

Automated Fingerprint Identification System

AFIS

NEC AFIS — an invaluable tool in the fight against crime

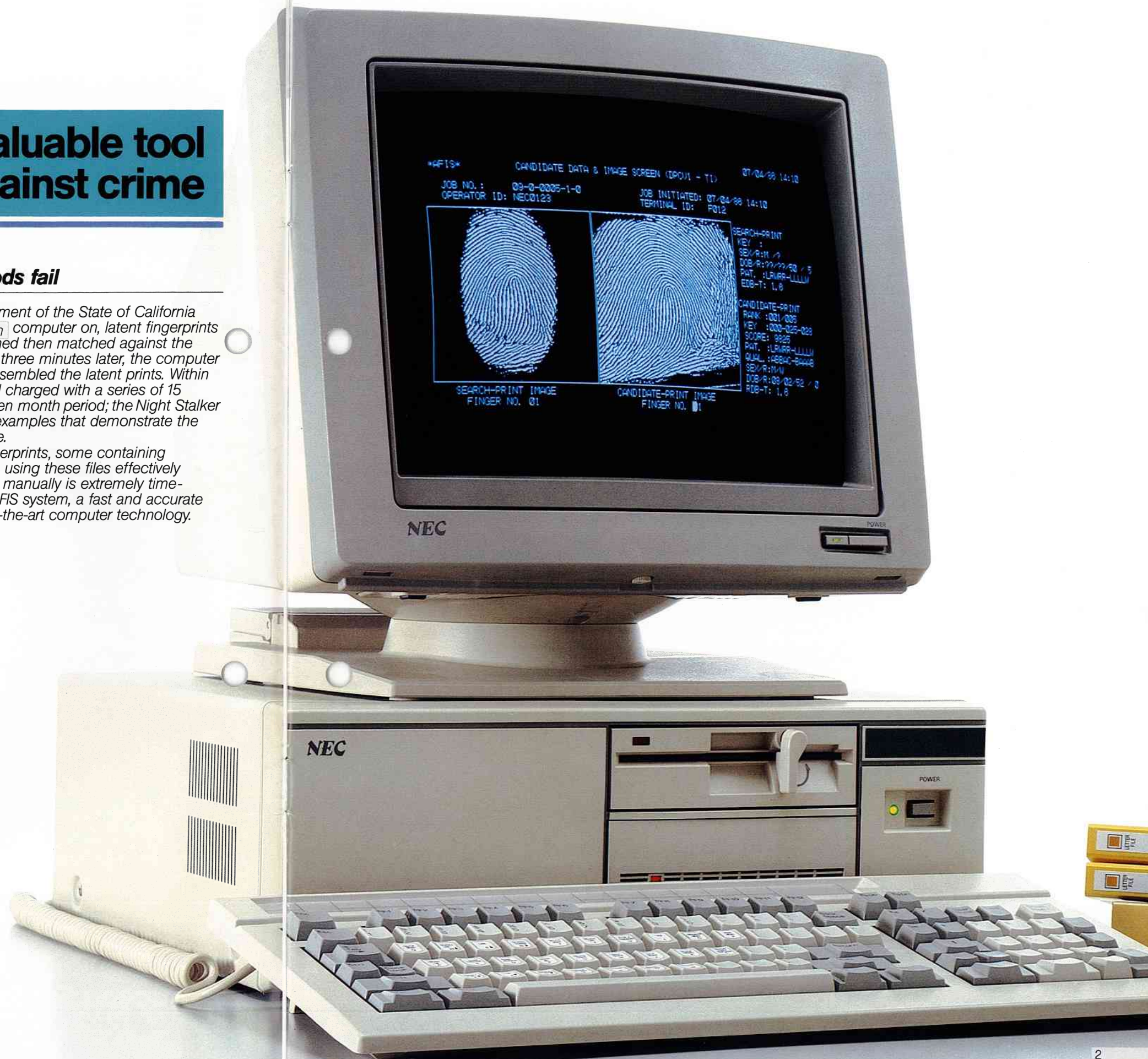
Succeeding where other methods fail

As its first job, when the Justice Department of the State of California switched its new AFIS fingerprint identification computer on, latent fingerprints found on a car used by a criminal were scanned then matched against the fingerprints of 380,000 known offenders. Just three minutes later, the computer output a list of suspects whose fingerprints resembled the latent prints. Within two days, the prime suspect was arrested and charged with a series of 15 murders that had been committed over a seven month period; the Night Stalker had been captured. This is just one of many examples that demonstrate the effectiveness of AFIS in the fight against crime.

All police departments have files of fingerprints, some containing thousands or millions of fingerprints. However, using these files effectively presents a problem as comparing fingerprints manually is extremely time-consuming. This is why NEC developed the AFIS system, a fast and accurate means of matching fingerprints using state-of-the-art computer technology.



International recognition of NEC's contribution to the fight against crime



NEC AFIS — a superior fingerprint identification system

Using the latest computer technology in the fight against crime

NEC AFIS uses the latest electronics technology to match fingerprints. With its unique fingerprint encoding system and ability to hold an unlimited number of records, it is able to identify possible matches with unparalleled accuracy.



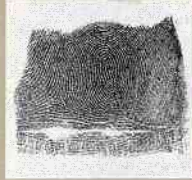




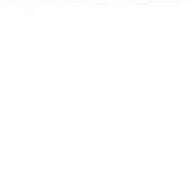
NEC is a world leader in computers and communications, in terms of both the hardware and software that are used in these increasingly related fields. It is this wide range of expertise that has made it possible for NEC to develop AFIS, the units making up the system, the customized pattern recognition and processing technologies used in them, and the sophisticated software without which AFIS could not perform its unique task. And with its position as a leader in so many related fields, NEC is able to provide the support that crime-fighting agencies need in implementing and expanding AFIS and related systems.

AFIS

1 Automated Fingerprint Identification

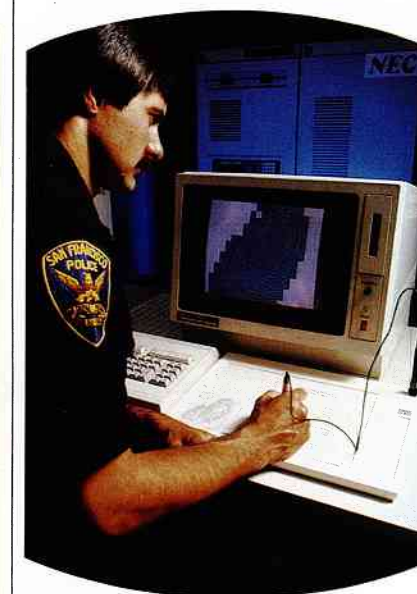
Police departments can use NEC AFIS to computerize their fingerprint identification operations. By supplementing rather than replacing fingerprint technicians, AFIS will result in a dramatic improvement in productivity. AFIS uses specially developed hardware and software to encode and match fingerprint and is able to recognize matches that would be almost prohibitively time-consuming if performed by manual methods.

Prints that make manual searching extremely difficult

Rolled print	Latent print	Type
		
		Slip print
		Overlapping print
		Partial print

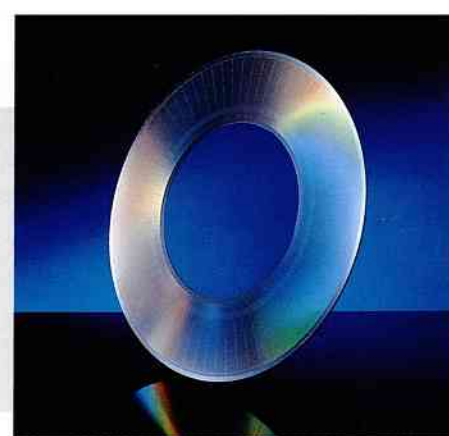
2 AFIS, through integration to a total system

NEC AFIS is designed so that it can also be used to assist police departments in many other areas of law enforcement. One example is its integration in a broad-based investigative system using existing "mugshot" and criminal history files; in this way, NEC can provide highly integrated systems that are easy to implement and use.



3 Wide range of applications of fingerprint matching technology

Through its use of the latest image recognition and computer technology, possible AFIS applications extend far beyond the traditional roles of law enforcement agencies. The uniqueness of fingerprints allows them to be used as "keys" to control access to restricted areas and as an additional and almost infallible means of identification in such procedures as immigration.



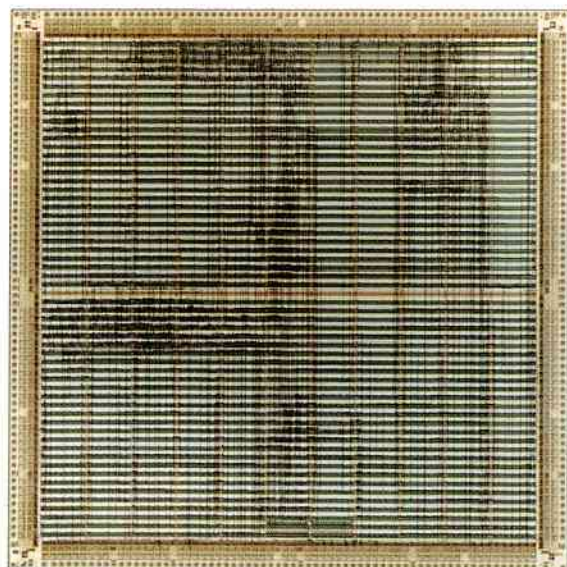
NEC AFIS: world-beating accuracy through unique minutiae encoding system

Dedicated hardware using the "relation" concept for the ultimate precision

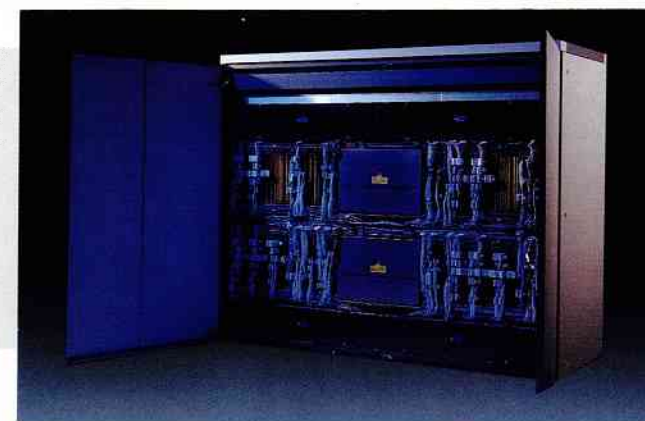
Why is NEC AFIS so accurate? The answer lies in its unique encoding process, using minutiae and the relation between them. Minutiae are the points at which ridge lines in fingerprints end or split into two — the characteristics that make each fingerprint unique. But, because the skin at the ends of fingers, where fingerprint patterns are located,

is very soft, the positions and directions of minutiae are subject to a great deal of distortion, depending on how the finger is pressed against the surface receiving the print. The number of ridges between minutiae however, never changes. By encoding these ridge-counts together with the minutiae, that is, the "relation" between minutiae, NEC AFIS provides the most positive matching between fingerprints.

NEC's experience in the design of advanced processors, in combination with its image processing and matching technology, has been utilized in designing a state-of-the-art fingerprint processing system which is able to match fingerprints accurately at high speed.

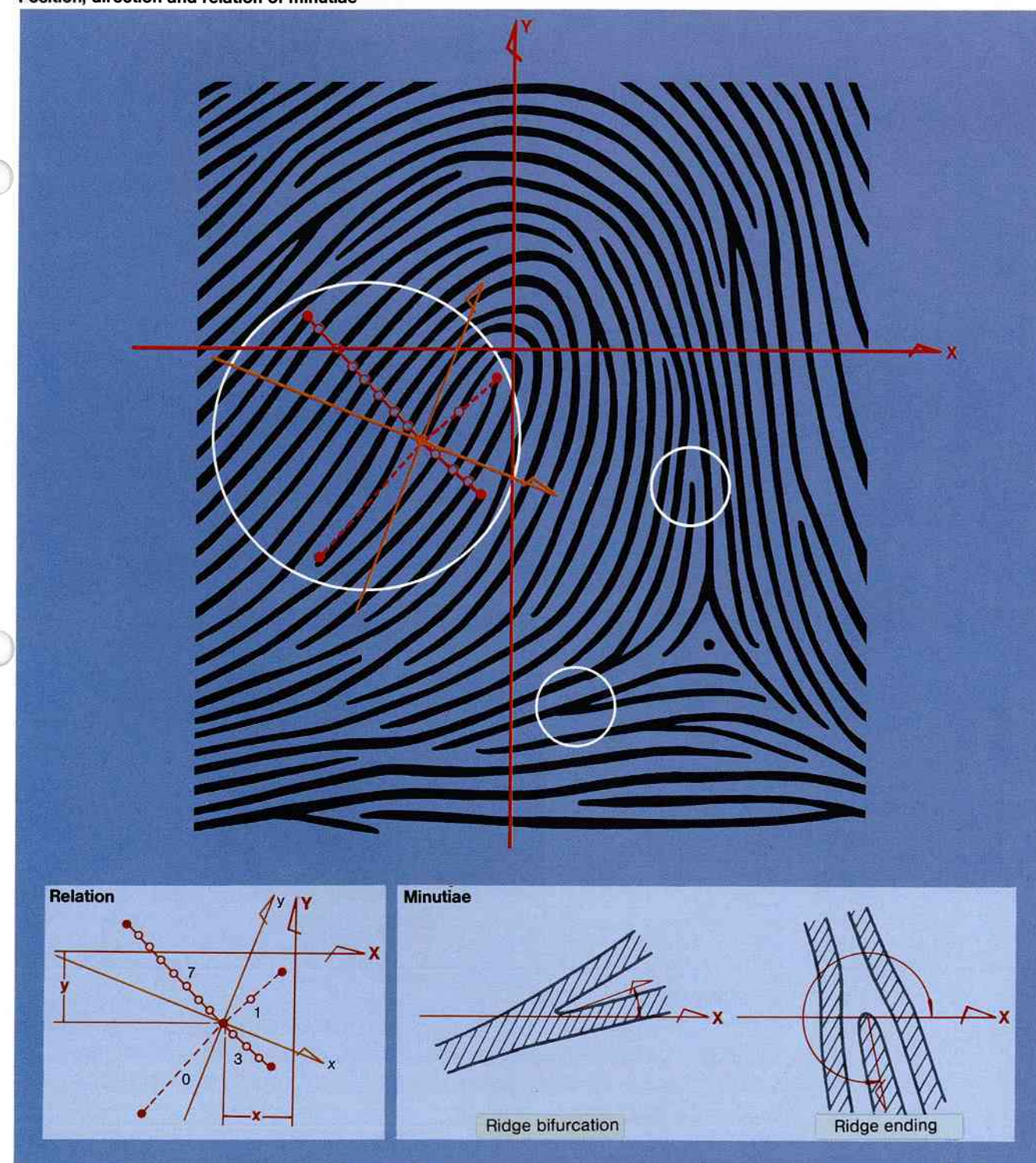


High-density circuit developed for high-speed fingerprint matching



Inside the Fingerprint Matching Processor

Position, direction and relation of minutiae



NEC AFIS: consisting of three high-performance, highly reliable subsystems

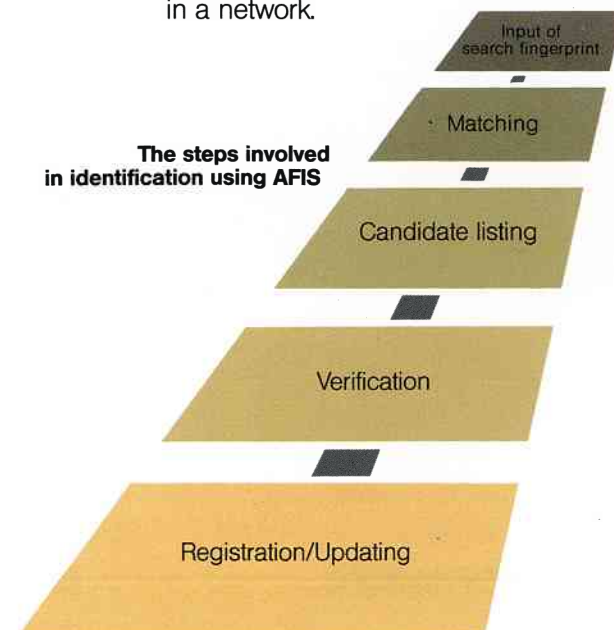
Improved efficiency in all phases of fingerprint processing

For optimum performance and flexibility, AFIS consists of three computer-controlled subsystems, the Input Subsystem, the Matching Subsystem and the Digitized Image Subsystem.

Fingerprints can be input using 3 options; a Fingerprint Reader which has an automatic feeder for batches of 10-print cards and is generally used in central offices, an Image Scanner for use in a Remote Input Station which reads individual cards and a Compact Scanner which reads individual fingerprints and which is specially designed for economical use, in a local Booking Terminal.

The Matching Subsystem uses a number of Fingerprint Matching Processors controlled by a computer; this also controls access to database files and communications devices when the system is used in a network.

The steps involved in identification using AFIS

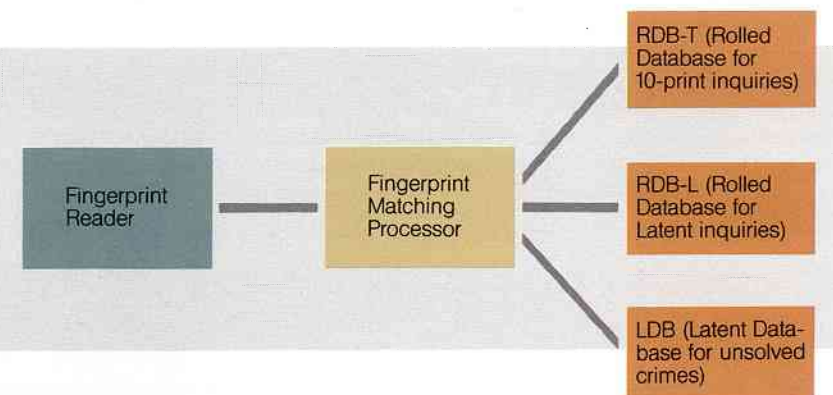


Using optical disk files, the Digitized Image Subsystem is used in the verification of the fingerprints of shortlisted candidates; this is used in combination with the Verification Terminal which uses a split-screen display to show the search and candidate fingerprints to the fingerprint technician, simultaneously.

These subsystems allow AFIS to be used in the following four ways:

1. 10-print to 10-print matching
AFIS can match 10-print cards against existing files of 10-print records to identify suspects and maintain criminal records.
2. Latent to 10-print matching
Latent prints lifted from the scene of a crime can be matched against the existing 10-print file.
3. 10-print to latent matching
The 10-print card of an arrested suspect can be matched against the file of latent prints to determine if the suspect has been involved in other crimes.
4. Latent to latent matching
By matching latent prints against the latent file, it is possible to determine if different crimes have been committed by the same individual.

Each of these four matching processes is performed with the highest possible accuracy, using the same high level of basic technology, encoding fingerprints using their minutiae and the relation between them, matching them using NEC's unique image processing and displaying them for verification by fingerprint technicians.



Small System



NEC AFIS: able to meet the needs of users, large and small

Storage capacities and speeds to suit all requirements

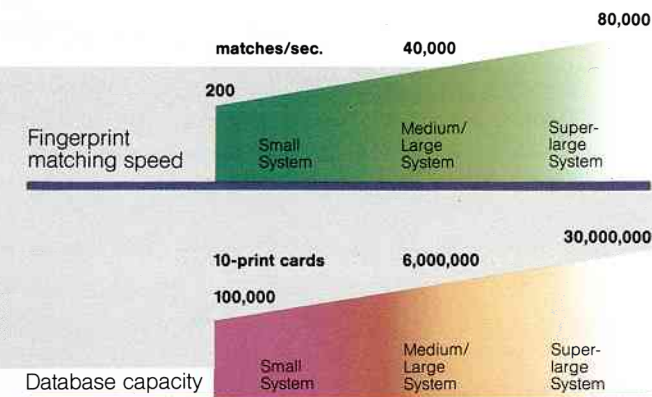
NEC AFIS can be tailored to meet the needs of any agency. With configurations ranging from small, stand-alone systems to large state-wide and nation-wide systems, whatever your requirements, NEC can supply an AFIS system that's just right for you.

NEC can provide small systems with a database capacity equivalent to 100,000 cards to large system capable of storing 6,000,000 records or more. The Matching Subsystem can also be tailored to meet individual requirements. In its smallest configuration, this performs 200 matches per second, while enhanced versions using more than one Fingerprint Matching Processor can handle 40,000 and more matches per second.

NEC has installed systems with various capacities in a number of countries. With a variety of configurations available, NEC AFIS systems are supplied on a turnkey basis. As well as providing training in all aspects of the use of AFIS, NEC has the facilities required for conversion from manual to computerized fingerprint processing and can handle fingerprint file conversion if required.



Fingerprint file conversion center



Medium/Large Systems



NEC AFIS — integrated with a communications network, an even more powerful system

State-of-the-art electronics in computers and communications

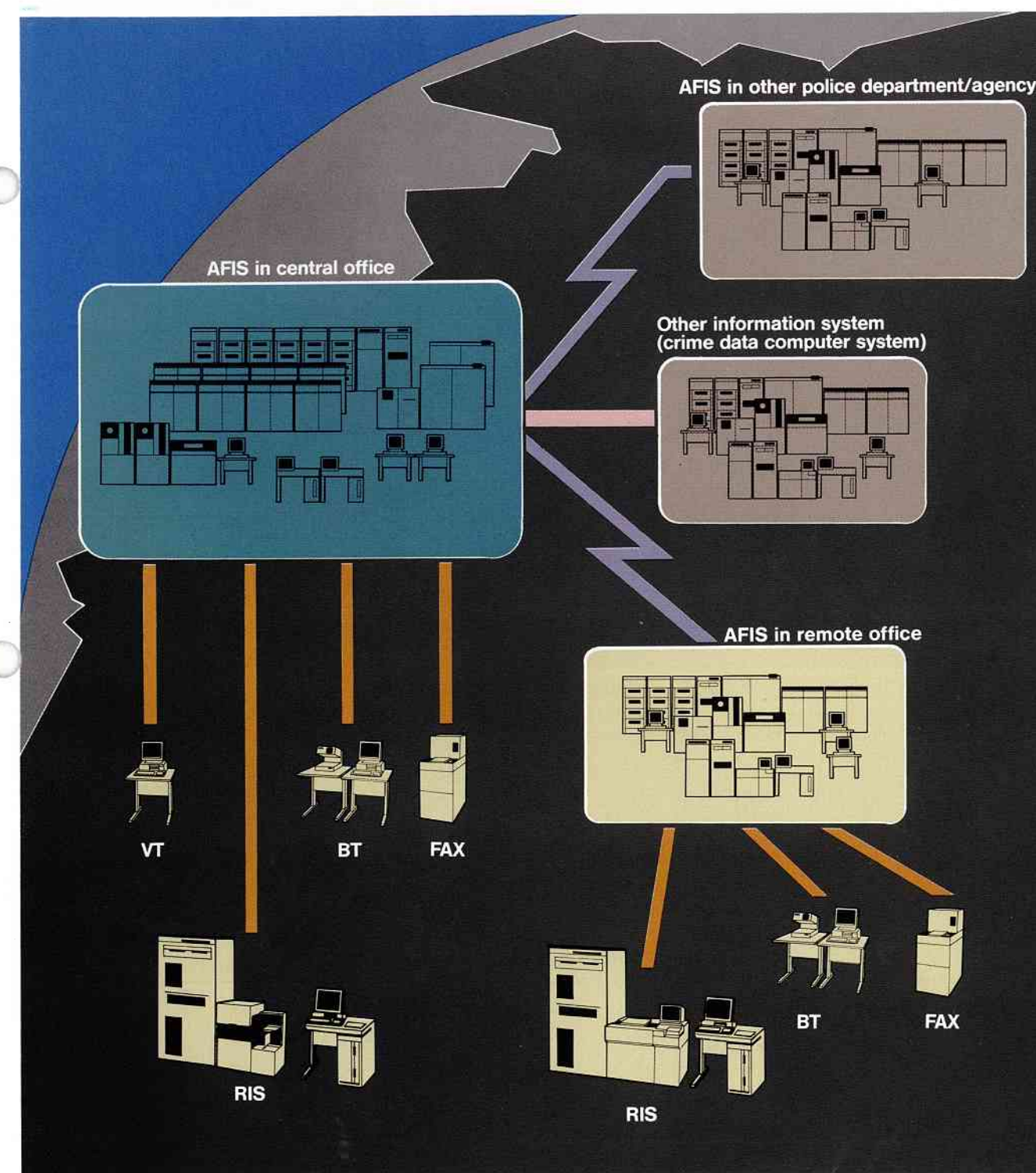
By networking the central AFIS processing system with Remote Input Stations and Booking and Verification Terminals, on-line searches can be performed from offices located anywhere. For even more powerful systems, when a number of different law enforcement agencies install AFIS systems and use a combined database, fingerprint matching becomes possible over a wider area.

NEC AFIS can also be integrated by connecting it with other systems in which computer files are maintained such as criminal history, "mugshot" and drivers licence files. NEC has the resources and can provide the equipment necessary to construct networks which will provide any required capabilities.

Remote Equipment & Functions

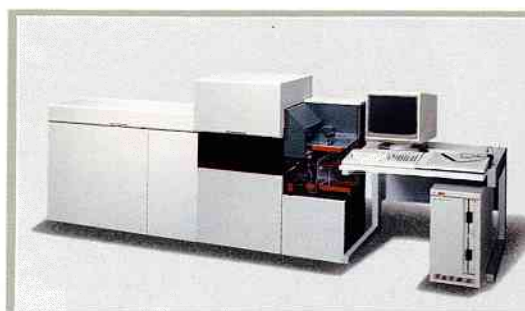
Function Equipment	Transmitting		Receiving	
	Fingerprint Image	Minutiae	Candidate List	Verification Image
Remote Input Station (RIS)*	x	x	x	x
Booking Terminal (BT)**	x		x	x
Verification Terminal (VT)				x
Photofacsimile	x			x

*Stack card feed and single card feed models are available. Up to 10 fingerprints can be scanned from a single card.
**Scans one finger only.



NEC AFIS: modular hardware for use in typical configurations

A variety of units, for use in systems with different capabilities



Fingerprint Reader

- Reads 10-print cards and latent print images.
- Automatically feeds fingerprint cards from the hopper, scans them, then returns them to the stacker.
- Picks up the images of fingerprints and automatically detects fingerprint features (minutiae and relation data).
- Processes cards at high speed, 15 seconds per 10-print card.
- Descriptive information (Reference No., sex., date of birth, etc.) can be input and fingerprint editing can be performed in the interactive mode when used together with the Fingerprint Input Monitor.



Fingerprint Matching Processor (FMP)

- Matches search prints against fingerprint database stored on magnetic disks.
- Lists candidate fingerprints in order of matching score.
- Performs highly accurate matching with an algorithm which uses relation as well as minutiae data.
- Advanced pipeline and parallel processing enables high speed matching, at 800 matches per second with a standard processor. One computer can control a number of processors when higher speed matching is required; with 50 FMPs, 40,000 matches per second are possible.



Optical Disk Systems

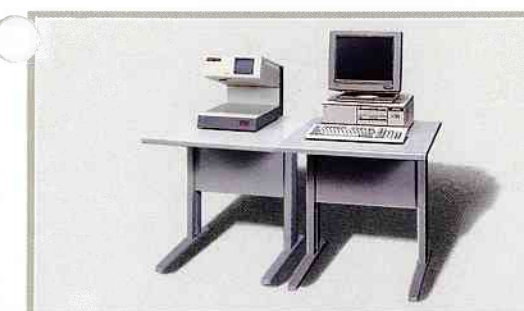
- For storage of fingerprint and "mugshot" images; these images can then be retrieved for verification, etc.
- Two optical disk units are available, one with a capacity of 4 Gbytes* and a jukebox-type unit with a capacity of 48 Gbytes.
- Enhanced binary and gray-scale images can be stored with the enhanced binary image of a single finger occupying 4.2 Kbytes of storage after compression.

*Optical Disk Units have individual heads for each platter, making them ideal for online real-time retrieval.



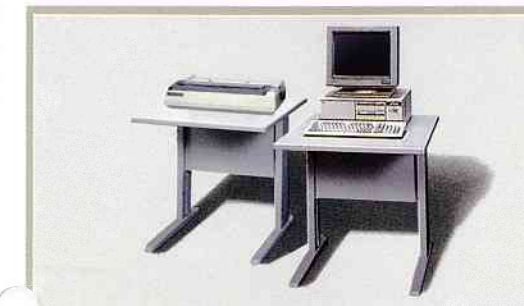
Remote Input Station (RIS)

- When installed in a remote office, transfers fingerprint data to the AFIS center and receives the results of matching.
- The RIS consists of an Image Scanner, a Fingerprint Image Processor, a Fingerprint Input Monitor and a Communications Processor.
- The RIS can be connected to the AFIS center via communication lines with capacities from 9600 bps to 48k bps, half or full duplex.
- The Image Scanner can read both 10-print cards and latent prints.
- The Fingerprint Image Processor (FIP) automatically detects fingerprint features.



Booking Terminal (BT)

- This is installed in remote offices as a fingerprint inquiry terminal.
- Transfers single fingerprint images to the AFIS center and receives the results of matching (candidate lists) for verification.
- Can be connected to the AFIS center using 9600 bps half duplex communications lines.
- The Compact Scanner can accept rolled fingerprints and latent prints for input to AFIS.



Verification Terminal (VT)

- The VT consists of a keyboard and CRT display and is for the retrieval and verification of fingerprint images.
- The 14" (diagonal) CRT has a resolution of 640 x 400 dots and can display 80 columns x 25 lines in the character display mode.
- Connection to the AFIS center is via a communications line with a capacity of 9600 bps, half duplex.
- Optional printer unit provides hardcopy of fingerprint images.



High-Resolution Photofacsimile

- This photofacsimile device was specially developed for fingerprints.
- Transmits and receives high-quality, high-resolution fingerprint images.
- The fingerprint portion of fingerprint cards can be transmitted clearly with a vertical resolution of 16 lines/mm* while the non-fingerprint (i.e. character) portion can be transmitted at high speed with a resolution of 5 lines/mm.

*20 lines/mm resolution available on request.

- Fingerprint data transmitted using flat-bed transmitter.
- Fingerprint images received by drum receiver.



"Mugshot" System

- Consists of File Controller, Color Image Scanner, Optical Disk Unit, and Color CRT Display Unit.
- Provides storage, retrieval and display of full-color mugshots.
- Color Image Scanner inputs both front and profile mugshots at speed of 15 seconds (max.) per A4 (letter size) sheet.

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