Using a Passive Anti-Jam Antenna to Combat GNSS Interference

Why This Case Study is Relevant

It demonstrates how to overcome interference using a low-cost anti-jam (AJ) antenna

Background

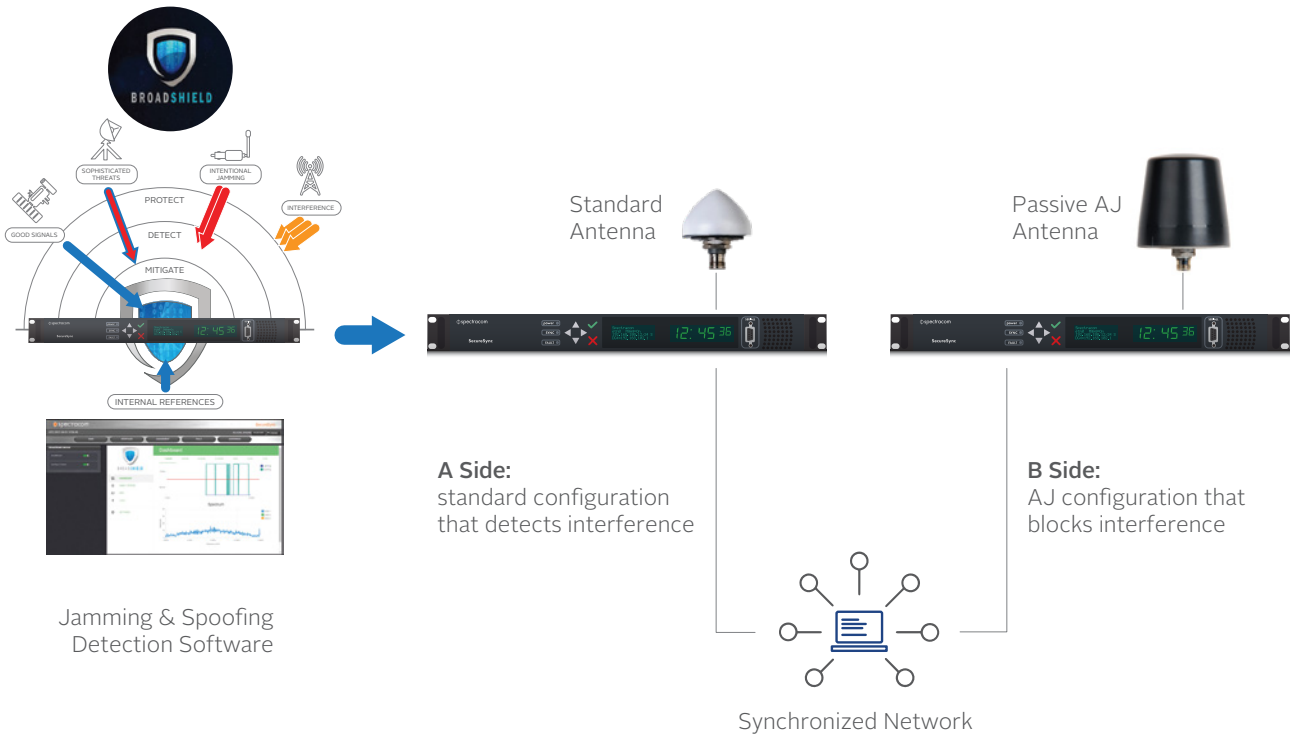
A customer with a major datacenter facility was experiencing issues with its GNSS based timing systems. For unknown reasons, GNSS reception was being intermittently lost. The timing system was architected and installed correctly using redundant time servers and components to ensure high availability and uptime. Testing was performed to ensure the fidelity of the system and components and the results indicated that everything was functioning properly. However, the issues persisted and the GNSS signal was lost almost daily. Though the timing system used time servers that had internal atomic clocks and could operate through a temporary loss of the GNSS signals, this datacenter was critical to network operations. Thus, any signal loss became an issue.

Challenge

The GNSS signal losses were intermittent, and every time the signal was lost, the timing systems would go into holdover and generate alarms. This was more than a nuisance because they couldn't be ignored; it was critical infrastructure. Even using sophisticated RF detection equipment yielded no results, because no interference or other issues were found when using detection equipment. Timing equipment changeout yielded no improvements either. In addition, an audit of the installation confirmed that everything was properly installed. However, this loss of signal and associated alarms was taxing the network operators, consuming valuable management time and lowering their confidence in the robustness of the time synchronization system. Ultimately, we suspected that there was interference coming from an outside source.

Solution

To solve this challenge, Spectracom turned to its new Anti-jam (AJ) antenna. Since this was critical infrastructure, the customer already had dual-redundant time servers in place, so Spectracom installed two different antennas to those time servers: one standard antenna on the "A" side and one AJ Antenna on the "B" side. The antennas were mounted on the roof of the single-story datacenter, which was an industrial building, co-located within 10 meters of each other.

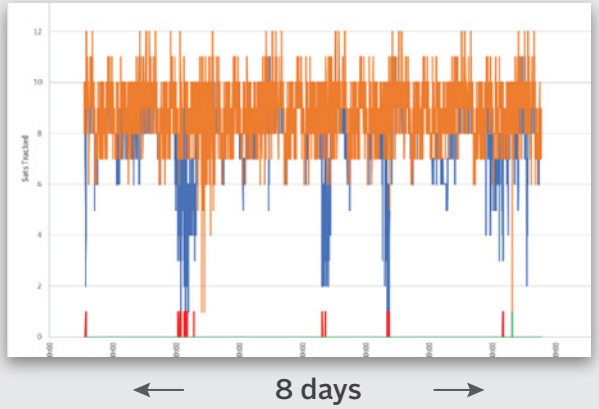


Spectracom time servers have "Holdover" oscillators in them – atomic clocks that continue to maintain very accurate time even when GNSS is absent. However, no matter how accurate one's internal clock is, it is still slightly different from the referenced Universal Coordinated Time (UTC) supplying the GNSS signals. So eventually time will drift from UTC. We refer to the period when the GNSS signal is lost and the time server is coasting on its internal atomic clock as a "Holdover Event." The following chart shows the performance comparison between the two co-located time servers over a period of eight days, with blue for the standard antenna and orange for the AJ antenna.

AJ Timing antenna: Field Test Data

- Two GNSS Time Servers with internal Rb Holdover oscillators: side by side, one with Standard Antenna; the other with AJ Antenna.
- Experiencing suspected "Privacy Jammer" interference – next to a trucking company.
- AJ Antenna drastically reduced GNSS dropout (Holdover Events) over a one week period.

	Standard Antenna	AJ Conical Antenna
Holdover events	40	4
Total time in Holdover	1 hour 32 minutes	41 seconds
Longest holdover event	14 minutes 26 seconds	17 seconds
Average holdover event	2 minutes 18 seconds	10 seconds
Satellite alarms	31	2



Results

The AJ antenna proved that the signal loss the customer was experiencing was a result of RF interference. As suspected, a nearby trucking company was being visited by trucks containing very illegal "privacy jammers" that interfered with GNSS reception. The AJ Antenna masked most of the RF energy coming from 20 degrees elevation and below, thereby mitigating the impact of illegal RF jammers.

Looking Ahead

Even companies that have not experienced interference are likely to face it in the future. This is a very real and growing problem. In fact, you may have already experienced a signal loss due to jamming and been unaware of it. Unless you have specialized software or equipment to monitor the signal, you have no way to know that it is gone due to jamming. You simply know the signal is gone ... but not why.

We recommend adding BroadShield™, an optional software package, to your GNSS-based SecureSync time servers, which will monitor the internal state variable of the receiver and alarm when jamming or spoofing is detected. The software contains more than 75 algorithms that examine the characteristics of the RF entering the receiver – including signal level, spectrum, data formats, data consistency and accuracy. Alarms can be configured as visual alerts, emails or holdover actions. If your timing system is critical to your network operations, a combination of an AJ antenna and BroadShield with a high-quality oscillator is a powerful way to secure your environment.

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For More Information

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