Building a Bridge to Next-Gen Fleet Connectivity:
A Practical Checklist of Best Practices for Upgrading Fleet Antenna Systems

By Ted Hebron, Senior Product Manager, Connectivity Solutions at Laird Connectivity
Introduction

The Golden Gate Bridge is a huge structure, and the job of maintaining its instantly recognizable orange vermilion color is equally enormous. Painting it is quite literally a never-ending job. There’s no moment when the maintenance team is able to step back from its work and declare it complete. The massive bridge is painted and maintained continuously in a never-ending cycle to keep the bridge functional, protected and ready to continue playing its vital role connecting one of America’s largest metro areas.

That never-ending cycle has some clear parallels to the way vehicle fleets are essentially in a continuous cycle of wireless upgrades. These upgrades will always be necessary to keep pace with the evolution of technology and with end user needs, but this continuous process doesn’t need to be arduous or inefficient. There are a number of best practices that will make the next wave of wireless upgrades more efficient, less expensive and less risky for the vehicle fleets you are responsible for. The purpose of this document is to share a number of best practices that the Laird Connectivity team has identified through its extensive work with customers in the fleet management industry - providing a practical checklist for your next projects.

Before discussing those best practices though, I should be clear in saying that the primary audiences for this piece are: 1) organizations that operate fleets of vehicles, and 2) the community of systems integrators and VARs that provide after-market wireless upgrades for those vehicle fleets in a number of vertical industries, including government agencies, utilities, public safety and trucking. Car manufacturers and the OEMs that provide connectivity for new vehicles face a separate set of opportunities and challenges related to connectivity that is different from connectivity for the vehicle after-market. For this piece, I am focusing specifically on the after-market, which is responsible for wireless upgrades to vehicles to ensure that their connectivity keeps pace with the needs of the end user as well as the evolution of wireless technology.

There are a number of best practices that will make the next wave of wireless upgrades more efficient, less expensive and less risky for the vehicle fleets you are responsible for.
Think About Scale Early and Often

If you only take one thing away from this checklist, this is the one to remember: what may seem OK for a single vehicle implementation can quickly become sub-optimal when you multiply that by 50 or 100 or 1000. To continue the Golden Gate analogy, a portrait painter might have a process that works great for a 12"x18" canvas, but will that paintbrush be the best bet for applying 47,000 gallons of paint to a mile-and-a-half long bridge? Scalability should be a key driver for every decision in a wireless upgrade planning process, because the impact of every decision gets magnified when vehicle upgrades are done at scale. For example, an antenna system might look like a good choice in terms of technical specs, but then turn out to require a difficult installation process that becomes a costly headache when done for a fleet of hundreds of cars. Choices that might add a negligible 20 extra minutes of installation time for a single vehicle will translate to hundreds of labor hours (and weeks of delay) when multiplied across an entire fleet. For every step in the planning process, your team should be asking: “What does this look like when we do this across the entire fleet?” That will help steer your team toward choices that ensure faster completion of the overall fleet upgrade and lower total cost of implementation.

Avoid Extra Drilling

As vehicles across industries evolve into mobile communications centers for workers, additional wireless technologies need to be added to vehicles. For example, first responder vehicles are requiring the addition of FirstNet connectivity in order to be ready for the dedicated LTE-based network for coordinating police, fire, rescue and other organizations during emergencies. Adding another antenna may seem like the simplest solution, but there is a significant downside. Adding more antennas typically means punching more holes in the exterior of the vehicle. That is the vehicle equivalent of major surgery, and just like with human surgery, it comes with risks. One major one is the threat of water intrusion. Water is the biggest threat to the Golden Gate Bridge, and it's also a major threat to an electronics-filled vehicle. Each hole has the potential to lead to leaks, which are often catastrophic. Another risk is that poor placement of the new antenna can completely undermine the RF performance of the existing antennas, creating an entirely new set of problems for the engineering and installation team to solve. For this reason, the best approach to adding more wireless technologies is to consolidate with a multi-band/multi-port antenna that provides all of the technologies and solutions in a single system that is already tested to resolve RF interference. One final point: Given that many vehicle fleets are leased rather than owned, it is particularly important to minimize drilling into the exterior. That may affect the vehicle warranty and the lease agreement, which is all the more reason why selecting a solution that works with existing penetrations in the vehicle body is important.

Keep an Eye on the Profile

For a number of vertical industries, the shape, size and placement of the mounted antenna system is critical.
to minimizing damage in the field. Utility trucks are a great example of this: high-profile antennas like whips are easily damaged when struck by vegetation. The same is true for construction vehicles, city maintenance vehicles, fire trucks and other vehicles that must operate in close quarters with objects that may come in contact with a large antenna. Keeping a low profile is often critical to reducing the risk of damage, and many next-generation antenna solutions are designed with low profiles not simply for the aesthetics but also because of the practicality of avoiding damage from the environments in which they are used. There is a misconception that a low-profile design may mean inadequate system performance, but that is a fallacy. It is possible to have high performance, excellent range and other capabilities in a small form factor.

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Take Note that FirstNet Is Real and the Volume of Fleet Upgrades Is an Enormous Task

This section is specifically intended for public safety organizations and the integrators/VARs that support their fleet needs. After nearly two decades of delays, the momentum behind nationwide deployment of the FirstNet LTE network is real, and that is driving the need for hundreds of thousands of vehicles to be upgraded on an accelerated timeline in order to achieve compatibility with the FirstNet wireless network. FirstNet upgrades are a special case unto themselves with best practices and caveats that are unique to this specific type of wireless upgrade. For those of you who will be involved in these types of projects, I recommend reading a recent white paper I wrote about how to successfully navigate FirstNet upgrades for public safety vehicles. It is titled, “Keeping the Signal Strong” and is available for free download on this page. In addition to best practices, it also offers practical tips about avoiding the most common mistakes regarding FirstNet upgrades.

Stay a Step ahead of the Relentless Upgrade Cycle

I started this piece with a discussion about how the job of painting the Golden Gate Bridge is a never-ending process. That will always be the case with vehicle upgrades of wireless systems, but there are ways to give these upgrades a longer life cycle. The way to do this is to broaden the horizon of the needs assessment to look further into the future. Most organizations are naturally so focused on immediate needs for wireless systems that those dominate the planning process. For many, many years that was no doubt the most sensible approach, given how many unknowns there were about end user needs in the future as well as how wireless standards would evolve. There was tremendous uncertainty if you looked out more than a year, but we can safely look further out on the horizon today and accurately anticipate what vehicular wireless systems will need to support beyond tomorrow. 5G is a perfect example. Another example is HD-quality real-time video communications, which will definitely be a standard element of mobile communications for fleets in the future. And so is a range of virtual reality and augmented reality applications that are in pilot projects now prior to large-scale rollouts in industries ranging from public safety to construction. None of these are “maybe technologies.” These are coming, and planning for them now (by selecting the right antenna systems with an adequate number of ports) will enable your organization to extend the life of your next wireless upgrades even as these new technologies and applications become more prevalent.
Remember that Modeling Is Not Enough. Test, Test, Test.

Up above, I mentioned that thinking about scalability was the most important takeaway in this discussion. I was wrong. This piece of advice is the most important: as the number of wireless technologies on vehicles increases, the RF environment becomes more and more complex, and the negative impacts on performance increase. Simply put: everything you add to the vehicle may “gunk up the entire works,” so you better be careful what you install and where you install it. Conducting RF modeling using software that predicts RF performance is a solid step, but it simply isn’t enough. To truly understand how a new antenna will perform and to understand how the existing antennas will perform with their new neighbor, you have to test it. Testing will reveal RF conflicts that are not anticipated by modeling software, and it will guide you toward proper antenna selection and installation locations that will optimize performance of all of the vehicle’s wireless systems. This is particularly important for organizations that are venturing into the use of wireless technologies that they have not traditionally worked with. LTE antennas behave differently than the RF dynamics of existing whips. GPS antennas have unique RF dynamics that are distinct from other types of protocols. Wi-Fi is a relatively new technology for many engineers working in the vehicle after-market industry. Luckily, you don’t have to become an expert in each of those wireless technologies. You just need to determine how to make them all play nicely in the sandbox together, and RF testing is the best means to accomplish that.

Pre-Tested, Pre-Certified Multi-Band Solutions Can Accelerate Deployments

The last suggestion I will make is to look for multi-band/multi-port solutions that have been designed to integrate multiple technologies in ways that are already optimized. These are designed to co-locate antennas in ways that avoid RF interference, optimize range, and minimize the amount of engineering burden on the organization deploying them. Yes, RF testing is still important, given that every antenna is impacted with the adjacent surfaces of a vehicle. For example, an antenna system mounted on a steel surface of a construction vehicle’s cab will behave differently than one mounted on the fiberglass roof of a police cruiser. The shape of each vehicle also impacts the RF dynamics in significant ways. That makes testing a must. But the process can be dramatically accelerated when the system has been designed to allow each of the adjacent technologies to operate without negatively affecting the others. When these systems are pre-certified that also removes a time-consuming and costly step that allows organizations to move forward faster with upgrades.

Conclusion

Wireless upgrades to fleets are a bridge that will always need to be painted, but those upgrade cycles will be faster, less risky, less complex and less costly with the considerations discussed above. That will leave you more time for other things, like how a colossal, bright orange bridge weighing almost a million tons can be one of the most elegant structures ever built. Pretty impressive for something made to help a hundred fleets’ worth of cars get to and from Marin County every day.
Laird Connectivity’s Fleet Antenna Solutions:

Laird Connectivity provides a range of antenna solutions for vehicle fleets, including the newest additions: the Gar and Barracuda low profile, MIMO vehicular antennas. Laird Connectivity’s Gar and Barracuda antennas feature multi-band operation (including 3G, 4G, 5G-ready, ISM, CBRS, Wi-Fi) as well as GNSS navigation and outstanding reliability, throughput and capacity.

Laird’s Gar antenna has five ports and comes configured for 2-port MIMO operation over the 3G/4G/ISM/CBRS bands, and 2-port MIMO operation over the low/high frequency Wi-Fi bands. The additional 5th port provides an active antenna for enabling GNSS global navigation services. Barracuda has the same form factor and capabilities as Gar and adds a 3rd port for MIMO operation over the low/high frequency Wi-Fi bands, with the 6th port providing GNSS services.

The Gar and Barracuda antennas are configured for FirstNet MIMO operation, allow for single-hole mounting, and are ideal for today’s hi-tech public safety and fleet environments. First responders are increasingly relying on networks like FirstNet, which is developing a national, interoperable LTE public safety broadband network to provide thousands of police officers and firefighters across the nation with advanced communication and collaboration technologies to help them do their jobs safely and efficiently, and better protect the public. Likewise, public works, urban transportation, and commercial and industrial fleets also depend on reliable mobile connectivity to better serve the public, improve customer service, and increase operational efficiencies.

About the Author:

Ted Hebron is a Senior Product Manager for Laird Connectivity, which provides a full range of antenna solutions and wireless modules that simplify the process of using wireless technology. In this role at the company, Hebron leads development of Laird’s FirstNet-related solutions among other families of connectivity products. Hebron has 36 years of experience in RF design and antenna engineering utilizing a range of wireless technologies including cellular, radar, radio, television and low-observable connectivity. Has managed engineering teams in six Laird operations centers around the globe, and his work prior to Laird includes positions at Boeing, Harris Broadcast. He earned his BSEE degree from the University of Kansas.

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About Laird Connectivity:

Laird Connectivity simplifies the enablement of wireless technologies with market-leading wireless modules and antennas, integrated sensor and gateway platforms, and customer-specific wireless solutions. Our best-in-class support and comprehensive engineering services help reduce risk and improve time-to-market. When you need unmatched wireless performance to connect electronics with security and confidence, Laird Connectivity delivers — no matter what.

Learn more at lairdconnect.com