NLECTC National Law Enforcement and Corrections Technology Center

An Introduction to Portal Contraband Detection Technology

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FACT SHEET

This primer discusses correctional operations in prisons and jails with respect to portal contraband detection, and includes descriptions of related technology either available in the market today or under development. It will help the correctional professional increase understanding of contraband detection and hopefully generate new thinking related to this area.

Webster defines "portal" as a door or entrance. In correctional institutions, portals are often at access/egress points where staff, inmates and visitors must "pass through" for detection of contraband hidden on the body on or, in some cases, hidden within the body.

The Process: A Quick Look

Time for the early afternoon shift change at a typical correctional institution in the United States. Day shift is leaving and the afternoon shift is coming in. In this security-minded era, as employees enter the facility, everything possible must be done to verify identity and to ensure they are not bringing contraband into the institution. Depending on the sensitivity of the institution's portal technology, uniformed staff may need to remove duty belts, restraints, uniform insignia and shoes with metal toes before they can pass through without causing an alarm. Those that trigger an alarm must stand aside for a more detailed search with a handheld device, often waiting in another line. Time given up to this process can be time lost in getting the outgoing shift off duty. For that reason, staff feel obligated to move as quickly as possible, but are also held responsible for any prohibited material that passes through the portal undetected.

This process is typically operated at either the perimeter gate house, in a lobby or at control points within the institution. The portal can process all staff, inmates, contractors and visitors through the perimeter of the facility. Similar systems can search large numbers of inmates moving to work assignments within the facility on a scheduled basis. Those in control rooms or towers can supplement the process by assisting in verification of identity and gate control. In most facilities, this area has become an established post that is staffed at all times with additional personnel on duty during peak periods such as shift change. Many institutions' security budgets do not include allocations for this level of staffing and, as a result, additional staff time in these areas and

additional technology must be provided by sacrificing from other budget areas, which often leads to additional concerns such as overtime management. For the decisionmaker, it is often the proverbial "squeezing blood from a turnip" situation, although technology has played a more supportive role over the years.

For the corrections organization, achieving safety means to do everything possible to prevent contraband (e.g., cell phones, weapons, drugs, money, escape plans, explosives) from entering the facility. A secondary objective is to balance effectiveness with efficiency in terms of results and budget, including staff time to perform the work. In combination with quality staff performance, technology promises to help provide a safer institutional environment.

The National Institute of Justice's (NIJ's) Institutional Corrections Technology Working Group (TWG) believes contraband detection is such an important issue that it has recommended as a high priority the development of a portal device that will integrate and improve existing methods of detecting a broad spectrum of contraband such as, but not limited to, metallic and nonmetallic weapons, drugs, tobacco and wireless communication devices.

Portal Types

Metal Detectors. This portal detection technology generates low frequency magnetic fields that interact with metallic objects. As a person passes through the portal, a signal is received and interpreted by software to determine whether the person is carrying a metallic object. If the alarm sounds, it means there is a metallic object on (or in) the person that falls within the system's detection limits. Units that have multiple zones indicate the section of the body where the object is located. Operators must make sure that a metal detector is properly adjusted for the desired sensitivity to objects of concern such as knives, guns, ammunition, cell phones, coins and drug paraphernalia and to the exclusion of zippers, buttons and wristwatches. Properly adjusted, these units will detect metal inside the body. However, in order to accomplish this, the machine must be adjusted to a high level of sensitivity, and may also trigger on artificial joints or extensive dental work. When alarms occur, the person is usually taken aside and subjected to further search.

This hardware is cost effective and is the most prevalent type of portal technology used generally throughout corrections. It helps focus staff's attention on possible problem areas and on the search process itself. It acts as a deterrent in that it reminds possible violators that a search process is in place, and is affordable by most agencies (less than $10,000 per unit). *Walk-Through Metal Detectors Market Survey Report*[1] provides a convenient overview of metal detectors on the market. This sensing equipment is not limited to a fixed portal or archway.

The shortcomings of this type of system are that it does not detect nonmetallic items such as explosives, paper money, drugs, tobacco and prohibited literature. A metal detector cannot indicate the type of the anomalous object or, with current designs, its exact location. The requirement for sensitivity adjustments, or calibration, creates the need for systematic equipment maintenance.

Although the deterrent effect of metal detectors is important, the advantages of this technology do not significantly reduce staff involvement in the search for all types of contraband. As a result, other types of technologies must be involved in preventing the introduction of all types of contraband into a correctional facility.

Millimeter Wave Detection Devices. This portal technology can detect foreign objects concealed on a person's body under layers of clothing. Systems can be divided into two major subcategories: active and passive. Active millimeter wave imaging technology projects beams of radio frequency (RF) energy over a person's body. The RF energy reflected back from the body, as well as from any objects that are on the body, is captured to create a 3-D image that illustrates the presence and location of any foreign objects. The level of exposure of the subject to radiation is considered to be very low in relation to everyday activities such as cell phone usage. Passive millimeter wave imaging technology works similarly to that of an infrared camera. Passive systems instead use the natural millimeter wave emissions given off by all objects, including the human body. These natural emissions pass through clothing and are registered by sensitive electronics to form images. The NIJ Information and Sensor Technologies Division has sponsored an operational evaluation of an active millimeter wave detection portal technology in partnership with L3 Communications and the Pennsylvania Department of Corrections (See "Scanning for Contraband," http://www.justnet.org/TechBeat%20Files/508%20Techbeat%20Summer2009.pdf).

The limitations of this type of system are that it is expensive (more than $150,000 per unit) and does not detect objects within the body such as in the digestive system, the anal canal or oral cavities. The radio frequency transceivers used to form the image must be calibrated to ensure interpretable images are formed. Systematic equipment maintenance is

[1] *Walk-Through Metal Detectors (WTMD) Market Survey Report.* 2006. Naval Surface Warfare Center, Dahlgren Division, National Innovative Technology and Mission Assurance Center, 17320 Dahlgren Road, Dahlgren, VA 22448-5100.

required to prevent malfunction of the mechanical scanning subsystem.

Magnetometer (Gradiometer) Metal Detection. This technology senses and reports the earth's natural magnetic field within the space of a portal opening, then measures the same space when a human is standing in the portal. Interpretative software shows the approximate location of any objects on the body of the person on a monitor. There are no fields of energy radiated at or through the body. This sensing equipment is not limited to a fixed portal or archway and may be moved and installed in door jambs, walls or other less conspicuous structures. The technology detects only ferromagnetic metals, such as those containing iron, on the body. For example, it will not detect aluminum, gold, copper, brass, lead, zinc, titanium, and some stainless steels because these metals do not perturb the earth's magnetic field. The company estimates that this product will be cost competitive with metal detectors (less than $10,000 per unit).

Further research into this technology is needed. Currently being considered is the fusion of this technology with that of conventional metal detectors.

Electric Field Tomagraphy. This technology, under development by an NIJ grantee, projects weak electrical energy into the body of the person being examined and is being considered for imaging of contraband hidden inside a body. This development is based on a Russian method for screening for breast cancer. An actual working model is expected in the fourth quarter 2009. An interpretation by software provides a graphical view, as if the operator were looking through a person's body. Assessment of the spatial resolution and discrimination, as required for this application, is being performed. This technology presents no apparent health concerns. The developers believe a final product will be cost competitive with metal detection technology. Issues such as throughput time, graphical quality and interpretability and privacy still remain to be resolved.

Ion Scan Technology. This technology (ion mobility spectrometry) senses organic compounds and typically is used to detect drugs and explosives. It works by detecting the ion profile of gaseous samples of the air associated with a person's body, vehicle or living space. A detection is reported when the profile of the air sample matches that of known contraband substance in a self-contained database. This is a close-proximity technology; the person or their belongings being examined must be close to the machine.

This technology is highly accurate but can be spoofed (false positive alarm) by compounds similar to the contraband compound. However, these false positives can be resolved by a trained operator. This technology could be used at a correctional checkpoint in the form of a portable/handheld device or as a "puffer" portal. In the portal, the machine encloses a single human, then puffs of air aimed at the body dislodge contraband particulates from the clothes for detection. The air is then analyzed for a contraband ion signature prior to the person's leaving the enclosure. *USA Today* has reported that U.S. Transportation Security Administration had planned to install 434 of the machines, but the puffers faced problems detecting explosives and with breaking down.[2]

A limitation of ion scan technology for corrections is that it is more costly (averaging $25,000 to $30,000 for the portable systems). Affordability has been achieved by sharing a portable unit across several correctional institutions. The portable models are enclosed in a case that can be easily carried to different locations. The "puffer" portal is large and not portable or readily transportable. Also, throughput time for each individual is slow (a few seconds). As a result, the operational procedure typically is not to examine each person in a fast-moving line. Sensitivity can be set too high so that excessive reporting of contraband (false positives) is experienced.

Heartbeat Detection. This technology uses geophone sensors combined with interpretive software to listen to vehicles parked in perimeter sally port enclosures for indications of a human heartbeat. The signal is analyzed and reported by software to a computer monitor. Under proper conditions, the information produced is highly accurate and reliable. Compared to the time normally needed to inspect a vehicle and its contents, this technology requires very little staff time.

Heartbeat detection often requires additional construction around a sally port enclosure to mitigate the effects of wind and weather. Additionally, although some lease arrangements are available, the cost of the equipment is high (greater than $30,000 per unit) and thus it is not affordable to most correctional agencies.

[2] *USA Today,* Tuesday, October 2, 2007, p. 5B.

Technology providers in the field of accelerometer technology claim the ability to achieve similar performance at significantly lower cost (less than $2,000 per unit). A prototype for testing may be produced in the next few years.

Backscatter X-Ray Contraband Detection. This technology is available to be used at personnel security checkpoints and as a device that searches for contraband on vehicles in sally ports. The checkpoint design uses a low-dose x-ray beam that passes over a human body. Based on Compton scattering, x-rays are scattered back to sensors that pass the information through analytic software. The software produces an immediate graphic display of a human with clear outlines of any contraband on the body. It will image all objects on a body, both organic and inorganic.

At some airports, either x-ray backscatter or millimeter wave scanning is being offered to passengers as an alternative to typical secondary searches if they trigger a metal detection alarm. Often the secondary search is using a handheld metal detector.

Conclusion

Successful security operations, including those at correctional institution security checkpoints, are seldom the result of one security system in operation, and include functions such as:

- Verification of incoming and outgoing staff, and inmate identification.
- Body searches of staff and inmates where appropriate.
- Manual and x-ray search of briefcases, handbags and lunch containers.
- Removal of metallic items, including shoes, to accommodate metal detector search.
- Passage through an contraband-detection portal.
- Staff search and investigation following an alarm.

All of these systems depend on electronics to support or focus the search efforts. As automatic detection improves, so will the success of the entire system. Additionally, less staff resources will likely be required in successful contraband detection at security checkpoints. The following are some of the criteria for technology development that are most important to the profession:

- This technology must be affordable.
- It must be accurate with a minimal false alarms or nuisance alarms.
- The technology must be easily maintained by appropriate staff under a variety of conditions.
- The technology must not be or perceived to be a health threat by the public or health professionals.
- It must pass owner testing requirements and meet national standards.

For More Information

NIJ's Center of Excellence (CoE) for Sensors, Surveillance and Biometrics has many ongoing projects related to portal detection. To learn more about this CoE's activities, visit http://www.justnet.org/coe_surveillance/Pages/home.aspx or call (888) 424-8424.

The CoE for Weapons and Protective Systems coordinates research and activities in the correctional environment. Visit http://www.justnet.org/coe_ppe/Pages/home.aspx or call (814) 865-7098.

NIJ is currently in the process of revising its standards on both walk-through and hand-held metal detectors. New versions of these standards should be published in the near future.

The National Law Enforcement and Corrections Technology Center-Rocky Mountain provided the research for this primer.