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Autor: Szogyen-Delmar, J.

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Security systems; American practice; highlights

By J. Szogyen-Delmar

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Nach einer kurzen Einleitung über die Entwicklung und Bedeutung des amerikanischen Marktes von Überwachungsanlagen wird über die Tendenz zur Computerisierung grosser Überwachungssysteme sowie über einige Besonderheiten der automatischen Fernsehüberwachung berichtet.

Après une brève introduction sur l'évolution et l'importance du marché américain des installations de surveillance, l'auteur explique la tendance à utiliser des ordinateurs pour les systèmes de surveillance importants et présente quelques particularités de la surveillance automatique par télévision.

1. Introduction

Troubled by the thought of being victimized by burglars, an Englishman named *Tildesley* devised, and later marketed commercially, a rudimentary alarm system consisting of a set of bells joined to a lock. If someone were to attempt to use a skeleton key to compromise the lock, the bells would ring.

Since these beginnings in the early 1700s, burglar alarm systems have become increasingly sophisticated, adapting man's best available technology to help solve an old problem: the need to protect life and property. Today, the need for effective protection is greater than ever.

Security systems in the U.S.A. are well developed and an integral part of contemporary life. They are rapidly growing and changing. Market demand is high, competition is keen both technically and commercially. There are one very large company, some medium size companies and thousands of small enterprises. It is a dynamic situation.

As concentrations of value and labor costs grow, there is a shift towards more computerization and microminiaturization in electronic protection. Microprocessors and LSI (large scale integration) are broadly introduced, they bring large scale economics, they require new technologies and disproportionally huge training of personnel. Testing is gaining in significance and is now a substantial part of manufacturing, operations and service.

2. Market data

Out of 10 crimes committed in recent years, nine have been directed at property. The list of offenses is a familiar one, including burglary, robbery, pilferage and incendiarism. Together, they add up to ever-increasing losses for American business, especially the insurance industry, and a formidable task for law enforcement agencies and the alarm industry.

In the United States the cost of crime, estimated at about $ 23600000.00 a year, is substantial; for the retail business the losses amount to about 2% of turnover, which is of the same order of magnitude as their net profit and therefore very important. Fire losses, too, have been increasing at the remarkable annual rate of 25%. Responding to these, the expected future expenditures (Market) are similarly important (see table I). Vigorous technical and commercial activities continue in spite of temporary occasional general economic setbacks. The security systems stand out in this respect. Multiplex systems, particularly central stations using digital computers and microminiaturization, are in the state of 'explosive' growth. There are now 6 large central stations of this kind with several thousand subscribers that have more than 1½ year completely satisfactory operation after extensive 'de-bugging'. The telephone rate increases are causing an upswing in technical developments of microminiaturized automatic digital dialers especially developed for security work; this expands the field of applications where dedicated telephone lines are prohibitively expensive.

Technical developments are the motive power that lead to great expected growth in the items marked * in table I. All of these enjoy the reduction in power levels, size, cost brought by microminiaturization. The multiplex systems are also spurred on by the disproportionally great increases in telephone line rates. Closed circuit television (CCTV) systems are encouraged by the trend to less reliance on expensive guards. Tape dialers have proven inferior to digital dialers. McCulloh and Direct Wire R/T equipment suffer from the often prohibitive telephone line rates.

In the following, two significant trends shall be considered more closely: the evolution of large central stations and the increasing importance of CCTV.

3. Large central stations: Computerization is changing central station alarm operations

One of the most effective forms of premises protection has long been the central station alarm system, since it first evolved into its present form just before the turn of the century. Basically, a central station is a manned reception point at which incoming alarm signals are received, after being actuated by sensing equipment at the protection site and transmitted to the station over alarm grade communications lines. Trained security operators receive, record and act upon incoming emergency signals that warn of burglary attempts, holdups, incipient fires and a wide range of other problems that could result in losses.

What many insurers, corporate security directors and others involved in the broad area of risk management and premises protection may be unaware of, however, is that central station operations are beginning to undergo radical change. That change involves the application of electronic data processing to central station operations (fig. 1). With its lightning-fast information retrieval, massive processing capabilities and automatic control capabilities, the computer is providing benefits to alarm system users, to companies supplying alarm services and, ultimately, to property/casualty insurers who have a very obvious stake in premises security and life safety.

Central station automation: The benefits of central station automation via the computer are many, and generally fall into the following groupings: increased efficiency, greater integrity, affordability.

At present, central stations are receiving points for a heavy volume of incoming information. In some large city locations, signals will be received from as many as 4500 separate locations, generally reaching peak volume in the morning hours when protected business locations are opened and later in the early evening when they are closed for the day. Included in the range of subscribers are small business, expensive residences, banks and other institutions, government agencies.

This information, well over 90% of it routine, requires fast and accurate response by central station personnel, although only a small fraction of the incoming data indicates actual alarm conditions. For the most part, these signals tell central station operators that a subscriber's alarm system has been turned on at the close of business or turned off the next morning.

In the conventional central station, these signals must be manually acknowledged and logged-in by the operator. At the same time, he matches it with his record of the location's predetermined schedule of opening and closing times for any irregularity. At an automated central station, these procedures are handled automatically by the computer, which matches the incoming signal to data stored in its memory. The 'ring back' to the subscriber, indicating that the signal has been received, is swift—often within 15 s—and the transaction is automatically logged by the computer and recorded by a high-speed printer.

All alarm system information on a given location, covering a week, month or even a longer period, can be retrieved swiftly, with the computer delivering on command a printed record detailing system activity—routine and emergency—during the specific period.

By thus being freed from the minute-by-minute chore of handling routine, scheduled signals, the operator is able to devote the greater part of his attention to non-routine signals, the ones that warn of potentially loss-producing emergencies such as intrusions, holdups, beginning fires, stoppage or malfunctions of automated procedures and other hazards.

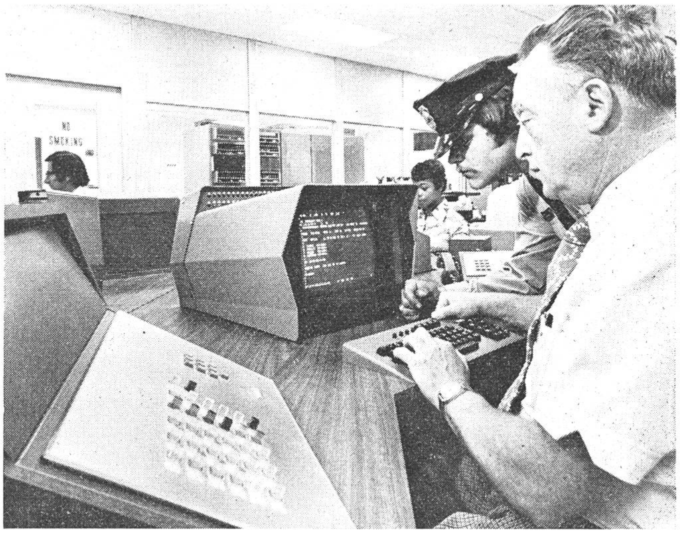

Fig. 1 A computerized central station surveillance system

As actual emergency signals are received at the automated central station, they are flashed on CRT (cathode ray tube) by priority so that the most urgent ones may be acted upon first. Naturally, fire alarms, holdup alarms and related life safety signals take priority, followed by intrusion signals and others. Each signal continues to be displayed on the screen until the operator follows up on it, virtually eliminating chances that a signal will become 'lost'.

To act on an alarm, the operator simply types out an access code on a keyboard and, within a fraction of a second, the CRT screen begins filling with the most important infor-

The U.S. market for selected security and fire alarm equipment, 1976–1985 ($ million)
(Industry Estimates)

Table I

Major equipment category	1976	1977	1978	1979	1980	1985	Percentage growth	
							1976–1980	1980–1985
Photoelectric alarm detectors	8.0	8.6	9.3	10.0	10.9	16.0	+ 36	+ 47
Ultrasonic intrusion detectors	14.9	15.0	16.0	17.0	17.5	19.0	+ 17	+ 8
Audio detection systems*)	6.0	6.9	7.9	9.1	10.5	21.1	+ 75	+101
Microwave intrusion detection systems	6.0	6.7	7.5	8.4	9.4	15.0	+ 57	+ 60
Infra-red detectors*)	5.0	6.2	7.8	9.8	12.2	24.5	+144	+101
Local control panels	15.0	17.0	20.0	23.0	26.0	52.0	+ 73	+100
Closed circuit T.V. (for security applications)*)	65.0	78.0	90.0	100.0	122.0	246.0	+ 88	+102
Tape dialers	7.0	7.3	7.6	7.9	8.2	6.7	+ 17	− 18
Digital dialers/digital communicator*)	4.0	4.8	5.8	6.9	8.3	19.0	+108	+129
McCulloh and direct wire receiving and transmitting equipment	7.0	7.0	6.5	6.0	3.5	3.5	− 14	− 48
Multiplex systems (central stations and proprietary)*)	1.0	1.4	1.8	2.5	3.5	15.0	+250	+328
Building automatic fire detection systems (for commercial market only)	410.0	470.0	520.0	600.0	680.0	800.0	+ 66	+ 18
Smoke detectors for non-residential applications*)	22.0	24.0	26.0	29.0	33.0	45.0	+ 50	+ 36
Total of above product categories	570.9	652.9	726.2	829.8	947.5	1282.8	+ 66	+ 35

*) Non-residential market only.

mation he will need: the address of the endangered location, the telephone numbers or retransmission codes of nearby police or fire facilities, the home numbers of the subscriber and others to be contacted, the approximate time it will take to reach the location and pertinent facts about the premises.

Because the computer provides this critical information instantly and accurately, operator response is swifter and more efficient, reducing the chances of mistakes or misinterpretations. What's more, with the computer taking over the job of record-keeping, including logging-in the operator's response, an accurate chronicle of activity is created.

One requirement for all Underwriters-Laboratories-approved central stations is for periodic testing of alarm transmission lines, both direct wire and McCulloh circuits, the latter being roughly the equivalent of a party line. Therefore another routine, but very critical, function that the computer assumes in the automated central station is checking the integrity of transmission lines to help guard against compromise attempts, malfunctions and other problems that could impede signal transmission. By way of contrast, in a conventional central station, direct wire systems are tested on the average of once every three hours, and McCulloh circuits once every four hours. At an automated central station, this time is cut to once every hour and two hours, respectively.

Sophisticated systems: Where the very highest possible level of line security is needed, additional safeguards can be applied. One advanced approach now available is the use of electronic devices to generate pseudorandom codes transmitted in synchronization between the central station and the protected location. Practically impossible to duplicate because they don't repeat themselves in a normal lifetime, these electronic codes help assure the highest available security for alarm systems at high risk locations that include bank vaults, jewelry stores and government installations. Defeat, disturbance is virtually impossible.

The final, but by no means least important, reason behind automation of central stations is the cost of service. Alarm signal transmission lines, as supplied by the nation's telephone system, are becoming scarcer and more costly. With the computer as its nerve center, the automated central station is able to make use of telco transmission means other than alarm-grade lines to hold the line on rising costs and decreasing availability of this transmission medium. The response time of computerized work is much shorter.

Additionally, by effectively permitting the use of other modes of transmission, the automated central station is able to provide alarm service to a broader geographic area. This is an important consideration as cities continue to spread beyond their older downtown cores into more distant suburban areas.

Currently, automated central stations are in operation in the New York City area, Houston, Baltimore, Montreal, Washington. In coming months, still more automated central stations of alarm surveillance will commence operation in other cities, marking a transition to a new era of electronic protection service. Generally, there is little change in the kind of customers respectively subscribers, nor has there been an explosive growth in the number of customers and subscribers.

4. Closed circuit television (CCTV) systems

4.1 General

Fundamental elements in CCTV are the lens, the pick-up tube, the video amplifier and the monitor. They are connected by coaxial cable; thereby interference and disturbance are minimized.

In a typical installation, a security officer may wish to observe several different locations; the separate cameras can be fed into a single monitor and, using a video switcher, each of these are seen for a selected time period of 1 s to say 1 min in a predetermined sequence. Freezing on one camera, changing the dwell time or recalling the view of one camera out of sequence is available through manual intervention.

In other typical installations, it is desirable to observe the same CCTV picture in several different locations; the CCTV signal from a camera can be fed to several different monitors in different locations.

Recording is often desirable. Video tape recorders with electronic date/time display generator furnish valuable data for analysis. One version of these recorders can be programmed to record what the camera sees at higher than normal speeds in a time lapse fashion. This technique permits the extension of a normal 1-hour-tape-recording time to up to 60 h.

The choice of the lens should suit the application. Table II illustrates the differences in viewing area obtainable by choice of the focal length of the lens. Automatic lenses are available which adjust the lens aperture to match existing light conditions.

In many applications scanning of an area is desirable rather than fix on a single scene. Motorized pan (horizontal movement) and tilt (vertical movement) combinations can view practically anything within 360⁰ pan and 90⁰ tilt. Pan and tilt can be automatic preprogrammed with manual override. The zoom lens maintains the ability to keep an object in focus while changing its focal length, thus magnifying distant scenes in the same way a telephoto lens might.

CCTV can see in the dark. Not in 100 % complete darkness, but with as little illumination as the 0.01 cd/m^2 of partial moonlight. LLLTV (low light level TV) cameras are capable of seeing within the range of 10^5 cd/m^2 of full sunlight and 0.01 cd/m^2. Illumination by infra-red light combined with silicon diode type CCTV cameras whose response is in the red region of the sprectrum will bring further 'dark vision' capability. These cameras, however, cannot tolerate strong sunlight and, therefore, need sophisticated filtering. In other cases, it may be desirable to use visible light, for instance mercury arc lamps; mercury arc sensitive vidicon cameras, whose spectral sensitivity is in the blue-green region, electronically intensify images.

Lens focal length and viewing area (m) Table II

9 mm extra-wide angle	12.5 mm wide angle	25 mm standard	50 mm telephoto	75 mm telephoto	100 mm zoom
0.75	0.9	1.8	4.2	5.5	9.1
1.4	1.8	3.7	7.3	10.7	15
2.9	4.0	7.6	15	23	30
4.9	5.8	11.6	23	30	45
5.5	7.6	15	30	45	60
6.9	9.1	18	37	58	75
14	19	38	75	112	150

4.2 Application example

The following system applies to CCTV surveillance of a nuclear power generating plant. The philosophy in designing the CCTV systems for this site was to design a system that will provide the utmost degree of system integrity and reliability commensurate with three other vital requirements:

– that the system be relatively simple and foolproof when operated by essentially non-technical personnel,

– that it complies with the requirements of all applicable codes and standards relating to this application of the system,

– and, finally, that it achieves all this not only at a moderate cost, but with low anticipated maintenance expenditures as well.

The philosophy of system application revealed the following basic system parameters that is the common denominator of a high security system.

1. All cameras must be located within the protected area. In the case of a planned compromise of the fence intrusion detection system, if the cameras were located outside, they could easily be disabled prior to attacking the fence.

2. The camera surveillance system must be defined by optical zones rather than by the intrusion detection zones (100 m) specified. An explanation follows.

A specified CCTV requirement is that a 1.8-m man must appear 7½ cm high on a 35-cm screen when at maximum zoom at furthest location from the camera. This ensures that the man is automatically detected. A 1.8-m man occupying 7.5 cm of the 20 cm vertical space implies a total scene height of approximately 5 m. The 4 : 3 aspect ratio of the monitor yields a corresponding 7 m in scene width.

The second specified CCTV requirement is that the camera shall automatically preset pan, tilt, zoom, to view the entire zone. This yields a scene width of 60 to 100 m. Thus the zoom lens is specified 7 m to 70 m maximum or 10 : 1. The usable camera to subject distances at both sites are about 75 m maximum implying that a wide angle 12.5-mm lens is required to see the maximum specified scene. The only lens available close to these specifications is 16–160, meaning that the camera to subject distance for this lens is ideally about 75 m. With a zone in excess of 70 m, the maximum *usable* zoom lens 10 : 1 (16–160 mm) cannot meet this requirement. There is a lens available with 14 : 1 zoom ratio, but it is not usable in this application because of its price.

To realize the specified performance from the system, the same contractor must design both the CCTV and intrusion detection systems around the optical limitations imposed above, because the relative camera placement with respect to the zone location is very important.

3. The noisy (electrically) environment associated with power plants presents the need for *hum* (60 Hz) reduction circuits and video cable equalizers on all outdoor video runs, the hum being an interference of 60-Hz frequency.

4. The cameras proposed as specified will only be effective if used within the lighted fence areas, where 2 cd/m² minimum illumination exists. The performance of the system could be greatly improved if the camera specification were changed to require silicon intensified cameras. With this type of camera, minimum scene illumination and automatic light compensation are greatly improved:

	Proposed	SIT Camera
Minimum scene illumination	2 cd/m²	0.03 cd/m²
Automatic light compensation	$50 \cdot 10^3$ to 1	$100 \cdot 10^6$ to 1

The silicon intensified cameras have the added advantage: If the fence lights are disabled in any way, the cameras will still be usable because they can virtually see in the dark. Infra-red (active or passive) and other systems will suit some applications; judgement must be applied to each large system to balance risks, costs, reliability, maintenance costs, immunity from disturbance, resolution capability.

Author's address

John R.M. Szogyen-Delmar, Vice President retired of ADT International Inc., 25 Douglas Road, Glen Ridge, N.J. 07028, USA.