

AIRPORT PERIMETER SECURITY



Fiber SenSys

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WHITE PAPER

BY

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Duwayne Anderson is Chief Technologist at Fiber SenSys and has over 20 years experience in the area of fiber optics. Mr. Anderson spent 15 years as a Principal Engineer at Tektronix where he was responsible for the definition and design of fiber-optic test equipment. He was also the Principal Engineer at Phoseon where he designed high-power solid state UV systems. His other industry experience includes several years each at Honeywell and Goodyear Aerospace. Mr. Anderson has 28 patents and is the principal author of a text book on trouble shooting fiber-optic networks.

INTRODUCTION

In recent years security at America's airports has focused on such things as access control, dangerous cargo, screening, and other measures associated with activities near the airport terminal. Today there's a broader aspect of airport security that's gaining increased recognition; the perimeter around the airfield as well as airport buildings and other assets.

To meet this challenge Fiber SenSys offers a perimeter-security product designed specifically with airports in mind. The **Airport Defender**TM uses distributed point-locating optical fibers to sense minute vibrations caused by intruders trying to climb over, cut through, or dig under the perimeter fence. Software under the brand name AutoTuneTM allows the user to teach the system through a process of simulating various sources of nuisance alarms and real intrusions. AutoTuneTM uses powerful search algorithms and simulations to rapidly test and evaluate how the system would perform when tuned using hundreds of different possible parametric configurations, and then it picks the best configuration; the configuration that optimizes both probability of detection (PD) and nuisance alarm rate (NAR). This sophisticated software automatically "learns" to distinguish the differences between vibrations caused by wind, traffic, and heavy equipment and those caused by intruders, giving **Airport Defender** industry-leading PD and ultra-low NAR. The all-fiber sensor is immune to electromagnetic interference from airport radar, as well as lightning strikes, and requires no maintenance over the 20-year expected lifetime of the product.

Airport Defender is designed to be the easiest and most effective perimeter system for airports and other critical infrastructure. With on-site solar power generation and a wireless mesh network, **Airport Defender** eliminates the cost and labor of installing power and network infrastructure at the perimeter. By eliminating the overhead costs and complexity associated with infrastructure, **Airport Defender** saves hundreds of thousands of dollars and improves installation schedules by weeks or even months.

DISCUSSION

Airport perimeters are large, often tens of kilometers long, and they frequently traverse varying environments, from areas along wooded or grassy regions to parts that are heavily encumbered by buildings, equipment, sidewalks, roads, and other infrastructure. These conditions often make it difficult to put perimeter security sensors around the entire perimeter, and very expensive to place localized security sensors around portions of the perimeter that are far from electrical and communications infrastructure.

Fiber SenSys provides an elegant solution to these problems with the **Airport Defender 525** (AD-525). This state-of-the-art sensor uses fiber optics to detect slight vibrations of the fence

and signal the alarm processor (APU) to sound an alarm when intruders are present. But unlike other systems the AD-525 doesn't require the expense of bringing power and communications lines to the perimeter, or installing the sensor electronics in a central location and then stringing non-sensing fiber out to the perimeter.

Stringing power and communications wires out to remote parts of an airport perimeter can be (and often is) more expensive than the security equipment itself. For example, installing optical fiber and electrical power in buried conduit can cost between \$20 and \$30 per foot. Since installers cannot simply trench straight across the airport runway (because that would shut down air traffic) the infrastructure and optical sensing cable must be put into conduit that is trenched and buried around much of the airport's perimeter. This distance can be thousands of yards, and at \$20 per foot the cost to install this infrastructure can easily exceed \$200,000.

Airport Defender circumvents these problems by using a secure, high-speed wireless network and on-site power generation (figure 1). Fiber SenSys can offer this new product because of unparalleled electrical energy efficiency and environmental robustness in our new point-locating fiber-optic sensors.

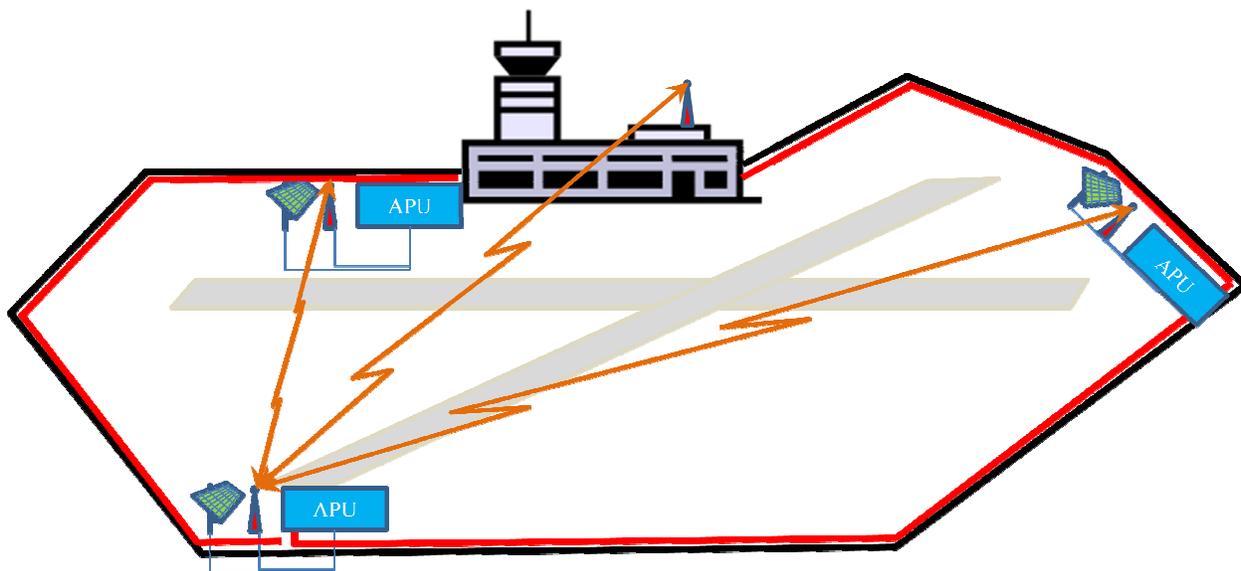


Figure 1. The APU (housing electronics and optics) senses disturbances at the perimeter, along the optical fiber. Alarms created by these disturbances are communicated wirelessly to the head end in the airport terminal. Remote electrical power (either solar or thermo-electric) powers the wireless modem and the APU.

The AD-525 electro-optics module is extremely efficient, requiring only 8 watts to monitor up to 25 zones.¹ This low power drain means the AD-525 can operate off of remote power-generating systems like solar/battery and thermo-electric (TE). The AD-525 is also environmentally robust and rated for outdoor operation.

Our unique fiber-optic sensor is the key to environmental robustness. Other point-locating systems have expensive and highly sensitive lasers, which are required for some fiber-optic interferometers. The AD-525 also uses interferometry, but unlike our competitors Fiber SenSys uses speckle interferometry, which allows the sensing element to consist of just one fiber. This enables us to use simple off-the-shelf lasers that are highly robust and able to operate properly over a wide range of temperatures.

The combination of low power drain and a rugged operating temperature profile means the AD 525 can be located remotely from the terminal and powered using an on-site power source such as a TE generator or solar panels. Competitors' products must be located in air-conditioned environments and may draw up to 500 watts, making them far too power hungry for remote/distributed installations.

Solar panels convert sunlight directly into DC electrical voltage using semiconductor materials. The solar panels are used to charge batteries that run the electronic equipment (APU and wireless modem). See figure 2.

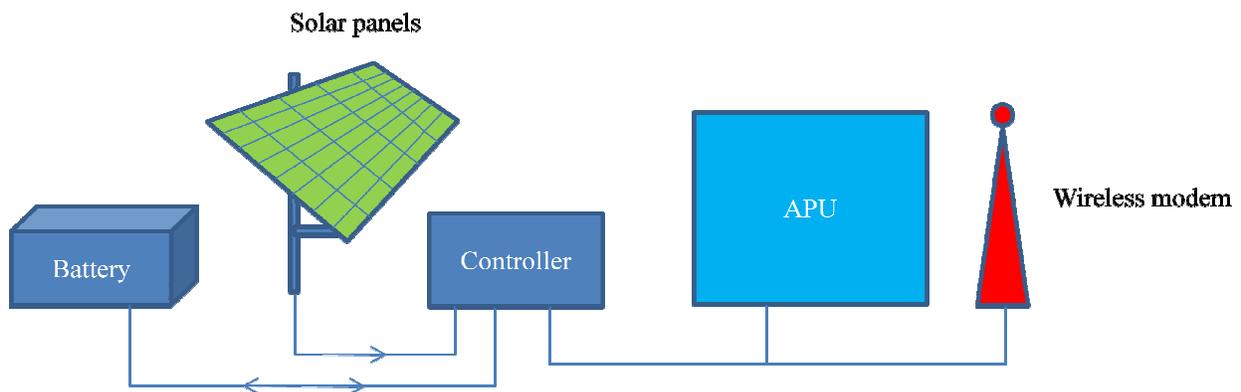


Figure 2. The solar-powered module consists of solar panels that charge batteries used to run the APU and wireless modem. A controller optimizes the charging process. The batteries are designed and sized to store enough energy to power the system during nighttime and seasonally expected periods of cloud cover.

The controller manages the flow of energy between the solar panels, the battery, and the electronic equipment. When there's an excess of solar energy the controller uses some of it to

¹ This works out to 0.32 watts per zone. Competitors' systems require up to 500 watts for operation in addition to the energy required for environmental controls, making them impractical for operation using remote power.

recharge the battery, and when there's no solar energy (rain, nighttime, etc.) the controller uses energy in the battery to operate the electronic equipment.

The solar-powered system is all solid state with no moving parts. In the northern hemisphere the solar panels are mounted in a fixed, optimum orientation facing south and tilted at 15 degrees plus the local latitude.² We use fixed panels to simplify the system, giving optimum reliability and greater MTBF. In most cases this also minimizes the cost.

The solar-powered system is carefully designed for each site to operate year round in all types of weather. These calculations draw on data bases that specify the average available solar energy during any particular month at a particular location. These data are used to determine the required size of the solar panel and the capacity of the batteries. For a typical North American location the panels are roughly one meter square and the batteries (12 volts) are rated at 200 amp-hours. A single outdoor-rated box contains the battery, controller, APU and wireless modem. This box is mounted slightly above the ground to the same metal pole that supports the solar panels.

In most parts of the United States, particularly the south and southwest, solar energy is plentiful making the solar option an obvious and economic choice. In those regions with inadequate solar power the best choice for on-site power generation is a TE generator. TE generators work on the principle that heat applied to the junction of two different semiconductors (or metals) creates a voltage across the junction (figure 3).

This phenomenon has many applications and is the basis of operation for thermocouples. The effect can also be used to generate electrical power by applying a heat source to a properly designed junction. For customers in areas with inadequate solar energy, Fiber SenSys offers a commercially available TE generator. Since our APUs are so efficient and draw so little electrical power, the TE generator (rated at 20 watts) can operate the AD-525 (APU and wireless modem) more than a year using the fuel in a single buried 500-gallon tank of propane. Like the solar option, the TE generator has no moving parts and is extremely reliable.

² For fixed panel systems designed to work year round, the solar panels are optimized for the month with the least amount of solar energy. This optimization involves tilting the panels 15 degrees toward the equator (total tilt = local latitude plus 15 degrees).

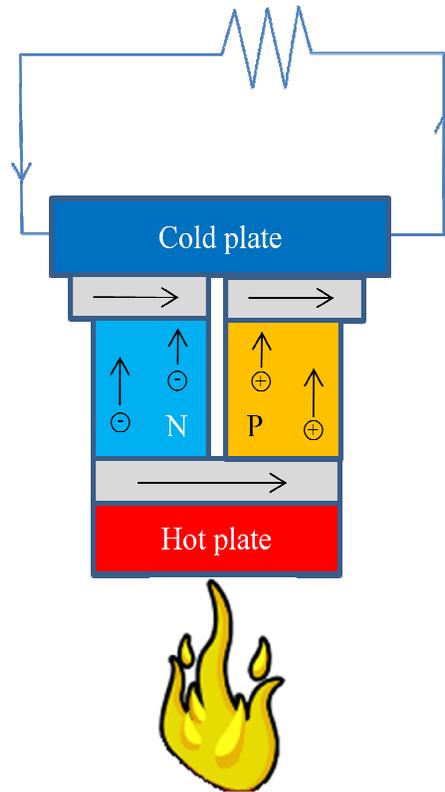


Figure 3. The TE generator uses heat, applied to a specially designed semiconductor junction, to generate electrical current. Because the AD-525 is so efficient a single 500-gallon buried propane tank holds enough fuel to run the system for an entire year.

The third critical component of the **Airport Defender** is the network. For **Airport Defender** the network requirements are simple:

1. Wireless (to avoid the cost of installing wired infrastructure)
2. Low power (to operate off remote solar or TE power systems)
3. Secure
4. Easy to use
5. Flexible architecture

To meet these system requirements Fiber SenSys uses wireless modems from Fluidmesh for the **Airport Defender** network.³ This is a self-healing wireless network configurable in point-to-point, point-to-multipoint, mesh, and mixed topologies.

³ Approvals: FCC CFR 47 Part 15, class B; Industry Canada RSS 210; CE

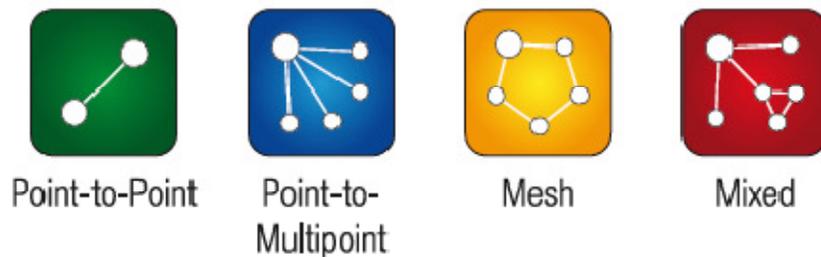


Figure 4. The wireless network can be configured in virtually any topology, making it highly versatile.

Operating at 2.4 and 5 GHz, the system’s high bandwidth facilitates transmission of both the alarm data from the APU as well as from optional cameras installed on the perimeter. The network is Web based and fully compatible with IP cameras and video servers and ensures security via proprietary communications protocol, VPN support and cryptography (SSL, HTTPS).



Figure 5. The Fluidmesh wireless modem provides a flexible, high-speed network that can be quickly and easily set up.

SUMMARY

These three components: fiber-optic sensor, remote electrical power, and a wireless network, when integrated together form a unique and powerful solution for hard-to-reach perimeters. With this integrated solution customers have an easy-to-use system solution that provides the ultimate in perimeter sensing while eliminating the need to bring communications and power wiring to the perimeter, saving hundreds of thousands of dollars in many applications.