

## Selecting the Optimal 700MHz LTE Antenna for Public Safety Communications

By Jerry Posluszny, Director of Engineering, Mobile Mark





Public safety industry communications methods are rapidly evolving as emergency responders increasingly rely on data like streaming video as an integral part of their daily communications. As emergency teams make use of expanding amounts of real-time video and data, it is crucial that they deploy an advanced, reliable antenna solution. This article explores the major trends and challenges facing the public safety industry and how today's advanced antenna solutions resolve these issues to ensure optimal communications in crucial emergency response situations.

## Key Challenges Facing the Public Safety Industry

Implementing the new First Responder Network Authority (FirstNet) within the 700 MHz spectrum is the top challenge facing the public safety industry. Since interoperability will be key to defining the various protocols needed for mass deployment, a cooperative effort to define communications standards will allow the industry to accelerate innovation and develop cost-effective systems. Already standards development is under way within the industry to ensure that whenever a police unit arrives at an event, rapid and seamless communication will be enabled through 700 MHz LTE systems.

The industry also faces other technical challenges beyond resolving interoperability. Quality and security both are concerns when communicating within the 700 MHz LTE spectrum because of the transmission standards, such as MIMO (multiple-input, multiple output), being used. The high cost of implementing this new system also means that traditional VHF and UHF systems will be used for local communications such as dispatch for the foreseeable future as interoperable LTE systems begin to be used at incident sites.

Given these interoperability and implementation challenges, emergency responders must carefully choose an LTE antenna to meet their communications needs. A multiband antenna (i.e., an antenna with MIMO LTE and MIMO Wi-Fi along with GPS in a common radome) simplifies installation and conserves vehicle mounting space. These factors, combined with proven MIMO LTE performance, top the list of requirements when purchasing an LTE antenna. A more in-depth discussion of LTE antenna technology follows.



## Multi-Frequency Support

The best solution for public safety communications is to use a cost-effective antenna that supports the entire 700 MHz LTE band while accommodating MIMO protocols and a variety of other features such as GPS and Wi-Fi. An antenna that can accommodate several frequencies enables emergency responders to seamlessly transition between communications systems. It is important to also be aware of next-generation frequency allocations such as the upcoming Sprint LTE allocation at 2600 MHz when choosing an antenna to ensure that the device covers more than just one frequency and is essentially future-proof in the face of new emerging technologies.

MIMO antennas use multiple antennas at the transmitter and receiver to improve communications performance. By using multiple data streams fed to separate antenna elements, MIMO antennas can achieve a significant increase in data throughput and link range without consuming additional bandwidth or increasing transmit power. As a result, the link reliability is improved and the quality of the overall communications increases. Because communications reliability is essential for public safety communications, MIMO antennas are increasingly used today.

Police vehicles equipped with multi-frequency antennas can support GPS for satellite positioning and use 700 MHz LTE to provide real-time high-speed data transmissions over 4G cellular networks to onboard computers in squad cars, voice-over LTE and push-to-talk over LTE.

These antennas also enable access to Wi-Fi for mobile hotspots. Wi-Fi has become a Swiss Army knife of communications. While the primary use of Wi-Fi is to tap into public or private hotspots for Internet connectivity, the wireless standard can be used for localized communications to address security issues. The IEEE 802.11i wireless security standard, by ensuring a secure Wi-Fi link for public safety communications, guarantees that a localized Wi-Fi network cannot be accessed by the public.

With an advanced Wi-Fi modem, an antenna can dedicate a secure Wi-Fi hotspot around a police vehicle. With this capability, a police officer wearing a uniform-mounted video device or accessing a tablet can use Wi-Fi to securely transmit data, such as a license plate check, back to the vehicle. The data can then be transmitted via high-speed LTE to the central dispatching desk. Thus, in a single incident, a public safety officer can securely use both Wi-Fi and LTE for rapid transmission of high bandwidth video information.

To sum up, when shopping for the best antenna solution, it is important to look for a high efficiency antenna that can support multiple elements such as two 700 MHz LTE, two WiFi and one GPS capability from a single compact, surface-mount radome. This type of antenna takes far less space than multiple antennas and significantly reduces installation time and costs.



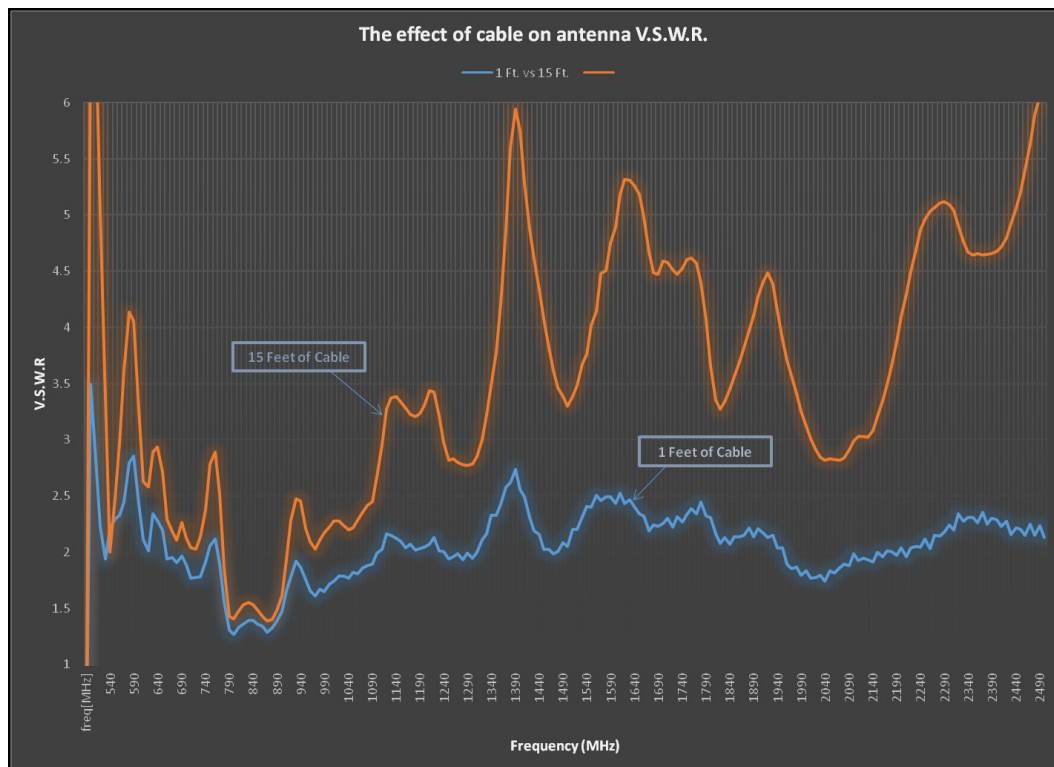
## Robustness and Design

Police fleet vehicles necessarily operate at high speeds, over long distance and in harsh weather conditions, making it important to choose an extremely robust antenna solution. Using a vendor with experience developing antennas for mobile installations guarantees durability in the field.

Modern antennas should also feature a design that matches the sleek look of new public safety vehicles. Aside from being aesthetically pleasing, a fully encased antenna design will be more reliable in the field. Traditional, large whip antennas are susceptible to damage and accidental impact and should be replaced by antennas with low profile, contoured characteristics.

## Low V.S.W.R.

An antenna's voltage standing wave ratio (V.S.W.R) should be tested by the manufacturer with one foot of cable to ensure that the true characteristics of the antenna have been measured and not masked by the effects of the coaxial cable.





Antennas that are characterized with long lengths of cable tend to corrupt the true measurement by flattening the V.S.W.R. curve because of loss in the cable itself. If the antenna is not truly tuned, extra losses will occur in the system. A V.S.W.R. of 2:1 or less is required for optimum system performance. A high V.S.W.R. number can reduce antenna efficiency by 10 to 20 percent.

Review the published specs carefully and be cautious with vendors reporting V.S.W.R. higher than 2:1 or those not stating the cable length that was used during testing, as this can be indicative of performance issues.

## Conclusion

The requirements for higher speed communications links continue to grow as police fleets accelerate their data communications use. This presents a constant challenge for network designers and antenna systems designers. While 4G LTE antennas are currently being deployed, talk of 5G is just on the horizon.

At this point, no decision has been made about what frequency bands 5G will use but it will likely rely on current bands while using newer technologies such as 6X or 8X MIMO to double current data rates. Anticipating this scenario, LTE antenna designers are studying methods to add more MIMO elements into next-generation antenna designs.

In conclusion, it is imperative that the public safety industry deploy multi-frequency MIMO antennas that support LTE, WiFi and GPS bands while concurrently offering a low V.S.W.R., robustness and a sleek design. Combined, these capabilities will ensure reliable, quality and secure communications within the 4G LTE band and beyond. Emergency response vehicles, appropriately equipped with these advance antennas, will remain on the cutting edge of communications.

About Mobile Mark, Inc:

Jerry Posluszny is the Director of Engineering for Mobile Mark, Inc. The company designs and manufactures antennas for commercial and governmental wireless applications such as GPS Fleet Tracking, Cellular M2M, WiFi and RFID. The antennas are used in Public Transit, Trains, Mining, Local Vans, Long Distance Trucks, Police & Public Safety, Security, Military, and Smart Grids & Smart Meters. Engineering and custom design services are available. Mobile Mark's global headquarters, which includes research facilities and manufacturing plant, are located near Chicago, Illinois. An additional manufacturing and sales facility is located near Birmingham, UK. Further information can be found at [www.mobilemark.com](http://www.mobilemark.com).