White Paper

# Going Beyond 6 GHz

## How Wi-Fi 6E Is Reshaping RF Security Requirements

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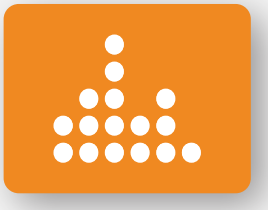
## OVERVIEW



**THIS PAPER** will introduce the Wi-Fi 6E standard and provide an overview of the new specifications, improvements over previous standards, and potential applications and uses. It will then explore how these new signals will impact RF security professionals before showing how a software-defined approach to spectrum analysis allows for greater performance at a lower cost than traditional hardware.

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## How Wi-Fi 6E Is Reshaping RF Security Requirements

Fixed and mobile internet usage continues to grow at a rapid pace as our world becomes more dependent on the wireless spectrum.

These trends have only accelerated as people work from home in increasing numbers. A May 2020 report found that overall internet traffic grew by more than 40 percent between February and April, with video streaming accounting for 58 percent of all traffic.[i] Much of this traffic is being driven away from mobile back to fixed Wi-Fi access points.

The arrival of Wi-Fi 6E will help to alleviate the congestion on existing Wi-Fi networks. In response to the need for greater reliability, access, and performance, the Federal Communications Commission (FCC) voted in April 2020 to open up the 6 GHz band (5.925 - 7.125 GHz) for unlicensed use.[ii] Adding more than 1.2 GHz of high frequency spectrum, the announcement represents the largest addition to Wi-Fi since the original 802.11b standard of the late 1990's and paves the way for the Internet of Things (IoT), virtual reality and augmented reality (VR/AR), and other high bandwidth, low-latency applications.

However, this jump to the **6-7 GHz** band and beyond presents a new challenge to RF security and technical surveillance countermeasures (TSCM) professionals. As a result, many users will need to start monitoring this new spectrum allocation and new bandwidth. And professionals using spectrum analysis equipment that only covers up to 6 GHz for their specific applications, will need to increase the frequency range of their RF equipment to get a complete view of the spectrum environment in their facility.

This paper will introduce the Wi-Fi 6E standard and provide an overview of the new specifications, improvements over previous standards, and potential applications and uses. It will then explore how these new signals will impact RF security professionals before showing how a software-defined approach to spectrum analysis allows for greater performance at a lower cost than traditional hardware.

**RF SECURITY** will always play an important role in corporate offices, government facilities, sensitive compartmented information facilities (SCIFs), and other environments where sensitive information needs to be protected. By understanding the new standard, security professionals can ensure they have the equipment and performance needed to maintain control of the wireless spectrum.

# Understanding Wi-Fi 6E

A recent Cisco report estimates that 5.6 billion people will use the internet by 2023. The number of connected devices is expected to grow from 18.4 billion in 2018 to more than 29 billion by 2023.[iii]

In addition to this rapid increase in the number of connected devices, high-definition video streams and other high bandwidth applications have dramatically increased the amount of data flowing at a given time.

Low-latency applications such as gaming, VR/AR, and autonomous vehicles also require high levels of performance and reliability, whereas IoT applications often have wide networks of low-powered sensors all sharing data in real-time.

In response to these changing requirements, the FCC has authorized a new band of spectrum for unlicensed use. This section will explore the differences and benefits of the new Wi-Fi 6E standard and the 6-7 GHz band.

## How Wi-Fi 6E Differs From Previous Standards?

Early Wi-Fi standards, such as 802.11b, were first deployed in the late 1990's. They operated in a tiny sliver of the unlicensed 2.4 GHz ISM band from 2.400 - 2.495 GHz. With a narrow range and overlapping channels, the ISM band eventually became crowded and unable to cope with the increasing density of devices and growing bandwidth requirements.[iv]

Though the first 5 GHz standards go back to the same period, widespread use became more common with the introduction of 802.11n, known today as Wi-Fi 4.[v] Operating in the 5.170 - 5.835 GHz bands, this higher frequency standard reduced the strain on the overcrowded 2.4 GHz band and improved speed, reliability, capacity, and bandwidth.

Further performance improvements were realized as technology advanced and new standards were launched, specifically 802.11ac (Wi-Fi 5) in 2013 and the more recent 802.11ax (Wi-Fi 6) in 2018.

**WITH** the approval from the FCC, Wi-Fi 6E represents one of the largest and most significant additions to Wi-Fi in its history. It has the potential to dramatically increase speed, bandwidth, capacity, and reliability while reducing congestion, latency, and power requirements.

Put simply, it will increase the amount of spectrum available for routers and other devices by nearly a factor of five, resulting in more bandwidth and less interference.[vi]

The biggest and more important change for RF Security professionals is that Wi-Fi 6E will use the 6 - 7 GHz band ranging from 5.925 - 7.125 GHz. Previously used to support utilities, public safety, and wireless backhaul, unlicensed devices will now be allowed to share this spectrum through a regulatory framework that protects existing users while allowing for more efficient use of the wireless spectrum. Telecom service operators use Wi-Fi bands as aggregate comms for 5G and this

# Understanding Wi-Fi 6E

newly allocated spectrum will provide Telecom service operators more opportunity in that regards.

Wi-Fi 6E will support 14 additional non-overlapping 80 MHz channels and 7 non-overlapping 160 MHz channels, a dramatic improvement from the 20 MHz non-overlapping channels currently available in Wi-Fi 5. Combined with advanced channel allocation technology, this will greatly reduce congestion and interference for users in high density environments such as office buildings, apartment complexes, or large public venues.

Wi-Fi 6E will also dramatically improve speed and latency. One industry report suggested that the average fixed broadband download speed would increase to 280 Mbps by 2022, more than double the current US average of 137 Mbps.[vii] Latency levels as low as 2-5 milliseconds have been demonstrated in tests.[viii]

Of course, the trade-off when dealing with higher frequency signals is a decrease in propagation and range. Compared to 2.4 GHz and 5 GHz signals, 6 GHz signals will travel shorter distances and be more susceptible to physical barriers such as buildings, walls, trees, and other obstacles. In larger spaces, multiple access points will be required to ensure coverage and maintain reliability. Finally, Wi-Fi 6E will only be accessible to new devices which support the standard and will have no backward compatibility. Early entrants will have a nearly clear playing field, away from the congestion and interference of the 2.4 GHz and 5 GHz bands.

With so many advantages and the potential for substantial performance improvements, it's no surprise that Wi-Fi 6E devices are expected to become prevalent in 2021. One IDC research director estimates there will be more than 338 million devices entering the market by the end of the year, and nearly 20 percent of all Wi-Fi 6 device shipments will support the 6 GHz band by 2022.[ix]

The resulting increase in broadband speeds, combined with the accelerated deployment of IoT and other advanced technologies, is expected to generate more than US$180 billion in revenue over the next 5 years.[x] So how does this affect RF security, and how will equipment requirements shift as new Wi-Fi 6E enabled devices enter the market?

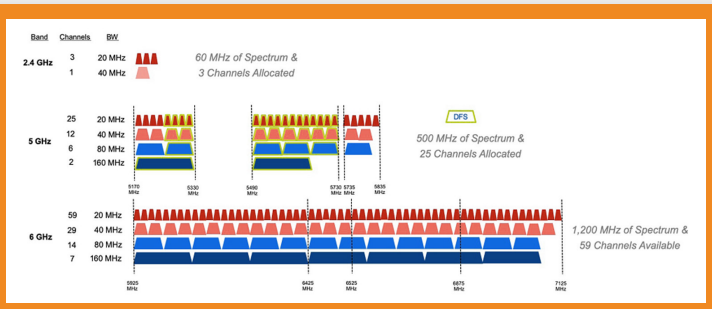


Figure 1.1[xi]: Wi-Fi 6E supports 14 non-overlapping 80 MHz channels and 7 non-overlapping 160 MHz channels, a significant improvement over previous 2.4 GHz and 5 GHz standards.

# The Changing Nature of RF Security

RF security has evolved over the years as devices, hackers, and covert surveillance products have become more sophisticated. For as long as there has been sensitive information, surveillance, and counter surveillance operators have found new ways to evade and outsmart the other.

The widespread proliferation of low-cost, easy-to-use, and powerful wireless communications technology has made it relatively simple for governments, rival corporations, or even individuals to deploy surveillance devices, transmit sensitive information, and disrupt the wireless signal environment.

This section will show how the new Wi-Fi 6E standard will change performance requirements for spectrum analysis equipment used for TSCM and RF security applications.

## What the New Standards Mean for Spectrum Analysis Hardware

As mentioned above, the new standard operates in the 5.925 – 7.125 GHz range, significantly higher than previous standards. Until now, users of specific applications were only concerned with signals below 6 GHz. Spectrum analysis equipment, in turn, was also limited to these ranges.

**The result is that their existing TSCM and spectrum analysis hardware deployed and used in the field today will be unable to detect and analyze these new 6-7 GHz signals.**

This is an obvious issue for RF security professionals because they will basically be blind to these new devices. This presents a serious security vulnerability. It not only limits how users can detect and remove unauthorized devices, but it also prevents them from getting a complete view of the signal environment in their facility.

A second challenge is the width of the new band and channels. With 1.2 GHz of spectrum divided into 80/160 MHz channels, equipment with low instantaneous bandwidth (IBW) and sweep rates may miss out on sporadic and short-duration signals of interest.




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# The Changing Nature of RF Security

**FINALLY,** as the requirements for TSCM and RF security become more complex and operators become more sophisticated, traditional sweeping techniques must be augmented with continuous, 24/7 coverage. Modern surveillance devices can store information and transmit it in short bursts outside of regular office hours to avoid detection by sweeps. Many also use frequency hopping or low-powered signals to further reduce the likelihood of detection.

Another consideration is that threats to RF security aren't necessarily malicious. For example, an employee may be unsatisfied with the connectivity in their office and decide to bring in a router from home to boost their connection. Similarly, an employee may forget to check their device before entering a SCIF or other restricted facility.

In these types of cases, the threat to RF security is the result of an honest mistake or accident rather than an intentional event. Continuous monitoring of the facility would allow security professionals to detect the transmitter and then take steps to remove or secure the device.

# A Continuous, Software-Defined Approach to RF Security Applications

With much of the existing equipment currently deployed in the field unable to detect and analyze signals in the 6-7 GHz band, RF Security and TSCM professionals will need to upgrade their capabilities. The question then becomes; What's needed to get the best coverage and ensure the wireless spectrum is effectively monitored?

Traditional, hardware-based spectrum analysis equipment does provide the frequency range and bandwidth required for Wi-Fi 6E devices, but they are otherwise poorly suited for TSCM and security applications. Large, complex, and expensive, these solutions are designed for lab or manufacturing environments where extremely high performance is required.

On the other hand, existing handheld and low-cost analyzers don't generally cover the frequency ranges and bandwidths needed.

Instead, users should consider the benefits of a software-defined approach to spectrum monitoring.

## thinkRF Real-Time Spectrum Analyzers & Surveillance Systems

In a software-defined spectrum analyzer the software runs over a hardware layer. The hardware components tend to make up only the RF to digital conversion, allowing a standard PC or laptop to provide the necessary computing power.

thinkRF Real-Time Spectrum Analyzers and Surveillance Systems provide the performance, versatility, and portability required for today's TSCM and RF Security applications. Featuring a frequency range of 9 kHz to 8 GHz, 100 MHz IBW, and 28 GHz/s sweep rate, the thinkRF R5550-408 Real-Time Spectrum Analyzer enables users to monitor, detect, and analyze Wi-Fi 6E signals. It can be used either as an RF analyzer or as an RF downconverter for existing equipment.

The thinkRF R5550-408 can be integrated with specialized TSCM software such as Kestrel TSCM® Professional Software from Professional Development TSCM Group (PDTG). When combined with directional antennas and other equipment, users gain a complete surveillance system that allows them to conduct full spectrum scans up to 8 GHz without additional upgrades. Users can distinguish between friendly and unauthorized signals, demodulate the signal if required, and locate the source for removal.

### With the thinkRF Surveillance System

- Conduct full spectrum scans
- Distinguish between friendly and hostile signals
- Create databases and signal libraries
- Monitor the signal of interest
- Demodulate the signal if required
- Locate the source

# A New Age of Wi-Fi Is Here

## Make Sure Your Equipment Is Ready

Networked for remote deployment, multiple units can be deployed throughout a facility for continuous, 24/7 coverage. Information from static and roaming units can be sent to a centralized location for analysis, while real-time alerts and triggers can be configured to notify security professionals of an unauthorized or unknown signal. Users can also create a signal library, record data for post analysis, and generate reports.

This approach offers numerous benefits when used in addition to regular sweeps by TSCM professionals. Not only does it provide greater coverage, but it also ensures that users maintain a full view of the spectrum environment and can identify unknown signals from new Wi-Fi 6E enabled devices operating above 6 GHz.


### thinkRF Surveillance System Incorporates

- thinkRF R5550 / R5750 Real-Time Spectrum Analyzers
- Laptop
- IP Networks for Multi-Sensor Deployments
- Kestrel TSCM® Professional Software
- Omni/Directional Antennas
- Carrying Case

[i] https://www.sandvine.com/hubfs/Sandvine_Redesign_2019/Downloads/2020/Phenomena/COVID Internet Phenomena Report 20200507.pdf

[ii] https://www.fcc.gov/document/fcc-opens-6-ghz-band-wi-fi-and-other-unlicensed-uses

[iii] https://www.cisco.com/c/en/us/solutions/collateral/executive-perspectives/annual-internet-report/white-paper-c11-741490.html

[iv] https://www.actiontec.com/wifihelp/evolution-wi-fi-standards-look-802-11abgnac/

[v] https://www.cablefree.net/wireless-technology/history-of-wifi-technology/

[vi] https://www.fcc.gov/document/fcc-opens-6-ghz-band-wi-fi-and-other-unlicensed-uses

[vii] http://wififorward.org/wp-content/uploads/2020/04/5.9-6.0-FINAL-for-distribution.pdf

[viii] https://www.counterpointresearch.com/wi-fi-66e-a-viable-alternative-to-5g-nr-for-low-latency-applications/

[ix] https://www.wi-fi.org/news-events/newsroom/wi-fi-alliance-delivers-wi-fi-6e-certification-program

[x] http://wififorward.org/wp-content/uploads/2020/04/5.9-6.0-FINAL-for-distribution.pdf

[xi] https://www.everythingrf.com/community/what-frequency-band-does-wi-fi-6e-use



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**ABOUT thinkRF**

thinkRF is the leader in software-defined spectrum analysis platforms that monitor, detect and analyze complex waveforms in today's rapidly evolving wireless landscape. By providing more flexibility, greater coverage, increased functionality and better ROI, thinkRF solutions are ideal for regulatory and intelligence monitoring, telecom deployment optimization and RF application development. With open APIs and proven integrations, thinkRF offers the only compact and networkable spectrum analyzer that can be deployed without a PC and the best price to performance on the market.
Aerospace and defense companies, spectrum regulators and wireless communications providers use the remotely deployable, PC-driven and easily-upgraded platform to replace traditional lab equipment for wireless spectrum analysis.

For more information, visit **www.thinkrf.com**.

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