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DURESS TECHNOLOGY WHITE PAPER

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INTRODUCTION

The purpose of this "White Paper" is to perform a detailed study of Detention Duress Systems – more specifically, Wireless Duress Systems.

The purpose of a Duress System, be it wired or wireless, is to assist in the protection of the detention facility's staff. The systems are to notify the Central or Master Control Room that a staff member is in some form of duress be it from detainees, outside visitors, or even a medical condition. In the "wired" system, there are switches or pushbuttons strategically located throughout the facility such as a nurse station, counselor room, etc., where staff and inmates are in regular contact. Depressing the switch typically lights an annunciator lamp outside of the room and, in some cases, the Local Control Station and/or Central Control Station is notified. In the least sophisticated wired duress system, the switch provides direct control of the lamps. In more sophisticated systems, the switches are interfaced to an electronic control system that can provide local annunciation and remote annunciation. These systems can include interface to Programmable Logic Controllers (PLCs), Touch Screen Computers (TSC) with Graphical User Interfaces (GUI), and Graphical Panels. The alarms can be networked to as many local stations as required, and all information about the alarm can be logged by the Control System that can provide hard copy printout of alarms and responses.

In a non-locating wireless duress system pushbuttons or panic switches at fixed locations are connected to RF transmitters which transmit the ID of the alarming device over the airways instead of through hard-wiring to the Central Control. There are also handheld or personal alarm devices that can transmit the alarm signal but provide no locating capabilities in the receivers.

In a wireless locating duress system, the staff member carries some form of wireless transmitter that can be manually initiated for an alarm condition, or the alarm condition can automatically be initiated if the device has a mandown feature – an automatic switch that, when tilted more than a programmed angle limit, e.g. 45°, will issue a call. Receivers are wired throughout the facility to locate the transmitter using some form of locating algorithm and relay the information to Central Control system where graphical maps on monitor screens show the location of the duress transmission. Central Control would then dispatch the response team. Again, the duress wireless system can be standalone or networked to the Security Control Systems, i.e., PLC, TSC, Graphical Panels, CCTV, and intercom systems.

How to size or determine what duress meets the user's requirements, the types of technologies employed, the pros and cons of each system type, the features available, the maintenance and training requirements, and the cost of typical systems will be addressed by this "White Paper."

TYPES OF WIRELESS TECHNOLOGIES

There are three (3) different technologies applied in wireless duress systems: Radio Frequency (RF), Infrared Light (IR), and Ultrasonic Sound Waves (US). Some wireless duress employs a combination of these technologies to locate the transmitters. Each technology has its pros and cons and the benefits versus costs must be weighed before deciding which technology fits best for which facility.

Pure Radio Frequency Locating Systems

In a pure RF System, the staff member being protected wears an RF transmitter device. The facility is equipped with an array of RF receiver sensors throughout the protected area, both indoors and outdoors. Some systems operate on a licensed frequency in the Public Safety band, protecting it from interference from other radio frequencies. The sensors are wired or networked to the headend computer system that computes the location of an activated transmitter. If the staff member activates the transmitter by depressing a panic button, or pulls a lanyard or automatically activates by a mandown feature, an RF frequency is emitted with both the identification and location information. The sensors that are within the zone detect the signal and its strength and pass this information to the Central Monitoring Computer, which, through proprietary algorithms, determines the location of the activated transmitter and displays the location on graphical screens of the facility on the computer system's monitor. The accuracy is dependent upon the number and location of the receivers and the sophistication of the locating software. The RF signals can pass through non-metallic materials such as clothing, masonry, and wood. They will not require a line of sight from the transmitter to the receiver. Though the RF is affected by metal, which is present in large quantities in detention facilities, the quality, quantity, and location of the receivers can overcome this limitation.

On less sophisticated, thus less costly RF systems there is one receiver for each zone covered. The receivers are de-tuned to receive only signals transmitted within their respective zone. These systems can be prone to incorrect zone locating if the receiver are tuned too high or have dead spaces in the zones if tuned too low.

The sensors can be either hardwired to the headend computer or transmit over existing AC power lines, telephone lines, or even a dedicated radio frequency link. The location accuracy in a steel/concrete environment can be as low as 12.5 ft. It can easily be used outdoors.

The RF systems can be equipped with continuous position monitoring, e.g., guard tour feature.

Infrared Technology and Combined RF/IR Technology

In a pure "IR" System, an infrared transmitter emits a coded light signal in the far infrared range of the spectrum, making it invisible to the eye. The receiver detects the signal and transmits the transmitter ID number to the head computer system with the zone number of the IR receiver that received the signal. IR technology is line-of-sight, so the signal can be blocked by clothing or any

material that will not transmit IR light. The system can only be located within the range of one (1) receiver. If two (2) receivers pick up the same signal, the system will not know which receiver the transmitter is closer to. Pure IR systems are not a viable technology for wireless duress in a detention facility because the signal can be easily blocked, and ambiguity of location crosstalk if multiple receivers are used in too close proximity.

In the combined RF/IR systems, the transmitter emits an IR signal whenever the IR locator for each zone detects each transmitter in its zone. It relays the information to the headend computer that stores the zone entered and the previous zone it came from. Under duress, the panic button, lanyard, or mandown transmits an RF identification signal to the RF receivers and repeaters. It relays the information to the headend computer which displays the duress ID information along with the zone information that was determined by the IR detector on a graphical map of the facility.

Since the IR is only needed for locating the zone and the RF is used to transmit the duress signal, less RF receivers are required than in the pure RF systems. The transmitter has to be on the outside of all clothing and in direct line of sight of the IR receivers. The RF/IR system cannot precisely locate or triangulate as a pure RF system can, nor can it be easily used outside. The combined IR/RF system is much more cost effective on smaller indoor facilities than a pure RF system.

The combined RF/IR systems can be equipped with interfaces to video surveillance systems and intercom systems to provide “Follow Me Audio/Video” features.

Ultrasonic Systems

In a pure Ultrasonic System, a coded ultrasonic signal is transmitted upon activation of a duress signal (panic button, lanyard, or mandown feature). The receivers must be located within line-of-sight for each zone protected with a typical range of 50 ft. The receivers throughout the facility are typically RS485 networked back to the control unit, utilizing a multiplexing scheme over shielded twisted pair. Each mux is polled four (4) times per second with each zone receiver polled every 3.4 milliseconds. Again, the ultrasonic signal can be blocked by clothing. Any hard surface is thus more prone to false alarms.

Combined Ultrasonic/RF systems utilize the ultrasonic receiver to locate or keep track of the zone entered and the previous zone the transmitter came from (similar to the IR receivers). The RF transmits to the headend control system the duress alarm with user ID information. To PSE’s knowledge, no manufacturer is utilizing the combined Ultrasonic/RF technology.

Wireless Non-Locating Duress Transmitters, Call-buttons

There are RF transmitter systems that are non-locating that utilize pulse position based digital RF that use 1, 2, 4, or 8 channel output receivers and supports 1,000,000 codes. When a panic button is depressed a coded signal is transmitted with a unique caller ID code. The signals are not located, i.e., there is no weighting or triangularizations of the RF signals. Most of these systems have limited range (less than 1500’) but some systems have extended range hand-held transmitters that have line

of sight ranges up to two (2) miles. Since these systems are based on single frequency per channel RF transmitters, they can be susceptible to interference from other radio transmitters and extraneous RF noise. The selection of the codes is critical since this is the same technology and frequency band used for wireless devices such as garage door openers. This is the technology used in many home wireless security systems. They also have difficulty in concrete and steel environment of most detention facilities.

Another RF technology that is much more noise immune is the spread spectrum RF technology. The signals are multiplexed over a spectrum of frequencies thus one fixed frequency noise signal will not interfere with the alarm signal. Again the RF signal is non-locating; however, if fixed location call-buttons are used, the unique ID for each button will locate the duress signal. The FCC-certified 900 MHz – spread spectrum callbutton transmitters are used with a pre-programmed duress message (customer-defined voice message) that, when activated, is broadcast to all handheld transmitters/receivers and the base station receivers. Repeaters are used to extend the range of coverage of the transmitters and receivers.

The “spread spectrum” technology provides redundancy required to ensure the reliability of the transmission without wires.

The voice announcement frequency can be VHF, UHF, 800 MHz, or any commercially available radio frequency; as such, the system can be compatible with existing handheld radio systems.

Since there is no wiring involved, many callbuttons can be employed to existing facilities at a minimal cost.

ADVANCED WIRELESS DURESS TECHNOLOGIES

Some advanced duress systems utilize Global Positioning Satellite (GPS) technology for identifying, locating, and tracking staff outside of the building while using RF or RF/IR technologies for tracking personnel inside the buildings. GPS technology cannot be used inside of buildings or around large or tall buildings. GPS technology requires an unobstructed signal from the ground transmitter unit to an earth-orbiting satellite.

The cellular phone system infrastructure is improving in capabilities and coverage. Systems for cordless telephony and messaging based on DECT technology are showing promise especially in Europe. They do require an independent low frequency transmitter for locating the hand-set. This technology is a very cost effective option for duress alarm signals.

In the future, low-orbiting satellite technology that will transmit data may prove to be beneficial in making duress alarm systems more intelligent, limitless in coverage, and much more cost effective.

Tracking software may be standard web browser-based. There would be no special CD to install, no special communications or networking lines, and standard non-proprietary computer hardware would be used. Using a standard web browser gives the freedom of tracking personnel and duress signals from anywhere by multiple personnel, e.g., in the Administrator or Warden's office or Chief Security officer's home, while traveling using laptop computers and mobile phones to connect to the Internet.

DETERMINATION CRITERIA FOR DURESS TECHNOLOGY

The following factors need to be considered when selecting the best duress system for your facility:

- Size, type, and location of the facility
    - Operating environment
    - Space, power, and lightning protection requirements
- Size and type of staff
- Budgetary constraints
- Wireless vs. wired duress system
- Locating wireless vs. non-locating wireless duress system
    - Accuracy of locating systems
    - Coverage

Size Type and Location of the Facility

Is the facility a maximum, medium, or minimum security prison? Obviously, the staff at the maximum security facility is potentially under more duress situations than a minimum security facility, requiring a more reliable accurate duress system.

Is the facility a youth facility, a county or city jail? Youth facilities will have more support staff who may need protection. County or city jails deal with transient detainees and many more visits by defense lawyers. There are small, medium, and large facilities to take into consideration, even when dealing with jails.

A campus-style facility with many separate buildings and large spaces between buildings would dictate a pure RF wireless duress system that can pinpoint location of the duress signal inside or outside of the buildings. A small compact facility would be better suited for an RF/IR based system or the spread spectrum wireless duress callbutton system.

The operating environment is critical to the type of system selected. The ability to operate in a concrete, steel, and masonry environment that is typical in many detention facilities can be a critical selection criteria.

The system component space, power, and lightning protection requirements must also be taken into consideration, as well as how to interface the duress system with the other security systems at the facility.

Size and Type of Staff

How much direct contact will the staff have with the inmates? Do staff members directly supervise prisoners? Are medical staff, clergy, counselors, or other staff members (non-correctional officers) ever alone with inmates or are they accompanied by a corrections officer? Wireless duress locating, in conjunction with wired duress at special locations such as the medical care units, the classrooms or counselor rooms, would be the recommended solution where there is high direct staff to inmate contact.

Budgetary Constraints

For new construction, the least expensive approach would be the wired duress callbuttons. Infrastructure is required for other security and electrical systems that can be utilized for the duress system. Wiring the callbuttons and the annunciator lights would be relatively inexpensive since the security conduits can be used and the control system hardware (PLC, TSC and GUI screens) can easily be adapted to support the duress system. This would be the most cost effective solution.

On existing facilities, if there is adequate unused conduit space and the electrical system is well documented, the wired duress may still be the most cost effective alternative; however, if the staff utilized radio systems to communicate with the Central Control, and if installing new wiring would

be difficult, the spread spectrum wireless duress callbutton system would be the most cost effective system.

If personal alarm wireless system is required, the zoned combined IF/IR technology would be more cost effective than the pure RF locating technology systems for smaller facilities that house 100 detainees or less. The size of each zone and the location of the infrared detectors must be carefully planned. Thorough testing of the system with mock duress testing including the response teams' time to locate and provide assistance should be closely analyzed to determine the adequacy of the zones.

Pure RF systems are the most expensive alternatives, although they provide the maximum protection. If the facility is large, includes indoor and outdoor areas that need protection, and the staff is interacting with inmates, then the pure RF wireless duress system is the best alternative.

The locating accuracy and the minimal dead spots, as well as the construction of the facility will dictate the cost. Locating the duress signal to 12.5 ft. with a 95% success rate is attainable even in a steel/concrete environment, although it will be costly. Reducing the accuracy to 20 ft. indoors and 50 ft. outdoors could significantly reduce the number of receivers required.

Again, testing system performance is imperative. As the systems are tested, they can be calibrated to improve accuracy and reliability. For example, locating a duress signal but being on the incorrect side of an outside wall can have serious effects on the response effectiveness and time.

Wired vs. Wireless Systems

Wired systems are the least expensive, especially for new construction, but are limited in that they do not identify the individual that is under duress. The locations for the callbuttons are fixed. The staff person may not be at the callbutton location when the duress situation occurs. If the duress callbuttons are distributed throughout the facility, the system will be prone to many false alarms. Callbuttons are well suited for medical staff locations, classrooms, counselor rooms, and local control consoles.

Wireless callbutton or paging systems have the same disadvantages as the wired system but have the advantage of ease of installation and relocating transmitters as needed and interfacing to handheld radio receivers.

In a wireless personal duress alarm system, the person being protected has a belt-worn transmitter or personal alarm device with a duress button, optional pullcord, lanyard, or tilt switch mandown feature. The person under duress is identified and located either to a specific point or to a zone or area. Usually, the higher the performance – the higher the cost.

Locating vs. Non-Locating Duress Systems

There are two (2) major categories of duress alarm systems – those that specifically identify and precisely locate the sender, and those that report the alarm but do not locate the duress sender. The

locating systems are further broken down to those systems that can locate within feet of the duress signal (pure RF weighting system) to those that locate within a zone or wing of a building (RF/IF systems). The pure RF locating systems can be further differentiated by the direction finding technology used, e.g., triangulation techniques versus pseudo-Doppler techniques. The definition of these techniques is beyond the scope of this paper. The more accurate the location information, the less time it will take for the response force to reach a person in duress. In other words, the more accurate the system, the more effective and typically more costly the system. When specifying locating systems, the accuracy and how to test and verify the accuracy is critical. You may consider loosing the accuracy requirements outside of buildings to control cost without sacrificing the functionality of the system. For example, you may have a 20-foot accuracy requirement within the buildings and 50 feet outside of the buildings. Accuracy of a locating system is specified in units of distance. Clear definition of the accuracy requirements is important. Locating the correct floor in a detention facility and locating the correct side of exterior walls are more critical than just locating distance. The system could be locating within the 20-foot locating specification but on the wrong floor or the incorrect side of an exterior wall, which will greatly hamper the duress response time - in conjunction with accuracy is reliability. Reliability is specified typically in percent of successful locating, i.e., within the specified accuracy requirements. No location system locates correctly 100% of the time. 95% reliability is considered good.

Coverage specification indicates the percentage of alarms completely missed for the designated coverage area. For example, if specified as 99.9%, then only one (1) missed alarm in 1,000 would be acceptable. The pseudo-Doppler effect locating RF duress systems can achieve this 99.9% coverage. The tuned RF locating receiver type systems can typically achieve only 97% coverage.

The response time in locating systems should be tightly specified. The Duress System must be compatible with the existing emergency response infrastructure. The response may be a local security force dispatched from a Central Control Station or may be as remote as the “911” operator dispatching State Police.

Non-locating systems require all personnel to follow strict procedures on reporting their location via some other systems, i.e., radio, intercom, and/or video surveillance to ensure the response center staff know their location at any given time, should an emergency arise and the duress signal is transmitted.

WIRELESS DURESS FEATURES

Headend Graphical User Interface computer systems with color graphic screens or maps depicting the facility's floor plan is a must. It provides rapid, accurate depiction of where the duress signal is coming from for rapid deployment of a response team. An interface to other security control systems and GUI screens is very desirable because it increases the efficiency of the Master Control Center's personnel. The control computer should log and archive all incidents and response reports, providing hard copy printout of both. Both acoustic and visual alerts should be provided so operators can perform their other job assignments between alarm occurrences.

The transmitter must be easy to operate both during daily activities and during emergency situations. It must be tamper resistant, small but ruggedly constructed.

The man-down feature, i.e., tilt switch that automatically transmits the duress signal if the transmitter is titled at a certain angle for a given amount of time (both attributes should be programmable and user-friendly), is a desirable feature. However, this feature can lead to a greater incidence of false alarms because they can be triggered accidentally when staff members are using the restroom or even sitting down.

A pullcord or lanyard is another option on most duress transmitters that is very desirable. A pin is attached by a cord to the user's belt or other uniform part that automatically sends a signal if an inmate pulls the transmitter from its holster, or if the user pulls the cord. Again, accidental pulling of the cord can lead to false alarms.

"Follow Me Audio/Video" feature allows the users to stay in contact with Master Control Center staff utilizing the intercom and/or video surveillance system in proximity to the duress call and would be a very useful feature.

Response team "Page Alert" feature is for transferring immediate alarm information including the ID of the duress caller and the location or zone information, to the response team through an alpha-numeric pager.

Built-in test mode for transmitters to reduce false alarms and assure system reliability is a mandatory feature.

After initial duress activation, continuous tracking graphically depicts the movement of the user or transmitter. Graphic maps would show where the user was located initially and continuously update the location until the response team arrived and cleared the alarm. Again, this is a very useful feature.

Receivers that can be networked or communicate over the facility AC power and telephone wiring is a feature that can reduce installation costs in existing facilities.

Long life lithium batteries for the transmitters with a minimum 8000 hours life expectancy – or better yet, rechargeable metal halide batteries in a standard "AA" or "AAA" configuration, are a preferred feature. Low battery warning should be included with each transmitter.

Portable transmitters should be ruggedly constructed so that they can withstand five ft. drop tests on to a hard surface (five continuous drops in a row) and be completely waterproof and functional from 0° to 40°C.

SUMMARY

To ensure that the facility's staff is adequately protected and the monies spent on a duress system are wisely spent, a detailed Programmatic Study should be performed, analyzing the facility and its staff and carefully taking into consideration any budgetary constraints. After the report is issued, reviewed by all parties, and a consensus of what type of system best meets the facility's needs is established, a detailed Design and Performance specification should be generated by a qualified Design Professional.

The specifications must clearly outline the desired performance including qualifying the locating accuracy and the probability that alarms will be reported, as well as acceptable false alarm limits. Detailed testing should be outlined that can be used for validating the system. The outline shall include how many tests per zone and precise definition of each zone. All features required of the system should be clearly stated.

The installation and calibration of the system should be performed by manufacturer's trained, certified contractors that have had minimum five (5) years experience installing similar duress systems. The manufacturer of the equipment should be in the business of manufacturing prison-grade duress systems for a minimum of five (5) years and preferably ten (10) or more years.

The systems headend hardware and software has to be clearly defined, listing the computer hardware; the peripherals (printers, backup systems, etc.); interfaces to other security systems; the type of the GUI interface; all the site map requirements; and all the software requirements such as the operating system (e.g., Windows XP), the password protection scheme, and the redundancy requirements of the system.

The reliability, service, and maintenance requirements for the system shall be clearly stated and include the mean time between failure (MTBF) for all equipment with a minimum of 50,000 hours being specified. All diagnostic features should be clearly stated. The service response time should be clearly outlined. 24/7 with a four (4) hour response time is typically specified. All training requirements and training and support materials should be listed. Training sessions for the operations of the equipment and maintenance and support should be provided. Training sessions should be videotaped to assist in training future staff members. All operational and training manuals should be provided at the time of the staff training or before complete acceptance of the system.

The contractor warranty and extended service plans should be specified. A minimum two (2) year parts and service warranty is typically specified with five (5) year extended warranties quoted as an add-alternate.

A successful duress system requires the commitment of ownership and management; a detailed study of the facility and the staff; a highly qualified Design Professional who prepares detailed designs and specifications; a quality equipment manufacturer who makes equipment that meets or exceeds the design document requirements; and a contractor that is trained and qualified to install, calibrate, test, and support the equipment for the specified times outlined in the design documents. This is the formula for a successful duress system that will protect the facility's staff for years to come.

CASE STUDY ESSEX COUNTY CORRECTIONAL FACILITY NEWARK, NEW JERSEY

The Essex County Correctional Facility is a newly constructed 800,000 square foot state-of-the-art Detention Facility consisting of three four-story housing units and a multilevel administration / support Services building. The facility houses approximately 2,000 detainees, making it the largest county jail in the country.

Because of the nature of the facility, the facility has to accommodate a very multi-faceted type of staff/visitors consisting of uniformed staff, administrative staff, medical staff, case workers / sociologists / clergy, judicial officers (the facility included a Municipal Court and a future Pre-trial Court), attorneys, contractors, court spectators, inmate/family visitors, and delivery services.

Meetings with the Owner (Essex County Improvement Authority), the Using Agency (Department of Public Safety, Division of Correctional Services) and the Design Team resulted in the following initial duress system approach:

1. Hardwired Duress Stations would be provided at the following locations:
    - Medical/mental health areas
    - Visitor areas
    - Inmate services area
    - Food services area
    - Education areas
2. Wireless Duress transmitters and receivers to protect select staff throughout the complete facility. The initial technology considered was based on Ultrasonic technology.

After further analysis and a Value Engineering program was instituted, it was decided to revisit the Wireless Duress technologies available. Previous installations of Ultrasonic-based Duress Systems were plagued by too many false positive alarms caused by stray ultrasonic noise. Another technology considered and investigated was the combined IR/RF zone locating systems. The major draw back from the combined IR/RF systems was the necessity of a clear line of sight for locating of the IR detectors. Wearing a coat over the transmitter would block the signal. Also the receivers would have to be exposed and would then be subject to inmate tampering and abuse. The facility was very large and complex and would require many IR zone receivers reducing its cost effectiveness.

A newer pure RF locating system utilizing pseudo-Doppler locating algorithm had been successfully installed in a few prisons in Canada and was undergoing extensive testing by the Michigan Department of Corrections. This technology seem to have the best locating accuracy, reliability, and coverage of any technologies evaluated, especially in the steel and concrete environment of a detention facility. After demonstrations of the technology by the manufacturer and confirming the references supplied, it was decided to develop a design based on this technology and a stringent performance specification outlining strict testing and validation criteria. The Duress system would be fully integrated into the PLC/TSC control system including GUI screens and the graphical control panels throughout the facility. The system would include wireless duress transmitters with a man-down feature and would also locate hand held radios with a duress panic button feature. The locating accuracy specified was: 1) on the correct floor within 20 ft. of true location, 2) on the outside of the buildings with an accuracy of 30 ft. on the correct side of the exterior wall of true location, and 3) exterior of the facility within 300 feet without any additional exterior transmitters.

Based on the reliability and accuracy of this technology the Value Engineering team was able to eliminate a significant number of hardwired duress/panic devices and the associated wiring and infrastructure, thus provide the owner with a substantial cost savings.

APPENDIX

Manufacturer	**Technology**	**Features**	**Comments**
Dominion Wireless	Pure RF locating, Licensed Public Safety band	Locating Wireless Duress; full featured system	Correctional grade Uses the latest pseudo-Doppler locating techniques
Detection Systems (Security Escort)	Pure RF locating 304Mhz	Locating Wireless Duress; full featured system, auto tracking	Correctional grade Spread spectrum wireless transponder links

Manufacturer	**Technology**	**Features**	**Comments**
Actall Corp.	RF/IR locating Supervised 900 MHz spread spectrum	IR Zone or area locating wireless duress; full featured system	Correctional grade Wireless repeaters both IR and RF Minimal wiring
Visonic Ltd. (Spider Alert)	RF/IR locating	Zone or area locating wireless; full featured system. Exterior RF locating.	Correctional grade Foreign Manufacturer
teleProtect 900	RF/IR zone locating 425-475 MHz	Limited features No GUI/TSC pull chord	Semi-Correctional grade Foreign mfg
Micro Technology Services, Inc. Emergency Paging System EXPRO	RF	100 – 150 ft. indoor range	
digiLARM	RF non-locating 420-480 Mhz superheterodyne FM	One way voice, man-down, multiple message programmability No GUI/TSC	Semi-correctional grade
Sentry Products, Inc.	Ultrasonic; zone locating	.Detention grade, no GUI TSC, audio monitoring	Standalone system does interface to other security system hardware – old technology that has not changed in 10 years
Vindicator Tech			

Manufacturer	**Technology**	**Features**	**Comments**
Ciscor (totally wireless)	RF tuned locators Wireless repeaters	Continuous tracking portable monitors Hand held CCTV camera control with duress unique feature	Semi-correctional grade Geared more toward courthouses than Detention facilities
Systems Technologies	IF/RF/900 MHz spread spectrum		
Linear Security	Non –locating RF, 315 Mhz short range 27.255 Mhz Narrow band	Limited features	Commercial grade not institutional grade; offer complete line of wireless security devices
SpreadNet wireless Security C&K	RF, 900 Mhz spread spectrum		Commercial grade not institutional grade; offer complete line of wireless security devices