International Association for Identification

1998 IAI AFIS COMMITTEE REPORT
On
Cross-Jurisdictional Use
Of AFIS Systems

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EXECUTIVE SUMMARY

The International Association for Identification (IAI) Automated Fingerprint Identification System (AFIS) Committee has demonstrated a method of conducting remote fingerprint searches across jurisdictional and fingerprint equipment vendor boundaries. Using AFIS systems at operational sites, vendors conducted remote searches of tenprint and latent images over the National Law Enforcement Transmission System (NLETS) frame relay network using ANSI-NIST and FBI approved standards. NLETS is a private network designed for the Criminal Justice community.

The AFIS Committee consists of leaders in fingerprinting from state and local law enforcement, the FBI, the National Institute of Standards and Technology (NIST) and private industry. Participating in the demonstrations were three major AFIS vendors--Cogent Systems, Printrak International and Sagem Morpho , along with Aware, who used their commercially available Electronic Fingerprint Transmission Specification (EFTS) Software, and the National Law Enforcement Transmission System (NLETS) who provided access to their frame relay network.

In 1997, testing was conducted to and from vendor facilities using the Internet as the transmission medium. Although the Internet is not a transmission medium of choice for regular law enforcement use due to security implications, the Internet allowed us to prove the feasibility of transmission using the Simple Management Transfer Protocol (SMTP) and Multipurpose Internet Mail Extensions (MIME), required for the FBI's Criminal Justice Information System (CJIS) Wide Area Network (WAN) and for potential application outside the criminal justice area.

This year, after regression testing on the Internet, we moved the tests from a simulation of vendor sites over the Internet to operational customer sites over the NLETS frame relay network. Sites that were not already directly connected the NLETS network were given dial-up access to the central NLETS site.

Testing was successful and further proved the AFIS Committee's theory that today searches can be run across jurisdictional and AFIS vendor boundaries. It was also shown that simply because a vendor is FBI certified for certain areas and considered standards-compliant doesn't necessary guarantee interoperability with other vendors. The FBI's Electronic Fingerprint Transmission Specification (EFTS) document was crucial to interoperability for it defined a common implementation of the ANSI NIST standard within which vendors could communicate, but we also needed to modify certain aspects of the transactions to make it applicable to cross-jurisdictional use (See Appendix C).

This testing has not been funded by the IAI or any outside source. All who participate do so at their own expense of staff time, equipment, travel and other expenses. The Committee Chair extends many thanks to the three AFIS vendors who contributed significant resource investments: Cogent Systems, Printrak International and Sagem Morpho. Thanks to Aware who did the same. Thanks to NLETS who accommodated our testing during a period of their own

upgrade testing and contributed the extra equipment we needed at no cost to us. And special thanks to the three operational sites that graciously supported the live testing.

This project, conceived two years ago at the IAI 81st Annual Educational Seminar, will be discussed by a Panel at this year's IAI 83rd Annual Educational Seminar in July at Little Rock, Arkansas. For more information, see the IAI AFIS Committee home page at http://www.iaibbs.org/afis.htm or contact Peter Higgins or Cynthia Way at 202-625-7780.

1. Introduction/Background

At the 1996 IAI Annual Training Conference, the AFIS Committee sponsored a Panel designed to provide an educational experience for the IAI members in the audience and to explore the possibility of establishing links between the various state and regional AFIS systems, regardless of the hardware and software vendor used to capture, store and compare the fingerprints.

Working with the major vendors of AFIS and scan equipment, the AFIS Committee, FBI, NIST and other law enforcement agencies, we developed a Concept of Operations that outlined how remote searches might be performed. The Concept of Operations explains the relevant U.S. standards and how they could be implemented to support cross-jurisdictional, multi-vendor AFIS searches. This document was also a basis for a series of cross-jurisdictional AFIS search demonstrations.

Next, a Demonstration Test Plan was written for the 1997 tests that specified a series of demonstrations to prove interoperability of AFIS systems and scanners. These demonstrations employed the transmission, reception and processing of image-based Types of Transactions (TOTs). Communication was via the Internet using Simple Mail Transfer Protocol (SMTP) and Multi-purpose Internet Mail Extensions (MIME).

Sagem Morpho, Inc. documented the agreed upon test message specifications for the 1998 testing in Inter-AFIS Message Specifications/NIST Record Layouts/IAI Inter-AFIS Demonstration Project.

2. Demonstration Participants

All AFIS vendors were invited to participate in 1996. The following list reflects the three AFIS vendors that participated in both last year's and this year's testing, the operational customer sites and other involved parties.

AFIS Vendors:

CogentSystems	Alhambra, CA Vendor Facility Ontario, CA Police Department (PD)
Printrak International	Anaheim, CA Vendor Facility NC Bureau of Investigation, Raleigh, NC
Sagem Morpho	Tacoma, WA Vendor Facility Arizona Dept. of Public Safety

Electronic Fingerprint Transmission Specification (EFTS) Software:

Aware, Inc.	Bedford, MA Vendor Facility

Criminal Justice Communication Network

NLETS Phoenix, AZ

3. Test Approach

3.1. 3.1 Standards-Based

To communicate across jurisdictional and vendor boundaries, standards are essential. In developing our tests, we adhered to the ANSI-NIST Data Format for the Interchange of Fingerprint Information. We used the FBI Electronic Fingerprint Transmission Specification as a standard, but found it necessary to make a few modifications based on the specific needs of cross-jurisdictional use. These are outlined in Appendix C. And lastly, we used the FBI's CJIS Wide Area Network Interface Specification to specify the mode of transmission, specifically, the use of SMTP with MIME partitioning.

3.2. Internet Testing

Last year, ComnetiX, a software integrator who participated in our testing, sent a suite of test messages to vendors via the Internet using SMTP with MIME partitioning, and vendors sent test messages back. ComnetiX confirmed the vendors were WSQ and ANSI-NIST compliant by nature of the fact they were able to decipher the messages. Higgins & Associates, International, then confirmed the messages were EFTS and ANSI-NIST compliant with help from FBI and NIST personnel. This year, we repeated the Internet testing, adding the latent transactions.

3.3. NLETS Testing

NLETS is the common name referring to the National Law Enforcement Telecommunications System message switching system created in 1968 for and dedicated to the criminal justice community. NLETS includes a wide area frame relay network (installed in 1997). For the IAI testing, we were concerned only with the frame relay network, not the message-switching computer.

Two of the sites (NC and AZ) connected to the NLETS frame relay network using existing circuitry to access their State's NLETS network at a speed of 56 KBS. The Cogent site in Ontario, CA and Aware in Bedford, MA used a dial-up line running at 14.4 KBS. The dial-up connections required modems and routers in Ontario and Bedford in order to connect to the NLETS Phoenix location.

While 14.4 KBS certainly sufficed for the testing where we compressed latent images using WSQ compression, this speed is rather slow for sending uncompressed images, as is desirable for the transmission of latent prints.

4. Demonstration Test Messages

We selected the following series of test messages, called Types of Transactions or TOTs, to include in our demonstrations. Our goal was not to be all encompassing, but to select a sampling that would be easily achievable and relevant to "real life" scenarios. We used Type-1, Type-2 and Type-4 records. A Type-1 record, mandatory for all transactions, provides information describing type and purpose of the transaction. A Type-2 record provides biographic and demographic details about an individual or an error message. Each Type-4 record contains a fingerprint image.

4.1. TOA/ATR

The Type of AFIS transaction (TOA) requests the make and model of the AFIS System, TOTs supported, maximum score obtainable, and response time. The AFIS Type Record (ATR) contains the response to the information requested in the TOA. These are two new messages devised by the AFIS Committee specifically for cross-jurisdictional use.

4.2. TPIS/SRT

The most relevant of the tests, the Ten Print Image Search (TPIS) AFIS transaction allows a PD to remotely search another jurisdiction's AFIS remotely with no manual intervention at the receiving site. The originating PD sends fingerprint images in a TPIS with descriptive data, the remote end automatically searches and responds with a Search Results - Ten Print (SRT) transaction. The SRT includes a candidate list with images of the top candidate.

4.3. IRQ/IRR

The Fingerprint Image Request (IRQ) transaction allows the receiver of the SRT to request fingerprint images for other candidates from the candidate list. The remote site responds with a Fingerprint Image Request Response (IRR) which provides the requested fingerprint images.

4.4. LFIQ/SRL

The Latent Fingerprint Image Request (LFIQ) allows the originator to send a latent image to a destination site. The destination site must edit the minutiae, then submit the request for processing in the destination AFIS. The destination AFIS returns the candidate list along with the image of the top candidate to the originator in a TOT called the SRL, or Search Results - Latent. The originator then must determine if there's a matching candidate.

4.5. ERRT, ERRI, ERRL

We purposely tested Error messages ERRT, ERRI, ERRL, which correspond to a TPIS, IRQ and LFIQ respectively.

5. Schedule

	Start	Finish
IAI AFIS Committee Panel Met	7/96	
Concept of Operations Published	10/96	
Demonstration Test Plan Published	2/97	
Sample Record Specifications Published	11/1/96	2/6/97
AFIS Vendor S/W Tuning & Development	2/7/97	4/4/97
Vendor Testing with ComnetiX	4/7/97	7/11/97
Brief NLETS Annual Conference	7/4/97	
Vendor Testing via Internet	7/14/97	7/25/97
Reconvene IAI Panel	7/27/97	8/2/97
Regression Internet Testing	5/98	5/98
Operational Testing via NLETS	6/1/98	6/4/98

6. Issues and Resolutions/Recommendations

The following categorized issues were encountered throughout the year.

6.1. Latent Prints

Issue L-1: Although the ANSI-NIST standard defines minutiae extraction standards in the Type-9 record, it is not considered optimal for latent searches due to each AFIS system having proprietary encoding and matching software. Thus, we could not send minutiae extractions, and required remote intervention for completing the minutiae extraction.

Resolution: The FBI, NIST and vendors continue to work on creating a more satisfactory solution. For purposes of our testing, we developed a variation of the EFTS Latent Fingerprint Image Search (LFIS). The LFIS specifies automatic extraction at the remote site with no human intervention. Instead, the IAI AFIS Committee participants on this effort created a transaction called an LFIQ, Latent Fingerprint Image Query, which specifies that the remote site must intervene to extract minutiae before processing.

Recommendation A: Support the FBI/NIST/Vendor effort.

Recommendation B: Establish the LFIQ as the standard for cross-jurisdictional use in the interim.

6.2. Standards

The FBI EFTS and ANSI-NIST Standards don't address everything needed for cross-jurisdictional interoperability. We had specific questions arise on the EFTS that we plan to discuss when the IAI AFIS Committee reconvenes in late July 1998.

Issue S-1: While the EFTS is key to cross-jurisdictional interoperability, there is no governing body that certifies EFTS compliance (other than Appendices F and G, Image Quality Specification).

> **Recommendation A:** The IAI AFIS Committee consider becoming the governing body, or find an organization that will.
>
> **Recommendation B:** The EFTS become an ANSI-NIST standard and is expanded to accommodate cross-jurisdictional use.
>
> **Recommendation C:** In order to implement Recommendation B, either NIST, the IAI or FBI hold a series of workshops to review what is needed for cross-jurisdictional use.

Issue S-2: Individual states and localities are implementing their own versions of the standard by defining their own transaction types and Record Type-2 tags (new field designators). This could inhibit future interoperability.

> **Recommendation:** One near-term option is the FBI listing a description of all EFTS Type-2 tags and transactions (including non-Federal) on their home page and/or the IAI AFIS Committee home page. This will allow local police departments to standardize more easily.

Issue S-3: The EFTS was primarily designed for hierarchical transmission, i.e., transmission to the FBI. Thus, there arose several questions on how to accommodate non-FBI transmissions. Our approach to these is documented in Appendix X. New transactions were devised for this testing.

> **Recommendation:** The IAI AFIS Committee take the lead to identify and resolve these issues.

Issue S-4: Most of the issues and questions on the EFTS documented in last year's report have been resolved (See Appendix C). However, a few items are still pending FBI resolution.

> **Recommendation:** The IAI AFIS Committee work with the FBI and NIST on resolution.

6.3. NLETS

Issue N-1: The NLETS frame relay network is accessed via a State Network. Some states and localities do not support TCP/IP (an Internet protocol), needed for cross jurisdictional AFIS searches.

Resolution: NLETS offered us the solution of a dial-up line into the central NLETS facility in Arizona.

Recommendation A: If law enforcement wants to begin cross-jurisdictional use of AFIS systems, they will have to work with NLETS to set up the transmission for long term use. Note: A dial-up speed of 14.4 KBS is rather slow to transport images.

Recommendation B: It would be useful to publish a list of law enforcement ORI's and IP addresses on a secure network such as NLETS. This would allow a police department to remotely search another AFIS by merely looking up the address information and submitting a request.

Issue N-2: NLETS Board of Directors expressed an interest in seeing a policy emerge on the use of cross jurisdictional AFIS searches.

Recommendation: Initiate an IACP/NSA/IAI (International Association of Chiefs of Police/National Sheriff's Association) Policy meeting on the use of this new capability.

7. Conclusion

Overall, testing was extremely successful and proved the IAI AFIS Committee's theory that searches can be run across jurisdictional and AFIS vendor boundaries. It was also shown that simply because a vendor is FBI certified for certain areas and considered standards-compliant doesn't necessarily guarantee interoperability. The FBI's Electronic Fingerprint Transmission Specification (EFTS) document, while crucial to interoperability, will need to be supplemented with standards that are specific to cross-jurisdictional use.

The Internet, a public network, is not a viable transmission medium for most law enforcement agencies at this time due to security restrictions. The Internet, however, may be useful for non-law enforcement use, e.g., interstate welfare enrollment checks. The secure NLETS network is a more appropriate transmission medium for law enforcement.

There seems to be a strong interest at all levels for this effort, from the vendors users group members, the vendors, and law enforcement. The IAI AFIS Committee would like to see this effort continue.

Most of all, the IAI wishes to thank all who participated in this volunteer effort--law enforcement, vendors, independent consultants, the FBI, NLETS and NIST, all of whom committed valuable resources to an unfunded effort. The IAI AFIS Committee is especially grateful to the vendors who stayed for the duration and displayed teamwork, dedication to our vision and commitment to support local and state law enforcement.

APPENDIX A - BIBLIOGRAPHY

ANSI/NIST-CSL 1-1993 Data Format for the Interchange of Fingerprint Information, Sponsored by National Institute of Standards and Technology, Published by American National Standards Institute, November 22, 1993.

CJIS Wide Area Network Interface Specification, CJIS-IC-0020, Federal Bureau of Investigation, November 1995.

Criminal Justice Information Services (CJIS) Electronic Fingerprint Transmission Specification (EFTS), CJIS-RS-0010 (V5), Federal Bureau of Investigation, June 1997.

IAFIS Planning Guide Integrated Automated Fingerprint Identification System, FBI/CJIS Advisory Policy Board with Assistance from SEARCH, Revised March 1995.

WSQ Gray-Scale Fingerprint Image Compression Specification, IAFIS-IC-0110V2, Criminal Justice Information Services (CJIS), Federal Bureau of Investigation, February 16, 1993.

IAI Concept of Operations for Cross-Jurisdictional Use of AFIS Systems, V3.0, Higgins & Associates, International, April 16, 1997 (available on the IAI AFIS Committee Home Page at http://www.iaibbs.org/afis.htm)

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Inter-AFIS Message Specifications/NIST Record Layouts/IAI Inter-AFIS Demonstration Project, Document Number D 349-001A, Sagem Morpho, May 6, 1998 (available on the IAI AFIS Committee Home Page at http://www.iaibbs.org/afis.htm)

APPENDIX B - GLOSSARY

AFIS	Automated Fingerprint Identification System
ANSI	American National Standards Institute
ANSI Standard	Shorthand for the American National Standard for Information Systems - Data Format for the Standard for the Interchange of Fingerprint Information
ATR	AFIS Type Record (Type of Transaction or TOT)
CJIS	Criminal Justice Information Services Division (of the FBI)
CTA	Control Terminal Agency
DAI	Destination Agency Identifier
EFIPS	Electronic Fingerprint Image Print Server (the system at the FBI which prints out electronically submitted fingerprint cards)
EFTS	Electronic Fingerprint Transmission Specification - the FBI's implementation of the ANSI Standard
IACP	International Association of Chiefs of Police
IAFIS	Integrated Automated Fingerprint Identification System - the FBI's new system for integrating fingerprint comparisons with criminal history record processing
IAI	International Association for Identification
IRQ	Fingerprint Image Request (TOT)
IRR	Fingerprint Image Request Response (TOT)
ISP	Internet Service Provider
LAN	Local Area Network
MIME	Multipurpose Internet Mail Extensions
NIST	National Institute of Standards and Technology
NLETS	National Law Enforcement Telecommunications System
NSA	National Sheriffs Association
ORI	Originating Agency Identifier
SMTP	Simple Mail Transfer Protocol
SRT	Search Results--Ten Print (TOT)
TBD	To be Determined
TCP/IP	Transmission Control Protocol/Internet Protocol
TOA	Type of AFIS (TOT)
TOT	Type of Transaction
TPIS	Ten Print Fingerprint Image Search (TOT)
WAN	Wide Area Network - a way of connecting computer sites across the country using special telephone lines, satellites, etc.
WSQ	Wavelet Scalar Quantization (the compression method required for submitting fingerprint images to the FBI)

APPENDIX C EFTS Issues Documented in July 1997

Existing Scope of EFTS:

1. **SRT "No Hit" Condition:** There is no specification in the FBI EFTS document on how to return a No-Hit message in response to a Ten Print Image Search (TPIS). Does one merely include the words "No Hit" in the 2.064 field (the mandatory field normally containing the candidate list)? In our testing, we had pre-sent cards to all vendors, so that a No Hit condition would not occur. **Resolution**: Still pending.

2. **DAI Size Discrepancy:** The EFTS lists contradictory size specifications of the Destination Agency Identifier (DAI) and Originating Agency Identifier (ORI) found in Type-1 records. In the ANSI-NIST standard and the EFTS, it says, "The size and data content of this field shall be defined by the user and be in accordance with the receiving agency." However, the EFTS goes on to say, "This field shall be a ten-byte [or nine-byte respectively] alphanumeric field." So if this in fact is true, and since the DAI is merely the other person's ORI, what constitutes the extra byte? **Resolution**: Still pending.:

3. **ORI/DAI Size Conflict with ANSI-NIST:** The EFTS specifies a size for the ORI and DAI, but the ANSI-NIST standard says that "the size and data content of this field shall be defined by the user and be in accordance with the receiving agency." Which is correct? **Resolution**: Still pending.:

4. **Candidate Scores:** Do we need another field in Type-2 Record for scores of candidates? Currently, scores are not returned with the candidates. **Resolution**: Still pending.:

5. **Score Meaning:** Currently, all vendors have different methods and values for scoring, e.g., a score of 1000 with Vendor A may not have the same significance as with Vendor B. Also, a score of 1000 is not necessarily "twice as good" as a score of 500. We need to further explore possible uniformity and understanding of the scoring process. NOTE: This point is of interest only if it's decided to return the scores with the candidate lists. **Resolution**: Still pending.:

6. **NTR Update:** Nominal Transmitting Resolution (NTR) needs to be updated. The Native Scanning Resolution (NSR) has a minimum value defined, but there is no upward limit. On the other hand, the NTR is limited to a maximum value of 20.47 pixels per millimeter (p/mm) plus/minus .20 p/mm (520 pixels per inch (p/in) plus/minus 5 p/in) for high resolution grayscale images, e.g., Type-4 records. The typical ten print scanner scans at 600 p/in. Therefore, we are unable to take advantage of the finer resolution that is today's commercial standard. **Resolution**: Still pending.:

7. **MIR Clarification:** The Multiple Image Request (MIR) transaction does not specify how to ask for multiple requests, nor how the response should look. For example, to request images from the 2nd and 3rd candidates on the SRT candidate list, is it correct to insert two State ID Numbers, e.g., 2.015:MD1002>MD2345*? And is the response to this request separate IRRs for each candidate that reference the same MIR? **Resolution**: Still pending.:

8. **EFTS Readability/Sample Messages**: It took hours to decipher the EFTS fields. Sample messages from an older version of EFTS proved quite helpful. It would be useful to re-include them as a permanent part of the EFTS document. **Resolution**: Still pending.:

9. **FNR Delimiter Discrepancy:** Fingerprint Number (FNR), Field 2.057 has conflicting descriptions of separators. Table E-18 gives a separator of RS, while the descriptor of FNR indicates use of a US. An RS was used for purposes of our testing, but this needs to be clarified. **Resolution**: Still pending.:

10. **TCR as Mandatory Field:** The Transaction Control Reference (TCR), Field 1.10 references the originator's Transaction Control Number (TCN). This is not listed as mandatory for responses, but seems that it should be. **Resolution**: Still pending.:

Expanded Scope of EFTS (Cross-Jurisdictional Use):

1. **Candidate Names (SRT & IRR):** Many operational sites do not keep a "Names" database in the AFIS system although the trend is toward integration. The EFTS calls out for mandatory fields with Names. For instance, Field 2.064 in the SRT asks for ID numbers and names. The EFTS would need to allow such an occurrence and describe how it would be handled, i.e., merely skip the R/S separator field and list ID numbers separated by a U/S separator, or use R/S separators with a blank or "No Name" as a place holder. The IRR also calls for a mandatory Name (NAM) field, 2.018. This would need to change to optional. **Resolution**: Still pending.:

2. **Local ID Use:** There is no accommodation for a Local Identification number. We used the State ID (SID) field (2.015), but that field is limited to a maximum of 10 characters, while local IDs may be more than 10 characters. We need to either expand the definition of 2.015 to include local IDs or designate a new tag for a local ID. **Resolution**: Still pending.:

3. **MIME Messages** Some vendors preferred to put text messages with their MIME message (a valuable debug tool for programmers), but for other vendors, this created a conflict in their software. The standards don't address this. **Resolution**: Still pending.:

4. **New TOTs:** For purposes of this test, we devised two new TOTs: 1) A Type of AFIS request (TOA) and 2) An AFIS Type Response (ATR). This response includes the make and model of the AFIS System, the TOTs supported, the maximum score obtainable, and response time in hours. Various questions came up about the usefulness of this information, as presented below. **Resolution**: Still pending.

- If we are talking about cross-vendor communication, what significance is make/model of AFIS system? The original intention is that if the AFIS was from the same vendor, they would have the option of communication using proprietary protocols. **Resolution**: Still pending.:

- What significance is maximum score obtainable on the ATR when no scores currently come back with the candidate list? **Resolution**: Still pending.:

- Should the response time, currently measured in hours, be predetermined, stated in minutes, etc.? **Resolution**: Still pending.:

- Expand the TOA/ATR to indicate which fingers a vendor would like supplied for a TPIS search. **Resolution**: Still pending.:

APPENDIX D - Standards

This IAI effort was based on the following standards:

ANSI/NIST-CSL 1-1993 Data Format for the Interchange of Fingerprint Information, ANSI, November 22, 1993.
Criminal Justice Information Services (CJIS) Electronic Fingerprint Transmission Specification, IAFIS-IC-0010, Federal Bureau of Investigation, December 1995.
WSQ Gray-Scale Fingerprint Image Compression Specification, IAFIS-IC-0110V2, Criminal Justice Information Services (CJIS), Federal Bureau of Investigation, February 16, 1993.
CJIS Wide Area Network Interface Specification, CJIS-IC-0020, Federal Bureau of Investigation, April 1997.

These standards, the first national and the remaining three FBI, cover:

- the scanning of fingerprints,
- the messages for the transmission of fingerprint transactions to and from the FBI's IAFIS (Integrated AFIS) system,
- the compression of fingerprint images, and
- the wide-band communication methods for the transmission of fingerprint transactions to and from the FBI.

These standards do not cover the following areas:

- the ability of scanners to produce and transmit output records in the Electronic Fingerprint Transmission Specification (EFTS) formats,
- the ability of AFIS systems to read EFTS-formatted records, and
- the ability of AFIS systems to process defined transaction types.

For electronic submissions, the transaction must be fully compliant with the ANSI specification, the EFTS and its Appendices, WSQ and CJIS WAN protocols. For more information, see the SEARCH - FBI/CJIS Advisory Policy Board's IAFIS Planning Guide.