



Leveraging Emergent Security Technologies and Design:

Illinois' New Kane County Adult Detention Center

By Patrick Keaty and Hugh D. Lester

The underpinning of any modern detention or correctional facility is security: physical barriers augmented by electronic systems to enable safe and secure facility operations. Recent technological advances are changing the landscape of security in detention and corrections, and they are changing how facility stakeholders do business as they realize the benefit in reduced initial and life-cycle costs.

Kane County, Ill., located on the western outskirts of Chicago, is at the forefront as it leverages electronic security advances in the design of its new jail project. Cost and long-term functionality are vital to officials because existing facility operations are strained by overcrowding, outdated systems and disparate approaches to inmate housing-unit supervision due to its incremental expansion throughout the years. The Kane County Board, which establishes county budgets, taxes and rules for the management of county departments, is proceeding with the project without a referendum, making fiscal discipline paramount.

Analog vs. Digital Systems

Central among these electronic security advances is the widely accepted, decades-long transition from analog to digital systems. Analog systems use one- or two-way signals analogous to a taut string between two tin cans. In contrast, digital signals are messages consisting of “zeros and ones” capable of representing anything that can be encoded and encrypted.

These messages convey complex information through smaller groupings called packets, which travel throughout the local area network within milliseconds. After reading the first portion of each packet, devices determine whether the packet is part of a message intended for them. If not, no action is taken. A well-established, nonproprietary set of rules called Internet protocol (IP), one of many possible protocols for digital communication, allows packets to be universally received and reconstituted for further use.

For the Kane County project, the following basis-of-design systems were specified:

Door Control — Programmable Logic Controller (PLC)-based door monitoring and control that is semidistributed and connected by a fiber-optic back-

bone. Active panning in lieu of pagination improves the human computer interface, and interactive system documentation and maintenance software enhances facility operations.

Closed-Circuit Television — IP video using power over Ethernet, and IP cameras used throughout. Archiving to digital video servers with Uninterruptible Power Supply (UPS) backup and emergency power, the system provides access to real-time or archived video and associated audio over the local area network or the Internet via a password-controlled Web browser interface. Virtual camera stitching improves the human factors of the monitoring task.

Intercommunication Systems — Microprocessor-based intercom and public address/paging in a semi-distributed network connected by a 20-channel digital audio trunk and Ethernet. Multiple talkpaths, audio monitoring and audio threshold alarming are supported. In-building radio is primary, and intercom secondary. Audio is archived digitally in the same way video is archived.

The main benefit of digital over analog technology is profoundly simple: complex systems no longer need to be rigidly hardwired. Why is this important? First, buildings evolve as local and global functions



and uses change. In contrast, security system infrastructure — the conduit and wiring connecting devices — is very difficult and expensive to change.

Additionally, equipment that field devices are wired back to often have limited scalability. For example, adding one camera may require an additional multicamera recording device or changes to proprietary software. Also, adding or relocating devices requires additional power distribution, resulting in expensive and time-consuming installation, possibly doubling the number of vendors required.

Keeping these factors in mind, the electronic security design goals for the Kane County Adult Detention Center included:

- Selecting highly distributed systems to limit infrastructure requirements;
- Incorporating flexibility to accommodate future change of use;
- Reducing the amount of wire in conduits without compromising security;
- Reducing 120-volt, alternating current power distribution through pneumatic locking, which allows devices to continue working during a power outage;
- Reducing emergency power distribution through power over Ethernet and pneumatic locking; and
- Increasing ease and effectiveness of operation, especially human computer interface.

Decision-making

Meeting these goals required the consensus of the entire design team. All maintenance spaces were located outside the secure perimeter, allowing the use of plenum-rated cable instead of wiring in conduits. Early and disciplined inclusion of vertical pathways for building systems allowed for a reduction in floor-to-floor heights and overall building height — a major cost-saving measure in a tower design — while reducing the length of cabling runs.

All options for locking devices were presented to Kane County officials. Pneumatic locking devices were selected, primarily because low-voltage lock monitoring and control is standard. The fact that these devices continue to function during a power outage — due to reserve pneumatic pressure and emergency-powered controls — clinched the decision for facility operations.

As a benchmark for consideration of system flexibility, consider the comparison to a human's loss of a finger: The nerves that innervated the finger wither and eventually disappear, while the area of the brain mapping those nerve impulses is remapped for adjacent (and active) fingers.

To broaden the metaphor, blood flow in the human body is similar to power distribution. Increased muscle mass requires additional capillaries to distribute oxygen, sugars and nutrients; the body rapidly produces the supplemental circulatory pathways. Biological systems are hundreds, if not thousands, of times more adaptive than the majority of building systems.

The gap is narrowing, however, because IP technology renders device location irrelevant, as long as a connection to the digital network can be provided. Careful considera-

tion of structured cabling design allows the maximum flexibility in future building use.

Soon, all devices will be identifiable by their unique digital addresses — instructions or data will be received only by those devices intended — and their status discernible remotely. Racks of hardwired matrix switches will eventually be replaced by increased flexibility or virtual matrices of related devices over digital networks. It will be equivalent to one gigantic party line: multiple, simultaneous conversations, but without crosstalk or eavesdropping.

This is when encryption comes into play, as well as firewalls, software and hardware partitioning, and added security measures. Innovations are filtering down to commercial markets rapidly, thereby safeguarding data and ensuring that IP and secure networks are no longer considered bleeding-edge technology.

Meeting the goal of reduced power distribution led to the use of power over Ethernet for the Kane County project. With a technology based on data and low-voltage power provided over the same cabling infrastructure, adding a camera is as simple as running category cable from the camera to the nearest point of connection to the network. The camera is instantly available for configuration and use.

If primary power to the building goes down, power is supplied to all connected cameras through Ethernet midspans, which inject power at high voltages in order to power attached IP devices and transmit data at the same time. In a traditional system, each camera must be individually wired to emergency power to remain operational during a power outage. Kane County's cameras will continue to operate, documenting everything happening during a crisis for later analysis and future training. Also, it costs less — both initially and over the life of the building.

Design Considerations

User considerations are paramount in the design of correctional facilities, where mission critical operations are conducted around the clock, every day of the year. Correctional facility and security electronics designers must design buildings and systems to reduce stress to improve employee satisfaction, retention and delivery of services.

The first thing designers should do is commit themselves to designing for those who will spend the most time in the facility — the employees. Employee health issues that tend to worsen over time, such as repetitive stress, can be avoided through the selection of adjustable ergonomic furniture. Considerations as global as sightlines — or as specific as the resilience of floor finishes — all have an impact. Taking a cue from the medical profession, designers must, at a minimum, "do no harm." Ideally, designers should enhance the experience of being in the spaces and using the systems they provide.

Designers also should design for detainees and inmates. Contrary to the prevailing view that design amenities coddle inmates and waste limited public funding, the use of design to facilitate inmate behavior management¹ reduces inmate stress levels. Inmates who are physically active, engaged in meaningful activity, and behaviorally at ease tend to be less aggressive, resulting in a cumulative positive impact on everyone involved.²

Operational integration with the facility design also contributes to efficiency. Developing an operational program, and soliciting input from members of the design team, particularly the operations staff, may lead to a consensus that carries through to policies, procedures and post orders in a facility designed to support them. Conversely, failure to address operational integration leads to the propped door phenomenon, where correctional officers reconfigure the jail design by eliminating perceived or actual barriers to efficient movement, often at the expense of facility security.

Electronic security designers also can offset stress through enlightened device layout, which may contribute to the seamlessness of human use. Display and control device selection — touch-screen technology vs. a graphic panel; boom microphone vs. press-to-talk handset — influences the line officer. Human computer interface design, the graphic design of displays and controls on computer screens, and the intuitiveness of software governing them, is central to controlling induced human error and stress levels.

In Kane County, facility size drove an ongoing assessment of officer workload in central control, prompting the question: Can this door be controlled locally or by card reader, rather than defaulting to central control? Sometimes discussions concluded with the reasoning of operations staff prevailing over theory or general practice.

For building perimeter and site-monitoring applications with line-of-sight between devices, wireless mesh networks are revolutionizing the approach to providing required coverage. If a wireless antenna fails, or power to a device is cut, information from other network devices is instantly rerouted. This is referred to as self-healing, and the system is more robust and reliable as a result. Additionally, the infrastructure is less expensive and infinitely more flexible.

A realistic assessment of the efficacy of closed-circuit television coverage of the building perimeter and site led to a recommendation to limit this scope. Consequently, wireless mesh networks were not included in the Kane County project. The beauty of this decision is that it is reversible at any time. If the county desires additional coverage in the future, the more mature and widespread technology likely will have reduced in price.

As the design of the Kane County Adult Detention Center exemplifies, cost savings, reliability and general peace of mind are increased when technological advances are leveraged. Jurisdictions have the option to commission safe, secure, adaptable and cost-effective buildings, both initially and as long as facilities are in operation.

Choosing to install digital, network-based systems today allows the seamless future implementation of emerging software-based advances, such as digital analytics of video surveillance feeds and domain-specific expert systems.

Digital Analytics

Digital analytics, one of the hottest areas of research and new product development in any industry, treats digital video as data that can be analyzed using advanced algorithms. Real-time recognition, interpretation and response to object activity provides the following functionality:

- Motion detection;
- People and defined object counting;
- Vehicle speed detection and alarming;
- License plate identification;
- Crowd behavior analysis;
- Unattended baggage detection;
- Object tracking;
- Zone alarming;
- Overtaking and wrong way alarming; and
- Camera occlusion notification.

While some of these functions are not applicable to corrections, others in development — such as facial recognition — have the potential to radically affect operations and supervision.

Moving Forward

Expert systems are only as powerful as the data available for analysis. Current trends toward the convergence of digital technologies provide holistic data for a holistic view of facility functioning. Meanwhile, inmate management software is evolving into systems for information-sharing between agencies, and longitudinal tracking of an individual's interactions with the entire justice system.

Enhanced data collection may result from devices only imagined today — for example, arrays of wireless heart-beat sensors providing real-time room occupancy counts or similar sensors for medical or stress monitoring. Those who invest in emergent electronic security technologies for replacement or renovation projects will be able to take advantage of such developments with minimum cost and disruption, once they are commercially available. Facility stakeholders must remain mindful that the convergence of digital technologies and emerging frontiers of digital analytics, along with expert systems, make forward-thinking and a commitment to the future a necessity instead of a luxury that one may or may not be able to afford.

ENDNOTES

¹ Hutchinson, V. 2005. Managing inmate behavior in jails. *Corrections Today*, 67(5):28-30.

Hutchinson, V., R. Lichtman and D. Liebert. 2005. Inmate behavior management. Presentation at the Academy of Architecture for Justice conference and exhibition, "Justice in the city," 4 November in San Diego.

² Millstone, K. 2005. Prison succeeds where schools failed. *The Potomac Almanac*. (June 7). Available at www.connectionnewspapers.com/article.asp?archive=true&article=48299&paper=70&cat=104.

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