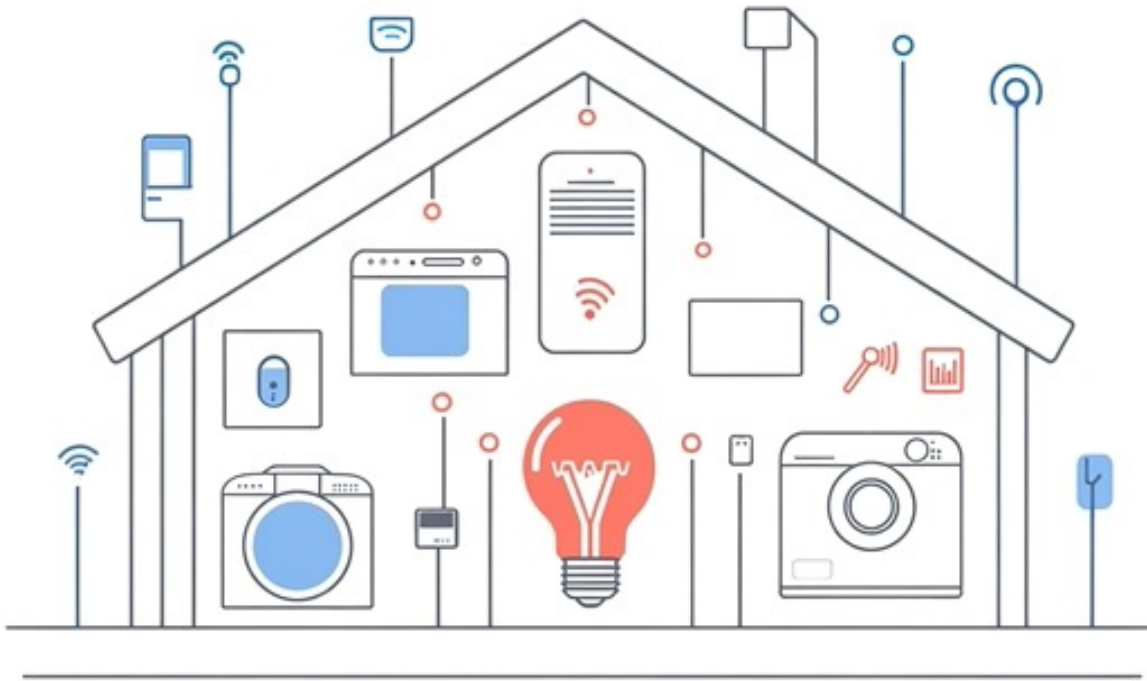
*An example of a wireless mesh network topology.*

## SO, WHY USE 2.4 GHz?

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Vendors primarily select the 2.4 GHz frequency for two cost-related reasons. First, due to the widespread adoption and ubiquity of Wi-Fi, the 2.4 GHz spectrum is extensively used in consumer electronics. Commercial manufacturers often leverage this abundance, benefiting from economies of scale and lower-cost components readily

available in the market. Second, the 2.4 GHz band has fewer regulatory hurdles, requiring less compliance certification compared to the 900 MHz ISM band, which faces fragmentation and varying regulatory standards depending on geographic regions or individual country requirements.





# REAL-WORLD RESULTS

In large-scale deployments — comprising tens of thousands of IoT sensors and controllers communicating over a 900 MHz wireless mesh network and gateway devices using 2.4 GHz Wi-Fi — differences between the technologies are evident. Despite the higher transmission power typically associated with 2.4 GHz Wi-Fi devices, their average uptime fell below 85%, as shown in the below chart

demonstrating 75F’s gateway connectivity in sites using customer Wi-Fi networks. This reduced reliability often goes unnoticed, as contemporary laptops and other Wi-Fi-connected devices increasingly utilize the less congested 5.8 GHz spectrum, alongside sophisticated upper-layer protocols like TCP/IP that provide robust error correction and retransmission capabilities.

■ 0 – 90% Connectivity   
 ■ 90 – 95% Connectivity   
 ■ 95 – 98% Connectivity   
 ■ 98 – 100% Connectivity



Gateway cloud connectivity using Wi-Fi networks. If Wi-Fi is ever down, 75F’s system automatically runs locally.





## CONCLUSION

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The 900 MHz frequency clearly offers substantial technical advantages over the 2.4 GHz frequency for wireless sensor communication in commercial buildings. Superior signal penetration through building materials, longer effective range, reduced interference, enhanced reliability, exceptional energy efficiency, and strengthened network

security collectively position 900 MHz as the optimal choice. Organizations committed to the efficiency, scalability, and robustness of IoT-enabled commercial building automation should strongly prioritize the adoption of 900 MHz technology to achieve superior network performance and long-term operational success.