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Design and Evaluation of the ReKon™: An Integrated Detection and Assessment Perimeter System

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Executive Summary:

This executive summary is taken from the full Sandia National Laboratories Report, "Design and Evaluation of the ReKon: An Integrated Detection and Assessment Perimeter System", which will be released in its entirety in January 2013.

Today's increasingly complex and varied security environments emphasize the need for an agile, modular perimeter security system. Many government and military sites continue to demand high performance security technologies such as those afforded by a traditional PIDAS, but require additional standoff beyond the existing perimeter. Additionally, there are other customers whose requirements favor installation flexibility or cost over performance, but still demand better detection performance than granted by most commercially-available technology. To meet such varied needs, a perimeter security system needs to be configurable to meet the demands unique to each site, adaptable to the latest sensor technology and security requirements, and scalable to provide for installation at short temporary perimeters just as well as large multi-mile perimeters.

Kontek, Industries (Kannapolis, NC) and their subsidiary, Stonewater Control Systems, Inc. (Kannapolis, NC) have entered into a cooperative research and development agreement (CRADA) with Sandia National Laboratories to jointly develop and evaluate a new modular perimeter security solution that satisfies these requirements. The resulting design, the ReKon™ System, integrates artificial intelligence techniques with a robust physical barrier to integrate improved detection with assessment and access delay. ReKon allows integration of any type of sensor input from simple contact switch to video to rich XML data stream, and provides configurable data security options to meet the needs of a variety of sites. The software and networking architecture are modular and scalable, to allow implementation on a wide range of sites. The ReKon allows high-level detection performance without requiring a full PIDAS installation through the use of multiple sensor types and innovative data fusion techniques that effectively manage the drawbacks faced by traditional sensor fusion methods.

After an initial twelve-month conceptual design phase and a formal design review, a prototype section was fabricated and installed at the Sandia Test and Evaluation Center in Albuquerque, NM. Testing was conducted over a period of five months, consisting of two weeks of active performance testing to characterize the standard behavior of each sensor, and an additional two weeks of system testing designed to attempt surreptitious bypass of the entire suite of sensors. A perimeter security system cannot sufficiently increase detection performance through the use of additional sensors without suffering a significant increase in nuisance alarm rate (NAR) unless

innovative approaches are considered. Thus, this project emphasized the evaluation of various sensor fusion techniques to reduce the nuisance alarm rate as compared to conventional methods.

The ReKon prototype system was evaluated with a suite of sensors including a MicroPoint fence disturbance sensor, Photon active infrared detector, a commercially-available high-definition video motion detection system, a prototype Sandia-developed ground sensor solution, and the LightLOC fiber-optic break sensor.

The conventional system simply performs a logical OR between all sensors. If any single sensor alarms, the system is considered to be in alarm state. The nuisance alarms are likewise combined. The logical inference system represents common simplistic data fusion techniques involving a logical AND, where the system alarms only if specific sets of sensors both register alarms within a 30 second time window. Finally, an innovative approach incorporating machine learning algorithms was also evaluated.

The conventional system achieved the high detection performance desired, with at least one of the sensors detecting each of the 140 system-level attacks attempted. However, the NAR was unacceptably high at an average of 1.78 alarms per day. The evaluation of the data fusion methods involved looking at a subset of the data, involving only the MicroPoint and Photon sensors, as the machine learning algorithm requires a rich dataset and robust sensor performance to inform its complex decision processes. Such rich data were not available from the ground sensor or video motion system. The performance of the conventional system on this data subset is shown in Table 1, as compared to the two data fusion methods.

Table 1: Results Comparison between Sensor Combination Methods, for Photon and MicroPoint Data

	Combined NAR	Detection Performance
Conventional System	1.78	102/102
Logical Inference Fusion	0.08	66/102
Machine Learning Fusion	0.02	102/102

As expected, the logical inference method was able to dramatically reduce the NAR, but at the expense of a large hit to detection performance. However, the machine learning approach was able to achieve an even greater reduction in NAR while maintaining similar levels of high detection performance.

The ReKon system has been designed with capability for enhanced modularity, scalability, and provides for integrated delay, detection, and assessment. ReKon enables the incorporation of advanced fusion algorithms that enables a low-cost perimeter to still maintain high detection performance while maintaining low NAR. Such a system may enable the use of high performance perimeter security for reduced cost in environments previously incapable of achieving such performance due to budget or installation constraints.

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